EMC Business Continuity for Microsoft Hyper-V Enabled by EMC Symmetrix VMAX and SRDF/CE

A Detailed Review

EMC Information Infrastructure Solutions

Abstract

This white paper provides a business continuity solution for Microsoft Hyper-V hosted on EMC® Symmetrix VMAX replicating to the other site with SRDF®/Synchronous mode. The solution uses EMC Cluster Enabler for automated failover and failback.

November 2010
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Executive summary

Business case
As customers start consolidating their servers using Microsoft Hyper-V, the availability of the Microsoft Hyper-V environment becomes crucial to the business. If the Hyper-V server goes down, it brings down the entire virtual machine infrastructure hosted within it. To prevent such host failures, Microsoft Failover Clustering can be used to provide high availability for the virtual machines.

If there is a power failure or natural disaster on that site, it will take down the entire environment. Recovery using other methods, such as from tape backups that are shipped offsite, will be slower. In many cases the recovery plan is more time-consuming and error-prone because of the need for human interaction.

Even when the data is replicated to another storage array at a different site, presenting that LUN to the host for read/write access can be a manual and time-consuming challenge. In this solution we provide best practices to ensure data availability.

Product solution
A Microsoft Hyper-V (Hyper-V) Shared Storage environment provides many benefits including the option of performing live migration. Customers running their environment on the EMC® Symmetrix VMAX™ series, unified storage, or RecoverPoint can use EMC Cluster Enabler with the corresponding plug-in for automated failover and failback of Microsoft failover cluster groups.

EMC Virtual Storage Integrator for Hyper-V provides better visibility of a virtual machine to its underlying storage on EMC storage platforms, in this case Symmetrix®. Administrators can also use this tool to migrate a virtual machine from one site to another.

Key results
This solution enables customers to:

• Provide better services to their clients
• Perform live migration of a virtual machine from one site to another to better serve application demands
• Automate the failover of virtual machines from one site to another
• Provide better visibility of the virtual machine-to-storage relationship for easier troubleshooting
## Introduction

### Purpose
The purpose of this document is to provide an overall understanding of:

- Hyper-V virtual machines in a Microsoft Failover Clustering environment
- Automated failover and failback using EMC Cluster Enabler
- EMC Virtual Storage Integrator for Hyper-V and what value it adds to the Hyper-V environment

### Scope
The scope of this white paper is to document the:

- Overview of Hyper-V virtual machines in Microsoft failover clusters
- Live migration of virtual machines from one site to another using EMC SRDF Cluster Enabler plug-in
- Benefits of using EMC Virtual Storage Integrator for Hyper-V

### Audience
This white paper is intended for:

- Field personnel who are tasked with implementing a business continuity solution for a Hyper-V environment using EMC Cluster Enabler
- Customers, including IT planners, storage architects, and administrators involved in evaluating, acquiring, managing, operating, or designing a virtualized data center using EMC products.
- EMC staff and partners, for guidance and the development of proposals
- Any person who is interested in learning more about virtual machines in a Microsoft Failover Clustering environment, EMC Cluster Enabler, and EMC Virtual Storage Integrator for Hyper-V
Solution overview

Overview

The validated solution is built with a Microsoft Hyper-V environment on an EMC Symmetrix VMAX storage platform.

In our solution environment, we have two sites configured as follows:

- One Symmetrix VMAX per site
- Two cluster nodes per site
- One domain controller per site

A third site hosts the following:

- System Center Virtual Machine Manager 2008 R2 (SCVMM)
- A file share acting as a witness node

VLANs are extended between the sites and the VMAX systems are replicated with SRDF/S. Live migration requires existing IP addressing to work on the remote site.
The following diagram illustrates the physical architecture of the use case solution.
**Solution environment**

All the physical servers are running Windows 2008 R2. Hyper-V roles are enabled on the cluster nodes. To cluster the Hyper-V servers, all the nodes are configured in the same manner.

Clustering of the Core Hyper-V servers and Full Edition Hyper-V servers in a same cluster is not supported; the system will not allow it.

Windows Failover Clustering is configured to use the Node and File-Share majority Quorum model. With two nodes on each site, plus the file share, there is a total of five votes. At least three votes are required for the cluster to run, and so it can withstand up to two node failures.

---

**Multi-site clustering**

The following table shows where our solution fits in the various replication methods supported by the Windows failover cluster in multi-site environments.

<table>
<thead>
<tr>
<th>Replication method</th>
<th>Our solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage-based block-level replication</td>
<td>Yes. This solution provides crash consistency for the Hyper-V virtual machines using SRDF/S. If you need application consistency, consult your EMC representative about additional solutions.</td>
</tr>
<tr>
<td>Host-based volume replication</td>
<td>n/a</td>
</tr>
<tr>
<td>Application-based replication (like Exchange CCR)</td>
<td>n/a</td>
</tr>
</tbody>
</table>

**Cluster nodes**

The following table lists the virtual machines for Site A and Site B.

In our environment, two virtual machines are created on the Hyper-V cluster: One virtual machine has a single VHD disk and the other contains the OS on VHD and data on pass-through disk.

EMC Solutions Enabler, Cluster Enabler, and PowerPath® are installed on the cluster nodes.

<table>
<thead>
<tr>
<th>Virtual Machine</th>
<th>Site A VMAX Device</th>
<th>Site B VMAX Device</th>
</tr>
</thead>
<tbody>
<tr>
<td>VHD-DVDStore</td>
<td>004E</td>
<td>01FD</td>
</tr>
<tr>
<td>Pass-DVDStore</td>
<td>004F;0050</td>
<td>01FE;020B</td>
</tr>
</tbody>
</table>
Hyper-V nodes  The virtual switch on each Hyper-V node is created with the same name, as shown in the following graphic. In our case, we created an external virtual switch named “VM Switch ports” and used a physical NIC as the uplink port.

![Network Configuration Diagram](image-url)
SRDF pairs are established and are synchronized as shown in the following graphic. For more information about establishing the SRDF pair, refer to the following documentation:

- The EMC Symmetrix management console online help
- The *EMC Symmetrix Remote Data Facility (SRDF) Product Guide*
- The *EMC Symmetrix Remote Data Facility (SRDF) Connectivity Guide*
- The student guide of the Symmetrix Business Continuity Management course

Microsoft failover cluster nodes must pass the cluster validation test before they can be added to the cluster. The nodes are initially created on the cluster on the site that has read-write access. EMC Cluster Enabler is then used to add the nodes to the other site. If you need to add more disks at a later time, you should pause the node that has read-only devices and resume after it is configured with EMC Cluster Enabler.
The following table describes the hardware resources used in this solution.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Quantity</th>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dell PowerEdge R710</td>
<td>4</td>
<td>2 x quad-core Intel Xeon 5500 processors, 96 GB RAM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 x 10 GE FCoE Emulex CNA adapters</td>
</tr>
<tr>
<td>Dell PowerEdge R900</td>
<td>2</td>
<td>4 x six-core Intel Xeon X7460 @ 2.66 GHz, 128 GB RAM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 x 10 GE FCoE Emulex CNA adapters</td>
</tr>
<tr>
<td>EMC Symmetrix VMAX</td>
<td>2</td>
<td>VMAX-1SE with Enginuity™ 5874.229.182</td>
</tr>
<tr>
<td>Cisco MDS 9509</td>
<td>2</td>
<td>8 GB SAN switches</td>
</tr>
<tr>
<td>Cisco Nexus 5000 series</td>
<td>2</td>
<td>Converged network switches</td>
</tr>
<tr>
<td>Cisco Ethernet Switch</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

The following table describes the software resources used in the solution application environment.

<table>
<thead>
<tr>
<th>Software</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsoft Windows 2008</td>
<td>R2 Enterprise edition</td>
</tr>
<tr>
<td>Microsoft System Center Virtual Machine Manager</td>
<td>2008 R2</td>
</tr>
<tr>
<td>EMC PowerPath</td>
<td>5.5.0</td>
</tr>
<tr>
<td>EMC Solutions Enabler</td>
<td>7.1.2</td>
</tr>
<tr>
<td>EMC Symmetrix Management Console</td>
<td>7.1.1.1</td>
</tr>
<tr>
<td>EMC Cluster Enabler for Microsoft Failover Clusters with SRDF Plug-in</td>
<td>4.0.1</td>
</tr>
<tr>
<td>EMC Virtual Storage Integrator for Hyper-V</td>
<td>1.0.1</td>
</tr>
</tbody>
</table>
Microsoft Hyper-V

Introduction

Microsoft Hyper-V in Windows 2008 R2 enables administrators to create a virtualized server computing environment. Each virtual machine is a virtualized computer system that operates in an isolated execution environment. This allows running multiple operating systems simultaneously on one physical computer.

Virtual machine files

A Hyper-V virtual machine is a set of files hosted on a Windows 2008 server that makes it easier to transport across different machines and still retain its identity. The following table lists the files that make the virtual machine.

<table>
<thead>
<tr>
<th>File Extension</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>.XML</td>
<td>Virtual Machine Configuration details. An XML file exists for each virtual machine and each snapshot of the virtual machine. These are always named with the GUID of the virtual machine or snapshot.</td>
</tr>
<tr>
<td>.BIN</td>
<td>Memory of virtual machine or snapshot that is in saved state.</td>
</tr>
<tr>
<td>.VSV</td>
<td>Saved state from the devices associated with the virtual machine.</td>
</tr>
<tr>
<td>.VHD</td>
<td>Virtual Hard Disk file.</td>
</tr>
<tr>
<td>.AVHD</td>
<td>Automatic Virtual Hard Disk file. These are differencing disk files that are used with VM snapshots.</td>
</tr>
<tr>
<td>.VFD</td>
<td>Virtual Floppy Disk file.</td>
</tr>
<tr>
<td>.ISO</td>
<td>ISO image for DVD or CD.</td>
</tr>
</tbody>
</table>

The following screenshot showing the files of a virtual machine that has no snapshots. If it has snapshots, there will be an additional snapshot folder with a bin and a VSV file.
The following graphic shows that the virtual machine files reside on SAN volume S:.

Hyper-V creates a symbolic link at “C:\ProgramData\Microsoft\Windows\Hyper-V\Virtual Machines”, All virtual machines registered on that Hyper-V server should have a symbolic link. There is no need to manually create this link.
Virtual machine failover cluster resources

Two or more Hyper-V servers can have Failover Clustering installed, and can be configured to have virtual machines for failover purposes. Thus in the event of a server failure, virtual machines can be restarted on other nodes.

When a virtual machine is created on a Windows failover cluster, cluster resources of the virtual machine, the virtual machine configuration, and a dependent cluster disk resource are added. The name of the cluster resource varies based on the management tool used to create the virtual machine as shown in the following tables.

With System Center Virtual Machine Manager (SCVMM):

<table>
<thead>
<tr>
<th>Resource Type</th>
<th>Resource Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Machine</td>
<td>SCVMM &lt;VM&gt;</td>
</tr>
<tr>
<td>Virtual Machine Configuration</td>
<td>SCVMM &lt;VM&gt; Configuration</td>
</tr>
</tbody>
</table>

With Hyper-V Manager:

<table>
<thead>
<tr>
<th>Resource Type</th>
<th>Resource Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Machine</td>
<td>Virtual Machine &lt;VM&gt;</td>
</tr>
<tr>
<td>Virtual Machine Configuration</td>
<td>Virtual Machine Configuration &lt;VM&gt;</td>
</tr>
</tbody>
</table>

The Virtual Machine cluster resource controls how the virtual machine action should be handled on the failover cluster and also how failover cluster actions should be treated on the virtual machine.

The following graphic shows the options for the cluster’s offline action. The options include:

- Saving the state of the virtual machine
- Shutting down the virtual machine
- Turning it off when the cluster resource goes offline

The option below that shows the cluster resource is set to be offline when the virtual machine is powered off.
The following graphics shows that with PowerShell you can view offline actions and shutdown actions. PowerShell also enables you to view additional properties of the virtual machine such as migration state, migration progress, and so on.
The virtual machine configuration resource contains the virtual machine's storage location and switch port information. It is also responsible for registering and unregistering the virtual machine to the host.

If the virtual machine configuration resource goes offline, the symbolic link for that virtual machine on "C:\ProgramData\Microsoft\Windows\Hyper-V\Virtual Machines" is removed. It is created on the host where the resource comes online.
Live migration

Live migration provides the capability to move a virtual machine from one node to another without affecting service to applications or clients connecting to that virtual machine.

For live migration you must meet the following requirements:

- You must have Failover Clustering (you can only live migrate virtual machines between nodes in the failover cluster).
- Cluster nodes must use the same type of 64-bit processors from the same manufacturer.
- Cluster nodes must be configured on the same TCP/IP subnet. Even though a Windows 2008 failover cluster doesn't require the cluster nodes to be on the same subnet, live migration requires this feature.
- Cluster nodes must have access to block-based shared storage (Fibre Channel or iSCSI).

The network used for live migration is configurable under the cluster virtual machine resource.

[Image: SCVMM Pass-DVDStore Properties]

Select one or more networks for this virtual machine to use for live migration. Use the buttons to set them in order from most preferred at the top to least preferred at the bottom.

- Internal
- VM Network
- Public
Quick migration provides the capability to move a virtual machine from one Hyper-V server to another by saving the state of the virtual machine to the disk at the source and then bringing it up on the target.

For quick migration you must meet the following requirements:

- You must have Failover Clustering (you can only quick migrate virtual machines between nodes in the failover cluster).
- Cluster nodes must use a 64-bit processor and have support for hardware-assisted virtualization technology.
- Cluster nodes must have access to block-based shared storage (Fibre Channel or iSCSI).

The Move option on the cluster group performs a quick migrate of the virtual machine with the default setting of Save the virtual machine when the resource goes offline.

While both live migration and quick migration are used to move the virtual machine from one host to another, each method differs in how it is performed and the availability of the virtual machine during the operation.
EMC Cluster Enabler works with EMC products like Symmetrix, CLARiiON®, and RecoverPoint with its corresponding plug-in to provide automated failover and failback of Microsoft failover clusters across multiple sites.

To protect against site failure, in a typical environment the storage data gets replicated to another storage array on the recovery site. It will have read-write access on the source array and read-only access on the target array. This adds additional steps to allow read/write access on the remote site after failover when implementing stretched clusters across data centers.

EMC Cluster Enabler (CE) helps to automate these additional steps by seamlessly providing a custom resource type called CECluRes as part of the failover cluster.
When the CE cluster is configured, it creates that custom resource for every resource group that contains the disk resource.

All the disk resources in a cluster group are made dependent on the EMC_<cluster group> resource. In our case, the cluster disk resource “Cluster Disk 1” is dependent on the EMC_VHD-DVDStore resource.
EMC CE Cluster Resource checks ownership of the resource group and ensures that it has read/write access of the volume before bringing the disk online. It interacts with EMC Solutions Enabler to perform the required task on the storage array including promoting the volume for read-write access and reversing the replication.

EMC Cluster Enabler also includes a Microsoft Management Console (MMC) to manage the disk resources of the cluster and provides storage device details and current state.

**Note**  If the cluster is managed by System Center Virtual Machine Manager (SCVMM), similar information can also be viewed from EMC Virtual Storage Integrator. An example with EMC Virtual Storage Integrator is covered later in this document.
Microsoft SCVMM enables an administrator to centrally manage multiple Hyper-V servers as well as VMware environments. SCVMM provides a complete library to help administrators quickly create new virtual machines.

SCVMM assists IT administrators in placing virtual machines on appropriate physical server hosts.

As described earlier in this document, SCVMM 2008 R2 enables administrators to quickly migrate a virtual machine from one Hyper-V server to another without using the Failover Cluster Manager GUI.
The EMC Virtual Storage Integrator (VSI) for Hyper-V provides storage viewing functionality to facilitate the discovery and identification of the underlying EMC Symmetrix and CLARiiON storage devices that are allocated to Hyper-V hosts and virtual machines. VSI can also perform live/quick migration of virtual machines that are managed by EMC Cluster Enabler.

The VSI server is installed on the SCVMM server and the VSI client can be installed on any machine that has the SCVMM console installed.

VSI provides an MMC to give a similar view of SCVMM along with the underlying EMC storage details, and the VSI PowerShell Snap-in can provide similar information from the CLI and can be used in scripting.

In the following graphic, we show the properties of our sample Hyper-V virtual machine named “VHD-DVDStore”. Notice the virtual machine is hosted on the HVCN01.virtual.local host, and is available in the S:\Hyper-V\VHD-DVDStore folder. The virtual hard disk of that virtual machine is hosted on S: of that Hyper-V server HVCN01.virtual.local, and that drive is a Symmetrix device 004E on the array with a serial number ending 680. The device type, storage group, and also whether the device is virtually provisioned can be viewed from the output.
```plaintext
PS C:\Users\administrator\VIRTUAL> get-vsi_on UHD-DUDStore
Get-VSI_UOM Powershell Cmdlet.

Loading information for the Virtual Machine UHD-DUDStore.

Found Virtual Machine UHD-DUDStore in the SCVM server.

Information about Virtual Machine UHD-DUDStore:

<table>
<thead>
<tr>
<th>UMId</th>
<th>0C9DFCBE-71C6-401F-995E-FBAD7227FP09</th>
</tr>
</thead>
<tbody>
<tr>
<td>UMName</td>
<td>UHD-DUDStore</td>
</tr>
<tr>
<td>UMHost</td>
<td>UHD\CMA1 virtual local</td>
</tr>
<tr>
<td>HostGroupPath</td>
<td>\All Hosts\UHD DUDStore</td>
</tr>
<tr>
<td>Location</td>
<td>$\Hyper-V\UHD-DUDStore</td>
</tr>
<tr>
<td>UMPath</td>
<td>$\Hyper-V\UHD-DUDStore\Virtual Machines\0C9DFCBE-71C6-401F-995E-FBAD7227FP09</td>
</tr>
<tr>
<td>CheckpointLocation</td>
<td>$\Hyper-V\UHD-DUDStore</td>
</tr>
<tr>
<td>OSName</td>
<td>64-bit edition of Windows Server 2008 R2 Enterprise</td>
</tr>
<tr>
<td>OSArchitecture</td>
<td>amd64</td>
</tr>
<tr>
<td>OSVersion</td>
<td>6.1</td>
</tr>
<tr>
<td>Status</td>
<td>Running</td>
</tr>
</tbody>
</table>

Devices on Virtual Machine UHD-DUDStore:

<table>
<thead>
<tr>
<th>DeviceType</th>
<th>\UHD</th>
</tr>
</thead>
<tbody>
<tr>
<td>PhysicalDrive</td>
<td>\PhysicalDrives</td>
</tr>
<tr>
<td>Product</td>
<td>Symmetrix</td>
</tr>
<tr>
<td>Array</td>
<td>\CMA1 \00010000</td>
</tr>
</tbody>
</table>
Failover within the same site

Overview

Two Hyper-V cluster nodes (HVCN01 and HVCN02) at Site A are hosting virtual machines.

This scenario covers what happens when one of the nodes goes down.

Ownership

On Windows failover clusters, each resource group has a preferred owner. That defines the order on which node it should fail to.

Note

Even if you deselect the nodes of the other site, the Windows Failover Cluster Manager will add those at the end of the list because they are part of the cluster. Refer to http://support.microsoft.com/kb/299631 for more info.
From the above screenshot, when HVCN02 goes down, it will be moved to HVCN01. But, when HVCN01 goes down, it is moved to the node HVCN04 on the other site. We observed the same during our testing.

It is necessary to verify the order after a cluster group moves from one node to another. Failback can also be configured to avoid failing to a different site because of a single node failure in a site.

Failback will try to move the cluster resource group to the preferred node at the top. Failback can be configured immediately, which means whenever the cluster service comes online on the first preferred owner, it will take ownership of that resource group. To avoid movement during busy times (remember that a cluster resource group move is doing quick migration not live migration, which means the virtual machine is not accessible during the move), it can be scheduled to perform at a later time. For example, if it’s necessary to fail back between 8 P.M. and 9 P.M., the administrator needs to specify between 20 and 21 hours. If this happen as expected, check for the required hot fix at [http://support.microsoft.com/kb/982636](http://support.microsoft.com/kb/982636).

The possible owner of the cluster resource specifies on which node that resource can be brought online.
If automatic failover to the other site is not preferred for certain virtual machines, then
the possible owners for that virtual machine can be updated so that it can’t run
automatically on the other site.

When the resource fails over to the other node on the same site, the SRDF device
state of the disk remains the same.

The following table shows how long it took for the resources to come online after the
cluster group was moved from one node to another within the same site.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Failover time</th>
</tr>
</thead>
<tbody>
<tr>
<td>VHD disk VM: failover within site</td>
<td>40 seconds</td>
</tr>
<tr>
<td>Pass-through disk VM: failover within site</td>
<td>41 seconds</td>
</tr>
</tbody>
</table>
Failover across sites

Overview

In this scenario, we cover a planned failover and unplanned failover event:

- A planned failover event is when you manually migrate a virtual machine from one site to another.
- An unplanned failover event is when all servers at a site suddenly fail, causing the system to migrate the virtual machines from one site to another.

Planned failover

In this case, the virtual machine Pass-DVDStore is initially located at Site A.

Now, we can either quick migrate or live migrate the virtual machine to the nodes on Site B. The following screenshot shows the symqng output of the source node showing the devices are in the R1 state and highlights the physical disks relevant to Cluster Disk 2 and Cluster Disk 3 shown in the previous graphic.
The source device has read-write access and the RDF states are synchronized. The devices 004F and 0050 are in the Symmetrix array with serial number ending in 680, and they are in the R1 state with RW enabled. The remote devices 01FE and 020B are write disabled. The Remote Write disabled state can be viewed from the RDF States in the following graphic.

There are no device groups defined on the source node.

The following screen shows a live migrate from the current node HVCN02 to HVCN04:
On the target node, the syminq output shows the device is now changed to R1.

```
C:\Program Files\EMC-SYMCCLI-bin>syminq
```

<table>
<thead>
<tr>
<th>Device</th>
<th>Product</th>
<th>Type</th>
<th>Vendor</th>
<th>ID</th>
<th>Rev</th>
<th>Ser Num</th>
<th>Cap (KB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYSICALDRIVE9</td>
<td>DELL</td>
<td>PERC 6/1</td>
<td>1.22</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYSICALDRIVE1</td>
<td>EMC</td>
<td>LUNZ</td>
<td>4000</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYSICALDRIVE2</td>
<td>EMC</td>
<td>LUNZ</td>
<td>4000</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYSICALDRIVE3</td>
<td>EMC</td>
<td>LUNZ</td>
<td>4000</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYSICALDRIVE4</td>
<td>EMC</td>
<td>LUNZ</td>
<td>4000</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYSICALDRIVE5</td>
<td>EMC</td>
<td>LUNZ</td>
<td>4000</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYSICALDRIVE6</td>
<td>EMC</td>
<td>LUNZ</td>
<td>4000</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYSICALDRIVE7</td>
<td>EMC</td>
<td>LUNZ</td>
<td>4000</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

```
C:\Program Files\EMC-SYMCCLI-bin>-
```

As part of the failover process, SRDF/CE reverses the mirror state. The devices 01FE and 020B on the array with the serial number ending with 670 now have the R1 state and are RW enabled. The remote devices 004F and 0050 become write disabled.

```
C:\Program Files\EMC-SYMCCLI-bin>symrdf list
```

```
Symmetrix ID: 00019740800670

Local Device View

<table>
<thead>
<tr>
<th>Sym Dec</th>
<th>RDev</th>
<th>HDF</th>
<th>Status</th>
<th>Modes</th>
<th>R1 Inv</th>
<th>R2 Inv</th>
<th>RDF States</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Synchronized</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Synchronized</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Synchronized</td>
</tr>
</tbody>
</table>
```

If needed, they can be failed back to Site A with no manual updates
Unplanned failover

In our scenario, when a site goes down the nodes in the other site sense the failure and initiate failover of the resource group to the surviving nodes. Clusters are designed to overcome failures. The *EMC SRDF/Cluster Enabler Plug-in Product Guide* covers the following failure scenarios in the “Cluster Behavior” section:

- LAN, heartbeat, or storage link failure
- Host NIC failure
- Server failure
- Application software failure
- Host bus adapter failure
- Storage array failure
- SRDF link failure
- Complete site failure

Refer to the Product Guide for more information. With two cluster nodes at each site and a file share witness at the third site, the cluster should automatically fail over to the other site because it has more than half of the votes to run the cluster. The virtual machines will perform a quick migration or restart based on the Cluster VM resource setting. The following graphic shows the Cluster VM resource parameters.

![SCVMM Pass-DVDStore Properties](image)

The following table shows how quickly failover and failback occurred when the cluster group was moved across the nodes on different sites.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Failover time</th>
</tr>
</thead>
<tbody>
<tr>
<td>VHD disk VM: failover across site</td>
<td>54 seconds</td>
</tr>
<tr>
<td>Pass-through disk VM: failover across site</td>
<td>57 seconds</td>
</tr>
<tr>
<td>VHD disk VM: failback across site</td>
<td>55 seconds</td>
</tr>
<tr>
<td>Pass-through disk VM: failback across site</td>
<td>53 seconds</td>
</tr>
</tbody>
</table>
Live migration with various tools

Overview

Windows Failover Clustering with EMC Cluster Enabler works transparently with existing tools. To move a virtual machine from one site to another, you can use your tool of choice to perform the migration.

In this solution we verified migration operations with the following tools:

- Failover Cluster Manager GUI
- PowerShell commandlets
- SCVMM tool

Live migration with Failover Cluster Manager

You can use one of the options listed below to live migrate a virtual machine to another node.

During a live migration, the resource state will be running and once complete, the resource fails over to the other node.
Live migration with PowerShell

A virtual machine can be live migrated from one site to another using the Windows Failover Clustering PowerShell commandlets, or using VSI PowerShell Snap-ins.

The following graphic shows the live migration of a virtual machine using the Failover Clustering commandlet:

Live migration with SCVMM

To execute the live migration from SCVMM:
Select the server. In our case, we selected HVCN01:

Next complete the creation of the live migration setup and initiate the migration:

The job status will provide the result:
The following graphic shows that the virtual machine VHD-DVDStore is now hosted on HVCN01.
Multiple virtual machines on the same LUN

Overview

With Windows Failover Clustering, the Resource group is the main entity on which live migration and quick migration operations are handled. This section explores what happens when multiple virtual machines are created on the same disk resource.

Windows Failover Cluster Manager

As shown in the following graphic, Windows Failover Cluster Manager allows creating multiple virtual machines on the same disk resource.

But if you try to live migrate that resource group, you will encounter an error as shown in the following graphic:

Error

An error occurred initiating VM migration.

This clustered instance contains none or more than one virtual machine. To perform a live migration, the clustered instance must have only one virtual machine.

The disk resources in a cluster group can only be owned by a single node. When multiple virtual machines are hosted on the same cluster group because of disk dependency, all of them need to be moved at the same time and so a live migration cannot be performed. This situation can be avoided by using Cluster Shared Volumes or third-party products like Sanbolic Melio File System.

Note Currently, Microsoft doesn't support Cluster Shared Volumes across multiple sites.
However, Windows Failover Cluster Manager can perform a quick migration without any issues as shown in the following graphic:

<table>
<thead>
<tr>
<th>Name</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>VHD-DVDstore</td>
<td>Saving (saving 10.3% completed)</td>
</tr>
<tr>
<td>Virtual Machine Configuration DEVMO1</td>
<td>Offline</td>
</tr>
<tr>
<td>Virtual Machine Configuration DEVMO1</td>
<td>Offline</td>
</tr>
</tbody>
</table>

Disk Drives

- Cluster Disk 1

Windows PowerShell

When we try to use Windows PowerShell to perform a live migration, the operation will error out, as shown in the following graphic:

```
PS C:\Users\Administrator\VIRL\> Move-ClusterVirtualMachineRole UHD-DVDstore -mode HCUO82
Move-ClusterVirtualMachineRole : The service or application is not configured correctly; it contains multiple resources of type 'The service or application is not configured correctly; it contains multiple resources of type 'Virtual Machine'.
Command Type: Activity Script
Category Info: None
Additional properties: None

PS C:\Users\Administrator\VIRL\> Get-ClusterGroup UHD-DVDstore | Get-ClusterResource
Name       | State     | Group      | ResourceType
-----------|-----------|------------|---------------
Cluster Disk 1 | Online  | UHD-DVDstore | Physical Disk
UHD-DVDstore | Online   | UHD-DVDstore | UHD-DVDstore
UHD-DVDstore Configuration | Online | UHD-DVDstore Configuration | UHD-DVDstore Configuration
Virtual Machine Configuration | Online | UHD-DVDstore Configuration | Virtual Machine Configuration

PS C:\Users\Administrator\VIRL\> Move-ClusterGroup UHD-DVDstore -mode HCUO82
Move-ClusterGroup : The service or application is not configured correctly; it contains multiple resources of type 'Virtual Machine'.
Command Type: Activity Script
Category Info: None
Additional properties: None
```

However, Windows PowerShell succeeds for quick migration for the same site and across sites as shown in the following two graphics:

```
PS C:\Users\Administrator\VIRL\> Move-ClusterGroup UHD-DVDstore -mode HCUO82
Move-ClusterGroup : The service or application is not configured correctly; it contains multiple resources of type 'Virtual Machine'.
Command Type: Activity Script
Category Info: None
Additional properties: None

PS C:\Users\Administrator\VIRL\> Move-ClusterGroup UHD-DVDstore -mode HCUO84
Move-ClusterGroup : The service or application is not configured correctly; it contains multiple resources of type 'Virtual Machine'.
Command Type: Activity Script
Category Info: None
Additional properties: None
```
SCVMM

System Center Virtual Machine Manager doesn’t allow placing multiple virtual machines on the same disk resource.

After creating the virtual machine with Failover Cluster Manager and refreshing the host, it adds the virtual machine to SCVMM, but fails to migrate:

The cluster resource in the following graphic shows the migration attempt failed:
Virtual machine hosted on the volume GUID

Overview

The restriction on the number of virtual machines per LUN for failover clusters that are stretched across sites can lead to a situation where the administrator runs out of drive letters. To overcome this issue, Microsoft supports hosting a virtual machine on the Volume GUID. This section covers how it is configured and used with SRDF/CE.

Virtual machine on volume GUID

The Hyper-V host volume is formatted with NTFS and is not assigned a drive letter. On the cluster resource for the disk, it will show the volume GUID.

Use that volume GUID for the virtual machine storage path and Snapshot path.
And also use the volume GUID for the VM Configuration Resource as shown in the following graphic:

**SRDF/CE with Volume GUID**

During our testing, we did not see any issues with failover or failback of virtual machines, within site or across sites, while using Volume GUID. EMC Cluster Enabler works at the device level and it supports both drive letter as well as Volume GUID.
Failover cluster with SRDF/CE

Overview
This section shows the information that was added to the cluster database by the EMC Cluster Enabler SRDF Plug-in. This information may be helpful during troubleshooting.

Cluster
The following screen shows the setting of the cluster HVFC01 parameters.

```
PS C:\Users\Administrator\Virtual> get-cluster : Get-ClusterParameter : f1 -
ClusterObject : HVFC01
Name : SiteList
IsReadOnly : False
ParameterType : StringCollection
Value :  
<Site>
  <SiteName>Site1</SiteName>
  <SiteNameUserSet>Site1</SiteNameUserSet>
  <Node>HUC003</Node>
  <Node>HUC004</Node>
  <Storage>SYMMETRIX:008174908698</Storage>
</Site>
<Site>
  <SiteName>Site2</SiteName>
  <SiteNameUserSet>Site2</SiteNameUserSet>
  <Node>HUC003</Node>
  <Node>HUC004</Node>
  <Storage>SYMMETRIX:008174908688</Storage>
</Site>
</SiteList>
```
Cluster node

The following screen shows the parameter settings of the cluster node. The private properties of the cluster node are populated with the connected Symmetrix array information.

```
PS C:\Users\administrator.VIRTUAL> get-clusternode | Get-ClusterParameter | f1 | sele...
The following screen shows the parameter settings for the Cluster Enable resource:

```
Get-ClusterResource EMC_UHD-00Store -f1
```

```
ClusterObject : EMC_UHD-00Store
 Name : StorageGroupDefinition
 InReadonly : False
 ParameterType : String
 Value : 

Get-ClusterResource EMC_UHD-00Store
```

```
ClusterObject : EMC_UHD-00Store
 Name : StorageGroupDefinition
 InReadonly : False
 ParameterType : String
 Value : 

Get-ClusterResource EMC_UHD-00Store
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Get-ClusterResource EMC_UHD-00Store
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Conclusion

Summary

EMC Virtual Information Infrastructure Business Continuity for Microsoft Hyper-V enabled by Symmetrix VMAX and SRDF/CE can protect virtual machines on all datastores supported by Hyper-V. This makes it easier for server consolidation and crash-consistent protection of virtual machines, providing customers with a fault-tolerant solution that:

- Provides better services to their clients
- Performs live migration of a virtual machine from one site to another to better serve their demands
- Automates the failover of virtual machines from one site to another
- Provides end-to-end visibility of the virtual machine-to-storage relationship for easier troubleshooting

EMC Virtual Information Infrastructure for Hyper-V can be used across locations to meet business needs, and provides the freedom for administrators to choose the right storage protocol for their datastore.

This solution offers customers the ability to quickly implement a virtualized infrastructure to support their mission-critical applications and ensure business continuity with a robust disaster recovery architecture while significantly reducing costs.

Next steps

To learn more about this and other solutions contact an EMC representative or visit: www.emc.com.
References

Download additional information

This section lists additional sources of information about the topics and products discussed in this white paper. To view or download the listed documents, you can:

- Simply click the link to access the document in your browser
- Copy and paste the URL into your browser
- Scan the QR code using your cell phone camera, smartphone, or other mobile device. (You will need a QR code reader app on your device.)

EMC documents can be found on Powerlink®, a customer- and partner-only extranet. Access is based on your login credentials.

White papers

For additional information, see the following white paper:

- **An Overview of Groups in EMC Symmetrix and Solutions Enabler Environments**

Product documentation

For additional information, see the following product documents:

- **EMC SRDF/Cluster Enabler Plug-in Product Guide**

- **EMC Virtual Storage Integrator for Hyper-V Product Guide**

- **EMC Solutions Enabler Symmetrix Array Controls CLI Product Guide**

- **Microsoft System Center Virtual Machine Manager 2008 R2 Product Guide**
• Microsoft Windows 2008 R2 Hyper-V Product Guide

• Microsoft Windows 2008 R2 Failover Clusters Guide

Other documentation
For additional information, see the following links:
• Hyper-V live migration across sites with SRDF/CE
  http://www.youtube.com/watch?v=g5Hhzay4Dqs

• Hyper-V TV