

Hewlett Packard
Enterprise

HPE 3PAR Command Line Interface Administrator Guide

Abstract

This manual is for all system and storage administrators, and provides instructions for downloading, installing, and using the HPE 3PAR CLI. Use the HPE 3PAR CLI to configure and manage HPE 3PAR StoreServ Storage systems.

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HPE 3PAR Command Line Interface (CLI)

The HPE 3PAR Command Line Interface (HPE 3PAR CLI) provides command line access to the HPE 3PAR Operating System on HPE 3PAR StoreServ Storage systems. You can use the HPE 3PAR CLI to monitor, manage, and configure HPE 3PAR StoreServ Storage systems.

More information

Prerequisites for installing the HPE 3PAR CLI on page 16

Specifications for HPE 3PAR CLI

Specifications include system requirements, supported operating systems, and other pertinent information for installing and accessing the HPE 3PAR CLI.

Accessing SPOCK for HPE 3PAR CLI Remote Client

Procedure

1. Log in to **SPOCK** (http://www.hpe.com/storage/spock) from any browser.

   Use your HPE Passport account to log on. If you do not have an HPE Passport account, you can create an account on SPOCK.
2. In the left navigation pane of the SPOCK Home page, scroll down to **Software**, and then click **Array SW: 3PAR**.
3. In the 3PAR Array Software window, scroll down to **HPE 3PAR Operating System Software: Array Software**.
4. To open the support matrix, click **3PAR CLI Remote Client**.

Disk space requirements for HPE 3PAR CLI installation

Before beginning the installation process, make sure there is enough free space on the system to complete the process.

The following table lists the disk space requirements for installing the HPE 3PAR CLI. The installer also creates temporary files during installation. The actual hard disk space required for the installation process is greater than the values listed.

Table 1: Free space required for installation

Operating system	Minimum disk space
HP-UX	300 MB
AIX	200 MB
Linux	150 MB
Solaris SPARC	150 MB

Table Continued

Operating system	Minimum disk space
Solaris x86[1]	150 MB
Microsoft Windows	200 MB

[1] Supported with HPE 3PAR CLI 3.2.2 MU3 and later.

System Requirements for remote systems

- 1.0 gigahertz processor or higher.
- 1 GB of installed RAM (2 GB recommended).
- CD or DVD drive (if installing from a CD).
- 1024 x 768 or better screen resolution.
- ¶

Default installation location for the HPE 3PAR CLI

HPE 3PAR OS 3.3.1. and later uses a new default installation location and allows only one installation of the HPE 3PAR CLI. Remove previous versions of the HPE 3PAR CLI.

Microsoft Windows

- 32-bit system:
  - Old: `C:\Program Files\Hewlett-Packard\HP 3PAR CLI`
  - New: `C:\Program Files\Hewlett Packard Enterprise\HPE 3PAR CLI`
- 64-bit system:
  - Old: `C:\Program Files (x86)\Hewlett-Packard\HP 3PAR CLI`
  - New: `C:\Program Files (x86)\Hewlett Packard Enterprise\HPE 3PAR CLI`

UNIX and Linux:

- Old: `/opt/hp_3par_cli`
- New: `/opt/hpe_3par_cli`

Supported operating systems for HPE 3PAR CLI

The HPE 3PAR CLI is supported on the following operating systems:

- HP-UX (with HPE 3PAR CLI 3.1.2 and later)
- IBM AIX (with HPE 3PAR CLI 3.1.3 and later)
- Linux
- Oracle Solaris SPARC

- Oracle Solaris x86 (with HPE 3PAR CLI 3.2.2 MU3 and later)
- Microsoft Windows

Visit Single Point of Connectivity Knowledge (SPOCK) for the latest information on supported versions and platforms (see, **Accessing SPOCK for HPE 3PAR CLI Remote Client**).

Software licenses and HPE 3PAR CLI

HPE 3PAR OS 3.3.1 and later introduced a new, All-inclusive Licensing model for software. All-inclusive software licensing is offered as an alternative to the traditional spindle-based licensing model.

HPE 3PAR continues to support existing HPE 3PAR customers who use the spindle-based licensing model on existing versions. When customers upgrade any hardware or software, HPE requires customers to switch to the new All-inclusive software licensing program.

The new licensing scheme is array/frame based, rather than drive/spindle based.

Software license keys

To acquire a software license key, contact your Hewlett Packard Enterprise representative. A valid license key includes an appropriate HPE 3PAR StoreServ Storage serial number, and is associated with the number of nodes in the system for which the license key is activated. When you activate a license key using the CLI, the system ignores all non-alpha or non-numerical characters. Alpha characters are not case-sensitive.

Activating a software license

Prerequisites

Obtain a software license key

Review the `setlicense` command in the *HPE 3PAR CLI Reference*

Procedure

1. To activate the license for the HPE 3PAR OS software suite, enter the following command:
   ```
   cli% setlicense
   ```
   The system returns the terms and conditions for use of the software.
2. Enter `Y` to accept the terms and continue.
3. Enter the license key.
   The system ignores and non-alpha or non-numeric characters, and the key is not case sensitive.
4. Verify and confirm the license changes presented on the screen.
5. To finish entering the license key, press the **Enter** key on the keyboard at a blank line.
6. To verify changes, enter the `showlicense` command.

More information

Software license keys on page 13
Task-specific license requirements on page 212

CLI user name restrictions

- root
- daemon
- bin
- console
- nobody
- sshd
- telnetd
- sys
- sync
- man
- proxy
- list
- statd
- ntp
- messagebus
- libuuid
- games
- lp
- mail
- news
- uucp
- www-data
- backup
- irc
- gnats
- dnsmasq
- libvirt-qemu

Creating new users

When creating a new user, specify a new user name that is not on the reserved name list.

Procedure

To create a new user, issue the `createuser` command. In the following example, a new user named `ROOT1` is created.

```
cli% createuser ROOT1 all edit
```

For complete information about this command, see the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Deleting existing users

Procedure

To delete a user, issue the `removeuser` command. In the following example, a user with the reserved user name of `pw1` is removed:

```
cli% removeuser pw1
User removed
```

For complete information about these commands, see the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Download and Install the HPE 3PAR CLI

Hewlett Packard Enterprise delivers the HPE 3PAR CLI as a download from the HPE Software Updates & Licensing portal. After downloading the installation files and completing the prerequisites, you can install the HPE 3PAR CLI on systems running Windows, HP-UX, Solaris, or Linux.

Procedure

1. Download the HPE 3PAR CLI
2. Install the HPE 3PAR CLI
3. Troubleshoot the HPE 3PAR CLI installation

Downloading the HPE 3PAR CLI

Prerequisites

- Obtain the SAID associated with your HPE support contract
- Create an HPE Passport account

Procedure

1. From the host system, log into the HPE Software Updates and Licensing (SU&L) portal using your HPE Passport account information.
2. Select your SAID number from the drop down list, or enter your SAID in the text box.

   The SAID number is provided as part of your HPE support contract.
3. Review the terms and conditions, and then select the box to indicate your acceptance.

4. Click **View available products**.
5. Enter the HPE 3PAR OS version into the search text box, and then click **Search**.
6. From the list of available products, select the latest HPE 3PAR OS version, and then click **Get software update**.
7. From the list of available downloads, select **HPE 3PAR CLI & SNMP**, and then click **Download**.

   The .iso file downloads to your current system.
8. Make note of the name a location of the .iso file for installation purposes.

Installing the HPE 3PAR CLI

You can install the HPE 3PAR CLI on systems running compatible versions of HP-UX, AIX, Linux, Microsoft Windows, and Solaris operating systems.

On Microsoft Windows, the installation defaults to an InstallAnywhere installation wizard. On UNIX and Linux, the packages default to a command-line installation. You can create a response file to install silently on any platform.

Prerequisites for installing the HPE 3PAR CLI

IMPORTANT: Do not install, uninstall, or run multiple installations of the HPE 3PAR CLI at the same time. Doing so can cause the system to malfunction.

Before installing the HPE 3PAR CLI on a host or remote system, complete the following tasks:

1. **Download the HPE 3PAR CLI**.
2. Determine the latest supported operating system, see **Finding supported operating systems**.
3. Update the host operating system with all required and recommended patches or service packs.
4. For 64-bit Linux systems, install the 32-bit compatibility libraries, including 32-bit `zlib` and `glibc` and their dependent packages. For example:

   ```
   # rpm -Uvh zlib-<version>.el6.i686.rpm glibc-<version>.
   e16.i686.rpm nss-softokn-freebl-<version>.e16.i686.rpm
   ```
5. If you are installing HPE 3PAR CLI for HPE 3PAR OS 3.3.1 and later, be sure to remove previous versions of the HPE 3PAR CLI (see, **Default installation locations for the HPE 3PAR CLI**
6. Review the HPE 3PAR CLI installation readme file packaged with the HPE 3PAR CLI & SNMP download. All platforms use the same download, but the installation files are different for each of the supported platforms.
7. Determine whether your HPE 3PAR StoreServ Storage uses only secure ports (see, *HPE 3PAR OS Common Criteria Administrator Guide* available from the **www.hpe.com/support/hpesc** (www.hpe.com/support/hpesc)). Command Line Interface operations can vary under Hewlett Packard Enterprise Common Criteria (CC) mode, and connections might require encryption. Be sure to familiarize yourself with CC operations.
8. Verify that the host or remote system meets the minimum system requirements (see, **System Requirements for host and remote systems**).
9. Verify that the host or remote system has enough disk space available (see, **Disk space requirements for HPE 3PAR CLI installation**).
10. Configure the firewall.

11. Terminate all active HPE 3PAR CLI sessions.
12. Disable virus-checking software.

Install the HPE 3PAR CLI in a Windows environment

Prerequisites

Before beginning the installation process, complete the **Prerequisites for installing the HPE 3PAR CLI**.

Procedure

1. Locate the `.iso` file, downloaded from the HPE Software Updates and Licensing (SU&L) portal (see, **Downloading the HPE 3PAR CLI**).

   If the .iso file was burned to a CD, the installation automatically begins when you insert the CD into the CD drive.

   If the installation does not start automatically, or if you are working directly with the .iso file, continue with the next step.
2. Double-click the **.iso** file.
3. To start the installation, navigate to the `\cli\windows\` folder, and then double-click the `setup.exe` file.
4. To complete the Windows installation, follow the onscreen instructions.

Installing the HPE 3PAR CLI silently on Microsoft Windows

Prerequisites

Before beginning the installation process, make sure that you have performed any **Prerequisites for installing the HPE 3PAR CLI**.

Procedure

1. To install silently without requiring any user input, **create a setup response file**.
2. Open a Windows command prompt and issue the following command:

```
\cli\windows\setup.exe -i silent -f C:\cli_setup_response.txt
```

Creating a response file for Windows environments

You can install or uninstall HPE 3PAR CLI from multiple Windows systems using the silent option. This option uses a response file that contains standard answers to the install or uninstall wizard.

Procedure

1. Open a Windows command prompt on a system where you want to install or uninstall the HPE 3PAR CLI.
2. To create a response file, use one of the following commands:

   Install:

```
<D>:\cli\windows\setup.exe -r C:\cli_install_response.txt
```

   Uninstall:

```
# /opt/hpe_3par_cli/uninstall/uninstall -r C:\cli_uninstall_response.txt
```

3. Complete the activity using the onscreen instructions.

   The responses you enter during this process are saved automatically to the `cli_<install> | <uninstall>_response.txt` file.

4. After you have completed the activity, locate the saved response file at `C:\cli_<type>_response.txt`.

   You can use this file to install or uninstall the HPE 3PAR CLI silently (without user input) on other hosts.

Install the HPE 3PAR CLI in a UNIX or Linux environment

Prerequisites

Before beginning the installation process, complete the **Prerequisites for installing the HPE 3PAR CLI**.

Procedure

1. Open a terminal window on the host system.
2. Log in as `root`.
3. Locate the `.iso` file, downloaded from the HPE Software Updates and Licensing (SU&L) portal (see, **Downloading the HPE 3PAR CLI**).

   If the .iso file was burned to a CD, insert and mount the CD.

   If the installation does not start automatically, or if you are working directly with the .iso file, continue with the next step. Note that the installation will start automatically only in Windows environment.

4. Start the installation using the `setup.bin` file and one of the following commands:

   - **AIX:** `# /cdrom/cli/aix/setup.bin`
   - **HP-UX:** `# /cdrom/cli/hp-ux/setup.bin`
   - **Linux:** `# /cdrom/cli/linux/setup.bin`
   - **Solaris** (HPE 3PAR CLI 3.2.2 MU2 and earlier)**:** `# /cdrom/cli/solaris/setup.bin`
   - **Solaris SPARC** (HPE 3PAR CLI 3.2.2 MU3 and later)**:** `# /cdrom/cli/solaris-sparc/setup.bin`
   - **Solaris x86:** `# /cdrom/cli/solaris-ix86/setup.bin`

5. To complete the installation, follow the onscreen instructions.
6. To finalize the installation, log out of the host system, and then log back in.

   The default installation location is `/opt/hpe_3par_cli`.

Installing the HPE 3PAR CLI silently on UNIX and Linux

Prerequisites

Before beginning the installation process, complete any **Prerequisites for installing the HPE 3PAR CLI** on page 16.

Procedure

1. To install silently (without requiring any user input), **create a setup response file**.
2. Open a terminal window on the host system.
3. Log in as **root**.
4. Locate the `.iso` file, downloaded from the HPE Software Updates and Licensing (SU&L) portal (see, Downloading the HPE 3PAR CLI).
5. Use `-i silent` or `-f` options while executing `setup.bin`:

   - **On AIX:**

     ```
     # /cdrom/cli/aix/setup.bin -i silent -f </full/path/to/cli_setup_response.txt>
     ```

   - **On HP-UX:**

     ```
     # /cdrom/cli/hp-ux/setup.bin -i silent -f </full/path/to/cli_setup_response.txt>
     ```

   - **On Linux:**

     ```
     # /cdrom/cli/linux/setup.bin -i silent -f </full/path/to/cli_setup_response.txt>
     ```

   - **On Solaris (old):**

     ```
     # /cdrom/cli/solaris/setup.bin -i silent -f </full/path/to/cli_setup_response.txt>
     ```

   - **On Solaris SPARC (new):**

     ```
     # /cdrom/cli/solaris-sparc/setup.bin -i silent -f </full/path/to/cli_setup_response.txt>
     ```

     HPE 3PAR CLI 3.2.2 MU3 and later uses a new location.

   - **On Solaris x86:**

     ```
     # /cdrom/cli/solaris-ix86/setup.bin -i silent -f </full/path/to/cli_setup_response.txt>
     ```

Creating a response file for a UNIX or Linux environment

Procedure

1. Open a terminal window on the host system.
2. Log in as `root`.
3. Create the setup response file using the `-r` option while executing `setup.bin`.

   ```
   # /cdrom/cli/[aix | hp-ux | linux | solaris | solaris-sparc | solaris-ix86]/
   setup.bin -r </full/path/to/cli_<install | uninstall>_response.txt>
   ```

4. Make note of the location of the response file.

Setting the path to the HPE 3PAR CLI on UNIX and Linux

After installing HPE 3PAR CLI on your system, the InstallAnywhere application attempts to add an entry to your local login file that sets the path to the HPE 3PAR CLI for the root user. The modification is specific to the shell you used during the HPE 3PAR CLI installation.

If InstallAnywhere is unable to modify the login file, set the path manually.

Procedure

- To use the HPE 3PAR CLI commands from the shell you are using, add the HPE 3PAR CLI command directory to your shell path.
- For example, if you are using the Bourne or Bash shells and the commands have been installed in `/opt/hpe_3par_cli/bin`, then issue the following commands:

```
$ PATH=$PATH:/opt/hpe_3par_cli/bin
$ export PATH
```

Accessing the HPE 3PAR CLI from Windows

Prerequisites

- **Install the HPE 3PAR CLI**
- **Create the first CLI user account**

Procedure

- Log in to the Windows system as an Administrator.
- Click **Start** > **Programs** > **HPE 3PAR** > **HPE 3PAR CLI <*version*>** .
  A command window opens with the system prompt:

```
system:
```

- Enter the system name or the IP address.
- Enter the user name and password.

Troubleshooting the HPE 3PAR CLI installation

The InstallAnywhere application creates an error log named `install.log` in the installation directory. If you encounter a failure while installing the HPE 3PAR CLI, locate the `install.log` file before contacting your local service provider for technical support.

If you installed the HPE 3PAR CLI in the default location, this log file is located as follows:

Windows 32–bit system

```
C:\Program Files\Hewlett Packard Enterprise\HPE 3PAR CLI\log\install.log
```

Windows 64–bit system

```
C:\Program Files (x86)\Hewlett Packard Enterprise\HPE 3PAR CLI\log
\install.log
```

UNIX and Linux

```
/opt/hpe_3par_cli/log/install.log
```

Remove the HPE 3PAR CLI

After completing the prerequisites, uninstall the HPE 3PAR CLI from systems running Microsoft Windows, UNIX, and Linux operating environments.

- **Prerequisites for uninstalling the HPE 3PAR CLI**

- **Uninstall the HPE 3PAR CLI from Microsoft Windows environment**
- **Uninstall the HPE 3PAR CLI from a UNIX or Linux environment**
- **Uninstall the HPE 3PAR CLI silently from Microsoft Windows**
- **Uninstall the HPE 3PAR CLI silently from UNIX or Linux**

Prerequisites for uninstalling the HPE 3PAR CLI

Prerequisites
Before uninstalling the HPE 3PAR CLI, complete the following tasks:

- Close all active HPE 3PAR CLI sessions.
- Disable any virus-checking software.

Uninstalling the HPE 3PAR CLI from Microsoft Windows environments

Prerequisites

Before uninstalling the HPE 3PAR CLI, complete the **Prerequisites for uninstalling the HPE 3PAR CLI** on page 21.

Procedure

1. From the taskbar, select **Start** > **Programs** > **HPE 3PAR CLI** > **Uninstall HPE 3PAR CLI <version>** (where *<version>* is the currently installed version, for example `3.3.1`).
2. Follow the onscreen instructions.

Uninstalling the HPE 3PAR CLI silently from Microsoft Windows environments

Prerequisites

Before beginning the uninstallation process, complete the **Prerequisites for uninstalling the HPE 3PAR CLI** on page 21.

Procedure

1. To uninstall the HPE 3PAR CLI silently from Microsoft Windows environments, **create a response file**.
2. Open a Windows command prompt and issue the following command:
   - **Windows 32-bit system:**

     ```
     C:\Program Files\Hewlett Packard Enterprise\HPE 3PAR CLI\uninstall\
     uninstall -i silent -f C:\cli_response.txt
     ```

   - **Windows 64-bit system:**

     ```
     C:\Program Files (x86)\Hewlett Packard Enterprise\HPE 3PAR CLI\uninstall\
     uninstall -i silent -r C:\cli_response.txt
     ```

Uninstalling the HPE 3PAR CLI from UNIX or Linux environments

Prerequisites

Before beginning the uninstallation process, make sure that you have performed any **Prerequisites for uninstalling the HPE 3PAR CLI** on page 21.

Procedure

1. Open a terminal window.
2. Log in as **root**.
3. Issue the following command:

```
# /opt/hpe_3par_cli/uninstall/uninstall
```

4. Complete the uninstallation process by following the on-screen instructions.
5. Log out and log back in.

Uninstalling the HPE 3PAR CLI silently on UNIX or Linux

Prerequisites

Before beginning the uninstallation process, make sure that you have performed any **Prerequisites for uninstalling the HPE 3PAR CLI** on page 21.

Procedure

1. To remove the HPE 3PAR CLI create a response file.
2. Open a terminal window.
3. Log in as **root**.
4. Issue the following command:

```
# /opt/hpe_3par_cli/uninstall/uninstall -i silent -f </full/path/to/
cli_<uninstall>_response.txt>
```

   The HPE 3PAR CLI is removed without any prompt.

Scripting considerations

If you have scripts that depend on the location of the binaries for any of the HPE 3PAR CLI commands, update your scripts or environment variables to point to the latest version of the HPE 3PAR CLI.

Alternatively, if you do not need to keep multiple versions of the HPE 3PAR CLI installed, you can change the default HPE 3PAR CLI installation location to a path of your choosing, so that the path stays consistent from release to release. If you change the default installation location, you must fully uninstall the previous version using the provided uninstaller before installing a new version.

More information:

Uninstalling the HPE 3PAR CLI from Microsoft Windows environments on page 21

Uninstalling the HPE 3PAR CLI from UNIX or Linux environments on page 22

Uninstalling the HPE 3PAR CLI silently from Microsoft Windows environments on page 21

Uninstalling the HPE 3PAR CLI silently on UNIX or Linux on page 22

Global options and environment variables

Global options are provided to help configure the CLI and control the operation of the system. Environment variables are provided to customize the CLI. The global CLI options and environment variables are listed in **Table 2: Global CLI options and environment variables** on page 23.

- You can use the global options with the CLI program and individual CLI commands.
- When used with the CLI program, global options remain in effect until you exit the Tcl shell (for information about the Tcl shell, see **Stand-alone commands** on page 40). The following example shows the `-sys` option used with the CLI program for a system named `betasystem1`:

```
$ cli -sys betasystem1
```

- When used with individual commands, global options are in effect only for that command. The following example shows the `-nohdtot` option used with the `showsysmgr` CLI command:

```
$ showsysmgr -nohdtot
```

- Global options, when used, override environment variables.

NOTE: Global options cannot be specified on the command line for commands issued from a Tcl shell. Global options must be specified before starting a Tcl shell.

You can use environment variables when configuring the CLI.

NOTE: Environment variables can only be used if the CLI is set up remotely. If you are accessing the CLI through SSH, environment variables cannot be used.

Table 2: Global CLI options and environment variables

Global option	Specifies...
Global option: `-sockssl` **Environment variable**: `TPDSOCKSSL`	That the connection between the client and server is secure. This is the default setting. For additional information, see **Using SSL** on page 27.
Global option: `-tpdportnum <portnum>` **Environment variable**: `--`	The TCP port of the CLI server to which the CLI client connects. The default SSL port number is 5783 and the default unsecured port number is 5782. Port 5782 is disabled when operating in Common Criteria mode.

Table Continued

Global option	Specifies...
Global option: `-sys <system_name>` **Environment variable**: `TPDSYSNAME`	The system name of the system you are accessing. For additional information, see **The TPDSYSNAME environment variable** on page 28. **CAUTION:** When you use environment variables to set the system name, user name, and password, you are not prompted for this information when running the CLI, which can be useful for scripting. However, passwords must be kept secure. Using passwords in scripts on the command line raises the risk of password exposure. To avoid compromising the encrypted password, the script or command-line history file must be strictly maintained. Failure to maintain the script or command-line history file can leave the user open to impersonation by anyone with access to the string.
Global option: `-nosockssl` **Environment variable**: `TPDNOSOCKSSL`	That the CLI client should attempt to connect to the storage server on port 5782, without using SSL. Doing so makes the connection insecure, and all data including authentication data passes in plain text packets. Port 5782 is disabled when operating in Common Criteria mode.
Global option: `-certfile <certfile>` **Environment variable**: `TPDCERTFILE`	The certificate file which is used to validate the authenticity of the CLI server. The certificate must be in a Privacy Enhanced Mail (PEM) format. The default file is `<certdir>/cert`. See the `-certdir` option.
Global option: `-certdir <certdir>` **Environment variable**: `TPDCERTDIR`	The directory in which to save the certificate exception (`excp`) file. When the CLI server certificate is not verified by the certificate file (`cert`), then the CLI looks for the information in the certificate exception file. If not found then the CLI prompts the user to accept and save it in this file. Next time the CLI connects to the same CLI server without a prompt. The default directory is: • `$HOME/.hpe3par` (on UNIX-based systems) • `%USERPROFILE%\.hpe3par` (on Microsoft Windows)

Table Continued

Global option	Specifies...
Global option: `-nocertprompt` **Environment variable**: `TPDNOCERTPROMPT`	That it will not prompt the user for a CLI server certificate which is not verified. The CLI will exit with an error message. The default behavior is to prompt the user.
Global option: `-cmdloop` **Environment variable**: `--`	After commands are issued on the command line, an interactive command loop is entered.
Global option: `-clientname <client_name>` **Environment variable**: `TPDCLIENTNAME`	The name of the client application.
Global option: `-clientver <client_version>` **Environment variable**: `TPDCLIENTVER`	The version of the client application.
Global option: `-clienthost <client_host>` **Environment variable**: `TPDCLIENTHOST`	The name of the host the client application runs on.
Global option: `-conntimeout <seconds>` **Environment variable**: `TPDCONNTIMEOUT`	The maximum time in seconds to establish the connection to the CLI server. The default is 36 seconds.
Global option: `-enherror` **Environment variable**: `TPDCLIENHERROR`	That enhanced error handling is to be performed.
Global option:`-noenherror` **Environment variable**: `--`	That enhanced error handling is not to be performed.
Global option: `--` **Environment variable**: `TPDCACHEDIR`	The location of the cache directory where the code that determines the version of the 3PAR software on the system resides. For additional information, see **Client bytecode cache directory** on page 33.
Global option:`--` **Environment variable**: `TPDSTARTFILE`	The Tcl script that the system sources before entering the command loop. For additional information, see **Setting startup files with TPDSTARTFILE** on page 34.
Global option: `-csvtable` **Environment variable**: `TPDCSVTABLE`	That commands that use the table formatting routines will print comma-separated output. For additional information, see **Comma-separated values** on page 35.
Global option: `-listdom` **Environment variable**: `TPDLISTDOM`	That domains are listed. For additional information, see **Listing domains** on page 36.

Table Continued

Global option	Specifies...
Global option: `-nohdtot` **Environment variable**: `TPDNOHDTOT`	That headers and totals are not printed after commands are executed. For additional information, see **Table headers and totals** on page 37
Global option: `-hafter` **Environment variable**: `TPDHAFTER`	The number of lines after which the header is printed again. For additional information, see **Table headers and totals** on page 37.
Global option: `--` **Environment variable**: `TPDFORCE`	That all commands are forced and do not return confirmation prompts before executing. For additional information, see **Forcing commands** on page 39.
Global option: `-v` **Environment variable**: `--`	The client-side version information, if a version mismatch or other problem that prevents connection with a server occurs. This option can only be used with the `cli` command. For additional information, see the *HPE 3PAR Command Line Interface Reference*.
Global option: `-h` **Environment variable**: `--`	Displays help about how to invoke the HPE 3PAR CLI.

General control and help commands

Table 3: General control commands on page 26 shows the general control and help commands that you can use to view help text while using the HPE 3PAR CLI.

Table 3: General control commands

Command	Action
`cmore`	Pages the output of commands. Valid syntax for using this command is `cmore <command>`.
`exit`	Exits the program.
`help -search <topic>`	Lists all commands or details for the specified topic. Specifying `-search <topic>` allows you to search command help by topic.
`clihelp -search <topic>`	Lists all commands or details for the specified topic. Allows you to search command help by topic. Use this command when running in the native shell of a system.
`help <command>`	Displays help text for individual CLI commands. Lists all help text for the specified command.

Table Continued

Command	Action
`clihelp <command>`	Displays help text for individual CLI commands. Lists all help text for the specified command. Use this command when running in the native shell of a system.
`clihelp -col <command>`	Display column help (when applicable). See **Using column help with 3PAR CLI commands** on page 27 for a list of applicable commands.
`<command> -h`	Displays help text for individual CLI commands. Lists all help text for the specified command.

Using column help with 3PAR CLI commands

Column help is provided for some commands to clarify the meaning of each column of data by defining the meaning of the column headers.

To access column help, issue the following command:

```
cli% clihelp -col <command>
```

When column help is not available, the following message appears:

```
No help for columns of command "<command>".
```

Using SSL

The HPE 3PAR OS provides an SSL protocol for secure transfer of data between the CLI client and system. The SSL protocol is set using either of the following methods:

- The `TPDSOCKSSL` environment variable.
- The `-sockssl` global option.

NOTE: This is the default behavior. The `-nosockssl` option overrides this behavior.

The HPE 3PAR CLI uses port number 5783 for secure communications and port 5782 for unsecured communications. When the `TPDSOCKSSL` environment variable or `-sockssl` global option is set, the socket port defaults to 5783.

Setting the TPDSOCKSSL environment variable on Unix, Linux, HP-UX, AIX, or Solaris

Procedure

To set the `TPDSOCKSSL` environment variable in Linux, HP-UX, AIX, or Solaris, see the following system output example:

```
$ TPDSOCKSSL=1
$ export TPDSOCKSSL
$ cli
```

Setting the TPDSOCKSSL environment variable on Microsoft Windows

Procedure

1. On the taskbar, click the **Start** > **Settings** > **Control Panel**.
2. In **Control Panel**, double-click the **System** icon.
3. In the **System Properties** dialog box, click the **Advanced** tab.
4. Click **Environment Variables**.
5. Enter `TPDSOCKSSL` in the **Variable** box.
6. Enter `1` in the **Value** box.
7. Click **OK**.

Using the `-sockssl` option

Procedure

A secure CLI connection is also available for single instances of a command. On the command line, enter `-sockssl` following the command name. See the following example:

```
$ createuser -sockssl
```

The `TPDSYSNAME` environment variable

After setting the system name, you will not be prompted for your system name when running the CLI, which can be useful for scripting.

You can specify the system name in the following three ways:

- Set the `TPDSYSNAME` environment variable. See:
  - **Setting the TPDSYSNAME environment variable on Unix, Linux, HP-UX, AIX, or Solaris** on page 28
  - **Setting the TPDSYSNAME environment variable on Microsoft Windows** on page 29
- Use the `-sys` command-line global option. See **Using the -sys option** on page 29.
- Enter the system name when prompted. See **Using the system name** on page 29.

Setting the `TPDSYSNAME` environment variable on Unix, Linux, HP-UX, AIX, or Solaris

Procedure

To set the environment variable on Linux, HP-UX, AIX, or Solaris, see the following system output example. Substitute your system name for `<sysname>` and use the correct syntax for your shell.

```
$ TPDSYSNAME=<sysname>
$ export TPDSYSNAME
$ cli
```

Setting the TPDSYSNAME environment variable on Microsoft Windows

Procedure

- To set the environment variable in Microsoft Windows for one instance of a **Command Prompt** window, run `set TPDSYSNAME=<sysname>`. Substitute `<sysname>` with the name of your system. The environment variable remains in effect for that window until you exit that window.
- To set the environment variable in Microsoft Windows indefinitely and for all newly created **Command Prompt** windows:

  1. Perform Step **1** through Step **4** of the procedure for setting the `TPDSOCKSSL` environment variable in Microsoft Windows as described in **Using SSL** on page 27.
  2. In the **Environment Variable** dialog box, enter `TPDSYSNAME` in the **Variable** box.
  3. Enter your system name in the **Value** box.
  4. Click **OK**.

Using the -sys option

The global option `-sys` (system) overrides any setting of the environment variable `TPDSYSNAME`.

Procedure

On the command line, enter `-sys` after the command name, followed by your system name. See the following output example. Substitute your system name for `<system1>`.

```
$ showhost -sys <system1>
```

Using the system name

If the environment variable `TPDSYSNAME` is not set and the `-sys` option is not used, the system prompts for the system name.

Procedure

To use the system name, see the following output example. Substitute your system name for `<system1>`.

```
$ cli
system: <system1>
```

HPE 3PAR CLI server certificate validation

When connecting with SSL, the HPE 3PAR CLI client attempts to validate the CLI server certificate using the certificate file. If the HPE 3PAR CLI client is not validated with the certificate file, then it will attempt the validation with the exception file.

The certificate file contains the certificate that validates the HPE 3PAR CLI server certificate. The user creates this file, which must be in PEM format. The user can retrieve the self-signed CLI server certificate using the `showcert` command with the `-pem` option and save it in the certificate file. The exception file

contains the information that is necessary to validate the HPE 3PAR CLI server certificate. The HPE 3PAR CLI client creates this file.

The default certificate file and exception files and their paths are shown in **Table 4: Default certificate file and exception file for Microsoft Windows** on page 30 and in **Table 5: Default certificate file and exception file for Linux, HP-UX, AIX, or Solaris** on page 30. These default values can be overridden by command-line options or by environment variables.

NOTE: The directory path has changed for the 3.3.1 version. If you are performing an upgrade, you must copy the files from the old location to the new one. If you are using a new CLI to manage many versions of 3PAR data, you must use the new locations. See the following tables for details.

Table 4: Default certificate file and exception file for Microsoft Windows

File	Default value

Default certificate file	Earlier than HPE 3PAR OS 3.3.1:
	`%USERPROFILE%\.hp3par\cert`
	With HPE 3PAR OS 3.3.1:
	`%USERPROFILE%\.hpe3par\cert`

Exception file	Earlier than HPE 3PAR OS 3.3.1:
	`%USERPROFILE%\.hp3par\excp`
	With HPE 3PAR OS 3.3.1:
	`%USERPROFILE%\.hpe3par\excp`

Table 5: Default certificate file and exception file for Linux, HP-UX, AIX, or Solaris

File	Default value

Default certificate file	Earlier than HPE 3PAR OS 3.3.1:
	`$HOME/.hp3par/cert`
	With HPE 3PAR OS 3.3.1:
	`$HOME/.hpe3par/cert`

Exception file	Earlier than HPE 3PAR OS 3.3.1:
	`$HOME/.hp3par/excp`
	With HPE 3PAR OS 3.3.1:
	`$HOME/.hpe3par/excp`

The `-certdir` global option and the `TPDCERTDIR` environment variable can be used to specify the directory (`<certdir>`) in which the certificate and the exception files are located. The default value is `%USERPROFILE%\.hpe3par` on Microsoft Windows and `$HOME/.hpe3par` on Linux, HP-UX, AIX, or Solaris. CLI client assumes `<certdir>/cert` and `<certdir>/excp` as the certificate file and the exception file, respectively (`<certdir>\cert` and `<certdir>\excp` on Windows).

The `-certfile` global option and the `TPDCERTFILE` environment variable can be used to specify the certificate file independently of where the exception file is located. Use of the `-certfile` global option or

the TPDCERTFILE environment variable is useful when the same certificate file is shared among multiple users.

- The TPDCERTDIR environment variable. See:
  - **Setting the TPDCERTFILE environment variable on Unix, Linux, HP-UX, AIX, or Solaris** on page 31
  - **Setting the TPDCERTFILE environment variable on Microsoft Windows** on page 31
- The -certdir global option. See **Using the -certdir option** on page 32.

Setting the TPDCERTFILE environment variable on Unix, Linux, HP-UX, AIX, or Solaris

The TPDCERTFILE variable will override the TPDCERTDIR variable.

Procedure

To set the TPDCERTFILE environment variable on Linux, HP-UX, AIX, or Solaris, see the following system output example. Substitute the name of your certificate file name for certfile1 and use the correct syntax for your shell.

```
$ TPDCERTFILE=certfile1
$ export TPDCERTFILE
$ cli
```

Setting the TPDCERTFILE environment variable on Microsoft Windows

To set the TPDCERTFILE environment variable in Microsoft Windows, see the following procedure. The TPDCERTFILE variable will override the TPDCERTDIR variable.

Procedure

1. Perform Step **1** through Step **4** of the procedure for setting the TPDSOCKSSL environment variable in Microsoft Windows as described in **Using SSL** on page 27.
2. In the **Environment Variable** dialog box, enter TPDCERTFILE in the **Variable** box.
3. Enter the certificate file name in the **Value** box.
4. Click **OK**.

Using the -certfile option

The -certfile option will override the -certdir option.

Procedure

To specify the certificate file, use the -certfile global option followed by the name of the certificate file. Substitute your certificate file name for <certfile1>.

```
$ cli -certfile <certfile1>
```

Saving a certificate file to a directory

You can save a certificate exception file to a directory where the HPE 3PAR CLI server will look for certificate information with either of the following methods:

- The `TPDCERTDIR` environment variable. See:
  - **Setting the TPDCERTDIR environment variable on Unix, Linux, HP-UX, AIX, or Solaris** on page 32
  - **Setting the TPDCERTDIR environment variable on Microsoft Windows** on page 32
- The `-certdir` global option. See **Using the -certdir option** on page 32.

When the CLI server certificate is not verified by the certificate file, the HPE 3PAR CLI looks for this information in the certificate exception file.

Setting the `TPDCERTDIR` environment variable on Unix, Linux, HP-UX, AIX, or Solaris

Procedure

To set the `TPDCERTDIR` environment variable on Linux, HP-UX, AIX, or Solaris, see the following system output example. Substitute the name of your certificate file name for `certdir1` and use the correct syntax for your shell.

```
$ TPDCERTDIR=certdir1
$ export TPDCERTDIR
$ cli
```

Setting the `TPDCERTDIR` environment variable on Microsoft Windows

Procedure

1. Perform Step **1** through Step **4** of the procedure for setting the `TPDSOCKSSL` environment variable in Microsoft Windows as described in **Using SSL** on page 27.
2. In the **Environment Variable** dialog box, enter `TPDCERTDIR` in the **Variable** box.
3. Enter the directory where the certificate file will be saved in the **Value** box.
4. Click **OK**.

Using the `-certdir` option

Procedure

To specify the directory in which the certificate file and the exception file are located, use the `-certdir` global option followed by the name of the directory. See the following example. Substitute your certificate directory name for `<certdir1>`.

```
$ cli -certdir <certdir1>
```

Suppressing the certificate verification prompt

You can suppress a prompt from the CLI client in cases where the CLI server certificate is not validated by either the certificate file or the exception file. Suppressing the prompt can be useful when the CLI client is used as part of a batch process, such as in a shell script. After you suppress the prompt, the CLI client prints an error message and exits.

To suppress the 3PAR CLI prompt, use one of the following methods:

Procedure

- The `TPDNOCERTPROMPT` environment variable. See:
  - **Setting the TPDNOCERTPROMPT environment variable on Unix, Linux, HP-UX, AIX, or Solaris** on page 33
  - **Setting the TPDNOCERTPROMPT environment variable on Microsoft Windows** on page 33
- The `-nocertprompt` global option. See **Using the -nocertprompt option** on page 33.

Setting the `TPDNOCERTPROMPT` environment variable on Unix, Linux, HP-UX, AIX, or Solaris

Procedure

To set the `TPDNOCERTPROMPT` environment variable on Linux, HP-UX, AIX, or Solaris, see the following system output example.

```
$ TPDNOCERTPROMPT=1
$ export TPDNOCERTPROMPT
$ cli
```

Setting the `TPDNOCERTPROMPT` environment variable on Microsoft Windows

Procedure

1. Perform Step **1** through Step **4** of the procedure for setting the `TPDSOCKSSL` environment variable in Microsoft Windows as described in **Using SSL** on page 27.
2. In the **Environment Variable** dialog box, enter `TPDNOCERTPROMPT` in the **Variable** box.
3. Enter the `1` for the certificate file in the **Value** box.
4. Click **OK**.

Using the `-nocertprompt` option

Procedure

To suppress prompt by CLI client when the CLI server certificate is not validated use the `-nocertprompt` global option followed by the name of the certificate file common name. See the following example.

```
$ cli -nocertprompt
```

Client bytecode cache directory

Client bytecode contains most of the functionality of the HPE 3PAR CLI and is version-specific. The CLI caches the code required for communication for each different version of the HPE 3PAR OS running on the system. The `TPDCACHEDIR` environment variable controls the location of the cache directory used by the CLI to determine the version of the HPE 3PAR OS running on the system.

The `TPDCACHEDIR` environment variable is set differently in Linux, HP-UX, AIX, or Solaris, and in Microsoft Windows.

For more information, see:

- **Setting the TPDCACHEDIR environment variable in Linux, HP-UX, AIX, or Solaris** on page 34
- **Setting the TPDCACHEDIR environment variable in Microsoft Windows** on page 34

Setting the `TPDCACHEDIR` environment variable in Linux, HP-UX, AIX, or Solaris

Procedure

To set the `TPDCACHEDIR` environment variable in Unix, Linux, HP-UX, AIX, or Solaris, see the following system output example. Substitute the name of your cache directory for `cache1` and use the correct syntax for your shell.

```
$ TPDCACHEDIR=cache1
$ export TPDCACHEDIR
$ cli
```

Setting the `TPDCACHEDIR` environment variable in Microsoft Windows

Procedure

1. Perform Step **1** through Step **4** of the procedure for setting the `TPDSOCKSSL` environment variable in Microsoft Windows as described in **Using SSL** on page 27.
2. In the **Environment Variable** dialog box, enter `TPDCACHEDIR` in the **Variable** box.
3. Enter the cache directory name in the **Value** box.
4. Click **OK**.

Setting startup files with `TPDSTARTFILE`

Startup files can be used to load user-defined procedures and commands. Setting the `TPDSTARTFILE` environment variable causes the CLI to use a specific startup file when starting the CLI.

The `TPDSTARTFILE` environment variable is set differently in Linux, HP-UX, AIX, or Solaris, and Microsoft Windows.

More information:

Setting the TPDSTARTFILE environment variable in Unix, Linux, HP-UX, AIX, or Solaris on page 34

Setting the TPDSTARTFILE environment variable in Microsoft Windows on page 35

Setting the `TPDSTARTFILE` environment variable in Unix, Linux, HP-UX, AIX, or Solaris

Procedure

To set the `TPDSTARTFILE` environment variable in Linux, HP-UX, AIX, or Solaris, see the following system output example. Substitute the name of your startup file for `<startfile1>` and use the correct syntax for your shell.

```
$ TPDSTARTFILE=<startfile1>
$ export TPDSTARTFILE
$ cli
```

Setting the TPDSTARTFILE environment variable in Microsoft Windows

Procedure

1. Perform Step **1** through Step **4** of the procedure for setting the TPDSOCKSSL environment variable in Microsoft Windows as described in **Using SSL** on page 27.
2. In the **Environment Variable** dialog box, enter TPDSTARTFILE in the **Variable** box.
3. Enter the startup file name in the **Value** box.
4. Click **OK**.

Comma-separated values

HPE 3PAR CLI output can be configured to display comma-separated values so that data can be easily input into spreadsheets. To set the output display, use one of the following methods:

- The TPDCSVTABLE environment variable. See:
  - **Setting the TPDCSVTABLE environment variable in Unix, Linux, HP-UX, AIX, or Solaris** on page 35
  - **Setting the TPDCSVTABLE environment variable in Microsoft Windows** on page 36
- The -csvtable global option. See **Setting the -csvtable option** on page 36.
- The setclienv csvtable command, if the output display is being set within the Tcl shell; for details about this command, see the *HPE 3PAR Command Line Interface Reference*, available at the following website:

  Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Once set, data is displayed as shown in the following example:

```
cli% showvv -csvtable
,,,,,,,,,,-Rsvd(MiB)-,,-(MiB)--
Id,Name,Prov,Compr,Dedup,Type,CopyOf,BsId,Rd,-Detailed_State-,Snp,Usr,VSize
3,.shared.cpg1_0,dds,NA,No,base,---,3,RW,normal,0,512,67108864
2, dedup.1,tdvv,No,Yes,base,---,2,RW,normal,0,512,17408
4, dedup.2,tdvv,No,Yes,base,---,4,RW,normal,0,512,17408
1,.srdata,full,NA,NA,base,---,1,RW,normal,0,153600,153600
0,admin,full,NA,NA,base,---,0,RW,normal,0,10240,10240
6,compr_tpvv.1,tpvv,Yes,No,base,---,6,RW,normal,0,512,17408
5,cpvv.1,full,NA,NA,base,---,5,RW,normal,0,17408,17408
-----------------------------------------------------------------------------------------------
7,total,,,,,,,,0,183296,67342336
```

Setting the TPDCSVTABLE environment variable in Unix, Linux, HP-UX, AIX, or Solaris

Procedure

To set the TPDCSVTABLE environment variable in Linux, HP-UX, AIX, or Solaris, see the following system output example:

```
$ TPDCSVTABLE=1
$ export TPDCSVTABLE
$ cli
```

Setting the `TPDCSVTABLE` environment variable in Microsoft Windows

Procedure

1. Perform Step **1** through Step **4** of the procedure for setting the `TPDSOCKSSL` environment variable in Microsoft Windows as described in **Using SSL** on page 27.
2. In the **Environment Variable** dialog box, enter `TPDCSVTABLE` in the **Variable** box.
3. Enter `1` in the **Value** box.
4. Click **OK**.

Setting the `-csvtable` option

Procedure

To set the `-csvtable` global option, issue the following command:

```
$ cli -csvtable
```

Listing domains

If you are using the HPE 3PAR Virtual Domains or HPE 3PAR All-inclusive Single-System software license, you can configure data output to display a domain column. You can configure the output by using the following:

- The `TPDLISTDOM` environment variable. See:
  - **Setting the TPDLISTDOM environment variable in Unix, Linux, HP-UX, AIX, or Solaris** on page 37
  - **Setting the TPDLISTDOM environment variable in Microsoft Windows** on page 37
- The `-listdom` global option. See **Setting the -listdom option** on page 37.
- The `setclienv listdom` command—if changing within the Tcl shell; for details about this command, see the *HPE 3PAR Command Line Interface Reference*, available at the following website:

  Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

The following example displays CLI output with the domain column:

```
$ showvv -listdom
                                                                    ---Rsvd(MB)--- -(MB)-
Id Name         Domain  Prov Type  CopyOf  BsId Rd -Detailed_State- Adm Snp Usr VSize_MB
0 admin         Dom001  full base ---        0 RW normal             0   0 10240 10240
...
30 V3              -    full base ---       30 RW normal            96 256 1024 1024
31 V3.ro           -    snp vcopy V3        30 RO normal            -- --    -- 1024
29 VV5             -    full base ---       29 RW normal            96 256 1024 1024
32 VV5.ro          -    snp vcopy VV5       29 RO normal            -- --    -- 1024
17 VV_TeamCPG_1 Dom001  full base ---       17 RW normal             0   0  2048 2048
18 VV_TeamCPG_2 Dom001  full base ---       18 RW normal             0   0  2048 2048
8 vvfromcpg2.0  Dom001  full base ---        8 RW normal             0   0  2048 2048
9 vvfromcpg2.1  Dom001  full base ---        9 RW normal             0   0  2048 2048
```

```
-------------------------------------------------------------------------------
22 total                                                  960 1536 42752 48896
```

NOTE: If you previously did not use domains and have pre-existing scripts in place, you may not wish to configure your output to display domains because your scripts may be adversely affected.

More information:

Activating a software license on page 13

Setting the TPDLISTDOM environment variable in Unix, Linux, HP-UX, AIX, or Solaris

Procedure

To set the `TPDLISTDOM` environment variable in Linux, HP-UX, AIX, or Solaris, see the following system output example:

```
$ TPDLISTDOM=1
$ export TPDLISTDOM
$ cli
```

Setting the `TPDLISTDOM` environment variable in Microsoft Windows

Procedure

1. Perform Step **1** through Step **4** of the procedure for setting the `TPDSOCKSSL` environment variable in Microsoft Windows as described in **Using SSL** on page 27.
2. In the **Environment Variable** dialog box, enter `TPDLISTDOM` in the **Variable** box.
3. Enter `1` in the **Value** box.
4. Click **OK**.

Setting the `-listdom` option

Procedure

To set the global `-listdom` option, issue the following command:

```
$ cli -listdom
```

Table headers and totals

HPE 3PAR CLI output can be configured to either display or not display column headings and totals. If you are using scripts, you may want to set the CLI output to omit the display of headings and totals to facilitate parsing by your scripts. Options and environment variables including "`no`" indicate that headings and totals are not displayed. To set the output display, use:

- The `TPDNOHDTOT` or `TPDHAFTER` environment variables. See:

- **Setting the TPDNOHDTOT or TPDHAFTER environment variable in Unix, Linux, HP-UX, AIX, or Solaris** on page 38
- **Setting the TPDNOHDTOT or TPDHAFTER environment variable on Microsoft Windows** on page 38

- The `-nohdtot` or `-hafter` global options. See:
  - **Setting the -nohdtot option** on page 39
  - **Setting the -hafter option** on page 39
- The `setclienv -nohdtot` or `setclienv -hafter` commands (if changing within the Tcl shell). For details about this command, see the *HPE 3PAR Command Line Interface Reference*, available at the following website:

  Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

The following example displays CLI output with column headings and totals:

```
cli% showvv -nohdtot
0 admin          Dom001    full base ---        0 RW normal       0   0 10240 10240
...
30 V3               -      full base ---        30 RW normal      96 256 1024 1024
31 V3.ro            -      snp vcopy V3         30 RO normal      -- --    -- 1024
29 VV5              -      full base ---        29 RW normal      96 256 1024 1024
32 VV5.ro           -      snp vcopy VV5        29 RO normal      -- --    -- 1024
17 VV_TechPubs_1 Dom001    full base ---        17 RW normal      0   0  2048 2048
18 VV_TechPubs_2 Dom001    full base ---        18 RW normal      0   0  2048 2048
8 vvfromcpg2.0  Dom001     full base ---         8 RW normal      0   0  2048 2048
9 vvfromcpg2.1  Dom001     full base ---         9 RW normal      0   0  2048 2048
```

Setting the TPDNOHDTOT or TPDHAFTER environment variable in Unix, Linux, HP-UX, AIX, or Solaris

Procedure

Substitute `TPDHAFTER` for `TPDNOHDTOT` in the following example, as necessary.

```
$ TPDNOHDTOT=1
$ export TPDNOHDTOT
$ cli
```

Setting the TPDNOHDTOT or TPDHAFTER environment variable on Microsoft Windows

Procedure

1. Perform Step **1** through Step **4** of the procedure for setting the `TPDSOCKSSL` environment variable in Microsoft Windows as described in **Using SSL** on page 27.
2. In the **Environment Variable** dialog box, enter `TPDNOHDTOT` or `TPDHAFTER` in the **Variable** box.
3. Enter `1` in the **Value** box.
4. Click **OK**.

Setting the `-nohdtot` option

Procedure

To set the global `-nohdtot` option, issue the following command:

```
$ cli -nohdtot
```

Setting the `-hafter` option

Procedure

To set the global `-hafter` option, see the following example:

```
$ cli -hafter 20
```

Forcing commands

A number of CLI commands have confirmation prompts before executing the command operations. For these commands, an `-f` option is provided allowing you to bypass the confirmation and force the execution of the command. The `TPDFORCE` environment variable automatically provides the functionality of the `-f` option and alleviates the need of having to specify the `-f` option when issuing commands that would otherwise require a confirmation.

The `TPDFORCE` environment variable is set differently in Linux, HP-UX, AIX, or Solaris, and Microsoft Windows.

More information:

Setting the TPDFORCE environment variable in Unix, Linux, HP-UX, AIX, or Solaris on page 39

Setting the TPDFORCE environment variable in Microsoft Windows on page 39

Setting the `TPDFORCE` environment variable in Unix, Linux, HP-UX, AIX, or Solaris

Procedure

To set the `TPDFORCE` environment variable in Linux, HP-UX, AIX, or Solaris, see the following system output example:

```
$ TPDFORCE=1
$ export TPDFORCE
$ cli
```

Setting the `TPDFORCE` environment variable in Microsoft Windows

Procedure

1. Perform Step **1** through Step **4** of the procedure for setting the `TPDSOCKSSL` environment variable in Microsoft Windows, as described in **Using SSL** on page 27.
2. Enter `TPDFORCE` in the **Variable** box.
3. Enter `1` in the **Value** box.
4. Click **OK**.

Stand-alone commands

There are two ways to issue CLI commands from a shell prompt in Linux, HP-UX, AIX, or Solaris, or from a Windows command prompt:

- CLI commands can be executed like typical UNIX and MS-DOS commands.
  - If the CLI commands are run as individual commands, you are prompted for your user name and password for each command.
  - If you are running the CLI commands as individual commands, you can put each command in a script or pipe them to other commands. You can use the shell of your choice for scripting or for initiating interactive sessions that provide history and line editing capabilities.
- You can enter `cli` at the DOS or at the Linux, HP-UX, AIX, or Solaris prompt to run the `cli` program. Running this program places you into an interactive Tcl shell where all CLI commands are available.
  - The Tcl shell connects to the system and remains connected until you exit from the shell or until the CLI session times out (when idle for the time period defined by the system parameter `SessionTimeout`). While the Tcl shell is connected, you are not prompted for your user name and password for each command you issue.
  - The Tcl shell provides access to the Tcl language that allows you to write Tcl procedures or source Tcl scripts that build on top of CLI commands.

NOTE: Help is available to display information about CLI commands. If you started the CLI with the `cli` command, you can obtain help by entering either `help` or `clihelp`. When you run individual CLI commands from the native shell of a system, use `clihelp`.

For details about HPE 3PAR CLI commands, see also the *HPE 3PAR Command Line Interface Reference*, available on the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Secure Shell (SSH)

The system is provided with Secure Shell (SSH) protocol version 2 that enables great flexibility in accessing the HPE 3PAR CLI and provides an alternative to installing the remote CLI client. SSH uses strong symmetric encryption to encrypt all traffic between the client and the server. SSH allows the use of encrypted passwords, or public/private keys for authentication of the user.

SSH client applications are typically provided with the following operating systems:

- AIX
- HP-UX
- Linux
- Solaris

For Microsoft Windows users, an SSH client is available at the following website:

http://www.openssh.org

Benefits of using SSH

SSH provides the following benefits:

- No HPE 3PAR CLI installation. HPE 3PAR CLI clients are not required to access and use the HPE 3PAR CLI (assuming SSH client is installed).
- No version matching. The HPE 3PAR CLI and HPE 3PAR OS versions do not need to match because the CLI does not need to be installed remotely.
- Strong encryption. All information exchanged between client machines and systems is encrypted.
- Data integrity. Integrity checking is executed to verify that data has not been altered during transmission from sender to receiver.
- Server authentication. The system can be authenticated using the public key authentication scheme. The public key for the system can be stored on client machines, allowing the SSH client to compare the key presented by the system to the key stored on the client machine.

Accessing the 3PAR CLI using SSH

NOTE: The following screen examples display output for UNIX systems. Microsoft Windows screens are identical, with DOS prompts replacing UNIX prompts.

The total number of connections depends on the model of storage system and the amount of memory.

Procedure

1. From any host that is running SSH client, issue the following command:

   ```
   $ ssh user@<System-host-name>
   ```

   Where:

   - `ssh user` is the first default user with `super` rights.
   - `<System-host-name>` is the array host name.

2. During the first login from the client host (for example, when the host does not already have a system public key for identity), expect the following message:

   ```
   The authenticity of host <System-host-name> can't be established.

    RSA key fingerprint is 68:a6:c9:60:a1:cb:….

   Are you sure you want to continue connecting (yes/no): yes
   ```

   When prompted to continue, enter `yes`.

   Displaying this message is normal SSH behavior, because the client host does not have the public key of the system. If the public key of the system has previously been stored on the client host, this message will not be displayed. After you have set the key, this message will not be displayed.

   NOTE: The validity of the key fingerprint presented at this point can be verified by using the public keys provided as part of the HPE 3PAR administration tools. These keys can be installed with the administration tools or can be obtained directly from the 3PAR Administration Tools CD. Consult the SSH client documentation for instructions on creating a key fingerprint from the public key.

3. When prompted, enter the default password. If you do not have the password, contact your service provider.
4. After you enter the password, the CLI prompt appears.

```
<System-host-name> cli %
```

In the previous example, `System-host-name` is the cluster name or name of the system.

You are now in the CLI shell and can issue the HPE 3PAR CLI commands that are documented in this manual.

5. To create additional CLI users, use the `createuser` command. For more information, see **Creating the first CLI user account** on page 53.
6. Terminate the CLI session by entering `exit` at the prompt.

```
<System-host-name> cli % exit
```

Newly created CLI users can access the CLI by following these instructions, while substituting their own user name, system name, and password when prompted.

CLI scripting through SSH

You can use SSH public key authentication to issue CLI commands in scripts. No password is required; however, you will need to generate a public/private key pair.

CAUTION: For security purposes, the file containing the private key must be protected from unauthorized access. Failure to protect the file can cause the key to be compromised.

- The public key must be stored on the system using the `setsshkey` command to enable users to log in without a password.
- The private key must be kept in a file accessible by scripts that use CLI commands.

The key pair is generated by using the **ssh–keygen** utility (typically included in an SSH client software package and available on UNIX and Microsoft Windows platforms).

NOTE: The following screen examples show output for UNIX systems. Microsoft Windows screens are similar, with DOS prompts replacing UNIX prompts.

Procedure

1. Create a CLI user and password using the `createuser` command.

```
$ssh user1@system1
user1 password: ******
system1 cli% createuser –c testpw3 user3 all browse
User created
```

In the previous example, user `user1` logs in to system `system1` and creates user `user3` with the password `testpw3`.

2. Create a key pair using the **ssh–keygen** utility. Both `rsa` and `dsa` key formats are supported by the system, and the recommended key length is at least 2048 bits. The RSA key format is more secure and therefore preferred over the DSA key format.

NOTE: For additional information about the **ssh–keygen** utility and the `rsa` and `dsa` key formats, consult the SSH client documentation.

To create a key pair using `rsa` format:

```
$ ssh-keygen -b 2048 -t rsa
```

To create a key pair using `dsa` format:

```
$ ssh-keygen -b 2048 -t dsa
Generating public/private dsa key pair.
Enter file in which to save the key (/home/usr/user3/.ssh/id_dsa):
Created directory '/home/usr/user3/.ssh'.
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/usr/user3/.ssh/id_dsa.
Your public key has been saved in /home/usr/user3/.ssh/id_dsa.pub.
The key fingerprint is:
3f:a0:b5:6a:4d:dd:45:76:37:fb:a3:3e:52:44:55:32 user3@3pardata.com
```

The **ssh–keygen** utility generates two files: `id_dsa` (private) and `id_dsa.pub` (public) (or `id_rsa` and `id_rsa.pub`).

- Generate the key with or without a passphrase.
  - When the key is generated with a passphrase, your private key is encrypted and stored in the file.

    NOTE: The passphrase must be entered and the private key decrypted before a script is run. To decrypt the private key, run the `ssh-agent` and `ssh-add` commands (see Step **6**).

  - When a passphrase is not specified, the key is stored unencrypted in the file.
- Ensure that only the owner has access and read/write permission on the private key file; otherwise the SSH client refuses the key file.

3. Log in to a system from any system with the SSH client installed.

```
$ssh user3@system1
user3@system1's password: testpw3
```

4. Issue the `setsshkey` command.

```
system1 cli% setsshkey
setsshkey

Please enter the SSH public key below. When finished, press enter twice.
The key is usually long. It's better to copy it from inside an editor
and paste it here. (Please make sure there are no extra blanks.)
The maximum number of characters used to represent the SSH key
(including the "from" option, key type, and additional comments) is 4095.

ssh-rsa AF5afPdciUTJ0PYzB6msRxFrCuDSqDwPshqWS5tGCFSoSZdE= user3's pubic key

 SSH public key successfully set!
```

5. Write your script. See the following example:

```
#!/bin/sh
# Assume that the user name "user3" exists on system1
# The private key file "id_rsa" is accessible.
SSH="ssh -i id_rsa -l user3 system1 "
#
# Execute the command passed in as command line argument $1
${SSH} $1
```

NOTE: You can redirect the standard input to execute multiple HPE 3PAR CLI commands by using the following command:

```
$ ssh user3@system1 < commands
```

Where `commands` is a file with a list of HPE 3PAR CLI commands.

6. If you specified a passphrase when creating the key pair, issue the `ssh-agent` and `ssh-add` commands to decrypt the key before running your script (`<script_name>` in the following example).

```
$ ssh-agent

echo Agent pid 24216

$ ssh-add

Enter passphrase for /home/usr/user3/.ssh/id_dsa: ******

Identity added: /home/usr/user3/.ssh/id_dsa (/home/usr/user3/.ssh/id_dsa)

$ <script_name>
```

SSL certificates

When you install the HPE 3PAR CLI on a new storage server, the installation creates a self-signed 2048-bit RSA Secure Sockets Layer (SSL) certificate.

When you upgrade the HPE 3PAR OS on an existing storage system that operates through HPE 3PAR Service Processor (SP), the upgrade also creates an SSL certificate. The SP administrator must distribute the certificate information to users of the storage system. When users log into the CLI client for the first time, they can accept the new certificate.

An administrator with `super` role access may re-create a certificate using the `createcert` command. A user with any role can view the certificate with the `showcert` command. For a complete list of options available for the `createcert` and `showcert` commands, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*. These documents are available at the following website:

A common certificate is created for CIM, CLI, and WSAPI services. The CIM and WSAPI services are restarted when a self-signed certificate is generated. Data at rest encryption with an external key manager (EKM) uses the `ekm-client` and `ekm-server` services. The external key manager services and `syslog` services (`syslog_gen_client`, `syslog_gen_server`, `syslog_sec_client`, and `syslog_sec_server`) are not covered by the `unified-server` service.

More information

Using external key management servers on page 174

Importing SSL certificates

Use the `importcert` command to import certificates for specified services. You can import a certification authority (CA) bundle containing the intermediate and root CA before importing the service certificate. Import the CA bundle with or without the service certificate.

Procedure

- To import the CA bundle for a service, issue the following command:
  `importcert <SSL_service> <service cert> [<CA bundle>]`
- To import the CA bundle without the service certificate, issue the following command:
  `importcert <SSL_service> -ca <CA bundle>`

Where:

- `<SSL_service>` specifies the service for which you are importing the certificate. Valid service names are:
  - `cim`
  - `cli`
  - `ekm-client`
  - `ekm-server`
  - `ldap`
  - `syslog_gen_client`
  - `syslog_gen_server`
  - `syslog_sec_client`

- syslog_sec_server
- unified-server
- vasa
- wsapi

- <service cert> specifies the certificate for the SSL service.
- <CA bundle> specifies the file name of the CA bundle.
- -ca specifies that you are importing a CA bundle without importing a service certificate.

For a list of importcert command options, see the HPE 3PAR CLI *Help*, or see the *HPE 3PAR Command Line Interface Reference*, available from the Hewlett Packard Enterprise Information Library.

Removing SSL certificates

Procedure

- To remove certificates that are no longer trusted, issue the importcert <SSL_service> <service cert> [<CA bundle>] to overwrite an existing certificate or the removecert {all| <SSL_service>} [-type <type_name>] command where:
  - all specifies you are removing certificates for all services.
  - <SSL_service> specifies the service for which you are removing the certificate. The valid service names are: cim, cli, ekm-client, and ekm-server, ldap, wsapi, unified-server, vasa.
  - -type <type_name> limits the removal of certificates to the specified type of SSL service. The valid service types are: csr, cert, intca, and rootca.

For a complete list of options available for the removecert command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available from the Hewlett Packard Enterprise Information Library.

Using a self-signed certificate

You can use self-signed certificates for services like the VASA Provider for VMware and CIM.

Procedure

1. Generate the self-signed certificate by using the createcert <SSL_service> -selfsigned [-keysize <key_size>] [-days <days_valid>] [-C <country_code>] [-ST <state>] [-L <locality>] [-O <organization>] [-OU <organizational_unit>] [-CN <common_name>] -SAN {DNS:<dns_name> | IP:<ip_address>} command, where:
   - <SSL_service> -selfsigned stipulates that a self-signed certificate is to be created for the SSL service.
   - <key_size> specifies the size in bits of the encryption key for the self-signed certificate. Valid values are 1024 and 2048. The default value is 2048.
   - <days_valid> specifies how many days the self-signed certificate is valid. Valid numbers are between 1 and 3650 days (10 years). The default value is 1095 days (3 years).

- <country_code> specifies the value of the country/region (C) field of the DN for the subject of the certificate.
- <state> specifies the value of the state (ST) field of the DN for the subject of the certificate.
- <locality> specifies the value of the locality (L) field of the DN for the subject of the self-signed certificate.
- <organization> specifies the value of the organization (O) field of the DN for the subject of the certificate.
- <organizational_unit> specifies the value of organizational unit (OU) field of the DN for the subject of the certificate.
- <common_name> specifies the value of the common name (CN) field of the DN for the subject of the certificate. When this option is not used, the default is: 3PAR <model> <serial>, where <model> and <serial> are the system model name and the serial number of the HPE 3PAR StoreServ Storage system for which the self-signed certificate is created. Over SSH connections, a value for the -CN option must be specified.
- -SAN DNS:<dns_name> | IP:<ip_address>

  NOTE: The -SAN DNS:<dns_name> | IP:<ip_address> is required only for the VMware VASA Provider service.

  The -SAN DNS:<dns_name> | IP:<ip_address> specifies, for the subject alternative name of the certificate, a DSN name or IP address to associate with the certificate. -SAN must be specified when creating an SSL certificate, and the SAN type (DNS or IP) must match the format displayed in the URL output of showcert -service <SSL_service>.

2. Verify that the certificate management mode for the SSL service is set to server by using the showcert -service <SSL_service> -cert command. If the certificate management mode must be changed, issue the setvasa -certmgmt server command.

Using an SSL certificate for an array service

Procedure

1. Identify the SSL service URL for the array (either an IP address or a DNS name) by using the showcert <SSL_service> command.
2. A certificate signing request (CSR) by using the createcert <SSL_service> -csr [-keysize <key_size>] [-days <days_valid>] [-C <country_code>] [-ST <state>] [-L <locality>] [-O <organization>] [-OU <organizational_unit>] [-CN <common_name>] -SAN {DNS:<dns_name> | IP:<ip_address>} command, where:
   - <SSL_service> -csr stipulates that a certificate signing request is created in order to request an SSL certificate for use by the SSL service.
   - <key_size> specifies the size in bits of the encryption key for the self-signed certificate. Valid values are 1024 and 2048. The default value is 2048.
   - <days_valid> specifies how many days the self-signed certificate is valid. Valid numbers are between 1 and 3650 days (10 years). The default value is 1095 days (3 years).

- `<country_code>` specifies the value of the country/region (C) field of the DN for the subject of the certificate.
- `<state>` specifies the value of the state (ST) field of the DN for the subject of the certificate.
- `<locality>` specifies the value of the locality (L) field of the DN for the subject of the self-signed certificate.
- `<organization>` specifies the value of the organization (O) field of the DN for the subject of the certificate.
- `<organizational_unit>` specifies the value of organizational unit (OU) field of the DN for the subject of the certificate.
- `<common_name>` specifies the value of the common name (CN) field of the DN for the subject of the certificate. When this option is not used, the default is HPE 3PAR <model> <serial>, where <model> and <serial> are the system model name and the serial number of the HPE 3PAR StoreServ Storage system for which the self-signed certificate is created. Over SSH connections, a value for the `-CN` option must be specified.

  For the VASA Provider service, the `<common_name>` option can be any name that represents the array; there are no special syntax requirements. For other services, the `<common_name>` option might have stricter syntax requirements; it is usually the same as the FQDN of the array.
- (Optional) `-SAN DNS:<dns_name> | IP:<ip_address>` specifies for the subject alternative name of the certificate a DSN name or IP address to associate with the certificate.

  NOTE: The `-SAN DNS:<dns_name> | IP:<ip_address>` is required only for the VMware VASA Provider service.
- Send the output from the `createcert` command executed in the previous step to the CA. Different CA systems may have different procedures for this process. For specific instructions, see the CA procedures of your organization. You should receive in return a signed SSL certificate and a copy of the CA certificate.
- Import the certificates by executing the `importcert vasa <cert_filename> <CA_cert_filename>` command, where:
  - `vasa` specifies that the VASA Provider service is the service with which the imported certificate will be associated.
  - `<cert_filename>` specifies the file name of the SSL certificate received from the CA. Must be in the PEM certificate format.
  - `<CA_cert_filename>` specifies the file name of the Certificate Authority certificate. Must be in the PEM certificate format.

User account and connection management

Access to any HPE 3PAR StoreServ Storage system requires a user account. Each HPE 3PAR CLI user account is assigned a role, and each role is assigned a set of rights.

The roles and rights assigned to the HPE 3PAR CLI user determine which tasks the user can perform with a system.

For a complete list of Mapping roles and rights, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available from the Hewlett Packard Enterprise Information Library.

More information

Creating the first CLI user account on page 53
Removing a user from the storage system on page 54
Viewing user roles and rights on page 52

User accounts created by default

Depending on the services you use with HPE 3PAR StoreServ Storage, you can see the following HPE 3PAR CLI, default user accounts.

- **3paradm** – A user account with the `super` role. This user account is not used by Hewlett Packard Enterprise personnel. You can modify or delete this user account, or use it to create CLI users. Hewlett Packard Enterprise recommends changing the password of this user.
- **3parcim** – A user account with `browse` rights. Reserved for use by the 3PAR administrator tools. If you intend to use CIM, do not modify or delete the **`3parcim`** user account or password. If you do not intend to use CIM, you can modify or delete the account.
- **3parbrowse** – Required for communication between the SP and the HPE 3PAR StoreServ Storage system. This user account has `browse` rights, and includes a randomly generated password known only to the HPE 3PAR Service Processor code. No Hewlett Packard Enterprise personnel or service providers have access to this user account.
- **3paredit** – Required for communication between the SP and the HPE 3PAR StoreServ Storage system. This user account has `edit` rights, and includes a randomly generated password known only to the HPE 3PAR Service Processor code. No Hewlett Packard Enterprise personnel or service providers have access to this user account.
- **3parsvc** – Required by SP to either monitor or maintain HPE 3PAR StoreServ Storage across domains. This user account has the rights of a `super` user.

  If you are using SP to monitor the storage server, do not change the password. SP resets the default password to a randomized value known only to SP. Changing the password prevents SP from performing monitoring operations.

  If you are usingSP for maintenance activities only, you can change the password.

  When a maintenance activity takes place, set password for **`3parsvc`** to a defined value; after the maintenance, the SP changes the password to a randomized value again. Once the maintenance is complete, the password can again be changed.
- **3parservice** – Required for communication between SP and HPE 3PAR StoreServ Storage. Do not remove the **`3parservice`** user account. This user account has `service` rights. Hewlett Packard Enterprise personnel and authorized service providers use this account to perform service and diagnostic functions on the system through the interactive CLI. SP resets the default password to a randomized value known only to SP.

User roles and role assignments

Assign roles to users based on the tasks you intend the users to perform. The HPE 3PAR CLI includes defined roles for standard user activities and for extended user activities.

There is no functional difference between standard and extended roles. The extended roles define a set of rights optimized for CLI users with specialized or restricted tasks. For example, assigning the `create` role allows the user to create virtual volumes and other objects but does not allow the user to remove virtual volumes. To maintain greater control over your system, assign CLI users roles with the minimum set of rights necessary to perform their tasks.

CLI standard roles

`browse`

Rights are limited to read-only access.

`edit`

Rights are granted to most operations. For example, creating, editing, and removing virtual volumes and other objects.

`super`

Rights are granted to all operations.

`service`

Rights are limited to operations required to service the system. Allows limited access to user information and group resources.

CLI extended roles

`create`

Rights are limited to creating objects. For example, virtual volumes, CPGs, hosts, and schedules.

`CO`

The Compliance Officer (CO) has the rights to approve Compliance WORM changes.

`basic_edit`

Rights are similar to the `edit` role. For example, creating and editing virtual volumes and other objects. The rights to remove objects are more restricted for the `basic_edit` role than the `edit` role.

`3PAR_AO`

Rights are limited to internal use by Hewlett Packard Enterprise for HPE 3PAR Adaptive Optimization operations.

`3PAR_RM`

Rights are limited to internal use by Hewlett Packard Enterprise for HPE 3PAR Recovery Manager for VMware vSphere Software operations.

`audit`

Rights are limited to scanning the HPE 3PAR OS for security issues. An audit user has no access to the CLI.

3PAR CLI user authentication and authorization

HPE 3PAR CLI supports several categories of users, including local users, LDAP users, and domain users.

Local user – Accesses the system using HPE 3PAR CLI or or Secure Shell (SSH). The configuration of these services provides authentication and authorization.

LDAP user – Authenticated using information from a Lightweight Directory Access Protocol (LDAP) server.

Domain user – Accesses a specific domain.

For more information about user accounts, LDAP, and domains, see the *HPE 3PAR StoreServ Storage Concepts Guide*, available from the Hewlett Packard Enterprise Information Library.

More information

LDAP user connections on page 57

User login banner messages

HPE 3PAR CLI supports the use of banner messages that you can customize, up to 4,095 characters. Users of the HPE 3PAR CLI see the customized banner at login.

You can create separate user login banner messages for SSH and CLI users, or you can use the same message for both. Editing the banner message requires the `Super` role or an assigned `sshbanner_set` right. View, update, or remove the banner using CLI commands.

For additional information, see the *HPE 3PAR Command Line Interface Reference*, available from the Hewlett Packard Enterprise Information Library.

More information

Setting the login banner message on page 51
Displaying the login banner message on page 52
Removing the login banner message on page 52

Setting the login banner message

Use the `setbanner` command to create or update the message banner that displays when a user logs in. Set either the CLI banner, the SSH banner, or both, up to 4,095 characters.

Prerequisites

Requires any role granted `Super` or `sshbanner_set` rights.

Procedure

1. Log in to the system as `Super` user, or as any user with `sshbanner_set` permission.
2. Enter the following command, choosing one option:
   `setbanner [-cli|-ssh|-all]`

   `-cli`

   Sets the CLI banner.

   `-ssh`

   Sets the SSH banner.

   `-all`

   Sets both the CLI and SSH banners.
3. Enter the text that you want to display.

4. To save the message, press the Enter key on the keyboard.
5. Verify the banner text using the `showbanner` command.

Displaying the login banner message

Procedure

- Enter the `showbanner [-cli|-ssh|-all]` command, where:
  - `-cli`—Shows the CLI banner.
  - `-ssh`—Shows the SSH banner.
  - `-all`—Shows both the CLI and SSH banners.

Removing the login banner message

Procedure

1. Log in to the system as `Super` user, or as any user with `sshbanner_set` permission.
2. Enter the **`removebanner [-cli|-ssh|-all]`** command, where:
   - `-cli`—Removes the CLI banner.
   - `-ssh`—Removes the SSH banner.
   - `-all`—Removes both the CLI and SSH banners.

   A message displays, informing you that the banner has been removed.
3. To verify a successful banner removal, enter the `showbanner` command.

Viewing user roles and rights

To view information about the roles and rights defined on a system, use the `showrole` command. For more information about the `showrole` command, see the *HPE 3PAR Command Line Interface Reference*, available from the Hewlett Packard Enterprise Information Library.

Procedure

1. Log in as a user with any role in the system.
2. To view a list of the available roles on a system, enter the **`showrole`** command.
3. To view the rights assigned with a specific role, enter the following command:
   `showrole <role_name>`

   Use any*<role_name>* listed under the **`showrole`** command.
4. To view a list of the rights available on a system, enter the **`showrole -listrights`** command.

Creating the first CLI user account

When creating the first user, you must assign the `super` role, which includes the right to create users. Assigning limited rights to the first user restricts your ability to configure the system.

You cannot assign the `super` role to a user in a specific domain because the `super` user requires access to all domains.

Procedure

1. To create a first user with the right to create additional users, enter the **createuser *<username>*** command with the *<role>* specified as `super`.
   cli% createuser *user1 super*
2. To verify user creation, enter **showuser *<user_name>*** command.

More information

User login banner messages on page 51
HPE 3PAR Virtual Domains on page 87
Activating a software license on page 13

Creating users

Create user accounts with a username, password format, domain, and specific roles.

Procedure

1. Log in as `super` user or as any user with the `user_create` right.
2. Enter the following command: command.
   createuser -c *<password> <user_name> <domain_name> <role>*

   Use the appropriate options as follows:

   -c <password>

   Specify the user password in clear-text format, up to 32 characters. If the administrator has not defined a minimum password length, it defaults to 6. If you do not specify a password, the user is prompted to enter one.

   <user_name>

   Specify the name of the CLI account user, up to 31 characters. Valid characters include alphanumeric and the symbols period (`.`), dash (`-`), and underscore (`_`). The first character must be alphanumeric or an underscore for HPE 3PAR CLIusers. To access the system with an SSH connection, the first character of the user name must be alphanumeric.

   <domain_name>

   Specify the domain to which the user belongs up to 31 characters. If you are using virtual domains, specify the name of an existing domain in your system. If you are not using virtual domains, specify the `all` domain. Users with `super`, `create`, `basic_edit`, `3PAR_AO`, and `3PAR_RM` roles cannot be restricted to a domain, and always belong to the `all` domain.

<role>

Define the role assigned to the user. The roles and rights assigned to the CLI user determine which tasks a user performs with a system. For a list of available roles, use the **showrole -listrights** command.

3. To verify the user creation, enter the **showuser *<user_name>*** command.

More information

Creating the first CLI user account on page 53
Viewing user roles and rights on page 52

Viewing users and user details

The `showuser` command displays information about one or all users, including the username, authority level, and system resources to which a given user has access.

NOTE: If you are not using the HPE 3PAR Virtual Domains or HPE 3PAR All-inclusive Single-System license, the output of the `showuser` command still displays a `Domain` column. By default, users in systems not using domains fall into the `all` domain.

If you are using Virtual Domains, users with the `super`, `create`, `basic_edit`, `3PAR_AO`, and `3PAR_RM` roles can view all system users across all domains. If the user belongs to a specific domain, the user can only view other users within the same domain.

Procedure

- Display all authorized users of a system:
  `cli% showuser`
- Display information for a specific user:
  `cli% showuser <user_name>`

  For example:

```
cli% showuser Joe
Username    Domain    Privilege    Default
  Joe                   all                    super                       N
```

- Display a list of users for a specified domain:
  `cli% showuser -domain <domain_name>`

Removing a user from the storage system

Procedure

1. Use the `showuser` command to view a list of users, the user roles, and user domain associations.
2. Verify the user name of the user you want to remove.
3. Enter the **removeuser *<user_name>*** command.

   This command permanently removes the user from the system.

Adding users to a domain

A user can belong to a maximum of 32 domains.

For additional details about domains, see the *HPE 3PAR StoreServ Storage Concepts Guide*, available from the Hewlett Packard Enterprise Information Library.

Procedure

1. Verify that the domain name exists:
   ```
   cli% showdomain
   ```
2. Verify that the user name exists:
   ```
   cli% showuser
   ```
3. Review the user rights you can assign from the available roles.
   ```
   cli% showrole -listrights
   ```
   You cannot assign domain users the roles of `super`, `create`, `basic_edit`, `3PAR_AO`, or `EPAR_RM`.
4. Add the verified user to the verified domain:
   ```
   setuser -adddomain <domain_name>:<role> <user_name>
   ```
   <domain_name>

   Specify the name of the domain to which you are adding the user.

   <role>

   Assign the appropriate role to the user. Permitted values are `browse` and `edit`.

   <user_name>

   Specify the name of the user you are adding to the specified domain.
5. Verify that the user exists in the intended domain.
   ```
   cli% showuser <user_name>
   ```

Removing users from a domain

Procedure

1. Verify that the domain name exists:
   ```
   cli% showdomain
   ```
2. Verify that the user name exists:
   ```
   cli% showuser
   ```
3. Remove the user from the domain.
   ```
   cli% setuser -rmdomain <domain_name> <user_name>
   ```
   <domain_name>

   Specify the name of the domain from which to remove the user. You can specify `all` to remove the user from all domains.

   <user_name>

   Specify the name of the user you intend to remove from the specified domain.
4. Verify that the user no longer exists.
   ```
   cli% showuser <user_name>
   ```

Setting the default domain for a user

Setting a default domain allows a user to automatically access that domain when logging into a CLI session.

For information about default domains, see, *HPE 3PAR StoreServ Storage Concepts Guide*.

For detailed information about the `setuser` command, see, *HPE 3PAR Command Line Interface Reference*.

Prerequisites

Provide the user with access to the requested default domain.

Procedure

1. Verify that the user has general access to the requested default domain:
2. Set the requested domain as the default:
   `cli%` **`setuser -defaultdomain <domain_name> <user_name>`**

   `<domain_name>`

   Specify the name of the default domain.

   `<user_name>`

   Specify the name of the user to whom you are assigning the default domain.
3. Verify that the user information shows the correct default domain:
   `cli%` **`showuser <user_name>`**

Removing the default domain for a user

Procedure

To remove the default domain for a user, issue the `setuser -defaultdomain -unset <user_name>` command, where `<user_name>` is the name of the user for whom you are removing the default domain.

Setting the current domain for a user

The current domain refers to the domain in which a user is working during a particular, single CLI session.

Procedure

To set the current domain for a user, issue the `changedomain <domain_name>` command, where `<domain_name>` is the working domain to assign for the current CLI session.

Removing the current domain for a user

Procedure

To remove the current domain for a user, issue the `setclienv currentdomain -unset` command.

NOTE: When you issue the `setclienv currentdomain -unset` command, you are not returned to your default domain.

Viewing user connections

Prerequisites

When using domains:

- If you are using domains, then before issuing the `showuserconn` command, you must first set the `TPDLISTDOM` environment variable or the `-listdom` global option to display domain information. If you are working in a Tcl shell, issue the `setclienv listdom 1` command to set your system output to display domain information. See **Listing domains** for further information.
- If the `setclienv listdom 1` command is issued when viewing system objects, a `Domain` column is displayed. Objects not belonging to any domain (`no` domain) are displayed with a dash (`-`) under the `Domain` column. Otherwise, the domain to which the object belongs appears under the `Domain` column.

Procedure

Viewing users connected to the system and their connection type

To view users currently connected to your system, including their IP addresses and their connection information, issue the `showuserconn` command.

For more information about the `showuserconn` command, see the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Removing user connections

Procedure

- To forcefully close the connection of a user to the system, issue the `removeuserconn <ID> <user_name> <IP_address>` command, where:
  - `<ID>` is the numeric ID of the connection.
  - `<user_name>` is the assigned name of the user.
  - `<IP_address>` is the IP address of the connection.

More information:

HPE 3PAR Command Line Interface Reference, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

LDAP user connections

CAUTION: Do not create local and LDAP users with the same name. If local and LDAP users have the same name, it can cause confusion about where access is controlled.

The HPE 3PAR OS provides an LDAP client that can be configured to use an LDAP server for authentication and authorization of system users. An LDAP user is similar to a local user; however, an LDAP user is authenticated and authorized using information from an LDAP server. Additionally, LDAP user rights within the system are tied to the groups to which the user belong.

Authentication is the process of using data from the LDAP server to verify the username and password. Authorization is the process of using data from the LDAP server to determine the user's group membership and rights in the system.

NOTE: Configuring LDAP connections is optional unless you need to override any default values. The default setting is enough to provide authentications through LDAP functioning.

By default, LDAP users cannot store an SSH public key using the HPE 3PAR CLI `setsshkey` command. Instead, LDAP users can use the `setsshkey` command by using the `allow-ssh-key` parameter with the `setauthparam` command. Assigned rights, domains, and access to the system continues as when the `setsshkey` command was issued, regardless of any changes to the user's data in the LDAP server.

For more information about using LDAP with HPE 3PAR Storage systems, see the *HPE 3PAR StoreServ Storage Concepts Guide*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

NOTE: Setting the `ldap-type` to `MSAD` enables all default settings, and little else is needed on the part of the user to get LDAP functioning.

If the `ldap-type MSAD` setting is **not** used, then use the procedures in following topics to make LDAP authorizations functional.

Using the Active Directory LDAP default settings

Procedure

1. Configure connection parameters using the following commands:
   - `cli% setauthparam ldap-type MSAD`
   - `cli% setauthparam kerberos-realm <LDAP_ServiceName>`
2. Configure account location parameters using the following command:

   `cli% setauthparam accounts-dn <dn_path>`
3. Configure group-to-role mapping parameters using the following command:

   `setauthparam <map_param> <map_value>`
4. Test the authentication/authorization for an Active Directory user account using the following command:

   `checkpassword <user_name>`

Each step in the process above is discussed in the following sections. Each section is followed by an example showing the implementation of the instructions described.

- **Configuring connection parameters** on page 59
- **Configuring account location parameters** on page 60
- **Configuring group-to-role mapping parameters** on page 61

NOTE: The examples used to illustrate the procedures described for Active Directory LDAP configuration with SASL binding specifically use GSSAPI as the SASL binding mechanism.

A single user is used to determine group hierarchies and path structures used in the system, which are then used to complete the LDAP configuration.

Configuring connection parameters

Procedure

1. If not already known, obtain the LDAP server's host name and Kerberos server information by running the `ldapsearch` command, or by using `ldp.exe` (available as part of the downloadable Windows Support Tools from Microsoft). You must know the LDAP server's IP address.

   NOTE: If you do not have access to the `ldapsearch` command, use the `ldp.exe` command shown below.

   - Issue the `ldapsearch` command and record the `ldapServiceName` (the value used for the `kerberos-realm` parameter) attributes for later use.
   - Run `ldp.exe` as follows:

     a. Click **Start** > **Run**

     b. In the **Open** box, enter **`ldp`** and click **OK**.

        The **Ldp** window opens.

     c. In the **Ldp** window, click **Connection** > **Connect**.

     d. In the **Server** box, enter the Active Directory server's IP address and click **OK**.

        The root DSE attributes and values are displayed in the right-side pane.

        NOTE: In `ldp.exe`, the Kerberos realm is the portion of the `ldapServiceName` value that follows the "at" (@) sign and terminates before the semicolon (;).

        In `ldapsearch` output, the Kerberos realm is the portion of the `ldapServiceName` value that follows the "at" (@) sign.

     e. Record the displayed `ldapServiceName` (the value used for the `kerberos-realm` parameter) attribute for later use.

2. Set the Kerberos realm by issuing the `setauthparam kerberos-realm <LDAP_ServiceName>` command, where `<LDAP_ServiceName>` is the value displayed by either using the `ldapsearch` command or `ldp.exe` in Step **1**.

   NOTE: The value displayed for the default naming context is used later in **Configuring account location parameters** on page 60.

Examples:

```
% ldapsearch -LLL -x -H ldap://192.168.10.13 -b "" -s base dnsHostName ldapServiceName defaultNamingContext
dn:
dnsHostName: domaincontroller.3par.com
ldapServiceName: 3par.com:domaincontroller$@NTDOM1.3PAR.COM defaultNamingContext: DC=3par,DC=com
```

The example above corresponds to Step **1** and displays the following:

- The `LDAP_ServiceName` is `NTDOM1.3PAR.COM`
- The `defaultNamingContext` is `DC=3par,DC=com`

```
system1 cli% setauthparam -f ldap-type MSAD
system1 cli% setauthparam -f kerberos-realm NTDOM1.3PAR.COM
```

The example above corresponds to Step **1** and Step **2**.

More information:

Active Directory LDAP configuration with default settings

Configuring account location parameters

By default, Active Directory LDAP configurations will search for users in the default Users OU in the root of the domain.

To configure the account location parameters for users in different OUs:

Procedure

1. If you are unsure of the user's account information, select a known user's full name (to be entered as the `cn` value) and run the `ldapsearch` command using the `defaultNamingContext` value previously displayed in **Configuring connection parameters** on page 59. Make a note of the group information displayed in the command's output.
2. Issue the `setauthparam accounts-dn <dn_path>` command.
3. Issue the `checkpassword` command to obtain information about the user's group memberships from the LDAP server.

   NOTE: You must know the user's password in order to successfully use the `checkpassword` command.

Examples:

```
% ldapsearch -LLL -x -H ldaps://192.168.10.13 -D 'NTDOM1\joeadmin' -W -b DC=3par,DC=com -s sub '(cn=3PARuser)' dn
Enter LDAP Password:
dn: CN=3PAR User,OU=Engineering,OU=Users,DC=3par,DC=com
```

The example above corresponds to Step **1**, and displays the following:

- `joadmin` is the user name of the Windows domain (`NTDOM1`) administrator searching for group information for user 3PARuser (`cn=3PAR User`).
- `dn: CN=3PAR User,OU=Engineering,OU=Users,DC=3par,DC=com` displays user locations in the LDAP server directory information tree.

```
system1 cli% setauthparam -f accounts-dn OU=Users,DC=3par,DC=com
```

The example above corresponds to Step **2**.

The `Users` group within the `3par` group is set as the basis for any user search when authenticating with the LDAP server.

```
system1 cli% checkpassword 3paruser password:
+ attempting authentication and authorization using system-local data
+ authentication denied: unknown username
+ attempting authentication and authorization using LDAP
+ connecting to LDAP server using URI: ldaps://192.168.10.13
+ simple bind to LDAP user 3paruser for DN uid=3paruser,ou=people,dc=ldaptest,dc=3par,dc=com
+ searching LDAP using:
search base:    ou=people,dc=ldaptest,dc=3par,dc=com filter:    (&(objectClass=posixAccount)(uid=3paruser)) for attributes:
gidNumber
+ search result DN: uid=3paruser,ou=people,dc=ldaptest,dc=3par,dc=com
+ search result:    gidNumber: 2345
+ searching LDAP using:
search base:    ou=groups,dc=ldaptest,dc=3par,dc=com filter:
(&(objectClass=posixGroup)(|(gidNumber=2345)(memberUid=3paruser))) for attributes: cn
+ search result DN: cn=software,ou=groups,dc=ldaptest,dc=3par,dc=com
+ search result:    cn: software
+ search result DN: cn=engineering,ou=groups,dc=ldaptest,dc=3par,dc=com
+ search result:    cn: engineering
+ search result DN: cn=hardware,ou=groups,dc=ldaptest,dc=3par,dc=com
+ search result:    cn: hardware
```

```
+ mapping rule: super mapped to by software
+ rule match: super mapped to by software
+ mapping rule: edit mapped to by engineering
+ rule match: edit mapped to by engineering
+ mapping rule: browse mapped to by hardware
+ rule match: browse mapped to by hardware user 3paruser is authenticated and authorized
```

The example above corresponds to Step **3**, and shows that 3PARuser is a member of the following hierarchy of groups:

- `Engineering`
- `Software`
- `Eng`
- `Golfers`

In this example, 3PARuser is not yet authenticated or authorized because 3PARuser's group-to-role mapping has not been configured.

More information:

Using the Active Directory LDAP default settings on page 58

Configuring group-to-role mapping parameters

After you have configured the group location parameters, decide what role to assign users for a given group. To configure group-to-role mapping:

Procedure

1. Issue the `setauthparam <map-param> <map-value>` command, where:
   - `<map-param>` is one of the following:
     - `super-map`—provides `Super` user rights within the specified group.
     - `edit-map`—provides `Edit` user rights within the specified group.
     - `browse-map`—provides `Browse` user rights within the specified group.
     - `create-map`—provides `Create` user rights within the specified group.
     - `basic_edit-map`—provides `Basic Edit` user rights within the specified group.
     - `3PAR_AO-map`—provides `3PAR AO` user rights within the specified group.
     - `3PAR_RM-map`—provides `3PAR RM` user rights within the specified group.
   - `<map-value>` is the group to which the user has membership. You can specify multiple groups with multiple `<map-value>` arguments.

     For Active Directory, the group is displayed as a string of information, for example:

     `CN=Software,CN=Users,DC=ACME,DC=com`

NOTE: The HPE 3PAR StoreServ Management Console (HPE 3PAR SSMC) refers to `<map-param>` specifiers as Authorization Groups.

2. Repeat Step **1** above to assign users a different role for another group to which that user has membership.
3. Issue the `checkpassword` command to verify that users have the roles you assigned for the groups. Use a member of a specific group to verify the role.

Examples:

```
system1 cli% setauthparam -f edit-map CN=Software,CN=Users,DC=3par,DC=com
system1 cli% setauthparam -f browse-map CN=Eng,CN=Users,DC=3par,DC=com
```

In the example above:

- Users belonging to the `Software` group are configured to have `Edit` rights within the system.
- Users belonging the `Eng` group are configured to have `Browse` rights within the system.

```
system1 cli% checkpassword 3PARuser
...
+ search result:    memberOf: CN=Software,CN=Users,DC=3par,DC=com
+ search result:    memberOf: CN=Eng,CN=Users,DC=3par,DC=com
+ search result:    memberOf: CN=Golfers,CN=Users,DC=3par,DC=com
+ mapping rule: edit mapped to by CN=Software,CN=Users,DC=3par,DC=com
+ rule match: edit mapped to by CN=Software,CN=Users,DC=3par,DC=com
+ mapping rule: browse mapped to by CN=Eng,CN=Users,DC=3par,DC=com
+ rule match: browse mapped to by CN=Eng,CN=Users,DC=3par,DC=com user 3PARuser is authenticated and authorized
```

In the example above:

- `3PARuser` is a member of the `Software` group and is assigned `Edit` rights within the system.
- Although `3PARuser` is also a member of the `Eng` group, the `Edit` rights associated with the `Software` group supersede the `Browse` rights associated with the `Eng` group.
- The mapping rules set for `3PARuser` are applied to all members of the `Software` and `Eng` groups. All `Software` group members have `Edit` rights within the system. All `Eng` group members have `Browse` rights within the system.

More information:

Active Directory LDAP configuration with default settings

Active Directory LDAP configuration with SASL binding

If `ldap-type` is `MSAD`, the steps in this section are required only if SASL or simple binding are used.

Procedure

1. Configure connection parameters using the following commands:
   - `setauthparam ldap-server <IP_address>`
   - `setauthparam ldap-server-hn <DNS_HostName>`
   - `setauthparam kerberos-realm <LDAP_ServiceName>`
2. Configure binding (authentication) parameters using the following commands:

- `setauthparam binding sasl`
- `setauthparam sasl-mechanism <SASL_type>`

To configure simple binding:

3. Configure account location parameters using the following commands:
   - `setauthparam accounts-dn <dn_path>`
   - `setauthparam account-obj user`
   - `setauthparam account-name-attr sAMAccountName`
   - `setauthparam memberof-attr memberOf`
4. Configure group-to-role mapping parameters using the following commands:

   ```
   setauthparam <map_param> <map_value>
   ```

5. Test the authentication/authorization for an Active Directory user account:

   ```
   checkpassword <user_name>
   ```

Each step in the process above is discussed in the following sections. Each section is followed by an example showing the implementation of the instructions described.

- **Configuring connection parameters** on page 63
- **Configuring binding parameters** on page 65
- **Configuring account location parameters** on page 65
- **Configuring group-to-role mapping parameters** on page 67

Configuring connection parameters

Procedure

1. If not already known, obtain the LDAP server's host name and Kerberos server information by running the `ldapsearch` command or using `ldp.exe` (available as part of the downloadable Windows Support Tools from Microsoft). You must know the LDAP server's IP address.

NOTE: If you do not have access to the `ldapsearch` command, use the `ldp.exe` command shown below.

- Issue the `ldapsearch` command and record the displayed `dnsHostName` (the value used for the `ldap-server-hn` parameter) and `ldapServiceName` (the value used for the `kerberos-realm` parameter) attributes for later use.
- Run `ldp.exe` as follows:

  a. Click **Start** > **Run**.

  b. In the **Open** box, enter **`ldp`** and click **OK**.

  The **Ldp** window opens.

  c. In the **Ldp** window, click **Connection** > **Connect**.

  d. In the **Server** box, enter the Active Directory server's IP address and click **OK**.

  The root DSE attributes and values are displayed in the right-side pane.

  NOTE: In `ldp.exe`, the Kerberos realm is the portion of the `ldapServiceName` value that follows the “at” (@) sign and terminates before the semicolon (;).

  In `ldapsearch` output, the Kerberos realm is the portion of the `ldapServiceName` value that follows the “at” (@) sign.

  e. Record the displayed `dnsHostName` (the value used for the `ldap-server-hn` parameter) and `ldapServiceName` (the value used for the `kerberos-realm` parameter) attributes for later use.

2. Set the address to which the LDAP server will connect by issuing the `setauthparam ldap-server <IP_address>` command, where `<IP_address>` is your LDAP server’s IP address.
3. Set the LDAP server’s host name by issuing the `setauthparam ldap-server-hn <DNS_HostName>` command, where `<DNS_HostName>` is the value displayed by either using the `ldapsearch` command or `ldp.exe` in Step **1**.
4. Set the Kerberos realm by issuing the `setauthparam kerberos-realm <LDAP_ServiceName>` command, where `<LDAP_ServiceName>` is the value displayed by either using the `ldapsearch` command or `ldp.exe` in Step **1**.

NOTE: The value displayed for the default naming context is used later in **Configuring account location parameters** on page 65.

Examples:

```
% ldapsearch -LLL -x -H ldap://192.168.10.13 -b "" -s base dnsHostName ldapServiceName defaultNamingContext
dn:
dnsHostName: domaincontroller.3par.com
ldapServiceName: 3par.com:domaincontroller$@NTDOM1.3PAR.COM defaultNamingContext: DC=3par,DC=com
```

The example above corresponds to Step **1** and displays the following:

- The LDAP server’s IP address is `192.168.10.13`.
- The `DNS_HostName` is `domaincontroller.3par.com`.

- The `LDAP_ServiceName` is `NTDOM1.3PAR.COM`.
- The `defaultNamingContext` is `DC=3par,DC=com`.

```
system1 cli% setauthparam -f ldap-server 192.168.10.13
system1 cli% setauthparam -f ldap-server-hn domaincontroller.3par.com
system1 cli% setauthparam -f kerberos-realm NTDOM1.3PAR.COM
```

The example above corresponds to Step **2** through Step **4**.

More information:

Active Directory LDAP configuration with SASL binding on page 62

Configuring LDAP connections on systems using domains on page 78

Configuring binding parameters

After you have configured the connection parameters to your LDAP server, you must configure the binding (authentication) parameters for users.

Procedure

1. Issue the `setauthparam binding sasl` command.
2. Issue the `setauthparam sasl-mechanism <SASL_type>` command, where `<type>` is specified as `PLAIN`, `DIGEST-MD5`, or `GSSAPI`.

   For information on binding types, see “Lightweight Directory Access Protocol” in the *HPE 3PAR StoreServ Storage Concepts Guide*.

Example:

In the example, GSSAPI SASL binding is used for authentication.

```
system1 cli% setauthparam -f binding sasl
system1 cli% setauthparam -f sasl-mechanism GSSAPI
```

More information:

Active Directory LDAP configuration with SASL binding on page 62

Configuring LDAP connections on systems using domains on page 78

Configuring account location parameters

Procedure

1. If you are unsure of the user’s account information, select a known user’s full name (to be entered as the `cn` value) and run the `ldapsearch` command using the `defaultNamingContext` value previously displayed in **Configuring connection parameters** on page 63. Make a note of the group information displayed in the command output.
2. Issue the `setauthparam accounts-dn <dn_path>` command.
3. Issue the `setauthparam account-obj user` command.
4. Issue the `setauthparam account-name-attr sAMAccountName` command.

5. Issue the `setauthparam memberof-attr memberOf` command.
6. Issue the `checkpassword` command to obtain information about the user's group memberships from the LDAP server.

   NOTE: You must know the user's password to successfully use the `checkpassword` command.

Examples:

```
% ldapsearch -LLL -x -H ldaps://192.168.10.13 -D 'NTDOM1\joeadmin' -W -b DC=3par,DC=com -s sub '(cn=3PARuser)' dn
Enter LDAP Password:
dn: CN=3PAR User,OU=Engineering,OU=Users,DC=3par,DC=com
```

The example above corresponds to Step **1** and displays the following:

- `joadmin` is the user name of the Windows domain (`NTDOM1`) administrator searching for group information for user `3PARuser` (`cn=3PAR User`).
- `dn: CN=3PAR User,OU=Engineering,OU=Users,DC=3par,DC=com` displays user locations in the LDAP server directory information tree.

```
system1 cli% setauthparam -f accounts-dn OU=Users,DC=3par,DC=com
system1 cli% setauthparam -f account-obj user
system1 cli% setauthparam -f account-name-attr sAMAccountName system1
cli% setauthparam -f memberof-attr memberOf
```

The example above corresponds to Step **2** through Step **4**.

- The `Users` group within the `3par` group is set as the basis for any user search when authenticating with the LDAP server.
- The values `user`, `SAMAccountName`, and `memberOf` for the `account-obj`, `account-name-attr`, and `memberof-attr` parameters are typical of Active Directory configurations.

```
system1 cli% checkpassword 3paruser password:
+ attempting authentication and authorization using system-local data
+ authentication denied: unknown username
+ attempting authentication and authorization using LDAP
+ connecting to LDAP server using URI: ldaps://192.168.10.13
+ simple bind to LDAP user 3paruser for DN uid=3paruser,ou=people,dc=ldaptest,dc=3par,dc=com
+ searching LDAP using:
search base:    ou=people,dc=ldaptest,dc=3par,dc=com filter:    (&(objectClass=posixAccount)(uid=3paruser)) for attributes:
gidNumber
+ search result DN: uid=3paruser,ou=people,dc=ldaptest,dc=3par,dc=com
+ search result:    gidNumber: 2345
+ searching LDAP using:
search base:    ou=groups,dc=ldaptest,dc=3par,dc=com filter:
(&(objectClass=posixGroup)(|(gidNumber=2345)(memberUid=3paruser))) for attributes: cn
+ search result DN: cn=software,ou=groups,dc=ldaptest,dc=3par,dc=com
+ search result:    cn: software
+ search result DN: cn=engineering,ou=groups,dc=ldaptest,dc=3par,dc=com
+ search result:    cn: engineering
+ search result DN: cn=hardware,ou=groups,dc=ldaptest,dc=3par,dc=com
+ search result:    cn: hardware
+ mapping rule: super mapped to by software
+ rule match: super mapped to by software
+ mapping rule: edit mapped to by engineering
+ rule match: edit mapped to by engineering
+ mapping rule: browse mapped to by hardware
+ rule match: browse mapped to by hardware user 3paruser is authenticated and authorized
```

The example above corresponds to Step **6**, and shows that `3PARuser` is a member of the following hierarchy of groups:

- `Engineering`
- `Software`

- `Eng`
- `Golfers`

In this example, `3PARuser` is not yet authenticated or authorized because the group-to-role mapping has not been configured.

More information:

Active Directory LDAP configuration with SASL binding on page 62

Configuring LDAP connections on systems using domains on page 78

Configuring group-to-role mapping parameters

After you have configured the group location parameters, decide what role to assign users for a given group. To configure group-to-role mapping:

Procedure

1. Issue the `setauthparam <map-param> <map-value>` command, where:
   - `<map-param>` is one of the following:
     - `super-map`—provides `Super` user rights within the specified group.
     - `edit-map`—provides `Edit` user rights within the specified group.
     - `browse-map`—provides `Browse` user rights within the specified group.
     - `create-map`—provides `Create` user rights within the specified group.
     - `basic_edit-map`—provides `Basic Edit` user rights within the specified group.
     - `3PAR_AO-map`—provides `3PAR AO` user rights within the specified group.
     - `3PAR_RM-map`—provides `3PAR RM` user rights within the specified group.
   - `<map-value>` is the group to which the user has membership. You can specify multiple groups with multiple `<map-value>` arguments.

     For Active Directory, the group is displayed as a string of information, as shown in the following example:

     `CN=Software,CN=Users,DC=ACME,DC=com`

   NOTE: The HPE 3PAR StoreServ Management Console (HPE 3PAR SSMC) refers to `<map-param>` specifiers as Authorization Groups.
2. Repeat Step **1** above to assign users a different role for another group to which that user has membership.
3. Issue the `checkpassword` command to verify that users have the roles you assigned for the groups. Use a member of a specific group to verify the role.

Examples:

```
system1 cli% setauthparam -f edit-map CN=Software,CN=Users,DC=3par,DC=com
system1 cli% setauthparam -f browse-map CN=Eng,CN=Users,DC=3par,DC=com
```

In the example above:

- Users belonging to the `Software` group are configured to have `Edit` rights within the system.
- Users belonging the `Eng` group are configured to have `Browse` rights within the system.

```
system1 cli% checkpassword 3PARuser
...
+ search result:    memberOf: CN=Software,CN=Users,DC=3par,DC=com
+ search result:    memberOf: CN=Eng,CN=Users,DC=3par,DC=com
+ search result:    memberOf: CN=Golfers,CN=Users,DC=3par,DC=com
+ mapping rule: edit mapped to by CN=Software,CN=Users,DC=3par,DC=com
+ rule match: edit mapped to by CN=Software,CN=Users,DC=3par,DC=com
+ mapping rule: browse mapped to by CN=Eng,CN=Users,DC=3par,DC=com
+ rule match: browse mapped to by CN=Eng,CN=Users,DC=3par,DC=com user 3PARuser is authenticated and authorized
```

In the example above:

- `3PARuser` is a member of the `Software` group and is assigned `Edit` rights within the system.
- Although `3PARuser` is also a member of the `Eng` group, the `Edit` rights associated with the `Software` group supersede the `Browse` rights associated with the `Eng` group.
- The mapping rules set for `3PARuser` are applied to all members of the `Software` and `Eng` groups. All `Software` group members have `Edit` rights within the system. All `Eng` group members have `Browse` rights within the system.

More information:

Active Directory LDAP configuration with SASL binding on page 62

Configuring LDAP connections on systems using domains on page 78

Active Directory LDAP configuration with simple binding over SSL

This configuration uses the default port number on the target server for LDAP and SSL. If LDAP and SSL do not use the default ports in your configuration, you must change the port number with the `setauthparam` command. To configure Active Directory with simple binding over SSL, follow this process, using the specified commands (detailed instructions follow):

Procedure

1. Configure connection parameters using the following commands:
   - `setauthparam ldap-server <IP_address>`
   - `setauthparam ldap-server-hn <DNS_HostName>`
   - `setauthparam -f ldap-ssl 1`
2. Configure binding (authentication) parameters using the following commands:
   - `setauthparam binding simple`
   - `setauthparam user-attr <DN_attribute>`
3. Set the CA certificate using the following command:

   `importcert ldap -ca <certificate>`
4. Configure account location parameters using the following commands:

- `setauthparam accounts-dn <DN_path>`
- `setauthparam account-obj user`
- `setauthparam account-name-attr sAMAccountName`
- `setauthparam memberof-attr memberOf`
- `checkpassword <user_name>`

5. Configure group-to-role mapping parameters using the following commands:
   - `setauthparam <map_param> <map_value>`
   - `checkpassword <user_name>`

Each step in the process is discussed in the following topics. Each topic is followed by an example showing the implementation of the instructions described.

- **Configuring connection parameters** on page 69
- **Configuring binding parameters** on page 71
- **Configuring the CA certificate** on page 71
- **Configuring account location parameters** on page 72
- **Configuring group-to-role mapping parameters** on page 73

Configuring connection parameters

Procedure

1. If not already known, obtain the LDAP server's host name and Kerberos server information by running the `ldapsearch` command, or by using `ldp.exe` (available as part of the downloadable Windows Support Tools from Microsoft). You must know the LDAP server's IP address.

NOTE: If you do not have access to the `ldapsearch` command, use the `ldp.exe` command shown below.

- Issue the `ldapsearch` command and record the displayed `dnsHostName` (the value used for the `ldap-server-hn` parameter); this is only necessary when setting CA certificates.
- Run `ldp.exe` as follows:

  a. Click **Start** > **Run**

  b. In the **Open** box, enter **`ldp`** and click **OK**.

  The **Ldp** window opens.

  c. In the **Ldp** window, click **Connection** > **Connect**.

  d. In the **Server** box, enter the Active Directory server's IP address and click **OK**.

  The root DSE attributes and values are displayed in the right-side pane.

  NOTE: In `ldp.exe`, the Kerberos realm is the portion of the `ldapServiceName` value that follows the “at” (@) sign and terminates before the semicolon (;).

  In `ldapsearch` output, the Kerberos realm is the portion of the `ldapServiceName` value that follows the “at” (@) sign.

  e. Record the displayed `dnsHostName` (the value used for the `ldap-server-hn` parameter) and `ldapServiceName` (the value used for the `kerberos-realm` parameter); only necessary if setting CA certificates).

2. Set the address to which the LDAP server will connect by issuing the `setauthparam ldap-server <IP_address>` command, where `<IP_address>` is your LDAP server IP address.
3. Set the LDAP server’s host name by issuing the `setauthparam ldap-server-hn <DNS_HostName>` command, where `<DNS_HostName>` is the value displayed by either using the `ldapsearch` command or `ldp.exe` in Step **1**.

NOTE: The value displayed for the `defaultNamingContext` is used later in **Configuring account location parameters** on page 72.

Examples:

```
% ldapsearch -LLL -x -H ldap://192.168.10.13 -b "" -s base dnsHostName ldapServiceName defaultNamingContext
dn:
dnsHostName: domaincontroller.3par.com
ldapServiceName: 3par.com:domaincontroller$@NTDOM1.3PAR.COM defaultNamingContext: DC=3par,DC=com
```

The example above corresponds to Step **1** and displays the following:

- The LDAP server’s IP address is `192.168.10.13`.
- The `DNS_HostName` is `domaincontroller.3par.com`.
- The `defaultNamingContext` is `DC=3par,DC=com`.

```
system1 cli% setauthparam -f ldap-server 192.168.10.13
system1 cli% setauthparam -f ldap-server-hn domaincontroller.3par.com
```

The example above corresponds to Step **2** through Step **3**.

More information:

Active Directory LDAP configuration with simple binding over SSL on page 68

Configuring binding parameters

After you have configured the connection parameters to your LDAP server, you must configure the binding (authentication) parameters for users.

Procedure

1. Issue the `setauthparam binding simple` command.

   Example:

   ```
   system1 cli% setauthparam -f binding simple
   ```

2. Issue the `setauthparam user-attr <DN_attribute>` command to set the attribute used to form a distinguished name (DN) to the Windows domain.

   Example:

   ```
   setauthparam -f user-attr NTDOM1\\
   ```

   In the example above, the Windows domain is `NTDOM1`.

More information:

Active Directory LDAP configuration with simple binding over SSL on page 68

Configuring the CA certificate

Procedure

1. Obtain the location of the CA certificate from the Active Directory server administrator.

   NOTE: If the certificate ends in the file extension `.crt`, it will need to be converted to a form compatible with the `setauthparam` command.

2. If necessary, convert the certificate to `.cer` file format. On a Microsoft Windows system, follow these steps:

   a. Double-click the certificate.

   b. Select the **Details** tab.

   c. Click **Copy to File....**

   d. Click **Next**.

   e. Select **Base-64 encoded x.5098** format.

   f. Click **Next**.

   g. Click **Browse...** and select a filename for the certificate (ending in the `.cer` file extension) and a folder in which the certificate will be stored.

   h. Click **Next** and then **Finish**.

Or use the `openssl x509` program.

3. Set the certificate using the `importcert ldap -ca <certificate>` command, where `<certificate>` is the name of the certificate you previously located or converted.

Configuring account location parameters

Procedure

1. If you are unsure of the user's account information, select a known user's full name (to be entered as the `cn` value) and run the `ldapsearch` command using the `defaultNamingContext` value previously displayed in **Configuring connection parameters** on page 69. Make a note of the group information displayed in the command output.
2. Issue the `setauthparam accounts-dn <DN_path>` command.
3. Issue the `setauthparam account-obj user` command.
4. Issue the `setauthparam account-name-attr sAMAccountName` command.
5. Issue the `setauthparam memberof-attr memberOf` command.
6. Issue the `checkpassword` command to obtain information about the user's group memberships from the LDAP server.

   NOTE: You must know the user's password in order to successfully use the `checkpassword` command.

Examples:

```
% ldapsearch -LLL -x -H ldap://192.168.10.13 -D 'NTDOM1\joeadmin' -W -b DC=3par,DC=com -s sub '(cn=3PARuser)' dn
Enter LDAP Password:
dn: CN=3PAR User,OU=Engineering,OU=Users,DC=3par,DC=com
```

The above example corresponds to Step **1** and displays the following:

- `joadmin` is the user name of the Windows domain (`NTDOM1`) administrator searching for group information for user 3PARuser (`cn=3PARuser`).
- `dn: CN=3PAR User,OU=Engineering,OU=Users,DC=3par,DC=com` displays user locations in the LDAP server directory information tree.

```
system1 cli% setauthparam -f accounts-dn OU=Users,DC=3par,DC=com
system1 cli% setauthparam -f account-obj user
system1 cli% setauthparam -f account-name-attr sAMAccountName
system1 cli% setauthparam -f memberof-attr memberOf
```

The example above corresponds to Step **2** through Step **5**. The following can be surmised based on the group information gathered from running the `ldapsearch` command:

- The `Users` group within the `3par` group is set as the basis for any user search when authenticating with the LDAP server.
- The values `user`, `SAMAccountName`, and `memberOf` for the `account-obj`, `account-name-attr`, and `memberof-attr` parameters are typical of Active Directory configurations.

```
system1 cli% checkpassword 3PARuser password:
+ attempting authentication and authorization using system-local data
+ authentication denied: unknown username
+ attempting authentication and authorization using LDAP
+ using Kerberos configuration file:
```

```
[domain_realm]
domaincontroller.3par.com = NTDOM1.3PAR.COM [realms]
NTDOM1.3PAR.COM = {
kdc = 192.168.10.13
}
+ temporarily setting name-to-address mapping: domaincontroller.3par.com -> 192.168.10.13
+ attempting to obtain credentials for 3PARuser@NTDOM1.3PAR.COM
+ connecting to LDAP server using URI: ldap://192.168.10.13
+ binding to user 3PARuser with SASL mechanism GSSAPI
+ searching LDAP using:
search base:    OU=Users,DC=3par,DC=com
filter:    (&(objectClass=user)(sAMAccountName=3PARuser)) for attribute: memberOf
+ search result DN: CN=3PARuser,OU=Engineering,OU=Users,DC=3par,DC=com
+ search result:    memberOf: CN=Software,CN=Users,DC=3par,DC=com
+ search result:    memberOf: CN=Eng,CN=Users,DC=3par,DC=com
+ search result:    memberOf: CN=Golfers,CN=Users,DC=3par,DC=com
+ authorization denied: no user groups match mapping rules user 3PARuser is not authenticated or not authorized
```

The example above corresponds to Step **6**. The following can be surmised based on the group information gathered from running the `ldapsearch` command:

- `Engineering`
- `Software`
- `Eng`
- `Golfers`

In this example, 3PARuser is not yet authenticated or authorized because 3PARuser's group-to-role mapping has not been configured.

More information:

Active Directory LDAP configuration with simple binding over SSL on page 68

Configuring group-to-role mapping parameters

After you have configured the group location parameters, decide what role to assign users for a given group. To configure group-to-role mapping:

Procedure

1. Issue the `setauthparam <map_param> <map_value>` command, where:
   - `<map_param>` is one of the following:
     - `super-map`—provides `super` user rights within the specified group.
     - `service-map`—provides `service` user rights within the specified group.
     - `edit-map`—provides `edit` user rights within the specified group.
     - `browse-map`—provides `browse` user rights within the specified group.
     - `create-map`—provides `create` user rights within the specified group.
     - `basic_edit-map`—provides `basic_edit` user rights within the specified group.
     - `3PAR_AO-map`—provides `3PAR_AO` user rights within the specified group.
     - `3PAR_RM-map`—provides `3PAR_RM` user rights within the specified group.
   - `<map_value>` is the group to which the user has membership. You can specify multiple groups with multiple `<map_value>` arguments.

For Active Directory, the group is displayed as a string of information as shown in the following example:

```
CN=Software,CN=Users,DC=ACME,DC=com
```

2. Repeat Step **1** above if you wish to assign any user a different role for another group to which that user has membership.
3. Issue the `checkpassword` command to verify that the users have the roles you assigned for the desired groups. Use a member of a specific group to verify the role.

Examples:

```
system1 cli% setauthparam -f edit-map CN=Software,CN=Users,DC=3par,DC=com
system1 cli% setauthparam -f browse-map CN=Eng,CN=Users,DC=3par,DC=com
```

In the example above:

- Users belonging to the `Software` group are configured to have Edit rights within the system.
- Users belonging the `Eng` group are configured to have Browse rights within the system.

```
system1 cli% checkpassword 3PARuser
...
+ search result:    memberOf: CN=Software,CN=Users,DC=3par,DC=com
+ search result:    memberOf: CN=Eng,CN=Users,DC=3par,DC=com
+ search result:    memberOf: CN=Golfers,CN=Users,DC=3par,DC=com
+ mapping rule: edit mapped to by CN=Software,CN=Users,DC=3par,DC=com
+ rule match: edit mapped to by CN=Software,CN=Users,DC=3par,DC=com
+ mapping rule: browse mapped to by CN=Eng,CN=Users,DC=3par,DC=com
+ rule match: browse mapped to by CN=Eng,CN=Users,DC=3par,DC=com user 3PARuser is authenticated and authorized
```

In the example above:

- `3PARuser` is found to be a member of the `Software` group and is assigned `Edit` rights within the system.
- Although `3PARuser` is also a member of the `Eng` group, the `Edit` rights associated with the `Software` group supersede the `Browse` rights associated with the `Eng` group.
- The mapping rules set for `3PARuser` are applied to all members of the `Software` group and `Eng` group. All `Software` group members have `Edit` rights within the system. All `Eng` group members have `Browse` rights within the system.

More information:

Active Directory LDAP configuration with simple binding over SSL

OpenLDAP configuration with simple binding over SSL

To configure your system to use OpenLDAP with simple binding over SSL, the following process must be performed (detailed instructions follow):

Procedure

1. Configure connection parameters using the following commands:
   - `setauthparam ldap-server <IP_address>`
   - `setauthparam ldap-ssl 1`
2. Configure binding (authentication) parameters using the following commands:

- `setauthparam binding <binding_type>`
- `setauthparam user-dn-base <value>`
- `setauthparam user-attr <attribute>`

3. Configure group location parameters using the following commands:
   - `setauthparam groups-dn <value>`
   - `setauthparam group-object <group_object_class>`
   - `setauthparam group-name-attr <attribute>`
   - `setauthparam member-attr <member_attribute>`
4. Configure group-to-role mapping parameters using the following commands:
   - `setauthparam <map_param> <map_value>`
   - `checkpassword <user_name>`

Different schemas can be used for user and group information with OpenLDAP. The instructions and example that follow describe configuration of the system using Posix users and groups.

- **Configuring connection parameters** on page 75
- **Configuring binding parameters** on page 76
- **Configuring group location parameters** on page 76
- **Configuring group-to-role mapping parameters** on page 77

Configuring connection parameters

Procedure

1. To configure connection parameters, issue the `setauthparam ldap-server <IP_address>` command, where `<IP_address>` is the OpenLDAP server IP address.
2. Issue the `setauthparam ldap-ssl 1` command.

   Example:

   ```
   system1 cli% setauthparam -f ldap-server 192.168.10.13
   system1 cli% setauthparam -f ldap-ssl 1
   ```

   In the example above:

   - The OpenLDAP server IP address is `192.168.10.13`.
   - SSL security is activated using the `1` parameter.

More information:

OpenLDAP configuration with simple binding over SSL on page 74

Configuring binding parameters

After you have configured the connection parameters to your LDAP server, configure the binding (authentication) parameters for users.

Procedure

1. Issue the `setauthparam binding <binding_type>` command.
2. Issue the `setauthparam user-dn-base <value>` command, where `<value>` is the base of the subtree where user information is kept in the OpenLDAP server directory information tree.
3. Issue the `setauthparam user-attr <attribute>` command, where `<attribute>` is the name of the attribute holding the `<user_name>`.

Examples

```
system1 cli% setauthparam -f binding simple
```

In the example above, simple binding is specified as the binding mechanism.

```
system1 cli% setauthparam -f user-dn-base ou=people,dc=ldaptest,dc=3par,dc=com
```

In the example above, the base of the user entries in the OpenLDAP server directory information tree is `ou=people,dc=ldaptest,dc=3par,dc=com`.

```
system1 cli% setauthparam -f user-attr uid
```

In the example above, `uid` is the attribute with the value of the user's user name of the `posixAccount` object class.

More information:

OpenLDAP configuration with simple binding over SSL on page 74

Configuring group location parameters

Procedure

1. Issue the `setauthparam groups-dn <value>` command, where `<value>` is the basis of the search for objects holding group information in the subtree of the directory information tree.
2. Issue the `setauthparam group-object <group_object_class>` command.
3. Issue the `setauthparam group-name-attr <attribute>` command, where `<attribute>` is the group object attribute that holds the group name.
4. Issue the `setauthparam member-attr <member_attribute>` command, where `<member_attribute>` is the attribute that holds the names of the users in the group.

Examples:

```
system1 cli% setauthparam -f groups-dn ou=groups,dc=ldaptest,dc=3par,dc=com
```

In the example above, `ou=groups,dc=ldaptest,dc=3par,dc=com` is the search base for objects holding group information in the directory information subtree.

```
system1 cli% setauthparam -f group-obj posixGroup
system1 cli% setauthparam -f group-name-attr cn
system1 cli% setauthparam -f member-attr memberUid
```

In the example above:

- `posixGroup` is the group object class.
- `cn` is the attribute of the `posixGroup`, which has a value of the group name.
- `memberUid` is the attribute with the value of the `<user_name>`.

More information:

OpenLDAP configuration with simple binding over SSL on page 74

Configuring group-to-role mapping parameters

After you have configured the group location parameters, decide what role to assign the users for a given group. To configure group-to-role mapping:

Procedure

1. Issue the `setauthparam <map_param> <map_value>` command, where:
   - `<map_param>` is one of the following user rights:
     - `super-map`—provides `super` user rights within the specified group.
     - `service-map`—provides `service` user rights within the specified group.
     - `edit-map`—provides `edit` user rights within the specified group.
     - `browse-map`—provides `browse` user rights within the specified group.
     - `create-map`—provides `create` user rights within the specified group.
     - `basic_edit-map`—provides `basic_edit` user rights within the specified group.
     - `3PAR_AO-map`—provides `3PAR_AO` user rights within the specified group.
     - `3PAR_RM-map`—provides `3PAR_RM` user rights within the specified group.
   - `<map_value>` is the group to which the user has membership. You can specify multiple groups with multiple `<map_value>` arguments.
2. Repeat Step **1** above to assign users a different role for another group to which that user has membership.
3. Issue the `checkpassword` command to verify that users have the roles you assigned for the groups. Use a member of a specific group to verify the role.

Examples:

```
system1 cli% setauthparam -f super-map software
system1 cli% setauthparam -f edit-map engineering
system1 cli% setauthparam -f browse-map hardware
```

In the example above:

- Users belonging to the `software` group are configured to have `Super` rights within the system.
- Users belonging to the `engineering` group are configured to have `Edit` rights within the system.
- Users belonging to the `hardware` group are configured to have `Browse` rights within the system.

```
system1 cli% checkpassword 3paruser password:
+ attempting authentication and authorization using system-local data
+ authentication denied: unknown username
+ attempting authentication and authorization using LDAP
+ connecting to LDAP server using URI: ldaps://192.168.10.13
+ simple bind to LDAP user 3paruser for DN uid=3paruser,ou=people,dc=ldaptest,dc=3par,dc=com
+ searching LDAP using:
search base:    ou=people,dc=ldaptest,dc=3par,dc=com filter:    (&(objectClass=posixAccount)(uid=3paruser)) for attributes:
gidNumber
+ search result DN: uid=3paruser,ou=people,dc=ldaptest,dc=3par,dc=com
+ search result:    gidNumber: 2345
+ searching LDAP using:
search base:    ou=groups,dc=ldaptest,dc=3par,dc=com filter:
(&(objectClass=posixGroup)(|(gidNumber=2345)(memberUid=3paruser))) for attributes: cn
+ search result DN: cn=software,ou=groups,dc=ldaptest,dc=3par,dc=com
+ search result:    cn: software
+ search result DN: cn=engineering,ou=groups,dc=ldaptest,dc=3par,dc=com
+ search result:    cn: engineering
+ search result DN: cn=hardware,ou=groups,dc=ldaptest,dc=3par,dc=com
+ search result:    cn: hardware
+ mapping rule: super mapped to by software
+ rule match: super mapped to by software
+ mapping rule: edit mapped to by engineering
+ rule match: edit mapped to by engineering
+ mapping rule: browse mapped to by hardware
+ rule match: browse mapped to by hardware user 3paruser is authenticated and authorized
```

In the example above:

- `3PARuser` is found to be a member of the `software` group and is assigned `Super` rights within the system.
- Although `3PARuser` is also a member of the `engineering` and `hardware` groups, the `Super` rights associated with the `software` group supersede the `Edit` and `Browse` rights associated with the `engineering` and `software` groups.
- The mapping rules set for `3PARuser` are applied to all members of the `software`, `engineering`, and `hardware` groups. All `software` group members have `Super` rights within the system. All `engineering` group members have `Edit` rights within the system. All `hardware` group members have `Browse` rights within the system.

More information:

OpenLDAP configuration with simple binding over SSL on page 74

Configuring LDAP connections on systems using domains

LDAP is also available for systems using virtual domains for access control. The configuration process is nearly identical to configuring LDAP on non-Domain systems, with the only difference being an additional authorization step to map a user's group to a domain.

For information about LDAP and domains, see "Lightweight Directory Access Protocol" in the *HPE 3PAR StoreServ Storage Concepts Guide*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

To configure your system to use an Active Directory LDAP server using SASL binding, the following process must be performed (detailed instructions follow):

- Configure connection parameters using the following commands:
  - `setauthparam ldap-server <IP_address>`
  - `setauthparam ldap-server-hn <DNS_HostName>`
  - `setauthparam kerberos-realm <LDAP_ServiceName>`
- Configure binding (authentication) parameters using the following commands:
  - `setauthparam binding sasl`
  - `setauthparam sasl-mechanism <SASL_type>`

- Configure account location parameters using the following commands:
  - `setauthparam accounts-dn <DN_path>`
  - `setauthparam account-obj user`
  - `setauthparam account-name-attr sAMAccountName`
  - `setauthparam memberof-attr memberOf`
  - `checkpassword <user_name>`
- Configure group-to-role mapping parameters using the following command:
  - `setauthparam <map_param> <map_value>`
- Configure group-to-domain mapping parameters using the following commands:
  - `setauthparam group-obj group`
  - `setauthparam domain-name-attr <attribute>`, and optionally `setauthparam domain-name-prefix <prefix>`
  - `checkpassword <user_name>`

The following instructions describe how to set up an Active Directory LDAP connection on a system using Domains:

Procedure

1. Follow the directions as described in the following sections:
   a. **Configuring connection parameters** on page 63
   b. **Configuring binding parameters** on page 65
   c. **Configuring account location parameters** on page 65
   d. **Configuring group-to-role mapping parameters** on page 67; however, do not issue the `checkpassword` command.
2. Configure the group-to-domain mapping parameters, as follows:
   - Issue the `setauthparam domain-name-attr <attribute>` command, where `<attribute>` is the name of an attribute that holds the potential domain name. A common parameter to specify as the `<attribute>` is `name`.
   - (Optional.) Issue the `setauthparam domain-name-prefix <prefix>` command, where `<prefix>` is the start point of the domain name search within the information returned from the `domain-name-attr <attribute>` parameter described above. An example parameter to specify as the `<prefix>` is `SystemDomain=`.
3. Issue the `checkpassword` command to verify that the users have the roles you assigned for the desired groups and the group-to-domain mapping is correct. Use a member of a specific group to verify the role.

Example using only the `domain-name-attr` parameter:

```
system cli% setauthparam domain-name-attr name
```

The example above corresponds to the first bullet in Step **2**. As shown, `name` is the attribute used as the basis of the domain name search.

```
system1 cli% checkpassword 3PARuser
...
+ search result:    memberOf: CN=Software,CN=Users,DC=3par,DC=com
+ search result:    memberOf: CN=Eng,CN=Users,DC=3par,DC=com
+ search result:    memberOf: CN=Golfers,CN=Users,DC=3par,DC=com
+ mapping rule: edit mapped to by CN=Software,CN=Users,DC=3par,DC=com
+ rule match: edit mapped to by CN=Software,CN=Users,DC=3par,DC=com
+ mapping rule: browse mapped to by CN=Eng,CN=Users,DC=3par,DC=com
+ rule match: browse mapped to by CN=Eng,CN=Users,DC=3par,DC=com
+ searching LDAP using:
search base:    CN=Software Group,CN=Users,DC=3par,DC=com filter:    (objectClass=group)
for attributes: name
+ search result DN: CN=Software Group,CN=Users,DC=3par,DC=com
+ search result:    name: Software Group
+ group "CN=Software Group,CN=Users,DC=3par,DC=com" has potential domain Software_Group (transformed from "Software Group")
+ searching LDAP using:
search base:    CN=Eng,CN=Users,DC=hq,DC=3par,DC=com filter:    (objectClass=group)
for attributes: name
+ search result DN: CN=Eng,CN=Users,DC=hq,DC=3par,DC=com
+ search result:    name: Engineering
+ group "CN=Eng,CN=Users,DC=hq,DC=3par,DC=com" has potential domain Engineering
+ domain match: Engineering mapped to browse
+ domain match: Software_Group mapped to edit user 3PARuser is authenticated and authorized
```

The example above corresponds to Step **3** and displays the following:

- `3PARuser` is found to be a member of the `Software` group with `Edit` rights. The `Software` group is mapped to the `Software_Group` domain. `3PARuser` is assigned `Edit` rights within the `Software` domain.
- `3PARuser` is also found to be a member of the `Eng` group with `Browse` rights. The `Eng` group is mapped to the `Engineering` domain. `3PARuser` is assigned `Browse` rights within the `Eng` domain.

Example using the `domain-name-prefix` parameter:

```
system cli% setauthparam domain-name-attr description
system cli% setauthparam domain-name-prefix SystemDomain=
```

The example above corresponds to the second bullet in Step **2**. As shown, `SystemDomain=` is the start point of the domain name search within the information returned from the `domain-name-attr description` parameter described above. The text following `SystemDomain=` is treated as the potential domain name.

Example using `checkpassword`:

```
system1 cli% checkpassword 3paruser
...
+ temporarily setting name-to-address mapping: domaincontroller.3par.com ->
192.168.10.13
+ attempting to obtain credentials for 3paruser@NTDOM1.3PAR.COM
+ connecting to LDAP server using URI: ldap://192.168.10.13
+ binding to user 3paruser with SASL mechanism GSSAPI
+ searching LDAP using:
search base:    OU=Users,DC=3par,DC=COM
filter:    (&(objectClass=user)(sAMAccountName=3paruser)) for attributes:
memberOf
+ search result DN: CN=3PAR User,OU=Eng,OU=Users,DC=3par,DC=COM
+ search result:    memberOf: CN=Software,CN=Users,DC=3par,DC=com
+ search result:    memberOf: CN=Eng,CN=Users,DC=3par,DC=com
+ mapping rule: edit mapped to by CN=Software,CN=Users,DC=3par,DC=com
+ rule match: edit mapped to by CN=Software,CN=Users,DC=3par,DC=com
+ mapping rule: browse mapped to by CN=Eng,CN=Users,DC=3par,DC=com
+ rule match: browse mapped to by CN=Eng,CN=Users,DC=3par,DC=com
+ searching LDAP using:
search base:    CN=Software,CN=Users,DC=3par,DC=com filter:
(objectClass=group)
for attributes: description
+ search result DN: CN=Software,CN=Users,DC=3par,DC=com
```

```
+ search result:    description: Software
+ group "CN=Software,CN=Users,DC=3par,DC=com" has potential domain Software
+ searching LDAP using:
search base:    CN=Eng,CN=Users,DC=3par,DC=com filter:    (objectClass=group)
for attributes: description
+ search result DN: CN=Eng,CN=Users,DC=3par,DC=com
+ search result:    description: Engineering Group, SystemDomain=engineering-
group-dom
+ group "CN=Eng,CN=Users,DC=3par,DC=com" has potential domain engineering-
group-dom (transformed from "Engineering Group, SystemDomain=engineering-
group-dom")
+ domain match: Engineering mapped to browse
+ domain match: Software mapped to edit
user 3paruser is authenticated and authorized
```

Configuring connection parameters

Procedure

1. If not already known, obtain the LDAP server's host name and Kerberos server information by running the `ldapsearch` command or using `ldp.exe` (available as part of the downloadable Windows Support Tools from Microsoft). You must know the LDAP server's IP address.

   NOTE: If you do not have access to the `ldapsearch` command, use the `ldp.exe` command shown below.

   - Issue the `ldapsearch` command and record the displayed `dnsHostName` (the value used for the `ldap-server-hn` parameter) and `ldapServiceName` (the value used for the `kerberos-realm` parameter) attributes for later use.
   - Run `ldp.exe` as follows:

     a. Click **Start** > **Run**.

     b. In the **Open** box, enter **`ldp`** and click **OK**.

        The **Ldp** window opens.

     c. In the **Ldp** window, click **Connection** > **Connect**.

     d. In the **Server** box, enter the Active Directory server's IP address and click **OK**.

        The root DSE attributes and values are displayed in the right-side pane.

        NOTE: In `ldp.exe`, the Kerberos realm is the portion of the `ldapServiceName` value that follows the "at" (@) sign and terminates before the semicolon (;).

        In `ldapsearch` output, the Kerberos realm is the portion of the `ldapServiceName` value that follows the "at" (@) sign.

     e. Record the displayed `dnsHostName` (the value used for the `ldap-server-hn` parameter) and `ldapServiceName` (the value used for the `kerberos-realm` parameter) attributes for later use.

2. Set the address to which the LDAP server will connect by issuing the `setauthparam ldap-server <IP_address>` command, where `<IP_address>` is your LDAP server's IP address.

3. Set the LDAP server's host name by issuing the `setauthparam ldap-server-hn <DNS_HostName>` command, where `<DNS_HostName>` is the value displayed by either using the `ldapsearch` command or `ldp.exe` in Step **1**.
4. Set the Kerberos realm by issuing the `setauthparam kerberos-realm <LDAP_ServiceName>` command, where `<LDAP_ServiceName>` is the value displayed by either using the `ldapsearch` command or `ldp.exe` in Step **1**.

NOTE: The value displayed for the default naming context is used later in **Configuring account location parameters** on page 65.

Examples:

```
% ldapsearch -LLL -x -H ldap://192.168.10.13 -b "" -s base dnsHostName ldapServiceName defaultNamingContext
dn:
dnsHostName: domaincontroller.3par.com
ldapServiceName: 3par.com:domaincontroller$@NTDOM1.3PAR.COM defaultNamingContext: DC=3par,DC=com
```

The example above corresponds to Step **1** and displays the following:

- The LDAP server's IP address is `192.168.10.13`.
- The `DNS_HostName` is `domaincontroller.3par.com`.
- The `LDAP_ServiceName` is `NTDOM1.3PAR.COM`.
- The `defaultNamingContext` is `DC=3par,DC=com`.

```
system1 cli% setauthparam -f ldap-server 192.168.10.13
system1 cli% setauthparam -f ldap-server-hn domaincontroller.3par.com
system1 cli% setauthparam -f kerberos-realm NTDOM1.3PAR.COM
```

The example above corresponds to Step **2** through Step **4**.

More information:

Active Directory LDAP configuration with SASL binding on page 62

Configuring LDAP connections on systems using domains on page 78

Configuring binding parameters

After you have configured the connection parameters to your LDAP server, you must configure the binding (authentication) parameters for users.

Procedure

1. Issue the `setauthparam binding sasl` command.
2. Issue the `setauthparam sasl-mechanism <SASL_type>` command, where `<type>` is specified as `PLAIN`, `DIGEST-MD5`, or `GSSAPI`.

   For information on binding types, see "Lightweight Directory Access Protocol" in the *HPE 3PAR StoreServ Storage Concepts Guide*.

Example:

In the example, GSSAPI SASL binding is used for authentication.

```
system1 cli% setauthparam -f binding sasl
system1 cli% setauthparam -f sasl-mechanism GSSAPI
```

More information:

Active Directory LDAP configuration with SASL binding on page 62

Configuring LDAP connections on systems using domains on page 78

Configuring account location parameters

Procedure

1. If you are unsure of the user's account information, select a known user's full name (to be entered as the `cn` value) and run the `ldapsearch` command using the `defaultNamingContext` value previously displayed in **Configuring connection parameters** on page 63. Make a note of the group information displayed in the command output.
2. Issue the `setauthparam accounts-dn <dn_path>` command.
3. Issue the `setauthparam account-obj user` command.
4. Issue the `setauthparam account-name-attr sAMAccountName` command.
5. Issue the `setauthparam memberof-attr memberOf` command.
6. Issue the `checkpassword` command to obtain information about the user's group memberships from the LDAP server.

   NOTE: You must know the user's password to successfully use the `checkpassword` command.

Examples:

```
% ldapsearch -LLL -x -H ldaps://192.168.10.13 -D 'NTDOM1\joeadmin' -W -b DC=3par,DC=com -s sub '(cn=3PARuser)' dn
Enter LDAP Password:
dn: CN=3PAR User,OU=Engineering,OU=Users,DC=3par,DC=com
```

The example above corresponds to Step **1** and displays the following:

- `joadmin` is the user name of the Windows domain (`NTDOM1`) administrator searching for group information for user `3PARuser` (`cn=3PAR User`).
- `dn: CN=3PAR User,OU=Engineering,OU=Users,DC=3par,DC=com` displays user locations in the LDAP server directory information tree.

```
system1 cli% setauthparam -f accounts-dn OU=Users,DC=3par,DC=com
system1 cli% setauthparam -f account-obj user
system1 cli% setauthparam -f account-name-attr sAMAccountName system1
cli% setauthparam -f memberof-attr memberOf
```

The example above corresponds to Step **2** through Step **4**.

- The `Users` group within the `3par` group is set as the basis for any user search when authenticating with the LDAP server.
- The values `user`, `SAMAccountName`, and `memberOf` for the `account-obj`, `account-name-attr`, and `memberof-attr` parameters are typical of Active Directory configurations.

```
system1 cli% checkpassword 3paruser password:
+ attempting authentication and authorization using system-local data
+ authentication denied: unknown username
+ attempting authentication and authorization using LDAP
+ connecting to LDAP server using URI: ldaps://192.168.10.13
+ simple bind to LDAP user 3paruser for DN uid=3paruser,ou=people,dc=ldaptest,dc=3par,dc=com
+ searching LDAP using:
search base:    ou=people,dc=ldaptest,dc=3par,dc=com filter:    (&(objectClass=posixAccount)(uid=3paruser)) for attributes:
gidNumber
+ search result DN: uid=3paruser,ou=people,dc=ldaptest,dc=3par,dc=com
```

```
+ search result:    gidNumber: 2345
+ searching LDAP using:
search base:    ou=groups,dc=ldaptest,dc=3par,dc=com filter:
(&(objectClass=posixGroup)(|(gidNumber=2345)(memberUid=3paruser))) for attributes: cn
+ search result DN: cn=software,ou=groups,dc=ldaptest,dc=3par,dc=com
+ search result:    cn: software
+ search result DN: cn=engineering,ou=groups,dc=ldaptest,dc=3par,dc=com
+ search result:    cn: engineering
+ search result DN: cn=hardware,ou=groups,dc=ldaptest,dc=3par,dc=com
+ search result:    cn: hardware
+ mapping rule: super mapped to by software
+ rule match: super mapped to by software
+ mapping rule: edit mapped to by engineering
+ rule match: edit mapped to by engineering
+ mapping rule: browse mapped to by hardware
+ rule match: browse mapped to by hardware user 3paruser is authenticated and authorized
```

The example above corresponds to Step **6**, and shows that `3PARuser` is a member of the following hierarchy of groups:

- `Engineering`
- `Software`
- `Eng`
- `Golfers`

In this example, `3PARuser` is not yet authenticated or authorized because the group-to-role mapping has not been configured.

More information:

Active Directory LDAP configuration with SASL binding on page 62

Configuring LDAP connections on systems using domains on page 78

Configuring group-to-role mapping parameters

After you have configured the group location parameters, decide what role to assign users for a given group. To configure group-to-role mapping:

Procedure

1. Issue the `setauthparam <map-param> <map-value>` command, where:
   - `<map-param>` is one of the following:
     - `super-map`—provides `Super` user rights within the specified group.
     - `edit-map`—provides `Edit` user rights within the specified group.
     - `browse-map`—provides `Browse` user rights within the specified group.
     - `create-map`—provides `Create` user rights within the specified group.
     - `basic_edit-map`—provides `Basic Edit` user rights within the specified group.
     - `3PAR_AO-map`—provides `3PAR AO` user rights within the specified group.
     - `3PAR_RM-map`—provides `3PAR RM` user rights within the specified group.
   - `<map-value>` is the group to which the user has membership. You can specify multiple groups with multiple `<map-value>` arguments.

     For Active Directory, the group is displayed as a string of information, as shown in the following example:

```
CN=Software,CN=Users,DC=ACME,DC=com
```

NOTE: The HPE 3PAR StoreServ Management Console (HPE 3PAR SSMC) refers to `<map-param>` specifiers as Authorization Groups.

2. Repeat Step **1** above to assign users a different role for another group to which that user has membership.
3. Issue the `checkpassword` command to verify that users have the roles you assigned for the groups. Use a member of a specific group to verify the role.

Examples:

```
system1 cli% setauthparam -f edit-map CN=Software,CN=Users,DC=3par,DC=com
system1 cli% setauthparam -f browse-map CN=Eng,CN=Users,DC=3par,DC=com
```

In the example above:

- Users belonging to the `Software` group are configured to have `Edit` rights within the system.
- Users belonging the `Eng` group are configured to have `Browse` rights within the system.

```
system1 cli% checkpassword 3PARuser
...
+ search result:    memberOf: CN=Software,CN=Users,DC=3par,DC=com
+ search result:    memberOf: CN=Eng,CN=Users,DC=3par,DC=com
+ search result:    memberOf: CN=Golfers,CN=Users,DC=3par,DC=com
+ mapping rule: edit mapped to by CN=Software,CN=Users,DC=3par,DC=com
+ rule match: edit mapped to by CN=Software,CN=Users,DC=3par,DC=com
+ mapping rule: browse mapped to by CN=Eng,CN=Users,DC=3par,DC=com
+ rule match: browse mapped to by CN=Eng,CN=Users,DC=3par,DC=com user 3PARuser is authenticated and authorized
```

In the example above:

- `3PARuser` is a member of the `Software` group and is assigned `Edit` rights within the system.
- Although `3PARuser` is also a member of the `Eng` group, the `Edit` rights associated with the `Software` group supersede the `Browse` rights associated with the `Eng` group.
- The mapping rules set for `3PARuser` are applied to all members of the `Software` and `Eng` groups. All `Software` group members have `Edit` rights within the system. All `Eng` group members have `Browse` rights within the system.

More information:

Active Directory LDAP configuration with SASL binding on page 62

Configuring LDAP connections on systems using domains on page 78

Federal Information Processing Standards (FIPS)

Federal Information Processing Standards (FIPS) is a U.S. government standard for approving cryptographic modules. The HPE 3PAR OS can use cryptographic modules that are FIPS 140-2 level 1 validated. With FIPS mode enabled, these modules operate in compliance with their validation criteria.

Managing FIPS

The `controlsecurity` command controls security parameters of a 3PAR StoreServ system. This includes enabling and disabling of FIPS 140-2 validated cryptographic modules on all management interfaces.

Management Interfaces are CIM, CLI, EKM, and are used for Data at Rest Encryption, LDAP Authentication, SNMP, Syslog, SSH, WSAPI, and VASA. EKM and Syslog interfaces always have FIPS mode enabled.

Prerequisites

Notify all management interface users to expect service disruption due to enabling or disabling FIPS mode. Enabling FIPS mode terminates ALL existing management interfaces, connections, and services.

Procedure

1. Log in to the system as `super` user or any user with the `security_control` right.
2. To enable or disable FIPS, use the following command and choose one option:
   `cli%` **`controlsecurity fips [ enable | disable ]`**

   You can use the `-f` option to force the operation without any confirmation messages.

HPE 3PAR Virtual Domains

An administrator can use HPE 3PAR Virtual Domains to create multiple domains, or spaces, within a system, where each domain is dedicated to a specific application. In effect, using domains restricts users to a subset of the volumes and hosts in a system, and prevents users from exporting virtual volumes to hosts outside of their assigned domains.

3PAR Virtual Domains Software requires a HPE 3PAR Virtual Domains or HPE 3PAR All-inclusive Single-System software license. Contact your local service provider for details.

For more information about domains, see the *HPE 3PAR StoreServ Storage Concepts Guide*, available from the Hewlett Packard Enterprise Information Library.

More information

Software licenses and HPE 3PAR CLI on page 13

Default domains

A HPE 3PAR CLI user's default domain is the domain that the user accesses at the start of each CLI session.

For example, if a user has `edit` rights to Domains A and B, and Domain A is the default domain, then each time a user starts a new CLI session, that user can only view and work with objects in Domain A. A user's default domain can be set or reset at any time by the administrator.

In the following figure, the default domain (defined as Domain A) can be reassigned to Domain B for the current working session using the `setclienv currentdomain <name>` command. When the `currentdomain <name>` is set, you are able to view and work on objects in Domain B for a single CLI session. However, when that session is over, your next session is again started in your default domain (Domain A). Thus, a current domain refers to the domain in which you are working during a particular, single CLI session.

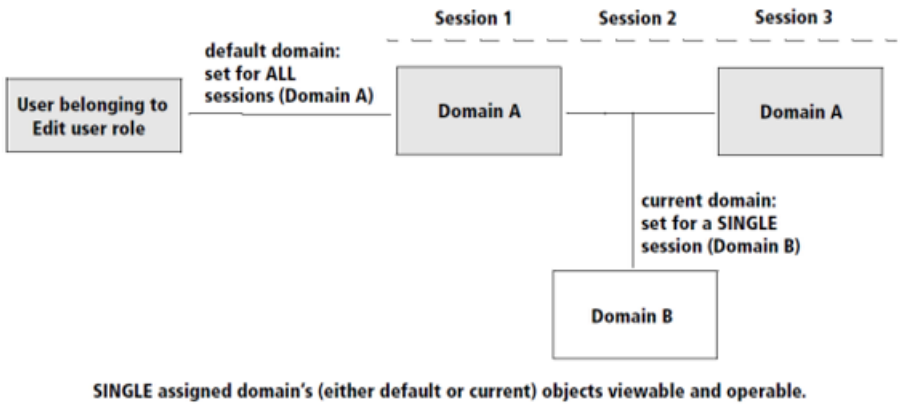


Figure 1: Assigned Default and Current Domains

Creating a domain

You can create up to 1,024 domains within a single system.

You can specify the maximum retention time for a virtual volume in the domain with the following option:

`-vvretentiontimemax`

Procedure

- To create a domain, issue the `createdomain <domain_name>` command, where `<domain_name>` is the name you want to assign the domain. The `<domain_name>` can be a maximum of 31 characters in length.
- To add an informational note to a domain during its creation, issue the `createdomain -comment <comment> <domain_name>` command, where `<comment>` is the text of the note you wish to add about the domain being created. The comment length is restricted to 511 characters, and the comment text must be enclosed in quotation marks.

For a complete list of options available for the `createdomainset` command, see the *HPE 3PAR Command Line Interface Reference* and HPE 3PAR CLI *Help*. For additional information about domains, see the *HPE 3PAR StoreServ Storage Concepts Guide*, available the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Viewing domains

From time to time, you may wish to view the domains in your system. Additionally, when managing your domain objects as described in **Managing domain objects** on page 89, you may need to view the domain associations for the domain objects.

Prerequisites

To set your system output to display domain information, you must first set the TPDLISTDOM environment variable, the `-listdom` global option, or if you are working in a Tcl shell, issue the `setclienv listdom 1` command. See **Listing domains** on page 36 for further information.

Procedure

- **Viewing domains on your system**:

  Issue the `showdomain -d` command.

  For details about the `showdomain` command, see the *HPE 3PAR Command Line Interface Reference*, available at the following website:

  Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

- **Viewing the domain association of a system object**:

  Issue the `showhost`, `showvv`, or `showcpg` commands

Modifying a domain

Procedure

For any existing domain, you can change the domain name or add comments to that domain using the `setdomain` command.

For details about the `setdomain` command, see the *HPE 3PAR Command Line Interface Reference*.

More information:

Changing a domain name on page 89

Adding comments to a domain on page 89

Removing a domain on page 89

Changing a domain name

Procedure

- Issue the `setdomain -name <name> <domain_name>` command, where:
  - `<name>` is the new name you wish to assign the domain.
  - `<domain_name>` is the current name of the domain you are renaming.

Once changed, users and comments previously belonging to the old domain name are displayed as belonging to the new domain name. All previous associations, objects, and settings (such as default settings) are also transferred.

Adding comments to a domain

Procedure

- If a comment was not added to a domain during its creation and you wish to add a note to that domain, issue the `setdomain -comment <comment> <domain_name>` command, where:
  - `<comment>` is the comment you are adding to the specified domain.
  - `<domain_name>` is the name of the domain to which you are adding a comment.

The comment length is restricted to 511 characters and the comment text must be enclosed in quotation marks.

Removing a domain

Domain objects include virtual volumes, common provisioning groups (CPGs), and hosts.

Prerequisites

Before removing a domain:

- Any users belonging to that domain must be removed (see **Removing users from a domain** on page 55). Users may be assigned to another domain (see **Adding users to a domain** on page 54), or deleted.
- Any objects belonging to the domain must be removed from the domain or moved to another domain.

Procedure

Issue the `removedomain <domain_name>` command, where `<domain_name>` is the domain you want to delete.

Managing domain objects

Domain objects can be moved in and out of a domain, or have their domain associations entirely removed. All objects related either directly or indirectly to the domain object being managed are also moved or removed. These relationships include, but are not limited to, VLUNs between hosts and VVs, VVs that are drawing from CPGs, and multiple VVs sharing the same LD.

Moving domain objects to another domain

Moving objects between domains is an online operation and does not interrupt host I/O.

Prerequisites

- To move or remove a domain object, you must have `super` or `edit` user rights with access to all domains.
- Before proceeding with any domain management activities, review the domain associations for your system objects as described in **Viewing domains** on page 88.

Procedure

- To move a domain object in or out of a domain, issue the `movetodomain -vv|-cpg|-host <object_name> <domain_name>|set:<set_name>` command, where:
  - `-vv|-cpg|-host` is the type of object (VV, CPG, host, respectively) you are moving.
  - `<object_name>` is the name of the VV, CPG, or host you are moving.
  - `<domain_name>` is the name of the domain to which you are moving the specified object.
  - `<set_name>` is the name of the domain set to which you are moving the specified host.

NOTE: If a CPG (or a VV in a CPG) is part of an AO configuration (aocfg), and if the VV or CPG is then specified as the target of a `movetodomain` command, **all** CPGs and related VVs in the aocfg will also be moved to the target domain.

Removing the domain association from a domain object

Prerequisites

- To move or remove a domain association from a domain object, you must have `super` or `edit` user rights with access to all domains.
- Before proceeding with any domain management activities, review the domain associations for your system objects as described in **Viewing domains** on page 88.

Procedure

- To remove the domain association from a domain object, issue the `movetodomain -vv|-cpg|-host <object_name> -unset` command, where:
  - `-vv|-cpg|-host` is the type of object (VV, CPG, host, respectively) from which you are removing the domain association.
  - `<object_name>` is the name of the VV, CPG, or host from which you are removing the domain association.

Managing virtual domain autonomic groups

Virtual domains can be combined into autonomic groups. Autonomic groups are sets of objects that can be managed as one object. If you have a group of domains that require the same administrative procedures, it is easier to group those domains into a set and manage them together.

For example, you can create a domain set and put all the hosts in a cluster into a host set. By setting the domain of the hosts in the host set to the newly created domain set, all the virtual volumes exported to one host in the cluster are accessible to all the hosts in the cluster. If one of the hosts in the cluster is a backup host, all the virtual volumes in the domain set can be accessed by the backup host. Without domain sets there is no way for a host to access volumes from different domains at the same time. Individual domains can be members of multiple domain sets.

Hosts are the only objects that can be members of a domain set. All other objects can only belong to a single domain. If a host that is a member of a domain set is moved with the `movetodomain` command to an individual domain, then all objects associated with the host must be members of the destination domain or the command will fail. Moving a host to a domain set does not change the domain of any objects associated with the host. If a volume is exported to a host that is a member of a domain set that is selected directly or indirectly by the `movetodomain` command, and if the domain set includes the destination domain of the volume, the move does not propagate to the host or any of the volumes exported to the host.

Virtual domains added to a set inherit the rights of that set. Any action that requires `browse` rights for a host requires the user to have `browse` rights in any domain in the domain set. Any action that requires `edit` rights for the host requires the user to have `edit` rights in all domains in the domain group.

A virtual domain in a virtual domain set cannot be removed from the system until it has been removed from the virtual domain set, or until the virtual domain set is removed from the system. Removing a virtual domain set does not remove the virtual domains in that set. Changing the name of a virtual domain in a set does not change the rights of the virtual domain or remove it from the virtual domain set.

More information:

Creating virtual domain sets on page 91

Adding virtual domains to virtual domain sets on page 91

Modifying virtual domain sets on page 92

Viewing virtual domain sets on page 92

Removing virtual domain sets on page 92

Creating virtual domain sets

Procedure

- To create a domain set, issue the `createdomainset <set_name> <domain_names>` command, where:
  - `<set_name>` is the name of the domain set being created.
  - `<domain_names>` are the names of the domains included in the domain set.

  For a complete list of options available for the `createdomainset` command, see the *HPE 3PAR Command Line Interface Reference* and the HPE 3PAR CLI *Help*.

Adding virtual domains to virtual domain sets

Procedure

- To add a domain to an existing domain set, issue the following command:

  ```
  createdomainset -add <set_name> <domain_names>
  ```

  Where:

- `<set_name>` is the name of the domain set that will include the added domains.
- `<domain_names>` are the names of the domains being added to the domain set.

For a complete list of options available for the `createdomainset` command, see the *HPE 3PAR Command Line Interface Reference* and the *3PAR CLI Help*.

Modifying virtual domain sets

Procedure

- To change the name of a domain set, issue the `setdomainset -name <new_name> <set_name>` command, where:
  - `<new_name>` is the new name of the domain set.
  - `<set_name>` is the name of the domain set being modified.

  For a complete list of options available for the `setdomainset` command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

  Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Viewing virtual domain sets

Procedure

- To view all domain sets in the System, issue the `showdomainset` command.
- To view the details of a specific domain, issue the `showdomainset -d <domainset_name>` command.
- To view domain sets containing domains matching a pattern, issue the `showdomainset -domain <pattern>*` command.

Removing virtual domain sets

Procedure

- To remove a domain set from the system, or to remove domains from a set, issue the `removedomainset <set_name> <domain_names>` command, where:
  - `<set_name>` is the name of the domain set being removed.
  - `<domain_names>` are the names of the domains being removed from the `<set_name>` domain set. This specifier is optional if you are removing the entire set.

  For a complete list of options available for the `removedomainset` command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

  Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Port and host management

The HPE 3PAR OS sees a host as a set of initiator port World Wide Names (WWNs) or iSCSI Names. The 3PAR OS automatically detects hosts that are physically connected to ports.

The HPE 3PAR CLI FC displays the port WWNs and iSCSI port iSCSI Names. You can also add new WWNs or iSCSI Names for unestablished host paths and assign them to a host before physically connecting them. These WWNs or iSCSI Names do not need to be associated with target ports on the system controller nodes. This allows for plug-and-play functionality that avoids the need for manual reconfiguration after connecting new hosts.

See the following documentation, available from the Hewlett Packard Enterprise Storage Information Library:

- *HPE 3PAR StoreServ Storage Concepts Guide* for more information about ports, hosts, and host personas.
- HPE 3PAR Implementation Guides for recommended practices and detailed configuration information about using your specific host devices with the system
- *HPE 3PAR Command Line Interface Reference* for usng the `startfs` command to manage ports used for file services.

Host personas are a set of behaviors that permit hosts connected to FC or iSCSI ports on the system to deviate from the default host behavior. By assigning a persona to a host, multiple host types that require distinct customized responses can share a single system port. For example, hosts running Microsoft Windows, Linux, and AIX operating systems can all connect to the same system port, which simplifies connecting hosts to the system and reduces management time related to complex host connections.

Support for FCoE connectivity through CNAs

The following HPE 3PAR StoreServ Storage systems support FCoE connectivity through the use of Converged Network Adapters (CNAs):

- HPE 3PAR StoreServ 7000 Storage
- HPE 3PAR StoreServ 8000 Storage
- HPE 3PAR StoreServ 9000 Storage
- HPE 3PAR StoreServ 10000 Storage
- HPE 3PAR StoreServ 20000 Storage

You can configure CNAs for use as FCoE or iSCSI ports.

Port target, initiator, and peer modes

Set ports in the same FC adapter to the same mode:

- For dual-port LSI cards, both ports must use the same mode.
- For quad-port LSI cards, each port pair (ports 1&2 and ports 3&4) must use the same mode.
- For QLogic cards, Hewlett Packard Enterprise strongly recommends setting all ports in a card to the same mode.

The system controller node ports operate in different modes. Depending on the type of port, the port can operate in target, initiator, or peer mode.

- FC ports use the following firmware mode settings:
  - Target mode for ports that connect to hosts and receive commands from those hosts.
  - Initiator mode for ports that connect to the system physical disks and send commands to those disks.
  - Initiator mode for Remote Copy over Fibre Channel (RCFC).
- iSCSI ports use the target mode for ports that connect to hosts and receive commands from those hosts.
- GigE ports use the peer mode for Ethernet ports, used for Remote Copy over IP (RCIP).
- FCoE ports use the target mode for ports that connect to hosts and receive commands from those hosts.
- File Persona ports use the target mode for ports that connect to hosts and receive commands from those hosts.

Use the HPE 3PAR CLI `showport` command to display the current mode for all ports. Use the `controlport` command to change the mode of an FC port. These commands are described in detail in the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Modifying port parameters

The following commands control several aspects of the ports. Whenever you use these commands, you must use a subcommand specifying the operation you want to perform and include the port location. Use the `controlport` command to alter the rate and connection type of the port.

Procedure

- To change the rate of the port, use the `controlport` command with the following options:

  ```
  controlport rate <rateval> [-f] <node:slot:port>
  ```

  Use the `controlport` command to change the rate of the port. The possible values when using the 16G FC HBA card are "1", "2", "4", "8", "16", "32", or "auto". The possible values when using the 32G FC HBA card are "8", "16", "32" and "auto".

  Example:

  If the rate being altered on a 32G FC HBA card is less than 8Gbps, an error message will be displayed:

  ```
  cli% controlport rate 4 0:3:2
  controlport Error: The minimum rate supported by port 0:3:2 is 8Gbps
  ```

- To change the connection point of a port, use the `controlport` command with the following options:

  ```
  controlport config <connmode> [-ct <ctval>][-unique_nwwn enable|disable] [-
  f] <node:slot:port>
  ```

  The possible values for connection types when using a 16G FC HBA card are loop and point.

  The only possible value for connection type when using a 32G FC HBA card is point.

  Example:

If a connection type "loop" is trying to be set on a 32G FC HBA card, an error will be displayed:

```
cli% controlport config host -ct loop 0:3:2
controlport Error: Port 0:3:2 is a 16/32Gb FC port - Connection type can only be "point"
```

NOTE: For information about configuring ports to use HPE 3PAR File Persona file services, see the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Controller node port locations

The HPE 3PAR CLI displays the controller node port locations in the following format: `<node>:<slot>:<port>`. For example: `2:4:1`.

- **Node**

  Valid node numbers are 0 to 7, depending on the type of system you have and the number of controller nodes installed in your system. When viewing a system from the rear of a cabinet:

  - HPE 3PAR StoreServ 20000 Storage nodes are numbered from bottom to top, from 0 to 3 (HPE 3PAR StoreServ 20400 Storage), or from 0 to 7 (HPE 3PAR StoreServ 20800 Storage).
  - HPE 3PAR StoreServ 10000 Storage nodes are numbered left to right, bottom to top, from 0 to 3 (HPE 3PAR StoreServ 10400 Storage) or from 0 to 7 (HPE 3PAR StoreServ 10800 Storage).
  - HPE 3PAR StoreServ 9000 Storage nodes are numbered from bottom to top, from 0 to 3.
  - HPE 3PAR StoreServ 7000 Storage and HPE 3PAR StoreServ 8000 Storage nodes are numbered 0 to 1 or 0 to 3 from bottom to top, depending on whether the system has two or four controller nodes.

- **Slot**

  Valid slot numbers are 0 to 9, depending on the system.

  - HPE 3PAR StoreServ 20000 Storage slots are numbered 0 to 6 from left to right in each controller node.
  - HPE 3PAR StoreServ 10000 Storage slots are numbered 0 to 9 from left to right, bottom to top in a node in the lower chassis. In the upper chassis, slots are numbered 0 to 9 from left to right, top to bottom.
  - HPE 3PAR StoreServ 9000 Storage slots are numbered 0 to 6 from left to right in each controller node.
  - HPE 3PAR StoreServ 8000 Storage systems have one available HBA slot per node, which is slot 2. The onboard FC ports are at slot 0, and the onboard SAS ports are at slot 1.
  - HPE 3PAR StoreServ 7000 Storage systems have one available HBA slot per node, which is slot 2. The onboard SAS ports are at slot 0, and the onboard FC ports are at slot 1.

- **Port**

  Valid node port numbers depend on the kind of host bus adapter installed. A given adapter may have two or four ports, numbered from 1 to 2 for HBAs with two ports or from 1 to 4 for HBAs with four ports.

  - HPE 3PAR StoreServ 20000 Storage ports are numbered from bottom to top in a given slot.
  - HPE 3PAR StoreServ 10000 Storage ports are numbered from bottom to top in a controller node in the lower chassis. In the upper chassis, ports are numbered from top to bottom.

- HPE 3PAR StoreServ 9000 Storage ports are numbered from bottom to top in a given slot.
- HPE 3PAR StoreServ 7000 Storage and 3PAR StoreServ 8000 Storage ports are numbered from left to right on controller nodes in enclosure slot 0 (bottom), and from right to left on controller nodes in enclosure slot 1 (top).

For more information see the relevant product documentation.

Configuring FC port settings

The HPE 3PAR CLI `controlport` command is described in detail in the *HPE 3PAR Command Line Interface Reference* and the HPE 3PAR CLI *Help*.

You can set the port mode using the `controlport` command with the `config` subcommand, followed by `disk|host|rcfc`. Set the port location in `node:slot:port` format.

Procedure

1. Disconnect the cable from the port on the system.
2. Set the port mode. Issue the `controlport config disk|host|rcfc <node>:<slot>:<port>` command.
3. Reconnect the cable to the port on the system.

Other options are available for the `controlport` command, including options for resetting the port mode, modifying Remote Copy settings, and issuing an FC Loop Initialization Primitive (LIP) procedure. These options are described in detail in the HPE 3PAR CLI *Help* and in the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Setting the port data rate

Procedure

- Set the port data rate in Gbps with the `rate` subcommand followed by `1`, `2` or `4`, and the port location in `node:slot:port` format:

  ```
  controlport rate <1|2|4> <node:slot:port>
  ```

- Alternatively, you can use the `controlport rate auto` command, followed by the port location in `node:slot:port` format, to allow the system to determine the data rate automatically.

  The default value for this option is `auto`.

Setting a unique node WWN option for a port

When `unique_nwwn` is enabled, the port presents a unique node name for the connection.

Procedure

- To set the unique node WWN option for the port, issue the `controlport config <connmode> [-ct <ctval>] [-unique_nwwn enable|disable] <node:slot:port>` command, where:

- `<connmode>` is one of the following connections: `disk|host|rcfc`.
- `<ctval>` is either `loop` or `point`. The loop parameter sets the port to arbitrated loop mode, and the point parameter sets the port to point-to-point mode.

For more information about the `controlport` command, see **Configuring FC port settings** on page 96.

Setting a Class 2 service support level for a port

Procedure

Issue the `controlport cl2 <cl2val> <node:slot:port>` command, followed by `ack0`, `ack1`, or `disable`, and then by the port location in `node:slot:port` format.

Setting VLUN change notification for a port

Procedure

Set the VLUN change notification (VCN) support generation for a port with the `vcn` subcommand, followed by either `enable` or `disable`, and the port location in `node:slot:port` format.

Setting a VCN support for a port

Procedure

Issue the `controlport vcn <enable|disable> <node:slot:port>` command.

iSCSI port settings

The `controliscsiport` command is used to configure and manage iSCSI ports.

The subcommands associated with the `controliscsiport` command can be used to perform various management tasks, such as:

- Setting the IP and gateway addresses of iSCSI ports.
- Setting the IP address and TCP port numbers for Internet Storage Name Service (iSNS) servers.
- Assigning iSCSI ports to groups of target ports to send to initiators in response to SendTargets requests.

More information:

Configuring the IP address of an iSCSI port on page 98

Setting the gateway address of an iSCSI port on page 98

Setting the IP address of an iSNS server on page 98

Setting the TCP port number for the iSNS server on page 98

Associating an iSCSI port with a group of target ports on page 99

Displaying information about iSCSI ports on page 99

Configuring the IP address of an iSCSI port

The `addr` subcommand configures IP addressing for an iSCSI port. Use the subcommand to set the IP address and netmask (for IPv4 addresses) or the IP address and prefix length (for IPv6 addresses).

Procedure

- Issue the `controliscsiport addr <IP_address> {<netmask> | <prefix_len>} <node:slot:port>` command, where:
  - `<IP_address>` specifies the IPv4 or IPv6 address of the iSCSI port.
  - `<netmask>` specifies, for IPv4 addresses, the subnet mask used on the network, for example, `255.255.255.0`.
  - `<prefix_len>` specifies, for IPv6 addresses, the prefix length comprising the network portion of the IP address.
  - `<node:slot:port>` specifies the physical location of the iSCSI port.

Setting the gateway address of an iSCSI port

Use the `gw` subcommand to set the gateway address of the iSCSI port.

Procedure

- Issue the `controliscsiport gw <gw_address> <node:slot:port>` command, where:
  - `<gw_address>` specifies the IP address of the gateway on the network.
  - `<node:slot:port>` specifies the physical location of the iSCSI port.

Setting the IP address of an iSNS server

Use the `isns` subcommand to set the IP address of an iSNS server.

Procedure

- Issue the `controliscsiport isns <isns_address> <node:slot:port>` command, where:
  - `<isns_address>` specifies the IP address of an available iSNS server on the network.
  - `<node:slot:port>` specifies the physical location of the iSCSI port.

Setting the TCP port number for the iSNS server

Use the `isnsport` subcommand to set the TCP port number for the iSNS server.

Procedure

- Issue the `controliscsiport isnsport <isns_port> <node:slot:port>` command, where:

- `<isns_port>` specifies the TCP port number for the iSNS server. The default TCP port for iSNS servers is 3205.
- `<node:slot:port>` specifies the physical location of the iSCSI port.

Associating an iSCSI port with a group of target ports

The `stgt` subcommand associates an iSCSI port with a group of target ports designated by a SendTargets Group Tag (STGT) value. An administrator can establish this group by assigning the same STGT value to multiple target ports. When a SendTargets request of "All" is received on an iSCSI port from an initiator, all ports with the same STGT value as the iSCSI port that received the request (that is, all the ports in the same target portal group) will be returned to the initiator as available target ports.

Procedure

- Issue the `controliscsiport stgt <sendtgt_grp> <node:slot:port>` command, where:
  - `<sendtgt_grp>` specifies the SendTargets Group Tag (STGT) value for the iSCSI port. The value must be an integer from 0 to 65535.
  - `<node:slot:port>` specifies the physical location of the iSCSI port.

NOTE: Other subcommands are available for the `controliscsiport` command, including subcommands for setting the maximum transmission unit (MTU) size for the iSCSI port, pinging IP addresses from a port, and deleting iSCSI port configurations. Other options are available to restrict the operation of commands to iSCSI ports on specific virtual LANs using VLAN tags.

The `controliscsiport` command, and its subcommands and options, are described in the HPE 3PAR CLI *Help* and in the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Displaying information about iSCSI ports

You can display information about iSCSI ports, including IP addresses, gateway addresses, iSNS addresses, and SendTargets Group Tags. You can also display iSCSI names, and information about VLANS.

Specify ports in `node:slot:port` format or by glob-style pattern.

Procedure

1. Log in to the system using any role.
2. To display information about iSCSI ports on a system, enter the following command:
   `showport -iscsi`
3. To display iSCSI names associated with iSCSI ports, enter the following command:
   `showport -iscsiname`
4. To display information about VLANs on iSCSI ports, enter the following command:
   `showport -iscsivlans`
5. To use other command options and specifiers, see, *HPE 3PAR Command Line Interface Reference*.

Adding an IPv6 address to 3PAR StoreServ storage

Procedure

1. Log in to the system as `Super` or `Service` user, or as any user with `set_net` permission.
2. To add an IPv6 address to an existing HPE 3PAR StoreServ Storage system, enter the following command:
   `cli%` **setnet addaddr *<old_IP> <new_IP> <prefix_len>***
   - `<old_IP>` is the existing IPv4 address of the storage system.
   - `<new_IP>` is the new IPv6 address of the storage system that you want to add.
   - `<prefix_length>` is the prefix length for the IPv6 address.

   ```
   # setnet addaddr 10.0.240.73 fe80:0:0:0:0:0:0a00:f049 64
   ```
3. To verify the addition of the new IPv6 address, enter the following command:
   `cli%` **shownet**

   ```
   # shownet
   IP Address                Netmask/PrefixLen Nodes Active Speed Duplex AutoNeg Status
   10.0.240.73                   255.255.240.0    01      1  1000 Full   Yes     Active
   fe80:0:0:0:0:0:0a00:f049                                              64    01      1
   1000 Full   Yes     Unverified
   ```

   The IPv6 address appears in the list, and its status is `Unverified`.
4. To verify the IPv6 address, use the CLI or SSH to log in to the HPE 3PAR StoreServ Storage system with the new iPv6 address.
5. Enter the `shownet` command from the array to make sure that the status has changed to `Verified`.

   ```
   # shownet
   IP Address                 Netmask/PrefixLen Nodes Active Speed Duplex AutoNeg Status
   10.0.240.73                    255.255.240.0    01      1  1000 Full   Yes     Active
   fe80:0:0:0:0:0:0a00:f049                  64    01      1  1000 Full   Yes     Verified
   ```
6. Enter the `setnet finish` to make the status active.
7. Enter the `shownet` command to confirm that the status is `Active`.

   ```
   # shownet
   IP Address                  Netmask/PrefixLen Nodes Active Speed Duplex AutoNeg Status
   10.0.240.73                     255.255.240.0    01      1  1000 Full   Yes     Active
   fe80:0:0:0:0:0:0a00:f049                        64    01      1  1000 Full   Yes
   Active
   ```

Active and inactive hosts

An active host is a host that is connected to a system port and recognized by the HPE 3PAR OS. Under normal operation, an active host may have a number of volumes exported to it and therefore the host has access to those volumes.

An inactive host is a host that is known to the HPE 3PAR OS but is not recognized as being connected to any system port at the moment. The host may be inactive because it is disconnected from the system port, because it is offline, or because of an error condition such as link failure.

When a host on a system port becomes inactive for any reason, the following happens:

- The HPE 3PAR OS recognizes that the host is missing on the port and changes the state of the host from `active` to `inactive`.
- The HPE 3PAR OS remembers all volumes exported to the host before it became `inactive`. It will not unexport the volumes on the port with the missing host.
- If and when the host reappears on the same port, the HPE 3PAR OS will change the state of the host to `active` again. At that time, the host will again have access to all previously exported volumes.

Managing hosts

The system sees a host as a set of initiator port WWNs or iSCSI Names. The HPE 3PAR OS administration tools allow you to create, modify, and remove FC and iSCSI host paths and their properties. When creating a new host, you can either create a host with or without assigning WWNs or iSCSI Names.

A virtual volume that is exported to a host is exported to all WWNs that make up the host. If you want to export virtual volumes to particular host computer WWNs or iSCSI Names, you can create separate hosts on the system and assign each WWN or iSCSI Name to its own host. The host management commands are described in detail in the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Host management 3PAR CLI commands

Use the following HPE 3PAR CLI commands to manage hosts and host paths:

- `showhost`—display information about defined hosts and host paths in the system.
- `showhostset`—list the defined host sets and their members.
- `createhost`—create a host or add paths to a host.
- `createhostset`—create a host set or add a host to an existing host set.
- `sethost`—modify properties of existing hosts.
- `sethostset`—change the name of a host set.
- `removehost`—remove a system host or paths to a host.
- `removehostset`—remove a host set from the system, or remove hosts from a set.
- `servicehost`—execute removal and replacement actions for a host connecting to a storage system port.

Creating hosts

When you create a host, you are defining the characteristics of a new host path from the system to the host. Defining host characteristics includes the assignment of a name to a host, and the assignment of a path to that host. Two types of host paths can be assigned: FC or iSCSI paths. You should create multiple paths to each host.

When creating a host, you can also annotate the host with descriptive information such as the host location, IP address, operating system, model, and owner, using either the `createhost` or `sethost` commands. This information is for annotation purposes only and it does not affect the operation of the system. See the *HPE 3PAR Command Line Interface Reference* or the HPE 3PAR CLI *Help* for further information.

CAUTION: To facilitate updates to the system, create at least two paths to each host. Failure to create at least two host paths may result in unnecessary system downtime.

See the appropriate HPE 3PAR implementation guide for recommended practices and detailed configuration information about using specific host devices with the system. HPE 3PAR implementation guides are available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Creating a host with a Fibre Channel path

Procedure

1. Determine the WWN of the HBA by issuing the `showhost` command.
2. Issue the `createhost -persona <persona_number> <host_name> <WWN>` command, where:
   - `<persona_number>` is the host persona number assigned to the host.
   - `<host_name>` is the user-designated name of the host being defined.
   - `<WWN>` is the WWN of the HBA.

If the Host Explorer agent is running on the host, the `createhost <host_name>` command automatically creates a host with the path information received from the Host Explorer agent.

Creating a host with an iSCSI path

Procedure

1. Determine the iSCSI name of the HBA by issuing the `showport -iscsiname` command.
2. Issue the `createhost -iscsi -persona <persona_number> <host_name> <iSCSI_name>` command, where:
   - `<persona_number>` is the host persona number assigned to the host.
   - `<host_name>` is the user-designated name of the host being defined.
   - `<iSCSI_Name>` is the host iSCSI Name, as determined in **1**.

If the Host Explorer agent is running on the host, the `createhost -iscsi <host_name>` command automatically creates a host with the path information received from the Host Explorer agent.

Creating a host without assigning a path

In instances where the FC WWN or iSCSI name of the HBA is unavailable, you can create a host as a placeholder until the path information becomes available. If the Host Explorer agent is not running on the host, the `createhost <host_name>` command creates a host without any path information. If the Host Explorer agent is running on the host, the `createhost <host_name>` command automatically creates a host with the path information received from the Host Explorer agent.

The host path information is required to display the device name. If the path information is not reported from the host to the system, then the device name appears as **Unknown**.

Procedure

Issue the `createhost <host_name>` command, where `<host_name>` is the user-designated name of the host being defined.

Modifying hosts

You can modify the following parameters and functions of an existing host:

- Change the host name. See **Changing a host name** on page 103.
- Add or remove WWNs. See:
  - **Adding Fibre Channel path WWNs** on page 103
  - **Removing Fibre Channel path WWNs** on page 104
- Add or remove iSCSI Names: See:
  - **Adding iSCSI path iSCSI names** on page 104
  - **Removing iSCSI path iSCSI names** on page 104
- Add or remove iSCSI CHAP authentication information. See **Configuring iSCSI CHAP authentication information** on page 104.
- **Removing iSCSI CHAP authentication information** on page 105

The following CLI commands are described in detail in the HPE 3PAR CLI *Help* and in the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Changing a host name

Procedure

- Issue the `sethost -name <new_host_name> <host_name>` command, where:
  - `<new_host_name>` is the new name you wish to assign to the existing host.
  - `<host_name>` is the original name of the host you are modifying.

Adding Fibre Channel path WWNs

Procedure

1. Determine the WWN of the HBA by issuing the `showhost` command.
2. Issue the `createhost -add <host_name> <WWN>` command, where:
   - `<host_name>` is the name of the host being modified.
   - `<WWN>` is the WWN of the HBA.
3. Repeat as necessary for any additional WWNs you wish to add to the host definition.

Removing Fibre Channel path WWNs

Procedure

- To remove a WWN from an existing host, issue the `removehost <host_name> <WWN>` command, where:
  - `<host_name>` is the name of the host being modified.
  - `<WWN>` is the FC path being removed.

Adding iSCSI path iSCSI names

You can add an additional iSCSI Name for an existing host.

Procedure

1. Determine the iSCSI name of the HBA by issuing the `showport -iscsiname` command.
2. Issue the `createhost -add -iscsi <host_name> <iSCSI_name>` command, where:
   - `<host_name>` is the name of the host being modified.
   - `<iSCSI_Name>` is the host iSCSI Name as determined in Step **1**.
3. Repeat as necessary for any additional iSCSI Names you wish to add to the host definition.

Removing iSCSI path iSCSI names

You can remove an iSCSI Name from an existing host.

Procedure

- Issue the `removehost -iscsi <host_name> <iSCSI_name>` command, where:
  - `<host_name>` is the name of the host being modified.
  - `<iSCSI_name>` is the iSCSI path being removed.

Configuring iSCSI CHAP authentication information

A host with an iSCSI path can be modified as an initiator or target with iSCSI CHAP authentication information. You cannot set the target CHAP authentication information before setting the initiator CHAP authentication information.

Procedure

- To configure a host as a CHAP initiator, issue the command:

```
sethost initchap <secret> <host_name>
```

- To configure a host as a CHAP target, issue the command:

```
sethost targetchap <secret> <host_name>
```

For both these commands, `<secret>` is the user-defined security key and `<host_name>` is the name of the host you are modifying.

During configuration, you can also optionally set the CHAP name and set the CHAP secret as a hexadecimal number. See the *HPE 3PAR Command Line Interface Reference* for further information.

Removing iSCSI CHAP authentication information

Procedure

- To remove CHAP authentication information from a host with an iSCSI path, issue one of the following commands:
  - `sethost removechap -target <host_name>`
  - `sethost removechap <host_name>`

For both these commands:

- `<host_name>` is the name of the host you are modifying.
- The `-target` argument is specified for removal of target CHAP authentication only.

Moving, removing, and disconnecting hosts

Use the following commands to display active hosts and the volumes exported to the hosts:

- `showhost`
- `showvlun`

To display inactive hosts and the volumes that were exported to the hosts, use the `servicehost list` command.

The `showhost`, `showvlun`, and `servicehost` CLI commands are described in detail in the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

After you move a host to a new port, you must:

- Remove the old host definitions.
- Disconnect the host from the system.
- Connect the host to the new port.

Procedure

1. To move the host to another system port, use the HPE 3PAR CLI command `servicehost copy` to create an inactive host on the system port to which you wish to move the host. The inactive host created with this command is identical to the active host that is to be relocated to this port.

   The `servicehost copy` command automatically exports all volumes that are currently exported to the active host to the new, inactive host once it is created. For more information about active and inactive hosts, see **Active and inactive hosts** on page 100.

The VLUNs from the specified source port (`src_node:slot:port`) are copied from the host WWNs or iSCSI Names matching the specified pattern (`WWN_or_iSCSI_name_pattern`) to the specified destination port (`dest_node:slot:port`). If necessary, the port is reset to target mode.

To create an inactive host on the system port to which you wish to move the host, issue the `servicehost copy <src_node:slot:port> <WWN_or_iSCSI_name_pattern> <dest_node:slot:port>` command, where:

- `<src_node:slot:port>` is the current port location.
- `<WWN_or_iSCSI_name_pattern>` specifies that the indicated WWN or iSCSI Name is treated as a glob-style pattern.
- `<dest_node:slot:port>` is the destination port location.

2. Remove the host definitions from the old port or ports.

   Removing the host definitions do not remove the old host paths. To remove the host paths, see **Removing host paths** on page 106. To remove host definitions and all VLUNs associated with the old host port, issue the `servicehost remove [<node:slot:port>[<WWN_or_iSCSI_name> ... ]]` command, where:

   - `<node:slot:port>` is the old port location.
   - `<WWN>` is the WWN path or paths to the host to be removed.
   - `<iscsi_name>` is the iSCSI path or paths to the host to be removed.

3. Disconnect the host from the system and then connect it to the new port.

   The system discovers the host on the new port automatically by matching the WWNs or iSCSI Names of the inactive host you created in Step **1** to the WWNs or iSCSI Names of the host. The HPE 3PAR OS automatically changes the state of the host from inactive to active. The host has immediate access to all volumes exported to the host.

Removing host paths

Host paths can be removed from the system before or after VLUNs are exported to the hosts. The `removehost` command removes a system host path to an FC or iSCSI host. If one or more paths are specified, the command removes only the specified paths; otherwise the entire host definition is removed. If VLUNs have been exported to the host, issue the `removehost -rvl <host_name>` command. For information about exporting VLUNs, see **Exporting virtual volumes** on page 139. The `removehost` CLI command is described in detail in the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Procedure

- To remove a host definition completely from your system, issue the `removehost <host_name> [<WWN>... | <iscsi_name> ...]` command, where:

- `<host_name>` is the host definition to be removed.
- `<WWN>...` is the WWN path or paths to the host to be removed.
- `<iscsi_name>...` is the iSCSI path or paths to the host to be removed.

NOTE: Physically disconnecting a host server from the system port does not delete the host from the system.

Managing host autonomic groups

Hosts can be combined into autonomic groups. Autonomic groups are sets of objects that can be managed as one object. If you have a group of hosts in a cluster and all the hosts require the same administrative procedures, it is easier to group those hosts into a set and manage them together. Individual hosts can be members of multiple host sets.

Hosts added to a set inherit the rights of that set. For example, if a virtual volume is exported to a group of hosts and a new host is added to the host set, the new host can see the virtual volume after it is added to the host set. The opposite is also true. If a host is removed from a set, all the rights of that host set are revoked for the removed host.

A host in a host set cannot be removed from the system until it has been removed from the host set, or until the host set is removed from the system. Removing a host set does not remove the hosts in that set. Changing the name of a host in a set does not change the rights of the host or remove it from the host set.

Creating host sets

Any hosts added to the host set automatically see all VLUNs available to the host set, provided there are no conflicting LUN IDs. If the added host has an exported LUN ID in the LUN ID range of the host set, the host cannot see the LUN and must be assigned a new ID. For more information about VLUN templates, see **Exporting virtual volumes** on page 139.

Procedure

- To create a host set, issue the `createhostset <set_name> <host_names>` command, where:
  - `<set_name>` is the name of the host set being created.
  - `<host_names>` are the names of the hosts included in the host set.

For a complete list of options available for the `createhostset` command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Adding hosts to host sets

Procedure

- To add a host to an existing host set, issue the `createhostset -add <set_name> <host_names>` command, where:

- `<set_name>` is the name of the host set that will include the added hosts.
- `<host_names>` are the names of the hosts being added to the host set.

For a complete list of options available for the `createhostset` command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Modifying host sets

Procedure

- To change the name of a host set, issue the `sethostset -name <new_name> <set_name>` command, where:
  - `<new_name>` is the new name of the host set.
  - `<set_name>` is the name of the host set being modified.

For a complete list of options available for the `sethostset` command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Removing host sets

If a host is removed from a host set, the removed host loses all the rights of the host set and cannot access volumes exported to the host set.

Procedure

- To remove a host set from the system, or to remove hosts from a set, issue the `removehostset <set_name> <host_names>` command, where:
  - `<set_name>` is the name of the host set being removed or modified.
  - `<host_names>` are the names of the hosts being removed from the `<set_name>` host set. This specifier is optional and it is not required if you are removing the entire set.

For a complete list of options available for the `removehostset` command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

The HPE 3PAR Host Explorer agent

The HPE 3PAR Host Explorer agent is a program that runs on a host connected to a system. The HPE 3PAR Host Explorer agent runs as a service on Microsoft Windows and as a daemon on Linux, HP-UX, AIX, or Solaris operating systems. No license is required to use the HPE 3PAR Host Explorer agent.

The HPE 3PAR Host Explorer agent communicates with the system over an FC or iSCSI connection and enables the host to send detailed host configuration information to the system. The information gathered from the HPE 3PAR Host Explorer agent is visible for uncreated hosts, and assists with host creation and diagnosing host connectivity issues.

When a host is created on the system, unassigned WWNs or iSCSI names are presented to the system. Without the HPE 3PAR Host Explorer agents running on the attached hosts, the system is unable to determine which host the WWN or iSCSI names belongs to, and you must manually assign each WWN or iSCSI name to a host. With HPE 3PAR Host Explorer agents running, the system automatically groups WWNs or iSCSI names for the host together, assisting with creating the host.

The HPE 3PAR Host Explorer agent collects the following information and sends it to the system:

- Host operating system and version.
- FC and iSCSI HBA details.
- Multipath driver and current multipath configuration.
- Cluster configuration information.

You can install the HPE 3PAR Host Explorer agent from the *HPE 3PAR Host Explorer* CD or from the HPE website at **https://h20392.www2.hpe.com/portal/swdepot/displayProductInfo.do?productNumber=HP3PARHE**.

For instructions on installing and using the HPE 3PAR Host Explorer agent, see the *HPE 3PAR Host Explorer User's Guide*.

For a list of supported host operating systems, go to the HPE SPOCK website:

SPOCK (http://www.hpe.com/storage/spock)

To display the information returned by the HPE 3PAR Host Explorer agent to the system, issue the `showhost -agent` or `showhost -agent -d` command.

Hosts and virtual domains

NOTE: Use of HPE 3PAR Virtual Domains requires the use of the HPE 3PAR Virtual Domains or HPE 3PAR All-inclusive Single-System software license. Contact your local Hewlett Packard Enterprise representative for details.

If you are using virtual domains, you can create and modify domain-specific FC or iSCSI hosts. In many instances, you follow the same process for creating and modifying hosts as you would for hosts that do not use domains.

More information:

Activating a software license on page 13

Creating a domain-specific host

To create a domain-specific host, you must have `super` or `edit` rights in the `all` domain. For details about this restriction, see the *HPE 3PAR StoreServ Storage Concepts Guide* and the `createhost` command in the *HPE 3PAR Command Line Interface Reference*. These documents are available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Procedure

To create a domain-specific host, issue the `createhost` command as described in `createhost` **Creating a host with a Fibre Channel path** on page 102 and **Creating a host with an iSCSI path** on

page 102 with the `-domain <domain_name>|set:<set_name>` option to specify the domain or domain set in which you are creating the host.

Modifying a domain-specific host

Perform modifications to domain-specific hosts using the `createhost` and `sethost` commands, as discussed in **Modifying hosts** on page 103.

Any existing domain-specific host can be modified as follows:

Procedure

- By changing the host name. See **Changing a host name** on page 103 for instructions. You must have `super` or `edit` rights in the `all` domain, or `edit` rights in a `specified` domain, to perform this operation.

  See the *HPE 3PAR StoreServ Storage Concepts Guide* for details about domain restrictions. This document is available at the following website:

  Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

- By adding or removing WWNs or iSCSI names. This operation is restricted to users with `super` or `edit` rights in the `all` domain.

  For details about domain restrictions, see the *HPE 3PAR StoreServ Storage Concepts Guide*. For instructions, see:

  - **Adding Fibre Channel path WWNs** on page 103
  - **Adding iSCSI path iSCSI names** on page 104
  - **Removing Fibre Channel path WWNs** on page 104
  - **Removing iSCSI path iSCSI names** on page 104

- By adding or removing iSCSI CHAP authentication information. This operation is restricted to users with `super` or `edit` rights in the `all` domain (see the *HPE 3PAR StoreServ Storage Concepts Guide* for details about this restriction).

  For instructions, see:

  - **Configuring iSCSI CHAP authentication information** on page 104
  - **Removing iSCSI CHAP authentication information** on page 105

Changing a host domain

This operation is restricted to users with `super` or `edit` rights in the `all` domain. For details about domain restrictions, see the *HPE 3PAR StoreServ Storage Concepts Guide*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

For information about changing the domain association of a host, see **Managing domain objects** on page 89. For more information about virtual domains, see **Managing HPE 3PAR Virtual Domains**.

Using persistent ports for nondisruptive online software upgrades

The HPE 3PAR OS 3.3.1 online software upgrade process does not require shutting down host-facing ports for an extended period. HPE 3PAR OS 3.3.1 supports using persistent ports during the online software upgrade process to provide a transparent mechanism for maintaining host I/O with no disruptions.

Persistent ports allow host-facing ports on HPE 3PAR StoreServ Storage systems to assume the identity of partner ports that are automatically designated by the system. For FC and FCoE ports, this is achieved through the use of N_Port ID Virtualization (NPIV). For iSCSI ports, this is achieved through the use of IP failover. The port failover operation takes place quickly enough to ensure that all host paths stay online and host multipath software is not affected. The online software upgrade completes without any dependency on host multipath software.

Persistent ports can also be used to ensure nondisruptive host I/O activity for planned and unplanned node downtime, such as HBA firmware upgrades, adding or replacing HBAs, adding or replacing DIMMs, node failures, and cable or switch failures.

NOTE: FC connections can support more than one partner port.

The following configuration requirements and limitations apply when using persistent ports for port-level failover:

- The host port must be connected and zoned through fabric topology to an HPE 3PAR StoreServ Storage system physical port.
- The automatically designated partner port must be connected to the same fabric as its partner port on the same switch.
- The partner port does not have to be zoned to the host port.
- Under normal conditions, a host port has a single I/O path to the storage array available.
- If a partner port is zoned to the same host port as the primary port, the host port has two I/O paths to the storage array available.
- Host-facing adapters on 3PAR storage systems used in the configuration must support NPIV.
- FC adapters on hosts used in this configuration do not require NPIV support.
- Port failover is only supported on target mode point-to-point port configurations.

Persistent port failover is only supported on the following NPIV-compliant HBAs:

- HPE 3PAR two-port 4G FC
- Emulex two-port 4G
- Emulex four-port 8G FC

Use the `showport` and `showportdev` commands to monitor the status of port failover and failback operations.

NOTE: When issuing the `statport` and `histport` commands, the statistics for a physical port reflect the aggregate for all persistent ports on the physical port.

More information:

Using the showport command on page 112

Using the showportdev command on page 113

Using the `showport` command

The operating system assigns failover ports using a fixed mapping of N¹:S:P. N¹ uses the XOR operator; therefore N¹ = N XOR 1. For example, port 0:1:1 partners with port 1:1:1, such that port 0:1:1 provides failover for 1:1:1 and port 1:1:1 provides failover for port 0:1:1.

Procedure

- Use the `showport` command to display information about ports in the system.

  The `showport` command output includes `Partner` and `FailoverState` columns that display the partner port `<node>:<slot>:<port>` information and failover state information. `FailoverState` values represent the failover state of the two ports listed in the `N:S:P` and `Partner` columns.

  The `FailoverState` value can be one of the following:

  - `none`—No failover in operation.
  - `failover_pending`—In the process of failing over to partner.
  - `failed_over`—Failed over to partner.
  - `active`—The partner port is failed over to this port.
  - `active_down`—The partner port is failed over to this port, but this port is down.
  - `failback_pending`—In the process of failing back from partner.

  In the following `showport` command output, primary port 0:0:1 corresponds to partner persistent port 1:0:1, with a failover state of `none`.

```
cli% showport
N:S:P      Mode     State ----Node_WWN---- -Port_WWN/HW_Addr-  Type Protocol Label Partner FailoverState
0:0:1    target     ready 2FF70002AC0000AA   20010002AC0000AA  host       FC     -   1:0:1          none
0:0:2 initiator     ready 2FF70002AC0000AA   20020002AC0000AA  disk       FC     -       -             -
0:0:3    target loss_sync 2FF70002AC0000AA   20030002AC0000AA  free       FC     -   1:0:3          none
0:0:4    target     ready 2FF70002AC0000AA   20040002AC0000AA  host       FC     -       -             -
0:3:1    target loss_sync 2FF70002AC0000AA   20310002AC0000AA  free       FC     -   1:3:1          none
0:3:2 initiator     ready 2FF70002AC0000AA   20320002AC0000AA  disk       FC     -       -             -
0:5:1 initiator     ready 2FF70002AC0000AA   20510002AC0000AA  disk       FC     -       -             -
0:5:2    target     ready 2FF70002AC0000AA   20520002AC0000AA  host       FC     -   1:5:2          none
0:6:1      peer   offline                -       0002AC53069C  rcip       IP RCIP0       -             -
1:0:1    target     ready 2FF70002AC0000AA   21010002AC0000AA  host       FC     -   0:0:1          none
1:0:2 initiator     ready 2FF70002AC0000AA   21020002AC0000AA  disk       FC     -       -             -
1:0:3    target loss_sync 2FF70002AC0000AA   21030002AC0000AA  free       FC     -   0:0:3          none
1:0:4 initiator     ready 2FF70002AC0000AA   21040002AC0000AA  host       FC     -       -             -
1:3:1    target loss_sync 2FF70002AC0000AA   21310002AC0000AA  free       FC     -   0:3:1          none
1:3:2 initiator loss_sync 2FF70002AC0000AA   21320002AC0000AA  free       FC     -       -             -
1:5:1 initiator     ready 2FF70002AC0000AA   21510002AC0000AA  disk       FC     -       -             -
1:5:2    target     ready 2FF70002AC0000AA   21520002AC0000AA  host       FC     -   0:5:2          none
1:6:1      peer   offline                -       0002AC520041  rcip       IP RCIP1       -             -
```

  In the following example, port 0:0:1 is in the process of failing over to port 1:0:1.

```
cli% showport 0:0:1 1:0:1
N:S:P   Mode   State ----Node_WWN---- -Port_WWN/HW_Addr- Type Protocol Label Partner    FailoverState
0:0:1 target offline 2FF70002AC0000AA   20010002AC0000AA free       FC     -   1:0:1 failover_pending
1:0:1 target   ready 2FF70002AC0000AA   21010002AC0000AA host       FC     -   0:0:1             none
```

  In this example, the failover from port 0:0:1 to port 1:0:1 has completed.

```
cli% showport 0:0:1 1:0:1
N:S:P   Mode   State ----Node_WWN---- -Port_WWN/HW_Addr- Type Protocol Label Partner FailoverState
0:0:1 target offline 2FF70002AC0000AA   20010002AC0000AA free       FC     -   1:0:1   failed_over
1:0:1 target   ready 2FF70002AC0000AA   21010002AC0000AA host       FC     -   0:0:1        active
```

- Issue the `showport` command with the `-ids` option to show the identities currently hosted by each port. For example, with no failovers in operation, each port hosts its own single ID.

```
cli% showport -ids 0:0:1 1:0:1 0:4:1 1:4:1
N:S:P -Node_WWN/IPAddr- -----------Port_WWN/iSCSI_Name-----------
0:0:1  2FF70002AC0000AA                          20010002AC0000AA
0:4:1     10.100.31.170 iqn.2000-05.com.3pardata:20410002ac0000aa
1:0:1  2FF70002AC0000AA                          21010002AC0000AA
1:4:1     10.101.31.170 iqn.2000-05.com.3pardata:21410002ac0000aa
```

With failovers in operation, the identities are assigned to the partner ports.

```
cli% showport -ids 0:0:1 1:0:1 0:4:1 1:4:1
N:S:P -Node_WWN/IPAddr- -----------Port_WWN/iSCSI_Name-----------
0:0:1
0:4:1
1:0:1  2FF70002AC0000AA                          21010002AC0000AA
       2FF70002AC0000AA                          20010002AC0000AA
1:4:1     10.101.31.170 iqn.2000-05.com.3pardata:21410002ac0000aa
          10.100.31.170 iqn.2000-05.com.3pardata:20410002ac0000aa
```

More information:

Using the showportdev command on page 113

Using the `showportdev` command

Procedure

Use the `showportdev` command to show the devices that are connected to physical ports. For persistent ports, the `vp_WWN` column indicates which persistent port WWN each device is associated with. For example, in normal mode, there is only a single native WWN hosted by the physical port.

```
cli% showportdev all 1:5:1
   PtId LpID Hadr ----Node_WWN---- ----Port_WWN----   ftrs   svpm   bbct   flen -----vp_WWN-----
0x10300 0x01 0x00 2FF70002AC0000AA 21510002AC0000AA 0x8800 0x0012    n/a 0x0800 21510002AC0000AA
0x10b00 0x06  n/a 200000E08B041B50 210000E08B041B50 0x0000 0x03a2 0x0000    n/a 21510002AC0000AA
```

When the identity of port 0:5:1 has failed over to 1:5:1, the `vp_WWN` column is populated with the device identities of port 0:5:1.

```
cli% showportdev all 1:5:1
   PtId LpID Hadr ----Node_WWN---- ----Port_WWN----   ftrs   svpm   bbct   flen -----vp_WWN-----
0x10300 0x01 0x00 2FF70002AC0000AA 21510002AC0000AA 0x8800 0x0012    n/a 0x0800 21510002AC0000AA
0x10b00 0x06  n/a 200000E08B041B50 210000E08B041B50 0x0000 0x03a2 0x0000    n/a 21510002AC0000AA
0x10301 0x01 0x00 2FF70002AC0000AA 20510002AC0000AA 0x8800 0x0012    n/a 0x0800 20510002AC0000AA
0x10b00 0x06  n/a 200000E08B041B50 210000E08B041B50 0x0000 0x03a2 0x0000    n/a 20510002AC0000AA
```

CPG and virtual volume management

A CPG creates a virtual pool of LDs that allows thousands of volumes to share the CPG resources and allocate space on demand. The maximum number of CPGs depends on your system configuration. VVol draw their resources from CPGs, and virtual volumes are exported as logical unit numbers (LUNs) to hosts. VVol are the only data layer visible to hosts. If the original base volume becomes unavailable, you can create physical copies or virtual copy snapshots of virtual volumes for use. Before creating virtual volumes, you must create CPGs to allocate space to the virtual volumes.

Creating TPVVs requires the HPE 3PAR Thin Provisioning or the HPE 3PAR All-inclusive Single-System software license. Creating virtual copies or **snapshots** requires the HPE 3PAR Virtual Copy or the HPE 3PAR All-inclusive Single-System software license. Contact your Hewlett Packard Enterprise representative for more information.

See SPOCK for more information about the maximum number of CPGs and volumes supported on your system.

For detailed information about CPGs and virtual volumes, see the *HPE 3PAR StoreServ Storage Concepts Guide*.

More information

Software licenses and HPE 3PAR CLI on page 13
VVol virtual and physical copies on page 148

Common provisioning groups

The default configuration for a CPG includes the auto-growth of new LDs when the amount of available LD space falls below a configured threshold. Initially, CPGs are empty. The initial buffer pool of LDs starts off at a fraction of the exported virtual capacity of mapped volumes. The buffer pool automatically grows over time, as required by application writes.

VVol in the same CPG can share an LD. In the unlikely event that multiple, simultaneous disk failures damage the LD, all the volumes associated with that LD become unavailable.

Virtual volume performance can suffer from too much interleaving within the LDs.

For detailed information about CPG growth warnings and growth limits, see the *HPE 3PAR StoreServ Storage Concepts Guide*, available from the Hewlett Packard Enterprise Information Library.

CPG HPE 3PAR CLI commands

Use the following CLI commands to manage CPGs:

- `showcpg`—Displays CPGs in the system.
- `createcpg`—Creates CPGs.
- `setcpg`—Modifies existing CPGs.
- `compactcpg`—Consolidates LD space in CPGs into as few LDs as possible.
- `removecpg`—Removes CPGs from the system or removes specific LDs from CPGs.

Creating a CPG

Procedure

1. Log in to the system as `Super` or `Edit` user, or as any user with `cpg_create` permission.
2. Enter the `createcpg` command using the following syntax:`createcpg -aw <percent> -sdgs <size> -sdgl <size> -sdgw <size> -t <RAID_type> <CPG_name>`.

   `-aw <percent>`

   Sets the percentage of used snapshot space and administration space that generates a warning alert. A setting of 0 (default) disables alert generation.

   `-sdgs <size>`

   Sets the amount of LD storage created during each autogrow operation. Verify the minimum default growth sizes per number of nodes before setting this size.

   `-sdgl`

   Sets the not-to-exceed growth limit for autogrow operations. If 0 (default), enforces no limit.

   `-sdgw <size>`

   Sets the space limit for LD space. Exceeding this limit generates a warning alert. If 0 (default), enforces no warning limit.

   `-t <RAID_type>`

   Sets the RAID type, specified as `r0` (RAID 0), `r1` (RAID 1), `r5` (RAID 5), or `r6` (RAID MP).

   With no RAID type specified, defaults to RAID 6 for fast class (FC), NearLine (NL), and solid-state drive (SSD) device types. Hewlett Packard Enterprise strongly recommends using RAID 6 for NL device types.

   Using RAID 5 for NL device types requires changing the `setsys AllowR5OnNLDrives` value to `yes` (the default is `no`).

   `<CPG_name>`

   Sets the name of the CPG being created.
3. To use all options and specifiers available for the `createcpg` command, see, HPE 3PAR CLI *Help* or *HPE 3PAR Command Line Interface Reference*

More information

Growth increment considerations for CPGs on page 116

Modifying a CPG

The following modifications are commonly performed on CPGs using variations of the `setcpg` command:

Procedure

- Specify the percentage of administration space or snapshot space that is used before an alert is generated.
- Specify the amount of LD space created with each auto-grow operation.

For a complete list of options available for the `setcpg` command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*.

Setting snapshot space usage warnings

Procedure

- Issue the `setcpg -sdgw <size> <CPG_name>` command, where:
  - `-sdgw <size>` is the space limit for LD space before a warning alert is generated. If 0 (default) is specified, no warning limit is enforced.
  - `<CPG_name>` is the name of the CPG being created.

Setting or modifying CPG autogrow size

Prerequisites

Before modifying CPG autogrow settings, see, **Growth increment considerations for CPGs** for guidelines.

Procedure

1. Log in to the system as `Super`, `Service`, or `Edit` user, or as any user with `cpg_set` permission.
2. Enter the **`setcpg -sdgs <size> <CPG_name>`** command.

   `-sdgs <size>`

   Defines the amount of LD storage created during each autogrow operation.

   `<CPG_name>`

   Name of the CPG to create.
3. To use additional options or specifiers for this command, see, HPE 3PAR Command Line Interface Reference.

More information

Growth increment considerations for CPGs on page 116

Growth increment considerations for CPGs

Plan CPG growth deliberately and cautiously. The system does not prevent you from setting growth warnings or growth limits that exceed the amount of currently available storage on a system.

When volumes associated with a CPG use all available space, either any new writes to TPVVs associated with the CPG fail, or snapshot volumes associated with the CPG may become invalid, or both. Invalid volumes do not handle write failures gracefully and can produce unexpected failures.

CAUTION: Do not allow volumes that draw from a CPG to exceed the CPG growth limit. Exceeding the CPG growth limit can invalidate snapshot volumes and prevent new writes.

The default and minimum growth increments vary according to the number of controller nodes in the system.

Table 6: Default and minimum growth increments

Number of nodes	Default	Minimum
2	32 GB	8 GB
4	64 GB	16 GB
6	96 GB	24 GB
8	128 GB	32 GB

There are several actions you can take, such as adding physical disks to the system, or limiting the future growth of volumes that draw from the CPG. Your response can vary, depending on several factors:

- Total available space on your system.
- Nature of the data running on the system.
- Number of CPGs in the system.
- Number of volumes associated with those CPGs.
- Anticipated growth rate of the volumes associated with the CPGs.

Growth warning and growth limits default to `none`, which effectively disables these safety features.

For additional information about specific alerts, see the *HPE 3PAR Alerts Reference: Customer Edition*.

Consolidating CPG group space

Compacting a CPG allows you to reclaim space from a CPG that has become less efficient in space usage as a result of creating, deleting, and relocating volumes. Compaction consolidates LD space in CPGs into as few LDs as possible.

Procedure

- Issue the `compactcpg <CPG_name>` or `compactcpg <pattern>` command, where:
  - `<CPG_name>` is the name of the CPG you wish to compact.
  - `<pattern>` is the pattern name to which matching CPGs are compacted.

For a complete list of options available for the `compactcpg` command, see the *HPE 3PAR Command Line Interface Reference* and the HPE 3PAR CLI *Help*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Removing a CPG

You cannot remove a CPG that still has virtual volumes provisioned from it.

Procedure

- To remove a CPG and the LDs that make up that CPG, issue the `removecpg <CPG_name>` command, where:

  `<CPG_name>` is the name of the CPG being removed.

For a list of options available for the `removecpg` command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Virtual volume types

Types of virtual volumes:

- Fully provisioned virtual volume (FPVV)
- Thinly provisioned virtual volume (TPVV)
- Thinly provisioned deduplicated virtual volume (TDVV)
- Administrative volume

Administrative volumes are created by the system and are for system usage only.

CAUTION: Hewlett Packard Enterprise strongly recommends that you do not tamper with the `admin` volumes.

Data components of virtual volumes include:

- **User space** is the area of the volume that corresponds to the LD regions in the CPG available to the host. The user space contains the user data and is exported as a LUN to the host.
- **Snapshot space**, also known as **copy space**, is the area of the volume that corresponds to LD regions in the CPG containing copies of user data that changed since a **snapshot** of the volume was created. The snapshot space contains the copy data.
- **Administration space**, also known as **admin space**, is the area of the volume that corresponds to LD regions in the CPG that track changes to the volume since a snapshot was created. The administration space contains pointers to copies of user data in the snapshot space. Administration space is managed by the system, not with the tools you use to manage user and snapshot space.

You can increase the size of volumes, the amount of user space, and the amount of snapshot space for volumes as the requirements increase. If the user space and snapshot space use all available space, the HPE 3PAR Virtual Copy copy-on-write operation will fail. To avoid running out of user space, use TPVVs to draw more user space automatically from a CPG. The HPE 3PAR OS automatically reclaims unused snapshot space from TPVVs and FPVVs and returns the space to the LDs.

For greater administrative flexibility, you can provision the virtual volume user space and snapshot space from the same or different CPGs. If the virtual volume user space and snapshot space are on different CPGs, the user space remains available to the host if the CPG containing the snapshot space becomes full. To save time by not repeating tasks, you can create many identical virtual volumes at one time. For planning information about virtual volumes and copies of volumes, see the *HPE 3PAR StoreServ Storage Concepts Guide*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Fully provisioned virtual volumes

A Fully Provisioned Virtual Volume (FPVV) is provisioned storage space from LDs that belong to a CPG. FPVVs are the default system volume and do not require any additional licenses. Unlike TPVVs, FPVVs have a set amount of user space allocated in the system for user data. They require the system to reserve the entire amount of space required by the FPVV, regardless of whether the space is in fact used. The FPVV size is fixed. You can set snapshot space allocation limits and usage warnings to help manage the growth of snapshot space.

NOTE: In most cases, the HPE 3PAR CLI refers to an FPVV as a `VV`. In some instances, the HPE 3PAR CLI refers to an FPVV as a `CPVV`.

The FPVV size limit for the following HPE 3PAR StoreServ Storage systems is 64 TB.

- HPE 3PAR StoreServ 7000 Storage
- HPE 3PAR StoreServ 8000 Storage
- HPE 3PAR StoreServ 9000 Storage
- HPE 3PAR StoreServ 10000 Storage
- HPE 3PAR StoreServ 20000 Storage

Thinly provisioned virtual volumes

With an HPE 3PAR Thin Provisioning or HPE 3PAR All-inclusive Single-System software license, you can create thinly provisioned virtual volumes (TPVVs). A TPVV is provisioned storage space from LDs that belong to a CPG. TPVVs associated with the same CPG draw space from the CPG as needed, allocating space on demand in 1 GB chunklets. As the volumes that draw space from the CPG require additional storage, the system automatically creates additional LDs. The LDs are added to the pool until the CPG reaches the user-defined growth limit that restricts the CPG maximum size.

The TPVV size limit for the following HPE 3PAR StoreServ Storage systems is 64 TB.

- HPE 3PAR StoreServ 7000 Storage
- HPE 3PAR StoreServ 8000 Storage
- HPE 3PAR StoreServ 9000 Storage
- HPE 3PAR StoreServ 10000 Storage
- HPE 3PAR StoreServ 20000 Storage

More information:

Activating a software license on page 13

Thinly provisioned deduplicated virtual volumes

With the HPE 3PAR Thin Deduplication feature, you can create thinly provisioned deduplicated virtual volumes (TDVV). A TDVV is a thinly provisioned virtual volume with in-line data deduplication. A TDVV has the same characteristics as a TPVV, with the additional capability of removing duplicated data before it is written to the volume. A TDVV is managed like any other TPVV. A TDVV must be associated with CPGs that are created from SSDs. Deduplication can be used in HPE 3PAR StoreServ Storage systems with mixed drive configurations, but TDVVs can reside only on SSDs.

Compressed virtual volumes

Consolidating data in a way that preserves the information while reducing the total amount of storage is the essence of storage compression. To increase space efficiency and consolidate stored data, a compression feature is available on HPE 3PAR StoreServ Storage systems to create Thinly Provisioned Virtual Volumes and Thinly Deduplicated Virtual Volumes. Virtual Volumes can be marked for compression during their creation, or an existing Virtual Volume can be updated with the compression feature.

Garbage collection

When data is deleted through the TPVV which is stored on the Dedup Store (DDS), the page is de-referenced on the TDVV. However, these pages are not tracked on the DDS, and pages can accumulate which have no reference on any TPVV in the CPG. Therefore, a Garbage Collection process runs in the background and periodically releases these unreferenced pages from the DDS.

When a TDVV is deleted or pages of data are zeroed out, the metadata is updated but the space is not reclaimed immediately. Over time, the Deduplication Garbage Collection process will free up pages. These pages will be available to the DDS for reuse. Only after 128 MB of contiguous space is freed will it go back to the CPG.

Virtual volume 3PAR CLI commands

Use the following HPE 3PAR CLI commands to manage virtual volumes:

- `showvv`—display virtual volumes in the system.
- `createvv`—create virtual volumes.
- `setvv`—modify existing volumes.
- `growvv`—increase the size of existing virtual volumes.
- `freespace`—free snapshot space from a virtual volume.
- `removevv`—remove virtual volumes from the system.
- `showvvset`—show information about a virtual volume set.
- `createvvset`—create a virtual volume set, or add virtual volumes to an existing set.
- `setvvset`—modify a virtual volume set.
- `removevvset`—remove a virtual volume set, or virtual volumes from an existing set.
- `checkvv`—validate and repair virtual volumes.

Creating virtual volumes

After you create CPGs, you can create FPVVs and TPVVs that draw space from the CPGs. Expiration dates can be set for virtual volumes to save space.

For information about planning for the growth of virtual volumes, see the *HPE 3PAR StoreServ Storage Concepts Guide*. For information about creating CPGs, see **Common provisioning groups** on page 114.

NOTE: Creating virtual copies or **snapshots** requires the HPE 3PAR Virtual Copyor HPE 3PAR All-inclusive Single-System software license. Creating TPVVs requires the HPE 3PAR Thin Provisioningor HPE 3PAR All-inclusive Single-System software license. Contact your Hewlett Packard Enterprise sales representative for more information.

NOTE: If your system is accessible by an OpenStack cloud, you may see volumes with prefixes indicating that the volumes were created through the OpenStack cloud. Volumes created through the OpenStack cloud use the OpenStack Volume (OSV) and OpenStack Snapshot (OSS) prefixes.

More information:

Activating a software license on page 13

Creating fully provisioned virtual volumes

An FPVV has a set amount of user space that is allocated for user data. The snapshot space of the virtual volume is allocated on demand.

Procedure

- Issue the `createvv -cnt <number> -snp_cpg <snp_cpg_name> <user_cpg> <VV_name>[.<index>] <VV_size g|G|t|T>` where:
  - `<number>` is the number of virtual volumes to create with the designated properties.
  - `<snp_cpg_name>` is the name of the CPG on which the created volume will allocate its snapshot space and administration space.
  - `<user_cpg>` is the name of the CPG from which the created virtual volume will draw its user space.
  - `<VV_name>[.<index>]` is the name of the virtual volume being created. If the `-cnt` option is used, the optional `<index>` integer specifies an index value to append to the first virtual volume name, for example, `myvvol.1`. The `<index>` value increases by 1 for each subsequent volume created (as specified by the `-cnt` option). If the `-cnt` option is specified (with a number greater than 1) and no initial `<index>` value is included as part of the VV name, the default initial index value will be 0. The index value must be an integer from 0 to 999999. The overall length of each VV name, including any appended index values, must be no greater than 31 characters.
  - `<VV_size g|G|t|T>` is the size of the volume in MB, GB, or TB. For example, `50g` specifies 50 GBs. If a unit designation of GB or TB (`g|G|t|T`) is not included, the default unit for the `VV_size` value is MB.

NOTE: If the `vv` type option is not specified, the default created volume is an FPVV.

For a complete list of options available for the `createvv` command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Creating thinly provisioned virtual volumes

A TPVV allocates user space and snapshot space on demand. If you do not specify a CPG to be used for snapshot space with the `-snp_cpg` option, the TPVV will have no snapshot space.

Procedure

- Issue the `createvv -tpvv` command:

```
createvv -tpvv [-dedup] [-compr] [-snp_cpg <snp_cpg_name>] [-usr_aw
<percent>] [-usr_al <percent>] [-minalloc <alloc_size>] <user_cpg>
<VV_name> <VV_size g|G|t|T>
```

Where:

- `-tpvv` indicates that you are creating a TPVV.
- `-compr` indicates that you are using compression.
- `-dedup` indicates that you are using deduplication.
- `<snp_cpg_name>` is the name of the CPG on which the volume will allocate its snapshot space and administration space.
- `-usr_aw <percent>` is the allocation warning alert limit for the user space specified as a percentage. This setting generates an alert when the user space of the volume exceeds a specified percentage of the volume size.
- `-usr_al <percent>` is the allocation limit of the user space specified as a percentage. The allocation limit prevents the user space from exceeding a specified percentage of the volume size.
- `<alloc_size>` specifies the default minimum allocation size for the TPVV in MB. The default minimum allocation size, and the smallest size that can be specified for the `-minalloc` option, is 256 MB.
- `<user_cpg>` is the name of the CPG from which the created virtual volume will draw its user space.
- `<VV_name>` is the name of the volume being created. The name can be up to 31 characters.
- `<VV_size g|G|t|T>` is the size of the volume in MB, GB, or TB. For example, `50g` specifies 50 GBs. If a unit designation of GB or TB (`g|G|t|T`) is not included, the default unit for the `VV_size` value is MB.

For a complete list of options available for the `createvv` command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Creating deduplicated virtual volumes

A thinly provisioned deduplicated virtual volume (TDVV) is a thinly provisioned volume with in-line data deduplication. The system removes duplicated data before it is written to the volume. A TDVV must be associated with CPGs that are created from solid-state drives (SSD). Use the `showcpg` command to verify that the device type of the drives used by the CPG is `SSD`.

Procedure

- Issue the `createvv -dedup` command:

  ```
  createvv -dedup [-snp_cpg <snp_cpg_name>] [-usr_aw <percent>] [-usr_al
  <percent>] [-minalloc <alloc_size>] <user_cpg> <VV_name> <VV_size g|G|t|T>
  ```

  Where:

- `-dedup` indicates that you are creating a TDVV.
- `<snp_cpg_name>` is the name of the CPG on which the volume will allocate its snapshot space and administration space.
- `-usr_aw <percent>` is the allocation warning alert limit for the user space specified as a percentage. The allocation warning alert limit generates an alert when the user space of the volume exceeds a specified percentage of the volume size.
- `-usr_al <percent>` is the allocation limit of the user space specified as a percentage. The allocation limit prevents the user space from exceeding a specified percentage of the volume size.
- `<alloc_size>` specifies the default minimum allocation size for the TDVV in MB. The default minimum allocation size, and the smallest size that can be specified for the `-minalloc` option, is 256 MB.
- `<user_cpg>` is the name of the CPG from which the created virtual volume will draw its user space.
- `<VV_name>` is the name of the volume being created. The name can be up to 31 characters.
- `<VV_size g|G|t|T>` is the size of the volume in MB, GB, or TB. For example, `50g` specifies 50 GBs. If a unit designation of GB or TB (`g|G|t|T`) is not included, the default unit for the `VV_size` value is MB.

For a complete list of options available for the `createvv` command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

For more information about calculating data compression with deduplication and converting fully provisioned volumes to TDVVs, see **Converting FPVVs to TDVVs** on page 125.

Creating compressed virtual volumes

Procedure

- Issue the `createvv -cmpr` command:

  `createvv -cmpr <usr_cpg> <vvname> <size>[g|G|t|T]` where:

  - `-cmpr` specifies that the volume is a thinly compressed volume.
  - `<usr_cpg>` specifies the name of the CPG from which the volume user space will be allocated. If the `-dedup` or `-tpvv` option is specified, the volume is thinly provisioned.
  - `<vvname>` specifies a VV name up to 31 characters in length.
  - `<size>` specifies the size for the volume. If a unit designation of GB or TB (`g|G|t|T`) is not included, the default unit for the `<size>` value is MB.

  The following example creates a thinly compressed volume named `vv1` of size 16 GB from the CPG named `cpg2`:

```
cli% createvv -compr cpg2 vv1 16g
```

For a complete list of options available for the `createvv` command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

More information:

Converting a TPVV to a compressed volume

Managing compression

Modifying virtual volumes

Use the `tunevv` command to move logical disks being used for user space and snapshot space to a different CPG.

Procedure

- To modify a volume to draw its snapshot space and administration space from a different CPG, issue the `tunevv snp_cpg <cpg> [options] <VV_name>` command, where:
  - `<cpg>` is the name of the CPG from which the modified volume will draw its snapshot space and administration space.
  - `<VV_name>` is the name of the virtual volume being modified.
- To modify a volume to draw its user space from a different CPG, issue the `tunevv user_cpg <cpg> [options] <VV_name>` command, where:
  - `<cpg>` is the name of the CPG from which the modified volume will draw its user space.
  - `<VV_name>` is the name of the virtual volume being modified.

For a complete list of options available for the `tunevv` command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Growing virtual volumes

You can automatically increase the size of, or grow, existing virtual volume user space when the volume reaches capacity.

Procedure

- To increase automatically the user space available to a virtual volume when the volume reaches capacity, issue the `growvv <VV_name> <size g|G|t|T>` command, where:
  - `<VV_name>` is the name of the virtual volume you are growing.
  - `<size g|G|t|T>` is the amount of space automatically added to the user space in MB, GB, or TB. If `g|G|t|T` is not specified, `VV_size` is the number of MBs.

For a complete list of options available for the `growvv` command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Converting virtual volumes online

You can convert existing FPVVs to TPVVs or TDVVs on the array, and you can convert TPVVs or TDVVs to FPVVs, without disrupting normal operations and without requiring changes to any host applications

that access the virtual volumes. If a TPVV is using most of its allocated storage capacity, you can convert the volume to an FPVV to increase its storage capacity and allow for continued growth of the volume. When a TPVV reaches approximately 80% of capacity, the incremental benefit of capacity savings versus accelerating performance is weighted towards performance. In addition, converting TPVVs to FPVVs can free up thinly provisioned capacity for other TPVVs. Similarly, if an FPVV storage space is largely unused, you can convert it to a TPVV to save storage space.

Converting Remote Copy virtual volumes and virtual volumes that contain snapshots is not supported. You can, however, convert virtual volumes with snapshots and use the `-keepvv` option of the `tunevv` command to create a new virtual volume with a new WWN that contains the original LDs and snapshots, in order to retain those snapshots. Snapshots cannot be exported in order for the `-keepvv` option to work. If the snapshots are exported, an error is returned.

Converting volumes from thin to full requires the HPE 3PAR Dynamic Optimization or HPE 3PAR All-inclusive Single-System software license.

Converting volumes from full to thin requires the HPE 3PAR Dynamic Optimization license and the HPE 3PAR Thin Provisioning or HPE 3PAR All-inclusive Single-System software license.

For a complete list of options available for the `tunevv` command, see the *HPE 3PAR Command Line Interface Reference* and the HPE 3PAR CLI *Help*. These documents are available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

More information:

Converting FPVVs to TPVVs on page 125

Converting FPVVs to TDVVs on page 125

Calculating space savings with deduplication on page 126

Converting TPVVs to FPVVs on page 127

Converting TDVVs to FPVVs on page 127

Activating a software license on page 13

Converting FPVVs to TPVVs

Procedure

- Issue the `tunevv usr_cpg <cpg> -tpvv <VV_name>`, where:
  - `usr_cpg <cpg>` is the name of the CPG from which the converted virtual volume will draw its user space.
  - `-tpvv` indicates that you are converting the existing FPVV to a TPVV. This option cannot be used with the `-dedup` or `-full` option.
  - `<VV_name>` is the name of the virtual volume being converted.

Converting FPVVs to TDVVs

Procedure

- Issue the `tunevv usr_cpg <cpg> -dedup <VV_name>`, where:

- `usr_cpg <cpg>` is the name of the CPG from which the converted virtual volume will draw its user space.
- `-dedup` indicates that you are converting the existing FPVV to a TDVV. This option cannot be used with the `-tpvv` or `-full` option.
- `<VV_name>` is the name of the virtual volume being converted.

More information:

Creating deduplicated virtual volumes on page 122.

Calculating space savings with compression

TPVVs, TDVVs, FPVVs, and their snapshots can be analyzed for compression.

Procedure

1. Log in to the system as `Super`, `Service`, or `Edit` user, or as any user with `vv_check` permission.
2. Enter the following command:
   `checkvv -compr_dryrun <vv_name>|<vv_set>`

   `<vv_name>`

   Name of the virtual volume to analyze. Multiple virtual volumes can be specified as a comma-separated list.

   `<vv_set>`

   Name of the virtual volume set to analyze. Multiple virtual volume sets can be specified as a comma-separated list.

   `-compr_dryrun`

   Starts the compression calculation `compr_dryrun` background task. The volumes are analyzed for potential space savings with 3PAR Thin Compression.
3. Enter the **`showtask`** command to get the `dedup_dryrun` task ID number.
4. To view the results of the analysis, enter the **`showtask -d <task_id>`** command.
5. To use the complete set of options and specifiers available for the `checkvv` command, see, *HPE 3PAR Command Line Interface Reference*

More information

Managing compression on page 146

Calculating space savings with deduplication

Only TPVVs can be analyzed for deduplication.

Procedure

1. To analyze the potential space savings for TPVVs with deduplication, issue the `checkvv -dedup_dryrun <vv_name>|<pattern>|set:<vv_set>` command, where:

- `<vv_name>` is the name of the virtual volume to analyze. Multiple virtual volumes can be specified as a comma-separated list.
- `<pattern>` is the pattern to which virtual volumes with matching names are analyzed.
- `<vv_set>` is the name of the virtual volume set to analyze. Multiple virtual volume sets can be specified as a comma-separated list.
- `-dedup_dryrun` starts the deduplication ratio calculation `dedup_dryrun` background task. The volumes are analyzed for potential space savings with 3PAR Deduplication.

2. Run the `showtask` command to get the `dedup_dryrun` task ID number.
3. View the results of the analysis by running the `showtask -d <task_id>` command.

For a complete list of options available for the `checkvv` command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Converting TPVVs to FPVVs

Procedure

- Issue the `tunevv usr_cpg <cpg> -full <VV_name>`, where:
  - `usr_cpg <cpg>` is the name of the CPG from which the converted virtual volume will draw its user space.
  - `-full` indicates that you are converting the existing TPVV to an FPVV. This option cannot be used with the `-dedup` or `-tpvv` option.
  - `<VV_name>` is the name of the virtual volume being converted.

For a complete list of options available for the `tunevv` command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Converting TDVVs to FPVVs

Procedure

- Issue the `tunevv usr_cpg <cpg> -full <VV_name>`, where:

- `usr_cpg <cpg>` is the name of the CPG from which the converted virtual volume will draw its user space.
- `-full` indicates that you are converting the existing TDVV to an FPVV. This option cannot be used with the `-tpvv` or `-dedup` option.
- `<VV_name>` is the name of the virtual volume being converted.

Converting a TPVV to a compressed volume

Procedure

- Issue the `tunevv usr_cpg <cpg_name> -compr <vv_name>` command, where:
  - `<cpg_name>` is the name of the CPG from which the TPVV draws its user space.
  - `<vv_name>` is the name of the virtual volume being converted.

Reducing volume size by manually converting FPVVs to TPVVs with HPE 3PAR Thin Conversion

HPE 3PAR Thin Conversion is an optional feature that converts a traditional volume to a TPVV. Virtual volumes with large amounts of allocated but unused space are converted to TPVVs that are much smaller than the original volume. Volumes are converted by creating a physical copy of the volume. During the conversion process, allocated but unused space is discarded and the result is a TPVV that uses less space than the original volume.

The conversion process has four steps:

1. Assessment
2. Data preparation
3. Zeroing unused space
4. Creating a physical copy

Prerequisites

Converting FPVVs to TPVVs with the thin-conversion feature requires an HPE 3PAR StoreServ Storage system, an HPE 3PAR Thin Provisioning license, and an HPE 3PAR Thin Conversion license, or a single HPE 3PAR All-inclusive Single-System software license. Contact your Hewlett Packard Enterprise representative for more information.

Procedure

1. For assessment and preparation considerations, see the *HPE 3PAR StoreServ Storage Concepts Guide*, available at the following website:

   Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)
2. Prepare the volumes for conversion to the new TPVV by removing unnecessary data. Perform clean-up tasks on the source volume by:

- Emptying trash cans.
- Archiving unused files.
- Shrinking databases.
- Deleting temporary files.

3. Use a host application to write zeros to the allocated but unused volume space. HPE 3PAR StoreServ Storage systems detect and discard the zeros during the volume copy operation.
4. Convert the base volume to a TPVV by creating a physical copy of the volume. Create a physical copy of the base volume with the `createvvcopy` command. For more information, see **Creating an offline physical copy** on page 151.

   The `createvvcopy` command automatically enables the `zero_detect` policy on the destination TPVV. After the copy operation is completed, the `zero_detect` policy is automatically disabled.
5. (Optional) Use the `showvv -s` command to view the size of the TPVV created. The destination TPVV should use significantly less total reserved space, and have a smaller volume size than the original base volume.
6. (Optional) After verifying the data on the converted destination TPVV, use the `removevv` command to remove the converted base volume.

More information:

Activating a software license on page 13

Setting the overprovisioning ratio limit or warning

Overprovisioning is the act of provisioning to hosts an amount of usable capacity that is greater than the amount of available system-usable storage space. Roughly, overprovisioning is the ratio of the virtual size of volumes divided by the physical space available to the volumes.

More information:

Types of overprovisioning on page 129

Restrictions on overprovisioning on page 130

Impact on volume creation when the overprovisioning ratio limit is enabled on page 130

Types of overprovisioning

Three ratios are necessary to estimate the amount of overprovisioning:

- **Per-CPG overprovisioning**. The restrictions placed on one CPG can vary greatly from the restrictions placed on another, resulting in varying degrees of overprovisioning.
- **Per-disk-type overprovisioning**. Multiple CPGs within a disk (near line, fast class, or solid-state drive) share free space. Calculating overprovisioning on a per-disk-type basis compensates for the fact that CPGs share free space.
- **Systemwide overprovisioning**. Calculating overprovisioning on a systemwide basis compensates for the fact that one disk type may be more overprovisioned than another.
- **Domain overprovisioning**. Systemwide overprovisioning broken down by domain.

More information:

Setting the overprovisioning ratio limit on page 130

Setting the overprovisioning ratio warning on page 131

Showing the current parameter settings on page 131

Showing overprovisioning for a CPG on page 131

Showing per-disk-type overprovisioning on page 132

Showing systemwide overprovisioning on page 133

Showing domain overprovisioning on page 133

Restrictions on overprovisioning

- When enabled, overprovisioning slows down volume creation.
- Because of CPGs growth, overprovisioning calculation is never precise. It is always an estimate.
- AO deduplication and compression ratios are factored into overprovisioning calculations.
- The ratios change over time as AO moves regions around.
- When you create a TPVV or a CPG, the amount of overprovisioning changes for other CPGs, the disk type, and the system as a whole.
- Overprovisioning calculations do not account for:
  - Snap admin (SA) space
  - Used space that might be freed later by means of `reclaim` or `compactcpg` operations.
  - Deduplication or compression “garbage” collection.

Impact on volume creation when the overprovisioning ratio limit is enabled

The amount of overprovisioning affects volume and snapshot creation. If the overprovisioning ratio limit (`OverprovRatioLimit`) is enabled, an error is returned when you attempt to create a TPVV and the per-CPG, per-disk-type, or systemwide overprovisioning value is exceeded.

The following commands will fail when overprovisioning is exceeded:

- `createvv`
- `createsv`
- `growvv`
- `createvvcopy -online`
- `setvv`

Setting the overprovisioning ratio limit

Procedure

To set or update the optional overprovisioning ratio limit, issue the `setsys OverprovRatioLimit <value>` command.

The `<value>` of the `OverprovRatioLimit` parameter is a ratio. The default is 0—that is, no limit is enforced. If a limit is set, the `createvv` and `createsv` commands will return an error when the per-CPG, per-disk-type, or systemwide overprovisioning ratio reaches the limit.

If the overall system overprovisioning value is already at the limit when set, a warning or message will appear in the command output.

Setting the overprovisioning ratio warning

Procedure

To set or update the optional overprovisioning ratio warning, issue the `setsys OverprovRatioWarning <value>` command.

The `<value>` of the `OverprovRatioWarning` parameter is a ratio. The default is 0—that is, the warning is not enabled.

NOTE: In systems with many CPGs, setting the overprovisioning limit and warning can slow the performance of CLI commands or steps that use the system manager (sysmgr). I/O is not affected.

Showing the current parameter settings

Procedure

Issue the `showsys -param` command.

```
cli% showsys -param
System parameters from configured settings

-------Parameter-------      --Value--
RawSpaceAlertFC         :             0
RawSpaceAlertNL         :             0
RawSpaceAlertSSD        :             0
RemoteSyslog            :             0
RemoteSyslogHost        :       0.0.0.0
SparingAlgorithm        :       Default
EventLogSize            :            4M
VVRetentionTimeMax      :    240 Hours
UpgradeNote             :
PortFailoverEnabled     :           yes
AutoExportAfterReboot   :           yes
AllowR5OnNLDrives       :           yes
AllowR0                 :           yes
ThermalShutdown         :           yes
FailoverMatchedSet      :           yes
SessionTimeout          :     01:00:00
HostDIF                 :            no
AllowWrtbackSingleNode  :           yes
AllowWrtbackUpgrade     :           yes
DisableDedup            :            no
OverprovRatioLimit      :             0
OverprovRatioWarning    :             0
```

NOTE: Errors will not appear if internal virtual volumes or Remote Copy snapshots exceed the overprovisioning value.

Showing overprovisioning for a CPG

Procedure

- Issue the `showspace` command with the `-cpg <cpg>` parameter:

```
cli% showspace -cpg cpg1
     -------------------(MiB)--------------------
 CPG --------EstFree--------                    -------------Efficiency--------------
Name  RawFree  LDFree OPFree  Base Snp  Free Total Compaction Dedup Compression DataReduce Overprov
cpg1 11462656 5731328      - 12288   0 30720 43008      442.9   0.0           -          -      5.8
```

- Another means of finding the amount of overprovisioning in a CPG is to issue the `showcpg` command with the `-space` parameter:

```
cli% showcpg -space
                -Private(MiB)- -------(MiB)-------- ------------ Efficiency -------------
Id Name  Warn%    Base    Snp Shared   Free  Total Compaction Dedup Compression DataReduce Overprov
 0 cpg1      -   11776      0    512  30720  43008      442.9   0.0           -          -      5.8
 1 cpg2      -     512      0    512  35840  36864      256.0   0.0           -          -      1.9
 2 cpg3      -     512      0    512  35840  36864      256.0   0.0           -          -      1.9
-----------------------------------------------------------------------------------------------
 3 total         12800      0   1536 102400 116736      324.5   0.0                        3.2
```

Showing per-disk-type overprovisioning

Procedure

Enter the `showsys -space -devtype <drive>` command:

```
cli% showsys -space -devtype FC
------------ System Capacity (MiB) -------------
Total Capacity                       :   13369344
  Allocated                          :    1906688
    Legacy Volumes                   :          0
      User                           :          0
      Snapshot                       :          0
    CPGs (TPVVs & TDVVs & CPVVs)     :     184320
      Shared                         :       2388
      Private                        :      24916
        Base                         :      24916
          Reserved                   :      24916
          Reserved (vSphere VVols)   :          0
        Snap                         :          0
          Reserved                   :          0
          Reserved (vSphere VVols)   :          0
      Free                           :     157016
    Unmapped                         :     161792
    System                           :    1560576
      Internal                       :     266240
      Admin                          :     737280
      Spare                          :     557056
        Used                         :       9216
        Unused                       :     547840
  Free                               :   11462656
    Initialized                      :   11417600
    Uninitialized                    :      45056
  Unavailable                        :          0
  Failed                             :          0
------------------ Efficiency ------------------
Compaction                           :      324.5
Dedup                                :        0.0
Compression                          :       0.00
```

```
Data Reduction                          :          -
Overprovisioning                        :        9.5
```

Showing systemwide overprovisioning

Procedure

Enter the `showsys -space` command:

```
 cli% showsys -space
------------ System Capacity (MiB) -------------
Total Capacity                          :   13369344
  Allocated                             :    1906688
    Legacy Volumes                      :          0
      User                              :          0
      Snapshot                          :          0
    CPGs (TPVVs & TDVVs & CPVVs)        :     184320
      Shared                            :       2388
      Private                           :      24916
        Base                            :      24916
          Reserved                      :      24916
          Reserved (vSphere VVols)      :          0
        Snap                            :          0
          Reserved                      :          0
          Reserved (vSphere VVols)      :          0
      Free                              :     157016
    Unmapped                            :     161792
    System                              :    1560576
      Internal                          :     266240
      Admin                             :     737280
      Spare                             :     557056
        Used                            :       9216
        Unused                          :     547840
  Free                                  :   11462656
    Initialized                         :   11419648
    Uninitialized                       :      43008
  Unavailable                           :          0
  Failed                                :          0
------------------ Efficiency ------------------
Compaction                              :      324.5
Dedup                                   :        0.0
Compression                             :       0.00
Data Reduction                          :          -
Overprovisioning                        :        9.5
```

Showing domain overprovisioning

Procedure

To find system capacity information broken down by domain, in MiB (1,048,576 bytes), issue the `showsys -domainspace` command.

```
cli% showsys -domainspace
       -Legacy(MiB)- -Private(MiB)- --CPG(MiB)--- -----(MiB)----- -----------Efficiency-----------
Domain    Used    Snp    Base    Snp Shared   Free Unmapped  Total Compaction Dedup Compr DataReduce Overprov
-            0      0     340      0   2388  95576   161792 260096      256.0   0.0  0.00          -      3.8
domain1      0      0   22188      0   2388  61440        0  86016      442.9   0.0  0.00          -      5.7
```

```
-------------------------------------------------------------------------------------------------
            0      0   22528      0   4776 157016   161792 346112      324.5   0.0                  4.7
```

Reducing volume size with HPE 3PAR Thin Persistence

HPE 3PAR Thin Persistence is an optional feature that keeps system TPVVs and read/write snapshots of TPVVs small by detecting pages of zeros during data transfers, and not allocating space for the zeros in the destination TPVV. This feature works in real time and analyzes the data before it is written to the destination TPVV. You must have an HPE 3PAR StoreServ Storage system to use thin persistence with TPVVs. For more information about the thin-persistence feature, see the *HPE 3PAR StoreServ Storage Concepts Guide*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

To enable the thin-persistence feature on a TPVV or a read/write snapshot of a TPVV, use the `setvv` command to enable the `zero_detect` policy on the destination TPVV. For more information, see **Modifying virtual volumes** on page 124.

NOTE: Thin persistence can have some performance implications during busy system conditions. Hewlett Packard Enterprise recommends the `zero_detect` policy only be enabled during thin-persistence and thin-conversion operations. The `zero_detect` policy should be disabled during normal operation.

Maintaining TPVV and read/write snapshot size with the thin-persistence feature requires one of the following sets of licenses:

- Both an HPE 3PAR StoreServ Storage license and an HPE 3PAR Thin Provisioning license
- Both an HPE 3PAR Thin Conversion license and an HPE 3PAR Thin Persistence license
- Or a single HPE 3PAR All-inclusive Single-System license

Contact your Hewlett Packard Enterprise representative for more information.

More information:

Activating a software license on page 13

Managing virtual volume autonomic groups

Virtual volumes can be combined into autonomic groups. Autonomic groups are sets of objects that can be managed as one object. If you have a group of volumes used by a database or another application and all the virtual volumes require the same administrative procedures, it is easier to group those volumes into a set and manage them together. Individual virtual volumes can be members of multiple virtual volume sets.

Virtual volumes added to a set inherit the rights of that set. For example, if a group of virtual volumes is exported to a host and a new virtual volume is added to the virtual volume set, the new virtual volume is visible to the host as soon as it is added to the virtual volume set. The opposite is also true. If a virtual volume is removed from a set, all the rights of that virtual volume set are revoked for the removed virtual volume.

A virtual volume in a virtual volume set cannot be removed from the system until it has been removed from the virtual volume set, or until the virtual volume set is removed from the system. Removing a virtual volume set does not remove the virtual volumes in that set. Changing the name of a virtual volume in a set does not change the rights of the virtual volume or remove it from the virtual volume set.

Creating virtual volume sets

Procedure

- Issue the `createvvset <set_name> <VV_names>` command, where:
  - `<set_name>` is the name of the virtual volume set being created.
  - `<VV_names>` are the names of the virtual volumes included in the virtual volume set.

For a complete list of options available for the `createvvset` command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Adding virtual volumes to virtual volume sets

Procedure

- To add a virtual volume to an existing virtual volume set, issue the `createvvset -add <set_name> <VV_names>` command, where:
  - `<set_name>` is the name of the virtual volume set that will include the added virtual volumes.
  - `<VV_names>` are the names of the virtual volumes being added to the virtual volume set.

For a complete list of options available for the `createvvset` command, see the *HPE 3PAR Command Line Interface Reference* and the HPE 3PAR CLI *Help*.

Modifying virtual volume sets

Procedure

- To change the name of a virtual volume set, issue the `setvvset -name <new_name> <set_name>` command, where:
  - `<new_name>` represents the new name of the virtual volume set.
  - `<set_name>` represents the name of the virtual volume set being modified.

For a complete list of options available for the `setvvset` command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Removing virtual volume sets

Procedure

- To remove a virtual volume set from the system, or to remove virtual volumes from a set, issue the `removevvset <set_name> <VV_names>` command, where:

- `<set_name>` is the name of the virtual volume set being removed or modified.
- `<VV_names>` are the names of the virtual volumes being removed from the `<set_name>` virtual volume set. This specifier is optional and it is not required if you are removing the entire set.

For a complete list of options available for the `removevvset` command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Freeing virtual volume snapshot space

Procedure

- To free unused snapshot administration and snapshot data space from a virtual volume that is not in use by the system, issue the `freespace <VV_name>` or `freespace <pattern>` command, where:
  - `<VV_name>` represents the names of the virtual volumes from which snapshot space is to be made available.
  - `<pattern>` represents the name of the pattern from which snapshot space is to be made available from all volumes matching that pattern name.

For a complete list of options available for the `freespace` command, see the *HPE 3PAR Command Line Interface Reference* and the HPE 3PAR CLI *Help*. For information about tuning your system for better performance, see **HPE 3PAR OS system performance tuning** on page 244.

Setting expiration times for virtual volumes

You can set virtual volume expiration times with the `-exp` option of the following commands:

- `createvv`
- `setvv`
- `createsv`
- `creategroupsv`

Use the `-exp` option to set an expiration time for any volume or copy of a volume. The expired virtual volumes are not automatically removed, so you must use the `removevv` command or the system scheduler to remove the expired volumes. The expiration time can be set during the volume creation time, or can be applied to an existing volume.

Procedure

- To set the volume expiration time for any volume, issue the `setvv -exp <time> d|D|h|H <VV_name>` command, where:
  - `-exp <time> d|D|h|H` specifies the amount of time from the current time in which the volume will expire. The value for `<time>` must be a positive integer in the range of 1 minute to 43,800

hours (1,825 days). The value for <time> can be specified in days with d|D or hours with h|H. For example, 14d specifies 14 days.

- <VV_name> is the name of the volume that is set to expire.

Setting retention times for virtual volumes

HPE 3PAR Virtual Lock is an optional feature that enforces the retention period of any volume or copy of a volume. You must purchase the HPE 3PAR Virtual Lock or HPE 3PAR All-inclusive Single-System software license to use the -retain option. Locking a volume prevents the volume from being deleted intentionally or unintentionally before the retention period elapses. You can use HPE 3PAR Virtual Lock to specify the retention period for any volume or copy of a volume.

More information:

Activating a software license on page 13

Rules for volume retention times

- The retention time can be set during volume creation or applied to an existing volume.
- The retention time can be increased, but it cannot be decreased.
- If both of the retention time and expiration time are specified, the retention time cannot be greater than the expiration time.
- The retention time can be set in hours or days. The minimum retention time is 1 hour and the maximum retention time is 43,800 hours (1,825 days or five years). The default is 336 hours (14 days). The vvMaxRetentionTime system parameter determines the maximum retention. This parameter can be set with the setsys command.
- The maximum retention time for a volume in a domain can be set during domain creation with the createdomain command, or applied to an existing domain with the setdomain command.
- If the volume belongs to a domain, then the volume retention time cannot exceed maximum retention time of the domain.
- A volume with remaining retention time cannot be removed until the end of the retention period.

Setting volume retention times

You can use the -retain option to set volume retention times while issuing the following commands:

- createvv
- setvv
- createsv
- creategroupsv

Creating a virtual volume with a specific retention time

Procedure

- To create a virtual volume that cannot be deleted for a specified number of hours, issue the createvv -retain <time> d|D|h|H <CPG_name> -snp_cpg <CPG_name> <user_CPG> <VV_name> <VV_size g|G|t|T> command, where:

- `-retain <time> d|D|h|H` specifies that the volume cannot be removed from the system for the specified number of hours or days. The value for `<time>` must be a positive integer in the range of 1 hour to 43,800 hours (1,825 days). The value for `<time>` can be specified in days with `d|D` or hours with `h|H`. For example, `14d` specifies 14 days.
- `<CPG_name>` is the name of the CPG from which the volume will draw its snapshot space and administration space.
- `<user_CPG>` is the name of the CPG from which the created virtual volume will draw its user space.
- `<VV_name>` is the name of the volume being created. The name can be up to 31 characters.
- `<VV_size g|G|t|T>` is the size of the volume in MB, GB, or TB. If `g|G|t|T` is not specified, `VV_size` is the number of MBs. For example, `50g` specifies 50 GBs.

Displaying volume retention information

Procedure

Use the `showvv -retained` command to display all volumes with retention times and the time at which the volume retention expires.

Removing virtual volumes

Procedure

- To remove virtual volumes, issue the `removevv <VV_name>` or `removevv <pattern>` command, where:
  - `<VV_name>` represents the names of the virtual volumes to be removed.
  - `<pattern>` represents the name of the pattern according to which virtual volumes are to be removed.

For a complete list of options available for the `removevv` command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Validating and repairing virtual volumes

Procedure

- To verify that virtual volumes are valid, and to repair virtual volumes corrupted by an uncontrolled system shutdown, issue the `checkvv {-y|-n} <VV_name>` command, where:
  - `{-y|-n}` specifies that if validity errors are found they are to be corrected (`-y`), or left unmodified (`-n`). If this option is not specified, errors are not corrected.
  - `<VV_name>` represents the name of the virtual volume to be validated and repaired.

For a complete list of options available for the `checkvv` command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Exporting virtual volumes

Virtual volumes are the only logical storage component visible to hosts. A virtual volume can be exported, or made accessible, to one or more hosts. The host sees the exported volume as a LUN connected to one or more ports. Once the virtual volume is exported to a host, the host can send requests to the LUN.

A virtual-LUN, or VLUN, is a pairing between a virtual volume and a LUN so the host can access its virtual volume and I/O writes can be saved to the virtual volume. The VLUN parameters determine whether a virtual volume is expressed as an **active VLUN**. The maximum number of supported VLUNs per host is 16,000. The maximum number of supported VLUNs per system is 32,000. For more information about VLUNs, see the *HPE 3PAR StoreServ Storage Concepts Guide*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

NOTE: When adding virtual volume sets, leave a gap between the virtual volume set export and any further exports to allow for expansion. This example uses the next free VLUN from 100 onwards, which allows you to take advantage of the auto LUN functionality while retaining separation between virtual volume set ranges: `createvlun <VV_name> 100+ <host>|set:<host_set>.`

Creating VLUN templates

A **VLUN template** creates an association between a virtual volume and a LUN-host, LUN-port, or LUN-host-port combination by establishing the **export rule**, or the manner in which the volume is exported. A VLUN template enables the export of a virtual volume as a VLUN to a host or hosts. Those volume exports, which are seen as LUNs by the host or hosts, are active VLUNs.

A VLUN template can be one of the following types:

- `host sees`—allows only a specific host to see a volume.
- `host set`—allows any host that is a member of the host set to see a volume.
- `port presents`—allows any host on a specific port to see the volume.
- `matched set`—allows only a specific host on a specific port to see the volume.

More information:

Creating a host sees or host set VLUN template on page 139

Creating a port presents VLUN template on page 140

Creating a matched set VLUN template on page 140

Creating a `host sees` or `host set` VLUN template

Procedure

- Issue the `createvlun <VV_name>|set:<set_name> <LUN> <host>|set:<host_set>` command, where:
  - `<VV_name>` is the name of the virtual volume being exported to the host.
  - `<set_name>` is the name of the virtual volume set being exported to the host.
  - `<LUN>` is the LUN where the virtual volume is to be exported, expressed as an integer ranging from 0 through 16383.

- `<host>` is the name of the host to which the virtual volume is exported. This option creates a `host sees` VLUN template.
- `<host_set>` is the name of the host set to which the virtual volume is exported. This option creates a `host set` VLUN template.

For detailed information about the `createvlun` command, see the *HPE 3PAR Command Line Interface Reference*.

Creating a `port presents` VLUN template

Procedure

- Issue the `createvlun <VV_name>|set:<set_name> <LUN> <N:S:P>` command, where:
  - `<VV_name>` is the name of the virtual volume being exported to the host.
  - `<set_name>` is the name of the virtual volume set being exported to the host.
  - `<LUN>` is the LUN where the virtual volume is to be exported, expressed as an integer ranging from 0 through 16383.
  - `<N:S:P>` is the location of the target port used to export the virtual volume.

For detailed information about the `createvlun` command, see the *HPE 3PAR Command Line Interface Reference*.

Creating a `matched set` VLUN template

Procedure

- Issue the `createvlun <VV_name>|set:<set_name> <LUN> <N:S:P> <host>|set:<host_set>` command, where:
  - `<VV_name>` is the name of the virtual volume being exported to the host.
  - `<set_name>` is the name of the virtual volume set being exported to the host.
  - `<LUN>` is the LUN to which the virtual volume is to be exported, expressed as an integer ranging from 0 through 16383.
  - `<N:S:P>` is the location of the target port used to export the virtual volume.
  - `<host>` is the name of the host to which the virtual volume is exported.
  - `<host_set>` is the name of the host set to which the virtual volume is exported.

For detailed information about the `createvlun` command, see the *HPE 3PAR Command Line Interface Reference*.

Unexporting virtual volumes

To halt the export of a virtual volume, you must remove the VLUNs associated with that volume. To remove the active VLUNs associated with a VLUN template, you must remove the template.

Removing all VLUNs for a host stops the host from accessing any volumes.

More information:

Removing a host sees or host set VLUN template on page 141

Removing a port presents VLUN template on page 141

Removing a matched set VLUN template on page 141

Removing a `host sees` or `host set` VLUN template

Procedure

- To remove a `host sees` VLUN template and all active VLUNs associated with it, issue the `removevlun <VV_name>|set:<set_name> <LUN> <host>|set:<host_set>` command, where:
  - `<VV_name>` is the name of the virtual volume.
  - `<set_name>` is the name of the virtual volume set.
  - `<LUN>` is the LUN for the virtual volume, expressed as an integer ranging from 0 through 16383.
  - `<host>` is the name of the host. This option creates a `host sees` VLUN template.
  - `<host_set>` is the name of the host set.

For detailed information about the `removevlun` command, see the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Removing a `port presents` VLUN template

Procedure

- To remove a `port presents` VLUN template and all active VLUNs associated with it, issue the `removevlun <VV_name>|set:<set_name> <LUN> <N:S:P>` command, where:
  - `<VV_name>` is the name of the virtual volume to halt exporting to the host.
  - `<set_name>` is the name of the virtual volume to halt exporting to the host.
  - `<LUN>` is the LUN that was exported, expressed as an integer ranging from 0 through 16383.
  - `<N:S:P>` is the location of the target port used to export the virtual volume.

For detailed information about the `removevlun` command, see the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Removing a `matched set` VLUN template

Procedure

- To remove a `matched set` VLUN template and all active VLUNs associated with it, issue the `removevlun <VV_name>|set:<set_name> <LUN> <N:S:P> <host>|set:<host_set>` command, where:

- <VV_name> is the name of the virtual volume being exported to the host.
- <set_name> is the name of the virtual volume set being exported to the host.
- <LUN> is the LUN that the virtual volume is to be exported, expressed as an integer ranging from 0 through 16383.
- <N:S:P> is the location of the target port used to export the virtual volume.
- <host> is the name of the host to which the virtual volume is exported.
- <host_set> is the name of the host set to which the virtual volume is exported.

For detailed information about the removevlun command, see the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Virtual domains, CPGs, and virtual volumes

You can use the CLI to create and manage virtual volumes belonging to domains just as you would manage virtual volumes that do not use virtual domains.

NOTE: Virtual domains require the HPE 3PAR Virtual Domains or HPE 3PAR All-inclusive Single-System software license. Contact your Hewlett Packard Enterprise sales representative for details.

More information:

Creating CPGs in a domain on page 142

Creating virtual volumes in a virtual domain on page 143

Modifying virtual volumes in domains on page 144

Growing virtual volumes in domains on page 144

Exporting virtual volumes in domains on page 144

Activating a software license on page 13

Creating CPGs in a domain

If you are using virtual domains, you can create domain-specific CPGs that are accessible only to those users with rights to that domain. To create a domain CPG, you must have super or edit rights in the all domain. For information about CPGs and virtual domains, see the *HPE 3PAR StoreServ Storage Concepts Guide*, available from the Hewlett Packard Enterprise Information Library.

Procedure

1. Log in to the system as Super or Edit user, or as any user with cpg_create permission.
2. To create a CPG within a domain, use the following syntax:
   createcpg -domain *<domain_name>* -aw *<percent>* -sdgs *<size>* -sdgl *<size>* -sdgw *<size>* -t *<RAID_type>* *<CPG_name>*

   <domain_name>

   Name of the domain in which to create the CPG.

-aw *<percent>*

Percentage of used snapshot space and administration space that generates a warning alert. If 0 (the default value), generates no alerts.

-sdgs *<size>*

Amount of LD storage created during each autogrow operation. Check minimum default growth sizes per number of nodes before specifying a size.

-sdgl *<size>*

Growth limit for autogrow operations. If 0 (the default value), enforces no limit.

-sdgw *<size>*

Space limit for LD space before a warning alert is generated. If 0 (the default value), enforces no warning limit.

-t *<RAID_type>*

RAID type, specified as `r0` (RAID 0), `r1` (RAID 1), `r5` (RAID 5), or `r6` (RAID MP).

<CPG_name>

Name of the CPG being created.

3. To use other options or specifiers with the `createcpg` command, see, *HPE 3PAR Command Line Interface Reference* or the HPE 3PAR CLI *Help*

More information

Growth increment considerations for CPGs on page 116

Creating virtual volumes in a virtual domain

If you are using virtual domains, you can create domain-specific virtual volumes which are accessible only by those users with rights to that domain. You must have `super` or `edit` rights in the domain in which you are creating the virtual volume. Virtual volumes are created by allocating resources from CPGs within a domain. A CPG must exist in the domain in which you wish to create a virtual volume before you can create a domain-specific virtual volume.

Procedure

- To create a virtual volume within a domain, issue the `createvv <usr_CPG> <VV_name> <VV_size g|G|t|T>` command, where:
  - `<usr_CPG>` is the name of the CPG from which the created virtual volume user space is drawn.
  - `<VV_name>` is the name of the virtual volume being created.
  - `<VV_size g|G|t|T>` is the size of the volume in MB, GB, or TB. If `g|G|t|T` is not specified, `VV_size` is the number of MBs. For example, `50g` specifies 50 GBs.

For a complete list of options available for the `createvv` command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

For instructions about creating domain CPGs, see **Moving a CPG to a domain** on page 145. For more information about virtual domains, see the *HPE 3PAR StoreServ Storage Concepts Guide*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Modifying virtual volumes in domains

Domain virtual volumes can be modified in the same way that virtual volumes in systems without domains can be modified. However, some restrictions apply to domain virtual volume modification.

- If you are a user with `super` or `edit` rights and belong to the `all` domain, all virtual volume modification options for the `setvv` command are available for use, and you can modify any virtual volume in the system.
- If you are a user with `edit` rights and belong to a `specified` domain, all options for the `setvv` command are available for use for virtual volumes that belong to the same `specified` domain.

See the *HPE 3PAR StoreServ Storage Concepts Guide* and the `setvv` command in the *HPE 3PAR Command Line Interface Reference* for additional information about this restriction. These documents are available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

To modify a virtual volume in a domain, see **Modifying virtual volumes** on page 124.

Growing virtual volumes in domains

Existing domain virtual volumes can be enlarged (grown) by automatically adding capacity in increments that you specify. Volumes that were created by `super` or `edit` users in the `all` domain can be grown only by `super` or `edit` users in the `all` domain. Volumes created from CPGs by users with `edit` rights in a `specified` domain can be grown by those users.

For instructions about growing domain virtual volumes, see **Growing virtual volumes** on page 124.

Freeing virtual volume snapshot space in domains

The snapshot space in virtual volumes belonging to domains can be made available in the same way that virtual volumes in systems without domains are made available.

For instructions about freeing virtual volume snapshot space, see **Freeing virtual volume snapshot space** on page 136.

Exporting virtual volumes in domains

Creating VLUN templates in domains is procedurally no different from creating VLUN templates in systems that do not use virtual domains. If you are using virtual domains, you can export virtual volumes in your domains. The right to perform interdomain exports is determined by the user role.

- Users with `super` or `edit` rights who belong to the `all` domain can export virtual volumes in any domain existing in the system. See **Creating VLUN templates in the all domain** on page 144.
- Users with `edit` rights who belong to a `specified` domain can only export virtual volumes to hosts belonging to that domain. See **Creating VLUN templates in a specific domain** on page 145.

Creating VLUN templates in the `all` domain

If you have `super` or `edit` rights in the `all` domain, you can create `host sees`, `matched set`, and `port presents` VLUN templates. For instructions about creating each template type, see:

- **Creating a host sees or host set VLUN template** on page 139
- **Creating a port presents VLUN template** on page 140
- **Creating a matched set VLUN template** on page 140

Creating VLUN templates in a specific domain

Users with `edit` rights who belong to a `specified` domain can export virtual volumes to hosts belonging to that domain. Only `host sees` and `matched set` VLUN templates may be created. For instructions about creating each template type, see:

- **Creating a host sees or host set VLUN template** on page 139
- **Creating a matched set VLUN template** on page 140

Moving a CPG to a domain

For instructions on moving CPGs into or out of a domain, see **Managing domain objects** on page 89.

Compression management with 3PAR CLI

Compression increases space efficiency and consolidates stored data. You can compress the following types of virtual volumes using the CLI:

- Thinly Provisioned Virtual Volumes (TPVV)
- Deduplicated Virtual Volumes

Creating TPVVs requires the HPE 3PAR Thin Provisioning or HPE 3PAR All-inclusive Single-System software license.

More information

Software licenses and HPE 3PAR CLI on page 13

Managing compression

CLI compression management includes:

Calculating space savings with compression on page 126
Converting a TPVV to a compressed volume on page 128
Creating compressed virtual volumes on page 123
Displaying current compression and deduplication states on page 146
Displaying the compression ratio of volumes in a CPG on page 147

Displaying current compression and deduplication states

Procedure

- To determine if virtual volumes are using compression and/or deduplication, issue the `showvv` command.
- To display the list of volumes with the compression state specified as a pattern, issue the following command:

  ```
  showvv -p -compr Yes
  ```

  Example:

  ```
  # showvv -p -compr Yes
                                                                                -Rsvd(MB)- -(MB)-
  Id Name  Prov Compr Dedup Type CopyOf Bald Rd -Detailed_State- Snp    Usr  VSize
   2 aa.0  tpvv Yes   No    base ---       2 RW normal             0   4608  10240
   3 aa.1  tpvv Yes   No    base ---       3 RW normal             0   4608  10240
   4 aa.2  tpvv Yes   No    base ---       4 RW normal             0   4608  10240
   5 aa.3  tpvv Yes   No    base ---       5 RW normal             0   4608  10240
   6 aa.4  tpvv Yes   No    base ---       6 RW normal             0   4608  10240
   ------------------------------------------------------------------------------
   5 total                                                        0  23040  51200
  ```

- To view the compression ratio per volume, issue the `showvv -s` command.

  Compression ratio = Total number of Volume pages (excluding DDS) / Total SD pages used

  The compression ratio is updated during every compression garbage collector run (every 3 minutes).

Displaying the compression ratio of volumes in a CPG

Procedure

To display the compression ratio of all volumes present in a CPG, issue the `showcpg -s` command.

Compression ratio = Total number of Volume pages (excluding DDS) / Total SD pages used

Data reduction ratio = Total number of Volume pages (Dedup + Compression) / Total SD pages used

VVol virtual and physical copies

You can create two types of copies from VVols: **virtual copies** and **physical copies**.

- A **virtual copy** is a snapshot of an original or base volume. A virtual copy records only the changes to the original virtual volume.
- A **physical copy** is a complete duplicate of all the data from a base volume to a destination volume.

If your system is accessible in an OpenStack cloud, you may see volumes with prefixes indicating that the volumes were created through the OpenStack cloud. Volumes created through the OpenStack cloud use the OSV and OSS prefixes.

Creating virtual copies or **snapshots** requires the HPE 3PAR Virtual Copy or HPE 3PAR All-inclusive Single-System software license.

For more information about virtual copies, see the *HPE 3PAR StoreServ Storage Concepts Guide*, available from the Hewlett Packard Enterprise Information Library.

Virtual Copies

A virtual copy is a snapshot of another VVol. You can make virtual copies of base volumes, physical copies, or other virtual copies.

Unlike a physical copy, which duplicates the entire base volume, a virtual copy only records the changes made to the original volume. You can recreate an earlier state of the original volume by starting with the current state, and then rolling back all the changes made since the virtual copy was created.

Creating virtual copies requires **copy-on-write** techniques available only with the HPE 3PAR Virtual Copy license.

For additional information about virtual copies, see the *HPE 3PAR StoreServ Storage Concepts Guide*, available from the Hewlett Packard Enterprise Information Library.

More information

Software licenses and HPE 3PAR CLI on page 13

Creating a virtual copy

Virtual copies can be read-only or read/write. Expiration dates can be set for virtual copies to save space. The system allows you to make a maximum of 500 virtual copies of a base volume. Up to 256 virtual copies can be read/write copies.

The maximum number of virtual copies that can be created on a system is determined by the system configuration. For the maximum number of virtual copies that can be created with your specific system configuration, see the SPOCK website:

http://www.hpe.com/storage/spock

Procedure

- To create a virtual copy, or snapshot, of a virtual volume or a virtual volume set, issue the `createsv -ro <snapshot_name> <source_VV>|set:<set_name>` command, where:
  - `-ro` specifies that the snapshot being created is read-only.
  - `<snapshot_name>` is the name of the snapshot being created.

- `<source_VV>` is the name of the virtual volume being copied.
- `<set_name>` is the name of the virtual volume set being copied.

For a complete list of options available for the `createsv` command, see the *HPE 3PAR Command Line Interface Reference* and the HPE 3PAR CLI *Help*.

Promoting a virtual copy

If you have created multiple copies of a base volume, you can roll back the data on a virtual copy to the base volume or to any of the virtual copy's RW parents in the same tree by **promoting** a virtual copy. Promoting a virtual copy copies the changes from the virtual copy back onto the base volume, overwriting the base volume with the copy. The virtual copy remains on the system.

The virtual copy and the target of the promote must not be exported.

Only one promote operation is allowed at a time within a virtual volume family tree.

Procedure

- To promote a virtual copy back to a base volume or back to any of the virtual copy's RW parents in the same virtual volume family tree, issue the `promotesv <VC_name>|set:<set_name> -pri high` command, where:
  - `<VC_name>` is the name of the virtual copy being promoted.
  - `<set_name>` is the name of the virtual copy set being promoted.
  - `-pri <high|med|low>` specifies the priority of the copy operation before it is started. This option allows you to control the speed at which the task is performed. If this option is not specified, the operation is started with default priority of medium. High priority indicates that the operation will complete as fast as possible. Low priority indicates that the operation will run slower than the default priority task. If your virtual volumes are unavailable and restoring access to the volume is the highest priority, you can use the `-pri` option to raise the priority of the task. However, raising the priority of the task may impact host I/O performance.

    The priority of the task can also be changed, after it has begun, with the `settask` command. For more information about changing the priority of a running task, see **Setting the priority of an active or valid task** on page 199.

    With the `-online` option, the volume can be promoted while it is online or exported. The `-rcp`, `-halt`, and `-pri` options cannot be combined with the `-online` option.

For a complete list of options available for the `promotesv` command, see the *HPE 3PAR Command Line Interface Reference* and the HPE 3PAR CLI *Help*.

NOTE: The `-halt` option cancels a running virtual copy promotion operation. The RW parent volume is marked with the `cpf` status, which indicates that the promotion failed. The `cpf` status can be cleared using the `promotevvcopy` command or by issuing a new instance of the `promotesv` command. This option cannot be used in conjunction with any other option.

To halt volume export, you must delete all VLUNs associated with the volume as described in **Unexporting virtual volumes** on page 140. After you delete all VLUNs, you can use the volume as the destination volume for a physical copy.

If you are using HPE 3PAR Remote Copy, you can optionally promote the virtual copy if the base volume is in a Remote Copy group. See the *HPE 3PAR Command Line Interface Reference* for detailed

information about the `promotesv` command. For details about HPE 3PAR Remote Copy, see the *HPE 3PAR Remote Copy Software User Guide*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Modifying a virtual copy

Any existing virtual copy can be modified to have a new name, new allocation warnings and limits, and adhere to new policies.

Procedure

To modify an existing VV, issue the `setvv` command.

For details on all the `setvv` command arguments and their usage, see the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Removing a virtual copy

Procedure

Issue the `removevv <VV_name>` command, where `<VV_name>` is the snapshot you are removing.

For detailed information about the `removevv` command, see the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Creating a group of virtual copies

The HPE 3PAR CLI also allows for the creation of consistent group snapshots of a list of virtual volumes. A maximum group size of 100 virtual volumes can be specified when making a group of virtual copies.

Procedure

To create group snapshots, issue the `creategroupsv <copy_of_VV>` command, where `<copy_of_VV>` is the name of the virtual volume being copied.

NOTE: If you wish to copy multiple volumes, the `<copy_of_VV>` argument can be repeated multiple times on the command line for a single instance of the `creategroupsv` command.

For a complete list of options available for the `creategroupsv` command, see the *HPE 3PAR Command Line Interface Reference* and the HPE 3PAR CLI *Help*.

Creating a virtual copy online

You can create a virtual copy while online, without interrupting host access. See, **Creating an online physical copy**.

Physical copies

A physical copy is a full copy of a volume. The data in a physical copy is static; it is not updated with subsequent changes to the parent volume. The parent volume is the source volume that is copied to the destination volume. The parent volume can be a single base volume, a volume set, a virtual copy, or another physical copy. Creating physical copies does not require a separate license.

Physical copies can be online physical copies or offline physical copies. When online physical copies are made, the destination volume is automatically created and can be exported for availability to hosts even before the copy operation is completed. Offline physical copies require a pre-existing destination volume that must have a user space size at least as large as the user space of the source volume being copied. Offline physical copies cannot be exported until after the copy operation is completed.

The maximum number of physical copies that can be created on a system is determined by the system configuration. For the maximum number of physical copies that can be created with your specific system configuration, see the following website:

SPOCK (http://www.hpe.com/storage/spock)

A physical copy can only be made from a volume with enough free space to accommodate writes to that volume during the physical copy operation. In addition, the destination volume must meet the following conditions:

- It must have snapshot space associated with it.
- It must have at least as much user space as the volume being copied.

You can also use the HPE 3PAR CLI to resynchronize or to promote offline physical copies. Online physical copies cannot be resynchronized or promoted.

For additional information about the rules governing physical copies, see the *HPE 3PAR StoreServ Storage Concepts Guide*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

NOTE: If the parent and destination volume are both TPVVs, only the space actually used is copied.

The `createvvcopy` command can be issued multiple times. However, the system allows only two physical copy tasks to run concurrently. Any additional physical copy tasks are queued, pending the completion of the active physical copy tasks.

More information:

Creating an offline physical copy on page 151

Creating an online physical copy on page 152

Creating a group of offline physical copies on page 153

Creating a group of online physical copies on page 154

Resynchronizing physical copies on page 154

Promoting physical copies or physical copy sets on page 155

Creating an offline physical copy

Procedure

- To create an offline physical copy of a virtual volume, issue the `createvvcopy -p {<parent_volume> | <parent_volumeset>} -s {<destination_volume> | <destination_volumeset>} -pri {high|med|low}` command, where:
  - `-p` creates a snapshot of the parent volume or volume set (designated by `<parent_volume>` or `<parent_volumeset>`) and copies the snapshot data to the destination volume (designated by `<destination_volume>` or `<destination_volumeset>`). The destination volume (or each

member of the destination volume set) must be equal to or greater in size than the parent volume, must be a writable volume, and must not be exported as a VLUN.

- `-s` specifies that a snapshot will be saved for resynchronization and that the parent/copy relationship between the parent and the destination volume will be retained.
- `-pri {high|med|low}` specifies the priority of the copy operation. This option allows you to control the speed at which the task is performed. If this option is not specified, the operation is started with default priority of medium. High priority indicates that the operation will complete as fast as possible. Low priority indicates that the operation will run slower than the default priority task. If your virtual volumes are unavailable and restoring access to the volume is the highest priority, you can use the `-pri` option to raise the priority of the task. However, raising the priority of the task may impact host I/O performance. This option cannot be used with the `-halt` option.

  The priority of the task can be changed after it has been started by using the `settask` command. For more information about changing the priority of a running task, see **Setting the priority of an active or valid task** on page 199.

For a complete list of options available for the `createvvcopy` command, see the *HPE 3PAR Command Line Interface Reference* and the HPE 3PAR CLI *Help*.

NOTE: The `-halt` option cancels a running physical copy operation. The destination volume is marked with the `cpf` status, which indicates that the copy operation failed. The `cpf` status can be cleared by issuing a new instance of the `createvvcopy` command.

Creating an online physical copy

The `createvvcopy` command creates a full physical copy of a virtual volume, or a read/write virtual copy on another virtual volume. You can create copies of virtual volumes to perform tasks such as moving data to a larger virtual volume or creating a copy of data for testing.

When you create an online physical copy, you create read/write virtual copy that is instantly available for export to hosts.

Procedure

To create an online physical copy of a virtual volume, use the following syntax:

```
createvvcopy -p <parent_volume> -online [-snp_cpg <snap_cpg>] [{-tpvv | -
dedup | -compr}] [-wwn <wwn>] <destination_cpg> <destination_volume>
```

`-p <parent_volume>`

Identifies the *<parent_volume>* from which to create a snapshot, and copies the snapshot data to the destination volume.

`-online`

Specifies the automatic creation of the destination volume and immediate export to the destination volume. Requires the `-p <parent_volume>` option. Do not use with `-r`, `-halt`, `-s`, `-b`, and `-pri` options.

`-snp_cpg <snap_cpg>`

Specifies the name of the CPG on which to allocate snapshot space for the destination volume.

`-tpvv`

Specifies that the virtual volume created is a thinly provisioned volume. Do no use with the `-dedup` option.

-dedup

Specifies that the virtual volume created is a thinly deduplicated volume, which is a thinly provisioned volume with inline data deduplication. Use with a CPG that has an SSD (Solid-State Drive) device type only. Do not use with the `-tpvv` option.

-compr

Specifies that the virtual volume created is a compressed virtual volume.

-wwn <wwn>

Specifies that the value of the supplied `<wwn>` is the WWN for the destination virtual volume. Without this option specified, the system automatically determines the WWN based on the system serial number, the volume ID, and the wrap counter.

<destination_cpg>

Specifies the destination CPG to use for the destination volume.

<destination_volume>

Specifies the destination volume name for the copy operation.

Creating a group of offline physical copies

The HPE 3PAR CLI also allows for the creation of a group of physical copies from a list of source virtual volumes. A maximum group size of 100 virtual volumes is recommended for making a group of physical copies.

Procedure

- Issue the `creategroupvvcopy -p -s <parent_VV1>:<destination_VV1>[, <parent_VV2>:<destination_VV2>]... -pri {high|med|low}` command, where:
  - `-p` specifies that an operation is to be executed to copy a group of parent volumes (designated by `<parent_VV1>`, `<parent_VV2>`, and so on) to the destination volumes (designated by `<destination_VV1>`, `<destination_VV2`, and so on).

    To specify the group of copies to make, include the `<parent_VV>:<destination_VV>` couplets indicating source and destination volumes in a comma-separated list. The destination volumes must be equal to or greater in size than the parent volumes, must be writable base volumes, and must not be exported as VLUNs. Destination volume names can be up to 31 characters in length.
  - `-s` specifies that snapshots for each parent volume will be saved for resynchronization and that the parent/copy relationship between parent and destination volumes will be retained.
  - `-pri {high|med|low}` specifies the priority of the copy operation. This option allows you to control the speed of the task. If this option is not specified, the operation is started with default priority of medium. High priority indicates that the operation will complete as fast as possible. Low priority indicates that the operation will run slower than the default priority task.

    If your virtual volumes are unavailable and restoring access to the volume is the highest priority, you can use the `-pri` option to raise the priority of the task. However, raising the priority of the task may impact host I/O performance.

This option cannot be used with the `-halt` option. The priority of the task can be changed after it has been started by using the `settask` command. For more information about changing the priority of a running task, see **Setting the priority of an active or valid task** on page 199.

Creating a group of online physical copies

The `creategroupvvcopy` command, like the `createvvcopy` command, can also create online copies of virtual volumes.

Procedure

- Issue the `createvvcopy -p <parent_volume | parent_volumeset> -online [-snp_cpg <snap_cpg>] [{-tpvv | -dedup | -compr}] [-wwn <wwn>] <destination cpg> <destination volume>` command, where:
  - `-p` specifies that an operation is to be executed to copy a group of parent volumes (designated by `<parent_VV1>`, `<parent_VV2>`, and so on) to new destination volumes (designated by `<VV1_name>`, `<VV2_name`, and so on) in destination CPGs (designated by `<destination_cpg1>`, `<destination_cpg2>`, and so on). As with the `createvvcopy` command, the destination virtual volumes will be created by the `creategroupvvcopy` command if executed with the `-online` option. The destination volumes should therefore not exist already; but the specified destination CPGs must exist already, and they must be specified in the execution of the command.
  - `-snp_cpg <snp_cpg>` specifies the name of the CPG on which space for snapshots will be allocated for the destination volume.
  - `-tpvv` indicates that the VV the online copy creates is a thinly provisioned volume. Cannot be used with the `-dedup` option.
  - `-dedup` indicates that the VV the online copy creates is a thinly deduplicated volume, which is a thinly provisioned volume with inline data deduplication. This option can only be used with a CPG that has SSD (Solid-State Drive) device type. Cannot be used with the `-tpvv` option.
  - `-compr` indicates that the VV the online copy creates is a compressed virtual volume.

NOTE: The `-halt` option cancels a running offline group copy operation. The destination volume is marked with the `cpf` status, which indicates that the group copy operation failed. The `cpf` status can be cleared by issuing a new instance of the `creategroupvvcopy` command.

The `creategroupvvcopy` command can be issued multiple times. However, the system allows only two physical copy tasks to run concurrently. Any additional physical copy tasks are queued, pending the completion of the active physical copy tasks.

The `-online` option for the `creategroupvvcopy` command cannot be used with the `-r`, `-halt`, `-s`, `-b`, or `-pri` options.

For a list of options available for the `creategroupvvcopy` command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Resynchronizing physical copies

At some point, you may want to **resynchronize** a physical copy with its original base volume because either the copy or the source volume may have been modified after the copy operation was executed.

When you resynchronize a physical copy, the system copies changes from one volume in the physical copy pair to the other.

Procedure

- To resynchronize a single physical copy, issue the `createvvcopy -r <destination_VV>` command, where `<destination_VV>` is the volume to be resynchronized with its parent volume.
- To resynchronize a group of physical copies, issue the `creategroupvvcopy -r <destination_VV1>[, destination_VV2]...` command, where destination volumes to be resynchronized with their parent volumes are specified in a comma-separated list (`<destination_VV1>`, `<destination_VV2>`, and so on).

NOTE: To be able to resynchronize destination volume copies with parent volumes using the `-r` option, it is necessary that when the parent volumes were copied, the `-s` option was included in the execution of the `createvvcopy` command or the `creategroupvvcopy` command. Use of the `-s` option creates snapshots of the parent volumes at the time the copies were made.

Promoting physical copies or physical copy sets

Over time, physical copies and their base volumes can change as data is written to each of them. At some point, the association between the two volumes may no longer be relevant. The association between a physical copy and a base volume is broken by promoting the physical copy back to a base volume.

Procedure

- To promote a physical copy back to a base volume, issue the `promotevvcopy {<copy_name> | set:<set_name>}` command, where:
  - `<copy_name>` is the name of the physical copy being promoted.
  - `<set_name>` is the name of the physical copy set being promoted. The `<set_name>` specification must be preceded by the `set:` label.

Snapshots and virtual domains

NOTE: Virtual domains require the HPE 3PAR Virtual Domains or HPE 3PAR All-inclusive Single-System software license. Contact your local Hewlett Packard Enterprise representative for further details.

As with standard systems, virtual copies and physical copies can also be created in systems using virtual domains. Domain snapshot creation and modification do not differ from snapshot creation and modification in systems not using domains. Domain snapshot creation and modification are limited to users with `super` or `edit` rights who belong to the `all` domain, and to users with `edit` rights who belong to a `specified` domain. Snapshots inherit the domain of their parent volumes.

- Virtual copies can be:
  - Created. See **Creating a virtual copy** on page 148 for instructions.
  - Promoted. See **Promoting a virtual copy** on page 149 for instructions.

- Modified. See **Modifying a virtual copy** on page 150 for instructions.
- Removed. See **Removing a virtual copy** on page 150 for instructions.

- Physical copies can be:
  - Created. See **Creating an offline physical copy** on page 151 for instructions.
  - Resynchronized. See **Resynchronizing physical copies** on page 154 for instructions.
  - Promoted. See **Promoting physical copies or physical copy sets** on page 155 for instructions.

More information:

Activating a software license on page 13

Moving snapshots into or out of domains

Snapshots can be moved in or out of a domain using the `movetodomain` command. This action is restricted to users with `super` rights in the `all` domain.

NOTE: If a snapshot is moved into or out of a domain, the base volume of the snapshot is also moved.

More information:

Moving domain objects to another domain on page 90

Templates for logical disks and common provisioning groups

The HPE 3PAR CLI supports the use of templates to create a common set of predetermined parameters and apply them to new LDs or CPGs.

Creating templates for LDs and CPGs

Create templates for Logical Disks or CPGs. For VVols, use the `creatvv` command.

Prerequisites

- Use of the `createtemplate` command requires access to all domains.
- Review the `createtemplate` command options and usage in the HPE 3PAR Command Line Reference.

Procedure

1. Log in as `super` user or any user with the `template_create` right.
2. Enter the following command: command, where:
   `cli%` **createtemplate *<obj_type> <template_name>***
   - *<obj_type>* – Identify the object to create (LD or CPG).
   - *<template_name>* – Name the template you are creating.
3. Include other object-specific options and arguments that you want to use in the template (see, *HPE 3PAR Command Line Interface Reference*).

   Options specified in the template are read-only or read-write. The read-write options may be overridden with new options at the time of their creation, but read-only options may not be overridden at the time of creation

   All options specified in the template are either read-write (`-rw`) or read-only (`-ro`). You can overwrite options specified as `-rw` with new values at the time you create the object (LD or CPG). You cannot overwrite option specified as `-ro`.

Applying templates using the CLI

Procedure

Creating virtual volumes and logical disks using a template

In addition to using a template to create volumes and LDs, you can also apply any optional argument available for the `createvv` command. You can overwrite read/write parameters in the applied template with new options at the time of creation. However, read-only parameters in the template cannot be overwritten.

Prerequisites

- Create an LD template using the `createtemplate` command (see, xref).
- Understand the options associated with both the `createtemplate` and the `createvv` commands and how they interact (see, *HPE 3PAR Command Line Interface Reference*).
- Use of the `createvv` command requires access to all domains.
- If you intend us use the `createvv` command with the -tdvv or -tpvv option, you need a Thin Provisioning license. Contact your local HPE representative for information.

Procedure

1. Log in as `super` user, `edit` user, or any role granted the `vv_create` right.
2. Create a virtual volume and its underlying LDs using a template, enter the following command: command, where:
   `cli%` **createvv -templ *<template_name> <VV_name> <size>***
   - `<template_name>` – Name of the template created using `createtemplate` and applied to this LD creation.
   - `<VV_name>` – Name of the VVol you intend to create.
   - `<size>` – Size of the user volume.

Creating a CPG using a template

In addition to applying a template to the creation of the CPG, you can also apply any optional argument available for the `createcpg` command. Read/write parameters in the applied template can be overwritten with new options at the time of creation. However, read-only parameters in the template cannot be overwritten.

Procedure

- Issue the `createcpg -templ <template_name> <CPG_name>` command, where:
  - `<template_name>` is the name of the template being applied to the creation of the CPG.
  - `<CPG_name>` is the user-designated name of the CPG being created.

See the *HPE 3PAR Command Line Interface Reference* for additional information.

Modifying templates

You can modify a template at any time by adding, replacing, or removing template parameters, regardless of whether the template has been applied to create LDs, VVs, or CPGs. When you edit a template, no changes are made to objects you have created with that template.

More information:

Viewing template parameters on page 159

Adding and replacing template parameters on page 159

Removing template parameters on page 159

Viewing template parameters

Before modifying a template, it may be helpful to view the existing template parameters.

Procedure

- To view the current template parameters, issue the `showtemplate <template_name>` command.

  If name of the template you wish to modify is unknown, you can, alternately, filter and display templates by object type.

- To view templates by object type, issue the `showtemplate -t <type>` command, where `<type>` can be:

  - `VV`—virtual volume
  - `LD`—logical disk
  - `CPG`—common provisioning group

Adding and replacing template parameters

Procedure

- To add parameters to an existing template or replace parameters in an existing template, issue the `settemplate <option> <template_name>` command, where:

  - `<option>` includes the parameter and, if applicable, the value of the parameter that is being added or replaced in the template. For a descriptive list of valid options that can be applied to your template, see the `createtemplate` command in the *HPE 3PAR Command Line Interface Reference*.
  - `<template_name>` is the name of the template being modified.

Removing template parameters

Procedure

- To remove parameters in an existing template, issue the `settemplate -remove <option> <template_name>` command, where:

  - `<option>` is the parameter being removed from the template. The parameters are the options that you specified during the creation of the template. It is not necessary to specify the value of the parameter during removal.
  - `<template_name>` is the name of the template being modified.

Removing templates

Removing a template deletes the template from the system, but does not delete objects created with that template.

Procedure

- To remove a template from the system, issue the `removetemplate <template_name>` command, where `<template_name>` is the name of the template being removed.
- You can optionally remove templates matching a specific pattern by issuing the `removetemplate -pat <template_name|pattern>` command.

For details about this option, see the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

System and physical disk capacity management

HPE 3PAR CLI commands can show the amount of used space and available space in a system. These commands allow you to review space usage information at the system level and for each physical disk.

Viewing system capacity

Use the HPE 3PAR CLI to view the total capacity of the system and the total capacity by storage device type.

Determining total system capacity

Procedure

1. Log in using any role in the system.
2. To determine system capacity, enter the following command:
   `showsys -space`

   The response displays system capacity in MBs. The first line displays the total capacity of the system, which is the sum of the allocated space (`Allocated`), free space (`Free`), and failed space (`Failed`).

   Allocated space includes the following:

   - All base volumes and the user, copy, and administration spaces of the volumes.
   - Provisioned groups and volumes, and their used and unused copy and administration spaces.
   - Unmapped volumes.
   - System space, which includes administration volumes, log files, and physical disk system data, as well as used and unused spare space.
   - Free space, which includes the total free initialized and uninitialized spaces available for use.

```
 cli% showsys -space
------------ System Capacity (MiB) -------------
Total Capacity                       :   13369344
  Allocated                          :    1906688
    Legacy Volumes                   :          0
      User                           :          0
      Snapshot                       :          0
    CPGs (TPVVs & TDVVs & CPVVs)     :     184320
      Shared                         :       2388
      Private                        :      24916
        Base                         :      24916
          Reserved                   :      24916
          Reserved (vSphere VVols)   :          0
        Snap                         :          0
          Reserved                   :          0
          Reserved (vSphere VVols)   :          0
      Free                           :     157016
    Unmapped                         :     161792
    System                           :    1560576
      Internal                       :     266240
      Admin                          :     737280
      Spare                          :     557056
```

```
        Used                          :       9216
        Unused                        :     547840
  Free                                :   11462656
    Initialized                       :   11419648
    Uninitialized                     :      43008
  Unavailable                         :          0
  Failed                              :          0
----------------- Efficiency -------------------
Compaction                            :      324.5
Dedup                                 :        0.0
Compression                           :       0.00
Data Reduction                        :          -
Overprovisioning                      :        9.5
```

Determining system capacity by physical disk type

You can display the total capacity for all physical disks of a specific type. There are three types of physical disks: Fast Class (FC), NearLine (NL), and Solid State Drive (SSD).

Procedure

1. Log in to the system using any role.
2. To display the total capacity for all physical disks of a specific type, enter the following command:
   showsys -space -devtype [FC|NL|SSD]

   Choose only one system type. For example, to show the capacity for all NearLine disks, enter
   showsys -space -devtype NL

Viewing physical disk capacity

Use the HPE 3PAR CLI to view capacity for all physical disks in your system. You can view the capacity for a single physical disk or view capacity of physical disks by device type. Device types include FC, NL, and SSD.

Displaying total physical disk capacity

The `showpd -space` provides disk capacity usage information in MB.

Procedure

1. Log in to the system using any role.
2. To view the total physical disk capacity of the system, enter the following command:
   showpd -space

   With no additional parameters, the command returns information about all drive types, separated into columns as shown in the following example. The `Free` column indicates the remaining space available for the physical disk.

```
cli% showpd -space
Id CagePos Type -State-    Size Volume  Spare    Free Unavail Failed
 0 0:0:0   FC   normal   139520  22272   8960  108288       0      0
 1 0:0:1   FC   normal   139520  13312   8704  117504       0      0
 2 0:0:2   FC   normal   139520  22272   8704  108544       0      0
 3 0:0:3   FC   normal   139520  13056   8704  117760       0      0
 4 0:1:0   SSD  normal    47360   1024      0   46336       0      0
 5 0:1:1   SSD  normal    47360   1024      0   46336       0      0
 6 0:1:2   SSD  normal    47360   1024      0   46336       0      0
 7 0:1:3   SSD  normal    47360   1024      0   46336       0      0
```

```
 8 0:9:0   FC   normal   139520  22272   8704  108544       0      0
 9 0:9:1   FC   normal   139520  13056   8704  117760       0      0
10 0:9:2   FC   normal   139520  22272   8704  108544       0      0
11 0:9:3   FC   normal   139520  12800   8704  118016       0      0
12 1:0:0   NL   normal  7150008  22528   8704  108288       0      0
13 1:0:1   NL   normal  7150008  13056   8704  117760       0      0
14 1:0:2   NL   normal  7150008   2272   8704  108544       0      0
15 1:0:3   NL   normal  7150008   3056   8704  117760       0      0
16 1:9:0   FC   normal   139520  22272   8704  108544       0      0
17 1:9:1   FC   normal   139520  13056   8704  117760       0      0
18 1:9:2   FC degraded   139520  22016   8704  108800       0      0
19 1:9:3   FC   normal   139520  13056   8704  117760       0      0
-------------------------------------------------------------------
20 total               2421760 286720 139520 1995520       0      0
```

3. To request information using specific column headings, enter the following command:

Total physical disk capacity response detail

The `showpd -space` command returns disk capacity usage information in MB.

The command response provides information using the following columns:

- `ID`—The physical disk ID.
- `CagePos`—The position of the physical disk within the drive cage. The format varies depending on the drive cage type.
- `Type`—The physical disk type. There are three types of physical disks: `FC`, `NL`, and `SSD`.
- `State`—The state of the physical disk. The following disk states can appear:
  - `normal`—The disk is normal.
  - `degraded`—The disk is not operating normally.
  - `new`—The disk is new and must be admitted with the `admitpd` command before it can be used.
  - `failed`—The disk has failed.

  Use `showpd -state` to display detailed state information.
- `Size`—The disk capacity.
- `Volume`—The volume capacity.
- `Spare`—The disk space reserved for spare chunklets.
- `Free`—The free space on the disk.
- `Unavail`—Unavailable disk space.
- `Failed`—Space in failed chunklets.

Displaying physical disk capacity by disk type

Use the showpd command with specific parameters to display the capacity of all physical disks of a specific type. Physical disk types are FC, NL, and SSD.

Procedure

1. Log in to the system using any role.
2. To display the total capacity for all physical disks of a specific type in a system, enter the following command:

   ```
   showpd -space -p -devtype [FC|NL|SSD]
   ```

   The command returns a result similar to the following example.

```
cli% showpd -space -p -devtype SSD
Id CagePos Type -State-    Size Volume  Spare    Free Unavail Failed
 4 0:1:0   SSD  normal    47360   1024      0   46336       0      0
 5 0:1:1   SSD  normal    47360   1024      0   46336       0      0
 6 0:1:2   SSD  normal    47360   1024      0   46336       0      0
 7 0:1:3   SSD  normal    47360   1024      0   46336       0      0
 ----------------------------------------------------------------------
 4 total                189440   4096      0  185344       0      0
```

Displaying the capacity of a specific physical disk

Use the `showpd -space <PD_ID>` command to display capacity information for a specific physical disk.

Procedure

1. Log in to the system using any role.
2. Enter the following command, where `<PD_ID>` is the physical disk identification.
   `showpd -space <PD_ID>`

   The command returns a result similar to the following example.

```
cli% showpd -space 0
Id CagePos Type -State-    Size Volume  Spare    Free Unavail Failed
 0 0:0:0   FC   normal   139520  22272   8960  108288       0      0

----------------------------------------------------------------------
1 total                 139520  22272   8960  108288       0      0
```

Managing spare chunklets

Use the HPE 3PAR CLI to view and manage spare chunklets.

Spare chunklets

The system setup and installation process often identifies some chunklets as spares. If a chunklet or disk becomes unavailable, the system moves data and reconstructs it on spare chunklets. The total amount of storage in a single drive magazine includes the spare storage associated with chunklets.

The system uses spare chunklets as follows:

1. The system loses a connection to physical disk or a physical disk fails.

   As data continues to come in for the unavailable disk, the system automatically routes the data to a Logical Disk (LD) set aside for logging. Writing to the logging LD continues until the physical disk

comes back online or until the time limit for logging expires. Allocation of logging disk space occurs during system setup.

2. If the time limit for logging expires, or if the logging LD becomes full, relocation of chunklets on the physical disk to other chunklets, whether free chunklets or allocated spares, starts automatically. Free chunklets are chunklets that are not used by the system.
3. The system generates an alert when there are no more free or spare chunklets available. Automatic relocation no longer occurs, and some data redundancy can be lost.

Additional chunklet details include:

- For automatic relocations, the system uses up to a maximum of one disk worth of chunklets per system node.
- Local chunklets are chunklets on disks owned by the node that also owns the LD for the relocated chunklet.

Spare chunklet command output

- The `showspare` command displays information about chunklets in the system. Chunklets are can be reserved for spares or can be previously free chunklets selected for spares by the system.

  The command response returns information using the following columns.

  `PdId` – Physical disk on which the chunklets reside.
- `Chnk` – Position on the physical disk of the spare chunklets.
- `LdName` – Name of the LD that is using the spare chunklet.
- `LdCh` – Position of the chunklet on the LD.
- `State` – State of the chunklet as identified by the kernel. This value can be `normal`, `none` (the chunklet has not been used by any LD), or `failed`.
- `Usage` – Shows whether the spare chunklet is in use by an LD. Values can be:
  - `available` – Chunklet is available for use as a spare.
  - `ld` – Chunklet is in use by an LD.
  - `relsrc` – Relocation source. The data has been moved to another chunklet.
  - `reltgt` – Relocation target. The data in the chunklet has been moved from another spare chunklet.
  - `abtrel` – Abort relocation. The system cancels the chunklet relocation operation.
  - `cmprel` – Completing relocation. The system is in the final phase of completing the chunklet relocation.
- `Media` – Status of the physical disk media for the chunklet. The value is `failed` if the media has encountered errors and is unavailable, or `valid` if it is available for use.
- `Sp` – Spare status of the chunklet. `Y` indicates that the chunklet is used for spare, `N` indicates that it is not.
- `Cl` – Cleaning status of the chunklet. Indicates whether the chunklet is in the process of being reinitialized for use, as happens when a physical disk is added to the system, or an LD is removed. The value can be `Y` (cleaned), `N` (not cleaned), or `Cg` (being cleaned now).

- `From` – Initial location of the chunklet before relocation. The format is `PD:CH`, where `PD` is the physical disk ID and `CH` is the chunklet ID.
- `To` – Destination location of the chunklet during relocation in the format `PD:CH`.

Viewing spare chunklets

Procedure

1. Log in to the system using any role.
2. To display information about all spare chunklets, use the following command.
   showspare

   The command returns a result similar to the following example.

```
%cli showspare
PdId Chnk LdName          LdCh State     Usage     Media   Sp Cl From    To
23   0    ----            ---  normal    available valid   Y  Y  ---     ---
23   1    sales1.0         2   normal    ld        valid   Y  Y  ---     ---
```

   The output for an available chunklet indicates that the chunklet usage is `available`, and the columns relating to the LD show only dashes.

   The output for a spare chunklet in use includes the `LdName` and the position of the chunklet on the LD.

Logical disks and chunklet initialization

After deleting logical disks, the underlying chunklets must be initialized before their space is available to build logical disks. The initialization process for chunklets generally takes about one minute per 1 GB chunklet. To see chunklets that are currently in the process of being initialized, issue the `showpd -c` command. Chunklets that are uninitialized are listed in the `Uninit` column.

Recovering failed RAID sets

Failed RAID sets can prevent chunklet relocation, which prevents `servicemag` operations from completing. Recover failed RAID sets before running `servicemag` operations.

Procedure

1. Log in to the system as `Super` or `Service` user, or as any user with `ld_check` permission.
2. To recover data from a failed RAID set, enter the following command:
   checkld -y *<LD_name>* -rs *<setnumber>* -recover -fd:-fp

   Parameters include:

   -y

   Modify errors so that they become valid. Required when using the `-recover` option.

   <LD_name>

   Specify the name of the LD that contains the failed RAID set.

   -rs *<setnumber>*

   Specify the RAID set number within the LD to check, fix, and recover.

-recover -fd:-fp

Specify the chunklet to recover by physical disk and chunklet position.

Viewing hardware inventory

Use the `showinventory` command to display information about all the hardware components in the system.

Procedure

1. Log in to the system using any role.
2. To view information about all hardware components, enter the following command:
   showinventory

   The command output includes the following sections:

   - Nodes
   - PCI Cards
   - CPUs
   - Internal Drives
   - Physical Memory
   - Power Supplies
   - Battery
   - Node Fans
   - Port Inventory
   - Cage Inventory
   - Disk Inventory

3. To view additional information about hardware components, such as serial number, spare part number, and so on, enter the following command:
   showinventory -svc

   The command output includes the following information:

   - Part number
   - Serial number
   - Assembly part number
   - Assembly serial number
   - Spare part number
   - Model name
   - Revision

Data encryption

HPE 3PAR encrypted storage systems provide data encryption by using self-encrypting drives (SEDs) with a Local Key Manager (LKM) or Enterprise Key Manager (EKM).

Data encryption prevents data exposure that might result from the loss of physical control of disk drives when disk drives are:

- Decommissioned at their end of life.
- Returned for warranty or repair.
- Lost or stolen.

HPE 3PAR Data Encryption uses SED technology to encrypt all data on the physical drives and prevent unauthorized access to data-at-rest (DAR). When encryption is enabled, the SED will lock when power is removed, and it will not be unlocked until the matching key from the HPE 3PAR StoreServ Storage system is used to unlock it.

SEDs contain special firmware and an application-specific integrated circuit (ASIC) that provides encryption. Each SED has a number of bands that control access to different areas of the drive.

Each band has an internal encryption key that is not exposed outside of the drive itself. This encryption key is always used to encrypt and decrypt all data stored on that band. All data encryption is handled at the physical disk layer. System features, such as thin provisioning and dynamic optimization, work independently of encryption.

Each band has a single authentication key that controls access to data on the band. In the HPE 3PAR StoreServ Storage data-encryption implementation, the entire disk is in one band. Access to data is controlled by setting the authentication key, which locks and unlocks the drive.

The LKM, which is part of the HPE 3PAR OS that runs on each node in a cluster, maintains the authentication key. You must back up and protect the keystore file; Hewlett Packard Enterprise does not have access to the key.

All drives in the same array will have the same authentication key. The disks become locked whenever they lose power, which guarantees that any disk removed from an HPE 3PAR StoreServ Storage will not be accessible except in its original array. When the drive is unlocked, all I/O to the drive behaves exactly as it would on a non-SED, and encryption and decryption happen at full interface speed, without data delays.

There is a minimal delay for booting (since each drive must be unlocked before the system becomes operational) and for data encryption management functions (since each disk must be updated whenever keys are changed on the system). Each of these operations takes up to 3 seconds per disk, but happens in several threads. On a system with 160 disks, for example, enabling encryption takes about 30 seconds, and booting takes an additional 5 seconds. Rekeying under a light load takes about 15 seconds.

CAUTION: Keep the encryption key file and password safe. If you lose the encryption key and the HPE 3PAR StoreServ Storage system is still functioning, you can always perform another backup of the encryption key file. However, if you lose the encryption key file or the password, and if the HPE 3PAR StoreServ Storage system then fails, the HPE 3PAR StoreServ Storage system will be unable to restore access to data. Ensure that backup copies of the latest encryption key file are kept and that the password is known.

If you mistakenly delete the key and all its replicas from an EKM, you must back up all data on the array, and then wipe and restore the data. Otherwise, all data will be lost during the first power failure.

The importance of keeping the encryption key file and password safe cannot be overstated. Hewlett Packard Enterprise does not have access to the encryption key or password.

Different arrays need separate backups, although the same password can be applied.

The SED Datastore provides an open interface for authentication key management. Datastore tracks the serial number of the array that owns each SED, which disallows SEDs from being used in other systems.

NOTE: If you use an external key manager and use all Federal Information Processing Standard (FIPS) compliant drives, then your system will meet the requirements for FIPS-validated data-at-rest encryption.

Data encryption—supported configurations

HPE 3PAR StoreServ Storage

HPE 3PAR StoreServ Storage systems support data encryption. They can be ordered with the HPE 3PAR Data Encryption or Data-at-Rest Encryption Software license and SEDs that provide data encryption.

NOTE: A nonencrypting array cannot be converted to an encrypting array. Hewlett Packard Enterprise does not support mixed configurations of encrypted and nonencrypted drives. The HPE 3PAR StoreServ Storage system must be purchased new, with only SED drives installed.

HPE 3PAR OS

HPE 3PAR OS 3.2.1 or later

HPE 3PAR Peer Motion and HPE 3PAR Remote Copy are supported on data-encryption enabled systems. If the data-encryption state of the target system does not match data-encryption state of the primary system when you are setting up HPE 3PAR Peer Motion or HPE 3PAR Remote Copy, a warning appears that must be acknowledged before you can continue setting up. However, you will not be prevented from replicating encrypted data to a nonencrypting system.

Self-Encrypting drives

SEDs are solid-state or hard disk drives.

More information:

Activating a software license on page 13

Data encryption licensing

An HPE 3PAR Data Encryption license is required to enable data encryption. This system-based encryption license key must be explicitly set by using the `setlicense` command.

More information:

Setting a data encryption license on page 170

Viewing a data encryption license on page 170

Data encryption restrictions on page 170

Setting a data encryption license

Procedure

To set the data encryption license, issue the `setlicense` command.

For more information about using the `setlicense` command, see the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Viewing a data encryption license

Procedure

To view the license using the HPE 3PAR CLI, issue the `showlicense` command:

```
cli% showlicense
License key was generated on Thu May 23 16:29:37 2013

License features currently enabled:
...
Data Encryption
...
```

Data encryption restrictions

- Data encryption is available only with the purchase of a new HPE 3PAR StoreServ Storage system.
- Data encryption can only be enabled on a StoreServ running HPE 3PAR OS 3.1.2 MU2 and later.
- Data encryption does not support mixed configurations of SEDs and non-SEDs; the array must contain only SEDs.
- A single authentication key is used to unlock all the drives in the array for reading and writing to media.
- Authentication keys are managed using an LKM or EKM.
- The encryption-related activities are recorded in the HPE 3PAR OS `eventlog`, but the filename and password contents are not. For example:

```
Time     : 2013-05-28 13:52:20 PDT
Severity : Informational
Type     : CLI command executed
Message  : {3parsvc super all {{0 8}} -1 127.0.0.1 9534} {controlencryption enable_start <password> <secret>} {}

Message  : {3paradm super all {{0 8}} -1 16.94.229.83 9706} {controlencryption status_details} {}

Message  : {3paradm super all {{0 8}} -1 16.94.229.83 30353} {controlencryption rekey_finish} {}
```

- A user with `super` rights is responsible for physical security of a backup file and for remembering the password.
- Enable encryption before you write data to the array. However, you can enable encryption any time after data is written. If encryption is enabled after data has been written to the array, all data stored on the array is still accessible. The only change is the array is secure after encryption is enabled.

Self-encrypting drives

The following topics cover aspects of administration of Self-encrypting drives (SED).

Taking ownership on page 171
Enabling data encryption on page 172
Backing up the authentication key file on page 173
Restoring the key file on page 173
Changing the authentication key on page 173
Using external key management servers on page 174
Showing data encryption status on page 174
Data encryption states and status on page 175
Failed disk drive replacement on page 176
Upgrading an SED with new firmware on page 176
Removing an existing SED on page 176
Data encryption commands on page 177

Taking ownership

Taking ownership in the context of self-encrypting disks means changing the authentication key and locking state of an SED from the default settings so that the data on the drive is secure.

Procedure

- To enable an SED, issue the `admitpd [-nold] [-nopatch] [-f] [<WWN>...]` command, where:
  - `-nold` specifies that the physical disk (as identified by the WWN specifier) will not be used for LD allocation. Specify the `-nold` option when adding a physical disk to replace a failed disk whose chunklets were moved to spare space. Including the `-nold` option prevents the allocation of the newly added physical disk and allows chunklets to be moved back to the new disk. After chunklets have been moved back to the new disk, the administrator can allow LDs to be allocated again by issuing the `setpd` command.
  - `-nopatch` specifies that the check for drive table update packages will be suppressed. Drive table patch updates will be identified and installed by the `admitpd` command unless this option is specified.
  - `-f` specifies that the command is forced and the user will not be prompted for confirmation when attempting to admit disks from other systems.
  - `<WWN>` indicates the WWNs of the physical disks to be admitted. If WWNs are specified, only the specified physical disks are admitted. Otherwise, all available physical disks are admitted.

  For example:

```
cli% admitpd
20 disks admitted
```

  When disks are admitted to the system, the system manager checks to see if they are SEDs. If they are, a cryptographic erasure is performed on the new drive, and ownership is taken (providing encryption was already enabled).

  For more information about the `admitpd` command, see the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Enabling data encryption

Because the key file must be saved on the local disk (a customer PC or server), encryption must be enabled not from an SSH connection, but from one of the following:

- HPE 3PAR OS CLI client running on a PC or server, using the HPE 3PAR CLI
- HPE 3PAR SSMC

When encryption is initially enabled, the system verifies that:

- The system is licensed for data encryption.
- All drives in the system are SEDs.
- There are no degraded or failed drives in the system.

If all these conditions are met, the system generates an authentication key and returns the backed-up key file.

You will be prompted twice for the password for the backup file. Backup is part of the encryption-enabling operation.

After the backup of the authentication key is acknowledged, the key is set on all the drives in the system.

For about the `controlencryption` command, see the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

More information:

Enabling data encryption using an SSH connection on page 172

Enabling data encryption using the 3PAR CLI on page 172

Enabling data encryption using Linux, HP-UX, AIX, or Solaris on page 173

Enabling data encryption using the Microsoft Windows CLI on page 173

Enabling data encryption using the SSMC

To enable data encryption using the SSMC, see the *HPE 3PAR StoreServ Storage Management Console Administrator Guide*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Enabling data encryption using an SSH connection

Procedure

To enable encryption using an SSH connection, name the file `stdin/stdout`.

Enabling data encryption using the 3PAR CLI

Procedure

Issue the following command:

```
cli% controlencryption enable <backup filename>
```

Enabling data encryption using Linux, HP-UX, AIX, or Solaris

Procedure

Issue the following command:

```
# controlencryption enable backupfile
```

Enabling data encryption using the Microsoft Windows CLI

Procedure

Issue the following command:

```
C:\>controlencryption enable C:\\backupfile
```

Backing up the authentication key file

The keystore must be backed up to prevent total loss of data. You will be prompted twice for a password for the backup file. The same password must be supplied on restore.

Procedure

Issue the `controlencryption backup <filename>` command. For example:

```
cli% controlencryption backup backup1
```

Restoring the key file

Restoration of a key file is necessary only if there is a catastrophic problem and the key files on all nodes are destroyed or corrupted. Restore the key file from an external source to the controller nodes in the HPE 3PAR StoreServ Storage system.

Procedure

Issue the `controlencryption restore <filename>` command. For example:

```
cli% controlencryption restore backup1
```

Changing the authentication key

You can change the authentication key on an array at any time. You can also save and back up a new copy of the authentication key file at any time. If a recovery operation requires restoration of the key file, the correct key file must be available; otherwise, the data will be lost.

Procedure

To change the authentication key and back up the authentication key file, issue the `controlencryption rekey` command.

Using external key management servers

Use the `controlencryption` command to enable and configure the HPE 3PAR StoreServ Storage system to use one or more EKM servers.

Procedure

- To create or modify a list of external key management servers used to manage your encryption keys, issue the `controlencryption setekm {-setserver|-addserver|-removeserver} <hostname|IP> <filename> -port <port> -ekmuser <username> -ekmpass` command where:
  - `-setserver` specifies that a list of EKMs is used to manage encryption keys.
  - `-addserver` specifies EKMs to be added to the EKM list.
  - `-removeserver` specifies EKMs to be removed from the EKM list.
  - `<hostname|IP>` specifies the host name or IP address of the EKMs. You can specify more than one host name or IP address with a comma-separated list.
  - `<filename>` specifies the backup file name.

    CAUTION: When running backups with an EKM, the backup file name is only used for configuration information. The file is required to recover from a disaster, but the encryption keys are only stored on the EKM and the keys must be backed up independently.

  - `<port>` specifies the port used to communicate with the EKMs.
  - `<username>` specifies the EKM user name used to communicate with the EKMs.
  - `-ekmpass` specifies that the HPE 3PAR StoreServ Storage system issue a prompt for the EKM user name password.

Showing data encryption status

Procedure

- To see the status of data encryption, issue the following command:

```
controlencryption status
```

Example:

```
cli% controlencryption status
Licensed Enabled BackupSaved State  SeqNum
yes      yes     yes         normal      2
cli% controlencryption status -d
```

```
Licensed Enabled BackupSaved State  SeqNum Non-SEDs FailedDisks
yes      yes     yes         normal      2        0           0
```

- To show disks that are failed or that do not support data encryption, issue the `controlencryption status -d` command to show details on encryption status.

Data encryption states and status

Data encryption states (as seen under the `State` column in the example in **Showing data encryption status**) are shown in **Table 7: Data encryption states** on page 175.

Table 7: Data encryption states

System Encryption State	Description
`initializing`	The data-encryption service is in the process of starting up.
`normal`	Data encryption is in a normal state.
`recovery_needed`	Rerun the previous operation after addressing the reason that the previous operation failed. (A failed drive is the most likely cause.)
`in_progress`	An encryption operation is in progress. A task is generated for the associated operations; the task can be reviewed in Task Manager.

Data encryption status information is shown in **Table 8: Data encryption status** on page 175.

Table 8: Data encryption status

Status Information	Description
`BackupSaved`	`Yes` if a backup has been saved.`No` if a backup has not been saved and one is required.
`Licensed`	The system is licensed with HPE 3PAR Data Encryption or Data-at-Rest Encryption software license, but data encryption is not necessarily enabled.
`Enabled`	Data encryption is enabled.

Table Continued

Status Information	Description
Non-SEDs	The number of drives that are not SEDs. If this number is nonzero, encryption operations cannot complete until these drives are removed from the system, as an encrypted system requires all drives to be self-encrypting.
FailedDisks	Number of disks that are not usable. If this number is nonzero, encryption operations cannot be completed until these drives are removed from the system.

Failed disk drive replacement

The drive-replacement feature and the `servicemag` command function as they do in a system without data encryption. With data encryption, the old or failed drive will be locked when it is removed from the system. When the system detects a new drive, the drive will be cryptographically erased before it is admitted into the system.

For more information about the `servicemag` command, see the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Upgrading an SED with new firmware

Upgrades to the firmware of SEDs are performed as they are for disks that are not self-encrypting, except that SED drives have different firmware. Typically, the upgrade is performed automatically for users.

Procedure

- To upgrade a SED, issue the `upgradepd [-f] [-skiptest] {-a | -w <WWN>... | <PD_ID>...}` command, where:
  - `-f` specifies that the upgrade to the PD firmware will be performed without requiring confirmation.
  - `-skiptest` specifies that the ten-second diagnostic test normally completed after each PD upgrade is skipped.
  - `-a` specifies that all PDs with valid IDs and whose firmware is not current are upgraded. If this option is not specified, then either the `-w <WWN>` option or the `<PD_ID>` specifier must be used.
  - `-w <WWN>`specifies that the firmware of either one or more PDs, identified by their WWNs, is upgraded. If this option is not specified, then either the `-a` option or the `<PD_ID>` specifier must be used.
  - `<PD_ID>` specifies that the firmware of one or more PDs identified by their IDs (`PD_ID`) will be upgraded. If this specifier is not used, then the `-a` option or the `-w <WWN>` option must be used.

If the disk is locked, it will be unlocked. The digitally signed firmware will be downloaded.

Removing an existing SED

After the sysmgr dismisses the drive, it is cryptographically erased (provided data encryption was enabled).

Procedure

To remove the physical disk definitions from a system, issue the `dismisspd <PD_ID>...`, where `<PD_ID>...` specifies the PDs, identified by integers, to be removed. For example, to dismiss a PD with ID 1, issue the following command:

```
cli% dismisspd 1
```

For more information about the `dismisspd` command, see the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Data encryption commands

Table 9: Data encryption commands

Command	Description
`controlencryption enable`	Enable data encryption on SEDs. Back up the authentication key file.
`controlencryption backup`	Back up the authentication key file.
`controlencryption restore`	Restore the key file from an external source to the controller nodes in the HPE 3PAR StoreServ Storage system. Restoration from an external source is needed only if there is a catastrophic problem and the key files on all nodes are destroyed or corrupted.
`controlencryption status`	Show the data encryption status. (See **Showing data encryption status** on page 174.)
`controlencryption rekey`	Change the authentication key. Back up the authentication key file.
`dismisspd`	Remove a drive from the system. This command also performs a cryptographic erase operation on the drive.
`servicemag`	Used to replace drives.

Event and alert management

The 3PAR system tracks system events internally. The system displays events or alerts that require action on the part of the system administrator. System event logs contain all event and alert conditions, so you can view the day-to-day health of the system.

Checking system health

The `checkhealth` command checks the status of system hardware and software components, and reports any issues. You can specify which components you want the `checkhealth` command to examine, or check all system components.

Procedure

1. Log in to the system using any role.

   Using these commands with Edit and Browse roles does not evaluate the system as fully as using Super and Service roles, and only evaluates items available to the domains in which the user has privileges.

2. To view a status summary of all system components, enter the following command: the command to view a status summary of all system components.
   `checkhealth`

3. To check the health of specific hardware and software components, enter the following command: command, where `<component>` is the component, or list of components, you want to check.
   `checkhealth <component>`

4. To view a list of all system components, enter the following command:
   `checkhealth -list`

System status requirements for health check

With HPE 3PAR OS 3.1.2 and later, the `checkhealth` command requires a minimum number of drives per controller node. The `checkhealth` returns an error if your system does not meet the requirements shown in the following table.

Table 10: Minimum drives per Controller Node

Drive type	Minimum Drives per each Controller Node	Minimum Drives per Node Pair
RAID 6 (default) NL	6	12
Three-way RAID1 for FC or SSD	3	6
RAID 5 for FC or SSD	4	8
Two-way RAID1 for SSD with Flash Cache	2 [1]	4

[1] When an active-active SSD is shown, 2 Drives per Node Pair, both Controller Nodes can create LDs on each SSD.

System alert configuration

The system generates most alerts automatically, without any need for user configuration. However, when you create CPGs and virtual volumes, certain settings can also trigger alerts.

Setting growth increment limits related to CPGs can trigger events when the growth exceeds those limits. Virtual volumes capable of allocating space on demand are also user-configurable and can trigger alerts.

For details about CPG creation precautions and on-demand virtual volume space allocation, see *HPE 3PAR StoreServ Storage Concepts Guide*, available from the Hewlett Packard Enterprise Information Library.

The raw space alert is a global threshold that you can set for the storage system. This alert notifies administrators when available space on the system falls below a user-specified level. For details, see *Setting the raw threshold space alert.*

More information

Setting the raw space threshold alert on page 180

Monitoring and managing alerts

Alerts are system events that require immediate attention. A single event can trigger an alert, as can a combination of events or repeated occurrences of the same event. You can use the following tasks to monitor and manage alerts:

Procedure

1. **View alerts**
2. **Set an alert state**
3. **Remove an alert**
4. **System alert configuration**
5. **Set the raw threshold space alert**

Viewing alerts

Procedure

1. Log in to the system using any role.
2. To display all new system alerts, enter the following command:
   showalert

   Displays all alerts in the `New` state.

   For information about all `showalert` options, see *HPE 3PAR Command Line Interface Reference*, available from the Hewlett Packard Enterprise Information Library.

Setting an alert state

Prerequisites

Make note of the alert ID if you are setting the state for a particular alert.

Procedure

1. Log in to the system as Super or Service user, or with as any user assigned the `alert_set` role.
2. To change the state of a specific alert, use the following command syntax:
   `setalert [new|fixed|ack] [<alert_ID> ... | -a]`
3. Enter only one status – `new`, `fixed` or acknowledged (`ack`).
4. Use either the `<alert_ID>` or the `-a` option.

   Separate multiple alert IDs (up to 99) with a space.

   If there are no specific alert IDs, enter `-a` to change all alerts to the selected status.

Removing an alert

Prerequisites

Make note of the alert ID for the alert you want to remove.

Requires access to all domains.

Procedure

1. Log in to the system as `Super` or `Service` user, or as any user with the `alert_remove` right.
2. Use the following command syntax:
   `removealert [<alert_ID>... | -a]`
3. Use either the `<alert_ID>` or the `-a` option.

   Separate multiple alert IDs (up to 99) with a space.

   To remove all alerts (not recommended), use the `-a` option.

Setting the raw space threshold alert

Use the `setsys` command to set system-wide parameters such as the raw space alert.

Prerequisites

The user configurable space alert threshold is 10 to 100000 GiB for Fast Class type drives.

When the total space on the available chunklets (both clean and unclean) for the drive type falls below the specified value (10 to 100000 GiB), the system returns one of the four system standard alert levels.

The used space system standard alert levels are at 50%, 75%, 85%, and 95%. The supplied space alert threshold is converted from GiB free to percentage used. If any of the system standard alert levels are below this computed value, they will be suppressed. A value of 0 will cancel the user-specified alert threshold and revert back to the system standard alerts of 50%, 75%, 85%, and 95%. To minimize the alerts, use the specified value of 10 (GiB).

Procedure

1. Log in to the system as `Super` or `Service` user, or as any user with the `sys_set` role.
2. To set a raw space alert for a storage system with NearLine (NL) drives, enter the following command.
   `setsys RawSpaceAlertNL <value>`
3. To set a raw space alert for a storage system with FC drives, issue the following command.

```
setsys RawSpaceAlertFC <value>
```

4. To set a raw space alert for a storage system with SSDs, issue the following command.
   ```
   setsys RawSpaceAlertSSD <value>
   ```

For each of these commands, `<threshold>` is an integer from 10 to 100,000 that represents the total available space on the system in gigabytes. A value of 0 enables the default raw space alerts of 50%, 75%, 85%, and 95%.

Monitoring and managing the event logs

The system generates an event log automatically to log system event and alerts. The system also maintains up to 11 copies of the event log to maintain a history of past events and alerts. You can use the CLI to view and manage event logs.

Procedure

1. **View the event logs**
2. **Display the current event log size**
3. **Change the default event log size**

Default event logs and usage

The event logs contain information about all notable occurrences on the system. System events include all system-generated alerts and alerts you have marked as acknowledged or fixed.

The HPE 3PAR StoreServ Storage system reserves 4 MB for event log entries, and maintains 11 versions. Versions include the current event log, for writing new events to the log, and the past 10 versions that maintain a record of past events. When the system has 11 versions, it automatically removes the oldest event log.

Viewing the event log

Procedure

1. Log in to the system using any role.
2. To view the events log, enter the following command:
   `showeventlog`

   You can refine the `showeventlog` command to display events occurring before or after a specified time, within a specified time period, or that match a specified pattern.

   For complete information on the event log display options, see *HPE 3PAR Command Line Interface Reference*, available from the Hewlett Packard Enterprise Information Library.

Displaying the current event log size

Procedure

1. Log in to the system using any role.
2. To display the current event log size, enter the following command:
   `showsys -param`

   The following example shows the `EventLogSize` at 4M.

```
cli% showsys -param

System parameters from configured settings
 ----Parameter----- ---Value----
RawSpaceAlertFC : 800
RawSpaceAlertNL : 0
RemoteSyslog : 1
RemoteSyslogHost : 192.168.6.15
SparingAlgorithm : Minimal
CopySpaceReclaim : 0
EventLogSize : 4M
VVRetentionTimeMax : 336 Hours
```

Changing the default event log size

Changing the event log size creates an event log entry. The default log size is 4 MB, and there are 11 total files (44 MB). Increasing this value increases space consumption to accommodate the larger file size.

Procedure

1. Log in to the system as `Super` or `Service` user, or as any user with the `sys_set` role.
2. To change the size of the event logs, enter the following command:
   `setsys EventLogSize <value>`

   Use a value in the range of 0.5 MiB to 10 MiB. Defaults to 4.

Exporting the event log to remote syslog servers

For additional information about the `showsys` and `setsys` commands used here, see *HPE 3PAR Command Line Interface Reference Guide*, available from the Hewlett Packard Enterprise Information Library.

Procedure

1. Log in to the system using any role.
2. To view the status of the remote syslog servers, enter the following command:
   `showsys -d`

```
cli% showsys -d

--------Remote Syslog Status--------
Active              :              1
General Server      :   15.186.67.24
General Connection  :            TCP
Security Server     :        0.0.0.0
Security Connection :           None
...
```

3. To send all non-debug events to the syslog server (general mechanism), enter the following command:
   `setsys RemoteSyslogHost {{<hostname>|<IPaddr>}[:<port>]`

   Use a comma to separate multiple server specifications (up to three).

   When configuring the destination with both the IPv6 address and port, you must enclose the IPv6 address in square brackets.
4. To send all security-related events to the syslog server for auditing purposes (security mechanism), enter the following command:

setsys RemoteSyslogSecurityHost {{<hostname>|<IPaddr>}[:<port>]

When configuring the destination with both the IPv6 address and port, you must enclose the IPv6 address in square brackets.

Using TLS encryption to export event logs

You can use both the general and security `syslog` mechanisms to send event logs over a TLS encryption. See **Exporting the event log to remote syslog servers** on page 182.

- The **General** mechanism uses the `syslog_gen_client` and `syslog_gen_server` certificate services.
- The **Security** mechanism uses the `syslog_sec_client` and `syslog_sec_server` certificate services.

Procedure

1. Import the Certificate Authority for the `syslog_<gen|sec>_server` service.

   See **Importing SSL certificates** on page 45 for more information.

2. (Optional) For additional security, enable Mutual Authentication by configuring the HPE 3PAR StoreServ Storage system to present a client certificate to the remote `syslog` server. Follow the steps in **Using an SSL certificate for an array service** on page 47 for an array service for the `syslog_<gen|sec>_client` service.
3. Refresh the `syslog` connections.

   a. Run `setsys RemoteSyslog 0`.

   b. Then run `setsys RemoteSyslog 1`.

Disabling event log exporting

Procedure

1. Log in to the system as `Super` or `Service` user, or as any user with the `set_sys` role.
2. To disable event log exporting to external syslog servers, enter the following command:
   setsys RemoteSyslog 0

Managing stopped logical disks

When the system is powered on, a physical disk might be unavailable. The system registers the state of these unavailable disks as **Missing**. The system manager does not immediately start Logical Disks (LDs) that have chunklets on these missing physical disks, so some LDs remain in the **Stopped** state.

You can use the `showpd` and `showld` CLI commands to view and manage these physical and logical disks.

For a complete list of options available for the `showpd` and `showld` commands, see HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available from the Hewlett Packard Enterprise Information Library.

Procedure

1. **Display the state of a physical disk**
2. **Display the state of a logical disk**
3. **Start a data-complete logical disk**
4. **View a preserved data logical disk**

Displaying the state of a physical disk

Procedure

1. Log in to the system with any role.
2. To display the state of all physical disks, enter the following command:
   showpd

   The default response lists the physical disks in the system using the following column headings:

   ```
   Id CagePos Type RPM State Size_MB Free_MB Port_A0 Port_B0 Port_A1 Port_B1 Capacity
   ```
3. To display the state of a particular physical disk, use the physical disk ID and enter the following command:
   showpd *<PD_ID>*

Displaying logical disk state

The `showld` command displays configuration information about logical disks in the system.

Procedure

1. Log in to the system with any role.
2. To display the state of all LDs in a system, enter the following command:
   `showld`

```
cli% showld
Id     Name                                RAID     -Detailed_State-     Own
SizeMB     UsedMB     Use     Lgct     LgId WThru MapV
2  .srdata.usr.0      1   normal            0/1  40960   40960   C,V   0    ---   N
Y
3  .srdata.usr.1      1   normal            1/0  40960   40960   C,V   0    ---   N
Y
0  admin.usr.0              1   normal            0/1  5120    5120    V     0    ---
N     Y
1  admin.usr.1              1   normal            1/0  5120    5120    V     0    ---
N     Y

8  log0.0                                  1   normal            0/-  20480   0
log   0    ---   Y     N
9  log1.0                                  1   normal            1/-  20480   0
log   0    ---   Y     N
10 pdsld0.0                       1   normal            1/0  1024    0       P,F   0
---   Y     N
11 pdsld0.1                       1   normal            0/1  4096    0       P     0
---   Y     N
12 pdsld0.2                       1   normal            1/0  4096    0       P     0
---   Y     N
```

3. To display the state of a particular logical disk, use the logical disk ID and enter the following command:

```
showld <LD_ID>
```

Starting a data-complete logical disk

At system power on, if the Logical Disk is data-complete, but missing three or fewer physical disks, the LDs automatically start after about five minutes. If there are more than four physical disks missing, the LDs are not started automatically.

The system manager begins reconstructing the missing mirrored data, and automatically relocates chunklets from the missing physical disks to free space or spare space.

Prerequisites

Requires access to all domains.

Procedure

1. Log in to the system as `Super` or `Service` user, or as any user with `ld_start` permission.
2. To start all data-complete logical disks, enter the following command:
   `startld`
3. To start one or more data-complete logical disks, use the logical disk ID (up to 31 characters) and enter the following command:
   `startld <LD_ID>`

Starting a logical disk when physical disks are missing

The system manager does not immediately start Logical Disks (LDs) that have chunklets on missing physical disks, so some LDs remain in the **Stopped** state.

Procedure

1. Log in to the system using the Super or Service user, or as any user with `ld_start` permission.
2. To force the logical disk to start, enter the following command
   `startld -ovrd`

Preserved data logical disk status and repair

At the time of storage system installation and configuration, the system automatically creates a Preserved Data Logical Disk. When the system holds data in cache and cannot write that data to the destination disk for any reason, it saves the data to the preserved data LD.

The data written to the preserved data LD is typically created due to a temporary loss of availability of disks. The situation corrects itself after the disks become available again. When the destination LDs become available again, the system automatically plays back the preserved data by writing it from the preserved data LDs to the destination LDs.

If you notice that the preserved data LD has data saved for a long time, you can check the state of the PDs to determine which are unavailable.

Making these disks available again requires corrective action. If you see that data is persistently saved to the preserved data LD, contact your service provider for technical support and services.

Write-back cache

Write-back cache is a storage methodology that writes data into the cache. The operating system sends confirmation of the written data back to the host by the operating system before writing (flushing) the data to external storage. The advantage of this industry-standard practice is increased I/O performance. Flushing occurs through internal operating system algorithms.

During unexpected events, such as power loss, the HPE 3PAR StoreServ Storage saves data in cache and restores the data using internal software. Write-through cache confirms I/O completion to the host only after the OS flushes the data to external storage, to ensure that the data is safely written to the external storage.

When the array is in a write-back cache state, data in cache is protected by a hardware design that leverages battery backup if an array suffers power loss. This is true regardless of single-node or all nodes online state.

Write-back cache behavior and management

Prior to HPE 3PAR OS 3.3.1, the HPE 3PAR StoreServ Storage system would enter write-through cache mode whenever it entered a single-node state. Write-back cache offers improved performance when in a single-node state.

Write-back cache is now supported on the following HPE 3PAR StoreServ Storage series running 3.3.1 or later:

- **HPE 3PAR StoreServ 8000 series**
- **HPE 3PAR StoreServ 9000 series**
- **HPE 3PAR StoreServ 20000 series**

By default, a system that enters a single node state does not stay in write-back cache state, especially during a two node system upgrade.

The `setsys` command supports two subcommands that control write-back cache behavior:

`AllowWrtbackUpgrade <value>`

The subcommand allows the system to continue caching when in a single node state during an upgrade, up to the specified number of days. This behavior does not include single node states that occur during a nonupgrade. The *<value>* is in the range of 0 to 7 days. The default value is 7 and write cache is enabled for that many days. Setting the value to 0 sets all LDs to transition into the write-through mode.

For example:

```
# setsys AllowWrtbackUpgrade 0
```

`AllowWrtbackSingleNode <value>`

Allows the system to continue caching when in a single node state up to the specified number of days. After expiration, all LDs become write-through, except single node states that occur as a result of an upgrade. The *<value>* is in the range of 0 to 7 days. The default value is 7 and write cache is enabled for that many days. Setting the value to 0 sets all LDs to transition into the write-through mode.

For example:

```
# setsys AllowWrtbackSingleNode 3
```

NOTE: In a single node scenario, any of the above commands can be used to the disable the cache and toggle the default state. Setting the value to 0 disables the cache in a single node state.

Statistics and histograms

The HPE 3PAR CLI allows you to view aspects of system performance over time. You can view statistics for the performance of VLUNs, virtual volumes, ports, physical disks, data cache memory, and CPU usage, using variations of the `stat` command.

In addition, the HPE 3PAR CLI provides service time and I/O size histograms for system resources such as chunklets, logical and physical disks, ports, VLUNs, and virtual volumes.

Viewing statistics

The HPE HPE 3PAR CLI commands provide access to performance statistics. To further refine any of these statistics, see, *HPE 3PAR Command Line Interface Reference*.

You can view performance statistics for the following:

Procedure

1. **Physical Disks**
2. **Ports**
3. **VLUNs**
4. **Virtual volumes**
5. **Data cache memory**
6. **Flash cache and data cache**
7. **Processor usage**
8. **Web Services API usage**

Viewing statistics for physical disks

Procedure

1. Log in to the system using any role.
2. To view physical disk statistics, enter the following command:
   `statpd`

   You can further refine data to display specific physical disk statistics, including the following:

   `-w <WWN>`

   Displays statistics for a particular PD identified by WWN

   `-nodes <node_list>`

   Displays statistics for specified nodes and physical disks connected to those nodes.

   `-slots <slot_list>`

   Displays statistics for specified PCI slots and physical disks connected to those PCI slots.

   `-ports <port_list>`

   Displays statistics for specified ports and physical disks connected to those ports.

-rpm *<number>*

Displays statistics for discs matching the specified speed. The number does not represent a rotational speed for drives without spinning media (SSD). The number is a rough estimate of the performance difference between the drive and the other drives in the system. For FC and NL drives, the number corresponds to both a performance measure and actual rotational speed. For SSD drives, the number is a relative performance benchmark that takes into account in I/O per second, bandwidth and the access time.

Viewing port statistics

Procedure

1. Log in to the system using any role.
2. To view port statistics, enter the following command:
   `statport`

   Displays statistics for data transfers only (default).
3. To display statistics for control transfers, enter the following command:
   `statport -ctl`
4. To display statistics for both data and control transfers, enter the following command:
   `statport -both`
5. To further refine these statistics, see, *HPE 3PAR Command Line Interface Reference*.

Viewing VLUN statistics

Procedure

1. Log in to the system using any role.
2. To view VLUN statistics for virtual volumes and LUN host attachments, enter the following command:
   `statvlun`
3. To further refine these statistics, see, *HPE 3PAR Command Line Interface Reference*.

Viewing virtual volume statistics

Virtual volumes can be accessed externally by hosts and internally by the system prefetcher. When viewing virtual volume I/O statistics, the information provided by the HPE 3PAR CLI includes access by the prefetcher. To see only external I/O statistics, use the `statvlun` command.

Procedure

1. Log in to the system using any role.
2. To view virtual volume statistics, enter the following command:
   `statvv`

   The result displays statistics for virtual volume read and write operations together (default).
3. To display statistics for virtual volume read and write operations separately, enter the following command:
   `statvv -rw`
4. To view Remote Copy virtual volume statistics, enter the following command:

```
statrcvv
```

5. To further refine data output, see the *HPE 3PAR Command Line Interface Reference*.

Viewing statistics for data cache memory

Procedure

1. Log in to the system using any role.
2. To view the Cache Memory Page (CMP) statistics by node or by virtual volume, enter the following command:
   ```
   statcmp
   ```
   This command displays the data cache memory statistics by node (default).
3. To display data cache memory statistics for all virtual volumes only, enter the following command:
   ```
   statcmp -v
   ```
4. To further refine these statistics, see the *HPE 3PAR Command Line Interface Reference*.

Viewing statistics for the flash cache and data cache

Procedure

1. Log in to the system using any role.
2. To view Flash Cache Memory Page (FMP) and Cache Memory Page (CMP) by node, enter the following command:
   `statcache`
   This command, with no options, displays statistics by node (default).
3. To view Flash Cache Memory Page (FMP) and Cache Memory Page (CMP) statistics for all volumes, enter the following command:
   `statcache -v`
   This command displays the statistics by virtual volume instead of by node. Displays statistics for all virtual volumes unless you specify the `-n` option.
4. To view Flash Cache Memory Page (FMP) and Cache Memory Page (CMP) statistics for specific volumes, enter the following command:
   `statcache -v -n <name|pattern>`
   Displays statistics for virtual volumes matching the specified `name` or `pattern`. Valid only if when you also specify `-v`
5. To further refine these statistics, see, *HPE 3PAR Command Line Interface Reference*.

Viewing statistics for processor usage

Procedure

1. Log in to the system using any role.
2. To view statistics for processor usage from all nodes, enter the following command:

```
statcpu
```

3. To further refine these statistics, see, *HPE 3PAR Command Line Interface Reference*.

Viewing statistics for Web Services API usage

Procedure

1. Log in to the system using any role.
2. To view Web Services API usage statistics, enter the following command:
   ```
   statwsapi
   ```
3. To further refine these statistics, see, *HPE 3PAR Command Line Interface Reference*.

Viewing statistical reports using the on-node System Reporter

The HPE 3PAR CLI commands can generate historical capacity and performance reports based on information collected by the on-node System Reporter. For a complete list of statistical reporting commands, see the *HPE 3PAR Command Line Interface Reference*.

In nearly all cases, you can refine the reports by specifying the following:

- A start time for the report
- An end time for the report.
- Whether to view the data across a specified time period or at a specific time. For this report, you can also specify attributes by which to group like items together.
- What granularity of samples to use in the report (high resolution – every 5 minutes, hourly, or daily).

Available procedures include the following:

Procedure

1. **Viewing statistical reports for region I/O density**
2. **Viewing statistical reports for used capacity**
3. **Viewing statistical reports for performance**

Viewing statistical report for region I/O density

Procedure

1. Log in to the system using any role.
2. To view a statistical report for region I/O density, enter the following command:
   `srrgiodensity`

   This command shows the distribution of IOP/s intensity for Logical Disk (LD) regions for a common provisioning group (CPG) or Adaptive Optimization (AO) configuration. You can use this for a single CPG to see whether AO can be used effectively. For an AO configuration the command shows how AO has moved regions between tiers.
3. To show region I/O density of a specific CPG during a particular time, enter the following command:
   `srrgiodensity -btsecs <secs> -cpg <cpg_name>`

-btsecs *<secs>*

Specifies the begin time in seconds for the report. With no *<secs>* specified, the report begins 12 hours prior to the time you issue the command. Other specification options include:

- Specify 0 to begin the report at the earliest sample.
- Absolute epoch time (such as, 1351263600).
- Absolute time as a text string:
  - Full time string including time zone: "2012-10-26 11:00:00 PDT"
  - Full time string excluding time zone: "2012-10-26 11:00:00"
  - Date string: "2012-10-26" or 2012-10-26
  - Time string: "11:00:00" or 11:00:00
  - A negative number indicating the number of seconds before the current time. Instead of a number representing seconds, you can specify a number with a suffix of m, h, or d to represent time in minutes (-30m), hours (-1.5h) or days (-7d).

-cpg *<cpg_name>*

Generates a report for all the CPGs with names that match one or more CPG names or glob-style patterns.

4. To further refine these statistics, see, *HPE 3PAR Command Line Interface Reference*.

Viewing statistical reports for used capacity

Procedure

1. Log in to the system using any role.
2. To view the space moved by Adaptive Optimization between tiers, enter the following command: **sraomoves**

   With no other options specified, the report begins 12 hours prior to issuing the command.
3. To show region I/O density of a specific CPG during a particular time, enter the following command: **sraomoves -btsecs *<secs>***

   -btsecs *<secs>*

   Specifies the begin time in seconds for the report. With no *<secs>* specified, the report begins 12 hours prior to the time you issue the command. Other specification options include:

   - Specify 0 to begin the report at the earliest sample.
   - Absolute epoch time (such as, 1351263600).
   - Absolute time as a text string:
     - Full time string including time zone: "2012-10-26 11:00:00 PDT"
     - Full time string excluding time zone: "2012-10-26 11:00:00"
     - Date string: "2012-10-26" or 2012-10-26

- Time string: "11:00:00" or 11:00:00
- A negative number indicating the number of seconds before the current time. Instead of a number representing seconds, you can specify a number with a suffix of m, h, or d to represent time in minutes (-30m), hours (-1.5h) or days (-7d).

4. To further refine these statistics, see, *HPE 3PAR Command Line Interface Reference*.

   Other System Reporter commands related to Adaptive Optimization include the following:

   `srcpgspace`

   Describes the space consumed in a CPG over time.

   `srldspace`

   Describes the space consumed by LDs.

   `srpdspace`

   Describes the space consumed by physical disks.

   `srsysspace`

   Displays historical space data reports for the system.

   `srvvspace`

   Describes the space consumed by virtual volumes.

Statistical reports for performance

The HPE 3PAR CLI provides commands to generate performance statistical reports, including the following:

- Cache memory
- CPU
- LDs
- Links
- Physical disks
- Ports
- Priority optimization
- Virtual volume LUN exports

For additional details about the System Reporter commands for these reports, see, *HPE 3PAR Command Line Interface Reference*

Viewing histograms

The HPE HPE 3PAR CLI commands provide access to histogram data on system resources. To further refine any of this data, see, *HPE 3PAR Command Line Interface Reference*.

Topics available for histogram data statistics include the following:

Procedure

1. **Chunklets**
2. **Physical Disks**
3. **Logical Disks**
4. **Ports**
5. **VLUNs**
6. **Virtual volumes**

Statistical histogram reports for performance

The HPE 3PAR CLI provides commands you can use to generate performance histogram statistical reports. You can specify whether to display I/O time and/or I/O size, the number of histogram columns, and whether to separate read and write data or display the total I/O. Report topics include the following:

- LDs
- Physical disks
- Ports
- Virtual volume LUN exports

Viewing histograms for chunklets

Prerequisites

The `setstatch` command must be issued to enable statistics collection on chunklets before chunklet histogram data can be viewed.

Procedure

1. Log in to the system using any role.
2. To view a histogram of service times in a timed loop for individual chunklets, enter the following command:
   `histch`

   The response includes information for individual chunklets.
3. To specify the logical disk name from which to sample chunklet statistics, enter the following command:
   `histch -ld <LD_name>`
4. To further refine these statistics, see, *HPE 3PAR Command Line Interface Reference*.

Viewing histograms for logical disks

Procedure

1. Log in to the system using any role.
2. To view a histogram of service times for LDs in a timed loop, enter the following command.
   `histld`

3. To view a histogram of logical disks mapped to virtual volumes, enter the following command:
   histld {*<VV_name>*|*<pattern>*}...

   Displays logical disks that are mapped to the specified virtual volumes, or with names matching any of the patterns specified. Use multiple volumes or patterns using a comma-separated list.

4. To further refine these statistics, see, *HPE 3PAR Command Line Interface Reference*.

Viewing histograms for physical disks

Procedure

1. Log in to the system using any role.
2. To view a histogram of service times for Physical Disks, enter the following command:
   histpd
   The result displays the service times for all PDs in the system.
3. To view a histogram limited to specified nodes and physical disks connected to those nodes, enter the following command:
   histpd -nodes *<node_list>*

   Use a single integer or a node list specified as a series of integers separated by commas (1,2,3). With no node list specified, the response includes all disks on all nodes.

4. To further refine these statistics, see, *HPE 3PAR Command Line Interface Reference*.

Viewing histograms for ports

Procedure

1. Log in to the system using any role.
2. To view a histogram of service times for ports within the system, enter the following command:
   histport

   The response includes histogram data for data transfers only (default).

3. To view a histogram for control transfers, data transfers, or both, use the following syntax:
   histport [-both|-ctl|-data]

   Choose one option.

4. To further refine these statistics, see, *HPE 3PAR Command Line Interface Reference*.

Viewing histograms for VLUNs

Procedure

1. Log in to the system using any role.
2. To view a histogram for VLUN service time, enter the following command:
   histvlun

   The response includes information about all VLUNs in the system.

3. To view a histogram for VLUN service related to a specific domain, enter the following command:
   histvlun -domain [*<domain_name>*...|*<pattern>*...]

The response shows VLUNs with virtual volumes in domains with names that match one or more of the specified domain names or patterns. Specify multiple domain names or patterns using a comma separated list.

4. To further refine this information, see, *HPE 3PAR Command Line Interface Reference*.

Viewing histograms for virtual volumes

Procedure

1. Log in to the system using any role.
2. To view a histogram for virtual volume service time in a timed loop, enter the following command:
   `histvv`

   The response includes service times for all virtual volumes in the system.
3. To view service times for all virtual volumes in a domain, enter the following command:
   `histvv -domain <domainname>...|<pattern>...`

   The response shows only the virtual volumes that are in domains with names that match the specified domain names or patterns.
4. To further refine these statistics, see, *HPE 3PAR Command Line Interface Reference*.

System task management

The HPE 3PAR CLI provides several methods for managing individual tasks.

Many CLI commands include options and specifiers that allow you to schedule the functionality employed by the command. File Persona commands, for example, include internal task management options, because the commands can take a long time to complete. Built-in management functionality provides flexibility to run resource-intensive commands during low use periods.

For commands without built-in management functionality, the CLI provides stand-alone task management commands. These commands allow you to control a limited number of other tasks. Task management commands allow you to pause, cancel, or remove specific tasks running on the system.

In addition, the CLI provides system scheduler commands. The scheduler commands allow you to create, modify, and remove schedules for specific tasks.

Stand-alone task management and scheduler commands support different sets of commands. For example, you can use task management commands to manage `tunevv` operations, but you cannot schedule `tunevv` using system scheduler commands.

More information

Task manager commands on page 197
System scheduler commands on page 201

Task manager commands

You can use the task manager commands to perform a number of administrator activities related to specific CLI commands. These include starting, displaying, and cancelling tasks running on the system. Task manager commands are:

`starttask`

Start a CLI command that runs as a background task.

`showtask`

Display information about tasks on the system.

`settask`

Set the priority of a running task.

`waittask`

Ask the CLI to wait for a task to complete before proceeding.

`removetask`

Remove information about one or more tasks and their details.

`canceltask`

Cancel one or more tasks.

CLI commands supported with task manager

The following list shows the tasks supported by the task management commands. For more information about each command, see, *HPE 3PAR Command Line Interface Reference*.

`admithw`

Admits new hardware into the system.

createsv

Creates a point-in-time (snapshot) copy of a VV.

moverelocpd

Moves chunklets that were on a physical disk to the target of relocation.

removevv

Removes virtual volumes from the system.

updatevv

Updates a snapshot virtual volume with a new snapshot.

upgradecage

Downloads new firmware into the specified cage.

upgradepd

Upgrades the physical disk firmware.

startao

Uses a specified data-region-level performance data collection to start an Adaptive Optimization (AO) configuration.

Using task manager commands

With task manager CLI commands, you can perform the following activities related to specific tasks running on the system.

Procedure

1. **Start a task**
2. **Display task information**
3. **Set task priority**
4. **Wait for a task**
5. **Remove a task**
6. **Cancel a task**

Starting a task

When you use the `starttask` command to start a supported CLI command, the command runs as a `background_command`. The system recognizes a task with the `background_command` task type as one that requires a long run time. These tasks run in the background, allowing multiple tasks to run concurrently.

Procedure

1. Log in to the system as `Super`, `Service`, or `Edit` user, or as any user with `task_start` permission.
2. To start a supported task, enter the following command:
   `starttask <command_name>`

If the command requires confirmation, use the `-f` option to force the command to run as though the user had affirmatively answered the prompt.

More information

Task manager commands on page 197

Displaying task information

When you start a task, the system returns the task ID. You can use the `showtask` command with the task ID to obtain information about a specific task. You can also use the `showtask` command without a task ID to obtain information about all tasks.

Procedure

1. Log in to the system using any role.
2. To see a list of all activated tasks within the last 24 hours, enter the following command:
   showtask

   The following example displays all tasks by task ID, including active and completed tasks. The system stores task information for up to 2,000 tasks.

```
cli% showtask
  Id Type               Name      Status Phase Step -------StartTime------- ------FinishTime------- -Priority- -User--
1125 background_command createsv  failed   ---  --- 2017-03-09 22:18:44 PST 2017-03-09 22:18:44 PST  n/a       3paradm
1126 background_command createsv  done     ---  --- 2017-03-09 22:19:27 PST 2017-03-09 22:19:27 PST  n/a       3paradm
```

3. To see a list of tasks more than 24 hours old, enter the following command:
   showtask -t *<hours>*

   Indicate in *<hours>* how far back you want to view. Use an integer from 1 through 99999.

4. To display status information about a specific task, ongoing or completed, use the task ID and enter the following command:
   showtask -d *<task_ID>*

   The system returns information similar to the following example:

```
cli% showtask -d 1126
  Id Type               Name      Status Phase Step -------StartTime------- ------FinishTime------- -Priority- -User--
1126 background_command createsv  done     ---  --- 2017-03-09 22:19:27 PST 2017-03-09 22:19:27 PST  n/a       3paradm

Detailed status:
2017-03-09 22:19:27 PST Created     task.
2017-03-09 22:19:27 PST Updated     Executing "createsv -ro myvv.2 myvv" as 0:29775
2017-03-09 22:19:27 PST Completed   scheduled task.
```

5. For an explanation of the column information, enter the following command:
   `clihelp -col showtask`

Setting the priority of an active or valid task

You can set task priorities one at a time, only. Options are `high`, `med`, or `low` priority.

Attempting to set task priorities for inactive or invalid tasks will result in an error.

Procedure

1. Log in to the system as `Super` or `Edit` user, or as any user with `set_task` permission.
2. To change the priority of a task, enter the following command:
   settask -pri high *<task_ID>*

   Without the `-f` option, the system requires user interaction, as shown in the following example:

```
cli% settask -pri high 497
Are you sure you want to set priority on task 497?
select q=quit y=yes n=no: y
high priority is set on task id: 497
```

3. To change the priority of a task without requiring user interaction, enter the following command:
   settask -f -pri high *<task_ID>*

Waiting for a task

The `waittask` command notifies the CLI to wait for a task to complete before proceeding, and automatically notifies you when the specified task is finished. This prevents users from issuing too many commands at one time.

Procedure

1. Login to the system using any role.
2. To wait for system tasks to complete, enter the following command and specify a task ID:
   waittask *<task_ID>*

   If you do not enter a task ID (no options or specifiers), the response includes only non-system tasks. To wait for system tasks, you must include the task ID.
3. To view a detailed status of the task, enter the following command:
   waittask -v *<task_ID>*

   Specify multiple task IDs, separating them with a comma (,).

   The following example shows the status of a `tunevv` task for which the user has requested a wait:

```
cli% waittask -v 1133
  Id Type    Name   Status Phase Step -------StartTime------- -FinishTime- -Priority- -User--
1133 tune_vv myvv.1 active   2/3  0/4 2017-03-09 22:39:50 PST -            n/a        3paradm

Detailed status:
2017-03-09 22:39:50 PST Created     task.
2017-03-09 22:39:50 PST Tuning      VV 'myvv.1'.
...
2017-03-09 22:39:54 PST Cleaning up task data for later restarts.
2017-03-09 22:39:54 PST Completed   region moves. Moved 4 regions for a total of 1024 MB in 4 seconds.
```

4. To cancel the `waittask` command, press **CTRL+C** on the keyboard.

   This action stops the `waittask` command and returns a command prompt, but does not affect the task that is running in the background.

Removing a task

The `removetask` command works only on completed, failed, and canceled tasks. The command removes the specified task ID and any information associated with it. The system does not recycle task IDs, so the next task started on the system uses the next integer in sequence. Task ID numbers roll over at 29999.

Task information remains on the system unless you remove it manually. The system stores information for the most recent 2000 tasks.

Procedure

1. Log in to the system as `Super` or `Edit` user, or as any user with `task_remove` permission.
2. To remove a task, enter the following command:
   removetask <task_ID>

The system prompts for confirmation, as shown in the following example:

```
cli% removetask 454
Remove the following tasks?
454
select q=quit y=yes n=no: y
```

3. To remove a task without requiring confirmation, enter the following command:
   removetask -f <task_ID>
4. For additional options, see, *HPE 3PAR Command Line Interface Reference*.

Canceling a task

You can use the `canceltask` command to cancel all active tasks types, except the following:

- `background_command`
- `remote_copy_sync`
- `scheduled_task`
- `snapspace_accounting`
- `system_task`

Procedure

1. Log in to the system as `Super`, `Service`, or `Edit` user, or as any user with `task_cancel` permission.

   The `Service` user is only allowed to cancel tasks started by that specific user.
2. To cancel a specific, active task, enter the following command:
   canceltask *<task_ID>*

   Task information is available using the `showtask <task_ID>` command, but the task status shows `Cancelled`.
3. To cancel all active tasks, enter the following command:
   canceltask all

System scheduler commands

The system scheduler allows you to create, modify, and remove schedules for initiating system operations with long running times. With the system scheduler, commands you can schedule specific CLI commands to run at regularly scheduled intervals, or to run once at a specified time.

NOTE: To run scheduled tasks when using LDAP, the `ldap-service-account` and `ldap-service-account` password must be defined to a user that is authorized with at least browse permissions to the array.

The following maximum task limits apply:

Table 11: Maximum scheduled tasks per storage system

Maximum Tasks	Storage System
500	HPE 3PAR StoreServ 9000 Storage, HPE 3PAR StoreServ 10000 Storage (V800 configuration), HPE 3PAR StoreServ 20000 Storage
375	HPE 3PAR StoreServ 7000 Storage, HPE 3PAR StoreServ 8000 Storage, HPE 3PAR StoreServ 10000 Storage (V400 configuration),

System scheduler commands are:

`createsched`

Create tasks to be initiated by the system scheduler.

`removesched`

Remove tasks initiated by the system scheduler from the system.

`setsched`

Modify tasks started by the system scheduler.

`showsched`

Show the state of tasks currently scheduled on the system.

CLI commands supported with system scheduler

The following list shows the tasks supported by the system scheduler commands. For more information about each command, see, *HPE 3PAR Command Line Interface Reference*.

Table 12: Commands initiated by the system scheduler

Command	Description
`checkhealth`	Displays the status of the system hardware and software components.
`compactcpg`	Consolidates LD space in a CPG into as few LDs as possible, allowing unused LDs to be removed.
`compactld`	Consolidates space on the LDs.
`createfsnap`	Creates a snapshot of an FPG.
`creategroupsv`	Creates consistent group virtual copies or snapshots of a list of virtual volumes.
`creategroupvvcopy`	Creates consistent group physical copies of a list of virtual volumes.
`createsv`	Creates a virtual copy or snapshot of a virtual volume.
`createvvcopy`	Creates a physical copy of a virtual volume.

Table Continued

Command	Description
importvv	Starts migrating data from a remote LUN to the local storage system.
moverelocpd	Relocates chunklets to specified physical disks.
removevv	Removes virtual volumes from the system.
setqos	Creates and updates QoS rules in a system.
setsralertcrit	Allows users to change the state and attributes of System Reporter threshold alert criteria.
setvv	Modifies existing volumes.
startao	Executes a specified HPE 3PAR Adaptive Optimization operation on the HPE 3PAR OS.
startfsav	Starts an antivirus scan on a VFS or a file store.
startfsnapclean	Reclaims snapshot space for an FPG.
syncrcopy	Synchronizes Remote Copy volume groups.
tunepd	Displays physical disks with high service times and optionally performs load balancing.
tunevv	Changes the layout of a virtual volume.
tunesys	Analyzes and automatically corrects space usage imbalances.
updatesnapspace	Updates the snapshot space actually used by a virtual volume. This task cannot be canceled.
updatevv	Updates a snapshot virtual volume with a new snapshot.

Using system scheduler commands

With system scheduler CLI commands, you can perform the following activities related to specific tasks running on the system.

Procedure

1. **Display scheduled tasks**
2. **Create scheduled tasks**
3. **Modify scheduled tasks**
4. **Suspend and resume scheduled tasks**

Displaying scheduled tasks

Procedure

1. Log in to the system as `Super`, `Service`, `Edit`, or `Browse` user, or as any user with an extended role .
2. To display all scheduled user and system tasks, enter the following commands:
   `showsched -all`
3. To display specific scheduled tasks, enter the following command: command, where:
   `showsched <schedule_name>|<pattern>`
   - *<schedule_name>* is the name of the schedule to display.
   - *<pattern>* displays all schedules that match the given pattern.

Creating a scheduled task

Procedure

1. Log in to the system as `Super`, `Service`, or `Edit` user, or as any user with `sched_create` permission.
2. To create a scheduled task, enter the following command:
   createsched *<command>* *<task_schedule>* *<schedule_name>*

   <command>

   Name of the supported CLI command to be initiated.

   <task_schedule>

   Crontab-style argument that specifies when the CLI command is initiated. You can use the minute, hour, day-of-month, month, and day-of-week format, or use one of the special entries to schedule when the CLI command is initiated.

   <schedule_name>

   Name of the schedule.

More information

CLI commands supported with system scheduler on page 202

Modifying a scheduled task

Procedure

1. Log in to the system as `Super`, `Service`, or `Edit` user, or as any user with `sched_setany` or `sched_setown` permission.
2. To change the name of a scheduled task, enter the following command:
   setsched -name *<new_name>* *<schedule_name>*

   <new_name>

   Enter the new name to be applied to the existing schedule name

<schedule_name>

Enter the name of the existing schedule.

3. To change the initiation time for a scheduled task, enter the following command:
   setsched -s *<new_schedule>*

   <new_schedule>

   Enter a crontab-style argument to change the schedule. Use minute, hour, day-of-month, month, and day-of-week format.

Suspending and resuming scheduled tasks

Procedure

1. Log in to the system as `Super`, `Service`, or `Edit` user, or as any user with `sched_setany` or `sched_setown` permission.
2. To suspend tasks, enter one of the following commands:

   - Suspend a specific scheduled task:

     setsched -suspend *<schedule_name>*

   - Suspend all scheduled tasks:

     setsched -suspend_all

3. To resume tasks, enter one of the following commands:

   - Resume a specific scheduled task:

     setsched -resume *<schedule_name>*

   - Resume all scheduled tasks:

     setsched -resume_all

Removing scheduled tasks

Procedure

1. Log in to the system as `Super`, `Service`, or `Edit` user, or as any user with `sched_setany` or `sched_setown` permission.
2. To remove scheduled tasks using a schedule name, enter the following command:
   removesched *<schedule_name>*
3. To remove scheduled tasks using a pattern, enter the following command:
   removesched -pat *<pattern>*

   Use the *<pattern>* specifier to indicate a glob-style pattern.

Task manager and system scheduler compatibility

Task manager and system scheduler each support specific CLI commands with very little cross-over. For example, in most cases, you cannot use the task manager `canceltask` command to cancel CLI commands initiated using system scheduler.

In contrast, a Super user can use the `canceltask` command to cancel some tasks that have a `scheduled_task` task type.

You can use the following task manager commands on CLI command operations initiated by system scheduler when the task type is `scheduled_task`.

- `showtask`
- `waittask`
- `removetask`

Task types

When users initiate various CLI commands, the system creates a record of the invoked task. This record includes a task ID and a task type. The task type assigned relates directly to the command used to generate the task.

You can view tasks by task type, and manage tasks as a group by task type. Task management and scheduling is subject to the defined command restrictions.

More information

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Task manager commands on page 197
System scheduler commands on page 201

background_command task type

When you initiate a supported task using the `starttask` CLI command, the system assigns the `background_command` task type. In addition, the system assigns the `background_command` task type to tasks generated by other commands, as shown in the following list.

The `background_command` task type has only one phase and one step. This means that there are no fixed number of logical divisions.

The `background_command` task type tracks operations of the following CLI commands:

- `backupfsconf`
- `createfpg`
- `createvfs`
- `growfpg`
- `removefpg`
- `removefsarchive`
- `restorefsconf`
- `setfsarchive`
- `setfpg`
- `setfsip`
- `setvfs`
- `startfs`

- `startfsnapclean`
- `starttask`
- `stopfs`
- `tuneld`
- `tunenodech`

For additional information about these commands, see, *HPE 3PAR Command Line Interface Reference*.

compact_cpg task type

The `compact_cpg` task type tracks the operations of the `compactcpg` command. To reclaim logical disk space and reduce the number of LDs, use the `compactcpg` command to compact a CPG.

The `compact_cpg` task type has only one phase, and the number of steps is equal to the number of LD regions to be moved.

compact_lds task type

The `compact_lds` task type tracks the operations of the `compactld` command. Use the `compactld` command to compact unused LD regions mapped to virtual volumes.

The `compact_lds` task type has only one phase, and the number of steps is equal to the number of LD regions to be moved.

promote_sv task type

The `promote_sv` task type tracks virtual copy snapshot promote operations. Promoting a virtual copy snapshot copies the differences of the virtual copy back to its base volume. You can promote a virtual copy snapshot using the `promotesv` command

Systems that use Remote Copy can promote virtual copy snapshots automatically. This promotion occurs, for example, with the `setrcopytarget reverse` or `setrcopygroup target` commands.

Remote Copy requires an HPE 3PAR Remote Copyor HPE 3PAR All-inclusive Multi-System software license.

The `promote_sv` task type requires the HPE 3PAR Virtual Copy or HPE 3PAR All-inclusive Single-System software license.

For `promote_sv` tasks, there is only one phase. The number of steps in that phase is equal to the number of gigabytes being copied.

More information

Activating a software license on page 13
Promoting a virtual copy on page 149

remote_copy_sync task type

The `remote_copy_sync` task type tracks Remote Copy volume synchronizations on systems using HPE 3PAR Remote Copy. The HPE 3PAR Remote Copy software is an optional volume mirroring solution used for disaster recovery and backup. The system creates a separate task for each primary volume undergoing synchronization.

You can initiate Remote Copy volume synchronizations manually by entering CLI commands. In some cases, the system initiates synchronizations automatically.

The `remote_copy_sync` task type requires the HPE 3PAR Remote Copy or HPE 3PAR All-inclusive Multi-System software license. The `tunevv` CLI command requires the HPE 3PAR Dynamic Optimizationor HPE 3PAR All-inclusive Single-System software license.

The `remote_copy_sync` tasks have three phases:

- Phase 1 (startup): Synchronization request received and synchronization scheduled.
- Phase 2: Performing the resynchronization.
- Phase 3: Completed copying and performing cleanup (such as deleting snapshots and setting state values).

For additional information aboutHPE 3PAR Remote Copy, see, *HPE 3PAR Remote Copy Software User Guide*

scheduled_task task type

The `scheduled_task` task type tracks system operations initiated by the following system scheduler commands:

- `checkhealth`
- `compactcpg`
- `compactld`
- `createsv`
- `creategroupsv`
- `createvvcopy`
- `creategroupvvcopy`
- `moverelocpd`
- `removevv`
- `syncrcopy`
- `tunepd`
- `tunevv`
- `updatesnapspace`
- `updatevv`

The `scheduled_task` task type has only one phase and one step.

More information

System scheduler commands on page 201
CLI commands supported with system scheduler on page 202

snapspace_accounting task type

The `snapspace_accounting` task type tracks the progress of the snapshot space usage accounting process, and runs the `updatesnapspace` command to refresh snapshot space usage information.

startao_task task type

The `startao` task type starts execution of an HPE 3PAR Adaptive Optimization configuration. The command uses data-region-level performance data collected for the specified number of hours.

The `startao` task type runs the `startao` command with the following options:

- `-btsecs`
- `-etsecs`
- `-maxrunh`
- `-compact`
- `-dryrun`

When you schedule a `startao` command, the user-defined schedule name appears in the list of schedules.

For more information about the `startao` command syntax and operation, see, *HPE 3PAR Command Line Interface Reference*.

More information

HPE 3PAR Adaptive Optimization on page 213

system_task task type

The `system_task` task type tracks the housekeeping tasks periodically run by the system.

You can display any active housekeeping tasks with the `showtask -all` command. Only the `3parsvc` user can run, change, or remove these tasks.

HPE 3PAR CLI housekeeping tasks and commands:

- The `move_back_chunklet` task runs the `moverelocpd` command.
- The `remove_expired_vvs` task runs the `removevv` command.

The `system_task` task type has only one phase and one step.

tune_sd task type

The `tune_sd` task type tracks the movement of LDs, used for the snapshot space of a volume, to a specified CPG.

The `tune_sd` task type runs the `tunevv snp _cpg` command to change the layout of a virtual volume using HPE 3PAR Dynamic Optimization.

For `tune_sd` tasks, there are three phases:

- Phase 1—Storing away region move information for future restarts, rollbacks, or both.
- Phase 2—Performing the actual region moves.
- Phase 3—Deleting the information stored in Phase 1.

The number of steps in the phase is equal to the number of regions being moved.

Changing the layout of a virtual volume with the `tunevv` commands requires the HPE 3PAR Dynamic Optimization or HPE 3PAR All-inclusive Single-System software license.

system_tuning task type

The `system_tuning` task type tracks operations performed with the `tunesys` command.

The `tunesys` command performs space usage-based analysis and tuning using HPE 3PAR Dynamic Optimization.

The `tune_sys` command task has three phases:

- Phase 1—Analyze the system, detect any virtual volume capacity imbalance between nodes, and rebalance the virtual volumes.
- Phase 2—Detect any chunklet imbalance between physical disks associated with the same node and rebalance the chunklets.
- Phase 3—Analyze the system and perform a consistency check on LDs to verify that they match the characteristics of any CPG to which the LD belongs. Any LDs that do not match are modified to match the characteristics of the CPG.

The `tune_sys` command task output displays information about the tuning process, including:

- Summary of `tunesys` command parameters.
- Physical disk analysis.
- Internode balance analysis.
- Intranode balance analysis.

More information

HPE 3PAR OS system performance tuning on page 244

tune_vv task type

The `tune_vv` task type is used to track `tunevv` operations performed with the System Tuner `tunevv` command.

For `tune_vv` tasks, there are three phases:

- Phase 1—Storing away region move information for future restarts and/or rollbacks.
- Phase 2—Performing the actual region moves.
- Phase 3—Deleting the information stored in Phase 1.

The number of steps in the phase is equal to the number of regions being moved.

The `tune_vv` task type and `tunevv` CLI command require the HPE 3PAR Dynamic Optimization or HPE 3PAR All-inclusive Single-System software license.

tune_vv_restart task type

The `tune_vv_restart` task type tracks `tunevv restart` interrupted operations performed with the System Tuner `tunevv restart` command.

For `tune_vv_restart` tasks, there are two phases:

- Phase 1—Performing the actual region moves.
- Phase 2—Deleting the information stored in Phase 1 of the corresponding `tune_vv` task.

The number of steps in the phase is equal to the number of regions being moved.

The `tune_vv` task type and `tunevv` CLI commands require the HPE 3PAR Dynamic Optimization or HPE 3PAR All-inclusive Single-System software license.

More information

HPE 3PAR OS system performance tuning on page 244

tunevv_rollback task type

The `tune_vv_rollback` task type tracks `tunevv rollback` operations performed with the System Tuner `tunevv rollback` command.

For `tune_vv_rollback` tasks, there are two phases:

- Phase 1—Performing the actual region moves.
- Phase 2—Deleting the information stored in Phase 1 of the corresponding `tune_vv` task.

The number of steps in the phase is equal to the number of regions being moved.

The `tunevv` CLI command requires the HPE 3PAR Dynamic Optimization or HPE 3PAR All-inclusive Single-System software license.

More information

HPE 3PAR OS system performance tuning on page 244

vv_copy task type

The `vv_copy` task type tracks physical copy operations. These operations include creating physical copies and resynchronizing a physical copy with its parent base volume.

For `vv_copy` tasks, there is only one phase. The number of steps in that phase is equal to the number of gigabytes being copied.

More information

Resynchronizing physical copies on page 154

Viewing task IDs

When you start a task using the HPE 3PAR CLI, the system displays the task ID as part of the command output. To use system manager commands, you need to know the task ID.

Procedure

1. Log in to the system using any role.
2. To display all available task IDs, enter the following command:
   `showtask -all`
3. To display details for a specific task, enter the following command:
   `showtask -d <task_ID>...`

   Do not use this option with any other options. Separate multiple task IDs using a comma (,).
4. To use other options related to this command, see, *HPE 3PAR Command Line Interface Reference*.

Task-specific license requirements

To use the HPE 3PAR File Persona, you must activate the HPE 3PAR File Persona or HPE 3PAR All-inclusive Single-System software license. Contact your Hewlett Packard Enterprise representative for more information about Hewlett Packard Enterprise licenses.

To view the licenses activated on your system, you can run the HPE 3PAR CLI `showlicense` command.

Specific system tasks require one of the following licenses:

Task type	Requires one of the following licenses
`promote_sv`	• HPE 3PAR Virtual Copy • HPE 3PAR All-inclusive Single-System software license
`remote_copy_sync`	• HPE 3PAR Remote Copy • HPE 3PAR All-inclusive Multi-System software license
`tune_vv`	• HPE 3PAR Dynamic Optimization • HPE 3PAR All-inclusive Single-System software license
`tune_sd`	• HPE 3PAR Dynamic Optimization • HPE 3PAR All-inclusive Single-System software license

More information:

Activating a software license on page 13

HPE 3PAR Adaptive Optimization

HPE 3PAR Adaptive Optimization (AO) uses 3PAR System Reporter statistics gathered from LDs and physical disks to optimize relocations of customer data on physical volumes. AO relocation accomplishes two primary goals:

- Increase performance of frequently accessed regions of data by moving those regions to higher-tier storage (for example, moving to SSDs from normal spinning media).
- Improve cost-efficiency by moving lightly accessed regions of data to a lower performance and less expensive tier of storage (for example, moving from regular drives to NL drives).

Other benefits include:

- Migrate data from a fully occupied tier of storage to another tier that has more available capacity.
- Schedule AO to run regularly so that AO can adjust the data layout as your data usage changes over time.
- Create, modify, or remove AO configurations using the HPE 3PAR CLI or using SSMC.
- Take advantage of the new database scheme, restructured on node to be more efficient and reliable.
- Move data from a given period in the past, not only from the immediate past. Data movement can occur at times of low utilization while using an analysis of statistics gathered during peak periods.
- Set a time limit for data movement so that scheduled data is moved only during low-utilization periods rather than during peak usage.

More information

System task management on page 197
Software licenses and HPE 3PAR CLI on page 13
HPE 3PAR Adaptive Optimization conversion on page 214
startao_task task type on page 209
License requirements for HPE 3PAR Adaptive Optimization on page 213

License requirements for HPE 3PAR Adaptive Optimization

Active use of HPE 3PAR Adaptive Optimization requires an HPE 3PAR Adaptive Optimization or license, or an HPE 3PAR All-inclusive Single-System software license. Contact your local Hewlett Packard Enterprise representative for information.

Adaptive Optimization LD/Region data retention policy

AO data retention policies handle the optimum number of samples possible within the limited capacity available for the on-node region data. The largest capacity stores about 25 samples.

Covering multiple regions per sample requires creating a separate database file for each interval (typically every 30 minutes). Recent data receives the highest resolution, and data becomes progressively coarser as it ages. Because of this progression, the intervals between samples are not uniform.

Data retention policy keeps half-hour samples for 2 hours, 1-hour samples for 8 hours, 3-hour samples for 24 hours, 12-hour samples for three days, and 24-hour samples for seven days.

HPE 3PAR Adaptive Optimization conversion

3.2.1 and later implements Adaptive Optimization (AO) on nodes, as well as an on-node version of System Reporter. In contrast, HPE 3PAR OS3.1.1 and earlier implement AO using System Reporter.

No direct conversion occurs from external System Reporter-based AO configurations and HPE 3PAR OS 3.2.1 AO configurations created using the `createaocfg` command. The following table lists the external System Reporter-AO configuration parameters and shows how those parameters translate to `createaocfg` command options.

An AO configuration does not include schedule and measurement intervals. Instead, you must specify measurement intervals as options (`-btsecs` and `-etsecs`) for the `startao` command. Implement the schedule is implemented using the `createsched` command to create a schedule and run the `startao` command.

Table 13: HPE 3PAR Adaptive Optimization conversion options

External System Reporter	`createaocfg` option	`startao` option	Comment
Id	AOCFG_name	AOCFG_name	Specify a name for the AO configuration in the `createaocfg` command, and use that name for the `startao` command as well.
System name			Not required. Creation of the AO is based on the system name itself.
Tier 0 CPG Name	`-t0cpg` `<cpgname>`		
Tier 1 CPG Name	`-t1cpg` `<cpgname>`		
Tier 2 CPG Name	`-t2cpg` `<cpgname>`		
Tier 0 GiB			Set a CPG warning or limit value for the tier 0 CPG instead.[1] Use `setcpg –sdg <warn limit>` for a warning limit, and `setcpg -sdgl <hard limit>` for a physical limit).
Tier 1 GiB			Set a CPG warning or limit value for the tier 1 CPG instead.[1] Use `setcpg –sdg <warn limit>` for a warning limit, and `setcpg -sdgl <hard limit>` for a physical limit).
Tier 2 GiB			Set a CPG warning or limit value for the tier 2 CPG instead.[1] Use `setcpg –sdg <warn limit>` for a warning limit, and `setcpg -sdgl <hard limit>` for a physical limit).

Table Continued

External System Reporter	`createaocfg` option	`startao` option	Comment
Schedule			The schedule is not part of the AO configuration. Instead, you can create a schedule using the `createsched` command to run `startao` on the AO configuration.
Measure Hours		`-btsecs` `-etsecs`	The measurement interval is not part of the AO configuration; rather, it is an option of the `startao` command. To translate the measure hours directly into a `startao` option, use the `-btsecs` option. For example, if the measure hours value is 2, use `-btsecs -2h`. The `startao` is even more flexible. By using the `-etsecs` options, you can specify not only the **beginning** of the measurement interval relative to the `startao` command start time, but also the **end** of the measurement interval relative to the `startao` command start time. For example, if the `startao` command is scheduled to run at 8 pm, you can specify `-btsecs -4h -etsecs -2h`. This argument specifies that the measurement interval starts 4 hours before the command start time (8 pm - 4 = 4 pm) and ends 2 hours before the command start time (8 pm - 2 = 6 pm). The measurement interval is 4 pm to 6 pm, for a command start time of 8 pm.
Mode	`-mode <mode>`		`-mode <mode>` This option overrides the optimization bias of the AO configuration and allows you to specify one of the following modes: • Performance • Balanced • Cost **NOTE:** The value of the mode is case-sensitive.

Table Continued

External System Reporter	`createaocfg` option	`startao` option	Comment
Active			Because the AO configuration itself does not execute if the `startao` command is not run, there is no option to disable it. Instead, use `setsched` to suspend or resume the schedules that run `startao` on that AO configuration.
Virtual volume sets		`-vv <vv_name>|<vv_set>`	Specify the virtual volumes or virtual volume sets to be analyzed, any volumes not specified are excluded. To be optimized, the user CPG of each volume must be part of the specified AOCFG. Snapshots in a volume's tree will not be optimized.

[1] Hewlett Packard Enterprise recommends that the CPG "warning limit" be used to limit AO use of a CPG. With a warning limit, VVs that use the CPG for growth can increase in size while limiting AO use of the CPG.

Creating an HPE 3PAR Adaptive Optimization configuration

Because AO is part of the HPE 3PAR OS, you can use a simple user interface to start AO either as a scheduled task or as a manual command using the `startao` command. AO is built on top of the new version of System Reporter (SR), which also now runs as part of the HPE 3PAR OS.

The `startao` command performs an analysis of the data collected by SR to identify regions within virtual volumes that are either heavily used or lightly used. Once identified, a series of secondary tasks move these regions to faster or slower storage tiers.

Storage tiers can be of different RAID types. Maximize capacity efficiency by using only RAID1 for the most frequently accessed storage, and then using RAID 5 or RAID 6 for less frequently accessed storage.

Prerequisites

- Define two or more tier CPGs .
- If you are using domains, make sure that all CPGs are either in the same domain or not in any domain.
- Make sure that each CPG belongs to one AO configuration only.
- Allow System Reporter the time to actively gather data on VV regions. This means a minimum of 3 hours (preferably longer), outside of time periods where the storage system has peak load/usage.
- **Make sure you have met all licensing requirements**.

Procedure

1. Log in to the system as `Super` or `Edit` user.
2. To create an AO configuration, enter the `createaocfg` command using the following syntax:
   `createaocfg -t0cpg <cpg_name> -t1cpg <cpg_name> -t2cpg <cpg_name> -mode [performace|balanced|cost] <AOCFG_name>`

Define tiers in “speed” order. Tier 0 must be the fastest tier (SSD) and tier 2 the slowest (NL). AO makes the assumption internally that you have defined tiers in this speed order.

`-t0cpg <cpg_name>`

Specifies the Tier 0 CPG name for this AO configuration. For example, `-t0cpg tier0_R1_SSD`.

`-t1cpg <cpg_name>`

Specify the Tier 1 CPG for this AO configuration. For example, `-t1cpg tier1_R6_FC`.

`-t2cpg <cpg_name>`

Specify the Tier 2 CPG for this AO configuration. For example, `-t1cpg tier2_R6_NL`

`-mode [performance|balanced|cost]`

Specify the optimization bias for the AO configuration.

`Performance`

Move more regions towards higher performance tier.

`Balanced`

Balance between higher performance and lower cost. (Default)

`Cost`

Move more regions towards lower-cost tier.

`AOCFG_name`

Specify the name of the AO configuration (up to 31 characters in length).

3. Set CPG warning limits to limit the size of tier 0 and tier 1, leaving tier 2 unlimited.

   In the following example, the tier 0 limits are set to 64 g and the tier 1 limits to 256 g, respectively:

```
cli% setcpg -sdgw 64g t0cpgname
cli% setcpg -sdgw 256g t1cpgname
```

4. Create a schedule to run AO periodically, using the system scheduler.

   In the following example, the AO configuration is set to run every day at 7:15 pm from Monday through Friday. The scheduled `startao` command considers 12 hours of statistics for its region moves. The 12 hours of statistics are from 7:15 am until 7:15 pm, as the `-etsecs` parameter was not specified.

```
cli% createsched "startao -btsecs -12h AOCFG_name" "15 19 * * 1-5" run_AOCFG_name
```

More information

Using system scheduler commands on page 203
startao command options not available with external 3PAR System Reporter on page 217
License requirements for HPE 3PAR Adaptive Optimization on page 213

`startao` command options not available with external 3PAR System Reporter

Using the `startao` command, you can take advantage of several features that are not available in the external 3PAR System Reporter by using the following options:

Table 14: Additional options not available in an external 3PAR System Reporter

Option	Description
`-maxrunh 6`	Instructs the `startao` to ensure that the command completes in 6 hours, limiting the number of region moves if necessary. For the command in Step **4**, this option would ensure that the command would complete by 11:15 pm. **CAUTION:** When executed, this command attempts to complete the action within `maxrunh` hours, but success is not guaranteed.
`-etsecs -4h`	Sets the end of the measurement interval 4 hours before the command starts. (With an external System Reporter, the measurement interval ends at the command start time.) In the command in Step **4**, this option would ensure that the end of the measurement interval occurred at 3:15 pm.
`-compactcpg trimonly`	Instructs `startao` not to do a full `compactcpg`, but rather eliminate additional `regionmoves` within the CPG by doing only `compactcpg -trimonly`.

The following example shows how each of the options in **Table 14: Additional options not available in an external 3PAR System Reporter** on page 218 is used. This command runs against data from 7:15 am until 3:15 pm Monday through Friday, completing by 1:15 am:

```
cli% createsched "startao -btsecs -12h -etsecs -4h -compact trimonly -maxrunh 6 AOCFG_name" "15 19 * * 1-5" run_AOCFG_name
```

Displaying a 3PAR Adaptive Optimization setting

Procedure

- Issue the `showaocfg` command:

  ```
  cli% showaocfg [-domain <domain_name_or_pattern>] [<AOCFG_name>...|<pattern>...]
  ```

  Where:

  - `-domain <domain_name_or_pattern>` shows only AO configurations that are in domains with names matching one or more of the `domain_name_or_pattern` arguments. This option does not allow listing objects within a domain of which the user is not a member. Patterns are glob-style (shell-style) patterns.
  - `[<AOCFG_name>...|<pattern>...]` specifies that AO configurations matching either the specified AO configuration name or those AO configurations matching the specified pattern are

displayed. This specifier can be repeated to display information for multiple AO configurations. If not specified, all AO configurations in the system are displayed.

Modifying an HPE 3PAR Adaptive Optimization configuration

Prerequisites

- Two or more tier CPGs must be present in an AO configuration at all times.
- If domains are used, all CPGs must be either in the same domain or not in any domain.
- A CPG can belong to only one AO configuration.
- A CPG can be removed from a tier by specifying a null string "". At least two tiers must remain.
- A CPG can be moved and swapped between tiers within the same AO configuration.
- A CPG cannot be moved between AO configurations; it must first be removed from one and then added to the second.
- Active use of HPE 3PAR Adaptive Optimization requires an HPE 3PAR Adaptive Optimization or HPE 3PAR All-inclusive Single-System software license. Contact your local Hewlett Packard Enterprise representative for information.
- A maximum of two tier CPG settings can be modified in a single `setaocfg` command. This includes swapping CPGs between tiers or replacing up to two CPGs with new ones. To maintain the minimum of two defined tier CPGs, a maximum of one CPG can be removed from an AO configuration.

Procedure

- To update an AO configuration, use the `setaocfg` command:

  ```
  cli% setaocfg [options <arg>] <AOCFG_name>
  ```

  For example:

  ```
  cli% setaocfg -t0cpg tier0_R6_SSD -t1cpg tier1_R5_FC -mode Performance AOCFG_name
  ```

  Where:

  - `-t0cpg` is the tier 0 CPG.
  - `tier0_R6_SSD` is the tier 0 CPG name.
  - `-t1cpg` is the tier 1 CPG.
  - `tier1_R5_FC` is the tier 1 CPG name.
  - `-mode <mode>` specifies one of the following optimization biases for the AO configuration:

  - `Performance`—Move more regions towards higher performance tier.
  - `Balanced`—Balance between higher performance and lower cost.
  - `Cost`—Move more regions towards lower-cost tier.
- `—name <AOCFG_name>` specifies a new name for the AO configuration (up to 31 characters in length).

In the following example, the tier 1 CPG for AO configuration `aocfg2` is set to `tier1_R5_FC2`. `tier1_R5_FC2` must not already be used in an AO configuration, and the tier 1 CPG for `aocfg2` must not already be set. Also, if domains are in use, the domain of `R5FCcpg` must match the existing tier CPGs, or have no domain if the other CPGs are not in a domain.

```
cli% setaocfg -t1cpg tier1_R5_FC2 aocfg2
```

In the following example, a CPG is swapped between tier 0 and tier 2:

```
cli% setaocfg -t0cpg tier1_R1_SSD2 -t2cpg tier2_R6_NL2 aocfg3
```

In the following example, a CPG is removed from a tier, assuming that three tiers were initially created. If there are two tiers, this command is not permitted, because AO configurations require a minimum of two storage tiers.

```
cli% setaocfg -t0cpg "" aocfg1
```

In the following example, the optimization bias (that is, the mode) of an AO configuration `aocfg1` is changed to `Balanced`.

```
cli% setaocfg -mode Balanced AOCFG_name
```

More information:

Activating a software license on page 13

Removing a 3PAR Adaptive Optimization configuration

Procedure

- To remove an AO configuration from the system, use the `removeaocfg` command:

  ```
  cli% removeaocfg [options] <AOCFG_name>
  ```

  Where:

  - `-pat <pattern>` indicates that specified patterns are treated as glob-style patterns and that all AO configurations matching the specified pattern are removed. By default, confirmation is required to proceed with the command unless the `-f` option is specified. This option must be used if the pattern specifier is used.

    This specifier can be repeated to remove multiple AO configurations. If this specifier is not used, the `<AOCFG_name>` specifier must be used.
  - `-f` specifies that the command is forced. If this option is not used, the command requires confirmation before proceeding with its operation.
  - `<AOCFG_name>`specifies the name of the AO configuration that is to be removed.

In the following example, AO configurations that start with `test` are removed without requiring user confirmation to remove them:

```
cli% removeaocfg -f -pat test*
```

NOTE: A CPG that is part of an AO configuration cannot be removed from the system until either the AO configuration is removed or the CPG is removed from the aocfg.

HPE 3PAR Priority Optimization

Consolidation of storage systems reduces the complexity of data storage, delivering efficiency in management, occupied floor space, and energy consumption. However, the consolidation of many disjointed workloads into a single storage system also results in contention for shared system resources on the system.

Examples of shared resources include front-end host Fibre Channel (FC), iSCSI and FCoE adapters, back-end FC or SAS disk connections, physical disks, data and control cache, ASICs, CPUs, and backplane interconnections. Data packets arriving at the front-end FC HBA adapters are handled on a first-come, first-serve basis. Processing data packets on a first-come first-serve basis can lead to unequal and inconsistent throughput for multiple concurrent workloads.

HPE 3PAR Priority Optimization manages and distributes the I/O capacity of a HPE 3PAR StoreServ Storage system across multiple workloads. The tool enables the colocation of data in workloads of different types, such as sequential, random, online transaction processing (OLTP), with different I/O packet sizes on a single storage system, while achieving adequate and stable performance in a multitenant environment.

HPE 3PAR Priority Optimization requirements

The HPE 3PAR Priority Optimization or HPE 3PAR All-inclusive Single System software license is required on the HPE 3PAR StoreServ Storage system and is supported on all HPE 3PAR StoreServ Storage systems.

The HPE 3PAR Priority Optimization license on the HPE 3PAR StoreServ Storage has its own license key. This license is spindle-based, available a-la-carte and as part of the HPE 3PAR Priority Optimization software suite.

NOTE: With HPE 3PAR OS 3.3.1, the 3PAR Priority Optimization license is part of the new array/frame-based HPE 3PAR All-inclusive Single-System software license. For more information on All-inclusive licensing, see **Activating a software license** on page 13 and the *HPE 3PAR StoreServ Storage Concepts Guide* available at **Hewlett Packard Enterprise Information Library** (http://www.hpe.com/info/storage/docs).

Consult your Hewlett Packard Enterprise representative or authorized Hewlett Packard Enterprise partner for more information on the HPE 3PAR Priority Optimization and HPE 3PAR All-inclusive Single-System software licensing.

Creating and managing quality of service (QoS) definitions requires 3PAR SSMC 3.1. To use the command line, you must install HPE 3PAR CLI 3.2.1 or later.

Reports on HPE 3PAR Priority Optimization is required on the HPE 3PAR StoreServ Storage system are available through HPE 3PAR System Reporter 3.1 MU1 and later, and through the 3PAR MC 4.5 and later. The reports on the QoS definitions require either a license for HPE 3PAR System Reporter or the HPE 3PAR All-inclusive Single-System software license.

While QoS is in principle OS-agnostic, see the SPOCK website for the list of operating systems that are certified for use with HPE 3PAR Priority Optimization is required on the HPE 3PAR StoreServ Storage system:

SPOCK (http://www.hpe.com/storage/spock)

QoS rule creation and management

The HPE 3PAR CLI provides three commands you can use to create and manage QoS rules:

setqos [options][{vvset|domain:{<name>|<pattern>}|sys:all_others}]...

Creates and updates QoS rules in a system.

showqos [options][{vvset|domain:{<name>|<pattern>}|sys:all_others}]...

Lists the QoS rules configured in a system.

statqos [options][{vvset|domain:{<name>|<pattern>}|sys:all_others}]...

Displays run-time statistics of active QoS rules.

The integer value for bandwidth in the `setqos` command can optionally be followed with:

- `k` or `K` to indicate a multiple of 1000.
- `m` or `M` to indicate a multiple of 1,000,000.
- `g` or `G` to indicate a multiple of 1,000,000,000.

If you specify "none", there is no limit on I/O issue bandwidth rate.

The CLI offers a number of features that are not available in the MC. For example, a QoS rule can be created with the `setqos` command and be kept inactive by using the `-off` option.

Removing a QoS rule

A QoS rule can be enabled and disabled at any moment. Clearing the QoS rule deactivates an enabled rule. Clearing a QoS rule does not require first disabling the rule.

After a QoS rule is disabled, the IOPS and bandwidth for the VVs in the VVset increases (if the rule was delaying them).

Procedure

To clear a QoS rule, issue the `setqos -clear vvset:<vvset>` command, where `<vvset>` is the name of VVset the QoS rule is cleared of.

Best practices for managing QoS rules

There is no limitation on the minimum number of IOPS and bandwidth that you can set on a given VVset QoS Rule. Make sure that you understand the workloads of the various applications before applying a QoS rule. You can use the 3PAR System Reporter to determine whether applying a QoS rule makes sense. The following best practices provide general guidelines only.

More information:

Virtual volumes and virtual volume sets on page 224

Values for IOPS and bandwidth for a system on page 224

Tier-1 applications on page 224

The System QoS rule on page 225

QoS rules and system provisioning on page 225

QoS influence on the host side on page 225

Maximum number of QoS rules per VV on page 226

QoS on a subset of VVset volumes on page 226

Application interoperability on page 226

Virtualization software on page 227

QoS rule reporting on page 229

Virtual volumes and virtual volume sets

VVsets group virtual volumes logically. Use cases for VVsets include taking simultaneous point-in-time virtual copies of multiple volumes, and then creating Remote Copy volume groups for write consistency during replication operations.

Include volumes that belong together in the same VVset. Belonging together can be because the same application owns the volumes, or because the volumes belong in the same virtual domain. You can also group unrelated virtual volumes into a VVset to reduce the administrative overhead when managing them. Grouping allows you to manage the I/O profile of the volumes using a single QoS rule for the parent VVset.

VVsets are especially useful in the deployment of 3PAR Priority Optimization, because QoS rules in 3PAR Priority Optimization are defined on VVsets. Hewlett Packard Enterprise strongly encourages the creation of VVsets and group volumes logically on HPE 3PAR StoreServ storage systems.

Values for IOPS and bandwidth for a system

HPE 3PAR Priority Optimization QoS rules define limits for IOPS and bandwidth in absolute numbers, not percentages. The QoS administrator needs reasonably accurate data about the maximum I/O and throughput capability of the system. The administrator also requires an understanding of actual I/O and throughput workloads to the volumes effected by QoS.

Hewlett Packard Enterprise Presales can estimate the maximum front-end workload for a system in IOPS and bandwidth. With this information available, you can define QoS rules per workload. The total sum of IOPS or bandwidth cannot exceed what is sustainable by the system configuration.

Analyze system capability and adjust the limit values for any existing QoS rules in the following cases:

- When upgrading the storage system with additional disk drives and/or nodes.
- When using additional FC and/or iSCSI interface cards to the storage system.
- When adding physical hosts of virtual machines with extra workloads to the storage system.
- When upgrading the host hardware to a newer generation that offers more CPU power and/or memory (for example, from G6 to Gen8 ProLiant blades), generating more IOPS and bandwidth, or when hardware details change in a virtualized server environment.
- When deploying a new generation of an operating system on the host like moving from Windows Server 2008 to Windows Server 2012 or Windows Server 2016, or when moving from a 32-bit to 64-bit environment.
- When deploying a new brand of generation of FC or iSCSI HBAs on the host that have specific queue depth requirements. Queue depth is the average number of I/O jobs, either processing or waiting to be processed, within a polling interval. The queue depth is a non-negative integer number.
- When upgrading the end-to-end SAN pathing from 4 Gb/sec to 8 Gb/sec.

In general, Hewlett Packard Enterprise recommends review of the system I/O capability and adjustment of the QoS rules in use whenever a change is made to one part of the entire chain from the host to the HPE 3PAR OS.

Tier-1 applications

The HPE 3PAR StoreServ Storage systems are Tier-1 arrays that can handle multiple mission-critical workloads concurrently, as opposed to workloads of medium importance and performance requirements.

Tier-1 applications should be given all resources they need during runtime, given their vital business impact.

Hewlett Packard Enterprise recommends that you define a QoS rule with sensible limits for IOPS and bandwidth on all VVsets that have a known I/O profile. You can define the `System` rule to control all volumes created on the system that do not have an explicitly defined QoS rule.

If you do not set a QoS rule, and the `all_others` rule is active, mission-critical applications will be subject to the `all_others` rule. To prevent the `System` rule from controlling the Tier-1 applications, define a QoS rule with high values for IOPS and bandwidth. This way, mission-critical workloads will be able to consume the I/O resources they require to perform optimally.

The `System` QoS rule

Workloads without a QoS rule consume I/O resources in an uncontrolled manner and may starve those workloads that are subject to a QoS rule. To ensure an acceptable level of performance across all applications on a storage system if QoS is used, all volumes must be part of a QoS rule with meaningful limits reflecting the I/O requirements of the application. The `System` QoS rule should be enabled and a value specified for its maximum IOPS and bandwidth to control the I/O traffic from VVs and VVsets not subject to a specific QoS rule. This prevents any new volumes added to the HPE 3PAR StoreServ Storage or existing ones that are not subject to a QoS rule from negatively affecting the entire system by overconsuming IOPS or bandwidth.

The default minimum allowed values for the `System` rule are 1000 for the I/O Limit and 100,000 KB/sec for the bandwidth limit. Be sure to change these settings to acceptable values if the defaults are deemed too small.

QoS rules and system provisioning

HPE 3PAR Priority Optimization allows overprovisioning when creating QoS rules—rules with combined values for IOPS or bandwidth that exceed the I/O capacity of an HPE 3PAR StoreServ Storage. Overprovisioning is an established practice if the workloads are sufficiently orthogonal in their I/O usage.

For example, a database used only during the daytime and a backup application running only during the night can each be given the entire I/O capacity of the system in their respective QoS rules. When overprovisioning concurrent workloads, QoS prevents a single application or customer from monopolizing the system.

For another example, a system capable of 50 k IOPS could have 10 customers, each limited to 10 k IOPS. The system is overprovisioned for IOPS, but no single customer can monopolize the system. Continuous monitoring of system performance by 3PAR System Reporter is mandatory to ensure that every application and customer performs well without reaching their I/O limits.

QoS influence on the host side

The QoS rules in HPE 3PAR Priority Optimization specify the relative importance of the I/O of each workload on the storage system. When the IOPS or bandwidth demand of an application reaches the implemented QoS limits, the performance of the application on the host will no longer grow.

Lowering the QoS cap will result in higher I/O response times and reduced throughput on the host, and eventually queue-full errors are returned by the array to the host.

NOTE: Response time is the average measured time that it takes the array to process an I/O request. On HPE 3PAR StoreServ Storage systems, response time may be reported as “service time.” Response time is measured in milliseconds.

On the other hand, a lowered QoS cap for one workload will free I/O resources on the host, which in turn may reduce memory and CPU cycle consumption to the benefit of other workloads. Priority Optimization can control host-side resources, obviating the need to define QoS and metrics in a workload manager tool

on the host. However, host-side and storage system QoS rules can be combined for tighter control, or when memory and CPU cycle consumption management is required on the host.

Maximum number of QoS rules per VV

A given VV can be part of many VVsets. Hewlett Packard Enterprise does not recommend application of multiple QoS rules to the same VV. For this reason, QoS rules can be defined on a maximum of eight VVsets that contain a particular VV. The lowest value for IOPS and bandwidth, for a VVset that hosts a VV, imposes its limits on the I/O traffic to and from the VV.

QoS on a subset of VVset volumes

By default, a QoS rule on a VVset governs all volumes in the set; but only a subset of the volumes in the VVset might need a QoS rule. In this situation, create a second VVset that contains only the volumes that need a QoS rule, and then define the rule. The volumes in the second VVset do not need to be exported for the QoS rule to take effect.

If the `System` rule is defined, it acts on all VVsets for which a QoS rule has not been defined. If at least one volume of the VVset has a QoS rule defined in another VVset, the named QoS rule takes precedence over the `System` rule, even if the named QoS rule has a lower value for IOPS or bandwidth.

Application interoperability

HPE 3PAR Priority Optimization software sets and manages QoS rules defined on I/O traffic. Software products for HPE 3PAR StoreServ Storage systems, such as HPE 3PAR Dynamic Optimization, HPE 3PAR Adaptive Optimization, HPE 3PAR Virtual Copy, HPE 3PAR System Reporter, HPE 3PAR Thin Provisioning, and HPE 3PAR Recovery Manager work on data in the backend. All these software products are compatible and operate transparently to HPE 3PAR Priority Optimization.

More information:

Databases and separate volumes on page 226

Microsoft Exchange Server on page 226

Databases and separate volumes

All database software vendors recommend that you separate data files, index files, and transactional and archive logs onto separate volumes. The write capability and location of the online transaction logs is especially important, because the entire performance of the database depends on the writes to these logs.

Carefully dimension a QoS rule on volumes that contain online transaction logs so you do not inhibit the performance of the database. QoS rules on the I/O performance of the database volumes take care of runaway queries that consume IOPS and bandwidth. Databases are often mission-critical, and placing a QoS rule on them should never inhibit their normal operation.

Microsoft Exchange Server

Microsoft Exchange Server is a scalable, commercial mail server that supports thousands of users per instance. As a general practice, it is recommended that the mailbox database files and the log files be separated onto different volumes. The databases can be spread over multiple volumes as well. A QoS rule that limits the IOPS and/or bandwidth to the volume sets for the mail database of a particular group of users stabilizes the mail database performance for other users and for other applications on the HPE 3PAR StoreServ Storage systems.

Microsoft Exchange is a highly interactive software application, and its users demand a swift response to mouse clicks in the Outlook client. To prevent Microsoft Exchange from reporting errors, be careful to ensure that volumes receive enough IOPS and throughput so that the Microsoft Exchange server delivers sufficiently low I/O response times.

Virtualization software

Virtualization platforms, such as VMware vSphere and Microsoft Hyper-V, use container files to store one or more virtual hard-disk drives used by virtual machines. Each container file is built on one or more LUNs accessed over a SAN. Adding the LUNs that make up the container file to a VVset permits application of a QoS rule. This rule will control the IOPS and/or bandwidth for all virtual machines (VMs) whose virtual hard drives are carved out of that LUN. Be careful to ensure that there is enough bandwidth and IOPS in the QoS rule, so that the applications running on the VMs can deliver acceptable I/O response times.

QoS I/O control operates on all VMs sharing a VMware datastore and, in some cases, this level of control may not be granular enough. Recent versions of VMware offer three native types of I/O resource control. Their characteristics, together with QoS characteristics, are listed in the following tables:

I/O control technique
Focus of action
Granularity
Management
Availability

Table 15: I/O control technique

Software	Comparison
HPE 3PAR QoS	Limit IOPS and bandwidth
VMware Storage DRS	Migrate VM to other datastore
VMware SIOC	Control queue depth of datastore SAN LUN in VMkernel; VM shares enforced
VMware Adaptive Queue Depth	Control queue depth of datastore SAN LUN in VMkernel

Table 16: Focus of action

Software	Comparison
HPE 3PAR QoS	None
VMware Storage DRS	I/O latency and space utilization
VMware SIOC	I/O latency
VMware Adaptive Queue Depth	Queue Full or Device Busy at LUN or port level

Table 17: Granularity

Software	Comparison
HPE 3PAR QoS	All VMs in datastore VV
VMware Storage DRS	Single VM

Table Continued

Software	Comparison
VMware SIOC	All VMs in a single datastore
VMware Adaptive Queue Depth	All hosts using the SAN LUN for the datastore or a particular port on the 3PAR

Table 18: Management

Software	Comparison
HPE 3PAR QoS	3PAR SSMC
VMware Storage DRS	VMware vSphere
VMware SIOC	VMware vSphere
VMware Adaptive Queue Depth	VMware vSphere

Table 19: Availability

Software	Comparison
HPE 3PAR QoS	HPE 3PAR OS 3.2.1 and later
VMware Storage DRS	vSphere 5.0 and later with VMware vSphere Enterprise Plus or HPE 3PAR All-inclusive Single-System software license
VMware SIOC	vSphere 4.1 and later with VMware vSphere Enterprise Plus or HPE 3PAR All-inclusive Single-System software license
VMware Adaptive Queue Depth	vSphere 3.5 U4 and later with VMware vSphere Standard or HPE 3PAR All-inclusive Single-System software license

HPE 3PAR Priority Optimization QoS rules operate on volumes inside VVsets on an HPE 3PAR StoreServ Storage system. QoS rules are agnostic for the application type they manage. A QoS rule, on a VVset that contains one or more VVs that make up a datastore, controls the I/O across all VMs using that datastore. This could be suboptimal, however, as some VMs need more I/O resources than others. Combining QoS with VMware Storage I/O Control (SIOC) offers I/O control up to the level of an individual VM—an I/O share and an optional IOPS limit defined per VM distribute the available I/O capacity in a fair way across VMs, ensuring that no single VM consumes all the I/O provided to the VVset through QoS settings. Note that SIOC will not respond to queue-full messages from QoS directly.

HPE 3PAR Priority Optimization can also cooperate with VMware adaptive queue depth to manage I/O. Adaptive queue depth handles I/O congestion in the I/O path to the datastore LUN. It does so by halving the queue length to the LUN when a queue-full message arrives at the ESXi host. This reduction in the queue length gives the array an opportunity to decrease the number of outstanding I/Os at its end. In vSphere 5.1 U1, adaptive queue depth can be configured by LUN, or globally for the ESXi host.

Combining QoS rules with SIOC and adaptive queue depth provides I/O congestion control on three different levels: the workload will honor the QoS limits, and it will be impacted indirectly when SIOC reacts

to latency increases and when adaptive queue depth responds to queue-full messages from QoS rules. Coordination and some experimenting may be necessary to deliver the best results.

VMware vSphere Storage Distributed Resource Scheduler (Storage DRS), a feature introduced in VMware vSphere 5.0, groups datastores into a cluster so that they are managed as a single unit. This allows for load balancing VMs across datastores based on I/O latency and space utilization in an automated or manual way. VMware vSphere Storage DRS leans on Storage vMotion for migrating VMDKs to different datastores. Combining HPE 3PAR Priority Optimization with Storage DRS requires careful planning of the QoS rules. A QoS rule governs one or more LUNs that make up a datastore. Storage DRS implies a source and a destination datastore, each possibly subject to a QoS rule. The QoS rule if any on the Storage DRS destination datastore should have enough headroom to accommodate the additional I/O capacity of the migrated VMDK. If the workload I/O characteristics are not well known, Hewlett Packard Enterprise recommends manual Storage DRS migrations over automated ones to detect any I/O congestion due to the migration in an early stage.

More information:

Activating a software license on page 13

QoS rule reporting

Managing a storage system requires continuous performance monitoring of all critical parameters of a storage system. HPE HPE 3PAR Priority Optimization features new charts in the 3PAR MC for monitoring QoS rules graphically over time.

The HPE 3PAR CLI command `statqos` displays run-time statistics for active QoS rules. The command produces output every 2 seconds (default). Depending on the active QoS rule, the command displays values for the following parameters:

- IOPS
- Bandwidth
- Service time (`Svt_ms`)
- Wait time (`Wtt_ms`)
- Size of the I/O requests (`IOSz_KB`)
- Accumulated number of rejected I/O requests (`Rej`)
- Instantaneous averaged QoS queue length (`Qlen`)
- Instantaneous averaged wait queue length (`WQlen`)

The column headers show:

`Type`

QoS target type (`vvset` or `sys`)

`Name`

QoS target name; also the name of the VVset on which the rule is defined

`I/O_per_second`

`Qt`

IOPS cap, set by the user

`Cur`

Current IOPS

Avg

Average IOPS over all iterations of the `statqos` command so far

Max

Maximum IOPS over all iterations of the `statqos` command so far

Kbytes_per_second

Qt

IOPS cap, set by the user

Cur

Current IOPS

Avg

Average IOPS over all iterations of the `statqos` command so far

Max

Maximum IOPS over all iterations of the `statqos` command so far

Svt_ms

Total service time of I/Os processed by QoS (including wait time and the real service time)

Wtt_ms

Wait time of I/Os delayed by QoS

IOSz_KB

I/O block size in KB (1 KB = 1000 bytes)

Rej

Accumulated number of I/Os rejected by QoS

WQlen

Instantaneous average number of I/Os delayed by QoS

Qlen

Instantaneous average number of I/Os processed by QoS. Includes the number of I/Os delayed by QoS and the number of I/Os processed by QoS without delay.

You can filter by VVset using the `srstatvlun` command. Filtering by VVset is useful for determining which VVs in a given VVset contribute the most in reaching the QoS limit.

Using the `statqos` interface, the on-node tool in 3PAR System Reporter samples QoS statistics periodically, and stores this information for all active QoS rules. The `srstatqos` command will report the statistics for the QoS rules for one or more VVsets for any desired time window. The high-resolution sampling extracts QoS statistics data in 5-minute periods. `srstatqos` options mirror the options of other `srstat` commands.

HPE 3PAR Peer Persistence

HPE 3PAR Peer Persistence enables federation of HPE 3PAR StoreServ Storage systems at geographically separated data centers. Peer persistence also allows applications to move and fail over from one site to another without any application downtime.

With HPE 3PAR Peer Persistence, you can redirect host I/O, either manually or automatically, from the primary to the secondary storage system in a manner that is transparent to the host while causing minimal disruption to service.

For more information about HPE 3PAR Peer Persistence, see the *HPE 3PAR Remote Copy Software User Guide*.

HPE 3PAR SNMP infrastructure

The HPE 3PAR OS includes an SNMP agent that allows you to perform basic management functions through network management software running on a management station. These SNMP management functions require SNMP management software not provided by Hewlett Packard Enterprise. For information about SNMP, see the *HPE 3PAR StoreServ Storage Concepts Guide*.

HPE 3PAR SNMP agent

The 3PAR SNMP agent runs on the system and provides a management interface that allows other software products to manage Hewlett Packard Enterprise hardware using SNMP. The 3PAR SNMP agent responds to GET, SET, GETNEXT, and GETBULK SNMP requests, and generates notification messages (**traps**) for critical events (**alerts**) and alert state changes (for information about requests and traps, see, *HPE 3PAR StoreServ Storage Concepts Guide*).

These traps include the same information as the alerts described in the *HPE 3PAR Alerts Reference: Customer Edition*.

The 3PAR SNMP agent supports SNMPv3, SNMPv2c, SMI-v2 standards, and the SNMPv2-MIB and a proprietary 3PAR MIB. For detailed information about these standards and MIBs, see, *HPE 3PAR StoreServ Storage Concepts Guide*.

You can find all reference documentation in the Hewlett Packard Enterprise Information Library.

More information

SNMP system alerts and alertNotify traps on page 232
Registering an SNMP manager on page 233
Monitoring and managing alerts on page 179
HPE 3PAR MIB location on page 232

HPE 3PAR MIB location

The HPE 3PAR MIB is located on the HPE 3PAR CLI and SNMP CD.

SNMP system alerts and alertNotify traps

The 3PAR SNMP agent converts all system-generated alerts and all alert status change events into `alertNotify` traps. An `alertNotify` trap contains details about events that can affect system operations and performance.

For additional information about system alerts, see the following documentation, available from the Hewlett Packard Enterprise Storage Information Library:

- *HPE 3PAR Alerts Reference: Customer Edition*
- *HPE 3PAR StoreServ Storage Concepts Guide*

Alert status change event notifications

An alert status change event is not an alert. It notifies you that an alert has changed status, such as, from New to Resolved. A trap with `messageCode == 1245186` indicates that an alert has a changed state.

For additional information about system alerts, see the following documentation, available from the Hewlett Packard Enterprise Storage Information Library:

- *HPE 3PAR Alerts Reference: Customer Edition*
- *HPE 3PAR StoreServ Storage Concepts Guide*

More information

Monitoring and managing alerts on page 179
http://www.hpe.com/info/storage/docs

Registering an SNMP manager

For detailed information about all HPE 3PAR CLI commands described in this topic, see the *HPE 3PAR Command Line Interface Reference* for additional information and examples.

Procedure

- To register the SNMP manager with the agent, use the `setsnmpmgr` command followed by the IP address of the SNMP manager. To use any of the following options, enter the option after the command and before the IP address:
  - `-p <port_number>`—Specifies the port number where the manager receives traps. The default port number is 162.
  - `-pw <password>`—Specifies the manager's access password, if the manager has one.
  - `-r <number>` —Specifies the number of times the system will attempt to resend the trap if the manager is not available. You can specify from 1 to 15 retries. The default is 2.
  - `-t <seconds>`—Specifies the number of seconds to wait between retries. You can set this timeout interval from 1 to 300 seconds. The default is 200.

NOTE: The HPE 3PAR OS supports a maximum of 10 registered SNMP managers.

More information:

Viewing registered managers on page 233

Removing a registered manager on page 233

Agent community strings on page 234

Viewing registered managers

To see which managers are already registered with the SNMP agent, issue the HPE 3PAR CLI command `showsnmpmgr`.

NOTE: If the manager that monitors the system has changed, remove the old manager and register the new one.

Removing a registered manager

You can remove a manager from the agent's list of registered managers, thus preventing that manager from receiving traps.

Procedure

- Issue the `removesnmpmgr` command.
- If there is more than one manager running on the same server, you can use the `-p <port_number>` to select the proper manager. Follow the command (and the option and its argument, if applicable) with the IP address of the manager's server.

  For more information about the `removesnmpmgr` command, see the *HPE 3PAR Command Line Interface Reference*, available at the following website:

  Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Agent community strings

The HPE 3PAR StoreServ Storage defaults to `public` as the single community string. The `public` string includes read permission for the SNMP agent. You can add read-only and write-only community strings, and you can change or remove any of the community strings.

For the SNMP manager to communicate with the 3PAR SNMP agent, it must pass the agent the correct community string.

More information

Viewing available community strings on page 234
Adding or updating a community string on page 234
Removing a community string on page 235

Viewing available community strings

Procedure

- To see community strings that are currently available on the system, issue the HPE 3PAR CLI command `showsnmppw`.

  By default, this command shows the read/write community string. If the community string you are requesting does not exist, you will get an error message.

  You can follow the command with one or more of the following options to specify the community string to which the command applies:

  - `-r` for the read-only community string.
  - `-w` for the write-only community string.
  - `-rw` for the read/write community string.

Adding or updating a community string

You can add or update a community string. By default, this command changes the read/write community string.

Procedure

- Issue the `setsnmppw` command followed by the new community string.

  You can follow the command with one or more of the following options to specify the community string to which the command applies:

- `-r` for the read-only community string.
- `-w` for the write-only community string.
- `-rw` for the read/write community string.

Removing a community string

You can remove a community string. Once the community string is removed, the manager can no longer send requests to the SNMP agent. By default, this command removes the read/write community string.

Procedure

- Issue the `removesnmppw` command.

  You can follow the command with one or more of the following options to specify the community string to which the command applies:

  - `-r` for the read-only community string.
  - `-w` for the write-only community string.
  - `-rw` for the read/write community string.

Testing SNMP managers

You can send a test trap to all SNMP managers displayed with the `showsnmpmgr` command.

Procedure

Issue the `checksnmp` command.

The CLI displays the IP addresses of the tested managers.

For details about the test trap sent by the `checksnmp` command, see the HPE 3PAR CLI *Help* and the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Creating SNMPv3 users

The `createsnmpuser` command creates the SNMPv3 user secret key, which is used for generating authentication and privacy keys.

Prerequisites

To create SNMPv3 users, you must have `super` role user rights, or any role that has been granted the `snmpuser_create` right.

Procedure

- To create an SNMPv3 user, issue the `createsnmpuser -p <password> <user_name>` command, where:

- `<password>` represents the password of the HPE 3PAR OS local user. The password is converted to an SNPMv3 secret key. If a password is not specified with the `-p` option, the system prompts you to enter the password of the local user.
- `<user_name>` represents the 3PAR OS local user name. This user name is used as the SNMPv3 user name. The user name must be an existing HPE 3PAR OS local user.

- You can verify the creation of a new user by using the `showsnmpuser` command.

For more information about the `createsnmpuser` command, see the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Viewing SNMPv3 users

You can display information about SNMPv3 users and privacy protocols.

Procedure

- To display all the SNMPv3 users of a system, issue the `showsnmpuser` command.
- To display information for a specific `showsnmpuser` user, issue the `showuser <user_name>` command, where `<user_name>` is the name of the user.

NOTE: Users with `browse` or `service` roles are limited to viewing the information for their own accounts.

For more information about the `showsnmpuser` command, see the *HPE 3PAR Command Line Interface Reference*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

Removing SNMPv3 users

After an SNMPv3 user is removed with the `removesnmpuser` command, an SNMPv3 manager can no longer use that user name to send requests to the SNMP agent. The 3PAR OS local user name remains valid unless it is removed with the `removeuser <user_name>` command. Removing a local user name with the `removeuser` command also removes the SNMPv3 user name from the system.

Procedure

1. To remove an SNMPv3 user from the system, issue the `removesnmpuser <user_name>` command, where `<user_name>` is the name of the user.
2. (Optional.) You can verify the removal of a user with the `showsnmpuser` command.

Modifying SNMP managers

Procedure

1. Log in as `Super` user, or as any user with `snmpmgr_set` permission.
2. To change properties associated with a previously configured SNMP manager, enter the **`setsnmpmgr`** command.
3. To use other options or specifiers associated with the setsnmpmgr command, see, *HPE 3PAR Command Line Interface Reference*, available from the Hewlett Packard Enterprise Information Library.

HPE 3PAR Adaptive Flash Cache

HPE 3PAR Adaptive Flash Cache is available on all HPE 3PAR StoreServ arrays running HPE 3PAR OS 3.2.1 and later. Adaptive Flash Cache operates on small block random read data only (read data whose IO size is less than 64 KiB). HPE 3PAR Adaptive Flash Cache is a built-in array functionality of the HPE 3PAR StoreServ that uses capacity on solid-state drives (SSDs) (flash) to act as a Level-2 read cache holding random read data that has been removed from the DRAM read cache.

IMPORTANT: HPE 3PAR Adaptive Flash Cache (AFC) is now supported on All Flash Array (AFA) based on the NVMe bus architecture and Intel's 3D X-Point technology running the HPE 3PAR OS 3.3.1 Technology Release T05. HPE 3PAR Adaptive Flash Cache is also available on the HPE 3PAR 750GB NVMe Storage Class Memory Module, which is supported on the all-flash array HPE 3PAR StoreServ 9000 Storage and HPE 3PAR StoreServ 20000 Storage systems. For more information, see the HPE 3PAR StoreServ Storage Concepts Guide.

With the HPE 3PAR Adaptive Flash Cache feature, you can create a flash cache using space from your SSDs. Requirements for each node pair are:

- HPE 3PAR StoreServ 7000 Storage system with at least two SSDs
- HPE 3PAR StoreServ 8000 Storage system with at least two SSDs
- HPE 3PAR StoreServ 9000 Storage series with at least four SSDs
- HPE 3PAR StoreServ 10000 Storage series with at least four SSDs
- HPE 3PAR StoreServ 20000 Storage series with at least four SSDs

Flash cache extends system cache without adding physical memory. Creating more cache space from your SSDs allows the HPE 3PAR StoreServ Storage system to deliver commonly accessed data at greater speed. The system automatically reserves the space for flash cache on the SSDs. You do not need to specify which SSDs to use.

The HPE 3PAR Adaptive Flash Cache feature does not require a separate license.

Use flash cache for specified virtual volume sets or for the entire system. Specify the size of the flash cache using the `createflashcache` command. Enable or disable flash cache using the `setflashcache` command.

View flash cache performance statistics using the `statcache` command. You can generate flash cache reports using HPE 3PAR System Reporter.

More information

Statistics and histograms on page 188
Creating flash cache on page 238
Enabling, disabling, and clearing flash cache on page 239
Removing flash cache from the HPE 3PAR StoreServ Storage on page 242

Creating flash cache

Procedure

1. Log in to the system as `Super` or `Edit` user, or as any user with `flashcache_create` permission.
2. Use the `showspace` command to determine how much available SSD space your array has for creating the Flash Cache. Keep in mind that Flash Cache is created as fully allocated RAID 1 Logical Disks behind all nodes on the array.

```
cli% showspace -p -devtype SSD -t r1 -ha mag
--Estimated(MB)---
RawFree UsableFree
1896448     948224
```

3. To run a flash cache in simulation mode, use the following command:
   createflashcache -sim

   The simulation can help you determine the size of the flash cache required to improve random read performance. The simulator mode does not require the use of SSD drives.

4. To **create** a flash cache in an NVMe Storage Class Memory Module environment, the entire flash cache has to be dedicated to the NVMe Storage Class Memory Module. The standard *<size>* parameter associated to the **createflashcache** command cannot be used. The syntax is as follows:
   createflashcache

   ```
   cli% createflashcache
   ```

   To **create** a flash cache in all other situations, use the following command:

   ```
   createflashcache <size>g|G|t|T
   ```

   where,

   ***<size>*g|G|t|T**

   Specifies the size for the flash cache in MiB for each node pair. The flash cache size is a multiple of 16384 (16GiB), and an integer. The minimum size of the flash cache is 64GiB. The maximum size of the flash cache is based on the node types, ranging from 768GiB up to 12288GiB (12TiB). An optional suffix (with no white space before the suffix) modifies the units to GiB (g or G suffix) or TiB (t or T suffix).

   ```
   cli% createflashcache 128g
   ```

5. To view the Flash Cache Logical Disks, use the following command:
   showld

```
cli% showld
 id Name             RAID -Detailed_State- Own   Size MB   Used MB Use  Lgct LgId WThru MapV
  0 admin.usr.0         1      normal       0/1  5120      5120    V    0    ---  N     Y
  1 admin.usr.1         1      normal       1/0  5120      5120    V    0    ---  N     Y
  2 .srdata.usr.0       1      normal       0/1  40960     40960   V    0    ---  N     Y
  3 .srdata.usr.1       1      normal       1/0  40960     40960   V    0    ---  N     Y
  4 log0.0              1      normal       0/-  20480     0       log  0    ---  Y     N
  5 log1.0              1        normal       1/-  20480     0       log  0    ---  Y     N
  6 pdsld0.0            1        normal       1/0  1024      0       P,F  0    ---  Y     N
  7 pdsld0.1            1        normal       1/0  8192      0       P    0    ---  Y     N
  8 pdsld0.2            1        normal       1/0  8192      0       P    0    ---  Y     N
  9 fcacheld.0          1        normal       0/1  65536     0       FLC  0    ---  N     N
 10 fcacheld.1          1        normal       1/0  65536     0       FLC  0    ---  N     N
```

6. To verify that the flash cache was created, enter the following command: **showflashcache**
7. To use other options, or for more detail about using flash cache commands, see, *HPE 3PAR Command Line Interface Reference*

Enabling, disabling, and clearing flash cache

Procedure

1. Log in to the system as `Super` or `Edit` user, or as any user with `flashcache_set` permission.
2. To enable, disable, and clear a flash cache for specific virtual volume sets, or for the entire StoreServ, use the following command syntax:

`setflashcache {enable|disable|clear} {vvset:<name>|sys:all} ...`

enable

Enables a flash cache on the specified virtual volume sets, or on all the volumes in the system.

disable

Disables a flash cache on the specified virtual volume sets, or on all the volumes in the system.

disable

Disables a flash cache at the system level but not the virtual volume set level. The caching policy for any specified virtual volume sets is not affected. This option is only valid with the `sys:all` option.

clear

Clears a flash cache on the specified virtual volume sets, or on all the volumes in the system.

vvset:<name>

Indicates the virtual volume set names that use the flash cache. You can also specify a list of names separated by a space. For example, `vvset:vs1 vvset:vs2`.

sys:all

Indicates that the flash cache is used for all volumes in the system.

The Adaptive Flash Cache is enabled for VVset "`devtest`", which includes VV `devtest.49`:

```
cli% showflashcache -vvset
Id VVSetName AFCPolicy
1 devtest enabled
----------------------
1 total

cli% showflashcache -vv
VVid VVName AFCPolicy
 50 devtest.48 enabled
 51 devtest.49 enabled
 52 devtest.50 enabled
 53 devtest.51 enabled
-------------------------
 4 total
```

Enable the Adaptive Flash Cache for VVset "`flashcachetest`"

```
cli% setflashcache enable vvset:flashcachetest
Flash Cache is now enabled for both devtest and flashcachetest:
cli% showflashcache -vvset
Id VVSetName AFCPolicy
1 devtest enabled
7 flashcachetest enabled
-------------------------
2 total
```

3. Verify the flash cache status with the `showflashcache` command.

   Check whether the Adaptive Flash Cache is still enabled for VV `devtest.49`:

```
cli% showflashcache -vv
VVid VVName AFCPolicy
 50 devtest.48 enabled
 51 devtest.49 enabled
 52 devtest.50 enabled
```

```
 53 devtest.51 enabled
-------------------------
 4 total
```

4. Use the disable option to `disable` the Adaptive Flash Cache.
   Disable the Adaptive Flash Cache for VVset `devtest`:

```
cli% setflashcache disable vvset:devtest

cli% showflashcache -vvset
Id VVSetName AFCPolicy
7 flashcachetest enabled
--------------------------
1 total
```

   The Adaptive Flash Cache is only enabled for VVset `flashcachetest`.

5. To use additional options, or for more information about `flashcache` commands, see, *HPE 3PAR Command Line Interface Reference*.

Verifying flash cache

Procedure

1. Log in to the system as `Super` or `Edit` user, or as any user with `flashcache_create` permission.
2. To verify that flash cache was created, use the following command. Moreover, to see how much flash cache has been allocated for each node on the array and how much of the configured flash cache is actually in use, issue the following command:
   `showflashcache`

```
cli% showflashcache
                    -(MB)-
Node Mode  State     Size   Used%
   0 SSD   normal    65536     0
   1 SSD   normal    65536     0
------------------------------
   2 total          131072
```

3. To verify that the flash cache was created in an NVMe Storage Class Memory Module environment, something like the following output must be displayed:
   `showflashcache`

```
cli% # showflashcache
                   -(MB)-
Node Mode  State      Size Used%
   0 SCM   normal  712704    53
   1 SCM   normal  712704    53
------------------------------
   2 total        1425408
```

4. To display the VVsets on the system flash cache that have been enabled, use the following command:
   `showflashcache -vvset`

```
cli% showflashcache -vvset
Id VVSetName AFCPolicy
 1 devtest   enabled
----------------------
 1 total
```

5. To display the Virtual Volumes (VVs) on the system flash cache that have been enabled, use the following command:
   showflashcache -vv

```
cli% showflashcache -vv
VVid VVName     AFCPolicy
  50 devtest.48 enabled
  51 devtest.49 enabled
  52 devtest.50 enabled
  53 devtest.51 enabled
------------------------
   4 total
```

6. To verify that flash cache is enabled for all virtual volumes, use the following command:
   showflashcache -vv

```
cli% showflashcache -vv
Flash Cache enabled for all Virtual Volumes
```

7. To use other options, or for more detail about using flash cache commands, see, *HPE 3PAR Command Line Interface Reference*

Removing flash cache from the HPE 3PAR StoreServ Storage

Procedure

1. Log in to the system as `Super` or `Edit` user, or as any user with `flashcache_remove` permission.
2. To remove a flash cache from the system, enter the following command:
   removeflashcache

   NOTE: The **removeflashcache** command does not affect any flash cache rules previously defined on the system with the `setflashcache` command.

   Example:

```
cli% showflashcache
                  -(MB)-
Node Mode State   Size  Used%
0    SSD  normal  65536  0
1    SSD  normal  65536  0
------------------------------
 2 total 131072

cli% removeflashcache
Are you sure you want to remove the flash cache?
select q=quit y=yes n=no: y
cli% showflashcache
Flash Cache is not present.
```

   This command removes flash cache from the cluster and stops use of the extended cache.

3. Respond to the request to verify removing flash cache.

   To bypass the response requirement, use the following command:

```
removeflashcache -f
```

4. Verify that the flash cache was removed with the `showflashcache` command.

HPE 3PAR OS system performance tuning

Changing the characteristics of CPGs and changing virtual volume growth patterns can reduce system performance over time. Tuning optimizes the system layout by balancing the use of all available resources.

The HPE 3PAR CLI `tunesys` command analyzes your entire system and automatically corrects space usage imbalances in the system. Virtual volume and physical disk capacity are analyzed and rebalanced for optimal performance. Access to virtual volumes is not interrupted during system tuning operations.

A dirty disk is a disk with chunklets which have been freed for reuse during space reclamation, volume deletion, or CPG compaction. They may still contain user data and must be cleaned before they can be reused.

To maximize the amount of space available for the next tuning operation, the `tunesys` command waits for chunklet cleaning between tuning operations.

Analyzing and tuning nodes and chunklets

Use the `tunesys` command to analyze and detect poor layout and disk utilization across an entire storage system. The command includes a series of low level operations that re-balance resources on the system.

Prerequisites
Review the details of the `tunsys` command in the HPE 3PAR Command Line Interface Reference.

Procedure

1. Log in to the system as `super` user or `edit` role, or with any role granted the `sys_tune` right.
2. To analyze and tune an HPE 3PAR StoreServ Storage system, use the `tunesys` command:
   `tunesys [-nodepct <percentage>] [-chunkpct <percentage>]`

   Use `-nodepct <percentage>` for internode tuning. Define the percentage of acceptable imbalance, in the range of 1 to 100 (defaults to 3). This option finds and rebalances nodes that have a *<percentage>* of imbalance greater than the average for the device type.

   Use `-chunkpct <percentage>` for intranode tuning. Define the percentage of acceptable chunklets, in the range of 1 to 100 (defaults to 5). This option finds nodes that have a *<percentage>* of chunklets in excess of the average for the device type. Stipulates movement of chunklets from the over-utilized disk to under-utilized disks associated with the same node.

Displaying virtual volume space distribution

The `showvvcpg` command displays how virtual volume space is distributed among CPGs.

Procedure

1. Log in to the system using any role.
2. To display virtual volume space distribution, use the following command syntax:
   `showvvcpg -domain {<domain_name>|<pattern>} {<vv_name>|<pattern>|set:<vv_set_name>}`

-domain

Displays virtual volumes in the domain designated by *<domain_name> or <pattern>*. Lists only virtual volumes that exist in domains where the user is a member. Separate multiple domain names or patterns using a comma (,).

<vv_name>|<pattern>|set:<vv_set_name>

Displays the designated virtual volumes, patterns, or virtual volume sets. The `set:` label must precede a virtual volume set specification (<vv_set_name>).

3. To use other available options, see, *HPE 3PAR Command Line Interface Reference*.

Tuning and modifying virtual volumes

The HPE 3PAR CLI provides the `tunevv` command, which you can use to change the properties of a virtual volume. Changes include modifying the virtual volumes so they use all available hardware resources, which can improve performance. You can also change the parameters, RAID levels, and set sizes for virtual volumes. Modifying virtual volumes does not interrupt access to the virtual volumes.

NOTE: Run the conversion procedures during off-peak hours. If you get any error, wait for some time and retry the command.

Use of this command requires a Dynamic Optimization license. Contact your local HPE representative for information.

Procedure

1. Log in to the system as `Super` or `Edit` user, or as any user with `vv_tune` permission.
2. The `tunevv` command uses the following syntax options:

```
tunevv usr_cpg <cpg> [options] <VV_name>
tunevv snp_cpg <cpg> [options] <VV_name>
tunevv restart [options] <VV_name>
tunevv rollback [options] <VV_name>
```

   The limit on the amount of data that can be tuned in a tunevv command is equivalent to ten 16TB virtual volumes. If you exceed this limit, the system rejects the command.
3. When Online Import migrates a volume, HPE 3PAR OS preserves the original volume size. The `tunevv` command could fail if the volume size is not a multiple of 256 MiB with the following message: "Error: VV needs to be a multiple of 256 MiB." To combat this situation, use the `growvv` command to increase the size of the volume to a multiple of 256 MiB before performing tuning the virtual volume.
4. To review and use the full capabilities of the tunevv command, see, *HPE 3PAR Command Line Interface Reference*.

Changing virtual volume layouts

Use the `tunevv` command to take advantage of new or upgraded hardware by creating new CPGs after a hardware upgrade and then running the `tunevv` command to associate specified virtual volumes with those new CPGs. By default, thinly provisioned virtual volumes and their underlying CPGs dynamically allocate space from all available resources as they grow, both from pre-existing and new or upgraded drive resources. The dynamic capability of TPVVs generally reduces the need for changing the logical disk layout of TPVVs after adding disks.

In addition to taking advantage of hardware upgrades, you may want to move the logical disks with which a virtual volume is associated to a CPG having a configuration different from the CPG on which the virtual

volume was created. You can create a CPG with a different RAID level or set size (specified in chunklets), or that supports different hardware failure levels, and then run the `tunevv` command to move a virtual volume to the CPG with the changed configuration.

In general terms, to associate a given virtual volume with a new CPG either as a consequence of a hardware upgrade or because changes to the current CPG are required, perform the following steps:

Procedure

1. Create the new CPG with the required configuration and characteristics. For instructions and options for creating CPGs, see **Creating a CPG**.
2. Associate the virtual volume with the new CPG by issuing the `tunevv usr_cpg <cpg_name> <VV_name>` command, where:
   - `usr_cpg` is the subcommand that moves logical disks on which user space has been allocated for a virtual volume to a different CPG.
   - `<cpg_name>` specifies the name of the CPG to which the logical disks associated with a virtual volume will be moved. Use the name of the CPG created in Step 1.
   - `<VV_name>` is the name of the existing virtual volume you are modifying, either a thinly provisioned virtual volume or an FPVV.
3. Associate the snapshot space of the virtual volume with a new CPG by issuing the `tunevv snp_cpg <cpg_name> <VV_name>` command, where:
   - `snp_cpg` is the subcommand that moves the logical disks being used for snapshot space for a virtual volume to a different CPG.
   - `<cpg_name>` specifies the CPG to which the snapshot space for the virtual volume is moved.
   - `<VV_name>` is the name of the virtual volume, either a TPVV or an FPVV, for which snapshot space is being moved.

Volume modification with tunevv

When performing a `tunevv` task, errors can occur that can interrupt the task. Depending on the cause of interruption, you can either roll back or restart a `tunevv` task.

Perform rollback and restart operations on FPVVs only.

You can schedule, monitor, and manage the `tunevv` command operations as a system task.

More information

Rolling back a volume modification task on page 246
Restarting a volume modification task on page 247
Task manager commands on page 197

Rolling back a volume modification task

Rolling back a `tunevv` task restores a volume to its directly previous state. Issuing a rollback command performs an undo of the last operation. A rollback task is appropriate if the operation was interrupted because of:

- Lack of space.
- User-initiated cancellation of a task.

Procedure

1. Log in to the system as `Super`, `Service`, or `Edit` user, or as any user with `task_cancel` permission.
2. To cancel a task, enter the following command:
   `canceltask <task_ID>`

   The `<task_ID>` is the ID of the `tunevv` task you want to cancel.
3. To restore the virtual volume to its former state, enter the following command:
   `tunevv rollback <VV_name>`

Restarting a volume modification task

You can restart a `tunevv` task that was previously interrupted. Reasons for interruption include:

- User-initiated cancellation of a task.
- Component failure.

Procedure

1. Log in to the system as `Super` or `Edit` user, or as any user with `vv_tune` permission.
2. To restart a `tunevv` task, enter the following command:
   `tunevv restart <VV_name>`

HPE 3PAR System Tuner

The HPE 3PAR System Tuner is an optional feature that improves performance by identifying overloaded physical disks, and performing load balancing on those disks without interrupting access. Use the HPE 3PAR CLI `tunepd` command to perform tuning tasks on physical disks.

Degraded performance of one or more physical disks reduces the throughput of the logical disks, and the entire system performance can decline. Physical disks can have degraded performance in the following circumstances:

- The physical disk has reached its maximum throughput due to an unbalanced load. A disk in this state typically has unusually high average service times when compared to other disks.
- The physical disk is a bad disk. A bad disk typically has unusually high maximum service times when compared to other disks.

The `tunepd` command allows you to:

- Perform physical disk performance tuning on an entire system or on a specified subset of disks.
- Set performance thresholds for physical disk tuning.
- Identify and relocate under-performing chunklets.

Tuning physical disks

Running the `tunepd` command does not eliminate the need to run the `tunesys` command. The `tunesys` command performs space-based balancing. The `tunepd` command performs service time and I/O based balancing. For information about how the system manages space usage, see the *HPE 3PAR StoreServ Storage Concepts Guide*.

The following procedure identifies physical disks with average service times exceeding 50 ms, and automatically relocates chunklets to rebalance the load on the physical disks.

Prerequisites

The `tunepd` command requires the HPE 3PAR System Tuner or the HPE 3PAR All-inclusive Single-System software license.

Procedure

1. To tune physical disks as defined in the preceding, enter the following command:
   `tunepd -vvlayout -chstat -movech auto avgsvct 50`

   `-vvlayout`

   Displays the layout of the virtual volume.

   `-chstat`

   Displays the chunklet statistics. To use this option with `-movech`, you must also specify on or force.

   `-movech auto`

   Detects disks with unbalanced loads and moves chunklets from those disks for load balancing. The auto specification allows the system to choose source and destination chunklets.

   `avgsvct <mesecs>`

   Specifies the average service time threshold in ms (in this case, 50).
2. To review and use more tuning options, see, *HPE 3PAR Command Line Interface Reference*.

More information

Statistics and histograms on page 188
Activating a software license on page 13

CPG and logical disk modification

CPGs provide a shared pool of LD capacity for use by all virtual volumes that draw space from that pool. If you delete volumes that draw from a CPG, the underlying LDs in the CPG pool can use space less efficiently. This inefficient use of space also occurs if copy space for these volumes grows and then shrinks.

Compacting a CPG consolidates CPG space into as few LDs as possible, reclaiming that space for more efficient uses.

Similarly, LDs also use space less efficiently when a user deletes volume groups.

Volume groups created using a single volume creation operation share the underlying LDs that support those volumes. If you later delete several of the members of that volume group, the underlying LDs can become less efficient in the usage of space.

One or more LDs shared by the volume group might map a small portion of a region to existing virtual volumes, and the system cannot use these regions to create LDs. Compacting the LD regions mapped to these volumes can recover and free LD space.

For more information about how the system manages space usage, see the *HPE 3PAR StoreServ Storage Concepts Guide*.

More information

Compacting CPGs on page 249
Compacting logical disks on page 249

Compacting CPGs

Use the `compactcpg` command to reclaim unused CPG space.

Procedure

1. Log in to the system as `Super` or `Edit` user, or as any user with `cpg_compact` permission
2. To compact a CPG by name, enter the following command:
   `compactcpg <CPG_name>`

   Separate multiple CPG names using a comma (`,`).
3. To compact CPGs using pattern recognition, enter the following command:
   `compactcpg -pat <pattern>`

   `-pat <pattern>`

   Specifies a glob-style pattern.

   Separate multiple patterns using a comma (`,`).
4. To use other options and specifiers, or to schedule compact CPG functions, see, *HPE 3PAR Command Line Interface Reference*.

Compacting logical disks

You can compact LDs for a group of volumes that share LDs by using the `compactld` command. The command migrates existing regions on the fragmented LDs to new, fully used LDs, and deletes the fragmented LDs. This action returns space to the free chunklet pool.

Procedure

1. Log in to the system as `Super` or `Edit` user, or as any user with `ld_compact` permission.
2. To reclaim unused LD space from a group of virtual volumes, enter the following command:
   `compactld <LD_name>`

   Separate multiple LD names using a comma (`,`).
3. To reclaim unused LD space using pattern recognition, enter the following command:
   `compactld -pat <pattern>`

   Separate multiple LD patterns using a comma (`,`).
4. To use additional options or to schedule this task, see, *HPE 3PAR Command Line Interface Reference*.

HPE 3PAR File Persona Software

The HPE 3PAR File Persona Software Suite adds file services to the native, block persona services available on HPE 3PAR StoreServ Storage systems. File Persona software uses standard file system protocols (SMB and NFS).

By enabling File Persona features on an HPE 3PAR StoreServ Storage system, you can create and manage various storage objects, including Virtual File Services (VFS), File Provisioning Groups (FPG), and File Stores.

Beginning with HPE 3PAR OS 3.2.1 MU3, the HPE 3PAR File Persona software comes installed on your 3PAR storage system. The software requires an HPE 3PAR File Persona or HPE 3PAR All-inclusive Single-System software license. You must also have the appropriate hardware installed, and have network components configured to support File Persona services. Contact a Hewlett Packard Enterprise representative for assistance.

For information about hardware compatibility, see Single Point of Connectivity Knowledge for Hewlett Packard Enterprise Storage Products (SPOCK).

For information about enabling and configuring File Persona, see, *HPE 3PAR File Persona User Guide*.

More information

Activating a software license on page 13

vSphere virtual volumes

VMware introduced the VVols feature in VMware vSphere 6.0. VMware VVols are the VMware implementation of software-defined storage, and enable vSphere to provision the array volumes used by VMs. This VMware implementation transfers VM storage volume provision and management tasks away from the storage array administrator and to the VMware vSphere administrator.

With traditional storage volumes, the storage administrator creates storage volumes manually with the necessary capabilities to meet VMware administrator requirements. With VVols, when creating individual VMs, the array advertises its capabilities and allows the VMware vSphere vCenter administrator to create VVols as needed with the requested capabilities.

Standard HPE 3PAR virtual volumes (accessible as LUNs) can still provision storage for vSphere VMs. An HPE 3PAR StoreServ Storage system supports both VVols and LUNs as containers for VMs on the same system.

For more information about using VVols with VMware vSphere, see, *HPE 3PAR VMware ESX/ESXi Implementation Guide*.

Prerequisites for VASA and VVol implementation

Prerequisites

1. Use the procedures found in the *HPE 3PAR VMware ESX/ESXi Implementation Guide* to complete the following:
   a. Synchronize all system clocks.
   b. Establish a PE for the array by configuring relevant vSphere hosts connected to the HPE 3PAR StoreServ Storage with the VMware host persona.
   c. Register the VASA Provider service in the vSphere environment.
2. **Start the VASA Provider service in the vSphere environment**.
3. **Start the VASA Provider service on the HPE 3PAR StoreServ Storage system**.
4. **Configure the SSL certificate and certificate management mode for the VASA Provider service**.
5. **Configure CPGs to define capability profiles for VMs**

vSphere VASA Provider service

The vSphere API for Storage Awareness (VASA) defines an interface for communication between vSphere administration systems and storage providers, such as HPE 3PAR StoreServ Storage system. vSphere administration systems include:

- vCenter Server
- vSphere Web Client
- ESXi hosts

The VASA Provider is a web service developed to take advantage of the VASA interface. The VASA Provider enables communication between the vCenter and the HPE 3PAR StoreServ Storage management interface by using the VMware VASA 2.0 or 3.0 protocols.

With the VASA Provider service enabled on an HPE 3PAR StoreServ Storage system, VASA brokers requests between vSphere and the HPE 3PAR StoreServ Storage system. vSphere administrators can use this service to query storage capabilities and manage VVols on the array.

Licenses for VMware VVol support

Beginning with the HPE 3PAR OS 3.3.1, the HPE 3PAR Virtual Copy license is part of the new array/frame-based HPE 3PAR All-inclusive Single-System software license.

The VASA Provider service comes preinstalled as a component of the HPE 3PAR OS, and VASA requires no specific license. However, HPE 3PAR Virtual Copy requires either a specific license or an HPE 3PAR All-inclusive Single-System software license. To enhance the VVol experience, Hewlett Packard Enterprise recommends either the HPE 3PAR All-inclusive Single-System software license or the following licenses:

- HPE 3PAR Adaptive Flash Cache
- HPE 3PAR Thin Deduplication
- HPE 3PAR Thin Persistence
- HPE 3PAR Thin Provisioning
- HPE 3PAR Virtual Domains

For more information on All-inclusive licensing, see, *HPE 3PAR StoreServ Storage Concepts Guide*.

For specific interoperability support information about using VVols with HPE 3PAR StoreServ Storage systems, see, SPOCK.

More information

Activating a software license on page 13

Starting VASA Provider

Prerequisites

Before starting the VASA provider, make sure that you have a certificate for the VASA provider. Use the `showvasa -cert` command to determine whether you currently have a certificate. If you do not, determine the VASA certificate management mode that you will use and create a new certificate for the VASA provider. See:

- The *HPE 3PAR VMware ESX/ESXi Implementation Guide*, available at the following website: **Hewlett Packard Enterprise Information Library** (http://www.hpe.com/info/storage/docs)
- **SSL certificate management mode for the VASA Provider service** on page 254

Procedure

- To start VASA provider in the vSphere environment, see **Starting VASA Provider in the vSphere environment**.
- To start VASA provider on the HPE 3PAR StoreServ Storage system, see **Starting VASA Provider on the HPE 3PAR StoreServ Storage system**.

Starting VASA Provider in the vSphere environment

Procedure

To start the VASA Provider service for processing VASA requests over HTTP from the vSphere environment, issue the `startvasa` command.

Starting VASA Provider on the HPE 3PAR StoreServ Storage system

The VASA Provider service is automatically started and enabled on the HPE 3PAR StoreServ Storage system.

Prerequisites

Starting the VASA Provider requires `super` rights.

Procedure

- Identify the VASA URL for the array (either an IP address or a DNS name) by using the `showvasa` command, as in the following example (which displays an IP address for the VASA URL):

```
cli% showvasa

-Service- ---------VASA_API2_URL---------- -MemUsage(MB)- -Version-
Enabled   https://192.123.45.111:9997/vasa             67 2.2.3
```

- The VASA Provider Service can also be started and enabled manually by using the `startvasa` command.

Displaying properties of the VASA Provider service

Procedure

- Issue the `showvasa` command to display the following information about the VASA Provider service:
  - Whether the VASA Provider is enabled or disabled
  - The VASA Provider web address
  - The memory being used by the VASA Provider service
  - The version of the VASA Provider (for example, 2.2.3)
  - The host name or IP address
- Issue the `showvasa -cert` command to display the following information about the SSL certificate used for secure VASA communications:
  - The certificate management mode for the VASA Provider service
  - The certificate subject (that is, the DN of the certificate)
  - The digital fingerprint of the certificate

Stopping the VASA Provider service

Procedure

To stop the VASA Provider service and to discontinue processing VASA requests from the vSphere environment, issue the `stopvasa` command.

SSL certificate management mode for the VASA Provider service

The 3PAR VASA Provider uses a CA certificate to provide encrypted connections between VMware vSphere and the 3PAR VASA Provider. The VASA 2.0 protocol allows for two different certificate management modes:

- VMware vSphere-managed (also known as “client-managed”) mode
- 3PAR VASA Provider-managed (also known as “server-managed”) mode

When using vSphere-managed certificates, a CA certificate associated with vCenter, known as the VMCA certificate, is used to sign the 3PAR VASA Provider certificate. VMware vSphere takes ownership of the 3PAR VASA Provider certificate and manages it from that point forward.

When SSL certificates for secure VASA communications are client-managed, the VASA Provider service is associated with only one SSL certificate. It is therefore possible to register the VASA Provider in only one vSphere environment at a time, because the same SSL certificate cannot be managed by multiple vSphere systems. With client-managed certificates, if you want to register the VASA Provider with a different vCenter Server, the VASA Provider must be unregistered from the current vCenter Server and its SSL certificate must be reset using the `setvasa -reset` command.

When SSL certificates are server-managed, the storage administrator on the HPE 3PAR StoreServ Storage system can associate multiple certificates with the 3PAR VASA Provider service. These certificates are used to provide simultaneous connections to different vSphere environments.

NOTE: Hewlett Packard Enterprise recommends use of the server-managed certificates. In HPE 3PAR OS 3.2.2 and later, SSL certificates for VASA communications are server-managed by default. If the VASA Provider service was enabled in an earlier version of the HPE 3PAR OS, and the HPE 3PAR OS is upgraded to 3.2.2, the SSL certificate management mode will be set for certificate management on the client (the vSphere host) unless the mode is changed to server-managed. Changing the SSL certificate management mode will disrupt any active VASA connections. If the certificate management mode is changed, the 3PAR VASA Provider must be reregistered for any VMware vSphere environments in which the 3PAR VASA Provider is currently registered to restore connectivity.

For more information about SSL certificate management, see the *HPE 3PAR VMware ESX/ESXi Implementation Guide*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

CPGs and capability profiles for VMs

For information on how default CPGs are selected for VVols, see the *HPE 3PAR VMware ESX/ESXi Implementation Guide*.

VVol management with the 3PAR CLI

Volumes for VMware virtual machines (VVols) default to `hidden`, and users would typically manage VVols from the vSphere environment. Because of the default VVol condition, some HPE 3PAR CLI commands might not operate on or display information for VVols using the base command.

You can include VVols in such commands by using the specific VVol name, modifying your CLI environment to show hidden VVols, or using VM pattern filters.

- **Name** – Specify the name of the VVol when executing the command:

  ```
  cli% statvv <vvol_name>
  ```

- **Setting the CLI environment** –

  Set the `matchbulkobj` environment variable of the `setclienv` command to a value of `1`. This setting includes VVols in virtual volume commands:

  ```
  cli% setclienv matchbulkobjs 1
  ```

- **VM pattern filters** – Use the `-p <pattern>` filtering option. For more information about VM pattern filtering, see the HPE 3PAR CLI Reference, or the CLI help for any of the following commands.
  - `showvv`
  - `histvv`
  - `statvv`
  - `statvlun`
  - `srstatvlun`
  - `histvlun`
  - `srhistvlun`

More information

Software licenses and HPE 3PAR CLI on page 13
General control and help commands on page 26

VVols abandoned by vSphere

Managing VMs in the vSphere environment includes automatic creation and removal of VVols and associated objects on the HPE 3PAR StoreServ Storage system. If the vSphere administrator removes a virtual machine created using VVols, the associated virtual volumes are removed automatically from the array, and space on the array is reclaimed. The storage administrator does not need to perform any actions to allocate or reclaim space used by VVols.

However, a storage administrator might need to remove abandoned volumes and VVols created by operations in the vSphere environment. Traditionally, the array administrator would remove the LUNs exported to certain ESXi hosts, and then remove the virtual volumes associated with those LUNs. With VVols, the storage administrator has more granular control and is able to remove VVols associated with individual virtual machines, or remove all VVols (and associated objects) for a particular storage container.

Before removing VVols, the storage administrator should confirm with a vSphere administrator that the VVols are abandoned and no longer needed. The storage administrator can request that the vSphere administrator reregister the abandoned VMs.

IMPORTANT: Removing VVols without coordinating with the vSphere administrator can have an adverse effect on VM functionality in the vSphere environment.

HPE 3PAR StoreServ Storage storage administrator might remove VVols under the following circumstances:

- The vSphere administrator removed a VVol-based VM from the vCenter inventory, without removing it from the disk.
- The vSphere administrator removed an ESXi host without cleaning up the VM resources associated with that ESXi host.
- The vSphere administrator abandoned the vCenter environment without cleaning up array resources.

Reregistering abandoned VMs

To ensure the integrity of the vSphere environment, Hewlett Packard Enterprise recommends that the vSphere administrator reregister abandoned VMs in the vSphere environment when cleaning up array resources associated with VVol VMs. Storage administrators can identify the abandoned VMs, and then request that the vSphere administrator reregister the VMs in the vSphere environment.

Procedure

1. Log in to the system using any role.
2. To identify VMs to reregister, use the following syntax:
   `showvvolvm -sc [sys:all|<container_name>]`

   `sys:all`

   Displays all VMs

   `<container_name>`

   Displays the VMs within the named storage container.
3. Send a reregistration request to the vSphere administrator and provide the list of VMs.
4. After coordinating with the vSphere administrator, you can reregister VMs on VVol datastores using the following procedure from the vSphere datastore browser:

   a. From the browser menu, select **Datastore** > **(DatastoreName)** > **Actions** > **Browse Files**.

   b. From the **Browse Files** dialog, expand the VMs to identify the VMX files.

   c. To register the VM with the vSphere environment, right-click a given VMX file, and then follow the onscreen prompts.

Removing VVols and sub-LUNs associated with individual VMs

Removing VVols and associated objects from an HPE 3PAR StoreServ Storage system can disrupt the vSphere environment. Coordinate any changes on the array with the vSphere administrator.

Procedure

1. Log in to the system using any role.
2. Identify the VVols and sub-LUN bindings:

   a. To identify the VVols associated with a given VM, enter the following command:
   `showvvolvm -sc [sys:all|<container_name>] -vv`

   `sys:all`

   Displays all VMs

<container_name>

Displays the VMs within the named storage container.

-vv

Displays the virtual volumes associated with the listed VMs.

The system returns information using the following column headings:

```
VM_Name VV_ID VVol_Name VVol_Type Prov Physical Logical
```

b. To identify any sub-LUN bindings associated with the VVols, enter the following command: **showvlun**

3. Remove VVols and sub-LUN bindings:

a. Log in to the system as `Super` or `Edit` user.

b. To remove the VVols, enter the following command:
`removevv`

c. To remove the sub-LUN bindings, enter the following command:
`removevlun`

4. To use additional options and specifiers related to any of these CLI command, see, *HPE 3PAR Command Line Interface Reference*.

Removing a VVol storage container

When you detect abandoned VVol storage containers left by the vSphere environment, you can remove these storage containers and the VVols they contain. Remove storage containers by using the `setvvolsc -remove set:<container_name>` command.

Procedure

1. Log in to the system using any role.

2. To identify the VVol storage containers on the array, enter the following command: **showvvolsc**

```
cli% showvvolsc
                                -------(MB)-------
Name          Num_VMs Num_VVols In_Use Provisioned
stor_con_s931       4         9  36096       98304
abcdef-vvset        0         0      0           0
Test-vvolsc         0         0      0           0
aks-sc              0         0      0           0
ghij-sc1            1         2   4352       45056
MSC003-arVjv5       0         1   3584        4096
MSC003-EqeI2x       0         2   5120        8192
-----------------------------------------------------
total               5        14  49152      155648
```

3. Verify with the vSphere administrator which storage containers, and which VVols within them, are no longer needed.

4. To remove the VVol storage containers, log in to the system as `Super` or `Edit` user, or as any user with `vv_set` permission.

5. Enter the **setvvolsc -remove set:*<container_name>*** command.

The system requires confirmation of the removal.

```
cli% setvvolsc -remove set:stor_con_s931
You are about to remove a VVol storage container and all of its volumes. Do you wish
to continue?
select y=yes n=no: y
Removing VVol storage container set:stor_con_s931 and all its volume
Unable to remove vvset. VLUNs are exported.
Use removevlun -set to remove exported VLUNs first.
```

In some cases, VVols in the storage container are still bound by ESX hosts, and the `setvvolsc` operation does not completely remove the VVol storage container. To confirm that the VMs using these VVols are no longer needed, contact the vSphere administrator.

6. To identify the remaining, bound virtual machines in the storage container, enter the following command:
   showvvolvm -b -sc *<container_name>*

7. To confirm whether the virtual machines are needed, give the list to the vSphere administrator.

```
cli% removevlun -set stor_con_s931
Issuing removevlun cfg-VM2cl-9ad4921a 1 dl160g6-44
select q=quit y=yes n=no: y
No matching vluns
No matching vluns
Issuing removevlun dat-VM2cl.vm-3f70cd26 2 dl160g6-44
select q=quit y=yes n=no: y
No matching vluns
No matching vluns
```

8. After coordinating with the vSphere administrator, the VMware administrator can and should unbind the virtual machines associated with these VVols. If that is not possible, you can force-remove the bindings from the array. To force-remove the bindings from the vSphere environment, enter the following command:
   removevlun -set *<container_name>*

9. To complete the removal of the storage container after removing the bindings, enter the following command:
   setvvolsc -remove set:*<container_name>*

```
cli% setvvolsc -remove set:stor_con_s931
You are about to remove a VVol storage container and all of its volumes. Do you wish to continue?
select y=yes n=no: y
Removing VVol storage container set:stor_con_s931 and all its volume
Removing vv cfg-VM1cl-859c7081
Removing vv dat-VM1cl.vm-beedbbe4
Removing vv cfg-VM2cl-9ad4921a
Removing vv dat-VM2cl.vm-3f70cd26
Removing vv cfg-VM1-9a25293b
Removing vv dat-VM1.vmd-10c31e52-Snap
Removing vv dat-VM1.vmdk-07b44bd3
Removing vv rcpy.33.533.1.1
Removing vv cfg-NewVirtu-e8e5eab9
Removing vv rcpy.33.537.1
Removing vv dat-NewVirtu-6d2b1687
```

Support and other resources

Accessing Hewlett Packard Enterprise Support

Procedure

1. For live assistance, go to the Contact Hewlett Packard Enterprise Worldwide website:

   www.hpe.com/assistance (www.hpe.com/assistance)

2. To access documentation and support services, go to the Hewlett Packard Enterprise Support Center website:

   www.hpe.com/support/hpesc (www.hpe.com/support/hpesc)

Information to collect

- Technical support registration number (if applicable)
- Product name, model or version, and serial number
- Operating system name and version
- Firmware version
- Error messages
- Product-specific reports and logs
- Add-on products or components
- Third-party products or components

Specify the type of support you are requesting:

HPE 3PAR StoreServ Storage	Support request
HPE 3PAR StoreServ 7000 Storage	StoreServ 7000 Storage
HPE 3PAR StoreServ 8000 Storage	StoreServ 8000 Storage
HPE 3PAR StoreServ 9000 Storage	StoreServ 9000 Storage
HPE 3PAR StoreServ 10000 Storage	StoreServ 10000 Storage
HPE 3PAR StoreServ 20000 Storage	StoreServ 20000 Storage

Accessing updates

- Some software products provide a mechanism for accessing software updates through the product interface. To identify the recommended software update method, review your product documentation.
- To download product updates, go to either of the following:

- Hewlett Packard Enterprise Support Center **Get connected with updates** page:

  www.hpe.com/support/e-updates

- 3PAR StoreServ Software Depot website:

  3PAR StoreServ Software Depot (www.hpe.com/support/softwaredepot-3PAR)

- To view and update your entitlements, and to link your contracts and warranties with your profile, go to the Hewlett Packard Enterprise Support Center **More Information on Access to Support Materials** page:

  www.hpe.com/support/AccessToSupportMaterials

  IMPORTANT: Access to some updates might require product entitlement when accessed through the Hewlett Packard Enterprise Support Center. You must have an HPE Passport set up with relevant entitlements.

HPE 3PAR documentation

For information about:	See:
Supported hardware and software platforms	The Single Point of Connectivity Knowledge for HPE Storage Products (SPOCK) website: **http://www.hpe.com/storage/spock**
Locating 3PAR documents	The Hewlett Packard Enterprise Storage Information Library: **Storage Information Library** (http://www.hpe.com/info/storage/docs/). By default, **HPE 3PAR Storage** is selected under **Products & Solutions**.
Customer Self Repair procedures (media)	The Hewlett Packard Enterprise Customer Self Repair Services Media Library: **Customer Self Repair Services Media Library** (http://www.hpe.com/support/softwaredepot-3PAR).
All Hewlett Packard Enterprise products	Hewlett Packard Enterprise Support Center: **Hewlett Packard Enterprise Support Center** (http://www.hpe.com/support/hpesc)

Websites

Website	Link
Hewlett Packard Enterprise Information Library	**www.hpe.com/info/enterprise/docs**
Hewlett Packard Enterprise Support Center	**www.hpe.com/support/hpesc**
Contact Hewlett Packard Enterprise Worldwide	**www.hpe.com/assistance**
Subscription Service/Support Alerts	**www.hpe.com/support/e-updates**

Table Continued

Website	Link
Software Depot	**www.hpe.com/support/softwaredepot**
Customer Self Repair	**www.hpe.com/support/selfrepair**
Insight Remote Support	**www.hpe.com/info/insightremotesupport/docs**
Serviceguard Solutions for HP-UX	**www.hpe.com/info/hpux-serviceguard-docs**
Single Point of Connectivity Knowledge (SPOCK) Storage compatibility matrix	**www.hpe.com/storage/spock**
Storage white papers and analyst reports	**www.hpe.com/storage/whitepapers**

Customer self repair

Hewlett Packard Enterprise customer self repair (CSR) programs allow you to repair your product. If a customer self-replaceable part must be replaced, it will be shipped directly to you so that you can install it at your convenience. Some parts do not qualify for CSR. Your Hewlett Packard Enterprise authorized service provider will determine whether a repair can be accomplished by CSR.

For more information about CSR, contact your local service provider or go to the CSR website:

www.hpe.com/support/selfrepair

Remote support

Remote support is available with supported devices as part of your warranty or contractual support agreement. It provides intelligent event diagnosis, and automatic, secure submission of hardware event notifications to Hewlett Packard Enterprise, which will initiate a fast and accurate resolution based on your product's service level. Hewlett Packard Enterprise strongly recommends that you register your device for remote support.

For more information and device support details, go to the following website:

www.hpe.com/info/insightremotesupport/docs

Documentation feedback

Hewlett Packard Enterprise is committed to providing documentation that meets your needs. To help us improve the documentation, send any errors, suggestions, or comments to Documentation Feedback (**docsfeedback@hpe.com**). When submitting your feedback, include the document title, part number, edition, and publication date located on the front cover of the document. For online help content, include the product name, product version, help edition, and publication date located on the legal notices page.

Glossary

For additional information about the srstatvlunHPE 3PAR OS, see the *HPE 3PAR StoreServ Storage Concepts Guide*, available at the following website:

Hewlett Packard Enterprise Information Library (http://www.hpe.com/info/storage/docs)

A

ACL

Access control list.

active host

A host that is connected to a system port and recognized by the HPE 3PAR OS.

active VLUN

The pairing of a virtual volume and a LUN so the host can access its virtual volume and I/O writes can be saved to the virtual volume. The VLUN parameters determine whether a virtual volume is expressed as an active VLUN. VLUNs that are not active will not communicate with the HPE 3PAR StoreServ Storage system.

admin volume

The base volume that is used by the system to store administration data such as the system event log. The admin volume is created as part of the system installation and setup process.

administrative space

Also known as admin space. The area of the volume that corresponds to logical disk regions that track changes to the volume since the previous snapshot was created.

alert

A system event that requires the immediate attention of the user and might also require user intervention.

allocation limit

User-defined threshold that can be set for thinly provisioned virtual volumes and FPVVs to cap their potential size.

ALUA

Asymmetric logical unit access.

aocfg

HPE 3PAR Adaptive Optimization configuration.

ASIC

Application-specific integrated circuit.

authentication key

A cryptographic key that protects data integrity on self-encrypting drives. The authentication key, maintained by a local or external (EKM) key manager and backed up and guarded by system administrators, locks and unlocks the drive.

availability

Level of fault-tolerance for a logical disk. For example, magazine-level availability means that the logical disk can tolerate a drive magazine failure. Cage-level availability means that the logical disk can tolerate a drive cage failure.

B

base volume

A thinly provisioned virtual volume, thinly-provisioned deduplicated virtual volume, or fully provisioned virtual volume that has been copied.

C

CA

Certificate authority.

CC

Common Criteria. An international standard (ISO/IEC 15408) for computer security certification.

chunklet

A block of contiguous storage space on a physical disk. On HPE 3PAR StoreServ Storage systems, all chunklets are 1 GB.

CIM

Common Information Model. An open standard interface for distributed storage management.

classes of service

The characteristics and guarantees of the transport layer of a Fibre Channel circuit. These classes include connection services (Class 1), guaranteed frame delivery with end-to-end flow control (Class 2), and packetized frame datagrams (Class 3).

cluster

A group of controller nodes connected via the same system backplane. The nodes in a cluster operate as a unified system, separate from any other clusters that may share the same service processor.

CMP

Cache memory page. A 16 KB block of control cache memory where I/O requests are stored.

CN

Common name.

CNA

Converged network adapter.

control cache

Memory modules that support the microprocessors located in a controller node.

controller node

An individual device that works with other controller nodes to cache and manage data in a system and to provide hosts with a coherent, virtualized view of the storage system.

controller node chassis

An enclosure that houses all the controller nodes of a system.

copy data

Data that occupies the snapshot data space (virtual copy space) on a virtual volume.

copy space

Also known as snapshot space. The area of the volume that corresponds to logical disk regions that contain copies of user data that has changed since the previous snapshot.

copy-on-write snapshot

A snapshot of a virtual volume made with the copy-on-write technique. This type of snapshot consists of a pointer to the source volume and a record of every change made to the source volume since the snapshot was created.

CPG

Common provisioning group (also known as a storage pool or logical disk pool). A set of logical disks from which you can create virtual volumes and virtual copies that are capable of allocating storage on demand.

CSR

Certificate signing request.

CSV

Comma Separated Values.

D

DAR

Data at rest; archived data. Data at rest may also include data that is seldom accessed and that is stored on hard drives, backup disks, or on a storage area network.

data cache

The dual in-line memory modules that support the HPE 3PAR ASIC located in a controller node.

DDS

Dedup Data Storage

destination volume

The virtual volume to which data is copied during a virtual or physical copy operation.

DN

Distinguished name.

DNS

Domain Name System.

DRAM

Dynamic random access memory.

drive cage

A component in a rack or chassis that contains a drive. Drive cages connect to nodes for communication with hosts.

drive magazine

An electronic circuit board mounted on a mechanical structure that is inserted into a drive bay in a drive cage. A drive magazine holds up to four physical disks.

DSA

Digital Signature Algorithm.

E

EKM

External key management.

encryption key

A cryptographic key that is not exposed outside of the drive itself. The encryption key is used to encrypt and decrypt all data stored on a drive.

event

A detectable system occurrence.

export

To present a virtual volume to a host. Exporting makes a volume available to a host by creating an association between the volume name and a logical unit number for the specified host and port.

F

FC

Fast class (drive type).

Fibre Channel (port).

FC adapter

Fibre Channel adapter. A Fibre Channel PCI host bus adapter located in a controller node. The Fibre Channel adapter connects a controller node to a host or to a drive chassis.

FCoE

Fibre Channel over Ethernet.

File persona

The HPE 3PAR File Persona solution provides file services on an HPE 3PAR StoreServ Storage system.

FIPS

Federal Information Processing Standard.

file share

A storage object containing the files to which the users and groups are allowed or disallowed access.

file store

A storage container for file shares.

flash cache

The HPE 3PAR OS Adaptive Flash Cache feature extends your cache space using space on your SSDs.

FMP

Flash cache memory page.

FPG

File provisioning group. An FPG is the highest-level object in the HPE 3PAR StoreServ Storage file service object hierarchy. FPGs contain the virtual file servers.

FPVV

Fully provisioned virtual volume. A virtual volume (snapshot) with a set amount of user space and for which snapshot administration space and snapshot data space draw resources from a common provisioning group. In most cases, the HPE 3PAR CLI refers to an FPVV as a VV. In some instances, the HPE 3PAR CLI refers to an FPVV as a CPVV.

fstore

File store.

G

GB

Gigabytes.

Gbps

Gigabits per second.

GigE

Gigabit Ethernet.

GiB

1 gibibyte = 2^{30} bytes = 1,073,741,824 bytes = 1024 mebibytes.

grow

To increase the size of a virtual volume, CPG, or FPG.

growth increment

The unit of storage space by which the system creates and allocates additional logical disks to a CPG when the volumes in that CPG require additional resources. The minimum growth increment varies according to the number of controller nodes in the system (from 8 GB for a two-node system to 32 GB for an eight-node system).

growth limit

An optional setting that enables you to specify the maximum size to which a CPG can grow.

growth warning

An optional setting that enables you to specify the size at which the system alerts you to the amount of CPG growth.

GSSAPI

Generic Security Service Application Program Interface.

H

HBA

Host bus adapter.

host

A path or set of paths, defined as either WWN or iSCSI names, to one or more ports on a system.

host definition

The name of the host and the list of the paths (WWN or iSCSI) assigned to the host, if any. If you remove all the paths assigned to the host, the host name becomes the host definition.

host persona

A set of behaviors that allows hosts connected to FC or iSCSI ports on the system to deviate from the default host behavior.

host-sees VLUN template

A VLUN template that allows a specified host connected to any port to see a virtual volume as a specified LUN (logical unit number).

host set VLUN template

A VLUN template that allows any host that is a member of the host set to see a volume.

HPE 3PAR Recovery Manager

A data-protection solution that provides restore operations for a variety of platforms, such as Oracle, SQL Server, Exchange, and more.

HPE 3PAR Remote Copy

Software that enables you to create and continually update backup Remote Copies of virtual volumes and use those copies for disaster recovery, if necessary.

HPE 3PAR System Tuner

The utility that enables the system to reallocate space usage to take advantage of additional resources, such as added hardware or updated CPGs. The System Tuner identifies underused chunklets and overused volumes, and balances the usage.

HPE 3PAR Thin Provisioning

Software that enables you to create a virtual volume that allocates resources from the CPG on demand and in small increments.

HPE 3PAR Virtual Copy

Software that enables you to create virtual copies (snapshots) of virtual volumes. To create a virtual copy, the system uses the copy-on-write technique, which creates an up-to-date snapshot at the same time as data is written to the host.

HPE 3PAR Virtual Domains

Software that enables you to create distinct domains with domain-specific users and objects.

I

ID

Identifier.

inactive host

A host that is known to the HPE 3PAR OS, but is not recognized as connected to any system port at the moment.

initiator port

A port that is connected to and relays commands to physical disks within a drive cage. Also known as a disk port.

IOPS

Input/output per second.

iSCSI

Internet Small Computer System Interface.

iSCSI name

The name of an iSCSI path. You use an iSCSI name to identify that iSCSI path to a host.

iSNS

Internet Storage Name Service.

L

LD

Logical disk. A collection of chunklets that reside on different physical disks and that are arranged as rows of RAID sets. When you create a CPG, the system creates and groups logical disks and assigns those logical disks to the CPG.

LDAP

Lightweight Directory Access Protocol.

LIP

Loop Initialization Primitive. The protocol by which a Fibre Channel Arbitrated Loop network initializes upon power-up or recovers after a failure or other unexpected condition. During loop initialization, the nodes present on the arbitrated loop identify themselves and acquire addresses on the loop. No data can be transferred on an arbitrated loop until initialization completes.

logging

Temporarily saving data to logging logical disks when physical disks are out of service (due to failure or during replacement procedures).

logging LD

Logging logical disk. A logical disk used for logging. During system setup, the system creates a 20 GB RAID 10 logging LD for each controller node in the system.

LUN

Logical unit number. A number used to access a virtual volume that has been assigned to a particular host on a particular port.

M

mapping

The correspondence of LD regions to virtual volume regions.

matched-set VLUN template

A rule that allows a particular host connected to a particular port to see a virtual volume as a specified LUN.

MB

Megabytes.

message code

A keycode that identifies a system alert.

MIB

Management information base.

mirror

One member of a group of mirrored chunklets, which is also known as a RAID 1 set.

mirroring

A data redundancy technique used by some RAID levels (in particular, RAID 1) to provide data protection on a storage array.

MTU

Maximum transmission unit

N

NACA

Normal Auto Contingent Allegiance.

NFS

Network File System.

NL

Near line (drive type).

node cabinet

A cabinet that houses the system backplane and controller nodes.

NPIV

N_Port ID Virtualization.

NTP

Network Time Protocol.

NVMe

Non-volatile Memory express

O

OLTP

Online transaction processing.

OLV

OpenStack Volume.

OSS

OpenStack Snapshot.

OU

Organizational unit.

P

parent volume

A virtual volume from which a virtual or physical copy is made.

PCI

Peripheral component interconnect.

PD

Physical disk. A dual-ported Fibre Channel or SAS disk mounted onto a drive enclosure.

PE

Protocol endpoint.

PEM

Privacy Enhanced Mail.

physical copy

A point-in-time copy of an entire virtual volume.

physical size

The total actual raw storage allocated to a logical disk, as determined by its size and RAID type.

port-presents VLUN template

A VLUN template that allows any host connected to a particular port to see a virtual volume as a specified LUN.

preserved data

Data that is suspended in the system's cache memory due to backend failure.

primary path

Connection between a controller node initiator port and a physical disk that is used by default. When the primary path cannot be used (a failure condition), the secondary path is used. The primary and secondary paths are not user configurable and are determined by drive magazine placement.

promote

For physical copies: to break the association between a physical copy and a base volume by changing the physical copy into an independent base volume.

For virtual copies: to copy the changes from a virtual copy back onto the base volume, therefore overwriting the base volume with the virtual copy.

R

RAID

Redundant array of independent disks.

RAID set

A grouping of mirrored or parity-protected chunklets.

RAID type

RAID 0, RAID 10 (1), RAID 50 (5), and HPE 3PAR RAID MP (Fast RAID 6) are all supported RAID types; however, not all RAID types may be available on your system.

RCFC

Remote Copy over Fibre Channel. The use of Remote Copy with two systems that are connected through Fibre Channel ports.

RCIP

Remote Copy over IP. The use of Remote Copy with two systems that are connected through Ethernet ports.

RDM

Raw device mapping.

region

A subdivision of a logical disk or virtual volume. The size of a region is always a multiple of 32 MB.

resynchronize

To copy changes from one volume in a physical copy pair to the other volume because the original volume was modified at some point after the physical copy operation took place.

RO

Read-only.

roles and rights

The roles and rights assigned to a user determine which tasks the user can perform with a system.

RSA

Rivest-Shamir-Adleman cryptosystem.

RTPG

Report target port group.

RW

Read-write.

S

SAN

Storage Area Network.

SASL

Simple Authentication and Security Layer.

secondary path

Connection between a controller node initiator port and a physical disk that is used when the primary path is inaccessible (a failure condition). The primary and secondary paths are not user-configurable; they are determined by drive magazine placement.

SCM

Storage Class Memory.

SD

Snap Data.

SED

Self-encrypting drive. An SED uses Advanced Encryption Standard keys to protect data from unauthorized access. SEDs contain special firmware and an ASIC that provides encryption. When encryption is enabled, the SED will lock when power is removed, and it will not be unlocked until the matching key from the HPE 3PAR StoreServ Storage system is used to unlock it.

service processor

A device inserted into a rack or virtual software that enables you to locally and remotely monitor and service HPE 3PAR StoreServ Storage systems.

set size

The number of chunklets in a set. Also known as mirror depth for RAID 1 sets and parity set for RAID 5 sets.

SIOC

Semantically-Interlinked Online Communities.

Smart SAN

Protocol agnostic software-defined fabric-aware software embedded in HPE 3PAR StoreServ and StoreFabric SAN components (target, host, switch), enabling the target (3PAR) to orchestrate configuration, settings, and SAN policies.

SMB

Server Message Block.

snapshot

A virtual or physical copy of a virtual volume.

snapshot administration space

The space on a virtual volume that is used to track changes to the data from the time that a snapshot of a virtual volume was created.

source volume

The virtual volume from which a copy is made.

spare chunklet

A chunklet that is reserved for use in case of a failure in the system. A certain number of chunklets are reserved for use as spares during the system setup and installation process; however, the system may temporarily set aside additional spares even though these chunklets are not permanently designated for use as spares.

spare status

Indicates whether a chunklet is reserved as a spare or has been selected by the system for use in sparing on a temporary basis.

sparing

The automatic relocation of chunklets on a physical disk when a logging logical disk becomes full.

SPOCK

Single Point of Connectivity Knowledge for HPE Storage Products website.

SR

System Reporter.

SSD

Solid-state drive.

SSL

Secure Sockets Layer.

SSMC

HPE 3PAR StoreServ Management Console.

Storage DRS

VMware vSphere Storage Distributed Resource Scheduler.

STGT

SendTargets Group Tag.

sysmgr

System manager. Software component that negotiates between the system and the user interfaces such as the SSMC and HPE 3PAR CLI.

system backplane

An electronic circuit board that contains sockets into which power supplies and controller nodes are plugged.

T

target mode

The firmware setting for a port that is connected to a host.

target port

The port that is connected to and receives commands from a host computer. Also known as a host port.

TB

Terabytes.

Tcl

Tool command language.

TDVV

TiB

Tebibyte [1 tebibyte = 2^{40} bytes= 1099511627776 bytes = 1024 gigibytes].

TPVV

Thinly provisioned virtual volume. A virtual volume that maps to logical disk space associated with a common provisioning group and is therefore capable of growing on demand.

U

user data

For standard base volumes, the data that is written to the user space.

user size

The amount of user space in a virtual volume, or the size of the volume as presented to the host.

user space

The space on a virtual volume that represents the size of the virtual volume as presented to the host. For standard base volumes, the user space holds all user data. For TPVVs, no storage is actually allocated to user space, so the user space represents the virtual size of the volume.

V

VAAI

VMware vStorage APIs for Array Integration.

VASA

vSphere Storage APIs – Storage Awareness.

VCN

VLUN change notification.

VFS

Virtual file server. VFSs act as a virtual device that controls many of the network policies for communications between the HPE 3PAR StoreServ Storage file service objects and your network. Many management tasks and policy decisions can be performed at the VFS level. VFSs contain the file stores.

virtual copy

A snapshot created using the copy-on-write technique.

virtual size

The size that the volume presents to the host. For standard base volumes, the virtual size is equal to the user space. For thinly-provisioned virtual volumes, no storage is actually allocated to user space, so the virtual size is determined by whatever value is assigned to the user space.

virtual volume

A virtual storage unit created by mapping data from one or more logical disks.

virtual volume region

A subdivision of a virtual volume. The size of a region is always a multiple of 32 MB.

VLAN

Very large area network.

VLUN

Virtual logical unit number. A VLUN is a virtual volume-LUN pairing expressed as either an active VLUN or as a VLUN template.

VLUN template

A rule that sets up the association between the name of the virtual volume and a LUN-host, LUN-port, or LUN-host-port combination. The three types of VLUN templates are host-sees, port-presents, and matched-set.

VM

Virtual machine.

VMCA

VMware Certificate Authority.

VMDK

Virtual Machine Disk file format.

VSA

Volume Set Addressing.

VV

Virtual volume.

VVol

VMware vSphere virtual volume.

W

WORM

Write once, read many.

WSAPI

HPE 3PAR Web Services Application Programming Interface.

WWN

World Wide Name. A unique 64-bit or 128-bit value used to identify Fibre Channel devices on an arbitrated loop. The WWN consists of a prefix issued by the IEEE to uniquely identify the company, and a suffix that is issued by the company.

Z

zone

(1) A unit of physical disk space reserved by a controller node for snapshot or snapshot administration data. A single zone may occupy space on more than one disk.

(2) A collection of devices or user ports that communicate with each other through a fabric. Any two devices or user ports that are not members of at least one common zone cannot communicate through the fabric.