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

Abstract
Dell EMC™ PowerMax/VMAX™ Non-Disruptive Migration (NDM) allows simple online data migrations that are non-disruptive to the host and application. This paper covers features available for PowerMax, VMAX All Flash, VMAX3™, and VMAX Family storage systems.

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# Revisions

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Executive summary

Prior to the introduction of Non-Disruptive Migration, migrating from a Dell EMC™ 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. Non-Disruptive Migration (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 Solutions Enabler, 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:

- **NDM Pass-through**: Source array is running 5876 code (VMAX, VMAX2)
- **Metro-Based NDM**: Source array running 5977 (VMAX3, VMAX All Flash)

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

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

Audience

This document is intended for the following audience:

- Customers including 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 EMC field personnel and partners involved in designing the NVMe-enabled 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

This section 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.

- **Q1 2018 (5978.xx.xx, SE 9.0) “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 (See appendix C)

- **Q2 2017 (5977.1125.1125, SE 8.4) “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) “Trinity”**
  - NDM (Cutover) Initial Release (5876 - 5977)
    > SRDF Pass-Thru
    > 16 Concurrent Migrations
    > Stand-alone hosts
    > Clusters SCSI2 and SCSI3
    > Required Initiators to be Logged in
  - SRDF/A DR Support
1 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.

Dell EMC has an extensive support matrix that should always be referenced when planning to migrate applications using NDM.

In addition to the support matrix, reference the appendices in this document for caveats on specific Host OS and multipathing combinations before attempting a migration.

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 EMC PowerPath™ or a supported host multipathing solution, to manage host access to the data during the migration process.

NDM comes in 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, both methods are outlined in the next section.

1. Pass-through NDM: Source array is a VMAX or VMAX2 running 5876 Code.
2. Metro-Based NDM: Source array is a VMAX All Flash or VMAX3 running 5977 Code.

![Pass-Through NDM Overview](figure1.png)
NDM overview

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 3 C's. 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 of 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 Dell EMC Unisphere™ or simple, 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 useable 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 OS 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 OS to support the migrations.

**Other supported NDM operations**

- **Cancel** – Ends a migration that has not been committed. It removes storage provisioned for the migration on the target array, releases resources allocated by Solutions Enabler to perform the migration, and places the source devices into the state they were in before the Create operation was run.

- **Cancel with Revert** - Run after a cutover operation to move the application’s data access back to the source array from the target array and cancel the migration.

- **Recover** – Attempts to complete a failed migration operation. Recover is run following a failure after the cause of the failure, such as a connectivity issue, has been resolved.
• **Sync** – Controls the replication from the target side devices to the source side devices after a cutover is done and all data has been migrated to the target side.

• **List** – Shows a list of migrations to or from a specified array, with the current status for each.

**Support matrix**

Information on supported host operating systems, multipathing software, and cluster software can be found using E-Lab Navigator on Dell EMC’s support site:

https://elabnavigator.emc.com/vault/pdf/VMAX_All_Flash_VMAX3_Features.pdf?key=1475179504315

**Benefits of using NDM**

• Allows migration from VMAX to PowerMax, VMAX3 or VMAX All Flash with hosts and applications completely online

• Designed for ease of use with control operations that automate the setup and configuration of the migration environment

• Managed by familiar and simple user interfaces via Solutions Enabler and Unisphere

• Migrations can be easily cancelled and failed back to the source array for any reason prior to commit

**Manipulation of Device IDs and Host Paths**

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

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

**Supported Distance Between the Source and Target**

NDM is supported across SRDF synchronous 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 that are included in 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 make sure that they are in the proper state to allow the migration to succeed. By maintaining existing replication NDM ensures that we are not sacrificing any RPO 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 setup in the CutoverNoSync state, which is reached when the sync command is used to stop replication. For local Snap/VX sessions running against the source volumes, existing session on the source array can continue as normal during the migration and new sessions can also be created at the same time that the new SRDF 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 executed, the operation is blocked until the changes that were made are undone, allowing the migration operation to proceed as expected.

**Examples of manual changes made to the NDM session that will cause the session to halt fail:**

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

**Configuration Requirements and Prerequisites**

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

**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.

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

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, where ‘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.

How NDM Handles Masking Groups and Views

When NDM sessions are created, NDM configures storage groups (SGs), initiator groups (IGs), port groups (PGs), and masking views (MVs) on the target array that exactly match the group names on the source array.
Both initiator groups and port groups can exist in multiple masking views, so these groups 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, a 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, and a PG is created on the target based on which ports the host HBAs are logged into.

When an SG on the second source array is migrated to the target array, the SG name must be different. If necessary, the SG can be renamed before it is migrated. The IG must have the same name because an initiator can only exist in one IG. If the PG on the second array has the same name as the PG on the first array, 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 manually creating the PG on the target prior to the NDM Create is an option. This can then be selected as the target PG for the NDM session.

**Rules Regarding Masking Groups and Views**

All migrations are performed against a Storage Group (SG), which is the data container that is migrated with NDM. The following rules 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 is also migrated.
- Devices in the SG which are considered to be GKs (20 cylinders or less) is not migrated to the target array. Devices must not be masked to FCoE ports.
- Devices must not be mapped 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, provided that the groups on the target array have the exact same initiators, child groups and port flags as the groups on the source array with the same names. Port flags that are not supported on the target array are ignored.
- 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.

**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
NDM overview

Session Limits

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

Hardware and Software Requirements

https://elabnavigator.emc.com/vault/pdf/VMAX_All_Flash_VMAX3_Features.pdf?key=1475179504315

1.1 Metro-Based NDM overview

The previous version of Non-Disruptive Migration (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.

For the Solutions Enabler 9.0 and HYPERMAX OS Q2 2018 release the Non-Disruptive Migration feature will be enhanced to help automate the process of moving applications from a VMAX3 (5977) or VMAX All Flash (5977) to another VMAX All Flash (5978) or PowerMax (5978)

The source hardware is not a limiting factor here. Metro Based NDM is supported from arrays running 5977 to 5978 Code regardless of the underlying technology.

Metro-NDM will be based on SRDF/Metro Active-Active technology with the Metro instant activate (Metro-IA) feature. For more on SRDF/Metro see the following article:


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 we enhanced the software such that the SRDF/Metro session goes Active-Active instantly on NDM Create. This is only applies to underlying metro technology for NDM and does not apply to regular SRDF/Metro for running active/active applications.

This make 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-NDM varieties of migration depends on the users need for a Pre-Copy feature:

1. Metro-Based NDM: This is the NDM mode where the synchronization will start right after create completes and create operation results in the creating NDM session using SRDF/Metro internally.
2. Metro-NDM with Pre-Copy: This mode of operation will offer a choice to start the NDM session using adaptive copy (SRDF/ADP) which helps them synchronize most of the data before moving into an Active-Active state. Eventually we can move to active-active mode and synchronize the remaining tracks. In essence, Pre-Copy allows end users to copy their application data from source array to target array while the application is still running on the source array.
Process Flow Metro-Based NDM

- Solutions Enabler creates an Active-Active SRDF group with NDM Attribute.
- Solutions Enabler activates the group.
- SCSI information, device personality and attributes are transferred to the target devices.
- Masking view to the source (R2) array created.
- Migration starts from R1 to R2 (Source to Target).
- User rescans host for extra paths to target array.
- Data Synchronization completed.
- Commit issued and Migration completed.

Component Flow Metro-NDM with Pre-Copy

- Solutions Enabler creates an Active/Active group with NDM Attribute and Pre-Copy Set. The SRDF group is set to Adaptive Copy mode.
- Pre-Copy Data Synch (R1-R2)
- Solutions Enabler sets READYTGT which will activate RDF group with Metro-IA
- SCSI information, device personality and attributes are transferred to the target devices.
- Masking view to the source array created.
- User rescans host for extra paths to the target array.
- Data Synchronization completed.
- Commit issued and migration completed.
Metro-Based NDM Operations

- **Create**: Creates Metro-Based NDM session. Creates SRDF/Metro with NDM source and target attributes and puts the NDM pair in active-active mode (Clear DEV-INACT on R2). Starts Data synchronization and SCSI info synchronization and moves into 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. Create results in RDF mirror invalids on R1 and local mirror invalids on R2.
- **Create with PreCopy**: Creates SRDF/Metro session with NDM attributes and puts the SRDF/Metro pair into Adaptive-Copy disk mode. Starts data synchronization from R1 to R2. Bias is enabled on Metro-NDM Source. Creates SRDF/Metro session with NDM attributes and puts the SRDF/Metro pair into Adaptive-Copy disk mode. Starts syncing data from R1 to R2. Bias is on Metro-NDM Source.
- **ReadyTGT**: Continues to synchronize the remaining invalid tracks from source target and also starts synchronization of SCSI Information. Puts the NDM pair in active-active mode (clear DEV-INACT on R2) without waiting for synchronization to finish.
- **Cancel**: Suspends SRDF/Metro NDM session. R2 device moves into DEV-INACT state and all IO are re-directed to R1.
- **Sync-Stop**: Once in synchronized state, the user might need to test the applications performance before committing. Sync Stop command would make the NDM SRC DEV-INACT and thus all IO would go through Metro-NDM Target R2 and Metro-NDM session moves into CutoverNoSync state. This operation results in moving bias to Metro-NDM Target.
- **Sync-Start**: Moves 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 NDM target after sync stop command and is ready to either commit or cancel NDM session. Bias remains on Metro-NDM target Commit.

Benefits of Metro-Based NDM

- Allows the complete migration from VMAX3 or VMAX All Flash to VMAX All Flash or PowerMax without need for downtime
- Leverages Metro technology to reduce the required commands the user needs to issue by removing the need to cutover
- Managed by familiar and simple user interfaces via Solutions Enabler and Unisphere for VMAX
- Migrations can be easily cancelled and failed back to the source array for any reason prior to commit
- Allows users to Pre-copy all or a large portion of their data before bringing the host live to the new array. This reduces the impact to the application during the migration period.

Manipulation of Device IDs and Host Paths

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

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

This Walkthrough describes two methods, NDM using:

- Unisphere for PowerMax
- CLI (Solutions Enabler)

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

Pass-Through NDM will be migrating SGs from 000198701161 to 000197800131

| Array ID | Percentage | MB/s |
|----------|------------|------|---|
| 000198701161 | 5% | - | - |
| 000197800131 | 8% | 691.0 | - |

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.

Cutover NDM Walkthrough Guide

Even though the Guide takes you through the detailed device examination after each step as well as diving into the workings of each of the issued commands it should be noted that in essence 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 cancelled 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.
3 Pass-Through NDM walkthrough guide (Source running 5876 code)

3.1 Using Unisphere for PowerMax

The following screenshots are taken from disk management on a Microsoft Windows 2016 host, this walkthrough intends to migrate disks 1-4 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 thru 1ED added to Storage Group Uni_Cut_SG1 which is masked to the virtual host.
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 8 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 useable 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.

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 popup 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
00296700558
00297800544

Data Migration Environment Setup

Success

Hide Task Details

Starting Tasks...
Migration Environment setup between: 000198701161 and: 000197800131...
Starting Data Migration environment setup between 000198701161 and 000197800131

Analyze Configuration..........................Completed.
Source SID: 000198701161
Target SID: 000197800131
Analyze Configuration..........................Done.
Setup Configuration...........................Completed.
Setup Configuration...........................In Progress.
Setup Configuration...........................In Progress.
Setup Configuration...........................In Progress.
Setup Configuration...........................In Progress.
Setup Configuration...........................Done.

Succeeded Data Migration environment setup
Refreshing Data Migration environment
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.

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

![Unisphere for PowerMax](image)

### Perform a Host Rescan

After the create operation completes the systems administrator must issue a host rescan to allow the host to discover the paths to the newly created devices. This host rescan is OS specific and also should include a rescan using the host multipathing software.

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 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 is 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.

Double clicking on 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 thru 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. These is highlighted in the *State* not showing a green tick.
The SRDF Groups tab in Data Protection shows the SRDF relationships established as part of the Create Command. The Devices 212 – 215 in the example below have been created as replicas of the source devices on the target array. The SyncInProg state can be ignored in this case as the data transfer from Source to Target has yet to start.
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 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 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.

Examine IDs of Source and Target
Pass-Through NDM walkthrough guide (Source running 5876 code)

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.

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.

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

**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 cancelled 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.
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.
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

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.
However, the host no longer have access the source array for I/O processing. All the Host I/O is being handled by the target array and is replicating via SRDF/Sync back to the source array. This mean 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.
Revert to the Source Array

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

The revert option moves the processing back to the source array and the cancel removes all of the target side entities created for the migration. This operation 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.

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

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.
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 non-disruptively. 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.
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 OS specific and also should include a rescan using the host multipathing software if it must be performed separately from the host rescan, as with PowerPath. See Appendix A for more details on the host multipathing software.
Because the commit completes the migration and removes all of the source side masking, there are no longer any paths seen to the source array. The logical device field only contains the target device and the Symmetrix ID contains the serial number of the target only.

```
applicenvmaxcore:~ # rpowermt display dev=emcpower204 host=10.60.136.186
  Pseudo name=emcpower204
  Symmetrix ID=000197800131
  Logical device ID=00212
  Device WWN=6000970000319870116153303134541
  Standard UID=nes.600097000019870116153303134541
  type=conventional; state=alive; policy=SymmOpt; queued-IQo=0

-------- HOST -------- | - Stor -- | I/O Path -- | -- Stats -- |
### HW Path | I/O Paths | Interf. Mode | State | Q-IoQ Errors |
-------------|-----------|---------------|-------|--------------|
3 vmbba6 | C0:T3:I0 | FA 2d:29 active alive 0 0
4 vmbba2 | C0:T12:I0 | 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 recreated, it will still show the identity of device 0212.

Therefore, the WWNs have effectively been reverse and the “spoofing” is permanent.
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.
The Tag or Identifier allow 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.
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.

![Data Migration Environment Remove](image)

3.2 Using Solutions Enabler 9.x

This example shows the migration of 5 devices (PHYSICALDRIVE0 to PHYSICALDRIVE4) as this symq display shows.

These devices were previously added as RDMs to the VM with VMware® vSphere®.
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 8 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.

Finally, the Storage Group in which our Application due to be migrated resides consists of 4 LUNS of 13 GB each, Symm Devices 0x1EE thru 0x1F1.
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 useable replication pathway for data migration is available between the source and target arrays and creating an SRDF group for the migration.

The setup only must be run once. When the migration pathways and SRDF group are configured, all storage groups on the source array can be migrated until all migrations from the source to the target have been completed.

```
symdm environment -src_sid <SN of Source> -tgt_sid <SN of target> -setup
```

![Environment Setup](image)

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
```

![Environment Validation](image)

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
```
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
```
Pass-Through NDM walkthrough guide (Source running 5876 code)

\texttt{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...

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

The DM 'Validate Create' operation successfully executed for storage group 'SE_Cut_SG1'.

\texttt{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>}

\texttt{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 SID:000198700131
- 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

<table>
<thead>
<tr>
<th>Storage Group</th>
<th>Source Array</th>
<th>Target Array</th>
<th>State</th>
<th>Total Capacity (GB)</th>
<th>Done (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE_Cut_SG1</td>
<td>000198701161</td>
<td>000197800131</td>
<td>CreateFailed</td>
<td>52.0</td>
<td>N/A</td>
</tr>
</tbody>
</table>
```

```
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......................................Done.
Create Masking View(s) on Target..............................Done.
Create Masking View(s) on Target..............................Started.
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
```
To explore in much finer detail the individual elements of the NDM session use the \(-v\) in combination with the \(-\text{detail}\) parameter. Cropped example:

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

```bash
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
Source Configuration: OK
  [ Storage Groups (1) : OK
    Masking Views (1) : OK
    Initiator Groups (1) : OK
    Port Groups (1) : OK
  ]
Target Configuration: OK
  [ Storage Groups (1) : OK
    Masking Views (1) : OK
    Initiator Groups (1) : OK
    Port Groups (1) : OK
  ]
Device Pairs (4): OK
```
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>symdm -sid 161 list
Symmetrix ID : 000198701161

<table>
<thead>
<tr>
<th>Storage Group</th>
<th>Source Array</th>
<th>Target Array</th>
<th>State</th>
<th>Total Capacity (GB)</th>
<th>Done (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE_Cut_561</td>
<td>000198701161</td>
<td>000198700131</td>
<td>Created</td>
<td>52.0</td>
<td>N/A</td>
</tr>
</tbody>
</table>
```

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 has more details on host multipathing software settings.

### CutoverReady and Passthrough Mode

Pass-through mode allows the host to write to or read from either the source or target array. Any write that is sent to the target array 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
```

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.

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 4 new volumes on the target array are 21A thru 21D. Volume 1EE and volume 21A for example are paired for NDM operations.

```bash
  dsm -sid <SN of Source or Target> -sg <SG to be Migrated> list -v -pairs_info -detail
```

```bash
C:\Windows\system32\symdm -sid 161 -sg SE_Cut_SG1 list -v -pairs_info -detail
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 Dev Status Target 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:\Program Files\EMC\SYMCLI\bin>symdev -sid 161 list
Symmetrix ID: 000198701161

<table>
<thead>
<tr>
<th>Sym</th>
<th>Physical</th>
<th>SA :P</th>
<th>Config</th>
<th>Attribute</th>
<th>Sts</th>
<th>Cap</th>
</tr>
</thead>
<tbody>
<tr>
<td>002B</td>
<td>Not Visible</td>
<td><strong>:</strong></td>
<td>2-WS Mir</td>
<td>N/Grp'd ACLX RW</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>001E</td>
<td>PhysicalDrive1</td>
<td>02E:000 RDF2-TDEV</td>
<td>N/Grp'd</td>
<td>RW</td>
<td>13313</td>
<td></td>
</tr>
<tr>
<td>001F</td>
<td>PhysicalDrive2</td>
<td>02E:000 RDF2-TDEV</td>
<td>N/Grp'd</td>
<td>RW</td>
<td>13313</td>
<td></td>
</tr>
<tr>
<td>001F</td>
<td>PhysicalDrive3</td>
<td>02E:000 RDF2-TDEV</td>
<td>N/Grp'd</td>
<td>RW</td>
<td>13313</td>
<td></td>
</tr>
</tbody>
</table>

C:\Program Files\EMC\SYMCLI\bin>symdev -sid 131 list
Symmetrix ID: 000197800131

<table>
<thead>
<tr>
<th>Sym</th>
<th>Physical</th>
<th>SA :P</th>
<th>Config</th>
<th>Attribute</th>
<th>Sts</th>
<th>Cap</th>
</tr>
</thead>
<tbody>
<tr>
<td>0001</td>
<td>Not Visible</td>
<td><strong>:</strong></td>
<td>TDEV</td>
<td>N/Grp'd ACLX RW</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>002A</td>
<td>Not Visible</td>
<td><strong>:</strong></td>
<td>RDF1+TDEV</td>
<td>N/Grp'd</td>
<td>RW</td>
<td>13313</td>
</tr>
<tr>
<td>002B</td>
<td>Not Visible</td>
<td><strong>:</strong></td>
<td>RDF1+TDEV</td>
<td>N/Grp'd</td>
<td>RW</td>
<td>13313</td>
</tr>
<tr>
<td>002C</td>
<td>Not Visible</td>
<td><strong>:</strong></td>
<td>RDF1+TDEV</td>
<td>N/Grp'd</td>
<td>RW</td>
<td>13313</td>
</tr>
<tr>
<td>002D</td>
<td>Not Visible</td>
<td><strong>:</strong></td>
<td>RDF1+TDEV</td>
<td>N/Grp'd</td>
<td>RW</td>
<td>13313</td>
</tr>
</tbody>
</table>
```

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>
```
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.

`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 its 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 or 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 via the SRDF link to the source where the I/O is processed as usual.

**Note:** Due to the extra latency added to I/O experiencing the a “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.

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

C:\Windows\system32\sydm -sid 161 list
Symmetrix ID : 000198701161

<table>
<thead>
<tr>
<th>Storage Group</th>
<th>Source Array</th>
<th>Target Array</th>
<th>State</th>
<th>Total Capacity (GB)</th>
<th>Done (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE_Cut_SG1</td>
<td>000198701161</td>
<td>000197800131</td>
<td>CutoverReady</td>
<td>52.0</td>
<td>N/A</td>
</tr>
</tbody>
</table>

C:\Windows\system32\sydm -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... 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'.

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

**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 cancelled 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 cancelled 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.

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

```
C:\Windows\system32>symdm -sid 161 list
Symmtry ID : 000198781161

<table>
<thead>
<tr>
<th>Storage Group</th>
<th>Source Array</th>
<th>Target Array</th>
<th>State</th>
<th>Total Capacity (GB)</th>
<th>Done (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE_Cut_SG1</td>
<td>000198781161</td>
<td>000197800131</td>
<td>CutoverReady</td>
<td>52.0</td>
<td>N/A</td>
</tr>
</tbody>
</table>
```

```
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:000198781161
  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.

```bash
symdm -sid <SN of source> list
```
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

**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.
**Pass-Through NDM walkthrough guide (Source running 5876 code)**

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

```
C:\Program Files\EMC\SYMCLI\bin\symdev -sid 161 show 1EE
```

```
Device Physical Name : \\.

Device Symmetrix Name : 001EE
Vendor ID : EMC
Product ID : SYMMETRIX
Product Revision : 5876

Device WWN : 6000097000019870116533030314545
Device Emulation Type : FBA
Device Defined Label Type: N/A
Device Defined Label : N/A
Device Sub System Id : 0x0001
Cache Partition Name : DEFAULT_PARTITION
Bound Pool Name : Sata_Pool

Device Block Size : 512

Device Capacity
{
  Cylinders : 14200
  Tracks : 213000
  512-byte Blocks : 27264000
  MegaBytes : 13313
  KiloBytes : 13632000

  Geometry Limited : No
}

Device External Identity
{
  Device WWN : 6000097000019870116533030314545
}
```

```
symdev -sid <Target SN> show <Device>
```
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 cancelled 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
```
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.

```
C:\Windows\system32\symdm -sid 161 -sg SE_Cut_SG1 cancel -revert

A DM 'Cancel Revert' operation is in progress for storage group 'SE_Cut_SG1'. Please wait...

Analyze Configuration..........................................................Started.
  Source SID:0001987801161
  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.
Wait for host path discovery on Source..................................In Progress.
Wait for host path discovery on Source..................................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........................................In Progress.
Remove Data Replication...................................................Done.
Remove Port Group(s) on Target............................................Done.
Remove Port Group(s) on Target............................................Done.
Remove Initiator Group(s) on Target......................................Started.
Remove Initiator Group(s) on Target......................................Done.
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....................................In Progress.
Remove Storage Group(s) on Target......................................Done.
Remove Storage Group(s) on Target......................................Done.

The DM 'Cancel Revert' operation successfully executed for storage group 'SE_Cut_SG1'.
```

```
pplicm@vmaxcse:~ $ rpowermt display dev=emcpower208 host=10.60.136.146
Pseudo name=emcpower208
Symmrix ID=0001987801161, 000197800131
Logical device ID=01EE, 00216
Device WNN=600000970000198701161533030314545
Standard UID=nma.600000970000198701161533030314545
 type=Conventional; state=alive; policy=SymmOpt; queued-IOs=0

---------- Host -------- I/O Paths --- I/O Path -- Stats ---
  HW Path Interf. Mode State Q-ICs Errors
  ID: L: FA i: a: s: d:  
1 vmbda2 C0:T12:L4 FA 1d:28 active dead 0 3
2 vmbda2 C0:T3:L4 FA 2d:29 active dead 0 3
3 vmbda6 C0:T19:L1 FA 1e:01 active alive 0 1
3 vmbda6 C0:T0:L1 FA 2e:01 active alive 0 1
3 vmbda6 C0:T20:L1 FA 2e:00 active alive 0 1
3 vmbda6 C0:T17:L1 FA 1e:00 active alive 0 1
4 vmbda2 C0:T17:L1 FA 2e:00 active alive 0 1
4 vmbda2 C0:T13:L1 FA 1e:00 active alive 0 1
4 vmbda2 C0:T15:L1 FA 2e:01 active alive 0 1
4 vmbda2 C0:T21: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
STORAGE GROUPS

Symetrix ID: 000197880131

<table>
<thead>
<tr>
<th>Flags</th>
<th>Number</th>
<th>Number Child</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>131_ESX146_GK SG</td>
<td>F.X ... 18 16 0</td>
</tr>
</tbody>
</table>
```

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

```
C:\Windows\system32>symdm -sid 161 list -environment
Symetrix ID: 000197880161
Remote SymmID Status
--------------------- ------
000197880131 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 non-disruptively.

\texttt{symdm -sid <SN of Source or Target> -sg <SG to be migrated> commit}

\texttt{symdm -sid <SN of Source or Target> -sg <SG to be Migrated> commit}

<table>
<thead>
<tr>
<th>Symmetrix ID</th>
<th>Source Array</th>
<th>Target Array</th>
<th>State</th>
<th>Total Capacity (GB)</th>
<th>Done (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>000198701161</td>
<td>000198701161</td>
<td>000197800131</td>
<td>CutoverSync</td>
<td>52.0</td>
<td>N/A</td>
</tr>
</tbody>
</table>

C:\windows\system32\symdm -sid 161 -sg SE_Cut_SG1 commit

Execute 'Commit' operation on SG 'SE_Cut_SG1' \((y/[n])\)? \texttt{y}

A DM 'Commit' operation is in progress for storage group 'SE_Cut_SG1'. Please wait...

\begin{itemize}
  \item Analyze Configuration..........................Started.
  \item Source SID:000198701161
  \item Target SID:000197800131
  \item Analyze Configuration..........................Done.
  \item Remove Masking View(s) on Source......................Started.
  \item Remove Masking View(s) on Source......................Done.
  \item Remove Data Replication............................Started.
  \item Remove Data Replication............................Done.
  \item The DM 'Commit' operation successfully executed for storage group 'SE_Cut_SG1'.
\end{itemize}

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 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.
Pre Rescan:

```
policonservermaxos:~ # rpowermt display dev=empower208 host=10.60.136.146
Symmetric ID=0001958701161, 000197800131
Logical device ID=01EE, 021A
Device WNN=600009700001958701161533030314545
Standard UID=nnn.600009700001958701161533030314545
Type=Conventional; state=alive; policy=SymmOpt; queued-IOS=0

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

<table>
<thead>
<tr>
<th>#</th>
<th>HW Path</th>
<th>I/O Paths</th>
<th>Inters. Mode</th>
<th>State</th>
<th>Q-IoTs Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>vahba2</td>
<td>C0:T1:1:A</td>
<td>1d:28 active</td>
<td>alive</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>vahba2</td>
<td>C0:T3:1:A</td>
<td>2d:29 active</td>
<td>alive</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>vahba6</td>
<td>C0:T1:1:L</td>
<td>1e:01 active</td>
<td>dead</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>vahba6</td>
<td>C0:T6:1:L</td>
<td>2e:01 active</td>
<td>dead</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>vahba6</td>
<td>C0:T2:1:L</td>
<td>2e:00 active</td>
<td>dead</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>vahba6</td>
<td>C0:T1:1:L</td>
<td>1e:00 active</td>
<td>dead</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>vahba2</td>
<td>C0:T7:1:L</td>
<td>2c:00 active</td>
<td>dead</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>vahba2</td>
<td>C0:T1:1:L</td>
<td>1e:00 active</td>
<td>dead</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>vahba2</td>
<td>C0:T2:1:L</td>
<td>2c:01 active</td>
<td>dead</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>vahba2</td>
<td>C0:T1:1:L</td>
<td>1e:01 active</td>
<td>dead</td>
<td>2</td>
</tr>
</tbody>
</table>
```

Post Rescan:

```
policonservermaxos:~ # rpowermt display dev=empower208 host=10.60.136.146
Pseudo name=empower208
Symmetric ID=0001958700131
Logical device ID=021A
Device WNN=60000970001958701161533030314545
Standard UID=nnn.60000970001958701161533030314545
Type=Conventional; state=alive; policy=SymmOpt; queued-IOS=0

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

<table>
<thead>
<tr>
<th>#</th>
<th>HW Path</th>
<th>I/O Paths</th>
<th>Inters. Mode</th>
<th>State</th>
<th>Q-IoTs Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>vahba2</td>
<td>C0:T1:1:A</td>
<td>1d:28 active</td>
<td>alive</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>vahba2</td>
<td>C0:T3:1:A</td>
<td>2d:29 active</td>
<td>alive</td>
<td>0</td>
</tr>
</tbody>
</table>
```

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 recreated, 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>
```

![Symmetrix Device Information]

```
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 SCV Device : N/A
Attached VDEV TGT Device : N/A
Vendor ID : EMC
Product ID : SYMMEFRIX
Product Revision : 5876
Device WWN : 60000000198701161533038314545
```

Device Capacity
```
{  
  Cylinders : 14200
  Tracks : 213000
  S16-Byte Blocks : 27264000
  MegaBytes : 13313
  KiloBytes : 13832000
  
  Geometry Limited : No
}
```
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 : 8
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 : 5878
Device WWN : 6000097000197800131533030323142
Device Capacity
{
  Cylinders : 7100
  Tracks : 105500
  512-byte Blocks : 27264000
  MegaBytes : 13313
  KiloBytes : 13652800
  Geometry Limited : No
}
Device External Identity
{
  Device WWN : 600009700019701161533030314545
}
```

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 syminq command.

**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.

```
symdm -src_sid <SN of Source> -tgt_sid <SN of Target> environment -remove
```
Once the environment remove operation is complete, the NDM process is complete.

### 3.3 Metro-Based NDM guide plan and environment overview

The following guide describes both versions of Metro-Based NDM:

1. Metro-Based NDM
   a. Unisphere for PowerMax
   b. CLI (Solutions Enabler)

2. Metro-Based NDM with Pre-Copy
   a. Unisphere for PowerMax
   b. CLI (Solutions Enabler)

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

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

Prior to the start of a planned migration:

- Ensure both source and target array are RDF capable that is, 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.
4 Metro-Based NDM walkthrough guide (Source running 5977 Code)

4.1 Using Unisphere for PowerMax

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

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 4 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

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 useable replication pathway for data migration is available between source and target arrays. Should we need a second target array from the same source then 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.

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 popup 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 all SG session between 558 and 131
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.
Metro-Based NDM walkthrough guide (Source running 5977 Code)

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 User Enhancements selection). Click **Next**.

On the next screen click Create Data Migration. This provides the option of selecting Compression and Pre-Copy. The scenario that this part of the example covers does not use PreCopy, so that remains deselected. (See Pre-Copy 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 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.
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

- 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 User 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.

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. 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.
Double clicking on 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 thru 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 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.

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.
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 is dependent 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.

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.
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.
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 (3 Dots) menu and Cancel Migration.
Confirm the Cancel operation of the SG with the correct source and target and click **Run Now**.
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 and 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. (VMAX - V3/AF, 5876 – 5977 or 5978)
Data Migration Cut Over

Fail

Starting Tasks...
The action code is not valid
Cutover Data Migration session for Storage Group: Demo_Uni_SG1 on source array: 000296700558 and target array: 000197800131 with force: No with SymForce: No... Starting Data Migration cutover

CLOSE
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. Once 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.
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.

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.
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.

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 on the trash icon. On the pop-up, screen click Run Now and the Environment is removed. This removes the RDF group setup and releases those resources.
At this point the data Migration is completed and the migration environment is removed for the specific source and target.

4.2 Using Metro NDM using Solutions Enabler 9.0

View devices from the Host

New Devices view using the Syminq command, devices added to the host as PhysicalDrive7 thru PhysicalDrive10
Power Path 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 4 paths to the source array. All are alive therefore available for host use. We do not yet have any paths to the target array.

![Power Path view of one of the new Devices](image)

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 useable replication pathway for data migration is available between the source and target. This needs to be issued once only as the environment is be used for all migrations between these arrays.

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

![Environment Setup output](image)

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`
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’s 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
```

If any of the above fail its work taking a look at the SYMAPI log file, more often than not not this points you towards 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 User 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.

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

```bash
C:\Program Files\EMC\SYMCLI\bin>symdm create -src_sid 558 -tgt_sid 131 -sg NDM_Beta_SG1 -nop
```

A DM 'Create' operation is in progress for storage group 'NDM_Beta_SG1'. Please wait...

```
Analyze Configuration..............................Started.
Source SID:008296700558
Target SID:008197800131
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..........Done.
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 '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.
Once 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.

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

**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.
sydm -sid <SN of Source> -sg <SG to be Migrated> list -v

To view the LUN pairings try using the -pairs_info parameter

sydm -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
```
**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>
```

![Image showing Symdev command output](image_url)
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.

```sql
C:\Program Files\EMC\SYMECLI\bin>symdev -sid 131 show 1fc

<table>
<thead>
<tr>
<th>Device Physical Name</th>
<th>Not Visible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device Symmetrix Name</td>
<td>001FC</td>
</tr>
<tr>
<td>Device Serial ID</td>
<td>N/A</td>
</tr>
<tr>
<td>Symmetrix ID</td>
<td>000197800131</td>
</tr>
<tr>
<td>Number of RAID Groups</td>
<td>0</td>
</tr>
<tr>
<td>Encapsulated Device</td>
<td>No</td>
</tr>
<tr>
<td>Encapsulated WWN</td>
<td>N/A</td>
</tr>
<tr>
<td>Encapsulated Device Flags</td>
<td>None</td>
</tr>
<tr>
<td>Encapsulated Array ID</td>
<td>N/A</td>
</tr>
<tr>
<td>Encapsulated Device Name</td>
<td>N/A</td>
</tr>
<tr>
<td>Attached BCV Device</td>
<td>N/A</td>
</tr>
<tr>
<td>Attached VDEV TGT Device</td>
<td>N/A</td>
</tr>
<tr>
<td>Vendor ID</td>
<td>EMC</td>
</tr>
<tr>
<td>Product ID</td>
<td>SYMECLI</td>
</tr>
<tr>
<td>Product Revision</td>
<td>5978</td>
</tr>
<tr>
<td><strong>Device WWN</strong></td>
<td>60000970000197800131533030314643</td>
</tr>
<tr>
<td>Device Emulation Type</td>
<td>FBA</td>
</tr>
<tr>
<td>Device Defined Label Type</td>
<td>N/A</td>
</tr>
<tr>
<td>Device Defined Label</td>
<td>N/A</td>
</tr>
<tr>
<td>Device Sub System Id</td>
<td>N/A</td>
</tr>
<tr>
<td>Cache Partition Name</td>
<td>N/A</td>
</tr>
<tr>
<td>Bound Pool Name</td>
<td>SRP_1</td>
</tr>
</tbody>
</table>

| Device Block Size    | 512         |

Device Capacity
{
    Cylinders    : 13654
    Tracks       : 264810
    512-byte Blocks : 52431360
    MegaBytes    : 25601
    KiloBytes    : 26215680
    Geometry Limited : No
}

Device External Identity
{
    **Device WWN** : 60000970000296700558533030314233
    ...
}
Cancelling a Migration in Progress

At any point up to the Commit, a migration can be cancelled. 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...

Analyse Configuration..............................................Started.
  Source SID:000296700558
  Target SID:000197800131
Analyse 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. Once the Commit operation is completed the replication relationship between the source and target devices will 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> -sg <SG to be Migrated> commit`

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.
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.
4.3 Using Unisphere for PowerMax using Pre-Copy

Looking at the devices in this migration from the host OS disk management (in this case, Windows 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 4 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

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 useable replication pathway for data migration is available between source and target arrays. Should we need a second target array from the same source then 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.

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 popup 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**.
Metro-Based NDM walkthrough guide (Source running 5977 Code)
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 for the duration of 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
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 Pre-Copy**

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.
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 User Enhancements selection) Click Next

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.
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.
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:

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 User 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. 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.

From the expanded menu in this example, the Pre-Copy is now 16% completed.

Double clicking on 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 thru 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.
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.

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

Once 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 "3 Dots" More Actions icon 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.
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 Pre-Copy state to a Migrating state and eventually to a Synchronized state.
At this point the storage administrator will run a host rescan to 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 picture shows below the extra paths to the target array as well as the dual device IDs 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.

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.
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 differ. Its External WWN has inherited the WWN of the source device. This means that both devices appear as a single device to the host. In effect, the multipathing software sees additional paths to the same LUN.
Cancelling a Migration

To cancel a migration regardless of its current state, click the Data Protection tab and select Migrations from the drop-down menu. Select the active NDM session and click the More Actions (3 Dots) icon and select Cancel Migration. The is no CutoverOver step for Metro-Based NDM so the -revert option is not needed.

A confirmation window appears. Check that it lists the correct storage group, source device and target device. The click Run Now.
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 returns the source devices to the state they were before the Create operation.

The Cancel operation:

1. Stops and 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 not in use in another masking view)
5. Removes the initiator group on the target array
6. Deallocates volumes created on the target array
7. Removes the devices created on the target array

Best practice suggests that a rescan on the host should be run at this point to clear up any dead or invalid paths.
**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.
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:

Before Rescan:
After Rescan:

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.
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.
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.
4.4 Using Solutions Enabler 9.0 using Pre-Copy

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

```
C:\Program Files\EMC\SYMCLI\bin>syminq

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Vendor</th>
<th>Product Id</th>
<th>Rev</th>
<th>Ser Num</th>
<th>Cap (KB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYSICALDRIVE0</td>
<td></td>
<td>VMware</td>
<td>Virtual disk 1.0</td>
<td>N/A</td>
<td></td>
<td>41943040</td>
</tr>
<tr>
<td>PHYSICALDRIVE1</td>
<td></td>
<td>EMC</td>
<td>SYMMETrIX</td>
<td>5876</td>
<td>6100165000</td>
<td>23068800</td>
</tr>
<tr>
<td>PHYSICALDRIVE2</td>
<td></td>
<td>EMC</td>
<td>SYMMETrIX</td>
<td>5876</td>
<td>6100166000</td>
<td>23068800</td>
</tr>
<tr>
<td>PHYSICALDRIVE3</td>
<td></td>
<td>EMC</td>
<td>SYMMETrIX</td>
<td>5978</td>
<td>3100093000</td>
<td>23068800</td>
</tr>
<tr>
<td>PHYSICALDRIVE4</td>
<td></td>
<td>EMC</td>
<td>SYMMETrIX</td>
<td>5978</td>
<td>3100094000</td>
<td>23068800</td>
</tr>
<tr>
<td>PHYSICALDRIVE5</td>
<td></td>
<td>EMC</td>
<td>SYMMETrIX</td>
<td>5876</td>
<td>610008A000</td>
<td>1048512</td>
</tr>
<tr>
<td>PHYSICALDRIVE6</td>
<td></td>
<td>EMC</td>
<td>SYMMETrIX</td>
<td>5977</td>
<td>58001B3000</td>
<td>26215680</td>
</tr>
<tr>
<td>PHYSICALDRIVE7</td>
<td></td>
<td>EMC</td>
<td>SYMMETrIX</td>
<td>5977</td>
<td>58001B4000</td>
<td>26215680</td>
</tr>
<tr>
<td>PHYSICALDRIVE8</td>
<td></td>
<td>EMC</td>
<td>SYMMETrIX</td>
<td>5977</td>
<td>58001B5000</td>
<td>26215680</td>
</tr>
<tr>
<td>PHYSICALDRIVE9</td>
<td></td>
<td>EMC</td>
<td>SYMMETrIX</td>
<td>5977</td>
<td>58001B6000</td>
<td>26215680</td>
</tr>
<tr>
<td>PHYSICALDRIVE10</td>
<td></td>
<td>EMC</td>
<td>SYMMETrIX</td>
<td>5977</td>
<td>58001B7000</td>
<td>26215680</td>
</tr>
</tbody>
</table>
```

**Power Path 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 4 paths to the source array. All are alive and available for host use. There are no paths to the target array.

```
Pseudo name=emcpower178
Symmetrix ID=000296700556
Logical device ID=01B6
Device NWWN=0000097000029670055853030314236
Standard UID=0600009700002967005553030314236
type=Conventional; state=alive; policy=SymmOpt; queued-I0s=0

### HW Path | I/O Paths | Interface | Mode | State | Q-I0s | Errors
---|---|---|---|---|---|---
3 vmhba6 | C0:11:L4 | FA | 1d:24 | active | alive | 0 | 0
3 vmhba6 | C0:13:L4 | FA | 2d:24 | active | alive | 0 | 0
4 vmhba2 | C0:76:L4 | FA | 2d:24 | active | alive | 0 | 0
4 vmhba2 | C0:11:L4 | FA | 1d:24 | active | alive | 0 | 0
```

**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 useable 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
```

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 Pre-Copy 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
```
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:

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 User Enhancements Section)
5. Starts the copy process in SRDF/Adaptive Copy mode

**Viewing Pre-Copy Status**

While the Pre-Copy 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`
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.

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

Symmetrix ID : 000296700558
Storage Group : NDM_Beta_PreCopy
Source Array : 000296700558
Target Array : 000197800131
State : Precopy
Total Capacity (GB) : 750.0
Done (%) : 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.

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>`
The `symstat` command shows the rate at which the Pre-Copy 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>
```

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.
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 Pre-Copy 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 ReadyTgt command:**

1. Moves RDF group state from Adaptive Copy mode to Active/Active.
2. Target Devices are moved into a Read/Write mode.
3. 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.

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.
Cancelling a Migration

A migration can be cancelled 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 devices into the state they were before the migration began.

The cancel operation:

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-thru 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
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 cancelled.

**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
```
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:

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.
**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
```

---

[Image of Symmetrix ID and Logical device ID]
Masking enhancements (SE 9.0):

With Solutions Enabler 9.0 there are new enhancements to manipulate masking views while maintaining host access to the array. Although the enhancement came about because of NDM, they are available for regular masking operations.

List of User Experience Enhancements

Added the ability to Select a Port Group on the target Array for the NDM session (see Section 5.1).

Added the ability to Migrate a Child only Storage Group (see Section 5.2).

Migrate a subset of devices in a Storage Group (see Section 5.3).

Consolidate a single application speed across two source arrays into a single target array (see Section 5.4).

When creating an NDM session automatically set the devices RDF capable (see Section 5.5).

Set up DR from the target array prior to the devices Synchronizing fully (see Section 5.6).

Create boot LUNs on the target array the same as the source arrays LUN address (see Section 5.7).

5.1 Selecting a Port Group during an NDM Create

Creating a Port Group

To 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. Then click Run Now.
To create a Port Group with Solutions Enabler, use the symaccess library, specifying the director numbers and specific ports. For example:

```
K:\Program Files\EMC\SYNCLI\bin>symaccess -sid 131 create -name EnhancementsPG -type port -dirport 1d:29,2d:28
```

When using the Create Migration wizard in Unisphere, you can select the Port Group when defining the target. For example:
In Solutions Enabler, use the `-tgt_pg` option to specify the Port Group on the target array. For example:

```bash
C:\Program Files\EMC\SYKMCLI\bin>symdm create -src_sid 558 -tgt_sid 131 -sg EnhancementsSgParent -tgt_pg EnhancementsPG

Execute 'Create' operation on SG 'EnhancementsSgParent' (y/[n])? y

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

  Analyze Configuration..............................................Started.
    Source SID:000296780958
    Target SID:000197880131
  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'.
5.2 Migrate a Child only SG

To 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.

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 create. Click Run Now.
Masking enhancements (SE 9.0):

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 Metro-Based NDM or Metro-Based NDM with Pre-copy.

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.
5.3 Migrate a subset of devices in an SG

To migrate a subset of devices in a 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 and click the More Actions menu and select SG Maintenance > Split From.
The result is a standalone 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 Metro NDM or Metro NDM with Pre-copy.

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 (`EnhancementsChild1_Split`) the devices to split with the `-devs` parameter and finally the `-view_name` option for the masking view create.

### 5.4 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.
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 (3 dots) icon and select SG Maintenance > Merge Into.

In the pop-up dialog, select the storage group you want to merge the selected group into. Then 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.

5.5 **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.

5.6 **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, however the NDM synchronization had to be complete before setting up the DR relationship.

Using PowerMaxOS 5978 and Solutions Enabler 9.0 release 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.
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 Metro NDM or Metro NDM with Pre-copy.

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.

From the target array navigate to the Storage group, highlight it and select Protect.
Masking enhancements (SE 9.0):

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.
Masking enhancements (SE 9.0):

The final confirmation of the planned configuration is displayed. Review and click **Run Now**.

The result is a 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 refer to **Metro NDM** or **Metro NDM with Pre-copy**.

To achieve the same result with Solutions Enabler:

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:

```
  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.

5.7 Create boot 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.
Host multipathing software notes

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

A.1 AIX Native Multipathing software

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

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

*`reserve_policy` may be set to `no_reserve` as long as GPFS/SCSI3 clusters are not part of the planned migration.

Please check if a “PR_key_value” is already assigned prior to changing the “reserve_policy” to PR_shared.

A.2 Linux Native Multipathing software (NPIO) (Device Mapper Multipath)

Use the default `/etc/multipath.conf` file. The following options are best practices to help the operating system and multipathing software detect path changes efficiently:

- `Path_grouping_policy multibus`
- `path_checker tur`
- `features "1 queue_if_no_path"`
- `path_selector "service-time 0"`
- `no_path_retry 6`

A.3 Linux multipathing software with LUNZ

If using address 0xf7, using NDM will result in a failure scenario. The recommendation is to modify with 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 “lsscsi | grep VMAXLUNZ”
2. Remove the scsi device by “echo 1 > /sys/block/xxx/device/delete”
3. Rescan the scsi devices by “rescan-scsi-bus.sh”

   - Some RedHat versions require the addition of the `-a` parameter
   - `rescan-scsi-bus.sh -a`
   - See [https://access.redhat.com/solutions/1314183](https://access.redhat.com/solutions/1314183)
A.4 PowerPath (version 5.7 and above)

Use the default PowerPath multipath settings.

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 for important information regarding PowerPath and AIX 6.x with GPFS.

A.5 PowerPath with Solaris

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

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

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

To recover all paths on a controller:

```
cfgadm -c configure c4
cfgadm -c configure c5
```

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

A.6 Windows 2012 with MPIO

Use default MPIO settings with the following parameters enabled:

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 unchecked, 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 EMC recommends setting it to lowest allowed value between 10 and 30 seconds.
A.7 Veritas Dynamic Multipathing

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

Check and modify the following DMP tunable parameters. If the parameter values are not set to the default values.

Note settings so the parameters can be returned to expected values following NDM migration.

<table>
<thead>
<tr>
<th>DMP Tunable Parameter</th>
<th>Default Value</th>
<th>NDM Required Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>dmp_path_age</td>
<td>300</td>
<td>0</td>
</tr>
<tr>
<td>dmp_health_time</td>
<td>60</td>
<td>0</td>
</tr>
<tr>
<td>dmp_restore_interval</td>
<td>300</td>
<td>10</td>
</tr>
<tr>
<td>dmp_restore_cycles</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>iopolicy (per DMP node name)</td>
<td>MinimumQ</td>
<td>MinimumQ</td>
</tr>
</tbody>
</table>

Use the rescan command.

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


A.8 Veritas cluster behavior with NDM

The SCSI Persistent Reservation won't be able to be read manually after non-disruptive migration until the nodes reboot or service failover. All other cluster functionality including fencing and failover will function properly. Once the cluster node reboot or the service failover occurs the persistent reservations can be manually read.

A.9 ESXi with Native Multipathing

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

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

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

Disk.PathEvalTime field.

A.10 Solaris 10 SPARC with Solaris cluster 3_3u2 using Pass-Through NDM, Missing Reservations
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:

```
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.
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.

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

The script can be downloaded on the EMCs support site: emc_pp_configure.sh
B.1 AIX LPM (Live Partition Mobility) with NDM

For Solutions Enabler version 8.3, customers need to 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 above, customer need do LPM operation at least once, let the passive initiator login into array and show up in Login History table (LHT), after this LPM operation then customer can do NDM.

It is not recommended to do LPM operations during the NDM session.
Consistent LUN

C Consistent LUN

If the source array does not have the Consistent LUN attribute set, but the target does (it is a pre-created IG) then there will be consistent LUN addresses on the Target array, but 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.

If the source array has the Consistent LUN attribute set, but for some reason the same LUN addresses are not all available on the target, then the LUN addresses on the Target will be consistent, but will not be the same as the LUN addresses on the source.

- By default VMAX and PowerMax arrays are delivered with the ACLX using LUN 0 and visible on a number of ports so if the SHOW_ACLX_DEV attribute is still in effect on a port that NDM will chose 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 because LUN 0 is not available on the target array for all the ports 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 used 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 – then when we migrate that application the LUN addresses we would want to use will not be available so you will get consistent, but different LUN addresses.
Device geometry behavior post NDM

<table>
<thead>
<tr>
<th>User Actions</th>
<th>Device Geometry Mode</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>User Defined</td>
<td>GCM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pre-5978</td>
<td>5978</td>
<td>Pre-5978</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5978</td>
</tr>
<tr>
<td>Not leave device geometry set post NDM Commit (when device geometry was getting set automatically during NDM)</td>
<td>Yes; starting with SE 8.4 (if target device size=source device size)</td>
<td>GCM ALWAYS set when there are odd # of cylinders on the source array</td>
<td></td>
</tr>
<tr>
<td>Unset/clear geometry of devices in replication relationship*</td>
<td>Allowed</td>
<td>Allowed</td>
<td>Not Allowed</td>
</tr>
<tr>
<td>Unset/clear geometry of devices NOT in replication relationship*</td>
<td>Allowed</td>
<td>Allowed</td>
<td>Allowed</td>
</tr>
<tr>
<td>Expansion of device (with geometry) in replication relationship*</td>
<td>Not Allowed</td>
<td>Allowed</td>
<td>Not Allowed</td>
</tr>
<tr>
<td>Expansion of device (with geometry) NOT in replication relationship*</td>
<td>Allowed***</td>
<td>Allowed</td>
<td>Allowed***</td>
</tr>
</tbody>
</table>

Clearing GCM on a device without replication that is mapped is a Unisphere for PowerMax and Solutions Enabler 9.0 feature only.
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.
Technical support and resources

Dell.com/support is focused on meeting customer needs with proven services and support.

Storage technical documents and videos provide expertise that helps to ensure customer success on Dell EMC storage platforms.