HITACHI
Inspire the Next

Data Protection for Hitachi Unified Compute Platform using Hitachi Virtual Infrastructure Integrator

TECHNICAL PAPER

Lab Validation Report

By Jeff Chen

January 2016

Hitachi Data Systems

Feedback

Hitachi Data Systems welcomes your feedback. Please share your thoughts by sending an email message to SolutionLab@hds.com. To assist the routing of this message, use the paper number in the subject and the title of this white paper in the text.

Contents

Data Protection for Hitachi Unified Compute Platform using Hitachi Virtual Infrastructure Integrator

Lab Validation Report

Hitachi Virtual Infrastructure Integrator helps administrators meet backup and recovery service level agreements at VM-level granularity while improving resource utilization. It leverages Hitachi Thin Image storage-based snapshots as the mechanism to create recovery points with instant recovery for Virtual Machines hosted on Hitachi storage. Until now, VMware vSphere administrators were forced to resort to traditional backup software to perform daily incremental backups and weekly full backups due to legacy technologies, and mandate a backup-window that impacts application performance.

This lab validation report demonstrates the use of Hitachi Virtual Infrastructure Integrator 3.0 on Hitachi Unified Compute Platform that has the following benefits:

- Agentless backup
- No backup window for crash-consistent backup
- Short backup window for application-consistent backup
- Fast recovery
- No network traffic
- Easily scalable

This lab validation report does not provide sizing of storage and virtual machine configurations. This paper is intended for storage or data center administrators who are backing up data and recovering data within a VMware vSphere environment.

Note — Testing of this configuration was done in a lab environment. Many factors 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 matches your production environment before your production implementation of this solution.

Product Features

The following are the featured hardware and software products tested for this report.

Hitachi Virtual Infrastructure Integrator v3

Hitachi Virtual Infrastructure Integrator v3 provides a comprehensive data protection and management solution for VMware vSphere environments. It provides you the ability to deliver scalable data protection and management services for your VMware ESXi based virtual infrastructure.

Virtual Infrastructure Integrator v3 simplifies data management with scheduled and instantaneous backup, recovery, and cloning services reducing risks, costs, and administrative overhead. It helps you meet backup and recovery SLAs at VM-level granularity while improving resource utilization.

It allows VM administrators to manage application-consistent data protection from the VMware vCenter console, leading to simplified IT operations.

Hitachi Unified Compute Platform for VMware vSphere

Hitachi Unified Compute Platform for VMware vSphere offers the following:

- Start small and grow your infrastructure as more workloads are transitioned to a private cloud.
- Simplify management of physical and virtual resources with tight integration into VMware vCenter.
- Improve troubleshooting with physical and virtual infrastructure monitoring and alerting within VMware vCenter.

Unified Compute Platform for VMware vSphere provides the following benefits:

- Centralization and automation of compute, storage, and networking components
- Significant reduction of time to value and operational costs across data centers
- Faster deployment of converged infrastructure with more efficient resource allocation
- Provides a foundation for the journey to the software defined datacenter using full support of the RESTful API

Hitachi Unified Compute Platform 4000

Hitachi Unified Compute Platform 4000 provides the following for your infrastructure:

- Tightly integrates server, network, storage and management infrastructure with preconfigured VLANs, server clusters and storage pools.
- On-demand scaling, with 2 to 128 high-density Intel-based blade servers.
- Include Hitachi Unified Compute Platform Director, a single infrastructure management tool to provision services and scale to multiple physical hosts and virtual machines.

Hitachi Unified Compute Platform Director

Hitachi Unified Compute Platform Director is a powerful single point of management tool offering end-to-end visibility of the entire converged virtualization infrastructure. Unified Compute Platform Director enables management of Unified Compute Platform (UCP), providing a unified view of resources from a single pane of glass.

Unified Compute Platform Director delivers visibility and management capability so you can align IT with business processes using familiar tools. The solution monitors all the elements of UCP in a single view and provides a health status of all solution elements.

It minimizes system downtime by directing proactive maintenance and provides an early indication of impending device failures. This innovative approach to monitoring reduces the complexity and maintenance challenges associated with managing underlying infrastructures, saving time and money.

- Provides a single, centralized point of administration, and comprehensive management
- Delivers seamless integration with virtualization tools and appears as an integrated application
- Monitors element performance, compares current trends to historical data, and enables thresholds and alerts

Hitachi Thin Image Snapshot Software

An essential component of data backup and protection solutions is the ability to quickly and easily copy data. 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.

- Maximum capacity of 5.0PB enables larger data sets or more virtual machines to be protected
- Maximum snapshots increased to 1024 for greater snapshot frequency and/or longer retention periods
- Asynchronous operation greatly improves response time to host
- Enhanced for super-fast data recovery performance

Hitachi Compute Blade 500

Hitachi Compute Blade 500 combines the high-end features with the high compute density and adaptable architecture you need to lower costs and protect investment. Safely mix a wide variety of application workloads on a highly reliable, scalable, and flexible platform. Add server management and system monitoring at no cost with Hitachi Compute Systems Manager, which can seamlessly integrate with Hitachi Command Suite in IT environments using Hitachi storage.

The Hitachi Compute Blade 500 chassis contains internal Fibre Channel and network switches for the high availability requirements of Hitachi Unified Compute Platform Select for VMware vSphere.

VMware vSphere

VMware vSphere is a virtualization platform that provides a datacenter infrastructure. It features vSphere Distributed Resource Scheduler (DRS), High Availability, and Fault Tolerance.

VMware vSphere has the following components:

- **ESXi** — A hypervisor that loads directly on a physical server. It partitions one physical machine into many virtual machines that share hardware resources.
- **vCenter Server** — Management of the vSphere environment through a single user interface. With vCenter, there are features available such as vMotion, Storage vMotion, Storage Distributed Resource Scheduler, High Availability, and Fault Tolerance.

Brocade Switches

Brocade and Hitachi Data Systems have collaborated to deliver storage networking and data center solutions. These solutions reduce complexity and cost, as well as enable virtualization and cloud computing to increase business agility.

- **Brocade 6510 Switch**

  The Brocade 6510 switch delivers market-leading throughput and an affordable switch form factor. The 48 ports produce an aggregate 768 Gb/sec full-duplex throughput. Any eight ports can be trunked for 128 Gb/sec inter-switch links (ISLs).

  Exchange-based dynamic path selection (DPS) optimizes fabric-wide performance and load balancing. It automatically routes data to the most efficient available path in the fabric. It augments ISL trunking to provide more effective load balancing in certain configurations.

- **Brocade VDX 6740 Switch**

  The Brocade VDX 6740 switch delivers VCS Ethernet Fabric technology to meet the needs of the following:

  - Cloud environments
  - Scale-out data center architectures
  - Mission-critical IP storage workloads
  - High performance connectivity to Fibre Channel SANs

  VCS fabric delivers a multipath-based, non-blocking architecture highly optimized for low latency, high bandwidth IP Storage traffic. Like Brocade Gen 5 Fibre Channel, VCS fabric provides a highly automated, efficient, and resilient infrastructure.

Test Environment Configuration

The testing of Hitachi Virtual Infrastructure Integrator took place in the Hitachi Data Systems laboratory using Hitachi Unified Compute Platform 4000 with Hitachi Virtual Storage Platform G1000.

Key Hardware Components

Table 1 describes the key hardware infrastructure components used for testing.

Table 1. Infrastructure Components

Hardware	Description	Version	Quantity
Hitachi Virtual Storage Platform G1000	■ 16 Fibre Channel ports ■ 60 SAS 10k 900 GB	80-02-41-00/00	1
Hitachi Compute Blade 500 (CB 500)chassis	■ 8-blade chassis ■ 2 Brocade 6546 Fibre Channel switch modules, each with 6 × 16 Gb/sec uplink ports ■ 2 Brocade VDX DCB 6746 Ethernet switch modules, each with 8 × 10 Gb/sec uplink ports ■ 2 management modules ■ 6 cooling fan modules ■ 4 power supply modules	SVP: A0250-E-10290 6546: FOS 7.2.1_hit DCB 6746: NOS 4.1.3	1
520B H3 server blade	■ Half blade ■ 2 × 14-core Intel Xeon E5-2697 v3 processors, 2.60 GHz ■ 256 GB RAM ■ 6 × 16 GB DIMMs ■ 4 ports on-board 10 GE CNA ■ 1 × 2 ports Hitachi 16 Gb/sec Fibre Channel mezzanine card	08-29	2
Brocade 6510	■ SAN switch with 48 × 8 Gb/sec Fibre Channel ports	FOS 7.3.1a	2
Brocade VDX 6740	■ Ethernet switch with 48 × 10 Gb/sec ports	NOS 4.1.3a	2

Key Software Components

Table 2 describes the key software components used for testing.

Table 2. Software Components

Software	Version
Hitachi Unified Compute Platform Director	4.0.0
VMware vSphere	5.5
VMware vCenter Server	5.5
Hitachi Virtual Infrastructure Integrator	3.0.33
Workload Virtual Machine	Microsoft® Windows® 2012 R2

Storage Configuration

Figure 1 shows the storage configuration used for performing the tests.

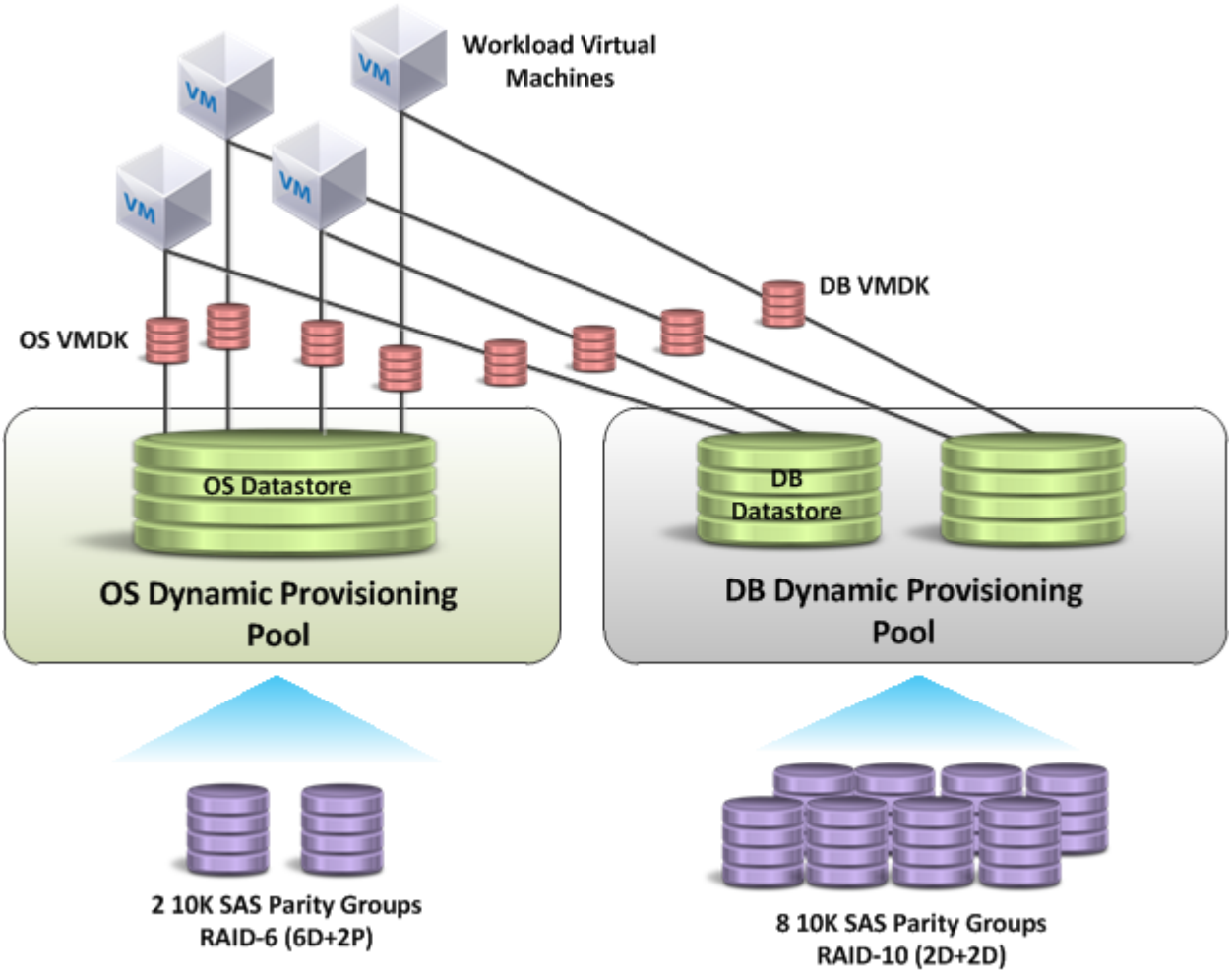

Figure 1

During this validation test, Microsoft® SQL Server® workload was simulated on the workload Virtual Machine. For each Virtual Machine workload, Operating System (OS) virtual machine disk (VMDK) and Database VMDK were presented from separate datastores. The storage configuration steps are listed as follows:

- The OS VMDK creation was performed as follows:

  (1) Two SAS 10K parity groups of RAID6 (6D+2P) were used to create the OS Dynamic Provisioning pool.

  (2) One 4 TB virtual volume was created from the dynamic provisioning pool and presented as an OS Datastore to two VMware ESXi hosts.

    - Hitachi Thin Image was used for underline storage snapshot.
    - Hitachi Thin Image supports a maximum of 4 TB per virtual volume.

  (3) A 40 GB VMDK was created as Eager Zeroed Thick from the OS Datastore and attached to each workload Virtual Machine as an OS volume.

- The DB VMDK creation was performed as follows:

  (1>)Because database application has a higher I/O performance requirement, eight SAS 10K parity groups of RAID10 (2D+2P) was used to create the DB dynamic provisioning pool.

  (1) Two 4 TB virtual volumes were created from the dynamic provisioning pool and presented as DB Datastores to two VMware ESXi hosts.

  (2) A 100 GB VMDK was created as Eager Zeroed Thick from the DB Datastore and attached to each workload Virtual Machine as a data volume.

  (3) Workload Virtual Machines were evenly distributed across two DB Datastores and two ESXi hosts.

  (4) Separately, a Hitachi Thin Image pool was created from two SAS 10K parity groups of RAID6 (6D+2P) for the snapshot volumes.

Test Methodology

This is the test methodology used. The purpose of the tests is to observe the impact of a Hitachi Virtual Infrastructure Integrator snapshot and its scalability while a moderate SQL workload is running.

Test Virtual Machine Configuration and Workload

The following virtual machine configuration was used to perform the test:

- 4 vCPU
- 16 GB RAM
- 40 GB OS VMDK Eager Zeroed Thick
- 100 GB DB VMDK Eager Zeroed Thick
- Microsoft Windows 2012 R2 Operating System

For each virtual machine, the SQL Server workload listed in Table 3 was generated against DB VMDK. The number of virtual machines were then scaled up to 40, and total IOPS generated was increased accordingly.

Table 3. Workload Definition

Workload	Block Size (KB)	Read Percent	Random Percent	IOPS/Virtual Machine
Microsoft SQL Server	64	66%	100%	25

Hitachi Virtual Infrastructure Integrator Snapshot with Quiesce Option

The Hitachi Virtual Infrastructure Integrator snapshot provides a quiesce option to create an application-consistent snapshot backup. This leverages the VMware Snapshot API and VSS framework.

As shown in Figure 2, the following is the sequence that is used to take a Hitachi Virtual Infrastructure Integrator snapshot with or without the quiesce option:

- Without the quiesce option:
  - (1) Take Hitachi Thin Image snapshot.
  - (2) Complete Hitachi Virtual Infrastructure Integrator snapshot.
- With quiesce option
  - (3) Take VMware snapshot with quiesce where a snapshot of the Virtual Machine is made and the original VMDK file is transferred to another storage location.
  - (4) Take Hitachi Thin Image snapshot.
  - (5) Delete the VMware snapshot that was created.
  - (6) Complete Hitachi Virtual Infrastructure Integrator snapshot.

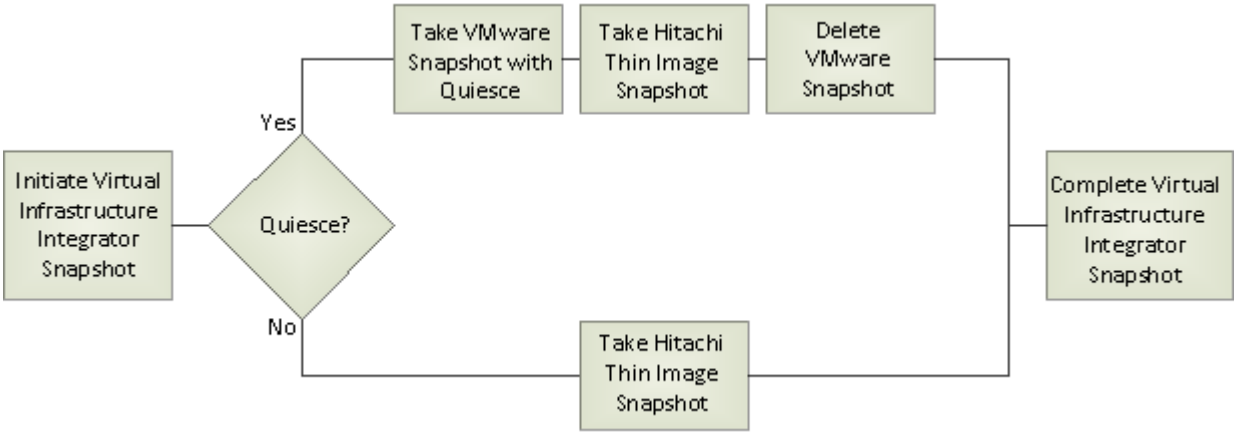

Figure 2

Test Cases

Table 4 lists the test cases and their description.

Table 4. Test Cases

Test Case	Description
Test Case 1- Measure the backup-window and the impact on 1 virtual machine with quiesce ON/OFF	In this test case, the workload is running on one virtual machine. The application latency is measured when the Hitachi Virtual Infrastructure Integrator snapshot is taken with and without the quiesce option.
Test Case 2 - Scale up to 40 virtual machines and take Virtual Infrastructure Integrator quiesce snapshots with workload running	In this test case, the scheduled snapshot backup is setup on the OS datastore level so that all of the Virtual Machines on the datastore are covered. The quiesce option is enabled. This test case measures the backup window. It also collects data points for the following options: ■ 1 × VM – 25 IOPS total ■ 10 × VMs - 250 IOPS total ■ 20 × VMs – 500 IOPS total ■ 40 × VMs – 800 IOPS total
Test Case 3 - Restore a virtual machine from a snapshot backup	In this test case, a Virtual Machine is restored after taking a Hitachi Virtual Infrastructure Integrator snapshot backup. The timestamp of a restore operation is measured.
Test Case 4 - Mount a VMDK snapshot to the original virtual machine	In this test case, VMDKs are mounted back to the original virtual machine after taking a Hitachi Virtual Infrastructure Integrator snapshot backup. The timestamp of a mount VMDK operation is measured.

Analysis

This section discusses the following topics:

Test Case 1 - Snapshot Backup Window and Impact with Quiesce ON/OFF

Application latency was measured during the time that the Hitachi Virtual Infrastructure Integrator snapshot was taken. One virtual machine was used with the workload running. Figure 3 shows the impact of application latency when the quiesce option was enabled and disabled.

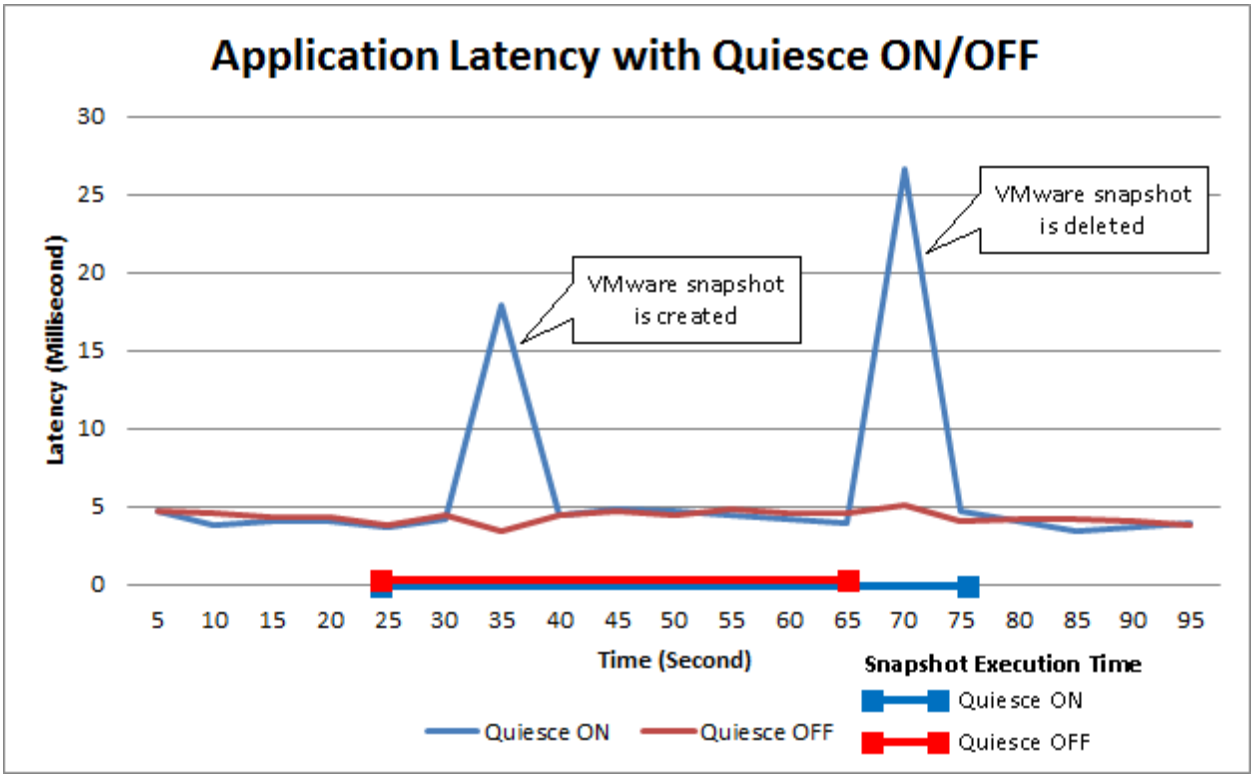

Figure 3

When the snapshot was taken with the Quiesce option, application latency increased slightly for a short period of time due to VMware snapshot creation and deletion.

When the snapshot was taken without the quiesce option, there was no impact on application latency and the Hitachi Thin Image snapshot was taken in the background. This shows that there was no backup window for a crush-consistent backup using Hitachi Virtual Infrastructure Integrator snapshot.

For this particular test, the operation execution times for Hitachi Virtual Infrastructure Integrator were:

- 43 seconds with quiesce enabled
- 38 seconds with quiesce disabled

Test Case 2 - Scale Out Virtual Machines with Workload Running

The scheduled snapshot backup was placed on the OS datastore level so that all the virtual machines on the datastore were covered in one snapshot operation. Table 5 shows the scheduled backup settings. The frequency was set to every 20 minutes to accelerate testing.

Table 5. Scheduled Backup Setting

Datastore	OS Datastore
Quiesce	Enabled
Frequency	Every 20 minutes
Retention	Keep 8 backups

The number of virtual machines were scaled out from 1 to 40 with following increments:

- 1 VM - total of 25 IOPS and 140 GB VMDK capacity
- 10 VMs - total of 250 IOPS and 1400 GB VMDK capacity
- 20 VMs - total of 500 IOPS and 2800 GB VMDK capacity
- 40 VMs - total of 1000 IOPS and 5600 GB VMDK capacity

Figure 4 shows the average completion time for the Hitachi Virtual Infrastructure Integrator snapshot operation.

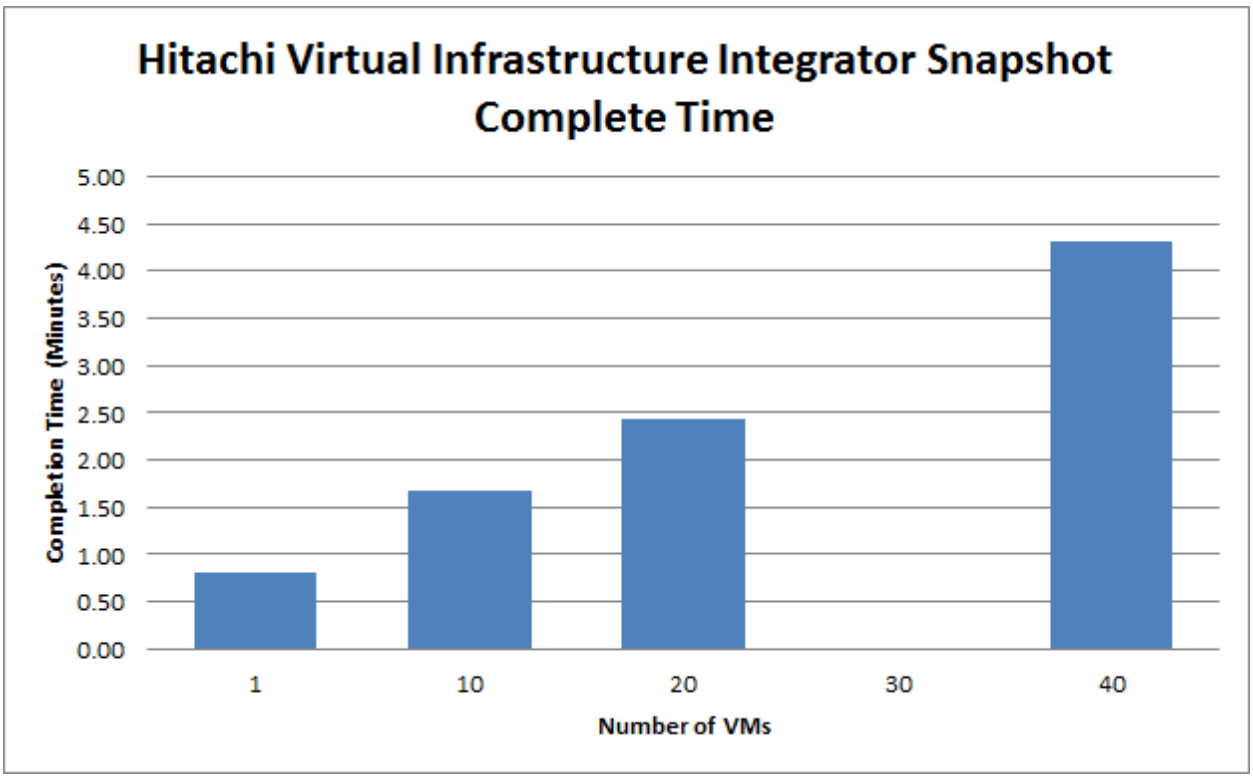

Figure 4

Figure 4 shows that the snapshot operation complete time increases linearly when the number of virtual machine increases. For 40 virtual machines, it took only 4 minutes 32 seconds to complete the snapshot operation with workload running. This is still very reasonable compared to traditional backups and considering that a fair amount of virtual machines were backed up in one operation.

Test Case 3 - Restore a Virtual Machine Snapshot from a Snapshot Backup

A restore operation can be performed for following reasons:

- A virtual machine is accidentally deleted
- A virtual machine has become corrupted

In this test, a virtual machine was restored from a Hitachi Virtual Infrastructure Integrator snapshot successfully. The average time for a virtual machine to be restored and powered up was 1 minutes 42 seconds.

Test Case 4 - Mount VMDK Snapshots Back to the Original Virtual Machine

If files need to be restored, the mount VMDK operation can be performed.

In this test, VMDKs from a snapshot backup were mounted back to the original virtual machine successfully. The average time for this operation was 1 minutes 40 seconds.

Considerations

The Hitachi Virtual Infrastructure Integrator utilizes Hitachi Thin Image to take LUN-based snapshots. If you have virtual machines with the same backup policy, place them in the same datastore. Use Hitachi Virtual Infrastructure Integrator to take datastore-level snapshots of all the virtual machines in the same datastore so they can be captured together at the same time.

If your application is sensitive to short latency spikes caused by the quiesce snapshot operation, minimize the impact by taking the following steps:

- Avoid backup during peak hours
- Place fewer virtual machines in the datastore

Appendix - Sample Hitachi Thin Image Capacity Usage

Table 6 shows a worst case scenario of HTI capacity usage on Microsoft SQL Server workload. The following steps are performed to test the Hitachi Thin Image capacity usage:

1. Take one Hitachi Virtual Infrastructure Integrator snapshot.
2. Run Microsoft SQL Server Workload against 100 GB VMDK and 100% randomly accessing the entire VMDK.

   After 9.96 GB of data change in a write operation, Hitachi Thin Image uses 33.42 GB of capacity.

Table 6. Hitachi Thin Image Capacity Usage on Microsoft SQL Server Workload

Workload	I/O Size (KB)	Read Percent	Random Percent	VMDK Size (GB)	Data Change (GB)	Hitachi Thin Image Usage
Microsoft SQL Server	64	66%	100%	100	9.96 GB	33.42 GB

Usually, applications do not access the entire range of VMDK randomly. It is common that an application will access only 10% to 20% of the volume regularly. So the expected Hitachi Thin Image capacity usage should somewhere between 10 GB and 33 GB.

Hitachi Data Systems

Corporate Headquarters
2845 Lafayette Street
Santa Clara, CA 96050-2639 USA
www.HDS.com community.HDS.com

Regional Contact Information
Americas: +1 408 970 1000 or info@hds.com
Europe, Middle East and Africa: +44 (0) 1753 618000 or info.emea@hds.com
Asia Pacific: +852 3189 7900 or hds.marketing.apac@hds.com

AS-463-00 January 2016.