White Paper

IMPLEMENTING EMC FEDERATED LIVE MIGRATION WITH MICROSOFT WINDOWS SERVER FAILOVER CLUSTERING SUPPORT

Abstract

This white paper examines deployment and integration of Federated Live Migration with Microsoft Failover Cluster. Details of integration with FLM and Windows Failover Cluster systems are documented with practical examples for storage and Windows Server administrators.

May 2012

EMC²

Part Number h 10645

Table of Contents

Executive summary

EMC® Symmetrix VMAX™ series with Enginuity™ is built on the strategy of simple, intelligent, modular storage, it incorporates a new scalable Virtual Matrix™ interconnect that connects all shared resources across all VMAX Engines, allowing the storage array to grow seamlessly and cost-effectively from an entry-level configuration into the world's largest storage system. Symmetrix® VMAX provides predictable, self-optimizing performance and enables organizations to scale out on demand in private cloud environments. Automated storage operations are used to exceed business requirements in virtualized environments, with management tools that integrate with virtualized servers. The Symmetrix VMAX environment reduces administration time in private cloud infrastructures by providing scalable, automated solutions to the most common operational tasks. Customers are able to achieve "always on" availability with maximum security, fully non-disruptive operations and multi-site migration, recovery, and restart to prevent application downtime.

Federated Live Migration (FLM) provides a truly non-disruptive migration from DMX™ to VMAX storage arrays. FLM does this by tying together the array-based migration of the data, provided by EMC Open Replicator for Symmetrix, with host-level application redirection, provided by EMC PowerPath and other multi-pathing tools[1]. This is done by using a set of coordinated commands through SYMCLI to initiate the migration session and coordinate the host application redirection from one central point, making the migration nondisruptive to production workloads.

Federated Live Migration supports a number of prequalified source/target array combinations, multi-pathing tools, and host operating systems that help eliminate time-consuming remediation processes. Federated Live Migration is quite flexible; capable of supporting combinations of migrating thick-to-thick, thick-to-thin, and thin-to-thin as well as consolidating many systems' data to one Symmetrix.

Traditional means of implementing a migration of a Microsoft Windows Server 2008 R2 Failover Cluster from one storage array to another provided challenges resulting in a longer than necessary disruption during the migration. In a Windows Failover Cluster environment, devices under cluster control maintain SCSI reservations against shared storage devices. Because of this, Open Replicator, when creating a pull or push session, is denied access to the remote devices as the storage array respects the SCSI reservation. This causes Open Replicator to not discover the remote devices successfully and as such the copy session will not be started.

Previously, the Windows Failover Cluster environment would need to be shut down, releasing the device SCSI reservations, in order for the SAN configuration for the Open Replicator migration to be validated. Elongated downtimes could then be experienced if the SAN configuration was discovered to be incorrect during remote device discovery. With the advent of Enginuity 5876 FLM now has the ability to overcome this

[1] It is envisaged that other vendor MPIO solutions such as, Veritas DMP, or host MPIO will be supported in time.

restriction of the SCSI reservation and full FLM support of a Windows Failover Clustered environment is possible.

Introduction

This white paper examines deployment and processes required for the integration of FLM with Microsoft Windows Sever 2008 R2 Failover Cluster support, all commands are valid and will perform in the same manner for Windows Server 2003 clusters. Details of FLM are documented with practical examples for storage and Windows Server administrators.

Audience

This White Paper is intended for anyone who needs to understand the FLM feature and functionality with Windows Server Failover Clusters; this includes Windows Server 2003, 2008 and 2008 R2. This document is specifically targeted at EMC field technical staff and EMC customers who are either planning a data migration or are considering Federated Live Migration between Windows Server 2003, 2003 R2, 2008 and 2008 R2 Failover Clusters as their migration solution.

Overview

Federated Live Migration allows a user to seamlessly migrate data from pre-existing storage into a new Enginuity 5876 VMAX array without the necessity to schedule any application downtime. Windows Server 2003, 2003 R2, 2008 and 2008 R2 clusters are supported. FLM makes use of existing Symmetrix features to move the data between the arrays and EMC PowerPath®, Veritas DMP, or another multipathing solution to manage the host access to the data while the migration is taking place. Control of the migration is accomplished via the Solutions Enabler (SE) SYMCLI user interface.

This white paper will concentrate on the use of FLM to migrate data from one DMX to a VMAX for a Windows Server 2008 R2 Failover cluster. The minimum Enginuity level for the target VMAX for this operation is 5876. The Enginuity 5876 release overcomes the inability to migrate the SCSI-3 persistent reservation lock a Windows failover cluster creates on a disk resource within the cluster.

Federated Live Migration operates by having the new VMAX device assume the identity and geometry of the donor DMX device and then performing an Open Replicator (ORS) data movement operation between the source and target arrays. The target VMAX device must be equal or larger than the source DMX device for the migrate operation to be allowed.

The source volume and the target device on the VMAX array cannot be the target of any type of local or remote replication. This restriction is necessary to ensure data integrity on the new device as an Open Replicator pull session will not be able to copy consistent data if new data is written to the donor DMX device while the session is running. Likewise, a volume cannot be the target of more than one kind of replication at the same time for consistency reasons. An FLM configuration including the

network, storage arrays, application hosts, and the Solutions Enabler (SE) host as shown in Figure 1.

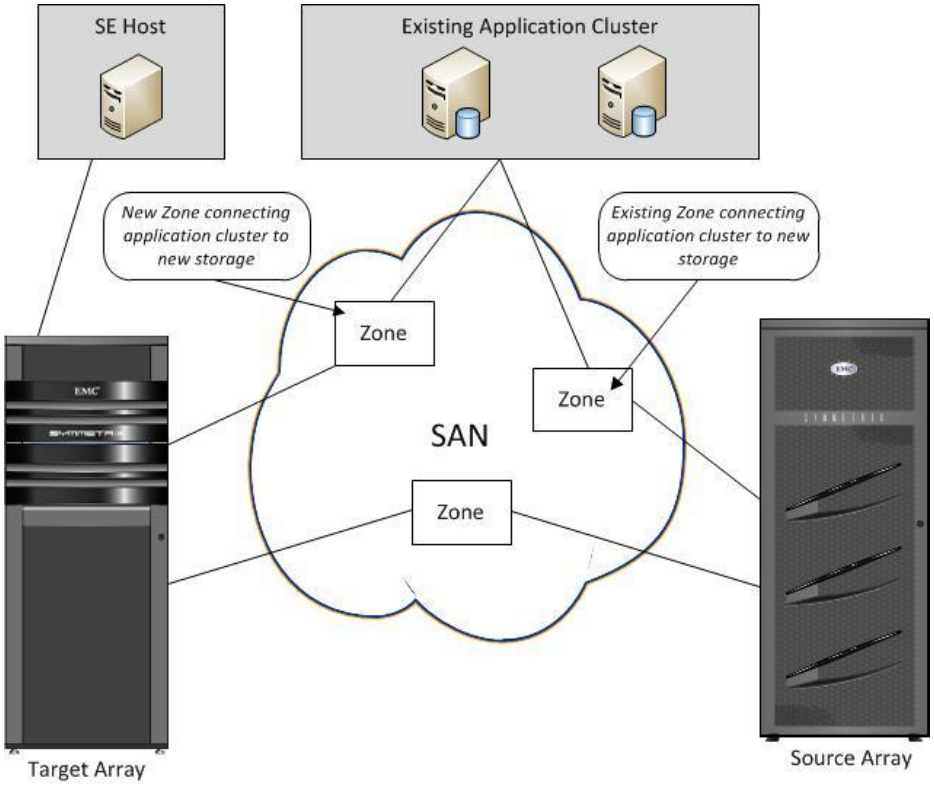

Figure 1 An FLM configuration

The SYMCLI interface for Federated Live Migration controls all functions of the data migration; however, it does not automatically set up any of the required Fibre Channel zones for the migration. This would include the zones from the application hosts to the target storage array and from the source storage array to the target storage array.

The SAN for the remote storage array must have connectivity to the control Symmetrix SAN. FLM and Open Replicator requires that at least one port on the remote array that allows access to the remote device have access to the control device through at least one port for a cold copy and all ports for a hot copy on the control array.

Additionally, after the migration has finished the user may optionally schedule a time to reboot the hosts and undo the assumed identity and/or geometry of the new VMAX devices. For the purpose of this white paper all migrations are between a DMX array and a VMAX array.

Considerations and dependencies

The following requirements are provided as a generic reference for setting up a data migration with FLM for Windows failover clusters and Open Replicator through a SAN:

- Enginuity 5876 is required on the target Symmetrix VMAX.
- Solutions Enabler 7.4 or greater is required.

- Target VMAX storage array must have ACLX enabled on ports used for FLM, as shown in Figure 2.

Figure 2 VMAX ACLX setting for FA port 07E

- Check the latest release of E-Lab EMC Simple Support Matrix (ESSM) for Federated Live Migration for the latest supported multi-pathing tools and environments.
- If the donor is a Symmetrix DMX this solution requires that the donor DMX storage be installed with an ePack, since the host_active/host_passive status of the donor DMX device must be controlled via Enginuity. The latest ePack requirements to support FLM can be obtained from http://powerlink.emc.com
- There is currently no FLM migration support for boot devices.
- There is currently no FLM migration support for cluster shared volumes (CSV).
- The donor DMX device is subject to the normal ORS restrictions for a hot pull operation and should not be the target of local or remote replication.
- Existing TF/Snap, TF/Clone, or SRDF sessions on the donor DMX device will not be migrated as part of Federated Live Migration.
- Upon completion of the migration, a new TimeFinder or SRDF session can be created against the newly migrated volumes.
- While PowerPath native naming as well as “pseudo” devices are supported, PowerPath “pseudo” devices are strongly recommended for use with FLM and PowerPath.

For more information refer to the Federated Live Migration Product Guide and Technical Notes available at http://powerlink.emc.com.

For information on supported operating systems, file systems, and logical volume managers, refer to the EMC Federated Live Migration Simple Support Matrix available at http://powerlink.emc.com.

For detailed migration support procedures using Federated Live Migration by host and multi path type, refer to the EMC Symmetrix Procedure Generator available at http://powerlink.emc.com.

Storage Area Network (SAN) and zoning

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

A Fibre Channel switch is required to implement Federated Live Migration. Direct connections (such as arbitrated loop) are not supported.

The SAN for the remote storage array must have connectivity to the source Symmetrix Array. Zoning must be set up on the Fibre Channel switch to zone the control Symmetrix fiber adapters (FAs) to the remote storage array front-end adapter(s).

If the FA port for the source devices is running volume configuration management (VCM) software Volume Logix for Symmetrix, setup will require granting permission to access the target device(s) from the target storage port. Target FA ports on the VMAX arrays must have ACLX enabled.

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

Refer to the EMC Solutions Enabler Symmetrix CLI Command Reference for additional information regarding `symsan`.

The operations for setting up the FLM environment are:

1. Application cluster is running on the source Symmetrix and the source Symmetrix is zoned to application cluster and SE Host, **Error! Reference source not found.**.

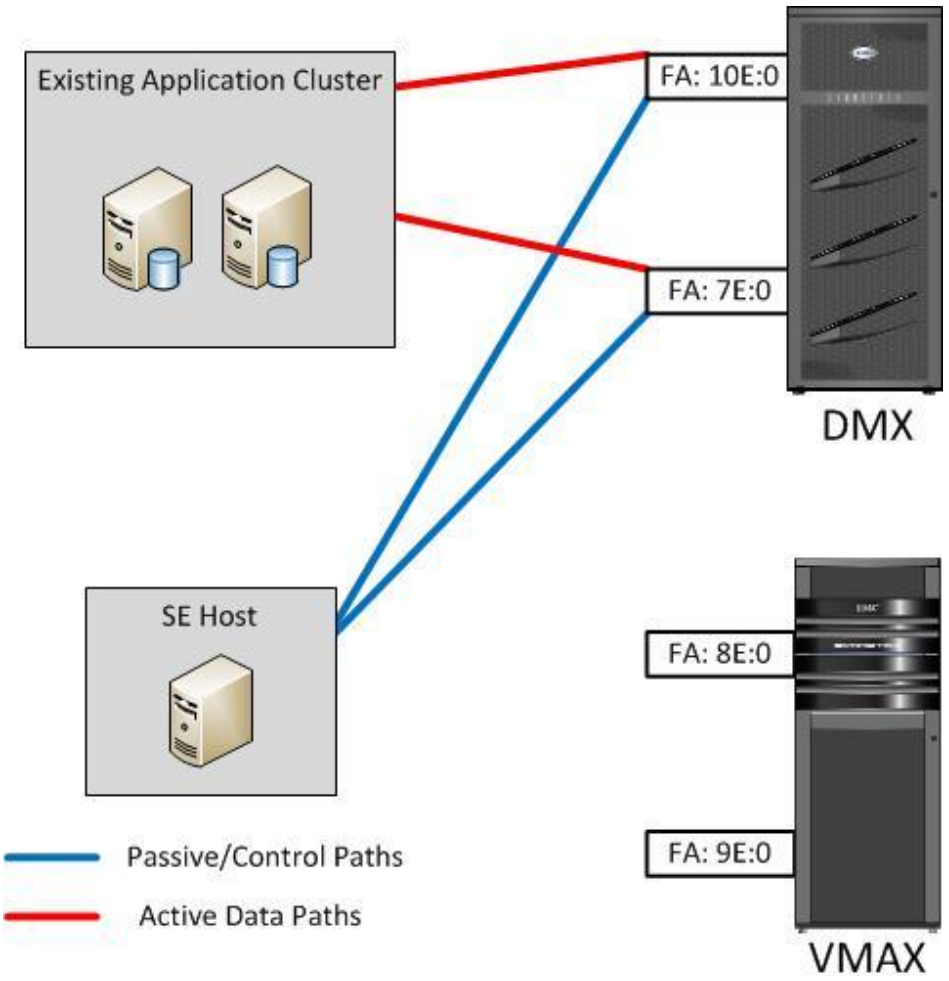

Figure 3 Initial zoning configuration

2. Zoning, Figure 4, is modified to support connectivity of:
   - Application cluster access to target Symmetrix (application access to target VMAX)
   - SE Host control of target Symmetrix
   - Source Symmetrix and target VMAX ORS zoning

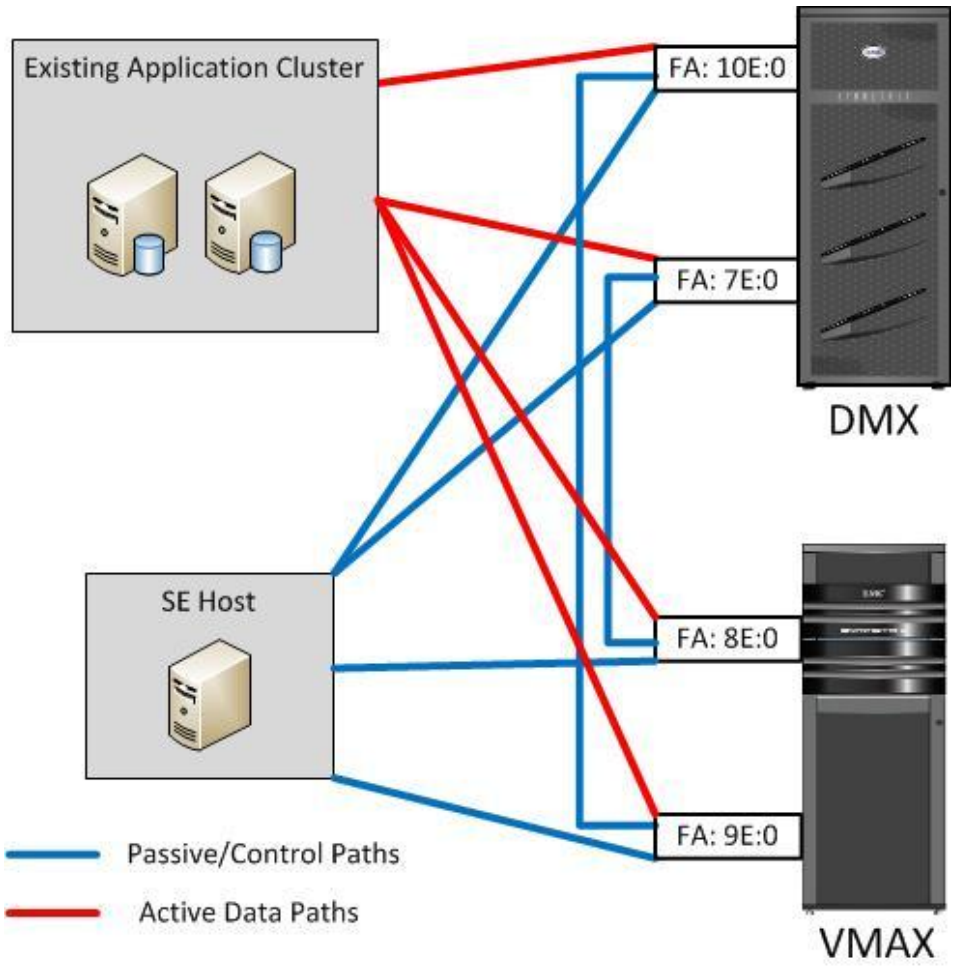

Figure 4: Zoning configuration ready for migration

3. Gatekeepers are masked from the Target VMAX to the SE Host to support control of the migration.

Using FLM to conduct a migration

In this solution an application cluster of 2 nodes has been presented with 4 LUNs. The cluster is running Windows Server 2008 R2 SP1.

Creating the FLM session

A pairing file is created to associate the source devices to the target devices in the format:

```
## FLM PAIR FILE
##
## COLUMN1: FLM Target [ VMAX - 5876 ]
## COLUMN2: FLM Source [ DMX  - 5671 ]

symdev=000194900275:0328 symdev=000187490076:0720
symdev=000194900275:0329 symdev=000187490076:075F
```

```
symdev=000194900275:032A symdev=000187490076:07B6
symdev=000194900275:032B symdev=000187490076:07E9
```

This file is saved as win_flm.

From the SE Host the `symrcopy` command is used to create a FLM session with the devices specified by the FLM pair file. As this is a Windows Failover cluster the `–mp_type` parameter is required for the `–host_type` Windows.

```
C:\> symrcopy -f win_flm create -pull -migrate -host_type windows -mp_type
ppath

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


'Create' operation successfully executed for the device list

in device file ' win_flm'.
```

Executing this command performs the following:

- FLM VMAX Target devices are set to passive host access mode.
- FLM VMAX Target devices assume external identity of FLM Source Devices.
- FLM VMAX Target devices assume external geometry of FLM Source Device (if necessary).

FLM VMAX Target FA Ports externally display a 2 port offset for FLM Target devices. As an example, VMAX devices mapped to FA 07F:0 and FA 08F:1 will be externally displayed on FA 07F:2 and FA 08F:3

Verify the FLM session is created

From the SE Host, execute the `symrcopy query` command to verify that the FLM session has been created, Figure 5.

```
C:\> symrcopy -f win_flm query

Device File Name      : win_flm

       Control Device                  Remote Device      Flags      Status      Done
----------------------------- ----------------------------- ------- -------------- ----
                    Protected
SID:symdev          Tracks    Identification           RI CDSHUTZ  CTL <=> REM    (%)
------------------ --------- ------------------------ -- ------- -------------- ----
000194900275:0328       60000 000187490076:0720        SD ...XXM. Created         N/A
000194900275:0329       60000 000187490076:075F        SD ...XXM. Created         N/A
000194900275:032A       60000 000187490076:07B6        SD ...XXM. Created         N/A
000194900275:032B       15000 000187490076:07E9        SD ...XXM. Created         N/A

Total                ---------
  Track(s)              195000
  MB(s)               12187.5

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

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

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

Figure 5 Symrcopy query command to verify FLM session

The value of M for type (T) in the Flags column indicates the session is an FLM migration session.

Verify the external identity on the target devices

From the SE Host execute the `symdev list –identity` command to verify that the target devices have been given the identity of the source devices. An optional –range can be used to focus on a specific range of devices, Figure 6.

```
C:\> symdev -sid 275 list -identity -range 0328:032B

Symmetrix ID: 000194900275

              Device                FLG            External Identity
---------------------------------- --- ----------------------------------------
Sym  Physical    Config        Sts IG  Array ID       Num    Ser Num    Cap (MB)
---------------------------------- --- ----------------------------------------

0328 Not Visible TDEV          RW  XX  000187490076   00720 7600720000     3750
0329 Not Visible TDEV          RW  XX  000187490076   0075F 760075F000     3750
032A Not Visible TDEV          RW  XX  000187490076   007B6 76007B6000     3750
032B Not Visible TDEV          RW  XX  000187490076   007E9 76007E9000      938

Legend:
  Flags:
   (I)dentity : X = The device has a non-native external identity set
                . = The device does not have an external identity set
   (G)eometry : X = The device has a user defined geometry
                . = The device does not have a user defined geometry
```

Figure 6 Symdev command to verify target devices identity

All the fields listed under the External Identity column for each device, must match the associated source devices. In this example, the X's under (I)dentity and (G)eometry in the FLG column indicate the FLM target devices have both external identity and geometry user defined.

Mask VMAX target devices to the application host

From the SE Host the target devices now have to be masked to the application cluster so that they are visible to the cluster. This can be done through SMC, Figure 7, or by using the `symaccess create` command to create the masking view.

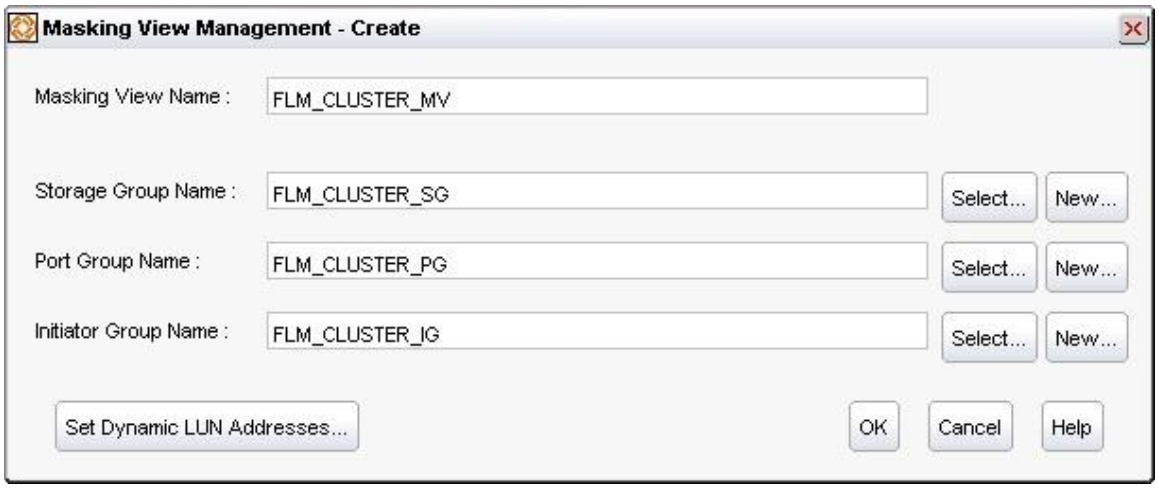

Figure 7 Target masking view through SMC

From the SE Host use the command `symaccess show view` to verify the masking view parameters, Figure 8.

```
C:\> symaccess -sid 275 show view FLM_CLUSTER_MV

Symmetrix ID          : 000194900275

Masking View Name     : FLM_CLUSTER_MV
Last updated at       : 12:36:37 PM on Tue Jan 04,2011

Initiator Group Name  : FLM_CLUSTER_IG

   Host Initiators
     {
       WWN   : 210000e08b1e45f9
     }

Port Group Name       : FLM_CLUSTER_PG

   Director Identification
     {
       FA-7E:0
       FA-8E:0
     }

Storage Group Name    : FLM_CLUSTER_SG

Sym Dev                                    Host
Name    Dir:P  Physical Device Name         Lun  Attr  Cap(MB)
------  -----  -----------------------  ----  ----  -------
0328    08E:0  Not Visible                 1           8631
        07E:0  Not Visible                 1
0329    08E:0  Not Visible                 2           8631
        07E:0  Not Visible                 2
032A    08E:0  Not Visible                 3           8631
        07E:0  Not Visible                 3
032B    08E:0  Not Visible                 4           8631
        07E:0  Not Visible                 4
                                                   -------
Total Capacity                                       34524
```

Figure 8 Target masking and validation using symaccess

In order for the cluster to see the new devices a disk rescan needs to be performed on all nodes within the cluster. This can be done through the Windows Server System Management MMC interface under Storage \ Disk Management \ Rescan Disks. Alternatively this can be carried out from the command line using the diskpart command and issuing a rescan command, Figure 9.

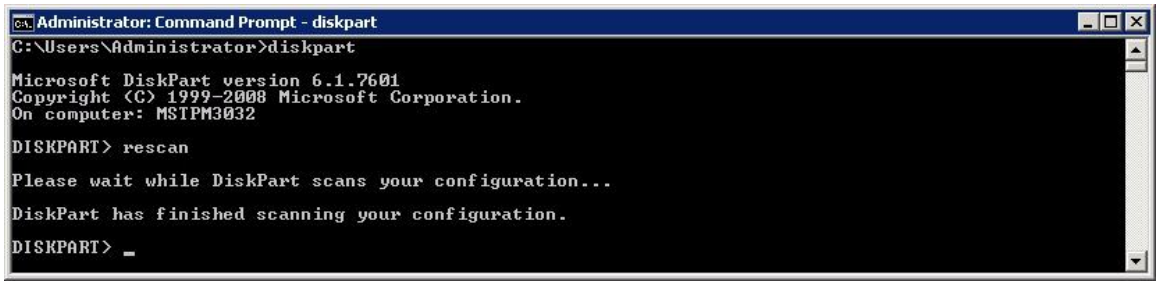

Figure 9 using diskpart to perform a SCSI disk rescan

Verify external device identity of the VMAX target device paths

Form each node in the cluster use `powermt display dev=all` to verify the target paths have been configured as alternate paths to the source devices, Figure 10.

FLM target device paths will be displayed on storage interfaces which end in C or D, reflective of the 2-port offset.

```
C:\> powermt display dev=all

Pseudo name=harddisk14
Symmetrix ID=000187490076
Logical device ID=0720
state=alive; policy=SymmOpt; priority=0; queued-IOs=0
==============================================================================
---------------- Host ---------------   - Stor -   -- I/O Path -  -- Stats ---
### HW Path                 I/O Paths    Interf.   Mode    State  Q-IOs Errors
==============================================================================
   5 port5\path0\tgt10\lun6    c5t10d6   FA 14cA   active  alive      0      0
   5 port5\path0\tgt11\lun6    c5t11d6   FA 14cB   active  alive      0      0
   5 port5\path0\tgt4\lun1     c5t4d1    FA  7eC   active  alive      0      0
   5 port5\path0\tgt6\lun1     c5t6d1    FA  8eC   active  alive      0      0

Pseudo name=harddisk15
Symmetrix ID=000187490076
Logical device ID=075F
state=alive; policy=SymmOpt; priority=0; queued-IOs=0
==============================================================================
---------------- Host ---------------   - Stor -   -- I/O Path -  -- Stats ---
### HW Path                 I/O Paths    Interf.   Mode    State  Q-IOs Errors
==============================================================================
   5 port5\path0\tgt10\lun54   c5t10d54  FA 14cA   active  alive      0      0
   5 port5\path0\tgt11\lun54   c5t11d54  FA 14cB   active  alive      0      0
   5 port5\path0\tgt4\lun2     c5t4d2    FA  7eC   active  alive      0      0
   5 port5\path0\tgt6\lun2     c5t6d2    FA  8eC   active  alive      0      0

Pseudo name=harddisk16
Symmetrix ID=000187490076
Logical device ID=07B6
state=alive; policy=SymmOpt; priority=0; queued-IOs=0
==============================================================================
---------------- Host ---------------   - Stor -   -- I/O Path -  -- Stats ---
### HW Path                 I/O Paths    Interf.   Mode    State  Q-IOs Errors
==============================================================================
   5 port5\path0\tgt10\lun108  c5t10d108 FA 14cA   active  alive      0      0
   5 port5\path0\tgt11\lun108  c5t11d108 FA 14cB   active  alive      0      0
   5 port5\path0\tgt4\lun3     c5t4d3    FA  7eC   active  alive      0      0
   5 port5\path0\tgt6\lun3     c5t6d3    FA  8eC   active  alive      0      0

Pseudo name=harddisk17
Symmetrix ID=000187490076
Logical device ID=07E9
state=alive; policy=SymmOpt; priority=0; queued-IOs=1
==============================================================================
---------------- Host ---------------   - Stor -   -- I/O Path -  -- Stats ---
### HW Path                 I/O Paths    Interf.   Mode    State  Q-IOs Errors
==============================================================================
   5 port5\path0\tgt10\lun150  c5t10d150 FA 14cA   active  alive      0      0
   5 port5\path0\tgt11\lun150  c5t11d150 FA 14cB   active  alive      1      0
   5 port5\path0\tgt4\lun4     c5t4d4    FA  7eC   active  alive      0      0
   5 port5\path0\tgt6\lun4     c5t6d4    FA  8eC   active  alive      0      0
```

Figure 10 powermt showing target paths as alternate paths

Activate the FLM Session

The migration now has to be activated from the SE host. This is carried out by using the `symrcopy activate -migrate` command. This will activate the FLM session with the devices specified in the FLM pair file, Figure 11.

```
C:\> symrcopy -f win_flm activate -migrate

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

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

Figure 11 Activating the migration session

Executing this command will perform the following functions:

- FLM VMAX target devices are set to active host access mode.
- FLM VMAX source devices are set to passive host access mode.
- FLM Session is set to Copy mode.

Verify the FLM pair status

To confirm that the session has been activated correctly the status of the FLM pair needs to be validated. This is done from the SE host by using the `symrcopy query` command to verify that the FLM pair status is "`CopyInProg`" (copy in progress) or "`Copied`", Figure 12.

```
C:\> symrcopy -f win_flm query

 Control Device                  Remote Device      Flags      Status      Done
------------------------------ ------------------------- ------- -------------- ----
                     Protected
SID:symdev           Tracks    Identification           RI CDSHUTZ  CTL <=> REM    (%)
------------------- --------- ------------------------ -- ------- -------------- ----
000194900275:0328       56252 000187490076:0720        SD X..XXM. CopyInProg        6
000194900275:0329       57358 000187490076:075F        SD X..XXM. CopyInProg        4
000194900275:032A       56592 000187490076:07B6        SD X..XXM. CopyInProg        5
000194900275:032B       12077 000187490076:07E9        SD X..XXM. CopyInProg       19

Total                ---------
  Track(s)              182279
  MB(s)                11392.4
```

Figure 12 verifying the copy status

Verify the cutover on the application host

From a node in the application cluster the `powermt display dev=all` command is used to verify the cutover. The activate sets the target devices to host access mode active and the source devices to host access mode passive. FLM target devices paths will be displayed on storage interfaces which end in C or D, reflective of the 2-port offset, Figure 13.

```
C:\> powermt display dev=all

Pseudo name=harddisk14
Symmetrix ID=000187490076
Logical device ID=0720
state=alive; policy=SymmOpt; priority=0; queued-IOs=0
==============================================================================
---------------- Host ---------------   - Stor -   -- I/O Path -  -- Stats ---
### HW Path                I/O Paths    Interf.   Mode    State  Q-IOs Errors
==============================================================================
   5 port5\path0\tgt10\lun6    c5t10d6   FA 14cA   active  alive      0      0
   5 port5\path0\tgt11\lun6    c5t11d6   FA 14cB   active  alive      0      0
   5 port5\path0\tgt4\lun1     c5t4d1    FA  7eC   active  alive      0      0
   5 port5\path0\tgt6\lun1     c5t6d1    FA  8eC   active  alive      0      0

Pseudo name=harddisk15
Symmetrix ID=000187490076
Logical device ID=075F
state=alive; policy=SymmOpt; priority=0; queued-IOs=0
==============================================================================
---------------- Host ---------------   - Stor -   -- I/O Path -  -- Stats ---
### HW Path                I/O Paths    Interf.   Mode    State  Q-IOs Errors
==============================================================================
   5 port5\path0\tgt10\lun54   c5t10d54  FA 14cA   active  alive      0      0
   5 port5\path0\tgt11\lun54   c5t11d54  FA 14cB   active  alive      0      0
   5 port5\path0\tgt4\lun2     c5t4d2    FA  7eC   active  alive      0      0
   5 port5\path0\tgt6\lun2     c5t6d2    FA  8eC   active  alive      0      0

Pseudo name=harddisk16
Symmetrix ID=000187490076
Logical device ID=07B6
state=alive; policy=SymmOpt; priority=0; queued-IOs=0
==============================================================================
---------------- Host ---------------   - Stor -   -- I/O Path -  -- Stats ---
### HW Path                I/O Paths    Interf.   Mode    State  Q-IOs Errors
==============================================================================
   5 port5\path0\tgt10\lun108  c5t10d108 FA 14cA   active  alive      0      0
   5 port5\path0\tgt11\lun108  c5t11d108 FA 14cB   active  alive      0      0
   5 port5\path0\tgt4\lun3     c5t4d3    FA  7eC   active  alive      0      0
   5 port5\path0\tgt6\lun3     c5t6d3    FA  8eC   active  alive      0      0

Pseudo name=harddisk17
Symmetrix ID=000187490076
Logical device ID=07E9
state=alive; policy=SymmOpt; priority=0; queued-IOs=0
==============================================================================
---------------- Host ---------------   - Stor -   -- I/O Path -  -- Stats ---
### HW Path                I/O Paths    Interf.   Mode    State  Q-IOs Errors
==============================================================================
   5 port5\path0\tgt10\lun150  c5t10d150 FA 14cA   active  alive      0      0
   5 port5\path0\tgt11\lun150  c5t11d150 FA 14cB   active  alive      0      0
   5 port5\path0\tgt4\lun4     c5t4d4    FA  7eC   active  alive      0      0
   5 port5\path0\tgt6\lun4     c5t6d4    FA  8eC   active  alive      0      0
```

Figure 13 Verifying the cutover from a cluster node

FLM VMAX Target FA Ports externally display a 2 port offset for FLM Target devices, as shown by storage interfaces which end in C or D.

If any paths other than the expected paths report a dead state, examine the cause before continuing.

Monitor the FLM session

The migration can be monitored from the SE host using the `symrcopy query` command to query the status of the FLM migration for the devices specified in the FLM pair file. The pair status will be "`CopyInProg`" or "`Copied`", as can be seen in an earlier example in Figure 12.

To monitor the progress the `symrcopy query` is run from the SE host to query the status of the FLM migration for the devices specified by the FLM pair file. This will confirm when the copy is complete. The pair status will be "`Copied`", Figure 14.

```
C:\> symrcopy -f win_flm query

Device File Name      : win_flm
       Control Device                  Remote Device      Flags      Status      Done
--------------------------- --------------------------- ------- -------------- ----
                    Protected
SID:symdev          Tracks    Identification            RI CDSHUTZ  CTL <=> REM    (%)
------------------ --------- ------------------------- -- ------- -------------- ----
000194900275:0328      45580 000187490076:0720         SD X..XXM. CopyInProg       24
000194900275:0329      45399 000187490076:075F         SD X..XXM. CopyInProg       24
000194900275:032A      45411 000187490076:07B6         SD X..XXM. CopyInProg       24
000194900275:032B        550 000187490076:07E9         SD X..XXM. CopyInProg       96
Total                --------

  Track(s)            136940
  MB(s)               8558.8
```

Figure 14 Confirmation that the copy process is in progress

Additionally, when all the pairs are in a copied state using the `symrcopy verify` command will confirm that all pairs are in a copied state by returning:

```
C:\> symrcopy -f win_flm query

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

Figure 15 Confirmation that the copy process is complete

Terminate the FLM session

When all of the pairs are in the "copied" state the migration session needs to be terminated. This is carried out from the SE Host with the `symrcopy terminate -migrate -symforce -force` command. This will terminate and finalize the FLM migration for the devices specified by the FLM pair file, Figure 16. The two force options are required to terminate donor update ORS sessions.

Once the session is terminated, the DMX source devices will no longer receive Donor Update writes, therefore the ability to failback to the old source device is removed.

```
C:\> symrcopy -f win_flm terminate -migrate -symforce -force

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

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

Figure 16 Terminate the migration session

Terminating the FLM session performs the following:

- ORS hot pull, donor update session is terminated.
- FLM source devices remain in a passive host access mode.
- FLM target devices remain in an active host access mode.

Remove masking for source devices

Once the FLM session is terminated the Symmetrix devices need to be removed from the source Symmetrix, Figure 17, if the source Symmetrix is a DMX at code 5773 or 5771 the `symmask remove devs` command is used to remove application cluster visibility for the source Symmetrix devices. This can also be carried out using the SMC interface.

The host may run indefinitely with federated identity on the new VMAX devices; however, EMC recommends that the spoofed identity be removed as soon as it is practical to do so following the migration. Leaving the identity spoofing in place long-term has the potential to cause confusion for systems administrators or other users who may not be familiar with the details of FLM and how device identities are federated. This recommendation is provided only to raise awareness and is not intended as a mandate for unspoofing; VMAX devices may remain federated indefinitely and there is no requirement to unspoof at any time.

```
C:\> symmask -sid 076 -dir 14c -p 0 -wwn 10000000c953f9f3 remove devs
0720,075F,07B6,07E9

C:\> symmask -sid 076 -dir 14c -p 1 -wwn 10000000c953f9f3 remove devs
0720,075F,07B6,07E9

C:\> symmask -sid 076 refresh

Symmetrix FA/SE directors updated with contents of SymMask Database 000187490076
```

Figure 17 Using SYMMASK to remove original devices from source Symmetrix

Use the `symmaskdb list assignment` command to verify that the source devices are no longer masked to the application host.

```
C:\> symmaskdb -sid 076 list assignment -devs 0720,075F,07B6,07E9

Symmetrix ID : 000187490076

Device  Identifier        Type   Dir:P
------  ----------------  -----  ----------------
0720    50000972c0044d18  FIBRE  FA-14C:0
        50000972c0044d1c  FIBRE  FA-14C:1
075F    50000972c0044d18  FIBRE  FA-14C:0
        50000972c0044d1c  FIBRE  FA-14C:1
07B6    50000972c0044d18  FIBRE  FA-14C:0
        50000972c0044d1c  FIBRE  FA-14C:1
07E9    50000972c0044d18  FIBRE  FA-14C:0
        50000972c0044d1c  FIBRE  FA-14C:1
```

Figure 18 Using SYMMASK to verify original devices from source Symmetrix have been removed

Perform a host SCSI rescan and remove source device paths

A host SCSI rescan on all cluster nodes is required to discover the removed DMX source device paths. PowerPath already knows the target VMAX paths from the bus rescan before FLM activation. This can be done through the System manager MMC interface under Storage \ Disk Management \ Rescan Disks. Alternatively this can be carried out from the command line using the diskpart command and issuing a rescan command, as detailed in a previous section at Figure 9.

This online process must be carried out on all nodes within the cluster.

Once the rescan completes, use `powermt display remove dev=all` to remove the source paths from the PowerPath configuration. This command is used in preference to `powermt check` for all FLM procedures. PowerPath will only remove paths that Windows has identified as no longer accessible, Figure 19.

```
C:\> powermt remove dev=all

Cannot remove device that is in use: c5t4d1
Cannot remove device that is in use: c5t4d2
Cannot remove device that is in use: c5t4d3
Cannot remove device that is in use: c5t4d4
Cannot remove device that is in use: c5t6d1
Cannot remove device that is in use: c5t6d2
Cannot remove device that is in use: c5t6d3
Cannot remove device that is in use: c5t6d4
```

Figure 19 Using powermt to remove redundant paths

Verify source device paths are removed and save PowerPath configuration

To verify that all of the redundant paths from the source Symmetrix have been removed from PowerPath the `powermt display dev=all` command, Figure 20.

```
C:\> powermt display dev=all

Pseudo name=harddisk14
Symmetrix ID=000187490076
Logical device ID=0720
state=alive; policy=SymmOpt; priority=0; queued-IOs=0
==============================================================================



---------------- Host ---------------   - Stor -   -- I/O Path -  -- Stats ---
### HW Path                I/O Paths    Interf.   Mode    State  Q-IOs Errors
==============================================================================
   5 port5\path0\tgt4\lun1     c5t4d1    FA  7eC   active  alive      0      1
   5 port5\path0\tgt6\lun1     c5t6d1    FA  8eC   active  alive      0      1

Pseudo name=harddisk15
Symmetrix ID=000187490076
Logical device ID=075F
state=alive; policy=SymmOpt; priority=0; queued-IOs=0
==============================================================================
---------------- Host ---------------   - Stor -   -- I/O Path -  -- Stats ---
### HW Path                I/O Paths    Interf.   Mode    State  Q-IOs Errors
==============================================================================
   5 port5\path0\tgt4\lun2     c5t4d2    FA  7eC   active  alive      0      1
   5 port5\path0\tgt6\lun2     c5t6d2    FA  8eC   active  alive      0      1

Pseudo name=harddisk16
Symmetrix ID=000187490076
Logical device ID=07B6
state=alive; policy=SymmOpt; priority=0; queued-IOs=0
==============================================================================
---------------- Host ---------------   - Stor -   -- I/O Path -  -- Stats ---
### HW Path                I/O Paths    Interf.   Mode    State  Q-IOs Errors
==============================================================================
   5 port5\path0\tgt4\lun3     c5t4d3    FA  7eC   active  alive      0      1
   5 port5\path0\tgt6\lun3     c5t6d3    FA  8eC   active  alive      0      1

Pseudo name=harddisk17
Symmetrix ID=000187490076
Logical device ID=07E9
state=alive; policy=SymmOpt; priority=0; queued-IOs=0
==============================================================================
---------------- Host ---------------   - Stor -   -- I/O Path -  -- Stats ---
### HW Path                I/O Paths    Interf.   Mode    State  Q-IOs Errors
==============================================================================
   5 port5\path0\tgt4\lun4     c5t4d4    FA  7eC   active  alive      0      1
   5 port5\path0\tgt6\lun4     c5t6d4    FA  8eC   active  alive      0      1
```

Figure 20 PowerPath active paths to target VMAX

Use PowerPath to check each path and clear any errors. It is necessary to ensure that all errors reported by PowerPath are resolved to ensure successful migration and operational stability of the Cluster environment.

The steps in this section must be run on all nodes in the cluster.

Conclusion

The Symmetrix Federated Live Migration functionality allows customers to seamlessly transition from existing storage infrastructure to VMAX arrays utilizing the Enginuity 5876 operating environment. This enables application portability within existing environments that meet the required availability of enterprise businesses. With support of Windows Server 2003 and Windows Server 2008 R2 Failover Cluster configurations, full enterprise class migrations are possible.