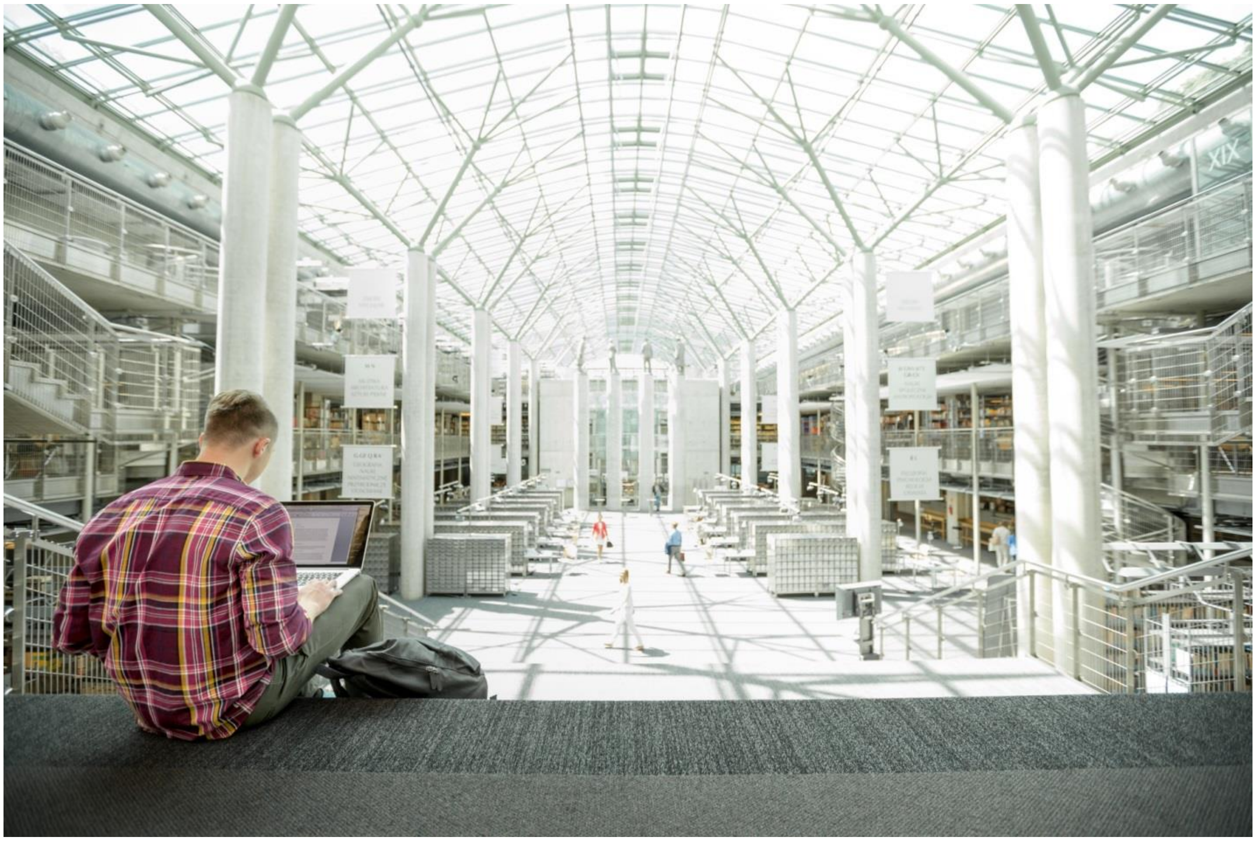

Cisco HyperFlex 2.5 for Virtual Server Infrastructure

Deployment Guide for Cisco HyperFlex 2.5 for Virtual Server Infrastructure

Last Updated: December 19, 2018

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Table of Contents

Executive Summary

With the proliferation of virtualized environments across most IT landscapes, other technology stacks which have traditionally not offered the same levels of simplicity, flexibility, and rapid deployment as virtualized compute platforms have come under increasing scrutiny. In particular, networking devices and storage systems have lacked the agility of hypervisors and virtual servers. With the introduction of Cisco HyperFlex, Cisco has brought the dramatic enhancements of hyperconvergence to the modern datacenter. Cisco HyperFlex systems are based on the Cisco UCS platform, combining Cisco HX-Series x86 servers and integrated networking technologies via the Cisco UCS Fabric Interconnects, into a single management domain, along with industry leading virtualization hypervisor software from VMware, and next-generation software defined storage technology. The combination creates a complete virtualization platform, which provides the network connectivity for the guest virtual machine (VM) connections, and the distributed storage to house the VMs, spread across all of the Cisco UCS x86 servers, versus using specialized storage or networking components. The unique storage features of the HyperFlex log based filesystem enable rapid cloning of VMs, snapshots without the traditional performance penalties, and data deduplication and compression. All configuration, deployment, management, and monitoring of the solution can be done with existing tools for Cisco UCS and VMware, such as Cisco UCS Manager and VMware vCenter. This powerful linking of advanced technology stacks into a single, simple, rapidly deployed solution makes Cisco HyperFlex a true second generation hyperconverged platform.

New, with the introduction of Cisco HyperFlex HXDP 2.5, are enterprise class data protection features, including snapshot-based virtual machine replication, and data-at-rest encryption. Virtual machine replication allows for easy configuration of a secondary HyperFlex site for disaster recovery. Data-at-rest encryption keeps all data on the disks encrypted to protect against accidental data loss or theft. Customers can choose to deploy SSD-only All-Flash HyperFlex clusters for improved performance, increased density, and reduced latency, or use HyperFlex hybrid clusters which combine high-performance SSDs and low-cost, high-capacity HDDs to optimize the cost of storing data. Further enhancements include an all-new HTML5 based native HyperFlex Connect management tool with role-based access control, support for 40 GbE connectivity, larger scale 16-node clusters, and support for NVMe based SSDs in place of SAS-based SSDs for the caching disks.

Solution Overview

Introduction

The Cisco HyperFlex System provides an all-purpose virtualized server platform, with hypervisor hosts, networking connectivity, and virtual server storage across a set of Cisco UCS HX-Series x86 rack mount servers. Legacy datacenter deployments have relied on a disparate set of technologies, each performing a distinct and specialized function, such as network switches connecting endpoints and transferring Ethernet network traffic, and Fibre Channel (FC) storage arrays providing block based storage via a dedicated storage array network (SAN). Each of these systems had unique requirements for hardware, connectivity, management tools, operational knowledge, monitoring, and ongoing support. A legacy virtual server environment was often divided up into areas commonly referred to as silos, within which only a single technology operated, along with their correlated software tools and support staff. Silos could often be divided between the x86 computing hardware, the networking connectivity of those x86 servers, SAN connectivity and storage device presentation, the hypervisors and virtual platform management, and finally the guest VM themselves along with their OS and applications. This model proves to be inflexible, difficult to navigate, and is susceptible to numerous operational inefficiencies.

A more modern datacenter model was developed called a converged infrastructure. Converged infrastructures attempt to collapse the traditional silos by combining these technologies into a more singular environment, which has been designed to operate together in pre-defined, tested, and validated designs. A key component of the converged infrastructure was the revolutionary combination of x86 rack and blade servers, along with converged Ethernet and Fibre Channel networking offered by the Cisco UCS platform. Converged infrastructures leverage Cisco UCS, plus new deployment tools, management software suites, automation processes, and orchestration tools to overcome the difficulties deploying traditional environments, and do so in a much more rapid fashion. These new tools place the ongoing management and operation of the system into the hands of fewer staff, with more rapid deployment of workloads based on business needs, while still remaining at the forefront of flexibility to adapt to workload needs, and offering the highest possible performance. Cisco has had incredible success in these areas with our various partners, developing leading solutions such as Cisco FlexPod, SmartStack, VersaStack, and VBlock architectures. Despite these advances, because these converged infrastructures contained some legacy technology stacks, particularly in the storage subsystems, there often remained a division of responsibility amongst multiple teams of administrators. Alongside, there is also a recognition that these converged infrastructures can still be a somewhat complex combination of components, where a simpler system would suffice to serve the workloads being requested.

Significant changes in the storage marketplace have given rise to the software defined storage (SDS) system. Legacy FC storage arrays often contained a specialized subset of hardware, such as Fibre Channel Arbitrated Loop (FC-AL) based controllers and disk shelves along with optimized Application Specific Integrated Circuits (ASIC), read/write data caching modules and cards, plus highly customized software to operate the arrays. With the rise of Serial Attached SCSI (SAS) bus technology and its inherent benefits, storage array vendors began to transition their internal hardware architectures to SAS, and with dramatic increases in processing power from recent x86 processor architectures, they also used fewer or no custom ASICs at all. As disk physical sizes shrank, x86 servers began to have the same density of storage per rack unit (RU) as the arrays themselves, and with the proliferation of NAND based flash memory solid state disks (SSD), they also now had access to input/output (IO) devices whose speed rivaled that of dedicated caching devices. If servers themselves now contained storage devices and technology to rival many dedicated arrays on the market, then the major differentiator between them was the software providing allocation, presentation and management of the storage, plus the advanced features many vendors offered. This has led to the rise of software defined storage, where the x86 servers with the storage devices ran software to effectively turn one or more of them, working cooperatively, into a storage array much the same as the traditional arrays were. In a somewhat unexpected turn of events, some of the major storage array vendors themselves were pioneers in this field, recognizing the technological shifts in the market, and attempting to profit from the software features they offered versus their specialized hardware, as had been done in the past.

Some early uses of SDS systems simply replaced the traditional storage array in the converged architectures as described earlier. That configuration still had a separate storage system from the virtual server hypervisor platform, and depending on the solution provider, still remained separate from the network devices. If the servers that hosted the VMs, and also provided the SDS environment were in fact the same model of server, could they simply do both things at once and collapse the two functions into one? This ultimate combination of resources becomes what the industry has given the moniker of a hyperconverged infrastructure. Hyperconverged infrastructures coalesce the computing, memory, hypervisor, and storage devices of servers into a single platform for virtual servers. There is no longer a separate storage system, as the servers running the hypervisors also provide the software defined storage resources to store the virtual servers, effectively storing the virtual machines on themselves. Now nearly all the silos are gone, and a hyperconverged infrastructure becomes something almost completely self-contained, simpler to use, faster to deploy, easier to consume, yet still flexible and with very high performance. Many hyperconverged systems still rely on standard networking components, such as on-board network cards in the x86 servers, and top-of-rack switches. The Cisco HyperFlex system combines the convergence of computing and networking provided by Cisco UCS, along with next-generation hyperconverged storage software, to uniquely provide the compute resources, network connectivity, storage, and hypervisor platform to run an entire virtual environment, all contained in a single monolithic system.

Some key advantages of hyperconverged infrastructures are the simplification of deployment, day to day management operations, as well as increased agility, thereby reducing the amount operational costs. Since hyperconverged storage can be easily managed by an IT generalist, this can also reduce technical debt going forward that is often accrued by implementing complex systems that need dedicated management teams and skillsets.

Audience

The intended audience for this document includes, but is not limited to, sales engineers, field consultants, professional services, IT managers, partner engineering, and customers deploying the Cisco HyperFlex System. External references are provided wherever applicable, but readers are expected to be familiar with VMware specific technologies, infrastructure concepts, networking connectivity, and security policies of the customer installation.

Purpose of this Document

This document describes the steps required to deploy, configure, and manage a Cisco HyperFlex system. The document is based on all known best practices using the software, hardware and firmware revisions specified in the document. As such, recommendations and best practices can be amended with later versions. This document showcases the installation, configuration and expansion of Cisco HyperFlex standard and also extended clusters, including both converged nodes and compute-only nodes, in a typical customer datacenter environment. While readers of this document are expected to have sufficient knowledge to install and configure the products used, configuration details that are important to the deployment of this solution are provided in this CVD.

Enhancements for Version 2.5

The Cisco HyperFlex system has several new capabilities and enhancements in version 2.5:

- Native replication of virtual machine snapshots between two Cisco HyperFlex clusters, enabling recovery of a single VM, multiple VMs, or an entire site as a disaster recovery.
- Data-at-rest encryption using hardware based self-encrypting disks (SED) to protect data written on the disks, preventing accidental data loss or data theft.
- Support for larger scale clusters; up to 16 converged nodes and up to 16 compute-only nodes per all-flash cluster, and support for managing up to 100 Cisco HyperFlex clusters per VMware vCenter instance.
- Support for using NVMe based SSDs as the caching disk in the Cisco HyperFlex all-flash converged nodes.
- The new HyperFlex Connect native HTML5 management GUI, with role-based access control.
- A fully supported release of the HyperFlex REST API, allowing programmatic management and monitoring of the cluster, and its features.
- HXAF240c-M4SX nodes now can scale to a full allotment of 23 capacity SSDs per node.
- Expanded Cisco UCS blade and rack-mount server model options for compute-only nodes.
- Smart Licensing
- FIPS/CC Certification
- VMware vSphere 6.5 support

Documentation Roadmap

For the comprehensive documentation suite, refer to the following location on the Cisco UCS HX-Series Documentation Roadmap: https://www.cisco.com/c/en/us/td/docs/hyperconverged_systems/HyperFlex_HX_DataPlatformSoftware/HX_Documentation_Roadmap/HX_Series_Doc_Roadmap.html

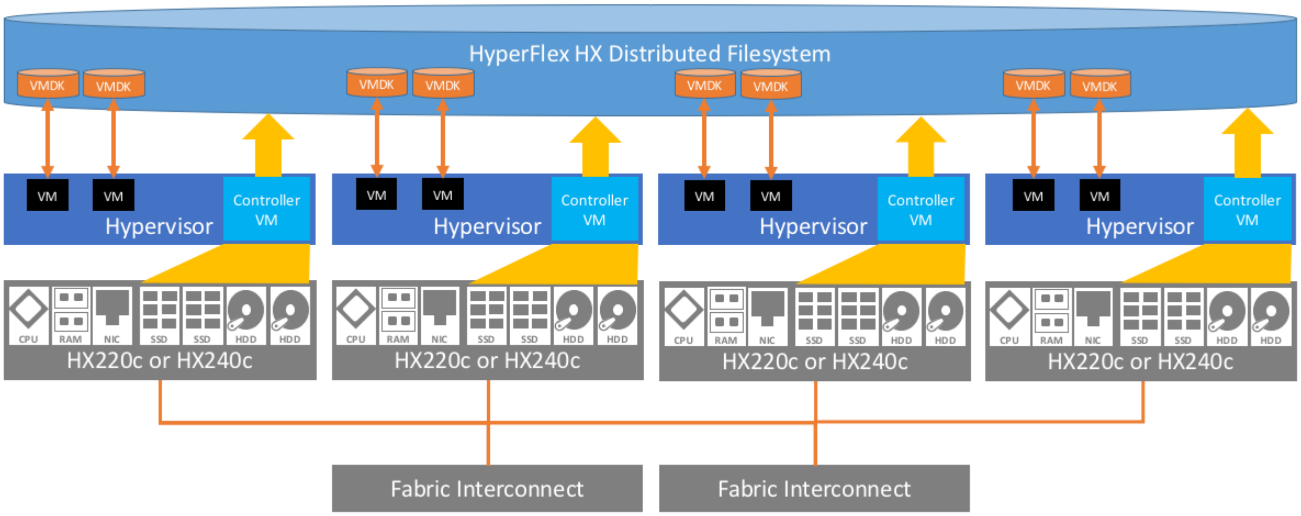
Note: A login is required for the Documentation Roadmap.

Hyperconverged Infrastructure web link: http://hyperflex.io

Solution Summary

The Cisco HyperFlex system provides a fully contained virtual server platform, with compute and memory resources, integrated networking connectivity, a distributed high-performance log based filesystem for VM storage, and the hypervisor software for running the virtualized servers, all within a single Cisco UCS management domain.

Figure 1 HyperFlex System Overview



The following are the components of a Cisco HyperFlex system:

- Cisco UCS Fabric Interconnects, choose from models:
  - Cisco UCS 6248UP Fabric Interconnect
  - Cisco UCS 6296UP Fabric Interconnect
  - Cisco UCS 6332 Fabric Interconnect
  - Cisco UCS 6332-16UP Fabric Interconnect
- Cisco HyperFlex HX-Series rack-mount servers, choose from models:
  - Cisco HyperFlex HX220c-M4S rack mount servers
  - Cisco HyperFlex HX240c-M4SX rack mount servers
  - Cisco HyperFlex HXAF220c-M4S All-Flash rack-mount servers
  - Cisco HyperFlex HXAF240c-M4SX All-Flash rack-mount servers
- Cisco HX Data Platform Software
- VMware vSphere ESXi Hypervisor
- VMware vCenter Server (end-user supplied)

Optional components for additional compute-only resources are:

- Cisco UCS 5108 Chassis
- Cisco UCS 2204XP, 2208XP or 2304 model Fabric Extenders
- Cisco UCS B200-M3, B200-M4, B260-M4, B420-M4 or B460-M4 blade servers
- Cisco UCS C220-M3, C220-M4, C240-M3, C240-M4 or C460-M4 rack-mount servers

All-Flash Versus Hybrid

The initial HyperFlex product release featured hybrid converged nodes, which use a combination of solid-state disks (SSDs) for the short-term storage caching layer, and hard disk drives (HDDs) for the long-term storage capacity layer. The hybrid HyperFlex system is an excellent choice for entry-level or midrange storage solutions, and hybrid solutions have been successfully deployed in many non-performance sensitive virtual environments. Meanwhile, there is significant growth in deployment of highly performance sensitive and mission critical applications. The primary challenge to the hybrid HyperFlex system from these highly performance sensitive applications, is their increased sensitivity to high storage latency. Due to the characteristics of the spinning hard disks, it is unavoidable that their higher latency becomes the bottleneck in the hybrid system. Ideally, if all of the storage operations were to occur in the caching SSD layer, the hybrid system's performance will be excellent. But in several scenarios, the amount of data being written and read exceeds the caching layer capacity, placing larger loads on the HDD capacity layer, and the subsequent increases in latency will naturally result in reduced performance.

Cisco All-Flash HyperFlex systems are an excellent option for customers with a requirement to support high performance, latency sensitive workloads. With a purpose built, flash-optimized and high-performance log based filesystem, the Cisco All-Flash HyperFlex system provides:

- Predictable high performance across all the virtual machines on HyperFlex All-Flash and compute-only nodes in the cluster.
- Highly consistent and low latency, which benefits data-intensive applications and databases such as Microsoft SQL and Oracle.
- Support for NVMe caching SSDs, offering an even higher level of performance.
- Future ready architecture that is well suited for flash-memory configuration:
  - Cluster-wide SSD pooling maximizes performance and balances SSD usage so as to spread the wear.
  - A fully distributed log-structured filesystem optimizes the data path to help reduce write amplification.
  - Large sequential writing reduces flash wear and increases component longevity.
  - Inline space optimization, for example; deduplication and compression, minimizes data operations and reduces wear.
- Lower operating cost with the higher density drives for increased capacity of the system.
- Cloud scale solution with easy scale-out and distributed infrastructure and the flexibility of scaling out independent resources separately.

Cisco HyperFlex support for hybrid and all-flash models now allows customers to choose the right platform configuration based on their capacity, applications, performance, and budget requirements. All-flash configurations offer repeatable and sustainable high performance, especially for scenarios with a larger working set of data, in other words, a large amount of data in motion. Hybrid configurations are a good option for customers who want the simplicity of the Cisco HyperFlex solution, but their needs focus on capacity-sensitive solutions, lower budgets, and fewer performance-sensitive applications.

Technology Overview

Cisco Unified Computing System

The Cisco Unified Computing System (Cisco UCS) is a next-generation data center platform that unites compute, network, and storage access. The platform, optimized for virtual environments, is designed using open industry-standard technologies and aims to reduce total cost of ownership (TCO) and increase business agility. The system integrates a low-latency, lossless 10 Gigabit Ethernet or 40 Gigabit Ethernet unified network fabric with enterprise-class, x86-architecture servers. It is an integrated, scalable, multi chassis platform in which all resources participate in a unified management domain.

The main components of Cisco Unified Computing System are:

- Computing: The system is based on an entirely new class of computing system that incorporates rack-mount and blade servers based on Intel Xeon Processors.
- Network: The system is integrated onto a low-latency, lossless, 10-Gbps or 40-Gbps unified network fabric. This network foundation consolidates LANs, SANs, and high-performance computing networks which are often separate networks today. The unified fabric lowers costs by reducing the number of network adapters, switches, and cables, and by decreasing the power and cooling requirements.
- Virtualization: The system unleashes the full potential of virtualization by enhancing the scalability, performance, and operational control of virtual environments. Cisco security, policy enforcement, and diagnostic features are now extended into virtualized environments to better support changing business and IT requirements.
- Storage access: The system provides consolidated access to both SAN storage and Network Attached Storage (NAS) over the unified fabric. By unifying storage access, the Cisco Unified Computing System can access storage over Ethernet, Fibre Channel, Fibre Channel over Ethernet (FCoE), and iSCSI. This provides customers with their choice of storage protocol and physical architecture, and enhanced investment protection. In addition, the server administrators can pre-assign storage-access policies for system connectivity to storage resources, simplifying storage connectivity, and management for increased productivity.
- Management: The system uniquely integrates all system components which enable the entire solution to be managed as a single entity by the Cisco UCS Manager (UCSM). The Cisco UCS Manager has an intuitive graphical user interface (GUI), a command-line interface (CLI), and a robust application programming interface (API) to manage all system configuration and operations.

The Cisco Unified Computing System is designed to deliver:

- A reduced Total Cost of Ownership and increased business agility.
- Increased IT staff productivity through just-in-time provisioning and mobility support.
- A cohesive, integrated system which unifies the technology in the data center. The system is managed, serviced and tested as a whole.
- Scalability through a design for hundreds of discrete servers and thousands of virtual machines and the capability to scale I/O bandwidth to match demand.
- Industry standards supported by a partner ecosystem of industry leaders.

Cisco UCS Fabric Interconnect

The Cisco UCS Fabric Interconnect is a core part of the Cisco Unified Computing System, providing both network connectivity and management capabilities for the system. Depending on the model chosen, the Cisco UCS Fabric Interconnect offers line-rate, low-latency, lossless 10 Gigabit or 40 Gigabit Ethernet, Fibre Channel over Ethernet (FCoE) and Fibre Channel connectivity. Cisco UCS Fabric Interconnects provide the management and communication backbone for the Cisco UCS C-Series, S-Series and HX-Series Rack mount Servers, Cisco UCS B-Series Blade Servers and Cisco UCS 5100 Series Blade Server Chassis. All servers and chassis, and therefore all blades, attached to the Cisco UCS Fabric Interconnects become part of a single, highly available management domain. In addition, by supporting unified fabrics, the Cisco UCS Fabric Interconnects provide both the LAN and SAN connectivity for all servers within its domain.

From a networking perspective, the Cisco UCS 6200 Series uses a cut-through architecture, supporting deterministic, low latency, line rate 10 Gigabit Ethernet on all ports, up to 1.92 Tbps switching capacity and 160 Gbps bandwidth per chassis, independent of packet size and enabled services. The product family supports Cisco low-latency, lossless 10 Gigabit Ethernet unified network fabric capabilities, which increase the reliability, efficiency, and scalability of Ethernet networks. The Fabric Interconnect supports multiple traffic classes over the Ethernet fabric from the servers to the uplinks. Significant TCO savings come from an FCoE-optimized server design in which network interface cards (NICs), host bus adapters (HBAs), cables, and switches can be consolidated.

The Cisco UCS 6300 Series offers the same features while supporting even higher performance, low latency, lossless, line rate 40 Gigabit Ethernet, with up to 2.56 Tbps of switching capacity. Backward compatibility and scalability are assured with the ability to configure 40 Gbps quad SFP (QSFP) ports as breakout ports using 4x10GbE breakout cables. Existing UCS servers with 10GbE interfaces can be connected in this manner, although Cisco HyperFlex nodes must use a 40GbE VIC adapter in order to connect to a Cisco UCS 6300 Series Fabric Interconnect.

Cisco UCS 6248UP Fabric Interconnect

The Cisco UCS 6248UP Fabric Interconnect is a one-rack-unit (1RU) 10 Gigabit Ethernet, FCoE and Fiber Channel switch offering up to 960 Gbps throughput and up to 48 ports. The switch has 32 1/10-Gbps fixed Ethernet, FCoE, or 1/2/4/8 Gbps FC ports, plus one expansion slot.

Figure 2 Cisco UCS 6248UP Fabric Interconnect

Cisco UCS 6296UP Fabric Interconnect

The Cisco UCS 6296UP Fabric Interconnect is a two-rack-unit (2RU) 10 Gigabit Ethernet, FCoE, and native Fibre Channel switch offering up to 1920 Gbps of throughput and up to 96 ports. The switch has 48 1/10-Gbps fixed Ethernet, FCoE, or 1/2/4/8 Gbps FC ports, plus three expansion slots.

Figure 3 Cisco UCS 6296UP Fabric Interconnect

Cisco UCS 6332 Fabric Interconnect

The Cisco UCS 6332 Fabric Interconnect is a one-rack-unit (1RU) 40 Gigabit Ethernet and FCoE switch offering up to 2560 Gbps of throughput. The switch has 32 40-Gbps fixed Ethernet and FCoE ports. Up to 24 of the ports can be reconfigured as 4x10Gbps breakout ports, providing up to 96 10-Gbps ports.

Figure 4 Cisco UCS 6332 Fabric Interconnect

Cisco UCS 6332-16UP Fabric Interconnect

The Cisco UCS 6332-16UP Fabric Interconnect is a one-rack-unit (1RU) 10/40 Gigabit Ethernet, FCoE, and native Fibre Channel switch offering up to 2430 Gbps of throughput. The switch has 24 40-Gbps fixed Ethernet and FCoE ports, plus 16 1/10-Gbps fixed Ethernet, FCoE, or 4/8/16 Gbps FC ports. Up to 18 of the 40-Gbps ports can be reconfigured as 4x10Gbps breakout ports, providing up to 88 total 10-Gbps ports.

Figure 5 Cisco UCS 6332-16UP Fabric Interconnect

Note: When used for a Cisco HyperFlex deployment, due to mandatory QoS settings in the configuration, the 6332 and 6332-16UP will be limited to a maximum of four 4x10Gbps breakout ports.

Cisco HyperFlex HX-Series Nodes

A HyperFlex cluster requires a minimum of three HX-Series "converged" nodes (with disk storage). Data is replicated across at least two of these nodes, and a third node is required for continuous operation in the event of a single-node failure. Each node that has disk storage is equipped with at least one high-performance SSD drive for data caching and rapid acknowledgment of write requests. Each node also is equipped with additional disks, up to the platform's physical limit, for long term storage and capacity.

Cisco HyperFlex HXAF220c-M4S All-Flash Node

This small footprint Cisco HyperFlex all-flash model contains two Cisco Flexible Flash (FlexFlash) Secure Digital (SD) cards that act as the boot drives, a single 120 GB or 240 GB solid-state disk (SSD) data-logging drive, a single 400 GB NVMe or a 400GB or 800 GB SAS SSD write-log drive, and six 960 GB or 3.8 terabyte (TB) SATA SSD drives for storage capacity. For configurations requiring self-encrypting drives, the caching SSD is replaced with an 800 GB SAS SED SSD, and the capacity disks are also replaced with 800 GB SAS SED SSDs. A minimum of three nodes and a maximum of sixteen nodes can be configured in one HX all-flash cluster.

Figure 6 HXAF220c-M4S All-Flash Node

Cisco HyperFlex HXAF240c-M4SX All-Flash Node

This capacity optimized Cisco HyperFlex all-flash model contains two FlexFlash SD cards that act as boot drives, a single 120 GB or 240 GB solid-state disk (SSD) data-logging drive, a single 400 GB NVMe or a 400GB or 800 GB SAS SSD write-log drive, and six to twenty-three 960 GB or 3.8 terabyte (TB) SATA SSD drives for storage capacity. For configurations requiring self-encrypting drives, the caching SSD is replaced with an 800 GB SAS SED SSD, and the capacity disks are also replaced with 800 GB SAS SED SSDs. A minimum of three nodes and a maximum of sixteen nodes can be configured in one HX all-flash cluster.

Figure 7 HXAF240c-M4SX Node

Note: In all-flash configurations, either a 400 GB or 800 GB caching SAS SSD may be chosen. This option is provided to allow flexibility in ordering based on product availability, pricing and lead times. There is no performance, capacity or scalability benefit in choosing the larger disk.

Cisco HyperFlex HX220c-M4S Hybrid Node

This small footprint Cisco HyperFlex hybrid model contains six 1.2 terabyte (TB) SAS HDD drives that contribute to cluster storage capacity, a 120 GB or 240 GB SSD housekeeping drive, a 480 GB SAS SSD caching drive, and two Cisco Flexible Flash (FlexFlash) Secure Digital (SD) cards that act as boot drives. For configurations requiring self-encrypting drives, the caching SSD is replaced with an 800 GB SAS SED SSD, and the capacity disks are replaced with 1.2TB SAS SED HDDs. A minimum of three nodes and a maximum of eight nodes can be configured in one HX hybrid cluster.

Figure 8 HX220c-M4S Node

Cisco HyperFlex HX240c-M4SX Hybrid Node

This capacity optimized Cisco HyperFlex hybrid model contains a minimum of six and up to twenty-three 1.2 TB SAS HDD drives that contribute to cluster storage, a single 120 GB or 240 GB SSD housekeeping drive, a single 1.6 TB SAS SSD caching drive, and two FlexFlash SD cards that act as the boot drives. For configurations requiring self-encrypting drives, the caching SSD is replaced with a 1.6 TB SAS SED SSD, and the capacity disks are replaced with 1.2TB SAS SED HDDs. A minimum of three nodes and a maximum of eight nodes can be configured in one HX hybrid cluster.

Figure 9 HX240c-M4SX Node

Note: In all configurations, either a 120 GB or 240 GB housekeeping disk may be chosen. This option is provided to allow flexibility in ordering based on product availability, pricing and lead times. There is no performance, capacity or scalability benefit in choosing the larger disk.

Cisco VIC 1227 and 1387 MLOM Interface Cards

The Cisco UCS Virtual Interface Card (VIC) 1227 is a dual-port Enhanced Small Form-Factor Pluggable (SFP+) 10-Gbps Ethernet and Fibre Channel over Ethernet (FCoE)-capable PCI Express (PCIe) modular LAN-on-motherboard (mLOM) adapter installed in the Cisco UCS HX-Series Rack Servers. The VIC 1227 is used in conjunction with the Cisco UCS 6248UP or 6296UP model Fabric Interconnects.

The Cisco UCS VIC 1387 Card is a dual-port Enhanced Quad Small Form-Factor Pluggable (QSFP+) 40-Gbps Ethernet and Fibre Channel over Ethernet (FCoE)-capable PCI Express (PCIe) modular LAN-on-motherboard (mLOM) adapter installed in the Cisco UCS HX-Series Rack Servers. The VIC 1387 is used in conjunction with the Cisco UCS 6332 or 6332-16UP model Fabric Interconnects.

The mLOM slot can be used to install a Cisco VIC without consuming a PCIe slot, which provides greater I/O expandability. It incorporates next-generation converged network adapter (CNA) technology from Cisco, providing investment protection for future feature releases. The card enables a policy-based, stateless, agile server infrastructure that can present up to 256 PCIe standards-compliant interfaces to the host, each dynamically configured as either a network interface card (NICs) or host bus adapter (HBA). The personality of the interfaces is set programmatically using the service profile associated with the server. The number, type (NIC or HBA), identity (MAC address and World Wide Name [WWN]), failover policy, adapter settings, bandwidth, and quality-of-service (QoS) policies of the PCIe interfaces are all specified using the service profile.

Figure 10 Cisco VIC 1227 mLOM Card

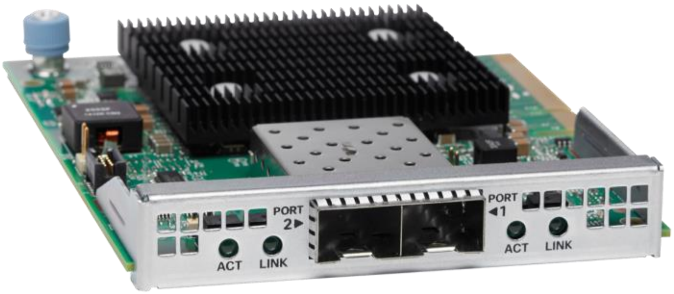
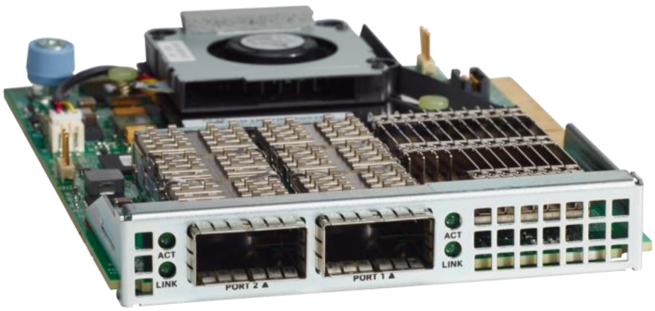


Figure 11 Cisco VIC 1387 mLOM Card



Note: Hardware revision V03 or later of the Cisco VIC 1387 card is required for the Cisco HyperFlex HX-series servers.

Cisco HyperFlex Compute-Only Nodes

HyperFlex 2.5 expands the number of options available for using standard model Cisco UCS Rack-Mount and Blade Servers as compute-only nodes. All current model Cisco UCS M4 generation servers, except the C880 M4, may be used as compute-only nodes connected to a Cisco HyperFlex cluster, along with a limited number of previous M3 generation servers. Any valid CPU and memory configuration is allowed in the compute-only nodes, and the servers can be configured to boot from SAN, local disks, or internal SD cards. The following servers may be used as compute-only nodes:

- Cisco UCS B200 M3 Blade Server
- Cisco UCS B200 M4 Blade Server
- Cisco UCS B260 M4 Blade Server
- Cisco UCS B420 M4 Blade Server
- Cisco UCS B460 M4 Blade Server
- Cisco UCS C220 M3 Rack-Mount Server
- Cisco UCS C220 M4 Rack-Mount Server
- Cisco UCS C240 M3 Rack-Mount Server
- Cisco UCS C240 M4 Rack-Mount Server
- Cisco UCS C460 M4 Rack-Mount Server

The following technical guidelines must be followed when adding compute-only nodes to a Cisco HyperFlex cluster:

- The number of compute-only nodes cannot exceed the number of HyperFlex converged nodes within a single HyperFlex cluster.
- The Cisco UCS infrastructure firmware revision, which provides the firmware for Cisco UCS Manager and the Fabric Interconnects, must be maintained at the minimum version required for the HyperFlex converged nodes, or higher, at all times.
- The version of VMware ESXi installed on the compute-only nodes must be compatible with the Cisco HyperFlex version in use, and it must match the version installed on the HyperFlex converged nodes.
- While the CPU models and memory capacities between the compute-only nodes and the HyperFlex converged nodes do not have to match, configuring the nodes to have similar capacities is recommended.
- Care must be taken that the addition of the compute-only nodes will not significantly impact the HyperFlex cluster by creating additional load, or by consuming too much space. Pay close attention to the space consumption and performance requirements of any net-new VMs that will run on the additional compute-only nodes, and note the current cluster performance and space utilization. If no new VMs will be created, then the current cluster performance will not be impacted.
- Mixing different models of compute-only nodes is allowed within the same cluster. Example: using Cisco UCS C220 M3 and C240 M4 servers as compute-only nodes is allowed.
- Connectivity between compute-only nodes and the HyperFlex cluster must be within the same Cisco UCS domain, and must be 10 GbE or 40 GbE. Connecting compute-only nodes from a different Cisco UCS domain is not allowed, and connecting standalone rack mount servers from outside of the Cisco UCS domain is not allowed.
- Blade servers installed in the Cisco UCS 5108 Blade Chassis can connect via 10 GbE or 40 GbE chassis links, using the Cisco UCS 2204XP, 2208XP, or 2304 model Fabric Extenders. The Fabric Extenders, also called I/O Modules (IOMs), are typically installed in pairs, and connect the 5108 chassis to the Fabric Interconnects, which provide all the networking and management for the blades. Care must be taken not to oversubscribe and saturate the chassis links.
- Mixing CPU generations will require configuring VMware Enhanced vMotion Compatibility (EVC) in order to allow vMotion to work between the compute-only nodes and the converged nodes. Enabling EVC typically requires all VMs to be powered off. If it is known ahead of time that EVC will be needed, then it is easier to enable EVC on the vCenter cluster prior to installing HyperFlex.
- Compute-only nodes can be configured to boot from SAN, local disks, or internal SD cards. No other internal storage should be present in a compute-only node. Manual configuration of the boot policy will be necessary if booting from any device other than SD cards.
- Compute-only nodes can be configured with additional vNICs or vHBAs in order to connect to supported external storage arrays via NFS, iSCSI or Fibre Channel, in the same way as HyperFlex converged nodes are allowed to do.

Cisco HyperFlex Data Platform Software

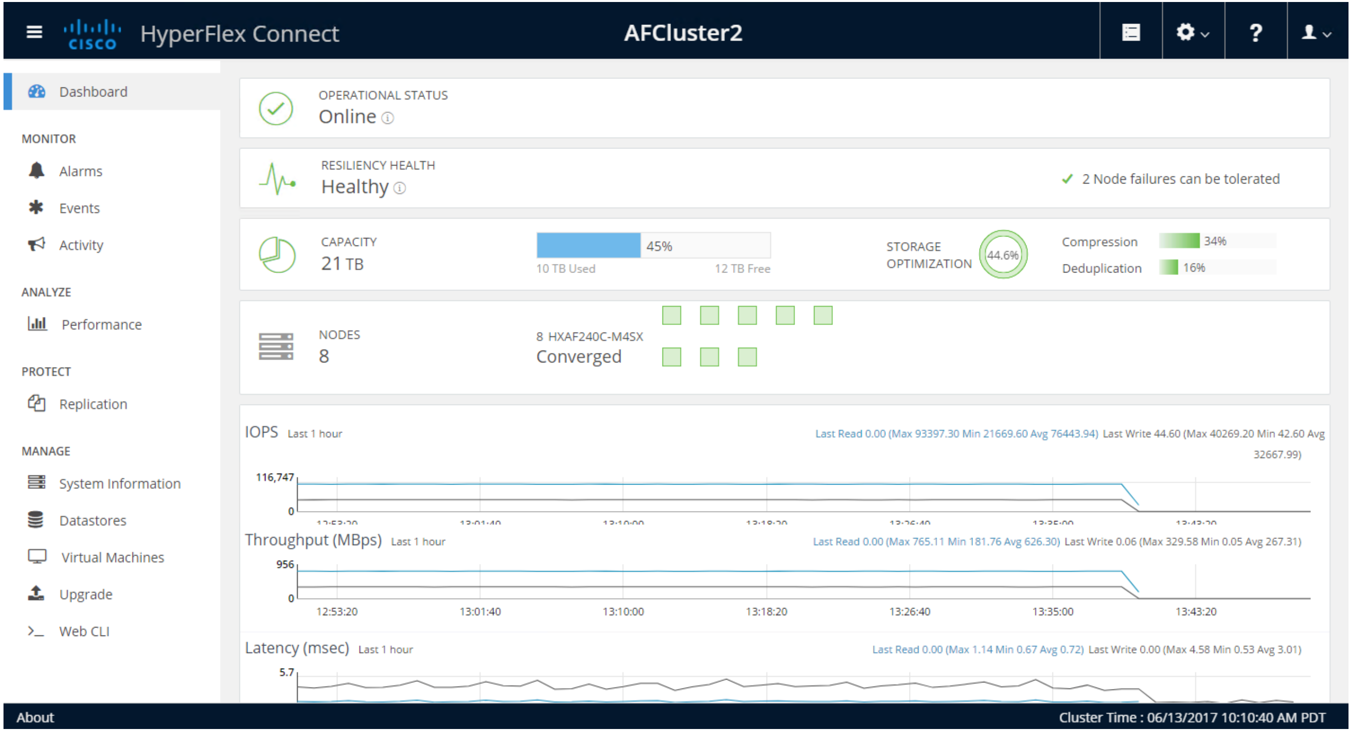
The Cisco HyperFlex HX Data Platform is a purpose-built, high-performance, distributed file system with a wide array of enterprise-class data management services. The data platform’s innovations redefine distributed storage technology, exceeding the boundaries of first-generation hyperconverged infrastructures. The data platform has all the features expected in an enterprise shared storage system, eliminating the need to configure and maintain complex Fibre Channel storage networks and devices. The platform simplifies operations and helps ensure data availability. Enterprise-class storage features include the following:

- **Data protection** creates multiple copies of the data across the cluster so that data availability is not affected if a single or multiple components fail (depending on the replication factor configured).
- **Deduplication** is always on, helping reduce storage requirements in virtualization clusters in which multiple operating system instances in guest virtual machines result in large amounts of replicated data.
- **Compression** further reduces storage requirements, reducing costs, and the log-structured file system is designed to store variable-sized blocks, reducing internal fragmentation.
- **Replication** copies virtual machine level snapshots from one Cisco HyperFlex cluster to another, to facilitate recovery from a cluster or site failure, via a failover to the secondary site of all VMs.
- **Encryption** stores all data on the caching and capacity disks in an encrypted format, to prevent accidental data loss or data theft. Key management can be done using local Cisco UCS Manager managed keys, or third-party Key Management Systems (KMS) via the Key Management Interoperability Protocol (KMIP).
- **Thin provisioning** allows large volumes to be created without requiring storage to support them until the need arises, simplifying data volume growth and making storage a “pay as you grow” proposition.
- **Fast, space-efficient clones** rapidly duplicate virtual storage volumes so that virtual machines can be cloned simply through metadata operations, with actual data copied only for write operations.
- **Snapshots** help facilitate backup and remote-replication operations, which are needed in enterprises that require always-on data availability.

Cisco HyperFlex Connect HTML5 Management Web Page

An all-new HTML 5 based Web UI is available for use as the primary management tool for Cisco HyperFlex. Through this centralized point of control for the cluster, administrators can create volumes, monitor the data platform health, and manage resource use. Administrators can also use this data to predict when the cluster will need to be scaled. To use the HyperFlex Connect UI, connect using a web browser to the HyperFlex cluster IP address: http://<hx controller cluster ip>.

Figure 12 HyperFlex Connect GUI



OPERATIONAL STATUS Online

RESILIENCY HEALTH Healthy — ✓ 2 Node failures can be tolerated

CAPACITY 21 TB — 45% — 10 TB Used — 12 TB Free

STORAGE OPTIMIZATION 44.6% — Compression 34% — Deduplication 16%

NODES 8 — 8 HXAF240C-M4SX Converged

IOPS Last 1 hour — Last Read 0.00 (Max 93397.30 Min 21669.60 Avg 76443.94) Last Write 44.60 (Max 40269.20 Min 42.60 Avg 32667.99)

Throughput (MBps) Last 1 hour — Last Read 0.00 (Max 765.11 Min 181.76 Avg 626.30) Last Write 0.06 (Max 329.58 Min 0.05 Avg 267.31)

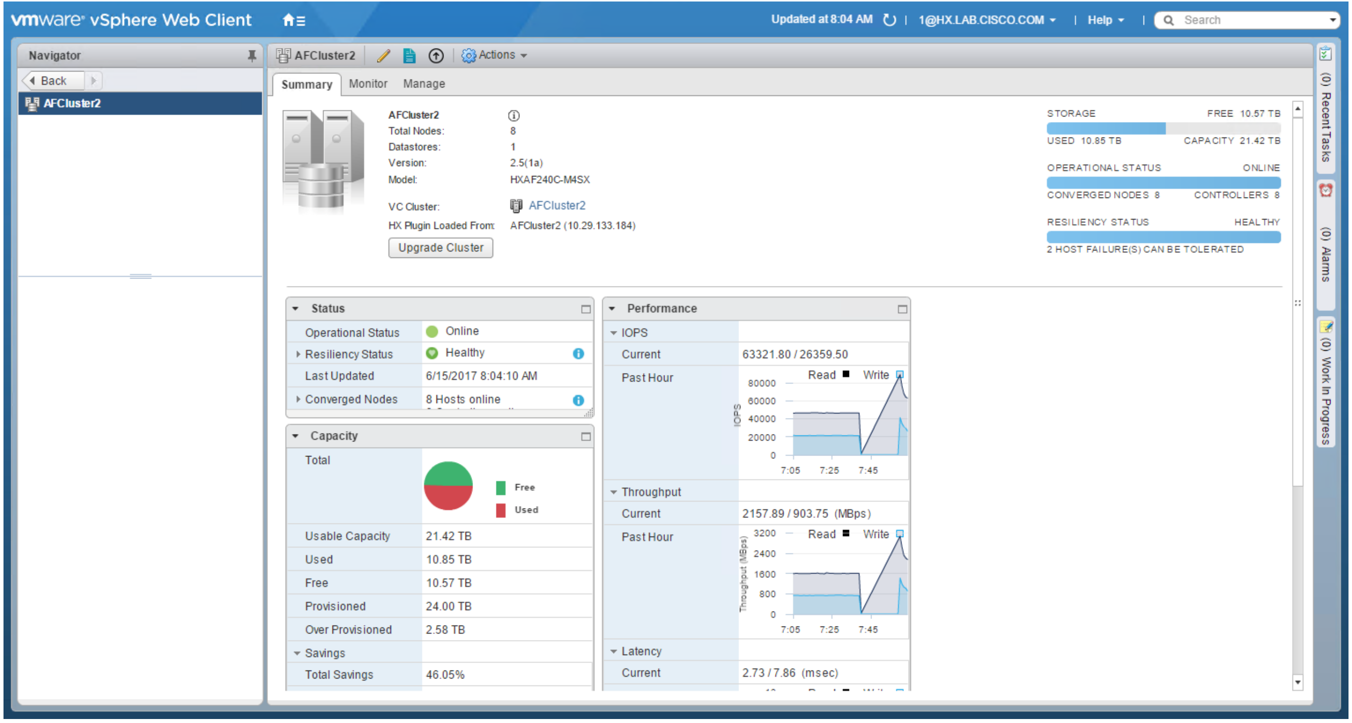
Latency (msec) Last 1 hour — Last Read 0.00 (Max 1.14 Min 0.67 Avg 0.72) Last Write 0.00 (Max 4.58 Min 0.53 Avg 3.01)

Cluster Time : 06/13/2017 10:10:40 AM PDT

Cisco HyperFlex HX Data Platform Administration Plug-in

The Cisco HyperFlex HX Data Platform is also administered secondarily through a VMware vSphere web client plug-in.

Figure 13 HyperFlex Web Client Plugin



AFCluster2	
Total Nodes:	8
Datastores:	1
Version:	2.5(1a)
Model:	HXAF240C-M4SX
VC Cluster:	AFCluster2
HX Plugin Loaded From:	AFCluster2 (10.29.133.184)

STORAGE FREE 10.57 TB — USED 10.85 TB — CAPACITY 21.42 TB

OPERATIONAL STATUS ONLINE — CONVERGED NODES 8 — CONTROLLERS 8

RESILIENCY STATUS HEALTHY — 2 HOST FAILURE(S) CAN BE TOLERATED

Status	
Operational Status	Online
Resiliency Status	Healthy
Last Updated	6/15/2017 8:04:10 AM
Converged Nodes	8 Hosts online

Capacity	
Total	Free Used
Usable Capacity	21.42 TB
Used	10.85 TB
Free	10.57 TB
Provisioned	24.00 TB
Over Provisioned	2.58 TB
Savings	
Total Savings	46.05%

Performance	
IOPS	
Current	63321.80 / 26359.50
Past Hour	
Throughput	
Current	2157.89 / 903.75 (MBps)
Past Hour	
Latency	
Current	2.73 / 7.86 (msec)

Cisco HyperFlex HX Data Platform Controller

A Cisco HyperFlex HX Data Platform controller resides on each node and implements the distributed file system. The controller runs as software in user space within a virtual machine, and intercepts and handles all I/O from the guest virtual machines. The Storage Controller Virtual Machine (SCVM) uses the VMDirectPath I/O feature to provide PCI passthrough control of the physical server's SAS disk controller. This method gives the controller VM full control of the physical disk resources, utilizing the SSD drives as a read/write caching layer, and the HDDs or SDDs as a capacity layer for distributed storage. The controller integrates the data platform into the VMware vSphere cluster through the use of three preinstalled VMware ESXi vSphere Installation Bundles (VIBs) on each node:

- **IO Visor:** This VIB provides a network file system (NFS) mount point so that the ESXi hypervisor can access the virtual disks that are attached to individual virtual machines. From the hypervisor's perspective, it is simply attached to a network file system. The IO Visor intercepts guest VM IO traffic, and intelligently redirects it to the HyperFlex SCVMs.
- **VMware API for Array Integration (VAAI):** This storage offload API allows vSphere to request advanced file system operations such as snapshots and cloning. The controller implements these operations via manipulation of the filesystem metadata rather than actual data copying, providing rapid response, and thus rapid deployment of new environments.
- **stHypervisorSvc:** This VIB adds enhancements and features needed for HyperFlex data protection and VM replication.

Data Operations and Distribution

The Cisco HyperFlex HX Data Platform controllers handle all read and write operation requests from the guest VMs to their virtual disks (VMDK) stored in the distributed datastores in the cluster. The data platform distributes the data across multiple nodes of the cluster, and also across multiple capacity disks of each node, according to the replication level policy selected during the cluster setup. This method avoids storage hotspots on specific nodes, and on specific disks of the nodes, and thereby also avoids networking hotspots or congestion from accessing more data on some nodes versus others.

Replication Factor

The policy for the number of duplicate copies of each storage block is chosen during cluster setup, and is referred to as the replication factor (RF).

- **Replication Factor 3:** For every I/O write committed to the storage layer, 2 additional copies of the blocks written will be created and stored in separate locations, for a total of 3 copies of the blocks. Blocks are distributed in such a way as to ensure multiple copies of the blocks are not stored on the same disks, nor on the same nodes of the cluster. This setting can tolerate simultaneous failures of 2 entire nodes in a cluster of 5 nodes or greater, without losing data and resorting to restore from backup or other recovery processes. RF3 is recommended for all production systems.
- **Replication Factor 2:** For every I/O write committed to the storage layer, 1 additional copy of the blocks written will be created and stored in separate locations, for a total of 2 copies of the blocks. Blocks are distributed in such a way as to ensure multiple copies of the blocks are not stored on the same disks, nor on the same nodes of the cluster. This setting can tolerate a failure of 1 entire node without losing data and resorting to restore from backup or other recovery processes. RF2 is suitable for non-production systems, or environments where the extra data protection is not needed.

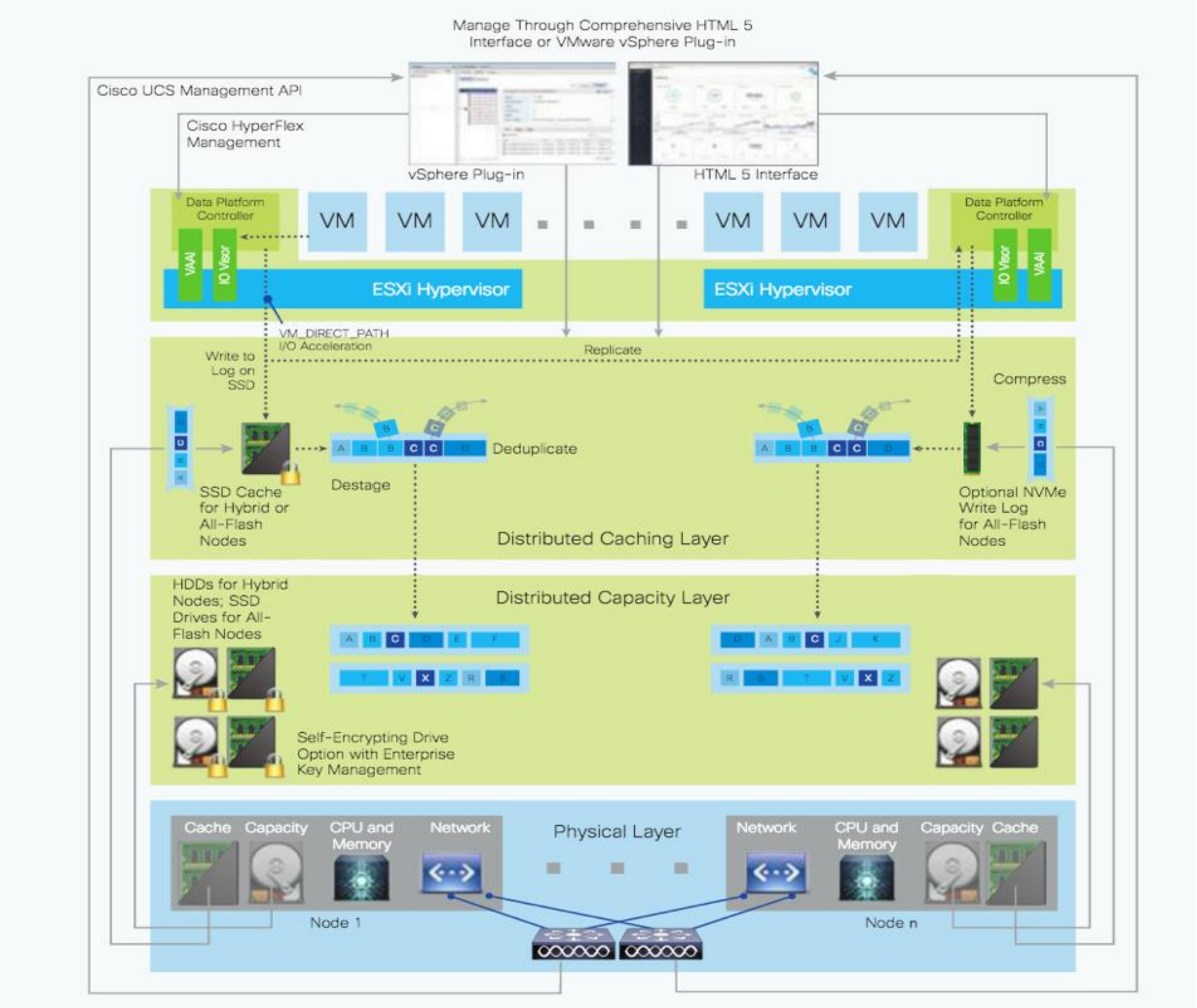
Data Write and Compression Operations

Internally, the contents of each virtual disk are subdivided and spread across multiple servers by the HXDP software. For each write operation, the data is intercepted by the IO Visor module on the node where the VM is running, a primary node is determined for that particular operation via a hashing algorithm, and then sent to the primary node via the network. The primary node compresses the data in real time, writes the compressed data to its caching SSD, and replica copies of that compressed data are written to the caching SSD of the remote nodes in the cluster, according to the replication factor setting. For example, at RF=3 a write will be written to the primary node for that virtual disk address, and two additional writes will be committed in parallel on two other nodes. Because the virtual disk contents have been divided and spread out, the hashing algorithm also means that all writes will be spread across all nodes, avoiding the problems with data locality and “noisy” VMs consuming all the IO capacity of a single node. The write operation will not be acknowledged until all three copies are written to the caching layer SSDs. Written data is also cached in a write log area resident in memory in the controller VM, along with the write log on the caching SSDs. This process speeds up read requests when reads are requested of data that has recently been written.

Data Destaging and Deduplication

The Cisco HyperFlex HX Data Platform constructs multiple write caching segments on the caching SSDs of each node in the distributed cluster. As write cache segments become full, and based on policies accounting for I/O load and access patterns, those write cache segments are locked and new writes roll over to a new write cache segment. The data in the now locked cache segment is destaged to the HDD capacity layer of the nodes for the Hybrid system or to the SDD capacity layer of the nodes for the All-Flash system. During the destaging process, data is deduplicated before being written to the capacity storage layer, and the resulting data can now be written to the HDDs or SDDs of the server. On hybrid systems, the now deduplicated and compressed data is also written to the dedicated read cache area of the caching SSD, which speeds up read requests of data that has recently been written. When the data is destaged to a HDD, it is written in a single sequential operation, avoiding disk head seek thrashing on the spinning disks and accomplishing the task in the minimal amount of time. Since the data is already deduplicated and compressed before being written, the platform avoids additional I/O overhead often seen on competing systems, which must later do a read/dedupe/compress/write cycle. Deduplication, compression and destaging take place with no delays or I/O penalties to the guest VMs making requests to read or write data, which benefits both the HDD and SDD configurations.

Figure 14 HyperFlex HX Data Platform Data Movement


Manage Through Comprehensive HTML 5 Interface or VMware vSphere Plug-in
Cisco UCS Management API
Cisco HyperFlex Management
vSphere Plug-in
HTML 5 Interface
Data Platform Controller
VAAI
IO Visor
VM
VM
VM
VM
VM
VM
Data Platform Controller
IO Visor
VAAI
ESXi Hypervisor
ESXi Hypervisor
VM_DIRECT_PATH I/O Acceleration
Write to Log on SSD
Replicate
Compress
Deduplicate
Destage
SSD Cache for Hybrid or All-Flash Nodes
Optional NVMe Write Log for All-Flash Nodes
Distributed Caching Layer
HDDs for Hybrid Nodes; SSD Drives for All-Flash Nodes
Distributed Capacity Layer
Self-Encrypting Drive Option with Enterprise Key Management
Cache
Capacity
CPU and Memory
Network
Physical Layer
Network
CPU and Memory
Capacity
Cache
Node 1
Node n

Data Read Operations

For data read operations, data may be read from multiple locations. For data that was very recently written, the data is likely to still exist in the write log of the local platform controller memory, or the write log of the local caching layer disk. If local write logs do not contain the data, the distributed filesystem metadata will be queried to see if the data is cached elsewhere, either in write logs of remote nodes, or in the dedicated read cache area of the local and remote caching SSDs of hybrid nodes. Finally, if the data has not been accessed in a significant amount of time, the filesystem will retrieve the requested data from the distributed capacity layer. As requests for reads are made to the distributed filesystem and the data is retrieved from the capacity layer, the caching SSDs of hybrid nodes populate their dedicated read cache area to speed up subsequent requests for the same data. This multi-tiered distributed system with several layers of caching techniques, ensures that data is served at the highest possible speed, leveraging the caching SSDs of the nodes fully and equally. All-flash configurations, however, do not employ a dedicated read cache because such caching does not provide any performance benefit; the persistent data copy already resides on high-performance SSDs.

In summary, the Cisco HyperFlex HX Data Platform implements a distributed, log-structured file system that performs data operations via two configurations:

- In a Hybrid configuration, the data platform provides a caching layer using SSDs to accelerate read requests and write responses, and it implements a storage capacity layer using HDDs.
- In an All-Flash configuration, the data platform provides a dedicated caching layer using high endurance SSDs to accelerate write responses, and it implements a storage capacity layer also using SSDs. Read requests are fulfilled directly from the capacity SSDs, as a dedicated read cache is not needed to accelerate read operations.

Solution Design

Requirements

The following sections detail the physical hardware, software revisions, and firmware versions required to install the Cisco HyperFlex system. Maximum cluster size of 32 nodes can be obtained by combining 16 converged nodes (storage nodes), and 16 compute-only nodes (all-flash only, hybrid cluster maximum size is 8 converged nodes, plus 8 compute-only nodes).

Physical Components

Table 1 HyperFlex System Components

Component	Hardware Required
Fabric Interconnects	Two Cisco UCS 6248UP Fabric Interconnects, or Two Cisco UCS 6296UP Fabric Interconnects, or Two Cisco UCS 6332 Fabric Interconnects, or Two Cisco UCS 6332-16UP Fabric Interconnects
Servers	Three to Sixteen Cisco HyperFlex HXAF220c-M4S All-Flash rack servers, or Three to Sixteen HyperFlex HXAF240c-M4SX All-Flash rack servers, or Three to Eight Cisco HyperFlex HX220c-M4S Hybrid rack servers, or Three to Eight Cisco HyperFlex HX240c-M4SX Hybrid rack servers

Table 2 lists some of the available processor models for the Cisco HX-Series servers. For a complete list and more information please refer to the links below:

Compare models:

http://www.cisco.com/c/en/us/products/hyperconverged-infrastructure/hyperflex-hx-series/index.html#compare-models

HXAF220c-M4S Spec Sheet:

http://www.cisco.com/c/dam/en/us/products/collateral/hyperconverged-infrastructure/hyperflex-hx-series/HXAF220c_M4_SpecSheet.pdf

HXAF240c-M4S Spec Sheet:

http://www.cisco.com/c/dam/en/us/products/collateral/hyperconverged-infrastructure/hyperflex-hx-series/HXAF240c_M4_SpecSheet.pdf

HX220c-M4S Spec Sheet:

http://www.cisco.com/c/dam/en/us/products/collateral/hyperconverged-infrastructure/hyperflex-hx-series/datasheet-c78-736817.pdf

HX240c-M4SX Spec Sheet:

http://www.cisco.com/c/dam/en/us/products/collateral/hyperconverged-infrastructure/hyperflex-hx-series/datasheet-c78-736818.pdf

Table 2 HyperFlex Server CPU Options

Model	Cores	Clock Speed	Cache	RAM Speed
E5-2699 v4	22	2.2 GHz	55 MB	2400 MHz
E5-2698 v4	20	2.2 GHz	50 MB	2400 MHz
E5-2697 v4	18	2.3 GHz	45 MB	2400 MHz
E5-2690 v4	14	2.6 GHz	35 MB	2400 MHz
E5-2683 v4	16	2.1 GHz	40 MB	2400 MHz
E5-2680 v4	14	2.4 GHz	35 MB	2400 MHz
E5-2667 v4	8	3.2 GHz	25 MB	2400 MHz
E5-2660 v4	14	2.0 GHz	35 MB	2400 MHz
E5-2650 v4	12	2.2 GHz	30 MB	2400 MHz
E5-2640 v4	10	2.4GHz	25 MB	2133 MHz

Model	Cores	Clock Speed	Cache	RAM Speed
E5-2630 v4	10	2.2 GHz	25 MB	2133 MHz
E5-2620 v4	8	2.1 GHz	20 MB	2133 MHz

Table 3 lists the hardware component options for the HXAF220c-M4S server model:

Table 3 HXAF220c-M4S Server Options

HXAF220c-M4S options		Hardware Required
Processors		Chose a matching pair from the previous table of CPU options
Memory		128 GB to 1.5 TB of total memory using 16 GB, 32 GB, or 64 GB DDR4 2400 MHz 1.2v modules, or 64 GB DDR4 2133 MHz 1.2v modules
Disk Controller		Cisco 12Gbps Modular SAS HBA
SSDs	Standard	• One 120 GB 2.5 Inch Enterprise Value 6G SATA SSD, or One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD • One 400 GB 2.5 Inch Enterprise Performance 12G SAS SSD, or One 800 GB 2.5 Inch Enterprise Performance 12G SAS SSD, or One 400 GB 2.5 Inch Enterprise Performance NVMe SSD • Six 3.8 TB 2.5 Inch Enterprise Value 6G SATA SSDs, or Six 960 GB 2.5 Inch Enterprise Value 6G SATA SSDs
	SED	• One 120 GB 2.5 Inch Enterprise Value 6G SATA SSD, or One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD • Seven 800 GB 2.5 Inch Enterprise Performance 12G SAS SED SSDs
Network		Cisco UCS VIC1227 VIC MLOM, or Cisco UCS VIC1387 VIC MLOM
Boot Devices		Two 64GB Cisco FlexFlash SD Cards for UCS Servers

Table 4 lists the hardware component options for the HXAF240c-M4SX server model:

Table 4 HXAF240c-M4S Server Options

HXAF240c-M4SX Options		**Hardware Required**
Processors		Chose a matching pair from the previous table of CPU options.
Memory		128 GB to 1.5 TB of total memory using 16 GB, 32 GB, or 64 GB DDR4 2400 MHz 1.2v modules, or 64 GB DDR4 2133 MHz 1.2v modules
Disk Controller		Cisco 12Gbps Modular SAS HBA
SSD	Standard	• One 120 GB 2.5 Inch Enterprise Value 6G SATA SSD, or One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD (in the rear disk enclosure) • One 400 GB 2.5 Inch Enterprise Performance 12G SAS SSD, or One 800 GB 2.5 Inch Enterprise Performance 12G SAS SSD, or One 400 GB 2.5 Inch Enterprise Performance NVMe SSD • Six to Twenty-three 3.8 TB 2.5 Inch Enterprise Value 6G SATA SSDs, or Six to Twenty-three 960 GB 2.5 Inch Enterprise Value 6G SATA SSDs
	SED	• One 120 GB 2.5 Inch Enterprise Value 6G SATA SSD, or One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD (in a front disk bay) • Seven to Twenty-three 800 GB 2.5 Inch Enterprise Performance 12G SAS SED SSDs
Network		Cisco UCS VIC1227 VIC MLOM, or Cisco UCS VIC1387 VIC MLOM
Boot Devices		Two 64GB Cisco FlexFlash SD Cards for UCS Servers

Table 5 lists the hardware component options for the HX220c-M4S server model:

Table 5 HX220c-M4S Server Options

HX220c-M4S Options	**Hardware Required**
Processors	Chose a matching pair from the previous table of CPU options.
Memory	128 GB to 1.5 TB of total memory using 16 GB, 32 GB, or 64 GB DDR4 2400 MHz 1.2v modules, or 64 GB DDR4 2133 MHz 1.2v modules
Disk Controller	Cisco 12Gbps Modular SAS HBA

HX220c-M4S Options		Hardware Required
SSDs	Standard	- One 120 GB 2.5 Inch Enterprise Value 6G SATA SSD, or One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD - One 480 GB 2.5 Inch Enterprise Performance 6G SATA SSD
	SED	- One 120 GB 2.5 Inch Enterprise Value 6G SATA SSD, or One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD - One 800 GB 2.5 Inch Enterprise Performance 12G SAS SED SSDs
HDDs	Standard	Six 1.2 TB SAS 12Gbps 10K rpm SFF HDD
	SED	Six 1.2 TB SAS 12Gbps 10K rpm SFF SED HDD
Network		Cisco UCS VIC1227 VIC MLOM, or Cisco UCS VIC1387 VIC MLOM
Boot Devices		Two 64GB Cisco FlexFlash SD Cards for Cisco UCS Servers

Table 6 lists the hardware component options for the HX240c-M4SX server model:

Table 6 HX240c-M4SX Server Options

HX240c-M4SX Options		Hardware Required
Processors		Chose a matching pair from the previous table of CPU options.
Memory		128 GB to 1.5 TB of total memory using 16 GB, 32 GB, or 64 GB DDR4 2400 MHz 1.2v modules, or 64 GB DDR4 2133 MHz 1.2v modules
Disk Controller		Cisco 12Gbps Modular SAS HBA
SSDs	Standard	- One 120 GB 2.5 Inch Enterprise Value 6G SATA SSD, or One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD (in the rear disk enclosure) - One 1.6 TB 2.5 Inch Enterprise Performance 6G SATA SSD

HX240c-M4SX Options		Hardware Required
	SED	• One 120 GB 2.5 Inch Enterprise Value 6G SATA SSD, or One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD (in a front disk bay) • One 1.6 TB 2.5 Inch Enterprise Performance 12G SAS SED SSD
HDDs	Standard	Minimum of six, up to twenty-three 1.2 TB SAS 12Gbps 10K rpm SFF HDD
	SED	Minimum of six, up to twenty-two 1.2 TB SAS 12Gbps 10K rpm SFF SED HDD
Network		Cisco UCS VIC1227 VIC MLOM, or Cisco UCS VIC1387 VIC MLOM
Boot Devices		Two 64GB Cisco FlexFlash SD Cards for Cisco UCS Servers

Software Components

Table 7 lists the software components and the versions required for the Cisco HyperFlex system:

Table 7 **Software Components**

Component	Software Required
Hypervisor	VMware ESXi 6.0 U1b, 6.0 U2, 6.0 U2 Patch 3, 6.0 U2 Patch 4, 6.0 U3 or VMware ESXi 6.5 Patch 1a ESXi 6.5 Patch 1a is recommended (CISCO Custom Image for ESXi 6.5 Patch 1a: HX-Vmware-ESXi-650-5224529-Cisco-Custom-6.5.0.3.iso) **Note:** Use of a published Cisco custom ESXi ISO installer file is required when reinstalling ESXi, or upgrading to a newer version. **Note:** VMware vSphere Standard, Essentials Plus, ROBO, Enterprise or Enterprise Plus licensing is required from VMware.
Management Server	VMware vCenter Server for Windows or vCenter Server Appliance 6.0 U1 or later. Refer to http://www.vmware.com/resources/compatibility/sim/interop_matrix.php for interoperability of your ESXi version and vCenter Server. **Note:** Using ESXi 6.5 on the HyperFlex nodes also requires using vCenter Server 6.5.
Cisco HyperFlex HX Data Platform	Cisco HyperFlex HX Data Platform Software 2.5.1b
Cisco UCS Firmware	Cisco UCS Infrastructure software, B-Series and C-Series bundles, revision 3.1(3c) **Note: Cisco** UCS Firmware 3.1(2g) is the minimum required for non-encrypting clusters, but 3.1(3c) is required to enable use of SED disks. Using version 3.1(3c) or later is highly recommended.

Considerations

Version Control

The software revisions listed in Table 7 are the only valid and supported configuration at the time of the publishing of this validated design. Special care must be taken not to alter the revision of the hypervisor, vCenter server, Cisco HX platform software, or the Cisco UCS firmware without first consulting the appropriate release notes and compatibility matrixes to ensure that the system is not being modified into an unsupported configuration.

vCenter Server

This document does not cover the installation and configuration of VMware vCenter Server for Windows, or the vCenter Server Appliance. The vCenter Server must be installed and operational prior to the installation of the Cisco HyperFlex HX Data Platform software. The following best practice guidance applies to installations of HyperFlex 2.5:

- Do not modify the default TCP port settings of the vCenter installation. Using non-standard ports can lead to failures during the installation.
- It is recommended to build the vCenter server on a physical server or in a virtual environment outside of the HyperFlex cluster. Building the vCenter server as a virtual machine inside the HyperFlex cluster environment is highly discouraged. There is a tech note for multiple methods of deployment if no external vCenter server is already available: http://www.cisco.com/c/en/us/td/docs/hyperconverged_systems/HyperFlex_HX_DataPlatformSoftware/TechNotes/Nested_vcenter_on_hyperflex.html

Scale

Cisco HyperFlex clusters currently scale up from a minimum of 3 to a maximum of 16 converged nodes per all-flash cluster, i.e. 16 nodes providing storage resources to the HX Distributed Filesystem. For clusters with HX hybrid nodes, the limit is 8 converged nodes. For the compute intensive “extended” cluster design, a configuration with 3-16 Cisco HX-series all-flash converged nodes can be combined with up to 16 compute nodes. Since the quantity of compute-only nodes cannot exceed the quantity of converged nodes, in clusters with hybrid HX converged servers, the maximum number of compute-only nodes is 8. Cisco blade servers and rack mount servers can be used for the compute only nodes. It is required that the number of compute-only nodes should always be less than or equal to number of converged nodes.

Once the maximum size of a cluster has been reached, the environment can be “scaled out” by adding additional HX model servers to the Cisco UCS domain, installing an additional HyperFlex cluster on them, and controlling them via the same vCenter server. A maximum of 8 clusters can be created in a single UCS domain, and up to 100 HyperFlex clusters can be managed by a single vCenter server.

Capacity

Overall usable cluster capacity is based on a number of factors. The number of nodes in the cluster must be considered, plus the number and size of the capacity layer disks. Caching disk sizes are not calculated as part of the cluster capacity. The replication factor of the HyperFlex HX Data Platform also affects the cluster capacity as it defines the number of copies of each block of data written.

Disk drive manufacturers have adopted a size reporting methodology using calculation by powers of 10, also known as decimal prefix. As an example, a 120 GB disk is listed with a minimum of 120 x 10^9 bytes of usable addressable capacity, or 120 billion bytes. However, many operating systems and filesystems report their space based on standard computer binary exponentiation, or calculation by powers of 2, also called binary prefix. In this example, 2^10 or 1024 bytes make up a kilobyte, 2^10 kilobytes make up a megabyte, 2^10 megabytes make up a gigabyte, and 2^10 gigabytes make up a terabyte. As the values increase, the disparity between the two systems of measurement and notation get worse, at the terabyte level, the deviation between a decimal prefix value and a binary prefix value is nearly 10%.

The International System of Units (SI) defines values and decimal prefix by powers of 10 as follows:

Table 8 SI Unit Values (Decimal Prefix)

Value	Symbol	Name
1000 bytes	kB	Kilobyte
1000 kB	MB	Megabyte
1000 MB	GB	Gigabyte
1000 GB	TB	Terabyte

The International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) defines values and binary prefix by powers of 2 in ISO/IEC 80000-13:2008 Clause 4 as follows:

Table 9 IEC unit values (binary prefix)

Value	Symbol	Name
1024 bytes	KiB	Kibibyte
1024 KiB	MiB	Mebibyte
1024 MiB	GiB	Gibibyte
1024 GiB	TiB	Tebibyte

For the purpose of this document, the decimal prefix numbers are used only for raw disk capacity as listed by the respective manufacturers. For all calculations where raw or usable capacities are shown from the perspective of the HyperFlex software, filesystems or operating systems, the binary prefix numbers are used. This is done primarily to show a consistent set of values as seen by the end user from within the HyperFlex vCenter Web Plugin and HyperFlex Connect GUI when viewing cluster capacity, allocation and consumption, and also within most operating systems.

Table 10 lists a set of HyperFlex HX Data Platform cluster usable capacity values, using binary prefix, for an array of cluster configurations. These values are useful for determining the appropriate size of HX cluster to initially purchase, and how much capacity can be gained by adding capacity disks. The calculations for these values are listed in Appendix A: Cluster Capacity Calculations. The HyperFlex tool to help with sizing is listed in Appendix B: HyperFlex Sizer.

Table 10 Cluster Usable Capacities

HX-Series Server Model	Node Quantity	Capacity Disk Size (each)	Capacity Disk Quantity (per node)	Cluster Usable Capacity at RF=2	Cluster Usable Capacity at RF=3
HXAF220c-M4S	8	3.8 TB	6	77.1 TiB	51.4 TiB
		960 GB	6	19.3 TiB	12.9 TiB
		800 GB	6	16.1 TiB	10.7 TiB
HXAF240c-M4SX	8	3.8 TB	6	77.1 TiB	51.4 TiB
			15	192.8 TiB	128.5 TiB
			23	295.7 TiB	197.1 TiB
		960 GB	6	19.3 TiB	12.9 TiB
			15	48.2 TiB	32.1 TiB
			23	73.9 TiB	49.3 TiB
		800 GB	6	16.1 TiB	10.7 TiB
			15	40.2 TiB	26.8 TiB
			22	58.9 TiB	39.3 TiB
HX220c-M4S	8	1.2 TB	6	24.1 TiB	16.1 TiB
HX240c-M4SX	8	1.2 TB	6	24.1 TiB	16.1 TiB
			15	60.2 TiB	40.2 TiB
			23	92.4 TiB	61.6 TiB

Physical Topology

Topology Overview

The Cisco HyperFlex system is composed of a pair of Cisco UCS Fabric Interconnects along with up to sixteen HX-Series rack-mount servers per cluster. Up to sixteen compute-only servers can also be added per HyperFlex cluster. Adding Cisco UCS rack-mount servers and/or Cisco UCS 5108 Blade chassis, which house Cisco UCS blade servers, allows for additional compute resources in an extended cluster design. Up to eight separate HX clusters can be installed under a single pair of Fabric Interconnects. The two Fabric Interconnects both connect to every HX-Series rack mount server, and both connect to every Cisco UCS 5108 blade chassis, and Cisco UCS rack-mount server. Upstream network connections, also referred to as "northbound" network connections are made from the Fabric Interconnects to the customer datacenter network at the time of installation.

Figure 15 HyperFlex Standard Cluster Topology

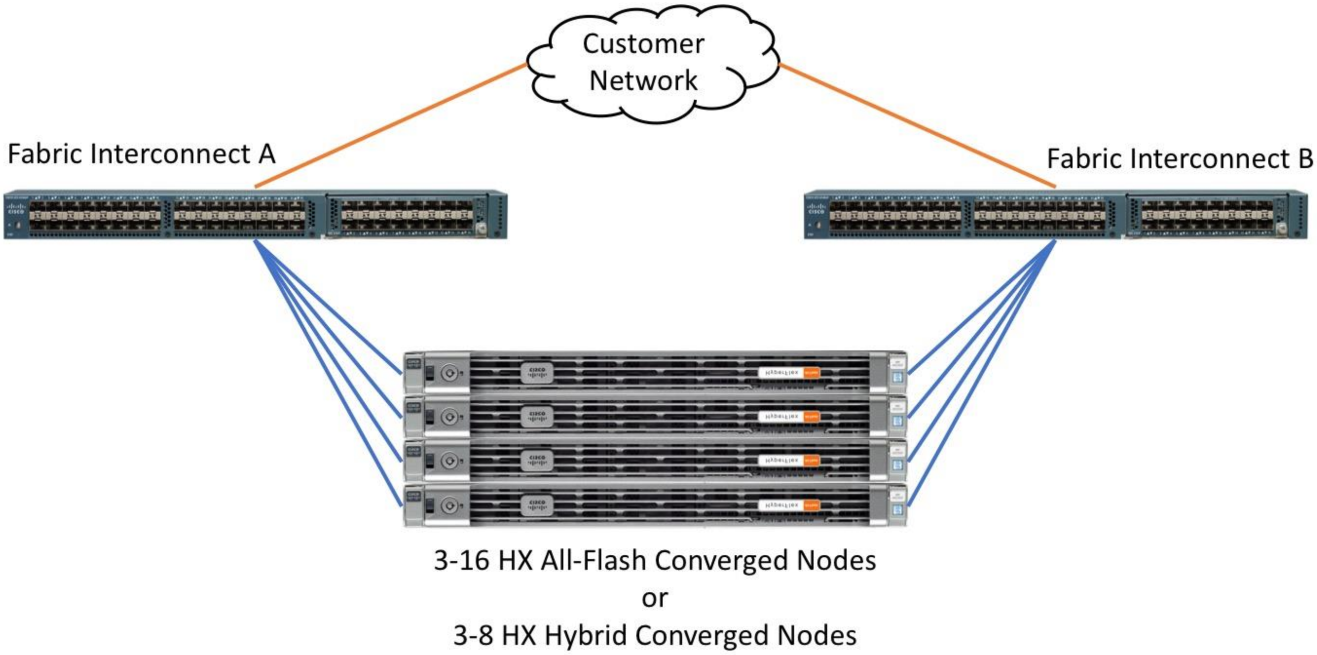
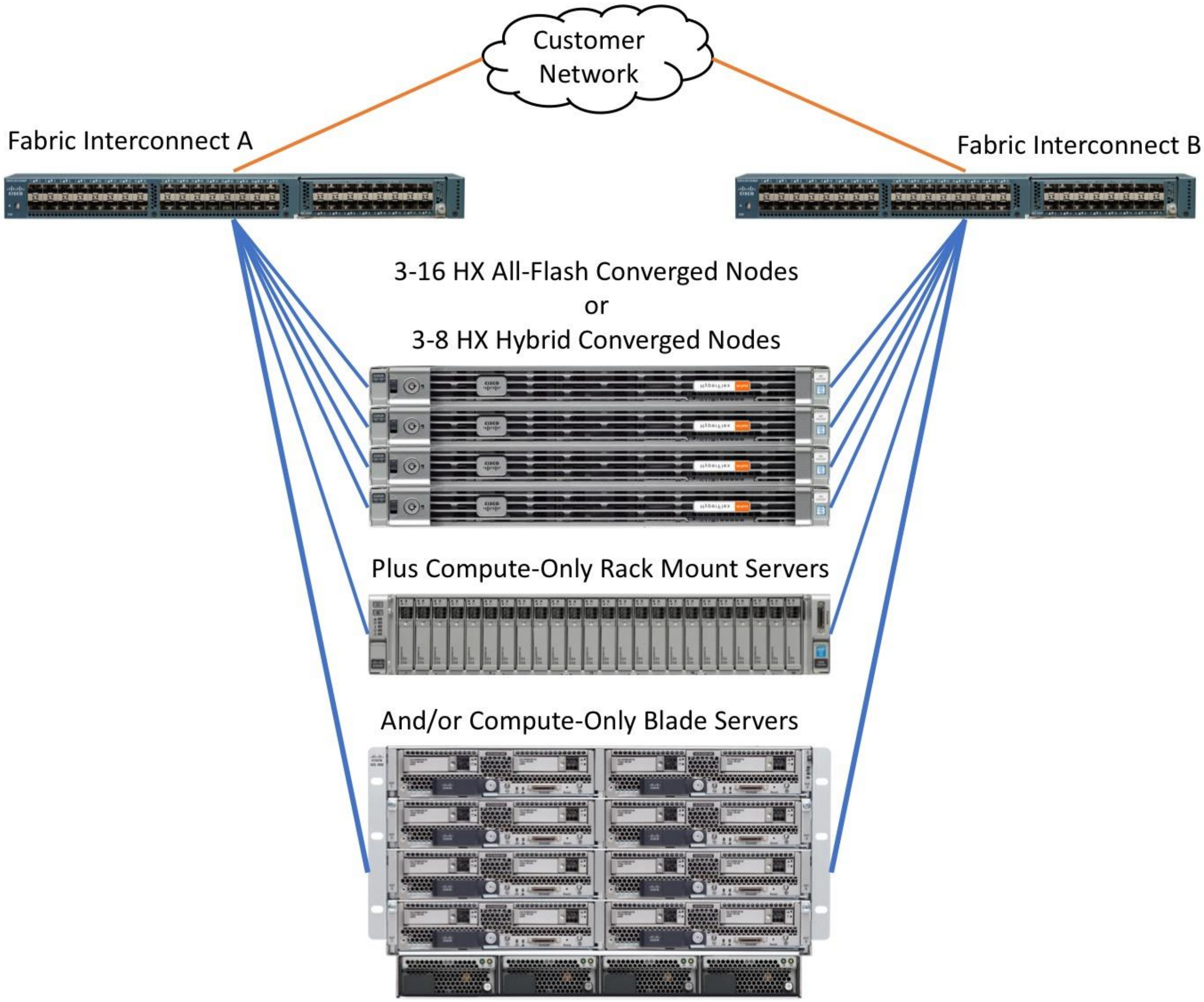

Customer Network
Fabric Interconnect A
Fabric Interconnect B
3-16 HX All-Flash Converged Nodes
or
3-8 HX Hybrid Converged Nodes

Figure 16 HyperFlex Extended Cluster Topology


Customer Network
Fabric Interconnect A
Fabric Interconnect B
3-16 HX All-Flash Converged Nodes
or
3-8 HX Hybrid Converged Nodes
Plus Compute-Only Rack Mount Servers
And/or Compute-Only Blade Servers

Fabric Interconnects

Fabric Interconnects (FI) are deployed in pairs, wherein the two units operate as a management cluster, while forming two separate network fabrics, referred to as the A side and B side fabrics. Therefore, many design elements will refer to FI A or FI B, alternatively called fabric A or fabric B. Both Fabric Interconnects are active at all times, passing data on both network fabrics for a redundant and highly available configuration. Management services, including Cisco UCS Manager, are also provided by the two FIs but in a clustered manner, where one FI is the primary, and one is secondary, with a roaming clustered IP address. This primary/secondary relationship is only for the management cluster, and has no effect on data transmission.

Fabric Interconnects have the following ports, which must be connected for proper management of the Cisco UCS domain:

- **Mgmt:** A 10/100/1000 Mbps port for managing the Fabric Interconnect and the Cisco UCS domain via GUI and CLI tools. This port is also used by remote KVM, IPMI and SoL sessions to the managed servers within the domain. This is typically connected to the customer management network.

- **L1:** A cross connect port for forming the Cisco UCS management cluster. This port is connected directly to the L1 port of the paired Fabric Interconnect using a standard CAT5 or CAT6 Ethernet cable with RJ45 plugs. It is not necessary to connect this to a switch or hub.

- **L2:** A cross connect port for forming the Cisco UCS management cluster. This port is connected directly to the L2 port of the paired Fabric Interconnect using a standard CAT5 or CAT6 Ethernet cable with RJ45 plugs. It is not necessary to connect this to a switch or hub.

- **Console:** An RJ45 serial port for direct console access to the Fabric Interconnect. This port is typically used during the initial FI setup process with the included serial to RJ45 adapter cable. This can also be plugged into a terminal aggregator or remote console server device.

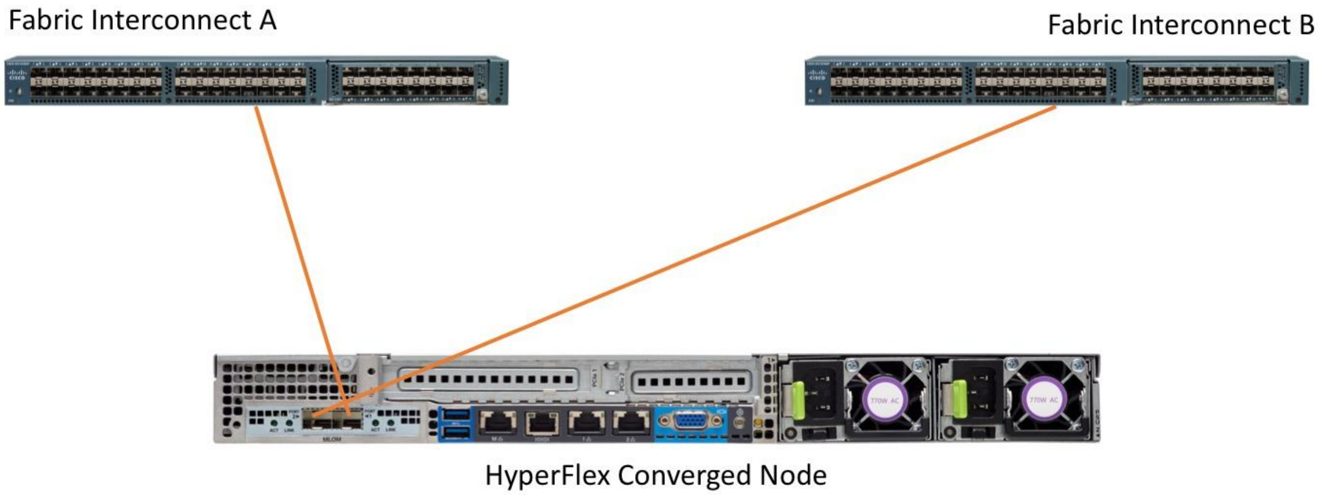
HX-Series Rack Mount Servers

The HX-Series converged servers are connected directly to the Cisco UCS Fabric Interconnects in Direct Connect mode. This option enables Cisco UCS Manager to manage the HX-Series rack mount Servers using a single cable for both management traffic and data traffic. All the HXAF220c-M4S, HXAF240c-M4SX, HX220c-M4S and HX240c-M4SX servers are configured with the Cisco VIC 1227 or Cisco VIC 1387 network interface card (NIC) installed in a modular LAN on motherboard (MLOM) slot, which has dual 10 Gigabit Ethernet (GbE) or 40 Gigabit Ethernet (GbE) ports. The standard and redundant connection practice is to connect port 1 of the VIC card (the right-hand port) to a port on FI A, and port 2 of the VIC card (the left-hand port) to a port on FI B (Figure 17). The HyperFlex installer checks for this configuration, and that all servers' cabling matches. Failure to follow this cabling practice can lead to errors, discovery failures, and loss of redundant connectivity.

Note: HyperFlex converged nodes configured with the Cisco VIC 1387 can only connect via 40 GbE to a Cisco UCS 6332 or 6332-16UP model Fabric Interconnect, using 40 GbE QSFP+ ports. Use of the Cisco QSA module to convert a 40 GbE QSFP+ port into a 10 GbE SFP+ port is not allowed.

Note: HyperFlex converged nodes configured with the Cisco VIC 1227 are not allowed to connect to the Cisco UCS 6332 or 6332-16UP model Fabric Interconnects. Using breakout ports for HyperFlex converged nodes is not allowed. In addition, HyperFlex converged nodes configured with the Cisco VIC 1227 are not allowed to connect to the 6332-16UP model Fabric Interconnect via the on-board 10 GbE unified ports.

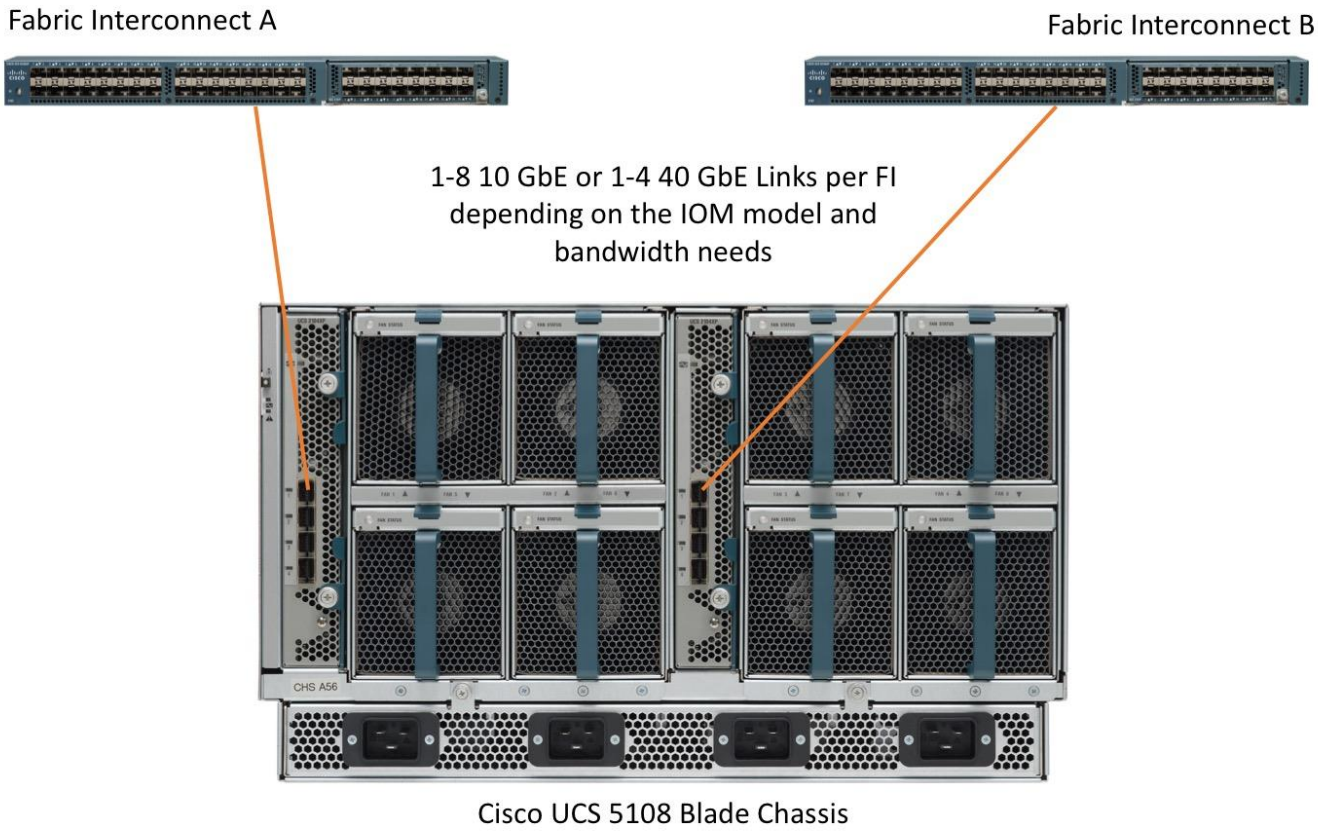
Figure 17 HX-Series Server Connectivity



Cisco UCS B-Series Blade Servers

HyperFlex extended clusters also incorporate 1-16 Cisco UCS blade servers for additional compute capacity. The blade chassis comes populated with 1-4 power supplies, and 8 modular cooling fans. In the rear of the chassis are two bays for installation of Cisco Fabric Extenders. The Fabric Extenders (also commonly called IO Modules, or IOMs) connect the chassis to the Fabric Interconnects. Internally, the Fabric Extenders connect to the Cisco VIC card installed in each blade server across the chassis backplane. The standard connection practice is to connect 1-8 10 GbE links, or 1-4 40 GbE links (depending on the IOMs and FIs purchased) from the left-side IOM, or IOM 1, to FI A, and to connect the same number of 10 GbE or 40 GbE links from the right-side IOM, or IOM 2, to FI B (Figure 18). All other cabling configurations are invalid, and can lead to errors, discovery failures, and loss of redundant connectivity.

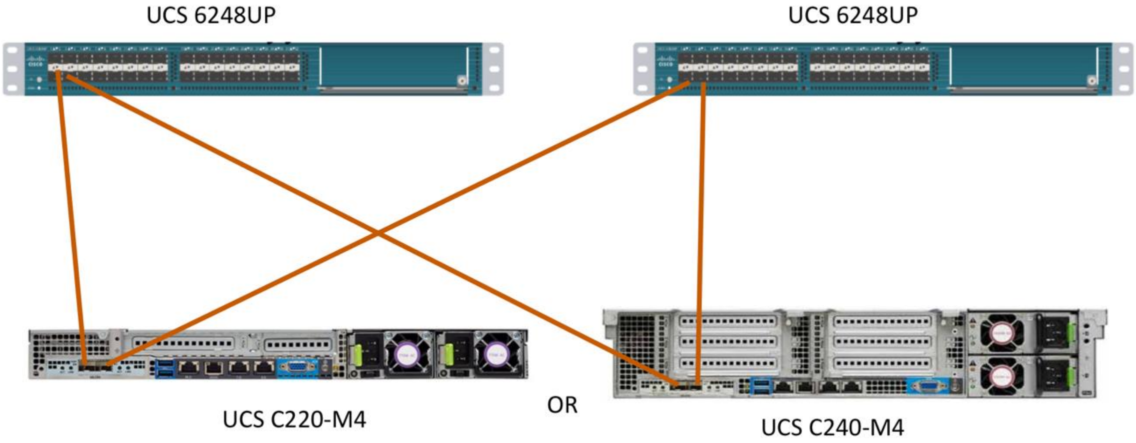
Figure 18 Cisco UCS 5108 Chassis Connectivity


Fabric Interconnect A
Fabric Interconnect B
1-8 10 GbE or 1-4 40 GbE Links per FI depending on the IOM model and bandwidth needs
CHS A56
Cisco UCS 5108 Blade Chassis

Cisco UCS C-Series Rack-Mount Servers

HyperFlex extended clusters also incorporate 1-16 Cisco UCS rack-mount servers for additional compute capacity. The C-Series rack mount servers are connected directly to the Cisco UCS Fabric Interconnects in Direct Connect mode. Internally the Cisco UCS C-Series servers are configured with the Cisco VIC 1227 or Cisco VIC 1387 network interface card (NIC) installed in a modular LAN on motherboard (MLOM) slot, which has dual 10 Gigabit Ethernet (GbE) ports or 40 Gigabit Ethernet (GbE) ports. The standard and redundant connection practice is to connect port 1 of the VIC card to a port on FI A, and port 2 of the VIC card to a port on FI B. Failure to follow this cabling practice can lead to errors, discovery failures, and loss of redundant connectivity.

Figure 19 Cisco UCS C-Series Server Connectivity



Logical Topology

Logical Network Design

The Cisco HyperFlex system has communication pathways that fall into four defined zones (Figure 20):

- **Management Zone:** This zone comprises the connections needed to manage the physical hardware, the hypervisor hosts, and the storage platform controller virtual machines (SCVM). These interfaces and IP addresses need to be available to all staff who will administer the HX system, throughout the LAN/WAN. This zone must provide access to Domain Name System (DNS) and Network Time Protocol (NTP) services, and allow Secure Shell (SSH) communication. In this zone are multiple physical and virtual components:
  - Fabric Interconnect management ports.
  - Cisco UCS external management interfaces used by the servers and blades, which answer via the FI management ports.
  - ESXi host management interfaces.
  - Storage Controller VM management interfaces.
  - A roaming HX cluster management interface.
  - Storage Controller VM replication interfaces.
  - A roaming HX cluster replication interface.
- **VM Zone:** This zone comprises the connections needed to service network IO to the guest VMs that will run inside the HyperFlex hyperconverged system. This zone typically contains multiple VLANs, that are trunked to the Cisco UCS Fabric Interconnects via the network uplinks, and tagged with 802.1Q VLAN IDs. These interfaces and IP addresses need to be available to all staff and other computer endpoints which need to communicate with the guest VMs in the HX system, throughout the LAN/WAN.
- **Storage Zone:** This zone comprises the connections used by the Cisco HX Data Platform software, ESXi hosts, and the storage controller VMs to service the HX Distributed Data Filesystem. These interfaces and IP addresses need to be able to communicate with each other at all times for proper

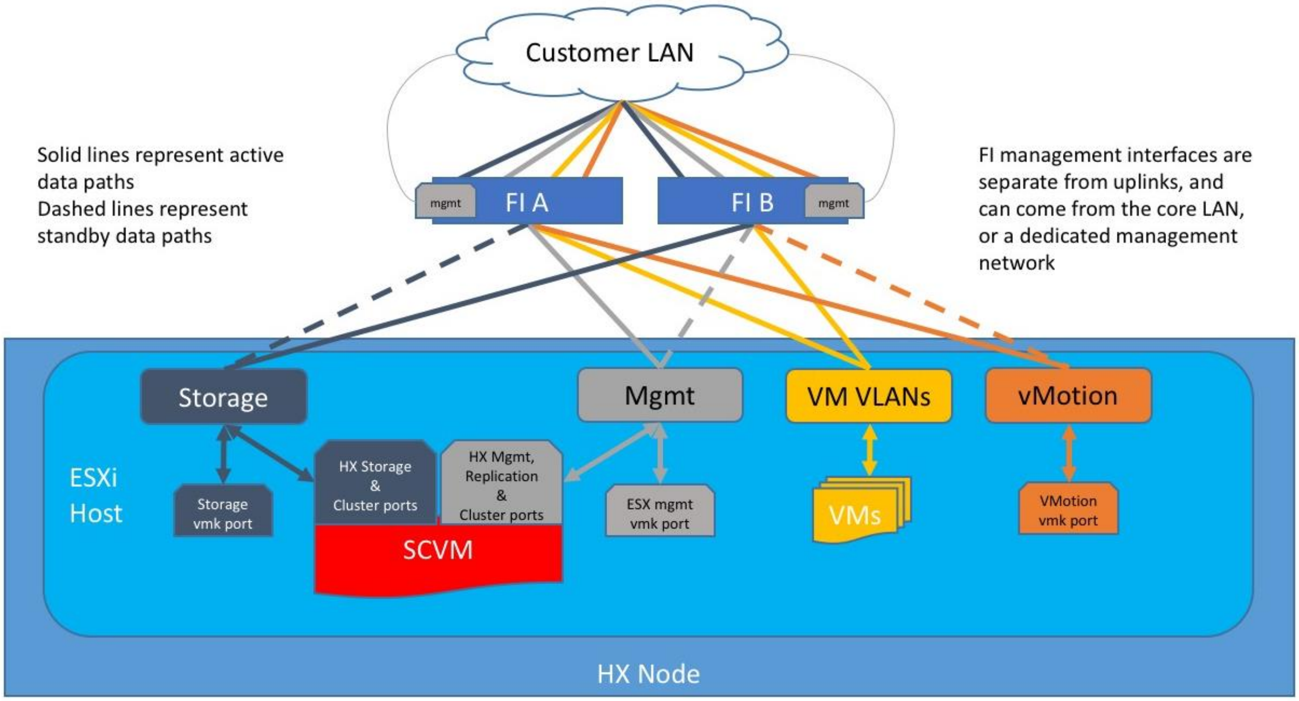
operation. During normal operation, this traffic all occurs within the Cisco UCS domain, however there are hardware failure scenarios where this traffic would need to traverse the network northbound of the Cisco UCS domain. For that reason, the VLAN used for HX storage traffic must be able to traverse the network uplinks from the Cisco UCS domain, reaching FI A from FI B, and vice-versa. This zone is primarily jumbo frame traffic therefore jumbo frames must be enabled on the Cisco UCS uplinks. In this zone are multiple components:

  - A VMkernel interface used for storage traffic on each ESXi host in the HX cluster.
  - Storage Controller VM storage interfaces.
  - A roaming HX cluster storage interface.

- **VMotion Zone:** This zone comprises the connections used by the ESXi hosts to enable vMotion of the guest VMs from host to host. During normal operation, this traffic all occurs within the Cisco UCS domain, however there are hardware failure scenarios where this traffic would need to traverse the network northbound of the Cisco UCS domain. For that reason, the VLAN used for HX vMotion traffic must be able to traverse the network uplinks from the Cisco UCS domain, reaching FI A from FI B, and vice-versa.

Refer to the following figure for an illustration of the logical network design:

Figure 20 Logical Network Design


Customer LAN
Solid lines represent active data paths
Dashed lines represent standby data paths
mgmt
FI A
FI B
mgmt
FI management interfaces are separate from uplinks, and can come from the core LAN, or a dedicated management network
Storage
Mgmt
VM VLANs
vMotion
ESXi Host
Storage vmk port
HX Storage & Cluster ports
HX Mgmt, Replication & Cluster ports
SCVM
ESX mgmt vmk port
VMs
VMotion vmk port
HX Node

Design Elements

Installation of the HyperFlex system is primarily done through a deployable HyperFlex installer virtual machine, available for download at cisco.com as an OVA file. The installer VM performs most of the Cisco UCS configuration work, it can be leveraged to simplify the installation of ESXi on the HyperFlex hosts, and also performs significant portions of the ESXi configuration. Finally, the installer VM is used to install the HyperFlex HX Data Platform software and create the HyperFlex cluster. Because this simplified installation method has been developed by Cisco, this CVD will not give detailed manual steps for the configuration of all the elements that are handled by the installer. Instead, the elements configured will be described and documented in this section, and the subsequent sections will guide you through the manual steps needed for installation, and how to utilize the HyperFlex Installer for the remaining configuration steps.

Network Design

Cisco UCS Uplink Connectivity

Cisco UCS network uplinks connect “northbound” from the pair of Cisco UCS Fabric Interconnects to the LAN in the customer datacenter. All Cisco UCS uplinks operate as trunks, carrying multiple 802.1Q VLAN IDs across the uplinks. The default Cisco UCS behavior is to assume that all VLAN IDs defined in the Cisco UCS configuration are eligible to be trunked across all available uplinks.

Cisco UCS Fabric Interconnects appear on the network as a collection of endpoints versus another network switch. Internally, the Fabric Interconnects do not participate in spanning-tree protocol (STP) domains, and the Fabric Interconnects cannot form a network loop, as they are not connected to each other with a layer 2 Ethernet link. All link up/down decisions via STP will be made by the upstream root bridges.

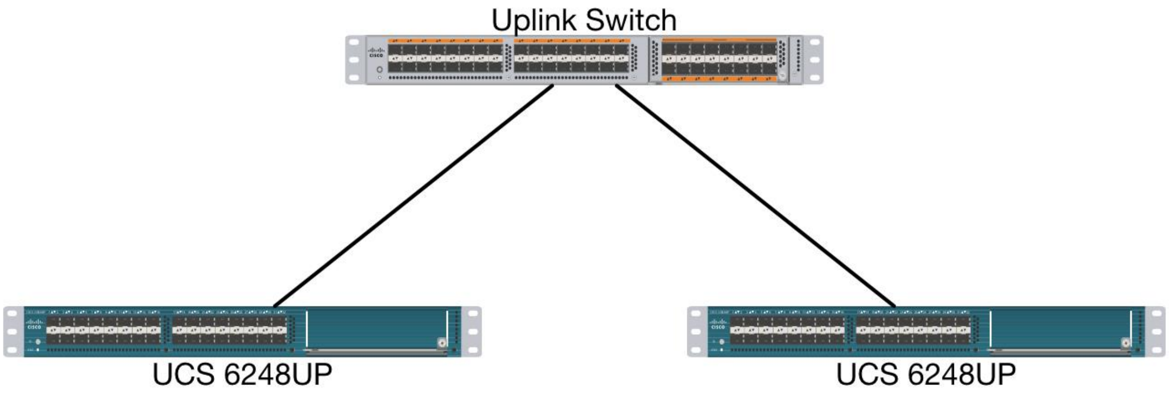
Uplinks need to be connected and active from both Fabric Interconnects. For redundancy, multiple uplinks can be used on each FI, either as 802.3ad Link Aggregation Control Protocol (LACP) port-channels, or using individual links. For the best level of performance and redundancy, uplinks can be made as LACP port-channels to multiple upstream Cisco switches using the virtual port channel (vPC) feature. Using vPC uplinks allows all uplinks to be active passing data, plus protects against any individual link failure, and the failure of an upstream switch. Other uplink configurations can be redundant, but spanning-tree protocol loop avoidance may disable links if vPC is not available.

All uplink connectivity methods must allow for traffic to pass from one Fabric Interconnect to the other, or from fabric A to fabric B. There are scenarios where cable, port or link failures would require traffic that normally does not leave the Cisco UCS domain, to now be forced over the Cisco UCS uplinks. Additionally, this traffic flow pattern can be seen briefly during maintenance procedures, such as updating firmware on the Fabric Interconnects, which requires them to be rebooted. The following sections and figures detail several uplink connectivity options.

Single Uplinks to Single Switch

This connection design is susceptible to failures at several points; single uplink failures on either Fabric Interconnect can lead to connectivity losses or functional failures, and the failure of the single uplink switch will cause a complete connectivity outage.

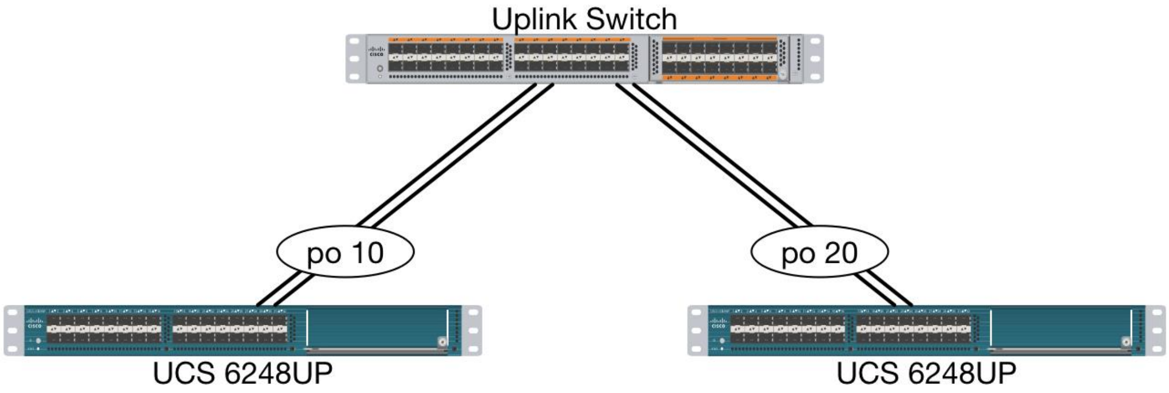
Figure 21 Connectivity with Single Uplink to Single Switch



Port Channels to Single Switch

This connection design is now redundant against the loss of a single link, but remains susceptible to the failure of the single switch.

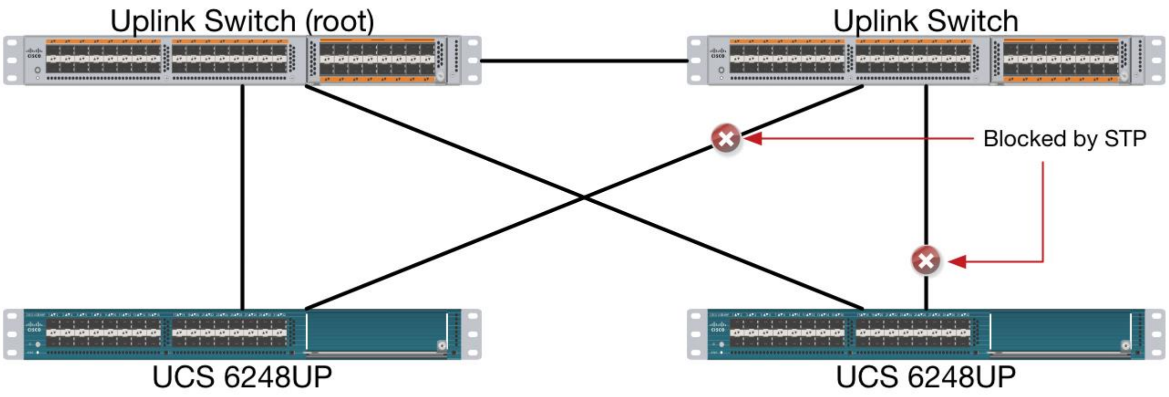
Figure 22 Connectivity with Port-Channels to Single Switch



Single Uplinks or Port Channels to Multiple Switches

This connection design is redundant against the failure of an upstream switch, and redundant against a single link failure. In normal operation, STP is likely to block half of the links to avoid a loop across the two upstream switches. The side effect of this is to reduce bandwidth between the Cisco UCS domain and the LAN. If any of the active links were to fail, STP would bring the previously blocked link online to provide access to that Fabric Interconnect via the other switch. It is not recommended to connect both links from a single FI to a single switch, as that configuration is susceptible to a single switch failure breaking connectivity from fabric A to fabric B. For enhanced redundancy, the single links in the figure below could also be port-channels.

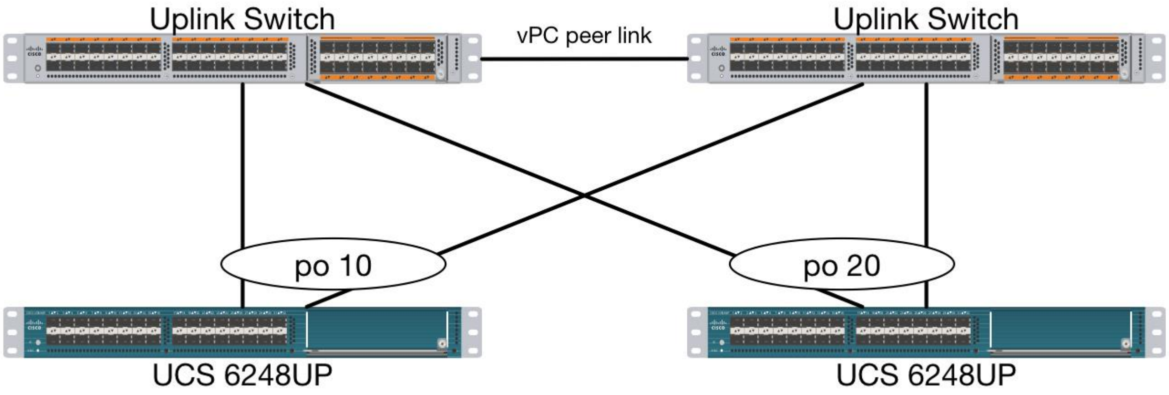
Figure 23 Connectivity with Multiple Uplink Switches



vPC to Multiple Switches

This recommended connection design relies on using Cisco switches that have the virtual port channel feature, such as Catalyst 6000 series switches running VSS, Cisco Nexus 5000 series, and Cisco Nexus 9000 series switches. Logically the two vPC enabled switches appear as one, and therefore spanning-tree protocol will not block any links. This configuration allows for all links to be active, achieving maximum bandwidth potential, and multiple redundancy at each level.

Figure 24 Connectivity with vPC



VLANs and Subnets

For the base HyperFlex system configuration, multiple VLANs need to be carried to the Cisco UCS domain from the upstream LAN, and these VLANs are also defined in the Cisco UCS configuration. The hx-storage-data VLAN must be a separate VLAN ID from the remaining VLANs. The following table lists the VLANs created by the HyperFlex installer in Cisco UCS, and their functions:

Table 11 VLANs

VLAN Name	VLAN ID	Purpose
hx-inband-mgmt	Customer supplied	ESXi host management interfaces HX Storage Controller VM management interfaces HX Storage Cluster roaming management interface
hx-inband-repl	Customer supplied	HX Storage Controller VM Replication interfaces HX Storage Cluster roaming replication interface
hx-storage-data	Customer supplied	ESXi host storage VMkernel interfaces HX Storage Controller storage network interfaces HX Storage Cluster roaming storage interface
hx-vm-data	Customer supplied	Guest VM network interfaces
hx-vmotion	Customer supplied	ESXi host vMotion VMkernel interfaces

Note: A dedicated network or subnet for physical device management is often used in datacenters. In this scenario, the mgmt0 interfaces of the two Fabric Interconnects would be connected to that dedicated network or subnet. This is a valid configuration for HyperFlex installations with the following caveat; wherever the HyperFlex installer is deployed it must have IP connectivity to the subnet of the mgmt0 interfaces of the Fabric Interconnects, and also have IP connectivity to the subnets used by the hx-inband-mgmt VLANs listed above.

Jumbo Frames

All HyperFlex storage traffic traversing the hx-storage-data VLAN and subnet is configured by default to use jumbo frames, or to be precise, all communication is configured to send IP packets with a Maximum Transmission Unit (MTU) size of 9000 bytes. In addition, the default MTU for the hx-vmotion VLAN is also set to use jumbo frames. Using a larger MTU value means that each IP packet sent carries a larger payload, therefore transmitting more data per packet, and consequently sending and receiving data faster. This requirement also means that the Cisco UCS uplinks must be configured to pass jumbo frames. Failure to configure the Cisco UCS uplink switches to allow jumbo frames can lead to service interruptions during some failure scenarios, including Cisco UCS firmware upgrades, or when a cable or port failure would cause storage traffic to traverse the northbound Cisco UCS uplink switches.

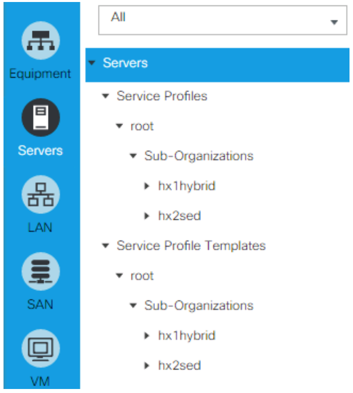
Cisco UCS Design

This section about Cisco UCS design will describe the elements within Cisco UCS Manager that are configured by the Cisco HyperFlex installer. Many of the configuration elements are fixed in nature, meanwhile the HyperFlex installer does allow for some items to be specified at the time of creation, for example VLAN names and IDs, external management IP pools and more. Where the elements can be manually set during the installation, those items will be noted in << >> brackets.

Cisco UCS Organization

During the HyperFlex installation a Cisco UCS Sub-Organization is created. You must specify a unique Sub-Organization name for each cluster during the installation, for example “hx1hybrid”, or “hx2sed”. The sub-organization is created underneath the root level of the Cisco UCS hierarchy, and is used to contain all policies, pools, templates and service profiles used by HyperFlex. This arrangement allows for organizational control using Role-Based Access Control (RBAC) and administrative locales at a later time if desired. In this way, control can be granted to administrators of only the HyperFlex specific elements of the Cisco UCS domain, separate from control of root level elements or elements in other sub-organizations.

Figure 25 Cisco UCS HyperFlex Sub-Organization



All

- Servers
  - Service Profiles
    - root
      - Sub-Organizations
        - hx1hybrid
        - hx2sed
  - Service Profile Templates
    - root
      - Sub-Organizations
        - hx1hybrid
        - hx2sed

Cisco UCS LAN Policies

QoS System Classes

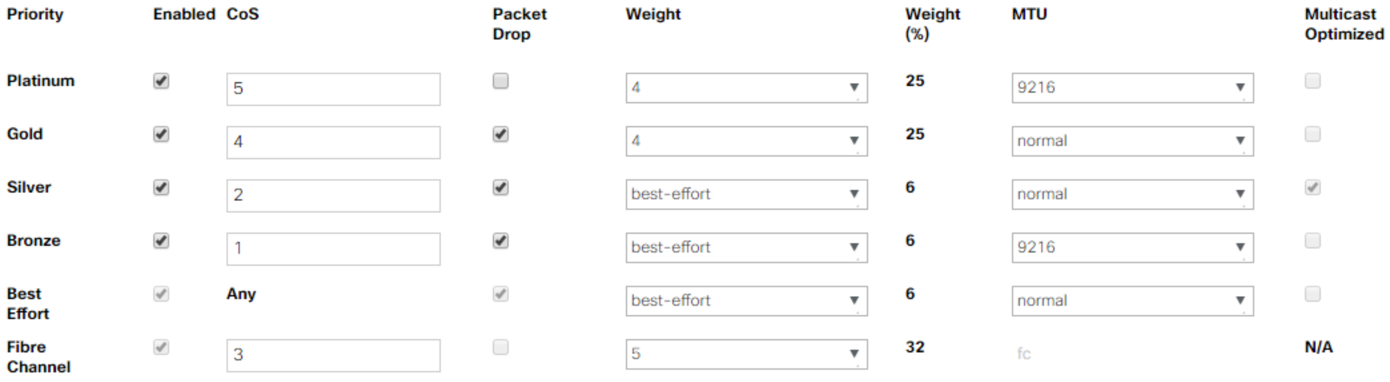
Specific Cisco UCS Quality of Service (QoS) system classes are defined for a Cisco HyperFlex system. These classes define Class of Service (CoS) values that can be used by the uplink switches north of the Cisco UCS domain, plus which classes are active, along with whether packet drop is allowed, the relative weight of the different classes when there is contention, the maximum transmission unit (MTU) size, and if there is multicast optimization applied. QoS system classes are defined for the entire Cisco UCS domain, the classes that are enabled can later be used in QoS policies, which are then assigned to Cisco UCS vNICs. The following table and figure details the QoS System Class settings configured for HyperFlex:

Table 12 QoS System Classes

Priority	Enabled	CoS	Packet Drop	Weight	MTU	Multicast Optimized
Platinum	Yes	5	No	4	9216	No
Gold	Yes	4	Yes	4	Normal	No
Silver	Yes	2	Yes	Best-effort	Normal	Yes
Bronze	Yes	1	Yes	Best-effort	9216	No

Priority	Enabled	CoS	Packet Drop	Weight	MTU	Multicast Optimized
Best Effort	Yes	Any	Yes	Best-effort	Normal	No
Fibre Channel	Yes	3	No	5	FC	N/A

Figure 26 QoS System Classes



Priority	Enabled	CoS	Packet Drop	Weight	Weight (%)	MTU	Multicast Optimized
Platinum	☑	5	□	4 ▾	25	9216 ▾	□
Gold	☑	4	☑	4 ▾	25	normal ▾	□
Silver	☑	2	☑	best-effort ▾	6	normal ▾	☑
Bronze	☑	1	☑	best-effort ▾	6	9216 ▾	□
Best Effort	☑	Any	☑	best-effort ▾	6	normal ▾	□
Fibre Channel	☑	3	□	5 ▾	32	fc	N/A

Note: Changing the QoS system classes on a Cisco UCS 6332 or 6332-16UP model Fabric Interconnect requires both FIs to reboot in order to take effect.

QoS Policies

In order to apply the settings defined in the Cisco UCS QoS System Classes, specific QoS Policies must be created, and then assigned to the vNICs, or vNIC templates used in Cisco UCS Service Profiles. The following table details the QoS Policies configured for HyperFlex, and their default assignment to the vNIC templates created:

Table 13 HyperFlex QoS Policies

Policy	Priority	Burst	Rate	Host Con-trol	Used by vNIC Template:
Platinum	Platinum	10240	Line-rate	None	storage-data-a storage-data-b
Gold	Gold	10240	Line-rate	None	vm-network-a vm-network-b
Silver	Silver	10240	Line-rate	None	hv-mgmt-a hv-mgmt-b

Policy	Priority	Burst	Rate	Host Control	Used by vNIC Template:
Bronze	Bronze	10240	Line-rate	None	hv-vmotion-a hv-vmotion-b
Best Effort	Best Effort	10240	Line-rate	None	N/A

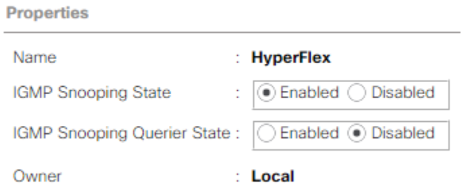
Multicast Policy

A Cisco UCS Multicast Policy is configured by the HyperFlex installer, which is referenced by the VLANs that are created. The policy allows for future flexibility if a specific multicast policy needs to be created and applied to other VLANs, that may be used by non-HyperFlex workloads in the Cisco UCS domain. The following table and figure details the Multicast Policy configured for HyperFlex:

Table 14 Multicast Policy

Name	IGMP Snooping State	IGMP Snooping Querier State
HyperFlex	Enabled	Disabled

Figure 27 Multicast Policy



Properties

Name : HyperFlex

IGMP Snooping State : ● Enabled ○ Disabled

IGMP Snooping Querier State : ○ Enabled ● Disabled

Owner : Local

VLANs

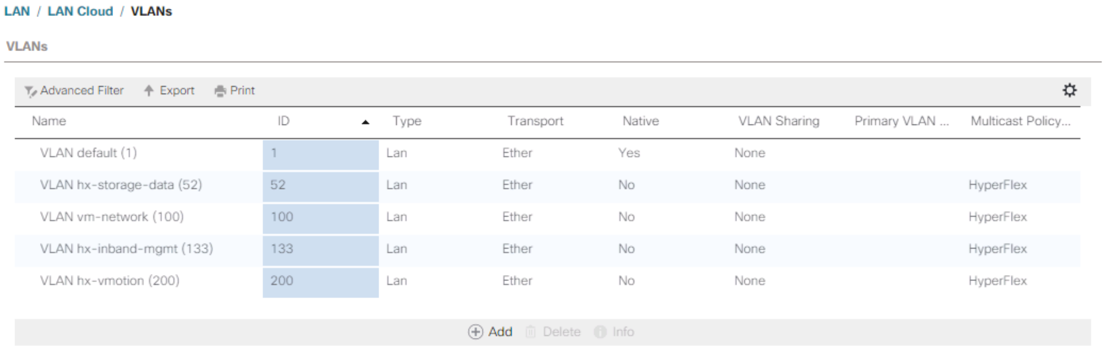
VLANs are created by the HyperFlex installer to support a base HyperFlex system, with a VLAN for vMotion, and a single or multiple VLANs defined for guest VM traffic. Names and IDs for the VLANs are defined in the Cisco UCS configuration page of the HyperFlex installer web interface. The VLANs listed in Cisco UCS must already be present on the upstream network, and the Cisco UCS FIs do not participate in VLAN Trunk Protocol (VTP). The following table and figure details the VLANs configured for HyperFlex:

Table 15 Cisco UCS VLANs

Name	ID	Type	Transport	Native	VLAN Sharing	Multicast Policy
<<hx-inband-mgmt>>	<user_defined>	LAN	Ether	No	None	HyperFlex
<<hx-inband-repl>>	<user_defined>	LAN	Ether	No	None	HyperFlex
<<hx-storage-data>>	<user_defined>	LAN	Ether	No	None	HyperFlex

Name	ID	Type	Transport	Native	VLAN Sharing	Multicast Policy
<<hx-vm-data>>	<user_defined>	LAN	Ether	No	None	HyperFlex
<<hx-vmotion>>	<user_defined>	LAN	Ether	No	None	HyperFlex

Figure 28 Cisco UCS VLANs

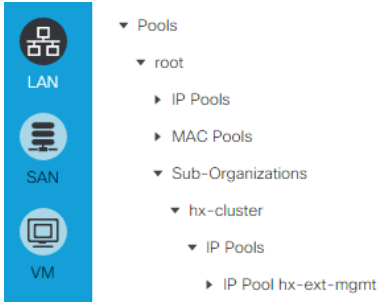


Name	ID	Type	Transport	Native	VLAN Sharing	Primary VLAN ...	Multicast Policy...
VLAN default (1)	1	Lan	Ether	Yes	None		
VLAN hx-storage-data (52)	52	Lan	Ether	No	None		HyperFlex
VLAN vm-network (100)	100	Lan	Ether	No	None		HyperFlex
VLAN hx-inband-mgmt (133)	133	Lan	Ether	No	None		HyperFlex
VLAN hx-vmotion (200)	200	Lan	Ether	No	None		HyperFlex

Management IP Address Pool

A Cisco UCS Management IP Address Pool must be populated with a block of IP addresses. These IP addresses are assigned to the Cisco Integrated Management Controller (CIMC) interface of the rack mount and blade servers that are managed in the Cisco UCS domain. The IP addresses are the communication endpoints for various functions, such as remote KVM, virtual media, Serial over LAN (SoL), and Intelligent Platform Management Interface (IPMI) for each rack mount or blade server. Therefore, a minimum of one IP address per physical server in the domain must be provided. The IP addresses are considered to be an “out-of-band” address, meaning that the communication pathway uses the Fabric Interconnects’ mgmt0 ports, which answer ARP requests for the management addresses. Because of this arrangement, the IP addresses in this pool must be in the same IP subnet as the IP addresses assigned to the Fabric Interconnects’ mgmt0 ports. A new IP pool, named “hx-ext-mgmt” is created in the HyperFlex sub-organization, and populated with a block of IP addresses, a subnet mask, and a default gateway by the HyperFlex installer. The default IP pool named “ext-mgmt”, in the root organization is no longer used as of HyperFlex 2.5 for new installations.

Figure 29 Management IP Address Pool



- Pools
  - root
    - IP Pools
    - MAC Pools
    - Sub-Organizations
      - hx-cluster
        - IP Pools
          - IP Pool hx-ext-mgmt

MAC Address Pools

One of the core benefits of the Cisco UCS and Virtual Interface Card (VIC) technology is the assignment of the personality of the card via Cisco UCS Service Profiles. The number of virtual NIC (vNIC) interfaces, their VLAN associations, MAC addresses, QoS policies and more are all applied dynamically as part of the service profile association process. Media Access Control (MAC) addresses use 6 bytes of data as a unique address to identify the interface on the layer 2 network. All devices are assigned a unique MAC address, which is ultimately used for all data transmission and reception. The Cisco UCS and VIC technology picks a MAC address from a pool of addresses, and assigns it to each vNIC defined in the service profile when that service profile is created.

Best practices mandate that MAC addresses used for Cisco UCS domains use 00:25:B5 as the first three bytes, which is one of the Organizationally Unique Identifiers (OUI) registered to Cisco Systems, Inc. The fourth byte (e.g. 00:25:B5:xx) is specified during the HyperFlex installation. The fifth byte is set automatically by the HyperFlex installer, to correlate to the Cisco UCS fabric and the vNIC placement order. Finally, the last byte is incremented according to the number of MAC addresses created in the pool. To avoid overlaps, when you define the values in the HyperFlex installer you must ensure that the first four bytes of the MAC address pools are unique for each HyperFlex cluster installed in the same layer 2 network, and also different from MAC address pools in other Cisco UCS domains which may exist.

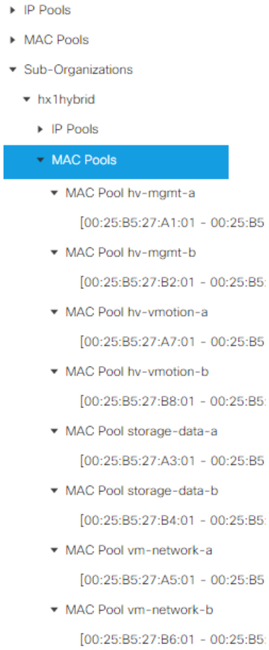
The following table details the MAC Address Pools configured for HyperFlex, and their default assignment to the vNIC templates created:

Table 16 MAC Address Pools

Name	Block Start	Size	Assignment Order	Used by vNIC Template:
hv-mgmt-a	00:25:B5:<xx>:A1:01	100	Sequential	hv-mgmt-a
hv-mgmt-b	00:25:B5:<xx>:B2:01	100	Sequential	hv-mgmt-b
hv-vmotion-a	00:25:B5:<xx>:A7:01	100	Sequential	hv-vmotion-a
hv-vmotion-b	00:25:B5:<xx>:B8:01	100	Sequential	hv-vmotion-b
storage-data-a	00:25:B5:<xx>:A3:01	100	Sequential	storage-data-a

Name	Block Start	Size	Assignment Order	Used by vNIC Template:
storage-data-b	00:25:B5:<xx>:B4:01	100	Sequential	storage-data-b
vm-network-a	00:25:B5:<xx>:A5:01	100	Sequential	vm-network-a
vm-network-b	00:25:B5:<xx>:B6:01	100	Sequential	vm-network-b

Figure 30 MAC Address Pools



- IP Pools
- MAC Pools
- Sub-Organizations
  - hx1hybrid
    - IP Pools
    - MAC Pools
      - MAC Pool hv-mgmt-a
        - [00:25:B5:27:A1:01 - 00:25:B5
      - MAC Pool hv-mgmt-b
        - [00:25:B5:27:B2:01 - 00:25:B5:
      - MAC Pool hv-vmotion-a
        - [00:25:B5:27:A7:01 - 00:25:B5
      - MAC Pool hv-vmotion-b
        - [00:25:B5:27:B8:01 - 00:25:B5:
      - MAC Pool storage-data-a
        - [00:25:B5:27:A3:01 - 00:25:B5
      - MAC Pool storage-data-b
        - [00:25:B5:27:B4:01 - 00:25:B5:
      - MAC Pool vm-network-a
        - [00:25:B5:27:A5:01 - 00:25:B5
      - MAC Pool vm-network-b
        - [00:25:B5:27:B6:01 - 00:25:B5:

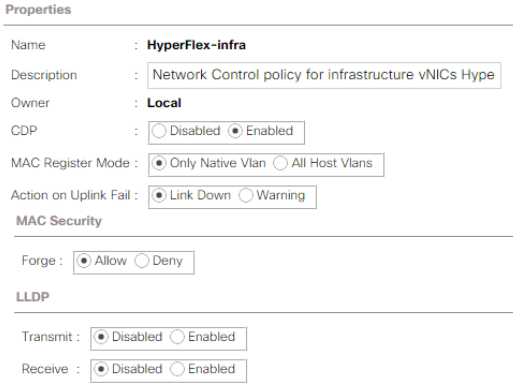
Network Control Policies

Cisco UCS Network Control Policies control various aspects of the behavior of vNICs defined in the Cisco UCS Service Profiles. Settings controlled include enablement of Cisco Discovery Protocol (CDP), MAC address registration, MAC address forging, and the action taken on the vNIC status if the Cisco UCS network uplinks are failed. Two policies are configured by the HyperFlex Installer, HyperFlex-infra is applied to the "infrastructure" vNIC interfaces of the HyperFlex system, and HyperFlex-vm, which is only applied to the vNIC interfaces carrying guest VM traffic. This allows for more flexibility, even though the policies are currently configured with the same settings. The following table details the Network Control Policies configured for HyperFlex, and their default assignment to the vNIC templates created:

Table 17 Network Control Policy

Name	CDP	MAC Register Mode	Action on Uplink Fail	MAC Security	Used by vNIC Template:
HyperFlex-infra	Enabled	Only Native VLAN	Link-down	Forged: Allow	hv-mgmt-a hv-mgmt-b hv-vmotion-a hv-vmotion-b storage-data-a storage-data-b
HyperFlex-vm	Enabled	Only Native VLAN	Link-down	Forged: Allow	vm-network-a vm-network-b

Figure 31 Network Control Policy



Properties

Name : **HyperFlex-infra**

Description : Network Control policy for infrastructure vNICs Hype

Owner : **Local**

CDP : ○ Disabled ● Enabled

MAC Register Mode : ● Only Native Vlan ○ All Host Vlans

Action on Uplink Fail : ● Link Down ○ Warning

MAC Security

Forge : ● Allow ○ Deny

LLDP

Transmit : ● Disabled ○ Enabled

Receive : ● Disabled ○ Enabled

vNIC Templates

Cisco UCS Manager has a feature to configure vNIC templates, which can be used to simplify and speed up configuration efforts. VNIC templates are referenced in service profiles and LAN connectivity policies, versus configuring the same vNICs individually in each service profile, or service profile template. VNIC templates contain all the configuration elements that make up a vNIC, including VLAN assignment, MAC address pool selection, fabric A or B assignment, fabric failover, MTU, QoS policy, Network Control Policy, and more. Templates are created as either initial templates, or updating templates. Updating templates retain a link between the parent template and the child object, therefore when changes are made to the template, the changes are propagated to all remaining linked child objects. An additional feature named "vNIC Redundancy" allows vNICs to be configured in pairs, so that the settings of one vNIC template, designated as a primary template, will automatically be applied to a configured secondary template. For all HyperFlex vNIC templates, the "A" side vNIC template is configured as a primary template, and the related "B" side vNIC template is a secondary. In each case, the only configuration difference between the two templates is which fabric they are configured to connect through. The following tables detail the initial settings in each of the vNIC templates created by the HyperFlex installer:

Table 18 vNIC Template hv-mgmt-a

vNIC Template Name:	hv-mgmt-a	
Setting	**Value**	
Fabric ID	A	
Fabric Failover	Disabled	
Target	Adapter	
Type	Updating Template	
MTU	1500	
MAC Pool	hv-mgmt-a	
QoS Policy	silver	
Network Control Policy	HyperFlex-infra	
VLANs	<<hx-inband-mgmt>>	Native: No

Table 19 vNIC Template hv-mgmt-b

vNIC Template Name:	hv-mgmt-b
Setting	**Value**
Fabric ID	B
Fabric Failover	Disabled
Target	Adapter
Type	Updating Template
MTU	1500
MAC Pool	hv-mgmt-b

QoS Policy	silver	
Network Control Policy	HyperFlex-infra	
VLANs	<<hx-inband-mgmt>>	Native: No

Table 20 vNIC Template hv-vmotion-a

vNIC Template Name:	**hv-vmotion-a**	
Setting	**Value**	
Fabric ID	A	
Fabric Failover	Disabled	
Target	Adapter	
Type	Updating Template	
MTU	9000	
MAC Pool	hv-vmotion-a	
QoS Policy	bronze	
Network Control Policy	HyperFlex-infra	
VLANs	<<hx-vmotion>>	Native: No

Table 21 vNIC Template hx-vmotion-b

vNIC Template Name:	**hv-vmotion-b**
Setting	**Value**
Fabric ID	B
Fabric Failover	Disabled

Target	Adapter	
Type	Updating Template	
MTU	9000	
MAC Pool	hv-vmotion-b	
QoS Policy	bronze	
Network Control Policy	HyperFlex-infra	
VLANs	<<hx-vmotion>>	Native: No

Table 22 vNIC Template storage-data-a

vNIC Template Name:	**storage-data-a**	
Setting	**Value**	
Fabric ID	A	
Fabric Failover	Disabled	
Target	Adapter	
Type	Updating Template	
MTU	9000	
MAC Pool	storage-data-a	
QoS Policy	platinum	
Network Control Policy	HyperFlex-infra	
VLANs	<<hx-storage-data>>	Native: No

Table 23 vNIC Template storage-data-b

vNIC Template Name:	storage-data-b	
Setting	**Value**	
Fabric ID	B	
Fabric Failover	Disabled	
Target	Adapter	
Type	Updating Template	
MTU	9000	
MAC Pool	storage-data-b	
QoS Policy	platinum	
Network Control Policy	HyperFlex-infra	
VLANs	<<hx-storage-data>>	Native: No

Table 24 vNIC Template vm-network-a

vNIC Template Name:	vm-network-a
Setting	**Value**
Fabric ID	A
Fabric Failover	Disabled
Target	Adapter
Type	Updating Template
MTU	1500
MAC Pool	vm-network-a

QoS Policy	gold	
Network Control Policy	HyperFlex-vm	
VLANs	<<hx-vm-data>>	Native: no

Table 25 vNIC Template vm-network-b

vNIC Template Name:	**vm-network-b**	
Setting	**Value**	
Fabric ID	B	
Fabric Failover	Disabled	
Target	Adapter	
Type	Updating Template	
MTU	1500	
MAC Pool	vm-network-b	
QoS Policy	gold	
Network Control Policy	HyperFlex-vm	
VLANs	<<hx-vm-data>>	Native: no

LAN Connectivity Policies

Cisco UCS Manager has a feature for LAN Connectivity Policies, which aggregates all of the vNICs or vNIC templates desired for a service profile configuration into a single policy definition. This simplifies configuration efforts by defining a collection of vNICs or vNIC templates once, and using that policy in the service profiles or service profile templates. The HyperFlex installer configures a LAN Connectivity Policy named HyperFlex, which contains all of the vNIC templates defined in the previous section, along with an Adapter Policy named HyperFlex, also configured by the HyperFlex installer. The following table details the LAN Connectivity Policy configured for HyperFlex:

Table 26 LAN Connectivity Policy

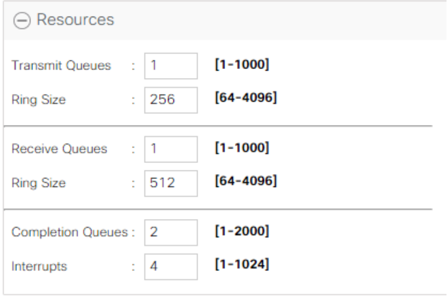
Policy Name	Use vNIC Template	vNIC Name	vNIC Template Used:	Adapter Policy
HyperFlex	Yes	hv-mgmt-a	hv-mgmt-a	HyperFlex
		hv-mgmt-b	hv-mgmt-b	
		hv-vmotion-a	hv-vmotion-a	
		hv-vmotion-b	hv-vmotion-b	
		storage-data-a	storage-data-a	
		storage-data-b	storage-data-b	
		vm-network-a	vm-network-a	
		vm-network-b	vm-network-b	

Cisco UCS Servers Policies

Adapter Policies

Cisco UCS Adapter Policies are used to configure various settings of the Converged Network Adapter (CNA) installed in the Cisco UCS blade or rack mount servers. Various advanced hardware features can be enabled or disabled depending on the software or operating system being used. The following figures detail the Adapter Policy configured for HyperFlex:

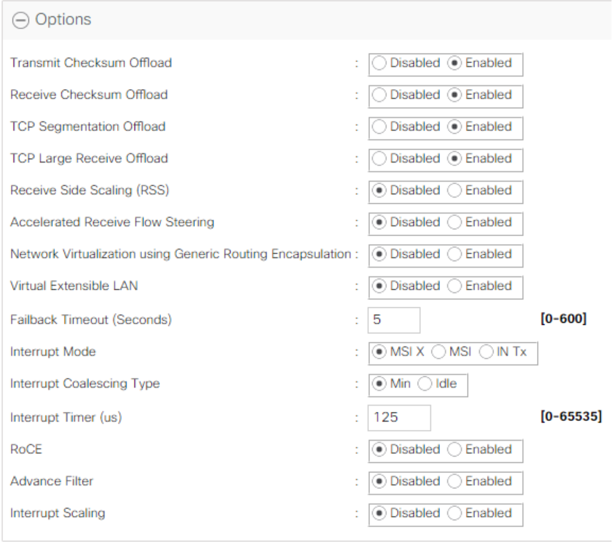
Figure 32 Cisco UCS Adapter Policy Resources



⊖ Resources

Transmit Queues :	1	[1-1000]
Ring Size :	256	[64-4096]
Receive Queues :	1	[1-1000]
Ring Size :	512	[64-4096]
Completion Queues :	2	[1-2000]
Interrupts :	4	[1-1024]

Figure 33 Cisco UCS Adapter Policy Options



⊖ Options

Transmit Checksum Offload :	○ Disabled ● Enabled	
Receive Checksum Offload :	○ Disabled ● Enabled	
TCP Segmentation Offload :	○ Disabled ● Enabled	
TCP Large Receive Offload :	○ Disabled ● Enabled	
Receive Side Scaling (RSS) :	● Disabled ○ Enabled	
Accelerated Receive Flow Steering :	● Disabled ○ Enabled	
Network Virtualization using Generic Routing Encapsulation :	● Disabled ○ Enabled	
Virtual Extensible LAN :	● Disabled ○ Enabled	
Failback Timeout (Seconds) :	5	[0-600]
Interrupt Mode :	● MSI X ○ MSI ○ IN Tx	
Interrupt Coalescing Type :	● Min ○ Idle	
Interrupt Timer (us) :	125	[0-65535]
RoCE :	● Disabled ○ Enabled	
Advance Filter :	● Disabled ○ Enabled	
Interrupt Scaling :	● Disabled ○ Enabled	

BIOS Policies

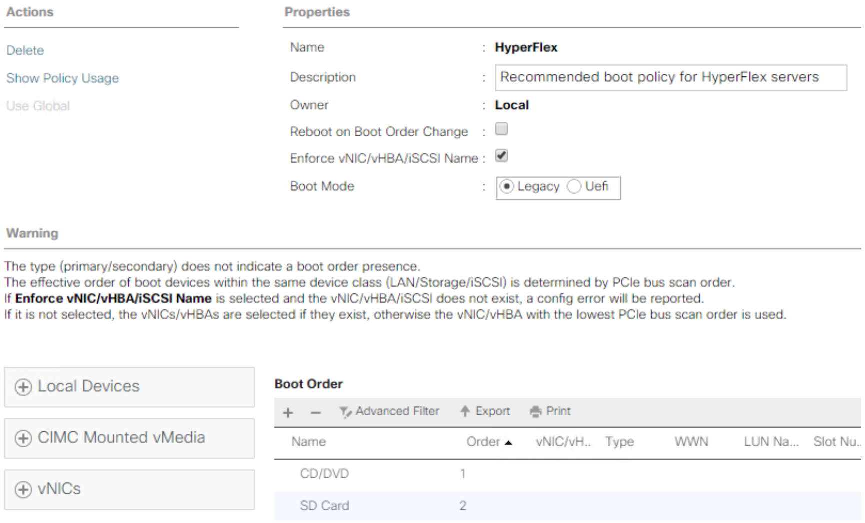
Cisco HX-Series servers have a set of pre-defined BIOS setting defaults defined in Cisco UCS Manager. These settings have been optimized for the Cisco HX-Series servers running HyperFlex. The HyperFlex installer creates a BIOS policy named “HyperFlex”, with all settings set to the defaults, except for enabling the Serial Port A for Serial over LAN (SoL) functionality. This policy allows for future flexibility in case situations arise where the settings need to be modified from the default configuration.

Boot Policies

Cisco UCS Boot Policies define the boot devices used by blade and rack mount servers, and the order that they are attempted to boot from. Cisco HX-Series rack mount servers have their VMware ESXi hypervisors installed to an internal pair of mirrored Cisco FlexFlash SD cards, therefore they require a boot policy defining that the servers should boot from that location. The HyperFlex installer configures a boot policy named “HyperFlex” specifying boot from the SD cards, which is used by the HyperFlex converged nodes, and should not be modified. The compute-only Cisco UCS blade servers and Cisco UCS rack mount servers can also boot from SD cards, or they can be configured to boot from local disks, boot from SAN, or via the network using PXE or iSCSI. The HyperFlex installer configures a boot policy named “hx-compute”, which can be modified as needed for the boot method used by the compute-only nodes.

The following figure details the HyperFlex Boot Policy configured to boot from SD card:

Figure 34 Cisco UCS Boot Policy



Actions

Delete
Show Policy Usage
Use Global

Properties

Name : **HyperFlex**
Description : Recommended boot policy for HyperFlex servers
Owner : **Local**
Reboot on Boot Order Change : □
Enforce vNIC/vHBA/iSCSI Name : ☑
Boot Mode : ● Legacy ○ Uefi

Warning

The type (primary/secondary) does not indicate a boot order presence.
The effective order of boot devices within the same device class (LAN/Storage/iSCSI) is determined by PCIe bus scan order.
If **Enforce vNIC/vHBA/iSCSI Name** is selected and the vNIC/vHBA/iSCSI does not exist, a config error will be reported.
If it is not selected, the vNICs/vHBAs are selected if they exist, otherwise the vNIC/vHBA with the lowest PCIe bus scan order is used.

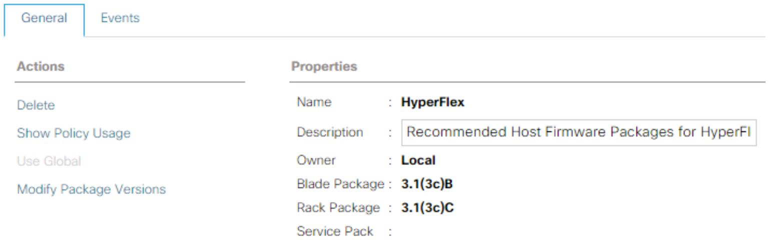
Boot Order

Name	Order ▲	vNIC/vH..	Type	WWN	LUN Na...	Slot Nu..
CD/DVD	1					
SD Card	2					

Host Firmware Packages

Cisco UCS Host Firmware Packages represent one of the most powerful features of the Cisco UCS platform; the ability to control the firmware revision of all the managed blades and rack mount servers via a policy specified in the service profile. Host Firmware Packages are defined and referenced in the service profiles. Once a service profile is associated to a server, the firmware of all the components defined in the Host Firmware Package are automatically upgraded or downgraded to match the package. The HyperFlex installer creates a Host Firmware Package named "HyperFlex" which uses the simple package definition method, applying firmware revisions to all components that matches a specific Cisco UCS firmware bundle, versus defining the firmware revisions part by part. The following figure details the Host Firmware Package configured by the HyperFlex installer:

Figure 35 Cisco UCS Host Firmware Package



Actions

Delete
Show Policy Usage
Use Global
Modify Package Versions

Properties

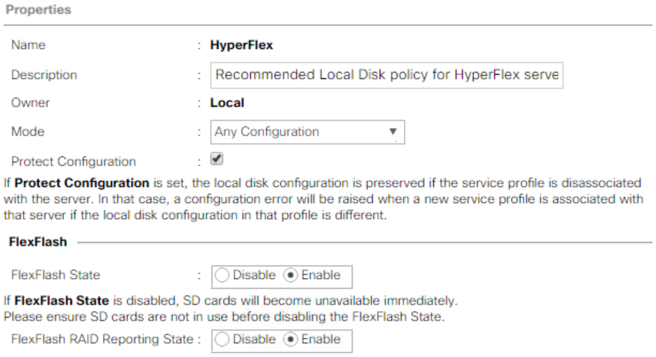
Name : **HyperFlex**
Description : Recommended Host Firmware Packages for HyperFl
Owner : **Local**
Blade Package : **3.1(3c)B**
Rack Package : **3.1(3c)C**
Service Pack :

Local Disk Configuration Policies

Cisco UCS Local Disk Configuration Policies are used to define the configuration of disks installed locally within each blade or rack mount server, most often to configure Redundant Array of Independent/Inexpensive Disks (RAID levels) when multiple disks are present for data protection. Since HX-Series converged nodes providing storage resources do not require RAID, the HyperFlex installer creates two Local Disk Configuration Policies, named "HyperFlex" and "hx-compute", both of which allows any local disk configuration. The policy also enables settings for the embedded FlexFlash SD cards used to boot the VMware ESXi hypervisor. The policy named "HyperFlex" is used by the service profile template named "hx-nodes", which is for the HyperFlex converged servers, and should not be modified. Meanwhile, the policy named "hx-compute" is used by the service profile template named "compute-nodes", which is used by compute-only nodes. The "hx-compute" policy can be modified as needed to suit the local disk configuration that will be used in compute-only nodes.

The following figure details the Local Disk Configuration Policy configured by the HyperFlex installer:

Figure 36 Cisco UCS Local Disk Configuration Policy



Properties

Name : **HyperFlex**

Description : Recommended Local Disk policy for HyperFlex serve

Owner : **Local**

Mode : Any Configuration ▼

Protect Configuration : ☑

If **Protect Configuration** is set, the local disk configuration is preserved if the service profile is disassociated with the server. In that case, a configuration error will be raised when a new service profile is associated with that server if the local disk configuration in that profile is different.

FlexFlash

FlexFlash State : ○ Disable ● Enable

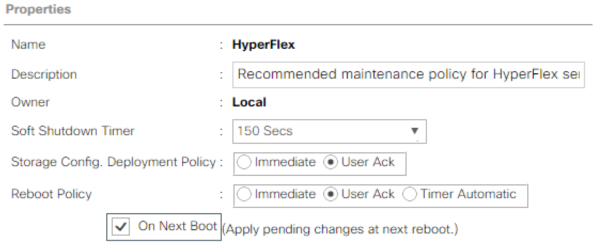
If **FlexFlash State** is disabled, SD cards will become unavailable immediately.
Please ensure SD cards are not in use before disabling the FlexFlash State.

FlexFlash RAID Reporting State : ○ Disable ● Enable

Maintenance Policies

Cisco UCS Maintenance Policies define the behavior of the attached blades and rack mount servers when changes are made to the associated service profiles. The default Cisco UCS Maintenance Policy setting is "Immediate" meaning that any change to a service profile that requires a reboot of the physical server will result in an immediate reboot of that server. The Cisco best practice is to use a Maintenance Policy set to "user-ack", which requires a secondary acknowledgement by a user with the appropriate rights within Cisco UCS Manager, before the server is rebooted to apply the changes. The HyperFlex installer creates a Maintenance Policy named "HyperFlex" with the setting changed to "user-ack". In addition, the On Next Boot setting is enabled, which will automatically apply changes the next time the server is rebooted, without any secondary acknowledgement. The following figure details the Maintenance Policy configured by the HyperFlex installer:

Figure 37 Cisco UCS Maintenance Policy



Properties

Name : **HyperFlex**

Description : Recommended maintenance policy for HyperFlex se

Owner : **Local**

Soft Shutdown Timer : 150 Secs ▼

Storage Config. Deployment Policy : ○ Immediate ● User Ack

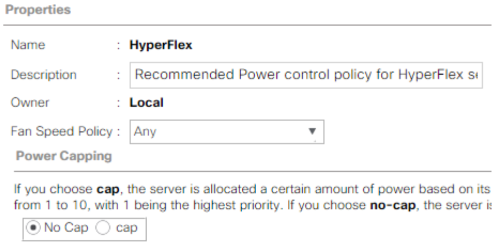
Reboot Policy : ○ Immediate ● User Ack ○ Timer Automatic

☑ On Next Boot (Apply pending changes at next reboot.)

Power Control Policies

Cisco UCS Power Control Policies allow administrators to set priority values for power application to servers in environments where power supply may be limited, during times when the servers demand more power than is available. The HyperFlex installer creates a Power Control Policy named "HyperFlex" with all power capping disabled, and fans allowed to run at full speed when necessary. The following figure details the Power Control Policy configured by the HyperFlex installer:

Figure 38 Cisco UCS Power Control Policy



Properties

Name : **HyperFlex**

Description : Recommended Power control policy for HyperFlex s

Owner : **Local**

Fan Speed Policy : Any ▼

Power Capping

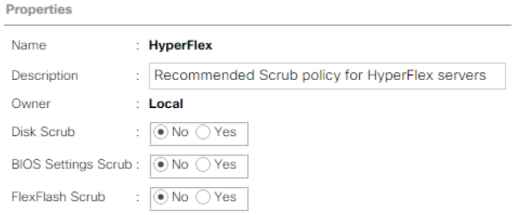
If you choose **cap**, the server is allocated a certain amount of power based on its
from 1 to 10, with 1 being the highest priority. If you choose **no-cap**, the server i

● No Cap ○ cap

Scrub Policies

Cisco UCS Scrub Policies are used to scrub, or erase data from local disks, BIOS settings and FlexFlash SD cards. If the policy settings are enabled, the information is wiped when the service profile using the policy is disassociated from the server. The HyperFlex installer creates a Scrub Policy named “HyperFlex” which has all settings disabled, therefore all data on local disks, SD cards and BIOS settings will be preserved if a service profile is disassociated. The following figure details the Scrub Policy configured by the HyperFlex installer:

Figure 39 Cisco UCS Scrub Policy



Properties

Name : **HyperFlex**

Description : Recommended Scrub policy for HyperFlex servers

Owner : **Local**

Disk Scrub : ● No ○ Yes

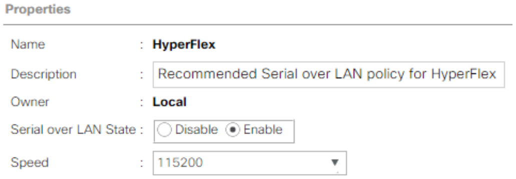
BIOS Settings Scrub : ● No ○ Yes

FlexFlash Scrub : ● No ○ Yes

Serial over LAN Policies

Cisco UCS Serial over LAN (SoL) Policies enable console output which is sent to the serial port of the server, to be accessible via the LAN. For many Linux based operating systems, such as VMware ESXi, the local serial port can be configured as a local console, where users can watch the system boot, and communicate with the system command prompt interactively. Since many blade servers do not have physical serial ports, and often administrators are working remotely, the ability to send and receive that traffic via the LAN is very helpful. Connections to a SoL session can be initiated from Cisco UCS Manager. The HyperFlex installer creates a SoL named “HyperFlex” to enable SoL sessions, and uses this feature to configure the ESXi hosts’ management networking configuration. The following figure details the SoL Policy configured by the HyperFlex installer:

Figure 40 Cisco UCS Serial over LAN Policy



Properties

Name : **HyperFlex**

Description : Recommended Serial over LAN policy for HyperFlex

Owner : **Local**

Serial over LAN State : ○ Disable ● Enable

Speed : 115200 ▼

vMedia Policies

Cisco UCS Virtual Media (vMedia) Policies automate the connection of virtual media files to the remote KVM session of the Cisco UCS blades and rack mount servers. Using a vMedia policy can speed up installation time by automatically attaching an installation ISO file to the server, without having to manually launch the remote KVM console and connect them one-by-one. The HyperFlex installer creates a vMedia Policy named “HyperFlex” for future use, with no media locations defined.

Cisco UCS Service Profile Templates

Cisco UCS Manager has a feature to configure service profile templates, which can be used to simplify and speed up configuration efforts when the same configuration needs to be applied to multiple servers. Service profile templates are used to spawn multiple service profile copies to associate with a group of servers, versus configuring the same service profile manually each time it is needed. Service profile templates contain all the configuration elements that make up a service profile, including vNICs, vHBAs, local disk configurations, boot policies, host firmware packages, BIOS policies and more. Templates are created as either initial templates, or updating templates. Updating templates retain a link between the parent template and the child object, therefore when changes are made to the template, the changes are propagated to all remaining linked child objects. The HyperFlex installer creates two service profile templates, named "hx-nodes" and "compute-nodes", each with nearly the same configuration, except for the local disk configuration and boot policies. This simplifies future efforts if the configuration of the compute only nodes needs to differ from the configuration of the HyperFlex converged storage nodes. The following tables detail the service profile templates configured by the HyperFlex installer:

Table 27 Cisco UCS Service Profile Template Settings and Values

Service Profile Template Name:	**hx-nodes**
Setting	**Value**
UUID Pool	Hardware Default
Associated Server Pool	None
Maintenance Policy	HyperFlex
Management IP Address Policy	hx-ext-mgmt
Local Disk Configuration Policy	HyperFlex
LAN Connectivity Policy	HyperFlex
Boot Policy	HyperFlex
BIOS Policy	HyperFlex
Firmware Policy	HyperFlex
Power Control Policy	HyperFlex
Scrub Policy	HyperFlex
Serial over LAN Policy	HyperFlex

vMedia Policy	Not defined

Service Profile Template Name:	**compute-nodes**
Setting	**Value**
UUID Pool	Hardware Default
Associated Server Pool	None
Maintenance Policy	HyperFlex
Management IP Address Policy	hx-ext-mgmt
Local Disk Configuration Policy	hx-compute
LAN Connectivity Policy	HyperFlex
Boot Policy	hx-compute
BIOS Policy	HyperFlex
Firmware Policy	HyperFlex
Power Control Policy	HyperFlex
Scrub Policy	HyperFlex
Serial over LAN Policy	HyperFlex
vMedia Policy	Not defined

vNIC/vHBA Placement

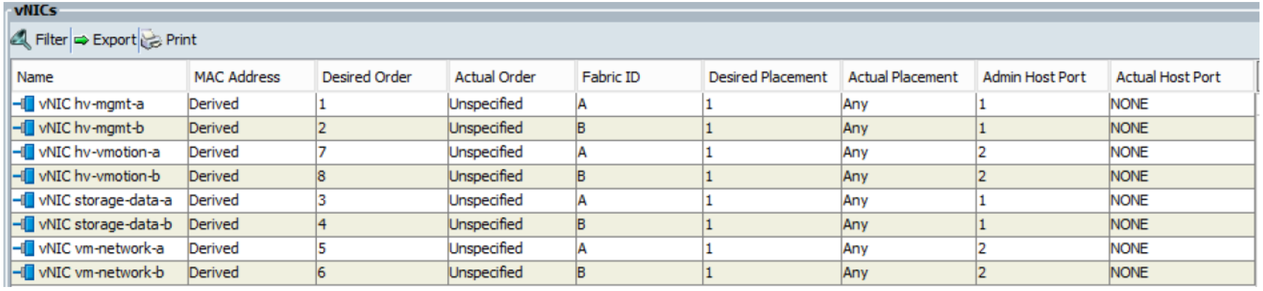
In order to control the order of detection of the vNICs and vHBAs defined in service profiles, Cisco UCS allows for the definition of the placement of the vNICs and vHBAs across the cards in a blade or rack mount server, and the order they are seen. Since HX-series servers are configured with a single Cisco UCS VIC 1227 mLOM card, the only valid placement is on card number 1. In certain hardware configurations, the physical mapping of cards and port extenders to their logical order is not linear, therefore each card is referred to as a virtual connection, or vCon. Because of this, the interface where the placement and order is defined does not refer to physical cards, but instead refers to vCons. Therefore, all the vNICs defined in the service profile templates for HX-series servers, places them on vCon 1, then their order is defined.

Through the combination of the vNIC templates created (vNIC Templates), the LAN Connectivity Policy (LAN Connectivity Policies), and the vNIC placement, every VMware ESXi server will detect the network interfaces in a known and identical order, and they will always be connected to the same VLANs via the same network fabrics. The following table outlines the vNICs, their placement, their order, the fabric they are connected to, their default VLAN, and how they are enumerated by the ESXi hypervisor:

Table 28 vNIC Placement

vNIC	Placement	Order	Fabric	VLAN	ESXi interface enumeration
hv-mgmt-a	1	1	A	<<hx-inband-mgmt>>	vmnic0
hv-mgmt-b	1	2	B	<<hx-inband-mgmt>>	vmnic1
storage-data-a	1	3	A	<<hx-storage-data>>	vmnic2
storage-data-b	1	4	B	<<hx-storage-data>>	vmnic3
vm-network-a	1	5	A	<<hx-vm-data>>	vmnic4
vm-network-b	1	6	B	<<hx-vm-data>>	vmnic5
hv-vmotion-a	1	7	A	<<hx-vmotion>>	vmnic6
hv-vmotion-b	1	8	B	<<hx-vmotion>>	vmnic7

Figure 41 vNIC Placement



Name	MAC Address	Desired Order	Actual Order	Fabric ID	Desired Placement	Actual Placement	Admin Host Port	Actual Host Port
vNIC hv-mgmt-a	Derived	1	Unspecified	A	1	Any	1	NONE
vNIC hv-mgmt-b	Derived	2	Unspecified	B	1	Any	1	NONE
vNIC hv-vmotion-a	Derived	7	Unspecified	A	1	Any	2	NONE
vNIC hv-vmotion-b	Derived	8	Unspecified	B	1	Any	2	NONE
vNIC storage-data-a	Derived	3	Unspecified	A	1	Any	1	NONE
vNIC storage-data-b	Derived	4	Unspecified	B	1	Any	1	NONE
vNIC vm-network-a	Derived	5	Unspecified	A	1	Any	2	NONE
vNIC vm-network-b	Derived	6	Unspecified	B	1	Any	2	NONE

Note: ESXi VMDirectPath relies on a fixed PCI address for the passthrough devices. If the configuration is changed by adding or removing vNICs or vHBAs, then the order of the devices seen in the PCI tree will change. The ESXi hosts will subsequently need to reboot one additional time in order to repair the configuration, which they will do automatically.

ESXi Host Design

The following sections detail the design of the elements within the VMware ESXi hypervisors, system requirements, virtual networking and the configuration of ESXi for the Cisco HyperFlex HX Distributed Data Platform.

Virtual Networking Design

The Cisco HyperFlex system has a pre-defined virtual network design at the ESXi hypervisor level. Four different virtual switches are created by the HyperFlex installer, each using two uplinks, which are each serviced by a vNIC defined in the Cisco UCS service profile. The vSwitches created are:

- **vswitch-hx-inband-mgmt**: This is the default vSwitch0 which is renamed by the ESXi kickstart file as part of the automated installation. The default VMkernel port, vmk0, is configured in the standard Management Network port group. The switch has two uplinks, active on fabric A and standby on fabric B, without jumbo frames. A second port group is created for the Storage Platform Controller VMs to connect to with their individual management interfaces. A third port group is created for cluster to cluster VM snapshot replication traffic. The VLANs are not Native VLANs as assigned to the vNIC templates, and therefore they are defined in ESXi/vSphere.

- **vswitch-hx-storage-data**: This vSwitch is created as part of the automated installation. A VMkernel port, vmk1, is configured in the Storage Hypervisor Data Network port group, which is the interface used for connectivity to the HX Datastores via NFS. The switch has two uplinks, active on fabric B and standby on fabric A, with jumbo frames highly recommended. A second port group is created for the Storage Platform Controller VMs to connect to with their individual storage interfaces. The VLAN is not a Native VLAN as assigned to the vNIC templates, and therefore they are defined in ESXi/vSphere.

- **vswitch-hx-vm-network**: This vSwitch is created as part of the automated installation. The switch has two uplinks, active on both fabrics A and B, and without jumbo frames. The VLANs are not Native VLANs as assigned to the vNIC templates, and therefore they are defined in ESXi/vSphere.

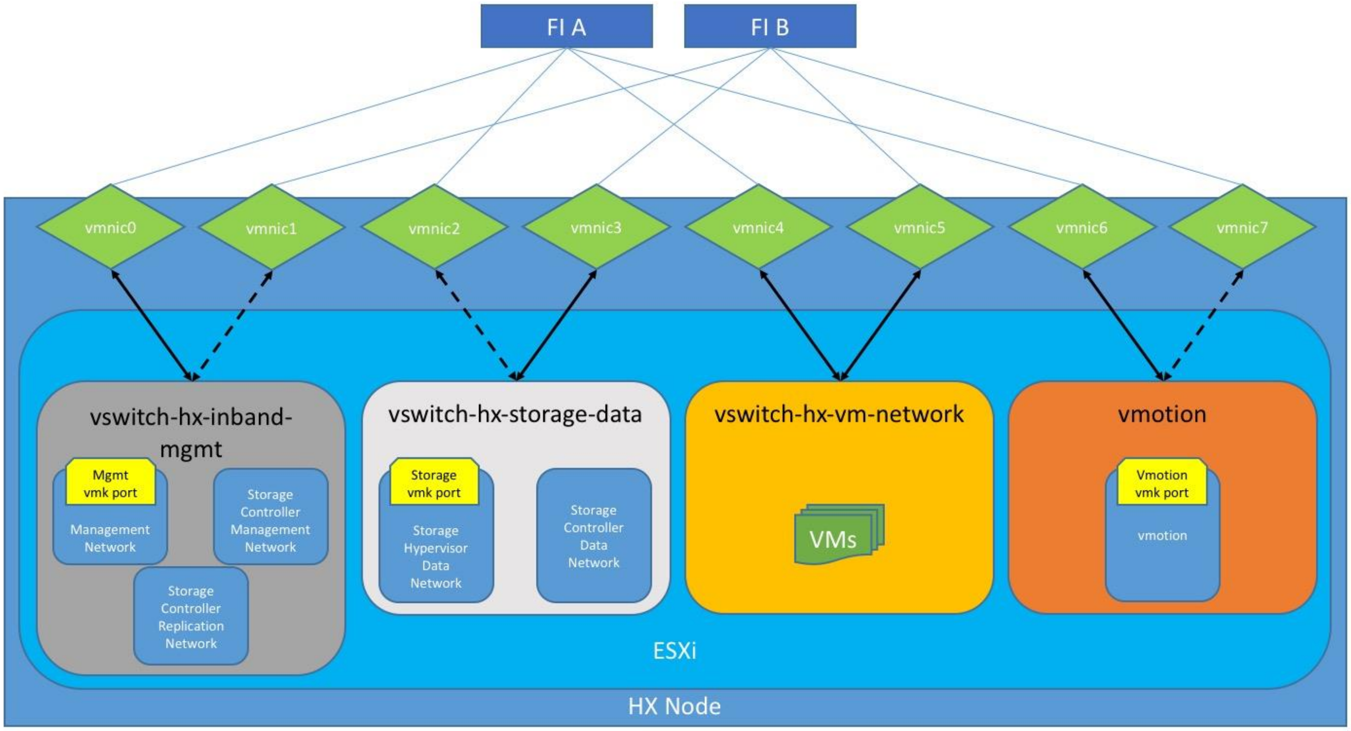
- **vmotion**: This vSwitch is created as part of the automated installation. The switch has two uplinks, active on fabric A and standby on fabric B, with jumbo frames highly recommended. The IP addresses of the VMkernel ports (vmk2) are configured during the post_install script execution. The VLAN is not a Native VLAN as assigned to the vNIC templates, and therefore they are defined in ESXi/vSphere.

The following table and figures help give more details into the ESXi virtual networking design as built by the HyperFlex installer by default:

Table 29 Virtual Switches

Virtual Switch	Port Groups	Active vmnic(s)	Passive vmnic(s)	VLAN IDs	Jumbo
vswitch-hx-inband-mgmt	Management Network Storage Controller Management Network	vmnic0	vmnic1	<<hx-inband-mgmt>>	no
	Storage Controller Replication Network	vmnic0	vmnic1	<<hx-inband-repl>>	no
vswitch-hx-storage-data	Storage Controller Data Network Storage Hypervisor Data Network	vmnic3	vmnic2	<<hx-storage-data>>	yes
vswitch-hx-vm-network	vm-network-<<VLAN ID>>	vmnic4 vmnic5		<<vm-network>>	no
vmotion	vmotion-<<VLAN ID>>	vmnic6	vmnic7	<<hx-vmotion>>	yes

Figure 42 **ESXi Network Design**



VMDirectPath I/O Passthrough

VMDirectPath I/O allows a guest VM to directly access PCI and PCIe devices in an ESXi host as though they were physical devices belonging to the VM itself, also referred to as PCI passthrough. With the appropriate driver for the hardware device, the guest VM sends all I/O requests directly to the physical device, bypassing the hypervisor. In the Cisco HyperFlex system, the Storage Platform Controller VMs use this feature to gain full control of the Cisco 12Gbps SAS HBA cards in the Cisco HX-series rack mount servers. This gives the controller VMs direct hardware level access to the physical disks installed in the servers, which they consume to construct the Cisco HX Distributed Filesystem. Only the disks connected directly to the Cisco SAS HBA are controlled by the controller VMs. Other disks, connected to different controllers, such as the SD cards, remain under the control of the ESXi hypervisor. The configuration of the VMDirectPath I/O feature is done by the Cisco HyperFlex installer, and requires no manual steps.

Storage Platform Controller VMs

A key component of the Cisco HyperFlex system is the Storage Platform Controller Virtual Machine running on each of the nodes in the HyperFlex cluster. The controller VMs cooperate to form and coordinate the Cisco HX Distributed Filesystem, and service all the guest VM IO requests. The controller VMs are deployed as a vSphere ESXi agent, which is similar in concept to that of a Linux or Windows service. ESXi agents are tied to a specific host, they start and stop along with the ESXi hypervisor, and the system is not considered to be online and ready until both the hypervisor and the agents have started. Each ESXi hypervisor host has a single ESXi agent deployed, which is the controller VM for that node, and it cannot be moved or migrated to another host. The collective ESXi agents are managed via an ESXi agency in the vSphere cluster.

The storage controller VM runs custom software and services that manage and maintain the Cisco HX Distributed Filesystem. The services and processes that run within the controller VMs are not exposed as part of the ESXi agents to the agency, therefore the ESXi hypervisors nor vCenter server have any direct knowledge of the storage services provided by the controller VMs. Management and visibility into the function of the controller VMs, and the Cisco HX Distributed Filesystem is done via the HyperFlex Connect HTML management webpage, or a plugin installed to the vCenter server or appliance managing the vSphere cluster. The plugin communicates directly with the controller VMs to display the information requested, or make the configuration changes directed, all while operating within the same web-based interface of the vSphere Web Client. The deployment of the controller VMs, agents, agency, and vCenter plugin are all done by the Cisco HyperFlex installer, and requires no manual steps.

Controller VM Locations

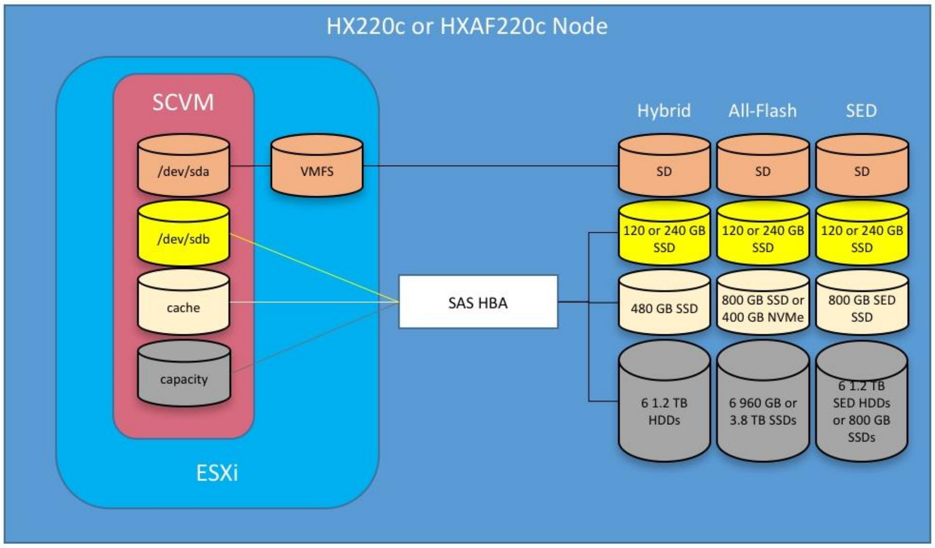
The physical storage location of the controller VMs differs among the Cisco HX-Series rack servers, due to differences with the physical disk location and connections on those server models. The storage controller VM is operationally no different from any other typical virtual machines in an ESXi environment. The VM must have a virtual disk with the bootable root filesystem available in a location separate from the SAS HBA that the VM is controlling via VMDirectPath I/O. The configuration details of the models are as follows:

- **HX220c and HXAF220c**: The controller VM's root filesystem is stored on a 2.2 GB virtual disk, /dev/sda, which is placed on a 3.5 GB VMFS datastore, and that datastore is provisioned from the internal mirrored SD cards. The controller VM has full control of all the front facing hot-swappable disks via PCI passthrough control of the SAS HBA. The controller VM operating system sees the 120 GB or 240 GB SSD, also commonly called the "housekeeping" disk as /dev/sdb, and places HyperFlex binaries and logs on this disk. The remaining disks seen by the controller VM OS are used by the HX Distributed filesystem for caching and capacity layers.
- **HX240c and HXAF240c**: The HX240c-M4SX and HXAF240c-M4SX server has a built-in SATA controller provided by the Intel Wellsburg Platform Controller Hub (PCH) chip, and the 120 GB or 240 GB housekeeping disk is connected to it, placed in an internal drive carrier. Since this model does not connect the housekeeping disk to the SAS HBA, the ESXi hypervisor remains in control of this disk, and a VMFS datastore is provisioned there, using the entire disk. On this VMFS datastore, a 2.2 GB virtual disk is created and used by the controller VM as /dev/sda for the root filesystem, and an 87 GB virtual disk is created and used by the controller VM as /dev/sdb, placing the HyperFlex binaries and logs on this disk. The front-facing hot swappable disks, seen by the controller VM OS via PCI passthrough control of the SAS HBA, are used by the HX Distributed filesystem for caching and capacity layers.

Note: On the HX240c and HXAF240c model servers, when configured with SEDs, the housekeeping disk is moved to a front disk slot. Since this disk is physically controlled by the SAS HBA in PCI passthrough mode, the configuration of the SCVM virtual disks changes to be the same as that of the HX220c and HXAF220c servers.

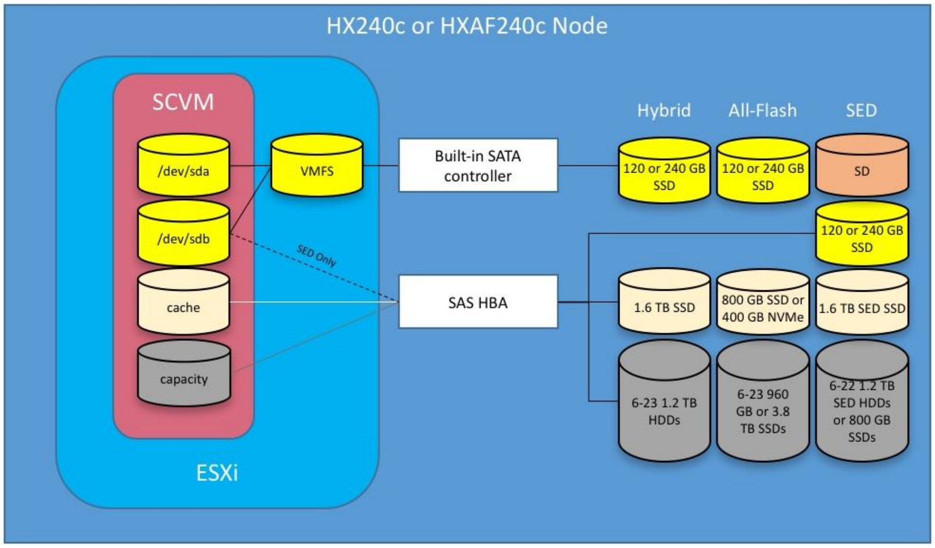
The following figures detail the Storage Platform Controller VM placement on the ESXi hypervisor hosts:

Figure 43 HX220c Controller VM Placement



Note: The HyperFlex compute-only Cisco UCS server blades or rack-mount servers also place a lightweight storage controller VM on a 3.5 GB VMFS datastore, which can be provisioned from the SD cards, or placed on a VMFS partition alongside the boot volume if booting from SAN or local disk.

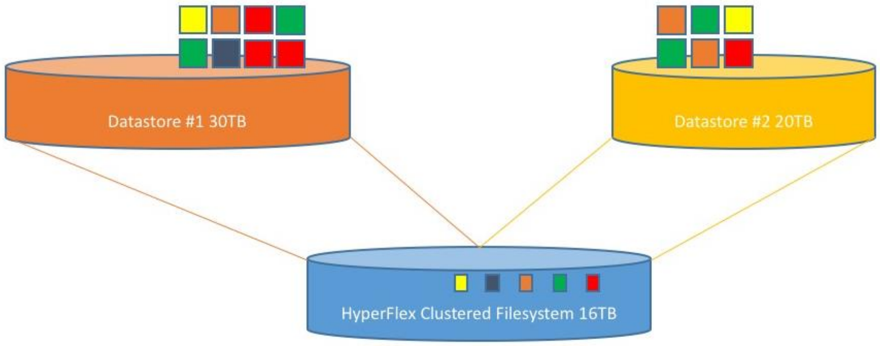
Figure 44 HX240c Controller VM Placement



HyperFlex Datastores

The new HyperFlex cluster has no default datastores configured for virtual machine storage, therefore the datastores must be created using the vCenter Web Client plugin or the HyperFlex Connect GUI. It is important to recognize that all HyperFlex datastores are thinly provisioned, meaning that their configured size can far exceed the actual space available in the HyperFlex cluster. Alerts will be raised by the HyperFlex system in HyperFlex Connect or the vCenter plugin when actual space consumption results in low amounts of free space, and alerts will be sent via auto support email alerts. Overall space consumption in the HyperFlex clustered filesystem is optimized by the default deduplication and compression features.

Figure 45 Datastore Example



CPU Resource Reservations

Since the storage controller VMs provide critical functionality of the Cisco HX Distributed Data Platform, the HyperFlex installer will configure CPU resource reservations for the controller VMs. This reservation guarantees that the controller VMs will have CPU resources at a minimum level, in situations where the physical CPU resources of the ESXi hypervisor host are being heavily consumed by the guest VMs. This is a soft guarantee, meaning in most situations the SCVMs are not using all of the CPU resources reserved, therefore allowing the guest VMs to use them. The following table details the CPU resource reservation of the storage controller VMs:

Table 30 Controller VM CPU Reservations

Number of vCPU	Shares	Reservation	Limit
8	Low	10800 MHz	unlimited

Memory Resource Reservations

Since the storage controller VMs provide critical functionality of the Cisco HX Distributed Data Platform, the HyperFlex installer will configure memory resource reservations for the controller VMs. This reservation guarantees that the controller VMs will have memory resources at a minimum level, in situations where the physical memory resources of the ESXi hypervisor host are being heavily consumed by the guest VMs. The following table details the memory resource reservation of the storage controller VMs:

Table 31 Controller VM Memory Reservations

Server Model	Amount of Guest Memory	Reserve All Guest Memory
HX220c-M4S and HXAF220c-M4S	48 GB	Yes
HX240c-M4SX and HXAF240c-M4SX	72 GB	Yes

Note: The compute-only nodes have a lightweight storage controller VM, it is configured with only 1 vCPU of 1024MHz and 512 MB of memory reservation.

Installation

Cisco HyperFlex systems are ordered with a factory pre-installation process having been done prior to the hardware delivery. This factory integration work will deliver the HyperFlex servers with the proper firmware revisions pre-set, a copy of the VMware ESXi hypervisor software pre-installed, and some components of the Cisco HyperFlex software already installed. Once on site, the final steps to be performed are reduced and simplified due to the previous factory work. For the purpose of this document, the setup process is described as though this factory pre-installation work was done, thereby leveraging the tools and processes developed by Cisco to simplify the process and dramatically reduce the deployment time.

Installation of the Cisco HyperFlex system is primarily done via a deployable HyperFlex installer virtual machine, available for download at cisco.com as an OVA file. The installer VM performs the Cisco UCS configuration work, the configuration of ESXi on the HyperFlex hosts, the installation of the HyperFlex HX Data Platform software and creation of the HyperFlex cluster. Because this simplified installation method has been developed by Cisco, this CVD will not give detailed manual steps for the configuration of all the elements that are handled by the installer. The following sections will guide you through the prerequisites and manual steps needed prior to using the HyperFlex installer, how to utilize the HyperFlex Installer, and finally how to perform the remaining post-installation tasks.

Prerequisites

Prior to beginning the installation activities, it is important to gather the following information:

IP Addressing

To install the HX Data Platform, an OVF installer appliance must be deployed on a separate virtualization host, which is not a member of the HyperFlex cluster. The HyperFlex installer requires one IP address on the management network and the HX installer appliance IP address must be able to communicate with Cisco UCS Manager, ESXi management IP addresses on the HX hosts, and the vCenter IP addresses where the HyperFlex cluster will be managed.

Additional IP addresses for the Cisco HyperFlex system need to be allocated from the appropriate subnets and VLANs to be used. IP addresses that are used by the system fall into the following groups:

- **Cisco UCS Manager**: These addresses are used and assigned by Cisco UCS manager. Three IP addresses are used by Cisco UCS Manager; one address is assigned to each Cisco UCS Fabric Interconnect, and the third IP address is a roaming address for management of the Cisco UCS cluster. In addition, at least one IP address per Cisco UCS blade or HX-series rack mount server is required for the hx-ext-mgmt IP address pool, which are assigned to the CIMC interface of the physical servers. Since these management addresses are assigned from a pool, they need to be provided in a contiguous block of addresses. These addresses must all be in the same subnet.

- **HyperFlex and ESXi Management**: These addresses are used to manage the ESXi hypervisor hosts, and the HyperFlex Storage Platform Controller VMs. Two IP addresses per node in the HyperFlex cluster are required from the same subnet, and a single additional IP address is needed as the roaming HyperFlex cluster management interface. These addresses can be assigned from the same subnet at the Cisco UCS Manager addresses, or they may be separate.

- **HyperFlex Replication:** These addresses are used by the HyperFlex Storage Platform Controller VMs for clusters that are configured to replicate VMs to one another. One IP address per HX node is required, plus one additional IP address as a roaming clustered replication interface. These addresses are assigned to a pool as part of a post-installation activity described later in this document, and are not needed to complete the initial installation of a HyperFlex cluster. These addresses can be from the same subnet as the HyperFlex and ESXi management addresses, but it is recommended that the VLAN ID and subnet be unique.

- **HyperFlex Storage**: These addresses are used by the HyperFlex Storage Platform Controller VMs, and as VMkernel interfaces on the ESXi hypervisor hosts, for sending and receiving data to/from the HX Distributed Data Platform Filesystem. Two IP addresses per node in the HyperFlex cluster are required from the same subnet, and a single additional IP address is needed as the roaming HyperFlex cluster storage interface. It is recommended to provision a subnet that is not used in the network for other purposes, and it is also possible to use non-routable IP address ranges for these interfaces. Finally, if the Cisco UCS domain is going to contain multiple HyperFlex clusters, it is recommended to use a different subnet and VLAN ID for the HyperFlex storage traffic for each cluster. This is a safer method, guaranteeing that storage traffic from multiple clusters cannot intermix.
- **VMotion**: These IP addresses are used by the ESXi hypervisor hosts as VMkernel interfaces to enable vMotion capabilities. One or more IP addresses per node in the HyperFlex cluster are required from the same subnet. Multiple addresses and VMkernel interfaces can be used if you wish to enable multi-nic vMotion, although this configuration would require additional manual steps.

The following tables will assist with gathering the required IP addresses for the installation of an 8 node standard HyperFlex cluster, or a 4+4 extended cluster, by listing the addresses required, and an example configuration:

Table 32 HyperFlex Cluster IP Addressing

Address Group:	UCS Management	HyperFlex and ESXi Management			HyperFlex Storage		VMotion
VLAN ID:							
Subnet:							
Subnet Mask:							
Gateway:							
Device	**UCS Management Addresses**	**ESXi Management Interface**	**Storage Controller Management Interface**	**Storage Controller Replication Network**	**ESXi Hypervisor Storage VMkernel Interface**	**Storage Controller Storage Interface**	**VMotion VMkernel Interface**
Fabric Interconnect A							
Fabric Interconnect B							
UCS Manager							
HyperFlex Cluster							
HyperFlex Node #1							
HyperFlex Node #2							
HyperFlex Node #3							
HyperFlex Node #4							
HyperFlex Node #5							
HyperFlex Node #6							

Address Group:	UCS Management	HyperFlex and ESXi Management			HyperFlex Storage		VMotion
HyperFlex Node #7							
HyperFlex Node #8							

Table 33 HyperFlex Extended Cluster IP Addressing

Address Group:	UCS Management	HyperFlex and ESXi Management			HyperFlex Storage		VMotion
VLAN ID:							
Subnet:							
Subnet Mask:							
Gateway:							
Device	**UCS Management Addresses**	**ESXi Management Interface**	**Storage Controller Management Interface**	**Storage Controller Replication Network**	**ESXi Hypervisor Storage VMkernel Interface**	**Storage Controller Storage Interface**	**VMotion VMkernel Interface**
Fabric Interconnect A							
Fabric Interconnect B							
UCS Manager							
HyperFlex Cluster							
HyperFlex Node #1							
HyperFlex Node #2							
HyperFlex Node #3							
HyperFlex Node #4							
Compute Node #1							
Compute Node #2							
Compute Node #3							
Compute Node #4							

Table 34 HyperFlex Cluster Example IP Addressing

Address Group:	UCS Management	HyperFlex and ESXi Management			HyperFlex Storage		VMotion
VLAN ID:	133	133		150	51		200
Subnet:	10.29.133.0	10.29.133.0		192.168.150.0	192.168.51.0		192.168.200.0
Subnet Mask:	255.255.255.0	255.255.255.0		255.255.255.0	255.255.255.0		255.255.255.0
Gateway:	10.29.133.1	10.29.133.1		192.168.150.1			
Device	**UCS Management Addresses**	**ESXi Management Interface**	**Storage Controller Management Interface**	**Storage Controller Replication Network**	**ESXi Hypervisor Storage VMkernel Interface**	**Storage Controller Storage Interface**	**VMotion VMkernel Interface**
Fabric Interconnect A	10.29.133.104						
Fabric Interconnect B	10.29.133.105						
UCS Manager	10.29.133.106						
HyperFlex Cluster			10.29.133.151	192.168.150.10		192.168.51.20	
HyperFlex Node #1	10.29.133.133	10.29.133.143	10.29.133.152	192.168.150.11	192.168.51.11	192.168.51.21	192.168.200.11
HyperFlex Node #2	10.29.133.134	10.29.133.144	10.29.133.153	192.168.150.12	192.168.51.12	192.168.51.22	192.168.200.12
HyperFlex Node #3	10.29.133.135	10.29.133.145	10.29.133.154	192.168.150.13	192.168.51.13	192.168.51.23	192.168.200.13
HyperFlex Node #4	10.29.133.136	10.29.133.146	10.29.133.155	192.168.150.14	192.168.51.14	192.168.51.24	192.168.200.14
HyperFlex Node #5	10.29.133.137	10.29.133.147	10.29.133.156	192.168.150.15	192.168.51.15	192.168.51.25	192.168.200.15
HyperFlex Node #6	10.29.133.138	10.29.133.148	10.29.133.157	192.168.150.16	192.168.51.16	192.168.51.26	192.168.200.16
HyperFlex Node #7	10.29.133.139	10.29.133.149	10.29.133.158	192.168.150.17	192.168.51.17	192.168.51.27	192.168.200.17
HyperFlex Node #8	10.29.133.140	10.29.133.150	10.29.133.159	192.168.150.18	192.168.51.18	192.168.51.28	192.168.200.18

Note: Table cells shaded in black do not require an IP address.

Note: The Cisco UCS Management, and HyperFlex and ESXi Management IP addresses can come from the same subnet, or be separate, as long as the HyperFlex installer can reach them both.

DHCP vs Static IP

By default, the HX installation will assign a static IP address to the management interface of the ESXi servers. Using Dynamic Host Configuration Protocol (DHCP) for automatic IP address assignment in not recommended.

DNS

DNS servers are highly recommended to be configured for querying Fully Qualified Domain Names (FQDN) in the HyperFlex and ESXi Management group. DNS records need to be created prior to beginning the installation. At a minimum, it is highly recommended to create A records and reverse PTR records for the ESXi hypervisor hosts' management interfaces. Additional A records can be created for the Storage Controller Management interfaces, ESXi Hypervisor Storage interfaces, and the Storage Controller Storage interfaces if desired.

The following tables will assist with gathering the required DNS information for the installation, by listing the information required, and an example configuration:

Table 35 DNS Server Information

Item	Value
DNS Server #1	
DNS Server #2	
DNS Domain	
vCenter Server Name	
SMTP Server Name	
UCS Domain Name	
HX Server #1 Name	
HX Server #2 Name	
HX Server #3 Name	
HX Server #4 Name	
HX Server #5 Name	
HX Server #6 Name	
HX Server #7 Name	
HX Server #8 Name	

Table 36 DNS Server Example Information

Item	Value
DNS Server #1	10.29.133.110
DNS Server #2	
DNS Domain	hx.lab.cisco.com
vCenter Server Name	vcenter.hx.lab.cisco.com
SMTP Server Name	outbound.cisco.com
UCS Domain Name	HX1-FI
HX Server #1 Name	hx220-01.hx.lab.cisco.com
HX Server #2 Name	hx220-02.hx.lab.cisco.com
HX Server #3 Name	hx220-03.hx.lab.cisco.com
HX Server #4 Name	hx220-04.hx.lab.cisco.com
HX Server #5 Name	hx220-05.hx.lab.cisco.com
HX Server #6 Name	hx220-06.hx.lab.cisco.com
HX Server #7 Name	hx220-07.hx.lab.cisco.com
HX Server #8 Name	hx220-08.hx.lab.cisco.com

NTP

Consistent time clock synchronization is required across the components of the HyperFlex system, provided by reliable NTP servers, accessible for querying in the Cisco UCS Management network group, and the HyperFlex and ESXi Management group. NTP is used by Cisco UCS Manager, vCenter, the ESXi hypervisor hosts, and the HyperFlex Storage Platform Controller VMs. The use of public NTP servers is highly discouraged, instead a reliable internal NTP server should be used.

The following tables will assist with gathering the required NTP information for the installation by listing the information required, and an example configuration:

Table 37 NTP Server Information

Item	Value
NTP Server #1	
NTP Server #2	
Timezone	

Table 38 NTP Server Example Information

Item	Value
NTP Server #1	171.68.38.65
NTP Server #2	171.68.38.66
Timezone	(UTC-8:00) Pacific Time

VLANs

Prior to the installation, the required VLAN IDs need to be documented, and created in the upstream network if necessary. At a minimum, there are 4 VLANs that need to be trunked to the Cisco UCS Fabric Interconnects that comprise the HyperFlex system; a VLAN for the HyperFlex and ESXi Management group, a VLAN for the HyperFlex Storage group, a VLAN for the VMotion group, and at least one VLAN for the guest VM traffic. If HyperFlex Replication is to be used, another VLAN must be created and trunked for the replication traffic. The VLAN IDs must be supplied during the HyperFlex Cisco UCS configuration step, and the VLAN names can optionally be customized.

The following tables will assist with gathering the required VLAN information for the installation by listing the information required, and an example configuration:

Table 39 VLAN Information

Name	ID
<<hx-inband-mgmt>>	
<<hx-inband-repl>>	
<<hx-storage-data>>	
<<hx-vm-data>>	
<<hx-vmotion>>	

Table 40 VLAN Example Information

Name	ID
hx-inband-mgmt	133
hx-inband-repl	150
hx-storage-data	51
vm-network	100
hx-vmotion	200

Network Uplinks

The Cisco UCS uplink connectivity design needs to be finalized prior to beginning the installation. One of the early manual tasks to be completed is to configure the Cisco UCS network uplinks and verify their operation, prior to beginning the HyperFlex installation steps. Refer to the network uplink design possibilities in the Network Design section.

The following tables will assist with gathering the required network uplink information for the installation by listing the information required, and an example configuration:

Table 41 Network Uplink Configuration

Fabric Interconnect Port		Port Channel	Port Channel Type	Port Channel ID	Port Channel Name
A		□ Yes □ No	□ LACP □ vPC		
		□ Yes □ No			
		□ Yes □ No			
		□ Yes □ No			
B		□ Yes □ No	□ LACP □ vPC		
		□ Yes □ No			
		□ Yes □ No			

Fabric Interconnect Port		Port Channel	Port Channel Type	Port Channel ID	Port Channel Name
		☐ Yes ☐ No			

Table 42 Network Uplink Example Configuration

Fabric Interconnect Port		Port Channel	Port Channel Type	Port Channel ID	Port Channel Name
A	1/25	☒ Yes ☐ No	☐ LACP ☒ vPC	10	vpc-10
	1/26	☒ Yes ☐ No			
		☐ Yes ☐ No			
		☐ Yes ☐ No			
B	1/25	☒ Yes ☐ No	☐ LACP ☒ vPC	20	vpc-20
	1/26	☒ Yes ☐ No			
		☐ Yes ☐ No			
		☐ Yes ☐ No			

Usernames and Passwords

Several usernames and passwords need to be defined or known as part of the HyperFlex installation process. The following tables will assist with gathering the required username and password information by listing the information required, and an example configuration:

Table 43 Usernames and Passwords

Account	Username	Password
HX Installer Administrator	root	<<hx_install_root_pw>>
UCS Administrator	admin	<<ucs_admin_pw>>
ESXi Administrator	root	<<esxi_root_pw>>

HyperFlex Administrator	root	<<hx_admin_pw>>
vCenter Administrator	<<vcenter_administrator>>	<<vcenter_admin_pw>>

Table 44 Example Usernames and Passwords

Account	**Username**	**Password**
HX Installer Administrator	root	Cisco123
UCS Administrator	admin	Cisco123
ESXi Administrator	root	Cisco123
HyperFlex Administrator	root	Cisco123!!
vCenter Administrator	administrator@vsphere.local	!QAZ2wsx

Physical Installation

Install the Fabric Interconnects, the HX-Series rack mount servers, standard C-series rack mount servers, the Cisco UCS 5108 chassis, the Cisco UCS Fabric Extenders, and the Cisco UCS blades according to their corresponding hardware installation guides:

Cisco UCS 6200 Series Fabric Interconnect:
http://www.cisco.com/c/en/us/td/docs/unified_computing/ucs/hw/6200-install-guide/6200_HIG.pdf

Cisco UCS 6300 Series Fabric Interconnect:

https://www.cisco.com/c/en/us/td/docs/unified_computing/ucs/hw/6300-install-guide/6300_Series_HIG.html

HX220c M4 Server:
http://www.cisco.com/c/en/us/td/docs/hyperconverged_systems/HX_series/HX220c_M4/HX220c/overview.html

HX240c M4 Server:
http://www.cisco.com/c/en/us/td/docs/hyperconverged_systems/HX_series/HX240c_M4/HX240c/overview.html

Cisco UCS 5108 Chassis, Servers and Fabric Extenders:
http://www.cisco.com/c/en/us/td/docs/unified_computing/ucs/hw/chassis-install-guide/ucs5108_install.pdf

Cabling

The physical layout of the HyperFlex system was previously described in section Physical Topology. The Fabric Interconnects, HX-series rack mount servers, Cisco UCS chassis and blades need to be cabled properly before beginning the installation activities.

The following table provides an example cabling map for installation of a Cisco HyperFlex system, with eight HX220c-M4SX servers, and one Cisco UCS 5108 chassis.

Table 45 Example Cabling Map

Device	Port	Connected To	Port	Type	Length	Note
UCS6248-A	L1	UCS6248-B	L1	CAT5	1FT	
UCS6248-A	L2	UCS6248-B	L2	CAT5	1FT	
UCS6248-A	mgmt0	Customer LAN				
UCS6248-A	1/1	HX Server #1	mLOM port 1	Twinax	3M	Server 1
UCS6248-A	1/2	HX Server #2	mLOM port 1	Twinax	3M	Server 2
UCS6248-A	1/3	HX Server #3	mLOM port 1	Twinax	3M	Server 3
UCS6248-A	1/4	HX Server #4	mLOM port 1	Twinax	3M	Server 4
UCS6248-A	1/5	HX Server #5	mLOM port 1	Twinax	3M	Server 5
UCS6248-A	1/6	HX Server #6	mLOM port 1	Twinax	3M	Server 6
UCS6248-A	1/7	HX Server #7	mLOM port 1	Twinax	3M	Server 7
UCS6248-A	1/8	HX Server #8	mLOM port 1	Twinax	3M	Server 8
UCS6248-A	1/9	2204XP #1	IOM1 port 1	Twinax	3M	Chassis 1
UCS6248-A	1/10	2204XP #1	IOM1 port 2	Twinax	3M	Chassis 1
UCS6248-A	1/11	2204XP #1	IOM1 port 3	Twinax	3M	Chassis 1
UCS6248-A	1/12	2204XP #1	IOM1 port 4	Twinax	3M	Chassis 1
UCS6248-A	1/13					
UCS6248-A	1/14					
UCS6248-A	1/15					
UCS6248-A	1/16					
UCS6248-A	1/17					
UCS6248-A	1/18					
UCS6248-A	1/19					
UCS6248-A	1/20					

Device	Port	Connected To	Port	Type	Length	Note
UCS6248-A	1/21					
UCS6248-A	1/22					
UCS6248-A	1/23					
UCS6248-A	1/24					
UCS6248-A	1/25	Customer LAN				uplink
UCS6248-A	1/26	Customer LAN				uplink
UCS6248-A	1/27					
UCS6248-A	1/28					
UCS6248-A	1/29					
UCS6248-A	1/30					
UCS6248-A	1/31					
UCS6248-A	1/32					

UCS6248-B	L1	UCS6248-A	L1	CAT5	1FT	
UCS6248-B	L2	UCS6248-A	L2	CAT5	1FT	
UCS6248-B	mgmt0	Customer LAN				
UCS6248-B	1/1	HX Server #1	mLOM port 2	Twinax	3M	Server 1
UCS6248-B	1/2	HX Server #2	mLOM port 2	Twinax	3M	Server 2
UCS6248-B	1/3	HX Server #3	mLOM port 2	Twinax	3M	Server 3
UCS6248-B	1/4	HX Server #4	mLOM port 2	Twinax	3M	Server 4
UCS6248-B	1/5	HX Server #5	mLOM port 2	Twinax	3M	Server 5
UCS6248-B	1/6	HX Server #6	mLOM port 2	Twinax	3M	Server 6
UCS6248-B	1/7	HX Server #7	mLOM port 2	Twinax	3M	Server 7
UCS6248-B	1/8	HX Server #8	mLOM port 2	Twinax	3M	Server 8
UCS6248-B	1/9	2204XP #1	IOM2 port 1	Twinax	3M	Chassis 1
UCS6248-B	1/10	2204XP #1	IOM2 port 2	Twinax	3M	Chassis 1
UCS6248-B	1/11	2204XP #1	IOM2 port 3	Twinax	3M	Chassis 1

Device	Port	Connected To	Port	Type	Length	Note
UCS6248-B	1/12	2204XP #1	IOM2 port 4	Twinax	3M	Chassis 1
UCS6248-B	1/13					
UCS6248-B	1/14					
UCS6248-B	1/15					
UCS6248-B	1/16					
UCS6248-B	1/17					
UCS6248-B	1/18					
UCS6248-B	1/19					
UCS6248-B	1/20					
UCS6248-B	1/21					
UCS6248-B	1/22					
UCS6248-B	1/23					
UCS6248-B	1/24					
UCS6248-B	1/25	Customer LAN				uplink
UCS6248-B	1/26	Customer LAN				uplink
UCS6248-B	1/27					
UCS6248-B	1/28					
UCS6248-B	1/29					
UCS6248-B	1/30					
UCS6248-B	1/31					
UCS6248-B	1/32					

Cisco UCS Installation

This section describes the steps to initialize and configure the Cisco UCS Fabric Interconnects, to prepare them for the HyperFlex installation.

Cisco UCS Fabric Interconnect A

To configure Fabric Interconnect A, complete the following steps:

1. Make sure the Fabric Interconnect cabling is properly connected, including the L1 and L2 cluster links, and power the Fabric Interconnects on by inserting the power cords.

2. Connect to the console port on the first Fabric Interconnect, which will be designated as the A fabric device. Use the supplied Cisco console cable (CAB-CONSOLE-RJ45=), and connect it to a built-in DB9 serial port, or use a USB to DB9 serial port adapter.

3. Start your terminal emulator software.

4. Create a connection to the COM port of the computer's DB9 port, or the USB to serial adapter. Set the terminal emulation to VT100, and the settings to 9600 baud, 8 data bits, no parity, and 1 stop bit.

5. Open the connection just created. You may have to press ENTER to see the first prompt.

6. Configure the first Fabric Interconnect, using the following example as a guideline:

```
         ---- Basic System Configuration Dialog ----

This setup utility will guide you through the basic configuration of
the system. Only minimal configuration including IP connectivity to
the Fabric interconnect and its clustering mode is performed through these steps.

Type Ctrl-C at any time to abort configuration and reboot system.
To back track or make modifications to already entered values,
complete input till end of section and answer no when prompted
to apply configuration.


Enter the configuration method. (console/gui) ? console

Enter the setup mode; setup newly or restore from backup. (setup/restore) ? setup

You have chosen to setup a new Fabric interconnect. Continue? (y/n): y

Enforce strong password? (y/n) [y]: y

Enter the password for "admin":
Confirm the password for "admin":

Is this Fabric interconnect part of a cluster(select 'no' for standalone)? (yes/no) [n]: yes

Enter the switch fabric (A/B) []: A

Enter the system name:  HX1-FI

Physical Switch Mgmt0 IP address : 10.29.133.104

Physical Switch Mgmt0 IPv4 netmask : 255.255.255.0

IPv4 address of the default gateway : 10.29.133.1

Cluster IPv4 address : 10.29.133.106

Configure the DNS Server IP address? (yes/no) [n]: yes

  DNS IP address : 10.29.133.110

Configure the default domain name? (yes/no) [n]: yes

  Default domain name : hx.lab.cisco.com

Join centralized management environment (UCS Central)? (yes/no) [n]: no

Following configurations will be applied:
  Switch Fabric=A
  System Name=HX1-FI
  Enforced Strong Password=no
  Physical Switch Mgmt0 IP Address=10.29.133.104
  Physical Switch Mgmt0 IP Netmask=255.255.255.0
  Default Gateway=10.29.133.1
  Ipv6 value=0
  DNS Server=10.29.133.110
  Domain Name=hx.lab.cisco.com

  Cluster Enabled=yes
  Cluster IP Address=10.29.133.106
  NOTE: Cluster IP will be configured only after both Fabric Interconnects are initialized

Apply and save the configuration (select 'no' if you want to re-enter)? (yes/no): yes
Applying configuration. Please wait.

Configuration file - Ok
```

Cisco UCS Fabric Interconnect B

To configure Fabric Interconnect B, complete the following steps:

1. Connect to the console port on the first Fabric Interconnect, which will be designated as the B fabric device. Use the supplied Cisco console cable (CAB-CONSOLE-RJ45=), and connect it to a built-in DB9 serial port, or use a USB to DB9 serial port adapter.

2. Start your terminal emulator software.

3. Create a connection to the COM port of the computer’s DB9 port, or the USB to serial adapter. Set the terminal emulation to VT100, and the settings to 9600 baud, 8 data bits, no parity, and 1 stop bit.

4. Open the connection just created. You may have to press ENTER to see the first prompt.

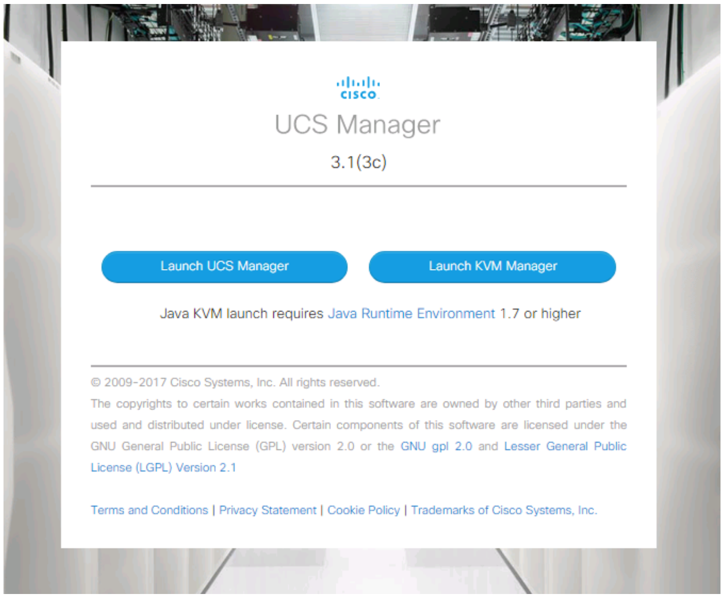
5. Configure the second Fabric Interconnect, using the following example as a guideline:

```
           ---- Basic System Configuration Dialog ----

  This setup utility will guide you through the basic configuration of
  the system. Only minimal configuration including IP connectivity to
  the Fabric interconnect and its clustering mode is performed through these steps.

  Type Ctrl-C at any time to abort configuration and reboot system.
  To back track or make modifications to already entered values,
  complete input till end of section and answer no when prompted
  to apply configuration.


  Enter the configuration method. (console/gui) ? console

  Installer has detected the presence of a peer Fabric interconnect. This Fabric interconnect
will be added to the cluster. Continue (y/n) ? y

  Enter the admin password of the peer Fabric interconnect:
    Connecting to peer Fabric interconnect... done
    Retrieving config from peer Fabric interconnect... done
    Peer Fabric interconnect Mgmt0 IPv4 Address: 10.29.133.104
    Peer Fabric interconnect Mgmt0 IPv4 Netmask: 255.255.255.0
    Cluster IPv4 address          : 10.29.133.106
    Peer FI is IPv4 Cluster enabled. Please Provide Local Fabric Interconnect Mgmt0 IPv4 Address

  Physical Switch Mgmt0 IP address : 10.29.133.105


  Apply and save the configuration (select 'no' if you want to re-enter)? (yes/no): yes
  Applying configuration. Please wait.

Configuration file - Ok
```

Cisco UCS Manager

Log in to the Cisco UCS Manager environment by completing the following steps:

1. Open a web browser and navigate to the Cisco UCS Manager Cluster IP address, for example https://10.29.133.106



Java KVM launch requires Java Runtime Environment 1.7 or higher

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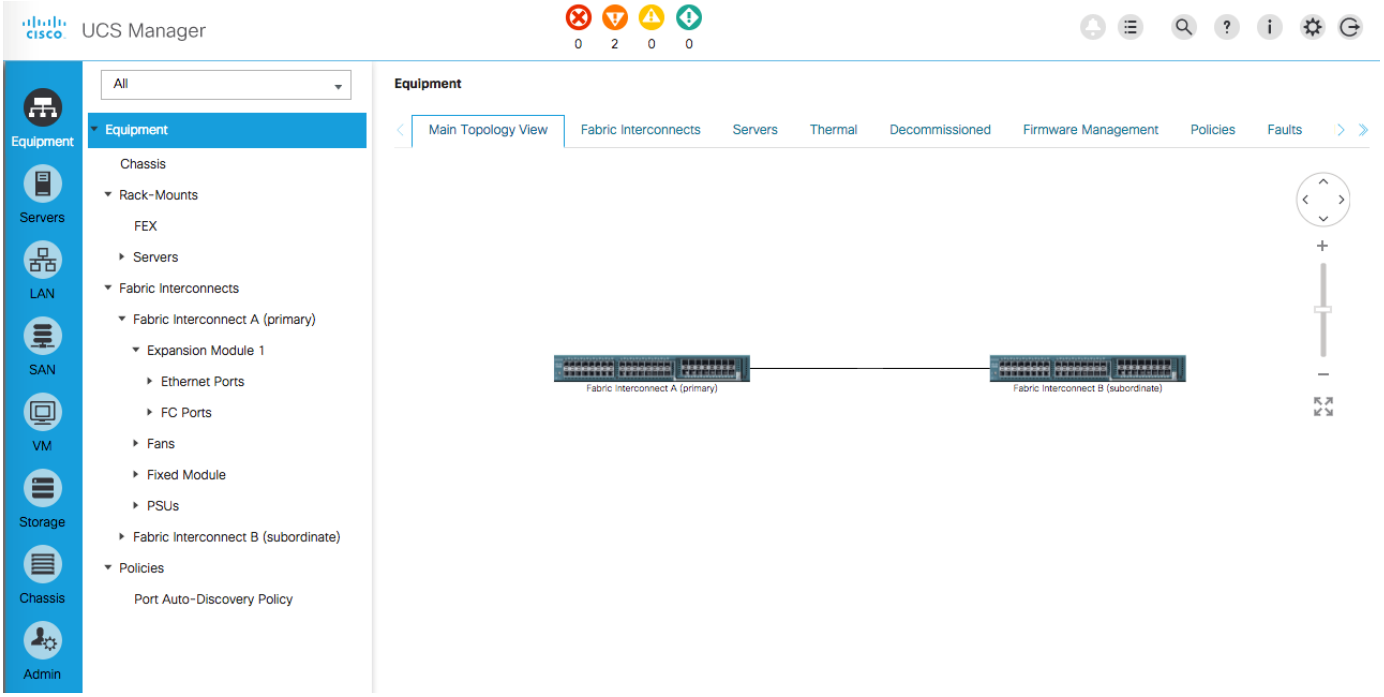
2. Click the “Launch UCS Manager” HTML link to open the Cisco UCS Manager web client.

3. At the login prompt, enter “admin” as the username, and enter the administrative password that was set during the initial console configuration.

4. Click No when prompted to enable Cisco Smart Call Home, this feature can be enabled at a later time.



Cisco UCS Configuration

Configure the following ports, settings and policies in the Cisco UCS Manager interface prior to beginning the HyperFlex installation.

Cisco UCS Firmware

Your Cisco UCS firmware version should be correct as shipped from the factory, as documented in the Software Components section. This document is based on Cisco UCS infrastructure, B-series bundle, and C-Series bundle software versions 3.1(3c). If the firmware version of the Fabric Interconnects is older than this version, the firmware must be upgraded to match the requirements prior to completing any further steps. To upgrade the Cisco UCS Manager version, the Fabric Interconnect firmware, and the server bundles, refer to these instructions:

http://www.cisco.com/c/en/us/td/docs/unified_computing/ucs/ucs-manager/GUI-User-Guides/Firmware-Mgmt/3-1/b_UCSM_GUI_Firmware_Management_Guide_3_1.html

NTP

To synchronize the Cisco UCS environment time to the NTP server, complete the following steps:

1. In Cisco UCS Manager, click the Admin button on the left-hand side.

2. In the navigation pane, select All > Time Zone Management, and click the carat next to Time Zone Management to expand it.

3. Click Timezone.

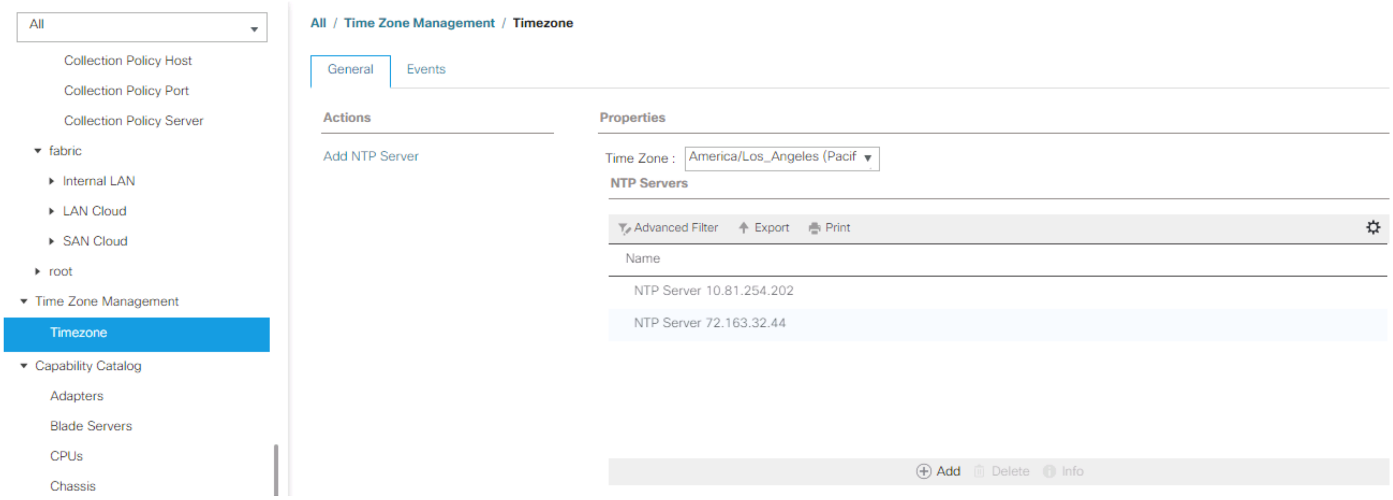
4. In the Properties pane, select the appropriate time zone in the Time Zone menu.

5. Click Add NTP Server.

6. Enter the NTP server IP address and click OK.

7. Click OK.

8. Click Save Changes, and then click OK.



Time Zone : America/Los_Angeles (Pacif

NTP Server 10.81.254.202

NTP Server 72.163.32.44

Uplink Ports

The Ethernet ports of a Cisco UCS Fabric Interconnect are all capable of performing several functions, such as network uplinks or server ports, and more. By default, all ports are unconfigured, and their function must be defined by the administrator. To define the specified ports to be used as network uplinks to the upstream network, complete the following steps:

1. In Cisco UCS Manager, click the Equipment button on the left-hand side.

2. Select Fabric Interconnects > Fabric Interconnect A > Fixed Module or Expansion Module as appropriate > Ethernet Ports.

3. Select the ports that are to be uplink ports, right click them, and click Configure as Uplink Port.

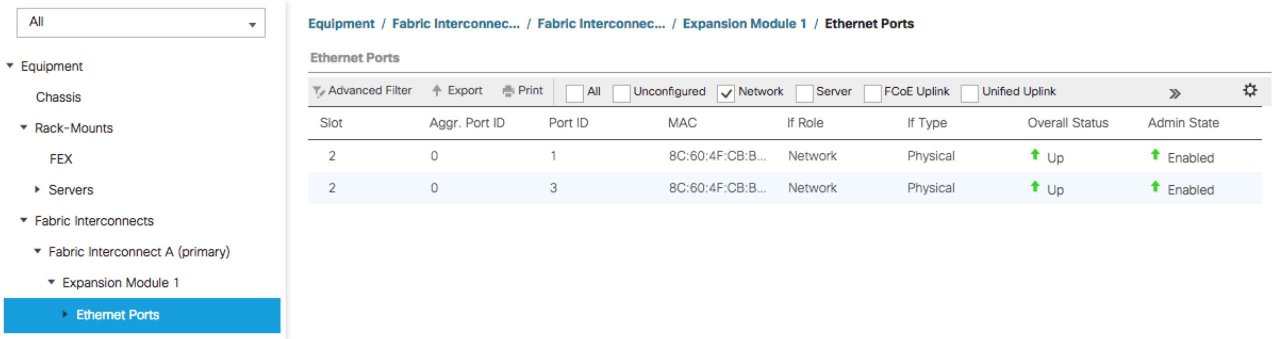
4. Click Yes to confirm the configuration, and click OK.

5. Select Fabric Interconnects > Fabric Interconnect B > Fixed Module or Expansion Module as appropriate > Ethernet Ports.

6. Select the ports that are to be uplink ports, right-click them, and click Configure as Uplink Port.

7. Click Yes to confirm the configuration and click OK.

8. Verify all the necessary ports are now configured as uplink ports, where their role is listed as “Network”.



Equipment / Fabric Interconnec... / Fabric Interconnec... / Expansion Module 1 / Ethernet Ports

Ethernet Ports

Slot	Aggr. Port ID	Port ID	MAC	If Role	If Type	Overall Status	Admin State
2	0	1	8C:60:4F:CB:B...	Network	Physical	↑ Up	↑ Enabled
2	0	3	8C:60:4F:CB:B...	Network	Physical	↑ Up	↑ Enabled

Uplink Port Channels

If the Cisco UCS uplinks from one Fabric Interconnect are to be combined into a port channel or vPC, you must separately configure the port channels, which will use the previously configured uplink ports. To configure the necessary port channels in the Cisco UCS environment, complete the following steps:

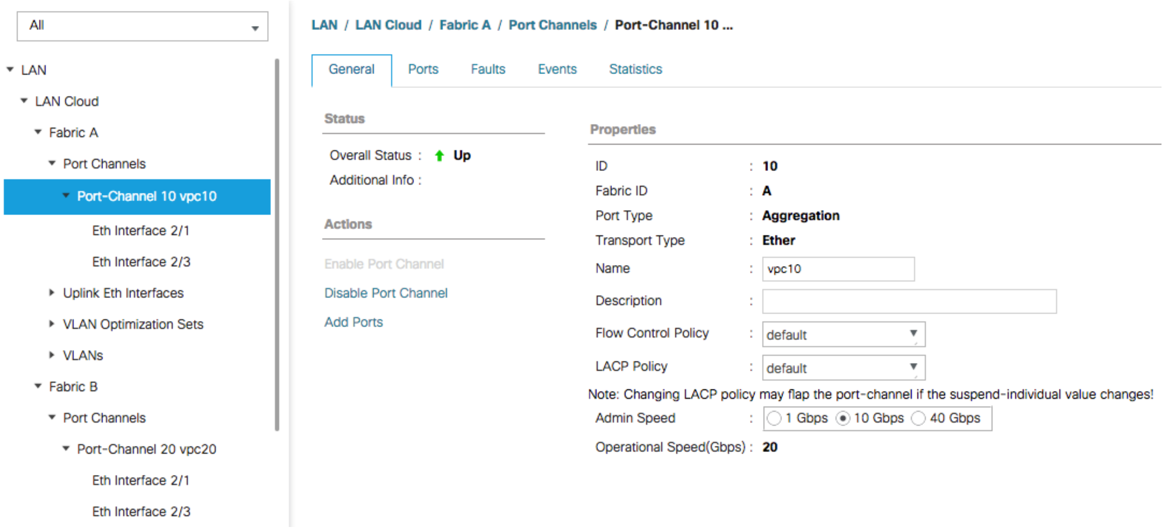
1. In Cisco UCS Manager, click the LAN button on the left-hand side.
2. Under LAN > LAN Cloud, click the carat to expand the Fabric A tree.
3. Right-click Port Channels underneath Fabric A, then click Create Port Channel.
4. Enter the port channel ID number as the unique ID of the port channel (this does not have to match the port-channel ID on the upstream switch).
5. Enter the name of the port channel.
6. Click Next.
7. Click each port from Fabric Interconnect A that will participate in the port channel, and click the >> button to add them to the port channel.
8. Click Finish.
9. Click OK.
10. Under LAN > LAN Cloud, click the carat to expand the Fabric B tree.
11. Right-click Port Channels underneath Fabric B, then click Create Port Channel.
12. Enter the port channel ID number as the unique ID of the port channel (this does not have to match the port-channel ID on the upstream switch).
13. Enter the name of the port channel.
14. Click Next.

15. Click each port from Fabric Interconnect B that will participate in the port channel, and click the >> button to add them to the port channel.

16. Click Finish.

17. Click OK.

18. Verify the necessary port channels have been created. It can take a few minutes for the newly formed port channels to converge and come online.



Status

Overall Status : Up
Additional Info :

Properties

ID : 10
Fabric ID : A
Port Type : Aggregation
Transport Type : Ether
Name : vpc10
Description :
Flow Control Policy : default
LACP Policy : default
Note: Changing LACP policy may flap the port-channel if the suspend-individual value changes!
Admin Speed : ○ 1 Gbps ● 10 Gbps ○ 40 Gbps
Operational Speed(Gbps) : 20

Chassis Discovery Policy

If the Cisco HyperFlex system will use blades as compute-only nodes in an extended cluster design, additional settings must be configured for connecting the Cisco UCS 5108 blade chassis. The Chassis Discovery policy defines the number of links between the Fabric Interconnect and the Cisco UCS Fabric Extenders which must be connected and active, before the chassis will be discovered. This also effectively defines how many of those connected links will be used for communication. The Link Grouping Preference setting specifies if the links will operate independently, or if Cisco UCS Manager will automatically combine them into port-channels. Cisco best practices recommends using link grouping, and the number of links per side is dependent on the hardware used in Cisco UCS 5108 chassis, and the model of Fabric Interconnects. For 10 GbE connections Cisco recommends 4 links per side, and for 40 GbE connections Cisco recommends 2 links per side.

To configure the necessary policy and setting, complete the following steps:

1. In Cisco UCS Manager, click the Equipment button on the left-hand side, and click Equipment in the top of the navigation tree on the left.

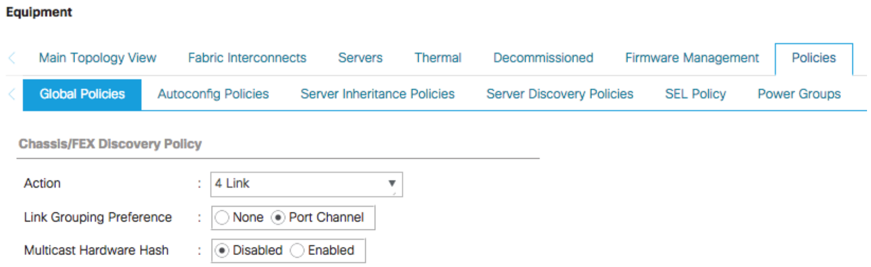
2. In the properties pane, click the Policies tab.

3. Under the Global Policies sub-tab, set the Chassis/FEX Discovery Policy to match the number of uplink ports that are cabled per side, between the chassis and the Fabric Interconnects.

4. Set the Link Grouping Preference option to Port Channel.

5. Click Save Changes.

6. Click OK.



Chassis/FEX Discovery Policy

Action : 4 Link

Link Grouping Preference : ○ None ● Port Channel

Multicast Hardware Hash : ● Disabled ○ Enabled

Server Ports

The Ethernet ports of a Cisco UCS Fabric Interconnect connected to the rack mount servers, or to the blade chassis must be defined as server ports. Once a server port is activated, the connected server or chassis will begin the discovery process shortly afterwards. Rack mount servers and blade chassis are automatically numbered in Cisco UCS Manager in the order which they are first discovered. For this reason, it is important to configure the server ports sequentially in the order you wish the physical servers and/or chassis to appear within Cisco UCS Manager. For example, if you installed your servers in a cabinet or rack with server #1 on the bottom, counting up as you go higher in the cabinet or rack, then you need to enable the server ports to the bottom-most server first, and enable them one-by-one as you move upward. You must wait until the server appears in the Equipment tab of Cisco UCS Manager before configuring the ports for the next server. The same numbering procedure applies to blade server chassis, although chassis and rack mount server numbers are separate from each other.

Auto Configuration

A new feature in Cisco UCS Manager 3.1(3a) and later is Server Port Auto-Discovery, which automates the configuration of ports on the Fabric Interconnects as server ports when a Cisco UCS rack mount server or blade chassis is connected to them. The firmware on the rack mount servers or blade chassis Fabric Extenders must already be at version 3.1(3a) or later in order for this feature to function properly. Enabling this policy eliminates the manual steps of configuring each server port, however it does configure the servers in a somewhat random order. For example, the rack mount server at the bottom of the stack, which you may refer to as server #1, and you may have plugged into port 1 of both Fabric Interconnects, could be discovered as server 2, or server 5, etc. In order to have fine control of the rack mount server or chassis numbering and order, the manual configuration steps listed in the next section must be followed.

To configure automatic server port definition and discovery, complete the following steps:

1. In Cisco UCS Manager, click the Equipment button on the left-hand side.

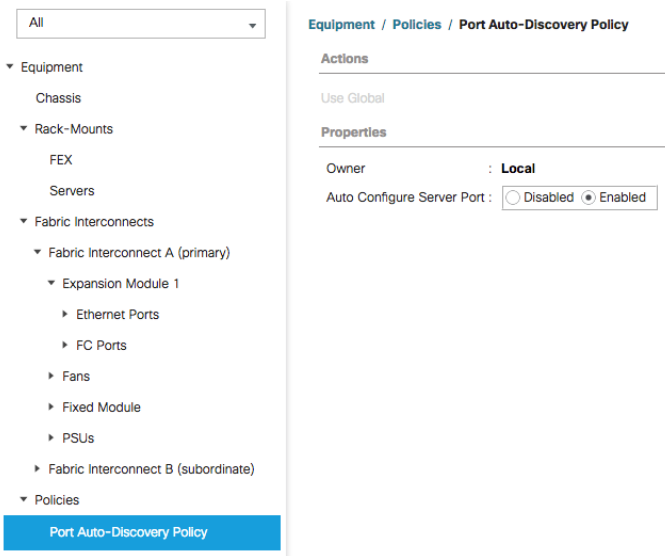
2. In the navigation tree, under Policies, click Port Auto-Discovery Policy

3. In the properties pane, set Auto Configure Server Port option to Enabled.

4. Click Save Changes.

5. Click OK.

6. Wait for a brief period, until the rack mount servers appear in the Equipment tab underneath Equipment > Rack Mounts > Servers, or the chassis appears underneath Equipment > Chassis.



Owner : Local

Auto Configure Server Port : ○ Disabled ● Enabled

Manual Configuration

To manually define the specified ports to be used as server ports, and have control over the numbering of the servers, complete the following steps:

1. In Cisco UCS Manager, click the Equipment button on the left-hand side.

2. Select Fabric Interconnects > Fabric Interconnect A > Fixed Module or Expansion Module as appropriate > Ethernet Ports.

3. Select the first port that is to be a server port, right click it, and click Configure as Server Port.

4. Click Yes to confirm the configuration, and click OK.

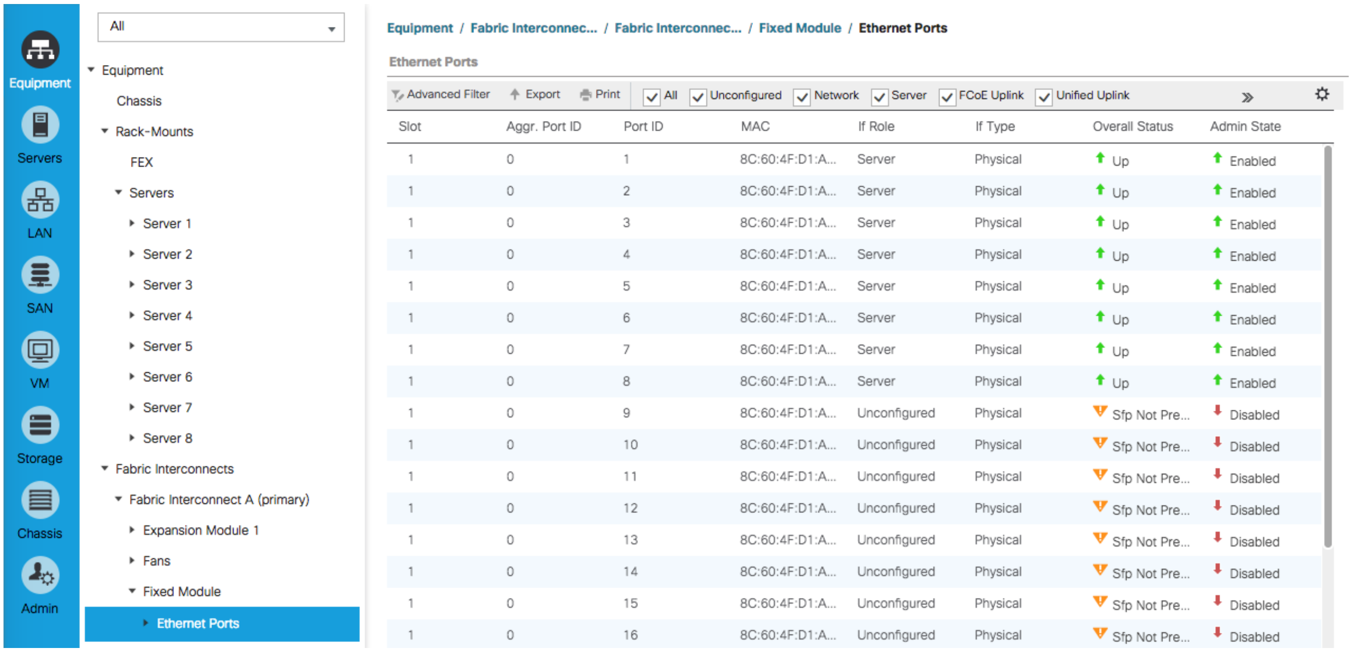
5. Select Fabric Interconnects > Fabric Interconnect B > Fixed Module or Expansion Module as appropriate > Ethernet Ports.

6. Select the matching port as chosen for Fabric Interconnect A that is to be a server port, right click it, and click Configure as Server Port.

7. Click Yes to confirm the configuration, and click OK.

8. Wait for a brief period, until the rack mount server appears in the Equipment tab underneath Equipment > Rack Mounts > Servers, or the chassis appears underneath Equipment > Chassis.

9. Repeat Steps 1-8 for each server port, until all rack mount servers and chassis appear in the order desired in the Equipment tab.



Equipment / Fabric Interconnec... / Fabric Interconnec... / Fixed Module / Ethernet Ports

Ethernet Ports

☑ All ☑ Unconfigured ☑ Network ☑ Server ☑ FCoE Uplink ☑ Unified Uplink

Slot	Aggr. Port ID	Port ID	MAC	If Role	If Type	Overall Status	Admin State
1	0	1	8C:60:4F:D1:A...	Server	Physical	↑ Up	↑ Enabled
1	0	2	8C:60:4F:D1:A...	Server	Physical	↑ Up	↑ Enabled
1	0	3	8C:60:4F:D1:A...	Server	Physical	↑ Up	↑ Enabled
1	0	4	8C:60:4F:D1:A...	Server	Physical	↑ Up	↑ Enabled
1	0	5	8C:60:4F:D1:A...	Server	Physical	↑ Up	↑ Enabled
1	0	6	8C:60:4F:D1:A...	Server	Physical	↑ Up	↑ Enabled
1	0	7	8C:60:4F:D1:A...	Server	Physical	↑ Up	↑ Enabled
1	0	8	8C:60:4F:D1:A...	Server	Physical	↑ Up	↑ Enabled
1	0	9	8C:60:4F:D1:A...	Unconfigured	Physical	▼ Sfp Not Pre...	↓ Disabled
1	0	10	8C:60:4F:D1:A...	Unconfigured	Physical	▼ Sfp Not Pre...	↓ Disabled
1	0	11	8C:60:4F:D1:A...	Unconfigured	Physical	▼ Sfp Not Pre...	↓ Disabled
1	0	12	8C:60:4F:D1:A...	Unconfigured	Physical	▼ Sfp Not Pre...	↓ Disabled
1	0	13	8C:60:4F:D1:A...	Unconfigured	Physical	▼ Sfp Not Pre...	↓ Disabled
1	0	14	8C:60:4F:D1:A...	Unconfigured	Physical	▼ Sfp Not Pre...	↓ Disabled
1	0	15	8C:60:4F:D1:A...	Unconfigured	Physical	▼ Sfp Not Pre...	↓ Disabled
1	0	16	8C:60:4F:D1:A...	Unconfigured	Physical	▼ Sfp Not Pre...	↓ Disabled

Server Discovery

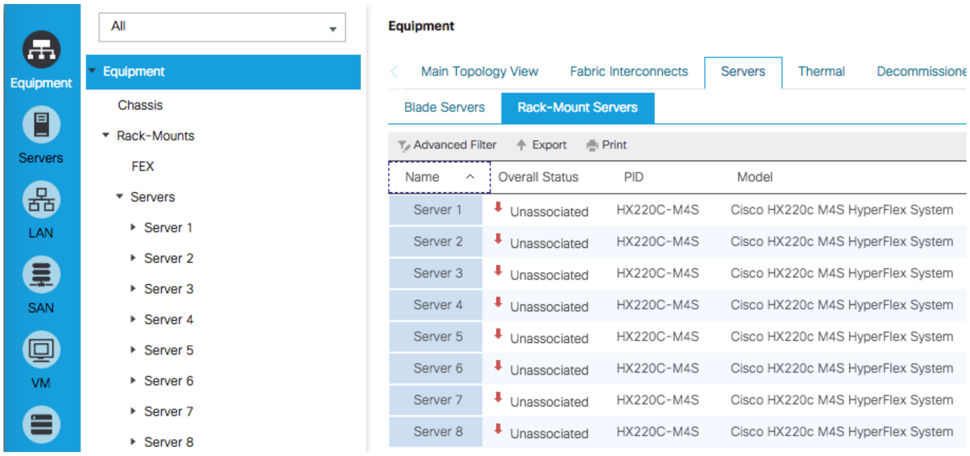
As previously described, once the server ports of the Fabric Interconnects are configured and active, the servers connected to those ports will begin a discovery process. During discovery, the servers' internal hardware inventories are collected, along with their current firmware revisions. Before continuing with the HyperFlex installation processes, which will create the service profiles and associate them with the servers, wait for all of the servers to finish their discovery process and to show as unassociated servers that are powered off, with no errors.

To view the servers' discovery status, complete the following steps:

1. In Cisco UCS Manager, click the Equipment button on the left-hand side, and click Equipment in the top of the navigation tree on the left.

2. In the properties pane, click the Servers tab.

3. Click the Blade Servers or Rack-Mount Servers sub-tab as appropriate, and view the servers' status in the Overall Status column.



Name	Overall Status	PID	Model
Server 1	Unassociated	HX220C-M4S	Cisco HX220c M4S HyperFlex System
Server 2	Unassociated	HX220C-M4S	Cisco HX220c M4S HyperFlex System
Server 3	Unassociated	HX220C-M4S	Cisco HX220c M4S HyperFlex System
Server 4	Unassociated	HX220C-M4S	Cisco HX220c M4S HyperFlex System
Server 5	Unassociated	HX220C-M4S	Cisco HX220c M4S HyperFlex System
Server 6	Unassociated	HX220C-M4S	Cisco HX220c M4S HyperFlex System
Server 7	Unassociated	HX220C-M4S	Cisco HX220c M4S HyperFlex System
Server 8	Unassociated	HX220C-M4S	Cisco HX220c M4S HyperFlex System

HyperFlex Installer Deployment

The Cisco HyperFlex software is distributed as a deployable virtual machine, contained in an Open Virtual Appliance (OVA) file format. The HyperFlex OVA file is available for download at cisco.com:

https://software.cisco.com/download/release.html?mdfid=286305544&flowid=&softwareid=286305994&release=2.1(1b)&relind=AVAILABLE&rellifecycle=&reltype=latest

This document is based on the Cisco HyperFlex 2.5.1b release filename: ***Cisco-HX-Data-Platform-Installer-v2.5.1b-26284.ova***

The HyperFlex installer OVA file can be deployed as a virtual machine in an existing VMware vSphere environment, VMware Workstation, VMware Fusion, or other virtualization environment which supports the import of OVA format files. For the purpose of this document, the process described uses an existing ESXi server managed by vCenter to run the HyperFlex installer OVA, and deploying it via the VMware vSphere Web Client.

Installer Connectivity

The Cisco HyperFlex Installer VM must be deployed in a location that has connectivity to the following network locations and services:

- Connectivity to the vCenter Server which will manage the HyperFlex cluster(s) to be installed.
- Connectivity to the management interfaces of the Fabric Interconnects that contain the HyperFlex cluster(s) to be installed.
- Connectivity to the management interface of the ESXi hypervisor hosts which will host the HyperFlex cluster(s) to be installed.
- Connectivity to the DNS server(s) which will resolve host names used by the HyperFlex cluster(s) to be installed.
- Connectivity to the NTP server(s) which will synchronize time for the HyperFlex cluster(s) to be installed.
- Connectivity from the staff operating the installer to the webpage hosted by the installer, and to log in to the installer via SSH.

If the network where the HyperFlex installer VM is deployed has DHCP services available to assign the proper IP address, subnet mask, default gateway, and DNS servers, the HyperFlex installer can be deployed using DHCP. If a static address must be defined, use the following table to document the settings to be used for the HyperFlex installer VM:

Table 46 HyperFlex Installer Settings

Setting	Value
IP Address	
Subnet Mask	
Default Gateway	
DNS Server #1	
NTP Servers	

Deploy Installer OVA

To deploy the HyperFlex installer OVA, complete the following steps:

1. Open the vSphere Web Client webpage of a vCenter server where the installer OVA will be deployed, and log in with admin privileges.

2. In the vSphere Web Client, from the Home view, click Hosts and Clusters.

3. From the Actions menu, click Deploy OVF Template.

4. Click the Local file option, then click Browse and locate the ***Cisco-HX-Data-Platform-Installer-v2.5.1b-26284.ova*** file, click the file and click Open.

5. Click Next.

6. Modify the name of the virtual machine to be created if desired, and click a folder location to place the virtual machine, then click Next.

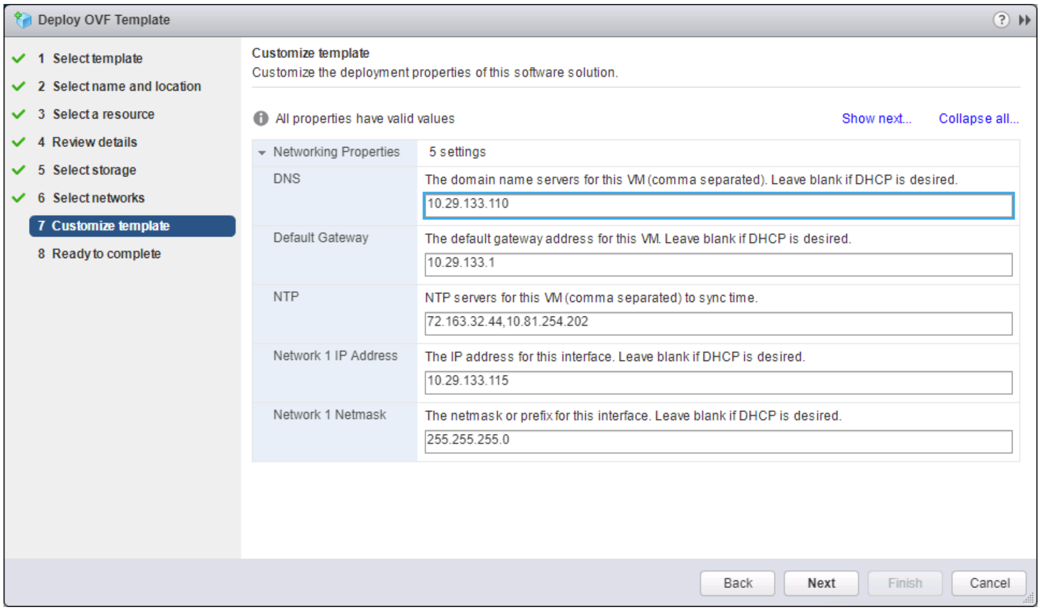
7. Click a specific host or cluster to locate the virtual machine and click Next.

8. After the file validation, review the details and click Next.

9. Select a Thin provision virtual disk format, and the datastore to store the new virtual machine, then click Next.

10. Modify the network port group selection from the drop-down list in the Destination Networks column, choosing the network the installer VM will communicate on, and click Next.

11. If DHCP is to be used for the installer VM, leave the fields blank, except for the NTP server value and click Next. If static address settings are to be used, fill in the fields for the DNS server, Default Gateway, NTP Servers, IP address, and subnet mask, then click Next.



Customize template
Customize the deployment properties of this software solution.

All properties have valid values

Networking Properties — 5 settings

DNS — The domain name servers for this VM (comma separated). Leave blank if DHCP is desired.
10.29.133.110

Default Gateway — The default gateway address for this VM. Leave blank if DHCP is desired.
10.29.133.1

NTP — NTP servers for this VM (comma separated) to sync time.
72.163.32.44,10.81.254.202

Network 1 IP Address — The IP address for this interface. Leave blank if DHCP is desired.
10.29.133.115

Network 1 Netmask — The netmask or prefix for this interface. Leave blank if DHCP is desired.
255.255.255.0

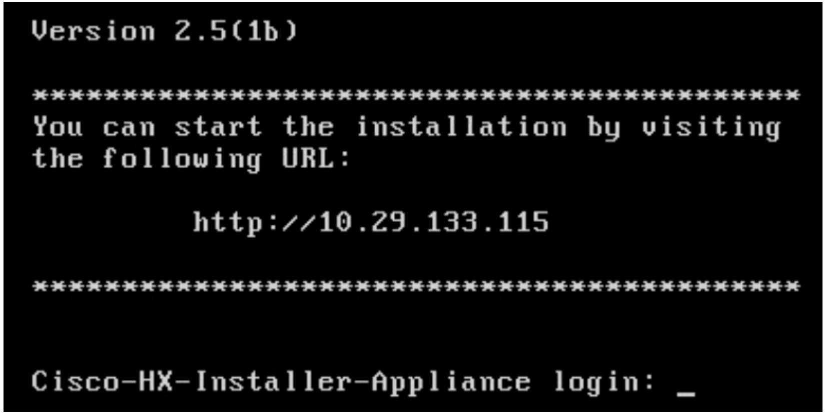
12. Review the final configuration and click Finish.

13. The installer VM will take a few minutes to deploy, once it has deployed, power on the new VM and proceed to the next step.

HyperFlex Installer Web Page

The HyperFlex installer is accessed via a webpage using your local computer and a web browser. If the HyperFlex installer was deployed with a static IP address, then the IP address of the website is already known. If DHCP was used, open the local console of the installer VM. In the console, you will see an interface similar to the example below, showing the IP address that was leased:

Figure 46 HyperFlex Installer VM IP Address



```
Version 2.5(1b)

*******************************************
You can start the installation by visiting
the following URL:

        http://10.29.133.115

*******************************************


Cisco-HX-Installer-Appliance login: _
```

To access the HyperFlex installer webpage, complete the following steps:

1. Open a web browser on the local computer and navigate to the IP address of the installer VM. For example, open http://10.29.133.115

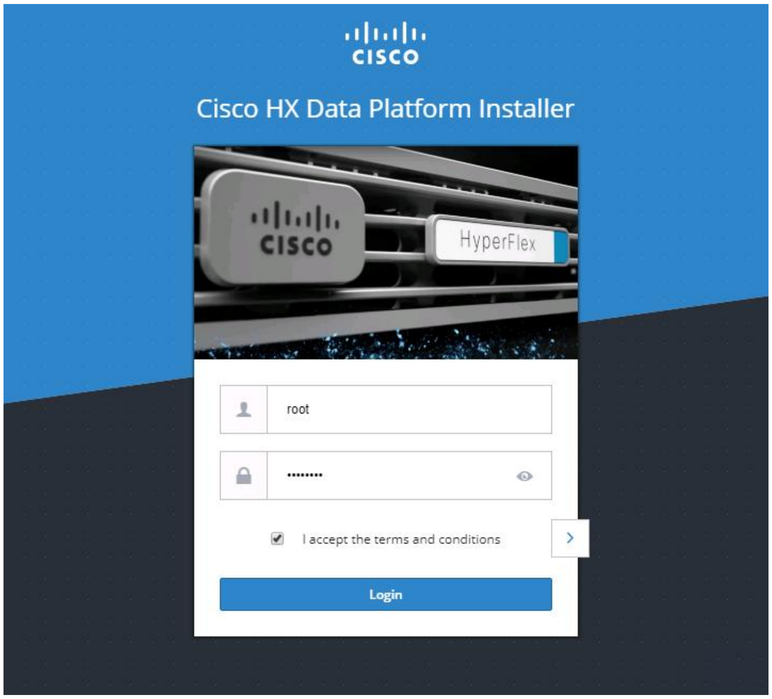
2. Click accept or continue to bypass any SSL certificate errors.

3. At the login screen, enter the username: root

4. At the login screen, enter the default password: Cisco123

5. Verify the version of the installer in the lower right-hand corner of the Welcome page is the correct version.

6. Check the box for "I accept the terms and conditions", and click Login.


cisco
Cisco HX Data Platform Installer
HyperFlex
root
••••••••
☑ I accept the terms and conditions
Login

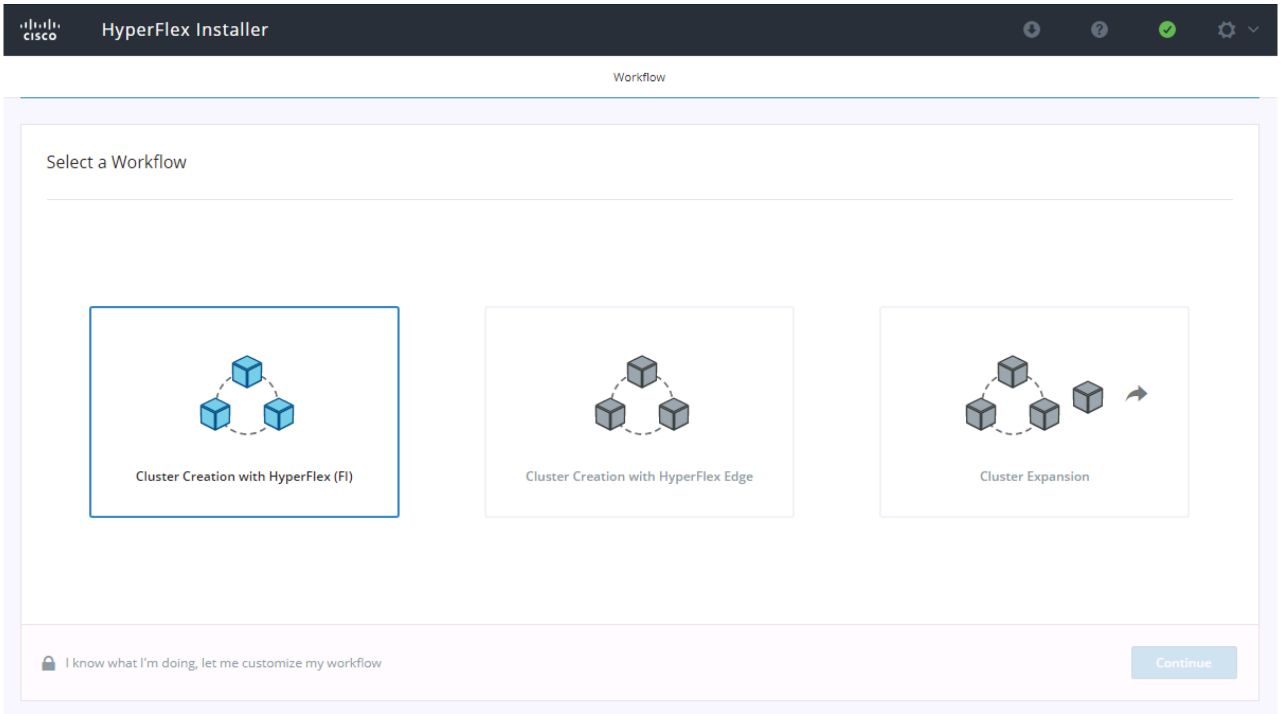
HyperFlex Installation

HyperFlex Cluster Creation

The HX installer will guide you through the process of setting up your cluster. It will configure Cisco UCS policies, templates, service profiles, and settings, as well as assigning IP addresses to the HX servers that come from the factory with ESXi hypervisor software preinstalled. The installer will load the HyperFlex controller VMs and software on the nodes, add the nodes to the vCenter cluster, then finally create the HyperFlex cluster and distributed filesystem. All of these processes can be completed via a single workflow from the HyperFlex Installer webpage.

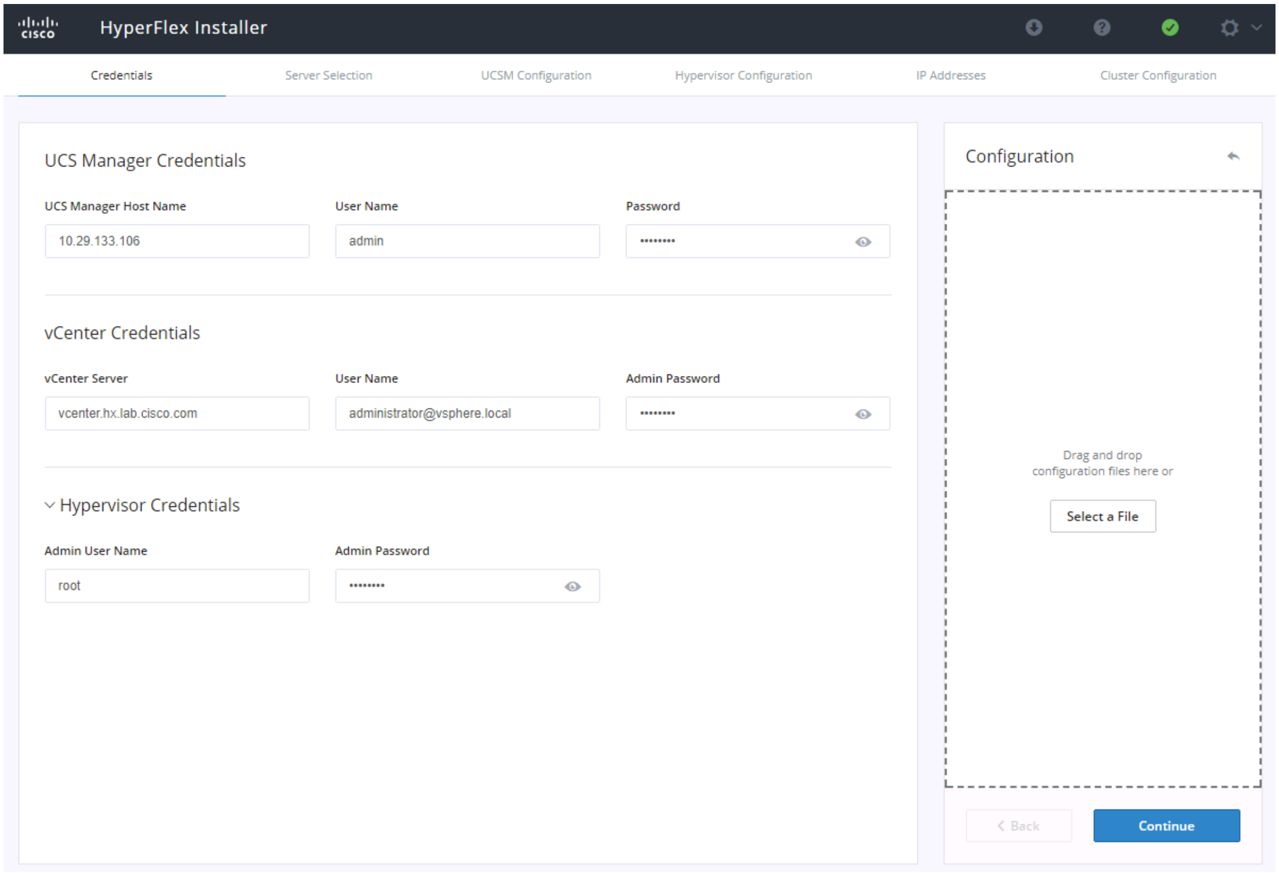
To install and configure a HyperFlex cluster, complete the following steps:

1. On the HyperFlex installer webpage select the workflow named "Cluster Creation with HyperFlex (FI)".



HyperFlex Installer
Workflow
Select a Workflow
Cluster Creation with HyperFlex (FI)
Cluster Creation with HyperFlex Edge
Cluster Expansion
I know what I'm doing, let me customize my workflow
Continue

2. Enter the Cisco UCS Manager and vCenter DNS hostname or IP address, the admin usernames, and the passwords. The default Hypervisor credential which comes installed from the factory is username: root with a password of "Cisco123" and these values are already entered in the installer. You can select the option to see the passwords in clear text. Optionally, you can import a JSON file that has the configuration information, except for the appropriate passwords.



UCS Manager Credentials

UCS Manager Host Name: 10.29.133.106

User Name: admin

Password: ••••••••

vCenter Credentials

vCenter Server: vcenter.hx.lab.cisco.com

User Name: administrator@vsphere.local

Admin Password: ••••••••

Hypervisor Credentials

Admin User Name: root

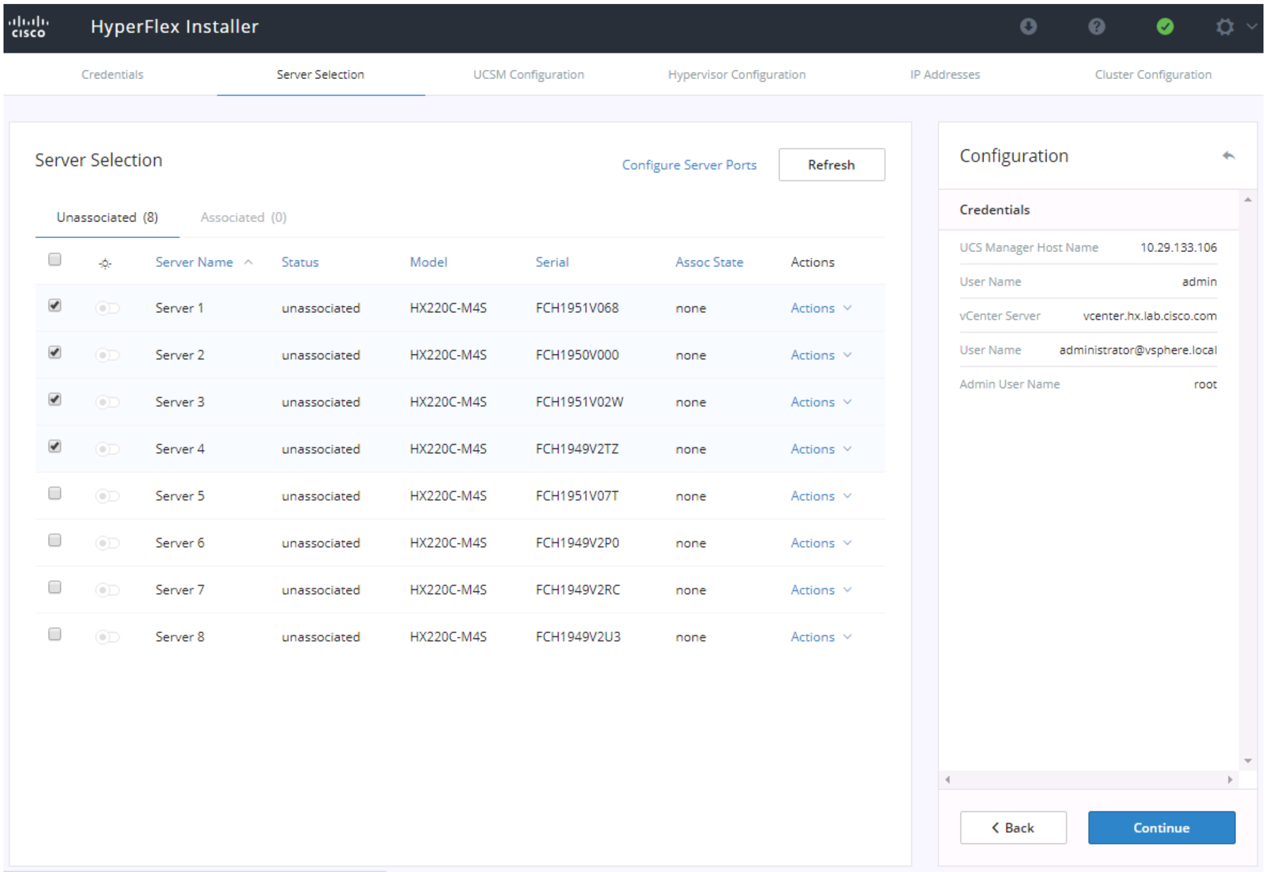
Admin Password: ••••••••

3. Click Continue.

4. Select the Unassociated HX server models that are to be used in the new HX cluster and click Continue. If the Fabric Interconnect server ports were not enabled in the earlier step, you have the option to enable them here to begin the discovery process by clicking the Configure Server Ports link.

Note: Using the option to enable the server ports within the HX Installer will not allow you to finely control the server number order, as would be possible when performing this step manually before installing the HyperFlex cluster. To have control of the server number order, perform the steps outlined earlier for manually configuring the server ports.

Note: The server discovery can take several minutes to complete, and it will be necessary to periodically click the Refresh button to see the unassociated servers appear once discovery is completed.



Server Selection

□		Server Name	Status	Model	Serial	Assoc State	Actions
☑		Server 1	unassociated	HX220C-M4S	FCH1951V068	none	Actions
☑		Server 2	unassociated	HX220C-M4S	FCH1950V000	none	Actions
☑		Server 3	unassociated	HX220C-M4S	FCH1951V02W	none	Actions
☑		Server 4	unassociated	HX220C-M4S	FCH1949V2TZ	none	Actions
□		Server 5	unassociated	HX220C-M4S	FCH1951V07T	none	Actions
□		Server 6	unassociated	HX220C-M4S	FCH1949V2P0	none	Actions
□		Server 7	unassociated	HX220C-M4S	FCH1949V2RC	none	Actions
□		Server 8	unassociated	HX220C-M4S	FCH1949V2U3	none	Actions

Configuration

Credentials

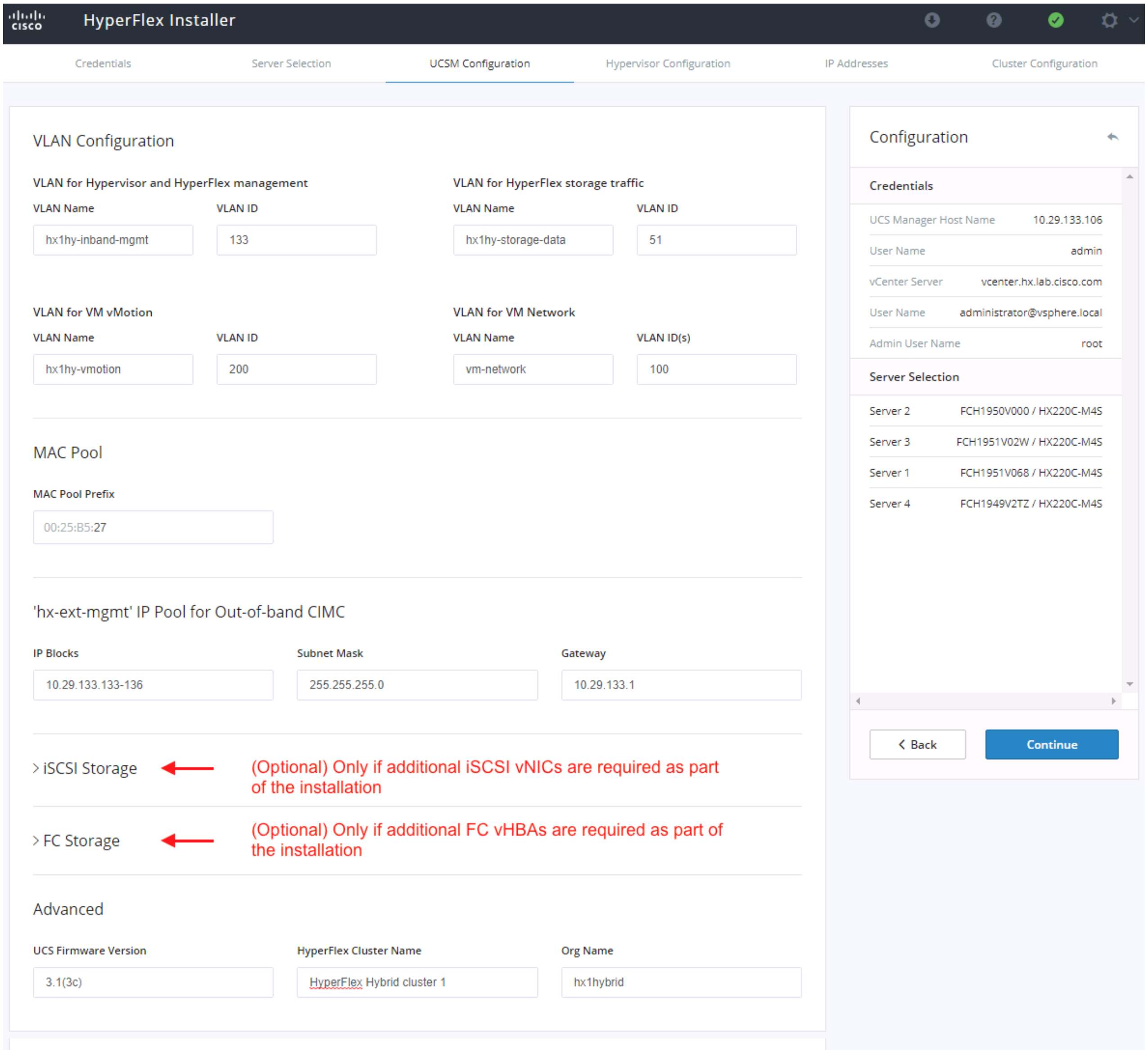
UCS Manager Host Name	10.29.133.106
User Name	admin
vCenter Server	vcenter.hx.lab.cisco.com
User Name	administrator@vsphere.local
Admin User Name	root

5. Enter the VLAN names and VLAN IDs that are to be created in Cisco UCS, as well as the MAC Pool prefix, (Only enter the 4th byte value, for example: 00:25:B5:ED). Multiple comma-separated VLAN IDs for different guest VM networks are allowed here.

6. Enter the IP address range to be used by the CIMC interfaces of the servers in this HX cluster.

7. Enter a unique Org name for the HyperFlex Cluster.

Important: When deploying a second or any additional clusters, you must put them into a different sub-org, use a different MAC Pool prefix, and you should also create new VLAN names for the additional clusters. Even if reusing the same VLAN ID, it is prudent to create a new VLAN name to avoid conflicts. For example, for a second cluster change the VLAN names, MAC Pool prefix, Cluster Name and Org Name so as to not overwrite the original cluster information.



VLAN Configuration

VLAN for Hypervisor and HyperFlex management

VLAN Name	VLAN ID
hx1hy-inband-mgmt	133

VLAN for HyperFlex storage traffic

VLAN Name	VLAN ID
hx1hy-storage-data	51

VLAN for VM vMotion

VLAN Name	VLAN ID
hx1hy-vmotion	200

VLAN for VM Network

VLAN Name	VLAN ID(s)
vm-network	100

MAC Pool

MAC Pool Prefix: 00:25:B5:27

'hx-ext-mgmt' IP Pool for Out-of-band CIMC

IP Blocks	Subnet Mask	Gateway
10.29.133.133-136	255.255.255.0	10.29.133.1

> iSCSI Storage ← (Optional) Only if additional iSCSI vNICs are required as part of the installation

> FC Storage ← (Optional) Only if additional FC vHBAs are required as part of the installation

Advanced

UCS Firmware Version	HyperFlex Cluster Name	Org Name
3.1(3c)	HyperFlex Hybrid cluster 1	hx1hybrid

Configuration

Credentials

UCS Manager Host Name	10.29.133.106
User Name	admin
vCenter Server	vcenter.hx.lab.cisco.com
User Name	administrator@vsphere.local
Admin User Name	root

Server Selection

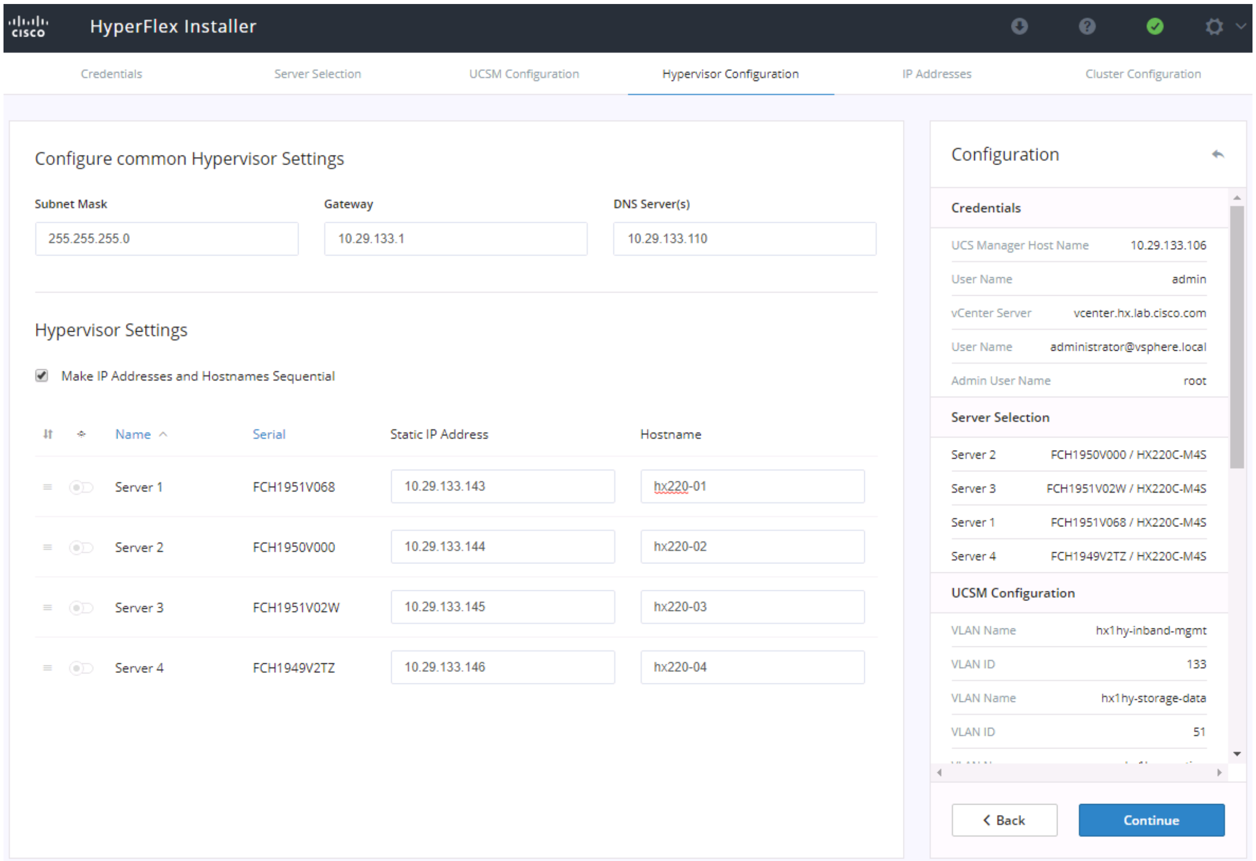
Server 2	FCH1950V000 / HX220C-M4S
Server 3	FCH1951V02W / HX220C-M4S
Server 1	FCH1951V068 / HX220C-M4S
Server 4	FCH1949V2TZ / HX220C-M4S

Important: (Optional) If you need to add extra iSCSI vNICs and/or FC vHBAs to connect the HX nodes to an external iSCSI or FC array, enable iSCSI Storage and/or FC Storage here using the procedure described in the following section: Process for adding additional vHBAs or iSCSI vNICs prior to cluster creation.

8. Click Continue.

9. Enter the subnet mask, gateway, DNS, and IP addresses and hostnames for the Hypervisors. The IP addresses will be assigned via Serial over Lan (SoL) through Cisco UCS Manager to the ESXi host systems as their management IP addresses.

10. Click Continue.



Configure common Hypervisor Settings

Subnet Mask	Gateway	DNS Server(s)
255.255.255.0	10.29.133.1	10.29.133.110

Hypervisor Settings

☑ Make IP Addresses and Hostnames Sequential

Name	Serial	Static IP Address	Hostname
Server 1	FCH1951V068	10.29.133.143	hx220-01
Server 2	FCH1950V000	10.29.133.144	hx220-02
Server 3	FCH1951V02W	10.29.133.145	hx220-03
Server 4	FCH1949V2TZ	10.29.133.146	hx220-04

Configuration

Credentials

UCS Manager Host Name	10.29.133.106
User Name	admin
vCenter Server	vcenter.hx.lab.cisco.com
User Name	administrator@vsphere.local
Admin User Name	root

Server Selection

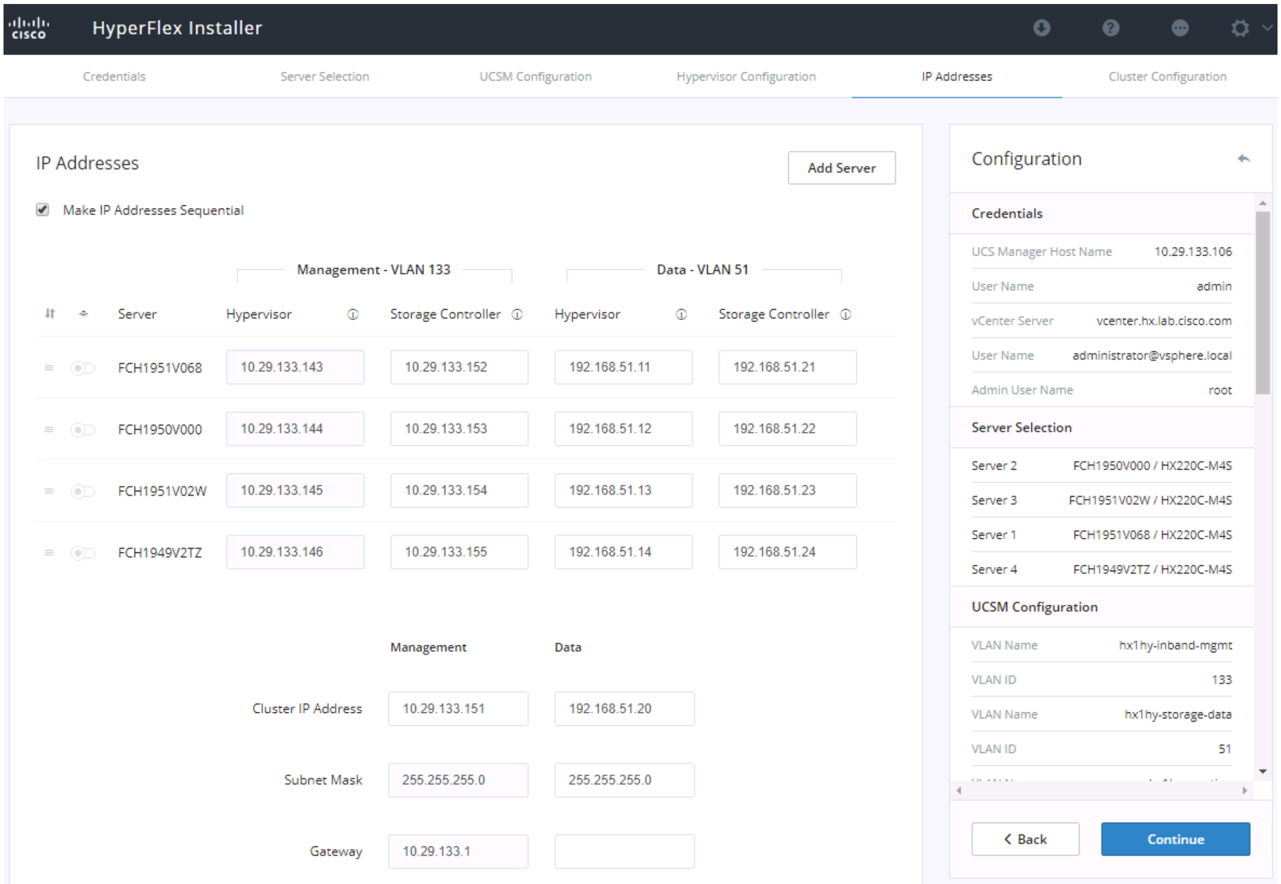
Server 2	FCH1950V000 / HX220C-M4S
Server 3	FCH1951V02W / HX220C-M4S
Server 1	FCH1951V068 / HX220C-M4S
Server 4	FCH1949V2TZ / HX220C-M4S

UCSM Configuration

VLAN Name	hx1hy-inband-mgmt
VLAN ID	133
VLAN Name	hx1hy-storage-data
VLAN ID	51

11. Assign the additional IP addresses for the Management and Data networks as well as the cluster IP addresses, then click Continue.

Note: A default gateway is not required for the data network, as those interfaces normally will not communicate with any other hosts or networks, and the subnet can be non-routable.



IP Addresses

☑ Make IP Addresses Sequential

	Management - VLAN 133		Data - VLAN 51	
Server	Hypervisor	Storage Controller	Hypervisor	Storage Controller
FCH1951V068	10.29.133.143	10.29.133.152	192.168.51.11	192.168.51.21
FCH1950V000	10.29.133.144	10.29.133.153	192.168.51.12	192.168.51.22
FCH1951V02W	10.29.133.145	10.29.133.154	192.168.51.13	192.168.51.23
FCH1949V2TZ	10.29.133.146	10.29.133.155	192.168.51.14	192.168.51.24

	Management	Data
Cluster IP Address	10.29.133.151	192.168.51.20
Subnet Mask	255.255.255.0	255.255.255.0
Gateway	10.29.133.1	

Configuration

Credentials

UCS Manager Host Name	10.29.133.106
User Name	admin
vCenter Server	vcenter.hx.lab.cisco.com
User Name	administrator@vsphere.local
Admin User Name	root

Server Selection

Server 2	FCH1950V000 / HX220C-M4S
Server 3	FCH1951V02W / HX220C-M4S
Server 1	FCH1951V068 / HX220C-M4S
Server 4	FCH1949V2TZ / HX220C-M4S

UCSM Configuration

VLAN Name	hx1hy-inband-mgmt
VLAN ID	133
VLAN Name	hx1hy-storage-data
VLAN ID	51

12. Enter the HX Cluster Name and Replication Factor setting.

13. Enter the Password that will be assigned to the Controller VMs.

14. Enter the Datacenter Name from vCenter, and vCenter Cluster Name.

15. Enter the System Services information for DNS, NTP, and Time Zone.

16. Enable Auto Support and enter the email address to receive Auto Support alerts, then scroll down.

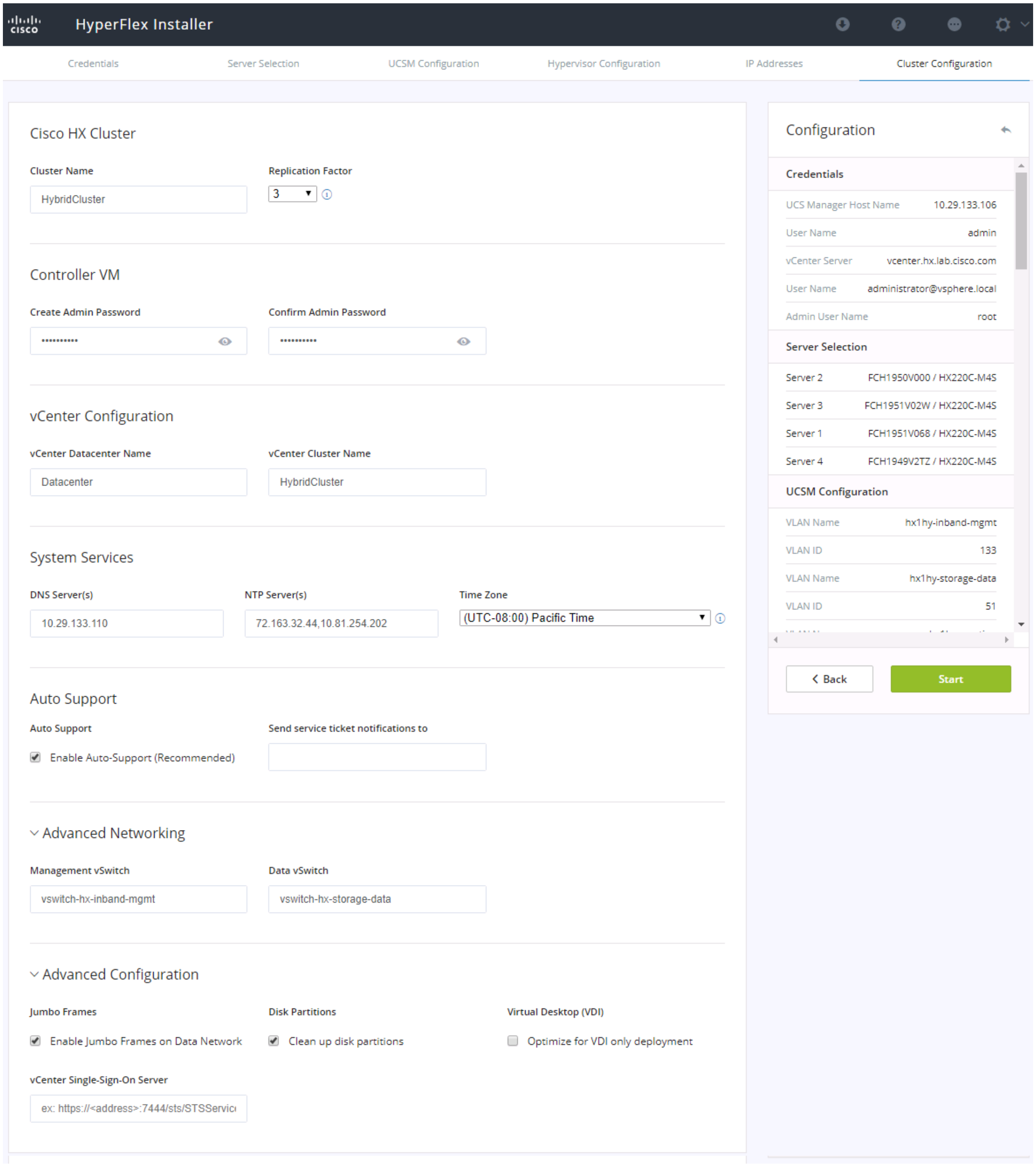
17. Leave the defaults for Advanced Networking.

18. Under Advanced Settings, validate that VDI is not checked (hybrid nodes only). Jumbo Frames should be enabled. It is not necessary to select Clean up disk partitions for a new cluster installation.

19. Click Start.

20. Validation of the configuration will now start. If there are warnings, you can review them and click “Skip Validation” if the warnings are acceptable. If there are no warnings, the installer will automatically continue on to the configuration process.

Note: The initial validation will always fail when using Cisco UCS 6332 or 6332-16UP model Fabric Interconnects. This is due to the fact that changes to the QoS system classes require these models to reboot. If the validation is skipped, the HyperFlex installer will continue the installation and automatically reboot both Fabric Interconnects sequentially. If this is an initial setup of these Fabric Interconnects, and no other systems are running on them yet, then it is safe to proceed. However, if these Fabric Interconnects are already in use for other workloads, then caution must be taken to ensure that the sequential reboots of both Fabric Interconnects will not interrupt those workloads, and that the QoS changes will not cause traffic drops. Contact Cisco TAC for assistance if this situation applies.



Cisco HX Cluster

Cluster Name: HybridCluster

Replication Factor: 3

Controller VM

Create Admin Password: ••••••••••

Confirm Admin Password: ••••••••••

vCenter Configuration

vCenter Datacenter Name: Datacenter

vCenter Cluster Name: HybridCluster

System Services

DNS Server(s): 10.29.133.110

NTP Server(s): 72.163.32.44,10.81.254.202

Time Zone: (UTC-08:00) Pacific Time

Auto Support

Auto Support: ☑ Enable Auto-Support (Recommended)

Send service ticket notifications to:

Advanced Networking

Management vSwitch: vswitch-hx-inband-mgmt

Data vSwitch: vswitch-hx-storage-data

Advanced Configuration

Jumbo Frames: ☑ Enable Jumbo Frames on Data Network

Disk Partitions: ☑ Clean up disk partitions

Virtual Desktop (VDI): □ Optimize for VDI only deployment

vCenter Single-Sign-On Server: ex: https://<address>:7444/sts/STSServic

Configuration

Credentials

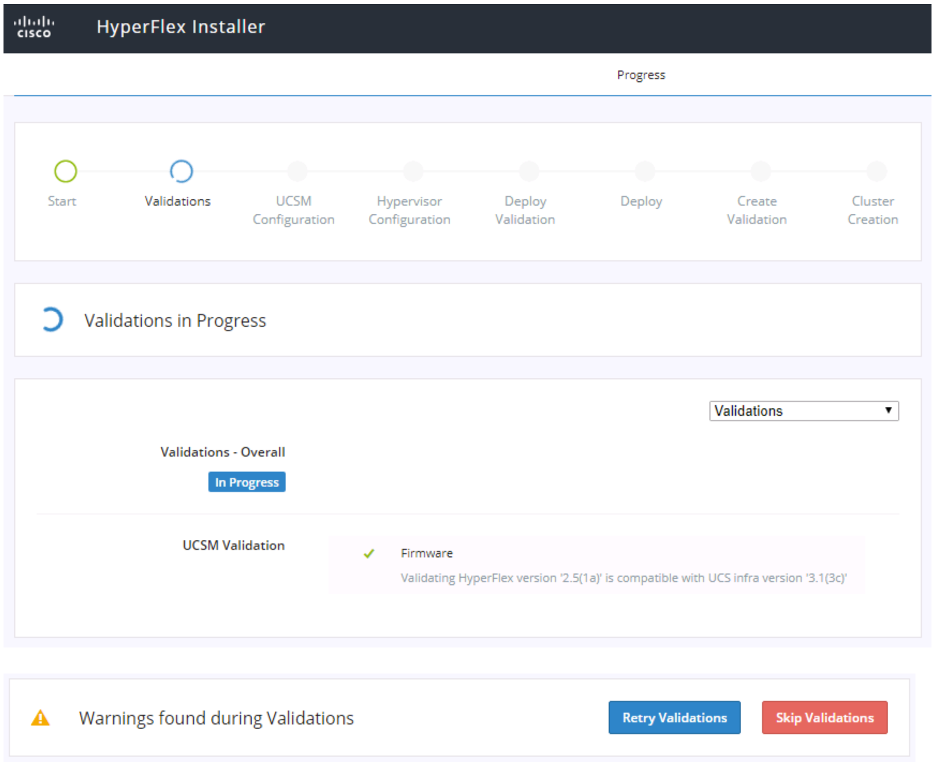
UCS Manager Host Name	10.29.133.106
User Name	admin
vCenter Server	vcenter.hx.lab.cisco.com
User Name	administrator@vsphere.local
Admin User Name	root

Server Selection

Server 2	FCH1950V000 / HX220C-M4S
Server 3	FCH1951V02W / HX220C-M4S
Server 1	FCH1951V068 / HX220C-M4S
Server 4	FCH1949V2TZ / HX220C-M4S

UCSM Configuration

VLAN Name	hx1hy-inband-mgmt
VLAN ID	133
VLAN Name	hx1hy-storage-data
VLAN ID	51



Validations in Progress

Validations - Overall

In Progress

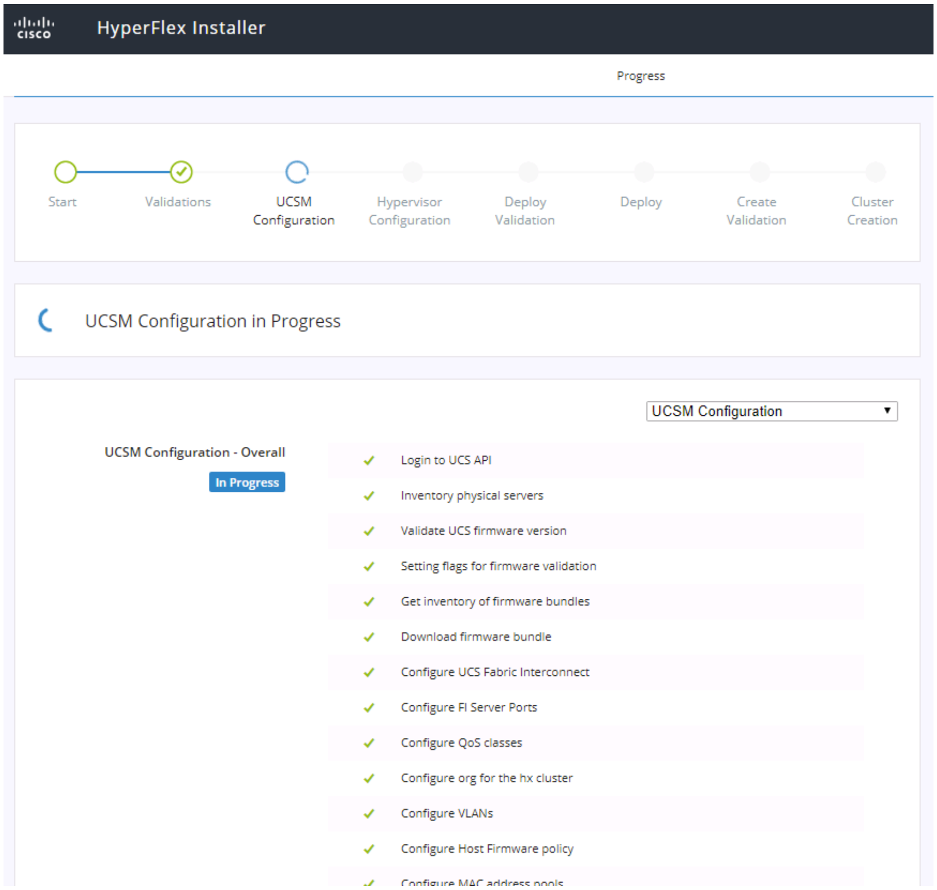
UCSM Validation

✓ Firmware

Validating HyperFlex version '2.5(1a)' is compatible with UCS infra version '3.1(3c)'

Warnings found during Validations

21. The HX installer will now proceed to complete the deployment and perform all the steps listed at the top of the screen along with their status. The process can also be monitored in Cisco UCS Manager and vCenter while the profiles and cluster are created.

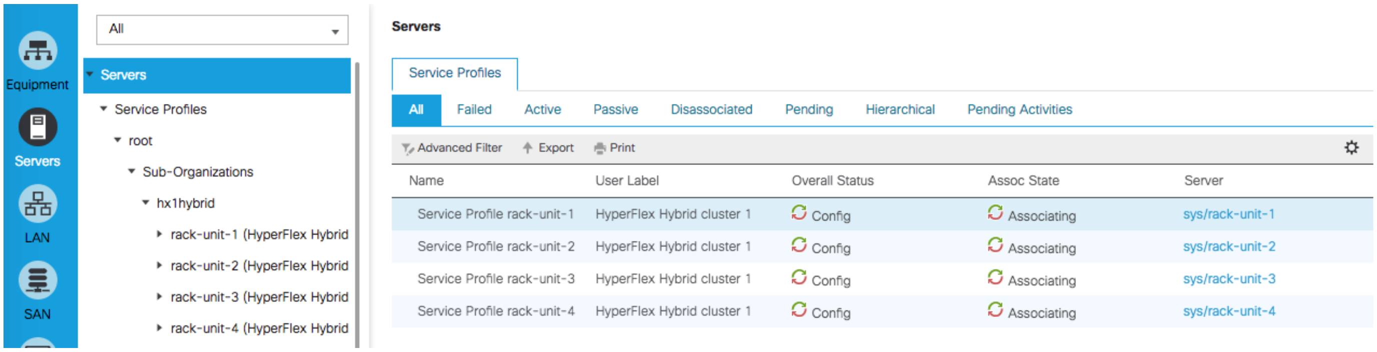


UCSM Configuration in Progress

UCSM Configuration - Overall

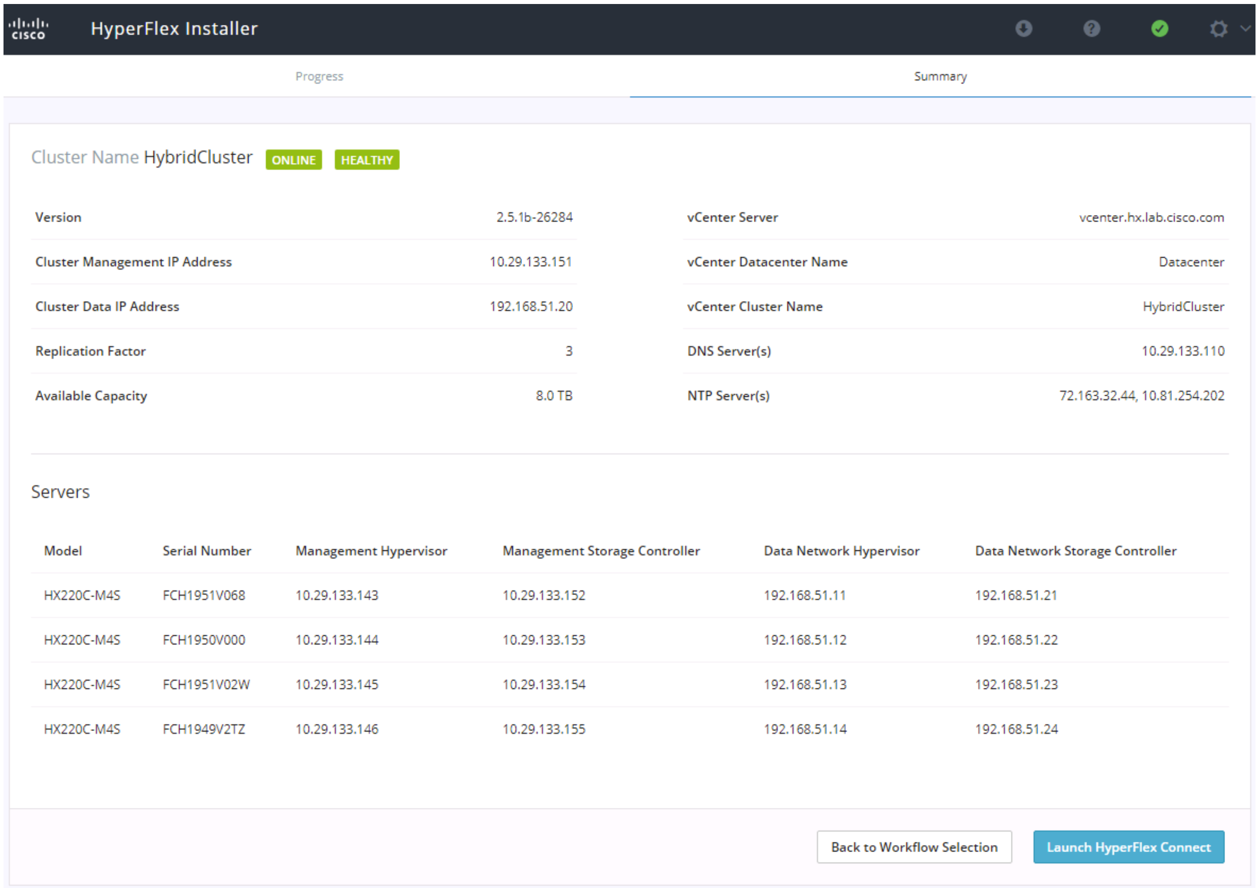
In Progress

- ✓ Login to UCS API
- ✓ Inventory physical servers
- ✓ Validate UCS firmware version
- ✓ Setting flags for firmware validation
- ✓ Get inventory of firmware bundles
- ✓ Download firmware bundle
- ✓ Configure UCS Fabric Interconnect
- ✓ Configure FI Server Ports
- ✓ Configure QoS classes
- ✓ Configure org for the hx cluster
- ✓ Configure VLANs
- ✓ Configure Host Firmware policy
- ✓ Configure MAC address pools



Name	User Label	Overall Status	Assoc State	Server
Service Profile rack-unit-1	HyperFlex Hybrid cluster 1	Config	Associating	sys/rack-unit-1
Service Profile rack-unit-2	HyperFlex Hybrid cluster 1	Config	Associating	sys/rack-unit-2
Service Profile rack-unit-3	HyperFlex Hybrid cluster 1	Config	Associating	sys/rack-unit-3
Service Profile rack-unit-4	HyperFlex Hybrid cluster 1	Config	Associating	sys/rack-unit-4

22. Review the summary screen after the install completes by selecting Summary on the top right of the window.



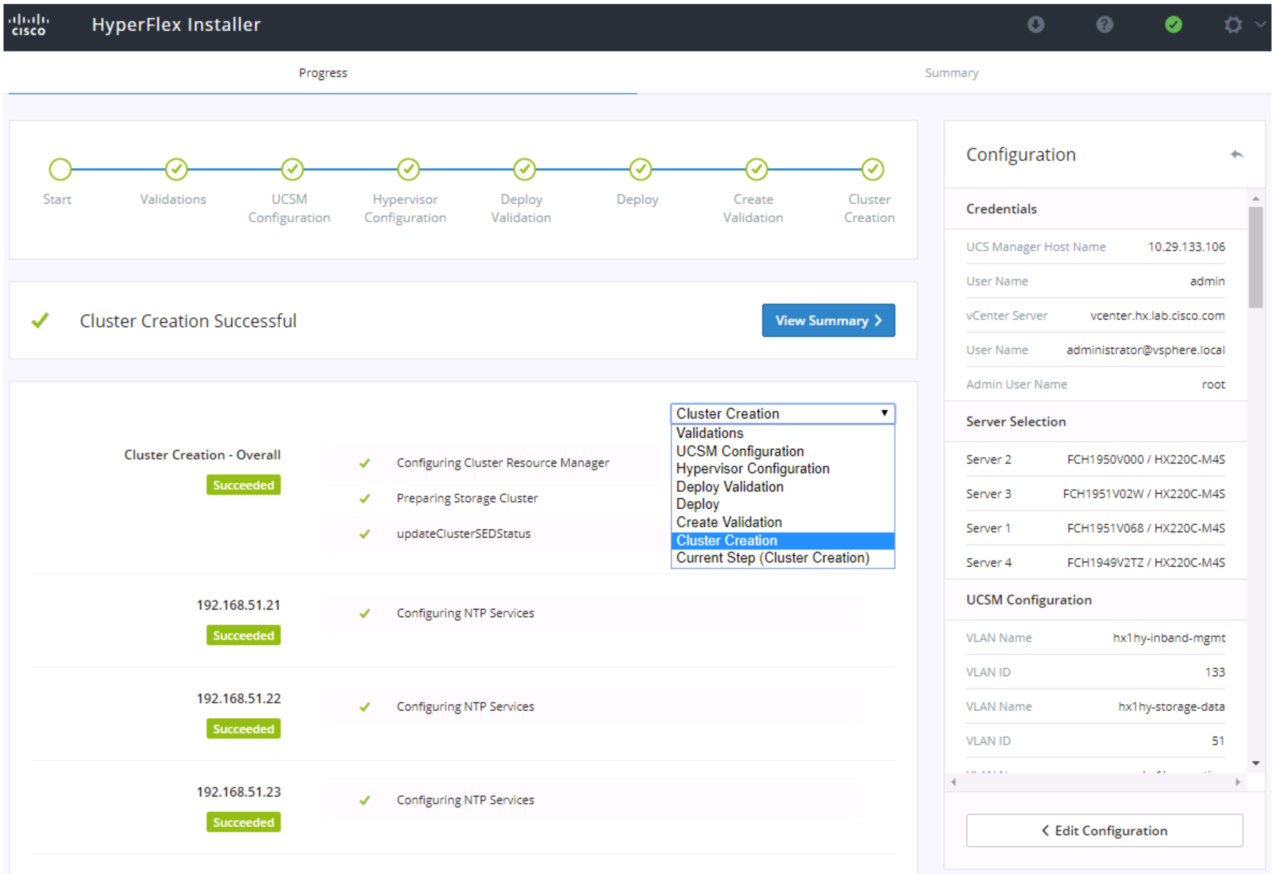
Cluster Name HybridCluster

Version	2.5.1b-26284	vCenter Server	vcenter.hx.lab.cisco.com
Cluster Management IP Address	10.29.133.151	vCenter Datacenter Name	Datacenter
Cluster Data IP Address	192.168.51.20	vCenter Cluster Name	HybridCluster
Replication Factor	3	DNS Server(s)	10.29.133.110
Available Capacity	8.0 TB	NTP Server(s)	72.163.32.44, 10.81.254.202

Servers

Model	Serial Number	Management Hypervisor	Management Storage Controller	Data Network Hypervisor	Data Network Storage Controller
HX220C-M4S	FCH1951V068	10.29.133.143	10.29.133.152	192.168.51.11	192.168.51.21
HX220C-M4S	FCH1950V000	10.29.133.144	10.29.133.153	192.168.51.12	192.168.51.22
HX220C-M4S	FCH1951V02W	10.29.133.145	10.29.133.154	192.168.51.13	192.168.51.23
HX220C-M4S	FCH1949V2TZ	10.29.133.146	10.29.133.155	192.168.51.14	192.168.51.24

23. You can also review the details of the installation process after the install completes by selecting Progress on the top left of the window.



✓ Cluster Creation Successful

Cluster Creation - Overall
Succeeded
- ✓ Configuring Cluster Resource Manager
- ✓ Preparing Storage Cluster
- ✓ updateClusterSEDStatus

192.168.51.21
Succeeded
- ✓ Configuring NTP Services

192.168.51.22
Succeeded
- ✓ Configuring NTP Services

192.168.51.23
Succeeded
- ✓ Configuring NTP Services

Configuration

Credentials

UCS Manager Host Name	10.29.133.106
User Name	admin
vCenter Server	vcenter.hx.lab.cisco.com
User Name	administrator@vsphere.local
Admin User Name	root

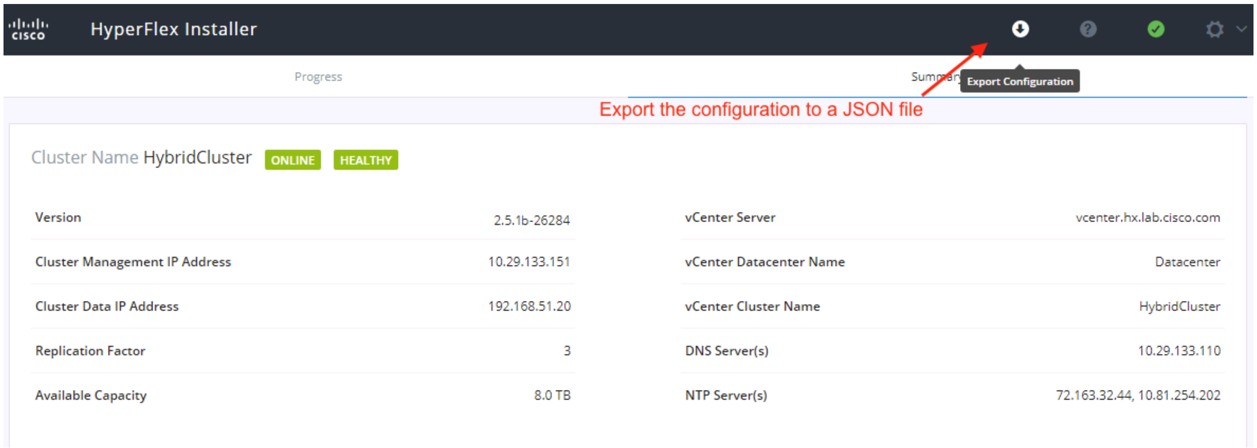
Server Selection

Server 2	FCH1950V000 / HX220C-M4S
Server 3	FCH1951V02W / HX220C-M4S
Server 1	FCH1951V068 / HX220C-M4S
Server 4	FCH1949V2TZ / HX220C-M4S

UCSM Configuration

VLAN Name	hx1hy-inband-mgmt
VLAN ID	133
VLAN Name	hx1hy-storage-data
VLAN ID	51

24. After the install completes, you may export the cluster configuration by clicking on the downward arrow icon in the top right of the screen. Click OK to save the configuration to a JSON file. This file can be imported to save time if you need to rebuild the same cluster in the future, and be kept as a record of the configuration options and settings used during the installation.



Cluster Name HybridCluster ONLINE HEALTHY

Version	2.5.1b-26284	vCenter Server	vcenter.hx.lab.cisco.com
Cluster Management IP Address	10.29.133.151	vCenter Datacenter Name	Datacenter
Cluster Data IP Address	192.168.51.20	vCenter Cluster Name	HybridCluster
Replication Factor	3	DNS Server(s)	10.29.133.110
Available Capacity	8.0 TB	NTP Server(s)	72.163.32.44, 10.81.254.202

25. After the installation completes, you can click the Launch HyperFlex Connect button to immediately log in to the new HTML5 GUI.

Post installation Script to Complete your HX Configuration

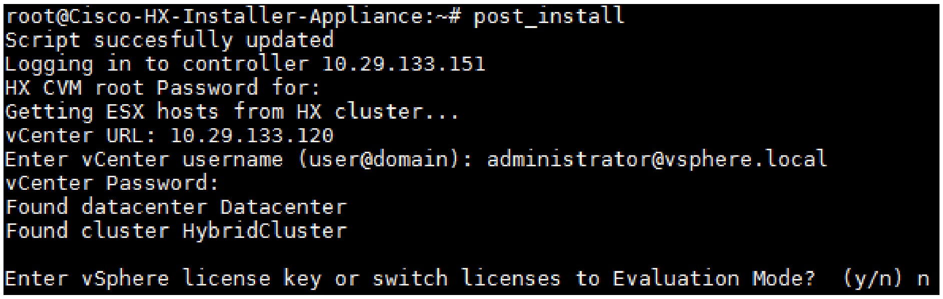
To automate the post installation procedures and verify the HyperFlex Installer has properly configured Cisco UCS Manager, a script has been provided on the HyperFlex Installer OVA. These steps can also be performed manually in vCenter if preferred. The following procedure will use the script.

1. SSH to the installer OVA IP as root with password Cisco123,

```
# ssh root@10.29.133.115
```

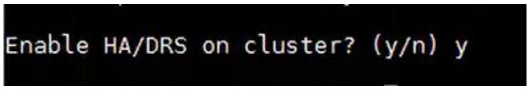
2. From the CLI of the installer VM, run the script named post_install.

3. The installer will already have the information from the just completed HX installation and it will be used by the script. Enter the HX Storage Controller VM root password for the HX cluster (use the one entered during the HX Cluster installation), as well as the vCenter user name and password. You can also enter the vSphere license or complete this task later.



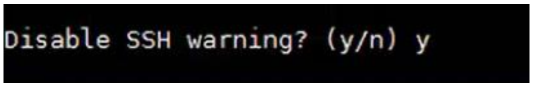
```
root@Cisco-HX-Installer-Appliance:~# post_install
Script succesfully updated
Logging in to controller 10.29.133.151
HX CVM root Password for:
Getting ESX hosts from HX cluster...
vCenter URL: 10.29.133.120
Enter vCenter username (user@domain): administrator@vsphere.local
vCenter Password:
Found datacenter Datacenter
Found cluster HybridCluster

Enter vSphere license key or switch licenses to Evaluation Mode?  (y/n) n
```

4. Enter “y” to enable HA/DRS.



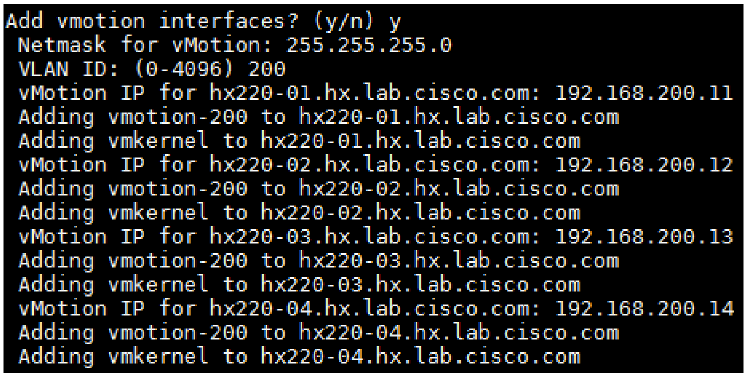
```
Enable HA/DRS on cluster? (y/n) y
```

5. Enter “y” to disable SSH warning.



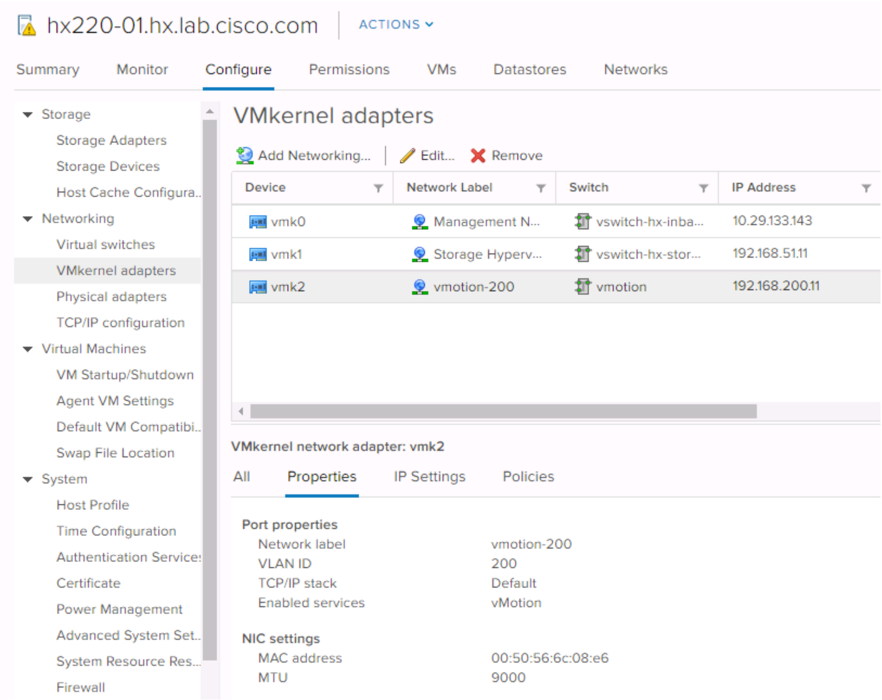
```
Disable SSH warning? (y/n) y
```

6. Add the vMotion VMkernel interfaces to each node by entering “y”. Input the netmask, the vMotion VLAN ID, and the vMotion IP addresses for each of the hosts as prompted.



```
Add vmotion interfaces? (y/n) y
 Netmask for vMotion: 255.255.255.0
 VLAN ID: (0-4096) 200
 vMotion IP for hx220-01.hx.lab.cisco.com: 192.168.200.11
 Adding vmotion-200 to hx220-01.hx.lab.cisco.com
 Adding vmkernel to hx220-01.hx.lab.cisco.com
 vMotion IP for hx220-02.hx.lab.cisco.com: 192.168.200.12
 Adding vmotion-200 to hx220-02.hx.lab.cisco.com
 Adding vmkernel to hx220-02.hx.lab.cisco.com
 vMotion IP for hx220-03.hx.lab.cisco.com: 192.168.200.13
 Adding vmotion-200 to hx220-03.hx.lab.cisco.com
 Adding vmkernel to hx220-03.hx.lab.cisco.com
 vMotion IP for hx220-04.hx.lab.cisco.com: 192.168.200.14
 Adding vmotion-200 to hx220-04.hx.lab.cisco.com
 Adding vmkernel to hx220-04.hx.lab.cisco.com
```

A vMotion VMkernel Port is created for each host in vCenter:



hx220-01.hx.lab.cisco.com | ACTIONS

Summary | Monitor | Configure | Permissions | VMs | Datastores | Networks

- Storage
  - Storage Adapters
  - Storage Devices
  - Host Cache Configura...
- Networking
  - Virtual switches
  - VMkernel adapters
  - Physical adapters
  - TCP/IP configuration
- Virtual Machines
  - VM Startup/Shutdown
  - Agent VM Settings
  - Default VM Compatibi...
  - Swap File Location
- System
  - Host Profile
  - Time Configuration
  - Authentication Service
  - Certificate
  - Power Management
  - Advanced System Set...
  - System Resource Res...
  - Firewall

VMkernel adapters

Add Networking... | Edit... | Remove

Device	Network Label	Switch	IP Address
vmk0	Management N...	vswitch-hx-inba...	10.29.133.143
vmk1	Storage Hyperv...	vswitch-hx-stor...	192.168.51.11
vmk2	vmotion-200	vmotion	192.168.200.11

VMkernel network adapter: vmk2

All | Properties | IP Settings | Policies

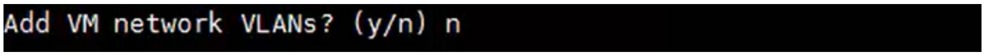
Port properties

Network label	vmotion-200
VLAN ID	200
TCP/IP stack	Default
Enabled services	vMotion

NIC settings

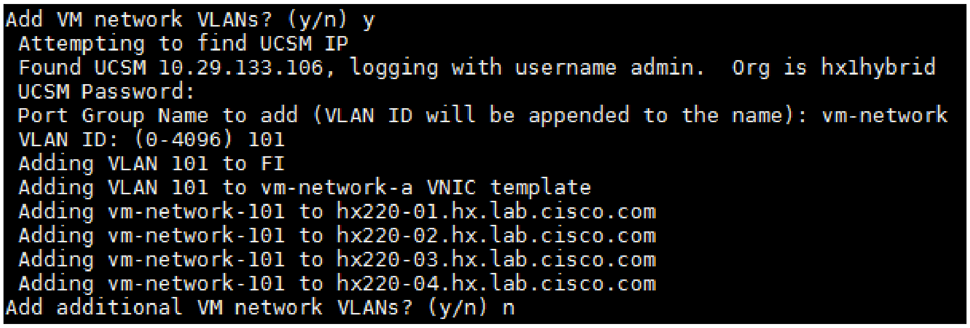
MAC address	00:50:56:6c:08:e6
MTU	9000

7. The main installer will have already created at least one vm-network port group and assigned the default VM network VLAN input from the cluster installation. Enter “n” to skip this step and use the group(s) that were created. If desired, additional VM network port groups can be created and the additional VLANs will be added to the vm-networks vSwitch. This option will also create the corresponding VLANs in Cisco UCS Manager, and assign the VLAN to the vm-network vNIC-Template. This script can be rerun at later time as well to create additional VM networks and Cisco UCS VLANs.



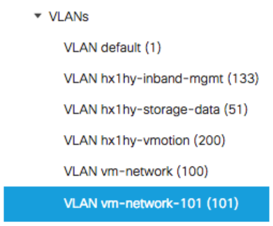
```
Add VM network VLANs? (y/n) n
```

Example: Using this option in the script to show how to add more VM networks:



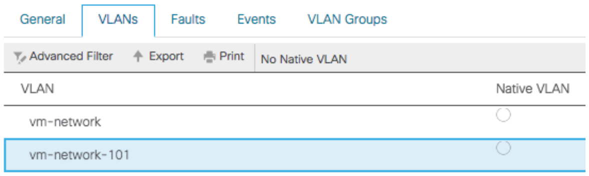
```
Add VM network VLANs? (y/n) y
 Attempting to find UCSM IP
 Found UCSM 10.29.133.106, logging with username admin.  Org is hx1hybrid
 UCSM Password:
 Port Group Name to add (VLAN ID will be appended to the name): vm-network
 VLAN ID: (0-4096) 101
 Adding VLAN 101 to FI
 Adding VLAN 101 to vm-network-a VNIC template
 Adding vm-network-101 to hx220-01.hx.lab.cisco.com
 Adding vm-network-101 to hx220-02.hx.lab.cisco.com
 Adding vm-network-101 to hx220-03.hx.lab.cisco.com
 Adding vm-network-101 to hx220-04.hx.lab.cisco.com
Add additional VM network VLANs? (y/n) n
```

VLANs are created in Cisco UCS:



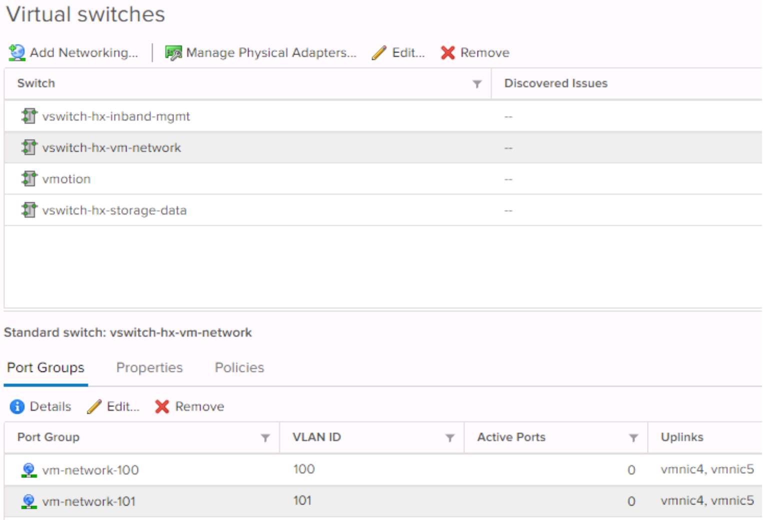
- VLANs
  - VLAN default (1)
  - VLAN hx1hy-inband-mgmt (133)
  - VLAN hx1hy-storage-data (51)
  - VLAN hx1hy-vmotion (200)
  - VLAN vm-network (100)
  - VLAN vm-network-101 (101)

VLANs are assigned to vNICs:



VLAN	Native VLAN
vm-network	○
vm-network-101	○

Port groups are created:



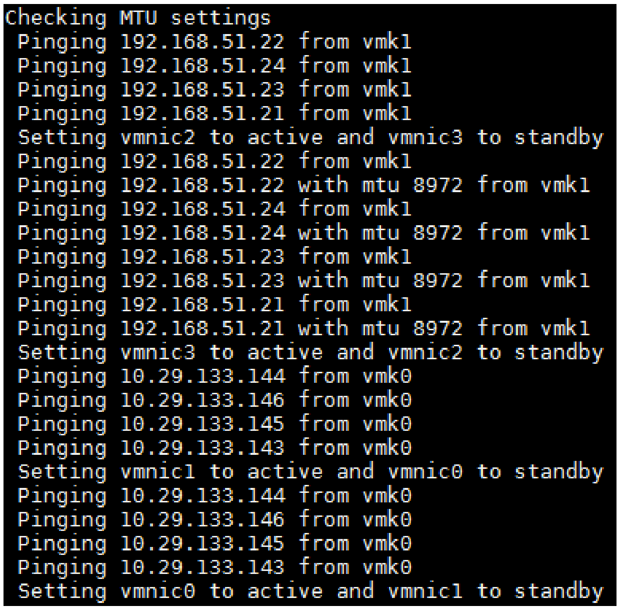
Switch	Discovered Issues
vswitch-hx-inband-mgmt	--
vswitch-hx-vm-network	--
vmotion	--
vswitch-hx-storage-data	--

Standard switch: vswitch-hx-vm-network

Port Group	VLAN ID	Active Ports	Uplinks
vm-network-100	100	0	vmnic4, vmnic5
vm-network-101	101	0	vmnic4, vmnic5

8. Enter "n" to skip testing the auto support email function, because the email configuration has not been completed yet.

9. The post install script will now check the networking configuration and jumbo frames.



```
Checking MTU settings
 Pinging 192.168.51.22 from vmk1
 Pinging 192.168.51.24 from vmk1
 Pinging 192.168.51.23 from vmk1
 Pinging 192.168.51.21 from vmk1
 Setting vmnic2 to active and vmnic3 to standby
 Pinging 192.168.51.22 from vmk1
 Pinging 192.168.51.22 with mtu 8972 from vmk1
 Pinging 192.168.51.24 from vmk1
 Pinging 192.168.51.24 with mtu 8972 from vmk1
 Pinging 192.168.51.23 from vmk1
 Pinging 192.168.51.23 with mtu 8972 from vmk1
 Pinging 192.168.51.21 from vmk1
 Pinging 192.168.51.21 with mtu 8972 from vmk1
 Setting vmnic3 to active and vmnic2 to standby
 Pinging 10.29.133.144 from vmk0
 Pinging 10.29.133.146 from vmk0
 Pinging 10.29.133.145 from vmk0
 Pinging 10.29.133.143 from vmk0
 Setting vmnic1 to active and vmnic0 to standby
 Pinging 10.29.133.144 from vmk0
 Pinging 10.29.133.146 from vmk0
 Pinging 10.29.133.145 from vmk0
 Pinging 10.29.133.143 from vmk0
 Setting vmnic0 to active and vmnic1 to standby
```

10. The script will complete and provide a summary screen. Validate there are no errors and the cluster is healthy.

Syslog

It is recommended to enable a syslog destination for permanent storage of the ESXi host logs. It is possible to use the vCenter server as the log destination in this case.

To configure syslog, complete the following steps:

1. Log on to the ESXi host via SSH as the root user.

2. Enter the following commands, replacing the IP address in the first command with the IP address of the vCenter server that will receive the syslog logs:

```
[root@hx220-01:~] esxcli system syslog config set --loghost='udp://10.29.133.120'
[root@hx220-01:~] esxcli system syslog reload
[root@hx220-01:~] esxcli network firewall ruleset set -r syslog -e true
[root@hx220-01:~] esxcli network firewall refresh
```

3. Repeat for each ESXi host.

Datastores

Create a datastore for storing the virtual machines. This task can be completed by using the vSphere Web Client HX plugin, or by using the HyperFlex Connect HTML management webpage. To configure a new datastore, complete the following steps:

1. Use a web browser to open the HX cluster IP management URL, for example: https://10.29.133.151

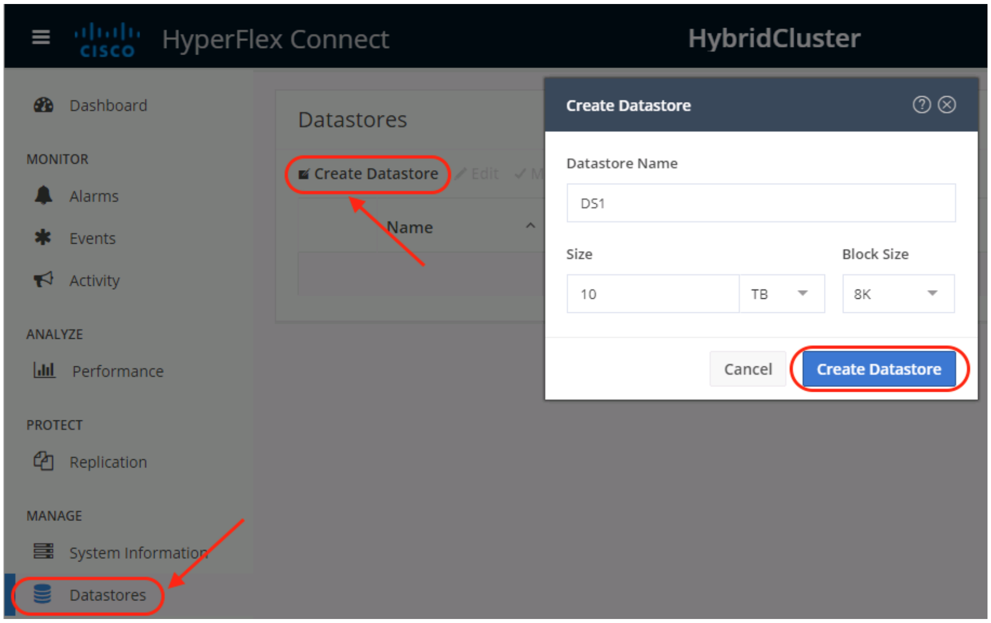
2. Enter a local credential, or a vCenter RBAC credential for the username, and the corresponding password.

3. Click Login.

4. Click Datastores in the left pane, and click Create Datastore.

5. In the popup, enter the Datastore Name and size. For most applications, leave the Block Size at the default of 8K.

6. Click Create Datastore.

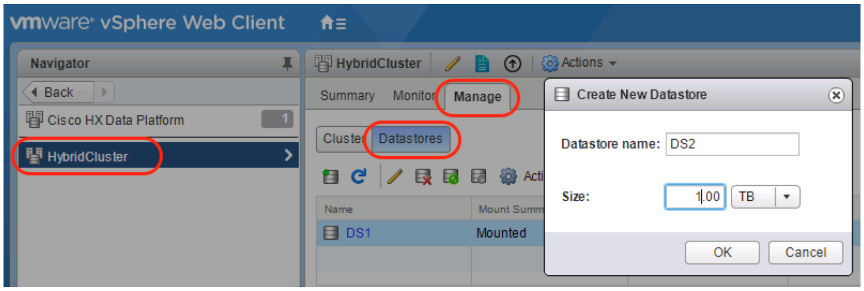


Datastore Name: DS1

Size: 10 TB

Block Size: 8K

7. Alternatively, to create the datastore using the vSphere web client, select vCenter Inventory Lists, and select the Cisco HyperFlex System, Cisco HX Data Platform, cluster-name, manage tab and the plus (+) icon to create a datastore.

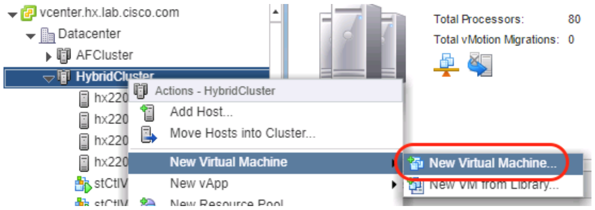


Datastore name: DS2

Size: 100 TB

Testing

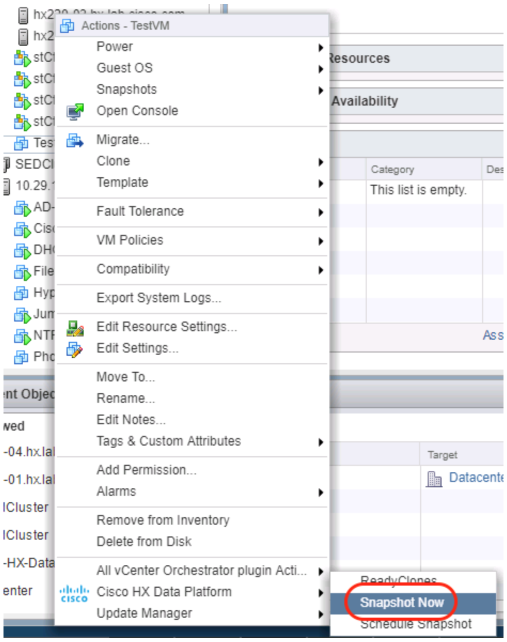
1. Create a test virtual machine stored on your new HX datastore in order to take a snapshot and perform a cloning operation.



Total Processors: 80

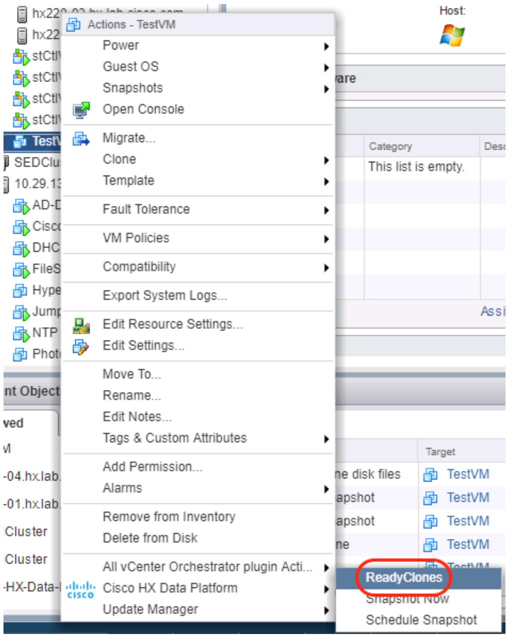
Total vMotion Migrations: 0

2. Take a snapshot of the new virtual machine via the vSphere Web Client prior to powering it on. This can be scheduled as well. In the vSphere web client, right-click the VM, select Cisco HX Data Platform, then select Snapshot Now.

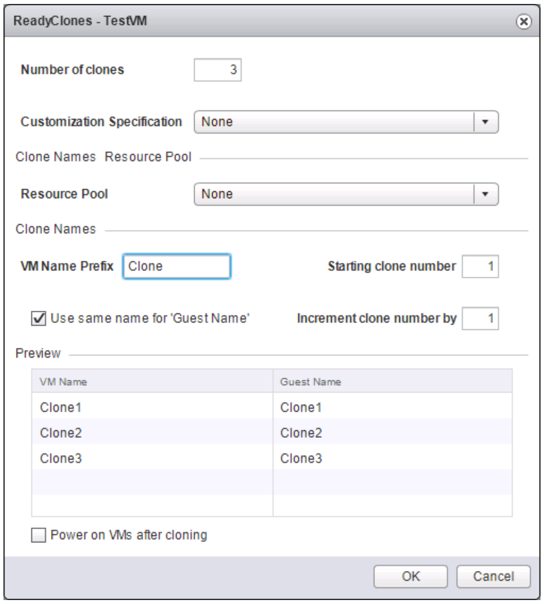


3. Input the snapshot name and click OK.

4. Create a few clones of our virtual machine. Right-click the VM, and select Cisco HX Data Platform, then ReadyClones.



5. Input the Number of clones and Prefix, then click OK to start the operation. The clones will be created in seconds.



ReadyClones - TestVM

Number of clones: 3

Customization Specification: None

Clone Names Resource Pool

Resource Pool: None

Clone Names

VM Name Prefix: Clone

Starting clone number: 1

☑ Use same name for 'Guest Name'

Increment clone number by: 1

Preview

VM Name	Guest Name
Clone1	Clone1
Clone2	Clone2
Clone3	Clone3

□ Power on VMs after cloning

Auto-Support and Notifications

Auto-Support should be enabled for all clusters during the initial HyperFlex installation. Auto-Support enables Call Home to automatically send support information to Cisco TAC, and notifications of tickets to the email address specified. If the settings need to be modified, they can be changed in the HyperFlex Connect HTML management webpage.

To change Auto-Support settings, complete the following steps:

1. From the HyperFlex Connect webpage, click the gear shaped icon in the upper right-hand corner, and click Auto-Support Settings.

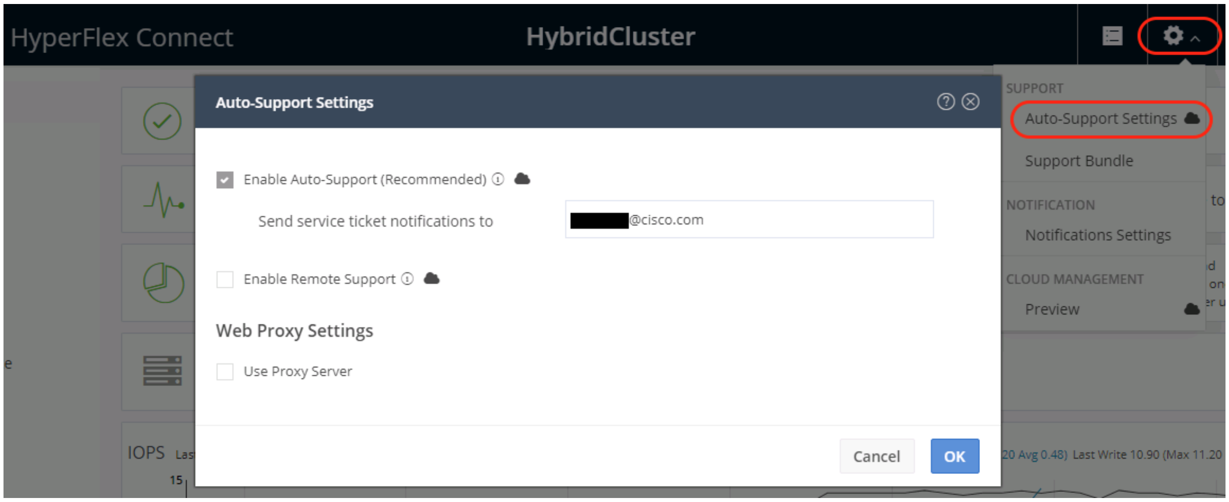
2. Enable or disable Auto-Support as needed.

3. Enter the email address to receive alerts when Auto-Support events are generated.

4. Enable or disable Remote Support as needed. Remote support allows Cisco TAC to connect to the HX cluster and accelerate troubleshooting efforts.

5. Enter in the information for a web proxy if needed.

6. Click OK.



Auto-Support Settings

☑ Enable Auto-Support (Recommended)

Send service ticket notifications to [redacted]@cisco.com

□ Enable Remote Support

Web Proxy Settings

□ Use Proxy Server

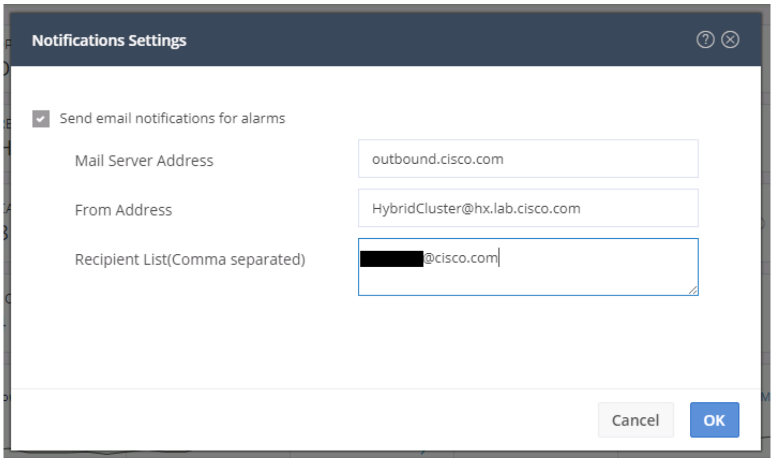
Email notifications which come directly from the HyperFlex cluster can also be enabled.

To enable direct email notifications, complete the following steps:

1. From the HyperFlex Connect webpage, click the gear shaped icon in the upper right-hand corner, and click Notifications Settings.

2. Enter the DNS name or IP address of the outgoing email server or relay, the email address the notifications will come from, and the recipients.

3. Click OK.



Notifications Settings

☑ Send email notifications for alarms

Mail Server Address: outbound.cisco.com

From Address: HybridCluster@hx.lab.cisco.com

Recipient List(Comma separated): [redacted]@cisco.com

Security

It is recommended that the default ESXi root passwords be changed for enhanced security. To change the root password of the ESXi host, complete the following steps:

1. Log into the ESXi host via SSH.

2. If the logon account used was not root, gain root privileges via su (you must know the root account password):

```
su -
```

3. Change the root password:

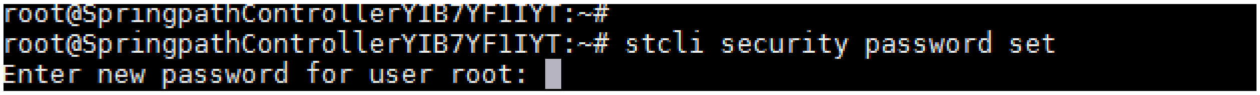
   ```
   passwd root
   ```

4. Enter the new password and press Enter.

5. Enter the new password again to confirm, and press Enter.

6. Repeat steps 1-5 for each ESXi host.

Optionally, you can change the HX controller password via the “stcli security password set” command.



```
root@SpringpathControllerYIB7YF1IYT:~#
root@SpringpathControllerYIB7YF1IYT:~# stcli security password set
Enter new password for user root:
```

Smart Licensing

HyperFlex 2.5 introduces Smart Licensing, which communicates with a Cisco Smart Account to validate and check out HyperFlex licenses to the nodes, from the pool of available licenses in the account. At the beginning, Smart Licensing is enabled but the HX storage cluster is unregistered and in a 90-day evaluation period or EVAL MODE. For the HX storage cluster to start reporting license consumption, it must be registered with the Cisco Smart Software Manager (SSM) through a valid Cisco Smart Account. Before beginning, verify that you have a Cisco Smart account, and valid HyperFlex licenses are available to be checked out by your HX cluster.

To create a Smart Account, see **Cisco Software Central** > **Request a Smart Account** https://webapps.cisco.com/software/company/smartaccounts/home?route=module/accountcreation .

To activate and configure smart licensing, complete the following steps:

1. Log into a controller VM.   Confirm that your HX storage cluster is in Smart Licensing mode.

   ```
   # stcli license show status

   Smart Licensing is ENABLED

   Registration:
     Status: UNREGISTERED
     Export-Controlled Functionality: Not Allowed

   License Authorization:
     Status: EVAL MODE
     Evaluation Period Remaining: 79 days, 8 hr, 52 min, 57 sec
     Last Communication Attempt: NONE
   ```

   Feedback should show Smart Licensing is ENABLED, Status: UNREGISTERED, and the amount of time left during the 90-day evaluation period (in days, hours, minutes, and seconds).

2. Navigate to Cisco Software Central (https://software.cisco.com/) and log in to your Smart Account.

3. From Cisco Smart Software Manager, generate a registration token.

4. In the License pane, click Smart Software Licensing to open Cisco Smart Software Manager.

5. Click Inventory.

6. From the virtual account where you want to register your HX storage cluster, click General, and then click New Token.

7. In the Create Registration Token dialog box, add a short Description for the token, enter the number of days you want the token to be active and available to use on other products, and check Allow export-controlled functionality on the products registered with this token.

8. Click Create Token.

9. From the New ID Token row, click the Actions drop-down list, and click Copy.

10. Log into a controller VM.

11. Register your HX storage cluster, where *idtoken-string* is the New ID Token from Cisco Smart Software Manager.

```
# stcli license register --idtoken idtoken-string
```

12. Confirm that your HX storage cluster is registered.

```
# stcli license show summary
```

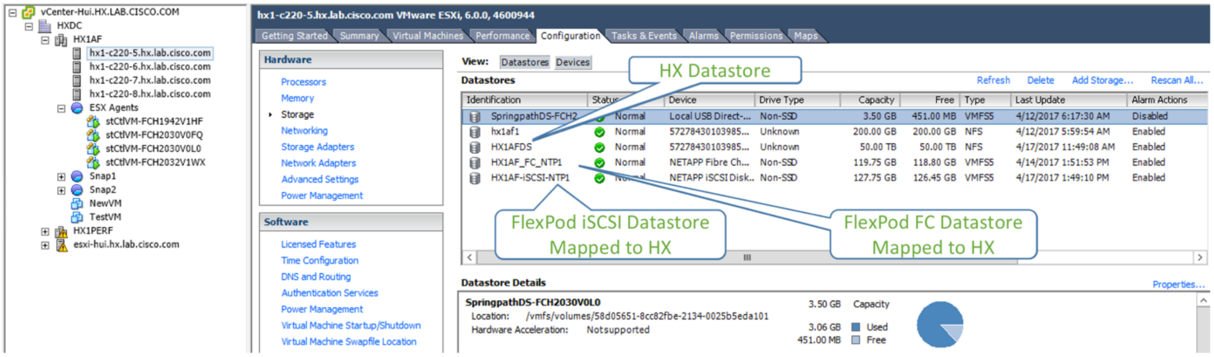
The cluster is now ready. You may run any other preproduction tests that you wish to run at this point.

Additional vHBAs or vNICs

Overview

From HXDP version 1.8 onward, customers have the flexibility to leverage third-party storage infrastructure by connecting external storage arrays to HX systems. As an example, one can map and connect Fibre Channel LUNs from an IBM VersaStack or NFS volumes from a NetApp FlexPod system, and then easily perform a Storage vMotion of virtual machines into the HyperFlex system.

Figure 47 External Storage in HX



Datastores

Identification	Status	Device	Drive Type	Capacity	Free	Type	Last Update	Alarm Actions
SpringpathDS-FCH2	Normal	Local USB Direct-...	Non-SSD	3.50 GB	451.00 MB	VMFS5	4/12/2017 6:17:30 AM	Disabled
hx1af1	Normal	57278430103985...	Unknown	200.00 GB	200.00 GB	NFS	4/12/2017 5:59:54 AM	Enabled
HX1AFDS	Normal	57278430103985...	Unknown	50.00 TB	50.00 TB	NFS	4/17/2017 11:49:08 AM	Enabled
HX1AF_FC_NTP1	Normal	NETAPP Fibre Ch...	Non-SSD	119.75 GB	118.80 GB	VMFS5	4/14/2017 1:51:53 PM	Enabled
HX1AF-iSCSI-NTP1	Normal	NETAPP iSCSI Disk..	Non-SSD	127.75 GB	126.45 GB	VMFS5	4/17/2017 1:49:10 PM	Enabled

Datastore Details

SpringpathDS-FCH2030V0L0
Location: /vmfs/volumes/58d05651-8cc82fbe-2134-0025b5eda101
Hardware Acceleration: Notsupported

3.50 GB Capacity
3.06 GB ■ Used
451.00 MB □ Free

In order to connect to other storage systems such as FlexPod via iSCSI or NFS, or an FC SAN, it is recommended that the additional vHBAs or vNICs be added during the creation of the HX cluster. If these are added post cluster creation, the PCI enumeration can change causing PCI passthrough device configuration errors. With HXDP 2.5 and onward, the system can repair these changes automatically via an additional reboot of the ESXi hosts. It is recommended that you do not make such hardware changes after the HX cluster is created. A better option is to add vHBAs or vNICs as necessary while the cluster is created. Both of these processes are documented below.

In this section only the addition of FC vHBAs or iSCSI vNICs to HX hosts is documented (A more detailed procedure about connecting other iSCSI or NFS storage to HX cluster is in the Appendix).

Note: Although in this CVD we use iSCSI as example to connect HX to external IP storage devices, the vNICs created by this procedure could be used for connecting to NFS storage devices.

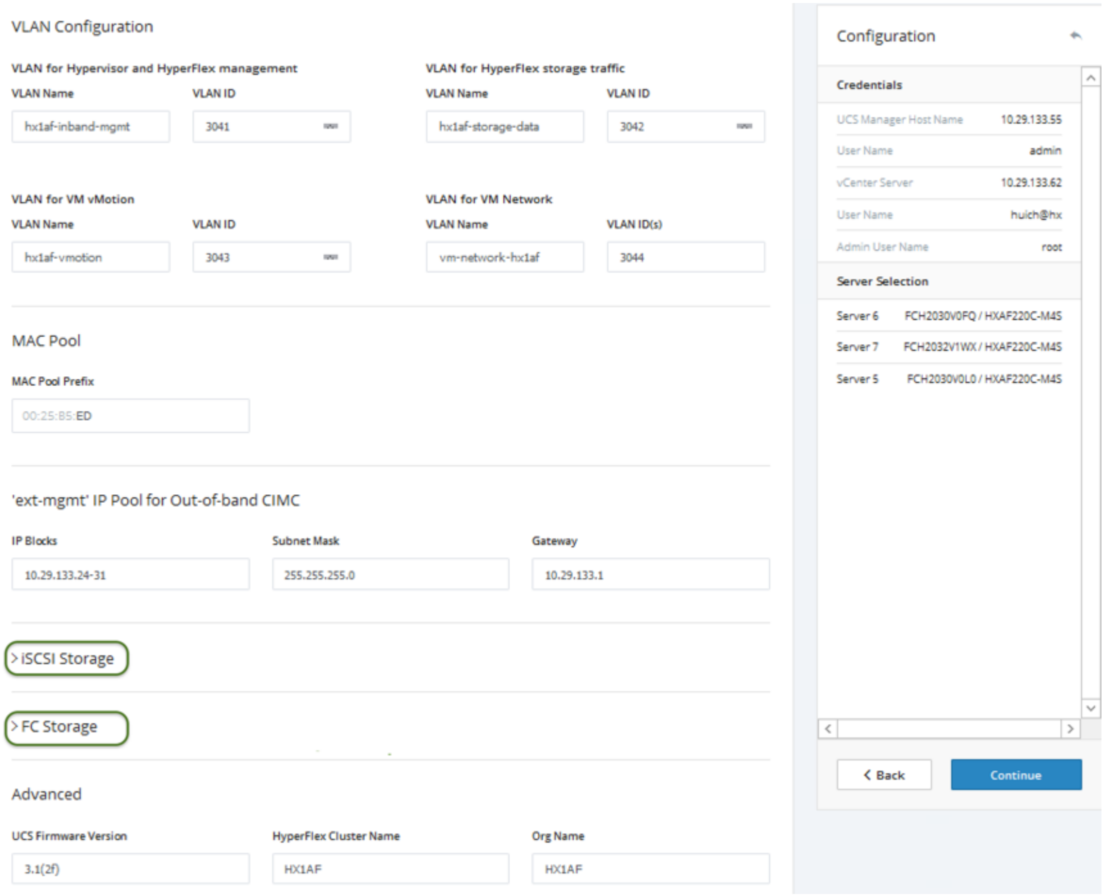
Adding vHBAs or iSCSI vNICs During HX Cluster Creation

From HXDP 2.0 onward, the HX installer supports adding supplemental vHBAs or vNICs as a part of the cluster creation. An overview of this procedure is as follows:

1. Open the HyperFlex Installer from a web browser, login as root user.

2. On the HyperFlex Installer webpage select a Workflow of Cluster Creation to start a fresh cluster installation.

3. Continue with appropriate inputs until you get to the page for Cisco UCS Manager configuration.



VLAN Configuration

VLAN for Hypervisor and HyperFlex management

VLAN Name	VLAN ID
hx1af-inband-mgmt	3041

VLAN for HyperFlex storage traffic

VLAN Name	VLAN ID
hx1af-storage-data	3042

VLAN for VM vMotion

VLAN Name	VLAN ID
hx1af-vmotion	3043

VLAN for VM Network

VLAN Name	VLAN ID(s)
vm-network-hx1af	3044

MAC Pool

MAC Pool Prefix: 00:25:B5:ED

'ext-mgmt' IP Pool for Out-of-band CIMC

IP Blocks	Subnet Mask	Gateway
10.29.133.24-31	255.255.255.0	10.29.133.1

> iSCSI Storage

> FC Storage

Advanced

UCS Firmware Version	HyperFlex Cluster Name	Org Name
3.1(2f)	HX1AF	HX1AF

Configuration

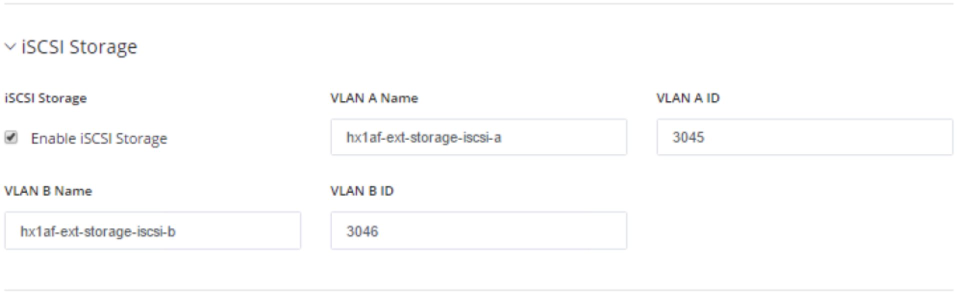
Credentials

UCS Manager Host Name	10.29.133.55
User Name	admin
vCenter Server	10.29.133.62
User Name	huich@hx
Admin User Name	root

Server Selection

Server 6	FCH2030V0FQ / HXAF220C-M4S
Server 7	FCH2032V1WX / HXAF220C-M4S
Server 5	FCH2030V0L0 / HXAF220C-M4S

4. Click the > carat to expand iSCSI Storage configuration. Check the box Enable iSCSI Storage if you want to create additional vNICs to connect to the external iSCSI storage systems. Enter a VLAN name and ID for Fabric A and B dual connections.



iSCSI Storage

iSCSI Storage

☑ Enable iSCSI Storage

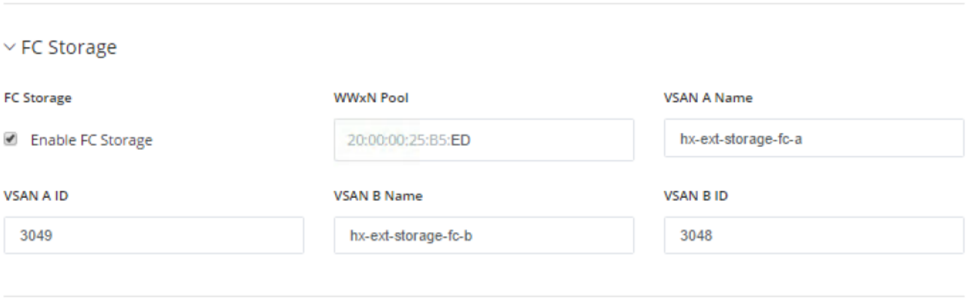
VLAN A Name: hx1af-ext-storage-iscsi-a

VLAN A ID: 3045

VLAN B Name: hx1af-ext-storage-iscsi-b

VLAN B ID: 3046

5. Click the > carat to expand FC Storage configuration. Check the box Enable FC Storage if you want to create Fibre Channel vHBAs to connect to the external FC or FCoE storage systems. Enter WWxN Pool prefix (For example: 20:00:00:25:B5:ED, only enter the last byte value), VSAN names and IDs for Fabric A and B dual connections.



FC Storage

FC Storage

☑ Enable FC Storage

WWxN Pool: 20:00:00:25:B5:ED

VSAN A Name: hx-ext-storage-fc-a

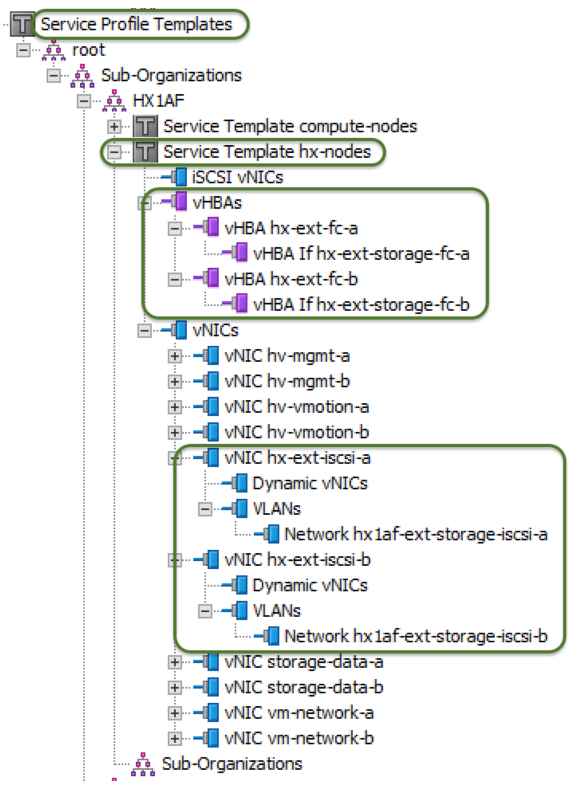
VSAN A ID: 3049

VSAN B Name: hx-ext-storage-fc-b

VSAN B ID: 3048

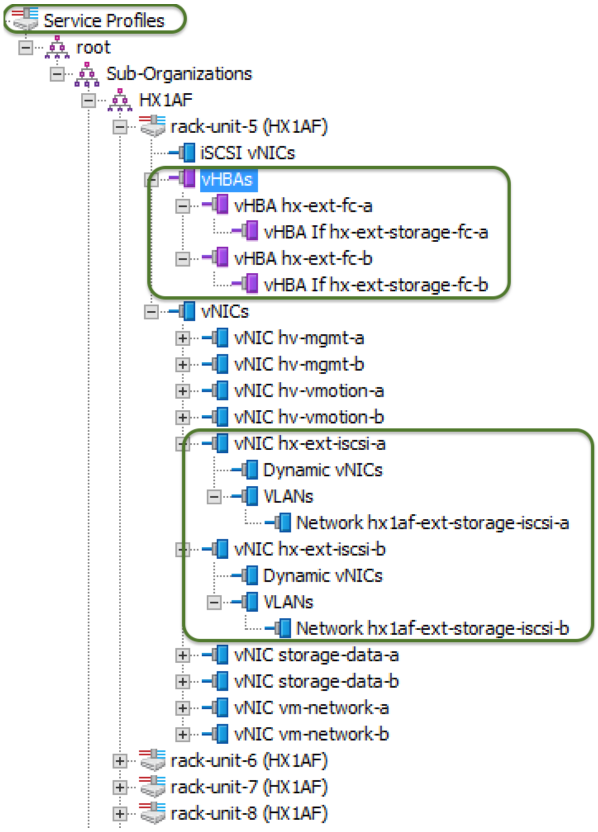
6. Continue and complete the inputs for all the remaining cluster configuration tasks, start the cluster creation and wait for the completion. Note that you can choose to enable either only iSCSI, only FC, or both according to your needs.

7. After the install is completed, the additional dual vHBAs and/or dual vNICs are created for the Service Profile Templates named “hx-nodes” and “compute-nodes”.



```
Service Profile Templates
  root
    Sub-Organizations
      HX1AF
        Service Template compute-nodes
        Service Template hx-nodes
          iSCSI vNICs
          vHBAs
            vHBA hx-ext-fc-a
              vHBA If hx-ext-storage-fc-a
            vHBA hx-ext-fc-b
              vHBA If hx-ext-storage-fc-b
          vNICs
            vNIC hv-mgmt-a
            vNIC hv-mgmt-b
            vNIC hv-vmotion-a
            vNIC hv-vmotion-b
            vNIC hx-ext-iscsi-a
              Dynamic vNICs
              VLANs
                Network hx1af-ext-storage-iscsi-a
            vNIC hx-ext-iscsi-b
              Dynamic vNICs
              VLANs
                Network hx1af-ext-storage-iscsi-b
            vNIC storage-data-a
            vNIC storage-data-b
            vNIC vm-network-a
            vNIC vm-network-b
        Sub-Organizations
```

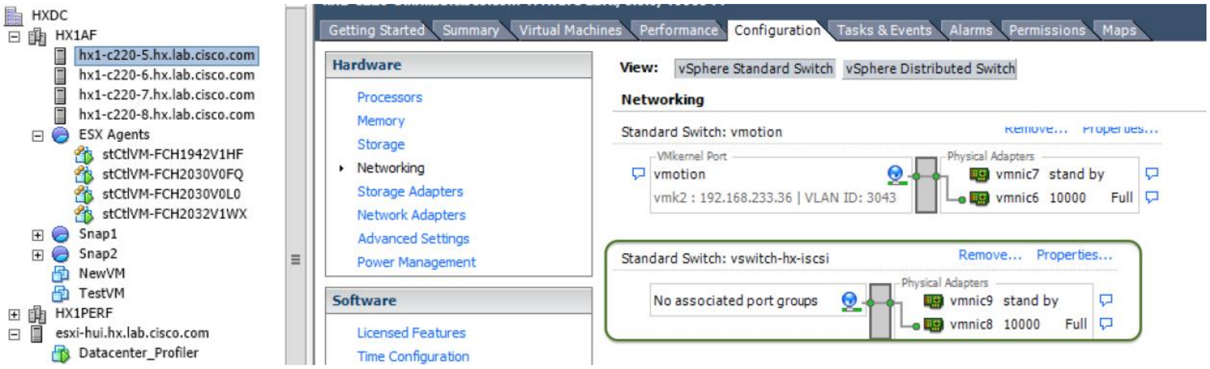
8. For each HX node, dual vHBAs and/or dual iSCSI vNICs are created as well.



```
Service Profiles
  root
    Sub-Organizations
      HX1AF
        rack-unit-5 (HX1AF)
          iSCSI vNICs
          vHBAs
            vHBA hx-ext-fc-a
              vHBA If hx-ext-storage-fc-a
            vHBA hx-ext-fc-b
              vHBA If hx-ext-storage-fc-b
          vNICs
            vNIC hv-mgmt-a
            vNIC hv-mgmt-b
            vNIC hv-vmotion-a
            vNIC hv-vmotion-b
            vNIC hx-ext-iscsi-a
              Dynamic vNICs
              VLANs
                Network hx1af-ext-storage-iscsi-a
            vNIC hx-ext-iscsi-b
              Dynamic vNICs
              VLANs
                Network hx1af-ext-storage-iscsi-b
            vNIC storage-data-a
            vNIC storage-data-b
            vNIC vm-network-a
            vNIC vm-network-b
        rack-unit-6 (HX1AF)
        rack-unit-7 (HX1AF)
        rack-unit-8 (HX1AF)
```

Note: In Cisco UCS Manager, the additional vNICs are configured as standard vNICs, not as iSCSI vNICs, as iSCSI vNICs are specifically used for iSCSI boot adapters.

9. In vCenter, a standard vSwitch vswitch-hx-iscsi is created on each HX ESXi host. Further configuration to create iSCSI VMkernel ports needs to be done manually for storage connections (see Appendix D).

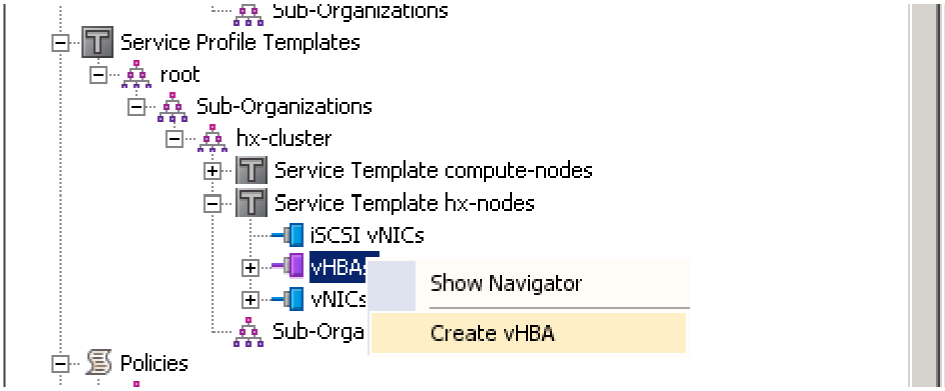


Adding vHBAs or iSCSI vNICs to an existing HX Cluster

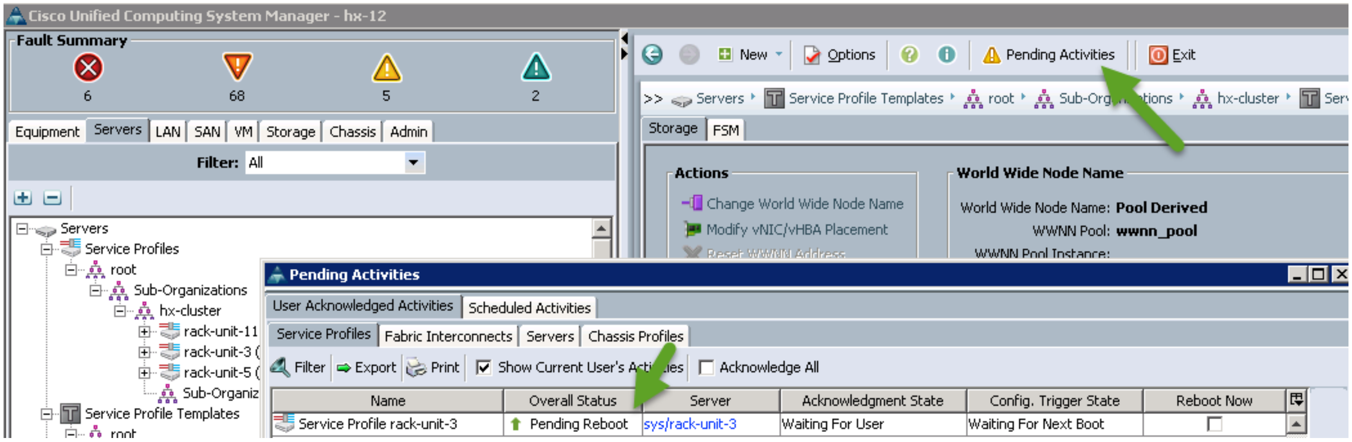
Should you decide to add additional storage such as a FlexPod after you have already installed your cluster, the following procedure can be used for adding vHBAs or vNICs that could cause PCI re-enumeration upon an ESXi host reboot. Beginning with HXDP 2.5, the DirectPath I/O configuration will repair itself automatically via an additional reboot of the node. Therefore, it is recommended you do not reboot multiple nodes at once after making these hardware changes, as it could lead to a cluster failure. Validate the health state of each host, and the HX cluster before rebooting or performing the procedure on subsequent nodes. In this example, we will be adding vHBAs after an HX cluster is created via the Cisco UCS service profile template. We will reboot one ESXi node at a time in a rolling upgrade fashion so there will be no outage.

To add vHBAs or iSCSI vNICs, complete the following steps:

1. Example of hardware change: Add vHBAs to the Service Profile Templates for HX (refer to Cisco UCS documentation for your storage device such as a FlexPod CVD for configuring the vHBAs).



2. After adding the vHBAs to the templates, the servers will be in a Pending Reboot state and require a re-boot to add the new interface. **Do NOT reboot the HX servers at this time.**



Filter: All

World Wide Node Name

World Wide Node Name: **Pool Derived**

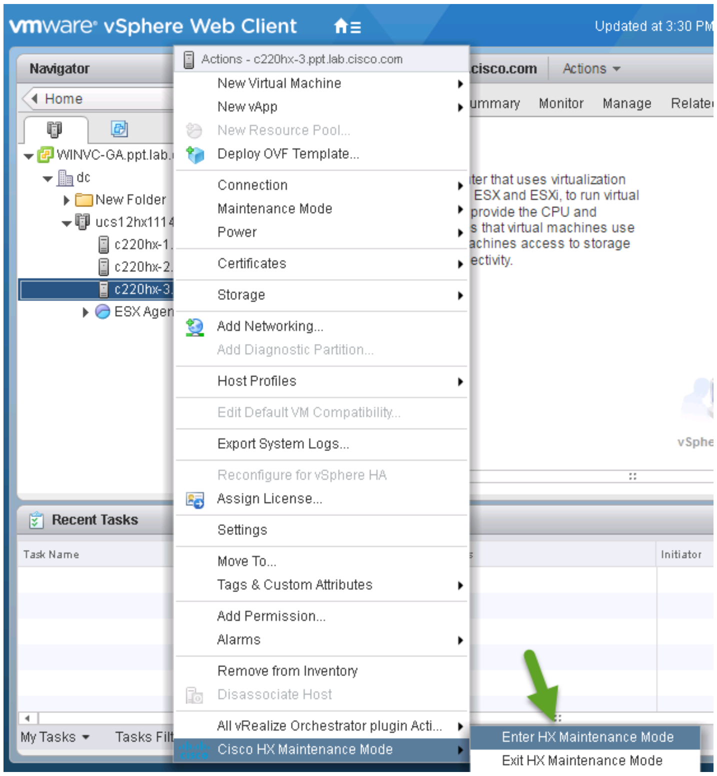
WWNN Pool: **wwnn_pool**

WWNN Pool Instance:

☑ Show Current User's Activities ☐ Acknowledge All

Name	Overall Status	Server	Acknowledgment State	Config. Trigger State	Reboot Now
Service Profile rack-unit-3	Pending Reboot	sys/rack-unit-3	Waiting For User	Waiting For Next Boot	☐

3. Using HyperFlex Connect, or the vSphere Web Client, place one of the HX ESXi hosts in HX-Maintenance Mode.



ter that uses virtualization ESX and ESXi, to run virtual provide the CPU and s that virtual machines use achines access to storage ectivity.

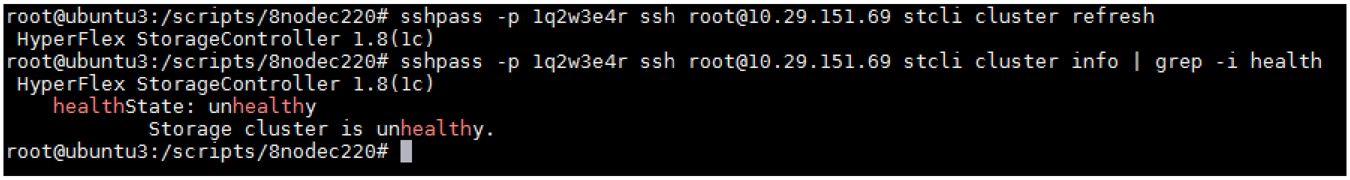
4. After the host has entered Maintenance Mode, reboot the associated node to complete the addition of the new hardware.

5. After the node has rebooted, the HXDP software will detect that the DirectPath I/O configuration has changed, and must be reconfigured. This will result in one additional automatic reboot of the node.

6. After the second reboot, exit the ESXi host from maintenance mode, the SCVM should start automatically without errors.

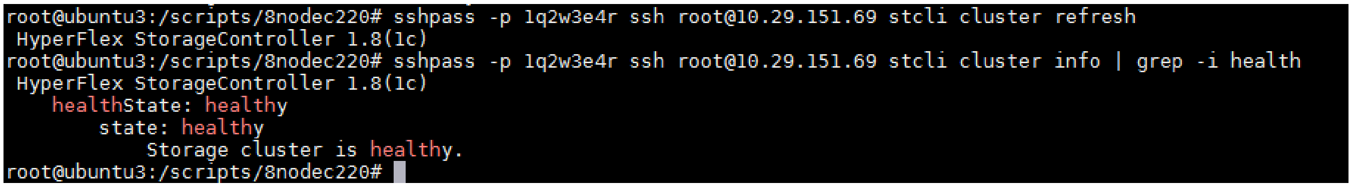
7. Check the health status of the cluster, validating that the cluster is healthy before proceeding to reboot the next node. The cluster health status can be viewed from HyperFlex Connect, or via the CLI. Example:

Run these command to the cluster IP for the HX Controllers “stcli cluster refresh” then “stcli cluster info | grep -i health”



```
root@ubuntu3:/scripts/8nodec220# sshpass -p 1q2w3e4r ssh root@10.29.151.69 stcli cluster refresh
 HyperFlex StorageController 1.8(1c)
root@ubuntu3:/scripts/8nodec220# sshpass -p 1q2w3e4r ssh root@10.29.151.69 stcli cluster info | grep -i health
 HyperFlex StorageController 1.8(1c)
    healthState: unhealthy
            Storage cluster is unhealthy.
root@ubuntu3:/scripts/8nodec220# 
```

8. Continue checking or refreshing until the HX cluster is healthy.



```
root@ubuntu3:/scripts/8nodec220# sshpass -p 1q2w3e4r ssh root@10.29.151.69 stcli cluster refresh
 HyperFlex StorageController 1.8(1c)
root@ubuntu3:/scripts/8nodec220# sshpass -p 1q2w3e4r ssh root@10.29.151.69 stcli cluster info | grep -i health
 HyperFlex StorageController 1.8(1c)
    healthState: healthy
          state: healthy
            Storage cluster is healthy.
root@ubuntu3:/scripts/8nodec220# 
```

9. Repeat the process for each node in the cluster as necessary.

ESXi Hypervisor Installation

HX nodes come from the factory with a copy of the ESXi hypervisor pre-installed, however there are scenarios where it may be necessary to redeploy or reinstall ESXi on an HX node. In addition, this process can be used to deploy ESXi on rack mount or blade servers that will function as HX compute-only nodes. The HyperFlex system requires a Cisco custom ESXi ISO file to be used, which has Cisco hardware specific drivers pre-installed, and customized settings configured to ease the installation process. The Cisco custom ESXi ISO file is available to download at cisco.com.

ESXi Kickstart ISO

The HX custom ISO is based on the Cisco custom ESXi 6.5 Patch 1a ISO release with the filename: ***HX-Vmware-ESXi-650-5224529-Cisco-Custom-6.5.0.3.iso*** and is available on the Cisco web site:

https://software.cisco.com/download/type.html?mdfid=286305544&catid=null

The custom Cisco HyperFlex ESXi ISO will automatically perform the following tasks with no user interaction required:

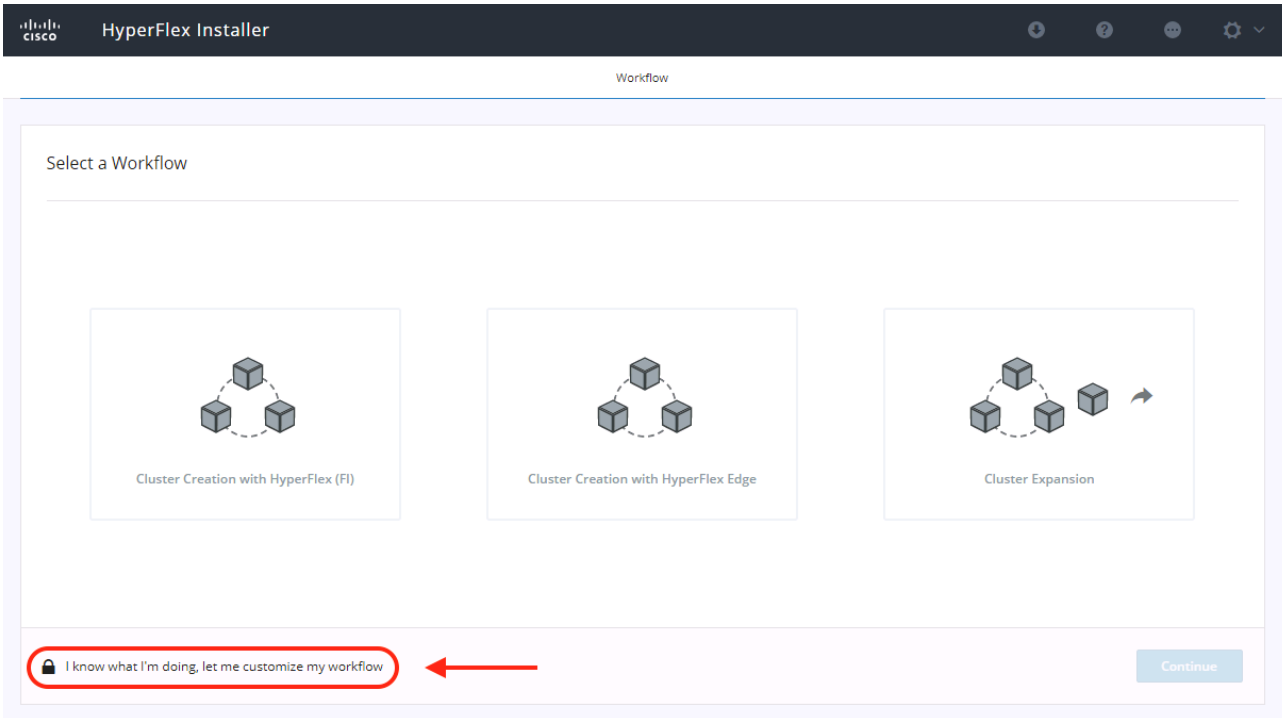
- Accept the End User License Agreement.
- Configure the root password to: Cisco123
- Install ESXi to the internal mirrored Cisco FlexFlash SD cards.
- Set the default management network to use vmnic0, and obtain an IP address via DHCP.
- Enable SSH access to the ESXi host.
- Enable the ESXi shell.
- Enable serial port com1 console access to facilitate Serial over LAN access to the host.
- Configure the ESXi configuration to always use the current hardware MAC address of the network interfaces, even if they change.

- Rename the default vSwitch to vswitch-hx-inband-mgmt.

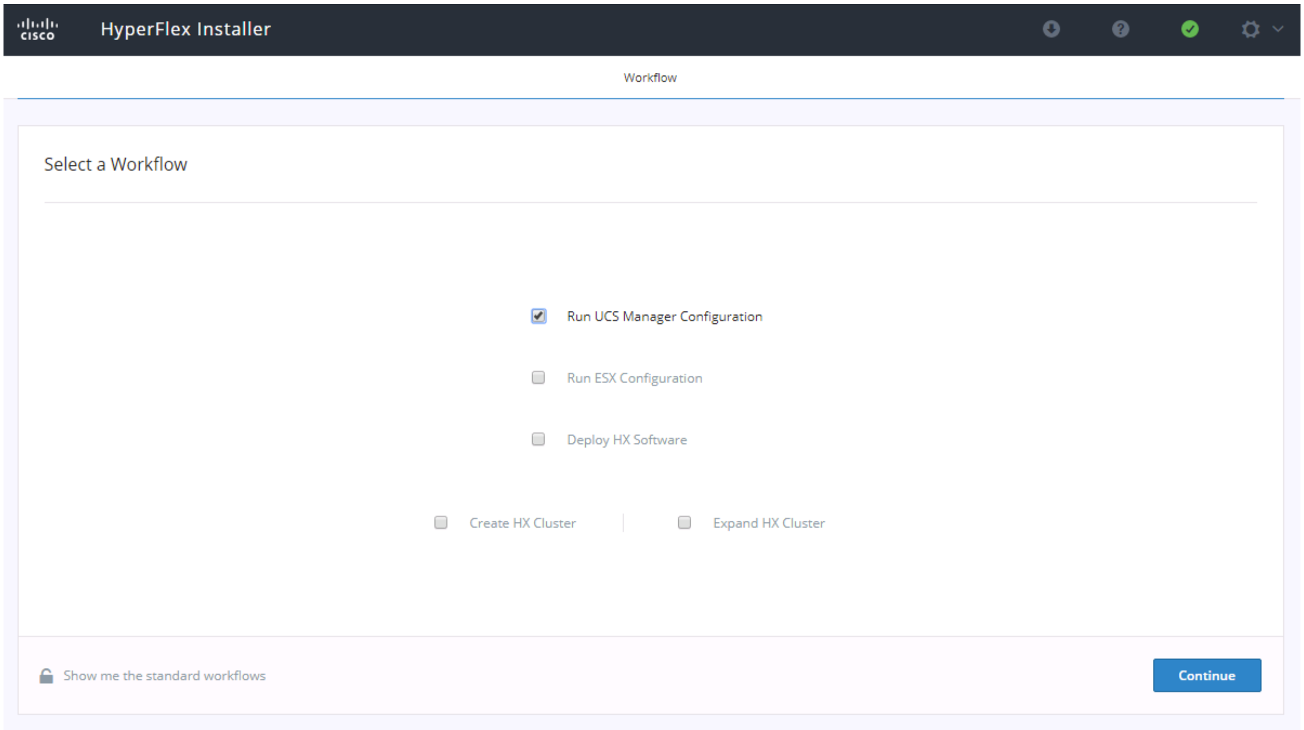
Reinstall HX Cluster

A high-level example of a HX rebuild procedure would be:

1. Clean up the existing environment by:
   - Deleting existing HX virtual machines and HX datastores.
   - Removing the HX cluster in vCenter.
   - Removing vCenter MOB entries for the HX extension.
   - Deleting HX sub-organization and HX VLANs in Cisco UCS Manager.
2. Run HX installer, use the customized version of the installation workflow by selecting the “I know what I am doing” link.


HyperFlex Installer
Workflow
Select a Workflow
Cluster Creation with HyperFlex (FI)
Cluster Creation with HyperFlex Edge
Cluster Expansion
I know what I'm doing, let me customize my workflow
Continue

3. Use customized workflow and only choose the “Run UCS Manager Configuration” option, click Continue.



Select a Workflow

☑ Run UCS Manager Configuration

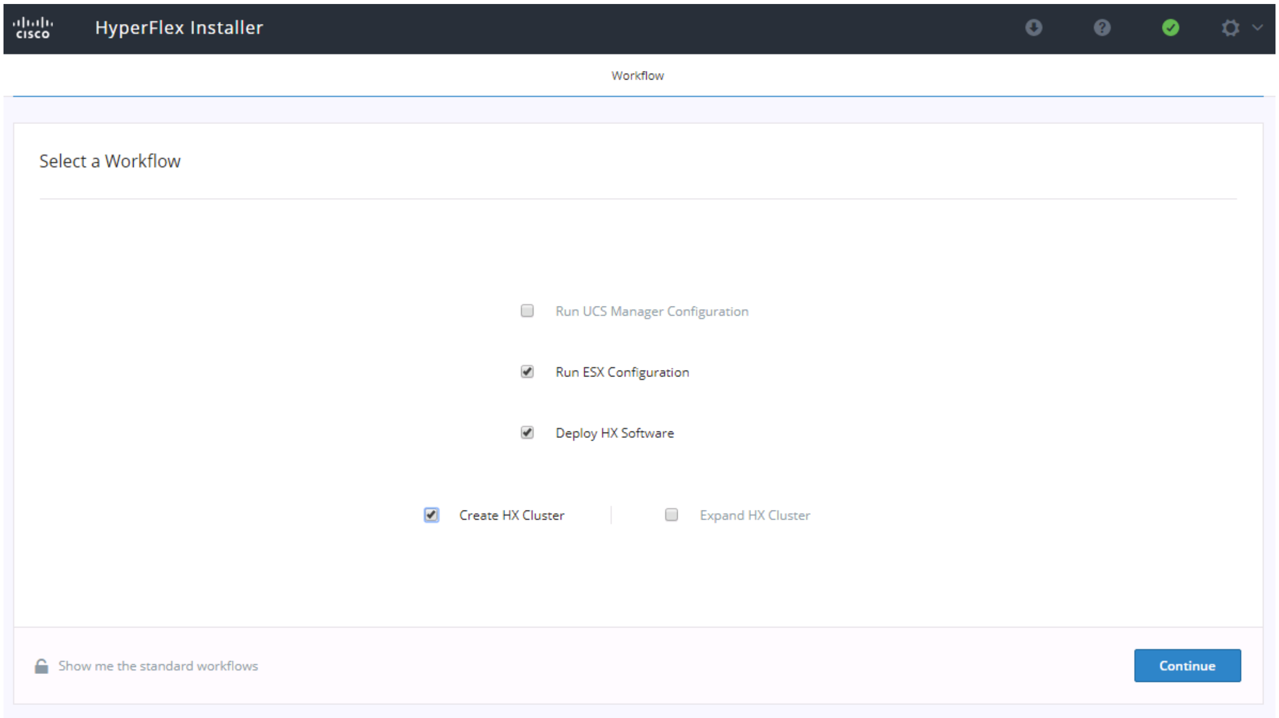
□ Run ESX Configuration

□ Deploy HX Software

□ Create HX Cluster | □ Expand HX Cluster

4. When the Cisco UCS Manager configuration is complete, HX hosts are associated with HX service profiles and powered on. Now perform a fresh ESXi installation using the custom ISO image and following the steps in section Cisco UCS vMedia and Boot Policies.

5. When the ESXi fresh installations are all finished, use the customized workflow and select the remaining 3 options; ESXi Configuration, Deploy HX Software, and Create HX Cluster, to continue and complete the HyperFlex cluster installation.



Select a Workflow

□ Run UCS Manager Configuration

☑ Run ESX Configuration

☑ Deploy HX Software

☑ Create HX Cluster | □ Expand HX Cluster

More information on the various installation methods can be found in the Getting Started Guide.

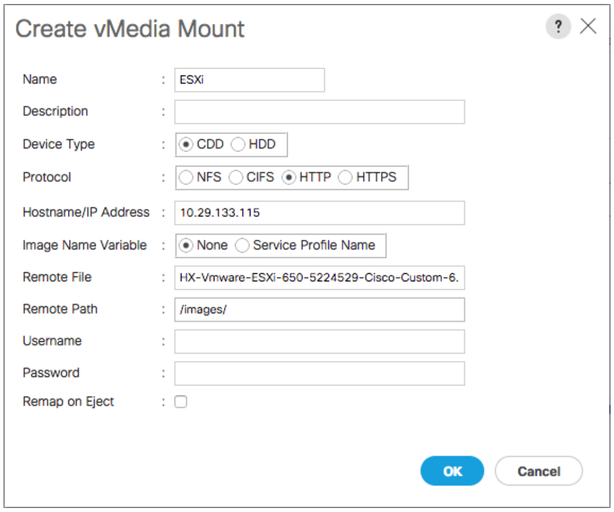
Cisco UCS vMedia and Boot Policies

By using a Cisco UCS vMedia policy, the custom Cisco HyperFlex ESXi installation ISO file can be mounted to all of the HX servers automatically. The existing vMedia policy, named “HyperFlex” must be modified to mount this file, and the boot policy must be modified temporarily to boot from the remotely mounted vMedia file. Once these two tasks are completed, the servers can be rebooted, and they will automatically boot from the remotely mounted vMedia file, installing and configuring ESXi on the servers.

WARNING: While vMedia policies are very efficient for installing multiple servers, using vMedia policies as described could lead to an accidental reinstall of ESXi on any existing server that is rebooted with this policy. Please be certain that the servers being rebooted while the policy is in effect are the servers you wish to reinstall. Even though the custom ISO will not continue without a secondary confirmation, extreme caution is recommended. This procedure needs to be carefully monitored and the boot policy should be changed back to original settings immediately after the intended servers are rebooted, and the ESXi installation begins. Using this policy is only recommended for new installs or rebuilds. Alternatively, you can manually select the boot device using the KVM console during boot, and pressing F6, instead of making the vMedia device the default boot selection.

To configure the Cisco UCS vMedia and Boot Policies, complete the following steps:

1. Copy the ***HX-Vmware-ESXi-650-5224529-Cisco-Custom-6.5.0.3.iso*** file to the HX Installer VM via SCP or SFTP, placing it in the folder /var/www/localhost/images/.
2. In Cisco UCS Manager, click the Servers button on the left-hand side of the screen.
3. Expand Servers > Policies > root > Sub-Organizations > <<HX_ORG>> > vMedia Policies, and click vMedia Policy HyperFlex.
4. In the configuration pane, click Create vMedia Mount.
5. Enter a name for the mount, for example: ESXi.
6. Select the CDD option.
7. Select HTTP as the protocol.
8. Enter the IP address of the HyperFlex installer VM, for example: 10.29.133.115
9. Select None as the Image Variable Name.
10. Enter HX-Vmware-ESXi-650-5224529-Cisco-Custom-6.5.0.3.iso as the Remote File.
11. Enter /images/ as the Remote Path.



Create vMedia Mount

Name	:	ESXi
Description	:	
Device Type	:	● CDD ○ HDD
Protocol	:	○ NFS ○ CIFS ● HTTP ○ HTTPS
Hostname/IP Address	:	10.29.133.115
Image Name Variable	:	● None ○ Service Profile Name
Remote File	:	HX-Vmware-ESXi-650-5224529-Cisco-Custom-6.
Remote Path	:	/images/
Username	:	
Password	:	
Remap on Eject	:	□

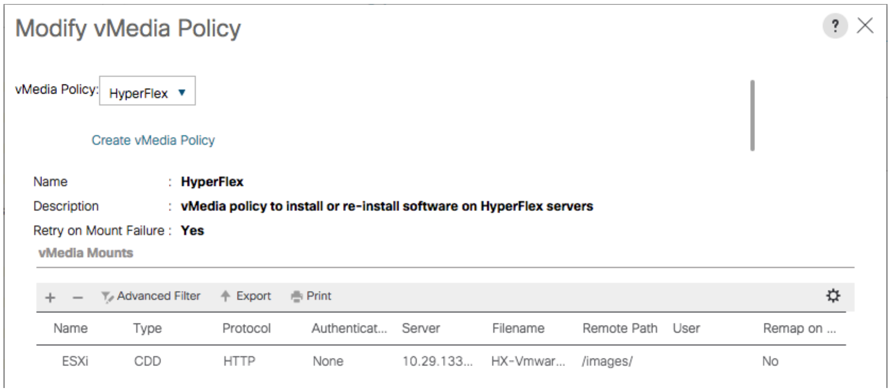
12. Click OK.

13. Select Servers > Service Profile Templates > root > Sub-Organizations > <<HX_ORG>> > Service Template hx-nodes.

14. In the configuration pane, click the vMedia Policy tab.

15. Click Modify vMedia Policy.

16. Chose the HyperFlex vMedia Policy from the drop-down selection and click OK twice.



Modify vMedia Policy

vMedia Policy: HyperFlex ▾

Create vMedia Policy

Name : HyperFlex
Description : vMedia policy to install or re-install software on HyperFlex servers
Retry on Mount Failure : Yes

vMedia Mounts

Name	Type	Protocol	Authenticat...	Server	Filename	Remote Path	User	Remap on ...
ESXi	CDD	HTTP	None	10.29.133...	HX-Vmwar...	/images/		No

17. For Compute-Only nodes (if necessary), select Servers > Service Profile Templates > root > Sub-Organizations > <<HX_ORG>> > Service Template compute-nodes.

18. In the configuration pane, click the vMedia Policy tab.

19. Click Modify vMedia Policy.

20. Chose the HyperFlex vMedia Policy from the drop-down selection and click OK twice.

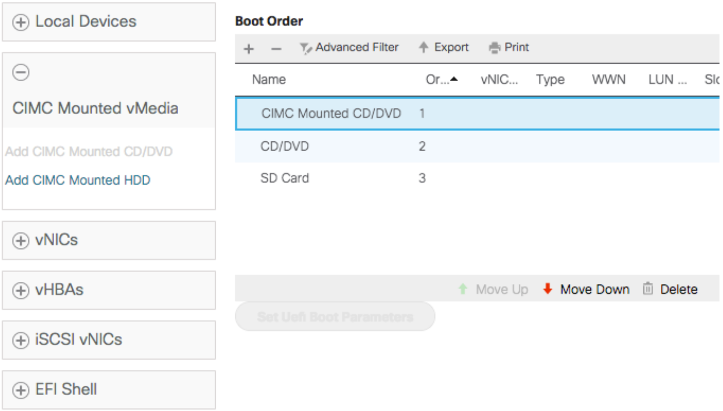
21. Select Servers > Policies > root > Sub-Organizations > <<HX_ORG>> > Boot Policy HyperFlex.

22. In the navigation pane, expand the section titled CIMC Mounted vMedia.

23. Click the entry labeled Add CIMC Mounted CD/DVD.

24. Select the CIMC Mounted CD/DVD entry in the Boot Order list, and click the Move Up button until the CIMC Mounted CD/DVD entry is listed first.

25. Click Save Changes and click OK.



Name	Or...	vNIC...	Type	WWN	LUN ...	Slo
CIMC Mounted CD/DVD	1					
CD/DVD	2					
SD Card	3					

Install ESXi

To begin the installation after modifying the vMedia policy, Boot policy and service profile template, the servers need to be rebooted. To complete the reinstallation, it is necessary to open a remote KVM console session to each server being worked on. To open the KVM console and reboot the servers, complete the following steps:

1. In Cisco UCS Manager, click the Equipment button on the left-hand side.

2. Expand Equipment > Rack mounts > Servers > Server 1.

3. In the configuration pane, click KVM Console.

4. The remote KVM Console window will open in a new browser tab. Click Continue to any security alerts that appear, and click the hyperlink to start the remote KVM session.

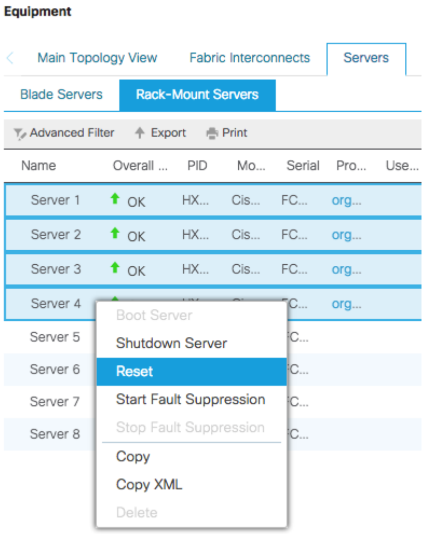
5. Repeat Steps 2-4 for all additional servers whose console you need to monitor during the installation.

6. In Cisco UCS Manager, click the Equipment button on the left-hand side.

7. Expand Equipment > Rack-Mount Servers > Servers.

8. In the configuration pane, click the first server to be rebooted, then shift+click the last server to be re-booted, selecting all of the servers.

9. Right-click the mouse and click Reset.



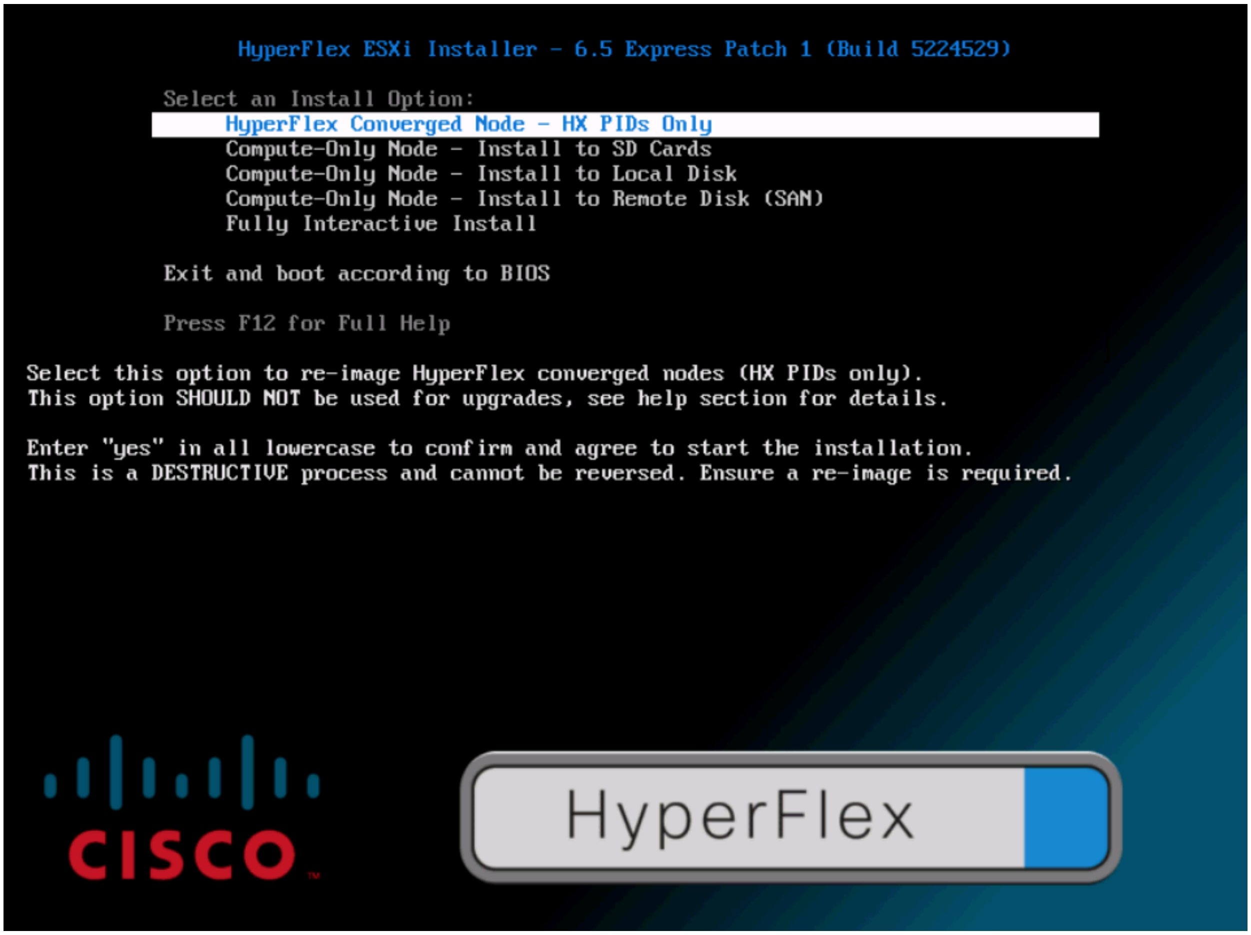
Name	Overall ...	PID	Mo...	Serial	Pro...	Use...
Server 1	↑ OK	HX...	Cis...	FC...	org...	
Server 2	↑ OK	HX...	Cis...	FC...	org...	
Server 3	↑ OK	HX...	Cis...	FC...	org...	
Server 4				C...	org...	
Server 5				C...		
Server 6				C...		
Server 7				C...		
Server 8				C...		

10. Click OK.

11. Select Power Cycle and click OK.

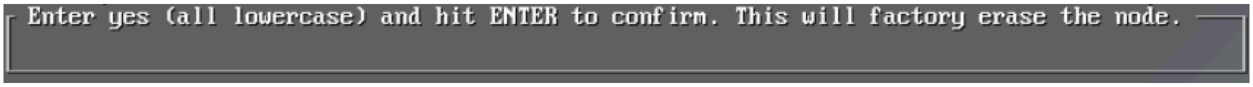
12. Click OK. The servers you are monitoring in the KVM console windows will now immediately reboot, and boot from the remote vMedia mount. Alternatively, the individual KVM consoles can be used to perform a power cycle one-by-one.

13. When the server boots from the installation ISO file, you will see a customized Cisco boot menu. In the Cisco customized installation boot menu, select “HyperFlex Converged Node – HX PIDs Only” and press enter.



```
HyperFlex ESXi Installer - 6.5 Express Patch 1 (Build 5224529)

Select an Install Option:
        HyperFlex Converged Node - HX PIDs Only
        Compute-Only Node - Install to SD Cards
        Compute-Only Node - Install to Local Disk
        Compute-Only Node - Install to Remote Disk (SAN)
        Fully Interactive Install

Exit and boot according to BIOS

Press F12 for Full Help

Select this option to re-image HyperFlex converged nodes (HX PIDs only).
This option SHOULD NOT be used for upgrades, see help section for details.

Enter "yes" in all lowercase to confirm and agree to start the installation.
This is a DESTRUCTIVE process and cannot be reversed. Ensure a re-image is required.
```

14. Enter “yes” in all lowercase to confirm and install ESXi. There may be error messages seen on screen, but they can be safely ignored.



```
Enter yes (all lowercase) and hit ENTER to confirm. This will factory erase the node.
```

15. (Optional) When installing Compute-Only nodes, the appropriate Compute-Only Node option for the boot location to be used should be selected. The “Fully Interactive Install” option should only be used for debugging purposes.

Undo vMedia and Boot Policy Changes

Once all the servers have booted from the remote vMedia file and begun their installation process, the changes to the boot policy need to be quickly undone, to prevent the servers from going into a boot loop, constantly booting from the installation ISO file. To revert the boot policy settings, complete the following steps:

1. Select Servers > Policies > root > Sub-Organizations > <<HX_ORG>> > Boot Policy HyperFlex.

2. Select the CIMC Mounted CD/DVD entry in the Boot Order list, and click Delete.

3. Click Save Changes and click OK.

The changes made to the vMedia policy and service profile template may also be undone once the ESXi installations have all completed fully, or they may be left in place for future installation work.

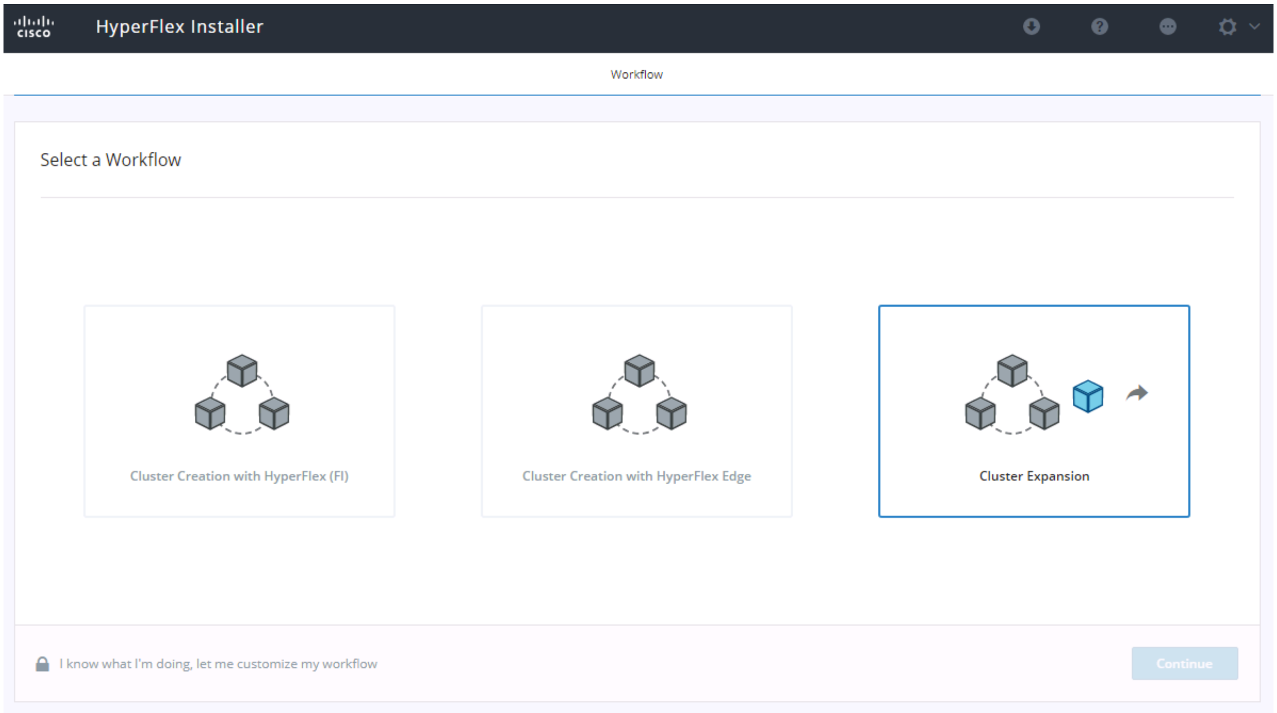
HyperFlex Cluster Expansion

The process to expand a HyperFlex cluster can be used to grow an existing HyperFlex cluster with additional converged storage nodes, or to expand an existing cluster with additional compute-only nodes to create an extended cluster.

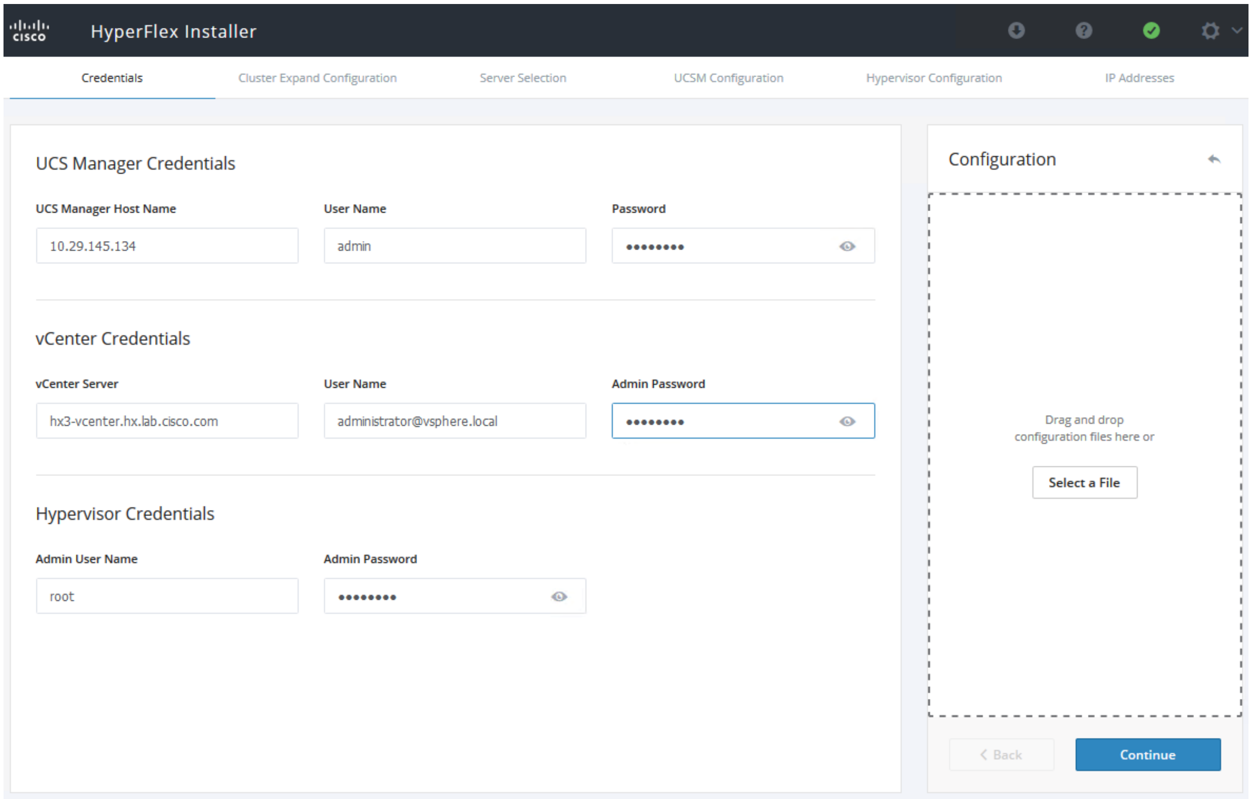
Expansion with Compute-Only Nodes

The HX installer has a wizard for Cluster Expansion with converged nodes and compute-only nodes, however the compute-only node process requires some additional manual steps to install the ESXi hypervisor on the nodes. To expand an existing HyperFlex cluster with compute-only nodes, creating an extended HyperFlex cluster, complete the following steps:

1. On the HyperFlex installer webpage select a Workflow of “Cluster Expansion”.


HyperFlex Installer
Workflow
Select a Workflow
Cluster Creation with HyperFlex (FI)
Cluster Creation with HyperFlex Edge
Cluster Expansion
I know what I'm doing, let me customize my workflow
Continue

2. Enter the Cisco UCS Manager and vCenter DNS hostname or IP address, the admin usernames, and the passwords. The default Hypervisor credential which comes installed from the factory is username: root with a password of “Cisco123” and are already entered in the installer. You can select the option to see the passwords in clear text. Optionally, you can import a JSON file that has the configuration information, except for the appropriate passwords.



UCS Manager Credentials

UCS Manager Host Name: 10.29.145.134

User Name: admin

Password: ••••••••

vCenter Credentials

vCenter Server: hx3-vcenter.hx.lab.cisco.com

User Name: administrator@vsphere.local

Admin Password: ••••••••

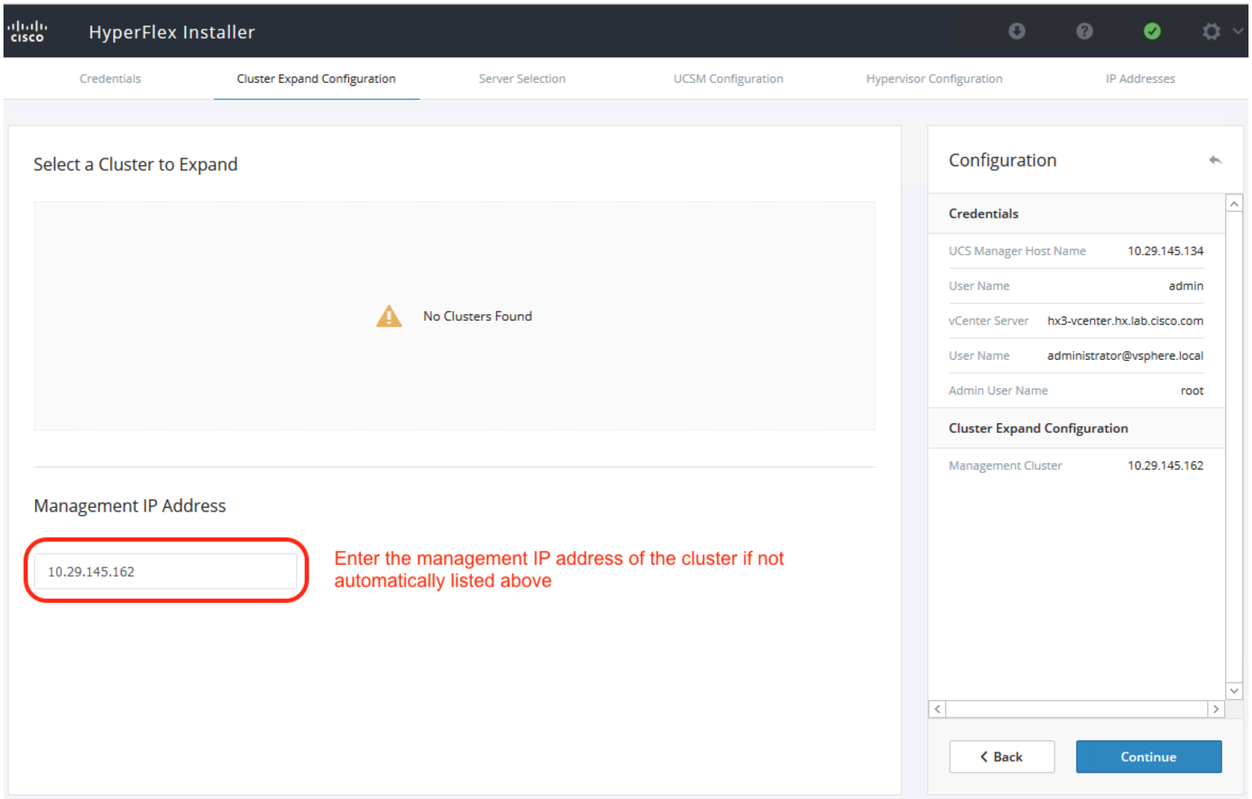
Hypervisor Credentials

Admin User Name: root

Admin Password: ••••••••

3. Click Continue.

4. Select the HX cluster to expand and click Continue. If the installer has been reset and does not show the previously installed cluster, enter the HX cluster management IP address instead.



HyperFlex Installer

Credentials | Cluster Expand Configuration | Server Selection | UCSM Configuration | Hypervisor Configuration | IP Addresses

Select a Cluster to Expand

No Clusters Found

Management IP Address

10.29.145.162

Enter the management IP address of the cluster if not automatically listed above

Configuration

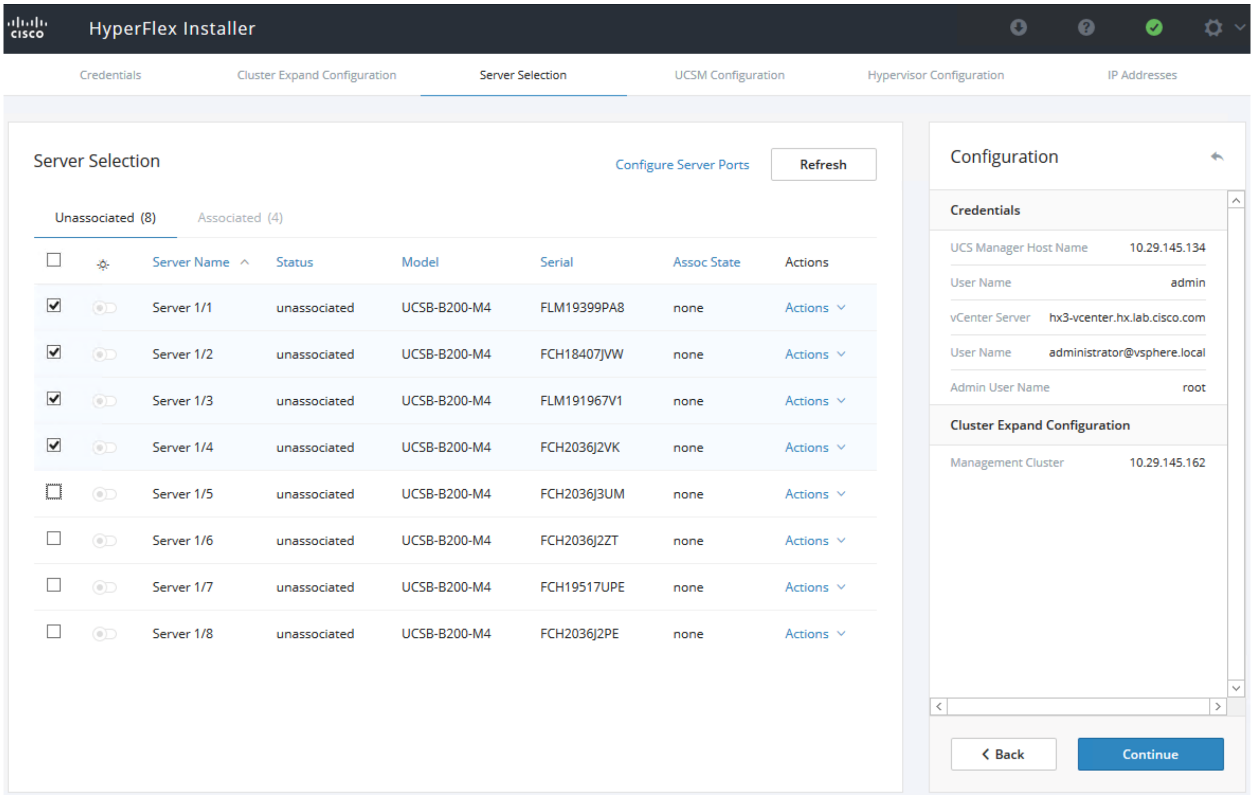
Credentials

UCS Manager Host Name	10.29.145.134
User Name	admin
vCenter Server	hx3-vcenter.hx.lab.cisco.com
User Name	administrator@vsphere.local
Admin User Name	root

Cluster Expand Configuration

Management Cluster	10.29.145.162

5. From the list of unassociated servers, select the blade or rack mount servers you wish to add to the cluster as compute-only nodes, then click Continue.



HyperFlex Installer

Credentials | Cluster Expand Configuration | Server Selection | UCSM Configuration | Hypervisor Configuration | IP Addresses

Server Selection

Unassociated (8) Associated (4)

☐		Server Name	Status	Model	Serial	Assoc State	Actions
☑		Server 1/1	unassociated	UCSB-B200-M4	FLM19399PA8	none	Actions
☑		Server 1/2	unassociated	UCSB-B200-M4	FCH18407JVW	none	Actions
☑		Server 1/3	unassociated	UCSB-B200-M4	FLM191967V1	none	Actions
☑		Server 1/4	unassociated	UCSB-B200-M4	FCH2036J2VK	none	Actions
☐		Server 1/5	unassociated	UCSB-B200-M4	FCH2036J3UM	none	Actions
☐		Server 1/6	unassociated	UCSB-B200-M4	FCH2036J2ZT	none	Actions
☐		Server 1/7	unassociated	UCSB-B200-M4	FCH19517UPE	none	Actions
☐		Server 1/8	unassociated	UCSB-B200-M4	FCH2036J2PE	none	Actions

Configuration

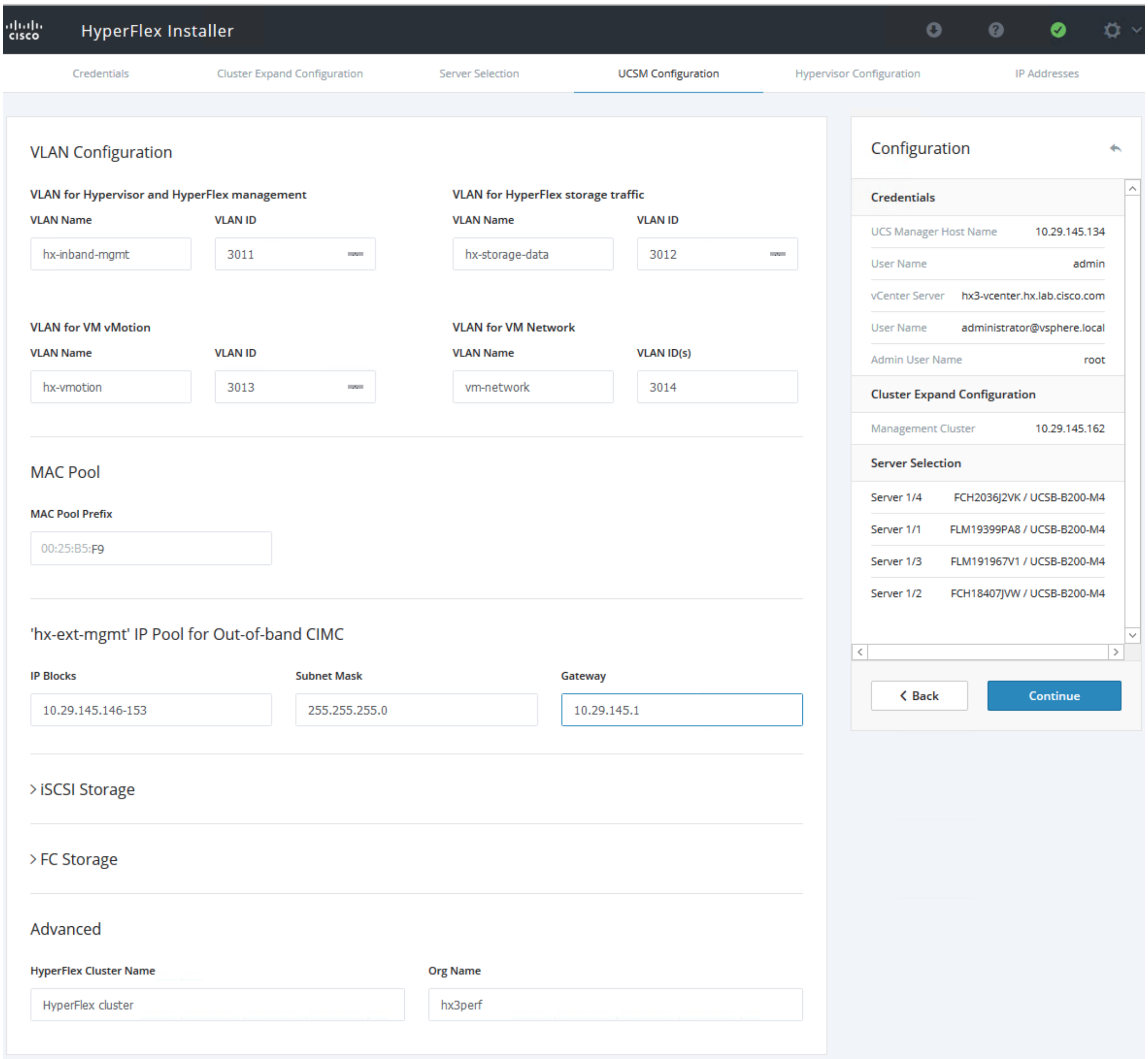
Credentials

UCS Manager Host Name	10.29.145.134
User Name	admin
vCenter Server	hx3-vcenter.hx.lab.cisco.com
User Name	administrator@vsphere.local
Admin User Name	root

Cluster Expand Configuration

Management Cluster	10.29.145.162

6. On the Cisco UCS Manager Configuration page, enter the VLAN settings, Mac Pool Prefix, UCS hx-ext-mgmt IP Pool for CIMC, iSCSI Storage setting, FC Storage setting, and sub-organization name, making sure that all the values match the existing settings for the cluster being expanded.



VLAN Configuration

VLAN for Hypervisor and HyperFlex management

VLAN Name	VLAN ID
hx-inband-mgmt	3011

VLAN for HyperFlex storage traffic

VLAN Name	VLAN ID
hx-storage-data	3012

VLAN for VM vMotion

VLAN Name	VLAN ID
hx-vmotion	3013

VLAN for VM Network

VLAN Name	VLAN ID(s)
vm-network	3014

MAC Pool

MAC Pool Prefix: 00:25:B5:F9

'hx-ext-mgmt' IP Pool for Out-of-band CIMC

IP Blocks	Subnet Mask	Gateway
10.29.145.146-153	255.255.255.0	10.29.145.1

› iSCSI Storage

› FC Storage

Advanced

HyperFlex Cluster Name	Org Name
HyperFlex cluster	hx3perf

Configuration

Credentials

UCS Manager Host Name	10.29.145.134
User Name	admin
vCenter Server	hx3-vcenter.hx.lab.cisco.com
User Name	administrator@vsphere.local
Admin User Name	root

Cluster Expand Configuration

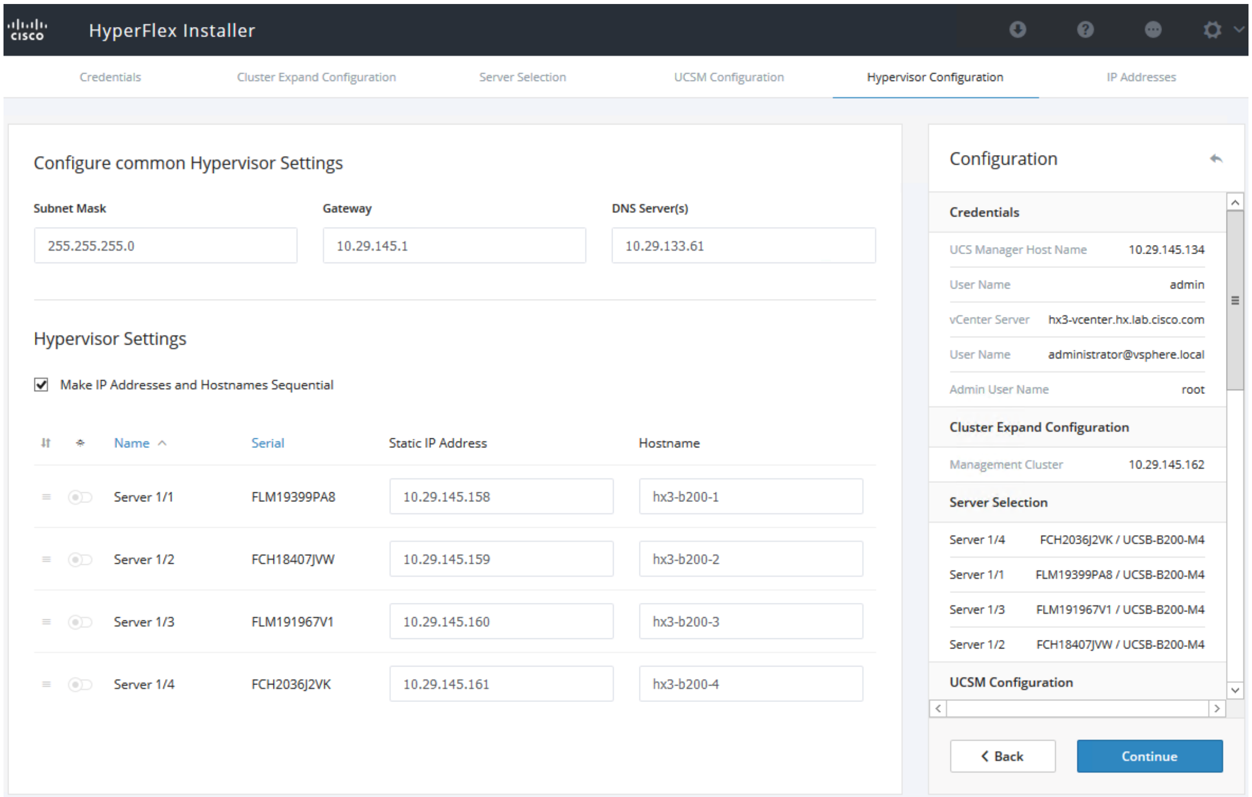
Management Cluster	10.29.145.162

Server Selection

Server 1/4	FCH2036J2VK / UCSB-B200-M4
Server 1/1	FLM19399PA8 / UCSB-B200-M4
Server 1/3	FLM191967V1 / UCSB-B200-M4
Server 1/2	FCH18407JVW / UCSB-B200-M4

7. Click Continue.

8. Enter the subnet mask, gateway, DNS, and IP addresses for the Hypervisors (ESXi hosts) as well as host names. The IPs will be assigned through Cisco UCS Manager to the new ESXi hosts.



Configure common Hypervisor Settings

Subnet Mask	Gateway	DNS Server(s)
255.255.255.0	10.29.145.1	10.29.133.61

Hypervisor Settings

☑ Make IP Addresses and Hostnames Sequential

Name	Serial	Static IP Address	Hostname
Server 1/1	FLM19399PA8	10.29.145.158	hx3-b200-1
Server 1/2	FCH18407JVW	10.29.145.159	hx3-b200-2
Server 1/3	FLM191967V1	10.29.145.160	hx3-b200-3
Server 1/4	FCH2036J2VK	10.29.145.161	hx3-b200-4

Configuration

Credentials	
UCS Manager Host Name	10.29.145.134
User Name	admin
vCenter Server	hx3-vcenter.hx.lab.cisco.com
User Name	administrator@vsphere.local
Admin User Name	root
Cluster Expand Configuration	
Management Cluster	10.29.145.162
Server Selection	
Server 1/4	FCH2036J2VK / UCSB-B200-M4
Server 1/1	FLM19399PA8 / UCSB-B200-M4
Server 1/3	FLM191967V1 / UCSB-B200-M4
Server 1/2	FCH18407JVW / UCSB-B200-M4
UCSM Configuration	

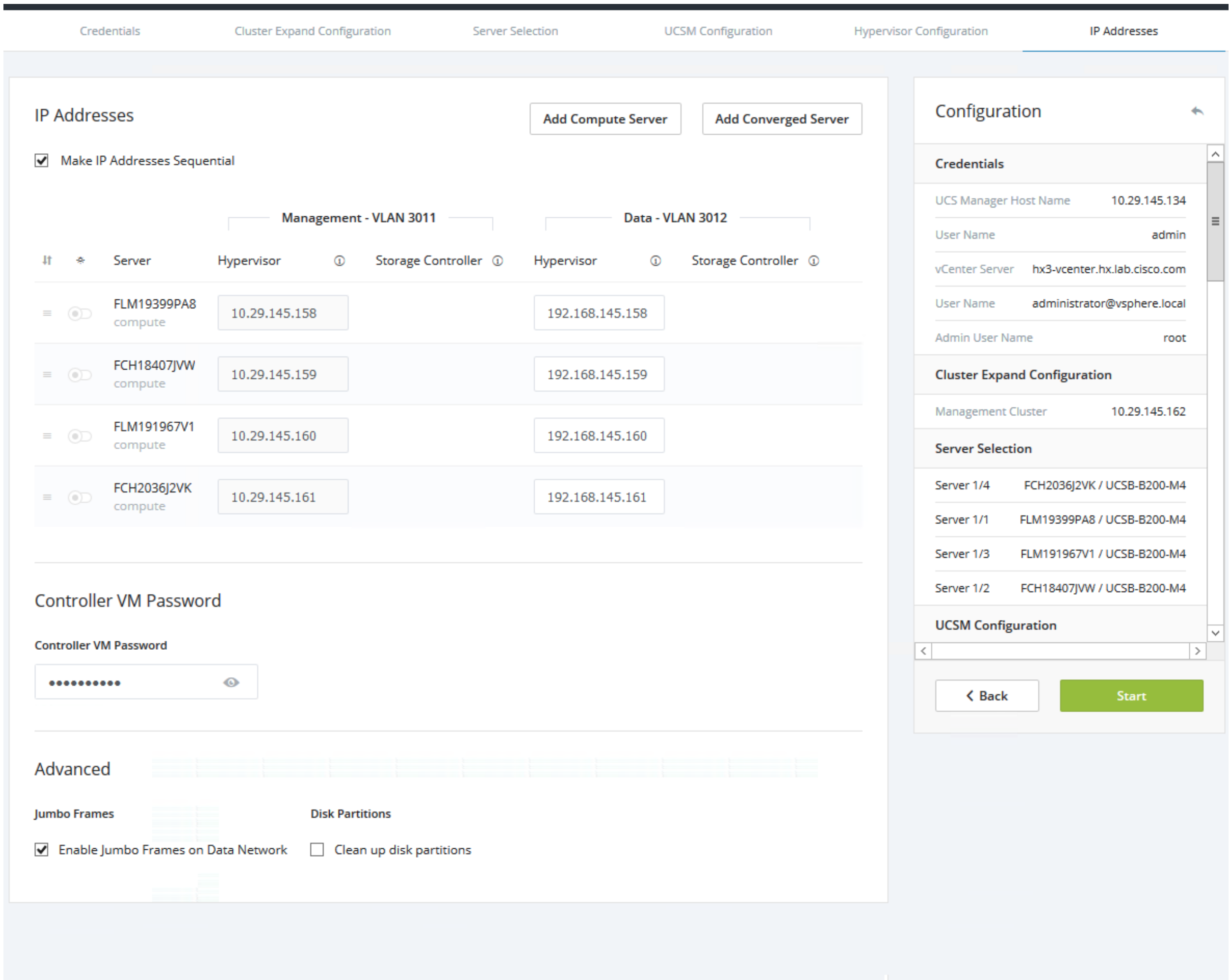
9. Click Continue.

10. Enter the additional IP addresses for the Hypervisor Data network of the new ESXi hosts.

11. Enter the current password that is set on the Controller VMs.

12. Enable Jumbo Frames. Since compute-only nodes have no local storage disks, you do not need to select Clean up disk partitions.

13. (Optional) At this step you can manually add more servers for expansion if these servers already have service profiles associated and the hypervisor is ready, by clicking on Add Compute Server or Add Converged Server and then entering the IP addresses for the storage controller management and data networks.



IP Addresses

☑ Make IP Addresses Sequential

Server	Management - VLAN 3011 Hypervisor	Management - VLAN 3011 Storage Controller	Data - VLAN 3012 Hypervisor	Data - VLAN 3012 Storage Controller
FLM19399PA8 compute	10.29.145.158		192.168.145.158	
FCH18407JVW compute	10.29.145.159		192.168.145.159	
FLM191967V1 compute	10.29.145.160		192.168.145.160	
FCH2036J2VK compute	10.29.145.161		192.168.145.161	

Controller VM Password

Controller VM Password: ••••••••••

Advanced

Jumbo Frames

☑ Enable Jumbo Frames on Data Network

Disk Partitions

☐ Clean up disk partitions

Configuration

Credentials

UCS Manager Host Name	10.29.145.134
User Name	admin
vCenter Server	hx3-vcenter.hx.lab.cisco.com
User Name	administrator@vsphere.local
Admin User Name	root

Cluster Expand Configuration

Management Cluster	10.29.145.162

Server Selection

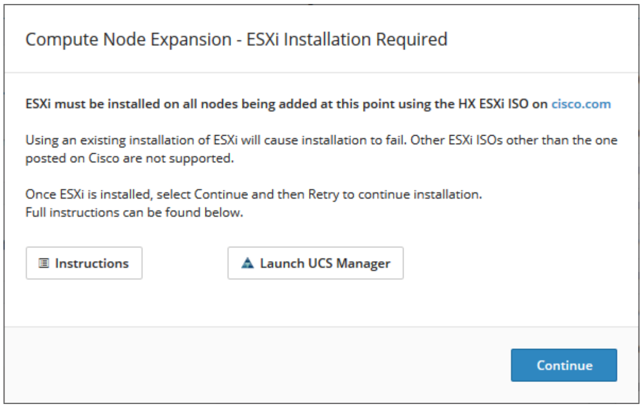
Server 1/4	FCH2036J2VK / UCSB-B200-M4
Server 1/1	FLM19399PA8 / UCSB-B200-M4
Server 1/3	FLM191967V1 / UCSB-B200-M4
Server 1/2	FCH18407JVW / UCSB-B200-M4

UCSM Configuration

14. Click Start.

15. Validation of the configuration will now start. After validation, the installer will create the compute-only node service profiles and associate them with the selected servers. Once the service profiles are associated, the installer will move on to the Hypervisor Configuration step and display an error. The error shown alerts you to the need to install the ESXi hypervisor onto the compute-only nodes. The following steps show how to install ESXi onto the new compute-only nodes.

16. Click the Instructions button to see the steps in a PDF document. If necessary, click the Launch UCS Manager button to log in to Cisco UCS Manager in another browser tab. Do not click Continue at this time.



Compute Node Expansion - ESXi Installation Required

ESXi must be installed on all nodes being added at this point using the HX ESXi ISO on cisco.com

Using an existing installation of ESXi will cause installation to fail. Other ESXi ISOs other than the one posted on Cisco are not supported.

Once ESXi is installed, select Continue and then Retry to continue installation.
Full instructions can be found below.

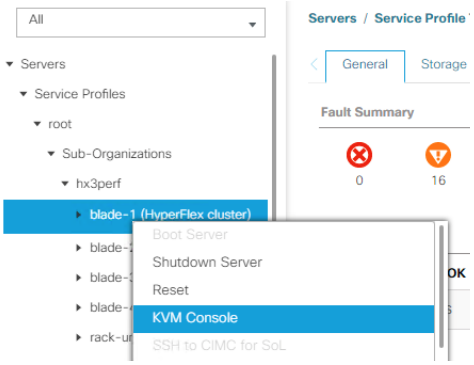
Instructions | Launch UCS Manager

Continue

17. In Cisco UCS Manager, click the Servers button on the left-hand side.

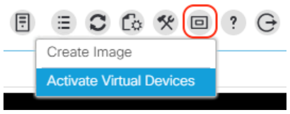
18. Expand Servers > Service Profiles > root > Sub-Organizations > <<HX_ORG>>.

19. Each new compute-only node will have a new service profile, for example: blade-1. Right-click the new service profile and click KVM Console. The remote KVM console will open in a new browser tab. Accept any SSL errors or alerts, then click the link to launch the KVM console.

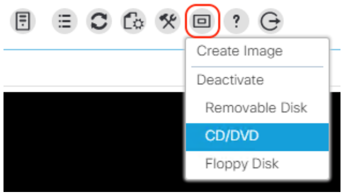


20. Repeat step 19 for each new service profile, that is associated with the new compute-only nodes.

21. In the remote KVM tab, click the Virtual Media button in the top right-hand corner of the screen, then click Activate Virtual Devices.

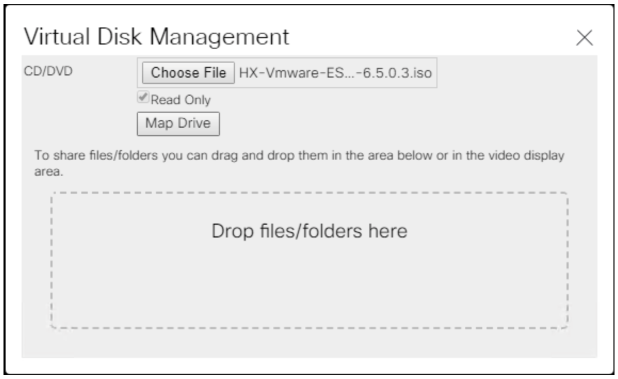


22. In the remote KVM tab, click the Virtual Media button in the top right-hand corner of the screen, then click the CD/DVD option.



23. Click Choose File, browse for the Cisco custom ESXi ISO installer file, and click Open.

24. Click Map Drive.



Virtual Disk Management

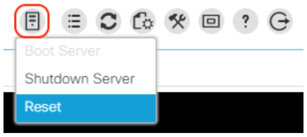
CD/DVD

To share files/folders you can drag and drop them in the area below or in the video display area.

Drop files/folders here

25. Repeat steps 21-24 for all the new compute-only nodes.

26. In the remote KVM tab, click the Server Actions button in the top right-hand corner of the screen, the click Reset.

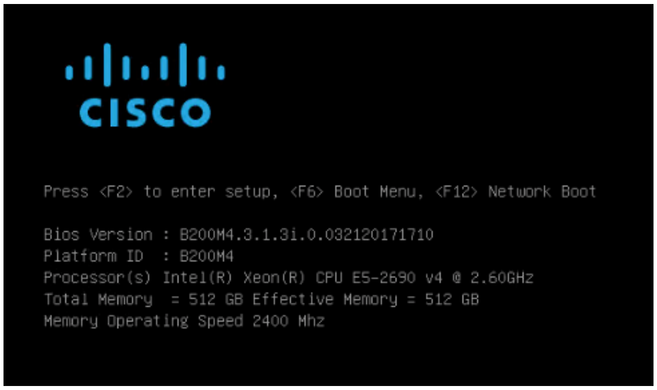


27. Click OK.

28. Choose the Power Cycle option, then click OK.

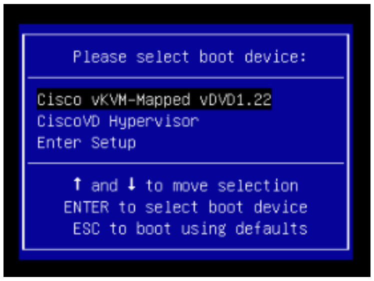
29. Click OK.

30. Observe the server going through the POST process until the following screen is seen. When it appears, press the F6 key to enter into the boot device selection menu.



```
Press <F2> to enter setup, <F6> Boot Menu, <F12> Network Boot

Bios Version : B200M4.3.1.3i.0.032120171710
Platform ID  : B200M4
Processor(s) Intel(R) Xeon(R) CPU E5-2690 v4 @ 2.60GHz
Total Memory  = 512 GB Effective Memory = 512 GB
Memory Operating Speed 2400 Mhz
```

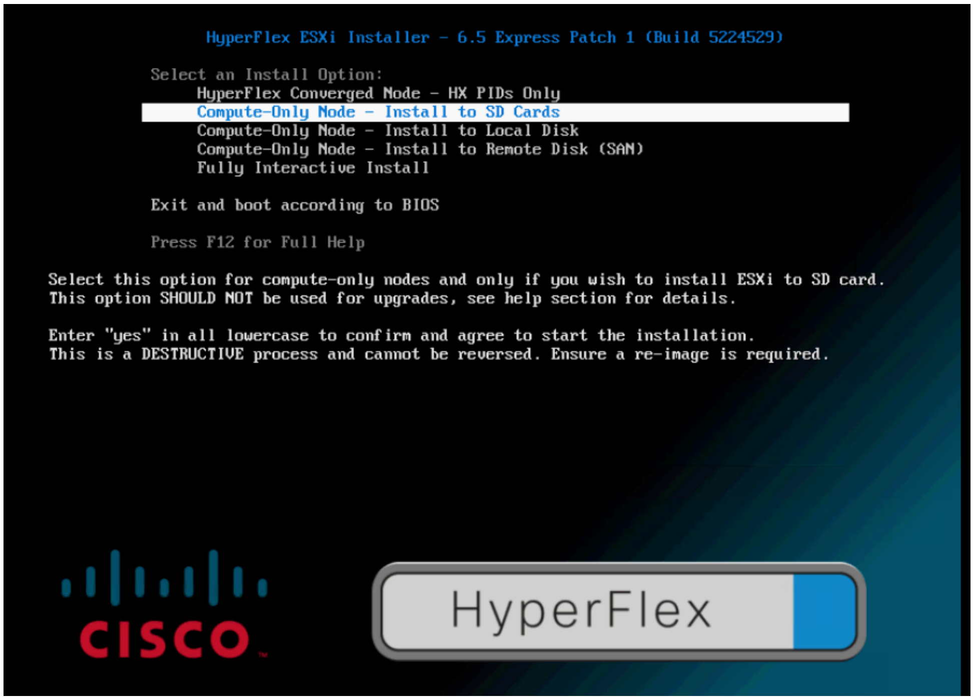
31. Select Cisco vKVM-mapped vDVD1.22, then press Enter.



```
Please select boot device:

Cisco vKVM-Mapped vDVD1.22
CiscoVD Hypervisor
Enter Setup

↑ and ↓ to move selection
ENTER to select boot device
ESC to boot using defaults
```

32. The server will boot from the remote KVM mapped ESXi ISO installer and display the following screen:

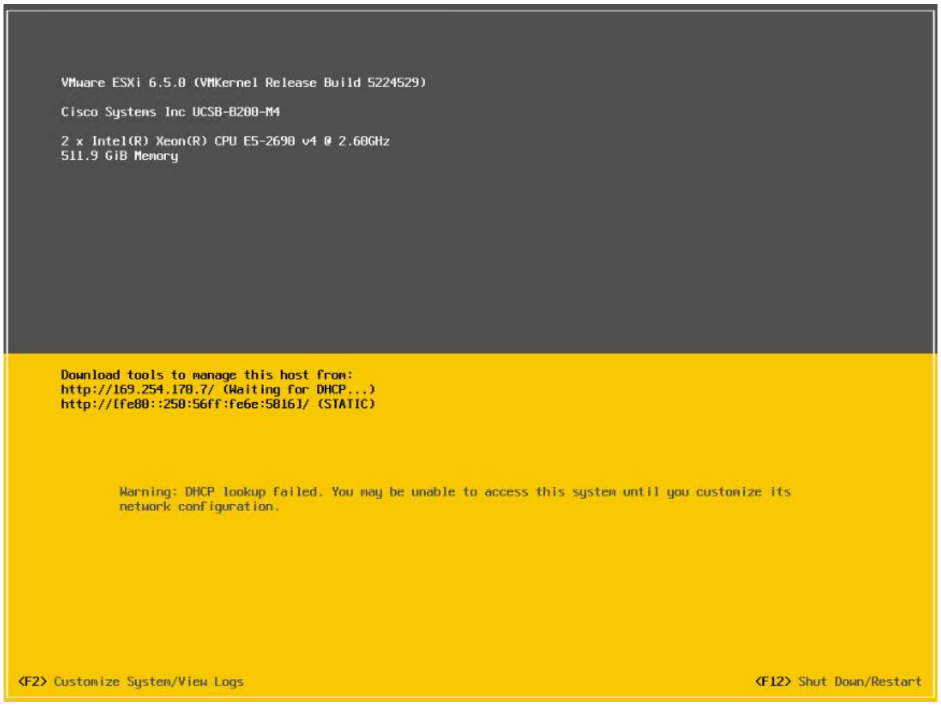
33. Select the appropriate installation option for the compute-only node you are installing, either installing to SD cards, local disks, or booting from SAN, then press Enter.



```
                HyperFlex ESXi Installer - 6.5 Express Patch 1 (Build 5224529)

          Select an Install Option:
              HyperFlex Converged Node - HX PIDs Only
              Compute-Only Node - Install to SD Cards
              Compute-Only Node - Install to Local Disk
              Compute-Only Node - Install to Remote Disk (SAN)
              Fully Interactive Install

          Exit and boot according to BIOS

          Press F12 for Full Help

   Select this option for compute-only nodes and only if you wish to install ESXi to SD card.
   This option SHOULD NOT be used for upgrades, see help section for details.

   Enter "yes" in all lowercase to confirm and agree to start the installation.
   This is a DESTRUCTIVE process and cannot be reversed. Ensure a re-image is required.
```

34. Type “yes” and press Enter to accept the warning and continue the installation.

35. The ESXi installer will now automatically perform the installation to the boot media. As you watch the process, some errors may be seen, but they can be ignored. Once the new server has completed the ESXi installation, it will be waiting at the console status screen seen below.

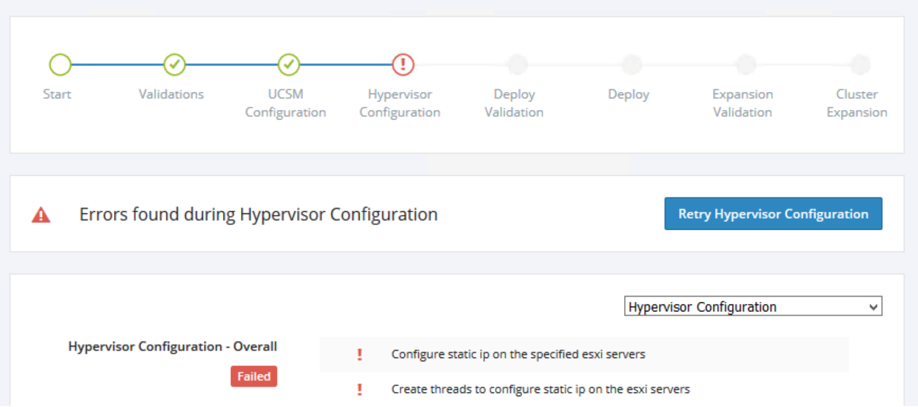


```
VMware ESXi 6.5.0 (VMKernel Release Build 5224529)

Cisco Systems Inc UCSB-B200-M4

2 x Intel(R) Xeon(R) CPU E5-2690 v4 @ 2.60GHz
511.9 GiB Memory

Download tools to manage this host from:
http://169.254.170.7/ (Waiting for DHCP...)
http://[fe80::250:56ff:fe6e:5816]/ (STATIC)

        Warning: DHCP lookup failed. You may be unable to access this system until you customize its
        network configuration.

<F2> Customize System/View Logs                                                    <F12> Shut Down/Restart
```

36. Repeat steps 26-35 for all the additional new compute-only nodes being added to the HX cluster.

37. Once all the new nodes have finished their fresh ESXi installations, return to the HX installer, where the error in step 15 was seen. Click Continue.

38. Click Retry Hypervisor Configuration.



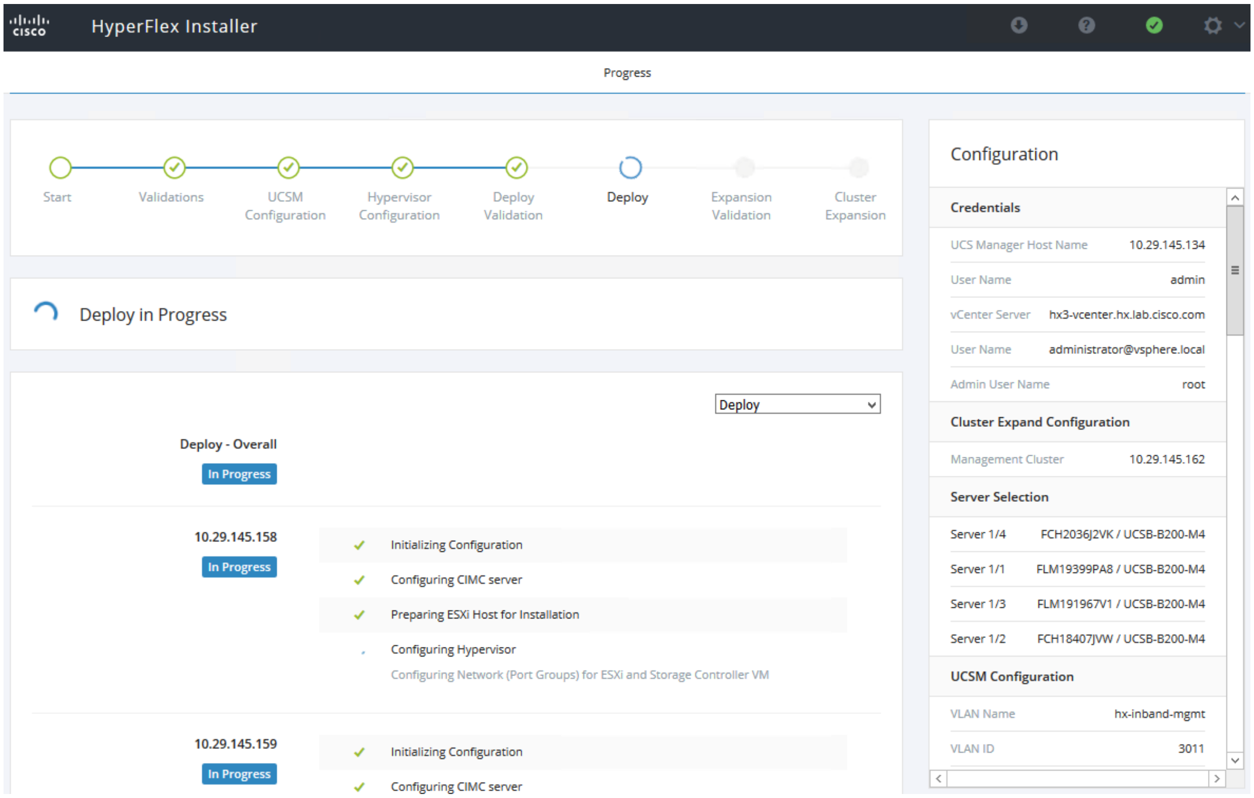
Errors found during Hypervisor Configuration

Hypervisor Configuration - Overall
Failed

! Configure static ip on the specified esxi servers

! Create threads to configure static ip on the esxi servers

39. The HX installer will now proceed to complete the deployment and perform all the steps listed at the top of the screen along with their status.



Deploy in Progress

Deploy - Overall
In Progress

10.29.145.158
In Progress

- ✓ Initializing Configuration
- ✓ Configuring CIMC server
- ✓ Preparing ESXi Host for Installation
- Configuring Hypervisor
  Configuring Network (Port Groups) for ESXi and Storage Controller VM

10.29.145.159
In Progress

- ✓ Initializing Configuration
- ✓ Configuring CIMC server

Configuration

Credentials

UCS Manager Host Name	10.29.145.134
User Name	admin
vCenter Server	hx3-vcenter.hx.lab.cisco.com
User Name	administrator@vsphere.local
Admin User Name	root

Cluster Expand Configuration

Management Cluster	10.29.145.162

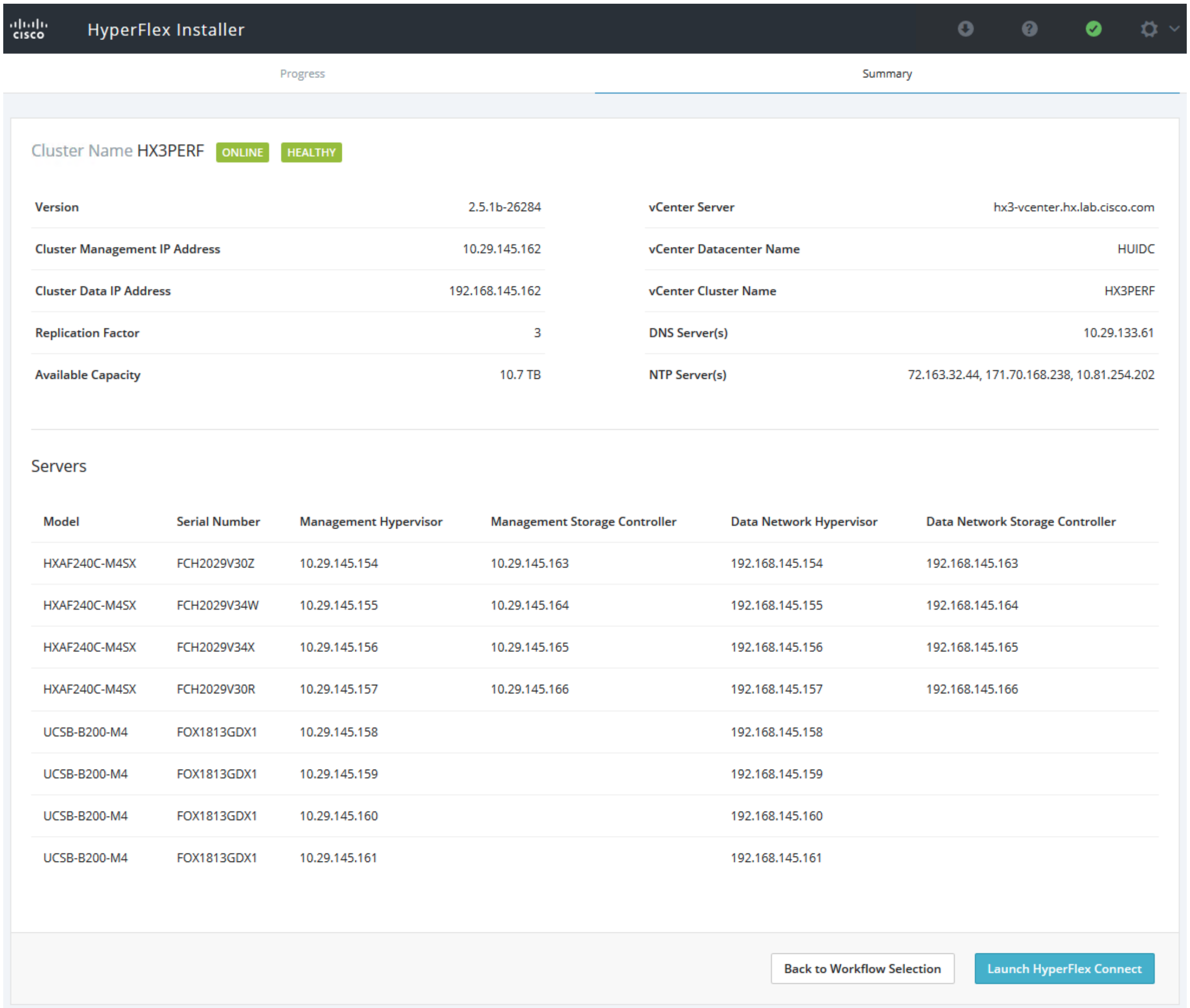
Server Selection

Server 1/4	FCH2036J2VK / UCSB-B200-M4
Server 1/1	FLM19399PA8 / UCSB-B200-M4
Server 1/3	FLM191967V1 / UCSB-B200-M4
Server 1/2	FCH18407JVW / UCSB-B200-M4

UCSM Configuration

VLAN Name	hx-inband-mgmt
VLAN ID	3011

40. When the expansion is completed, a summary screen showing the status of the expanded cluster and the expansion operation is shown.



Cluster Name HX3PERF ONLINE HEALTHY

Version	2.5.1b-26284	vCenter Server	hx3-vcenter.hx.lab.cisco.com
Cluster Management IP Address	10.29.145.162	vCenter Datacenter Name	HUIDC
Cluster Data IP Address	192.168.145.162	vCenter Cluster Name	HX3PERF
Replication Factor	3	DNS Server(s)	10.29.133.61
Available Capacity	10.7 TB	NTP Server(s)	72.163.32.44, 171.70.168.238, 10.81.254.202

Servers

Model	Serial Number	Management Hypervisor	Management Storage Controller	Data Network Hypervisor	Data Network Storage Controller
HXAF240C-M4SX	FCH2029V30Z	10.29.145.154	10.29.145.163	192.168.145.154	192.168.145.163
HXAF240C-M4SX	FCH2029V34W	10.29.145.155	10.29.145.164	192.168.145.155	192.168.145.164
HXAF240C-M4SX	FCH2029V34X	10.29.145.156	10.29.145.165	192.168.145.156	192.168.145.165
HXAF240C-M4SX	FCH2029V30R	10.29.145.157	10.29.145.166	192.168.145.157	192.168.145.166
UCSB-B200-M4	FOX1813GDX1	10.29.145.158		192.168.145.158	
UCSB-B200-M4	FOX1813GDX1	10.29.145.159		192.168.145.159	
UCSB-B200-M4	FOX1813GDX1	10.29.145.160		192.168.145.160	
UCSB-B200-M4	FOX1813GDX1	10.29.145.161		192.168.145.161	

After the install has completed, the compute-only nodes are added to the cluster and now have access to the existing HX datastores, but some manual post installation steps are required. Most steps can be done by running the post_install script from the HX Installer VM, similar to when performing a new installation, or via a custom script. A list of additional configuration steps necessary includes:

- Disable SSH warning
- Creation of the guest VM port groups
- Creation of the vMotion vmkernel port
- Syslog Server Configuration

Note: If at a later time the post_install script needs to be run against a specific HX cluster, the cluster can be specified by using the --cluster-ip switch, and entering the cluster's management IP address.

Example: PowerCLI script to complete tasks on the ESXi host.

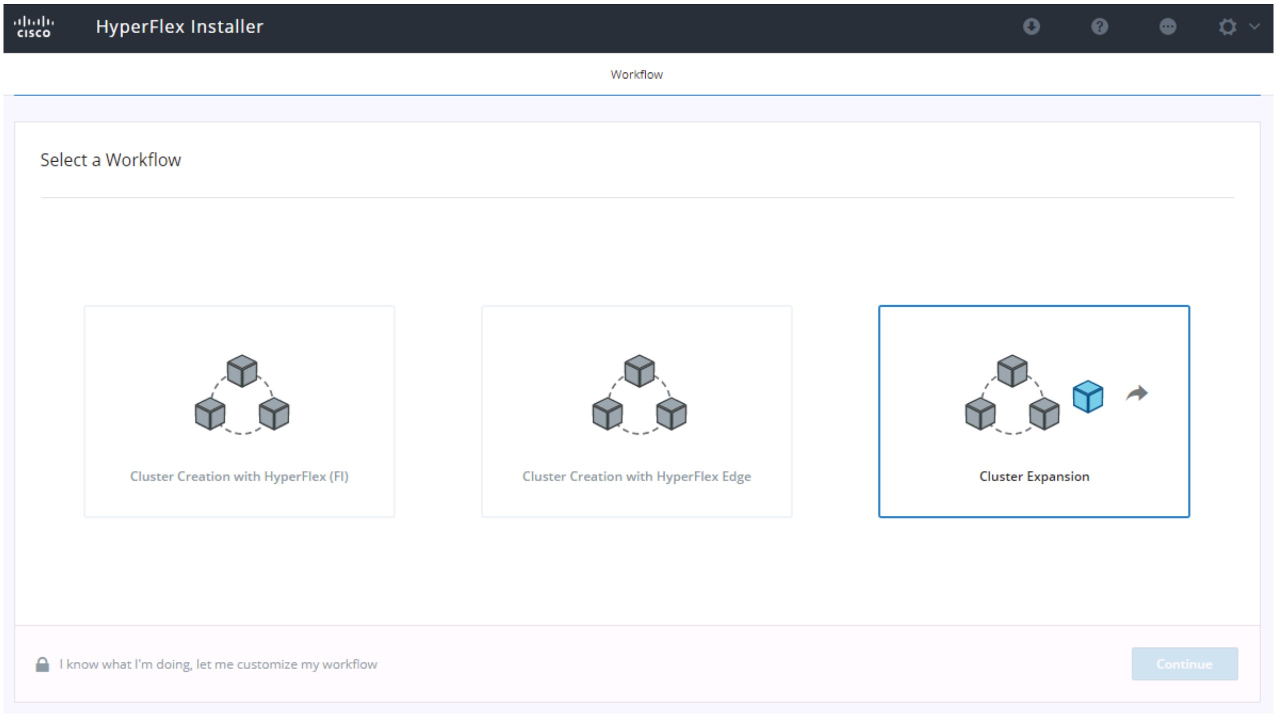
```
# Configure_ESXi_post_install.ps1
# Description: Configures ESXi options and settings after HyperFlex installation.
# Usage: Modify the variables to specify the ESXi root password, the servers to be
# configured, the guest VLAN ID, and the IP addresses used for the vMotion VMkernel
# interfaces.
#
Set-PowerCLIConfiguration -InvalidCertificateAction Ignore -Confirm:$false | Out-Null
$domainname ="hx.lab.cisco.com"
$rootpw = "Cisco123"
$servers="hx220-01.hx.lab.cisco.com","hx220-02.hx.lab.cisco.com","hx220-
03.hx.lab.cisco.com","hx220-04.hx.lab.cisco.com","hx220-05.hx.lab.cisco.com","hx220-
06.hx.lab.cisco.com","hx220-07.hx.lab.cisco.com","hx220-08.hx.lab.cisco.com"
$ip=11

Foreach ($server in $servers) {

# connect to the ESXi host server
Connect-VIServer -server $server -user root -password $rootpw
$vmhost = Get-VMHost -Name $server

#disable shell warning
$vmhost | Set-VMHostAdvancedConfiguration UserVars.SuppressShellWarning 1

#configure syslog traffic to send to vCenter or syslog server
Set-VMHostSysLogServer -SysLogServer '10.29.133.63:514' -VMHost $vmhost

# retrieve the virtual switch configurations
$vswitch2 =  Get-VirtualSwitch -VMHost $vmhost -Name vswitch-hx-vm-network
$vswitch3 =  Get-VirtualSwitch -VMHost $vmhost -Name vmotion

# create a port group for the guest VMs
New-VirtualPortGroup -VirtualSwitch $vswitch2 -Name "VM-Network" -VLanID 100

# create the vmotion port group and VMkernel interface
$vmip="192.168.233."+$ip
New-VMHostNetworkAdapter -VMHost $vmhost -VirtualSwitch $vswitch3 -PortGroup "vmotion" -Mtu 9000
-VMotionEnabled $true -IP $vmip -SubnetMask 255.255.255.0 -Confirm:$false
$ip=$ip+1

Disconnect-VIServer -server $server -Confirm:$false
}
```

To validate our configuration, vMotion a VM to the new compute-only node. You can validate your VM is now running on the compute only node through the Summary tab of the VM.

Expansion with Converged Nodes

The HX installer has a wizard for Cluster Expansion with Converged Nodes. This procedure is very similar to the initial HyperFlex cluster setup. The following process assumes a new Cisco HX node has been ordered, therefore it is pre-configured from the factory with the proper hardware, firmware, and ESXi hypervisor installed. To add converged storage nodes to an existing HyperFlex cluster, complete the following steps:

1. On the HyperFlex installer webpage select a Workflow of “Cluster Expansion”.


HyperFlex Installer
Workflow
Cluster Creation with HyperFlex (FI)
Cluster Creation with HyperFlex Edge
Cluster Expansion
Continue

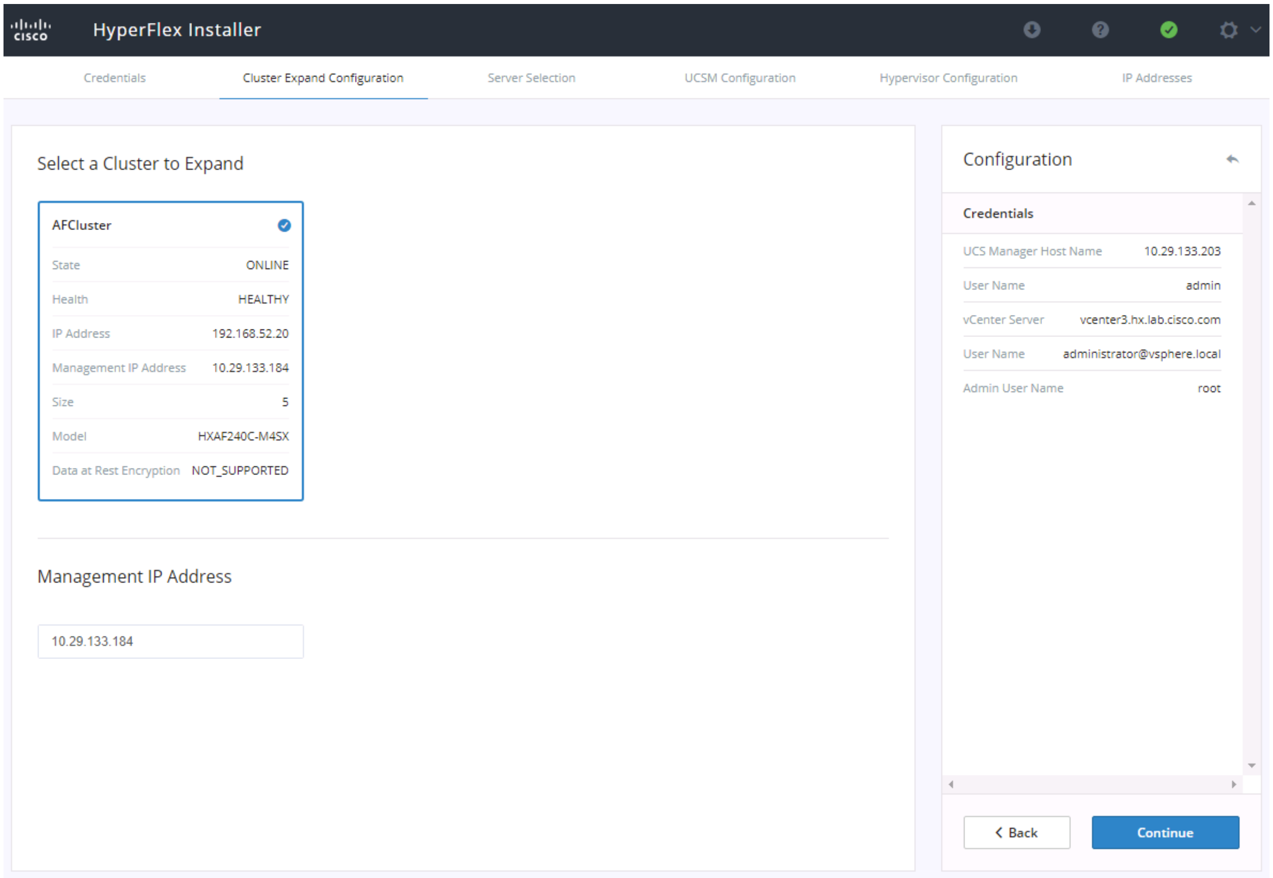
Select a Workflow

I know what I'm doing, let me customize my workflow

2. Enter the Cisco UCS Manager and vCenter DNS hostname or IP address, the admin usernames, and the passwords. The default Hypervisor credential which comes installed from the factory is username: root with a password of “Cisco123” and are already entered in the installer. You can select the option to see the passwords in clear text. Optionally, you can import a JSON file that has the configuration information, except for the appropriate passwords.

3. Click Continue.

4. Select the HX cluster to expand and click Continue. If the installer has been reset and does not show the previously installed cluster, enter the HX cluster management IP address instead.



HyperFlex Installer

Select a Cluster to Expand

AFCluster

State	ONLINE
Health	HEALTHY
IP Address	192.168.52.20
Management IP Address	10.29.133.184
Size	5
Model	HXAF240C-M4SX
Data at Rest Encryption	NOT_SUPPORTED

Management IP Address

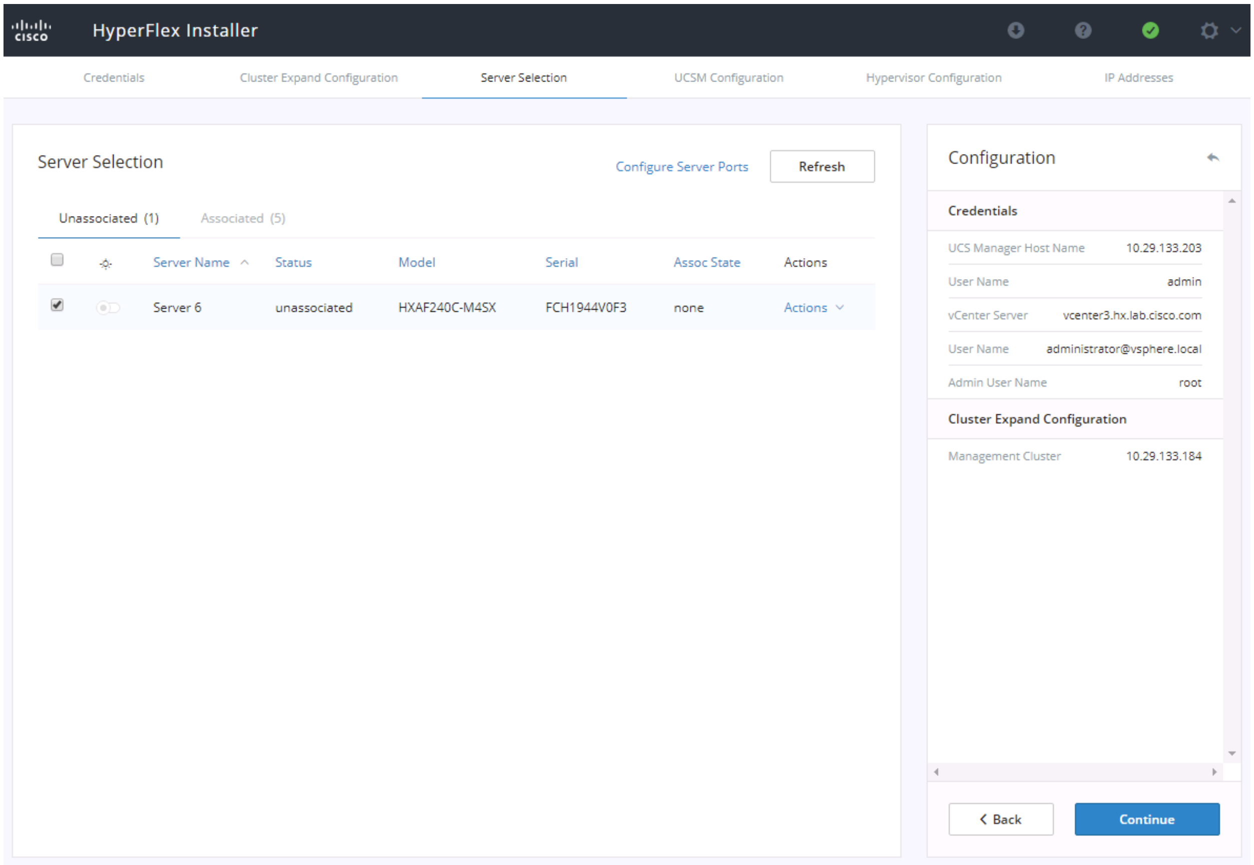
10.29.133.184

Configuration

Credentials

UCS Manager Host Name	10.29.133.203
User Name	admin
vCenter Server	vcenter3.hx.lab.cisco.com
User Name	administrator@vsphere.local
Admin User Name	root

5. Select the unassociated HX servers you want to add to the existing HX cluster. Click Continue.



Server Selection

□		Server Name	Status	Model	Serial	Assoc State	Actions
☑		Server 6	unassociated	HXAF240C-M4SX	FCH1944V0F3	none	Actions

Configuration

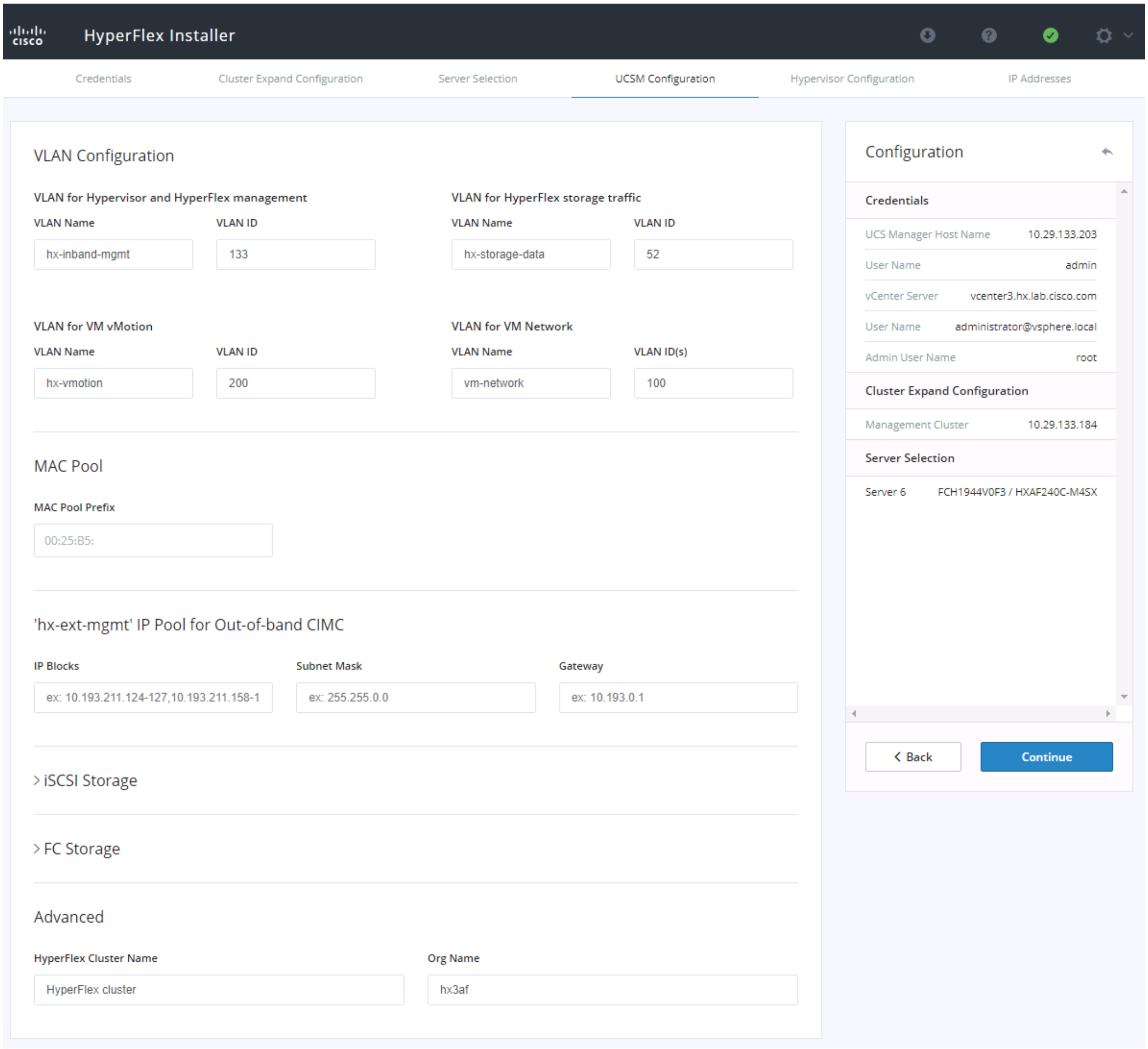
Credentials

UCS Manager Host Name	10.29.133.203
User Name	admin
vCenter Server	vcenter3.hx.lab.cisco.com
User Name	administrator@vsphere.local
Admin User Name	root

Cluster Expand Configuration

Management Cluster	10.29.133.184

6. On the Cisco UCS Manager Configuration page, enter the VLAN settings, Mac Pool Prefix, UCS hx-ext-mgmt IP Pool for CIMC, iSCSI Storage setting, FC Storage setting, and sub-organization name, making sure that all the values match the existing settings for the cluster being expanded.



VLAN Configuration

VLAN for Hypervisor and HyperFlex management

VLAN Name: hx-inband-mgmt

VLAN ID: 133

VLAN for HyperFlex storage traffic

VLAN Name: hx-storage-data

VLAN ID: 52

VLAN for VM vMotion

VLAN Name: hx-vmotion

VLAN ID: 200

VLAN for VM Network

VLAN Name: vm-network

VLAN ID(s): 100

MAC Pool

MAC Pool Prefix: 00:25:B5:

'hx-ext-mgmt' IP Pool for Out-of-band CIMC

IP Blocks: ex: 10.193.211.124-127,10.193.211.158-1

Subnet Mask: ex: 255.255.0.0

Gateway: ex: 10.193.0.1

> iSCSI Storage

> FC Storage

Advanced

HyperFlex Cluster Name: HyperFlex cluster

Org Name: hx3af

Configuration

Credentials

UCS Manager Host Name	10.29.133.203
User Name	admin
vCenter Server	vcenter3.hx.lab.cisco.com
User Name	administrator@vsphere.local
Admin User Name	root

Cluster Expand Configuration

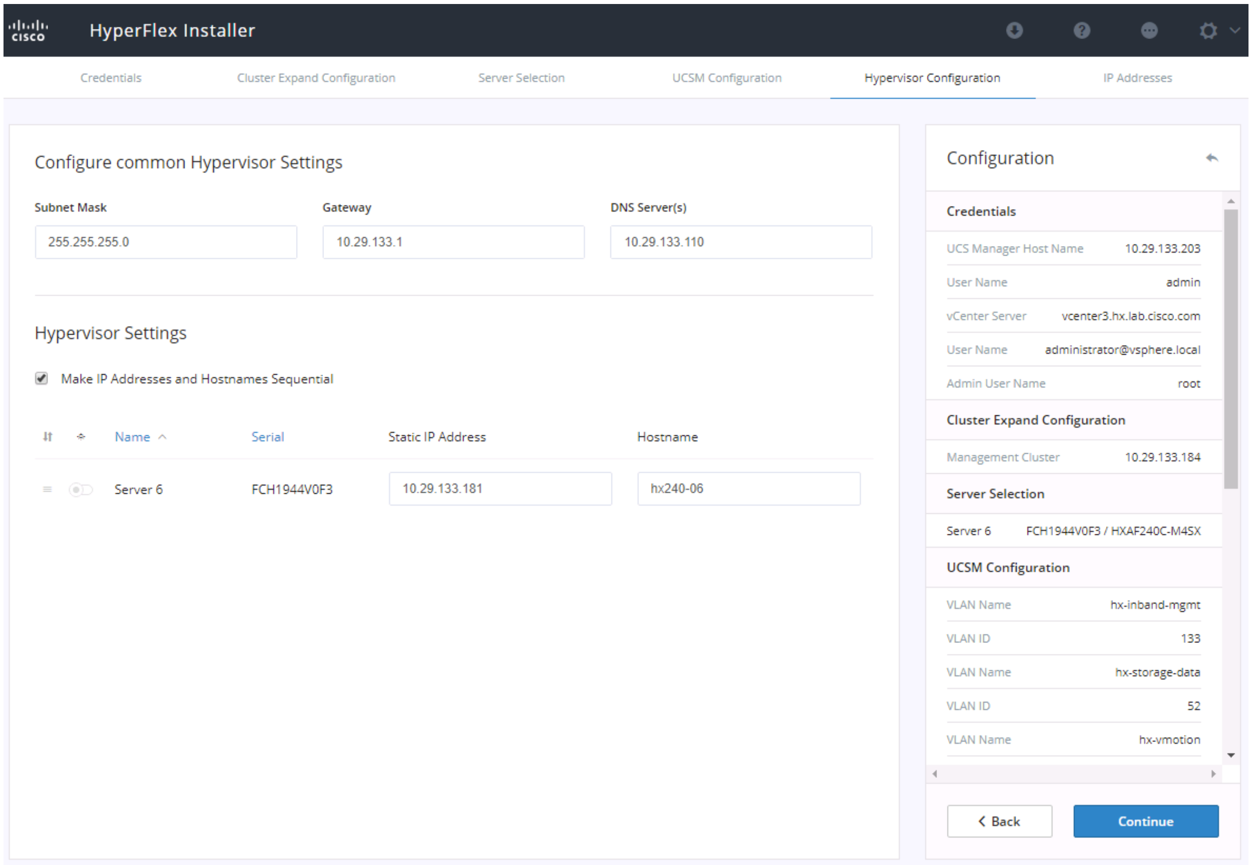
Management Cluster	10.29.133.184

Server Selection

Server 6	FCH1944V0F3 / HXAF240C-M4SX

7. Click Continue.

8. Enter the subnet mask, gateway, DNS, and IP addresses for the Hypervisors (ESXi hosts) as well as host names. The IPs will be assigned through Cisco UCS Manager to ESXi systems.



Configure common Hypervisor Settings

Subnet Mask: 255.255.255.0

Gateway: 10.29.133.1

DNS Server(s): 10.29.133.110

Hypervisor Settings

☑ Make IP Addresses and Hostnames Sequential

Name	Serial	Static IP Address	Hostname
Server 6	FCH1944V0F3	10.29.133.181	hx240-06

Configuration

Credentials

UCS Manager Host Name	10.29.133.203
User Name	admin
vCenter Server	vcenter3.hx.lab.cisco.com
User Name	administrator@vsphere.local
Admin User Name	root

Cluster Expand Configuration

Management Cluster	10.29.133.184

Server Selection

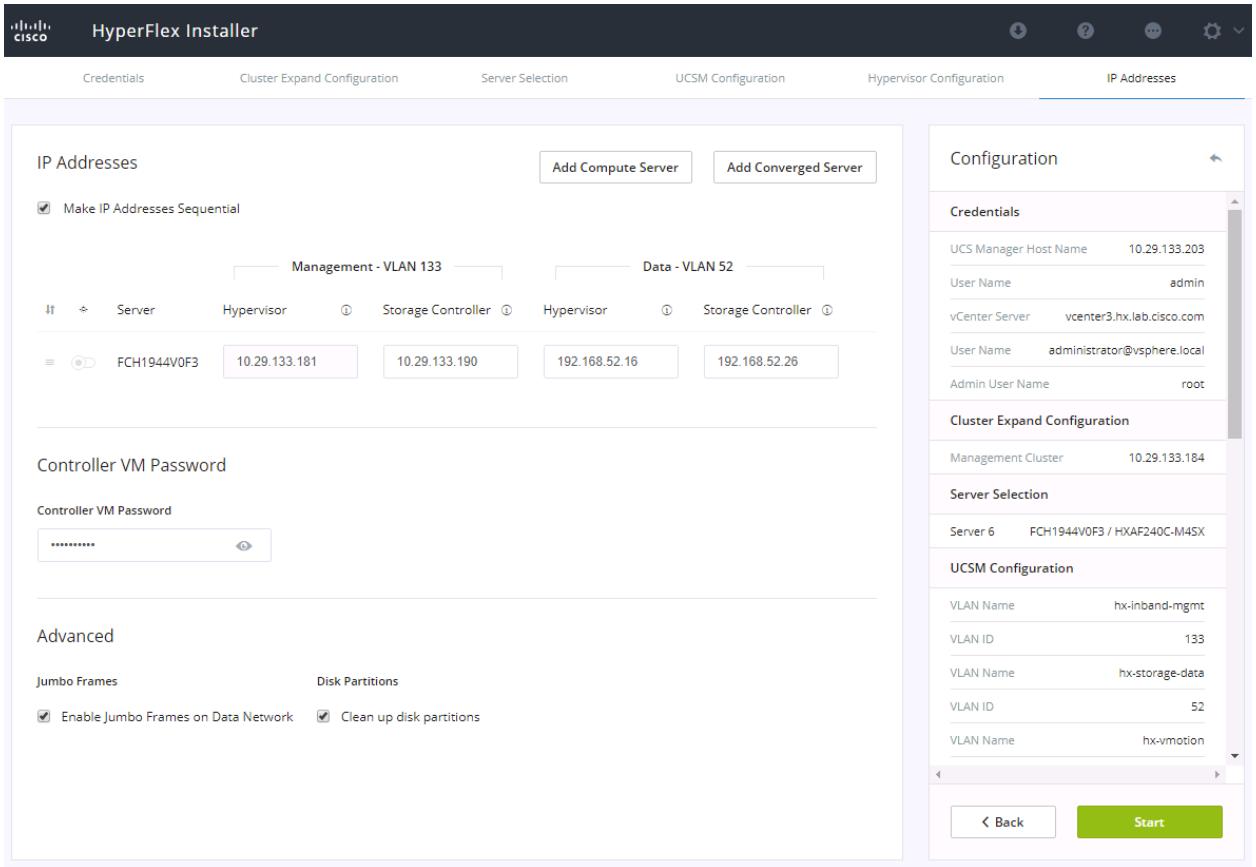
Server 6	FCH1944V0F3 / HXAF240C-M4SX

UCSM Configuration

VLAN Name	hx-inband-mgmt
VLAN ID	133
VLAN Name	hx-storage-data
VLAN ID	52
VLAN Name	hx-vmotion

9. Click Continue.

10. Enter the additional IP addresses for the Management and Data networks of the new nodes.



IP Addresses

Add Compute Server | Add Converged Server

☑ Make IP Addresses Sequential

			Management - VLAN 133		Data - VLAN 52	
		Server	Hypervisor	Storage Controller	Hypervisor	Storage Controller
		FCH1944V0F3	10.29.133.181	10.29.133.190	192.168.52.16	192.168.52.26

Controller VM Password

Controller VM Password: ••••••••••

Advanced

Jumbo Frames

☑ Enable Jumbo Frames on Data Network

Disk Partitions

☑ Clean up disk partitions

Configuration

Credentials

UCS Manager Host Name	10.29.133.203
User Name	admin
vCenter Server	vcenter3.hx.lab.cisco.com
User Name	administrator@vsphere.local
Admin User Name	root

Cluster Expand Configuration

Management Cluster	10.29.133.184

Server Selection

Server 6	FCH1944V0F3 / HXAF240C-M4SX

UCSM Configuration

VLAN Name	hx-inband-mgmt
VLAN ID	133
VLAN Name	hx-storage-data
VLAN ID	52
VLAN Name	hx-vmotion

11. Enter the current password that is set on the Controller VMs.

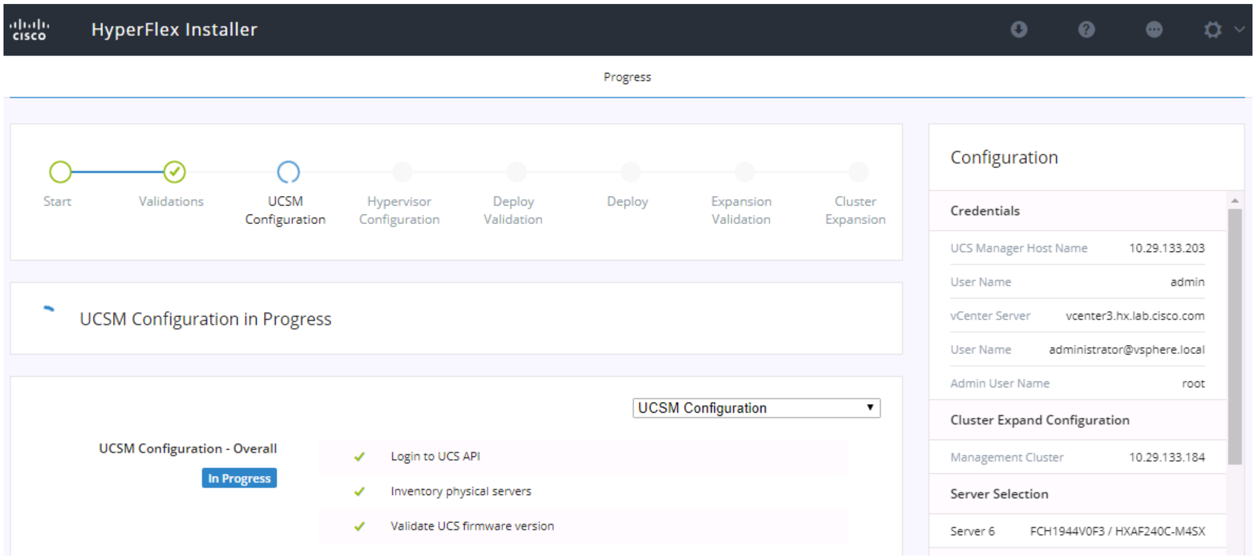
12. Enable Jumbo Frames and select Clean up disk partitions.

13. (Optional) At this step you can manually add more servers for expansion if these servers already have service profiles associated and the hypervisor is ready, by clicking on Add Compute Server or Add Converged Server and then entering the IP addresses for the storage controller management and data networks.

14. Click Start.

15. Validation of the configuration will now start. If there are warnings, you can review and click “Skip Validation” if the warnings are acceptable (e.g. you might get the warning from Cisco UCS Manger validation that the guest VLAN is already assigned). If there are no warnings, the validation will automatically continue on to the configuration process.

16. The HX installer will now proceed to complete the deployment and perform all the steps listed at the top of the screen along with their status.



UCSM Configuration in Progress

UCSM Configuration ▾

UCSM Configuration - Overall

In Progress

✓ Login to UCS API

✓ Inventory physical servers

✓ Validate UCS firmware version

Configuration

Credentials

UCS Manager Host Name	10.29.133.203
User Name	admin
vCenter Server	vcenter3.hx.lab.cisco.com
User Name	administrator@vsphere.local
Admin User Name	root

Cluster Expand Configuration

Management Cluster	10.29.133.184

Server Selection

Server 6	FCH1944V0F3 / HXAF240C-M4SX

17. You can review the summary screen after the install completes by selecting Summary on the top right of the window.

After the install has completed, the new converged node is added to the cluster, and its storage, CPU, and RAM resources are immediately available, however the new node still requires some post installation steps in order to be consistent with the configuration of the existing nodes. For example, the new converged node will not have a vMotion vmkernel interface, and it may not have all of the guest VM networks configured. The easiest method to make the changes is to use the post_install script, or the configuration can be done manually.

Management

HyperFlex Connect

HyperFlex Connect is the new, easy to use, and powerful primary management tool for HyperFlex clusters. HyperFlex Connect is an HTML5 web-based GUI tool which runs on all of the HX nodes, and is accessible via the cluster management IP address.

Local Access

Logging into HyperFlex Connect can be done using pre-defined local accounts. In order to log in with a local account prepend “local/” to the account name, for example, local/root. The password for the default root account is set during the cluster creation as the cluster password. Using local access is only recommended when vCenter direct or SSO credentials are not available.

Role-Based Access Control

HyperFlex Connect provides Role-Based Access Control (RBAC) via integrated authentication with the vCenter Server managing the HyperFlex cluster. Users can have two levels of rights and permissions within the HyperFlex cluster:

- Administrator: Users with administrator rights in the managing vCenter server will have read and modify rights within HyperFlex Connect. These users can make changes to the cluster settings and configuration.

- Read-Only: Users with read-only rights in the managing vCenter server will have read rights within HyperFlex Connect. These users cannot make changes to the cluster settings and configuration.

Users can log in to HyperFlex Connect using direct vCenter credentials, for example, administrator@vsphere.local, or using vCenter Single Sign-On (SSO) credentials, such as an Active Directory user, for example, domain\user. Creation and management of RBAC users and rights must be done via the vCenter Web Client or vCenter 6.5 HTML5 vSphere Client.

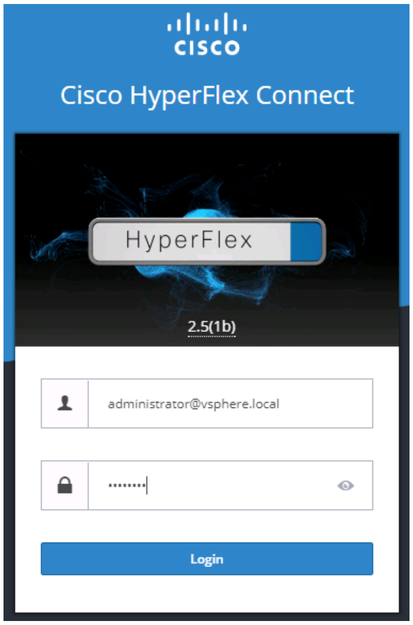
To manage the HyperFlex cluster using HyperFlex Connect, complete the following steps:

1. Using a web browser, open the HyperFlex cluster’s management IP address via HTTPS, for example, https://10.29.133.160.

2. Enter a local credential, or a vCenter RBAC credential for the username, and the corresponding password.

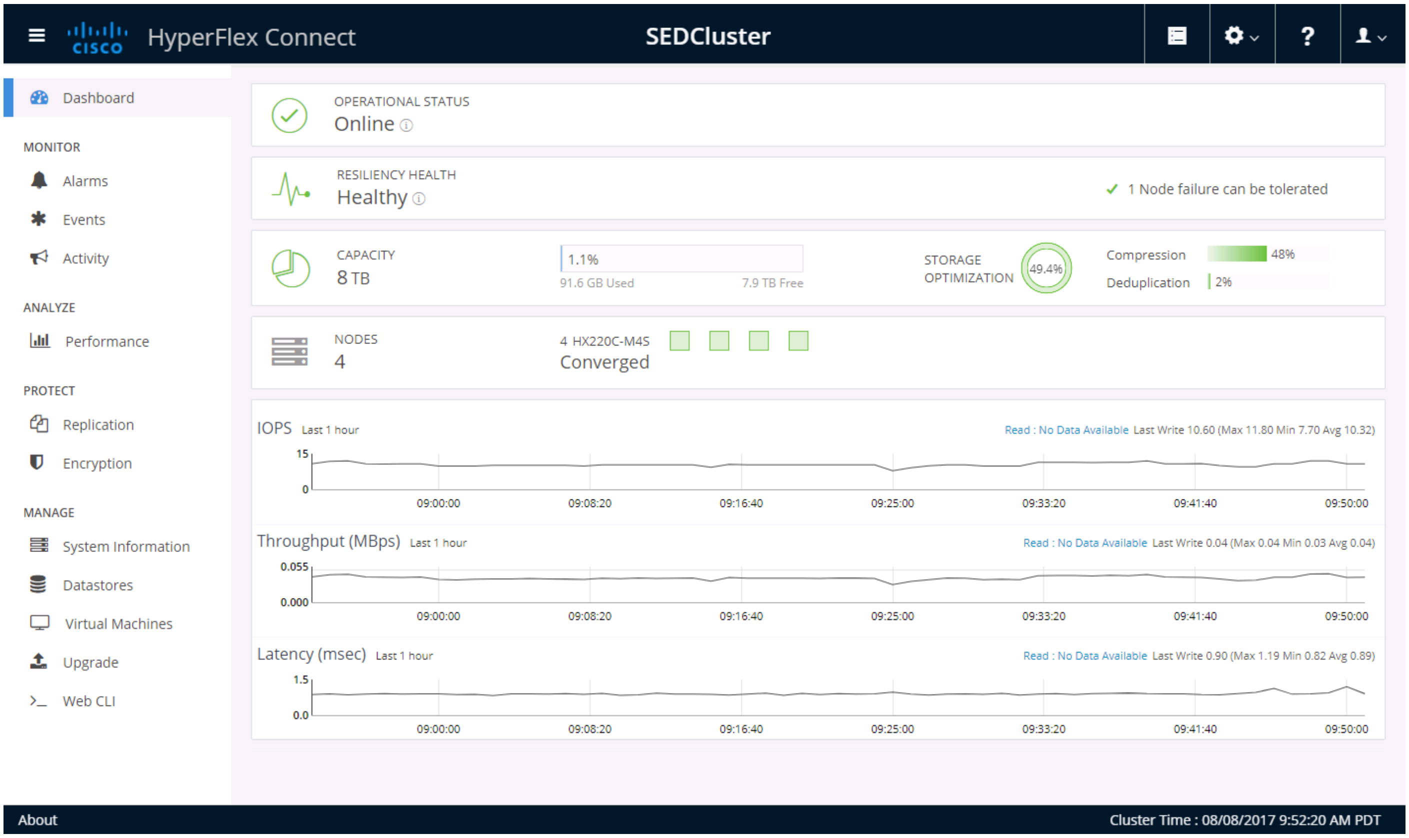
3. Click Login.

4. The Dashboard view will be shown after a successful login.



administrator@vsphere.local

••••••••



OPERATIONAL STATUS
Online

RESILIENCY HEALTH
Healthy

✓ 1 Node failure can be tolerated

CAPACITY
8 TB

1.1%
91.6 GB Used
7.9 TB Free

STORAGE OPTIMIZATION
49.4%

Compression 48%
Deduplication 2%

NODES
4

4 HX220C-M4S
Converged

IOPS Last 1 hour
Read : No Data Available Last Write 10.60 (Max 11.80 Min 7.70 Avg 10.32)

Throughput (MBps) Last 1 hour
Read : No Data Available Last Write 0.04 (Max 0.04 Min 0.03 Avg 0.04)

Latency (msec) Last 1 hour
Read : No Data Available Last Write 0.90 (Max 1.19 Min 0.82 Avg 0.89)

Cluster Time : 08/08/2017 9:52:20 AM PDT

Dashboard

From the Dashboard view, several elements are presented:

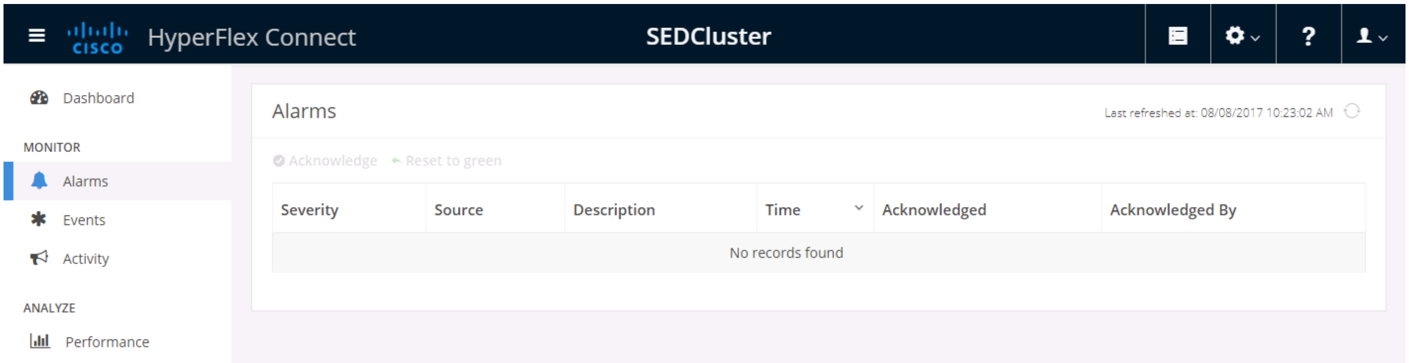
- Cluster operational status, overall cluster health, and the cluster’s current node failure tolerance.

- Cluster storage capacity, used and free space, compression and deduplication savings, and overall cluster storage optimization statistics.
- Cluster size and individual node health.
- Cluster IOPs, storage throughput, and latency for the past 1 hour.

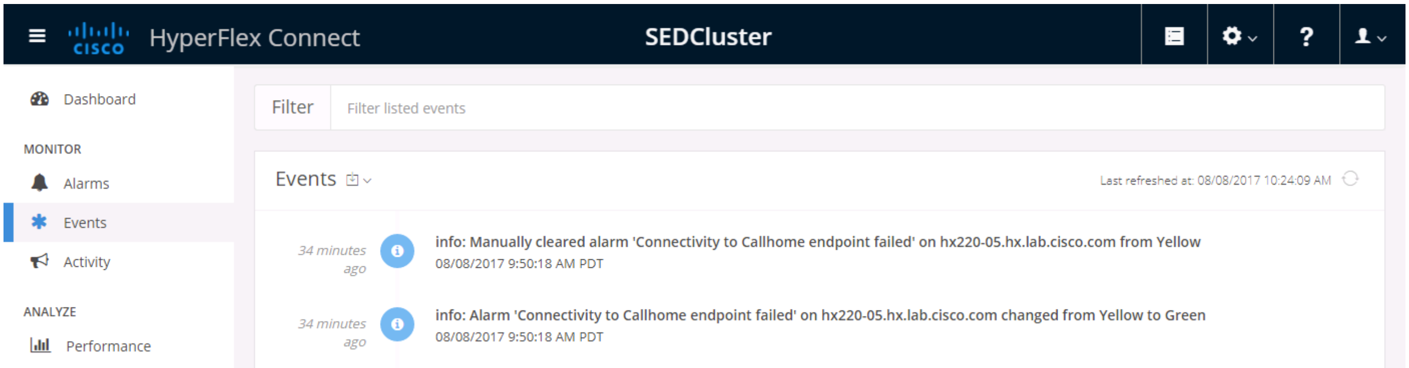
Monitor

HyperFlex Connect provides for additional monitoring capabilities, including:

- Alarms: Cluster alarms can be viewed, acknowledged and reset.
- Event Log: The cluster event log can be viewed, specific events can be filtered for, and the log can be exported.
- Activity Log: Recent job activity, such as ReadyClones can be viewed and the status can be monitored.



Severity	Source	Description	Time	Acknowledged	Acknowledged By
No records found					

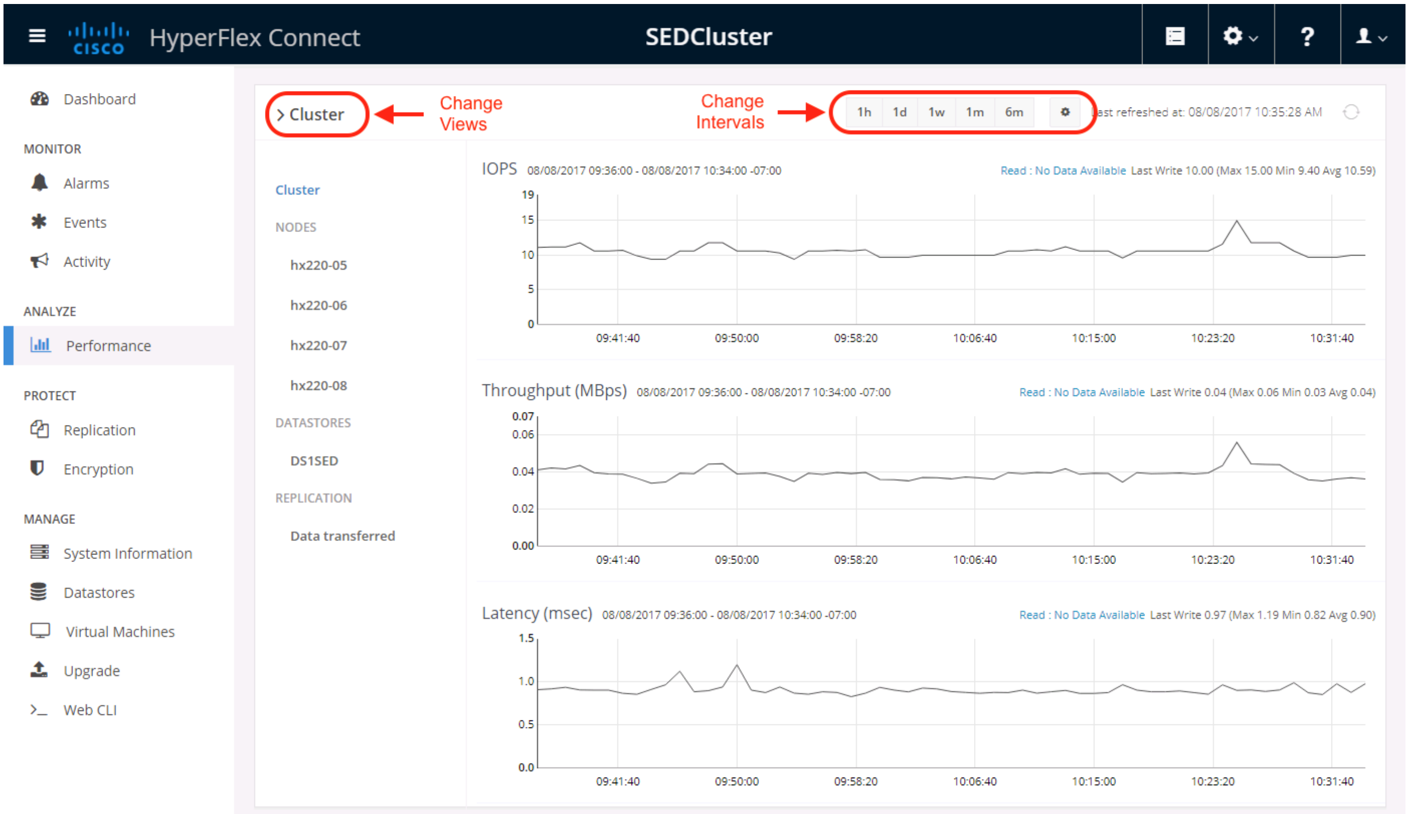


34 minutes ago — info: Manually cleared alarm 'Connectivity to Callhome endpoint failed' on hx220-05.hx.lab.cisco.com from Yellow
08/08/2017 9:50:18 AM PDT

34 minutes ago — info: Alarm 'Connectivity to Callhome endpoint failed' on hx220-05.hx.lab.cisco.com changed from Yellow to Green
08/08/2017 9:50:18 AM PDT

Analyze

The historical and current performance of the HyperFlex cluster can be analyzed via the built-in performance charts. The default view shows read and write IOPs, bandwidth, and latency over the past 1 hour for the entire cluster. Views can be customized to see individual nodes or datastores, and change the timeframe shown in the charts.



Protect

HyperFlex Connect is used as the management tool for all configuration of HyperFlex Data Protection features, including VM replication and data-at-rest encryption. Configuration of these features is covered in later sections of this document.

Manage

HyperFlex Connect presents several views and elements for managing the HyperFlex cluster:

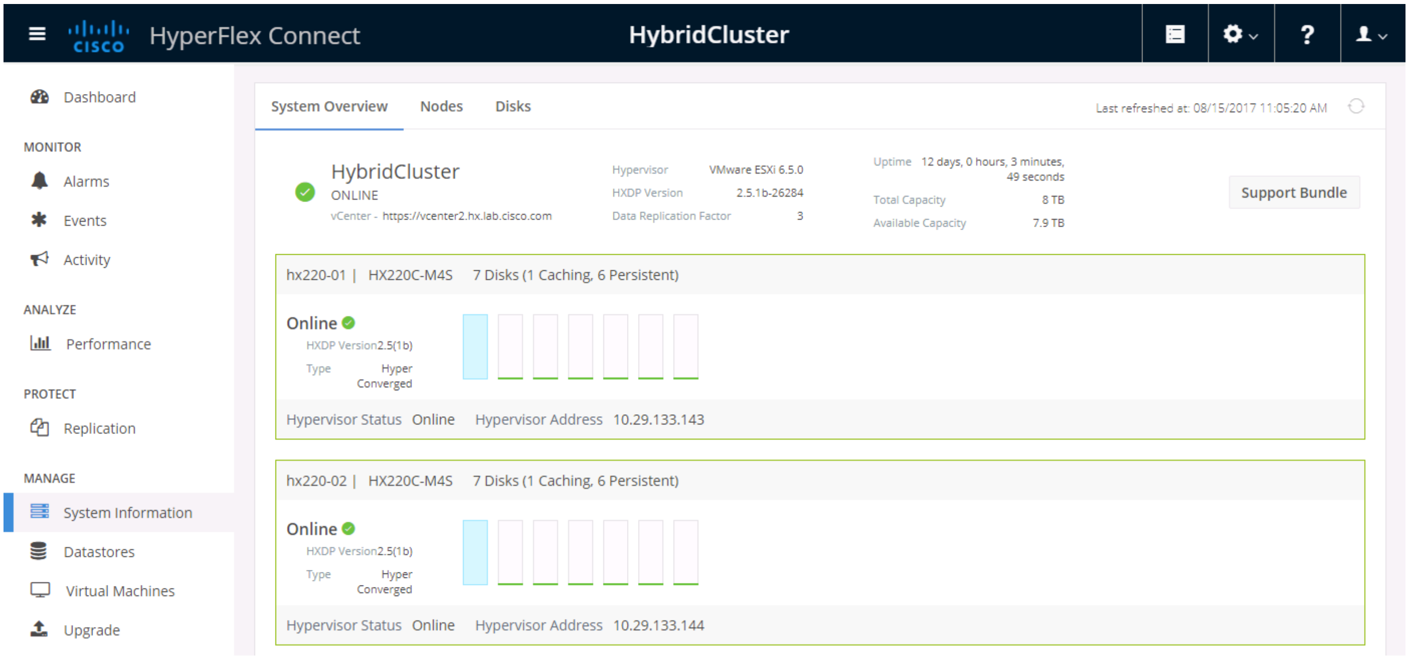
- System Information: Presents a detailed view of the cluster configuration, software revisions, hosts, disks, and cluster uptime. Support bundles can be generated to be shared with Cisco TAC when technical support is needed. Views of the individual nodes and the individual disks are available. In these views, nodes can be placed into HX Maintenance Mode, and disks can be securely erased, as described later in this document.

- Datastores: Presents the datastores present in the cluster, and allows for datastores to be created, mounted, unmounted, edited or deleted, as described earlier in this document as part of the cluster setup.

- Virtual Machines: Presents the VMs present in the cluster, and allows for the VMs to be cloned and protected via replication, as described later in this document.

- Upgrade: Upgrades to the HXDP software, and Cisco UCS firmware can be initiated from this view.

- Web CLI: A web based interface, from which CLI commands can be issued and their output seen, as opposed to directly logging into the SCVMs via SSH.



Last refreshed at: 08/15/2017 11:05:20 AM

HybridCluster
ONLINE
vCenter - https://vcenter2.hx.lab.cisco.com

Hypervisor VMware ESXi 6.5.0
HXDP Version 2.5.1b-26284
Data Replication Factor 3

Uptime 12 days, 0 hours, 3 minutes, 49 seconds
Total Capacity 8 TB
Available Capacity 7.9 TB

hx220-01 | HX220C-M4S 7 Disks (1 Caching, 6 Persistent)
Online
HXDP Version 2.5(1b)
Type Hyper Converged
Hypervisor Status Online Hypervisor Address 10.29.133.143

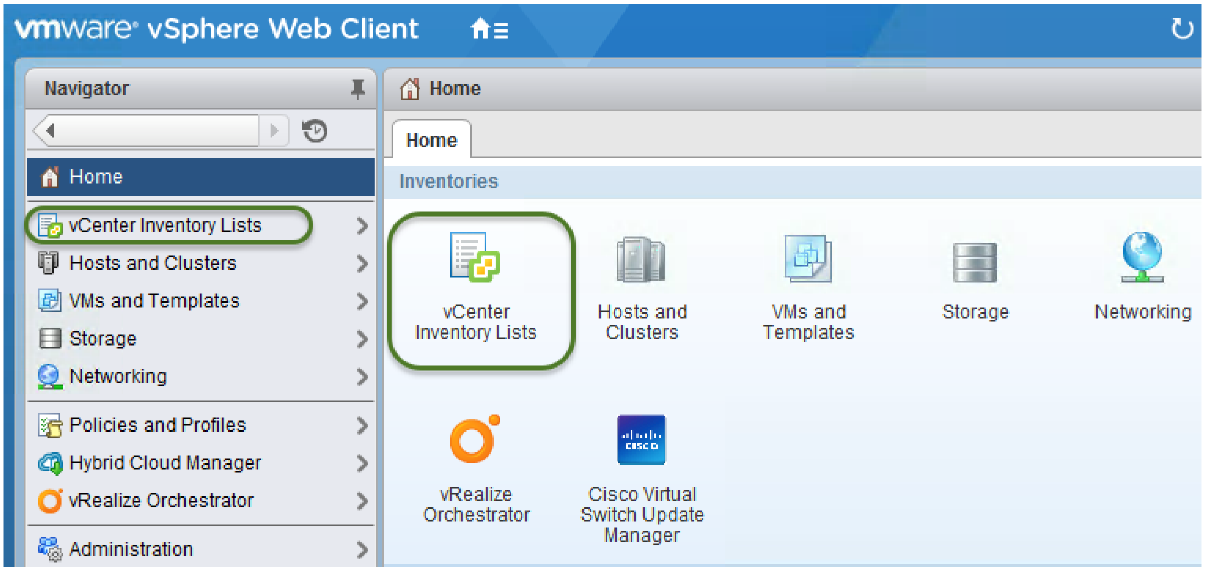
hx220-02 | HX220C-M4S 7 Disks (1 Caching, 6 Persistent)
Online
HXDP Version 2.5(1b)
Type Hyper Converged
Hypervisor Status Online Hypervisor Address 10.29.133.144

vCenter Web Client Plugin

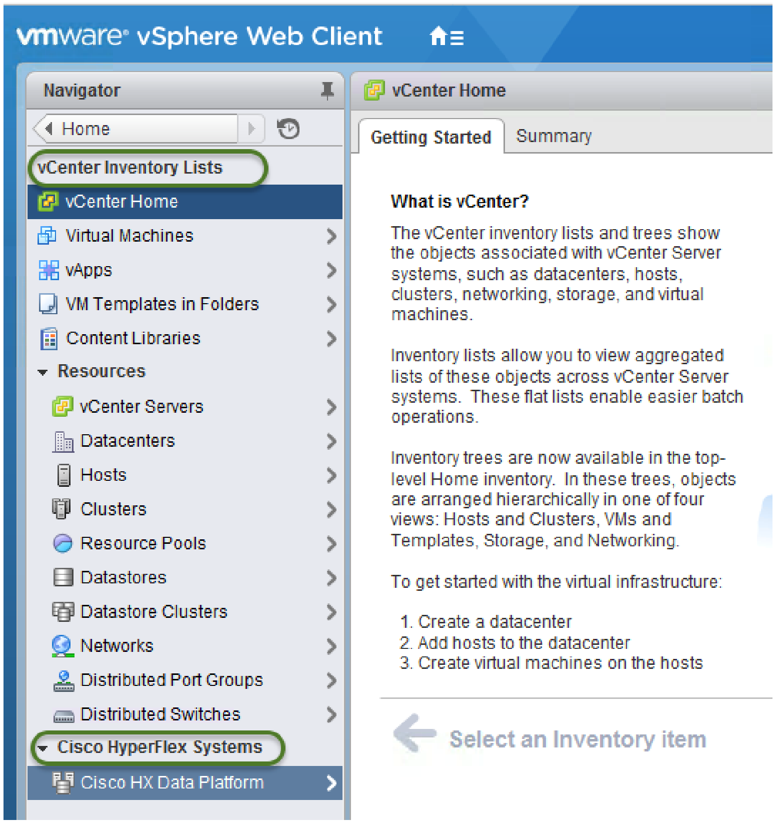
The Cisco HyperFlex vCenter Web Client Plugin is installed by the HyperFlex installer to the specified vCenter server or vCenter appliance. The plugin is accessed as part of the vCenter Web Client (Flash) interface, and is a secondary tool used to monitor and configure the HyperFlex cluster. This plugin is not integrated into the new vCenter 6.5 HTML5 vSphere Client. In order to manage a HyperFlex cluster via an HTML5 interface, i.e. without the Adobe Flash requirement, use the new HyperFlex Connect management tool. To manage the HyperFlex cluster using the vCenter Web Client Plugin, complete the following steps:

1. Open the vCenter Web Client, and login with admin rights.

2. In the home pane, from the home screen click vCenter Inventory Lists.



3. In the Navigator pane, click Cisco HX Data Platform.



What is vCenter?

The vCenter inventory lists and trees show the objects associated with vCenter Server systems, such as datacenters, hosts, clusters, networking, storage, and virtual machines.

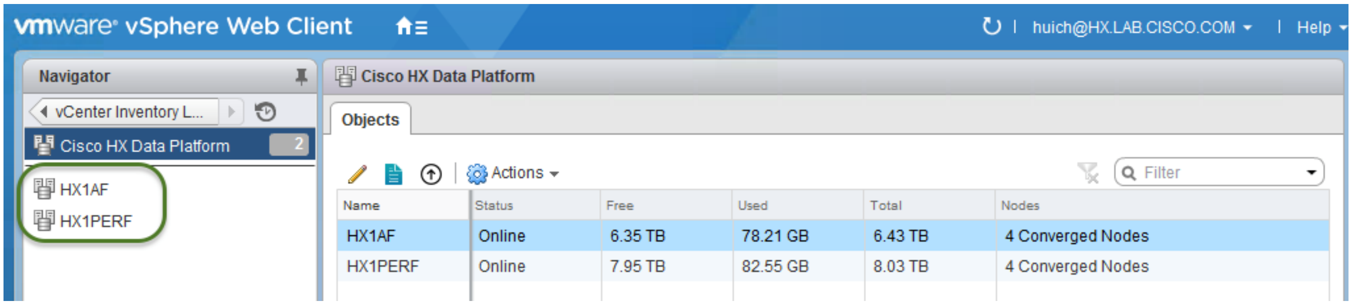
Inventory lists allow you to view aggregated lists of these objects across vCenter Server systems. These flat lists enable easier batch operations.

Inventory trees are now available in the top-level Home inventory. In these trees, objects are arranged hierarchically in one of four views: Hosts and Clusters, VMs and Templates, Storage, and Networking.

To get started with the virtual infrastructure:

1. Create a datacenter
2. Add hosts to the datacenter
3. Create virtual machines on the hosts

4. In the Navigator pane, choose the HyperFlex cluster you want to manage and click the name.

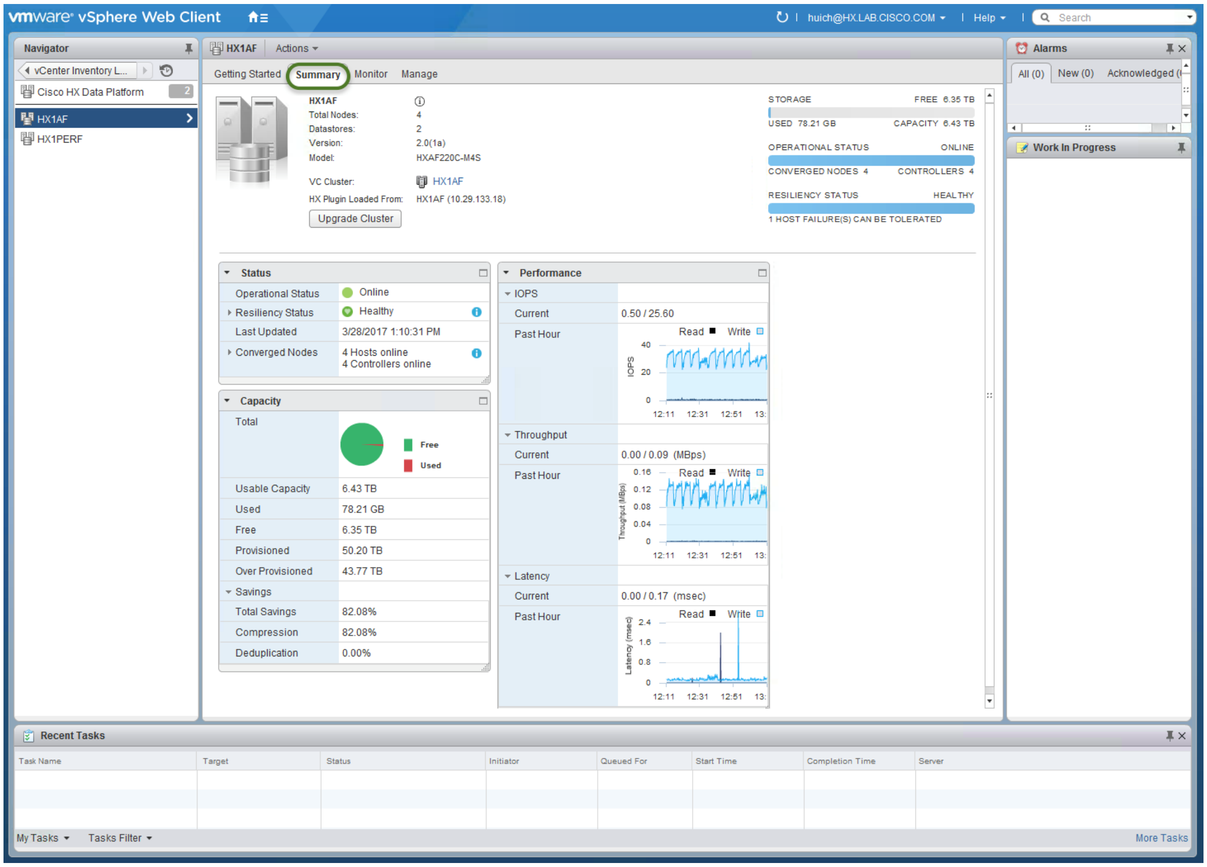


Name	Status	Free	Used	Total	Nodes
HX1AF	Online	6.35 TB	78.21 GB	6.43 TB	4 Converged Nodes
HX1PERF	Online	7.95 TB	82.55 GB	8.03 TB	4 Converged Nodes

Summary

From the Web Client Plugin Summary screen, several elements are presented:

- Overall cluster usable capacity, used capacity, free capacity, datastore capacity provisioned, and the amount of datastore capacity provisioned beyond the actual cluster capacity.
- Deduplication and compression savings percentages calculated against the data stored in the cluster.
- The cluster operational status, the health state, and the number of node failures that can occur before the cluster goes into read-only or offline mode.
- A snapshot of performance over the previous hour, showing IOPS, throughput, and latencies.



HX1AF
Total Nodes: 4
Datastores: 2
Version: 2.0(1a)
Model: HXAF220C-M4S
VC Cluster: HX1AF
HX Plugin Loaded From: HX1AF (10.29.133.18)

STORAGE FREE 6.35 TB
USED 78.21 GB CAPACITY 6.43 TB
OPERATIONAL STATUS ONLINE
CONVERGED NODES 4 CONTROLLERS 4
RESILIENCY STATUS HEALTHY
1 HOST FAILURE(S) CAN BE TOLERATED

Status	
Operational Status	Online
Resiliency Status	Healthy
Last Updated	3/28/2017 1:10:31 PM
Converged Nodes	4 Hosts online 4 Controllers online

Capacity	
Total	
Usable Capacity	6.43 TB
Used	78.21 GB
Free	6.35 TB
Provisioned	50.20 TB
Over Provisioned	43.77 TB
Savings	
Total Savings	82.08%
Compression	82.08%
Deduplication	0.00%

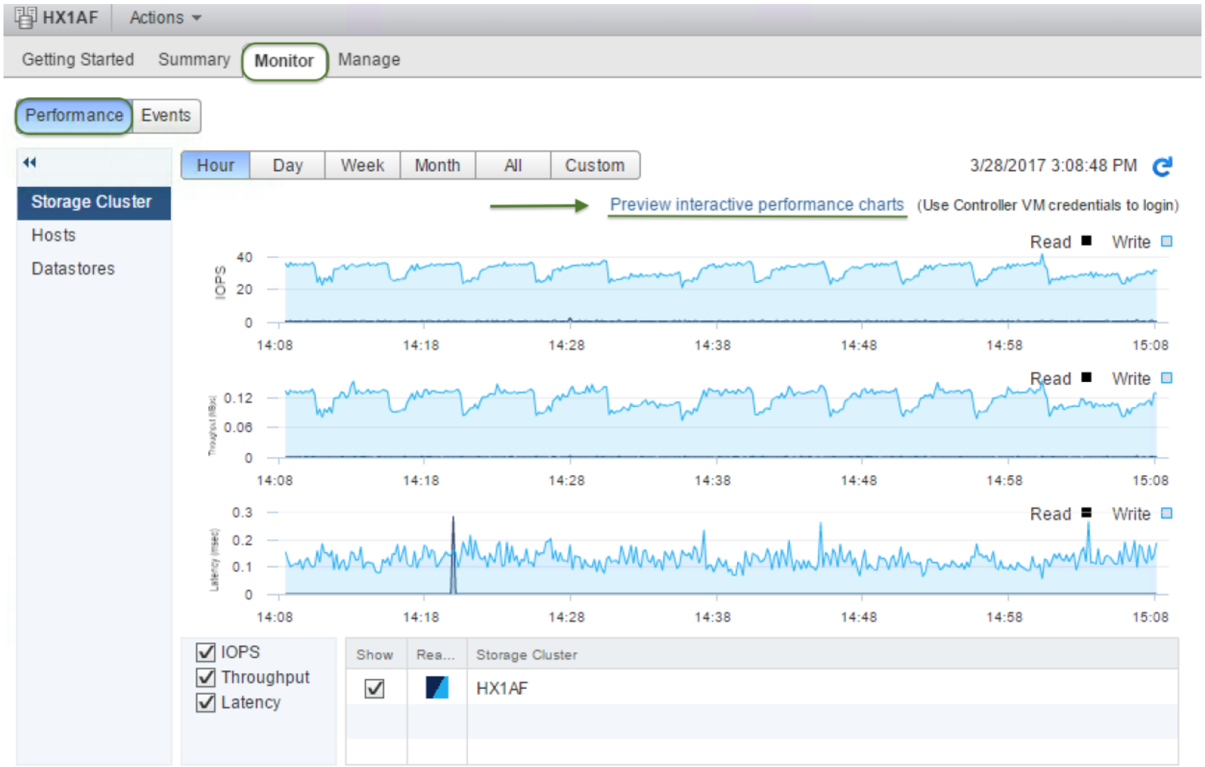
Performance	
IOPS	
Current	0.50 / 25.60
Past Hour	
Throughput	
Current	0.00 / 0.09 (MBps)
Past Hour	
Latency	
Current	0.00 / 0.17 (msec)
Past Hour	

Task Name	Target	Status	Initiator	Queued For	Start Time	Completion Time	Server

Monitor

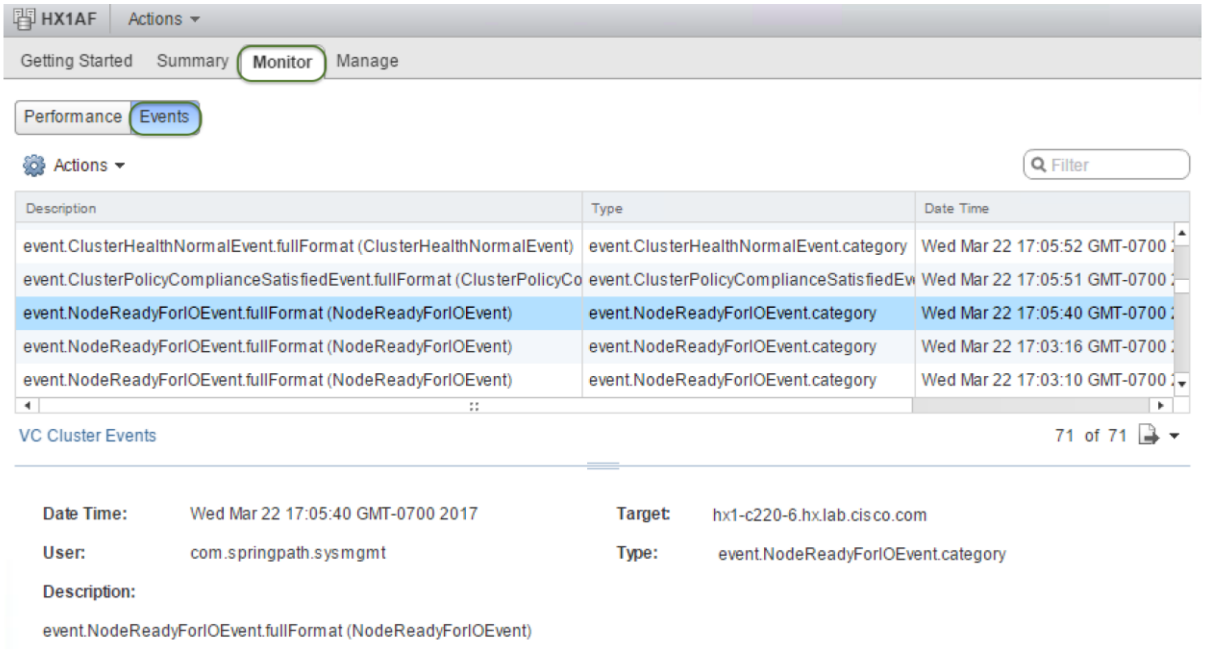
From the Web Client Plugin Monitor tab, several elements are presented:

- Clicking the Performance button displays a larger view of the performance charts. If a full webpage screen view is desired, click the Preview Interactive Performance charts hyperlink. Enter the username (root) and the password for the HX controller VM to continue.



Show	Rea...	Storage Cluster
☑	▨	HX1AF

- Clicking the Events button displays a HyperFlex event log, which can be used to diagnose errors and view system activity events.



Description	Type	Date Time
event.ClusterHealthNormalEvent.fullFormat (ClusterHealthNormalEvent)	event.ClusterHealthNormalEvent.category	Wed Mar 22 17:05:52 GMT-0700
event.ClusterPolicyComplianceSatisfiedEvent.fullFormat (ClusterPolicyCo	event.ClusterPolicyComplianceSatisfiedEv	Wed Mar 22 17:05:51 GMT-0700
event.NodeReadyForIOEvent.fullFormat (NodeReadyForIOEvent)	event.NodeReadyForIOEvent.category	Wed Mar 22 17:05:40 GMT-0700
event.NodeReadyForIOEvent.fullFormat (NodeReadyForIOEvent)	event.NodeReadyForIOEvent.category	Wed Mar 22 17:03:16 GMT-0700
event.NodeReadyForIOEvent.fullFormat (NodeReadyForIOEvent)	event.NodeReadyForIOEvent.category	Wed Mar 22 17:03:10 GMT-0700

Date Time: Wed Mar 22 17:05:40 GMT-0700 2017

Target: hx1-c220-6.hx.lab.cisco.com

User: com.springpath.sysmgmt

Type: event.NodeReadyForIOEvent.category

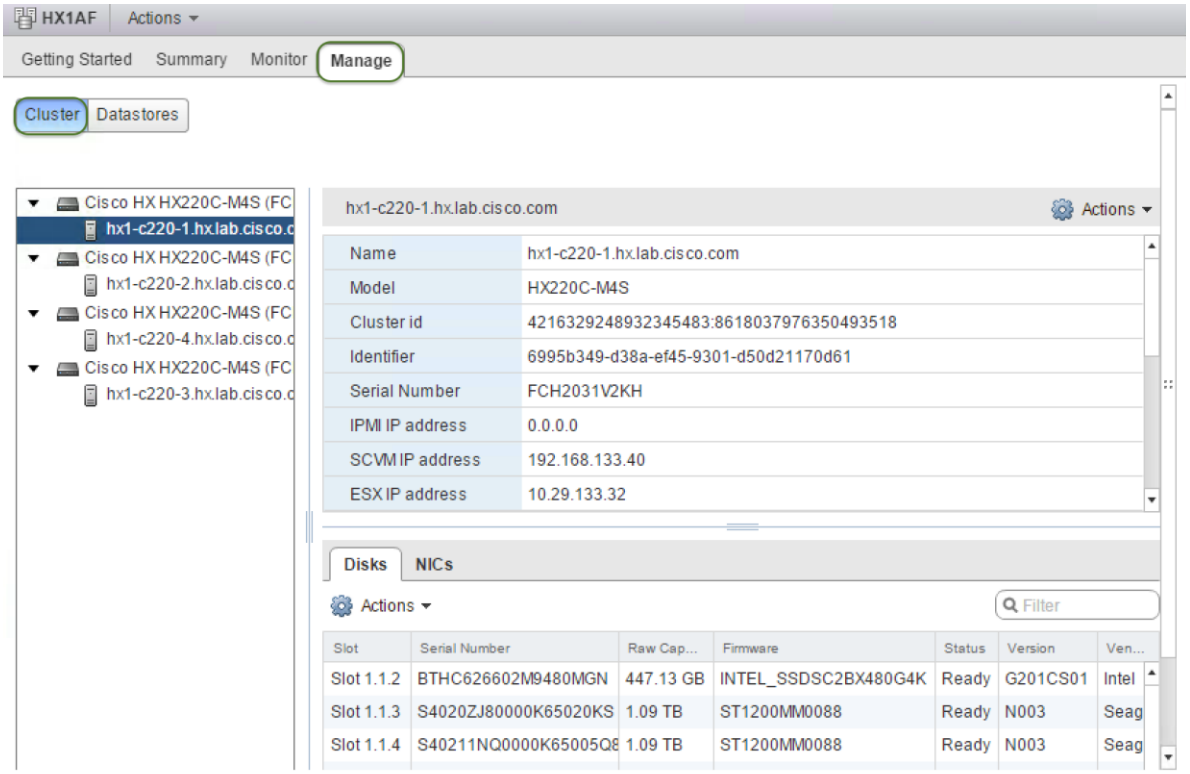
Description:

event.NodeReadyForIOEvent.fullFormat (NodeReadyForIOEvent)

Manage

From the Web Client Plugin Manage tab, several elements are presented:

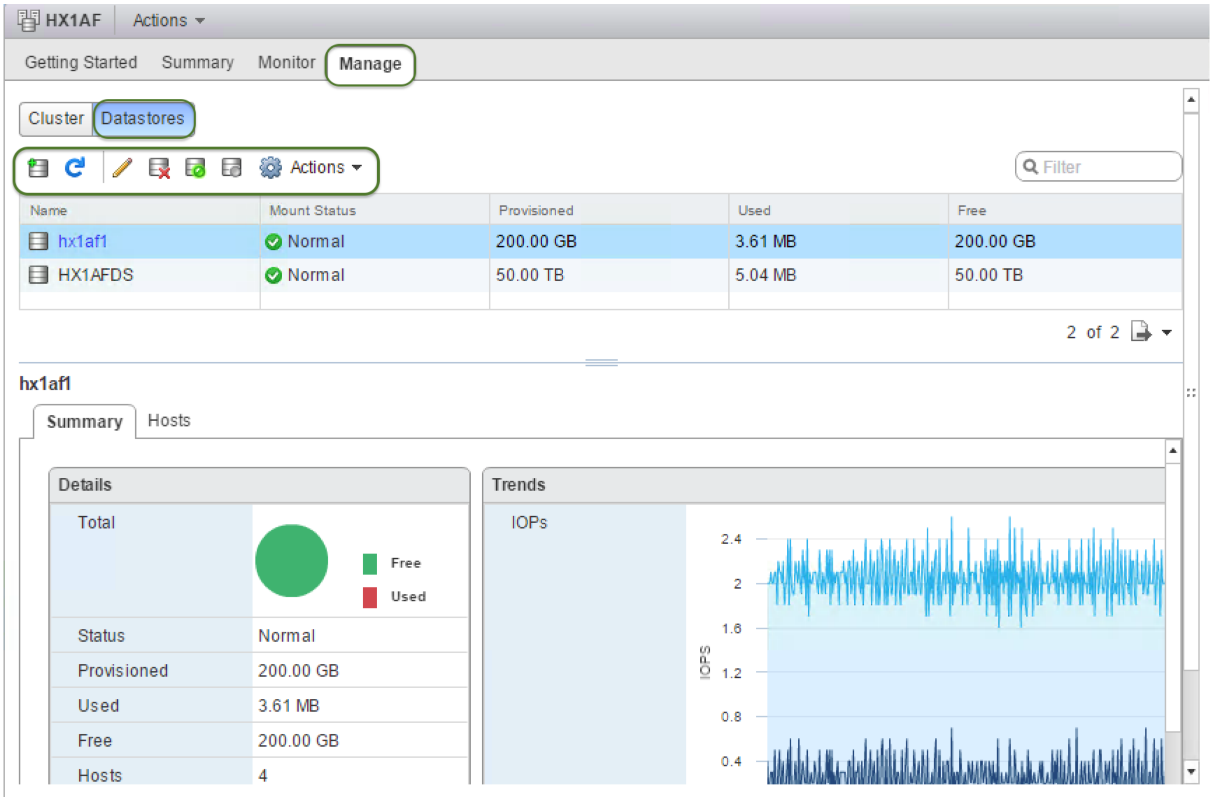
- Clicking the Cluster button displays an inventory of the HyperFlex cluster and the physical assets of the cluster hardware.



Name	hx1-c220-1.hx.lab.cisco.com
Model	HX220C-M4S
Cluster id	4216329248932345483:8618037976350493518
Identifier	6995b349-d38a-ef45-9301-d50d21170d61
Serial Number	FCH2031V2KH
IPMI IP address	0.0.0.0
SCVM IP address	192.168.133.40
ESX IP address	10.29.133.32

Slot	Serial Number	Raw Cap...	Firmware	Status	Version	Ven...
Slot 1.1.2	BTHC626602M9480MGN	447.13 GB	INTEL_SSDSC2BX480G4K	Ready	G201CS01	Intel
Slot 1.1.3	S4020ZJ80000K65020KS	1.09 TB	ST1200MM0088	Ready	N003	Seag
Slot 1.1.4	S40211NQ0000K65005Q8	1.09 TB	ST1200MM0088	Ready	N003	Seag

- Clicking the Datastores button allows datastores to be created, edited, deleted, mounted and unmounted, along with space summaries and performance snapshots of that datastore.



Name	Mount Status	Provisioned	Used	Free
hx1af1	✓ Normal	200.00 GB	3.61 MB	200.00 GB
HX1AFDS	✓ Normal	50.00 TB	5.04 MB	50.00 TB

2 of 2

hx1af1

Total	🟩 Free 🟥 Used
Status	Normal
Provisioned	200.00 GB
Used	3.61 MB
Free	200.00 GB
Hosts	4

Management Best Practices

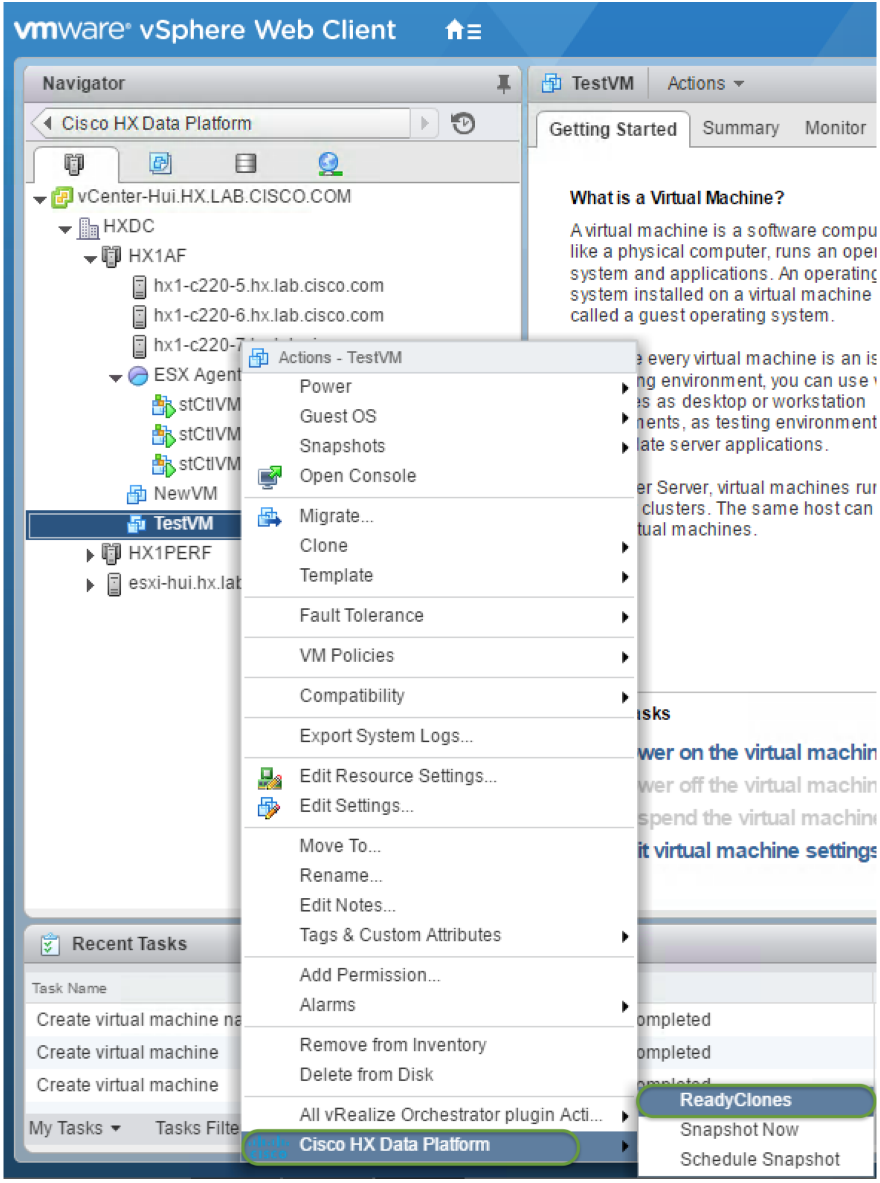
In this section, various best practices and guidelines are given for management and ongoing use of the Cisco HyperFlex system. These guidelines and recommendations apply only to the software versions upon which this document is based, listed in Software Components.

ReadyClones

For the best possible performance and functionality of the virtual machines that will be created using the HyperFlex ReadyClone feature, the following guidelines for preparation of the base VMs to be cloned should be followed:

- Base VMs must be stored in a HyperFlex datastore.
- All virtual disks of the base VM must be stored in the same HyperFlex datastore.
- Base VMs can only have HyperFlex native snapshots, no VMware redo-log based snapshots can be present.
- For very high IO workloads with many clone VMs leveraging the same base image, it might be necessary to use multiple copies of the same base image for groups of clones. Doing so prevents referencing the same blocks across all clones and could yield an increase in performance. This step is typically not required for most uses cases and workload types.

Figure 48 HyperFlex Management - ReadyClones



What is a Virtual Machine?

A virtual machine is a software compu like a physical computer, runs an opei system and applications. An operating system installed on a virtual machine called a guest operating system.

e every virtual machine is an is ng environment, you can use s as desktop or workstation nents, as testing environment late server applications.

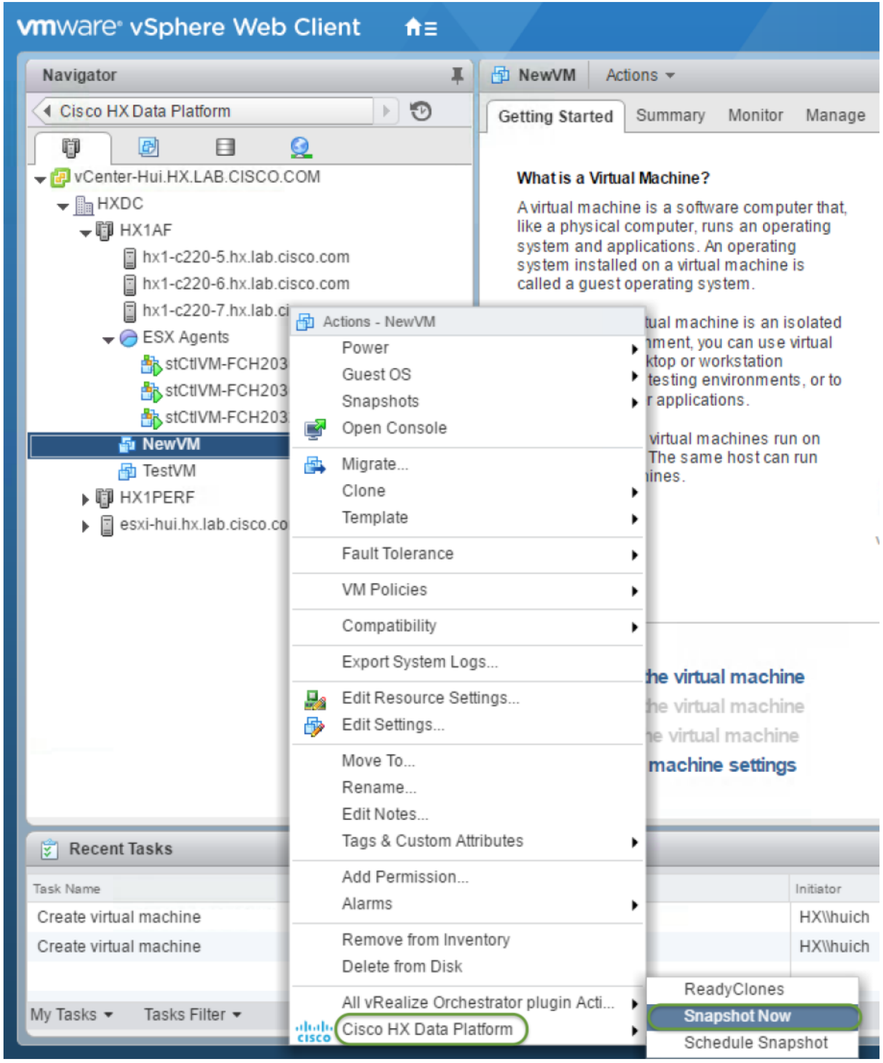
er Server, virtual machines rur clusters. The same host can tual machines.

Snapshots

HyperFlex native snapshots are high performance snapshots that are space-efficient, crash-consistent, and application consistent, taken by the HyperFlex Distributed Filesystem, rather than using VMware redo-log based snapshots. For the best possible performance and functionality of HyperFlex native snapshots, the following guidelines should be followed:

- Make sure that the first snapshot taken of a guest VM is a HyperFlex native snapshot, by using the "Cisco HX Data Platform" menu item in the vSphere Web Client, and choosing Snapshot Now or Schedule Snapshot. Failure to do so reverts to VMware redo-log based snapshots. (Figure 49)

Figure 49 HyperFlex Management - Snapshot Now

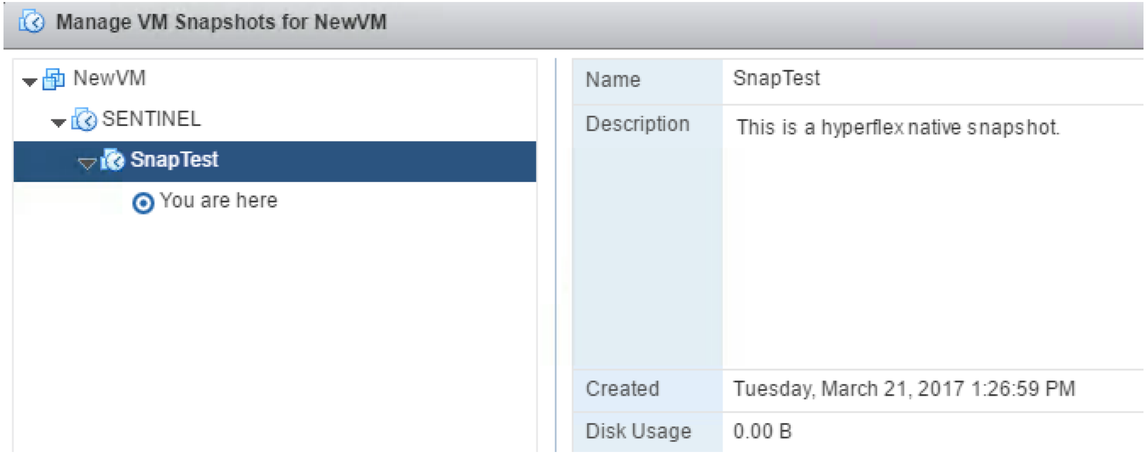


What is a Virtual Machine?

A virtual machine is a software computer that, like a physical computer, runs an operating system and applications. An operating system installed on a virtual machine is called a guest operating system.

- A Sentinel snapshot becomes a base snapshot that all future snapshots are added to, and prevents the VM from reverting to VMware redo-log based snapshots. Failure to do so can cause performance degradation when taking snapshots later, while the VM is performing large amounts of storage IO.
- Additional snapshots can be taken via the “Cisco HX Data Platform” menu, or the standard vSphere client snapshot menu. As long as the initial snapshot was a HyperFlex native snapshot, each additional snapshot is also considered to be a HyperFlex native snapshot.
- Do not delete the Sentinel snapshot unless you are deleting all the snapshots entirely.
- Do not revert the VM to the Sentinel snapshot. (Figure 50)

Figure 50 HyperFlex Management - Sentinel Snapshot

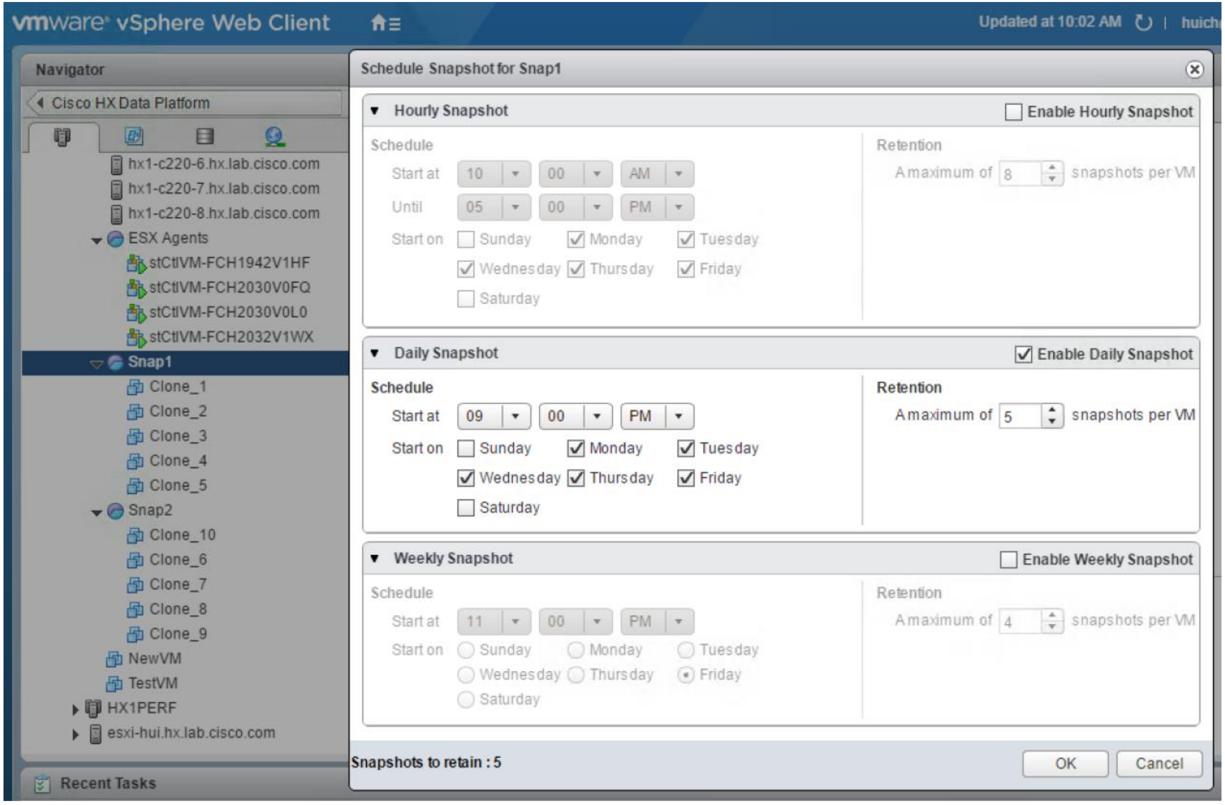


Manage VM Snapshots for NewVM

Name	SnapTest
Description	This is a hyperflex native snapshot.
Created	Tuesday, March 21, 2017 1:26:59 PM
Disk Usage	0.00 B

- If large numbers of scheduled snapshots need to be taken, distribute the time of the snapshots taken by placing the VMs into multiple folders or resource pools. For example, schedule two resource groups, each with several VMs, to take snapshots separated by 15 minute intervals in the scheduler window. Snapshots will be processed in batches of 8 at a time, until the scheduled task is completed. (Figure 51)

Figure 51 HyperFlex Management - Schedule Snapshots



Schedule Snapshot for Snap1

Hourly Snapshot — □ Enable Hourly Snapshot

Schedule
Start at 10 : 00 AM
Until 05 : 00 PM
Start on □ Sunday ☑ Monday ☑ Tuesday ☑ Wednesday ☑ Thursday ☑ Friday □ Saturday

Retention
A maximum of 8 snapshots per VM

Daily Snapshot — ☑ Enable Daily Snapshot

Schedule
Start at 09 : 00 PM
Start on □ Sunday ☑ Monday ☑ Tuesday ☑ Wednesday ☑ Thursday ☑ Friday □ Saturday

Retention
A maximum of 5 snapshots per VM

Weekly Snapshot — □ Enable Weekly Snapshot

Schedule
Start at 11 : 00 PM
Start on ○ Sunday ○ Monday ○ Tuesday ○ Wednesday ○ Thursday ● Friday ○ Saturday

Retention
A maximum of 4 snapshots per VM

Snapshots to retain : 5

OK Cancel

Storage vMotion

The Cisco HyperFlex Distributed Filesystem can create multiple datastores for storage of virtual machines. While there can be multiple datastores for logical separation, all of the files are located within a single distributed filesystem. As such, performing storage vMotions of virtual machine disk files has little value in the HyperFlex system. Furthermore, storage vMotions create additional filesystem consumption and generate additional unnecessary metadata within the filesystem, which must later be cleaned up via the filesystem's internal cleaner process.

Note: It is recommended to not perform storage vMotions of the guest VMs between datastores within the same HyperFlex cluster. Storage vMotions between different HyperFlex clusters, or between HyperFlex and non-HyperFlex datastores are permitted.

Virtual Disk Placement

HyperFlex clusters can create multiple datastores for logical separation of virtual machine storage, yet the files are all stored in the same underlying distributed filesystem. The only difference between one datastore and another are their names and their configured sizes. Due to this, there is no compelling reason for a virtual machine's virtual disk files to be stored on a particular datastore versus another.

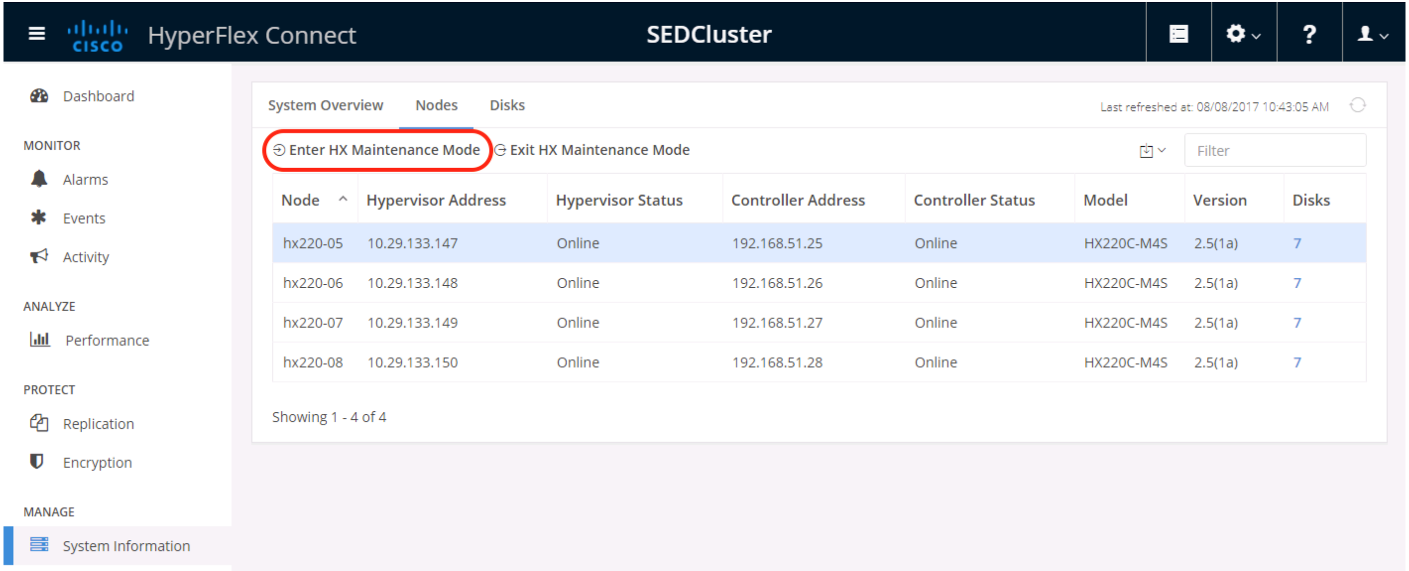
Note: All of the virtual disks that make up a single virtual machine must be placed in the same datastore. Spreading the virtual disks across multiple datastores provides no benefit, and can cause ReadyClone and Snapshot errors.

Maintenance Mode

In HyperFlex Connect, from the System Information screen, in the Nodes view, the individual nodes can be placed into HX Maintenance Mode. Also, within the vCenter Web Client, a specific menu entry for "HX Maintenance Mode" has been installed by the HyperFlex plugin. This option directs the storage platform controller on the node to shutdown gracefully, redistributing storage IO to the other nodes with minimal impact. Using the standard Maintenance Mode menu in the vSphere Web Client, or the vSphere (thick) Client can be used, but graceful failover of storage IO and shutdown of the controller VM is not guaranteed.

Note: In order to minimize the performance impact of placing a HyperFlex converged storage node into maintenance mode, it is recommended to use the HX Maintenance Mode menu selection to enter or exit maintenance mode whenever possible.

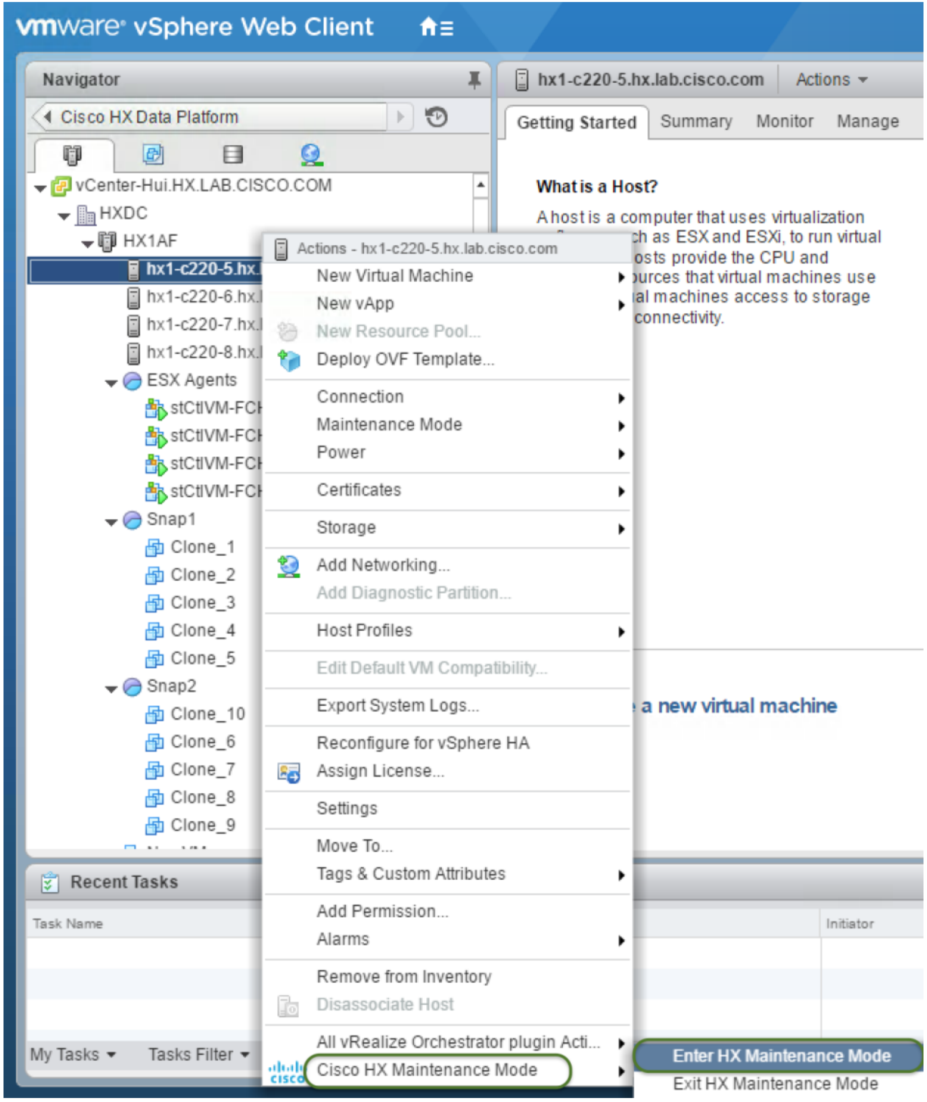
Figure 52 HyperFlex Connect - HX Maintenance Mode



Node	Hypervisor Address	Hypervisor Status	Controller Address	Controller Status	Model	Version	Disks
hx220-05	10.29.133.147	Online	192.168.51.25	Online	HX220C-M4S	2.5(1a)	7
hx220-06	10.29.133.148	Online	192.168.51.26	Online	HX220C-M4S	2.5(1a)	7
hx220-07	10.29.133.149	Online	192.168.51.27	Online	HX220C-M4S	2.5(1a)	7
hx220-08	10.29.133.150	Online	192.168.51.28	Online	HX220C-M4S	2.5(1a)	7

Showing 1 - 4 of 4

Figure 53 vCenter Web Client - HX Maintenance Mode



Encryption

HyperFlex 2.5 introduces new data protection features, including data-at-rest encryption. HyperFlex clusters can be ordered with self-encrypting disks (SED) which encrypt all of the data stored on them. A cluster using SEDs will store all of its data in an encrypted format, and the disks themselves perform the encryption and decryption functions. Since the hardware handles all the encryption and decryption functions, no additional load is placed on the CPUs of the HyperFlex nodes. Storing the data in an encrypted format prevents data loss and data theft, by making the data on the disk unreadable if it is removed from the system. This protection of the data enables HyperFlex to be used in environments where high security is required, such as healthcare providers (HIPAA), financial accounting systems (SOX), credit card transactions (PCI), and more.

Each SED contains a factory generated data encryption key (DEK) which is stored on the drive in a secured manner, and is used by the internal encryption circuitry to perform the encryption of the data. In truth, an SED always encrypts the data, but the default operation mode is known as the unlocked mode, wherein the drive can be placed into any system and the data can be read from it. To provide complete security, the SED needs to be locked, and reconfigured into what is called auto-unlock mode. This is accomplished via software, using another encryption key, called the authentication key (AK). The authentication key is generated externally from the SED and used to encrypt the DEK. When an SED operates in auto-unlock mode its DEK is encrypted, so when the SED is powered on, the AK must be provided by the system, via the disk controller, to decrypt the DEK, which then allows the data to be read. Once unlocked, the SED will continue to operate normally until it loses power, when it will automatically lock itself. If a locked SED is removed from the system, then there is no method for providing the correct AK to unlock the disk, and the data on the disk will remain encrypted and unreadable.

In order to configure a HyperFlex cluster for encryption, all of the disks on all of the nodes of the cluster must be SEDs. The authentication keys which are used to encrypt the data encryption keys on the disks must be supplied by the HyperFlex cluster. The authentication keys can be provided in one of three ways:

- Local keys in Cisco UCS Manager derived from an encryption passphrase. Local keys are simpler to configure, and are intended for use in testing, proof-of-concept builds, or environments where an external Key Management System (KMS) is not available. Local key configurations create a single authentication key (AK) which is used to encrypt all the disks on all the nodes of the cluster.

- Remote keys, where Cisco UCS Manager retrieves the keys via Key Management Interoperability Protocol (KMIP) from a remote KMS. The client/server communications between the HX nodes and the KMIP server are secured using trusted certificate authority (CA) signed keys, created from certificate signing requests (CSR). Remote key configurations create a unique authentication key for each node, and that AK is used for all disks on that node, providing an even higher level of security.

- Remote keys, where Cisco UCS Manager retrieves the keys via Key Management Interoperability Protocol (KMIP) from a remote KMS, but the client/server communications between the HX nodes and the KMIP server are secured using self-signed certificates.

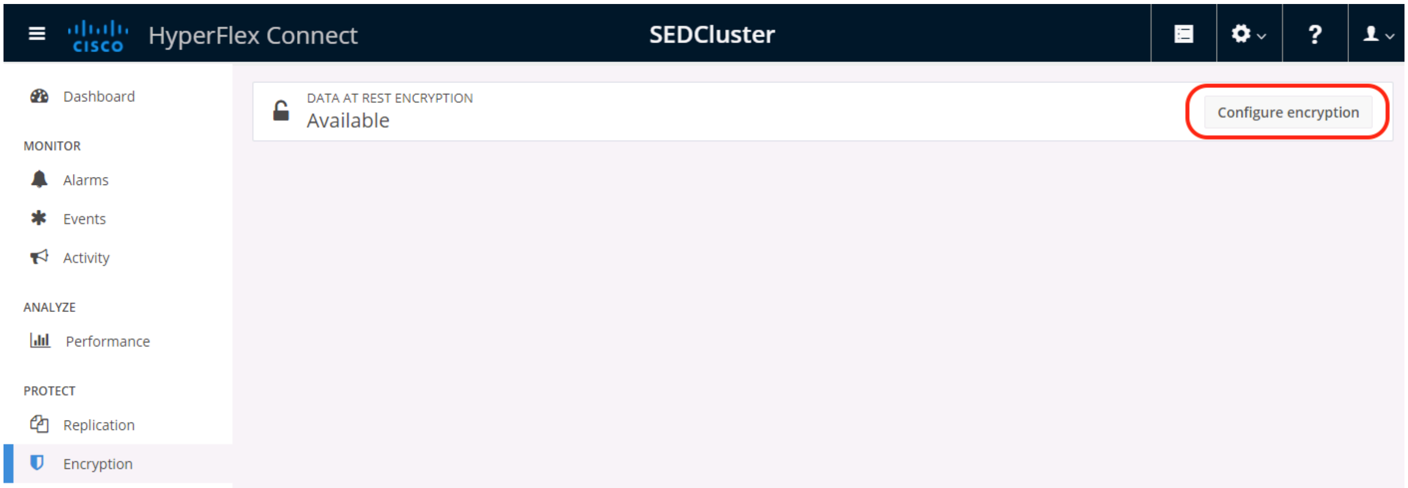
Cisco has tested remote and self-signed keys using KMS systems, including Gemalto SafeNet KeySecure, and Vormetric DSM. A large number of steps are required to perform the configuration of a certificate authority (CA), root certificates, and signing certificates. Additionally, these steps are significantly different depending on the KMS being used. Because of this, the specific steps needed to configure encryption with remote keys is not covered in this design document.

Note: The HyperFlex Connect encryption menu and configuration options are only available when the cluster contains encryption capable hardware on all of the nodes.

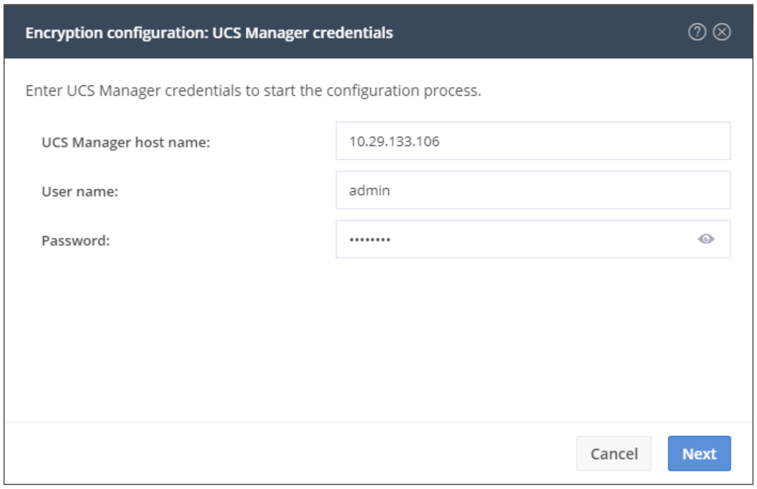
To enable encryption using locally managed keys in Cisco UCS Manager, complete the following steps:

1. Open HyperFlex Connect and log in with admin privileges.

2. Click Encryption in the menu on the left, then click the Configure encryption button.



3. Enter the Cisco UCS Manager IP address or hostname, an administrative username, and password, then click Next.



Encryption configuration: UCS Manager credentials

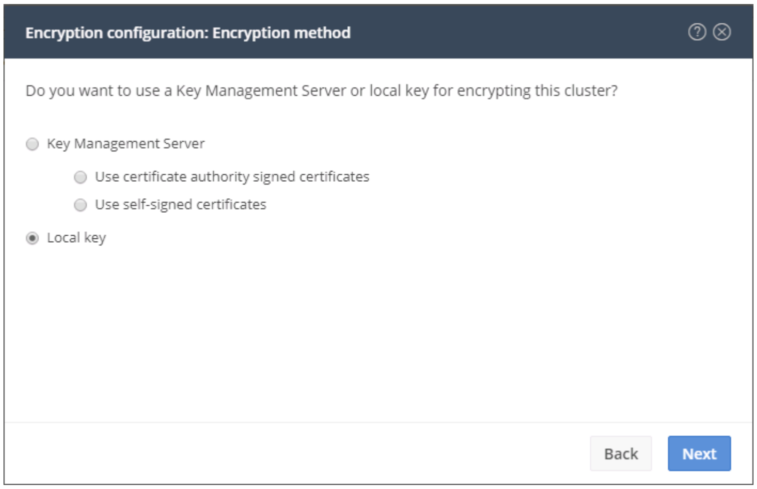
Enter UCS Manager credentials to start the configuration process.

UCS Manager host name: 10.29.133.106

User name: admin

Password: ••••••••

4. Click the option for Local key, then click Next.



Encryption configuration: Encryption method

Do you want to use a Key Management Server or local key for encrypting this cluster?

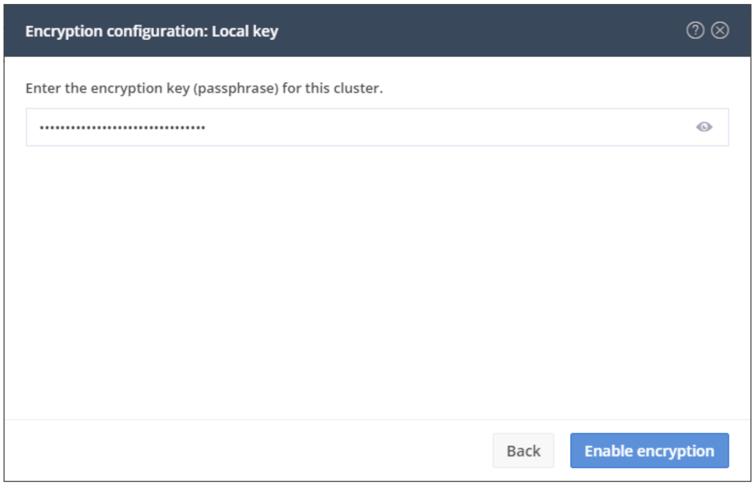
○ Key Management Server

○ Use certificate authority signed certificates

○ Use self-signed certificates

● Local key

5. Enter an encryption key passphrase, which must be exactly 32 characters long, then click Enable Encryption.



Encryption configuration: Local key

Enter the encryption key (passphrase) for this cluster.

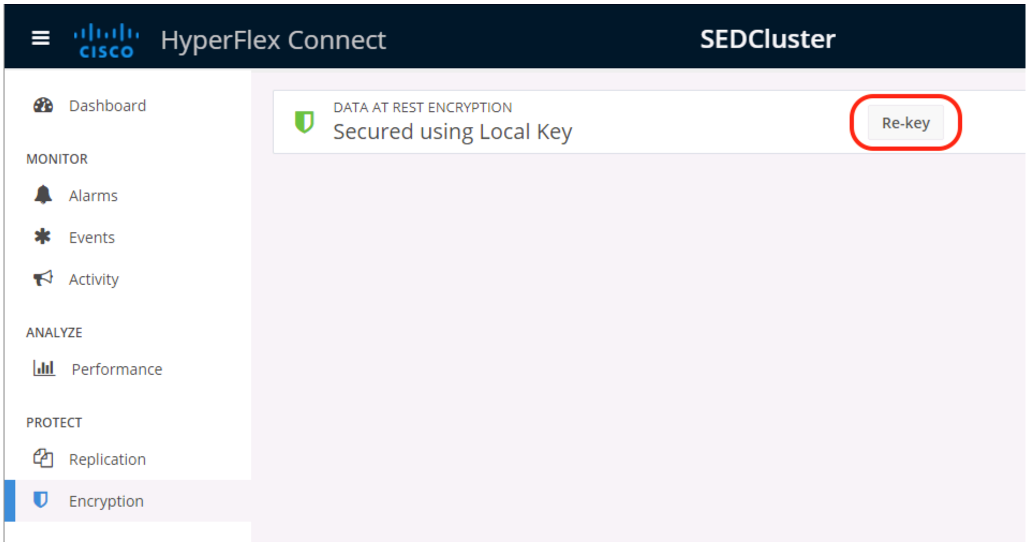
••••••••••••••••••••••••••••••••

Rekey

At any time, it may be determined for security purposes that it is necessary to regenerate the authentication keys in the cluster, which are used to unlock the encrypted contents of the disks. A rekey operation can be run to regenerate the keys, in case the existing keys may have been compromised, or as part of company policy. A rekey operation is non-destructive to the existing data, and the data remains encrypted at all times. To rekey the drives, complete the following steps:

1. Open HyperFlex Connect and log in with admin privileges.

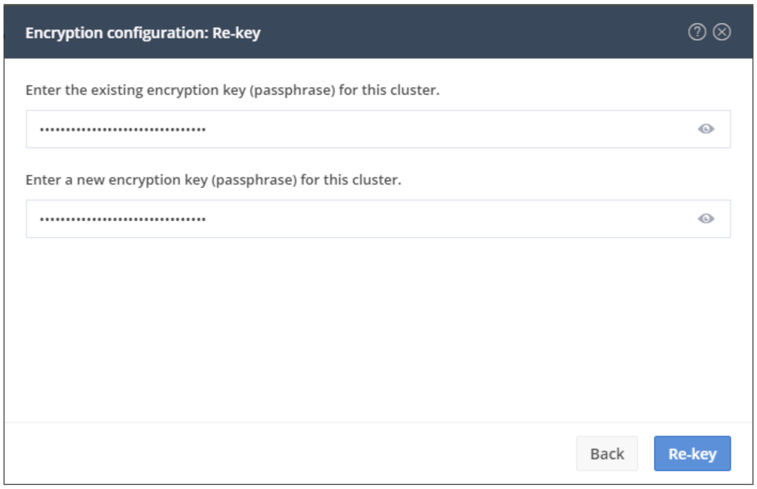
2. Click Encryption in the menu on the left, then click the Re-key button.



DATA AT REST ENCRYPTION
Secured using Local Key

3. Enter the Cisco UCS Manager IP address or hostname, an administrative username, and password, then click Next.

4. Enter the existing encryption passphrase, and a new 32 character encryption passphrase, then click Re-key.



Enter the existing encryption key (passphrase) for this cluster.

••••••••••••••••••••••••••••••••

Enter a new encryption key (passphrase) for this cluster.

••••••••••••••••••••••••••••••••

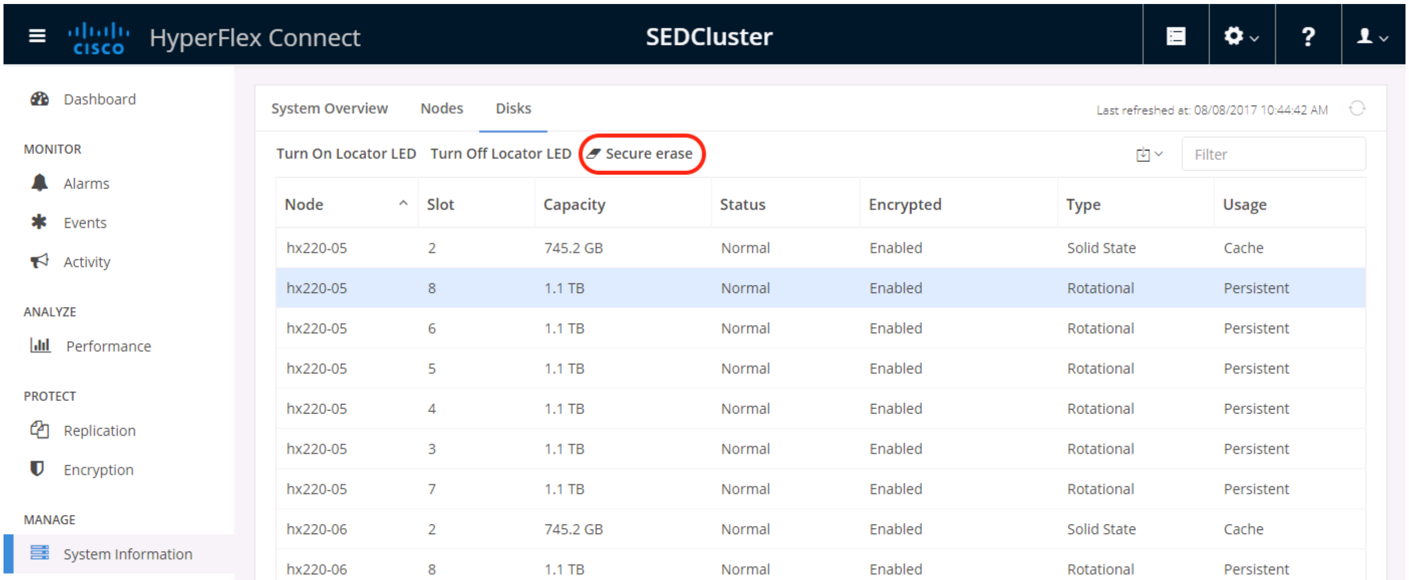
Secure Erase

If an encrypted drive is failed, a predicted failure alarm is triggered, or if a drive is otherwise going to be removed from a node, the drive can be securely erased before its removal. Erasing a drive is a destructive event to the data on that disk, however the data still exists as replicas in other locations across the cluster. A disk secure erase will trigger an event in the cluster similar to a disk failure, and the lost data segments will be recreated in other online locations in the cluster, in order to return the data to its configured replication factor. To securely erase a drive, complete the following steps:

1. Open HyperFlex Connect and log in with admin privileges.

2. Click System Information in the menu on the left, then click Disks.

3. Highlight the disk to be erased, then click Secure Erase.



Node	Slot	Capacity	Status	Encrypted	Type	Usage
hx220-05	2	745.2 GB	Normal	Enabled	Solid State	Cache
hx220-05	8	1.1 TB	Normal	Enabled	Rotational	Persistent
hx220-05	6	1.1 TB	Normal	Enabled	Rotational	Persistent
hx220-05	5	1.1 TB	Normal	Enabled	Rotational	Persistent
hx220-05	4	1.1 TB	Normal	Enabled	Rotational	Persistent
hx220-05	3	1.1 TB	Normal	Enabled	Rotational	Persistent
hx220-05	7	1.1 TB	Normal	Enabled	Rotational	Persistent
hx220-06	2	745.2 GB	Normal	Enabled	Solid State	Cache
hx220-06	8	1.1 TB	Normal	Enabled	Rotational	Persistent

4. For a cluster using local encryption keys, enter the encryption passphrase, for remote key configurations, no action is necessary.

5. Click Secure Erase.

6. Click “Yes, erase this disk” at the confirmation pop-up.

7. When complete, the disk status will change to “Ok to remove”.

8. Remove the disk from the HX node.

Warning: If an SED is securely erased, it cannot be put back into service in the same or even a different HX cluster. The only method to reuse an erased SED is to insert the drive into an HX node and install/reinstall that cluster from scratch.

Replication

HyperFlex 2.5 introduces new data protection features, including snapshot-based VM level replication between two HyperFlex clusters. Replication can be used to migrate or recover a single VM in the secondary HX cluster, groups of VMs can be coordinated and recovered, or all VMs can be recovered as part of a disaster recovery scenario. In order to start using replication, two HyperFlex clusters must be installed and have network connectivity between them. The clusters must both be either extended clusters, or all-flash clusters, it is not possible to replicate between hybrid and all-flash clusters. The clusters are allowed to use self-encrypting disks or standard disks in either location, both of them, or none of them, there is no restriction in that respect. To avoid complications with duplicate VM IDs, it is recommended that the two replicating HyperFlex clusters be managed by two different VMware vCenter servers.

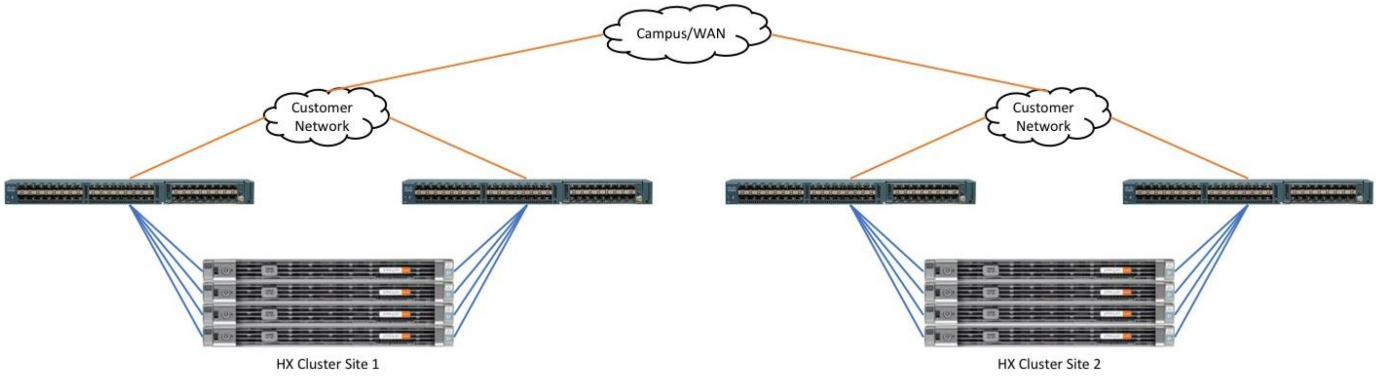
After a HyperFlex cluster is installed, none of the networking configuration required for replication is in place. In order to use replication, the replication networking must first be configured in HyperFlex Connect, which automates the changes in Cisco UCS Manager, configures the ESXi port groups, and assigns the new replication IP addresses to the SCVMs. Once the networking configuration work is completed for both clusters that will replicate to each other, a partnership, or pairing between the two clusters is established in HyperFlex Connect. After this replication pair is established, VMs can be protected individually, or they can be placed into protection groups, which are created to protect multiple VMs with the same replication settings. VMs can be replicated in intervals as often as once per 15 minutes, up to once per 24 hours, which is analogous to the Recovery Point Objective (RPO). Care must be taken to ensure that the two clusters have enough storage capacity to store the replicated snapshots of the remote cluster's VMs, and also have enough CPU and RAM resources to run those VMs in case they must be recovered. HyperFlex Connect can be used to monitor the status of the protected VMs. Protected VMs can be recovered in the secondary site via the HyperFlex CLI using the stcli command line tool.

Replication Networking

The two HyperFlex clusters that will replicate must have TCP/IP connectivity between them, and additional IP addresses must be provided to an internal IP address pool that the HX SCVMs will use. The minimum number of IP addresses required is the number of nodes in the cluster, plus 1 additional address. More addresses than are currently needed can be placed into the pool to allow for future growth of the HX cluster. An existing VLAN ID and subnet can be used, although it is more typical to configure a specific VLAN and subnet to carry replication traffic that will traverse the campus or WAN links between the two clusters. The VLANs that will be used for replication traffic must already be trunked to the Cisco UCS Fabric Interconnects from the northbound network by the upstream switches, and this configuration step must be done manually prior to beginning the HyperFlex Connect configuration. The bandwidth usage of the replication traffic can be set to a limit so as not to saturate the interconnecting network links, or it may be left unlimited. The bandwidth consumption will be directly affected by the number of VMs being protected, and the frequency of their replication.

The interconnection between the two clusters at the two sites can be done in several ways. In most cases, the uplinks from the HX clusters will carry all the needed VLAN IDs on the same set of interfaces, including HX management, vMotion, storage traffic, guest VM traffic, and the replication traffic. In some cases, it is desired that the replication traffic will traverse a set of independent uplinks, which is referred to as a split L2 topology. Due to a technical limitation of implementing a split L2 topology, the configuration of replication networking cannot accommodate a split L2 configuration. Specifically, a single UCS vNIC cannot carry multiple VLANs that traverse multiple uplink groups. Since the default configuration uses vmnic0 and vmnic1 to carry HX management traffic and replication traffic, both of those VLANs must arrive to UCS across a single set of uplinks. The replication subnets and VLANs used in the two sites can be different routed subnets, or they can be a single subnet if other technologies, such as OTV, are in use by the WAN. Replication traffic originates and terminates on the SCVMs running on each HX host.

Figure 54 Replication Networking

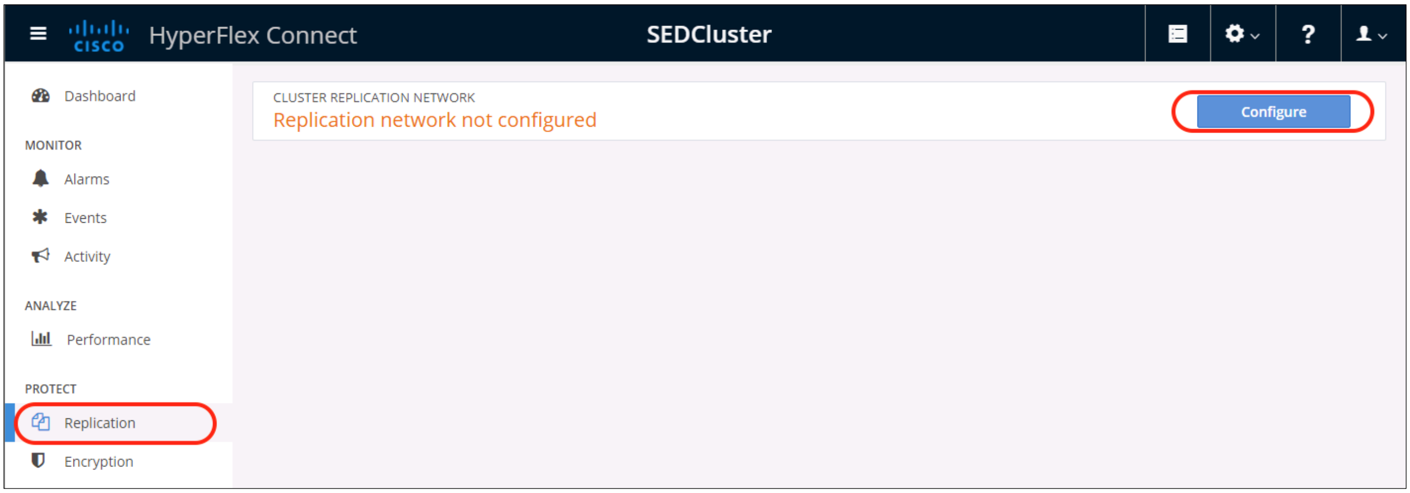


Configuring replication networking in HyperFlex Connect automates the following tasks:

- Creates the replication VLAN in Cisco UCS Manager.
- Adds the new replication VLAN to the VNIC templates named hv-mgmt-a and hv-mgmt-b in the appropriate sub-organization in Cisco UCS Manager.
- Sets the VLAN ID of the Storage Controller Replication Network port group on all ESXi nodes.
- Creates a pool of IP addresses internal to the HyperFlex cluster, from which each SCVM will draw one IP address, plus 1 additional IP will be used as a roaming clustered address.
- Instructs the SCVMs to request an individual IP address, and configures the clustered IP address.

To configure the replication network, complete the following steps:

1. Open HyperFlex Connect and log in with admin privileges.
2. Click Replication in the menu on the left, then click the Configure button.



CLUSTER REPLICATION NETWORK
Replication network not configured

3. Enter the VLAN name and VLAN ID that will be created in Cisco UCS Manager, and assigned to the Storage Controller Replication Network port group on the ESXi hosts.

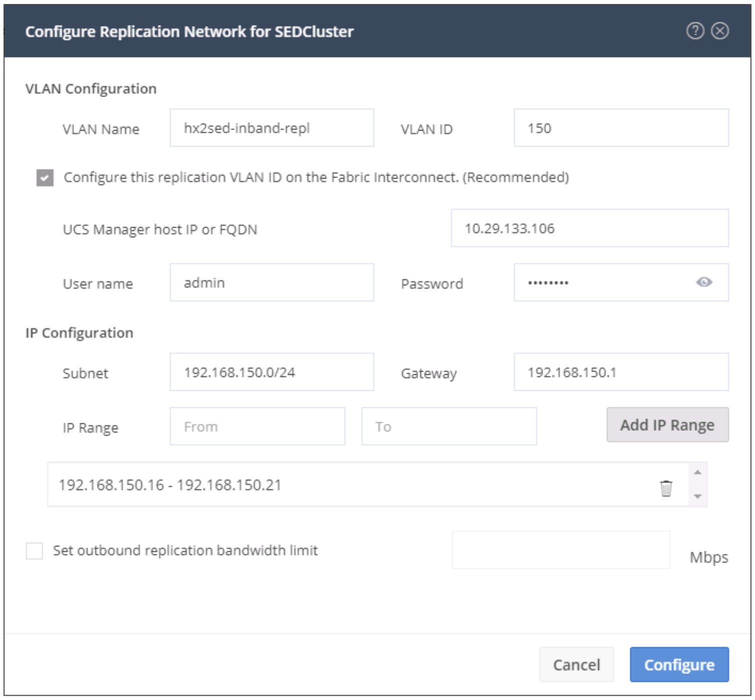
4. Enter the Cisco UCS Manager IP address or hostname, an administrative username, and password.

5. Enter the replication subnet in CIDR notation, i.e. a.b.c.d/n, and the gateway IP address for the subnet.

6. Enter the starting and ending IP addresses for the range that will be added to the pool assigned to the SCVMs, and click the Add button.

7. If outbound bandwidth limits must be set, check the box to enable it and enter a value between 10 and 100,000 Mbps. Cisco recommends limiting the bandwidth to 1000 Mbps or less.

8. Click Configure.



Configure Replication Network for SEDCluster

VLAN Configuration

VLAN Name: hx2sed-inband-repl
VLAN ID: 150

☑ Configure this replication VLAN ID on the Fabric Interconnect. (Recommended)

UCS Manager host IP or FQDN: 10.29.133.106

User name: admin
Password: ••••••••

IP Configuration

Subnet: 192.168.150.0/24
Gateway: 192.168.150.1

IP Range: From To

192.168.150.16 - 192.168.150.21

□ Set outbound replication bandwidth limit Mbps

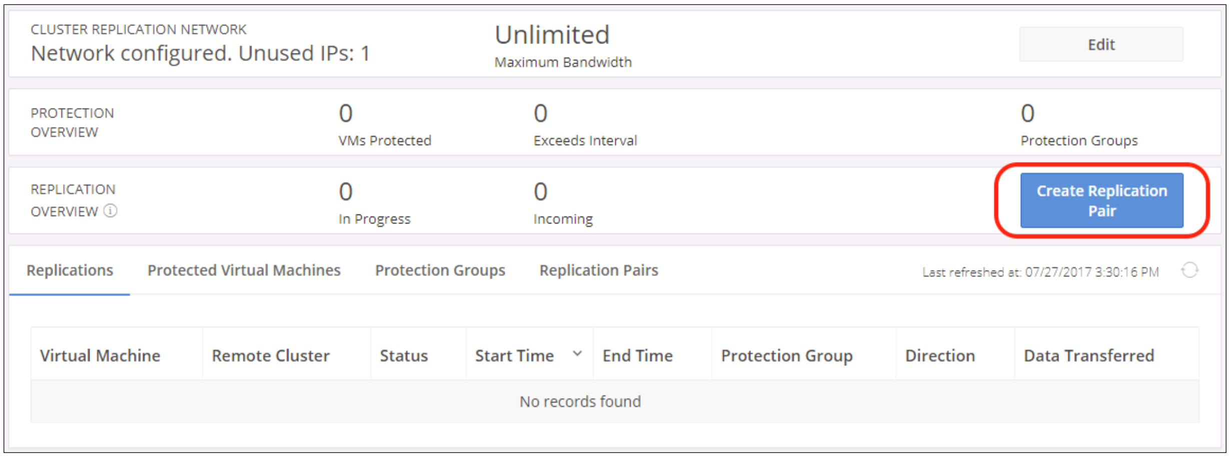
Replication Pairing

The two HyperFlex clusters that will be able to replicate VMs to each other must first be paired before the replication can begin. Prior to pairing, the replication networking on both clusters must be configured and datastores must have been created on both clusters. You must know the administrative login credentials of the remote cluster, and the remote cluster's management IP address in order to proceed.

To configure the replication pair, perform the following steps:

1. Open HyperFlex Connect and log in with admin privileges.

2. Click Replication in the menu on the left, then click the Create Replication Pair button.



CLUSTER REPLICATION NETWORK
Network configured. Unused IPs: 1

Unlimited
Maximum Bandwidth

Edit

PROTECTION OVERVIEW — 0 VMs Protected — 0 Exceeds Interval — 0 Protection Groups

REPLICATION OVERVIEW — 0 In Progress — 0 Incoming

Create Replication Pair

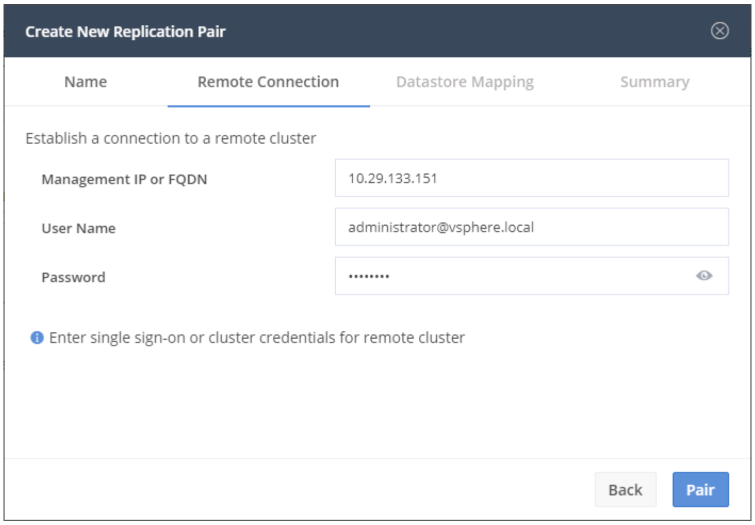
Replications | Protected Virtual Machines | Protection Groups | Replication Pairs

Last refreshed at: 07/27/2017 3:30:16 PM

Virtual Machine	Remote Cluster	Status	Start Time	End Time	Protection Group	Direction	Data Transferred
No records found							

3. Enter a name for the replication pair, then click Next.

4. Enter the cluster management IP address for the remote cluster, the username, and the password, then click Pair. The username and password must have admin rights in the vCenter server managing the remote cluster.



Create New Replication Pair

Name | Remote Connection | Datastore Mapping | Summary

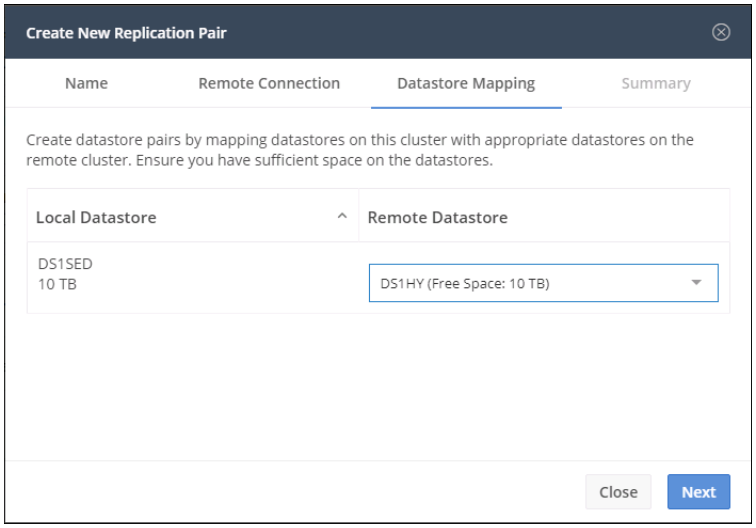
Establish a connection to a remote cluster

Management IP or FQDN	10.29.133.151
User Name	administrator@vsphere.local
Password	••••••••

Enter single sign-on or cluster credentials for remote cluster

Back Pair

5. Pick the local datastore and remote datastore to pair on the two clusters, then click Next.



Create datastore pairs by mapping datastores on this cluster with appropriate datastores on the remote cluster. Ensure you have sufficient space on the datastores.

Local Datastore	Remote Datastore
DS1SED 10 TB	DS1HY (Free Space: 10 TB)

6. At the summary screen, click Map Datastores.

Protection Groups

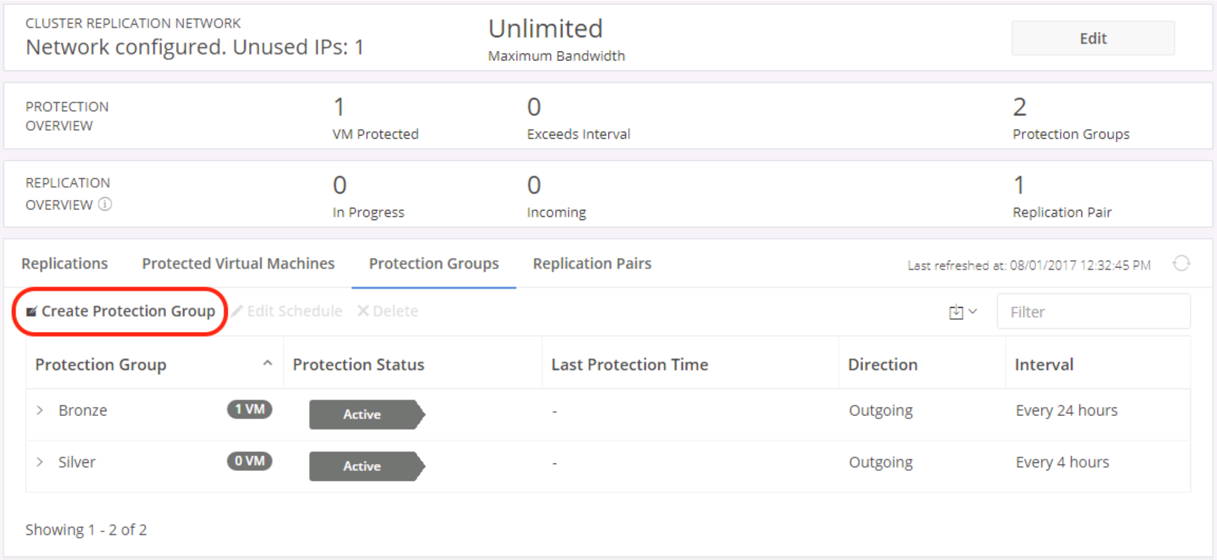
Once a replication pair is established, and datastores are mapped to each other across two HX clusters, VM Protection can be configured. VMs can be protected individually, or they can be added to a new or existing Protection Group. Protection Groups can be created to allow for a common configuration of replication parameters to be applied to a collection of VMs, without configuring them individually. A good example would be creating multiple Protection Groups for several classes of protection, each with a different replication schedule, such as a “Gold” group with a 15-minute schedule, a “Silver” group with a 2 or 4 hour schedule, and a “Bronze” group with a 12 or 24 hour schedule.

Migration or recovery operations can be carried out against an entire protection group. If a protection group is halted, marking it for recovery, then all VMs within the group must be recovered on the secondary, or target cluster. If a VM is a member of a protection group, it cannot be individually migrated or recovered. If an individual VM must be migrated or recovered, but it is a member of a protection group, that VM must be removed from the group, thereby unprotecting it, then it must be individually protected again. Care must be taken that the individual protection replicates at least one snapshot before attempting a migration or recovery.

To create a Protection Group, complete the following steps:

1. Open HyperFlex Connect and log in with admin privileges.

2. Click Replication in the menu on the left, then click Protection Groups, then click Create Protection Group.



CLUSTER REPLICATION NETWORK
Network configured. Unused IPs: 1

Unlimited
Maximum Bandwidth

PROTECTION OVERVIEW: 1 VM Protected; 0 Exceeds Interval; 2 Protection Groups

REPLICATION OVERVIEW: 0 In Progress; 0 Incoming; 1 Replication Pair

Last refreshed at: 08/01/2017 12:32:45 PM

Protection Group	Protection Status	Last Protection Time	Direction	Interval
Bronze 1 VM	Active	-	Outgoing	Every 24 hours
Silver 0 VM	Active	-	Outgoing	Every 4 hours

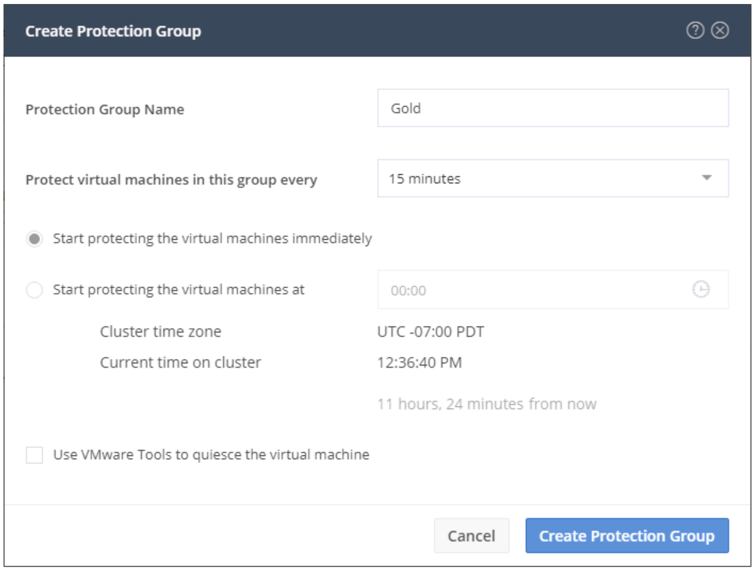
Showing 1 - 2 of 2

3. Enter a name for the group.

4. Choose the replication interval from the drop-down menu.

5. Choose a time for the replication to start, either immediately or at a future time.

6. Check the box if you wish to quiesce the VM's activity via VMware Tools during the snapshot, then click Create Protection Group.



Create Protection Group

Protection Group Name: Gold

Protect virtual machines in this group every: 15 minutes

● Start protecting the virtual machines immediately

○ Start protecting the virtual machines at 00:00

Cluster time zone: UTC -07:00 PDT

Current time on cluster: 12:36:40 PM

11 hours, 24 minutes from now

□ Use VMware Tools to quiesce the virtual machine

Virtual Machine Protection

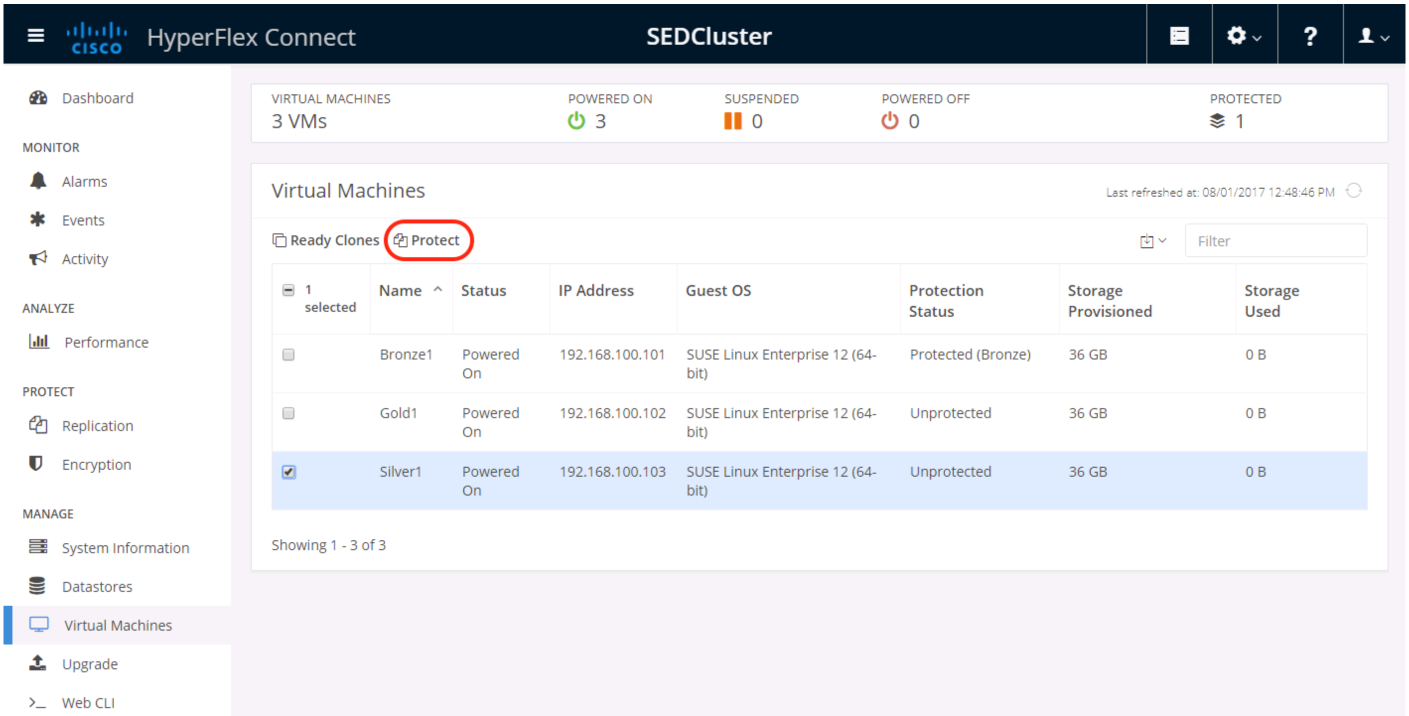
Virtual machines can be configured for protection, i.e. replication, individually, or be placed into a Protection Group. The protection settings that can be configured on an individual VM are the same as the settings that are configured for a protection group. In most cases, it is easier to configure multiple Protection Groups, each with the settings that are required, and then add VMs to those groups. This process simplifies operations and ensures that replication schedules are not set improperly.

To protect a virtual machine, or group of virtual machines, complete the following steps:

1. Open HyperFlex Connect and log in with admin privileges.

2. Click Virtual Machines in the menu on the left.

3. Check the box next to one or more VMs in the list, then click Protect.



VIRTUAL MACHINES	POWERED ON	SUSPENDED	POWERED OFF	PROTECTED
3 VMs	3	0	0	1

Virtual Machines

Last refreshed at: 08/01/2017 12:48:46 PM

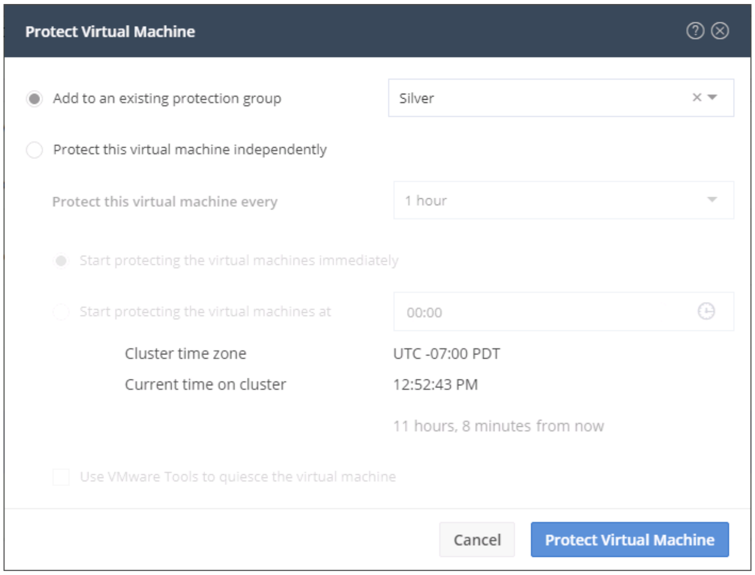
⊟ 1 selected	Name ^	Status	IP Address	Guest OS	Protection Status	Storage Provisioned	Storage Used
□	Bronze1	Powered On	192.168.100.101	SUSE Linux Enterprise 12 (64-bit)	Protected (Bronze)	36 GB	0 B
□	Gold1	Powered On	192.168.100.102	SUSE Linux Enterprise 12 (64-bit)	Unprotected	36 GB	0 B
☑	Silver1	Powered On	192.168.100.103	SUSE Linux Enterprise 12 (64-bit)	Unprotected	36 GB	0 B

Showing 1 - 3 of 3

4. Choose the option Add to an existing protection group, and choose the group to add the VM(s) to, then click Protect Virtual Machine.

   Or

5. Choose the option Protect this virtual machine independently, then choose the replication interval, choose a time for the replication to start, either immediately or at a future time, and choose if you would like to use the VMware Tools to quiesce the virtual machines, then click Protect Virtual Machine.



Protect Virtual Machine

- ● Add to an existing protection group: Silver
- ○ Protect this virtual machine independently

Protect this virtual machine every: 1 hour

- ● Start protecting the virtual machines immediately
- ○ Start protecting the virtual machines at: 00:00

Cluster time zone: UTC -07:00 PDT

Current time on cluster: 12:52:43 PM

11 hours, 8 minutes from now

□ Use VMware Tools to quiesce the virtual machine

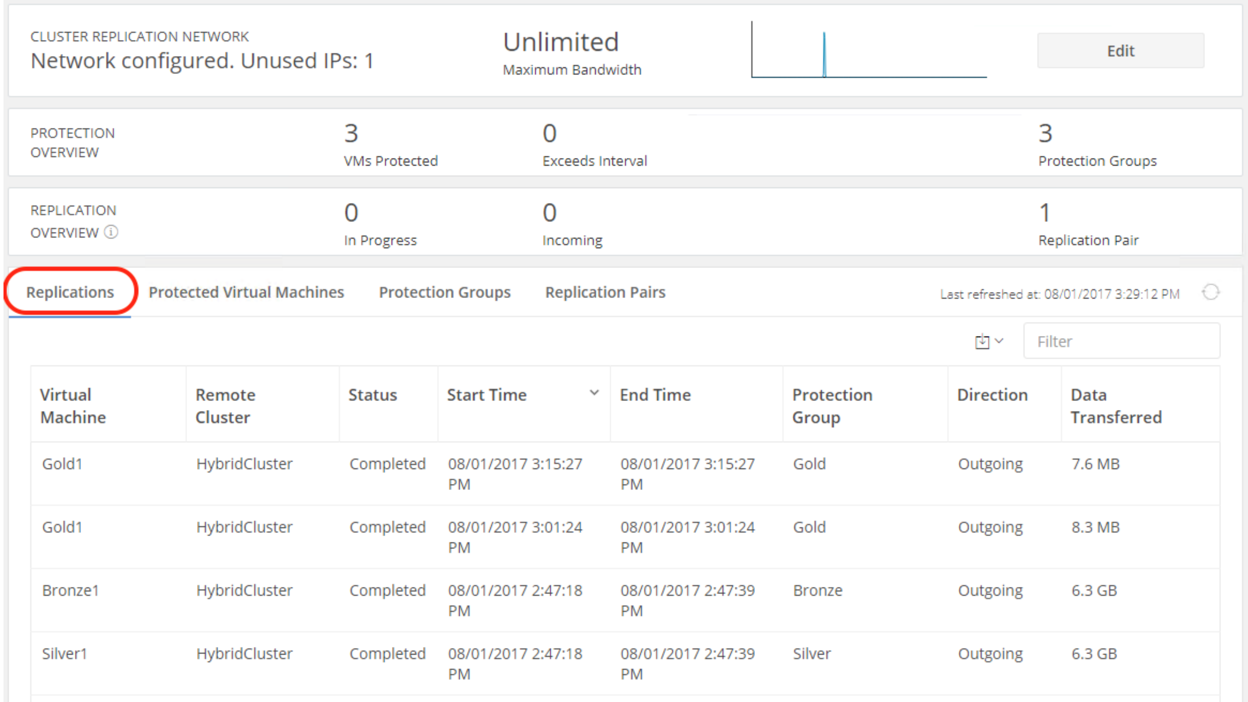
Note: When selecting multiple VMs to protect, the only options available are to place those VMs into a protection group, or create a new protection group. To protect multiple VMs with individual settings, each VM must be configured for protection, one-by-one.

Replication Monitoring

The HyperFlex Connect HTML GUI can be used to monitor the status of ongoing VM protection and replication.

The Replications view shows the status of each individual snapshot replication operation.

Figure 55 Source Replications View



CLUSTER REPLICATION NETWORK
Network configured. Unused IPs: 1

Unlimited
Maximum Bandwidth

PROTECTION OVERVIEW: 3 VMs Protected; 0 Exceeds Interval; 3 Protection Groups

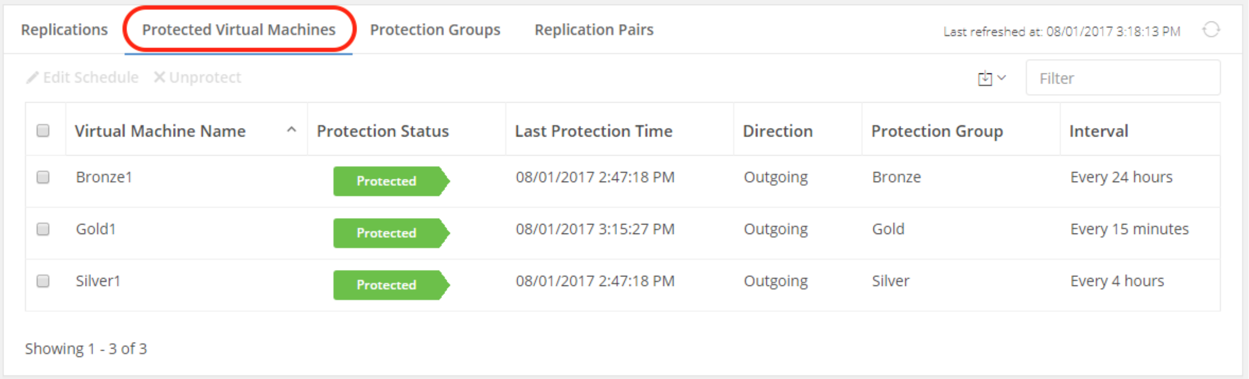
REPLICATION OVERVIEW: 0 In Progress; 0 Incoming; 1 Replication Pair

Replications
Protected Virtual Machines
Protection Groups
Replication Pairs
Last refreshed at: 08/01/2017 3:29:12 PM
Filter

Virtual Machine	Remote Cluster	Status	Start Time	End Time	Protection Group	Direction	Data Transferred
Gold1	HybridCluster	Completed	08/01/2017 3:15:27 PM	08/01/2017 3:15:27 PM	Gold	Outgoing	7.6 MB
Gold1	HybridCluster	Completed	08/01/2017 3:01:24 PM	08/01/2017 3:01:24 PM	Gold	Outgoing	8.3 MB
Bronze1	HybridCluster	Completed	08/01/2017 2:47:18 PM	08/01/2017 2:47:39 PM	Bronze	Outgoing	6.3 GB
Silver1	HybridCluster	Completed	08/01/2017 2:47:18 PM	08/01/2017 2:47:39 PM	Silver	Outgoing	6.3 GB

The Protected Virtual Machines View shows the protection status of all VMs which have been configured for protection. The green Protected icon indicates that the VM is being successfully protected according to the configured replication interval, or RPO.

Figure 56 Source Protected Virtual Machines



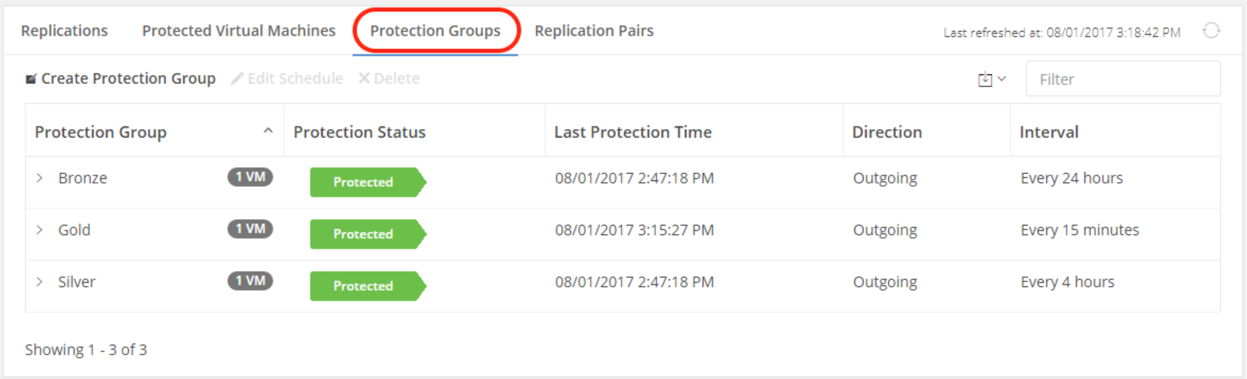
Last refreshed at: 08/01/2017 3:18:13 PM

□	Virtual Machine Name	Protection Status	Last Protection Time	Direction	Protection Group	Interval
□	Bronze1	Protected	08/01/2017 2:47:18 PM	Outgoing	Bronze	Every 24 hours
□	Gold1	Protected	08/01/2017 3:15:27 PM	Outgoing	Gold	Every 15 minutes
□	Silver1	Protected	08/01/2017 2:47:18 PM	Outgoing	Silver	Every 4 hours

Showing 1 - 3 of 3

The Protection Groups view will indicate the status of all VMs that are members of a Protection Group. The Protection Groups can be expanded by clicking on the carat on the left-hand side, to see the status of the individual VMs in that Protection Group.

Figure 57 Source Protection Groups



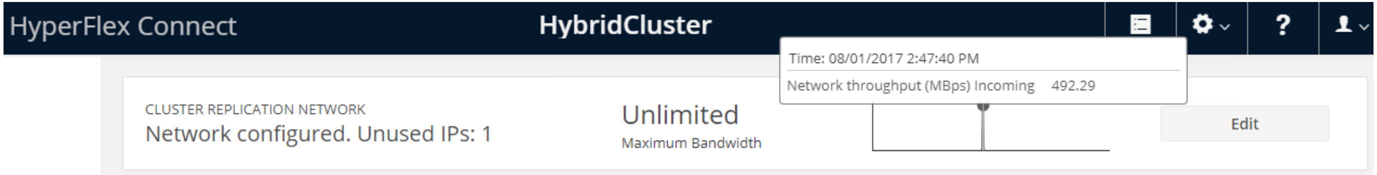
Last refreshed at: 08/01/2017 3:18:42 PM

Protection Group	Protection Status	Last Protection Time	Direction	Interval
› Bronze 1 VM	Protected	08/01/2017 2:47:18 PM	Outgoing	Every 24 hours
› Gold 1 VM	Protected	08/01/2017 3:15:27 PM	Outgoing	Every 15 minutes
› Silver 1 VM	Protected	08/01/2017 2:47:18 PM	Outgoing	Every 4 hours

Showing 1 - 3 of 3

The Bandwidth Monitor in the upper right-hand corner can be hovered over to see a pop-up box indicating the replication bandwidth used, or the graph can be clicked on to see an expanded view of the bandwidth consumed by the outgoing or incoming replication traffic.

Figure 58 Bandwidth Monitor



Time: 08/01/2017 2:47:40 PM

Network throughput (MBps) Incoming 492.29

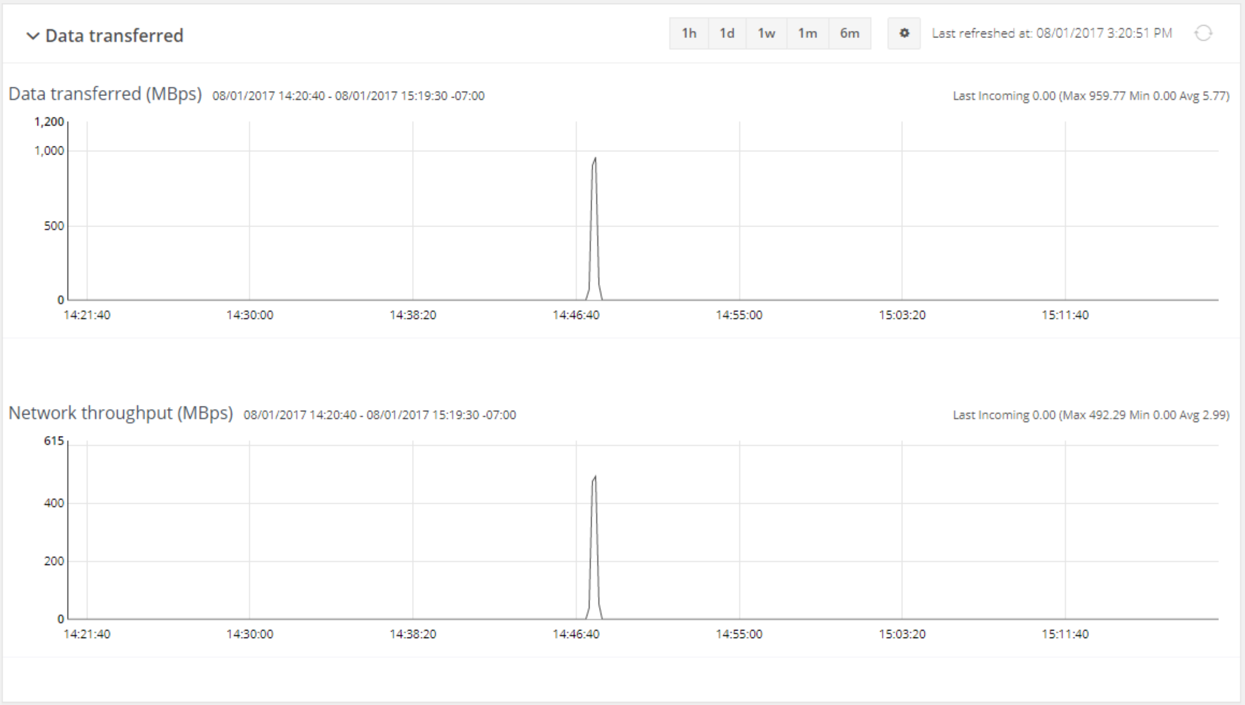
CLUSTER REPLICATION NETWORK

Network configured. Unused IPs: 1

Unlimited

Maximum Bandwidth

Figure 59 Bandwidth Charts


Data transferred
1h
1d
1w
1m
6m
Last refreshed at: 08/01/2017 3:20:51 PM
Data transferred (MBps) 08/01/2017 14:20:40 - 08/01/2017 15:19:30 -07:00
Last Incoming 0.00 (Max 959.77 Min 0.00 Avg 5.77)
1,200
1,000
500
0
14:21:40
14:30:00
14:38:20
14:46:40
14:55:00
15:03:20
15:11:40
Network throughput (MBps) 08/01/2017 14:20:40 - 08/01/2017 15:19:30 -07:00
Last Incoming 0.00 (Max 492.29 Min 0.00 Avg 2.99)
615
400
200
0
14:21:40
14:30:00
14:38:20
14:46:40
14:55:00
15:03:20
15:11:40

All of the replication monitoring views can also be accessed via the secondary, or target HX cluster, and the same VMs and protection groups will be presented, only as incoming VMs and groups instead of outgoing. Two paired HX clusters can replicate VMs in both directions, therefore the replication status of all VMs and Protection Groups, incoming and outgoing, are presented in the replication monitor of both clusters.

Replication Management

Once configured, replication will run continuously in the background according to the configured schedules for the VMs and Protection Groups. If it is necessary to pause replication, for example during a maintenance activity such as an upgrade, replication can be paused and resumed via the HyperFlex CLI.

To pause replication, complete the following steps:

1. Log in to the HyperFlex cluster’s management IP address via SSH as root.
2. At the command line, enter the command:

```
stcli dp schedule pause
```

To resume replication, complete the following steps:

3. Log in to the HyperFlex cluster’s management IP address via SSH as root.
4. At the command line, enter the command:

```
stcli dp schedule resume
```

Virtual Machine Recovery Operations

The snapshots taken by the HX Data Protection engine are separate from the HyperFlex native snapshots. Data Protection snapshots are triggered and tracked by the HX Data Platform software internally, and can only be used for the recovery of a virtual machine in the secondary, or target paired HX cluster. These snapshots are not visible in the snapshot manager of the VMware vSphere Web Client, the C# (thick) vSphere Client, or HTML5 vSphere Client, therefore they cannot be used to roll back a VM to an earlier state in the primary cluster location. In order to have the ability to roll back a VM to an earlier snapshot in the primary, or source location, HX snapshots must be scheduled on the VMs in addition to the Data Protection replication snapshots.

Virtual Machine Migration

When routine scheduled maintenance activities are required, or for other management purposes, virtual machines can be migrated from the source cluster to the target cluster. Migration of a virtual machine leaves the replication pairing between the two clusters in place, so that the VM can be protected again in the opposite direction of the original replication. As an overview of the process, a VM migration includes:

- Stopping the replication of the specific VM to be migrated.
- Shutting down the VM in the primary, or source HX cluster.
- Performing a recovery of the VM on the secondary, or target cluster.
- Unprotecting the VM to remove the replication configuration of that VM.
- Deleting the original source VM.
- Protecting the VM, replicating the VM from the secondary cluster, back to the original cluster.

Virtual machine migration and recovery operations are executed via the HyperFlex CLI. To perform a virtual machine migration, complete the following steps:

1. Log in to the secondary, or target HyperFlex cluster's management IP address via SSH as root.

1. List the virtual machines being replicated by entering the CLI command:

```
stcli dp vm list --brief
```

2. Determine the VM to be migrated and copy the UUID listed from the output of the previous command.

3. Alternatively, the UUIDs for the Protection Group itself, and all the VMs in the group can be found in the output from running the following CLI command:

```
stcli dp group list --groupname <<GROUP_NAME>>

vmGroupEr:
    type: dp_vmgroup
    id: 8b9fa36f-13a2-4199-9147-b39bc31b6162
    name: Silver
members:
    ----------------------------------------
    idtype: 2
    type: dp_vm
    id: 421a0ff3-a147-9ae8-881c-f91cf822e273
    name: Silver1
    ----------------------------------------
    idtype: 2
```

```
type: dp_vm
id: 421a38da-5c4a-e843-0728-583e317a7ad5
name: Bronze1
----------------------------------------
```

4. Halt the VM replication by entering the following command:

```
stcli dp vm halt --vmid <<VM_UUID>>
```

5. Alternatively, if the VMs are part of a Protection Group, the Protection Group must be halted using the following command:

```
stcli dp group halt --groupid <<GROUP_ID>>
```

Warning: If a Protection Group is halted, all VMs in that group must be migrated or recovered. There is no way to resume replication of a Protection Group once it has been halted. If a single VM needs to be migrated, and it is part of a Protection Group, the VM must be removed from the group and protected individually before attempting to migrate or recover the VM.

6. Verify the status of the VM or Protection Group shows Halted in HyperFlex Connect of both the source and target clusters.

7. Shut down the source VM in the primary, or source cluster, using the vSphere Web Client, or the HTML5 vSphere Client.

8. Run the migration by entering the CLI command:

```
stcli dp vm recover failover --vmid <<VM_UUID>>
```

Additional CLI syntax switches are available during a VM recovery operation:

Option	Required	Description
--vmid	Yes	Perform the recovery on the VM with the provided BIOS UUID.
--resourcepool-id	No	Place the recovered VM(s) in the resource pool with the specified ID. Specify a resource pool or folder, but not both.
--resourcepool-name	No	Place the recovered VM(s) in the resource pool with the specified name. Specify a resource pool or folder, but not both.
--folder-id	No	Place the recovered VM(s) in the folder with the specified ID. Specify a resource pool or folder, but not both.
--folder-name	No	Place the recovered VM(s) in the folder with the specified name. Specify a resource pool or folder, but not both.
--network-mapping	No	Modify the source VM to recovered VM network port group mapping. Use the format: `source_network:destination_network`
--poweron	No	Power on the recovered VM after the recovery job completes.
--force	No	Force the recovery job to run without validation of the arguments.

Note: Protection Groups can be recovered; however, the process involves recovering all of the VMs within the group one at a time. Each VM recovery must be completed before beginning the next recovery, in a serial fashion. Parallel recovery operations of multiple VMs within the same Protection Group are not supported. Recovery of multiple VMs in parallel can be done as long as each VM is a member of a separate Protection Group. For example, parallel recovery of 1 VM in the Bronze Protection Group and 1 VM in the Silver Protection Group can be done.

---

9. The recovery failover command will output a job ID for the operation. To view the status of the recovery job, copy the job ID and enter the CLI command:

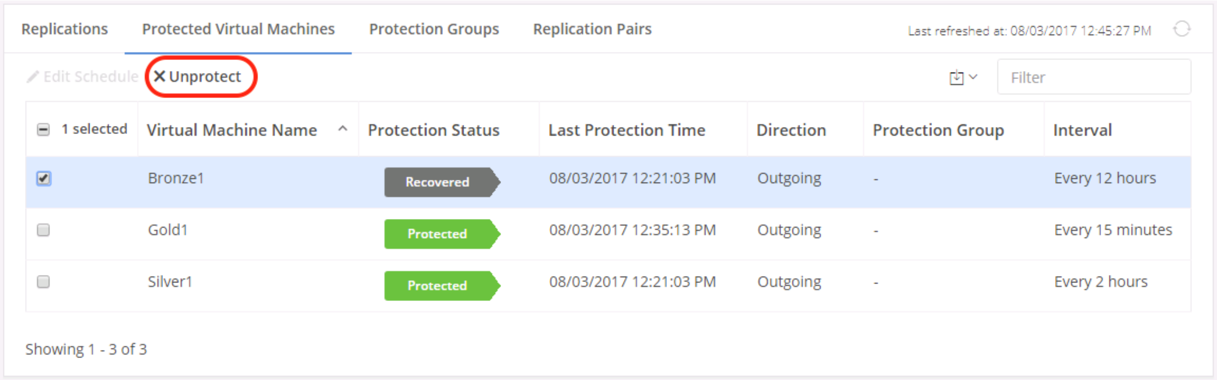
   ```
   stcli dp vm recover status --id <<JOB_ID>>
   ```

10. Once the job completes, verify the status of the VM shows Recovered in HyperFlex Connect of both the source and target clusters.

11. Power on the migrated VM via the vSphere Web Client or the HTML5 vSphere Client to test its functionality.

12. Perform any necessary post-recovery tasks on the VM, such as changing IP addresses, or updating DNS records, in order to make the VM and its applications available on the network.

13. From the HyperFlex Connect Replication page of the primary, or source cluster, click the Protected Virtual Machines menu, select the VM that was recovered, then click Unprotect. Alternatively, the VM protection can be removed via the CLI from the primary, or source cluster, using the “stcli dp vm delete” command.



☐ 1 selected	Virtual Machine Name	Protection Status	Last Protection Time	Direction	Protection Group	Interval
☑	Bronze1	Recovered	08/03/2017 12:21:03 PM	Outgoing	-	Every 12 hours
☐	Gold1	Protected	08/03/2017 12:35:13 PM	Outgoing	-	Every 15 minutes
☐	Silver1	Protected	08/03/2017 12:21:03 PM	Outgoing	-	Every 2 hours

Showing 1 - 3 of 3

14. Delete the source VM in the primary, or source cluster, using the vSphere Web Client, or the HTML5 vSphere Client.

15. Repeat steps 2 – 14 for each VM you wish to migrate.

16. If an entire Protection Group was migrated, once all the VMs have been recovered in the secondary, or target cluster, the Protection Group status will show as Recovered. The Protection Group must be deleted from the primary, or source cluster, as it is no longer possible to add VMs to a recovered group, nor is it possible to make the group active again.

17. Optionally, use HyperFlex Connect to reconfigure protection for the migrated VM(s), only now the protection would be in the opposite direction of the previous snapshots.

An example of the command line activities is given below:

```
# stcli dp vm list --brief
vmInfo:
    ----------------------------------------
```

```
    name: Bronze1
    uuid: 421a38da-5c4a-e843-0728-583e317a7ad5
    ----------------------------------------
    name: Gold1
    uuid: 421a8b07-6111-6701-9331-f418d88d8b4f
    ----------------------------------------
    name: Silver1
    uuid: 421a0ff3-a147-9ae8-881c-f91cf822e273
    ----------------------------------------

# stcli dp vm halt --vmid 421a38da-5c4a-e843-0728-583e317a7ad5
# stcli dp vm recover failover --vmid 421a38da-5c4a-e843-0728-583e317a7ad5
3976d406-e13a-4e5c-8f45-3577237436ca
# stcli dp vm recover status --id 3976d406-e13a-4e5c-8f45-3577237436ca
summary_step_state: SUCCEEDED
Description: Successfully completed Failover recovery for VMID 421a38da-5c4a-e843-0728-
583e317a7ad5
time_submitted: 08/03/17_19:39
time_elapsed_millis: 10635
Jobid: 3976d406-e13a-4e5c-8f45-3577237436ca
state: COMPLETED
Message: Performing Failover recovery for VMID 421a38da-5c4a-e843-0728-583e317a7ad5
time_started: 08/03/17_19:39
#
```

Virtual Machine Recovery Testing

A virtual machine recovery test can be conducted to verify that recovery of a VM can be completed successfully. The recovery test does not cause any interruption to the ongoing replication of the VM, nor does it break the replication pairing between the two clusters. The recovery test recovers the VM to a virtual machine folder in vCenter named “HxTestRecovery”.

All virtual machine migration and recovery operations are executed via the HyperFlex CLI. To perform a virtual machine recovery test, complete the following steps:

1. Log in to the secondary, or target HyperFlex cluster’s management IP address via SSH as root.

2. List the virtual machines being replicated by entering the CLI command:

   ```
   stcli dp vm list --brief
   ```

3. Determine the VM to be tested and copy the UUID listed from the output of the previous command.

4. Alternatively, the UUIDs for the Protection Group itself, and all the VMs in the group can be found in the output from running the following CLI command:

   ```
   stcli dp group list --groupname <<GROUP_NAME>>

   vmGroupEr:
       type: dp_vmgroup
       id: 8b9fa36f-13a2-4199-9147-b39bc31b6162
       name: Silver
   members:
       ----------------------------------------
       idtype: 2
       type: dp_vm
       id: 421a0ff3-a147-9ae8-881c-f91cf822e273
       name: Silver1
       ----------------------------------------
       idtype: 2
       type: dp_vm
   ```

```
        id: 421a38da-5c4a-e843-0728-583e317a7ad5
        name: Bronze1
           ----------------------------------------
```

5. Run the recovery test by entering the CLI command:

   ```
   stcli dp vm recover test --vmid <<VM_UUID>>
   ```

6. The recovery test command will output a job ID for the operation. To view the status of the recovery job, copy the job ID and enter the CLI command:

   ```
   stcli dp vm recover status --id <<JOB_ID>>
   ```

7. Once the job completes, verify the VM has been recovered to the HxRecoveryTest folder.

8. Repeat steps 3 – 7 for each VM you wish to test.

9. Power on the recovered VMs via the vSphere Web Client or the HTML5 vSphere Client to test their functionality.

An example of the command line activities is given below:

```
# stcli dp vm list --brief
vmInfo:
    ----------------------------------------
    name: Silver1
    uuid: 421a0ff3-a147-9ae8-881c-f91cf822e273
    ----------------------------------------
    name: Gold1
    uuid: 421a8b07-6111-6701-9331-f418d88d8b4f
    ----------------------------------------
    name: Bronze1
    uuid: 421a38da-5c4a-e843-0728-583e317a7ad5
    ----------------------------------------

# stcli dp vm recover test --vmid 421a38da-5c4a-e843-0728-583e317a7ad5
79d97050-d470-4616-ba60-b892b6d00d14
# stcli dp vm recover status --id 79d97050-d470-4616-ba60-b892b6d00d14
summary_step_state: SUCCEEDED
Description: Successfully completed Test recovery for VMID 421a38da-5c4a-e843-0728-
583e317a7ad5
time_submitted: 08/02/17_17:21
time_elapsed_millis: 361826
Jobid: 79d97050-d470-4616-ba60-b892b6d00d14
state: COMPLETED
Message: Performing Test recovery for VMID 421a38da-5c4a-e843-0728-583e317a7ad5
time_started: 08/02/17_17:21
#
```

Virtual Machine Disaster Recovery

In the case of a site outage, or the failure of a cluster, VMs can be recovered to their state as of the last successfully transmitted snapshot, running on the secondary, or target cluster as part of a disaster recovery operation. The recovery operation described assumes that the primary, or source site and cluster is either offline, or isolated in such a way that it can no longer communicate with the secondary, or target site, nor can it be managed. A recovery operation stops all replication and breaks the pairing of the two clusters, so that replication can be reestablished at a later time after the faults or outages have been repaired. As an overview of the process, a VM disaster recovery includes:

- Stopping the replication of the VM(s) to be recovered.

- Performing a recovery of the VM(s) on the secondary, or target cluster.
- Unpairing the two replicating HX clusters.
- Unprotecting the VM(s) to remove the replication configuration.
- Repair or bring the original cluster back online, and remove its replication configuration.
- Delete the original source VMs.
- Pairing the HX cluster with the running VMs to a new cluster, or to the original cluster once it is back online.
- Protecting the VMs, replicating the VM from the running cluster, to a new cluster, or back to the original cluster.

Virtual machine migration and recovery operations are executed via the HyperFlex CLI. To perform a virtual machine recovery, complete the following steps:

1. Log in to the secondary, or target HyperFlex cluster's management IP address via SSH as root.
2. List the virtual machines being replicated by entering the CLI command:

   ```
   stcli dp vm list --brief
   ```

3. Determine the VM to be recovered and copy the UUID listed from the output of the previous command.
4. Alternatively, the UUIDs for the Protection Group itself, and all the VMs in the group can be found in the output from running the following CLI command:

   ```
   stcli dp group list --groupname <<GROUP_NAME>>

   vmGroupEr:
       type: dp_vmgroup
       id: 8b9fa36f-13a2-4199-9147-b39bc31b6162
       name: Silver
   members:
       ----------------------------------------
       idtype: 2
       type: dp_vm
       id: 421a0ff3-a147-9ae8-881c-f91cf822e273
       name: Silver1
       ----------------------------------------
       idtype: 2
       type: dp_vm
       id: 421a38da-5c4a-e843-0728-583e317a7ad5
       name: Bronze1
       ----------------------------------------
   ```

5. Halt the VM replication by entering the following command:

   ```
   stcli dp vm halt --vmid <<VM_UUID>>
   ```

6. Alternatively, if the VMs are part of a Protection Group, the Protection Group must be halted using the following command:

   ```
   stcli dp group halt --groupid <<GROUP_ID>>
   ```

Warning: If a Protection Group is halted, all VMs in that group must be migrated or recovered. There is no way to resume replication of a Protection Group once it has been halted. If a single VM needs to be migrated, and it is part of a Protection Group, the VM must be removed from the group and protected individually before attempting to migrate or recover the VM.

7. Verify the status of the VM or Protection Group shows Halted in HyperFlex Connect of the secondary, or target cluster.

8. Run the recovery by entering the CLI command:

```
stcli dp vm recover failover --vmid <<VM_UUID>>
```

Additional CLI syntax switches are available during a VM recovery operation:

Option	Required	Description
--vmid	Yes	Perform the recovery on the VM with the provided BIOS UUID.
--resourcepool-id	No	Place the recovered VM(s) in the resource pool with the specified ID. Specify a resource pool or folder, but not both.
--resourcepool-name	No	Place the recovered VM(s) in the resource pool with the specified name. Specify a resource pool or folder, but not both.
--folder-id	No	Place the recovered VM(s) in the folder with the specified ID. Specify a resource pool or folder, but not both.
--folder-name	No	Place the recovered VM(s) in the folder with the specified name. Specify a resource pool or folder, but not both.
--network-mapping	No	Modify the source VM to recovered VM network port group mapping. Use the format: `source_network:destination_network`
--poweron	No	Power on the recovered VM after the recovery job completes.
--force	No	Force the recovery job to run without validation of the arguments.

Note: Protection Groups can be recovered; however, the process involves recovering all of the VMs within the group one at a time. Each VM recovery must be completed before beginning the next recovery, in a serial fashion. Parallel recovery operations of multiple VMs within the same Protection Group are not supported. Recovery of multiple VMs in parallel can be done as long as each VM is a member of a separate Protection Group. For example, parallel recovery of 1 VM in the Bronze Protection Group and 1 VM in the Silver Protection Group can be done.

9. The recovery failover command will output a job ID for the operation. To view the status of the recovery job, copy the job ID and enter the CLI command:

```
stcli dp vm recover status --id <<JOB_ID>>
```

10. Once the job completes, verify the status of the VM shows Recovered in HyperFlex Connect of the secondary, or target cluster.

11. Repeat steps 3 – 10 for each VM you need to recover.

12. Power on the recovered VMs via the vSphere Web Client or the HTML5 vSphere Client to test their functionality.

13. Perform any necessary post-recovery tasks on the VMs, such as changing IP addresses, or updating DNS records, in order to make the VMs and their applications available on the network.

14. List the HX cluster peers, and find the name of the pairing by using the following CLI command:

    ```
    stcli dp peer list
    ```

15. Delete the replication pairing between the two clusters by using the following CLI command:

    ```
    stcli dp peer forget --name <<PAIR_NAME>>
    ```

16. From the HyperFlex Connect Replication page of the secondary, or target cluster, click the Protected Virtual Machines menu, select all the VMs that were recovered, then click Unprotect. Alternatively, the VM protection can be removed via the CLI from the secondary, or target cluster, using the “stcli dp vm delete” or “stcli dp group vm delete” command.

17. If an entire Protection Group was migrated, once all the VMs have been recovered in the secondary, or target cluster, the Protection Group status will show as Recovered. The Protection Group must be deleted, as it is no longer possible to add VMs to a recovered group, nor is it possible to make the group active again. All the VMs in the group must be unprotected, as described in the previous step, before the group can be deleted. From the HyperFlex Connect Replication page of the secondary, or target cluster, click the Protection Groups menu, select Protection Groups that were recovered, then click Delete. Alternatively, the groups can be removed via the CLI from the secondary, or target cluster, using the “stcli dp group delete” command.

Note: The initial group delete command may give an error if issued immediately after removing protection from the VMs within the group. Wait a few minutes before retrying the command, and it should complete successfully.

An example of the command line activities is given below:

```
# stcli dp vm list --brief
vmInfo:
    ----------------------------------------
    name: Bronze1
    uuid: 421a38da-5c4a-e843-0728-583e317a7ad5
    ----------------------------------------
    name: Gold1
    uuid: 421a8b07-6111-6701-9331-f418d88d8b4f
    ----------------------------------------
    name: Silver1
    uuid: 421a0ff3-a147-9ae8-881c-f91cf822e273
    ----------------------------------------

# stcli dp group list
clusterEr:
    type: cluster
    id: 1257435955901676010:6385789462100613663
    name: SEDCluster
vmGroupState: active
vmGroupEr:
    type: dp_vmgroup
    id: 91e54586-2536-4f71-8925-348c1bbee2c2
    name: DR_Gold
members:
```

```
        idtype: 2
        type: dp_vm
        id: 421a8b07-6111-6701-9331-f418d88d8b4f
        name: Gold1
    schedules:
        replicationSchedule:
            targetClusterEr:
                type: cluster
                id: 1949045506490781161:5096245698033261308
                name: HybridCluster
            enabled: True
            mode: 1
            startTime: 08/11/17_15:57
            nextSnapshotTime: 1502467040255
            intervalInMinutes: 15

    # stcli dp group halt --groupid 91e54586-2536-4f71-8925-348c1bbee2c2

    # stcli dp vm halt --vmid 421a0ff3-a147-9ae8-881c-f91cf822e273

    # stcli dp vm halt --vmid 421a38da-5c4a-e843-0728-583e317a7ad5

    # stcli dp vm recover failover --vmid 421a38da-5c4a-e843-0728-583e317a7ad5
    022457f7-2596-4881-97d1-011d6bb76aff

    # stcli dp vm recover status --id 022457f7-2596-4881-97d1-011d6bb76aff
    summary_step_state: SUCCEEDED
    Description: Successfully completed Failover recovery for VMID 421a38da-5c4a-e843-0728-
    583e317a7ad5
    time_submitted: 08/11/17_16:27
    time_elapsed_millis: 12771
    Jobid: 022457f7-2596-4881-97d1-011d6bb76aff
    state: COMPLETED
    Message: Performing Failover recovery for VMID 421a38da-5c4a-e843-0728-583e317a7ad5
    time_started: 08/11/17_16:27

    # stcli dp vm recover failover --vmid 421a0ff3-a147-9ae8-881c-f91cf822e273
    7186364f-8631-47a2-a6b0-c7c85b772fba

    # stcli dp vm recover status --id 7186364f-8631-47a2-a6b0-c7c85b772fba
    summary_step_state: SUCCEEDED
    Description: Successfully completed Failover recovery for VMID 421a0ff3-a147-9ae8-881c-
    f91cf822e273
    time_submitted: 08/11/17_16:28
    time_elapsed_millis: 9872
    Jobid: 7186364f-8631-47a2-a6b0-c7c85b772fba
    state: COMPLETED
    Message: Performing Failover recovery for VMID 421a0ff3-a147-9ae8-881c-f91cf822e273
    time_started: 08/11/17_16:28

    # stcli dp vm recover failover --vmid 421a8b07-6111-6701-9331-f418d88d8b4f
    e82efb50-035e-40b2-a680-653d2ba34d10

    # stcli dp vm recover status --id e82efb50-035e-40b2-a680-653d2ba34d10
    summary_step_state: SUCCEEDED
    Description: Successfully completed Failover recovery for VMID 421a8b07-6111-6701-9331-
    f418d88d8b4f
    time_submitted: 08/11/17_16:28
    time_elapsed_millis: 11088
    Jobid: e82efb50-035e-40b2-a680-653d2ba34d10
    state: COMPLETED
    Message: Performing Failover recovery for VMID 421a8b07-6111-6701-9331-f418d88d8b4f
    time_started: 08/11/17_16:28
```

```
# stcli dp peer list
Datastores:
    aDs:
        clEr:
            confignum: 0
            type: cluster
            id: 1257435955901676010:6385789462100613663
            name: SEDCluster
        dsEr:
            confignum: 0
            type: datastore
            id: 00000000d31828f8:0000000000010103
            name: DS1SED
    bDs:
        clEr:
            type: cluster
            id: 1949045506490781161:5096245698033261308
            name: HybridCluster
        dsEr:
            type: datastore
            id: 00000000f5986cf9:00000000000100ed
            name: DS1HY
Name: HX1HX2
Replication IP: 192.168.150.16
Description:
Management IP: 10.29.133.160

# stcli dp peer forget --name HX1HX2
```

Disaster Recover Post Operations

After a disaster has been declared, and all VMs have been recovered to the secondary, or target cluster, work can begin to repair the primary, or source cluster. To complete disaster recovery post operation steps on the original source cluster, complete the following steps:

1. Repair the faults or failures in the original source HX cluster, and bring the cluster online in a healthy state. Do not power on the VMs that have been recovered in the secondary site. If for any reason the original cluster had to be reinstalled, no further action is necessary, and you may skip to step 7.

2. From the HyperFlex Connect Replication page of the primary, or source cluster, click the Protected Virtual Machines menu, select all the VMs that were recovered, then click Unprotect. Alternatively, the VM protection can be removed via the CLI from the secondary, or target cluster, using the “stcli dp vm delete” or “stcli dp group vm delete” command.

3. If an entire Protection Group was migrated, once all the VMs have been recovered in the secondary, or target cluster, the Protection Group status will show as Recovered. The Protection Group must be deleted, as it is no longer possible to add VMs to a recovered group, nor is it possible to make the group active again. All the VMs in the group must be unprotected, as described in the previous step, before the group can be deleted. From the HyperFlex Connect Replication page of the primary, or source cluster, click the Protection Groups menu, select Protection Groups that were recovered, then click Delete. Alternatively, the groups can be removed via the CLI from the primary, or source cluster, using the “stcli dp group delete” command.

Note: The initial group delete command may give an error if issued immediately after removing protection from the VMs within the group. Wait a few minutes before retrying the command, and it should complete successfully.

4. From the primary, or source cluster, list the HX cluster peers, and find the name of the pairing by using the following CLI command:

   ```
   stcli dp peer list
   ```

5. Delete the replication pairing between the two clusters by using the following CLI command:

   ```
   stcli dp peer forget --name <<PAIR_NAME>>
   ```

6. Delete the original source VMs on the primary, or source cluster.

7. At this point, the VMs have all been recovered, and both clusters have no replication pairing or configuration. The two clusters can be paired again, and the VMs can be migrated back to the original source cluster using the VM Migration steps documented earlier. Alternatively, the secondary, or target cluster, can be paired with a completely different cluster and replication can be established.

Validation

This section provides a list of items that should be reviewed after the HyperFlex system has been deployed and configured. The goal of this section is to verify the configuration and functionality of the solution, and ensure that the configuration supports core availability requirements.

Post Install Checklist

The following tests are critical to functionality of the solution, and should be verified before deploying for production:

1. Verify the expected number of converged storage nodes and compute-only nodes are members of the HyperFlex cluster in the vSphere Web Client plugin manage cluster screen.

2. Verify the expected cluster capacity is seen in the vSphere Web Client plugin summary screen. (See Appendix A)

3. Create a test virtual machine that accesses the HyperFlex datastore and is able to perform read/write operations.

4. Perform the virtual machine migration (vMotion) of the test virtual machine to a different host on the cluster.

5. During the vMotion of the virtual machine, make sure the test virtual machine can perform a continuous ping to default gateway and to check if the network connectivity is maintained during and after the migration.

Verify Redundancy

The following redundancy checks can be performed to verify the robustness of the system. Network traffic, such as a continuous ping from VM to VM, or from vCenter to the ESXi hosts should not show significant failures (one or two ping drops might be observed at times). Also, all of the HyperFlex datastores must remain mounted and accessible from all the hosts at all times.

1. Administratively disable one of the server ports on Fabric Interconnect A which is connected to one of the HyperFlex converged storage hosts. The ESXi virtual switch uplinks for fabric A should now show as failed, and the standby uplinks on fabric B will be in use for the management and vMotion virtual switches. Upon administratively re-enabling the port, the uplinks in use should return to normal.

2. Administratively disable one of the server ports on Fabric Interconnect B which is connected to one of the HyperFlex converged storage hosts. The ESXi virtual switch uplinks for fabric B should now show as failed, and the standby uplinks on fabric A will be in use for the storage virtual switch. Upon administratively re-enabling the port, the uplinks in use should return to normal.

3. Place a representative load of guest virtual machines on the system. Put one of the ESXi hosts in maintenance mode, using the HyperFlex HX maintenance mode option. All the VMs running on that host should be migrated via vMotion to other active hosts through vSphere DRS, except for the storage platform controller VM, which will be powered off. No guest VMs should lose any network or storage accessibility during or after the migration. This test assumes that enough RAM is available on the remaining ESXi hosts to accommodate VMs from the host put in maintenance mode. The HyperFlex cluster will show in an unhealthy state.

4. Reboot the host that is in maintenance mode, and exit it from maintenance mode after the reboot. The storage platform controller will automatically start when the host exits maintenance mode. The HyperFlex cluster will show as healthy after a brief time to restart the services on that node. VSphere DRS should rebalance the VM distribution across the cluster over time.

Note: Many vCenter alerts automatically clear when the fault has been resolved. Once the cluster health is verified, some alerts may need to be manually cleared.

5. Reboot one of the two Cisco UCS Fabric Interconnects while traffic is being sent and received on the storage datastores and the network. The reboot should not affect the proper operation of storage access and network traffic generated by the VMs. Numerous faults and errors will be noted in Cisco UCS Manager, but all will be cleared after the FI comes back online.

Appendix

A: Cluster Capacity Calculations

A HyperFlex HX Data Platform cluster capacity is calculated as follows:

(((<capacity disk size in GB> X 10^9) / 1024^3) X <number of capacity disks per node> X <number of HyperFlex nodes> X 0.92) / replication factor

Divide the result by 1024 to get a value in TiB

The replication factor value is 3 if the HX cluster is set to RF=3, and the value is 2 if the HX cluster is set to RF=2.

The 0.92 multiplier accounts for an 8% reservation set aside on each disk by the HX Data Platform software for various internal filesystem functions.

Calculation example:

<capacity disk size in GB> = 1200 for 1.2 TB disks

<number of capacity disks per node> = 15 for an HX240c-M4SX model server

<number of HyperFlex nodes> = 8

replication factor = 3

Result: (((1200*10^9)/1024^3)*15*8*0.92)/3 = 41127.2049

41127.2049 / 1024 = 40.16 TiB

B: HyperFlex Sizer

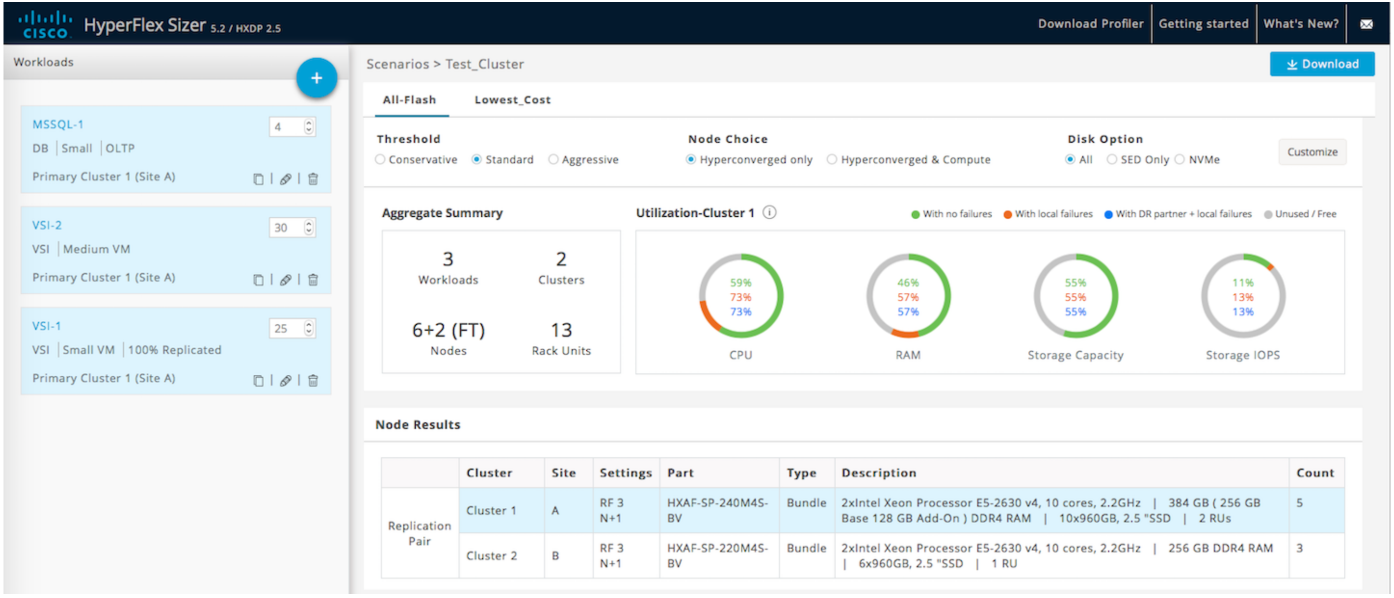
HyperFlex sizer is a cloud based end-to-end tool that can help the customers and partners find out how many Cisco HyperFlex nodes are needed and how the nodes can be configured to meet their needs for the compute resources, storage capacity and performance requirements in the datacenter. The sizing guidance of the HX system is calculated according to the information of workloads collected from the users. This cloud application can be accessed from anywhere at Cisco website (CCO login required):

https://hyperflexsizer.cloudapps.cisco.com

Improvements in the sizing tool for HXDP 2.5 release include:

- Replication support: workloads can be sized to account for replication
- Encryption support: systems can be sized using self-encrypting disks
- Performance enhancements in HXDP 2.5, including NVMe caching disk support
- Fully populate the HXAF240 model server with all disks, and M10 GPU support
- Provide sizing estimates against the HX Workload Profiler tool output

Figure 60 HyperFlex Sizer



MSSQL-1 4
DB | Small | OLTP
Primary Cluster 1 (Site A)

VSI-2 30
VSI | Medium VM
Primary Cluster 1 (Site A)

VSI-1 25
VSI | Small VM | 100% Replicated
Primary Cluster 1 (Site A)

Threshold: ○ Conservative ● Standard ○ Aggressive

Node Choice: ● Hyperconverged only ○ Hyperconverged & Compute

Disk Option: ● All ○ SED Only ○ NVMe

Aggregate Summary

3 Workloads	2 Clusters
6+2 (FT) Nodes	13 Rack Units

Node Results

	Cluster	Site	Settings	Part	Type	Description	Count
Replication Pair	Cluster 1	A	RF 3 N+1	HXAF-SP-240M4S-BV	Bundle	2xIntel Xeon Processor E5-2630 v4, 10 cores, 2.2GHz | 384 GB (256 GB Base 128 GB Add-On) DDR4 RAM | 10x960GB, 2.5 "SSD | 2 RUs	5
	Cluster 2	B	RF 3 N+1	HXAF-SP-220M4S-BV	Bundle	2xIntel Xeon Processor E5-2630 v4, 10 cores, 2.2GHz | 256 GB DDR4 RAM | 6x960GB, 2.5 "SSD | 1 RU	3

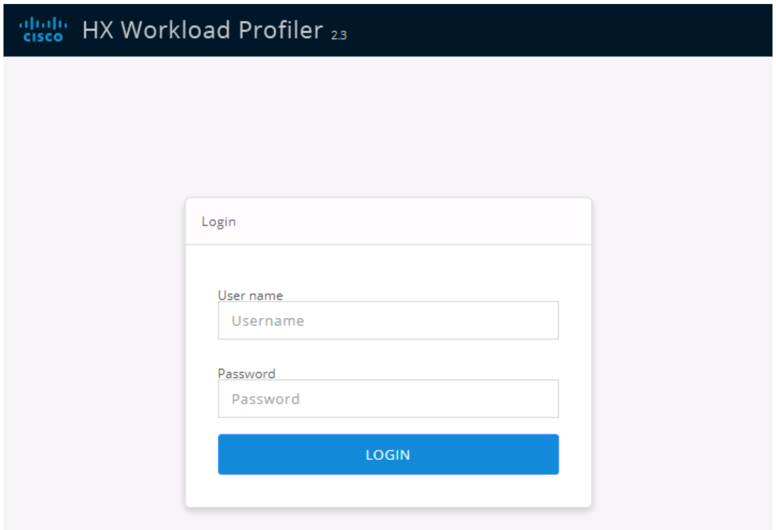
Note: The HyperFlex Sizer tool is designed to provide general guidance in evaluating the optimum solution for using selected Cisco products. The tool is not intended to provide business, legal, accounting, tax or professional advice. The tool is not intended as a substitute for your own judgment or for that of your professional advisors.

C: HyperFlex Workload Profiler

Also available at the https://hyperflexsizer.cloudapps.cisco.com website is an updated HyperFlex Workload Profiler, version 2.3. The HyperFlex Workload Profiler tool is used to capture storage usage and performance statistics from an existing VMware ESX cluster, enabling you to use that data to assist with sizing a HyperFlex cluster which would assume that workload. The workload profiler is distributed as an OVA file, which can be deployed using static or DHCP assigned addressing, on an existing VMware ESXi host. Once deployed, the profiler tool connects to an existing VMware vCenter server to gather storage statistics for the selected ESXi hosts. To capture performance data using the HyperFlex Workload Profiler, complete the following steps:

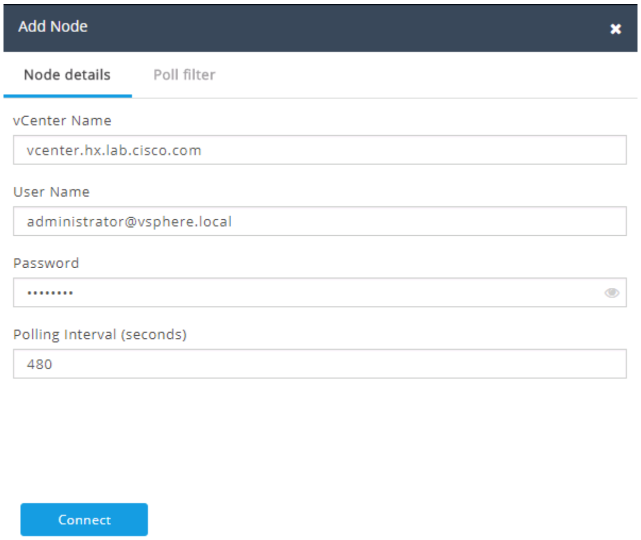
1. Deploy the HyperFlex Workload Profiler VM by using the Deploy OVF Template wizard, on the chosen existing ESXi host. Assign a static IP address or use DHCP addressing as part of the deployment wizard.

2. Using a web browser, connect to the IP address assigned or leased by the Workload Profiler VM.



3. Enter the username and password, the default username and password is “monitoring”, then click Login.

4. On first login, the Add Node wizard will run. Enter the vCenter server name or IP, a username with administrative rights, and the password, then click Connect.



vCenter Name: vcenter.hx.lab.cisco.com

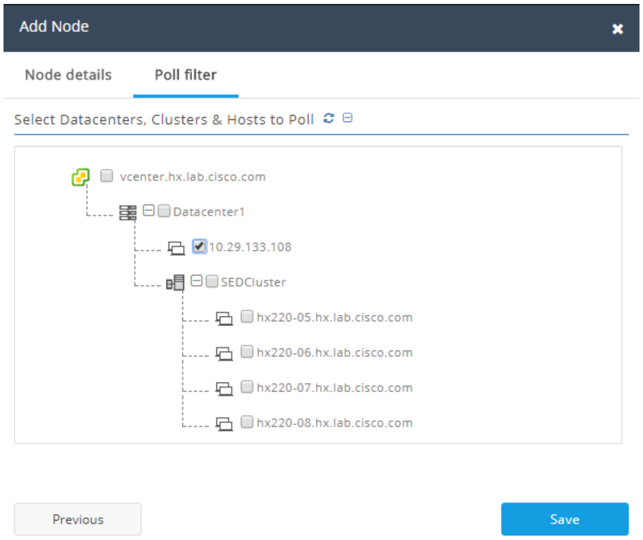
User Name: administrator@vsphere.local

Password: ••••••••

Polling Interval (seconds): 480

5. Once the vCenter server is connected, click Next to select the hosts to monitor.

6. Check the box next to the hosts to poll for data, then click Save.



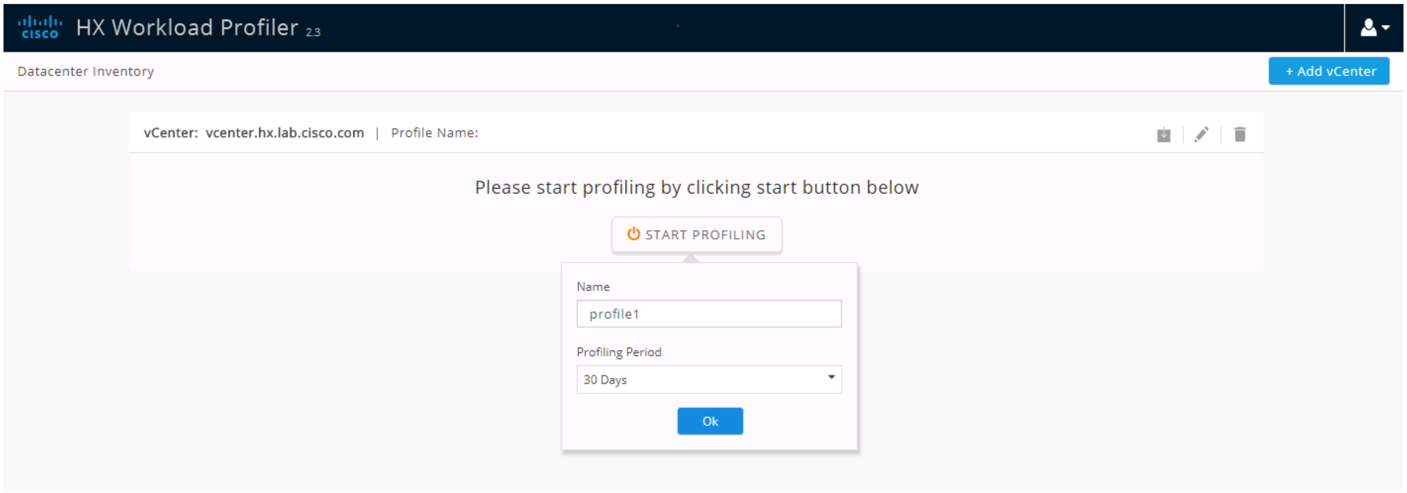
Add Node

Node details | Poll filter

Select Datacenters, Clusters & Hosts to Poll

- □ vcenter.hx.lab.cisco.com
  - □ Datacenter1
    - ☑ 10.29.133.108
    - □ SEDCluster
      - □ hx220-05.hx.lab.cisco.com
      - □ hx220-06.hx.lab.cisco.com
      - □ hx220-07.hx.lab.cisco.com
      - □ hx220-08.hx.lab.cisco.com

7. In the main screen, the vCenter server being polled will be listed. Click the Start Profiling button.



HX Workload Profiler 2.3

Datacenter Inventory

vCenter: vcenter.hx.lab.cisco.com | Profile Name:

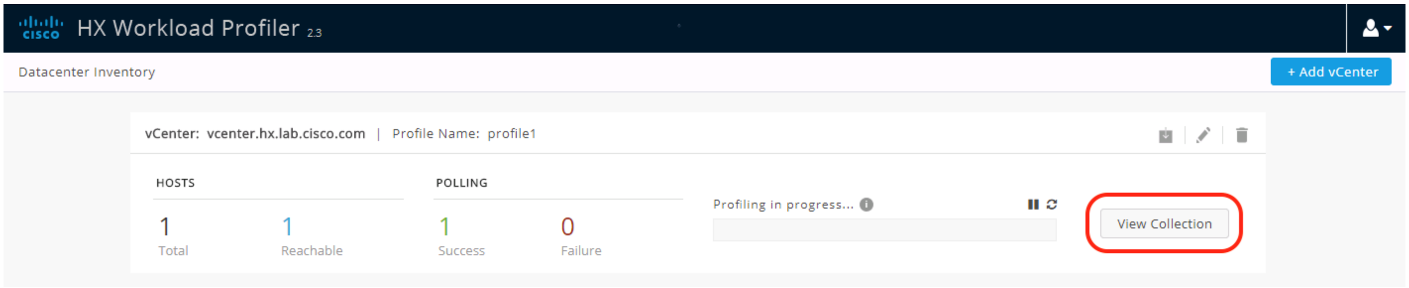
Please start profiling by clicking start button below

Name: profile1

Profiling Period: 30 Days

8. Choose a time interval to collect data on the system, then click OK. A 30-day collection is recommended for accurate sizing activities.

9. At any time during the collection polling, the data can be viewed by clicking on the View Collection button. The data for CPU and memory utilization, and storage statistics can be viewed, as an aggregate of all hosts, one host at a time, or from a per VM perspective.



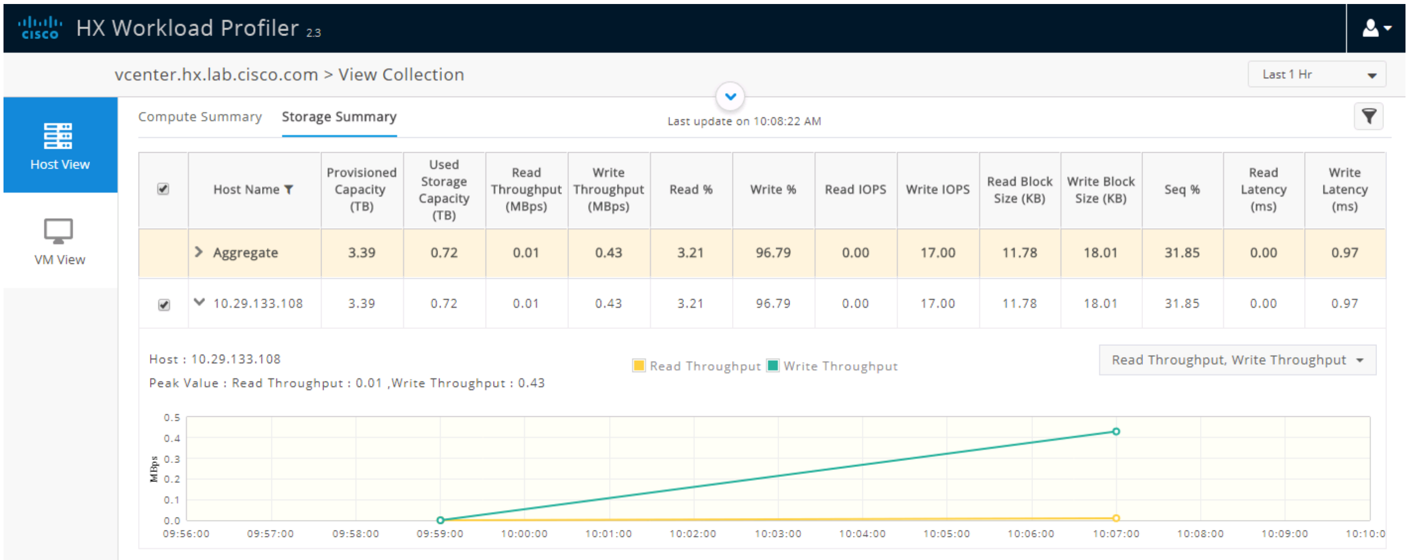
HX Workload Profiler 2.3

Datacenter Inventory

vCenter: vcenter.hx.lab.cisco.com | Profile Name: profile1

HOSTS		POLLING	
1	1	1	0
Total	Reachable	Success	Failure

Profiling in progress...



vcenter.hx.lab.cisco.com > View Collection

Last update on 10:08:22 AM

☑	Host Name	Provisioned Capacity (TB)	Used Storage Capacity (TB)	Read Throughput (MBps)	Write Throughput (MBps)	Read %	Write %	Read IOPS	Write IOPS	Read Block Size (KB)	Write Block Size (KB)	Seq %	Read Latency (ms)	Write Latency (ms)
	Aggregate	3.39	0.72	0.01	0.43	3.21	96.79	0.00	17.00	11.78	18.01	31.85	0.00	0.97
☑	10.29.133.108	3.39	0.72	0.01	0.43	3.21	96.79	0.00	17.00	11.78	18.01	31.85	0.00	0.97

Host : 10.29.133.108

Peak Value : Read Throughput : 0.01 ,Write Throughput : 0.43

🟨 Read Throughput 🟩 Write Throughput

Read Throughput, Write Throughput

10. Once the collection is complete, the complete dataset can be exported as a comma-separated file, and the data can be automatically imported into the HyperFlex sizer tool to help with computing and storage sizing efforts, or otherwise analyzed to help with sizing decisions.

D: Example Cisco Nexus 9372 Switch Configurations

Switch A

```
hostname HX-9K-A

no feature telnet
no telnet server enable
cfs eth distribute
feature interface-vlan
feature lacp
feature vpc

ip domain-lookup
ip domain-list cisco.com
ip name-server 171.70.168.183 173.36.131.10
logging event link-status default
policy-map type network-qos jumbo
  class type network-qos class-default
    mtu 9216
system qos
  service-policy type network-qos jumbo
clock timezone PST -8 0
clock summer-time PST
ntp server 171.68.38.65
ntp server 171.68.38.66

vrf context management
vlan 1
vlan 133
  name Management
vlan 51
  name HXCluster1
vlan 100
  name VM-Prod-100
vlan 200
```

```
  name VMotion

cdp enable

vpc domain 50
  role priority 10
  peer-keepalive destination 10.29.133.102 source 10.29.133.101
  auto-recovery
  delay restore 150

interface Vlan1

interface port-channel50
  description VPC-Peer
  switchport mode trunk
  switchport trunk allowed vlan 1,51,100,133,200
  spanning-tree port type network
  vpc peer-link

interface port-channel10
  description VPC to 6248-A
  switchport mode trunk
  switchport trunk allowed vlan 51,100,133,200
  spanning-tree port type edge trunk
  spanning-tree bpduguard enable
  mtu 9216
  vpc 10

interface port-channel20
  description VPC to 6248-B
  switchport mode trunk
  switchport trunk allowed vlan 51,100,133,200
  spanning-tree port type edge trunk
  spanning-tree bpduguard enable
  mtu 9216
  vpc 20

interface Ethernet1/1
  description uplink
  switchport mode trunk
  switchport trunk allowed vlan 51,100,133,200
  spanning-tree port type network

interface Ethernet1/2
  description NX9372-A_P1/2--UCS6248-A_2/1
  switchport mode trunk
  switchport trunk allowed vlan 51,100,133,200
  channel-group 10 mode active

interface Ethernet1/4
  description NX9372-A_P1/4--UCS6248-B_2/1
  switchport mode trunk
  switchport trunk allowed vlan 51,100,133,200
  channel-group 20 mode active

interface Ethernet1/47
  description NX9372-A_P1/47--NX9372-B_P1/47
  switchport mode trunk
  switchport trunk allowed vlan 1,51,100,133,200
  channel-group 50 mode active

interface Ethernet1/48
  description NX9372-A_P1/48--NX9372-B_P1/48
  switchport mode trunk
  switchport trunk allowed vlan 1,51,100,133,200
  channel-group 50 mode active

interface mgmt0
  ip address 10.29.133.101/24

vrf context management
ip route 0.0.0.0/0 10.29.133.1
```

Switch B

```
hostname HX-9K-B

no feature telnet
no telnet server enable
cfs eth distribute
feature interface-vlan
feature lacp
feature vpc

ip domain-lookup
ip domain-list cisco.com
ip name-server 171.70.168.183 173.36.131.10
logging event link-status default
policy-map type network-qos jumbo
  class type network-qos class-default
    mtu 9216
system qos
  service-policy type network-qos jumbo
clock timezone PST -8 0
clock summer-time PST
ntp server 171.68.38.65
ntp server 171.68.38.66

vrf context management
vlan 1
vlan 133
  name Management
vlan 51
  name HXCluster1
vlan 100
  name VM-Prod-100
vlan 200
  name VMotion

cdp enable

vpc domain 50
  role priority 10
  peer-keepalive destination 10.29.133.101 source 10.29.133.102
  auto-recovery
  delay restore 150

interface Vlan1

interface port-channel50
  description VPC-Peer
  switchport mode trunk
  switchport trunk allowed vlan 1,51,100,133,200
  spanning-tree port type network
  vpc peer-link

interface port-channel10
```

```
  description VPC to 6248-A
  switchport mode trunk
  switchport trunk allowed vlan 51,100,133,200
  spanning-tree port type edge trunk
  spanning-tree bpduguard enable
  mtu 9216
  vpc 10

interface port-channel20
  description VPC to 6248-B
  switchport mode trunk
  switchport trunk allowed vlan 51,100,133,200
  spanning-tree port type edge trunk
  spanning-tree bpduguard enable
  mtu 9216
  vpc 20

interface Ethernet1/1
  description uplink
  switchport mode trunk
  switchport trunk allowed vlan 51,100,133,200
  spanning-tree port type network

interface Ethernet1/2
  description NX9372-A_P1/2--UCS6248-A_2/3
  switchport mode trunk
  switchport trunk allowed vlan 51,100,133,200
  channel-group 10 mode active

interface Ethernet1/4
  description NX9372-A_P1/4--UCS6248-B_2/3
  switchport mode trunk
  switchport trunk allowed vlan 51,100,133,200
  channel-group 20 mode active

interface Ethernet1/47
  description NX9372-B_P1/47--NX9372-A_P1/47
  switchport mode trunk
  switchport trunk allowed vlan 1,51,100,133,200
  channel-group 50 mode active

interface Ethernet1/48
  description NX9372-B_P1/48--NX9372-A_P1/48
  switchport mode trunk
  switchport trunk allowed vlan 1,51,100,133,200
  channel-group 50 mode active

interface mgmt0
  ip address 10.29.133.102/24

vrf context management
ip route 0.0.0.0/0 10.29.133.1
```

E: Example Connecting to External Storage Systems

The following examples demonstrate scenarios where a newly built HX cluster connects to the existing third-party storage devices, using either iSCSI or FC protocols. The new HX system is built with its own Fabric Interconnect switches then connecting to upstream Ethernet switches or Fibre Channel switches where the existing storage devices reside.

Connecting to iSCSI Storage

The HX installer can guide you through the process of setting up your HX cluster allowing you to connect to existing third-party storage systems via the iSCSI protocol. The installer will automatically configure Cisco UCS profiles, and HX cluster nodes with extra vNICs for iSCSI, and proper VLANs in the setup. The procedure is described here in this CVD. It is assumed that the third-party storage system is already configured per a Cisco Validated Design and all networking configuration is completed on the upstream switches. For iSCSI, the VLANs are configured on the A fabric and B fabric separately, as per best practice. In this example topology, the HX hosts connect to the Cisco UCS Fabric Interconnects, that are in turn connected to the upstream Ethernet switches, e.g. Nexus 9000 series. The third-party storage is connected to the Ethernet switches. To configure the HX system with iSCSI external storage for HyperFlex, complete the following steps:

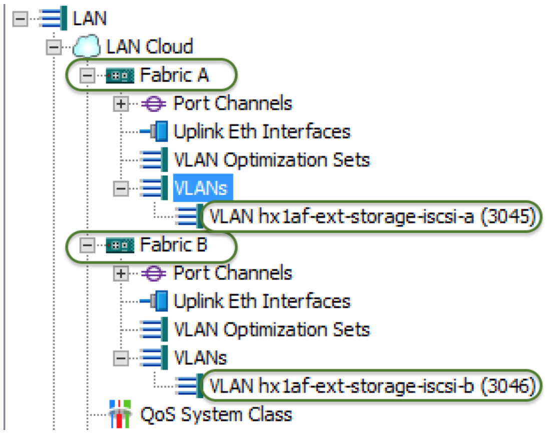
1. Prior to installation of HX, identify the iSCSI settings from the existing environment. Make sure that the third-party storage device has two iSCSI VLANs. Record them in the following table (Table 47). This information will be needed for later use during the HX install. Record the IP addresses of the iSCSI controller interfaces for the A and B path targets, and the iSCSI IQN name of the target device. Depending on how the redundant storage paths are configured in the production, more than two controlling interfaces might be recorded here. For example, in a Cisco validated FlexPod setup, where the NetApp storage array connects to Cisco Nexus 9000 series switches via VPC, normally four iSCSI IP addresses are assigned, two for each path (A and B).

Table 47 iSCSI Storage Settings

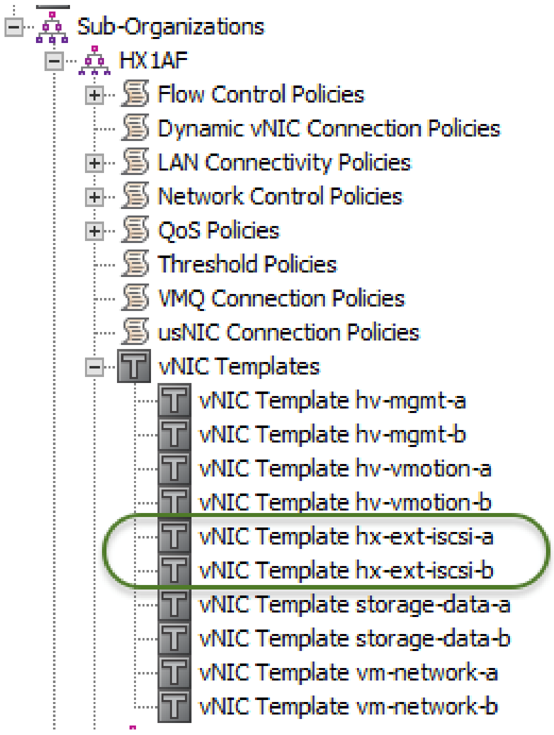
Items	Fabric A	Fabric B	
iSCSI VLAN ID			
iSCSI Target Ports	IP Address-A	IP Address-B	iSCSI IQN Name
iSCSI Storage Controller #1			
iSCSI Storage Controller #2			

2. Follow these steps to create HX cluster with the external storage adapters using the same VLAN ID's obtained from Step 1 for both Fabric A and B. Upon completion of HX install two additional vNICs for iSCSI will be created for each HX host.

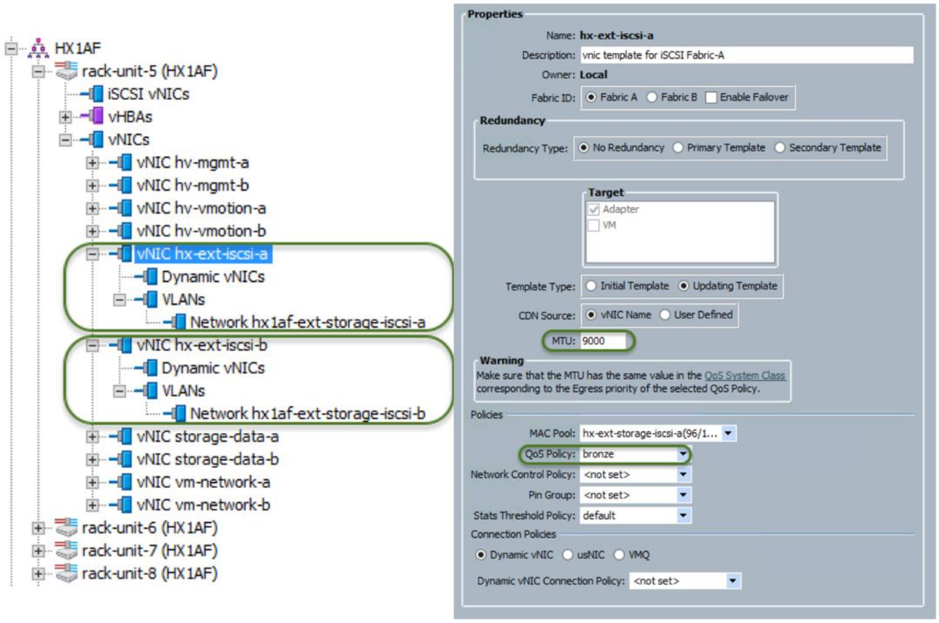
3. Open Cisco UCS Manager, expand LAN > LAN Cloud > Fabric A > VLANs, then Fabric B > VLANs to verify that the iSCSI VLANs are created and assigned to Fabric A and B.



4. On the LAN tab, expand Policies > root > Sub-Organizations, go to the HX sub-organization just created, view the iSCSI templates that were created.


Sub-Organizations
HX1AF
Flow Control Policies
Dynamic vNIC Connection Policies
LAN Connectivity Policies
Network Control Policies
QoS Policies
Threshold Policies
VMQ Connection Policies
usNIC Connection Policies
vNIC Templates
vNIC Template hv-mgmt-a
vNIC Template hv-mgmt-b
vNIC Template hv-vmotion-a
vNIC Template hv-vmotion-b
vNIC Template hx-ext-iscsi-a
vNIC Template hx-ext-iscsi-b
vNIC Template storage-data-a
vNIC Template storage-data-b
vNIC Template vm-network-a
vNIC Template vm-network-b

5. In Cisco UCS Manager, Expand Servers > Service Profiles > root > Sub-Organizations, go to the HX sub-organization just created, verify the iSCSI vNICs on all HX servers. Click one vNIC, view the properties of that iSCSI adapter. Make sure Jumbo MTU 9000 is set.



Properties

Name: **hx-ext-iscsi-a**

Description: vnic template for iSCSI Fabric-A

Owner: **Local**

Fabric ID: ● Fabric A ○ Fabric B □ Enable Failover

Redundancy

Redundancy Type: ● No Redundancy ○ Primary Template ○ Secondary Template

Target

☑ Adapter
□ VM

Template Type: ○ Initial Template ● Updating Template

CDN Source: ● vNIC Name ○ User Defined

MTU: 9000

Warning
Make sure that the MTU has the same value in the QoS System Class corresponding to the Egress priority of the selected QoS Policy.

Policies

MAC Pool: hx-ext-storage-iscsi-a(96/1...

QoS Policy: bronze

Network Control Policy: <not set>

Pin Group: <not set>

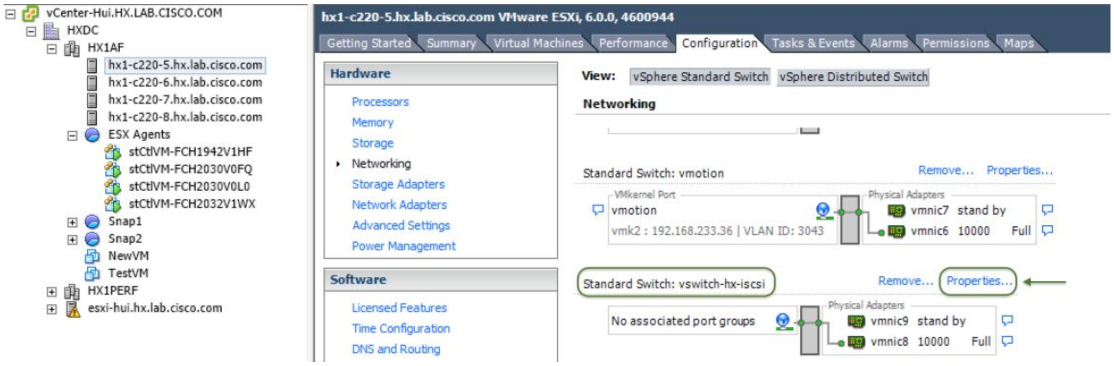
Stats Threshold Policy: default

Connection Policies

● Dynamic vNIC ○ usNIC ○ VMQ

Dynamic vNIC Connection Policy: <not set>

6. Next set up the networking for the vSphere iSCSI switch. Login to vCenter and select the first node of the HX cluster in the left screen, then on the right screen select the Configuration tab, select Networking in the hardware pane, then scroll to the iSCSI switch. Click Properties.



Standard Switch: vmotion

VMkernel Port
vmotion
vmk2 : 192.168.233.36 | VLAN ID: 3043

Physical Adapters
vmnic7 stand by
vmnic6 10000 Full

Standard Switch: vswitch-hx-iscsi

No associated port groups

Physical Adapters
vmnic9 stand by
vmnic8 10000 Full

7. Click Add.

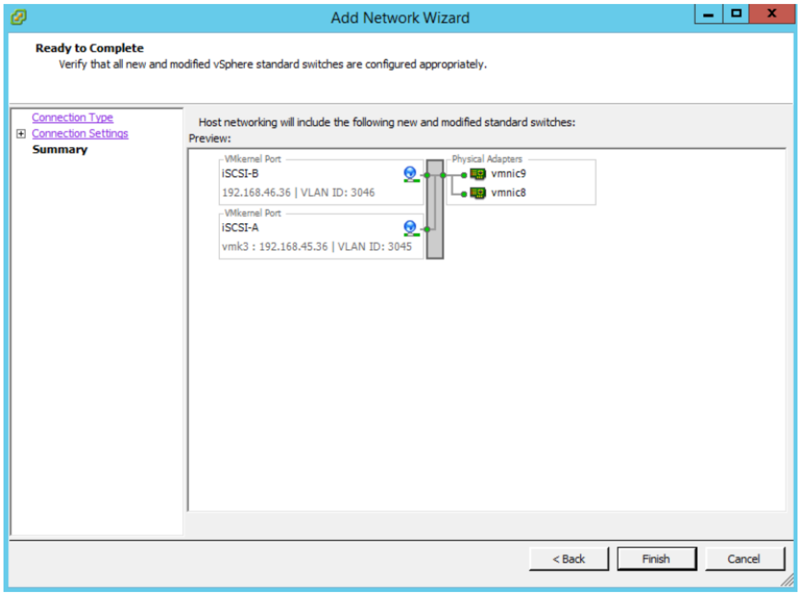
8. Select VMkernel and click Next.

9. Name iSCSI-A for the Network Label and input iSCSI VLAN ID for the A Fabric, then click Next.

10. Add the IP address for subnet for Fabric-A and click Next.

11. Click Finish to complete addition of iSCSI VMkernel port for A Fabric.

12. Repeat Steps 7-11 to add VMkernel Port for iSCSI-B.



Ready to Complete

Verify that all new and modified vSphere standard switches are configured appropriately.

Host networking will include the following new and modified standard switches:

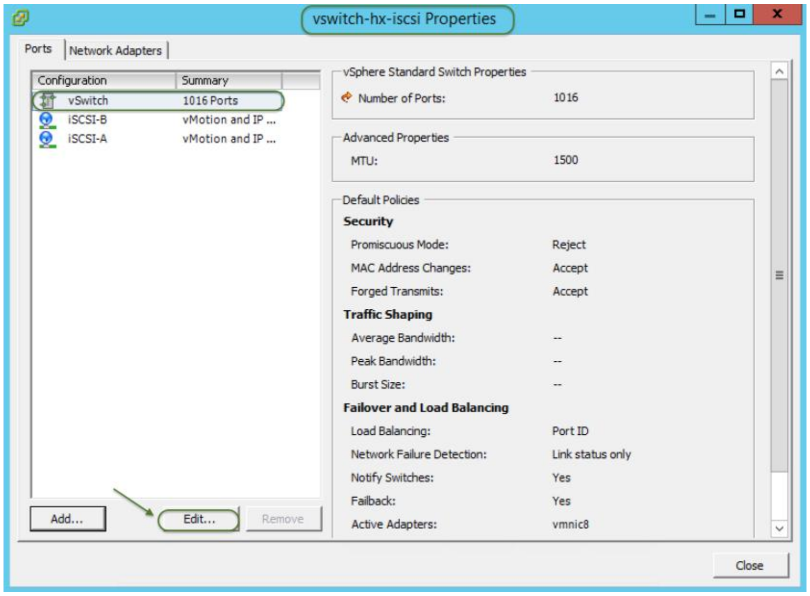
Preview:

VMkernel Port
iSCSI-B
192.168.46.36 | VLAN ID: 3046

VMkernel Port
iSCSI-A
vmk3 : 192.168.45.36 | VLAN ID: 3045

Physical Adapters
vmnic9
vmnic8

13. Back to the vSwitch Properties page, highlight the vSwitch and click Edit.



Configuration	Summary
vSwitch	1016 Ports
iSCSI-B	vMotion and IP ...
iSCSI-A	vMotion and IP ...

vSphere Standard Switch Properties

Number of Ports: 1016

Advanced Properties

MTU: 1500

Default Policies

Security

Promiscuous Mode: Reject

MAC Address Changes: Accept

Forged Transmits: Accept

Traffic Shaping

Average Bandwidth: --

Peak Bandwidth: --

Burst Size: --

Failover and Load Balancing

Load Balancing: Port ID

Network Failure Detection: Link status only

Notify Switches: Yes

Failback: Yes

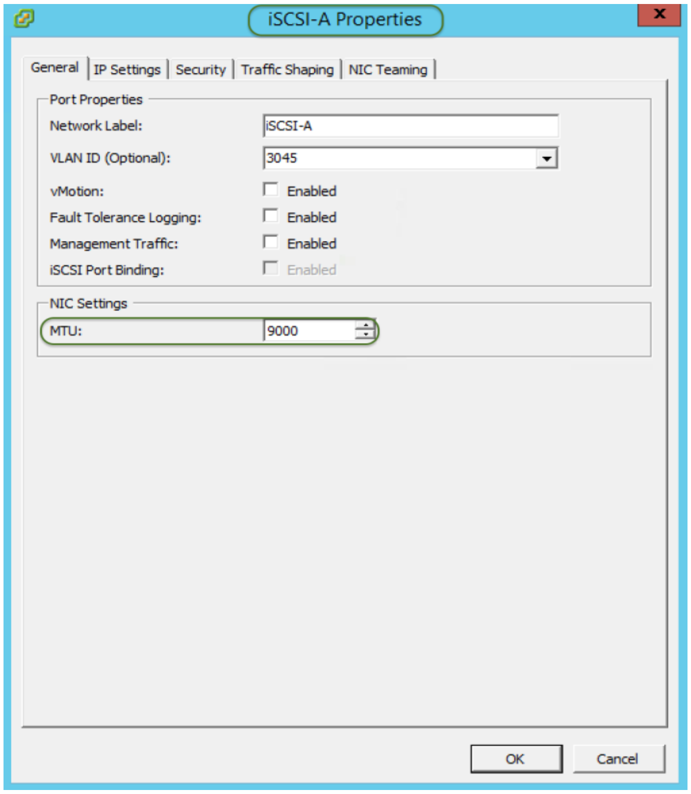
Active Adapters: vmnic8

14. Change MTU for vSwitch to 9000.

15. Select the NIC Teaming tab and make both adapters active by moving the standby adapter up. Click OK.

16. Highlight the iSCSI-A VMkernel port and click Edit in the vSwitch Properties page.

17. Change the port MTU t0 9000.



iSCSI-A Properties

General | IP Settings | Security | Traffic Shaping | NIC Teaming

Port Properties

Network Label: iSCSI-A

VLAN ID (Optional): 3045

vMotion: □ Enabled

Fault Tolerance Logging: □ Enabled

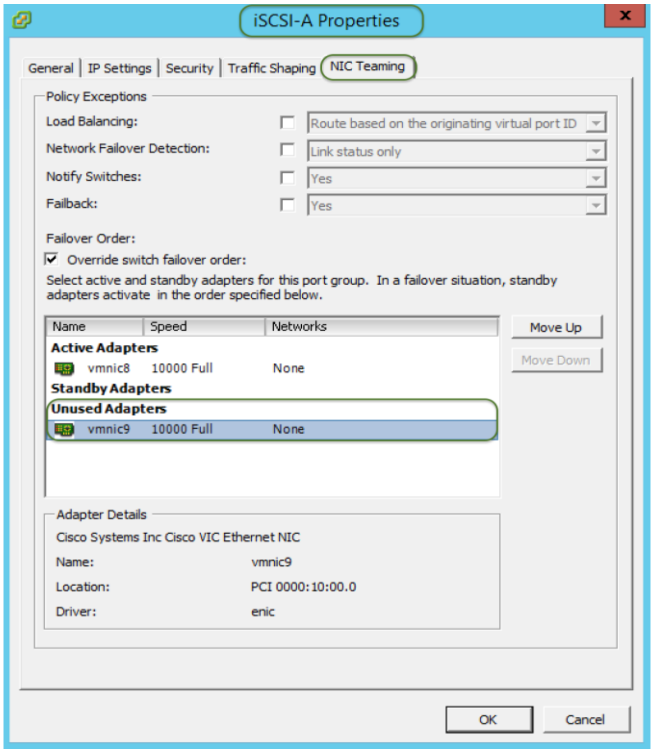
Management Traffic: □ Enabled

iSCSI Port Binding: □ Enabled

NIC Settings

MTU: 9000

18. Select the NIC Teaming tab. Choose the option of Override switch failover order, highlight vmnic9 and move it to Unused Adapters as this adapter is for the iSCSI-B connection. Click OK.



iSCSI-A Properties

General | IP Settings | Security | Traffic Shaping | NIC Teaming

Policy Exceptions

Load Balancing: □ Route based on the originating virtual port ID

Network Failover Detection: □ Link status only

Notify Switches: □ Yes

Failback: □ Yes

Failover Order:

☑ Override switch failover order:

Select active and standby adapters for this port group. In a failover situation, standby adapters activate in the order specified below.

Name	Speed	Networks
Active Adapters		
vmnic8	10000 Full	None
Standby Adapters		
Unused Adapters		
vmnic9	10000 Full	None

Adapter Details

Cisco Systems Inc Cisco VIC Ethernet NIC

Name: vmnic9

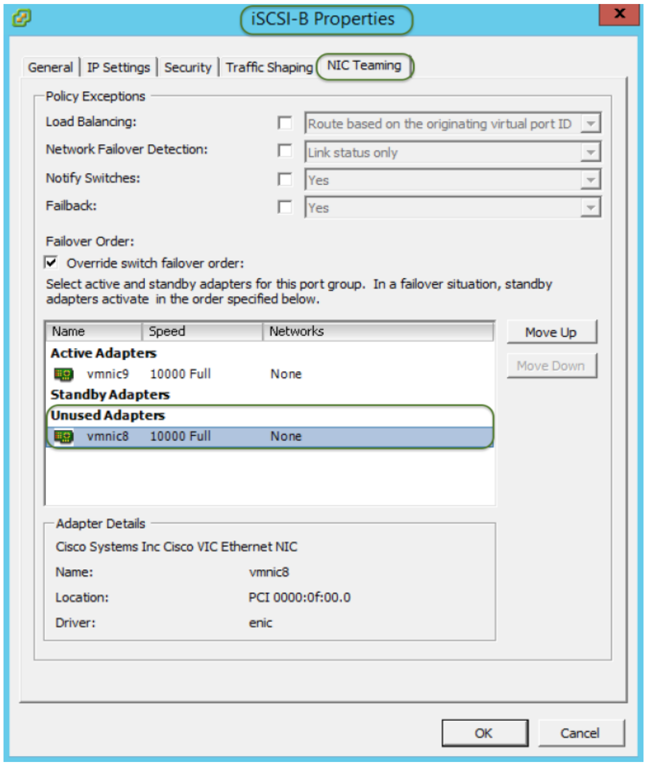
Location: PCI 0000:10:00.0

Driver: enic

19. Highlight the iSCSI-B VMkernel port and click Edit.

20. Change the port MTU t0 9000.

21. Select the NIC Teaming tab. Select the Override switch failover order, highlight vmnic8 and move it to Unused Adapters as this adapter is for the iSCSI-A connection. Click OK.



Policy Exceptions

Load Balancing:	□	Route based on the originating virtual port ID
Network Failover Detection:	□	Link status only
Notify Switches:	□	Yes
Failback:	□	Yes

Failover Order:

☑ Override switch failover order:

Select active and standby adapters for this port group. In a failover situation, standby adapters activate in the order specified below.

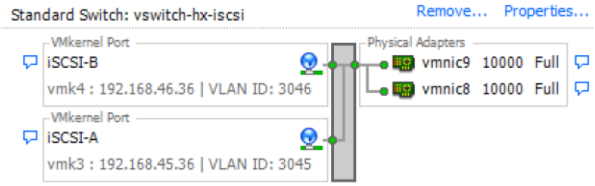
Name	Speed	Networks
Active Adapters		
vmnic9	10000 Full	None
Standby Adapters		
Unused Adapters		
vmnic8	10000 Full	None

Adapter Details

Cisco Systems Inc Cisco VIC Ethernet NIC

Name:	vmnic8
Location:	PCI 0000:0f:00.0
Driver:	enic

22. Click Close and review the iSCSI vSwitch. Now you should have two IP addresses used in the vSwitch on separate VLANs.



Standard Switch: vswitch-hx-iscsi

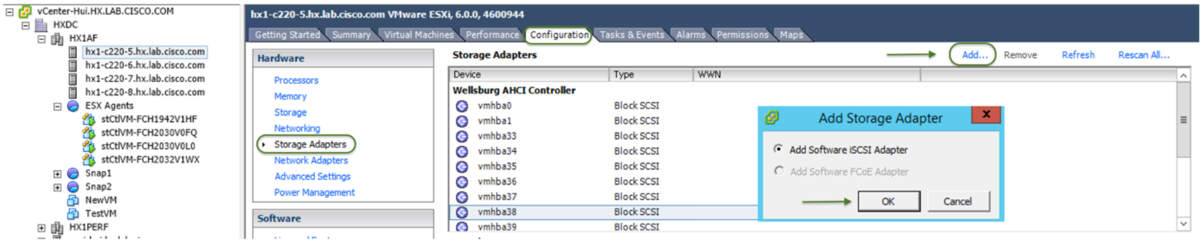
iSCSI-B
vmk4 : 192.168.46.36 | VLAN ID: 3046

iSCSI-A
vmk3 : 192.168.45.36 | VLAN ID: 3045

vmnic9 10000 Full
vmnic8 10000 Full

23. Repeat Steps 6-22 to configure the iSCSI vSwitch for the other HX nodes in the cluster.

24. Add the software iSCSI adapters on HX hosts. Select the first node of the HX cluster in the left screen, then on the right screen select the Configuration tab, select Storage Adapters in the hardware pane and click Add, then click OK to Add Software iSCSI Adapters, and then click OK again.



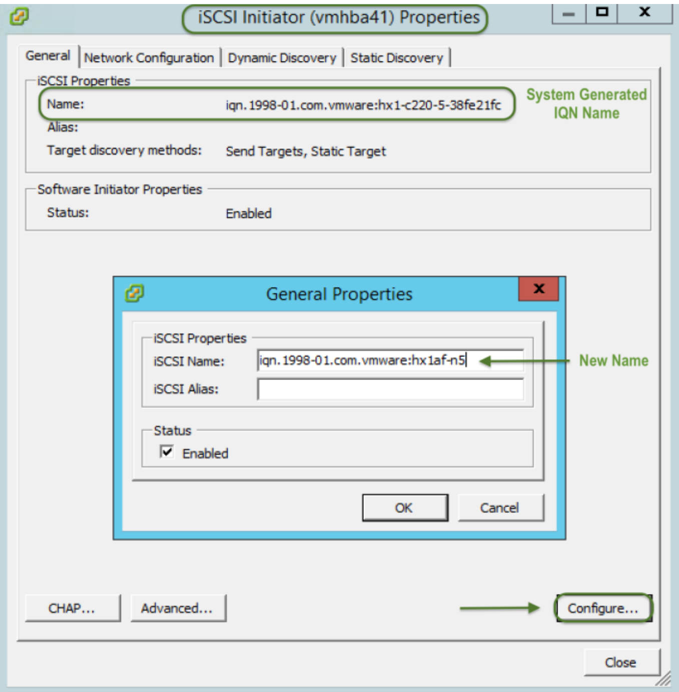
Storage Adapters

Device	Type	WWN
Wellsburg AHCI Controller		
vmhba0	Block SCSI	
vmhba1	Block SCSI	
vmhba33	Block SCSI	
vmhba34	Block SCSI	
vmhba35	Block SCSI	
vmhba36	Block SCSI	
vmhba37	Block SCSI	
vmhba38	Block SCSI	
vmhba39	Block SCSI	

● Add Software iSCSI Adapter
○ Add Software FCoE Adapter

25. Scroll down and right-click the newly created software initiator, right-click and select Properties.

26. Click Configure to change the iSCSI IQN name to a customized name.



iSCSI Properties

Name: iqn.1998-01.com.vmware:hx1-c220-5-38fe21fc

Alias:

Target discovery methods: Send Targets, Static Target

Software Initiator Properties

Status: Enabled

iSCSI Properties

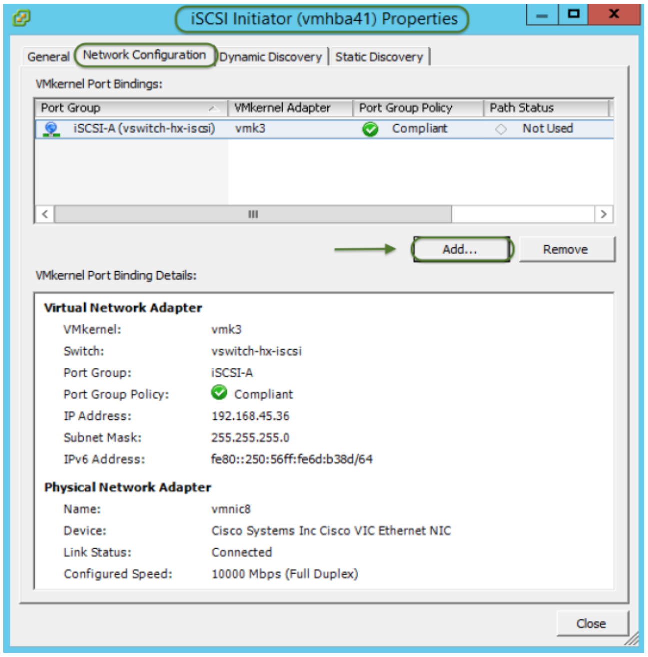
iSCSI Name: iqn.1998-01.com.vmware:hx1af-n5

iSCSI Alias:

Status

☑ Enabled

27. Click the Network Configuration tab, and click Add to bind the VMkernel Adapters to the software iSCSI adapter.



VMkernel Port Bindings:

Port Group	VMkernel Adapter	Port Group Policy	Path Status
iSCSI-A (vswitch-hx-iscsi)	vmk3	✓ Compliant	◇ Not Used

VMkernel Port Binding Details:

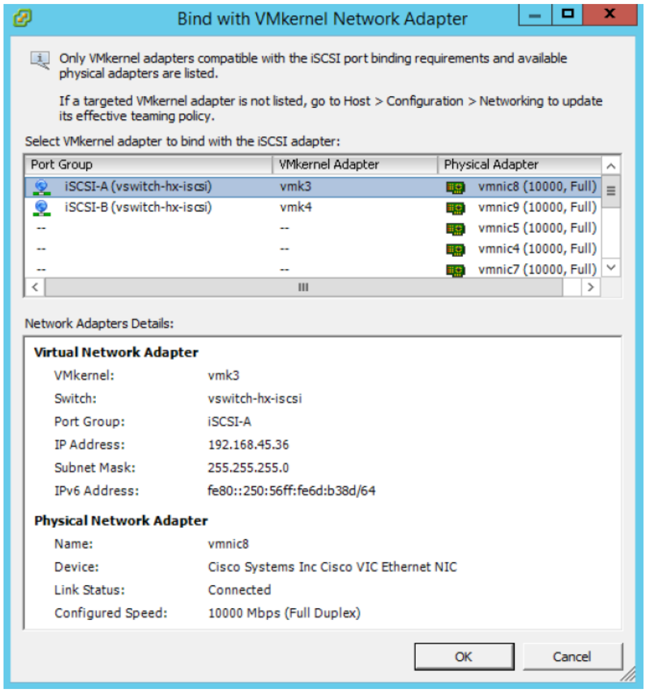
Virtual Network Adapter

VMkernel:	vmk3
Switch:	vswitch-hx-iscsi
Port Group:	iSCSI-A
Port Group Policy:	✓ Compliant
IP Address:	192.168.45.36
Subnet Mask:	255.255.255.0
IPv6 Address:	fe80::250:56ff:fe6d:b38d/64

Physical Network Adapter

Name:	vmnic8
Device:	Cisco Systems Inc Cisco VIC Ethernet NIC
Link Status:	Connected
Configured Speed:	10000 Mbps (Full Duplex)

28. Select iSCSI-A and click OK.



Only VMkernel adapters compatible with the iSCSI port binding requirements and available physical adapters are listed.

If a targeted VMkernel adapter is not listed, go to Host > Configuration > Networking to update its effective teaming policy.

Select VMkernel adapter to bind with the iSCSI adapter:

Port Group	VMkernel Adapter	Physical Adapter
iSCSI-A (vswitch-hx-iscsi)	vmk3	vmnic8 (10000, Full)
iSCSI-B (vswitch-hx-iscsi)	vmk4	vmnic9 (10000, Full)
--	--	vmnic5 (10000, Full)
--	--	vmnic4 (10000, Full)
--	--	vmnic7 (10000, Full)

Network Adapters Details:

Virtual Network Adapter

VMkernel:	vmk3
Switch:	vswitch-hx-iscsi
Port Group:	iSCSI-A
IP Address:	192.168.45.36
Subnet Mask:	255.255.255.0
IPv6 Address:	fe80::250:56ff:fe6d:b38d/64

Physical Network Adapter

Name:	vmnic8
Device:	Cisco Systems Inc Cisco VIC Ethernet NIC
Link Status:	Connected
Configured Speed:	10000 Mbps (Full Duplex)

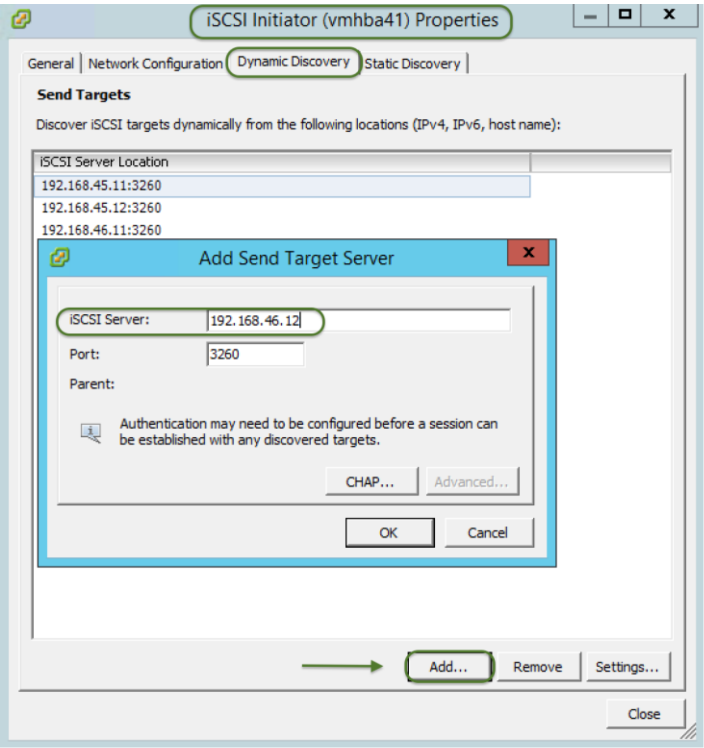
29. Click Add again, and select iSCSI-B and click OK.

30. Copy and record the initiator name, IP addresses of iSCSI-A and iSCSI-B VMkernel ports to the following table. Save these values for later use to add to the initiator group created on the storage array.

Table 48 HX iSCSI Initiators

Items	Fabric A	Fabric B	
iSCSI VLAN ID			
HX Hosts	IP Address-A	IP Address-B	iSCSI IQN Name
HX Server #1 iSCSI Initiator			
HX Server #2 iSCSI Initiator			
HX Server #3 iSCSI Initiator			
HX Server #4 iSCSI Initiator			
HX Server #5 iSCSI Initiator			
HX Server #6 iSCSI Initiator			
HX Server #7 iSCSI Initiator			
HX Server #8 iSCSI Initiator			

31. Click the Dynamic Discovery tab and click Add and enter the first IP address that you recorded from your storage device network interface. Click OK. Click Add again until all the interfaces for your storage controllers are entered.



iSCSI Initiator (vmhba41) Properties

Send Targets

Discover iSCSI targets dynamically from the following locations (IPv4, IPv6, host name):

iSCSI Server Location
192.168.45.11:3260
192.168.45.12:3260
192.168.46.11:3260

Add Send Target Server

iSCSI Server: 192.168.46.12

Port: 3260

Parent:

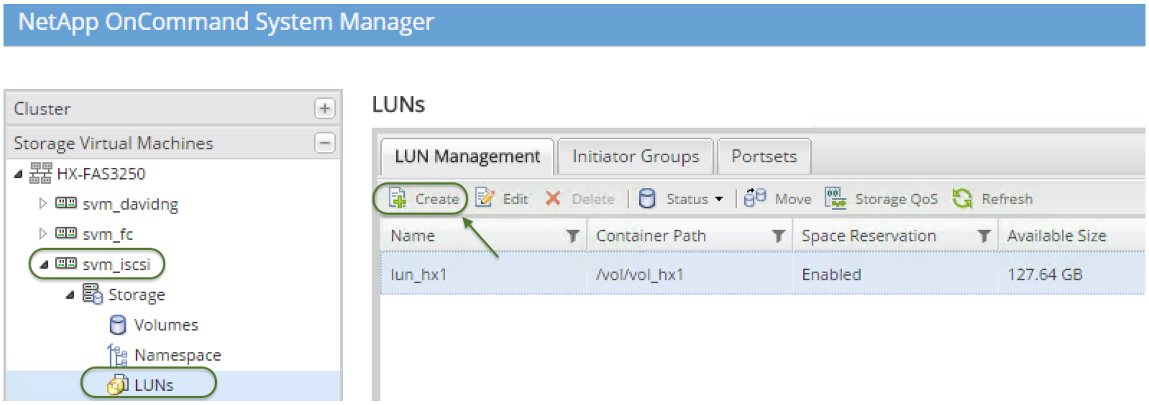
Authentication may need to be configured before a session can be established with any discovered targets.

32. Click Close. You do not need to rescan the host bus adapter at this point, so choose No to the scan popup.

33. Repeat Steps 24-32 adding the software iSCSI adapters for the remaining HX nodes.

34. Now create iSCSI initiator groups and then create an iSCSI LUN on the storage system and map it to the HX system. In this example, we are using NetApp OnCommand System Manager GUI to create a LUN on a FAS3250 array. Please consult your storage documentation to accomplish the same tasks. It is assumed you have already configured your iSCSI storage as shown in the CVD.

35. Open NetApp OnCommand System Manager GUI from the web browser, select the pre-configured iSCSI Storage Virtual Machine, expand Storage, then LUNs; from the right pane, click Create. This will open Create LUN wizard.

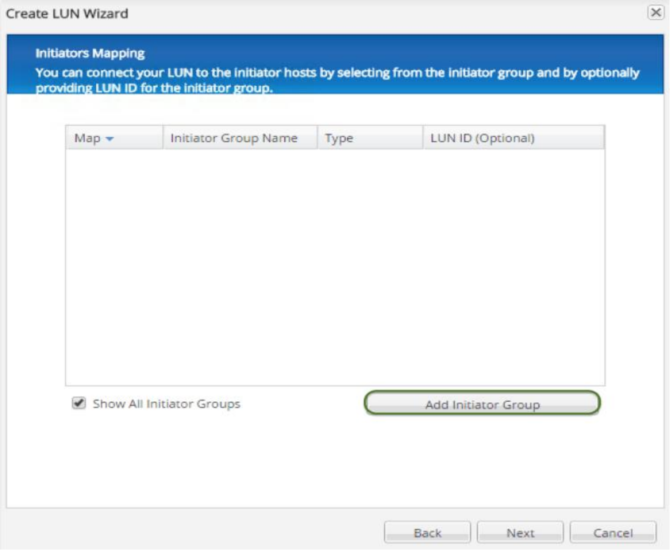


Name	Container Path	Space Reservation	Available Size
lun_hx1	/vol/vol_hx1	Enabled	127.64 GB

36. Click Next on the General Properties page, enter the LUN Name, Type and Size. Click Next.

37. Check "Select an existing volume or qtree for this LUN", browse and select an existing volume, then click Next.

38. On Initiators Mapping page, select Add Initiator Group.

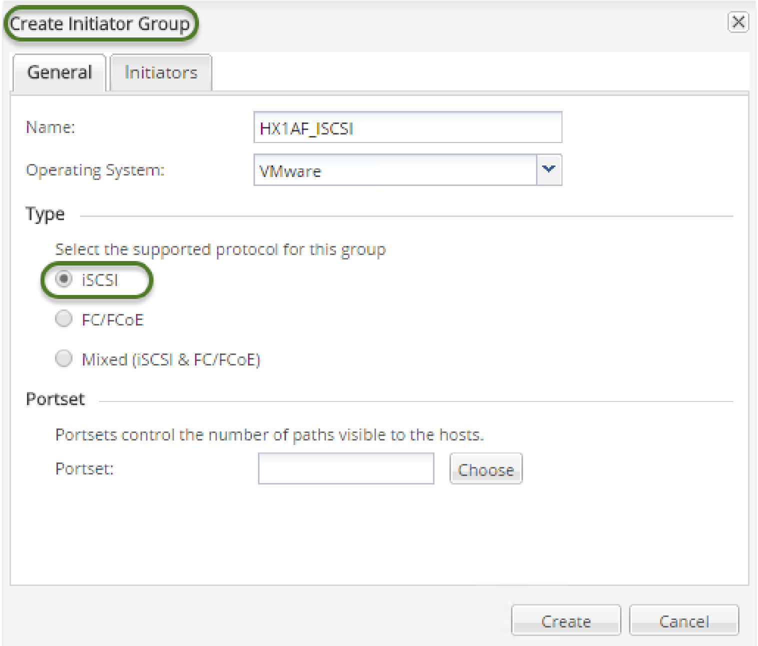


Initiators Mapping

You can connect your LUN to the initiator hosts by selecting from the initiator group and by optionally providing LUN ID for the initiator group.

Map	Initiator Group Name	Type	LUN ID (Optional)

39. In Create Initiator Group wizard, on the General tab, enter Name, Operation System, and select Type of iSCSI for the Initiator Group to be created.



Create Initiator Group

Name: HX1AF_ISCSI

Operating System: VMware

Type

Select the supported protocol for this group

● iSCSI

○ FC/FCoE

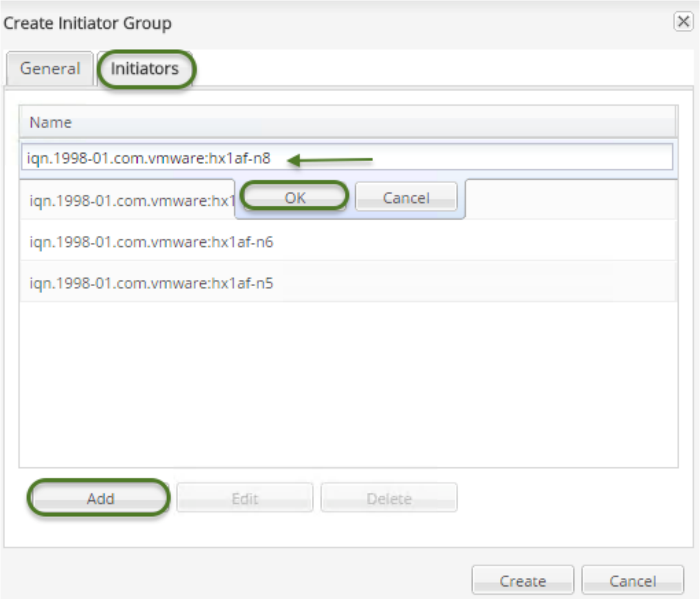
○ Mixed (iSCSI & FC/FCoE)

Portset

Portsets control the number of paths visible to the hosts.

Portset:

40. On Initiators tab, click Add then enter the iSCSI IQN Name of the first HX host (copy from Table 48), click OK.

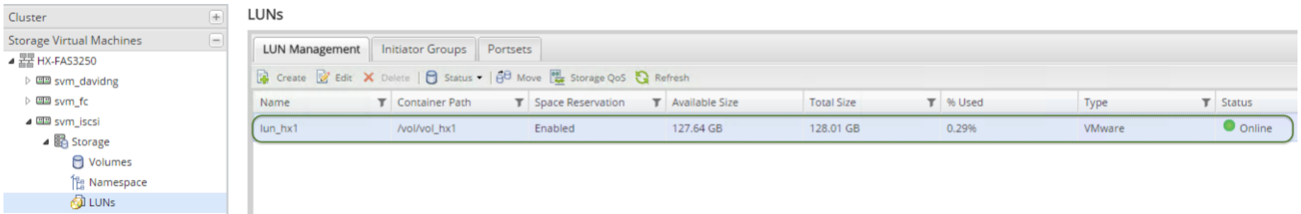


Create Initiator Group

Name
iqn.1998-01.com.vmware:hx1af-n8
iqn.1998-01.com.vmware:hx1
iqn.1998-01.com.vmware:hx1af-n6
iqn.1998-01.com.vmware:hx1af-n5

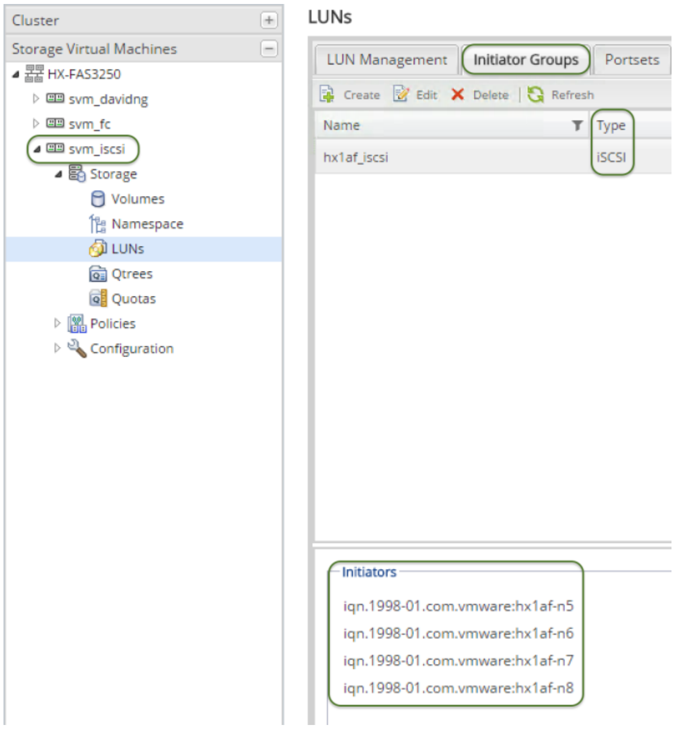
41. Repeat Step 40 until the IQN names of all HX iSCSI adapters are added. Select Create to create the Initiator Group.

42. The Create Initiator Group Wizard closes and reverts to the Initiators Mapping page of the Create LUN wizard. Select the HX initiator group that is just created, click Next three times then click Finish to complete the LUN creation.



Name	Container Path	Space Reservation	Available Size	Total Size	% Used	Type	Status
lun_hx1	/vol/vol_hx1	Enabled	127.64 GB	128.01 GB	0.29%	VMware	● Online

43. Check the iSCSI initiators mapped to this LUN.



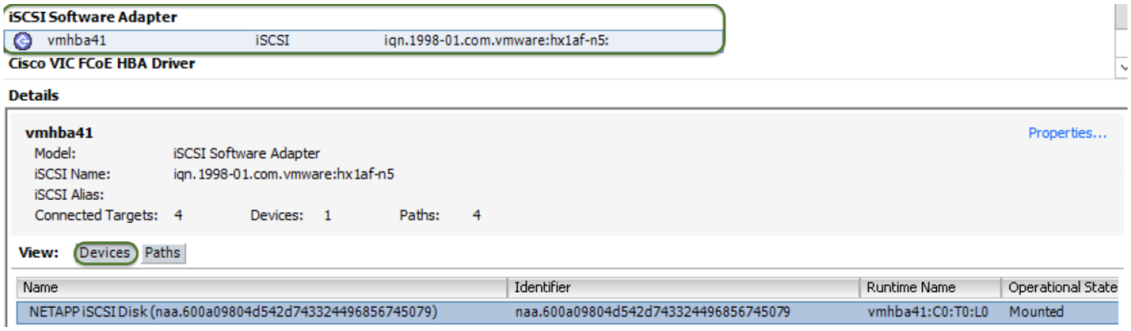
Name	Type
hx1af_iscsi	iSCSI

Initiators

iqn.1998-01.com.vmware:hx1af-n5
iqn.1998-01.com.vmware:hx1af-n6
iqn.1998-01.com.vmware:hx1af-n7
iqn.1998-01.com.vmware:hx1af-n8

44. With a mapped LUN, you can rescan the iSCSI software initiator. Login to the vCenter again, in the configuration tab, right-click the iSCSI software adapter and click Rescan or click Rescan All at the top of the pane (do this for each host).

45. The iSCSI disk will show up in the details pane.



iSCSI Software Adapter

vmhba41	iSCSI	iqn.1998-01.com.vmware:hx1af-n5:

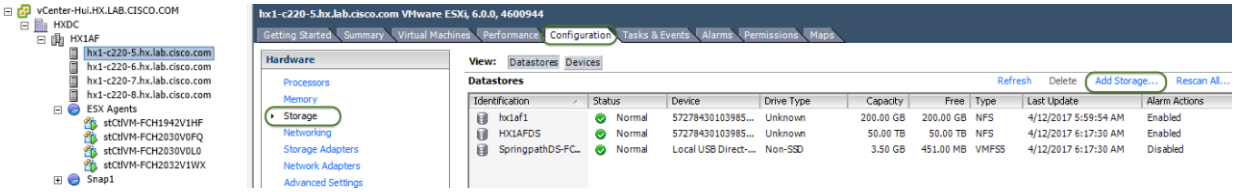
Cisco VIC FCoE HBA Driver

Details

vmhba41
Model: iSCSI Software Adapter
iSCSI Name: iqn.1998-01.com.vmware:hx1af-n5
iSCSI Alias:
Connected Targets: 4 Devices: 1 Paths: 4

Name	Identifier	Runtime Name	Operational State
NETAPP iSCSI Disk (naa.600a09804d542d743324496856745079)	naa.600a09804d542d743324496856745079	vmhba41:C0:T0:L0	Mounted

46. Add the disk to the cluster by selecting Storage in the Hardware pane, then Add Storage in the Configuration tab.



hx1-c220-5.hx.lab.cisco.com VMware ESXi, 6.0.0, 4600944

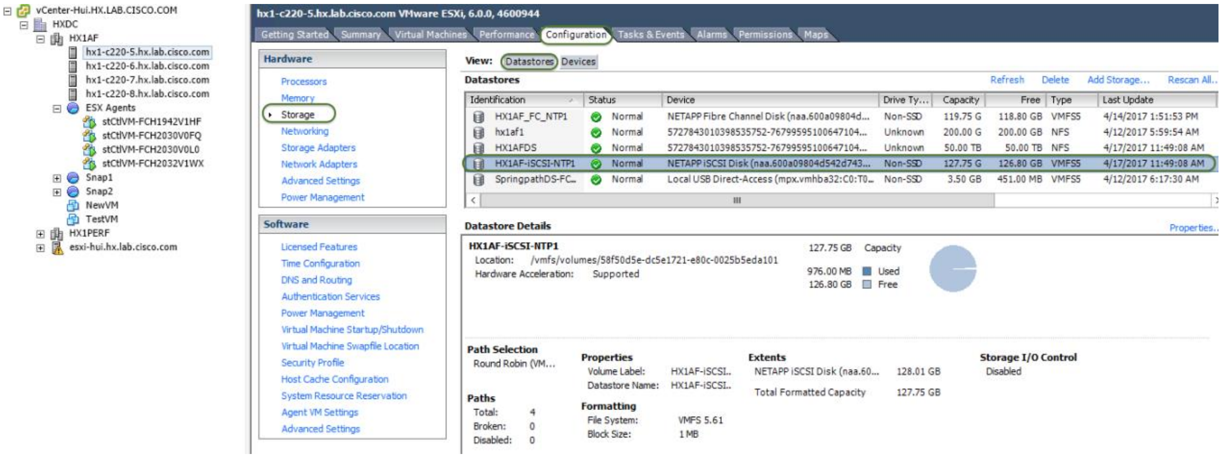
Datastores

Identification	Status	Device	Drive Type	Capacity	Free	Type	Last Update	Alarm Actions
hx1af1	Normal	57278430103985...	Unknown	200.00 GB	200.00 GB	NFS	4/12/2017 5:59:54 AM	Enabled
HX1AFDS	Normal	57278430103985...	Unknown	50.00 TB	50.00 TB	NFS	4/12/2017 6:17:30 AM	Enabled
SpringpathDS-FC...	Normal	Local USB Direct-...	Non-SSD	3.50 GB	451.00 MB	VMFS5	4/12/2017 6:17:30 AM	Disabled

47. Leave Disk/LUN selected and click Next.

48. Now the NetApp iSCSI LUN will be detected. Highlight the disk and click Next, and then click Next again.

49. Enter the new Datastore name and click Next then Finish. A new iSCSI datastore for the HX cluster will be created.



hx1-c220-5.hx.lab.cisco.com VMware ESXi, 6.0.0, 4600944

Datastores

Identification	Status	Device	Drive Ty...	Capacity	Free	Type	Last Update
HX1AF_FC_NTP1	Normal	NETAPP Fibre Channel Disk (naa.600a09804d...	Non-SSD	119.75 G	118.80 GB	VMFS5	4/14/2017 1:51:53 PM
hx1af1	Normal	57278430103985352752-76799595100647104...	Unknown	200.00 G	200.00 GB	NFS	4/12/2017 5:59:54 AM
HX1AFDS	Normal	57278430103985352752-76799595100647104...	Unknown	50.00 TB	50.00 TB	NFS	4/17/2017 11:49:08 AM
HX1AF-iSCSI-NTP1	Normal	NETAPP iSCSI Disk (naa.600a09804d542d743...	Non-SSD	127.75 G	126.80 GB	VMFS5	4/17/2017 11:49:08 AM
SpringpathDS-FC...	Normal	Local USB Direct-Access (mpx.vmhba32:C0:T0...	Non-SSD	3.50 GB	451.00 MB	VMFS5	4/12/2017 6:17:30 AM

Datastore Details

HX1AF-iSCSI-NTP1
Location: /vmfs/volumes/58f50d5e-dc5e1721-e80c-0025b5eda101
Hardware Acceleration: Supported

127.75 GB Capacity
976.00 MB ■ Used
126.80 GB □ Free

Path Selection
Round Robin (VM...

Paths
Total: 4
Broken: 0
Disabled: 0

Properties
Volume Label: HX1AF-iSCSI..
Datastore Name: HX1AF-iSCSI..

Formatting
File System: VMFS 5.61
Block Size: 1 MB

Extents
NETAPP iSCSI Disk (naa.60... 128.01 GB
Total Formatted Capacity 127.75 GB

Storage I/O Control
Disabled

50. You can now create VM's on this new datastore and migrate data between HX and the iSCSI datastore.

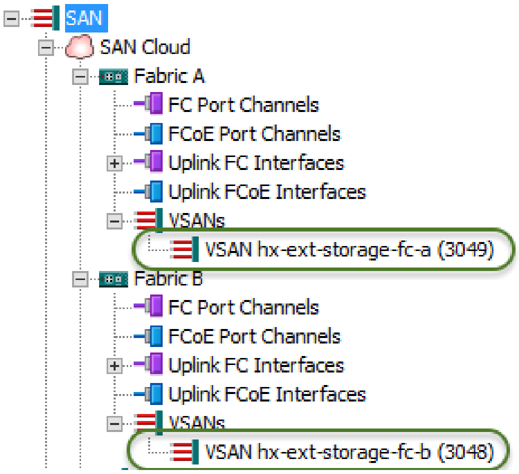
Connecting to Fibre Channel Storage

The HX installer can guide you through the process of setting up your HX cluster allowing you to leverage existing third-party storage via the Fibre Channel protocol. It will automatically configure Cisco UCS profiles, and HX cluster nodes with vHBAs, proper VSAN, and WWPN assignments, simplifying the setup. The procedure is described here in this CVD. It is assumed that the third-party storage system is already configured per a Cisco Validated Design and all networking configuration, including Fibre Channel for connecting via the upstream switches, is completed as well. In this example, we will be using Cisco MDS Fibre Channel switches that are connected to the Cisco UCS Fabric Interconnects, which are configured with Fibre Channel unified ports in End Host mode. Changing the identity of unified ports on a Cisco UCS Fabric Interconnect requires that the FIs are rebooted, so this task should be completed prior to the installation of the HyperFlex cluster(s). The third-party storage is connected to the MDS switches.

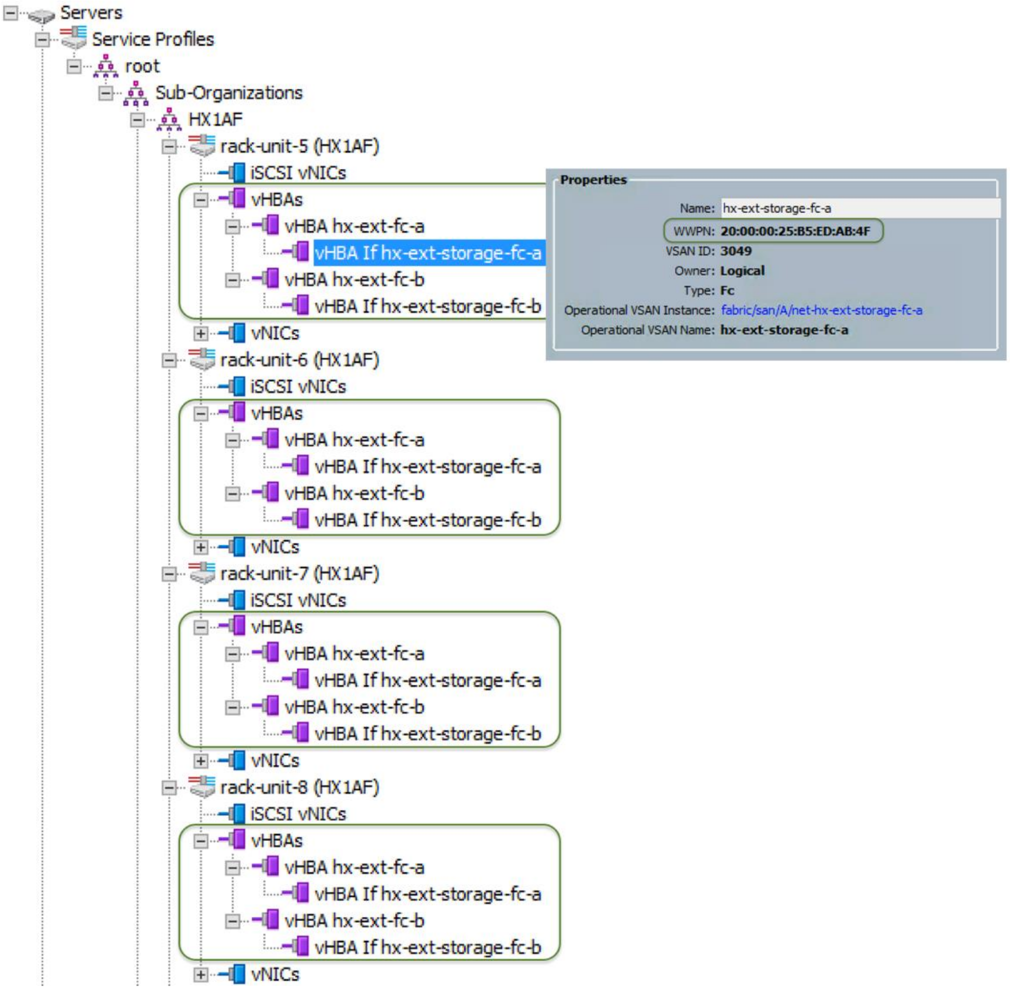
Note: It is required that you obtain the VSAN IDs being used in your current environment for the storage device that is already configured. This can be obtained from the SAN tab in Cisco UCS Manager, or from the upstream Fibre Channel switches.

1. Follow these steps for the HX cluster installation using the same VSAN IDs obtained from Step 1 for both Fabric A and B. Upon completion of HX install, two VSANs and two vHBAs (one for Fabric A and one for Fabric B) for each HX host will be created.

2. Open Cisco UCS Manager, Expand SAN > SAN Cloud > Fabric A > VSANs, then Fabric B > VSANs, verify the right VSANs are generated:



3. In Cisco UCS Manager, Expand Servers > Service Profiles > root > Sub-Organizations, go to the HX sub-organization you just created, verify vHBAs on all HX servers:



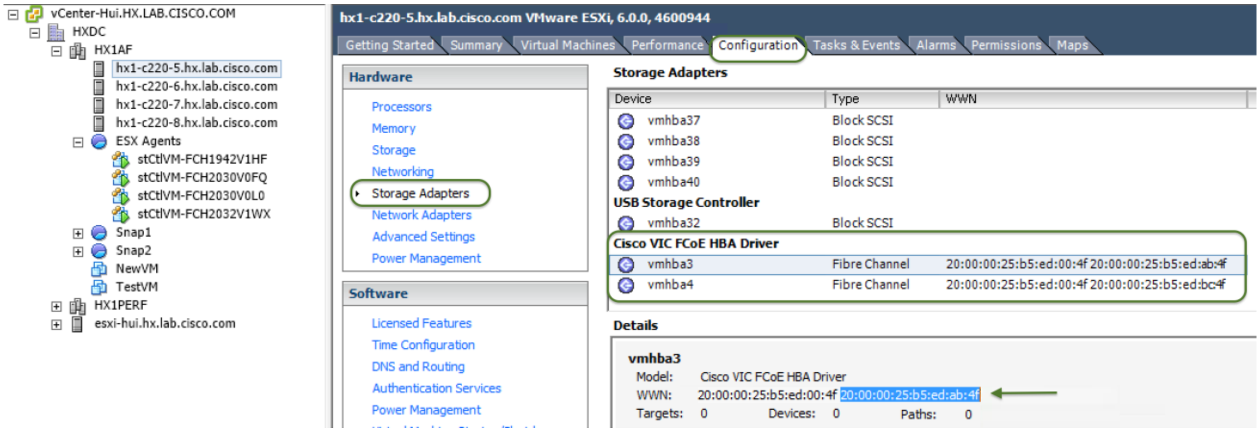
Name: hx-ext-storage-fc-a
WWPN: **20:00:00:25:B5:ED:AB:4F**
VSAN ID: **3049**
Owner: **Logical**
Type: **Fc**
Operational VSAN Instance: fabric/san/A/net-hx-ext-storage-fc-a
Operational VSAN Name: **hx-ext-storage-fc-a**

4. Record all the WWPN's for each HX node in the following table. These values are needed later for the zone configuration on the FC switches. You can copy the WWPN value by clicking on the vHBA in Cisco UCS Manager and the in the right pane, right-clicking the WWPN to copy.

Table 49 WWPNs on HX Hosts

Items		Fabric A	Fabric B
HX Server #1	WWPN		
	Alias		
HX Server #2	WWPN		
	Alias		
HX Server #3	WWPN		
	Alias		
HX Server #4	WWPN		
	Alias		
HX Server #5	WWPN		
	Alias		
HX Server #6	WWPN		
	Alias		
HX Server #7	WWPN		
	Alias		
HX Server #8	WWPN		
	Alias		

5. Alternatively, you can copy the WWPN value on the ESXi host in vCenter on the Configuration tab > Storage Adapters > Cisco VIC FCoE HBA Driver > <<vmhba>>.



Storage Adapters

Device	Type	WWN
vmhba37	Block SCSI	
vmhba38	Block SCSI	
vmhba39	Block SCSI	
vmhba40	Block SCSI	
USB Storage Controller		
vmhba32	Block SCSI	
Cisco VIC FCoE HBA Driver		
vmhba3	Fibre Channel	20:00:00:25:b5:ed:00:4f 20:00:00:25:b5:ed:ab:4f
vmhba4	Fibre Channel	20:00:00:25:b5:ed:00:4f 20:00:00:25:b5:ed:bc4f

Details

vmhba3
Model: Cisco VIC FCoE HBA Driver
WWN: 20:00:00:25:b5:ed:00:4f 20:00:00:25:b5:ed:ab:4f
Targets: 0 Devices: 0 Paths: 0

6. The WWPNs for the storage ports will also be recorded. These values are needed later for zone configuration on the FC switches. You can get that information from your storage device's management tool.

Table 50 Storage WWPNs

Items		Fabric A	Fabric B
Storage Device Port #1	WWPN		
	Alias		
Storage Device Port #2	WWPN		
	Alias		
Storage Device Port #3	WWPN		
	Alias		
Storage Device Port #4	WWPN		
	Alias		

7. Login to the MDS switch for A Fabric (MDS A), verify all HX vHBAs for A fabric have login to the name server and verify they are in the same VSAN as the target storage ports. Example:

```
HX1-C25-MDSA(config-vsan-db)# show flogi database vsan 3049

--------------------------------------------------------------------------------

INTERFACE        VSAN    FCID           PORT NAME               NODE NAME

--------------------------------------------------------------------------------

fc1/1            3049  0xba0000  20:1f:8c:60:4f:8d:dc:c0 2b:e9:8c:60:4f:8d:dc:c1

fc1/1            3049  0xba0001  20:00:00:25:b5:ed:ab:4f 20:00:00:25:b5:ed:00:4f

fc1/1            3049  0xba0002  20:00:00:25:b5:ed:ab:5f 20:00:00:25:b5:ed:00:5f

fc1/1            3049  0xba0003  20:00:00:25:b5:ed:ab:2f 20:00:00:25:b5:ed:00:2f

fc1/1            3049  0xba0004  20:00:00:25:b5:ed:ab:3f 20:00:00:25:b5:ed:00:3f

fc1/49           3049  0xba0020  50:0a:09:85:8d:b2:b9:0c 50:0a:09:80:8d:b2:b9:0c

fc1/49           3049  0xba0021  20:01:00:a0:98:1e:9c:9c 20:00:00:a0:98:1e:9c:9c
```

8. Complete the following steps to create the WWPN aliases using the values form the table. Example:

```
configure terminal

device-alias database

device-alias name HX1AF-N5a pwwn 20:00:00:25:b5:ed:ab:4f

device-alias name HX1AF-N6a pwwn 20:00:00:25:b5:ed:ab:5f

device-alias name HX1AF-N7a pwwn 20:00:00:25:b5:ed:ab:2f

device-alias name HX1AF-N8a pwwn 20:00:00:25:b5:ed:ab:3f
```

```
device-alias name FAS3250-010c pwwn 20:01:00:a0:98:1e:9c:9c

device-alias commit
```

9. Create the zones and add device-alias members (or PWWN members) for the HX servers. Example:

```
zone name HX1AF-N5a vsan 3049

 member device-alias HX1AF-N5a

 member device-alias FAS3250-010c

 exit

zone name HX1AF-N6a vsan 3049

 member device-alias HX1AF-N6a

 member device-alias FAS3250-010c

 exit

zone name HX1AF-N7a vsan 3049

 member device-alias HX1AF-N7a

 member device-alias FAS3250-010c

 exit

zone name HX1AF-N8a vsan 3049

 member device-alias HX1AF-N8a

 member device-alias FAS3250-010c

 exit
```

10. Create a zoneset and add the zones. Example:

```
zoneset name HX1AF-a vsan 3049

member HX1AF-N5a

member HX1AF-N6a

member HX1AF-N7a

member HX1AF-N8a

exit
```

11. Activate the zoneset. Example:

```
zoneset activate name HX1AF-a vsan 3049
```

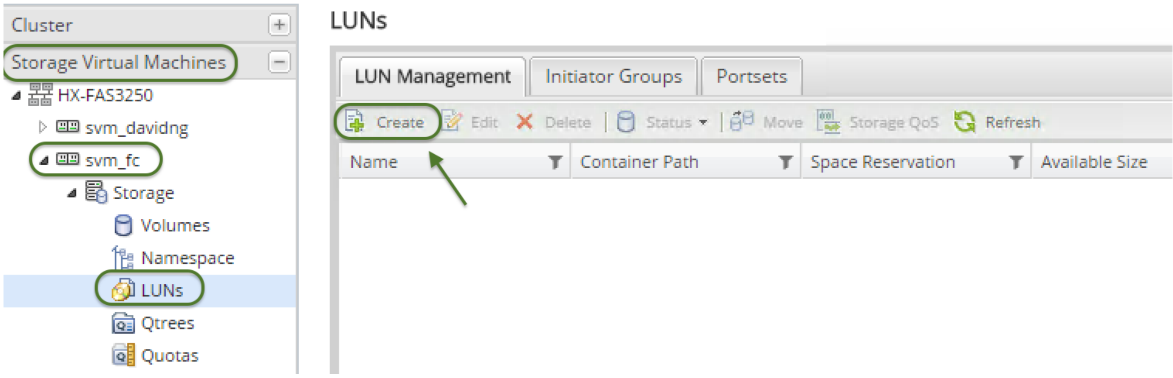
12. Validate the active zoneset and verify that all HX vHBAs and the target storage ports are logged into the switch (indicated by the * next to the devices). Example:

```
HX1-C25-MDSA(config)# show zoneset active vsan 3049
zoneset name HX1AF-a vsan 3049
  zone name HX1AF-N5a vsan 3049
  * fcid 0xba0001 [pwwn 20:00:00:25:b5:ed:ab:4f] [HX1AF-N5a]
  * fcid 0xba0021 [pwwn 20:01:00:a0:98:1e:9c:9c] [FAS3250-010c]

  zone name HX1AF-N6a vsan 3049
  * fcid 0xba0002 [pwwn 20:00:00:25:b5:ed:ab:5f] [HX1AF-N6a]
  * fcid 0xba0021 [pwwn 20:01:00:a0:98:1e:9c:9c] [FAS3250-010c]

  zone name HX1AF-N7a vsan 3049
  * fcid 0xba0003 [pwwn 20:00:00:25:b5:ed:ab:2f] [HX1AF-N7a]
  * fcid 0xba0021 [pwwn 20:01:00:a0:98:1e:9c:9c] [FAS3250-010c]

  zone name HX1AF-N8a vsan 3049
  * fcid 0xba0004 [pwwn 20:00:00:25:b5:ed:ab:3f] [HX1AF-N8a]
  * fcid 0xba0021 [pwwn 20:01:00:a0:98:1e:9c:9c] [FAS3250-010c]
```

13. Login to the MDS switch for the B fabric (MDS B) and complete steps 7-12 to create and activate the FC zones on the B side FC fabric.

14. Next, we will create initiator groups and then create a LUN on the storage system and map it to the HX system. In this example, we are using NetApp OnCommand System Manager GUI to create a LUN on a FAS3250 array. Please consult your storage documentation to accomplish the same tasks. It is assumed you have pre-existing FC storage configurations on an array as shown in this CVD.

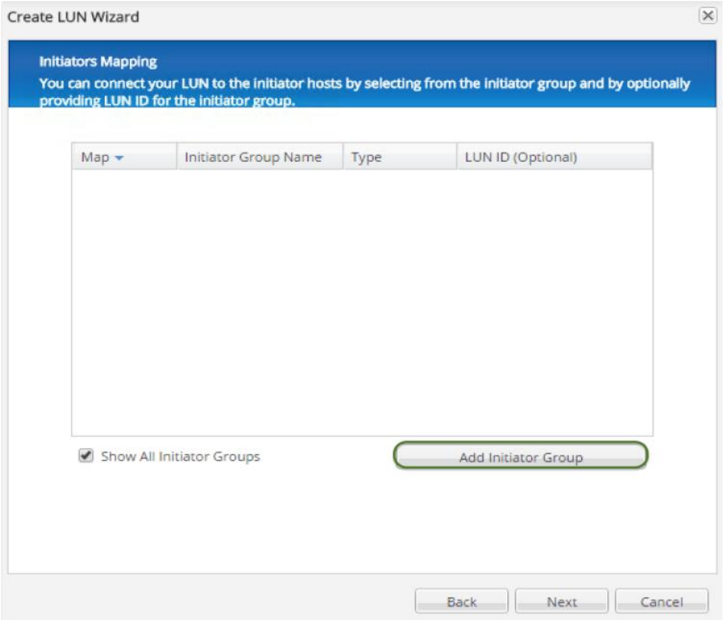
15. Open NetApp OnCommand System Manager GUI from the web browser, select the pre-configured FC Storage Virtual Machine, expand Storage, then LUNs; from the right pane, click Create. This opens the Create LUN wizard.



16. Click Next. In General Properties page, enter LUN Name, Type and Size. Click Next.

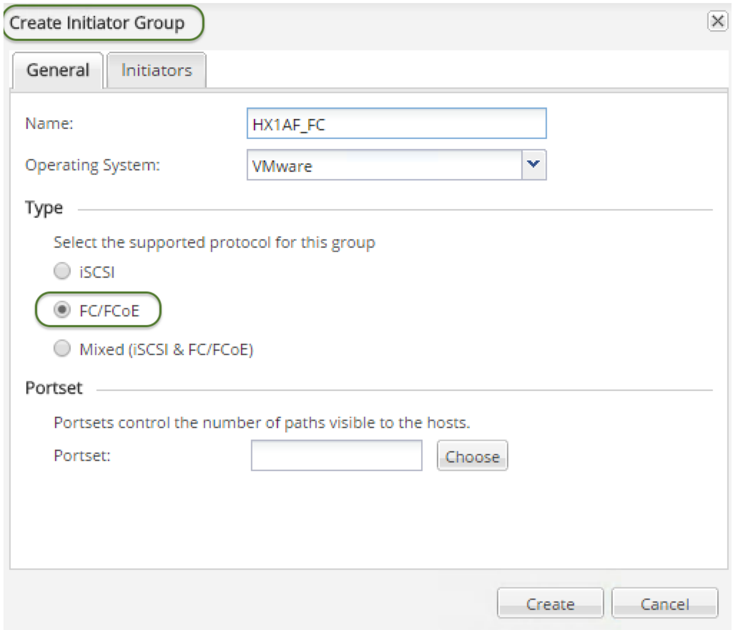
17. Check “Select an existing volume or qtree for this LUN”, browse and select an existing volume, then click Next.

18. On Initiators Mapping page, select Add Initiator Group.



You can connect your LUN to the initiator hosts by selecting from the initiator group and by optionally providing LUN ID for the initiator group.

19. In Create Initiator Group wizard, on General tab, enter Name, Operation System, and select Type of FC/FCoE for the Initiator Group to be created.



Create Initiator Group

Name: HX1AF_FC

Operating System: VMware

Type

Select the supported protocol for this group

○ iSCSI

● FC/FCoE

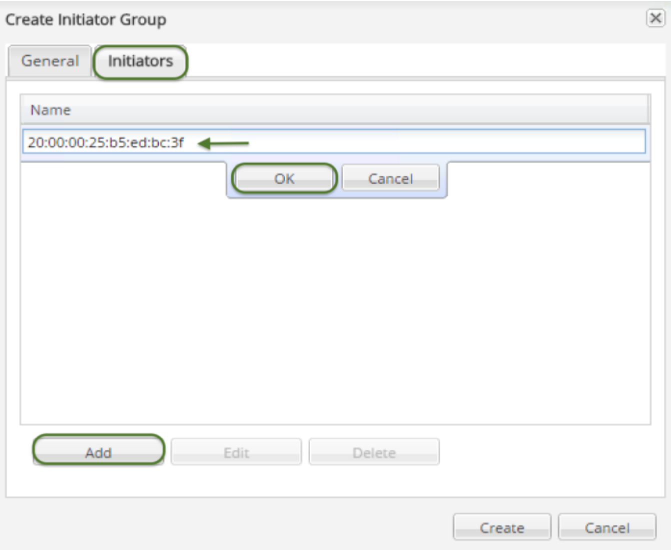
○ Mixed (iSCSI & FC/FCoE)

Portset

Portsets control the number of paths visible to the hosts.

Portset:

20. On Initiators tab, click Add then enter the WWPN of the first HX vHBA, click OK.



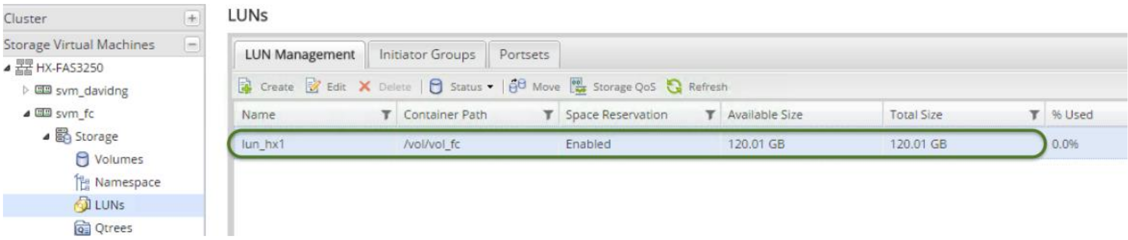
Create Initiator Group

Name

20:00:00:25:b5:ed:bc:3f

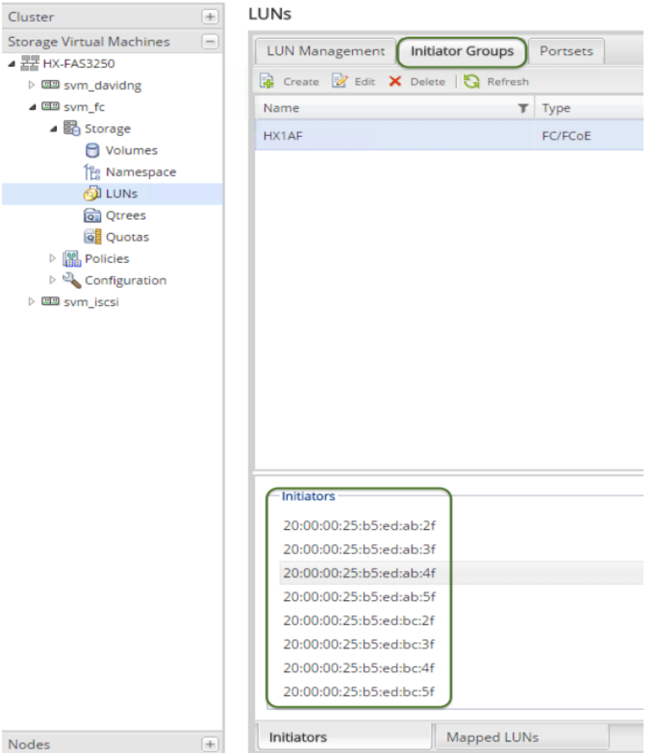
21. Repeat Step 21 until the WWPNs of all HX vHBAs (on both Fabric A and B) are added. Select Create to create the Initiator Group.

22. The Add Initiator Group Wizard exits back to Initiators Mapping page of the Create LUN wizard. Select the HX initiator group that is just created, click Next three times then click Finish to complete the LUN creation.



Name	Container Path	Space Reservation	Available Size	Total Size	% Used
lun_hx1	/vol/vol_fc	Enabled	120.01 GB	120.01 GB	0.0%

23. Check the initiators mapped to this LUN.

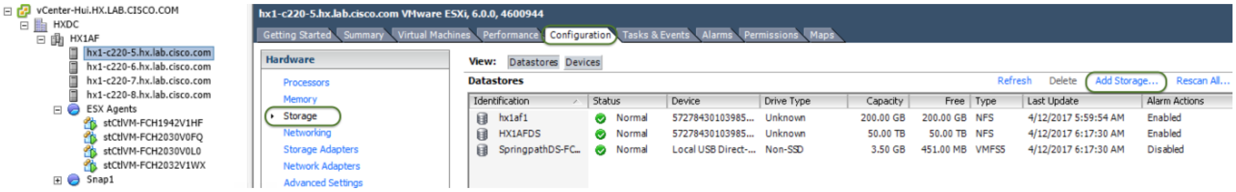


Name	Type
HX1AF	FC/FCoE

Initiators

20:00:00:25:b5:ed:ab:2f
20:00:00:25:b5:ed:ab:3f
20:00:00:25:b5:ed:ab:4f
20:00:00:25:b5:ed:ab:5f
20:00:00:25:b5:ed:bc:2f
20:00:00:25:b5:ed:bc:3f
20:00:00:25:b5:ed:bc:4f
20:00:00:25:b5:ed:bc:5f

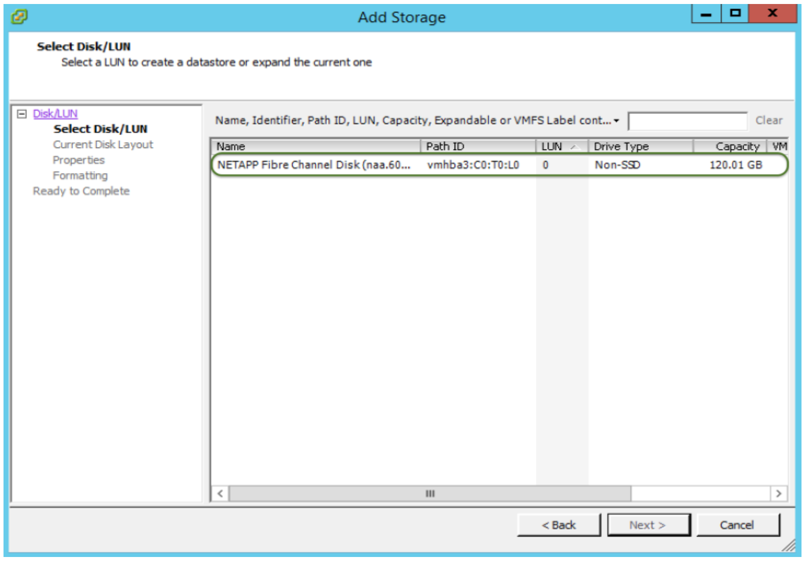
24. Return to vCenter and from the Configuration tab, select Storage, then Add Storage.



Identification	Status	Device	Drive Type	Capacity	Free	Type	Last Update	Alarm Actions
hx1af1	Normal	57278430103985...	Unknown	200.00 GB	200.00 GB	NFS	4/12/2017 5:59:54 AM	Enabled
HX1AFDS	Normal	57278430103985...	Unknown	50.00 TB	50.00 TB	NFS	4/12/2017 6:17:30 AM	Enabled
SpringpathDS-FC...	Normal	Local USB Direct-...	Non-SSD	3.50 GB	451.00 MB	VMFS5	4/12/2017 6:17:30 AM	Disabled

25. Leave Disk/LUN selected and click Next.

26. The NetApp Fibre Channel LUN just created will be detected. Highlight the disk and click Next, then click Next again.



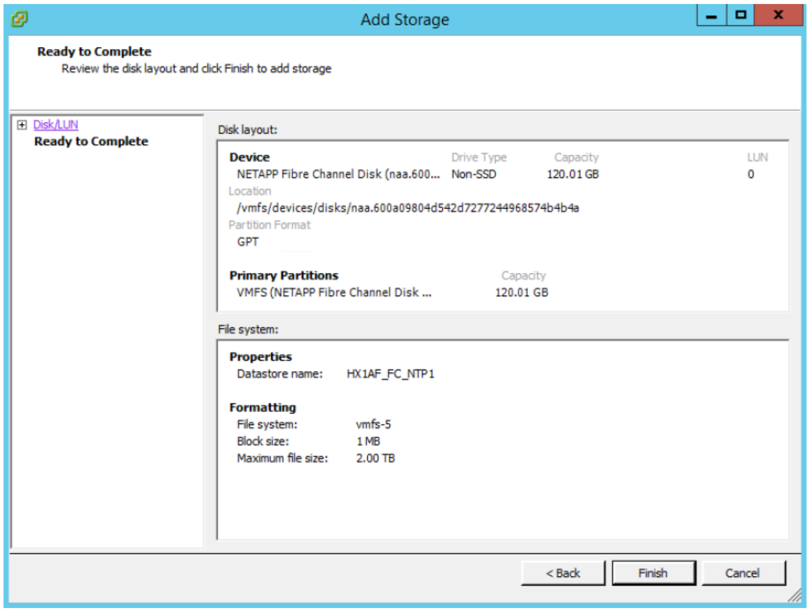
Select Disk/LUN

Select a LUN to create a datastore or expand the current one

Name	Path ID	LUN	Drive Type	Capacity	VM
NETAPP Fibre Channel Disk (naa.60...	vmhba3:C0:T0:L0	0	Non-SSD	120.01 GB	

27. Enter the Name of the Datastore and click Next.

28. Click Next for maximum available space as desired, then click Finish.



Ready to Complete

Review the disk layout and click Finish to add storage

Disk layout:

Device	Drive Type	Capacity	LUN
NETAPP Fibre Channel Disk (naa.600...	Non-SSD	120.01 GB	0

Location
/vmfs/devices/disks/naa.600a09804d542d7277244968574b4b4a

Partition Format
GPT

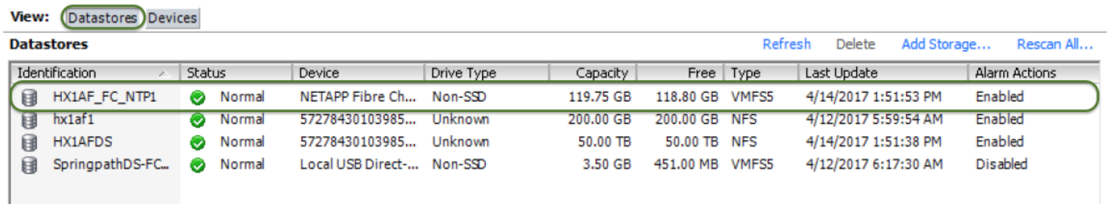
Primary Partitions	Capacity
VMFS (NETAPP Fibre Channel Disk ...	120.01 GB

File system:

Properties
Datastore name: HX1AF_FC_NTP1

Formatting
File system: vmfs-5
Block size: 1 MB
Maximum file size: 2.00 TB

29. You can now review your datastores in the configuration tab, and perform storage migration of any VM’s if necessary.



Datastores

Identification	Status	Device	Drive Type	Capacity	Free	Type	Last Update	Alarm Actions
HX1AF_FC_NTP1	✓ Normal	NETAPP Fibre Ch...	Non-SSD	119.75 GB	118.80 GB	VMFS5	4/14/2017 1:51:53 PM	Enabled
hx1af1	✓ Normal	57278430103985...	Unknown	200.00 GB	200.00 GB	NFS	4/12/2017 5:59:54 AM	Enabled
HX1AFDS	✓ Normal	57278430103985...	Unknown	50.00 TB	50.00 TB	NFS	4/14/2017 1:51:38 PM	Enabled
SpringpathDS-FC...	✓ Normal	Local USB Direct-...	Non-SSD	3.50 GB	451.00 MB	VMFS5	4/12/2017 6:17:30 AM	Disabled

F: Adding HX to an existing Cisco UCS Domain

For a scenario where HX nodes are added to an existing Cisco UCS domain, extreme caution is advised, as the HX installer will overwrite any conflicting configuration in the existing Cisco UCS domain, in particular the QoS system classes. A Cisco UCS firmware upgrade or changes to the configuration on the upstream switches may also be required. All of these changes can be disruptive to the existing systems and workloads, and need to be carefully planned and implemented within a maintenance window. It is recommended that you contact Cisco TAC, or your Cisco sales engineer support team for assistance when you need to connect HX nodes to an existing Cisco UCS domain.

About the Authors

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Brian is an IT industry veteran with over 19 years of experience deploying server, network, and storage infrastructures for companies around the world. During his tenure at Cisco, he has been a lead Advanced Services Solutions Architect for Microsoft solutions, virtualization, and SAP Hana on Cisco UCS. Currently his focus is on Cisco's portfolio of Software Defined Storage (SDS) and Hyperconverged Infrastructure solutions. Brian has earned multiple certifications from Microsoft, Cisco, and VMware.

Hui Chen, Technical Marketing Engineer, Cisco UCS Data Center Engineering Group, Cisco Systems, Inc.

Hui is a network and storage veteran with over 15 years of experience on Fibre Channel-based storage area networking, the LAN/SAN convergence systems, and how to build end-to-end; from the server to storage, and solutions in the data center. Currently he focuses on Cisco's Software Defined Storage (SDS) and Hyperconverged Infrastructure (HCI) solutions. Hui is also a seasoned CCIE.

Jeffery Fultz, Technical Marketing Engineer, Cisco UCS Data Center Engineering Group, Cisco Systems, Inc.

Jeff has over 20 years of experience in both Information Systems and Application Development dealing in Data Center Management, Backup, and Virtualization Optimization related technologies. Jeff works on design and test a wide variety of enterprise solutions encompassing Cisco, VMware, Hyper-V, SQL, and Microsoft Exchange. Jeff is a Microsoft Certified System Engineer with multiple patents filed in the Datacenter Solutions space.