Protect Microsoft Private Cloud Applications with Data Protection Manager 2012 SP1

Lab Validation Report

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Feedback

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Table of Contents

Key Solution Components ........................................................................................................... 3
  Hardware Components ............................................................................................................... 3
  Software Components .............................................................................................................. 5

Test Environment Configuration .................................................................................................. 9
  Network Architecture ................................................................................................................ 14
  System Center Data Protection Manager 2012 SP1
  Configuration .......................................................................................................................... 17
  Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service
  Configuration ......................................................................................................................... 22

Test Methodology ........................................................................................................................ 24
  Test Scenarios .......................................................................................................................... 24
  Workload Description ............................................................................................................... 24

Analysis ......................................................................................................................................... 25
Backups are important, but it's just as important to perform backups without affecting user access to critical data during the backup window. Backup and recovery in a private cloud virtual environment is a complex endeavor, with several factors to consider. Backups can be done from the server running the virtualization software like Microsoft® Hyper-V®, or they can be done from within the guest virtual machines executing under the Hyper-V server. Using Microsoft Volume Shadow Copy Service (VSS) software and hardware providers are additional options that must be considered. Use of Cluster Shared Volumes (CSVs) in a Hyper-V environment where multiple VMs and their associated data files might be hosted on a single LU adds complexity.

The use of CSVs allows all nodes in a Hyper-V failover cluster concurrent access to data on a CSV-enabled disk. CSV implements I/O redirection techniques through a file system mini-filter driver. This redirection introduces new challenges to backup and restore applications that use the Hyper-V VSS writer for host-based backup and restoration of virtual machines. It is important to use an application that fully supports CSVs, such as Data Protection Manager 2012 SP1, to ensure the integrity and usability of the backup. Support for CSV backups is provided by the Microsoft Volume Snapshot Service (VSS); all CSV backup and restore operations must be done from within the VSS framework.

It is important to note that with Windows Server® 2012 and Microsoft System Center Data Protection Manager 2012 SP1 significant improvements have been made in the backup of virtual machines and data that reside on CSVs. With Data Protection Manager (DPM) 2012 SP1 backups can now be done from both owner and non-owner nodes eliminating the performance penalty caused by I/O redirection. The testing in this lab validation report was done to determine if the actual performance penalty was caused by I/O redirection.

This solution covers the testing of Microsoft System Center Data Protection Manager 2012 SP1 in conjunction with the Microsoft VSS Software provider, Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service, Hitachi ShadowImage® and Hitachi Thin Image (HTI). Exchange 2013 was the application running on the Microsoft Private Cloud that was used for backup and restore testing. This lab validation report is based on testing done at the Hitachi Data Systems laboratory as a joint effort between Hitachi, Ltd. and Hitachi Data Systems.
This solution uses the following components:

- Hitachi Compute Blade 500
- Hitachi Unified Storage VM
- Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service
- Hitachi ShadowImage® Heterogeneous Replication
- Hitachi Thin Image
- Microsoft Windows Server 2012
- System Center Data Protection Manager 2012 SP1
- Microsoft Exchange 2013

This lab validation report used Exchange Loadgen 2013 to simulate a mailbox workload. System Center Data Protection Manager 2012 SP1 was then used to backup the Exchange databases using the following scenarios:

- Microsoft Host Level VSS Software backup
- Host Level VSS Hardware using the Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service and Hitachi ShadowImage® Heterogeneous Replication
- Host Level VSS Hardware using the Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service and Hitachi Thin Image.

This document is written for Windows and storage administrators charged with designing and implementing backup and recovery solutions. It assumes working knowledge of DPM 2012 SP1 and Windows Server 2012 operating systems and a basic understanding of SAN-attached storage concepts.

**Note** — Testing of this configuration was in a lab environment. Many things affect production environments beyond prediction or duplication in a lab environment. Follow the recommended practice of conducting proof-of-concept testing for acceptable results in a non-production, isolated test environment that otherwise matches your production environment before your production implementation of this solution.
Key Solution Components

This section describes the key hardware and software components used to deploy the test environment.

Hardware Components

Table 1 lists the detailed information about the hardware components used in the Hitachi Data Systems lab.

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Description</th>
<th>Version</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hitachi Unified Storage VM</td>
<td>- Dual controller</td>
<td>73-02-02</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>- 8 × 8 Gb/sec Fibre Channel ports</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 64 GB cache memory</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 64 × SAS 600 GB 10K RPM disks 2.5&quot; SFF</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 48 × SAS 3 TB 7.2K RPM disks LFF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hitachi Compute Blade 500 chassis</td>
<td>- Up to 4 full or 8 half blades</td>
<td>A0130-C-6655</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>- 2 × Brocade 5460 Fibre Channel Switch Modules</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 2 × Brocade VDX6746 10 Gb DCB switch modules</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 2 × management modules</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 6 × cooling fan modules</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 4 × power supply modules</td>
<td></td>
<td></td>
</tr>
<tr>
<td>520H-B1 server blade (with CNA)</td>
<td>- Half-size blade</td>
<td>01-51/03-04</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>- 2 × 8-Core Intel Xeon E5-2680 2.70 GHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 192 GB memory per blade</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 1 Hitachi Fibre Channel 2-port mezzanine card, Slot 2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Hitachi Unified Storage VM

Hitachi Unified Storage VM is an enterprise storage platform. It combines storage virtualization services with unified block, file, and object data management. This versatile, scalable platform offers a storage virtualization system to provide central storage services to existing storage assets.

Unified management delivers end-to-end central storage management of all virtualized internal and external storage on Unified Storage VM. A unique, hardware-accelerated, object-based file system supports intelligent file tiering and migration, as well as virtual NAS functionality, without compromising performance or scalability.

The benefits of Unified Storage VM are the following:

- Enables the move to a new storage platform with less effort and cost when compared to the industry average
- Increases performance and lowers operating cost with automated data placement
- Supports scalable management for growing and complex storage environment while using fewer resources
- Achieves better power efficiency and with more storage capacity for more sustainable data centers
- Lowers operational risk and data loss exposure with data resilience solutions
- Consolidates management with end-to-end virtualization to prevent virtual server sprawl

Hitachi Compute Blade 500

Hitachi Compute Blade 500 is an enterprise-class blade server platform. It features the following:

- A balanced system architecture that eliminates bottlenecks in performance and throughput
- Configuration flexibility
- Eco-friendly power-saving capabilities
- Fast server failure recovery using a N+1 cold standby design that allows replacing failed servers within minutes
Software Components

This section describes the software components deployed for this reference architecture. Table 2 describes the software used in this reference architecture.

Table 2. Software Components

<table>
<thead>
<tr>
<th>Software</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hitachi Storage Navigator Modular 2</td>
<td>Microcode Dependent</td>
</tr>
<tr>
<td>Hitachi Dynamic Provisioning</td>
<td>Microcode Dependent</td>
</tr>
<tr>
<td>Hitachi Command Suite</td>
<td>7.4.0</td>
</tr>
<tr>
<td>Hitachi ShadowImage Heterogeneous Replication</td>
<td>Microcode Dependent</td>
</tr>
<tr>
<td>Hitachi Thin Image</td>
<td>Microcode Dependent</td>
</tr>
<tr>
<td>Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service</td>
<td>4.9.2</td>
</tr>
<tr>
<td>Microsoft Multipath I/O (MPIO)</td>
<td>006.0001.7600.16385</td>
</tr>
<tr>
<td>Microsoft Windows Server® 2012</td>
<td>Datacenter edition</td>
</tr>
<tr>
<td>Microsoft Exchange</td>
<td>Enterprise 2013</td>
</tr>
<tr>
<td>Microsoft SQL Server® 2012 (used for DPM databases)</td>
<td>Enterprise edition SP1</td>
</tr>
<tr>
<td>Microsoft Systems Center Data Protection Manager</td>
<td>2012 SP1</td>
</tr>
</tbody>
</table>

Hitachi Dynamic Provisioning

On Hitachi storage systems, Hitachi Dynamic Provisioning provides wide striping and thin provisioning functionalities.

Using Dynamic Provisioning is like using a host-based logical volume manager (LVM), but without incurring host processing overhead. It provides one or more wide-striping pools across many RAID groups. Each pool has one or more dynamic provisioning virtual volumes (DP-VOLS) of a logical size you specify of up to 60 TB created against it without allocating any physical space initially.

Deploying Dynamic Provisioning avoids the routine issue of hot spots that occur on logical devices (LDEVs). These occur within individual RAID groups when the host workload exceeds the IOPS or throughput capacity of that RAID group. Dynamic provisioning distributes the host workload across many RAID groups, which provides a smoothing effect that dramatically reduces hot spots.

When used with Hitachi Unified Storage VM, or Hitachi Virtual Storage Platform Hitachi Dynamic Provisioning has the benefit of thin provisioning. Physical space assignment from the pool to the dynamic provisioning volume happens as needed using 1 GB chunks, up to the logical size specified for each dynamic provisioning volume. There can be a dynamic expansion or reduction of pool capacity without disruption or downtime. You can rebalance an expanded pool across the current and newly added RAID groups for an even striping of the data and the workload.
Hitachi ShadowImage Heterogeneous Replication

Hitachi ShadowImage Heterogeneous Replication is a storage-based solution that creates RAID-protected duplicate volumes within Hitachi Unified Storage VM product. ShadowImage Heterogeneous Replication primary volumes (P-VOLs) contain the original data. Up to nine secondary volumes (S-VOLs) can be created as copies.

On Hitachi Unified Storage VM, ShadowImage Heterogeneous Replication is used to implement clones, a full copy of the primary data. The clone is available to be used by secondary applications. The unique value of working with a clone is that any operation on the clone has no effect on the primary data.

This solution used Hitachi ShadowImage In-System Replication bundle to create full-volume copies within the Hitachi Unified Storage VM. Although Hitachi ShadowImage® software is the underlying technology that replicates the volumes necessary to perform a backup from the secondary volume, it cannot be used to achieve consistent, point-in-time backups of virtual machines on CSVs without integrating into the Microsoft VSS framework. This integration occurs through the Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service.

Detailed information on using Shadow Image Heterogeneous Replication is in Hitachi Command Control Interface User and Reference Guide (MK-90RD7010).

Hitachi Thin Image

Hitachi Thin Image snapshot provides logical, change-based, point-in-time data replication within Hitachi storage systems for immediate business use. Business usage can include data backup and rapid recovery operations, as well as decision support, information processing, and software testing and development.

Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service

The Storage Adapter for Microsoft Volume ShadowCopy Service works with Microsoft’s Volume Shadow Copy Service (VSS) to generate consistent point-in-time copies of data known as shadow copies. Microsoft’s VSS framework was introduced in Windows Server 2003, and Windows Server 2012 contains an enhanced version of the VSS framework. VSS works with three main components to produce the shadow copies. Table 3 lists definitions of these components.

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requestor</td>
<td>Application, such as Microsoft Data Protection Manager 2012 SP1, that requests that a volume shadow copy be taken</td>
</tr>
<tr>
<td>Writer</td>
<td>Software that is included with applications or an OS, such as Hyper-V, that helps provide consistent shadow copies</td>
</tr>
<tr>
<td>Provider</td>
<td>Component that creates and maintains the shadow copies</td>
</tr>
</tbody>
</table>
Microsoft Windows Server 2012 Hyper-V

Microsoft Windows Hyper-V is a hypervisor-based virtualization technology that is integrated into Windows Server 2012 x64 and Windows Server 2008 R2 versions of the operating system. It allows for the reduction of hardware footprints and capital expenses through server consolidation.

Microsoft System Center Data Protection Manager 2012 SP1

Data Protection Manager 2012 SP1 provides continuous data protection for virtual machines hosted on servers running Microsoft Hyper-V. This protection includes online backup of guest virtual machines hosted on a clustered or standalone environment, protection of virtual machines during the live migration process and item-level recovery from a host-level backup. DPM 2012 SP1 interacts with the Hyper-V VSS writer so that consistent versions of a virtual machine can be captured and protected without impacting client access to the virtual machine.

Table 4 lists the DPM 2012 SP1 components needed to protect virtual machines under Hyper-V.

Table 4. DPM Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPM 2012 SP1 Server</td>
<td>DPM 2010 server performs the replication synchronization, and recovery point creation for protection and recovery of data.</td>
</tr>
<tr>
<td>DPM 2012 SP1 Agent</td>
<td>Protection agents must be installed on each virtual machine requiring protection. This agent tracks changes to protected data and transfers the changes to the DPM 2012 server.</td>
</tr>
<tr>
<td>DPM 2012 SP1 Protection Groups</td>
<td>Protection groups are used to manage the protection of data on virtual machines.</td>
</tr>
<tr>
<td>SQL Server 2012 SP1</td>
<td>DPM 2012 requires a dedicated instance of SQL Server 2012, 32-bit or 64-bit version, and Enterprise or Standard edition.</td>
</tr>
</tbody>
</table>

Microsoft SQL Server 2012 Enterprise Edition

Microsoft SQL Server 2012 is a complete set of enterprise-ready database technologies and tools to help your business derive the most value from information. SQL Server provides high levels of performance, availability, and security while employing more productive management and application development tools.
Additional highlights of Microsoft SQL Server 2012 include the following:

- A complete business intelligence platform that connects users to the right information at the right time. This improves business decisions through familiar tools, such as Microsoft Excel® and Microsoft SharePoint® Server.

- You receive high levels of performance, scalability, availability, and security for mission-critical applications.

- With Microsoft Visual Studio®, the Microsoft .NET Framework, and Microsoft SQL Server, developers use integrated development tools to build rich, intuitive, and connected applications quickly.

For more information about the features of SQL Server 2012, see the Product Documentation page of SQL Server 2012 Books Online or “Product Information” on the Microsoft web site.
Test Environment Configuration

This section shows the high level configuration of the test environment.

The configuration used for the tested implementation consisted of a two-node Hyper-V failover cluster hosting four virtual machines each executing an Exchange workload using the Exchange 2013 Load Generator. Each Exchange Server instance hosted 100 mailboxes. For more information about the workload parameters used for Exchange Loadgen, see the “Engineering Validation” section of this white paper. This architecture also implements Hitachi Dynamic Provisioning pools, which take advantage of Hitachi Dynamic Provisioning performance-enhancing, wide-striping capabilities for both the Exchange database and transaction log volumes and the secondary ShadowImage copies for those volumes.
Figure 1 shows a high-level overview of the test configuration.
## Server Configuration

The Hitachi Compute Blade 500 was used to host the server configuration. Table 5 shows the configuration of each server blade. All virtual machines and the Hyper-V host on each blade are running Windows 2012 Datacenter.

<table>
<thead>
<tr>
<th>Server Blade #</th>
<th>Server Name</th>
<th>Server Type</th>
<th>CPU</th>
<th>RAM</th>
<th>Software and Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blade 1</td>
<td>CB500-07-B1</td>
<td>Physical</td>
<td>$8 \times 2$-Core Xeon x2680 2.70 GHz</td>
<td>192 GB</td>
<td>Windows Server 2012 Hyper-V</td>
</tr>
<tr>
<td></td>
<td>DPM 2012</td>
<td>Virtual</td>
<td>2 vCPU</td>
<td>16 GB</td>
<td>DPM 2012 SP1 Manager</td>
</tr>
<tr>
<td></td>
<td>CAS</td>
<td>Virtual</td>
<td>2 vCPU</td>
<td>8 GB</td>
<td>Exchange Server 2013 Client Access Server</td>
</tr>
<tr>
<td></td>
<td>LoadGenClient1</td>
<td>Virtual</td>
<td>2 vCPU</td>
<td>8 GB</td>
<td>Exchange Load Generator 2013</td>
</tr>
<tr>
<td></td>
<td>LoadGenClient2</td>
<td>Virtual</td>
<td>2 vCPU</td>
<td>8 GB</td>
<td>Exchange Load Generator 2013</td>
</tr>
<tr>
<td></td>
<td>LoadGenClient3</td>
<td>Virtual</td>
<td>2 vCPU</td>
<td>8 GB</td>
<td>Exchange Load Generator 2013</td>
</tr>
<tr>
<td></td>
<td>LoadGenClient4</td>
<td>Virtual</td>
<td>2 vCPU</td>
<td>8 GB</td>
<td>Exchange Load Generator 2013</td>
</tr>
<tr>
<td>Blade 2</td>
<td>CB500-07-B2</td>
<td>Physical</td>
<td>$8 \times 2$-Core Xeon x2680 2.70 GHz</td>
<td>192 GB</td>
<td>Windows Server 2012 Hyper-V</td>
</tr>
<tr>
<td></td>
<td>Exchange-AD</td>
<td>Virtual</td>
<td>1 vCPU</td>
<td>4 GB</td>
<td>Active Domain/DNS</td>
</tr>
<tr>
<td></td>
<td>MailBoxServer1</td>
<td>Virtual</td>
<td>2 vCPU</td>
<td>16 GB</td>
<td>Exchange Server 2013 MailBox Server</td>
</tr>
<tr>
<td></td>
<td>MailBoxServer2</td>
<td>Virtual</td>
<td>2 vCPU</td>
<td>16 GB</td>
<td>Exchange Server 2013 MailBox Server</td>
</tr>
<tr>
<td>Blade 3</td>
<td>CB500-07-B3</td>
<td>Physical</td>
<td>$8 \times 2$-Core Xeon x2680 2.70 GHz</td>
<td>192 GB</td>
<td>Windows Server 2012 Hyper-V</td>
</tr>
<tr>
<td></td>
<td>MailBoxServer3</td>
<td>Virtual</td>
<td>2 vCPU</td>
<td>16 GB</td>
<td>Exchange Server 2013 MailBox Server</td>
</tr>
<tr>
<td></td>
<td>MailBoxServer4</td>
<td>Virtual</td>
<td>2 vCPU</td>
<td>16 GB</td>
<td>Exchange Server 2013 MailBox Server</td>
</tr>
</tbody>
</table>
Storage Configuration

This section describes the storage configuration used for testing.

All LUNs used for this testing were allocated from Hitachi Dynamic Provisioning pools. All pools were Raid-1+0 (2+2) with 600 GB SAS disk drives. Table 6 shows the HDP pool configuration.

Table 6. HDP Pool Configuration

<table>
<thead>
<tr>
<th>Pool Number</th>
<th>Size</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>2.1 TB</td>
<td>DPM Server Pool (Backup Volumes)</td>
</tr>
<tr>
<td>11</td>
<td>2.1 TB</td>
<td>Exchange Server Database Pool (PVOLS)</td>
</tr>
<tr>
<td>14</td>
<td>2.1 TB</td>
<td>Exchange Server Log Pool (PVOLS)</td>
</tr>
<tr>
<td>08</td>
<td>2.1 TB</td>
<td>Exchange Server Database Pool (SVOLS)</td>
</tr>
<tr>
<td>09</td>
<td>2.1 TB</td>
<td>Exchange Server Log Pool (SVOLS)</td>
</tr>
<tr>
<td>15</td>
<td>2.1 TB</td>
<td>DPM Thin Image Data Pool</td>
</tr>
</tbody>
</table>

Table 7 shows the LUN configuration for this solution.

Table 7. LUN Configuration

<table>
<thead>
<tr>
<th>LUN Number</th>
<th>Size</th>
<th>Use</th>
<th>HDP Pool</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>600 GB</td>
<td>Exchange Server Databases (PVOL)</td>
<td>11</td>
</tr>
<tr>
<td>02</td>
<td>300 GB</td>
<td>Exchange Server Logs (PVOL)</td>
<td>14</td>
</tr>
<tr>
<td>03</td>
<td>600 GB</td>
<td>Exchange Server Databases (SVOL)</td>
<td>08</td>
</tr>
<tr>
<td>04</td>
<td>300 GB</td>
<td>Exchange Server Logs (SVOL)</td>
<td>09</td>
</tr>
<tr>
<td>05</td>
<td>300 GB</td>
<td>Exchange Client CAS Server</td>
<td>12</td>
</tr>
<tr>
<td>06</td>
<td>5 GB</td>
<td>Command Device for DPM Server</td>
<td>12</td>
</tr>
<tr>
<td>07</td>
<td>1 TB</td>
<td>DPM Server Backup Pool</td>
<td>12</td>
</tr>
</tbody>
</table>

Storage Area Network Architecture

The SAN architecture consists of two Fibre Channel switch modules within the Hitachi Compute Blade 500 chassis and two Brocade 6510 Fibre Channel switches.

The Hyper-V host cluster has two paths to Hitachi Unified Storage VM using ports 1B and 2B.
The configuration shown in Figure 2 supports high availability by providing multiple paths from the hosts within Hitachi Compute Blade 500 to multiple ports on Hitachi Unified Storage VM.

**Hitachi Compute Blade 500 Chassis**

Use the Microsoft MPIO software for multipathing, employing the round-robin multipathing policy. The Microsoft MPIO round-robin load balancing algorithm automatically selects a path by rotating through all available paths. By balancing the load across all available paths, you optimize IOPS and response time.

**Figure 2**

Use the Microsoft MPIO software for multipathing, employing the round-robin multipathing policy. The Microsoft MPIO round-robin load balancing algorithm automatically selects a path by rotating through all available paths. By balancing the load across all available paths, you optimize IOPS and response time.
Table 8 shows the configuration of the paths.

<table>
<thead>
<tr>
<th>Blade HBA and Port Number</th>
<th>Switch</th>
<th>Zone Name</th>
<th>Storage System Port</th>
<th>Storage System Host Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blade 1 HBA 1 Port 1</td>
<td>FCSW-0</td>
<td>Blade_1_HBA1_1_SW0_HUSVM_1B_2B</td>
<td>1B 2B</td>
<td>Hyper-V Cluster</td>
</tr>
<tr>
<td>Blade 1 HBA 1 Port 2</td>
<td>FCSW-1</td>
<td>Blade_1_HBA1_2_SW1_HUSVM_1B_2B</td>
<td>1B 2B</td>
<td>Hyper-V Cluster</td>
</tr>
<tr>
<td>Blade 2 HBA 1 Port 1</td>
<td>FCSW-0</td>
<td>Blade_2_HBA1_1_SW0_HUSVM_1B_2B</td>
<td>1B 2B</td>
<td>Hyper-V Cluster</td>
</tr>
<tr>
<td>Blade 2 HBA 1 Port 2</td>
<td>FCSW-1</td>
<td>Blade_2_HBA1_2_SW1_HUSVM_1B_2B</td>
<td>1B 2B</td>
<td>Hyper-V Cluster</td>
</tr>
<tr>
<td>Blade 3 HBA 1 Port 1</td>
<td>FCSW-0</td>
<td>Blade_3_HBA1_1_SW0_HUSVM_1B_2B</td>
<td>1B 2B</td>
<td>Hyper-V Cluster</td>
</tr>
<tr>
<td>Blade 3 HBA 1 Port 2</td>
<td>FCSW-1</td>
<td>Blade_3_HBA1_2_SW1_HUSVM_1B_2B</td>
<td>1B 2B</td>
<td>Hyper-V Cluster</td>
</tr>
</tbody>
</table>

A unique host group is required for the Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service to support the use of Hitachi ShadowImage® Heterogenous Replication. This host groups was created on ports 1B and 2B. This host group is not assinged to any server in the configuration. It is used to map the S-VOLS used by ShadowImage for a backup using the Hitachi VSS Hardware provider. The name of the host group must be HITACHI-VSS-HG.

**Network Architecture**

The following networks were defined for this solution:

- A dedicated management network to manage the Hyper-V hosts to avoid competition with the virtual machine guest traffic
- A dedicated CSV and cluster communication network to ensure that if storage connectivity is lost to CSVs due to a failure in the Fibre Channel network, the I/O can be re-directed using the cluster network
- A live migration network to ensure the high-speed transfer of virtual machines between nodes in the Hyper-V failover cluster
- A network dedicated to application virtual machine LAN traffic
Network Switch Module Configuration

Each 520H B1 server blade has a single on-board two-channel 10 GbE CNA card for network traffic.

Each CNA card can be split into two channels with up to four logical NICs per channel for a total of eight logical NICs per server blade. This design only uses three NICs per channel. This allows maximum bandwidth for the virtual machine network.

Set bandwidth allocation for each NIC as follows:

- **Channel 0 and 1 NIC 0**
  - Cluster management networks
    - VMHOST network virtual switch
    - 1 GbE per NIC, for a total of 2 GbE
- **Channel 0 and 1 NIC 1**
  - Live migration network and CSV/Cluster configuration
    - Live migration CSV/Cluster virtual switch
    - 2 GbE per NIC, for a total of 4 GbE
- **Channel 0 and 1 NIC 2**
  - Virtual machine network for Exchange and DPM traffic
    - Virtual machine network virtual switch
    - 7 GbE per NIC, for a total of 14 GbE

Figure 3 illustrates the CNA and Fibre Channel to switch module mapping for Hitachi Compute Blade 500.
Figure 4 shows the network configuration using Brocade Data Center Bridging for Switch Module 0 and Switch Module 1, connected to the Brocade switches used at the Hitachi Data Systems labs.
System Center Data Protection Manager 2012 SP1 Configuration

The following steps were done to configure and initiate backups of an Exchange mailbox server using DPM 2012 SP1.

1. Select the Create New Protection Group Wizard from the DPM Administrator console.

2. Click on Protection in left Action panel as shown in Figure 5.

3. Click New to start the wizard and then Next.

Figure 5
The Select Protection Group Type screen appears.

1. Click the radio button for **Servers** and then click **Next**.

   The **Select Group Members** menu will display as shown in Figure 6 below.

2. In the **Available Member section** select the Exchange Mailbox server for backup.

3. Click **Next**.

![Figure 6](image)

The **Select Data Protection Method** menu will display.

4. Under **Select your protection method** select "I want short term protection using disk"

5. Click **Next**

   The **Specify Short-Term Goals** menu will display.

6. Specify **Retention range in days** and Click **Next**.

   The **Review Disk Allocation menu** will display.

7. Review the **Disk Space Allocation** to ensure it is of adequate size for this protection group.
8. Click **Next**.

   The **Choose Replication Method** menu will display.

9. Select the Radio button for **Automatically over the Network** and the radio button for **Now**.

   The Consistency Check Options menu will display.

10. Select the check box for "**Run a consistency check if a replica becomes inconsistent**".

    The **Summary** menu will display as shown in Figure 7.

11. Click on **Create Group** which will create the Protection Group for the Exchange Mailbox server.

![Create New Protection Group]

**Figure 7**

The **Status** menu will display which will show the status of the Create Group wizard. Ensure that the Create Protection Group was successful.

12. Click **Close**.
At this point DPM 2012 SP1 will take an initial full backup of the Exchange Mailbox server. This backup will use the Microsoft VSS Software provider to perform the backup. To check the status of the backup job:

1. Select **Monitoring** in the Action pane

2. Select the radio button for **Status** in the **Group by** action bar as shown in Figure 8.

Check to ensure that the **Status** is **Completed** for the backup.

**Figure 8**
After a full backup has been completed recovery point backups can also be taken of the Exchange Mailbox server. To initiate a recovery point backup do the following steps.

1. From DPM Administrator Console select **Protection**.
2. Select **Recovery Point** as shown in Figure 9.
3. Click **OK to create a recovery point**.

![Figure 9](image)

**Figure 9**

To check the status of the Recovery Point job:

1. Select **Monitoring** in the Action pane
2. Select the radio button for **Status** in the **Group by** action bar.

Check to ensure that the **Status** is **Completed** for the recovery point job.
Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service Configuration

Before a backup can be taken using Hitachi ShadowImage® Heterogenous Replication, the ShadowImage secondary volumes or S-VOLs must be created and paired with the primary volumes or P-VOLs. Use the Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service to create the S-VOLs. The adapter was configured using the GUI. The high level steps are:

- Add the HUS-VM storage system to the Storage Adapter for Microsoft Volume ShadowCopy Service.
- Select ShadowImage in the adapter GUI
- Select the LUNs that will be used as P-VOLs
- Create SVOLs that will be paired with the P-VOLs
- The Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service must be installed on the DPM 2012 SP1 backup server and Exchange Mailbox servers
- A command device on the HUS-VM must be mapped to the DPM 2012 SP1 backup server and Exchange Mailbox servers

The Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service has three phases:

- Pair and split
- Backup
- Restore

The Hitachi ShadowImage® Heterogenous Replication software, pair and split phase, facilitated by Hitachi Storage Adapter for Microsoft® ShadowCopy Service, reduces the backup window to only a matter of seconds per virtual machine being backed up. The Hitachi Storage Adapter for Microsoft® ShadowCopy Service works with the Microsoft Volume Shadow Copy service to create a clone, or a full copy, of the original data on a volume. The data on this clone can be backed up without disrupting the production system.

To backup virtual machines and their respective files on a CSV using Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service with Hitachi ShadowImage® Heterogenous Replication software, the following sets of LUNs are required:

- Primary volumes (P-VOLs) for each guest machines system files, databases and transaction logs
- Secondary volumes (S-VOLs) for each guest machine's system files, databases and transaction logs
For backups using Hitachi Thin Image, the secondary volumes or V-VOLs are created and paired with the primary volumes or P-VOLs. The Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service will dynamically create the V-VOLs in the Thin Image pool. The Hitachi Storage Adapter for Microsoft® ShadowCopy Service was configured using the GUI. The high level steps are:

- Add the HUS-VM storage system to the Storage Adapter for Microsoft® Volume ShadowCopy Service
- Select Thin Image in the adapter GUI
- Select the LUNs that will be used as P-VOLs
- Create a Thin Image pool to contain the V-VOL snapshots
- The Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service must be installed on the DPM 2012 SP1 backup server and Exchange Mailbox servers

In contrast to Hitachi ShadowImage® Heterogenous Replication software where all data is copied from the P-VOL to the S-VOL during backup, with Thin Image only changed data is saved from P-VOL to the V-VOLS in the Thin Image pool. The Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service dynamically creates the V-VOLS during the backup process and creates the snapshot pair.
Test Methodology

The following sections describe the test scenarios.

Test Scenarios

Table 9 lists the test scenarios used in testing.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Scenario Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Baseline performance test of Exchange 2013</td>
</tr>
<tr>
<td>2</td>
<td>Determine performance impact of Host Level VSS software backup of Exchange Mailbox servers</td>
</tr>
<tr>
<td>3</td>
<td>Determine performance of Host Level VSS hardware backup of Exchange using Hitachi ShadowImage® Heterogenous Replication software</td>
</tr>
<tr>
<td>4</td>
<td>Determine performance of Host Level VSS hardware backup of Exchange using Hitachi Thin Image</td>
</tr>
<tr>
<td>5</td>
<td>Determine if performance impact of re-directed I/O with DPM 2012 SP1 has been reduced or eliminated when performing backups using the VSS Software provider</td>
</tr>
</tbody>
</table>

Workload Description

Exchange Loadgen 2013 was used to simulate a mailbox workload against the Exchange 2013 Mailbox servers. System Center Data Protection Manager 2012 SP1 was then used to backup the Exchange databases during load using the following scenarios:

- Host Level VSS Software backup
- Host Level VSS Hardware backup using the Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service with Hitachi ShadowImage® Heterogenous Replication software
- Host Level VSS Hardware backup using the Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service with Hitachi Thin Image.

Four Exchange 2013 mailbox servers were deployed across the Hyper-V cluster. Each Exchange mailbox server hosted 100 users for a total of 400 users.
Analysis

Two types of test results were collected. First a baseline test to determine the baseline performance of the Exchange 2013 environment was conducted and results were collected. Then comparison tests were run and performance results were collected, to show the benefits, if any, of using the Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service instead of the Microsoft VSS software provider. The test results for the all the scenarios are described in the following sections.

Scenario One Baseline Exchange 2013 Performance Results

Loadgen 2013 was used to determine the baseline performance of Exchange 2013. Four Exchange 2013 mailbox servers were deployed, two on blade server 2 and two on blade server 3. Each Exchange mailbox servers hosted 100 users for a total of 400 users.

Shown below are the processor usage data for the Exchange Mailbox servers when applying the Loadgen 2013 workload. Time was allowed for ramp up in order to reach a steady state of 72.5% processor utilization as shown in Figure 10 below:

![Processor Usage Data](image)

**Figure 10**
Figure 11 provides the performance results for each mailbox server under load from Loadgen 2013.

Total network utilization performance data was collected during the Loadgen 2013 run, with data collected on blade 2 (CB500-07-B2) and blade 3 (CB500-07-B3). Performance statistics were collected for both the application network and the cluster management network, as shown in Figure 12.
These baseline results were used to determine the impact on performance and response time during backup of the Exchange 2013 mailbox servers.

**Scenario Two Performance Impact of Host Level VSS Software Backup**

Scenario two was executed to determine the performance impacts when doing backups with DPM 2012 SP1 and Microsoft VSS Software provider. Prior to Windows Server 2012, using the Microsoft VSS software provider entailed the use of redirected I/O from the time the backup started to the time it finished, and used serialization, thus impacting performance. This limitation is removed in Windows Server 2012 and this scenario was tested to confirm that this limitation was removed.

Figure 13 shows that the total processor time increased by around 4% for both replica and recovery point creation using the Microsoft VSS software for backup of the Exchange Mailbox servers as compared to the baseline during which no DPM 2012 SP1 backups were occurring.

![Figure 13](image.png)
CPU utilization was also measured on the DPM 2012 SP1 server to determine the impact of Microsoft VSS Software provider backup of the Exchange Mailbox server. Figure 14 shows that the CPU utilization was 18% for replica creation and 8% for recovery point creation, as compared to 0.3% for the baseline.

![CPU Utilization Graph](image)

**Figure 14**
Disk IOPS for the database and log LUNs were measured during the backup and recovery point process. Figure 15 shows that disk IOPS increased during the DPM 2012 SP1 backup process.

**Figure 15**

During the replica and recovery point backup using the Microsoft VSS Software provider the average response time for the Exchange Mailbox servers were not impacted when compared to the baseline performance metrics.
The network bandwidth utilization did increase on the application and management network on the Hyper-V hosts during the backup process using the Microsoft VSS Software provider. This is shown in Figure 16.

Figure 16
Scenario Three Performance of Host Level VSS Hardware Backup Using Hitachi ShadowImage® Heterogenous Replication

Scenario three was executed to determine the performance impacts when doing backups of Exchange Mailbox servers with DPM 2012 SP1, Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service and Hitachi ShadowImage® Heterogenous Replication. The test results for CPU utilization and response time show:

- CPU utilization on the Exchange Mailbox servers increased by 3% during replica creation and recovery point creation as compared to the baseline.
- The response time for the Exchange Mailbox server workload did not change in comparison to the baseline.
- The total CPU utilization for the DPM 2012 SP1 server for this scenario was around 10% for replica creation and 3% for recovery point creation. This is shown in Figure 17.

![Figure 17](image)

Figure 17

Disk IOPS for the database and log LUNs were measured during the backup and recovery point process using the Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service and Hitachi ShadowImage® Heterogenous Replication. Figure 18 shows that:

- Disk IOPS did not increase for replica creation
- Disk IOPS did increase for recovery point creation as compared to the baseline during the DPM 2012 SP1 backup process.
Because the read request of the Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service using Hitachi ShadowImage® Heterogenous Replication targets the S-VOL, unlike Microsoft VSS Software backup which targets the P-VOL, read requests to the P-VOL do not occur during the replica creation thus reducing IOPS.

Figure 18

The network bandwidth utilization did increase on the application and management network on the Hyper-V hosts during the backup process using the Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service and Hitachi ShadowImage® Heterogenous Replication as compared to the baseline. However when compared to the network utilization using the Microsoft VSS Software provider the network bandwidth utilization is less than half. This is shown in Figure 19.

Figure 19
Using the Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service in conjunction with Hitachi ShadowImage® Heterogenous Replication reduces the load on network bandwidth during replica creation and recovery point creation as compared to the Microsoft VSS Software provider.

Scenario Four Performance of Host Level VSS Hardware Backup Using Hitachi Thin Image

Scenario four was executed to determine the performance impacts when doing backups of Exchange Mailbox servers with DPM 2012 SP1, Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service, and Hitachi Thin Image. The test results for CPU utilization and response time show:

- CPU utilization on the Exchange Mailbox servers increased by 3% during replica creation and recovery point creation as compared to the baseline when executing the backup of the Exchange Mailbox servers.

- The response time for the Exchange Mailbox server workload did not change in comparison to the baseline.

- The total CPU utilization for the DMP 2012 SP1 server did increase for this scenario by around 7% for replica creation and 1% for recovery point creation. This is shown in Figure 20.

![Figure 20](image-url)
Disk IOPS for the database and log LUNs were measured during the backup and recovery point process using the Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service and Hitachi Thin Image. The test results show:

- Disk IOPS for database reads did increase for replica creation as shown in Figure 21.
- Disk IOPS did not increase for recovery point creation as compared to the baseline during the DPM 2012 SP1 backup process

The read request of the Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service backup targets the Thin Image V-VOL versus the Microsoft VSS Software provider backup which targets the P-VOL. At the time of the backup data transfer for replica creation, there may be data that is not synchronized between P-VOL and S-VOL, the data may still remain in the P-VOL, meaning that the DB read request may occur to target P-VOL. If the database reads do not go to the P-VOL then the result is equal to replica creation with Hitachi ShadowImate®.

![Disk IOPS Graph](image)

**Figure 21**
The network bandwidth utilization did increase on the application and management network on the Hyper-V hosts during the backup process using the Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service and Hitachi Thin Image as compared to the baseline. However when compared to the network utilization using the Microsoft VSS Software provider the network bandwidth utilization is less than half. This is shown in Figure 22.

Figure 22

Using the Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service in conjunction with Hitachi Thin Image reduces the load on network bandwidth during replica creation and recovery point creation as compared to using the Microsoft VSS Software provider.

Scenario Five Performance Impact of Re-directed I/O with DPM 2012 SP1 Backups

Scenario five was executed to determine if there were any re-direction of I/O occurring when performing backups of the Exchange Mailbox servers using DPM 2012 SP1 using the Microsoft VSS Software provider.

In previous versions of Data Protection Manager when using the Microsoft VSS software provider instead of the hardware provider to create backups, the CSV is in redirected I/O mode for all the virtual machines on the CSV for the duration of the backup. This backup duration depends on the size of the VHD being backed up by DPM and the time can be significant. During the duration of redirected I/O mode, the performance of other virtual machines on the CSV is reduced.

The following graphs show Hyper-V network bandwidth utilization on the parent partition when executing the backup with the Microsoft VSS Software provider, and also the Hitachi Storage Adapter for Microsoft® Volume ShadowCopy Service with Hitachi ShadowImage® Heterogenous Replication and Hitachi Thin Image.
Figure 23 shows Hyper-V network bandwidth utilization on the parent partition when executing the backup with the Microsoft VSS Software provider. Transfer time as shown in Figure 23 is the data transfer time over the network by the DPM 2012 SP backup server. Backup time is measured from the start of the backup job until the end of the job from the DPM console.

As seen in Figure 23 the network bandwidth remained low and at a consistent level between all three backup options. This shows that Windows 2012 in combination with System Center DPM 2012 SP1 avoids the performance impact of re-directed I/O when backing up Exchange Mailbox servers whose data resides on CSV LUNs.
For More Information

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