Dell PowerMax and VMAX: Non-Disruptive and Minimally Disruptive Migration Best Practices and Operational Guide

August 2022

H17133.6

White Paper

Abstract

This document includes best practices and walkthrough procedures for Non-Disruptive Migration (NDM) with Dell PowerMax, VMAX All Flash, VMAX3, and VMAX family storage systems.

Dell Technologies

DCLTechnologies

Copyright

The information in this publication is provided as is. Dell Inc. makes no representations or warranties of any kind with respect to the information in this publication, and specifically disclaims implied warranties of merchantability or fitness for a particular purpose.

Use, copying, and distribution of any software described in this publication requires an applicable software license.

Copyright © 2018-2022 Dell Inc. or its subsidiaries. All Rights Reserved. Dell Technologies, Dell, EMC, Dell EMC and other trademarks are trademarks of Dell Inc. or its subsidiaries. Intel, the Intel logo, the Intel Inside logo and Xeon are trademarks of Intel Corporation in the U.S. and/or other countries. Other trademarks may be trademarks of their respective owners. Published in the USA August 2022 H17133.6.

Dell Inc. believes the information in this document is accurate as of its publication date. The information is subject to change without notice.

Contents

Executive summary
Migration overview
Pass-through NDM
Metro-based NDM
NDM Update: Offline migrations with minimal host downtime118
Online Minimally Disruptive Migration (O-MDM)138
Masking enhancements (SE 9.0)150
Masking enhancements (SE 9.1)162
Appendix A: Host multipathing software notes164
Appendix B: AIX, GPFS, and PowerPath with NDM167
Appendix C: Consistent LUN
Appendix D: Device geometry behavior post NDM170
Appendix E: VMware—VM Clone or Storage vMotion with NDM171
Appendix F: NDM with ESXi virtualized cluster environment172
Appendix G: NDM Update with Solaris cluster173
Appendix H: Technical support and resources174

Executive summary

Overview

This document provides best practices and walkthrough procedures for Non-Disruptive Migration (NDM) with Dell PowerMax, VMAX All Flash, VMAX3, and VMAX Family storage systems.

Prior to the introduction of NDM, migrating from a Dell VMAX storage array to a new VMAX storage array was a time-consuming and tedious process. It required detailed planning and application downtime.

Solutions Enabler Release 8.3 introduced a data migration feature to help automate the process of moving applications from a VMAX array to a VMAX3 array without application downtime in a non-disruptive fashion. NDM leverages VMAX replication technologies to move the application data to the new array, and it leverages VMAX Auto-Provisioning, in combination with host multipathing software, to manage and maintain host access to the data during the migration process.

With each release of HYPERMAX OS and PowerMaxOS along with <u>Solutions Enabler</u>, the core functionality of NDM has been iterated in order to streamline the user experience and align the support matrix to customer needs.

This document describes both versions of NDM:

- Pass-through NDM: Source array is running 5876 code (VMAX, VMAX2)
- Metro-based NDM: Source array running 5977 or 5978 (VMAX3, VMAX AF, PowerMax)

Each method uses a similar set of commands but has significantly differing underlying architectures leveraging the source arrays abilities.

Throughout this document, the term VMAX Family is applicable to all Dell PowerMax, VMAX 250F, VMAX 450F, VMAX 850F, VMAX 950F, VMAX 100K, VMAX 200K, VMAX 400K, and VMAX arrays.

This document also describes the NDM Update migration feature, in which the source array is running any VMAX or PowerMax code level.

Audience

This document is intended for the following audience:

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

Feature updates and code levels

The following table outlines each feature update and the code level when the feature became available. This is listed in reverse chronological order from the latest to first feature release.

Code release	Features
Q3 2020 (5978.xx.xx SE 9.2) Code name: Hickory	No new feature updates
Q3 2019 (5978.xx.xx, SE 9.1) Code name: Foxtail	 Enhanced Metro-based NDM (5977–5977, 5978–5978) Addition of NDM Update (orchestrated SRDF migrations) Ability to create DR from target while in a migrating state Migration support for overlapping SGs IBMi NDM support
Q1 2018 (5978.xx.xx, SE 9.0) Code name: Elm	 Enhanced Pass-through NDM (5876–5978) Introduced Metro-based NDM (5977–5978) 50 concurrent migrations User ability enhancements: Auto set DRX on 5876 devices User selectable target PG on create Honor Consistent LUN setting Non-Disruptive SG reconfiguration Honor Consistent LUN addresses (Appendix C: Consistent LUN)
Q2 2017 (5977.1125.1125, SE 8.4) Code name: Cypress	 Ability to have DR from target in SRDF/Synchronous Mode Mixed WWN and IGs in masking view Initiators not required to be logged in, entry in LHT sufficient Full Cascaded V2 IG support Increased support matrix including Veritas VCS and DMP Automatically clear device geometry on commit
Q3 2016 (5977.xxx.xxx, SE 8.3) Code name: Trinity	 NDM (cutover) initial release (5876–5977): SRDF Pass-through 16 concurrent migrations Stand-alone hosts Clusters SCSI2 and SCSI3 Required Initiators to be logged in SRDF/A DR support

Table 1. Feature updates per code release

Migration overview

Revisions

Date	Description				
June 2018	Initial release				
February 2019	 Added document revisions section PowerPath 6.4 typo changed to PowerPath 6.2 Added note on GK Adding warning about post Cutover Rescans to both pass through sections and Pass-through NDM overview Added note to Linux appendix outlining the requirement for the -a parameter and link to Red Hat KB article Added update to Windows 2012 appendix outline the Path Verify Enabled flag behavior Template and format update 				
September 2019	 Included updates from Q2 2019 release Included NDM Update section Included Enhancements to Solutions Enabler for 9.1 Appendixes updated for RDMs with NDM Template and format update 				
September 2020	Added link to the knowledgebase article in the technical support and resources section; format updates				
January 2021	Clarification added to Veritas cluster behavior with NDM				
January 2022	Updated template				
August 2022	Added Online Minimally Disruptive Migration (O-MDM) content				

We value yourDell Technologies and the authors of this document welcome your feedback on this
document. Contact the Dell Technologies team by email.

Authors: Richard Murphy, Mike Adams

Note: For links to other documentation for this topic, see the PowerMax and VMAX Info Hub.

Migration overview

NDM overview NDM is designed to help automate the process of migrating host applications to a PowerMax, VMAX All-Flash, or VMAX3 enterprise storage array with no downtime.

Benefits of using NDM include the following:

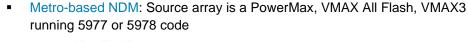
- Allows migration, with hosts and applications completely online, for the following:
 - From a VMAX array to a VMAX3, VMAX All Flash, or PowerMax array
 - From a PowerMax array to another PowerMax array
- Is designed for ease of use with control operations that automate the setup and configuration of the migration environment
- 6 Dell PowerMax and VMAX: Non-Disruptive and Minimally Disruptive Migration Best Practices and Operational Guide

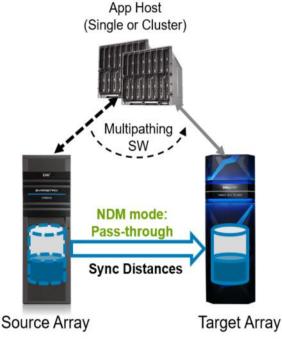
- Is managed by familiar and simple user interfaces, the Solutions Enabler, and Dell Unisphere
- Allows migrations to be canceled easily and failed back to the source array prior to commit

Non-Disruptive Migration leverages VMAX SRDF replication technologies to move the application data to the new storage array. It also uses PowerMax/VMAX auto-provisioning, in combination with Dell PowerPath or a supported host multipathing solution, to manage host access to the data during the migration process.

NDM is available in the following two forms depending on the source array involved in the migration session. From a user standpoint, the process is very similar in terms of interaction, but the architecture is fundamentally different.

Pass-through NDM: Source array is a VMAX or VMAX2 running 5876 code







Note: Reference the extensive <u>support matrix</u> when planning to migrate applications using NDM. In addition to the support matrix, reference the appendixes in this document for caveats on specific host-OS and multipathing combinations before attempting a migration.

NDM operations

Since the initial release of the NDM feature, the cutover feature has been the method by which migrations from an array running 5876.xx.xx code have been undertaken. This process uses what is referred to as the three Cs: create, cutover, and commit.

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 through simple and short Solutions Enabler commands.

- 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 usable replication pathway for data migration is available between the source and target arrays. 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. Once this is complete, I/O issued by the application is directed to either the source or the target arrays through the host multipathing software. The array operating system ensures 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 the array operating system to support the migrations.

Other supported NDM operations include the following:

- **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**: This is 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: This 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**: This controls the replication from the target side devices to the source side devices after a cutover is complete and all data has been migrated to the target side.
- List: This shows a list of migrations to or from a specified array, with the current status for each.

Manipulation of device IDs and host paths

Two of the underlying processes that ensure that NDM is non-disruptive is the technologies ability to maintain device visibility at all times by spoofing and swapping devices IDs between source and target devices.

NDM can migrate data and cut over 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 source and target

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

Effects on devices and existing replication sessions

Devices included in a migration session on the source array can remain in existing replication sessions throughout the migration. NDM evaluates the state of any current replication sessions before proceeding with the migration and ensures that they are in the proper state to allow the migration to succeed. By maintaining existing replication, NDM ensures there is no RPO impact during the period of the migration.

Though existing replication sessions can be left in place during the migration, replication relationships are not migrated to the target array. These replication resources 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 set up 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 sessions 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 to the DR site 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 performed, the operation is blocked until the changes that were made are undone, allowing the migration operation to proceed as expected.

The following are examples of manual changes made to the NDM session that will cause the session to stop or fail:

- Storage group manipulation, or adding or removing devices
- Masking view manipulation such as changing the name, or adding or removing elements

Configuration requirements and prerequisites

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

- SRDF ports must be configured across at least two directors.
- The source and target arrays must have SRDF directors and ports configured.
- 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.
- The host with the application being migrated must be zoned to the VMAX3 or VMAX All Flash array.
- For VMware, enable consistent_lun on the source array initiator before performing NDM operations.

Note: SRDF 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.

Restrictions

NDM SRDF restrictions

- Potential source devices cannot be R2 devices.
- Arrays must be within metro distances of each other.
- The source devices cannot be part of a concurrent RDF relationship.
- The source devices must not be enabled for RDF consistency.
- The source devices may not be part of an SRDF/Star configuration.
- The source devices may not be part of an SRDF/Metro configuration.

Environment restrictions

A minimum of two SRDF links (FC or GigE) are required to support an NDM session. These ports must be spread across at least two directors.

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.

TimeFinder restrictions

- The source or target devices 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.

RecoverPoint restrictions

The migration source or target devices cannot be tagged for RecoverPoint use.

Boot-from-SAN support

Cutover NDM supports hosts that boot directly from the VMAX array. 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, refer to the vendor specific HBA management guide or BIOS guides.

REST API support

Both methods of NDM, Pass-through and Metro-based, are fully supported through the REST API.

Recognizing the NDM SRDF group

The RDF group created for NDM between two arrays can be identified by its label. The label follows the format of M_XXXXYYYY. XXXX is the last four digits of the lower numbered storage array and YYYY is the last four digits of the higher numbered array. This group is used for all NDM migrations between the two arrays. This group is automatically created as part of the environment setup.

Setting up multiple NDM environments

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

Likewise, a single VMAX source array can have multiple NDM RDF groups, each connected to one of four different target PowerMax, VMAX All Flash, or VMAX3 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.

Masking groups and views with NDM

When NDM sessions are created, NDM configures the following items on the target array with the same names as those on the source array:

- Storage groups (SGs)
- Initiator groups (IGs)
- Port groups (PGs)
- Masking views (MVs)

Both initiator groups and port groups can exist in multiple masking views, so these groups are reused when applicable.

A host may also be attached to multiple source arrays. For example, if a storage group spans two source arrays, when the storage is migrated, the target array contains two sets of SGs, IGs, PGs, and MVs, one for each source array.

When the first SG on the first array is migrated to the target array, the following occurs:

- An SG is created on the target with the same name that contains the migration target devices.
- An IG is created on the target with the same name that contains the host initiators.
- A PG is created on the target based on which ports the host HBAs are logged into.

When a **second SG on the second source array** is migrated to the target array, the following rules apply:

- 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, the PG built by NDM during the first migration can 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.

Alternatively, you can manually create the PG on the target in advance. Then, select this as the target PG for the NDM session or create it as part of the NDM create process. This option is new for Solutions Enabler 9.1.

Rules for masking groups and views

All migrations are performed against an SG, which is the data container that is migrated with NDM. The following rules apply:

• 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 is not permitted.

- 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.
- If the SG is a parent, its child SGs are also migrated.
- Devices in the SG which are considered to be GKs (20 cylinders or less) are not 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.
- 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, the IG layout may differ on the target array to that on the source.
- 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.

NDM 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

- 50 SGs can be migrated concurrently. Child SGs do not count towards this limit.
- Each SG can contain up to 4096 devices.

Hardware and software requirements

For hardware and software requirements, refer to the <u>PowerMax/VMAX All Flash/VMAX3</u> <u>Features Simple Support Matrix.</u>

Metro-based NDM overview

Metro-based NDM is built upon SRDF/Metro active/active technology with the Metro instant activate (Metro-IA) feature. For more information about SRDF/Metro, see the <u>SRDF/Metro Overview and Best Practices</u> document.

Benefits of using Metro-based NDM include the following:

- Allows the complete migration from a VMAX3 or VMAX All Flash arrays to VMAX All Flash or PowerMax arrays without the need for downtime
- Leverages Metro technology to reduce the required commands users need to issue by removing the need to cut over
- Is managed by familiar and simple user interfaces: Solutions Enabler and Unisphere for VMAX
- Allows migrations to be canceled easily and failed back to the source array for any reason prior to commit

• Allows users to precopy all or a large portion of data before bringing the host live to the new array. This reduces the impact to the application during the migration period.

The previous version of NDM provided with Solutions Enabler 8.3, Unisphere 8.4, and HYPERMAX OS 5977.1125 releases allowed data to be migrated from a VMAX (5876) to a VMAX3 (5977) array without application downtime.

With the release of Solutions Enabler 9.0 and HYPERMAX OS Q2 2018, the NDM feature was enhanced to help automate the process of moving applications from a VMAX3 (5977) or VMAX All Flash (5977) array to another VMAX All Flash (5978) or PowerMax (5978) array.

With the release of Solutions Enabler 9.1, full interfamily migrations are possible (5977 to 5977, and 5978 to 5978).

The source hardware is not a limiting factor. Metro-based NDM is supported from arrays running 5977 or 5978 to 5977 or 5978 code, regardless of the underlying technology.

With SRDF/Metro, the session goes active/active only after all SCSI information and application data is synchronized from R1-R2 using SRDF adaptive copy technology. The time to be fully active/active largely depends on the time it takes for the data transfer to finish.

To improve the user experience with NDM, the software is enhanced such that the SRDF/Metro session goes active/active instantly on NDM create. This only applies to underlying Metro technology for NDM and does not apply to regular SRDF/Metro for running active/active applications. This makes both sides of the SRDF/Metro active and read/write to the host within the duration of the create command.

Metro-based NDM modes of operation

- Metro-based NDM: This is the NDM mode where the synchronization starts right after the create completes, and the create operation creates an NDM session using SRDF/Metro internally.
- Metro-based NDM with precopy: This mode of operation offers a choice to start the NDM session using adaptive copy (SRDF/ADP) which helps synchronize most of the data before moving into an active/active state. Eventually, this moves to active/active mode and synchronizes the remaining tracks. In essence, precopy allows end users to copy application data from the source array to target array while the application is still running on the source array.

Metro-based flows

The following steps and diagram describe the process flow for Metro-based NDM:

- 1. Solutions Enabler creates an active/active SRDF group with NDM attribute.
- 2. Solutions Enabler activates the group.
- 3. SCSI information, device personality, and attributes are transferred to the target devices.
- 4. Masking view to the source (R2) array created.
- 5. Migration starts from R1 to R2 (source to target).

- 6. User rescans host for extra paths to target array.
- 7. Data synchronization completed.
- 8. Commit issued and migration completed.

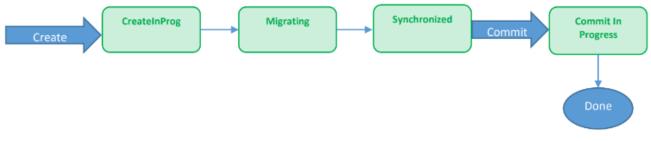


Figure 2. Process flow for Metro-based NDM

The following steps and diagram describe the component flow for Metro-NDM with precopy:

- 1. Solutions Enabler creates an active/active group with NDM attribute and precopy set. The SRDF group is set to adaptive copy mode.
- 2. Pre-copy data sync (R1-R2)
- 3. Solutions Enabler sets READYTGT which will activate RDF group with Metro-IA.
- 4. SCSI information, device personality, and attributes are transferred to the target devices.
- 5. Masking view to the source array created.
- 6. User rescans host for extra paths to the target array.
- 7. Data synchronization completed.
- 8. Commit issued and migration completed.

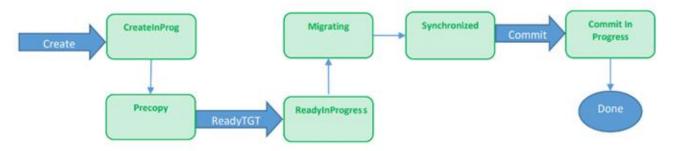


Figure 3. Component flow for Metro-based NDM with precopy

Metro-based NDM operations

• **Create:** This creates a Metro-based NDM session. It creates SRDF/Metro with NDM source and target attributes and puts the NDM pair in active/active mode (clear DEV-INACT on R2). This also starts data synchronization and SCSI info synchronization and moves into a migrating state. Once the data has been synchronized and the host paths to the target array have been discovered by

means of a host rescan, the NDM session reaches a synchronized state. A create results in RDF mirror invalids on R1 and local mirror invalids on R2.

- Create with precopy: This creates an SRDF/Metro session with NDM attributes and puts the SRDF/Metro pair into adaptive copy disk mode. It starts data synchronization from R1 to R2. Bias is enabled on the Metro-based NDM source. This creates an SRDF/Metro session with NDM attributes and puts the SRDF/Metro pair into adaptive copy disk mode. It starts syncing data from R1 to R2. Bias is on the Metro-based NDM source.
- **ReadyTGT:** This continues to synchronize the remaining invalid tracks from source target and also starts synchronization of SCSI Information. It puts the NDM pair in active/active mode (clear DEV-INACT on R2) without waiting for synchronization to finish.
- **Cancel:** This suspends the SRDF/Metro NDM session. The R2 device moves into a DEV-INACT state and all I/O is redirected to R1.
- **Sync-stop:** Once in synchronized state, the user might need to test the application performance before committing. The sync-stop command would make the NDM SRC DEV-INACT, all I/O would go through Metro-NDM target R2, and the Metro-NDM session moves into a CutoverNoSync state. This operation results in moving the bias to the Metro-NDM target.
- **Sync-start:** This moves the Metro-NDM session from CutoverNoSync to CutoverSyncing and finally to synchronized. This command should be used once the user has finished verifying the application against the NDM target after the sync-stop command and the user is ready to either commit or cancel the NDM session. The bias remains on the Metro-NDM target commit.

Manipulation of device IDs and host paths

NDM can migrate data and cut over 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.

NDM UpdateSolutions Enabler 9.1 introduces the NDM Update feature to help automate the process of
moving applications across arrays requiring a short application downtime.

Benefits of using NDM Update include the following:

- Allows application migration for the following:
 - From a VMAX (5876) array to a VMAX3 (5977), VMAX All Flash (5978), or PowerMax (5978) array

- From a VMAX3 (5977) array to a VMAX All Flash (5978) or PowerMax (5978) array
- Supports application (SG) level migration for open systems (FBA devices)
- Is built on existing NDM and SRDF technologies:
 - Provides the same streamlined user experience
 - Supports pre-sync data between arrays and then schedule downtime to do the cutover.
- Supports spoofing or not spoofing the LUN identity
- Requires minimal disruption of the host I/O:
 - Host application is briefly shut down when moving the host visibility to the target.
 - Application disruption time limited to its reboot time if spoofing is used.
 - Application disruption time limited to its reboot and LUN repointing time if no spoofing is used.
- Carries over existing NDM interoperability with array features to NDM Update, with all existing NDM interactions with LREP and SRDF remaining the same
- Provides the following capabilities:
 - Covers all host environments for open systems (FBA devices)
 - Addresses host environments where NDM is not supported but a high level of orchestration is preferred
 - Enables a high level of orchestration and ease of use
 - Has a similar workflow as NDM
 - Provides the same support for easy recovery of failed operations
 - Provides the same support for the easy cancellation of an ongoing migration
 - Maintains DR throughout migration
 - Places no additional hardware in the data path
 - Compresses data during migration to VMAX All Flash or PowerMax
 - Leverages SRDF/s or SRDF/Adp for data transfer
 - Is native to HYPERMAX OS with no license required (no SRDF license required)

For the latest connectivity information, see the support matrix.

NDM Update operations

Migrating an application from a source to a target array proceeds with a sequence of userinitiated operations, each fully automated. Using Solutions Enabler 9.1, the following operations are undertaken using the symdm library similar to NDM. When initiating an NDM Update session, the **create -offline** parameter is used. Similarly, if using Unisphere for PowerMax, select the **offline** checkbox. See the walkthrough sections for examples of the following operations:

• **Migration environment setup:** This operation configures the migration environment required to migrate any application from the source array to the target array.

One or more applications can be migrated serially or in parallel from the source to the target array using the migration environment:

- create -offline: This operation examines a specific application's storage on the source array and automatically provisions equivalent storage on the target array. Source and target devices are configured in a mode that starts copying the data to the target devices.
- -move_identity: This option assigns the target devices the identity of the source devices. If -move_identity is not selected, host applications need to be directed to the new target volumes prior to rebooting the application. This is not the case if move_identity is selected, much like NDM whereby the host sees what it perceives as the original volumes but with a spoofed WWN. (See the relevant NDM section for more information about WWN manipulation.)
- -precopy: This option modifies when the user must shut down the application to allow the source devices to be available during the time the data is copied to the target devices.
 - Without the -precopy option, the user must shut down the application before the create -offline command is given. The command will make the target devices visible to the host and the source devices host_inactive.
 - With the **-precopy** option, the command will not make the target devices visible to the host and the application can continue running only on the source array while the data is copied to the target. A migration 'cutover operation is required to continue the migration. The cutover operation makes the target devices visible to the host and the source devices host_inactive.
 - The migration cutover operation is only used in the CutoverReady state and requires the user to shut down the application before the cutover command is given.

After a create -offline or the cutover command completes, the administrator must perform a host rescan (or host reboot) and verify that new paths or new LUNs have been discovered prior to restarting the application. Unless the -move_identity option was given, the application configuration would also need to be changed to use the new LUNs.

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 application migration by releasing resources allocated to perform the migration, which also permanently disables access to the source devices. If the -move_identity option was given during the create -offline command, commit also assigns the identity the target device was created with to the source devices.

• Environment remove: This operation is performed after all migrations have been performed to remove any configuration created by the 'environment setup' operation.

Other supported operations provide means to the following:

- Cancel a migration, removing storage provisioned by Solutions Enabler on the target array, releasing resources allocated to perform the migration, and placing the source devices into the pre-create command state.
- Recover from a failed migration.
- List migration environments, to see an overview of the configured DM environments.
- List migrations to or from a specified array, showing the current status for each.

Pass-through NDM

Pass-through NDM walkthrough guide (source running 5876 code) describes two methods for NDM:

Pass-through NDM guide plan and environment review

- Unisphere for PowerMax
- <u>CLI (Solutions Enabler)</u>

The duration of this walkthrough uses the VMAX arrays in the graphic below.

Pass-through NDM migrates SGs from 000198701161 to 000197800131.

000198701161 VMAX10K 5876.309.401	5 %		-	MB/S	-	-	Z	ţ	
000197800131 VMAX250F 5978.100.100	8 %	000	-	MB/S		691.0:1		Ļ	

Prior to the start of a planned migration, ensure that the prerequisite checks for using NDM have been completed:

- Ensure both source and target array are RDF capable, that is RF emulation has been added to both arrays
- Ensure both arrays RDF ports are zoned to each other. There is a minimum of two connections required
- Check for the correct zoning from the target array to the application host.

Even though the guide takes you through the detailed device examination after each step and dives into the workings of each of the issued commands, the user needs to issue three commands to migrate an SG from source to target.

- Create, followed by a host rescan
- Cutover
- **Commit**, followed by a host rescan

Note: A host rescan that will result in the permanent removal of the now inactive paths should not be undertaken post-cutover, this will limit the ability for the migration to be seamlessly canceled and normal operation reverted to the source array. In the case of multiple concurrent NDM sessions sharing the same host the same rule should apply across all sessions when issuing rescans.

Pass-through NDM walkthrough guide (source running 5876 code)

Using Unisphere for PowerMax

The following screenshots are taken from disk management on a Microsoft Windows Server 2016 host, this walkthrough intends to migrate disks 1 to 4 using NDM without any impact to the operating system or application accessing these devices. This is a virtual host with physical Raw Device Mappings.

The VMAX devices involved in this example are 1EA through 1ED added to Storage Group Uni_Cut_SG1, which is masked to the virtual host.

🜆 Computer Management (Local	Mahama	Layout Type File System	Chature		Capacity Free Space	Of Free
System Tools	(C:)	Simple Basic NTFS	Healthy (Boot, Page File, Crash Dun		19.51 GB 94.91 GB	79 %
> P Task Scheduler		Simple Basic NTFS	Healthy (System, Active, Primary Pa		00 MB 154 MB	31 %
> 🛃 Event Viewer	- System Reserved	Simple Basic NTFS	Healthy (System, Active, Primary Pa	inition) 50	I D4 MD	51 %
> 👸 Shared Folders	i.					
> Decal Users and Groups	- Disk 0					
> 🔕 Performance	Basic	System Reserved		(C:)		
📇 Device Manager	120.00 GB	500 MB NTFS		119.51 GB NTFS		
🗸 🚰 Storage	Online	Healthy (System, Active, Prin	nary Partition)	Healthy (Boot, Page File	le, Crash Dump, Primar	y Partition)
> 🐞 Windows Server Backup						
📅 Disk Management						
> B Services and Applications	= Disk 1					
	Basic 8.00 GB	0.00.00				
	Online	8.00 GB Unallocated				
	onnic	Unallocated				
	- Disk 2					
	Basic					
	8.00 GB	8.00 GB				
	Online	Unallocated				
	= Disk 3					
	Basic					
	8.00 GB	8.00 GB				
	Online	Unallocated				
	- Disk 4					
	Basic					
	8.00 GB Online	8.00 GB				
	Unline	Unallocated				
	-					

<pre>pplicensevmaxcse:~ # rpowermt display dev=emcpower204 host=10.</pre>									
Pseudo name=emcpower204									
Symmetrix ID=000198701161									
Log	ical device	ID=01EA							
Dev	ice WWN=600	0097000019870116	15330303	31454	1				
Sta	ndard UID=n	aa.6000097000019	8701161	53303	0314541	L			
typ	e=Conventio	nal; state=aliv	e; poli	cy=Sy	mmOpt;	queued	-IOs=0		
		- Host		- S	tor -	I/O	Path	Sta	ats
***	HW Path	I/0) Paths	In	terf.	Mode	State	Q-IOs	Errors
	3 vmhba6						alive		0
	3 vmhba6	CO	:T8:L1	FA	2e:01	active	alive	0	
	3 vmhba6						alive		0
	3 vmhba6	CO	:T17:L1	FA	1e:00	active	alive	0	0
	4 vmhba2	CO	:T17:L1	FA	2e:00	active	alive	0	0
	4 vmhba2	CO	:T13:L1	FA	1e:00	active	alive	0	0
	4 vmhba2	CO	:T15:L1	FA	2e:01	active	alive	0	0
	4 vmhba2	CO	:T2:L1	FA	1e:01	active	alive	0	0

An example of the multipathing setup using device 1EA. It shows what the pathing looks like prior to the NDM create and the host rescan. For each of the four volumes here there are eight paths to the source array which are all alive and available for host use. At this point, there are no paths to the target array even though our zoning should be in place before the NDM create.

NDM environment setup

From the Unisphere Dashboard, select the Source array from the available arrays in the view. In this case, the source array is a 10K with the serial number ended in 161.

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 usable replication pathway for data migration is available between the source and target arrays and creating an SRDF group for the migration. The setup is run once only. 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.

		Unisphere for PowerMax > 000198701161 •
A		Migrations
		Storage Groups Environments
2		Create
Ţ		Remote Arrey State
0	DATA PROTECTION	
	Migrations	Currently no Items in this view
	SRDF/A DSE Pools	

From the **Data Protection** menu select **Migrations**, Select the **Environment** tab and this will display any existing Environments already setup. The parameter **In Use** shows us if the Environment is validated and usable. The **In Use** parameter tell us if there is an active Migration using this environment.

To create an environment, select **Create**, the pop-up window below allows the choice of target array. This is populated with suitable arrays. Should the required array not be present, verify the RDF zoning and confirm the intended target array is suitable and its current code level is within the support matrix. Select the relevant array and choose **Run Now.**

Setup Migration Environment
Remote Array *
000197000008
000197600156
000197800085
000197800131
000197900111
000296700558
000297800544

Success	
Hide Task Details	
Starting Tasks	
Migration Environment setup between: 00 Starting Data Migration environment setu 000197800131	
Analyze Configuration Source SID:000198701161 Target SID:000197800131	Started.
Analyze Configuration	Done.
Setup Configuration	Started.
Setup Configuration	In Progress.
Setup Configuration	Done.
Succeeded Data Migration environment se	etun

Pass-through NDM

		Unisphere for PowerMax > 000198701161 -	୯ ବ 🖬 🤹 💠
A		Migrations	
::		Storage Groups Environments	
3		Creete	1
Ţ		Remote Arrey State	In Use
0	DATA PROTECTION	000197800131	-
	Migrations		

Examining the RDF environment from the new **Topology** view shows the RDF group template that has been created. Go to the **Dashboard and Replication** and hover over the line between our source and target. From here the **SRDF Groups** window appears. Select **View Groups** to display the SRDF group window highlighted below.

	Unisphere for PowerMax > 0001987	01161 +		с	: < 🖬 🦸 💠 🔺 🥹		
🔒 НОМЕ	000198701161	SYSTEM HEALTH	SG COMPLIANCE	CAPACITY	REPLICATION		
DASHBOARD	ID 000198701161 Enginety 5876 309 401		3	5	0		
STORAGE	Enginuity 5876.309.401 Model VMAX10K Connection Local	SGS SGS		S S	SGS		
Г HOSTS							
DATA PROTECTION	Storage Group Summary	SRDF Topology 🔹		1.02	Actions		
15 PERFORMANCE	SRDF	DOUGH DROVEN			CREATE SRDF GROUP		
SYSTEM	Unprotected 3				CREATE MIGRATION		
EVENTS	Device Groups				ENVIRONMENT		
	TimeFinder Clone			CREATE DEVICE GROUP			
	TimeFinder Snap 0						
	TimeFinder Mirror 0						
	SRDF ()	e andre e andre e andre comment					
			CODUCTIONS	F, Q Q			
			nchronous Mixed	Other			

The dotted link between 161 and 131 suggest and "other" type of SRDF relationship. In this case, it is a migration link. The drop-down menu highlighted below allows the user to highlight just the migration relationships.

	Unisphere for PowerMax >	000198701161	•		(
🕈 НОМЕ	0001987	01161	SYSTEM HEALTH	SG COMPLIANCE	CAPACITY
DASHBOARD	ID 00019870116 Enginuity 5876.3 Model VMAX108			3	5
STORAGE	Model VMAX10k Connection Loca		\bigcirc	SGS	%
Г ноsts					
DATA PROTECTION	Storage Group Summar	y N	ligration Environments 🔹]	: 03
1. PERFORMANCE	SRDF		-		
SYSTEM	Unprotected	3	00019870116		
EVENTS	Device Groups				
SUPPORT	TimeFinder Clone	0			
	TimeFinder Snap	0		000197800 31	
	TimeFinder Mirror	0		\backslash	
	SRDF	0		$\langle \rangle$	
	SRUF	0			
				000296700558	F_ Q Q

Now the Environment is in place we can continue with the *NDM Create* for the SG containing the application to be migrated.

Note: NDM Environment setup creates RDF links between the Source and Target 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 –rdfg 250 –add -dir xx –remote_dir xx

Create migration session

From the **Storage** tab select **Storage Groups**, from there locate the SG that is to be migrated. Set the check box and click the **More Actions** "3-Dot" icon to the right of Set Host I/O Limits. From the drop-down menu, select **Migrate**.

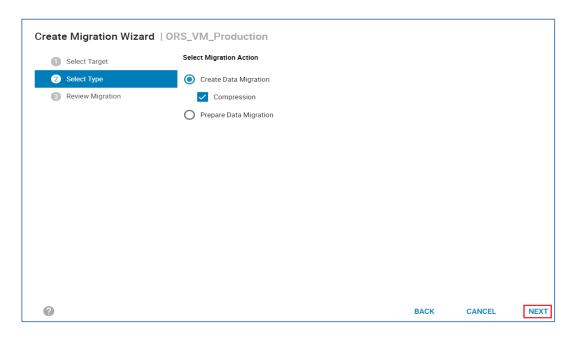
=		Unisphere for	PowerMa	ix > 000198701161					୯ ଏ 🖬
A		Storage Gr	oups						
		Create	Expand	Provision Storage To Host	Protect	Set Host I/O Limits	^ <u> </u>	ORS_VM_Prod	uction
8	STORAGE Storage Groups	Name	•	FAST Policy	Capacity (GB)	FAST	ng Views ≡	Symmetrix ID	000198701161
	Volumes		SX146_161 /M_Producti		0.05 44.00		1	FAST Policy	
			ut_SG1		32.00	Allocate/Free/Reclaim	• 1	Capacity (GB) Volumes	44 2
						SG Maintenance	•	Storage Groups	0
						RecoverPoint	→	Masking Views	2
							<u> </u>	SRDF	
	Disk Groups							Emulation	FBA

Pass-through NDM

		Unispl	nere for PowerMax > 00	0198701161 🝷		G
A						
55		Sto	Create Migration Wizard			
•	STORAGE		1 Select Target	Symmetrix ID * 000197800131		
			 Select Type Review Migration 	SRP		
				SRP_1		
				Select Port Group Name		
				Q Enter the name of the port group to filter 131_ESX146_GK_PG		
				ESK_140_PG		
				HOST_GK_PG		
				MB_Demo_PG 🛛		
Ţ						
•						
			0		CANCEL	NEXT

From the pop-up Create Migration Wizard, select the **Target array** (only Arrays with valid Environments setup appears on this drop-down menu). From Solutions Enabler 9.0 and later, the ability to select an existing **Port Group** on the target array is also an option. Select the target array SRP and Select **Next**.

From the next screen select Create Data Migration, from here we have the option of selecting Compression on the target SG. The Prepare Data Migration selection requires Performance data to be collected on the host. This runs a check for resources on the target array to ensure the addition of the new SG does not cause the target array to exceed any performance metrics on both FE and BE. It will also produce a spread sheet to help plan the zoning required for the host from the target array.



The final menu for the Wizard gives a final confirmation on the planned NDM session to be created. It breaks down the planned masking view elements and the NDM parameters. Select **Run Now** to continue.

Create Migration Wizard 0	RS_VM_Production								
 Select Target 	Review Migration Create Sum	/ Migration Create Summary							
2 Select Type	Storage Group	ORS_VM_Production							
3 Review Migration	Target VMAX	000197800131							
	SRP	SRP_1							
	Compression	Yes							
	Masking Views								
	Masking View	Port Group	Host/Host Group	=					
	ORS_mv	ORS_PG	ORS	^					
	ORS_Host_Production	161_ESX146_GK_PG	ESX_146_IG						
0			BACK CANCEL						
~				VI Run Now					

Creating the NDM session will also validate the Environment as part of the setup to ensure the migration complete successfully. The Create Command:

- Creates a Storage Group on the Target array (group name must not be in use on the target array) with the same name as the Source SG
- Creates duplicate devices on the target array to match those on the Storage Group
- Creates an initiator group using Initiators with entries in the login history table
- Creates a Port group (if one does not already exist)
- Effective (external) WWNs of the device created on the target are copied from the WWNs of the host devices
- Creates a masking view to the host from the target array

Note: During a Cutover NDM migration, the source of the migration is an R2 or an R21 device (if there is existing SRDF DR replication from the source device) and the target is 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.

Examine the migration session

The following screenshot shows how to examine a migration session.

=		Unisphere for Powe	erMax > 00019870	1161 -		
♠		Migrations				
		Storage Groups	Environments			
2		Cutover Con	nmit		1 items	÷ (i)
Ţ		Storage Group	State	Source	Target	≡
•	DATA PROTECTION	UNI_Cut_SG1	Created	000198701161	000197800131	^
	Migrations					

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 operating-system specific and also should include a rescan using the host multipathing software.

The NDM session goes from a Created state to a CutoverReady 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. Appendix A: Host multipathing software notes has more details on host multipathing software settings.

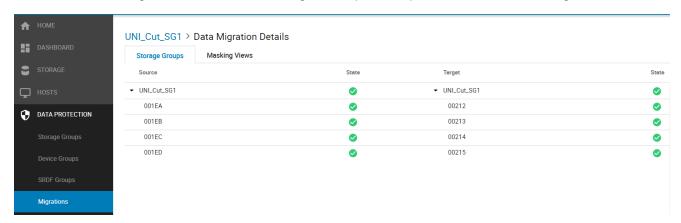
CutoverReady and pass-through mode

Pass-through mode allows the host to write to or read from either the source or target array. Any write that in sent to the target array is sent over the SRDF link and serviced by the source array. No data is 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.

=		Unisphere for Powe	erMax > 00019870)1161 -		
A		Migrations				
		Storage Groups	Environments			
8		Cutover Cor	nmit		1 items	÷ (i)
Ţ		Storage Group	State	Source	Target	≡
•	DATA PROTECTION	UNI_Cut_SG1	CutoverReady	000198701161	000197800131	^
	SRDF Groups					
	Migrations					

Double-clicking the NDM session displays the **Migration Details** view. This example below shows the individual devices involved in the session. Under the target tab we can see devices 200 through 203 have been created on the target side by the NDM create. The **State** also shows a live status of each of the devices involved. A device without a green tick should be investigated for potential problems before continuing.



Selecting the **Masking Views** tab opens up the pane outlining the masking and masking elements involved on both sides of the NDM session. This screen is useful for troubleshooting any issues with the migration such as an unplanned or unauthorized manipulation of any of the NDM elements hindering the progress to the commit stage. This is highlighted in the **State** not showing a green tick.

Pass-through NDM

		Unisphere for PowerMax > 000198	701161 -		C Q 🖬 🌢
		UNI_Cut_SG1 > Data Migration Deta Storage Groups Masking Views	ls		
3		Source Masking View	Source State	Target Masking View	Target State
Ģ		 Masking View 		 Masking View 	
•	DATA PROTECTION	 UNI_Cut_SG1_MV 	0	 UNI_Cut_SG1_MV 	S
\mathbf{v}	DAIATROTECTION	 Port Group 		 Port Group 	
		 UNI_Cut_SG1_PG 	Ø	 UNI_Cut_SG1_PG 	0
	Device Groups	▼ FA-2E:0	Ø	▼ FA-1D:28	0
		FA-1E:0	0	FA-2D:29	0
		FA-2E:1	0		
	Migrations	FA-1E:1	0		
		✓ Host		✓ Host	
		▼ NDM_IGs	0	 NDM_IGs 	0
		▼ 10000090fa9279b0	0		0
		10000090fa9279b1	0	10000090fa9279b1	0

The SRDF Groups tab in Data Protection shows the SRDF relationships established as part of the Create Command. The Devices 212 to 215 in the example below have been created as replicas of the source devices on the target array. The SynclnProg state can be ignored in this case as the data transfer from Source to Target has yet to start.

		Unisphere for Powe	rMax > 000198701161	*			C Q 🖬 🤹
		250 > SRDF Pairs	s - M_01311161 (250)				
		Name	Configuration	Remote Array ID	Remote Volume	Pair State	Larger SRDF Type
Ţ		001EA	RDF2+TDEV	000197800131	00212	SyncinProg	
0	DATA PROTECTION	001EB	RDF2+TDEV	000197800131	00213	SyncInProg	
		001EC	RDF2+TDEV	000197800131	00214	SyncinProg	
		001ED	RDF2+TDEV	000197800131	00215	SyncInProg	
	SRDF Groups						

View paths to new devices

Viewing the same device (1EA) from the multipathing software **post rescan** shows the highlighted extra paths online to the target array (in this case two extra paths) this depends on the zoning setup. It also displays the source and target SIDs and the device numbers involved for these paths. This highlights the WWNs on the LUNs to appear as a single device with just extra paths. Prior to version 6.2, PowerPath was not aware of the NDM process so the dual SIDs and devices IDs were not visible.

	ower204	0.03					
	198701161, 00019780013	11					
ogical device I							
	9700001987011615330303		Conserve and				
	.600009700001987011615	55.7.7		5.°			
ype=Conventiona	1; state=alive; polic	:y=Sy	mmOpt;	queued-	IOs=0		
	Host						
## HW Path	I/O Paths	In	terf.	Mode	State	Q-IOs	Errors
*************			******	*******			
3 vmhba6	C0:T3:L0	FA	2d:29	active	alive	0	0
4 vmhba2	C0:T12:L0	FA	1d:28	active	alive	0	0
3 vmhba6	C0:T19:L1	FA	le:01	active	alive	0	0
3 vmhba6	C0:T8:L1	FA	2e:01	active	alive	0	0
2 ATTENDED	C0:T20:L1	FA	2e:00	active	alive	0	0
3 vmhba6				active	alive	0	0
	C0:T17:L1	FA	le:00	accive	GTTAC		
3 vmhba6			1000	active			0
3 vmhba6 3 vmhba6	C0:T17:L1	FA	2e:00		alive	0	00000
3 vmhba6 3 vmhba6 4 vmhba2	C0:T17:L1 C0:T17:L1	FA FA	2e:00 1e:00	active	alive alive	0	0 0 0

Examine IDs of source and target

Viewing the devices WWNs after the Create process shows that the source device has a **WWN** and **External** (host visible) WWN with the same value. However, the target's WWN and External WWNs differ. The target's External WWN has inherited the WWN of the source in order to appear logically as the same device to the host and picked up my multipathing software as an extra path to the same device.

	Unisphere for	PowerMax >	00019870116	1 -						сq		4 4	* *
номе			_										
DASHBOARD	Storage Gro Details	Volumes Per	SG1 formance										
STORAGE	Create	Add Volumes To SG	Remove Volumes	Expend	:		4 items 😐	()	001EA				
Storage Groups	Name -	Type	Allocated (%)	Capacity (GB)	Emulation	Stetus	Pinned	=	Symmetrix Vol ID	001EA			
Volumes	001EA	RDF2+TDEV	0.02%	8.00	FBA	Ready		^	HP Identifier Name				
	001EB	RDF2+TDEV	0.02%	8.00	FBA	Ready			VMS Identifier Name				
	001EC	RDF2+TDEV	0.02%	8.00	FBA	Ready			Nice Name				
	001ED	RDF2+TDEV	0.02%	8.00	FBA	Ready			WWN	60000970	0001987	0116153	30303145
									External Identity WWN	60000970	001987	0116153	30303145

		Unisp	here for	PowerMax		000197800131						C Q 🖬 🤹	۵.4
		Sto	orage Gro	oups > UNI	Cut_S	G1							
			Details	Volumes	Perfo	rmance							
•	STORAGE		Create	Add Volumes	To SG	Remove Volumes	Expend	:	4 items 📃	0	00212		
	Storage Groups		Neme 🔺	Туре		Allocated (%)	Ce	pacity (GB) Emulation	Status	=	rir iusiiinsi ivains		
			00212	RDF1	TDEV	0%		8.00 FBA	Ready	^	VMS Identifier Name		
			00213	RDF1	TDEV	0%		8.00 FBA	Ready		Nice Name	-	
			00214	RDF1	TDEV	0%		8.00 FBA	Ready		WWN	6000097000019780013	15330303231
	Storage Resource Pools		00215	RDF1	TDEV			8.00 FBA	Ready		External Identity WWN	6000097000019870116	15330303145

Cancel a migration

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

≡		Unisphere for F	owerMa	× > 000198701161 -		
A	HOME	Migrations				
	DASHBOARD	Storage Grou	ps Env	vironments		
•	STORAGE	Cutover	Commit	Ready Target		1 items \Xi 🤅
Ţ	HOSTS	Storage Group		Recover		Target
•	DATA PROTECTION	UNI_Cut_SG	1	Recover	3701161	000197800131
	Storage Groups			Sync		
	Device Groups			Cancel Migration		
	SRDF Groups					
	Migrations					

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.

Note: It is best practice to run a rescan on the host after a Cancel to clear up any dead or invalid paths.

Cutover migration session

Note: A Host rescan that will result in the permanent removal of the now "inactive" paths should not be undertaken post Cutover, this will limit the ability for the migration to be seamlessly canceled and normal operation reverted to the source array. In the case of multiple concurrent NDM sessions sharing the same host the same rule should apply across all sessions when issuing rescans.

The normal operation following a successful Create is a 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 host paths to the source array inactive so that all I/Os are being serviced by the target array. From an SRDF point of view this initiates a full SRDF Restore on the devices.

=	:	Unisphere for Power	Max > 0001987011	61 🝷				G	۹ 🖬
ń		Migrations							
5		Storage Groups	Environments						
8		Cutover Comr	nit 🚦		1 items	÷ i	UNI_Cut_SG1		
Ţ		Storage Group	State	Source	Target	=	Consolar (CD)	00	
0	DATA PROTECTION	UNI_Cut_SG1	CutoverReady	000198701161	000197800131	^	Capacity (GB)	32	0
	Storage Groups						State	Cutov	verReady
							Done (%)		
							Source	0001	98701161
							Target	0001	97800131
	Migrations						Valid Components	9	

Success	
Hide Task Details	
Starting Tasks	
0	Storage Group: UNI_Cut_SG1 on local array: 000197800131 with force: No with SymForce: No
Starting Data Migration cutover	
Analyze Configuration	Started.
Source SID:000198701161	
Target SID:000197800131	
Analyze Configuration	Done.
Cutover	Started.
Cutover	Done.
Succeeded Data Migration cutover	
Refreshing Data Migration cutover	entities
Succeeded	

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.

	Unisphere for PowerMax > 000198701161 + C							
A		Migrations					Refresh S	elected System
5		Storage Groups	Environments					
8		Cutover Commit	:		1 items	- (j	UNI_Cut_SG1	
Ţ		Storage Group	State	Source	Target	≡	0	
0	DATA PROTECTION	UNI_Cut_SG1	Migrating	000198701161	000197800131	^	Capacity (GB)	32 Migrating
							Done (%)	60
							Source	000198701161
							Target	000197800131
	Migrations						Valid Components	Ø

In the example above, the migration session is 60% Copied. Copy time is affected by a number of factors such as:

- How busy the array is overall
- How many RDF paths are part of the NDM environment
- Whether the resources are shared between regular SRDF operations and NDM copies
- Amount of concurrent NDM session ongoing
- Amount of application I/O

		Unisphere for PowerM	ax > 0001987011	61 -				୯ ବ 🖬					
A		Migrations					Refresh S	elected System					
		Storage Groups E	Storage Groups Environments										
8		Cutover Commit	Cutover Commit : 1 Items = () UNI_Cut_SG										
Ţ		Storage Group	State	Source	Target	=	0(D)	32					
0	DATA PROTECTION	UNI_Cut_SG1	CutoverSync	000198701161	000197800131	^	Capacity (GB) State	32 CutoverSync					
							Done (%)	-					
							Source	000198701161					
							Target	000197800131					
	Migrations						Valid Components	0					

Note: The Done % shows 100% only for a very brief period of time. When the session transitions to a CutoverSync state it is always 100% synchronized.

Examine devices post CutoverSync

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.

	Unisphere for	PowerMax >	00019870116	1 -					C Q 🖬 🤹 🕯	* *
номе	Character Co	oups > UNI_Cut_	801							
DASHBOARD	Details		formance							
STORAGE	Create	Add Volumes To SG	Remove Volumes	Expend	:		4 items \Xi 🚺	001EA		
Storage Groups	Name -	Туре	Allocated (%)	Capacity (GB)	Emulation	Status	Pinned =	Symmetrix Vol ID	001EA	
Volumes	001EA	RDF2+TDEV	0.02%	8.00	FBA	Ready		HP Identifier Name		
	001EB	RDF2+TDEV	0.02%	8.00	FBA	Ready	-	VMS Identifier Name		
	001EC	RDF2+TDEV	0.02%	8.00	FBA	Ready	-	Nice Name		
	001ED	RDF2+TDEV	0.02%	8.00	FBA	Ready		WWN	6000097000019870116153	3030314
								External Identity WWN	6000097000019870116153	3030314

=		Unisphere for	PowerMax >	000197800131	*			८ ० 🖬 🕯	¢ ±
		Storage Gro	oups > UNI_Cut_S	SG1					
		Details	Volumes Perfe	ormance					
-	STORAGE	Create	Add Volumes To SG	Remove Volumes	Expand	4 items \Xi 🚺	00212		
	Storage Groups	Name •	Туре	Allocated (%)	Capacity (GB) Emulation	Status	ne lucilitei name		
	Service Levels	00212	RDF1+TDEV	0%	8.00 FBA	Ready	VMS Identifier Name		
		00213	RDF1+TDEV	0%	8.00 FBA	Ready	Nice Name		
		00214	RDF1+TDEV	0%	8.00 FBA	Ready	WWN	600009700001978001	315330303231
	Storage Resource Pools	00215	RDF1+TDEV	0%	8.00 FBA	Ready	External Identity WWN	600009700001987011	6153303031454

However, the host no longer has access to the source array for I/O processing. All the host I/O is being handled by the target array and is replicating by SRDF/Sync back to the source array. This means that application processing can revert non-disruptively to the source array without data loss or downtime.

Examining the multipathing following the Cutover the paths to the source array have transitioned to a Dead state. The Masking view remains to the source but the paths are in a suspended state so unavailable for host traffic.

ppli	censevmaxcse:	~ ‡ rpowermt d	iisplay d	ev=	emcpowe	er204 ho	st=10.60.	136.140	5	
Pseudo name=emcpower204										
Symm	etrix ID=0001	98701161, 0001	197800131							
Logi	cal device ID	=01EA, 00212								
Devi	ce WWN=600009	70000198701161	153303031	454	1					
Stan	dard UID=naa.	60000970000198	370116153	303	0314541	L				
type	=Conventional	; state=alive	; policy	=Sy	mmOpt;	queued-	-IOs=0			
	Н	ost		- S	tor -	I/O	Path	Sta	ats	
***	HW Path	1/0	Paths	In	terf.	Mode	State	Q-IOs	Errors	
3	vmhba6	C0:	:T3:L0	FA	2d:29	active	alive	0	0	
4	vmhba2	C0:	T12:L0	FA	1d:28	active	alive	0	0	
3	vmhba6	C0:	T19:L1	FA	1e:01	active	dead	0	3	
3	vmhba6	C0:	:T8:L1	FA	2e:01	active	dead	0	3	
3	vmhba6	C0:	:T20:L1	FA	2e:00	active	dead	0	2	
3	vmhba6	C0:	T17:L1	FA	1e:00	active	dead	0	2	
4	vmhba2	C0:	:T17:L1	FA	2e:00	active	dead	0	2	
4	vmhba2	C0:	T13:L1	FA	1e:00	active	dead	0	2	
4	vmhba2	C0:	T15:L1	FA	2e:01	active	dead	0	3	
4	vmhba2	C0:	T2:L1	FA	1e:01	active	dead	0	3	

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 canceled 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 leaves 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 system waits for deallocations to complete on the target LUNs before completing. Also, as the revert is running, that the paths to the source array are active again. This is monitored by the VMAX/PowerMax, which waits for the rediscovery before proceeding.

Pass-through NDM

		Unisphere for Po	werMax	> 000198701161 -								
A	НОМЕ	Migrations										
		Storage Groups	Storage Groups Environments									
•		Cutover	Commit	Ready Target		1 items	. ()					
Ţ		Storage Group		Recover		Target	≡					
•	DATA PROTECTION	UNI_Cut_SG1			3701161	000197800131	^					
				Sync								
	Device Groups			Cancel Migration								
	Migrations											

Cancel	Migratior	ו ∪NI_Cut_SG1
Source	000198701	1161
Target	000197800	0131
Revert	\checkmark	
Advance	ed Options	
0	CANCEL	ADD TO JOB LIST 👻
		Run Now

By default, the Revert Flag is selected once the session as reached a Migrating or CutoverSync state.

Perform a host rescan

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

Examine the devices post cancel with revert

```
pplicensevmaxcse:~ # rpowermt display dev=emcpower204 host=10.60.136.146
Pseudo name=emcpower204
Symmetrix ID=000198701161
Logical device ID=01EA
Device WWN=60000970000198701161533030314541
Standard UID=naa.60000970000198701161533030314541
type=Conventional; state=alive; policy=SymmOpt; queued-IOs=0
_____
----- I/O Path --- -- Stats ---
### HW Path
                                           I/O Paths Interf. Mode State Q-IOs Errors
 ______
                                                                                                                0
0
                                              C0:T19:L1 FA 1e:01 active alive
                                                                                                                              3
    3 vmhba6
                                                                                                                          3
2
2
2

      C0:T19:L1
      FA
      1e:01 active
      alive
      0
      3

      C0:T8:L1
      FA
      2e:01 active
      alive
      0
      3

      C0:T20:L1
      FA
      2e:00 active
      alive
      0
      2

      C0:T17:L1
      FA
      1e:00 active
      alive
      0
      2

      C0:T17:L1
      FA
      2e:00 active
      alive
      0
      2

      C0:T17:L1
      FA
      2e:00 active
      alive
      0
      2

      C0:T13:L1
      FA
      1e:00 active
      alive
      0
      2

      C0:T15:L1
      FA
      2e:01 active
      alive
      0
      3

      C0:T2:L1
      FA
      1e:01 active
      alive
      0
      3

   3 vmhba6
3 vmhba6
3 vmhba6
4 vmhba2
4 vmhba2
4 vmhba2
4 vmhba2
```

In this example, the paths to the source array are active once again and the paths to the target array no longer exist.

The SG on the target array has also been removed but the NDM environment remains for any future NDM session between the source and target arrays.

		Unisphe	ere for PowerN	/lax > 000)197800131]-				
ŵ		Stora	ige Groups							
			reate Modify	Provision	Protect	Set Host I/O Limits	:	10 items 😑	- ()	
8	STORAGE	_	Name 🔺	Compliance	SRP	Service Level		Capacity (GB)	Emulation	=
	Storage Groups		131_ESX146		NONE	NONE		0.09	FBA	^
	Templates									

=		Unisphere for PowerMax > 000197800131 -	сq
A		Migrations	
8		Storage Groups Environments	
8		Create	
Ţ		Remote Arrey State	In Use
Ø	DATA PROTECTION	000296700558	-
		000198701161	-
	Migrations		

Commit migration session

The normal operation following a successful Cutover is a Commit.

Note: Once the Commit has been run reverting to the Source array will not be possible nondisruptively. This is effectively the point of no return for Source array reversion.

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.

		Unisphere for PowerMax	> 0001987011	61 -		
A	HOME	Migrations				
		Storage Groups Envir	onments			
•		Cutover Commit	:		1 items	F (i)
Ţ		Storage Group Commit	State	Source	Target	≡
•	DATA PROTECTION	UNI_Cut_SG1	CutoverSync	000198701161	000197800131	^
	Storage Groups					
	Device Groups					
	Migrations					

Success		
Hide Task Details		
Starting Tasks		
Commit Data Migration session for Storage	1 = =	al
array: 000198701161 and remote array: 000	197800131	
Starting Data Migration commit		
Analyze Configuration	Started.	
Source SID:000198701161		
Target SID:000197800131	_	
Analyze Configuration		
Remove Masking View(s) on Source		
Remove Masking View(s) on Source		
Remove Data Replication		
Remove Data Replication	Done.	
Succeeded Data Migration commit		
Refreshing Data Migration commit entities		
Succeeded		

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.

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 operating-system 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: Host multipathing software notes for more details on the host multipathing software.

=	Unisphere for PowerMa	x > 00019870116]•	
★ HOME ■ DASHBOARD	Storage Groups			
	Create Expand	Provision Storage To Host	Protect :	3 items — jj Masking Views ≡
Storage Groups	Gks_ESX146_161		0.05 FBA	1
Volumes	ORS_VM_Production	_	44.00 FBA	2
External Storage	UNI_Cut_SG1	—	32.00 FBA	0

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. The logical device field only contains the target device and the Symmetrix ID contains the serial number of the target only.

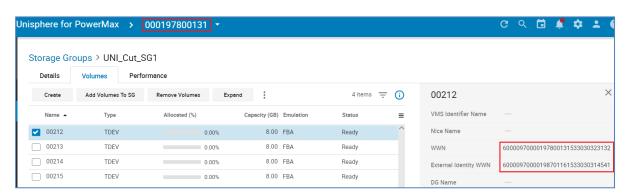
```
pplicensevmaxcse:~ # rpowermt display dev=emcpower204 host=10.60.136.146
Pseudo name=emcpower204
Symmetrix ID=000197800131
Logical device ID=00212
Device WWN=60000970000198701161533030314541
Standard UID=naa.60000970000198701161533030314541
type=Conventional; state=alive; policy=SymmOpt; queued-IOs=0
_____
                                  _____
----- Host ----- - Stor - -- I/O Path -- -- Stats ---
                 I/O Paths Interf. Mode State Q-IOs Errors
### HW Path
 3 vmhba6
                  CO:T3:L0 FA 2d:29 active alive 0
                                                     0
  4 vmhba2
                  C0:T12:L0 FA 1d:28 active alive
                                               0
                                                     0
```

Compare the SGs and LUN WWNs post 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 1EA is deleted, when re-created, it will still show the identity of device 0212.

Therefore, the WWNs have effectively been reverse and the "spoofing" is pe	permanent.
--	------------

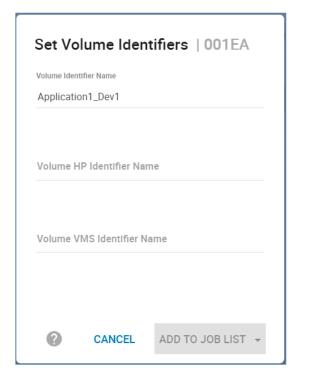
sphere for I	⊃owerMax >	00019870116	1 -						Go		* *	: +
Storage Gro	ups > UNI_Cut_	SG1										
Details	Volumes Per	formance										
Create	Add Volumes To SG	Remove Volumes	Expand	:		4 items 📃	()	001EA				
Name 🔺	Туре	Allocated (%)	Capacity (GB)	Emulation	Status	Pinned	≡	VMS Identifier Name				
001EA	TDEV	0.02%	8.00	FBA	Ready		^	Nice Name				
001EB	TDEV	0.02%	8.00	FBA	Ready	-		WWN	600009	700001987	01161533	030314
001EC	TDEV	0.02%	8.00	FBA	Ready	-						
001ED	TDEV	0.02%	8.00	FBA	Ready			External Identity WW	N 600009	700001978	00131533	030323



Using device identifiers to track migrated devices

One example of keeping track of devices as they migrate from one array to another is to tag the LUNs. This tagging will persist throughout an NDM session.

≡	Unisphere for F	¤owerMax →	00019870116	1 -				
✿ HOME ■ DASHBOARD	Storage Gro	ups > UNI_Cut_ Volumes	_SG1 Performance					
🗧 STORAGE	Create	Add Volumes To SG	Remove Volumes	Expand	Copy Volumes to SG		ÊF ()	001EA
Storage Groups	Name 🔺	Туре	Allocated (%)	Capacity (GB) Emul	Move Volumes to SG		=	Masking lafe
Volumes	💟 001EA	TDEV	0.02%	8.00 FBA			^	Masking Info
External Storage	001EB	TDEV	0.02%	8.00 FBA	Set Volumes	•	Emulation	ıps
	001EC	TDEV	0.02%	8.00 FBA	Allocate/Free/Reclaim	•		
FAST Policies	001ED	TDEV	0.02%	8.00 FBA			Set Volume A	ttributes d F
Tiers					Configuration	•	Set Volume Id	entifier
Thin Pools					Assign Dynamic Cache Partiti	ion	Set Volume St	
Disk Groups							Replication Q	DS tife
Mun Migration								



=	Unisphere for PowerMax >	000198701161 -		
★ HOME ■ DASHBOARD	Storage Groups > UNI_Cu	t_SG1 Performance		
STORAGE	Create Add Volumes To SC	Remove Volumes Expe	ind	4 items \Xi 🚺
Storage Groups	Name 🔺	Type Allocated (%)	Capacity (GB) Emulation Status	Pinned 🔳
Volumes	001EA:Application1_Dev1	TDEV 0.02%	8.00 FBA Ready	- ^
External Storage	001EB	TDEV 0.02%	8.00 FBA Ready	
	001EC	TDEV 0.02%	8.00 FBA Ready	-
FAST Policies	001ED	TDEV 0.02%	8.00 FBA Ready	

	Unisphere for PowerMax >	000197800	131 🝷					сq		4	* *
🛉 номе											
DASHBOARD	Storage Groups > UNI_Cu	t_SG1 Performance									
STORAGE	Create Add Volumes To St	Remove Volum	nes Expend	:	4 items 👳	0	00212				
Storage Groups	Name 🔺	Туре	Allocated (%)	Capacity (GB) Emulation	Status	=					
	00212:Application1_Dev1	TDEV	0.00%	8.00 FBA	Ready	^	Masking Info	4			
	00213	TDEV	0.00%	8.00 FBA	Ready		Storage Groups	1			
	00214	TDEV	0.00%	8.00 FBA	Ready		SRP	1			
Storage Resource Pools	00215	TDEV	0.00%	8.00 FBA	Ready		FBA Front End Paths	2			
							RDF Info	0			
							Volume Name	00212 Ap	plicatio	1_Dev1	

The Tag or Identifier allows a quick reference of a device's origin or application.

Remove the NDM environment

The environment remove operation removes 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. On successful completion of an environment remove operation, only running an environment setup operation is allowed. An environment removal operation should occur only after all migrations from the source array have been completed.

		Unisphere for PowerMax > 000198701161 -	G	۹	Ċ
ń		Migrations			
8		Storage Groups Environments			
•		Creste			
Ţ		Remote Ar., Delete State	ŀ	n Use	_
0	DATA PROTECTION	☑ 000197800131	[-	
	Migrations				

To delete the environment, select the relevant environment from the Environments tab. The In Use symbol identifies if an NDM session is active on this environment.

Once the environment remove operation is complete, the NDM process is complete.

Success	
Hide Task Details	
Starting Tasks	
Migration Environment remove bet	ween: 000198701161 and:
000197800131	
Starting Data Migration environme	
000198701161 and 00019780013	•
Analyze Configuration	Started.
Source SID:000198701161	
Target SID:000197800131	
Analyze Configuration	
Remove Configuration	
Remove Configuration	
Succeeded Data Migration environ	
Refreshing Data Migration environ	ment
Succeeded	

Using Solutions Enabler 9.x

This example shows the migration of five devices (PHYSICALDRIVE0 to PHYSICALDRIVE4) as this syminq display shows.

These devices were previously added as RDMs to the VM with VMware vSphere.

C:\Program Files\EMC\SYMCLI\bin>syminq											
Device			Product			.ce					
Name	Туре	Vendor	ID	Rev	Ser Num	Cap (KB)					
\\.\PHYSICALDRIVE	0	VMware	Virtual disk	1.0	N/A	125829120					
\\.\PHYSICALDRIVE	1	EMC	SYMMETRIX	5876	61001EE000	13632000					
\\.\PHYSICALDRIVE	2	EMC	SYMMETRIX	5876	61001EF000	13632000					
\\.\PHYSICALDRIVE	3	EMC	SYMMETRIX	5876	61001F1000	13632000					
\\.\PHYSICALDRIVE	4	EMC	SYMMETRIX	5876	61001F0000	13632000					

An example of the multipathing setup using device 1EE shows what the pathing looks like prior to the NDM create and the host rescan. For each of the four volumes here there are eight paths to the source array which are all alive and available for host use. At this point, there are no paths to the target array even though our zoning should be in place before the NDM create.

Pseu Symm Logi Devi Stan	do name=emcp etrix ID=000 cal device 1 ce WWN=60000 dard UID=naa	0198701161	11615330303 0198701161	31454 53303	5 0314545	5		136.140	5
	HW Path	Host	I/O Paths						
3	vmhba6		C0:T19:L1						0
3	vmhba6		C0:T8:L1	FA	2e:01	active	alive	0	0
3	vmhba6		C0:T20:L1	FA	2e:00	active	alive	0	0
3	vmhba6		C0:T17:L1	FA	1e:00	active	alive	0	0
4	vmhba2		C0:T17:L1	FA	2e:00	active	alive	0	0
4	vmhba2		C0:T13:L1	FA	1e:00	active	alive	0	0
4	vmhba2		C0:T15:L1	FA	2e:01	active	alive	0	0
4	vmhba2		C0:T2:L1	FA	1e:01	active	alive	0	0

Finally, the Storage Group in which our Application due to be migrated resides consists of four LUNS of 13 GB each, Symm Devices 0x1EE through 0x1F1.

:\Window	s\system32≻syms	g -sid 161 show SE_Cut_SG	L		
Devices {	(4):				
Sym Dev	Pdev Name	Device Config	Attr	Sts	Cap (MB)
001EE	N/A	TDEV		NR	13313
001EF	N/A	TDEV		NR	13313
001F0	N/A	TDEV		NR	13313
001F1 }	N/A	TDEV		NR	13313

Environment setup

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 usable 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.

symdm environment -src sid <SN of Source> -tgt sid <SN of target> -setup

To validate the Environment is working correctly the following can be run at any point.

symdm environment -src sid <SN of Source> -tgt sid <SN of target> -validate

```
C:\Windows\system32>symdm environment -src_sid 161 -tgt_sid 131 -validate
A DM 'Environment Validate' operation is in progress. Please wait...
Analyze Configuration.....Validated.
The DM 'Environment Validate' operation successfully executed.
```

To view all the environments currently configured as well as their status from all available local and remote arrays connected run the following:

```
symdm -environment list
```

```
C:\Windows\system32>symdm -environment list

Symmetrix ID: 000197600156

The migration session environment is not configured

Symmetrix ID: 000197800131

Remote SymmID Status

------

000198701161 OK

000296700558 OK

Symmetrix ID: 000197900111

The migration session environment is not configured

Symmetrix ID: 000198701161

Remote SymmID Status

------

000197800131 OK
```

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

Note: NDM Environment setup creates RDF links between the Source and Target using one port per Director for each zoned link. However, post-setup the user can add extra links manually using: symrdf modifygrp –rdfg 250 –add dir xx –remote_dir xx

Create migration and validate migration session

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 and the migration infrastructure exists on both arrays.

```
symdm create -src_sid <SN of Source> -tgt_sid <SN of target> -sg
<SG to be Migrated> -tgt_SRP <Target SRP> -validate
```

```
44 Dell PowerMax and VMAX: Non-Disruptive and Minimally Disruptive Migration Best Practices and 
Operational Guide
```

symdm create -src_sid <SN of Source> -tgt_sid <SN of target> -sg <SG to be Migrated> -tgt srp <target SRP> -tgt pg <target PG>

C:\Windows\system32>symdm create -src sid 161 -tgt sid 131 -sg SE Cut SG1 Execute 'Create' operation on SG 'SE_Cut_SG1' (y/[n])? y A DM 'Create' operation is in progress for storage group 'SE Cut SG1'. Please wait... Analyze Configuration.....Started. Source SID:000198701161 Target STD:000197800131 Analyze Configuration.....Done. Set Dynamic RDF attribute on Source Device(s).....Not Needed. Create Storage Group(s) on Target......Started. Create Storage Group(s) on Target.....Done. Duplicate Device(s) on Target.....Started. Preparing for device create on Target.....Started. Preparing for device create on Target.....Done. 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.....Done. Create Masking View(s) on Target.....Started. Create Masking View(s) on Target.....Done. The DM 'Create' operation successfully executed for storage group 'SE_Cut_SG1'.

Should the Create command fail for whatever reason (RDF link failure, Target array configuration lock), the session may partially complete some of the elements of the task. The example below shows how the RDF links had an issue just as the links were being established leaving the session in a CREATEFAILED state. The details of the create command show all the elements had been created on the target array such as Port Group, Devices, and the Storage Group.

Using the Recover Command, the NDM process tries to continue from where it left off while verifying all the completed steps are still valid. Should this fail the CANCEL command cleans up all the elements created and returns the array to the state it was before the CREATE was issued.

symdm -sid <SN of Source or Target> -sg <SG to be Migrated>
recover

```
C:\Windows\system32≻symdm create -src_sid 161 -tgt_sid 131 -sg SE_Cut_SG1 -validate
Execute 'Validate Create' operation on SG 'SE_Cut_SG1' (y/[n])? y
A DM 'Validate Create' operation is
in progress for storage group 'SE_Cut_SG1'. Please wait...
The migration session is not in a valid DM state for this operation
C:\Windows\system32>symdm -sid 161 list
Symmetrix ID : 000198701161
                                              Total
                                              Capacity Done
                Source
                         Target
                                   State
Storage Group
                Array
                                              (GB)
                         Arrav
                                                      (%)
                                   -----
     _____
                                                   ---
SE_Cut_SG1
                000198701161 000197800131 CreateFailed
                                                 52.0 N/A
C:\Windows\system32>symdm -sid 161 -sg SE Cut SG1 recover
Execute 'Recover' operation on SG 'SE_Cut_SG1' (y/[n])? y
A DM 'Recover' operation is
in progress for storage group 'SE Cut SG1'. Please wait...
  Analyze Configuration.....Started.
    Source SID:000198701161
    Target SID:000197800131
  Analyze Configuration.....Done.
  Set Dynamic RDF attribute on Source Device(s).....Not Needed.
  Create Storage Group(s) on Target.....Not Needed.
  Duplicate Device(s) on Target.....Not Needed.
  Create Initiator Group(s) on Target.....Not Needed.
  Create Port Group(s) on Target.....Not Needed.
  Setup Data Replication.....Started.
  Setup Data Replication.....Done.
  Recover Data Replication.....Started.
  Recover Data Replication.....In Progress.
  Recover 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 'Recover' operation successfully executed for
storage group 'SE_Cut_SG1'.
```

All active NDM sessions can be monitored using the list command, there are variations of this command that give a finer level of detail on the session such as using the -v parameter.

symdm -sid <SN of Source or Target> list

C:\Windows\system32	>symdm -sid 161 :	list			
Symmetrix ID : 0001	98701161			Tatal	
Storage Group	Source Array	Target Array	State	Total Capacity (GB)	Done (%)
SE_Cut_SG1	000198701161	000197800131	Created	52.0	N/A

symdm -sid <SN of Source or Target> -sg list -v

C:\Windows\system32>sym	ıdm -sid 161 list -v
Symmetrix ID : 0	00198701161
Source Array : 0	E_Cut_SG1 00198701161 00197800131
Migration State : C Fotal Capacity (GB) : 5 Done (%) : N	2.0
<pre>Source Configuration: 0 { Storage Groups (1) Masking Views (1) Initiator Groups (1) Port Groups (1) }</pre>	: OK : OK : OK
<pre>Target Configuration: 0 { Storage Groups (1) Masking Views (1) Initiator Groups (1) Port Groups (1) }</pre>	: OK : OK : OK
Device Pairs (4): OK	

To explore in much finer detail the individual elements of the NDM session use the –v in combination with the –detail parameter. Cropped example:

symdm -sid <SN of Source or Target> -sg list -v -detail

```
C:\Windows\system32≻symdm -sid 161 list -v -detail
Symmetrix ID
                  : 000198701161
Storage Group : SE_Cut_SG1
Source Array : 000198701161
Farget Array : 000197800131
Migration State : CutoverReady
Total Capacity (GB) : 52.0
Done (%) : N/A
Source Configuration: OK
  Storage Groups (1): OK
 {
Name : SE_Cut_SG1
Status : OK
   {
Dev
}
      001EE:001F1
  Masking Views (1): OK
 {
Masking View Name Initiator Group Port Group
                                                                        Status
   SE_Cut_SG1_MV
                       _, Jup
                                                                         ОК
                                                               -----
                                             SE_Cut_SG1_PG
  }
  Initiator Groups (1): OK
  {
   Name : NDM_IGs
Status : OK
    {
     Initiator WWN
      10000090fa9279b0
      10000090fa9279b1
   }
 }
  Port Groups (1): OK
 {
  Name : SE_Cut_SG1_PG
  Status : OK
   {
     Dirport Status
          ----
     02E:000 OK
```

In summary, the Create Command undertakes the following tasks:

- Creates a Storage Group on the Target array (name must not already exist in the target array) with the same name as the Source SG.
- Creates duplicate devices on the target array to match those on the Storage Group.
- Creates an initiator group using Initiators with entries in the login history table.
- Creates a Port group. (if one does not already exist)
- Effective (external) WWNs of the device created on the target are copied from the WWNs of the host devices.
- Creates a masking view to the host from the target array.

Note: During a Cutover NDM migration, the source of the migration is an R2 or an R21 device (if there is existing SRDF DR replication from the source device) and the target is an R1 device. This is different to basic SRDF operations and is required to allow DR protection during a migration using a cascaded SRDF configuration.

Perform a host rescan

Once the Create Command has completed the NDM session is in a Created state.

C:\Windows\system32>syn	ndm -sid 161]	list			
Symmetrix ID : 00019870	91161			Total	
Storage Group	Source Array	Target Array	State	Capacity (GB)	Done (%)
SE_Cut_SG1	000198701161	000197800131	Created	52.0	N/A

From this state, we cannot continue to the next step of the process without rescanning the host to pick up the new paths to the target devices.

The systems administrator must issue a host rescan to allow the host to discover the paths to the newly created devices.

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. Appendix A: Host multipathing software notes has more details on host multipathing software settings.

CutoverReady and pass-through mode

Pass-through mode allows the host to write to or read from either the source or target array. Any write that in sent to the target array is sent across the SRDF link and serviced by the source array. No data is 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.

symdm -sid <SN of Source or Target> list

Symmetrix ID : 000	9198701161			Total	
Storage Group	Source Array	Target Array	State	Capacity (GB)	Done (%)
SE_Cut_SG1	000198701161	000197800131	CutoverReady	52.0	N/A

Examining the multipathing software setup there are extra paths online to the target array (in this case two extra paths) after the rescan the number of extra paths is dependent on the zoning setup. It also displays the source and target SIDs and the device numbers involved for these paths. This highlights the fact the WWNs on the LUNs to appear are being spoofed as a single device with just extra paths. Prior to version 6.2 PowerPath was not aware of the NDM process so the dual SIDs and devices IDs were not visible.

Symmetrix ID=000198 Logical device ID=0	1910 2 190 Say 000-	1					
	0001987011615330303	1454	5				
tandard UID=naa.600	0009700001987011615	3303	031454	5			
ype=Conventional;	state=alive; polic	y=Syr	mmOpt;	queued-	-IOs=0		
*******************	******************						
	5		3.0.0		200 C 200		C
## HW Path	I/O Paths	Int	terf.	Mode	State	Q-IOs	Errors
4 vmhba2	C0:T12:L4	FA	1d:28	active	alive	0	0
3 vmhba6	C0:T3:L4		0.000		alive	0	0
3 vmhba6	C0:T19:L1	FA	1e:01	active	alive	0	0
3 vmhba6	C0:T8:L1	FA	2e:01	active	alive	0	0
3 vmhba6	C0:T20:L1	FA	2e:00	active	alive	0	0
5 VIIIIDao	C0:T17:L1	FA	1e:00	active	alive	0	0
3 vmhba6	CO:II/:DI	* **					
	C0:T17:L1		2e:00	active	alive	0	0
3 vmhba6		FA			alive		0
3 vmhba6 4 vmhba2	C0:T17:L1	FA FA	1e:00	active		000	0 0 0 0 0

Examine the device pairings and the identities following a create

The create operation automatically configures matching volumes on the target array. These volumes are the same size and configuration, though they unlikely to have the same VMAX volume numbers. Following the create operation the four new volumes on the target array are 21A through 21D. Volume 1EE and volume 21A, for example, are paired for NDM operations.

```
symdm -sid <SN of Source or Target> -sg <SG to be Migrated> list - v -pairs info -detail
```

C:\Windows\system32>symdm -sid 161 -sg SE_Cut_SG1 list -v -pairs_info -detail	L
Symmetrix ID : 000198701161	
Storage Group : SE_Cut_SG1 Source Array : 000198701161 Target Array : 000197800131	
Migration State : CutoverReady Total Capacity (GB) : 52.0 Done (%) : N/A	
Device Pairs (4): OK {	
Source Target	
Dev Status Dev Status	
001EE OK 0021A OK	
001EF OK 0021B OK	
001F0 OK 0021C OK	
001F1 OK 0021D OK	
}	

The RDF pairing information can also be seen in the symdev list output.

symdev -sid <SN of Source or Target> list

C:\Pro	C:\Program Files\EMC\SYMCLI\bin>symdev -sid 161 list							
Symmet	trix ID: 000198701161							
	Device Name	Dir		Device				
Sym	Physical	SA :P	Config	Attribute	Sts	Cap (MB)		
001EE 001EF 001F0	Not Visible \\.\PHYSICALDRIVE1 \\.\PHYSICALDRIVE2 \\.\PHYSICALDRIVE4 \\.\PHYSICALDRIVE3	02E:000 02E:000 02E:000	2-Wav Mir RDF2+TDEV RDF2+TDEV RDF2+TDEV RDF2+TDEV RDF2+TDEV	N/Grp'd ACLX N/Grp'd N/Grp'd N/Grp'd N/Grp'd N/Grp'd	RW RW RW RW RW	3 13313 13313 13313 13313 13313		

C:\Pro	C:\Program Files\EMC\SYMCLI\bin>symdev -sid 131 list							
Symmet	trix ID: 000197800131							
	Device Name	Dir		Device				
Sym	Physical	SA :P	Config	Attribute	Sts	Cap (MB)		
0021A 0021B 0021C	Not Visible Not Visible Not Visible Not Visible Not Visible	*** ***	TDEV RDF1+TDEV RDF1+TDEV RDF1+TDEV RDF1+TDEV	N/Grp'd ACLX N/Grp'd N/Grp'd N/Grp'd N/Grp'd N/Grp'd	RW RW RW RW RW	6 13313 13313 13313 13313 13313		

This again highlights the setup from an RDF standpoint with the target devices adopting an RDF R1 personality and the source taking on the identity of an RDF R2. **Note**: These personalities vary based on the presence of DR from the source side to a third array in which case the R2 is an R21. The addition of DR to another array from the Target side is possible once the Cutover command has been issued. This changes the personality of the Target devices from a R1 to a R11.

Looking in more detail the effective and native (Internal and External) WWNs of the devices. This shows how "spoofing" these values allows us to manipulate the multipathing software into believing it has just had new paths to the same devices added rather than paths to a completely different array.

symdev -sid <SN of Source> show <Source Device>

C:\Program Files\EMC\	\SYMCLI\bin≻symdev -sid 161 show 1EE
Device Physical N	Jame : \\.\PHYSICALDRIVE1
Device Symmetrix	Name : 001EE
Device Serial ID	: 61001EE000
Symmetrix ID	: 000198701161
Number of RAID Gr	roups : 0
Encapsulated Devi	ice : No
Encapsulated Devi Encapsulated WWN	: N/A
Encapsulated Devi	
Encapsulated Arra	ay ID : N/A
Encapsulated Devi	
Attached BCV Devi	ice : N/A
Attached VDEV TGT	Device : N/A
Vendor ID	: EMC
Product ID	: SYMMETRIX
Product Revision	: 5876
Device WWN	: 60000970000198701161533030314545
Device Emulation	
Device Defined La	abel Type: N/A
Device Defined La	abel : N/A
Device Sub System	abel : N/A Id : 0x0001 Name : DEFAULT_PARTITION
Cache Partition N	lame : DEFAULT_PARTITION
Bound Pool Name	: Sata_Pool
Device Block Size	2 : 512
Device Capacity	
{ Cultindana	
Cylinders	: 14200
Tracks	: 213000
512-byte Bloc	
MegaBytes	: 13313
KiloBytes	: 13632000
Geometry Limi	: 13632000
-	: 13632000
Geometry Limi	: 13632000 ited : No
Geometry Limi }	: 13632000 ited : No
Geometry Limi } Device External I	: 13632000 ited : No

From the example above of a source device we see the Device WWN, the device it was born with, and the external WWN, the WWN presented to the host remains the same at this stage of the process.

Program Files\EMC\SYMCLI\b	in≻symdev -sid 131 show 21A
Device Physical Name	: Not Visible
Device Symmetrix Name	: 0021A
Device Serial ID	: N/A
	: 000197800131
Number of RAID Groups	
Encapsulated Device Encapsulated WWN	: No
Encapsulated Device Flags	: None
Encapsulated Array ID	: N/A
Encapsulated Device Name	
Attached BCV Device	: N/A
Attached VDEV TGT Device	: N/A
	: EMC
	: SYMMETRIX
	: 5978
	: 60000970000197800131533030323141
Device Emulation Type	
Device Defined Label Type	
Device Defined Label Device Sub System Id	: N/A
Device Sub System Id	: N/A
Cache Partition Name	: N/A
Bound Pool Name	: SRP_1
Device Block Size	: 512
Device Capacity	
Cylinders	: 7100
Tracks	: 106500
512-byte Blocks	: 27264000
MegaBytes	: 13313
	: 13632000
Geometry Limited	: No
}	
Device External Identity	
{ Device WWN	
	: 60000970000198701161533030314545

symdev -sid <SN of Target> show <Source Device>

In contrast this example shows the target device. We see the WWN the device was born with and the WWN that it is presenting to the host differs. The device it is presenting to the host is inherited from the Source device thereby appearing as the same device to multipathing software.

Having both device presenting the same WWN means host I/O can use both source and target as its I/O path. However, at this point we are in Pass-Through mode so no data is stored on the target. It is merely passed through over the SRDF link to the source where the I/O is processed as usual.

Note: Due to the extra latency added to I/O that is experiencing the "double hop" if sent down a target path, it is not recommended that the migration session remains in a CutoverReady state for longer than is necessary.

Cancel a migration

At any point before a Commit operation is run on a Storage Group, a migration that has not been committed can 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.

symdm -sid <SN of Source or Target> -sg <SG to be Migrated> cancel

```
C:\Windows\system32>symdm -sid 161 list
Symmetrix ID : 000198701161
                                             Total
Source Target Capacity Done
Storage Group Array Array State (GB) (%)
    ----- ------
SE_Cut_SG1 000198701161 000197800131 CutoverReady 52.0 N/A
C:\Windows\system32>symdm -sid 161 -sg SE_Cut_SG1 cancel
Execute 'Cancel' operation on SG 'SE_Cut_SG1' (y/[n])? y
A DM 'Cancel' operation is
in progress for storage group 'SE_Cut_SG1'. Please wait...
  Analyze Configuration.....Started.
    Source SID:000198701161
    Target SID:000197800131
  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 'SE_Cut_SG1'.
```

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.

Note: It is best practice to run a rescan on the host after a Cancel to clear up any dead or invalid paths.

Cutover migration session

Note: A Host rescan that will result in the permanent removal of the now "inactive" paths should not be undertaken post Cutover, this will limit the ability for the migration to be seamlessly canceled and normal operation reverted to the source array. In the case of multiple concurrent NDM sessions sharing the same host the same rule should apply across all sessions when issuing rescans.

Assuming the previous Cancel was not undertaken, (or having canceled the migration, a new session was created), the host was rescanned and the session reached a CutoverReady state, and the Cutover command can be issued.

A cutover operation:

- Moves the target devices out of pass-through mode.
- Initiates data synchronization from the source to the target.
- Makes the host paths to the source array inactive. The target array is now servicing all I/O requests.

```
symdm -sid <SN of Source or Target> -sg <Sg to be Migrated>
cutover
```

```
C:\Windows\system32>symdm -sid 161 list
Symmetrix ID : 000198701161
                                            Total
               SourceTargetCapacityDoneArrayArrayState(GB)(%)
Storage Group
              Array
 000198701161 000197800131 CutoverReady 52.0 N/A
SE Cut SG1
C:\Windows\system32>symdm -sid 161 -sg SE_Cut_SG1 cutover
Execute 'Cutover' operation on SG 'SE_Cut_SG1' (y/[n])? y
A DM 'Cutover' operation is
in progress for storage group 'SE_Cut_SG1'. Please wait...
  Analyze Configuration.....Started.
    Source SID:000198701161
    Target SID:000197800131
  Analyze Configuration.....Done.
  Cutover.....Started.
  Cutover......Done.
The DM 'Cutover' operation successfully executed for
storage group 'SE_Cut_SG1'.
```

When the Cutover operation completes, the data copy begins. The session is in a Migrating state and remains in that state until either the pairs are cutover to the new array or other action is taken. The data movement can be monitored using symdm list command. This command has options for displaying Storage Group, Masking View, Initiator Group, Port Group, and device pairs.

symdm -sid <SN of source> list

```
C:\Windows\system32>symdm -sid 161 list

Symmetrix ID : 000198701161

Source Target Capacity Done

Storage Group Array Array State (GB) (%)

SE_Cut_SG1 000198701161 000197800131 Migrating 52.0 18
```

The list command used in this example can be used to see the copy progress to the target array.

In the example above, the migration session is 18% Copied. Copy time is affected by a number of factors such as:

- How busy the array is overall
- How many RDF paths are part of the NDM environment
- If the resources are shared between regular SRDF operations and NDM copies
- Amount of concurrent NDM session ongoing
- Amount of application I/O

C:\Windows\system32>syn	ndm -sid 161]	list			
Symmetrix ID : 00019870	91161			Total	
	Source	Target		Capacity	Done
Storage Group	Array	Array	State	(GB)	(%)
SE_Cut_SG1	000198701161	000197800131	CutoverSync	52.0	N/A

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

Examine devices at CutoverSync

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.

However, the host no longer has access to the source array for I/O processing. All the Host I/O is being handled by the target array and is replicating using SRDF/s back to the source array. This enables reversion of application processing non-disruptively to the source array without data loss or downtime.

Examining the multipathing following the Cutover, the paths to the source array have transitioned to a Dead state. The Masking view remains to the source but the paths are in a suspended state so unavailable for host traffic.

-	etrix 10=000198/	01161, 00019780013	1					
omi	cal device ID=01							
		001987011615330303	1454	5				
10.00		009700001987011615			5			
		state=alive; polic				TOe=0		
lbc.	CONVENCIONAL,	bouce arrie, porto	1.01		dacaca.			
	Host		- 5	tor -	I/O	Path	Sta	its
**	HW Path	I/O Paths	In	terf.	Mode	State	Q-IOs	Errors
4	vmhba2	C0:T12:L4	FA	1d:28	active	alive	0	0
3	vmhba6	C0:T3:L4	FA	2d:29	active	alive	0	0
3	vmhba6	C0:T19:L1	FA	1e:01	active	dead	0	1
3	vmhba6	C0:T8:L1	FA	2e:01	active	dead	0	1
3	vmhba6	C0:T20:L1	FA	2e:00	active	dead	0	1
3	vmhba6	C0:T17:L1	FA	1e:00	active	dead	0	1
4	vmhba2	C0:T17:L1	FA	2e:00	active	dead	0	1
4	vmhba2	C0:T13:L1	FA	1e:00	active	dead	0	1
	vmhba2	C0:T15:L1	FA	2e:01	active	dead	0	1
4	THURSDAN	~~··						

symdev -sid <Source SN> show <Device>

C:\Program Files\EMC\SYMCLI\b	i	n≻symdev -sid 161 show 1EE
Device Physical Name	:	\\.\PHYSICALDRIVE1
Device Symmetrix Name	:	001EE
Vendor ID	:	EMC
Product ID	:	SYMMETRIX
Product Revision	:	5876
Device WWN	:	60000970000198701161533030314545
Device Emulation Type		
Device Defined Label Type	1	N/A
Device Defined Label	:	N/A
Device Sub System Id	2	0x0001
Cache Partition Name	:	DEFAULT PARTITION
Bound Pool Name	:	Sata_Pool
Device Block Size	:	512
Device Capacity		
{		
Cylinders	2	14200
Tracks	:	213000
512-byte Blocks	:	27264000
MegaBytes	2	13313
KiloBytes	;	13632000
Geometry Limited	:	No
}		
Device External Identity		
{ Device WWN		60000970000198701161533030314545

symdev -sid <Target SN> show <Device>

C:\Program Files\EMC\SYMCLI\	bi	n≻symdev -sid 131 show 21A
Device Physical Name	:	Not Visible
Device Symmetrix Name	:	0021A
Product Revision	1	5978
Device WWN	1	60000970000197800131533030323141
Device Emulation Type	1	FBA
Device Defined Label Typ	e:	N/A
Device Defined Label	1	N/A
Device Sub System Id	1	N/A
Cache Partition Name	:	N/A
Bound Pool Name		
		-
Device Block Size	:	512
Device Capacity		
Cylinders		7100
Tracks	-	106500
512-byte Blocks	-	27264000
MegaBytes	-	13313
KiloBytes	-	13632000
Geometry Limited	:	No
}		
Device External Identity		
{		
Device WWN	:	60000970000198701161533030314545

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.

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 canceled and reverted to the source array. To revert back to the source array following a Cutover, a Cancel operation 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. The operation leaves 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 system waits for deallocations to complete on the target devices before completing. Also, as the revert is running, the paths to the source array become active again. This is monitored by the source and target, which waits for the rediscovery before proceeding.

symdm -sid <Source or Target SN> -sg <Migration SG> cancel -revert

```
C:\Windows\system32>symdm -sid 161 -sg SE_Cut_SG1 cancel -revert
Execute 'Cancel Revert' operation on SG 'SE_Cut_SG1' (y/[n])? y
A DM 'Cancel Revert' operation is
in progress for storage group 'SE_Cut_SG1'. Please wait...
  Analyze Configuration.....Started.
   Source SID:000198701161
   Target SID:000197800131
  Analyze Configuration.....Done.
  Revert Data Replication.....Started.
  Revert Data Replication......In Progress.
  Wait for host path discovery on Source.....In Progress.
  Wait for host path discovery on Source.....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 'SE_Cut_SG1'.
```

Perform a host rescan and examine the devices

Following the Cancel operation with the Revert option, the host paths to the target array are no longer available. The host systems administrator runs a rescan to remove the dead paths to the target array.

p	p1:	icensevmaxcse	:~ # rpower	rmt display	dev=	emcpowe	er208 ho	ost=10.60	.136.140	5
P	sei	ido name=emcp	ower208							
S	ym	netrix ID=000	198701161,	00019780013	1					
L	og:	ical device I	D=01EE, 002	216						
D	ev:	ice WWN=60000	97000019870	011615330303	1454	5				
S	tai	ndard UID=naa	.6000097000	01987011615	3303	031454	5			
t	ype	e=Conventiona	l; state=a	alive; polic	y=Sy	mmOpt;	queued-	-IOs=0		
=					====					
			Host		- S	tor -	I/O	Path	Sta	ats
#:	##	HW Path		I/O Paths	In	terf.	Mode	State	Q-IOs	Errors
=										
	- ·	4 vmhba2		C0:T12:L4	FA	1d:28	active	dead	0	3
	1	3 vmhba6		C0:T3:L4	FA	2d:29	active	dead	0	3
1		3 vmhba6		C0:T19:L1	FA	1e:01	active	alive	0	1
	1	3 vmhba6		C0:T8:L1	FA	2e:01	active	alive	0	1
	1	3 vmhba6		C0:T20:L1	FA	2e:00	active	alive	0	1
	1	3 vmhba6		C0:T17:L1	FA	1e:00	active	alive	0	1
		4 vmhba2		C0:T17:L1	FA	2e:00	active	alive	0	1
		4 vmhba2		C0:T13:L1	FA	1e:00	active	alive	0	1
		4 vmhba2		C0:T15:L1	FA	2e:01	active	alive	0	1
		4 vmhba2		C0:T2:L1	FA	1e:01	active	alive	0	1

Pseu	censevmaxcse:~ # rpowe: do name=emcpower208	rmt display	dev=	emcpowe	er208 ho	ost=10.60.	136.146	5
<u> </u>	etrix ID=000198701161	L						
	cal device ID=01EE			_				
	ce WWN=600009700001987			-	_			
	dard UID=naa.600009700				-			
type	=Conventional; state=	alive; polic	y=Syn	mmOpt;	queued-	-IOs=0		
====								
	Host		_					
###	HW Path	I/O Paths	In	cerr.	Mode	State	Q-103	Errors
3	vmhba6	C0:T19:L1	FA	1e:01	active	alive	0	1
3	vmhba6	C0:T8:L1	FA	2e:01	active	alive	0	1
3	vmhba6	C0:T20:L1	FA	2e:00	active	alive	0	1
3	vmhba6	C0:T17:L1	FA	1e:00	active	alive	0	1
4	vmhba2	C0:T17:L1	FA	2e:00	active	alive	0	1
4	vmhba2	C0:T13:L1	FA	1e:00	active	alive	0	1
4	vmhba2	C0:T15:L1	FA	2e:01	active	alive	0	1
4	vmhba2	C0:T2:L1	FA	1e:01	active	alive	0	1

The identity of the target array has been completely removed from the PowerPath device following the rescan. Before that the identity remained and the paths were showing as dead.

The SG on the target array has also been removed but the NDM environment remains for any future NDM session between the source and target arrays.

```
symsg -sid <SN of Target> list
```

```
C:\Windows\system32>symsg -sid 131 list
S T O R A G E G R O U P S
Symmetrix ID: 000197800131
Flags Number Number Child
Storage Group Name EFM SLC Devices GKs SGs
131_ESX146_GK_SG F.X ... 16 16 0
```

symdm -sid <SN of Source or Target> list -environment

C:\Windows\system32>symdm -sid 161 list -environment Symmetrix ID: 000198701161 Remote SymmID Status ------000197800131 OK

Commit migration session

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. The Commit operation requires that the state of the migration session is CutoverSync or CutoverNoSync.

Note: Once the Commit has completed, reverting to the Source array will not be possible nondisruptively. symdm –sid <SN of Source or Target> -sg <SG to be migrated> commit

symdm -sid <SN of Source or Target> -sg <SG to be Migrated> commit Symmetrix ID : 000198701161 Total Iotal Source Target Capacity Done Storage Group Array Array State (GB) (%) SE_Cut_SG1 000198701161 000197800131 CutoverSync 52.0 N/A C:\Windows\system32>symdm -sid 161 -sg SE_Cut_SG1 commit Execute 'Commit' operation on SG 'SE_Cut_SG1' (y/[n])? y A DM 'Commit' operation is in progress for storage group 'SE_Cut_SG1'. Please wait... Analyze Configuration.....Started. Source SID:000198701161 Target SID:000197800131 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 'SE_Cut_SG1'.

Once the Commit operation is complete, replication between the source and target array ends. 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.

Perform a host rescan

After the commit operation completes, the systems administrator runs a host rescan so that the host can 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. See Appendix A: Host multipathing software notes for more details on the host multipathing software.

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

The following shows the pre-rescan status:

Pseu Symme Logie Devie Stane	censevmaxcse:~ # r do name=emcpower20 etrix ID=000198701 cal device ID=01EE ce WWN=60000970000 dard UID=naa.60000 =Conventional; st	8 161, 00019780013 , 0021A 1987011615330303 9700001987011615	1 1454 3303	5			.136.146	i
	Host - HW Path	I/O Paths			-			ts Errors
4	vmhba2	C0:T12:L4	FA	1d:28	active	alive	0	0
3	vmhba6	C0:T3:L4	FA	2d:29	active	alive	0	0
3	vmhba6	C0:T19:L1	FA	1e:01	active	dead	0	2
3	vmhba6	C0:T8:L1	FA	2e:01	active	dead	0	2
3	vmhba6	C0:T20:L1	FA	2e:00	active	dead	0	2
3	vmhba6	C0:T17:L1	FA	1e:00	active	dead	0	2
4	vmhba2	C0:T17:L1	FA	2e:00	active	dead	0	2
4	vmhba2	C0:T13:L1	FA	1e:00	active	dead	0	2
4	vmhba2	C0:T15:L1	FA	2e:01	active	dead	0	2
4	vmhba2	C0:T2:L1	FA	1e:01	active	dead	0	2

The post-rescan status is displayed as follows:

```
pplicensevmaxcse:~ # rpowermt display dev=emcpower208 host=10.60.136.146
Pseudo name=emcpower208
Symmetrix ID=000197800131
Logical device ID=0021A
Device WWN=60000970000198701161533030314545
Standard UID=naa.60000970000198701161533030314545
type=Conventional; state=alive; policy=SymmOpt; queued-IOs=0
       ______
               _____
 ----- Host ---- Stats --- I/O Path -- -- Stats ---
                    I/O Paths Interf. Mode State Q-IOs Errors
### HW Path
 _____
                    C0:T12:L4 FA 1d:28 active alive 0 0
C0:T3:L4 FA 2d:29 active alive 0 0
 4 vmhba2
  3 vmhba6
```

Compare the SGs and LUN WWNs post 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 1EE is deleted and then re-created, it still retains the identity of device 021A.

Therefore, the WWNs have effectively been reversed and the spoofing is permanent.

symdev -sid <SN of Source> show <Device to be Migrated>

```
C:\Windows\system32>symdev -sid 161 show 1EE
   Device Physical Name
                             : Not Visible
   Device Symmetrix Name : 001EE
   Device Serial ID : N/A
   Symmetrix ID
                             : 000198701161
   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
Product ID
Product Revision
                              : EMC
                             : SYMMETRIX
                            : 5876
                             : 60000970000198701161533030314545
   Device WWN
  Device Capacity
      L
Cylinders : 14200
Tracks : 213000
512-byte Blocks : 27264000
MegaBytes : 13313
KiloBytes : 13632000
       Geometry Limited : No
       }
  Device External Identity
       Device WWN
                               60000970000197800131533030323141
```

The example shows that the Source device has inherited the WWN of the target device. This is the device WWN that it will display to a host should it be masked. This allows the customer to reuse the array and the devices previously migrated without the risk of data loss in the case where the same devices were masked into the SAN of the target devices.

```
C:\Windows\system32>symdev -sid 131 show 21A
    Device Physical Name
                               : Not Visible
    Device Symmetrix Name : 0021A
    Device Serial ID : N/A
Symmetrix ID : 000197800131
    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
    Vendor ID
Product ID
Product Revision
                              : SYMMETRIX
                              : 5978
: 60000970000197800131533030323141
    Device WWN
    Device Capacity
        L
Cylinders : 7100
Tracks : 106500
512-byte Blocks : 27264000
MegaBytes : 13313
KiloBytes : 13632000
        Geometry Limited : No
         }
    Device External Identity
                                 : 60000970000198701161533030314545
        Device WWN
```

On the target device, the device retains the external WWN from the source array that it inherited during the create step. This remains the WWN after the completion of the migration.

Note: The native identities of devices can be displayed using the –native option on the syming command.

Remove the NDM environment

The environment remove operation removes the replication pathway configured by the environment setup operation, and it removes the resources that were configured to support NDM on the source and target arrays. On successful completion of an environment remove operation, only running an environment setup operation is allowed. An environment removal operation should occur only after all migrations from the source array have been completed.

```
symdm -src_sid <SN of Source> -tgt_sid <SN of Target> environment
-remove
```

```
C:\Windows\system32>symdm -src_sid 161 -tgt_sid 131 environment -remove
A DM 'Environment Remove' operation is in progress. Please wait...
Analyze Configuration.....Started.
Source SID:000197800131
Analyze Configuration....Done.
Remove Configuration....Started.
Remove Configuration...Done.
The DM 'Environment Remove' operation successfully executed.
```

Once the environment remove operation is complete, the NDM process is complete.

Metro-based NDM

Introduction This section includes a guide plan, environment overview, and walkthrough guide for Metro-based NDM. **Metro-based** The following guide describes two methods for each version of Metro-based NDM: NDM guide plan Metro-based NDM: and environment overview Unisphere for PowerMax: Using Unisphere for PowerMax . CLI (Solutions Enabler): Using Metro NDM using Solutions Enabler 9.x Metro-based NDM with precopy: Unisphere for PowerMax: Using Unisphere for PowerMax with precopy . CLI (Solutions Enabler): Using Solutions Enabler 9.x with precopy

This guide uses the VMAX All Flash and VMAX3 arrays in the graphic below.

In the Metro-based NDM example SGs migrate from 000296700558 to 000197800131.

000197800131 VMAX250F15978.37.38	9 %	000	100	MB/S	28	-	Ø	¢	
000296700558 VMAX200K 5977.1125.1125	8 %	000	-	_ MB/S	-	35.3:1	Ø	٠	

Prior to the start of a planned migration, verify the following:

- Ensure both source and target array are RDF capable (the RF emulation has been added to both arrays).
- Ensure both arrays RDF ports are zoned to each other. There is a minimum of two connections required.
- Check for the correct zoning from the target array to the application host.

Metro-based NDM walkthrough guide (source running 5977 or 5978 code)

Using Unisphere for PowerMax

Looking at the devices in this migration from the host operating system disk management (in this case, Windows Server 2016), they show as Disk 11 through Disk 14. These were previously added as RDMs to the VMs using VMware vSphere.

A Computer Management (Local	Volume	Layout Type File System	Status	^ Actions	
System Tools One Task Scheduler Mit Scheduler Mit Scheduler Mit Sched Folders Mit Sched Folders Mit Local Users and Groups One Performance	(C:) NDM1 (NŁ) NDM2 (M:) ORS_Vol1 (O:) ORS_Vol2 (R:) <	Simple Basic NTFS Simple Basic NTFS Simple Basic NTFS Simple Basic NTFS Simple Basic NTFS	Healthy (Boot, Page File, Crash Dump, Primary Partition) Healthy (Primary Partition) Healthy (Primary Partition) Healthy (Primary Partition) Healthy (Primary Partition)	Disk Management More Actions	;
Device Manager Storage Windows Server Backup Disk Management Services and Applications	- Disk 11 Basic 20.00 GB Online	20.00 GB Unallocated			
	Disk 12 Basic 20.00 GB Online	20.00 GB Unallocated			
	- Disk 13 Basic 20.00 GB Online	20.00 GB Unallocated			
	- Disk 14 Basic 20.00 GB Online	20.00 GB Unallocated			

This is an example of the multipathing setup using device 1BA. It shows what the pathing looks like prior to the NDM Create operation and the host rescan. For each of the four volumes here there are four paths to the source array which are all alive and available for host use. At this point, there are no paths to the target array even though our zoning should be in place before the NDM create.

Pseu	do name=emcpowe	r140						
Symm	etrix ID=000296	700558						
Logi	cal device ID=0	OIBA						
Devi	ce WWN=60000970	0002967005585330303	1424	1				
Star	dard UID=naa.60	0009700002967005585	3303	031424	1			
type	-Conventional:	state=alive; polic	v=Sv	mmOpt:	queued-	-IOs=0		
	No.		- 5	tor -	T/O	Path	51	ats
	103							
	HW Path	I/O Paths						
			In	terf.	Mode		Q-IOs	Errors
***		I/O Paths	In	terf.	Mode	State	Q-IOs	Errors
***	HW Path	I/O Paths	In FA	ld:24	Mode	State alive	Q-IOs 0 0	Errors
***	HW Path vmhba3	I/O Paths C0:T2:L3	In FA FA	1d:24 2d:24	Mode active	State alive alive	Q-IOs 0 0	Errors

NDM environment setup

The Environment Setup operation configures the migration environment template required to setup the Metro groups used to migrate all applications from the source array to the target array. This template is used to define the RDF groups for each migration session. Within this definition are ports used, target ports and port count. The operation also confirms that both the source and target arrays can support the NDM operations. This includes ensuring that a usable replication pathway for data migration is available between source and target arrays. Should we need a second target array from the same source, a second environment is necessary.

To summarize, the Environment Setup runs once only for each array relationship. This Setup operation creates a template from which all other Metro-based NDM SRDF groups are modelled. Each individual NDM session requires its own RDF/Metro group to be created unlike Pass-through NDM which used a single RDF group for all sessions between the source and target.

	Unisphere for PowerMax >	000296700558 •		C Q 🕈 🗳 🔹 (
	Migrations			
	Storage Groups Environmen	tts		1 itema 📮
HOSTS	Source	Target	State	In Use
DATA PROTECTION	000198701161	000296700558	0	
Migrations				
II PERFORMANCE				

From the **Data Protection** menu select **Migrations**, Click the **Environment** tab to display any existing Environments already setup. The parameter **In Use** shows us whether the Environment is validated and usable. The **In Use** parameter also shows whether there is an active Migration using this environment.

To create an environment click **Create**, the pop-up window below appears. This contains a drop-down list of all the arrays available for migration operations. Should your array not be present, verify the RDF zoning and confirm the intended target array is suitable and its code level is within the support matrix. Select the relevant array and choose **Run Now**.

The new **Topology** view we can see the RDF group template that has been created. Go to the **DataProtection** dashboard and hover over the line between our source and target. This causes the **SRDF Groups** window to appear. Select **View Groups** to display the SRDF group window highlighted below.

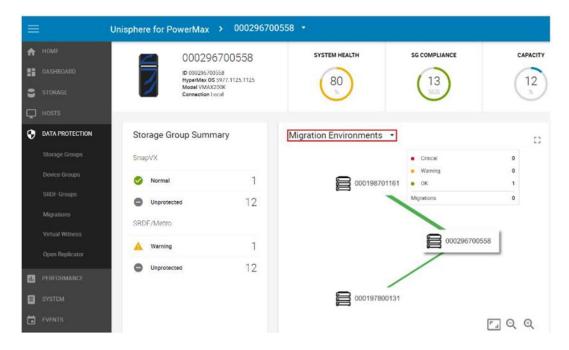


From an RDF standpoint you can examine the new RDF group created to handle NDM migrations for <u>all</u> SG sessions between 558 and 131.

	Unisphere for PowerMax	> 000296700558 •		
🕈 номе	0005 00000			
CASHEGARD	SRDF Groups Crease Pairs Modify	Create SROF Group		
STORAGE	SRDF Greup	SRDF Group Label	Remote SRDF Group	Online
HOSTS	• 000197000008			
BATA PROTECTION	• 030197803131			
Storage Groups	250 (F9)	M.01310558	250 (79)	٥
SRDF Groups				

	Unisphere for PowerMax >	000296700558 -		c < 🖬 🧍
A HOME	Migrations			
DASHBOARD	Storage Groups Environm	ients		
STORACE	Create			
HOSTS	Source	Target	State	In Use
DATA PROTECTION	000197800131	000296700558	0	
	000198701161	000296700558	٥	-
Migrations				

From the same Data Protection dashboard, the drop-down menu contains an option to monitor Migration Environments. A color-coded line indicates any problems. Hovering over the connection line displays the number of each connection status.



Now the Environment is in place so the NDM Create for the SG planned for migration can occur.

Create migration session

From the Storage tab click Storage Groups, from there locate the SG that is to be migrated. Select the check box and click the More Actions "3-Dot" icon to the right of Set Host I/O Limits. From the drop-down menu select Migrate.

		omoprie		r offernius		296700558							c d
		Me Storage Groups											
				-				<u>^</u>					
	STORAGE	C	eate	Modify	Provision	Protect	Set Host I/O Limits		Change SRP	- 1	L		
1	STURAGE		Name			SRP		s	Delete	- 1		Capacity (GB)	Emuletio
	Storage Groups		146_0	Gks_NDM_Cypre	15	SRP_1		0		-		0.06	FBA
			CSE_	eNAS		SRP_1		0	Migrate			1,600.01	FBA
	Reference Workloads		Demo	p_Uni_SG1		SRP_1		0	FAST Array Advisor			80.00	FBA
			EMBE	EDDED_NAS_DM	.SG	NONE		G	1999 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 -	- 1		213 60	FBA
	Storage Resource Pools		enas,	_dest		SRP_1		0	Expand ProtectPoint	- 1		1.00	FBA
			End2	End_SG1		SRP_1		Br	Set Volumes			5.00	FBA
			ESX_	142_GKS_SG		SRP_1		0			-	0.04	FBA
	External Storage		GKs			SRP_1		Op	timized			0.14	FBA

In the Create Migration Wizard, select the **Target array** (only arrays with valid environments setup appear on this drop-down menu). This example does not select a Port Group. (See the relevant masking enhancements section.) Click **Next**.

1 Select Target	Symmetric (0 * 000197800131	
Ø Select Type		
Summary	SRP_1	
	Select Port Group Name	
	Q Enter the name of the port group to filter	
	131_ESX146_GK_PG	
	ORS	
	SLO_TEST	

On the next screen click Create Data Migration. This provides the option of selecting Compression and precopy. The scenario that this part of the example covers does not use precopy, so that remains cleared.

(See precopy section) and select Next. The Prepare Data Migration selection requires Performance data to be collected on the host.

This runs a check for resources on the target array to ensure the addition of the new SG does not cause the target array to exceed any performance metrics on both FE and BE. It

array.

also produces a spread sheet to help plan the zoning required for the host from the target array.

The final page of the Wizard summarizes the planned NDM session to be created. It breaks down the planned masking view elements and the NDM parameters. Select **Run Now** to continue.

BACK

CANCEL

NEXT

0

Select Target	Summary page for creation selected source Storage G		will create the migration session for t	he
🙆 Select Type	Storage Group	Demo_Uni_SG1		
3 Summary	Target VMAX	000197800131		
	SRP	SRP_1		
	Compression	No		
	Precopy	No		
	Masking Views			
	Masking View	Port Group	Host/Host Group	=
	Demo_Uni_SG1_MV	NDM_PG	ESX_146	^
				×
0			BACK CANCEL	Run Now

Creating the NDM session will also perform an Environment validate as part of the setup to ensure it will complete successfully. As outlined in the create command output, the Create:

Metro-based NDM

- Creates a Storage Group on the Target array (name must not already exist in the target array) with the same name as the Source SG.
- Creates duplicate devices on the target array to match those on the Storage Group
- Creates an initiator group using Initiators with entries in the login history table
- Creates a Port group (if one does not already exist or has not been selected by the user, see the relevant masking enhancements section)
- Invalidates the tracks on the RDF mirror to prepare for the copy
- Starts the copy process.
- Creates a masking view to the host from the target array.

Success		
Hide Task Details		
Starting Tasks		^
Create Data Migration session for Storage G	roup: Demo_Uni_SG1, source Symmetrix: 000296700558 and	
target Symmetrix: 000197800131		
Create Data Migration session for Storage G	roup: Demo_Uni_SG1, source Symmetrix: 000296700558 and	
target Symmetrix: 000197800131		
Starting Data Migration entity creation		
Analyze Configuration	Started.	
Source SID:000296700558		
Target SID:000197800131		
Analyze Configuration	Done.	
Initialize Replication Environment		
Started.		
Initialize Replication Environment	Done.	
Create Storage Group(s) on Target	Started.	
Create Storage Group(s) on Target	Done.	
Duplicate Device(s) on Target	Started.	
Preparing for device create on Target		
Preparing for device create on Target	Done.	
Duplicate Device(s) on Target	Done.	
Create Initiator Group(s) on Target	Started.	
Create Initiator Group(s) on Target		
Create Port Group(s) on Target		
Create Port Group(s) on Target		
Start Data Replication		
Start Data Replication		
Create Masking View(s) on Target		
Create Masking View(s) on Target	Done.	
Succeeded Data Migration entity creation		
Refreshing Data Migration entities		~

Examine the created migration session

Selecting the Data Protection tab on the left task bar and selecting Migrations in the dropdown menu, the storage groups currently involved in an NDM session are highlighted along with the current State and details on the source and target arrays. Since data transfer begins immediately following a Create operation there is no need for the Pass-Through NDM Cutover operation. Once the data is synchronizing the systems administrator runs a rescan to allow the target paths to become active to the multipathing software. At this point, both source and target arrays are involved in an active/active relationship with all I/O serviced locally.

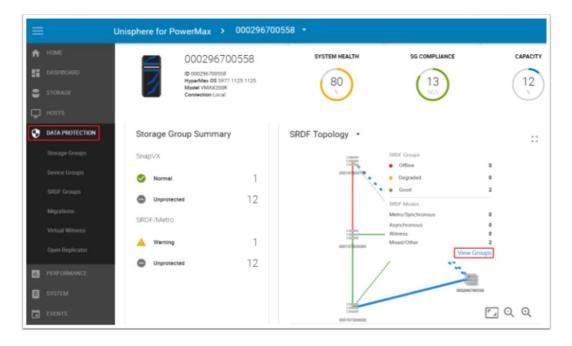
Metro-based NDM

=		Unisphere for PowerMax	> 000296700558 -		с
		Migrations			
		Storage Groups Environ	iments		
Ţ		Storege Group	State	Source	Target
Ø	DATA PROTECTION	Demo_Uni_SG1	Migrating	000296700558	000197800131
	SRDF Groups				

	Unisphere for PowerMax >	000296700558 -		c	
A HOME	Migrations				
DASHBOARD	Storage Groups Environme	ints			
STORAGE	Cutover Commit				
р Hosts	Storage Group	State	Source	Terget	
DATA PROTECTION	Demo_Uni_SG1	Synchronized	000296700558	000197800131	

Double-clicking the NDM session will take you into the Migration Details view. In the screen above, we can see the individual devices involved in the session. Under the target tab we can see devices 200 through 203 have been created on the target side by the NDM create. The State also shows a live status of each of the devices involved. A device without a green tick should be investigated for potential problems before continuing.

=	Unisphere for PowerMax > 000296700558	.€C		C Q 🖬
翰 номе	Demo_Uni_SG1 > Data Migration Details			
DASHE				
S STORA	GE Source	State	Terpet	State
HOSTS	Demo_Uni_SG1	۲	 Demo_Uni_SG1 	0
😧 DATA F	ROTECTION 00187	0	60200	0
Ĩ.	00188	0	00201	0
Storag	e Groups 00189	0	00202	0
Device	Groups 001BA	۲	00203	•
SRDF (Security			
Migrat	ons.			



Selecting the **Masking Views** tab displays the pane outlining the masking and masking elements involved on both sides of the NDM session. This screen can be useful for troubleshooting any issues with the migration such as an unplanned or unauthorized manipulation of any of the NDM elements that hinder progress to the commit stage. In such cases the State does not contain a green tick, rather a red warning.

	Unisphere for PowerMax > 0002	96700558 -		c < 🖬
🕈 НОМЕ	Dama Uni CO1 > Data Minatian	Dataila		
DASHBOARD	Demo_Uni_SG1 > Data Migration Storage Groups Masking Views	Details		
STORAGE	Source Masking View	Source State	Target Macking View	Target Stat
L HOSTS	 Demo_Uni_SG1_MV 	0	 Demo_Uni_SG1_MV 	٢
DATA PROTECTION	 NDM_PG 	0	▼ NDM_PG	0
UNIX PROTECTION	FA-1D:24	٢	FA-1D:29	0
	FA-20-24	0	FA-20-28	0
Device Groups	• ESX_146	۲	 ESX_146 	0
	10000090fa927c04	۲	10000090fa927c04	0
	10000090fa927c05	۲	10000090fa927c05	0
Migrations				

Examining the RDF environment from the **Topology** view shows the RDF group template that has been created. Go to the **DataProtection** dashboard and hover over the line between our source and target. This causes the **SRDF Groups** window to appear. Select **View Groups** to display the SRDF group window highlighted below.

The new SRDF group that has been created (248/249 on remote) as part of the Create command operation from the template (250). Group 248 is used for the duration of this migration.

=		Unisphere for PowerMax >	000296700558 -		c
ń		SRDF Groups			
55		Create SRDF Group Modify	Oracta Patry 🗑 🗄		
=		SRSF Group	SRDF Group Label	Remote SRDF Group	Online
ç		• 000197800131			
0	DATA PROTECTION	250 (F9)	M,01310558	250 (F9)	0
		248 (17)	M_M_6FA920	249 (F8)	0
	SRDF Groups				

View paths to new devices and SRDF pairs

Viewing the multipathing software after the rescan shows the extra paths online to the target array (in this case two extra paths) The number of extra paths depends on the zoning setup. It also displays the source and target SIDs and the device numbers involved for these paths. The WWNs on the LUNs to appear as a single device with just extra paths. Prior to version 6.2 PowerPath was not aware of the NDM process so the dual SIDs and devices IDs were not visible.

	etrix ID=000296700 cal device ID=0018		1					
	ce WWN=60000970000	and the second state of th	1424	1				
an	dard UID=naa.60000	9700002967005585	3303	0314243	1			
pe	=Conventional; st	ate=alive; polic	y=Sy	mmOpt;	queued-	IOs=0		
-					7/0	Date		
								ats
+	HW Path	I/O Paths	In	terf.	Mode	State	Q-105	Error
1	vmhba4	C0:T12:L3	FA	2d:28	active	alive	0	0
3	vmhba3	C0:T7:L3	FA	1d:29	active	alive	0	0
3	vmhba3	C0:T2:L3	FA	1d:24	active	alive	0	0
1	vmhba4	C0:T11:L3	FA	2d:24	active	alive	0	0
1	vmhba4	C0:T7:L3	FA	1d:24	active	alive	0	0
2	vmhba3	C0:T0:L3	FA	2d:24	active	alive	0	0

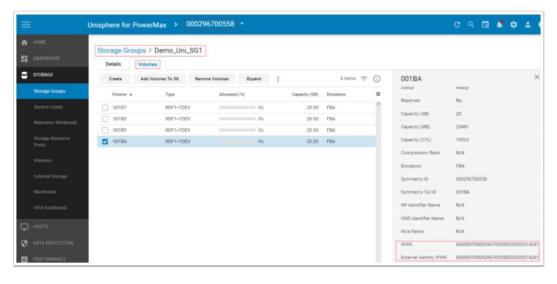
Once the Create operation and the scan have both completed, the migration is in an active/active functional state with I/Os being distributed to both source and target paths. Bias is set on the Source side which differs from Pass-Through NDM where the source side was the R2 in a standard R1- R2 synchronous relationship. The state in Unisphere is displayed as ActiveBias as we do not have a witness attached to this metro relationship. However, we are truly active/active from an array perspective.

Metro-based NDM

ł		Des	and that		Deles				
1			no_Uni_	SG1 > SRE	of Pairs				
8			Esteblish	Split	Suspend Ret	store			
Ţ		-	Source Vo	lume 🔺 7	Source Type	SRDF Group	Target Volume	State	SRDF Mode
0	DATA PROTECTION	E	00187		R1	248	00200	ActiveBias	Active
	Storage Groups		001B8		R1	248	00201	ActiveBias	Active
	Storage Groups	Ē	00189		R1	248	00202	ActiveBias	Active
	Device Groups	-	001BA		R1	248	00203	ActiveBias	Active

Examine IDs of source and target

Examining the devices WWNs post Create the source device has a WWN and External (host visible) WWN with the same value. However, the targets WWN and External WWNs differ. The target External WWN has inherited the WWN of the source in order to appear logically as the same device to the host.



		Stor	age Gro	ups > De	mo_Uni_S	GG1							
8		D	etails	Volumes	Perform	ance							
9	STORAGE		Creete	Add Volume	es To SG	Remove Volumes	Expend	1	4 items 🐨	0	00203		
	Storage Groups		Volume .		Туре	Allocated	(#) 1	Capacity (GB)	Emulation	=	Reserved	No	
			00200		RDF2+TDEV		0%	20.00	FBA	1	Capacity (GB)	20	
		_	00201		RDF2+TDEV	_	0%		FBA		Capacity (MB)	20481	
		_	00202		RDF2+TDEV RDF2+TDEV		0%	20.00			Capacity (CYL)	10923	
			00200		SDLT-IDEA			20.00	ron		Compression Ratio	1.1	
											Emulation	FBA	
											Symmetrix ID	000197800131	
											Symmetrix Vol ID	00203	
											HP Identifier Name	N/A	
2											VMS Identifier Name	N/A	
											Nice Name	N/A	
4											WWN	60000970000197800131	533030323
											External identity WWN	60000970000296700558	533030314

74 Dell PowerMax and VMAX: Non-Disruptive and Minimally Disruptive Migration Best Practices and Operational Guide

Cancel a migration

To Cancel a migration, click the **Data Protection** tab and select **Migrations** from the drop-down menu. Select the active NDM session and click the More Actions (three Dots) menu and Cancel Migration.

=		Unisphere for PowerM	ax > 000197800131 -		G
		Migrations Storage Groups E	nvironments		
		Cutover Commit Storage Group	Ready Target	Source	Target
•	DATA PROTECTION Storage Groups Device Groups SRDF Groups	Detto_Uni_S01	Recover Sync Cancel Migration	000296700558	000197800131
	Migrations				

Confirm the cancel operation of the SG with the correct source and target and click **Run Now**.

ource	000296700558	
arget	000197800131	
Advanced O	ptions	
0	CANCEL	ADD TO JOB LIST
		Run Now
		Run Now

-		
Hide Task Details		
rarger 302000157000131		
Analyze Configuration		
Stop Data Replication		
Stop Data Replication		
Remove Masking View(s) on Target		
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.	
Remove Replication Environment		
Started.		
Remove Replication Environment	Done	
Succeeded Data Migration cancel		
Refreshing Data Migration cancel entities		
Succeeded		
0000000		

The cancel operation removes the storage provisioned on the target array and releases any allocations and resources allocated by the NDM create operation. It also places the source devices into the same state they were before the create operation was issued.

The cancel operation:

- Stops replication between the source and target arrays
- Removes the masking view on the target array
- Removes the RDF pairings
- Removes the port group on the target array (if not in use in another masking view)
- Removes the initiator group on the target array
- Deallocates volumes created on the target array
- Removes the devices created on the target array

Note: It is best practice to run a rescan on the host should be run at this point to remove any dead or invalid paths.

Commit a migration

If an attempt is made to issue a **cutover** on a Metro NDM session, the above error will occur. This cutover command is only for Pass-through NDM (source array running 5876 code).

Fail				
Hide Task D	atails			
Starting Tasks.	-2			
The action cod	e is not valid			
Cutover Data N	ligration session for S	torage Group: Dem	io_Uni_SG1 on source arr	ay:
000296700558	and target array: 000	197800131 with fo	rce: No with SymForce: N	lo
Starting Data N	figration cutover			

=	1	Unisphere for	PowerMa	ax > 000296700558 -		e o
*		Migrations				
2		Storage Grou	-	nvironments		
		Cutover Storage Gro	Commit	State	Source	Target
0	DATA PROTECTION	Demo_Uni		Synchronized	000296700558	000197800131
	SRDF Groups					

Commit	Demo_Uni_S	G1
Source	000296700558	
Target	000197800131	
Ø	CANCEL	ADD TO JOB LIST 👻
		Run Now Add to Job List

When the data commit operation is completed and the devices are synchronized, the migration can be committed. The Commit operation completes the migration by removing the migrated application resources from the source array and releases system resources used for the migration. When the commit is completed the replication relationship between the source and target devices are removed, the masking view on the source removed and

the source devices take the native (internal) WWN of the target LUN as its effective (external) WWN.

The target has an external WWN of the source and the source having an external WWN of the target. Both devices retain their native (internal) WWNs but these are not presented to the host.

Success	
Hide Task Details	
Starting Tasks	
Commit Data Migration session for Storage	Group: Demo_Uni_SG1 on source array:
000296700558 and target array: 000197800	131
Starting Data Migration commit	
Analyze Configuration	Started.
Source SID:000296700558	
Target SID:000197800131	
Analyze Configuration	Done.
Stop Data Replication	Started.
Stop Data Replication	Done.
Remove Masking View(s) on Source	Started.
Remove Masking View(s) on Source	Done.
Remove Data Replication	Started
Remove Data Replication	Done.
Remove Replication Environment	
Started.	
Remove Replication Environment	Done.
Succeeded Data Migration commit	
Refreshing Data Migration commit entities	
Succeeded	
	h

Examine paths and device post commit

Post Commit and with the removal of the source masking view and before the host rescan the original Source paths are in a dead state. (This varies depending on your MP software) The two target paths are still active.

Pseu Symm Logi Devi Stan	censevmaxcse:~ do name=emcpower1 etrix ID=00029670 cal device ID=001 ce WWN=6000097000 dard UID=naa.6000 =Conventional; s	40 0558, 00019780013 BA, 00203 02967005585330303 09700002967005585	1 1424 3303	1 031424:	1		.136.140	5
***	HW Path	I/O Paths			C-0.070	E 2010 201	10.00	Errors
	and be d	~~~~~~		24.20		- 14		
-	vmhba4		100		active		0	1
5	vmhba3	C0:T7:L3	1000			121 20 20 20 20 20	0	1
3	vmhba3	C0:T2:L3	FA	1d:24	active	dead	0	1
1	vmhba4	C0:T11:L3	FA	2d:24	active	dead	0	1
1	vmhba4	C0:T7:L3	FA	1d:24	active	dead	0	1 1 1
3	vmhba3	C0:T0:L3	FA	2d:24	active	dead	0	1

Once the host Rescan has been completed, the dead paths are now removed and the SID that of the target array. The WWN inherited from the source array is displayed as before to allow the distinction of NDM devices.

Symmetrix ID=00019780	00131					
Logical device ID=002	203					
Device WWN=6000097000	002967005585330303	1424	1			
type=Conventional; :	state=alive; polic	y=Sy	mmOpt;	queued	-IOs=0	
Host		- s	tor -	1/0	Path	
		- s	tor -	1/0	Path	
Host	I/O Paths	- S In	tor - terf.	1/0	Path State	

Viewing the source and target devices after the Commit operation clearly shows the WWN manipulation that has occurred. The Source device now has the target's native WWN as its effective WWN and the target device has retained the source native WWN as its effective WWN.

		Unisphe	ere for l	PowerMa		000296700558							C Q 🖬 🥊 🛊 🛓	
		Stora	age Gro	ups > Der	mo_Uni	_SG1								
		De	tails	Volumes										
9	STORAGE	c	reate	Add Volume	e To SG	Remove Volumes	Expend	Ξ		4 items	= ()	001B7		
	Storage Groups	_	Volume .		Туре	Allocated	(%)		Capacity (GB)	Emulation	=	Nice Name	N/A	
			00187		TDEV		0%		20.00	FBA	^	WWN	6000097000029670055853303031	42
	Reference Workloads		001B8		TDEV		0%		20.00	FBA		External identity WWN	6000097000019780013153303032	230
			00189		TDEV		0%		20.00	FBA		Attached BCV	N/A	
	Storage Resource Pools		001BA		TDEV	_	- 0%		20.00	FBA		Attached VDEV TGT	N/A	

Remove NDM environment

When all migrations are complete between a specific source and target, the environment can be removed. Click the Data Protection tab and click Migrations. On the Environments tab, select the Environment and click the trash icon. On the window that appears, click **Run Now** and the Environment is removed. This removes the RDF group setup and releases those resources.

t HOME	Migrations		
DASHBOARD	Storage Groups Environ	ments	
STORAGE	Create		
D HOSTS	Source	Terget	State
DATA PROTECTION	000197800131	000296700558	0
Storage Groups			
Device Groups			

		Unisph	ere for	PowerMax >	000197800131							c < 🖻 🦸 🕈 🔺 🛋
ñ												
5			rage Gro Netails	Compliance Vo	_SG1 lumes Performan	ce						
9	STORAGE		Create	Add Volumes To SG	Remove Volumes	Expend	1		4 merra 👻	0	00200	1
	Storage Groups		Volume .	Туре	Allocated (*	6		Capacity (GB)	Emulation	=	Nice Name	N/A
			00200	TDEV		0%		20.00	FBA	1	WWN	600009700001976001315330303230
		0	00201	TDEV	-	- m		20.00	FBA		External identity WWN	600009700002967005585330303142
		0	00202	TDEV		- 0%		20.00	FBA		Attached BCV	N/A
	Storage Resource Pools	0	00203	TDEV		0%		20.00	FBA		Attached VDEV TGT	N/A

Success	
Hide Task Details	
Starting Tasks	
Migration Environment remove between: 0 000296700558	000197800131 and:
Starting Data Migration environment remo	oval between
000197800131 and 000296700558	
Analyze Configuration	Started.
Source SID:000197800131	
Target SID:000296700558	
Analyze Configuration	Done.
Remove Configuration	
Remove Configuration	
Succeeded Data Migration environment re	emoval
Refreshing Data Migration environment	
Succeeded	
	h

Note: At this point, the data migration is completed and the migration environment is removed for the specific source and target.

Using Metro NDM using Solutions Enabler 9.x

View devices from the host

This screenshot shows the New Devices view using the Syminq command, and the devices added to the host as PhysicalDrive7 through PhysicalDrive10.

Device			Product		Devic	e
Name	Type	Vendor	ID	Rev	Ser Num	Cap (KB)
\\.\PHYSICALDRIVE0		VMware	Virtual disk	1.0	N/A	41943040
\\.\PHYSICALDRIVE1		EMC	SYMMETRIX	5876	6100165000	23068800
\\.\PHYSICALDRIVE2		EMC	SYMMETRIX	5876	6100166000	23068800
\\.\PHYSICALDRIVE3		EMC	SYMMETRIX	5978	3100093000	23068800
\\.\PHYSICALDRIVE4		EMC	SYMMETRIX	5978	3100094000	23068800
\\.\PHYSICALDRIVE5		EMC	SYMMETRIX	5876	61000A8000	10485120
\\.\PHYSICALDRIVE6		EMC	SYMMETRIX	5876	61000A9000	10485120
<pre>\\.\PHYSICALDRIVE7</pre>		EMC	SYMMETRIX	5977	58001B3000	26215680
<pre>\\.\PHYSICALDRIVE8</pre>		EMC	SYMMETRIX	5977	58001B4000	26215680
<pre>\\.\PHYSICALDRIVE9</pre>		EMC	SYMMETRIX	5977	58001B5000	26215680
\\.\PHYSICALDRIVE10		EMC	SYMMETRIX	5977	58001B6000	26215680

PowerPath view of one of the new devices

PowerPath shows what the pathing looks like prior to the NDM Create (in this case dev 1B6) and the host rescan. For each of the four volumes, there are four paths to the source array. All are alive therefore available for host use. We do not yet have any paths to the target array.

Pseu	do name=emcpov	ver178						
Symm	etrix ID=00029	6700558						
Logi	cal device ID=	=01B6						
Devi	ce WWN=6000097	700002967005585330303	1423	6				
		500009700002967005585 state=alive; polic			-	-IOs=0		
	Ho	st	- S	tor -	I/O	Path	St	ats
***	HW Path	I/O Paths	In	terf.	Mode	State	Q-IOs	Errors

3	vmhba6	C0:T11:L4	FA	1d:24	active	alive	0	0
3	vmhba6	C0:T13:L4	FA	2d:24	active	alive	0	0
4	vmhba2	C0:T6:L4	FA	2d:24	active	alive	0	0
	vmhba2	C0:T1:L4		1	active	alive	0	0

Environment setup

The Environment Setup configures the migration environment template required to create SRDF/Metro groups for the migration of any application from the source array to the target array. It confirms that both the source and target arrays can support NDM. This includes that a usable replication pathway for data migration is available between the source and target. This needs to be issued once only as the environment is to be used for all migrations between these arrays.

symdm -src_sid <SN of Source> -tgt_sid <SN of Target> environment -setup

:\Program Files\EMC\SYMCLI\bin>symdm -src_s	
DM 'Environment Setup' operation is in pro	gress. Please wait
Analyze Configuration	Started.
Source SID:000296700558	
Target SID:000197800131	
Analyze Configuration	Done.
Setup Configuration	Started.
Setup Configuration	
Setup Configuration	
Setup Configuration	In Progress.
Setup Configuration	In Progress.
Setup Configuration	Done.

Validate environment

To validate the recently created environment or an existing environment to an alternative array use the - validate option to the symdm environment command.

```
symdm -src_sid <SN of Source> -tgt_sid <SN of Target> environment
-validate
```

C:\Program Files\EMC\SYMCLI\bin>symdm -src_sid 558 -tgt_sid 131 environment -validate

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

Analyze Configuration......Validated.

The DM 'Environment Validate' operation successfully executed.

Validating and creating an NDM session

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. Prior to running the create operation, it is always worth running the -validate to ensure the planned migration can succeed. This allows any potential issues to be addressed leading into the migration window.

```
symdm -src_sid <SN of Source> -tgt_sid <SN of Target> -sg <SG to
be Migrated> -validate
```

C:\Program Files\EMC\SYMCLI\bin>symdm create -src_sid	d 558 -tgt_sid 131 -sg NDM_Beta_SG1 -nop -validate
A DM 'Validate Create' operation is	
in progress for storage group 'NDM_Beta_SG1'. Please	wait
Analyze Configuration	Validated.
Initialize Replication Environment	
Create Storage Group(s) on Target	Validated.
Duplicate Device(s) on Target	
Create Initiator Group(s) on Target	
Create Port Group(s) on Target	
Create Masking View(s) on Target	Validated.
The DM 'Validate Create' operation successfully execution	uted for
storage group 'NDM_Beta_SG1'.	
storage group NDM_Beta_301 .	

If any of the above fails, it is worth taking a look at the SYMAPI log file, which, more often than not, points you toward an easily correctable issue within a masking view or zoning config. In the following example, one of the initiators in the source IG in an IG on the target array.

08/31/2017 12:41:28.688 EMC:SYMDM validateIGEntryInMul The initiator wwn 10000090fa927c04 is already in use in Initiator Group 131_GKs_IG for array 000197800131

08/31/2017 12:41:28.688 Create Initiator Group(s) on Target.....Failed.

Creating the NDM session also does a -validate of the environment to ensure the subsequent steps complete successfully. The Create operation:

- Creates a Storage Group on the Target array (name must not already exist in the target array) with the same name as the Source
- Creates duplicate devices on the target array to match those on the Storage Group
- Creates an initiator group using Initiators with entries in the login history table
- Creates a Port group (if one does not already exist or has not been selected by the user, see the relevant masking enhancements section)
- Invalidates the tracks on the RDF mirror to prepare for the copy
- Starts the copy process.
- Creates a masking view to the host from the target array.

```
symdm -src_sid<SN of source> -tgt_sid<SN of Source> -sg<Sg to
Migrate> -tgt SRP <SRP on Target>
```

DM 'Create' operation is	
in progress for storage group 'NDM_Beta_SG1'. Please wa	it
in highers for storage Broth insidentaliser i storage in	
Analyze Configuration	Started.
Source SID:000296700558	
Target SID:000197800131	
Analyze Configuration	Done.
Initialize Replication Environment	Started.
Initialize Replication Environment	Done.
Create Storage Group(s) on Target	Started.
Create Storage Group(s) on Target	Done.
Duplicate Device(s) on Target	Started.
Preparing for device create on Target	Started.
Preparing for device create on Target	Done.
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	
Create Port Group(s) on Target	Done.
Start Data Replication	Started.
Start Data Replication	
Create Masking View(s) on Target	Started.
Create Masking View(s) on Target	Done.
The DM 'Create' operation successfully executed for	
storage group 'NDM_Beta_SG1'.	

Viewing migration sessions

As outlined in the introduction NDM from 5977 to 5978 removes the Cutover operation and need for Pass-through mode. Once the Create operation has completed, data transfer begins immediately. As this example shows, the session entered a migration state and began copying data to the target as soon as the Create operation completed.

C:\Program Files\EM	C\SYMCLI\bin>sym	dm -sid 558 1	ist		
Symmetrix ID : 0002	96700558			T-1-1	
	6	Townsh		Total	0
	Source	Target		Capacity	Done
Storage Group	Array	Array	State	(GB)	(%)
				400.0	
NDM_Beta_SG1	000296700558	000197800131	Migrating	100.0	10

C:\Program Files\EMC\S	MCLI\bin>sym	dm -sid 558 1	ist		
Symmetrix ID : 00029670	00558				
	Source	Target		Total Capacity	Done
Storage Group	Array	Array	State	(GB)	(%)
NDM_Beta_SG1	000296700558	000197800131	Synchronized	100.0	N/A

When the migration is complete the system administrator runs a Host Rescan. This allows the multipathing software to discover extra paths to the host. Since Metro-based NDM uses SRDF/Metro as its transmission medium I/O operations passed through the target array. All writes are saved locally and replication to the remote array is handled by SRDF/Metro.

Symm Logi Devi Stan	dard UID=naa.6000	0558	3303	031423	2	IOs=0		
***	HW Path	I/O Paths	- S	tor - terf.		Path State	Sta	ats Errors
3	vmhba6	C0:T0:L3	FA	2d:61	active	alive	0	0
4	vmhba2	C0:T7:L3	FA	1d:60	active	alive	0	0
3	vmhba6	C0:T11:L4	FA	1d:24	active	alive	0	0
3	vmhba6	C0:T13:L4	FA	2d:24	active	alive	0	0
4	vmhba2	C0:T6:L4	FA	2d:24	active	alive	0	0
4	vmhba2	C0:T1:L4	FA	1d:24	active	alive	0	0

The example shows two additional paths to the device. These are the new paths to the target array. The number varies based on the number of paths zoned.

If target side Disaster Recovery (DR) is required, it is possible to start the process while the migration is ongoing. This can be setup using the standard symrdf commands:

symrdf addgrp -sid 131 -rdfg xx -dir xx -label xxxx -remote_dir xx
-remote sid xxx - remove rdfg xx

symrdf createpair -establish

Examining the NDM session in more detail

There are a number of ways of viewing the Session in more detail using the list -v commands. This section shows a summary of the selected session and verifies all entities are valid prior to attempting a Commit operation. Adding a -detail to this command option displays a complete breakdown of all the individual masking elements.

symdm -sid <SN of Source> -sg< SG to be Migrated> list -v

Metro-based NDM

```
C:\Program Files\EMC\SYMCLI\bin>symdm -sid 558 -sg NDM Beta SG1 list -v
Symmetrix ID
                        : 000296700558

        Storage Group
        : NDM_Beta_SG1

        Source Array
        : 000296700558

        Target Array
        : 000197800131

                       : Synchronized
Migration State
Total Capacity (GB) : 100.0
Done (%)
                      : N/A
Source Configuration: OK
{
  Storage Groups (1) : OK
Masking Views (1) : OK
  Masking Views (1)
  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
```

To view the LUN pairings, try using the -pairs_info parameter.

symdm -sid<SN of SRC or TGT> -sg <SG to be Migrated> list -v pairs info -detail

Host view of the devices

A symdev from the host shows the Label of RDF1 and RDF2 against the source arrays, in contrast to pass-through NDM the source device would have been given an R2 Mirror to cater for Pass-through mode. This does not apply for Metro NDM.

```
symdev -sid <SRC or TGT SN> list
```

C:\Program Files\EMC\SYMCLI\bin>symdev -sid 558 list Symmetrix ID: 000296700558 Device Name Dir Device Sym Physical SA :P Config Attribute Sts (MB) 00001 Not Visible 01D:027 TDEV N/Grp'd ACLX RW 6 00013 Not Visible ***:*** TDEV N/Grp'd RW 22875 00014 Not Visible ***:*** TDEV N/Grp'd RW 11619 00018 Not Visible ***:*** RDF1+TDEV N/Grp'd RW 4155 00019 Not Visible ***:*** TDEV N/Grp'd RW 4155 00019 Not Visible ***:*** TDEV N/Grp'd RW 4155 00018 Not Visible ***:*** TDEV N/Grp'd RW 2078 00018 Not Visible ***:*** TDEV N/Grp'd RW 2078 00018 Not Visible ***:*** RDF1+TDEV N/Grp'd RW 2078 •••• 001B3 Not Visible ***:*** RDF1+TDEV N/Grp'd RW 25601 001B4 Not Visible ***:*** RDF1+TDEV N/Grp'd RW 25601 001B5 Not Visible ***:*** RDF1+TDEV N/Grp'd RW 25601 001B6 Not Visible ***:*** RDF1+TDEV N/Grp'd RW 25601

C:\Program Files\EMC\SYMCLI\bin>symdev list -sid 131

Symmetrix ID: 000197800131

	Device Name	Dir		Device		
Sym	Physical	SA :P	Config	Attribute	Sts	Cap (MB)
00001	Not Visible	???:???	TDEV	N/Grp'd ACLX	RW	6
00002	Not Visible	???:???	TDEV	N/Grp'd	RW	10241
00003	Not Visible	???:???	TDEV	N/Grp'd	RW	10241
00004	Not Visible	???:???	TDEV	N/Grp'd	RW	6144
00005	Not Visible	???:???	TDEV	N/Grp'd	RW	5121
00006	Not Visible	???:???	TDEV	N/Grp'd	RW	8388609
001FC	Not Visible	***:***	RDF2+TDEV	N/Grp'd	WD	25601
001FD	Not Visible	***:***	RDF2+TDEV	N/Grp'd	WD	25601
001FE	Not Visible	***:***	RDF2+TDEV	N/Grp'd	WD	25601
001FF	Not Visible	***:***	RDF2+TDEV	N/Grp'd	WD	25601

Source and target post-create

The native and effective (internal and external) devices IDs (WWNs) are the same on the source device 1B3.

Symdev -sid <SRC or TGT> show <SRC or TGT device>

C:\Program Files\EMC\SYMCLI\bin>symdev -sid 558 show 1b3 Device Physical Name : Not Visible Device Symmetrix Name : 001B3 Device Serial ID : N/A Symmetrix ID : 000296700558 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 : SYMM Product Revision : 5977 : SYMMETRIX Device WWN : 60000970000296700558533030314233 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
 : 13654

 Tracks
 : 204810

 512-byte Blocks
 : 52431360

 MegaBytes
 : 25601

 KiloBytes
 : 26215680

 Geometry Limited : No } Device External Identity ł Device WWN : 60000970000296700558533030314233 •••

The native and effective (internal and external) devices IDs (WWNs) differ on the Target Array. The target device has inherited the WWN of the source and presented it as its effective or external WWN.

C:\Program Files\EMC\SYMCLI\bin>symdev -sid 131 show 1fc Device Physical Name : Not Visible Device Symmetrix Name : 001FC Device Serial ID : N/A Symmetrix ID : 000197800131 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 : 5978 Device WWN : 60000970000197800131533030314643 Device Emulation Type : FBA Device Defined Label Type: N/A Device Defined Label : N/A Device Sub System Id : N/A Cache Partition Name : N/A Bound Pool Name : SRP 1 Device Block Size : 512 Device Capacity { Cylinders : 13654 Tracks 204810 : 512-byte Blocks 52431360 : MegaBytes 25601 : KiloBytes : 26215680 Geometry Limited : No } Device External Identity Device WWN : 60000970000296700558533030314233 ...

Canceling a migration in progress

At any point up to the Commit, a migration can be canceled. This removes the storage provisioned on the target array and releases any allocations and resources allocated by the NDM create operation. It also returns the source devices to the state they were before the Create operation was issued.

The cancel operation carries out the following:

- Stops replication between the source and target arrays
- Removes the masking view on the target array
- Removes the RDF pairings
- Removes the port group on the target array (if not in use in another masking view)
- Removes the initiator group on the target array
- Deallocates volumes created on the target array
- Removes the devices created on the target array

Since there is no Cutover operation and therefore no pass-through state there is no need to use the - revert parameter as used in Pass-Through NDM.

```
C:\Users\Administrator>symdm -sid 558 -sg NDM_Beta_SG1 cancel -nop
A DM 'Cancel' operation is
in progress for storage group 'NDM_Beta_SG1'. Please wait...
  Analyze Configuration.....Started.
   Source SID:000296700558
   Target SID:000197800131
  Analyze Configuration.....Done.
  Stop Data Replication.....Started.
  Stop Data Replication.....Done.
  Remove Masking View(s) on Target.....Started.
  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.
  Remove Replication Environment.....Started.
  Remove Replication Environment......Done.
```

Committing a migration

When the data copy is completed, and the devices are synchronized the migration can be committed. The Commit operation completes the migration by removing the migrated application resources from the source array and releases system resources used for the migration. When the Commit operation is completed, the replication relationship between the source and target devices is removed, the masking view on the source is removed, and the source devices take the native (internal) WWN of the target LUN as its effective (external) WWN.

This leaves the target having an external WWN of the source and the source having an external WWN of the target. Both devices retain their native (internal) WWNs but these are not presented to the host.

```
symdev -sid <SRC or TGT SN> -sq <SG to be Migrated> commit
C:\Users\Administrator>symdm -sid 558 -sg NDM_Beta_SG1 commit -nop
A DM 'Commit' operation is
in progress for storage group 'NDM_Beta_SG1'. Please wait...
   Analyze Configuration.....Started.
    Source SID:000296700558
    Target SID:000197800131
   Analyze Configuration.....Done.
   Stop Data Replication.....Started.
   Stop Data Replication.....Done.
   Remove Masking View(s) on Source.....Started.
   Remove Masking View(s) on Source.....Done.
   Remove Data Replication.....Started.
   Remove Data Replication.....Done.
   Remove Replication Environment......Started.
   Remove Replication Environment......Done.
The DM 'Commit' operation successfully executed for
storage group 'NDM_Beta_SG1'.
```

Examining a device after the commit operation

With the removal of the masking view to the source storage array the systems administrator runs a host rescan. This removes any dead paths.

pplicensevmaxcse:~ # Pseudo name=emcpower Symmetrix ID=0002967		dev=	emcpow	er178 ho	ost=10.60	.136.140	6
Logical device ID=01	B6						
Device WWN=600009700	002967005585330303	31423	6				
Standard UID=naa.600				e .			
Scandard OID-naa.600	009/0000296/005563	53303	031423	0			
	second lines and in			the second second	TO0		
type=Conventional;	state=alive; polic	cy=Sy	mmOpt;	queued	-IOs=0		
type=Conventional; Host					-IOs=0 Path	Sta	ats
		- s	tor -	I/O	Path	1000	
Host		- S In	tor - terf.	I/O	Path State	1000	

Viewing the source and target devices after the Commit operation shows the WWN manipulation that has occurred. The source device now has the targets native WWN as its effective WWN and the Target device has retained the source native WWN as its effective WWN. In addition, the RDF mirror has been removed from the device.

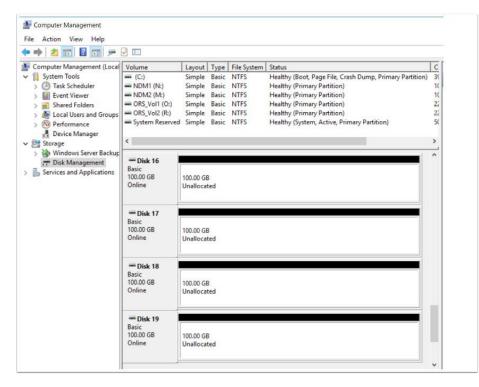
Removing the migration environment

Removing the environment removes the template used to create the SRDF/Metro groups for individual SG migrations. Once this template is removed another Environment Setup operation is necessary, which creates a new template, before being able to create migrations between the source and target arrays.

```
C:\Users\Administrator>symdm -sid 131 -environment list
Symmetrix ID: 000197800131
Remote SymmID Status
 -----
000296700558 OK
::\Users\Administrator>symdm -src_sid 558 -tgt_sid 131 environment -remove
A DM 'Environment Remove' operation is in progress. Please wait...
  Analyze Configuration.....Started.
    Source SID:000296700558
    Target SID:000197800131
  Analyze Configuration.....Done.
  Remove Configuration.....Started.
  Remove Configuration.....Done.
The DM 'Environment Remove' operation successfully executed.
2:\Users\Administrator>symdm -sid 131 -environment list
Symmetrix ID: 000197800131
The migration session environment is not configured
```

Using Unisphere for PowerMax with precopy

Looking at the devices in this migration from the host operating system disk management (in this case, Windows Server 2016), they show as Disk 16 through Disk 19. These were previously added as RDMs to the VMs using VMware vSphere.



An example of the multipathing setup using device 137. It shows what the pathing looks like prior to the create and the host rescan. For each of the four volumes here there are four paths to the source array which are all alive and available for host use. At this point, there are no paths to the target array even though our zoning should be in place before the NDM create.

Pseudo name=emcpower1	68					
Symmetrix ID=00029670	0558					
Logical device ID=001	37					
Device WWN=6000097000	02967005585330303	13337				
Standard UID=naa.6000	09700002967005585	3303031333	7			
type=Conventional; s	tate=alive; polic	y=SymmOpt;	queued-I	0s=0		
	***************	********	*******			
Host		- Stor -	I/O P	ath	Sta	ats
### HW Path	I/O Paths	Interf.	Mode	State	Q-IOs	Errors
	***************					******
1 vmhba4	C0:T11:L3	FA 2d:24	active	alive	0	0
	C0:T11:L3 C0:T7:L3				-	0 0
1 vmhba4		FA 1d:24	active	alive	0	-

NDM environment setup

The Environment Setup operation configures the migration environment template required to setup the Metro groups used to migrate all applications from the source array to the target array. This template is used to define the RDF groups for each migration session. Within this definition are ports used, target ports and port count. The operation also confirms that both the source and target arrays can support the NDM operations. This includes ensuring that a usable replication pathway for data migration is available between source and target arrays. Should we need a second target array from the same source, a second environment is necessary.

To summarize the Environment Setup runs once only for each array relationship. This Setup operation creates a template from which all other Metro-based NDM SRDF groups are modeled. Each individual NDM session requires its own RDF/Metro group to be created unlike Pass-through NDM which used a single RDF group for all sessions between the source and target.

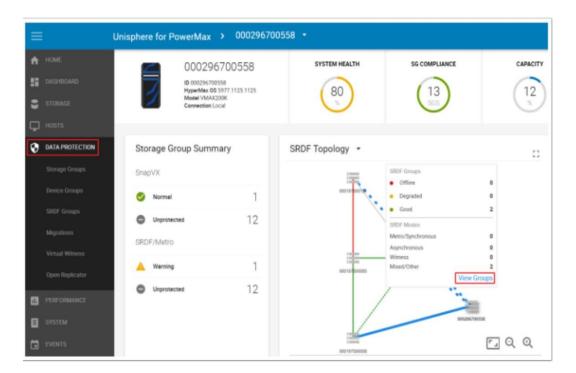
	Unisphere for PowerMax >	000296700558 -		C Q 🖬 🧍 🏟 🛓	. (
HOME DASHROARD	Migrations Storage Groups Environme	nts			
STORAGE	Creste			1 items	1 7
	Source	Target	State	In Use	ł
DATA PROTECTION	000198701161	000296700558	٢		
Migrations					
Virtual Witness					

From the **Data Protection** menu select **Migrations**, Click the **Environment** tab to display any existing Environments already setup. The parameter **In Use** shows us whether the Environment is validated and usable. The **In Use** parameter also shows whether there is an active Migration using this environment.

To create an environment, click **Create**, and the window below appears. This contains a drop-down list of all the arrays available for migration operations. Should your array not be present, verify the RDF zoning and confirm the intended target array is suitable and its code level is within the support matrix. Select the relevant array and choose **Run Now**.

000197800131 .	Remote Array *		
	00019780013	1	-
		0411051	
Run Now			
	0	CANCEL	ADD TO JOB LIST

Success	
Hide Task Details	
Starting Tasks	
Migration Environment setup between: 00029	6700558 and: 000197800131
Starting Data Migration environment setup be	tween 000296700558 and
000197800131	
Analyze Configuration	Started.
Source SID:000296700558	
Target SID:000197800131	
Analyze Configuration	
Setup Configuration	
Setup Configuration	-
Setup Configuration	
Setup Configuration	5
Setup Configuration	5
Succeeded Data Migration environment setup	
Refreshing Data Migration environment	
Succeeded	



=		Unisphere for PowerMax >	000296700558 -		c
		SRDF Groups Create SRDF Group. Modify	Create Peirs		
		SRDF Group • 000197800131	SRDF Group Label	Remote SRDF Group	Online
•	DATA PROTECTION Storage Groups	250 (F9) 248 (F7)	M_01310558 M_M_6FA920	250 (F9) 249 (F8)	0
	Device Groups				

The new **Topology** view we can see the RDF group template that has been created. Go to the **DataProtection** dashboard and hover over the line between our source and target. This causes the **SRDF Groups** window to appear. Select **View Groups** to display the SRDF group window highlighted below.

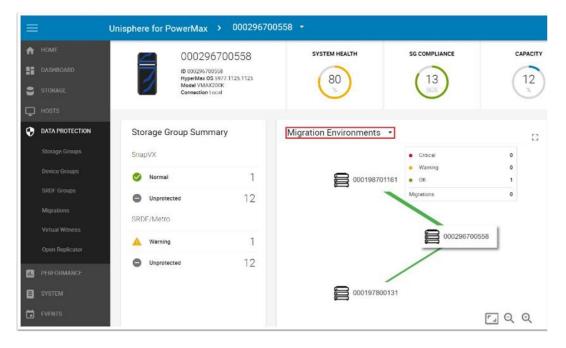
The new SRDF group that has been created (248/249 on remote) as part of the Create command operation from the template (250). Group 248 is used during this migration.

From an RDF standpoint you can examine the new RDF group created to handle NDM migrations for all SG session between 558 and 131.

Metro-based NDM

	Unisphere for PowerMa	ax > 000296700558 ▼		C Q 🖬 🦧
	Migrations			
DASHBOARD	Storage Groups Er	wironments		
STORAGE	Create			
HOSIS	Source	Target	State	In Use
DATA PROTECTION	000197800131	000296700558	0	-
Storage Groups	000198701161	000296700558	0	
Device Groups				
SRDF Groups				
Migrations				

From the same Data Protection dashboard, the drop-down menu contains an option to monitor Migration Environments. A color-coded line indicates any problems. Hovering over the connection line displays the number of each connection status.



Now the environment is in place so the NDM Create for the SG planned for migration can occur.

Create migration session with precopy

From the **Storage** tab click **Storage Groups**, from there locate the SG that is to be migrated. Select the check box and click the **More Actions** "3-Dot" icon to the right of Set Host I/O Limits. From the drop-down menu select **Migrate**.

HOME	Storage	e Groups						
DASHBOARD	Creat		Provision	Protect	Set Host I/O Limits		^	í.
STORAGE	Clean	ie moony	Provision	Protect	Set Host i/O Limits		Change SRP	
		Name +		SRP		Si	Delete	
Storage Groups		146_Gks_NDM_Cypres	55	SRP_1		0		
		CSE_eNAS		SRP_1		0	Migrate	
Reference Workloads		Demo_Uni_SG1		SRP_1		0	FAST Array Advisor	
Reference workloads		EMBEDDED_NAS_DM_SG enas_dest		NONE SRP_1		G		
Storage Resource Pools						0	Expand ProtectPoint	
End2End_SG1			SRP_1		Bi Set Volumes	Set Volumes		
		ESX_142_GKS_SG		SRP_1		0	~	
External Storage		GKs		SRP_1		Opt	timized	
		MFE_EXPAND		SRP_1		Op	timized	

In the Create Migration Wizard, select the **Target array** (only arrays with valid environments setup appear on this drop-down menu). This example does not select a Port Group. (See the relevant masking enhancements section.) Click **Next**

\equiv	Unisphere for PowerMax > 000	296700558 -	c
HOME	Stc Create Migration Wizard		
S STORAGE	Select Target Select Type	Symmetry 10 * 000197800131	
Storage Groups	Summary	SRP_1	
Reference Workloads Storage Resource		Select Port Group Name Q. Enter the name of the port group to filter 131_ESX146_GK_PG	
Pools Volumes		131_ESX146_UK_PG ORS SLO TEST	
External Storage			
Mainframe VVol Dashboard			
ГД Hosts			
DATA PROTECTION	0		CANCEL

On the next screen click Create Data Migration. This provides the option of selecting Compression and precopy. Check **Precopy** and select next. The Prepare Data Migration selection requires Performance data to be collected on the host. This runs a check for resources on the target array to ensure the addition of the new SG does not cause the target array to exceed any performance metrics on both FE and BE. It also produces a spread sheet to help plan the zoning required for the host from the target array.

Metro-based NDM

=	Unispl	nere for PowerMax >	000296700558 +			6
HOME	Ste		rd NDM_U4P_PreCopy			
STORAGE		 Select Target Select Type 	Create Data Migration			
Storage Groups	C	Summary	Compression			
Service Levels	C		Precopy			
Reference Workloads	0		O Prepare Data Migration			
Storage Resource Pools	T					
Volumes	C					
External Storage	-0					
Mainframe	-E					
VVol Dashboard.	C					
HOSTS	E					
		0		BACK	CANCEL	NEXT

The final page of the Wizard summarizes the planned NDM session to be created. It breaks down the planned masking view elements and the NDM parameters. Select **Run Now** to continue.

Success	
Hide Task Details	
Starting Tasks	
Create Data Migration session for Storage G	roup: NDM_U4P_PreCopy, source
Symmetrix: 000296700558 and target Symr	netrix: 000197800131
Create Data Migration session for Storage G	roup: NDM_U4P_PreCopy, source
Symmetrix: 000296700558 and target Symm	netrix: 000197800131
Starting Data Migration entity creation	
Analyze Configuration	Started.
Source SID:000296700558	
Target SID:000197800131	
Analyze Configuration	Done.
Initialize Replication Environment	
Started.	
Initialize Replication Environment	Done.
Create Storage Group(s) on Target	Started.
Create Storage Group(s) on Target	Done.
Duplicate Device(s) on Target	Started.
Preparing for device create on Target	Started.
Preparing for device create on Target	Done.
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	
Start Data Replication	Started.
Start Data Replication	Done.
Succeeded Data Migration entity creation	
Refreshing Data Migration entities	

Creating the NDM session with the precopy option will also perform an environment validate as part of the setup to ensure it will complete successfully. As outlined in the create command output, the Create command completes the following:

- 1. Creates a storage group on the target array (name must not already exist in the target array) with the same name as the Source
- 2. Creates duplicate devices on the target array to match those on the storage group
- 3. Creates an initiator group using Initiators with entries in the login history table
- 4. Creates a port group (if one does not already exist or has not been selected but the user (see the relevant masking enhancements section)
- 5. Starts the copy process in SRDF/Adaptive Copy mode

Examine the created migration session

Selecting the **Data Protection** tab on the left task bar and selecting **Migrations** in the drop-down menu, the storage groups currently involved in an NDM session are highlighted along with the current State and details on the source and target arrays. Since data transfer begins immediately following a Create operation, there is no need for the Pass-

Through NDM Cutover operation. When the data is synchronizing, the systems administrator runs a rescan to allow the target paths to become active to the multipathing software. At this point, both source and target arrays are involved in an active/active relationship with all I/O serviced locally.

	Unisphere for PowerMax >	000296700558 -		C Q 🖬	
A HOME	Migrations				
DASHBOARD	Storage Groups Environment				
S STORAGE	Cutover Commit :				1 items =
D HOSTS	Storege Group	State	Source	Terget	=
	NDM_U4P_PreCopy	Precopy	000296700558	000197800131	^
Device Groups					
SRDF Groups					
Migrations					

From the expanded menu in this example, the precopy is now 16% completed.

	Unisphere for PowerMax	> 000296700	558 -				C Q 🖬 I
HOME	Migrations						
STORAGE	Storage Groups Envi	ronments		1 items	₹ ()	NDM_U4P_Pre	Сору
HOSTS	Storage Group	State	Source	Terget	=	Capacity (GB)	400
DATA PROTECTION	NDM_U4P_PreCopy	Риесору	000296700558	000197800131	î	State	Ргесору
						Done (%)	16
Device Groups						Source Target	000296700558
Mgrations	- 10					Valid Components	O

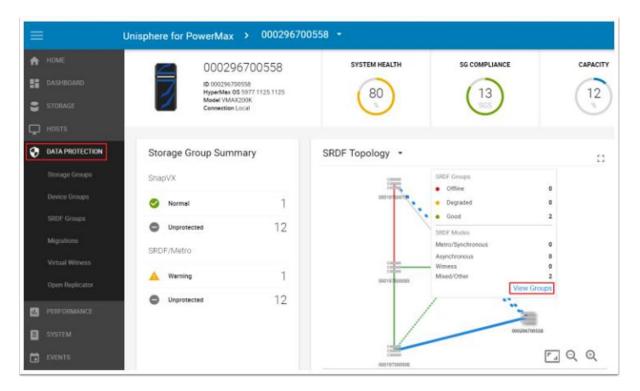
Double-clicking the NDM session will take you into the **Migration Details** view. In the screen above, we can see the individual devices involved in the session. Under the target tab, we can see devices 204 through 207 have been created on the target side by the NDM create. The **State** also shows a live status of each of the devices involved. A device without a green tick should be investigated for potential problems before continuing.

=	Unisphere for PowerMax > 0002	96700558 -		c < 🖬
nome	NDM_U4P_PreCopy > Data Migrat Storage Groups Masking Views	tion Details		
STORAGE	Source	State	Tarpet	State
П ноятя	 NDM_U4P_PreCopy 	0	 NDM_U4P_PreCopy 	0
DATA PROTECTION	00134 00135	0	00204 00205	0
Storage Groups	00136	0	00206	0
Device Groups	00137	٢	00207	۰
SRDF Groups				
Migrations				

Selecting the **Masking Views** tab displays the pane outlining the masking and masking elements involved on both sides of the NDM session. This screen can be useful for troubleshooting any issues with the migration such as an unplanned or unauthorized manipulation of any of the NDM elements that hinder progress to the commit stage. In such cases the **State** does not contain a green tick, rather a red warning.

	Unisphere for PowerMax > 0002	96700558 🝷		C Q 🗎
🕈 НОМЕ	Demo Lini SC1 > Data Migratian	Dataila		
DASHBOARD	Demo_Uni_SG1 > Data Migration Storage Groups Masking Views	Details		
STORAGE	Source Macking View	Source State	Target Masking View	Target State
HOSTS	 Demo_Uni_SG1_MV 	0	 Demo_Uni_SG1_MV 	0
	• NDM_PG	0	 NDM_PG 	0
DATA PROTECTION	FA-1D:24	0	FA-1D:29	0
	FA-20-24	0	FA-20:28	0
Device Groups	 ESX_146 	0		0
Derice Groups	10000090fa927c04	٢	10000090fa927c04	0
	10000090fa927c05	0	10000090fa927c05	9
Migrations				

Examining the RDF environment from the Topology view shows the RDF group template that has been created. Go to the DataProtection dashboard and hover over the line between our source and target. This causes the SRDF Groups window to appear. Select View Groups to display the SRDF group window highlighted below.



Making the target array ready to the host

When an adequate amount of data has been copied to the target array to negate the potential impact on the application host the target array can be made Ready to the Host.

From the active **Migrations** tab click the more actions icon (three dots) to the right of the Commit button. In the drop-down menu, select **Ready Target**. Confirm the arrays and SG are the correct combination for this migration (if multiple concurrent NDM sessions are in place) and click **Run Now**.

	Unisphere for PowerMax	x → 000296700558 +	
🕈 НОМЕ	Migrations		
DASHBOARD	Storage Groups Envi	ironments	
STORAGE	Cutover Commit	Ready Target	
L HOSTS	Storøge Group	Recover	Source
DATA PROTECTION	NDM_U4P_PreCopy	Sync	000296700558
Storage Groups			
Device Groups		Cancel Migration	
SRDF Groups			
Migrations			

Ready	Target NDM_U	14P_PreCopy	
Source	000296700558		
Target	000197800131		
0	CANCEL	ADD TO JOB LIST 👻	
		Run Now Add to Job List	

Success	
Hide Task Details	
Starting Tasks	
ReadyTgt Data Migration session for Storag	e Group;
NDM_U4P_PreCopy on source array: 000296	
000197800131	- /
Starting Data Migration readyTgt	
Analyze Configuration	Started
Source SID:000296700558	
Target SID:000197800131	
Analyze Configuration	
Preparing Devices for Host discovery Preparing Devices for Host discovery	
Create Masking View(s) on Target	
Create Masking View(s) on Target	
Succeeded Data Migration readyTot	
Refreshing Data Migration ready Tgt entities	
Succeeded	

When the ready target operation begins the RDF relationship changes to Metro from adaptive copy and the masking view is created. Running a host rescan the extra paths will become available for host I/O use:

- 1. RDF group state moved from adaptive copy mode to Metro active
- 2. Target Devices are moved into a Read/Write mode
- 3. Masking view is created on the target array
- 4. SRDF state between source and target switches to active/active

Once the ready target has been issued, we will move from a precopy state to a migrating state and eventually to a synchronized state.

	Unisphere for PowerMax >	000296700558 -		G
	Migrations Storage Groups Environment	15		
	Cutover Cammit : Storege Group	State Synchronized	Source 0002765700558	Terget 000197800131
	- Henry			
SRDF Groups Migrations				

At this point, the storage administrator will run a host rescan o allow the multipathing software to recognize the new paths created by issuing the Ready Target and the subsequent masking view creation on the target array. As the following figure shows, the extra paths to the target array and the dual device IDs are sharing a single effective (external) WWN. By sharing a WWN the multipathing software sees the new devices as just extra paths to the original devices.

Pseudo name=emcpower		-					
Symmetrix ID=0002967	00558, 00019780013	31					
Logical device ID=00	137, 00207						
Device WWN=600009700	002967005585330303	31333	7				
tandard UID=naa.600	009700002967005585	3303	031333	7			
ype=Conventional;	state=alive; polic	v=Sv	mmOpt;	queued-	-IOs=0		
Host		- 5	tor -	I/O	Path	Sta	ats
### HW Path	I/O Paths	In	terf.	Mode	State	0-105	Error
						~	
1 vmhba4	C0:T12:L8	FA	2d:28	active	alive	0	0
1 vmhba4 3 vmhba3	C0:T12:L8 C0:T7:L8			active active		0	0
			1d:29		alive	-	
3 vmhba3	C0:T7:L8	FA	1d:29 2d:24	active	alive alive	0	0
3 vmhba3 1 vmhba4	C0:T7:L8 C0:T11:L4	FA FA FA	1d:29 2d:24 1d:24	active active	alive alive alive	0	0

Selecting Storage Groups from the Data Protection tab and SRDF from the window to display the SRDF relationship. In this case, we are in ActiveBias as there is no witness between the arrays. From a system standpoint, we are now processing I/Os in a Metro active/active mode with our target array being read/write to the host also.

Metro-based NDM

=		Unisphere for PowerMax > 000296700558 -		ट < ⊡ # ≎ ± 0
ń		Storage Groups		
5		SnepVX SRDF		
5		Establish Split Suspend Restore	1 items = () NDM_U4P_Pr	reCopy ×
Q		Storage Group States Modes	SRDF Type SRDF Ormaps Storage Group	NDM_U4P_PreCopy
0	DATA PROTECTION	NDM_U4P_PreCopy ActiveBas Active	R1 248 States	ActiveBias
	Storage Groups		Modes	Active
			SRDF Groups	248
			Capacity (GB)	400
	Migrations		SRDF Pairs	4

=	Unisphere for PowerMax	→ 00029670	00558 -		
HOME	NDM_U4P_PreCopy >	SRDF Pairs			
STORAGE	Local Hop 2 Establish Split	Suspend Rea	store :		
HOSTS	Source Volume + 2	Source Type	SRDF Group Target Volume	State	SRDF Mode
DATA PROTECTION	00134	R1	248 00204	ActiveBias	Active
Storage Groups	00135	R1 R1	248 00205 248 00206	ActiveBias ActiveBias	Active
Device Groups	00137	R1	248 00207	ActiveBias	Active

Examining the WWNs of source and target

Viewing the WWN of the source device after the Create operation shows that its internal and external (that is, host visible) WWN are identical. However, in contrast, the internal WWN and external WWNs of the target device are different. Its external WWN has inherited the WWN of the source device, which means that both devices appear as a single device to the host. In effect, the multipathing software sees additional paths to the same LUN.

	Unisphere for	PowerMax > 0	00296700558						GQ	a 🤹 🕈	+
HOME DASHBOARD	Storage Gro Details	oups > NDM_U4P_F	PreCopy								
STORAGE	Create	Add Volumes To SG	Remove Volumes	Expend	:	4 items	0	00137			
Storage Groups	Volume .	Туре	Allocated	(%)	Cepecity (GB)	Emulation	=	VMS Identifier Name	N/A		
	00134	RDF1+TDEV	-	100%	100.00	FBA	^	Nice Name	N/A		
Reference Workloads	00135	RDF1+TDEV	(F	100%	100.00	FBA			-		
	00136	RDF1+TDEV		100%	100.00	FBA		WWN	600009700002	19670055853303	303133
Storage Resource Pools	00137	RDF1+TDEV		100%	100.00	FBA		External Identity WWN	600009700002	19670055853303	3031333

	Unisphere for Power	Max > 00019	7800131 -					c < 🖬 🤹	۵.4
	Storage Groups > Details Compil		Performance						
STORAGE	Creets Add Vo	olumes To SG Remo	re Volumes Expend		4 tema 👻	0	00207	N/A	
Service Levels	Volume •	Type RDF2+TDEV	Allocated (%)	Capacity (68)	Emulation FBA	-	Nice Name	N/A	
	00205	RDF2+TDEV RDF2+TDEV	on	100.00			WWN External Identity WWN	60000970000197800131: 60000970000296700558:	
Storage Resource Pools	00207	RDF2+TDEV		100.00			Attached BCV	N/A	
							Attached VDPV TIST	N/A	

Committing a migration

When the data copy is completed and the devices are synchronized, the migration can be committed. The Commit operation completes the migration by removing the migrated application resources from the source array and releases system resources used for the migration. When the commit is completed, the replication relationship between the source and target devices are removed, the masking view on the source is removed and the source devices take the native (internal) WWN of the target LUN as its effective (external) WWN.

The target device has the external WWN of the source and the source device has the external WWN of the target. Both devices retain their native (internal) WWNs but these are not presented to the host.

	l l	Unisphere for PowerMax	> 000197800131 •	
ŧ	HOME	Migrations		
5	DASHBOARD	Storage Groups Enviro	onments	
2	STORAGE	Cutover Commit	1	
Ţ	HOSTS	Storage Group	State	Source
0	DATA PROTECTION	NDM_U4P_PreCopy	Synchronized	000296700558
	Storage Groups			
	Device Groups			
	SRDF Groups			
	Migrations			

Commit	NDM_U4P_F	PreCopy
Source Target	000296700558 000197800131	
0	CANCEL	ADD TO JOB LIST -
		Run Now Add to Job List

Success	
Hide Task Details	
Starting Tasks	
Commit Data Migration session for Storage	Group: NDM 114P PreCopy on
source array: 000296700558 and target arr	
Starting Data Migration commit	
Analyze Configuration	Started
Source SID:000296700558	
Target SID:000197800131	
Analyze Configuration	Done.
Stop Data Replication	
Stop Data Replication	
Remove Masking View(s) on Source	
Remove Masking View(s) on Source	Done.
Remove Data Replication	Started.
Remove Data Replication	
Remove Replication Environment	
Started.	
Remove Replication Environment	Done.
Succeeded Data Migration commit	
Refreshing Data Migration commit entities	

Device paths after the commit operation

The number of paths depends on the multipathing software in use and the zoning policy.

Carrying out a Rescan operation on the host removes the dead paths, retaining only the ones to the target devices. It also removes the SID of the original, target array, as shown in these images:

The following shows the pre-rescan status:

-	cal device ID=00137,							
_	ce WWN=60000970000296			3				
Stan	dard UID=naa.60000970	00002967005585	3303	0313333	7			
ype	=Conventional; state	=alive; polic	y=Sy	mmOpt;	queued-	-IOs=0		
-							*******	
	Host		- S	tor -	I/O	Path	Sta	ts
**	HW Path	I/O Paths	In	terf.	Mode	State	Q-IOs	Error
-			-					-
1	vmhba4	C0:T12:L3	FA	2d:28	active	alive	0	1
3	vmhba3	C0:T7:L3	FA	1d:29	active	alive		1
3	vmhba3	C0:T2:L3	FA	1d:24	active	dead	0	1
1	vmhba4	C0:T11:L3	FA	2d:24	active	dead	0	1
	vmhba4	C0:T7:L3	FA	1d:24	active	dead	0	1
1	vmhba3		-	24.24	active	dead	0	

The post-rescan status is displayed as follows:

```
pplicensevmaxcse:- # rpowermt display dev=emcpower168 host=10.60.136.146
Pseudo name=emcpower168
Symmetrix ID=000197800131
Logical device ID=00207
Device WWN=60000970000296700558533030313337
Standard UID=naa.60000970000296700558533030313337
type=Conventional; state=alive; policy=SymmOpt; gueued-IOs=0
----- Host ---- - Stor - -- I/O Path -- -- Stats ---
### HW Path
                    I/O Paths Interf. Mode State Q-IOs Errors
 1 vmhba4 C0:T12:L8 FA 2d:28 active alive 0
                                                            0
                                                      0
 3 vmhba3
                     CO:T7:L8 FA 1d:29 active alive
                                                            0
                -
```

Viewing the details of the Source SG and devices demonstrate that the masking view to the host no longer exists, the RDF mirror is deleted from each of the devices and the Internal WWN from the target has been copied to the External WWN of the Source. This ensures the devices can remain on the same SAN without necessarily having to decommission the array entirely.

=		Unisphere for PowerMax > 000296700558 -
A		Storage Groupe > NDM LIAD DreCopy
::		Storage Groups > NDM_U4P_PreCopy Details Volumes
=	STORAGE	Set Host I/O Limits
	Storage Groups	
		Properties
	Reference Workloads	
	Storage Resource	Symmetrix ID 000296700558
	Pools	Compliance
	Volumes	Service Level Optimized
		Workload Type NONE
	External Storage	SRP SRP_1
	Mainframe	Masking Views 0

	Unisphere for I	PowerMax >	000296700558								2 🖬		٠	*
	Storage Gro Details	ups > NDM_U4P	_PreCopy											
STORAGE	Create	Add Volumes To 50	Remove Volumes	Expend	I		4 items 😨	0	00137					
	Volume .	Туре	Allocated ((%)	Cape	ecity (GB)	Emulation	=	VMS identifier Name	N/A				
	00134	TDEV		100%		100.00	PDA	n	Nice Name	N/A				
	00135	TDEV		100%		100.00	FBA		WWN		7000021	u monte		
	00136	TDEV		100%		100.00	FBA							
Slorage Resource Pools	00137	TDEV		100%		100.00	FBA		External Identity WWN	60000	97000025	670055	853303	33142

Similarly, the source device has lost its RDF mirror but retains its masking view to the host. The devices retain the Internal WWN of the Source in its External WWN identity it received at the Create stage.

Metro-based NDM

Ξ υ	Inisphere for PowerMax >	000197800131 •	
 HOME DASHBOARD STORAGE 	Storage Groups > NDM_U4P Details Compliance Vo Set Host I/O Limits	P_PreCopy olumes Performance	
Storage Groups			
Service Levels	Properties		
Reference Workloads			
Storage Resource	Symmetrix ID	000197800131	
Pools	Compliance	O	
Volumes	Service Level	Optimized	
	Workload Type	NONE	
External Storage	SRP	SRP_1	
VVol Dashboard	Masking Views	1	

Remove NDM environment

Once all migrations are completed for a specific source and target, the migration environment can be removed. Click the **Data Protection** tab and click Migrations. On the **Environments** tab, select the environment and click on trash icon to remove. On the confirmation screen, click **Run Now.** This deletes the RDF group setup and release its resources.

		Unisphere for Powerl	Max > 000197800131 -	
ŧ		Migrations		
		Storage Groups	Environments	
8		Create		
Ç		Source	Terget	State
0	DATA PROTECTION	000197800131	000296700558	0
	Device Groups			
	SRDF Groups			
	Migrations			

Using Solutions Enabler 9.x with precopy

The syminq command lists devices for migration. In this example, the devices are PhysicalDrive7 to PhysicalDrive10 consisting of VMAX devices 1B3 to 1B6.

Metro-based NDM

Device			Product		Device			
Name	Туре	Vendor	ID		Ser Num	Cap (KB		
\\.\PHYSICALDRIVE0		VMware	Virtual disk	1.0	N/A	41943040		
\\.\PHYSICALDRIVE1		EMC	SYMMETRIX	5876	6100165000	2306880		
\\.\PHYSICALDRIVE2		EMC	SYMMETRIX	5876	6100166000	2306880		
\\.\PHYSICALDRIVE3		EMC	SYMMETRIX	5978	3100093000	2306880		
\\.\PHYSICALDRIVE4		EMC	SYMMETRIX	5978	3100094000	2306880		
\\.\PHYSICALDRIVE5		EMC	SYMMETRIX	5876	61000A8000	1048512		
\\.\PHYSICALDRIVE6		EMC	SYMMETRIX	5876	61000A9000	1048512		
\\.\PHYSICALDRIVE7		EMC	SYMMETRIX	5977	58001B3000	2621568		
\\.\PHYSICALDRIVE8		EMC	SYMMETRIX	5977	58001B4000	2621568		
\\.\PHYSICALDRIVE9		EMC	SYMMETRIX	5977	58001B5000	2621568		
\\.\PHYSICALDRIVE10		EMC	SYMMETRIX	5977	58001B6000	2621568		

C:\Program Files\EMC\SYMCLI\bin>syming

PowerPath view of one of the new devices

PowerPath shows what the pathing configuration before the migration. (dev 1B6) For each of the four volumes there are four paths to the source array. All are alive and available for host use. There are no paths to the target array.

1.1.1.1 Environment setup

Environment Setup configures the migration environment template required to create SRDF/metro groups for the migration of any application from the source array to the target array. It confirms that both the source and target arrays can support NDM. This includes that a usable replication pathway for data migration is available between the source and target. This needs to be issued once as the environment is used for all migrations between these arrays going.

symdm -src sid <SRC SN> -tgt sid <TGT SN> environment -setup

Validate environment

To validate the recently created migration environment or an existing migration environment use the -validate command.

symdm -src_sid <SRC SN> -tgt_sid <TGT SN> environment -validate

C:\Program Files\EMC\SYMCLI\bin>symdm -src_sid 558 -tgt_sid 131 environment -validate

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

Analyze Configuration......Validated.

The DM 'Environment Validate' operation successfully executed.

Validating and creating an NDM session

Solutions Enabler examines a specific applications 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. Prior to running the Create command it is always worth running the –validate option to ensure the migration will be successful. This allows for the resolution of any issues before the migration takes place.

When issuing a Create with the -precopy parameter the Metro NDM session is created with the RDF relationship in SRDF/AdaptiveCopy disk mode. The data synchronization between R1 to R2 begins immediately. As with Metro-based NDM without precopy the source device is created with the R1 personality.

symdm -src_sid <SRC SN> -tgt_sid <TGT SN> -sg <SG to be Migrated>
- tgt_srp <SRP on TGT> -precopy -validate
symdm -src_sid <SRC SN> -tgt_sid <TGT SN> -sg <SG to be Migrated>
- tgt srp <SRP on TGT> -precopy

DM 'Precopy Create' operation is	
n progress for storage group 'NDM_Beta_PreCopy'. Please	e wait
Analyze Configuration	Started
Source SID: 000296700558	
Target SID:000197800131	
Analyze Configuration	Done
Initialize Replication Environment	
Initialize Replication Environment	
Create Storage Group(s) on Target	
Create Storage Group(s) on Target	
Duplicate Device(s) on Target	
Preparing for device create on Target	
Preparing for device create on Target	
Duplicate Device(s) on Target	
Create Initiator Group(s) on Target	
Create Initiator Group(s) on Target	
Create Port Group(s) on Target	
Create Port Group(s) on Target	
Start Data Replication	
Start Data Replication	

If any stage in the validation fails, the contents of the SYMAPI log file often contain an indication of the problem. For example, a problem with an asking view or zoning conflict.

08/31/2017 12:41:28.688 EMC:SYMDM validateIGEntryInMul The initiator wwn 10000090fa927c04 is already in use in Initiator Group 131_GKs_IG for array 000197800131

08/31/2017 12:41:28.688 Create Initiator Group(s) on Target.....Failed.

Creating the NDM session with the precopy option will also perform an environment validate as part of the setup to ensure it will complete successfully. The create command performs the following:

- 1. Creates a storage group on the target array that has the same name as the SG on the source array (the name cannot be in use on the target array already)
- 2. Creates duplicate devices on the target array to match those on the storage group
- 3. Creates an initiator group using Initiators with entries in the login history table
- 4. Creates a port group (if one does not already exist or has not been selected but the user, see the relevant masking enhancements section)
- 5. Starts the copy process in SRDF/adaptive copy mode

Viewing precopy status

While the precopy is ongoing the following commands are used to monitor its progress. It should be noted since this is an R1 - R2 RDF copy all of the usual RDF query commands are valid.

```
symdm -sid <SRC or TGT SN> list
```

C:\Program Files\EMC\S	YMCLI\bin>sym	dm -sid 558 1:	ist		
Symmetrix ID : 00029670	00558				
	Source	Target		Total Capacity	Done
Storage Group	Array	Array	State	(GB)	(%)
NDM_Beta_PreCopy	000296700558	000197800131	Precopy	750.0	10

Issuing the list command with the -v option the migration session displays a validation of the individual elements involved in the NDM session. Note the lack of masking view on the target side.

```
C:\Program Files\EMC\SYMCLI\bin>symdm -sid 558 -sg NDM_Beta_PreCopy list -v
Symmetrix ID
                       : 000296700558

        Storage Group
        : NDM_Beta_PreCopy

        Source Array
        : 000296700558

        Target Array
        : 000197800131

Migration State
                      : Precopy
Total Capacity (GB) : 750.0
Done (%)
                        : 10
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
  Initiator Groups (1) : N/A
Port Groups (1) : OK
 Masking Views (0)
  Port Groups (1)
                           : OK
3
Device Pairs (5): OK
```

The symrdf list command shows the created pairs and the progress in terms of tracks to be copied to the R2 side. It shows the Mode (D) highlight the SRDF mode is Adaptive Copy displays the MB to track equivalent.

symrdf list -sid <SRC or TGT SN>

```
C:\Program Files\EMC\SYMCLI\bin>symrdf list -sid 558
Symmetrix ID: 000296700558
                                                                          Local Device View
STATUS FLAGS
                                                                                                                                      RDF STATES
Sym Sym RDF
                                                 ----- R1 Inv R2 Inv ------
Dev RDev Typ:G SA RA LNK MTES Tracks Tracks Dev RDev Pair
  00018 00190 R1:13 RW RW RW S1.E
                                                                                                                              0 RW WD
                                                                                                        0
                                                                                                                                                        Synchronized

        Bools
        <th
0020A 0001C R2:13 RW WD RW S2.E
                                                                                                                              0 WD RW Synchronized
                                                                                                     0
Total
                                                                                         -----
                                                                                                        0
     Track(s)
                                                                                                                  253770
     MB(s)
                                                                                                     0.0 31721.3
```

The **symstat** command shows the rate at which the precopy data is copying to the target side. This can be used to estimate the time to completion for scheduling purposes. This rate will vary depending on a number of factors including RAs involved, array level of activity and distance to target. Note the RDFG will not always be 248.

symstat -rdfg<RDFG of Migration> -type RDF -i -sid <SRC SN>

RDF Group Le	vel I/O S	tatistic	s:						
GRP	IO READ	/sec WRITE	MB/ READ	sec WRITE	% Hits RD	IO Serv Min	vice Time Max	(usec) Avg	Q Len
12:02:15 248	0	12558	0	1594	0	295	10825	1474	3471
12:03:15 248	0	12605	0	1600	0	295	11825	1497	3964
12:04:15 248	0	12607	0	1600	0	295	11825	1468	3602
12:05:15 248	0	12604	0	1600	0	295	11825	1496	3833
12:06:15 248	0	11611	0	1474	0	295	11825	2161	3466
12:07:15 248	0	8881	0	1127	0	295	11825	2238	3458
12:08:16 248	0	8986	0	1140	0	295	11825	2056	3291
12:09:16 248	0	5823	0	739	0	295	12783	2394	0

During the NDM environment setup process, the first choice will be RDFG 250, descending from this number until a free group is found. In the example shown multiple NDM environments setup from array 558 so RDFG 248 was free for 558 - 131. The RDFG number does not necessarily have to be the same on both source and target.

```
C:\Program Files\EMC\SYMCLI\bin>symdm -sid 558 list

Symmetrix ID : 000296700558

Source Target Capacity Done

Storage Group Array Array State (GB) (%)

NDM_Beta_PreCopy 000296700558 000197800131 Precopy 750.0 100
```

From an SRDF pair standpoint as shown in the example, we are fully synchronized to the target device.

It should be noted that it is not necessary to let the precopy to fully Synchronize before moving onto the next step and issuing the ReadyTarget command. Depending on the rate at which data is copying across and the amount of data to be copied it can be issued when the user feels comfortable I/O processing can be shared between the source and target array in an active/active configuration.

Make the target array ready to the host

Once the ReadyTarget command is issued and the systems administrator runs a rescan on the host, the migration will transition to a migrating state. If the ReadyTarget command was completed before the data has fully pre-copied the migration will enter a Migrating state until fully synchronized and then transition to a Synchronized state.

If the data has been fully pre-copied, the migration will briefly enter a migrating state to confirm data synchronization and then to a Synchronized state.

At this point, we are active/active to the host from both source and target arrays.

Issuing the ReadyTarget command performs the following:

- 1. Moves RDF group state from adaptive copy mode to active/active
- 2. Target devices are moved into a read/write mode
- Masking view is created on the target array using the masking elements created during the create command

symdm -sid <SRC or TGT SN> -sg <SG to be Migrated> readytgt

Following the ReadyTarget command and the host rescan the state changes to Synchronized.

C:\Program Files\EMC\SY	/MCLI\bin>sym	dm -sid 558 l:	ist		
Symmetrix ID : 00029670	00558			Tatal	
Storage Group	Source Array	Target Array	State	Total Capacity (GB)	Done (%)
NDM_Beta_PreCopy	000296700558	000197800131	Synchronized	750.0	N/A

The **symrdf list** command now lists the pair state as ActiveBias signifying we are in Metro mode. And our target is read/write accessible to the host. The pairs source and target are active/active, but Solutions Enabler displays ActiveBias as there is not a witness present.

						Local	Device V:	iew			
			STA	TUS		FLAGS				RDE 9	STATES
Sym	Sym	RDF					R1 Inv	R2 Inv			
Dev	RDev		SA	RA L	NK	MTES	Tracks		Dev	RDev	Pair
00018	00190	R1:13	RW	RW R	W	\$1.E	0	0	RW	WD	Synchronized
001BB	00204	R1:248	RW	RW R	Ы	T1.E	0	0	RW	RW	ActiveBias
001BC	00205	R1:248	RW	RW R	IJ	T1.E	0	0	RW	RW	ActiveBias
001BD	00206	R1:248	RW	RW R	Ы	T1.E	0	0	RW	RW	ActiveBias
001BE	00207	R1:248	RW	RW R	W	T1.E	0	0	RW	RW	ActiveBias
001BF	00208	R1:248	RW	RW R	W	T1.E	0	0	RW	RW	ActiveBias
0020A	0001C	R2:13	RW	WD R	W	S2.E	0	0	WD	RW	Synchronized
Total											
Trad	ck(s)						0	0			
MB (0.0	0.0			

Canceling a migration

A migration can be canceled at any point up until the commit operation occurs. Cancellation removes the storage provisioned on the target array and releases any allocations and resources allocated by the NDM create –precopy operation. It also places the source deices into the state they were before the migration began.

The cancel operation performs the following:

- 1. Stops replication between the source and target arrays
- 2. Removes the masking view on the target array
- 3. Removes the RDF pairings
- 4. Removes the port group on the target array (if added as part of the create command)
- 5. Removes the initiator group on the target array (if not in use)

- 6. Deallocates volumes created on the target array
- 7. Removes the devices created on the target array.

Since there is no cutover step, and therefore no pass-through state, there is no need for the use of a -revert parameter as used in legacy NDM.

symdm -sid <SRC or TGT SN> -sg <SG to be Migrated> cancel

DM 'Cancel' operation is	
n progress for storage group 'NDM_Beta_PreCopy'. Please	e wait
Analyze Configuration	Started.
Source SID:000296700558	
Target SID:000197800131	
Analyze Configuration	Done.
Stop Data Replication	
Stop Data Replication	
Remove Masking View(s) on Target	
Remove Masking View(s) on Target	
Remove Data Replication	
Remove Data Replication	Done.
Remove Port Group(s) on Target	
Remove Port Group(s) on Target	
Remove Initiator Group(s) on Target	Started.
Remove Initiator Group(s) on Target	
Remove Duplicate Device(s) on Target	
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.
Remove Replication Environment	Started.
Remove Replication Environment	Done.

It is best practice for the storage administrator to run a rescan on the host to clear up any dead or invalid paths left over after the migration has been canceled.

Committing a migration

When the data copy is completed and the devices are synchronized, the migration can be committed. The Commit operation completes the migration by removing the migrated application resources from the source array and releases system resources used for the migration. Once the commit is completed the replication relationship between the source and target devices are removed, the masking view on the source is removed and the source devices take the native (internal) WWN of the target LUN as its effective (external) WWN.

The target device has the external WWN of the source and the source device has the external WWN of the target. Both devices retain their native (internal) WWNs but these are not presented to the host.

symdm -sid <SRC or TGT SN> -sg <SG to be Migrated> commit

```
C:\Program Files\EMC\SYMCLI\bin>symdm -sid 558 -sg NDM_Beta_PreCopy commit -nop
A DM 'Commit' operation is
in progress for storage group 'NDM_Beta_PreCopy'. Please wait...
  Analyze Configuration.....Started.
   Source SID:000296700558
    Target SID:000197800131
  Analyze Configuration.....Done.
  Stop Data Replication.....Started.
  Stop Data Replication.....Done.
  Remove Masking View(s) on Source.....Started.
  Remove Masking View(s) on Source.....Done.
  Remove Data Replication.....Started.
  Remove Data Replication.....Done.
  Remove Replication Environment.....Started.
  Remove Replication Environment.....Done.
The DM 'Commit' operation successfully executed for
storage group 'NDM_Beta_PreCopy'.
```

Device paths after the commit operation

The number of paths depends on the multipathing software in use and the zoning policy.

Carrying out a Rescan operation on the host removes the dead paths, retaining only the ones to the target devices. It also removes the SID of the original, target array, as shown in these images:

gical device ID=00	and the second se					
vice WWN=600009700			-			
andard UID=naa.600						
<pre>/pe=Conventional;</pre>	state=alive; polic	y=SymmOpt;	queued-	-105=0		
Host		- Stor -	T/O	Dath	St.	
## HW Path	I/O Paths					
1 vmhba4	C0:T12:L8	FA 2d:28	active	alive	0	1
		FA 14.20	active	alive	0	1
3 vmhba3	C0:17:L8	101 101 63				
3 vmhba3 1 vmhba4	C0:T11:L4		active	dead	0	1
		FA 2d:24	active active		0	1
1 vmhba4	C0:T11:L4	FA 2d:24 FA 1d:24		dead	0	1 1

Following the Commit operation but before the storage administrator runs a rescan PowerPath still shows signs of the old NDM Session in the example above. The paths are dead but still present even though the masking view has been removed from the source array during the Commit command. The Logical Device still shows the old source device number despite the RDF pairs having been broken down and the application running solely on the target array. This is why we always recommend rescanning post create, post Cancel and Commit operations.

Once the storage administrator has run a host rescan the old paths to the source array are removed as well as reference to the source array logical device and ID.

Pseu	do name=emc	oower1	64				_				
Symme	etrix ID=000	019780	0131								
Logi	cal device 1	ID=002	08								
Devi	ce WWN=60000	097000	029670	05585	5330303	1424	6				
Stan	dard UID=nag	a.6000	097000	02967	7005585	3303	031424	6			
	Convention							manad	TOREO		
cype.	=Conventiona	11; 3	tate=a	live;	pollo	:Y=2A	nmopt;	dacaca.	100-0		
cype	-conventione	al; s	tate=a	live;	polic	y=5y	mmope;	dacaca	103-0		
-ype									Path	Sta	ats
						- S	tor -	I/O			ats Errors
						- S	tor -	I/O	Path		
*** 1				I/O P	Paths	- S In	tor -	I/O	Path		

Removing the migration environment

Removing the environment removes the template used to create the SRDF/Metro groups for individual SG migrations. Once this template is removed another Environment Setup operation is necessary, which creates a new template, before being able to create migrations between the source and target arrays.

symdm -sid <SRC or TGT SN> -environment remove

```
C:\Users\Administrator>symdm -sid 131 -environment list
Symmetrix ID: 000197800131
Remote SymmID Status
-----
           ----
200296700558 OK
::\Users\Administrator>symdm -src_sid 558 -tgt_sid 131 environment -remove
A DM 'Environment Remove' operation is in progress. Please wait...
  Analyze Configuration.....Started.
    Source SID:000296700558
    Target SID:000197800131
   Analyze Configuration.....Done.
   Remove Configuration.....Started.
   Remove Configuration.....Done.
The DM 'Environment Remove' operation successfully executed.
2:\Users\Administrator>symdm -sid 131 -environment list
Symmetrix ID: 000197800131
The migration session environment is not configured
```

NDM Update: Offline migrations with minimal host downtime

Introduction

This section includes a guide plan, environment overview, and walkthrough procedures for the NDM Update migration feature.

NDM Update guide plan and environment overview With the inclusion of NDM update for HYPERMAXOS and PowerMaxOS (released in Q3 of 2019) and Solutions Enabler 9.1, parameters available during the create step include the following:

- Offline
 - Signifies that the migration will require a short application downtime
 - Applications to be shut down prior to running (if precopy was not used)
 - Successful create requires a host rescan or reboot prior to restarting application
- Move identity
 - Propagates device identities used to access source devices to the migration target
 - If not used, the application configuration needs to be changed to reflect the new devices on the target
- Precopy
 - Application can run on source during the create while data is being migrated
 - Requires a cutover to be run once data is migrated
 - Application must be shut down prior to cutover (makes target devices visible to host and source host inactive)
 - Host rescan or reboot needed

The offline parameter must be used in order to differentiate between NDM and a migration requiring minimal downtime (NDM Update). However, the move identity (NDM Update only) and precopy parameter are optional and can be used together or as individual parameters in addition to offline. Depending on the particular environment and user needs, the offline can be used with both precopy and move identity, or with either one.

The walkthrough guide in this section describes two methods for NDM Update using the following:

- Unisphere for PowerMax, Solutions Enabler included (Using Unisphere (no_precopy, no move_identity))
- Unisphere for PowerMax with precopy, Solutions Enabler included (Using Unisphere (with precopy, move_identity))

The duration of this walkthrough uses the PowerMax arrays in the graphic below.

NDM Update migrates SGs from 000197900111 to 000197600156.

000197600156 PowerMax_8000 5978.	7 %	0 0 0	-		-	14.4:1	×=	
000197900111 PowerMax_2000 5978.221.221	78 %	0 0 0	-	-	-	3.5:1		

Prior to the start of a planned migration, ensure that the prerequisite checks for using NDM Update have been completed:

- Ensure both the source and target array are RDF capable (RF emulation has been added to both arrays)
- Ensure that both arrays' RDF ports are zoned to each other (minimum of two connections required)
- Check for the correct zoning from the target array to the application host.

Even though the walkthrough guide provides a detailed device examination after each step, and inspects the workings of each of the issued commands, the user needs to issue three commands to migrate an SG from source to target:

- Create offline followed by a host rescan (if precopy was not used)
- Cutover (if precopy option used, followed by a host rescan)
- **Commit** followed by a host rescan

Note: If migrating Solaris Cluster environments using NDM Update, review Appendix G: NDM Update with Solaris cluster.

NDM Update walkthrough guide (source running 5977 or 5978 code)

Adding the migration environment: NDM or NDM Update environment setup

Once all the pre-requisites are met, use Unisphere for PowerMax to set up the NDM environment.

The environment setup configures the migration environment that will be required to setup the groups used to migrate all applications 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 usable replication pathway for data migration is available between source and target arrays.

This setup only needs to be run once and will be used for all NDM migrations between the selected source and target arrays. Should we need a second target array from the same source, then a second environment will need to be configured. Should RDF group 250 not be in use, the NDM environment will set up and use this group. If it is in use, the next available RDF group descending from 250 will be used. This applies to both arrays.

From the **Data Protection** menu, select **Migrations**. Select the **Environment** tab, and this will display any existing environments already set up.

To create an environment, select Create, choose the target array, and select Run Now.

≡	U	nisphere for PowerMax > 000197900111 -
	Home Dashboard Storage Hosts	Migrations Storage Groups Environments Create Remote Array
Ū	Data Protection	
	Storage Groups	
	SRDF Groups	Currently no
	Migrations	
	Virtual Witness	

Setup Migration	Environment	
Remote Array * 000197600156		<u>.</u>
0	CANCEL	ADD TO JOB LIST 👻
		Run Now Add to Job List

Using the CLI, run the following command:

symdm -src_sid 111 -tgt_sid 156 environment -setup

Examining further from the Replication dashboard, we can see the healthy migration environment between source array 130 and target 191.

Migrations		
Storage Groups En	vironments	
Create		
Remote Array	State	In Use
000197600156	Ø	~

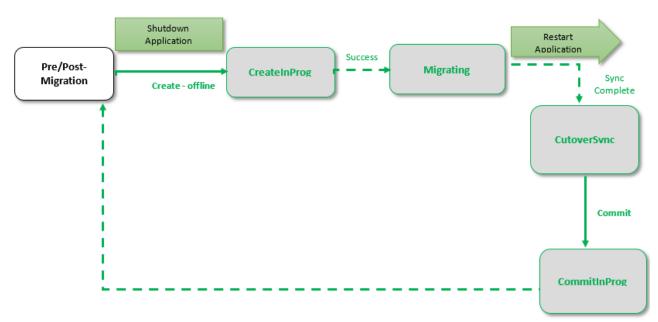
Using the CLI, run the following commands:

```
symdm -sid 111 -environment list
symdm -src sid 111 -tgt sid 156 environment -validate
```

Using Unisphere (no_precopy, no move_identity)

This process completes in the following sequence:

- 1. Shut down application
- 2. Create offline
- 3. Rescan/discover paths
- 4. Restart application
- 5. Complete synchronization
- 6. Commit



This use case involves migrating a storage group using NDM Update. Two reasons for choosing NDM Update for migration include the following:

- The host operating system and multipathing combination is not supported (see the support matrix).
- The user's application is capable at this time of taking an outage, and the user would prefer not to spoof devices WWNs on the new array.

Note: If migrating Solaris Cluster environments using NDM Update, review Appendix G: NDM Update with Solaris cluster.

Examining the five devices in this migration from the host operating system disk management (in this case, Windows Server 2016), they appear as Disk 2 through Disk 6. These were previously added as RDMs to the VMs using VMware vSphere.

Disk 2 Basic 17.00 GB Online	17.00 GB Unallocated
Disk 3 Basic 17.00 GB Online	17.00 GB Unallocated
Disk 4 Basic 17.00 GB Online	17.00 GB Unallocated
Disk 5 Basic 17.00 GB Online	17.00 GB Unallocated

Device			Device
Name	Num	Array ID	WWN
\\.\PHYSICALDRIVE3	001C3	000197900111	60000970000197900111533030314333
\.\PHYSICALDRIVE0	N/A	N/A	6000C29FC6F634EF2F656F630A7AC524
\.\PHYSICALDRIVE2	001C2	000197900111	60000970000197900111533030314332
\.\PHYSICALDRIVE5	001C5	000197900111	60000970000197900111533030314335
\.\PHYSICALDRIVE1	001C1	000197900111	60000970000197900111533030314331
\\.\PHYSICALDRIVE4	001C4	000197900111	60000970000197900111533030314334

The volumes are contained within the storage group **Minimally_Disrupt_Sg**:

	Minimally_Disrupt_Sg	SRP_1	Diamond	85.00 FBA	1
--	----------------------	-------	---------	-----------	---

NDM Update create with no_Precopy and No Move_Identity

This section migrates the storage group Minimally_Disrupt_Sg with the offline option. The offline parameter signifies this migration will require an application outage to complete successfully.

Before migrating with the offline parameter, the host application needs to be **shut down**. Once a successful create offline is run, a host **rescan** or reboot is required.

The move identity parameter is not used for this migration, which means that the device identity is propagated from the source to the target. When the create operation is complete, the host needs to be reconfigured for the new devices.

The create command performs the following:

- 1. Creates a storage group on the target array (name must not already exist in the target array) with the same name as the source storage group
- 2. Creates duplicate devices on the target array to match those on the storage group
- 3. Creates an initiator group using initiators with entries in the login history table
- Creates a port group (if one does not already exist or has not been selected by the user)

- 5. Invalidates the tracks on the RDF mirror to prepare for the copy
- 6. Starts the copy process in synchronous mode
- 7. Creates a masking view to the host from the target array.

At this point, you must **shut down your application**.

Note: There are measures in place to check for host I/O. However, this check is for a 15-second window and does **not** guarantee an application has been shut down, it is up to the user to verify manually that an application has been shut down successfully before progressing.

From the More Actions menu, click Migrate.

С	reate Modify	Provision	Protect	Set Host I/O Limits	Modify Service Levels
]	Name 🔺	Complian	ce SRP	Service Level	(Set Volumes
	111_Datastore		SRP_1	NONE	
	cse_pmax_poc_28		SRP_1	Diamond	Migrate
	cse_pmax_poc_30		SRP_1	Diamond	Allocate/Free/Reclaim
	cse_pmax_poc_32		SRP_1	Diamond	
	cse_pmax_poc_34		SRP_1	Diamond	SG Maintenance
)	EMBEDDED_NAS_DM_SG		NONE	Diamond	Change SRP
	ESX34_GKs		SRP_1	Optimized	,
]	Gks_SG	_	NONE	NONE	0.19 FBA
	Minimally_Disrupt_Sg		SRP_1	Diamond	85.00 FBA
	robtest		SRP_1	Diamond	800.00 FBA

From the resulting menu, select **Offline**. This alerts Unisphere for PowerMax that NDM Update is being used to migrate this storage group. This will then highlight the need for a host reboot.

eate Migration Wizard	d Minimally_Disrupt_Sg
1 Select Target	Array ID * 000197600156
2 Review Masking	
3 Review Migration	SRP
	Compression
	Ргесору
	Offline Move Identity
	Selecting offline will require a host reboot

From the next screen, there is the option to select a pre-existing port group from the target array, or with 9.1 and later, create a new port group as part of the create command. Click **Next**.

Create Migration Wizard Minimally_Disrupt_Sg						
Select Target	Front End Suitability Score					
2 Review Masking	Source and target systems must be collecting Performance Statistics to enable Front End Suitability.					
3 Review Migration	Target Masking Options					
	▼ Storage Group	Minimally_Disrupt_Sg				
	✓ Masking View	Minimally_Disrupt_Sg_MV				
	▼ Port Group	Minimally_PG				
	Ports	FA-2D:8				
	✓ Host	ESX_34_IG				
	Initiators	10000090fa9279b1 , 10000090fa927c04				

A breakdown of the planned migration session is displayed showing the masking elements and options selected for final approval. Click **Run Now**.

Create Migration Wizard Minimally_Disrupt_Sg				
 Select Target 	Target Array			
Review Masking	System ID	000197600156		
3 Review Migration	Options	Compression, Off	line	
	Migration Summary			
	Storage Group	Masking View	Port Group	Host
	Minimally_Disrupt_Sg	Minimally_Disrupt_Sg	Minimally_PG	ESX_34_IG

To validate and create the session using the CLI, run the following commands:

symdm -src_sid 111 -tgt_sid 156 -sg Minimally_Disrupt_Sg create offline -validate

```
symdm -src_sid 111 -tgt_sid 156 sg Minimally_Disrupt_Sg create -
offline
```

Once the create step has completed, click OK.

Task in Progress
Task in progress Hide Task Details
Starting Tasks Create migration for Minimally_Disrupt_Sg from 000197900111 to 000197600156, with compression: true, with offline selected Create migration for Minimally_Disrupt_Sg from 000197900111 to 000197600156, with compression: true, with offline selected Starting Data Migration entity creation Analyze ConfigurationStarted. Source SID:000197600110 Target SID:000197600156 Checking Source devices for I0Started.

Note: Run a host rescan at this point to discover the paths to the new devices on the target array.

Examine the created NDM Update session

To examine the migration session, click **Data Protection** > **Migrations**. The current state of the migration setting is **Migrating**.

G	Home	Migrations				
	Dashboard	-	Environ	monto		
	Storage	Storage Groups				2 it
Ŧ	Hosts		nmit	0 0 0		
D	Data Protection	Storage Group		State	Source	Target
Ť		Minimally_Disrupt_	Sg	Migrating	000197900111	000197600156
	Storage Groups					
	SRDF Groups					
	Migrations					

To view migration sessions using the CLI, run the following command:

symdm -sid 156 list

Reconfigure host and commit migration

During the create, paths to the source array will become host inactive. Since move identity was not used, **the host will need to be reconfigured reflect the new devices**. In this case, the new devices were added as RDMs to the VM using vSphere, also removing the old RDMs.

From the host operating system disk management, we can see the newly added devices.

NDM Update: Offline migrations with minimal host downtime

		-			1.0.1				
Volume			File System		Capacity	Free Space			
💳 (C:)	Simple	Basic	NTFS	Healthy (Boot, Page File, Crash Dump, Primary Partition)	119.51 GB	80.74 GB	68 %		
System Reserved	Simple	Basic	NTFS	Healthy (System, Active, Primary Partition)	500 MB	156 MB	31 %		
i.									_
Tisk 1									
Basic									
17.00 GB	17.00 GB								
Online	Unallocat	ed							
- Disk 2									
Basic									
17.00 GB	17.00 GB								
Online	Unallocat	ed							
-									
- Disk 3									
Basic									
	17.00 GB								
Online	Unallocat	ed							
- Disk 4									
Basic									
	17.00 GB								
	Unallocat	ad							
onne	Unallocat	eu							
-									
Disk 5 Rasic									
Unallocated	rimary pa	rtition							
	y pu							 	

Once the devices have been reconfigured to the host and the data is migrated from the source to the target array, we can commit the migration.

Click **Data Protection > Migrations**. The migration state will show **CutoverSync**.

Since this migration did not include precopy, a cutover is not necessary.

습	Home	Migrations			
믱	Dashboard	Storage Groups	Environments		
	Storage	Cutover Comn			2 items
Ē	Hosts	Storage Group	* State	Source	Target
V	Data Protection	Storage Group	State	Source	Target
	Storage Groups	Minimally_Disrupt_Sg	CutoverSync	000197900111	000197600156
	SRDF Groups				
	Migrations				

From here, select the **Minimally_Disrupt_Sg** storage group and click **Commit**. Click **Run Now**.

Commit	Minimally_Disrupt_S	g
Source	000197900111	
Target	000197600156	
0	CANCE	ADD TO JOB LIST 👻
	_	
		Run Now
		Add to Job List

Upon successful completion of a commit operation, the replication between source-side and target-side devices is removed and the application migration is complete.

To commit the session using the CLI, run the following command:

symdm -src_sid 156 -sg Minimally_Disrupt_Sg commit

Note: Run a host rescan at this point to remove any potential old paths to unmasked devices.

Canceling a migration

The cancel operation cancels a migration that has not yet been committed. If the application was reconfigured or running I/O against the target array, the administrator must shut down the application before issuing the cancel command. Upon successful completion of a cancel operation, if the -move_identity option was not given as part of the create operation, the application configuration needs to be changed to use the original source LUNs.

The administrator must perform a host rescan with the option to remove dead paths to clean up the paths that were created for the target-side LUNs. The administrator must identify the source or the target array as well as the application whose migration is to be canceled.

Upon completion of a cancel operation, the application storage will be as it was prior to the start of the migration:

- Connections between source-side and target-side devices that were used to migrate data through the DM replication pathway are severed.
- Any target-side resources configured for the application that are not used by other applications on the target array are removed. This includes pre-existing IGs or PGs used by the migrated view on the target array if these are not used in other masking views or groups.

To cancel a migration using the CLI, perform the following command:

symdm -sid 156 -sg Minimally Disrupt sg cancel

Note: If the administrator has configured local or remote replication of the target-side devices, a cancel will be blocked. The administrator needs to remove the replication sessions before the cancel can run.

Recovering a failed migration

A recover operation is needed after a migration step completes with a failed state, and it is not normally required as a part of a migration. Failed states, depending on the reason for the failure, can include the following:

- CreateFailed
- CutoverFailed
- MigrateFailed
- CancelFailed
- CommitFailed

After the condition that caused a migration operation (create, cutover, commit, or cancel) to fail has been corrected, a recover operation can be invoked to continue with the migration by completing the following:

- Determining which migration operation failed
- Putting the migration session resources (connections, devices) into the appropriate state to allow the failed operation to complete
- Repeating or resuming (depending on the cause of the failure) the failed action

To recover a failed migration using the CLI (once the reason for failure has been resolved), run the following command:

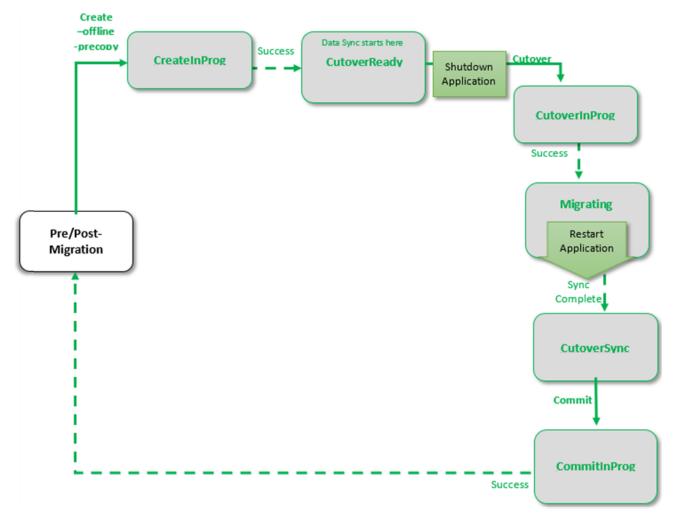
symdm -sid 156 -sg Minimally Disrupt sg recover

Note: The administrator must identify either the source or the target array as well as the application storage from which the data migration is to be recovered.

Using Unisphere (with precopy, move_identity)

This process completes in the following sequence:

- 1. Create offline with precopy
- 2. Monitor copy progress
- 3. Shut down application
- 4. Cutover
- 5. Rescan/discover paths
- 6. Restart application
- 7. Complete synchronization
- 8. Commit



This use case involves migrating a storage group using NDM Update. Two reasons for choosing NDM Update for migration include the following:

- The host operating system and multipathing combination is not supported (see the support matrix).
- The user's application is capable at this time of taking an outage and the user would prefer not to spoof device WWNs on restart

Examining the five devices in this migration from the host operating system disk management (in this case, Windows Server 2016), they show as Disk 2 through Disk 6. These were previously added as RDMs to the VMs using VMware vSphere.

NDM Update: Offline migrations with minimal host downtime

Disk 2 Basic 17.00 GB Online	17.00 GB Unallocated	
Disk 3 Basic 17.00 GB Online	17.00 GB Unallocated	
Disk 4 Basic 17.00 GB Online	17.00 GB Unallocated	
Disk 5 Basic 17.00 GB Online Unallocated	17.00 GB Unallocated Primary partition	

The volumes are contained within a storage group called Minimally_Disrupt_Sg:

C:\Users\Administrato Device	r≻syminq	-wwn Device		
Name	Num	Array ID	WWN	
<pre>\\.\PHYSICALDRIVE3 \\.\PHYSICALDRIVE0 \\.\PHYSICALDRIVE2 \\.\PHYSICALDRIVE5 \\.\PHYSICALDRIVE1 \\.\PHYSICALDRIVE4</pre>	N/A 001C2 001C5 001C1	000197900111 N/A 000197900111 000197900111 000197900111 000197900111	60000970000197900111533030314333 6000C29FC6F634EF2F656F630A7AC524 60000970000197900111533030314332 60000970000197900111533030314335 60000970000197900111533030314331 60000970000197900111533030314334	

Note: If migrating Solaris Cluster environments using NDM Update, review Appendix G: NDM Update with Solaris cluster.

NDM Update create using precopy and choosing to move identity

This walkthrough migrates the storage group Minimally_Disrupt_Sg with the offline option. The offline parameter signifies this is a migration that requires minimal disruption.

This walkthrough will also precopy the data to the target array and choose to move identity or spoof WWNs on the target.

The precopy option allows applications to continue running on the source during the create while data is being migrated. Once the data migration is complete, a cutover runs which requires the application to be shut down. The cutover also makes the target devices visible to the host and the source devices inactive.

The move identity parameter is also used, which propagates the source device identities to the target. Using the move identity does not require the host configuration to be changed to reflect new devices.

After successful completion of a create -precopy operation, the administrator can monitor the progress of the data copy and then perform a cutover operation when enough of the data copy is completed. The cutover operation switches the application to run on the target devices.

The create with precopy command completes the following:

- 1. Creates a storage group on the target array (name must not already exist in the target array) with the same name as the source storage group
- 2. Creates duplicate devices on the target array to match those on the storage group
- 3. Creates an initiator group using initiators with entries in the login history table
- Creates a port group (if one does not already exist or has not been selected by the user)
- 5. Invalidates the tracks on the RDF mirror to prepare for the copy
- 6. Starts the copy process in adaptive copy mode

From the More Actions menu, click Migrate.

Stora	ge Groups						
Cr	eate Modify	Provision	Protect	Set Host I/O Limits	Modify Service Levels		^]
	Name 🔺	Compli	ance SRP	Service Level	(Set Volumes	•	÷
	111_Datastore		SRP_1	NONE			
	cse_pmax_poc_28	•	SRP_1	Diamond	Migrate		
	cse_pmax_poc_30	•	SRP_1	Diamond	Allocate/Free/Reclaim	•	
	cse_pmax_poc_32		SRP_1	Diamond			
	cse_pmax_poc_34		SRP_1	Diamond	SG Maintenance	•	
	EMBEDDED_NAS_DM_SG		NONE	Diamond	Change SRP		
	ESX34_GKs		SRP_1	Optimized			~
	Gks_SG	_	NONE	NONE	0.19 FBA		8
	Minimally_Disrupt_Sg		SRP_1	Diamond	85.00 FBA		1
	robtest		SRP_1	Diamond	800.00 FBA		1

From the resulting menu, select **Offline**. This alerts Unisphere for PowerMax that we intend on using NDM Update to migrate this storage group. This will then highlight the need for a host reboot.

Also, for this example, choose the **Precopy** and **Move Identity** parameters.

Create	Create Migration Wizard Minimally_Disrupt_Sg							
1	Select Target	Array ID * 000197600156 -						
2	Review Masking							
3	Review Migration	 SRP Compression Precopy Offline Move Identity Selecting offline will require a host reboot 						

On the next screen, there is the option to select a pre-existing port group from the target array, or with 9.1 and later, create a new port group as part of the create command. Click **Next**.

Create Migration Wizard Minimally_Disrupt_Sg								
Select Target Front End Suitability Score Source and target systems must be collecting Performance Statistics to enable Front End Suitability.								
3 Review Migration	information (1)							
		Minimally_Disrupt_Sg						
	 Masking View 	Minimally_Disrupt_Sg_MV						
	▼ Port Group	Minimally_PG						
	Ports	FA-2D:8						
	▼ Host	ESX_34_IG						
	Initiators	10000090fa9279b1 , 10000090fa927c04						

A breakdown of the planned migration session is displayed showing the masking elements and options selected for final approval. Click **Run Now**.

Create Migration Wizard M	inimally_Disrupt_	Sg			
 Select Target 	Target Array				
Review Masking	System ID	000197600156			
3 Review Migration	Options	Compression, Pre	copy, Offline, Move Io	dentity	
	Migration Summary				
	Storage Group	Masking View	Port Group	Host	
	Minimally_Disrupt_Sg	Minimally_Disrupt_Sg	Minimally_PG	ESX_34_IG	

To validate and create the session using the CLI, run the following commands:

```
symdm -src_sid 111 -tgt_sid 156 -sg Minimally_Disrupt_Sg create -
offline -validate
symdm -src_sid 111 -tgt_sid 156 -sg Minimally_Disrupt_Sg create -
offline -precopy -move identity
```

Task in Progress	
7 Task In progress	
Hide Task Details	
Starting Tasks	
Create migration for Minimally_Disrupt_	Sg from 000197900111 to 000197600156, with compression: true, with precopy selected,
with offline selected, with move identity	selected
Create migration for Minimally_Disrupt_	Sg from 000197900111 to 000197600156, with compression: true, with precopy selected,
with offline selected, with move identity	selected
Starting Data Migration entity creation	
Analyze Configuration	Started.
Source SID:000197900111	
Target SID:000197600156	
Analyze Configuration	Done.
Duplicate Device(s) on Target	Started.
Preparing for device create on Target	Started.
Preparing for device create on Target	Done.
Wait for device create on Target	Started

Once the create step has completed, click OK.

Examine the created NDM Update session

To examine the migration session, click **Data Protection** > **Migrations**. The current state of the migration setting is **Migrating**.

۵	Home	Migrations				
88	Dashboard	Storage Groups	Enviro	nments		
	Storage			:		2 it
₹	Hosts		mm			
V	Data Protection	Storage Group	0	State	Source	Target
	Storage Groups	Minimally_Disrupt_	sg	Migrating	000197900111	000197600156
	SRDF Groups					
	Migrations					

To view migration sessions using the CLI, run the following command:

symdm -sid 156 list

Examine the created NDM Update session

Refreshing the migration list view or solutions enabler command, the migration session has completed the precopy process and has now entered a CutoverReady state, meaning all data has copied and a cutting-over control to the target array is now possible.

NDM Update: Offline migrations with minimal host downtime

Migrations							
Storage Groups	Environments						
Cutover Cor	Cutover Commit						
Storage Group		State	Source	Target			
Minimally_Disrupt_Sg		CutoverReady	000197900111	000197600156			

At this point, shut down your application (this example powered down the VM).

Note: There are checks in place to check for host I/O. However, this check is for a 15-second window and does not guarantee an application has been shut down. It is up to the user to verify manually that an application has been shut down successfully before progressing.

Cutover the migration

This operation is only used if the -precopy option was used with the create operation.

The cutover command makes the target devices visible to the host and the source devices inactive to the host. Any updates made to data on the target array are replicated back to the source array through the RDF link.

Before issuing the command, the administrator must first shut down the application. Upon successful completion of a cutover operation, the administrator must perform a host reboot and verify that new paths or new LUNs have been discovered prior to restarting the application.

Note: Since the move_identity parameter was selected for this example, a manual removal of old RDMs and the addition of new RDMs are not required. The host, upon reboot, will successfully discover the new LUNs assuming they are the original LUNs. However, before restarting an application, a visual verification of the paths should be undertaken.

<i>A</i> igrations								
Storage Groups Environments								
Cutover Commit								
Storage Group	State	Source	Target					
Flip_Test_RM	Invalid	000197900111	000197600156					
Minimally_Disrupt_Sg	CutoverReady	000197900111	000197600156					

Upon a successful cutover, the migration session state will switch to CutoverSync.

To cutover the migration session using the CLI, run the following command:

```
symdm -sid 156 -sg Minimally_Disrupt_Sg cutover
```

<i>Aigrations</i>							
Storage Groups	Environments						
Cutover Co	Cutover Commit						
Storage Group		State	Source	Target			
Flip_Test_RM		Invalid	000197900111	000197600156			
Minimally_Disrupt_	Sg	CutoverSync	000197900111	000197600156			

Since the move identity parameter was used, the device attributes were propagated from the source volumes to the target volumes. This can be seen below where the external identity differs from the native WWN. We have taken on the WWN of the paired source device and spoofed the target volume so it appears to the host as the same device.

ohere for P	owerMax	> 0001976001	56 -						(C' Q 🛱 🗘 🏟 2
Storage Gro	oups > Min	imally_Disrupt_Sg	1							
Details	Volumes									
Create	Expand	Add Volumes To SG	Remove Volumes				5 items \Xi	()	00041	
Name 🔺		Type	Allocated (%)		Capacity (GB) Emulation	Status		=	Emulation	гва
00041		RDF1+TDEV	_	88%	17.00 FBA	Ready		^	Symmetrix ID	000197600156
00042		RDF1+TDEV	_	91%	17.00 FBA	Ready			Symmetrix Vol ID	00041
00043		RDF1+TDEV		91%	17.00 FBA	Ready			HP Identifier Name	
00044		RDF1+TDEV		91%	17.00 FBA	Ready			VMS Identifier Name	
00045		RDF1+TDEV		91%	17.00 FBA	Ready			WWN	600009700001976001565330303
									External Identity WWN	600009700001979001115330303

At this point, **reboot the host and restart the application** (this example used a VM, requiring a rescan of the storage and restart of the VM).

Post-reboot, the device IDs remain the same to the host even though we are running on the target array 156.

C:\Users\Administrato Device	r≻syminq	-wwn	Device
Name	Num	Array ID	WWN
<pre>\\.\PHYSICALDRIVE3 \\.\PHYSICALDRIVE0 \\.\PHYSICALDRIVE2 \\.\PHYSICALDRIVE5 \\.\PHYSICALDRIVE1 \\.\PHYSICALDRIVE4</pre>	N/A 001C2 001C5 001C1	000197900111 N/A 000197900111 000197900111 000197900111 000197900111	60000970000197900111533030314333 6000C29FC6F634EF2F656F630A7AC524 60000970000197900111533030314332 60000970000197900111533030314335 60000970000197900111533030314331 60000970000197900111533030314334

Commit the migration

Once the CutoverSync state is reached and the user confirms all data has been successfully migrated to the target array, we can complete the migration by running the commit command. This will remove the migrated application resources from the source array and releasing resources used to perform the migration.

Upon successful completion of a commit operation, the replication between source-side and target-side devices are severed. The source-side devices migrated become longer be visible to a host, and since we chose the -move_identity option, the source-side devices are assigned the IDs the target-side devices were created with. This ensures they are no longer used by the application that was moved to the target array during the migration.

After completing the commit operation, the application migration is complete. The application will be running only on the target array and is no longer using the devices on the source array.

Migrations									
Storage Groups Environments									
Cutover Commit									
Storage Group	State	Source	Target						
Minimally_Disrupt_Sg	CutoverSync	000197900111	000197600156						

Data Migration Commit
Success
Hide Task Details
Starting Tasks
Commit migration for Minimally_Disrupt_Sg on array 000197900111
Starting Data Migration commit
Analyze ConfigurationStarted.
Source SID:000197900111
Target SID:000197600156
Analyze ConfigurationDone.
Remove Masking View(s) on SourceStarted.
Remove Masking View(s) on SourceDone.
Remove Data ReplicationStarted.
Remove Data ReplicationDone.
Succeeded Data Migration commit
Refreshing Data Migration commit entities
Succeeded

To commit the migration sessions using the CLI, run the following command:

symdm -sid 156 -sg Minimally_Disrupt_Sg commit

Once the migration session is committed, the session is removed from the migrations list view.

Environments									
Cutover Commit									
State	Source	Target							
	nit	nit							

Cancel a migration

A cancel operation cancels a migration that has not yet been committed. If the application was reconfigured, the administrator must shut down the application before issuing the cancel command. If I/O is currently running again on the target array, the cancel operation will fail.

The administrator must perform a host rescan with the option to remove dead paths to clean up the paths that were created for the target-side LUNs. The administrator must identify the source or the target array as well as the application whose migration is to be canceled.

Upon successful completion of a cancel operation, the application storage will be as it was prior to the start of the migration:

- Connections between source-side and target-side devices that were used to migrate data through the DM replication pathway are severed.
- Any target-side resources configured for the application that are not used by other applications on the target array are removed. This includes pre-existing IGs or PGs used by the migrated view on the target array if these are not used in other masking views or groups.

Recovering a failed migration

A recover operation is needed after a migration step completes with a failed state, and it is not normally required as a part of a migration. Failed states, depending on the reason for the failure can include the following:

- CreateFailed
- CutoverFailed
- MigrateFailed
- CancelFailed
- CommitFailed

After the condition that caused a migration operation (create, cutover, commit, or cancel) to fail has been corrected, a recover operation can be invoked to continue with the migration by completing the following:

- Determining which migration operation failed
- Putting the migration session resources (connections, devices) into the appropriate state to allow the failed operation to complete
- Repeating or resuming (depending on the cause of the failure) the failed action

To recover a failed migration using the CLI (once reason for failure has been resolved), run the following command:

symdm -sid 156 -sg Minimally_Disrupt_sg recover

Online Minimally Disruptive Migration (O-MDM)

This section includes an overview, updated interfaces, and procedures for the Online Minimally Disruptive Migration (O-MDM) feature.

Overview O-MDM (Open Minimally Disruptive Migration) utilizes Open Replicator (ORS) as the data transfer mechanism instead of native SRDF/Metro used by NDM. ORS is a SCSI block migration feature that transfers data from an external array through a WWN designated FBA source device.

As such, it is extremely flexible in the source arrays supported:

- Currently targeting support for all arrays supported by ORS, including all shipping VMAX/PowerMax, Dell and competitive arrays.
- OS and Multi-pathing software (MPIO, PowerPath, and so on) currently supported by ORS will be supported.

ORS integration supports the familiar create/cutover/commit as a typical NDM migration. Source array devices are presented to PowerMax front end FA ports through the donor array native provisioning mechanism. The symsan SYMCLI command can be used to verify PowerMax visibility on these devices.

New symdm command syntax, create -san -offline, is used to initiate a new O-MDM migration session. This new command syntax requires a new option (-file) specifying the input of a file containing a list of donor device WWNs familiar to ORS users. Target devices, associated SGs, and front-end host mapping are then created. Target devices created on the PowerMax are rounded to the nearest cylinder size.

Similarly, Unisphere 10.0 includes a SAN WWNS tab from the Data Protection -> Migration option for initiating and managing O-MDM migrations:

	Unis	phere	for PowerMax > (000120200107 -						
ធ	Overview		Migrations							
88	Dashboard		SESSIONS	ENVIRONMENTS	SAN WWNS					
	Storage	>	Scan							
۵	Hosts	>								
¢	Data Protection	~								
	Snapshot Policies MetroDR									
	SRDF Groups									
	Migrations									
	Virtual Witness									
	Open Replicator									
	Device Groups									
Ø	Performance	>				Ģ				
8	System	\rightarrow				No WWNs	Found			
	Events	>				To Find WWNs, launch				
0	Support									
«										

Prior to the cutover command, the source application must be shut down (minimally disruptive). After a cutover command, target devices from PowerMax are made visible to the host. Applications can then be restarted now that they are sourced from the PowerMax. ORS Donor Update is then used to keep the source devices/array updated.

Commit can then be initiated to stop the migration session and associated ORS Donor Update session to source devices.

The SYMCLI symdm command syntax has changed, with the following new options (highlighted in bold text) to support the O-MDM functionality:

symdm -tgt_sid <SymmID>

```
[-i <Interval>] [-c <Count>] [-noprompt]
[-tgt_srp <SRPName>] [-tgt_pg <PgName>]
[-nocompression] [-validate]
create -src_sid <SymmID> -sg <SgName> [-precopy]
create -src_sid <SymmID> -sg <SgName>
-offline [-move_identity] [-precopy]
```

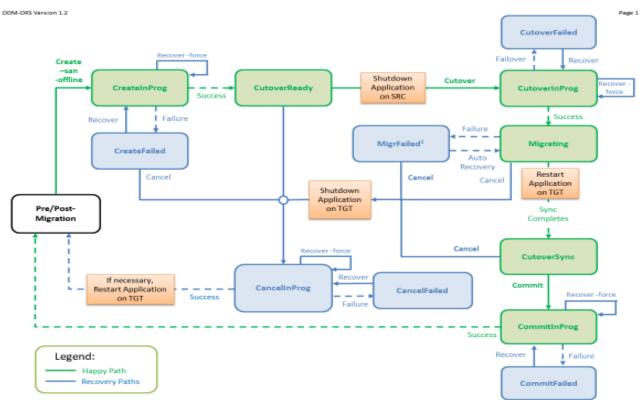
create -file <FileName> -tgt_sg <SgName>
-tgt_ig <IgName> -san -offline

Options:

- -san Specifies the migration to be an Open Data Migration (O-MDM).
- -file Specifies the file name that contains a list of source side device WWNs to be migrated.
- -tgt_sg Specifies the target storage group name that will be created for the target devices. This name will also be used for other target side masking objects (port group, if one does not exist and masking view) created during a migration.
- -tgt_ig Specifies the target side initiator group that contains host application initiators mapped to both the PowerMax and source side arrays.

Migration flow
and statesIt is important to understand the migration workflows and associated states supporting the
O-MDM functionality. Review the following chart and state description table with emphasis
on the new create, cutover, application shutdown, cancel, and recovery states:

Online Minimally Disruptive Migration (O-MDM)



Note 1: A application outage will likely occur if a failure happens during the application data migration phase.

Migration state	Description
No migration	There is no migration in progress.
CreateInProg	The migration session is being created. The create command has not run to completion with either a success or a failed status.
CreateFailed	The create command has run to completion with a failed status.
CutoverReady	The create command has run to completion with a success status. Target devices are not masked to the host.
CutoverInProg	The cutover command is in progress and the application is being moved to the target array. The cutover command has not run to completion with either a success or a failed status.
CutoverFailed	The cutover command has run to completion with a failed status.
Migrating	The Cutover command succeeded. I/O's can be serviced by devices on the target array.
MigrateFailed	This state occurs when a Migrating state is interrupted, as might occur with a loss of the required DM connectivity between the source and target arrays.
CutoverSync	The Cutover command completed successfully. The application is running on the target array, and all data has been synchronized between the target and source arrays.
CommitInProg	The commit command is in progress. The commit command has not run to completion with either a success or a failed status.
CommitFailed	The commit command has run to completion with a failed status.
CancelInProg	The cancel command is in progress. The cancel command has not run to completion with either a success or a failed status.
CancelFailed	The cancel command has run to completion with a failed status.

Create phase changes

This section describes the changes and new requirements in the create phase of an O-MDM migration.

The administrator must now identify the source WWNs, target array ID, and existing target array initiator group. The source WWNs are a list of hexadecimal WWNs. These WWNs can be verified using the 'symsan' CLI command.

Example contents of an 8 WWN source file: omdm_8wwn.txt:

```
60000970000197802041533030433742
60000970000197802041533030433743
60000970000197802041533030433744
60000970000197802041533030453941
60000970000197802041533030453942
60000970000197802041533030453943
60000970000197802041533030453944
60000970000197802041533030453945
```

This list may be created and verified from the following symsan command as an example:

symsan Symmet:				anluns -ww 97801721	n 5000	00973A	811	FE449 -dir all -p all			
-	Remote Port WWN: 50000973A81FE449										
	~ -										
	ST										
	A 					_					
	T Fl	ags	Block	Capacity	LUN	Dev		LUN			
DIR:P	E ICF	THS	Size	(MB)	Num	Num	W	WWN			
							-				
02D:11	RW	FXX	512	187500	38	00C7B	Х	60000970000197802044533030433742			
02D:11	RW	FXX	512	187500	39	00C7C	Х	60000970000197802044533030433743			
02D:11	RW	FXX	512	187500	ЗA	00C7D	Х	60000970000197802044533030433744			
02D:11	RW	FXX	512	187500	3B	00E9A	Х	60000970000197802044533030453941			
02D:11	RW	FXX	512	187500	3C	00E9B	Х	60000970000197802044533030453942			
02D:11	RW	FXX	512	187500	3D	00E9C	Х	60000970000197802044533030453943			
02D:11	RW	FXX	512	187500	ЗE	00E9D	Х	60000970000197802044533030453944			
02D:11	RW	FXX	512	187500	ЗF	00E9E	Х	60000970000197802044533030453945			

Similarly, the Unsphere 10.0 interface allow you to select donor devices from the WWNs that are available to the array:

Unisphere for Pov	werMax > 000120200107								
Migrations									
SESSIONS ENVIR	IONMENTS SAN WWNS								
SHOW SELECTED PORTS									
Scan Create									21 it
Remote Volume WWN 1	Vendor	Capacity (GB)	Volume	LUN	Emulation	Array ID	Thin	State	
514F0C500000000	EMC XtremiO	0.00	000-1	0	FBA	XID00190718313	No	Ready	
514F0C50E8E00040	EMC Xtremi0	5.00	000-1	1	FBA	XID00190718313	No	Ready	
514F0C50EBE00041	EMC Xtremi0	5.00	000-1	2	FBA	XID00190718313	No	Ready	
514F0C50EBE00042	EMC Xtremi0	5.00	000-1	3	FBA	XID00190718313	No	Ready	
514F0C50EBE00043	EMC XtremiO	5.00	000-1	4	FBA	X0000190718313	No	Ready	
514F0C50EBE00044	EMC XtremiO	10.00	000-1	5	FBA	XID00190718313	No	Ready	
514F0C50EBE00045	EMC Xtremi0	10.00	000-1	6	FBA	XI000190718313	No	Ready	
514F0C50E8E00046	EMC Xtremi0	10.00	000-1	7	FBA	XID00190718313	No	Ready	
514F0C50E8E00047	EMC XtremiO	10.00	000-1		FBA	XID00190718313	No	Ready	
514F0C50EBE00048	EMC Xtremi0	15.00	000-1	9	FBA	XID00190718313	No	Ready	
514F0C50EBE00049	EMC XtremI0	15.00	000-1	A	FDA	XI000190718313	No	Ready	
514F0C50EBE0004A	EMC XtremiO	15.00	000-1	8	FBA	XID00190718313	No	Ready	
514F0C50E8E00048	EMC XtremiO	15.00	000-1	С	FBA	XID00190718313	No	Ready	
514/0C50E8E0004C	EMC Xtremi0	29.00	000-1	D	FBA	XI000190710313	No	Ready	
514F0C50E8E0004D	EMC XtremIO	20.00	000-1	E	FBA	XI000190718313	No	Ready	
514F0C50E8E0004E	EMC XtremiO	29.00	000-1	F	FBA	XID00190718313	No	Ready	
514F0CS0EBE0004F	EMC Xtremi0	29.00	000-1	10	FBA	XID00190718313	No	Ready	
514F0C50EBE00050	EMC XtremIO	25.00	000-1	11	FBA	XI000190718313	No	Ready	

The 'create' command first verifies that the requirements and restrictions are met to ensure that the migration can proceed and verifies that the target array has sufficient resources available to duplicate the application's storage. The application's storage configuration is then copied to the target array, creating equivalently provisioned devices. ORS activate (data copy) does not start until the following cutover action occurs.

When creating the storage configuration on the target array:

- 1. A device created on the target array will be rounded up to the nearest cylinder size of the capacity of the source device.
- 2. An SG with the name as given in the command is created and all the devices created will be added to it.
- 3. If an SRP is specified, that SRP will be set on the SGs created on the target array. If not specified, then no SRP will be configured on the SG created on the target array. This will result in the default SRP being used.
- 4. When creating a new PG on the target array, ports are selected from the Login History Table (LHT) of ACLX enabled FC ports where the host initiators were seen, ignoring the current logged in status.
- 5. If a PG name is specified, an existing PG on the target array will be used and the host initiators must appear in the Login History Table (LHT) of at least one port, ignoring the current logged in status.
- 6. The name of any port group or masking view created will be derived from the storage group name provided in the command line for the migration.

Example of a Unisphere 10.0 create dialog after the donor device WWNs have been chosen:

Review WWNs	Review WWNs					
Storage Group	Review WWNs					
Hosts	Remote Volume WWN ↑	Vendor	Capaci	Volume	LUN	Array ID
Ports	514F0C50EBE00044	EMC XtremI0	10.00	000-1	5	XIO0019071
	514F0C50EBE00045	EMC XtremI0	10.00	000-1	6	XIO0019071
Summary	514F0C50EBE00046	EMC XtremI0	10.00	000-1	7	XIO0019071
	514F0C50EBE00047	EMC XtremIO	10.00	000-1	8	XIO0019071

After the application's storage configuration has been duplicated on the target array, the create operation concludes by connecting source-side devices with the corresponding target-side devices through a DM replication pathway and starts the data migration. The migration will immediately enter the CutoverReady state. The administrator must shut down the application before a Cutover operation can be issued. A 'cancel' command can

be used to cancel the migration and undo the target-side storage provisioning done by the create operation.

If the create action fails:

• When the cause of the failure has been corrected, a recover operation can be attempted ('symdm recover') to complete creation of the migration session.

(or)

 The migration can be canceled ('symdm cancel'), leaving the application's storage environment as it was before the start of the migration, with resources configured for the application on the target removed.

The following command creates an Open Data Migration (O-MDM) session. The following is displayed when the 'symdm create -san' command is issued:

```
symdm create -san -offline -file src wwn list.fil -tgt sid 644 -tgt sg APP1
-tgt ig APP1 INIT GRP
A DM 'Offline SAN Create' operation is
in progress for storage group 'APP1'. Please wait...
  Analyze
Configuration.....Started.
   Source Array: APM00150519204
   Target Array:000197900644
  Analyze Configuration.....Done.
  Creating
Device(s).....Started.
  Creating Device(s) on Target.....Done.
  Update target SG Device(s).....Started.
  Update target SG Device(s).....Done.
  Create Storage Group(s) on Target.....Started.
  Create Storage Group(s) on Target.....Done.
  Create Port Group(s) on Target.....Started.
  Create Port Group(s) on Target.....Done.
  Start Data
Replication.....Started.
  Start Data Replication.....Done.
The DM 'Offline Create' operation successfully executed for
```

```
storage group 'APP1'.
```

Cutover and
commit phase
changesThis section describes the changes and new requirements in the cutover phase of an O-
MDM migration.For minimally disruptive migrations, the administrator must first shut down the application
before issuing the 'cutover' command. The operation will make the target devices visible
to the host. Any updates made to data on the target array will be replicated back to the
source array through the DM replication pathway. Upon successful completion of a
cutover operation, the administrator must perform a host rescan (or host reboot) and
verify that new LUNs have been discovered prior to restarting the application. The

Dell PowerMax and VMAX: Non-Disruptive and Minimally Disruptive Migration Best Practices and Operational Guide

application configuration would also need to be changed to use the new LUNs.

This command is used when the migration session is in the CutoverReady state. It migrates the application's processing to run only against the target array. The following is displayed when the 'symdm cutover' command is issued:

symdm cutover -sid 643 -sg APP1

```
A DM 'Cutover' operation is
in progress for storage group 'APP1'. Please wait...
```

Analyze

Configuration.....Started. Source Array:APM00150519204 Target Array:000197900644 Analyze Configuration.....Done. Preparing Devices for Host discovery.....Started.

Started.

Cutover.....Done.

Create Masking V	iew(s) on	TargetStar	ted.
Create Masking V	iew(s) on	TargetDone	· .

```
The DM 'Cutover' operation successfully executed for storage group 'APP1'.
```

This command completes the migration by removing application resources from the source array and releasing resources used for the migration. The following is displayed when the 'symdm commit' command is issued:

```
symdm commit -sid 643 -sg DM_APP1
Analyze Configuration.....Started.
Source Array:APM00150519204
Target Array:000197900644
Analyze Configuration.....Done.
Remove Data Replication....Started.
Remove Data Replication....Done.
```

The DM 'Commit' operation successfully executed for storage group 'APP1'.

Canceling a The 'cancel' command cancels a migration that has not yet been committed. The administrator must identify the target array and the application whose migration is to be canceled. For minimally disruptive migrations, the administrator must shut down the application before issuing the cancel command. Upon successful completion of a cancel operation, the application configuration would need to be changed to use the original source LUNs before it can be restarted.

Upon successful completion of a cancel operation, the application storage will be as it was prior to the start of the migration:

- Connections between source-side and target-side devices that were used to migrate data through the DM replication pathway will be severed, and
- Any target-side resources configured for the application that are not used by other applications on the target array will be removed.
- This will include pre-existing PGs used by the migrated view on the target array, if these are not used in other masking views or groups.

The administrator must perform a host rescan with the option to remove dead paths to clean up the paths that were created for the target side LUNs.

If the administrator has configured local or remote replication of the target-side devices, then a cancel will be blocked. Administrator will need to remove the replication sessions before running the cancel operation.

The following command can be used to cancel a migration. After a successful cancel, the application will be running against its storage on the source array, and any resources configured for the application on the target array by the migration create processing will have been removed.

Analyze Configuration.....Started. Source Array: APM00150519204 Target Array:000197900644 Checking Target devices for IO.....Started. Checking Target devices for IO.....Done. Analyze Configuration.....Done. Remove Data Replication.....Started. Remove Masking View(s) on Target.....Started. Remove Masking View(s) on Target.....Done. Remove Data Replication.....Done. Remove Port Group(s) on Target.....Started. Remove Port Group(s) on Target.....Done. Remove Storage Group(s) on Target.....Started. Remove Storage Group(s) on Target.....Done. Remove created Device(s) on Target.....Started. Remove created Device(s) on Target.....Done.

The DM 'Cancel' operation successfully executed for storage group 'APP1'.

Recovery fromA 'recover' operation is needed after a step in the migration completes with a "failed" stateFailed Stateand is not normally required as a part of a migration.

Failed states include: CreateFailed, CutoverFailed, CancelFailed, and CommitFailed. The 'recover' command is not used for the MigrFailed state, because that state is auto recovered.

symdm cancel -sid 643 -sg APP1

After the condition that caused a migration operation to fail has been corrected (create, cutover, commit, or cancel), a recover operation can be invoked to continue with the migration by:

- Determining which migration operation failed.
- Putting the migration session's resources (connections, devices, and so on) into the appropriate state to allow the failed operation to complete.
- Repeating or resuming (depending on the cause of the failure) the failed action.

The administrator must identify the target array and the data migration session name to be recovered.

After an error, the 'symdm recover' can be used after correcting the cause of a failed symdm action (create, commit, or cancel) to put the migration into the appropriate state, and then repeat or resume the failed action.

symdm recover -sid 643 -sg APP1

Start Data

```
A DM 'Recover' operation is
in progress for storage group 'APP1'. Please wait...
Analyze
Configuration.....Started.
Source Array:APM00150519204
Target Array:000197900644
Analyze Configuration....Done.
Creating Device(s).....Not
Needed.
Update target SG Device(s).....Not
Needed.
Create Storage Group(s) on Target.....Not Needed.
Create Port Group(s) on Target.....Not Needed.
Start Data
```

Replication.....Started.

Replication.....Done.

The DM 'Recover' operation successfully executed for storage group 'APP1'.

The following is a recovery from a failed Commit:

symdm recover -sid 643 -sg APP1 A DM 'Recover' operation is in progress for storage group 'APP1'. Please wait... Analyze Configuration.....Started. Source Array:APM00150519204 Target Array:000197900644 Analyze Configuration....Done. Remove Data Replication....Started. Remove Data Replication....Done.

146 Dell PowerMax and VMAX: Non-Disruptive and Minimally Disruptive Migration Best Practices and Operational Guide

```
The DM 'Recover' operation successfully executed for
storage group 'APP1'.
          The following is a recovery from a failed Cancel:
symdm recover -sid 643 -sg APP1
A DM 'Recover' operation is
in progress for storage group 'APP1'. Please wait...
  Analyze
Configuration.....Started.
    Source Array: APM00150519204
    Target Array:000197900644
  Checking Target devices for IO.....Not
Needed.
  Analyze
Configuration.....Done.
  Remove Masking View(s) on Target.....Not Needed.
  Remove Data Replication.....Started.
  Remove Data Replication.....Done.
  Remove Port Group(s) on Target.....Started.
  Remove Port Group(s) on Target.....Done.
  Remove Storage Group(s) on Target.....Started.
  Remove Storage Group(s) on Target.....Done.
  Rollback update of target SG Device(s).....Started.
  Rollback update of target SG Device(s).....Done.
Remove created Device(s) on Target.....Started.
Remove created Device(s) on Target.....Done.
```

```
The DM 'Recover' operation successfully executed for storage group 'APP1'.
```

```
Additional query
and list output
changes This section describes the additional query and list outputs within an O-MDM migration.
The following list output displays a new flag column showing if the session is a SAN (O-
MDM) migration session:
```

symdm -sid 644 list

Symmetrix ID : 000197900644

Storage Group	-	Source Array	Target Array	State	Capacity (GB)	Done (%)
APP1	xx	APM00150519204	000197900644	CutoverSync	100.7	100
APP2	x.	000197100643	000197900644	Migrating	8.0	90

Legend:

Flags:	
(O)ffline	X = Offline, . = N/A
(S)AN	X = SAN, . = N/A

Total

Online Minimally Disruptive Migration (O-MDM)

If the -sg option is given, the new SAN flag will be shown as a new field below the SG name:

symdm list -sid 643 -sg APP1

Symmetrix ID :	000197100643
Storage Group:	APP1
Offline :	Yes
SAN :	Yes

			Total	
Source	Target		Capacity	Done
Array	Array	State	(GB)	(응)
APM00150519204	000197900644	CutoverReady	100.7	N/A

The following is an example of the verbose list output:

symdm list -sid 789 -sg APP3 -v -detail -pairs info

Symmetrix ID	: 0001978	01789					
Storage Group Offline SAN	: APP3 : Yes : Yes						
Source Array Target Array	: 0001978 : 0001978						
Migration State Total Capacity (GB) Done (%)	: 183.1	Ready					
Device Pairs (1): Failed {							
Source	Source	Source	Source	Target		Error	Last Error Code
WWN	Vendor	Array	Dev	Dev	Status	Code	Timestamp
 6000097000019790070953303038463 }	4 EMC Symmetrix	000197900709	008F4	01753	OK	NO_PATH	Fri Oct 15 10:41:05 2021

If the Migration State is MigrateFailed, the Source WWN Status (Error Code) field will be one of the following different values:

- NDEF (not defined, the initial status of an O-MDM device when the session is created)
- NO_PATH (all of the paths to the target are down)
- LUN_NR (LUN not ready, indicates that the target/source device LUN is not ready)
- WR_PROT (write protect set on the LUNs)

In addition, the Last Error Timestamp will note (format example, Thu Sep 19 07:03:12 2019) when the error was encountered for that specific source WWN – target device pair.

Limitations and The following are known limitations or restrictions regarding an O-MDM migration:

restrictions

- Target array must be PowerMax 2500/8500 (V4) Hardware.
- Source or donor array must be VMAX3, VMAX All Flash, PowerMax, other Dell storage, or supported third party array.
- Data migrations are often complex operations and require careful planning and execution of predetermined procedures. Failure to identify and perform necessary steps or work within supported configurations can result in data unavailability or loss.
- Source side WWNs must be 512 byte block size
- No more than 1,024 LUNs can be migrated in a single O-MDM session
- All initiators provisioned to an application on the source array must appear in the Login History Table (LHT) of the target array provided. The name of the port group must exist on the target array and have the initiators appear on the LHT for at least one port in the port group. These ports must be ACLX enabled FC ports.
- FCoE and iSCSI ports are not supported.
- The names of the masking groups that are being created as part of the migration must not exist on the target array.
- The SRP that will be used for target-side storage, whether specified or defaulted, must have enough free capacity to support the migration.
- The target array must be capable of supporting the additional devices that the migration will create to receive the source-side data.
- The target masking configuration of the migrated application must not be added.
- Changing the masking configuration after the start of the migration can cause the O-MDM controls to be disallowed.
- The only exceptions are:
 - Changing the SLs or SRPs on the SG
 - Changing the compression attribute on SG
 - Adding Host IO limits on SG
 - Adding more ports to the PG, only FC ports (not NVMe over FC) are supported
- After the migration has started copying the data to the target array, devices can have R1 mirrors added so they can be used for remote replication. Migration controls will evaluate the states of these devices when determining if the control can proceed.
- The R1 mirrors added to the target devices can be in Asynchronous, Adaptive Copy, or Synchronous Mode but:
 - Cannot be enabled for MSC
 - Cannot be part of a Star or SQAR configuration
 - Cannot be enabled for Synchronous SRDF Consistency
 - Cannot be part of an RDF/Metro configuration

- Devices in other SRDF groups paired with target devices cannot be the target of a data synchronization operation during the lifecycle of the migration session (that is, cannot copy data to devices being migrated).
- When the migration session reaches the complete state, LREP snapshot session will be allowed to be created on O-MDM target device.
- If a device has any association with the migration session, LREP snapshot session will be blocked from being created on O-MDM target device.

Masking enhancements (SE 9.0)

Introduction

Solutions Enabler 9.0 introduced enhancements to manipulate masking views while maintaining host access to the array. Although the enhancements came about because of NDM, they are available for regular masking operations.

These user-experience enhancements are listed as follows:

- Added the ability to select a port group on the target array for the NDM session (see Selecting a port group during an NDM create)
- Added the ability to migrate a child-only storage group (see Migrate a child-only SG)
- Enabled migrating a subset of devices in a storage group (see Migrate a subset of devices in an SG).
- Allowed consolidating a single application speed across two source arrays into a single target array (see Consolidate a single application on two arrays into a single target).
- When creating an NDM session, devices are automatically set to RDF capable (see When creating an NDM session set devices RDF capable).
- Added the ability to set up DR from the target array prior to the devices synchronizing fully (see Add DR to target SG before synchronization).
- Enabled creating boot LUNs on the target array the same as the source array's LUN address (see Create bot LUNs on the target array the same as the source array).

Selecting a port
group during an
NDM createCreating a port groupTo create a port group using Unisphere, select Hosts > Port Groups and click Create.
Give the group a name and select F or the ports for the group. Click Run Now.

150 Dell PowerMax and VMAX: Non-Disruptive and Minimally Disruptive Migration Best Practices and Operational Guide

	Unisphere for PowerMax > 000197800131 -	
A НОМЕ	Best Crewer	
DASHBOARD	Creete Modify	
STORAGE	Create	Ponts Masking Views
HOSTS	131_ESX146_GK_PG	2 2
Hosts	NDM_PG	2 1
Masking View	ORS	1 1
Masking view		4 1
Port Groups		

fort Group Name * EnhancementsPG				
Select Port Group Type				
Fibre O iSCSI				
Select one or more Ports t	o be added to the Port Group			
Dir:Port 🔺	Identifier	Port Groups	Masking Views	Volumea 🔳
FA-10-28	50000973a8020c1c	3	4	19
FA-1D:29	50000973a8020c1d	2	2	5
FA-2D:28	50000973a8020c5c	3	4	23
FA-20:29	50000973a8020c5d	1	1	1
				Run Now

To create a port group with Solutions Enabler, use the symaccess library, specifying the director numbers and specific ports. For example:

C:\Program Files\EMC\SYMCLI\bin>symaccess -sid 131 create -name EnhancementsPG -type port -dirport 1d:29,2d:28
C:\Program Files\EMC\SYMCLI\bin>_

When using the Create Migration wizard in Unisphere, select the port group when defining the target. For example:

 Select Target 	Symmetrix ID * 000197800131
Ø Select Type	00019/800131
Summary	SRP_1 ←
	Select Port Group Name
	Q. Enter the name of the port group to filter
	131_ESX146_GK_PG
	✓ EnhancementsPG
	ORS
	SLO.TEST

In Solutions Enabler, use the -tgt_pg option to specify the port group on the target array. For example:

C:\Program Files\EMC\SYMCLI\bin>symdm create -src_sid	558 -tgt_sid 131 -sg EnhancementsSgParent -tgt_pg EnhancementsPG
Execute 'Create' operation on SG 'EnhancementsSgParent	t' (y/[n])? y
A DM 'Create' operation is	
in progress for storage group 'EnhancementsSgParent'.	Please wait
Analyze Configuration	Started.
Source SID:000296700558	
Target SID:000197800131	
Analyze Configuration	Done.
Initialize Replication Environment	Started.
Initialize Replication Environment	Done.
Create Storage Group(s) on Target	Started.
Create Storage Group(s) on Target	Done.
Duplicate Device(s) on Target	Started.
Preparing for device create on Target	Started.
Preparing for device create on Target	Done.
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.
Start Data Replication	Started.
Start Data Replication	Done.
Create Masking View(s) on Target	Started.
Create Masking View(s) on Target	Done.
The DM 'Create' operation successfully executed for	
storage group 'EnhancementsSgParent'.	

Migrate a child-
only SGTo migrate a child SG, we must first non-disruptively remove the child SG from the parent
SG.

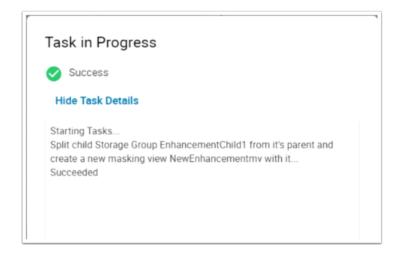
In Unisphere, select the parent SG from the **Storage Groups** dashboard. Click the **More**

Actions menu and select SG Maintenance > Split From.

		Unisphe	le loi i	owerivia	ax > 0002	96700558						CQI	
HOME													
DASHD		Stora	ge Gro	ups							~		
STORA	ICF.	Create Modify		Modify	Provision	Protect Set Host I/O Limits		Migrate			Enhancements	sSgParent	
aronoue		Name .					FAST Array Advisor			-	0000017005		
Storag	Storage Groups 146_Gks_NDM			Symmetrix ID					0002967005				
		CSE_eNAS Demo_Uni_SG1		SRP_1	Optimized		Expand ProtectPoint		Compliance				
Refere	nce Workloads			Uni_SG1	SRP_1	Optimiz	zed	Set Volum	es		Service Level	NONE	
	Ince Horniouda		EMBED	DED_NA	NONE	Gold			Workload Type	NONE			
Storag Pools			enas_d	est	SRP_1 Optimized		Allocate/Free/Reclaim +			SRP	NONE		
		End2End_SG1 SRP_1		SRP_1	Bronze		SG Maintenance			Convert to Cascaded	60.01		
			 Enhand 	ements	NONE NONE						10		
			Enha	ncement	SRP_1	Optimiz	zed	50.00	FBA		Split From	1	
Mainfr			Enha	ncement	SRP_1	Optimia	zed	10.00	FBA		Merge Into		
Mainth			ESX 14	2_GKS_	SRP_1	Optimiz	red	0.04	FBA			FBA	

If there are multiple child SGs, select which one you would like to migrate and give a name to the masking view that will be created. Click **Run Now**.

Enhancement	p*	
Ennancement		•
Masiding View Nam	ie *	
NewEnhancer	nentmv	
	and a	
-		
0	CANCEL	ADD TO JOB LIST -
ITTIZEU		
imized		Run Now



		Unis	spher	e for P	owerMax	> 000	296700558	3 •					C Q 🖬
ń			Storag	e Grou	ins								
5		ľ	Cree		Modify	Provision	Protect	Set Host I/O Limits	:	15 items \Xi	()	Enhancement	Child1
9	STORAGE			Name -			SRP	Service Level	Capacity (GB)	Emulation	=		
	Storage Groups			146. Gk	s NDM Cypres	5	SRP_1	Optimized	0.06	FBA		Symmetrix ID	000296700558
			1.1	CSE.eN	IAS		SRP_1	Optimized	1,600.01	FBA		Compliance	•
	Reference Workloads			Demo_l	Jni_SG1		SRP_1	Optimized	80.00	ГDА		Service Level	Optimized
				EMBED	DED_NAS_DM_	SG	NONE	Gold	1,013 60	FBA		Workload Type	NONE
	Storage Resource Pools			enas_de	est		SRP_1	Optimized	1.00	rва		SRP	SRP_1
				End2En	d_SC1		SRP_1	Bronze	5.00	FBA		Capacity (GB)	50
		[Enhano	ementChild1		SRP_1	Optimized	50.00	FBA		Volumes	5
			•	Enhano	ementsSgParer	4	NONE	NONE	10.00	ГВА			-
	1 State Street			Enhar	cementChild2		SRP_1	Optimized	10 00	FBA		Masking Views	1

Once the process is complete, the child storage group is promoted to tier one on the SG nesting with its own masking view to the host. For guidance on how to migrate the SG see the section on Metro-based NDM (Using Unisphere for PowerMax or Using Metro NDM using Solutions Enabler 9.x) or Metro-based NDM with precopy (Using Unisphere for PowerMax with precopy or Using Solutions Enabler 9.x with precopy).

With Solutions Enabler, use the **symsg** library:

symsg -sg <SgName> -sid <SymmID>
merge <SgName1>
split <SgName1> -view name <MvName>

For the split operation, the -sg <SgName> option to specify the source SG, for example, EnhancementsSgParent for the split operation.

For a cascaded (parent child) source SG, the <SgName1> (EnhancementChild1 for example) option is used to specify the child SG to split from the parent. Use the view_name option to specify the name of the new masking view to be created. The source SG must be in a single masking view.

C:\Program Files\EMC\SYMCLI\bin>symsg -sid 558 list

STORAGE GROUPS

Symmetrix ID:	000296700	558		
	Flags	Number	Number	Child
Storage Group Name	EFM SLC	Devices	GKs	SGs
146 Gks NDM Cypress	FXX	9	9	
CSE eNAS	FXX	8	-	ø
Demo Uni SG1	FX	4	0	0
EMBEDDED_NAS_DM_SG	FXX	19	1	0
enas_dest	FXX	1	0	0
End2End_SG1	FX	1	0	0
EnhancementChild1	FXX	5	0	0
EnhancementChild2	FXX C	5	0	0
EnhancementsSgParent	F.X P	5	0	1
ESX_142_GKS_SG	FXX	6	6	0
GKs	FXX	24	24	0
MFE_EXPAND	9X	1	0	0
NDM_Beta_PreCopy	F	5	0	0
NDM_U4P_PreCopy	FX	4	0	0
OpenStack_Instances	FXX	8	0	0

Migrate a subset of devices in an SG

To migrate a subset of devices in an SG, divide that SG into a number of SGs. This is a non-disruptive operation.

In Unisphere, select the SG on the **Storage Group Dashboard**, click the **More Actions** menu, and select **SG Maintenance** > **Split From**.

=	Unisphere for PowerMax > 0	00296700558 -		
🔒 НОМЕ	Ctore C			
DASHBOARD	Storage Groups	n Protect Set Host I/O Limits		n
	Creete Modiry Provisio	n Protect Set Host (/O Limits	Migrate	
	Name 🔺	SRP	Ser FAST Array Advisor	Capacity (Gi
Storage Groups	146_Gks_NDM_Cypress	SRP_1	Opt	0.0
	CSE_oNAS	SRP_1	Opr Expand ProtectPoint	1,600.0
Reference Workloads	Demo_Uni_SG1	SRP_1	Op Set Volumes +	80.0
	EMBEDDED_NAS_DM_SG	NONE	Gol	1,013 6
Storage Resource Pools	enas_dest	SRP_1	Op Allocate/Free/Reclaim	1.0
	End2End_SG1	SRP_1	Brd SG Maintenance +	Convert to Cascaded
Volumes	EnhancementChild1	SRP_1	Op	
	EnhancementsSgParent	NONE	NONE	Split From
Mainframe	ESX_142_GKS_SG	SRP_1	Optimized	Merge Into
Mainmame	GKs	SRP_1	Optimized	

	Unisphere for PowerMax	> 000296700558 -		c			٠	٠	÷
 HOME DASHBOARD STORAGE	Storage Groups > Enha Details Volumes	incementChildSplit1							
Service Levets Reference Workloads	Properties		Capacity Capacity (GB)					30	
Storage Resource Pools	Symmetrix ID Compliance Service Level	000296700558	Volumes Allocated Capacity	_	_	0	M6 (0 of	30 GB	_
	Workload Type SRP	NONE SRP_1	VP Saved	_		100%	(100 of	100 %	
Mainframe	Mesking Views	1	 Compression					-	

=	Unisphere for PowerMax > 00029	6700558 -		C Q 🖬 .
🛧 номе	Masking Views			
DASHBOARD STORAGE	Create Modify View Path Detail	• I		
ноsts	Name 146.Gks.NDM.Cypress.MV	Host ESX_146	Port Group GKs.PG	Storage Group 146_Gks_NDM_Cypress
Hosts	CSE_6NAS_MV	EMBEDDED_NAS_DM_IG	EMBEDDED_NAS_DM_PG	CSE_eNAS
Masking View	EMBEDDED_NAS_DM_MV enas_dest_MV	EMBEDDED_NAS_DM_IG EMBEDDED_NAS_DM_IG	EMBEDDED_NAS_DM_PG EMBEDDED_NAS_DM_PG	EMBEDDED_NAS_DM_SG enas_dest
Port Groups	EnhancementChrid1 mv	ESX 146	NDM PG	EnhancementChild1
Initiators	EnhancementChild1_MV_001 EnhancementParentMV	ESX_146 FSX_146	NDM_PG	EnhancementChildSplit1 EnhancementsSgParent

The result is a stand-alone SG with its own masking view, using the same components as before the split, that is fully capable of being migrated using NDM. For guidance on how to migrate the SG, see the section on Metro-based NDM (Using Unisphere for PowerMax or Using Metro NDM using Solutions Enabler 9.x) or Metro-based NDM with precopy (Using Unisphere for PowerMax with precopy or Using Solutions Enabler 9.x with precopy).

From Solutions Enabler, use the Symsg library.

```
symsg -sg <SgName> -sid <SymmID>
merge <SgName1>
split <SgName1> -view name <MvName> -devs
```

For the split operation, the -sg <SgName> option is used to specify the source SG, for example, EnhancementsChild1 for the split operation. Specifying the name of the Storage Group create after the Split parameter (EnhancementChild1_Split) the devices to split with the -devs parameter and finally the -view_name option for the masking view create.

Consolidate a single application on two arrays into a single target Storage arrays are more compact, have more power, and more storage as time progresses. So NDM is being used to consolidate a number of older arrays onto a single array. For various reasons, we see Storage groups spread across multiple arrays in data centers. Once the groups are moved, using NDM, to a single array they can be merged, as long as the IGs and PGs contain the same elements.

=	Unisphere for PowerMax >	000296700558 -			сq
HOME DASHBOARD	Storage Groups				
	Create Modify Pro	vision Protect Set Host I/O Lin	Service Level	Capacity (GB)	Emulatio
Storage Groups	146_Gks_NDM_Cypress	SRP_1	Optimized	0.06	FBA
	ApplicationSG1	SRP_1	Optimized	6.00	FBA
Reference Workloads	ApplicationSG2	SRP_1	Optimized	9.00	FBA
neterence municada	CSE_eNAS	SRP_1	Optimized	1,600.01	FBA

=	Unisphere for PowerMax > 00	0296700558 -		C Q 🖬
A HOME	Masking Views			
S STORAGE	Creste Modify View Path	Details Host	Port Group	Storage Group
L HOSTS	146_Cks_NDM_Cypress_MV	ESX_146	GKs_PG	146_Gks_NDM_Cypress
	ApplicationSG1_MV	ESX_146	Application_PG	ApplicationSG1
Masking View	ApplicationSG2_MV	ESX_146	Application_PG	ApplicationSG2
Masking View	CSE_eNAS_MV	EMBEDDED_NAS_DM_IG	EMBEDDED_NAS_DM_PG	CSE_eNAS

The example above shows two storage groups (ApplicationSG1 and ApplicationSG2) that have been migrated from two separate arrays. The groups use the same application host and so their IGs are identical. The target PG was selected manually by the storage administrator.

To merge the groups using Unisphere, select one of them on the Storage Groups dashboard. Click the more options (three dots) icon and select SG **Maintenance** > **Merge Into**.

	Stora	ge Group	s								
	Cr	eate	Modify	Provision	Protect	Set Host I/O Limits		Migrate		^	
STORAGE		Neme .			SRP		S	FAST Array Advisor		Capac	sity
Storage Groups		146_Gks_N	VDM_Cypress		SRP_1		0	FAST Array Advisor			1
		Application	nSG1		SRP_1		0	Expand ProtectPoint			
Reference Workloads		Application	nSG2		SRP_1		0	Set Volumes	,		
		CSE_eNAS			SRP_1		0			1.	,60
Storage Resource Pools		DemoUni.	SG1		SRP_1		0	Allocate/Free/Reclaim	•		8
		EMBEDDED	D_NAS_DM_S	G	NONE		Gr	SG Maintenance		Convert to Cascaded	
		enas_dest			SRP_1		0				
External Storage		End2End_S	SG1		SRP_1		Bro	onze		Split From	
		Enhancem	entChild1		SRP_1		00	timized		Merge Into	
Mainframe		Enhancem	entChild1_Spl	lit	SRP_1		00	timized			

In the pop-up box, select the storage group you want to merge the selected group into, and click **Run Now**. Only storage groups with the correct masking elements are available in this dialog.

The result is a single storage group, ApplicationSG2, that retains the original masking view.

With Solutions Enabler, use the **symsg** library:

symsg -sg <SgName> -sid <SymmID> merge <SgName1>
split <SgName1> -view name <MvName>

For the merge operation, the -sg <SgName> option is used to specify the source SG, for example, ApplicationSG1 for the merge operation. Specifying the name of the Storage Group to be merged (EnhancementChild1_Split)

The result is a single SG called ApplicationSG1 that contains the devices from both SGs.

When creating an NDM session set devices RDF capable

Previously it was not possible to migrate devices that did not have the Dynamic RDF compatibility. This applies to Pass-through NDM (5876 – 5977/5978) This required a configuration change and also it delayed NDM scheduling. Now, the NDM Create operation sets all source device to being Dynamic RDF capable. Therefore, there is no extra user intervention required.

=	Unisphere for PowerMax	> 000296700558 -		
🕈 НОМЕ	Storage Groups			
DASHBOARD	Create Modify	Provision Protect Set	Host I/O Limits	
─ STORAGF	Name .	SRP	Service Level	Capacity (G8)
Storage Groups	146_Gks_NDM_Cypres		Optimized	0.06
Service Levels	ApplicationSG2	SRP_1	Optimized	15.00
Deference Workfoorte	CSE eNAS	SRP 1	Optimized	1,600.01

Add DR to target SG before synchronization

Initially, it was possible to set up SRDF disaster recovery (DR) on the target array using SRDF/A. A later version enabled this use of SRDF/S. In both cases, the NDM synchronization had to be complete before setting up the DR relationship.

Using PowerMaxOS 5978 and Solutions Enabler 9.x, it is possible to setup SRDF/S or SRDF/A from the NDM target array to a disaster recovery site once the migration has entered a migrating state. This reduces significantly the migration process from a customer standpoint. This will also reduce the impact on response time to the host.

	Unisphere for	PowerMax	> 000	296700558	-		
🕈 НОМЕ							
DASHBOARD	Storage Gro						
STORAGE	Create	Modify	Provision	Protect	Set Host I/O Limits	Ch	nange SRP
	Name	•		SRP		Si De	lete
Storage Groups	146_0	Gks_NDM_Cypre	55	SRP_1		0	nete
Service Levels	Z Appli	cation_SG		SRP_1		oj Mi	igrate
Reference Workloads	CSE_	NAS		SRP_1		O FA	ST Array Advisor
Reference workloads	Demo	Uni SG1		SRP 1		OI	900 - 901 - 57 8 - 98 - 58 - 58 - 58 - 58 - 58 - 58 - 58

As before, select the Storage Group to be migrated and start the NDM create operation. For further guidance on how to migrate the SG, see the section on Metro-based NDM (Using Unisphere for PowerMax or Using Metro NDM using Solutions Enabler 9.x) or Metro-based NDM with precopy (Using Unisphere for PowerMax with precopy or Using Solutions Enabler 9.x with precopy).

In this example, the Storage Group view shows that the migration is 13% completed. In the previous version of NDM, it would have been necessary to let the migration complete to 100% before setting up DR.

\equiv	Unispl	here for VMA	x >	000296700558						c	۹	Ġ
A 11	Migrations Storage Groups E	nvironments										
€ 	Cutover Com						1 items 👳	0	Application_SG			
•	Storege Group		State Migrating		Source 000296700558	Terget 000197800131		=	Capacity (GB)	500		
8									State Done (%)	Migratin 13		
•									Source Target	0002967		
Ŭ	k.								Valid Components	0		

From the target array, navigate to the Storage group, highlight it, and select **Protect**.

Stora	ge Groups	e for VMAX > 000197800131		
Cr	ecte Modify	Provision Protect Set Host I/O Limi	15	
	Name 🔺	Protect a Storage Group, using SnapVX, RDF	SLO	Capacity (GB
	131_ESX146_GK_SG	NONE	NONE	0.0
	Application_SG	SRP_1	Optimized	500.0
	LINKOPT_TEST	SRP_1	Diamond	1.00
	ORS_VM_Tg1	NONE	NONE	44.00
	SLO_TEST	NONE	NONE	1.00
	TEST	SRP_1	Diamond	1.00

Select Technology	Remote Symmetrix ID 000197800085	Scen	
2 Configure SRDF	Replication Mode		
Review SRDF	Synchronous	•	
	Establish SRDF Pairs		
	Remote Storage Group Name *		
	Application_SG		
	Remote Service Level	Ŧ	
	Compression		

In the pop-up window, click Remote Replication using SRDF and click Next.

In the protection configuration window, select the target array, the SRDF mode, and the remote storage group name.

1 Select Technology	Select Protection Technology	
Configure SRDF	O Point In Time using SnapVX	
Review SRDF		
	Remote Replication using SRDF	
	O High Availability using SRDF/Metro	
	O Backup using ProtectPoint	

The final confirmation of the planned configuration is displayed. Review and click **Run Now**.

Select Technology	Review SRDF Summary			
Configure SRDF	Remote Symmetrix ID	000197800085		
3 Review SRDF	Replication Mode	Synchronous		
	SRDF Group	Automatic Selection		
	Remote Storage Group Name	Application_SG		
	Establish SRDF Pairs	Yes		
	Compression	Yes		
9		BACK	CANCEL	

The result is an SG with DR in an Active/Bias and Synchronous RDF state. Essentially, this cascaded R21 with the R1 being the NDM Source and the R2 being the new DR to 085. For guidance on how to continue with the migration, see the section on Metro-based NDM (Using Unisphere for PowerMax or Using Metro NDM using Solutions Enabler 9.x) or Metro-based NDM with precopy (Using Unisphere for PowerMax with precopy or Using Solutions Enabler 9.x with precopy).

=	Unisphere for VMAX > 00	0197800131 -			c < 🖬 🦸 🛊
	Storage Groups				
	SnapVX SRDF Establish Split Suspend Restore	I	1 items 😴 🕕	Application_SG	
	Storege Group Application_SG x	States Modes SRDF Type	SRDF Groups 🗮	Storage Group	Application_SG
	Application_SG	ActiveBias, Synchronized Active, Synchronous R21	3, 249	States Modes	ActiveBlas, Synchronized Active, Synchronous
				SRDF Groups Capacity (GB)	3, 249
				SRDF Pairs	10
				Masking Views	1

To achieve the same result with Solutions Enabler, perform the following:

1. Create an SRDF group between the NDM target and planned Disaster Recovery site:

```
symrdf addgrp -label DrSite1 -rdfg 3 -sid 131 -dir
1F:30,2F:30 -remote_rdfg 3 -remote_sid 085 - remote_dir
1F:31, 2F:31
```

2. Create the SRDF pairings using the following:

```
symrdf -file srdf.txt -sid 131 -rdfg 3 -type r1 -establish
createpair where the srdf.txt file contains the device
pairings
```

In this SRDF query, the RDFG is shown as 3 which shows that it is on the second leg of the R21. The devices on the DR target are Write disabled to the host and are Synchronized. Some other information such as the 'S' under the mode (M) signifies Synchronous mode.

```
C:\Program Files\EMC\SYMCLI\bin>symrdf -sid 131 -rdfg 3 query

        Symmetrix ID
        : 000197800131
        (Microcode Version: 5978)

        Remote Symmetrix ID
        : 000197800085
        (Microcode Version: 5977)

        RDF (RA) Group Number
        : 3 (02)
        : 3 (02)

                                    (R1) View Target (R2) View FLAGS
                    Source (R1) View
ST LI ST
Standard A N A
Logical Sym T R1 Inv R2 Inv K Sym T R1 Inv R2 Inv RDF Pa
Device Dev E Tracks Tracks S Dev E Tracks Tracks MCES STATE
                                                                                                               T R1 Inv R2 Inv RDF Pair

        N/A
        00006 RW
        0
        0 RW
        0000C9 WD
        0
        0 S..E
        Synchronized

        N/A
        00048 RW
        0
        0 RW
        000CE WD
        0
        0 S..E
        Synchronized

        N/A
        00058 RW
        0
        0 RW
        00096 WD
        0
        0 S..E
        Synchronized

        N/A
        00059 RW
        0
        0 RW
        002CC WD
        0
        0 S..E
        Synchronized

        N/A
        00208 RW
        0
        0 RW
        00055 WD
        0
        0 S..E
        Synchronized

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

Create bot LUNs on the target array the same as the source array NDM now retains the LUN addresses on the target array the same as the source array when using the -consistent LUN option on the NDM Create operation. Although the LUNs address will be the same note that redirecting of the BIOS to the new boot LUN must be done by the system administrator. NDM does not have control of the individual host BIOS.

Masking enhancements (SE 9.1)

Migrate storage groups with shared volumes Prior to Solutions Enabler 9.1, data migration using NDM would be blocked if devices were shared across storage groups selected for migration.

With Solutions Enabler 9.1, users can migrate storage groups that have fully or partially overlapping devices. This results in multiple SGs being migrated as part of the NDM session.

Create port group as part of the NDM or NDM Update create command

With the release of Solutions Enabler 9.0, the ability to target a specific port group as part of the NDM create command was introduced. This allowed users to pre-create a PG to be used for the target storage group.

Solutions Enabler 9.1 gives the user the ability to create the port group as part of the NDM or NDM Update create process. The user has the ability to name and select specific target-side ports.

Appendix A: Host multipathing software notes

Introduction	This section describes best practices for using multipathing software in an NDM environment. See the NDM Support Matrix for the latest operating system and multipathing software combinations.				
AIX Native	For Native Multipathing on AIX, best practice is to use the following settings for MPIO:				
Multipathing software	<pre>algorithm = round_robin (other algorithms may also be used) hcheck_cmd = inquiry queue_depth = 32 reserve_policy = PR_shared*</pre>				
	*reserve_policy may be set to no_reserve as long as GPFS/SCSI3 clusters are not part of the planned migration.				
	Check if a "PR_key_value" is already assigned prior to changing the "reserve_policy" to PR_shared.				
Linux multipathing software with LUNZ	If using address 0xf7, Using NDM with result in a failure scenario. The recommendation is to modify with other another address before attempting to use NDM.				
	If not greater than 0xF7 LUNs, as long as the system has a LUN with host id 0xF7, then a manual removal of the LUNZ and rescan is required:				
	1. Find the VMALUNZ by "Isscsi grep VMAXLUNZ".				
	 Remove the SCSI device by "echo 1 > /sys/block/xxx/device/delete". 				
	3. Rescan the SCSI devices by "rescan-scsi-bus.sh".				
	 Some Red Hat versions require the addition of the -a parameter 				
	 rescan-scsi-bus.sh -a 				
	See <u>https://access.redhat.com/solutions/1314183</u>				
PowerPath	Use the default PowerPath multipath settings.				
(version 5.7 and later)	First, run the SCSI device rescan (rescan_scsi_bus.sh).				
	To detect, rescan, and configure new paths use the powermt config command.				
	Use PowerPath commands/scripts to scan 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: AIX, GPFS, and PowerPath with NDM for important information regarding PowerPath and AIX 6.x with GPFS.				

PowerPath with
SolarisFor 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 Server Use default MPIO settings with the following parameters enabled:

2012 with MPIO

• PathVerifyEnabled - Enable for optimal results with path discovery.

- With "Path Verify Enabled" checked, the target V3 paths will be automatically discovered following an NDM create and a "cancel -revert"
- If "Path Verify Enabled" is cleared, the target V3 paths will not be automatically discovered following an NDM create (host rescan discovers target V3 paths) and a "cancel -revert" may fail. Recommendation is to initiate a manual rescan during the "Wait for host path discovery on Source" step.
- PathVerificationPeriod Set a time in seconds for automatic path detections. Dell Technologies recommends setting it to lowest allowed value between 10 and 30 seconds.

Veritas DynamicConfigure the DMP tunable parameters to NDM required values. From the applicationMultipathinghost:

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

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

Veritas clusterTo read the SCSI Persistent Reservation keys after the commit, you must perform a
cluster failover. We recommend performing a reboot of each node in the cluster. However,
this is not a mandatory action if you perform a cluster failover.

ESXi with Native 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 it 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.

When migrating from VMAX to PowerMax, VMAX All Flash or VMAX3 using Pass-through NDM the following could potentially be observed during the Cutover command:

SPARC with Solaris cluster 3_3u2 using Pass-Through NDM, Missing Reservations

Solaris 10

e2e-14-100242:/opt/emc/SYMCLI/bin # ./symdm cutover -sid 176 -sg
NDM176 4

Nov 29 22:10:24 soh4ser2 cl_runtime: [ID 868277 kern.warning] WARNING: CMM: Erstwhile online quorum device /dev/did/rdsk/d61s2 (qid 2) is inaccessible now. Nov 29 22:10:24 soh4ser2 cl_runtime: [ID 868277 kern.warning] WARNING: CMM: Erstwhile online quorum device /dev/did/rdsk/d44s2 (qid 3) is inaccessible now.

This also applies when migrating from VMAX3 or VMAX All Flash to VMAX All Flash or PowerMax. Reservations

An error message such as "reservation key on the quorum device gone"

These are temporary condition with no host impact. Waiting a few minutes will result in the Reservations returning from the target array.

Appendix B: AIX, GPFS, and PowerPath with NDM

Properly configuring multiple paths to the host with AIX 6.x, GPFS, and PowerPath requires an additional step when performing an NDM migration.

After the NDM create operation is completed, the target devices (appearing to the host as additional paths to the source devices) will be masked and available. After running cfgmgr to create the host native devices, the attached script, named emc_pp_configure.sh, must be run immediately following the completion of the cfgmgr command. The 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.

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 -1 $native -a reserve policy=$pseudo policy -a
PR_key_value=$pseudo_prkey
        fi
   done
done
powermt config
```

The script can be downloaded on the following support site: emc_pp_configure.sh

AIX LPM (Live Partition Mobility) with NDM

For Solutions Enabler version 8.3, remove the passive initiator (for LPM use) from IG when they do NDM. After NDM, they need to add the passive initiator back to IG, then they can do LPM.

For Solutions Enabler version 8.4 and later, perform the LPM operation at least once. Let the passive initiator log in to the array and show up in Login History table (LHT), and after this LPM operation, perform NDM.

It is not recommended to do LPM operations during the NDM session.

Appendix C: Consistent LUN

If the source array does not have the Consistent LUN attribute set, but the target does (if it is a pre-created IG) then there will be consistent LUN addresses on the Target array. However, there is no attempt to use the same LUN addresses as on the source even if, by chance, the LUN addresses on the source are consistent across all the paths.

- By default, VMAX and PowerMax arrays are delivered with the ACLX using LUN 0 and visible on a number of ports. Therefore, if the SHOW_ACLX_DEV attribute is still in effect on a port that NDM will choose and the source array is using Consistent LUN and is also using LUN 0, then we will not be able to set the same LUN addresses. This is because LUN 0 is not available on the target array for all the ports that NDM will use when it builds the Masking View.
- When the target VMAX or PowerMax array is deployed and storage is provisioned to the host and uses the LUN addresses for these new LUNs that it is also using for the 'application to be migrated' that resides currently on the source array:
 - Obviously, the existing application is using a different set of ports/paths because it is on a different array.
 - When we migrate that application, the LUN addresses we would want to use will not be available. Thus, you will get consistent, but different LUN addresses.

Appendix D: Device geometry behavior post NDM

	Device Geometry Mode				
User Actions	User Defined		GCM		
	Pre-5978	5978	Pre-5978	5978	
Not leave device geometry set post NDM Commit (when device geometry was getting set automatically during NDM)	Yes; starting with SE 8.4 (if target device size=source device size)		GCM ALWAYS set when there are odd # of cylinders on the source array		
Unset/clear geometry of devices in replication relationship*	Allowed	Allowed	Not Allowed	Not Allowed**	
Unset/clear geometry of devices NOT in replication relationship*	Allowed	Allowed	Allowed	Allowed	
Expansion of device (with geometry) in replication relationship*	Not Allowed	Allowed	Not Allowed	Allowed	
Expansion of device (with geometry) NOT in replication relationship*	Allowed***	Allowed	Allowed***	Allowed	

Note: Clearing GCM on a device without replication that is mapped is a Unisphere for PowerMax and Solutions Enabler 9.x feature only.

Appendix E: VMware—VM Clone or Storage vMotion with NDM

For NDM between 5977 and 5978, Metro-based NDM a slight delay in processing VAAI instructions, namely xCopy, during the copy and sync stages. This is a known code delay will not affect normal NDM operations.

Appendix F: NDM with ESXi virtualized cluster environment

This section describes a known procedure/timing in the VMware ESXi virtualized cluster environment:

NDM: Create > Discover V3/PowerMax Paths > Cancel > Create

This is the issue where we see the host/multipath assume that re-discovered V3 paths are still registered from before the cancel.

In the Microsoft virtualized cluster environment, this results in the symptom NTFS event 57 and unexpected cluster resource failover.

To Mitigate this issue Recommendation is to cleanup stale/dead host paths after a Cancel issued.

NDM: Create > Discover V3 Paths > Create > Cutover > Cancel -revert (immediate)

This is the issue where we introduce two NDM changes before all participating hosts have had change to recognize the first change (cutover).

We observe cases where a write can be rejected by both V2 and V3 and devices get marked PDL (permanent device loss) by VMware.

To mitigate this issue, Dell Technologies recommends that all participating hosts have realized the cutover change before running a cancel -revert.

Appendix G: NDM Update with Solaris cluster

Issue: After NDM Update cutover, sc3.3 nodes on Idom panicked when checking cluster status. OS log showed cluster lost access to quorum dev which is part of the NDM Update.

Recommendations:

- No access to LUNs during migration, especially quorum device. Cluster related operations will trigger access to LUNs including quorum. Opening FS mount point will also trigger access to corresponding LUNs. These operations are not allowed for LUNs in migration.
- It is mandatory to <u>always</u> use -move_identity when migrating Solaris Cluster Environments with NDM Update.
- Immediately run a path rescan after the NDM Update creation command if not using the -precopy option.
- Paths to source will become unusable after a cancellation and require a cfadm -c configure to allow them to be used again.

Appendix H: Technical support and resources

<u>Dell.com/support</u> is focused on meeting customer needs with proven services and support.

<u>Storage and data protection technical white papers and videos</u> provide expertise that helps to ensure customer success with Dell Technologies storage and data protection products.

Related resources

Here is a link to the comprehensive knowledge base articles referencing some previously experienced issues while using NDM as well as guides and best practices. https://www.dell.com/support/kbdoc/en-us/534580

Operations Failure:

- Create with Validate Option symdm create -validate
- Create symdm create
- Cancel symdm cancel
- Cutover symdm cutover
- Cancel with Revert Option symdm cancel -revert
- Commit symdm commit
- Recover symdm recover
- Remove Environment symdm environment -remove

Stuck Migration State:

- Created
- CutoverInProg (Level 50)
- Migrating
- CommitInProg
- CancelFailed
- Performance / Slow Copy Rate / Quality of Service (QoS)
- Hosts / Clusters
- PowerPath / Multipaths Stale Group Reservations / Locks
- Device External Identity / Non-Native / Effective WWNs
- Geometry Compatibility Mode (GCM)
- SRDF Metro
- SRDF CE (Cluster Enabler)
- RecoverPoint
- Errors
- Red boxes (Level 40 + Level 50)
- General
- Guides