



Global Distributed Storage Engineering

EMC Symmetrix Open Replicator

GDSE-06003-SG

Solutions Guide

1.0

1. Version Control

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3. Contact

Please address any comments or questions regarding the information contained in this document via email to the “*GT Global Distributed Storage Engineering” distribution list or alternatively to gdse@citigroup.com.

4. Latest Versions

It is recommended that the latest version of the document be used from the GDSE website <http://engineering.ti.citigroup.net/gdse/>. Newer versions may include certification on additional platforms, or comments on issues discovered after deployment.

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6. Introduction

EMC Open Replicator Symmetrix (ORS) is an array-based data migration tool (see [Appendix A: Host-based versus Array-based Data Migration](#)) that transfers raw block I/O between the source and target devices, rendering it indifferent to data protection schemes, disk configurations and host operating systems. ORS is a software product residing on a Symmetrix array and managed through the EMC Solution Enabler command line interface.

Open Replicator Terms/Definitions:

Control device - DMX device running the ORS software and acting as the host to direct I/O to and from the device on the remote storage system.

Remote device - Partner to the control device, the remote device does not need any special software and simply responds to host I/O request.

Session – Each ORS source volume is counted as a session.

Push - Sends data from the DMX to the remote storage array.

Pull - Fetches data from the remote storage array to the DMX.

Hot - Control device is read and write online to the host during the copy operation.

Cold – Control and remote devices are offline to the host during the copy operation.

Pace - Throttle to control the speed of the copy operation.

6.1 Open Replicator Objectives:

- Data Migration
 - Technology refreshes – transfer of data to newer storage entities
 - Storage tier alignment strategy – transfer of data to more cost effective storage configurations
- Data Distribution – simultaneously create multiple copies of the data in multiple locations

6.2 Open Replicator Features:

- Migrate data between EMC arrays within the SAN infrastructure without interfering with host applications and ongoing business operations.
- Control and remote device extents are agnostic to the RAID type or metavolume configuration.

6.3 Open Replicator Practical Considerations:

- In a push operation, the remote (target) device capacity must be equal to or larger than the control (source) device.
- In a pull operation, the control (target) device should be equal to or larger than the remote (source) device.
- In a push operation, the remote devices should be offline or inaccessible to changes until the copy process is complete.
- At the start of a hot push operation, all tracks in the source device are labeled as protected. Protected tracks are copied to the remote device before modification (CopyOnWrite).
- In a pull operation, the source devices should be write-disabled at the array for the duration of the copy operation.
- In a hot pull operation, all tracks in the source device are labeled as protected. Protected tracks are copied from the source device to the target device before a host can access it (CopyOnAccess) and the protection is removed.
- Accumulation of I/O errors between the remote and control devices will cause a session to fail in a hot copy mode and temporarily stall the cold copy operation.
- Symmetrix DMX-3 supports 512 concurrent push or pull sessions.
- Symmetrix DMX-2 supports 128 concurrent push or pull sessions.
- An offline push transfers data to multiple remote devices simultaneously.
- Access security to the ORS command set is provided through Solutions Enabler and the Symmetrix Microcode. View the Symmetrix DMX Solutions Guide (see [Section 8: Reference Documentation](#)) for security capabilities and configuration.

6.4 Open Replicator Restrictions:

- Up to fifteen incremental ORS copy sessions can exist for a single Symmetrix device.
- Only one copy session can be active at a time. The number of individual sessions in the copy session is defined by the device file.

- An ORS copy session is between two or more arrays. Creating a session between devices on the same DMX array is not supported.
- An offline push to multiple remote devices does not allow the removal of individual target devices from the session.
- ORS can only use FBA devices via Fibre Channel directors. CKD devices are not supported.
- Only one remote device is allowed for an online push operation.
- ORS copy sessions involving older Symmetrix arrays (prior to the DMX) requires a fibre channel switch connection.

7. Applicable Environments

Open Replicator v6.0 with Solution Enabler v6.0.3 supports data migrations between EMC Symmetrix DMX-3, Symmetrix DMX-2 and Clariion arrays.

8. Reference Documentation

EMC Documentation	Location
EMC Solutions Enabler V6.0.3	Available from EMC
Using the SYMCLI Configuration Manager	Available from EMC
EMC Solutions Enabler V6.0.3 CLI Quick Reference	Available from EMC
EMC Solutions Enabler V6.0.3 CLI Command Reference	Available from EMC
Engineering White Paper:EMC Solutions Enabler Symmetrix Device Masking CLI Product Guide	Available from EMC
Engineering White Paper: Using EMC SYMCLI Configuration Manager	Available from EMC
GDSE documentation	Location

Open Replicator Release Notes	http://engineering.ti.citigroup.net/gdse/products/platforms/symmetrix/releasenotes/06003-RN.pdf?a=5441
Solutions Enabler 6.0.3 Solaris Certification Solutions Guide	http://engineering.ti.citigroup.net/gdse/products/platforms/symmetrix/?a=5441
EMC Symmetrix DMX Solutions Guide	http://engineering.ti.citigroup.net/gdse/products/platforms/symmetrix/stdsdocs/03038-sg.pdf
Solaris 10 SAN Stack v3.0	http://engineering.ti.citigroup.net/gdse/products/services/sanstacks/solaris/stdsdocs/06042-SG.pdf?

9. Throughput Performance

9.1 Pull vs. Push Performance:

The pull configuration outperforms the push configuration in terms of transfer rate. A pull operation requires a single message from the initiator to start the flow of data, while a push operation requires additional exchange of messages to determine the readiness of the remote end to receive data.

In a pull operation, data is read into cache on the remote device, and then sent to the target array in specific chunks. The target array accepts the data into cache and acknowledges receipt, and the fast write procedure eventually destages the data to the physical drives. Monitoring of the pull sessions show 100% sequential writes with chunk sizes averaging 64.076 KB (note, 64KB is equal to 1 DMX-3 track) on the control array. The high volume of sequential writes to the control array increases performance by reducing the number of short writes and increases the probability of optimized writes for Raid-5 devices (see explanations below).

Note:

- 1) Short writes is where a write to a drive is less than one sector in size, requiring the array to read the remaining data from the sector into cache to calculate the Cyclic Redundancy Check (CRC). This procedure generates an additional I/O per back-end destage to fetch the remaining data to run against the CRC algorithm. Obviously, a high number of short writes increase the use of array resources.
- 2) Optimized writes is when there is sufficient data in cache to calculate the parity for an entire rank of a Raid-5 device. This has a pronounced effect on increasing the write

throughput, nearly removing the write penalty associated with typical Raid-5 write request.

9.2 Throughput Pace:

ORS allows dynamic adjustment of the transfer rate with the "symrcopy set pace" command. Throughput test indicates that setting the highest pace of "9" is 100 times faster than the slowest pace of "0" and 10 times faster than the default pace of "5". The pace can only be changed following the activation of a session.

9.3 Throughput Observations:

1. ORS transfers data in chunks equal to one DMX-3 track of 65,536 bytes (64KB) in size.
2. The layout and protection scheme of the source device is the major factor in determining the transfer rate. The Symmetrix Raid-0+1 source device shows the highest throughput regardless of the protection scheme of the target device.
3. In a cold push session, the I/O is distributed equivalently to each of the target devices.

10. Compatibility and Configuration

10.1 Device Profiles:

ORS utilizes a raw block transfer technique that is indifferent to device profiles or categorizations in the control and remote arrays. The following table exemplifies ORS compatibility between dissimilar device and array types:

Control Array	Device Type	Protection Type	Direction	Protection Type	Device Type	Remote Array
DMX-3	4-way Meta	Mirror	<=>	Mirror	4-way Meta	DMX
DMX-3	4-way Meta	Mirror	<=>	Raid 5	Volume	DMX-3
DMX-3	Volume	Raid 5	<=>	Mirror	4-way Meta	DMX
DMX-3	Volume	Raid 5	<=>	Mirror	Volume	Clariion

DMX-3	Volume	Raid 5	<=>	Raid 5	Volume	Clariion
DMX-3	4-way Meta	Mirror	<=>	Mirror	Volume	Clariion
DMX-3	4-way Meta	Mirror	<=>	Raid 5	Volume	Clariion

10.2 Device Sizing

ORS data migration requires the target device be equal to or greater in capacity than the source device. If a data migration is required to remedy an over-allocation of storage (migrating from a larger source device to a smaller target device), a host-based migration tool (see [Appendix A: Host-based versus Array-based Data Migration](#)) would be the most appropriate. A block-level tool such as ORS recognizes the entire source volume as needed to be transferred; therefore, a source and target device of equal proportions simplifies the migration process.

Creating source and target devices of equal size on like frames should not present an issue; however, this process becomes slightly more complex when dealing with dissimilar array types. Data migrations between a Symmetrix array that utilizes a 512B block and a Clariion array that utilizes a 520B block illustrates this challenge. For example, a 9207 cylinder Symmetrix device (Citi's standard RAID-10 LUN) contains 17,679,360 blocks equal to 9,051,832,320B. Creating a Clariion volume with 17,679,360 blocks results in a 9,193,267,200B device with a user space of 9,051,832,320B, identical to the 9207 cylinder Symmetrix device. However, if a value of 9,051,832,320B (8633MB) is used to create a Clariion LUN; the resultant device will be 9,052,356,608B in size or 1024 blocks (524,288B) larger than intended. Therefore, when creating a Clariion device for migration purposes, utilize the block format in Navisphere Manager to construct the device.

In array-based data migration, copying from a larger source device to a smaller target device may lead to data loss/corruption, therefore it is not recommended. However, if this procedure is necessary, ORS allows migrations from a larger source to a smaller target through the force activation of a session. The "-force_copy" argument added to the "symrcopy create" command (see example below) allows a larger source to be copied into a smaller target device.

```
symrcopy create -copy -name s11pull -pull -hot -file or2w-1 -force_copy
symrcopy activate -file or2w-1
symrcopy set pace 0 -file or2w-1 -nop
```

10.3 Device Status for copy Operations:

EMC recommends using the following table in setting the device status prior to activating the copy operation. As a sample illustration in the table below, the source device should be disabled and the target device should be online for a hot pull operation:

Cold Push:		Hot Push:	
Control	Remote	Control	Remote
NR	NR	R	NR
Cold Pull:		Hot Pull:	
Control	Remote	Control	Remote
NR	NR	R	NR
NR:	not ready		
R:	ready		

10.4 ORS, SRDF and TimeFinder Compatibility:

The following tables depict ORS basic operational compatibility with TimeFinder and SRDF:

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
BCV is RCopy control device pulling in	No
TimeFinder Restore, Full or Incremental	
STD is RCopy control device pushing out	Yes
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

Action	Allowed
SRDF RDF Establish, Full or Incremental	
R1 is RCopy control device pushing out	Yes
R1 is RCopy control device pulling in	No
R2 is RCopy control device pushing out	No
R2 is RCopy control device pulling in	No
SRDF 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	
SRDF RDF Restore, Full or Incremental, regardless of rcopy state.	
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
SRDF 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
SRDF 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

Note:

1. Consult the EMC Symmetrix ORS Symmetrix documentation for a comprehensive compatibility table.
2. 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.

11. Installation of Open Replicator Symmetrix

Installation of ORS is accomplished by initiating the “Remote-Copy” and “RcopyOnlinePull” license keys through Solution Enabler 6.0.3. The license keys

are installed through the “symlmf” Solutions Enabler command. The sample license file shows the baseline and the two additional ORS licenses keys (highlighted):

```
symlmf

      EMC SOLUTIONS ENABLER

      SOLUTIONS ENABLER LICENSE MANAGEMENT FACILITY

Register License Key (y/[n]) ? y
Enter License Key : A1BA-15F3-01B5-6660

Register License Key (y/[n]) ? n
symapi_licenses file
License Key: 7FBE-9150-E0BC-9CC0 SYMAPI Feature: BASE / Symmetrix
License Key: 3A64-6044-0190-0190 SYMAPI Feature: SERVER / Symmetrix
License Key: C7C7-B990-1954-4D90 SYMAPI Feature: DeltaMark / Symmetrix
License Key: A98E-6602-0ABA-9E20 SYMAPI Feature: DevMasking / Symmetrix
License Key: 515B-9295-06C4-1440 SYMAPI Feature:Remote-Copy / Symmetrix
License Key: A1BA-15F3-01B5-6660 SYMAPI Feature:RcopyOnlinePull/ Symmetrix

Note: all license keys depicted are invalid
```

Without all the proper license keys, the following nondescript error message is displayed when initiating an ORS session:

```
symrcopy create -copy -name test1 -push -hot -file or2w-1 -nop

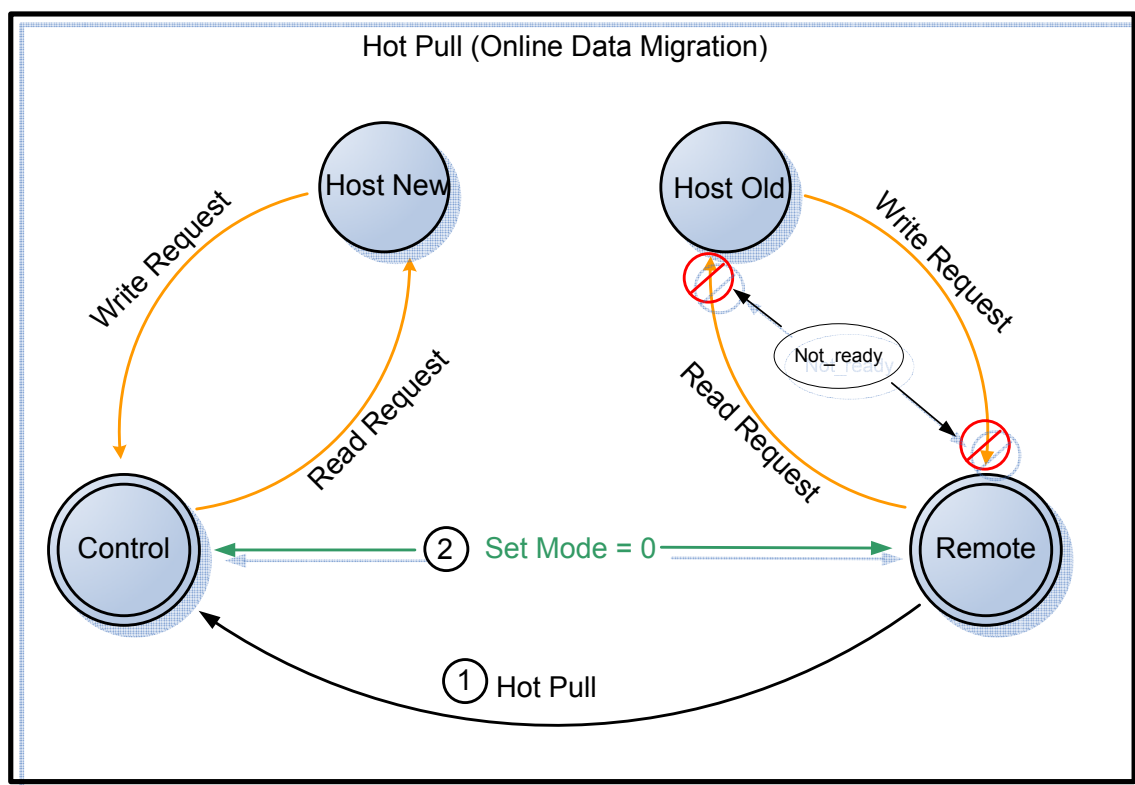
'Create' operation execution is in progress for the device list in
device file '/user/home/gs96899/openrep/push919to127'. Please wait...

An rcopy remote device discover error occurred
```

12. Hot Pull Online Data Migrations

12.1 Objective:

1. Provide a practical example of ORS online data migration between two Symmetrix arrays.
2. Demonstrate the capabilities of ORS to transfer data between dissimilar RAID protection schemes, metavolume configurations, and array types.



12.2 Introduction:

Online data migrations are accomplished through a hot pull operation, where the application host is online with the target devices and the source devices are offline. In a hot pull operation, all tracks for the source devices are marked protected and copied in the background to the target array. Once a track is copied from the source to the target, the protection bit is removed from that track.

When a host attempts to access a track that has not been copied over and still marked protected, ORS prioritizes the fetch of that track from the source device. Once the prioritized track is received, the protection bit is cleared and the host request is serviced.

The host application should be cutover to the target device(s) prior to activating the hot pull migration; therefore, expect an application outage during the cutover process. Higher than normal latency is expected as a host request maybe serviced through the remote device, whereby network latency between the source and target array will have a major effect in response time.

12.3 Procedural Example:

1. Configure the DMX-3 (Symm 919) as the control and the DMX-2 (Symm 127) as the remote frame. Disable (not_ready) the devices between the host and remote array.
2. Through the Solutions Enabler server, create a device file with the device relationships depicted in the following table. Note the format of the array and devices depicted:

Array ID	Device	Protection Type	Direction	Protection Type	Device	Array ID
DMX-3	00D8	Raid 5	<==	Raid 0+1	151	DMX-2
DMX-3	00B1	Raid 0+1	<==	Raid 0+1	159	DMX-2

Device File "or2w-1" created with two sessions:

```
# Control Devices Remote Devices:
#=====
symdev=919:00b1 symdev=127:0151
symdev=919:00d8 symdev=127:0159
```

3. An online data migration is accomplished in the hot pull mode. The target devices remain online to the host, while pulling data from the remote devices. The following procedure outlines the ORS command syntax to initiate a hot pull session at the highest transfer rate:

```
symrcopy create -copy -name s11pull -pull -hot -file or2w-1 (step 1 in Hot Pull diagram)
```

```
symrcopy activate -file or2w-1
```

```
symrcopy set pace 0 -file or2w-1 --nop (step 2 in Hot Pull diagram)
```

4. The “symrcopy –file <fdevice file> query” command is used to view the status of the pull sessions:

Device File Name : or2w-1						
Control Device		Remote Device		Flags	Status	Done

Protected						
SID:symdev	Tracks	Identification		RI CDSH	CTL <=> REM	(%)

000190100919:00B1	389026	000387430127:0151			SD X.XX CopyInProg	29
000190100919:00D8	502895	000387430127:0159			SD X.XX CopyInProg	8

Control Device		Remote Device		Flags	Status	Done

Protected						
SID:symdev	Tracks	Identification		RI CDSH	CTL <=> REM	(%)

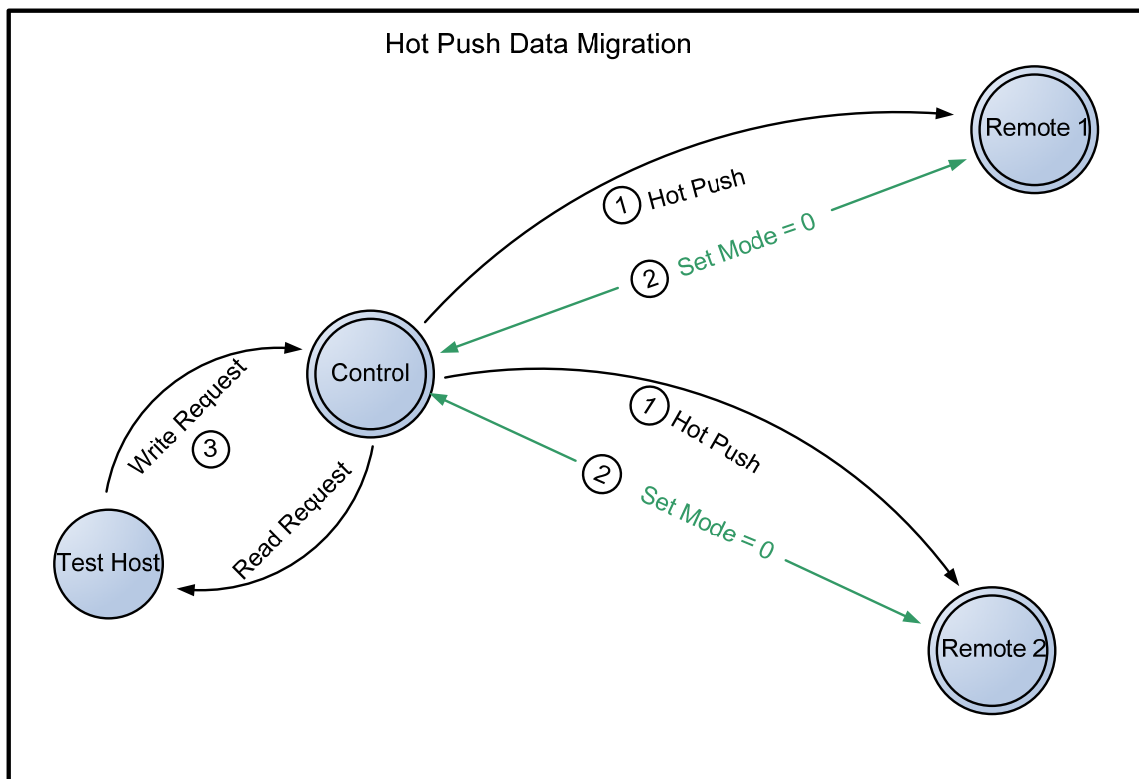
000190100919:00B1	279490	000387430127:0151			SD X..X CopyInProg	49
000190100919:00D8	405854	000387430127:0159			SD X..X CopyInProg	26

5. The hot pull operation does not guarantee that the tracks on the control frame are identical with the tracks on the remote frame. Data written to the target device(s) by ORS maybe changed by an online host, therefore the tracks in the source and target device maybe different.

13. Hot Push Data Migrations

13.1 Objective:

1. Provide a hot push ORS example, simultaneously transferring data from a control array (DMX-3) and two remote arrays (DMX-2, Clariion cx500), while the source device(s) remains online with the application host.
2. Demonstrate the capabilities of ORS to transfer data between dissimilar RAID protection schemes, metavolume configurations, and array types.



13.2 Introduction:

The ORS hot push allows the source devices to remain online during the copy process; therefore, allowing the host and applications to remain online. The hot push provides a Point-in-Time (PiT) copy of the data, whereby the data sent to the target frame represents a snap shot of the data taken upon activation of the copy process. Hot copies are limited to a one-to-one relationship between the

source and target device, and if communications is lost between the frames, the session fails.

The hot push PiT process takes a snap shot of the data by coping tracks from the source device to the target device prior to servicing any host write request (see step 3, in host push diagram above) to that online source device. This is accomplished through the Symmetrix Differential Data Facility (SDDF), which sets the track protection bitmap and monitor deltas between the source and target devices. Upon session activation all source tracks are marked as protected, and the protection bitmap is updated. The protection bit is cleared once the track has been received at the target array.

13.3 Procedural Example:

1. Configure the DMX-3 (Symm 919) as the control frame with the Clariion (cx500) and DMX-2 (Symm 127) as the remote frames.
2. Through the Solutions Enabler server, create a device file with the device relationships depicted in the following table. Note, the device profiles and multiple target arrays supported in a single ORS session:

Array ID	Device	Protection Type	Direction	Protection Type	Device	Array ID
DMX-3	00D9	Raid 5	>==>	Raid 0+1	0018	Clariion
DMX-3	00B5	Raid 0+1	>==>	Raid 5	0013	Clariion
DMX-3	00D8	Raid 5	>==>	Raid 0+1	0151	DMX-2
DMX-3	00B1	Raid 0+1	>==>	Raid 0+1	0159	DMX-2

Device File "or2w-1" created with four sessions:

```
# Control Devices Remote Devices:
#=====
symdev=919:00b5 clardev=APM00040800355:0013
symdev=919:00d9 clardev=APM00040800355:0018
symdev=919:00b1 symdev=127:0151
symdev=919:00d8 symdev=127:0159
```

3. Create/Activate an ORS hot push session from the control devices to the remote device on DMX-2 and Clariion (see step 1, in the hot push diagram above):

```
symrcopy create -copy -name s11push -push -hot -file or2w-1 -nop
symrcopy activate -file or2w-1
```

4. Set transfer pace to the highest level (see step 2, in hot push diagram above):

```
symrcopy set pace 0 -file or2w-1 -nop
```

5. The “symrcopy –file <fdevice file> query” command is used to view the status of the pull sessions:

Device File Name : or2w-1						
Control Device		Remote Device		Flags	Status	Done

Protected						
SID:symdev	Tracks	Identification	RI CDSH	CTL <=>	REM	(%)

000190100919:00B5	130082	APM00040800355:0013		CD X.XX	CopyInProg	76
000190100919:00D9	441295	APM00040800355:0018		CD X.XX	CopyInProg	20
000190100919:00B1	139342	000387430127:0151		SD X.XX	CopyInProg	74
000190100919:00D8	422978	000387430127:0159		SD X.XX	CopyInProg	23
Total -----						
Track(s)	1133697					
MB(s)	70856.1					
Copy rate : 226.6 MB/S						
Estimated time to completion : 00:05:12						
Device File Name : or2w-1						
Control Device		Remote Device		Flags	Status	Done

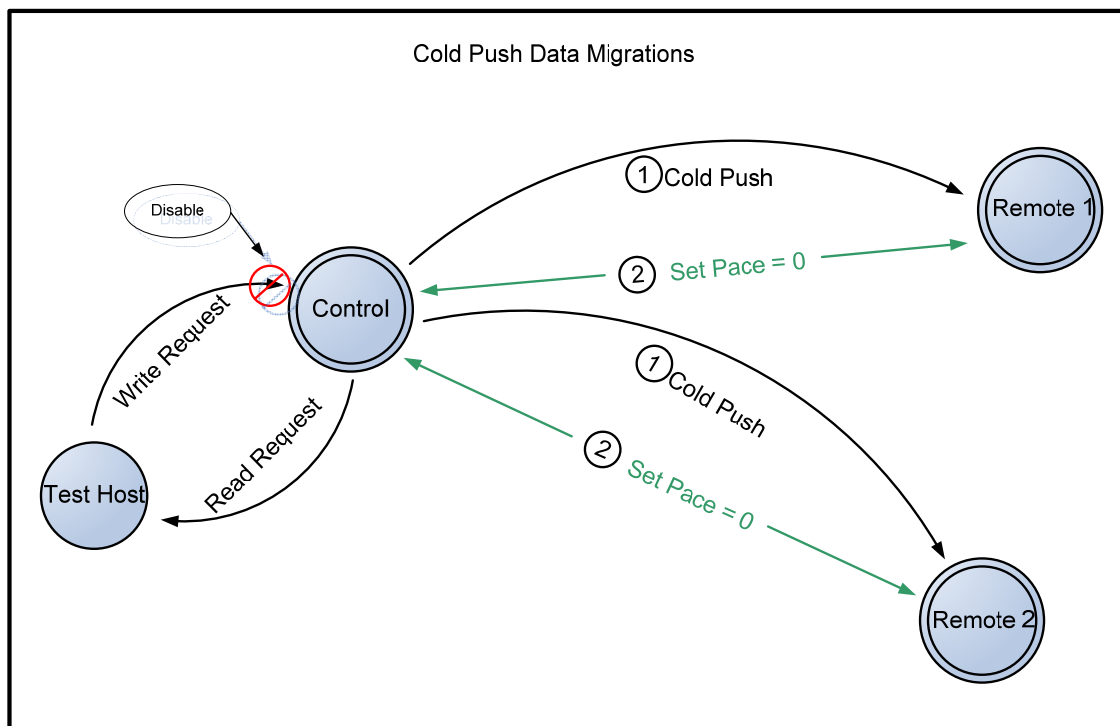
Protected						
SID:symdev	Tracks	Identification	RI CDSH	CTL <=>	REM	(%)

000190100919:00B5	0	APM00040800355:0013		CD X.XX	Copied	100
000190100919:00D9	0	APM00040800355:0018		CD X.XX	Copied	100
000190100919:00B1	0	000387430127:0151		SD X.XX	Copied	100
000190100919:00D8	0	000387430127:0159		SD X.XX	Copied	100
Total -----						
Track(s)	0					
MB(s)	0.0					

14. Cold Push Data Migration

14.1 Objective:

Provide a practical ORS example to simultaneously transfer data from one offline source to multiple remote devices on different arrays.



14.2 Introduction:

ORS cold copy operation requires that both the source and target devices be offline to a host. A cold push operation supports concurrent copies from one source device to up to 15 remote devices. If communications is lost between the source and target frames, the session will stall and continue to retry until the link recovers or the session is manually terminate.

14.3 Procedural Example:

1. Configure the DMX-3 (control array) with connections to the DMX-2 (remote 1 in diagram above) and Clariion CX500 (remote 2 in diagram above).
2. Through the Solutions Enabler server, create a device file with the relationships depicted in the following table:

Array ID	Device	Protection Type	Direction	Protection Type	Device	Array ID
DMX-3	00B5	Raid 0+1	>==>	Raid 0+1	0151	DMX-2
DMX-3	00B5	Raid 0+1	>==>	Raid 0+1	0018	Clariion

Device File: or2w-1

```
# Control Devices Remote Devices:
#=====
symdev=919:00b5 clardev=APM00040800355:0018
symdev=919:00b5 symdev=127:0151
```

3. Initiate a cold push from the Symmetrix DMX-3 to the DMX-2 and Clariion cx500 simultaneously at the highest transfer rate:

```
symrcopy create -copy -name s11push -push -cold -file or2w-1 -nop
symrcopy activate -file or2w-1 -nop (see step 1, in cold push diagram above)
symrcopy set pace 0 -file or2w-1 -nop (see step 2, in the cold push diagram above)
```

4. Query the "cold push" session. The query output shows a single percentage complete for both remote devices since each is updated simultaneously:

Device File Name : or2w-1						
Control Device		Remote Device		Flags	Status	Done

Protected						
SID:symdev	Tracks	Identification		RI CDSH	CTL <=> REM	(%)

000190100919:00B5	459861	000387430127:0151		SD X.X.	CopyInProg	16
-	-	APM00040800355:0018		CD -	-	-
Total						
Track(s)		459861				

MB(s)	28741.3
Copy rate	: 83.9 MB/S
Estimated time to completion	: 00:05:42

5. Symstat output shows the consistent I/O symmetry at which ORS pushes data from a 4-way metavolume to multiple remote devices:

DEVICE	IO/sec		KB/sec		% Hits %Seq		Num	WP
	READ	WRITE	READ	WRITE	RD	WRT	READ	Tracks
00B5 (Not Visible)	297	0	19046	0	28	N/A	0	0
00B6 (Not Visible)	304	0	19456	0	24	N/A	0	0
00B7 (Not Visible)	291	0	18636	0	25	N/A	0	0
00B8 (Not Visible)	281	0	18022	0	32	N/A	0	0
Total	1173	0	75160	0	27	N/A	0	0

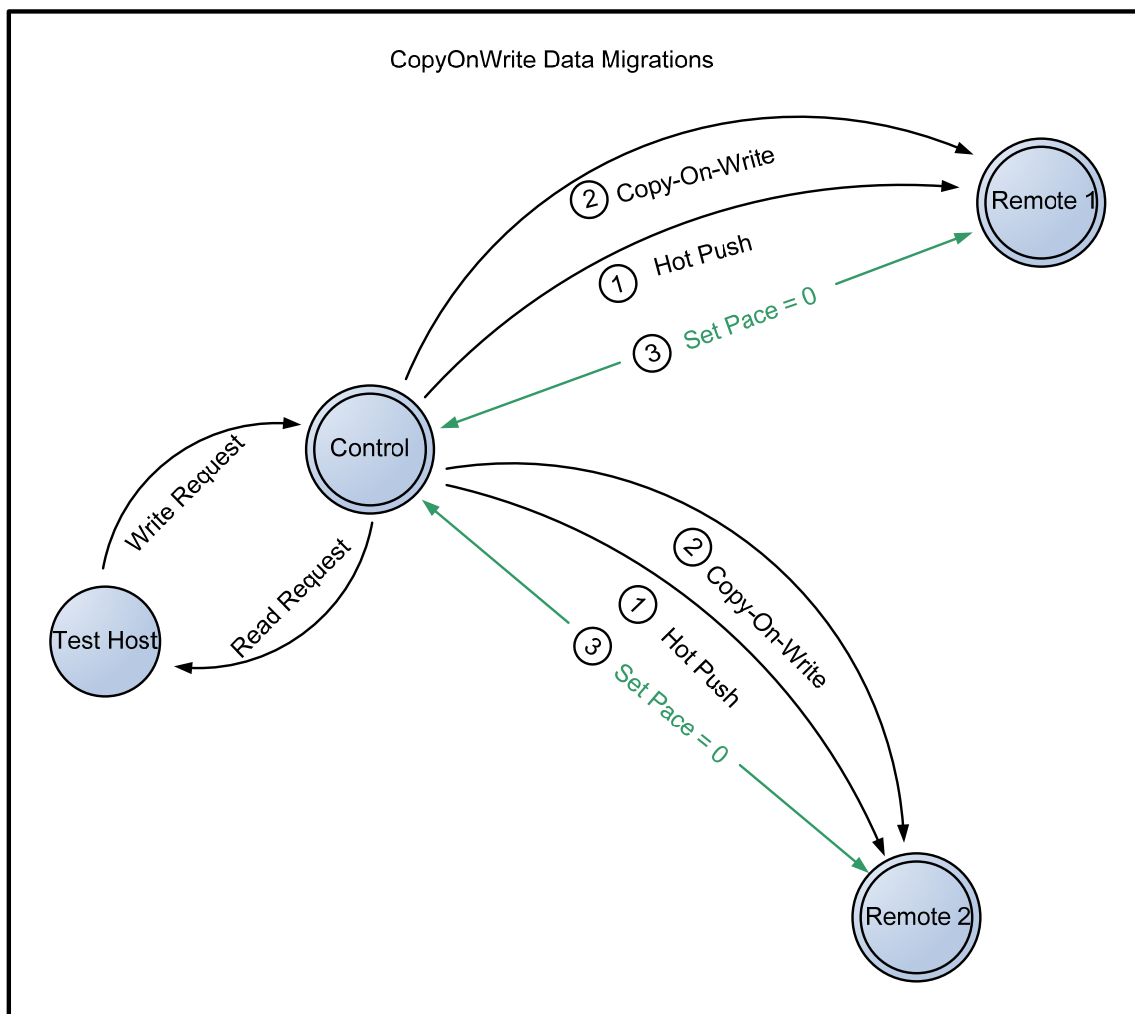
6. Termination of the cold push copy process:

```
symrcopy terminate -file or2w-1
```

15. CopyOnWrite Data Updates

15.1 Objective:

Provide a practical point-in-time copy example utilizing ORS CopyOnWrite (COW) capabilities.



15.2 Introduction:

CopyOnWrite (COW) mode transfers change tracks from the control device to the remote device(s), whereby creating a point-in-time copy of the original data.

ORS utilizes the Symmetrix Differential Data Facility (SDDF) to set the track protection bitmaps and monitor track changes between the source and target devices. A new write to the source device causes the tracks involved to be staged into cache and sent to the target device(s) prior to the writing of the new data. Therefore, a high number of Read-Write-Modify's generated by the application host, increases the number of tracks transferred to the target devices. Upon terminating of the COW process, the data image on the remote device is constructed from the unchanged source tracks in concert with a delta track table.

15.3 Procedural Example:

1. Configure the DMX-3 (control array) with connections to DMX-2 (remote 1) and Clariion CX500 (remote 2).
2. Through the Solutions Enabler server, create a device file with the device relationships depicted in the following table:

Array ID	Device	Protection Type	Direction	Protection Type	Device	Array ID
DMX-3	00D9	Raid 5	>==>	Raid 0+1	0018	Clariion
DMX-3	00B5	Raid 0+1	>==>	Raid 5	0013	Clariion
DMX-3	00D8	Raid 5	>==>	Raid 0+1	0151	DMX-2
DMX-3	00B1	Raid 0+1	>==>	Raid 0+1	0159	DMX-2

Device File:

```
#Control Devices    Remote Devices
#=====
symdev=919:00b5 clardev=APM00040800355:0013
symdev=919:00d9 clardev=APM00040800355:0018
symdev=919:00b1 symdev=127:0151
symdev=919:00d8 symdev=127:0159
```

3. Create/Activate an ORS hot push session from the control array (DMX-3 919) to both remote arrays (DMX-2 127 and cx500). Once the session is active, initiate the copy-on-write mode:

```
symrcopy create -copy -name s11push -push -hot -file or2w-1 -nop
symrcopy activate -file or2w-1 -nop (see step 1, in COW diagram)
symrcopy set mode nocopy -file or2w-1 -nop (see step 2, in COW diagram)
```

4. The progression of tracks being transferred from the control to the remote array is viewed by the "CopyOnWrite" percentage increasing while the "Protected Tracks" number decreases:

Session Status:

Device File Name : or2w-1						
Control Device		Remote Device		Flags	Status	Done

Protected						
SID:symdev	Tracks	Identification		RI CDSH	CTL <=> REM	(%)

000190100919:00B5	527258	APM00040800355:0013		CD ..XX	CopyOnWrite	4
000190100919:00D9	551456	APM00040800355:0018		CD ..XX	CopyOnWrite	0
000190100919:00B1	548537	000387430127:0151		SD ..XX	CopyOnWrite	0
000190100919:00D8	551453	000387430127:0159		SD ..XX	CopyOnWrite	0
Total						
Track(s)		-----				
2178704						
MB(s)		136169				
Copy rate : 13.2 MB/S						
Estimated time to completion : 02:51:26						

Device File Name : or2w-1						
Control Device		Remote Device		Flags	Status	Done

Protected						
SID:symdev	Tracks	Identification		RI CDSH	CTL <=> REM	(%)

000190100919:00B5	450673	APM00040800355:0013		CD ..XX	CopyOnWrite	18
000190100919:00D9	551456	APM00040800355:0018		CD ..XX	CopyOnWrite	0
000190100919:00B1	548537	000387430127:0151		SD ..XX	CopyOnWrite	0
000190100919:00D8	551453	000387430127:0159		SD ..XX	CopyOnWrite	0
Total		-----				

Track(s)	2102119
MB(s)	131382
Copy rate	: 20.3 MB/S
Estimated time to completion	: 01:47:48

5. Changing the transfer rate is not allowed while in CopyOnWrite mode:

symrcopy set pace 0 -file or2w-1 --nop (see step 3, in COW diagram)
'Set Pace' operation execution is in progress for the device list in device file 'or2w-1'. Please wait...
The operation cannot be performed because the copy mode is currently set to nocopy

6. Terminate the copy-on-write mode that initiates the original hot push operation. Set data transfer speed to maximum level:

symrcopy set mode copy -file or2w-1 --nop (step 2, in COW diagram)
symrcopy set pace 0 -file or2w-1 --nop (step 3, in COW diagram)

7. Terminating the copy-on-write session initiates the standard "CopyInProg" for all devices. Note, the change from "CopyOnWrite" to "CopyInProg" in the query output:

Device File Name : or2w-1					
Control Device		Remote Device		Flags	Status Done

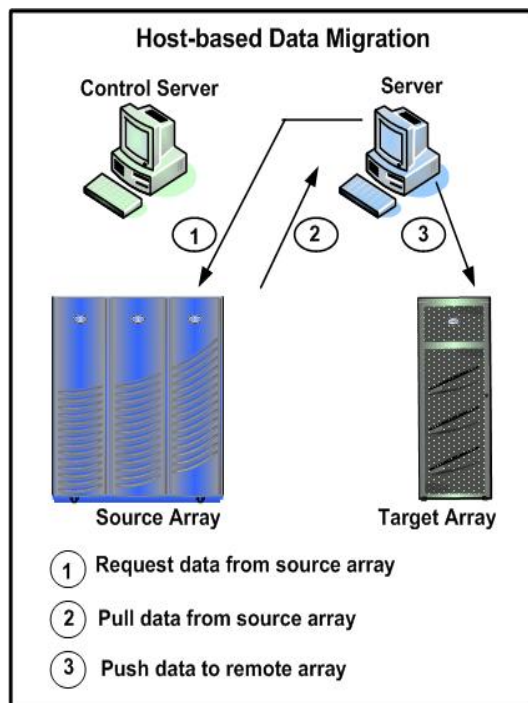
Protected					
SID:symdev	Tracks	Identification		RI CDSH	CTL <=> REM
(%)					

000190100919:00B5	277246	APM00040800355:0013		CD X.XX	CopyInProg
49					
000190100919:00D9	498123	APM00040800355:0018		CD X.XX	CopyInProg
9					
000190100919:00B1	397928	000387430127:0151		SD X.XX	CopyInProg
27					
000190100919:00D8	505728	000387430127:0159		SD X.XX	CopyInProg
8					

Total	-----
Track(s)	1679025
MB(s)	104939

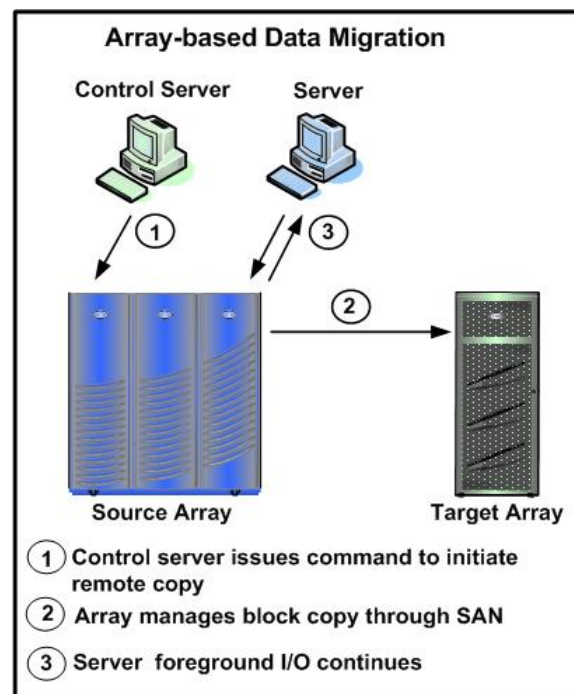
16. Appendix A: Host-based versus Array-based Data Migrations

The two most prominent forms of migrating data in the enterprise SAN environment are **host-based** and **array-based** architectures:



■ Array-based data migration transfers the data directly from the source devices in one array to the target devices in another array. The array manages the transport of the data through the SAN while continuing to support the foreground I/O access to the source devices. An example of array-based migration tool is EMC SRDF and Open Replicator.

■ Host-based data migrations functions by a host reading data from a source storage array and writing that data to a target array via the SAN. During the copy operation, server resources are dedicated to managing the copying process, and the SAN must transfer the data for both the read and write operations. A sample of host-based data migration applications are EMC Softtek Replicator, Open Migrator and Veritas Volume Manager.



17. Appendix C: SAN Topology Example

17.1 Introduction:

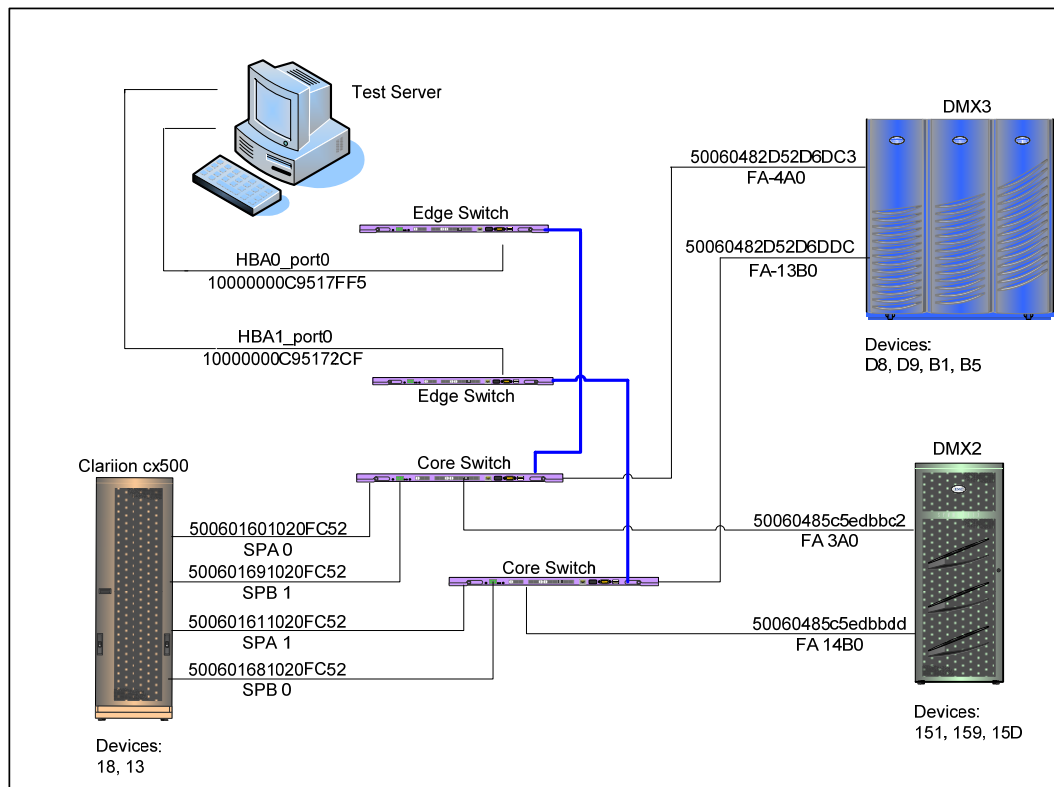
The SAN resource allocation is one of the key elements in determining a successful data migration with ORS. The following basic steps are required for ORS connectivity:

- All storage ports involved from the control and remote array(s) must be logged into the same fabric(s).
- The fibre adapters in the control and remote arrays participating in the ORS migration should be zoned together.
- The control (source) FA must be granted access to the remote devices.

17.2 Procedural Example:

The following example represents the zoning and masking configuration for ORS between a DMX-3, DMX-2 and Clariion arrays:

Connectivity Diagram Example:



1. Depicted below are the Symmetrix DMX-3 control device assignments to the Clariion cx500 and Symmetrix DMX-2 remote arrays. Note that the HBA, Clariion FE and DMX-2 FA WWN are assigned to each control device:

Device	Identifier	Type	Dir:P
00B1	10000000c9517ff5	FIBRE	FA-4A:0
	50060485c5edbbc2	FIBRE	FA-4A:0
	500601601020fc52	FIBRE	FA-4A:0
	500601691020fc52	FIBRE	FA-4A:0
	10000000c95172cf	FIBRE	FA-13B:0
	50060485c5edbbdd	FIBRE	FA-13B:0
	500601611020fc52	FIBRE	FA-13B:0
	500601681020fc52	FIBRE	FA-13B:0
00B2	-	-	-
00B3	-	-	-
00B4	-	-	-
00B5	10000000c9517ff5	FIBRE	FA-4A:0

```

50060485c5edbbc2 FIBRE FA-4A:0
500601601020fc52 FIBRE FA-4A:0
500601691020fc52 FIBRE FA-4A:0
10000000c95172cf FIBRE FA-13B:0
50060485c5edbbdd FIBRE FA-13B:0
500601611020fc52 FIBRE FA-13B:0
500601681020fc52 FIBRE FA-13B:0
00B6 - - -
00B7 - - -
00B8 - - -
00B9 - - -
00D8 10000000c9517ff5 FIBRE FA-4A:0
50060485c5edbbc2 FIBRE FA-4A:0
500601601020fc52 FIBRE FA-4A:0
500601691020fc52 FIBRE FA-4A:0
10000000c95172cf FIBRE FA-13B:0
50060485c5edbbdd FIBRE FA-13B:0
500601611020fc52 FIBRE FA-13B:0
500601681020fc52 FIBRE FA-13B:0
00D9 10000000c9517ff5 FIBRE FA-4A:0
50060485c5edbbc2 FIBRE FA-4A:0
500601601020fc52 FIBRE FA-4A:0
500601691020fc52 FIBRE FA-4A:0
10000000c95172cf FIBRE FA-13B:0
50060485c5edbbdd FIBRE FA-13B:0
500601611020fc52 FIBRE FA-13B:0
500601681020fc52 FIBRE FA-13B:0

```

2. Symmetrix DMX-2 remote device assignment to the DMX-3 control array:

Device	Identifier	Type	Dir:P
0151	50060482d52d6dc3	FIBRE	FA-3A:0
	50060482d52d6ddc	FIBRE	FA-14B:0
0152	-	-	-
0153	-	-	-
0154	-	-	-
0159	50060482d52d6dc3	FIBRE	FA-3A:0
	50060482d52d6ddc	FIBRE	FA-14B:0
015A	-	-	-
015B	-	-	-

```

015C - - -
015D 50060482d52d6dc3 FIBRE FA-3A:0
      50060482d52d6ddc FIBRE FA-14B:0
015E - - -
015F - - -
0160 - - -

```

- The “symmask list login” command shows the login history table, which lists the WWN of the hosts that have or are logged onto a specific Symmetrix fibre port. The login information is useful in verifying the control to remote storage array connection.

The symmask output below shows the Clariion cx500 SPA1 (500601611020fc52) and DMX-2 FA port 14B0 (50060485c5edbbdd) logged into DMX-3 FA 13B0:

```

symmask -sid XXX list logins -dir 13b -p 0

Symmetrix ID      : DMX-3

Director Identification : FA-13B
Director Port       : 0

Identifier      User-generated
Type Node Name      Port Name      Logged On
-----
500601611020fc52 Fibre NULL      NULL      6e0413 Yes Yes
50060485c5edbbdd Fibre DMX2_FA14B0 50060485c5edbbdd 6e0813 Yes Yes

```

The symmask output below depicts the Clariion cx500 SPA0 (500601601020fc52) and DMX-2 FA port 3A0 (50060485c5edbbc2) logged into DMX-3 FA 4A0:

```

symmask -sid XXX list logins -dir 4a -p 0

Symmetrix ID      : DMX-3

Director Identification : FA-4A
Director Port       : 0

User-generated      Logged On

```

Identifier	Type	Node	Name	Port Name	FCID	In	Fabric
500601601020fc52	Fibre	NULL		NULL	6c0413	Yes	Yes
50060485c5edbbc2	Fibre	DMX2_FA03A0		50060485c5edbbc2	6c0a13	Yes	Yes

18. Appendix D: Clariion Array Discovery

18.1 Introduction:

Discovery of the Clariion array by the Solutions Enabler server is required for ORS data migrations. This process requires access to the service processor(s) (SP-A and/or SP-B) for each Clariion array over the IP network. The login and password for each Clariion array is required, and stored within the Solutions Enablers server in an encrypted file.

18.2 Procedural Example:

1. Solutions Enabler discovers the Clariion array over the IP network. If a firewall exists between the Solutions Enabler server and Clariion array, TCP ports 80 and 443 needs to be open.
2. The authorization command is used to configure and manage the connectivity information required by certain arrays for use in the discovery operations:

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

The authorization command creates an encrypted file with the login and password:

```
cat /usr/emc/API/symapi/config/emcpwddb.dat  
  
PDS-Sealed V1 667474172  
9d13df7cf8f38f3c92f78b5f457e68f8437afd73fa5cef7c13af152a4c8e05b9  
8ee7bb679a9c94e9000a92f38a0aac53ebd10560ec48a6abd19ac6101000  
679bf1de3522acdb4cb9550430bcd4e4e20aefd72fa73
```

3. Discovering the Clariion array requires that a text file be created with the IP address of storage processor (SP) A in the left-hand column and the IP address of storage processor B in the right column.

```
# vi clarion_network_access
```

# SPA	SPB
#=====	
172.23.193.64	172.23.193.65

Note: If only one of the storage processors is required for the discovery, enter a dash (-) in the column of the undeclared processor.

4. The SE symcfg discover command discovers the CLARiiON storage processors through the IP address of the Clariion Service Processors. Once discovered, SE will be able to list the array and array devices as manageable entities:

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

CLARIIION						
ClarID	Firmware Model	Version	Num Disks	Num Phys Devices	Num Clar Devices	
APM00040800355	500	2.19.500.5.030	90	0	35	

```
sangs2# symdev list -cid APM00040800355
```

Clariion ID: APM00040800355

Device		Device		
Num	Physical Name	Config	Cap(MB)	WWN
0000	Not Visible	RAID-1/0	34816	600601606E2210001092B56F5A6BDA11
0001	Not Visible	RAID-1/0	34816	600601606E2210004C040C7A5A6BDA11
0002	Not Visible	RAID-1/0	34816	600601606E2210004621EF845A6BDA11
0003	Not Visible	RAID-5	30720	600601606E2210002C216AF251FADA11
0004	Not Visible	RAID-1/0	34816	60060160DC37100084BDF26DA5DBDA11
0005	Not Visible	RAID-1/0	34816	60060160DC371000DA733079A5DBDA11
0006	Not Visible	RAID-1/0	34816	600601606E221000DC188A5AA5DBDA11
0007	Not Visible	RAID-1/0	32768	60060160DC371000A6CD3E03CDE1DA11
0008	Not Visible	RAID-1/0	32768	60060160DC3710002ED23624CDE1DA11
0009	Not Visible	RAID-1/0	32768	60060160DC371000766F9436CDE1DA11
0010	Not Visible	RAID-1/0	32768	60060160DC371000BC4E0645CDE1DA11
0011	Not Visible	RAID-5	30720	600601606E221000844FD0DD51FADA11
0012	Not Visible	RAID-5	39936	60060160DC371000184145638CEADA11

0013	Not Visible	RAID-5	35354	600601606E2210009AD3C7158485DB11
0014	Not Visible	RAID-5	30720	600601606E221000C42FD7E851FADA11
0015	Not Visible	RAID-5	8634	60060160DC3710007831DCD37521DB11
0016	Not Visible	RAID-1/0	32768	600601606E221000C27C84E317FBDA11
0017	Not Visible	RAID-5	8634	60060160DC37100056C705DF8621DB11
0018	Not Visible	RAID-1/0	35354	600601606E221000EC7D66528485DB11
0019	Not Visible	RAID-5	30720	60060160DC3710009CC14076AE28DB11
0020	Not Visible	RAID-5	34816	600601606E221000D47FF69DA14DDB11
0023	Not Visible	RAID-5	16384	60060160DC371000C02A16189403DA11
0024	Not Visible	RAID-5	16384	60060160DC371000C12A16189403DA11
0025	Not Visible	RAID-5	16384	60060160DC371000C22A16189403DA11

19. Appendix E: Procedural Example for Solaris Filesystem Open Replicator Symmetrix Migration

19.1 Objective:

Provide an example of pushing and pulling of data from one device representing a single Solaris filesystem. This type of data migrations can be accomplished with host-based (see [Appendix A: Host-based versus Array-based Data Migration](#)) migration tools such as those from Softek or Veritas. However, if the utilization of host resources during the copy operation is of extreme concern, ORS performs this copy operation in the background with no host resources expenditure.

19.2 Procedural Example:

1. Available Devices:

```
inq
/dev/vx/rdmp/emcpower5s2      :EMC  :SYMMETRIX  :5771 :190B1000
:35354880
/dev/vx/rdmp/emcpower6s2      :EMC  :SYMMETRIX  :5771 :190D9000
:35354880
/dev/vx/rdmp/emcpower7s2      :EMC  :SYMMETRIX  :5771 :190D8000
:35354880
/dev/vx/rdmp/emcpower8s2      :EMC  :SYMMETRIX  :5771 :190B5000
:35354880
```

2. Display information on all devices defined to the volume manager: (note the status of each emcpower device)

```
vxdisk list
DEVICE    TYPE      DISK    GROUP    STATUS
c1t0d0s2  auto:none -        -        online invalid
c1t1d0s2  auto:none -        -        online invalid
c1t2d0s2  auto:none -        -        online invalid
c1t3d0s2  auto:none -        -        online invalid
emcpower5s2 auto      -        -        error
emcpower6s2 auto      -        -        error
emcpower7s2 auto      -        -        error
emcpower8s2 auto      -        -        error
```

3. Label devices:

```
format
```

AVAILABLE DISK SELECTIONS:

0. c1t0d0 <SUN72G cyl 14087 alt 2 hd 24 sec 424>
/pci@1f,700000/scsi@2/sd@0,0
1. c1t1d0 <SUN72G cyl 14087 alt 2 hd 24 sec 424>
/pci@1f,700000/scsi@2/sd@1,0
2. c1t2d0 <SUN72G cyl 14087 alt 2 hd 24 sec 424>
/pci@1f,700000/scsi@2/sd@2,0
3. c1t3d0 <SUN72G cyl 14087 alt 2 hd 24 sec 424>
/pci@1f,700000/scsi@2/sd@3,0
4. c2t50060482D52D6DC3d0 <EMC-SYMMETRIX-5771 cyl 1 alt 2 hd 15 sec 128>
/pci@1e,600000/lpfc@2/fp@0,0/ssd@w50060482d52d6dc3,0
5. c2t50060482D52D6DC3d8 <EMC-SYMMETRIX-5771 cyl 36826 alt 2 hd 15 sec 128>
/pci@1e,600000/lpfc@2/fp@0,0/ssd@w50060482d52d6dc3,8
6. c2t50060482D52D6DC3d9 <EMC-SYMMETRIX-5771 cyl 36826 alt 2 hd 15 sec 128>
/pci@1e,600000/lpfc@2/fp@0,0/ssd@w50060482d52d6dc3,9
13. c3t50060482D52D6DDCd17 <EMC-SYMMETRIX-5771 cyl 36826 alt 2 hd 15 sec 128>
/pci@1e,600000/lpfc@3/fp@0,0/ssd@w50060482d52d6ddc,11
14. emcpower5a <EMC-SYMMETRIX-5771 cyl 36826 alt 2 hd 15 sec 128>
/pseudo/emcp@5
15. emcpower6a <EMC-SYMMETRIX-5771 cyl 36826 alt 2 hd 15 sec 128>
/pseudo/emcp@6
16. emcpower7a <EMC-SYMMETRIX-5771 cyl 36826 alt 2 hd 15 sec 128>
/pseudo/emcp@7
17. emcpower8f <EMC-SYMMETRIX-5771 cyl 36826 alt 2 hd 15 sec 128>
/pseudo/emcp@8

Specify disk (enter its number): 14

selecting emcpower5a

[disk formatted]

format> format

Ready to format. Formatting cannot be interrupted
and takes 512 minutes (estimated). Continue? y

Beginning format.

Formatting...

done

Verifying media...

pass 0 - pattern = 0xc6dec6de

^C 108/12/12

Total of 0 defective blocks repaired.

format> label

Ready to label disk, continue? y

format> disk 15

selecting emcpower6a

[disk formatted]

Disk not labeled. Label it now? Y

format> disk 16

selecting emcpower7a

```
[disk formatted]
Disk not labeled. Label it now? Y
format> disk 17
selecting emcpower8f
[disk formatted]
Disk not labeled. Label it now? Y
format> q
```

4. Write the volume manager disk header for each device:

```
vxdisksetup -i emcpower5
vxdisksetup -i emcpower6
vxdisksetup -i emcpower7
vxdisksetup -i emcpower8
```

5. Display information on all devices defined to the volume manager: (note the status of each emcpower device)

```
vxdisk list
DEVICE    TYPE        DISK      GROUP    STATUS
c1t0d0s2  auto:none   -         -        online invalid
c1t1d0s2  auto:none   -         -        online invalid
c1t2d0s2  auto:none   -         -        online invalid
c1t3d0s2  auto:none   -         -        online invalid
emcpower5s2 auto:cdsdisk -         -        online
emcpower6s2 auto:cdsdisk -         -        online
emcpower7s2 auto:cdsdisk -         -        online
emcpower8s2 auto:cdsdisk -         -        online
```

6. Create a disk group with the first disk and then add the second disk to the volume group.

```
vxvg init oprep emcpower5=emcpower5s2
vxvg -g oprep adddisk emcpower6=emcpower6s2
vxvg -g oprep adddisk emcpower7=emcpower7s2
vxvg -g oprep adddisk emcpower8=emcpower8s2
```

7. View the freespace for each disk group:

```
vxvg -g oprep free
```

DISK	DEVICE	TAG	OFFSET	LENGTH	FLAGS
emcpower5	emcpower5s2	emcpower5	0	70703616	-
emcpower6	emcpower6s2	emcpower6	0	70703616	-
emcpower7	emcpower7s2	emcpower7	0	70703616	-
emcpower8	emcpower8s2	emcpower8	0	70703616	-

8. Create the new volumes:

```
vxassist -g oprep make oprep_b1 70703616 emcpower5
vxassist -g oprep make oprep_d9 70703616 emcpower6
vxassist -g oprep make oprep_d8 70703616 emcpower7
vxassist -g oprep make oprep_b5 70703616 emcpower8
```

9. Display records from the Volume Manager configuration:

```
vxprint -th
Disk group: oprep
DG NAME      NCONFIG  NLOG  MINORSS  GROUP-ID
ST NAME      STATE    DM_CNT SPARE_CNT APPVOL_CNT
DM NAME      DEVICE   TYPE  PRIVLEN  PUBLEN  STATE
RV NAME      RLINK_CNT KSTATE STATE  PRIMARY DATAVOL  SRL
RL NAME      RVG      KSTATE STATE  REM_HOST REM_DG  REM_RLKN
CO NAME      CACHEVOL KSTATE STATE
VT NAME      NVOLUME  KSTATE STATE
V NAME       RVG/VSET/CO KSTATE STATE  LENGTH  READPOL  PREFPLEX
UTYPE
PL NAME      VOLUME   KSTATE STATE  LENGTH  LAYOUT  NCOL/WID
MODE
SD NAME      PLEX     DISK  DISKOFFS LENGTH  [COL/]OFF DEVICE  MODE
SV NAME      PLEX     VOLNAME NVOLLAYR LENGTH  [COL/]OFF AM/NM
MODE
SC NAME      PLEX     CACHE  DISKOFFS LENGTH  [COL/]OFF DEVICE
MODE
DC NAME      PARENTVOL LOGVOL
SP NAME      SNAPVOL  DCO

dg oprep      default    default 41000  1164668729.23.f5-v440-01

dm emcpower5  emcpower5s2 auto  2048  70703616 -
dm emcpower6  emcpower6s2 auto  2048  70703616 -
dm emcpower7  emcpower7s2 auto  2048  70703616 -
dm emcpower8  emcpower8s2 auto  2048  70703616 -

v oprep_b1    -          ENABLED ACTIVE 70703616 SELECT - fsgen
pl oprep_b1-01 oprep_b1  ENABLED ACTIVE 70703616 CONCAT - RW
sd emcpower5-01 oprep_b1-01 emcpower5 0 70703616 0 emcpower5 ENA

v oprep_b5    -          ENABLED ACTIVE 70703616 SELECT - fsgen
pl oprep_b5-01 oprep_b5  ENABLED ACTIVE 70703616 CONCAT - RW
sd emcpower8-01 oprep_b5-01 emcpower8 0 70703616 0 emcpower8 ENA

v oprep_d8    -          ENABLED ACTIVE 70703616 SELECT - fsgen
pl oprep_d8-01 oprep_d8  ENABLED ACTIVE 70703616 CONCAT - RW
sd emcpower7-01 oprep_d8-01 emcpower7 0 70703616 0 emcpower7 ENA
```

```
v oprep_d9 - ENABLED ACTIVE 70703616 SELECT - fsgen
pl oprep_d9-01 oprep_d9 ENABLED ACTIVE 70703616 CONCAT - RW
sd emcpower6-01 oprep_d9-01 emcpower6 0 70703616 0 emcpower6 ENA
```

10. Create a Veritas filesystem for each device:

```
mkfs -F vxfs -o largefiles /dev/vx/rdisk/orep/orep_b1
version 6 layout
70703616 sectors, 35351808 blocks of size 1024, log size 65536 blocks
largefiles supported

mkfs -F vxfs -o largefiles /dev/vx/rdisk/orep/orep_b5
version 6 layout
70703616 sectors, 35351808 blocks of size 1024, log size 65536 blocks
largefiles supported

mkfs -F vxfs -o largefiles /dev/vx/rdisk/orep/orep_d8
version 6 layout
70703616 sectors, 35351808 blocks of size 1024, log size 65536 blocks
largefiles supported

mkfs -F vxfs -o largefiles /dev/vx/rdisk/orep/orep_d9
version 6 layout
70703616 sectors, 35351808 blocks of size 1024, log size 65536 blocks
largefiles supported
```

11. Edit the /etc/vfstab to reflect the new filesystems:

```
#device    device    mount    FS    fsck    mount    mount
#to mount  to fsck    point    type    pass    at boot options
#
fd - /dev/fd fd - no -
/proc - /proc proc - no -
/dev/md/dsk/d20 - - swap - no -
/dev/md/dsk/d10 /dev/md/rdisk/d10 / ufs 1 no logging
/devices - /devices devfs - no -
ctfs - /system/contract ctfs - no -
objfs - /system/object objfs - no -
swap - /tmp tmpfs - yes size=1024m
/opt - /export/opt lofs - yes -
#Open Replicator Test Devices
/dev/vx/dsk/orep/orep_b1 /dev/vx/rdisk/orep/orep_b1 /export/orep_b1
vxfs 1 yes largefiles
/dev/vx/dsk/orep/orep_b5 /dev/vx/rdisk/orep/orep_b5 /export/orep_b5
vxfs 1 yes largefiles
/dev/vx/dsk/orep/orep_d8 /dev/vx/rdisk/orep/orep_d8 /export/orep_d8
vxfs 1 yes largefiles
```

/dev/vx/dsk/oprep/oprep_d9	/dev/vx/rdisk/oprep/oprep_d9	/export/oprep_d9
vxfs	1	yes largefiles

12. Create a directory on each filesystem :

```
mkdir -p /export/oprep_b1
mkdir -p /export/oprep_b5
mkdir -p /export/oprep_d8
mkdir -p /export/oprep_d9
```

13. Mount Filesystems:

```
mount -F vxfs /dev/vx/dsk/oprep/oprep_b1 /export/oprep_b1
mount -F vxfs /dev/vx/dsk/oprep/oprep_b5 /export/oprep_b5
mount -F vxfs /dev/vx/dsk/oprep/oprep_d8 /export/oprep_d8
mount -F vxfs /dev/vx/dsk/oprep/oprep_d9 /export/oprep_d9
```

```
df -k
Filesystem      kbytes  used  avail capacity  Mounted on
/dev/vx/dsk/oprep/oprep_b1
                 35351808 74899 33072110    1%  /export/oprep_b1
/dev/vx/dsk/oprep/oprep_b5
                 35351808 74899 33072110    1%  /export/oprep_b5
/dev/vx/dsk/oprep/oprep_d8
                 35351808 74899 33072110    1%  /export/oprep_d8
/dev/vx/dsk/oprep/oprep_d9
                 35351808 74899 33072110    1%  /export/oprep_d9
```

14. Generate data into filesystems /dev/vx/dsk/oprep/oprep_b1 and /dev/vx/dsk/oprep/oprep_d9 until 30% capacity is reached:

```
df -k
Filesystem      kbytes  used  avail capacity  Mounted on
/dev/vx/dsk/oprep/oprep_b1
                 35351808 9866382 23892631   30%  /export/oprep_b1
/dev/vx/dsk/oprep/oprep_b5
                 35351808 74899 33072110    1%  /export/oprep_b5
/dev/vx/dsk/oprep/oprep_d8
                 35351808 74963 33072114    1%  /export/oprep_d8
/dev/vx/dsk/oprep/oprep_d9
                 35351808 9866374 23892638   30%  /export/oprep_d9
```

15. Configure ORS to migrate from the DMX-3 (control frame to DMX-2 (remote frame):

Create Device File:

```
symdev=0919:00D9 symdev=0127:0159
```

Set Configuration:

```
symrcopy create -copy -name s11pull -push -hot -file s11oprep -nop
```

'Create' operation execution is in progress for the device list in device file 's11oprep'. Please wait...

'Create' operation successfully executed for the device list in device file 's11oprep'.

16. Start Migration:

```
symrcopy activate -file s11oprep -nop
```

'Activate' operation execution is in progress for the device list in device file 's11oprep'. Please wait...

'Activate' operation successfully executed for the device list in device file 's11oprep'.

17. Set the Pace of Migration:

```
symrcopy set pace 0 -file s11oprep -nop
```

'Set Pace' operation execution is in progress for the device list in device file 's11oprep'. Please wait...

'Set Pace' operation successfully executed for the device list in device file 's11oprep'.

18. Monitor Status of Migration:

```
symrcopy query -file s11oprep -c 10 -i 60
```

Device File Name : s11oprep

Control Device	Remote Device	Flags	Status	Done

Protected				
SID:symdev	Tracks	Identification	RI CDSH CTL <=> REM	(%)

```
000190100919:00D9 148904 000387430127:0159 SD X.XX CopyInProg
73

Total -----
Track(s)      148904
MB(s)         9306.5

Copy rate      : 98.0 MB/S
Estimated time to completion : 00:01:34
```

19. With a hot pull, retrieve the data from the remote array back to the control frame:

```
Unmount the filesystem to be restored:
umount /export/oprep_d9

Device file:
symdev=0919:00D9 symdev=0127:0159

Configure the migration:
symrcopy create -copy -name s11pull -pull -hot -file s11oprep -nop

'Create' operation execution is in progress for the device list in
device file 's11oprep'. Please wait...

'Create' operation successfully executed for the device list
in device file 's11oprep'.

Start migration:
symrcopy activate -file s11oprep -nop

'Activate' operation execution is in progress for the device list in
device file 's11oprep'. Please wait...

'Activate' operation successfully executed for the device list
in device file 's11oprep'.
```

20. Set the Pace of Migration:

```
symrcopy set pace 0 -file s11oprep -nop

'Set Pace' operation execution is in progress for the device list in
device file 's11oprep'. Please wait...
```

'Set Pace' operation successfully executed for the device list in device file 's11oprep'.

21. Monitor migration status:

```
symrcopy query -file s11oprep -c 10 -i 30
```

Device File Name : s11oprep

Control Device	Remote Device	Flags	Status	Done

Protected				
SID:symdev	Tracks	Identification	RI CDSH	CTL <=> REM (%)

000190100919:00D9	228583	000387430127:0159	SD X..X	CopyInProg
58				

Total				
Track(s)	228583			
MB(s)	14286.4			

Copy rate	: 116.4 MB/S			
Estimated time to completion	: 00:02:02			

22. Check and mount the restored filesystem:

```
fsck -F vxfs -y /dev/vx/dsk/oprep/oprep_d9
```

```
mount /export/oprep_d9
```

```
df -k
```

Filesystem	kbytes	used	avail	capacity	Mounted on
/dev/vx/dsk/oprep/oprep_b1	35351808	9866382	23892631	30%	/export/oprep_b1
/dev/vx/dsk/oprep/oprep_b5	35351808	74899	33072110	1%	/export/oprep_b5
/dev/vx/dsk/oprep/oprep_d8	35351808	74963	33072114	1%	/export/oprep_d8
/dev/vx/dsk/oprep/oprep_d9	35351808	9866374	23892638	30%	/export/oprep_d9