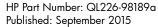# HP 3PAR Command Line Interface Administrator's Manual
HP 3PAR OS 3.2.2

Abstract

This manual is for all levels of system and storage administrators. This guide provides instructions for installing the HP 3PAR CLI and using the CLI to configure and manage HP 3PAR storage systems.

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1 Installing the HP 3PAR Command Line Interface

The purpose of this chapter is to provide instructions for installing and uninstalling the HP 3PAR Command Line Interface.

About the HP 3PAR Command Line Interface

Use the HP 3PAR Command Line Interface (CLI) to monitor, manage, and configure HP 3PAR storage systems. See the HP 3PAR CLI installation readme file on the *HP 3PAR CLI and SNMP* CD. All platforms use the same CD, but the installation files are different for each of the supported platforms.

Supported Platforms

The HP 3PAR CLI is supported on HP-UX (with HP 3PAR OS 3.1.2 and later), AIX (with HP 3PAR OS 3.1.3 and later), Linux, Oracle Solaris (Solaris), and Microsoft Windows operating systems. For a list of supported versions of each operating system:

1. Go to the Single Point of Connectivity Knowledge for HP Storage Products at

   http://www.hp.com/storage/spock

2. Use your HP Passport account to log on. If you do not have an HP Passport account, you can create an account on SPOCK.

3. Navigate to **Software** > **Array SW: 3PAR** from the left pane and locate the HP 3PAR CLI Remote Client support matrix.

NOTE:

1. Update your host operating system with all required and recommended patches or service packs before installing the HP 3PAR CLI.

2. For Redhat Enterprise Linux 64-bit system, the 32-bit compatibility libraries should be installed prior to the start of the CLI installation.

   a. To include the 32-bit compatibility libraries, the "Compatibility Libraries" should be added during the software customization in the system installation.

   b. If those 32-bit libraries were not included, they can be installed by manually installing the 32-bit rpm package glibc and its' dependent packages. An example to do so is:

   ```
   # rpm -Uvh glibc-<version>.el6.i686.rpm
   nss-softokn-freebl-<version>.el6.i686.rpm
   ```

System Requirements

The HP 3PAR CLI uses port number 5783 for secure communications and port 5782 for unsecure communications. If you intend to keep the HP 3PAR CLI connected to your system for an extended period of time, you must configure your firewall to allow the CLI to remain connected when there is no activity.

Before installing the HP 3PAR CLI on a remote computer, verify that the system meets the following requirements:

- 1.0 gigahertz processor or higher.

- 1 GB of installed RAM (2 GB recommended).

- CD-ROM or DVD-ROM drive (if installing from a CD-ROM).

- 1024 x 768 or better screen resolution.

- Mouse or compatible pointing device.

Disk Space Requirements

The table below lists the disk space requirements for the HP 3PAR CLI installation.

NOTE: The installer creates temporary files during installation so the actual hard disk space required at that time is greater than the values listed.

Table 1 Free Space Required for Installation

Operating System	Disk Space Required
HP-UX	870 MB
AIX	200 MB
Linux	150 MB
Solaris	150 MB
Windows	200 MB

Installation Instructions

The following sections describe how to install the HP 3PAR CLI on remote systems running compatible versions of HP-UX, AIX, Linux, Solaris, and Microsoft Windows operating systems.

You have a choice between the following types of installation:

1. Graphical (on Windows)
2. Command line or Console (on UNIX and Linux)
3. Silent (on Windows, UNIX, and Linux)

The installation packages default to a graphical installation on Windows and command line installation on UNIX and Linux.

For installation instructions, see:

1. Graphical Installation on Windows
2. Command-Line Installation UNIX and Linux
3. Silent Installation on Windows
4. Silent Installation on UNIX and Linux

Before Installation

Prior to installing the HP 3PAR CLI:

- Shut down all active HP 3PAR CLI sessions.

- Disable any virus-checking software.

- Verify that all system requirements have been met. See "System Requirements" (page 12) for specifics.

NOTE:

1. The default installation location changed in HP 3PAR CLI 3.1.3. From this version 3.1.3 on, the default location can have only one installation of the HP 3PAR CLI.

   - Windows 32–bit system:

     ```
     Old: C:\Program Files\3PAR\inform_cli_<version>
     New: C:\Program Files\Hewlett-Packard\HP 3PAR CLI
     ```

   - Windows 64–bit system:

     ```
     Old: C:\Program Files (x86)\3PAR\inform_cli_<version>
     New: C:\Program Files (x86)\Hewlett-Packard\HP 3PAR CLI
     ```

   - UNIX and Linux:

     ```
     Old: /opt/3PAR/inform_cli_<version>
     New: /opt/hp_3par_cli
     ```

2. In Windows, the Programs Menu has changed:

   ```
   Old: Start->Programs->HP 3PAR->HP 3PAR CLI <version>
   New: Start->Programs->HP 3PAR CLI->HP 3PAR CLI <version>
   ```

△ **CAUTION:**

- If you install or remove one or more versions of the HP 3PAR CLI simultaneously, the procedure may fail.
- Do not run multiple installations of the HP 3PAR CLI at the same time.

Graphical Installation on Windows

Installing HP 3PAR CLI can be completed with the InstallAnywhere™ application.

The installation should start automatically once you put the *HP 3PAR CLI and SNMP* CD into your CD ROM drive.

If the installation does not start automatically, use the following procedure:

1. Insert the CD-ROM.
2. The installation should start automatically once you insert the CD-ROM. If the installation does not start automatically
   a. Open your CD-ROM drive in Windows Explorer.
   b. Double-click the file `<D>:\cli\windows\setup.exe`, where `<D>` is the letter associated with your CD-ROM drive.
3. Complete the installation by following the on-screen directions.

Command-Line Installation on UNIX and Linux

To install the HP 3PAR CLI on UNIX and Linux:

1. Bring up a terminal window.
2. Log in as `root`.
3. Insert the CD-ROM.
4. Start the installation using the `setup.bin` file:

   ` # /cdrom/cli/solaris/setup.bin` (on Solaris)

   ` # /cdrom/cli/aix/setup.bin` (on AIX)

   ` # /cdrom/cli/hp-ux/setup.bin` (on HP-UX)

```
# /cdrom/cli/linux/setup.bin (on Linux)
```

5. Complete the installation by following the on-screen directions.
6. Log out and log back in.
7. The default installation location is `/opt/hp_3par_cli`.

Silent Installation on Windows

To install the HP 3PAR CLI silently on Windows:

1. Create the response file first time (use `-r` option).
   a. Instead of double-clicking the `setup.exe` as described in the section, *Graphical Installation on Windows*, open a Windows command prompt and issue the following commands (where `<D>` is the letter associated with your CD-ROM drive):

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

   b. Complete the installation by following the on-screen directions.
   c. Response file `C:\cli_setup_response.txt` will be created. From now on, you can use this file to install silently.

2. From next time onwards, use the response file to install silently (use `-i silent` and `-f` option).
   a. Instead of double-clicking the setup.exe as described in the section, *Graphical Installation on Windows*, open a Windows command prompt and issue the following commands (where `<D>` is the letter associated with your CD-ROM drive):

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

   b. No GUI will appear and the HP 3PAR CLI will be installed.

Silent Installation on UNIX and Linux

To install the HP 3PAR CLI silently on UNIX and Linux:

1. Create the response file first time (use `-r` option)
   a. Use `-r` option while executing `setup.bin` as described in the section, *Command-Line Installation on UNIX and Linux*.

   ```
   # /cdrom/cli/solaris/setup.bin -r
   </full/path/to/cli_setup_response.txt> (on Solaris)

   # /cdrom/cli/aix/setup.bin -r
   </full/path/to/cli_setup_response.txt> (on AIX)

   # /cdrom/cli/hp-ux/setup.bin -r
   </full/path/to/cli_setup_response.txt> (on HP-UX)

   # /cdrom/cli/linux/setup.bin -r
   </full/path/to/cli_setup_response.txt> (on Linux)
   ```

   b. Complete the installation by following the on-screen directions.
   c. A response file `</full/path/to/cli_setup_response.txt>` will be created. From now on, you can use this file to install silently.

2. From next time onwards, use the response file to install silently (use `-i silent -f` option).

   a. Use `-i silent -f` option while executing `setup.bin` as described in the section, *Command-Line Installation on UNIX and Linux*.

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

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

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

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

   b. HP 3PAR CLI will be installed without any prompt.

Setting the Path to the CLI on UNIX and Linux

Once the CLI has been installed on your system, the InstallAnywhere application attempts to automatically set the path to the CLI for the root user by adding an entry to your local login file. The modified file is specific to the shell that you are using during the CLI installation.

If InstallAnywhere is unable to modify the login file, you will need to set the path to the CLI manually. In order to call commands on the CLI easily from the shell you are using, add the directory where the CLI commands are installed to your shell path.

For example, if you are using the Bourne or bash shells and the commands have been installed in `/opt/hp_3par_cli/bin`, then issue the following commands:

```
$ PATH=$PATH:/opt/hp_3par_cli/bin
$ export PATH
```

Troubleshooting the Installation

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

If you installed the HP 3PAR CLI in the default location, this log file is located at:

- Windows 32–bit system:

  ```
  C:\Program Files\Hewlett-Packard\HP 3PAR CLI\log\install.log
  ```

- Windows 64–bit system:

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

- UNIX and Linux:

  /opt/hp_3par_cli/log/install.log

Removing the HP 3PAR CLI

The following section describes how to remove HP 3PAR CLI on systems running on Microsoft Windows, UNIX, and Linux operating environments.

NOTE: Shut down all running applications and disable virus-checking software before proceeding with the following instructions.

GUI Uninstall on Windows

To remove HP 3PAR CLI from Windows:

1. Close all copies of the administration software currently running on your system.
2. From the taskbar, click **Start→Programs→HP 3PAR CLI→Uninstall HP 3PAR CLI <version>** where <version> is the current release version, for example 3.2.1.
3. Complete the uninstallation by following the on-screen directions.

Command-Line Uninstall on UNIX and Linux

To remove the HP 3PAR CLI from UNIX and Linux:

1. Bring up a terminal window.
2. Log in as root.

   `# /opt/hp_3par_cli/uninstall/uninstall.`

3. Complete the uninstallation by following the on-screen directions.
4. Log out and log back in.

Silent Uninstall on Windows

To remove the HP 3PAR CLI silently on Windows use `-i silent` option:

1. Open a Windows command prompt and execute:
   a. Windows 32-bit system:

   ```
   C:\Program Files\Hewlett-Packard\HP 3PAR CLI\uninstall\uninstall
   -i silent
   ```

   b. Windows 64-bit system:

   ```
   C:\Program Files (x86)\Hewlett-Packard\HP 3PAR CLI\uninstall\
   uninstall -i silent
   ```

2. HP 3PAR CLI will be removed without displaying any GUI.

Silent Uninstall on UNIX and Linux

To remove the HP 3PAR CLI silently on UNIX and Linux use `-i silent` option:

1. In a terminal window execute:

   `# /opt/hp_3par_cli/uninstall/uninstall -i silent`

2. HP 3PAR CLI will be removed without any prompt.

Scripting Considerations

If you have scripts that depend on the location of the binaries for any of the HP 3PAR CLI commands, you will need to update your scripts or environment variables to point to the latest version of the HP 3PAR CLI. As an alternative, if you do not need to keep multiple versions of the HP 3PAR CLI installed, you can change the default install location of the HP 3PAR CLI to a path of your choosing so that the path stays consistent from release to release. If you do this, you must fully uninstall the previous version using the provided uninstaller before installing a new version.

Activating a Software License

Contact your HP representative to acquire an HP 3PAR OS software license key. The license key is accepted only if it is recognized as a valid key. A valid license key includes an appropriate StoreServ serial number and is associated with the number of nodes in the system for which the license key is being activated. You must accept the terms and conditions to complete the license activation.

All characters in the specified license key other than letters and numbers are ignored and the letters are not case-sensitive. After the new license key has been entered, the changes between the existing license key and the new license key are displayed. You are prompted to confirm the changes unless the -noconfirm option is specified. If the -noconfirm option is specified, the changes are not displayed and the new license key is entered immediately. To finish entering the license key, press enter on a blank line.

To activate the license for an HP 3PAR OS software suite, enter the setlicense -f <filename> -noconfirm command, where:

- <filename> specifies the name of the file from which the license key is read.
- -noconfirm specifies that the system does not prompt you for confirmation before activating the new license key.

View the currently activated licenses, or verify changes to licenses with the showlicense command. For more information about the setlicense and showlicense commands, see the *HP 3PAR Command Line Interface Reference*.

2 SSL Certificates

During the installation of the HP 3PAR OS on a new storage system or an OS upgrade on a storage system currently in operation through Service Processor (SP), a self-signed 2048-bit RSA SSL certificate will be created. The SP administrator must distribute the fingerprint of the certificate to users of the storage system so they can accept the certificate when they connect to the storage system through the CLI client for the first time. An administrator with Super role access may re-create a certificate using the `createcert` command. You can view the certificate with the `showcert` command. For a complete list of options available for the `createcert` and `showcert` commands, see the *HP 3PAR Command Line Interface Reference* and HP 3PAR CLI Help.

A common certificate for CIM, CLI, and WASPI services is created. The CIM and WASPI 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 are not covered by the unified-server service. For more information about using external key management servers with the StoreServ, see "Using External Key Management Servers" (page 116).

Importing SSL Certificates

The `importcert` command allows you to import certificates for specified services. You can import a certification authority (CA) bundle containing the intermediate and root CA prior to importing the service certificate. The CA bundle can be imported with or without the service certificate.

To import the CA bundle or certificate, issue the `importcert <SSL service> <service cert> [<CA bundle>]` or `importcert <SSL service> -ca <CA bundle>` where:

- `<SSL service>` specifies service for which you are importing the certificate. The valid service names are `cim`, `cli`, `wsapi`, `unified-server`, `ekm-client` and `ekm-server`.
- `<service cert>` specifies the certificate for the SSL service.
- `<CA bundle>` specifies the file name for the CA bundle.
- `-ca` specifies you are importing a CA bundle without importing a service certificate.

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

Removing SSL Certificates

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 service for which you are removing the certificate. The valid service names are `cim`, `cli`, `wsapi`, `unified-server`, `ekm-client` and `ekm-server`.
- `-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 *HP 3PAR Command Line Interface Reference* and HP 3PAR CLI Help.

3 Managing User Accounts and Connections

Learning About User Accounts

In order to access an HP 3PAR storage system you must have a user account. Each HP 3PAR CLI user is assigned a role, and each role is assigned a set of rights. The roles and rights assigned to the CLI user determine which tasks the user can perform with a system. Assign roles to users based on the tasks you intend the users to perform.

Eight roles are defined in the HP 3PAR CLI. See Table 2 (page 20) for a description of each role.

There are four standard roles:

- Browse
- Edit
- Super
- Service

There are also five extended roles:

- Create
- Basic Edit
- 3PAR AO
- 3PAR RM
- Audit

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 a CLI user 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 they need to perform their tasks.

- For procedures to create and remove user accounts, see "Creating Users" (page 22) and "Removing Users" (page 24).
- For information about viewing user roles and rights with the CLI see "Viewing User Roles and Rights" (page 22).
- To view a list of roles and all of the rights assigned to the roles, see "Mapping Roles and Rights" (page 186).

Table 2 HP 3PAR CLI User Roles

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

Table 2 HP 3PAR CLI User Roles *(continued)*

User Roles	Rights Assigned to Roles
3PAR AO	Rights are limited to internal use by HP for Adaptive Optimization operations.
3PAR RM	Rights are limited to internal use by HP for Recovery Manager operations.
Audit	Rights are limited to scanning the HP 3PAR OS for security issues. An audit user has no access to the CLI.

Default User Accounts

During the HP 3PAR storage system's moment of birth operation, the following HP 3PAR CLI user accounts are created:

- **3paradm** is a user account with Super rights. This user account is not used by HP personnel and you can modify or delete this user account. Use the `3paradm` user account to create new CLI users. You should change the password of this user.

- **3parcim** is a user account with Browse rights. This user account is reserved for use by the HP 3PAR administration tools. The `3parcim` user account and password must not be modified or deleted if you intend to use CIM. If CIM will never be used, then the account may be modified or deleted.

- **3parbrowse** is a user account with Browse rights. No HP personnel or service providers have access to this user account. The password is randomly created and is unknown to anyone. This user account is required for communication between the HP 3PAR Service Processor (SP) and the HP 3PAR array.

- **3paredit** is a user account with Edit rights. No HP personnel or service providers have access to this user account. The password is randomly created and is unknown to anyone. This user account is required for communication between the SP and the HP 3PAR array.

- **3parsvc** is a user account with Super rights. This Super user account is used by the SP to monitor the HP 3PAR storage system. The `3parsvc` user account should not be removed. If the SP is being used to monitor the storage server, the SP resets the default password to a randomized value. Changing the password prevents the SP from performing monitoring operations. If the SP is not being used for monitoring and is only used for maintenance activities, the password can be changed. When a maintenance activity takes place, the password for `3parsvc` should be set 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** is a user account with Super rights. This Super user account is used by HP personnel and authorized service providers to perform service and diagnostic functions on the system through the interactive CLI. The `3parservice` user account should not be removed. The password can be modified by the system administrator. During SP maintenance activities, the password may be reset by the system to allow service to proceed. After the maintenance activities are complete, the password can be reset by the system administrator.

Authenticating and Authorizing CLI Users

Users accessing the system with the HP 3PAR CLI client or Secure Shell (SSH) connections are authenticated and authorized directly on the system. These users are referred to as *local users*. An *LDAP user* is authenticated and authorized using information from a Lightweight Directory Access Protocol (LDAP) server. A *domain user* is a user with access to a specific domain. For more information about user accounts, domains, and LDAP, see the *HP 3PAR StoreServ Storage Concepts Guide*. For more information about configuring LDAP connections , see .

Viewing User Roles and Rights

The `showrole` command displays information about the roles and rights defined on a system. For more information about the `showrole` command, see the *HP 3PAR Command Line Interface Reference*. For more information about user roles and rights, see "Learning About User Accounts" (page 20).

- To view a list of the available roles on a system, issue the `showrole` command.
- To view a list of the available rights on a system, issue the `showrole -listrights` command.
- To view the rights assigned to a specific role, issue the `showrole <role_name>` command, where `<role_name>` is the name of the role.
- To view a list of roles and all of the rights assigned to each role, see "Mapping Roles and Rights" (page 186).
- To view a list of the rights required to use each CLI command, see "Mapping Rights and CLI Commands" (page 200).

Creating Users

The first user created should be assigned the Super user role by specifying `super` for the `<role>` when issuing the `createuser` command. For more information about the `createuser` command, see the *HP 3PAR Command Line Interface Reference*.

NOTE:

- The first HP 3PAR storage system user account created must have a role with the right to create additional users. If the first user created has limited rights, the ability to configure the system will be restricted.

- The `<object_set>_set` rights include the right to remove the object. For example, the `vvset_set` right includes the right to remove virtual volume sets.

- If you are using HP 3PAR Virtual Domains for access control, you must assign users a domain you created in your system or the `all` domain. See "Managing HP 3PAR Virtual Domains" (page 56) for instructions on creating domains. For more information about domains, see the *HP 3PAR StoreServ Concepts Guide*.

- To create a new user, issue the `createuser -c <password> <user_name> <domain_name> <role>` command, where:

  ○ `-c <password>` specifies the user's password in clear-text format. The length of clear-text-password must be between a minimum length (as defined by an administrator) and 32 characters. If no minimum has been defined then the default minimum value is 6. If no password is specified, then you are prompted to enter a password.

  ○ `<user_name>` is the name of the CLI account user. The user name can be up to 31 characters long. Valid characters include alphanumeric characters, the period symbol (.), dash symbol (-), and underscore symbol (_). The first character must be alphanumeric or an underscore symbol for users connecting to the system with the HP 3PAR CLI application. To access the system with an SSH connection, the first character of the user name must be alphanumeric.

  ○ `<domain_name>` is the name of the domain to which the user will belong. The domain name can be up to 31 characters long. If you are not using Virtual Domains, specify the `all` domain. If you are using virtual domains, specify the name of an existing domain in your system.

    NOTE: By default, users in systems not using virtual domains are in the `all` domain. Users in the all domain have rights over the entire system. The Super, Create, Basic Edit, 3PAR AO, and 3PAR RM roles cannot be restricted and always belong to the `all` domain. For more information about the `all` domain, see the *HP 3PAR StoreServ Storage Concepts Guide*.

  ○ `<role>` is the role assigned to the user. Valid values include `browse`, `edit`, `super`, `service`, `create`, `basic_edit`, `3PAR_AO`, and `3PAR_RM`. The roles and rights assigned to the CLI user determine which tasks a user can perform with a system. For information about viewing the roles and rights defined on a system, see "Viewing User Roles and Rights" (page 22). To view a list of roles and all of the rights assigned to the roles, see "Mapping Roles and Rights" (page 186).

You can verify the creation of a new user with the `showuser` command.

Viewing Users

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.

If you are not using Virtual Domains, the output of the `showuser` command still displays a `Domain` column. By default, users in systems not using domains fall into the `all` domain. For additional details about domains, see the *HP 3PAR StoreServ Storage Concepts Guide*.

To view a list of users, the user roles, and user domain associations, issue the `showuser` command. For more information about the `showuser` command, see the *HP 3PAR Command Line Interface Reference*.

- To display all the users of a system, issue the `showuser` command.
- To display information for a specific user, issue the `showuser <user_name>` command, where `<user_name>` is the name of the user.

Removing Users

Removing a user permanently deletes the user account from the system.

To remove a user from the system, issue the `removeuser <user_name>` command, where `<user_name>` is the name of the user.

Adding Users to a Domain

To add a user to an existing domain, issue the `setuser -adddomain <domain_name>:<role> <user_name>` command, where:

- `<domain_name>` is the name of the domain to which you are adding the specified user.
- `<role>` is the role assigned to the user. Permitted values for `<role>` are `browse` and `edit`.
- `<user_name>` is the name of the user being added to the specified domain.

NOTE: A user can belong to a maximum of 32 domains. For additional details about domains, see the *HP 3PAR StoreServ Storage Concepts Guide*.

Removing Users From a Domain

To remove a user from a domain, issue the `setuser -rmdomain <domain_name> <user_name>` command, where:

- `<domain_name>` is the name of the domain from which the specified user is being removed.
- `<user_name>` is the name of the user being removed from the specified domain. You can specify `all` in place of a specific domain name to remove the user from all domains.

Setting a User's Default Domain

A user's default domain is the domain that the user will access upon each working CLI session.

NOTE: Prior to setting a specific domain as a user's default, the user must previously have been assigned accessibility within that domain.

To set a user's default domain, issue the `setuser -defaultdomain <domain_name> <user_name>` command, where:

- `<domain_name>` is the name of the domain which is being set as the default.
- `<user_name>` is the name of the user for whom you are assigning a default domain.

For information about default domains, see the *HP StoreServ Storage Concepts Guide*. For detailed information about the `setuser` command, see the *HP 3PAR Command Line Interface Reference*.

Removing a User's Default Domain

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

Setting a User's Current Domain

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

To set a user's current domain, issue the `setclienv currentdomain <domain_name>` command, where `<domain_name>` is the domain you wish to set as the working domain for the current CLI session.

Removing a User's Current Domain

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

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

Viewing User Connections

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

If you are using domains, prior to 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" (page 48) 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.

To view a user's connection to the system, issue the `showuserconn` command. For more information about the `showuserconn` command, see the *HP 3PAR Command Line Interface Reference*.

Removing User Connections

To terminate a user's connection to the system, issue the `removeuserconn <ID> <user_name> <IP_address>` command, where:

- `<ID>` is the user's numeric ID.
- `<user_name>` is the user's assigned name.
- `<IP_address>` is the user's IP address.

See the *HP 3PAR Command Line Interface Reference* for details about this command.

Configuring LDAP Connections

The HP 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 users' rights within the system are tied to the groups to which the users belong. The StoreServ supports multiple IP entries for DNS settings.

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

By default, LDAP users cannot store an SSH public key using the HP 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 HP 3PAR Storage systems, see the *HP 3PAR StoreServ Storage Concepts Guide*.

△ **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.

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 these procedures using the specified commands (detailed instructions follow):

- Configure connection parameters using the following commands:

  ○ `setauthparam ldap-server <IP_address>`

  ○ `setauthparam ldap-server-hn <DNS_HostName>`

  ○ `setauthparam -f ldap-ssl 1`

- Configure binding (authentication) parameters using the following commands:

  ○ `setauthparam binding simple`

  ○ `setauthparam user-attr <DN_attribute>`

- Set the CA certificate using the following command:

  ○ `setauthparam ldap-ssl-cacert <certificate>`

- 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 commands:

  ○ `setauthparam <map_param> <map_value>`

  ○ `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

To configure connection parameters:

1. If not already known, obtain the LDAP server's host name 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.

   - 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:
     1. Click **Start→Run**.
     2. In the **Open** box, enter `ldp` and click **OK**.
     3. The **Ldp** window opens.
     4. In the **Ldp** window, click **Connection→Connect**.
     5. 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.
     6. Record the displayed `dnsHostName` (the value used for the `ldap-server-hn` 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'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 .

   NOTE: The value displayed for the defaultNamingContext is used later.

   Example:

```
cli% 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 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`.

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

   The example above corresponds to through .

Configuring Binding Parameters

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

1. Issue the `setauthparam binding simple` command.

   Example:

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

2. Issue the `setauthparam user-atter <DN_attribute>` command to set the attribute used to form a DN to the Windows domain.

   Example

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

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

Configuring the CA Certificate

To configure the CA certificate:

1. Obtain the location of the CA certificate from the Active Directory server's 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 Windows system:
   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 `setauthparam ldap-ssl-cacert <certicate>` command, where `<certificate>` is the name of the certificate you previously located or converted.

   Example:

   ```
   openssl x509 -inform DER -in ca.crt -outform PEM -out ca.cer
   ```

   In the example above, the `openssl x509` command is used to convert the CA certificate from `ca.crt` format to `ca.cer` format, which can then be used with the `setauthparam` command.

   ```
   cli% setauthparam -f ldap-ssl-cacert ca.cer
   ```

   In the example above, the `setauthparam` command is issued to set the CA certificate to the `ca.cer` file.

Configuring Account Location Parameters

To configure the account location parameters:

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" (page 26). 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 `setauthparam account-obj user` command.
4. Issue the `setauthparam account-name-attr sAMAccountName` command.
5. Issue the `setauthparam memberof-attr memberOf` command.

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

6. Issue the `checkpassword` command to obtain information about the user's group memberships from the LDAP server.

Example:

```
cli% 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 example above corresponds to Step 1, and displays the following:

- `joadmin` is the user name of the NT 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.

```
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.

```
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, and displays 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.

Configuring Group-To-Role Mapping Parameters

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

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 users 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.

Example:

```
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.

```
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 and all `Eng` group members have Browse rights within the system.

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):

- Configure connection parameters using the following command:
  - `setauthparam ldap-server <IP_address>`
  - `setauthparam ldap-ssl 1`
- Configure binding (authentication) parameters using the following commands:
  - `setauthparam binding <binding_type>`
  - `setauthparam user-dn-base <value>`
  - `setauthparam user-attr <attribute>`
- 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>`

- 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

1. To configure connection parameters, issue the `setauthparam ldap-server <IP_address>` command, where `<IP_address>` is the OpenLDAP server's 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's IP address is `192.168.10.13`.
- SSL security is activated using the `1` parameter.

Configuring Binding Parameters

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

To configure binding parameters:

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's `<user_name>`.

   Example:

   ```
   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.

Configuring Group Location Parameters

To configure group location parameters, perform the following:

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's attribute that holds the group name.
4. Issue the `setauthparam member-attr <member_attribute>` command, where `<member_attribute>` is attribute that holds the names of the users in the group.

   Example:

   ```
   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's name.
   - `memberUid` is the attribute with the value of the user's `<user_name>`.

Configuring Group-To-Role Mapping Parameters

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

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.
2. Repeat Step 1 above if you wish to assign users 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.

Example:

```
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:

- User 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, and all `hardware` group members have Browse rights within the system.

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 *HP 3PAR StoreServ Storage Concepts Guide*.

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:

1. 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=.

2. 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 1. 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 2 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 . 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.

```
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
```

4 Running the HP 3PAR Command Line Interface

After the CLI is installed (as described in "Installing the HP 3PAR Command Line Interface" (page 12)) and a user account is set up (as described in "Managing User Accounts and Connections" (page 20)), a CLI connection requires the following information:

- System name or IP address
- User name
- Password

You are prompted as follows when running the CLI:

```
system:

user:
password:
```

The example above displays the simplest way to connect to the CLI.

In addition to the method described above, you can also:

- Use environment variables and global options to customize the CLI ("Global Options and Environment Variables" (page 39)).
- Set up a secure connection using SSL ("Using SSL" (page 42)).
- Issue stand-alone CLI commands from a shell prompt in Solaris or Linux, HP-UX, AIX or from a Windows command prompt ("Stand-alone Commands" (page 50)).
- Use SSH to encrypt all traffic between the client and server, including passwords ("SSH" (page 51)).

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 "Global CLI Options and Environment Variables" (page 40).

- 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" (page 50)). 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. Environment variables cannot be used if you are accessing the CLI through SSH.

Table 3 Global CLI Options and Environment Variables

Global Option	Environment Variable	Specifies...
-sockssl	TPDSOCKSSL	that the connection between the client and server is secure. This is the default setting. For additional information, see "Using SSL" (page 42).
-tpdportnum <portnum>	--	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.
-sys <system_name>	TPDSYSNAME	the system name of the system you are accessing. For additional information, see "Setting the TPDSYSNAME Environment Variable" (page 43).
CAUTION: By setting the system name, user name, and password using environment variables, you are not prompted for this information when running the CLI, which can be useful for scripting. However, passwords must be kept secure. Using encrypted passwords in scripts, using an encrypted pwfile, or the encrypted password on the command line raises the risk of password exposure. It is imperative that the script, pwfile, or command line history file be strictly maintained to avoid compromise of the encrypted password. Failure to do so can leave the user open to impersonation by anyone with access to the encrypted string.		
-nosockssl	TPDNOSOCKSSL	that the CLI client should attempt to connect to the storage server on port 5782, without using SSL. This makes the connection insecure, and all data including authentication data passes in plain text packets.
-certfile <certfile>	TPDCERTFILE	the certificate file which is used to validate the authenticity of the CLI server. The certificate must be in a (PEM) Privacy Enhanced Mail format. The default file is <certdir>/cert. See the -certdir option.
-certdir <certdir>	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 is $HOME/ .hp3par on UNIX based systems and %USERPROFILE%\.hp3par on Windows.
-nocertprompt	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.
-cmdloop	--	that after commands are issued on the command line, an interactive command loop is entered.
-clientname <client_name>	TPDCLIENTNAME	the name of the client application.
-clientver <client_version>	TPDCLIENTVER	the version of the client application.
-clienthost <client_host>	TPDCLIENTHOST	the name of the host the client application runs on.
-conntimeout <seconds>	TPDCONNTIMEOUT	the maximum time in seconds to establish the connection to the CLI server. The default is 36 seconds.
-enherror	TPDCLIENHERROR	that enhanced error handling is to be performed.

Table 3 Global CLI Options and Environment Variables *(continued)*

Global Option	Environment Variable	Specifies...
-noenherror	--	that enhanced error handling is not to be performed.
--	TPDCACHEDIR	the location of the cache directory where the code that determines the version of the HP 3PAR software on the system resides. For additional information, see "Caching Client Bytecode" (page 46).
--	TPDSTARTFILE	the Tcl script that the system sources before entering the command loop. For additional information, see "Startup Files" (page 47).
-csvtable	TPDCSVTABLE	that commands that use the table formatting routines will print comma-separated output. For additional information, see "Comma Separated Values" (page 47).
-listdom	TPDLISTDOM	that domains are listed. For additional information, see "Listing Domains" (page 48).
-nohdtot	TPDNOHDTOT	that headers and totals are not printed after commands are executed. For additional information, see "Table Headers and Totals" (page 49)
-hafter	TPDHAFTER	the number of lines after which the header is printed again. For additional information, "Table Headers and Totals" (page 49).
--	TPDFORCE	that all commands are forced and do not return confirmation prompts before executing. For additional information, see "Forcing Commands" (page 50).
-v	--	the client-side version information, in the event of a version mismatch or other problem that prevents connection with a server. This option can only be used with the cli command. For additional information, see the *HP 3PAR Command Line Interface Reference*.

General Control and Help Commands

Table 4 (page 41) shows the general control and help commands that you can use to view help text while using the HP 3PAR CLI.

Table 4 General Control Commands

Command	Action
cmore	Pages the output of commands. Valid syntax for using this command is cmore <command>.
exit	Terminates 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 a system's native shell.
help <command>	Displays help text for individual CLI commands. Lists all help text for the specified command.

Table 4 General Control Commands *(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 a system's native shell.
`clihelp –col <command>`	Display column help (when applicable). See "Commands with Column Help" (page 42) for a list of applicable commands.
`<command> –h`	Displays help text for individual CLI commands. Lists all help text for the specified command.

Commands with Column Help

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

Access column help as follows:

```
cli% clihelp –col <command>
```

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

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

Using SSL

The HP 3PAR OS provides a Secure Sockets Layer (SSL) protocol for secure transfer of data between the CLI client and system, and is set with either of the following:

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

NOTE: This is the default behavior. TPDSOCKSSL and `-sockssl` are present for compatibility. The `-nosockssl` option overrides this behavior.

The HP 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 Solaris, Linux, HP-UX, and AIX

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

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

Setting the TPDSOCKSSL Environment Variable on Windows

To set the TPDSOCKSSL environment variable in Windows:
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

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 output example:

```
$ createuser -sockssl
```

Setting the TPDSYSNAME Environment Variable

After setting the system name you are not 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.

- Use the `-sys` command line global option.

- Enter the system name when prompted.

Setting the TPDSYSNAME Environment Variable on Solaris, Linux, HP-UX, and AIX

To set the environment variable on Solaris, Linux, HP-UX, or AIX 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 Windows

- 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 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 Windows as described in "Using SSL" (page 42).
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. 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

The system prompts for the system name if the environment variable TPDSYSNAME is not set and the `-sys` option is not used. To use the system name, see the following output example. Substitute your system name for `<system1>`.

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

Validating CLI Server Certificate

When connecting with SSL, the CLI client attempts to validate the CLI server certificate using the certificate file. If the 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 CLI server certificate. This file is created by user and must be in Privacy Enhanced Mail (PEM) format. 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 CLI server certificate. This file is created by CLI client.

The default certificate file and exception file are $HOME/.hp3par/cert and $HOME/.hp3par/excp on Solaris, Linux, HP-UX and AIX, and %USERPROFILE%\.hp3par\cert and %USERPROFILE\.hp3par\excp on Windows. These defaults values can be overridden by the command line options or by the environment variables described.

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 $HOME/.hp3par on Solaris, Linux, HP-UX, and AIX, and %USERPROFILE%\.hp3par on Windows. 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 TPDCERFILE environment variable is useful when the same certificate file is shared among multiple users.

- The `-certdir` global option.
- The TPDCERTDIR environment variable.
- The `-certfile` global option.
- The TPDCERFILE environment variable.

Setting the TPDCERTFILE Environment Variable on Solaris, Linux, HP-UX, and AIX

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

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

Setting the TPDCERTFILE Environment Variable on Windows

To set the TPDCERTFILE environment variable in Windows. The TPDCERTFILE variable will override the TPDCERTDIR variable:

1. Perform Step 1 through Step 4 of the procedure for setting the TPDSOCKSSL environment variable in Windows as described in "Using SSL" (page 42).

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

To specify the certificate file use the -certfile global option followed by the name of the certificate file, see the following example. Substitute your certificate file name for <certfile1>. The -certfile option will override the -certdir option.

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

Saving a Certificate File to a Directory

To save a certificate exception file to a directory where the CLI server will look for certificate information. When the CLI server certificate is not verified by the certificate file, then the CLI looks for this information in the certificate exception file.

- The -certdir global option.
- The TPDCERTDIR environment variable.

Setting the TPDCERTDIR Environment Variable on Solaris, Linux, HP-UX, and AIX

To set the TPDCERTDIR environment variable on Solaris, Linux, HP-UX, or AIX, 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 on Windows

To set the TPDCERTDIR environment variable in Windows:

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

Using the -certdir Option

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

User can suppress prompt by CLI client when the CLI server certificate is not validated by the certificate file and the exception file. CLI client prints an error message and exits. Suppressing prompt can be useful when CLI client is used as part of batch process such as shell script.

- The -nocertprompt global option.
- The TPDNOCERTPROMPT environment variable.

Setting the TPDNOCERTPROMPT Environment Variable on Solaris, Linux, HP-UX, and AIX

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

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

Setting the TPDNOCERTPROMPT Environment on Windows

To set the TPDNOCERTPROMPT environment variable in Windows:

1. Perform Step 1 through Step 4 of the procedure for setting the TPDSOCKSSL environment variable in Windows as described in "Using SSL" (page 42).
2. In the **Environment Variable** dialog box, enter TPDNOCERTPROMPT in the **Variable** box.
3. Enter the 1 for he certificate file in the **Value** box.
4. Click **OK**.

Using the -nocertprompt Option

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
```

Caching Client Bytecode

Client bytecode contains the majority of functionality of the HP 3PAR CLI and is version specific. The CLI caches the code required for communication for each different version of the HP 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 HP 3PAR OS running on the system.

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

Setting the TPDCACHEDIR Environment Variable on Solaris, Linux, HP-UX, AIX

To set the TPDCACHEDIR environment variable in Solaris, Linux, HP-UX, and AIX, 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 on Windows

To set the TPDCAHCEDIR environment variable in Windows:

1. Perform Step 1 through Step 4 of the procedure for setting the TPDSOCKSSL environment variable in Windows as described in "Using SSL" (page 42).
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**.

Startup Files

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 Solaris, Linux, HP-UX, AIX and Windows.

Setting the TPDSTARTFILE Environment Variable on Solaris, Linux, HP-UX, AIX

To set the TPDSTARTFILE environment variable in Solaris, Linux, HP-UX, and AIX 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 on Windows

To set the TPDSTARTFILE environment variable in Windows:

1. Perform Step 1 through Step 4 of the procedure for setting the TPDSOCKSSL environment variable in Windows as described in "Using SSL" (page 42).
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

HP 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:

- The -csvtable global option.
- The TPDCSVTABLE environment variable.
- The setclienv csvtable command (if changing within the Tcl shell; see the *HP 3PAR Command Line Interface Reference* for details about this command).

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

```
cli% showvv -csvtable
,,,,,,,,,---Rsvd(MB)---,,,,-(MB)-
Id,Name,Prov,Type,CopyOf,BsId,Rd,-Detailed_State-,Adm,Snp,Usr,VSize
 0,admin,full,base,---,0,RW,normal,0,0,10240,10240
 1,par,full,base,VV_01,1,RW,normal,128,512,16384,256
 2,copy,cpvv,vcopy,VV_02,2,RW,normal,0,0,16384,5120
 3,vvcp.1.2,tpvv,base,par,1,RO,normal,--,--,16384,10240
 4,tpvv,full,base,VV_03,4,RW,normal,128,512,65536,10240
-------------------------------------------------------------------------------
 5,total,,,,,,,256,1024,43008,36096
```

Setting the TPDCSVTABLE Environment Variable on Solaris, Linux, HP-UX, AIX

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

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

Setting the TPDCSVTABLE Environment Variable on Windows

To set the TPDCSVTABLE environment variable in Windows:

1. Perform Step 1 through Step 4 of the procedure for setting the TPDSOCKSSL environment variable in Windows as described in "Using SSL" (page 42).
2. In the **Environment Variable** dialog box, enter TPDCSVTABLE in the **Variable** box.
3. Enter 1 in the **Value** box.
4. Click **OK**.

Using the -csvtable Option

To set the -csvtable global option, see the following example:

```
$ cli -csvtable
```

Listing Domains

If you are using HP 3PAR Virtual Domains, you can configure data output to display a domain column. You can configure the output by using the following:

- The -listdom global option.
- The TPDLISTDOM environment variable.
- The setclienv-listdom command (if changing within the Tcl shell; for details about this command, see the *HP 3PAR Command Line Interface Reference*).

The following example displays CLI output with and without 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.

Setting the TPDLISTDOM Environment Variable on Solaris, Linux, HP-UX, and AIX

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

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

Setting the TPDLISTDOM Environment Variable on Windows

To set the TPDLISTDOM environment variable in Windows:

1. Perform Step 1 through Step 4 of the procedure for setting the TPDSOCKSSL environment variable in Windows as described in "Using SSL" (page 42).
2. In the **Environment Variable** dialog box, enter TPDLISTDOM in the **Variable** box.
3. Enter 1 in the **Value** box.
4. Click **OK**.

Using the -listdom Option

To set the -listdom global option, see the following example:

```
$ cli -listdom
```

Table Headers and Totals

HP 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 -nohdtot or -hafter global options.
- The TPDNOHDTOT or TPDHAFTER environment variables.
- The setclienv -nohdtot or setclienv -hafter commands (if changing within the Tcl shell; for details about this command, see the *HP 3PAR Command Line Interface Reference*)).

The following example displays CLI output with and without column headings and totals:

```
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 Environment Variable on Solaris, Linux, HP-UX, and AIX

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

Substitute TPDHAFTER for TPDNOHDTOT in the example above, as necessary.

Setting the Environment Variable on Windows

To set the TPDNOHDTOT or TPDHAFTER environment variable in Windows:

1. Perform Step 1 through Step 4 of the procedure for setting the TPDSOCKSSL environment variable in Windows as described in "Using SSL" (page 42).
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**.

Using the -nohdtot Option

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

```
$ cli -nohdtot
```

Using the -hafter Option

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

```
$ cli -hafter 20
```

Forcing Commands

A number of CLI commands return 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 Solaris, Linux, HP-UX, AIX and Windows.

Setting the TPDFORCE Environment Variable on Solaris, Linux, HP-UX, and AIX

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

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

Setting the TPDFORCE Environment Variable on Windows

To set the TPDFORCE environment variable in Windows:

1. Perform Step 1 through Step 4 of the procedure for setting the TPDSOCKSSL environment variable in Windows, as described in "Using SSL" (page 42).
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 Solaris, Linux, HP-UX, and AIX 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. This can be avoided by setting your system to read your user name and password from a file.

  ○ 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.

- Enter `cli` at the DOS or Solaris, Linux, HP-UX, or AIX 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. 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 typing either `help` or `clihelp`. When you run individual CLI commands from a system's native shell, use `clihelp`.

For details about HP 3PAR CLI commands, see also the *HP 3PAR Command Line Interface Reference*.

SSH

The system is provided with Secure Shell (SSH) protocol version 2 that enables great flexibility in accessing the HP 3PAR OS 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
- Oracle® Solaris™

For Microsoft® Windows® users, an SSH client is available at http://www.openssh.org.

Benefits of Using SSH

SSH provides the following benefits:

- No HP 3PAR CLI installation. CLI clients are not required to access and use the CLI (assuming SSH client is installed).
- No version matching. The HP 3PAR CLI and HP 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 are 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 system's public key 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.

CLI User Name Restrictions Using SSH

There are several CLI user names that are reserved for use by HP. Reserved names are as follows:

- `root`
- `daemon`
- `bin`

- console
- nobody
- sshd
- telnetd
- sys
- sync
- man
- proxy
- list

New Users

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

Existing Users

To delete a user, issue the `removeuser` command.

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

In the previous example, a user with the reserved user name of `pw1` is removed.

To create a new user, issue the `createuser` command.

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

In the previous example, new user `ROOT1` is created.

See the *HP 3PAR Command Line Interface Reference* for complete information about these commands.

Creating, Displaying, and Removing the SSH User Login Message

You can use the `setsshbanner` command to create a message to display to users before they enter their user name and password. There are no options for the interactive command, run the `setsshbanner` command and follow the interactive command instructions. To remove the login message run the `setsshbanner` command but only enter a blank space for the message text. The blank space indicates you are removing the current message.

You can use the `showsshbanner` command to show the message displayed to users before they enter their user name and password. There are no options for the command, run the `removesshbanner` command.

Accessing the CLI Using SSH

NOTE: The following screen examples display output for UNIX systems. 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.

To access the CLI using SSH:

1. From any host that is running SSH client, enter the following example:

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

    In the previous example, `ssh user` is the first default user with Super rights and `<System-host-name>` is the array host name.

2. If this is 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`.

    This is normal SSH behavior, because the client host does not have the system's public key. If the system's public key 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 HP 3PAR Administration Tools. These keys can be installed with the administration tools or can be obtained directly from the HP 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 system's cluster name or host name.

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

5. If you need to create additional CLI users, use the `createuser` command. For more information, see "Creating Users" (page 22).

6. Terminate the CLI session by typing `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 Windows platforms).

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

The following steps describe setting up CLI scripting through SSH:

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 into 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 `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 pass phrase.
  - When the key is generated with a pass phrase, your private key is encrypted and stored in the file.

> **NOTE:** The pass phrase 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 pass phrase 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 is no extra blanks.)

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
```

6. If you specified a pass phrase when creating the key pair, run ssh-agent and ssh-add 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>
```

> **NOTE:** You can redirect the standard input, or *stdin*, to execute multiple CLI commands.

5 Managing HP 3PAR Virtual Domains

Overview

HP 3PAR Virtual Domains Software (domains) enables an administrator 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 the users' assigned domains. For more information about domains, see the *HP 3PAR StoreServ Storage Concepts Guide*. This chapter provides instructions on creating domains and describes the administration tasks associated with maintaining domains.

NOTE: HP 3PAR Virtual Domains Software requires an HP 3PAR Virtual Domains Software license. Contact your local service provider for details.

Default Domains

An HP 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 the default domain has been set to Domain A, each time a user starts a new CLI session, only objects in Domain A can be viewed and worked with (Figure 1 (page 56)). The user's default domain can be set and reset at any time by the administrator.

In the following example, the default domain (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. When that session is over, your next session is started in your default domain (Domain A) (see Figure 1 (page 56)). 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

SINGLE assigned domain's (either default or current) objects viewable and operable.

Creating a Domain

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.

If you want 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.

- 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 `-vvretentiontimemax` option.

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

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" (page 58), you may need to view the objects' domain associations.

To view the domains in your system, issue the `showdomain -d` command. For details about the `showdomain` command, see the *HP 3PAR Command Line Interface Reference*.

NOTE: 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" (page 48) for further information.

To view a system object's domain association, issue the `showhost`, `showvv`, or `showcpg` commands.

Modifying a Domain

For any existing domain, you can change the domain's name or add comments to that domain using the `setdomain` command. For details about the `setdomain` command, see the *HP 3PAR Command Line Interface Reference*.

Changing a Domain Name

To change a domain's name, 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

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

Prior to removing a domain, any users belonging to that domain must be removed (see "Removing Users From a Domain" (page 24)) and assigned to another domain (see "Adding Users to a Domain" (page 24)), or must be removed completely. Any objects belonging to the domain must be removed from the domain or moved to another domain before removing the domain. Domain objects include virtual volumes, common provisioning groups (CPGs), and hosts.

To remove a domain, 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. In doing so, 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 which are drawing from CPGs and multiple VVs sharing the same LD. In order to move or remove a domain object or domain association, you must have Super or Edit user rights with access to all domains.

NOTE: Before proceeding with any domain management activities, you may want to view the domain associations for your system objects as described in "Viewing Domains" (page 57).

Moving Domain Objects to Another Domain

Moving objects between domains is an online operation and does not interrupt host I/O. 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 VV in a CPG is part of an Adaptive Optimization configuration (aocfg), then if the VV or CPG is 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

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 of 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 of 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.

Creating Virtual Domain Sets

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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Adding Virtual Domains to Virtual Domain Sets

To add a domain to an existing domain set, issue the `createdomainset -add <set_name> <domain_names>` command, 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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Modifying Virtual Domain Sets

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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Removing Virtual Domain Sets

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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Viewing Virtual Domain Sets

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.

6 Managing Ports and Hosts

Overview

The system sees a host as a set of initiator port World Wide Names (WWNs) or iSCSI Names. Hosts that are physically connected to ports on the system are automatically detected. The FC port WWNs and iSCSI port iSCSI Names are displayed in the HP 3PAR CLI. You can also add new WWNs or iSCSI Names for unestablished host paths and assign them to a host before they are physically connected. 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. FCoE connectivity is supported on HP 3PAR StoreServ 7000 Storage systems, HP 3PAR StoreServ 8000 Storage systems, HP 3PAR StoreServ 10000 Storage systems, and HP 3PAR StoreServ 20000 Storage system through the use of Converged Network Adapters (CNA). CNA ports can be configured to be used as FCoE or iSCSI ports.

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 Windows, Linux, and AIX operating systems can all connect to the same system port. This simplifies connecting hosts to the system and reduces management time related to complex host connections.

For more information about ports, hosts, and host personas, see the *HP 3PAR StoreServ Storage Concepts Guide*.

NOTE: See the HP 3PAR Implementation Guides for recommended practices and detailed configuration information about using your specific host devices with the system.

NOTE: Ports used for file services are managed with the `startfs` command. For more information see, ???.

Modifying Port Parameters

NOTE: For information about configuring ports to use HP 3PAR File Persona software file services, see ???.

Use the HP 3PAR CLI `controlport` command to modify the FC ports and the Gigabit Ethernet ports used for the HP 3PAR Remote Copy Software over IP (RCIP) solution. Use the `controliscsiport` command to modify the iSCSI ports on the system. These commands control several aspects of the ports. Whenever you use these commands, you must use a sub-command specifying the operation you want to perform and include the port location.

The HP 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:

    ◦ HP 3PAR StoreServ 7000 and 8000 nodes are numbered 0 to 1 or 0 to 3 from bottom to top, depending on whether the system has 2 or 4 controller nodes.

    ◦ HP 3PAR StoreServ 10000 nodes are numbered left to right, bottom to top, from 0 to 3 (HP 3PAR StoreServ 10400) or from 0 to 7 (HP 3PAR StoreServ 10800).

    ◦ HP 3PAR StoreServ 20000 nodes are numbered from bottom to top, from 0 to 3 (HP 3PAR StoreServ 20400), or from 0 to 7 (HP 3PAR StoreServ 20800).

- **Slot**: Valid slot numbers are 0 to 9, depending on the system.

    ◦ HP StoreServ 7000 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.

    ◦ HP StoreServ 8000 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.

    ◦ HP 3PAR StoreServ 10000 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.

    ◦ HP 3PAR StoreServ 20000 slots are numbered 0 to 6 from left to right in each controller node.

- **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 0 to 3 or 1 to 4 for HBAs with four ports.

    ◦ HP StoreServ 7000 and 8000 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).

    ◦ HP 3PAR StoreServ 10000 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.

    ◦ HP 3PAR StoreServ 20000 ports are numbered from bottom to top in a given slot.

FC Port Settings

The HP 3PAR CLI `controlport` command is described in detail in the *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help. Use the `controlport` command to perform the following tasks:

- Set the port mode with the `config` sub-command followed by `disk|host|rcfc`, and set the port location in `node:slot:port` format.
  To set the port mode:
  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.

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

To set the port data rate in Gbps, issue the `controlport rate <1|2|4> <node:slot:port>` command.

- When `unique_nwwn` is enabled, the port presents a unique node name for the connection. To set the mode of an FC port, or 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.

- Set the port's Class 2 service support level with the `cl2` sub-command followed by `ack0`, `ack1`, or `disable` and then by the port location in `node:slot:port` format.

    To set the port's Class 2 service support level, issue the `controlport cl2 <cl2val> <node:slot:port>` command.

- Set the port's VLUN Change Notification (VCN) support generation with the `vcn` sub-command followed by either `enable` or `disable`, and the port location in `node:slot:port` format.

    To set the port's VLUN Change Notification (VCN) support, issue the `controlport vcn <enable|disable> <node:slot:port>` command.

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

iSCSI Port Settings

Use the `controliscsiport` command to configure and manage iSCSI ports. The sub-commands associated with the `controliscsiport` command can be used to perform various management tasks, including setting the IP and gateway addresses of iSCSI ports, setting the IP address and TCP port numbers for Internet Storage Name Service (iSNS) servers, and assigning iSCSI ports to groups of target ports to send to initiators in response to SendTargets requests.

The `addr` sub-command configures IP addressing for an iSCSI port. Use the sub-command to set the IP address and netmask (for IPv4 addresses) or the IP address and prefix length (for IPv6 addresses). To configure the IP address of an iSCSI port, 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.

Use the `gw` sub-command to set the gateway address of the iSCSI port. 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.

Use the `isns` sub-command to set the IP address of an iSNS server. 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.

Use the `isnsport` sub-command to set the TCP port number for the iSNS server. 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.

The `stgt` sub-command 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 the ports having 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. To associate an iSCSI port with a given group of target ports, 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 an integer from 0 to 65535.
- `<node:slot:port>` specifies the physical location of the iSCSI port.

NOTE: Other sub-commands are available for the `controliscsiport` command, including sub-commands for setting the maximum transmission unit (MTU) size for the iSCSI port, for pinging IP addresses from a port, and for deleting iSCSI port configurations. Additional options are available to restrict the operation of commands to iSCSI ports on specific virtual LANs using VLAN tags. The `controliscsiport` command and its sub-commands and options are described in detail in the *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

To display information about iSCSI ports on a system, including IP addresses, gateway addresses, iSNS addresses, and SendTargets Group Tags, issue the `showport -iscsi` command.

Port Target, Initiator, and Peer Modes

The system controller node ports operate in different modes. Depending on the type of port, the port may 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 FC (RCFC).

iSCSI ports use the following firmware mode setting:

- Target mode for ports that connect to hosts and receive commands from those hosts.

Gigabit Ethernet ports use the following firmware mode setting:

- Peer mode for Ethernet ports, used for Remote Copy over IP (RCIP).

FCoE ports use the following firmware mode setting:

- Target mode for ports that connect to hosts and receive commands from those hosts.

Use the HP 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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

△ **CAUTION:** Ports in the same FC adapter should be set 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 3&4) must use the same mode.
- For QLogic cards, it is strongly recommended that all ports in a card be set to the same mode.

Active and Inactive Hosts

An active host is a host that is connected to a system port and recognized by the HP 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 HP 3PAR OS but is not recognized as being connected to any system port at the moment. This may be because the host is currently disconnected from the system port, or due to an error condition such as link failure, or because the host is offline.

When a host on a system port becomes inactive for any reason, the following happens:

1. The HP 3PAR OS recognizes that the host is missing on the port and changes the state of the host from `active` to `inactive`.
2. The HP 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.
3. If and when the host reappears on the same port, the HP 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 HP 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 the WWNs that make up the host. If you need 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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Host Management CLI Commands

Use the following CLI commands to manage hosts and host paths:

- `showhost`—display information about defined hosts and host paths in the system.
- `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.

Creating Hosts

When you create a new 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.

In addition to assigning FC or iSCSI paths when creating a host, you can also annotate the host with descriptive information such as the host's 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 *HP 3PAR Command Line Interface Reference* or the HP 3PAR CLI Help for further information.

NOTE: There should be at least two paths to each host to facilitate updates to the system. Failure to create at least two host paths may result in unnecessary system downtime.

See the HP 3PAR Implementation Guide for recommended practices and detailed configuration information about using specific host devices with the system.

Creating a Host with a Fibre Channel Path

To create a host with an FC path:
1. Determine the HBA's WWN 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 HBA's WWN.

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

To create a host with an iSCSI path:
1. Determine the HBA's iSCSI Name 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 from step 1 above.

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 HBA's FC WWN or iSCSI name 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*.

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's name.
- Add or remove WWNs or iSCSI Names.
- Add or remove iSCSI CHAP authentication information.

The following CLI commands are described in detail in the *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Changing a Host Name

To change a host name, 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

To add a WWN to an existing host:

1. Determine the HBA's WWN 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 HBA's WWN.
3. Repeat as necessary for any additional WWNs you wish to add to the host definition.

Adding iSCSI Path iSCSI Names

To add an additional iSCSI Name for an existing host:

1. Determine the HBA's iSCSI Name 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 from step 1 above.
3. Repeat as necessary for any additional iSCSI Names you wish to add to the host definition.

Removing Fibre Channel Path WWNs

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.

Removing iSCSI Path iSCSI Names

To remove an iSCSI Name from an existing host, 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.

- To configure a host as a CHAP initiator, issue the `sethost initchap <secret>` `<host_name>` command.

- To configure a host as a CHAP target, issue the `sethost targetchap <secret>` `<host_name>` command.

For both commands listed above, `<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 *HP 3PAR Command Line Interface Reference* for further information.

Removing iSCSI CHAP Authentication Information

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 commands listed above:

  - `<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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

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.

To move the host to another system port, you must do the following:

1. Use the HP 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" (page 65).

   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" (page 69). 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 HP 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" (page 90). The `removehost` CLI command is described in detail in the *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

To completely remove a host definition 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 as soon as 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" (page 90).

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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Adding Hosts to Host Sets

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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Modifying Host Sets

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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

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.

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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Managing Host Personas

A host persona is a set of behaviors that allows hosts that are connected to FC, iSCSI, or FCoE 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 that run Windows, Linux, and AIX operating systems can all connect to the same system port. This simplifies connecting hosts to the system and reduces management costs related to complex host connections.

A host persona defines the custom responses for certain iSCSI commands and does not affect any of the FC port settings. Host personas are tied to the host name and identified by the host persona number. You can set the host persona number when the host is created or modify it later. Use the HP 3PAR CLI commands or the StoreServ Management Console (SSMC) to display, create, modify, and remove host personas. See the *HP 3PAR Command Line Interface Administrator's Manual* or the SSMC Online Help for instructions on displaying, creating, modifying, and removing host personas.

Different host personas have different functions and support different host operating systems. The specific host persona is designated by the host persona number. Depending on the selected host persona number, the following additional capabilities are supported:

- UARepLun—Sends a unit attention when the VLUNs are added to or removed from the LUN list.
- ALUA—Enables the asymmetric logical unit access (ALUA) command and asymmetric state change unit attention when path counts change due to adding or removing ports in the host's definition.
- VolSetAddr—Enables HPUX Volume Set Addressing (VSA).
- SoftInq—Enables inquiry data formats for hosts such as Egenera and NetApp.
- NACA—Enables the Normal Auto Contingent Allegiance (NACA) bit for AIX.
- SESLun—Enables iSCSI Enclosure Services (SES) LUN ID 254 for Host Explorer agent support.
- SubLun—Enables SCSI two-level LUN addressing.
- LUN0SCC—Enables a SCSI Command Controller at LUN 0 for HPUX and OpenVMS systems.
- WSC—Enables inquiry responses to support Window systems.

NOTE: Each host connected to the system must use a host persona with the SESLun enabled, or the Host Explorer agent cannot communicate with the system.

Table 5 (page 72) describes the specific functionality for each host persona number. For a list of supported host operating systems, go to the Single Point of Connectivity Knowledge (SPOCK) website http://www.hp.com/storage/spock.

Table 5 Host Personas

Persona Number	Persona Name	Host Operating System	Additional Capabilities
1	Generic	Linux, Windows, and Solaris	UARepLun, SESLun
2	Generic-ALUA	Linux, Windows, and Solaris	UARepLun, ALUA, SESLun
6	Generic-Legacy	Linux, Windows, and Solaris	None
7	HPUX-Legacy	HP-UX	VolSetAddr, Lun0SCC
8	AIX-Legacy	AIX	NACA
9	Egenera	Egenera, NetApp	SoftInq
10	NetApp ONTAP	Data ONTAP	SoftInq
11	VMware	Linux and Windows	SubLun, ALUA
12	OpenVMS	OpenVMS	UARepLun, RTPG, SESLun, LunoSCC
13	HPUX	HP-UX	UARepLun, VolSetAddr, SESLun, ALUA, LunoSCC
15	WindowsServer	Windows	UARepLun, SESLun, ALUA, WSC

NOTE: Only the Generic, Generic-ALUA, and Generic-Legacy personas are supported for iSCSI connections.

The NetApp host operating system requires unique WWNs for hosts in an FC fabric.

A host device must use either iSCSI, FC, or FCoE connections. Mixed ports are not supported on a single device.

The Host Explorer Software Agent

The HP 3PAR Host Explorer Software agent is a program that runs on a host connected to a system. The Host Explorer agent runs as a service on Windows and as a daemon on Linux, Solaris, HP-UX, and AIX operating systems. No license is required to use the HP 3PAR Host Explorer agent.

The 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 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 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 Host Explorer agents running, the system automatically groups WWNs or iSCSI names for the host together, assisting with creating the host.

The 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 Host Explorer agent from the *HP 3PAR Host Explorer* CD. For instructions on installing and using the Host Explorer agent, see the *HP 3PAR Host Explorer User's Guide*. For a list of supported host operating systems, go to the HP SPOCK website:http://www.hp.com/storage/spock.

To display the information returned by the Host Explorer agent to the system, issue the `showhost -agent` or `showhost -agent -d` command.

Hosts and Virtual Domains

NOTE: Virtual domains requires the use of the HP 3PAR Virtual Domain Software license. Contact your local HP 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.

Creating a Domain-Specific Host

In order to create a domain-specific host, you must have Super or Edit rights in the `all` domain. For details about this restriction, see the *HP 3PAR StoreServ Storage Concepts Guide* and the `createhost` command in the *HP 3PAR Command Line Interface Reference*.

To create a domain-specific host, issue the `createhost` command as described in `createhost` "Creating a Host with a Fiber Channel Path" (page 66) and "Creating a Host with an iSCSI Path" (page 66) 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" (page 67).

Any existing domain-specific host can be modified as follows:

- By changing the host's name. See "Changing a Host Name" (page 67) 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 *HP 3PAR StoreServ Storage Concepts Guide* for details about domain restrictions.

- 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 *HP 3PAR StoreServ Storage Concepts Guide*. See the following sections for instructions:

  ◦ "Adding Fiber Channel Path WWNs" (page 67).

  ◦ "Adding iSCSI Path iSCSI Names" (page 67).

  ◦ "Removing Fibre Channel Path WWNs" (page 67).

  ◦ "Removing iSCSI Path iSCSI Names" (page 68).

- 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 *HP 3PAR StoreServ Storage Concepts Guide* for details about this restriction). See the following for instructions:

  ◦ "Configuring iSCSI CHAP Authentication Information" (page 68)

  ◦ "Removing iSCSI CHAP Authentication Information" (page 68)

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 *HP 3PAR StoreServ Storage Concepts Guide*.

For information about changing a host's domain association, see "Managing Domain Objects" (page 58).

Using Persistent Ports for Nondisruptive Online Software Upgrades

The HP 3PAR OS 3.2.1 online software upgrade process does not require shutting down host-facing ports for an extended period of time. HP 3PAR OS 3.2.1 supports using persistent ports during the online software upgrade process in order to provide a transparent mechanism for maintaining host I/O with no disruptions.

Persistent ports allow HP 3PAR storage systems' host-facing ports 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 down time, 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 HP 3PAR 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 HP 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:

- HP 3PAR 4-port 4G FC
- Emulex 2-port 4G
- Emulex 4-port 8G FC

Use the `showport` and `showportdev` commands to monitor the status of port failover and failback operations.

The operating system assigns failover ports using a fixed mapping of N^1:S:P. N^1 uses the XOR operator; therefore N^1 = N XOR 1. For example, port 0:1:1 partners with port 1:1:1. This means that port 0:1:1 provides failover for 1:1:1 and port 1:1:1 provides failover for port 0:1:1.

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 `showport` command output shown below, 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 shows 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
```

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
```

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.

7 Managing CPGs and Virtual Volumes

Overview

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. Virtual volumes draw their resources from CPGs, and virtual volumes are exported as Logical Unit Numbers (LUNs) to hosts. Virtual volumes are the only data layer visible to hosts. You can create physical copies or virtual copy snapshots of virtual volumes for use if the original base volume becomes unavailable. Before creating virtual volumes, you must first create CPGs to allocate space to the virtual volumes.

To learn about the maximum number of CPGs and volumes supported on your system, go to the Single Point of Connectivity Knowledge (SPOCK) website http://www.hp.com/storage/spock.

For detailed information about CPGs and virtual volumes, see the *HP 3PAR StoreServ Storage Concepts Guide*.

For instructions on how to create copies of volumes, see "Managing Virtual Volume Copies" (page 96).

NOTE: Creating TPVVs requires the HP 3PAR Thin Provisioning Software license. Creating virtual copies or *snapshots* requires the HP 3PAR Virtual Copy Software license. Contact your HP representative for more information.

Common Provisioning Groups

By default, a CPG is configured to auto-grow new LDs when the amount of available LD space falls below a configured threshold. CPGs are initially empty. The initial buffer pool of LDs starts off at a fraction of the exported virtual capacity of mapped volumes and automatically grows over time, as required by application writes. For detailed information about CPG growth warnings and growth limits, see the *HP 3PAR StoreServ Storage Concepts Guide*.

NOTE: Virtual volumes in the same CPG can share the same LD. In the unlikely event that the LD is damaged by multiple simultaneous disk failures, all the volumes associated with that LD will be unavailable.

Virtual volume performance may suffer from too much interleaving within the LDs.

Growth Increment Considerations for Common Provisioning Groups

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 courses of action 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.

△ **CAUTION:**   Use caution in planning CPGs. 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 space available to that CPG, either any new writes to TPVVs associated with the CPG will fail, or snapshot volumes associated with the CPG may become invalid, or both. Invalid volumes do not handle write failures gracefully and may produce unexpected failures.

Do not allow volumes that draw from a CPG to exceed the CPG's growth limit. Exceeding the CPG growth limit can invalidate snapshot volumes.

NOTE: By default, the growth warning and growth limits are set to `none`, which effectively disables these safety features.

See the site, http://www.hp.com/support/hpgt/3par for additional information about specific alerts. Managing alerts is described in "Managing Events and Alerts" (page 120).

System Guidelines for Creating Common Provisioning Groups

When you use the advanced parameters for LD creation, use the following guidelines to ensure maximum performance and optimal reliability in the volumes supported by those LDs:

- Chunklets in the same RAID set should be from different drive magazines or drive cages.
- Chunklets in the same row should be from different physical disks. In other words, a physical disk should not appear twice in the same row.
- Chunklets should belong to a disk that is connected through the primary path to the LD's owner node.
- The growth increment is limited to 40 chunklets.
- The system should use as many physical disks as possible.
- The load on all physical disks should be balanced.
- The system should use the largest possible row size.

Common Provisioning Group CLI Commands

Use the following CLI commands to manage CPGs:

- `showcpg`—display CPGs in the system.
- `createcpg`—create CPGs.
- `setcpg`—modify existing CPGs
- `compactcpg`—consolidate LD space in CPGs into as few LDs as possible.
- `removecpg`—remove CPGs from the system or remove specific LDs from CPGs.

Creating a Common Provisioning Group

- To create a CPG, issue the `createcpg -aw <percent> -sdgs <size> -sdgl <size> -sdgw <size> -t <RAID_type> <CPG_name>` command, where:

  ○ `-aw <percent>` is the percentage of used snapshot space and administration space that will generate a warning alert. If 0 (default) is specified, alert generation is disabled.

  ○ `-sdgs <size>` is the amount of LD storage created during each autogrow operation. For the minimum default growth sizes per number of nodes, see Table 6 (page 77).

  ○ `-sdgl` is the growth limit which cannot be exceeded during autogrow operations. If 0 (default) is specified, no limit is enforced.

  ○ `-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.

  ○ `-t <RAID_type>` is the RAID type, specified as `r0` (RAID 0), `r1` (RAID 1), `r5` (RAID 5), or `r6` (RAID MP).

  ○ `<CPG_name>` is the name of the CPG being created.

  If no RAID type is specified with the `-t` option, the default is RAID 1 for Fast Class (FC or SAS) and Solid State Disk (SSD) device types, and RAID 6 for NL device types.

  HP strongly recommends using RAID 6 for NL device types. If you want to use RAID 5 for NL device types, you must first change the `setsys AllowR5OnNLDrives` value to `yes` (the default is `no`).

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

Modifying a Common Provisioning Group

The following modifications are commonly performed on CPGs using variations of the `setcpg` command:

- 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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Setting Snapshot Space Usage Warnings

To set or modify the space usage warning for a CPG, 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 a Common Provisioning Group's Autogrow Size

NOTE: Before modifying your CPG's autogrow settings, see "Growth Increment Considerations for Common Provisioning Groups" (page 77) for guidelines.

To set or modify a CPG's autogrow size, issue the `setcpg -sdgs <size> <CPG_name>` command, where:

- `-sdgs <size>` is the amount of LD storage created during each autogrow operation. For the minimum default growth sizes per number of nodes, see Table 6 (page 77).
- `<CPG_name>` is the name of the CPG being created.

Consolidating Common Provisioning Group Space

Compacting a CPG allows you to reclaim space from a CPG that has become less efficient in space usage from creating, deleting, and relocating volumes. Compacting consolidates LD space in CPGs into as few LDs as possible.

To consolidate CPG space, 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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Removing a Common Provisioning Group

You cannot remove a CPG that still has virtual volumes provisioned from it.

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 complete list of options available for the `removecpg` command, see the *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Virtual Volume Types

There are four types of virtual volumes:

- Fully Provisioned Virtual Volume
- Thinly Provisioned Virtual Volume (TPVV)
- Thinly Deduplicated Virtual Volume (TDVV)
- Administrative Volume

Administrative volumes are created by the system and are for system usage only.

△ **CAUTION:** It is strongly recommended that you do not tamper with the `admin` volumes.

Virtual volumes have three separate data components:

- *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 HP 3PAR Virtual Copy Software feature's copy-on-write operation will fail. To avoid running out of user space, use TPVVs to automatically draw more user space from a CPG. The HP 3PAR OS automatically reclaims unused snapshot space from TPVVs and fully provisioned virtual volumes and returns the space to the LDs.

For greater administrative flexibility, you can provision the virtual volume's user space and snapshot space from the same or different CPGs. If the virtual volume's 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 *HP 3PAR StoreServ Storage Concepts Guide*.

Fully Provisioned Virtual Volumes

A fully provisioned virtual volume is provisioned storage space from LDs that belong to a CPG. Fully provisioned virtual volumes are the default system volume and do not require any additional licenses. Unlike TPVVs, fully provisioned virtual volumes 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 fully provisioned virtual volume, whether or not the space is actually used. The fully provisioned virtual volume size is fixed, and the size limit is 16 TB. You can set snapshot space allocation limits and usage warnings to help manage the growth of snapshot space.

NOTE: In most cases the CLI refers to a fully provisioned volume as a `VV`. In some instances the CLI refers to a fully provisioned virtual volume as a `CPVV`.

Thinly Provisioned Virtual Volumes

With an HP 3PAR Thin Provisioning Software license, you can create Thinly Provisioned Virtual Volumes (TPVV). 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 and adds them to the pool until the CPG reaches the user-defined growth limit that restricts the CPG's maximum size. The TPVV volume size limit is 16 TB.

Thinly Deduplicated Virtual Volumes

With the HP 3PAR Deduplication feature you can create Thinly-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. Thinly-deduplicated Virtual Volumes are managed like any other TPVV. A TDVV must be associated with CPGs that are created from solid-state disk drives (SSD). Deduplication can be used in StoreServs with mixed drive configurations, but TDVVs can only reside on SSDs.

Virtual Volume CLI Commands

Use the following 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. For greater administrative flexibility, you can provision the virtual volume's user space and snapshot space from the same or different CPGs. If the virtual volume's 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. You can create many identical virtual volumes at one time. Expiration dates can be set for virtual volumes to save space.

For information about planning for the growth of virtual volumes, see the *HP 3PAR StoreServ Storage Concepts Guide*. For information about creating CPGs, see "Common Provisioning Groups" (page 77).

NOTE: Creating virtual copies or *snapshots* requires the HP 3PAR Virtual Copy Software license. Creating TPVVs requires the HP 3PAR Thin Provisioning Software license. Contact your HP 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.

Creating Fully Provisioned Virtual Volumes

A fully provisioned virtual volume has a set amount of user space that is allocated for user data. The virtual volume's snapshot space is allocated on demand.

To create a group of fully provisioned virtual volumes, issue the `createvv -cnt <number> -snp_cpg <snp_cpg_name> <user_cpg> <VV_name>[.<index>] <VV_size g|G|t|T>` command, 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 is incremented 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 and 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 `-tpvv` option is not specified, the created volume is a fully provisioned virtual volume.

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

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.

To create a TPVV, issue the `createvv -tpvv [-snp_cpg <snp_cpg_name>] [-usr_aw <percent>] [-usr_al <percent>] [-minalloc <alloc_size>] <user_cpg> <VV_name> <VV_size g|G|t|T>` command, where:

- `-tpvv` indicates that you are creating a TPVV.
- `<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's size.
- `-usr_al <percent>` is the allocation limit of the user space specified as a percentage. This prevents the user space from exceeding a specified percentage of the volume's 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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Creating Deduplicated Virtual Volumes

A Thinly 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 disk drives (SSD). Use the `showcpg` command to verify that the device type of the drives used by the CPG is `SSD`.

To create a TDVV, issue the `createvv -tdvv [-snp_cpg <snp_cpg_name>] [-usr_aw <percent>] [-usr_al <percent>] [-minalloc <alloc_size>] <user_cpg> <VV_name> <VV_size g|G|t|T>` command, where:

- `-tdvv` 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. This generates an alert when the user space of the volume exceeds a specified percentage of the volume's size.
- `-usr_al <percent>` is the allocation limit of the user space specified as a percentage. This prevents the user space from exceeding a specified percentage of the volume's 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 information about calculating data compression with deduplication and converting fully provisioned volumes to TDVVs, see "Converting Fully Provisioned Virtual Volumes to Thinly Deduplicated Virtual Volumes" (page 85) .

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

Modifying Virtual Volumes

Existing virtual volumes can be modified to use a new name, draw space from a different CPG, set allocation warnings, or to use new policies.

To modify a volume to draw its snapshot space and administration space from a different CPG, issue the `setvv -snp_cpg <CPG_name> -usr_cpg <user_cpg> <VV_name>` command, where:

- <CPG_name> is the name of the CPG from which the modified volume will draw its snapshot space and administration space.

- <user_CPG> is the name of the CPG from which the modified virtual 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 `setvv` command, see the *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Growing Virtual Volumes

You can increase the size of, or grow, an existing virtual volume's user space automatically when the volume reaches capacity.

To automatically increase 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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Converting Virtual Volumes Online

You can convert existing fully-provisioned virtual volumes to TPVVs or TDVVs, and you can convert TPVVs or TDVVs to fully-provisioned virtual volumes on the array, without disrupting normal storage system 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 a fully-provisioned virtual volumes in order 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 fully-provisioned virtual volumes can free up thinly-provisioned capacity for other TPVVs. Similarly, if a fully-provisioned virtual volume's storage space is largely unused, you can convert it to a TPVV in order 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 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 HP 3PAR Dynamic Optimization license.

Converting volumes from full to thin requires the HP 3PAR Dynamic Optimization Software license and HP 3PAR Thin Provisioning Software license.

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

Converting Fully Provisioned Virtual Volumes to Thinly Provisioned Virtual Volumes

To convert an FPVV to a TPVV, 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 `-tdvv` or `-full` option.
- `<VV_name>` is the name of the virtual volume being converted.

Converting Fully Provisioned Virtual Volumes to Thinly Deduplicated Virtual Volumes

To convert an FPVV to a TDVV, issue the `tunevv usr_cpg <cpg> -tdvv <VV_name>`, where:

- `usr_cpg <cpg>` is the name of the CPG from which the converted virtual volume will draw its user space.
- `-tdvv` 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.

For information about creating TDVVs, see "Creating Deduplicated Virtual Volumes" (page 83).

Calculating Space Savings with Deduplication

Only TPVVs can be analyzed for deduplication. 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 HP 3PAR Deduplication.

Run the `showtask` command to get the `dedup_dryrun` task ID number. 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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Converting Thinly Provisioned Virtual Volumes to Fully Provisioned Virtual Volumes

To convert a TPVV to an FPVV, 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 `-tdvv` 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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Converting Thinly Deduplicated Virtual Volumes to Fully Provisioned Virtual Volumes

To convert a TDVV to an FPVV, 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 `-tdvv` option.

- `<VV_name>` is the name of the virtual volume being converted.

Reducing Volume Size with HP 3PAR Thin Conversion Software

HP 3PAR Thin Conversion Software 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. To convert volumes located on a system, you must have a HP 3PAR StoreServ 10000 Storage system or HP 3PAR StoreServ 7000 Storage system to perform the copy operation.

The conversion process has four steps:

1. Assessment.
2. Data preparation.
3. Zeroing unused space.
4. Creating a physical copy.

NOTE: Converting fully provisioned volumes to TPVVs with the Thin Conversion feature requires a StoreServ 10000 or StoreServ 7000 storage system, an HP 3PAR Thin Provisioning Software license, and an HP 3PAR Thin Conversion Software license. Contact your HP representative for more information.

Manually Converting a Fully Provisioned Virtual Volume to a Thinly Provisioned Virtual Volume

To convert an FPVV to a TPVV:

1. For assessment and preparation considerations,, see the *HP 3PAR StoreServ Storage Concepts Guide*.
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. StoreServ 10000 and StoreServ 7000 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" (page 99).

   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. Use the `showvv-s` command to view the size of the TPVV created in Step 4. 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, you can use the `removevv` command to remove the base volume converted in Step 4.

Reducing Volume Size with HP 3PAR Thin Persistence Software

HP 3PAR Thin Persistence Software 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 a StoreServ 10000 or StoreServ 7000 storage system to use Thin Persistence with TPVVs. For more information about the Thin Persistence feature, see the *HP 3PAR StoreServ Storage Concepts Guide*.

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" (page 84).

NOTE: Thin persistence can have some performance implications during extremely busy system conditions. HP 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 a StoreServ 10000 or StoreServ 7000 storage system, an HP 3PAR Thin Provisioning Software license, an HP 3PAR Thin Conversion Software license, and an HP 3PAR Thin Persistence Software license. Contact your HP representative for more information.

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 neither changes the rights of the virtual volume nor removes it from the virtual volume set.

Creating Virtual Volume Sets

To create a virtual volume set, 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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Adding Virtual Volumes to Virtual Volume Sets

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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Modifying Virtual Volume Sets

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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Removing Virtual Volume Sets

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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Freeing Virtual Volume Snapshot Space

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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help. For information about tuning your system for better performance, see "Performance Tuning" (page 165).

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.

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 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.

- `<VV_name>` is the name of the volume that is set to expire.

Setting Retention Times for Virtual Volumes

HP 3PAR Virtual Lock Software is an optional feature that enforces the retention period of any volume or copy of a volume. You must purchase the Virtual Lock license to use the `-retained` option. Locking a volume prevents the volume from being deleted intentionally or unintentionally before the retention period elapses. You can use Virtual Lock to specify the retention period for any volume or copy of a volume.

Use the `showvv -retained` command to display all volumes with retention times, and the time at which the volume retention expires.

Rules for using 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 43800 hours (1,825 days or 5 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 the domain's maximum retention time.

- A volume with remaining retention time cannot be removed until the end of the retention period.

You can use the `-retain` option to set volume retention times while issuung the following commands:

- `createvv`
- `setvv`
- `createsv`
- `creategroupsv`

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.

Removing Virtual Volumes

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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Validating and Repairing Virtual Volumes

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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

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 volume-LUN, or VLUN, is a pairing between a virtual volume and a logical unit number (LUN), expressed as either a *VLUN template* or 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 *HP 3PAR StoreServ Storage Concepts Guide*.

> **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.

Creating a Host Sees or Host Set VLUN Template

To create a host sees or host set VLUN template, 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 *HP 3PAR Command Line Interface Reference*.

Creating a Port Presents VLUN Template

To create a port presents VLUN template, 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 *HP 3PAR Command Line Interface Reference*.

Creating a Matched Set VLUN Template

To create a matched set VLUN template, 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 *HP 3PAR Command Line Interface Reference*.

Unexporting Virtual Volumes

In order to halt the export of a virtual volume, you must remove the VLUNs associated with that volume. You must remove a VLUN template in order to remove the active VLUNs associated with that template.

Removing all VLUNs for a host stops the host from accessing any volumes.

Removing a Host Sees or Host Set VLUN Template

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 *HP 3PAR Command Line Interface Reference*.

Removing a Port Presents VLUN Template

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 to the *HP 3PAR Command Line Interface Reference*.

Removing a Matched Set VLUN Template

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 *HP 3PAR Command Line Interface Reference*.

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 HP 3PAR Virtual Domains Software license. Contact your HP sales representative for details.

Creating a Common Provisioning Group in a Domain

If you are using virtual domains, you can create domain-specific CPGs which are accessible by only those users with rights to that domain. You must have Super or Edit rights in the `all` domain in order to create a domain CPG. For information about CPGs and virtual domains, see the *HP 3PAR StoreServ Storage Concepts Guide*.

To create a CPG within a domain, issue the `createcpg -domain <domain_name> -aw <percent> -sdgs <size> -sdgl <size> -sdgw <size> -t <RAID_type> <CPG_name>` command, where:

- `<domain_name>` is the domain in which you are creating the CPG.
- `-aw <percent>` is the percentage of used snapshot space and administration space which will generate a warning alert. If 0 (the default value) is specified, no alerts are generated.
- `-sdgs <size>` is the amount of LD storage created during each autogrow operation. For the minimum default growth sizes per number of nodes, see Table 6 (page 77).
- `-sdgl <size>` is the growth limit which cannot be exceeded during autogrow operations. If 0 (the default value) is specified, no limit is enforced.
- `-sdgw <size>` is the space limit for LD space before a warning alert is generated. If 0 (the default value) is specified, no warning limit it enforced.
- `-t <RAID_type>` is the RAID type, specified as `r0` (RAID 0), `r1` (RAID 1), `r5` (RAID 5), or `r6` (RAID MP).
- `<CPG_name>` is the name of the CPG being created.

All arguments are identical to those specified in "Creating a Common Provisioning Group" (page 79). For a complete list of options available for the `createcpg` command, see the *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

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.

For instructions on creating domain CPGs, see "Moving a Common Provisioning Group to a Domain" (page 95). For more information about virtual domains, see the *HP 3PAR StoreServ Storage Concepts Guide*.

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's 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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

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 Super or Edit user belonging 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 an Edit user belonging 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 *HP 3PAR StoreServ Storage Concepts Guide* and the `setvv` command in the *HP 3PAR Command Line Interface Reference* for additional information about this restriction.

To modify a virtual volume in a domain, see "Modifying Virtual Volumes" (page 84).

Growing Virtual Volumes in Domains

Existing domain virtual volumes can be enlarged (grown) by automatically adding capacity in increments that you specify. Volumes which were created by Super or Edit users in the `all` domain can only be grown by Super or Edit users in the `all` domain. Volumes created from CPGs by Edit users in a `specified` domain can be grown by those users.

For instructions on growing domain virtual volumes, see "Growing Virtual Volumes" (page 84).

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 on freeing virtual volume snapshot space, see "Freeing Virtual Volume Snapshot Space" (page 88).

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 inter-domain exports is determined by the user's role.

- Users with Super and Edit rights who belong to the `all` domain can export virtual volumes in any domain existing in the system.
- Users with Edit rights who belong to a `specified` domain can only export virtual volumes to hosts belonging to that domain.

Creating VLUN Templates in the All Domain

You can create host sees, matched set, and port presents VLUN templates if you have Super or Edit rights in the `all` domain. For instructions on creating each template type, see "Creating a Host Sees or Host Set VLUN Template" (page 91), "Creating a Port Presents VLUN Template" (page 91), and "Creating a Matched Set VLUN Template" (page 92).

Creating VLUN Templates in a Specific Domain

Edit users belonging 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 on creating each template type, see "Creating a Host Sees or Host Set VLUN Template" (page 91) and "Creating a Matched Set VLUN Template" (page 92).

Moving a Common Provisioning Group to a Domain

For instructions on moving CPGs into or out of a domain, see "Managing Domain Objects" (page 58).

8 Managing Virtual Volume Copies

There are two types of copies that can be created from virtual volumes: *virtual copies* and *physical copies*.

- A *virtual copy* is a snapshot of an original or base volume. A virtual copy only records 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.

For more information about virtual copies, see the *HP 3PAR StoreServ Storage Concepts Guide.*

NOTE: Creating TPVVs requires the HP 3PAR Thin Provisioning Software license. Creating virtual copies or *snapshots* requires the HP 3PAR Virtual Copy Software license.

NOTE: 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 OpenStack Volume (OSV) and OpenStack Snapshot (OSS) prefixes.

Virtual Copies

A virtual copy is a snapshot of another virtual volume. You can make virtual copies of base volumes, physical copies, or other virtual copies. Virtual copies are created using *copy-on-write* techniques available only with the HP 3PAR Virtual Copy Software license. Unlike a physical copy which duplicates the entire base volume, a virtual copy only records the changes to the original volume. This allows an earlier state of the original volume to be recreated by starting with the current state and rolling back all of the changes that have been made since the virtual copy was created.

You can use the HP 3PAR CLI to perform the following virtual copy tasks:

- Create

- Promote

- Modify

- Remove

For additional information about virtual copies, see the *HP 3PAR StoreServ Storage Concepts Guide.*

Creating a Virtual Copy

Virtual copies can be read-only or read/write. You can only make a read-only copy of a read/write volume and a read/write copy of a read-only volume. 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 website:

http://www.hp.com/storage/spock

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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Promoting a Virtual Copy

If you have created multiple copies of a base volume, the data on a virtual copy can be rolled back to the base volume or to any of the virtual copy's RW parents in the same tree by *promoting* a virtual copy. This copies the changes from the virtual copy back onto the base volume, overwriting the base volume with the copy. The virtual copy still 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.

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. You can use the `-pri` option to raise the priority of the task if your virtual volumes are unavailable and restoring access to the volume is the highest priority. 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 a Running Task" (page 131).

  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 `createsv` command, see the *HP 3PAR Command Line Interface Reference* and the HP 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" (page 92). After you delete all VLUNs, you can use the volume as the destination volume for a physical copy.

If you are using HP 3PAR Remote Copy Software, you can optionally promote the virtual copy if the base volume is in a Remote Copy group. See the *HP 3PAR Command Line Interface Reference* for detailed information about the `promotesv` command. For details about Remote Copy, see the *HP 3PAR Remote Copy Software User's Guide.*

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. To modify an existing VV, issue the `setvv` command. For details on all of the `setvv` command arguments and their usage, see the *HP 3PAR Command Line Interface Reference*.

Removing a Virtual Copy

To remove a virtual copy, issue the `removevv <VV_name>` command, where `<VV_name>` is the snapshot you are removing.

See the *HP 3PAR Command Line Interface Reference* for detailed information about the `removevv` command.

Creating a Group of Virtual Copies

The HP 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.

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 *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Creating a Virtual Copy Online

A virtual copy can be created while online without interrupting host access. The destination can be immediately exported and is automatically created by using the command `createvvcopy -online` although this means that it cannot exist prior to executing this command. This option requires the specification of a CPG for the destination volume and allows for the `-snp_cpg` and `-tpvv` or `-tdvv` options. The `-online` option requires the `-p` option and cannot be used with the `-r`, `-halt`, `-s`, `-b`, and `-pri` options.

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, and 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 website:

http://www.hp.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.

In addition to creating offline or online physical copies, you can also use the HP 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 *HP 3PAR StoreServ Storage Concepts Guide.*

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.

Creating an Offline Physical Copy

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. You can use the `-pri` option to raise the priority of the task if your virtual volumes are unavailable and restoring access to the volume is the highest priority. However, raising the priority of the task may impact host I/O performance. This option cannot be used with `-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 a Running Task" (page 131).

For a complete list of options available for the `createvvcopy` command, see the *HP 3PAR Command Line Interface Reference* and the HP 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

An online physical copy is created by an operation that allows for the physical copy or read-write virtual copy to be instantly available for export to hosts. To create an online physical copy of a virtual volume, issue the `createvvcopy -p <parent_volume> -online [-snp_cpg`

```
<snap_cpg>] [{-tpvv | -tdvv}] [-wwn <wwn>] <destination_cpg>
<destination_volume> command, where:
```

- `-p` creates a snapshot of the parent volume, as identified by the `<parent_volume>` specifier, and copies the snapshot data to the destination volume.

- `-online` specifies that the copy is to be performed such that the destination volume will be created automatically and exported for availability to hosts even before the copy operation is completed.

- `-snp_cpg <snap_cpg>` specifies the name of the CPG on which space for snapshots will be allocated for the destination volume.

- `-tpvv` indicates that the destination volume is a thinly-provisioned virtual volume. Cannot be used with the `-tdvv` option.

- `-tdvv` indicates that the destination volume is a thinly-deduplicated virtual volume. Cannot be used with the `-tpvv` option.

- `-wwn <wwn>` indicates that the value of the supplied `<wwn>` specifier be used as the WWN for the destination virtual volume. If this option is not included, the system will automatically determine 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.

NOTE: The `-online` option for the `createvvcopy` command cannot be used with the `-r`, `-halt`, `-s`, `-b`, or `-pri` options.

Creating a Group of Offline Physical Copies

The HP 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.

To create a group of offline physical copies, 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). Include the `<parent_VV>:<destination_VV>` couplets indicating source and destination volumes in a comma-separated list to specify the group of copies to make. 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. You can use the `-pri` option to raise the priority of the task if your virtual volumes are unavailable and restoring access to the volume is the highest priority. However, raising the

priority of the task may impact host I/O performance. This option cannot be used with `-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

Creating a Group of Online Physical Copies

The `creategroupvvcopy` command, like the `createvvcopy` command, can also create online copies of virtual volumes. To create a group of online physical copies, issue the

```
creategroupvvcopy -p -online [-snp_cpg <snp_cpg>] [{-tpvv|-tdvv}]
<parent_VV1>:<destination_cpg1>:<VV1_name>[:<wwn1>][,
<parent_VV2>:<destination_cpg2>:<VV2_name>[:<wwn2>]] 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 destination volume is a Thinly Provisioned Virtual Volume. Cannot be used with the `-tdvv` option.

- `-tdvv` indicates that the destination volume is a Thinly-Deduplicated Virtual Volume. Cannot be used with the `-tpvv` option.

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 complete list of options available for the `creategroupvvcopy` command, see the *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

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.

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: In order 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 so that snapshots of the parent volumes were created at the time copies were made.

Promoting a Physical Copy

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 the base volume.

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 Domains

NOTE: Virtual domains require the Virtual Domains Software license. Contact your local HP 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 does not differ from snapshot creation and modification in systems not using domains. Domain snapshot creation and modification is limited to users with Super and 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" (page 96) for instructions.

  ○ Promoted. See "Promoting a Virtual Copy" (page 97) for instructions.

  ○ Modified. See "Modifying a Virtual Copy" (page 97) for instructions.

  ○ Removed. See "Removing a Virtual Copy" (page 98) for instructions.

- Physical copies can be:

  ○ Created. See "Creating an Offline Physical Copy" (page 99) for instructions.

  ○ Resynchronized. See "Resynchronizing Physical Copies" (page 101) for instructions.

  ○ Promoted. See "Promoting a Physical Copy" (page 102) for instructions.

Moving Snapshots

Snapshots can be moved in or out of a domain using the `movetodomain` command. This action is restricted to Super users in the `all` domain.

NOTE: If a snapshot is moved in or out of a domain, the snapshot's base volume is also moved.

For further instructions see "Moving Domain Objects to Another Domain" (page 58).

9 Creating and Applying Templates

Overview

You can use the HP 3PAR CLI to create templates that enable you to apply a set of parameters that automatically create LDs, virtual volumes, or CPGs with the same or similar characteristics.

The following general rules apply to templates:

- A property can either be *included* in a template or *not included*.

  Properties are virtual volume, LD, or CPG attributes such as set size.

- A property included in a template can have a *defined value* or have a value that is left *unspecified*.

  A property with a defined value has had a specific value assigned to it (for example, a set size of 2). A property with an unspecified value does not have a specific value assigned to it. When you apply a template that includes a property with one or more unspecified values, the system will either use the default value (when applicable) or calculate the optimized setting for you.

- For all templates, you can either *allow overrides* of property values or not.

  When you allow overrides of a property, users can modify that property's value when applying the template. When you do not allow overrides of a property, it is not possible to modify the defined value, system default, or system-calculated value for that property when applying the template.

Creating Templates

You can create three types of templates that can then be applied to create LDs, virtual volumes, and CPGs.

To create a template, issue the `createtemplate <obj_type> <template_name>` command, where:

- `<obj_type>` is the object type the template is used to create. Specify VV, LD, or CPG for virtual volume, LD, or CPG, respectively.
- `<template_name>` is the name of the template being created.

The VV, LD, and CPG templates have object-specific arguments that must be specified during creation.

Additionally, depending on the type of template you are creating, you may wish to specify other arguments to further refine the template's parameters. For required and optional arguments specific to each template object type, see the *HP 3PAR Command Line Interface Reference*.

Applying Templates

Once you have created a template, you can apply that template to create LDs, virtual volumes, or CPGs.

Creating Virtual Volumes and Logical Disks Using a Template

To create a virtual volume and its underlying LDs using a template, issue the `createvv -templ <template_name> <VV_name> <size>` command, where:

- `<template_name>` is the name of the template being applied to the creation of the volume and LDs.
- `<VV_name>` is the user-designated name of the virtual volume being created.
- `<size>` is the size of the user volume.

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. For additional information, see the *HP 3PAR Command Line Interface Reference*.

Creating a Common Provisioning Group Using a Template

To create a CPG using a template, 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.

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. See the *HP 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, virtual volumes, or CPGs. When you edit a template, no changes are made to objects you have created with that template.

Viewing Template Parameters

Before modifying a template it may be helpful to view the template's existing parameters:

- To view a template's current 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 (LD), or CPG (common provisioning group).

Adding and Replacing Template Parameters

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 parameter's value 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 *HP 3PAR Command Line Interface Reference*.
- `<template_name>` is the name of the template being modified.

Removing Template Parameters

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 parameter's value 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.

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 *HP 3PAR Command Line Interface Reference*.

10 Monitoring System and Physical Disk Capacity

Overview

The HP 3PAR CLI provides commands to 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.

Use the following CLI commands to review space usage information:

- `showpd`—displays configuration information about the physical disks in the system.
- `showspare`—displays information about spare chunklets in the system.
- `showsys`—displays an overview of the system's capacity and connectivity.

System Capacity

The HP 3PAR CLI provides detailed views of the system's total capacity, as well as the system's total capacity by storage device type.

Determining Total System Capacity

To determine system capacity, issue the `showsys -space` command. The following is an example of the data returned by issuing this command:

```
 ---Adm--- ----------Snp---------- ----------Usr-----------

                  --(MB)--- --(MB)--- --(% VSize)-- ---(MB)---- --(% VSize)--
-----(MB)------ -Capacity Efficiency-
Id Name    Prov Type  Rsvd Used Rsvd Used  Used Wrn Lim  Rsvd  Used  Used Wrn Lim
Tot_Rsvd  VSize   Compaction    Dedup
 1 .srdata full base    0    0    0    0   0.0  --  -- 81920 81920 100.0  --  --
 81920  81920           --            --
 0 admin   full base    0    0    0    0   0.0  --  -- 10240 10240 100.0  --  --
 10240  10240           --            --
 2 cpvv    cpvv base  384    3 1024  400  39.1   0   0  1024  1024 100.0  --  --
  2432   1024          1.4            --
 7 cpsv    snp  vcopy   --   *0   -- *300 *29.3   0   0    --    --    -- --  --
    --   1024          --            --
 5 tdvv    tdvv base  256    3 1024    0   0.0   0   0   512     0   0.0   0   0
  1792   1024          4.4           1.0
11 tdsv    snp  vcopy   --   *0   --   *0  *0.0   0   0    --    --    -- --  --
    --   1024          --            --
13 tdsv2   snp  vcopy   --   *0   --   *0  *0.0   0   0    --    --    -- --  --
    --   1024          --            --
 3 tpvv    tpvv base  256    4  512    0   0.0   0   0  1536  1024 100.0   0   0
  2304   1024          3.0            --
 9 tpsv    snp  vcopy   --   *0   --   *0  *0.0   0   0    --    --    -- --  --
    --   1024          --            --
15 tpsv2   snp  vcopy   --   *0   --   *0  *0.0   0   0    --    --    -- --  --
    --   1024          --            --
-----------------------------------------------------------------------------------
10 total             896   10 2560  400                95232 94208
 98688 100352         2.6           1.0
```

As shown in the example above, system capacity is displayed in MBs. The first line displays the system's total capacity, which is the sum of the allocated space (`Allocated`), free space (`Free`), and failed space (`Failed`).

The allocated space includes the following:

- All base volumes and the volumes' user, copy, and administration spaces.
- 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.
- The free space includes the total free initialized and uninitialized spaces available for use.

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: FC, NL, and SSDs.

To display the total capacity for all physical disks of a specific type in a system, issue the `showsys -space -devtype FC|NL|SSD` command.

NOTE: The output of the `showsys -space -devtype FC|NL|SSD` command is displayed in the same format as the `showsys -space` command output example in "Determining Total System Capacity" (page 106).

Physical Disk Capacity

The HP 3PAR CLI allows you to view capacity for all physical disks in your system, capacity of physical disks by device type, and the capacity for a single physical disk in your system.

NOTE: The Device Speed number does not represent a rotational speed for SSDs without spinning media. It is meant as a rough estimation 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 an SSD, the number is to be treated as a relative performance benchmark that takes into account I/O per second, bandwidth, and the access time.

Determining Total Physical Disk Capacity

To view the total physical disk capacity of the system, issue the `showpd -space` command. The following is an example of the data returned by issuing this command:

```
cli% showpd -space
                           -------------------(MB)-------------------
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
```

As shown in the example above, physical disk capacity is displayed in MBs. The data columns are identified as follows:

- `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 needs to 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's capacity.
- `Volume`—The volume's capacity.
- `Spare`—The disk's space reserved for spare chunklets.
- `Free`—The disk's free space.
- `Unavail`—Unavailable disk space.
- `Failed`—Space in failed chunklets.

Determining Physical Disk Capacity by Disk Type

You can display the capacity of all physical disks of a specific type. There are three types of physical disks: FC, NL, and SSD.

To display the total capacity for all physical disks of a specific type in a system, issue the `showpd -space -devtype FC|NL|SSD` command.

NOTE: The output of the `showpd -space -devtype FC|NL|SSD` command is displayed in the same format as the `showpd -space` command output example in "Determining Total Physical Disk Capacity" (page 107).

Determining the Capacity of a Specific Physical Disk

Physical disk capacity can be filtered by disk ID to display a specific disk's capacity information.

NOTE: The output for the command listed below is displayed in the same format as the `showpd -space` command output example in "Determining Total Physical Disk Capacity" (page 107).

To display the capacity information for a single physical disk, issue the `showpd -space <PD_ID>` command, where `<PD_ID>` is the physical disk whose capacity information is shown.

Spare Chunklets

Some chunklets are identified as spares when the system is first set up at installation. Data from other chunklets is moved or reconstructed onto these spare chunklets in response to a chunklet or

disk failure, or when a drive magazine needs to be serviced. This initial spare storage totals the amount of storage in a single drive magazine, using the largest size physical disks.

How spare chunklets work:

- When a connection is lost to a physical disk or a physical disk fails, all future writes to the disk are automatically written to a logging LD until the physical disk comes back online or until the time limit for logging is reached. Logging disk space is allocated when the system is set up.

- If the time limit for logging is reached, 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.

- For automatic relocations, the system uses up to a maximum of one disk worth of chunklets per system node.

  NOTE: Local chunklets are chunklets on disks, which are used by the node that owns the LD for the chunklet being relocated.

- If the system uses up its free or spare chunklets for relocation, an alert is generated.

- Once the spare and free chunklets are used up, automatic relocation no longer occurs. In most cases, some data redundancy is lost. The system also generates an alert.

Viewing Spare Chunklets

Use the showspare command to display information about all spare chunklets. If a spare chunklet is in use, the showspare output includes the name and ID of the LD using it, as well as the chunklet's position on the LD. If the spare chunklet is not in use, it is listed as available, and the columns relating to the LD show only dashes.

The following example displays information about two spare chunklets, 0 and 1, on physical disk 23:

```
%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 fields in this output provide the following information:

- PdId—The physical disk on which the chunklets reside.

- Chnk—The position on the physical disk of the spare chunklets.

- LdName—The name of the LD that is using the spare chunklet.

- LdCh—The position of the chunklet on the LD.

- State—The 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—The chunklet is available for use as a spare.

  ○ ld—The 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`—The current 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`—The spare status of the chunklet. `Y` indicates the chunklet is used for spare, `N` indicates that it is not.
- `Cl`—The 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`—The initial location of the chunklet prior to relocation. The format is PD:CH, where PD is the physical disk ID and CH is the chunklet ID.
- `To`—The destination location of the chunklet during relocation in the format PD:C H.

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 in turn prevents `servicemag` operations from completing. Use the `checkld` command to recover data from a failed RAID set:

`checkld -y <LD_name> -rs <setnumber> -recover -fd:-fp`, where:

- `-y`—Indicates that any errors that are found should be fixed; this option is required when using the `-recover` option.
- `<LD_name>`—Specifies the name of the LD that contains the failed RAID set.
- `-rs <setnumber>`—Specifies the RAID set number within the LD to be checked, fixed, and recovered.
- `-recover -fd:-fp`—Specifies the chunklet to be recovered by physical disk and chunklet position.

Viewing Hardware Inventory

Use the `showinventory` command to display information about all the hardware components in the system. The command output is divided into sections such as the following:

- Nodes
- PCI Cards
- CPUs
- Internal Drives
- Physical Memory
- Power Supplies
- Battery
- Node Fans
- Port Inventory

- Cage Inventory
- Disk Inventory

Along with specific component details, the `showinventory` command also displays the following information:

- Part number
- Serial number
- Assembly part number
- Assembly serial number
- Spare part number
- Model name
- Revision

11 Data Encryption

HP 3PAR encrypted storage systems provide data encryption by using self-encrypting drives (SEDs) with a local key manager (LKM) or an external 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.

The HP 3PAR StoreServ Data Encryption solution 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 HP 3PAR StoreServ 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 HP 3PAR StoreServ 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 HP 3PAR OS that runs on each node in a cluster, maintains the authentication key. You must back up and protect the keystore file; HP 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 HP 3PAR Storage system 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 HP 3PAR StoreServ system is still functioning, you can always perform another backup of the encryption key file. However, should you lose the encryption key file or the password, and should the HP 3PAR StoreServ system then fail, the HP 3PAR StoreServ 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.
>
> The importance of keeping the encryption key file and password safe cannot be overstated. HP 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 be FIPS compliant.

Supported Configurations

HP 3PAR StoreServ Storage

The following HP 3PAR Storage systems support data encryption. They can be ordered with an HP 3PAR Data Encryption license and SEDs that provide data encryption.

- HP 3PAR StoreServ 10000 Storage
- HP 3PAR StoreServ 7450 Storage
- HP 3PAR StoreServ 7000 Storage

> **NOTE:** A non-encrypting array cannot be converted to an encrypting array. HP does not support mixed configurations of encrypted and non-encrypted drives. The HP 3PAR StoreServ Storage system must be purchased new, with only SED drives installed.

HP 3PAR Operating System

- HP 3PAR OS 3.2.1 or later

HP Peer Motion and HP Remote Copy are supported on data-encryption enabled systems. If the target system's data-encryption state does not match the primary system's data-encryption state when you are setting up HP Peer Motion or HP Remote Copy, you will get a warning that must be acknowledged in order to continue setting up. However, you will not be prevented from replicating encrypted data to a non-encrypting system.

Self-Encrypting Drives

SEDs are solid-state or hard disk drives.

Data Encryption Licensing

An HP 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.

To view the license using the HP 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
...
```

Restrictions

- Data encryption is available only with the purchase of a new HP 3PAR StoreServ system.

- Data encryption can only be enabled on a StoreServ running HP 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 a local key manager (LKM) or external key manger (EKM).

- The encryption related activities are recorded in the HP 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 authority is responsible for physical security of a backup file and for remembering the password.

- Encryption should be enabled *before* writing data to the array. The system will function, and the same data can be accessed before and after encryption is enabled, but it will not be secure until encryption is enabled.

- Encryption should be enabled prior to writing 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.

Using Self-Encrypting Disks

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.

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 *HP 3PAR Command Line Interface Reference*.

Managing Data Encryption

Enabling Data Encryption

Because the key file must be saved on the local disk (a customer PC or server), enabling encryption using the CLI must be performed from an HP 3PAR OS CLI Client running on a PC or server, or through the HP 3PAR SSMC, not from an SSH connection.

To enable encryption using the HP 3PAR CLI, issue the following command:

`cli% controlencryption enable <backup filename>`

To enable encryption using the Solaris, Linux, HP-UX, or AIX CLI, issue the following command:

`# controlencryption enable backupfile`

To enable encryption using the Windows CLI, issue the following command:

`C:\>controlencryption enable C:\\backupfile`

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 of 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 more information about the `controlencryption` command, see the *HP 3PAR Command Line Interface Reference*.

Backing up the Authentication Key File

To back up the authentication key file, issue the `controlencryption backup <filename>` command. For example:

```
cli% controlencryption backup backup1
```

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.

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 HP 3PAR StoreServ Storage system.

To restore the key file, issue the `controlencryption restore <filename>` command. For example:

```
cli% controlencryption restore backup1
```

Changing the Authentication Key

To change the authentication key and back up the authentication key file, issue the `controlencryption rekey` command.

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. In the event of a recovery operation requiring restoration of the key file, the correct key file must be available; otherwise, the data will be lost.

Using External Key Management Servers

Use the `controlencryption` command to enable and configure the StoreServ system to use one or more External Key Management (EKM) servers.

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 mange 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 HP 3PAR StoreServ Storage system issue a prompt for the EKM user name password.

Showing Data Encryption Status

To see the status of data encryption, issue the following command:

`controlencryption status`

Execute the command with the `-d` option to show disks that are failed or that do not support data encryption.

```
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
```

Data encryption states (as seen under the `State` column in the foregoing example) are shown in Table 7 (page 117).

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	Re-run the previous operation after addressing the reason that the previous operation failed. (This is most likely to have been a failed drive.)
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 (page 117).

Table 8 Data Encryption Status

Status Information	Description
Backup Saved	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 data encryption, but data encryption is not necessarily enabled.
Enabled	Data encryption is enabled.
Non-SEDs	The number of drives that are not SEDs. If this number is non-zero, 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 non-zero, encryption operations cannot be completed until these drives are removed from the system.

Replacing a Failed Disk Drive

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 *HP 3PAR Command Line Interface Reference*.

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.

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

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
```

After the system manager (sysmgr) dismisses the drive, it is cryptographically erased (provided data encryption was enabled).

For more information about the `dismisspd` command, see the *HP 3PAR Command Line Interface Reference*.

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 HP 3PAR StoreServ Storage system. This is needed only if there is a catastrophic problem and the key files on all nodes are destroyed or corrupted.

Table 9 Data Encryption Commands *(continued)*

Command	Description
controlencryption status	Show the data encryption status. (See "Showing Data Encryption Status" (page 117).)
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, especially in HP 3PAR StoreServ 10000 Storage systems.

12 Managing Events and Alerts

Overview

The system tracks system events internally. Some of these events require action on the part of the system administrator, so they trigger alerts that are displayed for the administrator. Events are logs created by the system which allow you to view the day-to-day health of your system. Alerts are generated by the system when a system event requires immediate operator action or attention.

Checking the Status of a System

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.

- Use the `checkhealth` command to view a status summary of all system components.
- Use the `checkhealth -list` command to view a list of all system components.

To check the health of specific hardware and software components, issue the `checkhealth <component>` command, where `<component>` is the component, or list of components, you want to check.

For more information about troubleshooting your system with the `checkhealth` command, see the troubleshooting guide for your StoreServ storage server.

Monitoring and Managing Alerts

Alerts are system events that require your immediate attention. An alert may be triggered by a single event, a combination of events, or by repeated occurrences of the same event. The system administrator is responsible for responding to alerts. For information about system alerts, go to http://www.hp.com/support/hpgt/3par and select your server platform.

Viewing Alerts

To display system alerts, issue the `showalert` command.

You can additionally display alerts by type (fixed alerts, acknowledged alerts, and so on). For information about alert display options, see the *HP 3PAR Command Line Interface Reference*.

Setting an Alert State

To mark an alert as new, fixed, or acknowledged, issue the `setalert new|fixed|ack <alert_ID>` command, where `<alert_ID>` is the alert whose status you wish to acknowledge.

Removing an Alert

To remove an alert, issue the `removealert <alert_ID>` command, where `<alert_ID>` is the alert you wish to remove.

Setting System Alerts

While most system alerts are generated automatically without any need for user configuration, there are several types of alerts that you can specifically configure:

- Limits relating to CPGs can be set when creating a CPG and can later trigger alerts. For information on setting the growth increment limits, see "Common Provisioning

Groups" (page 77). For details about CPG creation precautions, see the *HP 3PAR StoreServ Storage Concepts Guide*.

- Limits for virtual volumes capable of allocating space on demand are also user-configurable and can trigger alerts. For information about on-demand virtual volume space allocation, see the *HP 3PAR StoreServ Storage Concepts Guide*.

- The raw space alert is a global threshold that can be set for the storage system to alert administrators when available space on the system falls below a user-specified level. When the available space on the storage system falls below this user-specified threshold, an alert is generated.

There are also four default system thresholds which alert you when the available space on the system falls below 50%, 75%, 85%, and 95% of the total available space on the system. When the user-defined threshold is set, alerts for system thresholds below the user-defined threshold are suppressed. The following section describes how to set and change this raw space alert threshold.

Setting the Raw Space Threshold Alert

- To set a raw space alert for a storage system with NL drives, issue the `setsys RawSpaceAlertNL <threshold>` command.

- To set a raw space alert for a storage system with FC drives, issue the `setsys RawSpaceAlertFC <threshold>` command.

- To set a raw space alert for a storage system with SSDs, ssue the `setsys RawSpaceAlertSSD <threshold>` command.

For each command above, `<threshold>` is an integer from 100 to 100,000 that represents the total available space on the system in gigabytes. A value of 0 effectively disables the raw space alert safety feature. Any alerts for system thresholds below the user-defined thresholds are suppressed.

Monitoring and Managing the Event Log

The event log has information about all notable occurrences on the system. System events include all alerts the system has generated and alerts marked as acknowledged or fixed. These system events are generated and logged in the system event log.

By default, the HP 3PAR storage system reserves 3 MB for event log entries. However, the actual default size is 33 MB because the storage system maintains 11 versions of the event log: the current version, for writing new events to the log, and the past 10 versions for reading past events. When 11 versions have been written, the oldest event log is deleted. The 3 MB log size default value can be changed by administrators using the CLI `setsys` command `EventLogSize` parameter within a size range of 512 KB to 4 MB. An event is logged if the event log size is changed. The current event log size can be obtained using the CLI `showsys -param` command.

```
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 : 3M
VVRetentionTimeMax : 336 Hours
```

Viewing the Event Log

To view the events log, issue the `showeventlog` command.

The `showeventlog` display can be refined to include only events occurring before or after a specified time, within a specified time period, or that match a specified pattern. For complete information on the events log display options, see the *HP 3PAR Command Line Interface Reference*.

Stopped Logical Disks and Missing Physical Disks

If physical disks in the system are unavailable when the system is powered on, the physical disk is in the **Missing** state. The system manager will not immediately start LDs that have chunklets on these missing disks. The result is some LDs remain in the **Stopped** state. Use the `showpd` and `showld` commands to display the state of physical and LDs.

If the LD is data-complete, but a few of the physical disks are missing, the LDs will be automatically started after waiting five minutes. If more than four physical disks are missing, the LDs will not be started automatically. You can start a data-complete LD using the HP 3PAR OS CLI `startld` command, and the system manager will begin reconstructing the missing mirrored data. The system automatically relocates the chunklets from the missing physical disks to free space or spare space.

For a complete list of options available for the `showpd` and `showld` commands, see the *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Preserved Data

When the system is holding data in cache but is not able to write that data to the destination disk for any reason, it saves the data to the *preserved data LD*. This LD is automatically created at the time that the storage system is installed and initially configured.

The data written to the preserved data LDs is typically created due to a temporary loss of availability of disks, a situation that usually corrects itself once 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, use the `showpd` command to see which physical disks are in an unavailable state. If any disks are in an unavailable state, it is necessary to take corrective action in order to make those disks available again. If data is persistently saved to the preserved data LD, contact your local service provider for technical support and services.

13 Viewing Statistics and Histograms

Overview

The HP 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 HP 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

This section provides instructions on using commonly used CLI commands to access performance statistics. The commands described here are a subset of the statistics commands available. For a complete list of statistics commands, see the *HP 3PAR Command Line Interface Reference*.

Performance statistics are available for the following:

- physical disks
- ports
- VLUNs
- virtual volumes
- data cache memory
- flash cache
- CPU usage

Viewing Statistics for Physical Disks

To view physical disk statistics, issue the `statpd` command.

Data output can be further refined to display only physical disk statistics from:

- a specific physical disk, specified by either its ID or WWN.
- specific nodes.
- specific PCI slots.
- specific ports.

Additional filters can be used to refine the data output. For complete details about `statpd` command options and for sample command data output, see the *HP 3PAR Command Line Reference*.

NOTE: The device speed number does not represent a rotational speed for SSDs without spinning media. It is meant as a rough estimation 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 an SSD, the number is to be treated as a relative performance benchmark that takes into account I/O per second, bandwidth, and the access time.

Viewing Port Statistics

To view port statistics, issue the `statport` command.

By default, only statistics for data transfers are displayed. You can optionally display statistics for control transfers, or both data and control transfers, by issuing the `statport -ctl` or `statport -both` command, respectively.

Data output can be further refined to display only port statistics from:

- specific nodes.
- specific PCI slots.
- specific ports.
- host-connected (target) ports.
- disk-connected (initiator) ports.
- FC ports (for Remote Copy).
- Ethernet ports (for Remote Copy).

You can use additional filters to refine the data output. For complete details about `statport` command options and for sample command data output, see the *HP 3PAR Command Line Reference*.

Viewing VLUN Statistics

To view VLUN statistics, issue the `statvlun` command.

The data output can be further refined to display only VLUN statistics from:

- Specific domains.
- Specific hosts.
- Specific virtual volumes.
- Specific LUNs.
- Specific nodes, slots, or ports.

You can use additional filters to refine the data output. For complete details about `statvlun` command options and for sample command data output, see the *HP 3PAR Command Line Reference*.

Viewing Virtual Volume Statistics

> **NOTE:** Virtual volumes may be accessed externally by hosts and internally by the system prefetcher. When viewing virtual volume I/O statistics, the information provided by the HP 3PAR CLI includes access by the prefetcher. To see only external I/O statistics, view the VLUN statistics for a specific virtual volume/host combination.

To view virtual volume statistics, issue the `statvv` command.

To view remote copy virtual volume statistics, issue the `statrcvv` command.

By default, statistics for virtual volume read and write operations are displayed together. You can optionally display statistics for volume reads and writes separately by issuing the `statvv -rw` command.

You can use additional filters to refine the data output. For complete details about `statvv` and `statrcvv` command options and for sample command data output, see the *HP 3PAR Command Line Reference*.

Viewing Statistics for Data Cache Memory

To view the DRAM data cache memory statistics, issue the `statcmp` command.

By default, data cache memory statistics are displayed by node. You can optionally display data cache memory statistics by virtual volume by issue the `statcmp -v` command.

You can use additional filters to refine the data output. For complete details about `statcmp` command options and for sample command data output, see to the *HP 3PAR Command Line Reference*.

Viewing Statistics for the Flash Cache and Data Cache

To view Flash Cache Memory Page (FMP) and Cache Memory Page (CMP) DRAM statistics, issue the `statcache -v -n <name|pattern> -domain {<domainname|pattern>}... -metadata -d <seconds> -iter <number>` command, where:

- `-v` specifies that FMP and CMP statistics are displayed by virtual volume instead of the default by node. By default, all virtual volumes are displayed unless the `-n` option is specified.

- `-n <name|pattern>` specifies that statistics are displayed for virtual volumes matching the specified `name` or `pattern`. This option is valid only if `-v` is also specified.

- `-domain {<domainname|pattern>}...` displays the virtual volumes in domains with names that match one or more of the specified domains or patterns. If `-domain` is not specified, the virtual volumes in the current domain are shown.

- `-metadata` specifies that statistics for the Snapshot Administration (SA) volumes are displayed with the statistics for user volumes. This option is only valid if `-v` is also specified.

- `-d <seconds>` specifies the interval in seconds that statistics are sampled using an integer from 1 through 2147483. If no interval is specified, the option defaults to an interval of two seconds.

- `-iter <number>` specifies that statistics are displayed a specified number of times as indicated by the number using an integer from 1 through 2147483647.

Viewing Statistics for CPU Usage

To view statistics for CPU usage from all nodes, issue the `statcpu` command.

For complete details about `statcpu` command options and for sample command data output, see the *HP 3PAR Command Line Reference*.

Viewing Statistical Reports Using the On-node System Reporter

This section provides instructions on using HP 3PAR CLI commands to generate reports of historical capacity and performance information that has been collected by the on-node System Reporter. The commands here are a subset of the statisics commands available. For a complete list of statistical reporting commands, see the *HP 3PAR Command Line Interface Reference*.

In nearly all cases, the reports can be refined 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).

Viewing Statistical Report for Region I/O Density

To view a statistical report for region I/O density, issue the `srrgiodensity` command. Data output can be further refined by the common fields listed in "Viewing Statistical Reports Using the On-node System Reporter" (page 125), in addition to specifying a CPG name or an AO configuration name. The report contains the distribution of IOP intensity for the LD region for a CPG or AO configuration.

For complete details about `srrgiodensity` command options and for sample command data output, see the *HP 3PAR Command Line Reference*.

Viewing Statistical Reports for Used Capacity (Space Reports)

To view statistical reports for capacity usage over time, issue the following commands. Most of these commands also allow the specification of the type of drive and RAID type for which to generate the report:

`sraomoves`	Describes the space moved by Adapative Optimization over time between tiers in an Adapative Optimization configuration.
`srcpgspace`	Describes the space consumed in a CPG over time.
`srldsapce`	Describes the space consumed by LDs.
`srpdspace`	Describes the space consumed by physical disks.
`srvvspace`	Describes the space consumed by virtual volumes.

For complete details about command options and for sample command data output, see the *HP 3PAR Command Line Reference*.

Viewing Statistical Reports for Performance

Performance statistical reports are available for the following:

- Cache memory
- CPU
- LDs
- Links
- Physical disks
- Ports
- Priority optimization
- Virtual volume LUN exports

Viewing Statistical Histogram Reports for Performance

Performance histogram statistical reports are available for the following. 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 for:

- LDs
- Physical disks
- Ports
- Virtual volume LUN exports

Viewing Histograms

This section provides instructions on using common CLI commands to access histogram data on system resources. The commands described here are a subset of the histogram commands available.

Histogram data can be viewed for the following resources:

- chunklets
- LDs
- physical disks
- ports
- VLUNs
- virtual volumes

For a complete list of histogram commands, see the *HP 3PAR Command Line Interface Reference*.

Viewing Histograms for Chunklets

NOTE: The `setstatch` command must be issued to enable statistics collection on chunklets before chunklet histogram data can be viewed.

To view histogram data for chunklets, issue the `histch` command.

Several filters are provided to refine the data output to display only data from specific chunklets and LDs. Additional filters are provided to customize the way the histogram data is displayed. For complete details about `histch` command options and for sample command data output, see the *HP 3PAR Command Line Reference*.

Viewing Histograms for Logical Disks

To view histogram data for LDs, issue the `histld` command.

The `histld` command provides filters to refine the data output to display only data from LDs mapped to specific virtual volumes. Additional filters are provided to customize the way the histogram data is displayed. For complete details about `histld` command options and for sample command data output, see the *HP 3PAR Command Line Reference*.

Viewing Histograms for Physical Disks

To view histogram data for physical disks, issue the `histpd` command.

Histogram data output can be further refined to display physical disk data from:

- a physical disk, specified by either its ID or WWN.
- specific nodes.
- specific PCI slots.
- specific ports.

You can use additional filters to customize the way the histogram data is displayed. For complete details about `histpd` command options and for sample command data output, see the *HP 3PAR Command Line Reference*.

NOTE: The device speed number does not represent a rotational speed for SSDs without spinning media. It is meant as a rough estimation 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 an SSD, the number is a relative performance benchmark that takes into account I/O per second, bandwidth, and access time.

Viewing Histograms for Ports

To view histogram data for ports, issue the `histport` command.

By default, only histogram data for data transfers are displayed. You can optionally display histogram data for control transfers or both data and control transfers by issuing the `histport -ctl` or `histport -both` command, respectively.

Histogram data output can be further refined to display only port data from:

- specific nodes.
- specific PCI slots.
- specific port slots.
- host-connected (target) ports.
- disk-connected (initiator) ports.

- FC ports (for Remote Copy).
- Ethernet ports (for Remote Copy).

You can use additional filters to refine the histogram data output and specify how that data is displayed. For complete details about `histport` command options and for sample command data output, see the *HP 3PAR Command Line Reference*.

Viewing Histograms for VLUNs

To view histogram data for VLUNs, issue the `histvlun` command.

Histogram data output can be further refined to display only VLUN data from:

- Specific domains.
- Sspecific hosts.
- Specific virtual volumes.
- Specific LUNs.
- Ports from specific nodes, slots, or ports.

You can use additional filters to refine the histogram data output and specify how that data is displayed. For complete details about `histvlun` command options and for sample command data output, see the *HP 3PAR Command Line Reference*.

Viewing Histograms for Virtual Volumes

To view histogram data for virtual volumes, issue the `histvv` command.

To view histogram data for remote copy virtual volumes, issue the `histrcvv` command.

You can use additional filters to refine the histogram data output and specify how that data is displayed. For complete details about `histvv` and `histrcvv` command options and for sample command data output, see the *HP 3PAR Command Line Reference*.

14 Managing Tasks

Overview

Some system operations with long running times can be managed as system tasks and initiated at scheduled times. The larger your system, the longer some CLI command operations take to complete. With the task manager you can pause, cancel, or remove tasks running on the system. The System Scheduler allows you to create, modify, and remove schedules for initiating tasks.

The group of CLI commands that can be managed with the task manager CLI commands is different from the group of CLI commands that can be scheduled with System Scheduler commands. For example, the `tunevv` command can be managed as a task but the `tunevv` command cannot be scheduled with System Scheduler commands.

- See Table 10 (page 129) for a complete list of task manager commands.

- See Table 11 (page 133) for a complete list of the commands that can be managed with the task manager commands.

- See Table 13 (page 141) for a complete list of the System Scheduler commands.

- See Table 14 (page 141) for a complete list of the commands that can be scheduled with the System Scheduler commands.

Task Manager

With the task manager CLI commands, you can display, cancel, or remove tasks running on the system.

Tasks are created in one of two ways:

- by a user or script issuing certain HP 3PAR CLI commands, such as the `tunevv` command.

- by the system initiating certain automated or scheduled processes, such as the periodic resynchronization of remote copy volumes groups.

Task IDs

Each task is identified by a task ID. When a task is started with the HP 3PAR CLI, the system displays the task ID as part of the command output. For example, when you issue the `tunevv` command with the HP 3PAR CLI, a task is started in order to track the progress of the `tunevv` operation. The task ID is indicated in the output for the `tunevv` command. In the following example, `Task 454` is started as part of the `tunevv` operation.

```
cli% tunevv usr_cpg testcpg testvol
Task 454 started
```

Use the CLI `showtask` command to display the task IDs. For information about displaying task IDs in the system, see "Displaying Task Information" (page 130).

Task Manager Commands

You can use the task manager commands to display, cancel, and remove tasks running on the system. See Table 10 (page 129) for a list of the HP 3PAR CLI task manager commands.

Table 10 Task Manager Commands

Command	Description
canceltask	Cancel one or more tasks.
removetask	Remove information about one or more tasks and their details.

Table 10 Task Manager Commands *(continued)*

Command	Description
settask	Set the priority of a running task.
showtask	Display information about tasks on the system.
starttask	Start a CLI command that runs as a background task.
waittask	Ask the CLI to wait for a task to complete before proceeding.

For a complete list of options available for the CLI task manager commands, see the *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Starting a Task

You can use the `starttask` command to start a CLI command that runs as a `background_command` task type. The `background_command` manages CLI commands with long running times in the background so that multiple tasks can run concurrently. The `background_command` task type can be managed with the task manager commands:

- See Table 10 (page 129) for a complete list of the task manager commands.
- See the `background_command` task type in Table 11 (page 133) for a list of the commands that can be run by the `starttask` command.

If the command running as a `background_command` requires user confirmation, you must force the command with the `-f` option.

To start a `background_command` task, issue the `starttask <command_name>` command, where:

- `<command_name>` is the name of the CLI command to run as a `background_command`.

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

Displaying Task Information

Once a task is started, you can use the task ID to obtain information about the task. To see a list of all tasks that have been active within the last 24 hours, you can use the `showtask` command without specifying a task ID. For example:

```
cli% showtask
Id Type   Name Status Phase Step -----Start_Time------      --------FinishTime-------
1 vv_copy vv1a done   0/0    0/0 Wed Oct 06 18:44:05 EDT 2004 Wed Oct 06 18:44:57 EDT
 2004
2 vv1b vv_copy active 2/3    0/8 Wed Oct 06 19:44:34 EDT 2004 --
```

All tasks are displayed by their task IDs, including active and completed tasks. The system stores information for up to 1,000 tasks. You can use the `showtask -t <hours>` command to show tasks older than 24 hours.

You can use the `showtask -d` command and the task ID to display status information about a specific ongoing or completed task. Task `454` is shown in the following example:

```
cli% showtask -d 454
Id  Type     Name  Status Phase Step ----------StartTime---------
-------FinishTime-------
454 tune_vv testvol done 0/0   0/0 Fri Apr 29 11:42:06 PDT 2005 Fri Apr 29 11:42:19
PDT 2005
```

```
Detailed status:
(...)
```

The columns in the example above are identified as follows:

- `Id`—The task ID for the displayed task.
- `Type`—The task type. Task types are explained in "Task Types" (page 133).
- `Name`—The name of the system object that is being operated on. When there are multiple objects, those objects are not identified individually but as a group (for example, `multiple lds` or `multiple cpgs`).
- `Status`—The task state. Task states are as follows:
  - `done`—The task has completed successfully.
  - `active`—The task is still in process.
  - `cancelled`—The task was cancelled by the user.
  - `failed`—The task failed to complete due to a reason other than user cancellation.
- `Phase`—For `active` tasks, indicates the number of completed phases and the total number of phases in the current step, using the format `<#completed_phase>/<#total_phases>`. See individual task type descriptions for an indication of the number of phases for all tasks of that type.
- `Step`—For `active` tasks, indicates the number of completed steps and the total number of steps in the current task, using the format `<#completed_step>/<#total_steps>`. For most task types, the total steps is equal to the number of regions in the operation. See individual task type descriptions for step definitions.
- `Start Time`—Indicates the time at which the task was started.
- `Finish Time`—For `done`, `cancelled`, and `failed` tasks, indicates the time at which the task stopped due to completion, cancellation, or failure.

  Use the `showtask -t` option to see older tasks. For a complete list of options available for the `showtask` command, see the *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Setting the Priority of a Running Task

You can use the `settask` command to change the priority of a running physical copy operation or virtual copy promotion operation. Using the `settask` command with other task operations is not supported. You can also set the priority before running a task with the `createvvcopy`, `creategroupvvcopy`, and `promotesv` commands and the `-pri` option. Task priorities can be set to high, medium, or low before or after the task is running. For more information about copies of volumes, see the "Managing Virtual Volume Copies" (page 96).

By default, physical copy operations and virtual copy promotion operations run as background tasks so they do not degrade host I/O performance. You can use the `-pri` option to raise the priority of the task if your virtual volumes are unavailable and restoring access to the volume is the highest priority. However, raising the priority of the task may impact host I/O performance.

The following example shows how to set the priority of task 497 to high.

```
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
```

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

Waiting for a Task

You can use the task ID and the `waittask` command to ask the system to wait for a task to complete before returning a command prompt. This prevents you from running too many tasks at once. If you use the `waittask -v` option, the command displays detailed task status and progress messages as the task executes.

For example:

```
cli% waittask -v 454
Id  Type         Name         Status Phase Step -----StartTime---- -----FinishTime--
454 tune_vv testvol Active   2/3   0/4 Fri Apr 29 11:42:06 PDT 2005


Detailed status:
{Fri Apr 29 11:42:06 PDT 2005} Created      task.
{Fri Apr 29 11:42:06 PDT 2005} Tuning       VV 'testvol'.
{Fri Apr 29 11:42:06 PDT 2005} Scheduled    region move of 256MB from (testvol.usr.1:0MB)
 to (testvol.usr.2:0MB).
{Fri Apr 29 11:42:06 PDT 2005} Scheduled    region move of 256MB from (testvol.usr.0:0MB)
 to (testvol.usr.3:0MB).
{Fri Apr 29 11:42:06 PDT 2005} Scheduled    region move of 256MB from
(testvol.usr.1:256MB) to (testvol.usr.2:256MB).
{Fri Apr 29 11:42:06 PDT 2005} Scheduled    region move of 256MB from
(testvol.usr.0:256MB) to (testvol.usr.3:256MB).
{Fri Apr 29 11:42:06 PDT 2005} Storing      task data for later restarts.
{Fri Apr 29 11:42:06 PDT 2005} Started      region move of 256MB from (testvol.usr.1:0MB)
 to (testvol.usr.2:0MB).
{Fri Apr 29 11:42:06 PDT 2005} Started      region move of 256MB from (testvol.usr.0:0MB)
 to (testvol.usr.3:0MB).
{Fri Apr 29 11:42:06 PDT 2005} Started      region move of 256MB from
(testvol.usr.1:256MB) to (testvol.usr.2:256MB).
{Fri Apr 29 11:42:06 PDT 2005} Started      region move of 256MB from
(testvol.usr.0:256MB) to (testvol.usr.3:256MB).
{Fri Apr 29 11:42:19 PDT 2005} Completed    region move of 256MB from
(testvol.usr.1:256MB) to (testvol.usr.2:256MB) in 13 seconds.
{Fri Apr 29 11:42:19 PDT 2005} Completed    region move of 256MB from (testvol.usr.1:0MB)
 to (testvol.usr.2:0MB) in 13 seconds.
{Fri Apr 29 11:42:19 PDT 2005} Completed    region move of 256MB from (testvol.usr.0:0MB)
 to (testvol.usr.3:0MB) in 13 seconds.
{Fri Apr 29 11:42:19 PDT 2005} Completed    region move of 256MB from
(testvol.usr.0:256MB) to (testvol.usr.3:256MB) in 13 seconds.
{Fri Apr 29 11:42:19 PDT 2005} Waiting to  switch regions to their new locations.
{Fri Apr 29 11:42:19 PDT 2005} Switching    regions to their new locations.
{Fri Apr 29 11:42:19 PDT 2005} Reclaiming   unused LD space.
{Fri Apr 29 11:42:19 PDT 2005} Deleted      LD testvol.usr.1.
{Fri Apr 29 11:42:19 PDT 2005} Deleted      LD testvol.usr.0.
{Fri Apr 29 11:42:19 PDT 2005} Cleaning up task data for later restarts.
{Fri Apr 29 11:42:19 PDT 2005} Completed    region moves. Moved 4 regions for a total
 of 1024 MB in 13 seconds.
```

NOTE: To cancel the `waittask` command, use **CTRL-C**. This 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 only works on completed, failed, and cancelled tasks. Information about a task remains on the system unless it is manually removed using the `removetask` command and the task ID. For example:

```
cli% removetask 454
Remove the following tasks?
454
select q=quit y=yes n=no: y
```

The specified task ID and any information associated with it are removed from the system. However, task IDs are not recycled, so the next task started on the system will use the next whole integer that has not already been used (for example, `455`). Task ID numbers roll over at 9999.

Canceling a Task

For all task types except `remote_copy_sync`, `scheduled_task`, `snapspace_accounting`, `background_command`, and `system_task`, you can cancel an active task using the `canceltask` command and the task ID. For example:

```
cli# canceltask <task_ID>
select q=quit y=yes n=no: y
```

Information for the task will still be available with the `showtask` command, where the status of the task will now appear as `Cancelled`.

Task Types

Table 11 (page 133) shows a list of all task types and their associated operations. The table also includes information about the CLI commands associated with each operation. For a complete list of options available for the CLI commands listed in Table 11 (page 133), see the *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Table 11 Task Types by Operation and Command

Task Type	Operation (Feature or Product)	Commands	Description
background_command[1]	The `starttask` CLI command.	creategroupsv createsv moverelocpd removevv updatevv upgradecage upgradepd	Tracks commands initiated by the `starttask` CLI command.
background_command[1]	The `setfpg` CLI command.	setfpg	The background task for `setfpg`, used for modification and failover of FPGs.
background_command	The `removefpg` CLI command.	removefpg	The background task for `removefpg`; appears when an FPG is being removed.
background_command[1]	The `createfpg` CLI command.	createfpg	The background task for `createfpg`; appears when an FPG is being created.
background_command[1]	The `createvfs` CLI command.	createvfs	The background task for `createvfs`; appears when

Table 11 Task Types by Operation and Command *(continued)*

Task Type	Operation (Feature or Product)	Commands	Description
			a virtual file server is being created.
background_command[1]	The setfsip CLI command.	setfsip	The background task for setfsip; modifies file services networking options.
background_command[1]	The setvfs CLI command.	setvfs	The background task for setvfs; used during modifications of the virtual file server options.
background_command[1]	The startfs CLI command.	startfs	The background task for startfs; appears during initial configuration of file services.
background_command[1]	The startfsnapclean CLI command.	startfsnapclean	The background task for startfsnapclean. Starts a snapshot space reclamation task on an FPG.
compact_cpg	Reclaim logical disk space.	compactcpg	Compacts a CPG to reclaim space and reduce the number of LDs.
compact_lds	Reclaim logical disk space.	compactld	Compacts unused LD regions mapped to virtual volumes.
promote_sv	Virtual copy promote (Virtual Copy) (Remote Copy).	promotesv	Copies the differences of a virtual copy back to its base volume.
remote_copy_sync	Remote copy volume synchronization (Remote Copy).	startrcopygroup	Starts a remote copy volume group and synchronizes the primary and secondary groups.
remote_copy_sync	Remote copy volume synchronization (Remote Copy).	syncrcopy	Synchronizes remote copy volume groups.
scheduled_task	System scheduler.	checkhealth compactcpg compactld createsv creategroupsv createvvcopy creategroupvvcopy moverelocpd removevv syncrcopy tunepd tunevv updatesnapspace updatevv	Schedules when to initiate specified CLI commands.
snapspace_accounting	Refresh the snapshot space usage information.	updatesnapspace	Tracks progress of the snapshot space usage accounting process.
startao	Starts an Adaptive Optimization configuration.	-btsecs -etsecs -maxrunh -compact -dryrun	Starts execution of an Adaptive Optimization configuration using data region level performance

Table 11 Task Types by Operation and Command *(continued)*

Task Type	Operation (Feature or Product)	Commands	Description
			data collected for the specified number of hours.
`system_task`	Tasks initiated by the `3parsvc` user.	`moverelocpd removevv`	Tracks housekeeping tasks periodically run by the system.
`tune_sd`	Change the layout of a virtual volume (Dynamic Optimization).	`tunevv snp _cpg`	Moves the LDs used for the volume's snapshot space to the specified CPG.
`tune_sys`	Perform space usage based analysis and tuning (Dynamic Optimization).	`tunesys`	Analyzes and automatically corrects space usage imbalances.
`tune_vv`	Tuning virtual volumes (Dynamic Optimization).	`tunevv`	Changes the layout of the user space of an existing virtual volume.
`tune_vv_restart`	Restart tuning virtual volumes (Dynamic Optimization).	`tunevv restart`	Restarts a `tunevv` operation that was previously interrupted.
`tune_vv_rollback`	Rollback tuning virtual volumes (Dynamic Optimization).	`tunevv rollback`	Rolls back a `tunevv` operation that was previously interrupted.
`vv_copy`	Physical Copy.	`createvvcopy`	Copies a virtual volume.

[1] For information about background tasks, see "Starting a Task" (page 130).

Specific system tasks require the following licenses:

- The `promote_sv` task type requires the HP 3PAR Virtual Copy Software license.
- The `remote_copy_sync` task types require the HP 3PAR Remote Copy Software license.
- The `tune_vv` task types require the HP 3PAR Dynamic Optimization Software license.
- The `tune_sd` task type requires the HP 3PAR Dynamic Optimization Software license.
- To use the HP 3PAR File Persona software, you must activate the HP 3PAR File Persona Software license.

To view the licenses activated on your system, run the HP 3PAR CLI `showlicense` command.

NOTE: Contact your HP representative for more information about HP licenses.

background_command

The `background_command` task type tracks commands initiated by the `starttask` CLI command. The `background_command` task type has only one phase and one step.

See the `background_command` task type in Table 11 (page 133) for a list of the commands that can be run by the `starttask` command.

See "Starting a Task" (page 130) for more information about the `starttask` command.

The `background_command` task type tracks operations of the following CLI commands:

- `setfpg`
- `removefpg`
- `createfpg`

- `setfsip`
- `createvfs`
- `setvfs`
- `startfs`
- `startfsnapclean`

compact_cpg

The `compact_cpg` task type tracks the operations of the `compactcpg` command. For more information about compacting CPGs, see "Compacting Common Provisioning Groups" (page 169). 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

The `compact_lds` task type tracks the operations of the `compactld` command. For more information about compacting LDs, see "Compacting Logical Disks" (page 169). 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

The `promote_sv` task type is used to track 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; see the "Promoting a Virtual Copy" (page 97) for details. Virtual copy snapshots may also be automatically promoted by systems using Remote Copy, for example when issuing the `setrcopytargetreverse` or `setrcopygrouptarget` commands on a primary storage system or a system with primary groups in order to reverse targets. Use of Remote Copy requires an HP 3PAR Remote Copy 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.

NOTE: The `promote_sv` task type requires the HP 3PAR Virtual Copy Software license.

remote_copy_sync

The `remote_copy_sync` task type is used to track remote copy volume synchronizations on systems using Remote Copy. Remote Copy is an optional volume mirroring solution that can be 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 issuing CLI commands, or it can be performed automatically by the system. For instance, you can manually synchronize remote copy volume groups using the command. Restarting remote copy volume groups, by using the `startrcopygroup` command, can also initiate a remote copy synchronization on the system. However, with periodic mode volume groups, the `startrcopygroup` command will initiate synchronization only the first time that it is issued for that volume group. In addition, periodic mode remote copy volume groups may be automatically resynchronized by systems using Remote Copy, but only if the resynchronization period has been set for the volume groups.

For `remote_copy_sync` tasks, there are three phases:

- Phase 1 (startup): sync request has been received and synchronization is scheduled to start.
- Phase 2: performing the resynchronization.
- Phase 3: copying has completed and cleanup (such as deleting snapshots and setting state values) is taking place.

In the `showtask` output, the `Step` column indicates the completed and total volume size, in MBs, using the format `<completed_size>/<total_size>`.

For remote copy synchronizations, the finish time in the `showrcopy` output for the resynchronization task may not match the **LastSync** column in the `showrcopy` command output for the system holding the primary volumes. This is because the times are taken at different points in the process. The task time is set by the task subsystem when it is marked as `completed`, whereas the `LastSync` time is set when remote copy completes the sync. These two times should be similar, but may differ by up to a few seconds.

You cannot use the `canceltask` command to cancel a remote copy synchronization task.

For details about volume synchronizations and remote copy commands, see the *HP 3PAR Remote Copy Software User's Guide*.

NOTE: The `remote_copy_sync` task type requires the HP 3PAR Remote Copy Software license. The `tunevv` CLI command requires the HP 3PAR Dynamic Optimization Software license.

scheduled_task

The `scheduled_task` task type is used to track system operations initiated by the System Scheduler commands. See Table 13 (page 141) for a complete list of the System Scheduler commands. See Table 14 (page 141) for a complete list of the CLI commands that can be initiated with the System Scheduler commands. The `scheduled_task` task type has only one phase and one step.

snapspace_accounting

The `snapspace_accounting` task type tracks the progress of the snapshot space usage accounting process and runs the `updatesnapspace` command. The snapshot space usage displayed by `showvv-s` is not necessarily the current usage. You have to issue the `showvv -hist` command to display the last time `updatesnapspace` was run on the virtual volumes. The `TimeCalculated` column shows the last time the usage was calculated. The `updatesnapspace` command causes the system to begin calculating current snapshot space usage. If one or more virtual volume names or patterns are specified, only the specified virtual volumes are updated. If no virtual volume names are specified, all virtual volumes are updated.

The `updatesnapspace` command immediately returns the task ID associated with the updated snapshot space usage accounting process. The `canceltask` command cannot be used to cancel the `snapspace_accounting` task type. To wait for completion, use the `waittask` command. The `snapspace_accounting` task type has only one phase, and the number of steps is equal to the number of virtual volumes affected by the `updatesnapspace` command.

startao

When a `startao` command is scheduled, the user-defined schedule name appears in the list of schedules. The `startao` command syntax and operation are described in the *HP 3PAR Command Line Interface Reference*, "Start Commands" section. For more information about Adaptive Optimization concepts and usage, see "Adaptive Optimization" (page 144).

system_task

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.

CLI housekeeping tasks and commands:

- The `move_back_chunklet` runs the `moverelocpd` command.
- The `remove_expired_vvs` runs the `removevv` command.

The `system_task` task type has only one phase and one step.

tune_vv

The `tune_vv` task type is used to track `tunevv` operations performed with the System Tuner `tunevv` command. Dynamic Optimization is an optional HP 3PAR OS feature that allows you to identify over-used physical disks and perform load balancing on them. The `tunevv` command enables you to perform load balancing and to dynamically change volume parameters.

You can suspend an active `tune_vv` task using the `canceltask` command and the task ID as follows:

```
cli# canceltask <task_ID>
select q=quit y=yes n=no: y
```

After cancelling the task, you can perform one of two additional operations:

- You can restart the `tunevv` operation by using `tunevv restart` command. This starts a `tunevv_restart` task.
- You can completely reverse the tunevv operation by using `tunevv rollback` command. This starts a `tune_vv_rollback` task.

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.

For more information about the `tunevv` command, see "Performance Tuning" (page 165).

NOTE: The `tune_vv` task type and `tunevv` CLI command require the HP 3PAR Dynamic Optimization Software license.

tune_vv_restart

The `tune_vv_restart` task type is used to track `tunevv restart` operations performed with the System Tuner `tunevv restart` command. The `tunevv restart` command enables you to resume a failed or cancelled `tunevv` operation.

△ **CAUTION:** Restart operations should not be performed on TPVVs.

The following examples shows how to start, cancel, and then restart a `tunevv` operation on virtual volume `testvol`:

```
cli% tunevv -t r5 -ha mag testvol
Task 1 started.
```

```
cli% canceltask 1
 Are you sure you want to cancel task 1?
select q=quit y=yes n=no: y

cli% tunevv -restart testvol
Task 2 started.
```

Note that the `tune_vv_restart` task is a new task and receives a new task ID number.

After restarting the `tunevv` operation, you can use the `showtask` command to see the cancelled and restarted tasks:

```
cli% showtask
Id Type     Name   Status Phase Step --------Start_Time------ ------Finish_Time-------
1 tune_vv  testvol cancelled 2/3 8/8 Thu Oct 07 19:55:33 EDT 2004 Thu Oct 07 19:56:54
 EDT 2004
2 tune_vv_restart testvol active 1/2 0/8 Thu Oct 07 19:57:23 EDT 2004 -
```

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.

For more information about the `tunevv` command, see "Performance Tuning" (page 165).

NOTE: The `tune_vv` task type and `tunevv` CLI command require the HP 3PAR Dynamic Optimization Software license.

tunevv_rollback

The `tune_vv_rollback` task type is used to track `tunevv rollback` operations performed with the System Tuner `tunevv rollback` command. The `tunevv rollback` command enables you to reverse any changes that resulted from a previously interrupted `tunevv` operation.

The following examples shows how to start, cancel, and then rollback a `tunevv` operation on virtual volume `testvol`:

```
cli% tunevv -t r5 -ha mag testvol
Task 3 started.

cli% canceltask 1
 Are you sure you want to cancel task 3?
select q=quit y=yes n=no: y

cli% tunevv -rollback testvol
Task 4 started.
```

Note that the `tune_vv_rollback` task is a new task and takes a new task ID number.

You cannot start a `tune_vv_rollback` task for a `tunevv` operation that completed successfully. The following error message appears:

```
cli% tunevv -rollback testvol2
Are you sure you want to rollback the tune process for VV 'testvol2' ?
select y=yes n=no: y
```

```
Command failed
error: No restart state for VV testvol2.
```

For `tune_vv_rollback` tasks, there are two phases:

⚠ **CAUTION:** Rollback operations should not be performed on TPVVs.

- 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.

For more information on System Tuner and the `tunevv` command see "Performance Tuning" (page 165), and the *HP 3PAR Command Line Interface Reference*.

For more information about the `tunevv` command, see "Performance Tuning" (page 165).

NOTE: The `tunevv` CLI command requires the HP 3PAR Dynamic Optimization Software license.

tune_sys

The `tune_sys` task type is used to track operations performed with the `tunesys` command.

The `tune_sys` 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 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` task output displays information about the tuning process including:

- Summary of `tunesys` command parameters.
- Physical disk analysis.
- Internode balance analysis.
- Intranode balance analysis.

For more information about the `tunesys` command, see "Performance Tuning" (page 165).

NOTE: A dirty disk is a disk with chunklets which have been freed for re-use during space reclaimation, volume deletion or CPG compaction. They may still contain user data and need to be cleaned before they can be re-used.

The `tunesys` command waits for chunklet cleaning between tuning operations in order to maximize the amount of space available for the next tuning operation.

tune_sd

The `tune_sd` task type is used to track the movement of the LDs used for the volume's snapshot space to the specified CPG. Changing the layout of a virtual volume with the `tunevv` commands requires the HP 3PAR Dynamic Optimization Software license.

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.

vv_copy

The `vv_copy` task type is used to track physical copy operations. This includes creating physical copies and resynchronizing a physical copy with its parent base volume. You can create physical copies using the `createvvcopy` command. See the *HP 3PAR Command Line Interface Reference* for details. You can also resynchronize a physical copy using the `createvvcopy` command with the `-r` resyncronization option. See "Resynchronizing Physical Copies" (page 101) for details.

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.

System Scheduler

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.

Table 12 Maximum Scheduled Tasks Per Storage System

Maximum Tasks	Storage System
500	HP 3PAR StoreServ 10000 (V800 configuration) HP 3PAR StoreServ 20000
375	HP 3PAR StoreServ 10000 (V400 configuration) HP 3PAR StoreServ 7000 HP 3PAR StoreServ 8000

System Scheduler Commands

Table 13 (page 141) summarizes the System Scheduler commands.

Table 13 System Scheduler Commands

Command	Description
`showsched`	Show the state of tasks currently scheduled on the system.
`createsched`	Create tasks to be initiated by the System Scheduler.
`setsched`	Modify tasks started by the System Scheduler.
`removesched`	Remove tasks initiated by the System Scheduler from the system.

Only the following command operations can be scheduled with the System Scheduler commands:

Table 14 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.

Table 14 Commands Initiated by the System Scheduler *(continued)*

Command	Description
`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.
`moverelocpd`	Relocates chunklets to specified physical disks.
`removevv`	Removes virtual volumes from the system.
`setvv`	Modifies existing volumes.
`startao`	Executes a specified Adaptive Optimization operation on the HP 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 cancelled.
`updatevv`	Updates a snapshot virtual volume with a new snapshot.

The `canceltask` command cannot be used with the CLI commands initiated by the System Scheduler commands. The task type `scheduled_task` can be canceled with the `canceltask` command by users with Super rights. The following task manager commands can be used on CLI command operations initiated by the System Scheduler with the task type `scheduled_task`:

- `showtask`

- `waittask`

- `removetask`

For more information about the task manager commands, see "Task Manager Commands" (page 129).

Displaying Scheduled Tasks

To display all scheduled user and system tasks, issue the `showsched-all` command.

To display specific scheduled tasks, issue the `showsched <schedule_name>|<pattern>` command, where:

- `<schedule_name>` is the name of the schedule to display.

- `<pattern>` displays all schedules that match the pattern.

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

Scheduling Tasks

To create a scheduled task, issue the `createsched <command> <task_schedule> <schedule_name>` command, where:

- `<command>` is the name of the CLI command to be initiated. The CLI command must be one of the commands listed in .
- `<task_schedule>` is a 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>` specifies the name of the schedule.

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

Modifying a Scheduled Task

To change the name of a scheduled task or change when the task is initiated, issue the `setsched -s <new_schedule> -name <new_name> <schedule_name>` command, where:

- `<new_schedule>` is a crontab-style argument that changes when the schedule 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.
- `<new_name>` is new name to be applied to the existing schedule name.
- `<schedule_name>` is the existing schedule name.

Suspending and Resuming Scheduled Tasks

To suspend or resume scheduled tasks, issue the `setsched[-suspend|-resume]<schedule_name>` command, where:

- `<suspend>` suspends the schedule specified by the schedule name.
- `<resume>` resumes the schedule specified by the schedule name.
- `<schedule_name>` is the name of the schedule to suspend or resume.

NOTE: You can use the `-suspend_all` and `-resume_all` options in place of the `-suspend` and `-resume` options to suspend or resume all scheduled tasks in the system.

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

Removing Scheduled Tasks

To remove scheduled tasks, issue the `removesched <schedule_name>|<pattern>` command, where:

- `<schedule_name>` is the name of the schedule to remove.
- `<pattern>` is the name of the pattern according to which schedules are removed.
- `removesched [options] <name|pat>`

  Where options are `-pat` and `-f`, without `-pat` the system does not match the pattern but looks for a specific name.

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

15 Adaptive Optimization

Adaptive Optimization (AO) uses System Reporter statistics gathered from LDs and physical disks to relocate customer data on physical volumes in an optimal way. 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).

Because storage tiers can be of different RAID types, capacity efficiency is maximized by using only RAID1 for the most frequently accessed storage and by using RAID5 or RAID6 for less frequently accessed storage. Other benefits include:

- AO can migrate data from a fully occupied tier of storage to another tier that has more available capacity.
- AO can also be regularly scheduled so that it can adjust the data layout as your data usage changes over time.

AO is part of the HP 3PAR OS. A simple user interface has been developed so that AO can be started either as a scheduled task or as a manual command using the `startao` command. For more information about tasks, see "Managing Tasks" (page 129).

> **NOTE:** Active use of AO requires an Adaptive Optimization license. Contact your local HP representative for information.

AO is built on top of the new version of System Reporter (SR), which also now runs as part of the HP 3PAR OS.

SR must have been actively gathering data on VV regions for a period of time (a minimum of 3 hours, but preferable for a longer time including any time periods where the storage system has had peak load/usage).

The `startao` command is then used to perform an analysis of the data collected by SR to identify regions within virtual volumes that are either heavily used or lightly used, and then generates a series of secondary tasks to move these regions to faster or slower storage tiers.

Running AO on the HP 3PAR OS itself offers these advantages:

- AO configurations can now be created, modified, and removed using the HP 3PAR CLI or the HP 3PAR MC.
- The database scheme has been restructured on node to be more efficient and reliable.
- The actual movement of data can use data from a given time period in the past rather than only from the immediate past. This means data movement can occur at low-utilization time periods while using an analysis of statistics gathered during peak periods.
- A time limit can be set for data movement so that scheduled data is moved only during low-utilization periods rather than during peak periods.

An AO configuration is specified as part of the `startao` command. When this is run as a scheduled task, details of the analysis and generated move commands can be viewed using `showtask -d <task id>`, where `<task id>` is the ID of the `startao` command.

Adaptive Optimization Conversion

> **NOTE:** This section applies only to HP 3PAR OS 3.1.2. To modify an Adaptive Optimization (AO) configuration in HP 3PAR OS 3.1.1 or earlier, see the "Changing an Adaptive Optimization Configuration" section in the *System Reporter Software User's Guide*.

Beginning with HP 3PAR OS 3.1.2, AO is implemented on the nodes together with an on-node version of System Reporter (SR). For HP 3PAR OS 3.1.1 or 2.3.1, AO is implemented by SR.

There is no direct conversion from external System Reporter-based AO configurations and HP 3PAR OS 3.2.1 AO configurations created using the `createaocfg` command. Table 15 (page 145) lists the external SR AO configuration parameters and shows how they translate to `createaocfg` command options.

NOTE: The schedule and measurement intervals are not part of an AO configuration. Instead, the measurement interval is specified as options (`-btsecs` and `-etsecs`) for the `startao` command, and the schedule is implemented by using the `createsched` command to create a schedule to run the `startao` command.

Table 15 Adaptive Optimization Conversion Options

External SR	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			The system name is not required because it is the system name itself on which the AO configuration is being created.
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).
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, allowing you to specify not only the *beginning* of the measurement interval relative to the `startao` command start time, but also the *end* of the

Table 15 Adaptive Optimization Conversion Options *(continued)*

External SR	createaocfg option	startao option	Comment
			measurement interval relative to the `startao` command start time by using the `-etsecs` options.
			For example, if the `startao` command is scheduled to run at 8 pm, you can specify `-btsecs -4h -etsecs -2h`, which 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). So the measurement interval is 4 pm–6 pm for an 8 pm command start time.
Mode	`-mode <mode>`		`-mode Mode` specifies one of the following modes: • Performance • Balanced • Cost **NOTE:** The value of the mode is case-sensitive.
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. Each volume's user CPG must be part of the specified AOCFG in order to be optimized. Snapshots in a volume's tree will not be optimized.

[1] It is recommended 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 Adaptive Optimization Configuration

To create an AO configuration, use the `createaocfg` command.

NOTE: Two or more tier CPGs must be defined.

If domains are used, all CPGs must be either in the same domain or not in any domain.

A CPG can only belong to one AO configuration.

Active use of AO requires an Adaptive Optimization license. Contact your local HP representative for information.

1. Create an AO configuration using the `createaocfg` command.

   Example:

   ```
   cli% createaocfg -t0cpg tier0_R1_SSD -t1cpg tier1_R6_FC -t2cpg tier2_R6_NL -mode
     Performance AOCFG_name
   ```

   where:

   - `-t0cpg` is the tier 0 CPG.
   - `tier0_R1_SSD` is the tier 0 CPG name.
   - `-t1cpg` is the tier 1 CPG.
   - `tier1_R6_FC` is the tier 1 CPG name.
   - `-t2cpg` is the tier 2 CPG.
   - `tier2_R6_NL` is the tier 2 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.

   - `AOCFG_name` is the name of the AO configuration (up to 31 characters in length).

   NOTE: Tiers must be defined in "speed" order—tier 0 must be the fastest tier (SSD), tier 2 the slowest (NL). AO makes the assumption internally that tiers are defined in this speed order.

2. 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% cli% setcpg -sdgw 256g t1cpgname
   ```

3. Create a schedule to run `startao` on the AO configuration periodically.

   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
   ```

You can take advantage of several features that are not available in the external System Reporter by using the following options:

Table 16 Additional Options Not Available in an External 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.

Table 16 Additional Options Not Available in an External System Reporter *(continued)*

Option	Description
	For the command in Step 3, this 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 3, this would mean that the end of the measurement interval would be 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 16 (page 147) 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 an Adaptive Optimization Setting

To display AO configurations in the system, use 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` argument. 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 Adaptive Optimization Configuration

To update an AO configuration, use the `setaocfg` command:

```
cli% setaocfg [options <arg>] <AOCFG_name>
```

NOTE: 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 only belong to 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 Adaptive Optimization requires an Adaptive Optimization license. Contact your local HP 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. A maximum of one CPG can be removed from an AO configuration in order to maintain the minimum of two defined tier CPGs.

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 optimization bias (that is, the mode) of an AO configuration `aocfg1` is changed to `Balanced`.

```
CLI% setaocfg -mode Balanced AOCFG_name
```

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
```

Removing an Adaptive Optimization Configuration

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.

16 HP 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 Fiber 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.

HP 3PAR's Priority Optimization software manages and distributes the I/O capacity of an HP 3PAR StoreServ Storage system across multiple workloads. The tool enables the co-location of the data of 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 multi-tenant environment.

Requirements

HP 3PAR Priority Optimization is supported on all HP 3PAR StoreServ Storage systems that are certified for HP 3PAR OS 3.2.1:

- HP 3PAR StoreServ Storage 7000
- HP 3PAR StoreServ Storage 10000

A valid license for HP 3PAR Priority Optimization is required on the HP 3PAR StoreServ Storage system. The HP 3PAR Priority Optimization has its own license key. The license is spindle-based, available a-la-carte and as part of the Data Optimization Suite available for HP 3PAR StoreServ 7000 and HP 3PAR StoreServ 10000 systems. Consult your HP representative or authorized HP partner for more information on HP 3PAR Priority Optimization licensing.

Creating and managing Quality of Service (QoS) definitions requires the HP 3PAR MC 4.5 and later. To use the command line, you must install HP 3PAR CLI 3.2.1.

Reports on HP 3PAR Priority Optimization are available through HP 3PAR System Reporter 3.1 MU1 and later, and through the HP 3PAR MC 4.5 and later. The reports on the QoS definitions require a license for HP 3PAR System Reporter.

While QoS is in principle OS-agnostic, see the HP SPOCK website for the list of operating systems that are certified for use with HP 3PAR Priority Optimization:

http://www.hp.com/storage/spock

Using HP 3PAR Priority Optimization

You can manage HP 3PAR Priority Optimization with the HP 3PAR CLI. This section describes procedures and best practices.

Modifying a QoS Rule with the HP 3PAR CLI

Three CLI commands are available to create and manage QoS rules. The commands and their syntax details are:

- `setqos [options]`
  `[{vvset|domain:{<name>|<pattern>}|sys:all_others}]...`

  The `setqos` command creates and updates QoS rules in a system.

- `showqos [options]`
  `[{vvset|domain:{<name>|<pattern>}|sys:all_others}]...`

  The `showqos` command lists the QoS rules configured in a system.

- `statqos [options]`
  `[{vvset|domain:{<name>|<pattern>}|sys:all_others}]...`

  The `statqos` command displays run-time statistics of active QoS rules.

For details about command syntax and the columns in their output, see the HP 3PAR CLI Help page for each of the commands.

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.

All user-defined rules can be switched off simultaneously by using the `setqos -off vvset:*` command; use the `setqos -on vvset:*` command to enable them again.

Rules can be shown in ordered form by issuing the `showqos -sortcol X,[inc|dec]`, where X is the column number, and `inc` and `dec` sort on increasing or decreasing values in the column, respectively. Column counting in the output of `showqos` starts with the left column, which is numbered 0. The table below shows output of the `showqos` command, with the sorting option set on decreasing IOPS value.

```
cli% showqos -sortcol 4,dec
         I/O per second  KBytes per sec
Id Type    Name       QoS          Limit           Limit
22 vvset   MS-SQL     on           40000          500000
 8 vvset   Exchange5  on           12000           80000
13 vvset   Sub-ESX51  off          12000           80000
 7 vvset   Oracle11i  on            8000           64000
12 sys     all_others on            6000          120000
----------------------------------------------------------
 5 total
```

An option of particular interest for `setqos` is `-vv <name>|<pattern>`. This option changes the QoS rule, for all VVsets that include VVs with names matching any of the names or patterns specified, to the value contained in the `setqos` statement. If a VV is in a VVset for which no QoS rule has yet been defined, a new rule is created with the limits in the setqos command.

The built-in rule `all_others` is switched off by the command `setqos -off sys:all_others`. The `showqos` and `statqos` command provide a centralized view of the QoS rules in the systems and how the workloads conform to them.

Executing the QoS CLI commands requires a logon to an account with Super or Edit rights. Any role granted the qos_set right can set QoS configurations. QoS rules can be scheduled using the createsched command for automated QoS policy changes for example to adapt to day/night or weekday/weekend workload conditions.

The HP 3PAR CLI command, `srstatqos`, displays historical performance data reports for the QoS rules. This command is integrated in HP 3PAR System Reporter (SR) on the 3PAR nodes. SR 3.1 MU1, installed on a separate server, includes statistics on QoS. To learn more about the QoS information in SR, see the *HP 3PAR System Reporter 3.1 Software User's Guide* and the *HP 3PAR System Reporter Software Release Notes*.

Removing a QoS Rule

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. Clearing a QoS rule does not require first disabling the rule. Clearing the QoS rule deactivates an enabled rule. A QoS rule can be enabled and disabled at any moment. Once a QoS rule is disabled, the IOPS and bandwidth for the VVs in the VVset increases (if they were being delayed by the rule).

Managing QoS Rules

There is no limitation on the minimum number of IOPS and bandwidth that can be set on a given VVset QoS Rule. It is important that the workloads of the various applications be fully understood before applying a QoS rule. HP 3PAR System Reporter can be used to make this determination. The following best practices provide general guidelines only.

Assembling Virtual Volumes into Virtual Volume Sets

VVsets group virtual volumes logically. Use cases for VVsets include taking simultaneous point-in-time virtual copies of multiple volumes, and creating Remote Copy volume groups for write consistency during replication operations.

Volumes that belong together because they are owned by the same application or because they belong in the same virtual domain should be included in the same VVset. Even if a number of virtual volumes are unrelated and do not need write consistency, you can group them to a VVset so as to reduce the administrative overhead when managing them. This way the I/O profile of the volumes can be managed by a single QoS rule for their parent VVset.

VVsets are especially useful in the deployment of HP 3PAR Priority Optimization, because QoS rules in HP 3PAR Priority Optimization are defined on VVsets. HP strongly encourages the creation of VVsets and group volumes logically on HP 3PAR StoreServ storage systems.

Determining the Values for IOPS and Bandwidth for a System

HP 3PAR Priority Optimization's QoS rules define limits for IOPS and bandwidth in absolute numbers, not percentages. Because of this, the QoS administrator needs reasonably accurate data on the system's maximum I/O and throughput capability as well as an accurate understanding of actual I/O and throughput workloads to the volumes that will have QoS applied to them.

HP Presales can estimate the maximum front-end workload for a system in IOPS and bandwidth, assuming a particular I/O size and a given ratio for read/write I/Os. With this information, QoS rules can be defined per workload, ensuring that the total sum of IOPS or bandwidth does not exceed what is sustainable by the system configuration if no oversubscription is allowed. Re-analysis of the system's capability and re-adjustments of the limit values for any existing QoS rules must take place in the following cases:

- When upgrading the storage system with additional disk drives and/or nodes.
- When making use of additional FC and/or iSCSI interface cards to the storage system.
- When adding additional 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 2003 to the Windows Server 2008 or Windows Server 2012 version, 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.

  NOTE: 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, HP recommends review of the system I/O capability and adjustment of the QoS rules in use whenever a change was made to one part of the entire chain from the host to the HP 3PAR OS.

Handling Tier-1 Applications

The HP 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.

HP recommends that a QoS rule be defined with sensible limits for IOPS and bandwidth on all VVsets that have a known I/O profile. The System rule should be defined to control all volumes created on the system that do not have an explicitly defined QoS rule.

If you don't 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 very high values for IOPS and bandwidth. This way, the mission-critical workload will be able to consume the I/O resources they need to perform optimally.

Implementing the System Rule

Workloads without a QoS rule consume I/O resources in an uncontrolled manner and may starve those 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 application's I/O requirements. 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 HP 3PAR StoreServ or existing ones that are not subject to a QoS rule from negatively affecting the entire system 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 to acceptable values if the defaults are deemed too small.

Overprovisioning the System

HP 3PAR Priority Optimization allows over-provisioning when creating QoS rules: rules whose combined value for IOPS or bandwidth can exceed the I/O capacity of an HP 3PAR StoreServ. This is an established practice if the workloads are sufficiently orthogonal in their I/O usage.

For example, a database used only during the day time 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 over-provisioned for IOPS, but no single customer can monopolize the system. Continuous monitoring of system performance by HP 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 HP 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 HP 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. HP 3PAR 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 a large number of VVsets. HP 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 action.

If the System rule is defined, it takes action 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

HP 3PAR Priority Optimization sets and manages QoS rules defined on I/O traffic. Software products for HP 3PAR StoreServ storage systems, such as Dynamic Optimization (DO), Adaptive Optimization (AO), Virtual and Physical Copy, HP 3PAR System Reporter, the Thin Provisioning Suite, and the Recovery Manager packages work on data in the backend. This means they are all compatible and operate transparently to HP 3PAR Priority Optimization.

Databases

All database software vendors recommend that you separate data files, index files, and transactional and archive logs on separate volumes. The write capability and location of the online transaction logs are most important as the entire performance of the database depends on the writes to these logs. For this reason a QoS rule on the volumes containing the online transaction logs should be carefully dimensioned to not inhibit the performance of the database. QoS rules on the I/O performance of the database volumes will take care of runaway queries that consume IOPS and

bandwidth. Databases at many customers are considered mission-critical and placing a QoS rule on them should never inhibit their normal operation.

Microsoft Exchange

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. Using a QoS rule, to limit the IOPS and/or bandwidth to the volume sets for the mail database of a particular group of users, enhances the performance stability for mail databases for other users and for other applications on the HP 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, make use of 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 those of QoS, are listed in Table 17 (page 156).

Table 17 VMware I/O Resource Control

Control Mechanism	HP 3PAR QoS	VMware Storage DRS[1]	VMware SIOC[2]	VMware AQD[3]
I/O control technique:	Limit IOPS and bandwidth	Migrate VM to other datastore	Control queue depth of datastore SAN LUN in VMkernel; VM shares enforced	Control queue depth of datastore SAN LUN in VMkernel
Reacts on:	None	I/O latency and space utilization	I/O latency	Queue Full or Device Busy at LUN or port level
Granularity:	All VMs in datastore VV	Single VM	All VMs in a single datastore	All hosts using the SAN LUN for the datastore or a particular port on the 3PAR
Managed from:	HP 3PAR MC	VMware vSphere	VMware vSphere	VMware vSphere
Availability:	HP 3PAR OS 3.2.1	vSphere 5.0 and later with Enterprise Plus license	vSphere 4.1 and later with Enterprise Plus license	vSphere 3.5 U4 and later with Standard license
1, 2, 3				

[1] Distributes Resource Scheduler

[2] Storage I/O Control

[3] Adaptive Queue Depth

HP 3PAR Priority Optimization QoS rules operate on volumes inside VVsets on an HP 3PAR StoreServ 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 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.

HP 3PAR Priority Optimization can also cooperate with AQD to manage I/O. AQD 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, AQD can be configured by LUN, or globally for the ESXi host.

Combining QoS rules with SIOC and ADQ 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 AQD responds to queue-full messages from QoS rules. Coordination and some experimenting may be necessary to deliver the best results.

VMware Storage DRS, a new 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. Storage DRS leans on Storage vMotion for migrating VMDKs to different datastores. Combining HP 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's I/O characteristics are not very well known, HP recommends manual Storage DRS migrations over automated ones to detect any I/O congestion due to the migration in an early stage.

Reporting

Continuous performance monitoring of all critical parameters of a storage system is essential in managing a storage system. HP 3PAR Priority Optimization features new charts in the HP 3PAR MC for monitoring QoS rules graphically over time.

Use the HP 3PAR CLI command `statqos` to display run-time statistics of active QoS rules in columns. The command produces output every 2 seconds; this interval can be changed. Depending on the active QoS rule, values for the following parameters are displayed:

- 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 (including the number of I/Os delayed by QoS and number of I/Os processed by QoS without delay)

You can filter by VVset by using the `srstatvlun` command. This can be useful in determining which VVs in a given VVset contribute the most in reaching the QoS limit.

Using the `statqos` interface, the On-Node tool in HP 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.

Event Management

There is no mechanism to alert storage administrators of rejected I/O requests. Instead, monitor the QoS rules as described in . The debug event logs will show QFULL messages for rejected I/O requests if they occur. To display the debug event log, issue the following HP 3PAR CLI command:

```
# showeventlog –debug –msg Qfull
```

The following example shows a rejected I/O request:

```
Time     : 2013-06-03 14:04:23 CEST
Severity : Debug
Type     : Host error
Message  : Port 0:1:1 -- SCSI status 0x28 (Qfull) Host:ireland.bel.hp.com (WWN
50060B0000C26612) LUN:2 LUN WWN:60002AC000000000000000AC000009AD VV:0
CDB:28002552AA4000002000 (Read10) Skey:0x00 (No sense) asc/q:0x00/00 (No additional
sense information) VVstat:0x00 (TE_PASS -- Success) after 0.000s (-) toterr:9720,
lunerr:2
```

17 Using the HP 3PAR SNMP Infrastructure

Overview

In addition to managing the system with the HP 3PAR CLI, the HP 3PAR OS includes an SNMP agent that allows you to perform some basic management functions via network management software running on a management station. These SNMP management functions require that you have SNMP management software not provided by HP. For information about SNMP, see the *HP 3PAR StoreServ Storage Concepts Guide*.

The HP 3PAR SNMP Agent

The HP 3PAR SNMP agent runs on the system and provides a management interface to enable other software products to manage HP hardware using SNMP. The HP 3PAR SNMP agent responds to GET, SET, GETNEXT, and GETBULK SNMP requests and also generates notification messages (*traps*) for critical events (*alerts*) and alert state changes (for information about requests and traps, see the *HP 3PAR StoreServ Storage Concepts Guide*). These traps include the same information as the alerts described at this site, http://www.hp.com/support/hpgt/3par.

The HP 3PAR SNMP agent supports SNMPv3, SNMPv2c, SMI-v2 standards, and the SNMPv2-MIB and a proprietary HP 3PAR MIB. For detailed information about these standards and MIBs, see the *HP 3PAR StoreServ Storage Concepts Guide*.

Locating the HP 3PAR MIB

The HP 3PAR MIB is located on the *HP 3PAR CLI and SNMP* CD.

alertNotify Traps

All alerts generated by the system, as well as all alert status change events, are translated into `alertNotify` traps. For information about system alerts, go to http://www.hp.com/support/hpgt/3par and select your server platform.

> **NOTE:** If you receive a trap with `messageCode == 1245186`, this is to notify you that an alert has changed state. In order to find out which alert has changed state, you must extract the alert ID from the `id` trap field.

See the *HP 3PAR StoreServ Storage Concepts Guide* for additional information about `alertNotify` traps.

Registering an SNMP Manager

For detailed information about all HP 3PAR CLI commands described in this section, see the *HP 3PAR Command Line Interface Reference* for additional information and examples.

To register the SNMP manager with the agent, use the `setsnmpmgr` command followed by the manager's IP address. If you need to use one of the following options, enter it after the command and before the IP address:

- `-p <port_number>`—Specifies the port number where the manager receives traps. The default port 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 HP 3PAR OS supports a maximum of 10 registered SNMP managers.

Viewing Registered Managers

Use the HP 3PAR CLI command `showsnmpmgr` to see which managers are already registered with the SNMP agent.

NOTE: If the manager that monitors the system has changed, remove the old manager and register the new one.

Removing a Manager

To remove a manager from the agent's list of registered managers, thus preventing that manager from receiving traps, use the `removesnmpmgr` command. If there is more than one manager running on the same server, you can distinguish between them by using the `-p` option followed by the port to which the manager is listening. 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 *HP 3PAR Command Line Interface Reference*.

Agent Community Strings

In order for the SNMP Manager to communicate with the HP 3PAR SNMP agent, it must pass the agent the correct community string. To do this, the manager needs to know the agent community string. The system comes with the single default community string "`public`" with reading permissions for the agent. You can add read-only and write-only community strings, and you can change or remove any of the community strings.

To see community strings that are currently available on the system, use the HP 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.

To add or update a community string, use the `setsnmppw` command followed by the new community string. By default, this command changes the read/write community string.

To remove a community string, use the `removesnmppw` command. 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.

For any of these three HP 3PAR CLI commands (`showsnmppw`, `setsnmppw`, and `removesnmppw`), 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

To send a test trap to all SNMP managers displayed with the `showsnmpmgr` command, issue the `checksnmp` command. The CLI displays the IP addresses of the tested mangers.

For details about the test trap sent by the `checksnmp` command, see the *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Creating SNMPv3 Users

To create SNMPv3 users you must have Super role user rights, or any role that has been granted the `snmpuser_create` right. The `createsnmpuser` command creates the SNMPv3 user secret key, which is used for generating authentication and privacy keys. The user name must be an existing HP 3PAR OS local user.

To create an SNMPv3 user, issue the `createsnmpuser -p <password> <user_name>` command, where:

- `<password>` represents the password of the HP 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 HP 3PAR OS local user name. This user name is used as the SNMPv3 user name.

You can verify the creation of a new user by using the `showsnmpuser` command.

For more information about the `createsnmpuser` command, see the *HP 3PAR Command Line Interface Reference*.

Viewing SNMPv3 Users

To display information about SNMPv3 users and privacy protocols, use the `showsnmpuser` command:

- 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 *HP 3PAR Command Line Interface Reference*.

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 HP 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.

To remove an SNMPv3 user from the system, issue the `removesnmpuser <user_name>` command, where `<user_name>` is the name of the user.

You can verify the removal of a user with the `showsnmpuser` command.

Modifying SNMP Versions

Use the `setsnmpmgr` command to change properties associated with a previously configured SNMP manager.

18 Using mySnapshot

Overview

This chapter describes how to use the mySnapshot feature. The mySnapshot feature enables safe and easy copy and provisioning access to non-storage professionals such as DBAs, software developers, and test engineers working with systems. Users can safely and easily restore their own copies of test data in seconds, without relying on the storage administrator.

About mySnapshot

mySnapshot is a copy feature that uses an access control list to associate a user with certain administrative rights and specified storage resources. Once these administrative rights are granted for the specified resources, the user can easily replace and restore copies of their own test database with the HP 3PAR CLI `updatevv` command. This enables users who normally only have Browse rights on the system to be able to update specific snapshots with more recent snapshots, a right usually only permitted for users with less restrictive roles. This enables faster results for developers who need to have their snapshots refreshed and reduces the workload for storage administrators.

See "Learning About User Accounts" (page 20) for more information about user roles and rights.

Setting Administrative Rights

To enable a user to easily replace and restore copies of a test database using mySnapshot, it is necessary to set administrative rights for that user. Administrative rights are set with the HP 3PAR CLI `setuseracl` command. In order to use this command, you must have at least an Edit rights. For additional details, see "Learning About User Accounts" (page 20).

The following example shows how to set administrative rights for user `testuser1` to allow `testuser1` to update copies of virtual volumes `test.rw1` and `test.rw2`:

```
cli% setuseracl testuser1 updatevv test.rw1 test.rw2
```

This command sets the access control list (ACL) for user `testuser1`, therefore enabling this user access to the `updatevv` command for the specified volumes only (in this example, `test.rw1` and `test.rw2`). The `updatevv` command is described further in the following section, "Updating Virtual Volume Snapshots" (page 162).

NOTE: In place of the specific virtual volume names used in the above example, it is also possible to specify a pattern. See the *HP 3PAR Command Line Interface Reference* for additional details.

You can view current administrative rights for all users with the `showuseracl` command as follows:

```
cli% showuseracl
User        Operation Object_Names_or_Patterns
  testuser1     updatevv test.rw1, test.rw2
  testuser2     updatevv avvro*
```

Updating Virtual Volume Snapshots

A user with the appropriate rights set (see "Setting Administrative Rights" (page 162)) can use the `updatevv` command to update a snapshot volume with a new snapshot.

⚠ **CAUTION:**   When the `updatevv` command is used to update snapshots of a virtual volume, the virtual volume is put into stand-by mode and access to the volume will be temporarily unavailable. Hosts or applications attempting to access the volume while the snapshot is being updated may encounter errors.

NOTE: The `updatevv` command can also update sets of virtual volumes. For a complete list of options available for the `updatevv` command, see the *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help.

Update a Read-Only Snapshot

The following example shows how to update a read-only snapshot volume with a new read-only snapshot volume.

In this example:

- `test` is a base volume (or a read-write snapshot). This volume holds the database.
- `test.ro` is a read-only snapshot of `test`. This snapshot is a read-only copy of the database.
- `testuser1` is a user with `updatevv` rights for volume `test.ro`. See "Setting Administrative Rights" (page 162) for instructions on setting rights for replacing a read-only snapshots.

When `test.ro` needs to be updated, `testuser1` issues the following HP 3PAR CLI command to replace `test.ro` with a new read-only copy:

```
cli% updatevv test.ro
```

This command removes `test.ro` and replaces it with a new read-only snapshot of `test`. This new volume is also called `test.ro`.

Update a Read-Write Snapshot

The following example shows how to update a read-write snapshot volume with a new read-write snapshot volume.

In this example:

- `test` is a base volume (or a read-write snapshot). This volume holds the database.
- `test.ro1` is a read-only snapshot of `test`. This snapshot is the reference copy of the database.
- `test.rw1` is a read-write snapshot of `test.ro1`. This is a snapshot of the reference copy of the database, created for development purposes.
- `testuser1` is a user with `updatevv` rights for volume `test.rw1`. See "Setting Administrative Rights" (page 162) for instructions on setting rights for replacing a read-write snapshots.
- When `test.rw1` needs to be restored, `testuser1` issues the following HP 3PAR CLI command to replace test copy `test.rw1` with a new copy:

```
cli% updatevv test.rw1
```

This command removes `test.rw1` and replaces it with a new snapshot of `test.ro1`. This new volume is also called `test.rw1`.

In the above example, the replaced copy (`test.rw1`) is a new copy of the database made from the reference copy (`test.ro1`), and not from the database itself (`test`).

To get an up-to-date read-write copy of the original database, `testuser1` can issue the following HP 3PAR CLI command:

```
cli% updatevv -ro test.rw1
```

This command removes `test.rw1` and `test.ro1`, and replaces them with a new read-only snapshot of `test` called `test.ro1` and a new read/write snapshot of `test.ro1` called `test.rw1`. This gives the user an up-to-date read-write copy of the original database by creating a new read-only snapshot of the original in addition to the new read-write copy.

19 Performance Tuning

Analyzing and Tuning a System

The `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.

Analyze and tune an HP 3PAR StoreServ Storage system by issuing the `tunesys [-nodepct <percentage>] [-chunkpct <percentage>]` command, where:

- `-nodepct <percentage>` controls internode tuning. Virtual volumes are analyzed for balance between nodes. If any node has an imbalance of more than `<percentage>`, the virtual volume will be rebalanced. The threshold `<percentage>` must be between 1 and 100. The default value is 3.

- `-chunkpct <percentage>` controls intra-node tuning. Stipulates that if a physical disk contains more chunklets than average for the same device type, chunklets from the over-utilized disk may be moved to under-utilized physical disks associated with the same node. The percentage threshold of utilization above the average at which chunklets may be moved by the tuning operation is designated by a value for `<percentage>`. The percentage value must be between 1 and 100 and the default is 5. This option cannot be used with the `-cpg` option.

Other options for controlling the operation of the `tunesys` command:

- `-cpg <cpg_name|pattern>` limits the `tunesys` operations to the specified CPGs. The specified CPGs must all be in the same domain as the CLI user. The `-cpg` option cannot be used with the `-nodepct <percentage>` and `-chunkpct <percentage>` options. Intra-node tuning does not take place if the `-cpg` option is specified.

- `-maxchunk <number>` indicates the maximum number of chunklets that can be moved from any physical disk in a single operation. The `<number>` must be between 1 and 8. The default value is 8.

- `-tunenodech` limits tuning to chunklet level rebalancing at the intra-node level.

- `-dr` indicates the command is a dry run and no tuning operations are performed. The results are displayed immediately. On large, heavily loaded systems the analysis may take some time.

- `-spindlepct <percentage>` specifies the PD percentage difference between node pairs that can exist and still allow the `tunesys` command to run. The percentage difference calculated between the node pairs must be less than `-spindlepct <percentage>`. The `<percentage>` must be between 1 and 200. The highest value is the least restrictive and allows the `tunesys` command to run with any difference in the number of PDs. The lowest value is the most restrictive. A value of zero cannot be specified because it prevents the `tunesys` command from running even when the number of PDs between the node pairs is the same. The default is to allow for a 50% difference.

- `-fulldiskpct <percentage>` specifies a utilization percentage for use in the intra-node tuning phase. If a PD has more than the specified percentage of its capacity utilized, chunklets on that PD may be moved to other PDs in order to reduce utilization before LD tuning is used to complete the rebalance effort. If, for example, a PD is at 98% utilization and the `-fulldiskpct` option is included with a value of 90 supplied for `<percentage>`, chunklets will be redistributed to other PDs until the utilization of the disk is less than 90%. The `<percentage>` value must be between 1 and 100. The default value is 90.

- `-maxtasks <number>` specifies the maximum number of individual tuning subtasks the `tunesys` command can run simultaneously. The `<number>` must be between 1 and 8. The default value is 2.

- -waittask specifies that all tasks created by the tunesys command will complete before returning.

- -f specifies the system will not ask for confirmation before initiating the tunesys command.

You can schedule, monitor, and manage the tunesys command operations as a system task. For information about system tasks, see "Managing Tasks" (page 129).

For more information about when to use the Dynamic Optimization feature and the tunesys command, see the *HP 3PAR StoreServ Storage Concepts Guide*.

Displaying Virtual Volume Space Distribution

The showvvcpg command displays how virtual volume space is distributed among CPGs.

Display virtual volume space distribution by issuing the showvvcpg -domain {<domain_name>|<pattern>} {<vv_name>|<pattern>|set:<vv_set_name>} command, where:

- -domain specifies that virtual volumes in the domain designated by <domain_name> or in any one of the domains with names matching a given pattern are displayed. Only virtual volumes within domains that the user is a member of can be listed. Multiple domain names or patterns can be repeated using a comma-separated list.

- <vv_name>|<pattern>|set:<vv_set_name> indicates which virtual volumes, patterns, or virtual volume sets are displayed. A virtual volume set specification (<vv_set_name>) must be preceded by the set: label.

For more information about the showvvcpg command, see the *HP 3PAR Command Line Interface Reference*.

Tuning and Modifying Virtual Volumes

Use the tunevv command to improve the performance of a system by modifying the virtual volumes to use all available hardware resources. 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.

You can schedule, monitor, and manage the tunevv command operations as a system task. For information about system tasks, see "Managing Tasks" (page 129).

For more information about when to use the Dynamic Optimization feature and the tunevv command, see the *HP 3PAR StoreServ Storage Concepts Guide*.

Changing Virtual Volume Layouts

You can 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 preexisting 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.

But 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 with a different 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:

1. Create the new CPG with the required configuration and characteristics. See "Creating a Common Provisioning Group" (page 79) for instructions and options for creating CPGs.
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 sub-command that moves logical disks on which user space has been allocated for a virtual volume to a different CPG.
   - `<cpg_name>` species 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 a fully provisioned virtual volume.
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 sub-command 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 a fully provisioned virtual volume, for which snapshot space is being moved.

Additional Options Available for the `tunevv` Command

When the `usr_cpg` sub-command is used with the `tunevv` command, other options to control the operation of the command are available:

- The `-tpvv` option specifies that the virtual volume indicated by `<VV_name>` should be converted to a thinly provisioned virtual volume. This option cannot be used with either the `-tdvv` option or the `-full` option.

- The `-tdvv` option specifies that the virtual volume indicated by `<VV_name>` should be converted to a thinly deduplicated virtual volume. This option cannot be used with either the `-tpvv` option or the `-full` option.

- The `-full` option specifies that the virtual volume indicated by `<VV_name>` should be converted to a fully provisioned virtual volume. This option cannot be used with either the `-tpvv` option or the `-tdvv` option.

- The `-keepvv` option specified along with a virtual volume name stipulates that the original logical disks associated with the virtual volume before conversion to a different type of virtual volume are to be saved to a new volume with the specified name. This option can be used only if the `-tpvv`, `-tdvv`, or `-full` options are specified.

- The `-src_cpg` option specified along with a source CPG name (`<src_cpg_name>`) helps preserve adaptive optimizations. When a virtual volume is part of an adaptive optimization configuration, certain regions of the VV may be distributed across as many as three different CPGs as part of the optimization process. The `-src_cpg` option specifies that only those regions of the VV that are on the CPG designated by `<src_cpg_name>` will be moved to the new CPG, preventing the disruption of any prevailing optimizations.

Troubleshooting Modifying Virtual Volumes

When performing a `tunevv` task, errors can occur that can interrupt the task. Depending on the cause of interruption, you can either rollback or restart a `tunevv` task.

You can schedule, monitor, and manage the `tunevv` command operations as a system task. For information about system tasks, see "Managing Tasks" (page 129).

△ **CAUTION:** Rollback and restart operations should not be performed on TPVVs.

Rolling Back a Volume Modification Task

Rolling back a `tunevv` task restores a volume to its state prior to the initiation of the task. Essentially, issuing a rollback command performs an undo of the operation. You may choose to roll back a `tunevv` task if the operation was interrupted because of:

- Lack of space.

- User-initiated cancellation of a task.

To perform a rollback operation, perform the following:

1. Issue the `canceltask <task_ID>` command, where `<task_ID>` is the ID of the `tunevv` task you wish to cancel. For more information about tasks and viewing tasks, see "Managing Tasks" (page 129)

2. Issue the `tunevv rollback <VV_name>` command.

Restarting a Volume Modification Task

Restarting a `tunevv` task restarts a task that was previously interrupted. You may choose to restart a `tunevv` task if the operation was interrupted because of:

- User-initiated cancellation of a task.

- Component failure.

To restart a `tunevv` task, issue the `tunevv restart <VV_name>` command.

Tuning Physical Disks

HP 3PAR System Tuner Software is an optional feature that improves performance by identifying over-used physical disks, and performing load balancing on those disks without interrupting access. Use the `tunepd` command to perform tuning tasks on physical disks. You must purchase the HP 3PAR System Tuner Software license to use the `tunepd` command.

If the performance of one or more physical disks degrades, the throughput of the LDs is reduced and the entire system performance may decline. There are two general reasons why a physical disk may have degraded performance:

- 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.

In the following example, physical disks with average service times exceeding 50 milliseconds are identified and their chunklets are automatically relocated to rebalance the load on the physical disks.

To tune physical disks, issue the `tunepd -vvlayout -chstat -movech auto avgsvct 50` command, where:

- `<vvlayout>` specifies that the layout of the virtual volume is displayed.

- `<chstat>` specifies that chunklet statistics are displayed.

- `<movech>` specifies that if any disks with unbalanced loads are detected, the chunklets are moved from those disks for load balancing

- <auto> specifies that the system automatically chooses source and destination chunklets.
- <avgsvct> specifies the average service time threshold in milliseconds.

For more information about viewing system performance statistics, see "Viewing Statistics and Histograms" (page 123). For more information about how the system manages space usage, see the *HP 3PAR StoreServ Storage Concepts Guide*.

NOTE: 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.

Compacting Logical Disks

Reclaim unused LD space with the compactcpg command. When multiple identical virtual volumes are created as a result of a single volume creation operation, the underlying LDs that support those volumes are shared by the volume group. If several of the members of that volume group are later deleted, the underlying LDs may become less efficient in the usage of space. One or more LDs shared by the volume group may have only a small portion of their regions mapped to existing virtual volumes. However, their unused regions are not available to the system for use in creating new LDs. Compacting the LD regions mapped to these volumes may recover and free LD space. For more information about how the system manages space usage, see the *HP 3PAR StoreServ Storage Concepts Guide*.

You can compact LDs for a group of volumes that share LDs with the compactld command. Existing regions on the fragmented LDs are migrated to new, fully use LDs and the older ones are deleted so that unused space can be returned to the system's free chunklet pool.

To reclaim unused LD space from the group of virtual volumes, issue thecompactld <LD_name> or compactld -pat <pattern> command, where:

- <LD_name> is the name of the LD you wish to compact.
- <pattern> displays all LDs that match the pattern.

See the *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help for detailed information about this command.

Compacting Common Provisioning Groups

Reclaim unused CPG space with the compactld command. CPGs provide a shared pool of LD capacity for use by all virtual volumes that draw space from that pool. If volumes that draw from a CPG are deleted, or if copy space for these volumes grows and then shrinks, the underlying LDs in the CPG pool can become less efficient in space usage. Compacting a CPG allows you to reclaim space from a CPG that has become less efficient in space usage from creating, deleting, and relocating volumes. Compacting consolidates LD space in CPGs into as few LDs as possible.

- compactcpg <CPG_name> or compactcpg <pattern>

  ◦ <CPG_name> is the name of the CPG you wish to compact.

  ◦ <pattern> displays all CPGs that match the pattern.

  See the *HP 3PAR Command Line Interface Reference* and the HP 3PAR CLI Help for detailed information about this command.

  For more information about how the system manages space usage, see the *HP 3PAR StoreServ Storage Concepts Guide*.

Increasing Read Performance with Adaptive Flash Cache

With the Adaptive Flash Cache feature you can create a flash cache using space from your SSDs. To use Adaptive Flash Cache you must have a 7000 series StoreServ with at least 2 SSDs for each

node, or a 10000 series StoreServ with at least 4 SSDs for each node. The flash cache effectively extends the system cache without adding more physical memory. Creating more cache space from your SSDs allows the StoreServ to deliver commonly accessed data at greater speed. The space for the flash cache on the SSDs is automatically reserved by the system, you do not need to specify which SSDs to use. The Adaptive Flash Cache feature does not require a separate license.

Use the flash cache for specified virtual volume sets or the entire system. The size of the flash cache is set when it is created with the `createflashcache` command. The flash cache can be enabled and disabled with the `setflashcache` command. The flash cache performance statistics can be viewed with the `statcache` command. For more information about viewing system statistics, see Viewing Statistics and Histograms. Reports on the flash cache are generated with the HP 3PAR System Reporter software.

Creating the Flash Cache

To create a flash cache from available space on your SSDs, issue the `createflashcache <size>g|G|t|T` command, where:

- `<size>` indicates the size of the flash cache for each node pair in GB or TB. The size must be a multiple of 4 GB. The minimum size of the flash cache is 64 GB. The maximum size is 768 GB to 2,096 GB depending the space available on your SSDs. The maximum size of the flash cache for each node pair is determined by the system configuration. For the maximum size of the flash cache for each node pair with your specific system configuration, see the SPOCK website: http://www.hp.com/storage/spock.

NOTE: The flash cache can be run in simulation mode with the `-sim` option. The simulation can help you determine the size of the flash cache required to improve random read performance.

Verify the flash cache was created with the `showflashcache` command. For more information about the `createflashcache` and `showflashcache` commands, see the *HP 3PAR Command Line Interface Reference* and HP 3PAR CLI Help.

Enabling and Disabling the Flash Cache

To enable or disable a flash cache for specific virtual volume sets or the entire StoreServ, issue the `setflashcache {enable|disable|clear} {vvset:<name>|sys:all} ...` command, where:

- `enable` enables the flash cache on the specified virtual volume sets or all of the volumes in the system.
- `disable` disables the flash cache on the specified virtual volume sets or all of the volumes in the system.
- `clear` disables the 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.
- `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 the flash cache is used for all volumes in the system.

Verify the flash cache status with the `showflashcache` command. For more information about the `setflashcache` and `showflashcache` commands, see the *HP 3PAR Command Line Interface Reference* and HP 3PAR CLI Help.

Removing a Flash Cache from the StoreServ

To remove a flash cache from the system, issue the `removeflashcache` command.

Verify the flash cache was removed with the `showflashcache` command. For more information about the `removeflashcache` and `showflashcache` commands, see the *HP 3PAR Command Line Interface Reference and HP 3PAR CLI Help.*

20 The HP 3PAR File Persona Software Suite

The HP 3PAR File Persona Software Suite adds file services to the native Block Persona services available on HP 3PAR StoreServ Storage systems. The File Persona Software Suite provides file services for such uses as home directory consolidation and user shares accessible as directory or file paths over standard distributed file system protocols (SMB and NFS). Enabling File Persona features on an HP 3PAR StoreServ storage system allows for the creation and management of various storage objects, including virtual file servers, file provisioning groups, and file stores, to support your file service requirements.

The HP 3PAR File Persona Software Suite is already installed on your system as a feature of the HP 3PAR OS but an HP 3PAR File Persona Software Suite license must be installed and enabled in order to use File Persona services. (Contact an HP representative for details about acquiring an HP 3PAR File Persona Software Suite license.) In addition to meeting licensing requirements, to use File Persona services the appropriate hardware must be installed in your system, File Persona services must be started, and network components must be configured to support File Persona services. For information about hardware compatibility with File Persona services, see the Single Point of Connectivity Knowledge for HP Storage Products website, SPOCK (http://www.hp.com/storage/spock).

For detailed information about enabling and configuring File Persona and for information about the CLI commands available for managing File Persona components, see the *HP 3PAR File Persona User Guide*, available in the HP Storage Information Library at http://www.hp.com/go/storage/docs.

21 Using vSphere Virtual Volumes and the VASA Provider Service

Overview

VMware vSphere Virtual Volumes (VVOLs), available with VMware vSphere 6.0, are logical containers for objects associated with virtual machines. A given VM may be comprised of several VVOLs. Each virtual disk (VMDK) for a VM is stored as a VVOL on the HP 3PAR StoreServ Storage system. VVOLs are also used to contain configuration information, swap disk space, and data and virtual memory snapshots for a VM. The VVOLs required for a VM are created on the HP 3PAR array as needed. A swap disk VVOL, for example, is automatically created on the array when a VM is powered on in VMware vCenter.

Before the introduction of VVOLs, the prevailing unit of storage for VMs was an entire LUN on the HP 3PAR array. A storage administrator would create a standard 3PAR virtual volume and export that volume as a VLUN for accessibility in the vCenter Server management interface by a vSphere administrator. The vSphere administrator would create a single datastore from the VLUN, formatted with the virtual machine file system (VMFS). All the VMs created on that VMFS datastore reside on the same LUN in the HP 3PAR array. With traditional VMFS datastores on HP 3PAR LUNs, a storage administrator on the array is unable to provision storage at units smaller than an entire LUN or configure the characteristics of storage (such as RAID levels or disk types like FC, NL, or SSD) to meet differing individual requirements for multiple VMs stored on the LUN.

With VVOLs, a storage administrator creates storage containers on the HP 3PAR array and those containers are made available to a vSphere administrator as VVOL datastores, which don't require formatting with VMFS. A vSphere administrator can create (or remove) VMs on those datastores, with space provisioned (or reclaimed) as necessary for each VM, and the various VVOLs associated with a given VM are subsequently visible on the array and available for operations like snapshots or statistical usage reporting. Storage administrators can also create storage capability profiles (implemented as CPGs) that can be discovered and used by vSphere administrators for Storage Policy-Based Management (SPBM) for specific VMs. Storage administrators on HP 3PAR systems are not restricted only to higher-level operations on LUNs, but they can manage VMs and their associated VVOLs individually.

NOTE: Standard 3PAR virtual volumes (accessible as LUNs) are still available to provision storage for vSphere VMs. An HP 3PAR array can support both VVOLs and LUNs as containers for VMs on the same system.

The VASA Provider Service

The vSphere API for Storage Awareness (VASA) defines an interface for communications between vSphere administration systems (like vCenter Server or the vSphere Web Client), ESXi hosts, and storage providers like the HP 3PAR StoreServ Storage system. The VASA Provider Service is a web service developed to take advantage of the VASA interface. When the VASA Provider Service is enabled on an HP 3PAR StoreServ Storage system, it will broker requests between vSphere and the HP 3PAR StoreServ Storage system, allowing storage capabilities to be queried and VVOLs to be managed on the array by vSphere administrators.

Prerequisites for Using the VASA Provider Service

The VASA Provider Service is included as a component of the HP 3PAR OS and no additional software must be installed to use the service. No specific license for the VASA Provider Service is necessary, but the service requires functionality on the array furnished by the following licenses:

- HP 3PAR Virtual Copy
- HP 3PAR Thin Provisioning

Implementing VVOLs on an HP 3PAR StoreServ Storage System

To use the VASA Provider Service and implement VVOLs on an HP 3PAR StoreServ Storage system, perform the following steps:

- Ensure synchronization of all system clocks.

- Configure relevant vSphere hosts connected to the HP 3PAR array with the VMware host persona in order to establish a protocol endpoint (PE) for the array.

- Enable the VASA Provider Service on the HP 3PAR StoreServ Storage system.

- Configure the SSL certificate and certificate management mode for the VASA Provider Service.

- Confirm that at least one common provisioning group (CPG) has been created on the HP 3PAR array. (Additional CPGs can be created after the VASA Provider Service is registered in the vSphere environment.)

- Register the VASA Provider Service in the vSphere environment.

Ensuring Synchronization of System Clocks

Secure communication between vSphere systems and the VASA Provider Service on an HP 3PAR StoreServ Storage system relies on SSL certificates. If certificates are being managed in the vSphere environment, the VASA Provider dynamically generates certificates. These certificates are generated based, in part, on a timestamp derived from the system clock. The system clocks on all associated systems (ESXi hosts, vCenter Server, and the HP 3PAR StoreServ Storage system) should therefore be synchronized before registering the VASA Provider in vSphere. Even when the VASA Provider Service is configured to manage SSL certificates rather than the vSphere system (in which case, the certificates are not dynamically generated by the VASA Provider), it is recommended that all system clocks be synchronized. If system clocks are not synchronized, failures may occur in the registration of the VASA Provider in vSphere, in mounting VVOL storage containers as datastores, or in creating virtual machines on VVOL datastores.

To adjust the time for vCenter Server, refer to the documentation associated with the OS on which vCenter Server is to be installed. The system time should be set accurately before vCenter Server is installed.

VMware recommends using Network Time Protocol (NTP) servers to ensure time synchronization of vSphere (ESXi) hosts. To configure NTP servers for vSphere hosts, refer to article 2012069 in the VMware Knowledge Base (http://kb.vmware.com/kb/2012069).

To adjust the date and time on an HP 3PAR StoreServ Storage system, use the `setdate` command. If the date and time on the array must be adjusted, a new SSL certificate for the VASA Provider must be generated by using the `setvasa -reset` command. The `setvasa -reset` command should only be used when the VASA Provider is not registered with the vSphere environment.

If the clocks on the ESXi host and vCenter Server must be adjusted after they have already been set up, the VMware Certificate Authority (VMCA) certificates assigned to them may be incorrect. They may need to be re-installed to re-generate their certificates.

Establishing and Verifying the Protocol Endpoint

VMware vSphere 6.0 doesn't access VM objects stored in VVOLs on the HP 3PAR StoreServ Storage system directly but through a protocol endpoint (PE). A single PE is established automatically for a given HP 3PAR array when an existing vSphere (ESXi) host connected to the array is configured with the VMware host persona (persona 11) or a new host is created on the array with the VMware persona. (For information on configuring hosts, see "Creating Hosts" (page 66).) In order to assure that the protocol endpoint is exposed to a vSphere host, you must set the host persona for an existing host to a value of 11 (the VMware persona) by using the `sethost -persona` command or you can set the host persona to 11 when the host path is created on the array using the `createhost` command.

Any host connected to the array that is configured with the VMware host persona should be able to access the PE for the array. You can verify that the vSphere host can access the PE on the array by identifying the WWN of a particular vSphere host node using the `showport` command from the HP 3PAR CLI and then executing the following command on the vSphere host:

```
esxcli storage core device list --pe-only
```

Confirm that the PE displayed by this command matches the given host node WWN on the HP 3PAR array, for example, 2ff70002ac01832a, and that the value for Is VVOL PE in the displayed results is `true`, as in the following sample output:

```
naa.2ff70002ac01832a
    Display Name: 3PARdata Fibre Channel Disk (naa.2ff70002ac01832a)
    Has Settable Display Name: true
    Size: 0
    Device Type: Direct-Access
    Multipath Plugin: NMP
    Devfs Path:
    Vendor: 3PARData
    Model: VV
    Revision: 3210
    SCSI Level: 6
    Is Pseudo: false
    Status: dead timeout
    Is RDM Capable: false
    Is Local: false
    Is Removable: false
    Is SSD: false
    Is VVOL PE: true
    Is Offline: false
    Is Perennially Reserved: false
    Queue Full Sample Size: 0
    Queue Full Threshold: 0
    Thin Provisioning Status: unknown
    Attached Filters:
    VAAI Status: supported
```

Enabling the VASA Provider Service

To enable the VASA Provider Service for processing VASA requests over HTTP from the vSphere environment, issue the `startvasa` command.

Stopping the VASA Provider Service

To stop the VASA Provider Service and to discontinue processing VASA requests from the vSphere environment, issue the `stopvasa` command.

Displaying Properties of the VASA Provider Service

The `showvasa` command displays the following information about the VASA Provider Service:

- Whether the VASA Provider is enabled or disabled
- The VASA Provider URL
- The memory being used by the VASA Provider Service
- The version of the VASA Provider (e.g., 2.2.3)

The `showvasa` command executed with the `-cert` option displays 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 distinguished name (DN) of the certificate)

- The digital fingerprint of the certificate.

The SSL Certificate Management Mode for the VASA Provider Service

The VASA Provider Service uses public-key SSL certificates to establish secure connections between vSphere and an HP 3PAR StoreServ Storage system. In the context of VASA communications, the VASA Provider Service on the HP 3PAR StoreServ Storage system is considered the "server" and the vSphere environment (the vCenter Server in particular) is considered the "client" in making requests of the VASA Provider. In versions of the HP 3PAR OS prior to 3.2.2, SSL certificates for VASA communications were managed only by the vSphere host. That is, they were managed on the client (or "client-managed"). With version 3.2.2 of the HP 3PAR OS, two certificate management modes are supported. SSL certificates can continue to be client-managed or they can be managed by the VASA Provider Service on the HP 3PAR StoreServ Storage system (that is, they can be managed on the server, or "server-managed"). If certificates are client-managed, a certificate authority (CA) certificate associated with vCenter Server, known as the VMCA certificate, is used to sign the SSL certificate used in secure communications between the vSphere environment and the VASA Provider Service. If SSL certificates are server-managed, a storage administrator on the HP 3PAR StoreServ Storage system where the VASA Provider Service is enabled is responsible for managing certificates (including renewing certificates after expiration). The storage administrator can use self-signed certificates or certificates signed by a CA associated with a public key infrastructure (PKI) for VASA communications.

When SSL certificates for secure VASA communications are client-managed, the VASA Provider Service is associated with only one SSL certificate and it is therefore possible to register the VASA Provider in only one vSphere environment at a time, because the same SSL certificate can't 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 HP 3PAR array can associate multiple certificates with the VASA Provider Service to be used for simultaneous connections to different vSphere environments.

NOTE: In HP 3PAR OS 3.2.2, SSL certificates for VASA communications are server-managed by default. If the VASA Provider Service was enabled in an earlier version of the HP 3PAR OS and the 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 VASA Provider must be re-registered for any vSphere environments in which the VASA Provider is currently registered to restore connectivity.

Setting the SSL Certificate Management Mode

Client Management Mode

If SSL certificates for VASA communications are client-managed, the storage administrator on the HP 3PAR StoreServ Storage system is not required to create or manage SSL certificates. The vSphere environment serves as a PKI and includes a certificate authority for issuing certificates, the VMware Certificate Authority (VMCA). When the VASA Provider is registered in the vSphere environment, the vSphere system requests that the VASA Provider generate a certificate signing request (CSR). The vSphere system uses the CSR to create an SSL certificate that is signed by the VMCA and

returns that certificate to the VASA Provider. Any existing connections to the VASA Provider are closed and new connections are established using the certificate.

To determine the current SSL certificate management mode for the VASA Provider Service, issue the `showvasa -cert` command, as in the following example:

```
cli% showvasa -cert

Mgmt_Mode -Subject- -Fingerprint-
client     Unknown   Unknown
```

If the `showvasa` command indicates that the certificate management mode is set to `server`, you can specify that the SSL certificate for the VASA Provider is to be managed by the vSphere environment (that is, client-managed), by issuing the `setvasa -certmgmt client` command.

Then, to remove any current certificates and recreate a self-signed SSL certificate for the VASA Provider, issue the `setvasa -reset` command. Now the VASA Provider Service can be registered in the vSphere environment.

Server Management Mode

If SSL certificates for the VASA Provider are server-managed, the storage administrator on the HP 3PAR StoreServ Storage system can use self-signed certificates or certificates issued by a CA associated with a particular PKI.

To use a self-signed certificate for the VASA Provider Service, perform the following steps:

1. 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://191.123.45.111:9997/vasa              67 2.2.3
```

2. Generate the self-signed certificate by using the `createcert vasa -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:

   - `vasa -selfsigned` stipulates that a self-signed certificate is to be created for the VASA Provider 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 (C) field of the Distinguished Name (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 HP 3PAR <model> <serial>, where <model> and <serial> are the system model name and the serial number of the HP 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>specifies for the subject alternative name of the certificate a DSN name or IP address to associate with the certificate.

3. Verify that the certificate management mode for the VASA Provider Service is set to `server` by using the `showvasa -cert` command. If the certificate management mode needs to be changed, issue the `setvasa -certmgmt server` command.

To use an SSL certificate from a given PKI for the VASA Provider Service, perform the following steps:

1. Identify the VASA URL for the array (either an IP address or a DNS name) by using the `showvasa` command.
2. A certificate signing request (CSR) by using the `createcert vasa -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:

   - `vasa -csr` stipulates that a certificate signing request is to be created in order to request an SSL certificate from a given PKI for use by the VASA Provider 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 (C) field of the Distinguished Name (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 HP 3PAR <model> <serial>, where <model> and <serial> are the system model name and the serial number of the HP 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> specifies for the subject alternative name of the certificate a DSN name or IP address to associate with the certificate.

3. Send the output from the `createcert` command executed in the previous step to the Certification Authority associated with a given PKI. Different PKI systems may have different procedures for this process. Refer to your organization's PKI procedures for specific instructions. You should receive in return a signed SSL certificate and a copy of the Certification Authority's certificate.

4. Import the certificates by executing the `importcert vasa <cert_filename> <CA_cert_filename>` command, where:
   - `vasa` specifies that the VASA Provider 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's certificate. Must be in the PEM certificate format.

5. If necessary, change the certificate management mode to `server` by issuing the `setvasa -certmgmt server` command.

After configuring or importing SSL certificates as necessary and setting the SSL certificate management mode either to `client` or `server`, the VASA Provider Service is ready to be registered in the vSphere environment.

Registering the VASA Provider in the vSphere Environment

In order for the vSphere environment to be able to access the protocol endpoint of the HP 3PAR array for VASA communications over HTTPS, the VASA Provider must be registered in the vSphere environment as a storage provider. In preparation for registering the VASA Provider in the vSphere environment, the storage administrator on the HP 3PAR StoreServ Storage system should confirm certain settings and collect information to provide to the vSphere administrator.

- The storage administrator should determine whether storage containers for VVOLs will be created on the HP 3PAR array in an existing virtual domain or in a new domain. If necessary, a new virtual domain for VVOLs can be created by using the `createdomain` command.

- A user on the HP 3PAR array with sufficient administrative credentials and associated with the appropriate domain must be provided to the vSphere administrator in order to register the VASA Provider. The user must be granted at least the `edit` role in the domain. If necessary, a new user can be created for the purpose of registering the VASA Provider by using the `createuser` command, as in the following example:

```
cli% createuser -c vvolpw123 vvoladmin vvoldomain edit

User created
```

The user name (`vvoladmin` in this example) and the password (`vvolpw123`) should be supplied to the vSphere administrator for registration of the VASA Provider.

- Identify the VASA Provider URL where VASA communications will be received on the HP 3PAR array. Use the `showvasa` command to display the URL, which can be an IP address (such as `https://191.123.45.111:9997/vasa`) or a DNS name (such as `https://storeserv.storage.com:9997/vasa`).

- Identify the SSL certificate for VASA communications by using the `showvasa -cert` command.

- Confirm that the VASA Provider Service has been enabled on the HP 3PAR StoreServ Storage system by issuing the `showvasa` command. If the service is indicated as disabled, execute the `startvasa` command to enable it.

The user name and password, along with the VASA Provider URL and the SSL certificate, should be supplied to the vSphere administrator. The vSphere administrator can register the VASA Provider in vCenter Server by using the vSphere Web Client. See the vSphere 6.0 Documentation Center

(http://pubs.vmware.com/vsphere-60/index.jsp) for information and procedures related to managing storage providers in the vSphere environment.

⚠ **WARNING!** Once the VASA Provider is registered in the vSphere environment, if the user name or password is changed on the HP 3PAR StoreServ Storage system, the VASA Provider Service on the array will no longer be accessible from the vSphere environment. Modifying the user name or password used in registering the VASA Provider should be done in coordination with the vSphere administrator responsible for VASA Provider registrations. If the user name or password is changed on the array, it will be necessary to register the VASA Provider again in the vSphere environment.

NOTE: If registration fails with an indication that VMCA certificate registration has not completed, confirm that the vSphere systems (vCenter Server, ESXi hosts) and HP 3PAR array system clocks are synchronized. Then issue the `setvasa` command with the `-reset` option and attempt registration again. If registration fails with an indication that the VASA Provider URL is invalid, make sure the VASA Provider URL specified during registration in the vSphere environment exactly matches the URL that is displayed by the `showvasa` command on the HP 3PAR array.

Working with Storage Containers for VVOLs

In versions of the HP 3PAR OS prior to 3.2.2, storage containers for VVOLs on the HP 3PAR StoreServ Storage system were implemented as virtual domains. Either the entire array served as the storage container for VVOLs or a storage administrator could create a specific virtual domain dedicated to VVOLs. In the vSphere environment, only one datastore for VVOLs could be mounted from the array, comprising the array itself (treated as a root domain) or a given virtual domain.

In version 3.2.2 of the HP 3PAR OS, a storage administrator on an HP 3PAR array can create multiple storage containers, represented as sets of virtual volumes, to be mounted as VVOL datastores in the vSphere environment. To create a storage container, issue the `createvvset <set_name>` command to create an empty virtual volume set and then execute the `setvvolsc` command to designate the set as a storage container for VVOLs, as in the following example:

```
cli% createvvset salesvvols
cli% setvvolsc -create set:salesvvols
Setting set:salesvvols as a VVol storage container
```

Displaying Storage Containers

You can confirm that a given virtual volume set is designated as a storage container by using the `showvvset -summary` command, as in the following example:

```
cli% showvvset -summary
Id Name          VV_Cnt VVOLSC Flashcache QoS
 1 salesvvols         0 YES    NO         NO
 2 standardset        0 NO     NO         NO
------------------------------------------
 2 total              0 1      0          0
```

Virtual volume sets designated as storage containers for VVOLs will be indicated in the results displayed by the command with value of YES in the VVOLSC column.

You can also display information only for those virtual volume sets that have been designated as VVOL storage containers by issuing the `showvvolsc` command, as in the following example:

```
cli% showvvolsc
                     -------(MB)-------
Name        Num_VMs Num_VVols In_Use Provisioned
salesvvols        0         0      0           0
```

```
------------------------------------------------
total          0         0      0          0
```

For more information about the `showvvset` and `showvvolsc` commands, see the *HP 3PAR Command Line Interface Reference*.

Removing Storage Containers

To remove a VVOL storage container, along with all of its volumes, issue the `setvvolsc -remove set:<set_name>` command. You will be prompted to confirm the removal of the storage container.

Mounting Storage Containers in the vSphere Environment

Configuring CPGs to Define Capability Profiles for VMs

Common provisioning groups are used on the HP 3PAR array to implement capability profiles for VVOLs. At least one CPG must be configured on the HP 3PAR array for use as the default capability profile for VMs created on VVOL datastores in the vSphere environment. (This CPG will be associated with a "Datastore Default" VM storage policy in the vSphere environment.) But a storage administrator can also create additional CPGs on the HP 3PAR array, each defined with specific capabilities, and a vSphere administrator can then implement VM storage policies in vSphere based on the capabilities associated with those different CPGs.

A storage administrator on the HP 3PAR array may create, for example, a CPG with a RAID type of 5 on solid-state disk drives (SSDs) and name the CPG "SSD_R5". For snapshots, the storage administrator may create a CPG with a RAID type of 6 on nearline drives, naming the CPG, for example, "NL_R6". In the vSphere environment, using the vSphere Web Client, an administrator can then create a new VM storage policy named, for example, "3PAR Gold Policy" and specify that the policy use rules based on vendor-specific capabilities. The vSphere administrator can choose **Common Provisioning Group** as the implementation for the vendor-specific set of rules (that is, the capability profile). A list of CPGs available on the HP 3PAR array is displayed and the vSphere administrator can select the "SSD_R5" CPG to take advantage of its capabilities for data storage for VMs. The administrator can specify additional capabilities by clicking **Snapshot Common Provisioning Group** and selecting the "NL_R6" CPG for VM snapshot storage.

When creating a VM in vSphere, the administrator can then specify "3PAR Gold Policy" as the storage policy for the VM and the VVOLs generated for that VM will be stored on the CPGs associated with that policy, with data VVOLs on the "SSD_R5" CPG and snapshot VVOLs on the "NL_R6" CPG.

NOTE: A storage container must be associated with a default capability profile in order to be used as a VVOL datastore, so at least one CPG must be defined on the HP 3PAR array in order for the registration of the VASA Provider in the vSphere environment to succeed. (A default CPG is automatically created on an HP 3PAR array on installation.) If no CPGs are configured on the array, registration of the VASA Provider will fail, reporting a "Rescan Error" on the Storage Provider page in vCenter.

Controlling Space Allocation with CPGs

In addition to defining capability profiles for VMs by using CPGs, the storage administrator may also use CPGs to control space allocation for VVOLs on the HP 3PAR array. The storage administrator can control usage of array storage space in the following three ways:

- If the VASA Provider is registered in a given virtual domain, the vSphere environment will be allowed to access only the capabilities and storage space associated with the CPGs within that domain.

- If the CPGs on which a storage container is created are configured with growth limits, the vSphere administrator will be constrained by these growth limits when creating new virtual

machines in that storage container. In order to guarantee that growth is limited, each CPG on the array (or each CPG within a virtual domain dedicated to VVOLs) must be configured with a total growth limit (by using the `setcpg` with the `-sdgl` option). If any single CPG is not configured with a growth limit, that CPG can consume all available space for a particular storage drive device type for VVOL usage.

- Storage administrators on HP 3PAR arrays can append a special "vvol_" prefix to the name of CPGs to designate those CPGs as available by default for VVOL VMs. In the vSphere environment, if a VM is created on a VVOL datastore that is not associated with specific storage capabilities other than the default storage policy, that VM will use only those CPGs that have been appended with the special prefix.

For additional information on how default CPGs are selected for VVOLs, refer to the *HP 3PAR VMware ESX Implementation Guide.*

Administering VVOLs

The VVOLs associated with VMs are generally managed from the vSphere environment. Consequently, the various HP 3PAR CLI commands (for example, `showvv`, `histvv`, `statvv`, etc.) that operate on or display information for HP 3PAR virtual volumes may not operate on or display information for VVOLs by default. In order to include VVOLs in such commands, you can specify a given VVOL by name in the execution of the command.

Alternatively, you can set the `matchbulkobjs` environment variable such that VVOLs are included in the operation of the commands associated with virtual volumes. Use the `setclienv` command to set the `matchbulkobj` environment variable to a value of 1 to include VVOLs in virtual volume commands, as in the following example:

```
cli% setclienv matchbulkobjs 1
```

Cleaning up VVOLs Abandoned by vSphere

VVOLs and their associated objects are generally created and removed automatically on the HP 3PAR StoreServ Storage system when VMs are created or managed in the vSphere environment. If the vSphere administrator removes a virtual machine created using VVOLs, those virtual volumes on the array will be removed automatically, and space on the array will be reclaimed. The storage administrator does not need to perform any actions to allocate or reclaim space used by VVOLs.

A storage administrator may occasionally be required to remove the volumes and VVOLs that may have been created by operations in the vSphere environment. Traditionally, this meant 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).

The storage administrator on the HP 3PAR array may need to remove VVOLs for the following reasons:

- The vSphere administrator may have removed a VVOL-based VM from the vCenter inventory, without removing it from the disk.
- The vSphere administrator may have removed an ESXi host without cleaning up the VM resources associated with that ESXi host.
- The vSphere administrator may have abandoned the vCenter environment without cleaning up array resources.

In these circumstances, a storage administrator might request that the vSphere administrator re-register the abandoned VMs or the storage administrator may have to remove VVOLs from the HP 3PAR array.

⚠ **WARNING!**   Before removing VVOLs, the storage administrator should confirm with a vSphere administrator that the VVOLs are indeed abandoned and no longer needed. Removing VVOLs without coordinating with the vSphere administrator may have an adverse effect on VM functionality in the vSphere environment.

Requesting the vSphere Administrator Re-register Abandoned VMs

Re-registering abandoned VMs in the vSphere environment is the preferred method for cleaning up array resources associated with VVOL VMs. This assures the integrity of the vSphere environment.

A vSphere administrator may re-register VMs on VVOL datastores using the vSphere datastore browser, available under *Datastores→<DatastoreName>Actions→Browse Files*. From the Browse Files dialog, the vSphere administrator can expand the VMs to identify the VMX files, and then right-click a given VMX file to register the VM back with the vSphere environment.

The storage administrator can use the `showvvolvm` command to identify the VMs that need to be re-registered and provide that list of VMs to the vSphere administrator. Apart from identifying the VMs in question, no additional action should be required by the storage administrator after notifying the vSphere administrator which VMs need to be re-registered.

Removing VVOLs and Subluns Associated with Individual VMs

Removing VVOLs and associated objects from an HP 3PAR array can disrupt the vSphere environment. Such changes on the array should be coordinated with the vSphere administrator. VVOLs on an HP 3PAR array can be removed by performing the following steps:

- Identify the VVOLs associated with a given VM by executing the `showvvolvm -vv` command.
- Identify any sublun bindings associated with those VVOLs by using the `showvlun` command.
- Remove the sublun bindings by using the `removevlun` command.
- Remove the VVOLs by using the `removevv` command.

22 Support and Other Resources

Contacting HP

For worldwide technical support information, see the HP support website:

http://www.hp.com/support

Before contacting HP, collect the following information:

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

Specify the type of support you are requesting:

HP 3PAR storage system	Support request
HP 3PAR StoreServ 7000 Storage	StoreServ 7000 Storage
HP 3PAR StoreServ 8000 Storage	StoreServ 8000 Storage
HP 3PAR StoreServ 10000 Storage	3PAR or 3PAR Storage
HP 3PAR StoreServ 20000 Storage	StoreServ 20000 Storage

HP 3PAR documentation

For information about:	See:
Supported hardware and software platforms	The Single Point of Connectivity Knowledge for HP Storage Products (SPOCK) website: SPOCK (http://www.hp.com/storage/spock)
Locating HP 3PAR documents	The HP Storage Information Library: Storage Information Library (http://www.hp.com/go/storage/docs/) By default, **HP 3PAR Storage** is selected under **Products and Solutions**.
Customer Self Repair procedures (media)	The HP Customer Self Repair Services Media Library: Customer Self Repair Services Media Library (http://h20464.www2.hp.com/index.html) Under **Product category**, select **Storage**. Under **Product family**, select **3PAR StoreServ Storage** for HP 3PAR StoreServ 7000, 8000, 10000, and 20000 Storage systems.
All HP products	HP Support Center: HP Support Center (http://h20564.www2.hpe.com/portal/site/hpsc)

Typographic conventions

Table 18 Document conventions

Convention	Element
Bold text	• Keys that you press • Text you typed into a GUI element, such as a text box • GUI elements that you click or select, such as menu items, buttons, and so on
`Monospace text`	• File and directory names • System output • Code • Commands, their arguments, and argument values
`<Monospace text in angle brackets>`	• Code variables • Command variables
`Bold monospace text`	• Commands you enter into a command line interface • System output emphasized for scannability

⚠ **WARNING!**   Indicates that failure to follow directions could result in bodily harm or death, or in irreversible damage to data or to the operating system.

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

NOTE: Provides additional information.

Required

Indicates that a procedure must be followed as directed in order to achieve a functional and supported implementation based on testing at HP.

Documentation feedback

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A Mapping Roles and Rights

NOTE: The show, hist, and stat commands can be used by any role in the system. The Audit role cannot access the HP 3PAR CLI.

In this appendix

3PAR AO Role

Table 19 3PAR AO Rights

Right	Description of Right
cpg_compact	Consolidate space in a CPG.
password_checkown	Check a user's own password.
password_setown	Set a user's own password.
reg_move	Move virtual volume regions between LDs.

3PAR RM Role

Table 20 3PAR RM Role

Right	Description of Right
groupsv_create	Create a virtual volume group.
host_set	Set host properties.
ld_remove	Remove an LD.
password_checkown	Check a user's own password.
password_setown	Set a user's own password.
rcopy_start	Start the remote copy service.
rcopy_stop	Stop the remote copy service.
rcopy_sync	Synchronize remote copy groups.
rcopygroup_create	Create a remote copy group.
rcopygroup_set	Set remote copy group properties.
rcopygroup_start	Start remote copy group.
rcopygroup_stop	Stop a remote copy group.
rcopytarget_admit	Add a target to a remote copy volume.
rcopytarget_set	Set remote copy target properties.

Table 20 3PAR RM Role *(continued)*

Right	Description of Right
sched_create	Create a schedule for tasks.
sched_setown	Set a user's own scheduled task properties.
sshkey_remove	Remove users public SSH keys.
sshkey_set	Set the public SSH key for a user.
sv_create	Create a virtual copy volume.
sv_promote	Promote a virtual copy volume.
sv_remove	Remove virtual copy of a volume.
sv_set	Set properties of a virtual copy of a volume.
task_start	Run commands in the background.
user_setown	Set a user's own properties.
vlun_create	Export a virtual volume as a SCSI LUN.
vlun_remove	Remove a VLUN.
vv_create	Create a Virtual Volume.
vvcopy_remove	Remove physical copy of a volume.
vvcopy_set	Set properties of a physical copy of a volume.
vvset_create	Create a virtual volume set.
vvset_set	Set virtual volume set properties.

Basic Edit Role

Table 21 Edit Rights

Right	Description of Right
alert_set	Set alert properties.
authparam_set	Set LDAP authentication properties.
cpg_compact	Consolidate space in a CPG.
cpg_create	Create CPG.
domain_create	Create a domain.
domain_moveto	Move objects in or out of a domain.
domainset_create	Create a domain set.
domainset_set	Set domain set properties.
groupsv_create	Create a virtual volume group.
groupvvcopy_create	Create a physical copy volume group.
health_check	Check the current health of the system.
host_create	Create a host.
host_set	Set host properties.
hostset_create	Create paths to a system host set.
hostset_set	Set host set properties.

Table 21 Edit Rights *(continued)*

Right	Description of Right
ld_remove	Remove an LD.
password_checkown	Check a user's own password.
password_setown	Set a user's own password.
rcopy_start	Start the remote copy service.
rcopy_stop	Stop the remote copy service.
rcopy_sync	Synchronize remote copy groups.
rcopygroup_create	Create a remote copy group.
rcopygroup_remove	Remove a remote copy group.
rcopygroup_set	Set remote copy group properties.
rcopygroup_start	Start remote copy group.
rcopygroup_stop	Stop a remote copy group.
rcopylink_admit	Add remote copy links.
rcopylink_dismiss	Dismiss remote copy links.
rcopytarget_admit	Add a target to a remote copy volume.
rcopytarget_create	Create a remote copy target.
rcopytarget_dismiss	Dismiss a remote copy target from a group.
rcopytarget_remove	Remove a remote copy target.
rcopytarget_set	Set remote copy target properties.
rcopyvv_admit	Add a volume to a remote copy volume group.
rcopyvv_dismiss	Dismiss a virtual volume from a remote copy group.
sched_create	Create a schedule for tasks.
sched_setown	Set a user's own scheduled task properties.
snapspace_update	Update snapshot space accounting information.
sshkey_set	Set the public SSH key for a user.
sv_create	Create a virtual copy volume.
sv_promote	Promote a virtual copy volume.
sv_remove	Remove virtual copy of a volume.
sv_set	Set properties of a virtual copy of a volume.
user_create	Create a user.
user_setown	Set a user's own properties.
vlun_create	Export a virtual volume as a SCSI LUN.
vv_create	Create a Virtual Volume.
vv_grow	Grow a virtual volume.
vv_tune	Tune a virtual volume.
vvcopy_create	Create physical copy volume.
vvcopy_promote	Promote a physical volume back to its base volume.

Table 21 Edit Rights *(continued)*

Right	Description of Right
vvcopy_remove	Remove physical copy of a volume.
vvcopy_set	Set properties of a physical copy of a volume.
vvset_create	Create a virtual volume set.
vvset_set	Set virtual volume set properties.

Browse Role

Table 22 Browse Rights

Right	Description of Right
password_checkown	Check a user's own password.
password_setown	Set a user's own password.
sshkey_remove	Remove users public SSH keys.
sshkey_set	Set the public SSH key for a user.
user_setown	Set a user's own properties.
vv_update	Remove old virtual copy and create a new virtual copy of a volume.

Create Role

Table 23 Create Rights

Right	Description of Right
cpg_create	Create Common Provision Group.
domainset_annotate	Annotate the comment of a domain set.
domainset_create	Create a domain set.
groupsv_create	Create a virtual volume group.
groupvvcopy_create	Create a physical copy volume group.
health_check	Check the current health of the system.
host_create	Create a host.
hostset_annotate	Annotate the comment of a host set.
hostset_create	Create paths to a system host set.
password_checkown	Check a user's own password.
password_setown	Set a user's own password.
sched_create	Create a schedule for tasks.
sched_setown	Set a user's own scheduled task properties.
sv_create	Create a virtual copy volume.
vlun_create	Export a virtual volume as a SCSI LUN.
vv_create	Create a Virtual Volume.
vvcopy_create	Create physical copy volume.

Table 23 Create Rights *(continued)*

Right	Description of Right
vvset_annotate	Annotate the comment of a virtual volume set.
vvset_create	Create a virtual volume set.

Edit Role

Table 24 Edit Rights

Right	Description of Right
aocfg_start	Start execution of an Adaptive Optimization configuration.
ch_move	Move chunklets from one physical disk to another.
ch_movetospare	Move chunklets from a physical disk to spare space.
cpg_compact	Consolidate space in a CPG.
cpg_create	Create CPG.
cpg_set	Set CPG properties.
domain_moveto	Move objects in or out of a domain.
domainset_annotate	Annotate the comment of a domain set.
domainset_create	Create a domain set.
domainset_set	Set domain set properties.
flashcache_create	Create a flash cache.
flashcache_remove	Remove a flash cache.
flashcache_set	Set the policy for a flash cache.
fpg_create	Create a file provisioning group.
fpg_remove	Remove a File Provisioning Group.
fpg_set	Modify the properties of a File Provisioning Group.
fs_grow	Grow a File Provisioning Group.
fsav_set	Set antivirus properties for file services.
fsav_start	Start antivirus service or scan.
fsav_stop	Stop the antivirus service or stops/pauses a scan.
fsconf_backup	Create a configuration backup for a Virtual File System.
fsconf_restore	Restore a configuration backup for a Virtual File System on the same system or a different system with same fspool and vfs structure.
fsgroup_create	Create a local group account associated with file services.
fsgroup_remove	Remove a local group account associated with file services.
fsgroup_set	Modify a local group account associated with file services.
fshare_create	Create a file share.
fshare_remove	Remove a file share from file services cluster.
fshare_set	Set or modify file share properties.
fsip_create	Assign an IP address to a specified Virtual File Server.

Table 24 Edit Rights *(continued)*

Right	Description of Right
fsip_remove	Remove an IP address entry from a specified virtual file server.
fsip_set	Modify an IP address entry associated with a specified Virtual File Server.
fsnap_create	Create a Snapshot for file services.
fsnap_remove	Remove file store Snapshots from file services.
fsquota_set	Set the quotas for a specific Virtual File Server.
fstore_remove	Remove a file store.
fstore_set	Modify a file store.
fsuser_create	Create a local user account associated with file services.
fsuser_set	Modify a local user account associated with file services.
fsuser_remove	Remove a local user account associated with file services.
groupsv_create	Create a virtual volume group.
groupvvcopy_create	Create a physical copy volume group.
host_create	Create a host.
host_remove	Remove a host.
host_set	Set host properties.
hostset_annotate	Annotate the comment of a host set.
hostset_create	Create paths to a system host set.
hostset_set	Set host set properties.
ld_compact	Consolidate space in an LD.
ld_create	Create an LD.
ld_remove	Remove an LD.
password_checkown	Check a user's own password.
password_setown	Set a user's own password.
pd_movetospare	Move used chunklets from a physical disk to spare space.
qos_set	Set QoS configurations for a VVset.
rclink_check	Remote copy link validity checks.
rcopy_start	Start the remote copy service.
rcopy_stop	Stop the remote copy service.
rcopy_sync	Synchronize remote copy groups.
rcopygroup_create	Create a remote copy group.
rcopygroup_remove	Remove a remote copy group.
rcopygroup_set	Set remote copy group properties.
rcopygroup_start	Start remote copy group.
rcopygroup_stop	Stop a remote copy group.
rcopylink_admit	Add remote copy links.
rcopylink_dismiss	Dismiss remote copy links.

Table 24 Edit Rights *(continued)*

Right	Description of Right
rcopytarget_admit	Add a target to a remote copy volume.
rcopytarget_create	Create a remote copy target.
rcopytarget_dismiss	Dismiss a remote copy target from a group.
rcopytarget_remove	Remove a remote copy target.
rcopytarget_set	Set remote copy target properties.
rcopyvv_admit	Add a volume to a remote copy volume group.
rcopyvv_dismiss	Dismiss a virtual volume from a remote copy group.
reg_move	Move virtual volume regions between LDs.
fs_set	Update Global file services Settings.
snapspace_update	Update snapshot space accounting information.
sshkey_remove	Remove users public SSH keys.
sshkey_set	Set the public SSH key for a user.
sv_create	Create a virtual copy volume.
sv_promote	Promote a virtual copy volume.
sv_remove	Remove virtual copy of a volume.
sv_set	Set properties of a virtual copy of a volume.
task_cancel	Cancel a task.
task_remove	Remove a task.
task_set	Edit tasks.
task_start	Run commands in the background.
user_setown	Set a user's own properties.
useracl_set	Set user Access Control List properties.
vfs_create	Create a Virtual File Server.
vfs_remove	Remove a Virtual File Server.
vfs_set	Modify a Vitual File Server.
vlun_create	Export a virtual volume as a SCSI LUN.
vlun_remove	Remove a VLUN.
vv_create	Create a Virtual Volume.
vv_grow	Grow a virtual volume.
vv_import	Import a remote virtual volume to local storage.
vv_remove	Remove a base Virtual Volume.
vv_set	Set virtual volume properties.
vv_tune	Tune a virtual volume.
vv_update	Remove old virtual copy and create a new virtual copy of a volume.
vvcopy_create	Create physical copy volume.
vvcopy_promote	Promote a physical volume back to its base volume.

Table 24 Edit Rights *(continued)*

Right	Description of Right
vvcopy_remove	Remove physical copy of a volume.
vvcopy_set	Set properties of a physical copy of a volume.
vvset_annotate	Annotate the comment of a virtual volume set.
vvset_create	Create a virtual volume set.
vvset_set	Set virtual volume set properties.

Service Role

Table 25 Service Rights

Right	Description of Right
alert_remove	Remove alerts.
alert_set	Set alert properties.
battery_set	Set battery properties.
cage_locate	Locate a drive cage.
cage_set	Set cage properties.
cage_upgrade	Upgrade cage firmware.
ch_move	Move chunklets from one physical disk to another.
ch_movetospare	Move chunklets from a physical disk to spare space.
cim_set	Set CIM server properties.
cim_start	Starts the CIM server.
cpg_set	Set Common Provision Group properties.
date_set	Set system date and time properties.
health_check	Check the current health of the system.
fsconf_backup	Create a configuration backup for a Virtual File System.
fsconf_restore	Restore a configuration backup for a Virtual File System on the same system or a different system with same fspool and vfs structure.
fstore_create	Create a file store.
host_service	Service a host.
ld_create	Create an LD.
ld_remove	Remove an LD.
ld_start	Start an LD.
mag_control	Take magazines or disks on or off a loop.
mag_service	Service a magazine or physical disk.
node_locate	Locate a controller node by blinking its LEDs.
node_service	Service a controller node.
node_set	Set controller node properties.
node_shutdown	Shutdown a controller node.

Table 25 Service Rights *(continued)*

Right	Description of Right
password_checkown	Check a user's own password.
password_setown	Set a user's own password.
pd_admit	Admit a physical disk to the system.
pd_control	Spin up or spin down a physical disk.
pd_dismiss	Dismiss a physical disk from the system.
pd_movereloc	Move relocated chunklets from one physical disk to another.
pd_movetospare	Move used chunklets from a physical disk to spare space.
pd_set	Set physical disk properties.
pd_upgrade	Update physical disk firmware.
port_check	Perform diagnostic tests on ports.
port_control	Control the characteristics of Fibre Channel, Remote Copy, or file services ports.
sched_create	Create a schedule for tasks.
sched_setany	Set any user scheduled task properties.
sched_setown	Set a user's own scheduled task properties.
spare_create	Create spare chunklet.
sshkey_remove	Remove users public SSH keys.
sshkey_set	Set the public SSH key for a user.
sys_locate	Locate a system by blinking its LEDs.
sys_set	Set System Properties.
sys_shutdown	Shutdown the system.
task_start	Run commands in the background.
vv_check	Virtual volume validity checks.
vv_start	Start a virtual volume.
wsapi_start	Start the Web Services API server.
wsapi_stop	Stop the Web Services API server.

Super Role

Table 26 Super Rights

Right	Description of Right
alert_remove	Remove alerts.
alert_set	Set alert properties.
aocfg_start	Start execution of an Adaptive Optimization configuration.
authparam_set	Set LDAP authentication properties.
battery_set	Set battery properties.
cage_locate	Locate a drive cage.

Table 26 Super Rights *(continued)*

Right	Description of Right
cage_set	Set cage properties.
cage_upgrade	Upgrade cage firmware.
ch_move	Move chunklets from one physical disk to another.
ch_movetospare	Move chunklets from a physical disk to spare space.
cim_set	Set CIM server properties.
cim_start	Starts the CIM server.
cpg_compact	Consolidate space in a CPG.
cpg_create	Create CPG.
cpg_set	Set CPG properties.
date_set	Set system date and time properties.
domain_create	Create a domain.
domain_moveto	Move objects in or out of a domain.
domain_remove	Remove a domain.
domain_set	Set domain properties.
domainset_annotate	Annotate the comment of a domain set.
domainset_create	Create a domain set.
domainset_set	Set domain set properties.
encryption_control	Perform encryption operations (enable, back up, restore, rekey).
encryption_status	Check encryption status of the system.
flashcache_create	Create a flash cache.
flashcache_remove	Remove a flash cache.
flashcache_set	Set the policy for a flash cache.
fpg_create	Create a file provisioning group.
fpg_remove	Remove a File Provisioning Group.
fpg_set	Modify the properties of a File Provisioning Group.
fs_grow	Grow a File Provisioning Group.
fsav_set	Set antivirus properties for file services.
fsav_start	Start antivirus service or scan.
fsav_stop	Stop the antivirus service or stops/pauses a scan.
fsconf_backup	Create a configuration backup for a Virtual File System.
fsconf_restore	Restore a configuration backup for a Virtual File System on the same system or a different system with same fspool and vfs structure.
fsgroup_create	Create a local group account associated with file services.
fsgroup_remove	Remove a local group account associated with file services.
fsgroup_set	Modify a local group account associated with file services.
fshare_create	Create a file share.

Table 26 Super Rights *(continued)*

Right	Description of Right
fshare_remove	Remove a file share from file services cluster.
fshare_set	Set or modify file share properties.
fsip_create	Assign an IP address to a specified Virtual File Server.
fsip_remove	Remove an IP address entry from a specified virtual file server.
fsip_set	Modify an IP address entry associated with a specified Virtual File Server.
fsnap_create	Create a Snapshot for file services.
fsnap_remove	Remove file store Snapshots from file services.
fsquota_set	Set the quotas for a specific Virtual File Server.
fstore_create	Create a file store.
fstore_remove	Remove a file store.
fstore_set	Modify a file store.
fsuser_create	Create a local user account associated with file services.
fsuser_set	Modify a local user account associated with file services.
fsuser_remove	Remove a local user account associated with file services.
groupsv_create	Create a virtual volume group.
groupvvcopy_create	Create a physical copy volume group.
health_check	Check the current health of the system.
host_create	Create a host.
host_remove	Remove a host.
host_service	Service a host.
host_set	Set host properties.
hostset_annotate	Annotate the comment of a host set.
hostset_create	Create paths to a system host set.
hostset_set	Set host set properties.
ld_compact	Consolidate space in an LD.
ld_create	Create an LD.
ld_remove	Remove an LD.
ld_start	Start an LD.
mag_control	Take magazines or disks on or off a loop.
mag_service	Service a magazine or physical disk.
node_locate	Locate a controller node by blinking its LEDs.
node_service	Service a controller node.
node_set	Set controller node properties.
node_shutdown	Shutdown a controller node.
password_checkany	Check any user password.
password_checkown	Check a user's own password.

Table 26 Super Rights *(continued)*

Right	Description of Right
password_setany	Change any user password.
password_setown	Set a user's own password.
pd_admit	Admit a physical disk to the system.
pd_control	Spin up or spin down a physical disk.
pd_dismiss	Dismiss a physical disk from the system.
pd_movereloc	Move relocated chunklets from one physical disk to another.
pd_movetospare	Move used chunklets from a physical disk to spare space.
pd_set	Set physical disk properties.
pd_upgrade	Update physical disk firmware.
port_check	Perform diagnostic tests on ports.
port_control	Control and configure ports.
qos_set	Set QoS configurations for a VVset.
rclink_check	Remote copy link validity checks.
rcopy_start	Start the remote copy service.
rcopy_stop	Stop the remote copy service.
rcopy_sync	Synchronize remote copy groups.
rcopygroup_create	Create a remote copy group.
rcopygroup_remove	Remove a remote copy group.
rcopygroup_set	Set remote copy group properties.
rcopygroup_start	Start remote copy group.
rcopygroup_stop	Stop a remote copy group.
rcopylink_admit	Add remote copy links.
rcopylink_dismiss	Dismiss remote copy links.
rcopytarget_admit	Add a target to a remote copy volume.
rcopytarget_create	Create a remote copy target.
rcopytarget_dismiss	Dismiss a remote copy target from a group.
rcopytarget_remove	Remove a remote copy target.
rcopytarget_set	Set remote copy target properties.
rcopyvv_admit	Add a volume to a remote copy volume group.
rcopyvv_dismiss	Dismiss a virtual volume from a remote copy group.
reg_move	Move virtual volume regions between LDs.
sched_create	Create a schedule for tasks.
sched_remove	Remove a schedule for tasks.
sched_setany	Set any user scheduled task properties.
sched_setown	Set a user's own scheduled task properties.
fs_set	Update Global file services Settings.

Table 26 Super Rights *(continued)*

Right	Description of Right
snapspace_update	Update snapshot space accounting information.
snmpmgr_add	Add an SNMP manager.
snmpmgr_remove	Remove an SNMP manager.
snmppw_remove	Remove an SNMP community strings.
snmppw_set	Set SNMP community strings.
spare_create	Create spare chunklet.
sshbanner_set	Set the login screen banner for SSH users.
sshkey_remove	Remove users public SSH keys.
sshkey_set	Set the public SSH key for a user.
sv_create	Create a virtual copy volume.
sv_promote	Promote a virtual copy volume.
sv_remove	Remove virtual copy of a volume.
sv_set	Set properties of a virtual copy of a volume.
sys_locate	Locate a system by blinking its LEDs.
sys_set	Set System Properties.
sys_shutdown	Shutdown the system.
task_cancel	Cancel a task.
task_remove	Remove a task.
task_set	Edit tasks.
task_start	Run commands in the background.
template_create	Create a template for a VV, CPG, or LD.
template_remove	Remove template for a VV, CPG, or LD.
template_set	Set template properties.
user_create	Create a user.
user_remove	Remove a user.
user_setany	Set any user properties.
user_setown	Set a user's own properties.
useracl_set	Set user Access Control List properties.
userconn_remove	Remove user connections.
vfs_create	Create a Virtual File Server.
vfs_remove	Remove a Virtual File Server.
vfs_set	Modify a Vitual File Server.
vlun_create	Export a virtual volume as a SCSI LUN.
vlun_remove	Remove a VLUN.
vv_admit	Admit remote virtual volume to the system.
vv_check	Virtual volume validity checks.

Table 26 Super Rights *(continued)*

Right	Description of Right
vv_create	Create a Virtual Volume.
vv_grow	Grow a virtual volume.
vv_import	Import a remote virtual volume to local storage.
vv_remove	Remove a base Virtual Volume.
vv_set	Set virtual volume properties.
vv_start	Start a virtual volume.
vv_tune	Tune a virtual volume.
vv_update	Remove old virtual copy and create a new virtual copy of a volume.
vvcopy_create	Create physical copy volume.
vvcopy_promote	Promote a physical volume back to its base volume.
vvcopy_remove	Remove physical copy of a volume.
vvcopy_set	Set properties of a physical copy of a volume.
vvset_annotate	Annotate the comment of a virtual volume set.
vvset_create	Create a virtual volume set.
vvset_set	Set virtual volume set properties.
wsapi_start	Start the Web Services API server.
wsapi_stop	Stop the Web Services API server.

B Mapping Rights and CLI Commands

Mapping Rights and CLI Commands

Table 27 Required Rights for CLI Commands

Right	CLI Commands
alert_remove	removealert
alert_set	setalert
aocfg_start	startao
authparam_set	setauthparam
battery_set	setbattery
cage_locate	locatecage
cage_set	setcage
cage_upgrade	upgradecage
ch_move	movech
ch_movetospare	movechtospare
cim_set	setcim
cim_start	startcim
cpg_compact	compactcpg
cpg_create	createcpg
cpg_set	setcpg
date_set	setdate
domain_create	createdomain
domain_moveto	movetodomain
domain_remove	removedomain
domain_set	setdomain
domainset_annotate	setdomainset
domainset_create	createdomainset
domainset_set	setdomainset removedomainset
encryption_control	controlencryption
encryption_status	controlencryption (status subcommand)
flashcache_create	createflashcache
flashcache_remove	removeflashcache
flashcache_set	setflashcache
fpg_create	createfpg
fpg_remove	removefpg
fpg_set	setfpg
fs_grow	growfpg

Table 27 Required Rights for CLI Commands *(continued)*

Right	CLI Commands
fsav_set	setfsav
fsav_start	startfsav
fsav_stop	stopfsav
fsconf_backup	backupfsconf
fsconf_restore	restorefsconf
fsgroup_create	createfsgroup
fsgroup_remove	removefsgroup
fsgroup_set	setfpg
fshare_create	createfshare
fshare_remove	removefshare
fshare_set	setfshare
fsip_create	createfsip
fsip_remove	removefsip
fsip_set	setfsip
fsnap_create	createfsnap
fsnap_remove	removefsnap
fsquota_set	setfsquota
fstore_create	createfstore
fstore_get	showfstore
fstore_remove	removefstore
fstore_set	setfstore
fsuser_create	createfsuser
fsuser_set	setfsuser
fsuser_remove	removefsuser
groupsv_create	creategroupsv
groupvvcopy_create	creategroupvvcopy
health_check	checkhealth
host_create	createhost
host_remove	removehost
host_service	servicehost
host_set	sethost
hostset_annotate	sethostset
hostset_create	createhostset
hostset_set	sethostset, removehostset
ld_compact	compactld
ld_create	createald createld

Table 27 Required Rights for CLI Commands *(continued)*

Right	CLI Commands
ld_remove	removeld
ld_start	startld
mag_control	controlmag
mag_service	servicemag
node_locate	locatenode
node_service	servicenode
node_set	setnode
node_shutdown	shutdownnode
password_checkany	checkpassword
password_checkown	checkpassword
password_setany	setpassword
password_setown	setpassword
pd_admit	admitpd
pd_control	controlpd
pd_dismiss	dismisspd
pd_movereloc	moverelocpd
pd_movetospare	movepdtospare
pd_set	setpd
pd_upgrade	upgradepd
port_check	checkport
port_control	controliscsiport controlport
rclink_check	checkrclink
rcopy_start	startrcopy
rcopy_stop	stoprcopy
rcopy_sync	syncrcopy
rcopygroup_create	creatercopygroup
rcopygroup_remove	removercopygroup
rcopygroup_set	setrcopygroup
rcopygroup_start	startrcopygroup
rcopygroup_stop	stoprcopygroup
rcopylink_admit	admitrcopylink
rcopylink_dismiss	dismissrcopytarget
rcopytarget_admit	admitrcopytarget
rcopytarget_create	creatercopytarget
rcopytarget_dismiss	dismissrcopytarget
rcopytarget_remove	removercopytarget

Table 27 Required Rights for CLI Commands *(continued)*

Right	CLI Commands
rcopytarget_set	setrcopytarget
rcopyvv_admit	admitrcopyvv
rcopyvv_dismiss	dismissrcopyvv
reg_move	movereg
sched_create	createsched
sched_remove	removesched
sched_setany	setsched
sched_setown	setsched
fs_set	setfs
snapspace_update	updatesnapspace
snmpmgr_add	addsnmpmgr
snmpmgr_remove	removesnmpmgr
snmppw_remove	removesnmppw
snmppw_set	setsnmppw
spare_create	createspare
sshkey_remove	removesshkey
sshkey_set	setsshkey
sv_create	createsv
sv_promote	promotesv
sv_remove	removevv
sv_set	setvv
sys_locate	locatesys
sys_set	setsys
sys_shutdown	shutdownsys
task_cancel	canceltask
task_remove	removetask
task_set	settask
task_start	starttask
template_create	createtemplate
template_remove	removetemplate
template_set	settemplate
user_create	createuser
user_remove	removeuser
user_setany	setuser
user_setown	setuser
useracl_set	setuseracl

Table 27 Required Rights for CLI Commands *(continued)*

Right	CLI Commands
userconn_remove	removeuserconn
vasa_set	setvasa
vasa_start	startvasa stopvasa
vfs_create	createvfs
vfs_remove	removevfs
vfs_set	setvfs
vlun_create	createvlun
vlun_remove	removevlun
vv_admit	admitvv
vv_check	checkvv
vv_create	createaldvv createavv createtpvv createvv
vv_grow	growaldvv growavv growtpvv growvv
vv_import	importvv
vv_remove	removevv
vv_set	setvv
vv_start	startvv
vv_tune	tunealdvv tunevv tunetpvv
vv_update	updatevv
vvcopy_create	createvvcopy
vvcopy_promote	promotevvcopy
vvcopy_remove	removevv
vvcopy_set	setvv
vvset_annotate	setvvset
vvset_create	createvvset
vvset_set	setvvset removevvset
wsapi_start	startwsapi
wsapi_stop	stopwsapi

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