Feedback

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Hitachi Unified Compute Platform 2000 for Microsoft® Private Cloud

Reference Architecture Guide

Hitachi Unified Compute Platform 2000 for Microsoft® Private Cloud provides rapid provisioning and de-provisioning of virtual machines. It also provides tight integration of the storage architecture. The solution has automation to provision a new LUN to support additional virtual machines and add that LUN to a host cluster. This solution provides high availability to management systems.

Unified Compute Platform 2000 for Microsoft Private Cloud is an entry level converged infrastructure. A converged infrastructure is a single, optimized platform that combines compute, storage and networking. It brings tremendous flexibility and scalability to manage, monitor and provision virtual machine resources in the data center. The converged infrastructure is based on the following hardware components.

- One, two, three, or four QuantaPlex T41S-2U compute chassis
- One Hitachi Virtual Storage Platform G200
- One Brocade ICX7450 switch
- Two Brocade 6740 switches
- Two Brocade 6505 switches (optional)

Unified Compute Platform for Microsoft Private Cloud supports the shift from server operator to a service provider. It has a set of services to accompany the infrastructure, such as reporting, usage metering, and self-service provisioning.

Without these United Compute Platform services to accompany the infrastructure, the cloud service layer is unavailable. Your investment would be little more than a traditional data center.

Unified Compute Platform 2000 for Microsoft Private Cloud provides the following:

- A more cost-effective Unified Compute Platform system with a smaller size
- A single converged infrastructure that runs VMware, Microsoft, and OpenStack virtualized workloads
- A converged hardware stack for the following:
  - Remote office, branch office (ROBO)
  - Tier 2 workloads
  - Development or test environments
  - Virtual desktop infrastructure (VDI)
With this solution you have the following:

- **Faster deployment** with the ability to adapt to market pressures by leveraging the scalable design of the architecture.
- **Reduced risk** with a tested and validated solution with end-to-end interoperability of compute, storage, and network components.
- **Predictability** with a consistent experience to the hosted workloads with standardized physical servers, network devices, and storage systems.

This solution uses Hitachi Virtual Storage Platform G200. It scales as you host additional workloads in the cloud, providing high availability to these workloads.

This reference architecture is for IT administrators involved in data center planning and design, particularly a Microsoft Hyper-V® private cloud infrastructure. You need some familiarity with the following:

- Hitachi Virtual Storage Platform Gx00 models
- Hitachi Storage Navigator
- Microsoft Windows Server® 2012 R2
- Microsoft SQL Server® 2012
- Microsoft System Center Virtual Machine Manager 2012 R2

**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

Hitachi Unified Compute Platform 2000 for Microsoft Private Cloud is built on hardware and software from Hitachi, Quanta, Brocade, and Microsoft.

- The QuantaPlex T41S-2U compute blade provides the compute resources.
- Hitachi Virtual Storage Platform G200 provides the storage resources for Windows Server SAN boot, infrastructure, management, and tenant virtual machines.
- The Brocade ICX7450 switch provides the network management resources.
- The Brocade VDX6740 switch provides local area network resources.

Unified Compute Platform 2000 for Microsoft Private Cloud is configured using a four node Hyper-V cluster that hosts a mixed of infrastructure, management, and tenant virtual machines. The cluster contains the Hitachi and Microsoft software required to deploy virtual machines to the cluster along with the products and tools to manage the Hyper-V private cloud infrastructure components. This reference architecture provides the following capabilities:

- **Hyper-V host failover cluster** — Failover clusters provide high availability and scalability to the server workloads.
- **Hyper-V virtual machine live migration** — Moves running virtual machines from one physical server to another with no impact on virtual machine availability to users.
- **Hyper-V storage live migration** — Moves running virtual machines storage from one cluster shared volume to another with no impact on virtual machine availability to users.
- **Template based virtual machine provisioning** — Virtual machine templates allow administrators to rapidly deploy virtual machines.
- **Integration with System Center Operations Manager** — Hitachi provides monitoring packs for Hitachi Virtual Storage Platform Gx00.
- **Hitachi Storage Adapter for Microsoft Windows PowerShell** — Allows an administrator to discover, manage, and automate using scripts to automate complex tasks.

Figure 1 on page 4 provides a high-level design of the Unified Compute Platform 2000 for Microsoft Private Cloud base unit. Figure 2 on page 5 provides a high-level design of the scale out of Unified Compute Platform 2000 for Microsoft Private Cloud to a fully populated unit.
Figure 1
Figure 2
Key Solution Components

These are the key hardware and software components used to deploy Hitachi Unified Compute Platform 2000 for Microsoft Private Cloud.

Hardware Components

Figure 1 lists the hardware components used in this solution.

Table 1. Hardware Components

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Description</th>
<th>Version</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>QuantaPlex T41S-2U</td>
<td>4-node chassis</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2 Intel Xeon E5-2620 v3 processors, 2.40 GHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>192 GB memory</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intel 82599 10GigE OCP dual-port card</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Emulex LPe12002 dual-port 8GB HBA card</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Firmware Revision: 3.30.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>BIOS Version: S2S_3A14</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Emulex HBA Firmware v2.01A10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intel driver 3.9.58.9101</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Emulex HBA driver v10.4.246.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hitachi Virtual Storage Platform G200</td>
<td>Dual controller</td>
<td>83-01-21-40/00</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>16 × 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>SFF Disk Tray</td>
<td>24 × 1.2 TB 10k RPM SAS disks</td>
<td>N/A</td>
<td>1</td>
</tr>
<tr>
<td>Brocade VDX 6740 switch</td>
<td>48-port 10 GbE switch</td>
<td>5.0.1d</td>
<td>2</td>
</tr>
<tr>
<td>Brocade ICX7450 switch</td>
<td>24-port 1 GbE management switch</td>
<td>08.0.20c</td>
<td>1</td>
</tr>
</tbody>
</table>

Hitachi Virtual Storage Platform Gx00 (Midrange) Model Family

The Hitachi Virtual Storage Platform Gx00 model family systems are based on industry-leading enterprise storage technology. With flash-optimized performance, these systems provide advanced capabilities previously available only in high-end storage arrays. With the Virtual Storage Platform Gx00 family, you can build a high performance, software-defined infrastructure to transform data into valuable information.

Hitachi Storage Virtualization Operating System provides storage virtualization, high availability, superior performance, and advanced data protection for all models in the Virtual Storage Platform family. This proven, mature software provides common features to consolidate assets, reclaim space, extend life, and reduce migration effort. New management software improves ease of use to save time and reduce complexity. The infrastructure of Storage Virtualization Operating System creates a management framework for improved IT response to business demands.

This solution uses Virtual Storage Platform G200.
Quanta Cloud Technology QuantaPlex T41S-2U
Quanta Cloud Technology QuantaPlex T41S-2U is a rack mounted server designed for optimal performance and power efficiency which supports up to 1.5 TB highly scalable memory capacity. It is powered by the Intel Xeon E5-2600 v3 processor product family for complex and demanding workloads. It supports flexible OCP and PCIe I/O expansion card options.

Brocade Switches
Brocade and Hitachi Data Systems partner 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.

The solution using the following Brocade products:

- **VDX 6740**
  Brocade VDX 6740 is a 1U 48-port rack mounted switch that delivers high performance and reduces network congestion with 10 GbE ports, low latency, and deep buffers.

- **ICX 7450**
  Brocade ICX 7450 is a 1U 24-port rack mounted switch that delivers the performance, flexibility, and scalability required for enterprise gigabit Ethernet access deployment. This switch is used for management networks only.

- **6505**
  Brocade 6505 is a 1U 24-port 8 Gb/sec Fibre Channel rack mounted switch that delivers reliable and high performance storage area network. The basic configuration uses direct connect. When you scale out to three or four compute chassis, then two Brocade 6505 switches are required.

Software Components
Table 2 lists the important software used in this solution.

**Table 2. Software Components**

<table>
<thead>
<tr>
<th>Software</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hitachi Storage Virtualization Operating System with Hitachi Dynamic Provisioning</td>
<td>Microcode Dependent</td>
</tr>
<tr>
<td>Hitachi Storage Navigator</td>
<td>Microcode Dependent</td>
</tr>
<tr>
<td>Hitachi Compute Advisor</td>
<td>1.1</td>
</tr>
<tr>
<td>Hitachi Infrastructure Director</td>
<td>1.1</td>
</tr>
<tr>
<td>Hitachi Storage Adapter for Microsoft® Windows PowerShell</td>
<td>6.1.0</td>
</tr>
<tr>
<td>Hitachi Storage Adapter for Microsoft® System Center Virtual Machine Manager</td>
<td>1.2.0</td>
</tr>
<tr>
<td>Microsoft Windows Server with Hyper-V</td>
<td>2012 R2 Standard and Datacenter edition</td>
</tr>
<tr>
<td>Microsoft SQL Server</td>
<td>2012 SP1 Enterprise edition</td>
</tr>
<tr>
<td>Microsoft System Center Virtual Machine Manager</td>
<td>2012 R2</td>
</tr>
</tbody>
</table>
Hitachi Storage Virtualization Operating System
Hitachi Storage Virtualization Operating System spans and integrates multiple platforms. It is integrates storage system software to provide system element management and advanced storage system functions. Used across multiple platforms, Storage Virtualization Operating System includes storage virtualization, thin provisioning, storage service level controls, dynamic provisioning, and performance instrumentation.

Storage Virtualization Operating System includes standards-based management software on a Hitachi Command Suite base. This provides storage configuration and control capabilities for you.

Storage Virtualization Operating System uses Hitachi Dynamic Provisioning to provide wide striping and thin provisioning. Dynamic Provisioning provides one or more wide-striping pools across many RAID groups. Each pool has one or more dynamic provisioning virtual volumes (DP-VOLs) without initially allocating any physical space. Deploying Dynamic Provisioning avoids the routine issue of hot spots that occur on logical devices (LDEVs).

Hitachi Compute Advisor
Hitachi Compute Advisor (HCA) is a software management tool used to configure, manage, and monitor server resources.

Hitachi Infrastructure Director
Hitachi Infrastructure Director (HID) is a software management tool used to provision and manage storage resources.

Hitachi Storage Adapter for Microsoft® Windows PowerShell
Hitachi Storage Adapter for Microsoft Windows PowerShell with the Hitachi Storage cmdlets allow an administrator to discover, manage, and automate using scripts to automate complex tasks.

Hitachi Storage Adapter for Microsoft® System Center Virtual Machine Manager
Hitachi Storage Adapter for Microsoft System Center Virtual Machine Manager allows LUN provision to hosts and clone virtual machine using Hitachi Snapshot or ShadowImage technology.

Microsoft Windows Server with Hyper-V
Microsoft Windows Server with Hyper-V is a virtualization platform that helps organizations of all sizes realize considerable cost savings and operational efficiencies. With industry-leading size and scale, Hyper-V is the platform of choice for you to run your mission critical workloads.

Microsoft SQL Server
Microsoft SQL Server is a complete set of enterprise-ready technologies and tools to derive the most value from information at the lowest total-cost-of-ownership. Enjoy high levels of performance, availability, and security; employ more productive management and development tools; and deliver pervasive insight with self-service business intelligence (BI).

Microsoft Virtual Machine Manager
Virtual Machine Manager, a part of Microsoft System Center, is a management solution for the virtualized datacenter. It lets you configure and manage your virtualization host, networking, and storage resources to create and deploy virtual machines and services to private clouds.
Solution Design

The detailed design for Hitachi Unified Compute Platform 2000 for Microsoft Private Cloud includes the following:

- **Compute Architecture**
  
  The basic solution uses one QuantaPlex T41S-2U compute chassis.
  
  - For a scale out configuration, use up to four QuantaPlex T41S-2U compute chassis

- **Storage Architecture**

  The basic solution uses one Hitachi Virtual Storage Platform G200, one SFF drive expansion tray with 24 x 1.2 TB 10K SAS drive to support Windows Server SAN boot, infrastructure, management, and tenant virtual machines.

  - For a scale up configuration, use up to seven SFF drive expansion trays. Each tray houses 24 x 2.5 inch disks.

- **Switch Architecture**

  - The basic solution uses one Brocade ICX 7450 switch for management, two Brocade VDX 6740 switches for local area network, and direct connect from compute HBA ports to storage ports.
  
  - For a scale out configuration to three or four compute chassis, use two Brocade 6505 switches for the storage area network.

- **Management Architecture**

  The management architecture uses the following:

  - Hitachi Compute Advisor
  
  - Hitachi Infrastructure Director
  
  - Microsoft System Center Virtual Machine Manager

Compute Architecture

Hitachi Unified Compute Platform 2000 for Microsoft Private Cloud uses one QuantaPlex T41S-2U compute chassis. It can scale out to support two, three or four chassis.

Each chassis supports up to four compute blades.

Compute Chassis

QuantaPlex T41S-2U compute chassis consists of four mainboard sleds and two power supply units. The power supply units are directly connected to the power distribution boards, the HDD backplane, and middle plane. This allows each power supply unit to individually provide power for all mainboards (MB1 to MB4).
Compute Blade
The compute blade architecture is a critical component of the virtualized infrastructure. Powered by the Intel Xeon E5-2600 v3 processor product family and DDR4 memory technology, the compute blade provides flexible I/O scalability. Each compute blade uses the following hardware components.
- 2 Intel Xeon E5-2620 v3 processor at 2.40 GHz
- 192 GB memory
- Intel 10 GbE network adapter
- Emulex 8 GB/sec Fibre Channel host bust adapter

Figure 3 shows the QuantaPlex T41S-2U rear view I/O ports for blade 1 to blade 4.

Figure 3

Storage Architecture
Hitachi Unified Compute Platform 2000 for the Microsoft Private Cloud uses the following on Hitachi Virtual Storage Platform G200:
- One controller
- One service processor (SVP)
- One SFF disk expansion tray with 24 × 1.2 TB 10k RPM SAS disks.

On Virtual Storage Platform G200, Hitachi Dynamic Provisioning, a part of Hitachi Storage Virtualization Operating System, provisions the storage pools. Using Hitachi Dynamic Provisioning provides the following benefits for you:
- **Wide striping** — Dynamic Provisioning avoids 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.
- **Thin provisioning functionalities** — Physical space assignment from the pool to the dynamic provisioning volume happens as needed using 42 MB pages, 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.
Direct Connect Configuration
The solution uses two 8 Gb/sec 2-port Emulex Fibre Channel card installed on the PCIe slot of the compute blade as shown in Figure 4.

![Figure 4](image)

Each server blade uses the ports in Table 3.

Table 3. Server Blade Port Configuration

<table>
<thead>
<tr>
<th>Compute Chassis Number</th>
<th>Server Blade Number</th>
<th>Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1A/2A</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3A/4A</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>5A/6A</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
<td>7A/8A</td>
</tr>
</tbody>
</table>

Configure the storage port property values as shown in Table 4. On the Emulex host bus adapter BIOS, configure the connection type as FC-AL.

Table 4. Storage Port Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port Attribute</td>
<td>Target</td>
</tr>
<tr>
<td>Port Security</td>
<td>Disable</td>
</tr>
<tr>
<td>Port Speed</td>
<td>Auto (8 Gb/sec)</td>
</tr>
<tr>
<td>Fabric</td>
<td>OFF</td>
</tr>
<tr>
<td>Connection Type</td>
<td>FC-AL</td>
</tr>
</tbody>
</table>

Use Microsoft Multipath I/O for multipathing, using the round-robin policy. Round-robin load balancing in Multipath I/O automatically selects a path by rotating through all available paths. By balancing the load across all available paths, you optimize IOPS and response time.
RAID Configuration
This solution uses 16 × 1.2 TB 10k RPM SAS disks. Create the parity groups as follows:

- One parity group for RAID-10 (2D+2D), using four disks
- Two parity groups for RAID-6 (6D+2P), using 12 disks.

Dynamic pools can be expanded by adding additional parity groups to support additional work loads and virtual machines.

Pool Configuration
Create three dynamic provisioning pools, as shown in Table 5.

Table 5. Dynamic Provisioning Pool Configuration

<table>
<thead>
<tr>
<th>Dynamic Provisioning Pool</th>
<th>RAID Configuration</th>
<th>Number of Parity Groups</th>
<th>Number of Disks</th>
<th>Capacity</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>RAID-10 (2D+2D)</td>
<td>1</td>
<td>4</td>
<td>2 TB</td>
<td>SAN operating system boot</td>
</tr>
<tr>
<td>1</td>
<td>RAID-6 (6D+2P)</td>
<td>1</td>
<td>8</td>
<td>3 TB</td>
<td>Infrastructure and management virtual machines</td>
</tr>
<tr>
<td>2</td>
<td>RAID-6 (6D+2P)</td>
<td>1</td>
<td>8</td>
<td>6 TB</td>
<td>Tenant virtual machines</td>
</tr>
</tbody>
</table>

Clustered Shared Volumes Configuration
Hitachi Unified Compute Platform 2000 for Microsoft Private Cloud implements clustered shared volumes (CSV) to host the virtual machine operating system and application data. CSVs are exclusively for use with Microsoft Hyper-V failover clustering. They enable all nodes in the cluster to access the same cluster storage volumes at the same time.

Using CSVs eliminates the one virtual machine per LUN requirement, allowing multiple virtual machines to be placed on a single CSV. This simplifies the management of the storage infrastructure in a private cloud environment.

Because all cluster nodes can access all CSVs simultaneously, standard LUN allocation methodologies based on performance and capacity requirements of the expected workloads can be used.

- **Pool 0** contains the following:
  - SAN operating system boot volumes for Quanta servers
- **Pool 1** contains the following:
  - Infrastructure and management virtual machines
- **Pool 2** contains the following:
  - Tenant virtual machines

CSV architecture differs from other traditional clustered file systems. This frees it of scalability limitations, such as one virtual machine per LUN and drive letter limitations. As a result, there is no special guidance for scaling the number of Hyper-V nodes or virtual machines on a CSV volume.
The virtual disks of all virtual machines running on a particular CSV contend for storage I/O. To best implement your solution, do the following:

- Understand the I/O workload characteristics for the virtual machines hosted on the CSVs located in dynamic provisioning pools.
- Take into consideration the IOPS requirements of any virtual machine to be deployed along with its I/O profile. For example, consider the requirements of random read and write operations versus sequential write operations.

**Network Architecture**

Hitachi Unified Compute Platform 2000 for Microsoft Private Cloud uses two Brocade VDX 6740 switches for network traffic. Configure the two Brocade VDX 6740 switches as link aggregation using Brocade Virtual Cluster Switching and Brocade Inter-Switch Link technologies for redundancy and performance. Each switch has 48 ports.

For performance enhancement and security, configure the networks using the following VLANs:

- **Management Network**
  The switches provide connectivity between the Microsoft Hyper-V hosts and Microsoft Virtual Machine Management. It is recommended to leave management network as untagged.

- **Cluster Network**
  VLAN 411 provides inter-node cluster communication. This includes the cluster heartbeat and cluster shared volumes (CSV) redirection.

- **Live Migration Network**
  VLAN 412 provides virtual machine live migration.

- **Virtual Machine Network**
  VLAN 413 provides virtual machine connectivity.

Each QuantaPlex compute blade uses the following:

- An onboard 1 GbE adapter for management
- A dual-port Intel 10 GbE OCP card for network traffic

Use Virtual Machine Manager in Microsoft System Center to configure the logical network, logical switches, and port profiles. Configure the network adapters as follows for NIC teaming:

- **Team mode** — Switch independent
- **Load balancing mode** — Dynamic
- **Standby adapter** — None (all adapter active)
Figure 5 shows the rear view of the QuantaPlex compute chassis connected to the Brocade VDX 6740 switches for network traffic.

**Figure 5**

**Management Architecture**

Managing the infrastructure for Hitachi Unified Compute Platform 2000 for Microsoft Private Cloud is critical to the health and operation of the compute, storage, and networking. Use these software tools for management:

- “Hitachi Compute Advisor” on page 14
- “Hitachi Infrastructure Director” on page 15
- “Hitachi Storage Adapter for Microsoft Windows PowerShell” on page 15
- “Hitachi Storage Adapter for Microsoft System Center Virtual Machine Manager” on page 15
- “Microsoft System Center 2012 R2 Virtual Machine Manager” on page 15

**Hitachi Compute Advisor**

Use Hitachi Compute Advisor to do the following tasks:

- Power management options
  - Turn on the power of a managed server and start the operating system.
  - Shut down the operating system and turn off the power of a managed server.
- Firmware management options
  - Update compute BIOS
  - Update compute BMC
- Monitor managed servers
  - SNMP trap reception settings
  - SNMP trap forward settings
Hitachi Infrastructure Director
Use Infrastructure Director to create, edit, view, and delete the following:

- Parity groups
- Pools
- Volumes

Hitachi Storage Adapter for Microsoft Windows PowerShell
Use Hitachi Storage Adapter for Microsoft Windows PowerShell to automate complex tasks.

Hitachi Storage Adapter for Microsoft System Center Virtual Machine Manager
Use Hitachi Storage Adapter for Microsoft System Center Virtual Machine Manager to provision LUN to hosts and clone virtual machines using Hitachi Snapshot or ShadowImage technology. A license is required to enable Snapshot or ShadowImage on the storage.

Microsoft System Center 2012 R2 Virtual Machine Manager
Use Microsoft System Center Virtual Machine Manager to install, configure, deploy, and maintain Microsoft Hyper-V hosts, virtual machines, and virtual network.

Microsoft Hyper-V Host Installation and Configuration
Hitachi Unified Compute Platform 2000 for Microsoft Private Cloud uses a base configuration of four Hyper-V hosts. It can scale out to support 16 nodes if needed.

Install and configure Microsoft Windows Server 2012 R2. Present the volumes to all Hyper-V hosts shown in Table 6. Install and configure Windows multipathing software for multipath I/O.

Table 6. Volume Configuration

<table>
<thead>
<tr>
<th>Hyper-V Number</th>
<th>Pool Number</th>
<th>Pool Volume</th>
<th>Capacity</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1 GB</td>
<td>Quorum drive for Hyper-V cluster</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2 TB</td>
<td>Infrastructure and management cluster shared volume</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
<td>4 TB</td>
<td>Tenant cluster shared volume</td>
</tr>
</tbody>
</table>

Install and configure Microsoft Windows Server 2012 R2. Present the volumes to all Hyper-V hosts shown in Table 6. Install and configure Windows multipathing software for multipath I/O.
Virtual Machine Installation and Configuration
Hitachi Unified Compute Platform 2000 for Microsoft Private Cloud requires the infrastructure and management virtual machines shown in Table 7.

Table 7. Required Infrastructure and Management Virtual Machine

<table>
<thead>
<tr>
<th>Number of Virtual Machines Required</th>
<th>Purpose</th>
<th>Virtual Machine Names</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Domain controllers</td>
<td>DC1, DC2</td>
</tr>
<tr>
<td>2</td>
<td>Hitachi Compute Advisor</td>
<td>HCA</td>
</tr>
<tr>
<td>2</td>
<td>Hitachi Infrastructure Director</td>
<td>HID</td>
</tr>
<tr>
<td>2 (2 recommended)</td>
<td>Microsoft SQL Server</td>
<td>SQL</td>
</tr>
<tr>
<td>2</td>
<td>Microsoft System Center with Virtual Machine Manager</td>
<td>SCVMM</td>
</tr>
</tbody>
</table>

Configure the vCPU, vRAM, vDISK and vNIC for the virtual machines shown in Table 8. Create the VHDX disks as fixed disk for best performance.

In a production environment, it is recommended to use the following:

- If it exists, join an existing Microsoft Active Directory® domain. Otherwise create a new Active Directory domain.
- Create two SQL Server virtual machines for redundancy.

Table 8. Virtual Machine Configuration

<table>
<thead>
<tr>
<th>Hyper-V Host</th>
<th>Cluster Shared Volume</th>
<th>Virtual Machine Name</th>
<th>vCPU</th>
<th>vRAM (GB)</th>
<th>vDisk</th>
<th>vNIC</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>HCA</td>
<td>4</td>
<td>8</td>
<td>100</td>
<td>1</td>
<td>Compute management</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>HID</td>
<td>4</td>
<td>8</td>
<td></td>
<td></td>
<td>Storage management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DC1</td>
<td>2</td>
<td>4</td>
<td></td>
<td></td>
<td>Primary domain controller for Active Directory</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>DC2</td>
<td>2</td>
<td>4</td>
<td></td>
<td></td>
<td>Secondary domain controller for Active Directory</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>SCVMM</td>
<td>2</td>
<td>24</td>
<td></td>
<td></td>
<td>Virtual Machine Manager</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>SQL</td>
<td>2</td>
<td>24</td>
<td></td>
<td></td>
<td>SQL Server database for SCVMM</td>
</tr>
</tbody>
</table>
Microsoft Hyper-V Cluster Configuration
Add all four Microsoft Hyper-V hosts for management to Virtual Machine Manager in Microsoft System Center. Create a Hyper-V cluster. During the cluster creation process, Virtual Machine Manager does the following:

- Validates that all hosts meet the prerequisites, such as required operating system and domain membership
- Enables the failover clustering on each host
- Unmasks the selected storage logical units to each host
- Creates the configured external virtual networks
- Runs the cluster validation process
- Creates the cluster with quorum and enables cluster shared volumes
- For each logical unit that is designated as a cluster shared volume, assigns the logical unit as a cluster shared volume on the cluster

Virtual Network Configuration
In keeping with Microsoft best-practice recommendations for private cloud implementations, do the following:

- Break network traffic down into separate networks.
- Assign each network type to a different subnet.
- Use sub-netting to break the configuration into smaller, more efficient networks.
- Achieve further isolation of network types by using VLAN isolation and dedicated network switches.

For VLAN-based network segmentation or isolation, several components must be configured specifically to enable rapid provisioning and network segmentation.

With Microsoft Hyper-V and host clusters, define identical virtual networks on all nodes. This is necessary so a virtual machine is able to failover to any node and to maintain its connection to the network.
Engineering Validation
This describes the tools, test methodology, and test results used to validate this solution for Hitachi Unified Compute Platform 2000 for the Microsoft Private Cloud.

Test Methodology
This test methodology validated the storage disk subsystem.

The purpose of using IOmeter is to validate the maximum IOPS the storage subsystem can produce using a RAID-6 (4D+2P) configuration for 6 × 1.2 TB 10k RPM SAS disks with a latency of less than 20 msec.

Table 9 shows the IOmeter parameters configuration.

Table 9. Iometer Configuration

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of worker</td>
<td>2</td>
</tr>
<tr>
<td>Maximum disk size</td>
<td>80%</td>
</tr>
<tr>
<td>Number of outstanding I/Os</td>
<td>32</td>
</tr>
<tr>
<td>Assigned access specifications</td>
<td>Web server</td>
</tr>
<tr>
<td>Run time</td>
<td>1 minute</td>
</tr>
<tr>
<td>Number of Run</td>
<td>8</td>
</tr>
<tr>
<td>Total run time</td>
<td>8 minutes</td>
</tr>
</tbody>
</table>

Test Results
These are the test results from IOmeter.

These tables show the IOmeter test results for 4 KB (Table 10 on page 19) and 8 KB (Table 11 on page 19) using a RAID-6 (4D+2P) configuration for 6 × 1.2 TB 10k RPM SAS disks with a latency of less than 20 msec. These results provide a baseline used to determine the number of virtual machines to support a specific level of IOPS.

Testing for this environment used the following standard Microsoft profile:

- A minimum of 50 IOPS per virtual machine
- Up to a maximum of 100 IOPS per machines when deploying virtual machines in a private cloud with a 4KB I/O size available to each virtual machine.

For some workloads this may be too little and for other workloads too large. Hitachi Data Systems and you should work together to determine appropriate sizing and solution hardware alignment.
Table 10. Iometer test results for 4 KB

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
<th>Number of Disk</th>
<th>RAID Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size (KB)</td>
<td>4096</td>
<td>6</td>
<td>RAID 6 (4D+2P)</td>
</tr>
<tr>
<td>Total IOPS</td>
<td>1209</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Response Time (msec)</td>
<td>13.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of supported VM total IOPS (50 IOPS per VM)</td>
<td>24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of supported VM total IOPS (100 IOPS per VM)</td>
<td>12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 11. Iometer test results for 8K

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
<th>Number of Disk</th>
<th>RAID Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size (KB)</td>
<td>8192</td>
<td>6</td>
<td>RAID 6 (4D+2P)</td>
</tr>
<tr>
<td>Total IOPS</td>
<td>1728</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Response Time</td>
<td>18.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of supported VM total IOPS (50 IOPS per VM)</td>
<td>34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of supported VM total IOPS (100 IOPS per VM)</td>
<td>17</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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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