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Deploy Hitachi Unified Compute Platform Select for VMware vSphere with Cisco Unified Computing System Using Hitachi Unified Storage VM in a Scalable Environment

Reference Architecture Guide

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April 8, 2014

In collaboration with CISCO

Hitachi Data Systems

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Deploy Hitachi Unified Compute Platform Select for VMware vSphere with Cisco Unified Computing System Using Hitachi Unified Storage VM in a Scalable Environment

Reference Architecture Guide

This is a reference architecture guide for deploying Hitachi Unified Compute Platform Select for VMware vSphere with Cisco Unified Computing System using Hitachi Unified Storage VM. There is advice on how to build a virtual infrastructure with the following primary design goals:

- Availability
- Scalability
- Elasticity
- Manageability

The benefits of this solution include the following:

- Faster deployment
- Reduced risk
- Predictability
- Ability to scale out
- Lower cost of ownership

Hitachi Unified Compute Platform (UCP) is a family of completely integrated and flexible solutions. Each solution is configured for immediate deployment to run top-tier infrastructure applications without over-purchasing or provisioning unnecessary equipment. Each custom-built-solution has its entire solution stack-certified. There are no known compatibility issues.

This reference architecture guide focuses on designing a virtual infrastructure capable of hosting virtual machines running general server application workloads. It is strongly recommended to run a server capacity-planning pilot to gather sizing and IOPS information before designing your environment.

You need familiarity with the use and configuration of the following to use this reference architecture guide:

- Hitachi Unified Storage VM
- Cisco Unified Computing System – Servers and fabric interconnects
- Cisco Nexus Switches
- Hitachi Dynamic Provisioning
- VMware vSphere 5

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

This reference architecture for Hitachi Unified Compute Platform Select for VMware vSphere with Cisco Unified Computing System creates a flexible end-to-end converged stack solution. This is a validated integration of the hardware stack (compute, storage, and networking) with the software stack (hypervisor and management for software and hardware components).

This solution uses following components to create Hitachi Unified Compute Platform Select for VMware vSphere with Cisco Unified Computing System using Hitachi Unified Storage VM:

- **Hitachi Unified Storage VM** — Storage virtualization system designed to manage your storage assets more efficiently
- **Hitachi Dynamic Provisioning —** Wide striping and thin provisioning functionalities for greater operational and storage efficiency
- **Cisco UCS Server** — Enterprise-class performance, versatility, and density for virtual and bare-metal workloads
- **Cisco UCS 6248UP Fabric Interconnect Switch** — A single, highly available management domain that supports all attached UCS Server chassis, blade servers, and rack servers connectivity to the data center network
- **Cisco Nexus 5548UP Unified Switch** — Infrastructure to consolidate LAN and storage traffic to Hitachi Unified Storage VM
- **VMware vSphere 5** — Virtualization technology providing the infrastructure for the data center

Figure 1 illustrates the high-level logical design of this reference architecture.

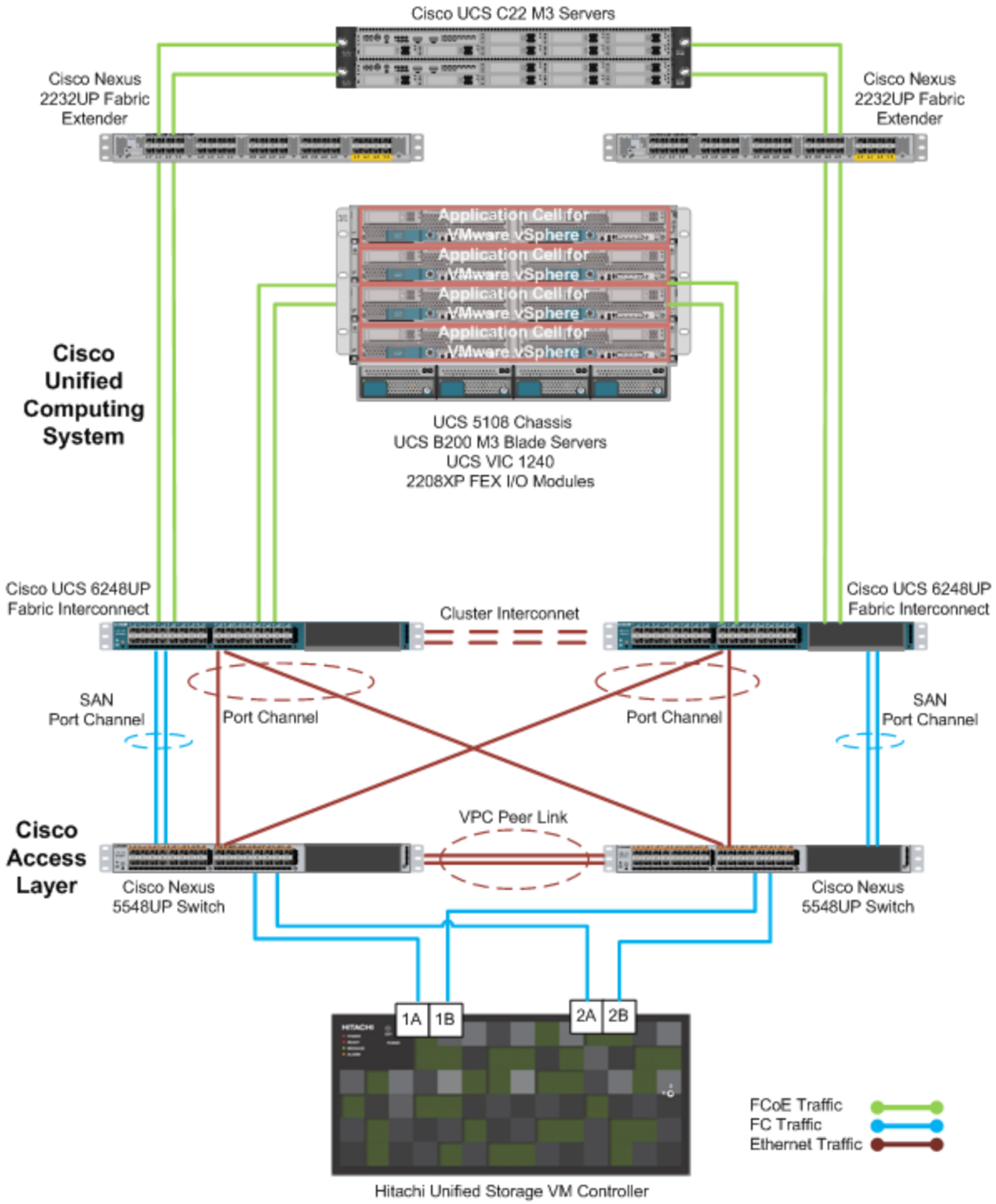

Figure 1

Key Solution Components

These are the key hardware and software components used to deploy this reference architecture on Hitachi Unified Compute Platform for VMware vSphere with Cisco Unified Computing System using Hitachi Unified Storage VM.

Hardware Components

Table 1 lists detailed information about the hardware components needed for this solution.

Table 1. Hardware Components

Hardware	*Description*	*Version*
Hitachi Unified Storage VM	■ Dual controller ■ 16 × 8 GB/sec Fibre Channel Ports ■ 118 GB total cache ■ 96 × 600 GB 10k RPM SAS disks, 2.5 inch SFF	73-02-03-00 or later
Cisco Unified Computing System	■ Cisco UCS 5108 Chassis ▪ 8-blade chassis ▪ 2 Cisco UCS 2208XP FEX I/O Modules with 8 × 10 Gb/sec uplink ports, 32 × 10 GB/sec Internal ports ▪ 8 Cooling fan modules ▪ 4 Power supply modules ■ Cisco UCS B200 M3 Blade Servers ▪ 2 × 8 core Intel Xeon E5-2650 processor, 2.0 GHz ▪ 128 GB RAM using 16 × 8 GB DIMMS ■ Cisco UCS 1240 virtual interface card ■ Cisco UCS 6248UP fabric interconnect ▪ 32 unified ports	2208XP: 2.1.(3a) B200 M3: v2.1.(1f) 6248UP: v2.1(1e)A

Table 1. Hardware Components (Continued)

Hardware	*Description*	*Version*
Cisco Nexus 5548UP switch	■ 32 Unified Ports	6.0(2)N1(2)
Cisco UCS C22 M3 series rack server for management	■ Optional rack mounted servers for the following: ▪ VMware vCenter ▪ Hitachi Command Suite	C22M3.1.5.1c.0
Cisco MDS 9710 Series Multilayer Directors	■ Optional dedicated SAN director	5.2.8b and 6.2.1

Hitachi Unified Storage VM

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

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

The benefits of Unified Storage VM are the following:

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

Cisco Unified Computing System

Cisco Unified Computing System unites compute, network, storage access, and virtualization into a cohesive system designed to reduce total cost of ownership and increase business agility. It integrates low-latency, lossless 10 Gigabit Ethernet unified network fabric with enterprise-class, x86-architecture servers.

As an integrated, scalable, multi-chassis platform, all resources participate in a unified management domain. You manage Unified Computing System as a single system, whether it has one server or 160 servers with thousands of virtual machines. .

Accelerate the delivery of new services simply, reliably, and securely with Unified Compute System through end-to-end provisioning and migration support for virtualized and non-virtualized systems.

Cisco Unified Computing System consists of the following components:

- Cisco Unified Computing System 6200 Series Fabric Interconnects

  This is a family of line-rate, low-latency, lossless, 10 Gb/sec Ethernet and Fibre Channel over Ethernet interconnect switches. They provide the management and communication backbone for Unified Computing System. This supports VM-FEX technology.

- Cisco UCS 5100 Series Blade Server Chassis

  This supports up to eight blade servers and up to two fabric extenders in a six rack unit enclosure.

- Cisco UCS B-Series Blade Servers

  These increase performance, efficiency, versatility, and productivity with these Intel based blade servers.

- Cisco UCS Adapters

  The wire-once architecture offers a range of options to converge the fabric, optimize virtualization, and simplify management. Cisco adapters support Cisco VM-FEX.

- Cisco UCS Manager

  - This provides unified, embedded management of all software and hardware components in the Cisco UCS.

For more information, see: Servers - Unified Computing

Cisco Nexus 5500 Series Switch

The Cisco Nexus 5000 series switch is designed for data center environments. With cut-through technology this switch enables consistent low-latency Ethernet solutions. There is front-to-back or back-to-front cooling. The data ports are in the rear, bringing switching into close proximity with servers and making cable runs short and simple. The switch series is highly serviceable, with redundant, hot-pluggable power supplies and fan modules. It uses data center-class Cisco NX-OS software for high reliability and ease of management.

The Cisco Nexus 5500 platform extends the industry-leading versatility of the Cisco Nexus 5000 series 10 Gigabit Ethernet data center-class switches, providing innovative advances toward higher density, lower latency, and multilayer services. The Cisco Nexus 5500 platform is well suited for enterprise-class data center server access-layer deployments across a diverse set of physical, virtual, storage-access, and high-performance computing (HPC) data center environments.

The Cisco Nexus 5548UP is a 1RU 10 Gigabit Ethernet, Fibre Channel, and FCoE switch offering up to 960 Gb/sec of throughput and up to 48 ports. The switch has 32 unified ports and one expansion slot supporting modules with 10 Gigabit Ethernet and FCoE ports, or to connect to Fibre Channel SANs with 8/4/2/1 Gb/sec Fibre Channel switch ports, or both.

Cisco MDS 9700 Series Multilayer Directors (Optional)

Cisco MDS 9700 series multilayer directors address the requirements of large, virtualized, data center storage environments. They provide availability, scalability, flexibility, security, ease of management, and transparent integration of new technologies.

Cisco MDS 9700 series multilayer directors offer the following:

- Outstanding SAN performance with support for 16 Gb/sec Fibre Channel and 1.5 Tb/sec throughput per slot
- High availability with fully redundant components, including fabric cards, supervisors, and power supplies
- Industry-leading scalability with up to 384 line rate 2/4/8 Gb/sec, 2/4/8/10/16 Gb/sec, or 10 Gb/sec autosensing Fibre Channel ports
- Intelligent network features such as virtual SAN technology, ACLs, intelligent frame processing, and fabric-wide Quality of Service (QoS)

Software Components

Table 2 lists the detailed information about the software components needed in this solution.

Table 2. Software Components

Software	*Version*
Hitachi Dynamic Provisioning	73-01-33-00 or later
VMware vSphere	5.5
Cisco Nexus 1000v Series Switch (optional-distributed virtual switch)	1000v: 4.2(1)SV2(2.1)
VM-FEX technology (distributed virtual switch)	cisco-vem-v151-5.1-1.1.1.1
Nexus Operating System	6.0(2)N1(2)
Cisco UCS Manager	2.1(3a)
Cisco Prime Data Center Network Manager	6.2.3
Cisco UCS Director (will be supported in future versions)	N/A
Hitachi Command Suite	7.5.0-06
Hitachi Storage Navigator for Hitachi Unified Storage VM	SVP 73-02-04/00
VMware vCenter	5.1
vCenter Plugin - Storage Manager for VMware vCenter	2.4.3
vStorage API for Storage Awareness (VASA) - Storage Provider for VMware vCenter	2.1.1

Hitachi Dynamic Provisioning

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

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

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

When used with Hitachi Unified Storage VM, Hitachi Dynamic Provisioning has the benefit of thin provisioning. 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.

Hitachi Command Suite

Hitachi Command Suite manages virtualized storage and server infrastructures. With usability, workflow, performance, scalability, and private cloud enablement, Hitachi Command Suite lets you build sustainable infrastructures with leading storage technologies. It helps you flexibly align with changing business requirements and maximize return on IT investments.

Hitachi Storage Navigator

Hitachi Storage Navigator enables essential management and optimization functions. Using Java agents, Storage Navigator runs on most browsers. A command line interface is available.

Use Storage Navigator for the following:

- Pool creation and expansion
- LUN creation and expansion
- Online microcode updates and other system maintenance functions
- Performance metrics

You need Storage Navigator to take advantage of the full features of Hitachi Unified Storage VM.

Cisco Nexus 1000v (Optional)

Cisco Nexus 1000V series switches provide a comprehensive and extensible architectural platform for virtual machine and cloud networking. The switches are designed to accelerate server virtualization and multi-tenant cloud deployments in a secure and operationally transparent manner. Integrated into the VMware vSphere hypervisor and fully compatible with VMware vCloud Director, the Cisco Nexus 1000V Series provides the following:

- Advanced virtual machine networking based on Cisco NX-OS operating system and IEEE 802.1Q switching technology
- Cisco vPath technology for efficient and optimized integration of virtual network services
- Virtual extensible local area network (VXLAN), supporting cloud networking
- Hypervisor agnostic

These capabilities help ensure that the virtual machine is a basic building block of the data center, with full switching capabilities and a variety of Layer 4 through 7 services in both dedicated and multi-tenant cloud environments. With the introduction of VXLAN on the Nexus 1000V Series, network isolation among virtual machines can scale beyond traditional VLANs for cloud-scale networking.

The Cisco Nexus 1000V Series Switches are virtual machine access switches for the VMware vSphere environments running the Cisco NX-OS operating system. Operating inside the VMware ESX or ESXi hypervisors, the Cisco Nexus 1000V Series provides the following:

- Policy-based virtual machine connectivity
- Mobile virtual machine security and network policy
- Nondisruptive operational model for your server virtualization and networking teams
- Virtualized network services with Cisco vPath providing a single architecture for L4 -L7 network services such as load balancing , firewalling and WAN acceleration

Cisco VM-FEX

Cisco VM-FEX technology collapses virtual switching infrastructure and physical switching infrastructure into a single, easy-to-manage environment. Its benefits include the following:

- Simplified operations: Eliminates the need for a separate, virtual networking infrastructure
- Improved network security: Contains VLAN proliferation
- Optimized network utilization: Reduces broadcast domains
- Enhanced application performance: Offloads virtual machine switching from host CPU to parent switch application-specific integrated circuits (ASICs)

VM-FEX is supported on Red Hat Kernel-based Virtual Machine (KVM) and VMware ESX hypervisors. Live migration and vMotion are also supported with VM-FEX.

VM-FEX eliminates the virtual switch within the hypervisor by providing individual virtual machines virtual ports on the physical network switch. VM I/O is sent directly to the upstream physical network switch that takes full responsibility for VM switching and policy enforcement. This leads to consistent treatment for all network traffic, virtual or physical. VM-FEX collapses virtual and physical switching layers into one and reduces the number of network management points by an order of magnitude.

The VIC (virtual interface card) uses Direct Path I/O technology from VMware to improve throughput and latency of VM I/O. Direct Path allows direct assignment of PCIe devices to virtual machines. VM I/O bypasses the hypervisor layer and is placed directly on the PCIe device associated with the virtual machine. VM-FEX unifies the virtual and physical networking infrastructure by allowing a switch ASIC to perform switching in hardware, not on a software based virtual switch. VM-FEX is offloading the ESXi hypervisor, and that improves the performance of any hosted virtual machine applications.

Cisco UCS Manager

Cisco UCS Manager provides unified, centralized, embedded management of all Cisco Unified Computing System software and hardware components across multiple chassis and thousands of virtual machines. Use this software to manage the entire Cisco UCS as a single logical entity through a graphical user interface, a command-line interface, or an XML API.

The Cisco UCS Manager resides on a pair of Cisco UCS 6200 series fabric interconnects using a clustered, active-standby configuration for high availability. The software gives you a single interface for performing server provisioning, device discovery, inventory, configuration, diagnostics, monitoring, fault detection, auditing, and statistics collection. Cisco UCS Manager service profiles and templates support versatile role- and policy-based management. System configuration information can be exported to configuration management databases to facilitate processes based on IT Infrastructure Library concepts.

Service profiles let you treat Cisco UCS servers as raw computing capacity to be allocated and reallocated as needed. The profiles define server I/O properties and are stored in the Cisco UCS 6200 series fabric interconnects. Using service profiles, you can provision infrastructure resources in minutes instead of days, creating a more dynamic environment, and more efficient use of server capacity.

Each service profile consists of a server software definition and the LAN and SAN connectivity requirements of the server. When a service profile is deployed to a server, Cisco UCS Manager automatically configures the server, adapters, fabric extenders, and fabric interconnects to match the configuration specified in the profile. The automatic configuration of servers, network interface cards, host bus adapters, and LAN and SAN switches lowers the risk of human error, improves consistency, and decreases server deployment times.

Service profiles benefit both virtualized and non-virtualized environments. The profiles increase the mobility of non-virtualized servers, such as when moving workloads from server to server or taking a server offline for service or upgrade. Profiles can also be used in conjunction with virtualization clusters to bring new resources online, complementing existing virtual machine mobility.

Cisco Prime Data Center Network Manager

Cisco Prime Data Center Network Manager (DCNM) is designed to help you efficiently implement and manage virtualized data centers. It includes a feature-rich, customizable dashboard that provides visibility and control to Cisco Nexus and MDS products.

Cisco Prime DCNM optimizes the overall uptime and reliability of your data center infrastructure and helps improve business continuity. This advanced management product:

- Automates provisioning of data center LAN and SAN elements
- Proactively monitors the SAN and LAN, and detects performance degradation
- Helps secure the data center network
- Eases diagnosis and troubleshooting of data center outages
- Simplifies operational management of virtualized data centers

The primary benefits of Cisco Data Center Network Manager are the following:

- Faster problem resolution
- Intuitive domain views that provide a contextual dashboard of host, switch, and storage
- Infrastructures
- Real-time and historical performance and capacity management for SANs and LANs
- Virtual-machine-aware path analytics and performance monitoring
- Easy-to-use provisioning of Cisco NX-OS features with preconfigured, customized templates
- Customized reports which can be scheduled at certain intervals

Cisco UCS Director (supported in future versions)

Cisco UCS Director is a unified management solution that enhances the value of shared infrastructure solutions, which bring together compute, network, and storage resources. Together, Cisco UCS Director and shared infrastructures improve IT agility, protect investments, simplify deployment of new services, and optimize asset use.

Cisco UCS Director allows a continued drive towards data center transformation and innovation with holistic management, centralized automation, and orchestration across virtual and physical infrastructure layers. Cisco UCS Director delivers effective unified shared infrastructure management through these capabilities:

- Centralized management console, which provides a comprehensive view of the shared infrastructure stack
- Native performance monitoring across all shared infrastructure resources to quickly address over or under-utilized resources before they compromise service
- Model-based orchestration to build and execute repeatable workflows without custom scripts
- Ability to manage virtualized and non-virtualized environments running side-by-side
- Fast time to value, with installation to production in less than four hours without any service engagement

VMware vSphere 5

VMware vSphere 5 is a virtualization platform that provides a data center infrastructure. It features vSphere Distributed Resource Scheduler (DRS), high availability, and fault tolerance.

VMware vSphere 5 has the following components:

- **ESXi 5** — This is a hypervisor that loads directly on a physical server. It partitions one physical machine into many virtual machines that share hardware resources.
- **vCenter Server 5** — This allows 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.

VMware vCenter Server

Use VMware vCenter Server to manage VMware vSphere. It provides advanced data management that improves storage operations, provisioning, optimization and resilience for Hitachi storage environments. There is unified management of all hosts and virtual machines from a single console, aggregating performance monitoring of clusters, hosts, and virtual machines.

VMware vCenter Server gives your insight into the status and configuration of clusters, hosts, virtual machines, storage, guest operating system, and other critical components of a virtual infrastructure. Using VMware vCenter Server, you can manage 100 or more virtualization environment workloads, more than doubling typical productivity in managing physical infrastructure.

Storage Manager for VMware vCenter

Storage Manager for VMware vCenter from Hitachi provides a scalable and extensible platform that forms the foundation for virtualization management. It centrally manages VMware vSphere environments, allowing you improved control over the virtual environment.

Storage Manager for VMware vCenter connects to VMware vCenter Server. It associates the Hitachi storage system information with VMware ESX datastore and virtual machine information.

Storage Provider for VMware vCenter

Storage Provider for VMware vCenter from Hitachi Data Systems is a VMware vCenter 5.0 plug-in that provides integrated information of physical storage resources. The information is based on topology, capability, and state. This information is then used by vSphere for various features, including VMware Storage Distributed Resource Scheduler (SDRS) and profile-based storage.

Storage Provider for VMware vCenter enables coordination between vSphere and vCenter with the storage system. It provides built-in storage insight in vCenter to support intelligent virtual machine storage provisioning, bolster storage troubleshooting, and enable new SDRS-related use cases for storage.

Hitachi Data Systems supports vSphere Provider for VMware vCenter through the plug-in, or “provider.” This provider is compatible with vSphere and vCenter, supporting storage system makes and models, as described on the VMware Compatibility Guide.

Solution Design

This is the detailed design for the reference architecture with Hitachi Unified Compute Platform Select for VMware vSphere with Cisco Unified Computing System using Hitachi Unified Storage VM. It includes software and hardware design information required to build the basic infrastructure for the virtualized data center environment.

To provide you with options for scaling out your environment in modular increments, this solution uses converged cell architecture. This has cells with pre-defined elements necessary to configure, size, and scale your implementation of this solution.

Each cell defines the compute, network, and storage resources necessary to support a specific workload. Solutions can be architected, sized, and scaled using pre-defined cells, with each cell designed for a different function:

- Infrastructure cells
- Application cells
- Resource cells
- Expansion cells

Designing with cells offers a more efficient, flexible, and granular approach to sizing and scaling converged solutions than the more common uniform building blocks.

This design defines compute and storage resource groups to support a specific usage scenario. You can add additional converged cells to scale out the environment to meet your organization's requirements.

Figure 2 illustrates a high-level concept of the cell architecture. Note that the vCPU, vRAM, and capacity numbers are for illustration only. Your solution may be different.

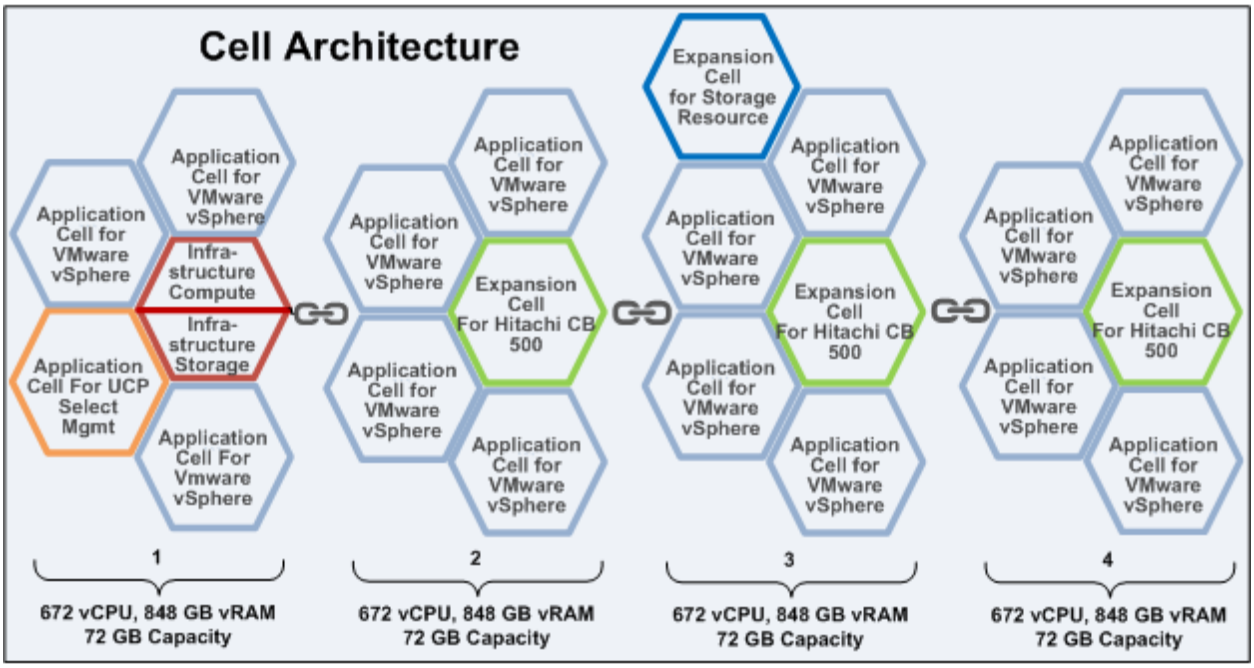

Figure 2

The architecture consists of preconfigured cells designed to support general server workload. These cells provide the following:

- **Infrastructure cell for compute resources** — Foundation for compute components
- **Infrastructure cell for storage resources** — Foundation for storage components
- **Application cell for Hitachi Unified Compute Platform Select management** — Resource to manage this environment
  - This cell is required only if an existing resource for managing a VMware vSphere environment does not exist.
- **Application cell for VMware vSphere** — Resource for hosting virtual machines running general server application workloads.
- **Expansion cell for compute resources** — Compute resources for scaling out the Unified Compute Platform Select for VMware vSphere environment.
- **Expansion cell for storage resources** — Storage resources for scaling out the Unified Compute Platform Select for VMware vSphere environment.

Infrastructure Cell for Compute Resources

The infrastructure cell for compute resources provides the foundation for the compute components needed to start building this solution.

Figure 3 shows the infrastructure cell for compute resources.

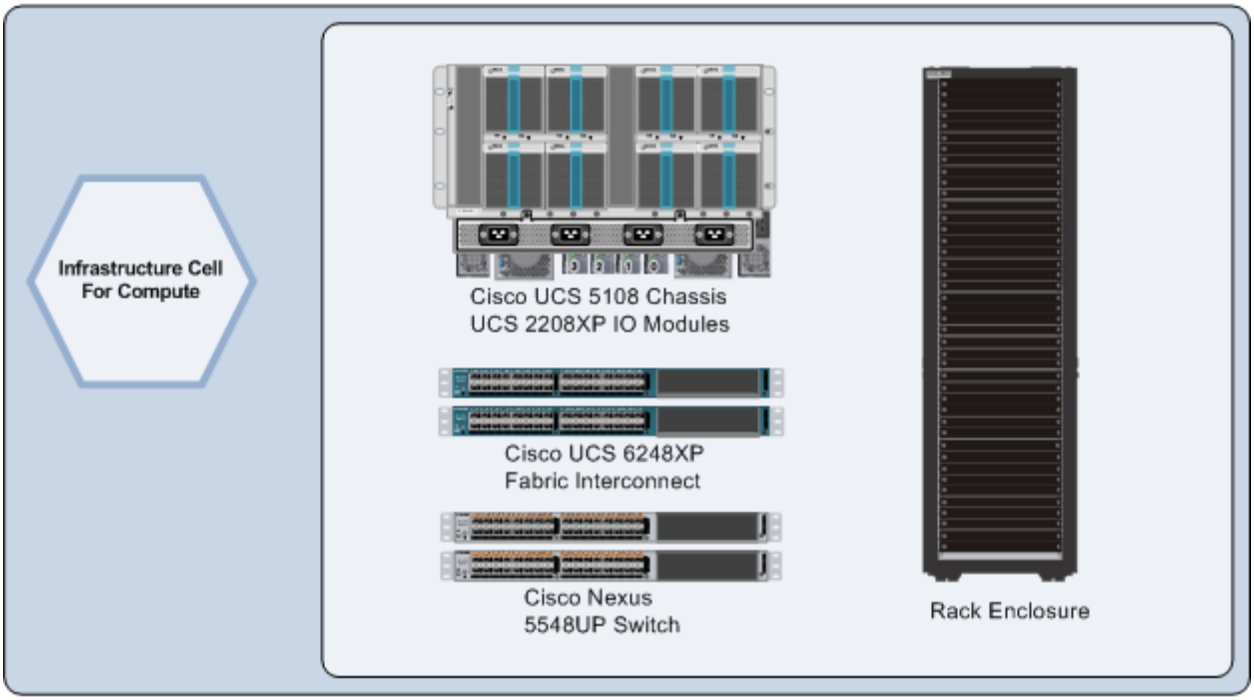

Figure 3

Use the infrastructure cell for compute resources in conjunction with the following cells:

- Infrastructure cell for storage resources
- Application cell for Hitachi Unified Compute Platform Select management
- Application cell for VMware vSphere
- Expansion cell for compute resources

The infrastructure cell for compute resources and the infrastructure cell for storage resources are the core infrastructure cells required to build a scalable solution. Both infrastructure cells support up to three expansion cells for Cisco UCS 5108 chassis before requiring new infrastructure cells. Every infrastructure cell for compute resources requires one infrastructure cell for storage resources.

Table 3 shows the components of the infrastructure cell for compute.

Table 3. Hardware Components for the Infrastructure Cell for Compute Resource

Hardware	*Description*	*Version*	*Quantity*
Cisco Unified Computing System	Cisco UCS 5108 chassis ▪ 8-blade chassis ▪ 2 × Cisco UCS 2208XP FEX I/O Modules with 8 × 10 Gb/sec uplink ports, 32 × 10 GB/sec Internal ports ▪ 8 cooling fan modules ▪ 4 power supply modules	2208XP: 2.1.(3a)	1
Cisco UCS 6248UP fabric interconnect switch	▪ 32 unified ports	6248UP: v2.1(3a)A	2
Cisco Nexus 5548UP switch	▪ 32 unified ports	5548UP: 6.0(2)N1(2)	2
Cisco MDS 9700 Series multilayer directors (optional)	▪ Dedicated SAN director	6.2.1	2

The hardware in the infrastructure cell for compute resources makes up the core compute hardware in this solution for Unified Compute Platform Select for VMware vSphere with Cisco UCS.

Chassis Components

The Cisco UCS 5108 blade chassis has the following:

- Redundant management modules to provide high availability access to manage and monitor the chassis, switch modules, and server blades.
- Redundant switch modules for high availability and maximum throughput.
- Hot-swappable power and fan modules allow for non-disruptive maintenance.

Network Infrastructure

The network design used in this solution provides ample bandwidth and redundancy for the following:

- A fully populated infrastructure cell for compute resources
- An infrastructure cell for storage resources
- Up to three expansion cells for compute resources

Figure 4 shows the physical network configuration of the infrastructure cell for compute resources.

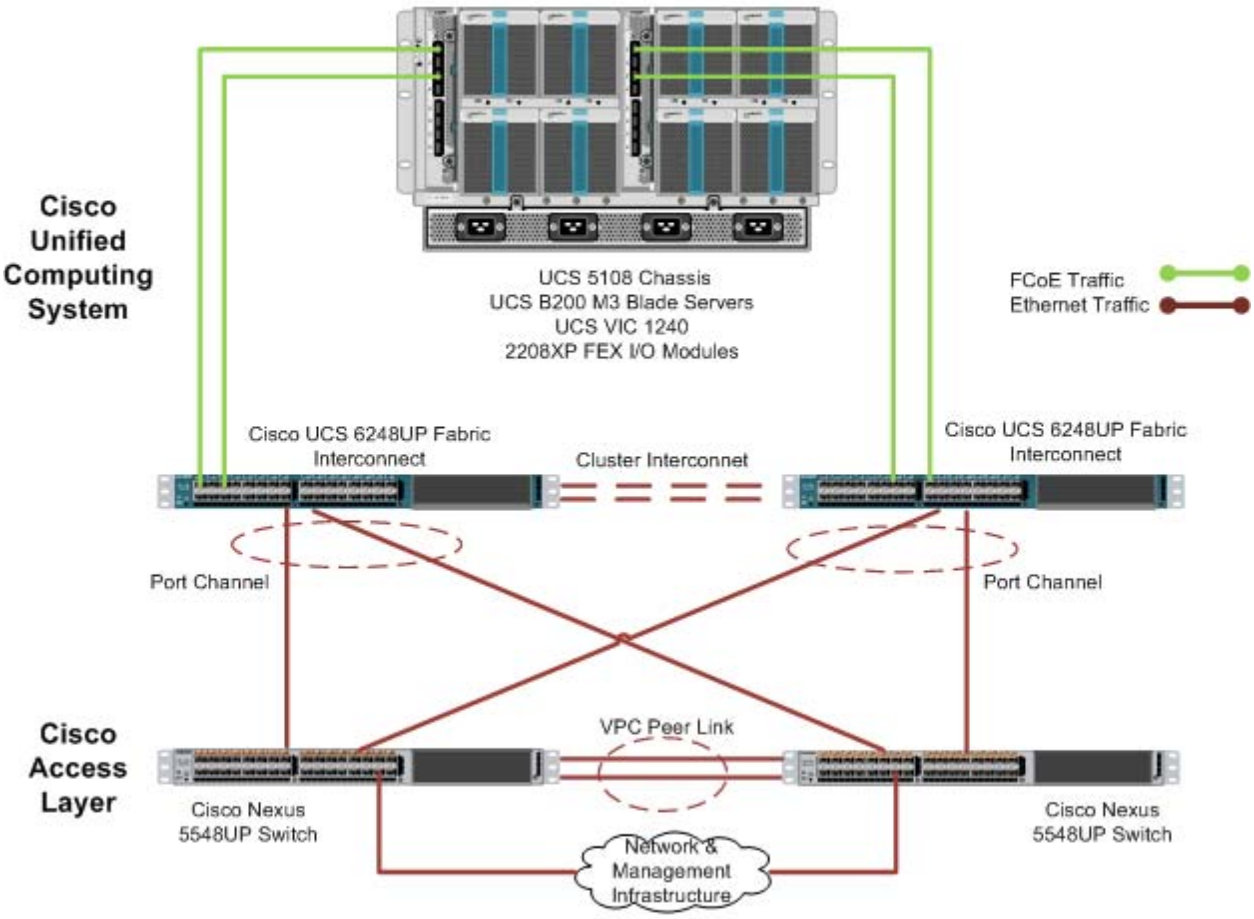

Figure 4

The network design also allows for the utilization of advanced features inherent in the Nexus 5500UP switch family and the Cisco UCS 6200UP. Fabric interconnects, such as Unified Switching Technology from Cisco, help provide the following:

- Nonstop networking
- Simplified, automated networks
- An evolutionary approach that protects existing IT investments

See the Cisco website for more information about Cisco Nexus switch family and Cisco fabric interconnect switches.

SAN Infrastructure

The Hitachi Unified Storage VM controller used for this solution has 16 ports for connections to the Nexus 5548UP switches. For this reference architecture, zone the infrastructure cell for compute resources to four ports on the Unified Storage VM controller, two ports per cluster.

When adding expansion cells for compute resources to the solution, zone four new open storage ports on the cluster. Dedicating four ports to each Cisco UCS 5108 chassis ensures bandwidth between the chassis and Unified Storage VM.

Figure 5 on page 23 illustrates the physical SAN architecture of the infrastructure cell for compute.

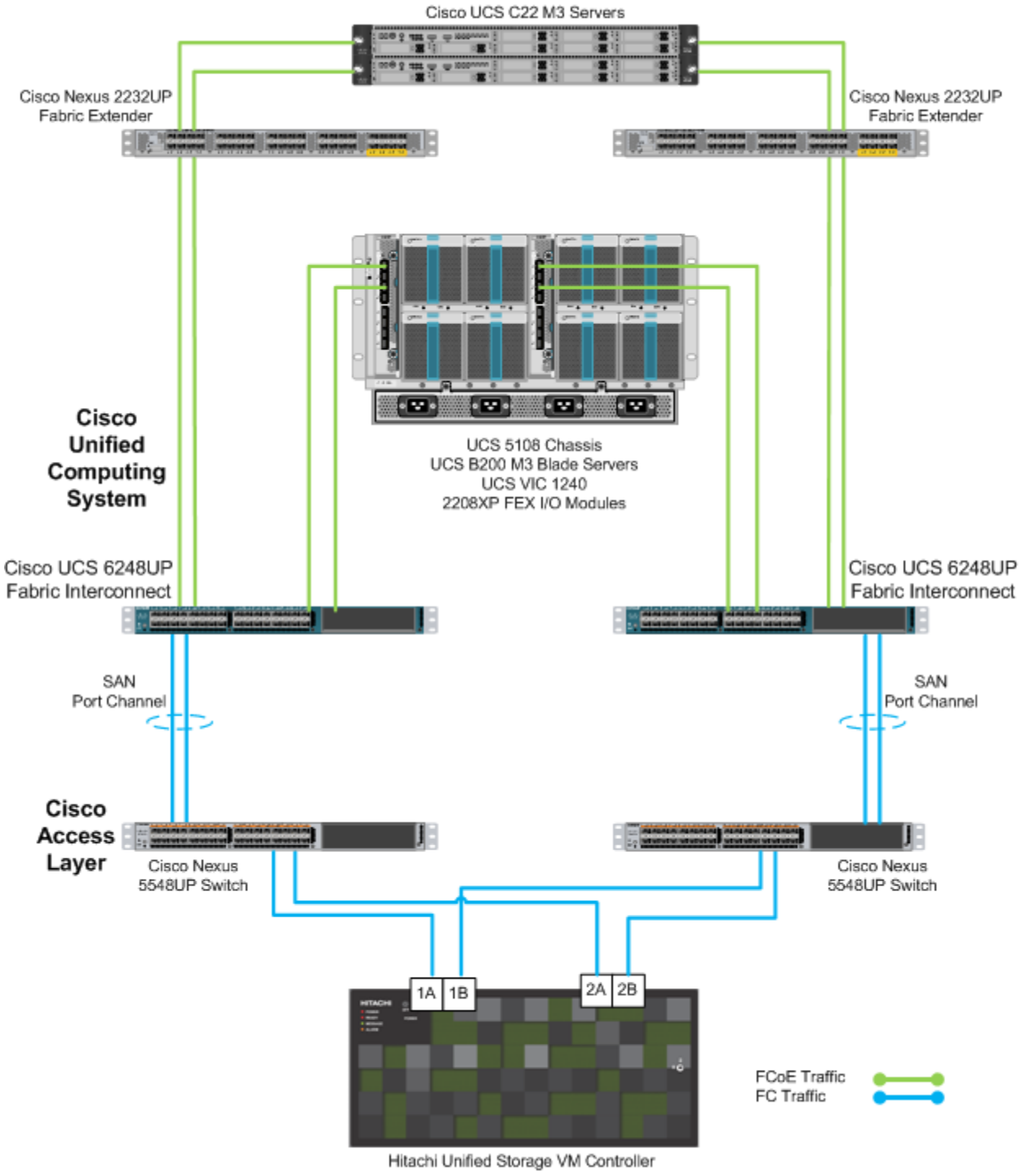
Cisco UCS C22 M3 Servers
Cisco Nexus 2232UP
Fabric Extender
Cisco Nexus 2232UP
Fabric Extender
Cisco
Unified
Computing
System
UCS 5108 Chassis
UCS B200 M3 Blade Servers
UCS VIC 1240
2208XP FEX I/O Modules
Cisco UCS 6248UP
Fabric Interconnect
Cisco UCS 6248UP
Fabric Interconnect
SAN
Port Channel
SAN
Port Channel
Cisco
Access
Layer
Cisco Nexus
5548UP Switch
Cisco Nexus
5548UP Switch
1A
1B
2A
2B
FCoE Traffic
FC Traffic
Hitachi Unified Storage VM Controller

Figure 5

Optional Dedicated SAN Design Using Cisco MDS 9700 Series Multilayer Directors

The Cisco MDS 9700 directors may be used in a Hitachi Unified Compute Platform Select for VMWare vSphere solution that involves a dedicated SAN design. Access to the Hitachi Unified Storage VM is provided by these MDS 9700 Fibre Channel directors.

Two distinct data paths, further enhanced with independent VSAN definitions, are created by attaching each of the NPV-enabled Cisco UCS 6248UP fabric interconnects to one of the MDS 9700 directors with a Fibre Channel port channel. Link Fault Tolerance and increased aggregate throughput between devices are offered by the Fibre Channel port channels.

Resiliency and traffic load balancing are achieved by dual-homing the Fibre Channel links from the MDS directors into ports on either cluster on the Hitachi Unified Storage VM controller units. To balance the I/O across the connections, use VMWare native multipathing using the round-robin hashing algorithm.

For access control and added security within the storage domain, do the following:

- Perform Fibre Channel zoning on the MDS 9700 directors.
- Apply Fibre Channel masking on Unified Storage VM.

Adding MDS 9700 directors into the solution with dedicated SAN design does not change the Ethernet forwarding configuration of the solution. It is identical to the unified access layer design in the non-dedicated SAN design.

Infrastructure Cell for Storage Resources

The infrastructure cell for storage resources contains all of the base storage hardware required to start building this solution.

Figure 6 shows the infrastructure cell for storage resources.

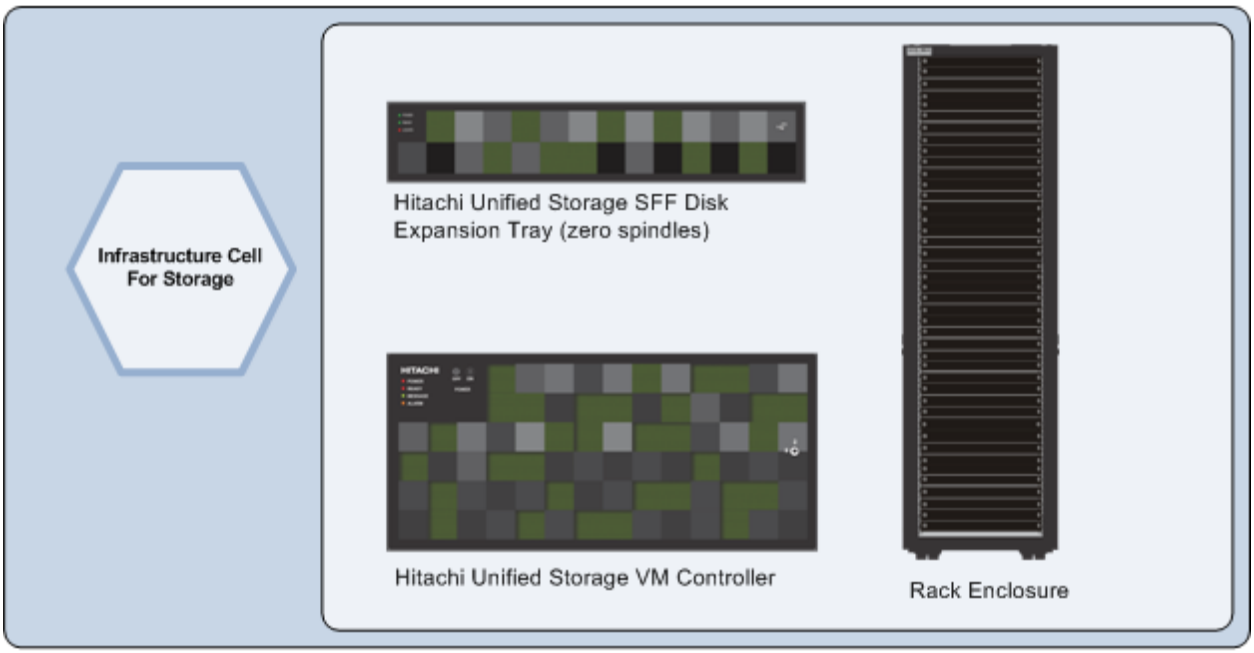

Figure 6

Use an infrastructure cell for storage resources in conjunction with the following cells:

- Infrastructure cell for compute resources
- Application cell for Hitachi Unified Compute Platform Select management
- Application cell for VMware vSphere

The infrastructure cell for storage resources provides the storage infrastructure for the other cells in the solution. Once an infrastructure cell for storage resources is fully populated, add additional infrastructure cells for storage resources to scale out the solution.

Table 4 shows the components of the infrastructure cell for storage.

Table 4. Infrastructure Cell for Storage Resources Hardware

Hardware	*Description*	*Version*	*Quantity*
Hitachi Unified Storage VM	■ Dual Controllers and Fibre Channel Modules ■ 16 × 8 GB/sec Fibre Channel Ports ■ 32 GB total cache	73-02-03-00 or later	1
SFF disk expansion tray for Hitachi Unified Storage VM	■ Contains disks for other cells		1

The infrastructure cell for storage resources contains a Hitachi Unified Storage VM controller and a disk expansion tray. This disk expansion tray holds disks for this infrastructure cell. Add storage disks to this cell for the following:

- Application cell for Hitachi Unified Compute Platform Select management
- Hot spares (optional)

Note — Scalability limits depend on application workloads running on this infrastructure.

Application Cell for Hitachi Unified Compute Platform Select Management

The application cell for Hitachi Unified Compute Platform Select management contains the compute and storage components for hosting the VMware vSphere infrastructure services as well as Hitachi Command Suite shared management framework for advanced data management.

Note — This cell is required only if an existing configuration for managing a VMware vSphere environment or for managing Hitachi Command Suite does not exist.

Figure 7 shows the application cell for UCP Select management.

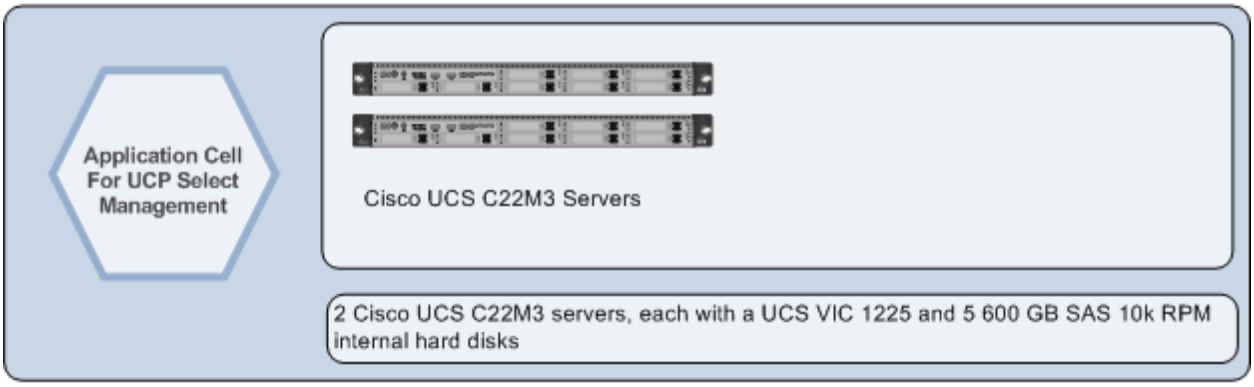

Figure 7

Use an application cell for Hitachi Unified Compute Platform Select management when a VMware vCenter and/or Hitachi Command Suite environment does not already exist.

Note — Scalability limits depend on application workloads running on this infrastructure.

Compute Infrastructure

The application cell for Hitachi Unified Compute Platform Select management provides enough capacity to support an emergency high availability event if one single server fails. Use VMware High Availability and VMware Distributed Resource Scheduler to configure a cluster dedicated to the application cell for Unified Compute Platform Select management to ensure virtual machine failover in the event of a hardware failure.

Table 5 shows the details of the hardware configuration in the application cell for Unified Compute Platform Select management.

Table 5. Application Cell for Unified Compute Platform Select management Hardware

Hardware	*Description*	*Version*	*Quantity*
Cisco UCS C22 M3 rack mounted Servers	■ 2 × 8 core Intel Xeon E5-2450 processors, 2.10 GHz ■ 64 GB RAM	C22M3.1.5.1c	2
SFF Disk Drives (Internal)	■ 600 GB 10k RPM SAS drives in a RAID10 (2D+2D) configuration		4
	■ Hot Spare		1

The compute infrastructure of the application cell for UCP Select management supports all associated Hitachi Command Suite, Microsoft® SQL Server®, Microsoft Active Directory®, and VMware vCenter and their associated requirements.

Manage your environment using the resources in this section or by connecting to a preexisting VMware vSphere and Hitachi Command Suite management environment.

Network Infrastructure

Configure each of the C22M3 servers with two NICs connected to the infrastructure network. All management and vMotion traffic flows over these NICs.

Optionally, these C22M3 servers can be connected to the Cisco UCS fabric using Cisco UCS 2232PP fabric extenders and configured for high availability. This means these C22M3 servers are no longer stand alone, but are deployed in an integrated model and managed by Cisco UCS Manager.

Storage Infrastructure

The storage infrastructure of the application cell for Hitachi Unified Compute Platform Select management consists of five units of 600 GB 10k RPM SAS drives internal to each of the UCS C22M3 servers.

Configure the storage into a single RAID-10 (2D+2D) group. The RAID group provides an overall capacity of 1.2 TB. Configure 1 unit of 600 GB 10k RPM SAS drives internal as a spare to protect against a single drive failure.

Optionally, the storage infrastructure may reside on one of the dynamic provisioning pools on Hitachi Unified Storage VM, and may be set up for SAN boot.

Server Configuration Sizing Guidelines

Apply the proper resource allocation for virtual machines used to manage the following:

- Hitachi Unified Compute Platform Select for VMware vSphere with Cisco Unified Computing System using Hitachi Unified Storage VM
- Hitachi Command Suite shared management environment

If using a separate environment outside of this solution for management, use the virtual machine sizing recommendations in Table 6.This table lists the virtual machine configurations used for each component of the management infrastructure used in this reference architecture.

Table 6. Virtual Machine Sizing Recommendations

Virtual Machine Purpose	*Configuration*	*Quantity*
Microsoft Active Directory, DNS, DHCP	■ vCPU — 1 ■ vMemory — 4 GB	1
VMware vCenter	■ vCPU — 2 ■ vMemory — 8 GB	1
Microsoft SQL Server® 2008 database for VMware vCenter	■ vCPU — 2 ■ vMemory — 8 GB	1
Hitachi Command Suite v7.5	■ vCPU – 2 ■ vMemory – 8 GB	1
Hitachi Tuning Manager v7.5	■ vCPU – 2 ■ vMemory – 8 GB	1

Application Cell for VMware vSphere

The application cell for VMware vSphere contains all compute and storage components necessary to run general server application workloads consisting of the following:

- 64 virtual CPUs (32 virtual CPUs per blade server)
- 256 GB of virtual machine memory (128 GB of virtual machine memory per blade server)
- 31 TB of storage capacity in dynamic provisioning pool (10 groups configured as RAID-6 (6D+2P) created from 80 × 600 GB 10k RPM SAS hard disk drives)

It is possible to over commit resources to the virtual machines running under VMware vSphere and care should be taken to avoid any performance issues.

Figure 8 shows the application cell for VMware vSphere.

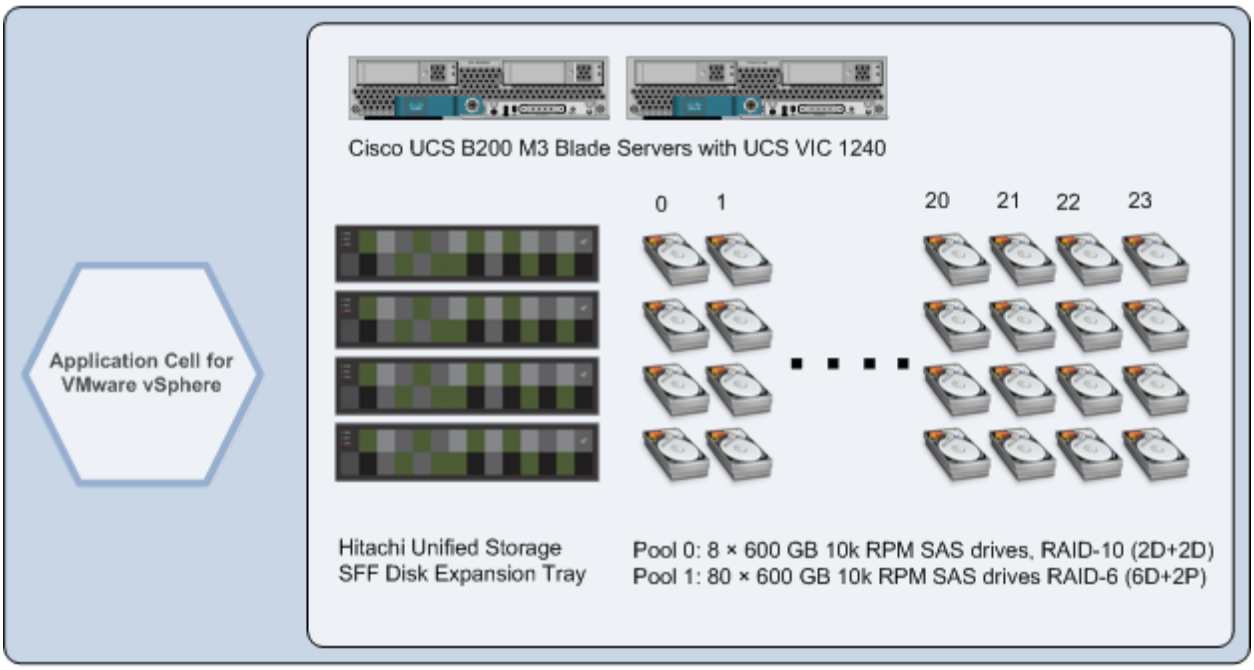

Figure 8

Use the application cell for VMware vSphere in conjunction with the following cells:

- Infrastructure cell for compute resources
- Infrastructure cell for storage resources
- Expansion cell for compute resources (used for scale-out)

To start building a scalable Unified Compute Platform Select for VMware vSphere with Cisco UCS using Hitachi Unified Storage VM environment, do the following:

- Add the compute components of the application cell for VMware vSphere to the infrastructure cell for compute
- Add the storage components to the infrastructure cell for storage resources

To scale out the solution and increase capacity, add additional application cells for VMware vSphere to your infrastructure cells for compute resources or expansion cells for compute resources. A single infrastructure cell for compute resources and an infrastructure cell for storage resources may physically support up to 16 application cells for VMware vSphere before you require a new infrastructure cell.

Note — Scalability limits depend on application workloads running on this infrastructure.

Compute Infrastructure

The application cell for VMware vSphere supports a maximum density of 132 virtual CPUs and 128 GB of virtual machine memory.

It is possible to over commit resources and increase these limits of maximum density. However, in such a maximum density configuration, a cell cannot support the failover of virtual machines in case of a server blade failure.

To provide high availability, do the following:

- Reduce the number of virtual CPUs and virtual machine memory per host up to 50%.
- Configure a VMware High Availability and VMware Distributed Resource Scheduler cluster dedicated to application cells for VMware vSphere.

Place additional hosts from each application cell for VMware vSphere into the cluster. When scaling the solution, increase the numbers of virtual machines per host as you add more resources to the cluster.

Based on VMware maximums, each High Availability and Distributed Resource Scheduler cluster can support up to 16 application cells for VMware vSphere (32 hosts).

Table 7 on page 32 shows the details of the hardware used in the application cell for VMware vSphere.

Table 7. Application Cell for VMware vSphere Hardware

Hardware	*Description*	*Version*	*Quantity*
Cisco UCS B200 M3 blade servers	■ 2 × 8 core Intel Xeon E5-2650 processors, 2.0 GHz ■ 128 GB RAM ■ 1240 VIC	B200 M3: v2.1.(1f)	2
SFF disk drives ■ 600 GB 10k RPM ■ Installed in the infrastructure cell for storage resources disk tray	■ RAID-6 (6D+2P)		80
	■ Hot spare		4
SFF disk expansion tray			4

Network Infrastructure

Configure each UCS VIC 1240 on board the B200M3 server blades to obtain two logical NICs per VIC 1240 port. Use Cisco UCS Manager to create a single service profile template that can be applied to each B200 M3 blade server.

The Cisco UCS VIC offers each virtual machine a virtual Ethernet interface (vNIC). This vNIC provides direct access to the fabric interconnects and Nexus 5500 series switches, where forwarding decisions can be made for each virtual machine using a VM-FEX interface.

Figure 9 on page 33 illustrates the networking details for the Cisco UCS B200 M3 to the Cisco 6248UP fabric interconnects.

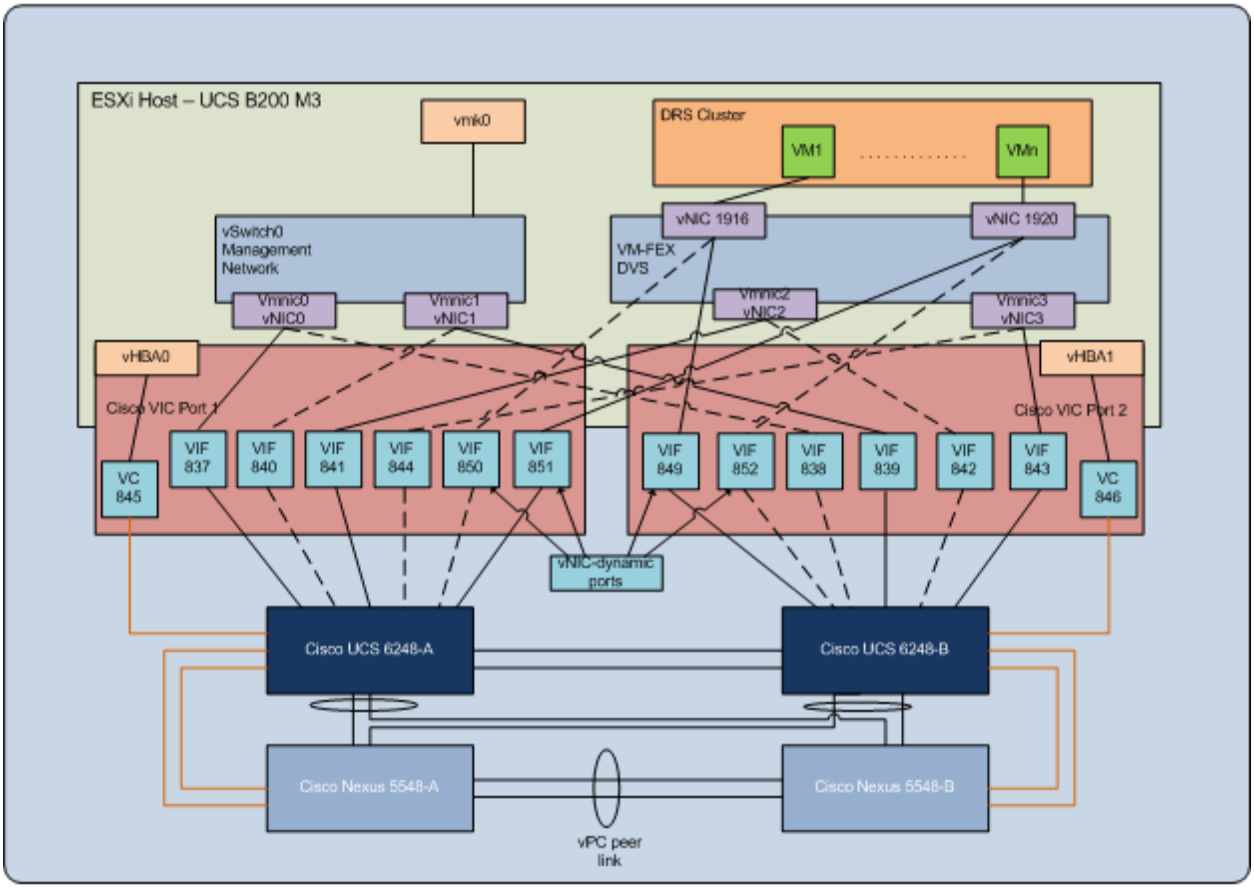

Figure 9

As shown in Figure 9, the path for a single virtual machine is fully redundant across the Cisco fabric. The virtual machine has an active virtual interface (VIF) and standby VIF defined on the adapter, an adapter that is dual-homed to Fabric A and Fabric B.

Combined with the Cisco UCS fabric failover, the VM-FEX solution provides fault tolerance and removes the need for software-based high availability teaming mechanisms. If the active uplink fails, the vNIC automatically fails over to the standby uplink and simultaneously updates the network through gratuitous ARP. In this figure, the active links are shown as solid and the standby links are shown as dashed.

Following best practice, separate following traffic to achieve greater security and better performance:

- **ESXi-Mgmt** — Chassis management connections and primary management of the ESXi hypervisors
- **vMotion** — Configured for VMware vMotion
- **VM-Data** — Configured for the virtual machine network

Storage Infrastructure

The storage infrastructure of the application cell for VMware vSphere consists of 80 units of 600 GB 10k RPM SAS drives in one dynamic provisioning pool with the following configuration:

- **Number of SFF Trays** — 4
- **Number of Hard Disk Drives** — 96 (24 per tray)
- **Provisioning Pool 0** — 8 drives consisting of 2 parity groups configured as RAID-10 (2D+2D)
- **Provisioning Pool 1** — 80 drives consisting of 10 parity groups configured as RAID-6 (6D+2P)

Figure 10 on page 35 shows the storage configuration for the application cell for VMware vSphere.

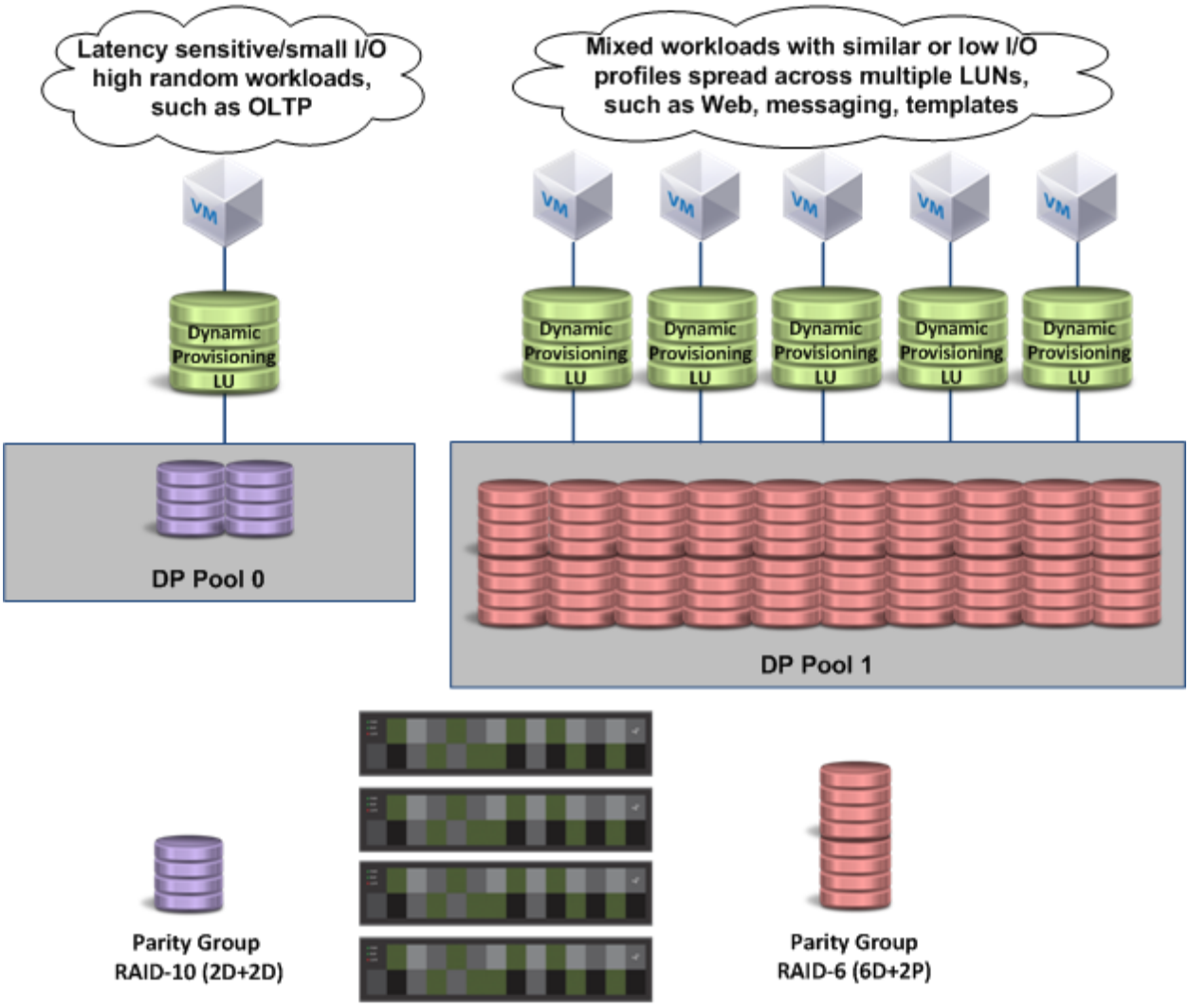

Figure 10

Use RAID-10 to maximize performance for random workloads, which is common with virtualized environments.

Use RAID-6 to balance performance and efficient use of pool space. Hitachi Data System recommends RAID-6 when you need a guarantee against data loss when other associated recommendations are also followed.

Create two dynamic provisioning pools to separate virtual machine workloads with different performance characteristics.

Because of its wide striping capability, Hitachi Dynamic Provisioning can balance the I/O load in dynamic provisioning pools of RAID groups. Mixing workloads in a single dynamic provisioning pool is possible to obtain certain levels of performance. However, grouping virtual machines with similar I/O profiles optimizes storage performance and results in a more efficient use of disk resources. Within a dynamic provisioning pool, create additional LUNs as necessary to spread the workload and avoid possible queue depth issues.

When scaling out with additional application cells for VMware vSphere, add RAID groups to grow the existing dynamic provisioning pools. Increasing spindle count allows a dynamic provisioning pool to support the increasing IOPS requirement dynamically. Create additional LUNs to assign to VMDKs (virtual machine disk) to prevent virtual machine workloads from saturating the LUN. Dynamic provisioning pools may grow to 60 TB in size.

SAN Infrastructure

Use Cisco UCS Manager to create a single service profile template that can be applied to each of the B200 M3 blade servers.

Configure each UCS VIC 1240 on board the B200M3 server blade to obtain one logical HBA per VIC 1240 port.

The Cisco UCS virtual interface card (VIC) offers each virtual machine a virtual HBA interface, or vHBA. This vHBA provides direct access to the fabric interconnects and Nexus 5500 series switches where forwarding decisions can be made for each virtual machine using a VM-FEX interface.

See Figure 9 on page 33 to see the Fibre Channel traffic paths.

The environment uses single initiator to multi-target zoning for each port on the B200 M3 server blades from Cisco. Following best practice, configure the SAN environment in a dual fabric topology for redundancy and high availability. This results in four paths available to each ESXi host, providing the following:

- Resiliency to failure
- Redundant paths to the storage subsystem

The storage multipath policy for each target in ESXi was set to **round robin**. This results in optimal load distribution during an all paths available situation.

Table 8 shows the zone configuration used for the application cell for VMware vSphere.

Table 8. Application Cell for VMware vSphere Zone Configuration

Host	Host HBA Number	Fabric	Zone Name	Storage Port
UCSESX01	HBA1_1	Fabric A	ESX1_HBA1_1_HUS_VM_1A_2A	1A
				2A
	HBA1_2	Fabric B	ESX1_HBA1_2_HUS_VM_1B_2B	1B
				2B
UCSESX02	HBA1_1	Fabric A	ESX2_ HBA1_1_HUS_VM_1A_2A	1A
				2A
	HBA1_2	Fabric B	ESX2_HBA1_2_HUS_VM_1B_2B	1B
				2B

Scaling Using Expansion Cell for Compute Resources

Use an expansion cell for compute resources to scale out this solution beyond the first infrastructure cell for compute resources.

Figure 11 shows the expansion cell for compute resources.

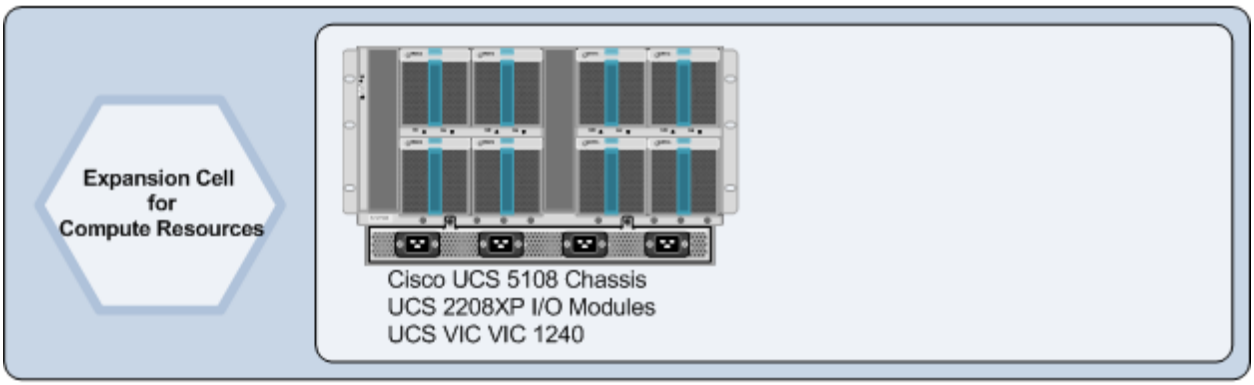

Figure 11

Use an expansion cell for compute resources in conjunction with the following cells:

- Infrastructure cell for compute resources
- Application cell for VMware vSphere

Once the chassis in the infrastructure cell for compute resources becomes fully populated, use an expansion cell for compute resources to provide additional resource capacity. This expansion cell for compute resources uses the storage and networking infrastructure provided in the following:

- Infrastructure cells for compute resources
- Storage resources

House this cell in the rack enclosure of the infrastructure cell for compute resources.

You can physically add up to three expansion cells for compute resources to an infrastructure cell for compute resources and an infrastructure cell for storage resources before you need to add new infrastructure.

One infrastructure cell for compute resources and two expansion cells for compute resources may support a maximum of 10 application cells for VMware vSphere (20 server blades and 33 storage trays).

Note — Scalability limits depend on application workloads running on this infrastructure.

Chassis Components

The expansion cell for compute resources uses the same chassis components contained in the infrastructure cell for compute resources.

Networking Infrastructure

The networking for the expansion cell for compute resources uses the same networking configurations as the infrastructure cell for compute resources.

Storage Infrastructure

Use four of the open storage target ports on Hitachi Unified Storage VM in the infrastructure cell for storage resources. Follow the same storage configuration described for the infrastructure cell for compute resources to use the newly provisioned storage target ports in the zoning configuration.

Figure 12 shows the storage target ports of a fully scaled-out solution.

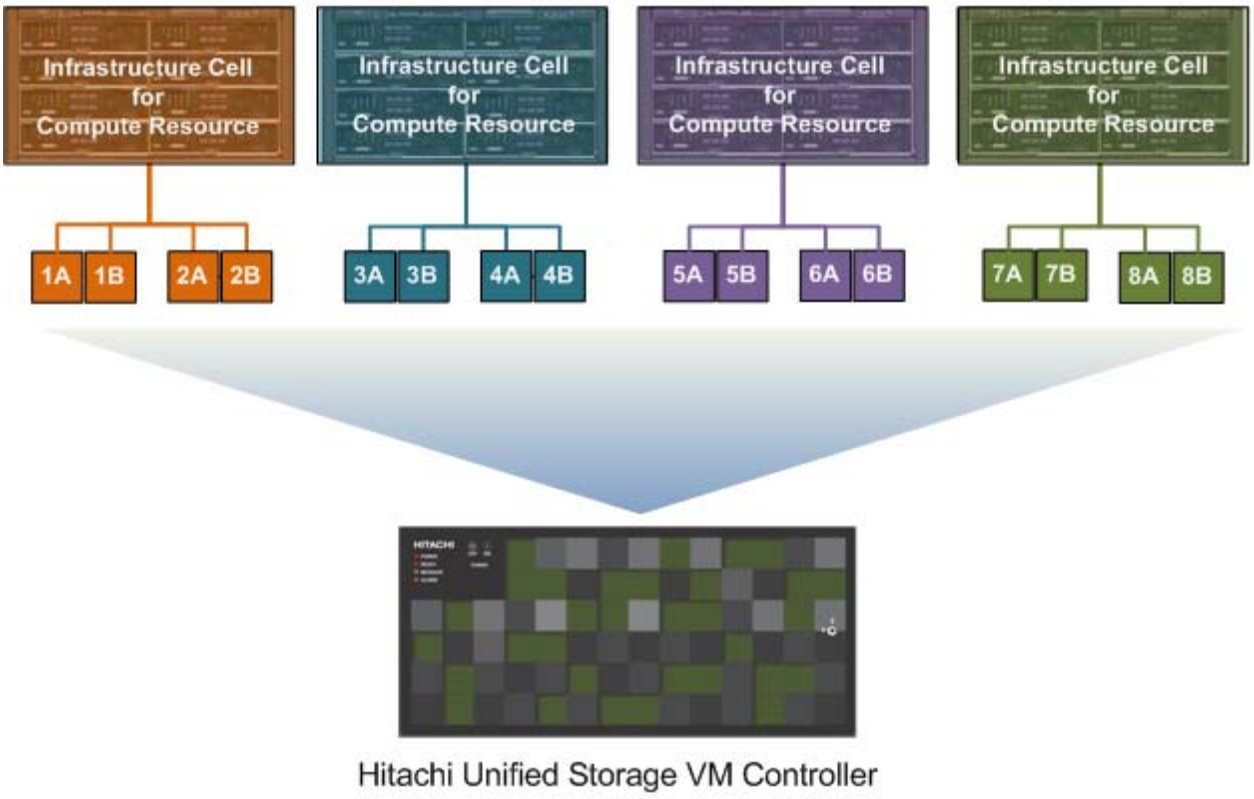

Figure 12

Scale Using Expansion Cell for Storage Resources

Use an expansion cell for storage resources to scale out the VMware vSphere solution beyond the first infrastructure cell for storage resources.

The expansion cell for storage contains up to 4 units of 2.5 inch SFF disk trays for Hitachi Unified Storage VM.

Use an expansion cell for storage resources in conjunction with the following cells:

- Infrastructure cell for storage resources
- Application cell for VMware vSphere

Once the original infrastructure cell for storage drive chassis becomes fully populated, use an expansion cell for storage resources to provide additional capacity.

Put hot spares for the first application cells in the disk tray for the infrastructure cell for storage resources. When the tray in the infrastructure cell fills, use the expansion cell for storage resources.

Engineering Validation

This describes the test methodology, test load, and the verification tests used to validate this reference architecture for Hitachi Unified Compute Platform Select for VMware vSphere with Cisco Unified Computing System using Hitachi Unified Storage VM. The reference architecture consists of systems and solutions that are designed, tested, and documented to facilitate and improve your deployment.

Test Methodology

The focus of the methodology was on validating the benefits of the Hitachi Unified Compute Platform Select for VMware vSphere with Cisco Unified Computing System reference architecture using Hitachi Unified Storage VM. This includes the following features that provide better utilization of compute resources:

- Move functions previously handled by the server onto the storage platform
- Control better how storage traffic flows through the system

The following are the systems validation tests, including differentiated feature benefit analysis:

- High availability/resiliency

  System resiliency (high availability) testing was limited to major component failures in order to demonstrate system resiliency at each layer of the solution. The test cases included testing and validating the following:

  - I/O Module failure and recovery
  - Fabric interconnect failure and recovery
  - Fabric interconnect SAN uplink (F-port port channel) failure and recovery
  - Nexus 5000 failure and recovery
  - Hitachi Unified Storage VM controller failure (FED failure on one cluster) and recovery
  - Nexus 1000V — Create, configure, and apply port profile
  - Demonstrate VMware vMotion — Migrate virtual machine server between two ESX hosts
  - Demonstrate high availability failover for UCS blade server with VMware High Availability

- High availability of Hitachi Unified Storage VM
- Hitachi Dynamic Provisioning
- VMware vStorage APIs for Array Integration (VAAI)

  This testing validated the VMware Storage APIs that are part of Storage Provider for VMware vCenter.

  - VAAI Full Copy — Clone virtual machines (eagerzeroedthick to eagerzeroedthick vmdk)
  - VAAI Full Copy — Clone virtual machines (eagerzeroedthick to zeroedthick vmdk)
  - VAAI Full Copy — Clone virtual machines (eagerzeroedthick to thin vmdk)
  - VAAI Full Copy — Clone virtual machines (zeroedthick to zeroedthick vmdk)
  - VAAI Full Copy — Clone virtual machines (zeroedthick to thin vmdk)
  - VAAI Full Copy — Clone virtual machines (thin to zeroedthick vmdk)
  - VAAI Full Copy — Clone virtual machines (thin to thin vmdk)
  - VAAI Full Copy — Storage vMotion virtual machines (zeroedthick to zeroedthick vmdk)
  - VAAI Block Zeroing — (Provisioning eagerzeroedthick vmdk)
  - VAAI Hardware Assisted Locking — Large Scale VM boot storms
  - VAAI Hardware Assisted Locking — Large scale simultaneous vMotion
  - VAAI and Hitachi Dynamic Provisioning Hardware Accelerated Thin Provisioning (eagerzeroedthick vmdk)
- Advanced Cisco UCS SAN features
  - Link aggregation (F-port trunk)
  - F-port (port channel)

Test Infrastructure

Testing involved these cells:

- Infrastructure cell for compute resources
- Infrastructure cell for storage resources
- Application cell for Unified Compute Platform Select management
- Application cell for VMware vSphere
  - 128 vCPUs
  - 512 GB vRAM
  - 31 TB HDP Pool capacity

Figure 13 shows the cells used to validate this reference architecture.

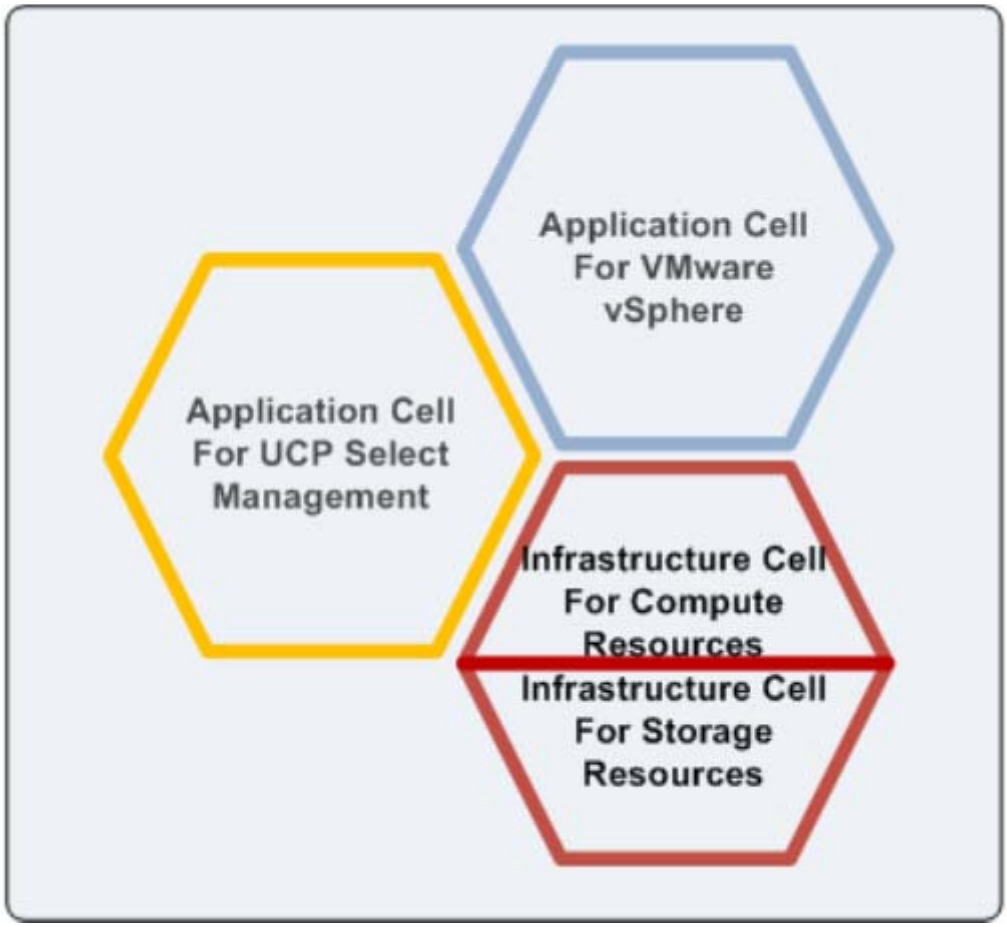

Figure 13

Each application cell for VMware vSphere ran eight virtual machines with Microsoft Windows Server® 2008 R2 EE SP1. Each virtual machine had two vCPUs, four GB RAM, and 100 GB storage space.

Test Load

The system was subjected to load while when performing the system tests. DVD Store, IOMeter, and IOZone were used to produce storage, compute, and SAN load. NetPerf was used to create the IP network traffic load. An additional server was installed to run NetPerf and generate the IP traffic to the Nexus 5548 switch.

Interoperability Verification

Before and during the build of the environment, it was ensured that all hardware components, firmware, and software deployed are supported in the HiFIRE Interoperability Test database. All make, model, and version numbers have been documented.

Conclusion

Hitachi Unified Compute Platform Select for VMware vSphere with Cisco Unified Computing System using Hitachi Unified Storage VM gives you a build-as-you-go model that uses performance-proven hardware resources. The modular design, using cell architecture, permits implementing an initial environment for modest needs that gives you the flexibility to scale out as your IT needs grow.

Validation with general server application workloads of this reference architecture in the Hitachi Data Systems ISV Solutions and Engineering laboratory provides general guidance on the virtual resources available with this solution.

Use Hitachi Dynamic Provisioning to reallocate I/O capabilities dynamically, as necessary. Having the capability to provision additional spindles to an already provisioned datastore within vSphere allows for nondisruptive upgrades to the underlying storage infrastructure. This provides immediate benefits to your environment without confusing shuffling of virtual machines, datastores, or LUs.

Each implementation has its own unique set of data center and application requirements. Design your implementation of this environment by understanding the I/O workload of the server applications in your environment. Creating an environment that meets your unique needs results in increased ROI from avoiding over or under provisioning resources.

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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AS-246-01, March 2014