Hitachi Unified Storage using Symantec™ NetBackup™ OpenStorage Connector for Hitachi Storage integrated with Symantec NetBackup

Reference Architecture Guide

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# Table of Contents

**Solution Overview**......................................................................................................................3

**Key Solution Component**...........................................................................................................4
  - Hardware Components..............................................................................................................4
  - Software Components.............................................................................................................5

**Solution Design**............................................................................................................................7
  - SAN Architecture......................................................................................................................8
  - Storage Architecture...............................................................................................................8

**Engineering Validation**................................................................................................................10
  - Test Methodology..................................................................................................................10
  - Test Scenarios.......................................................................................................................11
  - Test Results..........................................................................................................................12

**Conclusion**....................................................................................................................................20
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Reference Architecture Guide

This reference architecture guide is a proven template for a Hitachi Unified Storage solution to deploy Symantec NetBackup using Symantec™ NetBackup™ OpenStorage Connector for Hitachi Storage. The solution has undergone performance baseline and optimized duplication testing in the Hitachi Data Systems laboratory.

This reference architecture showcases the following:

- Best practices for optimal configuration
- Capability of Symantec™ NetBackup™ OpenStorage Connector for Hitachi Storage to deliver value through tight integration of native storage features and technologies to the storage system and not available through data protection applications

The document assumes that you have familiarity with the following:

- Dell PowerEdge Rack Server R710
- Hitachi Unified Storage 100 Family
- Symantec™ NetBackup™ OpenStorage Connector for Hitachi Storage
- Symantec NetBackup
- Hitachi Storage Navigator Modular 2
- Hitachi Dynamic Link Manager
- Microsoft Windows Server 2008 R2

This includes information for planning, best practice, configuration, and deployment.
**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.
Solution Overview

The main solution components are the following:

- Symantec NetBackup master server, which is also the media server
- A separate media server to host the following Symantec™ NetBackup™ OpenStorage Connector for Hitachi Storage components:
  - Open storage plug-in
  - Storage server component
    - Can be installed anywhere, although most commonly installed on the media server
- The media server is also the storage server.
- Microsoft Windows clients, which are the workload drivers

The following is the approach taken to design this solution:

- Building blocks were adapted to execute the backup operation
- Back-up data driven by eight Microsoft Windows clients (workload drivers) running on VMware vSphere
- A write-sequential IOPS profile with very few random write IOPS
- All data backed up on the LSU (logical storage unit), provisioned to the media/storage server

The data transfer path is over TCP/IP from the clients to media/storage server. The media server writes the backup images to the storage array over Fibre Channel.
**Key Solution Component**

These are the key solution components used in this validated solution.

**Hardware Components**

The hardware components in Table 1 create a highly optimized, scalable, and reliable environment. They provide a good system performance for backup and for disaster recovery.

### Table 1. Hardware Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>Version</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Server</strong></td>
<td>Dell PowerEdge Rack Server</td>
<td>R710</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>- Intel Xeon Dual quad core processors</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 12GB RAM</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Storage Platform — Primary Site</strong></td>
<td>Hitachi Unified Storage 130</td>
<td>0920/B-S</td>
<td>1</td>
</tr>
<tr>
<td><strong>Storage Platform — Secondary Site</strong></td>
<td>Hitachi Unified Storage 150</td>
<td>0920/B-S</td>
<td>1</td>
</tr>
<tr>
<td><strong>Host Bus Adapter</strong></td>
<td>Emulex LPe12002-E</td>
<td>31004549</td>
<td>1</td>
</tr>
<tr>
<td><strong>Fibre Channel Switch</strong></td>
<td>Brocade 4140 Switch</td>
<td>5.3.0a</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>- 32 ports</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Hitachi Unified Storage**

*Hitachi Unified Storage* is a midrange storage platform for all data. It helps businesses meet their service level agreements for availability, performance, and data protection.

The performance provided by Hitachi Unified Storage is reliable, scalable, and available for block and file data. Unified Storage is simple to manage, optimized for critical business applications, and efficient.

Using Unified Storage requires a smaller capital investment. Deploy this storage, which grows to meet expanding requirements and service level agreements, for critical business applications. Simplify your operations with integrated set-up and management for a quicker time to value.

Unified Storage enables extensive cost savings through file and block consolidation. Build a cloud infrastructure at your own pace to deliver your services.
This solution uses two Unified Storage platforms, as follows:

- **Unified Storage 130** — Primary site
- **Unified Storage 150** — Secondary site

**Hitachi Unified Storage 130**
Hitachi Unified Storage 130 is a symmetric active/active midrange storage platform. It has broad interoperability for critical data and application needs through the flexibility of Fibre Channel or iSCSI support.

There is a wide range of disk RAID configurations supported on the Hitachi Unified Storage 130, using SAS, SATA, and SSD drives. It has a capacity to scale up to 960 total drives using 2U or 4U expansion trays.

**Hitachi Unified Storage 150**
Hitachi Unified Storage 150 provides reliable, flexible, scalable, and cost-effective modular storage. Its symmetric active-active controllers provide input-output load balancing that is integrated, automated, and hardware-based.

Both controllers in Unified Storage 150 dynamically and automatically assign the access paths from the controller to a logical unit (LU). All LUs are accessible, regardless of the physical port or the server that requests access.

**Brocade 4140 Fibre Channel Switch**
The Brocade 4140 is a Fibre Channel switch that provides the following:

- Up to 32 ports of 4 Gb/sec performance with high availability
- Ports on demand capabilities

**Software Components**
These are the software components used in this solution.

**Symantec™ NetBackup™ OpenStorage Connector for Hitachi Storage**
Symantec™ NetBackup™ OpenStorage Connector for Hitachi Storage consists of the following components:

- **Open storage plug-in** — Software interface linking NetBackup to Hitachi storage systems
- **Storage server component** — Mediates I/O access between the open storage plug-in and the logical storage unit (LSU) configured on the Hitachi storage system to control all physical allocations on the LSU and maintain an internal catalog of all stored NetBackup images
Hitachi Storage Navigator Modular 2

*Hitachi Storage Navigator Modular 2* provides essential management and optimization of storage system functions. Using Java agents, Storage Navigator Modular 2 runs on most browsers. A command line interface is available.

Use Storage Navigator Modular 2 for the following:

- RAID-level configurations
- LUN creation and expansion
- Online microcode updates and other system maintenance functions
- Performance metrics

Hitachi Dynamic Link Manager

*Hitachi Dynamic Link Manager*, used for SAN multipathing, has configurable load balancing policies. These policies automatically select the path having the least amount of input/output processing through all available paths. This balances the load across all available paths, which optimizes IOPS and response time.

Hitachi TrueCopy® Synchronous Remote Replication

For synchronous replication up to 190 miles (300 km), *Hitachi TrueCopy® Synchronous Remote Replication bundle* provides a no-data-loss, rapid restart solution. Real-time copies are the same as the originals. This reduces recovery time to minutes.

Synchronous replication provides very fast recovery time (low RTO) and good data currency (low RPO) between Hitachi Data Systems storage systems.

Symantec NetBackup

*Symantec NetBackup* is an enterprise heterogeneous backup and recovery suite. It provides cross-platform backup functionality to a large variety of Windows and UNIX operating systems.
Solution Design

Figure 1 is a high level infrastructure diagram for the two-site implementation described in this reference architecture. The figure also depicts the Hitachi TrueCopy® pair configured between the replicated and duplicated P-VOL and S-VOL using Hitachi TrueCopy® Synchronous Remote Replication optimized duplication and Hitachi True Copy.
SAN Architecture

The SAN configuration uses the following on the media server to storage Port 0A and Port 1A for redundancy:

- A Brocade 4 Gb/sec Fibre Channel switch
- An Emulex dual-port HBA.

This reference architecture used the point-to-point Fibre Channel switch option.

Multipathing Options and Settings

This solution uses Hitachi Dynamic Link Manager for multipathing with its round-robin policy. The round-robin load balancing algorithm automatically selects a path by distributing through all available paths. This balances the load across all available paths, optimizing IOPS and response time.

HBA Queue Depth Settings

The HBA queue depth setting controls the number of disk access requests that are in flight to the storage. This solution uses the default value of 32. Only change this value if I/O contention results in queuing at the HBA level, triggering low throughput and high response time.

Storage Architecture

This is how to configure Hitachi Unified Storage for this solution using Symantec™ NetBackup™ OpenStorage Connector for Hitachi Storage.

For this reference architecture, the storage configuration and sizing considered performance parameters such as latency, throughputs, and backup time.

Sizing of Storage Infrastructure and RAID Group Design

This reference architecture uses SAS 2 TB hard disk drives. However, you can adapt this solution to other size environments.

This architecture can use a RAID-5 (8D+1P) or RAID-10 (8D+8D) configuration.

Limit the RAID group size to no more than eight hard disk drives, as the performance gain using more is small.

The advantages of using a RAID-10 (8D+8D) configuration are the following:

- Best performance and reliability
- High write throughputs, suitable for data backup operations
- Sustain multiple drive failures without affecting the data loss if the drives are not in the same pair
- While RAID-5 (8D+1P) offers reliability, better capacity utilization, and cost effectiveness, the write penalty with this RAID type is not the best performance option.
Volume Design and Stripe Size
Based on the capacity requirements and adding 30-40% additional overhead, this solution uses a 250 GB LU that was configured as the logical storage unit (LSU) for storing backup images.

The default stripe size of 256 KB gives notably better results than a 64 KB strip size. This is attributable to the sequential I/O of 252 KB block sizes.

Multi-Stream Mode and Prefetch Settings (LUN and System Level)
Set the Hitachi Unified Storage multi-stream mode to read/write, from the default read mode. This helps with a sequential I/O profile.

Using the multi-stream mode helps Unified Storage search the cache for previous sequential I/O in order to decide any pre-fetch action. It allows pre-allocation of contiguous cache space for write data.

The recommended multi-stream information settings for the volume are in Table 2.

<table>
<thead>
<tr>
<th>Setting</th>
<th>Select the Check Box</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode</td>
<td>Change multi stream mode</td>
<td>Read/White</td>
</tr>
<tr>
<td>Prefetch Next</td>
<td>Change prefetch next</td>
<td>Enable</td>
</tr>
<tr>
<td>Prefetch Criteria</td>
<td>Change prefetch criteria</td>
<td>Fixed</td>
</tr>
<tr>
<td>Prefetch Size</td>
<td>Change fixed prefetch size</td>
<td>256 KB</td>
</tr>
<tr>
<td></td>
<td>Change base prefetch size</td>
<td>128 KB</td>
</tr>
<tr>
<td>Count of Judgment Sequential</td>
<td>Change count of judgment sequential</td>
<td>3</td>
</tr>
</tbody>
</table>

Storage Load Distribution
Hitachi Unified Storage 100 family has two controllers with two processors per controller for the best possible throughput and high availability. Each LU and RAID group receives adequate storage processing resources during peak performance, balancing the LUNs across available storage processors. Configure the distribution of LUNs to each storage processor using LUN ownership.

Zeroed Disks
Always use the zeroed disks. These disks have all space allocated and wiped clean of any previous content.

Zero the disks by formatting the volume using Hitachi Storage Navigator Modular 2.

Note — Do not zero disks in production use. Formatting a volume deletes all stored content.
Engineering Validation

These are the performance baseline tests executed to validate the Symantec™ NetBackup™ OpenStorage Connector for Hitachi Storage solution integrated with Symantec NetBackup and Hitachi Unified Storage:

- **RAID-5 (8D+1P) with default storage settings** — The objective of these tests was to attain the performance baselines using RAID-5 (8D+1P) with default storage settings.

- **Settings and performance tuning parameters** — The objective of these tests was to establish the best practices and performance tuning parameters for this reference architecture.

Test Methodology

For the baseline tests, the following approach was adopted;

- **LUN** — Create and provision a 250 GB LUN on the storage server which has the LSU.
  - Set the LSU to drive a maximum of 10 concurrent jobs.

- **Workload** — Consisted of backup data of the following sizes:
  - 40 GB
  - 80 GB
  - 160 GB

- **Workload Generation** — [Spawner](https://sourceforge.net/projects/spawner/) from SourceForge generated the sample test and backup data. The populated data was delimited text. The I/O profile is the following:
  - 100% write-sequential IOPS
  - Block size of each IO/ was an average of 252 KB

- **Load Drivers** — Eight clients each drove a load of the following:
  - 5 GB (40 GB total)
  - 10 GB (80 GB total)
  - 20 GB (160 GB total)

All eight clients were virtual machines running Microsoft Windows Server 2008 hosted on a VMware vSphere platform. Concurrent load was driven from all the clients.
Media and Storage Server — The target media server was also the storage server.

Backup Policy — The backup policy created using the NetBackup administration console comprises of all the workload clients driving the load and includes the path for the files that need to be backup.

Performance counters — The following were used to collect and monitor system performance:
- Storage array — Hitachi Storage Navigator Modular 2
- Storage server — Microsoft Windows Performance Monitor for CPU and memory resources
- Backup operations — Activity Monitor in the Symantec NetBackup Administration Console

Test Scenarios
The following are the test scenarios used to validate this solution.

Baseline Configuration Tests
Test a baseline storage system using all the default storage settings. The objective of these tests was to determine the performance baseline results for the following:

- Time taken to complete the backup
- CPU, memory and storage utilization in terms of the following:
  - IOPS
  - Throughput
  - Latency

The default settings are the following:

- RAID configuration — RAID-5 (8D+1D)
- Hitachi Dynamic Link Manager multipathing policy — Least I/O
- Default HBA queue depth — 32
- Multi-stream mode — Read
- Pre-fetch next — Enable
- Pre-fetch criteria — Base
- Default stripe size — 256 KB
Three different backup tests were executed to establish the baseline:

- 40 GB
- 80 GB
- 160 GB

**Best Practices and Performance Tuning Tests**
Test a storage system after making the following changes to the baseline configuration:

- **RAID configuration** — RAID-10 (8D+8D)
- **Hitachi Dynamic Link Manager multipathing policy** — Round robin
- **Multi-stream mode** — Read/write
- **Pre-fetch next** — Enable
- **Pre-fetch criteria** — Fixed (system and volume level)
- **Architecture** — Zeroed disks

**Test Results**
These are the results of the validation tests.

**Baseline Configuration Tests**
Table 3 summarizes the results of the baseline configuration tests.

**Table 3. Baseline Test Results Summary**

<table>
<thead>
<tr>
<th>Backup Test Size</th>
<th>Average IOPS</th>
<th>Average Throughput (MB/sec)</th>
<th>Average Latency (msec)</th>
<th>Total Backup Time (min)</th>
<th>Average CPU Utilization (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 GB</td>
<td>228</td>
<td>57</td>
<td>0.88</td>
<td>13</td>
<td>8.6</td>
</tr>
<tr>
<td>80 GB</td>
<td>251</td>
<td>63</td>
<td>0.88</td>
<td>21</td>
<td>12.45</td>
</tr>
<tr>
<td>160 GB</td>
<td>260</td>
<td>65</td>
<td>0.89</td>
<td>43</td>
<td>18</td>
</tr>
</tbody>
</table>

Figure 2 on page 13 is a graph of the baseline configuration test results in Table 1 on page 4.
Table 4 summarizes the results of the best practices and performance tuning tests.

The following are graphs comparing the baseline test results with the best practices and performance tuning test results.
Figure 3 graphs the total IOPS comparison between the baseline and performance tuning results. The performance tuning environment results shows about two times the total IOPS over the baseline results.

Figure 4 graphs the total write throughput comparison between the baseline and performance tuning results. The performance tuning environment results shows completing the backup in about half the time.
Figure 5 graphs the I/O latency comparison between the baseline and performance tuning results. The performance tuning environment results shows consistently smaller latency when compared to the baseline test results.

![I/O Latency Chart](image)

Figure 5

**80 GB**

Figure 6 graphs the total IOPS comparison between the baseline and performance tuning results. The performance tuning environment results shows about two times the total IOPS over the baseline results.

![Total IOPS Chart](image)

Figure 6
Figure 7 graphs the total write throughput comparison between the baseline and performance tuning results. The performance tuning environment results shows completing the backup in about half the time.

![Total Write Throughput](image)

**Figure 7**

Figure 8 on page 17 graphs the I/O latency comparison between the baseline and performance tuning results. The performance tuning environment results shows consistently smaller latency when compared to the baseline test results.
Figure 8

Figure 9 graphs the total IOPS comparison between the baseline and performance tuning results. The performance tuning environment results show about two times the total IOPS over the baseline results.
Figure 10 graphs the total write throughput comparison between the baseline and performance tuning results. The performance tuning environment results shows completing the backup in about half the time.

Figure 11 graphs the I/O latency comparison between the baseline and performance tuning results. The performance tuning environment results shows consistently smaller latency when compared to the baseline test results.
Observations and Analysis
These are observations and analysis from the validation testing:

- There is a significant boost to the total IOPS and throughput using a RAID-10 (8D+8D) configuration and the performance tuning parameters.
- With the notable increase in the IOPS and throughput using the performance tuning configuration, the time to back up the data reduces without using additional resources.
- The overall CPU utilization is about the same using the performance tuned environment, with only a marginal difference.
Conclusion

Symantec™ NetBackup™ OpenStorage Connector for Hitachi Storage from Hitachi Data Systems and Symantec integrates with Symantec NetBackup and Hitachi Unified Storage to provide a solution for data backup.

In this solution, NetBackup leverages and takes better advantage of Unified Storage features.

The test scenarios and results described in this technical paper give a good insight on what to anticipate on a similar hardware configuration. This helps you to plan your environment with respect to the following:

- Capacity planning
- Deployment
- Backup window time

The best practices validated in this reference architecture guide provide optimized performance with minimal storage latency resulting in shorter data backup window. 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.
For More Information

Hitachi Data Systems Global Services offers experienced storage consultants, proven methodologies and a comprehensive services portfolio to assist you in implementing Hitachi products and solutions in your environment. For more information, see the Hitachi Data Systems Global Services website.

Live and recorded product demonstrations are available for many Hitachi products. To schedule a live demonstration, contact a sales representative. To view a recorded demonstration, see the Hitachi Data Systems Corporate Resources website. Click the Product Demos tab for a list of available recorded demonstrations.

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