

# Hyper-V v2 Host Level Backups Using Symantec NetBackup 7.0 and the Hitachi VSS Hardware Provider with the Hitachi Adaptable Modular Storage 2000 Family

Lab Validation Report

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# Hyper-V v2 Host Level Backups Using Symantec NetBackup 7.0 and the Hitachi VSS Hardware Provider with the Hitachi Adaptable Modular Storage 2000 Family

## Lab Validation Report

In most enterprise environments, it's critical to reduce backup and recovery times. However, backing up large amounts of data within a very short backup window can be extremely difficult using standard backup technologies in which data is copied from production volumes across a local area network to the backup media. This white paper documents an approach using the Hitachi VSS Hardware Provider with Symantec NetBackup 7.0 in Microsoft Hyper-V v2 environments that makes host-level backups in a short backup window with minor effect on the production environment.

This solution uses the internal replication technologies built into the Hitachi Adaptable Modular Storage 2000 family and the VSS features of Windows 2008 to copy data from clones of the production volumes across a storage area network to the backup media, thereby reducing backup and recovery times.

This lab validation report is based on joint testing performed by Symantec and Hitachi at the Symantec Japan Development Center. This testing verified the functionality and performance of a backup environment in which host level backups of Microsoft Hyper-V virtual servers were done using Symantec NetBackup 7.0 and the Hitachi VSS Hardware Provider. The storage used for this testing was a Hitachi Adaptable Modular Storage 2300.

This white paper is written for IT administrators charged with backing up Hyper-V environments. Readers need to be familiar with backup and recovery concepts, Hyper-V and VSS.

## Product Features

The following sections describe the features of the key components used in testing this solution.

### Hitachi Adaptable Modular Storage 2000 Family

The Hitachi Adaptable Modular Storage 2300 is a member of the Hitachi Adaptable Modular Storage 2000 family, which provides a reliable, flexible, scalable and cost-effective modular storage system. Although the testing documented in this white paper used a 2300, any member of the 2000 family is suitable for this solution.

The 2000 family's symmetric active-active controllers provide integrated, automated, hardware-based, front-to-back-end I/O load balancing. Both controllers in a 2000 family storage system are able to dynamically and automatically assign the access paths from the controller to the logical unit (LU). All LUs are accessible regardless of the physical port or the server from which the access is requested.

Utilization rates of each controller are monitored so that a more even distribution of workload between the two controllers can be maintained. Storage administrators are no longer required to manually define specific affinities between LUs and controllers, simplifying overall administration. In addition, this controller design is fully integrated with standard host-based multipathing, thereby eliminating mandatory requirements to implement proprietary multipathing software.

The point-to-point back-end design virtually eliminates I/O transfer delays and contention associated with Fibre Channel arbitration and provides significantly higher bandwidth and I/O concurrency. It also isolates any component failures that might occur on back-end I/O paths.

For more information about the 2000 family, see the [Hitachi Adaptable Modular Storage 2000 Family Overview](#) brochure.

The testing documented in this white paper used Hitachi ShadowImage® In-System Replication software and Hitachi Copy on Write Snapshot software to manage the snapshots created by the VSS environment.

The high-speed, nondisruptive full volume local mirroring technology of Hitachi ShadowImage In-System Replication software can rapidly create multiple copies of a volume within the Hitachi Adaptable Modular Storage 2300. The primary volume is referred to as a P-VOL and any copy of the volume is referred to as an S-VOL. For more information, see the ShadowImage In-System Replication software [web site](#).

Hitachi Copy-on-Write Snapshot software rapidly creates point-in-time snapshot copies of any data volume within Hitachi storage systems, without affecting host service or performance levels. Because these snapshots only store the changed data blocks in the Copy-on-Write Snapshot storage pool, the amount of storage capacity required for each snapshot copy is substantially smaller than the source volume. As a result, you realize significant savings as compared to full cloning methods. For more information see the Copy-on-Write Snapshot software [web site](#).

## Hitachi VSS Hardware Provider

The Hitachi VSS Hardware Provider 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 was introduced in Windows Server 2003, and Windows Server 2008 contains an enhanced version of the VSS framework. The Volume Shadow Copy Service works with three main components to produce the shadow copies. Table 1 lists definitions of these components.

**Table 1. Required Volume Shadow Copy Service Components**

<i>Component</i>	<i>Description</i>
Requestor	Application, such as Symantec NetBackup, that requests that a volume shadow copy be taken
Writer	Software that is included with applications, such as Hyper-V, Exchange and SQL Server, that helps provide consistent shadow copies
Provider	Component that creates and maintains the shadow copies

In the test environment described in this white paper, the Hitachi VSS Hardware Provider was installed on both the Hyper-V host and the backup server. Hardware-based shadow copy providers, like Hitachi VSS Hardware Provider, act as an interface between Microsoft VSS and the storage system. The work of creating a shadow copy is done by the 2000 family storage controller; Microsoft VSS ensures that the copy and other processes comply with VSS standards. You can download the Hitachi VSS Hardware Provider from the Hitachi web site. The link to download the software is in the **Downloads** section on the **Resources** tab.

## Symantec NetBackup

Symantec NetBackup Platform simplifies the protection of your information driven enterprise by automating advanced technologies and standardizing operations across applications, platforms and virtual environments. Integrated deduplication, replication and patent-pending virtual machine protection help you improve storage efficiency, infrastructure use and recovery times. A single console offers multi-site monitoring, analytics and reporting, which allow you to standardize operations and risk management. For more information, see the Symantec NetBackup [web site](#).

## Test Environment Configuration

The following sections describe the hardware and software components used in the test environment, the backup process, and the configurations of the test environments.

### Hardware Components

Table 2 lists the hardware components used in the test environments.

**Table 2. Hardware Components**

<i>Component</i>	<i>Label</i>	<i>Configuration</i>
Storage	Hitachi Adaptable Modular Storage 2300	Firmware: 08-80A/M, 1GB cache
Server	Host#1	CPU: Intel Xeon X5460 3160 MHz (1 socket, 4 cores) Memory: 4GB HBA: Emulex LightPulse LPe12002
Server	Host#2	CPU: AMD Opteron 8350 2000 MHz (4 sockets, 16 cores) Memory: 32GB HBA: Emulex LightPulse LPe12002
Server	Host#3	CPU: AMD Opteron 8350 2000 MHz (4 sockets, 16 cores) Memory: 32GB HBA: Emulex LightPulse LPe12002
Backup server	Backup server	CPU: AMD Opteron 8350 2000 MHz (4 sockets, 16 cores) Memory: 32GB HBA: Emulex LightPulse LPe12002
Domain controller	Domain controller	CPU: Intel Xeon 3400 MHz (2 sockets, 2 cores) Memory: 2GB

## Software Components

Table 3 lists the software used in the test environments.

**Table 3. Software Components**

<i>Hardware Component</i>	<i>Function</i>	<i>Software</i>
Hitachi Adaptable Modular Storage 2300	Replication	ShadowImage in dynamically provisioned environments Copy-on-Write Snapshot in standard provisioned environments <sup>†</sup>
	Volume management	Hitachi Dynamic Provisioning software
Host#1	Host	Windows Server 2008 R2 Hyper-V enabled NBU7 Enterprise client .NET Framework 3.5 SP1 Hitachi VSS Hardware Provider 04.0.1
	Guests (Guest#1, #2, #3, #4)	Windows Server 2008 R2 Dynamic VHD and fixed VHD NBU7 Enterprise client VDbench
Host#2	Host	Windows Server 2008 R2 Hyper-V enabled Microsoft failover clustering NBU7 Enterprise client .NET Framework 3.5 SP1 Hitachi VSS Hardware Provider 04.0.1
	Guests (Guest#5 and #6)	Windows Server 2008 R2 Dynamic VHD and fixed VHD NBU7 Enterprise client VDbench
Host#3	Host	Windows Server 2008 R2 Hyper-V enabled Microsoft failover clustering NBU7 Enterprise client .NET Framework 3.5 SP1 Hitachi VSS Hardware Provider 04.0.1
	Guests (Guest#5 and #6)	Windows Server 2008 R2 Dynamic VHD and fixed VHD NBU7 Enterprise client VDbench

<i>Hardware Component</i>	<i>Function</i>	<i>Software</i>
Backup server	Backup	NBU7 Enterprise server .NET Framework 3.5 SP1 Hitachi VSS Hardware Provider 04.0.1

<sup>1</sup>Note: The firmware used for the original testing did not support Hitachi Copy-on-Write Snapshot software on Hitachi Dynamic Provisioning software. Firmware version 9.7H and later support this configuration. Follow-up testing was performed to verify support.

The Vdbench utility was installed on the virtual machines and used to drive I/O to the SAN-attached storage.

Microsoft hotfix KB975688 was installed on all Hyper-V hosts and on the backup server for this testing. This was to avoid an issue with snapshots being corrupted when a VSS provider takes longer than 10 seconds to create a snapshot.

## Backup Workflow

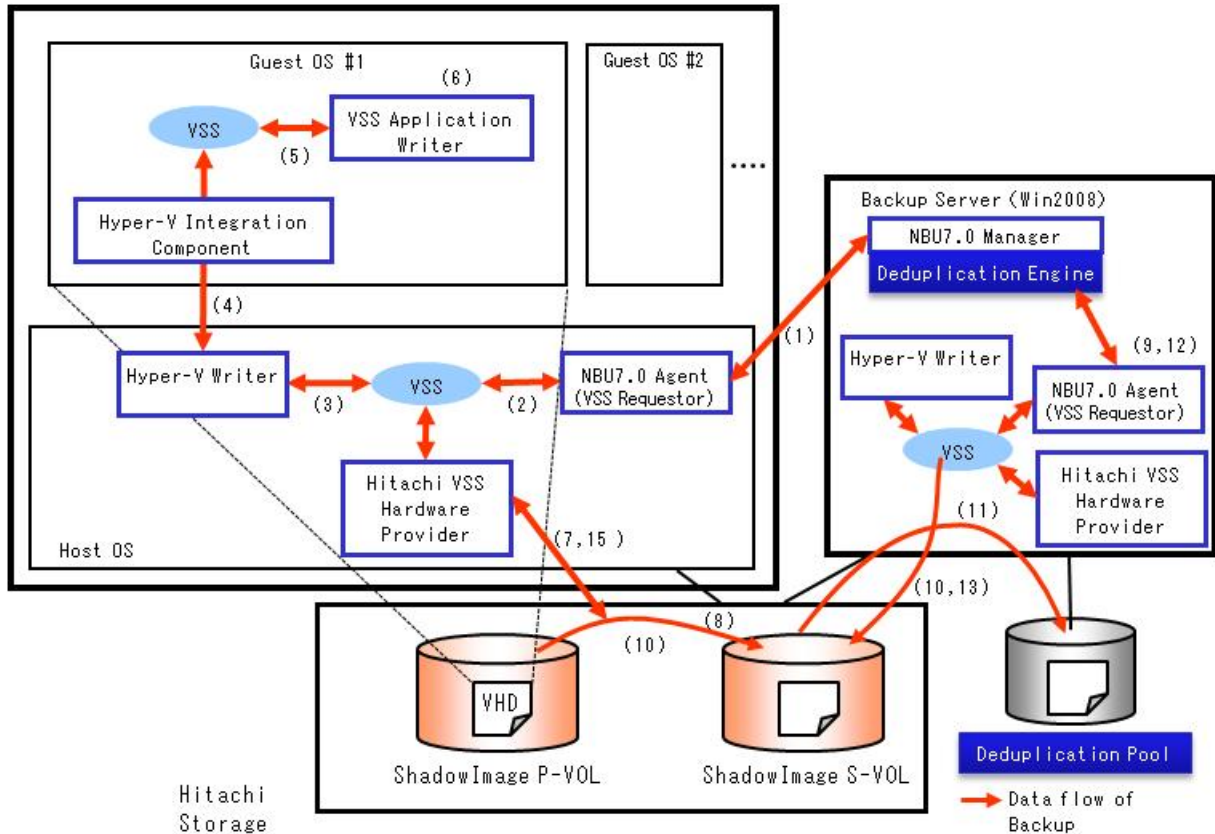
This section describes the steps that take place when a host-level backup of a virtual machine is performed using NetBackup 7 and the Hitachi VSS Hardware Provider. You must understand this process so that you have the necessary context to understand configuration details and test descriptions in later sections.

A host-level backup in a Hyper-V v2 environment using NetBackup 7.0 and the Hitachi VSS Hardware Provider follows this workflow:

1. The NetBackup manager on the backup server sends a request to the NetBackup agent on the Hyper-V host to start a backup.
2. The NetBackup agent on the Hyper-V host sends a request to the VSS on the host OS to freeze the guest OS.
3. VSS on the host OS sends a request to the Hyper-V writer to freeze the guest OS.
4. The Hyper-V writer passes the freeze request to VSS on the guest OS through the Hyper-V integration component.
5. VSS on the guest OS sends a request to the VSS application writer to freeze the application.
6. The VSS application writer freezes the application and flushes data from the guest OS memory.
7. VSS on the host OS sends a request to the Hitachi VSS Hardware Provider to create a snapshot.
8. The storage system creates a snapshot.
9. NetBackup sends a request to VSS on the backup server to attach to the snapshot.
10. VSS on the backup server attaches to the snapshot by making the S-VOL visible.
11. NetBackup performs a backup from the snapshot copy to tape or disk.

12. NetBackup sends a request to VSS on the backup server to detach from the snapshot.
13. VSS on the backup server detaches from the snapshot by hiding the S-VOL.
14. NetBackup sends a request to VSS to delete the snapshot.
15. Hitachi VSS Hardware Provider performs a resync.

Figure 1 shows the workflow for the backup process.



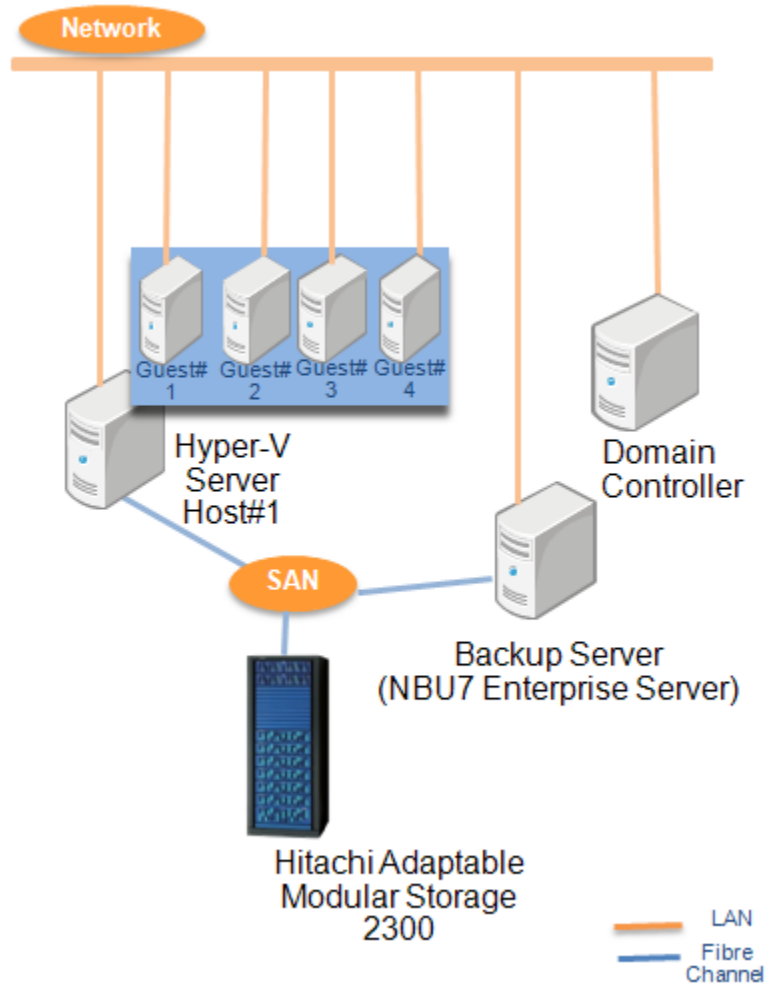
**Figure 1**

Two environments were used for the validation testing. These are described in the following sections.

## Single Host Environment Configuration

A single host environment was used to validate the solution for a single, non-clustered Hyper-V host. This environment was also used to test the effects of NetBackup's deduplication feature.

This environment consisted of Hyper-V Host#1, the NetBackup backup server, and the Hitachi Adaptable Modular Storage. For more information about these components, see Table 2. Depending on the test case, either a single VM or multiple VMs were used for testing. Figure 2 shows the layout for the single host environment.



**Figure 2**

The storage configuration for the tests run in the single host environment depended on the purpose of the test. Two storage configurations were used.

Table 4 lists the storage configuration for single host functional and performance testing.

**Table 4. Single Host Testing Storage Configuration**

<i>LUN</i>	<i>LUN Size (GB)</i>	<i>VHD Format</i>	<i>Mapped To</i>	<i>Description</i>
0	10	N/A	N/A	DMLU
1	20	Dynamic or fixed	Guest#1	System VHD
2	10	Dynamic or fixed	Guest#1	Data VHD
3	20	N/A	Backup server	ShadowImage S-VOL for LUN 1
4	10	N/A	Backup server	ShadowImage S-VOL for LUN 2
5	20	N/A	Backup server	Copy-on-Write V-VOL for LUN 1
6	10	N/A	Backup server	Copy-on-Write V-VOL for LUN 2
7	100	N/A	N/A	Data pool for Copy-on-Write software
8	400	N/A	Backup server	Backup volume for NetBackup

Table 5 shows the storage configuration used for the deduplication testing.

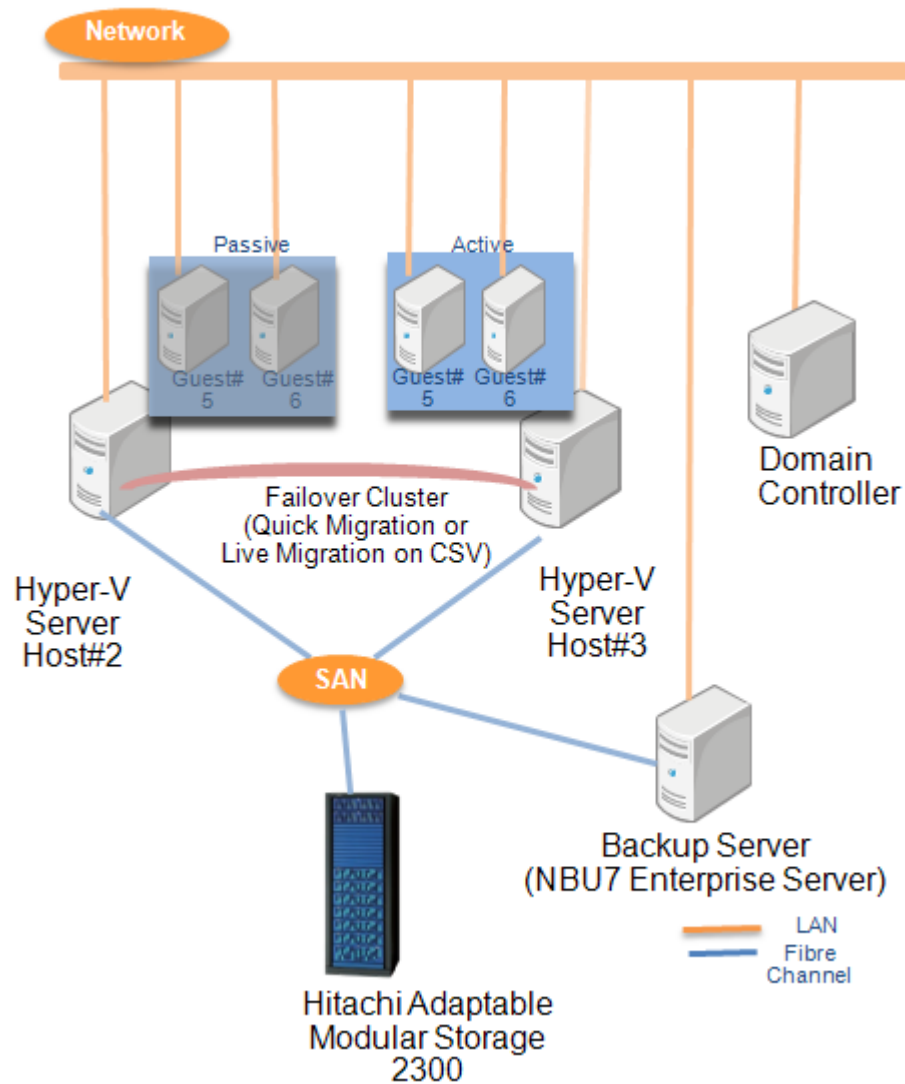
**Table 5. Deduplication Testing Storage Configuration**

<i>LUN</i>	<i>LUN Size (GB)</i>	<i>VHD Format</i>	<i>Mapped To</i>	<i>Description</i>
0	10	N/A	N/A	DMLU
1	50	Fixed	Guest#1	System VHD
2	50	Fixed	Guest#2	System VHD
3	50	Fixed	Guest#3	System VHD
4	50	Fixed	Guest#4	System VHD
5	50	N/A	Backup server	ShadowImage S-VOL for LUN 1
6	50	N/A	Backup server	ShadowImage S-VOL for LUN 2
7	50	N/A	Backup server	ShadowImage S-VOL for LUN 3
8	50	N/A	Backup server	ShadowImage S-VOL for LUN 4
9	400	N/A	Backup server	Backup volume for NetBackup

## Failover Cluster Environment Configuration

The failover cluster environment was used to validate the solution for a Hyper-V cluster consisting of two Hyper-V hosts.

This environment consisted of the Hyper-V Host#2 and Host#3, the NetBackup backup server and the Hitachi Adaptable Modular Storage 2300. For more information about these components, see Table 2. Figure 3 shows the layout for the failover cluster environment.



**Figure 3**

The storage configuration for the tests run in the failover cluster environment depended on migration type configured. Two storage configurations were used.

Table 6 lists the storage configuration for the functional and performance testing using quick migration in the failover cluster environment.

**Table 6. Quick Migration Storage Configuration**

<i>LUN</i>	<i>LUN Size (GB)</i>	<i>VHD Format</i>	<i>Mapped To</i>	<i>Description</i>
0	10	N/A	N/A	DMLU
1	20	Dynamic or fixed	Guest#5	System VHD
2	10	Dynamic or fixed	Guest#5	Data VHD
3	20	Dynamic or fixed	Guest#6	System VHD
4	10	Dynamic or fixed	Guest#6	Data VHD
5	20	N/A	Backup Server	ShadowImage S-VOL for LUN 1
6	10	N/A	Backup Server	ShadowImage S-VOL for LUN 2
7	20	N/A	Backup Server	ShadowImage S-VOL for LUN 3
8	10	N/A	Backup Server	ShadowImage S-VOL for LUN 4
9	400	N/A	Backup Server	Backup volume for NetBackup

Table 7 lists the storage configuration for the functional and performance testing using live migration in the failover cluster environment. LUN 1 is a CSV.

**Table 7. Live Migration Storage Configuration**

<i>LUN</i>	<i>LUN Size (GB)</i>	<i>VHD Format</i>	<i>Mapped To</i>	<i>Description</i>
0	10	N/A	N/A	DMLU
1	200	Dynamic or fixed	Guest#5 and Guest#6	System VHD and data VHD
2	200	N/A	Backup Server	ShadowImage S-VOL for LUN 1
3	400	N/A	Backup Server	Backup volume for NetBackup

# Test Scenarios and Results

The following sections describe test scenarios and test results.

## Test Scenarios

Table 8 lists the test scenarios used in testing.

**Table 8. Test Scenarios**

<i>Scenario</i>	<i>Scenario Description</i>	<i>CSV Used</i>	<i>Standalone or Failover Cluster</i>
1	Host-level VSS hardware backup using ShadowImage software	No	Standalone
2	Host-level VSS hardware backup using Copy-on-Write software	No	Standalone
3	Host-level VSS hardware backup with deduplication using ShadowImage software	No	Standalone
4	Host-level VSS hardware backup using ShadowImage software with quick migration	No	Failover cluster
5	Host-level VSS Hardware backup using ShadowImage software with live migration	Yes	Failover cluster
6	Comparison of deduplication backup to normal backup	No	Standalone

## Test Results

Two types of test results were collected. Functional test results were collected for all of the scenarios except for scenario 6 with a success/fail evaluation criterion. Performance results were collected for comparison tests that were performed to show the benefits of using the Hitachi VSS hardware provider instead of the VSS software provider. The test results are described in the following sections.

### *Functional Test Results*

The functional test results for the six scenarios are described in the following tables.

Table 9 lists the results for the functional testing of the standalone environment. Results were based on a success or fail evaluation criterion.

**Table 9. Single Host Functional Test Results**

<i>Scenario</i>	<i>Scenario Description</i>	<i>Result</i>
1	Host-level VSS hardware backup using ShadowImage software	Success with limitation: LU must contain a single VM
2	Host-level VSS hardware backup using Copy-on-Write software	Success
3	Host-level VSS hardware backup with deduplication using ShadowImage software	Success

Table 10 lists the results for the functional testing of the failover cluster environment. Results were based on a success or fail evaluation criterion.

**Table 10. Failover Cluster Functional Test Results**

<i>Scenario</i>	<i>Scenario Description</i>	<i>Result</i>
4	Host-level VSS hardware backup using ShadowImage software with quick migration	Success with limitation: <b>Client Name Selection</b> in NetBackup client configuration must be set to <b>VM Display Name</b> .
5	Host-level VSS Hardware backup using ShadowImage software with live migration	Success with limitation: Target VM resource must be deleted from failover cluster manager before restore.

A separate functional test was not performed for scenario 6 because the functional testing of an environment using deduplication is covered by scenario 3.

### *Comparison Test Results*

The following comparison tests run were run:

- Comparison of performance during a backup in a single host environment using the Hitachi VSS hardware provider and a backup using the VSS software provider.
- Comparison of performance during a backup in a failover cluster environment using the Hitachi VSS hardware provider and a backup using the VSS software provider.
- Comparison of storage capacity used for standard full backups and backups using the NetBackup PureDisk Deduplication Engine (PDDE)

For the VSS hardware provider and VSS software provider testing, the following measures were compared:

- Backup time (time to complete backup to disk)
- CPU utilization
- Network utilization
- Response time

The results for these three tests are described in the following sections.

#### *Comparison of Backups Using VSS Hardware Provider and VSS Software Provider in Single Host Environments*

For this test, the backup using the Hitachi VSS Hardware Provider took 11 minutes and 11 seconds and the backup using the VSS software provider took 14 minutes and 7 seconds.

CPU utilization on the production server was much higher during the backup when the VSS software provider was used. The CPU utilization on the backup server was not significantly different for the two test cases.

Figure 4 shows CPU utilization when the Hitachi VSS Hardware Provider was used.

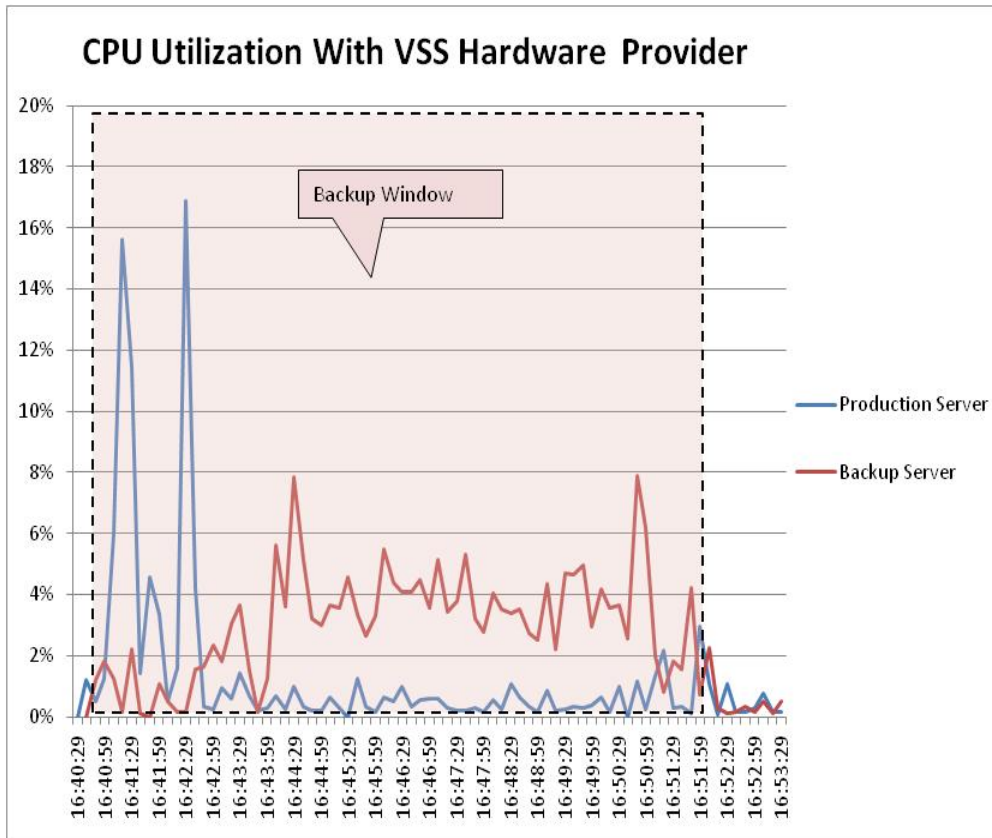
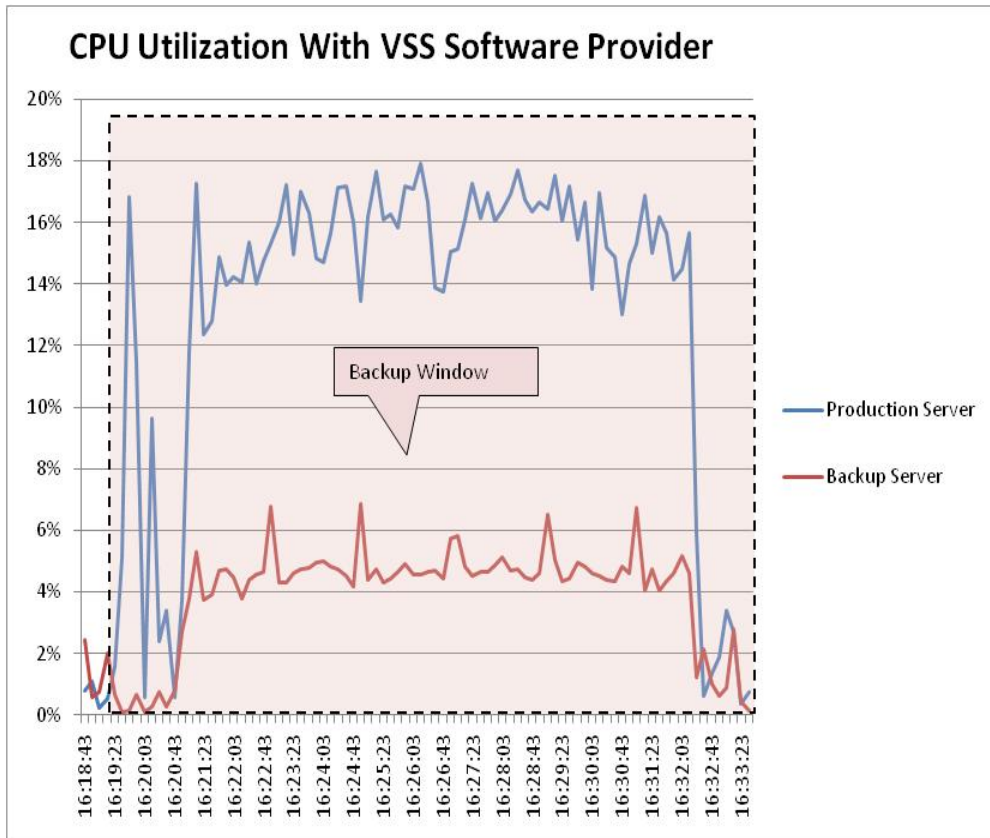


Figure 4

Figure 5 shows CPU utilization when the VSS software provider was used.



**Figure 5**

Network utilization was substantially higher when the VSS software provider was used. This is because the data being backed up was copied across the LAN instead of the SAN.

Figure 6 shows network utilization in bytes per second when the Hitachi VSS Hardware Provider was used.

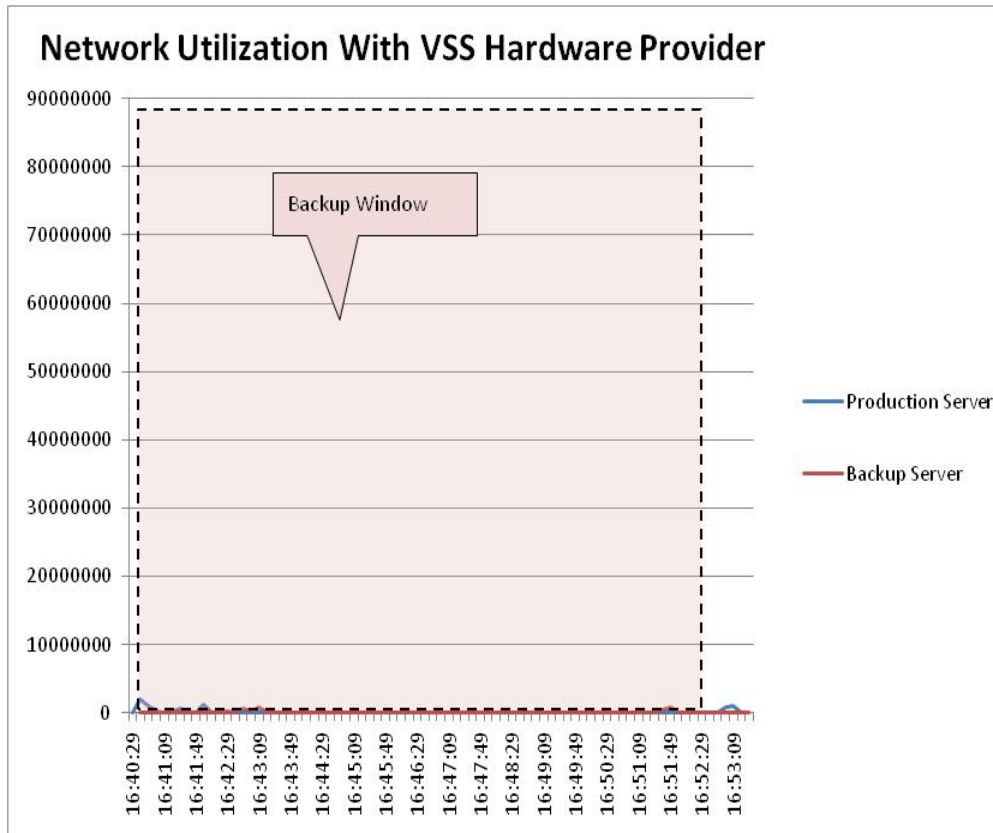


Figure 6

Figure 7 shows network utilization in bytes per second when the VSS software provider is used.

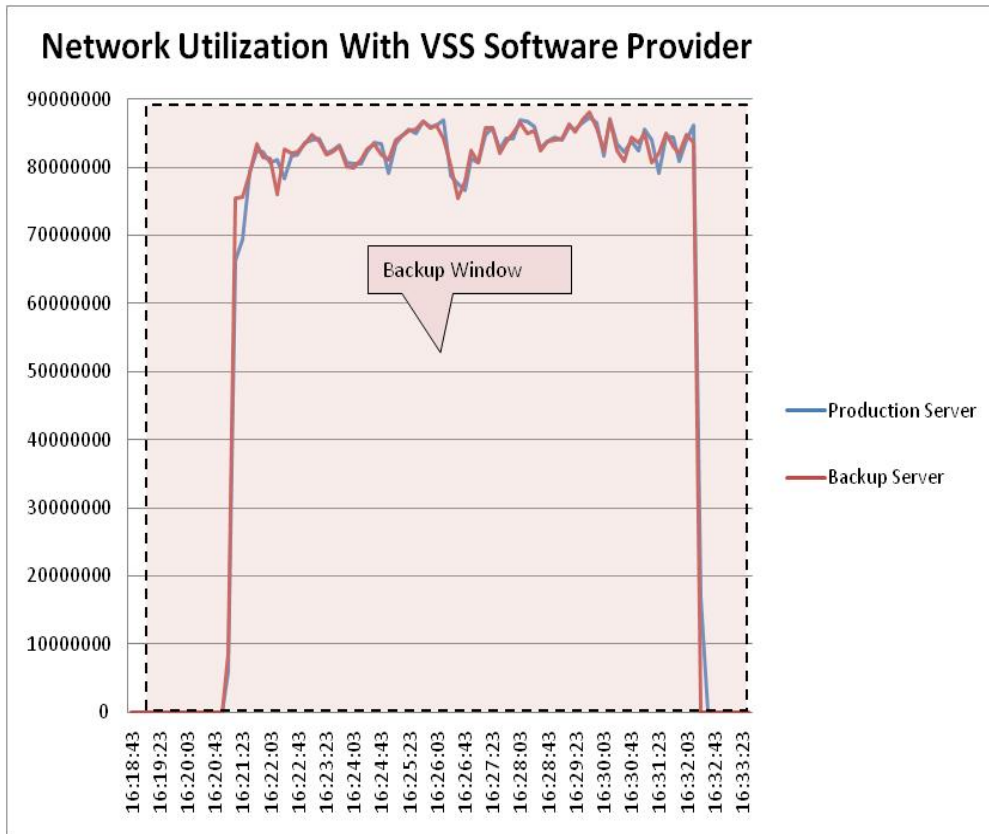


Figure 7

The response times for the Vdbench workload for these tests were slightly higher when the VSS software provider was used but in both cases the response times were within acceptable limits.

#### *Comparison of Backups Using VSS Hardware Provider and VSS Software Provider in Failover Cluster Environments using CSV*

For these tests, two VMs were backed up from a Hyper-V failover cluster. A 50GB VHD was backed up for each VM.

The backup using Hitachi VSS Hardware Provider took 31 minutes and 30 seconds and the backup using the VSS software provider took 52 minutes and 43 seconds. It is also important to note that the amount of time that the redirected I/O mode was in use was much greater with the VSS software provider than with the Hitachi VSS Hardware Provider.

CPU utilization on the production server (Host#3) was much higher during the backup when the VSS software provider was used. The CPU utilization on the backup server and on the other server in the failover cluster (Host#2) was not significantly different for the two test cases.

Figure 8 shows CPU utilization on Host#3 when the Hitachi VSS Hardware Provider was used.

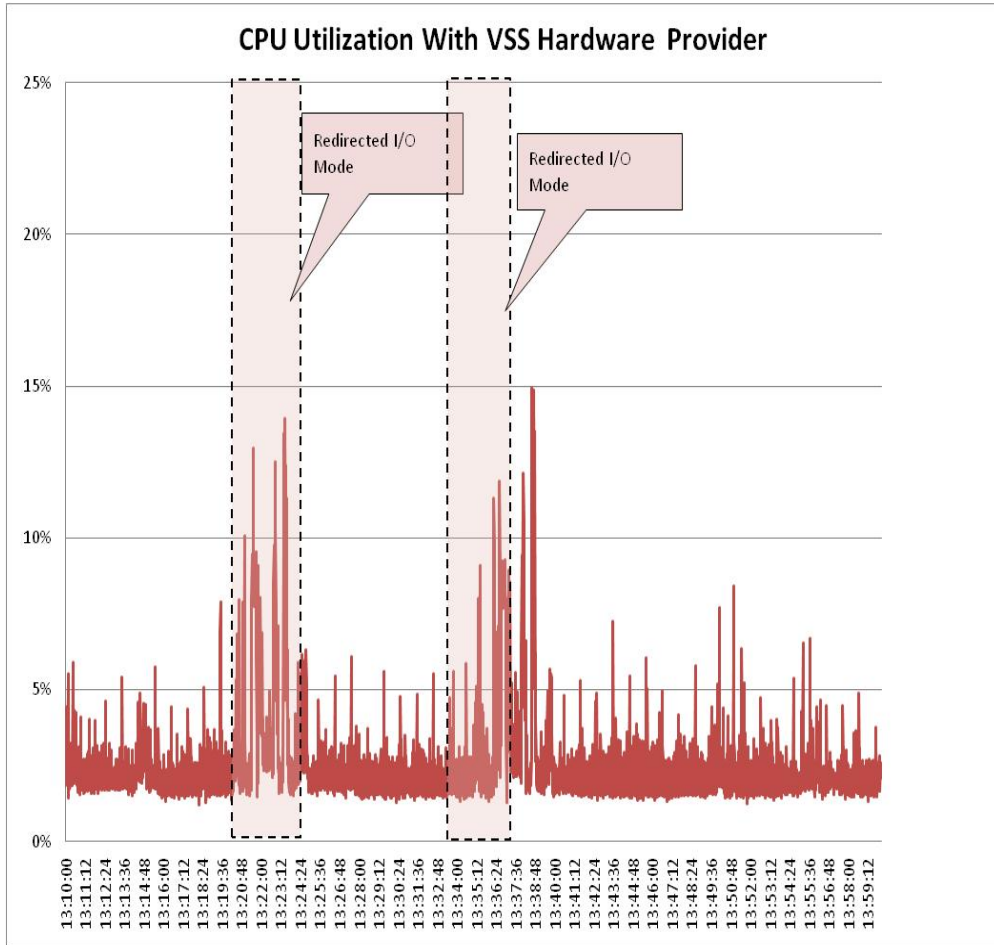
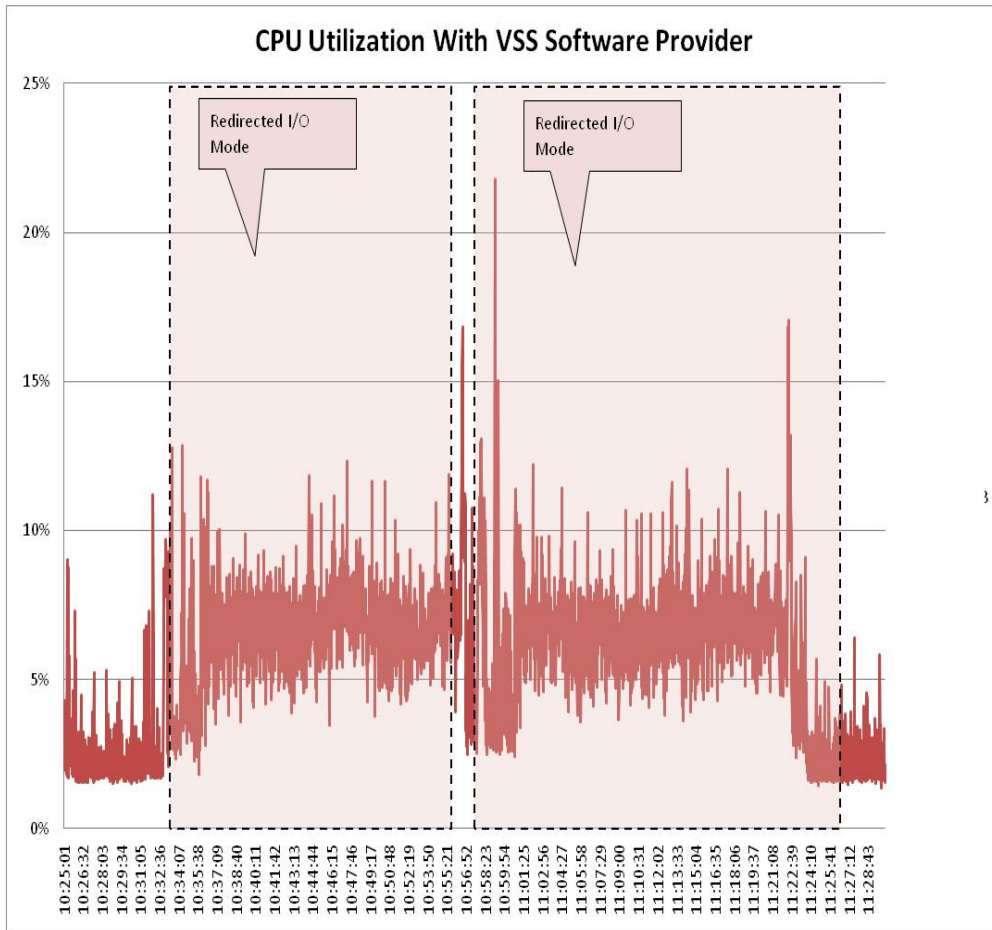


Figure 8

Figure 9 shows CPU utilization on Host#3 when the VSS software provider was used.



**Figure 9**

Network utilization on Host#3 was substantially higher when the VSS software provider was used. This is because the data being backed up was copied across a LAN instead of a SAN. The network utilization on the backup server was almost identical because all of the traffic was between the two servers. Network utilization for Host#2 showed no change.

Figure 10 shows network utilization in bytes per second on Host#3 when the Hitachi VSS Hardware Provider was used.

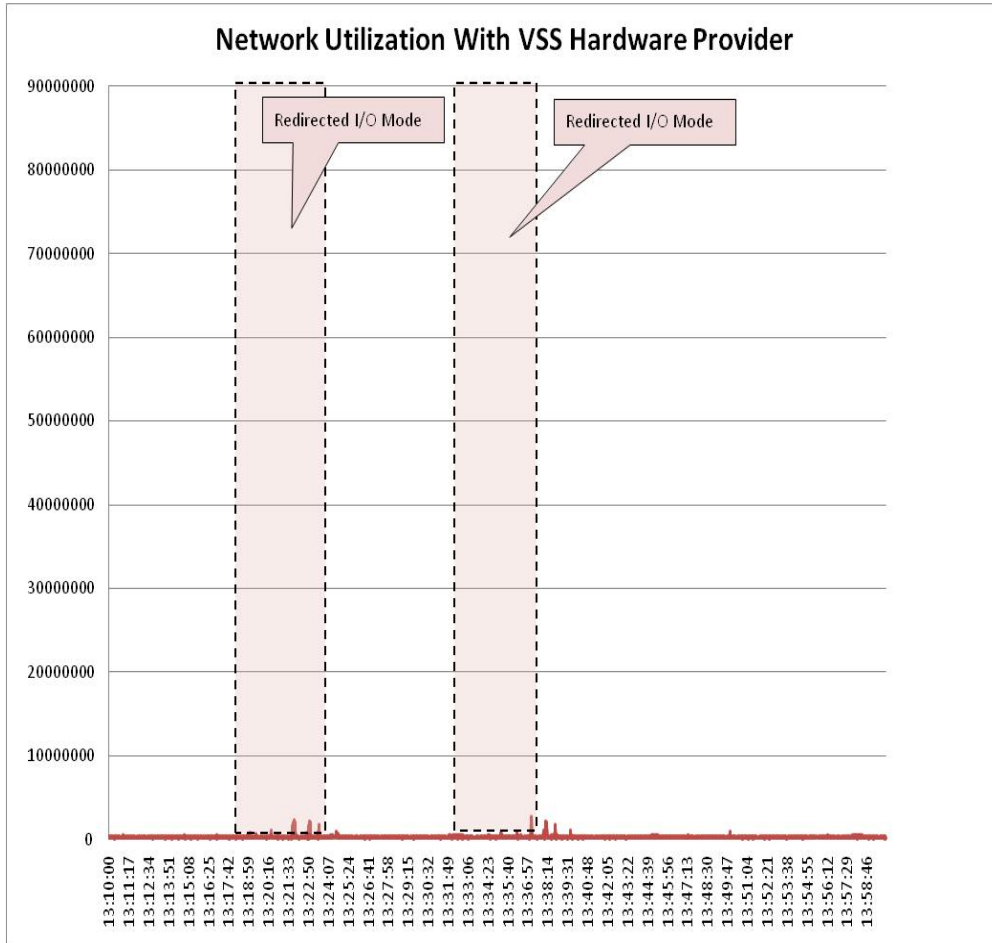
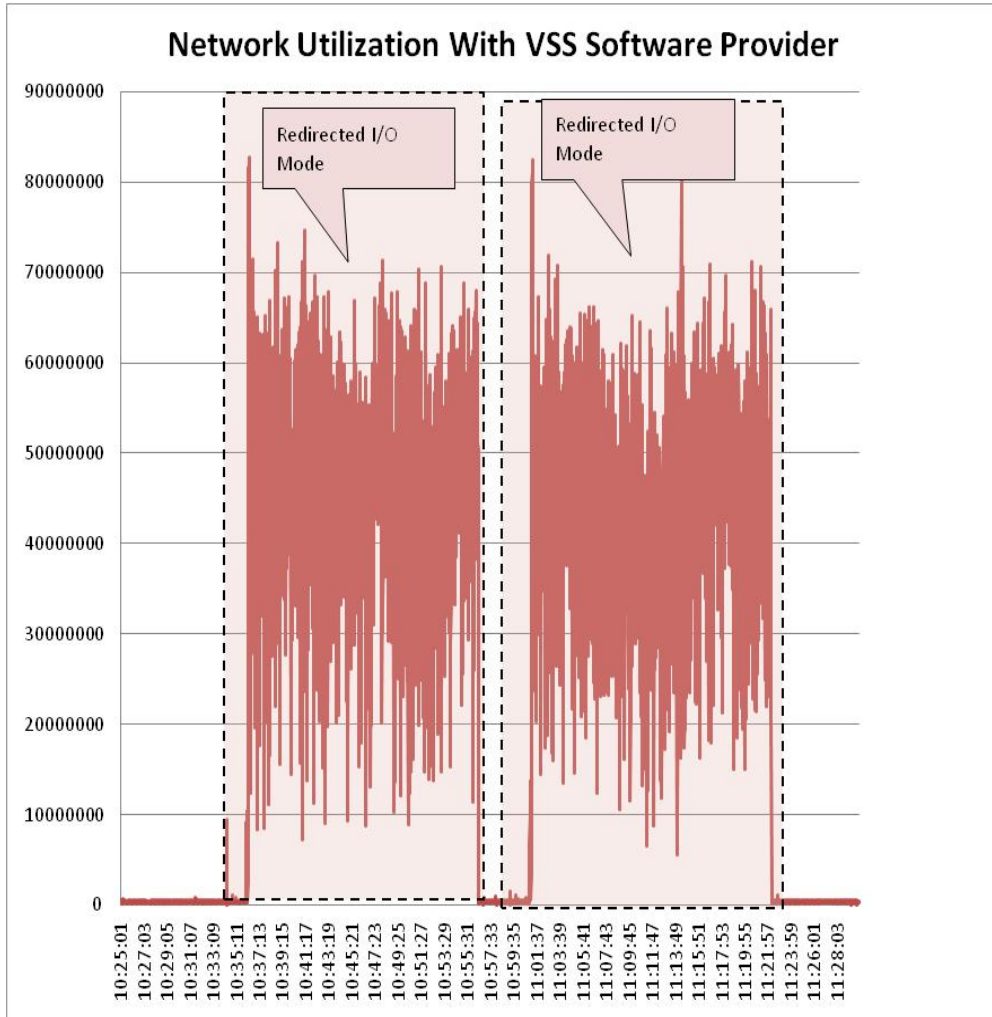


Figure 10

Figure 11 shows network utilization in bytes per second on Host#3 when the VSS software provider was used.



**Figure 11**

*Comparison of Storage Capacity Used for Standard Full Backups and Backups Using the NetBackup PureDisk Deduplication Engine*

For these tests, four VMs were used. Each VM used a single 50GB VHD. 500MB of data was modified and 500MB of new data was added on each VM daily for nine days. Backups were performed daily. The storage capacity used over a nine-day period for standard full backups was 1.8TB.

Figure 12 shows that using the NetBackup PureDisk Deduplication Engine reduced the total space required for the nine backups to 370GB.

### Comparison of Normal Backup with Deduplication

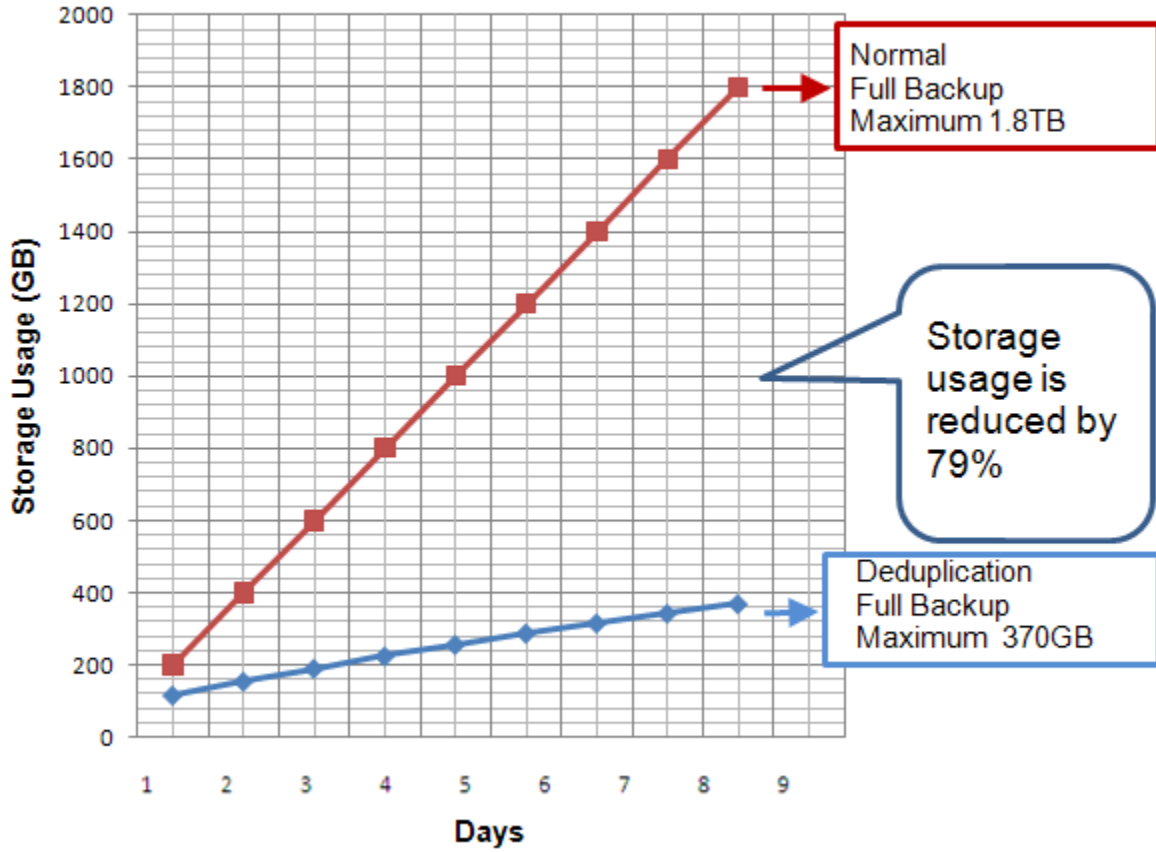


Figure 12

## Conclusion

This white paper documents test results that show that you can expect the following benefits when using the Hitachi VSS Hardware Provider with Symantec NetBackup 7.0 to do host-level backups of Hyper-V VMs:

- Reduced CPU utilization on the Hyper-V server hosting production VMs
- Reduced network utilization
- Reduced time to complete backup

These benefits are made possible by the in-system replication features of the Hitachi Adaptable Modular Storage 2000 family and by the Hitachi VSS Hardware Provider that enables the use of those features in a NetBackup 7.0 environment. These features allow the backup server to provide the processing power to perform the backup instead of the production servers and allow the data being backed up to be copied across the SAN instead of the LAN.

The testing also demonstrates that you can expect substantial storage usage savings when using the PureDisk Deduplication Engine feature of NetBackup 7.0.

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