



VMAX NON-DISRUPTIVE MIGRATION

Configuration and Best Practices Technical Notes

ABSTRACT

Data migrations have always been challenging in an enterprise environment. The complexity and size of very large storage environments makes planning for, scheduling, and executing migrations extremely difficult. Migrations also often involve applications that cannot be taken offline, even briefly for cutover to a new storage array. Dell EMC's VMAX Non-Disruptive Migration, or NDM, allows customers to perform online data migrations that are simple as well as completely non-disruptive to the host and application.

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EXECUTIVE SUMMARY

Data migrations have always been challenging in an enterprise environment. The complexity and size of very large storage environments makes planning for, scheduling, and executing migrations extremely difficult. Migrations also often involve applications that cannot be taken offline, even briefly for cutover to a new storage array. Dell EMC's VMAX Non-Disruptive Migration, or NDM, allows customers to perform online data migrations that are simple as well as completely non-disruptive to the host and application.

AUDIENCE

These Technical Notes are intended for:

- Customers, including IT management and planners, storage architects, and administrators involved in evaluating, acquiring, managing, operating, or designing and implementing VMAX3 or VMAX All Flash storage arrays.
- EMC field personnel and partners involved in designing VMAX3 or VMAX All Flash solutions and planning for and implementing migrations to VMAX3 or VMAX All Flash arrays.

Please ensure you are working off the latest version of this document as there are frequent updates made. The latest version can always be found here:

<https://www.emc.com/collateral/technical-documentation/h15464-vmax-non-disruptive-migration.pdf>

NON-DISRUPTIVE MIGRATION OVERVIEW

Non-Disruptive Data Migration (NDM) is available for VMAX3 and VMAX All Flash storage arrays running HYPERMAX OS 5977 Q3 2016 Service Release or later and Solutions Enabler 8.3 or later. NDM is designed to help automate the process of migrating hosts and applications to a new VMAX3 or VMAX All Flash array with no downtime.

Non-Disruptive Migration leverages VMAX SRDF replication technologies to move the application data to the new array. It also uses VMAX auto-provisioning, in combination with PowerPath or a supported host multi-pathing solution, to manage host access to the data during the migration process. Note - Migrations should take place during low IO activity to minimize Performance Impact.

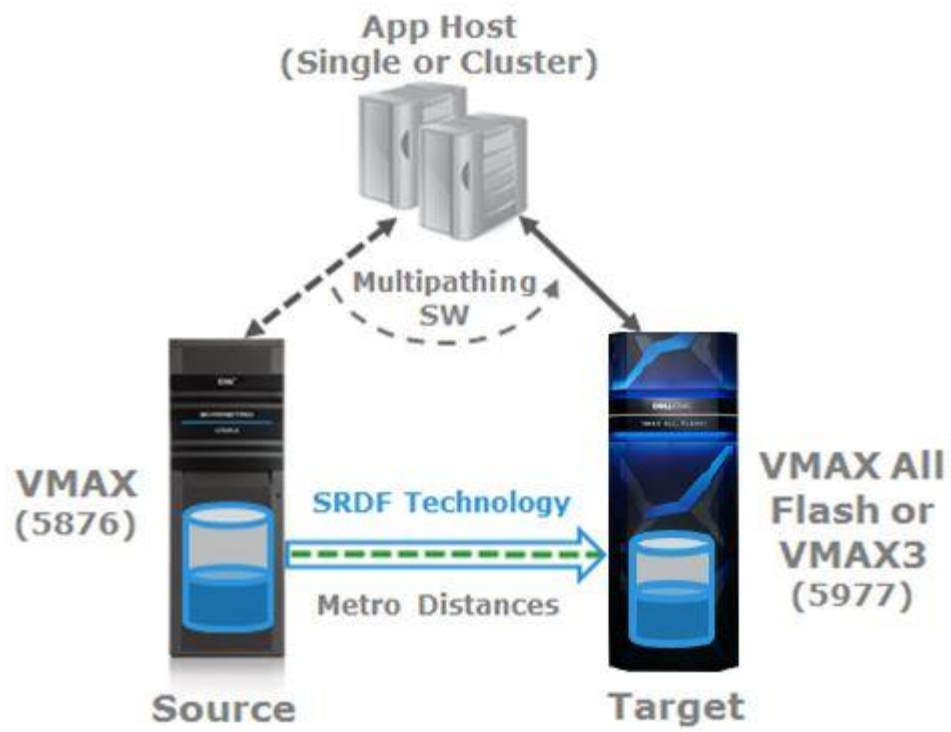


Figure 1. NDM Overview

NDM MIGRATION OPERATIONS

The migration of an application from the source to the target array is completed using a sequence of user-initiated operations, each which is fully automated. These migrations are performed at the Storage Group (SG) level. The entire migration of a storage group can be accomplished with a few clicks in Unisphere or simple, short Solutions Enabler commands that perform the following five operations:

- **Environment Setup** – Setup configures the migration environment that will be required to migrate any application from the source array to the target array. It confirms that both the source and target arrays can support the NDM operations. This includes ensuring that a useable replication pathway for data migration is available between the source and target arrays. Once the Environment Setup has completed successfully, a Create operation can be run. The environment setup command is run only once prior to the initial migration between two arrays. All other storage groups migrating between those arrays will use the same migration environment.
- **Create** – Solutions Enabler examines a specific application's storage on the source array and automatically provisions equivalent storage on the target array. The target devices are assigned the identity of the source devices and are configured in a pass-through mode that allows the data to be accessed from both the source and target devices.
 - After the create operation completes the administrator issues a host rescan to allow the host to discover the paths to the newly created devices. After this is complete, I/O issued by the application will be directed to either the source or the target arrays through the host multi-pathing software. HYPERMAX OS will ensure that all I/Os that are directed to the target by the host are actually serviced by the source array until the cutover.
- **Cutover** – A cutover operation moves the target devices out of pass-through mode, initiates data synchronization from the source to the target and makes the paths to the source array inactive so that all I/Os are being serviced by the target array.
- **Commit** – After the source to target data synchronization is complete and all application data has been migrated to the target array, a commit operation is performed. During a commit operation, Solutions Enabler completes the migration by releasing temporary resources allocated to perform the migration, permanently disabling access to the source devices, and assigning the target device ID to the source devices.
- **Environment Remove** – This is performed after all migrations have been completed to remove the migration environment. The array to array connectivity configured for the data migration pathway is removed along with the rest of the infrastructure on both arrays that was configured by HYPERMAX OS to support the migrations.

Other supported NDM operations

- **Cancel** – Ends a migration that has not been committed. It removes storage provisioned for the migration on the target array, releases resources allocated by Solutions Enabler to perform the migration, and places the source devices into the state they were in before the Create operation was run.
- **Cancel with Revert** - Run after a cutover operation to move the application's data access back to the source array from the target array and cancel the migration.
- **Recover** – Attempts to complete a failed migration operation. Recover is run following a failure after the cause of the failure, such as a connectivity issue, has been resolved.
- **Sync** – Controls the replication from the target side devices to the source side devices after a cutover is done and all data has been migrated to the target side.
- **List** – Shows a list of migrations to or from a specified array, with the current status for each.

BENEFITS

- Allows migration from VMAX to VMAX3 or VMAX All Flash with hosts and applications completely online
- Designed for ease of use with control operations that automate the setup and configuration of the migration environment
- Managed by familiar and simple user interfaces via Solutions Enabler and Unisphere for VMAX
- Migrations can be easily cancelled and failed back to the source array for any reason prior to commit

MANIPULATION OF DEVICE IDS AND HOST PATHS

NDM is able to migrate data and cutover to the target array non-disruptively by both swapping device IDs between the source and target devices and manipulating the paths from the host to both arrays. The device ID contains the device's unique WWN and other information about it, such as a device identifier that the user has assigned to a device through Solutions Enabler or Unisphere. All of this information is copied to the target devices.

NDM performs the data migration and device ID swap without the host being aware. The path management changes appear as either the addition of paths or the removal of paths to the existing source device. To the host and application, there is no change in the device that it is accessing and access to the device is maintained throughout the entire migration process.

SUPPORTED DISTANCE BETWEEN THE SOURCE AND TARGET

NDM is supported across SRDF synchronous distance. However, because of the requirement that the host see both the source and target storage, migrations will typically be performed between arrays within a data center.

EFFECTS ON DEVICES AND EXISTING REPLICATION SESSIONS

Devices that are included in migration session in both the source array can remain in existing replication sessions throughout the migration. NDM will evaluate the states of any current replication sessions before proceeding with the migration and make sure that they are in the proper state to allow the migration to succeed.

Though existing replication sessions can be left in place during the migration, replication relationships will not be migrated to the target array. These replication resources will need to be created on the target array, if required, at the appropriate point in the migration.

For example, SRDF replication can be configured between the target array and its remote array while in the CutoverSyncing state or after the CutoverSync state is reached. The new DR RDF pairs can then be allowed to synchronize before the Commit so that DR is maintained throughout the migration. SRDF can also be setup in the CutoverNoSync state, which is reached when the sync command is used to stop replication. For local Snap/VX sessions running against the source volumes, existing session on the source array can continue as normal during the migration and new sessions can also be created at the same time that the new SRDF replication is configured.

Storage on the source and target arrays that is involved in the migration of an application should never be altered, and the migration resources should not be managed, outside of the NDM commands. If any changes in the migration session are detected when a migration operation is executed, the operation will be blocked until the changes that were made are undone, allowing the migration operation to proceed as expected.

SRDF Restrictions:

- Migrating devices cannot be R2 devices.
- Cannot be concurrent RDF devices.
- The devices must not be enabled for RDF Consistency.
- The R1 may not be part of an SRDF/Star configuration.
- The RDF relationship may not be part of an SRDF/Metro configuration.
- SRDF must not be replicating data from the target to the source, such as during an in-progress restore.

TimeFinder Restrictions:

- The migration source or target may not be the target of a TimeFinder copy session.
- SRDF must not be replicating data from a local replication operation, such as during an in-progress TimeFinder restore.

Open Replicator Restrictions:

- The migration source device may not be the control device in an Open Replicator pull operation.
- Open Replicator must not be replicating data from a remote device to a control device, such as during an in-progress restore.

BOOT FROM SAN SUPPORT

NDM supports hosts that boot directly from the VMAX. The host boot BIOS must be updated to point to the target volume so that when the host is rebooted at a later date it will find the volume containing the operating system. For details on boot drive configuration please refer to the vendor specific HBA management guide or BIOS guides.

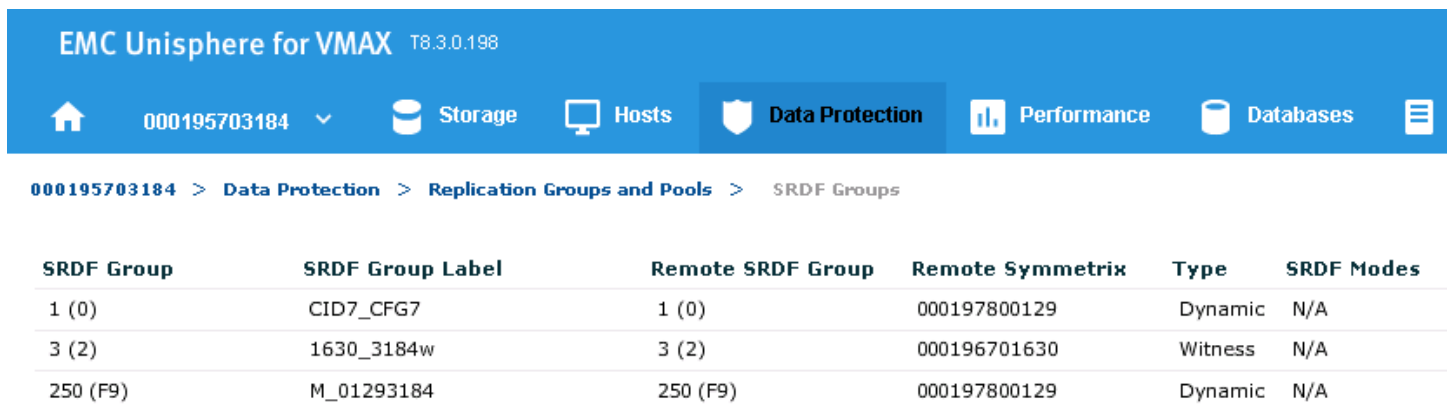
Please refer to one of the Dell EMC's host connectivity guides for more additional information regarding Boot from SAN configuration guidelines.

RECOGNIZING THE NDM RDF GROUP

The RDF group created for NDM between two arrays can be identified by its label. The label follows the format of M_XXXXYYYY, where 'XXXX' is the last four digits of the lower numbered VMAX and 'YYYY' is the last four digits of the higher numbered VMAX. This group will be used for all NDM migrations between the two arrays.

In this example, the arrays are 000197800129 and 000195703184, making the NDM RDF group label M_01293184. Unisphere will detect and use best available RDF ports for the NDM RDF group.

Note: The NDM RDF group should not be removed or relabeled. Doing either will cause NDM operations to fail.



The screenshot shows the EMC Unisphere for VMAX T8.3.0.198 interface. The navigation bar includes icons for Home, Storage, Hosts, Data Protection (selected), Performance, and Databases. The breadcrumb trail is: 000195703184 > Data Protection > Replication Groups and Pools > SRDF Groups. Below the breadcrumb is a table with the following data:

SRDF Group	SRDF Group Label	Remote SRDF Group	Remote Symmetrix	Type	SRDF Modes
1 (0)	CID7_CFG7	1 (0)	000197800129	Dynamic	N/A
3 (2)	1630_3184w	3 (2)	000196701630	Witness	N/A
250 (F9)	M_01293184	250 (F9)	000197800129	Dynamic	N/A

Figure 2. NDM RDF Group

SETTING UP MULTIPLE NDM RELATIONSHIPS

Multiple environment setup operations can be performed for a single source array, provided that a different target array is specified for each migration environment. All NDM RDF groups on a source or target array can be in use simultaneously, for concurrent migrations to, or from, an array.

For example, a single VMAX3 or All Flash target array can have multiple NDM RDF groups, each connected to one of four different source VMAX arrays. This means that the VMAX3 array can be the target of migrations from each of those four VMAX arrays.

Likewise, a single VMAX source array can have multiple NDM RDF groups, each connected to one of four different target VMAX3 or All Flash arrays. This means that the VMAX array can be the source of migrations to each of those four VMAX3 or All Flash arrays.

When migrations are completed, separate environment remove operations are required for each array pair. The environment remove operation removes the NDM RDF group between the two arrays, provided that no devices on either array have an RDF mirror in the NDM RDF group.

HOW NDM HANDLES MASKING GROUPS AND VIEWS

When NDM sessions are created, NDM configures storage groups (SGs), initiator groups (IGs), port groups (PGs), and masking views (MVs) on the target array that exactly match the group names on the source array. Both initiator groups and port groups can exist in multiple masking views, so these groups will be reused when applicable.

When the first SG on the first array is migrated to the target array, a SG will be created on the target with the same name that contains the migration target devices, an IG will be created on the target with the same name that contains the host initiators, and a PG will be created on the target based on which ports the host HBAs are logged into.

When an SG on the second source array is migrated to the target array, the SG name must be different. If necessary, the SG can be renamed before it is migrated. The IG must have the same name because an initiator can only exist in one IG. If the PG on the second array has the same name as the PG on the first array, then the PG built by NDM during the first migration will be reused. If it has a different name, a new PG will be created with the same ports used in the PG created during the first migration.

NDM also supports migration of a Parent IG which has child IG's.

RULES REGARDING MASKING GROUPS AND VIEWS

All migrations are performed against a Storage Group (SG), which is the data container that is migrated with NDM. The following rules must be met:

- Only SGs contained in masking views can be migrated. If the device is mapped to a port that it is not masked to for this SG, the create operation will not be permitted.
- A SG will not be able to be migrated using NDM if it contains devices that have been added to a second SG that belongs to a masking view.
- Multiple masking views on the SG using the same IG are not allowed unless PGs on the target array already exist for each view and the ports in the PGs are selected to avoid duplicate host paths.
- Only parent SGs and standalone SGs with masking views can be migrated. A child SG with a masking view on the child SG is not supported.
- If the SG is a parent, its child SGs will also be migrated.
- Devices in the SG which are considered to be GKs (20 cylinders or less) will not be migrated to the target array.
- Devices must not be masked to FCoE ports.
- Devices must not be masked to iSCSI ports.
- Devices must not be mapped to ports where the ACLX is not enabled.

There are restrictions on the entities that might already exist on the target array.

- If a Storage Resource Pool (SRP) on the target array is specified for the migration, that SRP must already exist on the target array.
- The names of the SGs (parent and children) that are being migrated must not exist on the target array.
- The names of the masking views that are being migrated must not exist on the target array.
- The names of the initiator groups that are being migrated may exist on the target array, provided that the groups on the target array have the exact same initiators, child groups and port flags as the groups on the source array with the same names. Port flags that are not supported on the VMAX3 are ignored. One exception to this is if the source IG was a parent IG that contained both group names and initiators. With SE 8.4 on the target array, the IG will only need to have the same group names since when SE migrates this IG; it will move all the initiators to a separate IG and will make it a child of the parent.

- The names of the port groups that are being migrated may exist on the target array, provided that the groups on the target array have the initiators logged in into at least one port in the port group, or are visible in the LHT (Login History Table).

GENERAL CONSIDERATIONS AND LIMITATIONS

- Migrating hosts must have access and be zoned to both the source and target array
- Migrating hosts must use fibre channel connectivity

SESSION LIMITS

- 16 Storage Groups can be migrated concurrently.
 - Child SGs do not count towards this limit.
- Each Storage Group can contain up to 4096 devices.

HARDWARE AND SOFTWARE REQUIREMENTS

- For full connectivity information see the following:
 - [RDF Interfamily Connectivity Guide](#)
 - [NDM Connectivity Support Article \(support.emc.com\)](#)
- Solutions Enabler 8.3 or later
- Unisphere for VMAX 8.3 or later
- Solutions Enabler or Unisphere control host
- Supported host operating system and multi-pathing software
- Supported cluster software (if applicable)
- To enable the ability for SGs with existing DR in SRDF/S mode to be migrated the following minimum code levels are required:
 - Vmax with Engenuity 5876.309.xxx & Fix 90270 (Epack)
 - VMAX3 or All Flash with HYPERMAX OS 5977 Q2 2017 Release
 - Unisphere 8.4
 - Solutions Enabler 8.4 or later

CONFIGURATION REQUIREMENTS AND PREREQUISITES

Most of the steps for configuring and un-configuring NDM is done automatically using the environment setup and remove commands. Prior to running the setup, the following is required:

- SRDF must be enabled in the bin file.
- The source and target arrays must have SRDF directors and ports configured.
- SRDF Ports on the Target array must be configured across at least two Directors with a minimum of 2 Ports up to a maximum of 8.
- The SRDF ports between the source and target arrays in a Fibre Channel environment must be zoned to each other.
- A Solutions Enabler or Unisphere management host that sees at least one of the arrays must be available.
- Both the source and target array are connected to the same SAN.

For more information on the process to enable SRDF on the array for use with NDM, please visit KB article#495041 (web link below).

<https://support.emc.com/kb/495041>

Prior to running the Create, the following is required:

- The host with the application being migrated must be zoned to the VMAX3 or VMAX All Flash.

- All devices that will be migrated must be set for dynamic SRDF capability (must be RDF1 or RDF2 Capable).

Note: RDF ports do not need to be dedicated to NDM operations. Ports involved in ongoing SRDF disaster recovery operations may be shared with NDM sessions, but analysis should be performed prior to setting up NDM to make certain there is adequate bandwidth to handle both DR and migration traffic.

SUPPORT MATRIX

Information on supported host operating systems, multipathing software, and cluster software can be found at the E-Lab Navigator (ELN) on Dell EMC's support site below.

<https://elabnavigator.emc.com/eln/elhome>

Please ensure that the environment you are planning to migrate has a match in the support matrix prior to starting the migration. The E-Lab Advisor (ELA) application available at the weblink below provides a way for Dell EMC employees and authorized partners and customers to upload host grab files to validate the environment against NDM support matrix and generate a Migration Readiness report.

<https://elabadvisor.psapps.emc.com/app/home/index>

PREFORMING NDM OPERATIONS USING SOLUTIONS ENABLER

EXAMINE THE PRE-MIGRATION ENVIRONMENT

Prior to any NDM operation, the application is running in production against the source VMAX array. A VMAX All Flash, which will be the target of the migration in this example, has been attached physically, zoned to the host, and has been discovered by Solutions Enabler.



Figure 3. Pre-Migration with Prerequisites Completed

The All Flash, along with the source 40K, is locally attached, meaning directly connected to the host and not discovered as a remote array via SRDF. Both arrays will appear as local arrays if the Solutions Enabler host is directly attached to both. This is not required for NDM operations. Only the host being migrated is required to be directly attached to both arrays.

Note: In the lab environment used here, the Solutions Enabler commands are run from the host that is being migrated. That is acceptable for non-production environments but it is not recommended for production hosts. The SE or Unisphere control host should be a separate management host, not a host with volumes being migrated.

```
C:\>symcfg list
```

S Y M M E T R I X						
SymmID	Attachment	Model	Mcode Version	Cache Size (MB)	Num Phys Devices	Num Symm Devices
000195703184	Local	VMAX40K	5876	43008	2	348
000197800129	Local	VMAX250F	5977	84992	4	231
000196701630	Remote	VMAX200K	5977	214016	0	216
000197000002	Remote	VMAX450F	5977	472064	0	227

There are four, 50 GB data volumes presented to the host from the source array (volumes 0158 to 015B). They are non-SRDF volumes.

C:\>syminq

Device		Product			Device	
Name	Type	Vendor	ID	Rev	Ser Num	Cap (KB)
\\.\PHYSICALDRIVE0		DGC	VRAID	0533	255723B2	125829120
\\.\PHYSICALDRIVE1		EMC	SYMMETRIX	5876	8400158000	52429440
\\.\PHYSICALDRIVE2		EMC	SYMMETRIX	5876	8400159000	52429440
\\.\PHYSICALDRIVE3		EMC	SYMMETRIX	5876	840015A000	52429440
\\.\PHYSICALDRIVE4		EMC	SYMMETRIX	5876	840015B000	52429440
\\.\PHYSICALDRIVE5	GK	EMC	SYMMETRIX	5876	8400028000	2880
\\.\PHYSICALDRIVE6	GK	EMC	SYMMETRIX	5977	2900001000	5760
\\.\PHYSICALDRIVE7	GK	EMC	SYMMETRIX	5977	2900001000	5760
\\.\PHYSICALDRIVE8	GK	EMC	SYMMETRIX	5876	8400028000	2880
\\.\PHYSICALDRIVE9	GK	EMC	SYMMETRIX	5977	2900001000	5760
\\.\PHYSICALDRIVE10	GK	EMC	SYMMETRIX	5977	2900001000	5760

Note: Using the -native parameter with the inq utility will allow the user to display native WWNs of specific devices

These devices are in a storage group (SG) called lcseb246_sg.

C:\>symaccess show lcseb246_sg -type storage -sid 84

```
Symmetrix ID          : 000195703184
Storage Group Name    : lcseb246_sg
Last update time      : 10:39:08 AM on Fri May 27,2016
Group last update time : 10:39:08 AM on Fri May 27,2016

Number of Storage Groups : 0
Storage Group Names      : None

Devices                : 00158:0015B

Masking View Names
{
  lcseb246_mv
}
```

There are two paths to the four devices on the source array.

```
C:\>powermt display dev=all
Pseudo name=harddisk1
Symmetrix ID=000195703184
Logical device ID=0158
Device WWN=60000970000195703184533030313538
state=alive; policy=SymmOpt; queued-I/Os=0
=====
----- Host ----- - Stor - -- I/O Path -- -- Stats ---
### HW Path          I/O Paths   Interf.  Mode   State  Q-I/Os  Errors
=====
  2 port2\path0\tgt4\lun0  c2t4d0    FA 7e:00 active  alive    0      0
```

```
1 port1\path0\tgt4\lun0 c1t4d0 FA 8e:00 active alive 0 0
```

Pseudo name=harddisk2

Symmetrix ID=000195703184

Logical device ID=0159

Device WWN=60000970000195703184533030313539

state=alive; policy=SymmOpt; queued-IOS=0

```
=====
----- Host ----- - Stor - -- I/O Path -- -- Stats ---
### HW Path          I/O Paths   Interf.  Mode    State   Q-IOS Errors
=====
    2 port2\path0\tgt4\lun1 c2t4d1   FA 7e:00 active  alive    0     0
    1 port1\path0\tgt4\lun1 c1t4d1   FA 8e:00 active  alive    0     0
```

Pseudo name=harddisk3

Symmetrix ID=000195703184

Logical device ID=015A

Device WWN=60000970000195703184533030313541

state=alive; policy=SymmOpt; queued-IOS=0

```
=====
----- Host ----- - Stor - -- I/O Path -- -- Stats ---
### HW Path          I/O Paths   Interf.  Mode    State   Q-IOS Errors
=====
    2 port2\path0\tgt4\lun2 c2t4d2   FA 7e:00 active  alive    0     0
    1 port1\path0\tgt4\lun2 c1t4d2   FA 8e:00 active  alive    0     0
```

Pseudo name=harddisk4

Symmetrix ID=000195703184

Logical device ID=015B

Device WWN=60000970000195703184533030313542

state=alive; policy=SymmOpt; queued-IOS=0

```
=====
----- Host ----- - Stor - -- I/O Path -- -- Stats ---
### HW Path          I/O Paths   Interf.  Mode    State   Q-IOS Errors
=====
    2 port2\path0\tgt4\lun3 c2t4d3   FA 7e:00 active  alive    0     0
    1 port1\path0\tgt4\lun3 c1t4d3   FA 8e:00 active  alive    0     0
```

...

After completing the prerequisites, the application host or cluster is zoned to the target array FA ports. The ports that the target devices will be masked to is determined automatically by NDM based on where the host HBAs are zoned.

Note: Workload Planner (WLP) is a Unisphere utility that can be used to determine the ideal target ports to use for an NDM migration. If WLP is used, it must be run from a control host that has access to both arrays. It cannot be run from Embedded Unisphere for VMAX.

SET UP THE ENVIRONMENT

Once the required pre-migration tasks are completed, the environment can be setup using NDM. All further steps required to setup and perform the migrations will now be handled automatically by NDM.

The Environment Setup configures the migration environment that will be required to migrate any application from the source array to the target array. It confirms that both the source and target arrays can support the NDM operations. This includes ensuring that a useable replication pathway for data migration is available between the source and target arrays and creating an SRDF group for the migration. The setup only must be run once. When the migration pathways and SRDF group are configured, all storage groups on the source array can be migrated until all migrations from the source to the target have been completed.

```
C:\>symdm environment -src_sid 3184 -tgt_sid 0129 -setup
```

A DM 'Environment Setup' operation is in progress. Please wait...

```
Analyze Configuration.....Started.
  Source SID:000195703184
  Target SID:000197800129
Analyze Configuration.....Done.
Setup Configuration.....Started.
Setup Configuration.....Done.
```

The DM 'Environment Setup' operation successfully executed.

Once the setup is complete, the migration sessions can be created.

Note: NDM Environment setup will create RDF links between the Source and Target arrays using one port per Director for each zoned link. However post Setup the user has the ability to add extra links manually using: symrdf modifygrp -rdg 250 -add dir xx -remote_dir xx

VALIDATE AND CREATE MIGRATION SESSIONS

Solutions Enabler examines a specific application's storage on the source array and automatically provisions equivalent storage on the target array. The target devices are assigned the identity of the source devices and are configured in pass-through mode which allows the data to be accessed through both the source and target devices.

Prior to running the create operation, the target array resources can be validated to ensure that the target array has the resources required to configure the migration sessions:

```
C:\>symdm create -src_sid 3184 -tgt_sid 0129 -sg lcseb246_sg -validate -nop
```

A DM 'Validate Create' operation is in progress for storage group 'lcseb246_sg'. Please wait...

```
Analyze Configuration.....Validated.
Create Storage Group(s) on Target.....Validated.
Duplicate Device(s) on Target.....Validated.
Create Initiator Group(s) on Target.....Validated.
Create Port Group(s) on Target.....Validated.
Create Masking View(s) on Target.....Validated.
```

The DM 'Validate Create' operation successfully executed for storage group 'lcseb246_sg'.

The lcseb246_sg storage group and devices are configured properly and the create operation will succeed. If there are configuration issues that will prevent the create from completing, the validate, as in this example with another storage group, will fail and reference the SYMAPI logs for more information:

```
C:\>symdm create -src_sid 3184 -tgt_sid 0129 -sg lcseb246_TEST_sg -nop -validate
```

A DM 'Validate Create' operation is in progress for storage group 'lcseb246_TEST_sg'. Please wait...

An invalid DM configuration has been detected. Operation not allowed. Check the symapi log file

The log file shows the reason for the failure:

```
06/09/2016 15:20:48.791    904    1320 EMC:SYMDM    emcValidateNDMDevice SG: lcseb246_TEST_sg
SrcSymm: 000195703184 TgtSymm: 000197800129. Source device: 00164 is not valid for migration,
status: 6002 (The specified device does not have the 'dynamic RDF1 OR RDF2 capable' attribute set)
```

The validate operation on lcseb246_sg confirms that the devices and masking can be configured on the target array. The create operation can now be run to create the migration sessions:

```
C:\>symdm create -src_sid 3184 -tgt_sid 0129 -sg lcseb246_sg -nop
```

A DM 'Create' operation is
in progress for storage group 'lcseb246_sg'. Please wait...

```
Analyze Configuration.....Started.  
  Source SID:000195703184  
  Target SID:000197800129  
Analyze Configuration.....Done.  
Create Storage Group(s) on Target.....Started.  
Create Storage Group(s) on Target.....Done.  
Duplicate Device(s) on Target.....Started.  
Duplicate Device(s) on Target.....Done.  
Create Initiator Group(s) on Target.....Started  
Create Initiator Group(s) on Target.....Done.  
Create Port Group(s) on Target.....Started.  
Create Port Group(s) on Target.....Done.  
Setup Data Replication.....Started.  
Setup Data Replication.....In Progress.  
Setup Data Replication.....Done.  
Create Masking View(s) on Target.....Started.  
Create Masking View(s) on Target.....Done.  
Update Device State.....Started.  
Update Device State.....Done.
```

The DM 'Create' operation successfully executed for
storage group 'lcseb246_sg'.

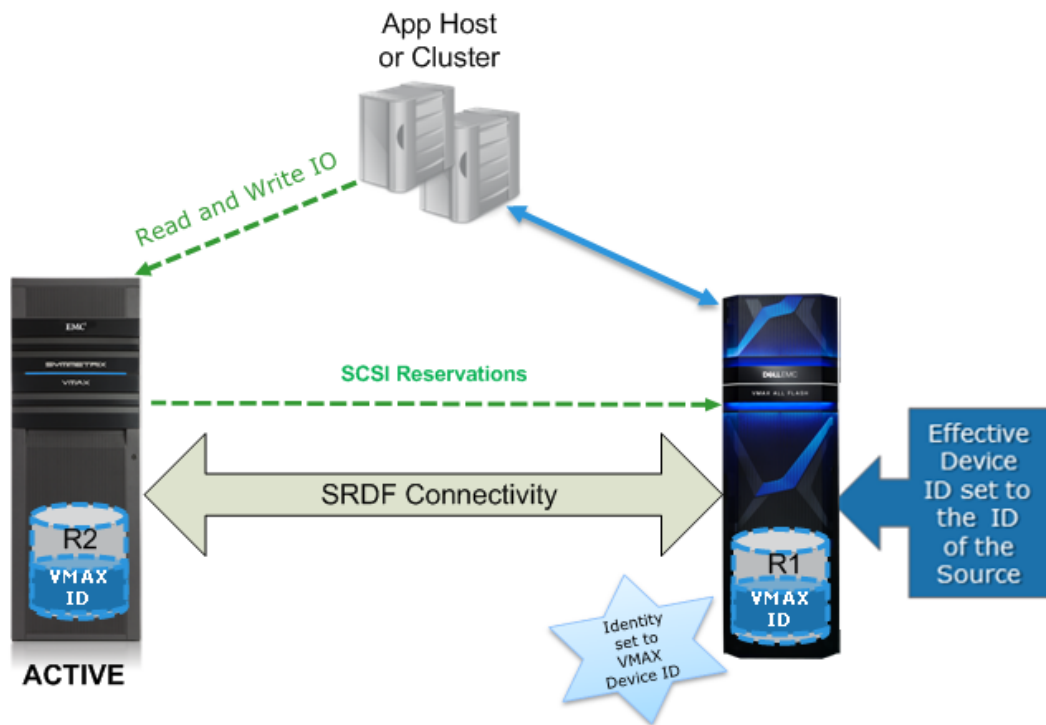


Figure 4. Created

The sessions can be viewed, in this case from the source VMAX. No user data has copied between the source and target devices, but SCSI reservations put in place by PowerPath, the host LVM, or cluster software are copied to the target.

The session is initially in a Created state:

```
C:\>symdm -sid 3184 -sg lcseb246_sg list
```

```
Symmetrix ID : 000195703184
Storage Group: lcseb246_sg
```

Source Array	Target Array	State	Total Capacity (GB)	Done (%)
000195703184	000197800129	Created	200.0	N/A

Note: During an NDM migration, the source of the migration will be an R2 or an R21 device (if there is existing SRDF DR replication from the source device) and the target will be an R1 device. This is different than basic SRDF operations and is required to allow DR protection during a migration using a cascaded SRDF configuration. See the section entitled "ADDING DISASTER RECOVERY TO THE TARGET ARRAY" for more details.

PERFORM A HOST RESCAN

After the create operation completes the systems administrator must issue a host rescan to allow the host to discover the paths to the newly created devices. This host rescan is OS specific and also should include a rescan using the host multipathing software if it must be performed separately from the host rescan, as with PowerPath.

Devices go into a CutoverReady state from a Created state after the host rescan is performed and the target devices are discoverable. After this is complete, I/O issued by the application will be directed to either the source or the target arrays through the host multipathing software. This is possible because the target devices are in pass-through mode. See Appendix A for more details on host multipathing software settings.

CUTOVERREADY AND PASSTHROUGH MODE

Passthrough mode allows the host to write to or read from either the source or target array. Any write that is sent to the target array will be sent across the SRDF link and serviced by the source array. No data will be kept on the target array while in a CutoverReady state.

The CutoverReady state is a transitional state. The devices should only be in a CutoverReady state and using pass-through mode for as long as it takes to check that the Create has succeeded properly, to run the host rescan, and to run the Cutover operation.

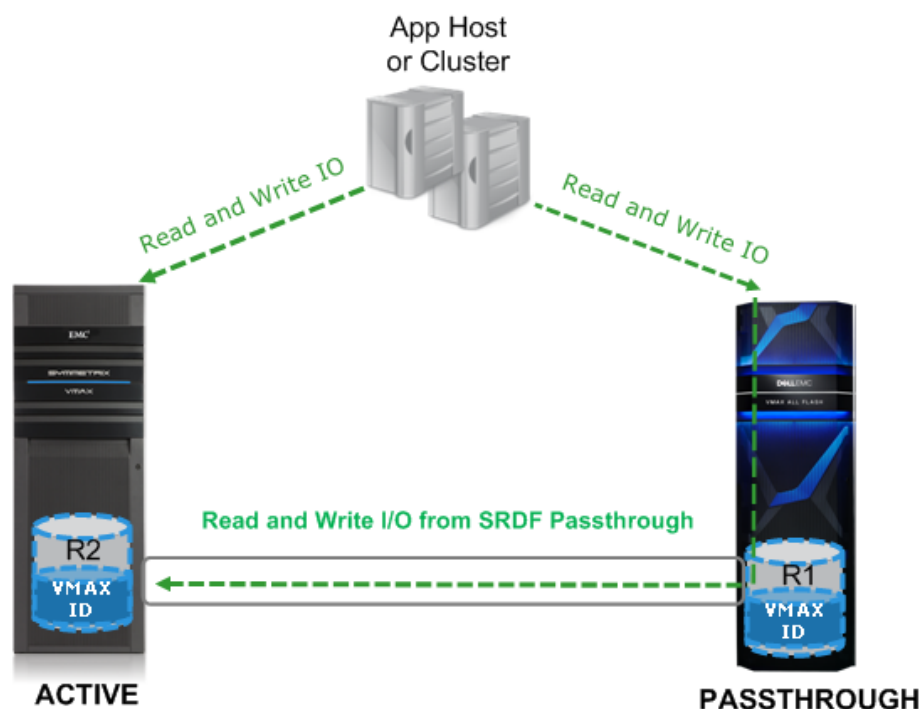


Figure 5. Cutover Ready and Passthrough Mode

PowerPath shows all paths to the source and target devices as alive. HYPERMAX OS will ensure that all I/Os that are directed to the target by the host are actually serviced by the source array until the cutover.

The paths will all remain in an alive state until after the commit operation.

Note: A Host rescan that will result in the permanent removal of the now “inactive” paths should not be undertaken at this point, this will limit the ability for the migration to be seamlessly cancelled and normal operation reverted back to the source array.

```

C:\>powermt display dev=all
Pseudo name=harddisk1
Symmetrix ID=000195703184
Logical device ID=0158
Device WWN=60000970000195703184533030313538
state=alive; policy=SymmOpt; queued-IOS=0

```

```

=====
----- Host ----- - Stor - -- I/O Path -- -- Stats ---
### HW Path          I/O Paths   Interf.  Mode    State   Q-IOS Errors
=====

```

###	HW Path	I/O Paths	Interf.	Mode	State	Q-IOS	Errors
2	port2\path0\tgt6\lun1	c2t6d1	FA 1d:61	active	alive	0	0
2	port2\path0\tgt5\lun1	c2t5d1	FA 1d:60	active	alive	0	0
2	port2\path0\tgt4\lun0	c2t4d0	FA 7e:00	active	alive	0	0
1	port1\path0\tgt6\lun1	c1t6d1	FA 2d:61	active	alive	0	0
1	port1\path0\tgt5\lun1	c1t5d1	FA 2d:60	active	alive	0	0
1	port1\path0\tgt4\lun0	c1t4d0	FA 8e:00	active	alive	0	0

```

Pseudo name=harddisk2
Symmetrix ID=000195703184
Logical device ID=0159
Device WWN=60000970000195703184533030313539
state=alive; policy=SymmOpt; queued-IOS=0

```

```

=====
----- Host ----- - Stor - -- I/O Path -- -- Stats ---
### HW Path          I/O Paths   Interf.  Mode    State   Q-IOS Errors
=====

```

###	HW Path	I/O Paths	Interf.	Mode	State	Q-IOS	Errors
2	port2\path0\tgt6\lun2	c2t6d2	FA 1d:61	active	alive	0	0
2	port2\path0\tgt5\lun2	c2t5d2	FA 1d:60	active	alive	0	0
2	port2\path0\tgt4\lun1	c2t4d1	FA 7e:00	active	alive	0	0
1	port1\path0\tgt6\lun2	c1t6d2	FA 2d:61	active	alive	0	0
1	port1\path0\tgt5\lun2	c1t5d2	FA 2d:60	active	alive	0	0
1	port1\path0\tgt4\lun1	c1t4d1	FA 8e:00	active	alive	0	0

```

Pseudo name=harddisk3
Symmetrix ID=000195703184
Logical device ID=015A
Device WWN=60000970000195703184533030313541
state=alive; policy=SymmOpt; queued-IOS=0

```

```

=====
----- Host ----- - Stor - -- I/O Path -- -- Stats ---
### HW Path          I/O Paths   Interf.  Mode    State   Q-IOS Errors
=====

```

###	HW Path	I/O Paths	Interf.	Mode	State	Q-IOS	Errors
2	port2\path0\tgt6\lun3	c2t6d3	FA 1d:61	active	alive	0	0
2	port2\path0\tgt5\lun3	c2t5d3	FA 1d:60	active	alive	0	0
2	port2\path0\tgt4\lun2	c2t4d2	FA 7e:00	active	alive	0	0
1	port1\path0\tgt6\lun3	c1t6d3	FA 2d:61	active	alive	0	0
1	port1\path0\tgt5\lun3	c1t5d3	FA 2d:60	active	alive	0	0
1	port1\path0\tgt4\lun2	c1t4d2	FA 8e:00	active	alive	0	0

```

Pseudo name=harddisk4
Symmetrix ID=000195703184
Logical device ID=015B
Device WWN=60000970000195703184533030313542
state=alive; policy=SymmOpt; queued-IOS=0

```

```

=====
----- Host ----- - Stor - -- I/O Path -- -- Stats ---

```

###	HW Path	I/O Paths	Interf.	Mode	State	Q-I/Os	Errors
2	port2\path0\tgt6\lun4	c2t6d4	FA 1d:61	active	alive	0	0
2	port2\path0\tgt5\lun4	c2t5d4	FA 1d:60	active	alive	0	0
2	port2\path0\tgt4\lun3	c2t4d3	FA 7e:00	active	alive	0	0
1	port1\path0\tgt6\lun4	c1t6d4	FA 2d:61	active	alive	0	0
1	port1\path0\tgt5\lun4	c1t5d4	FA 2d:60	active	alive	0	0
1	port1\path0\tgt4\lun3	c1t4d3	FA 8e:00	active	alive	0	0

Note: When device ID information from the source device is assigned by NDM to the target device, 32 is added to the port numbers for the target FA ports. This is done so that the host will not see the same device ID being accessed through the same director and port when the new paths are configured. In the above example, the devices are mapped to ports 28 and 29, which are displayed as ports 60 and 61. This does not apply to PP 6.2 and above where the ports are displayed correctly.

LIST THE NDM SESSIONS

There are different options that can be used to list the NDM sessions. Adding `-v` to the `symdm list` command provides more detail about the session.

```
C:\>symdm -sid 3184 -sg lcseb246_sg list -v
```

```
Symmetrix ID : 000195703184
```

```
Storage Group      : lcseb246_sg
Source Array       : 000195703184
Target Array      : 000197800129
```

```
Migration State    : CutoverReady
Total Capacity (GB) : 200.0
Done (%)          : N/A
```

```
Source Configuration: OK
```

```
{
  Storage Groups (1) : OK
  Masking Views (1)  : OK
  Initiator Groups (1): OK
  Port Groups (1)   : OK
}
```

```
Target Configuration: OK
```

```
{
  Storage Groups (1) : OK
  Masking Views (1)  : OK
  Initiator Groups (1): OK
  Port Groups (1)   : OK
}
```

```
Device Pairs (4): OK
```

Adding `-detail` to `-v` provides information broken down by Storage Group, Masking View, Initiator Group, and Port Group from each array as well as a listing and status of the device pairs:

```
C:\>symdm -sid 0129 -sg lcseb246_sg list -v -detail
```

```
Symmetrix ID : 000197800129
```

```
Storage Group      : lcseb246_sg
```

Source Array : 000195703184
Target Array : 000197800129

Migration State : CutoverReady
Total Capacity (GB) : 200.0
Done (%) : N/A

Source Configuration: OK

```
{  
  Storage Groups (1): OK  
  {  
    Name : lcseb246_sg  
    Status : OK  
    {  
      Dev  
      -----  
      00158:0015B  
    }  
  }  
}
```

Masking Views (1): OK

```
{  
  Masking View Name      Initiator Group      Port Group      Status  
  -----  
  lcseb246_mv           lcseb246_ig           lcseb246_pg           OK  
}
```

Initiator Groups (1): OK

```
{  
  Name : lcseb246_ig  
  Status : OK  
  {  
    Initiator WWN  
    -----  
    20000025b570a00f  
    20000025b570b00f  
  }  
}
```

Port Groups (1): OK

```
{  
  Name : lcseb246_pg  
  Status : OK  
  {  
    Dirport Status  
    -----  
    08E:000 OK  
    07E:000 OK  
  }  
}
```

Target Configuration: OK

```
{  
  Storage Groups (1): OK  
  {  
    Name : lcseb246_sg
```

```

Status : OK
{
  Dev
  -----
  00013:00016
}
}
Target Configuration: OK
{
  Storage Groups (1): OK
  {
    Name   : lcseb246_sg
    Status : OK
    {
      Dev
      -----
      00013:00016
    }
  }
}
Masking Views (1): OK
{
  Masking View Name      Initiator Group      Port Group      Status
  -----
  lcseb246_mv            lcseb246_ig            lcseb246_pg            OK
}
Initiator Groups (1): OK
{
  Name   : lcseb246_ig
  Status : OK
  {
    Initiator WWN
    -----
    20000025b570a00f
    20000025b570b00f
  }
}
Port Groups (1): OK
{
  Name   : lcseb246_pg
  Status : OK
  {
    Dirport Status
    -----
    01D:028 OK
    01D:029 OK
    02D:028 OK
    02D:029 OK
  }
}
}

```

```

Device Pairs (4): OK
{
  Source      Target
  Dev        Status Dev        Status
  -----
  00158 OK    00013 OK
  00159 OK    00014 OK
  0015A OK    00015 OK
  0015B OK    00016 OK
}

```

All of the group, view, and pair information can also be listed individually. As an example, by pairs and then by storage group:

```
C:\>symdm -sid 0129 -sg lcseb246_sg list -v -pairs_info -detail
```

```

Symmetrix ID : 000197800129

Storage Group      : lcseb246_sg
Source Array       : 000195703184
Target Array       : 000197800129

Migration State    : CutoverReady
Total Capacity (GB) : 200.0
Done (%)           : N/A

```

```

Device Pairs (4): OK
{
  Source      Target
  Dev        Status Dev        Status
  -----
  00158 OK    00013 OK
  00159 OK    00014 OK
  0015A OK    00015 OK
  0015B OK    00016 OK
}

```

```
C:\>symdm -sid 0129 -sg lcseb246_sg list -v -detail -sg_info
```

```

Symmetrix ID : 000197800129

Storage Group      : lcseb246_sg
Source Array       : 000195703184
Target Array       : 000197800129

Migration State    : CutoverReady
Total Capacity (GB) : 200.0
Done (%)           : N/A

```

```
Source Configuration: OK
```

```

{
  Storage Groups (1): OK
  {
    Name      : lcseb246_sg
    Status    : OK
    {
      Dev
    }
  }
}

```

```

-----
00158:0015B
}
}
}
Target Configuration: OK
{
Storage Groups (1): OK
{
Name : lcseb246_sg
Status : OK
{
Dev
-----
00013:00016
}
}
}

```

A syminq run from the host following the create shows the four devices listed as SRDF R2 devices:

```
C:\>syminq
```

Device		Product				Device
Name	Type	Vendor	ID	Rev	Ser Num	Cap (KB)
\\.\PHYSICALDRIVE0		DGC	VRAID	0533	255723B2	125829120
\\.\PHYSICALDRIVE1	R2	EMC	SYMMETRIX	5876	8400158000	52429440
\\.\PHYSICALDRIVE2	R2	EMC	SYMMETRIX	5876	8400159000	52429440
\\.\PHYSICALDRIVE3	R2	EMC	SYMMETRIX	5876	840015A000	52429440
\\.\PHYSICALDRIVE4	R2	EMC	SYMMETRIX	5876	840015B000	52429440

EXAMINE THE DEVICE PAIRING AND IDENTITIES FOLLOWING A CREATE

The create operation automatically configures matching volumes on the target array. These volumes will be the same size and configuration, though they will most likely not have the same VMAX volume numbers. Following the create operation the 4 new volumes on the target array are 0013 through 0016. Volume 0158 and volume 0013 are paired for NDM operations. The RDF pairing information can also be seen in the symdev show output.

```
C:\>symdev list -sid 3184
```

Symmetrix ID: 000195703184

Device Name	Dir	Device
Sym	Physical	SA :P Config Attribute Sts Cap (MB)
00028	\\.\PHYSICALDRIVE5	08E:000 2-Way Mir N/Grp'd ACLX RW 3
...		
00158	Not Visible	???:??? TDEV N/Grp'd RW 51201
00159	Not Visible	???:??? TDEV N/Grp'd RW 51201
0015A	Not Visible	???:??? TDEV N/Grp'd RW 51201

0015B Not Visible ??????? TDEV N/Grp'd RW 51201

C:\>symdev list -sid 0129

Symmetrix ID: 000197800129

Device Name		Dir		Device			Cap
Sym	Physical	SA :P	Config	Attribute	Sts	(MB)	
00001	\\.\PHYSICALDRIVE6	02D:028	TDEV	N/Grp'd ACLX	RW	6	
00013	\\.\PHYSICALDRIVE7	02D:028	TDEV	N/Grp'd	RW	51201	
00014	\\.\PHYSICALDRIVE8	02D:028	TDEV	N/Grp'd	RW	51201	
00015	\\.\PHYSICALDRIVE9	02D:028	TDEV	N/Grp'd	RW	51201	
00016	\\.\PHYSICALDRIVE10	02D:028	TDEV	N/Grp'd	RW	51201	

Source Device IDs:

The native and effective device IDs are the same on the source device (0158).

C:\>symdev show 0158 -sid 3184

Device Physical Name : Not Visible

Device Symmetrix Name : 00158

Device Serial ID : N/A

Symmetrix ID : 000195703184

Number of RAID Groups : 0

Encapsulated Device : No

Encapsulated WWN : N/A

Encapsulated Device Flags: None

Encapsulated Array ID : N/A

Encapsulated Device Name : N/A

Attached BCV Device : N/A

Attached VDEV TGT Device : N/A

Vendor ID : EMC

Product ID : SYMMETRIX

Product Revision : 5876

Device WWN : 60000970000195703184533030313538

Device Emulation Type : FBA

Device Defined Label Type: N/A

Device Defined Label : N/A

Device Sub System Id : 0x0001

Cache Partition Name : DEFAULT_PARTITION

Bound Pool Name : lcseb245-246

Device Block Size : 512

```

Device Capacity
{
  Cylinders      :      54614
  Tracks         :      819210
  512-byte Blocks :    104858880
  MegaBytes     :      51201
  KiloBytes     :    52429440

  Geometry Limited : No
}

```

Device External Identity

```

{
  Device WWN      : 60000970000195703184533030313538
}

```

...

Target Device IDs:

The native and effective target device IDs are not the same on the target device (0013). Device 0013 has a unique native device ID, but its effective ID is the same as device 0158. This is required at this stage of the migration because all device paths are active.

C:\>symdev show 0013 -sid 0129

```

Device Physical Name      : Not Visible

Device Symmetrix Name     : 00013
Device Serial ID         : N/A
Symmetrix ID             : 000197800129

Number of RAID Groups    : 0
Encapsulated Device      : No
Encapsulated WWN        : N/A
Encapsulated Device Flags: None

Encapsulated Array ID    : N/A
Encapsulated Device Name : N/A
Attached BCV Device      : N/A

Attached VDEV TGT Device : N/A

Vendor ID                 : EMC
Product ID                : SYMMETRIX
Product Revision         : 5977
Device WWN              : 60000970000197800129533030303133
Device Emulation Type    : FBA
Device Defined Label Type: N/A
Device Defined Label     : N/A
Device Sub System Id     : N/A
Cache Partition Name     : DEFAULT_PARTITION
Bound Pool Name          : SRP_1

Device Block Size        : 512

```

```

Device Capacity
{
  Cylinders      :      27307
  Tracks         :      409605
  512-byte Blocks :    104858880
  MegaBytes      :      51201
  KiloBytes      :    52429440

  Geometry Limited : No
}

```

Device External Identity

```

{
  Device WWN      : 60000970000195703184533030313538
}

```

...

CANCEL A MIGRATION

At any point before a commit operation is run on a Storage Group, a migration that has not been committed may be canceled. In this example, the cancel is occurring before the cutover. This operation does not require the `-revert` flag because processing has not moved to the target array.

Canceling a migration removes the storage and groups provisioned for the migration on the target array, releases resources allocated by Solutions Enabler to perform the migration, and places the source devices into the state they were in before the Create operation was run. It does not affect the replication pathways put in place with the environment setup.

```
C:\>symdm -sid 0129 -sg lcseb246_sg cancel -nop
```

A DM 'Cancel' operation is in progress for storage group 'lcseb246_sg'. Please wait...

```

Analyze Configuration.....Started.
  Source SID:000195703184
  Target SID:000197800129
Analyze Configuration.....Done.
Remove Masking View(s) on Target.....Started.
Remove Masking View(s) on Target.....In Progress.
Remove Masking View(s) on Target.....Done.
Remove Data Replication.....Started.
Remove Data Replication.....Done.
Remove Port Group(s) on Target.....Started.
Remove Port Group(s) on Target.....Done.
Remove Initiator Group(s) on Target.....Started
Remove Initiator Group(s) on Target.....Done.
Remove Duplicate Device(s) on Target.....Started.
Wait for deallocation to complete.....Started.
Wait for deallocation to complete.....Done.
Remove Duplicate Device(s) on Target.....In Progress.
Remove Duplicate Device(s) on Target.....Done.
Remove Storage Group(s) on Target.....Started.
Remove Storage Group(s) on Target.....Done.

```

The DM 'Cancel' operation successfully executed for storage group 'lcseb246_sg'.

Following the cancel operation, the host paths to the target array are no longer available. The host systems administrator should perform a rescan to remove the dead paths to the target array.

PERFORM A CUTOVER TO THE TARGET ARRAY

Prior to this step, the migration session that was canceled in the last section was simply created again. The host rescan has been performed and the devices are CutoverReady:

```
C:\>symdm -sid 0129 -sg lcseb246_sg list -v -detail -pairs_info
```

```
Symmetrix ID : 000197800129
```

```
Storage Group      : lcseb246_sg  
Source Array       : 000195703184  
Target Array       : 000197800129
```

```
Migration State   : CutoverReady
```

```
Total Capacity (GB) : 200.0
```

```
Done (%)           : N/A
```

```
Device Pairs (4): OK
```

```
{  
  Source      Target  
  Dev        Status Dev        Status  
  -----  
  00158 OK      00013 OK  
  00159 OK      00014 OK  
  0015A OK      00015 OK  
  0015B OK      00016 OK  
}
```

A cutover operation moves the target devices out of pass-through mode, initiates data synchronization from the source to the target and makes the host paths to the source array inactive so that all I/Os are being serviced by the target array.

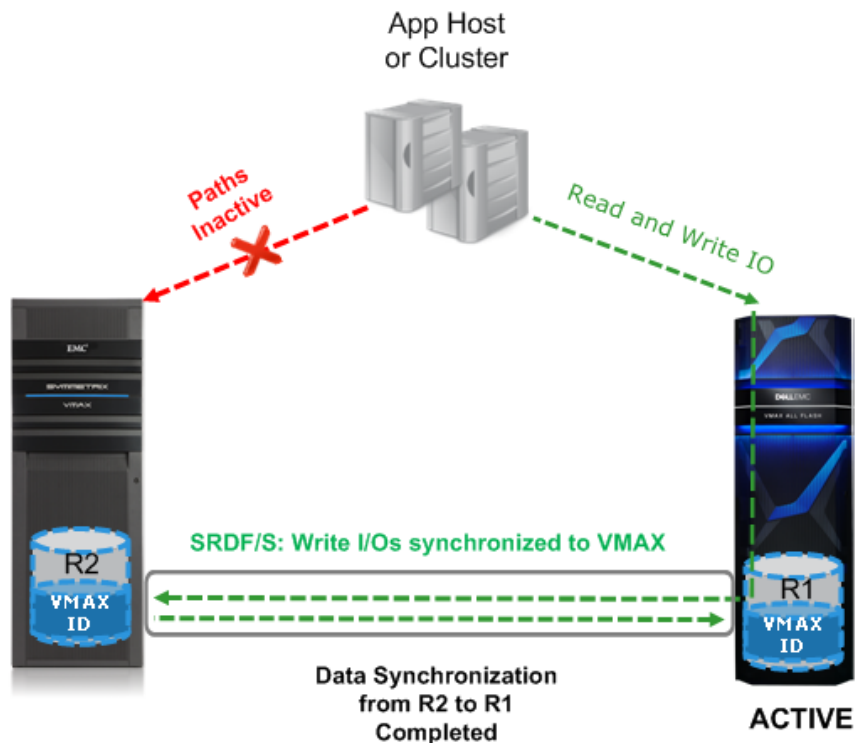


Figure 5. Cutover

```
C:\>symdm -sg lcseb246_sg cutover -sid 0129 -nop
```

A DM 'Cutover' operation is in progress for storage group 'lcseb246_sg'. Please wait...

```
Analyze Configuration.....Started.
  Source SID:000195703184
  Target SID:000197800129
Analyze Configuration.....Done.
Cutover.....Started.
Cutover.....Done.
```

The DM 'Cutover' operation successfully executed for storage group 'lcseb246_sg'.

When the cutover operation completes, the data copy begins. The session is in a Migrating state and will remain in that state until either the pairs are cutover to the new array or other action is taken. The data movement can be monitored with symdm list using any of the options for displaying Storage Group, Masking View, Initiator Group, Port Group, and device pairs or run without any of the details:

```
C:\>symdm -sid 0129 -sg lcseb246_sg list
```

```
Symmetrix ID : 000197800129
Storage Group: lcseb246_sg
```

Source Array	Target Array	State	Total Capacity (GB)	Done (%)
000195703184	000197800129	Migrating	200.0	67

C:\>symdm -sid 0129 -sg lcseb246_sg list -v -detail -pairs_info

Symmetrix ID : 000197800129

Storage Group : lcseb246_sg
Source Array : 000195703184
Target Array : 000197800129

Migration State : Migrating
Total Capacity (GB) : 200.0
Done (%) : 37

Device Pairs (4): OK

```
{
  Source      Target
  Dev        Status Dev        Status
  -----
  00158 OK      00013 OK
  00159 OK      00014 OK
  0015A OK      00015 OK
  0015B OK      00016 OK
}
```

C:\>symdm -sid 0129 -sg lcseb246_sg list

Symmetrix ID : 000197800129

Storage Group: lcseb246_sg

Source Array	Target Array	State	Total Capacity (GB)	Done (%)
000195703184	000197800129	Migrating	200.0	100

The volumes are now in a CutoverSync state.

C:\>symdm -sid 0129 -sg lcseb246_sg list

Symmetrix ID : 000197800129

Storage Group: lcseb246_sg

Source Array	Target Array	State	Total Capacity (GB)	Done (%)
000195703184	000197800129	CutoverSync	200.0	N/A

Note: The symdm list command will only show 100% done for a very brief period of time. When the session transitions to a CutoverSync state it will always be 100% synchronized.

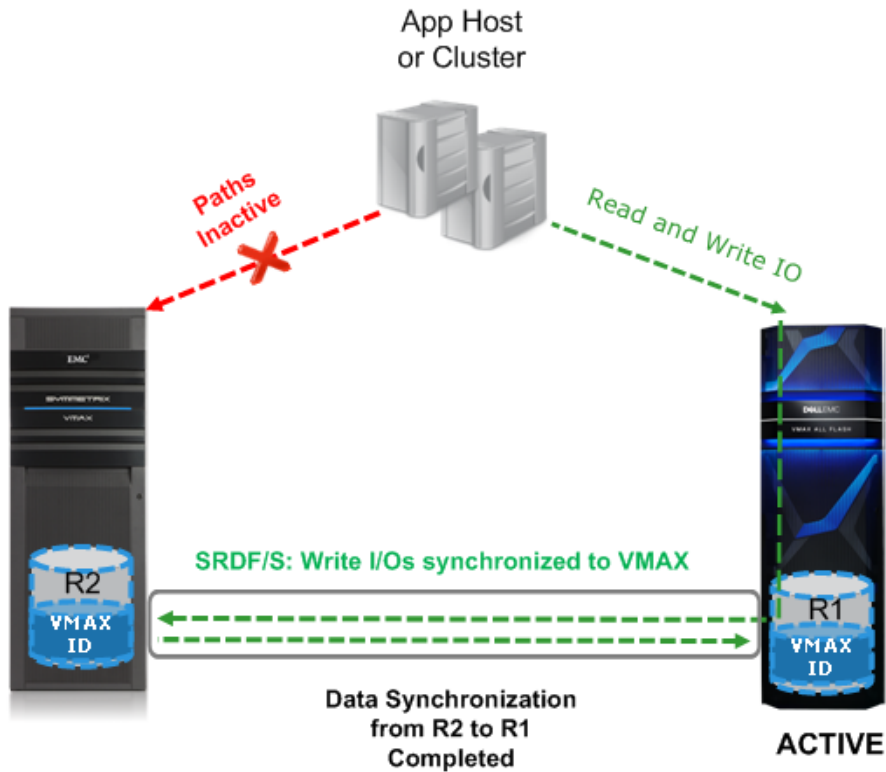


Figure 6. CutoverSynchronized

Following a cutover, the two paths to the source array are inactive (FAs 7e:00 and 8e:00) and the four paths to the target are active. In PowerPath, the terms used are "dead" and "alive".

Note: The PowerPath mode is "active" for all paths. This is a PowerPath term and is unrelated to the active and inactive path states in NDM terminology. PowerPath will show the state of the path and whether it is alive or dead in the "state" field.

```
C:>powermt display dev=all
Pseudo name=harddisk1
Symmetrix ID=000195703184
Logical device ID=0158
Device WWN=60000970000195703184533030313538
state=alive; policy=SymmOpt; queued-IOs=0
=====
----- Host ----- - Stor - -- I/O Path -- -- Stats ---
### HW Path          I/O Paths   Interf.  Mode   State  Q-IOs Errors
=====
    2 port2\path0\tgt6\lun1  c2t6d1    FA  1d:61 active  alive    0    0
    2 port2\path0\tgt5\lun1  c2t5d1    FA  1d:60 active  alive    0    0
    2 port2\path0\tgt4\lun0  c2t4d0    FA  7e:00 active  dead     0    0
    1 port1\path0\tgt6\lun1  c1t6d1    FA  2d:61 active  alive    0    0
    1 port1\path0\tgt5\lun1  c1t5d1    FA  2d:60 active  alive    0    0
    1 port1\path0\tgt4\lun0  c1t4d0    FA  8e:00 active  dead     0    0

Pseudo name=harddisk2
Symmetrix ID=000195703184
```

Logical device ID=0159
 Device WWN=60000970000195703184533030313539
 state=alive; policy=SymmOpt; queued-IOS=0

```
=====
----- Host ----- - Stor - -- I/O Path -- -- Stats ---
### HW Path          I/O Paths   Interf.  Mode   State   Q-IOS Errors
=====
```

###	HW Path	I/O Paths	Interf.	Mode	State	Q-IOS	Errors
2	port2\path0\tgt6\lun2	c2t6d2	FA 1d:61	active	alive	0	0
2	port2\path0\tgt5\lun2	c2t5d2	FA 1d:60	active	alive	0	0
2	port2\path0\tgt4\lun1	c2t4d1	FA 7e:00	active	dead	0	0
1	port1\path0\tgt6\lun2	c1t6d2	FA 2d:61	active	alive	0	0
1	port1\path0\tgt5\lun2	c1t5d2	FA 2d:60	active	alive	0	0
1	port1\path0\tgt4\lun1	c1t4d1	FA 8e:00	active	dead	0	0

Pseudo name=harddisk3
 Symmetrix ID=000195703184
 Logical device ID=015A
 Device WWN=60000970000195703184533030313541
 state=alive; policy=SymmOpt; queued-IOS=0

```
=====
----- Host ----- - Stor - -- I/O Path -- -- Stats ---
### HW Path          I/O Paths   Interf.  Mode   State   Q-IOS Errors
=====
```

###	HW Path	I/O Paths	Interf.	Mode	State	Q-IOS	Errors
2	port2\path0\tgt6\lun3	c2t6d3	FA 1d:61	active	alive	0	0
2	port2\path0\tgt5\lun3	c2t5d3	FA 1d:60	active	alive	0	0
2	port2\path0\tgt4\lun2	c2t4d2	FA 7e:00	active	dead	0	0
1	port1\path0\tgt6\lun3	c1t6d3	FA 2d:61	active	alive	0	0
1	port1\path0\tgt5\lun3	c1t5d3	FA 2d:60	active	alive	0	0
1	port1\path0\tgt4\lun2	c1t4d2	FA 8e:00	active	dead	0	0

Pseudo name=harddisk4
 Symmetrix ID=000195703184
 Logical device ID=015B
 Device WWN=60000970000195703184533030313542
 state=alive; policy=SymmOpt; queued-IOS=0

```
=====
----- Host ----- - Stor - -- I/O Path -- -- Stats ---
### HW Path          I/O Paths   Interf.  Mode   State   Q-IOS Errors
=====
```

###	HW Path	I/O Paths	Interf.	Mode	State	Q-IOS	Errors
2	port2\path0\tgt6\lun4	c2t6d4	FA 1d:61	active	alive	0	0
2	port2\path0\tgt5\lun4	c2t5d4	FA 1d:60	active	alive	0	0
2	port2\path0\tgt4\lun3	c2t4d3	FA 7e:00	active	dead	0	0
1	port1\path0\tgt6\lun4	c1t6d4	FA 2d:61	active	alive	0	0
1	port1\path0\tgt5\lun4	c1t5d4	FA 2d:60	active	alive	0	0
1	port1\path0\tgt4\lun3	c1t4d3	FA 8e:00	active	dead	0	0

Once the data copy is done, the migration for that storage group can be completed with a commit or the host access can be reverted back to the source array from the target array and the migration can be cancelled.

EXAMINE THE DEVICE IDENTITIES FOLLOWING A CUTOVER

The device IDs used on the source and target devices have not changed following the Cutover operation. The target devices are still using the effective WWN of the source devices. The source devices still have the same native and effective IDs.

Source device:

```
C:\>symdev show 0158 -sid 3184
```

```
Device Physical Name      : Not Visible

Device Symmetrix Name     : 00158
Device Serial ID         : N/A
Symmetrix ID             : 000195703184

Number of RAID Groups    : 0
Encapsulated Device      : No
Encapsulated WWN        : N/A
Encapsulated Device Flags: None

Encapsulated Array ID    : N/A
Encapsulated Device Name : N/A
Attached BCV Device      : N/A

Attached VDEV TGT Device : N/A

Vendor ID                : EMC
Product ID               : SYMMETRIX
Product Revision         : 5876
Device WWN              : 60000970000195703184533030313538
Device Emulation Type    : FBA
Device Defined Label Type: N/A
Device Defined Label     : N/A
Device Sub System Id     : 0x0001
Cache Partition Name     : DEFAULT_PARTITION
Bound Pool Name          : lcseb245-246

Device Block Size        : 512

Device Capacity
{
  Cylinders      :      54614
  Tracks         :      819210
  512-byte Blocks :    104858880
  MegaBytes     :      51201
  KiloBytes     :    52429440

  Geometry Limited : No
}

Device External Identity
{
  Device WWN      : 60000970000195703184533030313538
...

```

Target device:

```
C:\>symdev show 013 -sid 0129
```

```
Device Physical Name      : Not Visible

Device Symmetrix Name     : 00013
Device Serial ID         : N/A
Symmetrix ID             : 000197800129

Number of RAID Groups    : 0
Encapsulated Device      : No
Encapsulated WWN         : N/A
Encapsulated Device Flags: None

Encapsulated Array ID    : N/A
Encapsulated Device Name : N/A
Attached BCV Device      : N/A

Attached VDEV TGT Device : N/A

Vendor ID                : EMC
Product ID               : SYMMETRIX
Product Revision         : 5977
Device WWN              : 60000970000197800129533030303133
Device Emulation Type    : FBA
Device Defined Label Type: N/A
Device Defined Label     : N/A
Device Sub System Id     : N/A
Cache Partition Name     : DEFAULT_PARTITION
Bound Pool Name          : SRP_1

Device Block Size        : 512

Device Capacity
{
  Cylinders              :      27307
  Tracks                 :      409605
  512-byte Blocks       :     104858880
  MegaBytes              :         51201
  KiloBytes              :     52429440

  Geometry Limited      : No
}

Device External Identity
{
  Device WWN          : 60000970000195703184533030313538

```

```
...
```

REVERT TO THE SOURCE ARRAY

Because the migration is not permanent until the commit operation is run, after a cutover, the migration can still be cancelled and reverted to the source array. To revert back to the source array following a cutover, a cancel is run with the -revert option.

The -revert option moves the processing back to the source array and the cancel removes all of the target side entities created for the migration. This operation will leave the environment in the same state as it was prior to the create operation.

The revert operation may take some time to run. As the revert is running, the host will discover that the paths to the source array are active again. This is monitored by the VMAX, which will wait for the rediscovery before proceeding.

```
C:\>symdm cancel -sid 0129 -sg lcseb246_sg -revert -nop
```

A DM 'Cancel Revert' operation is in progress for storage group 'lcseb246_sg'. Please wait...

```
Analyze Configuration.....Started.
  Source SID:000195703184
  Target SID:000197800129
Analyze Configuration.....Done.
Revert Data Replication.....Started.
Revert Data Replication.....In Progress.
Revert Data Replication.....Done.
Remove Masking View(s) on Target.....Started.
Remove Masking View(s) on Target.....In Progress.
Remove Masking View(s) on Target.....Done.
Remove Data Replication.....Started.
Remove Data Replication.....Done.
Remove Port Group(s) on Target.....Started.
Remove Port Group(s) on Target.....Done.
Remove Initiator Group(s) on Target.....Started.
Remove Initiator Group(s) on Target.....Done.
Remove Duplicate Device(s) on Target.....Started.
Wait for deallocation to complete.....Started.
Wait for deallocation to complete.....Done.
Remove Duplicate Device(s) on Target.....In Progress.
Remove Duplicate Device(s) on Target.....Done.
Remove Storage Group(s) on Target.....Started.
Remove Storage Group(s) on Target.....Done.
```

The DM 'Cancel Revert' operation successfully executed for storage group 'lcseb246_sg'.

After a revert operation, the state of the devices and the systems are the same as they were prior to the create operation.

Note: Following the cancel -revert operation, the host paths to the target array are no longer available. The paths to the source array should be returned to the original configuration to avoid Data Unavailability. A host HBA rescan should be undertaken to ensure application stability. Note: The revert operation may take some time to complete. The "Revert Data Replication" step will repeat and remain "In Progress" until the step is complete. However the application will immediately be reverted back to operating on the source array. The length of the revert task is based around the time the target array takes to deallocate the target devices and clean up after the cancelled migration.

COMMIT A MIGRATION

When the data copy is complete, the migration can be committed. The commit operation completes the migration by removing the migrated application resources from the source array and temporary system resources used for the migration. To commit, the state of the migration sessions must be CutoverSync or CutoverNoSync.

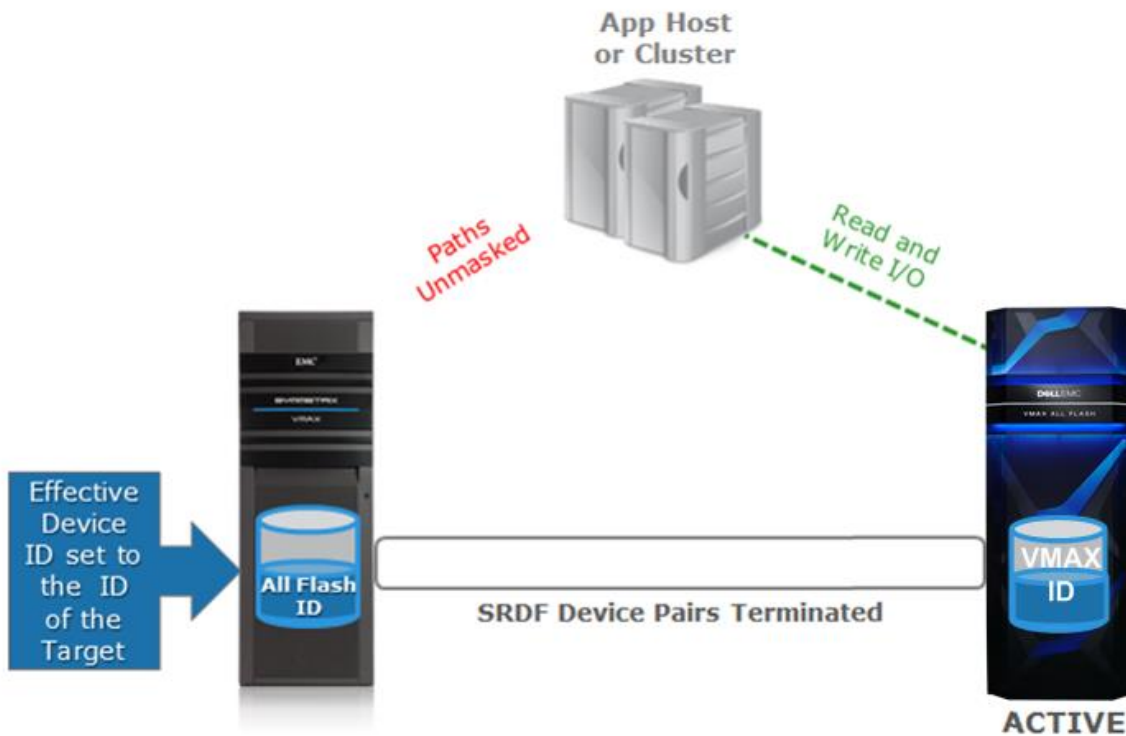


Figure 7. Commit

Once the commit is complete, replication between the source and target arrays is terminated. The source devices are no longer be visible to a host because the masking has been removed. The source device IDs have also been permanently swapped with the target device IDs.

```
C:\>symdm commit -sid 0129 -sg lcseb246_sg -nop
```

```
A DM 'Commit' operation is  
in progress for storage group 'lcseb246_sg'. Please wait...
```

```
Analyze Configuration.....Started.  
  Source SID:000195703184  
  Target SID:000197800129  
Analyze Configuration.....Done.  
Remove Masking View(s) on Source.....Started.  
Remove Masking View(s) on Source.....Done.  
Remove Data Replication.....Started.
```

Remove Data Replication.....Done.

The DM 'Commit' operation successfully executed for storage group 'lcseb246_sg'.

PERFORM A HOST RESCAN

After commit operation completes the systems administrator can issue a host rescan to allow the host to clean up the dead paths left by the removed paths to the source array. This host rescan is OS specific and also should include a rescan using the host multipathing software if it must be performed separately from the host rescan, as with PowerPath. See Appendix A for more details on the host multipathing software.

Because the commit completes the migration and removes all of the source side masking, there are no longer any paths seen to the source array. Only the four paths to the target array remain configured:

```
C:\>powermt display dev=all
Pseudo name=harddisk1
Symmetrix ID=000195703184
Logical device ID=0158
Device WWN=60000970000195703184533030313538
state=alive; policy=SymmOpt; queued-IOS=0
=====
----- Host ----- - Stor - -- I/O Path -- -- Stats ---
### HW Path          I/O Paths   Interf.  Mode    State   Q-IOS Errors
=====
    2 port2\path0\tgt6\lun1  c2t6d1    FA  1d:60 active  alive    0     0
    2 port2\path0\tgt5\lun1  c2t5d1    FA  1d:61 active  alive    0     0
    1 port1\path0\tgt6\lun1  c1t6d1    FA  2d:61 active  alive    0     0
    1 port1\path0\tgt5\lun1  c1t5d1    FA  2d:60 active  alive    0     0
```

```
Pseudo name=harddisk2
Symmetrix ID=000195703184
Logical device ID=0159
Device WWN=60000970000195703184533030313539
state=alive; policy=SymmOpt; queued-IOS=0
=====
----- Host ----- - Stor - -- I/O Path -- -- Stats ---
### HW Path          I/O Paths   Interf.  Mode    State   Q-IOS Errors
=====
    2 port2\path0\tgt6\lun2  c2t6d2    FA  1d:60 active  alive    0     0
    2 port2\path0\tgt5\lun2  c2t5d2    FA  1d:61 active  alive    0     0
    1 port1\path0\tgt6\lun2  c1t6d2    FA  2d:61 active  alive    0     0
    1 port1\path0\tgt5\lun2  c1t5d2    FA  2d:60 active  alive    0     0
```

```
Pseudo name=harddisk3
Symmetrix ID=000195703184
Logical device ID=015A
Device WWN=60000970000195703184533030313541
state=alive; policy=SymmOpt; queued-IOS=0
=====
----- Host ----- - Stor - -- I/O Path -- -- Stats ---
### HW Path          I/O Paths   Interf.  Mode    State   Q-IOS Errors
=====
    2 port2\path0\tgt6\lun3  c2t6d3    FA  1d:60 active  alive    0     0
    2 port2\path0\tgt5\lun3  c2t5d3    FA  1d:61 active  alive    0     0
```

```

1 port1\path0\tgt6\lun3 c1t6d3 FA 2d:61 active alive 0 0
1 port1\path0\tgt5\lun3 c1t5d3 FA 2d:60 active alive 0 0

```

```

Pseudo name=harddisk4
Symmetrix ID=000195703184
Logical device ID=015B
Device WWN=60000970000195703184533030313542
state=alive; policy=SymmOpt; queued-IOS=0

```

```

=====
----- Host ----- - Stor - -- I/O Path -- -- Stats ---
### HW Path          I/O Paths   Interf.  Mode   State  Q-IOS Errors
=====
  2 port2\path0\tgt6\lun4 c2t6d4   FA 1d:60 active  alive   0    0
  2 port2\path0\tgt5\lun4 c2t5d4   FA 1d:61 active  alive   0    0
  1 port1\path0\tgt6\lun4 c1t6d4   FA 2d:61 active  alive   0    0
  1 port1\path0\tgt5\lun4 c1t5d4   FA 2d:60 active  alive   0    0

```

The devices are no longer SRDF devices and the host is accessing devices on the target array only. The source devices are no longer accessible, though they are not removed by NDM.

```
C:\>symdev show 013 -sid 0129
```

```

Device Physical Name : \\.\PHYSICALDRIVE11

Device Symmetrix Name : 00013
Device Serial ID      : 2900013000
Symmetrix ID          : 000197800129

Number of RAID Groups : 0
Encapsulated Device   : No
Encapsulated WWN      : N/A
Encapsulated Device Flags: None

Encapsulated Array ID : N/A
Encapsulated Device Name : N/A
Attached BCV Device   : N/A

Attached VDEV TGT Device : N/A

Vendor ID              : EMC
Product ID             : SYMMETRIX
Product Revision       : 5977
Device WWN             : 60000970000197800129533030303133
Device Emulation Type  : FBA
Device Defined Label Type: N/A
Device Defined Label   : N/A
Device Sub System Id   : N/A
Cache Partition Name   : DEFAULT_PARTITION
Bound Pool Name        : SRP_1

Device Block Size     : 512

Device Capacity
{
  Cylinders           : 27307
  Tracks              : 409605
  512-byte Blocks     : 104858880

```

MegaBytes : 51201
KiloBytes : 52429440

Geometry Limited : No
}

Device External Identity

{
Device WWN : 60000970000195703184533030313538

Front Director Paths (4):

{

DIRECTOR PORT LUN

Type Num Sts VBUS TID SYMM Host

FA 02D:030 RW N/A N/A N/A 001
FA 01D:030 RW N/A N/A N/A N/A
FA 01D:031 RW N/A N/A N/A N/A
FA 02D:031 RW N/A N/A N/A N/A
}

Geometry : User Defined

{
Sectors/Track : 128
Tracks/Cylinder : 15
Cylinders : 54614
512-byte Blocks : 104858880
MegaBytes : 51201
KiloBytes : 52429440
}

}

Device Configuration : TDEV

SCSI-3 Persistent Reserve: Enabled

Dynamic Spare Invoked : No

Dynamic RDF Capability : RDF1_OR_RDF2_Capable

STAR Mode : No

STAR Recovery Capability : None

STAR Recovery State : NA

SQAR_MODE : No

Device Service State : Normal

Device Status : Ready (RW)

Device SA Status : Ready (RW)

Device User Pinned : False

Host Access Mode : Active

Device Tag(s) : None

Extent Based Clone : None

Snapvx Source : False

Snapvx Target : False

Data Destaged : True

```

DIF1 Flag           : False
Gatekeeper Device   : False
AS400_GK            : False
Host Cache Registered : False
Optimized Read Miss : N/A

```

```
Front Director Paths (4):
```

```
{
-----
                POWERPATH   DIRECTOR   PORT           LUN
                -----
PdevName        Type        Type Num      Sts  VBUS  TID  SYMM  Host
-----
\\.\PHYSICALDRIVE11  N/A        FA   02D:028  RW   N/A  N/A  N/A  001
Not Visible       N/A        FA   01D:028  RW   N/A  N/A  N/A  N/A
Not Visible       N/A        FA   01D:029  RW   N/A  N/A  N/A  N/A
Not Visible       N/A        FA   02D:029  RW   N/A  N/A  N/A  N/A
}
```

```
Mirror Set Type      : [Thin,N/A,N/A,N/A]
```

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

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

```
Mirror Configuration Information
```

```
{
Mirror Number       : 1
Mirror Type         : Thin
Mirror Status       : Ready           (RW)
}
```

COMPARE THE PRE AND POST DEVICE IDENTITIES FOLLOWING A COMMIT

Following the commit operation, each device presents the opposite device ID. The source device now presents the target device ID as its external identity and the target presents the source device ID as its external identity. These changes are permanent and will persist across system power cycles and even the deletion and recreation of the devices. In other words, if device 158 is deleted, when recreated, it will still show the identity of device 0013.

Source Device:

```
C:\>symdev show 0158 -sid 3184
```

```
Device Physical Name      : Not Visible
```

```
Device Symmetrix Name     : 00158
```

```
Device Serial ID         : N/A
```

```
Symmetrix ID             : 000195703184
```

```
Number of RAID Groups    : 0
```

```
Encapsulated Device      : No
```

```
Encapsulated WWN         : N/A
```

```
Encapsulated Device Flags: None
```

```
Encapsulated Array ID    : N/A
```

```
Encapsulated Device Name : N/A
```

```
Attached BCV Device      : N/A
```

Attached VDEV TGT Device : N/A

Vendor ID : EMC
Product ID : SYMMETRIX
Product Revision : 5876
Device WWN : 60000970000195703184533030313538
Device Emulation Type : FBA
Device Defined Label Type: N/A
Device Defined Label : N/A
Device Sub System Id : 0x0001
Cache Partition Name : DEFAULT_PARTITION
Bound Pool Name : lcseb245-246

Device Block Size : 512

Device Capacity
{
Cylinders : 54614
Tracks : 819210
512-byte Blocks : 104858880
MegaBytes : 51201
KiloBytes : 52429440

Geometry Limited : No
}

Device External Identity

{
Device WWN : 60000970000197800129533030303133

...

Target device:

C:\>symdev show 013 -sid 0129

Device Physical Name : Not Visible

Device Symmetrix Name : 00013
Device Serial ID : N/A
Symmetrix ID : 000197800129

Number of RAID Groups : 0
Encapsulated Device : No
Encapsulated WWN : N/A
Encapsulated Device Flags: None

Encapsulated Array ID : N/A
Encapsulated Device Name : N/A
Attached BCV Device : N/A

Attached VDEV TGT Device : N/A

Vendor ID : EMC
Product ID : SYMMETRIX

```

Product Revision      : 5977
Device WWN          : 60000970000197800129533030303133
Device Emulation Type : FBA
Device Defined Label Type: N/A
Device Defined Label  : N/A
Device Sub System Id  : N/A
Cache Partition Name  : DEFAULT_PARTITION
Bound Pool Name       : SRP_1

```

```
Device Block Size    : 512
```

```
Device Capacity
```

```

{
  Cylinders      :      27307
  Tracks         :      409605
  512-byte Blocks :    104858880
  MegaBytes      :      51201
  KiloBytes      :    52429440

```

```

  Geometry Limited : No
}

```

```
Device External Identity
```

```

{
  Device WWN      : 60000970000195703184533030313538

```

```
...
```

Note: the native identities of devices can be displayed by adding the `-native` option to `syminq`. Also with the release of PowerPath 6.2 both native and effective IDs will be displayed.

USE THE RECOVER COMMAND

The recover command can be used if a migration step fails due to some problem in the environment, such as a connectivity issue between the source and target arrays or the failure of a command to complete that leaves an NDM operation only partially finished. In this example, a create failed because of a transient issue on the target array. The transient issue resolved itself within seconds and a recover operation was immediately run. The recover operation picks up where the create command failed and completes the create operation.

```
C:\>symdm create -src_sid 3184 -tgt_sid 0129 -sg lcseb246_sg -nop
```

```
A DM 'Create' operation is
in progress for storage group 'lcseb246_sg'. Please wait...
```

```
The migration session is not in a valid DM state for this operation
```

```
C:\>symdm -sid 0129 -sg lcseb246_sg list
```

```
Symmetrix ID : 000197800129
```

```
Storage Group: lcseb246_sg
```

Source Array	Target Array	State	Total Capacity (GB)	Done (%)
000195703184	000197800129	CreateFailed	200.0	N/A

The recover operation picks up where the create command failed and completes the create operation.

```
C:\>symdm recover -sg lcseb246_sg -nop -sid 3184
```

A DM 'Recover' operation is in progress for storage group 'lcseb246_sg'. Please wait...

```
Analyze Configuration.....Started.
Analyze Configuration.....Done.
Create Storage Group(s).....Started.
Create Storage Group(s).....Done.
Create Initiator Group(s).....Started.
Create Initiator Group(s).....Done.
Create Port Group(s).....Started.
Create Port Group(s).....Done.
Duplicate Device(s).....Started.
Duplicate Device(s).....In Progress.
Duplicate Device(s).....Done.
Initiate Data Replication.....Started.
Initiate Data Replication.....In Progress.
Initiate Data Replication.....In Progress.
Initiate Data Replication.....Done.
Create Masking View(s).....Started.
Create Masking View(s).....Done.
Update Device State.....Started.
Update Device State.....Done.
```

The DM 'Recover' operation successfully executed for storage group 'lcseb246_sg'.

REMOVE THE MIGRATION ENVIRONMENT

Running the environment remove takes down the replication pathway configured by the environment setup operation, deletes the RDF group, and removes all resources that were used to support NDM on the source and target arrays. Upon successful completion of an environment remove operation, the only NDM operation that can be run is an environment setup.

This command is run when all of the storage groups have migrated off of the source array.

```
C:\>symdm -src_sid 3184 -tgt_sid 0129 environment -remove -nop
```

A DM 'Environment Remove' operation is in progress. Please wait...

```
Analyze Configuration.....Started.
  Source SID:000195703184
  Target SID:000197800129
Analyze Configuration.....Done.
Remove Configuration.....Started.
Remove Configuration.....Done.
```

The DM 'Environment Remove' operation successfully executed.

PRERFORMING NDM OPERATIONS USING UNISPHERE

Prior to any NDM operation, the application is running in production against the source VMAX array. A VMAX All Flash, which will be the target of the migration in this example, has been attached physically, zoned to the host, and has been discovered by Unisphere.

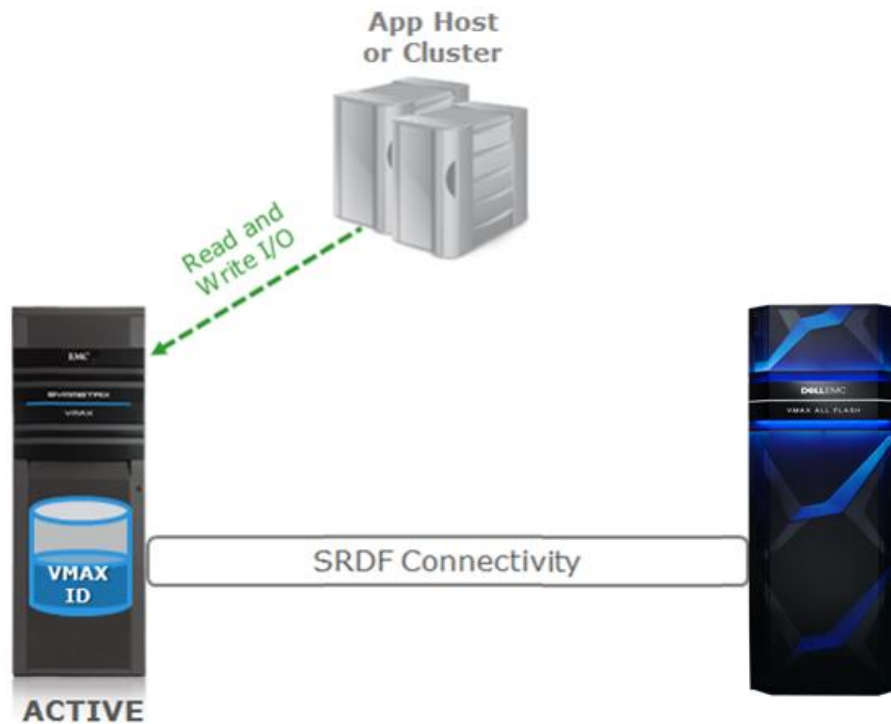


Figure 8. Pre-Migration with Prerequisites Completed

The All Flash, along with the source 40K, is locally attached, meaning directly connected to the host and not discovered as a remote array via SRDF. Both arrays will appear as local arrays if the Unisphere host is directly attached to both. This is not required for NDM operations. Only the host being migrated is required to be directly attached to both arrays.

Note: In the lab environment used here, the Solutions Enabler commands are run from the host that is being migrated. That is acceptable for non-production environments but it is not recommended for production hosts. The SE or Unisphere control host should be a separate management host, not a host with volumes being migrated.

EMC Unisphere for VMAX X8.3.0.138

All Symmetrix Performance Support

000195703184

Model: VMAX40K | Connection: Local | Engenuity: 5876.288.195

CAPACITY
Physical: 50471 GB of 51462 GB
Virtual: 2 GB of 6252 GB

PERFORMANCE
Register this system to collect performance data.

000197800129

Model: VMAX250F | Connection: Local | HYPERMAX OS: 5977.840.815 | Array Type: All Flash

CAPACITY
Virtual: 1236 GB of 18364 GB

SYSTEM UTILIZATION
Register this system to collect performance data.

000196701630

Model: VMAX200K | Connection: Remote | HYPERMAX OS: 5977.811.784

CAPACITY | **REMOTE CONNECTION**

Remote Connection
Capacity and performance components only collect data on local systems.

000196801454

Model: VMAX100K | Connection: Remote | HYPERMAX OS: 5977.811.784

CAPACITY | **REMOTE CONNECTION**

Remote Connection
Capacity and performance components only collect data on local systems.

There are four, 50 GB data volumes presented to the host from the source array (volumes 0158 to 015B). They are non-SRDF volumes.

Computer Management

File Action View Help

Computer Management (Local)

- System Tools
 - Task Scheduler
 - Event Viewer
 - Shared Folders
 - Local Users and Groups
 - Performance
 - Device Manager
- Storage
 - Windows Server Backup
 - Disk Management
 - Services and Applications

Volume	Layout	Type	File System	Status
UNI_Vol1 (N:)	Simple	Basic	NTFS	Healthy (Primary Partition)
UNI_Vol2 (O:)	Simple	Basic	NTFS	Healthy (Primary Partition)
UNI_Vol3 (P:)	Simple	Basic	NTFS	Healthy (Primary Partition)
UNI_Vol4 (Q:)	Simple	Basic	NTFS	Healthy (Primary Partition)

Disk	Layout	Type	File System	Status
Disk 21	Basic	50.00 GB	Online	UNI_Vol1 (N:) 50.00 GB NTFS Healthy (Primary Partition)
Disk 22	Basic	50.00 GB	Online	UNI_Vol2 (O:) 50.00 GB NTFS Healthy (Primary Partition)
Disk 23	Basic	50.00 GB	Online	UNI_Vol3 (P:) 50.00 GB NTFS Healthy (Primary Partition)
Disk 24	Basic	50.00 GB	Online	UNI_Vol4 (Q:) 50.00 GB NTFS Healthy (Primary Partition)

■ Unallocated ■ Primary partition

Actions: Disk Management, More Actions

C:\>syminq

Device		Product				Device
Name	Type	Vendor	ID	Rev	Ser Num	Cap (KB)
...						
\\.\PHYSICALDRIVE21		EMC	SYMMETRIX	5876	8400158000	52429440
\\.\PHYSICALDRIVE22		EMC	SYMMETRIX	5876	8400159000	52429440
\\.\PHYSICALDRIVE23		EMC	SYMMETRIX	5876	840015A000	52429440
\\.\PHYSICALDRIVE24		EMC	SYMMETRIX	5876	840015B000	52429440
...						

After completing the prerequisites, the application host or cluster is zoned to the target array FA ports. The ports that the target devices will be masked to is determined automatically by NDM based on where the host HBAS are zoned.

EXAMINE THE MULTIPATHING CONFIGURATION

PowerPath shows what the pathing looks like prior to the create and the host rescan. For each of the four selected volumes, there are two paths to the source array, which are both alive, meaning that they are available for host use. There are no paths yet to the target array.

Note: Workload Planner (WLP) is a Unisphere utility that can be used to determine the ideal target ports to use for an NDM migration. If WLP is used, it must be run from a control host that has access to both arrays. It cannot be run from Embedded Unisphere for VMAX.

Disk Number	Path Status	Path State	Path Mode	IOs/Sec	Q-IOs	Errors	Storage Class	Path Metric	Storage ID	Device Number	Storage Group
Disk 000	Optimal	Alive	Active	0	0	0	VNX	8/8	APM001445139...	-	B246_SG
Disk 001	Optimal	Alive	Active	72	0	0	Symmetrix	2/2	000195703184	0160	-
Disk 002	Optimal	Alive	Active	0	0	0	Symmetrix	2/2	000195703184	0161	-
Disk 003	Optimal	Alive	Active	0	0	0	Symmetrix	2/2	000195703184	0162	-
Disk 004	Optimal	Alive	Active	0	0	0	Symmetrix	2/2	000195703184	0163	-
Disk 007	Optimal	Alive	Active	0	0	0	Symmetrix	4/4	000195703184	0158	-
Disk 008	Optimal	Alive	Active	0	0	0	Symmetrix	4/4	000195703184	0159	-
Disk 009	Optimal	Alive	Active	0	0	0	Symmetrix	4/4	000195703184	015A	-
Disk 010	Optimal	Alive	Active	0	0	0	Symmetrix	4/4	000195703184	015B	-
Disk 011	Optimal	Alive	Active	0	0	0	Symmetrix	4/4	000195703184	015C	-
Disk 012	Optimal	Alive	Active	0	0	0	Symmetrix	4/4	000195703184	015D	-
Disk 013	Optimal	Alive	Active	0	0	0	Symmetrix	4/4	000195703184	015E	-
Disk 014	Optimal	Alive	Active	0	0	0	Symmetrix	4/4	000195703184	015F	-
Disk 015	Optimal	Alive	Active	0	0	0	Symmetrix	4/4	000195703184	0164	-
Disk 016	Optimal	Alive	Active	0	0	0	Symmetrix	4/4	000195703184	0165	-
Disk 021	Optimal	Alive	Active	0	0	0	Symmetrix	2/2	000195703184	0166	-
Disk 022	Optimal	Alive	Active	0	0	0	Symmetrix	2/2	000195703184	0167	-
Disk 023	Optimal	Alive	Active	0	0	0	Symmetrix	2/2	000195703184	0168	-
Disk 024	Optimal	Alive	Active	0	0	0	Symmetrix	2/2	000195703184	0169	-

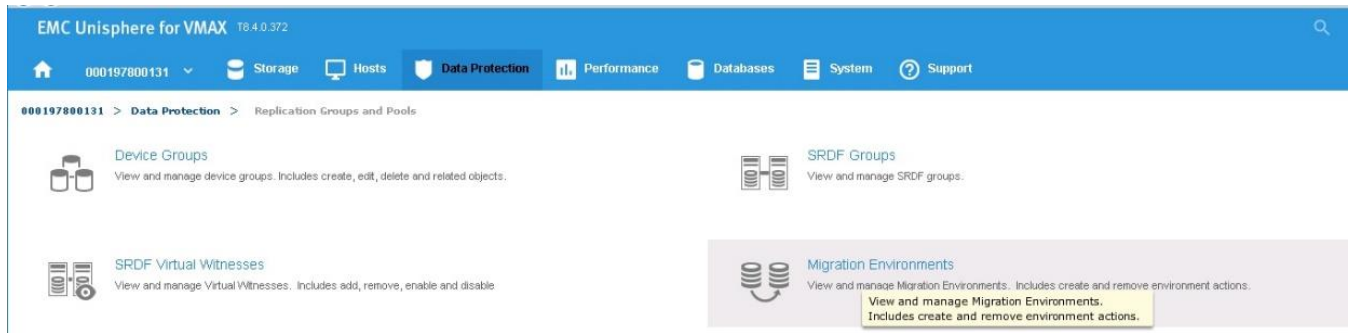
Note: The Windows disk numbers will change in the output due to changes in the test environment.

SET UP THE ENVIRONMENT

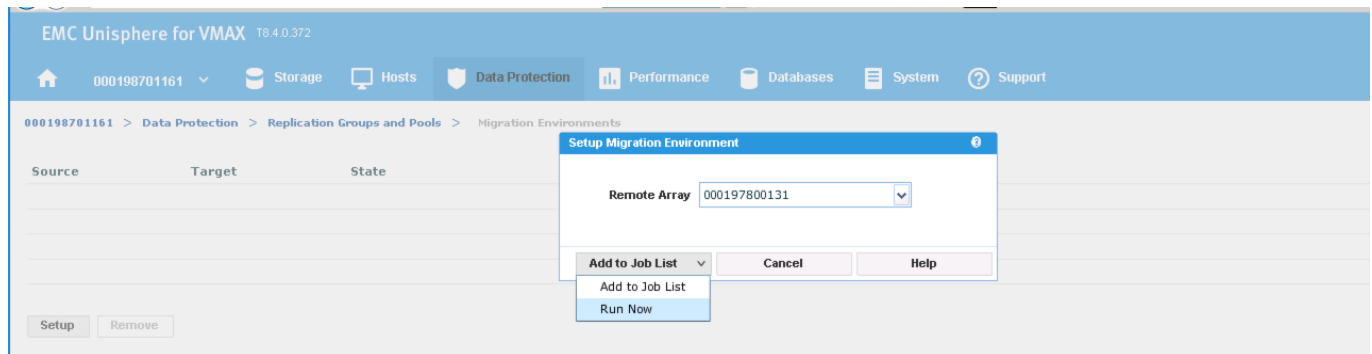
Once the required pre-migration tasks are completed, the environment can be setup using NDM. All further steps required to setup and perform the migrations will now be handled automatically by NDM. To start the setup, click on the **Storage** menu followed by **Migrations**.

The Environment Setup configures the migration environment that will be required to migrate any application from the source array to the target array. It confirms that both the source and target arrays can support the NDM operations. This includes ensuring that a useable replication pathway for data migration is available between the source and target arrays. The setup only must be run once. When the migration pathways are configured, any storage groups can be migrated until all migrations from the source to the target are complete.

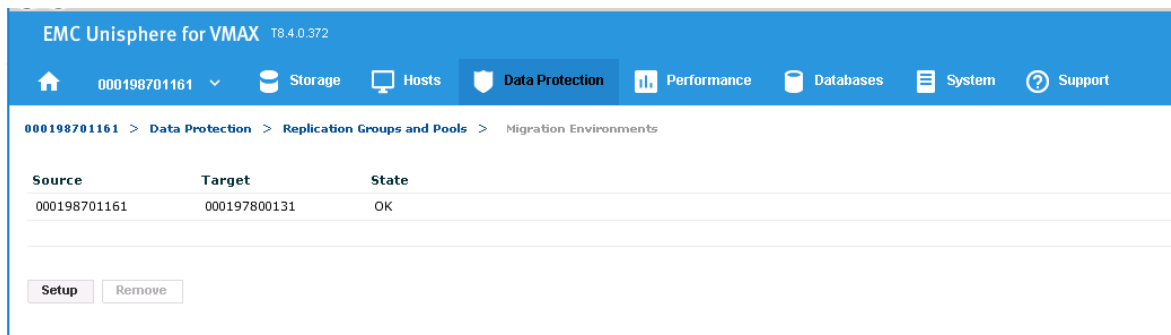
Select the Data Protection tab in Unisphere 8.4 or later. (Previously: Storage – Migrations – Manage Environments)



Click the **Manage Environments** Option.



Click the Setup option and choose the Remote array for the migration, and select Run Now.



When the task completes the Source and Target arrays are displayed in a State of OK, indicating migrations are now possible between the arrays listed.

Note: Workload Planner (WLP) is a Unisphere utility that can be used to determine the ideal target ports to use for an NDM migration. If WLP is used, it must be run from a control host that has access to both arrays. It cannot be run from Embedded Unisphere for VMAX.

CREATE MIGRATION SESSIONS

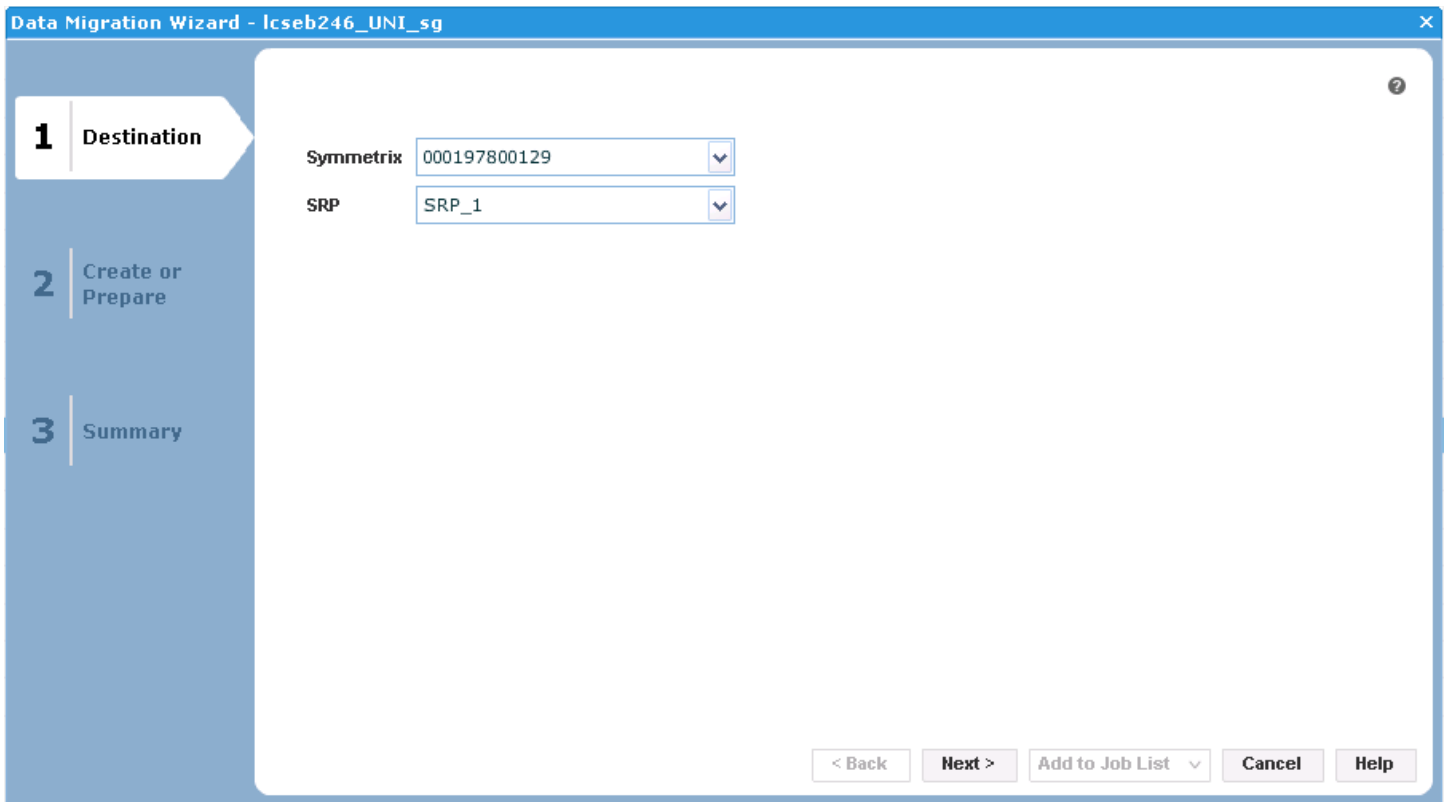
Unisphere examines a specific application's storage on the source array and automatically provisions equivalent storage on the target array. The target devices are assigned the identity of the source devices and are configured in a Passthrough mode that allows the data to be accessed from both the source and target devices.

Prior to running the create, the target array resources can be validated to ensure that the target array has the resources required to configure the migration sessions. Click on **the storage group** to select it, click the **double angle brackets**, and click **Manage**.

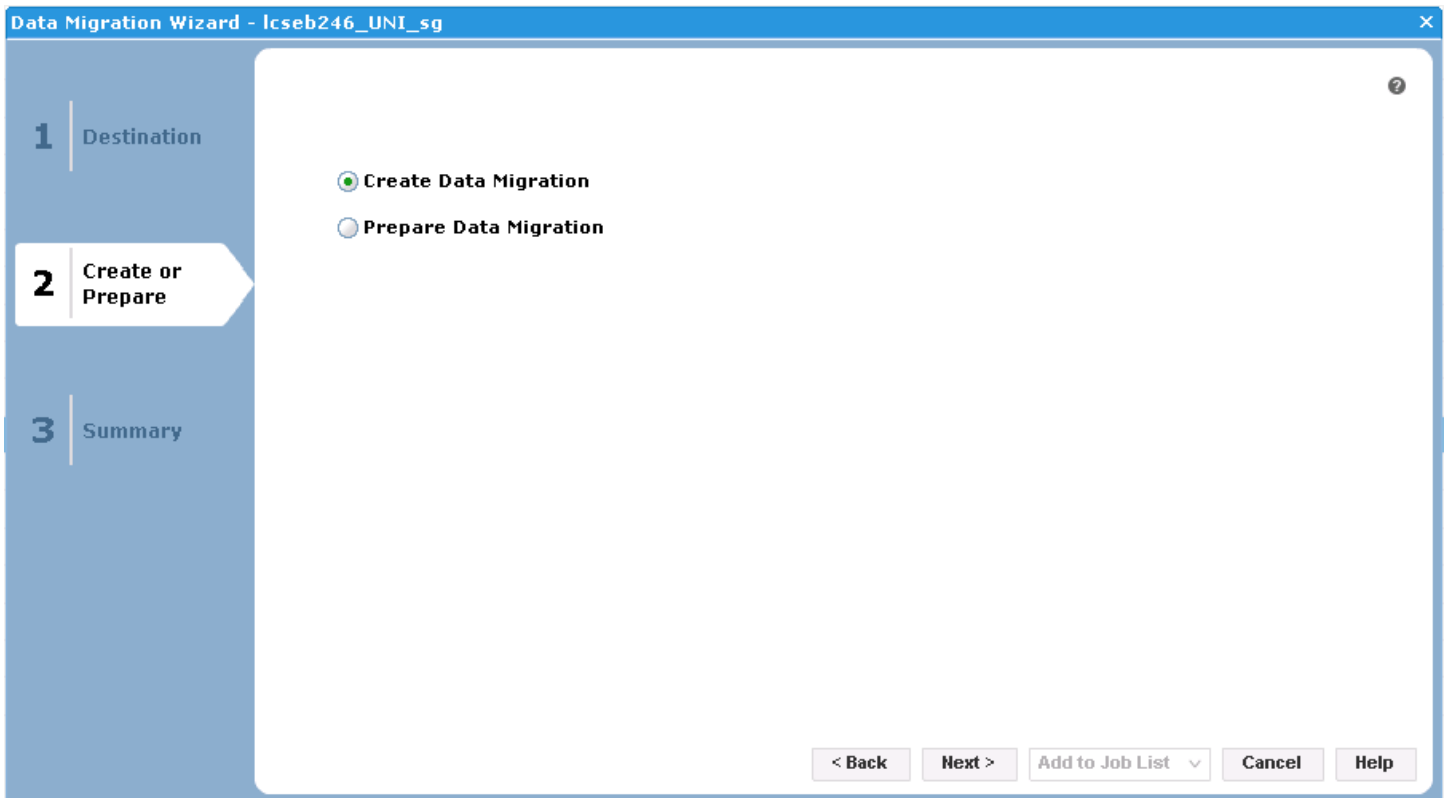
The screenshot shows the EMC Unisphere for VMAX interface. The top navigation bar includes 'Storage', 'Hosts', 'Data Protection', 'Performance', 'Databases', and 'System'. The main content area displays a table of storage groups. The 'lcseb246_UNI_sg' storage group is selected, and a context menu is open over it. The menu options include 'Migrate', 'FAST Array Advisor', 'Delete', 'Associate to FAST', 'Bind S/G', 'Unbind S/G', 'Rebind S/G', 'Reassociate to FAST Policy', 'Disassociate', 'Set Host I/O Limits', 'Set Optimized Read Mix', 'Pin S/G', 'Unpin S/G', 'VLUN Migration', 'Assign Dynamic Cache Partition', 'VP Compression', 'Replication QOS', 'Assign Symmetric Priority', 'Start Allocate/Free/Reclaim', 'Stop Allocate/Free/Reclaim', 'Tag for RecoverPoint', and 'Untag for RecoverPoint'. The 'Migrate' option is highlighted. At the bottom of the table, there are buttons for 'Create SG', 'Expand', 'Provision Storage to Host', 'Protect', 'Manage Protection', and 'View Details'. A double angle bracket button is also visible.

Name	FAST Policy	Capacity (GB)	Volumes	Masking Views
▼ CUST_CSE	—	400.02	10	1
b145_or	—	400	4	1
cust_gks	—		6	1
▼ FASTX_MIG_POD	—		18	1
fastx_mig_gks	—		18	1
Finance_NDM	—		2	1
▼ GA_POD	—		6	1
ga_pod_gks	—		6	1
lcseb246_od_sg	—		4	0
lcseb245_sg	—		6	1
lcseb246_GK_sg	—		4	1
lcseb246_UNI_sg	—		4	1

Select the **remote VMAX array** from the "Symmetrix" pulldown menu. **Select the desired SRP** from the "SRP" pulldown menu.



Click the **Create Data Migration** radio button and click **Next**.



Note: If compression is available on a VMAX All Flash target array, a "Compression" checkbox will appear on this screen.

View the summary. **Click the angle bracket** next to "Add to Job List" and **click "Run Now"**

1 Destination

2 Create or Prepare

3 Summary

Storage Group lcseb246_UNI_sg

Symmetrix 000197800129

SRP SRP_1

Masking Views

Masking View	Port Group	Host/Host Group
lcseb246_UNI_MV	lcseb246_pg	lcseb246_ig

< Back Next > Add to Job List v Cancel Help

Confirm that the migration session was created.

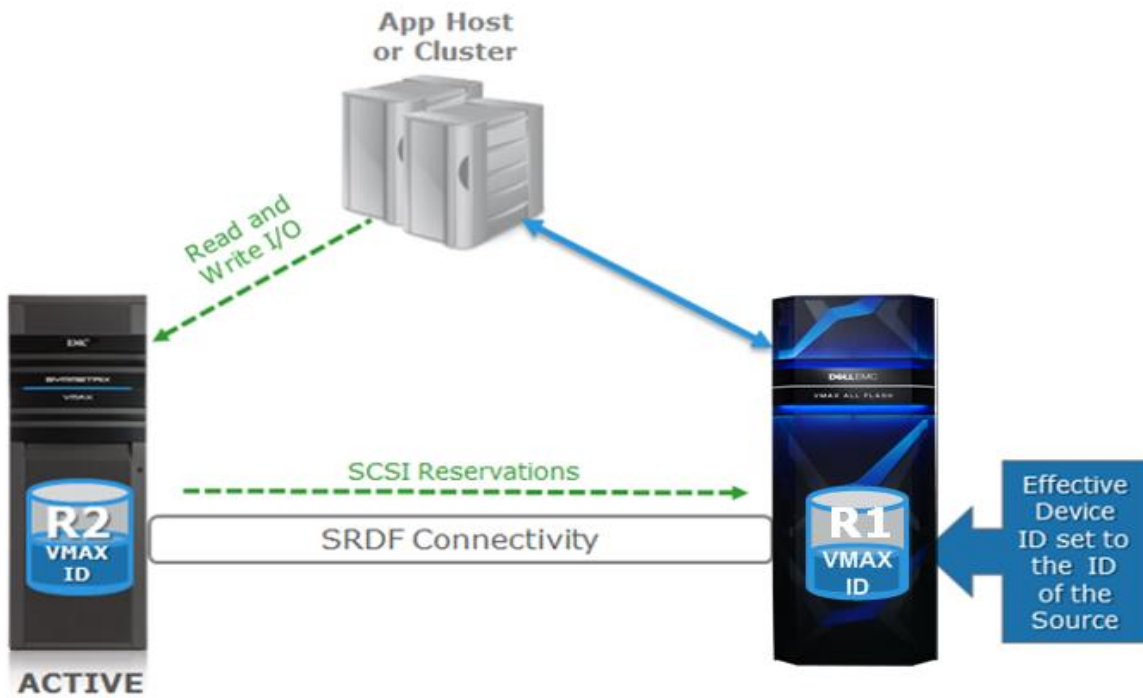
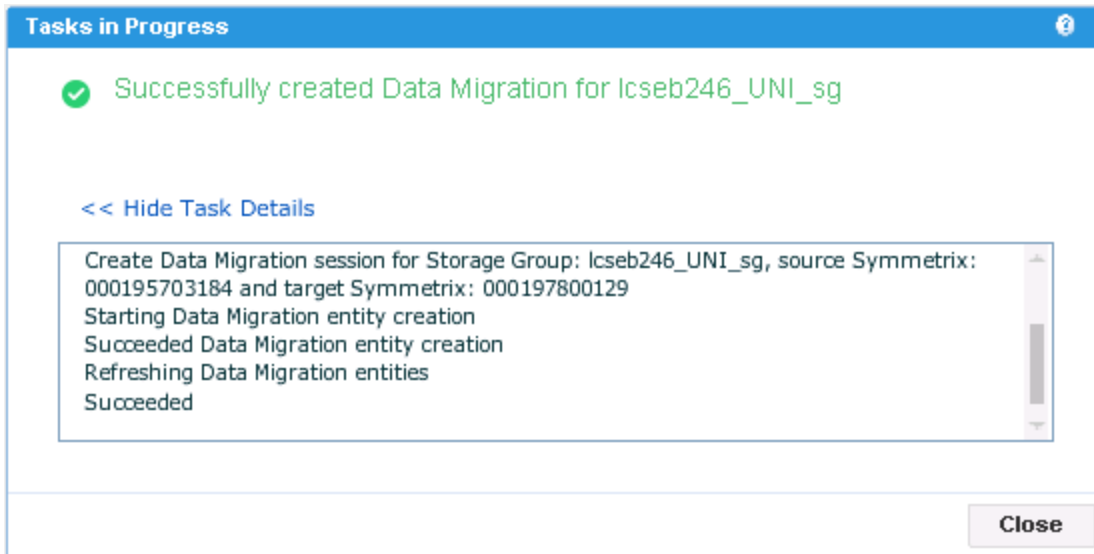


Figure 9. Created

Note: During an NDM migration, the source of the migration will be an R2 or an R21 device (if there is existing SRDF DR replication from the source device) and the target will be an R1 device. This is different than basic SRDF operations and is required to allow DR protection during a migration using a cascaded SRDF configuration. See the section entitled "ADDING DISASTER RECOVERY TO THE TARGET ARRAY" for more details.

PERFORM A HOST RESCAN

After the create operation completes the systems administrator must issue a host rescan to allow the host to discover the paths to the newly created devices. This host rescan is OS specific and also should include a rescan using the host multipathing software if it must be performed separately from the host rescan, as with PowerPath.

Devices go into a CutoverReady state from a Created state after the host rescan is performed and the target devices are discoverable. After this is complete, I/O issued by the application will be directed to either the source or the target arrays through the host multipathing software. This is possible because the target devices are in Passthrough mode. See Appendix A for more details on the host multipathing software.

CUTOVERREADY AND PASSTHROUGH MODE

Passthrough mode allows the host to write to or read from either the source or target array. Any write that is sent to the target array will be sent across the SRDF link and serviced by the source array. No data will be kept on the target array while in a CutoverReady state.

The CutoverReady state is a transitional state. The devices should only be in a CutoverReady state and using pass-through mode for as long as it takes to check that the Create has succeeded properly, to run the host rescan, and to run the Cutover operation.

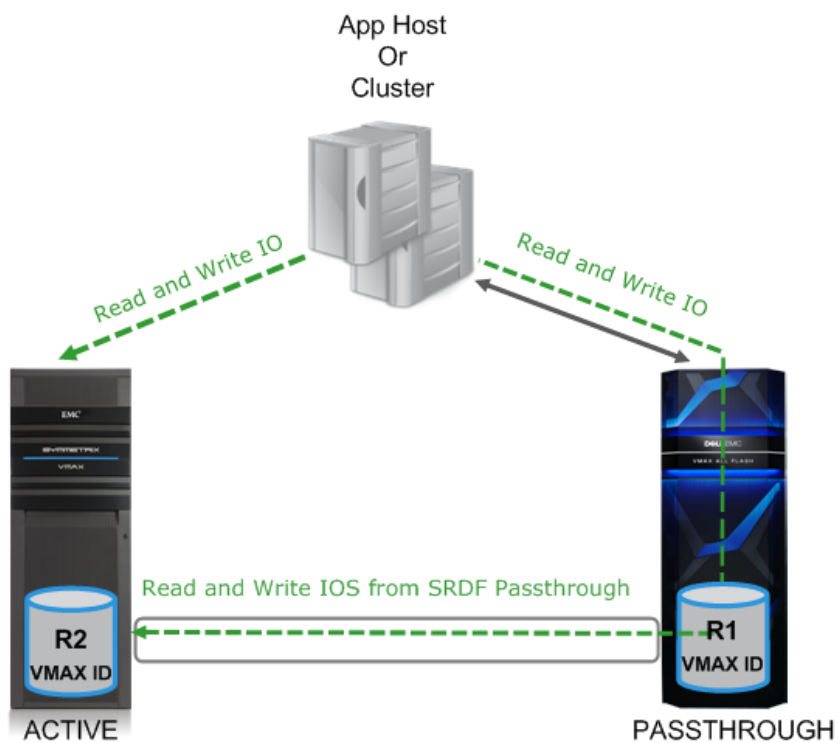
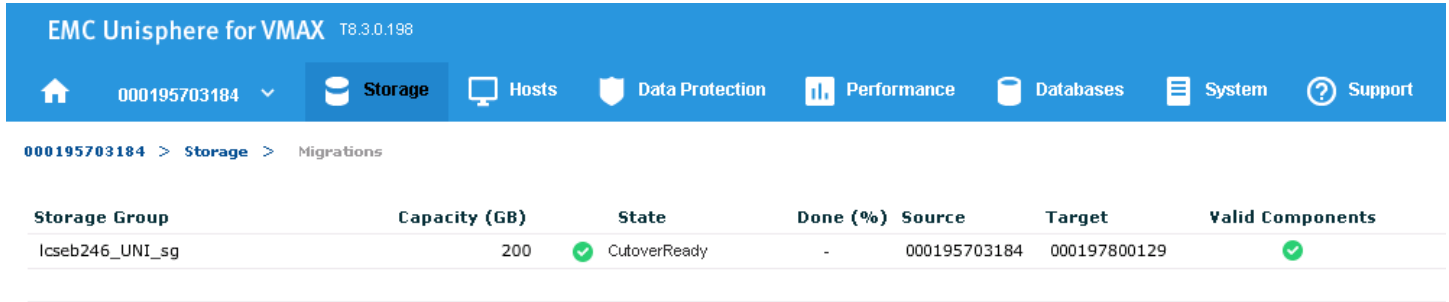


Figure 10. Figure 10. CutoverReady and Passthrough Mode

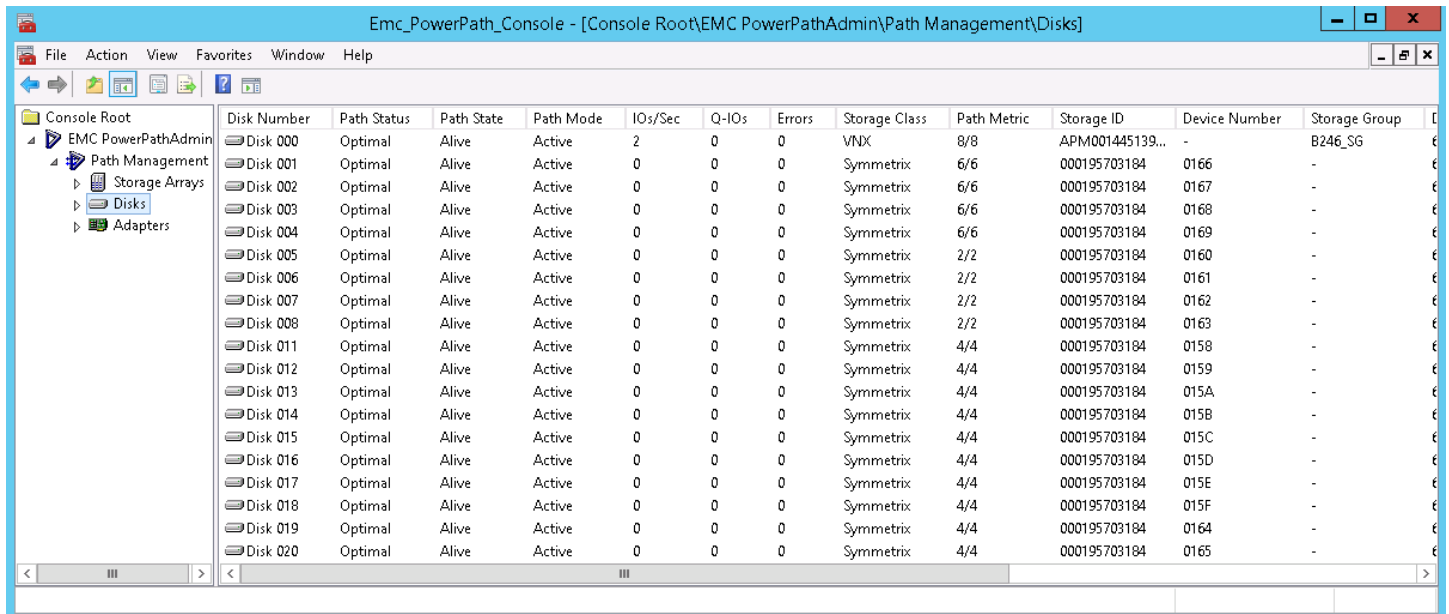
Go to **Storage > Migration** again to view the migration session and a high level view of its properties and state.



Note: During an NDM migration, the source of the migration will be an R2 or an R21 device (if there is existing SRDF DR replication from the source device) and the target will be an R1 device. This is different than basic SRDF operations and is required to allow DR protection during a migration using a cascaded SRDF configuration. See the section entitled "ADDING DISASTER RECOVERY TO THE TARGET ARRAY" for more details.

PowerPath shows all paths to the source and target devices as alive. HYPERMAX OS will ensure that all I/Os that are directed to the target array by the host are actually serviced by the source array until the cutover.

The paths will all remain in an alive state until after the commit operation.



VIEW MIGRATION SESSION DETAILS

Double Click the migration session to view details about it and the groups that the volumes, ports, and initiators belong to. For more information, the view and groups on the left side of the GUI can be selected and will display details on the right side. In this case, the port group is selected. Selecting "View Volumes" will show the source and target device pairs.

Storage Group	1cseb246_UNI_sg	
State	CutoverReady	
Source	000195703184	
Target	000197800129	
Capacity (GB)	200	
Synched Capacity (GB)	200	
Storage Group	Source Status	Target Status
1cseb246_UNI_sg	✓	✓ View Volumes
Select a row to populate Port Groups and Hosts/Host Groups tables		
Masking View	Source Status	Target Status
1cseb246_UNI_mv	✓	✓
Port Group	Source Status	Target Status
1cseb246_pg	✓	✓ View Ports
Hosts	Source Status	Target Status
1cseb246_ig	✓	✓ View Initiators

Ports ←

Symmetrix	Port Name	Status
000195703184	FA-8E:0	✓
000195703184	FA-7E:0	✓
000197800129	FA-1D:28	✓
000197800129	FA-2D:28	✓
000197800129	FA-1D:29	✓
000197800129	FA-2D:29	✓

EXAMINE THE DEVICE IDENTITIES FOLLOWING A CREATE

The create operation automatically configures matching volumes on the target array. These volumes will be the same size and configuration, though they will most likely not have the same VMAX volume numbers. Following the create operation the 4 new volumes on the target array are 0166 through 0169. Volume 0166 and volume 002E are paired for NDM operations.

Source Device ID:

The native and effective device IDs are the same on the source device (0166):



PROPERTIES

Name	00166
Physical Name	\\PHYSICALDRIVE1
Volume Identifier	N/A
Type	RDF2+TDEV
Encapsulated Volume	No
Encapsulated WWN	N/A
Status	Ready
Reserved	No
Capacity (GB)	50
Capacity (MB)	51201
Capacity (Cylinder)	54614
Emulation	FBA
Compression Ratio	1:1
Symmetrix ID	000195703184
Symmetrix Volume ID	00166
HP Identifier Name	N/A
VMS Identifier Name	N/A
Nice Name	N/A
WWN	60000970000195703184533030313636
External Identity WWN	60000970000195703184533030313636
DG Name	

Target Device IDs:

The native and effective target device IDs are not the same on the target device (001D). Device 001D has a unique native device ID, but its effective ID is the same as device 0158. This is required at this stage of the migration because all device paths are active.



PROPERTIES

Name	0001D
Physical Name	N/A
Volume Identifier	N/A
Type	RDF1+TDEV
Encapsulated Volume	No
Encapsulated WWN	N/A
Status	Ready
Reserved	No
Capacity (GB)	50
Capacity (MB)	51201
Capacity (Cylinder)	27307
Emulation	FBA
Symmetrix ID	000197800129
Symmetrix Volume ID	0001D
HP Identifier Name	N/A
VMS Identifier Name	N/A
Nice Name	N/A
WWN	60000970000197800129533030303144
External Identity WWN	60000970000195703184533030313636
DG Name	

CANCEL A MIGRATION

At any point before a commit operation is run on a Storage Group, a migration that has not been committed may be canceled. In this example, the cancel is occurring before the cutover. This operation does not require the revert flag because processing has not moved to the target array.

Cancelling a migration removes the storage and groups provisioned for the migration on the target array, releases resources allocated by Solutions Enabler to perform the migration, and places the source devices into the state they were in before the Create operation was run. It does not affect the replication pathways put in place with the environment setup.

To cancel the migration, click the **double angle brackets** and click **Cancel Migration**.

000195703184 > Storage > Migrations

Storage Group	Capacity (GB)	State	Done (%)	Source	Target	Valid Comp...
lcseb246_UNI_sg	200	Created	N/A	000195703184	000197800129	✓

1 Selected

- Recover
- Sync
- Cancel Migration
- Manage Environments

Cutover Commit View Details >>



Last Updated: Tue 06/14/2016 07:17:06 PM GMT-0400

Click the angle bracket next to "Add to Job List" and click Run Now.

Cancel Migration - lcseb246_UNI_sg

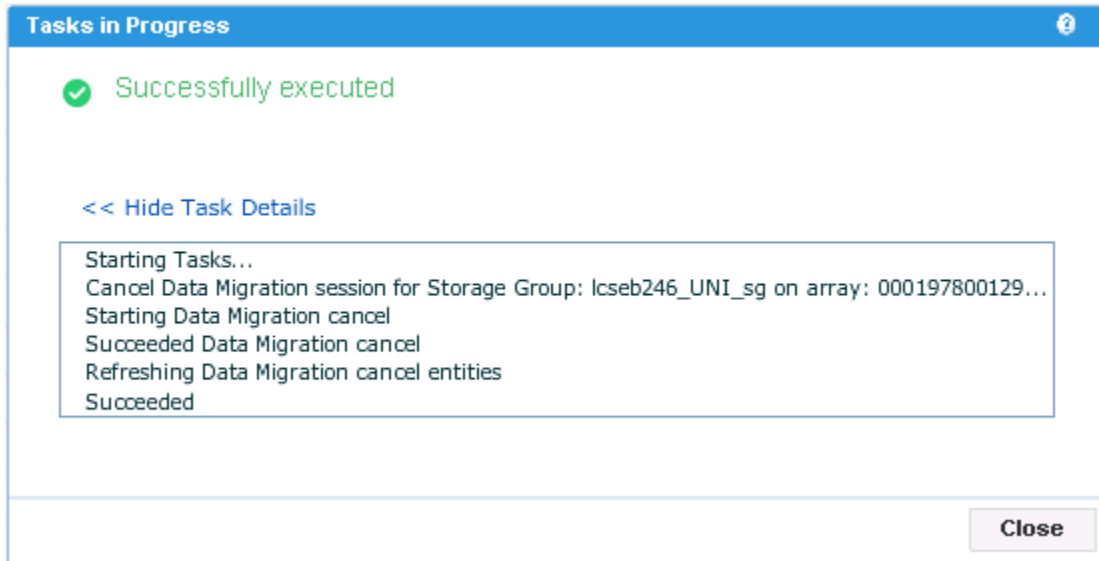
Cancel Migration: lcseb246_UNI_sg

Source: 000195703184

Target: 000197800129

Revert: —

Note: The "Revert" option will have a checkbox when a revert operation is applicable. It is not required before running a cancel operation while the SG is in a CutoverReady state.



PERFORM A RESCAN FOLLOWING A CANCEL

Following the cancel operation, the host paths to the target array are no longer available. The host systems administrator should perform a rescan to remove the dead paths to the target array.

PERFORM A CUTOVER TO THE TARGET ARRAY

Prior to this step, the migration session that was cancelled in the last step was simply created again. The host also rescanned for devices, so the pairs are in a CutoverReady state.

To cut the storage group over to the target, click **Cutover**.

000195703184 > Storage > Migrations

Storage Group	Capacity (GB)	State	Done (%)	Source	Target	Valid Comp...
lcseb246_UNI_sg	200	✔ CutoverReady	N/A	000195703184	000197800129	✔

1 Selected

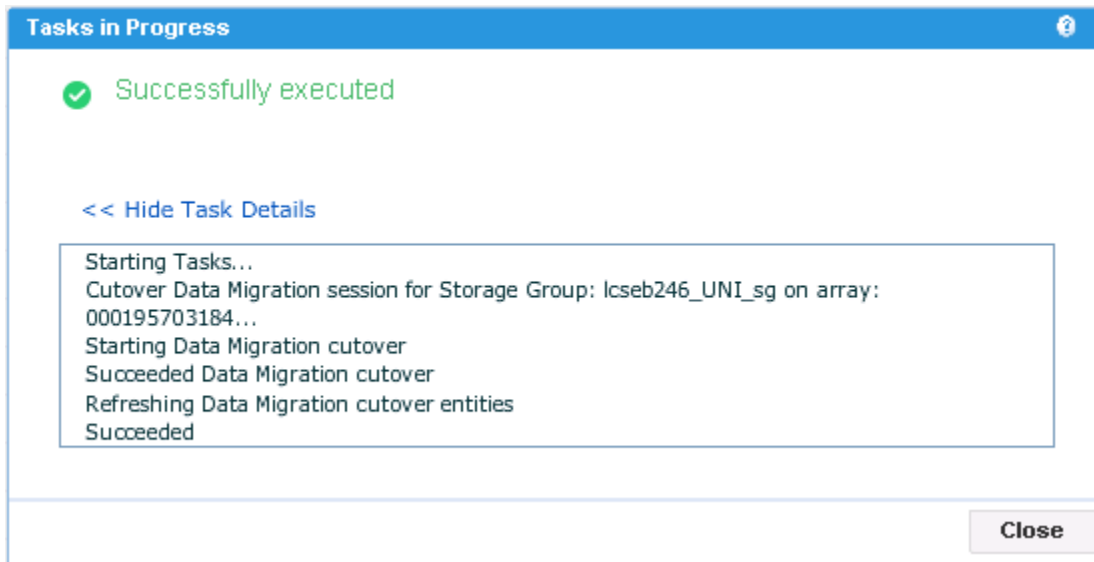
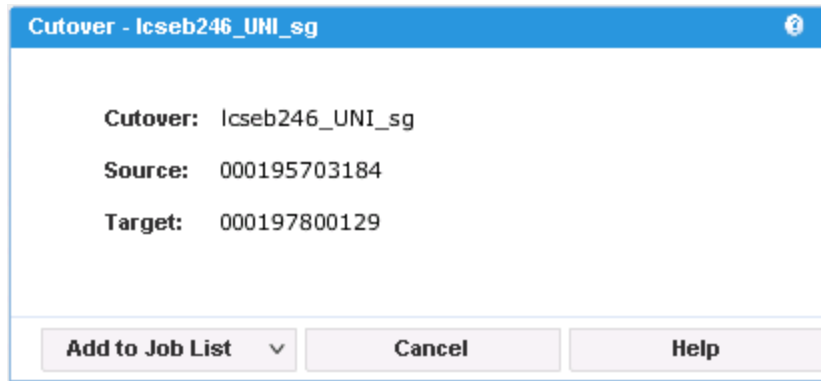


Cutover Commit View Details >>



Last Updated: Wed 06/15/2016 10:09:32 AM GMT-0400

Click the angle bracket next to "Add to Job List" and click "Run Now".



A cutover operation moves the target devices out of pass-through mode, initiates data synchronization from the source to the target and makes the host paths to the source array inactive so that all I/Os are being serviced by the target array.

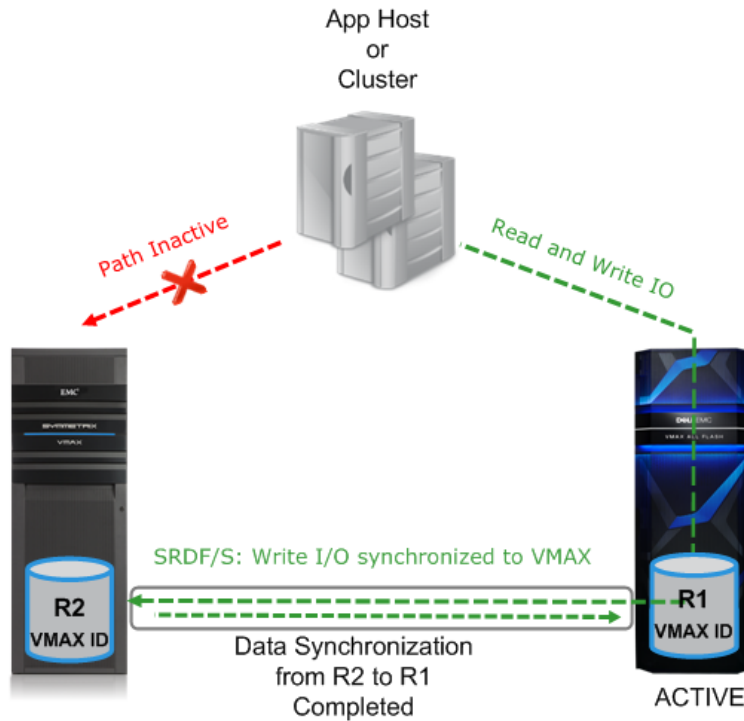


Figure 11. Cutover

When the cutover operation completes, the data copy begins. The session is in a Migrating state and will remain in that state until either the pairs are cutover to the new array or other action is taken.

EMC Unisphere for VMAX X8.3.0.138

000195703184 > Storage > Migrations

Storage Group	Capacity (GB)	State	Done (%)	Source	Target	Valid Comp...
lcseb246_UNI_sg	200	Migrating	N/A	000195703184	000197800129	✓

The volumes are now in a CutoverSync state.

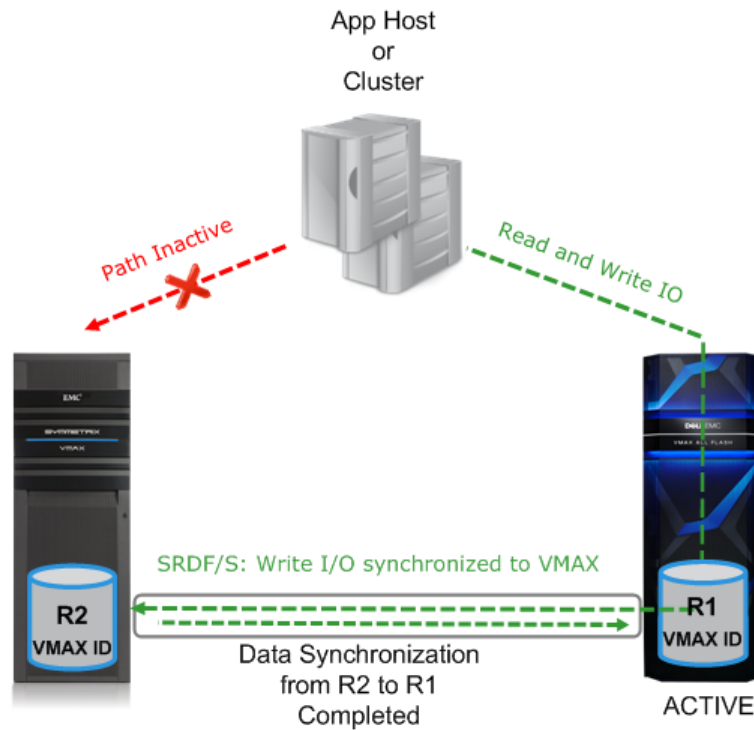


Figure 12. CutoverSynchronized

Following a cutover, the two paths to the source array are inactive (FAs 7e:00 and 8e:00) and the four paths to the target are active. In PowerPath, the terms used are "dead" and "alive".

Note: The PowerPath mode is "active" for all paths. This is a PowerPath term and is unrelated to the active and inactive path states in NDM terminology. PowerPath will show the state of the path and whether it is alive or dead in the "state" field.

Following the cutover, two paths are dead and the devices are degraded.

Emc_PowerPath_Console - [Console Root\EMC PowerPathAdmin\Path Management\Disks]

Disk Number	Path Status	Path State	Path Mode	IOs/Sec	Q-IOs	Errors	Storage Class	Path Metric	Storage ID	Device Number	Storage Group
Disk 000	Optimal	Alive	Active	14	0	0	VNX	8/8	APM001445139...	-	B246_SG
Disk 001	Degraded	Degraded	Active	0	0	2	Symmetrix	4/6	000195703184	0166	-
Disk 002	Degraded	Degraded	Active	0	0	2	Symmetrix	4/6	000195703184	0167	-
Disk 003	Degraded	Degraded	Active	0	0	2	Symmetrix	4/6	000195703184	0168	-
Disk 004	Degraded	Degraded	Active	0	0	2	Symmetrix	4/6	000195703184	0169	-
Disk 005	Optimal	Alive	Active	0	0	0	Symmetrix	2/2	000195703184	0160	-
Disk 006	Optimal	Alive	Active	0	0	0	Symmetrix	2/2	000195703184	0161	-
Disk 007	Optimal	Alive	Active	0	0	0	Symmetrix	2/2	000195703184	0162	-
Disk 008	Optimal	Alive	Active	0	0	0	Symmetrix	2/2	000195703184	0163	-

Emc_PowerPath_Console - [Console Root\EMC PowerPathAdmin\Path Management\Disks\Disk 001]

Path Name	Status	State	Mode	IOs/Sec	Queued IO	Errors	Disk Number	Storage Class	Storage ID	Storage Port	Port	Path	Target	Lun
c1t4d0	Failed	Dead	active	0	0	1	Disk 001	Symmetrix	000195703184	FA--8e:00	1	0	4	0
c1t5d11	Optimal	Alive	active	0	0	0	Disk 001	Symmetrix	000195703184	FA--2d:61	1	0	5	11
c1t6d11	Optimal	Alive	active	0	0	0	Disk 001	Symmetrix	000195703184	FA--2d:60	1	0	6	11
c2t4d0	Failed	Dead	active	0	0	1	Disk 001	Symmetrix	000195703184	FA--7e:00	2	0	4	0
c2t5d11	Optimal	Alive	active	0	0	0	Disk 001	Symmetrix	000195703184	FA--1d:60	2	0	5	11
c2t6d11	Optimal	Alive	active	0	0	0	Disk 001	Symmetrix	000195703184	FA--1d:61	2	0	6	11

Once the data copy is done, the migration for that storage group can be completed with a commit or the host access can be reverted back to the source array from the target array and the migration can be cancelled.

EXAMINE THE DEVICE IDENTITIES FOLLOWING A CUTOVER

The device IDs used on the source and target devices have not changed following the Cutover operation. The target devices are still using the effective WWN of the source devices. The source devices still have the same native and effective IDs.

Source device:

EMC Unisphere for VMAX X8.3.0.138

000195703184 **Storage** Hosts Data Protection Performance

000195703184 > Storage > Storage Groups > lcseb246_UNI_sg > Volumes > 00166

PROPERTIES

Name	00166
Physical Name	\\.\PHYSICALDRIVE1
Volume Identifier	N/A
Type	RDF2+TDEV
Encapsulated Volume	No
Encapsulated WWN	N/A
Status	Ready
Reserved	No
Capacity (GB)	50
Capacity (MB)	51201
Capacity (Cylinder)	54614
Emulation	FBA
Compression Ratio	1:1
Symmetrix ID	000195703184
Symmetrix Volume ID	00166
HP Identifier Name	N/A
VMS Identifier Name	N/A
Nice Name	N/A
WWN	60000970000195703184533030313636
External Identity WWN	60000970000195703184533030313636
DG Name	

Target device:

The screenshot displays the EMC Unisphere for VMAX X8.3.0.138 interface. The top navigation bar includes a home icon, a dropdown menu with '000197800129', and tabs for 'Storage', 'Hosts', 'Data Protection', and 'Performance'. The breadcrumb trail shows the path: '000197800129 > Storage > Storage Groups Dashboard > Icseb246_UNI_sg > Volumes > 0001D'. Below the breadcrumb is a 'PROPERTIES' table with the following data:

PROPERTIES	
Name	0001D
Physical Name	N/A
Volume Identifier	N/A
Type	RDF1+TDEV
Encapsulated Volume	No
Encapsulated WWN	N/A
Status	Ready
Reserved	No
Capacity (GB)	50
Capacity (MB)	51201
Capacity (Cylinder)	27307
Emulation	FBA
Symmetrix ID	000197800129
Symmetrix Volume ID	0001D
HP Identifier Name	N/A
VMS Identifier Name	N/A
Nice Name	N/A
WWN	60000970000197800129533030303144
External Identity WWN	60000970000195703184533030313636
DG Name	

REVERT TO THE SOURCE ARRAY

Because the migration is not permanent until the commit operation is run, after a cutover, the migration can still be cancelled and reverted to the source array. To revert back to the source array following a cutover, a cancel is run with the revert option.

The revert option moves the processing back to the source array and the cancel removes all of the target side entities created for the migration. This operation will leave the environment in the same state as it was prior to the create operation. The revert operation may

take some time to run. As the revert is running, the host will discover that the paths to the source array are active again. This is monitored by the VMAX, which will wait for the rediscovery before proceeding.

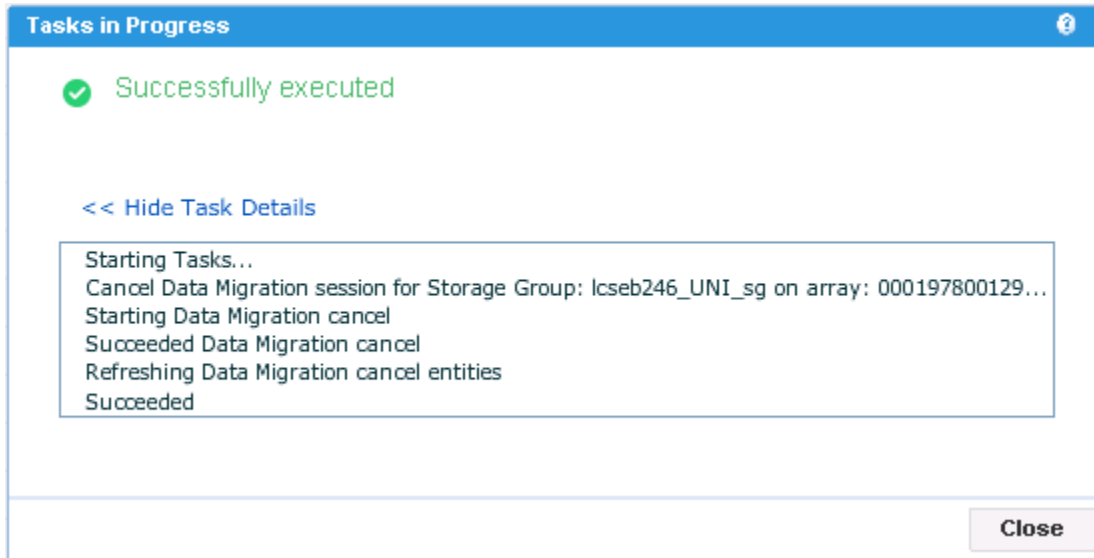
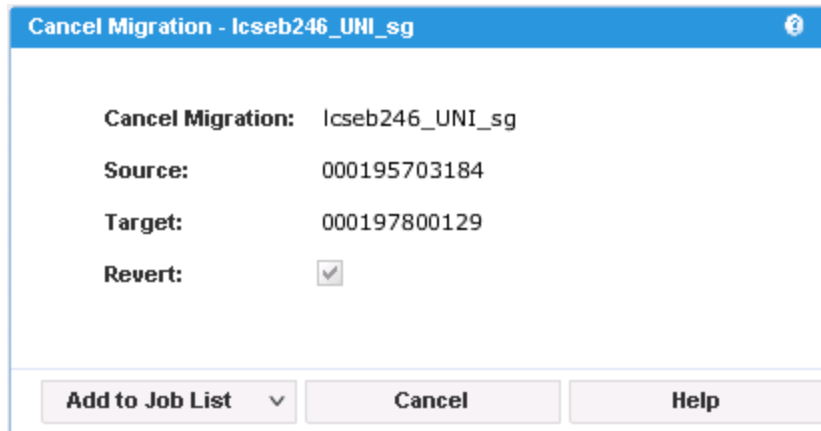
To cancel the migration, click the **double angle brackets** and click **Cancel Migration**.

The screenshot shows the EMC Unisphere for VMAX interface. The top navigation bar includes a home icon, a dropdown menu with '000197800129', and several menu items: Storage, Hosts, Data Protection, Performance, Databases, System, and Support. Below the navigation bar, the breadcrumb path is '000197800129 > Storage > Migrations'. A table displays migration details:

Storage Group	Capacity (GB)	State	Done (%)	Source	Target	Valid Comp...
lcseb246_UNI_sg	200	✔ CutoverSync	N/A	000195703184	000197800129	✔

Below the table, there is a '1 Selected' label and a context menu with the following options: Recover, Sync, Cancel Migration, and Manage Environments. A red arrow points to the 'Cancel Migration' option. At the bottom of the interface, there are buttons for 'Cutover', 'Commit', 'View Details', and a double angle bracket '>>'.

At the Cancel Migration dialog box, **make sure the “Revert” box is checked**. Click the angle bracket next to "Add to Job List" and click **“Run Now”**.



PERFORM A RESCAN FOLLOWING A CANCEL REVERT

Note: Following the cancel -revert operation, the host paths to the target array are no longer available. The paths to the source array should be returned to the original configuration to avoid Data Unavailability. A host HBA rescan should be undertaken to ensure application stability.

Note: The cancel -revert operation may take some time to complete. The "Revert Data Replication" step will repeat and remain "In Progress" until the step is complete.

COMMIT A MIGRATION

When the data copy is complete, the migration can be committed. The commit operation completes the migration by removing the migrated application resources from the source array and releases temporary system resources used for the migration.

Once the commit is complete, replication between the source and target arrays is terminated. The source devices are no longer be visible to a host because the masking has been removed. The source device IDs have also been permanently swapped with the target device IDs.

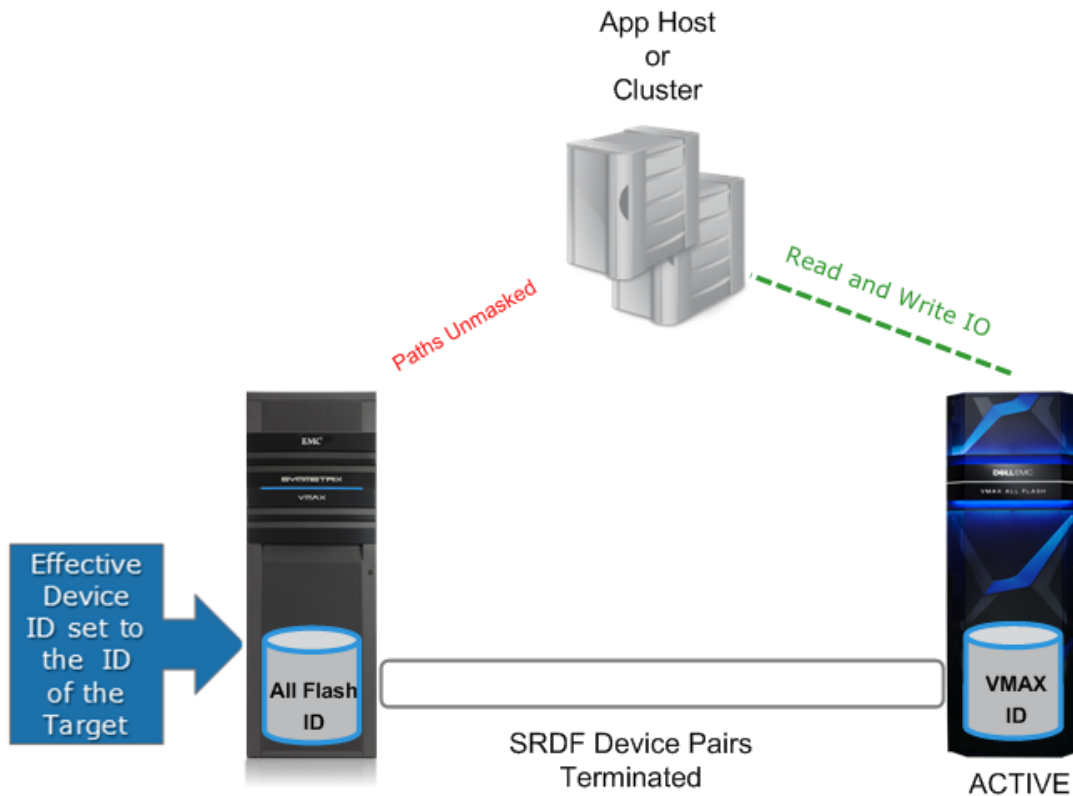


Figure 13. Commit

To commit, the state of the migration sessions must be CutoverSync or CutoverNoSync. Click **Commit**.

000195703184 > Storage > Migrations

Storage Group	Capacity (GB)	State	Done (%)	Source	Target	Valid Comp...
lcseb246_UNI_sg	200	✓ CutoverSync	N/A	000195703184	000197800129	✓

1 Selected

Cutover **Commit** View Details >>



To commit the migration, click **the angle bracket next to "Add to Job List"** and click **Run Now**.

Commit - lcseb246_UNI_sg

Commit: lcseb246_UNI_sg
Source: 000195703184
Target: 000197800129

Add to Job List **Cancel** **Help**

After the commit operation succeeds, the migration is complete.

Because the commit completes the migration and removes all of the source side masking, there are no longer any active paths seen to the source array.

Disk Number	Path Status	Path State	Path Mode	IOs/Sec	Q-IOs	Errors	Storage Class	Path Metric	Storage ID	Device Number	Storage Group
Disk 000	Optimal	Alive	Active	0	0	0	VNX	8/8	APM001445139...	-	B246_SG
Disk 001	Degraded	Degraded	Active	0	0	6	Symmetrix	4/6	000195703184	0166	-
Disk 002	Degraded	Degraded	Active	0	0	6	Symmetrix	4/6	000195703184	0167	-
Disk 003	Degraded	Degraded	Active	0	0	6	Symmetrix	4/6	000195703184	0168	-
Disk 004	Degraded	Degraded	Active	0	0	2	Symmetrix	4/6	000195703184	0169	-
Disk 005	Optimal	Alive	Active	0	0	0	Symmetrix	2/2	000195703184	0160	-
Disk 006	Optimal	Alive	Active	0	0	0	Symmetrix	2/2	000195703184	0161	-
Disk 007	Optimal	Alive	Active	0	0	0	Symmetrix	2/2	000195703184	0162	-

The four remaining active paths are the four paths to the target array.

Path Name	Status	State	Mode	IOs/Sec	Queued IO	Errors	Disk Number	Storage Class	Storage ID	Storage Port	Port	Path	Target
c1t4d0	Failed	Dead	active	0	0	1	Disk 001	Symmetrix	000195703184	FA--8e:00	1	0	4
c1t5d11	Optimal	Alive	active	0	0	1	Disk 001	Symmetrix	000195703184	FA--2d:61	1	0	5
c1t6d11	Optimal	Alive	active	0	0	1	Disk 001	Symmetrix	000195703184	FA--2d:60	1	0	6
c2t4d0	Failed	Dead	active	0	0	1	Disk 001	Symmetrix	000195703184	FA--7e:00	2	0	4
c2t5d11	Optimal	Alive	active	0	0	1	Disk 001	Symmetrix	000195703184	FA--1d:60	2	0	5
c2t6d11	Optimal	Alive	active	0	0	1	Disk 001	Symmetrix	000195703184	FA--1d:61	2	0	6

COMPARING THE PRE AND POST DEVICE IDENTITIES FOLLOWING A COMMIT

Following the commit operation, each device presents the opposite device ID. The source device now presents the target device ID as its external identity and the target presents the source device ID as its external identity. These changes are permanent and will persist across system power cycles and even the deletion and recreation of the devices. In other words, if device 166 is deleted, when recreated, it will still show the identity of device 001D.

EMC Unisphere for VMAX X8.3.0.138

000195703184 **Storage** Hosts Data Protection Performance

000195703184 > Storage > Storage Groups > Icseb246_UNI_sg > Volumes > 00166

PROPERTIES

Name	00166
Physical Name	\\.\PHYSICALDRIVE1
Volume Identifier	N/A
Type	TDEV
Encapsulated Volume	No
Encapsulated WWN	N/A
Status	Ready
Reserved	No
Capacity (GB)	50
Capacity (MB)	51201
Capacity (Cylinder)	54614
Emulation	FBA
Compression Ratio	1:1
Symmetrix ID	000195703184
Symmetrix Volume ID	00166
HP Identifier Name	N/A
VMS Identifier Name	N/A
Nice Name	N/A
WWN	60000970000195703184533030313636
External Identity WWN	60000970000197800129533030303144

Target Device:

EMC Unisphere for VMAX X8.3.0.138

000197800129 **Storage** Hosts Data Protection Performance

000197800129 > Storage > Storage Groups Dashboard > Icseb246_UNI_sg > Volumes > 0001D

PROPERTIES

Name	0001D
Physical Name	N/A
Volume Identifier	N/A
Type	TDEV
Encapsulated Volume	No
Encapsulated WWN	N/A
Status	Ready
Reserved	No
Capacity (GB)	50
Capacity (MB)	51201
Capacity (Cylinder)	27307
Emulation	FBA
Symmetrix ID	000197800129
Symmetrix Volume ID	0001D
HP Identifier Name	N/A
VMS Identifier Name	N/A
Nice Name	N/A
WWN	60000970000197800129533030303144
External Identity WWN	60000970000195703184533030313636
DG Name	

GEOMETRY COMPATIBILITY MODE (GCM)

During NDM, “user defined” geometry is set on all devices within the SG. To allow the expansion of target devices post migration we will require the geometry to be set to “Native”. This will require Solutions Enabler 8.4 and is user configurable at this level.

In the case where the device being migrated was an odd cylinder count the GCM flag will also be set. This flag is not currently user configurable. Expansion of such devices will require the LUN to be taken offline and adjusted by contacting Dell EMC support. This is to be rectified in the next Hypermax OS release and will be user adjustable as long as the LUN is not in a replication session.

USE THE RECOVER COMMAND

The recover command can be used if a migration step fails due to some problem in the environment, such as a connectivity issue between the source and target arrays or the failure of a command to complete that leaves an NDM operation only partially finished.

In this example, a commit failed because of a transient issue on the target array. The transient issue resolved itself and a recover operation was immediately run. The recover operation picks up where the command failed and completes the commit operation.

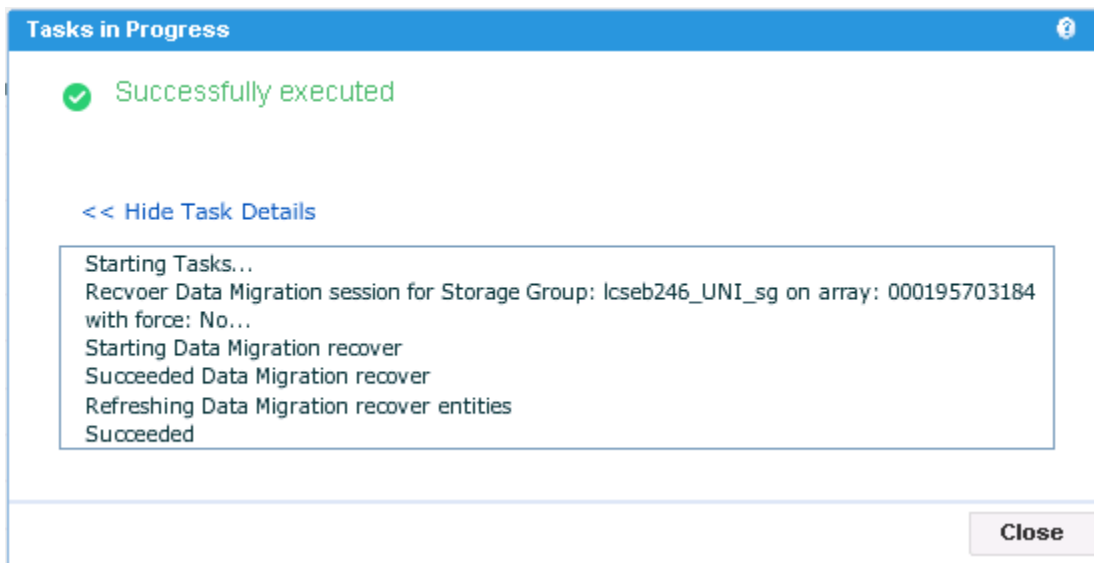
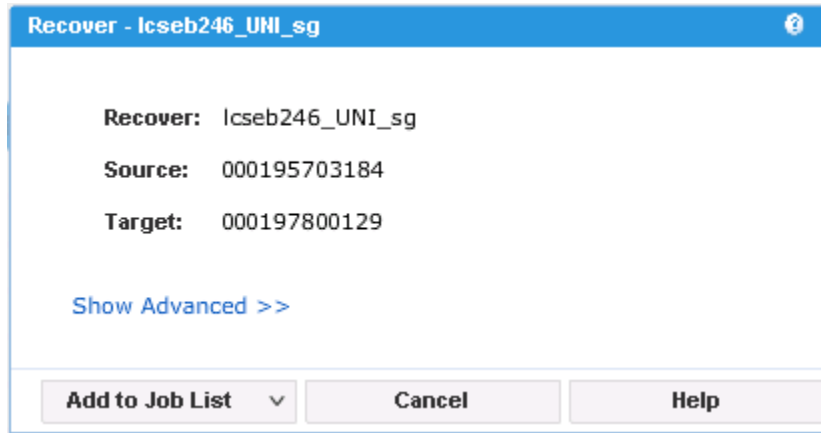
The screenshot displays the EMC Unisphere for VMAX interface. At the top, the title bar reads "EMC Unisphere for VMAX v8.30.130". Below the title bar is a navigation menu with icons for Storage, Hosts, Data Protection, Performance, Databases, System, and Support. The main content area shows a table of migration tasks. The first row is highlighted, showing a storage group "lcseb246_UNI_sg" with a capacity of 200 GB, a state of "CutoverSync", and a "Valid Comp..." status of "Yes".

Overlaid on the interface is a "Tasks in Progress" dialog box. The dialog box has a red "X" icon and the message: "The migration session is not in a valid DM state for this operation". Below the message is a "Hide Task Details" link. A text box contains the following information:

```
Starting Tasks...
The migration session is not in a valid DM state for this operation
Commit Data Migration session for Storage Group: lcseb246_UNI_sg on array:
000195703184...
Starting Data Migration commit
```

At the bottom of the dialog box is a "Close" button. Below the dialog box, a "Commit - lcseb246_UNI_" window is partially visible, showing fields for "Commit:", "Source:", and "Target:".

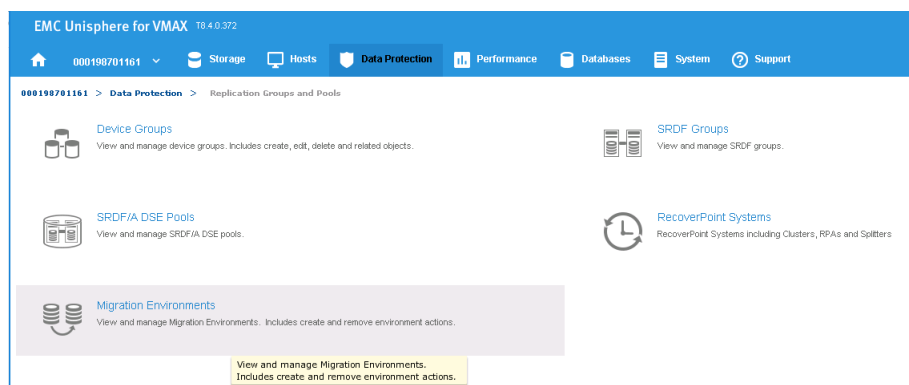
To run the recover, click the double angle brackets and click Recover.

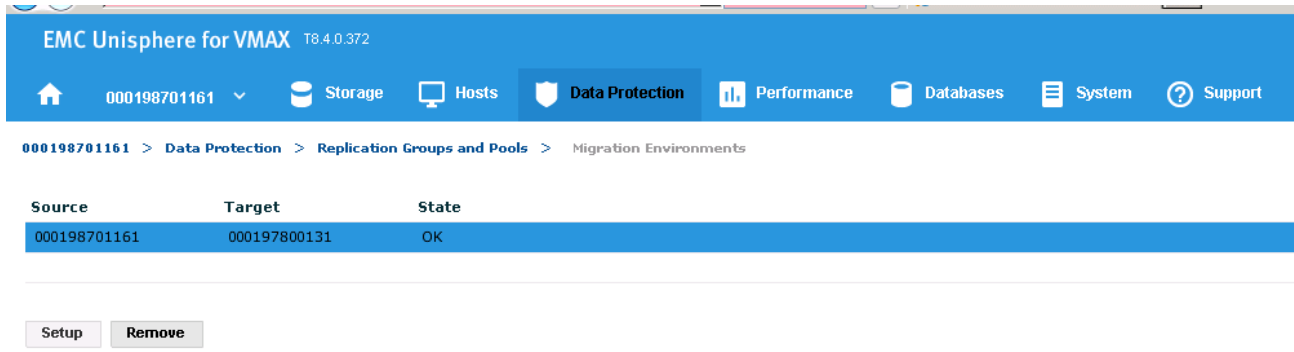


REMOVE THE ENVIRONMENT

Running the environment remove takes down the replication pathway configured by the environment setup operation, and removes the resources that were configured to support NDM on the source and target arrays. Upon successful completion of an environment remove operation, only running an environment setup operation is allowed. This should be run only after all migrations from the source array have been completed.

From the Data Protection Tab , click the **Manage Environments Option**.





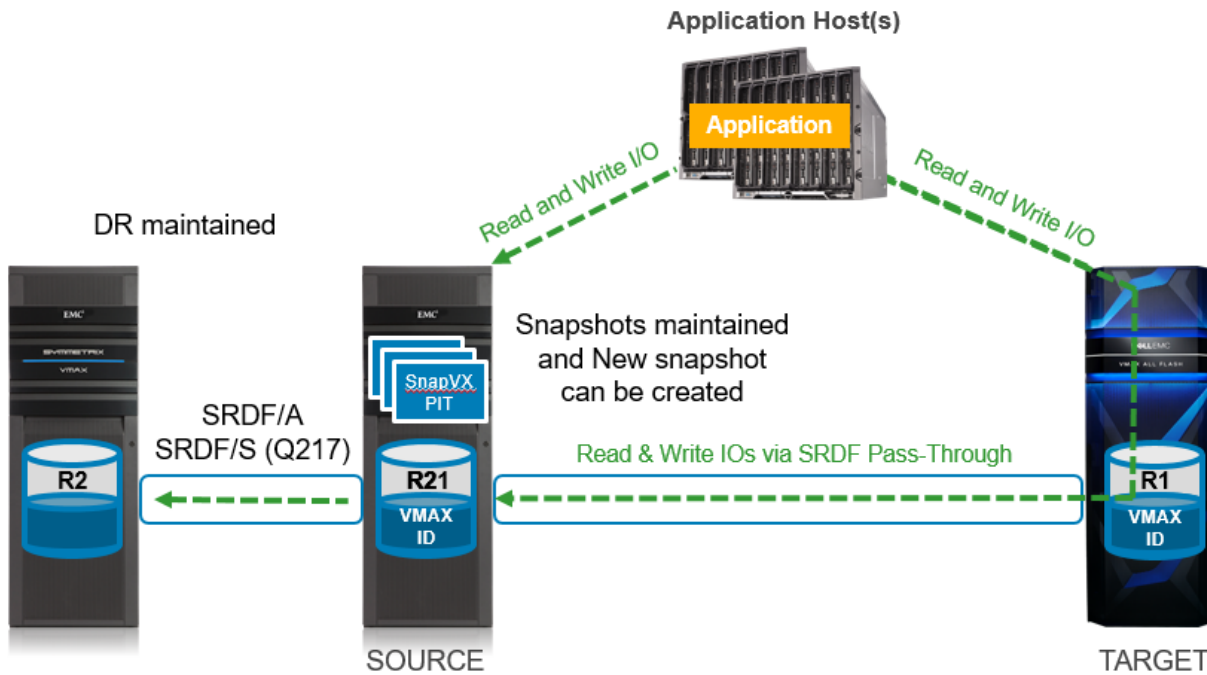
From the Migration Environments screen select the environment you want to remove and select Remove.

Once the task has complete the Environment is no longer available for migrations and will need to be setup should further migrations be required.

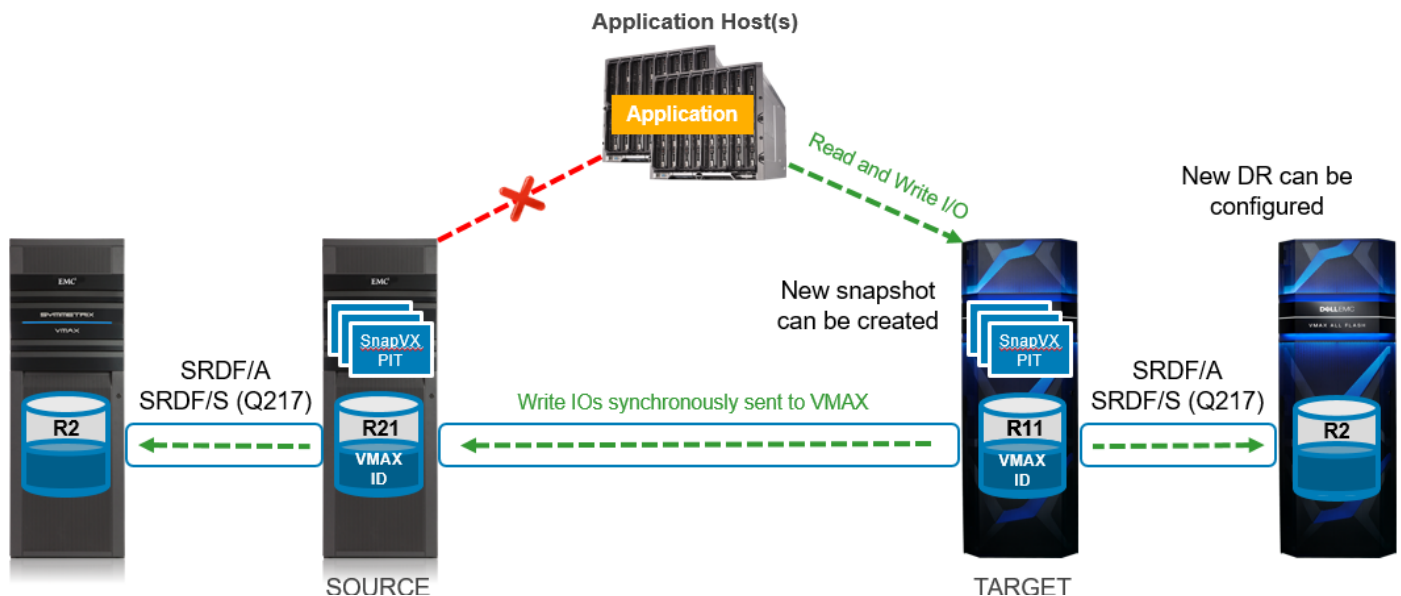
ADD DISASTER RECOVERY TO THE TARGET ARRAY

Prior to a migration, many environments contain both local Snap/VX sessions and SRDF remote replication sessions.

The Diagram shows what a migration with existing SRDF replication would look like after a create operation has been performed. This is a configuration that closely resembles a regular cascaded SRDF environment. The main difference is that in a created state, the host can access the R1 or the R21. In most SRDF environments, only the R1 or R2 can be written to, never both at the same time. The exceptions to this are NDM and SRDF/Metro.



During an NDM migration, DR is preserved by configuring local and remote replication (SRDF and Snap/VX) when the NDM session is in a CutoverSync state. The following diagram shows the configuration with existing SRDF replication and what the environment looks like following the configuration of SRDF on the target volumes.



APPENDIX A: HOST MULTIPATHING SOFTWARE NOTES AND SETTINGS

This section describes best practices for using multi-pathing software in an NDM environment. Refer to the NDM Support Matrix for the latest operating system and multi-pathing software combinations.

AIX NATIVE MULTI-PATHING SOFTWARE

For Native Multipathing on AIX, best practice is to use the following settings for MPIO:

```
algorithm = round_robin (other algorithms may also be used)
check_cmd = inquiry
queue_depth = 32
reserve_policy = PR_shared
```

LINUX NATIVE MULTI-PATHING SOFTWARE (DEVICE MAPPER)

Use reload/rescan multipath (`multipath -r` command) to detect and add new paths. Use the default `/etc/multipath.conf` file. The following options are best practices to help the operating system and multi-pathing software detect path changes efficiently:

```
Path_grouping_policy multibus
path_checker tur
features "1 queue_if_no_path"
path_selector "round-robin 0"
no_path_retry 10
```

POWERPATH (VERSION 5.7 AND ABOVE)

Use the default Powerpath multi-path settings.

To detect, rescan, and configure new paths use the `powermt config` command. Specifically for Linux use `/etc/opt/emcpower/emcplun_linux scan all --noprompt` may be used. This will rescan and perform a `powermt config`. Refer to the PowerPath for Linux manual on <http://support.emc.com> for further information.

Use Powerpath commands/scripts to scan (on Linux: `/usr/bin/rescan_scsi_bus.sh -r`) and remove stale paths (`powermt check`).

The `powermt restore` command can be used to detect path changes faster than PowerPath will discover them on its own.

Note: See Appendix B for important information regarding PowerPath and AIX 6.x with GPFS.

POWERPATH WITH SOLARIS

For Solaris with PowerPath, a cancel revert operation will end with the session in a "CancelFailed" state. The host paths to the source array running 5876 must be recovered using `cfgadm`.

For example, to recover the dead paths one by one:

```
cfgadm -c configure c5::50000973f001d109
cfgadm -c configure c5::50000973f001d105
cfgadm -c configure c4::50000973f001d109
cfgadm -c configure c4::50000973f001d105
```

To recover all paths on a controller:

```
cfgadm -c configure c4
```

```
cfgadm -c configure c5
```

Once the paths are online, the cancel revert can be resumed by performing an NDM recover operation.

WINDOWS 2012 WITH MPIO

Use default MPIO settings with the following parameters enabled:

PathVerifyEnabled - Enable for optimal results with path discovery.

PathVerificationPeriod - Set a time in seconds for automatic path detections. Dell EMC recommends setting it to lowest allowed value between 10 and 30 seconds.

VERITAS DYNAMIC MULTI-PATHING

Configure DMP tunable parameters to NDM required values from the application host:

Check and modify the following DMP tunable parameters. If the parameter values are not set to the default values, note settings so the parameters can be returned to expected values following NDM migration.

DMP Tunable Parameter	Default Value	NDM Required Value
dmp_path_age	300	0
dmp_health_time	60	0
dmp_restore_interval	300	10
dmp_restore_cycles	10	10
iopolicy (per DMP node name)	MinimumQ	MinimumQ

When these values are not set, the cancel `-revert` will not work correctly.

Use the rescan command.

On Linux: `/usr/bin/rescan_scsi_bus.sh` followed by `vxdisk scandisks` to detect new paths. Use `vxdmpadm` to verify that the new paths are added.

https://sort.symantec.com/public/documents/dmp/6.0/vmwareesx/productguides/html/dmp_admin/ch06s08.htm

ESXI WITH NATIVE MULTI-PATHING

Use the `rescan` command to detect new paths, or wait for NMP to detect the paths automatically.

To reduce the delay in automatic detection, change to 30 seconds.

To set the path polling time, login to the host and navigate to Configuration -> Advanced Settings -> Disk and update the

Disk.PathEvalTime field.

APPENDIX B: AIX, GPFS, ORACLE RAC, POWERHA AND POWERPATH WITH NDM

Properly configuring multiple paths to the host with AIX 6.1/7.1/7.2, GPFS, ORACLE RAC 11gR2/12cR1, POWERHA 6.1/7.1/7.2 and PowerPath 5.7SP2/6.0 requires an additional step when performing an NDM migration. Please review the details in this appendix prior to migrating such environment.

During NDM, after 'syndm create' cli command is issued and new paths have been discovered by the host, all new native devices on the target side will have reserve_policy set to single_path. This is PowerPath's default setting for the VMAX array.

According to IBM documentation:

Single_path_reserve: Applies a SCSI2 reserve methodology for the device, which means the device can be accessed only by the initiator that issued the reserve. This policy prevents other initiators in the same host or on other hosts from accessing the device. That means only one host can access and use the new disks.

If the NDM Cutover and Commit is issued with the reserve_policy set to single_path for all new native devices, the cluster will not function correctly since multiple hosts in the cluster need to share the same disks. With the single_path setting, only one host will be allowed to access the disks. Therefore it's important to run the below steps when migrating such environment.

Note: If the customer is able to upgrade PowerPath to 6.1 or is running PowerPath 6.1, then this procedure is not necessary as PowerPath 6.1 will maintain a no_reserve policy on all new paths.

1. Select Storage Group to migrate.
2. Create the migration session.
3. Discover paths to the host.
- 3a. Set reserve_policy to no_reserve for all new native devices by running [emc_pp_configure.sh script](#). This script will configure the new native devices on the target side into PowerPath by copying the attributes of the PowerPath hdiskpower pseudo devices into the new native devices and reconfigure the native devices.
4. Cutover Storage Group to VMAX3 or VMAX All Flash array.
5. Monitor for synchronization to complete.
6. Commit the migration.

Note: This script MUST be used in order to perform a migration non-disruptively in this environment. Failing to run the script following the configuration of the new native target devices can lead to data unavailability.

```
#!/bin/ksh
devlist=`powermt config 2>&1 | grep -p 0514-034 | grep hdiskpower | awk '{print $5}'`
for pseudo in $devlist
do
    pseudo_policy=`lsattr -El $pseudo -a reserve_policy | awk '{print $2}'`
    pseudo_prkey=`lsattr -El $pseudo -a PR_key_value | awk '{print $2}'`
    nativelist=`powermt display dev=$pseudo | grep -i hdisk| grep -v power | awk '{print $3}'`
    echo $nativelist
    for native in $nativelist
    do
        native_policy=`lsattr -El $native -a reserve_policy | awk '{print $2}'`
        native_prkey=`lsattr -El $native -a PR_key_value | awk '{print $2}'`
        #change reserve_policy and PR_key_value of native(s), whose policy or PR_key_value
        #vary from that of pseudo.
        if [[ $native_policy != $pseudo_policy || $native_prkey != pseudo_prkey ]]
        then
            powermt remove dev=$native
            echo changing reserve_policy,PR_key_value of $native to $pseudo_policy and $pseudo_prkey
            chdev -l $native -a reserve_policy=$pseudo_policy -a PR_key_value=$pseudo_prkey
        fi
    done
done
powermt config
```

The script can be downloaded on EMC's support site: [emc_pp_configure.sh](#)

APPENDIX C: HOST REBOOTS DURING NDM PROCESS

The following outlines the outcomes of a host reboot either planned or unplanned during each of the discrete steps of the NDM process.

Note: Manual verification of host paths following a reboot of any kind should be undertaken before continuing with a migration.

- **Created:** Once the host reboots paths will be re-detected on the source array. As the rescan of the SAN hadn't occurred before the reboot the target paths don't have to be considered. The migration can continue as normal as a host reboot will conduct a rescan as part of the boot process and pick up the new paths to the Target. This in turn will move the NDM session to a Cutover Ready state.
- **Migrating:** The paths to the source system are not active and a reboot may cause the MP software to permanently remove the inactive paths to the source array. If the reboot causes the inactive paths to be removed then this will cause a complication when choosing to cancel the migration and revert back to the source array. Manually rescanning the host while the cancel –revert is in the “Wait for the host path discovery on Source” step will reconfigure the removed paths and the migration will cancel and revert back to the source array. Choosing to continue with synchronization and movement towards the CutoverSyncing state will not be affected by the removal of the inactive paths following a reboot.
- **Cutover Ready:** Since the paths to both arrays were alive at the time of reboot they will not be affected. Recommendation at the point is to verify all paths initialize as expected before continuing.
- **CutoverNoSync:** A reboot during the CutoverNoSync state may cause the MP software to permanently remove the inactive paths to the source array. The removed paths will not affect the ability to perform a sync –start to move to the CutoverSyncing state or the ability to commit the migration.
- **CutoverSyncing:** A reboot during the CutoverSyncing state may cause the MP software to permanently remove the inactive paths to the source array, but will not change the state of the migration session. The Synchronization will continue reaching a CutoverSync state when completed.
- **CutoverSync:** A reboot during the CutoverSync state may cause the MP software to permanently remove the inactive paths to the source array, but will not change the state of the migration session. If a reboot has removed the inactive paths and a cancel and revert back to the source is desired, then follow the steps documented under the migrating state to process the cancel –revert operation. A commit operation will not be affected after the inactive paths have been removed and no special steps are necessary to commit the migration session.