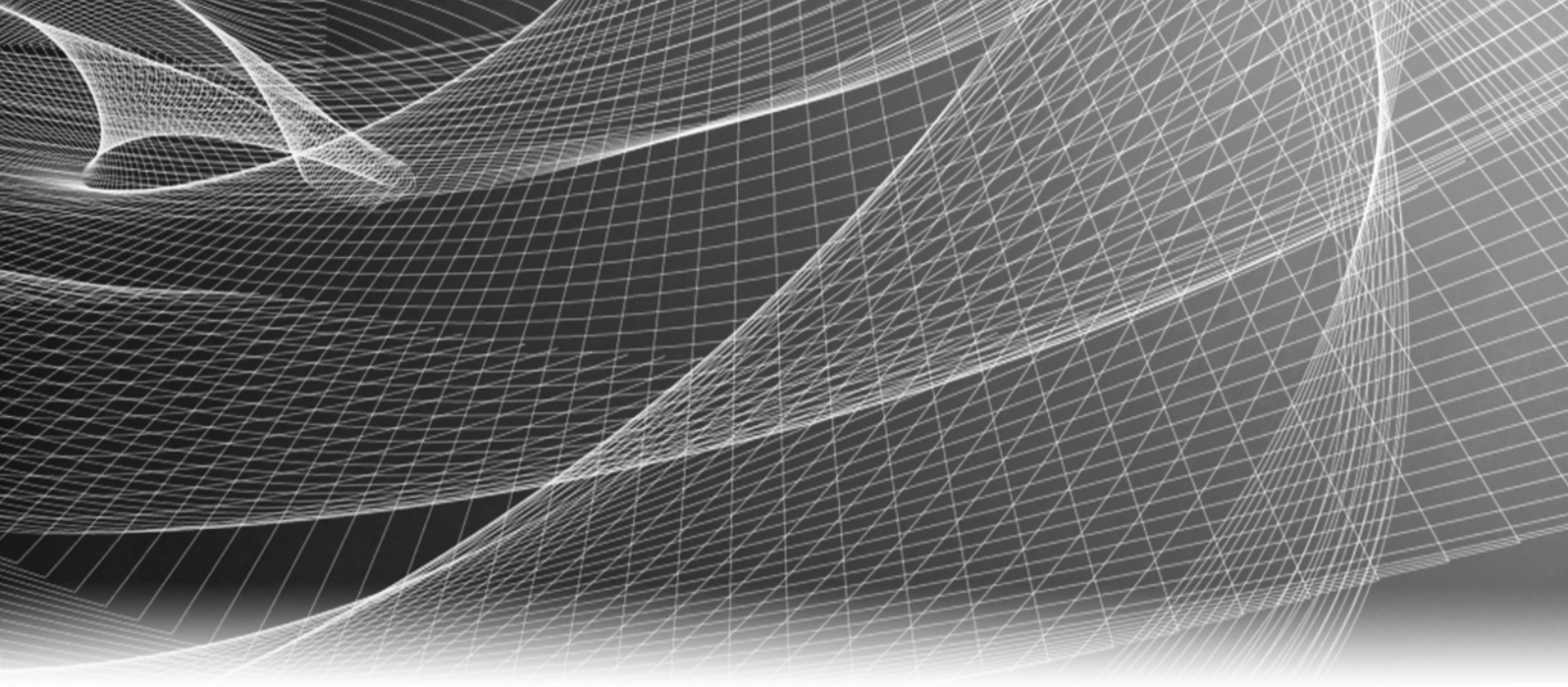

EMC® Solutions Enabler Symmetrix® Array Management CLI

Version 7.6

Product Guide

REV 03

EMC²

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PREFACE

As part of an effort to improve its product lines, EMC periodically releases revisions of its software and hardware. Therefore, some functions described in this document might not be supported by all versions of the software or hardware currently in use. The product release notes provide the most up-to-date information on product features.

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Note: This document was accurate at publication time. New versions of this document might be released on the EMC online support website. Check the EMC online support website to ensure that you are using the latest version of this document.

Purpose

This document describes how to configure and use EMC Solutions Enabler software.

Audience

This document is part of the Solutions Enabler documentation set, and is intended for use by advanced command-line users and script programmers to manage various types of control operations on Symmetrix arrays and devices using the SYMCLI commands of the EMC Solutions Enabler software.

Related documentation

Other Symmetrix publications of related interest are:

- *EMC Solutions Enabler Release Notes*
- *EMC Solutions Enabler Installation Guide*
- *EMC Symmetrix Security Configuration Guide*
- *EMC Solutions Enabler SYMCLI Command Reference Guide*
- *EMC Solutions Enabler Symmetrix Array Controls CLI Product Guide*
- *EMC Solutions Enabler Symmetrix SRM CLI Product Guide*
- *EMC Solutions Enabler Symmetrix SRDF Family CLI Product Guide*
- *EMC Solutions Enabler Symmetrix SRDF/Star CLI Product Guide*
- *EMC Solutions Enabler Symmetrix TimeFinder Family CLI Product Guide*
- *EMC Solutions Enabler Symmetrix Migration CLI Product Guide*
- *EMC Symmetrix Remote Data Facility Product Guide*
- *EMC Symmetrix Remote Data Facility for VMAX 10K Series Product Guide*
- *EMC Symmetrix TimeFinder Product Guide*
- *EMC Symmetrix TimeFinder for VMAX 10K Series Product Guide*
- *EMC host connectivity guides for [your operating system]*

For detailed interoperability information, please refer to E-Lab Interoperability Navigator, which can be reached at http://elabnavigator.EMC.com.

Conventions used in this document

EMC uses the following conventions for special notices:

⚠CAUTION

CAUTION, used with the safety alert symbol, indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

Note: A note presents information that is important, but not hazard-related.

IMPORTANT

An important notice contains information essential to software or hardware operation.

Typographical conventions

EMC uses the following type style conventions in this document:

Normal	Used in running (nonprocedural) text for: • Names of interface elements, such as names of windows, dialog boxes, buttons, fields, and menus • Names of resources, attributes, pools, Boolean expressions, buttons, DQL statements, keywords, clauses, environment variables, functions, and utilities • URLs, pathnames, filenames, directory names, computer names, links, groups, service keys, file systems, and notifications
Bold	Used in running (nonprocedural) text for names of commands, daemons, options, programs, processes, services, applications, utilities, kernels, notifications, system calls, and man pages Used in procedures for: • Names of interface elements, such as names of windows, dialog boxes, buttons, fields, and menus • What the user specifically selects, clicks, presses, or types
Italic	Used in all text (including procedures) for: • Full titles of publications referenced in text • Emphasis, for example, a new term • Variables
`Courier`	Used for: • System output, such as an error message or script • URLs, complete paths, filenames, prompts, and syntax when shown outside of running text
`Courier bold`	Used for specific user input, such as commands
`Courier italic`	Used in procedures for: • Variables on the command line • User input variables
‹ ›	Angle brackets enclose parameter or variable values supplied by the user
[ ]	Square brackets enclose optional values

|	Vertical bar indicates alternate selections — the bar means “or”
{ }	Braces enclose content that the user must specify, such as x or y or z
...	Ellipses indicate nonessential information omitted from the example

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CHAPTER 1
Introduction

This chapter provides an introduction to the Solutions Enabler Symmetrix command line interface (SYMCLI) used to manage your storage environment. The chapter describes terminology and the interface between the host and the Symmetrix systems.

- SYMCLI introduction 20
- SYMCLI usage tips 20

SYMCLI introduction

The EMC® Solutions Enabler SYMCLI is a specialized library consisting of commands that can be invoked on the command line, or within scripts. These commands can be used to monitor device configuration and status, and perform control operations on devices and data objects within your managed storage complex. The target storage environments are typically Symmetrix®-based as shown in Figure 1, though some features are supported for CLARiiON® arrays as well.

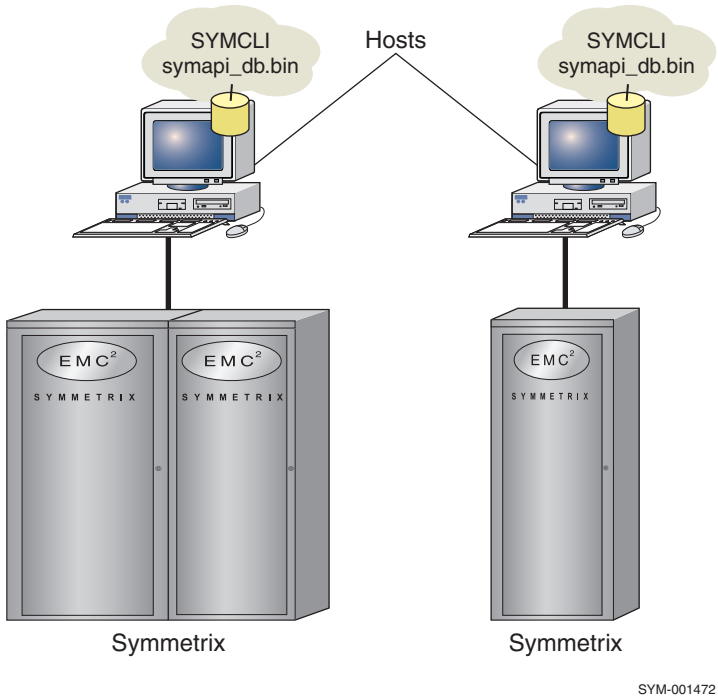

Figure 1 SYMCLI host/array interaction

SYMCLI resides on a host system to monitor and perform control operations on Symmetrix arrays. SYMCLI commands are invoked from the host operating system command line (shell). The SYMCLI commands are built on top of SYMAPI library functions, which use system calls that generate low-level I/O SCSI commands to the storage arrays.

To reduce the number of inquiries from the host to the storage arrays, configuration and status information is maintained in a Symmetrix host database file (called the Symmetrix configuration database; `symapi_db.bin` by default).

SYMCLI usage tips

This section describes some tips on obtaining help and streamlining your command line entries.

Obtaining SYMCLI help

SYMCLI provides multiple avenues to obtain help using the command set.

SYMCLI help command

Table 1 describes the various help options of the `symcli` command:

Table 1 SYMCLI help options

Command	Description
`symcli`	Provides the version number of the installed Symmetrix command line interface.
`symcli -h`	Describes how to use the SYMCLI command.
`symcli -v`	Displays the SYMCLI commands and a brief description of each command.
`symcli -env`	Displays a list of the environment variables that can be set for a SYMCLI session.
`symcli -def`	Displays a list of the environment variables that are set for the current SYMCLI session.

Command help

Command line help is available for each SYMCLI command. For example, to display command line help for the `symcli` command, enter:

```
symcli -h
```

In addition, each command has its own viewable man page for quick online reference purposes.

For example on UNIX, to view the man page for the `symcli` command, enter:

```
man symcli
```

Note: In a UNIX environment, you need to have the SYMCLI man page directory (`/usr/symcli/man/`) included in your MANPATH environment variable.

On Windows, the man pages are located, by default, in the following directory:

```
C:\Program Files\EMC\symcli\man
```

These man pages can be viewed in any text editor.

Referencing devices and objects

There are a number of different terms to identify and specify a Symmetrix device using the SYMCLI commands:

PdevName or `pd` — Indicates a physical (host) device name

SymDevName or `dev` — Indicates a Symmetrix device name

LdevName or `ld` — Indicates a logical device name

`-devs` — Indicates a range or list of devices

.

Environment variables: Altering the command line response

SYMCLI provides environment variables that can be preset to streamline and expedite your command line session. These environment variables can be set to commonly used values, which eliminates the need to specify those arguments on the command line.

To view a list of environment variables that can be set for a given SYMCLI session, enter:

```
symcli -env
```

To view the environment variables you currently have set, enter:

```
symcli -def
```

Note: The UNIX command examples shown in this section are C-shell based.

Enabling: setenv

To set an environment variable, use the command `setenv`. For example, to always display the output of BCV and SRDF® commands in detail, set the verbose mode, `-v` option when specified on the command line, as the default display behavior as follows:

```
setenv SYMCLI_VERBOSE 1
```

Disabling: unsetenv

To disable or turn off an environment variable, use the command `unsetenv`. You can turn off or remove any environment variable. For example, to turn off the verbose mode, enter:

```
unsetenv SYMCLI_VERBOSE
```

Call the command `symcli -env` or refer to the *EMC Solutions Enabler SYMCLI Command Reference* for a complete list of environment variables.

Presetting the names and IDs

To reduce repeated key strokes for a group of commands that require the same argument, you can preset the device group name or the Symmetrix ID to a specified default value. The following variables can be preset to a specified value for the same argument of a command set:

`SYMCLI_DG` — Defines the device group name for all `-g` arguments.

`SYMCLI_SID` — Defines the Symmetrix ID for all `-sid` arguments.

For example, to set the Symmetrix ID to `100200000567` for the next group of commands in a sequence, enter:

```
setenv SYMCLI_SID 100200000567
```

Setting group names to display full name

By default, If a composite group (CG) or storage group (SG) name is longer than 21 characters, or a device group (DG) name is longer than 17 characters, the displayed name is truncated in the command output for the `symcg`, `symdg`, and `symsg list` commands.

To control the output of group names and allow the full name to be displayed in the list command output, set the CLI environment variable to SYMCLI_FULL_NAME. For example, to set the Symmetrix ID to `100200000567` to display full group names for the `symcg`, `symdg`, and `symsg list` commands, enter:

```
setenv SYMCLI_FULL_NAME 100200000567
```

Note: To disable or turn off the full name environment variable, use the command `unsetenv`.

Time-saving command input tips

The following are examples of some time-saving tips:

- Actions can be shortened by typing three or more unique characters as follows:

  ```
  symcfg discover
  ```

  or:

  ```
  symcfg dis
  ```

- The last two or more digits of the Symmetrix Identifier (SID) can be used in place of the entire 12-digit SID as follows:

  ```
  symcfg -sid 000002304324 sync
  ```

  or:

  ```
  symcfg -sid 24 sync
  ```

- Actions, keywords, and options are case-insensitive as follows:

  ```
  symcfg LIST
  ```

  or:

  ```
  symcfg list
  ```

Physical device names can be abbreviated as follows:

```
sympd show /dev/rdsk/c2t1d1s2
```

or:

```
sympd show c2t1d1s2
```

Truncated output

In some cases, the output data from SYMCLI list commands may exceed the available column width. In these cases the returned data is truncated and appended with an asterisk (*). To view the full data, use the `show` command or verbose option, when available.

Compatibility mode: Preserving old Solutions Enabler scripts

If you have specialized scripts that were developed against a prior version of Solutions Enabler and you are concerned that they will not work because of output changes in the latest release, you can run your commands or scripts in compatibility mode. Compatibility mode specifies the command output reporting style to be compatible with prior SYMCLI versions.

Note: While running older scripts in compatibility mode, you may not return output that is only available in later releases.

You can set your compatibility mode as a global environment variable using `setenv SYMCLI_MODE` or at the command line using the `-mode` option on any command. This specifies the command output reporting style to be compatible with prior SYMCLI versions. Possible values are V72, V73, V74, V75 and V76.

For example, to set the compatibility mode to Solutions Enabler V7.3, enter the following on the command line:

```
symcfg list -mode V73
```

Note: Attempts to specify a compatibility mode earlier than V7.2 fails with an Invalid mode error. For example:

```
symauth -sid 111 -mode V71
'V71': Invalid mode specified.
```

Solutions Enabler V7.6 compatibility restrictions

Version 7.6 of Solutions Enabler has restrictions limiting the interoperability / compatibility with older versions of Solutions Enabler. The following restrictions are enforced in this release:

- Database files that were originally written by SE versions earlier than V7.2 will not be read.
- CLI compatibility mode (`-mode XX`) only extends back as far as the V7.2 release.
- Client connections to Servers older than V7.6 are rejected.
- Server connections from later than V7.6 clients or earlier than V7.2 clients are rejected.
- Attempts to open a database file written by a version prior to V7.2 fails with the following error code:

  ```
  SYMAPI_C_DB_VERSION_TOO_OLD

  The SYMAPI database file cannot be used because it was written by a
  version of SYMAPI that is no longer supported.
  ```

Client/Server mode connections

The following client/server error codes are returned for the described client/server mode connections:

- SYMAPI server connections from clients earlier than Solutions Enabler V7.2 are rejected with the error code: `SYMAPI_C_NET_VERSION_TOO_OLD`

  The remote connection is refused, as the client SYMAPI version is not supported by the server.

- SYMAPI server connections from clients with a Solutions Enabler version later than V7.6 are rejected with error code: `SYMAPI_C_NET_VERSION_TOO_NEW`

  The remote connection is refused, as the client cannot have a newer SYMAPI version than the server.

- When comparing the versions of client and server, only the major and minor numbers are compared (for example: 7.3, 7.2). The edit and patch levels are ignored.

CHAPTER 2
Discovery

This chapter describes the SYMCLI discovery process.

- Discovering configuration and status data 28
- Synchronizing configuration updates with the database 31
- SYMAPI configuration database file 32

Discovering configuration and status data

This chapter describes the process for retrieving array and device-level configuration and status information from the Symmetrix or CLARiiON environment known as *discovery*. Discovered configuration and status data for all arrays, as well as their directors and devices, is maintained in a configuration database file on each host. Once your environment is discovered, you can direct information requests to retrieve array-level (high-level) data or device-level (low-level) information from the storage environment using SYMCLI commands.

Performing discovery

During your first command line session, or if a configuration change has occurred, the configuration database must be built, or rebuilt, with the most complete and current information for all physical devices connected to your host. The following are the discovery syntax options:

```
symcfg

   discover [-all | -symmetrix | -clariion |
     -pdev [-sid SymmID] | -sid SymmID]
           [-cache | -nocache]
```

To scan the hardware and rebuild the database, enter:

```
symcfg discover
```

This command scans all SCSI buses, collects information about all the arrays and devices found, and rebuilds the database with the collected device information and parameters from all local and remotely attached devices. You can limit the discovery to just Symmetrix arrays by specifying the `-symmetrix` option, locally attached CLARiiON arrays by specifying the `-clariion` option, only physical device information by specifying the `-pdev` option, or a specific Symmetrix array by specifying the `-sid` option (this option can also be used with the `-pdev` option to return only physical device information for a specific array). For more information about the Symmetrix configuration database, refer to "SYMAPI configuration database file" on page 32.

CLARiiON-assisted discovery

To discover CLARiiON arrays, Solutions Enabler requires authorization to access the targeted arrays and the hostname or IP address of the storage processors — SPA and SPB.

To discover all CLARiiON arrays, local or remote, you first need to create a connectivity authorization for the targeted arrays. For more information, refer to "Connectivity authorization" on page 30.

Once you have established authorization via the `symcfg authorization` command, you can use the CLARiiON assisted discovery command to discover both local and remote CLARiiON arrays using the following command line:

```
symcfg discover -clariion -file AsstDiscoFile
```

where *`AsstDiscoFile`* is the fully-qualified pathname of a user created file containing the host name or IP address for each SPA and SPB of each targeted CLARiiON array, one array per line, as shown in the following example:

```
losat246     losat247
EngDev101    EngDev112
```

Note: `symcfg discover` scans all SCSI buses on the host, not just those connected to Symmetrix arrays. This can take a significant amount of time to complete (refer to the post-installation section of the *EMC Solutions Enabler Installation Guide* for information on configuring base daemon caching options to improve performance). Only use `symcfg discover` if you have added or removed devices seen by the host. Also, if you had previously run `discover` and had subsequently removed one or more array(s), a later execution of `discover` will not remove information from the database relating to the removed Symmetrix array(s).

Synchronizing the database

Use the `symcfg verify` command to determine if the host configuration database file is synchronized with the current configuration of a specific Symmetrix array. If they are out of sync, the verify action returns code 24 (`CLI_C_NOT_IN_SYNC`). If they are in sync, the verify action returns code zero (the `CLI_C_SUCCESS` value) as shown below using the `echo $status` command.

```
symcfg verify -sid 814

The Symmetrix configuration and the database file are in sync.

echo $status
0
```

In addition, the `symcfg list -status` command provides a list of all arrays connected to your host, whether the configuration has changed, and if the array was discovered during the last discovery operation. The following is an example output:

```
symcfg list -status

                              S Y M M E T R I X

                                          Mcode
    SymmID        Attachment  Model       Version  Config Changed  Discovered

    000192600305  Local       VMAX        5875     Yes             Yes
    000192600321  Local       VMAX        5875     Yes             Yes
    000192600198  Remote      VMAX        5875     Yes             Yes
    000192600256  Remote      VMAX        5875     Yes             Yes
    000192600282  Remote      VMAX        5875     No              Yes
    000192600284  Remote      VMAX        5875     No              Yes
```

Scanning for new devices

When new devices are mapped to a host on nodes that have not yet been created, those nodes must exist before discover can find the devices along their path. A `symcfg scan` command searches your environment for devices accessible to a given host, creating the nodes for the new or changed devices, and activating the necessary processing on the host system to recreate a list of accessible devices. It should be followed by a `symcfg discover -symmetrix`, if the changes are associated with Symmetrix devices.

Connectivity authorization

Some arrays, such as CLARiiON arrays, require authorization information to provide access to the array. The `symcfg authorization` command can be used to supply this information for use in subsequent discovery operations. The `symcfg authorization` command allows you to list, add, update, or delete this connectivity information. The `update` action allows you to update the password of an existing entry. Use the following syntax:

```
symcfg

       authorization list [-hyperv] [-v]

        authorization add | update -host HostName
           -username UserName -password PassWord
           [-namespace NameSpace] [-ahost HostName]
           [<-vmport | -port> port] [-vmware]

        authorization add | update -host HostName
           -username UserName -password PassWord
           [-hyperv]

        authorization delete -host HostName
            -username UserName
           [-namespace NameSpace] [-vmware]
```

Note: Users added for CLARiiON arrays must exist in the CLARiiON Navisphere domain.

VMware virtual disk mapping support

Solutions Enabler can now resolve all virtual disks that have only one Symmetrix device in the VMware datastore (supported with ESX 3.5 and higher). To use VMware virtual disk mapping, credentials must be configured using the following `symcfg auth` command. For example, enter:

```
symcfg auth add -host HostName -username root -password PassWord
-namespace -vmware
```

In addition, copy the SSL certificate from the server (for example, `/etc/vmware/ssl/rui.crt`) to the VM OS as `/var/symapi/config/viclient_cert.pem`.

When virtual disk mapping is configured, the `syminq` command returns the virtual disk information:

```
./syminq

      Device              Product                   Device
---------------- --------------------------- ---------------------
Name       Type  Vendor    ID           Rev  Ser Num      Cap (KB)
---------------- --------------------------- ---------------------
/dev/sda         VMware    Virtual disk 1.0  N/A          20971520
/dev/sdb         DGC       DISK         0326 0100003C      1048576
/dev/sdc         VMware    Virtual disk 1.0  N/A           8388608
/dev/sdd         EMC       SYMMETRIX    5773 8600022000      92160
/dev/sde         VMware    Virtual disk 1.0  N/A           8388608
/dev/dm-0        VMware    Virtual disk 1.0  N/A           8388608
```

Note: An expected capacity difference is visible between the output of `syminq` and `sympd list`. When creating the virtual disk, it can use all the space or less space than the Symmetrix device; so the `syminq` output may show smaller capacity than what `sympd` shows. In some cases, `syminq` shows larger capacity than `sympd`, because the VMware datastore (or virtual disk) can have multiple Symmetrix devices.

The `sympd` displays virtual disks as Symmetrix devices. The example below shows an output of the `sympd list`:

```
sympd list

Symmetrix ID: 000190300186
Device Name           Directors                  Device
   ---------------------------------------------------------------------------
   Cap
Physical                Sym  SA :P DA :IT  Config        Attribute    Sts   (MB)
-------------------------- ------------- ------------------------------------
/dev/sdd                0022 16C:0 01A:C6  2-Way Mir     N/Grp'd  VCM RW      90
/dev/sde                0085 16C:0 02B:D5  2-Way Mir     N/Grp'd      RW    8631
```

Synchronizing configuration updates with the database

Once a discovery operation has occurred, configuration data in the host configuration database file can be synchronized with the storage environment, which is less performance-intensive than a full discover operation.

A *sync* operation interrogates just the known arrays (previously discovered) that are accessible from the host, and updates the configuration and status information in the configuration database file. In addition, this synchronization can be limited to a specific array or array type, where a configuration change may have occurred.

Sync operations

A sync operation only updates state, mode, and configuration information (if a configuration change has occurred). It does not update statistical information. Refer to Chapter 8, “Statistics,” for information about obtaining Symmetrix performance statistics.

The `sync` option updates data for all known entities in the configuration database file, but does not scan for SCSI devices on the host. That means that any newly configured physical devices will not be added to the database during a sync operation.

Synchronizing data is an array-specific operation. Both Symmetrix and CLARiiON arrays use different options to limit the scope to a specific data set.

Table 2 Database synchronization options

Array	Command and options	Description

Symmetrix	`symcfg sync`
	`[-sid SymmID]`
	
	`[-rdf|`
	`-bcv|`
	`-local|`
	`-dirsts|`
	`-snap|`
	`-cfgmgr|`
	`-rcopy|`
	`-env_data|`
	`-fast|`
	`-tier|`
	`-sg|`
	`-vpdata]`
		Performs a basic sync of all known Symmetrix entities.
		Limits the scope to the entities of a specified Symmetrix array.
		Options limit the scope to one of the following:
		SRDF information
		BCV information
		Local Symmetrix array information
		Director status information
		TimeFinder/Snap information
		Disk space and Symmetrix configuration metrics
		R-Copy information
		Environmental data
		Fully-Automated Storage Tiering (FAST) information
		Symmetrix array tier definition information
		Storage group information
		Virtual Provisioning data

CLARiiON	`symcfg -clariion sync` `[-cid ClarID]`	Performs a basic sync of all known CLARiiON entities. Limits the scope to the entities of a specified CLARiiON array.

SYMAPI configuration database file

A SYMAPI configuration database (`.bin`) file, which is stored on the host system, contains the physical configuration information of SCSI devices and Symmetrix parameters that define your entire storage complex. More than one configuration database file may be required to support your operational needs.

The SYMAPI configuration database is sometimes referred to as the host configuration database, SYMAPI database (because of how the file is named), or the Symmetrix database file. All of these names are referring to the same configuration database file, `symapi_db.bin`, described next.

Note: For information about discovering your storage environment and building your Symmetrix configuration database, refer to "Discovering configuration and status data" on page 28.

Database file location

On UNIX, the default pathname for the configuration database file is:

```
/var/symapi/db/symapi_db.bin
```

On Windows, the default configuration database path is:

```
C:\Program Files\EMC\SYMAPI\db\symapi_db.bin
```

On OpenVMS, the default configuration database path is:

```
SYMAPI$DB:symapi_db.bin
```

You can create an additional configuration database (`.bin`) file to meet your requirements.

Note: In a multi-database environment, carefully verify that you are operating on the correct database. Always confirm the current database before applying a command. For safe command line environments, it is recommended that you use the common (default) database.

Database file lock

Solutions Enabler V7.1 and higher utilizes a configuration database locking file. The lock file is created automatically and is given has the same name as the configuration database file, but it is appended with an *_xlock* suffix. For example, `symapi_db.bin_xlock`.

Solutions Enabler uses this lock file to serialize access to the configuration database file. It contains no data and is only used as a lock.

If you protect the `symapi_db.bin` file to restrict the users permitted to perform Solutions Enabler management operations, this lock file should be protected as well. Both `symapi_db.bin` and `symapi_db.bin_xlock` should be given the same level of protection.

Changing the current database file

To check which Symmetrix configuration database file is being used, enter:

```
symcli -def
```

To change the current Symmetrix configuration database file, you need to modify the environment variable SYMCLI_DB_FILE.

For example, to change the database file to `symbackup_db.bin` from a UNIX host in C shell (csh), enter:

```
setenv SYMCLI_DB_FILE /var/symapi/db/symbackup_db.bin
```

To perform the same operation on Windows, enter:

```
set SYMCLI_DB_FILE=C:\Program Files\EMC\Symapi\db\symbackup_db.bin
```

Changing the database in client/server mode

For security reasons, in client/server mode the configuration database file must be located within the default database directory.

On UNIX, the default pathname for the configuration database file is:

```
/var/symapi/db
```

On Windows, the default configuration database path is:

```
C:\Program Files\EMC\Symapi\db
```

Access modes

The SYMCLI commands utilize different modes to access the Symmetrix configuration database file:

read/write — Commands that control and/or modify database parameters, read the database file into memory, and provide simultaneous modification of both the in-memory database and the database file. During this access cycle, the database file is locked.

read/no write — Commands that list or show database parameters, read the database file into memory and allow modifications to the in-memory database. No modifications to the database file occur. During the access cycle, the database file is not locked.

Command modes: Online and offline

SYMCLI commands can either run in online or offline mode. Commands that execute in online mode, such as configuration control operations, automatically attempt to gather the latest state and mode information from the arrays, and update the in-memory database and configuration database file on the host. In the event a configuration change has occurred, commands that execute in online mode will attempt to discover the changed entity to retrieve and load any updated configuration information.

Commands that can execute in offline mode, such as `symcfg list`, retrieve data exclusively from the configuration database.

Inhibiting database synchronization

You can force some commands to operate in offline mode using the environment variable SYMCLI_OFFLINE, which inhibits accessing the Symmetrix array to update the database.

For example, to globally force these commands to their offline mode (`-offline` option) from a UNIX host in C shell (csh), enter:

```
setenv SYMCLI_OFFLINE 1
```

Note: You may need to refresh the database if you execute commands while offline mode is enabled or execute commands that normally run in the offline mode, such as `symcfg list`. Most display commands can be run in the offline mode, which provides the fastest response, and does not require access to the Symmetrix array.

Database configuration information

The `symcfg -db` command, returns basic configuration information about the current database in use. The following example may not match the values present in your configuration:

```
symcfg -db

  Type of SYMAPI Database                          : Full
  Host Node Name which discovered the DB           : api99
  Host OS Type which discovered the DB             : AIX

  Version of SYMAPI Library which discovered the DB : 7.2.X.X (Edit Level: 1102)
  Version of SYMAPI Library which wrote the DB      : 7.2.X.X (Edit Level: 1102)
  Min Edit Level of SYMAPI Lib Reqd to Read the DB  : 1101

  Time Database Was Last Synchronized              : Thu Oct 21 09:04:06 2010
  Time Any Device Group Was Last Modified          : Thu Oct 21 13:52:03 2010

  GNS State                                        : Enabled
```

Note: The above output includes the minimum edit level of the SYMAPI library required to read the database. Any SYMAPI library with this version or higher and edit level or higher can read the current database.

CHAPTER 3
Configuration Data

This chapter describes how to use the SYMCLI to collect and display configuration data about arrays, Symmetrix devices, CLARiiON devices, disks, and virtual environments.

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Configuration data: Layer by layer

Solutions Enabler SYMCLI allows you to gather and display various levels of information about your storage environment. Each layer of your storage environment reveals a new, or slightly different, perspective on a given entity. For example, from the array perspective, information about a specific device is very limited. It would be included as part of the count of devices on the array and the devices addressing as mapped to a specific director could be obtained. Yet, by delving down to the device-level data — using SYMCLI to gather data from the device perspective — you can obtain much greater detail about the device itself, such as capacity, status, and mirrors. From this device view, the array layer becomes obscured as it reflects the relationship from the device's perspective, such as the associated array ID.

SYMCLI provides various commands that can be used to focus your queries on the following levels:

- SCSI-level — Data can be returned at the SCSI level, whereby the SYMCLI issues SCSI INQUIRY and SCSI READ CAPACITY to return low-level physical device data (such as vendor, configuration, and basic configuration) and host HBA information (such as vendor, model, firmware, and basic configuration).
- Array-level — Array queries allow you to return further detailed data about the configuration of one or all arrays. The data returned includes host relationship information (local or remote), cache size, and number of devices. Further details include vendor specific configuration information, ports, flags, adapters, Data at Rest Encryption data, pool information, and environment data.
- Device-level — As you go deeper into your storage array, you can gather more detailed information about the devices in a given array (or all arrays, either locally or remotely attached). Device-level data includes capacity, cache, emulation, configuration, group, and usage information that is critical to all other storage management operations.
- Disk-level — Returns detailed information about the raw disks from which your storage devices are derived, including detailed identification, vendor, and capacity.
- Virtual environment — Returns configuration information about a VMware or Microsoft Hyper-V environment, such as the type and capacity of their storage pools.

SCSI inquiries

The `syminq` command can be used to obtain SCSI disk device information using a SCSI INQUIRY command, and optionally SCSI READ CAPACITY command, on host HBAs and one or all locally attached physical devices.

You can limit the scope of an inquiry to Symmetrix, CLARiiON, StorageWorks, or HDS devices. When specifying a specific array, options can be specified to control what data is returned and its presentation as specified in the `syminq` manpage, which can be found in the *EMC Solutions Enabler SYMCLI Command Reference Guide.*

The `syminq` command can be used to list all of the HBAs on the local host. Using the options available, the scope of this request can be limited to list only the Fibre HBAs, SCSI HBAs, iSCSI HBAs, or HBAs derived from a SNIA API query. In the UNIX environment, if the SNIA libraries are unavailable, HBA information is obtained from the lost log files.

The returned results can also be limited to devices with target mapping information (only for devices mapped through fibre HBAs using the `-mapinfo` option or, for Symmetrix or CLARiiON devices, to devices given device identifiers by a user or application by using the `-identifier` option; identifiers are limited to `device_name`, `nice_name`, `hp_id`, and `vms_id`.

Note: Data returned from issuing any `syminq` command is not stored in the configuration database.

The returned data and output format is determined by the scope of options specified on the command line and the array information available. The following examples illustrate a few typical option combinations and an example of the possible output.

SCSI device information

The following is an example of a SCSI inquiry of all devices listed by physical device name:

syminq

```
      Device              Product                    Device
---------------- --------------------------- ---------------------
Name      Type   Vendor    ID           Rev  Ser Num      Cap (KB)
---------------- --------------------------- ---------------------
/dev/sda         MAXTOR    ATLAS10K4_3* DFL0 B2CS5FSM     35916548
/dev/sdb  GK     EMC       SYMMETRIX    5772 150009E020       5760
/dev/sdi  GK     EMC       SYMMETRIX    5772 15000A7020       5760
/dev/sdj  GK     EMC       SYMMETRIX    5772 15000A8020       5760
/dev/sdk  GK     EMC       SYMMETRIX    5772 15000A9020       5760
/dev/sdl  GK     EMC       SYMMETRIX    5772 15000AA020       5760
/dev/sdm  GK     EMC       SYMMETRIX    5772 15000AB020       5760
/dev/sdn  GK     EMC       SYMMETRIX    5874 0700022000       5760
/dev/sdo  GK     EMC       SYMMETRIX    5874 0700023000       5760
/dev/sdp  GK     EMC       SYMMETRIX    5874 0700024000       5760
/dev/sdq  GK     EMC       SYMMETRIX    5874 0700025000       5760
/dev/sdr  GK     EMC       SYMMETRIX    5874 0700026000       5760
/dev/sds  GK     EMC       SYMMETRIX    5874 0700027000       5760
/dev/sdt  R1     EMC       SYMMETRIX    5874 0700042000     919680
/dev/sdu  R1     EMC       SYMMETRIX    5874 0700043000     919680
/dev/sdv  R1     EMC       SYMMETRIX    5874 0700044000     919680
/dev/sdw  R1     EMC       SYMMETRIX    5874 0700045000     919680
/dev/sdx  R1     EMC       SYMMETRIX    5874 0700046000     919680
/dev/sdy  R1     EMC       SYMMETRIX    5874 0700047000     919680
/dev/sdz  R2     EMC       SYMMETRIX    5874 0700048000     919680
/dev/sdaa R2     EMC       SYMMETRIX    5874 0700049000     919680
/dev/sdch CKD    EMC       SYMMETRIX    5772 5500228000     934920
/dev/sdci CKD    EMC       SYMMETRIX    5772 5500229000     934920
/dev/sdcj CKD    EMC       SYMMETRIX    5772 550022A000     934920
```

Devices listed by array ID

The following is an example of a SCSI inquiry of Symmetrix devices listed by Symmetrix ID:

syminq -symmids

```
      Device          Symmetrix               Device
---------------- --------------------- ---------------------
Name      Type   ID                Rev  Ser Num      Cap (KB)
---------------- --------------------- ---------------------
/dev/sdb  GK     000190300215     5772 150009E020       5760
/dev/sdc  GK     000190300215     5772 150009F020       5760
/dev/sdd  GK     000190300215     5772 15000A2020       5760
/dev/sde  GK     000190300215     5772 15000A3020       5760
/dev/sdf  GK     000190300215     5772 15000A4020       5760
/dev/sdg  GK     000190300215     5772 15000A5020       5760
/dev/sdh  GK     000190300215     5772 15000A6020       5760
/dev/sdi  GK     000190300215     5772 15000A7020       5760
/dev/sdj  GK     000190300215     5772 15000A8020       5760
/dev/sdk  GK     000190300215     5772 15000A9020       5760
/dev/sdl  GK     000190300215     5772 15000AA020       5760
/dev/sdm  GK     000190300215     5772 15000AB020       5760
```

The following is an example of a SCSI inquiry of CLARiiON devices listed by CLARiiON ID:

syminq -cids

```
      Device                   Clariion              Device
------------------------- --------------------- ---------------------
        Name              ID                Rev  Ser Num      Cap (KB)
------------------------- --------------------- ---------------------

/dev/rdsk/c5t0d0s2        APM00034501433   0216 09000017      2097152
/dev/rdsk/c5t0d1s2        APM00034501433   0216 07000017      2097152
```

Devices without capacity

The following is an example of a SCSI inquiry of Symmetrix devices without issuing a SCSI READ CAPACITY:

syminq -symmids -nocap

```
Device           Symmetrix             Device
---------------- --------------------- ----------
Name      Type   ID                Rev  Ser Num
---------------- --------------------- ----------
/dev/sdv  BCV    000190300516     5771 1600028000
/dev/sdw  BCV    000190300516     5771 1600029000
/dev/sdx  BCV    000190300516     5771 160002A000
/dev/sdy  BCV    000190300516     5771 160002B000
/dev/sdz  BCV    000190300516     5771 160002C000
```

The following is an example of a SCSI inquiry of CLARiiON devices without issuing a SCSI READ CAPACITY:

syminq -cids -nocap

```
        Device                   Clariion          Device
------------------------- --------------------- ----------
        Name              ID                Rev  Ser Num
------------------------- --------------------- ----------

/dev/rdsk/c5t0d0s2        APM00034501433   0216 09000017
/dev/rdsk/c5t0d1s2        APM00034501433   0216 07000017
```

Devices with WWN

The following is an example of a SCSI inquiry of Symmetrix devices returning the WWN for each device:

```
syminq -sym -wwn

Device                                                Device
------------------------------ ---------------- --------------------------------
Name                        Num  Array ID         WWN
------------------------------ ---------------- --------------------------------
/dev/sdv                    0028 000190300516     60060480000190300516533030303238
/dev/sdw                    0029 000190300516     60060480000190300516533030303239
/dev/sdx                    002A 000190300516     60060480000190300516533030303241
/dev/sdy                    002B 000190300516     60060480000190300516533030303242
/dev/sdz                    002C 000190300516     60060480000190300516533030303243
```

Colon formatted WWN

The following is an example of how the `-colon` option can be used to return a list of devices with WWN for each device using colons as spacers:

```
syminq -sym -wwn -colon

Device                                                Device
------------------------------ ---------------- --------------------------------
Name                        Num  Array ID         WWN
------------------------------ ---------------- --------------------------------
/dev/sdv                    0028 000190300516     60:06:04:80:00:01:90:30:05:16:53:30:30:30:32:38
/dev/sdw                    0029 000190300516     60:06:04:80:00:01:90:30:05:16:53:30:30:30:32:39
/dev/sdx                    002A 000190300516     60:06:04:80:00:01:90:30:05:16:53:30:30:30:32:41
/dev/sdy                    002B 000190300516     60:06:04:80:00:01:90:30:05:16:53:30:30:30:32:42
/dev/sdz                    002C 000190300516     60:06:04:80:00:01:90:30:05:16:53:30:30:30:32:43
/dev/sdaa                   002D 000190300516     60:06:04:80:00:01:90:30:05:16:53:30:30:30:32:44
```

Pdevfile format

The following is an example of a SCSI inquiry of Symmetrix devices returning a list of device names in a format for use as `pdevfile`:

```
syminq -pdevfile

# Symm_id    pdev                dev dir  dir_port
000187900771 /dev/rdsk/c2t0d0s2 0017 15D  0
000187900771 /dev/rdsk/c2t0d1s2 0018 15D  0
000187900771 /dev/rdsk/c2t0d2s2 0019 15D  0
000187900771 /dev/rdsk/c2t0d3s2 001A 15D  0
```

HBA information

To obtain a list of all of the local host's HBAs, use the `syminq hba` command entry. You can filter the returned data by using one or a combination of available options, such as to list only the Fibre (`-fibre`), SCSI (`-scsi`), or iSCSI (`-iscsi`) HBAs. In addition, the `-snia` option allows you to return HBA information using the native SNIA SMI-S Provider rather than by issuing a SCSI inquiry. The returned data will be exactly the same as the data returned with a `-fibre` SCSI inquiry; the only difference is how the data was obtained.

Example: HBA inquiries

To obtain a list of the local host's HBAs, enter:

syminq hba

```
  Host Name : api171

  HBA Type            : FibreChannel
  HBA Name            : Emulex-LPe11002-E-1
  Vendor              : Emulex Corporation
  Model               : LPe11002-E
  Serial Number       : VM63487963
  Firmware Version    : 2.50A4 (Z2F2.50A4)
  Driver Version      : 8.1.10.3; HBAAPI(I) v2.1.d, 07-28-06
  Node WWN            : 0000000000000000
  Number of Ports     : 2

      Port WWN            : 10000000c9594dce
      Port name           : /sys/class/scsi_host/host1
      Port type           : NPort
      Port FCID           : 7434496
      Port speed          : 4gbit
      Supported speed     : 4gbit
      Port state          : Online
      Supported COS       : 00000008
      Supported FC4 types : 0000010000000001000000000000000000000000000000000000000000000000
      Active FC4 types    : 0000010000000001000000000000000000000000000000000000000000000000
      Max frame size      : 2048

      Port WWN            : 10000000c9594dcf
      Port name           : /sys/class/scsi_host/host2
      Port type           : Unknown
      Port FCID           : 0
      Port speed          : Unknown
      Supported speed     : 4gbit
      Port state          : LinkDown
      Supported COS       : 00000008
      Supported FC4 types : 0000010000000001000000000000000000000000000000000000000000000000
      Active FC4 types    : 0000010000000001000000000000000000000000000000000000000000000000
      Max frame size      : 2048
```

Note: HBA returned data will vary slightly when the `-scsi` or `-iscsi` option is specified.

Mapping information

The `syminq` command returns target mapping information when the `-mapinfo` option is specified. The following is the `syminq -mapinfo` syntax:

```
syminq -mapinfo[PdevName]
    [-sym[-powerpath]|-clariion[-powerpath]|-hds|-storworks]
    [-cache | -nocache][-colons][-winvol]
```

When the `syminq -mapinfo` command is called, the physical device name, HBA port WWN, and target port WWN is output for each host device. The following is an example of the `syminq -mapinfo` command output:

syminq -mapinfo

```
               Device                           Target Mapping
------------------------------------ ---------------------------------
Name                                 HBA Port WWN     Target Port WWN
------------------------------------ ---------------------------------

/dev/rdsk/c0t0d0s2                   N/A              N/A
/dev/rdsk/c1t1d0s2                   N/A              N/A
/dev/rdsk/c2t5000097208013558d0s2    210000e08b80a234 5000097208013558
/dev/rdsk/c2t5000097208013558d1s2    210000e08b80a234 5000097208013558
/dev/rdsk/c2t5000097208013558d2s2    210000e08b80a234 5000097208013558
/dev/rdsk/c2t5000097208013558d3s2    210000e08b80a234 5000097208013558
/dev/rdsk/c2t5000097208013558d4s2    210000e08b80a234 5000097208013558
/dev/rdsk/c2t5000097208013558d5s2    210000e08b80a234 5000097208013558
/dev/rdsk/c2t5000097208013558d6s2    210000e08b80a234 5000097208013558
/dev/rdsk/c2t5000097208013558d7s2    210000e08b80a234 5000097208013558
/dev/rdsk/c2t5000097208013558d8s2    210000e08b80a234 5000097208013558
/dev/rdsk/c2t5000097208013558d9s2    210000e08b80a234 5000097208013558
```

Device identifiers

To list the Symmetrix device identifiers assigned to devices by the user or other applications, use the `syminq -identifier` option and specify one of the four options: `device_name`, `nice_name`, `hp_id`, or `vms_id`.

Example: -identifier device_name

syminq -identifier device_name

```
      Device                                Device

--------------- ----------------------- ----------------

Name        Num Vendor         Array ID Name

--------------- ----------------------- ----------------

/dev/sdg   0020 EMC        000190300343 test device_name

/dev/sdh   002B EMC        000190300343 N/A

/dev/sdi   002C EMC        000190300343 N/A

/dev/sdj   002D EMC        000190300343 N/A
```

Example: -identifier nice_name

syminq -identifier nice_name

```
      Device                                Device

--------------- ----------------------- ----------------

Name        Num Vendor         Array ID Nice Name

--------------- ----------------------- ----------------

/dev/sdb  00200 DGC         HK192200881 LUN 200

/dev/sdc  00201 DGC         HK192200881 LUN 201

/dev/sdd  00202 DGC         HK192200881 LUN 202

/dev/sdg   0020 EMC        000190300343 0001903003430020
```

```
/dev/sdh   002B EMC        000190300343 000190300343002B

/dev/sdi   002C EMC        000190300343 000190300343002C

/dev/sdj   002D EMC        000190300343 000190300343002D
```

Example: -identifier hp_id

```
symiq -identifier hp_id

      Device                                  Device

--------------- ----------------------- ----------------

Name        Num Vendor         Array ID HP ID

--------------- ----------------------- ----------------

/dev/sdg   0020 EMC        000190300343 N/A

/dev/sdh   002B EMC        000190300343 test hp_id
```

Example: -identifier vms_id

```
symiq -identifier vms_id

     Device                                  Device

--------------- ----------------------- ----------------

Name        Num Vendor         Array ID VMS ID

--------------- ----------------------- ----------------


/dev/sdg   0020 EMC        000190300343 32

/dev/sdi   002C EMC        000190300343 44

/dev/sdj   002D EMC        000190300343 45
```

Storage array data

To query your storage environment configuration data, you must first identify the arrays in your storage environment. Each array has a serial number that is used to uniquely identify it. On Symmetrix arrays, it is called a Symmetrix ID (SID) and on CLARiiON arrays a CLARiiON ID (CID).

A storage array contains a complex set of data. The `symcfg` command provides arguments and options to use to pinpoint specific components and access the information you need. The storage array data includes the following:

- Storage arrays — A list of all arrays attached to the host and configuration details about them.
- Registered applications — Applications registered with SYMAPI that have accessed all, or a specific, Symmetrix array(s) to which your host is connected.

- Host connections — Detailed information about the hosts that have accessed a Symmetrix array, the host node name and the Symmetrix ID, director/port information, and array capacity.
- Director information — Configuration and status information about all directors of a given array including address, port, and status information. Details can be limited to a specific type of director.
- SELs (Symmetrix External Locks) and Semaphores — Status information on SELs (by number or type) and SYMAPI semaphores.
- Cache management — Information on the LRU cache, including the cache slots that each LRU occupies, and the percentage of the total cache utilized.
- Network services — A list of network services available to SYMAPI client applications.
- Environment data — Detailed information on the memory boards, and the array's environmental data, including fans and power supplies, can be obtained.
- CU Images — Information for mainframe users.
- Enginuity patches — A list of installed Enginuity™ operating environment for Symmetrix patches.
- Bay location descriptions — Information listing the bay names and location details of a Symmetrix array.
- Symmetrix Data at Rest Encryption — Information about hardware-based, on-array, back-end encryption for Symmetrix systems.

Listing Symmetrix arrays

Using SYMCLI, you can obtain a list of all the accessible Symmetrix arrays by SID or the accessible CLARiiON arrays by CID, including the model number and the number of accessible devices.

For Symmetrix arrays, you can use SYMCLI commands to obtain detailed configuration information about a specific Symmetrix array. This high-level information (such as the SID) can be used with subsequent commands to obtain configuration information for each of the directors and devices within an array.

To obtain a list of all Symmetrix IDs for the arrays connected to your host, with one entry for each Symmetrix array accessible from the host, enter:

```
symcfg list

                          S Y M M E T R I X

                                      Mcode    Cache      Num Phys  Num Symm
 SymmID        Attachment  Model      Version  Size (MB)  Devices   Devices

 000190100097  Local       DMX3-24    5771       98304        20     32088
 000000006206  Remote      2000P-M2   5671       32768         0      4139
 000187900035  Remote      800-M2     5671        8192         0      1314
 000187900041  Remote      800-M2     5671        8192         0       960
 000190300174  Remote      DMX3-6     5771       16384         0       335
 000190300175  Remote      DMX3-6     5771       16384         0       914
 000190300184  Remote      DMX3-6     5771       16384         0       417
```

To obtain a list of all CLARiiON IDs for the arrays connected to your host, with one entry for each CLARiiON array accessible from the host, enter:

```
symcfg list -clariion
```

When used with the `-v` option and a provided Symmetrix ID, the `symcfg list` command displays detailed information about a specific Symmetrix array.

```
symcfg list -v -sid 2300

Product Model                        : VMAX40K
         Symmetrix ID                         : 000195602300

    Microcode Version (Number)           : 5876 (16F40000)
    Microcode Registered Build           : 0
    Microcode Date                       : 10.16.2012

    Microcode Patch Date                 : 10.16.2012
    Microcode Patch Level                : 159

    Symmwin Version                      : 30
    Enginuity Build Version              : 5876.159.30
    Service Processor Time Offset        : - 00:00:02

    Cache Size (Mirrored)                :   18432 (MB)
    # of Available Cache Slots           :  253968
    Max # of System Write Pending Slots  :  152777
    Max # of DA Write Pending Slots      :       0
    Max # of Device Write Pending Slots  :    7638
    Max # of Replication Cache Slots     :   43174
    Replication Cache Usage (Percent)    :      10

        . . .
```

Note: For Enginuity releases prior to 5875, the Replication Cache Maximum is reported as N/A. For compatibility modes earlier than 7.6, the Replication Cache Maximum is not reported.

Listing Symmetrix bay locations

To list the bay names and location information of Symmetrix 166, enter:

```
symcfg list -bay_location -sid 166

Symmetrix ID               : 000192600166

    Bay Name     : SB-1
    Bay LED state: On
    Bay Location : This is the system bay located in the upper side of the B lab near
    the water cooler. Walk through the double glass doors and take a left turn at the
    air conditioning unit. The system bay has a yellow sticker marked VJX on it.

    Bay Name     : DB-1A
    Bay LED state: On
    Bay Location : Tile 88AD

    Bay Name     : DB-2A
    Bay LED state: On
    Bay Location : Near Pole21, floor 2, bld8F
```

The above information is only displayed if an EMC Customer Engineer has created it, and if the Symmetrix array is running Enginuity 5875 or higher.

Setting Symmetrix VMAX 10K and 40K LED door feature

For Enginuity 5876Q22013 SR and higher on Symmetrix VMAX® 10K and 40K arrays, the Symmetrix Identification Blinking Door LED feature can be activated and deactivated for a blinking state mode (`blue_flash` or `slow_blink`) simultaneously on all system bays using the `symcfg set` command. The `-led` option is used to indicate that the system or drive bay LED will be controlled. The `-bay_name` option specifies the system bay or drive bay for control of the LED.

The following syntax is used to set the LED by Symmetrix ID or bay name:

```
symcfg
    set -led [blue_flash | on] [-sid SymmID]

    set -led [slow_blink | on] [-bay_name Bay Name]
```

The bay name (`-bay_name Bay Name`) parameter must be specified as follows:

SB-x where x is a system bay drive

DB-xy where x is a drive bay index

where y is the bay side (A, B, C, or D)

If the `on` operand is specified and the `-bay_name` option is not specified, the command sets all system bay and drive bay LEDs to ON.

If the `blue_flash` operand is specified, the command sets all system bay LEDs to Blue flash state mode. Drive bay LEDs do not currently support Blue flash and will not be set to this mode when the `blue_flash` operand is specified.

Note: The `slow_blink` operand may be specified either as an abbreviation with a minimum of four characters, `slow` up to the complete `slow_blink`, provided that all supplied characters match. Also, the `blue_flash` operand may be specified either as an abbreviation with a minimum of four characters, `blue` up to the complete `blue_flash`, provided that all supplied characters match.

The following example command sets the LED mode to `blue_flash` for Symmetrix array 188:

```
symcfg set -led blue_flash -sid 188
```

If successful, this command displays:

```
LED state successfully changed.
```

If failed, this command displays a descriptive error message.

The following example command sets the LED mode to `slow_blink` for system bay 2 on Symmetrix array 188:

```
symcfg set -led slow_blink -bay_name SB-2 -sid 188
```

If successful, this command displays:

```
Bay SB-2 LED successfully set to slow blink.
```

If failed, this command displays a descriptive error message.

Note: Controlling the LED door feature requires Enginuity 5876 and higher, and a VMAX 10K or 40K array. This feature is not supported on VMAX 20K arrays.

Use the `symcfg list -v` command to display the LED state as a composite of all bays.

Listing Symmetrix bay LED states

Use the `symcfg list -bay_info` command to display a Symmetrix bay's LED state. The `-bay_info` option is equivalent to the `-bay_location` option, but is more descriptive of its functionality. In addition to Bay Name and Bay Location, a Bay LED State field has been added.

```
Bay Name     : DB-1A
Bay LED state: On
Bay Location :

Bay Name     : SB-1
Bay LED state: On
Bay Location :

Bay Name     : DB-1D
Bay LED state: On
Bay Location :
```

For a Symmetrix running Enginuity 5875 or above, the reported Bay LED states are: `BLUE_FLASH`, `FAST_BLINK`, `SLOW_BLINK`, `ON`, `OFF`, or `N/A`. The `symcfg list -v` output displays the LED state as a composite of all bays.

```
symcfg list -sid 341 -v
. . .
Maximum number of hypers per disk    :   512
Composite door LED status            : On
Number of Powerpath Devices          :   0
. . .
```

For a Symmetrix running Enginuity 5874 or below, the LED status displays N/A:

```
symcfg list -sid 237 -v
. . .
Maximum number of hypers per disk    :   512
Composite door LED status            : N/A
Number of Powerpath Devices          :   0
. . .
```

Note: The Composite door LED status display requires Enginuity 5875 or above. All other LED state display functionality requires Enginuity 5876 or above.

Monitoring Symmetrix Data at Rest Encryption

Symmetrix Data at Rest Encryption is an Enginuity 5875 feature for Symmetrix VMAX Series arrays.

Data at Rest Encryption provides hardware-based, on-array, back-end encryption for Symmetrix systems. Back-end encryption protects your information from unauthorized access when disk drives are removed from the system. Data Encryption provides encryption on the back end using Fibre Channel I/O modules that incorporate AES-XTS 256-bit data-at-rest encryption. These modules encrypt and decrypt data as it is being

written to or read from disk. All configured drives are encrypted, including data drives, spares, and drives with no provisioned volumes. In addition, all array disk data is encrypted, including Symmetrix File System and PowerVault contents.

Data at Rest Encryption supports either an internal embedded key manager, or RSA Data Protection Manager for external, enterprise-grade key management. For external key management, Data at Rest Encryption is qualified for interoperability with the RSA Key Manager Appliance version 2.7 SP1, and the RSA Data Protection Manager (DPM) version 3.1 (appliance).

Note: For more information refer to the *EMC Symmetrix VMAX 20K Series Product Guide* and the *EMC Symmetrix VMAX 40K Series Product Guide*.

By securing data on enterprise storage, Data Encryption ensures that the potential exposure of sensitive data on discarded, re-used, or stolen media is reduced or eliminated. As long as the key used to encrypt the data is secured, encrypted data cannot be read. In addition to protecting against threats related to physical removal of media, this also means that media can readily be repurposed by destroying the encryption key used for securing the data previously stored on that media. In this way, disk rotation, migration and upgrade are secured, without changes to operational procedures.

Data Encryption is compatible with all Symmetrix system features, allows for encryption of any supported local drive types or volume emulations, and delivers powerful encryption without performance degradation or disruption to existing applications or infrastructure.

Note: All key management is transparent to the storage administrator; no direct control of keys is allowed through Solutions Enabler. Encryption must be turned on by an EMC Customer Engineer during the installation of the Symmetrix array. There is no way to turn encryption on or off using Solutions Enabler.

Listing data encryption status

Solutions Enabler displays whether a Symmetrix array has encryption enabled. If encryption is enabled on the Symmetrix array, the `symcfg -v` display shows this information, as in the following example command and output:

```
symcfg list -sid 343 -v

Symmetrix ID: 000194900343
Time Zone   : Eastern Standard Time

    Product Model                       : VMAX
    Symmetrix ID                        : 000194900343
. . .
    3 Dynamic Mirrors                   : Enabled
    Cache Partitioning                  : Disabled
    IPSec Status                        : Pass Thru
    Allow spare in mirror 4 position    : Disabled
    Disks Service                       : Customer Replaceable
    Symmetrix Data Encryption           : Enabled
. . .
```

If encryption has not been turned on at install time, the `symcfg -v` command displays `Disabled` for the row displaying Symmetrix Data Encryption.

If encryption is not supported on the Symmetrix array, the `symcfg -v` command displays `N/A` for the row displaying Symmetrix Data Encryption.

Identifying key management events

The Symmetrix Enginuity generates entries in the Symmetrix Audit Log for every key management event. To view these events, use the following command, which lists the initial DEK configuration information:

```
symaudit list -text -sid 012 -function_class Security

             A U D I T   L O G   D A T A

Symmetrix ID            : *********012

  Record                       Function   Action    Activity
  Number   Date      Time      Class      Code      ID
  -------  --------  --------  ---------- -------   ----------------
            Text
            -----------------------------------------------------
        2  11/30/10  14:50:55  Security   Init      SW_Men_6829
            DARE Local Install.

        3  11/30/10  14:50:55  Security   Create    SW_Men_6829
            New KEK key generated. MUID:
   61A3770EDBEE3154463E15A5FA91006C6DA4F9C14C96653635962DE21F636125

        4  11/30/10  14:50:55  Security   Create    SW_Men_6829
           New DEK key generated. Drive WWN: 20000024b65d871b Location: DA07 A0:00
   MUID: 828547DA8EA4D623F674C1FE659329A0D8487308E7BC77979BABC8554ED9B7BF

        5  11/30/10  14:50:55  Security   Create    SW_Men_6829
           New DEK key generated. Drive WWN: 20000024b65d3606 Location: DA07 A0:02
   MUID: C0D587D1EEBC66196EFB63449E31281B50AB3F6B048440661334056FF18EFD4C

        6  11/30/10  14:50:55  Security   Create    SW_Men_6829
           New DEK key generated. Drive WWN: 20000024b65ddb94 Location: DA07 A0:04
   MUID: 2D518DC19DB2D6856DEC5064653EC59CE8FAEA36D11A2078ECA088589F62A647

        7  11/30/10  14:50:55  Security   Create    SW_Men_6829
           New DEK key generated. Drive WWN: 20000024b65d9bef Location: DA07 A0:06
   MUID: 3738B80DF56F65F3E1526E7F16A2721ACED2774A08A35A8B7ABF1442C665F2F1

        8  11/30/10  14:50:55  Security   Create    SW_Men_6829
           New DEK key generated. Drive WWN: 20000024b65ddb3c Location: DA07 A0:08
   MUID: 40932F670A3CF4B15909EA309D3A10E1CDD66ED4D5564F75BD75F96A9CA58040

        9  11/30/10  14:50:55  Security   Create    SW_Men_6829
           New DEK key generated. Drive WWN: 20000024b6864000 Location: DA07 A0:0A
   MUID: 99234F816501718AA87B29C525976DF7EE9351DC6CAD5756DB7347345F27E3BB

       10  11/30/10  14:50:55  Security   Create    SW_Men_6829
           New DEK key generated. Drive WWN: 20000024b64e634e Location: DA07 A0:10
   MUID: 0FC78B4ECA29D0ACD218A05E9A7CE8020EF8E1981CC14B0CB4E849C8A7180482
```

When a drive replacement results in the destruction of the Data Encryption Key for the original drive and the creation of a DEK for the new drive, these events are logged in the Symmetrix Audit Log. The following output lists this information:

symaudit list -text -function_class Security -sid 012

```
             A U D I T   L O G   D A T A

Symmetrix ID            : *********012

  Record                        Function   Action    Activity
  Number   Date      Time       Class      Code      ID
  -------  --------  --------   ---------- -------   ----------------
            Text
            -------------------------------------------------------
      135  11/30/10  10:15:58  Security   Modify    SW_Men_E757
            DEK key deactivated. Drive WWN: 20000024b654edce Location: DA08 C1:3E
   MUID: E0252F83955C803D03596CF3B3331CED715FA985A6F99E2F6EC0DF325A47458E

      136  11/30/10  10:15:59  Security   Delete    SW_Men_E757
            DEK key destroyed. Drive WWN: 20000024b654edce Location: DA08 C1:3E
   MUID: E0252F83955C803D03596CF3B3331CED715FA985A6F99E2F6EC0DF325A47458E

      142  11/30/10  10:17:49  Security   Create    SW_Men_E757
           New DEK key generated. Drive WWN: 20000024b65dd7ea Location: DA08 C1:3E
   MUID: 5EC4CF4E2B4D92C98A9FE9A8A19E527B090D95E75C305DAD21E98ED630C5A467
```

The following output lists audit log data about drives added to Symmetrix 32:

symaudit list -text -function_class Security -sid 032

```
             A U D I T   L O G   D A T A

Symmetrix ID            : *********032

  Record                        Function   Action    Activity
  Number   Date      Time       Class      Code      ID
  -------  --------  --------   ---------- -------   ----------------
            Text
            -------------------------------------------------------
     2700  11/30/10  15:11:15  Security   Create    SW_Men_7348
           New DEK key generated. Drive WWN: 2000001d385398ee Location: DA09 A0:06
   MUID: CD45BE05EA03273C78D75EFD58C3092839E218D57E2F5713A188E446EE1D6106

     2701  11/30/10  15:11:17  Security   Create    SW_Men_7348
           New DEK key generated. Drive WWN: 2000001d385529e3 Location: DA09 A1:05
   MUID: 69D7D3124001938A031E3CE39058C6D7F21876A0748F73DB33DBF6CE8E5EE137

     2702  11/30/10  15:11:17  Security   Create    SW_Men_7348
           New DEK key generated. Drive WWN: 2000001d3853aeb4 Location: DA10 A0:05
   MUID: 2C4722A89D473B9AAE70B5706C018B71E231913D76E32C8A8F786A4312FE19CE

     2703  11/30/10  15:11:16  Security   Create    SW_Men_7348
           New DEK key generated. Drive WWN: 2000001d3853a3a8 Location: DA10 A1:06
   MUID: 3FBAEA60781E6E4D1DF31DCD660FE6C6B1C8708FCF85E4B1FAC323DA10DC9207

     2704  11/30/10  15:11:16  Security   Create    SW_Men_7348
           New DEK key generated. Drive WWN: 2000001d3853a53e Location: DA09 B0:05
   MUID: 7518CC4B24D2238F8B93612672B7B6AD014DEDC8CC80FF232F2E06053A9F5CF9

     2705  11/30/10  15:11:17  Security   Create    SW_Men_7348
           New DEK key generated. Drive WWN: 2000001d3853632f Location: DA09 B1:06
   MUID: CFC4658191395836B45105FDD93A3A4CDB6849220164F4D86740E4E9E57A37B4

     2706  11/30/10  15:11:18  Security   Create    SW_Men_7348
           New DEK key generated. Drive WWN: 2000001d3853c06f Location: DA10 B0:06
   MUID: 4FE34F06EF936D115391D49CEDB01EC83396B074CF01001E4CB804D11ADD10E4

     2707  11/30/10  15:11:17  Security   Create    SW_Men_7348
```

```
        New DEK key generated. Drive WWN: 2000001d3853af15 Location: DA10 B1:05
MUID: 6700CBBEF94147353A9E8E63E6A2CC7A53C4116B9C2EB224EEDE49CD59D13610

  2708  11/30/10  15:11:18  Security   Create    SW_Men_7348
        New DEK key generated. Drive WWN: 2000001d3853a932 Location: DA09 C0:06
MUID: 001874E51C67A16734DC2936E0993178765A2DE5BE6DA3297797E7F7F63B0606

  2709  11/30/10  15:11:18  Security   Create    SW_Men_7348
        New DEK key generated. Drive WWN: 2000001d3853b1e9 Location: DA09 C1:05
MUID: 8FA8A2094CE7FDC793E5663C28CEE9E1021BF93445DAC484FE129B87357F931A

  2710  11/30/10  15:11:17  Security   Create    SW_Men_7348
        New DEK key generated. Drive WWN: 2000001d385396e4 Location: DA10 C0:05
MUID: C5DA6495303F86971DEC724D379E58E3E21A6205527C76A40A3BB553A78CCD3E

  2711  11/30/10  15:11:18  Security   Create    SW_Men_7348
        New DEK key generated. Drive WWN: 2000001d3853a4f5 Location: DA10 C1:06
MUID: 408C812499CA22A0C0375169EA84D456779C7615FAB08FCFA6049FF0F272CEDF
```

Viewing application registrations with Symmetrix access

You can view all the applications registered with SYMAPI that have accessed all, or a specific, Symmetrix array(s) to which your host is connected. For example, to list all the applications that have worked with Symmetrix array `282`, enter `-sid` *`SymmID`* (omit the `-sid` option in order to list connections for all arrays.

```
symcfg list -applications -sid 282

Symmetrix ID     : 000192600282

            Host                                Application
----------------------------  ------------------------------------------------
Node Name
 IP Address
                              ID               Vendor ID        Version   Attr
----------------------------  ---------------- ---------------- --------------

HK192600282
 0.0.0.1
                              OPTIMIZER        EMC Corp         9.1.0.56    -
                              SYMACCESS        EMC Corp         7.3.0.194   -
                              OPTIMIZER        EMC Corp         9.1.0.57    -
                              SMC              EMC Corp         7.3.12.9    -
                              EVTdaemon        EMC Corp         7.3.0.194   -
                              SMBASE           EMC Corp         7.3.12.9    -
                              SYMACCESS        EMC Corp         7.3.0.177   -
                              OPTIMIZER        EMC Corp         9.1.0.54    -
                              OPTIMIZER        EMC Corp         9.1.5.51    -
                              SMC              EMC Corp         7.3.11.8    -
                              EVTdaemon        EMC Corp         7.3.0.177   -
                              SMBASE           EMC Corp         7.3.11.8    -
                              EVTdaemon        EMC Corp         7.3.0.175   -
                              SYMLMF           EMC Corp         7.3.1202.0  -
                              SYMACCESS        EMC Corp         7.3.0.175   -
                              OPTIMIZER        EMC Corp         9.1.0.46    -

HK192604045
 0.0.0.1
                              OPTIMIZER        EMC Corp         9.1.4.35   (R)

api101
 10.247.80.101
                              SYMCFG           EMC Corp         7.3.0.234  (R)
                              SYMRDF           EMC Corp         7.3.0.230  (M)
                              SYMCG            EMC Corp         7.3.0.230  (M)
                              GNSdaemon        EMC Corp         7.3.0.230  (R)
                              SYMCFG           EMC Corp         7.3.0.230  (R)
                              SYMCG            EMC Corp         7.3.0.227  (M)
                              SYMRDF           EMC Corp         7.3.0.227  (M)
                              SYMCFG           EMC Corp         7.3.0.227  (R)
                              GNSdaemon        EMC Corp         7.3.0.227  (R)
                              GNSdaemon        EMC Corp         7.3.0.228  (R)
                              SYMCFG           EMC Corp         7.3.0.226  (R)
                              GNSdaemon        EMC Corp         7.3.0.224  (R)
                              SYMCFG           EMC Corp         7.3.0.224  (R)
                              SYMCFG           EMC Corp         7.3.0.193  (R)
                              SYMRDF           EMC Corp         7.3.0.189  (M)
                              SYMCFG           EMC Corp         7.3.0.189  (R)

Legend for Attribute(s):

(M) : Application Registered Remotely via RDF links (Multi-Hop).
(R) : Application Registered Remotely via RDF links (One-Hop).
```

Listing host connections to Symmetrix arrays

The `-connections` option of the `symcfg list` command returns the host connections to the array. Only hosts that have at least one registered application are listed. To view all the hosts that have accessed a Symmetrix array to which your host is connected, enter (omit the `-sid` value for all arrays):

```
symcfg list -connections -capacity -sid 097

    Host                Symmetrix                      Capacity (GB)
------------  --------------------------  -----------------------------------
Node Name     ID           Director Port  Mapped STDs Mapped BCVs Paired BCVs
------------  ------------ -------- ----  ----------- ----------- -----------

6I            000190100097 FA-3B     0          135.0        67.4         8.4
                                                ----------- ----------- -----------
6I totals:                                      130.8        54.8         8.4

LBQA0074      000190100097 FA-3B     0          135.0        67.4         8.4
                                                ----------- ----------- -----------
LBQA0074 totals:                                  0.0         0.0         0.0

api105        000190100097 FA-3A     0          134.9         0.0         0.0
                                                ----------- ----------- -----------
api105 totals:                                  134.9         0.0         0.0

api150        000190100097 FA-3A     0          134.9         0.0         0.0
                                                ----------- ----------- -----------
api150 totals:                                  134.9         0.0         0.0

api31         000190100097 FA-7A     0          404.6         0.0         0.0
                                                ----------- ----------- -----------
api31 totals:                                   404.6         0.0         0.0

lbqa0074      000190100097 FA-3B     0          135.0        67.4         8.4
                                                ----------- ----------- -----------
lbqa0074 totals:                                  0.0         0.0         0.0
```

In the previous example, the display of the host connections are sorted according to each Symmetrix array.

For IPv6 addresses or host names, which would appear truncated in the default display layout, specify the `-ipv6` option to display a layout that does not truncate node names or addresses.

To list all of the host connections (sorted by host names) of Symmetrix array 097, enter:

```
symcfg list -connections -sorthost -sid 097

Host                                  Symmetrix
-------------------------------------------------  --------------------------
Node Name    IP Address      OS Name  OS Revision  ID           Director Port
------------ --------------- -------- -----------  ------------ -------- ----

6I           172.23.195.65   WinNT    5.2.3790     000190100097 FA-3B     0

LBQA0074     172.23.195.74   WinNT    5.2.3790     000190100097 FA-3B     0

api105       172.23.192.105  SunOS    5.8          000190100097 FA-3A     0

api150       172.23.192.150  WinNT    5.2.3790     000190100097 FA-3A     0

api31        172.23.192.31   SunOS    5.8          000190100097 FA-7A     0
```

Listing director configuration data

SYMCLI can be used to gather information about the Symmetrix directors. The following director type options are available:

- `-DIR` — All types of directors
- `-CA` — Channel directors
- `-DA` — Disk directors
- `-DX` — External disk directors
- `-EA` — ESCON directors
- `-SE` — GIGE directors
- `-EF` — FICON (Fibre-ESCON) directors
- `-RA` — SRDF directors
- `-SA` — Front-end (SCSI, GIGE, or Fibre) directors
- `-FA` — Front-end (Fibre Channel) directors, including Fibre Channel over Ethernet (FCoE)

For example, to list configuration and status information about all directors on Symmetrix array 000190100097, enter:

```
symcfg -dir all list -sid 097

Symmetrix ID: 000190100097

          S Y M M E T R I X    D I R E C T O R S

    Ident  Symbolic  Numeric  Slot  Type          Status

    DA-1A     01A       1       1   DISK          Online
    DA-2A     02A       2       2   DISK          Online
    FA-3A     03A       3       3   FibreChannel  Online
    FA-4A     04A       4       4   FibreChannel  Online
    DA-5A     05A       5       5   DISK          Online
    DA-6A     06A       6       6   DISK          Online
    FA-7A     07A       7       7   FibreChannel  Online
    FA-10A    10A      10      10   FibreChannel  Online
    DA-11A    11A      11      11   DISK          Online
. . .
```

Note: Solutions Enabler V7.4 and Enginuity 5876, or higher allows the conversion of director emulation types from FA to RF and RF to FA in a switched SRDF environment using the `symconfigure convert` command. The `symcfg list` output can be used to verify new director types. Refer to the *EMC Solutions Enabler Symmetrix Array Controls CLI Product Guide* for detailed information on converting director emulation types.

You can use the `symcfg list` command to display verbose (-v) detailed information about directors on a Symmetrix array by providing the director and port number along with the Symmetrix ID. For example, to list detailed configuration and status information about director 7e and port 0 on Symmetrix array 000198700230, enter:

```
symcfg list -v -dir 7e -p 0 -sid 230

Symmetrix ID: 000198700230 (Local)
Time Zone   : EST

    Product Model                        : VMAX10K
    Symmetrix ID                         : 000198700230
      . . .
    Director Identification: FA-7E
```

```
        Director Type                      : FibreChannel (563)
        Director Status                    : Online
          . . .
        Director Port: 0

          WWN Node Name                    : 5000097300039800
          WWN Port Name                    : 5000097300039918
            . . .
          Fibre Specific Flags
            {
              Volume_Set_Addressing(V)     : Disabled
              Non_Participating(NP)        : Disabled
              Init_Point_to_Point(PP)      : Enabled
              Unique_WWN(UWN)              : Enabled
              Access_Logix(ACLX)           : Disabled
              OpenVMS(OVMS)                : Disabled
              AS400(AS4)                   : Disabled
              Auto_Negotiate(EAN)          : Enabled
              VNX_Gateway_Direct_Attach    : Enabled
            }
```

Note: For Fibre Specific Flags, the VNX_Gateway_Direct_Attach line only displays for Solutions Enabler V76 and higher.

You can use the `symcfg list` command to list configuration and status information for a specific director type. For example, to list information about all fibre channel (-FA) directors on Symmetrix array 000198700230, enter:

```
symcfg list -fa all -sid 230

Symmetrix ID: 000198700230 (Local)

          S Y M M E T R I X   F I B R E   D I R E C T O R S

    Dir    Port  WWN                Flags  Max
                                    AVPFG  Speed

    FA-7E   0    5000097300039918  ..X..      8
    FA-7E   1    5000097300039919  ..X..      8
    FA-8E   0    500009730003991C  ..X..      8
    FA-8E   1    500009730003991D  ..X.X      8
    FA-9E   0    5000097300039920  ..X..      8
    FA-9E   1    5000097300039921  ..X..      8
    FA-10E  0    5000097300039924  ..X..      8
    FA-10E  1    5000097300039925  ..X..      8
    FA-9F   0    5000097300039960  ..X..      8
    FA-9F   1    5000097300039961  ..X..      8

Legend:
  Flags:
      (A)CLX Enabled              : X = True, . = False
      (V)olume Set Addressing     : X = True, . = False
      (P)oint to Point            : X = True, . = False
      (F)COE Director             : X = True, . = False
     VNX (G)ateway Direct Attach  : X = True, . = False
```

Note: The VNX (G)ateway Direct Attach Flags column in the above Legend only displays for Solutions Enabler V7.6 and higher.

Note: The Max speed column presents an expression of the FA director port's maximum speed in Gb/second.

Director information by type

You can get configuration and status information about one or all directors of a certain type. For example, to get information about all the front-end directors (SA, SE, or FA) on Symmetrix 039, enter:

```
symcfg -sid 039 -sa all list

Symmetrix ID: 000187900039

          S Y M M E T R I X    D I R E C T O R S

    Ident  Symbolic  Numeric  Slot  Type          Status

    FA-2C     02C      34       2   FibreChannel  Online
    FA-15C    15C      47      15   FibreChannel  Online
    FA-16C    16C      48      16   FibreChannel  Online
    FA-2D     02D      50       2   FibreChannel  Online
    FA-15D    15D      63      15   FibreChannel  Online
    FA-16D    16D      64      16   FibreChannel  Online
```

The following `symcfg` example lists all external disk directors (-DX) for Symmetrix 306:

```
symcfg list -DX ALL -sid 306

Symmetrix ID: 000194900306

          S Y M M E T R I X    D I S K    D I R E C T O R S

                                          Num Of Serviced
    Ident  Symbolic  Numeric  Slot  Type    Hyper Volumes    Status

    DX-7E     07E       7       7   EDISK         0          Online
    DX-7F     07F      23       7   EDISK         4          Online
```

Director details by name and type

Use the verbose option to retrieve details about a specific director and type. For example, to display information about the front-end Fibre Channel director `8f` on Symmetrix 343, enter:

```
symcfg list -fa 8f -sid 343 -v

Symmetrix ID: 000194900343
Time Zone   : EST

    Product Model                        : VMAX40K
    Symmetrix ID                         : 000195700343

    Microcode Version (Number)           : 5876 (16F40000)
    Microcode Registered Build           : 0
    Microcode Date                       : 10.01.2012

    Microcode Patch Date                 : 10.01.2012
    Microcode Patch Level                : 120

    Symmwin Version                      : 112
. . .
    Director Identification: FA-8F

        Director Type                      : FibreChannel
        Director Status                    : Online

        Number of Director Ports           : 1
        Director Ports Status              : [ON,N/A,N/A,N/A]
```

```
Director Connection Status         : [Yes,N/A,N/A,N/A]

Director Symbolic Number           : 08F
Director Numeric Number            :  88
Director Slot Number               :  8

Director Port: 0

  WWN Node Name                    : 5000097310066800
  WWN Port Name                    : 5000097310066900

  Fibre Channel Loop ID            : N/A
  Fibre Adapter Type               : N/A
  Negotiated Speed (Gb/Second)     : 16
  Director Port Speed (Gb/Second)  : 16
. . .
```

Note: In Solutions Enabler V7.4 and higher, a Director Port Speed line has been added. When using compatibility mode 7.3 or earlier it is not shown. The description of the units for Negotiated Speed has also changed from GB/Second to Gb/Second .

Director port data

Use the `-port` option to see which ports are online or offline on SA, FA, SE, or RA directors. For example, to get the port status on all FA directors on all attached arrays, enter:

```
symcfg -fa all list -port -sid 097

Symmetrix ID: 000190100097

        S Y M M E T R I X   D I R E C T O R   P O R T S


                        Director   Port Status     Connection Status
  Ident  Type           Status    P0  P1  P2  P3    P0  P1  P2  P3

  FA-3A  FibreChannel   Online    ON  ON  N/A N/A    X   -   -   -
  FA-4A  FibreChannel   Online    ON  ON  N/A N/A    -   -   -   -
  FA-7A  FibreChannel   Online    ON  ON  N/A N/A    X   -   -   -
  FA-10A FibreChannel   Online    ON  ON  N/A N/A    -   -   -   -
  FA-13A FibreChannel   Online    ON  ON  N/A N/A    -   -   -   -
  FA-14A FibreChannel   Online    ON  ON  N/A N/A    -   -   -   -
  FA-3B  FibreChannel   Online    ON  ON  N/A N/A    X   -   -   -
  . . .
```

This return output includes the director identification (number and type), director status, available ports and status, and connection status. In the connection status, the (X) indicates that a Fibre port is connected to a Fibre port (HBA, Switch, or RF Director) and the dash (-) indicates that the Fibre port is not connected.

Addresses of devices mapped to directors

Use the `-address` option to identify the address information for devices accessible through specific directors via a host-based view of the storage environment. For example, to list the address information for all director types of Symmetrix `097`, enter:

```
symcfg list -dir all -address -sid 097

Symmetrix ID: 000190100097

            Director                 Device Name          Attr     Address
```

```
---------------------- ----------------------------- ---- -------------
Ident   Symbolic  Port Sym   Physical                     VBUS  TID  LUN
------  --------  ---- ----  ------------------------     ----  ---  ---
FA-3A   03A       0    0E2A  /dev/vx/rdmp/c5t0d0s2           0   00  000
                       0E2B  /dev/vx/rdmp/c5t0d1s2           0   00  001
                       04AA  /dev/vx/rdmp/c5t0d2s2   (M)     0   00  002
                       04AE  /dev/vx/rdmp/c5t0d3s2   (M)     0   00  003
                       04B2  /dev/vx/rdmp/c5t0d4s2   (M)     0   00  004
                       04B6  /dev/vx/rdmp/c5t0d5s2   (M)     0   00  005
                       04BA  /dev/vx/rdmp/c5t0d6s2   (M)     0   00  006
                       04BE  /dev/vx/rdmp/c5t0d7s2   (M)     0   00  007
                       04C2  /dev/vx/rdmp/c5t0d8s2   (M)     0   00  008
                       04C6  /dev/vx/rdmp/c5t0d9s2   (M)     0   00  009

FA-7A   07A       0    0E2C  Not Visible                     0   00  000
                       0E2D  Not Visible                     0   00  001
                       046A  Not Visible                     0   00  002
                       046B  Not Visible                     0   00  003
                       046C  Not Visible                     0   00  004
```

Next available device address

Used in conjunction with the `-address` option, the `-availability` option returns the next available address that can be used for a device. Those VBUS, TID, and LUN address values with an asterisk (*) represent a gap in the address assignments, or are the next available address in the run. For example, to list the available address information, enter:

```
symcfg list -dir all -address -available -sid 097

Symmetrix ID: 000190100097

        Director                 Device Name          Attr     Address
---------------------- ----------------------------- ---- -------------
Ident   Symbolic  Port Sym   Physical                     VBUS  TID  LUN
------  --------  ---- ----  ------------------------     ----  ---  ---

FA-3A   03A       0    0E2A  /dev/vx/rdmp/c5t0d0s2           0   00  000
                       0E2B  /dev/vx/rdmp/c5t0d1s2           0   00  001
                       04AA  /dev/vx/rdmp/c5t0d2s2   (M)     0   00  002
                       04AE  /dev/vx/rdmp/c5t0d3s2   (M)     0   00  003
                       04B2  /dev/vx/rdmp/c5t0d4s2   (M)     0   00  004
                       04B6  /dev/vx/rdmp/c5t0d5s2   (M)     0   00  005
                       04BA  /dev/vx/rdmp/c5t0d6s2   (M)     0   00  006
                       04BE  /dev/vx/rdmp/c5t0d7s2   (M)     0   00  007
                       04C2  /dev/vx/rdmp/c5t0d8s2   (M)     0   00  008
                       04C6  /dev/vx/rdmp/c5t0d9s2   (M)     0   00  009
                       -     AVAILABLE                       0   00  00A *
```

Taking RA directors offline

One or all RA director(s) of a specified Symmetrix array can be taken offline. For example, to take `RA-12` of Symmetrix `097` offline, enter:

```
symcfg offline -RA 12 -sid 097
```

To bring the director back online, enter:

```
symcfg online -RA 12 -sid 097
```

Taking front-end director ports offline

A specific port of a front-end director can be taken offline as well. For example, to take port `1` of `SA-12` in Symmetrix `097` offline, enter:

```
symcfg offline -SA 12 -P 1 -sid 097
```

CAUTION

If you turn off the only connection from your host to your Symmetrix array, you will not be able to contact the Symmetrix array in order to turn it back on (online).

If you have turned off the only connection from your host, you can use another host, if one exists, to bring the director port back online. For example, to bring port `1` of `SA-12` in Symmetrix `097` back online, enter:

```
symcfg online -SA 12 -P 1 -sid 097
```

Symmetrix external locks

Symmetrix external locks are used by SYMAPI (locks 0 to 15) and also for applications assigned by EMC (›15) to lock access to the entire Symmetrix array during critical operations. (Base SRDF operations use lock 0 and the Optimizer uses lock 13.) Using the `symcfg list -lockn` parameters, you can list all locks on one or all arrays or just those locks targeted to specific operations.

A list can be returned for all, a specific number, only SRDF, only SRDF-A, only MSCS, or only GNS locks (`ALL`, `#`, `RDF`, `RDFA`, `SRDF_MSCS`, and `GNS` values respectively).

Listing all locks

To return a list of all host-visible Symmetrix arrays (local and remote), along with details about all Symmetrix exclusive locks (known to SYMAPI) that are currently locked, enter:

```
symcfg list -lockn all

             S Y M M E T R I X      L O C K S

                                Lock       Lock    Lock                Time
    SymmID       Attachment     Status     Number  Usage               Held (Sec)

    000000006196 Local          Unknown    N/A     N/A                 N/A
    000184600063 Local          Unknown    N/A     N/A                 N/A
    000184600282 Local          Unknown    N/A     N/A                 N/A
    000187900039 Remote         EXCLUSIVE  15      ConfigChg           307
```

In the previous example, the returned list contains three local Symmetrix arrays that have no known locks, as specified by the N/A values. However, remote Symmetrix 000187900039 has an exclusive lock number 15 for a configuration change activity.

Listing details about a lock number

To focus your returned data on one or all lock number(s) on one or all Symmetrix array(s), use the `-lockn` option. For example, to return a list of all host-visible Symmetrix arrays (local and remote), along with details about any lock 0, enter:

```
symcfg list -lockn 0

                        S Y M M E T R I X      L O C K S
                                Lock       Lock    Lock                Time
    SymmID       Attachment     Status     Number  Usage               Held (Sec)

    000000006196 Local          Unknown    N/A     N/A                 N/A
    000184600063 Local          Unknown    N/A     N/A                 N/A
    000184600282 Local          Unknown    N/A     N/A                 N/A
```

```
000187900039 Remote       Unknown    N/A     N/A                 N/A
```

In the example above, the returned list shows that none of the Symmetrix arrays currently have lock 0 locked, as specified by N/A.

Note that Symmetrix 000187900039 still holds lock 15 from the previous example, however, the command line query specifically requested information on exclusive lock 0, so the returned data for a Symmetrix array that held any other lock number would be returned as N/A.

Note: To return information on all known Symmetrix exclusive locks currently locked, use the keyword `ALL` with the `-lockn` option. When using `symcfg list -lock`, where the `-lockn` option is omitted, the lock number 0 (base SRDF operations) is assumed.

Listing details about a lock

To focus your returned data on all possible locks, use the keyword `ALL`. For SRDF-related locks use the keyword `RDF`, for SRDF-A-related locks use the keyword `RDFA`, for MSCS-related locks use the keyword `SRDF_MSCS`, and for GNS-related locks use the keyword `GNS` with the `-lockn` option. In addition, you can specify a specific lock number. For example, to return information about lock 23, enter:

```
symcfg list -lockn 23  -sid 190

Symmetrix ID: 000000006190

              S Y M M E T R I X      L O C K S

                                Lock       Lock    Lock                Time
    SymmID       Attachment     Status     Number  Usage               Held (Sec)
    000000006190 Local          Locked     23      Unknown             20
```

In addition, the verbose option (`-v`) can be used to provide, if available from the base daemon, extended lock information about the application and host that owns the lock. For example, to return verbose information about lock 15, enter:

```
symcfg list -lockn 15 -sid 207 -v

Symmetrix ID: 000192600207

    Symmetrix ID                        : 000192600207   (local)
    Lock Number                         : 15
    Lock Usage                          : Config Change
    Time Held in Seconds                : 1801
    Lock Holder ID                      : 0xf000128e

    Initiator                           : 0
    Director Number                     : 55
    Logical Path ID                     : -1
    Lock Owner                          : Config Server
    Config Change Session ID            : 4356
    Migration Session Name              : N/A
```

Releasing a lock

SYMCLI provides the ability to release a lock on a Symmetrix array. This is not a recommended procedure and is only useful for locks which you have confirmed are stranded. For example, to release an external lock `0`, which has confirmed to be stranded on Symmetrix `097`, enter:

```
symcfg -sid 097 -lockn 0 release
```

On an array running Enginuity 5874 and higher, if a lock is held by the configuration server, the SYMCLI does not allow you to abort the configuration change session. Instead, the command fails with a message that identifies the lock owner. You can then use `symconfigure abort` command to abort the session.

When Solutions Enabler is run against an array running Enginuity 5874 or higher, the `symcfg release` command determines the lock owner and releases the lock. If held by an SRDF control operation, or held by the configuration change server, SYMCLI blocks the user command and displays a failure message identifying the lock owner. The lock owner can be a configuration change session, a migrate session, or an internal change. The user can then abort the correct session that owns the lock, using the `symconfigure` or the `symmigrate` command, whichever is applicable.

Example: Solutions Enabler V7.x release lock behavior

The following examples show three instances of the `symcfg release` command on lock 15:

```
symcfg release -sid 343 -lockn 15 -force

Release lock #15 for Symmetrix unit 000190300343 (y/[n]) ?  y

Lock 15 is held by a configuration change session <654>.
The session should be aborted to release the lock.

symcfg release -sid 343 -lockn 15 -force

Release lock #15 for Symmetrix unit 000190300343 (y/[n]) ?  y

Lock 15 is held by a migration session: <session name>
The session should be aborted to release the lock.

symcfg release -sid 343 -lockn 15 -force

Release lock #15 for Symmetrix unit 000190300343 (y/[n]) ?  y

Lock 15 is held by an internal config change session and cannot be released.
```

For information about device external locks that only target specific devices, refer to "Releasing device external locks" on page 120.

LRU cache management group

All, or a specific, least-recently-used (LRU) cache management group(s) for one or all Symmetrix array(s) can be obtained using the `-lru` option of the `symcfg list` command. For example, to view a list of all LRUs for the array `6196`, enter:

```
symcfg list -lru all -sid 6196

Symmetrix ID: 000000006196 (Local)

    LRU Num   LRU Name    Cache Slots  Percent of Total
    -------   --------    -----------  ----------------
          1    GROUP_0          11971        4%
          2    GROUP_1          11971        4%
          3    GROUP_2          11971        4%
          4    GROUP_3          11971        4%
          5    GROUP_4          11971        4%
          6    GROUP_5          11971        4%
          7    GROUP_6          11971        4%
          8    GROUP_7          11971        4%
          9    GROUP_8          11971        4%
         10    GROUP_9          11971        4%
         11    GROUP_A          11971        4%
         12    GROUP_B          11971        4%
         13    GROUP_C          11971        4%
         14    GROUP_D          11971        4%
         15    GROUP_E          11971        4%
         16    GROUP_F          11971        4%
                 -------    ---------
                   Total       278616
```

The output returned includes a table listing the LRU number and name, the cache slots that LRU occupies, and the percentage of the total cache. In addition, the total number of cache slots occupied by the listed LRUs is provided at the bottom.

Note: LRU statistics are not supported on Enginuity version 5x70 or higher.

EMC XtremSW Cache integration

Solutions Enabler V7.6 supports integration with EMC XtremSW Cache™ 2.0 and higher (host-based cache cards). The XtremSF™ Flash card is installed on the host and supports LUNs from various vendor storage arrays, including the Symmetrix array. Certain CLI commands (`symcfg`, `symdev`, `sympd`, and `syminq`) provide additional reporting and status information for LUNs from Symmetrix arrays running Enginuity version 5876 and higher.

The `symcfg` command reports detailed information about host-based cache cards for each host associated with the specified Symmetrix array. The `-host_cache` option is used to request the detailed host cache card data. The command reports which Symmetrix devices are currently controlled by cache cards and the status (Caching/Not Caching) for each.

Note: The `-offline` option is not supported along with the`-host_cache` option.

The following `symcfg list` command is used to report host cache card data for Symmetrix array 230:

```
symcfg list -host_cache -sid 230

Symmetrix ID            : 000195700230
```

```
Host Name                       : host123
Host IP Address                 : 156.32.0.123
Host OS Name                    : LINUX

Host Cache Cards (2):
    {
    Host Cache Card S/N         : SN58760000001
    Card Code Version           : Sym_LT_Rev001
    Card Vendor Name            : EMC Corp
    Card Size (GB)              :   2
    Memory Used (GB)            :   1
    Symmetrix Devices (6):
        {
        Dev   Status
        ----- -----------
        00B6  Not Caching
        00B7  Caching
        00B8  Caching
        017B  Not Caching
        03F1  Caching
        03F2  Caching
        }

    Host Cache Card S/N         : SN58760000002
    Card Code Version           : Sym_LT_Rev002
    Card Vendor Name            : EMC Corp
    Card Size (GB)              :   3
    Memory Used (GB)            :   2
    Symmetrix Devices (9):
        {
        Dev   Status
        ----- -----------
        0060  Not Caching
        0061  Not Caching
        0062  Caching
        0063  Caching
        0064  Caching
        0065  Caching
        0066  Caching
        0067  Caching
        0068  Caching
        }
    }

Host Name                       : host456
Host IP Address                 : 156.32.0.124
Host OS Name                    : SunOS

Host Cache Cards (1):
    {
    Host Cache Card S/N         : SN58760000003
    Card Code Version           : Sym_LT_Rev003
    Card Vendor Name            : EMC Corp
    Card Size (GB)              :   2
    Memory Used (GB)            :   1
    Symmetrix Devices (4):
        {
        Dev   Status
        ----- -----------
        0076  Not Caching
        0077  Caching
        0078  Caching
        0079  Not Caching
        }
```

The `symdev list` and `show` commands can be used to indicate, in verbose output, whether a device is currently registred for control by a host cache card. In addition, the `-host_cache` option allows the selection of devices registered for control by host cache cards in `symdev list` output. The `host_cache` command limits the list to only those devices currently registered for control by host cache cards.

The `symdev` command uses the following syntax:

```
symdev [-sid SymmID] [-offline] [-v] [-resv | -pgr]
            [-wwn] [-all]

        list [ -FA <#|ALL> [-P <#>] |
          -SA <#|ALL> [-scsi] [-fibre] [-P <#>]]
            . . .
          [-technology <EFD | FC | SATA>]
          [-host_cache]

        list pd [ -FA <#|ALL> [-P <#>] |
          -SA <#|ALL> [-scsi] [-fibre] [-P  <# >]]
            . . .
          [-technology <EFD | FC | SATA>]
          [-host_cache]

symdev [-sid SymmID] [-offline]

        list -space <-DA <#|ALL> | -DX <#|ALL>> [-cyl] [-spindle]

        list -inventory

symdev [-sid SymmID] [-hyper <#|ALL>] [-spindle]
            [-firstport] [-host_cache] [-offline]

        list [-internal |
              [-DA <#|ALL>] [-interface <#|ALL>] [-disk <#|ALL>]]

        list [-external |
              [-DX <#|ALL>] [-encapsulated [-limited]]]
```

For example, the following command provides host cache information for device 01F1:

```
symdev show 01F1 -sid 46
    . . .
    AS400_GK                  : False
    Host Cache Registered     : True
    Optimized Read Miss       : Off

    Mirror Set Type           : [RAID-1,N/A,N/A,N/A]
```

Note: The `sympd show` and `sympd list -v` output provides the same information.

The `syminq` command also indicates, in verbose output, whether a device iscurrently registered for control by a host cache card. The `-host_cache` option can also be used to select devices registered for control by host cache cards.

For example, the `syminq -v` output reports whether a device is currently registered for control by a host cache card:

```
syminq -v

    Device Physical Name      : /dev/sdb
      . . .
    Meta Device               : N/A

    Host Cache Registered     : True
```

Optimized Read Miss mode

The Optimized Read Miss feature reduces the I/O processing overhead of read miss operations for both DA and DX emulations. The feature is supported on Symmetrix VMAX arrays running Solutions Enabler V7.6 and Enginuity 5876Q22013 and higher. Solutions Enabler reports the current Optimized Read Miss state and permits setting the Optimized Read Miss mode to Off or System Managed for a device, a list of devices, or devices in a storage group, device group, or composite group. The Off setting explicitly disables the Optimized Read Miss mode for the specified device(s). The System Managed setting, which is the default, allows the Symmetrix to determine the appropriate Optimized Read Miss mode for the specified device(s). Optimized Read Miss mode is supported only for FBA devices or AS400 devices with D910 emulation.

Note: All members of a meta device should have the same Optimized Read Miss mode. The `symconfigure` command used for creating and modifying a meta device prevents building a meta device with different settings. In the event of inconsistent modes for meta members, the Optimized Read Miss mode of the head device is reported for the meta head.

The `symdev set -orm` command can be used to set the Optimized Read Miss mode to Off or System Managed for a single device or a list of devices. Use the `symdev list` command to indicate whether Optimized Read Miss mode is currently set to Off or System Managed for a device. In addition, output can be filtered by using the `-orm off` option to select devices with Optimized Read Miss mode set to Off.

Use the following `symdev` command syntax to set the Optimized Read Miss mode for a single device or a list of devices:

```
symdev -sid SymmID [-devs <<SymDevStart>:<SymDevEnd> | <SymDevName>
              [,<<SymDevStart>:<SymDevEnd> | <SymDevName>>...]>]
[-noprompt] [-rp] [-celerra] [-star]

       set -orm [off | system]


symdev -sid SymmID -file FileName
       [-noprompt] [-celerra] [-star]

       set -orm [off | system]
```

Output from the `symdev show` command indicates whether Optimized Read Miss mode is currently disabled (Off), or system managed (System) for a device. If the ORM feature is not available for your Enginuity version, the Optimized Read Miss mode displays as N/A.

For example:

```
symdev show 01F2 -sid 46
    . . .
    AS400_GK                 : False
    Host Cache Registered    : True
    Optimized Read Miss      : Off

    Mirror Set Type          : [RAID-1,N/A,N/A,N/A]
    . . .
```

Note: The Optimized Read Miss mode can also be set to Off or System Managed for devices in a storage group (`symsg`), device group (`symdg`), or composite group (`symcg`).

Network services

To view the configured network services available for use by the SYMAPI client connection, enter:

```
symcfg list -services
```

These services are also listed in the network services file (`netcnfg`) located in the `/var/symapi/config` directory.

Memory board information

SYMCLI provides the ability to view memory board information per Symmetrix array. This information includes the number of boards, the slot number, and the capacity information in MBs. To view the available memory board information for all Symmetrix arrays, enter:

```
symcfg list -memory
```

Mainframe CU image

If your storage environment contains devices mapped to either EA (ESCON) or EF (FICON) front-end directors, you can utilize the `symcfg` command to return mainframe CU (Controller Unit) image information. Since devices in the mainframe environment are managed with respect to the CU image that they are a part of, SYMCLI has created a view of the CU images that are defined within the Symmetrix array. A CU image definition includes the SSID assigned to the image, the front-end ports to which it is mapped, the devices included in the image, and their base and alias addresses. It also indicates whether it uses dynamic or static PAV (parallel access volumes) and whether the CU is online or not.

To view a list of CU images for all Symmetrix arrays (you can optionally limit the return data to one array by specifying the Symmetrix ID), use the following command:

```
symcfg list -cuimage
```

From the list of returned CU images, you can obtain details about a specific image using the `show` command:

```
symcfg show -cuimage 0 -ssid_num 640
```

The example above makes use of the `-ssid_num` option to return the specified CU image located on a specific subsystem ID in the case where multiple CU images with the number `0` may exist across multiple subsystems.

Enginuity patches

To list all of the Enginuity patches installed on a specific Symmetrix array, enter:

```
symcfg list -upatches -sid 207

Symmetrix ID: 000192600207

 Enginuity Level    : 5874_63
 Total Patches      : 2371
 Permanent Patches  : 2347
 Temporary Patches  : 24

 P00022136:001 P00033135:001 P00033563:012 P00034999:002 P00035237:001
```

```
 P00035422:001 P00035530:009 P00036633:001 P00036812:001 P00036889:002
 P00036896:001 P00037223:004 P00037353:001 P00037388:001 P00037536:001
 P00037577:001 P00037580:001 P00037648:001 P00037747:001 P00037817:002
 P00037894:001 P00038171:001 P00038219:001 P00038287:001 P00038326:001
 P00038347:001 P00038352:001 P00038403:001 P00038485:001 P00038612:006
 P00038713:001 P00038785:001 P00038821:001 P00038896:004 P00038921:007
 P00038967:001 P00039002:002 P00039013:001 P00039089:001 P00039111:002
 T00039113:002 P00039146:001 P00039151:001 P00039195:001 P00039208:001
 P00039224:001 P00039289:001 P00039300:001 P00039319:001 P00039338:001
. . .
```

Environmental data

You can return the status of the major hardware modules including fans, power supplies, drive enclosures, and link control cards. When querying for environmental data, you must specify an array ID. To return an overall status for all environmental components of a given array, enter:

```
symcfg -sid 150 list -env_data
```

To return a detailed status for each environmental component of a given bay (in this example, the bay name is `SystemBay`) for a specified Symmetrix array, enter:

```
symcfg -sid 150 show -env_data SystemBay
```

The `symcfg` command provides options that allow the returned data to be limited to a specific service state (`-service_state` option) — either `degraded`, `failed`, or `normal`—, or all service states except one by preceding the service state value with a `not`, such as `-service_state notfailed`.

For example, to return the environmental data for Symmetrix 097 with a service state of `failed`, enter:

```
symcfg -sid 150 list -env_data -service_state failed
```

Notice that the returned data only contains information about the bay containing the failure, and the components in the failed state.

Listing system and drive bays

The following example lists environmental output for Symmetrix arrays running Enginuity 5874 or higher containing a system bay and at least one drive bay:

```
symcfg -sid 150 list -env_data

Symmetrix ID               : 000192600150
Timestamp of Status Data   : 02/03/2009 12:06:42

    System Bay

      Bay Name                            :    SB-1
      Number of Standby Power Supplies    :    2
      Number of Drive Enclosures          :    0
      Number of Enclosure Slots           :    1
      Number of MIBE Enclosures           :    2

      Summary Status of Contained Modules
        All Standby Power Supplies        :    Normal
        All Enclosure Slots               :    Normal
        All Power Supplies                :    Normal
        All Fans                          :    Normal
        All Management Modules            :    Normal
```

```
        All IO Module Carriers              :    Normal
        All Directors                       :    Normal
        All MIBE Enclosures                 :    Normal
        All Power Supplies                  :    Normal

    Drive Bays

      Bay Name                              :    DB-1A
      Number of Standby of Power Supplies   :    2
      Number of Drive Enclosures            :    8

      Summary Status of Contained Modules
        All Enclosures                      :    Normal
        All Link Control Cards              :    Normal
        All Power Supplies                  :    Normal
        All Standby Power Supplies          :    Normal
```

The following example shows detailed system bay output for Symmetrix arrays running Enginuity 5875 or higher containing a system bay and at least one drive bay:

symcfg list -sid 601 SB-1 -env_data -v

```
Symmetrix ID               : 000195700601
Timestamp of Status Data   : 09/05/2012 10:07:23

    System Bay

      Bay Name                              :    SB-1
      Number of Standby Power Supplies      :    8
      Number of Drive Enclosures            :    0
      Number of Enclosure Slots             :    4
      Number of MIBE Enclosures             :    2

      Status of Contained Modules
        Standby Power Supplies

        Enclosure Number                    :    1
          Enclosure State                   :    Normal
          PS-A                              :    Normal
          PS-B                              :    Normal
          FAN-A                             :    N/A
          FAN-B                             :    Normal
          FAN-C                             :    Normal
          FAN-D                             :    Normal
          MM-A                              :    Failed
          MM-B                              :    N/A
          IOMC-A                            :    Normal
          IOMC-B                            :    Normal
          DIR-1                             :    Normal
          DIR-2                             :    Normal

        MIBE Name                           :    MIBE-L-2A
          MIBE State                        :    Normal
          PS-A                              :    Normal
          PS-B                              :    Normal

        MIBE Name                           :    MIBE-L-2B
          MIBE State                        :    Normal
          PS-A                              :    Normal
          PS-B                              :    Normal

    Drive Bays

      Bay Name                              :    DB-1A
      Number of Standby Power Supplies      :    2
      Number of Drive Enclosures            :    8
```

```
Status of Contained Modules
  Standby Power Supplies
    SPS-1A                          :    Normal
    SPS-1B                          :    Normal

  Enclosure Number                  :    1
    Enclosure State                 :    Normal
    LCC-A                           :    Normal
    LCC-B                           :    Normal
    PS-A                            :    Normal
    PS-B                            :    Normal

  Enclosure Number                  :    2
    Enclosure State                 :    Normal
    LCC-A                           :    Normal
    LCC-B                           :    Normal
    PS-A                            :    Normal
    PS-B                            :    Normal

  Enclosure Number                  :    3
    Enclosure State                 :    Normal
    LCC-A                           :    Normal
    LCC-B                           :    Normal
    PS-A                            :    Normal
    PS-B                            :    Normal

  Enclosure Number                  :    4
    Enclosure State                 :    Normal
    LCC-A                           :    Normal
    LCC-B                           :    Normal
    PS-A                            :    Normal
    PS-B                            :    Normal

  Enclosure Number                  :    5
    Enclosure State                 :    Normal
    LCC-A                           :    Normal
    LCC-B                           :    Normal
    PS-A                            :    Normal
    PS-B                            :    Normal

  Enclosure Number                  :    6
    Enclosure State                 :    Normal
    LCC-A                           :    Normal
    LCC-B                           :    Normal
    PS-A                            :    Normal
    PS-B                            :    Normal

  Enclosure Number                  :    7
    Enclosure State                 :    Normal
    LCC-A                           :    Normal
    LCC-B                           :    Normal
    PS-A                            :    Normal
    PS-B                            :    Normal

  Enclosure Number                  :    8
    Enclosure State                 :    Normal
    LCC-A                           :    Normal
    LCC-B                           :    Normal
    PS-A                            :    Normal
    PS-B                            :    Normal
```

Note: With Enginuity version 5875 or higher, an environmental module service state of N/A displays when the actual service state cannot currently be obtained.

The following example shows detailed drive bay output for Symmetrix arrays running Enginuity 5874 or higher containing a system bay and at least one drive bay:

```
symcfg show -sid 150 DB-1A -env_data

Symmetrix ID               : 000192600150
Timestamp of Status Data   : 02/03/2009 12:06:42

    Drive Bay

      Bay Name                              :    DB-1A
      Number of Standby of Power Supplies   :    0
      Number of Drive Enclosures            :    8

      Status of Contained Modules
        Standby Power Supplies

        Enclosure Number                    :    1
          Enclosure State                   :    Normal
          LCC-A                             :    Normal
          LCC-B                             :    Normal
          PS-A                              :    Normal
          PS-B                              :    Normal

        Enclosure Number                    :    2
          Enclosure State                   :    Normal
          LCC-A                             :    Normal
          LCC-B                             :    Normal
          PS-A                              :    Normal
          PS-B                              :    Normal

        Enclosure Number                    :    3
          Enclosure State                   :    Normal
          LCC-A                             :    Normal
          LCC-B                             :    Normal
          PS-A                              :    Normal
          PS-B                              :    Normal

        Enclosure Number                    :    4
          Enclosure State                   :    Normal
          LCC-A                             :    Normal
          LCC-B                             :    Normal
          PS-A                              :    Normal
          PS-B                              :    Normal

        Enclosure Number                    :    5
          Enclosure State                   :    Normal
          LCC-A                             :    Normal
          LCC-B                             :    Normal
          PS-A                              :    Normal
          PS-B                              :    Normal

        Enclosure Number                    :    6
          Enclosure State                   :    Normal
          LCC-A                             :    Normal
          LCC-B                             :    Normal
          PS-A                              :    Normal
          PS-B                              :    Normal

        Enclosure Number                    :    7
          Enclosure State                   :    Normal
          LCC-A                             :    Normal
          LCC-B                             :    Normal
          PS-A                              :    Normal
          PS-B                              :    Normal
```

```
Enclosure Number                    :    8
  Enclosure State                   :    Normal
  LCC-A                             :    Normal
  LCC-B                             :    Normal
  PS-A                              :    Normal
  PS-B                              :    Normal
```

Listing VMAX 40K environmental data

Hardware configurations for the Symmetrix VMAX 40K array are different from the Symmetrix VMAX 20K array. The `symcfg list -env_data -v` output provides additional environmental data for the Symmetrix VMAX 40K array.

VMAX 40K arrays may contain multiple system bays (for example: SB-1, SB-2). The System Bays section contains additional Bay Name sections showing environmental data for each distinct system bay. For VMAX 40K arrays, individual MIBE Enclosures are designated using a single character, versus two characters for VMAX 20K (for example, MIBE-A for VMAX 40K and MIBE-1A for VMAX 20K).

VMAX 40K arrays may contain Standby Power Supplies (SPSs), which are composed of two separate components; a tray (charger) and a separate battery. The Lithium Ion Standby Power Supplies use these separate components. These dual-component SPSs can exist in a VMAX 40K array alongside the existing single-unit SPSs, and both are reported. For dual-component SPSs, the Standby Power Supplies sections of the output contain both SPS-TRAY and SPS-BATTERY entries with the same alpha-numeric identifier, indicating that they constitute a single dual-component SPS (e.g. SPS-TRAY-1A and SPS-BATTERY-1A).

Note: The dual-component SPSs are only counted once when calculating the Number of Standby Power Supplies displayed.

VMAX 40K arrays may contain LED modules in system bays and/or drive bays. The Bay LED state is reported for the respective LED modules. In addition to the LED module service state (Normal, Degraded or Failed), the Bay LED state also contains a LED state in parenthesis () to indicate whether the LED is in a On, Off, Blink Slow or Blink Fast state.

Note: With Enginuity version 5875 or higher, an environmental module service state of N/A displays when the actual service state cannot currently be obtained.

The following example shows verbose (-v) environmental data for Symmetrix VMAX 40K 64, containing multiple system bays:

```
symcfg list -env_data -v -sid 64

Symmetrix ID               : 000195700064
Timestamp of Status Data   : 09/21/2011 14:01:51

    System Bays

      Bay Name                            :    SB-1
      Bay LED state                       :    Normal (On)
      Number of Standby Power Supplies    :    8
      Number of Drive Enclosures          :    1
      Number of Enclosure Slots           :    1
      Number of MIBE Enclosures           :    2

      Status of Contained Modules
        Standby Power Supplies
          SPS-1A (Aggregate)              :    Normal
```

```
            SPS-TRAY-1A                    :    Normal
            SPS-BATTERY-1A                 :    Normal
          SPS-1B                           :    Normal
          SPS-4A                           :    Normal
          SPS-4B                           :    Normal
          SPS-5A                           :    Normal
          SPS-5B                           :    Normal
          SPS-8A                           :    Normal
          SPS-8B                           :    Normal

        Enclosure Number                   :    1
          Enclosure State                  :    Normal
          MM-A                             :    Normal
          MM-B                             :    Normal
          DIR-1                            :    Normal
          DIR-2                            :    Normal

        Enclosure Number                   :    1
          Enclosure State                  :    Normal
          LCC-A                            :    Normal
          LCC-B                            :    Normal
          PS-A                             :    Normal
          PS-B                             :    Normal

        MIBE Name                          :    MIBE-A
          MIBE State                       :    Normal
          PS-A                             :    Normal
          PS-B                             :    Normal

        MIBE Name                          :    MIBE-B
          MIBE State                       :    Normal
          PS-A                             :    Normal
          PS-B                             :    Normal

Drive Bays

      Bay Name                             :    DB-1A
      Bay LED state                        :    Normal (On)
      Number of Standby Power Supplies     :    4
      Number of Drive Enclosures           :    16

      Status of Contained Modules
        Standby Power Supplies
          SPS-1A (Aggregate)               :    Normal
            SPS-TRAY-1A                    :    Normal
            SPS-BATTERY-1A                 :    Normal
          SPS-1B                           :    Normal
          SPS-4A                           :    Normal
          SPS-4B                           :    Normal

        Enclosure Number                   :    2
          Enclosure State                  :    Normal
          MM-A                             :    Normal
          MM-B                             :    Normal
          DIR-3                            :    Normal
          DIR-4                            :    Normal
. . .
```

With Enginuity 5876 or later, for each tray/battery pair, a line representing the aggregation (Dual component standby power supply) of associated tray/battery components is displayed. State information is reported at both the aggregate and components levels. The module name appears as `SPS-XX (Aggregate)` , where `XX` identifies the unique alpha-numeric identifier of the corresponding tray and battery components.

Listing Symmetrix arrays with a bay of up to eight DAEs

The following sample output for Symmetrix 139 running Enginuity 5874 or higher, displays a system bay with up to eight disk array enclosures (DAEs):

Note: In the following example, there is no Drive Bay information.

```
symcfg -sid 139 list -env_data

Symmetrix ID               : 000194900139
Timestamp of Status Data   : 02/26/2009 14:35:57

    System Bay

      Bay Name                              :    SB-1
      Number of Standby Power Supplies      :    6
      Number of Drive Enclosures            :    8
      Number of Enclosure Slots             :    1
      Number of MIBE Enclosures             :    2

      Summary Status of Contained Modules
        All Standby Power Supplies          :    Normal
        All Enclosures                      :    Normal
        All Link Control Cards              :    Normal
        All Power Supplies                  :    Normal
        All Enclosure Slots                 :    Normal
        All Power Supplies                  :    Normal
        All Fans                            :    Normal
        All Management Modules              :    Normal
        All IO Module Carriers              :    Normal
        All Directors                       :    Normal
        All MIBE Enclosures                 :    Normal
        All Power Supplies                  :    Normal

    Drive Bays
```

The following detailed sample output for Symmetrix 139 running Enginuity 5874 or higher, displays a system bay with up to eight disk array enclosures (DAEs):

```
symcfg show -sid 139 SB-1 -env_data

Symmetrix ID               : 000194900139
Timestamp of Status Data   : 02/26/2009 14:35:57

    System Bay

      Bay Name                              :    SB-1
      Number of Standby Power Supplies      :    6
      Number of Drive Enclosures            :    8
      Number of Enclosure Slots             :    1
      Number of MIBE Enclosures             :    2

      Status of Contained Modules
        Standby Power Supplies
          SPS-4A                            :    Normal
          SPS-4B                            :    Normal
          SPS-1A                            :    Normal
          SPS-1B                            :    Normal
          SPS-2A                            :    Normal
          SPS-2B                            :    Normal

        Enclosure Number                    :    1
          Enclosure State                   :    Normal
          LCC-A                             :    Normal
```

```
  LCC-B                              :    Normal
  PS-A                               :    Normal
  PS-B                               :    Normal

Enclosure Number                     :    2
  Enclosure State                    :    Normal
  LCC-A                              :    Normal
  LCC-B                              :    Normal
  PS-A                               :    Normal
  PS-B                               :    Normal

Enclosure Number                     :    3
  Enclosure State                    :    Normal
  LCC-A                              :    Normal
  LCC-B                              :    Normal
  PS-A                               :    Normal
  PS-B                               :    Normal

Enclosure Number                     :    4
  Enclosure State                    :    Normal
  LCC-A                              :    Normal
  LCC-B                              :    Normal
  PS-A                               :    Normal
  PS-B                               :    Normal

Enclosure Number                     :    5
  Enclosure State                    :    Normal
  LCC-A                              :    Normal
  LCC-B                              :    Normal
  PS-A                               :    Normal
  PS-B                               :    Normal

Enclosure Number                     :    6
  Enclosure State                    :    Normal
  LCC-A                              :    Normal
  LCC-B                              :    Normal
  PS-A                               :    Normal
  PS-B                               :    Normal

Enclosure Number                     :    7
  Enclosure State                    :    Normal
  LCC-A                              :    Normal
  LCC-B                              :    Normal
  PS-A                               :    Normal
  PS-B                               :    Normal

Enclosure Number                     :    8
  Enclosure State                    :    Normal
  LCC-A                              :    Normal
  LCC-B                              :    Normal
  PS-A                               :    Normal
  PS-B                               :    Normal

Enclosure Slot Number                :    4
  Enclosure Slot State               :    Normal
  PS-A                               :    Normal
  PS-B                               :    Normal
  FAN-A                              :    Normal
  FAN-B                              :    Normal
  FAN-C                              :    Normal
  FAN-D                              :    Normal
  MM-A                               :    Normal
  MM-B                               :    Normal
  IOMC-A                             :    Normal
  IOMC-B                             :    Normal
  DIR-7                              :    Normal
```

```
  DIR-8                              :    Normal

MIBE Name                            :    MIBE-L-2A
  MIBE State                         :    Normal
  PS-A                               :    Normal
  PS-B                               :    Normal

MIBE Name                            :    MIBE-L-2B
  MIBE State                         :    Normal
  PS-A                               :    Normal
  PS-B                               :    Normal
```

Device pools

Use the `symcfg` command to view all device pools.

The `symcfg list -pools` command lists information for all the types of pools. You can limit the display to a certain type of pools by using the options `-snap`, `-rdfa_dse,` or `-thin`. The `-rdfg` *`GrpNum`* option can be used with the `-rdfa_dse` option to limit the display to the SRDF/A DSE pools that are related to a specified SRDF group. When used, the returned data includes pools that are currently associated with the group or pools that have been disassociated from the group but still have the group's data.

Note: When issued against a VMAX 10K array with Enginuity 5875Q32011SR, the `symcfg list -pool` and `symcfg show -pool` commands report information about SRDF/A DSE pools.

When you specify the `-all` option, both enabled and disabled devices are included in the calculations of `Free Tracks` and `Full %`. Otherwise, only enabled devices are included. For example, without the `-all` option, the Free Tracks field would include free tracks from all enabled devices and the `Full %` field would be based on the Enabled tracks. With the `-all` option specified, the Free Tracks field would include free tracks from both enabled and disabled devices and the `Full %` would be based on the Usable Tracks.

The `[-fba] [-ckd3390] [-ckd3380] [-as400]` options can be used to narrow the returned data set to specific emulation type(s).

The -v option is used to list details of each pool in the returned data set. It is equivalent to using the `symcfg show -pool` command on all desired pools.

```
symcfg  [-sid SymmID] [-offline] [-mb | -gb]
       [-i Interval] [-c Count]

   list [-pool [-snap][-rdfa_dse [-rdfg GrpNum]][-thin]
          [-fba] [-ckd3390] [-ckd3380] [-as400] [-all] [-v]]
```

Where:

`-i Interval -c Count` — The interval and count options can be used to look at the status of the pool(s) continuously for a certain period of time.

`-mb | -gb` — By default, the space consumption of devices and pools is shown as a number of tracks. For the `symcfg list` and `symcfg show` commands, the output can be shown in megabytes or gigabytes by specifying one of these options. The gigabytes display has one decimal point precision.

`-pool` — Lists information for TF/Snap, SRDFA/DSE, and thin pools in a common output.

`-snap` — Lists information for TF/Snap pools only.

-rdfa_dse — Lists information for SRDF/A DSE pools only.

-rdfg — Can be used with `-rdfa_dse` to limit the display to the SRDF/A DSE pools that are related to the specified SRDF group. This includes pools that are associated with the group and pools that have been disassociated from the group, but may still have some data for the group.

-thin — Displays information about Virtual Provisioning™ thin device pools.

-all — Includes both enabled and disabled devices in the calculations for `Free Tracks` and `Full %`. Otherwise, only enabled devices are included.

-fba | -ckd3390 | -ckd3380 | -as400 — Filters the pool display to the specified emulation type.

The display of the pool information for the `symcfg list pool` command includes the pool name, pool type, device emulation type in the pool, tracks usage of the pool as well as pool state. The pool state indicates whether there are any devices enabled in the pool. If yes, pool state is Enabled, otherwise it is Disabled.

The following example shows the details of an SRDF/A DSE SAVE device pool:

```
symcfg show -pool yan_pool -sid 166 -rdfa_dse

Symmetrix ID                  : 000287400166
Pool Name                     : yan_pool
Pool Type                     : Rdfa DSE
Dev Emulation                 : FBA
Pool State                    : Enabled
# of Devices in Pool          :   3
# of Enabled Devices in Pool  :   2
# of Enabled Tracks in Pool   : 678240
# of Allocated Tracks in Pool : 497700
# of Shared Tracks in Pool    : 31002
# of Related RDF Groups       :   3

Enabled SAVE Devices(2):
  {
   ----------------------------------------------------------------
   Sym       Usable    Used      Free    Full  Device    Session
   Dev       Tracks    Tracks    Tracks   (%)  State     Status
   ----------------------------------------------------------------
   018B       66000    33000     33000    50  Enabled    Active
   018C       66000    33000     33000    50  Enabled    Active
           --------  --------  --------  ----
   Tracks    132000    66000     66000     0
   MB(s)       4125    2062.5    2062.5
  }

Related RDF Groups(3) :
  {
   -------- ------------
             Pool Rdfg
    RA-Grp   Attribute
   -------- ------------
 2 ( 1)  Associated
 3 ( 2)  Disassociated
27 (1A)  Associated
  }
```

Listing all pools in a Symmetrix array

The following output lists all pools in Symmetrix 432:

```
symcfg -sid 432 list -pool

Symmetrix ID: 000194900432

                    S Y M M E T R I X   P O O L S
-----------------------------------------------------------------------
Pool         Flags Dev              Usable       Free      Used  Full
Name         PTES  Config           Tracks     Tracks    Tracks   (%)
------------ ----- ------------ ---------- ---------- ---------- ----
DEFAULT_POOL SSFE  2-Way Mir        600000     600000          0    0
  . . .
Pool1        TSFE  2-Way Mir      12923748   12945324     105408    0
  . . .
Mig_src2     TSFE  RAID-6(6+2)       19224      16824       2400   12
Mig_trg2     TSFE  2-Way Mir         19224      19188         36    0

Total                            ---------- ---------- ---------- ----
Tracks                             15638331   15616299     149016    0

Legend:
  (P)ool Type:
    S = Snap,  R = Rdfa DSE  T = Thin
  (T)echnology:
    S = SATA, F = Fibre Channel, E = Enterprise Flash Drive, M = Mixed, - = N/A
  (E)mulation:
    F = FBA, A = AS400, 8 = CKD3380, 9 = CKD3390, - = N/A
  (S)tate:
    E = Enabled, D = Disabled, B = Balancing
```

Listing all Virtual Provisioning pools in a Symmetrix array

To list only the Virtual Provisioning pools in the output, use the `-thin` option. The following output lists details about all thin pools in Symmetrix 432:

```
symcfg list -pool -sid 432 -thin -all -detail

Symmetrix ID: 000194900432

                         S Y M M E T R I X   T H I N   P O O L S
-------------------------------------------------------------------------------------
Pool         Flags Dev              Total     Usable       Free      Used  Full     Shared
Name         PTES  Config          Tracks     Tracks     Tracks    Tracks   (%)     Tracks
------------ ----- ------------ ---------- ---------- ---------- ---------- ---- ----------
DEFAULT_POOL SSFE  2-Way Mir       600000     600000     600000          0    0          -
  . . .
Pool1        TSFE  2-Way Mir     12923748   12839916   12945324     105408    0          0
. . .
Mig_src2     TSFE  RAID-6(6+2)      19224      19224      16824       2400   12          0
Mig_trg2     TSFE  2-Way Mir        19224      19224      19188         36    0          0

Total                           ---------- ---------- ---------- ---------- ---- ----------
Tracks                            15156435   15029451   14880435     149016    0          0

Legend:
  (P)ool Type:
    S = Snap,  R = Rdfa DSE  T = Thin
  (T)echnology:
S = SATA, F = Fibre Channel, E = Enterprise Flash Drive, M = Mixed, - = N/A
  (E)mulation:
    F = FBA, A = AS400, 8 = CKD3380, 9 = CKD3390, - = N/A
  (S)tate:
E = Enabled, D = Disabled, B = Balancing
```

Showing Virtual Provisioning pool rebalancing

The `symcfg show -thin -pool -detail -all` report shows the following pool rebalancing parameters:

- **Rebalancing variance** — Targets the device utilization variance for the rebalancing algorithm. The rebalancing algorithm attempts to level distribution of data in a pool so that the percentage utilization of any device in the pool is within the target variance of the percentage utilization of any other device in the pool.
- **Max devs per rebalance scan** — Lists the maximum number of devices in a pool to use in the rebalancing algorithm. The following output shows `256`, which is the default.

Pool rebalancing is for thin pools only and is not applicable to Snap or SRDF/A DSE pools.

```
symcfg show -pool Mig_trg2 -thin -sid 432 -all -detail

Symmetrix ID: 000194900432

Symmetrix ID                     : 000194900432
Pool Name                        : Mig_trg2
Pool Type                        : Thin
Disk Location                    : External
Technology                       : N/A
Dev Emulation                    : FBA
Dev Configuration                : 2-Way Mir
Pool State                       : Enabled
Compression State                : Enabled
# of Devices in Pool             :   6
# of Enabled Devices in Pool     :   6
# of Usable Tracks in Pool       : 19224
# of Allocated Tracks in Pool    : 2688
# of Tracks saved by compression : 960
# of Shared Tracks in Pool       :   0
Pool Utilization (%)             :  14
Pool Compression Ratio (%)       :  36
Max. Subscription Percent        : None
Rebalance Variance               :   1%
Max devs per rebalance scan      : 256
Pool Reserved Capacity           : None

. . .

Legend:
  Enabled devices FLG:
    (S)hared Tracks : X = Shared Tracks , . = No Shared Tracks
  Bound devices FLG:
    S(T)atus    : B = Bound, I = Binding, U = Unbinding, A = Allocating,
                  D = Deallocating, R = Reclaiming, C = Compressing,
                  N = Uncompressing, . = Unbound
```

Note: The **FLG S** flag field indicates whether or not there are shared allocations on each device as noted in the above legend.

Listing feature registrations and usage data

The `symcfg list -feature` command lists feature registrations and usage data. Where appropriate, capacity types and limits are also displayed. Usage information is displayed when the -v option is provided.

You can limit the feature display to a specified class of features by using the `-class` option. The following example lists Symmetrix feature classes for Local Replication:

```
symcfg list -feature -sid 341 -class Local Replication

Symmetrix ID : 000194900341

    Feature Name           : TimeFinder/Mirror
    Feature Type           : Product
    Feature Class          : Local Replication
    Feature Capacity Type  : TB of Total Capacity
    Feature Capacity       : 0
    SATA Capacity          : 0
    Enabled Status         : Disabled
    Enabled Change Date    : 05-Jan-2011 17:10
    Feature Name           : SYMM_TF_CLONE
    Feature Type           : Product
    Feature Class          : Local Replication
    Feature Capacity Type  : TB of Registered Capacity
    Feature Capacity       : 500
    SATA Capacity          : 0
    Enabled Status         : Disabled
    Enabled Change Date    : 10-Mar-2011 14:32
    Feature Name           : SYMM_TF_SNAP
    Feature Type           : Product
    Feature Class          : Local Replication
    Feature Capacity Type  : TB of Total Capacity
    Feature Capacity       : 100
    SATA Capacity          : 500
    Enabled Status         : Disabled
    Enabled Change Date    : 10-Mar-2011 14:30
```

Note: When issued against a VMAX 10K array with Enginuity 5875Q32011SR, the `symcfg list -feature` CLI command returns a list of additional feature classes that are supported for VMAX 10K.

Symmetrix devices

From the perspective of software running on a host system, a Symmetrix array appears to be a number of *physical devices* connected to one or more I/O controllers. A host application addresses each of these devices using a physical device name. Each physical device defined in the configuration database has a specific set of attributes (such as vendor ID, product ID, revision level, and serial ID).

A Symmetrix device can map to a part of a physical disk or to an entire disk. The part of a physical disk to which a Symmetrix device is mapped is called a *hypervolume* or a *hyper*. A Symmetrix device may map to multiple hypers (containing identical copies of data) depending on its mirror configuration.

The Symmetrix database file maintains device-level configuration and status information for each device on every Symmetrix array that is accessible from the host. Using SYMCLI, you can obtain a list of all the available devices. You can then use the returned device data from this list to obtain configuration and status information. This information can lead you to back-end information for the device's disk director(s) and corresponding hypervolumes, and their mappings to disk drives.

Device types

SYMCLI provides the ability to define and configure devices for numerous specialized roles defined as *device types*. Each device type has specialized characteristics to enable a device to participate in various SYMAPI operations. Table 3 on page 81 describes the device types of the Symmetrix storage environment.

Table 3 Device types (page 1 of 3)

Device type	Description
ACLX devices	ACLX devices are device masking devices similar to VCM devices that are used for storage provisioning using Auto-Provisioning Groups on Enginuity 5874 and higher. For more information, refer to the *EMC Solutions Enabler Symmetrix Array Controls CLI Product Guide.*
BCV devices	Specialized devices used to create a local copy of data contained in a standard Symmetrix device, which can be used for backup, restore, decision support, and application testing. Symmetrix TimeFinder is a business continuance solution that allows you to use these special Symmetrix devices called BCV devices (Business Continuance Volume). Each BCV device has its own host address, and is configured as a stand-alone Symmetrix device. For more information, refer to the *EMC Solutions Enabler Symmetrix TimeFinder Family CLI Product Guide.*
DATA devices (datadev or TDAT)	DATA devices are used for Virtual Provisioning and are similar to SAVE devices, in that they are not visible to the host and must be contained in a pool before they can be used. Pools can only contain devices of the same emulation and protection type, however, the DATA devices can be different sizes. For more information, refer to the *EMC Solutions Enabler Symmetrix Array Controls CLI Product Guide.*
Device Masking (VCM) devices	Symmetrix devices that have been masked for visibility only to certain hosts. The device masking database (VCMDB) holds device masking records and typically resides on a 24 or 48 cylinder disk device. *VCM devices are used for device masking on Enginuity 5773 and earlier.* For more information, refer to the *EMC Solutions Enabler Symmetrix Array Controls CLI Product Guide.*

Table 3 Device types (page 2 of 3)

Device type	Description
Diskless devices	The SRDF/Extended Distance Protection (EDP) streamlines a cascaded SRDF linkage out to the remote site with a direct (diskless) connection. In a cascaded SRDF/EDP environment, the cascaded R21 devices are designated as diskless devices. This provides replication between the source site and remote target site without requiring disks at the middle site. Because the diskless R21 device has no local disk space allocated to store the user data, it reduces the cost of having disk storage at the middle site.
DRV devices	Dynamic Reallocation Volume. A non-user-addressable Symmetrix device used by the Symmetrix Optimizer to temporarily hold user data while reorganization of the devices is being executed. Typically, it is used by the Optimizer in logical volume swapping operations. For more information, refer to the *EMC Solutions Enabler Symmetrix Array Controls CLI Product Guide.*
Dynamic SRDF devices	Devices can be configured to be dynamic SRDF-capable devices. Dynamic SRDF functionality enables you to create, delete, and swap SRDF pairs while the Symmetrix array is in operation. Using dynamic SRDF technology, you can establish SRDF device pairs from non-SRDF devices, then synchronize and manage them in the same way as configured SRDF pairs. The dynamic SRDF configuration state of the Symmetrix array must be enabled via the configuration manager and the devices must be designated as dynamic SRDF-capable devices. For information about dynamic SRDF devices, refer to the *EMC Solutions Enabler Symmetrix SRDF Family CLI Product Guide*.
Gatekeeper devices	For detailed information on gatekeeper management, refer to the *EMC Solutions Enabler Installation Guide*. For specific gatekeeper sizing recommendations for all Symmetrix configurations, refer to Primus article EMC255976 available on Powerlink.
Metadevices	Allows individual devices to be concatenated to create larger devices. A metadevice consists of a metahead and its member devices. The *metahead* is the first device in the metadevice sequence and is responsible for receiving all incoming commands. It also identifies the entire metadevice. When an incoming command for the metahead is processed, the Symmetrix determines which metadevice member should execute the command. Metahead devices can be added to a device group while a *metamember* cannot be added to a device group. This holds true for both standard and BCV devices.
SAVE devices	Special devices (not mapped to the host) that provide physical storage space for pre-update images or changed tracks during a virtual copy session of TF/Snap and SRDF/A DSE operations. SAVE devices are a predefined pool of storage devices and must be configured for this purpose. The SAVE device pool acts as a group for storing data in striped form. SAVE devices are assigned a Symmetrix device number and can be unprotected, mirrored, or parity RAID. For more information, refer to the *EMC Solutions Enabler Symmetrix TimeFinder Family CLI Product Guide* and the *EMC Solutions Enabler Symmetrix SRDF Family CLI Product Guide.*
Standard devices	A Symmetrix device configured for normal Symmetrix operation under a desired protection method (such as RAID 1, RAID-5, and SRDF).
SRDF devices	Devices configured as RDF1, RDF2, or RDF21 to support SRDF operations. The Symmetrix Remote Data Facility (SRDF) is a business continuance solution that maintains a device-level mirror of Symmetrix data on remotely attached Symmetrix arrays. These arrays also may be located in physically separate sites. SRDF provides a recovery solution for component or site failures using remotely mirrored devices. SRDF reduces backup and recovery costs and significantly reduces recovery time after a disaster. For more information, refer to the *EMC Solutions Enabler Symmetrix SRDF Family CLI Product Guide.*

Table 3 Device types (page 3 of 3)

Device type	Description
Thin devices (TDEV)	Thin devices for Virtual Provisioning are devices that do not have storage allocated to them when they are created. Thin devices can be created with an inflated capacity, because the actual storage space for the data written to the thin devices is on the DATA devices.To a host operating system, they look like regular devices with their configured capacity. The host treats them as regular devices and writes and reads from these devices like regular devices. For more information, refer to the *EMC Solutions Enabler Symmetrix Array Controls CLI Product Guide.*
Virtual devices (VDEV)	A host-accessible device containing track-level location information (pointers), which indicates where the copy session data is located in the physical storage. Device copies use *virtual devices* to support TF/Snap operations. Virtual devices consume minimal physical disk storage, as they store only the address pointers to the data stored on the source device or a pool of SAVE devices. For more information, refer to the *EMC Solutions Enabler Symmetrix TimeFinder Family CLI Product Guide.*

Using the sympd and symdev commands

You can use two commands to gather information about Symmetrix devices:

- `sympd` — Lists Symmetrix devices that are host-visible.
- `symdev` — Displays information about all Symmetrix devices, host-visible or not.

The following `sympd list` command lists the physical device names with their corresponding Symmetrix device names (`Sym`), director information, and device-specific information for all devices on Symmetrix 196:

```
sympd list -sid 196

Symmetrix ID: 000000006196

        Device Name           Directors                   Device
---------------------------- ------------- -------------------------------------
                                                                          Cap
Physical                Sym  SA :P DA :IT  Config        Attribute    Sts   (MB)
---------------------------- ------------- -------------------------------------

/dev/rdsk/c1t0d0s2      0000 02A:1 01C:C6  Unprotected   N/Grp'd  VCM WD      47
/dev/rdsk/c1t0d1s2      0040 02A:1 16A:D4  Unprotected   N/Grp'd      RW     188
/dev/rdsk/c1t0d2s2      0041 02A:1 01D:D4  Unprotected   N/Grp'd      RW     188
/dev/rdsk/c1t0d3s2      0042 02A:1 16B:C4  Unprotected   N/Grp'd      RW     188
/dev/rdsk/c1t0d4s2      0043 02A:1 01A:C4  Unprotected   N/Grp'd      RW     188
```

When using this command, a number of filter options can be specified to reduce the output of the command to the specific types of devices you are investigating. Limit the device output to a specific Symmetrix array by specifying the `-sid` option. List host-visible Symmetrix devices that match a specific DA (`-da`), DX (`-dx`), interface (`-interface`), disk (`-disk`) or hyper-volume (`-hyper`) values. When specified along with the `-spindle` option, the output includes Spindle ID information. The `-vm` option displays valid virtual machine names on VMware ESX server environments.

You can also list the host-visible Symmetrix devices that match a specific front-end director number (`-SA`) or front-end director port number (`-P #`). The output can be further limited to devices that are mapped to SCSI front-end directors (`-scsi`), Fibre front-end directors (`-fibre`), FICON front-end directors (`-ficon`), ESCON front-end directors (`-escon`), or Gig-E front-end directors (`-gige`).

While the `sympd` command only provides a limited amount of filter options, additional filter options on physical devices can be found by utilizing the `symdev` command with the `list pd` argument and associated options. Refer to "Filtering device data" on page 114 for more information.

The following example shows `sympd list` output when the `-hyper` and `-spindle` options are specified.

```
sympd list -sid 341 -hyper all -spindle

Symmetrix ID: 000194900341

        Device Name                 Directors                Device
---------------------------- --------------------- -------------------------
                                                                        Cap
Physical                 Sym  SA :P Spindle   Hyper Config              (MB)
---------------------------- --------------------- -------------------------

/dev/sdi                 0042 07E:0 5A3           2 2-Way Mir              6
/dev/sdj                 002E 07F:0 10B2          1 2-Way Mir              6
/dev/sdk                 0056 07E:0 10B2          2 2-Way Mir              6
/dev/sdj                 002E 07F:0 341C          1 2-Way Mir              6
/dev/sdi                 0042 07E:0 341C          2 2-Way Mir              6
/dev/sdk                 0056 07E:0 7C58          1 2-Way Mir              6

. . .
```

The following `sympd list` example output shows a device created on an external spindle that has been mapped to director 2F:

```
sympd list -sid 306 -DX ALL -spindle

Symmetrix ID: 000194900306

        Device Name                 Directors                Device
---------------------------- --------------------- -------------------------
                                                                        Cap
Physical                 Sym  SA :P  Spindle  Hyper Config              (MB)
---------------------------- --------------------- -------------------------

/dev/sdae                00E5 02F:0       3c      1 Unprotected         1031
```

Note: The `sympd show` and `sympd list -v` commands also include spindle ID information as part of both the back-end disk director Information section and the RAID group Information section.

The `sympd show` command's output reports spindle ID information as follows:

For Enginuity versions 5874 and higher

- For all but unprotected devices, the spindle ID will be reported as part of the RAID group Information section of the `sympd show` output.
- For unprotected devices, the spindle ID will be reported in both the RAID Group information section and the back-end disk director Information section.
- For non-RAID devices (VAULT devices), spindle IDs are reported in the back-end disk director Information section.

For Enginuity versions earlier than 5874

- For RAID-5 or RAID-6 devices, the Spindle ID will not be included in the CLI output.

- For Unprotected, RAID-1, and other devices which normally contain disk-identifying information in the Back End Disk Director Information Section, the Spindle ID will be reported as well.

Note: For Enginuity versions lower than 5875, the specified/returned Spindle ID does not represent an actual Enginuity entity, but is a string representation of a unique hexadecimal number, which upon being returned may be used as an input parameter for `sympd show` commands.

The `symdev` command provides similar output as the `sympd` command, but includes all Symmetrix devices and lists them by Symmetrix device names.

The `symdev list` command also lists host-visible Symmetrix devices that match specific DA (`-da`), DX (`-dx`), interface (`-interface`), disk (`-disk`) or hyper-volume (`-hyper`) values. Like `sympd`, when specified along with the `-spindle` option, the output includes Spindle ID information.

Note: The same Spindle ID reporting criteria described above for `sympd show` also applies to `symdev show`.

The following output shows the Symmetrix device names (`Sym`), physical device (`Physical`) names, director information, and device-specific information for all devices on Symmetrix 164.

Note: The physical device names are not known for those devices that are not visible to the host making the request. A value of `???:?` for the directors means there is no mapping to a front-end director port. A value of `***:*` means there are multiple mappings.

symdev list -sid 164

```
Symmetrix ID: 000000006164

        Device Name          Directors                    Device
--------------------------- ------------- -------------------------------------
                                                                          Cap
Sym  Physical               SA :P DA :IT  Config        Attribute    Sts   (MB)
--------------------------- ------------- -------------------------------------

0002 /dev/sdjt              06A:0 ???:?   TDEV          N/Grp'd      RW   10000
0003 /dev/sdju              06A:0 ???:?   TDEV          N/Grp'd  (M) RW   10000
0004 Not Visible            ???:? ???:?   TDEV          N/Grp'd  (m) RW       -
0005 Not Visible            ???:? ???:?   TDEV          N/Grp'd  (m) RW       -
0006 /dev/sdjv              06A:0 ???:?   R1+TDEV       N/Grp'd      RW   10000
0007 /dev/sdjw              06A:0 ???:?   R2+TDEV       N/Grp'd      RW   10000
0008 Not Visible            ???:? 16D:D5  2-Way Mir     N/A     (DT) RW   10000
0009 Not Visible            ???:? 16A:D1  2-Way Mir     N/A     (DT) RW   10000
000A Not Visible            ???:? 16A:D3  RAID-5        N/A     (DT) RW   10000
000B Not Visible            ???:? 16A:D5  RAID-5        N/A     (DT) RW   10000
000C Not Visible            ???:? 16B:D1  RAID-6        N/A     (DT) RW   10000
000D Not Visible            ???:? 16B:D3  RAID-6        N/A     (DT) RW   10000
```

The following is an example of `symdev list` output when `-DA`, `-space`, and `-spindle` are specified.

```
symdev list -sid 341 -DA all -space -spindle

Symmetrix ID: 000194900341

Spindle           Capacity (MegaBytes)                Details
-------- ------------------------------------- -----------------
  ID     Total        Configured   Unconfigured Hypers Format
-------- ------------ ------------ ------------ ------ ----------
4C7            953870       224020       729850     70 Mixed
1B03           953870       226834       727035     71 Mixed
6D5A2          953870       183232       770638     75 Mixed
. . .
Total     ----------- ------------ ------------ ------ ----------
             38154788      7047493     30826438   2940 FBA
             38154788        72856     30826438     42 CKD-3390
             38154788       208000     30826438     40 VAULT_DEVICE
```

Using symdev to view external spindle devices

Information about eDisks (external spindles) added using Solutions Enabler Federated Tiered Storage (FTS) can be viewed using the `symdev list` command with the `-external` option.

Federated Tiered Storage gives you the ability to use an external disk to attach external storage to a Symmetrix array. Adding an eDisk to a Symmetrix array makes the eDisk's capacity available to the Symmetrix array as an external spindle.

Note: FTS is supported with Solutions Enabler V7.4 and Enginuity 5876 and higher.

Refer to the *Solutions Enabler Symmetrix Array Controls CLI Product Guide* for information on adding and removing eDisks using the FTS feature.

The `symdev list` command with the `-DX` option allows you to list devices on a specific external director (DX) or all DX directors. The existing DA option only shows devices on an internal DA director. The `-internal` option allows you to list devices on internal spindles and the `-external` option allows you to list devices on external spindles. TDEV, VDEV and DLDEV devices are not considered either internal or external and are not returned by either of these options. The `-encapsulated` option allows you to list encapsulated devices, and the `-limited` option allows you to list devices that are geometry limited. These two options can also be used to report which TDEVs are considered encapsulated or geometry limited. Each of the `-internal`, `-external` and `-encapsulated` options can be abbreviated down to 3 characters.

Note: The `symdisk list` command also provides options for listing external spindle information. For more information, also refer to "Viewing external spindle information" on page 127.

The `symdev list` command uses the following syntax:

```
symdev [-sid SymmID] [-offline] [-v] [-resv | -pgr]
            [-wwn| -wwn_encapsulated [-detail]] [-all]

          list [ -FA <#|ALL> [-P <#>] |
            -SA <#|ALL> [-scsi] [-fibre] [-P <#>]]
        . . .
```

```
        [-technology <EFD | FC | SATA>]
              [-internal | -external | -encapsulated [-limited]]

            list pd [ -FA <#|ALL> [-P <#>] |
              -SA <#|ALL> [-scsi] [-fibre] [-P <#>]]
          . . .
        [-technology <EFD | FC | SATA>]
              [-internal | -external | -encapsulated [-limited]]

symdev [-sid SymmID] [-offline]

            list [-DA <#|ALL> | -DX <#|ALL>] -space [-cyl]
        [-spindle]

            list [-DA <#|ALL>] [-interface <#|ALL>]
              [-disk <#|ALL>] [-hyper <#|ALL>] [-firstport]
              [-spindle] [-internal]

            list [-DX <#|ALL>] [-hyper <#|ALL>]
              [-spindle] [-external]
```

The following `symdev` list example shows output for all external directors on Symmetrix 306 when the `-DX ALL` option is specified.

```
symdev list -DX ALL -sid 306

Symmetrix ID: 000194900306

        Device Name                Directors             Device
---------------------------- ------------------- -------------------------
                                                                      Cap
Sym  Physical                SA :P DA :IT  Hyper Config                (MB)
---------------------------- ------------------- -------------------------
00E5 Not Visible             ***:* 07F:--      1 Unprotected          1031
00E6 Not Visible             ***:* 07F:--      2 Unprotected    (M)   9437
00E7 Not Visible             ***:* 07F:--      3 Unprotected    (m)   9437
00E8 Not Visible             ***:* 07F:--      4 Unprotected    (m)   4194
```

The following `symdev list` example shows all Symmetrix devices that are created on external spindles for Symmetrix 306, using the `-external` option.

```
symdev list -external -sid 306

Symmetrix ID: 000194900306

        Device Name           Directors                  Device
---------------------------- ------------- -------------------------------------
                                                                          Cap
Sym  Physical                SA :P DA :IT  Config        Attribute    Sts   (MB)
---------------------------- ------------- -------------------------------------

00E5 Not Visible             ***:* 07F:--  Unprotected   N/Grp'd      RW    1031
00E6 Not Visible             ***:* 07F:--  Unprotected   N/Grp'd  (M) RW    9437
00E7 Not Visible             ***:* 07F:--  Unprotected   N/Grp'd  (m) RW    9437
00E8 Not Visible             ***:* 07F:--  Unprotected   N/Grp'd  (m) RW    4194
```

RAID group information

The `symdev` command indicates, in verbose output, whether a rebuild or copy is in progress for a member of a device's RAID Group(s). The RAID Group Information section of `symdev show` output includes an additional parenthetical indicator under the Status column, which is displayed when a specific member is undergoing a rebuild (`R`), is the target of a member copy (`C`), or is in a failed state (`F`).

Note: For Solutions Enabler V7.4 and higher, the *Failing Member Mask* line located under the RAID Group Information section no longer displays, as the information is redundant. The Failing Member Mask line still displays if running Solutions Enabler V73 or earlier compatibility mode.

Example The following example displays output for `symdev show`, but note that the output from `symdev list -v` also displays that same information:

```
symdev show 1234 -sid 123
    . . .
  Device Service State              : Normal
    . . .
  RAID Group Information
    {
    . . .
  RAID Group Service State      : Normal
    . . .
        Hyper Devices:
            {
            Device : 1234
                {
                ------------------------------------------------------------
                Spindle   Disk    DA      Hyper        Member       Disk
                         DA :IT  Vol#  Num  Cap(MB)  Num Status Grp#  Cap(MB)
                ------------------------------------------------------------
                528C     08A:D4    347   61       9    1 RW (R)    1   953870
                2D7      07C:C4    205   61       9    2 RW (C)    1   953870
                12C      07A:C6    134   61       9    3 RW        1   953870
                7E44     09C:D2    543   61       9    4 RW        1   953870
                }
```

Device states

A device can be in one of the following states:

- Ready
- Not ready
- Write disable
- Read/write enable

Changing the device state

To change the device state, set or reset the hold bit on a device, or relabel a device, use the following `symdev` command syntax:

```
symdev -sid SymmID [-devs <<SymDevStart>:<SymDevEnd> | <SymDevName>
                [,<<SymDevStart>:<SymDevEnd> | <SymDevName>>...]>]
[-noprompt] [-rp] [-celerra] [-star]

        rw_enable     [-SA <#|ALL>[-P <#>]]

        write_disable [-SA <#|ALL>[-P <#>]

        ready

        not_ready

        relabel
```

```
          hold

          unhold        [-symforce]
```

You can also specify a file with a list of devices that you want to change using the `-file FileName` option in the following `symdev` command:

```
symdev -sid SymmID -file FileName
       [-noprompt] [-celerra] [-star]

          rw_enable     [-SA <#|ALL> [-P <#>]

          write_disable [-SA <#|ALL> [-P <#>]

          ready

          not_ready

          relabel

          hold

          unhold        [-symforce]
```

Device service states

The `symdev list` and `symdev list pd` commands provide options that allow the returned data to be limited to a specific service state (`-service_state` option) — `degraded`, `failed`, or `normal`—, or all service states except one preceded by the service state value with a not, such as such as `-service_state notfailed`. For example, the following command line returns all devices on Symmetrix array 097 that are not in the failed service state:

```
symdev list -service_state notfailed -sid 097
```

There are three possible device service states:

- Normal
- Failed
- Degraded

Note: Degraded indicates that one or more mirror positions of the protected device are not ready.

Device emulation

All host I/O transactions with an array of Symmetrix disk devices are managed by the Enginuity operating environment, which runs in the Symmetrix I/O subsystem (channel directors and disk directors). Because each of the physical disks are indirectly seen as part of the I/O protocol, Symmetrix devices are presented to the host with the following configuration or emulation attributes:

- Each device has N cylinders. The number is configurable (blocks ÷ 960).
- Each cylinder has 15 tracks (heads).

- Each device track in a fixed block architecture (FBA) has 64 blocks of 512 bytes. (For non-FBA operating systems, the blocks are recognized without regard to the number of bytes.)

Note: With Enginuity 5771 and higher, track sizes for FBA devices have been increased to 64 K.

To return a list of configured devices by emulation type, enter:

```
symdev list -inventory

Symmetrix ID: 000192603139

    Device Config      FBA   CKD3390  CKD3380  AS400  CELERRA
  -----------------   -----  -------  -------  -----  -------
  Unprotected           256      N/A      N/A    N/A    N/A
  2-Way Mir            4040      N/A      N/A    N/A    N/A
  RAID-5                483      N/A      N/A    N/A    N/A
  RAID-6                515        8      N/A    N/A    N/A
  TDEV                  496      N/A      N/A    N/A    N/A
  DLDEV                2381      N/A      N/A    N/A    N/A
  RDF1+Mir                8      N/A      N/A    N/A    N/A
  RDF1+R-6               16      N/A      N/A    N/A    N/A
  RDF1+DLDEV           1275      N/A      N/A    N/A    N/A
  RDF2+Mir               40      N/A      N/A    N/A    N/A
  RDF2+R-5                8      N/A      N/A    N/A    N/A
  RDF2+R-6                8      N/A      N/A    N/A    N/A
  RDF21+R-5              16      N/A      N/A    N/A    N/A
  RDF21+TDEV             16      N/A      N/A    N/A    N/A
  BCV                    10      N/A      N/A    N/A    N/A
  2-Way BCV Mir           5      N/A      N/A    N/A    N/A
  BCV+R-5                 5      N/A      N/A    N/A    N/A
  BCV+R-6                 5      N/A      N/A    N/A    N/A
  2-Way DRV Mir          10      N/A      N/A    N/A    N/A
  VDEV                  213      N/A      N/A    N/A    N/A
  BCV+TDEV               32      N/A      N/A    N/A    N/A
```

This list can be limited to the devices in a specific Symmetrix array by specifying a Symmetrix ID (`-sid`).

Showing details about a device

The following command provides information about the Symmetrix `15DB` device. In this example, the device is tagged for exclusive use by RecoverPoint.

```
symdev show 15DB -sid 397

Device Physical Name     : Not Visible

Device Symmetrix Name    : 15DB
Device Serial ID         : N/A
Symmetrix ID             : 000194900397

Number of RAID Groups    : 1

Attached BCV Device      : N/A

Attached VDEV TGT Device : N/A

Vendor ID                : EMC
Product ID               : SYMMETRIX
Product Revision         : 5875
Device WWN               : 60000970000194900397533031354442
Device Emulation Type    : FBA
Device Defined Label Type: N/A
Device Defined Label     : N/A
Device Sub System Id     : 0x0016
Cache Partition Name     : DEFAULT_PARTITION

Device Block Size        : 512

Device Capacity
    {
    Cylinders            :          3
    Tracks               :         45
    512-byte Blocks      :       5760
    MegaBytes            :          3
    KiloBytes            :       2880
    }

Device External Identity
    {
    Device WWN           : 60000970000194900397533031354442

    Front Director Paths (1):
        {
        -----------------------------------
         DIRECTOR   PORT             LUN
        ----------  ---- -------- ---------
        Type Num    Sts  VBUS TID SYMM Host
        -----------------------------------
        FA   07E:0  RW   000  00  1EF  N/A
        }

    Geometry             : Native
        {
        Sectors/Track        :        128
        Tracks/Cylinder      :         15
        Cylinders            :          3
        512-byte Blocks      :       5760
        MegaBytes            :          3
        KiloBytes            :       2880
        }
    }

Device Configuration     : 2-Way Mir
```

```
Device is WORM Enabled   : No
Device is WORM Protected : No

SCSI-3 Persistent Reserve: Enabled

Dynamic Spare Invoked    : No

Dynamic RDF Capability   : None

STAR Mode                : No
STAR Recovery Capability : None
STAR Recovery State      : NA

Device Service State     : Normal

Device Status            : Ready            (RW)
Device SA Status         : Ready            (RW)
Device User Pinned       : FALSE
Host Access Mode         : ACTIVE
Device Tag(s)            : RecoverPoint

Extent Based Clone       : None

Front Director Paths (1):
    {
    ----------------------------------------------------------------------
                            POWERPATH  DIRECTOR   PORT             LUN
                            --------- ----------  ---- -------- ---------
    PdevName                Type      Type Num    Sts  VBUS TID SYMM Host
    ----------------------------------------------------------------------
    Not Visible             N/A       FA   07E:0  RW   000  00  1EF  N/A
    }

Mirror Set Type          : [RAID-1,N/A,N/A,N/A]

Mirror Set DA Status     : [RW,N/A,N/A,N/A]

Mirror Set Inv. Tracks   : [0,0,0,0]

Back End Disk Director Information
    {
    Hyper Type                              : RAID-1
    Hyper Status                            : Ready           (RW)
    Disk [Director, Interface, TID]         : [N/A,N/A,N/A]
    Disk Director Volume Number             : N/A
    Hyper Number                            : N/A
    Mirror Number                           : 1
    Disk Group Number                       : 3
    Disk Group Name                         : DiskGrp3
    }

RAID Group Information
    {
    Mirror Number                             : 1
    RAID Type                                 : RAID-1
    Device Position                           : Primary
    Protection Level                          : 2
    RAID Group Service State                  : Normal
    Failing Member Mask                       : N/A
    Hyper Devices:
        {
        Device : 15DB
            {
            -------------------------------------------------------
             Disk     DA      Hyper        Member        Disk
```

```
DA :IT   Vol#  Num  Cap(MB)  Num Status  Grp#  Cap(MB)
-----------------------------------------------------
08A:C3     258   81       6    1 RW         3   953870
07C:D3    1231   82       6    2 RW         3   953870}
```

Showing physical device names with multiple access paths

The following shows the physical device names `(PDevName)` for device `48`, an Agile device supported by HP-UX, accessed along multiple paths:

```
symdev show -sid 323 48

  Device Physical Name     : /dev/rdisk/disk146
  Device Symmetrix Name    : 0048
  Device Serial ID         : 2300048000
  Symmetrix ID             : 000290300323
   . . .
  Front Director Paths (2):
      {
       ----------------------------------------------------------------------
                                POWERPATH  DIRECTOR   PORT             LUN
                                --------- ----------  ---- -------- ---------
      PdevName                  Type      Type Num    Sts  VBUS TID SYMM Host
      ----------------------------------------------------------------------
      /dev/rdisk/disk146        N/A       FA   15C:0  RW   000  05  000  050
      /dev/rdisk/disk146        N/A       FA   01C:0  RW   000  05  000  073
. . .
```

Showing an encapsulated device residing on an external spindle

The following is an example of `symdev show` output for an encapsulated device residing on an external spindle:

```
symdev show -sid 306 00E5

    Device Physical Name     : Not Visible

    Device Symmetrix Name    : 00E5
    Device Serial ID         : N/A
    Symmetrix ID             : 000194900306
    Number of RAID Groups    : 1
    Encapsulated Device      : Yes
    Encapsulated WWN         : 60000970000195700233533030333142
    Encapsulated Array ID    : 000195700233
    Encapsulated Device Name : 031B
      . . .
    Device Block Size        : 512

    Device Capacity
        {
        Cylinders            :       1100
        Tracks               :      16500
        512-byte Blocks      :    2112000
        MegaBytes            :       1031
        KiloBytes            :    1056000

        Geometry Limited     : No
        }

    Device External Identity
        {
        Device WWN           : 60000970000194900397533031344337

        Front Director Paths (0): N/A
```

```
                Geometry             : User Defined
                    {
                    Sectors/Track        :        128
                    Tracks/Cylinder      :         15
                    Cylinders            :       1100
                    512-byte Blocks      :    2112000
                    MegaBytes            :       1031
                    KiloBytes            :    1056000
                    }
                }
              . . .
            Mirror Set Type          : [Ext-Data,N/A,N/A,N/A]

            Mirror Set DA Status     : [RW,N/A,N/A,N/A]

            Mirror Set Inv. Tracks   : [0,0,0,0]

                Back End Disk Director Information
        {
                Hyper Type                              : Ext-Data
                Hyper Status                            : Ready           (RW)
                Disk [Director, Interface, TID]         : [07E, N/A, N/A]
                Spindle ID                              : 5289
                Disk Director Volume Number             : N/A
                Hyper Number                            :     1
                Mirror Number                           : 1
                Disk Group Number                       : 521
                Disk Group Name                         : DISK_GROUP_521
                }

            RAID Group Information
                {
                Mirror Number                             : 1
                RAID Type                                 : Unprotected
                Device Position                           : Primary
                Protection Level                          : 1
                RAID Group Service State                  : Normal
                Hyper Devices:
                    {
                    Device : 00E5
                        {
                        ----------------------------------------------------------------
                         Disk    Spindle   DA      Hyper        Member        Disk
                        DA :IT     ID     Vol#  Num  Cap(MB)  Num Status  Grp#  Cap(MB)
                        ----------------------------------------------------------------
                        07E:--       5289 N/A      1    1031    1 RW       521     1031
        }}}
```

To list all of the WWN encapsulated device information by Symmetrix ID, enter:

symdev -sid 647 -wwn_encapsulated -all list -detail

```
         Device                  Encapsulated Information
----------------------- ---------------------------------------------------------------------
Sym  Config        Attr Vendor     Array ID         Dev   WWN
---- ------------- ---- ---------- ---------------- ----- ----------------------------------

01CF Unprotected        EMC        000195700230      031B 60000970000195700230533030333142
01D0 Unprotected   (DT) EMC        000195700230      031C 60000970000195700230533030333143
01D1 Unprotected        EMC        000195700230      031C 60000970000195700230533030333143
```

Note: The encapsulated array ID and WWN information is supported for Enginuity 5876 and higher. For earlier Enginuity releases, the encapsulated array ID and device name display values of N/A.

Showing clone state flags

Solutions Enabler V7.4 and Enginuity 5876, or higher support TimeFinder VP Snap functionality. VP Snap leverages TimeFinder/Clone technology to create space-efficient snaps for thin devices by allowing multiple sessions to share capacity allocations within a thin pool. The clone Virtual Space Efficient (VSE) mode indicates a VP Snap session.

The following CLI list and show commands report the Clone State Flags:

- `symdev show`
- `symdev list -v`
- `sympd list -v`
- `sympd show`
- `symdg show ld`
- `symdg list ld -v`
- `symcg show ld`

Note: Refer to the *EMC Solutions Enabler Symmetrix TimeFinder Family CLI Version 7.5 Product Guide* for more information on the VP Snap feature and VSE.

Showing disk geometry details

When the `-geometry` option is specified, the **Effective Device Geometry** field can have three possible values:

- **User Defined** —Indicates the user has defined geometry for this device.
- **Native** — Indicates the current device geometry is the same as the native geometry for the Symmetrix array.
- **Array wide emulation** — Indicates that the array-wide flag for FBA geometry emulation is set to enabled and the effective geometry shown in the output is derived from this setting.

Note: Even if the array-wide setting is turned on, the user can still define the geometry at the individual device level and this setting will take precedence over the array-wide setting. In addition, for non FBA devices, the CLI will indicate N/A with the `-v` and the `-geometry` options.

Example The following is an example of the device geometry output:

```
symdev show 0016 -geometry -sid 516

 Device Physical Name      : /dev/sdd
 Device Symmetrix Name     : 0516
 Device Serial ID          : 1600016000
 Symmetrix ID              : 000190300516

 Attached BCV Device       : N/A

 Attached VDEV TGT Device  : N/A

 Vendor ID                 : EMC
 Product ID                : SYMMETRIX
 Product Revision          : 5771
 Device WWN                : 60060480000190300516533030303136
 Device Emulation Type     : FBA
 Device Defined Label Type: N/A
 Device Defined Label      : N/A
```

```
Device Sub System Id     : 0x0001

Device Block Size        : 512

Device Capacity
    {
    Cylinders            :       4400
    Tracks               :      66000
    512-byte Blocks      :    4224000
    MegaBytes            :       2063
    KiloBytes            :    2112000
    }

   Effective Device Geometry:    User Defined
    {
   Sectors/Track        :        128
   Tracks/Cylinder      :         15
   Cylinders            :       2000
   512-byte Blocks      :    3840000
   MegaBytes            :       1875
   KiloBytes            :    1920000

    }

Device Configuration     : RDF1            (Non-Exclusive Access)

Device is WORM Enabled   : No
Device is WORM Protected : No

SCSI-3 Persistent Reserve: Disabled

Dynamic Spare Invoked    : No

Dynamic RDF Capability   : None

STAR Mode                : No
STAR Recovery Capability : Sync_Tgt
STAR Recovery State      : Inactive

Device Service State     : Normal

Device Status            : Not Ready        (NR)
Device SA Status         : Ready            (RW)

Front Director Paths (2):
```

DATA and SAVE devices

Use the `symcfg` command to return details about all DATA devices, SAVE devices, and their pool memberships. The `-devs` and `-nonpooled` options can be used to filter the resulting output.

```
symcfg [-sid SymmID] [-offline] [-mb | -gb]

list [-savedevs [-fba] [-ckd3390] [-ckd3380] [-as400]
          [-nonpooled]
     [-devs [SymDevStart:SymDevEnd | SymDevName]
             [,SymDevStart:SymDevEnd | SymDevName...]]

        list [-datadev [-fba] [-nonpooled]
     [-devs [SymDevStart:SymDevEnd | SymDevName]
             [,SymDevStart:SymDevEnd | SymDevName...]]
```

When the `symcfg list` command is used to return pool information, the returned data will include pools that are currently associated with the group, or pools that have been disassociated from the group but still have the group's data.

When the `-all` option is specified, both enabled and disabled devices are included in the calculations of `Free Tracks` and `Full %`. Otherwise, only enabled devices are included. For example, without the `-all` option, the `Free Tracks` field includes free tracks from all enabled devices, and the `Full %` field is based on the enabled tracks. When the `-all` option specified, the `Free Tracks` field includes free tracks from both enabled and disabled devices, and the `Full %` is based on the `Usable Tracks`.

Listing DATA devices

The following command returns a list of DATA devices for a specific Symmetrix array:

```
symcfg list -sid 237 -datadev

Symmetrix ID: 000192600237

               S Y M M E T R I X   D A T A   D E V I C E S
-----------------------------------------------------------------------------
     Dev   Dev          Pool                          Usable      Used Full
Sym  Emul  Config       Type Pool Name    State     Tracks    Tracks  (%)
---- ----- ------------ ---- ------------ ----- --------- --------- ----
019D FBA   2-Way Mir     TH  2mir          Ena      69045        12    0
019E FBA   2-Way Mir     TH  2mir          Ena      69045        12    0
019F FBA   2-Way Mir     TH  2mir          Ena      69045        24    0
01A0 FBA   2-Way Mir     TH  2mir          Ena      69045        24    0
01A1 FBA   2-Way Mir     TH  2mir          Ena      69045        12    0
01A2 FBA   2-Way Mir     TH  2mir          Ena      69045        12    0
01A3 FBA   2-Way Mir     TH  2mir          Dis      69045        24    0
01A4 FBA   2-Way Mir     TH  2mir          Dis      69045        24    0
01A5 FBA   2-Way Mir     TH  2mir          Dea      69045        12    0
01A6 FBA   2-Way Mir     TH  2mir          Dea      69045        36    0

. . .

Legend for Pool Types/States:

    SN = Snap,  RS = Rdfa DSE,  TH = Thin,   - = N/A
    Ena = Enabled,   Dis = Disabled,   Dea = Deactivated,   Drn = Draining
```

You can filter the following output using the `-nonpooled` option to show only the DATA or SAVE devices not associated with a pool, and the `-devs` option to display only a range of devices. The following example shows how the `-devs` option can filter the resulting output:

```
symcfg list -savedev -sid 343 -gb -devs 0147:0150

Symmetrix ID: 000190300343

          S Y M M E T R I X   S N A P   S A V E   D E V I C E S
-----------------------------------------------------------------------------
     Dev   Dev          Pool                          Usable   Used Full
Sym  Emul  Config       Type Pool Name    State       GBs       GBs  (%)
---- ----- ------------ ---- ------------ ----- --------- --------- ----
0147 FBA   2-Way Mir     SN  xt_snap_2way  Dis        2.0       0.0    0
0148 FBA   2-Way Mir     SN  xt_snap_2way  Ena        2.0       0.0    0
0149 FBA   2-Way Mir     SN  xt_snap_2way  Ena        2.0       0.0    0
014A FBA   2-Way Mir     SN  DEFAULT_POOL  Dis        2.0       0.0    0
014B FBA   2-Way Mir     SN  DEFAULT_POOL  Dis        2.0       0.0    0
014C FBA   2-Way Mir     SN  DEFAULT_POOL  Dis        2.0       0.0    0
```

```
014D FBA   2-Way Mir     SN  range_pool2   Ena        2.0       0.0    0
014E FBA   2-Way Mir     SN  range_pool2   Ena        2.0       0.0    0
014F FBA   2-Way Mir     SN  range_pool2   Ena        2.0       0.0    0
0150 FBA   2-Way Mir     SN  DEFAULT_POOL  Ena        2.0       0.0    0

Total                                            --------- --------- ----
  GBs                                                 20.1       0.0    0


Legend for Pool Types:

    SN = Snap,  RS = Rdfa DSE,  TH = Thin,   - = N/A
```

Thin device information

Using the `-tdev` option in the `symcfg list` command returns a list of thin devices in the system. The displayed list can be filtered by emulation type or by a pool name to which the thin devices belong. The `-bound` or the `-unbound` option allows the listing of the thin devices to be filtered further. The `-unbound` option shows all the thin devices that are unbound, while the `-bound` option shows the bound thin devices.

```
symcfg [-sid SymmID] [-offline] [-mb | -gb]
list [-tdev
          [-devs SymDevStart:SymDevEnd | SymDevName
             [,SymDevStart:SymDevEnd | SymDevName...]]
          [-pool PoolName | [-fba] [-ckd3390]
             [-bound | -unbound]]
          [-sg SgName] [-detail | -tier]]
```

Listing thin devices

The following command lists thin devices on Symmetrix 397, in a range from 1620 to 1630. The columns `Allocated Tracks (%)` and `Written Tracks (%)` display the percentage of the entire thin device allocated and written. The `M` under `Flgs` indicates whether the thin device is sharing allocations with another thin device (`X = multi-pool allocations`), and the `P` under `Flgs` reports the presence of persistent tracks on each thin device.

```
symcfg -sid 397 -devs 1620:1630 list -tdev

Symmetrix ID: 000195700397

Enabled Capacity (Tracks) :    2884812
Bound   Capacity (Tracks) :      20700

                  S Y M M E T R I X   T H I N   D E V I C E S
-------------------------------------------------------------------------------
                                        Total           Total      Compressed
       Bound      Flgs      Total      Allocated        Written     Size/Ratio
Sym  Pool Name    EMPT     Tracks     Tracks (%)     Tracks (%)     Tracks (%)
---- ------------ ---- ---------- ---------- --- ---------- --- ---------- ---
1623 testCust     FX.B      14700       2652  18        744   5       1692  36
1625 -            8...       1500          0   0          0   0          0   0
1626 -            8...       1500          0   0          0   0          0   0
1627 -            8...       1500          0   0          0   0          0   0
162E testCust     F..B       6000       4800  80       3600  60       1200  75

Total                   ---------- ---------- --- ---------- --- ---------- ---
Tracks                       25200       7452  30       4344  17       2892  61

Legend:
 Flags:  (E)mulation : A = AS400, F = FBA, 8 = CKD3380, 9 = CKD3390
         (M)ultipool : X = multi-pool allocations, . = single pool allocation
```

```
(P)ersistent Allocs : A = All, S = Some, . = None
S(T)atus    : B = Bound, I = Binding, U = Unbinding, A = Allocating,
              D = Deallocating, R = Reclaiming, C = Compressing,
              N = Uncompressing, . = Unbound
```

Note: "Virtual Provisioning (VP) Compression" on page 101 provides information on compressing and uncompressing thin devices.

The following `symcfg list` example reports thin device tier allocations and displays both technology and disk locations.

```
symcfg list -tdev -tier -sid 234

Symmetrix ID: 000194900234

                S Y M M E T R I X   T H I N   D E V I C E S
-------------------------------------------------------------------------------
                           Total                      Tier
                Total     Allocated Flag ------------------------------------
Sym  Emul      Tracks     Tracks (%)  LT   Protection    Name
---- ----- --------- --------- --- ---- ------------ -------------------------
1078 FBA       33000         0   0  IF  RAID-5(3+1)  FC_R5_VPTier
     -             -        12   0  IE  RAID-5(7+1)  EFD_R5_VPTier
1079 FBA       33000         0   0  --  -            -
107A FBA       66000       144   0  IS  RAID-6(6+2)  SATA_R6_VPTier
     -             -        36   0  --  -            [OutOfTier]
10EC FBA       33000       132   0  IF  RAID-6(14+2) FC_R6_VPTier
10EE FBA       33000         0   0  --  -            -
10F9 FBA        1500        20   0  X-  Unprotected  EXT_VPTIER
1128 FBA        8010        24   0  IF  RAID-6(14+2) Finance_VPTier
11A2 FBA       33000       216   1  --  -            [OutOfTier]

Total      --------- --------- ---
Tracks        240510       584   0

Legend:

  Disk (L)ocation:
    I = Internal, X = External, M = Mixed, - = N/A
  (T)echnology:
    S = SATA, F = Fibre Channel, E = Enterprise Flash Drive, M = Mixed, - = N/A
```

Listing thin devices in a pool

To display a list of thin devices in a pool, use the following sample syntax:

```
symcfg -sid 343 list -tdev -pool HR_THIN_R5
```

Showing thin BCV devices with dynamic SRDF capability

The following `symdev show` command lists device `15F9` as a thin BCV device enabled for either dynamic RDF1 or RDF2 capability:

```
symdev show 15F9 -sid 397

Device Physical Name      : Not Visible

Device Symmetrix Name     : 15F9
Device Serial ID          : N/A
Symmetrix ID              : 000194900397

Number of RAID Groups     : 0
```

```
Attached VDEV TGT Device : N/A

Vendor ID                : EMC
Product ID               : SYMMETRIX
Product Revision         : 5875
Device WWN               : 60000970000194900397533031354639
Device Emulation Type    : FBA
Device Defined Label Type: N/A
Device Defined Label     : N/A
Device Sub System Id     : 0x0016
Cache Partition Name     : DEFAULT_PARTITION
Bound Thin Pool Name     : N/A
  . . .
Device Configuration     : BCV+TDEV

Device is WORM Enabled   : No
Device is WORM Protected : No

SCSI-3 Persistent Reserve: Enabled

Dynamic Spare Invoked    : No

Dynamic RDF Capability   : RDF1_OR_RDF2_Capable
```

Listing data allocations across multiple pools

When you specify the `-detail` option, thin devices are listed with all the pools in which they have allocated tracks. The `Total Written Tracks` display for only bound pools and represent all tracks written to the thin device for any allocation in any pool, as shown in the following output:

```
symcfg -sid 397 -devs 1620:1630 list -tdev -detail

Symmetrix ID: 000195700397

Enabled Capacity (Tracks) :    2884812
Bound   Capacity (Tracks) :      20700

                 S Y M M E T R I X   T H I N   D E V I C E S
-------------------------------------------------------------------------------
                                    Pool         Pool           Total      Compressed
       Bound      Flgs       Total  Subs      Allocated        Written     Size/Ratio
Sym  Pool Name    ESPT      Tracks   (%)     Tracks (%)     Tracks (%)     Tracks (%)
---- ------------ ----- ---------- ----- ---------- --- ---------- --- ---------- ---
1623 testCust     F..B       14700    13       2400  16        744   0       1692  30
     test_pool    ----           -     -        252   2          -   -          0   0
1625 -            8...        1500     0          0   0          0   0          0   0
1626 -            8...        1500     0          0   0          0   0          0   0
1627 -            8...        1500     0          0   0          0   0          0   0
162E testCust     F..B        6000    10       4800  80       3600  60       1200  75

Total                     ---------- ----- ---------- --- ---------- --- ---------- ---
Tracks                       25200     1       7452  30       4344  17       2892  61

Legend:
 Flags:  (E)mulation : A = AS400, F = FBA, 8 = CKD3380, 9 = CKD3390
         (S)hared Tracks : S = Shared Tracks Present, . = No Shared Tracks
         (P)ersistent Allocs : A = All, S = Some, . = None
         S(T)atus    : B = Bound, I = Binding, U = Unbinding, A = Allocating,
                       D = Deallocating, R = Reclaiming, C = Compressing,
                       N = Uncompressing, . = Unbound
```

Monitoring space reclamation

Use the `symcfg list -tdev` command to monitor the progress of space reclamation. The following example output lists thin devices in the process of being reclaimed to free up unwritten allocated space (as a result of using the `symconfigure free` command). The `Reclaiming` status indicates the thin devices are in the process of being reclaimed. The allocated tracks and written tracks adjust accordingly as the space is reclaimed.

Virtual Provisioning (VP) Compression

Solutions Enabler V7.5 with Enginuity 5876 Q42012SR provides a compression feature for thin pools and thin devices. Data can be compressed and uncompressed manually or can be compressed by Fully-Automated Storage Tiering (FAST) as part of its processing.

Data that is compressed can be read and written. To allow this, Enginuity uncompresses the data when needed into some space that is reserved in the VP pool that contains the thin devices compressed allocations. To reserve this space and enable allocations in a pool to be compressed, a pool must be enabled for compression. This is done by setting the compression capability on a VP Pool to enabled. When compression is no longer desired for allocations in a pool, the compression capability on a pool can be disabled.

Once a pool is enabled for compression, a background process runs to reserve storage in the pool for temporarily uncompressing data. No compressions of allocations in this pool can occur until this process completes. When compression is disabled, the reserved storage in the pool returns to the pool after all compressed allocations are uncompressed. Disabling the compression capability on a pool does not automatically cause compressed allocations to be uncompressed. This must be done manually. Solutions Enabler reports the current state of the compression capability on a pool, the amount of compressed allocations in the pool, and which thin devices have compressed allocations.

When you compress a device, only allocations that have been written are compressed. Any allocations that were created during the bind or allocate process that have not been written are reclaimed during the compression process. This means that when a compressed device is uncompressed, these allocations will no longer exist. The fact that unwritten allocations can be reclaimed imposes a restriction that persistent allocations, which can not be reclaimed automatically, can not be compressed. In order to allow the compression of persistent allocations, which implies the possible reclaiming of allocations that have not been written, the persistent indicator on the allocations must be manually removed. Note that compression of allocations for a thin device is a background task. Once the compression request is accepted, the thin device will have a background task associated with it that performs the compression. While this task is running, no other background task, like allocate or reclaim, can be run against the thin device.

The `symconfigure` command is used to enable and disable VP Compression for a VP pool on a Symmetrix array. The *EMC Solutions Enabler Symmetrix Array Controls CLI Product Guide* provides information on using the `symconfigure` command to set thin pool attributes for compression.

Note: The pool must be a VP pool. Compression cannot be set on a pool of encapsulated data devices.

Once a pool has been enabled for compression, one of the following CLI commands can be used to start/stop VP compression or VP uncompression for allocations on a thin device:

```
symdev -sid SymmID -file FileName [-noprompt] [-star]
```

```
    compress [-stop]
    uncompress [-stop]

symdev -sid SymmID [-noprompt] [-star]
   -devs [SymDevStart:SymDevEnd | SymDevName
                [,SymDevStart:SymDevEnd | SymDevName...]]
    compress [-stop]
    uncompress [-stop]

symsg -sg SgName -sid SymmID [-i interval][-c count] [-v]
    [-noprompt] [-rp] [-star] [-celerra] [-skip -lockid lockNum]
    compress [-stop]
    uncompress [-stop]

symdg -dg DgName [-noprompt] [-i interval][-c count]
    [-bcv [-hop2] | -rbcv  | -brbcv | -rrbcv |
    -vdev [-hop2] | -rvdev | -tgt [-hop2] |
    -rtgt] [-rp] [-star] [-celerra]
    compress [LdevName [LdevName ...]] [-stop]
    uncompress [LdevName [LdevName ...]] [-stop]

symcg -cg CgName [noprompt] [-i interval][-c count] [-v]
    [-noprompt] [-force]
    [-bcv [-hop2] | -rbcv | -brbcv | -rrbcv |
     -vdev [-hop2] | -rvdev | -tgt [-hop2] | -rtgt ]
    [-rp] [-star] [-sid <SymmID> |
     -rdfg SymmID:GrpNum[,GrpNum,...]|all [,...] |
     name:RdfGroupName [,RdfGroupName]] [-celerra]
    compress [LdevName [LdevName ...]] [-stop]
    uncompress [LdevName [LdevName ...]] [-stop]
```

Operations can be directed to a list of devices (`symdev`), all thin devices in a storage group (`symsg`), or by choosing selected devices in a device group (`symdg`), or composite group (`symcg`) using the various device options.

VP Compression rules

The following rules apply for VP Compression processing:

- Devices in a thin pool that are enabled for compression become uncompressed when tracks are written to or changed as a result of another action, therefore, compressing devices is not permanent. You must continually compress a device if the tracks become uncompressed.
- If all the targeted devices are already in the state for the specified action (that is, all are compressing and a compress start was issued), then the command fails the request with a SYMAPI_C_ALREADY_IN_STATE status.
- If some of the targeted devices are in the desired state (that is, compressing on a compress start action) and the remaining devices do not have a conflicting state (that is, in a uncompressing state when the action is compress start), then the command processes the request and skips the devices that are already in the desired state.
- If any of the targeted devices are in a conflicting state relative to the command (that is, some devices are in a compressing state and the action is uncompress start), then the command fails the request with the SYMAPI_C_INVALID_STATE_FOR_ACTION status.
- If compression has not been enabled for any pool in which a device has allocations, the CLI does not fail a compress start action, but compression does not occur for those allocations.

- Any non-thin device is skipped. If the requested devices are all non-thin devices, then the command fails with a SYMAPI_C_NO_DEVICES_SELECTED status.
- The Symmetrix array must be running Enginuity 5876 or higher.
- Encapsulated devices and Snap VP target devices cannot be compressed.

Any allocations that are not written are reclaimed during compression if the tracks are not persistently allocated. This implies that after an uncompression, the allocated tracks do not match the original allocated track count for the TDEV. By making the allocations persistent, the allocated tracks are maintained and no compression takes place. If allocations are persistent and a reclaim of space is desired, then the persistent attribute for existing allocations may be cleared, allowing compression and reclamation to occur.

Compressing or uncompressing a thin device occurs as a background task. Use the `symcfg show -detail` or `symcfg list -devs` commands to view a percentage of tracks compressed as displayed in the `Compressed Size/Ratio Tracks %` column.

Showing details about thin devices

Use the `-detail` option with the `symcfg show` command to return details about a Virtual Provisioning pool. Any thin devices bound to a specified pool are listed along with thin devices that have allocated tracks within the pool but are not bound to that pool, as shown in `Other-Pool Bound Thin Devices` in the following sample output.

If the `-all` option is added, the disabled devices in the pool are also shown.

The Pool State displays as Enabled, Disabled, or Balancing. If the Virtual Provisioning pool is enabled and the write balancing feature is turned on, the Pool State displays as Balancing. A thin device status of Reclaiming indicates the thin devices are in the process of being reclaimed as a result of using the `symconfigure free` command.

```
symcfg show -pool Mig_trg2 -thin -sid 432 -all -detail

Symmetrix ID: 000195700432

Symmetrix ID                     : 000194900432
Pool Name                        : Mig_trg2
Pool Type                        : Thin
Disk Location                    : Internal
Technology                       : SATA
Dev Emulation                    : FBA
Dev Configuration                : 2-Way Mir
Pool State                       : Enabled
Compression State                : Enabled
# of Devices in Pool             :   6
# of Enabled Devices in Pool     :   6
# of Usable Tracks in Pool       : 19224
# of Allocated Tracks in Pool    : 2688
# of Tracks saved by compression : 960
# of Shared Tracks in Pool       :   0
Pool Utilization (%)             :  14
Pool Compression Ratio (%)       :  36
Max. Subscription Percent        : None
Rebalance Variance               :   1%
Max devs per rebalance scan      : 256
Pool Reserved Capacity           : None

Enabled Devices(6):
  {
```

```
   ----------------------------------------------------------
   Sym        Usable      Alloc       Free Full FLG Device
   Dev        Tracks     Tracks     Tracks  (%)  S  State
   ----------------------------------------------------------
   0811         3204        456       2748   14  .  Enabled
   0812         3204        456       2748   14  .  Enabled
   0813         3204        444       2760   14  .  Enabled
   082A         3204        444       2760   14  .  Enabled
   082B         3204        444       2760   14  .  Enabled
   082C         3204        444       2760   14  .  Enabled
          ---------- ---------- ---------- ----
   Tracks      19224       2688      16536   14
  }

Pool Bound Thin Devices(3):
{
   ----------------------------------------------------------------------
                     Pool          Pool          Total        Compressed
   Sym   FLG       Total Sub     Allocated      Written       Size/Ratio
   Dev    T       Tracks (%)    Tracks (%)     Tracks (%)     Tracks (%)
   ----------------------------------------------------------------------
   0816   B         4800  25        144   3          0   0        144   0
   082F   B         4800  25       1440  30          0   0        720  50
   086E   B          750   4        372  50          0   0        252  32
             ---------- --- ---------- --- ---------- --- ---------- ---
   Tracks          10350  54       1956  19          0   0       1116  42
  }

Other-Pool Bound Thin Devices(2):
{
   ----------------------------------------------------------
                                      Pool        Compressed
          Bound           Total      Allocated     Size/Ratio
   Sym  Pool Name        Tracks     Tracks (%)     Tracks (%)
   ----------------------------------------------------------
   0826 Mig_src2           6000        360   6        360   0
   092C HR_Archive         3000        372  12        252  32
                     ---------- ---------- --- ---------- ---
   Tracks                  9000        732   8        612  16
  }

Legend:
  Enabled devices FLG:
    (S)hared Tracks : X = Shared Tracks , . = No Shared Tracks
  Bound devices FLG:
    S(T)atus    : B = Bound, I = Binding, U = Unbinding, A = Allocating,
                  D = Deallocating, R = Reclaiming, C = Compressing,
                  N = Uncompressing, . = Unbound
```

Note: The **FLG S** flag field indicates whether there are shared allocations on each device as noted in the above legend.

Note: For Symmetrix arrays running Enginuity 5773 and earlier, the Pool Written Tracks (%) information does not display and shows as "-".

Using symdev to perform actions against thin devices

For Symmetrix arrays running Solutions Enabler V7.6 and Enginuity 5876, or higher, the `symdev` command supports the following control actions when issued against thin devices: binding, unbinding and rebinding, the ability to start and stop allocations, and freeing and reclaiming of space on a thin device. The operations can be directed at a single device or a list of devices.

Use the following `symdev` command syntax to perform control actions on thin devices:

```
symdev -sid SymmID [-devs <<SymDevStart>:<SymDevEnd> | <SymDevName>
               [,<<SymDevStart>:<SymDevEnd> | <SymDevName>>...]>]
               [-noprompt] [-star]

         bind -pool <PoolName>

         rebind -pool <PoolName>

         unbind

         allocate [-persistent | -stop]

         free [-stop]

         reclaim [-persistent | -stop]
```

Note: You can also specify a file with a list of devices using the `symdev` command and the `-file FileName` option.

A `bind` action associates a thin device to a thin pool. A `rebind` action changes the thin device's current binding to a new pool. Rebind does not move the existing data to the new pool, but directs all new allocations to the thin device in the new pool after the rebind action completes. An `unbind` action disassociates a thin device from a thin pool.

The `allocate` action fully allocates all of the storage for the specified device(s). The `-persistent` option can be specified to allocate storage that will not be able to be reclaimed or freed, except by using the optional persistent control with the reclaim action.

Unwritten storage can be recovered with either a `free` or a `reclaim` action. Allocations that were written as zeros can only be recovered by using the `reclaim` action. Additionally, storage that was allocated with the persistent attribute can only be recovered by using the `-persistent` option with the `reclaim` action.

Actions to allocate, free, or reclaim thin devices are performed asynchronously in the background and are started with an explicit start action. They may be stopped, while in progress using the `-stop` option.

Verifying thin and DATA device states

You can verify the state of thin or DATA devices using the following syntax:

```
symcfg -sid SymmID [-i Interval] [-c Count]
[-pool PoolName |
-g DgName |
-sg SgName |
-cg CgName |
-devs SymDevStart:SymDevEnd | SymDevName
[,SymDevStart:SymDevEnd | SymDevName...]

symcfg verify -tdev
[-bound | -binding | -allocating | -deallocating |
-unbound | -unbinding | -reclaiming]

symcfg verify -datadev
[-draining | -drainwait | -disabled | -enabled |
-deactivated | -nonpooled | -balancing]
```

If the `-dev` option is specified, the status of a single device returns. If the `-pool` option is specified, all thin or DATA devices within a pool return, and must be in one of the requested states to pass verification.

More than one state may be tested. All devices must be in any of the requested states for the verification to succeed. Normally, the command executes a single poll and exits with status 0 (all devices in requested state) or nonzero status indicating which devices were not ready. A message, such as, "`One or more of the specified devices are not in the requested state`", returns.

If you require more than one poll to be executed, the default time between polls is 10 seconds. You may specify the `-i` option to set the polling rate. The default minimum interval value used for calculating the action is 15 seconds. A message displays at each poll.

Use the `-c` option to specify the numbers of polls to be executed. The command will terminate at the end of the count or when all devices are in the correct state. If only the `-i` command is used, the command will loop infinitely, exiting only when all devices are in the correct state (or when manually interrupted).

Verifying device usage

For example, to continually check the status of a thin device (`5AC`) on Symmetrix 1234 and exit the loop when it enters a bound state, enter:

```
symcfg -sid 1234 verify -tdev -dev 5ac -bound -I 5
```

To check once to see if all of the DATA devices in a pool (`devpool`) on Symmetrix 1234 are disabled, enter:

```
symcfg -sid 1234 verify -datadev -pool devpool -disabled
```

SRDF group information

To display information about an SRDF group, use the `-rdfg` option with `symcfg list`. The following `symcfg list` command shows the remote connections of all SRDF groups from Symmetrix 345:

```
symcfg list -sid 345 -rdfg all -detail

Symmetrix ID : 000190300345

                S Y M M E T R I X   R D F   G R O U P S

    Local             Remote                   Group                      RDFA Info
-------------- --------------------- ------------------------------- ---------------
            LL                                     Flags   Dir Copy Flags Cycle
 RA-Grp  (sec)  RA-Grp  SymmID       T    Name    LPDS CHT  Cfg Jobs CSRM  time  Pri
-------------- --------------------- ------------------------------- ----- ----- ---
  1 ( 0)    10   1 ( 0) 000190300341 D sd_rdfg_1  XX.. ..X  F-S   80 -IS-     15  33
  4 ( 3)    10   4 ( 3) 000190300341 S RDFGRP_3   .X.. ..X  F-S   80 -IS-     30  33
214 (D5)    10 132 (83) 000190300351 D sd_214_132 XX.N ..X  F-S  120 XAM-     15  33
217 (D8)    10 225 (E0) 000190300341 D ls3453415  XX.. ..X  F-S   80 -IS-     15  33

Legend:
  ?                 : Unknown
  Group (T)ype      :  S = Static, D = Dynamic
  Director (C)onfig :  F-S = Fibre-Switched, F-H = Fibre-Hub
                       G = GIGE, E = ESCON, T = T3, - = N/A
  Group Flags       :
      Prevent Auto (L)ink Recovery      : X = Enabled, . = Disabled
      Prevent RAs Online Upon (P)ower On: X = Enabled, . = Disabled
      Link (D)omino                     : X = Enabled, . = Disabled
      (S)TAR mode                       : N = Normal, R = Recovery, . = OFF
      RDF Software (C)ompression        : X = Enabled, . = Disabled, - = N/A
      RDF (H)ardware Compression        : X = Enabled, . = Disabled, - = N/A
      RDF Single Round (T)rip           : X = Enabled, . = Disabled, - = N/A

RDFA Flags        :
      (C)onsistency : X = Enabled, . = Disabled, - = N/A
      (S)tatus      : A = Active, I = Inactive, - = N/A
      (R)DFA Mode   : S = Single-session, M = MSC, - = N/A
      (M)sc Cleanup : C = MSC Cleanup required, - = N/A
```

Note: The `-detail` option includes a column titled Copy Jobs, which displays the number of Copy Jobs for each SRDF group. The value in the Copy Jobs column only applies when the Symmetrix is running Enginuity 5773 with the supported patch or 5874 SR2. For all other Symmetrix Enginuity levels the value in this column will be set to a dash (-) indicating N/A.

Note: Symmetrix Remote Data Facility for VMAX 10K Series (SRDF) solutions are supported with Enginuity version 5875Q32001SR and higher. Refer to the *EMC Solutions Enabler SRDF Family CLI Product Guide* and the *EMC Symmetrix Remote Data Facility for VMAX 10K Series Product Guide* for details about which features are supported with your platform.

Listing directors with SRDF groups

The following command lists all the directors defined with SRDF group number 51. If a director is not associated with a specified group number, a dash (-) displays under `Local RA Grp` and `Remote RA Grp`.

```
symcfg list -ra all -rdfg 51 -sid 306

Symmetrix ID: 000192600306

                S Y M M E T R I X   R D F   D I R E C T O R S

                                          Remote        Local    Remote
Ident  Symb  Num  Slot  Type       Attr  SymmID        RA Grp   RA Grp  Status

RF-7F   07F   87     7  RDF-BI-DIR   -   000192600083  51 (32)  52 (33) Online
RF-8F   08F   88     8  RDF-BI-DIR   -   -              -        -      Online
RF-9F   09F   89     9  RDF-BI-DIR   -   -              -        -      Online
RF-10F  10F   90    10  RDF-R1       -   000192600083  51 (32)  52 (33) Online
```

Listing SRDF/A group information

To list SRDF/A group information, use the `-rdfg` and `-rdfa` options with `symcfg list`. After this example, SRDF/A write pacing is described in detail.

```
symcfg list -sid 198 -rdfg 180 -rdfa

                 S Y M M E T R I X   R D F A   G R O U P S
-------- ----------- -------- ------ --- --- --------- ----------------------
                                                          Write Pacing
RA-Grp  Group       Flags    Cycle  Pri Thr Transmit      Delay   Thr GRP DEV
         Name        CSRM TDA time           Idle Time   (usecs)  (%) SAU SAU
-------- ----------- -------- ------ --- --- --------- ---------- --- --- ---
180 (B3) rdfg_180    XAS- XI.     30  33  70 000:00:00    1000000  60 AXX AXX

Legend:

RDFA Flags          :
      (C)onsistency   : X = Enabled, . = Disabled, - = N/A
      (S)tatus        : A = Active, I = Inactive, - = N/A
      (R)DFA Mode     : S = Single-session, M = MSC, - = N/A
      (M)sc Cleanup   : C = MSC Cleanup required, - = N/A
      (T)ransmit Idle : X = Enabled, . = Disabled, - = N/A
      (D)SE Status    : A = Active,  I = Inactive, - = N/A
      DSE (A)utostart : X = Enabled, . = Disabled, - = N/A

  Write Pacing Flags  :
    (GRP) Group-Level Pacing:
      (S)tatus        : A = Active, I =  Inactive, - = N/A
      (A)utostart     : X = Enabled, . = Disabled, - = N/A
      S(U)pported     : X = Supported, . = Not Supported, - = N/A

   (DEV) Device-Level Pacing:
      (S)tatus        : A = Active, I =  Inactive, - = N/A
      (A)utostart     : X = Enabled, . = Disabled, - = N/A
      S(U)pported     : X = Supported, . = Not Supported, - = N/A
```

SRDF/A write pacing

The SRDF/A group-level and device-level write pacing feature helps secure the availability of an SRDF/A session by preventing conditions that cause cache overflow on both the R1 and R2 sides. SRDF/A group-level write pacing detects when the I/O service rates are lower than the host I/O rates, and then takes corrective actions to slow down the host I/O rates to match the SRDF I/O service rates. It occurs on an SRDF group-wide (SRDF/A session) basis. It also provides an exemption capability to prevent group-level write I/O pacing on specified devices in within the group.

SRDF/A device-level write pacing extends SRDF/A group-level write pacing to address conditions that lead to cache overflow specifically due to TF/Snap and TF/Clone sessions on an R2 device running in asynchronous mode.

SRDF/A write pacing fields

The `Write Pacing Delay` field displays the host I/O delay value in microseconds (usecs). The `Write Pacing Thr` field displays the configured minimum system write pending cache threshold as a percentage value, when the pacing of the host write I/Os can be invoked. This value represents the percentage of the system write pending cache used by all active SRDF/A sessions on the Symmetrix array.

Under `GRP` (group-level write pacing) and `DEV` (device-level writing pacing), the Status (`S`) flag displays the SRDF/A write pacing status as Active, Inactive, or N/A. An Active status indicates that write pacing can occur if the system write pending cache threshold is surpassed. The Autostart (`A`) flag indicates if the write pacing Autostart feature is enabled or disabled. The Supported (`U`) flag indicates whether Enginuity can support write pacing in the current configuration. The Supported flag values only display when the Status flag indicates that Write Pacing is Active.

For all SRDF/A write pacing flag values, the N/A (-) status indicates this feature is not supported on the Symmetrix Enginuity version.

For detailed information on SRDF/A write pacing, see the *EMC Solutions Enabler Symmetrix SRDF Family CLI Product Guide*. To enable this feature, refer to setting SRDF group attributes in the *EMC Solutions Enabler Symmetrix Array Controls CLI Product Guide*.

Verifying SRDF hardware and software compression

With Solutions Enabler V7.4 and Enginuity 5876, or higher Hardware Compression is supported on RDF groups that are defined on GIGE directors and Fibre RDF (RF) directors.

The output of the `symcfg list -switched -ra all -rdfg` command displays whether RDF Hardware Compression is supported for each Fibre RDF director link, as well as disabled or enabled for the specified RDF group. The information displays under the `FLGS` column under `GROUP` and `LINK`, where `H` is for Hardware Compression.

To determine if SRDF hardware and software compression is enabled for SRDF groups and whether the director links of the RDG groups support this functionality, use the following command:

```
symcfg list -sid 306 -ra all -switched -rdfg 12

Symmetrix ID: 000195600061

            S Y M M E T R I X    R D F    D I R E C T O R S

           Local                 Group    Link              Remote
-------------------- ---------------- ---- ---------------------------------
                                     FLGS FLGS
    Ident  Symb  RA Grp  T Name       SH   SH  SymmID       Ident  Symb  RA Grp
    ------ ---- -------- ---------------- ---- ------------ ------ ---- --------

    RF-7F  07F    -      U     -      --   --  -            -      -     -
    RF-8F  08F   12 (0B) D sdb12_27   .X   XX  000195600432 RF-8F  08F   27 (1A)
    RF-9F  09F    -      U     -      --   --  -            -      -     -
    RF-10F 10F   12 (0B) D sdb12_34   X.   X.  000195600311 RF-8F  08F   34 (21)

Legend:
  Group (T)ype                     : D = Dynamic, S = Static, - = Unknown
```

```
Group Flags                     :
    RDF (S)oftware Compression : X = Enabled, . = Disabled, - = N/A
    RDF (H)ardware Compression : X = Enabled, . = Disabled, - = N/A

Link Flags                      :
    RDF (S)oftware Compression : X = Supported, . = Not supported, - = N/A
    RDF (H)ardware Compression : X = Supported, . = Not supported, - = N/A
```

Note: If using compatibility mode 72 or lower, the above SRDF hardware and software compression information does not display.

SRDF group flags

The Group FLGS SH column shows if software and hardware compression are enabled for an SRDF group. The S field is for software compression and the H field is for hardware compression. For each SRDF group, these fields can contain the following:

- X to indicate software/hardware compression is enabled on the local SRDF group.
- Period (.) to show software/hardware compression is disabled on the local SRDF group.
- Dash (-) to indicate this functionality is not supported. Software and hardware compression require a Symmetrix array running Enginuity 5875 or higher.

Director link flags

The Link FLGS SH column shows if software compression and hardware compression are supported on the director links of SRDF groups. The S field is for software compression and the H field is for hardware compression. For each director link, these fields can contain the following:

- X to indicate software/hardware compression is supported on both local and remote directors.
- Period (.) to show software/hardware compression is not supported on the local and/or remote director links.
- Dash (-) to indicate the local side supports this functionality but cannot reach the remote side to verify software/hardware support.

You can also use the following verbose option to list the above hardware and software compression information:

```
symcfg list -sid 332 -ra all -switched -v
```

Migrated devices

Both `symdev list` and `symdev show` provide information about devices that were changed or virtualized during a migration.

Changed devices

The `-identity_set` option of `symdev list` displays the devices whose effective identity changed after a migrate operation, as shown in the example output:

```
symdev -sid 207 -identity_set list

Symmetrix ID: 000192600207

        Device Name           Directors                  Device
--------------------------- ------------- -------------------------------------
                                                                          Cap
Sym  Physical               SA :P DA :IT  Config        Attribute    Sts   (MB)
--------------------------- ------------- -------------------------------------

0477 /dev/sddv              ***:* 06E:C1  2-Way Mir     N/Grp'd  (M) RW    2063
```

Virtualized devices

The `-identity` option of `symdev show` displays the effective identity information of devices that were virtualized during a migrate operation, as shown in the following example output:

```
symdev -sid 207 -identity show 0477

Device Physical Name     : Not Visible

Device Symmetrix Name    : 0477
Device Serial ID         : N/A
Symmetrix ID             : 000192600207

Number of RAID Groups    : 1

Attached BCV Device      : N/A

Attached VDEV TGT Device : N/A

Vendor ID                : EMC
Product ID               : SYMMETRIX
Product Revision         : 5825
Device WWN               : 60000970000192600207533030343737
Device Emulation Type    : FBA
Device Defined Label Type: N/A
Device Defined Label     : N/A
Device Sub System Id     : 0x0001
Cache Partition Name     : DEFAULT_PARTITION

Device Block Size        : 512

Device Capacity

    Cylinders            :        960
    Tracks               :      14400
    512-byte Blocks      :    1843200
    MegaBytes            :        900
    KiloBytes            :     921600

Effective Device Information
```

```
    Device WWN           : 60000970000192600306533030313732

    Front Director Paths (12): (See note below)

        ------------------------------------
         DIRECTOR   PORT             LUN
        ----------  ---- -------- ---------
        Type Num    Sts  VBUS TID SYMM Host
        ------------------------------------
        FA N/A  07E:3  RW   000  00  247  N/A
        FA N/A  07F:3  RW   000  00  247  N/A


    Geometry: User Defined
        {
        Sectors/Track    :         64
        Tracks/Cylinder  :         15
        Cylinders        :        200
        512-byte Blocks  :     192000
        MegaBytes        :         94
        KiloBytes        :      96000


Device Configuration     : Unprotected

Device is WORM Enabled   : No
Device is WORM Protected : No

SCSI-3 Persistent Reserve: Disabled

Dynamic Spare Invoked    : No

Dynamic RDF Capability   : RDF1_OR_RDF2_Capable

STAR Mode                : No
STAR Recovery Capability : None
STAR Recovery State      : NA

Device Service State     : Normal

Device Status            : Ready            (RW)
Device SA Status         : N/A              (N/A)
Host Access Mode         : Active
Device Tag(s)            : None


Front Director Paths (21):

    ----------------------------------------------------------------------
                            POWERPATH  DIRECTOR   PORT             LUN
                            --------- ----------  ---- -------- ---------
    PdevName                Type      Type Num    Sts  VBUS TID SYMM Host
    ----------------------------------------------------------------------
    Not Visible             N/A       FA   07E:1  RW   000  00  247  N/A
    Not Visible             N/A       FA   07F:1  RW   000  00  247  N/A

  . . .

Remote Copy Device Information

    Remote Copy Session Name               : N/A
    Session State                          : Created
    Pull                                   : True
    Offline Copy                           : False
    Differential Copy                      : Disabled
    Background Copy                        : Disabled
```

```
Incremental Copy                        : False
Donor Update                            : True
Federated Live Migration                : True
Starting Block                          :          0
Total Blocks                            :    192000
Percent Copied                          : N/A
Remote Devices [1]

  ---------------------------------------------------------------------
  Array:Dev             WWN                                Starting Block
  --------------------- ---------------------------------- --------------
  000187990007:012E     60000970000192600306533030313732              0
```

Host access mode

When a federated live migration session is activated, the remote device is placed into the passive host access mode and its control device is placed into the active host access mode. After the migration session completes, the remote device remains in this passive mode. To use this remote device, you must set it in host active mode, as shown in the previous output. This functionality is available on Symmetrix arrays running Enginuity 5875 or higher.

For example, if you want to use the remote devices in `prod1` after a migration, reset them to active mode by entering:

```
symdg -g prod1 host_active
```

To list the passive devices on Symmetrix 441, enter:

```
symdev -sid 441 -host_passive list
```

You can also view this information using the `symdev show` command.

Pinned devices

A user-pinned device is a standard or thin device that cannot be moved by any FAST automated process but can be moved by the Symmetrix Optimizer and the `symmigrate` operation. This functionality is available on Symmetrix arrays running Enginuity 5875 or higher.

To pin the devices in group `prod1`, enter:

```
symdg -g prod1 pin
```

To unpin the devices in group `prod1`, enter:

```
symdg -g prod1 unpin
```

To list the pinned devices in Symmetrix 341, enter:

```
symdev -sid 341 -pinned list

Symmetrix ID: 000194900341

        Device Name           Directors                  Device
--------------------------- ------------- -------------------------------------
                                                                          Cap
Sym  Physical               SA :P DA :IT  Config        Attribute    Sts   (MB)
--------------------------- ------------- -------------------------------------

 115 /dev/sdcq              08F:0 07A:D3  RAID-6        N/Grp'd      RW    2063
```

You can also view this information using the `symdev show` command.

Filtering device data

The `symdev list` and `symdev list pd` commands return a list of devices configured in one or more Symmetrix arrays connected to the controlling host. The `pd` qualifier returns only physical devices, and must appear after the list action on the command line, and is valid with all the `symdev list` options.

The `symdev list` command provides the following filter options to help you retrieve various types of information about your Symmetrix devices:

```
symdev [-sid SymmID] [-offline] [-v] [-resv | -pgr]
            [-wwn | -wwn_encapsulated [-detail]] [-all]

         list [ -FA <#|ALL> [-p <#>] |
           -SA <#|ALL> [-scsi] [-fibre] [-p <#>]]
           [-devs SymDevStart:SymDevEnd | SymDevName
               [,SymDevStart:SymDevEnd | SymDevName...]]
           [-cap <#> [-captype <mb | cyl>]] [-N <#>]
           [-vcm | -aclx] [-held] [-gige]
           [-ficon] [-escon] [-dldev]
           [-noport|-firstport|-multiport] [-bcv|-nobcv|-drv]
           [-meta] [-nomember]
           [-spare] [-dynamic] [-worm] [-vdev]
           [-savedev [-nonpooled]] [-raids]
           [-disk_group DskGrpNum | name:DskGrpName]
           [-rg][-sec_raid] [-unprotected] [-sec_unprotected]
           [-raid1] [-sec_raid1] [-bcv_emulation]
           [-raid5 [-protection <3+1 | 7+1>]]
           [-raid6 [-protection <6+2 | 14+2>]]
           [-sec_raid5 [-sec_protection <3+1 | 7+1>]]
           [-sec_raid6 [-sec_protection <6+2 | 14+2>]]
           [-emulation fba|ckd|ckd3390|ckd3380|as400|celerra]
           [-star_mode] [-star_sync_target] [-star_async_target]
           [-reserved | -noreserved] [-cyl] [-geometry_set]
           [-service_state [not]degraded | [not]failed |
                           [not]normal]
           [-tdev [-bound | -unbound]] [-datadev [-nonpooled]]
           [-migr_tgt] [-pinned] [-host_passive] [-identity_set]
           [-identity [-detail]] [-sg SgName] [-rcvrpnt]
           [-technology <EFD | FC | SATA>]
           [-host_cache] [-dif1] [-as400_gk] [-fast]
           [-internal | -external | -encapsulated [-limited]]
           [ -notrdf | [-rdfg RdfGrpNum [-rdfa]
           [-R1] [-R2] [-R21] [-half_pair] [-dup_pair]]]
```

The following sections provide additional details about some of the above options. For more information on these options, refer to the *EMC Solutions Enabler SYMCLI Command Reference Guide.*

Using the -all option

The `symdev` command has an `-all` option, which returns all configured devices.

Filtering by director

You can list the host-visible Symmetrix devices that match a specific front-end director number (`-SA`) or front-end director port number (`-P #`). The output can be further limited to devices that are mapped to SCSI front-end directors (`-scsi`), or Fibre front-end directors (`-fibre`).

Filtering by director port mapping

In addition, you can limit the returned list of Symmetrix devices to one of the following: devices that are mapped to more than one front-end director port (`-multiport`), devices that are not mapped to any front-end director port (`-noport`), or first port information for devices that have more than one port mapping schemas (`-firstport`). If none of these options are specified, then devices with all director-port relationships are returned.

Filtering by metadevice

You can list meta member devices by using the `-meta` option. The `-nomember` option prevents meta member devices from being displayed, but still displays meta head devices. These options are valid with any combination of `symdev` command options.

Filtering by SRDF devices

There are various `symdev` command options that can be used to filter SRDF devices. SRDF device filter options include: `-R1`, `-R2`, `-R21`, `-rdfg` *RdfGrpNum*, `-notrdf`, `-rdfa`, `-half_pair`, and `-dup_pair`. The `-R1`, `-R2`, and `-R21` device options can be used to list all of those types of SRDF devices respectively, and can be used together or independently to achieve the desired results. The `-rdfg` option only returns devices belonging to the the specified SRDF group number (*RdfGrpNum*). The `-notrdf` option returns all devices not configured as SRDF. The `-notrdf` option can also be used in conjunction with the `-R1`, `-R2`, and `-R21` device options to include non-RDF devices in the list along with those specified devices.

When used in conjunction with the `-dynamic` option, the `-notrdf` option can be used to return all dynamic capable devices that are not already SRDF devices. This allows you to quickly find non-SRDF devices that have dynamic SRDF capability.

Note: The `-R21` option is not currently supported in conjunction with the `-dynamic` option.

Use the `-rdfa` option to list all devices that are SRDF/Asynchronous capable. Use the `-half_pair` option to list all devices that are not partnered with an SRDF device. Existing half pair devices could have resulted from an SRDF/Star failover scenario, a half_deletepair operation, or a configuration change. Use the `-dup_pair` option to list all devices that are paired with the same SRDF type. Existing duplicate pair devices could have resulted from an SRDF/Star failover scenario or a configuration change.

Note: Refer to the *EMC Solutions Enabler Symmetrix SRDF Family CLI Product Guide* for detailed information on SRDF device types and failover configurations.

Filtering by FAST

With Solutions Enabler 7.5 and higher, you can use the `symdev list` command with the `-fast` option to filter Fully-Automated Storage Tiering (FAST) controlled devices. This returns all devices from storage groups that are associated with either a FAST or FAST VP policy.

Solutions Enabler does not filter based on the policy it is associated with. For example, if you have a thick device under a storage group that is associated with a FAST VP policy, that device is returned as part of the result. Unbound and pinned devices are also returned as part of this filter.

Listing RAID device information

You can list RAID-S devices by RAID group using the `-raids` option (or `-raid` option, which performs the same operation).

When viewing device output for RAID 5 devices, it is important to note that the total device capacity (`Device Capacity`) displayed is actually the total logical capacity. By contrast, the hyper capacity (`Hyper Num Cap`) displayed for each member is the physical capacity, which includes all device space—available and unavailable. The truncated example output below highlights the differences:

```
symdev list -v -raid5 -sid 256

Device Symmetrix Name    : 5160
    Device Serial ID         : N/A
    Symmetrix ID             : 000192600256

    Number of RAID Groups    : 1

    Attached BCV Device      : N/A

    Attached VDEV TGT Device : N/A

    Vendor ID                : EMC
    Product ID               : SYMMETRIX
    Product Revision         : 5875
    Device WWN               : 60000970000192600256533030313630
    Device Emulation Type    : FBA
    Device Defined Label Type: N/A
    Device Defined Label     : N/A
    Device Sub System Id     : 0x0002
    Cache Partition Name     : DEFAULT_PARTITION

    Device Block Size        : 512

    Device Capacity

        Cylinders            :       4602
        Tracks               :      69030
        512-byte Blocks      :    8835840
        MegaBytes            :       4314
        KiloBytes            :    4417920

    Effective Device Information

        Device WWN           : 60000970000192600256533030313630

        Front Director Paths (0): N/A

        Geometry             : Native

            Sectors/Track        :        128
            Tracks/Cylinder      :         15
            Cylinders            :       4602
            512-byte Blocks      :    8835840
            MegaBytes            :       4314
            KiloBytes            :    4417920

    Device Configuration     : RAID-5

    Device is WORM Enabled   : No
    Device is WORM Protected : No

    SCSI-3 Persistent Reserve: Disabled
```

```
Dynamic Spare Invoked    : No

Dynamic RDF Capability   : RDF1_OR_RDF2_Capable

STAR Mode                : No
STAR Recovery Capability : None
STAR Recovery State      : NA

Device Service State     : Normal

Device Status            : Ready            (RW)
Device SA Status         : N/A              (N/A)
Device User Pinned       : FALSE

Host Access Mode         : ACTIVE

Extent Based Clone       : None

Mirror Set Type          : [RAID-5,N/A,N/A,N/A]

Mirror Set DA Status     : [RW,N/A,N/A,N/A]

Mirror Set Inv. Tracks   : [0,0,0,0]

Back End Disk Director Information

    Hyper Type                            : RAID-5
    Hyper Status                          : Ready           (RW)
    Disk [Director, Interface, TID]       : [N/A,N/A,N/A]
    Disk Director Volume Number           : N/A
    Hyper Number                          : N/A
    Mirror Number                         : 1
    Disk Group Number                     : 2
    Disk Group Name                       : DISK_GROUP_002

RAID Group Information

    Mirror Number                           : 1
    RAID Type                               : RAID-5
    Device Position                         : Primary
    Protection Level                        : 7+1
    RAID Group Service State                : Normal
    Failing Member Mask                     : N/A
    Hyper Devices:

        Device : 0160

            -----------------------------------------------------
             Disk     DA      Hyper        Member        Disk
            DA :IT   Vol#  Num  Cap(MB)  Num Status  Grp#  Cap(MB)
            -----------------------------------------------------
            08A:D4     597  212     626    1 RW         2   953870
            10C:D4     574  212     626    2 RW         2   953870
            08C:D4     574  212     626    3 RW         2   953870
            09B:D4     573  212     626    4 RW         2   953870
            07B:D4     573  212     626    5 RW         2   953870
            09D:D4     572  212     626    6 RW         2   953870
            07D:D4     572  212     626    7 RW         2   953870
            10A:D4     574  212     626    8 RW         2   953870
```

Filtering by technology type

By using the `-technology` option, you can filter on the drive technology (FC, EFD, and SATA) of the primary local back-end storage of the device. This is supported on Symmetrix arrays running Enginuity 5874 and higher.

Filtering by DA, interface, disk, or hypervolume

Host-visible Symmetrix devices can be listed that match a specific DA (`-da`), DX (`-dx`), interface (`-interface`), disk (`-disk`), disk group number or name (`-disk_group`), or hypervolume (`-hyper`) values. The interface, disk, and hyper values default to ALL if the corresponding options are not specified.

Filtering by storage group

By using the `-sg` option, you can filter devices by a specified storage group.

Filtering by DIF1 attribute

The Data Integrity Field (DIF) is a setting on a device that is relevant to an Oracle environment and all hosts that support the DIF protocol. If the DIF1 attribute has been set on a device, output displays as `TRUE` or `FALSE` in the results of device list and show CLIs. The `symdev list` command with the `-dif1` option allows you to filter for devices that have the DIF1 attribute turned on.

Note: Refer to the *EMC Solutions Enabler Symmetrix Array Controls CLI Product Guide* for detailed information on setting device attributes.

DIF1 restrictions

The following restrictions apply while setting/resetting DIF1 attribute on devices:

- Only supported with Solutions Enabler V7.4 and Enginuity 5876, or higher.
- DIF1 attribute can only be set on FBA devices.
- DIF1 attribute can be set on both standard provisioned (thick) and virtually provisioned (thin) host accessible devices, setting the DIF1 attribute request on any internal devices will be rejected.
- Device must be unmapped while resetting the DIF1 attribute.
- Device can be mapped to only fiber front end directors (no iSCSI or FCoE) while setting the DIF1 attribute.
- If a device has DIF1 attribute already set then it can be mapped only to fiber front end directors (no iSCSI or FCoE).
- If creating a meta device, both the head and members need to have the DIF1 attribute in the same state (either all set or all reset).
- DIF1 attribute needs to be set before requesting reset. If the reset request is for a device range and if any one of the device has the DIF1 attribute not set, then the request will fail.
- DIF1 attribute can not be set on DATA and SAVE devices.
- Devices can only have the RDB_Checksum attribute or the DIF1 attribute set , but not both.
- The DIF1 flag can not be set on a device having active DCS.
- Devices can only have the ACLX attribute or the DIF1 attribute set, but not both.
- There is no relation between the DIF1 attribute and replication. Both source and target devices of any replication can have their own DIF1 setting.

Filtering by AS400_GK attribute

The AS400_GK attribute setting on a Symmetrix device is required when a AS400 device is used in conjunction with IBM host control software. The attribute is also used in conjunction with the Celerra Network Attached Storage for Celerra gatekeeper devices.

If the AS400_GK attribute has been set on a device, output displays as `TRUE` or `FALSE` in the results of device list and show CLIs. The `symdev list` command with the `-as400_gk` option allows you to filter for devices that have the AS400_GK attribute turned on.

Note: Refer to the *EMC Solutions Enabler Symmetrix Array Controls CLI Product Guide* for detailed information on setting device attributes.

AS400_GK restrictions

- The following restrictions apply while setting/resetting the AS400_GK attribute on devices:
- Only supported with Solutions Enabler V7.4 and Enginuity 5876 or higher.
- AS400_GK attribute can only be set on AS400 or Celerra FBA devices.
- The device cannot be configured as a SAVE, DATA, BCV, RDF or dynamic RDF device.
- If an AS400 or a Celerra FBA device is created using the `symconfigure create gatekeeper` command, then its AS400_GK attribute will be set to enable.
- The symconfigure create gatekeeper command is only supported for the following disk group provisioned emulations:
  - AS/400_M2107_A02
  - AS/400_M2107_A04
  - AS/400_M2107_A05
  - AS/400_M2107_A06
  - AS/400_M2107_A07
  - AS/400_M2107_A82
  - AS/400_M2107_A84
  - AS/400_M2107_A85
  - AS/400_M2107_A86
  - AS/400_M2107_A87
  - AS/400_M2107_050
  - AS/400_M2107_099
  - AS/400 D910_099
- The AS400_GK attribute can only be set on non meta devices.
- Setting the AS400_GK attribute is only supported on 2-48 cyl sized AS400 devices having the following disk group provisioned emulations:
  - AS/400_M2107_A02
  - AS/400_M2107_A04
  - AS/400_M2107_A05
  - AS/400_M2107_A06
  - AS/400_M2107_A07
  - AS/400_M2107_A82
  - AS/400_M2107_A84

- AS/400_M2107_A85
- AS/400_M2107_A86
- AS/400_M2107_A87
- AS/400_M2107_050
- AS/400_M2107_099
- AS/400 D910_099

Device output options

Specifying the `-cyl` option modifies the output list to include device capacity in cylinders rather than the default of megabytes (MB). The `-pd` option will only display the host visible devices (PDevs).

Releasing device external locks

The EMC Solutions Enabler uses *device external locks* in the Symmetrix array to lock pairs during replication operations (such as Open Replicator, TimeFinder, and SRDF operations).

To list a range of Symmetrix devices (0000 to 000A) that have a device external lock, enter:

```
symdev list -sid 870 -devs 0000:000A -lock
```

If you discover a lock from your host that has been held for well over two hours and you have confirmed no one is using the device resources, you can choose to release the lock. To release the device lock on a range of Symmetrix devices in Symmetrix 870, enter:

```
symdev release -sid 870 -devs 0000:000A
```

⚠CAUTION

Use the release lock action only if you believe that the Symmetrix device lock was forgotten and there are NO other operations in progress to the specified Symmetrix devices (local or remote). Locks are typically of short duration (one second to an hour or so). However, it is critical to be able to recognize when a device lock being held by certain applications (such as an SRDF action) are allocated as long duration locks.

Aborting the session, if successful, will release all locks held by the session including device locks. The following examples show two instances of the `symdev release` command when the user attempts to release device locks held by the configuration server.

```
symdev release -sid 343 -devs 200:205

Within Symmetrix unit 000190300343, release lock for device 205 (y/[n]) ? y

Device lock is held by a configuration change session <654>. The session should be
   aborted to release the lock.

symdev release -sid 343 204

Within Symmetrix unit 000190300343, release lock for device 204 (y/[n]) ? y

Device lock is held by a migration session <654>. The session should be aborted to
   release the lock.
```

CLARiiON devices

The `symdev -clariion list` command can be used to return data about CLARiiON devices. The returned list of CLARiiON devices can be limited to a specific CLARiiON by specifying a CLARiiON ID (`-cid`), by capacity (`-CAP`), by a number of devices (`-N`), or a range of devices (`-devs`).

Listing CLARiiON devices

The following example shows the output for a list of CLARiiON devices in the device number range of `230` to `250`:

```
symdev -clariion list -devs 230:250

Clariion ID: APM00034501433

             Device                                Device
---- ---------------------  ---------------------------------------------
Num   Physical Name         Config    Cap(MB)  WWN
---- ---------------------  ---------------------------------------------

0230  Not Visible           RAID-5       1024  6006016095E30D005B6301EFAD10D911
0231  Not Visible           RAID-5       1024  6006016095E30D005C6301EFAD10D911
0232  Not Visible           RAID-5       1024  6006016095E30D005D6301EFAD10D911
0233  Not Visible           RAID-5       1024  6006016095E30D005E6301EFAD10D911
0234  Not Visible           RAID-5       1024  6006016095E30D00F4691DF5AD10D911
0235  Not Visible           RAID-5       1024  6006016095E30D00F5691DF5AD10D911
0236  Not Visible           RAID-5       1024  6006016095E30D00F6691DF5AD10D911
0237  Not Visible           RAID-5       1024  6006016095E30D00F7691DF5AD10D911
0238  Not Visible           RAID-5       1024  6006016095E30D00F8691DF5AD10D911
0239  Not Visible           RAID-5       1024  6006016095E30D00F9691DF5AD10D911
0240  Not Visible           RAID-5       1024  6006016095E30D00FA691DF5AD10D911
0241  Not Visible           RAID-5       1024  6006016095E30D00FB691DF5AD10D911
0242  Not Visible           RAID-5       1024  6006016095E30D00FC691DF5AD10D911
0243  Not Visible           RAID-5       1024  6006016095E30D00FD691DF5AD10D911
0244  Not Visible           RAID-5       1024  6006016095E30D00FE691DF5AD10D911
0245  Not Visible           RAID-5       1024  6006016095E30D00B0BE47FBAD10D911
0246  Not Visible           RAID-5       1024  6006016095E30D00B1BE47FBAD10D911
0247  Not Visible           RAID-5       1024  6006016095E30D00B2BE47FBAD10D911
0248  Not Visible           RAID-5       1024  6006016095E30D00B3BE47FBAD10D911
0249  Not Visible           RAID-5       1024  6006016095E30D00B4BE47FBAD10D911
0250  Not Visible           RAID-5       1024  6006016095E30D0066D61F3BAF10D911
```

Disk-level data

The configuration database file maintains low-level configuration and status information for each disk on every Symmetrix array that is accessible from the host, as well as external spindles (eDisks). Using SYMCLI, you can get a list of all the available disks. You can then choose a disk from this list and get its configuration and status information.

List and show disk information

The `symdisk list` and `show` commands use the following syntax:

```
symdisk [-sid SymmID] [-offline] [-cyl]
             [-disk_group DskGrpNum | name:DskGrpName | ALL
              [-all]] [-failed]

        list [-spindle [-internal]] [-isspare] [-nospares]
             [-v [-hypers] [-spare_info] [-gaps]]
```

```
                    [-DA <# | ALL>] [-interface <# | ALL>]
                    [-tid <# | ALL>]

                list [-spindle [-external [-detail] [-encapsulated [-free]]]]
                    [-v [-hypers] [-gaps]]
                    [-DX <# | ALL>]

          symdisk [-sid SymmID] -external -spindle -paths
                    [-spid SpindleID |-DX <# | ALL> [-port <# | ALL>]]
                list -detail
                list [-offline]

          symdisk [-sid SymmID] [-offline] [-cyl]
                list -dskgrp_summary [-v]
                    [-disk_group DskGrpNum | name:DskGrpName | ALL]
                     | -internal | -external]

                show DiskAddress [-gaps_only]

          symdisk -sid SymmID [-offline] [-cyl]
                show -spid SpindleID [-gaps_only]
                show -wwn ExternalWWN [-gaps_only]
```

Note: Do not specify the `-spare_info` and `-failed` options together in the `symdisk` command. This is an invalid combination.

The following `symdisk list` command shows an example listing including both internal and external disks (eDisks):

```
symdisk list -sid 306

Symmetrix ID                  : 000194900306
Disks Selected                : 64

                                                                  Capacity(MB)
Ident  Symb Int TID Vendor     Type       Hypr   Total       Free      Actual
------ ---- --- --- ---------- ---------- ---- ---------- ---------- ----------
DF-8A  08A    C   1 SEAGATE    T146155      14     139028     120506     139028
DF-8A  08A    C   3 SEAGATE    T146155       1     139028     138911     139028
DF-8B  08B    C   0 SEAGATE    T146155      15     139028     123071     139028
DF-8B  08B    C   2 SEAGATE    T146155      15     139028     124751     139028
DX-7E  07E    -   - EMC Corp   N/A           0     103100     103100     103100
DX-7F  07F    -   - EMC Corp   N/A           3      23068          0      23068
DX-7F  07F    -   - EMC Corp   N/A           1     103100          0     103100
  . . .
                                                ---------- ---------- ----------
Totals                                             2785380    1610339    2785380
```

The following example displays list information about the disks and hypers on the specified disk adapter (`02A`):

```
symdisk list -da 02A -sid 039

Symmetrix ID                  : 000187900039
Disks Selected                : 7

                                                                Capacity(MB)
Ident  Symb Int TID Vendor     Type       Hypers   Total    Free    Actual
------ ---- --- --- ---------- ---------- ------ -------- -------- --------
DF-2A  02A    C   1 SEAGATE    CH146LF         9   139814   123266   140014
DF-2A  02A    C   3 SEAGATE    CH146LF         9   139814   122329   140014
DF-2A  02A    C   5 SEAGATE    CH146LF         9   139814   121171   140014
DF-2A  02A    C   7 SEAGATE    CH146LF         8   139814   125334   140014
```

```
DF-2A  02A    C   9 SEAGATE    CH146LF         8   139814   127397   140014
DF-2A  02A    C   B SEAGATE    CH146LF         8   139814   125334   140014
DF-2A  02A    C   D SEAGATE    CH146LF         8   139814   127397   140014
```

Note: The `-DA` option only lists internal disks.

The following example shows details about the specified disk (`7A:C0`):

```
symdisk show 7A:C0 -sid 345

Symmetrix ID                  : 000194900345
  Director                    : DF-7A
  Interface                   : C
  Target ID                   : 0
  Spindle ID                  : 189C
  Disk Group Number           : 1
  Disk Group Name             : DISK_GROUP_001
  Technology                  : SAS
  Speed (RPM)                 : 7200
  Form Factor                 : 3.5
   . . .
  Spare Disk                  : True

  Failed Disk                 : False

  Hypers (115):
  {
  #   Vol   Emulation         Dev  Type           Mir Mbr Status          Cap(MB)
  --- ----- ---------------- ---- ------------- --- --- -------------- --------
    1     1 VAULT_DEVICE     0000 Data           1  N/A N/A                5200
    2     2 FBA              1021 RAID-1         1   2  Ready              2098
  . . .
```

When virtual devices (VDEVs) are part of your disk configuration, the capacity shown for these virtual hypers reflects only space to store track tables (pointers). Typically, a low number, such as 3 MB, is needed for these devices.

SAS devices

Serial Attached SCSI (SAS) disk drives in 300 GB, 450 GB and 600 GB capacity versions are supported. This includes the Cobra-D SAS 300, 450, and 600 GB disks drives (2.5" drive using 3.5" carrier and SAS/FC paddle card). The `symdisk show` and `symdisk list -v` CLI commands display the SAS disk technology type under the Technology label. The Form Factor label displays 2.5, 3.5, or N/A to note the Enterprise Flash Drive.

Note: For Disk Groups that contain internal spindles with different form factors (e.g. 2.5" and 3.5"), the Form Factor label displays as Mixed.

Disk gaps

Using the `-gaps` option with the `symdisk list` command lists any gaps found on the disk, and the `-spare_info` option tells you what disk the spare disk is substituting for, if it has been invoked.

The `symdisk show` command has a `-gaps_only` option that lists any gaps found on the disk without listing all of the hyper information.

Actual vs. rated disk capacity

The `Actual Disk Capacity` and the `Rated Disk Capacity` are calculated differently. The `Actual Disk Capacity` reports on the physical disk capacities in MBs and GBs, where the MB is defined as (1024 x 1024) bytes and the GB is defined as 1024 MBs (or 1024 x 1024 x 1024 bytes). The `Rated Disk Capacity` is based on the MB being defined as (1000 x 1000 bytes), the GB being defined as 1000 MBs (or 1000 x 1000 x 1000 bytes), and the TB defined as 1000 GBs. The `Rated Disk Capacity` is typically shown in sales and licensing documentation. This functionality is for Symmetrix arrays running Enginuity 5875 or higher.

Disk groups

When returning a list of disks, the `-by_diskgroup` option organizes the returned list of disks by disk group number. The `-disk_group` option allows you to limit the resulting list to disks belonging to a specified disk group. Disk groups can be specified by group number (*DskGrpNum*) or group name (`name:` *DskGrpName*). The `ALL` option returns disk information for all disk groups.

The `symdisk list -dskgrp_summary` command is used to display summary information for disk groups. Using the `-dskgrp_summary` option without the `-v` option displays disk group summary information in a table format. Using the `-dskgrp_summary` option with the `-v` option displays disk group information in expanded format (one field per line). Information regarding spare disks is not included in the `-dskgrp_summary` output.

Note: The `-dskgrp_summary` option is incompatible with the `-hypers`, `-spare_info`, `-gaps`, `-isspare` and `-failed` options.

Note: With Solutions Enabler V7.5, display output for disk groups now support disk group numbers in excess of 1000. Display output columns have been adjusted.

The following example shows disk group summary information for all disk groups on Symmetrix 332:

```
symdisk list -dskgrp_summary -sid 332

Symmetrix ID: 000194900332

      Disk Group                Disk                        Capacity
---------------------- ----------------------- --------------------------------
                                Speed  Size      Total      Free      Actual
Num Name               Cnt Tech (RPM)  (MB)      (MB)       (MB)       (MB)
---------------------- ----------------------- --------------------------------

  1 DISK_GROUP_001       16 SATA  7200  953870   15261915   10627769   15261915
  2 DISK_GROUP_SAS       16 FC    7200  953870   15261915   12231733   15261915
  3 DISK_GROUP_003        8 FC   15000  418710    3349684    3152379    3349684
  4 DISK_GROUP_004        8 FC   15000  418710    3349684    3009503    3349684
                                                ---------- ---------- ----------
Total                                            37223198   29021384   37223198

Legend:
  (Tech)nology : SATA = SATA, FC = Fibre Channel, EFD = Enterprise Flash Drive
```

Note: When reporting at the disk-group level, the Technology type for a group containing SAS disks is always displayed as FC.

Spare physical disks

The `symdisk -isspare` command exclusively returns information about spare physical disks (spindles). If a spare disk is invoked against a failed disk, the `symdisk -v -spare_info` option can be used to return information about the failed disk that has been replaced. The `-v` option must be specified. Note that this display option is not applicable for permanent sparing.

Note: Dynamic sparing is only supported on Symmetrix arrays running Enginuity 5873 and lower. Permanent sparing is supported on Symmetrix arrays running Enginuity versions 5874 and higher.

The selection criteria allows you to return only data about the disks on a certain disk director (`-DA`), disk interface (`-interface`), or disk SCSI target ID (`-tid`). In addition, the `-isspare` option may be used to select only those disks that are configured as spare disks.

The following example shows the truncated output, where the spare disk has been invoked against disk `16B:C0`:

```
symdisk list -v -spare_info
   ...
     Spare Disk                 : False

     Director                   : DF-16B
     Interface                  : C
     Target ID                  : A
     Disk Group Number          : 2

     Vendor ID                  : SEAGATE
     Product ID                 : SX3146807FC
     Product Revision           : CH146LF
     Serial ID                  : 3HY9CQVK

     Disk Blocks                : 0
     Block Size                 : 512
     Actual Disk Blocks         : 286749475
     Total Disk Capacity (MB)   : 0
     Free Disk Capacity (MB)    : 0
     Actual Disk Capacity (MB)  : 140014
     Hypers                     : 0

     Spare Disk                 : True

     Failed Director            : DF-15A
     Failed Interface           : C
     Failed Target ID           : 0
```

The `-gaps` option on the `list` command lists gaps found between hypers on the disk, as the hypers are listed. To see a short list of only the gap information, either do not specify the `-hypers` option on the `symdisk list` command, or specify the `-gaps_only` option on the `symdisk show` command.

Note: The gap sizes provided by this report are only an approximation. The report can be used as a general guide to the location and size of free space gaps, but it may not be accurate down to the last cylinder.

The `-nospares` option indicates that only internal disks (spindles) that are capable of being covered by a spare, but currently are not, should be displayed. This option is only supported on Enginuity version 5876 and higher. No disks (spindles) will be displayed if this option is issued for a Symmetrix running a prior Enginuity version. In addition, this option is not applicable for external spindles (external spares do not exist) and no external spindles will be returned when this option is specified.

Spindle information

The `symdisk list` command with the `-spindle` option provides a disk listing that identifies each disk by Spindle ID and includes the director number for each. The `symdisk -spid` *`Spindle_ID`* option allows specifying physical disks by Spindle ID.

Note: For Enginuity versions less than 5875, the specified/returned Spindle ID does not represent an actual Enginuity entity, but is a string representation of a unique hexadecimal number, which upon being returned may be used as an input parameter for `symdisk show` commands.

The following `symdisk list` command output shows an example of a disk listing using the `-spindle` option:

```
symdisk list -spindle -sid 306

Symmetrix ID                  : 000194900306
Disks Selected                : 64

                                                        Capacity(MB)
Spindle  Dir Vendor     Type       Hypr   Total       Free      Actual
-------- --- ---------- ---------- ---- ---------- ---------- --------
32E      08A SEAGATE    T146155      14     139028     120506     139028
16B35    08A SEAGATE    T146155      19     139028     118758     139028
1D83     08B SEAGATE    T146155      15     139028     123071     139028
22C34    08B SEAGATE    T146155      15     139028     124751     139028
 . . .
                                        ---------- ---------- ----------
Totals                                     7785556    6975177    7785556
```

The following `symdisk show` command shows sample output for a physical disk specified by Spindle ID (`-spid` *`Spindle_ID`*). Note that this is the same output format as `symdisk list -v` (verbose).

```
symdisk show -spid 1B935 -sid 306

Symmetrix ID                  : 000194900306
  Director                    : DF-8A
  Interface                   : C
  Target ID                   : 1
  Spindle ID                  : 1B935
  External WWN                : 60000970000195700233533030333132
  External Array ID           : 0001957000233
  External Device Name        : 031B
  Disk Group Number           : 001
  Disk Group Name             : DISK_GROUP_001
  Technology                  : FC
  Speed (RPM)                 : 15000
```

```
  Form Factor                    : N/A

  Vendor ID                      : EMC
  Product ID                     : Symmetrix
   . . .
```

Note: For Solutions Enabler V7.6 and Enginuity 5876, the `symdisk list` and `show` commands for spindles now identify remote Data Domain appliances when reporting on virtualized disks and LUNs on external arrays. If applicable, DataDomain displays in the Product ID field.

The following example shows `symdisk list` output for a specific disk group, with a request for the `-spindle` display, which includes director and Spindle ID information:

```
symdisk list -disk_group 004 -spindle -sid 306

Symmetrix ID                     : 000194900306
Disks Selected                   : 8
Disk Group                       : 4
Disk Group Name                  : DISK_GROUP_004
Technology                       : FC
Speed (RPM)                      : 15000
                                                        Capacity(MB)
Spindle  Dir Vendor     Type       Hypr   Total        Free       Actual
-------- --- ---------- ---------- ---- ---------- ---------- --------
32A      07A SEAGATE    HUC4515      52     418710     380208     418710
B7       08A SEAGATE    HUC4515      52     418710     380208     418710
5C9      07B SEAGATE    HUC4515      53     418710     379729     418710
1D01     08B SEAGATE    HUC4515      53     418710     364605     418710
 . . .
                                        ---------- ---------- ----------
Total                                      3349684    3009503    3349684
```

Note: The `sympd list` command with the `-spindle` option also provides spindle ID information. "Using the sympd and symdev commands" on page 83 provides more information.

Viewing external spindle information

Information on eDisks (external spindles) added using Federated Tiered Storage (FTS) can be viewed using the `symdisk show` command with the `-wwn` option. This command allows you to find the spindle ID of a newly added eDisk.

Federated Tiered Storage gives you the ability to use an external disk to attach external storage to a Symmetrix array. Adding an eDisk to a Symmetrix array makes the eDisks capacity available to the Symmetrix array as an external spindle.

Note: Note: FTS is supported with Solutions Enabler V7.4 and Enginuity 5876 and higher.

Refer to the *Solutions Enabler Symmetrix Array Controls CLI Product Guide* for information about the FTS feature.

The output from the `symdisk` CLI command shows the Disk Location as *Internal* for internal disks or *External* eDisks. The output also shows whether or not the eDisk is encapsulated. The Disk Service State represents the availability of the eDisk. For versions of Enginuity earlier than 5876, the Disk Location of the disks is shown as Internal. For external disks, the Technology shown for the disk displays as N/A. The number of external paths available to the external LUN to reach the eDisk is also displayed.

The Failed Disk State is reported as part of the Disk Service State, showing states of *Normal* or *Failed* for internal disks. For external disks the Disk Service State is shown as Failed if there are no network paths available to the eDisk (neither active nor passive), *Degraded* if there are paths from only one of its supporting DX directors to the eDisk (either active or passive), and Normal if there is at least one active and one passive network path available from both supporting DX directors to the eDisk.

The following `symdisk show` output can be used to show the newly added external spindle. The new spindle ID is found using the eDisk WWN. The command output also shows hyper information if a metadevice was created to encapsulate the user data.

```
symdisk show -sid 306 -wwn 60000970000194900306533030314345

  Director                   : DX-7F
  Interface                  : N/A
  Target ID                  : N/A
  Spindle ID                 : 2256
  External WWN               : 60000970000194900306533030314345

  Disk Group Number          : 522
  Disk Group Name            : DISK_GROUP_0522
  Disk Location              : External
  Technology                 : N/A
  Speed (RPM)                : N/A
  Form Factor                : N/A

  Vendor ID                  : EMC Corp
  Product ID                 : N/A
  Product Revision           : N/A
  Serial ID                  : N/A

  Disk Blocks                : 47243264
  Block Size                 : 512
  Actual Disk Blocks         : 47243264
  Total Disk Capacity (MB)   : 23068
  Free Disk Capacity (MB)    : 0
  Actual Disk Capacity (MB)  : 23068
  Rated Disk Capacity (GB)   : N/A
  Hot Spare                  : False
  Encapsulated                 : True

  Disk Service State         : Normal

  Hypers (3):
  {
  #   Vol  Emulation        Dev  Type          Mir Mbr Status         Cap(MB)
  --- ---- ---------------- ---- ------------- --- --- -------------- --------
    1    3 FBA              00E6 Ext-Data       1   1  Ready              9437
    2    3 FBA              00E7 Ext-Data       1   2  Ready              9437
    3    3 FBA              00E8 Ext-Data       1   3  Ready              4194
  }
```

The following `symdisk list` command shows an example using the `-external` option to list only external spindles:

```
symdisk -sid 647 list -external -spindle -detail

Symmetrix ID                 : 000192600647
Disks Selected               : 3
                       External Information              Capacity(MB)
Spindle  Dir Array ID         Dev   Vendor     Type       Hypr   Total       Free      Actual
-------- --- ---------------- ----- ---------- ---------- ---- ---------- ---------- ----------
1E00     16G 000195700233      031A EMC        N/A           1       2063          0       2063
1E80     16G 000195700233      031B EMC        N/A           1       2063          0       2063
```

```
1F36     15G 000195700233      031C EMC        N/A           1     204801     204751     204801
                                                                 ---------- ---------- ----------
Totals                                                                 208927     204751     208927
```

Note: Prior to Enginuity 5876, the vendor name displays values of N/A.

The following `symdisk list` command shows an example using the `-encapsulated` option to list the Spindle IDs for eDisks that have been encapsulated:

symdisk list -spindle -external -encapsulated -sid 306

```
Symmetrix ID                 : 000194900306
Disks Selected               : 38

                                                        Capacity(MB)
Spindle  Dir Vendor     Type       Hypr   Total       Free      Actual
-------- --- ---------- ---------- ---- ---------- ---------- --------
2D2      07F EMC Corp   N/A           3      23068          0      23068
30C      07F EMC Corp   N/A           1     103100          0     103100
  . . .
```

Use the `symdisk list` command with the `-free` option to show only external encapsulated spindles that have no allocations on all of their datadevs or that have no raid groups existing on them. This means that the devices that resided on these spindle have been fully migrated and these external spindles can be deleted.

symdisk list -spindle -external -encapsulated -free -sid 306

```
Symmetrix ID                 : 000194900306
Disks Selected               : 38

                                                        Capacity(MB)
Spindle  Dir Vendor     Type       Hypr   Total       Free      Actual
-------- --- ---------- ---------- ---- ---------- ---------- --------
30C      07F EMC Corp   N/A           0     103100          0     103100
  . . .
```

Use the `symdisk list` command with the `-paths` option to display path information for an external spindle. Output shows the number of external paths available to each external spindle to reach the virtualized eDisk and how many of those paths are actively used for SCSI I/O.

symdisk list -external -spindle -paths

```
Symmetrix ID: 000194900306

              Paths
Spindle  DIR Active Total
-------- --- ------ -----
2D1      07E      1     1
         08E      0     1
2D2      07F      1     2
         08F      0     2
4D2      09E      1     1
         10E      0     1
4D3      09E      1     1
         10E      0     0
  . . .
```

Use the `symdisk list` command with the `-detail` option to display detailed path information for an external spindle. Output shows the external paths available to each external spindle to reach the virtualized eDisk, and which of those paths are actively used for SCSI I/O.

```
symdisk list -external -spindle -paths -detail

Symmetrix ID: 000194900306

         Flags
Spindle    A   DIR:P Remote Port WWN
-------- ----- ----- --------------------------------
2D1        X   07E:0 5006048ACD1FFDDF
           .   08E:0 5006048AD5EFDC10
2D2        X   07F:0 5006048ACD1FFDDF
           .   07F:1 5006048ACD1FFDDE
           .   08F:0 5006048AD5EFDC10
           .   08F:1 5006048AD5EFDC10
4D2        X   09E:0 5006048AD5EFDC00
           .   10E:0 5006048AD5EFDC00
4D3        X   09E:0 5006048AD5EFDC00
           .   10E:- -
  . . .
Legend:
 (A)ctive path: X = Active, . = Failover
```

Virtual environment

The `symvm command` maps devices to virtual machines (VM) and displays configuration information about your virtual environment.

This command works with VMware ESX and VMware ESXi (Linux/Windows x86) and Microsoft Hyper-V environments. Microsoft Hyper-V requires the installation of the EMC SMI-S Host Provider to provide a detailed view of the visible disks.

Note: The `symvm` command can access a ESX Server either by specifying the IP address in the authorization list or by using the ESX Server's FQDN/Hostname (exactly in the correct case as returned by the `uname` command) in the authorization list.

Authorization

Each virtual server must have credentials stored in the authorization database. Use the `symcfg auth` command to set credentials for a virtual server. For more information about this command, see "Connectivity authorization" on page 30.

Examples:

```
symcfg auth -hyperv add -host VM00002 -username jupiter\connor -password 1045@abV!

symcfg auth -vmware add -host api105.emc.com -username root -password !@#123Abx
```

Mapping devices to VMs

Mapping devices is only supported for VMware hosts, not Hyper-V hosts.

Use the following `symvm` command syntax to map devices to any VM in your environment. This command supports Symmetrix and CLARiiON devices.

```
symvm
map [-server ServerName] [-VM VMname]
                -array_id ArrayID
    [-devs [SymDevStart:SymDevEnd | SymDevName]
        [,SymDevStart:SymDevEnd | SymDevName...]]
     -file FileName ]
```

Note: This operation only supports raw device mapping.

The following command shows the available disks (not mapped) on the VMware server `api106`:

```
symvm list -server api106.lss.emc.com -disks -available

Device Name                          Vendor   ID             Rev   Array ID        Dev ID Cap (KB)
------------------------------------ -------- ---------------- ----- ---------------- ----
mpx.vmhba3:C0:T0:L0                                                                          0
mpx.vmhba33:C0:T0:L0                                                                         0
naa.600009700001926003215330304138 41 EMC SYMMETRIX       5875  000192600321     0A8A   9600
naa.600009700001926003055330303732 32 EMC SYMMETRIX       5875  000192600305     0722   4417920
naa.600009700001926003055330303732 33 EMC SYMMETRIX       5875  000192600305     0723   4417920
naa.600009700001926003055330303732 34 EMC SYMMETRIX       5875  000192600305     0724   4417920
```

The following command, executed at the guest host, `api115`, maps the specified range of devices to `api115`:

```
symvm map -server api106.lss.emc.com -VM api115 -array_id 000192600305 -devs 722:723
```

The following command shows the range of devices mapped to `api115`:

```
symvm show -server api106.lss.emc.com -VM api115

 VM Name                : api115
 VM OS Name             : Red Hat Enterprise Linux 5 (64-bit)
 VM Hostname            :
 VM State               : Power On
 VM Num of CPUs         : 2
 VM Memory              : 2048 MB
 VM Device count        : 13
 VM Physical Devices:
 {
   Device Name                                Vendor   Array ID         Device ID
   ---------------------------------------------------------------------------------
   naa.600009700001926003215330304238 30      EMC      000192600321         0B80
   naa.600009700001926003215330304138 37      EMC      000192600321         0A87
   naa.600009700001926003055330304236 38      EMC      000192600305         0B68
   naa.600009700001926003055330303732 32      EMC      000192600305         0722
   naa.600009700001926003055330303732 33      EMC      000192600305         0723
   naa.600009700001926003215330304138 30      EMC      000192600321         0A80
   naa.600009700001926003215330304138 31      EMC      000192600321         0A81
   naa.600009700001926003215330304138 32      EMC      000192600321         0A82
   naa.600009700001926003215330304138 33      EMC      000192600321         0A83
   naa.600009700001926003215330304138 34      EMC      000192600321         0A84
   naa.600009700001926003215330304138 35      EMC      000192600321         0A85
   naa.600009700001926003215330304138 36      EMC      000192600321         0A86
```

Listing virtual server names

Use the following `symvm` command syntax to list devices in your VM environment. This command supports Symmetrix and CLARiiON devices.

```
symvm
list [-server ServerName | ALL] -disks
     [-available | -mapped] [-sid SymmID] [-N #]
```

```
list [-server ServerName | ALL] -gk [-sid SymmID]
     [-mapped] [-vm VMname] [-N #]
```

The following lists the server name for VM0002:

```
symvm list -server VM00002

Server Name
---------------------------------------------
VM0002.lss.emc.com
```

To list all servers in the authorization database, enter the following:

```
symvm list -server ALL

Server Name
---------------------------------------------
VM0001.lss.emc.com
VM0002.lss.emc.com
VM0003.lss.emc.com
VM0004.lss.emc.com
```

Note: To limit the number of devices displayed in the output, use the -N option and specify the maximum number of devices to be listed.

Listing operating systems

The following displays the guest operating systems for all virtual machines on VM00002:

```
symvm list -server VM00002 -VM ALL

Virtual Machine                 Virtual Machine OS                        State
------------------------------- ----------------------------------------- ----------
VM00002.lss.emc.com             Microsoft Windows 7(64bit) (experimental) Powered On
```

Listing storage

Use the -storage option to list datastores for VMware environments or to list available NTFS volumes that are not in use by any virtual machines in Hyper-V environments:

The following lists all datastores on server VM00002.

```
symvm list -server VM00002 -storage ALL

Storage Name        Type      Capacity
------------------- --------- --------
DS1                 Datastore 9728 MB
DS2                 Datastore 9728 MB
```

The following lists provides details on datastore DS1 on server VM00002:

```
symvm list -server VM00002 -storage DS1

Storage Name   : DS1
Storage type   : Datastore
Capacity       : 9728 MB
Extent

Device Name                             Vendor Array ID      Device ID
  ------------------------------------- ------ ------------- ---------
  naa.600604800001903002155330303046 36    EMC   000190300215         F8
  naa.600604800001903002155330303046 37    EMC   000190300215         F9
```

Listing mapped and available gatekeepers

The following command lists the gatekeepers for Symmetrix 555 that are mapped to VMs:

```
symvm list -server VM00002 -gk -sid 555 -mapped

Device ID Vendor Array ID              VM name
--------- ---------------------------- -------------------
F8        EMC    000190300215          VM1
F9        EMC    000190300215          VM2
```

The following command lists the gatekeepers for Symmetrix 555 that are not mapped to any VM:

```
symvm list -server VM00002 -gk -sid 555 -available

Device ID Vendor Array ID
--------- ----------------------------
F8        EMC    000190300215
F9        EMC    000190300215
```

Verifying the existence of dedicated gatekeepers

To verify that there are dedicated gatekeepers available for use, run the following command:

```
stordaemon action storapid -cmd show -gk_stats
```

Displaying gatekeeper statistics

To display information on the number of gatekeeper candidates, dedicated gatekeepers, unique gatekeepers, open gatekeepers, and gatekeeper utilization information, use the following command:

```
stordaemon action storapid -cmd show -gk_stats [-sid SymmID]
```

Listing virtual devices visible to the host

The following `symvm list pd` command can only be run within a virtual machine. It lists the virtual devices visible to the local host, as shown below:

```
symvm list pd

Device Name                      Type      Storage Name     Capacity
------------------------------- --------- ---------------- --------
/dev/sdb                         VMware    DS1                   512
/dev/sdc                         VMware    DS1                   512
```

Note: The `symvm list pd` is only supported when running in a virtual machine and is not supported on a server, such as Hyper-V.

The following lists details about the virtual devices visible to the local host, including back-end mapping:

```
symvm list pd

Device Physical Name  : /dev/sdb
Capacity              : 528 MB
Dtorage Name          : DS1
Storage type          : Datastore
```

```
Extent

Device Name                              Vendor Array ID      Device ID
  ------------------------------------- ------ ------------- ---------
  naa.60060480000190300215534030304636    EMC   000190300215         F8
  naa.60060480000190300215534030304637    EMC   000190300215         F9
```

Showing details about a virtual server

The following provides details about the virtual environment of `VM00002`:

```
symvm show -server VM00002 -v

Server Name         : VM00002
Version             : 4.0.0
Build               : 164009
Num Processors      : 4
Total Memory        : 8000 MB
System Memory       : 628.3 MB
Virtual Machine Memory : 7259 MB
Service Console Memory : 300 MB
Physical Devices:

Device Name                                        Vendor   ID          Rev   Ser Num      Cap (KB)
------------------------------------------------------- ---------------------------
---------------------
/vmfs/devices/disks/naa.600009700001949003125330303130 33  EMC      SYMMETRIX     5874
000190300215    96000
/vmfs/devices/disks/naa.600009700001949003125330303130 42  EMC      SYMMETRIX     5874
000190300215    96000

Storage:
Storage Name   : DS1
Storage type   : Datastore
Capacity       : 10200547328
extent

  naa.60060480000190300215533030304636
  naa.60060480000190300215533030304637

VMs:
VM Name                          VM OS                                        State
------------------------------- ----------------------------------------- ----------
VM00002.lss.emc.com              Microsoft Windows 7(64bit) (experimental) Powered On
```

Showing information about storage

This following displays information about datastore `DS1`:

```
symvm show -server VM00002 -storage DS1

 Storage Name            : DS1
 Storage Type            : Datastore
 Storage Capacity        : 0
 Number of extents       : 4
 Extents

   Device Name                                Vendor   Array ID         Device ID
   ------------------------------------------------------------------------------
   naa.600009700001949003125330303030 39      EMC      0194900312           0069
   naa.600009700001949003125330303030 38      EMC      0194900312           0068
   naa.600009700001949003125330303030 44      EMC      0194900312           006D
   naa.600009700001949003125330303030 37      EMC      0194900312           0067
```

Showing information about a virtual device

The following shows information about the virtual device `/dev/sdb`:

```
symvm show -pd /dev/sdb

Device Physical Name  : /dev/sdb
Virtualization Type   : VMware
Capacity              : 528 MB
Extent

Device Name                             Vendor Array ID      Device ID
--------------------------------------- ------ ------------- ---------
naa.600604800001903002155330303046 36    EMC   000190300215         F8
naa.600604800001903002155330303046 37    EMC   000190300215         F9
```

CHAPTER 4
User and Group Authorization

This chapter describes how to set up user and group authorization using the SYMCLI `symauth` command.

- Overview 138
- Authorization management 142
- Authorization monitoring 146

Overview

Authorization provides an additional tool to restrict the management operations allowed for individual users or groups in a Symmetrix array. Authorization and the Access Control's host-based authorization are independent utilities but can be used together for maximum security.

By using the SYMCLI `symauth` command, a user or group is mapped to a specific role that defines the operations the user or group can perform on either an entire Symmetrix array or on individual components within an array.

Authorization is configured independently for each Symmetrix array.

Roles

A role is a predefined set of permissions, or access types, that determine what operations a user can perform. Unlike host-based access control, a user is assigned a particular role for the entire Symmetrix array or certain components within the array. Roles are predefined in Solutions Enabler and cannot be modified. For each Symmetrix array, a given user or group can only be assigned a single role.

These are the roles defined in Solutions Enabler:

- **None** — Has no rights.
- **Monitor** — Performs read-only operations on a Symmetrix array excluding the ability to read the audit log or Access Control definitions.
- **PerfMonitor** —Includes Monitor role permissions and grants additional privileges within the performance component of Unisphere for VMAX application to setup various alerts and update thresholds to monitor Symmetrix performance.
- **StorageAdmin** — Performs all management operations on a Symmetrix array or on individual components within an array. This is the only role that can be given access rights to specific components within an array and is limited to Virtualization domain users.

  A StorageAdmin can modify the GNS group definitions and monitor all operations (even if only granted rights to one component); includes application performance monitor privileges. Only Virtualization domain users (`V:Domain\Users`) assigned the role of StorageAdmin of an entire array can create or delete component-specific authorization rules.
- **SecurityAdmin** — Performs security operations (`symaudit`, `symacl`, `symauth`) on a Symmetrix array in addition to all monitor operations. Users or groups assigned the SecurityAdmin or Admin roles can create or delete component-specific authorization rules.
- **Admin** — Performs all operations on a Symmetrix array, including security operations, in addition to all monitor operations, and including application performance monitor privileges. Has both StorageAdmin and SecurityAdmin rights.
- **Auditor** — Grants the ability to view, but not modify, security settings for a Symmetrix array (including reading the audit log, `symacl list`, and `symauth`) in addition to all monitor operations. This is the minimum role required to view the Symmetrix audit log.

To list the roles supported by an array, enter:

```
symauth list -roles

S Y M M E T R I X   A U T H O R I Z A T I O N   R O L E S

  Role Name                 Capabilities
  --------------------      -------------------------------------
  Admin                     Security and Storage control
  SecurityAdmin             Security control
  Auditor                   Security auditor
  StorageAdmin              Storage control
  Monitor                   View storage environment and status
  PerfMonitor               Monitor Performance
  None                      None
```

Components

A Virtualization domain user (`V:Domain\User`) assigned the StorageAdmin role can be given authorization rights to specific storage group and thin pool components within a Symmetrix array.

For a storage group, a StorageAdmin role can do the following operations:

- Add devices to that storage group (SG).
- Delete devices from that SG (but not create, delete, or rename the SG).

For a thin pool, a StorageAdmin role can do the following operations:

- Create TDEVs (permitted if user has rights to any thin pool on the Symmetrix array).
- Delete unbound TDEVs (permitted if user has rights to any thin pool on the Symmetrix array).
- Bind TDEVs to the thin pool.
- Unbind TDEVs from the thin pool.
- Make TDEVs bound to the thin pool ready or not ready.

Authorization rules

When a user or group attempts access to a Symmetrix array or one of its components, Solutions Enabler performs the following authorization checks:

a. Verifies if user has access to the entire Symmetrix array.

b. Checks if group has access to the entire Symmetrix array.

c. Verifies if user has access to the ThinPool or StorageGroup component within the Symmetrix array.

d. Checks if group has access to the ThinPool or StorageGroup component within the Symmetrix array.

When determining the rights of a user or group, each of the above authorization checks is performed. The rights granted by each check are combined together to form an overall set of rights for the user or group. For example:

- User Larry is assigned the SecurityAdmin role.
- Group Finance is assigned the Monitor role.

Because User Larry belongs to Group Finance, he is granted both SecurityAdmin and Monitor rights.

The matching occurs as follows:

- Type [a] rule matches if the name matches the user name for checks against either the entire Symmetrix array or one of its component.
- Type [b] rule matches if the name matches the group name for checks against either the entire Symmetrix array or one of its component.
- Type [c] rule matches if the name matches the user name for checks against the component specified in the rule. The component is only allowed for Virtualization domains.
- Type [d] rule matches if the name matches the group name for checks against the component specified in the rule. The component is only allowed for Virtualization domains.
- If any component rule (type [c] or [d]) matches the user or group name, they are automatically granted monitor rights to the entire Symmetrix array regardless of the component type or name.
- Rules with fully-qualified names take precedence over those with unqualified ones. If a fully-qualified name is found (for example, `H:jupiter\james Auditor`), it is used. If a fully-qualified name does not exist, an unqualified one (for example, `james monitor`) is used if found.

Role mappings

Within the user and group role mappings, users are identified by User IDs (the ‹*UserName*› parameter) and groups are identified by Group IDs (the ‹*GroupName*› parameter). Both these IDs consist of a three-part string containing *Type:Qualifier\Name.*

Where:

- *Type* specifies the type of security authority used to authenticate the user.
- *Qualifier* specifies the specific authority that was used.
- *Name* specifies the username or groupname relative to that authority. It cannot be greater than 32 characters, and spaces are allowed if delimited with quotes.

Authentication types

The following authentication types are supported at this time:

- `L` — Indicates a user or group authenticated by LDAP. In this case, Domain specifies the domain controller on the LDAP server. For example:

  `L:danube.com\Finance` — Indicates that user group Finance logged in through the domain controller danube.com.
- `C` — Indicates a user or group authenticated by the SMC server. For example:

  `C:Boston\Legal`— Indicates that user group Legal logged in through SMC sever Boston.
- `D` — Indicates a user authenticated by a Windows domain. The qualifier specifies the domain or realm name. For example:

`D:sales\putman` — User putman logged in through the Windows domain sales.

`D:jupiter\Sales` — Group Sales logged in through the Windows domain on host jupiter.

- `H` — Indicates a user authenticated (by logging in) to some host. On Windows, this corresponds to logging into a local account on the host. The qualifier specifies the hostname. For example:

  `H:jupiter\mason` — User mason logged in on host jupiter.

  `H:jupiter\Sales` — Group Sales logged in on host jupiter.

- `V` — Indicates a user authenticated by a Virtualization domain. The qualifier specifies the domain host name. For example:

  `V:host932jx\connor` — User connor logged in through a Virtualization domain host932jx.

Note: For a given Symmetrix array, you can assign a user or group to a single role. When you assign this role, it replaces any role currently associated with that user.

UserName and GroupName formats

Within role definitions, user IDs or group IDs can be either fully qualified (as shown previously), partially qualified, or unqualified. When the hostname or domain portion of the *UserName* parameter or *GroupName* parameter is an asterisk, the asterisk is treated as a wildcard meaning any host or domain. Examples of this include: `H:*\user`, `D:*\user`, and `*\user`. In all other cases, the asterisk is treated as a regular character.

For example, the following are valid formats:

- `D:ENG\Sales` — Fully qualified name with a domain and groupname.
- `D:*\jones` — Partially qualified name that matches username `jones` within any domain.
- `H:HOST\Eng` — Fully qualified name with a hostname and groupname.
- `H:*\jones` — Partially qualified name that matches username `jones` within any host.
- `jones` — Unqualified username that matches any `jones` in any domain on any host.

When a wildcard (such as the asterisk) is used, a given user or group may be matched by more than one mapping in the database. When searching for a role, the authorization mechanism uses the closest ID match that it can find. If an exact match (for example, `D:sales\putman`) is found, that is used, if a partial match (for example, `D:*\putman`) is found, that is used, if an unqualified match (for example, `putman`) is found, that is used, otherwise the user is assigned a role of None.

Note: When using the asterisk to allow wildcarding of user or group names, the `symauth` command may fail with an invalid augument error, if it is used to establish a rule (`assign` or `reassign`) with a user or group that is deemed to be invalid through API validity checks.

Note: For any Symmetrix array, a given user or group can be assigned only a single role. When a role is assigned to a user or group (on a Symmetrix array), it replaces any role currently associated with that user or group.

Authorization management

The `symauth` command is used to manage user and group authorization. It allows you to enable and disable user and group authorization, set enforcement mode, list defined users and groups with their roles, and assign roles to users and groups.

Identifying the current username

To return the current username (and groupname if applicable) that Solutions Enabler identifies as accessing the Symmetrix array, enter:

```
symauth show -username

Your current username is: D:ENG\ljacobs
Your current groupname is: D:ENG\test
```

In Solutions Enabler V7.4 and higher the `symauth show -username` command displays all groups to which the user belongs.

```
Your current username:D:Corp\Joe
Your current groupname:D:Corp\Finance
      D:Corp\Sales
      H:HostName\PowerUsers
      ...
```

Group names are sorted alphabetically.

Note: In compatibility mode (for example: `symauth show username -mode v73`), the output is the same as in prior releases, showing only the single group (the same one).

Setting up authorization

It is a good practice to define your user and group role mapping before enabling authorization. At a minimum, you must create at least one mapping for yourself to Admin or SecurityAdmin. You can only enable authorization if you (as shown by `symauth show -username`) are already mapped to a role of either Admin or SecurityAdmin.

The following example provides an overview of the recommended steps for setting up user authorization:

1. Create the user-to-role and group-to-role mappings. At a minimum, map users to the Admin and SecurityAdmin roles when you initially configure authorization. These roles provide the ability to perform authorization control operations. You must have one of these mappings created before you can successfully enable authorization. This can be done using a command file, or, on a UNIX host, by supplying a redirection of STDIN, as shown next:

   ```
   symauth -sid 1234 commit <<!
   assign user H:jupiter\laura to role SecurityAdmmin;
   assign user D:Eng\neil to role Monitor;
   assign user D:Eng\dave to role Admin;
   ```

```
assign user D:Eng\steve to role Admin;
assign user D:Eng\paul to role PerfMonitor;
assign group V:Host932jx\joe to role StorageAdmin for component
ThinPool ThinPool:Sales-2;
assign group D:Finance to role Monitor;
!
```

In the previous example, seven role mappings were created, including two Admin roles (`D:Eng\dave` and `D:Eng\steve`), one SecurityAdmin role (`H:jupiter\laura`), one StorageAdmin role (`V:Host932jx\joe`), one Monitor role (`D:Eng\neil`), and one PerfMonitor role (`D:Eng\paul`).

Note: When using the asterisk to allow wildcarding of user or group names, the `symauth` command may fail with an invalid augument error, if it is used to establish a rule (`assign` or `reassign`) with a user or group that is deemed to be invalid through API validity checks.

2. Once the role mappings are created, you can then enable authorization (if you assigned yourself the Admin or SecurityAdmin role), as shown below:

   ```
   symauth -sid 097 enable
   ```

   In the example above, user authorization is enabled on Symmetrix array 097. Specifying a Symmetrix ID is optional when enabling user and group authorization.

Enabling and disabling authorization

By default, user and group authorization is disabled. As such, any user can make changes to the authorization control data, including creating and removing user and group role mappings. Once authorization is enabled for an array, only users or groups with the Admin or SecurityAdmin, StorageAdmin role can change authorization control data. However, only a Virtualization Domain user assigned the role of StorageAdmin of an entire array can create or delete component-specific authorization rules.

A user or group granted the role of Admin or SecurityAdmin can enable or disable authorization for an entire Symmetrix array. To enable user and group authorization, enter:

```
symauth -sid 1234 enable
```

Note: Enabling user and group authorization is only allowed if the user performing the request is granted the Admin or SecurityAdmin role for the Symmetrix array.

Setting enforcement

Once user authorization is enabled, failed access attempts can be enforced in one of two ways. An authorization failure can either result in operation failure or simply log a warning. The level of security enforced, can be set using `symauth -sid <SymmID> set enforcement <advise | enforce>`.

- `advise` — This parameter allows the operation to proceed when user or group authorization is denied, but generates a warning message (less secure) to the Solutions Enabler log file. This is an effective mode for validating your user and group role mapping without preventing access to array functionality.

- `enforce` — This parameter, which is the default setting, causes the operation to fail when user or group authorization is denied (more secure), and logs the authorization attempt with its associated User or Group ID to the common audit log, `symaudit` log, and the Solutions Enabler log file.

This value can also be set using a command file as described in, "Command file usage" on page 144.

Modifying role mappings

Users or groups can be assigned a specific role using the `symauth` command by either supplying the role mappings through a command file, or, on a UNIX host, by supplying a redirection of STDIN. Each line of the command file must contain a valid username or groupname with a supported role (refer to "Roles" on page 138 for supported roles), and end with a semicolon. For further details on using the command file, refer to "Command file usage" on page 144.

To modify these mappings using a command file, use the following command syntax:

```
symauth -sid SymmID commit -file PathName
```

Where *PathName* is the fully qualified path of the file containing the user-to-role mappings.

Commit using STDIN

On a UNIX host, users can be assigned a specific role by supplying a redirection of STDIN, as shown in the example below:

```
symauth -sid 1234 commit <<!
assign user H:jupiter\laura to role Monitor;
assign user D:Eng\neil to role Admin;
assign user lauren to role StorageAdmin for StorGrp SG10;
reassign group Sales to role Auditor;
delete group Marketing for ThinPool ThinPool:Sales-1;
reassign user D:Eng\bob to role Monitor;
reassign user V:Host932jx\joe to role StorageAdmin for ThinPool
ThinPool:Sales-4;
!
```

Note: When using the asterisk to allow wildcarding of user or group names, the `symauth` command may fail with an invalid augument error, if it is used to establish a rule (`assign` or `reassign`) with a user or group that is deemed to be invalid through API validity checks.

Command file usage

One or many authorization management operations can be added to a command file so a sequence of operations can be previewed and committed at once. A command file is a simple text file of any name and location, the contents of which must be formatted, as specified by the operation below:

Adding a user to a Role:

```
assign user UserName to role RoleName;
```

Reassigning an existing group to Role:

```
reassign group GroupName to role RoleName;
```

Deleting a user:

```
delete user UserName;
```

Set enforcement:

```
set enforcement [advise | enforce];
```

Where:

- *UserName or GroupName* — The name of a user or a group (32-character maximum). Spaces are allowed if the *UserName* or *Group Name* is quote delimited. Examples of a valid *UserName* include: `"D:domain\joe"`, `"H:host\joe"`, `"domain\joe"`, and `"joe"`. In the case of `"domain\joe"`, the *UserName* is interpreted as `D:domain\joe`. In the case of `joe`, this *UserName* is allowed regardless of domain or host.

  Note: When the hostname or domain portion of a *UserName* or a *UserName* is an asterisk, the asterisk is treated as a wildcard meaning any host. Examples of this include: `H:*\user`, `D:*\user`, and `*\group`. In all other cases, the asterisk is treated as a regular character.

- *RoleName* — The name of the role to be assigned to a user or group. Current valid roles include: Admin, SecurityAdmin, StorageAdmin, Monitor, and None. These are case insensitive.

Preview and commit actions

To safely apply any of these authorization actions (command file entries) to the array, perform the following progressive `symauth` operations on the command file:

- Preview — `symauth -sid SymmID preview -file PathName`
  After you first create the command file, the *preview* operation verifies the syntax and correctness of the contents of the entries in the command file.
- Commit — `symauth -sid SymmID commit -file PathName`
  The commit operation performs both the preview and prepare checks and then commits the contents of the command file to the Symmetrix array.

Backing up and restoring the authorization database

The backup operation saves the contents of the user and group authorization database from a Symmetrix array to the specified file. Use the following command syntax to back up your user authorization database, where *SymmID* is the 12-character ID that specifies the Symmetrix array and *BackupFile* is the fully qualified path and filename of the backup that will be created:

```
symauth -sid SymmID backup -f BackupFile
```

The restore operation re-initializes the user and group authorization database on a Symmetrix array from a previously generated backup file and then re-enables user authorization. The specified file must be created by an earlier backup operation from the same or a different Symmetrix array. Use the following command syntax to restore a

previously created backup file, where *SymmID* is the 12-character ID that specifies the Symmetrix array to restore the file and *BackupFile* is the fully qualified path and filename of an existing backup file:

```
symauth -sid SymmID commit -restore -f BackupFile [-noprompt]
```

The restored file must assign the current user a role of Admin or SecurityAdmin; if it does not, the final restore step, which re-enables user authorization will fail. If this occurs, assign a role of Admin or SecurityAdmin to the current user and manually enable user authorization. Alternatively, you can have a user with Admin or SecurityAdmin privileges re-enable user authorization on the array.

Authorization monitoring

Monitoring operations allow you to view the current user authorization settings on a specific array.

Viewing user authorization policies

To list the user authorization policies in effect, enter:

```
symauth -sid 1234 list

Symmetrix ID: 000000001234

Authorization Control  : Enabled

Time Enabled           : Thu Jun   3 15:02:14 2010
Time Disabled          : Thu Jun   3 12:01:44 2010
Time Updated           : Thu Jun   3 15:02:14 2010

Authorization Mode     : Advise
```

Listing supported roles

To list the roles supported by an array, enter:

```
symauth list -roles

S Y M M E T R I X   A U T H O R I Z A T I O N   R O L E S

  Role Name                Capabilities
  --------------------     -------------------------------------
  Admin                    Authorization and Storage control
  SecurityAdmin            Authorization control
  Auditor                  View authorization settings
  StorageAdmin             Storage control
  Monitor                  View storage environment and status
  PerfMonitor              Monitor Performance
  None                     None
```

Viewing supported component types

To list the component types supported by an array, enter:

```
symauth list -components
```

```
Component Type        Meaning
----------------      -------------------
ThinPool              Thin Pool
StorGrp               Storage Group
```

Listing roles, names, and components

The following display shows the mapping of user and group names to the roles and applicable components for Symmetrix 1234. As shown, the `StorageAdmin` role has authorized access to specific components within an array. For example, user `V:Host932jx\joe` is granted access to `ThinPool:Sales-1,` and this authorization rule is active as noted by the period (.) in the `Flags` column.

Note that user `V:Host932jx\james` is granted authorization to `ThinPool:Sales-3` but the Flag displays `N` (NoEffect) because another rule supersedes this one. In this case, `V:Host932jx\james` also belongs to `Group V:Host932jx\paul` assigned the StorageAdmin of all components within the array, and already has rights to `ThinPool:Sales-3.`

To list the mappings of roles to user and group names and their applicable components for Symmetrix 1234, enter:

```
symauth -sid 1234 list -users

  S Y M M E T R I X   A U T H O R I Z A T I O N   U S E R S

 Symmetrix ID: 000000001234
Role               User / Group name       Component            Flags
                                                                E
--------------     ---------------------   ----------------     -----
Admin              User  D:ENG\james       N/A                  .
StorageAdmin       User  V:Host932jx\joe   ThinPool:Sales-1     .
StorageAdmin       User  V:Host932jx\james ThinPool:Sales-3     N
StorageAdmin       Group V:Host932jx\paul  N/A                  .
Monitor            Group D:Corp\dave       StorGrp:Sales-2      .
PerfMonitor        User  H:DLDV0180\mvartak N/A                 .

 Legend for Flags
 (E) : N = Rule has no effect since a different rule grants greater
           rights.
     : . = Rule is active.
```

Using the -v (verbose) option

Use the `-v` option in `symauth list` when the length of the user/group name and component name exceeds the 79-character limit. To request a multi-line display for authorization information for Symmetrix 1234, enter the following command:

```
symauth -sid 1234 list -users -v

  S Y M M E T R I X   A U T H O R I Z A T I O N   U S E R S

 Symmetrix ID: 000000001234
Role Name                      Admin
User Name                      D:ENG\james
Component type
Component name
Flags
```

```
Role Name                       StorageAdmin
User Name                       V:Host932jx\joe
Component type                  ThinPool
Component name                  Sales-1
Flags

Role Name                       StorageAdmin
User Name                       V:Host932jx\james
Component type                  ThinPool
Component name                  Sales-3
Flags                           NoEffect
            ...
```

In Solutions Enabler V7.4 and higher, the `symauth list -users` command supports a new offline mode of operation (`-offline`). The list operations retrieves up-to-date information from the specified Symmetrix array. If up-to-date information cannot be retrieved, the operation fails.

With the `-offline` option, Solutions Enabler retrieves information from cached authorization data on disk and does not communicate with the specified Symmetrix array. If there is no cached data on disk, no data displays (as if there is no authorization data on the Symmetrix array).

The following syntax is used:

```
symauth [-sid SymmID] [-offline]

    list

    list -users [-by_domain | -by_role | -by_user]
```

CHAPTER 5
Host-based Access Control

This chapter describes how to set up host-based Access Control and how to perform Symmetrix Access Control actions using SYMCLI.

- Overview 150
- Creating and modifying access control data 153
- Creating and managing access groups 155
- Creating and managing limited access to access pools 159
- Creating and managing access control entries 162
- Obtaining access control information 166
- Releasing pending locked sessions 167
- Understanding access strategies 168
- Backing up and restoring the access control database 172

Overview

Anyone with access to Symmetrix-based management software can execute any function on any Symmetrix device. Many product applications, such as EMC ControlCenter®, Symmetrix Management Console, Unisphere for VMAX Series array (with V7.4 and higher), TimeFinder, SRDF, Optimizer, Resource View, Database Tuner, and various ISV products, can issue management commands to any device in a Symmetrix complex. Open systems hosts can manipulate mainframe devices, Windows hosts can manipulate UNIX data, and vice versa.

Shared systems, such as these, may be vulnerable to one host, accidentally or intentionally, tampering with another's devices. To prevent this, the `symacl` command can be used by an administrator of the Symmetrix storage site to set up and restrict host access to defined sets of devices (access pools) across the various Symmetrix arrays.

Note: For information on user-based authorization, refer to Chapter 4, "User and Group Authorization."

Access Control command

This SYMCLI component supports Symmetrix Access Control requirements. The Access Control command allows you to set up and maintain an access controlled environment over the Symmetrix resource (access pools). The command (`symacl`) sets up access control mechanisms and changes access control entries in the access control database.

For more information about the syntax of the `symacl` command, refer to the *EMC Solutions Enabler SYMCLI Command Reference Guide*.

Note: When issued against a VMAX 10K array with Enginuity 5875Q32011SR, the `symacl` command can be used to grant SRDF permissions to a pool of devices (or all devices).

Access Control database

A Symmetrix-based access control database (shown in Figure 2) contains all the mechanisms or information to govern access to Symmetrix access pools.

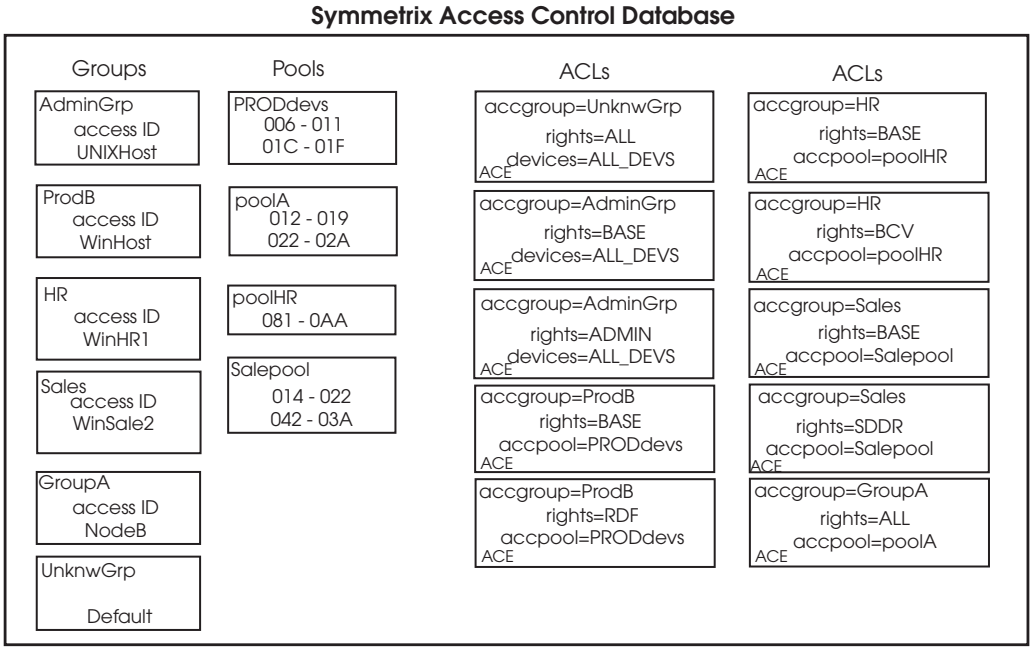


Figure 2 ACLs and ACEs in the Symmetrix Access Control database

Information about the following access control mechanisms comprise the access control database:

- **Access Control groups** — Unique *access IDs* and *names* are assigned (together) to hosts and then sorted into access control *groups* according to similar needs (determined by an Administrator). Access groups are allowed to act on access pools based on *permissions* (*access types*) granted by the Administrator. The unique host ID for open systems can be viewed by running `symacl -unique`.
- **Access pools** — Permissions (or access types), such as BCV, SRDF, ADMIN, are assigned to allow a host to perform certain Solutions Enabler functionality on a specified set of devices. These sets of devices are referred to as access pools or `accpool`.
- **Access Control Entries (ACEs)** — Once the group and access pool mechanisms are established, the *access control entries* (ACEs) are created, which grant permissions to these pools. The ACEs of the various access groups (along with groups and pools) are managed and stored in the access control database.
- **Access Control Lists (ACLs)** — A group of ACEs that are associated with the same group. For example, in Figure 2, the ACEs that are associated to group HR comprise an ACL in the database.

Figure 3 on page 152 illustrates a Symmetrix site that is managing the permissions of various types of host connections to the Symmetrix devices. Each Symmetrix array has its own access control database, which are separately managed by `symacl`.

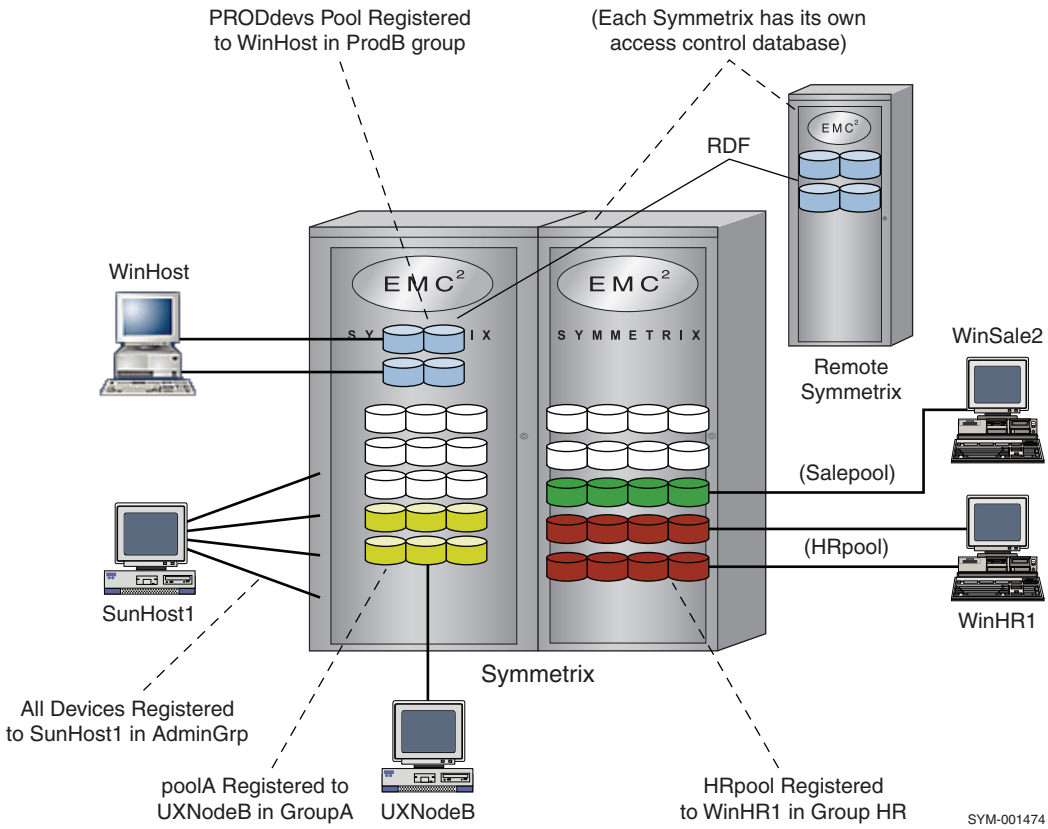


Figure 3 A Symmetrix site using Access Control

Securely identifying hosts with access IDs

Symmetrix access control identifies individual management hosts with an access ID. There are two different approaches to generating access IDs:

- **Hardware-based access ID:** By default, a host's access ID is derived from hardware characteristics of that host. On x86 (32-bit Intel), x86_64 (64-bit Intel/AMD), and IA 64 platforms, a network interface MAC address is used. On other platforms, different characteristics of the host, such as a processor identifier, are used.
- **Alternate access ID:** Optionally, a host's access ID can be generated at random or from a provided passphrase and stored to a secure location on disk. This functionality is supported for all platforms but is strongly recommended on platforms where the access ID is derived from a network interface MAC address. This functionality is available for all hosts with Solutions Enabler 7.3.2 and higher.

Note: For added security on x86 (32-bit Intel), x86_64 (64-bit), IA64, and BS2000 hardware platforms, it is recommended that you use alternate access IDs instead of hardware-based access IDs. For more information on using alternate access IDs, refer to *EMC Solutions Enabler V7.5 Security Configuration Guide*.

Creating and modifying access control data

To create or change the Access Control information in the database, you need to enter the changes in a command file and commit the file to the access control database.

The command file format contains various command entries terminated with a semicolon (;). The command syntax is case insensitive, but any variable parameter entered must be case sensitive.

The following are various types of permissions creation and changes possible in the command file:

- Create new access groups
- Add and remove access IDs to access groups
- Move an access ID from one group to another
- Create new access pools
- Add and remove devices to access pools
- Delete access pools and access groups
- Add ACEs to grant access
- Remove ACEs to deny access

Note: After Access Control changes are made, you must run a discover operation (`symcfg discover`).

Command file execution

To safely apply any of these Access Control actions (command file entries) to the access control database, you should perform the following progressive `symacl` operations on the command file:

- Preview
- Prepare
- Commit

After you first create the command file, the *preview* operation verifies the syntax and correctness of the contents of the entries in the command file.

The *prepare* operation (also before you commit) performs the preview checks, but also verifies the appropriateness of the requested access control modifications against the current state of the access control database in the Symmetrix array.

The *commit* operation performs both the preview and prepare checks and then commits the contents of the command file to the Symmetrix Access Control database.

Note: It is not mandatory to execute a preview or prepare action prior to a commit. However, these actions can ensure that the commit action will not be rejected or can be used to debug the command file entries.

Minimum Access Control configuration

Typically, following the initial delivery and setup of a Symmetrix array at a site, EMC Customer Support needs to set some minimal access control parameters to enable you to begin administrative actions. For a delivered setup, the Symmetrix array has its Access Control Database initialized with the creation of a Host Based Administrator and an access pin. This task is usually carried out by an EMC Engineer and is described in the following example:

Table 4 Initial access groups set

Access groups	ID names
AdminGrp	SunHost1 ACCPIN
UnknwGrp	unknown

The name `SunHost1` shown in the Table 4 (associated with `AdminGrp`) is the ID name that designates the machine from which you administer access controls. To perform prepare, commit, and release actions, an access ID (PIN) with the name `ACCPIN` was created in the delivered setup. This ID name is also used for the value setting of SYMCLI_ACCESS_PIN. For more information, see "Creating and managing access groups" on page 155.

Initial ACL setup

As shown in Table 5 for the delivered setup described in "Minimum Access Control configuration", access group AdminGrp has access to all devices (ALL_DEVS) and this group was granted both ADMIN and ALL permissions. Also in the initial setup, a group called UnknwGrp is established with permissions to all devices in the Symmetrix array. At the outset of system usage, this gives all unknown hosts BASE permissions to all devices (ALL_DEVS), until it becomes clear what restrictions should be established.

The initial `UnknwGrp` setup also grants ALL permissions to any devices not already assigned to an access pool (i.e., !INPOOLS).

Table 5 Initial delivered ACLs setup

Access groups	permissions (access types)	Access pools
AdminGrp	ADMIN ALL	ALL_DEVS
UnknwGrp	BASE	ALL_DEVS
UnknwGrp	ALL	!INPOOLS

Note: The access type ALL excludes ADMIN privileges.

For access control with Optimizer/FAST VP, EMC Customer Support provides a unique access control ID internal to the Symmetrix. This unique ID can be named EMC_SP and must be assigned to a group which is given Access Types BASE and OPTMZR to all devices (ALL_DEVS).

VLOGIX permission behavior

During initial setup of the system, the access group UnknwGrp (with Access Type ALL for NON-POOLED Devices) is present, as shown in Table 5 above. In this scenario, the VLOGIX privilege returns as true since you are granted access to all devices in the Symmetrix array. Initially, because no pools are present, the VLOGIX privilege is associated implicitly with all devices by this ACL.

Once a user creates an access pool and adds a device to it, the VLOGIX privilege is no longer implicitly associated with all devices and, therefore, a check for the VLOGIX privilege would now fail. For the UnknwGrp to still have VLOGIX privilege, that privilege must be explicitly granted to the UnknwGrp and associated with ALL_DEVS.

Creating and managing access groups

Typically various sets of users tend to use the same applications that utilize common Solutions Enabler features from a given host. They typically require the same device resources and permissions of access to these shared devices. For this reason, hosts are registered in groups identified with a group name, which serves as a root for all ACEs in the group (see Figure 2 on page 151).

Access groups contain groups of access IDs and their ID names. Any ID and name must belong to just one group and are entered into the database together. For ease of management, it is highly recommended that you choose an access ID name that best associates with the particular host in use. For example, SunHost1 is more appropriate than a name such as JRSMITH.

Once the group is created, the group name can be used to create access control entries (ACEs).

Setting up an access group

To set up an access control group, you need to create a group and then add the various access IDs of the hosts as members of that group.

Initially, you can check to see if the host you are using has the administrative authority to make access control changes using the following command:

```
symacl list -v [-sid SymmID|ALL]
```

Create a group

For example, in the command file (`addnewgroups.cmd`), to create access groups named HR and Sales in Symmetrix 12345, enter:

```
create accgroup HR;
create accgroup Sales;
```

You can now commit the file or wait until you have added access IDs to the group. To commit the file (addnewgroups.cmd) that executes the creation of the groups, enter:

```
symacl -sid 12345 commit -file addnewgroups.cmd
```

At this point, you may be prompted for your 4 - 12 character access PIN (if environment variable SYMCLI_ACCESS_PIN is not already set to this PIN value).

Add host access IDs to a group

To add a host access ID to an access group, use the following command syntax in the command file:

```
add host accid_Id name ldName to accgroup GroupName;
```

For example, in the command file (`addnewgroups.cmd`), to add WinHost with an encrypted ID `73900158-06174491-16225515` to the ProdB group, enter:

```
add host accid 73900158-06174491-16225515 name WinHost to accgroup
ProdB;
```

Also in this example, add UXNodeB with encrypted ID 23300178-56078991-00665410 to the group GroupA, enter:

```
add host accid 23300178-56078991-00665410 name UXNodeB to accgroup
GroupA;
```

Note: To preserve access ID security for any host, host IDs are encrypted. Use `symacl -unique` to get this encrypted value.

Then you must commit the file (`addnewgroups.cmd`) to execute the addition of these IDs to their groups (and any create group entries if you have not already committed them):

```
symacl -sid 12345 commit -file addnewgroups.cmd
```

Note: After Access Control changes are made, you must run a discover operation (`symcfg discover`) to update your configuration.

Alternate Access ID mechanism

Prior to Solutions Enabler V7.4, the Alternate Access ID was assigned a random number by Solutions Enabler when it was enabled. With version 7.4 and higher, you can supply a Pass Phrase from which the Access ID will be derived. The CLI checks that the length of the supplied passphrase (whether from the command line or a file) is between 4 and 1000 and that it contains only the legal characters.

Note: The following legal characters are permitted: letters a-z, capital letters A-Z, numbers 0-9, and the following characters:_ ! @ # $ % ^ & * ( ) - . ‹space›.

The `symacl -unique` option has been enhanced to allow a Pass Phrase to be supplied either on the command line itself or from a file.

The following syntax is used:

```
symacl -unique [-passphrase [PassPhrase | -file PassFile]]
               [-force]
```

The `-passphrase` option can be abbreviated by supplying 5 or more characters (`-pass`, `-passp`, `-passph`, etc.).

The `-file` option can be abbreviated as `-f` , `-fi`, or `-fil`.

Note: If the `SYMAPI_CLIENT_SIDE_ACCESS_ID` is enabled, then the `SYMAPI_ALTERNATE_ACCESS_ID` is required to be enabled.

If the client side option (SYMAPI_CLIENT_SIDE_ACCESS_ID) is enabled, the access ID will be generated and stored in a lockbox on the client side host. Once this setting is enabled, all the SYMCLI commands issued from that client host will use the client side access ID when validating access control privileges. The server side will accept the client side ID if the SYMAPI_USE_ACCESS_ID option is set to either CLIENT or ANY.

Note: If the Alternate Access ID option is enabled on a host for the first time along with the `SYMAPI_CLIENT_SIDE_ACCESS_ID` option and the client/server is set up, any command executed displays the following error: `Unable to obtain unique ID for host`. This is because the client is attempting to send the client access ID to the server, but there is no client access ID to send. Using the `symacl -unique -force` command in client/server mode to generated a client access ID is not permitted. To work around the issue, you must exit client/server mode on the client and execute the normal commands to generate a new access ID for the client. Again, this is only for a client that has never had the Alternate Access ID option enabled on it before.

To activate an Alternate Access ID using a Pass Phrase specified on the command line, enter:

```
symacl -unique -passphrase PassPhrase
```

To activate an Alternate Access ID using a Pass Phrase stored in a file on the local disk, enter:

```
symacl -unique -passphrase -file PathnameToFile
```

Note: In Client/Server mode, the file location is on the Client host although the Alternate Access ID is activated on the Server.

To forcibly generate a new Alternate Access ID from a random value, enter:

```
symacl -unique -force
```

To forcibly generate a new Alternate Access ID using a supplied Pass Phrase, enter:

```
symacl  -unique -passphrase PassPhrase -force
```

or

```
symacl -unique -passphrase -file PathnameToFile -force
```

User access IDs (PINs) for the AdminGrp

A user access ID is a 4- to 12-character PIN that allows a host to perform commit, prepare, or release operations as the `AdminGrp`. When a host attempts a commit, prepare, or release operation as the `AdminGrp`, `symacl` will prompt for this PIN.

To add the user access ID for the `AdminGrp` access group, use the following command syntax in the command file:

```
add user accid Id name IdName to accgroup AdminGrp;
```

For example, in the command file (`addnewgroups.cmd`), to add the administrative user access ID for `JOEPIN` as `1234PIN`, enter:

```
add user accid 1234PIN name JOEPIN to accgroup AdminGrp;
```

Note: User access IDs may only be set for the `AdminGrp` access group. Setting an ID for other groups will not return an error or prompt for a PIN in most scenarios.

If a host is ever prompted for a PIN, the host should enter `1234PIN`. The `addnewgroups.cmd` file must be committed to execute the addition of these new IDs:

```
symacl -sid 12345 commit -file addnewgroups.cmd
```

Editing and managing an access group

Once access groups are established, you can remove access IDs or ACEs from a group, move IDs from one group to another, or delete an entire group.

Remove an access ID from a group

To remove an access ID from an access group, use the following command syntax in the command file:

```
remove accid name IdName from accgroup GroupName;
```

For example, in the command file (`removeaces.cmd`), to remove user HRUser2 from the HR group, enter:

```
remove accid name HRUser2 from accgroup HR;
```

At some point, you must commit the file (`removeaces.cmd`) to execute the removal of this ACE from group HR.

Move an access ID to another group

To move an access ID from one access group to another, use the following command syntax in the command file:

```
move accid name IdName to accgroup GroupName;
```

For example, in the command file (`moveaces.cmd`), to move user HRUser1 to GroupA, enter:

```
move accid name HRUser2 to accgroup GroupA;
```

Then you must commit the file (`moveaces.cmd`) to execute the move of this ACE to GroupA.

Remove all ACEs from a group

To remove all ACEs from an access group, use the following command syntax in the command file:

```
remove aces from accgroup GroupName;
```

For example, in the command file (`removeaces.cmd`), to remove all ACEs from the HR group, enter:

```
remove aces from accgroup HR;
```

At some point, you must commit the file (`removeaces.cmd`) to execute the removal of the ACEs from group HR.

Delete a group

To delete an access group from the database, use the following command syntax in the command file:

```
delete accgroup GroupName [remove_aces=true];
```

Note that when you need to delete a group, you either must have removed all ACEs from the group, or you can optionally remove all ACEs with the `[remove_aces=true]` option within this delete command.

For example, in the command file (`deletegroup.cmd`), to delete group HR and any registered ACEs in that group, enter:

```
delete accgroup HR remove_aces=true;
```

At some point, you must commit the file (`deletegroup.cmd`) to execute the removal of access group HR.

Creating and managing limited access to access pools

Access pools are groups of devices controlled by access groups. When the various Symmetrix devices used by a host application must function as nonshareable resources, the target devices must be identified and assigned into an access pool for protection. Once an access pool is created, the pool can be a target to create access control entries (ACEs). More than one access group can access a pool with different permissions. For example, group AdminGrp might access PoolA with ALL permissions, while group HR could access the same PoolA with just BASE permissions.

Note: Once an access pool is created, any host in the access group UnknwGrp is denied access to the `symmask` and `symaccess` commands. In addition, when a host in UnknwGrp calls the `symmaskdb list database` or `symaccess list view -detail` commands, only its own devices will be returned in the list. To provide hosts in access group UnknwGrp with full access to the `symmask` commands, grant the access type VLOGIX (for ALL DEVS) to access group UnknwGrp. For more information on granting access types with full access to the `symmask` and `symaccess` commands, refer to "Grant permissions to an access group" on page 162.

Setting up access pools

You can create an access pool and add devices to a pool.

Initially, you can check to see if the host you are using has the administrative authority to make access control changes using the following command syntax:

```
symacl list -v [-sid SymmID|ALL]
```

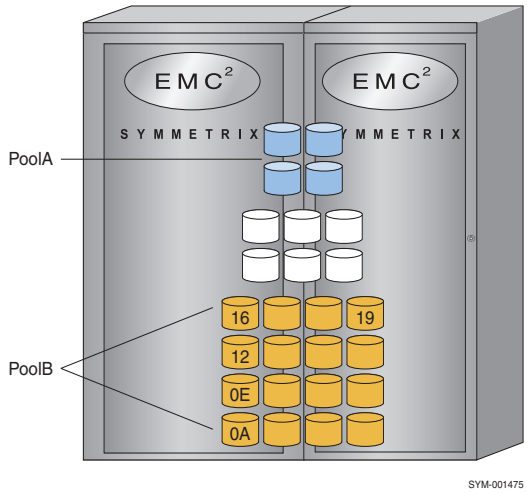


Figure 4 Creating access pools

In this Figure 4, 16 devices are assigned to PoolB.

Create a pool

For example, in the command file (`addnewpool.cmd`), to create an access pool named PoolB in Symmetrix 12345, enter:

```
create accpool PoolB;
```

You can now commit the file or wait until you have added devices to the pool. To now commit the file (`addnewpool.cmd`) to execute the creation of the pool, enter:

```
symacl -sid 12345 commit -file addnewpool.cmd
```

Add devices to a pool

To add the specific Symmetrix devices to a pool, use the following command syntax in the command file:

```
add dev StartDevName[:EndDevName] to accpool PoolName;
```

For example, in the command file (`addnewpool.cmd`), to assign Symmetrix device names 0A through 19 to PoolB, enter:

```
add dev 00A:019 to accpool PoolB;
```

Then you must commit the file (`addnewpool.cmd`) to the database:

```
symacl -sid 12345 commit -file addnewdevs.cmd
```

Editing and managing access pools

You can edit and manage the existing access pool information in the access control database. Devices can be removed from the access pool, and access pools can be deleted.

Note: After Access Control changes are made, you must run a discover operation (`symcfg discover`) to update your configuration.

Remove devices from a pool

To remove specific Symmetrix devices from a pool, use the following command syntax in the command file:

```
remove dev StartDevName[:EndDevName] from accpool PoolName;
```

For example, in the command file (`removedevs.cmd`), to assign Symmetrix device names 16 through 19 for removal in PoolB as shown in Figure 5, enter:

```
remove dev 016:019 from accpool PoolB;
```

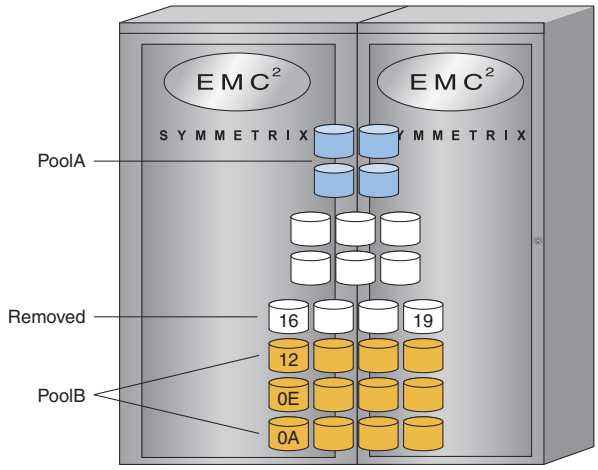


Figure 5 Removing devices from a pool

At some point, you must commit the file (`removedevs.cmd`) to execute the removal of devices 16 through 19 from PoolB.

Delete a access pool

You can delete an access pool and at the same time remove any associated access control entries (ACEs) with the specified pool. Note that all ACEs must be removed before you can delete a pool.

To delete an access pool and remove all ACEs, use the following command syntax in the command file:

```
delete accpool PoolName [remove_aces=true];
```

For example, in the command file (`deletepool.cmd`), to remove PoolB and any associated ACEs, enter:

```
delete accpool PoolB remove_aces=true;
```

At some point, you must commit the file (`deletepool.cmd`) to execute the removal of PoolB.

Creating and managing access control entries

Once you have created groups and access pools, you can now create access control entries (ACEs) that grant permissions to the groups and pools.

A group can have multiple permissions and pools, which requires an ACE for each.

Initially, you can check to see if the host you are using has the administrative authority to make access control changes using the following command syntax:

```
symacl list -v [-sid SymmID | ALL]
```

Grant permissions to an access group

Once you have created an access group, you need to determine and grant, to the access group, the permissions (*AccessType*) of access to a specified pool or to all the devices in the Symmetrix array (or all devices not in a pool) using the following command syntax:

```
grant access=AccessType to accgroup GroupName
   for accpool PoolName | ALL | NON-POOLED devs
```

The `AccessType` parameter specifies the permissions to the SYMCLI or SYMAPI features or functionality that is to be granted to selected devices.

Note: When issued against a VMAX 10K array with Enginuity 5875Q32011SR, the `symacl` command can be used to grant SRDF permissions to a pool of devices (or all devices).

AccessTypes: Available permissions

The possible permissions values are listed and described in Table 6.

Table 6 Permissions: AccessType (page 1 of 4)

Permissions (*AccessType*)	Description	Commands affected
ADMIN [2]	Grants administrator privilege to grant/deny access control entries to hosts and users.	symacl ‹prepare, commit, release, list, show›
ADMINRD [2]	Grants read-only access to all access control information.	symacl ‹list, show›
ALL [2]	All possible access types granted except ADMIN and ADMINRD. Must be directed to ALL devices.	All
BASE [4]	Allows the discovery of devices and to obtain states and statistics from the Symmetrix array (directors and devices).	Base component commands symevent, symcfg, symaudit, symdg, symdev, symcg ‹list, show›, symdisk, symstat, symipsec (Policy priority list, Policy get, and IPSec statistics get operations symmigrate query and list symlmf query, list, and show (for Symmetrix arrays running Enginuity 5875 or higher with elicensing)
BASECTRL	Allows base control operations on devices and device groups.	symdg ‹controls›, symcg ‹controls›, symdev ‹controls›, symsg ‹controls›

Table 6 Permissions: AccessType (page 2 of 4)

Permissions (*AccessType*)	Description	Commands affected
BCV	Allows TimeFinder BCV and TF/Clone control and status operations.	symbcv, symmir ‹controls›, symclone ‹controls›
CACHCTRL	Allows Cache control operations concerning LRU partition management.	symqos ‹set LRU ›
CFGDEV	Allows powerful configuration control operations that manage various types of configuration changes on devices in the Symmetrix array.	symconfigure Allows the following types of operations: • Convert device configurations (BCV, SRDF, DRV) • Convert device configuration (changing mirroring) • Set device attributes • Set device emulation • Metadevice management
CFGSYM [2]	Allows access to set Symmetrix attributes, set port flags, and swap RA groups with `symconfigure` command. It also affects the `symmaskdb`, `symaccess`, and `symrdf` commands as specified in the next column. Must be directed to ALL devices.	symconfigure, symmaskdb, symrdf, symaccess Allows the following types of operations: • Spare management • SAVE device pool create/delete • SAVE device pool member management • Enable/disable SRDFA • Set matrix across Symmetrix array • Add/remove dynamic SRDF groups • Change director supporting a dynamic SRDF group • Set the link limbo value for a dynamic SRDF group • Modify User Authorization settings via `symauth` • Converting thin device (adding SRDF) • Setting thin dev attributes • Bind/unbind thin device • Configuring thin metadevices • Allocate/free thin device • Creating thin device pools • Adding devices to thin pools • Enabling/disabling devices in thin pools • Removing devices from thin pools • Deleting thin pools • symipsec policy add, replace/modify, and delete • Initialize the VCMDB • Convert the database type • Restore the database • Manage storage groups • Manage port groups • Manage initiator groups • Manage masking views

Table 6 Permissions: AccessType (page 3 of 4)

Permissions (*AccessType*)	Description	Commands affected
CHECKSUM	Allows Symmetrix device Double Checksum operations.	symchksum ‹controls›
CREATEDV[2]	Allows the creation and deletion of Symmetrix devices (part of `symconfigure`). CREATEDV access can only be granted to ALL devices or on !INPOOLS when there are no accpools defined.	symconfigure • Create new devices • Configure disk space (create/map/mask/meta/attributes) • Delete devices • Create thin devices
DIRCTRL[2]	Allows you to take directors and their ports offline and online. Must be directed to ALL devices. Also allows you to set CHAP authentication.	symcfg ‹online/offline› • Online/offline RA directors • Online/offline front-end ports symconfigure • Set port flags and attributes symconnect, symaccess • CHAP authentication
ECC[1 - 2]	Allows the ECC symmetrix agent to run on the requested host.	Not applicable
OPTMZR	Allows user-configurable attributes that may affect the Optimizer and Symmetrix Migration behavior.	symoptmz ‹controls› symmigrate ‹controls› symfast ‹controls›
POWRPATH [1 - 2]	Access to PowerPath-directed devices in an SRDF consistency group. Must be directed to ALL devices.	Not applicable
QOS	Allows the execution of Quality of Service (QOS) performance control operations to manage copy priorities. Excludes LRU cache control functionality.	symqos ‹set pace›
RCOPY	Manage Open Replicator sessions.	symrcopy
RDF	Allows SRDF control and set operations.	symrdf ‹control›
RPA	For RecoverPoint VMAX splitter to operate correctly, you are required to grant BASE, BASECTRL, RPA, and CFGDEV access types.	Not applicable
SDDF	Allows the DeltaMark (Change Tracker) functionality that monitors track changes.	symchg
SDR	Allows mapping/unmapping of devices to directors/ports for the Symmetrix Disk Reallocation (SDR) feature, Device Masking, and Auto-provisioning Groups.	symconfigure • Manage CKD aliases • Map/unmap devices • Map/unmap thin device symmask, symmaskdb, symaccess • mapping and unmapping
SNAP	TF/Snapshot allows the creation and management of virtual copy sessions between a source device and multiple virtual (VDEV) target devices.	symsnap

Table 6 Permissions: AccessType (page 4 of 4)

Permissions (*AccessType*)	Description	Commands affected
VLOGIX [1 - 4]	Enables access to Device Masking devices and Auto-provisioning Groups.	symmask, symmaskdb, symaccess

1. See the appropriate product documentation for use of these access types.
2. These access types must be granted to either ALL devices or all NON-POOLED devices in a Symmetrix array.
3. This access type must be granted to ALL devices in a Symmetrix array.
4. BASE access allows the creation/modification of symaccess group types, which are not part of a view. VLOGIX access is required to create or manipulate items within a view

Before you can grant a group the permissions to any value-added, non-base feature, you must grant the group BASE permissions.

To grant BASE permissions to access group ProdB for all devices, use the following command in the command file (`grantrights.cmd`):

```
grant access=BASE to accgroup ProdB for ALL devs;
```

To grant BASE permissions to access group ProdB for poolPRODdevs, specify:

```
grant access=BASE to accgroup ProdB for accpool PRODdevs;
```

Note: When restricting a host to BASE access to a pool of devices, all devices mapped to the host will be visible along with any devices that are not mapped to the host, but are in the pool. To configure a host to see only devices that are in the pool, map only those devices to the host. In addition, remote (SRDF) arrays and their devices will not be discovered and the Symmetrix application registration database and the audit logs cannot be accessed since these may contain data relevant to other hosts.

To grant SRDF permissions to access group ProdB for pool PRODdevs, use the following command in the command file (`grantrights.cmd`):

```
grant access=RDF to accgroup ProdB for accpool PRODdevs;
```

Note: When issued against a VMAX 10K array with Enginuity 5875Q32011SR, the `symacl` command can be used to grant SRDF permissions to a pool of devices (or all devices).

To grant BCV and SDR permissions to access group HR for pool poolHR, use the following command in the command file:

```
grant access=BCV, SDR to accgroup HR for accpool poolHR;
```

Note that these command examples created three ACEs for BASE, BCV, and the SDR permissions, which now could be committed.

To make any nonregistered (*unknown*) host have BASE permissions to access group UnknwGrp for all devices in the Symmetrix environment, use the following command in the command file:

```
grant access=BASE to accgroup UnknwGrp for ALL devs;
```

At some point, you must commit the file (`grantrights.cmd`) to execute the granting of permissions with these various command entries.

Remove permissions from an access group

To remove permissions for an access group, use the following command in the command file:

```
remove access=AccessType from accgroup GroupName
   for accpool PoolName | ALL|NON-POOLED devs;
```

To remove SDR permissions from access group HR for poolHR, use the following command in the command file:

```
remove access=SDR from accgroup HR for accpool poolHR;
```

At some point, you must commit the file (`grantrights.cmd`) to execute the change of permissions with these entries.

Obtaining access control information

You can check the current Symmetrix Access Control database to view the various groups, pools, and also the ACLs. Only if you have ADMIN or ADMINRD permissions, can you view all access objects in the access control database.

Using the list action when you do not have administrative permissions, you only see access objects that are associated with the access group to which your host belongs.

Listing access control information

Using the list argument in the following command, you can list information about groups, pools, and ACLs with the following syntax:

```
symacl [-sid SymmID|ALL] [-h]
     list [-v]
     list [-accpool | -accgroup | -acl]
```

For example, the following command lists the access groups on Symmetrix 0133:

```
symacl -sid 0133 list -accgroup
```

The following command example lists all the access pools on Symmetrix 0133:

```
symacl -sid 0133 list -accpool
```

The following example lists all the ACEs (with their pools and access types) for the entire Symmetrix environment:

```
symacl list -acl
```

Showing access control information

Using the show actions when you do not have administrative permissions, you only see access objects that are associated with the access group to which your host belongs.

To show detailed information about a specified group or pool, use the following syntax:

```
symacl [-sid SymmID | ALL]

        list [-v]

        list [-accpool | -accgroup | -acl]

        show accpool PoolName [-acl]
```

```
show accgroup GroupName [-acl]
```

For example, the following command shows all the details about access group ProdB on Symmetrix 0133:

```
symacl -sid 0133 show accgroup ProdB
```

The following command example shows all the details about the PRODdevs access pool on Symmetrix 0133:

```
symacl -sid 0133 show accpool PRODdevs
```

Getting your host access ID

You can get the access ID for the host you are using. The following command will return a unique access ID in an encrypted format:

```
symacl -unique
```

The `-unique` option returns the encrypted access ID in the following segmented, 24-digit numeric form:

```
xxxxxxxx-yyyyyyyy-zzzzzzzz
```

For example:

```
12301558-94200021-00347892
```

Releasing pending locked sessions

During the processing of the command file, the `prepare` and `commit` actions are critical SYMCLI or SYMAPI operations that are considered access control *sessions*. In the event a host machine or application should abnormally fail and stop processing any prepare or commit access operation on its command file, you can abort this locked session from your current host or another host using the following command:

```
symacl release -sid SymmID
```

Note: If you are the security administrator and you intend to release a lock on the command file session, you must either set environment variable `SYMCLI_ACCESS_PIN` to your access ID or enter your PIN every time `symacl` prompts you.

Verifying a locked session

To verify an access controlled session is locked on any Symmetrix array, you can use:

```
symacl list -v
```

This command can tell you how long the session has been locked and who locked it.

Understanding access strategies

This section describes the access control strategies that can be applied in an access controlled Symmetrix environment. Several strategies can be considered for establishing or restricting access for a node or group of users or hosts to your Symmetrix environment. These strategies should be considered when you are setting up an access control environment for the first time.

Note: Remember, that after Access Control changes are made, you must run a discover operation (`symcfg discover`) to update your configuration.

Initially grant all permissions to everybody

The initial (delivered) strategy is to employ a default ID that controls all nodes not yet explicitly registered. This default ID can be used to grant a certain level or a minimal level of access for all unregistered nodes.

In Figure 6, when the Symmetrix array was initially configured (delivered), a group named UnknwGrp was created for nonregistered hosts (with no ID).

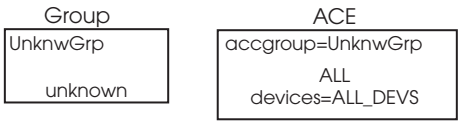


Figure 6 Example default configuration

A special *Default* access ID named `unknown` was added to the group granting all unknown hosts and users ALL permissions.

Next, an ACE was created for group UnknwGrp granting them ALL permissions to all the Symmetrix devices. In this scenario, all users and hosts can perform any of the SYMCLI command set operations.

Customizing, granting and denying default access

At a point during Symmetrix Access Control implementation, the access IDs of all hosts that need to communicate to the Symmetrix array (for performing Symmetrix operations using applications such as Solutions Enabler) are registered in the database and granted sufficient permissions to accomplish the functions they need to perform. Once the setup of Symmetrix Access Control is complete, one strategy could be to block or severely limit access for any other host not specifically defined. This is accomplished by adjusting the permissions of the default accgroup UnknwGrp.

The default access id UNKNOWN, affiliated with the accgroup UnknwGrp, was provided upon setup, to allow any host not specifically defined, to have a specific access. The accgroup UnknwGrp access rights can be tailored to provide certain hosts a specific access.

With special planning, the default access id UNKNOWN and the accgroup UnknwGrp can be removed which will prevent any access by a host, unless it is specifically defined with its own entries. This means that a host, unless specifically defined and associated with a group, will be denied any access.

To remove the UnknwGrp, issue the following command from an admin host:

```
delete accgroup UnknwGrp remove_aces=true;
```

If you need to revert back to the default settings concerning the UnknwGrp, you can issue the following commands from an admin host:

```
create accgroup UnknwGrp;
grant access=ALL to accgroup UnknwGrp for NON-POOLED devs;
grant access=BASE to accgroup UnknwGrp for ALL devs;
add default accid name UNKNOWN to accgroup UnknwGrp;
```

To create the UnknwGrp with limited access, for example just BASE permission to all undefined hosts, use the following commands:

```
create accgroup UnknwGrp;
grant access=BASE to accgroup UnknwGrp for ALL devs;
add default accid name UNKNOWN to accgroup UnknwGrp;
```

Only one default accid is allowed. The one provided during setup is called UNKNOWN. Optionally, you can create a personalized default accid, by providing a name, and adding it to a Default type group using the following syntax:

```
add default accid name IdName to accgroup GroupName;
```

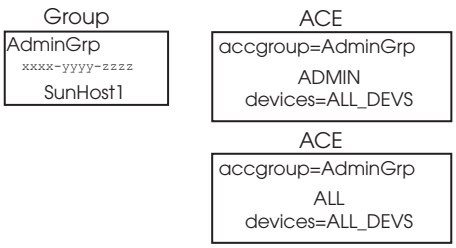
In the following example, after the default accid UNKNOWN is removed, a group named OtherGrp is created. A default ID of Others is assigned to the OtherGrp. The OtherGrp is then given permissions, which will be the limitations for all undefined hosts. These hosts are able to discover devices, obtain states and statistics from the Symmetrix array, with BASE permission granted to a default accid named OTHERS.

```
create accgroup OtherGrp;
grant access=BASE to accgroup OtherGrp for ALL devs;
add default accid name Others to accgroup OtherGrp;
```

Establishing an administrator

As shown in Figure 2 on page 151 and Figure 3 on page 152, the delivered setup allows at least one host assigned with administrative (ADMIN) privileges to be designated the administrator of the information in the access control database.

In the following example, when the Symmetrix array was initially configured, an access group named AdminGrp was created. Then a UNIX workstation named SunHost1 with an encrypted access ID (of the form *xxxxxxxx-yyyyyyyy-zzzzzzzz*) was added to the AdminGrp group. (The access ID was obtained by running `symacl -unique`.)

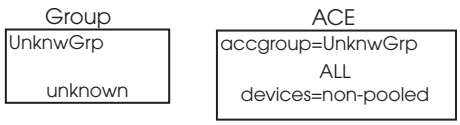


Next, two ACEs were created: one granting ADMIN permissions and one granting ALL permissions to group AdminGrp for all devices in the Symmetrix array.

Grant all permissions to the nonpooled devices

A second possible strategy once access controlled access pools have been established is to allow no restrictions on all the Symmetrix devices that are not otherwise registered (*Nonpooled*) in any access pool.

In the following example, the ACE for the access group named UnknwGrp was modified to restrict access to only those devices not registered in an access control pool.



General absolute control strategy

A third strategy, which is more controlled, is to register access to only certain devices on an as-needed basis. In this scenario, the UnknwGrp group was removed. Therefore, a node must be known to the Symmetrix array, and only specific users/hosts in defined groups with limited or unlimited permissions have access to certain devices defined in their working pools.

Initial setup summary

Whatever strategy you apply during the initial building of the access control database, you need to survey all user needs, organize their limitations into groups, determine what Symmetrix devices to allocate to who, and what permissions are appropriate for each group. It is highly recommended to use the preview and prepare actions on your first major command file before you commit it; particularly if it is an extensive list. The preview and prepare will identify any coding errors or mistakes in the logic.

BCV setup strategy

To set up an access controlled environment for TimeFinder operations, you need to set up both the standard and BCV devices as follows:

1. Define your working access pool to contain both the standard and BCV SymDevNames.
2. For your group name, grant BASE permissions to access all devices.
3. For your group name, grant BCV permissions to the access pool holding the pairs.

TF/Snap setup strategy

To set up an access controlled environment for TF/Snap operations, you need to set up both the source and target devices and the SAVE devices as follows:

Source and target strategy

1. Define your working access pool to contain both the source and target device's SymDevnames.
2. For your group name, grant BASE permissions to access all devices.
3. For your group name, grant SNAP permissions to the access pools holding the pairs.

SAVE device strategy

1. Define your working access pool to contain the SAVE devices.
2. For your group name, grant BASE permissions to access the SAVE devices.

3. For your group name, grant CFGSYM permissions to create and delete the SAVE devices.
4. For your group name, grant SNAP permissions to manage the SAVE devices.

SRDF setup strategy

To set up an access controlled environment for SRDF operations, you need to set up both the local Symmetrix array and remote Symmetrix array. Because both Symmetrix arrays have their own access controlled database, you must:

1. With the ADMIN host, create an access control group for the local Symmetrix array. Then with an ADMIN local or remote host, define the same access control group name for the remote Symmetrix array.
2. With an ADMIN host, create an access pool defined with the R1 SymDevnames. Then with the ADMIN local or remote host, define an access pool with the R2 SymDevnames.
3. Grant BASE permissions for the group to access all devices on R1 Symmetrix. Then with an ADMIN host, grant BASE permissions for the group to access all devices on R2 Symmetrix.
4. Grant SRDF permissions for the group to access the R1 access pool. Then with an ADMIN host, grant SRDF permissions for the group to access the R2 access pool.

Note: When issued against a VMAX 10K array with Enginuity 5875Q32011SR, the `symacl` command can be used to grant SRDF permissions to a pool of devices (or all devices).

RecoverPoint Symmetrix Splitter setup strategy

For the RecoverPoint VMAX splitter to operate correctly when Symmetrix array host-based access controls are enabled, you are required to grant BASE, BASECTRL, RPA, and CFGDEV access types.

For example, to grant BASE, BASECTRL, RPA, and CFGDEV permissions to access group ProdB for pool PRODdevs, specify:

```
grant access=BASE,BASECTRL,RPA,CFGDEV to accgroup ProdB for accpool
   PRODdevs;
```

FAST/Optimizer setup strategy

To set up an access controlled environment for FAST operations, permission of OPTMZR must be granted to the host. Obtain the unique access control ID of the Symmetrix from EMC Customer Support. This unique ID must then be added to access control and granted BASE and OPTMZR permissions.

SMC/Unisphere setup strategy

Symmetrix Management Console (SMC) and Unisphere software provide a GUI interface to query and manage a Symmetrix array. The GUI can be used to perform any operations to which the host has been granted rights.

Symaccess setup strategy

To enable symaccess control for a host, use the permission VLOGIX. This permission must be granted to ALL devices in the Symmetrix array. Note that the behavior of symaccess changes once access pools are created. Once access pools containing devices are created, VLOGIX type privileges are denied to groups unless the privilege is explicitly granted to any group needing access. Note that this includes the default UnknwGrp.

Backing up and restoring the access control database

When working with access control, it is a good practice to create a backup file of your existing access control database prior to making changes.

Create a backup file

You can create a backup of your current access control database, using the following command:

```
symacl -sid SymmID backup -file CommandFile
```

The backup operation saves the contents of the access control database in the file specified by the file option. The file must not previously exist. The backup file created is compatible for use with the `symacl` utility.

Note: The backup file contains encrypted versions of the unique IDs, therefore if you compare the values in the backup file to the original file used to create the database, they will be different.

Restore the backup file to the access control database

In the event a host machine or application makes undesirable changes to your access control configuration, you can utilize a backup file you have created to restore the previous configuration data to the access control database.

When you restore a backup using `symacl`, you use the `-restore` option as shown below:

```
symacl    -sid SymmID commit [-v|-noecho]
          -restore -file CommandFile
```

The restore operation replaces the contents of the access control database with the contents of the file specified by the file option. It eliminates whatever currently exists in the Symmetrix configuration database and replaces it with the contents of the backup.

Note: The backup file contains encrypted versions of the unique IDs, therefore if you compare the values in the backup file to the original file used to create the database, they will be different.

CHAPTER 6
Grouping Devices

This chapter describes the benefits of grouping devices, the types of groups, and how to create and modify them.

- Overview 174
- Device Groups 175
- Storage groups 190
- Composite groups 214

Overview

A collection of devices can be assigned to a named group to provide a more manageable object to query status and impart control operations. Groups can be used to identify and work with a subset of available Symmetrix devices, obtain configuration, status, and performance statistics on a collection of related devices, or issue control operations that apply to all devices in the specified device group.

Grouping types

Devices are associated with either a device group, storage group, or a composite group.

- A *device group* (DG) is a user-defined group comprised of devices that can belong to one or more locally-attached Symmetrix arrays. A control operation can be performed on the group as a whole, or on the individual device pairs that comprise it. For more information on device groups, refer to "Device Groups" on page 175.
- A *storage group* (SG) is a user-defined group comprised of devices or other storage groups that belong to a single Symmetrix array that can be used for masking/mapping, Virtual LUN Technology, Fully-Automated Storage Tiering (FAST), and various base control operations. For more information on storage groups, refer to "Storage groups" on page 190.
- A *composite group* (CG) is a user-defined group comprised of devices or device groups that can belong to one or more locally-attached Symmetrix arrays and one or more SRDF groups within a Symmetrix array. For more information on composite groups, refer to "Composite groups" on page 214.
- An *SRDF consistency group* is a CG comprised of SRDF devices (RDF1, RDF2, or RDF21) enabled for SRDF consistency. The SRDF consistency group acts in unison to preserve dependent write consistency of a database distributed across multiple SRDF systems. Refer to "SRDF consistency groups" on page 216 for information on using SRDF consistency groups.

Group name services

In a default Symmetrix environment, device group and composite group definitions are created through a locally-attached host. Upon creation, the group definition is stored in the host configuration database file. Therefore, only the host that created the group can see the group and control it. To perform control operations from another locally-attached host, the group definition must be manually copied to other hosts.

Optionally, you could enable the Group Name Services (GNS) on your Symmetrix-based hosts. GNS provides the optional ability to store device and composite group definitions in a shared repository located on each Symmetrix array, which then becomes automatically visible to all locally-attached hosts. This allows all GNS-enabled hosts to see the same group definitions across your Symmetrix environment, while sharing real-time updates to group definitions and configurations made by other hosts. For more information on GNS, refer to Chapter 7, "Group Name Services."

Note: Group Name Services does not apply to storage groups.

Note: With Solutions Enabler V7.4 and higher, device groups and composite groups of type REGULAR are allowed to contain remote SRDF devices. However, on systems running GNS, any peer hosts running older versions of Solutions Enabler will see these groups as invalid.

Device Groups

A device group is a user-defined group comprised of devices that can belong to one or more locally-attached Symmetrix arrays. A control operation can be performed on the group as a whole, or on the individual device pairs that comprise it. By default, a device cannot belong to more than one device group and all of the standard devices in a group must reside on the same Symmetrix array. However, if the Symmetrix options file parameter SYMAPI_ALLOW_DEV_IN_MULT_GRPS is enabled, a device can be added to multiple groups.

You can use device groups to identify and work with a subset of available Symmetrix devices; obtain configuration, status, and performance statistics on a collection of related devices; or issue control operations that apply to all devices in the specified device group.

A device group can belong to one or more composite groups. For more information, see "Composite groups" on page 214.

Names of device groups and devices

Device groups, as well as the devices in a device group, are assigned names that facilitate reference in a session. You assign a device group name at the time you create it. The name can have up to 31 characters and must be unique for a given configuration database.

When you add a device to a device group, it is given a logical name. This name allows you to refer to the device independently of its physical device name or Symmetrix device name. The name can have up to 31 characters and must be unique within the device group. It is known only within the context of the device group to which the device belongs. You must use this logical name in any SYMCLI command with the argument `LdevName or ld`.

Device group types

You create a device group using one of the following types:

- REGULAR (Solutions Enabler V7.4 and higher allows the inclusion of SRDF devices)
- RDF1 (R1 and concurrent R11 devices)
- RDF2 (R2 and concurrent R22 devices)
- RDF21 (cascaded R21 devices)
- ANY (can contain a device mix of the above types)

Device lists

A device is placed into a logical list when added to a device group. For example, an SRDF device is placed into the SRDF device list. The following explains the device lists:

- **SRDF device list** — You can group SRDF (Symmetrix Remote Data Facility) standard devices in a device group subject to the following restrictions:
  - You cannot mix SRDF and non-SRDF devices in the same device group *unless* you specify ANY for the type when creating a device group. The group type of ANY pertains to Solutions Enabler V7.2 and higher, and if used with versions lower than this, an error message stating "Unknown" or "Invalid" group type is generated.
  - All SRDF devices in a given device group must belong to the same Symmetrix SRDF group[1] or if concurrent SRDF, then two SRDF groups.
- **TimeFinder BCV device list** — You can associate Business Continuance Volume (BCV) regular devices and RDF1 BCV devices with a device group. You can perform BCV control operations on any BCV pair in the device group. Also, you can perform SRDF operations on just the associated RDF1 BCV devices. Refer to *EMC Solutions Enabler Symmetrix TimeFinder Family CLI Product Guide* for more information on adding BCV devices to a device group.
- **TF/Snap virtual device list** — A virtual device is a host-accessible device containing address pointers to the data stored on the source device or a pool of SAVE devices, which indicate where the copy session data is located in the physical storage. You can associate virtual devices (VDEV) paired with standard and BCV devices with any device group. In addition, TF/Snap control operations can be performed on any virtual device in a device group.
- **TF/Clone target list** — Target lists provide a mechanism for establishing source (SRC) and target (TGT) devices for TF/Clone operations. They can be created for both device groups and composite groups. A target list can contain various types of devices, including STDs, VDEVs, or BCV devices (based on a set of rules discussed in "Clone target restrictions" on page 178) and can use those devices as targets in clone operations. Remote target lists can also be created for remote operations.

  Note: VDEVs cannot be mixed with other types of devices in any target list. In other words, a target list cannot contain both VDEVs and STDs.

- **Gatekeeper device list** — You can *associate* one or more gatekeeper devices with a device group. SYMCLI uses the associated gatekeeper to issue requests to the Symmetrix array for control operations on the devices within the specified device group. You can *add* a standard device to a device group. However, the gatekeeper cannot be added to the device group, only associated with a device group. For more information about associating a gatekeeper device with a group, refer to the *EMC Solutions Enabler Installation Guide*.

1. SRDF groups (also known as RA groups) are configured by the Symmetrix Enginuity software. When concurrent SRDF devices are configured, any R1 device may be mapped to two R2 devices, each one belonging to a different RA. Otherwise, an RA director and any one SRDF storage device can belong to just one SRDF group. Typically, there are two or more RA directors per SRDF group. The Enginuity load balances I/O on all healthy RA directors in an SRDF group.

Note: A BCV device or a RDF2 device cannot be assigned as a gatekeeper, nor can a device that is a member of a device group be defined as a gatekeeper.

Creating a device group

A device group is created by first defining a named empty group of a specific type. Then, devices are added to the group. A newly-created device group is defined by the devices you add to it and each type of device list has its own set of restrictions.

Creating an empty device group

Device groups are created using the `symdg` command. When you create a device group, you assign it a name and choose it one of the group types explained in "Device group types" on page 175.

For example, to create a device group named `prod` whose members are operating as SRDF source devices, enter:

```
symdg -type RDF1 create prod
```

If a group type is not specified, the default group created is REGULAR.

Device restrictions

Some basic restrictions on the devices that you can add to a device group are based on the device type.

RDF1 and RDF2 type device restrictions

If you are adding an SRDF device to a device group, all devices in the device group:

- Must be SRDF devices.
- Must be either all source (RDF1 type) or all target (RDF2 type) devices.
- Must have the same SRDF group number.
- When there is a combination of R1 and R11 devices in a DG, the R1 and one of its R11 mirrors must have the same SRDF group number. This also applies for R2 and R22 devices.

RDF21 type device restrictions

The following device restrictions apply to all devices added to an RDF21 device group:

- All devices must be R21 STD devices. No mixture of STD device types is allowed.
- All R21 devices in a DG must maintain mirror consistency. All R1 mirrors must have the same SRDF group number and all R2 mirrors must have the same SRDF group number.
- Groups that have the same first SRDF group number, must have the same cascaded SRDF group number in a cascaded SRDF configuration.
- The existing rules for adding BCV, VDEV, and TGT devices to RDF21 groups still apply.

Virtual device restrictions

To add a device as a VDEV, the device must be defined as a virtual device. Virtual devices are VDEV, RVDEV and Hop-2 VDEV.

Clone target restrictions

STD, BCV and VDEV devices can be added to a target list. Below are the sets of device types allowed in a target list, although devices from only one set of devices is allowed in a given device group's target list at any given time:

- Non-SRDF STDs
- R1 STDs
- R2 STDs
- R1 + Non-SRDF Standards
- R2 + Non-SRDF Standards
- Non-SRDF BCVs.
- R1-BCVs
- R2-BCVs
- R1-BCVs + Non-SRDF BCVs
- R2-BCVs + Non-SRDF BCVs
- VDEVs (cannot mix VDEVs with other device types in the list)

By default, the logical device name (LdevName) for devices in a target list is TGT*xxx*. For devices in the remote target list, the default Ldevname is RTGT*xxx.*

ANY group type restrictions

The group type of ANY allows a mix of non-SRDF and SRDF (R1, R11, R2, R22, and R21) devices in a single device group. It lifts the restrictions pertaining to the type of devices added to the device group but still follows the previous restrictions for SRDF devices. For example, all SRDF mirrors in a SRDF list must be of the same device type.

When there is a combination of R1 and R21 devices in a DG, the R1 mirror of the R21 devices must have the same SRDF group number. This also applies to R2 and R21 devices in a DG.

The following devices are allowed in a device group of ANY:

- All REGULAR devices
- All R1 and R11 devices
- All R2 and R22 devices
- All R21 devices
- A combination of REGULAR, R1, R11 and R21 devices
- A combination of REGULAR, R2, R22 and R21 devices

Note: A device group or composite group of any SRDF type can change its type because of an `symrdf` control operation. For example, an RDF1 CG can change to an RDF2 when the device personalities are swapped. The `symrdf swap` operation does not change the type of an ANY device or composite group.

SYMCLI provides various commands to add standard devices, virtual devices, or TF/Clone target devices to a device group. Once a device group is created, SYMCLI commands can be used to add a single device, all devices on a Symmetrix not yet assigned to a device group, or a list of devices from a file to that group. For more information on adding a list of devices from a file, refer to "Device groups: Exporting and importing device lists" on page 183.

Adding devices to a device group

Use the `symdg` command to add a single device to a device group. Devices can be added by specifying either the physical device name (`add pd`) or the Symmetrix device name (`add dev`). When adding virtual devices or target devices, specify the Symmetrix device name (*SymDevName*). Specify the interval and count options (`-i` and `-c`) to wait a predetermined time (interval) between attempts (count) to acquire an exclusive lock on the Symmetrix host database. The following is the syntax for adding a device:

```
symdg -g DgName [-offline] [-i Interval] [-c Count][-v]

        add pd PdevName [LdevName]

        add dev SymDevName [LdevName][-sid SymmID]
          [-rdf | -hop2 | -vdev | -tgt]
           [-rdfg GrpNum [-remote_rdfg RemoteGrpNum]
```

To add a single device using the physical device name `/dev/rhdisk32` to a device group named `prod`, enter:

```
symdg -g prod add pd /dev/rhdisk32
```

Optionally, you can assign a logical device name to the device. This logical device name can have up to 31 characters and must be unique within the device group. If a logical device name is not specified, one will be supplied automatically by SYMCLI.

To add Symmetrix device `0005` to a device group named `prod` and assign the logical device name `temp1`, enter:

```
symdg -g prod add dev 0005 temp1
```

Adding virtual devices

You can add a virtual device to the virtual device list (VDEV) of a device group or the remote virtual device list (RVDEV). When adding virtual devices from a local array, specify the `-vdev` option along with the Symmetrix device name. For example, to add virtual device 0005 to a device group named `prod1` and assign the logical device name `vdev1`, enter:

```
symdg -g prod1 add dev 0005 vdev1 -vdev
```

When adding virtual devices from a remote array (RVDEV), specify the `-vdev -rdf` option along with the Symmetrix device name. This targets the operation to the specified virtual device over SRDF links on the remote array. In the situation where you have concurrent SRDF, whereby there are two Symmetrix arrays on the remote side, you must specify the SRDF group number (`-rdfg GrpNum`) with `-rdf` option.

When adding virtual devices from a Symmetrix array two hops away, specify the `-vdev -hop2 -remote_rdfg RemoteGrpNum` option along with the Symmetrix device name. This targets the operation to the specified virtual device over SRDF links on the remote array two hops away.

For example, to add virtual device `0006` belonging to SRDF group `12` to a device group named `prod2` and assign the logical device name `vdev2`, enter:

```
symdg -g prod2 add dev 0006 vdev2 -vdev -rdf -rdfg 12
```

Adding devices to the target list

You can add a device to the target device list (TGT) of a device group or the remote target device list (RTGT) for TF/Clone operations. You can add STD, SRDF, BCV and VDEV devices to the TGT, RTGT, and Hop2 TGT target lists.

When adding devices from a local array, specify the `-tgt` option along with the Symmetrix device name. For example, to add target device `0023` to a device group named `prod1` and assign the logical device name `tgt23`, enter:

```
symdg -g prod1 add dev 0023 tgt23 -tgt
```

When adding target devices from a remote array, specify the `-tgt -rdf` option along with the Symmetrix device name. This targets the operation to the specified target device over SRDF links on the remote array. In the situation where you have concurrent SRDF, whereby there are two Symmetrix arrays on the remote side, you must specify the SRDF group number (`-rdfg GrpNum`) with `-rdf` option.

When adding target devices from a Symmetrix array two hops away, specify the `-tgt -hop2 -remote_rdfg RemoteGrpNum` option along with the Symmetrix device name. This targets the operation to the specified target device list over SRDF links on the remote array two hops away.

For example, to add target device `0069` belonging to SRDF group `12` to a device group named `mywork` and assign the logical device name `tgt2`, enter:

```
symdg -g mywork add dev 0069 tgt2 -vdev -rdf -rdfg 12
```

For details on the types of devices that can be added to a device group's target list, refer to "Clone target restrictions" on page 178.

Logical device names for virtual devices

When a virtual device is added to a target list, its logical device name is assigned a TGT default logical name according to these rules:

- VDEVs added to the target list are named TGTxxx.
- VDEVs added to the remote target list are named RTGTxxx.
- VDEVs added to the Hop-2 target list are named 2TGTxxx.

Adding ungrouped devices

Use `symdg` to add ungrouped devices on a Symmetrix array to a device group. By default, this command adds all standard devices (or local virtual devices) to a device group. However, various optional criteria can be set to specify the types of devices to add to the specified device group.

Specify the interval and count options (`-i` and `-c`) to wait a predetermined time (interval) between attempts (count) to acquire an exclusive lock on the Symmetrix host database on the local and/or remote Symmetrix arrays.

Use the following syntax to add ungrouped devices to a device group:

```
symdg -g DgName [-offline] [-i Interval] [-c Count][-v]
            [-sid SymmID]
            [-vdev | -tgt -rdf | -hop2
            [-rdfg GrpNum [-remote_rdfg RemoteGrpNum]]

         addall dev
           [-SA # | ALL] [-P #] [-N #]
           [-cap # [-captype mb | cyl]]
           [-sel_rdfg SelRdfgNum]
           [-devs SymDevStart:SymDevEnd | SymDevName
           ,SymDevStart:SymDevEnd | SymDevName . . .]
```

- All ungrouped Symmetrix devices from a specific Symmetrix ID (`-sid`).
- All virtual devices from a local or remote array (`-vdev -rdf -rdfg` *`GrpNum`*).
- All devices are to be added to the target list of the device group for TF/Clone operations on a remote array (`-tgt -rdf -rdfg` *`GrpNum`*).
- All virtual devices from a remote array two hops away (`-vdev -hop2 -remote_rdfg` *`RemoteGrpNum`*).
- All devices are to be added to the target list of the device group for TF/Clone operations on an array two hops away (`-tgt -rdf -hop2 -remote_rdfg` *`RemoteGrpNum`*).
- All devices visible to one or all front-end directors (`-SA <#|ALL>`).
- All devices visible to one or all front-end port number (`-P #`).
- The number of devices to add to the device group (`-N #)`.
- Any combination of device ranges and single devices, such as 225:22a,120,a5,7a0:7af (`-devs`), or that are of a specific capacity (`-CAP #`).
- Only SRDF devices belonging to that group number are added (`-sel_rdfg`).

Note: In the situation where you have concurrent SRDF, whereby there are two Symmetrix arrays on the remote side, you must specify the SRDF group number (`-rdfg GrpNum`) with `-rdf` option. When the `-hop2` option is specified, you must specify a `-remote_rdfg RemoteGrpNum`.

Logical names

The `addall` argument assigns the following logical names to the devices it adds: DEV001, DEV002,..., DEV*nnn*. You can use the `rename` argument to change these logical names after the devices have been added. Or, prior to calling this command, you can change the

default logical device naming conventions using the SYMCLI_LDEV_NAMING environment variable. You can also set the SYMCLI_FULL_LDEVNAME environment variable to not truncate logical names too long to fit in the columns of the `symdg show` and `symcg show` output.

Restrictions

When using `addall`, you **cannot**:

- Mix devices from different Symmetrix arrays.
- Mix SRDF devices that have different SRDF group numbers.
- Add device(s) defined as a gatekeeper or BCVs.
- Add devices whose device type does not match the device group type.

Setting controls on Celerra devices

Use the following `-celerra` option to set the `rw_enble`, `write_disable`, `ready`, and `non_ready` controls on Celerra FBA devices in a device group:

```
symdg -g DgName [-noprompt] [-i Interval] [-c Count]
   [-bcv | -vdev | -tgt] [-star] [-celerra]
```

Listing devices in a device group

After adding devices to a device group, use the following syntax to list them:

```
symdg -g DgName list ld
```

Listing device groups

To list all device groups defined in the configuration database, enter:

symdg list

```
                          D E V I C E      G R O U P S
                 Flags                          Number of
  Name    Type    VC    Symmetrix ID  Devs  GKs  BCVs  VDEVs  TGTs
  dgnocgs RDF1    YN    N/A              0    0     0      0     0
  dgincg  REGULAR YY    000194900341  2154    0   128      0     0

Legend:
  Flags:
       V(alid) DG    : Y = Valid, N = Invalid, - = N/A
       (In) C(g)     : Y = Contained by a CG, N = Not contained by a CG
```

This command returns a list of all device group names, group type, Symmetrix ID, the number of standard, BCV, gatekeeper, virtual devices, and TF/Clone target devices (TGTs). It also tells you if the device group is valid and whether it is contained by a composite group.

Note: Device groups with names longer than 17 characters display with their first 17 characters followed by an asterisk (*). "Setting group names to display full name" on page 22 explains how to set the environmental variable to display longer group names.

Showing details about a device group

Use `symdg show` to display information about a specific device group. For example, the following output shows that device group `dgincg` is of type RDF1. This is only partial output for this command:

```
symdg show dgincg

Group Name:  dgincg

    Group Type                                    : ANY
    Device Group in GNS                           : No
    Valid                                         : Yes
    Symmetrix ID                                  : 000194900341
    Group Creation Time                           : Tue Dec 1 8:6:9 2009
    Vendor ID                                     : EMC Corp
    Application ID                                : SYMCLI

    Number of STD Devices in Group                : 2154
    Number of Associated GK's                     :    0
    Number of Locally-associated BCV's            :  128
    Number of Locally-associated VDEV's           :    0
Number of Locally-associated TGT's            :    0
    Number of Remotely-associated VDEV's(STD RDF):    0
    Number of Remotely-associated BCV's (STD RDF):    0
    Number of Remotely-associated TGT's(TGT RDF) :    0
    Number of Remotely-associated BCV's (BCV RDF):    0
    Number of Remotely-assoc'd RBCV's (RBCV RDF) :    0
    Number of Remotely-assoc'd BCV's (Hop-2 BCV) :    0
    Number of Remotely-assoc'd VDEV's(Hop-2 VDEV):    0
    Number of Remotely-assoc'd TGT's (Hop-2 TGT) :    0
    Number of Composite Groups                    :    2
    Composite Group Names                         : cg110
                                                  : cgregular
. . .
```

Device groups: Exporting and importing device lists

You can save the list of devices from an existing group to a file on your host system, and this file can later be imported to create a device group. This can be useful if you delete the group and later wish to recreate it, or if you wish to import the group definition to another system.

Exporting a device list

You can remove all devices from a group but retain or export the list of devices in the group to a file on your host system using the following syntax:

```
symdg
        export DgName [-delete] [-f FileName]
          [[-rdf [-rdfg GrpNum]] | [-sid SymmID]]

        exportall [-delete] [-f FileName]
          [[-rdf [-rdfg GrpNum]] | [-sid SymmID]]
```

For example, to export the device group membership from group `prod2` to file `prod2list`, enter:

```
symdg export prod2 -f prod2list
```

To export an SRDF group, specifying the `-rdf` option uses the remote Symmetrix ID and device names and changes the SRDF group type from R1 to R2 or vice versa. In addition, an SRDF group number can be specified as well (`-rdfg GrpNum`).

In addition, a text file that contains the details of all members of the existing device groups can be created using the `symdg exportall` operation. The device groups can later be recreated from this file using the `symdg importall` command.

Exporting and deleting a device group

The delete option allows you to export the device group membership to a file and delete the existing device group in the same operation. To reinstate the same group again, you can import this list (refer to "Importing device lists" on page 184) to the same or different device group.

Exporting device lists with -delete option

You can delete a group, but export the list of devices in the group to a file on your host system. For example, to export the device group membership to file `prod2list` from group `prod2` and then delete the group, enter:

```
symdg export prod2 -f prod2list -delete
```

For information on deleting a device group, refer to "Deleting a device group" on page 188.

Note: The `-rdf` option is not supported when exporting R21 device groups.

Importing device lists

You can add multiple devices to a new or existing device group by importing an existing file that contains a list of devices created by the export action.

For example, to create a device group named `prod2` from the file `prod2list`, enter:

```
symdg import prod2 -f prod2list
```

Typically, you import files that were previously exported (refer to "Exporting a device list" on page 183).

The `import` action creates the device group if the group name specified in the command does not already exist, or you can import to an existing group name that is partially populated. If you import to an existing group, the devices in the imported file are appended to the existing group membership.

In addition, you can recreate all device groups, using the `symdg importall` command, from data contained in a text file that was previously created using the `symdg exportall` command.

Renaming device groups

Device groups—and the logical device name of devices in a device group—can be renamed.

Device group

Use `symdg` to rename a device group. The new name can contain up to 31 characters and must be unique for the configuration database on which the device group is defined.

For example, to rename the device group `prod` to `prod_B`, enter:

```
symdg rename prod prod_b
```

If the DG is a member of one or more composite groups, specify the verbose option to view its associated CGs, such as:

```
symdg rename prod prod_b -v

DG prod contained by CG cg1 was renamed
DG prod contained by CG cg14 was renamed
```

Devices

Use `symdg` to change the logical name of a device. The name can have up to 31 characters and must be unique within its device group.

For example, to rename the logical name of device `DEV003` to `TEMP3` in device group named `prod`, enter:

```
symdg -g prod rename ld DEV003 TEMP3
```

Moving devices

Use `symdg` to move one device, specifying the logical device name, from one existing device group to another existing device group. The source and destination device groups must be compatible types. Specify the interval and count options (`-i` and `-c`) to wait a predetermined time (interval) between attempts (count) to acquire an exclusive lock on the Symmetrix host database and, for SRDF control operations, on the local and/or remote Symmetrix arrays. The following syntax is used to move an individual device:

```
symdg -g DgName [-h] [-offline] [-i Interval] [-c Count]
   move ld LdevName DestDgName [-force] [-rename]
```

For example, to move logical device `DEV003` from device group `prod` to device group `test`, enter:

```
symdg -g prod move ld DEV003 test
```

If there exists a device within the destination device group with the same logical device name as device you wish to move into the destination device group, you must use the `-rename` option to avoid encountering an error. When this option is used, SYMCLI will rename the moved device to the next available logical device name as defined in the SYMCLI_LDEV_NAMING environment variable.

Moving all devices

When choosing to move all devices from one existing device group to another, you can move all devices, or use the additional options to focus the operation to devices that meet a specific criteria. By default, this operation only affects standard devices. Specify the interval and count options (`-i` and `-c`) to wait a predetermined time (interval) between attempts (count) to acquire an exclusive lock on the Symmetrix host database and, for

SRDF control operations, on the local and/or remote Symmetrix arrays. However, the other option can be specified to only move specific device types as shown in the following syntax:

```
symdg -g DgName [-h] [-offline] [-i Interval] [-c Count][-v]

      moveall DestDgName [-force] [-rename]
         [-vdev | -tgt [-hop2] | -rvdev | -rtgt]
```

Other options include specifying devices mapped to a specific front-end (SCSI or Fibre) director number, (`-SA <#|ALL>`), devices mapped to a specific (SCSI or Fibre) director port number (`-P #`), devices of a specified capacity (`-CAP #`), total number of devices (`-N #`), or any combination of device ranges and single devices (`-devs`) to move. If `-devs` is not specified, all devices in the specified Symmetrix array are moved. The `–vdev` option adds only the Symmetrix virtual devices to the composite group. If the `-hop2` option is specified, it indicates that the specified device is two hops away. The `-tgt` option adds only the TGTs to the composite group. If the `-hop2` option is specified, it indicates that the specified device is two hops away.

The source and destination device groups must have compatible types.

For example, to move all virtual devices from device group `prod` to device group `test`, enter:

```
symdg -g prod moveall -vdev test
```

Copying devices

Devices from an existing device group can be copied into another existing device group of compatible type. When the `copy` action is used, one standard device is copied from the specified source device group to the destination device group. The source and destination device groups must have compatible types. When the `copyall` action is used, copies of all standard devices are copied from the specified source device group to the destination device group. The source and destination device groups must have compatible types. When performing a `copyall` action, the types or number of devices that are included in the copy can be limited using the various filter options.

For a device to exist in multiple DGs (which a copy would do), requires the option file setting `SYMAPI_ALLOW_DEV_IN_MULT_GRPS = ENABLE`.

Use the following syntax to copy devices from one device group to another device group:

```
symdg -g DgName [-i Interval] [-c Count] [-v][-offline]

   copy ld LdevName DestDgName [-force] [-rename]

symdg -g DgName [-i Interval] [-c Count] [-v]
          [-offline] [-sid SymmID]
          [-SA # | ALL] [-P #] [-N #]
          [-cap # [-captype mb | cyl]]
          [-sel_rdfg SelRdfgNum]
          [-devs SymDevStart:SymDevEnd | SymDevName
               [,SymDevStart:SymDevEnd | SymDevName...]]
          [-R1 | -R2 | -R21 | -noRDF]

   copyall DestDgName [-force] [-rename]
      [-vdev | -tgt [-hop2] | -rvdev | -rtgt]
```

Copying devices from a DG to a SG

Devices from an existing device group can be copied (or added) to a storage group. The copied devices remain in the device group (*DgName*) and are added to the destination storage group (*SgName*).

Use the following syntax to add devices from an existing device group to a storage group:

```
symdg dg2sg DgName SgName [-bcv|-vdev|-tgt]
```

If the storage group does not exist, it will be created. If optional device types are not specified, only standard devices will be added.

Example To add devices from a device group named `prod to a storage group named prod_2`, enter:

```
dg2sg prod prod_2
```

All standard devices in device group `prod` were added to storage `group prod_2`.

Removing devices

Use `symdg` to remove a device from a device group. Devices can be removed individually using the `remove` argument, or all devices can be removed from a device group using `rmall`. By default, the `remove` and `rmall` arguments will affect standard devices only. However, the `-vdev` option can be specified to remove just the virtual devices.

For example, to remove logical device `DEV003` from a device group named `prod`, enter:

```
symdg -g prod -force remove ld DEV003
```

In this example, the `-force` option removes the device regardless of its BCV state.

Note: If you remove the only member of a device group, the device group is not automatically deleted. You must execute `symdg delete` to explicitly delete the device group, as described in the "Deleting a device group" on page 188.

Removing all devices

When choosing to remove all devices from an existing device group, you can use the additional options shown in the following syntax:

```
symdg -g DgName [-i Interval] [-c Count] [-v]
          [-offline] [-sid SymmID]
          [-SA # | ALL] [-P #] [-N #]
          [-cap # [-captype mb | cyl]]
          [-sel_rdfg SelRdfgNum]
          [-devs SymDevStart:SymDevEnd | SymDevName
               [,SymDevStart:SymDevEnd | SymDevName...]]
          [-R1 | -R2 | -R21 | -noRDF]

      rmall [-force]
          [-vdev | -tgt -rdf [-rdfg GrpNum] | -hop2]
```

- Options include specifying devices mapped to a specific front-end (SCSI or Fibre) director number, (`-SA <#|ALL>`), devices mapped to a specific (SCSI or Fibre) director port number (`-P #`), devices of a specified capacity (`-CAP #`), or any combination of device ranges and single devices (`-devs`) to remove, or local and remote virtual and target devices (`[-vdev | -tgt -rdf [-rdfg GrpNum] -hop2]`).

Deleting a device group

Use the following syntax to delete a device group:

```
symdg delete DgName [-force]
```

For example, to delete device group named `prod`, enter:

```
symdg delete prod
```

If the DG is a member of one or more composite groups, specify the verbose option to view its associated CGs, such as:

```
symdg delete prod -force -v
DG prod was removed from CG cg1
DG prod was removed from CG cg14
```

Note: Deleting populated device groups or a device group of a composite group requires the use of the `-force` option.

Performing miscellaneous operations on DG devices

Use the command syntax shown below to perform the following control operations on devices within a device group:

- Change the state (ready, not ready) of a device
- Set or reset the hold bit on a device
- Compress or uncompress a thin device
- Bind, unbind, rebind, start or stop allocations, free, and reclaim thin devices
- Set or unset persistence on a device
- Set the Optimized Read Miss mode

```
symdg -dg DgName [-noprompt] [-i Interval] [-c Count]
          [-bcv [-hop2] | -rbcv | -brbcv |-rrbcv |
           -vdev [-hop2] | -rvdev | -tgt [-hop2] |
           -rtgt] [-rp] [-star] [-celerra]

        not_ready [LdevName [LdevName ...]]

        ready [LdevName [LdevName ...]]

        hold [LdevName [LdevName ...]]

        unhold [LdevName [LdevName ...]]

        compress [LdevName [LdevName ...]] [-stop]

        uncompress [LdevName [LdevName ...]] [-stop]

        bind [LdevName [LdevName...]] -pool <PoolName>

        rebind [LdevName [LdevName...]] -pool <PoolName>

        unbind [LdevName [LdevName...]]

        allocate [LdevName [LdevName...]] [-persistent | -stop]

        free [LdevName [LdevName...]] [-stop]
```

```
reclaim [LdevName [LdevName...]] [-persistent | -stop]

set -persistent [LdevName [LdevName ...]]

unset -persistent [LdevName [LdevName ...]]

set -orm [off | system] [LdevName [LdevName...]]
```

Note: "Virtual Provisioning (VP) Compression" on page 101 provides information on compressing and uncompressing thin devices.

For Symmetrix arrays running Solutions Enabler V7.6 and Enginuity 5876Q22013SR, or higher, the `symdg` command supports the following control actions when issued against thin devices: binding, unbinding and rebinding, the ability to start and stop allocations, and freeing and reclaiming of space on a thin device. The operations can be directed at all devices in a DG group. By default the actions only apply to the standard devices in the group. If a control operation needs to be performed on devices in a specific list, the appropriate qualifier needs to be used (such as, `-bcv`, `-rbcv`, etc.).

A `bind` action associates a thin device to a thin pool. A `rebind` action changes the thin device's current binding to a new pool. Rebind does not move the existing data to the new pool, but directs all new allocations to the thin device in the new pool after the rebind action completes. An `unbind` action disassociates a thin device from a thin pool.

The `allocate` action fully allocates all of the storage for the specified device(s). The `-persistent` option can be specified to allocate storage that will not be able to be reclaimed or freed, except by using the optional persistent control with the reclaim action.

Unwritten storage can be recovered with either a `free` or a `reclaim` action. Allocations that were written as zeros can only be recovered by using the `reclaim` action. Additionally, storage that was allocated with the persistent attribute can only be recovered by using the `-persistent` option with the `reclaim` action.

Actions to allocate, free, or reclaim thin devices are performed asynchronously in the background and are started with an explicit start action. They may be stopped, while in progress using the `-stop` option.

For Symmetrix VMAX arrays running Solutions Enabler V7.6 and Enginuity 5876Q22013SR or higher, the `symdg` command allows you to set the Optimized Read Miss mode to Off or System Managed for devices in a device group. By default, the action is only applied to standard devices in the group. If the action needs to be performed on devices in a specific list, the appropriate qualifier needs to be used (such as, `-bcv`, `-rbcv`, etc.). "Optimized Read Miss mode" on page 66 provides additional information on this feature.

Storage groups

Storage groups (SG) are a collection of devices stored on the Symmetrix array that are used for masking/mapping, Virtual LUN Technology, FAST, and various base operations. Solutions Enabler provides the `symsg` command for creating and managing these storage groups.

With Solutions Enabler V7.4 and higher, storage groups have the capability to contain other storage groups (Cascaded Storage Groups). This cascading of SGs allows for individual FAST policies on the SGs containing devices and a masking view for the SG containing other SGs. The SG containing other SG(s) is referred to as the Parent SG. The SG contained is referred to as the Child SG.

Solutions Enabler V7.5 with Enginuity 5876Q42012SR or higher provides a Host I/O Limits feature that allows you to limit front-end port performance by storage group. Information on setting front-end bandwidth limits for storage groups is provided in "Using the Host I/O Limits feature" on page 196.

With Solutions Enabler V7.6 and Enginuity 5876Q22013SR and higher, you can optionally configure a dynamic distribution of the FE Host I/O limits by using the `-dynamic` option. Information on setting the dynamic distribution attribute is provided in "Dynamic Distribution setting for FE Host I/O Limits" on page 198.

Restrictions

The restrictions for storage groups are described in three separate sections, one for storage groups containing just devices (children), one for cascaded storage groups (parent SGs containing childen SGs), and additional restrictions pertaining to storage groups using the Host I/O Limits feature. The three sections are available on the following pages:

- "General restrictions on all storage groups" on page 190
- "Restrictions on Parent and Child Storage Groups in a Cascaded Relationship" on page 192
- "Restrictions for SGs with defined Host I/O Limits" on page 196

General restrictions on all storage groups

The following general restrictions apply to all storage groups containing only devices. This applies to SGs containing children devices only, not cascaded storage groups containing both parent SGs with children SGs:

- GNS does not support storage groups. Storage groups are saved in a special area on the Symmetrix array.
- A single Symmetrix array can contain a maximum of 8192 storage groups.
- Each storage group can contain a maximum of 4096 devices.
- Storage groups are supported only on Symmetrix arrays running Enginuity version 5874 and higher.
- Storage group names can be up to 64 characters in length. Names must begin with an alphanumeric character and may contain embedded hyphens and underscore characters. Names are not case sensitive. Therefore, two storage groups named test and Test are not allowed.

- The `symcfg discover` command does not perform a synchronization of storage group data as part of its operation. To perform a synchronization of storage group data, use the `symcfg sync` command and specify the `-sg` option.
- A device cannot be added to a storage group associated with a FAST policy if the device already exists in another storage group that is associated with a FAST policy.
- A device cannot be added to a storage group with a masking view if the device already exists in another storage group that is part of a masking view.
- Diskless devices are not permitted in storage groups.
- Logical device names are not supported by storage groups.

Creating a storage group

An empty storage group is created by first defining a named group on the Symmetrix array. Devices are then added to the group.

Use the following syntax to create an empty storage group:

```
symsg -sid SymmID [-i Interval] [-c Count][-v]
   create SgName [-bw_max MBperSec] [-iops_max IOperSec]
                 [-dynamic NEVER | ALWAYS | ONFAILURE]
```

Example To create an empty storage group named prod on Symmetrix array ID 123, enter:

```
symsg -sid 123 create prod
```

Adding devices to a storage group

Devices can be added individually to a storage group containing devices, using a range of devices or a combination of device ranges and single devices, such as 225:22a,120,a5,7a0:7af, or grouped in a text file.

Use the following syntax to add a single device to a storage group:

```
symsg -sg SgName -sid SymmID [-i Interval] [-c Count]
   add dev SymDevName
```

Use the following syntax to add multiple devices, devices within a given range, or devices in a file to a storage group:

```
symsg -sg SgName -sid SymmID [-i Interval] [-c Count][-v]
      [-SA # | ALL] [-P #] [-N #]
      [-cap # [-captype mb | cyl]][-celerra] [-rp] [-ckd]
      [-devs SymDevStart:SymDevEnd | SymDevName
      <,<SymDevStart:SymDevEnd | SymDevName>...]>
      [-file DeviceFileName [-tgt]>]

   addall [pd | devs]
```

Although the `-devs` option implies that you can enter a single range or a list of comma delimited devices, the option supports a free-form combination of entries. An example of `-devs` usage is:

```
symsg -sid 123 -sg sg1 -devs 64:105,22a,505,600:605,0700
```

Example To add a single device to a storage group named `prod on Symmetrix array 123`, enter:

```
symsg -sid 123 -sg prod add dev 30
```

Storage device 30 is added to storage group `prod`.

Example To add all devices that are primarily visible from the host (mapped) to a storage group named `prod on Symmetrix array123`, enter:

```
symsg -sid 123 -sg prod addall pd
```

All storage devices with physical (host) device names are added to storage group `prod`.

Example To add a range of physical devices to a storage group named `prod on Symmetrix array 123`, enter:

```
symsg -sid 123 -sg prod addall pd -devs 30:3F
```

All storage devices within range 30:3F are added to storage group `prod`.

Example To add all devices listed in a text file named `storgrp_a.txt` to a storage group named `prod on Symmetrix array 123`, enter:

```
symsg -sid 123 -file storgrp_a.txt -sg prod addall
```

All storage devices within text file `storgrp.txt` are added to storage group `prod`.

Note: Device text files can be in either a one or two column format, specifying source and target devices. If the `-tgt` option is specified, only devices from the second column are added to the storage group.

Note: Any attempt made to add a device belonging to a storage group that is part of a masking view to a second storage group fails.

Cascaded storage groups

Solutions Enabler V7.4 with Enginuity 5876 and higher provides the capability for storage groups to contain other storage groups (Cascaded Storage Groups). This cascading of SGs allows for individual FAST policies for the SGs containing devices and a masking view for the SG containing other SGs. The SG, containing only devices, that is contained within a Parent SG is referred to as the Child SG.

Restrictions on Parent and Child Storage Groups in a Cascaded Relationship

The following restrictions apply to cascaded storage groups. This applies to SGs containing other storage groups (a parent SG and children SGs):

- Support for cascaded SG is only provided on Symmetrix arrays running Enginuity 5876Q42012SR and higher.
- Only a single level of cascading is permitted. A parent SG may not be a child of another SG.
- SGs can only contain devices or other SGs. No mixing is permitted. This covers attempts to add devices to a parent SG using `add`, `copy`, `move`, and `dg2sg`. This also covers attempts to add child SGs to an SG containing devices.
- A parent can have up to 32 child SGs.
- Empty SG's can be added to a parent SG as long as the parent SG inherits at least one device when the parent SG is in a view.

- A parent SG cannot inherit the same device from more than one child SG.
- A child SG may only be contained by a single parent SG.
- No parent SG can have a FAST association.
- An SG already associated with a FAST policy is not allowed to be a parent SG.
- Masking is not permitted for a child SG which is contained by a parent SG already part of a masking view.
- Masking is not permitted for the parent SG which contains a child SG that is already part of a masking view.
- A child SG cannot be deleted until it is removed from its parent SG.

Child storage group operation restrictions

The following restrictions exist for device operations involving child SG device operations. This includes the `symsg add` and `addall` commands, as well as the `copy`, `copyall`, `move` and `moveall` commands because they involve adding devices to an SG:

- A `moveall` operation is not permitted from an SG that contains a masking view or is associated with a FAST policy.
- A `copy` or `copyall` operation is not permitted from an SG that is associated with a FAST policy into an SG that is associated with a FAST policy
- When in a view, the total number of devices inherited by a parent SG cannot exceed 4096 devices.
- If adding Celerra devices into an SG or a child SG with Celerra devices to a parent SG within a view, you must use the `-celerra` flag.
- If adding a CKD device or a child SG with CKD devices to a parent SG within a view, you must use the `-ckd` flag.
- If adding a RecoverPoint tagged device or a child SG with RecoverPoint tagged devices to a parent SG within a view, you must use the `-rp` flag.
- Adding an RecoverPoint tagged device to a SG that is in a masking view containing FCoE directors is not allowed.
- Adding an AS400 device to a SG that is in a masking view containing FCoE directors is not allowed.

The following restrictions exist for child SG `remove` and `removeall` operations. This also includes `move` and `moveall` operations because they perform device removals:

- If the parent SG has a masking view, any operations involving device removes from the child SGs will not be permitted, if it causes the parent SG to have no more devices. This includes removes and moves.

When they are performed on the parent SG, the following `symsg` control operations affect all of the devices in all of the child SGs contained by that parent:

- `ready` and `not_ready`
- `rw_enable` and `write_disable`
- `hold` and `unhold`

- `pin` and `unpin`

Adding Cascaded storage groups

Child SG(s) can be added individually to a parent SG using the `symsg add sg` command. The symsg command uses the following syntax for adding child SGs to a parent SG:

```
symsg -sg SgName -sid SymmID [-i Interval]
     [-c Count] [-v] [-celerra] [-rp] [-ckd]

   add sg SgName1[,SgName2,SgName3,…,SgNamen]
```

The following additional restrictions apply to `symsg add sg` operations:

- You cannot add a device to an SG associated with a FAST policy, if the device already exists in another SG that is also associated with a FAST policy.
- Any attempt made to add a storage group that is part of a masking view to a second storage group fails.

The `symsg` command uses the following syntax for adding child SGs to a parent SG:

```
symsg -sg SgName -sid SymmID [-i Interval]
     [-c Count] [-v] [-celerra] [-rp] [-ckd]

   add sg SgName1[,SgName2,SgName3,…,SgNamen]
```

Note: With Solutions Enabler V7.6 and Enginuity 5876Q22013SR, the `symsg add` command allows a storage group with Host I/O limits set to be added to a parent storage group that is in a provisioning view using a port group that has FCoE ports.

Note: If the Host I/O limits (either `-bw_max` or `-iops_max`) on the child storage group that is being added is greater than what is configured on the parent storage group, then the operation will fail.

Removing devices from a storage group

Devices can be removed from a storage group singularly, using a combination of device ranges and single devices, or grouped in a text file.

To remove a single device from a storage group, use the following syntax:

```
symsg -sg SgName -sid SymmID [-i Interval] [-c Count][-V]
   remove dev SymDevName [-FORCE]
```

To remove multiple devices, or devices in a range, or a file, use the following syntax:

```
symsg -sg SgName -sid SymmID [-i Interval] [-c Count][-v]
    [-SA # | ALL] [-P #] [-N #]
    [-cap # [-captype mb | cyl]][-celerra] [-rp] [-ckd]
    [-devs <SymDevStart:SymDevEnd | SymDevName
    [,SymDevStart:SymDevEnd | SymDevName>...] >|
    -file DeviceFileName [-tgt]>]

 rmall [-force]
```

Example To remove a single device from a storage group named `prod on Symmetrix array 123`, enter:

```
symsg -sid 123 -sg prod remove dev 30
```

Storage device 30 is removed from storage group `prod`.

Example To remove all devices from a storage group named `prod on Symmetrix array 123`, enter:

```
symsg -sid 123 -sg prod rmall
```

All storage devices are removed from storage group `prod`.

Example To remove multiple devices from a storage group named `prod on Symmetrix array 123`, enter:

```
symsg -sid 123 -sg prod rmall -devs 31:35,37,40:43
```

Storage devices 31 through 35, 37, and 40 through 43 are removed from storage group `prod`.

Example To remove all devices that are listed in a text file named `storgrp_a.txt` from a storage group named `prod on Symmetrix array 123`, enter:

```
symsg -sid 123 -file storgrp_a.txt -sg prod rmall
```

All storage devices within text file `storgrp.txt` are removed from storage group `prod`.

Note: Device text files can be in either a one or two column format, specifying source and target devices. If the `-tgt` option is specified, only devices from the second column are removed from the storage group.

Note: As a restriction, you cannot remove all (`rmall`) devices in a storage group out of that group, if the group is part of a masking view or associated with a FAST policy.

Removing cascaded storage groups

Child SG(s) can be removed individually from a parent SG using the `symsg remove sg` command.

The following restrictions apply to `symsg remove sg` operations:

- If the parent SG has a masking view, any operations involving device removes from the child SGs will not be permitted, if it causes the parent SG to have no more devices. This includes removes and moves.
- You cannot remove devices from a child SG using the parent SGs name.
- If you are removing Celerra devices from an SG or a child SG with Celerra devices from a parent SG within a view, you must use the `-celerra` flag.
- If your are removing a CKD device or a child SG with CKD devices from a parent SG within a view, you must use the `-ckd` flag.
- If you are removing an RP tagged device or a child SG with RP tagged devices from a parent SG within a view, you must use the `-rp` flag.

The `symsg` command uses the following syntax for removing child SGs from a parent SG:

```
symsg -sg SgName -sid SymmID [-i Interval]
          [-c Count] [-v] [-celerra] [-rp] [-ckd]
        remove sg SgName1 [,SgName2,SgName3,SgNamen]
```

Using the Host I/O Limits feature

The Host I/O Limits feature (`-bw_max MBperSec` and `-iops_max IOperSec`) allows you to limit front-end (FE) port performance by setting FE bandwidth limits on a storage group. This feature is used to limit the amount of FE bandwidth and I/Os per second (IOPs) that can be consumed by a set of Symmetrix devices over a set of director ports. The bandwidth and I/Os controls are then monitored by the Symmetrix array to ensure that they do not exceed the specified maximum bandwidth or maximum IOPs. This feature allows you to place limits on the FE bandwidth and IOPs consumed by applications on the Symmetrix array.

Note: The Host I/O Limits feature requires Solutions Enabler V7.5 with Enginuity 5876Q42012SR or higher.

Note: For additional documentation on using this feature, refer to the *Host I/O Limits for Symmetrix VMAX Family Arrays Technical Notes*, which are available on EMC Online support at: `https://support.EMC.com`. The paper explains the benefits of implementing the Host I/O Limits feature and provides use case examples.

Restrictions for SGs with defined Host I/O Limits

The following restrictions apply to a storage group that has defined Host I/O Limits:

- At any given time, a storage group with defined Host I/O Limits can be associated with at most, one port group in any provisioning view. This means, that if the storage group with defined Host I/O Limits is in a provisioning view with a port group, the storage group and port group combination must be used when creating other provisioning views on this storage group. If you attempt to create the view using a different port group, the following error returns:

  ```
  The operation cannot be performed because the storage group with a
  Host I/O Limit can be associated with at most one port group in any
  masking view.
  ```

- For Solutions Enabler V7.5, creating a provisioning view on child storage group is not allowed if the parent storage group has defined Host I/O Limits. If you attempt to create a view, the following error returns:

  ```
  The operation can not be performed because the child storage group
  or the parent storage group has a Host I/O Limit defined.
  ```

- For Solutions Enabler V7.5, setting Host I/O Limits on a parent storage group is not allowed if any child storage group is already part of a provisioning view that was created using the child storage group. If you attempt to create a view, the following error returns:

  ```
  Cannot perform the requested operation because the group is currently
  within a masking view or a masking view through cascading.
  ```

- Any device can be in at most one storage group with Host I/O Limits. If you attempt to add the same device to another storage group with Host I/O Limits, the following error returns:

  ```
  The operation cannot be performed because the device already exists
  in a storage group with a Host I/O Limit.
  ```

- If a device is in a masking view with Host I/O Limits, it cannot be in another masking view without Host I/O limits. If you attempt to add a device in a masking view with Host I/O Limits to another masking view without Host I/O Limits, the following error returns:

  ```
  The operation cannot be performed because the device already exists
  in a masking view with or without Host I/O Limit.
  ```

- If the Host I/O Limits (either `-bw_max` or `-iops_max`) being configured on a child storage group is greater than what is set on the parent storage group, then the operation will fail.
- If the Host I/O limits (either `-bw_max` or `-iops_max`) on the child storage group that is being added is greater than what is configured on the parent storage group, then the operation will fail.
- If a Host I/O Limits (either `-bw_max` or `-iops_max`) being configured on a parent storage group is less than the what is set on any one of its child storage groups, then the operation will fail.
- The Host I/O Limits dynamic (`-dynamic`) setting for the parent and children must match. Child SGs inherit the dynamic distribution setting from the parent SG if set.
- When issued from Solutions Enabler V7.4 or earlier, the following operations are blocked:
  - Deleting a storage group with Host I/O Limits
  - Deleting a port group if it is associated with any Host I/O Limits
  - Deleting a provisioning view if one of the storage groups has Host I/O Limits
  - Creating a provisioning view if the storage group has Host I/O Limits defined
  - Creating a provisioning view if the port group is already in another view with Host I/O Limits defined
  - Modifying a storage group that has active Host I/O Limits
  - Restoring the provisioning view database.

Setting the Host I/O Limit

The `symsg create` command provides two options for setting the storage group Host I/O Limit (`-bw_max` *`MBperSec`* and `-iops_max` *`IOperSec`*). The `-bw_max` option specifies the front-end maximum bandwidth in MBs/sec for the storage group. The valid range for bandwidth is from 1 MB/Sec to 100,000 MB/Sec. The `-iops_max` option specifies the front-end maximum IOs/sec. The valid range for IOPs is from 100 IO/Sec to 2,000,000 IO/Sec and must be specified in units of 100 IO/Sec. An error returns if an invald range is specified.

To configure Host I/O Limits on a set of devices, the FE limits are added to a storage group. When you create a provisioning view using that storage group, the limits are applied to the devices in the storage group for the ports defined in the port group.

Note: Refer to the *EMC Solutions Enabler Symmetrix Array Controls CLI Product Guide* for information on creating provisioning views.

Example To create an empty storage group named prod with a FE bandwidth limit of 40,000 MB per second on Symmetrix array ID 123, enter:

```
symsg -sid 123 create prod -bw_max 40000
```

Changing the Host I/O Limit

The `symsg set` command also provides two options for setting the storage group Host I/O Limit. Use the following syntax to set or change performance limits for an existing storage group:

```
symsg -sg SgName -sid SymmID [-i Interval] [-c Count]
   set [-bw_max MBperSec | NOLIMIT] [-iops_max IOperSec | NOLIMIT]
```

The same range limits described for the `create` command apply, but if `NOLIMIT` is specified, then the maximum bandwidth or IOs/Sec is set to unlimited.

Example To set an IOPs limit of 50,000 I/Os per second for a storage group named prod on Symmetrix array ID 123, enter:

```
symsg -sid 123 set prod -iops_max 50000
```

Host I/O Limits can be added, removed, or modified for a storage group. For Solutions Enabler V7.6 and Enginuity 5876Q22013SR and higher, the Host I/O Limit for a cascaded storage group can be added for both the parent and the child storage group. If a parent storage group has a control set, the setting is shared among all its child storage groups when a provisioning view is created using the parent storage group. If a parent storage group has a control set, you cannot create provisioning views using the child storage groups.

If the Host I/O Limits (either `-bw_max` or `-iops_max`) being configured on a child storage group is greater than what is set on the parent storage group, then the operation will fail. If a Host I/O Limits (either `-bw_max` or `-iops_max`) being configured on a parent storage group is less than the what is set on any one of its child storage groups, then the operation will fail.

Note: With Solutions Enabler V7.6 and Enginuity 5876Q22013SR and higher, the `symsg set`command allows Host I/O Limits to be set on a storage group that is in a provisioning view using a port group that has FCoE ports.

"Listing storage groups" on page 200 provides information on listing storage group information including Host I/O Limit and demand reports.

Dynamic Distribution setting for FE Host I/O Limits

With Solutions Enabler V7.6 and Enginuity 5876Q22013SR and higher, you can optionally configure a dynamic distribution of the FE Host I/O limits by using the `-dynamic` option. Setting port failure capability causes the fraction of the configured Host I/O limits available to a configured port to be adjusted, based on the number of ports that are

currently online. Setting dynamic distribution causes the configured limits to be dynamically distributed across the configured ports, allowing the limits on each individual port to adjust to fluctuating demand. The Dynamic Distribution feature is supported on Front-End ports from Fibre Channel, iSCSI and FCoE directors.

If port failure capability is set on the FE Host I/O Limit and one of the directors is taken offline or goes down, its percentage of the limit is then redistributed, and the two remaining ports can consume the remaining portion of the limit. Once the faulted director comes back online, the limit is again redistributed across all three ports.

If dynamic distribution is set on the FE Host I/O Limit, then the maximum IOPs for the provisioned view are distributed dynamically across all three of the active ports within the view. The distribution fluctuates based on the current demand on each of the ports

The `-dynamic` option is available for the `symsg set` and `create` commands to allow setting of the dynamic distribution attribute type on a storage group. If the option field is not given a default of `NEVER` is used.

When the dynamic distribution attribute is set on a parent storage group, every child storage group inherits the same attribute value. The operation is blocked If you attempt to set the attribute on a child storage group.

Note: The parent and child storage groups must have the same dynamic distribution attribute value before they can be placed in a cascaded relationship.

Use the following syntax to set or change dynamic distribution for an existing storage group:

```
symsg -sid <SymmID> [-i <Interval>] [-c <Count>] [-v]

   create <SgName> [-bw_max <MBperSec>]
                   [-iops_max <IOperSec>]
                   [-dynamic <NEVER | ALWAYS | ONFAILURE>]
     . . .
symsg -sg <SgName> -sid <SymmID> [-i <Interval>]
     [-c <Count>]

   set <[-bw_max <<MBperSec> | NOLIMIT>]
        [-iops_max <<IOperSec> | NOLIMIT>]
        [-dynamic <NEVER | ALWAYS | ONFAILURE>]>
```

Setting the `-dynamic` option to `ALWAYS` indicates that the Host IO Limits for the storage group should always be dynamically redistributed. Setting to `NEVER` indicates that the Host IO Limits for the storage group should never be dynamically redistributed and setting to `ONFAILURE` indicates that the Host IO Limits for the storage group should dynamically redistributed only upon afailure of a Front-End Port.

Note: Use the `symsg show` command to display the value of a storage group's Dynamic Distribution setting. If a provisioning view has not been created on the parent storage group, the Dynamic Distribution displays as N/A.

Copying devices from a SG to a DG

Devices from an existing storage group can be copied (or added) to a device group. The copied devices remain in the storage group (*SgName*) and are added to the destination device group (*DgName*).

Use the following syntax to add devices from an existing storage group to a device group:

```
symsg -sid SymmID [-i Interval] [-c Count] [-v]
      sg2dg SgName DgName [-bcv | -vdev | -tgt]
      [-R1 | -R2 | -R21 | -noRDF]
```

Adds RDF1 (-R1) devices, RDF2 (-R2) devices, RDF21 (-R21) devices, or non-SRDF devices (-noRDF) to the device group. This option must match the device type.

If the device group does not exist, an error is returned.

Example To copy only R1 devices belonging to group number 008 from storage group `prod to device group prod_2,` enter:

```
symsg sg2dg prod prod_2 -R1 -sel_rdfg 008
```

Note: For cascaded storage groups, the `sg2dg` command behavior has been modified to create a DG from a parent SG with the DG containing devices from all the child SGs.

Listing storage groups

To retrieve a list of all storage groups defined in your Symmetrix array, enter:

```
symsg list
```

The `symsg list` command returns a list of all storage group names, the number of devices each contains, and indicates whether the storage group is associated with a FAST policy, contained in a masking view, is the parent or child in a cascaded relationship, if a Host I/O Limit is defined, shared, or both. Note that for parent SGs, the display includes both the number of child SGs it contains and the cumulative total of all devices contained by those child SGs.

The following example displays all storage groups for Symmetrix array 000195700601:

```
symsg list -sid 601

        S T O R A G E  G R O U P S


Symmetrix ID:        000195700601

                        Flags Number   Child
Storage Group Name      FMSL  Devices  SGs
---------------------------------------------
Sales_Data              .X.D       17      0
Fin_Data                .X..        4      0
SG_Eng1                 .XPD       23      2
Eng1_Data               .XCS       10      0
Eng2_Data               .XCS       13      0
SG_Eng2                 ..P.       30      2
Eng4_Data               ..CD       10      0
Eng5_Data               ..C.       20      0

Legend:
  Flags:
    (F)ast Policy,     X = Associated with Fast Policy, . = N/A
```

```
 (M)asking View,    X = Contained in Mask View(s),    . = N/A
 Cascade (S)tatus,  P = Parent SG, C = Child  SG,     . = N/A
 Host IO (L)imit,   D = Host IO Limit Defined, S = Host IO Limit
Shared, . = N/A
```

Note: For the (M)asking View flag, if a Parent SG contains a masking view, all its child SGs show that they are contained within the same masking view.

Note: Storage groups with names longer than 21 characters display with their first 21 characters followed by an asterisk (*). "Setting group names to display full name" on page 22 explains how to set the environmental variable to display full group names.

Host I/O Limit demand reports

Two Host I/O Limit demand options (`-by_port -demand` and `-by_pg -demand`) can be used with the `symsg list` command to report the Host I/O Limit demand on each individual director port or port group. The demand reports show that the Host I/O Limit is divided equally among all of the directors in the port group, independent of the number of ports on each director. This means that the demand reports show the same Host I/O Limit on both ports even though the Host I/O Limit is shared by the ports. Because of this, it is recommended that you configure only one of the ports of a director in the same port group.

Note: Solutions Enabler V7.5 with Enginuity 5876Q42012SR or higher is required for this feature.

To list Host I/O Limit demands, use the following syntax:

```
symsg -sid SymmID [-i Interval] [-c Count] [-V]
   list -by_port -demand [-pg PgName | -dir <# [-p # | ALL] | ALL>]
   list -by_pg -demand [-pg PgName]
```

Example To list a demand report for all director ports, enter:

```
symsg list -by_port -demand

Symmetrix ID   : 000195700123

 Director     IO Limit              Bandwidth Limit
----------- ---------------- ---------------------------------------
      Host   Maximum  Number     Port    Maximum    Number
      Limit  Demand  Nolimit    Speed     Demand   NoLimit   Excess
DIR:P Exist (IO/Sec)     SGs (MB/Sec) (MB/Sec) (%)     SGs (MB/Sec)
----- ----- -------- ------- -------- -------- --- ------- --------
01A:0 No           0       0     1000        0   0       0    +1000
01A:1 Yes       2000       0     1000     1000 100       0       +0
  . . .
01E:0 Mixed     1200       1     1000     1500 150       1     -500
01E:1 Yes        750       0     1000     1500 150       0     -500
  . . .
02E:0 Yes       1200       0     1000     1500 150       0     -500
02E:1 No           0       0     1000        0   0       0    +1000
03E:0 Yes        750       0     1000     1500 150       0     -500
03E:1 No           0       0     1000        0   0       0    +1000
  . . .
```

Note: Only storage groups that have a provisioning view created on them will be shown as placing a Host I/O Limit demand on the director port.

Note: If both the parent and child storage group has a Host I/O defined, the maximum demand is calculated based on the parent Host I/O settings.

The Host Limit Exist column indicates whether a limit demand has been configured on a port, and if storage groups with no limits configured are sharing the port. The Maximum Demand columns indicate the total Host I/O Limit demand on the specified director port in MB/Sec or IO/Sec. The Port Speed column indicates the bandwidth in MB/Sec for that port (the port negotiated speed). The Number Nolimit SGs columns indicate the number of storage groups with no limits configured that are sharing the port. The Excess column indicates the amount of bandwidth in MB/sec that is available on the director port after accounting for the demands on the port.

Example To list a demand report for all port groups, enter:

```
symsg list -by_pg -demand

Symmetrix ID   : 000195700123

Port Group                IO Limit             Bandwidth Limit
----------------------- ---------------- -------------------------------------
                  Host   Maximum  Number Port Grp    Maximum    Number
                 Limit  Demand  Nolimit    Speed     Demand   NoLimit   Excess
Name              Exist (IO/Sec)     SGs (MB/Sec) (MB/Sec) (%)      SGs (MB/Sec)
----------------- ----- -------- ------- -------- -------- --- ------- --------
PG_Eng1           Yes          0       1     2000     3000 150       0    -1000
PG_Eng2           Yes       1500       0     2000     3000 150       0    -1000
PG_Eng3           Yes          0       1     1000        0   0       1    +1000
PG_Eng4           No        2000       0     1000     1000 100       0        0
  . . .
```

Note: Only storage groups that have a provisioning view created on them will be shown as placing a Host I/O Limit demand on the port group.

The Host Limit Exist column indicates whether a limit demand has been placed on a port group, and if storage groups with no limits configured are sharing the port group. The Maximum Demand columns indicate the total Host I/O Limit demand on the specified port group in MB/Sec or IO/Sec. The Port Grp Speed column indicates the bandwidth in MB/Sec for that port group (the aggregated port negotiated speed for the ports in the group). The Number Nolimit SGs columns indicate the number of storage groups with no limits configured that are sharing the port group. The Excess column indicates the amount of bandwidth in MB/sec that is left available on the port group after the demands have been accounted for.

Example The following example shows a verbose (-v) demand report for all port groups. The verbose option can also be used for director ports.

```
symsg list -by_pg -demand -v

Symmetrix ID   : 000195700123

Port Group Name                      : PG_Eng1
Port Group Total Demand (IO/Sec)     :         0
Number of SGs without Limit (IO/Sec):         1
```

```
Port Group Negotiated Speed (MB/Sec):     2000
Port Group Total Demand (MB/Sec)    :     3000
Percent Port Group Capability (%)   :      150
Port Group Excess        (MB/Sec)   :    -1000
Number of SGs without Limit (MB/Sec):        0

Storage Groups (3)
    {
    ---------------------------------------------
                               Maximum  Demand
                            ---------------------
    Name                     MB/Sec  (%)  IO/Sec
    ----------------------  -------- --- --------
    SG_Eng1                     1000  50  NoLimit
      Eng1_Data                  800  40      800
      Eng2_Data                  600  30  NoLimit
    SG_Eng2                     2000 100     1000
      Eng3_Data                    -   -        -
      Eng4_Data                    -   -        -
    SG_Eng4                  NoLimit   -  NoLimit
    }


Port Group Name                     : PG_Eng2
Port Group Total Demand (IO/Sec)    :     1500
Number of SGs without Limit (IO/Sec):        0

Port Group Negotiated Speed (MB/Sec):     2000
Port Group Total Demand (MB/Sec)    :     3000
Percent Port Group Capability (%)   :      150
Port Group Excess        (MB/Sec)   :    -1000
Number of SGs without Limit (MB/Sec):        1

Storage Groups (1)
    {
    ---------------------------------------------
                               Maximum  Demand
                            ---------------------
    Name                     MB/Sec  (%)  IO/Sec
    ----------------------  -------- --- --------
    SG_Eng4                  NoLimit   -  NoLimit
      Eng1_Data                 1000  50      500
      Eng2_Data                 2000 100     1000
    }


Port Group Name                     : PG_Eng3
Port Group Total Demand (IO/Sec)    :        0
Number of SGs without Limit (IO/Sec):        1

Port Group Negotiated Speed (MB/Sec):     1000
Port Group Total Demand (MB/Sec)    :        0
Percent Port Group Capability (%)   :        0
Port Group Excess        (MB/Sec)   :    +1000
Number of SGs without Limit (MB/Sec):        1

Storage Groups (1)
    {
    ---------------------------------------------
                               Maximum  Demand
                            ---------------------
    Name                     MB/Sec  (%)  IO/Sec
    ----------------------  -------- --- --------
    SG_Eng4                  NoLimit   -  NoLimit
    }
. . .
```

Showing details about a storage group

Use the `symsg show` command to gather detailed information about a specific storage group. For example, to show information about storage group `SG_Corp1` on Symmetrix array 000195700601, enter:

```
symsg show -sid 601 SG_Corp1
```

Note: The example output below is truncated and is intended to provide the overall example of a possible data set.

```
symsg show SG_Corp1

Name: SG_Corp1

   Symmetrix ID             : 000195700601
   Last updated at          : Wed Apr 09 00:28:16 2012
   Masking Views            : Yes
   FAST Policy              : Yes
   Host I/O Limit           : None
   Host I/O Limit MB/Sec    : N/A
   Host I/O Limit IO/Sec    : N/A
   Dynamic Distribution     : N/A
   Number of Storage Groups : 0
   Storage Group Names      : N/A

   Devices (10):
    {
    ----------------------------------------------------------
    Sym                              Device                Cap
    Dev    Pdev Name                 Config        Sts     (MB)
    ----------------------------------------------------------
    0A41   N/A                       2-Way Mir      RW    2000
    0A42   N/A                       2-Way Mir      RW    2000
      . . .
```

Note: The above example shows a storage group without a defined Host I/O Limit. Host I/O Limit fields are only displayed for Solutions Enabler V7.5 with Enginuity 5876Q42012SR or higher.

The `symsg show` command can be used to display parent and child information for cascaded storage groups. Using the `symsg show` command on a parent SG displays devices from all child SGs in ascending sorted order.

The following example shows information for a parent SG:

```
symsg show SG_Eng1

Name: SG_Eng1

   Symmetrix ID             : 000195700601
   Last updated at          : Wed Apr 11 00:28:16 2012
   Masking Views            : Yes
   FAST Policy              : No
   Host I/O Limit           : Defined
   Host I/O Limit MB/Sec    : 1000
   Host I/O Limit IO/Sec    : NoLimit
   Dynamic Distribution     : N/A
   Number of Storage Groups : 2
   Storage Group Names      : Eng1_Data       (IsChild)
                              Eng2_Data       (IsChild)
   Number of Composite Groups : 0
   Composite Group Names      : N/A
```

```
   Number of Groups           : 2
   Group Names                : DG1
                              : DG2
   Devices (20):
    {
    ------------------------------------------------------------
    Sym                                Device                Cap
    Dev    Pdev Name                   Config        Sts     (MB)
    ------------------------------------------------------------
    1A41   N/A                         2-Way Mir      RW     2000
    1A42   N/A                         2-Way Mir      RW     2000
    1A43   N/A                         2-Way Mir      RW     2000
    1A44   N/A                         2-Way Mir      RW     2000
    1A45   N/A                         2-Way Mir      RW     2000
      . . .
```

Note: The above example shows a parent storage group with a defined Host I/O Limit . Host I/O Limit fields are only displayed for Solutions Enabler V7.5 with Enginuity 5876Q42012SR or higher.

The following example shows information for a child SG:

```
symsg show Eng1_Data

Name: Eng1_Data

   Symmetrix ID             : 000195700601
   Last updated at          : Wed Apr 11 00:28:16 2012
   Masking Views            : Yes
   FAST Policy              : No
   Host I/O Limit           : Shared
   Host I/O Limit MB/Sec    : 1000
   Host I/O Limit IO/Sec    : NoLimit
   Dynamic Distribution     : N/A
   Number of Storage Groups : 1
   Storage Group Names      : SG_Eng1        (IsParent)

   Devices (10):
    {
    ------------------------------------------------------------
    Sym                                Device                Cap
    Dev    Pdev Name                   Config        Sts     (MB)
    ------------------------------------------------------------
    1A41   N/A                         2-Way Mir      RW     2000
    1A42   N/A                         2-Way Mir      RW     2000
    1A43   N/A                         2-Way Mir      RW     2000
    1A44   N/A                         2-Way Mir      RW     2000
    1A45   N/A                         2-Way Mir      RW     2000
      . . .
```

Note: The above example shows a child storage group when it is sharing the Host I/O Limit defined in the parent storage group. This is only shown when a provisioning view is created using the parent storage group. If a provisioning view was not created on the parent storage group, the limit is not reported as being shared.

Note: Host I/O Limit fields are only displayed for Solutions Enabler V7.5 with Enginuity 5876Q42012SR or higher.

For a SG that is not part of a cascaded relationship, the following fields display:

```
   Number of Storage Groups          : 0
   Storage Group Names               : N/A
```

Exporting and importing device lists

You can save the list of devices from an existing storage group to a text file on your host system, and this file can later be imported to create a storage group. This can be useful if you then delete the group and later wish to recreate it. The device list file contains a device description line for as many devices as there are listed in the storage group. Lines that are blank or include a pound (#) sign in the first column are ignored.

Group files for the `import` and `export` commands contain device parameters in the following format:

```
SymmID
SymDevName
SymDevName
. . .
```

Group files for the `importall` and `exportall` commands contain device parameters in the following format:

```
SgName
SymmID
SymDevName
SymDevName
. . .
```

Note: This format can be repeated in the file for multiple storage groups.

Note: If a filename is not specified with the `symsg import` or export command, a default file named `symsg.txt` is created in the directory where the `symsg` command is executed. If a filename is not specified with the `symsg importall` or `exportall` command, a default file named `symsgall.txt` is created in the directory where the `symsg` command is executed.

Exporting a device list

You can export a list of devices in a storage group to a file on your host system using the following syntax:

```
symsg -sid SymmID [-i Interval] [-c Count][-v]

   export SgName [-f FileName]
   exportall [-f FileName]
```

Example For example, to export the storage group membership from group `prod2` to device file named `prod2list.txt`, enter:

```
symsg -sid 123 export prod2 -f prod2list.txt
```

Importing a device list

You can add multiple devices to a new or existing storage group by importing an existing file that contains a list of devices created by the export action using the following syntax:

```
symsg -sid SymmID [-i Interval] [-c Count][-v]

   import SgName [-f FileName]
   importall [-f FileName]
```

Example For example, to create a storage group named `prod2` from the device file `prod2list.txt`, enter:

```
symsg -sid 123 import prod2 -f prod2list.txt
```

Typically, you import files that were previously exported (refer to "Exporting a device list" on page 183).

The `import` action will create the storage group if the group name specified in the command does not already exist, or you can import to an existing group name that is partially populated. If you import to an existing group, the devices in the imported file will be appended to the existing group membership.

In addition, you can recreate all storage groups, using the `symsg importall` command, that were from data contained in a text file previously created using the `symsg exportall` command.

Note: For `importall`, if any of the storage groups that you you are attempting to create already exist, Solutions Enabler displays a message indicating its existence, and the operation will continue to create the next storage group in the list.

The `symsg export/exportall` command output has been modified to include a new identifier (S), to denote that the line contains the name of a Child SG.

For example, the output of an export of parent SG sgparent displays as follows:

```
000194900341
S sgchild1
S sgchild2
An example of the output of an exportall will be:

<sgparent>
000194900341
S sgchild1
S sgchild2

<sgchild1>
000194900341
00201
00206

<sgchild2>
000194900341
00404
00405
00406
```

Rename, move, copy, and delete storage groups

The `symsg` command also provides the ability to rename, move, copy, and delete existing storage groups.

Note: A parent SG may not be specified as the destination for a `move`, `moveall`, `copy` or `copyall` operation, as a parent SG may not contain both child SG's and devices.

Renaming a storage group

To rename an existing storage group, use the following syntax:

```
symsg -sid SymmID [-i Interval] [-c Count]
   rename OldSgName NewSgName
```

Example To rename a storage group named `prod on Symmetrix array ID#59866000123 to prod_B,` enter:

```
symsg rename -sid 123 prod prod_B
```

Moving a device

Use the `symsg move dev` command to move one device, specifying the Symmetrix device name, from one existing storage group to another existing storage group. The moved device is deleted from the current storage group (*SgName*) and added to the destination storage group (*DestSgName*).You can specify the interval and count options (`-i` and `-c`) to wait a predetermined time (interval) between attempts (count) to acquire an exclusive lock on the Symmetrix host database. The following syntax is used to move an individual device:

```
symsg -sg SgName -sid SymmID [-i Interval] [-c Count]
move dev SymdevName DestSgName
```

Example For example, to move Symmetrix device `30 on Symmetrix array ID#59866000123` from storage group `prod` to storage group `test`, enter:

```
symsg -sid 123 -sg prod move dev 30 test
```

Note: You cannot move the last device in a storage group out of the group, if the group is part of a masking view or associated with a FAST policy.

Note: If the devices are associated with a FAST policy, the `symsg move` and `moveall` commands do not work to move devices between storage groups. You must first remove the devices from the original storage group using the `symsg remove` or `rmall` command, and then add them to the new storage group using the `symsg add` command.

If the parent SG has a masking view, any operations involving device removes from the child SGs are not permitted, if it causes the parent SG to have no more devices. This includes removes and moves.

Moving all devices

Multiple devices can be moved from a storage group in a list, using a combination of device ranges and single devices, or grouped in a text file. The moved devices are deleted from the current storage group (*SgName*) and added to the destination storage group (*DestSgName*). To move multiple devices, devices in a range, or listed a file, use the following syntax:

```
symsg -sg SgName -sid SymmID [-i Interval] [-c Count][-v]
    [-SA # | ALL] [-P #] [-N #]
    [-cap # [-captype mb | cyl]][-celerra] [-rp] [-ckd]
    [-devs <SymDevStart:SymDevEnd | SymDevName>
    [<,SymDevStart:SymDevEnd | SymDevName...]> |
    -file DeviceFileName -tgt]

    moveall DestSgName
```

When choosing to move all devices from one existing storage group to another, you can move all devices, or use the additional options to select specific devices. Specify the interval and count options (`-i` and `-c`) to wait a predetermined time (interval) between attempts (count) to acquire an exclusive lock on the Symmetrix host database.

Note: You cannot move all devices out of a storage group if the group is part of a masking view or associated with a FAST policy.

Example For example, to move all devices from a storage group named `prod` to a storage group named `test on Symmetrix array 123,` enter:

```
symsg -sid 123 -sg prod moveall test
```

Example To move multiple devices from a storage group named `prod` to a storage group named `test on Symmetrix array 123`, enter:

```
symsg -sid 123 -sg prod moveall -devs 31:35,37,40:43
```

Storage devices 31 through 35, 37, and 40 through 43 are moved from storage group `prod` to storage group `test`.

The `symsg moveall` command requires the `-force` option under the following conditions:

- Moving device(s) from a source SG contained in a masking view, either directly or indirectly (inherited from a parent SG contained in a masking view) to a destination SG that is also contained in a masking view, either directly or indirectly.
- Moving device(s) between two SG's, both associated with a FAST policy.

Copying a device

Use the `symsg copy dev` command to copy one device, specifying the Symmetrix device name, from one existing storage group to another existing storage group. The copied device remains in the current storage group (*SgName*) and is added to the destination storage group (*DestSgName*). You can specify the interval and count options (`-i` and `-c`) to wait a predetermined time (interval) between attempts (count) to acquire an exclusive lock on the Symmetrix host database. The following syntax is used to copy an individual device:

```
symsg -sg SgName -sid SymmID [-i Interval] [-c Count][-v]
copy dev SymdevName DestSgName
```

Example For example, to copy Symmetrix device `30 on Symmetrix array ID#59866000123` in device group `prod` to device group `test`, enter:

```
symsg -sid 123 -sg prod copy dev 30 test
```

Device 30 is now contained in both storage group `prod` and storage group `test`.

Note: As a restriction, you cannot copy a device from a storage group that is associated with a FAST policy into another storage group that is also associated with a FAST policy.

Copying all devices

Multiple devices can be copied from a storage group in a list, range, or grouped in a text file. The copied devices remain in the current storage group (*SgName*) and are added to the destination storage group (*DestSgName*).

Use the following syntax to copy multiple devices from a storage group:

```
symsg -sg SgName -sid SymmID [-i Interval] [-c Count][-v]
    [-SA # | ALL] [-P #] [-N #]
    [-cap # [-captype mb | cyl]][-celerra] [-rp] [-ckd]
    [-devs <SymDevStart:SymDevEnd | SymDevName >
    [<,SymDevStart:SymDevEnd | SymDevName...]> |
    -file DeviceFileName [-tgt]]

    copyall DestSgName
```

When choosing to copy all devices from one existing storage group to another, you can copy all devices, or use the additional options to select specific devices. Specify the interval and count options (`-i` and `-c`) to wait a predetermined time (interval) between attempts (count) to acquire an exclusive lock on the Symmetrix host database.

Note: You cannot copy all devices from a storage group that is associated with a FAST policy into another storage group that is also associated with a FAST policy.

Example For example, to copy all devices from a storage group named `prod` to a storage group named `test on Symmetrix array 123,` enter:

```
symsg -sid 123 -sg prod copyall test
```

All devices from storage group `prod` are now also contained in storage group `test`.

Example To copy multiple devices from a storage group named `prod` to a storage group named `test on Symmetrix array 123`, enter:

```
symsg -sid 123 -sg prod copyall -devs 31:35,37,40:43
```

Storage devices 31 through 35, 37, and 40 through 43 from storage group `prod` are now also contained in storage group `test`.

Example To copy multiple devices from a device file named `test_2.txt` to a storage group named `test and a destination storage group` (*DestSgName*) `named test_2 on Symmetrix array 123`, enter:

```
symsg -sid 123 -sg test copyall -file test_2.txt test_2
```

All devices listed in device file `test_2.txt` are now contained in both storage group `test` and `test_2`.

Copying devices from a SG to a DG

Devices from an existing storage group can be copied (or added) to a device group. The copied devices remain in the storage group (*SgName*) and are added to the destination device group (*DgName*). Use the following syntax to add devices from an existing storage group to a device group:

```
symsg -sid SymmID [-i Interval] [-c Count][-v]
sg2dg SgName DgName [-bcv | -vdev | -tgt]
```

If the device group does not exist, it will be created. If optional device types are not specified, only standard devices will be added.

Example To add devices from a storage group named `prod on Symmetrix array 123 to a device group named prod_2,` enter:

```
symsg -sid 123 sg2dg prod prod_2
```

All standard devices in storage group `prod` have been added to device group `prod_2`.

Example To add only the target devices from a storage group named `prod on Symmetrix array 123 to a device group named prod_2,` enter:

```
symsg -sid 123 sg2dg prod prod_2 -tgt
```

All target devices in storage group `prod` have been added to device group `prod_2`.

Note: An error will be returned if the `-tgt` option is specified and the storage group contains both standard and BCV devices.

Deleting a storage group

Use the `symsg delete` command to delete a storage group using the following syntax:

```
symsg -sid SymmID [-i Interval] [-c Count]
delete SgName [-force]
```

Example To delete an empty storage group named `prod on Symmetrix array 123,` enter:

```
symsg delete -sid 123 prod
```

Note: As a restriction, you cannot delete a storage group if the group is part of a masking view or associated with a FAST policy.

The following restrictions apply to the `symsg delete` command for cascaded SGs:

- A parent SG cannot be deleted unless the `-force` flag is used.
- A parent SG cannot be deleted if it has a masking view
- A child SG must be removed from its parent SG before it can be deleted.

Performing miscellaneous operations on SG devices

Use the following command syntax to perform the following operations on devices within a storage group:

- Change the state (write disable, read write enable, ready, not ready) of a device
- Set or reset the hold bit on a device
- Compress or uncompress a thin device
- Bind, unbind, rebind, start or stop allocations, free, and reclaim thin devices
- Set or unset persistence on a device
- Set the Optimized Read Miss mode

```
symsg -sg sgName -sid SymmID [-i Interval]
          [-c Count] [-v] [-noprompt] [-rp] [-star]
          [-celerra] [-skip -lockid locknum]

        not_ready

        ready

        rw_enable
```

```
write_disable

hold

unhold [-symforce]

compress [-stop]

uncompress [-stop]

bind -pool <PoolName>

rebind -pool <PoolName>

unbind

allocate [-persistent | -stop]

free [-stop]

reclaim [-persistent | -stop]

set -persistent

unset -persistent

set -orm [off | system]
```

Note: "Virtual Provisioning (VP) Compression" on page 101 provides information on compressing and uncompressing thin devices.

For Symmetrix arrays running Solutions Enabler V7.6 and Enginuity 5876Q22013SR, or higher, the `symsg` command supports the following control actions when issued against thin devices: binding, unbinding and rebinding, the ability to start and stop allocations, and freeing and reclaiming of space on a thin device. The operations can be directed at all devices in a SG group.

A `bind` action associates a thin device to a thin pool. A `rebind` action changes the thin device's current binding to a new pool. Rebind does not move the existing data to the new pool, but directs all new allocations to the thin device in the new pool after the rebind action completes. An `unbind` action disassociates a thin device from a thin pool.

The `allocate` action fully allocates all of the storage for the specified device(s). The `-persistent` option can be specified to allocate storage that will not be able to be reclaimed or freed, except by using the optional persistent control with the reclaim action.

Unwritten storage can be recovered with either a `free` or a `reclaim` action. Allocations that were written as zeros can only be recovered by using the `reclaim` action. Additionally, storage that was allocated with the persistent attribute can only be recovered by using the `-persistent` option with the `reclaim` action.

Actions to allocate, free, or reclaim thin devices are performed asynchronously in the background and are started with an explicit start action. They may be stopped, while in progress using the `-stop` option.

For Symmetrix VMAX arrays running Solutions Enabler V7.6 and Enginuity 5876Q22013SR and higher, the `symsg` command allows you to set the Optimized Read Miss mode to Off or System Managed for all devices in a storage group. "Optimized Read Miss mode" on page 66 provides additional information on this feature.

Composite groups

A composite group (CG) is a user-defined group comprised of devices or device groups, that can belong to one or more locally-attached Symmetrix arrays and one or more SRDF groups within a Symmetrix array. Members can be individual devices or device groups spanning multiple Symmetrix arrays and SRDF groups.

Device members

A single composite group can contain devices from the following different device lists:

- Standard device list (STD) — Non-BCV devices that are local to the host.
- Local Business Continuance Volume (BCV) list — BCV devices local to the host.
- Local VDEV list (VDEV) — Virtual devices that are local to the host.
- Remote VDEV list (RVDEV) — Virtual devices that are remote.
- Remote BCV list (RBCV) — BCV devices that are to be associated with the remote mirrors of the STD devices.
- BCV-Remote BCV list (BRBCV) — BCV devices that are to be associated with the remote mirrors of the local BCV devices.
- Remote-Remote BCV List (RRBCV) — Remote BCV devices that are to be associated with the remote mirrors of the RBCV devices.
- Local TGT list (TGT) — TF/Clone target devices that are local to the host.
- Remote TGT list (RTGT) — TF/Clone target devices that are remote.
- R21 STD devices — R21 devices utilize two mirrors and are considered to be concurrent SRDF devices.

Logical device name support

A composite group can contain logical device names (aliases) for devices. However, CGs created with Solutions Enabler versions prior to 6.0 will not contain *LdevNames*. Therefore, you are unable to use command options that contain *LdevNames*.

All new CGs, and any devices added to them, will automatically be assigned an *LdevName* if you do not specify one.

Note: Hosts running prior versions of Solutions Enabler have no knowledge of these device alias names and will not provide them when a consistency group is modified.

The devices added to device groups and composite groups are assigned a default logical names at add time. The name is unique within the group to which it was added.

Device group members

A device group can be a member of more than one composite group.

The integrity of control operations is maintained separately at the DG and CG level. For example, pairing STD devices with BCV devices is only allowed if both devices are contained within the same DG.

Device group membership of composite groups provides the following:

- Building blocks to creating CGs.
- Support for auto-correct of the CG.
- SRDF consistency at the CG and SRDF group name levels.
- GNS support of the CG.

Restrictions

Before you create a composite group containing device groups, review the following restrictions:

- GNS does not remotely mirror CGs containing DGs.
- CGs can contain either individual devices or device groups, but not both.
- If any of the DGs contained by a CG become invalid, the CG also becomes invalid.
- Cannot add a DG to an enabled CG.
- A CG cannot contain multiple DGs that all have the same devices.
- Control operations are only allowed at the DG or CG level if currently supported at that level. For example, control operations such as `symdg` and `symqos` are allowed at the DG level.
- A device group must exist before it can be added to the CG.
- The device groups in a composite group must follow the guidelines and restrictions outlined in "Device lists" on page 176 and "Creating a device group" on page 177.

Adding DGs to a CG

When adding more than one DG to a CG, a DG may contain devices with the same logical names, resulting in a CG having more than one device with the same logical name. To prevent this, the logical name of a device in a DG is not carried over into the CG. A new logical name is created for each device using the following format:

xxxxxsssss_ddddd

where:

- xxxxx is the one of the following reserved words representing the device type:
  - DEV
  - BCV
  - RBCV
  - BRBCV
  - RRBCV
  - 2BCV
  - VDEV
  - RVDEV
  - 2VDEV

- TGT
- RTGT
- 2TGT

- `sssss` is the last five characters of the Symmetrix array ID containing the device.
- `ddddd` is the device number, in hexadecimal, which is guaranteed to be unique within the Symmetrix array.

These naming conventions guarantee that all devices have unique logical names from the CG point of view. Devices in the DGs maintain the logical names that were assigned at the time when the devices were added to the CG.

Composite group types

You create a composite group using one of these types:

- REGULAR (Solutions Enabler V7.4 and higher allows the inclusion of SRDF devices)
- RDF1 (R1 and concurrent R11 devices)
- RDF2 (R2 and concurrent R22 devices)
- RDF21 (cascaded R21 devices)
- ANY (can contain as device mix of the above types)

Note: A composite group of any SRDF type can change its type because of a `symrdf` control operation. For example, an RDF1 CG can change to an RDF2 when the device personalities are swapped. SRDF control operations (such as the `suspend`, `establish`, and `swap` operations) cannot change the type of an ANY composite group but can affect the devices in that CG.

SRDF consistency groups

An SRDF consistency group is a composite group comprised of SRDF devices (RDF1, RDF2, or RDF21) acting in unison to preserve dependent write consistency of a database distributed across multiple SRDF systems. If a source R1 device in the consistency group cannot propagate data to its corresponding target R2 device, data propagation from all R1 devices in the consistency group is suspended, halting all data flow to the R2 targets.

Consistency is maintained by using either Multisession Consistency (MSC) for SRDF/A or SRDF Enginuity Consistency Assist (RDF-ECA) for SRDF/S. For detailed information about SRDF consistency groups, refer to the *EMC Solutions Enabler Symmetrix SRDF Family CLI Product Guide.*

A group is considered an SRDF consistency group if it is a composite group meeting all of the following criteria:

- Created as type RDF1, RDF2, RDF21, or ANY
- Contains STD devices
- Set for consistency using the `-rdf_consistency` option, which registers it with the SRDF daemon, and then enabled using the `symcg enable` command

Note: Deleting a device group from a composite group enabled for SRDF consistency causes the SRDF daemon to stop monitoring this CG.

Note: For detailed interoperability information, please refer to E-Lab Interoperability Navigator which can be reached at http://elabnavigator.EMC.com.

Creating a composite group

A composite group is created by first defining a named empty group of a specific type explained in "Composite group types" on page 216. Then, devices OR device groups are added to the composite group.

Creating an empty composite group

Composite groups are created using the `symcg` command. When you create a composite group, you assign it a name and a group type.

Use the following command syntax to create a composite group:

```
symcg [-i Interval] [-c Count][-v]
   create CgName [-type REGULAR | RDF1 | RDF2 | RDF21 | ANY ]
   [-apidb | -rdf_consistency]
```

If a group type is not specified, the default group created is REGULAR.

Specify the interval and count options (`-i` and `-c`) to wait a predetermined time (interval) between attempts (count) to acquire an exclusive lock on the Symmetrix host database and, for SRDF control operations, on the local and/or remote Symmetrix arrays.

Creating composite groups with SRDF consistency

A composite group of type RDF1, RDF2, or RDF21 is registered with the SRDF daemon when the `-rdf_consistency` option parameter is supplied with `symcg create`.

Note: A composite group created with SRDF consistency must be enabled using the `symcg enable` command before the SRDF daemon can begin monitoring and managing it.

Note: The `symcg enable` command will be blocked if the type of the enable being performed is MSC or SRDF-ECA and the scope of the enable contains multiple SRDF Groups.

When creating a composite group with SRDF consistency, the CG name is compared against all existing CG names for uniqueness. This comparison is not case sensitive, ensuring there are no CG naming collisions in the Symmetrix File System (SFS).

For example, to create a composite group named `mycg1` of type RDF1 with consistency enabled, enter:

```
symcg create mycg1 -rdf_consistency -type rdf1
```

In the options file, you must set the following option to `ENABLE` to create composite groups with SRDF consistency:

```
SYMAPI_USE_RDFD=ENABLE
```

Note: If devices set for consistency protection are in an existing CG, you cannot add them to another CG enabled for consistency protection. However, you can add these devices to a CG not enabled for consistency protection.

Setting controls on Celerra devices

Use the following `-celerra` option to set the `rw_enble`, `write_disable`, `ready`, and `non_ready` controls on Celerra FBA devices in a composite group:

```
symcg -cg CgName [-i Interval] [-c Count]
   [-noprompt] [-v] [-force]
   [-bcv | -vdev | -tgt] [-star][-sid SymmID]
   [-celerra]
```

Exporting a composite group to file

Use the following syntax to export a composite group to file:

```
symcg [-i Interval] [-c Count][-v]
   export CgName [-f FileName] [-rdf]
   exportall [-f FileName] [-rdf]
```

Specify the interval and count options (`-i` and `-c`) to wait a predetermined time (interval) between attempts (count) to acquire an exclusive lock on the Symmetrix host database and, for SRDF control operations, on the local and/or remote Symmetrix arrays.

Note: The `-rdf` option cannot be used on REGULAR or cascaded SRDF composite groups or when the composite group is of type ANY. Specifying the `-rdf` option produces an error if any Hop-2 devices are detected in the CG.

If `-rdf` is specified, the remote partners of the STD devices and BCV devices are added to the file instead of those devices that exist in the current local composite group. The RBCV devices will become local BCVs. Non-SRDF BCVs, VDEVs, BRBCVs, and RRBCVs will be ignored in this case. The resulting file will have as many device description lines as the composite group has members.

Deleting a composite group

Use the following syntax to delete an existing composite group:

```
symcg [-i Interval] [-c Count][-v]
   delete CgName [-force] [-symforce]
```

If the composite group has members, the command fails unless `-force` is used. If `-force` is specified, the device members of the group are removed, and the group is deleted.

If the composite group is enabled for SRDF consistency, you must use `-force` to delete it.

Importing a composite group

Use the following syntax to import a composite group from a previously generated file:

```
symcg [-i Interval] [-c Count][-v]
   import CgName [-f FileName]
   [-apidb | -rdf_consistency] [-rename]

   importall [-f FileName] [-rdf_consistency]
```

When the-rdf_consistency parameter is specified, the composite group is registered with the SRDF daemon.

If -rename is specified, the devices are given the next available default device name when added to the group. If -rename is not used, the devices are added with the name specified in the import file. This may result in a failure if a device already has that name in the composite group.

Adding devices to a composite group

Once a composite group is created, you can add standard devices or device groups to it.

Standard devices

Use the following syntax to add a standard device to a composite group:

```
symcg [-i Interval] [-c Count][-v]
   add pd PdevName [LdevName] -cg CgName
```

or

```
symcg -cg CgName -sid SymmID
      [-i Interval] [-c Count] [-v]
      [-rdf | -hop2]
      [-rdfg GrpNum [-remote_rdfg RemoteGrpNum]]

   add dev SymDevName [LdevName] [-vdev | -tgt]
```

When adding devices by specifying a Symmetrix device name, the Symmetrix array's ID (-sid) is required and additional options provide greater controls. Specify the interval and count options (-i and -c) to wait a predetermined time (interval) between attempts (count) to acquire an exclusive lock on the Symmetrix host database on the local and/or remote Symmetrix arrays.

Composite groups allow remote BCV devices (RBCVs) on both links to be associated with the SRDF group. These RBCVs may be R1 or R2 type BCVs and may also have a remote BCV (RRBCV) associated behind each.

When the -vdev option is specified, the devices are added to the virtual device list. For this action to succeed, the device must already be configured as a VDEV. In addition, to add a VDEV to the remote virtual device list, specify the -rdf option with the -vdev options. If the device is two hops away, specify the -hop2 option instead.

When the -tgt option is specified, the devices are added to the target device list. In addition, to add a target device to the remote target device list, specify the -rdf option with the -tgt options. If the device is two hops away, specify the -hop2 option instead.

All devices

Use the following syntax to add devices of a Symmetrix array to a specified composite group. By specifying -noRDF, you can prohibit any SRDF devices from becoming members of the composite group.

```
symcg -cg CgName [-i Interval] [-c Count] [-v]
        [-sid SymmID]
        [-SA # | ALL] [-P #] [-N #]
        [-cap # [-captype mb | cyl]]
        [-rdf | -hop2] [-vdev | -tgt]
        [-rdfg GrpNum [-remote_rdfg RemoteGrpNum]]
```

```
                [-sel_rdfg SelRdfGrpNum]
                [-devs SymDevStart:SymDevEnd | SymDevName
                    [,SymDevStart:SymDevEnd | SymDevName...]]

        addall [pd | devs [-rdf | -hop2]]
                [-R1 | -R2 | -R21 | -noRDF] [-v]
```

Adding and removing device groups

A device group does not have to contain devices before adding it to a CG.

Use the following syntax to add one or more device groups to a composite group.

```
symcg -cg CgName [-i Interval] [-c Count][-v]
   add dg DgName[DgName1,DgName2,…,DgName10]
```

Note: The command fails if the device group contains one or more storage groups.

Use the following syntax to remove one or more device groups from a composite groups.

```
symcg -cg CgName -sid SymmID
          [-i Interval] [-c Count] [-v]
          [-rdf | -hop2]
          [-rdfg GrpNum [-remote_rdfg RemoteGrpNum]]

      remove dg DgName[DgName1,DgName2,…,DgName10]
```

The `-force` option is required if removing a DG that changes the integrity of the scope of the CG enabled. For example, if CG1 is enabled at the CG level, no DG can be removed from it without `-force`. If CG1 is enabled only at the SRDF group name level, any DG that is not part of that group name may be removed without using `-force`.

Moving and copying devices

Devices from an existing composite group can be moved or copied into another existing composite group of compatible type. When the `move ld` or `moveall` action is used, the devices are removed from the source composite group and added to the destination composite group. When the `copy ld` or `copyall` action is used, copies of the devices are added to the destination composite group, and the source composite group remains unchanged. You can assign a new name to a device being copied or moved. Note that by specifying the `-sel_rdfg` option, only SRDF devices belonging to that group number are moved or copied. By using this option with `-R1`, `-R2`, `-R21`, or `-noRDF`, you can further limit the number of SRDF devices added to a composite group.

Use the following syntax to move or copy devices from one composite group to another.

```
symcg -cg CgName [-i Interval] [-c Count][-v]

   move ld LdevName DestCgName [-force] [-rename]
   copy ld LdevName DestCgName [-force] [-rename]

symcg -cg CgName [-i Interval] [-c Count] [-v]
          [-sid SymmID]
          [-SA # | ALL] [-P #] [-N #]
          [-cap # [-captype mb | cyl]]
          [-vdev | -tgt [-hop2] | -rvdev | -rtgt]
          [-rdfg GrpNum [-remote_rdfg RemoteGrpNum]]
          [-sel_rdfg SelRdfGrpNum]
          [-devs SymDevStart:SymDevEnd | SymDevName
```

```
                [,SymDevStart:SymDevEnd | SymDevName...]]

        moveall DestCgName [-force] [-symforce] [-rename]
            [-R1 | -R2 | -R21 | -noRDF]

        copyall DestCgName [-force] [-symforce]
            [-R1 | -R2 | -R21 | -noRDF]
```

Note: The `symcg copy` and `symcg copyall` commands do not allow you to copy any devices from a CG containing DGs. In this case, use the `symdg copy` or `symdg copyall` command to copy devices from a DG.

Copying devices from a DG to a CG

Devices from an existing device group can be copied (or added) to a composite group. If the CG does not exist, it is created.

Use the following syntax to add devices from an existing device group to an existing composite group:

```
dg2cg DgName CgName [-rename] [-force]
   [-bcv [-hop2] | -nobcv | -rbcv | -rrbcv | -brbcv |
   -vdev [-hop2] | -rvdev | -tgt [-hop2] | -rtgt]
   [-apidb | -rdf_consistency]
```

The following additional options are available:

- `-bcv` adds only the BCVs to the composite group. If the `-hop2` option is specified, it indicates that the specified device is two hops away.
- `-vdev` adds only the Symmetrix virtual devices to the composite group. If the `-hop2` option is specified, it indicates that the specified device is two hops away.
- `-rbcv` adds only the RBCVs to the composite group.
- `-rrbcv` adds only the RRBCVs to the composite group.
- `-brbcv` adds only the BRBCVs to the composite group.
- `-nobcv` adds only the STDs to the composite group.
- `-rvdev` adds only the Symmetrix remote virtual devices to the composite group.
- `-tgt` adds only the TGTs to the composite group. If the `-hop2` option is specified, it indicates that the specified device is two hops away.
- `-rtgt` adds only the RTGTs to the composite group.

By default, all device lists from the device group are added to the composite group.

Removing standard devices

Devices may be removed from an existing composite group. You can either remove devices individually, remove all devices, or remove all devices meeting the specified criteria.

Use the following syntax to remove a standard device from a composite group:

```
symcg -cg CgName -sid SymmID
   [-i Interval] [-c Count] [-v]
   [-rdf | -hop2]
   [-rdfg GrpNum [-remote_rdfg RemoteGrpNum]]
```

```
      remove dev SymDevName [-force] [-symforce]
         [-vdev | -tgt]
```

or

```
   symcg -cg CgName [-i Interval] [-c Count] [-v]
   remove ld LdevName [-force] [-symforce]
```

or

```
   symcg -cg CgName [-i Interval] [-c Count] [-v]
   remove [pd] PdevName [-force] [-symforce]
```

When the SRDF group option, `-sel_rdfg GrpNum`, is specified, the devices in that group are removed from the composite group.

Use the following syntax to remove all standard devices from a composite group:

```
   symcg -cg CgName [-i Interval] [-c Count] [-v]
      [-sid SymmID]
      [-SA # | ALL] [-P #] [-N #]
      [-cap # [-captype mb | cyl]]
      [-rdf | -hop2] [-vdev | -tgt]
      [-rdfg GrpNum [-remote_rdfg RemoteGrpNum]]
      [-sel_rdfg SelRdfGrpNum]
      [-devs SymDevStart:SymDevEnd | SymDevName
      [,SymDevStart:SymDevEnd | SymDevName...]]

      rmall [-rdf | -hop2] [-force] [-symforce]
         [-R1 | -R2 | -R21 | -noRDF]
```

Removing an consistency-enabled device does not disable the device. You must use `symcg disable` to disable the CG. If SRDF consistency is enabled and cannot be disabled, use `-symforce`.

Renaming a composite group

To rename a composite group, enter:

```
   symcg [-i Interval] [-c Count]
      rename OldCGName NewCGName
```

Note: You cannot rename an SRDF consistency CG that is enabled.

Setting SRDF group attributes

Use the following `set` syntax to associate a logical name or an SRDF/Star recovery SRDF group number with an SRDF group.

```
   symcg -cg CgName [-i Interval] [-c Count] [-v]
      set -name [Name] | -recovery_rdfg GrpNum
      [-rdfg SymmID:GrpNum[,GrpNum,...]|all[,...] |
         name:RdfGroupName[,RdfGroupName]]
```

This command provides a mechanism to group multiple RA groups within a specified CG to perform operations on all associated devices by specifying the SRDF group name. If the `-rdfg` argument is not specified, then the action is applied to all SRDF groups.

Composite group creation and output example

The `symcg` command can be used to obtain information about the composite groups visible to your host system. Use the following syntax to list the host-visible composite groups:

```
symcg list
```

The `-inactive` option is available for use in GNS-enabled environments to return the list of composite groups from the inactive group definition list. For information on active and inactive group lists in GNS, refer to "Active vs. inactive group lists" on page 234.

The following example creates a nonconsistent RDF1 composite group:

```
symcg create MyNewCG -type rdf1
```

RDF1 devices are added to our `MyNewCG` example:

```
symcg -cg MyNewCG addall -devs CEE:CFD -sid 79
symcg -cg MyNewCG addall -devs 2:7 -sid 32
```

Then, RBCV devices are associated with the `MyNewCG` composite group:

```
symbcv -cg MyNewCG associateall -devs E92:EA1 -rdf -rdfg 64 -sid 79
symbcv -cg MyNewCG associateall -devs 48:4D -rdf -rdfg 1 -sid 32
```

In addition, RRBCV devices are associated with the `MyNewCG` composite group:

```
symbcv -cg MyNewCG associateall -devs 328:337 -rrdf -rdfg 64 -sid 79
symbcv -cg MyNewCG associateall -devs 30:35 -rrdf -rdfg 1 -sid 32\
```

As a result, the `symcg list` command returns the following output:

```
symcg list

                    C O M P O S I T E    G R O U P S

                    Number of            Number of
  Name   Type   Valid  Symms RAGs  DGs  Devs   BCVs   VDEVs    TGTs

MyNewCG RDF21   Yes       1    2    2     3      0       0       0
```

Note that this command returns the number of DGs contained in the MyNewCG composite group.

Use the `show` action to return additional details about the `MyNewCG` composite group.

Displaying CG information

Use the following syntax to list the available composite groups:

```
symcg [-i Interval] [-c Count][-v]
   list [-offline] [-v]
```

```
symcg list

                    C O M P O S I T E    G R O U P S

                    Number of            Number of
  Name   Type   Valid  Symms RAGs  DGs  Devs   BCVs   VDEVs    TGTs

  cgr21 RDF21   Yes       1    2    2     3      0       0       0
  cgreg REGULAR Yes       0    0    0     0      0       0       0
```

Note: Composite groups with names longer than 21 characters display with their first 21 characters followed by an asterisk (*). "Setting group names to display full name" on page 22 explains how to set the environmental variable to display full group names.

Use the `show` action to return additional details about a composite group. For example, to show the details about composite group `cgr21`, enter:

```
symcg show cgr21

Composite Group Name:  cgr21

  Composite Group Type                                : RDF21
  Valid                                               : Yes
  CG in PowerPath                                     : No
  CG in GNS                                           : No
  RDF Consistency Protection Allowed                  : No
  RDF Consistency Mode                                : NONE
  Concurrent RDF                                      : YES
  Cascaded RDF                                        : No

  Number of RDF (RA) Groups                           :    2
  Number of STD Devices                               :    3
  Number of CRDF STD Devices                          :    3
  Number of BCV's (Locally-associated)                :    0
  Number of VDEV's (Locally-associated)               :    0
  Number of TGT's Locally-associated                  :    0
  Number of CRDF TGT Devices                          :    0
  Number of RVDEV's (Remotely-associated VDEV)        :    0
  Number of RBCV's (Remotely-associated STD-RDF)      :    0
  Number of BRBCV's (Remotely-associated BCV-RDF)     :    0
  Number of RRBCV's (Remotely-associated RBCV)        :    0
  Number of RTGT's (Remotely-associated)              :    0
  Number of Hop2 BCV's (Remotely-assoc'ed Hop2 BCV)   :    0
  Number of Hop2 VDEV's (Remotely-assoc'ed Hop2 VDEV):    0
  Number of Hop2 TGT's (Remotely-assoc'ed Hop2 TGT)   :    0
  Number of Device Groups                             :    2
  Device Group Names                                  : dg1
                                                      : dg2

  Number of Symmetrix Units (1):

    1) Symmetrix ID                                    : 000194900341
       Microcode Version                               : 5874
       Number of STD Devices                           :    3
       Number of CRDF STD Devices                      :    3
       Number of BCV's (Locally-associated)            :    0
       Number of VDEV's (Locally-associated)           :    0
       Number of TGT's Locally-associated              :    0
       Number of CRDF TGT Devices                      :    0
       Number of RVDEV's (Remotely-associated VDEV)    :    0
       Number of RBCV's (Remotely-associated STD_RDF)  :    0
       Number of BRBCV's (Remotely-associated BCV-RDF):    0
       Number of RTGT's (Remotely-associated)          :    0
       Number of RRBCV's (Remotely-associated RBCV)    :    0
       Number of Hop2BCV's (Remotely-assoc'ed Hop2BCV):    0
       Number of Hop2VDEVs(Remotely-assoc'ed Hop2VDEV):    0
       Number of Hop2TGT's (Remotely-assoc'ed Hop2TGT):    0

       Number of RDF (RA) Groups (2):


         1) RDF (RA) Group Number          :  11            (0A)
            Remote Symmetrix ID            : 00019490237
```

```
            Microcode Version             : 5874
            Recovery RA Group             : N/A            (N/A)
            RA Group Name                 : N/A

            STD Devices (3):

              -------------------------------------------------------
                                      Sym  Device        Flags  Cap
              LdevName      PdevName   Dev  Config     Sts CSRT  (MB)
              -------------------------------------------------------
              DEV341_30     /dev/sdl   0030 RDF21+R-5  WD  X--2  2063
              DEV341_31     /dev/sdm   0031 RDF21+R-5  WD  X--2  2063
DEV341_E6     N/A        00E6 RDF21+R-5  WD  X--2  2063

         2) RDF (RA) Group Number         :  18            (11)
            Remote Symmetrix ID           : 00019490016
            Microcode Version             : 5874
            Recovery RA Group             : N/A            (N/A)
            RA Group Name                 : N/A

            STD Devices (3):
            CRDF STD Devices (3):

              -------------------------------------------------------
                                      Sym  Device        Flags  Cap
              LdevName      PdevName   Dev  Config     Sts CSRT  (MB)
              -------------------------------------------------------
              DEV341_30     /dev/sdl   0030 RDF21+R-5  WD  XAM1  2063
              DEV341_31     /dev/sdm   0031 RDF21+R-5  WD  XAM1  2063
              DEV341_E6     N/A        00E6 RDF21+R-5  WD  XAM1  2063
```

Note: The displayed logical device names are truncated to an existing standard length of eleven characters.

Showing CGs associated with a DG

The following output shows that the `dgincg` device group is a member of two composite groups, `cg110` and `cgregular`. Also, `dgincg` is a group type of `ANY`.

To show the composite groups containing the `dgincg` device group, enter:

```
symdg show dgincg

Group Name:  dgincg

    Group Type                                  : ANY
    Device Group in GNS                         : No
    Valid                                       : Yes
    Symmetrix ID                                : 000194900341
    Group Creation Time                         : Tue Dec 1 8:6:9 2009
    Vendor ID                                   : EMC Corp
    Application ID                              : SYMCLI

    Number of STD Devices in Group              : 2154
    Number of Associated GK's                   :    0
    Number of Locally-associated BCV's          :  128
    Number of Locally-associated VDEV's         :    0
    Number of Locally-associated TGT's          :    0
    Number of Remotely-associated VDEV's(STD RDF):    0
    Number of Remotely-associated BCV's (STD RDF):    0
    Number of Remotely-associated TGT's(TGT RDF) :    0
    Number of Remotely-associated BCV's (BCV RDF):    0
    Number of Remotely-assoc'd RBCV's (RBCV RDF) :    0
```

```
Number of Remotely-assoc'd BCV's (Hop-2 BCV) :    0
Number of Remotely-assoc'd VDEV's(Hop-2 VDEV):    0
Number of Remotely-assoc'd TGT's (Hop-2 TGT) :    0
Number of Composite Groups                   :    2
Composite Group Names                        : cg110
                                             : cgregular
```

Performing miscellaneous operations on CG devices

Use the following command syntax to perform the following operations on devices within a composite group:

- Change the state (ready, not ready) of a device.
- Set or reset the hold bit on a device.
- Compress or uncompress a thin device
- Bind, unbind, rebind, start or stop allocations, free, and reclaim thin devices
- Set or unset the persistence of a device
- Set the Optimized Read Miss mode

```
symcg -cg CgName [-i Interval] [-c Count] [-v]
          [-noprompt] [-force]
          [-bcv [-hop2] | -rbcv | -brbcv | -rrbcv |
           -vdev [-hop2] | -rvdev | -tgt [-hop2] | -rtgt ]
          [-rp] [-star] [-sid SymmID |
          -rdfg SymmID:GrpNum[,GrpNum,...]|all [,...] |
            name:RdfGroupName [,RdfGroupName]] [-celerra]

        not_ready [LdevName [LdevName ...]]

        ready [LdevName [LdevName ...]]

        hold [LdevName [LdevName ...]]

        unhold [LdevName [LdevName ...]]

        compress [LdevName [LdevName ...]] [-stop]

        uncompress [LdevName [LdevName ...]] [-stop]

        bind [LdevName [LdevName...]] -pool <PoolName>

        rebind [LdevName [LdevName...]] -pool <PoolName>

        unbind [LdevName [LdevName...]]

        allocate [LdevName [LdevName...]] [-persistent | -stop]

        free [LdevName [LdevName...]] [-stop]

        reclaim [LdevName [LdevName...]] [-persistent | -stop]

        set -persistent [LdevName [LdevName ...]]

        unset -persistent [LdevName [LdevName ...]]

        set -orm [off | system] [LdevName [LdevName...]]
```

Note: "Virtual Provisioning (VP) Compression" on page 101 provides information on compressing and uncompressing thin devices.

For Symmetrix arrays running Solutions Enabler V7.6 and Enginuity 5876Q22013SR, or higher, the `symcg` command supports the following control actions when issued against thin devices: binding, unbinding and rebinding, the ability to start and stop allocations, and freeing and reclaiming of space on a thin device. The operations can be directed at all devices in a CG group. By default the actions only apply to the standard devices in the group. If a control operation needs to be performed on devices in a specific list, the appropriate qualifier needs to be used (such as, `-bcv`, `-rbcv`, etc.).

A `bind` action associates a thin device to a thin pool. A `rebind` action changes the thin device's current binding to a new pool. Rebind does not move the existing data to the new pool, but directs all new allocations to the thin device in the new pool after the rebind action completes. An `unbind` action disassociates a thin device from a thin pool.

The `allocate` action fully allocates all of the storage for the specified device(s). The `-persistent` option can be specified to allocate storage that will not be able to be reclaimed or freed, except by using the optional persistent control with the reclaim action.

Unwritten storage can be recovered with either a `free` or a `reclaim` action. Allocations that were written as zeros can only be recovered by using the `reclaim` action. Additionally, storage that was allocated with the persistent attribute can only be recovered by using the `-persistent` option with the `reclaim` action.

Actions to allocate, free, or reclaim thin devices are performed asynchronously in the background and are started with an explicit start action. They may be stopped, while in progress using the `-stop` option.

For Symmetrix VMAX arrays running Solutions Enabler V7.6 and Enginuity 5876Q22013SR and higher, the `symcg` command allows you to set the Optimized Read Miss mode to Off or System Managed for devices in a composite group. By default, the action is only applied to standard devices in the group. If the action needs to be performed on devices in a specific list, the appropriate qualifier needs to be used (such as, `-bcv`, `-tgt`, etc.). "Optimized Read Miss mode" on page 66 provides additional information on this feature.

CHAPTER 7
Group Name Services

This chapter describes the optional Group Name Services (GNS) feature.

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- GNS configuration 235
- GNS daemon control 236
- Mirroring remote device group definitions 238
- Identify GNS groups 241
- GNS backup and restore mechanism 242
- Troubleshooting GNS 243

Overview

Group name services (GNS) provides a common repository to store and maintain SYMAPI device group (DG) and composite group (CG) definitions across Symmetrix arrays that are visible to all locally attached hosts. By default, with GNS disabled, group definitions are stored in the local SYMAPI configuration database file on the host that created the group. Enabling GNS enables group definitions to be stored on the Symmetrix array in a shared GNS repository. This shared GNS repository is visible to any GNS-enabled locally-attached host, enabling these hosts to perform control operations, regardless of which host initially defined the group. In addition, if one host goes down, you can still perform SYMCLI control operation from another local host in your Symmetrix environment.

Note: If User Authorization is enabled, configuration and management of GNS now require a minimum role of StorageAdmin.

How the GNS daemon works

In the GNS-enabled environment, each host performing management operations must run an instance of the GNS daemon (`storgnsd`). In this case, the Solutions Enabler SYMAPI and SYMCLI do not directly access the GNS shared repository. Instead, requests are forwarded to the GNS daemon, which processes all GNS operations. This daemon is the only entity that directly accesses the GNS shared repository and is responsible for ensuring that each host has access to the most current GNS definitions.

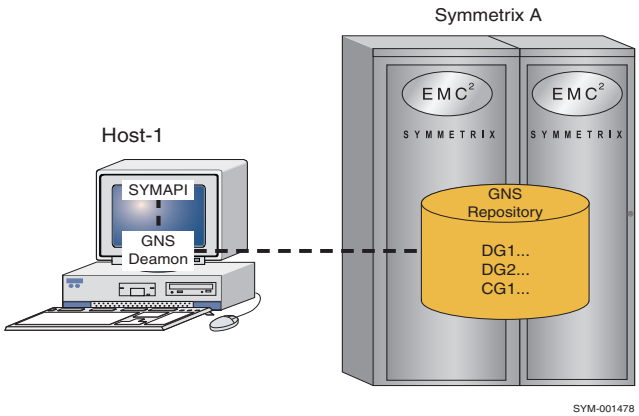

Figure 7 GNS daemon controls GNS activity

From each host, a GNS daemon listens for GNS requests from local clients (same host) and carries them out on the locally attached Symmetrix array. In addition, the GNS daemon monitors the GNS repositories on all locally-attached Symmetrix arrays, at a user-configured polling interval, for changes made to the shared GNS repository by other daemons (on other hosts) as shown in Figure 7. When a change is identified, the GNS daemon will update the host to ensure that all GNS-enabled hosts refer to the same group definitions.

A set of options are available for controlling the GNS daemon. For information on configuring the GNS daemon, refer to "GNS daemon options file" on page 237.

Shared group definitions with GNS

GNS provides a common repository to share device group and composite group definitions across hosts locally-attached to the same set of Symmetrix arrays. A *device group* is a user-defined object comprised of devices that belong to a single Symmetrix array and a single RA group. In a GNS-enabled environment, device group definitions are stored in the GNS repository of the Symmetrix array on which the devices within the device group reside and are visible to all hosts locally attached to that Symmetrix array.

A *composite group* is also a user-defined object comprised of devices. However, the device members of a composite group can belong to multiple Symmetrix arrays and RA groups. In a GNS-enabled environment, composite group definitions are distributed across all Symmetrix arrays that contain device members of the composite group by the GNS daemon. A host must be locally attached to all arrays containing devices in the composite group to manage or control that composite group. If a host is only attached to a subset of the Symmetrix arrays that a composite group spans, that group will be visible to the host, but in an invalid and unusable state. This is not a recommended configuration.

The GNS state that is visible from a given host is determined by the set of arrays to which the host is connected. As seen in Figure 8 on page 232, Host-1 is GNS-enabled and locally attached to Symmetrix A, Symmetrix B, and Symmetrix C. Host-1 can access and modify the group definitions on all three arrays. The group definitions that are visible to Host-1 include device groups DG1, DG2, DG3, DG4, DG5, and DG6 and composite group CG1's definition, which contains devices on Symmetrix B and C.

Host-2 is GNS-enabled and locally attached to Symmetrix B and Symmetrix C. The group definitions that are visible to Host-2 include device groups DG3, DG4, DG5, and DG6 and composite group CG1. Since Host-2 is locally attached to only Symmetrix array B and C, it cannot see any device groups or composite groups on Symmetrix A (that is, DG1 and DG2).

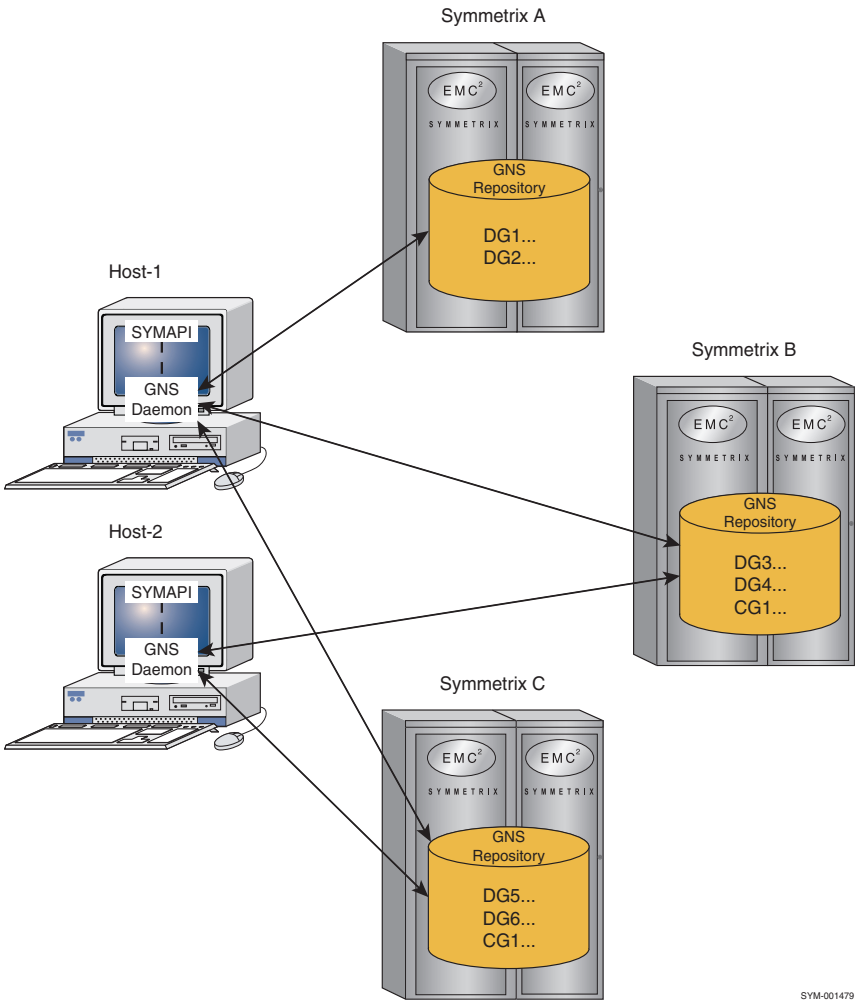

Figure 8 Host-visible GNS state

How GNS handles updates to group definitions

When GNS is enabled, device group and composite group definitions are stored in the common GNS repository.

For example, in Figure 9, Host-1 makes a change to composite group CG1. (1) The Host-1 GNS daemon gets this request to process and (2) updates the GNS-shared repository on all relevant Symmetrix arrays, in this case Symmetrix A, B, and C. The GNS daemon running on Host-2 detects the change (3) while polling its locally-attached GNS repositories (attached Symmetrix A, B, and C) and updates Host-2 with the updates made by Host-1. Host-2's client application will detect the change (4) on its next group call.

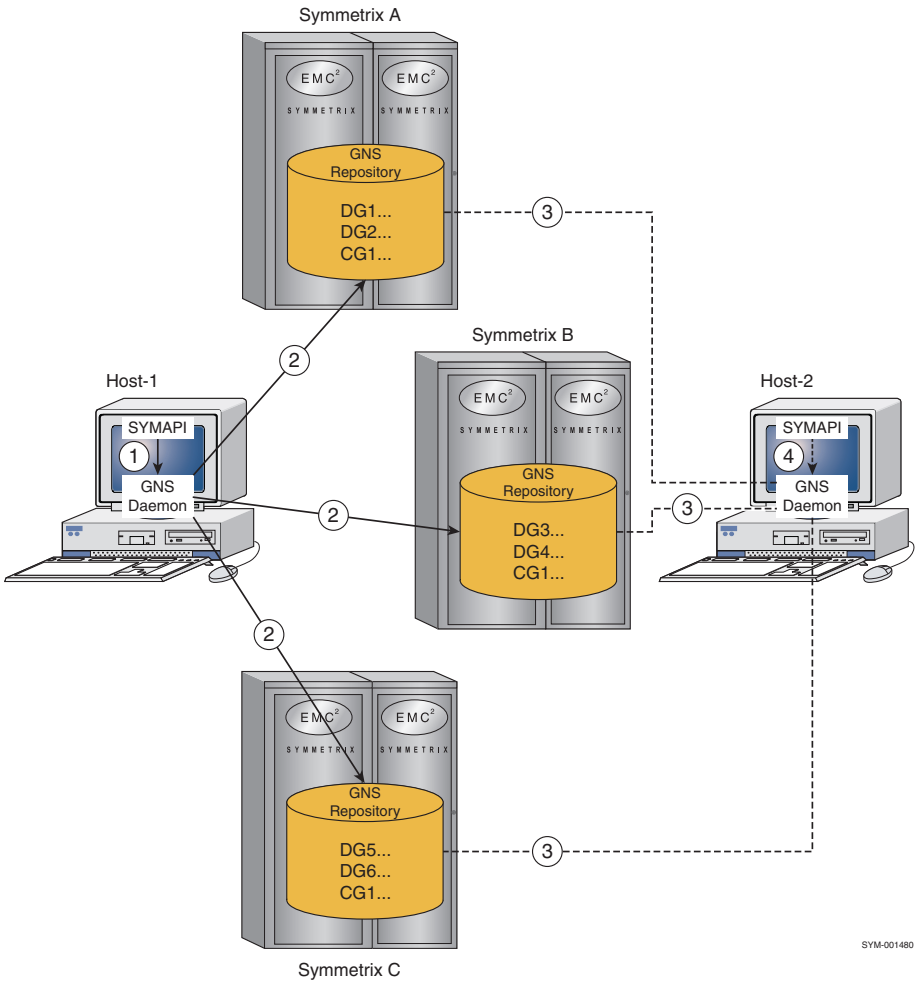

Figure 9 GNS across multiple hosts

GNS and consistency groups

An SRDF consistency group is a composite group comprised of SRDF devices (RDF1, RDF2, or RDF21) acting in unison to preserve dependent write consistency of a database distributed across multiple SRDF systems. It maintains this consistency by using either Multisession Consistency (MSC) for SRDF/A or SRDF Enginuity Consistency Assist (SRDF-ECA) for SRDF/S. Both use the SRDF daemon to maintain SRDF consistency.

In a GNS-enabled environment, certain changes made to any composite group set for consistency are automatically propagated to the SRDF daemon on all relevant hosts, such as changes to the group type, SRDF group name, recovery RA group number, device membership, device group membership, and device LdevName. When updates are made to the GNS repository, the GNS daemon updates the SRDF daemon.

For more information on setting SRDF consistency to composite groups, refer to "Creating composite groups with SRDF consistency" on page 217.

GNS device groups and SRDF

In an SRDF scenario, a local GNS-backed device group (either RDF1 or RDF2) can be automatically mirrored on the remote Symmetrix array through SRDF links — for activation and use during a disaster fail-over situation. By default, the GNS device group definitions are stored on the local (directly attached) Symmetrix array — where the local devices are located.

Optionally, any changes made to the local group definition (for example, adding a standard or BCV device) can be set to automatically maintain a mirrored group definition on the remote Symmetrix array. This remotely mirrored group is for disaster recovery situations, where entire applications (including group aware ones), fail-over and are restarted on the remote side (where the remote devices are).

As changes are made to the local group definition, GNS automatically propagates corresponding changes to the remote array, so that the two are kept synchronized. For more information on configuring this option, refer to "Mirroring remote device group definitions" on page 238.

GNS behavior in client/server mode

In client/server mode the SYMAPI server's SYMAPI options file setting SYMAPI_USE_GNS must be enabled to use GNS.

Active vs. inactive group lists

When GNS is enabled, group definitions are stored in the global GNS repository in addition to individual host-based configuration database files. To facilitate the importing of groups into GNS, a limited access to the group definitions held within a host-based configuration database is provided while GNS is enabled.

The groups within the individual host-based configuration database files can be listed using the following commands:

```
symdg list -inactive
symcg list -inactive
```

A group contained in the host-based configuration database can be imported into GNS via the following commands:

```
symdg activate DgName
symcg activate CgName
```

All groups in the host-based configuration database can be imported into GNS using the following commands:

```
symdg activateall
symcg activateall
```

Note: Importing groups into GNS may fail if the group name is already in use within GNS.

Although the above commands can be used while GNS is disabled, their use is discouraged since in this situation it provides access to a copy of the GNS-based group definitions written, for diagnostic purposes, into the host-based configuration database when GNS was enabled in the past.

GNS configuration

To take advantage of the GNS features, you must first configure your Symmetrix environment to support GNS.

Setting up the GNS option

GNS use is optional and can be either enabled or disabled on each host through the SYMAPI options file setting `SYMAPI_USE_GNS`. This option is enabled as follows:

```
SYMAPI_USE_GNS=ENABLE
```

The default setting is `DISABLE`. Setting this option to ENABLE enables GNS for any applications using the default SYMAPI configuration database file. It is assumed that applications running with a private configuration database file intend to keep their modifications private, and therefore, do not make use of GNS.

Configuring GNS in a multihost environment

When configuring GNS in a multihost environment, it is recommended that you first review the groups currently stored on all hosts that share access to a set of Symmetrix arrays. Resolve any potential conflicts with other hosts. Also, if using composite groups, ensure that all hosts on which you intend to enable GNS are local to the same set of arrays to avoid composite groups appearing invalid to hosts that are not attached to all referenced arrays.

When ready, enable GNS on a single array being sure to configure any options or user authentication that you desire. For details on managing GNS use through the options file, refer to the *EMC Solutions Enabler SYMCLI Command Reference Guide*. In addition to enabling GNS on the host, you can configure: GNS User Authentication (set up a specific set of users with access to the GNS daemon) and GNS Daemon Control (start and stop the daemon, and configure GNS daemon options).

Once GNS is enabled on a host, activate those groups that you wish to expose using GNS. Enable GNS on a second host. Validate that the new host can see the previously activated groups and resolve any conflicts with other hosts before activating additional groups.

Note: With Solutions Enabler V7.4 and higher, device groups and composite groups of type REGULAR are allowed to contain remote SRDF devices. However, on systems running GNS, any peer hosts running older versions of Solutions Enabler will see these groups as invalid.

GNS user authentication

GNS is intended to share group definitions across multiple users and hosts in a Symmetrix environment via the host-installed GNS daemons. As such, access to GNS functionality is controlled by limiting permission to the GNS daemon. This access is controlled through the common daemon authorization file, `daemon_users`. This file is located in the following directories:

UNIX	`/var/symapi/config/daemon_users`
Windows	`c:\Program Files\EMC\SYMAPI\config\daemon_users`

Note: It is important to protect this file so that only privileged administrators can modify it.

Users meeting any of the following criteria will be permitted to control and use the GNS daemon:

- User with privileges; UNIX users with root access and Windows users that are a members of the Administrators group
- Users listed in the `daemon_users` file located on each host from which they require access

For example, the following lines in the `daemon_users` file would permit users named `Smith` and `Jones` to use the GNS daemon:

```
smith     storgnsd
jones     storgnsd
```

GNS daemon control

There are three ways that the GNS daemon can be started. If GNS is enabled, the daemon will be started automatically by the Solutions Enabler libraries the first time they attempt to connect with it, which can cause a slight delay in performance on that initial connection while the daemon starts and builds its cache.

Note: Prior to starting `storgnsd`, ensure that your default SYMAPI configuration database is up-to-date, since `storgnsd` uses the information stored in it to establish contact with your Symmetrix arrays. Refer to "Discovering configuration and status data" on page 28 for details.

Alternatively, the daemon can be started manually using the `stordaemon` command line utility as follows:

```
stordaemon start storgnsd
```

In addition, the daemon can be set to start automatically every time the local host is booted using the following command line:

```
stordaemon install storgnsd -autostart
```

Prestarting the daemon, either manually or using the automatic option, is useful because the daemon may take a while to initially construct its cache — depending on the number of groups and Symmetrix arrays it has to load.

If the daemon is stopped for some reason, it can optionally be restarted automatically by an internal Solutions Enabler watchdog mechanism. A combination of the watchdog mechanism and the auto-start option described above can be used to ensure that the daemon is always running, which is important with SRDF consistency composite groups to ensure that the MSC SRDF daemon is updated whenever group changes are made.

Enabling the watchdog

This watchdog mechanism is enabled by default. The watchdog daemon will restart the GNS daemon if it crashes or is killed. This behavior can be disabled through the `storgns:autorestart` entry in the `daemon_options` file (for more information, refer to

"GNS daemon options file" on page 237). On UNIX, this restart functionality is provided by a dedicated watchdog daemon (`storwatchd`). This is started automatically as needed. On Windows, this restart functionality is provided by the Service Control Manager.

Note: A maximum of three restarts within a 15-minute period will be attempted. Following a third restart (again, within a given 15-minute period), no subsequent restart will be attempted.

Managing the GNS daemon

The GNS daemon can be controlled by the existing `stordaemon` utility. These control options include:

- Stopping the daemon.
- Querying the daemon's status.
- Querying the daemon's log files.

For details, refer to the `stordaemon` man page in the *EMC Solutions Enabler Installation Guide*.

GNS daemon and Symmetrix external locks

The GNS daemon uses two Symmetrix External Locks (SELs) to maintain exclusive access to the GNS repository on each Symmetrix array: F0 and F1.

The following commands can be used to view available GNS locks:

```
symcfg -sid nnnn -lockn GNS list
```

The following command can be used to manually release a GNS lock:

```
symcfg -sid nnnn -lockn GNS release
```

GNS daemon log file

The GNS daemon writes its log (trace) messages to the standard location used by all daemons. The locations are:

UNIX `/var/symapi/log/storgnsd.log0`
`storgnsd.log1`

Windows `c:\Program Files\EMC\SYMAPI\log\storgnsd.log0`
`storgnsd.log1`

These two files are written in an alternating, round-robin manner. When the active one becomes full, it is closed and the other one is truncated and made active.

The contents of the log file can also be displayed as follows:

```
stordaemon showlog storgnsd -lines 200
```

GNS daemon options file

Configuration options for the GNS daemon are contained within the daemon options file (`storgnsd`) located in the following directories:

UNIX `/var/symapi/config/daemon_options`
Windows `c:\Program Files\EMC\SYMAPI\config\daemon_options`

Options can be specified in this file using the following syntax:

```
storgnsd:OptName = OptValue
```

Where the *OptName* is the name of the option and the *OptValue* is the new value you wish to set.

Editing or removing parameters manually

The daemon options file contains a set of parameters that can be modified to affect GNS behavior when using SYMCLI or SYMAPI commands. The file contains editable behavior parameters set to certain optional defaults in the line entries. Commented lines beginning with a pound sign (#) are ignored.

To remove any parameter option, remove the line entry, rename the file, or comment the line by adding a pound sign (#) at the beginning of the line entry.

Editing or removing parameters via the CLI

Option file values also can be set using the `stordaemon setoption` CLI utility, which programmatically makes changes to the `daemon_options` file. The following is the command-line syntax for this option:

```
stordaemon setoption DaemonName
-name OptName=OptValue [-force]
```

Where the *OptName* is the name of the option and the *OptValue* is the new value you wish to set.

The following example shows how this utility can be used to set or change an option setting:

```
stordaemon setoption storgnsd -name autorestart=enable
```

The following example shows how this utility can be used to remove an option setting:

```
stordaemon setoption storgnsd -name autorestart=
```

Note: In the above example an empty value has been passed.

By default, only options already present in the file (such as those in use or commented out) can be set. The `-force` option can be supplied to force a change, even if it requires adding a new option line to the file.

Note: For information on the possible GNS daemon options file parameters, refer to the *EMC Solutions Enabler SYMCLI Command Reference Guide*.

Mirroring remote device group definitions

The option `gns_remote_mirror` in the GNS daemon's options file determines whether GNS should attempt to remotely mirror a device group or a composite group SRDF definition contained in the shared GNS repository for a given Symmetrix array.

When enabled, GNS will maintain a remote mirrored group definition with the same name as the local one creating a usable group to hosts (including GNS daemons) directly connected to the remote Symmetrix array(s). The remote mirrored group has the same

name as the local one, and has a mirror image of its contents; in other words, the data reflects the perspective of the local array. This done to ensure that the mirrored group is a legal, usable group to hosts directly connected to the remote Symmetrix arrays.

Note: Symmetrix Remote Data Facility for VMAX 10K Series (SRDF) solutions are supported with Enginuity version 5875Q32001SR and higher. GNS supports the remote mirroring of groups between local and remote VMAX 10K arrays, connected via SRDF and between a VMAX 10K array and a non-VMAX 10K array running Enginuity 5773 or higher.

Controlling the mirrored group

An SRDF group that has been created by this mirroring mechanism is flagged internally by GNS as being a mirror.

By default, these mirrored groups are read-only and cannot be modified or renamed—although GNS will continue to update them as the local groups, upon which they are based, are changed. This behavior can be changed by setting the SYMAPI_GNS_MIRRORED_GROUP_CONTROL option in the SYMAPI options file to `ENABLE` (the default value is `DISABLE`).

If a mirrored group is directly modified (from a host connected to the remote Symmetrix on which it is defined), the connection between it and the local group, on which it was based, is broken. At that point, it is no longer a mirror and changes to its base group (the local group) are no longer propagated to it. If a mirrored group is renamed or deleted, GNS will subsequently recreate the mirrored group from its base group.

Mirroring exceptions

Any group containing one or more of the following configurations cannot be mirrored:

- Groups containing any concurrent devices
- Groups containing any cascaded devices
- Composite groups comprised of device groups
- Groups containing any hop-2 devices (including 2TGT, 2BCV, 2VDEV devices)
- Device and composite groups of type=ANY
- If a standard device in the group is paired with an remote SRDF BCV
- If there are no standard SRDF devices in the group

Impact of remotely mirroring group definitions

The following changes are made to the remote group's definition:

- The remote group definition maintains the same name and type as the local group.
- The group subtype is reversed: an RDF1 local group becomes an RDF2 remote one; an RDF2 local group becomes an RDF1 remote one.
- Attributes that are unrelated to particular devices or storage arrays are copied to the remote copy without change. For example, modification time, vendor, and group name.

- The remote RA group number (RRAGRP) attribute is changed on the remote side to contain the corresponding local SRDF group number.
- A number of attributes come in pairs: local and remote. On the remote side, these are swapped. For example:
  - The local and remote standard (DEVS and RDEVS), the local and remote BCV device lists (BCVs and RBCVs), and remote BCVs of the remote BCV device lists (BRBCVs and RRBCVs) are swapped.
- The device logical device name list is left unchanged. The device and remote device lists are swapped as noted above, but the logical device name list is not. The same names apply to the local device in both the original and mirrored copy.

BCV and remote BCV device alias name swap

In the remote mirror name transformation, the BCV alias list becomes the RBCV alias list in the remote mirror. Alias names that have a value of BCV*nnn* are automatically changed to RBCV*nnn*.

In turn, the RBCV alias list becomes the BCV alias list in the remote mirror. In this case the alias names that have a default value of RBCV*nnn* are automatically changed to BCV*nnn*.

Similarly, the RRBCV logical list becomes the BRBCV list in the remote mirror. Logical names that have a default value of RRBCV*nnn* are automatically changed to BRBCV*nnn*.

As expected, the BRBCV logical list becomes the RRBCV list in the remote mirror. Logical names that have a default value of BRBCV*nnn* are automatically changed to RRBCV*nnn*.

These names are the default names (logical device names) supplied by SYMCLI if the user does not provide one. If the user has overridden the defaults and supplied their own names that look like the above, they will still be transformed as described.

In the unlikely scenario that the user has explicitly supplied aliases, for example, BCV*nnn* and RBCV*nnn*, it is possible that the above transformation may result in duplicate alias names in the remote mirror. For example, if the original BCV alias list contained `BCV001,RBCV001`, the remote mirror's RBCV alias list would contain `RBCV001,RBCV001`, which would cause a name conflict.

Figure 10 illustrates the mirrored group data:

```
--- Local DG Group, on Symm1 ---
Type            RDF1
Role            Have a Remote Mirror
Remote Symm     Sym2
Local RDFGrp    2
Remote RDFGrp   5
Devices         0001,0002,0003
Remote-Devs     0091,0092,0093
LDevNames    DEV001,DEV002,DEV003

BCVs            0010,0011
Remote-BCVs     0020,0021,0022
BCV LdevName    BCV001,BCV002
RBCV LdevName   RBCV001,RBCV002,RBCV003

Vendor          EMC
ModTime         12345
GateKeepers     /dev/rdsk/c2t0d2
```

```
--- Remote DG Group, on Symm2 ---
Type         RDF2
Role         Am a Remote Mirror
Remote Symm  Sym1
Local raGrp  5
Remote raGrp 2
Devices      0091,0092,0093
Remote-Devs  0001,0002,0003
Dev Aliases  DEV001,DEV002,DEV003

BCVs         0020,0021,0022
Remote-BCVs  0010,0011
BCV Aliases  BCV001,BCV002,BCV003
RBCV Aliases RBCV001,RBCV002

Vendor       EMC
ModTime      12345
```

Figure 10 Mirrored remote group definition

Identify GNS groups

After you have configured your Symmetrix environment to support the GNS option, you can begin to create and modify groups. Use `symdg show` *`DgName`*, for device groups, or `symcg show` *`CgName`*, for composite groups, to determine if a group is stored in the GNS group list.

Group output

For a device group, the output of the command `symdg show` *`DgName`* identifies whether a group definition is stored in GNS. The sample output below shows that group `MyRegDeviceGroup` is stored in the GNS list since the output parameter **`Device Group in GNS`** has a value of **`Yes`**. It also shows the device group's GNS mirror state.

```
% symdg show MyRegDeviceGroup

Group Name: MyRegDeviceGroup

    Group Type                                    : REGULAR
    Device Group in GNS                           : Yes (Is Mirror)
    Valid                                         : Yes
    Symmetrix ID                                  : 000184500160
    Group Creation Time                           : Tue Aug 4 16:44:18 2006
    Vendor ID                                     : EMC Corp
    Application ID                                : SYMCLI

    Number of STD Devices in Group                :   20
    Number of Associated GKs                     :    0
    Number of Locally-associated BCVs            :   20
    Number of Locally-associated VDEVs           :    0
. . .
```

In addition, for a composite group, the output of the command `symcg show CgName` identifies whether a group definition is stored in GNS. The sample output below shows that group `MyCompGroup` is stored in the GNS list since the output parameter **`CG in GNS`** has a value of **`Yes`**. It also shows the composite group's GNS mirror state. The group definition has been enabled for SRDF consistency using MSC.

```
% symcg show MyCompGroup

Composite Group Name: MyCompGroup

  Composite Group Type                                : RDF1
  Valid                                               : Yes
  CG in PowerPath                                     : No
  CG in GNS                                           : Yes (Is Mirror)
  RDF Consistency Protection Allowed                  : Yes
  RDF Consistency Enabled                             : Yes

  Number of RDF (RA) Groups                           :    4
  Number of STD Devices                               :   64
  Number of BCVs (Locally-associated)                :    0
  Number of VDEVs (Locally-associated)               :    0
  Number of RBCVs (Remotely-associated STD-RDF)      :    0
  Number of BRBCVs (Remotely-associated BCV-RDF)     :    0
  Number of RRBCVs (Remotely-associated RBCV)        :    0

. . . .
```

GNS backup and restore mechanism

GNS group definitions are stored within each individual Symmetrix array. A GNS daemon can be configured to automatically back up and restore GNS data from individual arrays. When a backup is enabled, the daemon will write an image of the GNS group information to the host's local disk each time it makes a change or it notices a change made from another locally attached host. These backups are maintained as separate per-Symmetrix files, named *`SID`*`.shadow`, where *`SID`* is the Symmetrix array ID, and is stored in the following directory on the host machine:

UNIX	`/var/symapi/gns/`*`SID`*`.shadow`
Win32	`c:\\Program Files\\EMC\\SYMAPI\\gns\\`*`SID`*`.shadow`

Note: Because the maintenance of numerous backup images can impact performance, it is recommended you do not enable it on all GNS daemons. Typically, it is recommended that you configure a maximum of two or three GNS daemons to maintain backups for each Symmetrix array that may hold GNS data.

By default, the `storgnsd` daemon is located, on Windows, at:

`c:\Program Files\EMC\SYMCLI\daemons`

Unless a different location was chosen at installation time, `storgnsd` commands can be run from this location.

Automatic GNS backups

An option in the GNS daemon's options file determines whether it will perform automatic backup and restore. To enable GNS backups, enter:

```
storgnsd:gns_shadow_file=enable
```

The default is `disable`. For more information on the GNS options file, refer to "GNS daemon options file" on page 237.

Manual backups and restores using storgnsd

Backups to and restores from the shadow files can be manually triggered by invoking the `storgnsd` program as follows.

To generate a GNS backup file for the specified Symmetrix array, enter:

```
storgnsd backup -sid SID
```

To generate a GNS backup file for all locally attached Symmetrix arrays, enter:

```
storgnsd backup
```

To restore GNS data to the specified Symmetrix array from a backup file previously created, enter:

```
storgnsd restore -sid SID [-noprompt]
```

Since this operation is destructive in nature, a confirmation is required prior to completing the operation. Using the `-noprompt` argument will skip the confirmation step.

Troubleshooting GNS

When using GNS, be aware of the possibility of group name collision and invalid groups and what SYMAPI does to rectify each scenario.

Group name collisions

Each GNS daemon attempts to ensure that group names are unique (relative to a group type). It is possible, however, for duplicate-named groups to occur.

For example, it is possible for two different groups to be created with the same name on different Symmetrix arrays. A subsequent consideration change could then allow the GNS daemon to see both groups.

If a GNS daemon detects duplicate group names, it returns a state flag informing clients of this fact and modifies the group names to be unique by attaching a numeric suffix. For example, duplicate device groups with the name `MyDG` could be modified in the following way:

```
MyDG#12345678
MyDG#87654321
```

While in this state (duplicate names), the only operations permitted are those used to resolve the name conflict: group rename and delete (with the `-force` flag). For example:

```
symdg delete MyDG#12345678 -force
symdg rename MyDG#87654321 MyDG
```

Note: For information on renaming composite groups, see "Renaming a composite group" on page 222.

If users at two different hosts simultaneously create groups of the same type with the same name using devices on different Symmetrix arrays, both attempts might succeed. Because each host's GNS daemon is polling for changes made elsewhere, the daemons might not detect the name conflict until after the fact.

Invalid groups

A composite group is marked as invalid if one or more of the Symmetrix arrays that it resides on (in a GNS-enabled environment) cannot be reached. For example, each Symmetrix array that a consistency group spans records the identity of the other arrays that the group spans. If a discrepancy is noticed where a composite group is not defined on an array, even though some other array indicates it should be there, that group is assumed to be invalid.

Groups are also placed into an invalid state if certain internal bookkeeping information maintained by GNS is found to be missing or incorrect. For example, a consistency group spans two arrays and the GNS state recorded on each Symmetrix verifies that the group also resides on the other array. If at some point one array is found to not contain the group (while the other array still thinks it should be found there), the group is assumed to be invalid.

This could happen if one of the arrays is reinitialized or a host attached only to one array decides to delete the composite group there. Since the group definition is also stored on an unreachable array, that group state is seen as invalid from that host. A user there would have to use the `-force` flag to delete the group. Groups marked as invalid can be deleted with the `-force` flag.

Displaying GNS data about a composite group

The following command lists the GNS data about the composite group `cg1`. In this example, the composite group is comprised of three device groups.

```
storgnsd -cmd show_group cg1

storgnsd                  GNS Group cg:cg1:
 --------------------
 CG cg1                      Version: 0xb0e507eeb41d66fd
                             State: [0]
 ArrayID:  000187940256
                SubType              1 RDF1
                Created              Mon Jan  4 10:14:36 2010
                Flags                2  NotPPath,
                Flags2               0
                INT:GrpValTimestamp  190015750
                INT:GenerationNum    1418058138
                INT:ArrayLinkage     000194900341
                Device Groups        dggns1
                                     dggns2
                                     dggns3
```

CHAPTER 8
Statistics

This chapter describes how to use SYMCLI to retrieve the performance-related statistics such as the number of I/O requests and throughput activities for the Symmetrix devices.

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- Director statistics 253
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- CACHE statistics 260
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Overview

The Symmetrix array maintains statistical counters for performance-critical operations. The statistics command, `symstat`, enables you to view the performance statistics derived from these counters.

The `symstat` command performs the following:

- Queries Symmetrix devices to capture raw performance counts and stores them in memory.
- Retrieves the performance counts for the Symmetrix array as a whole.
- Retrieves the performance counts for a director or director port.
- Retrieves the performance counts for one or more Symmetrix devices.
- Retrieves the performance counts for one or more Symmetrix device groups, composite groups, or SRDF groups.
- Retrieves the performance counts for a selection of, or all, Symmetrix disks.
- Retrieves the timestamp of the performance count sample.
- Retrieves and displays replication session statistics for SRDF/A.
- Retrieves GigE iSCSI network statistics.

Note: Performance counters are not stored in the configuration database and only exist in the session context.

About the symstat command

The `symstat` command captures, in real-time, statistics information about a Symmetrix array. You can examine the performance of one or more devices, a device group, or any or all directors. For the capture of a sample period, `symstat` only displays devices or directors that had activity.

The `-c` argument defines the number of samples. The default for this argument is continuous sampling. If you do not specify this argument, but you specify an -i value, the command produces continuous statistical output, requiring a cancel (`Ctrl-C`) to stop the process. For the `symstat` command, a minimum default interval of 60 seconds is used for effective statistical sampling.

Reporting objects

The SYMCLI `symstat` command allows you to return valuable statistics on the how the following objects are performing in your environment:

- Devices — Statistical data can be returned on device throughput and I/O. Also, throughput activity to a specific set of devices within a device group can be obtained in addition to cache memory to disk activity for selected devices. And dynamic mirroring service policy (DMSP) statistics for the selected device(s) can be obtained.
- Directors — Throughput, back-end I/O, and port activity statistics can be obtained for a specific director or type of director.

- Disk — Reports back-end I/O requests and throughput for selected disks and tracks prefetch disk activity for selected back-end directors only.
- SRDF/A sessions — Monitor activity of SRDF/A sessions using the CYCLE, CACHE, and REQUESTS types in conjunction with the `reptype rdfa` flag of the `symstat` command.

For more details about performance types, refer to "Performance type options" on page 247.

Performance type options

The `symstat` command provides different types of performance display options in Table 7:

Table 7 Performance display options

Option	Description
REQUESTS	Reports I/O requests and throughput for selected devices, directors, or SRDF/A sessions. (This is the default type; if no type is specified, REQUESTS is used.)
BACKEND	Reports back-end I/O requests and throughput for selected devices.
PORT	Reports performance statistics for a director port.
ISCSI	Reports GigE network statistics.
CACHE	Reports cache activity for selected front-end or remote link directors, or SRDF/A sessions.
MEMIO	Reports cache memory to disk activity for selected devices.
PATH	Reports R-Copy path information for nonincremental sessions. Symmetrix arrays that have all or some incremental sessions will report an error.
CYCLE	Reports cycle summary information for SRDF-A sessions.
DISK	Reports back-end I/O requests and throughput for selected disks.
PREFETCH	Reports track prefetch disk activity for selected back-end directors only.
DMSP	Reports dynamic mirroring service policy (DMSP) statistics for the selected device(s).
RDF	Reports SRDF statistics from the perspective of RA groups, devices, or directors.

REQUESTS statistics

Using `symstat`, you can display performance statistics such as I/O requests and throughput for the devices within a Symmetrix array, a device group, or SRDF/A sessions by specifying the REQUESTS type. REQUESTS is the default type for `symstat` operations, therefore, if no type is specified, REQUESTS performance information is returned.

Note: When using the `symstat` command against Symmetrix arrays running Enginuity 5874, some device and director output fields have been changed to support 64-bit counters. Refer to the"Compatibility mode: Preserving old Solutions Enabler scripts" on page 24 for information on returning output as seen in prior Solutions Enabler versions.

Array statistics

I/O and throughput statistics can be returned for all devices on a specific array by specifying the Symmetrix ID in the command-line, specifying the interval and the number of samples (counts) for the statistical run. The following example returns performance statistics for Symmetrix array 150:

```
symstat -type REQUEST -sid 150 -i 60 -c 100
```

```
DEVICE            IO/sec                  KB/sec                 % Hits   %Seq     Num WP
09:30:11        READ    WRITE         READ         WRITE         RD  WRT  RD  WRT  Tracks
   1      2      3       4             5             6              7       8        9

09:31:11 002B 1345344 18900230 1345344836009850 1345344836009850 100 99  99   99     240
```

The following statistics are returned:

1. Host timestamp of the sample.
2. Active Symmetrix device name and host physical device name (if the device is visible).
3. Read cache request rate (requests per second).
4. Write cache request rate (requests per second).
5. Read throughput rate (kilobytes per second).
6. Write throughput rate (kilobytes per second).
7. Read/write cache hit ratio (percentage of write hits).
8. Sequential read/write ratio (percentage of sequential reads).
9. Write-pending track count.

Device statistics

Using `symstat` with the REQUESTS type (default) specified, you can display performance statistics such as I/O requests via SAs (or other front-end adapters) and throughput on a device.

From the device list shown in the device group statistical run, select a logical device to examine I/O requests and throughput activity and choose the interval and number of samples (count) for the statistical run.

For example, for sample intervals of `120` seconds and a sample count of `3` on logical device `DEV001` in device group `prod_r1`, enter:

```
symstat -i 120 -c 3 -g prod_r1 -ld DEV001
```

The fields returned are identical to those returned in "REQUESTS statistics" on page 247, except that the statistics are limited to the one logical device specified.

SRDF/A session statistics

Using `symstat` with the REQUESTS type (default) specified, you can display a table of host writes and SRDF throughput information for SRDF/A sessions in Symmetrix arrays by specifying the `-repType rdfa` option.

When requesting SRDF/A session statistics for a specified Symmetrix array, the output differs depending upon the flag arguments specified:

- If the `-sid` flag is used with no further qualifiers (`[-g ALL | -rdfg <#|ALL> | -cg CgName|ALL]`), then the output display lists SRDF/A sessions that have a status of `active`.
- If the `-sid` flag is used with qualifier `-g all`, then the output display list all device groups, regardless of status. If the `-sid` flag is used with the qualifier `-rdfg ALL`, then the output display lists all SRDF groups, regardless of status. If the `-sid` flag is used with the qualifier `-cg ALL`, then the output display lists all composite groups, regardless of status.
- If the `-g DgName` device group qualifier is used (whereby the `-sid` option is not specified), then the output display only lists details for the specified device group.
- If the `-sid` flag is used with the qualifier `-rdfg #`, then the output display lists just the specified SRDF group.
- If the `-sid` flag is used with the qualifier `-cg CgName`, then the output display lists just the specified composite group.
- If the `-v` option is specified, the returned statistics are expanded and grouped by device group (SRDF/A session) for all sessions.

Example: All device groups

For example, to return SRDF/A session statistics on Symmetrix array `0011` for all active device groups, with sample intervals of `60` seconds and a sample count of `3`, enter:

Note: Notice that this option displays rates calculated over the specified interval, therefore more than one interval must be run for the data to be meaningful. The first set of data has no values, since it is a baseline for the remainder statistical data:

```
symstat -i 60 -c 3 -sid 0011 -RepType rdfa

SRDF/A Session Throughput Summary Information
Symmetrix Id  : 000187400011
Timestamp     : 14:23:30

                                  Host Write Workload  RDF Throughput R1->R2
                    RA   Session  -------------------  ----------------------
Device Group Name   Grp  Number    IO/sec    MB/sec      IO/sec      MB/sec
-----------------   ---  -------  --------  ---------  ----------  ----------
RaGrpNum_25          25       24         0        0.0           0         0.0
RaGrpNum_26          26       25         0        0.0           0         0.0
RaGrpNum_27          27       26         0        0.0           0         0.0

SRDF/A Session Throughput Summary Information
Symmetrix Id  : 000187400011
Timestamp     : 14:24:30

                                  Host Write Workload  RDF Throughput R1->R2
                    RA   Session  -------------------  ----------------------
```

```
Device Group Name  Grp  Number    IO/sec    MB/sec      IO/sec      MB/sec
 ❶                 ❷   ❸       ❹         ❺          ❻          ❼
-----------------  ---  -------  --------  ---------  ----------  ----------
RaGrpNum_25         25       24       353       2.8         691         7.2
RaGrpNum_26         26       25       553       4.3        1004        11.6
RaGrpNum_27         27       26       383       3.0         758         8.1

SRDF/A Session Throughput Summary Information
Symmetrix Id  : 000187400011
Timestamp     : 14:25:30

                                  Host Write Workload  RDF Throughput R1->R2
                   RA   Session  -------------------  ----------------------
Device Group Name  Grp  Number    IO/sec    MB/sec      IO/sec      MB/sec
-----------------  ---  -------  --------  ---------  ----------  ----------
RaGrpNum_25         25       24       343        2.7         549         5.7
RaGrpNum_26         26       25       519        4.1         531         6.0
RaGrpNum_27         27       26       398        3.1         741         7.9
```

The following statistics are returned:

1. Name of the device group.
2. The RA Group number.
3. SRDF/A session number.
4. Number of host I/O writes per second.
5. Workload rate, in MB per second of host writes.
6. Number of SRDF I/O writes per second in the SRDF/A session.
7. Throughput rate, in MB per second of the total I/O writes in the SRDF/A session.

Example: Verbose SRDF/A session statistics

For example, to return verbose details about SRDF/A session statistics on Symmetrix array `6163` for all active device groups, with a sample intervals of `60` seconds and a sample count of `3`, enter:

```
symstat -sid 6163 -i 60 -c 3 -reptype rdfa -v

SRDF/A Session Information:

Symmetrix Id                                  : 000000006163
Timestamp                                     : 16:26:24

System Write Pending Limit                    : 236462   (7.22 GB)
Cache Slots available for all SRDF/A sessions : 222274   (6.78 GB)
Total Local Write Pending Count               : 0
Total System Write Pending Count              : 0

  Device Group Name                           : RaGrpNum_60
  RA Group Number                             : 60
  Session Type                                : RDF1
  Session Number                              : 59
  Session Priority                            : 33
  Number of Device in Session                 : 3
  Session Status                              : Active
  Session Attributes                          : MSC
  Local Active Cycle Number                   : 443
  Minimum Cycle Time                          : 00:00:30
  Average Cycle Time                          : 00:00:30
  Last Cycle Time                             : 00:00:30
  Time Since Last Cycle Switch                : 00:00:14
```

```
Time that R2 is behind R1 (RPO)             : 00:00:44
Tracks not Committed to the R2 Side         : 0
RDF1 Active (Capture) Cycle Size            : 0
RDF1 Inactive (Transmit) Cycle Size         : 0
RDF2 Active (Receive) Cycle Size            : N/A
RDF2 Inactive (Apply) Cycle Size            : N/A
Cache Slots in Use                          : 0
Percent Available Cache Used                : 0.0
Host Write Workload (IO/s)                  : 0
Host Write Workload (MB/s)                  : 0.0
RDF Throughput R1->R2 (IO/s)                : 0
RDF Throughput R1->R2 (MB/s)                : 0.0
RDF Throughput R2->R1 (IO/s)                : 0
RDF Throughput R2->R1 (MB/s)                : 0.0
Last Restore Time    (R2 only)              : 00:00:00
Average Restore Time (R2 only)              : 00:00:00
Total HA writes                             : 0
Total HA repeat writes                      : 0
```

R-Copy session statistics

Using `symstat` with the REQUESTS type (default) specified, you can display a table of host writes and SRDF throughput information for Open Replicator R-Copy sessions in Symmetrix arrays by specifying the `-repType rcopy` option.

You can refine the data returned for R-Copy sessions by specifying an optional session name as shown in the following syntax:

```
symstat [-i Interval] [-c Count] [-type REQUESTS] -sid SymmID
   -RepType rcopy [-name SessionName]
```

To return R-Copy session statistics for a Symmetrix array 0003, enter:

```
symstat -sid 0003 -reptype rcopy -i 60 -c 3

                                      RCopy
                                 ---------------
          Device                      KB/sec
15:28:45                            PULL     PUSH

15:29:45 0644  (Not Visible )   15189        0
          0645  (Not Visible )   15276        0
          0646  (Not Visible )   15275        0
          0647  (Not Visible )   15383        0
```

This example shows the KB/sec throughput for an R-Copy, hot-pull operation.

Mainframe (Ficon) statistics

Using `symstat` with the REQUESTS type (default) specified, you can display a table of mainframe Ficon throughput information in Symmetrix arrays by specifying the `-EF` option. You can either specify a specific port number or all port numbers, as shown in the example below.

To return mainframe Ficon statistics, enter:

```
symstat -sid 179 -i 60 -c 2 -EF all -type REQUESTS

         DIRECTOR     IO/sec        KB/sec        Avg. Queue  % RW
12:07:50                        READ    WRITE       Length    Hits

12:08:50 EF-16B          122   12345    67890         15      10
```

```
12:09:50 EF-16B          126   34521    78900         12      7

15:25:30
```

This example shows the KB/sec READ (bytes received) and WRITE (bytes transmitted), which includes both protocol overhead and data.

BACKEND statistics and PREFETCH activity

Statistics for I/O requests on back-end directors, the throughput on the corresponding devices, and prefetch disk activity on back-end directors can be returned using the Solutions Enabler SYMCLI.

Returning BACKEND statistics

Using `symstat` with the BACKEND type specified, you can display performance statistics such as I/O requests using a DA (back-end director) and throughput on a device.

From the device list shown in the device group statistical run, select the logical device for which you want to examine I/O requests and throughput activity. Choose the interval and number of samples (count) for the statistical run.

For example, for sample intervals of `60` seconds and a sample count of `3` on logical device `DEV001` in device group `prod_r1`, enter:

```
symstat -type BACKEND -i 60 -c 3 -g prod_r1 -ld DEV001
```

The display would be similar to the front-end REQUESTS display showing read/write I/O, prefetched tracks, and unused track activity.

Prefetch activity

From the Symmetrix list, select the Symmetrix array that you want to examine for prefetch disk activity on the back-end directors (DAs). Choose the interval and number of samples (counts) for the statistical run.

For example, for sample intervals of `60` seconds and a sample count of `4` for prefetch activity on Symmetrix `010050010333`, enter:

```
symstat -i 60 -c 4 -sid 333 -da all -type prefetch
```

The following is an example output:

```
            Director    Prefetch  Prefetch Trk/sec
16:42:30                Trk/sec   Used     Unused
  ❶         ❷           ❸         ❹        ❺
16:43:30    DA-2A         1         1        0
16:44:30    DA-2A         7         6        1
16:45:30    DA-2A        19        19        0
                        ----      ----     ----
 Total                    27        26        1
```

The following statistics are returned:

1. Host timestamp of sample.
2. Active director name type and number.

3. Track prefetch rate (tracks per second).
4. Used prefetched track rate (tracks per second).
5. Unused (superseded) prefetched track rate (tracks per second).

Solutions Enabler V7.4 with Enginuity 5876 and higher provides the `symstat` command with the `-DX` option to allow prefetch disk activity on external directors (DXs). Choose the interval and number of samples (counts) for the statistical run.

For example, for sample intervals of 60 seconds and a sample count of 4 for prefetch activity on Symmetrix 010050010333, enter:

```
symstat -i 60 -c 4 -sid 333 -dx all -type prefetch
```

Director statistics

Using `symstat`, you can display the I/O requests and throughput activity performance statistics on any or all directors. In addition, you can return director statistics for R-Copy sessions. To return a list of directors available on all visible Symmetrix arrays, use `symcfg list -dir all`.

Note: You can run statistics for a FICON directors. The `-dir` option of `symstat` accepts a FICON director as an argument for Symmetrix arrays running Enginuity 5874 or higher.

Director I/O requests

From the list, select the Symmetrix array for which you want to examine I/O requests and throughput activity on the directors. Choose the interval and number of samples (counts) for the statistical run.

For example, to output statistics for all directors on Symmetrix array 150, enter:

```
symstat -type REQUESTS -sid 150 -dir ALL -i 60 -c 100

  DIRECTOR        IO/sec                    Cache Requests/sec                  % RW
09:32:13                        READ              WRITE            RW           Hits
   1        2        3           4                 5               6             7

09:33:13 FA-7E 29224856000 10003424332159670 1000000234654674 11003424566814344 99
```

The following statistics are returned:

1. Host timestamp of sample.
2. Active director identifier and number.
3. I/O rates (operations per second) for:
   - Host to Front-end directors
   - Disk to Back-end directors
   - Local to Remote link directors
4. Read cache request rate (requests per second).
5. Write cache request rate (requests per second).

6. Total read/write cache request rate (requests per second).
7. Cache hit ratio (percentage of cache read and write hits).

Note: The `symstat` CLI will be modified to report statistic for external disks and new DX director type.

R-Copy session statistics

Using `symstat` with the REQUESTS type (default) specified, you can display a table of directors on the specified array and SRDF throughput information for Open Replicator R-Copy sessions in Symmetrix arrays by specifying the `-repType rcopy` option.

You can refine the data returned for R-Copy sessions by specifying an optional session name as shown in the following syntax:

```
symstat [-i Interval] [-c Count] [-type REQUESTS] -sid SymmID
   -RepType rcopy [-name SessionName]
```

To return R-Copy session statistics for a Symmetrix array 097, enter:

```
symstat -sid 097 -reptype rcopy -dir 7a -i 60

                      RCopy     Cache Requests/sec    %RW
16:06:49   Director   MB/sec    READ   WRITE   RW     Hits
   1          2          3       4      5      6      7
16:07:49   FA-7A          58      716      0    716    80
                     ------   ------ ------ ------   ---
                          58      716      0    716    79
```

The following statistics are returned:

1. Host timestamp of sample.
2. Active director identifier and number.
3. R-Copy director throughput in MB/sec.
4. Number, or the count, of cache read requests per second.
5. Number, or the count, of write requests per second.
6. Total number, or count, of combined read and write requests per second.
7. Cache hit ratio (percentage of cache read and write hits).

PORT statistics

Using `symstat` with the PORT type specified, you can display performance statistics such as I/O requests and throughput of director ports for a specific Symmetrix array.

How to return director port statistics

Choose a Symmetrix array for which you want to examine I/O requests and throughput activity on the directors. Choose the interval and number of samples (counts) for the statistical run. The `symstat -type PORT` syntax allows you to return statistics for one or all directors on one or all Symmetrix arrays. In addition, you can optionally specify one or all port numbers. Use the following syntax for director port statistics:

```
symstat [-i Interval] [-c Count] -type PORT [-sid SymmID]
   -dir <#|ALL> [-port <#|ALL>]
```

For example, for sample intervals of `60` seconds, and a sample count of `3` (for I/O requests and throughput) on Symmetrix `0256`, enter (the output follows):

```
symstat -i 60 -c 5 -type PORT -sid 0256 -dir ALL

15:24:30    DIRECTOR    PORT      IO/sec     Kbytes/sec
15:25:30      FA-15C       0          40              0
15:26:30      FA-15C       0          28              0
15:27:30      FA-15C       0          27              0

15:28:30    DIRECTOR    PORT      IO/sec     Kbytes/sec
15:28:30      FA-15C       0          24              0
```

R-Copy session director port statistics

Using `symstat` with the PORT type specified and the `-reptype` set to `rcopy`, you can display a table of director ports on the specified array and session throughput information for Open Replicator R-Copy sessions.

```
symstat -sid 0003 -reptype rcopy -type port -dir 14c -i 60 -c 3

                                RCopy
          Director   ------------------------
15:34:07    Port     MB/sec  Ceiling  Devices
  ❶         ❷        ❸       ❹        ❺
          FA-14C:1   23      30       4

          FA-14C:1   24      30       4
```

The following statistics are returned:

1. Host timestamp of sample.
2. Active director and port number.
3. R-Copy session throughput in MB/sec.
4. The maximum percentage of that director/port's bandwidth that is allotted to R-Copy operations.
5. Number of remote devices. The number of remote devices is only available when all R-Copy sessions are nonincremental.

ISCSI statistics (GigE)

Using `symstat` with the iSCSI type specified, you can display GigE performance statistics, such as I/O requests and throughput of director ports for a specific Symmetrix array. Statistics can be returned for GigE directors configured as SRDF directors (`-RE`) and for GigE directors (`-DIR`) configured as SCSI directors.

TCP Connection-based statistics

To return TCP connection-based statistics, specify the `-tcp_conn` option and the SCSI director number (ALL can be specified as a value). For example, enter:

```
symstat -type ISCSI -i 60 -c 5 -sid 237 -tcp_conn -DIR 20

GigE ISCSI Statistics
TCP Connection Based Statistics
            Queue    Segments/sec   RTT             IP Addr:Port
15:40:57  Send Recv  Trans   Recv            Local              Remote
15:40:58  100  200   1000   4000    10   192.168.100.101:123  192.168.100.211:456
15:41:58  200  300   2000   3000    20   192.168.100.101:123  192.168.100.211:456
```

Network Interface-wide statistics

To return network interface-wide statistics, specify the `-gige_dir` option and the SCSI director number (ALL can be specified as a value). For example, enter:

```
symstat -type ISCSI -i 60 -c 5 -sid 237 -gige_dir -DIR 20

GigE ISCSI Statistics
Network Interface Wide Statistics
              IP Pkts       ICMP Msgs      TCP Sgmts       UDP Pkts
              /sec          /sec           /sec            /sec
15:41:10   Sent    Rcvd   Sent    Rcvd    Sent    Rcvd   Sent    Rcvd
15:41:11   1000    2000   1500    1200    3000    2500   1800    2200

15:42:11   2000    1500   1800    1400    2000    2300   2000    2000
```

SRDF speedlimit statistics

To return SRDF speedlimit statistics, specify the `-rdf_spdlmt` option and the SRDF director number (ALL can be specified as a value). For example, enter:

```
symstat -type ISCSI -i 60 -c 5 -sid 237 -rdf_spdlmt -RE 24

GigE ISCSI Statistics
RDF Speedlimit Statistics

15:41:33 10

15:42:33 15
```

SRDF network compression statistics

To return SRDF network compression statistics, specify the `-rdf_nw_comp` option, SRDF director number (ALL can be specified as a value), and the IP address of the remote array. For example, enter:

```
symstat -type ISCSI -i 60 -c 5 -sid 237 -rdf_nw_comp -RE 24 -ip 192.168.100.150

GigE ISCSI Statistics
```

```
RDF Network Compression Statistics
                Compressed Bytes/sec          Uncompressed Bytes/sec
15:41:45     Transmitted     Received     Transmitted       Received
15:41:46        12345678     11222456        34456788       45667899

15:42:46        14566778     13456456        45636788       56757899
```

Speedlimit group statistics

To return SRDF speedlimit group statistics, specify the `-spdlmt_grp` option and the SRDF director number (ALL can be specified as a value). For example, enter:

```
symstat -type ISCSI -i 60 -c 5 -sid 237 -spdlmt_grp -RE 24

GigE ISCSI Statistics
Speedlimit Group Statistics
             Speedlimit Grp   Director   Active   Speedlimit    Bandwidth
15:42:09                     Number               State
15:42:10                       0x1        16C       10            20          1000

15:43:10                       0x2         1D       12            25          2000
```

MEMIO statistics

Using `symstat`, you can display performance statistics, such as cache memory to disk I/O on a device group. However, you may need to first list the current device groups (use `symdg list)`. From the device group list, select the device group for which you want to examine the I/O or cache memory to disk activity. Choose the interval and number of samples (counts) for the statistical run.

Note: When using Solutions Enabler V7.1 `symstat` command against Symmetrix arrays running Enginuity 5874, some device and director output fields have been changed to support 64-bit counters. Refer to the "Compatibility mode: Preserving old Solutions Enabler scripts" on page 24 for information on returning output as seen in prior Solutions Enabler versions.

Example: Memory and I/O statistics

The following display is an example output of cache to disk activity for the devices of Symmetrix array 150:

```
symstat -type MEMIO -sid 150 -i 60 -c 100

DEVICE                                  Tracks/sec                  % Dev
09:31:24       WP Tracks          Prefchd            Destgd          WPmax
    (1)            (2)               (3)                (4)             (5)

09:32:24 002B   119003    347825900002675400  37232619000345011    84
```

If `-output` was specified, the above output would appear in the following XML format:

```
<SymCLI_ML>
  <Statistics>
    <time>Thu Nov 11 2010 06:00:42</time>
    <Memory>
      <dev_name>002B</dev_name>
      <pd_name>/dev/sdaa</pd_name>
```

```
      <wp_tracks>119003</wp_tracks>
      <pf_tracks>347825900002675400</pf_tracks>
      <destaged_tracks>37232619000345011</destaged_tracks>
      <wp_max_pct>84</wp_max_pct>
    </Memory>
<SymCLI_ML>
```

The following statistics are returned:

1. Host timestamp of sample and Symmetrix device name.
2. Write pending track count not yet destaged to disk.
3. Track prefetch rate (tracks per second).
4. Track destage rate (tracks per second).
5. Write-pending device limit percentage (percentage of device parameter).

By default, BCV devices are not included in these results. Optionally, you can choose to return statistics for only BCV devices in the device group by specifying the `-bcv` option. Alternatively, you can choose to return statistics for both standard and BCV devices in the device group by specifying the `-all` option.

DMSP statistics

Using `symstat` with the DMSP type specified, you can display DMSP (dynamic mirroring service policy) statistics such as service policy and I/O performance attributes for a specified Symmetrix device.

Note: DMSP statistics are not supported on Enginuity version 5772 or higher.

Device dynamic mirroring service policy statistics

From the device list shown in the device group statistical run, select the logical device for which you want to examine DMSP statistics and throughput activity. Choose the interval and number of samples (count) for the statistical run.

For example, for sample intervals of `60` seconds and a sample count of `3` on logical device `DEV001` in device group `prod_r1`, enter:

```
symstat -type DMSP -i 60 -c 3 -g prod_r1 -ld DEV001
```

The display provides DMSP information for mirror 1 and 2, the preferred mirror, new and old mirror service policies, the percent of sequential I/O, the percent of write I/O, and the activity level.

Disk statistics

Using `symstat` with the DISK type specified, you can display performance statistics, such as I/O requests and throughput on a physical disk, at specified time intervals for the duration of a specified count.

Specifying a disk

Select the physical DA director number, interface ID, and disk SCSI ID interface on a specified Symmetrix array for which you want to examine I/O requests and throughput activity. To retrieve the statistics of all DA directors, interfaces, or disk SCSI IDs, use the value ALL. For example, for sample intervals of `60` seconds and a sample count of `3` on disk `02A:C5`, enter:

```
symstat -type disk -i 60 -c 3 -sid 577 -disk 2a,C,5
```

If you want to retrieve statistics at the same interval and sample count, but for all SCSI IDs on DA 02A, interface C, enter:

```
symstat -type disk -i 60 -c 3 -sid 577 -disk 2a,C,ALL
```

The display provides the disk ID, I/O read/writes, and kilobytes per read and write for each disk.

Returning spindle statistics

Solutions Enabler V7.4 with Enginuity 5876 and higher provides the `symstat` command with the `-spindle` option to allow the identification of disks by Director and Spindle ID for internal or external (DX director) disks. Also the `-spid` *`SpindleID`* option allows statistics to be requested for a disk through the specification of a Spindle ID or for all disks. The `symstat` command uses the following syntax:

```
symstat -i Interval [-c Count]
        -type DISK -sid SymmID [-spindle [-internal|-external]]
        [[-disk <da|ALL>[,<int|ALL>[,<id|ALL>]]] |
         [-spid SpindleID|ALL]] [-DX <#|ALL>]]
```

For example, to request an output format which identifies disks by director and Spindle ID for Symmetrix 109, enter:

```
symstat -type DISK -sid 109 -spindle -i 60

         Spindle  Dir             IO/sec          KB/sec
15:45:22                        READ  WRITE    READ   WRITE

15:46:22
         53       07A               0      0      44       0
         325      08A               0      0      25       0
Total                           ------ ------ ------- -------
                                     0      0      69       0
```

Note: For Enginuity versions less than 5875, the specified/returned Spindle ID does not represent an actual Enginuity entity, but is a string representation of a unique hexadecimal number.

For example, to request an output format which identifies disks by Spindle ID for Symmetrix 306, enter:

```
symstat -type DISK -sid 306 -spid all -spindle -external -i 60

         Spindle  Dir             IO/sec          KB/sec
12:51:27                        READ  WRITE    READ   WRITE

12:52:27
         2D1      07E              1      0      64       0
         2D2      07F              0      0      25       0
    . . .
Total                          ------ ------ ------- -------
                                     6      0    2889       0
```

Note: Use the `-DX #` option to request statistics for a specific external director or all external directors (`-ALL`).

CACHE statistics

You can return data about the cache activity on the front-end directors, LRU, or SRDF/A sessions.

Front-end director statistics

Statistics for front-end directors can be returned by specifying options for SA, EA, FA, FE, CA, RA, director number, or all. In addition you can choose the interval and number of samples (counts) for the statistical run. For example, to return cache activity for all SAs on Symmetrix `010050010333`, for sample intervals of `60` seconds and a sample count of `4`, enter:

```
symstat -i 60 -c 4 -sid 097 -sa all -type cache

         DIRECTOR    Misses/sec    Disconnects/sec
15:21:52             Cache Read    System   Device
   1         2            3            4        5

15:22:52   FA-15C         0            24       0
```

As shown in this example, there was one sample of cache activity to report on one director during the sample period and `symstat` lists the following statistical items:

1. Host timestamp of sample.
2. Active director identifier and number.
3. Cache read miss rate (misses per second).
4. System disconnect rate (disconnects per second) due to write pending limit.
5. Device disconnect rate (disconnects per second) due to write pending limit.

LRU cache management statistics

Using `symstat`, you can display the LRU cache statistics. However, you may need to first list the LRUs and Symmetrix arrays (use `symcfg list -lru ALL)` to see the LRUs for all units and specify a Symmetrix ID.

Note: LRU statistics are not supported on Enginuity version 5*x*70 or higher.

For example, to obtain a list of `ALL` LRUs on Symmetrix `063` and their cache partitioning, enter:

```
symcfg list -lru ALL -sid 063
```

The following is an example output:

```
LRU Num   LRU Name    Cache Slots  Percent of Total
-------   --------    -----------  ----------------
      1      LRU_0          13831        25%
      2      LRU_1          13831        25%
      3      LRU_2          13831        25%
      4      LRU_3          13831        25%

              -------    ---------
                Total        55325
```

Select the Symmetrix array for which you want to examine the LRUs I/O requests and throughput activity. Choose the interval and number of samples (counts) for the statistical run.

For example, for sample intervals of `60` seconds and a sample count of `3` (for I/O requests and throughput) on Symmetrix `0011`, enter:

```
symstat -type cache -lru all -i 60 -c 3 -sid 0011
```

The following display is an example of the LRU cache statistics obtained using this command:

```
             LRU                    Cache Requests/sec        % RW     Locks/sec
14:29:44  #     NAME             READ     WRITE       RW     HITS
   (1)    (2)    (3)              (4)       (5)       (6)     (7)        (8)

14:30:44  1   GROUP_0           5353       835      6189      75           0
14:31:44  1   GROUP_0           3468       537      4005      75           0
```

The following statistics are returned:

1. Host timestamp of sample.
2. LRU number.
3. LRU name.
4. Read cache request rate (requests per second).
5. Write cache request rate (requests per second).
6. Total read/write cache request rate (requests per second).
7. Cache hit ratio (percentage of cache read and write hits).
8. LRU lock request rate per second.

SRDF/A session statistics

Use the `symstat` command to return a table of cache usage for device groups (SRDF/A sessions) in the specified Symmetrix that have active status or have nonzero cache usage by specifying the `-repType rdfa` option. SRDF/A cache statistic data can be returned for all or a specific device group or RA group number.

When you request SRDF/A session statistics for a specified Symmetrix array, the output differs depending on the flag arguments specified:

- If the `-sid` flag is used with no further qualifiers (`[-g ALL | -rdfg <#|ALL> | -cg <CgName|ALL>]`), the output displays SRDF/A sessions that have a status of `active`.
- If the `-sid` flag is used with qualifier `-g all`, the output displays all device groups, regardless of status. If the `-sid` flag is used with the qualifier `-rdfg ALL`, the output displays all SRDF groups, regardless of status. If the `-sid` flag is used with the qualifier `-cg ALL`, the output displays all composite groups, regardless of status.
- If the `-g DgName` device group qualifier is used (whereby the `-sid` option is not specified), then the output displays only details for the specified device group.
- If the `-sid` flag is used with the qualifier `-rdfg #`, then the output displays just the specified SRDF group.
- If the `-sid` flag is used with the qualifier `-cg CgName`, then the output displays just the specified composite group.
- If the `-v` option is specified, the returned statistics are expanded and grouped by device group (SRDF/A session) for all sessions.

Example: R1 SRDF/A session statistics for active groups

For example to return SRDF/A session statistics for all active device groups on Symmetrix array `0011`, enter:

```
symstat -type cache -i 60 -c 3 -sid 0011 -repType rdfa
```

The following statistics are returned:

```
symstat -type CACHE -RepType rdfa -sid 16

SRDF/A Session Cache Summary Information

Symmetrix Id                                  : 000190300016
Timestamp                                     : 06:20:44

System Write Pending Limit                    : 949494   (57.95 GB)
Cache Slots available for all SRDF/A sessions : 712120   (43.46 GB)
Total Local Write Pending Count               : 0
Total System Write Pending Count              : 0
Total System SRDF/A DSE Used Tracks           : 0        (0.00 GB)
Total System Cache Slots In Use               : 0        (0.00 GB)
Total System Cache Slots Shared               : 0        (0.00 GB)
Total System Cache Full Percentage            : 0.0

                      Session    Rdfa DSE         Cache Slots
                      -------- --------------- --------------------- Cache
                  RA  Flgs                                           Full
Device Group Name Grp TAS  Pri Thr  UsedTrks      In Use      Shared  (%)
----------------- --- ---- --- --- ----------- ----------- --------- -----
RaGrpNum_63        63 RDF1  62  33    60           0           0      0.0
RaGrpNum_05         5 RDF1   4  33    60           0           0      0.0

Total                                          ----------- --------- -----
  Slots                                            0           0      0.0
  GB                                               0.00        0.00
```

SRDF/A session statistics descriptions

The following SRDF/A session statistics are returned:

- **System Write Pending Limit** — The number of cache slots available in the Symmetrix array, which are used to hold writes awaiting destaging locally or transfer in an SRDF/A cycle. Typically, this limit is approximately 80 percent of the total cache available, however, in some case it is less.
- **Cache Slots Available for all SRDF/A sessions** — The upper limit of cache slots available for all SRDF/A sessions. This value typically is determined by the SRDF/A Max Cache Usage parameter, which allows the user to specify what percentage of the System Write Pending Limit slot count should be used for SRDF/A sessions. If the Max Host Throttle parameter is 0, then Cache slots available for all SRDF/A sessions is a percentage of System Write Pending Limit as specified by SRDF/A Max Cache Usage setting. The default value of this limit is approximately 94 percent of the System Write Pending limit. If the Max Host Throttle parameter is not 0, then the number of Cache Slots Available for all SRDF/A sessions will be equal to the System Write Pending limit.
- **Total Local Write Pending Count** — The sum of local write pending tracks for all RDF devices. Note this is for RDF devices ONLY.
- **Total System Write Pending Count** — This count represents all write pending tracks in the system, which in most cases sum of write pending tracks for all of the devices. There are cases when the same write pending track belongs to more than one device. This includes all devices that are RDF.
- **Total System SRDF/A DSE Used Tracks —** Identifies the SRDF/A DSE threshold and used track counts.
- **Total System Cache Slots in Use** — Cache slots in use is the total number of cache slots in the active and inactive cycle for that SRDF/A session. These are tracks that are used by the SRDF/A session but are not directly related to write pending tracks. Tracks can be write pending, slots in memory, or in DSE pool. Therefore, using this number in combination with any write pending count does not produce any meaningful value.

  Note: The sum of the Cache Slots in Use and the Local Write Pending Count does not equal the Total System Write Pending Count. This is because Cache Slots in Use and Local Write Pending Count include every cache slot in those states, while the Total System Write Pending Count includes slots with either of those states, but not both. So a cache slot with both a local write pending and an SRDF/A write pending would increase the individual counts of each, but only increment the total count by one.

- **Total System Cache Slots Shared** — A count of total system cache slots that measures the amount of data shared.
- **Total System Cache Full Percentage** — The percentage of the available SRDF/A cache in use for the device group.

PATH statistics

Using the SYMCLI you can report R-Copy path information for nonincremental sessions. Symmetrix arrays that have all or some incremental sessions will report an error.

Note: These statistics are only available when all R-Copy sessions are nonincremental.

The data can either be presented by session, where the data is organized by session name (`-by_session` option), or by port, where the data will be organized by director port (`-by_port` option).

Organized by session

The following example shows the R-Copy PATH statistics for Symmetrix array 003 organized by session name:

```
symstat -sid 0003 -reptype rcopy -type path -by_session -i 60 -c 3

Time      Session  Control      Target           Tracks      Director  RCopy
Stamp      Name    Device     Destination     Total Remaining   Port   Ceiling

15:43:24  hotpull   0644      N/A              264960       0 FA-14C:1    30
          hotpull   0645      N/A              264960       0 FA-14C:1    30
          hotpull   0646      N/A              264960       0 FA-14C:1    30
          hotpull   0647      N/A              264960       0 FA-14C:1    30


Time      Session  Control      Target           Tracks      Director  RCopy
Stamp      Name    Device     Destination     Total Remaining   Port   Ceiling

15:44:24  hotpull   0644      N/A              264960       0 FA-14C:1    30
          hotpull   0645      N/A              264960       0 FA-14C:1    30
          hotpull   0646      N/A              264960       0 FA-14C:1    30
          hotpull   0647      N/A              264960       0 FA-14C:1    30


Time      Session  Control      Target           Tracks      Director  RCopy
Stamp      Name    Device     Destination     Total Remaining   Port   Ceiling

15:45:24  hotpull   0644      N/A              264960       0 FA-14C:1    30
          hotpull   0645      N/A              264960       0 FA-14C:1    30
          hotpull   0646      N/A              264960       0 FA-14C:1    30
          hotpull   0647      N/A              264960       0 FA-14C:1    30
```

Organized by port

The following example shows the R-Copy PATH statistics for Symmetrix array 003 organized by director port:

```
symstat -sid 0003 -reptype rcopy -type path -by_port -i 60 -c 3

Time      Director   RCopy    Port   RCopy   Control      Tracks       Session
Stamp       Port    Ceiling  KB/sec  KB/sec  Device   Total Remaining   Name

15:44:44  FA-14C:1     30         -       -    0644    264960       0  hotpull
                                               0645    264960       0  hotpull
                                               0646    264960       0  hotpull
                                               0647    264960       0  hotpull


Time      Director   RCopy    Port   RCopy   Control      Tracks       Session
Stamp       Port    Ceiling  KB/sec  KB/sec  Device   Total Remaining   Name
```

```
15:45:44  FA-14C:1     30        17       0    0644    264960       0  hotpull
                                                0645    264960       0  hotpull
                                                0646    264960       0  hotpull
                                                0647    264960       0  hotpull

Time      Director   RCopy    Port   RCopy   Control      Tracks       Session
Stamp       Port    Ceiling  KB/sec  KB/sec  Device   Total Remaining   Name

15:46:44  FA-14C:1     30        19       0    0644    264960       0  hotpull
                                                0645    264960       0  hotpull
                                                0646    264960       0  hotpull
                                                0647    264960       0  hotpull
```

CYCLE statistics

The CYCLE type statistics return a table of cycle information for device groups (SRDF/A sessions) in Symmetrix arrays that have active status or have nonzero cache usage.

When you request SRDF/A session statistics for a specified Symmetrix array, the output differs depending on the flag arguments specified:

- If the `-sid` flag is used with no further qualifiers (`-g all`, `-rdfg # | ALL`), the output displays SRDF/A sessions that have a status of `active`.
- If the `-sid` flag is used with qualifier `-g all`, the output displays all device groups, regardless of status. If the `-sid` flag is used with the qualifier `-rdfg all`, the output displays all SRDF groups, regardless of status.
- If the `-sid` flag is used with the qualifier `-rdfg #`, the output displays just the specified SRDF group.
- If the `-g` *`DgName`* device group qualifier is used (without specifying the `-sid`), the output displays only details for the specified device group.
- If the `-v` option is specified, the returned statistics are expanded and grouped by device group (SRDF/A session) for all sessions.

Example: All device groups

For example, to return SRDF/A session cycle statistics of active sessions for Symmetrix array `0011`, enter:

```
symstat -type cycle -i 60 -c 3 -sid 0011 -RepType rdfa -g all
```

The following statistics are returned for one count:

```
SRDF/A Session Cycle Summary Information
Symmetrix Id  : 000187400011
Timestamp     : 14:40:16


Session    Cycle Time  (sec)        Cycle Size
                       ----------- ------------------- -----------------------
                  RA   FLGS Active                Last
Device Group Name Grp  TAS  Cycle# Min Avg Last Switch Active  Inact   Shared
----------------- ---  ---- ------ --- --- ---- ------ ------- ------- -------
RaGrpNum_111      111  2YA     853   -  15   15      1       0       0       0
RaGrpNum_112      111  2YA     753   -  15   15      1       0       0       0
RaGrpNum_121      111  2YA     853   -  15   15      2       0       0       0
RaGrpNum_122      111  2YA     853   -  15   15      1       0       0       0
RaGrpNum_123      111  2YA     855   -  15   15      1       0       0       0
RaGrpNum_124      111  2YA     856   -  15   15      1       0       0       0

Legend for Session Flags:

  T(ype)          : 1 = RDF1, 2 = RDF2
  A(SYNC)         : Y = Yes, N = No
  S(tatus)        : A = Active, I = Inactive, - = N/A
```

Note: The table headings Active and Inactive are used to represent the Captured and transmitted data on the R1 side and Receive and Apply on the R2 side of the operation.

The following statistics are returned:

- Device Group Name
- RA Group number

Session Flags

- Type of SRDF group (RDF1 or RDf2); inactive sessions do not have an assigned type.
- Asynchronous (Yes or No).
- Status (Active or Inactive).
- Active cycle number identifier for the given SRDF/A session. MSC cycle numbers are not displayed.

Cycle Time

- Min — The setting for the minimum number of seconds for a specific cycle.

  Note: The Min Cycle Time value is not shown on the R2 side.

- Avg — A measure of the average time of all cycles in the session in seconds.
- Last — A measure of the last cycle in seconds.
- Last Switch — A measure of time in seconds since the last switch from active to inactive or vice versa.

Cycle Size

- Active — A count of cache slots that measures the amount of data captured (on the R1 side) or received (on the R2 side).
- Inactive — A count of cache slots that measures the amount of data transmitted (on the R1 side) or applied (on the R2 side).
- Shared — A count of cache slots that measures the amount of data shared.

SRDF statistics

The SRDF type statistics extend the statistical information provided by the SRDF director to external applications providing greater visibility into the performance and behavior of Symmetrix arrays in the field. These statistics can be used to monitor on-going activity and to analyze problematic behavior.

Note: SRDF directors are supported on VMAX 10K arrays running Enginuity 5876. `symstat` commands specifying a SRDF director using the `-dir` option produces the appropriate output if SRDF directors exist on such arrays. The `symstat` command produces the appropriate output when issued against a VMAX 10K array with SRDF specific options including the `-hop2` option. These options include `-type RDF`, `-RepType rdfa`, `-RepType rdf`, and `-type REQUESTS -RA`.

SRDF/A session statistics by RA group

Statistics for SRDF/A sessions can be monitored by RA group number. To return statistics for all RA group numbers, specify `all`.

```
symstat -sid 179 -i 60 -c 2 -type RDF -rdfg 11

RDF Group Level I/O Statistics:

GRP       IO/sec        MB/sec    % Hits   IO Service Time (usec)    Q
13:33:31 READ   WRITE   READ  WRITE     RD    Min        Max    Avg  Len
13:33:31  11      100    200  12345   34500    30        23       0   10

13:34:31  11      110    220  15000   45000    40        30       0   15
```

SRDF device-level statistics

SRDF statistics can be monitored at the device level. Device-level statistics can be obtained by specifying a Symmetrix device name (`-dev` *`SymDevname`*), logical device name (`-ld` *`LDevname`*), or device group name (`-g` *`DgName`*).

Note: A device group name (`-g` *`DgName`*) must be specified when a logical device name (`-ld` *`LDevname`*) is used.

For example, to return SRDF device-level statistics for device 37, enter:

```
symstat -sid 179 -i 60 -c 2 -type RDF -dev 37

RDF Device Level I/O Statistics:

          DEV   RDF        IO/sec        MB/sec    % Hits  IO Service Time(usec)
13:37:31      GRP MODE   READ  WRITE   READ  WRITE     RD    Min       Max   Avg
13:37:33   37  17    0    100    200  12345  34500     30      30       0

13:38:33   37  17    0    110    220  15000  45000     40      50       0
```

SRDF statistics by director number

SRDF statistics can be monitored at the SRDF director level. Director-level statistics can be obtained by specifying a specific director number or specifying `all`.

For example, to return SRDF director level statistics, enter:

```
symstat -sid 179 -i 60 -c 2 -type RDF -dir 1d

RDF Device Level I/O Statistics:

         DIR       IO/sec        MB/sec    % Hits   IO Service Time (usec)    Q
13:37:31        READ   WRITE   READ  WRITE     RD    Min        Max    Avg  Len
14:08:34  32     100     200  12345  34500     30     30          0     10
14:08:34  40     120     220  24567  55432     25     40          0     12

14:09:34  32     110     210  15000  45000     40     50          0     15
14:09:34  40     130     230  26265  61250     35     55          0     20
```

SRDF link-level statistics

SRDF director-level statistics can be further enhanced to return throughput information of the SRDF links. To return link-level details, specify the `-rdflink` option as shown in the example below.

```
symstat -sid 179 -i 60 -c 2 -type RDF -dir 2c -rdflink

RDF Link Level I/O Statistics:

          LINK      IO/sec       MB/sec     % Hits   IO-Service-Time(usec)    Echo
14:18:27         READ   WRITE   READ  WRITE     RD    Min    Max    Avg       Delay
14:18:29    0     100    200   12000  21000     35     30      0     50
14:18:29    1     110    210   13000  22000     40     40      0     60
14:18:29    2     120    220   14000  23000     45     50      0     70
14:18:29    3     130    230   15000  24000     50     60      0     80

14:19:29    0     110    210   23000  31000     45     35      0     60
14:19:29    1     120    220   24000  32000     50     45      0     70
14:19:29    2     130    230   25000  33000     55     55      0     80
14:19:29    3     140    240   26000  34000     60     65      0     90
```

CHAPTER 9
Change Tracker

This chapter introduces the Change Tracker SYMCLI (`symchg`) command and explains how to monitor Symmetrix data objects for change within your storage environment.

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- Monitoring data objects for changes 274
- Generating reports of changes 280
- Using Change Tracker for SRDF capacity planning 284

Overview

The EMC Solutions Enabler Change Tracker software measures changes to data on a Symmetrix volume or a group of volumes. The Change Tracker command (`symchg`) is used on FBA devices to mark selected areas of Symmetrix disk storage so that Symmetrix logical volume occupying those areas can be monitored for change.

Change Tracker uses DeltaMark bitmap technology (formerly called the Symmetrix Differential Data Facility) to identify logical blocks that were changed on a Symmetrix FBA device. Before change tracking can begin, a Change Tracker (DeltaMark) session must be created using the `symchg create` command. The `symchg mark` command is then used to perform a timestamp and mark the selected area of disk storage occupied by a data object using a DeltaMark bitmap.

This allows a marked area to be examined at a later time to view changes to the stored object. The tracked changes can also be saved to a log file for later analysis. Change Tracker data is often used to analyze and design TimeFinder and SRDF configurations.

The Symmetrix system stores information about track changes internally, and makes this information available to applications through a DeltaMark bitmap vector or table. Each DeltaMark bitmap contains a bit for every track on the monitored volume. When a write to the volume alters a track of information, the bitmap is updated to reflect that the track has been changed. (Subsequent changes to that same track have no effect on the bitmap.) Figure 11 illustrates a DeltaMark bitmap table.

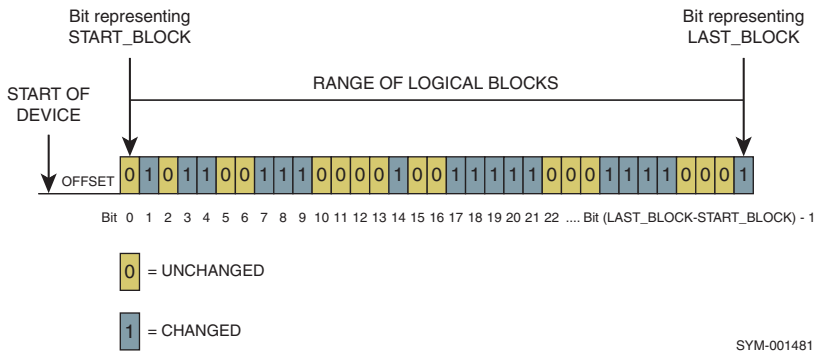

Figure 11 A DeltaMark bitmap table

Note: Change Tracker sessions are allowed on count key devices (CKD) starting with Enginuity 5773. You can create, mark, view, list, and delete a Change Tracker session on CKDs.

Note: The `symchg` command provides full support to non-geometry limited encapsulated devices or external provisioned devices with Solutions Enabler V7.4 and Enginuity 5876 and higher.

Practical uses

Using TimeFinder and SRDF software to mirror data from a source Symmetrix system to a remotely associated Symmetrix system located across the hall or across the globe creates a global data storage solution. That is, production data can be available at a remote site

for data mining, e-business content delivery, application development, testing, backups, and numerous other uses. Moreover, SRDF configurations provide a recovery solution for component or site failures between remotely mirrored devices.

With the wide acceptance of SRDF for remote storage and as a disaster tolerance and disaster restart tool, assessing incremental changes to data over discrete periods of time is a necessary part of planning for data transfer and storage at remote sites. Change Tracker assists in this task by measuring volume changes, providing information so that informed decisions can be made about the communication line bandwidths and links required for such configurations.

Change Tracker command summary

The Change Tracker command (`symchg`) allows you to monitor selected Symmetrix disk storage objects using DeltaMark bitmap technology to track changes and generate reports for later analysis. Change Tracker can monitor individual devices, standard or BCV devices in a device group or composite group, devices in a storage group, or devices listed in a device file.

Note: Change Tracker control operations using the `symchg` command support Symmetrix thin devices (TDEVs) on arrays running Enginuity 5874.210.168 or higher.

Table 8 summarizes the SYMCLI `symchg` commands you can use to create a Symmetrix Change Tracker session, mark areas to be monitored, remove or delete a session, and generate a report.

Table 8 Change Tracker command summary

Command	Argument	Displays
`symchg`	`create`	Creates a Change Tracker session for the disk device containing the disk storage object to be monitored.By including the `-type` option in the command, you can create a write (default), read, or read/write Change Tracker session. Only one session can exist on a device at a time. For example, you cannot create a read session on a device that already has a write session on it.
	`delete`	Unmarks the disk storage object and deletes the Change Tracker session.
	`list`	Lists all devices marked as Change Tracker objects, including object name and type, session type, and timestamp of marking. The`-type` option lists write, read, or read/write sessions.
	`mark`	Marks disk storage objects as unchanged so that new changes can be tracked. Requires that a Change Tracker session first be created.
	`remove`	Unmarks the disk storage object while retaining the Change Tracker session.
	`report`	Generates a report on the amount of change for the specified object in a given log file. Reports can be generated for device groups, composite groups, and device files.
	`view`	Displays the amount and rate of change for marked disk storage objects or shows if a Change Tracker session exists for a specified disk storage object.

For information about performing Change Tracker control operations, refer to "Monitoring data objects for changes" on page 274. For details about the `symchg` command syntax and other SYMCLI commands, refer to the *EMC Solutions Enabler SYMCLI Command Reference Guide*.

Using -force with delete and remove

The `symchg remove` does not remove devices from the Change Tracker database if the object type does not match the object type in the command. Additionally, if the `symchg remove` command fails half way through its device list, you must issue a remove on each device that was not removed. In this case, you can use the `-force` option to force the removal of all the devices from the database.

You can also use the `-force` option with `symchg delete` to force the deletion of the Change Tracker session from a Symmetrix array and the deletion of the devices from the Change Tracker database.

Monitoring data objects for changes

To mark areas of Symmetrix disk storage for change monitoring, you first create a Change Tracker session for the objects that you want to monitor. Creating a Change Tracker session creates DeltaMark bitmaps for the specified objects. Once a session has been established, the objects can be marked at any particular point in time, which resets the bitmaps for those objects (that is, marks all tracks as unchanged). Marking the objects is the starting point from which changes will be measured.

Monitoring the objects is accomplished by viewing the objects in a session. Viewing objects processes the bitmaps that correspond to the objects and displays the amount and rate of change. Viewing can be performed at discrete intervals of time and for a particular number of executions, and the bitmaps can also be reset after each sample. The display may be saved to a user-defined log file, where it is stored in a comma-separated format, enabling the data to be imported into a spreadsheet for analysis. A summary report can be produced from the results in a log file, and the log file can be used to perform capacity planning by specifying particular variables and calculating other parameters.

The `symchg` command operates on Symmetrix disk storage objects by specifying a Symmetrix device name, a logical device name, a device group, a composite group, or a device file. Individual objects may be removed from a session without terminating that session (so other objects in the same session continue to be monitored), and a session can be deleted, terminating the monitoring of all objects included in that session.

Note: SYMCLI `symchg` only monitors FBA devices. CKD devices can be monitored using the mainframe change tracker utility.

Change Tracker does not work correctly if the configuration of a metadevice changes. Once a Change Tracker session is created, the following is blocked through `symconfigure`:

- Non-meta device becomes a metadevice.
- Changing of metamembers.
- Changing a metadevice from a concatenated meta to a striped meta.

- Meta device dissolves and is no longer a metadevice.

Change Tracker does not allow you to create a session on a thin device that is not bound. Therefore, once a device has a Change Tracker session defined on it, `symconfigure` does not allow you to unbind that device.

Creating a Change Tracker session

Before marking objects, you must create a Change Tracker session for the device(s) containing the objects by using the `symchg create` command.

Use the following syntax to create a Change Tracker session:

```
symchg [-sid SymmID] [-v]
   create dev SymDevName [-type read | write | rw]

symchg -g DgName | -cg CgName [-bcv] [-v]
   create [ld LdevName] [-type read | write | rw]

symchg -sg SgName -sid SymmID [-v]
   create [-type read | write | rw]
symchg -file DevFile -sid SymmID [-v]
   create [-type read | write | rw]
```

Setting the session type

The `symchg create` control operation has a `-type` option to indicate the type of session to create for the devices in a Change Tracker object. This feature is available with Enginuity 5875 and higher.

The sessions are:

- Write (W): determines how much data was written to a device. Many write sessions can be opened on a device. This is the default.
- Read (R): identifies a protection bitmap of the tracks read by a host. Only one read session can be opened on a device.
- Read/Write (RW): can perform both a read and a write on a device.

For example, to create a Change Tracker session of type write for a single Symmetrix device (`17C`) on Symmetrix ID 55, enter:

```
symchg create dev 17c -sid 55
```

Since the write session type is the default, you do not have to specify a type.

To create a Change Tracker session of type read for devices in the device group `ProdDB`, enter:

```
symchg -g ProdDB create -type read
```

To create a Change Tracker session of type read/write for devices in the storage group `storgrp` on Symmetrix ID 332, enter:

```
symchg -sg storgrp-a create -type rw -sid 332
```

To create a Change Tracker session of type read for devices listed in a device text file `dev_file_1`, enter:

```
symchg -file dev_file_1 create -read
```

You can mark and examine more than one object per session and you can specify a Symmetrix device name (*SymDevName*) or a logical device (*LdevName*) name within a device group or composite group for the session. You can specify the standard or BCV device (`-bcv`) of a device group or composite group.

Creating a device text file

You can create a Change Tracker session for devices listed in a device text file. The device file syntax contains a single column of devices specified by Symmetrix device name (*SymDevName*). Lines in the device file that begin with a pound symbol (#) will be ignored. The device filename (`-file FileName`) will be inserted into the command line for control operations. A sample of a device text file listing Symmetrix devices is shown in the following example.

Example of a device text file

```
# dev_file_1
# Symmetrix Device List for Change Tracker session
#
00A
00B
00C
057
058
# End
```

Marking a data object

After creating a session, you can mark the device storage objects for change monitoring using the `symchg mark` command. This allows objects to be marked from a particular point in time, with all tracks being marked as unchanged. Once marked, the objects can be monitored for changes. To do this, use the following command syntax:

```
symchg [-sid SymmID] [-v]
   mark   dev SymDevName

symchg -g DgName | -cg CgName [-bcv] [-v]
   mark   [ld LdevName]

symchg -sg SgName -sid SymmID [-v]
   mark

symchg -file DevFile -sid SymmID [-v]
   mark
```

Note: You must use the same convention for the `mark` command as was used with the `symchg create` command when the session was created. If the session was created using a device group, composite group, storage group, or device file, the devices must be managed using the same method.

When you mark an object, an entry is added or updated for the specified object in the `symchg` database. The mark command causes the DeltaMark bitmaps to be reset (no changes) for the devices of the specified object.

You can specify a Symmetrix device name (00A) or a logical device name (DEV001) for the object to be marked. You can also mark the BCV devices (`-bcv` option) of a device group or composite group.

For example, to mark Symmetrix device (17C) on Symmetrix ID 000125600055, enter:

```
symchg mark dev 17c -sid 55
```

To mark BCV devices in the device group ProdDB, enter:

```
symchg -g ProdDB mark -bcv
```

For example, to mark devices listed in the device text file dev_file_1, enter:

```
symchg -file dev_file_1 mark
```

Listing marked objects

You can use the symchg list command to list disk storage objects that were marked and exist in the Change Tracker database.

To list all logical disk storage objects marked for change monitoring, enter:

```
symchg list
```

To list all disk devices marked for a Change Tracker session of a read/write type, enter:

```
symchg list -session -type rw
```

To list all disk devices marked for a Change Tracker session of type read and visible to the host, enter:

```
symchg list -session dev
```

To list all Change Marker objects marked in Symmetrix 109, enter:

```
symchg list -sid 109
```

```
Symmetrix ID: 000194900109


        C H A N G E   T R A C K E R   M A R K E D   O B J E C T S

------------------------------------ -------- ---- --------------------------
Object                                 TYPE   Sym  Mark
Name                                 OBJ  SES Dev  Timestamp
------------------------------------ -------- ---- --------------------------

dg_1                                 DG   R   -    Thu Aug 13 2010 10:47:12
cg_2                                 CG   RW  -    Thu Aug 13 2010 11:47:12
0356                                 DEV  W   0356 Thu Aug 13 2010 12:47:12
Dev001:                              LDEV RW  -    Thu Aug 13 2010 01:47:12
cg_1                                 CBCV R   -    Thu Aug 13 2010 02:47:12
dg_2                                 DBCV RW  -    Thu Aug 13 2010 03:47:12
/usr/files/dev_list                  FILE RW  -    Thu Aug 13 2010 04:47:12


Legend for Type:

 OBJ(ect)              : DEV = Device, DG = Device Group, CG = Composite Group,
                         DBCV = DG_BCV, CBCV = CG_BCV, LDEV = Logical Device,
                         SG = Storage Group, FILE = Device File
 SES(sion)             : R = Read, W = Write, RW = R/W
```

Removing marked objects

You can unmark a disk storage object from the `symchg` database without terminating the Change Tracker session by using the `symchg remove` command. To do this, use the following command syntax:

```
symchg [-sid SymmID] [-v]
   remove dev SymDevName [-force]

symchg -g DgName | -cg CgName [-bcv] [-v]
   remove [ld LdevName] [-force]

symchg -sg SgName -sid SymmID [-v]
   remove [-force]

symchg -file DevFile -sid SymmID [-v]
   remove [-force]
```

Note: You must use the same convention for the `remove` command as was used with the `symchg create` command when the session was created. If the session was created using a device group, composite group, storage group, or device file, the devices must be managed using the same method.

The remove command causes the DeltaMark bitmaps to stop monitoring changes for the devices of the specified object, while maintaining the session.

You can specify a Symmetrix device name (such as, 00A) or a logical device name (such as, DEV001) for the object to be unmarked. You can also unmark the BCV devices (`-bcv` option) of a device group or composite group.

For example, to unmark Symmetrix device (`17C`) on Symmetrix ID 000125600055, enter:

```
symchg remove dev 17c -sid 55
```

To unmark BCV devices in the device group `ProdDB`, enter:

```
symchg -g ProdDB remove -bcv
```

To unmark devices listed in the device text file `dev_file_1`, enter:

```
symchg -file dev_file_1 remove
```

Deleting marked objects

You can unmark a disk storage object from the `symchg` database and delete (terminate) the Change Tracker session by using the `symchg delete` command. To do this, use the following command syntax:

```
symchg [-sid SymmID] [-v]
   delete dev SymDevName [-force]

symchg -g DgName | -cg CgName [-bcv] [-v]
   delete [ld LdevName] [-force]

symchg -sg SgName -sid SymmID [-v]
   delete [-force]

symchg -file DevFile -sid SymmID [-v]
   delete [-force]
```

Note: You must use the same convention for the `delete` command as was used with the `symchg create` command when the session was created. If the session was created using a device group, composite group, storage group, or device file, the devices must be managed using the same method.

The delete command causes the DeltaMark bitmaps to stop monitoring changes for the devices of the specified object and deletes the session.

You can specify a Symmetrix device name (such as, 00A) or a logical device name (such as, DEV001) for the object to be unmarked. You can also unmark the BCV devices (`-bcv` option) of a device group or composite group.

For example, to unmark Symmetrix device (`17C`) on Symmetrix ID 000125600055 and delete the session, enter:

```
symchg delete dev 17c -sid 55
```

To unmark BCV devices in the device group `ProdDB`, enter:

```
symchg -g ProdDB delete -bcv
```

To unmark devices listed in the device text file `dev_file_1`, enter:

```
symchg -file dev_file_1 delete
```

Viewing marked objects

You can process the DeltaMark bitmap corresponding to the disk storage object to display the amount and the rate of change by using the `symchg view` command. For example, to display the amount and the rate of change for Symmetrix device (`17C`) on Symmetrix ID 000125600055, enter:

```
symchg view dev 17c -sid 55
```

Note: You can verify the existence of a Change Tracker session for a specified object by including the `-session` option.

To display the amount and the rate of change for BCV devices in the device group `ProdDB`, enter:

```
symchg -g ProdDB view -bcv
```

To display the amount and the rate of change for devices listed in the device text file `dev_file_1`, enter:

```
symchg -file dev_file_1 view
```

Change information for marked objects in a device group, composite group, storage group, or listed in a device file can be saved to a separate log file. The data written in log file is based on 32k track size; optionally, you can choose to return the output in the native track size by specifying the `-native` option instead. For example, to save change information to file `/tmp/logfile` for marked storage objects in device group `ProdDB`, enter:

```
symchg -g ProdDB view -reset -log /tmp/logfile -c 10
```

The `-reset` option resets the DeltaMark bitmaps for each reporting interval and requires using the count (`-c`) or interval (`-i`) options. The reset after each measurement of changed tracks is called the DELTA collection method.

The SUM collection method calculates the cumulative number of changed tracks from the starting point of when the object was first marked. To collect changed tracks for both the SUM and DELTA collection methods at the same time, you can use the `-multi` option.

For example, to save change information to file `/tmp/logfile` for marked storage objects in device group `ProdDB` using both the SUM and DELTA collection methods, enter.

```
symchg -g ProdDB view -multi -log /tmp/logfile -c 10
```

Note: At each specified interval, the log file will capture both the cumulative number of changed tracks and the number of changed tracks per interval.

Generating reports of changes

Change Tracker allows you to generate two kinds of reports—SUM and DELTA. Reports can be generated for devices in a device group, composite group, or devices listed in a device file.

SUM reports

SUM reports track changes from the point-in-time the DeltaMark bitmap was marked at the beginning of change measurement. Subsequent writes to the same track are not monitored, because the bitmap is not reset after every measurement interval. For instance if the initial *mark* action occurred at 6 A.M. and change data was collected each hour for 12 hours, it would be possible to measure the tracks changed between 6 and 7 A.M., 6 and 8 A.M., 6 and 9 A.M. and so on. It would not be possible to measure the changes between 7 and 8, or 8 and 9 using the SUM report. The SUM reports lend themselves to refresh interval estimations for SRDF/AR installations. Understanding the change measurement at various intervals, enables one to determine the amount of SRDF bandwidth required for different SRDF/AR refresh intervals. Refer to the log file entry below.

```
04/10/2006 06:00:11 , 000184600166 , DG , devgrp , 109 , /dev/rdsk/c3t13d2s2 , 0 , 131070 , SUM
04/10/2006 06:00:11 , 000184600166 , DG , devgrp , 10A , /dev/rdsk/c3t13d3s2 , 0 , 131070 , SUM
04/10/2006 06:00:11 , 000184600166 , DG , devgrp , 10B , /dev/rdsk/c3t13d4s2 , 0 , 131070 , SUM
04/10/2006 06:05:45 , 000184600166 , DG , devgrp , 108 , /dev/rdsk/c3t13d1s2 , 5 , 131070 , SUM
04/10/2006 06:05:45 , 000184600166 , DG , devgrp , 109 , /dev/rdsk/c3t13d2s2 , 0 , 131070 , SUM
04/10/2006 06:05:45 , 000184600166 , DG , devgrp , 10A , /dev/rdsk/c3t13d3s2 , 0 , 131070 , SUM
04/10/2006 06:05:45 , 000184600166 , DG , devgrp , 10B , /dev/rdsk/c3t13d4s2 , 0 , 131070 , SUM
04/10/2006 06:10:38 , 000184600166 , DG , devgrp , 108 , /dev/rdsk/c3t13d1s2 , 9 , 131070 , SUM
04/10/2006 06:10:38 , 000184600166 , DG , devgrp , 109 , /dev/rdsk/c3t13d2s2 , 0 , 131070 , SUM
04/10/2006 06:10:38 , 000184600166 , DG , devgrp , 10A , /dev/rdsk/c3t13d3s2 , 0 , 131070 , SUM
04/10/2006 06:10:38 , 000184600166 , DG , devgrp , 10B , /dev/rdsk/c3t13d4s2 , 0 , 131070 , SUM
       A              B       C    D     E          F            G     H             I
```

The fields in the log file entry are:

A - Date and time that the sample was collected.

B - Symmetrix ID.

C - Type of entity (device group).

D - Name of the device group.

E - Symmetrix device name.

F - Physical device name. If the device has not been host visible, this field would say `Not Visible.`

G - Number of tracks changed since the group was marked.

H - Total number of tracks on device.

I - SUM indicates that the number in column G represents the cumulative tracks changed since the group was marked.

DELTA reports

DELTA reports track changes that have occurred since the last measurement interval. The DeltaMark bitmap is reset after each measurement of changed tracks. Thus, an hourly report from 6 A.M. to 6 P.M. using the DELTA method would identify how many tracks changed during any given one-hour period. This is useful for determining peak change rates for a given interval of data collection.

To assess the bandwidth requirements for an SRDF/AR implementation, you should first collect a SUM report to determine how often you would want to refresh the remote site. Once the determination of the refresh interval has been finalized (T hours), generate a DELTA report using T hours as the collection interval. This will result in identifying the peak number of changed tracks during any T-hour interval. Refer to the log file entry below for an example of a DELTA report.

```
04/10/2006 06:00:11 , 000184600166 , DG , devgrp , 108 , /dev/rdsk/c3t13d1s2 , 16 , 131070 , DELTA
04/10/2006 06:00:11 , 000184600166 , DG , devgrp , 109 , /dev/rdsk/c3t13d1s2 , 8 , 131070 , DELTA
04/10/2006 06:00:11 , 000184600166 , DG , devgrp , 10A , /dev/rdsk/c3t13d1s2 , 803 , 131070 , DELTA
04/10/2006 06:00:11 , 000184600166 , DG , devgrp , 10B , /dev/rdsk/c3t13d1s2 , 549 , 131070 , DELTA
04/10/2006 06:05:39 , 000184600166 , DG , devgrp , 108 , /dev/rdsk/c3t13d1s2 , 24 , 131070 , DELTA
04/10/2006 06:05:39 , 000184600166 , DG , devgrp , 109 , /dev/rdsk/c3t13d1s2 , 48 , 131070 , DELTA
04/10/2006 06:05:39 , 000184600166 , DG , devgrp , 10A , /dev/rdsk/c3t13d1s2 , 1085 , 131070 , DELTA
04/10/2006 06:05:39 , 000184600166 , DG , devgrp , 10B , /dev/rdsk/c3t13d1s2 , 809 , 131070 , DELTA
04/10/2006 06:10:21 , 000184600166 , DG , devgrp , 108 , /dev/rdsk/c3t13d1s2 , 25, 131070 , DELTA
04/10/2006 06:10:21 , 000184600166 , DG , devgrp , 109 , /dev/rdsk/c3t13d1s2 , 13, 131070 , DELTA
04/10/2006 06:10:21 , 000184600166 , DG , devgrp , 10A , /dev/rdsk/c3t13d1s2 , 561 , 131070 , DELTA
04/10/2006 06:10:21 , 000184600166 , DG , devgrp , 10B , /dev/rdsk/c3t13d1s2 , 541, 131070 , DELTA
```

Viewing reports

When viewing the changes for an object of a device group, the output can either be sent to `stdout` or saved to a user-defined log file. The information saved to the log file is stored in a comma-separated format. This allows the data to be imported into a spreadsheet for analysis. The results in the log file can be examined with the following command:

```
symchg [-ra NumRAs] [-rate KB/s]
            [-resync [mmmm|hh:mm]]
        [-start mmddyyyy hh:mm] [-stop mmddyyyy hh:mm]
        [-backend] [-native] [-v]
        [-devs <[SymDevStart:SymDevEnd | SymDevName]>
               <[,SymDevStart:SymDevEnd | SymDevName...]>]

        report -log LogFile -g <DgName | -cg CgName >
           [-bcv]

        report -file DevFile -log LogFile [-sid SymmID]
```

Each report in a log file shows the amount of change for a specified object of a device group. For more information about the syntax of `symchg`, refer to the *EMC Solutions Enabler SYMCLI Command Reference Guide*.

Report options

Table 9 lists the command line options available for generating a report using the `symchg report` command.

Table 9 SYMCLI report options

Option	Description
`-backend`	Displays information about the DA and back-end disk address of marked devices.
`-bcv`	Generates a report for the BCV devices in the device group or composite group.
`-cg`	Specifies a composite group on which to report.
`-devs`	Specifies a set of Symmetrix device ranges and/or individual Symmetrix devices for the report action.
`-file`	Specifies a file containing a device list with one *SymDevName* per line.
`-g`	Specifies a device group on which to report.
`-log`	Specifies the log file (`-log LogFile`) to read from.
`-native`	Reports data based on native track size.
`-sid`	Specifies the 12-digit ID of a Symmetrix array.
`-sg`	Specifies a storage group on which to report.
`-start`	Defines the start point in the log file to begin processing data. Format is *mmddyyyy hh:mm*. Default is the beginning of the log file.
`-stop`	Defines the stop point in the log file to stop processing data. Format is *mmddyyyy hh:mm*. Default is the end of the log file.
`-ra`	Defines the number of RA directors to use when resynchronizing device pairs in the group.
`-rate`	Specifies the transfer rate to use when resynchronizing device pairs in the group. Format is in *Kb/second*.
`-resync`	Specifies the required time frame in minutes, or hours and minutes, for resynchronizing SRDF device pairs in the group. Format is *mmmm* or *hh:mm*.

Example procedure

The following is an example of typical steps to follow when you are saving change information to a user-defined log file and you are generating a report:

1. Create Change Tracker sessions for each standard device in a device group (such as DATABASE_DG), enter:

   `symchg create -g DATABASE_DG`

2. Mark the devices within the device group (DATABASE_DG).

   `symchg mark -g DATABASE_DG`

   This will reset the DeltaMark change information to zero for each device in the device group.

3. Save the change information for the devices of the group (DATABASE_DG) to a log file (`/tmp/change_data.log`) by entering:

For SUM Reports:

```
symchg view -g DATABASE_DG -log /tmp/change_data.log \ -i 60 -c 100
```

For DELTA Reports:

```
symchg view -g DATABASE_DG -log /tmp/change_data.log \ -reset -i 60 -c 100
```

Note: In this example, there were 100 samples made at an interval of 60 seconds and the DeltaMark change information is reset after each sample.

For combined SUM and DELTA Reports:

```
symchg view -g DATABASE_DG -log /tmp/change_data.log -multi -i 60 -c 100
```

4. Produce a summary report of the changed track information for each device in the group (DATABASE_DG) by entering:

   ```
   symchg report -g DATABASE_DG -log /tmp/change_data.log -v
   ```

   The data in the log file is in a comma-separated format, so you could also import it into a spreadsheet to view the data.

5. If you need to provide SRDF capacity planning that determines how long it would take to resynchronize a device group (DATABASE_DG) with RA directors at a transfer rate of 1000 KB/second, enter:

```
symchg report -g DATABASE_DG -log /tmp/change_data.log -rate 1000 -ra 2
```

6. If you need to view information for a device group (DATABASE_DG) on your screen showing the log entries, enter:

   ```
   symchg view -g DATABASE_DG
   ```

7. To list the objects that are marked and being monitored for change, enter:

   ```
   symchg list
   ```

8. To verify a Change Tracker session has been created for a device group (DATABASE_DG) and that it is marked, enter:

   ```
   symchg view -g DATABASE_DG -session
   ```

9. To remove the marked object (DATABASE_DG), enter:

   ```
   symchg remove -g DATABASE_DG
   ```

   This does not delete the sessions for the devices of the group. It simply records the object indicating it is no longer being monitored (from a host view point).

Using Change Tracker for SRDF capacity planning

The Symmetrix Remote Data Facility (SRDF) maintains a mirror image of data at the device level in Symmetrix systems located in physically separate sites. The mirroring in SRDF can be accomplished in real-time (Synchronous mode) or near real-time (Asynchronous or Adaptive Copy modes). These modes of operation are described fully in the *EMC Solutions Enabler Symmetrix SRDF Family CLI Product Guide*. The Adaptive Copy mode is especially useful when transferring large amounts of data during data center migrations, consolidations, and in data mobility environments.

When performing periodic SRDF transfers using Adaptive Copy mode, it is important to estimate the rate of change of data on the volumes to be mirrored in order to make informed decisions about communication line parameters. Change Tracker can help in this process by calculating certain SRDF capacity values (the resynchronization time, the number of remote adapters (RAs), and the RA transfer rates) based on the amount of change to monitored objects.

In the SRDF configuration shown in Figure 12, the R1-BCV is used to periodically transmit changed tracks from the primary site to the remote site. When the BCV is established with the standard as a BCV pair, the SRDF link to its R2 target is suspended. When you split the local BCV pair, you can resume the SRDF link, sending the changes to the remote site. Using Change Tracker to measure the extent of changes to the local BCV pair while the R1-BCV is suspended from its R2 target allows you to make informed choices about link bandwidth and frequency of transmission for the SRDF transfer.

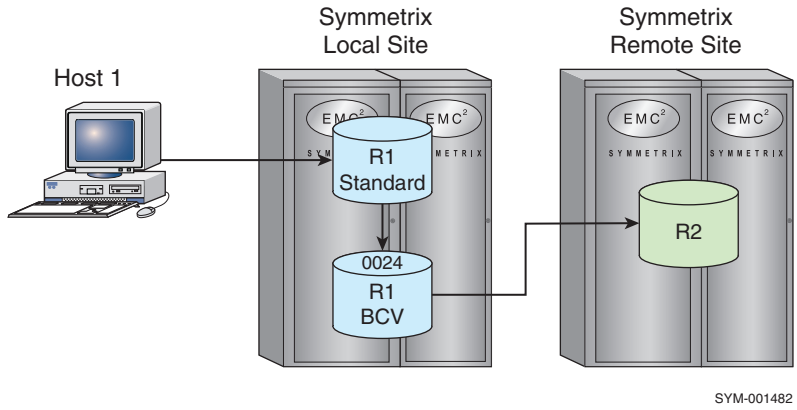

Figure 12 SRDF configuration

The following steps outline an example of setting up devices and using Change Tracker to perform SRDF capacity planning:

1. Identify the device group that you want to monitor. If the group does not exist, you can create it using the `symdg` command. For example, to create a device group named deltadg, enter:

   ```
   symdg create deltadg
   ```

2. Add a device (Symmetrix device name 085 on Symmetrix number 000000003264) to the device group:

   ```
   symdg -g deltadg -sid 3264 add dev 085
   ```

   By default, SYMCLI assigns a logical device name (of the form DEVnnn) to this device.

3. Create a Change Tracker session for the device group:

   symchg -g deltadg create

4. List the sessions that have just been created for the device group:

   symchg -session list

5. Mark the device group (this is the starting point from which changes will be measured):

   symchg -g deltadg mark

6. In a log file, record cumulative track changes that occur on each device in the device group. This example collects 60 samples at two-minute (120 seconds) intervals in a log file named deltalog:

   symchg -g deltadg -log deltalog -i 120 -c 60 view

7. Use the collected data from the log file for SRDF capacity planning by providing two of the following three variables to a `symchg report` command:

   - The number of links
   - The link bandwidth
   - The amount of time available to synchronize the source (R1) and target (R2) devices

   The `symchg report` command calculates the third variable.

CHAPTER 10
Events and Logs

This chapter describes how to configure, manage, and query Symmetrix events and logs.

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Symmetrix event logs

SYMCLI and SYMAPI normally log significant events and actions to a daily log file. On UNIX, the log file has the following pathname:

```
/var/symapi/log/symapi-yyyymmdd.log
```

On Windows, the log file has the following pathname:

```
C:\Program Files\EMC\Symapi\log\symapi-yyyymmdd.log
```

where:

yyyy — year

mm — month

dd — day

The log displays the following items concerning each event:

- Time tag of the event occurrence
- Process ID (PID)
- Source of the event (application name)
- Related (internal) API function call
- Name of the specific operation or event
- Variable event field that describes the event or error in detail

Note: Log files accumulate over time and can consume needed disk space. Periodically, you may need to purge the log files to conserve space.

For a detailed list of possible Symmetrix events, refer to the *EMC Solutions Enabler SYMCLI Command Reference Guide*.

Configuring log options

Table 10 lists the options to customize how and where events are logged in your Symmetrix environment.

Table 10 Log file configuration options (page 1 of 2)

Logging option	Configuration description

Enable/disable logging	You can disable logging by setting the environment variable SYMCLI_NOLOGGING to 1. For example, to disable logging on UNIX (C shell) enter:
	`setenv SYMCLI_NOLOGGING 1`
	To turn logging back on, enter:
	`unsetenv SYMCLI_NOLOGGING`

Log file name	You can change the name and path of the default log file.
	For example, to change the log file name on UNIX (C shell), use the following form:
	`setenv SYMCLI_LOG filename`
	To turn daily log files back on, enter:
	`unsetenv SYMCLI_LOG`

Table 10 Log file configuration options (page 2 of 2)

Logging option	Configuration description

Allow undated SYMAPI log file names	You can allow the creation of undated SYMAPI log files by setting the environment variable SYMAPI_DATED_LOGFILE_NAME in the options file to `disable`.
	To allow undated log file names, set:
	`SYMAPI_DATED_LOGFILE_NAME=DISABLE`
	
	To reenable dates, set:
	`SYMAPI_DATED_LOGFILE_NAME=ENABLE`

Change date formats	You can change date formats in the log entries by setting the environment variable SYMAPI_LOGFILE_DATE_FORMAT in the options file to `FORMAT2`. This formats the date as *yyyy-mm-dd*.
	To change the date format, set:
	`SYMAPI_LOGFILE_DATE_FORMAT=FORMAT2`
	
	To change the date format back to the default (*mm/dd/yyyy*), set:
	`SYMAPI_LOGFILE_DATE_FORMAT=FORMAT1`

Log file configuration options	You can change format of optional fields within each log record by setting the environment variable SYMAPI_LOGFILE_FORMAT in the options file. Zero or more of the following optional fields can be included: • `pid` — include the process ID. • `tid` — include the thread ID. • `userid` — include the user ID (useful with User Authorization is enabled). • `activityid` — include the activity ID. The default value is `pid tid`. To see the log file format, create an entry in the options file with values separated by spaces. For example: `SYMAPI_LOGFILE_FORMAT = userid pid tid activityid`
Log file retention	Log file retention is an option set in the options file to specify the number of days to retain the log files: • Maximum value: 1825 (or 5 years) • Minimum value: 6 • Alternative value: 0 (setting it to zero maintains the log file forever. This is the default for everything except the service processor whose default is 30.) For example, to change the log file Retention to 60 days, enter: `SYMAPI_LOGFILE_RETENTION=60` **Note:** When the log file retention option is set, it overrides all existing log file Retention values including those set for the service processor during initialization. The default for the service processor is 30 days. Setting this options file value will override that default. In addition, if you have accumulated many years of log files prior to setting this option, when the option is set, it deletes those log files that do not meet the specified criteria.

Monitoring Symmetrix events using SYMCLI

The `symevent` command allows an administrator to monitor or track events within a Symmetrix array that may affect its operation. In some cases, reported events represent conditions that have already been repaired. This command allows the user to monitor the Symmetrix array for all reported events.

You can use `symevent` to either:

- `Monitor` — This action causes the command to run in the foreground, polling the Symmetrix array for new events every interval in seconds, either until the iteration count is satisfied or the program is stopped.
- `List` — This action examines the history of events, stored on the Symmetrix array, for those that meet the requested criteria. The `-start` and `-end` options allow the user to retrieve events that occurred between certain time bounds. In addition, you can sort the returned events based upon the reporting director using the `-DIR` option.

You can further refine your query to a Symmetrix ID and restrict the reported events to those of a minimum severity (warnings, errors, or fatal events).

Monitor

In its most basic invocation, `symevent` polls for and reports on all events, on all locally-connected Symmetrix systems, every 15 seconds, continuously:

```
symevent monitor
```

The following example polls for and displays events with a severity of warning or greater on Symmetrix 0207 every 15 seconds for a 50-second period:

```
symevent monitor -sid 0207 -i 15 -c 50 -warn

Symmetrix ID: 000192600207

Detection time           Dir    Src  Category     Severity     Error Num
------------------------ ------ ---- ------------ ------------ ----------
Mon Dec 29 21:26:04 2008 DF-7A  Symm Communication Warning      0x001a
    The Symmetrix Service Processor could not complete a Call Home for service
```

List

The following example illustrates how to retrieve a verbose list of the events which have occurred on the specified Symmetrix array between 12 p.m. and 3 p.m. today:

```
symevent list -sid 0207 -start 12:00 -end 15:00 -v

Symmetrix ID: 000192600207
Time Zone   : EST

Event at Mon Dec 29 13:00:10 2008:
   Reporting Director : RF-7H
   Source             : Symmetrix
   Category           : RDF
   Severity           : Informational
   Numeric Code       : 0x000d
   Event Code Symbol  : RDF_SIM_MESSAGE
   Description        : The RDF subsystem initiated a SIM message to a Symmetrix
 remotely-attached via RDF links

Event at Mon Dec 29 13:01:38 2008:
   Reporting Director : FA-7E
   Source             : Symmetrix
   Category           : RDF
   Severity           : Informational
   Numeric Code       : 0x0018
   Event Code Symbol  : RDF2_DEVICE_NR
   Description        : One of the RDF2 devices was found to be Not Ready
```

Common audit log

Data is written to a common audit file during Symmetrix control operations initiated by host applications. The common audit log correlates activity from all hosts into one file that is stored in the Symmetrix File System (SFS).

The `symaudit` command enables the examination and filtering of the common audit log file for a specified Symmetrix array. The audit log resides on the Symmetrix array and currently has a maximum size of 40 MB. Once the 40 MB limit is reached, the log begins to overwrite itself. You do not have to do anything to maintain this file, unless you want to capture records before the circular 40 MB space recycles.

Use the following actions to parse or monitor the audit log contents:

- `show` — Displays details about the audit log itself for a specific Symmetrix array, including: the total range of records, the date/time range, and the starting record number.
- `list` — Lists details about the requested records in either a brief or verbose format. The range of records to extract can be filtered by one or all of the following: record number, record count, date/time, functional area, control action, vendor ID, application ID, hostname, username, and device acted upon.
- `monitor` — Monitors the Symmetrix array for new audit log data in realtime.

Note: For details on valid parameter values on which to filter, refer to the `symaudit` command in the *EMC Solutions Enabler SYMCLI Command Reference Guide*.

Example output

The following is an example output of the `show` action for a specified Symmetrix array:

```
symaudit show -sid 0207

                A U D I T   L O G   D A T A

Symmetrix ID            : 000192600207

Starting date           : 12/17/2008 21:42:57
Ending date             : 01/02/2009 15:30:35

Starting record number  :       1
Ending record number    :    1737
Total record count      :    1737
```

The following is an example output of the `list` option for a specified Symmetrix array between a specified time period:

```
symaudit list -sid 0207 -start_date 01/02/2009:12:00:00 -end_date
   01/02/2009:12:15:00 -v

              A U D I T   L O G   D A T A

Symmetrix ID            : 000192600207

  Record Number         :     1663
    Records in Seq      :        2
    Offset in Seq       :        1
    Time                : 01/02/09 12:11:50
    Vendor ID           : EMC Corp
```

```
    Application ID      : SYMCONFIGURE
    Application Version : 7.0.0.302
    API Library         : SDK
    API Version         : T7.0.302.2 (Edit Level: 907)
    Host Name           : api1051.lss.
    OS Name             : LINUX
    OS Revision         : 2.6.9-11.E
    Client Host         :
    Process ID          : 00027021
    Task ID             : 00000002
    Function Class      : CfgChg
    Action Code         : Release
    Text                : STARTING a Device Reservation 'RELEASE'. Owner=m; Rese
rveID=1; Comment="t";
    Username            : H:api1051\root
    Activity ID         : SE69f82805ea

  Record Number         :     1664
    Records in Seq      :        2
    Offset in Seq       :        2
    Time                : 01/02/09 12:11:50
    Vendor ID           : EMC Corp
    Application ID      : SYMCONFIGURE
    Application Version : 7.0.0.302
    API Library         : SDK
    API Version         : T7.0.302.2 (Edit Level: 907)
    Host Name           : api1051.lss.
    OS Name             : LINUX
    OS Revision         : 2.6.9-11.E
    Client Host         :
    Process ID          : 00027021
    Task ID             : 00000002
    Function Class      : CfgChg
    Action Code         : Release
    Text                : Devices: [ 0020 ]
    Username            : H:api1051\root
    Activity ID         : SE69f82805ea

  Record Number         :     1665
    Records in Seq      :        1
    Offset in Seq       :        1
    Time                : 01/02/09 12:11:51
    Vendor ID           : EMC Corp
    Application ID      : SYMCONFIGURE
    Application Version : 7.0.0.302
    API Library         : SDK
    API Version         : T7.0.302.2 (Edit Level: 907)
    Host Name           : api1051.lss.
    OS Name             : LINUX
    OS Revision         : 2.6.9-11.E
    Client Host         :
    Process ID          : 00027021
    Task ID             : 00000002
    Function Class      : CfgChg
    Action Code         : Release
    Text                : Device Reservation 'RELEASE' SUCCEEDED. ReserveID=1;
    Username            : H:api1051\root
    Activity ID         : SE69f82805ea

<. . .>
```

- Record Number — The current record number.
- Records in Seq — Total number of records requested.
- Offset in Seq — Offset number from the first record requested.

- Time — Date and time the record was entered.
- Vendor ID — ID of the vendor whose application logged the record.
- Application ID — ID of the application that logged the record.
- Application Version — Application version number.
- API Library — Name of the SYMAPI library the application ran against.
- API Version — Version of the SYMAPI.
- Host Name — Name of the host that logged the record.
- OS Name — Operating system on which the host is running.
- OS Revision — Operating system revision number.
- Client Host — Any SYMCLI client communicating with the SYMAPI server.
- Process ID — ID of the process that logged the record.
- Task ID — ID of the task.
- Function Class — Class name of the SYMAPI functional area.
- Action Code — Name of the SYMAPI control action associated with an audit log entry.
- Text — Text details of the given entry.
- Username — Identifies the user that generated the log entry.
- Activity ID — A randomly generated ID that uniquely identifies this action.

Event daemon

Solutions Enabler also provides an asynchronous event daemon that can be used to monitor and manage Symmetrix events. The event daemon (`storevntd`) provides the necessary services required to monitor the status of Symmetrix storage environments from third-party enterprise management frameworks. The following targets are supported:

- SNMP
- File on disk
- System logger on the host
- Unix syslog service
- Windows event log
- The syslog listener across the network (bypasses the syslog service (calls) on the local host and directly sends events/traps to this remote listener).

To learn more about enabling and configuring the event daemon, refer to the *EMC Solutions Enabler Installation Guide*.

CHAPTER 11
XML Structured Output

This chapter describes the XML output option of the SYMCLI.

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XML structured output data

The XML (Extensible Markup Language) output option provides a mechanism to facilitate the automated processing of SYMCLI output data. XML is a deterministic parsing tool that eases parsing of output data, providing a functional advantage over screen-scraping tools like awk or Perl. The XML industry standard is based on the experience of SGML and is endorsed by the World Wide Web Consortium. Detailed information on XML may be found at:

```
http://w3.org/XML/
```

XML has the look and feel of HTML, as it employs the same tag-based syntax. However, XML uses tags to delimit data—as opposed to defining the data as with HTML—allowing the document author to specify the tags most applicable to the given application. For the SYMCLI, tags represent the physical and logical structures within the Symmetrix array and its environments.

When XML mode is utilized, the data returned is identical to that of the *standard* output, but “marked-up” with tags. These tags enable individual pieces of data to be readily called upon by name. In addition, they provide a definitive way to express the relationship between different objects, an advantage over the standard CLI display output.

XSLT: XML data transformations

Many tools are available to query, filter, retrieve, and format specific information stored in complex XML files. Among these, eXtensible Stylesheet Language Transforms (XSLT) is a particularly useful and widely available technology. While using XML will result in less ambiguous, more robust scripts, XSLT will make the information presented in XML accessible to the more familiar plain text-based scripting techniques. To introduce you to XSLT, a directory containing several examples of the types of queries that can be performed on XML data using XSLT is provided. The examples are designed only to provide a brief introduction to the power and usefulness of XSLT, and can help ease the transition to XML.

Element-based XML

Solutions Enabler provides element-based XML that describes data in a hierarchical manner by using the notion of parent and children. An element can have several different content types. It can have element content (child element), a mixed content containing both text and child element, a simple content containing text only, or an empty content carrying no information. An element can also have attributes. These additional content types would allow users to modify the data structures in a fairly flexible manner. On the other hand, an attribute is used to provide additional information about an element. An attribute is in general used to store the metadata describing the data that stored in XML. Although data can be stored in attributes, it is best practice to store data in child elements.

Using XML mode

To use XML mode with SYMCLI, an environment variable or a command line option can be used. Use the environment variable to globally set your command output to XML or globally return it to standard mode. Use the following syntax to set the environment variable:

```
SYMCLI_OUTPUT_MODE = xml_element|standard
```

- **xml_element** — Returns the output of all commands in element-based XML tags.
- **standard** — Returns the output of all commands to the default output without the XML tags.

Note: When the environment variable output mode is set to `xml`, `xml_element`, commands that do not support XML output generate a runtime error message. You can override this behavior by setting the command line `-output` option to a value of `standard`. This allows you to successfully execute the given command in standard mode.

The command line method provides a means of outputting any single command as either XML or standard output. Using the command line method overrides the current environment variable setting:

```
<SymcliCommand> -output <xml|xml_element|standard>
```

The `-output` flag is not found in `-help` or man pages because of its wide scope and usage.

Example output

Notice that a new element tag `<Symm_Info>` was added to the XML data shown below to store general Symmetrix data.

`symcfg list -out xml` OR **`symcfg list -out xml_element`**

```
<?xml version="1.0" standalone="yes" ?>

<SymCLI_ML>
  <Symmetrix>
    <Symm_Info>
      <symid>000190102055</symid>
      <attachment>Local</attachment>
      <model>DMX3-24</model>
      <microcode_version>5772</microcode_version>
      <cache_megabytes>32768</cache_megabytes>
      <devices>683</devices>
      <physical_devices>94</physical_devices>
    </Symm_Info>
  </Symmetrix>
  <Symmetrix>
    <Symm_Info>
      <symid>000190300215</symid>
      <attachment>Local</attachment>
      <model>DMX3-6</model>
      <microcode_version>5772</microcode_version>
      <cache_megabytes>32768</cache_megabytes>
      <devices>239</devices>
      <physical_devices>2</physical_devices>
    </Symm_Info>
  </Symmetrix>
  <Symmetrix>
    <Symm_Info>
      <symid>000190300237</symid>
      <attachment>Remote</attachment>
      <model>DMX3-6</model>
      <microcode_version>5773</microcode_version>
      <cache_megabytes>16384</cache_megabytes>
      <devices>3756</devices>
```

```
        <physical_devices>0</physical_devices>
      </Symm_Info>
    </Symmetrix>
    <Symmetrix>
      <Symm_Info>
        <symid>000190300343</symid>
        <attachment>Remote</attachment>
        <model>DMX3-6</model>
        <microcode_version>5773</microcode_version>
        <cache_megabytes>32768</cache_megabytes>
        <devices>751</devices>
        <physical_devices>0</physical_devices>
      </Symm_Info>
    </Symmetrix>
  </SymCLI_ML>
```

Note: To maintain consistent element names in all SYMCLI commands, some tag names are redefined. For example, in current SYMCLI command, different names exist to describe Symmetrix identification number, such as id, symmetrix, or symid. A new consistent tag name is defined across all SYMCLI commands in the element-based XML output.