EMC® Solutions Enabler Symmetrix® Migration CLI

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Product Guide

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CONTENTS

FIGURES

TABLES

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.

Contact your EMC representative if a product does not function properly or does not function as described in this document.

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 intended for the host system administrator, system programmer, or operator who will be involved in managing ConGroup.

Related documentation

Other Symmetrix publications of related interest are:

- *EMC Solutions Enabler Release Notes*
- *EMC Solutions Enabler Installation Guide*
- *EMC Solutions Enabler Security Configuration Guide*
- *EMC Solutions Enabler Symmetrix Array Controls CLI Product Guide*
- *EMC Solutions Enabler Symmetrix CLI Command Reference*
- *EMC Solutions Enabler Symmetrix SRM CLI Product Guide*
- *EMC Solutions Enabler Symmetrix SRDF Family CLI Product Guide*
- *EMC Symmetrix Remote Data Facility Product Guide*
- *EMC Solutions Enabler Symmetrix TimeFinder Family CLI Product Guide*
- *EMC Symmetrix TimeFinder Product Guide*

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

Where to get help

EMC support, product, and licensing information can be obtained as follows:

Product information — For documentation, release notes, software updates, or information about EMC products, licensing, and service, go to the EMC online support website (registration required) at:

http://Powerlink.EMC.com

Technical support — For technical support, go to EMC online support and select Support. On the Support page, you will see several options, including one to create a service request. Note that to open a service request, you must have a valid support agreement. Contact your EMC sales representative for details about obtaining a valid support agreement or with questions about your account.

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PART 1

Open Replicator Migration

This guide is divided into two parts: “Open Replicator Migration” and “Federated Live Migration”.

Part 1 contains the following chapters:

CHAPTER 1
Open Replicator Operations

This chapter introduces the EMC Symmetrix Open Replicator SYMCLI command (`symrcopy`) and explains how to implement this command for copying device data between arrays across the storage network.

Open Replicator overview

The EMC® Symmetrix® Open Replicator command (`symrcopy`) for Symmetrix VMAX™ Family arrays with Enginuity™ Operating Environment provides a method for copying device data from various types of arrays within a storage area network (SAN) infrastructure to or from a Symmetrix DMX™ or VMAX Family array. For example, Symmetrix Open Replicator provides a tool that can be used to migrate data from older Symmetrix arrays, CLARiiON® arrays, and certain third-party storage arrays to a Symmetrix DMX or VMAX Family array.

Open Replicator RecoverPoint sessions can be listed or terminated using the `symrcopy` command, however RecoverPoint sessions cannot be created or modified through this command.

⚠CAUTION

Data migrations are often complex operations and require careful planning and execution of predetermined procedures. Failure to identify and perform necessary steps or work within supported configurations can result in data unavailability or loss.

Note: For detailed interoperability information, please refer to the E-Lab Interoperability Navigator available at http://elabnavigator.EMC.com.

The Open Replicator command can also be used to migrate data from a Symmetrix DMX or VMAX Family array to other types of storage arrays within the SAN infrastructure. Copying data from a Symmetrix DMX or VMAX Family array to devices on remote storage arrays allows for data to be copied fully or incrementally.

Note: Refer to the *EMC Solutions Enabler Installation Guide* for Open Replicator license information.

Note: The `symrcopy` command is part of the EMC Solutions Enabler (SYMCLI) command library. For a detailed introduction to the Solutions Enabler, SYMCLI, and the Symmetrix array, refer to the *EMC Solutions Enabler Symmetrix Array Management CLI Product Guide*.

Practical uses

The `symrcopy` command can be used for:

- Migrating data between Symmetrix DMX or VMAX Family arrays and third-party storage arrays within the SAN infrastructure without interfering with host applications and ongoing business operations.
- Backing up and archiving existing data within the SAN infrastructure as part of an information lifecycle management solution.
- Federated Live Migration operations. FLM allows device copying, from donor DMX Symmetrix arrays to new VMAX Family arrays, without restarting the application hosts. Refer to Chapter 4, “Symmetrix Federated Live Migration Operations” for more information.
- Listing and terminating RecoverPoint sessions.

Functionality

Open Replicator copy (Rcopy) operations are controlled from a local host attached to the Symmetrix DMX or VMAX Family array. Data copying is accomplished as part of the storage system process and does not require host resources. The data can be copied online between the Symmetrix array and remote devices, allowing host applications, such as a database or file server, to remain operational (function normally) during the copy process.

Rcopy concepts

The following Rcopy concepts and terminology are used throughout the Open Replicator Migration section of this product guide:

- The Symmetrix DMX or VMAX Family array and its devices are referred to as the *control* side of the copy operation. Older Symmetrix arrays, CLARiiON arrays, or third-party arrays on the SAN are referred to as the *remote* array/devices.
- The copy direction is always from the perspective of the control side. There are two types of copy operations, *push* and *pull*. A push operation copies data from the control device to the remote device(s). A pull operation copies data to the control device from the remote device(s).
- Copy operations are either *hot* (online) or *cold* (offline).
- Use the `-name` option to give the session a name. Use the `-session_name` option when specifying the session name for control operations.
- There can be only one control device per active session.

Open Replicator can be used to migrate data into a Symmetrix DMX or VMAX Family array from older Symmetrix arrays, CLARiiON, or other third-party arrays. Figure 1 on page 18 shows two Open Replicator copy sessions performing a *pull* operation, where data is copied through the SAN infrastructure from remote devices to the Symmetrix array.

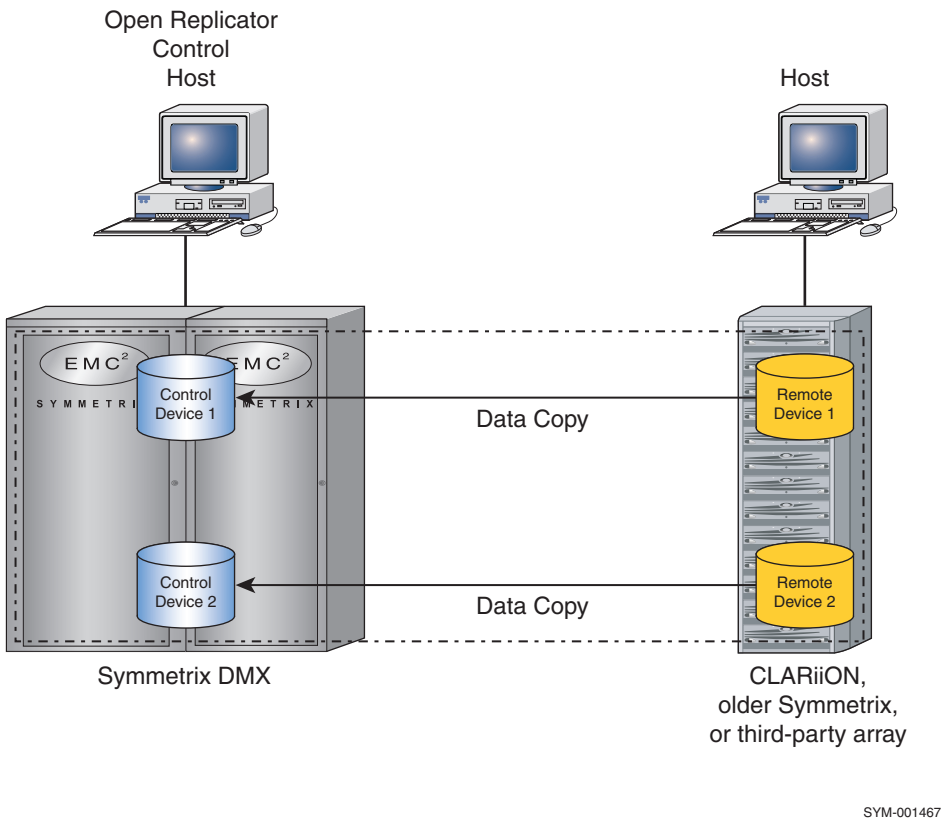


Figure 1 Symmetrix array device pull operation

Note: Since data is copied through the SAN infrastructure, Open Replicator may require updating the zoning configuration before copying data between arrays is allowed. For zoning requirements and suggestions, refer to "SAN setup requirements" on page 22.

Open Replicator can be used to copy data from a Symmetrix DMX or VMAX Family array to older Symmetrix and CLARiiON arrays. Figure 2 on page 19 shows two Open Replicator copy sessions performing a *push* operation, where data is copied from the Symmetrix array to remote devices within the SAN infrastructure.

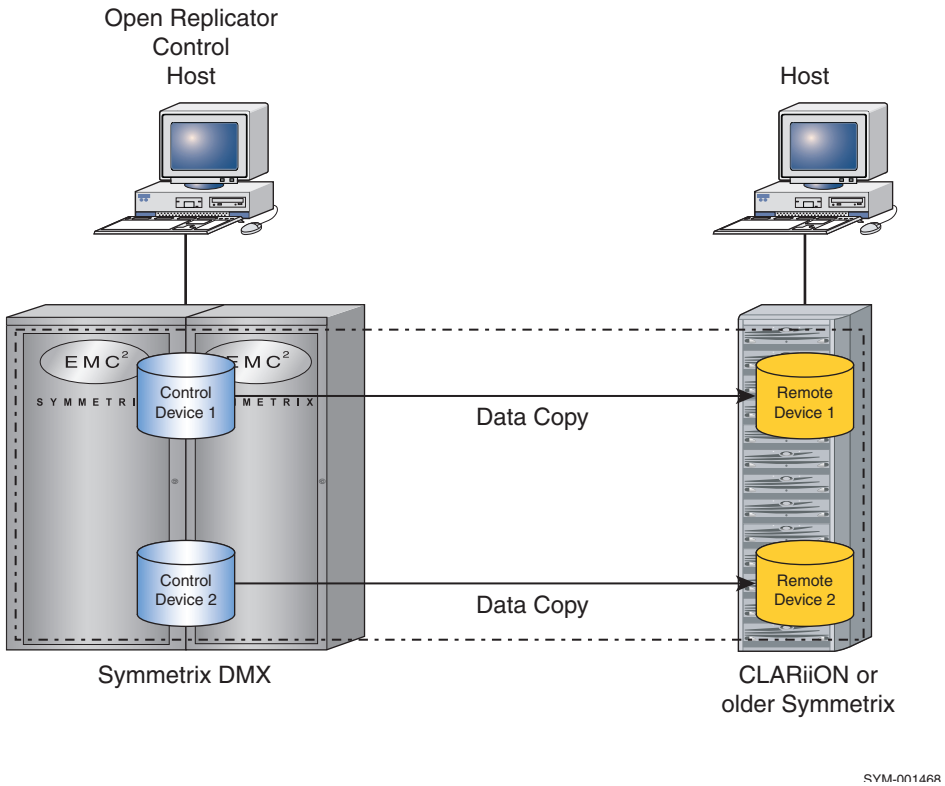


Figure 2 Symmetrix array device push operation

Considerations

Note the following considerations for Open Replicator:

- Remote devices do not have to be the same RAID type or meta-configuration.
- For a push operation, remote capacity must be equal to or larger than the control device extents and vice versa for a pull operation. The exception to this is when data has been pushed to a remote device that is larger than the control device, and the data needs to be pulled back to the control device. In this case, use the `-force_copy` option.
- On push copy operations, remote devices should not be accessed by their remote hosts until copying has completed.
- On pull operations, the remote devices should not be updated by array hosts for the duration of the copy process.
- For pull operations from devices with SCSI reservations, if the remote devices have a cluster running against them or the devices are AIX LVM devices, the cluster, AIX host, or other software that is creating the SCSI reservations must be shutdown before creating the Open Replicator session.
- Data corruption to devices is possible during a copy operation if another host on the SAN has write access to the remote device. If this is a concern, EMC recommends that the remote device be unmounted or marked as Not Ready to any other hosts on the SAN to guarantee that the device cannot change while copying is in process.

- Accumulated I/O errors between the control device and remote device will cause a session to fail if the copy operation is a hot push. The failed session may be activated again as long as no new data has been written to the control device since the session failed. The session will temporarily stall and restart on any other type of copy operation.
- Open Replicator fully supports copy operations for Symmetrix thin devices. For information on Symmetrix Virtual Provisioning™ and creating thin devices, refer to the *EMC Solutions Enabler Symmetrix Array Controls CLI Product Guide*.
- Open Replicator supports copy operations for a cold push from a virtual device (VDEV). For more information and instructions, refer to "Using VDEVs in Open Replicator" on page 48.

Limitations

Note the following limitations for Open Replicator:

- Up to 15 incremental Open Replicator copy sessions can exist for a single Symmetrix device. Up to 1024 copy sessions are allowed per Symmetrix array when running Enginuity version 5773 or higher. When running Enginuity version 5772 or earlier, only a maximum of 512 copy sessions are allowed. The maximum concurrent remote devices is 16 per session.
- Only one copy session per control device can be active at a time. The active session must be completed or terminated before another session can be created or started on a device.
- An Open Replicator copy session is between two arrays and cannot be created with control and remote devices on the same Symmetrix array. Copying within the same Symmetrix array must be done using SYMCLI control operations, such as TimeFinder®/Snap and Clone.
- Devices that are accessible only through the SAN cannot be specified with Symmetrix device names. Any World Wide Name (WWN) of a remote system that is more than two RDF links away must be obtained using platform-native tools.
- On an offline push operation to multiple devices that were created as part of one session, devices in the session must be updated together, a single device cannot be updated independently.
- Open Replicator can be used only with FBA devices using Fibre Channel integrated directors. The following device types, that could be mapped to the host, are not supported:
  - CKD
  - VCM
  - WORM
  - Metamembers
- Only one remote device is allowed for a hot push operation.
- Open Replicator copy sessions involving older Symmetrix arrays (prior to the DMX) require a connection through a switch to copy data.
- Third party or non-visible storage systems cannot be validated by the Solutions Enabler.

Session limitations

The maximum number of active sessions allowed is 1024 when running Enginuity version 5773 or higher. The default for Enginuity version 5773 or higher is set to 1024.

When running Enginuity version 5772 or earlier, the maximum number of active sessions allowed is 512. The default for Enginuity version 5772 or earlier is set to 512.

Note: To change the session limit, use the SYMAPI_RCOPY_SESSION_LIMIT option.

Copy limitations

Copying is device-based; extent copying is not supported. Device configuration changes cannot be made during an Open Replicator session, as making device changes may lead to inconsistent data on the local device if pulling, or on the remote device if pushing data.

Open Replicator cannot detect changes to a remote device during, or between incremental copies. Before each session, make sure that there are no changes being made to the remote device.

The Open Replicator command cannot accept a `clardev` entry for a remote device unless the CLARiiON array is discovered by the host executing the command. Refer to "Example 2: Performing a cold push operation to two different arrays" on page 72. This example shows how to discover and reference CLARiiON devices directly connected to the controlling host, or how to discover a CLARiiON array from controlling host that is not directly connected to the array.

Federated Tiered Storage limitations

There is support for Federated Tiered Storage devices with Open Replicator operations, however there are some limitations as listed below.

With Federated Tiered Storage (FTS), an external LUN (eDisk) is attached through the SAN to a Symmetrix array, and is used as an external back-end disk for the Symmetrix array. FTS requires a new external disk director (DX) and the Enginuity 5876.

Adding an eDisk through the SAN to the Symmetrix array provides the ability to migrate user data from the external storage into the Symmetrix array. There are two modes for presenting the eDisk to the Symmetrix array, *external provisioning* and *encapsulation*.

Refer to the *EMC Solutions Enabler Symmetrix Array Control CLI Product Guide* for more information on FTS operations.

FTS rules and restrictions with Open Replicator:

- Externally provisioned devices are fully supported.
- Encapsulated devices that are not geometry limited are fully supported.
- Encapsulated devices that are geometry limited devices are not supported for `-pull` operations.

Device guidelines

Table 1 provides some guidelines for control and remote devices.

Table 1 Control and remote device guidelines

Action	Control device	Remote device
Creating the device file	Symmetrix DMX or VMAX Family arrays Always listed on left Format: symdev=arrayid:device Example: symdev=7098:E9	Symmetrix, CLARiiON, third-party array Always listed on right Format: symdev | clardev=array:device or wwn=WWN Example: wwn=60060480000000000314353594D303737 Refer to "Creating a device file" on page 28 for device format rules
Hot push	One device per session All directors must see remote device	One device per session Device not accessible to host Can use `-consistent`, `-nodifferential`, and `-precopy` **Note:** Differential copying is the default for copy sessions and does not need to be specified in the `symrcopy create` command.
Cold push	One device per session Device Not Ready to host At least one director must see remote device(s)	Can use `-nodifferential` **Note:** Differential copying is the default for copy sessions and does not need to be specified in the `symrcopy create` command.
Hot pull	One device per session Device online to the host All directors must see the remote device	One device per active session Can use `-donor_update` Can use `-frontend_zero`
Cold pull	One device per session At least one director must see the remote device	One device per session Can use `-frontend_zero`

SAN setup requirements

Since data is copied through the SAN infrastructure, Open Replicator may require a SAN configuration update before copying data between storage arrays is allowed. Because of the various types of cabling, zoning, and masking that can exist within a SAN configuration, the following requirements are provided as a generic reference for setting up a data migration with Open Replicator through a SAN:

- A Fibre Channel switch is required for Open Replicator. Direct connections (such as arbitrated loop) are not supported.
- The SAN for the remote storage array must have connectivity to the control Symmetrix SAN. Open Replicator requires that at least one port on the remote array that allows access to the remote device have access to the control device through at least one port for a cold copy and all ports for a hot copy on the control array.
- Zoning must be set up on the Fibre Channel switch to zone the control Symmetrix fibre adapters (FAs) to the remote storage array front-end adapter(s).

- If the storage port for the source devices is running volume configuration management (VCM) software (such as Volume Logix for Symmetrix or EMC Access Logix™ for CLARiiON) or a similar software product, setup may require granting permission to access the target device(s) from the target storage port. For instance, on Symmetrix, the control FA(s) must be enabled to have access to the remote storage array device(s).

  Note: Specific instructions for granting access to target devices vary depending on the selected target storage array and VCM software.

SYMCLI symsan support

The SYMCLI command `symsan` lists port and LUN WWNs as seen from a specific Symmetrix director and port. This can be used to validate that the zoning between the port and target is correct. It does not require a created Open Replicator session. Use this command to display remote port WWNs, and a LUN WWN seen behind a remote port WWN.

The `symsan` command allows for:

- Listing all ports or luns in the SAN that can be seen by a specific DX director or all DX directors.
- Listing all ports or luns in the SAN that can be seen by a specific FA director or all FA directors.
- Listing all ports or luns in the SAN that can be seen by a specific FA/DX director or all FA/DX directors, using the `-dir` option.

Refer to the *EMC Solutions Enabler Symmetrix CLI Command Reference* for the `symsan` manpage. "Example 8: Obtaining port and LUN information" on page 110 provides a usage example.

Open Replicator command summary

Table 2 summarizes the SYMCLI commands used to manage a Symmetrix Open Replicator copy session.

Table 2 SYMCLI Open Replicator command summary

Command	Argument	Displays
`symrcopy`	`activate`	Starts the copying process on an existing Open Replicator copy session.
	`create`	Defines a new Open Replicator copy session.
	`export`	Creates the file (*FileName* given) with all of the session information for sessions matching the session name.
	`list`	Lists all Open Replicator copy sessions for a given Symmetrix array.
	`list ceiling`	Lists the maximum bandwidth percentage for a given director, port, director/port pair, or all directors and ports.
	`query`	Queries for the status of Open Replicator copy sessions.
	`recreate`	Creates an incremental copy session on an existing copy session. Only valid for copy sessions created with differential copying.
	`remove`	Removes remote devices from a differential session in the copied state.
	`rename`	Changes the name of a session. Can be executed only on a differential session in the Copied state.
	`restore`	Restores data from a remote device that was previously copied during a differential push operation back to the control device.
	`set ceiling`	Sets the maximum allowed bandwidth percentage for a given director, port, director, and port, or all directors and ports. Acceptable values are 0-100 or NONE to shut the ceiling function off.
	`set donor_update off`	Turns off the donor update option for the session. When `set donor_update off` is used with the `-consistent` option, the consistency of data on the remote devices will be maintained.
	`set frontend_zero off`	Turns off the front-end zero detection option for thin control devices for the session.
	`set mode`	Sets the mode for copying to either CopyInProg, CopyOnAccess, CopyOnWrite, or Precopy.
	`failback`	Used with the `-migrate` option to stop a Federated Live Migration session.
	`set pace`	Sets the session pace for the CopyInProg, RecreateInProg, and RestInProg states. Possible value are 0-9, with 9 being the slowest pace.
	`terminate`	Terminates a copy session and removes it from the Symmetrix array.
	`verify`	Verifies that a copy session is in an existing state.

For details about the `symrcopy` command syntax, refer to the *EMC Solutions Enabler Symmetrix CLI Command Reference*.

Open Replicator operations

Open Replicator copies data in sessions across the SAN infrastructure. A device file is used to specify the device pairs to be used in the copy session. These devices are referred to as the *control* and *remote* devices. The control device always resides on the locally-attached Symmetrix DMX or VMAX Family array and is responsible for controlling data copying to or from its partner remote device. Devices listed in the device file are identified by either logical unit number (LUN), World Wide Name (WWN), or by a combination of the storage array ID and device name (use `symdev` for Symmetrix and `clardev` CLARiiON). Refer to "Creating a device file" on page 28 for instructions on how to obtain device information and create the device file.

A copy session is first defined by using the `symrcopy create` command. A session name can be specified for later use in control operations. The push/pull options (`-push`|`-pull`) are used to define the direction of the copy operation for device pairs listed in the device file. If the copy direction option is set as a pull operation, data will be pulled in through the SAN to the control device(s) from the remote device(s). If the copy direction option is set as a push operation, data will be pushed across the SAN from the control device(s) to the remote device(s).

A copy session is also defined as either *hot* (online) or *cold* (offline) copying by using the `-hot` or `-cold` option parameters. Hot copying allows the control device to be read/write online to the host while the copy operation is in progress. With hot copying, all directors that have the local devices mapped are required to participate in the session. A hot copy session cannot be created unless all directors can discover the remote device. With cold copying the control device is write disabled to the host while the copy operation is in progress. A cold copy session can be created as long as one or more directors discovers the remote device.

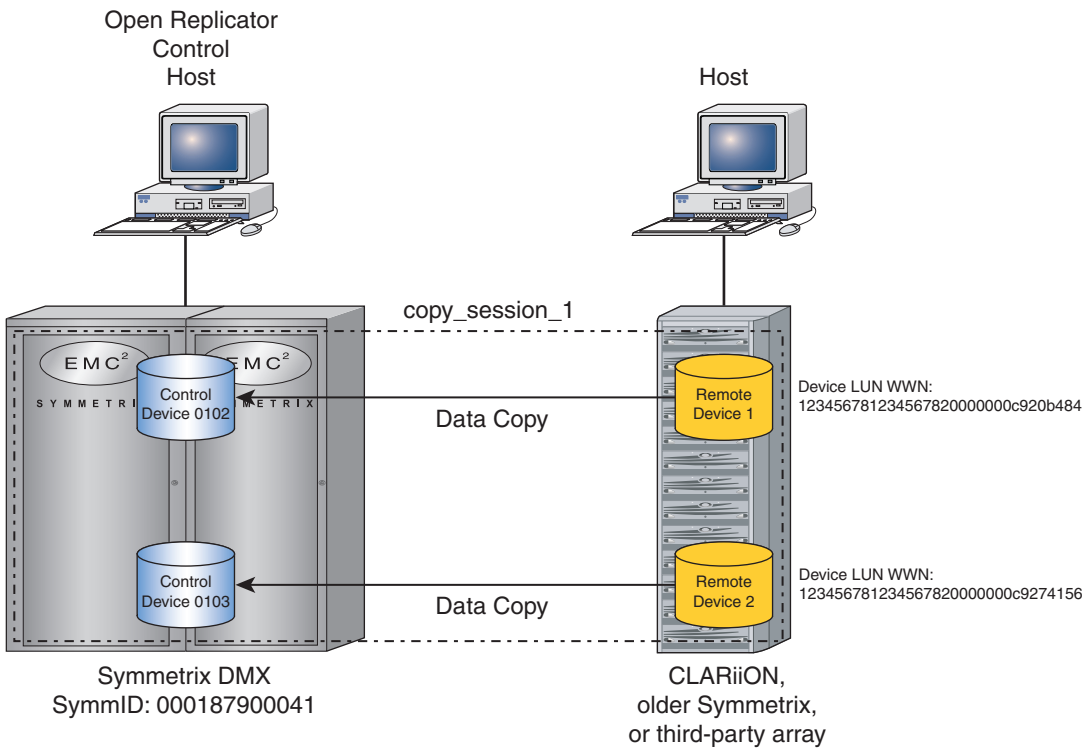
If a control device is pushing data to a remote device and that control device is currently online for host write I/O operations, a consistent point-in-time copy can be made across multiple control devices using the Enginuity Consistency Assist (ECA) feature (`-consistent`). This will temporarily prevent any host write I/Os while the Open Replicator copy session begins.

Copying data to a Symmetrix DMX or VMAX Family array

Figure 3 on page 26 shows Open Replicator copy sessions created and activated for a hot pull copy operation. The device file (`-file`) contains the pairing information for the control and remote devices. Each line in the device file is a copy session. Remote devices in the file are specified by "LUN WWN" and control devices are specified by "Symmetrix ID: device number" as follows:

```
symdev=000187900041:0102   wwn=1234567812345678200000000c920b484
symdev=000187900041:0103   wwn=1234567812345678200000000c9274156
```

Note: Refer to "Creating a device file" on page 28 for instructions on how to obtain device information and create the device file.




```
symrcopy create -name copy_session_1 -pull -hot -file pairs
symrcopy activate -file pairs
```

SYM-001469

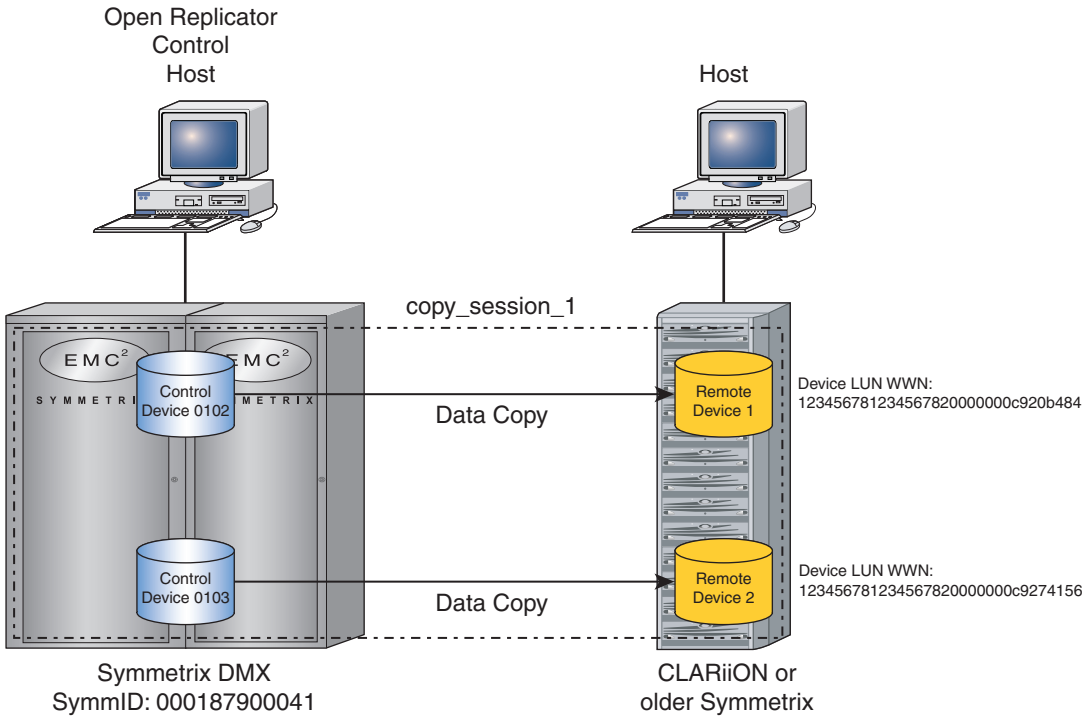
Figure 3 Symmetrix array device hot pull using the **`symrcopy`** command

Copying data from a Symmetrix DMX or VMAX Family array

Figure 4 on page 27 shows Open Replicator copy sessions created and activated for a cold push operation. The device file (`-file`) contains the pairing information for the control and remote devices. Each line in the device file is a copy session. Control devices are specified by "Symmetrix ID: device number" and remote devices in the file are specified by "LUN WWN" as follows:

```
symdev=000187900041:0102   wwn=1234567812345678200000000c920b484
symdev=000187900041:0103   wwn=1234567812345678200000000c9274156
```

Note: Refer to "Obtaining device information" on page 29 and "Creating the file" on page 30 for instructions on how to obtain device information and create the device file.




```
symrcopy create -name copy_session_1 -push -cold -file pairs
symrcopy activate -file pairs
```

SYM-001470

Figure 4 Symmetrix array device cold push using the **`symrcopy`** command

Using Open Replicator to perform a migration

SYMCLI Open Replicator control operations are performed from a local host attached to the Symmetrix DMX or VMAX Family array and are implemented in sessions across the SAN infrastructure. Open Replicator copy sessions are first created using a device file, which lists the device pairs (control and remote) for the operation.

Open Replicator uses the SYMCLI `symrcopy` command to perform copy sessions. The main control operations required to successfully complete a copy session are as follows:

- Create the session.
- Activate the session.
- Terminate the session.

The following optional settings and actions are also available:

- Data protection and recovery options for hot pulls.
- Precopy data before activating a session.
- Enable or disable front-end zero detection for pull operations to thin control devices.
- Background copying mode of a session.
- Ceiling value for bandwidth.
- Session pace for copying, recreating, and restoring.
- List, query and verify copy sessions to display the current session status.
- Remove a remote device from a session.
- Recreate a differential copy session.
- Rename a differential copy session.
- Restore data from a remote device of a copy session.
- Export the run information to an output file.

Note: For detailed syntax of the `symrcopy` command, refer to the *EMC Solutions Enabler Symmetrix CLI Command Reference*.

Creating a device file

Before an Open Replicator copy session can be created, a device file must be created that lists the control and remote device pairs for the copy operation. The device file syntax contains two columns (for control and remote devices). Devices in the file must be specified either by their unique LUN WWN, or by the storage array ID and device number (`Storage ID:device#`). Valid identifiers for devices are `wwn`, `symdev` (Symmetrix device) and `clardev` (CLARiiON device).

Use the following rules to determine the correct device ID format in the device file:

- If the array for the remote device is visible to the host where the `symrcopy` command is run (locally or by a remote RDF connection), either the storage array ID and device number or the LUN WWN can be used for the remote device ID in the device file.

- If the array for the remote device is only visible using the `symsan` command, only the LUN WWN can be used for the remote device ID in the device file.

Obtaining device information

The Solutions Enabler (SYMCLI) provides several commands that can be used to obtain device information, including device number, director information, WWN, and capacity. This information is helpful in determining and identifying devices for inclusion in the device file. Some of these commands include: `symdev`, `syminq`, `sympd`, `symsan` and `symstat`. Example usage for two of these commands, `symdev` and `syminq` are provided below. For detailed information on using these and other SYMCLI array management commands, refer to the *EMC Solutions Enabler Symmetrix Array Management CLI Product Guide*.

Symmetrix and CLARiiON device information for a given array is obtained by using the `symdev list` command with the appropriate Symmetrix ID (`-sid`) or CLARiiON ID (`-cid`) option. For example, for a list of Symmetrix devices on Symmetrix 041, enter:

```
symdev list -sid 6190
```

```
Symmetrix ID: 000187900041

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

0102 /dev/vx/rdmp/c5t0d2s2  03A:0 01A:C2  2-Way Mir     Grp'd    (M) RW   17261
0103 /dev/vx/rdmp/c5t0d3s2  03A:0 01D:C3  2-Way Mir     Grp'd    (M) RW   17261
0104 /dev/vx/rdmp/c5t0d4s2  03A:0 16C:D2  TDEV          N/Grp'd  (M) RW   17261
0105 /dev/vx/rdmp/c5t0d5s2  03A:0 16C:C3  TDEV          N/Grp'd  (M) RW   17261
0106 /dev/vx/rdmp/c5t0d6s2  03A:0 01A:C4  RAID-5        Grp'd    (M) RW   17261
0107 /dev/vx/rdmp/c5t0d7s2  03A:0 01A:D5  RAID-5        Grp'd    (M) RW   17261
<. . .>
```

Note: The output in the above example has been truncated.

Note: For details about `symdev` command syntax, refer to the *EMC Solutions Enabler Symmetrix CLI Command Reference*.

The following example shows a SCSI inquiry of all Symmetrix devices listed by the device WWN:

```
syminq -sym -wwn
```

```
Device                                              Device
------------------------------ ---------------- ---------------------------------
Name                        Num  Array ID         WWN
------------------------------ ---------------- ---------------------------------
/dev/vx/rdmp/c5t0d2s2      0168 000000006190     60060480000190300016533030303238
/dev/vx/rdmp/c5t0d3s2      01F8 000000006190     60060480000190300016533030303239
/dev/vx/rdmp/c5t0d4s2      01F9 000000006190     60060480000190300016533030303241
/dev/vx/rdmp/c5t0d5s2      0170 000000006190     60060480000190300016533030303242
/dev/vx/rdmp/c5t0d6s2      0172 000000006190     60060480000190300016533030303243
/dev/vx/rdmp/c5t0d7s2      01B2 000000006190     60060480000190300016533030303244
```

Note: For details about `syminq` command syntax, refer to the *EMC Solutions Enabler Symmetrix CLI Command Reference*.

Creating the file

The Symmetrix control device is always listed in the first column of the device file. Lines in the device file that begin with a pound symbol (#) will be ignored. The device filename (`-file Filename`) is inserted into the command line for control operations. The device text file shown below lists control and remote devices for six copy sessions. Each line in the device file is a separate copy session.

```
# dev_file_1
## column1:target column2:source
# Symmetrix and StorageID:device always listed first
symdev=0000000006190:0168 wwn=60060480000000000619053594D314638
symdev=0000000006190:01F8 wwn=60060480000000000619053594D314640
symdev=0000000006190:01F9 wwn=60060480000000000619053594D314637
symdev=0000000006190:0170 wwn=60060480000000000619053594D314642
symdev=0000000006190:0172 wwn=60060480000000000619053594D314646
symdev=0000000006190:01B2 wwn=60060480000000000619053594D314649
# End
```

The following file will control a session with one control device (01) and multiple remote devices (41 and 42). This is only used with cold push sessions:

```
symdev=000000001234:01 symdev=000000005678:41
symdev=000000001234:01 symdev=000000005678:42
```

The following file shows a mix of symdev and wwn device ID usage:

```
symdev=000000001234:01 symdev=000000005678:42
symdev=000000001234:02 symdev=000000005678:43
symdev=000000001234:03 wwn=60060480000000000567853594D303434
```

Exporting device runs to a file

A session device list can be exported to a text file.

The following example shows how to use the `symrcopy export` command to create a file containing a list of device runs corresponding to a session name:

```
symrcopy export -session_name rcopy_1 -file dev_file_1.txt
```

The output file (`dev_file_1.txt`) contains the session device list, as shown here:

```
symdev=0000000006190:0168 wwn=60060480000000000619053594D314638
symdev=0000000006190:01F8 wwn=60060480000000000619053594D314640
symdev=0000000006190:01F9 wwn=60060480000000000619053594D314637
symdev=0000000006190:0170 wwn=60060480000000000619053594D314642
symdev=0000000006190:0172 wwn=60060480000000000619053594D314646
symdev=0000000006190:01B2 wwn=60060480000000000619053594D314649
```

Creating a session

An Open Replicator copy session is created by using the `symrcopy create` command to define a new session. Other mandatory syntax session controls that are included in the `symrcopy create` command line are the copy direction parameter (`-push|-pull`), the online/offline parameter (`-hot|-cold`), and the device text filename (`-file Filename`).

These parameters identify the direction for the copy operation, what directors will be used, and the filename of the device text file providing the list of the control and remote devices. Refer to "Creating a device file" on page 28 for instructions on how to create the device file.

Note: A session name (`-name`), which can be used for control operations, can also be included in the `symrcopy create` command.

When creating a copy session, the `symrcopy` command must indicate whether the control Symmetrix DMX or VMAX Family devices will be pushing data to, or pulling data from the remote devices in the copy session. A pull operation signifies that data will be copied through the SAN from remote devices to a Symmetrix DMX or VMAX Family array. A push operation signifies that data will be copied from Symmetrix DMX or VMAX Family arrays to remote devices within the SAN.

The copy direction for a session is designated by a flag in the output of `symrcopy list` command. Refer to "Monitoring session status" on page 39 for more detail.

The following example shows how to define an Open Replicator copy session using the `symrcopy` command:

```
symrcopy create -name rcopy_1 -pull -hot -file dev_file_1
```

In the above example, the name of the copy session is assigned as `rcopy_1`. The copy session is identified as a pull (`-pull`) operation, so data will be copied to the control devices from the remote devices. Devices will be copied online (`-hot`), meaning that all directors mapped to the local devices will be used for the copy operation.

After the session is activated, all device tracks are background copied in the CopyInProg state. The name of the device text file to be used for the session is specified as `dev_file_1`.

Precopying

For hot push operations only, the `-precopy` option is used with the `create` or `recreate` commands to begin copying session data immediately in the background before the session is activated. The `-precopy` option does not need to be specified in the `symrcopy create` command.

The following example shows how to define an Open Replicator copy session using the `-precopy option.`

```
symrcopy create -name rcopy_1 -precopy -file dev_file_1
```

Refer to "Background copying" on page 37 for more information on background copying mode options.

Note: The `-precopy` option requires Enginuity version 5772 or higher.

⚠CAUTION

Potential data loss could occur during a hot pull operation in the event of a SAN failure or other connectivity issue. For optional data protection against such failures, refer to "Donor update" on page 35.

Note: For pull operations from devices with SCSI reservations, if the remote devices have a cluster running against them or the devices are AIX LVM devices, the cluster, AIX host, or other software that is creating the SCSI reservations must be shut down before creating the Open Replicator session.

Differential copying

Differential copying is the default for a push operation only, so the `-differential` option does not need to be specified in the `symrcopy create` command. Differential copying allows sessions to be to recreated at a later time using the `symrcopy recreate` command. The `recreate` command is used to incrementally update from the control to remote devices. Refer to "Recreating a session" on page 46 for more information.

Differential copying also allows sessions for a push operation to be restored back to the control device by using the `symrcopy restore` command. Refer to "Restoring a session" on page 47 for more information.

With the `-nodifferential` option specified in the `symrcopy create` command, sessions cannot be recreated or restored.

The `-nodifferential` option is the default for pull operations.

The differential copy status for a session is designated by a flag in the output of `symrcopy list` command. Refer to "Monitoring session status" on page 39 for more detail.

Hot and cold copying

Open Replicator copy sessions running *online* (`-hot`) are up and running other host applications, such as a database or file server, while devices are being copied. All directors mapped to the control host must be able to copy to the remote devices. A hot copy session that is copying data from the host Symmetrix array to other devices located in the SAN (`-push`) are limited to a single control device copying to a single remote device. The control device may be read/write enabled to the host, but the remote device should not be accessible from its host.

During hot push operations, if the Symmetrix DMX or VMAX Family array attempts to write to control device tracks that have not yet been copied, Open Replicator immediately copies those tracks to the remote device first and then services the I/O request.

⚠CAUTION

Potential data loss could occur during a hot pull operation in the event of a SAN failure or other connectivity issue. For optional data protection against such failures, refer to "Donor update" on page 35.

With an *offline* (`-cold`) copy session, directors are used that are mapped to the control device and can reach the remote device. The control device must be set as user Not Ready to the Symmetrix host. Concurrent data copying from one control device to up to 16 remote devices, is only allowed with a cold push operation. Refer to Figure 5 on page 34 for a depiction of a cold copy session to multiple remote devices.

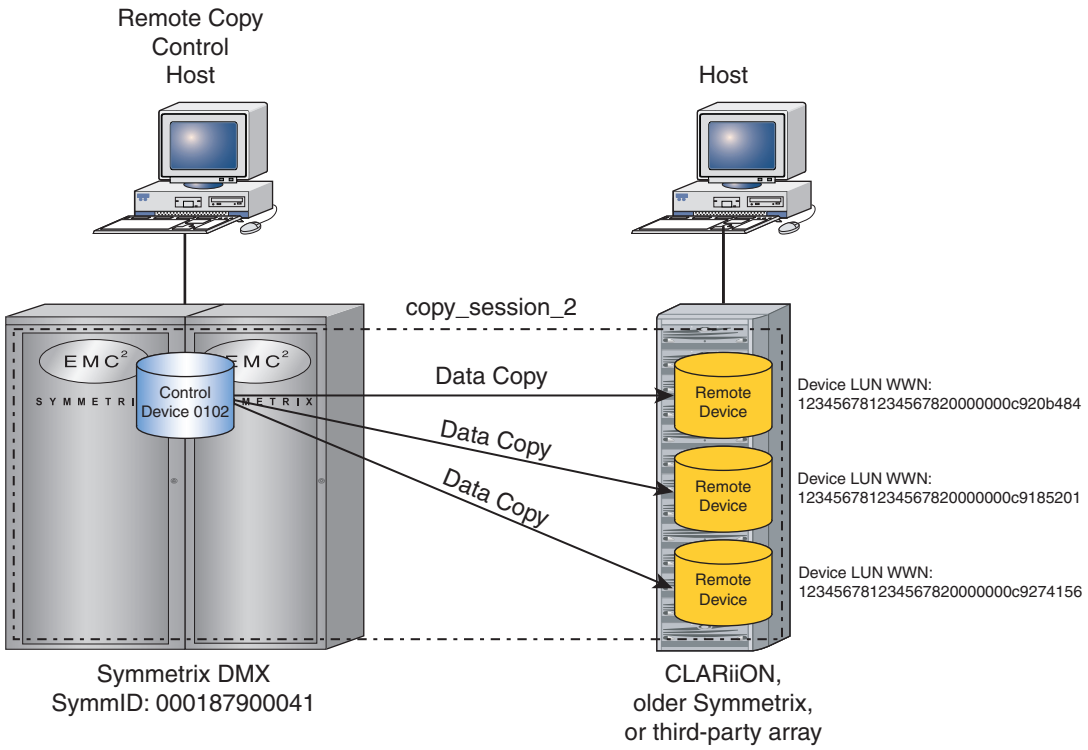
When the `symrcopy create` command is executed, it initiates a discovery process, which enables the directors that are mapped to the control devices to discover the remote devices for the session. With hot copying, all directors that have the control devices mapped are required to participate in the session. If any director cannot see the remote device after the discovery process, the session creation will fail. This situation can be avoided with cold copying, as the session will be created as long as one or more directors have discovered the remote device during the discovery.

If there is a network failure while hot copying from a Symmetrix DMX or VMAX Family array to other devices in the SAN (`-push`), the copy session will fail. However, the local host can still continue writing to the control device without impact to the application. If there is a network failure while performing a cold pull operation, the session will stall and retry.

With cold copying, the control device is already disabled for both reads and writes (Not Ready) to the control host. Open Replicator will continue to attempt the copy operation until the network is operational again. For the `symrcopy create` operation to be successful, devices must be in the proper state when the command is initiated.

Note: Failed push sessions can be activated again only if no new data has been written to the control device since the session failed. Refer to "Recovering from a failed session" on page 46 for more information.

The online or offline status for a session is designated by a flag in the output of `symrcopy list` command. Refer to "Monitoring session status" on page 39 for more detail.




```
symrcopy create -name copy_session_2 -push -cold -file multi_tgt
symrcopy activate -file multi_tgt
```

SYM-001471

Figure 5 Cold push copy session: single device to multiple remote devices

Front-end zero detection

Front-end zero detection looks for incoming zero patterns from the remote device, and instead of writing the incoming data of all zeros to the thin control device, the group on the thin device is de-allocated. Front-end zero detection is allowed for `-pull` operations only and is indicated by the `-frontend_zero` option. This option is ignored for any standard control devices.

Note: With front-end zero detection enabled, "persistent" allocations will be treated as regular allocations, and track group will be de-allocated.

Enabling front-end zero detection

By default pull sessions have `-frontend_zero` disabled. The following example shows how to enable front-end zero detection:

```
symrcopy create -session_name rcopy_1 -pull -hot -frontend_zero -file
dev_file_1
```

Disabling front-end zero detection

The `set frontend_zero off` command disables zero detection for the session, and is only allowed during active `-pull` operations. This command is ignored for any standard control devices.

The following example shows how to disable front-end zero detection:

```
symrcopy -session_name rcopy_1 set frontend_zero off
```

The front-end zero detection status for a session is designated by a flag in the output of `symrcopy list` command. Refer to "Monitoring session status" on page 39 for more detail.

Note: Once front-end zero detection is disabled during an active session, it cannot be enabled again during the session.

Donor update

To protect against potential data loss due to a SAN failure or other connectivity issue during a hot pull operation, use the `-donor_update` option. With this option , all writes to the control device from the host are immediately copied to the remote device as well. Because the data is fully copied to both the remote device and the control device, if a failure occurs, the session can be safely terminated and created again to fully recover from any mid-copy failure.

Enabling donor update option

The following example shows how to create and activate an Open Replicator copy session for a hot pull operation using the `donor_update` option:

```
symrcopy create -name rcopy_1 -pull -hot -donor_update -file
dev_file_1
symrcopy activate -session_name rcopy_1
```

Note: For information on the `activate` command, refer to "Activating a session" on page 36.

If during an activated hot pull operation, a SAN failure or other connectivity issue is detected, then terminate the Open Replicator sessions.

The following example shows how to terminate the Open Replicator sessions associated with the control device:

```
symrcopy terminate -file dev_file_1 -symforce
```

The following example shows how to start the copy session again after the problem has been resolved:

```
symrcopy create -name rcopy_1 -pull -hot -donor_update -file
dev_file_1
symrcopy activate -session_name rcopy_1
```

Note: The above example restarts the copy process from where it left off at the time of failure.

The donor update status for a session is designated by a flag in the output of `symrcopy list` command. Refer to "Monitoring session status" on page 39 for more detail.

Note: The `donor_update` option must be included in the original `symrcopy create` command to fully recover all writes made to the devices prior to the failure.

Disabling donor update option

The donor update option may be disabled by using the `set donor_update off` command. This command stops the copying of data to the remote devices. Thus stopping all new writes to the control device from being immediately copied to the remote device. When used with the `-consistent` option, the consistency of the data on the remote devices will be maintained. When used without the `-consistent` option, donor update will still be deactivated, but consistency on the remote devices will not be maintained.

Note: The `set donor_update off` command requires Enginuity version 5773 or higher.

This option is useful for a hot pull session, with donor update enabled, where the session has finished copying and maintaining a consistent image on the remote devices is desired. By using the `set donor_update off` command with the `-consistent` option after the session has fully copied, the donor update portion of the session is disabled, but data consistency on the remote devices is maintained.

The following example shows how to set the donor update option to off and maintain consistency on the remote devices:

```
symrcopy set donor_update off -session_name rcopy_1 -consistent
```

Note: The `donor_update` option may also be turned off while the session is in the CopyInProg (copy in progress) state by including the `-force` option in the command line. The session will continue to copy in its current mode without donor update.

If the session is terminated, renamed, restored, recreated, a device is removed, or another session is created using the same control device, the donor update portion of the session is automatically deactivated and consistency on the remote devices is lost. To maintain the consistency on the remote devices, issue the `set donor_update off -consistent` command prior to any of these actions.

Note: The donor update option may also be used on an incremental restore session. Refer to "Restoring a session" on page 47 for more information.

Activating a session

To begin the copying process for an Open Replicator copy session, use the `symrcopy activate` command and specify the device file (`-file` *`Filename`*) or the session name (`-session_name` *`SessionName`*). This activates the copy sessions for device pairs listed in the device file and begins copying data to (*pushing*) or from (*pulling*) the remote devices.

The following example shows how to activate an Open Replicator copy session using the `symrcopy` command:

```
symrcopy activate -session_name rcopy_1
```

The above example starts the copy session that was previously created in the example shown in "Creating a session" on page 30.

Note: Any other Open Replicator copy sessions that were previously created using the specified device file (and session name) will also be started.

If control devices are pushing data to remote devices and the control devices are currently online for host I/O operations, include the Enginuity Consistency Assist (ECA) option (`-consistent`) in the command line to temporarily prevent host I/O while the Open Replicator copy session begins. This begins a consistent point-in-time copy to the remote devices using an ECA window, which temporarily freezes host I/O to the control devices.

Note: Under certain circumstances, failed sessions may be reactivated. Refer to "Recovering from a failed session" on page 46.

Working with Veritas file systems and Oracle databases

When activating the copy session on devices that contain a Veritas file system or an Oracle database, the devices must be frozen just before the activate is performed and thawed as soon as the activate completes. Use the following options with the `symrcopy activate` command, when applicable:

```
-vxfs MountPoint
-rdb dbtype DbType -db DbName
```

The device specified in the command line must match the device in the device file or the activate will fail.

Background copying

Open Replicator copy sessions that are actively background copying to devices are in the CopyInProg state. This is the default state for copy sessions. This state can be changed to the CopyOnAccess state for a pull operation, the CopyOnWrite state for a push operation, or the Precopy state for a hot push operation by using the `symrcopy set mode [-copy|-nocopy|-precopy]` options. An activated session in the CopyOnAccess state copies data to the control device only when those tracks have been accessed on the control device. An activated session in the CopyOnWrite state copies data to the remote device only when those tracks are accessed on the control device.

A hot push session that is in the Precopy state will immediately begin copying data in the background before the session is activated. Session data will continuing copying to the remote device until either the mode is changed to `nocopy`, `copy`, or the session is activated, at which time a point-in-time copy of the control device is made. After the session has been activated, copying will continue in the CopyOnWrite (`nocopy`) or CopyInProg (`copy`) state. The Precopy feature is available only for hot push operations. Hot push sessions can also be set to Precopy mode by including the `-precopy` option with either the `create` or `recreate` command.

The background copy status for a session is designated by a flag in the output of `symrcopy list` command. Refer to "Monitoring session status" on page 39 for more detail.

Note: The `-precopy` option requires Enginuity version 5772 or higher.

The following example shows how to temporarily stop the background copying for a session by changing the state to CopyOnAccess or CopyOnWrite from CopyInProg using the `symrcopy` command:

```
symrcopy set mode nocopy -file dev_file_1
```

The following example shows how to resume background copying for a session and change to the CopyInProg state:

```
symrcopy set mode copy -file dev_file_1
```

The following are examples of how to immediately begin background copying on a hot push session without making a point-in-time copy:

```
symrcopy set mode precopy -file dev_file_1
```

or

```
symrcopy create dev_file_1 -precopy
```

Note: Precopy mode can only be set when the session is not activated.

Note: To see an example of the `-precopy` option as used with the recreate command, refer to "Recreating a session" on page 46.

Setting the ceiling value

The `symrcopy set ceiling` command sets the maximum allowed bandwidth percentage for a given director, port, director/port pair, or all directors and ports. Valid values are 0 - 100 (%), or NONE (shuts off the ceiling function).

Note: Ceiling values should be adjusted to optimize the performance of the specific SAN environment.

The following example shows how to set a bandwidth ceiling of 100% for all directors on Symmetrix 6190:

```
symrcopy set ceiling 100 -dir all -sid 6190
```

The new ceiling setting is viewed by using the following `list ceiling` command:

```
symrcopy list ceiling
```

For example, setting the ceiling value to 100% causes Open Replicator to consume as much bandwidth as possible, typically:

- 80 MB/s for a 1 GB SAN
- 150 MB/s for a 2 GB SAN
- 180 MB/s for a 4 GB SAN (for Symmetrix DMX-4 systems)
- 300 MB/s for a 4 GB SAN (for Symmetrix VMAX Family arrays)
- 300 MB/s for an 8 GB SAN (for Symmetrix VMAX Family arrays)

Note: Setting the ceiling to a value (other than NONE) renders the session pace value ineffective to the copy. If the ceiling value is set to NONE, the session pace is in effect for the copy.

Note: When using ORS with SRDF/A, users should monitor and adjust the ORS ceiling/session pace or turn on SRDF/A pacing to prevent ORS I/O from causing SRDF/A to drop. Refer to Primus case emc292509 for guidelines on setting these values.

Setting the session pace

If the ceiling value is set to NONE, the session pace can be set for devices being copied, recreated, or restored to manage the speed of the replication process. The session pace designates how fast data copies between devices. Values can range from 0 to 9, with 0 being the fastest pace, and 9 being the slowest pace. If set to 0, there is no inserted delay time and the replication will proceed as fast as possible.

Values of 1 - 9 add delays, which takes longer to complete copying but conserves system resources. The default for both online (hot) replication and offline (cold) replication is 5.

The following example shows how to set the session copy pace:

```
symrcopy set pace 0 -file dev_file_1
```

Note: The session pace becomes ineffective to the copy if the ceiling is set to a value other than NONE.

Monitoring session status

Open Replicator session status is checked using the `symrcopy query`, `symrcopy list`, or `symrcopy verify` command.

Listing all sessions

To list the Open Replicator copy sessions for the local Symmetrix array, use the `symrcopy list` command. This command returns status information for all created sessions. To list session information for a specific Symmetrix array, include the Symmetrix ID (`-sid` *`SymmID`*) option in the command line.

The following options are available for the `symrcopy list` command:

- `-offline` option displays only information held in the database and does not query the Symmetrix array for updated session information.
- `-detail` option displays additional device information for modified tracks, session pace, and session name.
- `-wwn` option displays the full device world wide name.

Note: Using the `-detail` and `-wwn` options expands the width of the character display, which may not view properly for some displays.

The following is a list example of all Open Replicator sessions for Symmetrix ID 6190:

```
symrcopy list -sid 6190

Symmetrix ID: 0000000006190

     Control Device              Remote Device                Flags        Status       Done
    ----------------------- ------------------------------- -------      --------     -----
                   Protected
        SID:symdev    Tracks    Identification              RI  CDSHUTZ SRC <=> TGT     (%)
     ------------  --------- ------------------------------- -- ------- -------------   ----
        0168         33000  6006048000000000619053594D314638  .W  X..XXM. Copied          100
        01F8         33000  6006048000000000619053594D314640  .W  X..XXS. CreateInProg    N/A
        01F9         33000  6006048000000000619053594D314637  .W  X..XXS. CreateInProg    N/A
        0170         20000  6006048000000000619053594D314642  .W  X..XXSX CopyInProg       50
        0172         30000  6006048000000000619053594D314646  .W  X..XXSX CopyInProg       75
        01B2         33000  6006048000000000619053594D314649  .W  X..XXRX CopyInProg       75

        Total      ---------
         Tracks     152000
         MB(s)      12062.5

       Legend:
        R (Remote Device Vendor Identification)
        S = Symmetrix, C = Clariion, . = Unknown.

        I:  (Remote Device Specification Identifier)
          D = Device Name, W = LUN WWN, World Wide Name.

        Flags:
        (C): X = The background copy setting is active for this pair.
             . = The background copy setting is not active for this pair.
        (D): X = The session is a differential copy session.
             . = The session is not a differential copy session.
        (S): X = The session is pushing data to the remote device(s).
             . = The session is pulling data from the remote device(s).
        (H): X = The session is a hot copy session.
             . = The session is a cold copy session.
        (U): X = The session has donor update enabled.
             . = The session does not have donor update enabled.
        (T): M = The session is a migration session.
             R = The session is a RecoverPoint session.
             S = The session is a standard ORS session.
        (Z): X = The session has front-end zero detection enabled.
             . = The session does not have front-end zero detection enabled.
        (*): The failed session can be reactivated.
```

Filtering session types

The list `symrcopy list` command provides the `-type` option that lists either standard ORS sessions or RecoverPoint sessions.

Note: For listing Federated Live Migration (FLM) sessions, refer to "Listing a FLM session" on page 130.

The following is a list example of standard sessions only:

```
symrcopy list -sid 6190 -type standard

Symmetrix ID: 0000000006190

        Control Device              Remote Device                Flags    Status       Done
        ----------------------- ------------------------------- -------  --------     -----
```

```
                Protected
SID:symdev      Tracks     Identification                    RI CDSHUTZ SRC <=> TGT   (%)
----------- --------- --------------------------------- -- ------- ------------  ----
01F8            33000 60060480000000000619053594D314640 .W X..XXS. CreateInProg  N/A
01F9            33000 60060480000000000619053594D314637 .W X..XXS. CreateInProg  N/A
0170            20000 60060480000000000619053594D314642 .W X..XXSX CopyInProg     50
0172            30000 60060480000000000619053594D314646 .W X..XXSX CopyInProg     75

Total        ---------
 Tracks        152000
 MB(s)         12062.5
```

The following is a list example of RecoverPoint sessions only:

symrcopy list -sid 90 -type recoverpoint

```
Symmetrix ID: 000000006190

         Control Device            Remote Device                  Flags      Status      Done
         --------------- ------------------------------------- --------    ------     -----
                   Protected
     SID:symdev    Tracks    Identification                   RI CDSHUTZ SRC <=> TGT    (%)
    ------------  --------- ---------------------------------  -- ------ -------------- ----
     01B2              33000 60060480000000000619053594D314649  SW ...XXR. Created        75

        Total       ---------
         Tracks        33000
         MB(s)          2062.5
```

For the output legend, refer to page 40.

Note: If the `symrcopy list` command is run without the `-type` option, the default behavior is to include all sessions in the list, as shown in "Listing all sessions" on page 39.

Querying session status

Open Replicator session status is checked using the `symrcopy query` or `symrcopy verify` command.

The `symrcopy query` command is used to display details for remote copy sessions defined in a device file. The query command provides current status information for control/remote device pairs. If the device pair state is CopyInProg, the query command displays the percentage of copying that has completed.

The following options are available for the `symrcopy query` command:

- `-i` (interval) is used to execute the query command in repeated intervals (in seconds). The default for interval is 10 seconds if the count option is used, and 5 seconds is the minimum interval that can be specified.
- `-c` (count) is used with the `-i` and specifies the duration of the query intervals. See "Copy session status detailed query" for an example command with the `-c` and `-i` options .

Note: Estimated time to copy completion is shown in the query output when the `-i` and *-c* options are used or if the protected track count has changed since the last interval.

- `-offline` option displays only information held in the database and does not query the Symmetrix array for updated session information.

Note: If the `-offline` option is included with the `symrcopy query` command, the `-i` and *-c* options are not useful as the output will not change between intervals.

- `-detail` option displays additional device information for modified tracks, session pace, and session name.
- `-wwn` option displays the full device world wide name.

Note: Using the `-detail` and `-wwn` options expands the width of the character display, which may not view properly for some displays.

Copy session status detailed query

The following example shows how to query for copy session status:

```
symrcopy query -file dev_file_1
```

```
       Control Device                   Remote Device              Flags     Status       Done
---------------------------- ----------------------------------- ----- -------------    ----
                   Protected
SID:symdev         Tracks    Identification                   RI CDSHUTZ SRC <=> TGT     (%)
------------------ --------- ---------------------------------- -- ------- -----------    ----
000000006190:0168      33000 60060480000000000619053594D314638 .W X..XXM. Copied         100
000000006190:01F8      33000 60060480000000000619053594D314640 .W X..XXS. CreateInProg   N/A
000000006190:01F9      33000 60060480000000000619053594D314637 .W X..XXS. CreateInProg   N/A
000000006190:0170      20000 60060480000000000619053594D314642 .W X..XXSX CopyInProg      50
000000006190:0172      30000 60060480000000000619053594D314646 .W X..XXSX CopyInProg      75
000000006190:01B2      33000 60060480000000000619053594D314649 .W X..XXRX CopyInProg      75

Total              ---------
  Tracks              152000
  MB(s)               12062.5
```

For the output legend, refer to page 40.

The following example shows a query command that will be run every 30 seconds for 1 hour:

```
symrcopy query -file dev_file_1 -i 30 -c 120
```

The `symrcopy query` command can also be used with a session name, as shown in the following example:

```
symrcopy query -session_name rcopy_2
```

Copy session status summary query

The output from the summary query is an abbreviated listing that shows all possible session states and the number of sessions that are in each state.

The `-wwn` and the `-detail` options cannot be used with the `-summary` option.

The following example shows how to query for a copy session status with `-summary` option:

```
symrcopy -file dev_file_1 query -summary
```

```
Device File Name : dev_file_1

  RCopy Session State           Count
  -----------------------      ------
  CreateInProg                      2
  Created                           0
  RecreateInProg                    0
  Recreated                         0
  CopyInProg                        3
  CopyOnAccess                      0
  CopyOnWrite                       0
  Copied                            1
  SyncInProg                        0
  Synchronized                      0
  Restored                          0
  RestoreInProg                     0
  Precopy                           0
  TerminateInProg                   0
  Failed                            0
  Stopped                           0
  FailedBack                        0
  VerifyInProg                      0
  Invalid                           0
  -----------------------      -------
  Total                             6

                                 Track(s)    MB(s)
                               -----------  -------
  Total Protected                   152000  12062.5
```

Verifying session state

The `symrcopy verify` command can be used to verify copy session states. Command syntax for `verify` is as follows:

```
symrcopy verify [-createinprog | -created | -recreateinprog |
-recreated | -copyinprog | -copyonaccess | -copyonwrite | -copied |
-terminateinprog | -failed | -verifyinprog | -restored | -restinprog |
-precopy [-cycled] | -syncinprog | -synchronized | -failedback]
```

Table 3 Verifying session state (page 1 of 2)

Verify option	Description
`-createinprog`	Verifies that the copy session is in the process of being created.
`-created`	Verifies that the copy session has been created.
`-recreateinprog`	Verifies that the copy session is in the process of being recreated (incrementally updating the targets).
`-recreated`	Verifies that the copy session has been recreated. Device pairs in the session have finished incrementally updating.
`-copyinprog`	Verifies which device pairs in the copy session are currently in the CopyInProg state (actively background copying).
`-copyonaccess`	Verifies which device pairs in the copy session are currently in the CopyOnAccess state (only copying the device tracks to the control device as they are being accessed on the remote device for a pull operation).
`-copyonwrite`	Verifies which device pairs in the copy session are currently in the CopyOnWrite state (only copying the device tracks to the remote device as they are being written to on the remote device for a push operation).

Table 3 Verifying session state (page 2 of 2)

Verify option	Description
`-copied`	Verifies which device pairs in the copy session have finished copying data. This is the default if no option is provided.
`-terminateinprog`	Verifies that the copy session is in the process of terminating.
`-failed`	Verifies if any of the device pairs in the copy session have failed to copy.
`-failedback`	Verifies if a FLM session has failed back.
`-verifyinprog`	Verifies that all active directors for the copy session have completed copy operations.
`-precopy`	Verifies that the device pair is currently in the Precopy state (copying device tracks in the background without activation). Adding the `-cycled` option verifies all precopy sessions that have completed one cycle.
`-restinprog`	Verifies that the copy session is in the process of being restored.
`-restored`	Verifies that the copy session has been fully restored.
`-syncinprog`	Verifies which device pairs in the copy session are currently in the SyncInProg state (actively background copying).
`-synchronized`	Verifies which device pairs in the copy session are in the Synchronized state.

The following example shows the output result for the `verify` command:

```
symrcopy -file dev_file_1 verify
```

One of the device(s) in the list are in 'Copied' state.

The following example shows the output result when the `verify` command is used with the `-summary` option:

```
symrcopy -file dev_file_1 verify -summary
```

Note: The one-line `verify` command output comes after the `-summary` output.

```
Device File Name : dev_file_1

RCopy Session State           Count
  -----------------------      ------
  CreateInProg                      2
  Created                           0
  RecreateInProg                    0
  Recreated                         0
  CopyInProg                        3
  CopyOnAccess                      0
  CopyOnWrite                       0
  Copied                            1
  SyncInProg                        0
  Synchronized                      0
```

```
  Restored                          0
  RestoreInProg                     0
  Precopy                           0
  TerminateInProg                   0
  Failed                            0
  Stopped                           0
  FailedBack                        0
  VerifyInProg                      0
  Invalid                           0
  ------------------------      ------
  Total                             6

                                 Track(s)    MB(s)
                               -----------  -------
Total Protected                  156000    12062.5

One of the device(s) in the list are in 'Copied' state.
```

Note: If no verify option is provided, then “copied” is the default state that is verified.

Terminating a session

To terminate a copy session and remove it from the Symmetrix array, use the `symrcopy terminate` command. If the session is activated and in the CopyInProg, CopyOnAccess, or CopyOnWrite state, the `-symforce` option is mandatory to terminate the session.

The following are examples of how to terminate a copy session that has finished copying or has not yet been activated using the `symrcopy` command:

```
symrcopy terminate -file dev_file_1
```

or

```
symrcopy terminate -session_name rcopy_1
```

The following are examples of how to terminate a copy session that has been activated and has not yet finished copying:

```
symrcopy terminate -file dev_file_1 -symforce
```

The following example shows how to terminate all sessions associated with the control device:

```
symrcopy terminate -all_sessions -symforce -file dev_file_1
```

Note: Remote devices in the device file are ignored.

⚠CAUTION

Use care when applying the `-symforce` option to terminate an active session. At termination, the receiving devices will contain an incomplete data copy and should be considered invalid.

Terminating a RecoverPoint session

The `symrcopy` command does not support control of Open Replicator RecoverPoint sessions, however for cleanup purposes RecoverPoint sessions can be terminated and removed as follows:

```
symrcopy terminate -file dev_file_1 -rp
```

Removing a remote device from a session

To remove a remote device from a session, it must be put in the device file.

The following example shows the `symrcopy remove` command:

```
symrcopy remove -file dev_file_1
```

Note: The remote device must be from a differential session in the Copied state.

Recreating a session

For differential push operations only, the copy session can be recreated using the `symrcopy recreate` command. The session must have been originally created with differential copying. Activating a recreated session begins an incremental update of the devices to copy any device tracks that were changed since the last time the copy session actively finished copying. Up to 15 sessions can be created for incremental updates per Symmetrix logical volume. Open Replicator uses the Symmetrix Differential Data Facility (SDDF) to set the track protection bitmaps and monitor track differences between the control and remote devices.

Note: Recreating a session creates a new point-in-time copy of the data.

The following example shows how to recreate and activate a copy session for incremental track updates:

```
symrcopy recreate -name rcopy_2 -file dev_file_3
symrcopy activate -session_name rcopy_2
```

When a session is recreated, the session can be renamed using the `-name` option.

For hot push operations, a copy session can be recreated to pre copy the incremental track updates in the background without activating the session by including the `-precopy` option in the command line. This shown in the following example:

```
symrcopy recreate -name rcopy_2 -file dev_file_3 -precopy
```

Note: The `-pace` option can be included in the command line to manage the speed of the replication process. Refer to "Setting the session pace" on page 39.

Recovering from a failed session

Failed sessions can be reactivated by issuing the `activate` command again, only if there has been no new data written to the control device since the failure occurred. If new data is indicated on devices that are part of the session, session activation will be blocked. If session activation is blocked and it is a non-differential session, terminate the session and issue the `create` and `activate` commands again, which will begin the copy from the beginning. If session activation is blocked and it is a differential session, recreate the session to create a new point-in-time copy.

Note: Support for reactivating failed sessions requires Enginuity version 5773 or higher.

When no new data is indicated on the devices in the session, the session is eligible to be reactivated. Use the `symrcopy query` command to check the status of a failed session. Failed sessions eligible for reactivation are indicated by a failed(*) status that includes an asterisk (*) symbol.

The following example presents a query output showing the failed devices in the session. The sessions shown are eligible for reactivation.

```
symrcopy -file dev_file_1 query -detail
```

```
Symmetrix ID: 000190300237

     Control Device                Remote Device            Flags     Status     Done Pace Name
------------------------- ------------------------------- ----- -------------- ---- --- ----
      Protected Modified
Sym   Tracks    Tracks    Identification                RI  CDSHUTZ CTL<=> REM (%)
----- --------- --------- ----------------------------- -- -------- ------------ ---- --- ---
01F8   33000         0  006048000000000619053594D314640 SD  X.XX.S.   Failed (*) N/A 5   N/A
01F9   33000         0  006048000000000619053594D314637 SD  X.XX.S.   Failed (*) N/A 5   N/A

Total ---------
 Tracks   66000
 MB(s)     4062.4
```

For the output legend, refer to page 40.

Restoring a session

For differential push operations only, the copy session is restored back to the control device by pulling back only the changed tracks from the remote device. The session must have been created with differential copying, and must be in the copied state. Hot or cold differential push sessions can be restored.

Note: Refer to the *EMC Solutions Enabler Installation Guide* for license information required for restore functionality.

For example, if all data is copied from the control device to the remote device(s) and then changes are made to the control device, use the `symrcopy restore` command to recover the original data from the remote device. When the command is issued, the session is recreated in restore mode and automatically activated. At the start of the restore operation, all control devices will be set to Not Ready status. If running a hot session, control devices will be returned to Ready status at the end of the operation (as the data begins copying). If running a cold session, the control devices will remain in Not Ready status.

The following example shows how to restore original data from a differential push session back to the control device:

```
symrcopy restore -file dev_file_3
```

Note: A session name can also be provided by using the `-session_name` option.

Note: The `-pace` option can be included in the command line to manage the speed of the replication process. Refer to "Setting the session pace" on page 39.

Restoring data using donor update

Differential push operations may be restored using the `-donor_update` option. Using this option with the `symrcopy restore` command, a copy is maintained on the remote device of any new data that has been written to the control device while the session is in the process of restoring.

The following example shows how to restore data back to the control device using the donor update option:

```
symrcopy restore -file dev_file_3 -donor_update
```

Note: The control device will be set to not ready before the operation and then set back to its previous state after the restore has begun.

If `-donor_update` option is used, a session cannot be renamed or devices cannot be removed from a session that is in the Restored state. The `-force` option must be used to create a new session using the same control device, recreate, or restore sessions that are in the Restored state when donor update is enabled. The `-force` option must be used to terminate a session that has donor update enabled.

After the session has finished restoring to the control device, use the `set donor_update off -consistent` command to deactivate the donor update portion of the session and maintain the consistency of data on the remote devices.

The following is an example how to set the donor update option to off and maintain consistency on the remote devices:

```
symrcopy set donor_update off -file dev_file_3 -consistent
```

Note: The `-donor_update` option may also be turned off while the session is in the RestInProg (restore in progress) state by including the `-force` option in the command line. The session will continue to restore in its current mode without donor update.

If the session is terminated, renamed, recreated, a device is removed, or another session is created using the same control device, the donor update portion of the session will automatically be deactivated and consistency on the remote devices will be lost. To maintain the consistency on the remote devices, issue the `set donor_update off -consistent` command prior to any of the previously listed actions.

Using VDEVs in Open Replicator

Open Replicator supports copy operations for a cold push session from a virtual device (VDEV). To accomplish this, Open Replicator works in conjunction with TimeFinder/Snap operations by copying data from an existing Snap session. This feature provides an alternative to hot copying, where all mapped directors must participate in the session. In a cold push session from a VDEV, the VDEV is required to be mapped to at least one director. At least one of the directors, to which the device is mapped, must be zoned to the remote device.

Note: This functionality requires Enginuity version 5874 or higher. Refer to the *EMC Solutions Enabler Installation Guide* for license information on snap devices.

To begin, a snapshot of the standard device data is created on a VDEV in a TimeFinder/Snap session. The VDEV is then used as the control device in the Open Replicator copy session. Only the directors to which the VDEV are mapped are required to adhere to the zoning rules for Open Replicator. The directors to which the standard device are mapped are not required to be zoned to the remote device.

Device requirements

The following devices and configuration requirements are necessary for running an Open Replicator session using VDEVs:

- A device containing the data to be copied to the remote array.
- A VDEV to hold a snapshot of the device containing the data to be copied. The VDEV must be mapped to at least one director and at least one of the mapped directors must be zoned to the remote device.
- A remote device that is mapped to at least one director, which is zoned to the Symmetrix array containing both the device that contains the data to be copied and the VDEV.

Limitations

The following limitations apply to Open Replicator sessions when using VDEVs:

- The VDEV must remain Not Ready to the user while the Open Replicator session exists.
- Only one Open Replicator session is allowed per VDEV control device. The number of Open Replicator sessions is limited to the number of VDEVs that can be created from the source device.
- Open Replicator restore to a TimeFinder/Snap session is not supported.
- Open Replicator sessions can only be created as cold differential or non-differential push operations.
- Open Replicator precopy feature is not supported.

Performing an Open Replicator session with VDEVs

The following steps explain how to run an Open Replicator session with VDEVs using TimeFinder/Snap and Open Replicator:

1. Create a TimeFinder/Snap session using the `symsnap create` command. Do not activate the session. Detailed instructions for creating a TimeFinder/Snap session and performing snap operations are provided in the *EMC Solutions Enabler TimeFinder Family CLI Product Guide*.
2. Create an Open Replicator session using the `symrcopy create` command, defining the snap device as control device. Do not activate the session. This creates an Open Replicator protected session on the VDEV.
3. Activate the Snap session using the `symsnap activate` command with the `-not_ready` option. If consistency is required, specify the `-consistent` option.

4. Activate the Open Replicator session using the `symrcopy activate` command. The Open Replicator protected session begins copying the data.
5. Wait for the Open Replicator copy session to complete. When the session has completed, the remote devices will contain a point-in-time copy of data from when the snap session was activated.

   Once the Open Replicator session has finished copying all of the data, the sessions can be recreated and reactivated as many times as desired.

The following steps describe how to recreate, activate, and terminate the sessions:

1. Recreate the TimeFinder/Snap session using the `symsnap recreate` command. This command clears the VDEV pointers and sets the Open Replicator protected tracks.
2. Recreate the Open Replicator session using the `symrcopy recreate` command.
3. Activate the TimeFinder/Snap session using the `symsnap activate` command. If consistency is required, specify the `-consistent` option.
4. Activate the Open Replicator session using the `symrcopy activate` command. The Open Replicator session begins copying the data.
5. When completely done using the Open Replicator session, use the `symrcopy terminate` command to terminate the session.
6. When completely done using the TimeFinder/Snap session, use the `symsnap terminate` command to terminate the session.

"Example 9: Performing a cold push from a VDEV" on page 112 provides a detailed example.

CHAPTER 2
Operational Rules and State Reference

This chapter details which SYMCLI and Rcopy operations are permissible outside of any current replicator session and whether an RCopy operation is permissible for certain specified device types.

Rules and conflicts with other SYMCLI operations

This section details whether a SYMCLI operation is permissible outside of any current replicator session.

The information in this section is organized by SYMCLI product and is from the command perspective, looking at an Rcopy controlling device.

Note: RCopy control devices that are pulling in are difficult to detect in the case of a push, and sources are difficult to detect in the case of a pull. Therefore, the following table is for the *controlling* device (the source of a push, or a target of a pull).

TimeFinder operations

Table 4 details which TimeFinder operations are permissible outside of any current replicator session.

SYMAPI_C_RCOPY_DEVICE is returned for the disallowed TimeFinder/Snap and TimeFinder/Clone operations below.

Table 4 TimeFinder operations

Action	Allowed
TimeFinder Establish, Full or Incremental	
STD is RCopy control device pushing out	Yes
STD is RCopy control device pulling in	Yes
BCV is RCopy control devices pushing out	Yes, only if in copied or restored state without donor_update
BCV is RCopy control device pulling in	No
TimeFinder Restore, Full or Incremental	
STD is RCopy control device pushing out	Yes, only if in copied or restored state without donor_update
STD is RCopy control device pulling in	No
BCV is RCopy control device pushing out	Yes
BCV is RCopy control device pulling in	No

SRDF operations

Table 5 details which SRDF® operations are permissible outside of any current replicator session.

Regardless of SRDF action, if the RCopy state is INVALID, FAILED, or TERMINATE_IN_PROG, the SRDF action will be rejected. The session must be terminated first.

Note: If the device is a cascaded SRDF R21 device, then both the R1 and R2 rules listed in Table 5 apply. If the action is not allowed for either an R1 or R2 device, then the action is not allowed for an R21 device.

Table 5 SRDF operations (page 1 of 2)

Action	Allowed
RDF Establish, Full or Incremental	
R1 is RCopy control device pushing out	Yes
R1 is RCopy control device pulling in	Yes, only applies to Enginuity version 5874 and higher.
R2 is RCopy control device pushing out	Yes, only if copied, created, recreated or restored without donor update.
R2 is RCopy control device pulling in	No
RDF Split	
R1 is RCopy control device pushing out	Yes
R1 is RCopy control device pulling in	Yes
R2 is RCopy control device pushing out	Yes
R2 is RCopy control device pulling in	N/A
RDF Restore, Full or Incremental, regardless of Rcopy state.	
R1 is RCopy control device pushing out	Yes, only if copied, created, recreated or restored without donor update.
R1 is RCopy control device pulling in	No
R2 is RCopy control device pushing out	Yes
R2 is RCopy control device pulling in	No
RDF Failover	
R1 is RCopy control device pushing out	Yes
R1 is RCopy control device pulling in	Yes
R2 is RCopy control device pushing out	Yes
R2 is RCopy control device pulling in	Yes
RDF Failback	
R1 is RCopy control device pushing out	No
R1 is RCopy control device pulling in	No
R2 is RCopy control device pushing out	No
R2 is RCopy control device pulling in	No

Table 5 SRDF operations (page 2 of 2)

Action	Allowed
RDF Update R1	
R1 is RCopy control device pushing out	No
R1 is RCopy control device pulling in	No
R2 is RCopy control device pushing out	Yes
R2 is RCopy control device pulling in	No
RDF Swap	
R1 is RCopy control device pushing out	No
R1 is RCopy control device pulling in	No
R2 is RCopy control device pushing out	No
R2 is RCopy control device pulling in	No
RDF Create Pair	
R1 is RCopy control device pushing out	No
R1 is RCopy control device pulling in	No
R2 is RCopy control device pushing out	No
R2 is RCopy control device pulling in	No
RDF Delete Pair	
R1 is RCopy control device pushing out	Yes
R1 is RCopy control device pulling in	Yes
R2 is RCopy control device pushing out	Yes
R2 is RCopy control device pulling in	Yes

Single SRDF operations

Table 6 details which single SRDF operations are permissible outside of any current replicator session.

Note: If the device is a cascaded SRDF R21 device, then both the R1 and R2 rules listed in Table 6 apply. If the action is not allowed for either an R1 or R2 device, then the action is not allowed for an R21 device

.

Table 6 Single SRDF operations (page 1 of 4)

Action	Allowed
RDF Link Suspend Suspends I/O traffic on the RDF links for the remotely mirrored RDF pair(s).	
R1 is RCopy control device pushing out	Yes
R1 is RCopy control device pulling in	Yes
R2 is RCopy control device pushing out	Yes
R2 is RCopy control device pulling in	N/A
RDF Link Resume Resumes I/O traffic on the RDF links for the remotely mirrored RDF pair(s).	
R1 is RCopy control device pushing out	Yes, only if copied, created, recreated, or restored without donor update.
R1 is RCopy control device pulling in	Yes, only if copied or created (applies to Enginuity version 5874 and higher).
R2 is RCopy control device pushing out	Yes, only if copied, created, recreated, or restored without donor update.
R2 is RCopy control device pulling in	No
RDF RW Enable R1 Mirror Write enables the source (R1) device to its local host.	
R1 is RCopy control device pushing out, cold	Yes
R1 is RCopy control device pushing out, hot	Yes
R1 is RCopy cold target	Yes
R1 is RCopy control device pulling in, hot	Yes
R2 is RCopy control device pushing out, cold	Yes
R2 is RCopy control device pushing out, hot	Yes
R2 is RCopy cold target	Yes
R2 is RCopy control device pulling in, hot	Yes

Table 6 Single SRDF operations (page 2 of 4)

Action	Allowed
RDF RW Enable R2 Mirror These link status changes do not affect the device status and so do not affect Rcopy.	
R1 is RCopy, RCopy control device pushing out, cold	Yes
R1 is RCopy control device pushing out, hot	Yes
R1 is RCopy, RCopy control device pulling in, cold	Yes
R1 is RCopy control device pulling in, hot	Yes
R2 is RCopy, RCopy control device pushing out, cold	Yes
R2 is RCopy control device pushing out, hot	Yes
R2 is RCopy, RCopy control device pulling in, cold	Yes
R2 is RCopy control device pulling in, hot	Yes
RDF Merge Track Tables Merge the track tables of the R1 and R2 devices.	
R1 is RCopy control device pushing out	Yes, an R1 is not owed tracks if its local invalids are zero and the R2 remote invalids are zero.
R1 is RCopy control device pulling in	Yes, an R1 is not owed tracks if its local invalids are zero and the R2 remote invalids are zero.
R2 is RCopy control device pushing out	Yes
R2 is RCopy control device pulling in	Yes
RDF RW Disable R2 Mirror Write disables the target (R2) device to its local host.	
R1 is RCopy control device pushing out	Yes
R1 is RCopy control device pulling in	Yes
R2 is RCopy control device pushing out	Yes
R2 is RCopy control device pulling in	Yes
RDF WD R1 Mirror	
R1 is RCopy control device pushing out	Yes
R1 is RCopy control device pulling in	Yes
R2 is RCopy control device pushing out	Yes
R2 is RCopy control device pulling in	Yes

Table 6 Single SRDF operations (page 3 of 4)

Action	Allowed
RDF WD R2 Mirror	
R1 is RCopy control device pushing out	Yes
R1 is RCopy control device pulling in	Yes
R2 is RCopy control device pushing out	Yes
R2 is RCopy control device pulling in	Yes
RDF Refresh R1 Mirror Marks any changed tracks on the source (R1) side to refresh from the R2 side.	
R1 is RCopy control device pushing out	No
R1 is RCopy control device pulling in	No
R2 is RCopy control device pushing out	Yes
R2 is RCopy control device pulling in	Yes
RDF Refresh R2 Mirror	
R1 is RCopy control device pushing out	Yes
R1 is RCopy control device pulling in	Yes
R2 is RCopy control device pushing out	No
R2 is RCopy control device pulling in	No
RDF Invalidate R1 Mirror	
R1 is RCopy control device pushing out	Yes
R1 is RCopy control device pulling in	Yes
R2 is RCopy control device pushing out	Yes
R2 is RCopy control device pulling in	Yes
RDF Invalidate R2 Mirror	
R1 is RCopy control device pushing out	Yes
R1 is RCopy control device pulling in	Yes
R2 is RCopy control device pushing out	Yes
R2 is RCopy control device pulling in	Yes
RDF Ready R1 Mirror	
R1 is RCopy control device pushing out	Yes
R1 is RCopy control device pulling in	Yes
R2 is RCopy control device pushing out	Yes
R2 is RCopy control device pulling in	Yes

Table 6 Single SRDF operations (page 4 of 4)

Action	Allowed
RDF Ready R2 Mirror	
R1 is RCopy control device pushing out	Yes
R1 is RCopy control device pulling in	Yes
R2 is RCopy control device pushing out	Yes
R2 is RCopy control device pulling in	Yes
RDF Not Ready R1 Mirror	
R1 is RCopy control device pushing out	Yes
R1 is RCopy control device pulling in	Yes
R2 is RCopy control device pushing out	Yes
R2 is RCopy control device pulling in	Yes
RDF Not Ready R2 Mirror	
R1 is RCopy control device pushing out	Yes
R1 is RCopy control device pulling in	Yes
R2 is RCopy control device pushing out	Yes
R2 is RCopy control device pulling in	Yes
RDF Resv 1 (Enable)	
R1 is RCopy control device pushing out	Yes
R1 is RCopy control device pulling in	Yes
R2 is RCopy control device pushing out	Yes
R2 is RCopy control device pulling in	Yes
RDF Resv 2 (Disable)	
R1 is RCopy control device pushing out	Yes
R1 is RCopy control device pulling in	Yes
R2 is RCopy control device pushing out	Yes
R2 is RCopy control device pulling in	Yes

TimeFinder/Snap and TimeFinder/Clone operations

Table 7 details which TimeFinder/Snap and TimeFinder/Clone operations are permissible outside of any current replicator session.

Table 7 TimeFinder/Snap and TimeFinder/Clone operations (page 1 of 2)

Action	Allowed
Snap — Create/Recreate	
To RCopy control device pushing out	No
To RCopy control device pulling in	No
From RCopy control device pushing out	Yes
From RCopy control device pulling in	No
Snap — Restore	
To RCopy control device pushing out	No
To RCopy control device pulling in	No
VDEV	
Can a VDEV be an RCopy control device pushing out	Yes (cold push only)
Can a VDEV be an RCopy control device pulling in	No
Clone — Create/Recreate	
To RCopy control device pushing out	Yes, only if in the copied or restored state without donor_update
To RCopy control device pulling in	No
From RCopy control device pushing out	Yes
From RCopy control device pulling in	Yes
Clone — Restore	
To RCopy control device pushing out	No
To RCopy control device pulling in	No
Online Configuration Change	
	No, hold bit is used on remote to prevent this.
Ready	
Online RCopy control device pushing out	Yes
Online RCopy control device pulling in	Yes
Offline RCopy control device pushing out	No
Offline RCopy control device pulling in	No
Not Ready	
Online RCopy control device pushing out	Yes
Online RCopy control device pulling in	Yes
Offline RCopy control device pushing out	N/A
Offline RCopy control device pulling in	N/A

Table 7 TimeFinder/Snap and TimeFinder/Clone operations (page 2 of 2)

Action	Allowed
RW Enable	
Online RCopy control device pushing out	Yes
Online RCopy control device pulling in	Yes
Offline RCopy control device pushing out	No
Offline RCopy control device pulling in	No
Write Disable	
Online RCopy control device pushing out	Yes
Online RCopy control device pulling in	Yes
Offline RCopy control device pushing out	No
Offline RCopy control device pulling in	No

Rules and states for replication sessions

This section details whether or not an Open Replicator copy operation is permissible outside of any current replicator session.

Note: If the device is a cascaded SRDF R21 device, then both the R1 and R2 rules listed in Table 8 apply. If the action is not allowed for either an R1 or R2 device, then the action is not allowed for an R21 device.

The information in Table 8 is from the RCopy command perspective.

Table 8 Replication copy operations (page 1 of 4)

Action	Allowed
RCopy Create/Activate/Set precopy mode, Push on a STD (src), where the BCV state is:	
NEVER_EST SYNC_IN_PROG SYNCHRONIZED SPLIT_IN_PROG SPLIT_BEFORE_SYNC SPLIT SPLIT_NO_INC RESTORED	Yes
SPLIT_BEFORE_RESTORE INVALID RESTORE_IN_PROG	No
RCopy Create/Activate/Set precopy mode, Push on a BCV (src), where the BCV state is:	
NEVER_EST SPLIT_NO_INC SPLIT	Yes
SPLIT_BEFORE_RESTORE INVALID SYNC_IN_PROG SYNCHRONIZED SPLIT_IN_PROG bkg SPLIT_IN_PROG SPLIT_BEFORE_SYNC RESTORE_IN_PROG RESTORED	No
RCopy Create/Recreate/Activate/Restore, Pull on a STD, where the BCV state is:	
NEVER_EST SYNC_IN_PROG SYNCHRONIZED SPLIT_IN_PROG SPLIT_BEFORE_SYNC SPLIT SPLIT_NO_INC RESTORED SPLIT_BEFORE_RESTORE	Yes

Table 8 Replication copy operations (page 2 of 4)

Action	Allowed
INVALID RESTORE_IN_PROG	No
RCopy Create/Recreate/Activate/Restore, Pull on a BCV, where the BCV state is:	
NEVER_EST SPLIT SPLIT_NO_INC SPLIT_BEFORE_RESTORE SPLIT_BEFORE_SYNC	Yes
SYNC_IN_PROG SYNCHRONIZED SPLIT_IN_PROG bkg SPLIT_IN_PROG RESTORE_IN_PROG RESTORED INVALID	No
RCopy Create/Recreate/Activate/Set precopy mode, push on an R1 (R1is RCopy control device pushing out), where the RDF state is:	
SPLIT SUSPENDED PARTITIONED	Yes
SYNCINPROG SYNCHRONIZED CONSISTENT TRANSMIT IDLE	Yes, only if the device is not owed tracks.
INVALID FAILED_OVER R1_UPDATED R1_UPDINPROG	No
RCopy Create/Recreate/Activate/Restore, pull on an R1 (R1 is copy target), where the RDF state is:	
SPLIT SUSPENDED PARTITIONED	Yes
SYNCHRONIZED CONSISTENT SYNCINPROG	Yes, only if the device is 5874 or higher, the device is not owed any tracks, and front-end zero detection is not specified.
INVALID FAILED_OVER R1_UPDATED R1_UPDINPROG TRANSMIT IDLE	No

Table 8 Replication copy operations (page 3 of 4)

Action	Allowed
RCopy Create/Recreate/Activate/Set precopy mode, push on an R2 (R2 is RCopy control device pushing out), where the RDF state is:	
SPLIT SUSPENDED FAILED_OVER PARTITIONED R1_UPDATED R1_UPDINPROG	Yes
MIXED INVALID SYNCINPROG SYNCHRONIZED NA CONSISTENT TRANSMIT IDLE	No
RCopy Create/Recreate/Activate/Restore, pull on an R2 (R2 is RCopy control device pulling in), where the RDF state is:	
SPLIT SUSPENDED FAILED_OVER PARTITIONED R1_UPDATED	Yes
INVALID SYNCINPROG SYNCHRONIZED R1_UPDINPROG MIXED NA CONSISTENT TRANSMIT IDLE	No
RCopy Create/Recreate/Activate/Restore/Set precopy mode, push/pull to Snap/Clone source:	
COPY_IN_PROGRESS COPIED COPY_ON_ACCESS CREATE_IN_PROG COPY_ON_WRITE RESTORED RECREATED PRECOPY CREATED	Yes (NO for Pull Snap.)
INVALID TERMINATE_IN_PROG RESTORE_IN_PROG FAILED	No

Table 8 Replication copy operations (page 4 of 4)

Action	Allowed
RCopy Create/Recreate/Activate/Restore/Set precopy mode, push/pull, to Snap/Clone target:	
COPIED	Yes
COPY_IN_PROGRESS COPY_ON_ACCESS INVALID CREATE_IN_PROG COPY_ON_WRITE RESTORED TERMINATE_IN_PROG RESTORE_IN_PROG FAILED RECREATED PRECOPY CREATED	No

Rules and states for device types

This section details whether or not an RCopy operation is permissible for the device types listed in Table 9.

Note: Open Replicator fully supports copy operations for Symmetrix thin devices. For information on Symmetrix Virtual Provisioning and creating thin devices, refer to the *EMC Solutions Enabler Symmetrix Array Controls CLI Product Guide*.

Table 9 RCopy operations by device type (page 1 of 2)

Action	Allowed
RCopy Create push where local device type is:	
Gatekeeper	Yes, as long as it is not the gatekeeper for the syscall.
WORM	No
CKD_3380 CKD_3390	No
AS400	No
RCopy Create pull, where local device type is:	
Gatekeeper	Yes, as long as it is not the gatekeeper for the syscall.
WORM	No
CKD_3380 CKD_3390	No
AS400	Yes on Symmetrix DMX arrays running Enginuity 5773.150 or higher and Symmetrix VMAX Family arrays running Enginuity 5874 or higher.
RCopy Create push or pull, where local device type is:	
Virtual device (VDEV)	Yes, as long as the following conditional are met: • Session is a cold push ONLY • Symmetrix VMAX Family arrays are running Enginuity 5874 or higher.
SFS device	No
STAR	Yes
Unconfigured device	No
Meta member	No
RCopy Create push, where remote device type is:	
WORM	No
CKD_3380 CKD_3390	No

Table 9 RCopy operations by device type (page 2 of 2)

Action	Allowed
RCopy Create pull, where remote device type is:	
WORM	No
CKD_3380 CKD_3390	No
AS400	Yes

CHAPTER 3
Open Replicator Examples

This chapter provides the following examples of using Symmetrix Open Replicator.

Example 1: Performing a hot pull operation

This example shows the migration of data from an older array to a Symmetrix DMX array. The hardware setup consists of the DMX control array whose array ID is 000187900041 (abbreviated as 41) connected to a controlling host. The remote array on the SAN is an older Symmetrix array. Three remote devices are each identified by their LUN WWN. Three control devices on the DMX are E9, EA, and EB. The control device capacity should be equal to or larger than the remote device extents that are being copied.

Note: If a copy needs to be forced from a larger device to a smaller device (for example, data was initially copied to a larger device and now the same data needs to be copied back to the smaller device), this is done by including the `-force_copy` option with the `symrcopy create` command.

For online (`-hot`) copying to the DMX, the control devices may be Read/Write enabled. The remote devices should not be receiving any updates from their local host.

The first step in a DMX remote copy operation is to define the control/remote device pairings in a text file. A control device or remote device is specified by either its unique LUN WWN or by a combination of the array ID and the device name (array ID:device). Enter the DMX control devices in the left-hand column, and the remote devices in the right-hand column, as shown below in the filename tango:

```
vi tango

   symdev=000187900041:E9  wwn=60060480000000000314353594D303737
   symdev=000187900041:EA  wwn=60060480000000000314353594D303738
   symdev=000187900041:EB  wwn=60060480000000000314353594D303739
```

The `symrcopy create` command creates three online copy sessions so that data on the remote devices specified in file `tango` can be copied to the control devices when the copy operation is activated. The `-pull` parameter specifies that the DMX control array is pulling the data to it. The `-hot` parameter indicates that the DMX remains online during the operation. The `-name` option gives these sessions the label name `Monday`. The `-donor_update` parameter indicates that all writes to the control device from the host will also be copied to the remote device.

```
symrcopy create -name Monday -pull -hot -donor_update -file tango
   -noprompt

'Create' operation execution is in progress for the device list in
device file 'tango'. Please wait...

'Create' operation successfully executed for the device list
in device file 'tango'.
```

The `symrcopy query` command indicates that the sessions for the control/remote device pairs in the file `tango` are in the Created state and are considered to be active sessions. When the control host can “see” the remote devices (in this case, a remote Symmetrix array), Open Replicator converts the remote device LUN WWN identifier (specified in file `tango`) to the “array ID:device” format (for example, `000000003143:0077`).

symrcopy query -file tango

```
Device File Name      : tango

       Control Device                  Remote Device             Flags     Status      Done
---------------------------- ---------------------------------- ----- --------------   ---
                   Protected
SID:symdev         Tracks    Identification                   RI CDSHUTZ CTL <=> REM     (%)
------------------ --------- --------------------------------- -- ----- --------------   ---
000187900041:00E9     138090 000000003143:0077                SD X..XXS. Created         N/A
000187900041:00EA     138090 000000003143:0078                SD X..XXS. Created         N/A
000187900041:00EB     138090 000000003143:0079                SD X..XXS. Created         N/A

Total              ---------
  Track(s)            414270
  MB(s)              12945.9

         Legend:
         R (Remote Device Vendor Identification)
            S = Symmetrix, C = Clariion, . = Unknown.

         I:  (Remote Device Specification Identifier)
            D = Device Name, W = LUN WWN, World Wide Name.

         Flags:
         (C): X = The background copy setting is active for this pair.
              . = The background copy setting is not active for this pair.
         (D): X = The session is a differential copy session.
              . = The session is not a differential copy session.
         (S): X = The session is pushing data to the remote device(s).
              . = The session is pulling data from the remote device(s).
         (H): X = The session is a hot copy session.
              . = The session is a cold copy session.
         (U): X = The session has donor update enabled.
              . = The session does not have donor update enabled.
         (T): M = The session is a migration session.
              R = The session is a RecoverPoint session.
              S = The session is a standard ORS session.
         (Z): X = The session has front-end zero detection enabled.
              . = The session does not have front-end zero detection enabled.
         (*): The failed session can be reactivated.
```

The `symrcopy activate` command activates the copy sessions for the pairings in the file `tango`. Copying from the remote array to the control array begins. At this point, migrated data on the on the DMX array can be accessed without waiting for the copy operation to complete.

symrcopy activate -file tango -noprompt

```
'Activate' operation execution is in progress for the device list in
device file 'tango'. Please wait...

'Activate' operation successfully executed for the device list
in device file 'tango'.
```

The `symrcopy query` command with the `-detail` option indicates that the sessions for the device pairs defined in the file `tango` are in the CopyInProg state and the percent (%) completion. The display also contains other details such as the pace. The default pace value of 5 provides relatively fast copy time with only a moderate impact on the application.

symrcopy query -file tango -detail

```
Device File Name      : tango

           Control Device             Remote Device         Flags     Status Done Pace Name
------------------------------------ ------------------------------- -------- ---- ----
                 Protected Modified
SID:symdev        Tracks    Tracks    Identification      RI  CDSHUTZ  CTL <=> REM (%)
--------------- --------- --------- --------------------------------- ---------- ---- ----
000187900041:00E9  128083     0     000000003143:0077   SD  X..XXS. CopyInProg 7  5  Monday
000187900041:00EA  123742     0     000000003143:0078   SD  X..XXS. CopyInProg10  5  Monday
000187900041:00EB  127455     0     000000003143:0079   SD  X..XXS. CopyInProg 7  5  Monday

Total               ---------
  Track(s)          379280
  MB(s)            11852.5
```

For the output legend, refer to page 69.

The `symrcopy verify` command checks at 60-second intervals (`-i`) to verify whether the control/remote device pairs are in the Copied state.

symrcopy verify -i 60 -file tango

```
NONE of the devices are in the 'Copied' state.

NONE of the devices are in the 'Copied' state.

NOT ALL of the devices are in the 'Copied' state.

ALL of the devices are in the 'Copied' state.
```

A subsequent `symrcopy query` command indicates that the sessions for the device pairs defined in the file `tango` are now in the Copied state and that copying is 100% complete.

symrcopy query -file tango

```
Device File Name      : tango

       Control Device                  Remote Device             Flags     Status       Done
---------------------------- ------------------------------------ ----- --------------   ----
                   Protected
SID:symdev         Tracks    Identification                   RI CDSHUTZ CTL <=> REM     (%)
------------------ --------- -------------------------------- -- ----- --------------   ----
000187900041:00E9          0 000000003143:0077                SD X..XXS. Copied          100
000187900041:00EA          0 000000003143:0078                SD X..XXS. Copied          100
000187900041:00EB          0 000000003143:0079                SD X..XXS. Copied          100

Total              ---------
  Track(s)                 0
  MB(s)                  0.0
```

For the output legend, refer to page 69.

The `symrcopy list` command displays the three inactive copy sessions on the DMX control array whose `sid` is 000187900041 (abbreviated as `41`).

symrcopy list -sid 41

```
Symmetrix ID: 000187900041

Control Device            Remote Device             Flags     Status       Done
--------------- ---------------------------------- ----- --------------   ----
      Protected
Sym   Tracks    Identification                   RI CDSHUTZ CTL <=> REM     (%)
----- --------- ---------------------------------- -- ----- --------------   ----
00E9          0 000000003143:0077                SD X..XXS. Copied          100
00EA          0 000000003143:0078                SD X..XXS. Copied          100
00EB          0 000000003143:0079                SD X..XXS. Copied          100

Total   -------
  Tracks      0
  MB(s)     0.0
```

For the output legend, refer to page 69.

The `symrcopy terminate` command ends all copy sessions defined in the file `tango`.

symrcopy terminate -file tango -noprompt

```
'Terminate' operation execution is in progress for the device list in
device file 'tango'. Please wait...

'Terminate' operation successfully executed for the device list
in device file 'tango'.
```

Another `symrcopy list` command verifies that there are no longer any copy sessions on the DMX control array.

symrcopy list -sid 41

```
Symmetrix ID: 000187900041
  No Devices with RCopy sessions were found.
```

With the copy operation complete, the remote application on the remote host can be started. However, any changes to remote data at this point are not migrated to the DMX array unless another full Open Replicator pull operation is performed.

Example 2: Performing a cold push operation to two different arrays

This example shows *offline* (`-cold`) copying of data from a DMX control array to two remote arrays on the SAN. The hardware setup consists of the DMX control array (sid 58) connected to a controlling host. Two remote arrays on the SAN are a Symmetrix array and a CLARiiON array. The single DMX control device is 1C5. An initial copy session copies to two remote devices (one on the Symmetrix and one on the CLARiiON).

Note: If copying data *online* from a DMX to other arrays, the control device cannot copy to multiple remote devices.

A subsequent copy session copies again from the same control device to devices on the two remote arrays. The remote device capacity should be equal to or larger than the control device extents that are being copied.

Note: If a copy needs to be forced from a larger device to a smaller device (for example, data was initially copied to a larger device and now the same data needs to be copied back to the smaller device), this is done by including the `-force_copy` option with the `symrcopy create` command.

Discovering CLARiiON arrays

The Open Replicator command cannot accept a `clardev` entry for a remote device unless the CLARiiON array is discovered by the host executing the command.

The first example shows how to discover a CLARiiON array that is directly connected to the controlling host. The second example shows the more common configuration in which the controlling host has to discover the CLARiiON array over the network.

Discovering an array directly connected to controlling host

The example shows how to discover a CLARiiON array that is directly connected to the controlling host. This example also shows how to discover and reference CLARiiON devices using the SYMCLI without having to use their LUN WWNs.

To discover the array, enter the `symcfg discover` command:

```
symcfg discover -clariion

This operation may take up to a few minutes. Please be patient...
```

To display the array discovered by the host, enter the `symcfg list` command:

```
symcfg list -clariion

                        C L A R I I O N

                        Firmware          Num     Num Phys   Num Clar
ClarID          Model   Version           Disks   Devices    Devices

APM00034801589  700     2.16.700.3.149     35      156        223
```

To display the physical device names on the CLARiiON array, enter the `symdev list` command. The display shows physical device names for those devices that have been mapped to a front-end director and recognized by the host. (Front-end mapping is a mechanism for exporting the logical view of a device to a host directly connected to the array.) The ellipsis (...) indicates output that was omitted for brevity.

```
symdev list -clariion
```

```
Clariion ID: APM00034801589

             Device                                Device
---- ---------------------  ---------------------------------------------------
Num   Physical Name         Config    Cap(MB)  WWN
---- ---------------------  ---------------------------------------------------

0034  rdmp/c4t0d7s2         RAID-5       5120  60060160F2810D00FC7ED16CC3D5D811
0035  rdmp/c4t0d6s2         RAID-5       5120  60060160F2810D00FD7ED16CC3D5D811
0036  rdmp/c4t0d5s2         RAID-5       5120  60060160F2810D00FE7ED16CC3D5D811
0037  rdmp/c4t0d4s2         RAID-5       5120  60060160F2810D00FF7ED16CC3D5D811
0038  rdmp/c4t0d3s2         RAID-5       5120  60060160F2810D00007FD16CC3D5D811
0039  rdmp/c4t0d2s2         RAID-5       5120  60060160F2810D00017FD16CC3D5D811
0040  rdmp/c4t0d1s2         RAID-5       4315  60060160F2810D00F859A07BC3D5D811
0041  rdmp/c4t0d0s2         RAID-5       4315  60060160F2810D00F959A07BC3D5D811
..................................................................................
0212  Not Visible           RAID-5       4315  60060160F2810D001F6947834B3AD911
0213  Not Visible           RAID-5       4315  60060160F2810D002E65F3904B3AD911
0214  Not Visible           RAID-5       4315  60060160F2810D002F65F3904B3AD911
0215  Not Visible           RAID-5       4315  60060160F2810D003065F3904B3AD911
0216  Not Visible           RAID-5       4315  60060160F2810D003165F3904B3AD911
0217  Not Visible           RAID-5       4315  60060160F2810D003265F3904B3AD911
0218  Not Visible           RAID-5       4315  60060160F2810D003365F3904B3AD911
0219  Not Visible           RAID-5       4315  60060160F2810D003465F3904B3AD911
0220  Not Visible           RAID-5       4315  60060160F2810D003565F3904B3AD911
0221  Not Visible           RAID-5       4315  60060160F2810D003665F3904B3AD911
0222  Not Visible           RAID-5       4315  60060160F2810D003765F3904B3AD911
...
```

Discovering an array over the network

If the controlling host does not have direct access to the CLARiiON array, the array needs to be discovered over the network. Using SYMCLI, there are two options for discovering the array on the controlling host.

The first option is as follows:

1. FC connect the CLARiiON array to the controlling host.
2. Register the username/password of storage processor A and storage processor B using the `symcfg authorization add` command.
3. To discover the arrays, enter the command `symcfg discover -clariion` or `symcfg discover -all`.

The second option is as follows:

1. To allow the controlling host access one or both CLARiiON array storage processors, enter the `symcfg authorization command` and provide the authorization information, as shown in this example:

```
symcfg authorization add -host api1064 -username clariion -password clariion
symcfg authorization add -host api1065 -username clariion -password clariion
```

Note: This command uses the `-host` parameter to specify the names of the storage processors (api1064 and api1065), including the username and password for the controlling host.

2. Use the `vi` command to create a text file named `clariion` that contains the IP address of each CLARiiON storage processor to be discovered as follows:

```
vi clariion

172.23.193.64   172.23.193.65
```

Note: The left-hand column must contain the IP address of storage processor A and the right-hand column must contain the IP address of storage processor B. If discovering only one of the storage processors, enter a dash (-) in the column of the undeclared processor.

3. Run the `discover -clariion` command using the text file created in step 2:

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

```
This operation may take up to a few minutes. Please be patient...
Discovering Clariion at SpA: 172.23.193.64 and SpB: 172.23.193.65 ...
   Done
```

The `symcfg list` command displays the CLARiiON array that was discovered remotely over the network by the second controlling host. The display reports only the number of physical device names that are visible to the controlling host, which does not "see" *remote* physical device names. Thus, the heading "Num Phys Devices" indicates zero.

```
symcfg list -clariion
```

```
                    C L A R I I O N

                         Firmware          Num     Num Phys   Num Clar
    ClarID         Model  Version           Disks   Devices    Devices

    APM00034801589  700     2.16.700.3.149     35        0         223
```

The `symdev list` command issued from this second host displays the devices on the CLARiiON array.

```
symdev list -clariion
```

```
Clariion ID: APM00034801589

             Device                                Device
---- ---------------------  ---------------------------------------------------
Num   Physical Name         Config    Cap(MB)  WWN
---- ---------------------  ---------------------------------------------------

0034  Not Visible           RAID-5       5120  60060160F2810D00FC7ED16CC3D5D811
0035  Not Visible           RAID-5       5120  60060160F2810D00FD7ED16CC3D5D811
0036  Not Visible           RAID-5       5120  60060160F2810D00FE7ED16CC3D5D811
0037  Not Visible           RAID-5       5120  60060160F2810D00FF7ED16CC3D5D811
0038  Not Visible           RAID-5       5120  60060160F2810D00007FD16CC3D5D811
0039  Not Visible           RAID-5       5120  60060160F2810D00017FD16CC3D5D811
0040  Not Visible           RAID-5       4315  60060160F2810D00F859A07BC3D5D811
0041  Not Visible           RAID-5       4315  60060160F2810D00F959A07BC3D5D811
.......................................................................................
0212  Not Visible           RAID-5       4315  60060160F2810D001F6947834B3AD911
0213  Not Visible           RAID-5       4315  60060160F2810D002E65F3904B3AD911
```

```
0214  Not Visible          RAID-5       4315  60060160F2810D002F65F3904B3AD911
0215  Not Visible          RAID-5       4315  60060160F2810D003065F3904B3AD911
0216  Not Visible          RAID-5       4315  60060160F2810D003165F3904B3AD911
0217  Not Visible          RAID-5       4315  60060160F2810D003265F3904B3AD911
```

Identifying control and remote devices, and ensuring that they are in the correct state are prerequisites for the DMX remote copy operation. To copy data offline *from* a DMX to other arrays, the DMX control device must be Not Ready to its host. For example, if the control device is not in the correct state, then execute the `symdev not_ready` command from the local host connected to the DMX control array. (Keep in mind that the remote devices should not be receiving any updates from their host during the copy operation.)

```
symdev not_ready 1c5 -sid 58 -noprompt
```

```
'Not Ready' Device operation successfully completed for the device.
```

The first step in a copy operation is to define the control/remote device pairings in a text file. The following command uses the vi text editor to create a text file named `samba`. The first pairing entered in this file is control device 1C5 on DMX control array 000187720758 (abbreviated as 58), and it is paired with device 39 on the remote CLARiiON whose ID is APM00034801589. The second line pairs the same control device with a second remote device (19C) located on a remote Symmetrix array whose ID is 000184500160.

```
vi samba
```

```
symdev=58:1C5 clardev=APM00034801589:39
symdev=58:1C5 symdev=000184500160:19C
```

The `symrcopy create` command with the `-cold` option creates a single offline copy session for the controlling DMX push operation. A full and immediate copy is made. All subsequent copying during that copy session automatically performs incremental copies, capturing only new writes to the control device. It is imperative, however, that the remote devices not be accessed by their host if a subsequent differential push (recreate and activate) will be performed. If the remote data needs to be accessed during this time, then a copy of the data needs to be made on the remote storage array:

```
symrcopy create -name Wednesday -push -cold -file samba -noprompt
```

```
'Create' operation execution is in progress for the device list in
device file 'samba'. Please wait...

'Create' operation successfully executed for the device list
in device file 'samba'.
```

The `symrcopy query` command indicates that the control/remote device pairs for the session defined in the file `samba` are in the Created state:

```
symrcopy -file samba query
```

```
Device File Name      : samba

       Control Device                  Remote Device             Flags     Status      Done
---------------------------- ----------------------------------- ----- --------------  ----
                    Protected
SID:symdev          Tracks    Identification                   RI CDSHUTZ CTL <=> REM     (%)
------------------- --------- ------------------------------- -- ----- --------------  ----
000187720758:01C5     138090 APM00034801589:0039              CD XXX..S. Created         N/A
-                          - 000184500160:019C                SD -     -                 -

Total               ---------
  Track(s)             138090
```

```
  MB(s)                 4315.3
```

For the output legend, refer to page 69.

The `symrcopy activate` command starts the copy operation for the device pairs defined in the file `samba`. Copying from the control device to the two remote devices begins:

symrcopy -file samba activate -noprompt

```
'Activate' operation execution is in progress for the device list in
device file 'samba'. Please wait...

'Activate' operation successfully executed for the device list
in device file 'samba'.
```

The `symrcopy query` command with the `-detail` option indicates that the device pairs defined in the file `samba` are in the CopyInProg state and that copying is 3% complete. Note that the default pace value 5 provides a moderately fast copy operation but with some impact on the application:

symrcopy -file samba query -detail

```
Device File Name       : samba

            Control Device          Remote Device            Flags     Status   Done Pace Name
------------------------------------ ------------------------------- ------------ ---- ----
                   Protected Modified
SID:symdev         Tracks    Tracks    Identification      RI CDSHUTZ CTL <=> REM (%)
------------------ --------- --------- ------------------------------- ------------ ---- ----
000187720758:01C5    133419        0   APM00034801589:0039 CD XXX..S.  CopyInProg  3  5 Wed
                        -              000184500160:019C    SD -    -             -   - -


Total               ---------
  Track(s)           133419
  MB(s)             4169.3
```

For the output legend, refer to page 69.

The `symrcopy set pace` command slows up the copy operation by setting the pace value to 7. This setting will result in less impact on the application.

symrcopy -file samba set pace 7 -noprompt

```
'Set Pace' operation execution is in progress for the device list in
device file 'samba'. Please wait...

'Set Pace' operation successfully executed for the device list
in device file 'samba'.
```

A subsequent `symrcopy query` command indicates that the device pairs defined in the file `samba` are still Copy-In-Progress (now 15% complete):

symrcopy -file samba query -detail

```
Device File Name       : samba

           Control Device                  Remote Device        Flags       Status Done Pace Name
------------------------------------ ---------------------------------- -------- ---- ----
                 Protected  Modified
SID:symdev         Tracks     Tracks    Identification      RI CDSHUTZ CTL <=> REM(%)
----------------- --------- --------- -------------------------- -- ----- --------------
000187720758:01C5  116667         0     APM00034801589:0039 CD XXX..S. CopyInProg 15  7  Wed
-                      -             -   000184500160:019C    SD -    -             -   - -
```

```
Total                 ---------
  Track(s)           116667
  MB(s)             3645.8
```

For the output legend, refer to page 69.

The `symrcopy verify` command checks at 30-second intervals (`-i`) to verify whether the control/remote device pairs are in the Copied state:

symrcopy -file samba verify -i 30

```
NONE of the devices are in the 'Copied' state.

NONE of the devices are in the 'Copied' state.

NONE of the devices are in the 'Copied' state.

ALL of the devices are in the 'Copied' state.
```

A subsequent `symrcopy query` command, as shown below, indicates that the device pairs defined in the file `samba` are in the Copied state (100% complete). This session is now considered to be inactive:

symrcopy -file samba query -detail

```
Device File Name       : samba

           Control Device                Remote Device      Flags      Status Done Pace Name
------------------------------------- ------------------------------ -------- ---- ---- -----
                    Protected Modified
SID:symdev          Tracks    Tracks    Identification       RI CDSHUTZ CTL <=> REM    (%)
------------------ --------- --------- -------------------------------- -- --------- ---- ----
000187720758:01C5          0         0   APM00034801589:0039 CD  XXX..S. Copied  100     7 Wed
  -                                  -   000184500160:019C    SD    -   -           -   - -

Total                 ---------
  Track(s)                  0
  MB(s)                   0.0
```

For the output legend, refer to page 69.

Since the first copy session is now inactive, a new copy session can be created using the same control device and other remote devices. The following command uses the `vi` text editor to create a text file named `foxtrot`. The first pairing entered in this file is again control device `1C5` on DMX array `58`. It is paired with a different remote CLARiiON device (specified this time by its LUN WWN). The second line pairs the same control device with a different remote device (`19D`) on the Symmetrix array whose abbreviated ID is `60`.

```
vi foxtrot

symdev=58:1C5  wwn=60060160F2810D00007FD16CC3D5D811
symdev=58:1C5  symdev=60:19D
```

The `symrcopy create` command with the `-cold` option creates another offline copy session for a second DMX push operation. A full and immediate copy is made. All subsequent copying during that copy session automatically performs incremental copies. The `-name` option gives this session the label name `Thursday`.

```
symrcopy create -name Thursday -push -cold -file foxtrot -noprompt
```

```
'Create' operation execution is in progress for the device list in
device file 'foxtrot'. Please wait...

'Create' operation successfully executed for the device list
in device file 'foxtrot'.
```

The `symrcopy query` command indicates that the control/remote pairs for the session defined in the file `foxtrot` are in the Created state. Note that Open Replicator converted the CLARiiON device LUN WWN identifier (specified in file `foxtrot`) to its "array ID:device" format (`APM00034801589:0038`):

symrcopy -file foxtrot query -detail

```
Device File Name      : foxtrot

        Control Device                Remote Device          Flags     Status  Done Pace Name
------------------------------------ ----------------------------------- --------- ---- ----
                 Protected Modified
SID:symdev       Tracks    Tracks      Identification        RI  CDSHUTZ CTL <=>REM    (%)
------------------ --------- -------- ------------------------- ------- ------ --- ----
000187720758:01C5    138090       0     APM00034801589:0038  CD   XXX..S. Created N/A 5   Thur
-                         -            000184500160:019D    SD           -    - -

Total              ---------
  Track(s)           138090
  MB(s)              4315.3
```

For the output legend, refer to page 69.

The `symrcopy activate` command starts the copy operation for the device pairs defined in the file `foxtrot`. Copying from the control device to two remote devices begins:

```
symrcopy -file foxtrot activate -noprompt

'Activate' operation execution is in progress for the device list in
device file 'foxtrot'. Please wait...

'Activate' operation successfully executed for the device list
in device file 'foxtrot'.
```

The `symrcopy list` command indicates that the previous copy sessions on the DMX control array (`sid 58`) are in the Copied state and considered inactive. The active copy sessions defined in the file `foxtrot` are in progress (CopyInProg):

symrcopy list -sid 58

```
Symmetrix ID: 000187720758

Control Device            Remote Device             Flags     Status     Done
--------------- ----------------------------------- ----- -------------- ----
      Protected
Sym   Tracks    Identification                   RI CDSHUTZ CTL <=> REM     (%)
----- --------- -------------------------------- -- ----- -------------- ----
01C5          0 APM00034801589:0039              CD XXX..S. Copied          100
-             - 000184500160:019C                SD -     -                 -
01C5     130669 APM00034801589:0038              CD XXX..S. CopyInProg        5
-             - 000184500160:019D                SD -     -                 -

Total              ---------
  Tracks             130669
  MB(s)              4083.4
```

For the output legend, refer to page 69.

The `symrcopy verify` command checks every 30 seconds to verify whether the control/remote device pairs are in the Copied state:

```
symrcopy -file foxtrot verify -i 30

NONE of the devices are in the 'Copied' state.

NONE of the devices are in the 'Copied' state.
.....................................................................
NONE of the devices are in the 'Copied' state.

ALL of the devices are in the 'Copied' state.
```

A subsequent `symrcopy list` command displays again the copy sessions on the DMX control array whose `sid` is `58`. All sessions are in the Copied state:

```
symrcopy list -sid 58
```

```
Symmetrix ID: 000187720758

Control Device            Remote Device             Flags     Status     Done
--------------- ---------------------------------- ----- -------------- ----
      Protected
Sym   Tracks    Identification                   RI CDSHUTZ CTL <=> REM     (%)
----- --------- -------------------------------- -- ----- -------------- ----
01C5          0 APM00034801589:0039              CD XXX..S. Copied          100
-             - 000184500160:019C                SD -     -                 -
01C5          0 APM00034801589:0038              CD XXX..S. Copied          100
-             - 000184500160:019D                SD -     -                 -

Total              ---------
  Tracks                   0
  MB(s)                  0.0
```

For the output legend, refer to page 69.

Since copy operations are complete, the `symdev ready` command can be used to make the control device Ready again to the DMX control host. Once the device is Ready, the host can again perform reads and writes to the device, for example, to make the control device `1C5` Ready again:

```
symdev ready 1c5 -sid 58 -noprompt

'Ready' Device operation successfully completed for the device.
```

After a time interval when write I/O occurs on the control device, an incremental copy operation to the same remote devices may be performed to move changed data there. Before doing this, make the control device Not Ready again to the DMX control host:

```
symdev not_ready 1c5 -sid 58 -noprompt

'Not Ready' Device operation successfully completed for the device.
```

The `symrcopy recreate` command recreates the `samba` copy session for the DMX control device and sets it up for a differential copy operation. (For brevity, the example does not recreate the `foxtrot` copy session, but it can be done in a similar way):

```
symrcopy -file samba recreate -noprompt

'Recreate' operation execution is in progress for the device list in
device file 'samba'. Please wait...

'Recreate' operation successfully executed for the device list
```

```
in device file 'samba'.
```

The `symrcopy activate` command starts the copy session defined in the file `samba`. Differential copying from control device to the remote devices begins:

```
symrcopy -file samba activate -noprompt

'Activate' operation execution is in progress for the device list in
device file 'samba'. Please wait...

'Activate' operation successfully executed for the device list
in device file 'samba'.
```

The `symdev ready` command shows here that the device cannot be made Ready while the copy is in progress (CopyInProg):

```
symdev ready 1c5 -sid 58 -noprompt

A specified device is involved in a Copy session and cannot be
   modified
```

The `symrcopy query` command shows that the sessions for the device pairs defined in the file `samba` are now in the Copied state:

```
symrcopy -file samba query

Device File Name      : samba

       Control Device                  Remote Device             Flags     Status     Done
---------------------------- ---------------------------------- ----- -------------- ----
                    Protected
SID:symdev          Tracks    Identification                   RI CDSHUTZ CTL <=> REM     (%)
------------------ --------- ---------------------------------- -- ----- -------------- ----
000187720758:01C5          0 APM00034801589:0039               CD XXX..S. Copied          100
-                          - 000184500160:019C                 SD -     -                 -

Total               ---------
  Track(s)                 0
  MB(s)                  0.0
```

For the output legend, refer to page 69.

Now that the copy is complete, a subsequent `symdev ready` command can make the control device Ready again to the DMX control host:

```
symdev ready 1c5 -sid 58 -noprompt

'Ready' Device operation successfully completed for the device.
```

The `symrcopy terminate` command ends the control device copy session defined in the file `samba`:

```
symrcopy -file samba terminate -noprompt

'Terminate' operation execution is in progress for the device list in
device file 'samba'. Please wait...

'Terminate' operation successfully executed for the device list
in device file 'samba'.
```

The `symrcopy terminate` command ends the control device copy session defined in the file `foxtrot`:

```
symrcopy -file foxtrot terminate -noprompt
```

```
'Terminate' operation execution is in progress for the device list in
device file 'foxtrot'. Please wait...

'Terminate' operation successfully executed for the device list
in device file 'foxtrot'.
```

The `symrcopy list` command indicates that there are no longer any copy sessions on the DMX control array (`sid 58`):

```
symrcopy list -sid 58

Symmetrix ID: 000187720758
  No Devices with RCopy sessions were found.
```

Example 3: Performing a hot push operation

The following example pushes data online from two DMX control devices to two remote CLARiiON devices, using various performance parameters.

The `vi` command uses the vi text editor to create a text file named `rumba` to set up the Open Replicator copy pairings. The first pairing is control device 1E3 on DMX control array 58 paired with a remote CLARiiON device whose LUN WWN is `60060160F2810D007E40DA1ABE00D911`. The second pairing is control device `1E4` on DMX control array `58` paired with a remote CLARiiON device whose LUN WWN is `60060160F2810D007D40DA1ABE00D911`.

```
vi rumba

symdev=58:1E3  wwn=60060160F2810D007E40DA1ABE00D911
symdev=58:1E4  wwn=60060160F2810D007D40DA1ABE00D911
```

The `symrcopy create` command with the `-hot` option creates two online copy sessions for the controlling DMX push operation. A full and immediate copy is made. All subsequent copying during that copy session automatically performs incremental copies, capturing only new writes to the control device. The `-name` option gives these sessions the label name `Friday`:

```
symrcopy create -name Friday -push -hot -file rumba -noprompt

'Create' operation execution is in progress for the device list in
   device file 'rumba'. Please wait...

'Create' operation successfully executed for the device list
in device file 'rumba'.
```

The `symrcopy activate` command starts the copy operation for the device pairs defined in the file `rumba`. Copying from the control devices to the two remote devices begins. Using the `-consistent` option creates a consistent point-in-time copy:

```
symrcopy activate -file rumba -consistent -noprompt

'Activate' operation execution is in progress for the device list in
   device file 'rumba'. Please wait...

'Activate' operation successfully executed for the device list in
   device file 'rumba'.
```

The `symrcopy query` command shows that copying is in progress (CopyInProg):

```
symrcopy query -file rumba

Device File Name      : rumba

       Control Device                  Remote Device             Flags     Status     Done
---------------------------- ---------------------------------- ----- -------------- ---
                   Protected
SID:symdev         Tracks    Identification                   RI CDSHUTZ CTL <=> REM     (%)
------------------ --------- ---------------------------------- -- ----- -------------- ---
000187720758:01E3     130588 60060160F2810D007E40DA1ABE00D911 CW XXXX.S. CopyInProg        5
000187720758:01E4     115750 60060160F2810D007D40DA1ABE00D911 CW XXXX.S. CopyInProg       16

Total              ---------
  Track(s)            246338
  MB(s)               7698.1
```

For the output legend, refer to page 69.

Setting the pace to 9 slows down the copy operation but results in less impact on the application:

symrcopy set pace 9 -file rumba -noprompt

```
'Set Pace' operation execution is in progress for the device list in
   device file 'rumba'. Please wait...

'Set Pace' operation successfully executed for the device list in
   device file 'rumba'.
```

Another `symrcopy query` shows that the copy operation is still in progress and that the percent “Done” is not much greater than previously:

symrcopy query -file rumba -detail

```
Device File Name       : rumba

          Control Device              Remote Device                      Flags     Status Done
Pace Name
------------------------------------- ---------------------------------- --------- ----
                 Protected Modified
SID:symdev         Tracks    Tracks     Identification                  RI CDSHUTZ CTL <=> REM
 (%)
------------------ --------- --------- ----------------------------- -- --------- ---- ----
000187720758:01E3    124405       0   60060160F2810D007E40DA1ABE00D911 CW XXXX.S.CopyInProg  9
9 Friday
000187720758:01E4    100767       0   60060160F2810D007D40DA1ABE00D911 CW XXXX.S.CopyInProg 27
9 Friday

Total               ---------
  Track(s)             225172
  MB(s)                7036.6
```

For the output legend, refer to page 69.

The `symrcopy set mode nocopy` command alters the copy operation for the least amount of impact on the application, changing the status from CopyInProg to CopyOnWrite:

symrcopy set mode nocopy -file rumba -noprompt

```
'Set Mode NoCopy' operation execution is in progress for the device
   list in
device file 'rumba'. Please wait...

'Set Mode NoCopy' operation successfully executed for the device list
in device file 'rumba'.
```

The `symrcopy query` command with the `-detail` option indicates that the copy status is now CopyOnWrite. Copying occurs only when there are writes to the DMX control device. The device pair state remains CopyOnWrite until the copy session is terminated or all tracks have been written. The host must write all tracks on the control device before the session state is Copied. Because writing all tracks seldom occurs, the `set mode copy` can be performed at some point when the application is least used to push the remaining data:

symrcopy query -detail -sid 58

```
Symmetrix ID: 000187720758

Control Device                      Remote Device           Flags     Status     Done Pace Name
------------------------ ----------------------------------- ----- -------------- ---- ----
--------
     Protected Modified
Sym  Tracks    Tracks    Identification                RI CDSHUTZ CTL <=> REM    (%)
----- --------- --------- ------------------------------- -- ----- -------------- ---- ----
---------
01E3     132725         0 60060160F2810D007E40DA1ABE00D911 .W .XXX.S. CopyOnWrite      19    9
Friday
01E4     127398         0 60060160F2810D007D40DA1ABE00D911 .W .XXX.S. CopyOnWrite      36    9
Friday

Total              ---------
  Tracks              260123
  MB(s)               8128.8
```

For the output legend, refer to page 69.

The `symrcopy set mode copy` command changes the operation so that continuous copying resumes:

```
symrcopy set mode copy -file rumba -noprompt

'Set Mode Copy' operation execution is in progress for the device list
   in
device file 'rumba'. Please wait...

'Set Mode Copy' operation successfully executed for the device list
in device file 'rumba'.
```

The `symrcopy verify` command checks every 30 seconds to verify whether the control/remote device pairs are in the Copied state:

```
symrcopy verify -file rumba -i 30

NONE of the devices are in the 'Copied' state.

NONE of the devices are in the 'Copied' state.
.....................................................................
NOT ALL of the devices are in the 'Copied' state.

ALL of the devices are in the 'Copied' state.
```

The `symrcopy query` command confirms that the copy operation is 100 percent complete:

```
symrcopy query -file rumba -detail

Device File Name      : rumba

          Control Device                        Remote Device           Flags     Status
Done Pace Name
------------------------------------- ----------------------------------- -----
-------------- ---- ----
               Protected Modified
SID:symdev          Tracks    Tracks    Identification                  RI CDSHUTZ   CTL <=>
REM    (%)
------------------ --------- --------- ------------------------------- -- -----
-------------- ---- ----
000187720758:01E3         0         0 60060160F2810D007E40DA1ABE00D911  CW XXXX.S. Copied 100
9 Friday
```

```
000187720758:01E4        0        0 60060160F2810D007D40DA1ABE00D911  CW XXXX.S. Copied 100
9 Friday

Total               ---------
  Track(s)                  0
  MB(s)                   0.0
```

For the output legend, refer to page 69.

The `symrcopy terminate` command ends the control device copy sessions defined in the file `rumba`:

```
symrcopy terminate -file rumba -noprompt
```

```
'Terminate' operation execution is in progress for the device list in
device file 'rumba'. Please wait...

'Terminate' operation successfully executed for the device list
in device file 'rumba'.
```

Example 4: Pushing data using BCVs as the control devices

This example shows the pushing of data from a DMX control array using TimeFinder BCVs as the control devices. The example shows how to get the full data initially to the remote devices via the BCVs, then repeats it incrementally. An important setup requirement is that the BCVs be mapped to an FA, and that FA must be zoned to the remote storage array. Also, the FA should not be the same FA for the control standard devices. The example uses two standard devices and two BCV devices on a DMX control array (`sid 35`) running Enginuity version 5671, and two remote devices on a remote Symmetrix array (`sid 60`).

To perform TimeFinder operations, the example first needs to create a device group (`conga`), add the two standard devices (`86` and `87`), and associate the BCV devices (`B8` and `B9`) to the device group:

```
symdg create conga
symdg -g conga addall dev -range 86:87 -sid 35
symbcv -g conga associateall dev -range B8:B9 -sid 35
```

The `vi` command uses the vi text editor to create a text file (also named `conga`) to set up the Open Replicator copy pairings. For example, the first pairing is BCV B8 on Symmetrix 35 with a remote device whose LUN WWN is 6006048000018450016053594D374646.

```
vi conga
```

```
symdev=35:B8  wwn=6006048000018450016053594D374646
symdev=35:B9  wwn=6006048000018450016053594D383030
```

The TimeFinder `symmir establish` command synchronizes the DMX control array's BCV pairs defined in device group `conga`. The result is a full copy of the data from the DMX standard devices to its BCV devices:

```
symmir -g conga establish -full -noprompt
```

```
'Full Establish' operation execution is in progress for
device group 'conga'. Please wait...
```

```
'Full Establish' operation successfully initiated for device group
   'conga'.
```

The `symmir verify` command checks at 60-second intervals to verify when the BCV pairs are synchronized:

```
symmir -g conga verify -i 60

None of the devices in group 'conga' are in the 'Synchronized or
   Restored'
state.

None of the devices in group 'conga' are in the 'Synchronized or
   Restored'
state.

All of the devices in group 'conga' are in the 'Synchronized or
   Restored' state.
```

The `symmir split` command with the `-consistent` option splits the DMX control array's BCV pairs so that the data is consistent after the split. To make the BCV inaccessible to the host after the split, use the `-not_ready` option:

```
symmir -g conga split -consistent -noprompt -not_ready

'Split' operation execution is in progress for
device group 'conga'. Please wait...

'Split' operation successfully executed for device group 'conga'.
```

The `symmir verify -split` command checks at 60-second intervals to determine when the BCV pairs have completed splitting in the background (`-bg`):

```
symmir -g conga verify -split -bg -i 60

All of the devices in group 'conga' have finished splitting in the
   background.
```

The `symmir query` command shows that the BCVs in the device group are split, which means they are ready to be the control devices in the Open Replicator copy sessions:

```
symmir -g conga  query

Device Group (DG) Name: conga
DG's Type             : REGULAR
DG's Symmetrix ID     : 000187900035


     Standard Device                    BCV Device                  State
------------------------- ------------------------------------- ------------
                     Inv.                                  Inv.
Logical        Sym  Tracks Logical              Sym       Tracks STD <=> BCV
------------------------- ------------------------------------- ------------

DEV001         0086      0 BCV001               00B8 *         0 Split
DEV002         0087      0 BCV002               00B9 *         0 Split

Total              -------                                -------
  Track(s)               0                                      0
  MB(s)                0.0                                    0.0
```

```
Legend:

(*): The paired BCV device is associated with this group.
```

The `symrcopy create` command with the `-cold` and `-push` options creates two offline copy sessions for those pairings defined in the `conga` text file. A full and immediate copy is made. All subsequent copying during that copy session automatically performs incremental copies, capturing only new writes to the control device. It is imperative, however, that the remote devices not be accessed by their host if a subsequent differential push (`recreate` and `activate`) will be performed. If the remote data needs to be accessed during this time, a copy of the data needs to be made on the remote storage array:

```
symrcopy create -file conga -cold -push -noprompt

'Create' operation execution is in progress for the device list in
   device file 'conga'. Please wait...

'Create' operation successfully executed for the device list
in device file 'conga'.
```

The `symrcopy activate` command starts the copy operation for the device pairs defined in the text file `conga`. Copying from the control devices to the two remote devices begins:

```
symrcopy activate -file conga -noprompt

'Activate' operation execution is in progress for the device list in
   device file 'conga'. Please wait...

'Activate' operation successfully executed for the device list in
   device file 'conga'.
```

The `symrcopy verify` command checks at 60-second intervals to verify whether the control/remote device pairs are in the Copied state:

```
symrcopy verify -file conga -i 60

NONE of the devices are in the 'Copied' state.

NONE of the devices are in the 'Copied' state.

NOT ALL of the devices are in the 'Copied' state.

ALL of the devices are in the 'Copied' state.
```

The `symrcopy query` command shows that the control/remote device pairs are in the Copied state:

```
symrcopy -file conga query

Device File Name      : conga

       Control Device                  Remote Device             Flags     Status     Done
---------------------------- ----------------------------------- ----- -------------- ----
                   Protected
SID:symdev         Tracks    Identification                   RI CDSHUTZ CTL <=> REM     (%)
------------------ --------- ---------------------------------- -- ----- -------------- ----
```

```
000187900035:00B8          0 000184500160:07FF                SD XXX..S. Copied          100
000187900035:00B9          0 000184500160:0800                SD XXX..S. Copied          100

Total              ---------
  Track(s)                 0
  MB(s)                  0.0
```

For the output legend, refer to page 69.

A TimeFinder `symmir query` command displays the device group `conga` and shows that changes have occurred (invalid tracks) on the DMX control array's standard devices while they were split from the BCVs:

symmir -g conga query

```
Device Group (DG) Name: conga
DG's Type             : REGULAR
DG's Symmetrix ID     : 000187900035


     Standard Device                    BCV Device                  State
------------------------- ------------------------------------- ------------
                     Inv.                                 Inv.
Logical        Sym  Tracks Logical              Sym       Tracks STD <=> BCV
------------------------- ------------------------------------- ------------

DEV001         0086   3125 BCV001               00B8 *        30 Split
DEV002         0087   3125 BCV002               00B9 *        30 Split

Total              -------                              -------
  Track(s)            6250                                   60
  MB(s)              195.3                                  1.9


Legend:

(*): The paired BCV device is associated with this group.
```

The `symmir establish` command incrementally re-establishes the TimeFinder BCV pairs:

symmir -g conga establish -noprompt

```
'Incremental Establish' operation execution is in progress for device
   group 'conga'. Please wait...

'Incremental Establish' operation successfully initiated for device
   group 'conga'.
```

The `symmir verify` command checks at 60-second intervals to verify when the BCV pairs reach the Synchronized state:

symmir -g conga verify -i 60

```
None of the devices in group 'conga' are in the 'Synchronized or
   Restored'
state.

All of the devices in group 'conga' are in the 'Synchronized or
   Restored' state.
```

The `symmir split` command splits the BCV pairs again in a consistent fashion, making the BCV devices Not Ready to their host:

symmir -g conga split -consistent –noprompt –not_ready

```
'Split' operation execution is in progress for
device group 'conga'. Please wait...

'Split' operation successfully executed for device group 'conga'.
```

The `symmir verify –split` command verifies again when the BCV pairs are finished splitting in the background:

symmir -g conga verify -split -bg

```
All of the devices in group 'conga' have finished splitting in the
   background.
```

The `symrcopy recreate` command recreates the copy sessions defined in the text file `conga`:

symrcopy recreate -file conga -noprompt

```
'Recreate' operation execution is in progress for the device list in
   device file 'conga'. Please wait...

'Recreate' operation successfully executed for the device list in
   device file 'conga'.
```

The `symrcopy query` command shows the control/remote pairs in the Recreated state. Note that the protected track count for the control devices is the same as their invalid track count displayed in the previous `symmir query` command:

symrcopy query -file conga

```
Device File Name      : conga

       Control Device                   Remote Device             Flags     Status     Done
---------------------------- ----------------------------------- ----- -------------- ----
                   Protected
SID:symdev         Tracks    Identification                   RI CDSHUTZ CTL <=> REM     (%)
------------------ --------- ------------------------------- -- ----- -------------- ----
000187900035:00B8       3125 000184500160:07FF                SD XXX..S. Recreated       N/A
000187900035:00B9       3125 000184500160:0800                SD XXX..S. Recreated       N/A

Total              ---------
  Track(s)              6250
  MB(s)                195.3
```

For the output legend, refer to page 69.

The `symrcopy activate` command activates the copy sessions. This initiates an incremental copy operation that copies only those device tracks that have changed since the initial full copy was performed:

symrcopy activate -file conga -noprompt

```
'Activate' operation execution is in progress for the device list in
   device file 'conga'. Please wait...

'Activate' operation successfully executed for the device list in
   device file 'conga'.
```

The `symrcopy verify` command checks at 60-second intervals to verify whether the control/remote device pairs are in the Copied state:

```
symrcopy verify -file conga -i 60

NONE of the devices are in the 'Copied' state.

NONE of the devices are in the 'Copied' state.

NOT ALL of the devices are in the 'Copied' state.

ALL of the devices are in the 'Copied' state.
```

Example 5: Pulling data online from an IBM F20 array to a DMX array

This example shows online data migration using a hot pull from an IBM F20 array to a DMX Symmetrix array. Oracle is part of the environment, as is the Veritas volume manager and file system. The example performs Open Replicator operations on the controlling host connected to the DMX. It performs operations that affect the remote devices on a remote host connected to the F20 array.

⚠CAUTION

An application on the DMX control devices can be run while Open Replicator is pulling remote data to those devices. The "copy-on-first-access" mechanism is used if the DMX host reads or writes data on tracks that have not been copied yet from the remote devices. In the case of write I/O, the I/O is temporarily suspended, the track is copied, and then the write is applied to the track. These changed tracks are not reflected back to the remote array.

The example uses the following steps to perform the operation (the “reconfigure” steps and remote shutdown/start steps are not shown):

1. Reconfigure the Fibre Channel switch to zone the DMX to the IBM F20.
2. Reconfigure the F20 array to assign devices to the DMX.
3. On the remote host, get the WWN of the IBM devices.
4. Get the DMX Symmetrix device numbers.
5. Create the Open Replicator device file.
6. Create the Open Replicator session.
7. On the remote host, shut down the remote application that uses the F20 array devices, un mount the remote file system(s), and deport volume group(s). By performing this step after creating the Open Replicator session, this ensures that the `create` is successful and the setup is correct before incurring application down time.
8. Activate the Open Replicator session.
9. Immediately after a successful `activate` command and before copy operations are complete, volume group(s) can be imported, file system(s) mounted on the DMX control host, and the application can be run on the DMX array.

10. When the copy operation (migration) is complete, the remote application on the remote host can be restarted. However, any changes to remote data at this point are not migrated to the DMX array unless another full Open Replicator pull operation is performed.

Prior to running Open Replicator in this environment, the following tasks must be performed:

- The Fibre Channel switch needs a zone from the DMX array's FA(s) to the IBM F20 host adapter(s).
- "Hosts" on the IBM F20, that represent the FA(s) on the DMX need to be configured and the IBM devices need to be assigned access to those hosts.

The example needs to identify the remote IBM devices that will be migrated to the DMX array. The EMC Inquiry Utility (version 7.3) can accomplish this when run on the remote host connected to the IBM array. If the Inquiry Utility is not available, use IBM tools. The following `inq` command identifies the IBM storage devices. Open Replicator needs to know the WWN of each IBM device:

`inq -shark_wwn`

```
For help type inq -h.


----------------------------------------------------------------------
IBM Device                Unit Serial          WWN
----------------------------------------------------------------------
/dev/rdsk/c3t10d0s2       02720499
49424d202020202032313035202020202020202020202020303237323034393 9
/dev/rdsk/c3t10d1s2       02820499
49424d202020202032313035202020202020202020202020303238323034393 9
/dev/rdsk/c3t10d2s2       02920499
49424d202020202032313035202020202020202020202020303239323034393 9
/dev/rdsk/c3t10d3s2       02A20499
49424d202020202032313035202020202020202020202020303241323034393 9
/dev/rdsk/c3t10d4s2       02B20499
49424d202020202032313035202020202020202020202020303242323034393 9
/dev/rdsk/c3t10d5s2       02C20499
49424d202020202032313035202020202020202020202020303243323034393 9
/dev/rdsk/c3t10d6s2       02D20499
49424d202020202032313035202020202020202020202020303244323034393 9
/dev/rdsk/c3t10d7s2       02E20499
49424d202020202032313035202020202020202020202020303245323034393 9
/dev/rdsk/c3t10d8s2       02F20499
49424d202020202032313035202020202020202020202020303246323034393 9
/dev/rdsk/c3t10d9s2       03020499
49424d202020202032313035202020202020202020202020303330323034393 9
```

After identifying the DMX control devices (`1C4` – `1CD`) that will receive the data, define the control/remote device pairings in a text file. The following command uses the `vi` text editor to create a text file named `devfile.pull`. The first pairing entered in this file is control device `1C4` on DMX control array `000187990125` (abbreviated as `25`), paired with the IBM device whose WWN is `49424d202020202032313035202020202020202020202020303237323034393 9`. The next DMX control device is paired with the next remote IBM device, and so forth:

```
vi devfile.pull
```

```
SYMDEV=25:1C4  wwn=49424d2020202020323130352020202020202020202020303237323034393 9
SYMDEV=25:1C5  wwn=49424d2020202020323130352020202020202020202020303238323034393 9
SYMDEV=25:1C6  wwn=49424d2020202020323130352020202020202020202020303239323034393 9
SYMDEV=25:1C7  wwn=49424d2020202020323130352020202020202020202020303241323034393 9
SYMDEV=25:1C8  wwn=49424d2020202020323130352020202020202020202020303242323034393 9
SYMDEV=25:1C9  wwn=49424d2020202020323130352020202020202020202020303243323034393 9
SYMDEV=25:1CA  wwn=49424d2020202020323130352020202020202020202020303244323034393 9
SYMDEV=25:1CB  wwn=49424d2020202020323130352020202020202020202020303245323034393 9
SYMDEV=25:1CC  wwn=49424d2020202020323130352020202020202020202020303246323034393 9
SYMDEV=25:1CD  wwn=49424d2020202020323130352020202020202020202020303330323034393 9
```

A `symrcopy create` command from the control host now sets up the Open Replicator hot pull operation. The command creates ten online copy sessions so that data on the remote IBM devices specified in file devfile.pull can be copied to the control devices when the copy operation is started. The `-pull` parameter specifies that the DMX control array is pulling the data to it. The `-hot` parameter indicates that the DMX application remains online during the operation. The `-name` option gives these sessions the label name IBM:

```
symrcopy create -name IBM -pull -hot -file devfile.pull -noprompt

'Create' operation execution is in progress for the device list in
device file 'devfile.pull'. Please wait...

'Create' operation successfully executed for the device list
in device file 'devfile.pull'.
```

Although not shown here, tasks are now performed on the remote host connected to the IBM F20 array. These operational tasks shutdown the remote application that uses the F20 array devices, un mount the remote file system(s), and deport volume group(s).

The `symrcopy activate` command activates the copy sessions for the pairings in the file devfile.pull. Copying from the remote IBM array to the DMX control array begins. At this point the migrated data can be accessed on the DMX array. The copy operation does need to be complete:

```
symrcopy activate -file devfile.pull -noprompt

'Activate' operation execution is in progress for the device list in
device file 'devfile.pull'. Please wait...

'Activate' operation successfully executed for the device list
in device file 'devfile.pull'.
```

The `symrcopy query` command with the `-detail` option indicates that the sessions for the device pairs defined in the file devfile.pull are in the CopyInProg state and the percent (0 %) completion. The display also contains other details such as the pace. The default pace value of 5 provides relatively fast copy time with only a moderate impact on the application:

```
symrcopy query -file devfile.pull -detail
```

```
Device File Name      : devfile.pull

Control Device                          Remote Device                   Flags     Status    Done Pace Name
------------------------------ ---------------------------------- ----- -------------- ---- ---- -------
                   Protected Modified
SID:symdev          Tracks   Tracks    Identification                 RI CDSHUTZ CTL <=> REM   (%)
----------- --------- --------- ---------------------------------- -- ----- -------------- ---- ---- ------
000187990125:01C4    304380       0 49424D2020202020323130352020202* .W X..X.S. CopyInProg      0    5 IBM
000187990125:01C5    304382       0 49424D2020202020323130352020202* .W X..X.S. CopyInProg      0    5 IBM
000187990125:01C6    304383       0 49424D2020202020323130352020202* .W X..X.S. CopyInProg      0    5 IBM
000187990125:01C7    304384       0 49424D2020202020323130352020202* .W X..X.S. CopyInProg      0    5 IBM
000187990125:01C8    304387       0 49424D2020202020323130352020202* .W X..X.S. CopyInProg      0    5 IBM
000187990125:01C9    304387       0 49424D2020202020323130352020202* .W X..X.S. CopyInProg      0    5 IBM
000187990125:01CA    304389       0 49424D2020202020323130352020202* .W X..X.S. CopyInProg      0    5 IBM
000187990125:01CB    304390       0 49424D2020202020323130352020202* .W X..X.S. CopyInProg      0    5 IBM
000187990125:01CC    304391       0 49424D2020202020323130352020202* .W X..X.S. CopyInProg      0    5 IBM
000187990125:01CD    304391       0 49424D2020202020323130352020202* .W X..X.S. CopyInProg      0    5 IBM

Total               ---------
  Track(s)            3043864
  MB(s)               95120.8
```

For the output legend, refer to page 69.

The ceiling value is the percentage of the bandwidth available for Open Replicator background copy transfers. This value can be set but should *only* be done after understanding the bandwidth being used by all other applications. There may be other applications using the same Fibre Channel director(s) as Open Replicator. Setting the Open Replicator ceiling too high for a director/port can have an adverse impact on these other applications. The ceiling settings that this example uses are for demonstration purposes only.

By default, the ceiling is undefined (as indicated by NONE in the display). The “Max” value is the estimated maximum bandwidth (MB/second) for each director/port of the DMX Symmetrix array. A bandwidth ceiling can be set that balances application performance against Open Replicator copy time. Because the ceiling is not set, the speed of the copy operation is currently controlled by the default pace setting (5) displayed earlier:

symrcopy list ceiling

```
Symmetrix ID: 000187990125

    Symmetrix Remote Copy Bandwidth Ceiling

                   Max   Set   Actual
          Dir:P   (MB)  (%)    (MB)
          -----   ----  ----  ------
          01C:0    130  NONE       0
          01C:1    130  NONE       0
          02C:0    130  NONE       0
          02C:1    130  NONE       0
          15C:0    130  NONE       0
          15C:1    130  NONE       0
          16C:0    130  NONE       0
          16C:1    130  NONE       0
          02D:0    130  NONE       0
          02D:1    130  NONE       0
          16D:0    130  NONE       0
          16D:1    130  NONE       0
```

The `symrcopy set ceiling` command sets a bandwidth ceiling of 10% for all director/ports in the DMX array (`sid 25`). This means that Open Replicator’s ceiling will be 10% of the estimated 130 MB/second FA bandwidth:

symrcopy set ceiling 10 -dir all -sid 25 -noprompt

```
'Set Ceiling' operation execution is in progress

'Set Ceiling' operation successfully executed
```

The `symrcopy list ceiling` command shows that the ceiling settings for all director/ports in the DMX array are now at 10%. Because the DMX control devices are mapped only to director/port `16C:1`, copying occurs only through this director/port. Note that the "Actual" bandwidth being used by Open Replicator for this operation is 13 MB/second, which is 10% of the estimated maximum. The pace value that controlled copy speed earlier is now ignored for any copy session that uses an FA where the ceiling is set:

symrcopy list ceiling

```
Symmetrix ID: 000187990125

    Symmetrix Remote Copy Bandwidth Ceiling

                   Max   Set   Actual
            Dir:P  (MB)  (%)    (MB)
            -----  ----  ----  ------
            01C:0   130    10       0
            01C:1   130    10       0
            02C:0   130    10       0
            02C:1   130    10       0
            15C:0   130    10       0
            15C:1   130    10       0
            16C:0   130    10       0
            16C:1   130    10      13
            02D:0   130    10       0
            02D:1   130    10       0
            16D:0   130    10       0
            16D:1   130    10       0
```

Another `symrcopy query` command displays the status of the copy operation at 30-second intervals:

symrcopy query -file devfile.pull -detail -i 30

```
Device File Name      : devfile.pull

Control Device                          Remote Device            Flags     Status     Done Pace Name
------------------------------------- ---------------------------------- ----- ------------- ---- ----
                   Protected Modified
SID:symdev         Tracks    Tracks     Identification                  RI CDSHUTZ CTL <=> REM   (%)
------------------ --------- --------- ---------------------------------- -- ----- -------------- ---- ----
000187990125:01C4    299935         0 49424D20202020203231303520202 02* .W X..X.S. CopyInProg       1   5 IBM
000187990125:01C5    299415         0 49424D20202020203231303520202 02* .W X..X.S. CopyInProg       1   5 IBM
000187990125:01C6    299500         0 49424D20202020203231303520202 02* .W X..X.S. CopyInProg       1   5 IBM
000187990125:01C7    299584         0 49424D20202020203231303520202 02* .W X..X.S. CopyInProg       1   5 IBM
000187990125:01C8    299692         0 49424D20202020203231303520202 02* .W X..X.S. CopyInProg       1   5 IBM
000187990125:01C9    299772         0 49424D20202020203231303520202 02* .W X..X.S. CopyInProg       1   5 IBM
000187990125:01CA    299774         0 49424D20202020203231303520202 02* .W X..X.S. CopyInProg       1   5 IBM
000187990125:01CB    299989         0 49424D20202020203231303520202 02* .W X..X.S. CopyInProg       1   5 IBM
000187990125:01CC    300146         0 49424D20202020203231303520202 02* .W X..X.S. CopyInProg       1   5 IBM
000187990125:01CD    301044         0 49424D20202020203231303520202 02* .W X..X.S. CopyInProg       1   5 IBM
Total               ---------
  Track(s)           2998851
  MB(s)              93714.1

Copy rate                      :     13.0 MB/S
Estimated time to completion   : 02:00:11
```

For the output legend, refer to page 69.

Another `symrcopy set ceiling` command sets a new bandwidth ceiling of 80% for director 16c, port 1, giving Open Replicator most of the possible FA bandwidth. Most likely this setting would impact any applications using director/port FA `16C:1`:

```
symrcopy set ceiling 80 -dir 16c -port 1 -sid 25 -noprompt

'Set Ceiling' operation execution is in progress

'Set Ceiling' operation successfully executed
```

The following `symrcopy list ceiling` command displays the ceiling setting for all directors, including director 16c, port 1. Although the actual bandwidth being used (currently 37 MB/second) is not at 80% of the maximum, it may approach that value as the copy operation progresses. However, the “Actual” value is affected by the SAN and the remote storage, which may keep this value below the percentage allowed for Open Replicator. If the ceiling is never reached, then the ceiling does not affect the copy rate:

```
symrcopy list ceiling

Symmetrix ID: 000187990125

    Symmetrix Remote Copy Bandwidth Ceiling

                   Max   Set   Actual
            Dir:P  (MB)  (%)    (MB)
            -----  ----  ----  ------
            01C:0   130    10       0
            01C:1   130    10       0
            02C:0   130    10       0
            02C:1   130    10       0
            15C:0   130    10       0
            15C:1   130    10       0
            16C:0   130    10       0
            16C:1   130    80      37
            02D:0   130    10       0
            02D:1   130    10       0
            16D:0   130    10       0
            16D:1   130    10       0
```

The `symrcopy verify` command checks at 60-second intervals (`-i`) whether the control/remote device pairs are in the Copied state. The Open Replicator copy operation is now complete:

```
symrcopy verify -copied -file devfile.pull -i 60

NONE of the devices are in the 'Copied' state.

NONE of the devices are in the 'Copied' state.
....
ALL of the devices are in the 'Copied' state.
```

The `symrcopy terminate` command ends all copy sessions defined in the file `devfile.pull`:

```
symrcopy terminate -file devfile.pull -noprompt

'Terminate' operation execution is in progress for the device list in
device file 'devfile.pull'. Please wait...

'Terminate' operation successfully executed for the device list
in device file 'devfile.pull'.
```

With the copy operation complete, the remote application on the remote host can be restarted (if necessary). However, any changes to remote data at this point are not migrated to the DMX array unless another full Open Replicator pull operation is performed.

Example 6: Pushing data online from a DMX to an Hitachi HDS 9960

This example shows online data copy in the form of a hot push from a DMX Symmetrix array to a Hitachi HDS 9960 array. The example performs Open Replicator operations on the controlling host connected to the DMX array. It performs operations that affect the remote devices on a remote host connected to the HDS array.

⚠CAUTION

Applications against remote HDS devices cannot be run at any time during the copy operation.

In general, use the following operations to perform a “hot push” copy operation:

1. Reconfigure the Fibre Channel switch to zone the DMX array to the HDS array.
2. Reconfigure the HDS array to assign devices to the DMX array.
3. On the remote host, get the WWN of the HDS array devices.
4. Get the DMX Symmetrix device numbers.
5. Create the Open Replicator device file.
6. Create the Open Replicator session.
7. Activate the Open Replicator session.
8. If necessary, recreate the Open Replicator session to set up copying of changes incrementally.
9. If Open Replicator is set up for differential copying, activate the Open Replicator session to copy the changes incrementally.

The example needs to identify the remote HDS devices that will receive data from the DMX array. EMC’s Inquiry Utility version 7.3 (SIL version 6.0.2) can accomplish this when run on the remote host connected to the HDS array. If the Inquiry Utility is not available, use HDS tools. The following `inq` command identifies the HDS storage devices. Open Replicator needs to know the WWN of each HDS device:

```
inq -hds_wwn

Inquiry utility, Version V7.3-690 (Rev 0.38)
(SIL Version V6.0.2.0 (Edit Level 640)
Copyright (C) by EMC Corporation, all rights reserved.
For help type inq -h.

-----------------------------------------------------------------------------------------------
-
HDS Device                Array Serial #   WWN                                          Array Type
-----------------------------------------------------------------------------------------------
-
/dev/rdsk/c3t10d0s2       65535            48495441434849205234303039434244303030  R400
/dev/rdsk/c3t10d1s2       65535            48495441434849205234303039434244303032  R400
/dev/rdsk/c3t10d2s2       65535            48495441434849205234303039434244303034  R400
/dev/rdsk/c3t10d3s2       65535            48495441434849205234303039434244303036  R400
/dev/rdsk/c3t10d4s2       65535            48495441434849205234303039434244303038  R400
/dev/rdsk/c3t10d5s2       65535            48495441434849205234303039434244303041  R400
/dev/rdsk/c3t10d6s2       65535            48495441434849205234303039434244303043  R400
/dev/rdsk/c3t10d7s2       65535            48495441434849205234303039434244303045  R400
```

After identifying the DMX control devices (1C4 – 1CD) that will send the data, define the control/remote device pairings in a text file. The following command uses the vi text editor to create a text file named devfile.push. The first pairing entered in this file is control device 1C4 on DMX control array 000187990125 (abbreviated as 25), paired with the HDS device whose WWN is 4849544143484920523430303943424430303030. The next DMX control device is paired with the next remote HDS device, and so forth:

```
vi devfile.push

   symdev=25:1C4  wwn=4849544143484920523430303943424430303030
   symdev=25:1C5  wwn=4849544143484920523430303943424430303032
   symdev=25:1C6  wwn=4849544143484920523430303943424430303034
   symdev=25:1C7  wwn=4849544143484920523430303943424430303036
   symdev=25:1C8  wwn=4849544143484920523430303943424430303038
   symdev=25:1C9  wwn=4849544143484920523430303943424430303041
   symdev=25:1CA  wwn=4849544143484920523430303943424430303043
   symdev=25:1CB  wwn=4849544143484920523430303943424430303045
   symdev=25:1CC  wwn=4849544143484920523430303943424430303130
   symdev=25:1CD  wwn=4849544143484920523430303943424430303132
```

A symrcopy create command from the control host now sets up the Open Replicator hot push operation. The command creates ten online copy sessions so that data on the control devices specified in file devfile.push can be copied to the remote HDS devices when the copy operation is started. The –push parameter specifies that the DMX control array is pushing the data to the remote array. The –hot parameter indicates that the DMX application remains online during the operation. Subsequent copying during these copy sessions will perform incremental copies, capturing only new writes to the control devices. The –name option gives these sessions the label name HDS:

```
symrcopy create -name HDS -push -hot -file devfile.push -noprompt

'Create' operation execution is in progress for the device list in
device file 'devfile.push'. Please wait...

'Create' operation successfully executed for the device list
in device file 'devfile.push'.
```

The symrcopy query command indicates that the sessions for the device pairs defined in the file devfile.plus are in the Created state. To display more detail, include the –detail option. To see the full WWN identifier of each remote device, include the –wwn option:

```
symrcopy query -file devfile.push

Device File Name      : devfile.push

       Control Device                  Remote Device             Flags     Status     Done
---------------------------- ----------------------------------- ----- -------------- ----
                   Protected
SID:symdev         Tracks    Identification                   RI CDSHUTZ CTL <=> REM     (%)
------------------ --------- --------------------------------- -- ----- -------------- ----
000187990125:01C4     435150 4849544143484920523430303943424* .W XXXX.S. Created         N/A
000187990125:01C5     435150 4849544143484920523430303943424* .W XXXX.S. Created         N/A
000187990125:01C6     435150 4849544143484920523430303943424* .W XXXX.S. Created         N/A
000187990125:01C7     435150 4849544143484920523430303943424* .W XXXX.S. Created         N/A
000187990125:01C8     435150 4849544143484920523430303943424* .W XXXX.S. Created         N/A
000187990125:01C9     435150 4849544143484920523430303943424* .W XXXX.S. Created         N/A
000187990125:01CA     435150 4849544143484920523430303943424* .W XXXX.S. Created         N/A
```

```
000187990125:01CB     435150 484954414348492052343030394342 4* .W XXXX.S. Created         N/A
000187990125:01CC     435150 484954414348492052343030394342 4* .W XXXX.S. Created         N/A
000187990125:01CD     435150 484954414348492052343030394342 4* .W XXXX.S. Created         N/A

Total               ---------
  Track(s)            4351500
  MB(s)                135984
```

For the output legend, refer page 69.

The ceiling value is the percentage of the bandwidth available for Open Replicator background copy transfers. This value can be set but should *only* be done after understanding the bandwidth being used by all other applications. There may be other applications using the same Fibre Channel director(s) as Open Replicator. Setting the Open Replicator ceiling too high for a director/port can have an adverse impact on these other applications. The ceiling settings that this example uses are for demonstration purposes only.

By default, the ceiling is undefined (as indicated by NONE in the display). The “Max” value is the estimated maximum bandwidth (MB/second) for each director/port of the DMX Symmetrix array. A bandwidth ceiling can be set that balances application performance against Open Replicator copy time:

```
symrcopy list ceiling

Symmetrix ID: 000187990125

    Symmetrix Remote Copy Bandwidth Ceiling

                   Max   Set   Actual
            Dir:P  (MB)  (%)    (MB)
            -----  ----  ----  ------
            01C:0   130  NONE       0
            01C:1   130  NONE       0
            02C:0   130  NONE       0
            02C:1   130  NONE       0
            15C:0   130  NONE       0
            15C:1   130  NONE       0
            16C:0   130  NONE       0
            16C:1   130  NONE       0
            02D:0   130  NONE       0
            02D:1   130  NONE       0
            16D:0   130  NONE       0
            16D:1   130  NONE       0
```

The `symrcopy set ceiling` command sets a bandwidth ceiling of 10% for all director/ports in the DMX array (`sid 25`). This means that Open Replicator’s ceiling will be 10% of the estimated 130 MB/second FA bandwidth:

```
symrcopy set ceiling 10 -dir all -sid 25 -noprompt

'Set Ceiling' operation execution is in progress

'Set Ceiling' operation successfully executed
```

The `symrcopy list ceiling` command displays that the ceiling settings for all director/ports in the DMX array are now at 10%. Once the Open Replicator session is activated, the `ceiling` can be displayed again to show its "Actual" value. Note that the pace value (including the default) is ignored for any copy session that uses an FA where the ceiling is set:

```
symrcopy list ceiling

Symmetrix ID: 000187990125

    Symmetrix Remote Copy Bandwidth Ceiling

                   Max   Set   Actual
            Dir:P  (MB)  (%)    (MB)
            -----  ----  ----  ------
            01C:0   130    10       0
            01C:1   130    10       0
            02C:0   130    10       0
            02C:1   130    10       0
            15C:0   130    10       0
            15C:1   130    10       0
            16C:0   130    10       0
            16C:1   130    10       0
            02D:0   130    10       0
            02D:1   130    10       0
            16D:0   130    10       0
            16D:1   130    10       0
```

The `symrcopy activate` command starts the copy operation for the device pairs defined in the file `devfile.push`. Copying from the control devices to the remote devices begins. Using the `-consistent` option creates a consistent point-in-time copy:

```
symrcopy activate -file devfile.push -consistent -noprompt

'Activate' operation execution is in progress for the device list in
device file 'devfile.push'. Please wait...

'Activate' operation successfully executed for the device list
in device file 'devfile.push'.
```

The `symrcopy list ceiling` command shows that the ceiling settings for all director/ports in the DMX array are now at 10%. Because the DMX control devices are mapped only to director/port `16C:1`, copying occurs only through this director/port. Note that the "Actual" bandwidth being used by Open Replicator for this operation is 13 MB/second, which is 10% of the estimated maximum:

```
symrcopy list ceiling

Symmetrix ID: 000187990125

    Symmetrix Remote Copy Bandwidth Ceiling

                   Max   Set   Actual
            Dir:P  (MB)  (%)    (MB)
            -----  ----  ----  ------
            01C:0   130    10       0
            01C:1   130    10       0
```

```
02C:0   130    10       0
02C:1   130    10       0
15C:0   130    10       0
15C:1   130    10       0
16C:0   130    10       0
16C:1   130    10      13
02D:0   130    10       0
02D:1   130    10       0
16D:0   130    10       0
16D:1   130    10       0
```

The `symrcopy query` command displays the status of the copy operation at 30-second intervals:

symrcopy query -file devfile.push -i 30

```
Device File Name      : devfile.push

       Control Device                   Remote Device              Flags     Status     Done
---------------------------- ------------------------------------ ----- -------------- ----
                    Protected
SID:symdev          Tracks    Identification                    RI CDSHUTZ CTL <=> REM     (%)
------------------ --------- -------------------------------- -- ----- -------------- ----
000187990125:01C4     416645 484954414348492052343030394342 4* .W XXXX.S. CopyInProg        4
000187990125:01C5     416888 484954414348492052343030394342 4* .W XXXX.S. CopyInProg        4
000187990125:01C6     416691 484954414348492052343030394342 4* .W XXXX.S. CopyInProg        4
000187990125:01C7     416632 484954414348492052343030394342 4* .W XXXX.S. CopyInProg        4
000187990125:01C8     416799 484954414348492052343030394342 4* .W XXXX.S. CopyInProg        4
000187990125:01C9     417123 484954414348492052343030394342 4* .W XXXX.S. CopyInProg        4
000187990125:01CA     416876 484954414348492052343030394342 4* .W XXXX.S. CopyInProg        4
000187990125:01CB     417092 484954414348492052343030394342 4* .W XXXX.S. CopyInProg        4
000187990125:01CC     417009 484954414348492052343030394342 4* .W XXXX.S. CopyInProg        4
000187990125:01CD     416717 484954414348492052343030394342 4* .W XXXX.S. CopyInProg        4

Total               ---------
  Track(s)            4168472
  MB(s)                130265
```

For the output legend, refer to page 69.

The `symrcopy set ceiling` command sets a bandwidth ceiling of 100% for all director/ports in the DMX array (`sid 25`), giving Open Replicator all of the possible FA bandwidth. Most likely this setting would impact any applications using director/port FA 16C:1:

symrcopy set ceiling 100 -dir all -sid 25 -noprompt

```
'Set Ceiling' operation execution is in progress.

'Set Ceiling' operation successfully executed.
```

The following `symrcopy list ceiling` command displays the new ceiling setting for all directors, including director 16c, port 1. Although the actual bandwidth being used (currently 47 MB/second) is not at 100% of the maximum, it may approach that value as the copy operation progresses. However, the “Actual” value is affected by the SAN and the remote storage, which may keep this value below the estimated maximum of the DMX director/port. If the ceiling is never reached, then the ceiling does not affect the copy rate:

symrcopy list ceiling

```
Symmetrix ID: 000187990125
```

```
                    Symmetrix Remote Copy Bandwidth Ceiling

                           Max    Set    Actual
                   Dir:P   (MB)   (%)     (MB)
                   -----   ----   ----   ------
                   01C:0    130    100        0
                   01C:1    130    100        0
                   02C:0    130    100        0
                   02C:1    130    100        0
                   15C:0    130    100        0
                   15C:1    130    100        0
                   16C:0    130    100        0
                   16C:1    130    100       47
                   02D:0    130    100        0
                   02D:1    130    100        0
                   16D:0    130    100        0
                   16D:1    130    100        0
```

Another `symrcopy query` command displays an updated status of the copy operation at 30-second intervals:

symrcopy query -file devfile.push -i 30

```
Device File Name      : devfile.push

       Control Device                  Remote Device             Flags     Status     Done
---------------------------- ----------------------------------- ----- -------------- ----
                    Protected
SID:symdev          Tracks    Identification                   RI CDSHUTZ CTL <=> REM     (%)
------------------ --------- ---------------------------------- -- ----- -------------- ----
000187990125:01C4     390617 484954414348492052343030394342 4* .W XXXX.S. CopyInProg       10
000187990125:01C5     381968 484954414348492052343030394342 4* .W XXXX.S. CopyInProg       12
000187990125:01C6     386389 484954414348492052343030394342 4* .W XXXX.S. CopyInProg       11
000187990125:01C7     386463 484954414348492052343030394342 4* .W XXXX.S. CopyInProg       11
000187990125:01C8     381195 484954414348492052343030394342 4* .W XXXX.S. CopyInProg       12
000187990125:01C9     399176 484954414348492052343030394342 4* .W XXXX.S. CopyInProg        8
000187990125:01CA     396252 484954414348492052343030394342 4* .W XXXX.S. CopyInProg        8
000187990125:01CB     399542 484954414348492052343030394342 4* .W XXXX.S. CopyInProg        8
000187990125:01CC     398678 484954414348492052343030394342 4* .W XXXX.S. CopyInProg        8
000187990125:01CD     397450 484954414348492052343030394342 4* .W XXXX.S. CopyInProg        8

Total               ---------
  Track(s)            3917730
  MB(s)                122429

Copy rate                      : 48.3 MB/S
Estimated time to completion   : 00:42:16
```

For the output legend, refer to page 69.

The `symrcopy verify` command checks at 60-second intervals (`-i`) to verify whether the control/remote device pairs are in the Copied state. The Open Replicator copy operation is now complete:

symrcopy verify -Copied -i 60 -file devfile.push

```
NONE of the devices are in the 'Copied' state.

NONE of the devices are in the 'Copied' state.

...

NOT ALL of the devices are in the 'Copied' state.

ALL of the devices are in the 'Copied' state.
```

Example 7: Pushing data online to a CLARiiON array

The following example shows an online data copy in the form of a hot push from a DMX Symmetrix array to a CLARiiON array. The example performs Open Replicator operations on the controlling host connected to the DMX. It performs copy operations using the `-precopy` option to begin copying data before the session is activated. The session is then activated and the data fully copied. The example also shows sessions that are created using the `-differential` option, which are then recreated and restored.

The DMX control devices (`04B3` – `04C2`) and the CLARiiON remote devices are defined in the device text file. The following command uses the `vi` text editor to create a text file named `production01`. The first pairing entered in this file is control device `04B3` on DMX control array `000190101982` (abbreviated as `82`), paired with the CLARiiON device whose WWN is `60060160F2810D00FC7ED16CC3D5D811`. The next DMX control device is paired with the next remote CLARiiON device, and so forth.

```
vi production01

symdev=82:04B3 wwn=60060160F2810D00FC7ED16CC3D5D811
symdev=82:04B4 wwn=60060160F2810D00FD7ED16CC3D5D811
symdev=82:04B5 wwn=60060160F2810D00FE7ED16CC3D5D811
symdev=82:04B6 wwn=60060160F2810D00FF7ED16CC3D5D811
symdev=82:04B7 wwn=60060160F2810D00007FD16CC3D5D811
symdev=82:04B8 wwn=60060160F2810D00017FD16CC3D5D811
symdev=82:04B9 wwn=60060160F2810D00F859A07BC3D5D811
symdev=82:04BA wwn=60060160F2810D00F959A07BC3D5D811
symdev=82:04BB wwn=60060160F2810D007C32B313BE00D911
symdev=82:04BC wwn=60060160F2810D007D32B313BE00D911
symdev=82:04BD wwn=60060160F2810D007E32B313BE00D911
symdev=82:04BE wwn=60060160F2810D007F32B313BE00D911
symdev=82:04BF wwn=60060160F2810D008032B313BE00D911
symdev=82:04C0 wwn=60060160F2810D008132B313BE00D911
symdev=82:04C1 wwn=60060160F2810D007C40DA1ABE00D911
symdev=82:04C2 wwn=60060160F2810D007D40DA1ABE00D911
```

The `symrcopy create` command is entered from the control host to set up the Open Replicator hot push operation. The command creates 16 online copy sessions, one for each device pair listed in the device file (`production01`). The `-push` parameter specifies that the DMX control array is pushing the data to the remote array. The `-hot` parameter indicates that the DMX application remains online during the operation. The `-precopy` option indicates that data will immediately begin copying in the background before the session is activated. Background copying in the Precopy state begins as soon as the command line is entered. Refer to "Background copying" on page 37 for information on the Precopy state:

```
symrcopy -file production01 create -precopy -hot -push -noprompt

'Create' operation execution is in progress for the device list
in device file 'production01'. Please wait...

'Create' operation successfully executed for the device list
in device file 'production01'.
```

The `symrcopy query` command indicates that the sessions for the device pairs defined in the file `production01` are in the Precopy state. To display more detail, include the `-detail` option. To see the full WWN identifier of each remote device, include the `-wwn` option:

```
symrcopy -file production01 query

Device File Name      : production01

       Control Device                  Remote Device             Flags     Status     Done
---------------------------- ---------------------------------- ----- -------------- ----
                    Protected
SID:symdev          Tracks    Identification                   RI  CDSHUTZ CTL <=> REM     (%)
------------------ --------- ---------------------------------- --  ----- -------------- ----
000190101982:04B3     275252  60060160F2810D00FC7ED16CC3D5D811 CW X.XX.S. Precopy          30
000190101982:04B4     275256  60060160F2810D00FD7ED16CC3D5D811 CW X.XX.S. Precopy          30
000190101982:04B5     275228  60060160F2810D00FE7ED16CC3D5D811 CW X.XX.S. Precopy          30
000190101982:04B6     275208  60060160F2810D00FF7ED16CC3D5D811 CW X.XX.S. Precopy          30
000190101982:04B7     275196  60060160F2810D00007FD16CC3D5D811 CW X.XX.S. Precopy          30
000190101982:04B8     275220  60060160F2810D00017FD16CC3D5D811 CW X.XX.S. Precopy          30
000190101982:04B9     275234  60060160F2810D00F859A07BC3D5D811 CW X.XX.S. Precopy          30
000190101982:04BA     275284  60060160F2810D00F959A07BC3D5D811 CW X.XX.S. Precopy          30
000190101982:04BB     275194  60060160F2810D007C32B313BE00D911 CW X.XX.S. Precopy          30
000190101982:04BC     275248  60060160F2810D007D32B313BE00D911 CW X.XX.S. Precopy          30
000190101982:04BD     275258  60060160F2810D007E32B313BE00D911 CW X.XX.S. Precopy          30
000190101982:04BE     275206  60060160F2810D007F32B313BE00D911 CW X.XX.S. Precopy          30
000190101982:04BF     275244  60060160F2810D008032B313BE00D911 CW X.XX.S. Precopy          30
000190101982:04C0     275280  60060160F2810D008132B313BE00D911 CW X.XX.S. Precopy          30
000190101982:04C1     275278  60060160F2810D007C40DA1ABE00D911 CW X.XX.S. Precopy          30
000190101982:04C2     275254  60060160F2810D007D40DA1ABE00D911 CW X.XX.S. Precopy          30

Total               ---------
  Track(s)            4403840
  MB(s)                137620
```

For the output legend, refer to page 69.

When the session is activated using the `symrcopy activate` command, the copy operation continues in the CopyInProg state. Using the `-consistent` option creates a consistent point-in-time copy:

```
symrcopy -file production01 activate -consistence -noprompt

'Activate' operation execution is in progress for the device list
in device file 'production01'. Please wait...

'Activate' operation successfully executed for the device list
in device file 'production01'.
```

Entering the `symrcopy query` command again indicates that the sessions for the device pairs defined in the file `production01` are in the CopyInProg state:

```
symrcopy -file production01 query

Device File Name      : production01
```

```
       Control Device                   Remote Device             Flags     Status      Done
---------------------------- ----------------------------------- ----- -------------- ----
                    Protected
SID:symdev          Tracks    Identification                    RI  CDSHUTZ CTL <=> REM     (%)
------------------ --------- -------------------------------- --  ----- -------------- ----
000190101982:04B3     267170 60060160F2810D00FC7ED16CC3D5D811 CW  X.XX.S. CopyInProg       60
000190101982:04B4     267220 60060160F2810D00FD7ED16CC3D5D811 CW  X.XX.S. CopyInProg       60
000190101982:04B5     267146 60060160F2810D00FE7ED16CC3D5D811 CW  X.XX.S. CopyInProg       60
000190101982:04B6     267188 60060160F2810D00FF7ED16CC3D5D811 CW  X.XX.S. CopyInProg       60
000190101982:04B7     267178 60060160F2810D00007FD16CC3D5D811 CW  X.XX.S. CopyInProg       60
000190101982:04B8     267082 60060160F2810D00017FD16CC3D5D811 CW  X.XX.S. CopyInProg       60
000190101982:04B9     267218 60060160F2810D00F859A07BC3D5D811 CW  X.XX.S. CopyInProg       60
000190101982:04BA     267226 60060160F2810D00F959A07BC3D5D811 CW  X.XX.S. CopyInProg       60
000190101982:04BB     267068 60060160F2810D007C32B313BE00D911 CW  X.XX.S. CopyInProg       60
000190101982:04BC     267128 60060160F2810D007D32B313BE00D911 CW  X.XX.S. CopyInProg       60
000190101982:04BD     267106 60060160F2810D007E32B313BE00D911 CW  X.XX.S. CopyInProg       60
000190101982:04BE     267214 60060160F2810D007F32B313BE00D911 CW  X.XX.S. CopyInProg       60
000190101982:04BF     267240 60060160F2810D008032B313BE00D911 CW  X.XX.S. CopyInProg       60
000190101982:04C0     267184 60060160F2810D008132B313BE00D911 CW  X.XX.S. CopyInProg       60
000190101982:04C1     267100 60060160F2810D007C40DA1ABE00D911 CW  X.XX.S. CopyInProg       60
000190101982:04C2     267236 60060160F2810D007D40DA1ABE00D911 CW  X.XX.S. CopyInProg       60

Total               ---------
  Track(s)            4274704
  MB(s)                133584
```

For the output legend, refer to page 69.

A later entry of the `symrcopy query` command indicates that the sessions for the device pairs defined in the file `production01` have completed data copying and are in the Copied state:

`symrcopy -file production01 query`

```
Device File Name      : production01

       Control Device                   Remote Device             Flags     Status        Done
---------------------------- ----------------------------------- ----- --------------    ----
                    Protected
SID:symdev          Tracks    Identification                    RI  CDSHUTZ CTL <=> REM     (%)
------------------ --------- -------------------------------- --  -----   -------------- ----
000190101982:04B3          0 60060160F2810D00FC7ED16CC3D5D811 CW  X.XX.S. Copied          100
000190101982:04B4          0 60060160F2810D00FD7ED16CC3D5D811 CW  X.XX.S. Copied          100
000190101982:04B5          0 60060160F2810D00FE7ED16CC3D5D811 CW  X.XX.S. Copied          100
000190101982:04B6          0 60060160F2810D00FF7ED16CC3D5D811 CW  X.XX.S. Copied          100
000190101982:04B7          0 60060160F2810D00007FD16CC3D5D811 CW  X.XX.S. Copied          100
000190101982:04B8          0 60060160F2810D00017FD16CC3D5D811 CW  X.XX.S. Copied          100
000190101982:04B9          0 60060160F2810D00F859A07BC3D5D811 CW  X.XX.S. Copied          100
000190101982:04BA          0 60060160F2810D00F959A07BC3D5D811 CW  X.XX.S. Copied          100
000190101982:04BB          0 60060160F2810D007C32B313BE00D911 CW  X.XX.S. Copied          100
000190101982:04BC          0 60060160F2810D007D32B313BE00D911 CW  X.XX.S. Copied          100
000190101982:04BD          0 60060160F2810D007E32B313BE00D911 CW  X.XX.S. Copied          100
000190101982:04BE          0 60060160F2810D007F32B313BE00D911 CW  X.XX.S. Copied          100
000190101982:04BF          0 60060160F2810D008032B313BE00D911 CW  X.XX.S. Copied          100
000190101982:04C0          0 60060160F2810D008132B313BE00D911 CW  X.XX.S. Copied          100
000190101982:04C1          0 60060160F2810D007C40DA1ABE00D911 CW  X.XX.S. Copied          100
000190101982:04C2          0 60060160F2810D007D40DA1ABE00D911 CW  X.XX.S. Copied          100

Total               ---------
  Track(s)                  0
  MB(s)                   0.0
```

For the output legend, refer to page 69.

The following example shows the same sessions created again. Sessions are then recreated and restored. In order for sessions to be recreated or restored, they must originally be created with differential copying. This functionality is available only for push operations.

The `symrcopy create` command is entered from the control host to set up the Open Replicator hot push operation. The session will perform incremental copies, capturing only new writes to the control devices. The `-precopy` option indicates that data will immediately begin copying in the background before the session is activated:

```
symrcopy -file production01 create -precopy -hot -push -noprompt

'Create' operation execution is in progress for the device list
in device file 'production01'. Please wait...

'Create' operation successfully executed for the device list
in device file 'production01'.
```

The session is then activated using the `symrcopy activate` command with the `-consistent` option to create a consistent point-in-time copy:

```
symrcopy -file production01 activate -consistence -noprompt

'Activate' operation execution is in progress for the device list
in device file 'production01'. Please wait...

'Activate' operation successfully executed for the device list
in device file 'production01'.
```

A subsequent `symrcopy query` command shows that the sessions for the device pairs defined in the file `production01` are in the CopyInProg state. The Flags indicate that the sessions are differential copy sessions:

```
symrcopy -file production01 query

Device File Name      : production01

       Control Device                  Remote Device             Flags     Status     Done
---------------------------- ----------------------------------- ----- -------------- ----
                    Protected
SID:symdev          Tracks    Identification                   RI  CDSHUTZ CTL <=> REM     (%)
------------------ --------- ---------------------------------- --  ----- -------------- ----
000190101982:04B3     273226 60060160F2810D00FC7ED16CC3D5D811 CW  XXXX.S. CopyInProg       30
000190101982:04B4     273148 60060160F2810D00FD7ED16CC3D5D811 CW  XXXX.S. CopyInProg       30
000190101982:04B5     273236 60060160F2810D00FE7ED16CC3D5D811 CW  XXXX.S. CopyInProg       30
000190101982:04B6     273242 60060160F2810D00FF7ED16CC3D5D811 CW  XXXX.S. CopyInProg       30
000190101982:04B7     273236 60060160F2810D00007FD16CC3D5D811 CW  XXXX.S. CopyInProg       30
000190101982:04B8     273246 60060160F2810D00017FD16CC3D5D811 CW  XXXX.S. CopyInProg       30
000190101982:04B9     273214 60060160F2810D00F859A07BC3D5D811 CW  XXXX.S. CopyInProg       30
000190101982:04BA     273206 60060160F2810D00F959A07BC3D5D811 CW  XXXX.S. CopyInProg       30
000190101982:04BB     273268 60060160F2810D007C32B313BE00D911 CW  XXXX.S. CopyInProg       30
000190101982:04BC     273248 60060160F2810D007D32B313BE00D911 CW  XXXX.S. CopyInProg       30
000190101982:04BD     273260 60060160F2810D007E32B313BE00D911 CW  XXXX.S. CopyInProg       30
000190101982:04BE     273224 60060160F2810D007F32B313BE00D911 CW  XXXX.S. CopyInProg       30
000190101982:04BF     273162 60060160F2810D008032B313BE00D911 CW  XXXX.S. CopyInProg       30
000190101982:04C0     273286 60060160F2810D008132B313BE00D911 CW  XXXX.S. CopyInProg       30
000190101982:04C1     273182 60060160F2810D007C40DA1ABE00D911 CW  XXXX.S. CopyInProg       30
000190101982:04C2     273196 60060160F2810D007D40DA1ABE00D911 CW  XXXX.S. CopyInProg       30
```

```
Total                 ---------
  Track(s)              4371580
  MB(s)                  136612
```

For the output legend, refer to page 69.

A subsequent query operation shows that the sessions for the device pairs defined in the file `production01` have completed copying data and are in the Copied state:

symrcopy -file production01 query

```
Device File Name      : production01

       Control Device                   Remote Device             Flags     Status     Done
---------------------------- ----------------------------------- ----- -------------- ----
                    Protected
SID:symdev          Tracks    Identification                    RI  CDSHUTZ CTL <=> REM     (%)
------------------ --------- ---------------------------------- --  ----- -------------- ----
000190101982:04B3          0 60060160F2810D00FC7ED16CC3D5D811 CW  XXXX.S. Copied          100
000190101982:04B4          0 60060160F2810D00FD7ED16CC3D5D811 CW  XXXX.S. Copied          100
000190101982:04B5          0 60060160F2810D00FE7ED16CC3D5D811 CW  XXXX.S. Copied          100
000190101982:04B6          0 60060160F2810D00FF7ED16CC3D5D811 CW  XXXX.S. Copied          100
000190101982:04B7          0 60060160F2810D00007FD16CC3D5D811 CW  XXXX.S. Copied          100
000190101982:04B8          0 60060160F2810D00017FD16CC3D5D811 CW  XXXX.S. Copied          100
000190101982:04B9          0 60060160F2810D00F859A07BC3D5D811 CW  XXXX.S. Copied          100
000190101982:04BA          0 60060160F2810D00F959A07BC3D5D811 CW  XXXX.S. Copied          100
000190101982:04BB          0 60060160F2810D007C32B313BE00D911 CW  XXXX.S. Copied          100
000190101982:04BC          0 60060160F2810D007D32B313BE00D911 CW  XXXX.S. Copied          100
000190101982:04BD          0 60060160F2810D007E32B313BE00D911 CW  XXXX.S. Copied          100
000190101982:04BE          0 60060160F2810D007F32B313BE00D911 CW  XXXX.S. Copied          100
000190101982:04BF          0 60060160F2810D008032B313BE00D911 CW  XXXX.S. Copied          100
000190101982:04C0          0 60060160F2810D008132B313BE00D911 CW  XXXX.S. Copied          100
000190101982:04C1          0 60060160F2810D007C40DA1ABE00D911 CW  XXXX.S. Copied          100
000190101982:04C2          0 60060160F2810D007D40DA1ABE00D911 CW  XXXX.S. Copied          100

Total                 ---------
  Track(s)                  0
  MB(s)                   0.0
```

For the output legend, refer to page 69.

At a later time, it is desired to recreate the session to incrementally update the remote devices to copy any device tracks that were changed since the time that the session actively finished copying. The `symrcopy recreate` command recreates the `production01` copy session for the DMX control devices and sets it up for a differential copy operation:

symrcopy -file production01 recreate -noprompt

```
'Recreate' operation execution is in progress for the device list
in device file 'production01'. Please wait...

'Recreate' operation successfully executed for the device list
in device file 'production01'.
```

The `symrcopy query` command shows that the control/remote pairs are in the Recreated state:

symrcopy -file production01 query

```
                        Device File Name      : production01

       Control Device                  Remote Device             Flags     Status     Done
---------------------------- ---------------------------------- ----- -------------- ----
                    Protected
SID:symdev          Tracks    Identification                   RI  CDSHUTZ CTL <=> REM     (%)
------------------ --------- -------------------------------- --  ----- -------------- ----
000190101982:04B3          0 60060160F2810D00FC7ED16CC3D5D811 CW  XXXX.S. Recreated       N/A
000190101982:04B4          0 60060160F2810D00FD7ED16CC3D5D811 CW  XXXX.S. Recreated       N/A
000190101982:04B5          0 60060160F2810D00FE7ED16CC3D5D811 CW  XXXX.S. Recreated       N/A
000190101982:04B6          0 60060160F2810D00FF7ED16CC3D5D811 CW  XXXX.S. Recreated       N/A
000190101982:04B7          0 60060160F2810D00007FD16CC3D5D811 CW  XXXX.S. Recreated       N/A
000190101982:04B8          0 60060160F2810D00017FD16CC3D5D811 CW  XXXX.S. Recreated       N/A
000190101982:04B9          0 60060160F2810D00F859A07BC3D5D811 CW  XXXX.S. Recreated       N/A
000190101982:04BA          0 60060160F2810D00F959A07BC3D5D811 CW  XXXX.S. Recreated       N/A
000190101982:04BB          0 60060160F2810D007C32B313BE00D911 CW  XXXX.S. Recreated       N/A
000190101982:04BC          0 60060160F2810D007D32B313BE00D911 CW  XXXX.S. Recreated       N/A
000190101982:04BD          0 60060160F2810D007E32B313BE00D911 CW  XXXX.S. Recreated       N/A
000190101982:04BE          0 60060160F2810D007F32B313BE00D911 CW  XXXX.S. Recreated       N/A
000190101982:04BF          0 60060160F2810D008032B313BE00D911 CW  XXXX.S. Recreated       N/A
000190101982:04C0          0 60060160F2810D008132B313BE00D911 CW  XXXX.S. Recreated       N/A
000190101982:04C1          0 60060160F2810D007C40DA1ABE00D911 CW  XXXX.S. Recreated       N/A
000190101982:04C2          0 60060160F2810D007D40DA1ABE00D911 CW  XXXX.S. Recreated       N/A

Total               ---------
  Track(s)                  0
  MB(s)                   0.0
```

For the output legend, refer to page 69.

Once the recreated session is activated, the incremental update of devices begins, copying any device tracks that were changed since the last time the copy session actively finished copying:

```
symrcopy -file production01 activate -noprompt

'Activate' operation execution is in progress for the device list
in device file 'production01'. Please wait...

'Activate' operation successfully executed for the device list
in device file 'production01'.
```

A later query operation shows that the devices have finished copying the incremental data:

```
symrcopy -file production01 query

Device File Name      : production01

       Control Device                  Remote Device             Flags     Status     Done
---------------------------- ---------------------------------- ----- -------------- ----
                    Protected
SID:symdev          Tracks    Identification                   RI  CDSHUTZ CTL <=> REM     (%)
------------------ --------- -------------------------------- --  ----- -------------- ----
000190101982:04B3          0 60060160F2810D00FC7ED16CC3D5D811 CW  XXXX.S. Copied          100
000190101982:04B4          0 60060160F2810D00FD7ED16CC3D5D811 CW  XXXX.S. Copied          100
000190101982:04B5          0 60060160F2810D00FE7ED16CC3D5D811 CW  XXXX.S. Copied          100
000190101982:04B6          0 60060160F2810D00FF7ED16CC3D5D811 CW  XXXX.S. Copied          100
000190101982:04B7          0 60060160F2810D00007FD16CC3D5D811 CW  XXXX.S. Copied          100
000190101982:04B8          0 60060160F2810D00017FD16CC3D5D811 CW  XXXX.S. Copied          100
000190101982:04B9          0 60060160F2810D00F859A07BC3D5D811 CW  XXXX.S. Copied          100
000190101982:04BA          0 60060160F2810D00F959A07BC3D5D811 CW  XXXX.S. Copied          100
000190101982:04BB          0 60060160F2810D007C32B313BE00D911 CW  XXXX.S. Copied          100
000190101982:04BC          0 60060160F2810D007D32B313BE00D911 CW  XXXX.S. Copied          100
000190101982:04BD          0 60060160F2810D007E32B313BE00D911 CW  XXXX.S. Copied          100
```

```
000190101982:04BE          0 60060160F2810D007F32B313BE00D911 CW  XXXX.S. Copied          100
000190101982:04BF          0 60060160F2810D008032B313BE00D911 CW  XXXX.S. Copied          100
000190101982:04C0          0 60060160F2810D008132B313BE00D911 CW  XXXX.S. Copied          100
000190101982:04C1          0 60060160F2810D007C40DA1ABE00D911 CW  XXXX.S. Copied          100
000190101982:04C2          0 60060160F2810D007D40DA1ABE00D911 CW  XXXX.S. Copied          100

Total               ---------
  Track(s)                  0
  MB(s)                   0.0
```

For the output legend, refer to page 69.

In the scenario described above, differential copy sessions were copied completely and then recreated to capture any additional changes made to the control devices since the last copy. This has created a point-in-time copy on the remote devices.

At a later time, it was discovered that a possible data corruption had occurred, which may have affected data on the control devices. To correct the issue, it has been decided that the last incremental copy of data to the remote devices should be restored back to the control devices.

To recover the original data from the remote devices since the last activation of the sessions, use the `symrcopy restore` command. For additional information, refer to "Restoring a session" on page 47:

```
symrcopy -file production01 restore -noprompt
```

```
'Incr Restore' operation execution is in progress for the device list
in device file 'production01'. Please wait...

'Incr Restore' operation successfully executed for the device list
in device file 'production01'.
```

A subsequent query operation shows that the control/remote pairs are now in the Restored state. Data has been 100% restored back to the control devices from the last time the sessions were activated for the differential recreate. Note that the flags identify that data is being pulled from the remote devices back to the control devices (S):

```
symrcopy -file production01 query
```

```
Device File Name      : production01

       Control Device                   Remote Device             Flags     Status     Done
---------------------------- ------------------------------------ ----- -------------- ----
                    Protected
SID:symdev          Tracks    Identification                    RI  CDSHUTZ CTL <=> REM     (%)
------------------ --------- ---------------------------------- --  ----- -------------- ----
000190101982:04B3          0 60060160F2810D00FC7ED16CC3D5D811 CW  XX.X.S. Restored        100
000190101982:04B4          0 60060160F2810D00FD7ED16CC3D5D811 CW  XX.X.S. Restored        100
000190101982:04B5          0 60060160F2810D00FE7ED16CC3D5D811 CW  XX.X.S. Restored        100
000190101982:04B6          0 60060160F2810D00FF7ED16CC3D5D811 CW  XX.X.S. Restored        100
000190101982:04B7          0 60060160F2810D00007FD16CC3D5D811 CW  XX.X.S. Restored        100
000190101982:04B8          0 60060160F2810D00017FD16CC3D5D811 CW  XX.X.S. Restored        100
000190101982:04B9          0 60060160F2810D00F859A07BC3D5D811 CW  XX.X.S. Restored        100
000190101982:04BA          0 60060160F2810D00F959A07BC3D5D811 CW  XX.X.S. Restored        100
000190101982:04BB          0 60060160F2810D007C32B313BE00D911 CW  XX.X.S. Restored        100
000190101982:04BC          0 60060160F2810D007D32B313BE00D911 CW  XX.X.S. Restored        100
000190101982:04BD          0 60060160F2810D007E32B313BE00D911 CW  XX.X.S. Restored        100
000190101982:04BE          0 60060160F2810D007F32B313BE00D911 CW  XX.X.S. Restored        100
000190101982:04BF          0 60060160F2810D008032B313BE00D911 CW  XX.X.S. Restored        100
000190101982:04C0          0 60060160F2810D008132B313BE00D911 CW  XX.X.S. Restored        100
000190101982:04C1          0 60060160F2810D007C40DA1ABE00D911 CW  XX.X.S. Restored        100
000190101982:04C2          0 60060160F2810D007D40DA1ABE00D911 CW  XX.X.S. Restored        100
```

```
Total                 ---------
  Track(s)                    0
  MB(s)                     0.0
```

For the output legend, refer to page 69.

The `symrcopy terminate` command ends all copy sessions defined in the file `production01`:

```
symrcopy terminate -file production01 -noprompt

'Terminate' operation execution is in progress for the device list in
device file 'production01'. Please wait...

'Terminate' operation successfully executed for the device list
in device file 'production01'.
```

Example 8: Obtaining port and LUN information

The following example shows how to list the port and LUN WWNs seen from a specific Symmetrix (000190101982) using the `symsan` command. The example also shows how to list all director and port information for a specific CLARiiON by WWN (5006016010601DAC) and Symmetrix information for a specific director (3c) and port (0). The `symsan` command can be used to validate that the zoning between the port and target is correct. It does not require a created Open Replicator session. Use the `symsan` command to display remote ports' WWNs, and the LUN's WWNs seen behind a remote port WWN.

Note: For details about `symsan` command syntax, refer to the *EMC Solutions Enabler Symmetrix CLI Command Reference*.

Use the `symsan` command with the `-sanports` option to list all of the SAN ports and remote port WWNs for Symmetrix ID 000190101982. The Symmetrix ID number may be truncated as long as there are no other Symmetrix arrays existing with the same ending numbers:

```
symsan list -sid 82 -dir all -p all -sanports

Symmetrix ID: 000190101982

      Flags                                  Num
DIR:P   I   Vendor        Array            LUNs Remote Port WWN
----- ----- ------------- ---------------- ---- --------------------------------
13A:0   .   EMC Symmetrix 000187900830        9 5006048ACCC8E78F
14A:0   .   EMC Symmetrix 000190101978        8 50060482D52E768D
03B:0   X   EMC Symmetrix 000190101978        1 50060482D52E7692
03B:0   .   EMC CLARiiON  APM00034801589    167 5006016810601DAC
03B:0   .   EMC CLARiiON  APM00051602590      8 50060160306021F1
03B:0   X   EMC CLARiiON  N/A                 1 50060168306021F1
04B:0   .   EMC Symmetrix 000190101978       55 50060482D52E7693
03C:0   .   EMC Symmetrix 000190101982       16 5006048AD52E7783
03C:0   .   EMC Symmetrix 000190101978     1024 5006048AD52E7682
04C:0   .   EMC Symmetrix 000190101978       10 5006048AD52E7683
04C:0   .   EMC Symmetrix 000190101982     1026 5006048AD52E7782
13D:0   .   EMC Symmetrix 000190101978       38 50060482D52E7696

Legend:
```

```
 Flags: (I)ncomplete : X = record is incomplete, . = record is complete.
```

The above output shows that remote port WWN 5006016010601DAC is listed for CLARiiON array APM00034801589, director 03B and port 0. By obtaining this information, the device LUNs and the LUN WWNs for that array can be listed.

Use the `symsan` command with the `-sanluns` option to list all of the device LUNs and ports that are visible behind the CLARiiON remote port WWN (5006016010601DAC):

```
symsan list -sid 82 -dir all -p all -sanluns -wwn 5006016010601DAC

Symmetrix ID:      000190101982
Remote Port WWN:   5006016010601DAC

      ST
       A
       T Flags  Block   Capacity   LUN   Dev  LUN
DIR:P  E ICRTHS Size      (MB)     Num   Num  WWN
----- -- ------ ----- ----------- ----- ----- --------------------------------
03B:0 RW ...F.X   512       56320    34  0034 60060160F2810D00FC7ED16CC3D5D811
03B:0 RW ...F.X   512       10240    35  0035 60060160F2810D00FD7ED16CC3D5D811
03B:0 RW ...FXX   512       10240    36  0036 60060160F2810D00FE7ED16CC3D5D811
03B:0 RW ...FXX   512       10240    37  0037 60060160F2810D00FF7ED16CC3D5D811
03B:0 RW ...F.X   512       10240    38  0038 60060160F2810D00007FD16CC3D5D811
03B:0 RW ...F.X   512       10240    39  0039 60060160F2810D00017FD16CC3D5D811
03B:0 RW ...FXX   512       14555    40  0040 60060160F2810D00F859A07BC3D5D811
03B:0 RW ...FXX   512        9435    41  0041 60060160F2810D00F959A07BC3D5D811
03B:0 RW ...F.X   512       10240    42  0042 60060160F2810D007C32B313BE00D911
03B:0 RW ...F.X   512       10240    43  0043 60060160F2810D007D32B313BE00D911

<. . .>
Legend:
Flags:  (I)ncomplete : X = record is incomplete, . = record is complete.
        (C)ontroller : X = record is controller, . = record is not controller.
        (R)erserved  : X = record is reserved,   . = record is not reserved.
        (T)ype       : X = A = AS400, F = FBA, C = CKD, . = Unknown
       t(H)in        : X = record is a thin dev, . = record is not a thin dev.
        (S)ymmetrix  : X = Symmetrix device,     . = not Symmetrix device
```

Note: The output in the above example has been truncated for brevity.

The SAN port output obtained in the first example shows remote port WWN 5006048AD52E7682 listed for Symmetrix array 000190101982, director 03C and port 0. By obtaining this information, the device LUNs and the LUN WWNs for that array can be listed.

Use the `symsan` command with the `-sanluns` option to list the specific device LUNs and ports that are visible behind the Symmetrix remote port WWN (5006048AD52E7682) for a specific director (3c) and port (0):

```
symsan list -sid 82 -dir 3c -p 0 -sanluns -wwn 5006048AD52E7682

Symmetrix ID:      000190101982
Remote Port WWN:   5006048AD52E7682

      ST
       A
       T Flags  Block   Capacity   LUN   Dev  LUN
DIR:P  E ICRTHS Size      (MB)     Num   Num  WWN
----- -- ------ ----- ----------- ----- ----- ---------------------------------
03C:0 RW ..F.X    512         898     0  0477 6006048000019010197853303034373 7
03C:0 RW ..F.X    512         898     1  0478 6006048000019010197853303034373 8
03C:0 RW ..FXX    512         898     2  0479 6006048000019010197853303034373 9
```

```
03C:0 RW ..FXX    512         898     3  047A 60060480000190101978533030343741
03C:0 RW ..F.X    512         898     4  047B 60060480000190101978533030343742
03C:0 RW ..F.X    512         898     5  047C 60060480000190101978533030343743
03C:0 RW ..FXX    512         898     6  047D 60060480000190101978533030343744
03C:0 RW ..FXX    512         898     7  047E 60060480000190101978533030343745
03C:0 RW ..FXX    512         898     8  047F 60060480000190101978533030343746
03C:0 RW ..FXX    512         898     9  0480 60060480000190101978533030343830
03C:0 RW ..F.X    512         898     A  0481 60060480000190101978533030343831
03C:0 RW ..F.X    512         898     B  0482 60060480000190101978533030343832
03C:0 RW ..FXX    512         898     C  0483 60060480000190101978533030343833
03C:0 RW ..FXX    512         898     D  0484 60060480000190101978533030343834
03C:0 RW ..F.X    512         898     E  0485 60060480000190101978533030343835
```

For the output legend, refer to previous output example.

Example 9: Performing a cold push from a VDEV

The following example shows how to perform a cold push session from a Virtual Device (VDEV).

The first step is to create a TimeFinder/Snap session using the `symsnap create` command. Do not activate the session:

Note: Detailed instructions for creating a TimeFinder/Snap session and performing snap operations are provided in the *EMC Solutions Enabler TimeFinder Family CLI Product Guide*.

```
symsnap -g snap1 create -noprompt -v

'Create' operation execution is in progress for
device group 'snap1'. Please wait...


SELECTING Source devices in the group:

  Device: 00E5 [SELECTED]
  Device: 00E9 [SELECTED]

SELECTING Target devices in the group:

  Device: 00AA [SELECTED]
  Device: 00AE [SELECTED]

PAIRING of Source and Target devices:

  Devices: 00E5(S) - 00AA(T) [(M) PAIRED]
  Devices: 00E6(S) - 00AB(T) [(m) PAIRED]
  Devices: 00E7(S) - 00AC(T) [(m) PAIRED]
  Devices: 00E8(S) - 00AD(T) [(m) PAIRED]
  Devices: 00E9(S) - 00AE(T) [(M) PAIRED]
  Devices: 00EA(S) - 00AF(T) [(m) PAIRED]
  Devices: 00EB(S) - 00B0(T) [(m) PAIRED]
  Devices: 00EC(S) - 00B1(T) [(m) PAIRED]

STARTING a Snap 'CREATE' operation.

The Snap 'CREATE' operation SUCCEEDED.

'Create' operation successfully executed for device group
'snap1'.
```

Verify that the TimeFinder/Snap session is in the created state:

```
symsnap -g snap1 verify -created -i 30
```

```
All devices in the group 'snap1' are in 'Created' state.
```

Perform a query operation on the device group:

```
symsnap -g snap1 query
```

```
Device Group (DG) Name: snap1
DG's Type             : REGULAR
DG's Symmetrix ID     : 000192600161

      Source Device          Target Device                  State     Copy
------------------------- ------------------- ---------- ------------ ----
                Protected                          Changed
Logical   Sym   Tracks    Logical   Sym     G    Tracks  SRC <=> TGT  (%)
------------------------- ------------------- ---------- ------------ ----

DEV001    00E5     552360 VDEV001   00AA    X          0 Created        0
DEV002    00E9     552360 VDEV002   00AE    X          0 Created        0

Total            --------                     ----------
  Track(s)        1104720                              0
  MB(s)           69045.0                            0.0

Legend:

(G): X = The Target device is associated with this group,
     . = The Target device is not associated with this group.
```

Next, create an Open Replicator session using the `symrcopy create` command to define the snap device as the control device. Do not activate the session. This creates an Open Replicator session on the VDEV. The contents of the device file `vORS_to_symm` for this example is:

```
symdev=000192600161:aa symdev=000192600141:a5d
symdev=000192600161:ae symdev=000192600141:a61
```

```
symrcopy -file vORS_to_symm create -cold -push -noprompt -v
```

```
'Create' operation execution is in progress for the device list
in device file 'vORS_to_symm'. Please wait...

STARTING a REMOTE Copy CREATE (PUSH) (COLD) (DIFFERENTIAL)

SELECTING Control device - Remote devices:

  (Ctl)Sym: 000192600161 Device: 000AA -  LUN WWN: 600009700001926001415330304135 44
   - [SELECTED]
  (Ctl)Sym: 000192600161 Device: 000AE -  LUN WWN: 600009700001926001415330304136 31
   - [SELECTED]

STARTING a RCOPY 'CREATE' operation.

SELECTING Control device - Remote devices:
```

```
(Ctl)Sym: 000192600161 Device: 000AA -   LUN WWN: 60000970000192600141533030413544
 - [CREATED]
(Ctl)Sym: 000192600161 Device: 000AE -   LUN WWN: 60000970000192600141533030413631
 - [CREATED]

The Rcopy 'CREATE' operation SUCCEEDED.
'Create' operation successfully executed for the device list
in device file 'vORS_to_symm'.
```

Perform a query operation on the device file:

symrcopy -file vORS_to_symm query

```
Device File Name      : vORS_to_symm

       Control Device                  Remote Device             Flags     Status     Done
---------------------------- ---------------------------------- ----- -------------- ----
                   Protected
SID:symdev         Tracks    Identification                   RI CDSHUTZ CTL <=> REM    (%)
------------------ --------- --------------------------------- -- ----- -------------- ----
000192600161:00AA     552360 000192600141:0A5D                SD XXX..S. Created         N/A
000192600161:00AE     552360 000192600141:0A61                SD XXX..S. Created         N/A

Total              ---------
  Track(s)           1104720
  MB(s)              69045.0
```

For the output legend, refer to page 69.

Next, activate the Snap session that was created previously using the `symsnap activate` command. If consistency is required, the command will run within a consistency window:

symsnap -g snap1 activate -consistent -not_ready -noprompt

```
'Activate' operation execution is in progress for
device group 'snap1'. Please wait...

'Activate' operation successfully executed for device group
'snap1'.
```

Perform a query operation on the device group:

symsnap -g snap1 query

```
Device Group (DG) Name: snap1
DG's Type             : REGULAR
DG's Symmetrix ID     : 000192600161


      Source Device          Target Device                  State     Copy
------------------------- ------------------- ---------- ------------ ----
                Protected                        Changed
Logical   Sym   Tracks    Logical   Sym     G    Tracks  SRC <=> TGT  (%)
------------------------- ------------------- ---------- ------------ ----

DEV001    00E5     550904 VDEV001   00AA    X       1456 CopyOnWrite    0
DEV002    00E9     550913 VDEV002   00AE    X       1447 CopyOnWrite    0
```

```
Total            --------                      ----------
  Track(s)        1101817                            2903
  MB(s)           68863.6                           181.4

Legend:

(G): X = The Target device is associated with this group,
     . = The Target device is not associated with this group.
```

Next, activate the Open Replicator session that was created previously using the `symrcopy activate` command. The Open Replicator session begins copying the data:

symrcopy -file vORS_to_symm activate -noprompt -v

```
'Activate' operation execution is in progress for the device list
in device file 'vORS_to_symm'. Please wait...

STARTING a REMOTE Copy ACTIVATE

SELECTING Control device - Remote devices:

  (Ctl)Sym: 000192600161 Device: 000AA -   LUN WWN: 60000970000192600141533030413544
   - [SELECTED]
  (Ctl)Sym: 000192600161 Device: 000AE -   LUN WWN: 60000970000192600141533030413631
   - [SELECTED]

STARTING a RCOPY 'ACTIVATE' operation.

SELECTING Control device - Remote devices:

  (Ctl)Sym: 000192600161 Device: 000AA -   LUN WWN: 60000970000192600141533030413544
   - [ACTIVATED]
  (Ctl)Sym: 000192600161 Device: 000AE -   LUN WWN: 60000970000192600141533030413631
   - [ACTIVATED]

The Rcopy 'ACTIVATE' operation SUCCEEDED.
'Activate' operation successfully executed for the device list
in device file 'vORS_to_symm'.
```

Perform a query operation on the device file:

symrcopy -file vORS_to_symm query

```
Device File Name      : vORS_to_symm

       Control Device                  Remote Device             Flags     Status     Done
---------------------------- ----------------------------------- ----- -------------- ----
                   Protected
SID:symdev         Tracks    Identification                   RI CDSHUTZ CTL <=> REM    (%)
------------------ --------- ------------------------------- -- ----- -------------- ----
000192600161:00AA     544488 000192600141:0A5D               SD XXX..S. CopyInProg        1
000192600161:00AE     544481 000192600141:0A61               SD XXX..S. CopyInProg        1

Total              ---------
  Track(s)           1088969
  MB(s)              68060.6
```

For the output legend, refer to page 69.

This output shows the copy status as currently copy-in-progress. When copying has finished, terminate the Open Replicator session using the `symrcopy terminate` command. Then terminate the Time Finder/Snap session using the `symsnap terminate` command.

Note: Before terminating, sessions may also be recreated using the `symrcopy recreate` and `symsnap recreate` commands.

PART 2

Federated Live Migration

This guide is divided into two parts: “Open Replicator Migration” and “Federated Live Migration”.

Part 2 contains the following chapter:

This chapter provides an operation overview of FLM, example CLI commands that support FLM, and example reporting commands.

CHAPTER 4
Symmetrix Federated Live Migration Operations

This chapter introduces EMC Symmetrix Federated Live Migration and explains how to use the `symrcopy` command to copy device data, without host disruption, from DMX arrays to VMAX Family arrays in the storage network.

Federated Live Migration overview

Federated Live Migration (FLM) allows device copying, from donor Symmetrix DMX arrays to new Symmetrix VMAX Family arrays, without restarting the application hosts. It does this by having the new VMAX Family device assume the identity and geometry of the donor DMX device and then performs a hot pull operation.

The SYMCLI interface for FLM performs all of the actual data migration; however, it does not automatically setup any of the required zones for the migration. This includes the zones from the application hosts to the new storage array, and from the donor DMX array to the new VMAX Family array.

⚠CAUTION

Data migrations are often complex operations and require careful planning and execution of predetermined procedures. Failure to identify and perform necessary steps or actions within supported configurations can result in data unavailability or loss. Before proceeding with FLM, EMC strongly recommends that the *Symmetrix Procedure Generator* is referenced for critical details on FLM operations for each supported host and multpath type.

IMPORTANT

For information on supported operating systems, file systems, and logical volume managers, refer to the *EMC Federated Live Migration Simple Support Matrix*. For any recent updates on FLM refer to *EMC Solutions Enabler Release Notes.*

All documents mentioned above are available at `www.Powerlink.EMC.com.`

A FLM configuration includes the network, storage arrays, application hosts, and the Solutions Enabler host, along with the required zoning and masking (Figure 6).

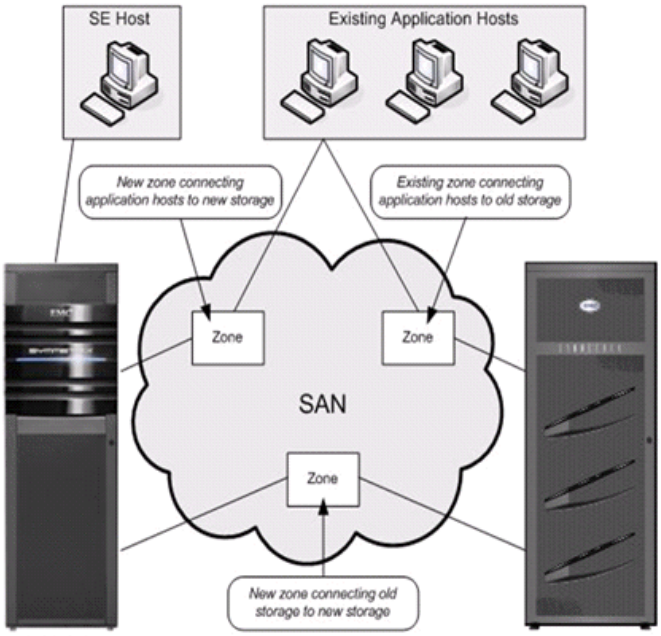


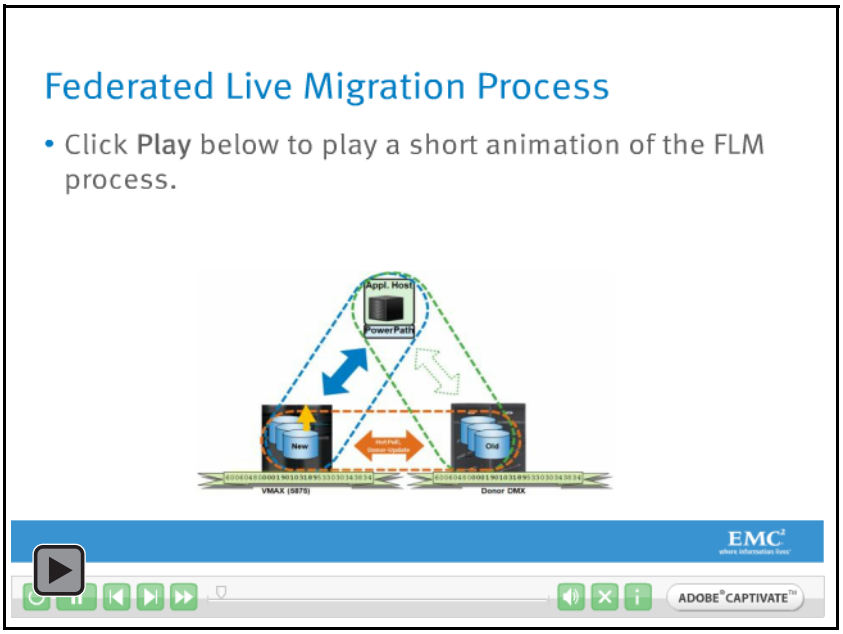
Figure 6 Example FLM configuration

The FLM process

The FLM process, as shown in the short animation in Figure 7, begins with verifying that the donor DMX array is zoned to the application host. The donor DMX array is then zoned to the new VMAX Family array, and the new VMAX Family array is zoned to the application host.

When the FLM session is created, a device file is used to pair devices from the donor DMX array to the new VMAX Family array. During the create session, the new VMAX Family devices assume the identity of donor DMX devices. The donor DMX array remains active to the host and the new VMAX Family array is passive to the host.

When the FLM session is activated, the donor DMX devices are put into host_passive mode and the new VMAX Family device into host_active mode. The host sees a new path for the donor devices. The data tracks are copied from the donor DMX devices to the new VMAX Family devices using a hot, pull with donor update enabled. Donor update maintains a consistent image between devices in the event of a failed session.



To replay click the Rewind or Back

Figure 7 FLM process animation

Environmental and system requirements for FLM

FLM sessions require specific system prerequisites and preparation to the SAN environment, prior to creating and activating a session, and there are some array and device limitations as listed below.

Array/device requirements

FLM requires the following Enginuity versions and array/device configuration:

- Enginuity 5875 or higher on the new VMAX Family array.
- Enginuity 5671 or 5773 on the donor DMX array.
- The new VMAX Family device must be the same size or larger than the donor DMX device.
- The donor array must be a Symmetrix and the devices are subject to the same restrictions as Open Replicator for a hot pull operation. Before and during each session, make sure the donor device is not the target of local or remote replication.

Array/device limitations

FLM has the following array and device limitations:

- A maximum of 8 paths to the VMAX Family and DMX devices.
- A maximum of 32 device pairs at one time per host.
- No donor devices used for host-based clusters.
- No load balancing across multiple FAs.
- Boot devices cannot be migrated.

This is not a complete list of FLM requirements and restrictions. For further requirements/restrictions, refer to the *EMC Federated Live Migration Simple Support Matrix* and the *EMC Solutions Enabler Release Notes* available at `www.Powerlink.EMC.com.`

Federated Tiered Storage limitations

There is limited support for Federated Tiered Storage devices with FLM operations as described below.

With Federated Tiered Storage (FTS), an external LUN (eDisk) is attached through the SAN to a Symmetrix array, and is used as an external back-end disk for the Symmetrix array. FTS requires a new external disk director (DX) and the Enginuity 5876.

Adding an eDisk through the SAN to the Symmetrix array provides the ability to migrate user data from the external storage into the Symmetrix array. There are two modes for presenting the eDisk to the Symmetrix array, *external provisioning* and *encapsulation*.

For FLM, externally provisioned devices are fully supported and encapsulated devices are not supported.

Refer to the *EMC Solutions Enabler Symmetrix Array Control CLI Product Guide* for more information on FTS devices.

Configuring the application hosts

Each operating system on the application host must be configured for FLM.

For information on supported operating systems, file systems, and logical volume managers, refer to the *EMC Federated Live Migration Simple Support Matrix* available at www.Powerlink.EMC.com.

Zoning and masking prerequisites

Prior to performing a FLM, zoning and masking must be configured as follows:

⚠CAUTION

Due to requirements of multipath environments, you must correctly configure paths to the new VMAX Family devices to maintain data availability. Refer to "SAN setup requirements" on page 22 for more information on zoning requirements. For information on zoning and masking, refer to *Solutions Enabler Symmetrix Array Controls CLI Product Guide* available at www.Powerlink.EMC.com.

- Verify the application donor DMX array is visible on the application host and error-free.
- Verify the donor DMX array is zoned to the application and SYMAPI hosts.
- Setup/modify zoning as follows:
  - New VMAX Family array to application host — for application access to the new VMAX Family array.
  - New VMAX Family array to SYMAPI host — for control of the new VMAX Family array.
  - New VMAX Family array to donor DMX array — for application data transfer.
- Mask the gatekeepers of the new VMAX Family array to the SYMAPI host, and mask the donor DMX devices to the new VMAX Family FA port(s).

Using FLM to perform a migration

FLM uses the SYMCLI `symrcopy` command to perform a migration session, The main control operations required to successfully complete a migration session are as follows:

- Create the session.
- Activate the session.
- Terminate the session.

Note: This section is an overview of the FLM process and the `symrcopy` operations, and is not a complete list of all steps required to successfully perform a FLM. For detailed steps for each supported operating system, refer to *EMC Symmetrix Procedure Generator* available at `www.Powerlink.EMC.com`.

Creating a device file

A device file is required to perform a FLM session. The device file specifies the source and target devices using the format:

```
symdev=<symid>:<dev> symdev=<symid>:<dev>
```

The following is an example device file:

```
## FLM DEVICE PAIR FILE
## column1:target column2:source
symdev=000194900307:0171 symdev=000190100860:027A
symdev=000194900307:0172 symdev=000190100860:027B
symdev=000194900307:0173 symdev=000190100860:027C
symdev=000194900307:0174 symdev=000190100860:027D
```

Creating a session

To begin an FLM session, run the `symrcopy create` command and specify the `-migrate` and `-pull` options. The `-migrate` option indicates that this is a FLM operation, and this option must be used on all subsequent FLM operations.

The following is an example `create` command with the `-migrate` option:

```
symrcopy -f win_flm create -pull -migrate -host_type windows
-hba_type Qlogic -mp_type PPath_45 -v
```

Where:

- `win_flm` is the device file name.
- `Windows` is the application host platform type.
- `Qlogic` is the HBA type.
- `PPath_45` is the multipathing type.

Note: For the `symrcopy create` command, `-mp_type`, `-host_type`, or `-hba_type` are required for certain operating system types. For specific OS requirements, refer to *EMC Federated Live Migration Simple Support Matrix* available at `www.Powerlink.EMC.com`.

When a FLM session is created, the new VMAX Family device assumes the WWN and geometry of the donor DMX device. The new VMAX Family device is put in host_passive mode, so the donor DMX device is still accessed by the application hosts for reads and writes.

Prior to running the `symrcopy create` command, the geometry of the new VMAX Family device can be changed using the `symconfigure` command. If this is not done, the geometry will be changed by the `create` command. While the migration session is active, the geometry cannot be changed using the `symconfigure` command.

IMPORTANT

The `-migrate` option must be used with the `activate, terminate, failback`, `set frontend_zero off,` and `set pace` commands when these commands are directed at the FLM session. If the `-migrate` option is used for any command for a session that was not created with this option, the operation is rejected. Refer to "Setting the session pace" on page 39 for more information on the `set pace` command.

Note: If the session creation fails at any point, the system is left in the same state prior to the `create` command.

Verifying the created session

Use the `symrcopy query` command to verify that the FLM pairs are listed as migration sessions in the "Created" state, as follows:

```
symrcopy -f win_flm query
```

```
Device File Name      : win_flm

       Control Device                   Remote Device      Flags      Status     Done
---------------------------- ---------------------------- ------- -------------- ----
                   Protected
SID:symdev         Tracks    Identification           RI CDSHUTZ  CTL <=> REM    (%)
------------------ --------- ------------------------ -- ------- -------------- ----
000194900307:0171      30000 000190100860:027A        SD ...XXM.   Created       N/A
000194900307:0172      30000 000190100860:027B        SD ...XXM.   Created       N/A
000194900307:0173      30000 000190100860:027C        SD ...XXM.   Created       N/A
000194900307:0174      30000 000190100860:027D        SD ...XXM.   Created       N/A

Legend:
R:  (Remote Device Vendor Identification)
  S = Symmetrix, C = Clariion, . = Unknown.

I:  (Remote Device Specification Identifier)
  D = Device Name, W = LUN WWN, World Wide Name.

Flags:
(C): X = The background copy setting is active for this pair.
     . = The background copy setting is not active for this pair.
(D): X = The session is a differential copy session.
     . = The session is not a differential copy session.
(S): X = The session is pushing data to the remote device(s).
     . = The session is pulling data from the remote device(s).
(H): X = The session is a hot copy session.
     . = The session is a cold copy session.
(U): X = The session has donor update enabled.
     . = The session does not have donor update enabled.
(T): M = The session is a migration session.
```

```
     R = The session is a RecoverPoint session.
     S = The session is a standard ORS session.
(Z): X = The session has front-end zero detection enabled.
     . = The session does not have front-end zero detection enabled.
(*): The failed session can be reactivated.
```

Restoring VMAX Family device to host-active mode

If a created session is terminated before it is activated, the VMAX Family device can be restored to host-active mode. Use the following syntax to restore a new VMAX Family device to host-active mode:

```
symdev host_active -sid SymmID SymDevName
```

Activating a FLM session

When a FLM session is activated, the donor DMX device is put into host_passive mode and the new VMAX Family device into host_active mode. The host access is now directed to the new VMAX Family device. Any device reservations are transferred from the donor DMX device to the new VMAX Family device, and the tracks copy from the donor DMX to the new VMAX Family device.

IMPORTANT

Do not proceed with the `activate` command unless all the new VMAX Family devices have been configured as new paths to each of the old DMX devices involved in FLM. The next step in the process will set the old DMX devices to host_passive. VMAX Family devices must be masked, discovered, and configured into the multipath configuration on the application host, otherwise the activate command will be rejected. For details on performing these steps, refer to *EMC Symmetrix Procedure Generator* available at www.Powerlink.EMC.com.

The following is an example `activate` command with the `-migrate` option:

```
symrcopy activate -f win_flm -migrate
```

Note: The `-symforce` option can be included with a FLM `activate` command. This forces the `activate` operation to execute when it would otherwise be rejected. Use caution when using this option.

After the session has been successfully activated, tracks are copied from the donor DMX device to the new VMAX Family device.

If the activate fails, the session will remain in the created state. If an error occurs after a session has been activated, the new VMAX Family device is set to host_passive mode and the donor DMX device is set to host_active mode. All host access is directed back to the donor DMX array.

Note: Any existing snap, clone, or RDF session on the donor DMX device will not be migrated.

Setting the ceiling value

The `symrcopy set ceiling` command sets the maximum allowed bandwidth percentage for a given director, port, director/port pair, or all directors and ports. Valid values are 0 - 100 (%), or NONE (shuts off the ceiling function).

For Solutions Enabler V7.4, the recommended ceiling value for the new VMAX Family array is:

- 20% if the donor DMX array is running Enginuity 5671
- 40% if the donor DMX array is running Enginuity 5773

Note: Ceiling values may need to be adjusted to optimize the performance of the specific SAN environment.

The following example shows how to set a bandwidth ceiling of 40% for all directors on Symmetrix 307:

```
symrcopy set ceiling 40 -dir all -sid 307
```

The new ceiling setting is viewed by using the following `list ceiling` command:

```
symrcopy list ceiling
```

Note: Setting the ceiling to a value (other than NONE) renders the session pace value ineffective to the copy. If the ceiling value is set to NONE, the session pace is in effect for the copy. For more information refer to "Setting the session pace" on page 39.

Monitoring FLM session status

A FLM session status is checked using the `symrcopy query`, `symrcopy verify`, or `symrcopy list` command.

Querying a session status

The following is an example session status query:

```
symrcopy query -f win_flm
```

```
Device File Name       : win_flm

       Control Device                  Remote Device            Flags     Status     Done
---------------------------- --------------------------------- ------ -------------- ----
                   Protected
SID:symdev         Tracks    Identification                 RI CDSHUTZ CTL <=> REM    (%)
------------------ --------- --------------------------------- -- ----- -------------- ----
000194900307:0171      30000 000190100860:027A               SD ...XXM. CopyInProg     N/A
000194900307:0172      30000 000190100860:027B               SD ...XXM. CopyInProg     N/A
000194900307:0173      30000 000190100860:027C               SD ...XXM. CopyInProg     N/A
000194900307:0174      30000 000190100860:027D               SD ...XXM. CopyInProg     N/A


Total              ---------
  Track(s)            120000
  MB(s)                80062.5
```

For the output legend, refer to page 126.

The output from the `summary query` command is an abbreviated listing that shows all possible session states and the number of sessions that are in each state.

The following is an example session status query with the `-summary` option:

```
symrcopy query -f win_flm -summary
```

```
Device File Name : win_flm

  RCopy Session State           Count
 -----------------------       ------
  CreateInProg                       2
  Created                            0
  RecreateInProg                     0
  Recreated                          0
  CopyInProg                         3
  CopyOnAccess                       0
  CopyOnWrite                        0
  Copied                             1
  SyncInProg                         0
  Synchronized                       0
  Restored                           0
  RestoreInProg                      0
  Precopy                            0
  TerminateInProg                    0
  Failed                             0
  Stopped                            0
  FailedBack                         0
  VerifyInProg                       0
  Invalid                            0
  -----------------------       ------
  Total                              4

                      Track(s)    MB(s)
                     -----------  -------
                      120000      80062.5
```

Verifying a session status

The following is an example session verify status:

```
symrcopy -f win_flm verify
```

None of the device(s) in the list are in 'Copied' state.

Note: If no verify option is provided, then “copied” is the default state that is verified. Refer to “Verifying session state” on page 43 for more information on verify options.

The following example shows the output result when the `verify` command is used with the `-summary` option:

```
symrcopy -f win_flm verify -summary
```

Note: The one-line `verify` command output comes after the `-summary` output.

```
Device File Name : win_flm

RCopy Session State           Count
  -----------------------      ------
  CreateInProg                       0
  Created                            0
```

```
  RecreateInProg                    0
  Recreated                         0
  CopyInProg                        4
  CopyOnAccess                      0
  CopyOnWrite                       0
  Copied                            0
  SyncInProg                        0
  Synchronized                      0
  Restored                          0
  RestoreInProg                     0
  Precopy                           0
  TerminateInProg                   0
  Failed                            0
  Stopped                           0
  FailedBack                        0
  VerifyInProg                      0
  Invalid                           0
  -----------------------      -------
  Total                             4

                                 Track(s)    MB(s)
                               -----------  -------
Total Protected                  120000      80062.5

None of the device(s) in the list are in 'Copied' state.
```

Note: If no verify option is provided, then “copied” is the default state that is verified. Refer to “Verifying session state” on page 43 for more information on verify options.

Listing a FLM session

The `symrcopy list` command lists all migration sessions for a specific array. This command can be filtered to list only FLM sessions using the `-type <migrate|standard|RecoverPoint>` option.

The following is an example `list` command for FLM sessions only:

```
symrcopy list -sid 307 -type migrate
```

```
Symmetrix ID: 000194900307

Control Device            Remote Device             Flags      Status     Done
--------------------- ---------------------------------- ------ -------------- ----
         Protected
Sym      Tracks                Identification          RI CDSHUTZ    CTL <=> REM  (%)
-----   ------------ --------------------------------- -- ------ -------------- ----
0171        30000    60060480000000006190535 94D314638 SW ...XXM.     Copied     N/A
0172        30000    60060480000000006190535 94D314637 SW ...XXM.     Copied     N/A
0173        30000    60060480000000006190535 94D314642 SW ...XXM.     Copied     N/A
0174        30000    60060480000000006190535 94D314646 SW ...XXM.     Copied     N/A


Total ---------
  Track(s) 120000
  MB(s)     80062.5
```

For the output legend, refer to page 126.

Note: For listing all session types or only listing RecoverPoint sessions, refer to “Listing all sessions” on page 39 and “Filtering session types” on page 40.

Failing Back

Session failback can occur automatically or it can be performed manually. The following section describes automatic and manual failback of a FLM session.

Automatic failback

If an error occurs after activating a session, the session automatically fails back and the following actions occur:

- The new VMAX Family device is set back to host_passive mode.
- The donor DMX device is set back to host_active mode.
- All host I/O is directed back to the donor array.

Manual failback

A migration session can be canceled anytime after the session is activated, which results in full data access to the donor DMX device.

Use the `failback` command with the `-migrate` option to cancel an activated session. The `failback` command can be run anytime following session activation, or when the copy is complete.

Running the `failback` command:

- Stops the FLM session
- Restores the donor DMX device to host_active mode
- Restores the new VMAX Family device to host_passive mode.
- Does not restore the new VMAX Family device identity. VMAX Family device still maintains the WWN and geometry of the donor DMX device.
- Restores any existing device reservations to the donor DMX device.

The following is an example `failback` command with the `-migrate` option:

```
symrcopy failback -session_name sym1_to_sym2 -migrate
```

Note: Automatic or manual failback will leave a session in the "FailedBack" state, and the only subsequent operation allowed is a `terminate` command.

Terminating a FLM session

After the copy session is complete or if a session has failed, use the `terminate` command with the `-migrate` option to end the FLM session.

Running the `terminate` command:

- Does not restore the new VMAX Family device identity. VMAX Family device still maintains the WWN and geometry of the donor DMX device.
- Does not effect the host_active/passive mode setting of the donor DMX device. If the `terminate` command is run after a failback the donor DMX device is in host_active mode. If the `terminate` command is run after a session completes, the DMX device remains in host_passive mode.

- Keeps any device reservations with the new VMAX Family device.

The following is an example `terminate` command with the `-migrate` option:

```
symrcopy terminate -session_name sym1_to_sym2 -migrate
```

Restoring new VMAX Family device identity

The host may run indefinitely with federated identity on the new VMAX Family devices; however, EMC recommends that the original VMAX Family device identity be restored as soon as possible following a migration. Leaving the identity spoofing in place long-term has the potential to cause confusion for systems administrators or other users who may not be familiar with the details of FLM and how device identities are federated. This recommendation is provided only to raise awareness and is not intended as a mandate for unspoofing; VMAX Family devices may remain federated indefinitely and there is no requirement to unspoof at any time.

IMPORTANT

If the donor DMX device will be reused and is on the same SAN as the VMAX Family device, then the VMAX Family device must be restored to its original identity.

Refer to the *EMC Symmetrix Procedure Generator* available at `www.Powerlink.EMC.com` for details on restoring original device identity.

Restoring donor DMX device to host-active mode

After the migration session is terminated and the new VMAX Family device original identity is restored; or if the new VMAX Family and donor DMX device are not on the same SAN, the donor DMX device can be restored to an active state using the `symdev host_active` command.

However, to avoid a situation where the donor DMX device and the new VMAX Family device are both available to the host with the same identity, when `symdev host_active` command is issued the following conditions determine whether the operation is allowed to proceed or not:

- For any FLM supported Enginuity version, if either of the following conditions exist when the `symdev host_active` command is issued, the operation is blocked:
  - The device is mapped to an FA with VCM/ACLX enabled and masking records exist.
  - The device is mapped to an FA with VCM/ACLX disabled.
- If either of the following conditions exist when the `symdev host_active` command is issued, the operation is allowed:
  - The device is mapped to an FA with VCM/ACLX enabled, but no masking records exist.
  - The device is not mapped to any FA.

Use the following syntax to restore a donor DMX device to host_active mode:

```
symdev host_active -sid SymmID SymDevName
```