Abstract

This white paper describes the design, deployment, and validation of a virtualized SAP environment with Microsoft Hyper-V and SAP ERP 6.0 EHP 4 on virtualized storage presented by EMC® VPLEX™ Geo.

July 2011
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Simplifying SAP Disaster Recovery Across Distributed Environments

Enabled by EMC VPLEX Geo
Executive summary

Business case

Today’s global enterprise demands always-on availability of applications and information to remain competitive. The priority is mission-critical applications—the applications that with downtime result in lost productivity, lost customers, and ultimately lost revenue. EMC has continuously led in products, services, and solutions that ensure uptime and protect business from disastrous losses. EMC® VPLEX™ enables customers to quickly move an entire SAP virtual environment over distance to protect information or to better support business continuity around the globe. Leveraging the architecture documented here, customers can recover their whole SAP environment or migrate live workloads to different physical locations, up to 2,000 km apart. This provides an unprecedented level of flexibility while ensuring application and information availability and protection.

EMC VPLEX helps customers easily migrate workloads around the globe to:

- Provide dramatically shorter recovery time objectives (RTOs) and recovery point objectives (RPOs) in a disaster
- Increase ROI by increasing utilization of hardware and software assets
- Maximize availability of information and applications
- Minimize interruption of revenue generating processes
- Optimize application and data access to better meet specific geographic demands

Solution overview

The EMC VPLEX family is a solution for federating EMC and non-EMC storage. The VPLEX platform logically resides between the servers and heterogeneous storage assets supporting a variety of arrays from various vendors. VPLEX simplifies storage management by allowing LUNs, provisioned from various arrays, to be managed through a centralized management interface.

The EMC VPLEX platform removes physical barriers within, across, and between data centers. VPLEX Local provides simplified management and non-disruptive data mobility across heterogeneous arrays. VPLEX Metro provides mobility, availability, and collaboration between two VPLEX clusters within synchronous distances. VPLEX Geo further dissolves those distances by extending these use cases to asynchronous distances.

With a unique scale-up and scale-out architecture, VPLEX’s advanced data caching and distributed cache coherency provide workload resiliency, automatic sharing, balancing and failover of storage domains, and enable both local and remote data access with predictable service levels.

The solution described in this paper shows the benefits of VPLEX Geo in a disaster recovery scenario involving an SAP ERP 6.0 environment.
VPLEX Geo provides a more effective way of managing virtual storage environments by enabling transparent integration with existing applications and infrastructure, and by providing the ability to migrate systems between remote data centers with minimal interruption in service. In the event of a disaster organizations do not need to perform traditionally complex and time-consuming tasks to migrate their data between geographically dispersed data centers, such as restoring physical backups or using data replication services.

With VPLEX Geo employed as described in this solution, organizations can:

- Provide an application-transparent and minimally-disruptive solution for disaster recovery, interruption avoidance, and data migration. This dramatically reduces the operational impact associated with traditional solutions (such as tape backup and data replication) from days or weeks, to minutes
- Easily migrate applications in real time from one site to another with no downtime, using a virtualized environment such as Microsoft Hyper-V.
- Transparently share and balance resources between geographically-dispersed data centers.
Introduction

Purpose

The purpose of this document is to provide an overall understanding of the VPLEX Geo technology and how it can be used with virtualized environments such as Microsoft Hyper-V to provide effective SAP disaster recovery between data centers across distances of up to 2,000 km with minimal downtime.

VPLEX Geo enables application disaster recovery and mobility between data centers at asynchronous distances. Using VPLEX Geo in conjunction with Microsoft Hyper-V, IT administrators can provide recovery across existing WANs.

SAP ERP operations are an important part of most companies' operations, and these systems require maximum availability and minimal downtime to satisfy their business requirements. In the event of an impending disaster or a critical local infrastructure failure, a virtualized SAP environment can easily be switched to a distant data center with minimal downtime and small maintenance costs. Today this scenario is a challenging business need for most organizations, and one that can require days of work to recover their SAP environments, increasing their infrastructure costs and complexity to provide a solution that works. The virtualized SAP environment overcomes these challenges by building on Microsoft Hyper-V with EMC VPLEX Geo, which enables disparate storage arrays at two locations to provide a single, shared array for an SAP environment.

Scope

The scope of this white paper is to document the:

- Key role VPLEX Geo plays in a disaster recovery scenario involving an SAP environment
- SAP application mobility within a geographically-dispersed VPLEX Geo virtualized storage environment
- Environment configuration for SAP using virtualized storage presented by EMC VPLEX Geo

Audience

This white paper is intended for EMC employees, partners, and customers including IT planners, virtualization architects and administrators, and any other IT professionals involved in evaluating, acquiring, managing, operating, or designing a virtual infrastructure leveraging EMC technologies.
This paper includes the following terminology.

### Table 1. Terminology

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asynchronous group</td>
<td>Asynchronous consistency groups are used for distributed volumes in VPLEX Geo to ensure that I/O to all volumes in the group is coordinated across both clusters, and all directors in each cluster. All volumes in an asynchronous group share the same detach rule, are in write-back cache mode, and behave the same way in the event of an inter-cluster link failure. Only distributed virtual volumes can be included in an asynchronous consistency group.</td>
</tr>
<tr>
<td>CNA</td>
<td>Converged Network Adapter</td>
</tr>
<tr>
<td>Consistency group</td>
<td>Consistency groups allow you to group volumes together and apply a set of properties to the entire group. In a VPLEX Geo where clusters are separated by asynchronous distances (up to 50 ms RTT), consistency groups are required for asynchronous I/O between the clusters. In the event of a director, cluster, or inter-cluster link failure consistency groups ensure consistency in the order in which data is written to the back-end arrays, preventing possible data corruption.</td>
</tr>
<tr>
<td>Distributed device</td>
<td>Distributed devices use storage from both clusters. A distributed device’s components must be other devices, and those devices must be created from storage in both clusters in the Geo-plex.</td>
</tr>
<tr>
<td>DR</td>
<td>Disaster Recovery</td>
</tr>
<tr>
<td>HA</td>
<td>High Availability</td>
</tr>
<tr>
<td>OLTP</td>
<td>On-line transaction processing</td>
</tr>
<tr>
<td>SAP ABAP</td>
<td>SAP Advanced Business Application Programming</td>
</tr>
<tr>
<td>SAP ERP</td>
<td>SAP Enterprise Resource Planning</td>
</tr>
<tr>
<td>Synchronous group</td>
<td>Synchronous consistency groups provide a convenient way to apply rule sets and other properties to a group of volumes at a time, simplifying system configuration and administration on large systems. Volumes in a synchronous group behave the same in a VPLEX, and can have global or local visibility. Synchronous consistency groups can contain local, global, or distributed volumes.</td>
</tr>
<tr>
<td>UCS</td>
<td>Cisco Unified Computing System</td>
</tr>
<tr>
<td>VM</td>
<td>Virtual Machine. A software implementation of a machine that executes programs like a physical machine.</td>
</tr>
<tr>
<td>VPLEX Geo</td>
<td>Provides distributed federation within, across, and between two clusters (within asynchronous distances).</td>
</tr>
<tr>
<td>VHD</td>
<td>Virtual Hard Disk. A Hyper-V virtual hard disk (VHD) is a file that encapsulates a hard disk image.</td>
</tr>
<tr>
<td>WWN</td>
<td>World Wide Name, Fibre Channel (FC) adapter unique identification.</td>
</tr>
</tbody>
</table>
Solution Overview

Overview

The validated solution is built in a Microsoft Hyper-V environment on EMC VPLEX Geo infrastructure that incorporates EMC Symmetrix VMAX and EMC VNX storage arrays. The key components of the physical architecture are:

- EMC VPLEX Geo infrastructure blocks providing access and management of virtualized storage
- An EMC VNX5700 storage array
- EMC Symmetrix VMAX storage arrays
- Microsoft Hyper-V clusters supporting the SAP environment

Physical architecture

Figure 1 illustrates the physical architecture of the use case solution.
Table 2 describes the hardware resources used in this solution.

Table 2.  Hardware resources

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Quantity</th>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rack servers</td>
<td>4</td>
<td>Production site (Datacenter A)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 six-core Xeon 5650 CPUs, 96 GB RAM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 10-GB Emulex CNA adapters</td>
</tr>
<tr>
<td>Unified computing blade servers</td>
<td>4</td>
<td>Disaster recovery site (Datacenter B)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 quad-core Xeon 5670 CPUs, 48 GB RAM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 10-GB QLogic CNA adapters</td>
</tr>
<tr>
<td>EMC Symmetrix VMAX</td>
<td>1</td>
<td>FC, 600 GB/15k FC drives</td>
</tr>
<tr>
<td>EMC VNX5700</td>
<td>1</td>
<td>FC connectivity, 600 GB/15k FC drives</td>
</tr>
<tr>
<td>EMC VPLEX</td>
<td>2</td>
<td>VPLEX Geo cluster with two engines and four directors on each cluster</td>
</tr>
<tr>
<td>WAN emulation</td>
<td>1</td>
<td>2 1-GbE network emulators</td>
</tr>
<tr>
<td>Enterprise-class switches</td>
<td>4</td>
<td>Converged network switches</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 per site for array and server connectivity</td>
</tr>
</tbody>
</table>

Table 3 describes the software resources used in the solution application environment.

Table 3.  Software resources

<table>
<thead>
<tr>
<th>Software</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMC PowerPath®</td>
<td>5.5</td>
</tr>
<tr>
<td>Microsoft Windows (physical)</td>
<td>2008 R2 SP1 64-bit</td>
</tr>
<tr>
<td>Microsoft Windows (VMs)</td>
<td>2008 SP1 64-bit</td>
</tr>
<tr>
<td>Microsoft Windows Hyper-V</td>
<td>2008 R2 SP1 64-bit</td>
</tr>
<tr>
<td>Microsoft SQL Server Enterprise</td>
<td>2008 R2 64-bit</td>
</tr>
<tr>
<td>SAP ERP</td>
<td>6.0 EHP4 64-bit</td>
</tr>
<tr>
<td>SAP NetWeaver</td>
<td>7.0 EHP 1 Unicode 64-bit</td>
</tr>
</tbody>
</table>
**Key components**

**Introduction**

The virtualized data center environment described in this white paper was designed and deployed using an optimized infrastructure. All layers of the environment are shared to create the greatest return on infrastructure investment, while supporting multiple requirements for functionality and performance.

Using server virtualization based on Microsoft Hyper-V, Intel x86-based servers are shared by the SAP ERP components and clustered to achieve redundancy and failover capability. VPLEX Geo is used to present shared data stores across the physical data center locations, enabling a fast migration of the SAP virtual machines (VMs) between the physical sites. Datacenter A storage consists of a Symmetrix VMAX, and a VNX5700 is used for the Datacenter B storage.

**Common elements**

The following sections briefly describe the components used in this solution, including:

- EMC VPLEX Geo
- EMC VPLEX Geo administration
- EMC VNX5700
- EMC Symmetrix VMAX
- Microsoft Windows 2008 R2 with Hyper-V
- Microsoft Systems Center Virtual Machine Manager (SCVMM)
- SAP ERP 6.0
EMC VPLEX Geo overview

EMC VPLEX is a storage virtualization platform for the private and hybrid cloud. EMC VPLEX implements a distributed virtualization layer within and across geographically disparate Fibre Channel storage area networks (SANs) and datacenters. EMC VPLEX is available in Local, Metro, and Geo platforms:

- **EMC VPLEX Local** is a standalone solution used within a data center to provide aggregation and federation of multiple heterogeneous back-end storage arrays.

- **EMC VPLEX Metro** is a campus solution that permits communication synchronously between the two VPLEX clusters with less than 5 ms of latency. EMC VPLEX Metro introduces the concept of distributed devices, which allow a device to be accessed and written to through either VPLEX cluster.

- **EMC VPLEX Geo** introduces asynchronous distributed devices, which must be contained within a consistency group. VPLEX Geo, which we used in this use case, permits up to 50 ms of latency across an IP network. Either 1 GigE or 10 GigE I/O modules facilitate inter-cluster communication, depending on the engine type (VS1 or VS2).

EMC VPLEX Geo design considerations

EMC VPLEX Geo uses *consistency groups* to organize virtual volumes. A consistency group is a set of virtual volumes that are grouped together and require write-order consistency. Consistency groups commit their deltas to disk in a coordinated fashion to maintain consistency. In a consistency group, the data on disk is guaranteed to represent a consistent point in time.

Volumes in a consistency group require the same I/O behavior in the event of a link or site outage. A failure is considered to be an inter-VPLEX-cluster link failure or complete VPLEX cluster failure. The behavior during a failure is controlled by predefined rules that are configured on the consistency groups by the administrator.

For asynchronous consistency groups there are four different rules that can be configured, as described in Table 4.

**Table 4. EMC VPLEX Geo consistency group failure rules**

<table>
<thead>
<tr>
<th>Consistency group failure rule</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>No-automatic-winner</td>
<td>If there is a failure, both clusters suspend I/O.</td>
</tr>
<tr>
<td>Cluster-1 wins</td>
<td>During a failure I/O will continue at Cluster-1 and I/O will suspend at Cluster-2.</td>
</tr>
<tr>
<td>Cluster-2 wins</td>
<td>During a failure, Cluster-2 will continue I/O and Cluster-1 will suspend.</td>
</tr>
<tr>
<td>Active-cluster wins</td>
<td>If there is a failure I/O will continue at the cluster that was active. Active means that the cluster has data in cache that has yet to be written to the back-end storage.</td>
</tr>
</tbody>
</table>

**Note:** In the first release of EMC VPLEX Geo, only the Active-cluster wins bias rule is supported.
When distributed devices are created, they are in synchronous mode by default. VPLEX Geo clusters require consistency groups to be configured to make distributed devices in asynchronous mode.

Figure 2 shows that the Consistency Group VPLEX-Async-Group was created on both clusters. There are a total of nine virtual volumes in the group.

To verify that all virtual volumes are in asynchronous mode, you can use the VPLEX CLI as shown in Figure 3.

```
VPLEXcsl2:/> virtual-volume summary
Virtual-volume health summary (cluster-1):
    Total 9 virtual-volumes, 0 unhealthy.
    Locality summary:
        distributed : 9 virtual-volumes.
    Cache-mode summary:
        asynchronous : 9 virtual-volumes.
    Total virtual-volume capacity is 12.3T.

Virtual-volume health summary (cluster-2):
    Total 9 virtual-volumes, 0 unhealthy.
    Locality summary:
        distributed : 9 virtual-volumes.
    Cache-mode summary:
        asynchronous : 9 virtual-volumes.
    Total virtual-volume capacity is 12.3T.
```

Figure 3. Verify asynchronous mode
After establishing the VPLEX Geo cluster WAN connection, and introducing the distance latency of 20 ms between two clusters (representing two geographical locations), we observed a delay on both network traffic and the SAN.

Figure 4 shows the VPLEX WAN port status.

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
<th>Role</th>
<th>Port Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>B0-FC00</td>
<td>0x50001442700b2c00</td>
<td>front-end</td>
<td>up</td>
</tr>
<tr>
<td>B0-FC01</td>
<td>0x50001442700b2c01</td>
<td>front-end</td>
<td>no-link</td>
</tr>
<tr>
<td>B0-FC02</td>
<td>0x50001442700b2c2</td>
<td>front-end</td>
<td>no-link</td>
</tr>
<tr>
<td>B0-FC03</td>
<td>0x50001442700b2c3</td>
<td>front-end</td>
<td>no-link</td>
</tr>
<tr>
<td>B1-FC00</td>
<td>0x50001442700b2c10</td>
<td>back-end</td>
<td>up</td>
</tr>
<tr>
<td>B1-FC01</td>
<td>0x50001442700b2c11</td>
<td>back-end</td>
<td>no-link</td>
</tr>
<tr>
<td>B1-FC02</td>
<td>0x50001442700b2c12</td>
<td>back-end</td>
<td>no-link</td>
</tr>
<tr>
<td>B1-FC03</td>
<td>0x50001442700b2c13</td>
<td>back-end</td>
<td>no-link</td>
</tr>
<tr>
<td>B2-XG00</td>
<td>192.168.22.70</td>
<td>wan-com</td>
<td>up</td>
</tr>
<tr>
<td>B2-XG01</td>
<td>10.6.22.70</td>
<td>wan-com</td>
<td>up</td>
</tr>
<tr>
<td>B3-FC00</td>
<td>0x50001442700b2c30</td>
<td>local-com</td>
<td>up</td>
</tr>
<tr>
<td>B3-FC01</td>
<td>0x50001442700b2c31</td>
<td>local-com</td>
<td>up</td>
</tr>
<tr>
<td>B3-FC02</td>
<td>0x0000000000000000</td>
<td></td>
<td>no-link</td>
</tr>
<tr>
<td>B3-FC03</td>
<td>0x0000000000000000</td>
<td></td>
<td>no-link</td>
</tr>
</tbody>
</table>

Figure 4. VPLEX WAN port status

Figure 5 shows the packet round-trip time (RRT) between the VPLEX directors.

```bash
Vplexcli:/> director ping 192.168.11.35 director-2-1-B
Round-trip time to 192.168.11.35: 20.74 ms

Vplexcli:/> director ping 192.168.11.35 director-1-1-B
Round-trip time to 192.168.11.35: 0.13 ms

Vplexcli:/> cd: /engines/engine-2-1/directors/director-2-1-B
Vplexcli:/engines/engine-2-1/directors/director-2-1-B> ping 192.168.11.35
Round-trip time to 192.168.11.35: 20.749 ms
```

Figure 5. RRT between VPLEX directors

In our test, we configured the VPLEX Geo cluster with a consistency group rule-set in which the surviving datacenter is the winner (continues I/O) if communication between the datacenters is lost. The consistency group volume was in active-active mode. All of the SAP VMs were running on Datacenter A, while the Microsoft Active Directory Hyper-V VM was running on Datacenter B. All VMs were part of the same consistency group.
When bringing an existing storage array into a virtualized storage environment, the options are to:

- Encapsulate storage volumes from existing storage arrays that have already been used by hosts

or

- Create a new VPLEX Geo LUN and migrate the existing data to that LUN

VPLEX Geo provides an option to encapsulate the existing data using the VPLEX CLI. When application consistency is set (using the –appc flag), the volumes claimed are data-protected and no data is lost.

**Note:** There is no GUI equivalent for the appc flag.

In this solution, we encapsulated existing storage volumes with real data and brought them into VPLEX Geo clusters, as shown in Figure 6. The data was protected when storage volumes were claimed with the –appc flag to make storage volumes “application consistent.”

![Figure 6. Encapsulated storage volumes]
In this solution, administration of VPLEX Geo was done primarily through the Management Console, although the same functionality exists with the VPLEX CLI.

Figure 7 shows the EMC VPLEX Management Console.

![EMC VPLEX Management Console](image)

**Figure 7. EMC VPLEX Management Console**

When authenticating to the secure web-based GUI, the user is presented with a set of on-screen configuration options, listed in the order of completion. For more information about each step in the workflow, refer to the EMC VPLEX Management Console online help. Table 5 summarizes the steps to be taken, from the discovery of the arrays up to the storage being visible to the host.

**Table 5. VPLEX Geo administration process**

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| 1 | Discover available storage  
VPLEX Geo automatically discovers storage arrays that are zoned to the back-end ports. All arrays connected to each director in the cluster are listed in the Storage Arrays view. |
| 2 | Claim storage volumes  
Storage volumes must be claimed before they can be used in the cluster (with the exception of the metadata volume, which is created from an unclaimed storage volume). Only after a storage volume is claimed, can it be used to create extents, devices, and then virtual volumes. |
| 3 | Create extents  
Create extents for the selected storage volumes and specify the capacity. |
| 4 | Create devices from extents  
A simple device is created from one extent and uses storage in one cluster only. A distributed device is created from the extents on both clusters. In VPLEX Geo, we are using distributed devices. |
| 5 | Create a virtual volume  
Create a virtual volume using the device created in the previous step. |
<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| 6    | Register initiators  
When initiators (hosts accessing the storage) are connected directly or through a Fibre Channel fabric, VPLEX Geo automatically discovers them and populates the Initiators view. Once discovered, you must register the initiators with VPLEX Geo before they can be added to a storage view and access storage. Registering an initiator gives a meaningful name to the port’s WWN, which is typically the server’s DNS name, to allow you to easily identify the host. |
| 7    | Create a storage view  
For storage to be visible to a host, first create a storage view and then add VPLEX Geo front-end ports and virtual volumes to the view. Virtual volumes are not visible to the hosts until they are in a storage view with associated ports and initiators.  
The Create Storage View wizard enables you to create a storage view and add initiators, ports, and virtual volumes to the view. Once all components are added to the view, it automatically becomes active. When a storage view is active, hosts can see the storage and begin I/O to the virtual volumes.  
After creating a storage view, you can only add or remove virtual volumes through the GUI. To add or remove ports and initiators, use the CLI. For more information, refer to the *EMC VPLEX CLI Guide*. |
EMC VNX5700

EMC VNX5700 overview

The EMC VNX family delivers industry-leading innovation and enterprise capabilities for file, block, and object storage in a scalable, easy-to-use solution. This next-generation storage platform combines powerful and flexible hardware with advanced efficiency, management, and protection software to meet the demanding needs of today’s enterprises.

The VNX series is designed to meet the high-performance, high-scalability requirements of midsize and large enterprises, delivering leadership performance, efficiency, and simplicity for demanding virtual application environments.

EMC VNX5700 configuration

This section describes how the VNX5700 is configured for this solution.

Pool configuration

Table 6 describes the VNX5700 pool configuration used in this solution.

Table 6. VNX5700 pool configuration

<table>
<thead>
<tr>
<th>Pool</th>
<th>Protection type</th>
<th>Drive count</th>
<th>Drive technology</th>
<th>Drive capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>VNXPool0</td>
<td>RAID 1/0</td>
<td>16</td>
<td>SAS</td>
<td>300 GB</td>
</tr>
<tr>
<td>VNXPool1</td>
<td>RAID 5</td>
<td>30</td>
<td>SAS</td>
<td>300 GB</td>
</tr>
<tr>
<td>VNXPool2</td>
<td>RAID 1/0</td>
<td>16</td>
<td>SAS</td>
<td>300 GB</td>
</tr>
<tr>
<td>VNXPool3</td>
<td>RAID 1/0</td>
<td>2</td>
<td>SATA Flash</td>
<td>200 GB</td>
</tr>
<tr>
<td>VNXPool4</td>
<td>RAID 1/0</td>
<td>2</td>
<td>SAS</td>
<td>300 GB</td>
</tr>
</tbody>
</table>

LUN configuration

Table 7 describes the VNX5700 LUN configuration used in this solution.

Table 7. VNX5700 LUN configuration

<table>
<thead>
<tr>
<th>LUN</th>
<th>LUN ID</th>
<th>LUN size</th>
<th>Pool</th>
</tr>
</thead>
<tbody>
<tr>
<td>R10CSV01</td>
<td>1</td>
<td>2 TB</td>
<td>VNXPool0</td>
</tr>
<tr>
<td>R5CSV01</td>
<td>2</td>
<td>2 TB</td>
<td>VNXPool1</td>
</tr>
<tr>
<td>R5CSV02</td>
<td>3</td>
<td>2 TB</td>
<td>VNXPool1</td>
</tr>
<tr>
<td>R5CSV03</td>
<td>4</td>
<td>2 TB</td>
<td>VNXPool1</td>
</tr>
<tr>
<td>R10CSV02</td>
<td>38</td>
<td>2 TB</td>
<td>VNXPool2</td>
</tr>
<tr>
<td>R10CSV03</td>
<td>39</td>
<td>150 GB</td>
<td>VNXPool3</td>
</tr>
<tr>
<td>ORALOG</td>
<td>43</td>
<td>150 GB</td>
<td>VNXPool4</td>
</tr>
</tbody>
</table>
The EMC Symmetrix VMAX series is the latest generation of the Symmetrix product line. Built on the strategy of simple, intelligent, modular storage, it incorporates a scalable fabric interconnect design that allows the storage array to seamlessly grow from an entry-level configuration into a large-scale enterprise storage system. Symmetrix VMAX arrays provide improved performance and scalability for demanding enterprise environments such as those found in large virtualization environments, while maintaining support for EMC’s broad portfolio of platform software offerings.

Symmetrix VMAX systems deliver software capabilities that improve capacity use, ease of use, business continuity, and security. These features provide significant advantage to customer deployments in a virtualized environment where ease of management and protection of virtual machine assets and data assets are required.

This section describes how the EMC Symmetrix VMAX is configured for this solution.

**Symmetrix volume configuration**
Table 8 describes the Symmetrix VMAX volume configuration used in this solution.

<table>
<thead>
<tr>
<th>Volume ID</th>
<th>Protection type</th>
<th>Device size</th>
<th>Drive technology</th>
<th>Drive capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1FD:229</td>
<td>RAID 5 (7+1)</td>
<td>240 GB</td>
<td>Fibre Channel</td>
<td>450 GB 15k</td>
</tr>
<tr>
<td>22A:22B</td>
<td>RAID 5 (7+1)</td>
<td>150 GB</td>
<td>Fibre Channel</td>
<td>450 GB 15k</td>
</tr>
</tbody>
</table>

**Note:** Devices 22A:22B are used as stand-alone devices.

**Meta device configuration**
Table 9 describes the Symmetrix VMAX metadevice configuration used in this solution.

<table>
<thead>
<tr>
<th>Volume ID</th>
<th>Protect</th>
<th>Meta configuration</th>
<th>Meta members</th>
<th>Volume size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1FD</td>
<td>RAID 5 (7+1)</td>
<td>striped</td>
<td>1FE:205</td>
<td>2.1 TB</td>
</tr>
<tr>
<td>206</td>
<td>RAID 5 (7+1)</td>
<td>striped</td>
<td>207:20E</td>
<td>2.1 TB</td>
</tr>
<tr>
<td>20F</td>
<td>RAID 5 (7+1)</td>
<td>striped</td>
<td>210:217</td>
<td>2.1 TB</td>
</tr>
<tr>
<td>218</td>
<td>RAID 5 (7+1)</td>
<td>striped</td>
<td>219:220</td>
<td>2.1 TB</td>
</tr>
<tr>
<td>221</td>
<td>RAID 5 (7+1)</td>
<td>striped</td>
<td>222:229</td>
<td>2.1 TB</td>
</tr>
</tbody>
</table>
Microsoft Hyper-V

Microsoft Hyper-V overview

Microsoft Hyper-V is a hypervisor-based virtualization technology that organizations use to reduce costs by using virtualization through Windows Server 2008 R2. Microsoft Hyper-V enables customers to make the best use of their server hardware by consolidating multiple server roles as separate virtual machines running on a single physical machine.

Microsoft Hyper-V configuration

This section describes the configuration of the Microsoft Hyper-V environment used in this solution.

This solution uses Windows Failover Cluster to provide high-availability features as well as live migration and cluster shared volume capability. Using the VPLEX volume for the cluster shared volume allows multiple virtual machines to be hosted on a single LUN, while still allowing for live migration of a virtual machine from one site to another independent of the other virtual machines on that volume.

Figure 8 shows that four nodes are used at each site and three Ethernet network connections are used for Heartbeat, live migration, and client access at the respective site. Microsoft System Center Virtual Machine Manager (SCVMM) and Microsoft Failover Cluster Manager were used to manage the virtual machines on the Hyper-V cluster.

![Hyper-V cluster nodes and connections](image)

Figure 8. Hyper-V cluster nodes and connections
One Hyper-V virtual switch, named MSvSwitch, is created for the virtual machine network. Figure 9 shows the relationship between the virtual machine, virtual switch, and physical NIC on one of the cluster nodes.

Figure 9. Virtual switch relationship
The virtual machine network is configured to use VLAN tagging as shown in Figure 10.

Figure 10. VLAN tagging on the virtual machine network

EMC PowerPath installed on the cluster nodes, as shown in Figure 11, provides load balancing and fault tolerance on the FC network. To provide support for the VPLEX device, we selected Invista Devices Support during installation. It can also be changed after installation using Add/Remove Programs.

Figure 11. EMC PowerPath installed
The distributed volume on VPLEX Geo is presented to the nodes on both sites. A basic volume is created, formatted with NTFS on one of the nodes, and then added to the cluster. With Windows 2008 R2, the Cluster Shared Volumes feature is activated by right-clicking on the cluster and selecting Enable Cluster Shared Volumes, as shown in Figure 12. The disk resource can then be added into cluster shared volume.

**Figure 12.  Enabling cluster shared volumes**

**Note:** All nodes must be available when enabling the Cluster Shared Volume feature otherwise you will need to use the Cluster CLI command later to add the node into the owner list of the cluster resource. See Figure 13.

**Figure 13.  Cluster resource owner list**
Cluster Shared Volume mounts the disk under C:\SharedStorage on every node of the cluster, as shown in Figure 14.

The virtual machine can be configured to use that path to place the virtual disk on the shared volume, as shown in Figure 15.

If the storage network between the host and array fails, there is an option to redirect the traffic over the LAN to the node that owns the cluster shared disk resource.
If you need to move the virtual machine disk to a different volume, you can use the Migrate Storage option with Microsoft Systems Center Virtual Machine Manager (SCVMM), as shown in Figure 16.

Figure 16. SCVMM Migrate Storage option

Next provide the target volume, as shown in Figure 17.

Figure 17. Target volume

Note: The virtual machine must be in a saved state or powered off to move the underlying storage.
### Networking infrastructure overview

This section describes the virtual machine network environment used in this solution. Topics include:

- Network design considerations
- Network infrastructure configuration

### Network design considerations

The virtual machine network environment in this solution consists of a single Layer-2 network extended across the WAN between Datacenter A and Datacenter B. The following design considerations apply to this environment:

- This extension was done using Cisco's Overlay Transport Virtualization (OTV) rather than by bridging the VLAN over the WAN. OTV allows for Ethernet LAN extension over any WAN transport by dynamically encapsulating Layer 2 “Mac in IP” and routing it across the WAN.

- Edge devices and Nexus 7000 switches exchange information about learned devices on the extended VLAN at each site via multicast, which negates the need for ARP and other broadcasts to be propagated across the WAN.

- Additionally, using OTV rather than bridging eliminates BPDU forwarding (part of normal spanning tree operations in a bridged VLAN scenario) and provides the ability to eliminate or rate-limit other broadcasts to conserve bandwidth.

- OTV enables us to keep all the original IP addresses of all the Hyper-V VMs unchanged when moving from Datacenter A to Datacenter B at any point in time.

**Note:** For recommendations about using live migration in your own Hyper-V environment, refer to the *Hyper-V: Live Migration Network Configuration Guide* at the Microsoft TechNet site.
Table 10 lists the OTV configuration for each edge device in the virtual machine network.

### Table 10. Virtual machine network OTV configuration

<table>
<thead>
<tr>
<th>Site OTV</th>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Datacenter A: Pcloud-7000-OTV</td>
<td>feature otv</td>
</tr>
<tr>
<td></td>
<td>otv site-vlan 1</td>
</tr>
<tr>
<td></td>
<td>interface Overlay1</td>
</tr>
<tr>
<td></td>
<td>description VPLEX-WAN</td>
</tr>
<tr>
<td></td>
<td>otv isis authentication key-chain VPLEX</td>
</tr>
<tr>
<td></td>
<td>otv join-interface Ethernet3/16</td>
</tr>
<tr>
<td></td>
<td>otv control-group 239.1.1.1</td>
</tr>
<tr>
<td></td>
<td>otv data-group 239.194.1.0/29</td>
</tr>
<tr>
<td></td>
<td>otv extend-vlan 580</td>
</tr>
<tr>
<td></td>
<td>otv site-identifier 1</td>
</tr>
<tr>
<td>Datacenter B: Pcloud-7000-VPLEX-SITE-B</td>
<td>feature otv</td>
</tr>
<tr>
<td></td>
<td>interface Overlay1</td>
</tr>
<tr>
<td></td>
<td>description VPLEX-WAN</td>
</tr>
<tr>
<td></td>
<td>otv isis authentication key-chain VPLEX</td>
</tr>
<tr>
<td></td>
<td>otv join-interface Ethernet3/33</td>
</tr>
<tr>
<td></td>
<td>otv control-group 239.1.1.1</td>
</tr>
<tr>
<td></td>
<td>otv data-group 239.194.1.0/29</td>
</tr>
<tr>
<td></td>
<td>otv extend-vlan 580</td>
</tr>
<tr>
<td></td>
<td>otv site-identifier 1</td>
</tr>
</tbody>
</table>

**Note:** For more detail on Cisco OTV refer to the [Cisco Quick Start Guide](#).
SAP overview

Large and midsize organizations deploy SAP ERP 6.0 EHP4 to meet their core business needs such as financial analysis, human capital management, procurement and logistics, product development, manufacturing, and sales and service; supported by analysis, corporate services, and end-user service delivery.

EMC VPLEX Geo enables virtualized storage for SAP to access LUNs between data center sites, and enables Microsoft Hyper-V to restart or move virtual machines quickly between data centers. This optimizes data center resources and results in minimal downtime in the event of a disaster.

SAP environment

Figure 18 shows SAP applications and modules distributed among several virtual servers.

Figure 18. SAP environment
Because SAP is a major part of the core business operations in many organizations, it is crucial that these organizations have a business continuity management plan to:

- safeguard the continuity of their business operations and protect revenue, and
- recover to at least a minimum operational level if a disaster occurs.

A business continuity management plan:

- helps to manage risks in an IT environment, and
- plans for recovery if a disaster occurs.

This use case does not include a complete business continuity management plan, but focuses on one solution that quickly recovers a SAP environment after a disaster.

The IT Infrastructure Library (ITIL), a public framework of best practices for IT service management, outlines the concepts and general procedures to provide continuity of operations and data consistency. For more information, refer to the ITIL publication ITSC – IT Service Continuity Management.

**Types of failures**

There are three main types of failures to be considered in a business continuity management plan:

- **Technical failure:** These range from the crashes of individual hardware components to entire datacenters being affected by fire, flood, storms, or other disasters.

- **Logical failure:** These can be caused by faulty or malicious software, or the incorrect use of software that can corrupt data and disrupt business processes.

- **Logistical failure:** These are failure of operational or logistical business operations such as unavailable staff or facilities.

**Recovery**

After a disaster there are two major steps to recovery:

- **System recovery:** Technical availability of failed systems must be reestablished.

- **Business recovery:** Logical or data inconsistencies must be corrected. (Logical errors may sometimes be the result of technical failures.)

**Simplifying SAP recovery**

In this use case we focus on one part of an overall business continuity solution. We tested the system recovery of an SAP datacenter after a major technical failure.
SAP configuration

**SAP configuration overview**

SAP ERP system PRD was installed as a high-availability system with the International Demonstration and Education System (IDES) database ABAP stack on Windows 2008 Enterprise SP2 and Microsoft SQL Server 2008 R2 Enterprise.

IDES represents a model international company with subsidiaries in several countries. IDES contains application data for various business scenarios that can be run in the system. The business processes in the IDES system are designed to reflect real-life business requirements and characteristics.

**SAP design considerations**

In this SAP ERP 6.0 EHP4 environment, the major configuration considerations include:

- SAP patches, parameters, basis settings, and load balancing; as well as Microsoft Windows 2008, Hyper-V, and SQL Server 2008 R2 were all installed and configured according to SAP procedures and guidelines.
- SAP update processes (UPD/UP2) were configured on the Application Server instances.
- Some IDES functionality—for example, synchronization with the external GTS system—was deactivated to eliminate unnecessary external interfaces that were outside the scope of the test.
- The storage for the entire SAP environment was encapsulated and virtualized in this test. The storage was distributed across the two sites and made available to the SAP servers through VPLEX Geo.
The SAP system PRD consists of one SAP database instance, one ABAP system central services (ASCS) instance, and two application server (AS) instances. All instances are installed on Hyper-V virtual machines with the configuration as described in Table 11.

### Table 11. SAP virtual machine resources

<table>
<thead>
<tr>
<th>Server role</th>
<th>Hyper-V VM name</th>
<th>Quantity</th>
<th>vCPUs</th>
<th>Memory (GB)</th>
<th>OS bootdisk (GB)</th>
<th>Additional disks (GB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAP database instance</td>
<td>SAPERPDB</td>
<td>1</td>
<td>4</td>
<td>16</td>
<td>90</td>
<td>842</td>
</tr>
<tr>
<td>SAP ASCS instance</td>
<td>SAPERPENQ1</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>90</td>
<td>32</td>
</tr>
<tr>
<td>SAP application server instances</td>
<td>SAPERPDI1</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>90</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>SAPERPDI2</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>90</td>
<td>25</td>
</tr>
</tbody>
</table>

In our testing we used the SAP ERP transaction SGEN tool to generate a sample SAP workload before the simulated disaster to provide I/O to the VPLEX virtualized LUN. The transaction SGEN tool provides mass generation of ABAP program loads.

The process consists of the following operations:

1. Configuring the transaction SGEN tool to generate all objects of the selected SAP software components.
2. Setting the number of objects to be generated (Generation Set) to a total of 4190 objects in the following SAP software components:
   - SAP_AP
   - SAP_APPL
   - SAP_BW
3. Configuring the servers to use parallel generation, in which the generation set is divided into small subsets that are processed by parallel processes. We selected the following SAP application servers:
   - SAPERPDI1
   - SAPERPDI2

**Note:** The parallel servers are depicted via the logon groups in transaction RZ12. For transaction SGEN, the logon group “parallel_generators” is used.

4. Starting the process with the option Start job directly to avoid the time to schedule and wait for the job to start the generation.
SAP testing and validation

Test summary
In our use case, we show how EMC VPLEX Geo helps to protect and recover the entire datacenter after a major technical disruption, such as a natural disaster, during which all the physical servers and external communications are affected.

The test objectives were to:

- Validate that the SAP system components running on VPLEX Geo and Hyper-V virtual machines can be consistently restarted on Datacenter B (failover) after a simulated disaster on Datacenter A.
- Validate that the SAP system components running on VPLEX Geo and Hyper-V virtual machines can be non-disruptively moved back from Datacenter B to Datacenter A (failback).

Test scenarios
Table 12 describes the SAP test scenarios.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failover</td>
<td>Demonstrate how VPLEX and Hyper-V can quickly move SAP Systems to Datacenter B in the event of a disaster on Datacenter A</td>
</tr>
<tr>
<td>Failback</td>
<td>Demonstrate how VPLEX and Hyper-V can non-disruptively migrate the SAP VMs back to Datacenter A</td>
</tr>
</tbody>
</table>

We identified the steps required to execute the scenarios and measured the duration of the key activities during these scenarios.

We also collected other metrics and statistics from the Windows OS level and from the Microsoft Failover Cluster Manager.

SAP sample load generation
The SAP ERP 6.0 EHP4 system used to validate this solution was a standard IDES system with a custom configuration and additional master data and transactional data. The database size was 511 GB and the SAP SID was PRD.

The SAP SGEN transaction was started before the simulated disaster happened to create a sample system workload activity during the testing period. Based on the configuration defined in the SAP ERP workload profile, the SGEN generated processes on the SAP system PRD were distributed across both SAP application server instances.

The objective of having a sample workload running on the SAP ERP system was to create changes at the storage level to verify that the changes were carried over from Datacenter A to Datacenter B by VPLEX Geo virtual LUNs provisioned to support the SAP ERP system.
Table 13 describes the test procedure for failover testing.

**Table 13. Failover test procedure**

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| 1    | Generate changes inside SAP system PRD on Datacenter A.  
SAP transaction SGEN was executed to create sample I/O activity in the database. Additionally a copy of an existing user was created for later verification that the update in the SAP/SQL database instance was replicated by VPLEX Geo from Datacenter A to Datacenter B. |
| 2    | Simulate a disaster on Datacenter A.  
A disaster was simulated by removing power to all physical servers and interrupting the WAN link communication between Datacenter A and B simultaneously, so that the Microsoft Failover Cluster could not restart the VMs locally on Datacenter A. |
| 3    | Verify if all the SAP VMs were moved to Datacenter B.  
Microsoft Failover Cluster Manager was used to verify that all of the SAP Hyper-V VMs on the physical servers on Datacenter A (VPLEX-PR1, VPLEX-PR2, VPLEX-PR3, and VPLEX-PR4) were moved immediately to the physical servers on Datacenter B (VPLEX_DR1, VPLEX-DR2, VPLEX-DR3, and VPLEX-DR4). |
| 4    | Declare a disaster and resume disk access on the Datacenter B VPLEX Geo.  
At Datacenter B, read/write disk access to the VPLEX Geo consistency group supporting the Hyper-V Cluster Shared Volumes (CSVs) assigned to the SAP VMs was enabled. This allowed Datacenter B to take over as the primary virtual storage provider. The I/O access was resumed from the latest disk-consistent state. |
| 5    | Restart SAP VMs on Datacenter B and verify their integrity.  
The VMs were configured to start manually after the move from Datacenter A to Datacenter B to allow Step 4 to be executed and avoid a split-brain scenario and make the CSV volume come online faster. The SAP VMs were restarted in the following order: SAPERPDB, SAPERPENQ1, SAPERPDI1, and SAPERPDI2. |
| 6    | Verify if the data changes done in Step 1 were copied to Datacenter B.  
We logged into SAP to verify that the SAP system was running, that the new user existed, and to verify the status of the SGEN process. |
Table 14 lists the steps for each phase of failback testing.

Table 14. Failback test procedure

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Restore power and restart the physical servers on Datacenter A.</td>
</tr>
<tr>
<td>2</td>
<td>Verify all the Hyper-V and VPLEX Geo configurations.</td>
</tr>
<tr>
<td>3</td>
<td>Re-establish the WAN communication link between Datacenter A and B. This allows VPLEX Geo and the Microsoft Failover Cluster to resynchronize the Hyper-V cluster information between the two locations.</td>
</tr>
<tr>
<td>4</td>
<td>Ensure that the VPLEX consistency volume is healthy at both locations. I/O access to the CSV volumes on Datacenter A was resumed. VPLEX Geo and Microsoft Failover Cluster resynchronized data with Datacenter B and updated the VPLEX cluster status.</td>
</tr>
<tr>
<td>5</td>
<td>Execute a Hyper-V live migration to move the SAP VMs back to Datacenter A. The failback process used was Microsoft Hyper-V live migration, because it is fast and doesn't cause SAP downtime to move the VMs from Datacenter B back to Datacenter A.</td>
</tr>
</tbody>
</table>

For more information about SAP application long distance mobility using Microsoft Hyper-V live migration and VPLEX Geo, refer to the EMC white paper *EMC Long Distance Application Mobility Enabled by EMC VPLEX Geo - An Architectural Overview.*
Test results

Overview

This section covers the results of our SAP failover and failback tests.

Our testing verified the following:

- Failover and failback process duration
- Consistency of the SAP SQL database
- Restart of all the SAP services and instances.

Failover test results

Table 15 lists the test results for the failover tests.

<table>
<thead>
<tr>
<th>Failover event</th>
<th>Duration (mm:ss)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VMs switched to Datacenter B</td>
<td>0:05</td>
</tr>
<tr>
<td>Reaction time (human action)</td>
<td>5:53</td>
</tr>
<tr>
<td>VPLEX CLI command (human action)</td>
<td>0:10</td>
</tr>
<tr>
<td>SAPERPDB VM restart</td>
<td>0:36</td>
</tr>
<tr>
<td>VM verification time (human action)</td>
<td>1:38</td>
</tr>
<tr>
<td>SAPERPENQ1 VM restart</td>
<td>0:44</td>
</tr>
<tr>
<td>VM verification time (human action)</td>
<td>3:13</td>
</tr>
<tr>
<td>SAPERPDI1 VM restart</td>
<td>3:18</td>
</tr>
<tr>
<td>VM verification time (human action)</td>
<td>0:58</td>
</tr>
<tr>
<td>SAPERPDI2 VM restart</td>
<td>3:09</td>
</tr>
<tr>
<td><strong>Failover duration</strong></td>
<td><strong>8:02</strong></td>
</tr>
</tbody>
</table>

The failover duration described in Table 15 includes all of the steps in the failover process including manual steps, the Hyper V VM relocation executed by Windows Failover Cluster Manager from Datacenter A to Datacenter B, and the restart of each VM and the SAP system. The total elapsed failover time was 19:45 mm:ss, including the delays caused by human-related actions in the reaction and verification times.

Note: The VPLX CLI command line to resume I/O access on Datacenter B after the disaster was only necessary because the consistency group volume was in active-active mode. Before the disaster, I/O access existed locally on both datacenters. When the communication between the datacenters was interrupted, a decision had to be made to determine which VPLEX Geo cluster site would become active.
Figure 19 illustrates the timeline of the failover tests, including the duration of each failover event.

![Failover Timeline](image1.png)

**Failback test results**

Table 16 lists the test results for the failback tests.

**Table 16. SAP failback test results**

<table>
<thead>
<tr>
<th>Failback event</th>
<th>Duration (mm:ss)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAPERPDB (SAP SQL database) restart</td>
<td>4:49</td>
</tr>
<tr>
<td>SAPERPENQ1 (SAP ASCS) restart</td>
<td>1:08</td>
</tr>
<tr>
<td>SAPERPD1 (SAP AS 1) restart</td>
<td>2:36</td>
</tr>
<tr>
<td>SAPERPD2 (SAP AS 2) restart</td>
<td>2:37</td>
</tr>
<tr>
<td><strong>Failback duration</strong></td>
<td><strong>12:10</strong></td>
</tr>
</tbody>
</table>

The failback durations depicted in Table 16 includes all of the steps in the failback process. The total duration was 12:10. The testing demonstrated that the failback process was simple, fast, and non-disruptive to the SAP application, because it leveraged the Hyper-V live migration technology.

Figure 20 illustrates the timeline of the failback tests, including the duration of each failback event.

![Failback Timeline](image2.png)

**Figure 20. SAP failback test results**
Table 17 lists both the failover and failback durations for our tests.

**Table 17.  SAP failover and failback duration comparison**

<table>
<thead>
<tr>
<th>Hyper-V VM</th>
<th>Failover (mm:ss)</th>
<th>Failback (mm:ss)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAPERPDDB (SAP database)</td>
<td>0:36</td>
<td>4:49</td>
</tr>
<tr>
<td>SAPERPENQ1 (SAP ASCS)</td>
<td>0:44</td>
<td>1:08</td>
</tr>
<tr>
<td>SAPERPD11 (SAP AS 1)</td>
<td>3:18</td>
<td>2:36</td>
</tr>
<tr>
<td>SAPERPD12 (SAP AS 2)</td>
<td>3:09</td>
<td>2:37</td>
</tr>
</tbody>
</table>

Figure 21 shows a comparison of the failover and failback durations.

The failover sequence was based on the Microsoft Windows Failover Cluster restart process. The complete failover process took less than 20 minutes. The total failover time was longer than the failback time because the failback sequence was based on Hyper-V live migration, where all the physical servers and VMs were up and running on both sides in advance, and did not require reaction or verification steps after each VM migration.

The failback process was executed sequentially, with one SAP VM being migrated at a time from Datacenter A to Datacenter B to minimize the duration of the Hyper-V live migration process.
Our testing showed that using EMC VPLEX Geo and Hyper-V Live Migration for disaster recovery provides an advantage when compared to other typical methods of recovery.

Table 18 lists the durations of typical RTOs (recovery time objectives) and the RPOs (recovery point objectives) for typical recovery solutions.

Table 18. Recovery solution comparison

<table>
<thead>
<tr>
<th>Recovery solution</th>
<th>RTO (technical recovery)</th>
<th>RPO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Database restore and recovery</td>
<td>Gradual/intermediate</td>
<td>0 (complete recovery)</td>
</tr>
<tr>
<td></td>
<td>12 to 72 hours</td>
<td></td>
</tr>
<tr>
<td>Tape shipping; pickup truck access method (PTAM)</td>
<td>Gradual/intermediate</td>
<td>24 to 168 hours</td>
</tr>
<tr>
<td></td>
<td>48 to 168 hours</td>
<td></td>
</tr>
<tr>
<td>Standby database (asynchronous log shipping)</td>
<td>Intermediate/Immediate</td>
<td>10 minutes to 24 hours</td>
</tr>
<tr>
<td></td>
<td>1 to 8 hours</td>
<td></td>
</tr>
<tr>
<td>Remote point-in-time copies</td>
<td>Intermediate/Immediate</td>
<td>4 to 24 hours</td>
</tr>
<tr>
<td></td>
<td>4 to 24 hours</td>
<td></td>
</tr>
<tr>
<td>Asynchronous replication</td>
<td>Immediate</td>
<td>5 minutes or more</td>
</tr>
<tr>
<td></td>
<td>30 minutes to 8 hours</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(in combination with HA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>solutions)</td>
<td></td>
</tr>
<tr>
<td>Synchronous replication</td>
<td>Immediate</td>
<td>0 (depending on continuation</td>
</tr>
<tr>
<td></td>
<td>5 minutes to 8 hours</td>
<td>policy)</td>
</tr>
<tr>
<td></td>
<td>(in combination with HA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>solutions)</td>
<td></td>
</tr>
</tbody>
</table>

Source: Section 3.6.3, Recovery Options, *SAP Business Continuity Management for SAP System Landscapes Best Practice Solution Management*
Figure 22 compares the recovery times (in minutes) from Table 18, using the lowest value listed for each recovery solution excluding tape shipping (PTAM).

EMC VPLEX Geo provides distributed volumes, asynchronous replication, and storage virtualization in one product. In our tests the total duration of the failover process was less than 20 minutes; lower than the RTO for asynchronous replication shown in Table 18.
Conclusion

Summary

To meet today’s demanding business challenges an organization’s data must be highly available—in the right place, at the right time, and at the right cost to the enterprise. This solution demonstrates the virtual storage capabilities of VPLEX Geo in a fully virtualized application environment with Microsoft Hyper-V and SAP.

With EMC VPLEX Geo, organizations can manage their virtual storage environments more effectively through:

- Increased protection in the event of unplanned application outages.
- Transparent integration with existing applications and infrastructure.
- The ability to migrate data stores across storage arrays nondisruptively for maintenance and technology refresh operations.
- The ability to migrate data between remote data centers with no disruption in service.

Findings

This solution validates the effectiveness of VPLEX Geo for presenting LUNs to a Microsoft Hyper-V cluster spanning multiple datacenter locations, separated by 2,000 km, to optimize a disaster recovery. As detailed in previous sections, we confirmed the following results:

- Virtual machines restart and recover between the local and remote sites within minutes, preserving the data consistency during the move.
- Using Hyper-V cluster shared volumes (CSVs) we were able to place the same data at both locations and maintain cache coherency (active-active). Testing confirmed that the data was synchronized correctly within the expected tolerance at 2,000 km.
- Virtual machine Hyper-V live migration times in the failback process were also executed in minutes, providing continuous end-user access during the migration.

The capabilities of VPLEX Geo demonstrated in this solution highlight its potential to enable true dynamic disaster recovery, disaster avoidance, workload balancing and migration across geographically disparate data centers, to support operational and business requirements. VPLEX Geo augments the flexibility introduced into a server infrastructure by Microsoft Hyper-V with storage flexibility, to provide a truly scalable, dynamic, virtual data center.
References

White papers
For additional information, see the white papers listed below.

- *EMC Long Distance Application Mobility Enabled by EMC VPLEX Geo - An Architectural Overview*
- *EMC Business Continuity for Microsoft Hyper-V Enabled by EMC Symmetrix VMAX and SRDF/CE*
- *EMC VPLEX 5.0 Architecture Guide – April 2011*
- *Guide to Multisite Disaster Recovery for VMware and Enabled by EMC Symmetrix VMAX, SRDF and VPLEX – April 2011*
- *Microsoft Collaboration Brief - Best Practices for SAP on Hyper-V- April 2010*
- *EMC Business Continuity for SAP Disaster Recovery Enabled by EMC CLARiiON CX4, EMC RecoverPoint, and VMware vCenter Site Recovery Manager - Reference Architecture*
- *Microsoft Hyper-V Live Migration with EMC VPLEX Geo –June 2011*

Product documentation
For additional information, see the product documents listed below.

- *Installation Guide: SAP ERP 6.0 – EHP4 Ready ABAP on Windows: SQL Server Based on SAP NetWeaver 7.0 Including Enhancement Package 1*

Other documentation
For additional information, see the documents listed below.

- *Business Continuity Management for SAP System Landscapes - Best Practice for Solution Management - May 2008*
- SAP Note 1246467 - Hyper-V Configuration Guideline
- SAP Note 1374671 - High Availability in Virtual Environment on Windows
- SAP Note 1383873 - Windows Server 2008 R2 Support