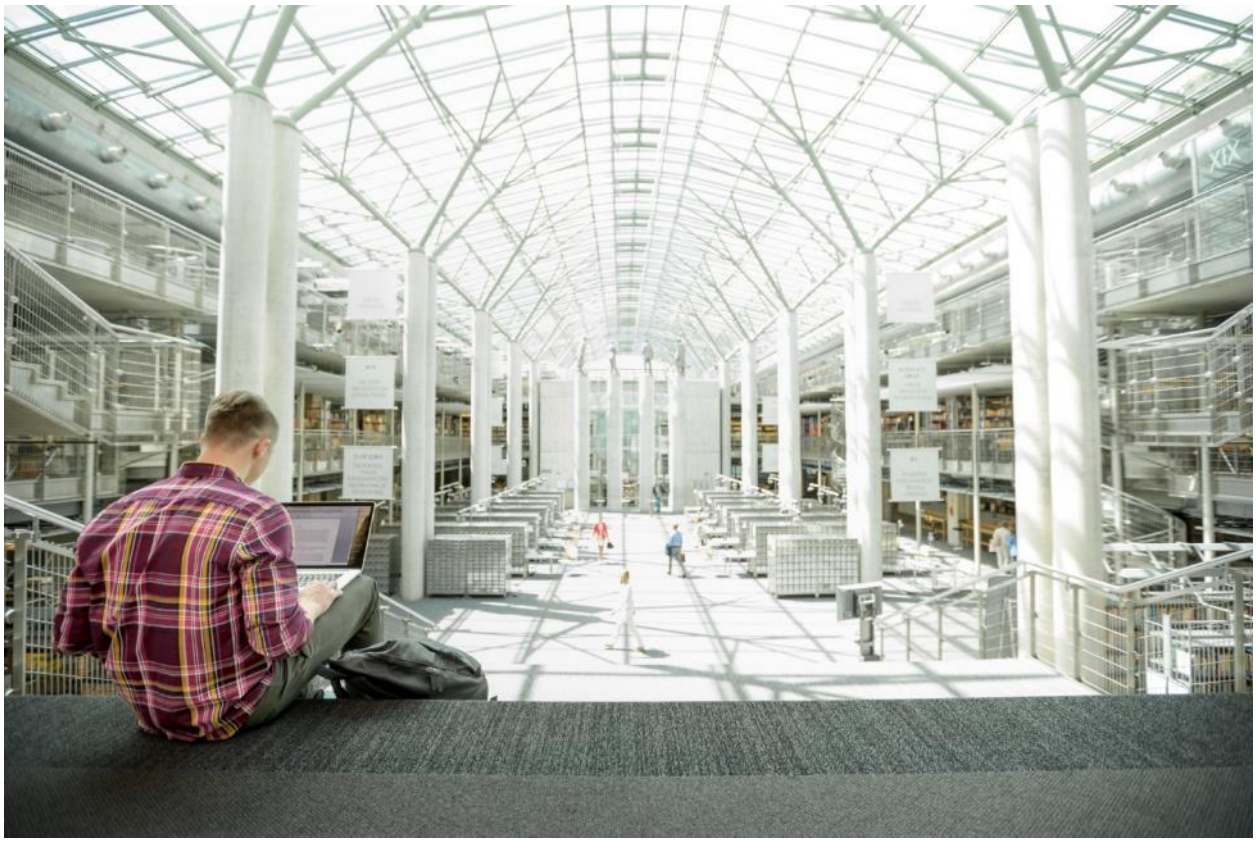

Cisco HyperFlex M5 All-Flash Hyperconverged System with Hyper-V 2016 and Citrix XenDesktop

Deployment Guide for Cisco HyperFlex with Virtual Desktop Infrastructure for Citrix XenDesktop 7.16 using Cisco UCS 3.2(3), Cisco HyperFlex Data Platform v 3.0.1c, and Microsoft Hyper -V 2016

Last Updated: December 21, 2018

CISCO VALIDATED DESIGN

About the Cisco Validated Design Program

The Cisco Validated Design (CVD) program consists of systems and solutions designed, tested, and documented to facilitate faster, more reliable, and more predictable customer deployments. For more information, refer to:

http://www.cisco.com/go/designzone.

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Executive Summary

To keep pace with the market, you need systems that support rapid, agile development processes. Cisco HyperFlex™ Systems let you unlock the full potential of hyper-convergence and adapt IT to the needs of your workloads. The systems use an end-to-end software-defined infrastructure approach, combining software-defined computing in the form of Cisco HyperFlex HX-Series Nodes, software-defined storage with the powerful Cisco HyperFlex HX Data Platform, and software-defined networking with the Cisco UCS fabric that integrates smoothly with Cisco® Application Centric Infrastructure (Cisco ACI™).

Together with a single point of connectivity and management, these technologies deliver a pre-integrated and adaptable cluster with a unified pool of resources that you can quickly deploy, adapt, scale, and manage to efficiently power your applications and your business

This document provides an architectural reference and design guide for up to 1250 VDI users and 1600 RDS session workload on an 8-node (8x Cisco HyperFlex HXAF220C-M5SX server) Cisco HyperFlex system. We provide deployment guidance and performance data for Citrix XenDesktop 7.16 virtual desktops running Microsoft Windows 10 with Office 2016 Machine Creation Services. The solution is a pre-integrated, best-practice data center architecture built on the Cisco Unified Computing System (UCS), the Cisco Nexus® 9000 family of switches and Cisco HyperFlex Data Platform software version 3.0.1c.

The solution payload is 100 percent virtualized on Cisco HyperFlex HXAF220C-M5SX hyperconverged nodes booting via on-board M.2 SATA SSD drive running Microsoft Hyper-V 2016 hypervisor and the Cisco HyperFlex Data Platform storage controller VM. The virtual desktops are configured with XenDesktop 7.16, which incorporates both traditional persistent and non-persistent virtual Windows 7/8/10 desktops, hosted applications and remote desktop service (RDS) Microsoft Server 2008 R2, Server 2012 R2 or Server 2016 based desktops. The solution provides unparalleled scale and management simplicity. Citrix XenDesktop Provisioning Services or Machine Creation Services Windows 10 desktops, full clone desktops or XenApp server based desktops can be provisioned on an eight node Cisco HyperFlex cluster. Where applicable, this document provides best practice recommendations and sizing guidelines for customer deployment of this solution.

The solution boots 1250 virtual desktops machines in 30 minutes or less, making sure that users will not experience delays in accessing their virtual workspace on HyperFlex.

Our past Cisco Validated Design studies with HyperFlex show linear scalability out to the cluster size limits of 8 HyperFlex hyperconverged nodes with Cisco UCS B200 M5, Cisco UCS C220 M5, or Cisco UCS C240 M5 servers. You can expect that our new HyperFlex all flash system running HX Data Platform 3.0.1 on Cisco HXAF220 M5 or Cisco HXAF240 M5 nodes will scale up to 1250 knowledge worker users per cluster with N+1 server fault tolerance.

The solution is fully capable of supporting hardware accelerated graphic workloads. Each Cisco HyperFlex HXAF240c M5 node and each Cisco UCS C240 M5 compute only server can support up to two NVIDIA M10 or P40 cards. The Cisco UCS B200 M5 server supports up to two NVIDIA P6 cards for high density, high performance graphics workload support. See our Cisco Graphics White Paper for our fifth generation servers with NVIDIA GPUs and software for details on how to integrate this capability with Citrix XenDesktop.

The solution provides outstanding virtual desktop end user experience as measured by the Login VSI 4.1.25 Knowledge Worker workload running in benchmark mode. Index average end-user response times for all tested delivery methods is under one second, representing the best performance in the industry.

Solution Overview

Introduction

The current industry trend in data center design is towards small, granularly expandable hyperconverged infrastructures. By using virtualization along with pre-validated IT platforms, customers of all sizes have embarked on the journey to “just-in-time capacity” using this new technology. The Cisco HyperFlex hyper converged solution can be quickly deployed, thereby increasing agility and reducing costs. Cisco HyperFlex uses best of breed storage, server and network components to serve as the foundation for desktop virtualization workloads, enabling efficient architectural designs that can be quickly and confidently deployed and scaled-out.

Audience

The audience for this document includes, but is not limited to; sales engineers, field consultants, professional services, IT managers, partner engineers, and customers who want to take advantage of an infrastructure built to deliver IT efficiency and enable IT innovation.

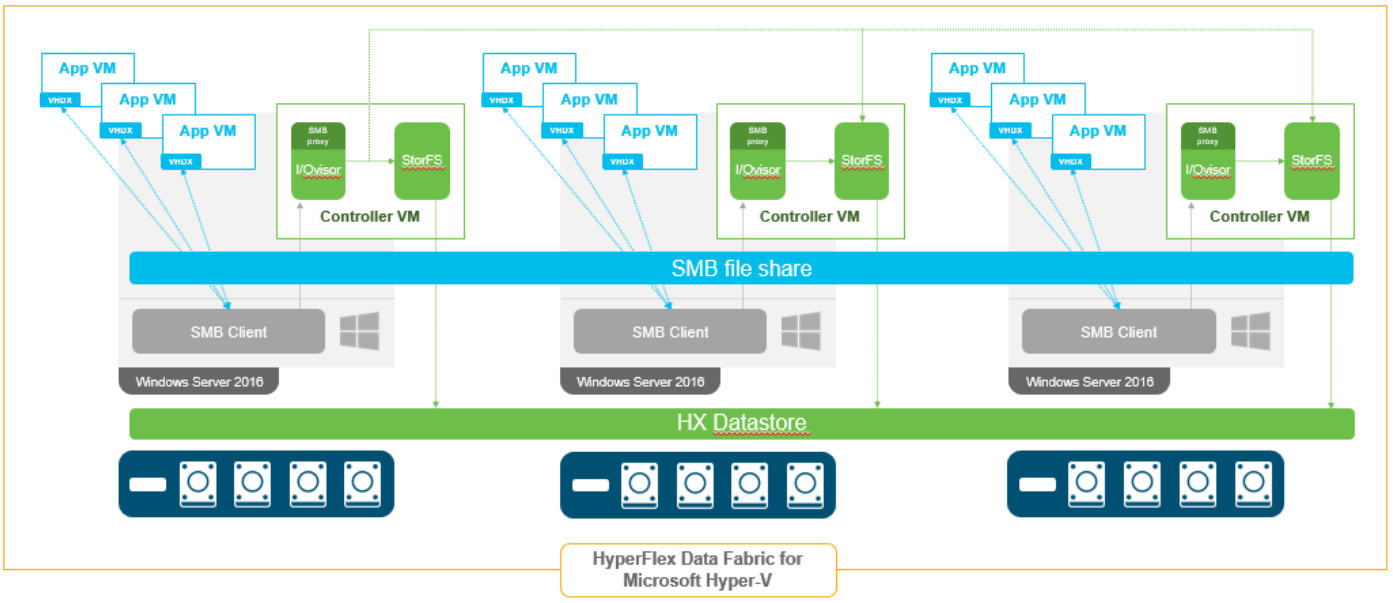
Purpose of this Document

This document provides a step-by-step design, configuration, and implementation guide for the Cisco Validated Design for a Cisco HyperFlex All-Flash system running four different Citrix XenDesktop/XenApp workloads with Cisco UCS 6300 series Fabric Interconnects and Cisco Nexus 9300 series switches.

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 Cisco HyperFlex System Overview



The following are the components of a Cisco HyperFlex system using Microsoft Hyper-V as the hypervisor:

- One pair of Cisco UCS Fabric Interconnects, choose from models:

  - Cisco UCS 6332 Fabric Interconnect
  - Cisco UCS 6332-16UP Fabric Interconnect
- Eight Cisco HyperFlex HX-Series Rack-Mount Servers, choose from models:
  - Cisco HyperFlex HXAF220c-M5SX All-Flash Rack-Mount Servers
    - Cisco HyperFlex Data Platform Software
    - Microsoft Windows Server 2016 Hyper-V Hypervisor
    - Microsoft Windows Active Directory and DNS services, RSAT tools (end-user supplied)
    - SCVMM – Needed for XenDesktop (end-user supplied)
    - Citrix XenApp/XenDesktop 7.16
    - Citrix Provisioning Services 7.16

Solution Summary

This Cisco Validated Design prescribes a defined set of hardware and software that serves as an integrated foundation for both Citrix XenDesktop Microsoft Windows 10 virtual desktops and Citrix XenApp server desktop sessions based on Microsoft Server 2016. The mixed workload solution includes Cisco HyperFlex hardware and Data Platform software, Cisco Nexus® switches, the Cisco Unified Computing System (Cisco UCS®), Citrix XenDesktop and Microsoft Hyper-V software in a single package. The design is efficient such that the networking, computing, and storage components occupy an 8-rack unit footprint in an industry standard 42U rack. Port density on the Cisco Nexus switches and Cisco UCS Fabric Interconnects enables the networking components to accommodate multiple HyperFlex clusters in a single Cisco UCS domain.

A key benefit of the Cisco Validated Design architecture is the ability to customize the environment to suit a customer's requirements. A Cisco Validated Design scales easily as requirements and demand change. The solution can be scaled both up (adding resources to a Cisco Validated Design unit) and out (adding more Cisco Validated Design units).

The reference architecture detailed in this document highlights the resiliency, cost benefit, and ease of deployment of a hyper-converged desktop virtualization solution. A solution capable of consuming multiple protocols across a single interface allows for customer choice and investment protection because it truly is a wire-once architecture.

The combination of technologies from Cisco Systems, Inc. and Microsoft Inc. produced a highly efficient, robust and affordable desktop virtualization solution for a virtual desktop, hosted shared desktop or mixed deployment supporting different use cases. Key components of the solution include the following:

- **More power, same size.** Cisco HX-series nodes, dual 18-core 2.3 GHz Intel Xeon (Gold 6140) Scalable Family processors with 768GB of 2666Mhz memory with Citrix XenDesktop support more virtual desktop workloads than the previously released generation processors on the same hardware. The Intel Xeon Gold 6140 18-core scalable family processors used in this study provided a balance between increased per-server capacity and cost.

- **Fault-tolerance with high availability built into the design.** The various designs are based on multiple Cisco HX-Series nodes, Cisco UCS rack servers and Cisco UCS blade servers for virtual desktop and infrastructure workloads. The design provides N+1 server fault tolerance for every payload type tested.

- **Stress-tested to the limits during aggressive boot scenario.** The 1250 user mixed hosted virtual desktop and 1600 user hosted shared desktop environment booted and registered with the XenDesktop Studio in under 5 minutes, providing our customers with an extremely fast, reliable cold-start desktop virtualization system.

- **Stress-tested to the limits during simulated login storms.** All 1250 users logged in and started running workloads up to steady state in 48-minutes without overwhelming the processors, exhausting memory or exhausting the storage subsystems, providing customers with a desktop virtualization system that can easily handle the most demanding login and startup storms.

- **Ultra-condensed computing for the data center.** The rack space required to support the initial 1250 user system is 8 rack units, including Cisco Nexus Switching and Cisco Fabric interconnects. Incremental Citrix XenDesktop users can be added to the Cisco HyperFlex cluster up to the cluster scale limits, currently 16 hyper converged and 16 compute only nodes, by adding one or more nodes.

- **100 percent virtualized:** This CVD presents a validated design that is 100 percent virtualized on Microsoft Hyper-V 2016. All of the virtual desktops, user data, profiles, and supporting infrastructure components, including Active Directory, SQL Servers, Citrix XenDesktop components, XenDesktop VDI desktops and XenApp servers were hosted as virtual machines. This provides customers with complete flexibility for maintenance and capacity additions because the entire system runs on the Cisco HyperFlex hyper-converged infrastructure with stateless Cisco UCS HX-series servers. (Infrastructure VMs were hosted on two Cisco UCS C220 M4 Rack Servers outside of the HX cluster to deliver the highest capacity and best economics for the solution.)

- **Cisco data center management:** Cisco maintains industry leadership with the new Cisco UCS Manager 3.2(2) software that simplifies scaling, guarantees consistency, and eases maintenance. Cisco's ongoing development efforts with Cisco UCS Manager, Cisco UCS Central, and Cisco UCS Director insure that customer environments are consistent locally, across Cisco UCS Domains and across the globe. Cisco UCS software suite offers increasingly simplified operational and deployment management, and it continues to widen the span of control for customer organizations' subject matter experts in compute, storage and network.
- **Cisco 40G Fabric:** Our 40G unified fabric story gets additional validation on 6300 Series Fabric Interconnects as Cisco runs more challenging workload testing, while maintaining unsurpassed user response times.
- **Cisco HyperFlex Connect (HX Connect):** An all-new HTML 5 based Web UI Introduced with HyperFlex v2.5 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.
- **Cisco HyperFlex storage performance:** Cisco HyperFlex provides industry-leading hyper converged storage performance that efficiently handles the most demanding I/O bursts (for example, login storms), high write throughput at low latency, delivers simple and flexible business continuity and helps reduce storage cost per desktop.
- **Cisco HyperFlex agility:** Cisco HyperFlex System enables users to seamlessly add, upgrade or remove storage from the infrastructure to meet the needs of the virtual desktops.
- **Optimized for performance and scale.** For hosted shared desktop sessions, the best performance was achieved when the number of vCPUs assigned to the virtual machines did not exceed the number of hyper-threaded (logical) cores available on the server. In other words, maximum performance is obtained when not overcommitting the CPU resources for the virtual machines running virtualized RDS systems.

Cisco Desktop Virtualization Solutions: Data Center

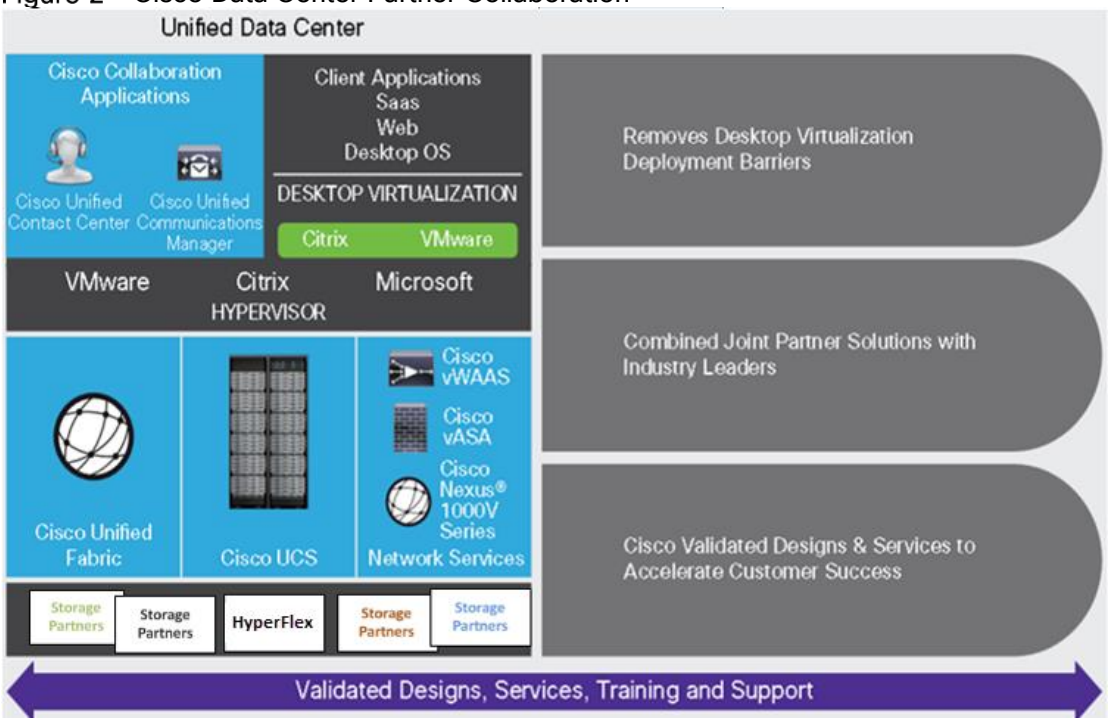
The Evolving Workplace

Today's IT departments are facing a rapidly evolving workplace environment. The workforce is becoming increasingly diverse and geographically dispersed, including offshore contractors, distributed call center operations, knowledge and task workers, partners, consultants, and executives connecting from locations around the world at all times.

This workforce is also increasingly mobile, conducting business in traditional offices, conference rooms across the enterprise campus, home offices, on the road, in hotels, and at the local coffee shop. This workforce wants to use a growing array of client computing and mobile devices that they can choose based on personal preference. These trends are increasing pressure on IT to ensure protection of corporate data and prevent data leakage or loss through any combination of user, endpoint device, and desktop access scenarios (Figure 2).

These challenges are compounded by desktop refresh cycles to accommodate aging PCs and bounded local storage and migration to new operating systems, specifically Microsoft Windows 10 and productivity tools, specifically Microsoft Office 2016.

Figure 2 Cisco Data Center Partner Collaboration



Some of the key drivers for desktop virtualization are increased data security, the ability to expand and contract capacity and reduced TCO through increased control and reduced management costs.

Cisco Desktop Virtualization Focus

Cisco focuses on three key elements to deliver the best desktop virtualization data center infrastructure: simplification, security, and scalability. The software combined with platform modularity provides a simplified, secure, and scalable desktop virtualization platform.

Simplified

Cisco UCS and Cisco HyperFlex provide a radical new approach to industry-standard computing and provides the core of the data center infrastructure for desktop virtualization. Among the many features and benefits of Cisco UCS are the drastic reduction in the number of servers needed and in the number of cables used per server, and the capability to rapidly deploy or re-provision servers through Cisco UCS service profiles. With fewer servers and cables to manage and with streamlined server and virtual desktop provisioning, operations are significantly simplified. Thousands of desktops can be provisioned in minutes with Cisco UCS Manager service profiles and Cisco storage partners' storage-based cloning. This approach accelerates the time to productivity for end users, improves business agility, and allows IT resources to be allocated to other tasks.

Cisco UCS Manager automates many mundane, error-prone data center operations such as configuration and provisioning of server, network, and storage access infrastructure. In addition, Cisco UCS B-Series Blade Servers, C-Series and HX-Series Rack Servers with large memory footprints enable high desktop density that helps reduce server infrastructure requirements.

Simplification also leads to more successful desktop virtualization implementation. Cisco and its technology partners like Microsoft have developed integrated, validated architectures, including predefined hyper-converged architecture infrastructure packages such as HyperFlex. Cisco Desktop Virtualization Solutions have been tested with Microsoft Hyper-V.

Secure

Although virtual desktops are inherently more secure than their physical predecessors, they introduce new security challenges. Mission-critical web and application servers using a common infrastructure such as virtual desktops are now at a higher risk for security threats. Inter–virtual machine traffic now poses an important security consideration that IT managers need to address, especially in dynamic environments in which virtual machines, using Microsoft Live Migration, move across the server infrastructure.

Desktop virtualization, therefore, significantly increases the need for virtual machine–level awareness of policy and security, especially given the dynamic and fluid nature of virtual machine mobility across an extended computing infrastructure. The ease with which new virtual desktops can proliferate magnifies the importance of a virtualization-aware network and security infrastructure. Cisco data center infrastructure (Cisco UCS and Cisco Nexus Family solutions) for desktop virtualization provides strong data center, network, and desktop security, with comprehensive security from the desktop to the hypervisor. Security is enhanced with segmentation of virtual desktops, virtual machine–aware policies and administration, and network security across the LAN and WAN infrastructure.

Scalable

Growth of a desktop virtualization solution is accelerating, so a solution must be able to scale, and scale predictably, with that growth. The Cisco Desktop Virtualization Solutions support high virtual-desktop density (desktops per server) and additional servers scale with near-linear performance. Cisco data center infrastructure provides a flexible platform for growth and improves business agility. Cisco UCS Manager service profiles allow on-demand desktop provisioning and make it just as easy to deploy dozens of desktops as it is to deploy thousands of desktops.

Cisco HyperFlex servers provide near-linear performance and scale. Cisco UCS implements the patented Cisco Extended Memory Technology to offer large memory footprints with fewer sockets (with scalability to up to 1.5 terabyte (TB) of memory with 2- and 4-socket servers). Using unified fabric technology as a building block, Cisco UCS server aggregate bandwidth can scale to up to 80 Gbps per server, and the northbound Cisco UCS fabric interconnect can output 2 terabits per second (Tbps) at line rate, helping prevent desktop virtualization I/O and memory bottlenecks. Cisco UCS, with its high-performance, low-latency unified fabric-based networking architecture, supports high volumes of virtual desktop traffic, including high-resolution video and communications traffic. In addition, Cisco HyperFlex helps maintain data availability and optimal performance during boot and login storms as part of the Cisco Desktop Virtualization Solutions. Recent Cisco Validated Designs based on Citrix XenDesktop, Cisco HyperFlex solutions have demonstrated scalability and performance, with up to 450 hosted virtual desktops and hosted shared desktops up and running in 5 minutes.

Cisco UCS and Cisco Nexus data center infrastructure provides an excellent platform for growth, with transparent scaling of server, network, and storage resources to support desktop virtualization, data center applications, and cloud computing.

Savings and Success

The simplified, secure, scalable Cisco data center infrastructure for desktop virtualization solutions saves time and money compared to alternative approaches. Cisco UCS enables faster payback and ongoing savings (better ROI and lower TCO) and provides the industry's greatest virtual desktop density per server, reducing both capital expenditures (CapEx) and operating expenses (OpEx). The Cisco UCS architecture and Cisco Unified Fabric also enables much lower network infrastructure costs, with fewer cables per server and fewer ports required. In addition, storage tiering and deduplication technologies decrease storage costs, reducing desktop storage needs by up to 50 percent.

The simplified deployment of Cisco HyperFlex for desktop virtualization accelerates the time to productivity and enhances business agility. IT staff and end users are more productive more quickly, and the business can respond to new opportunities quickly by deploying virtual desktops whenever and wherever they are needed. The high-performance Cisco systems and network deliver a near-native end-user experience, allowing users to be productive anytime and anywhere.

The key measure of desktop virtualization for any organization is its efficiency and effectiveness in both the near term and the long term. The Cisco Desktop Virtualization Solutions are very efficient, allowing rapid deployment, requiring fewer devices and cables, and reducing costs. The solutions are also extremely effective, providing the services that end users need on their devices of choice while improving IT operations, control, and data security. Success is bolstered through Cisco's best-in-class partnerships with leaders in virtualization and through tested and validated designs and services to help customers throughout the solution lifecycle. Long-term success is enabled through the use of Cisco's scalable, flexible, and secure architecture as the platform for desktop virtualization.

The ultimate measure of desktop virtualization for any end user is a great experience. Cisco HyperFlex delivers class-leading performance with sub-second base line response times and index average response times at full load of just under one second.

Use Cases

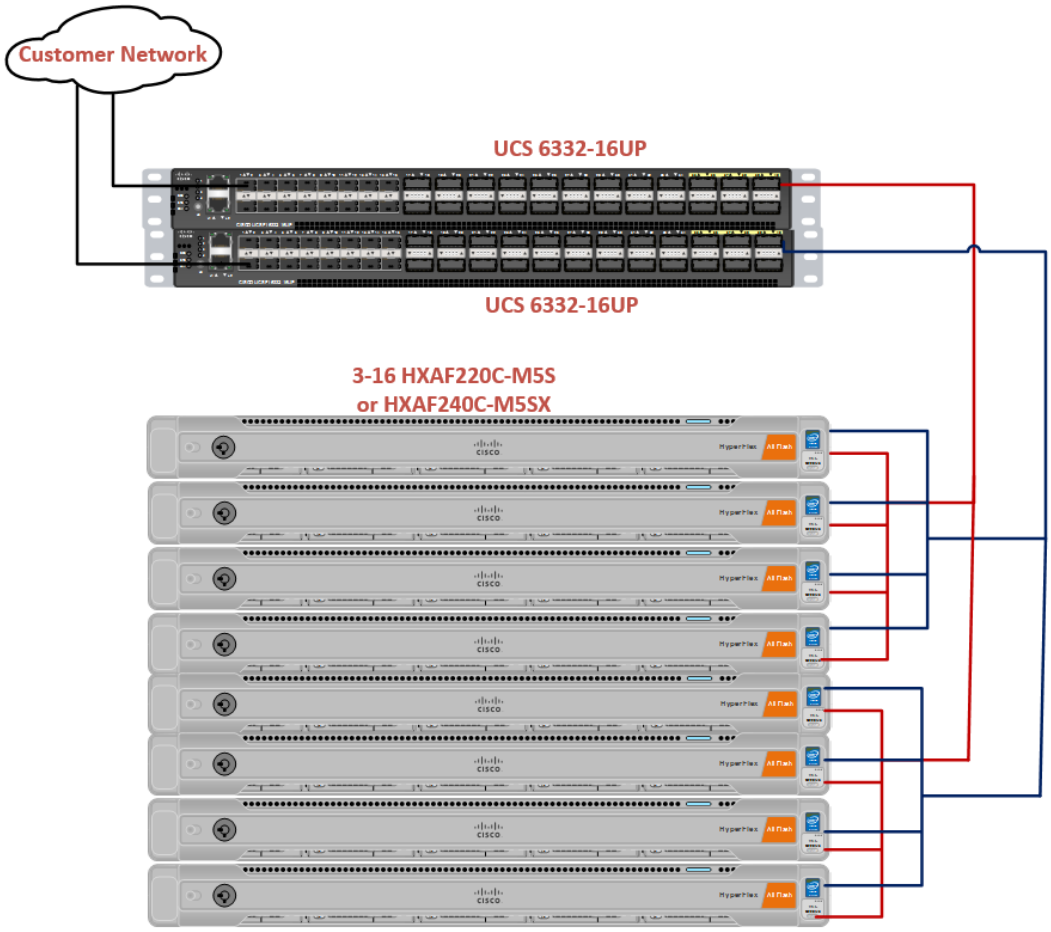
- Healthcare: Mobility between desktops and terminals, compliance, and cost
- Federal government: Teleworking initiatives, business continuance, continuity of operations (COOP), and training centers
- Financial: Retail banks reducing IT costs, insurance agents, compliance, and privacy
- Education: K-12 student access, higher education, and remote learning
- State and local governments: IT and service consolidation across agencies and interagency security
- Retail: Branch-office IT cost reduction and remote vendors
- Manufacturing: Task and knowledge workers and offshore contractors
- Microsoft Windows 10 migration
- Graphic intense applications
- Security and compliance initiatives
- Opening of remote and branch offices or offshore facilities
- Mergers and acquisitions

Physical Topology

The Cisco HyperFlex system is composed of a pair of Cisco UCS 6200/6300 series Fabric Interconnects, along with up to 8 HXAF-Series rack mount servers per cluster Up to 8 separate HX clusters can be installed under a single pair of Fabric Interconnects. The Fabric Interconnects both connect to every HX-Series rack mount server, and both connect to every Cisco UCS 5108 blade chassis. 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.

For this study, we uplinked the Cisco 6332-16UP Fabric Interconnects to Cisco Nexus 93108YCPX switches.

Figure 3 Cisco HyperFlex Standard Topology



Fabric Interconnects

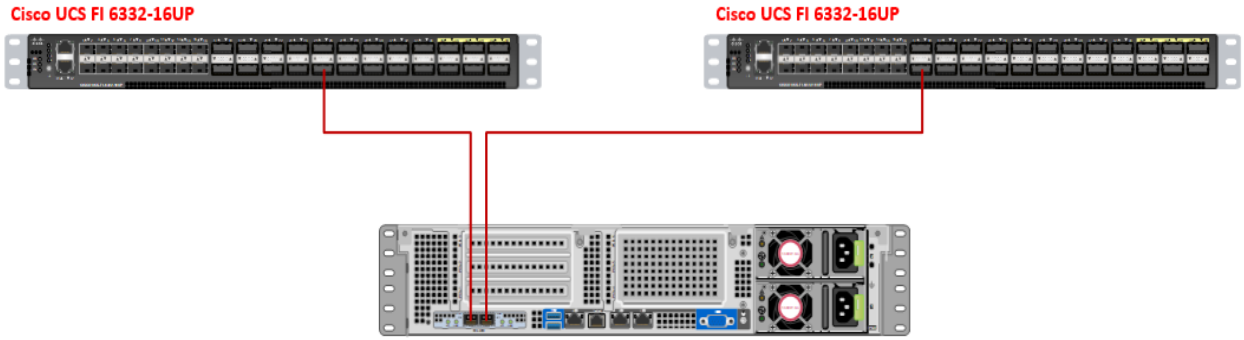
Fabric Interconnects (FI) are deployed in pairs, wherein the two units operate as a management cluster, while forming two separate network fabrics, referred to as the A side and B side fabrics. Therefore, many design elements will refer to FI A or FI B, alternatively called fabric A or fabric B. Both 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.

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. Both the HXAF220C-M5SX and HXAF240C-M5SX servers are configured with the Cisco VIC 1387 network interface card (NIC) installed in a modular LAN on motherboard (MLOM) slot, which has dual 40 Gigabit Ethernet (GbE) ports. The standard and redundant connection practice is to connect port 1 of the VIC 1387 to a port on FI A, and port 2 of the VIC 1387 to a port on FI B (Figure 4).

Failure to follow this cabling practice can lead to errors, discovery failures, and loss of redundant connectivity.

Figure 4 HX-Series Server Connectivity



Logical Network Design

The Cisco HyperFlex system has communication pathways that fall into four defined zones (Figure 5):

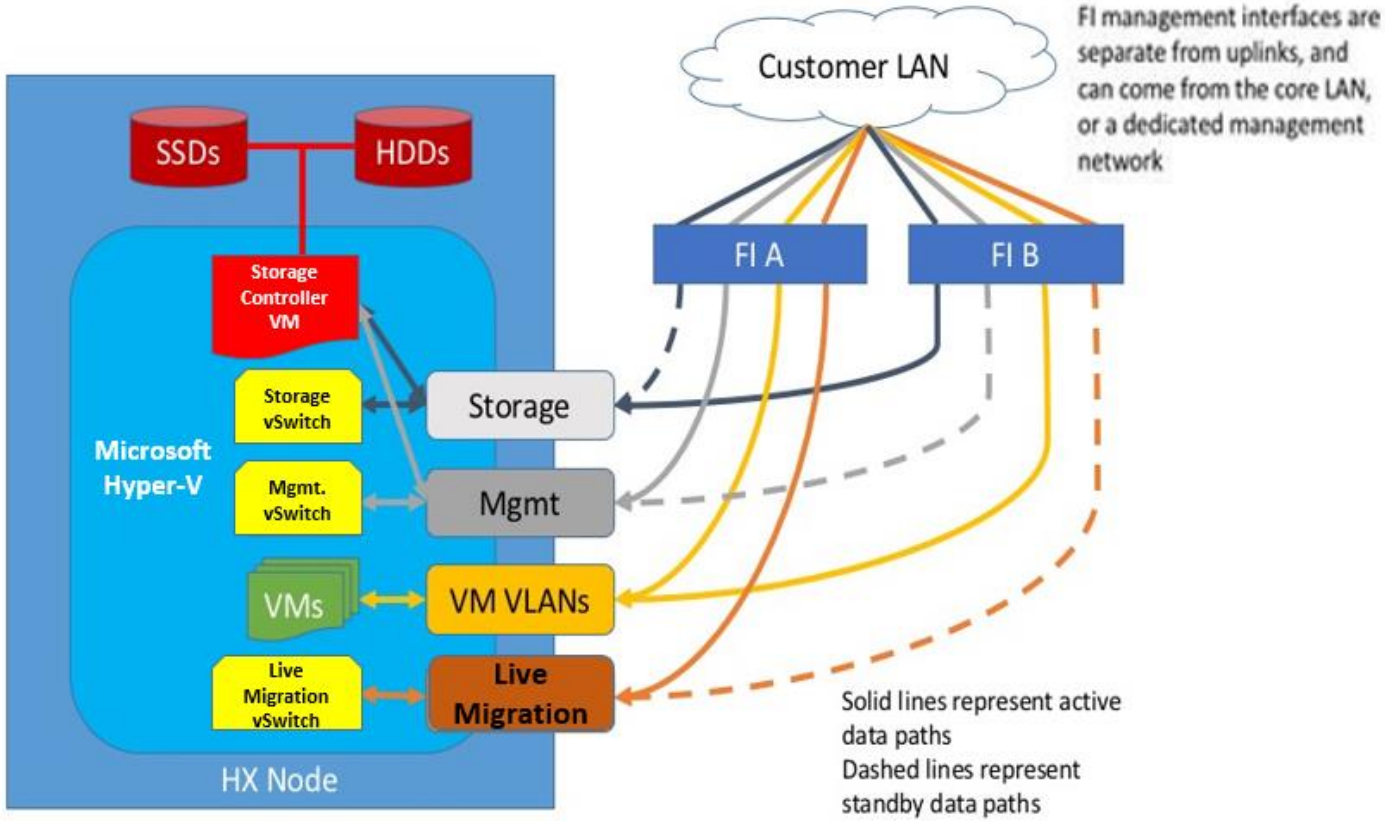
- **Management Zone:** This zone comprises the connections needed to manage the physical hardware, the hypervisor hosts, and the storage platform controller virtual machines (SCVM). These interfaces and IP addresses need to be available to all staff who will administer the HX system, throughout the LAN/WAN. 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 through the FI management ports.
  - Hyper-V host management interfaces.
  - Storage Controller VM management interfaces.
  - A roaming HX cluster management 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, Hyper-V 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 vmnic interface used for storage traffic for each Hyper-V host in the HX cluster.
  - Storage Controller VM storage interfaces.

  - A roaming HX cluster storage interface.

- **Live Migration Zone:** This zone comprises the connections used by the Hyper-V hosts to enable LiveMigration 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 storage traffic must be able to traverse the network uplinks from the Cisco UCS domain, reaching FI A from FI B, and vice-versa.

Figure 5 illustrates the logical network design.

Figure 5 Logical Network Design



The reference hardware configuration includes:

- Two Cisco Nexus 93108YCPX switches
- Two Cisco UCS 6332-16UP fabric interconnects
- Eight Cisco HX-series Rack server running HyperFlex data platform version 3.0.1c.

For desktop virtualization, the deployment includes Citrix XenDesktop running on Microsoft Hyper-V. The design is intended to provide a large scale building block for persistent/non-persistent desktops with following density per four-node configuration:

- 1250 Citrix XenDesktop Windows 10 non-persistent virtual desktops using PVS
- 1600 Citrix XenApp Windows 2016 Server Desktops using PVS

All of the Windows 10 virtual desktops were provisioned with 4GB of memory for this study. Typically, persistent desktop users may desire more memory. If more than 4GB memory is needed, the second memory channel on the Cisco HXAF220c-M5SX HX-Series rack server should be populated.

Data provided here will allow customers to run VDI desktops to suit their environment. For example, additional drives can be added in existing server to improve I/O capability and throughput, and special hardware or software features can be added to introduce new features. This document guides you through the low-level steps for deploying the base architecture, as shown in Figure 3. These procedures covers everything from physical cabling to network, compute and storage device configurations.

Technology Overview

This section describes the infrastructure components used in the solution outlined in this study.

Cisco Unified Computing System

Cisco UCS Manager (UCSM) provides unified, embedded management of all software and hardware components of the Cisco Unified Computing System™ (Cisco UCS) and Cisco HyperFlex through an intuitive GUI, a command-line interface (CLI), and an XML API. The manager provides a unified management domain with centralized management capabilities and can control multiple chassis and thousands of virtual machines.

Cisco UCS is a next-generation data center platform that unites computing, networking, 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 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.

Cisco Unified Computing System Components

The main components of Cisco UCS are:

- **Compute:** The system is based on an entirely new class of computing system that incorporates blade, rack and hyperconverged servers based on Intel® Xeon® scalable family processors.
- **Network:** The system is integrated on a low-latency, lossless, 40-Gbps unified network fabric. This network foundation consolidates LANs, SANs, and high-performance computing (HPC) networks, which are separate networks today. The unified fabric lowers costs by reducing the number of network adapters, switches, and cables needed, 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**: The Cisco HyperFlex rack servers provide high performance, resilient storage using the powerful HX Data Platform software. Customers can deploy as few as three nodes (replication factor 2/3,) depending on their fault tolerance requirements. These nodes form a HyperFlex storage and compute cluster. The onboard storage of each node is aggregated at the cluster level and automatically shared with all of the nodes.
- **Management:** Cisco UCS uniquely integrates all system components, enabling the entire solution to be managed as a single entity by Cisco UCS Manager. The manager has an intuitive GUI, a CLI, and a robust API for managing all system configuration processes and operations. Our latest advancement offers a cloud-based management system called Cisco Intersight.

Cisco UCS and Cisco HyperFlex are designed to deliver:

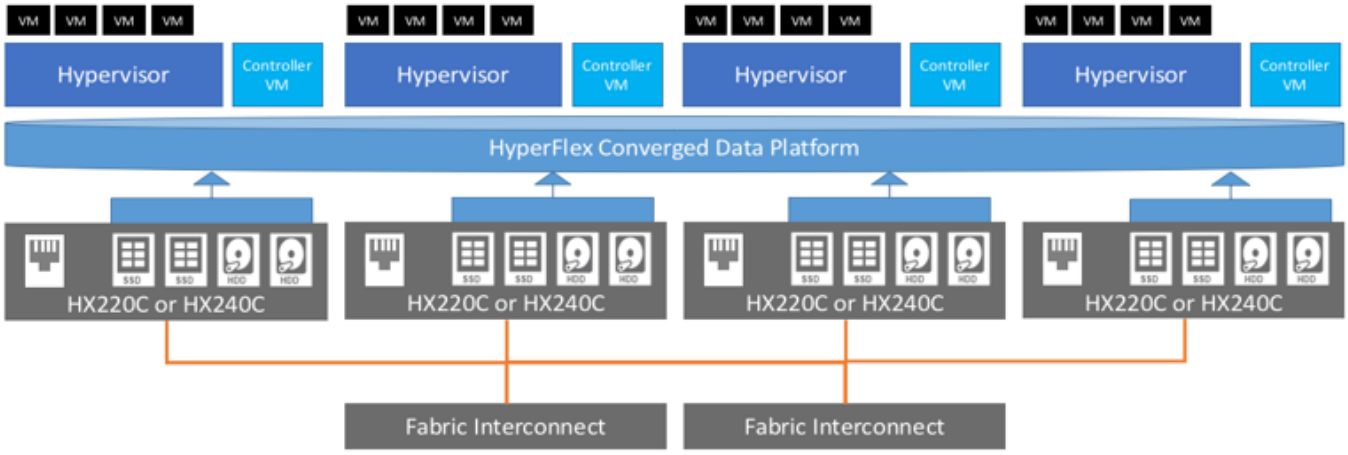
- Reduced TCO and increased business agility.
- Increased IT staff productivity through just-in-time provisioning and mobility support.
- A cohesive, integrated system that unifies the technology in the data center; the system is managed, serviced, and tested as a whole.
- Scalability through a design 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 Manager provides unified, embedded management of all software and hardware components of the Cisco Unified Computing System across multiple chassis, rack servers, and thousands of virtual machines. Cisco UCS Manager manages Cisco UCS as a single entity through an intuitive GUI, a command-line interface (CLI), or an XML API for comprehensive access to all Cisco UCS Manager Functions.

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

Figure 6 Cisco HyperFlex System Overview



Supported Versions and System Requirements

Cisco HX Data Platform requires specific software and hardware versions, and networking settings for successful installation.

For a complete list of requirements, see: Cisco HyperFlex Systems Installation Guide on Microsoft Hyper-V

Hardware and Software Interoperability

For a complete list of hardware and software inter-dependencies, refer to respective Cisco UCS Manager release version of Hardware and Software Interoperability for Cisco HyperFlex HX-Series.

Software Requirements for Microsoft Hyper-V

The software requirements include verification that you are using compatible versions of Cisco HyperFlex Systems (HX) components and Microsoft Server components.

HyperFlex Software Versions

The HX components—Cisco HX Data Platform Installer, Cisco HX Data Platform, and Cisco UCS firmware—are installed on different servers. Verify that each component on each server used with and within an HX Storage Cluster are compatible.

- Verify that the preconfigured HX servers have the same version of Cisco UCS server firmware installed. If the Cisco UCS Fabric Interconnects (FI) firmware versions are different, see the Cisco HyperFlex Systems Upgrade Guide for steps to align the firmware versions.
- M5: For NEW hybrid or All Flash (Cisco HyperFlex HX240c M5 or HX220c M5) deployments, verify that Cisco UCS Manager 3.2(3b) or later is installed.

Cisco UCS Fabric Interconnect

The Cisco UCS 6300 Series Fabric Interconnects are a core part of Cisco UCS, providing both network connectivity and management capabilities for the system. The Cisco UCS 6300 Series offers line-rate, low-latency, lossless 40 Gigabit Ethernet, FCoE, and Fibre Channel functions.

The fabric interconnects provide the management and communication backbone for the Cisco UCS B-Series Blade Servers, Cisco UCS C-Series and HX-Series rack servers and Cisco UCS 5100 Series Blade Server Chassis. All servers, attached to the fabric interconnects become part of a single, highly available management domain. In addition, by supporting unified fabric, the Cisco UCS 6300 Series provides both LAN and SAN connectivity for all blades in the domain.

For networking, the Cisco UCS 6300 Series uses a cut-through architecture, supporting deterministic, low-latency, line-rate 40 Gigabit Ethernet on all ports, 2.56 terabit (Tb) switching capacity, and 320 Gbps of bandwidth per chassis, independent of packet size and enabled services. The product series supports Cisco low-latency, lossless, 40 Gigabit Ethernet unified network fabric capabilities, increasing the reliability, efficiency, and scalability of Ethernet networks. The fabric interconnects support multiple traffic classes over a lossless Ethernet fabric, from the blade server through the interconnect. 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.

Figure 7 Cisco UCS 6332 Fabric Interconnect

Figure 8 Cisco UCS 6332-16UP Fabric Interconnect

Cisco HyperFlex HX-Series Nodes

Cisco HyperFlex systems are based on an end-to-end software-defined infrastructure, combining software-defined computing in the form of Cisco Unified Computing System (Cisco UCS) servers; software-defined storage with the powerful Cisco HX Data Platform and software-defined networking with the Cisco UCS fabric that will integrate smoothly with Cisco Application Centric Infrastructure (Cisco ACI™). Together with a single point of connectivity and hardware management, these technologies deliver a pre-integrated and adaptable cluster that is ready to provide a unified pool of resources to power applications as your business needs dictate.

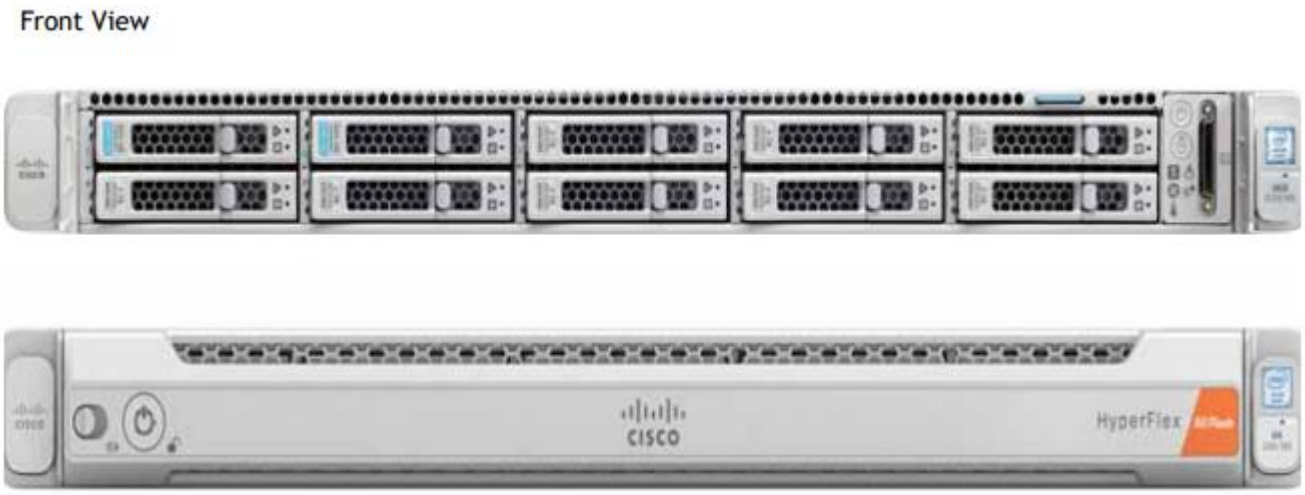
A Cisco HyperFlex cluster requires a minimum of three HX-Series nodes (with disk storage). Data is replicated across at least two of these nodes, and a third node is required for continuous operation in the event of a single-node failure. Each node that has disk storage is equipped with at least one high-performance SSD drive for data caching and rapid acknowledgment of write requests. Each node is also equipped with the platform's physical capacity of either spinning disks or enterprise-value SSDs for maximum data capacity.

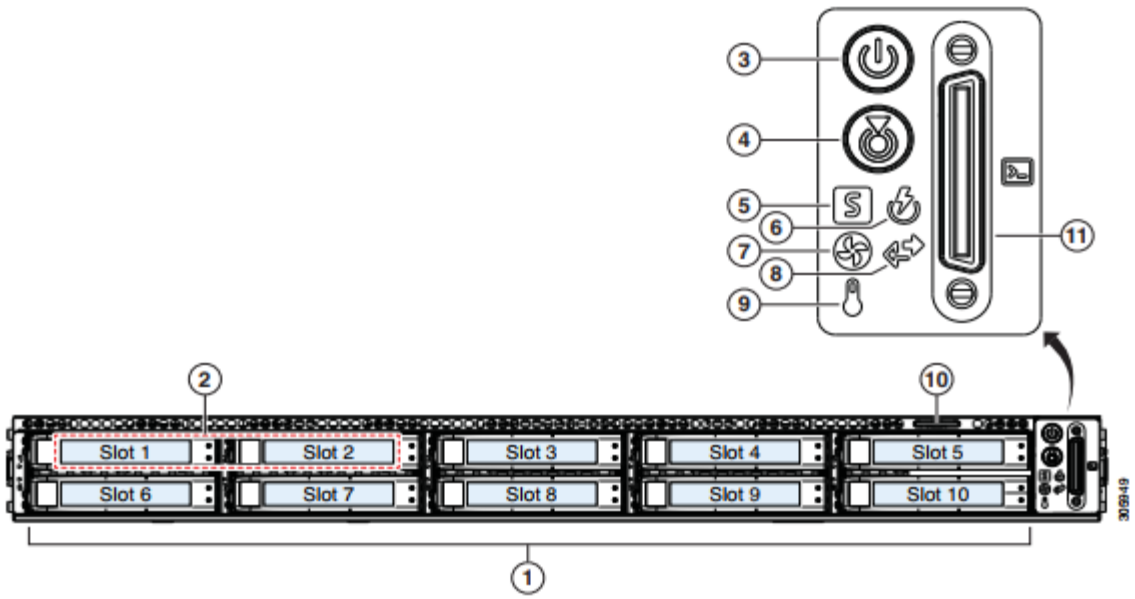
Cisco UCS HXAF220c-M5S Rack Server

The HXAF220c M5 servers extend the capabilities of Cisco's HyperFlex portfolio in a 1U form factor with the addition of the Intel® Xeon® Processor Scalable Family, 24 DIMM slots for 2666MHz DIMMs, up to 128GB individual DIMM capacities and up to 3.0TB of total DRAM capacities.

This small footprint configuration of Cisco HyperFlex all-flash nodes contains one M.2 SATA SSD drive that act as the boot drives, a single 240-GB solid-state disk (SSD) data-logging drive, a single 400-GB SSD write-log drive, and up to eight 3.8-terabyte (TB) or 960-GB SATA SSD drives for storage capacity. A minimum of three nodes and a maximum of eight nodes can be configured in one HX cluster. For detailed information, see the Cisco HyperFlex HXAF220c-M5S specsheet.

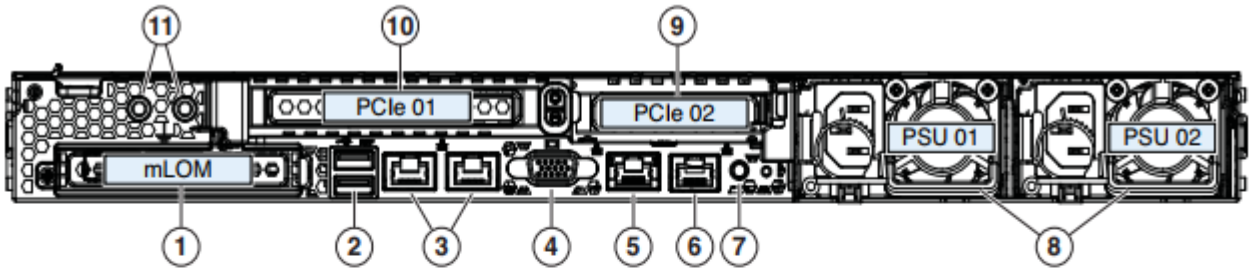
Figure 9 Cisco UCS HXAF220c-M5SX Rack Server Front View





1	Drive Slots Slot 01 (For System/Log drive) • 1 x SATA SSD Slot 02 (For Cache drive) • 1 x NVMe SSD **OR** • 1 x SAS SSD **OR** • 1 x SED SAS SSD Slot 03 through 10 (For Capacity drives) • Upto 8 x SATA SSD **OR** • Upto 8 x SED SATA SSD **OR** • upto 8 x SED SAS SSD	7	Fan status LED
2	N/A	8	Network link activity LED
3	Power button/Power status LED	9	Temperature status LED
4	Unit identification button/LED	10	Pull-out asset tag
5	System status LED	11	KVM connector (used with KVM cable that provides two USB 2.0, one VGA, and one serial connector)
6	Power supply status LED	–	–

Figure 10 Cisco UCS HXAF220c-M5SX Rack Server Rear View



1	Modular LAN-on-motherboard (mLOM) card bay (x16)	7	Rear unit identification button/LED
2	USB 3.0 ports (two)	8	Power supplies (two, redundant as 1+1)
3	Dual 1/10-Gb Ethernet ports (LAN1 and LAN2). LAN1 is left connector and LAN2 is right connector	9	PCIe riser 2 (slot 2) (half-height, x16);
4	VGA video port (DB-15)	10	PCIe riser 1 (slot 1) (full-height, x16)
5	1-Gb Ethernet dedicated management port	11	Threaded holes for dual-hole grounding lug
6	Serial port (RJ-45 connector)	–	–

The Cisco UCS HXAF220c-M5S delivers performance, flexibility, and optimization for data centers and remote sites. This enterprise-class server offers market-leading performance, versatility, and density without compromise for workloads ranging from web infrastructure to distributed databases. The Cisco UCS HXAF220c-M5SX can quickly deploy stateless physical and virtual workloads with the programmable ease of use of the Cisco UCS Manager software and simplified server access with Cisco® Single Connect technology. Based on the Intel Xeon scalable family processor product family, it offers up to 1.5TB of memory using 64-GB DIMMs, up to ten disk drives, and up to 40 Gbps of I/O throughput. The Cisco UCS HXAF220c-M5Soffers exceptional levels of performance, flexibility, and I/O throughput to run your most demanding applications.

The Cisco UCS HXAF220c-M5S provides:

- Up to two multicore Intel Xeon scalable family processor for up to 56 processing cores
- 24 DIMM slots for industry-standard DDR4 memory at speeds 2666 MHz, and up to 1.5TB of total memory when using 64-GB DIMMs
- Ten hot-pluggable SAS and SATA HDDs or SSDs
- Cisco UCS VIC 1387, a 2-port, 80 Gigabit Ethernet and FCoE−capable modular (mLOM) mezzanine adapter
- Cisco FlexStorage local drive storage subsystem, with flexible boot and local storage capabilities that allow you to install and boot Hypervisor
- Enterprise-class pass-through RAID controller
- Easily add, change, and remove Cisco FlexStorage modules

Cisco VIC 1387 MLOM Interface Card

The Cisco UCS Virtual Interface Card (VIC) 1387 is a dual-port Enhanced Small Form-Factor Pluggable (QSFP+) 40-Gbps Ethernet and Fibre Channel over Ethernet (FCoE)) in a modular LAN-on-motherboard (mLOM) adapter installed in the Cisco UCS HX-Series Rack Servers (Figure 10). 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 that can be dynamically configured as either network interface cards (NICs) or host bus adapters (HBAs). The personality of the card is determined dynamically at boot time using the service profile associated with the server. The number, type (NIC or HBA), identity (MAC address and World Wide Name [WWN]), failover policy, bandwidth, and quality-of-service (QoS) policies of the PCIe interfaces are all determined using the service profile.

Figure 11 Cisco VIC 1387 mLOM Card

Cisco HyperFlex Converged 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 that you would expect of 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:

- **Replication** replicates data across the cluster so that data availability is not affected if 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 client 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.
- **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.

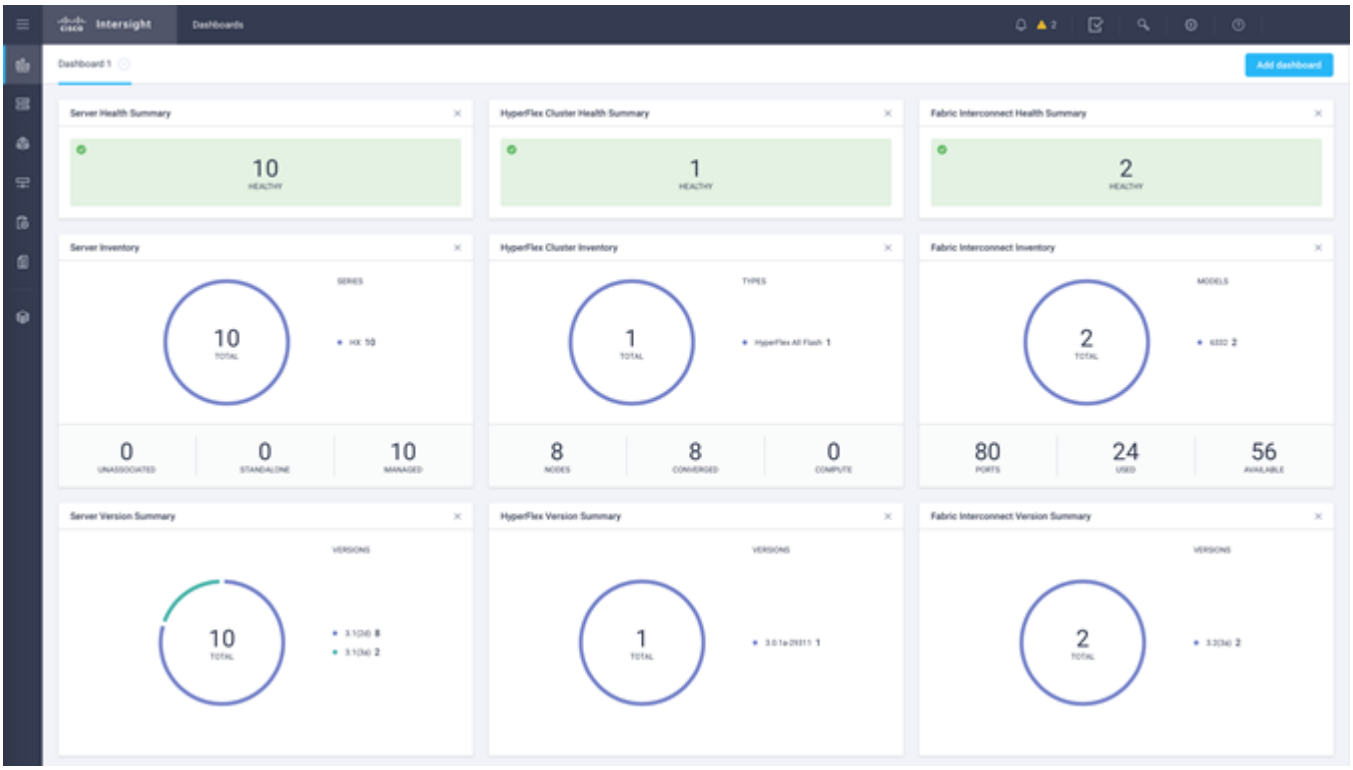
- **Fast, space-efficient clones** rapidly replicate storage volumes so that virtual machines can be replicated simply through metadata operations, with actual data copied only for write operations.
- **Snapshots** help facilitate backup and remote-replication operations: needed in enterprises that require always-on data availability.

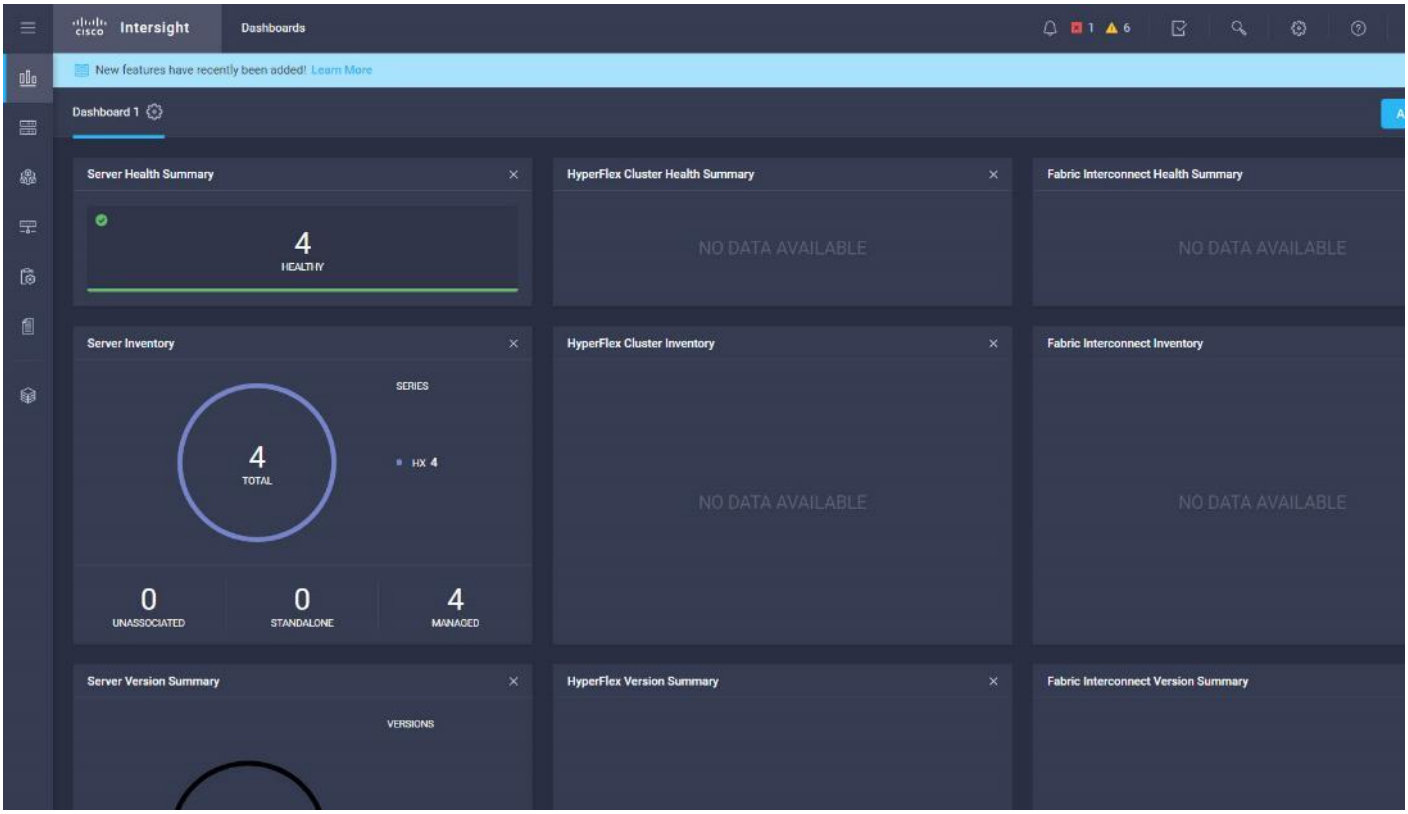
Cisco HyperFlex Connect HTML5 Management Web Page

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>.

Cisco Intersight Management Web Page

Cisco Intersight (https://intersight.com), previously known as Starship, is the latest visionary cloud-based management tool, designed to provide a centralized off-site management, monitoring and reporting tool for all of your Cisco UCS based solutions. In the initial release of Cisco Intersight, monitoring and reporting is enabled against Cisco HyperFlex clusters. The Cisco Intersight website and framework can be upgraded with new and enhanced features independently of the products that are managed, meaning that many new features and capabilities can come with no downtime or upgrades required by the end users. Future releases of Cisco HyperFlex will enable further functionality along with these upgrades to the Cisco Intersight framework. This unique combination of embedded and online technologies will result in a complete cloud-based management solution that can care for Cisco HyperFlex throughout the entire lifecycle, from deployment through retirement.




Intersight
Dashboards
New features have recently been added! Learn More
Dashboard 1
Server Health Summary
4
HEALTHY
HyperFlex Cluster Health Summary
NO DATA AVAILABLE
Fabric Interconnect Health Summary
NO DATA AVAILABLE
Server Inventory
SERIES
4
TOTAL
HX 4
0
UNASSOCIATED
0
STANDALONE
4
MANAGED
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Fabric Interconnect Inventory
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Server Version Summary
VERSIONS
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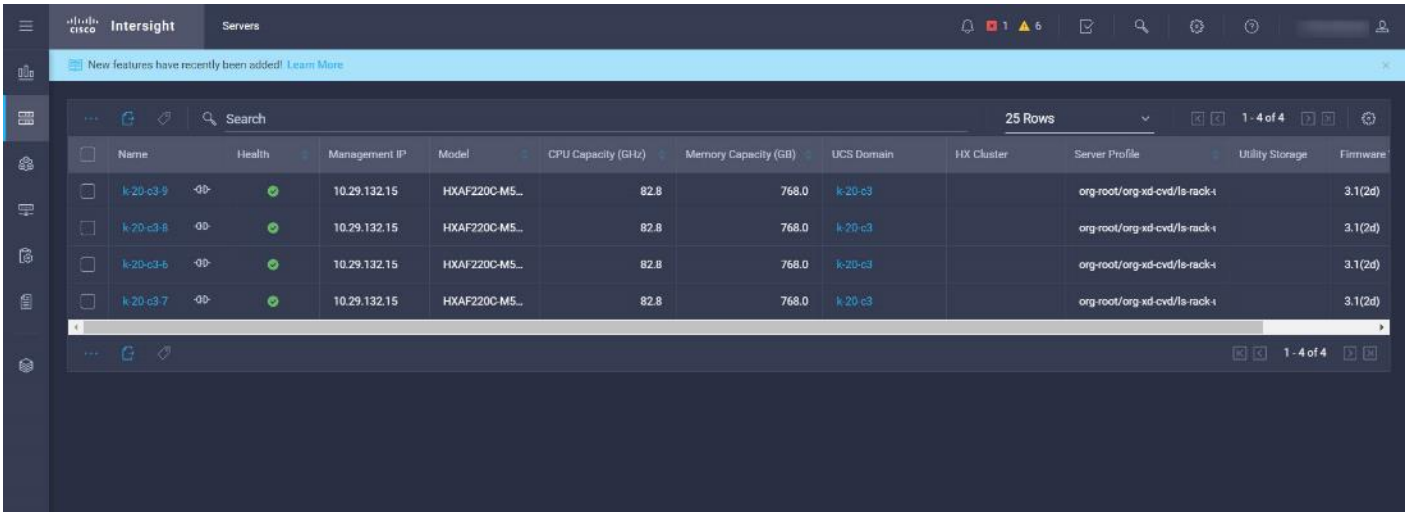
Fabric Interconnect Version Summary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Servers
New features have recently been added! Learn More
Search
25 Rows
1 - 4 of 4
Name
Health
Management IP
Model
CPU Capacity (GHz)
Memory Capacity (GB)
UCS Domain
HX Cluster
Server Profile
Utility Storage
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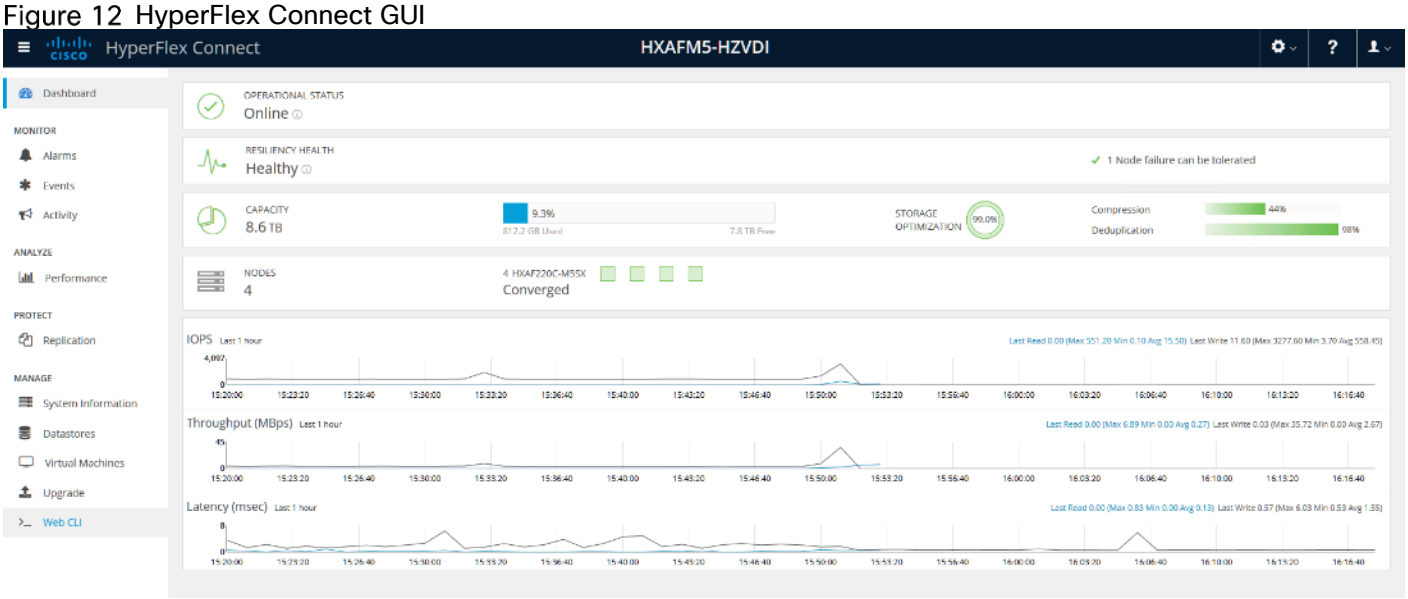
Figure 12 HyperFlex Connect GUI



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 2 entire nodes without losing data and resorting to restore from backup or other recovery processes.
- **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 1 entire node without losing data and resorting to restore from backup or other recovery processes.

Data Distribution

Incoming data is distributed across all nodes in the cluster to optimize performance using the caching tier. Effective data distribution is achieved by mapping incoming data to stripe units that are stored evenly across all nodes, with the number of data replicas determined by the policies you set. When an application writes data, the data is sent to the appropriate node based on the stripe unit, which includes the relevant block of information. This data distribution approach in combination with the capability to have multiple streams writing at the same time avoids both network and storage hot spots, delivers the same I/O performance regardless of virtual machine location, and gives you more flexibility in workload placement. This contrasts with other architectures that use a data locality approach that does not fully use available networking and I/O resources and is vulnerable to hot spots.

When moving a virtual machine to a new location using tools such as Hyper-V Cluster Optimization, the Cisco HyperFlex HX Data Platform does not require data to be moved. This approach significantly reduces the impact and cost of moving virtual machines among systems.

Data Operations

The data platform implements a distributed, log-structured file system that changes how it handles caching and storage capacity depending on the node configuration.

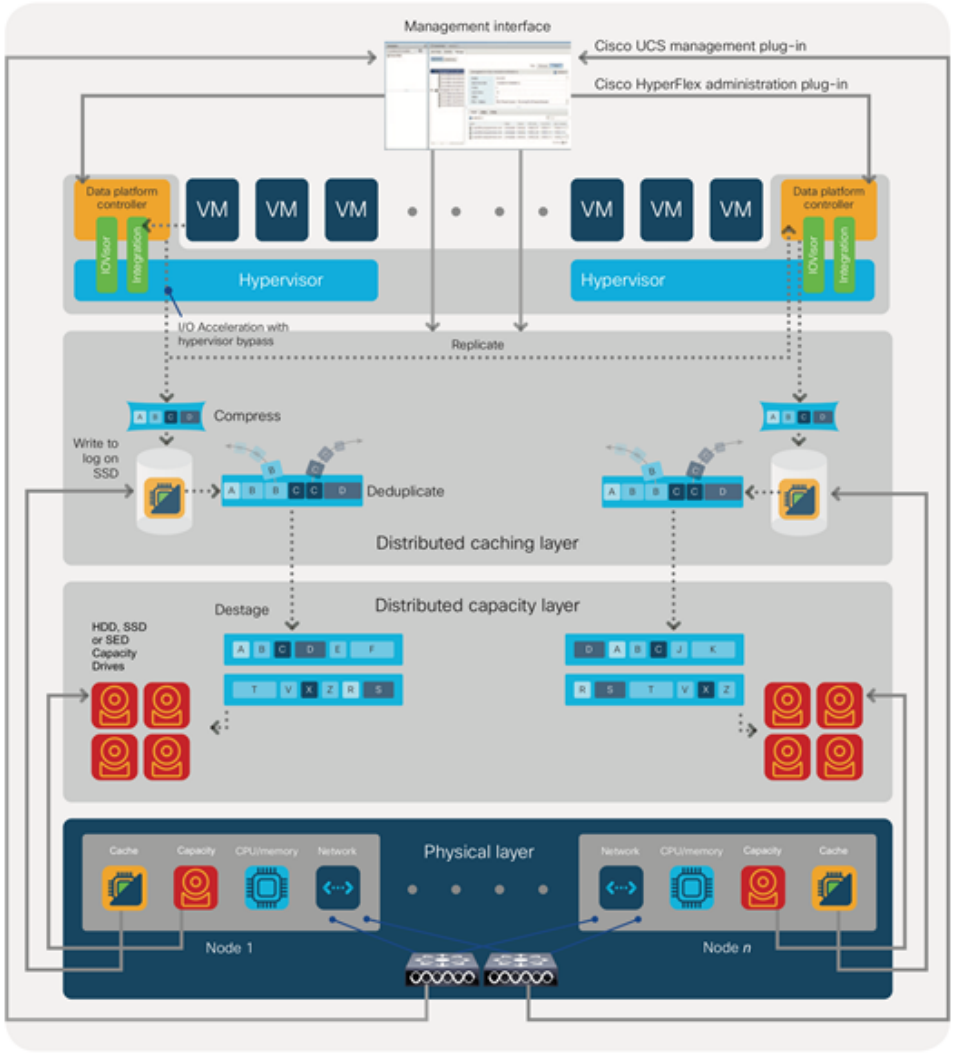
In the all-flash-memory configuration, the data platform uses a caching layer in SSDs to accelerate write responses, and it implements the capacity layer in SSDs. Read requests are fulfilled directly from data obtained from the SSDs in the capacity layer. A dedicated read cache is not required to accelerate read operations.

Incoming data is striped across the number of nodes required to satisfy availability requirements—usually two or three nodes. Based on policies you set, incoming write operations are acknowledged as persistent after they are replicated to the SSD drives in other nodes in the cluster. This approach reduces the likelihood of data loss due to SSD or node failures. The write operations are then de-staged to SSDs in the capacity layer in the all-flash memory configuration for long-term storage.

The log-structured file system writes sequentially to one of two write logs (three in case of RF=3) until it is full. It then switches to the other write log while de-staging data from the first to the capacity tier. When existing data is (logically) overwritten, the log-structured approach simply appends a new block and updates the metadata. This layout benefits SSD configurations in which seek operations are not time consuming. It reduces the write amplification levels of SSDs and the total number of writes the flash media experiences due to incoming writes and random overwrite operations of the data.

When data is de-staged to the capacity tier in each node, the data is deduplicated and compressed. This process occurs after the write operation is acknowledged, so no performance penalty is incurred for these operations. A small deduplication block size helps increase the deduplication rate. Compression further reduces the data footprint. Data is then moved to the capacity tier as write cache segments are released for reuse (Figure 13).

Figure 13 Data Write Operation Flow Through the Cisco HyperFlex HX Data Platform



Hot data sets, data that are frequently or recently read from the capacity tier, are cached in memory. All-Flash configurations, however, does not use an SSD read cache since there is no performance benefit of such a cache; the persistent data copy already resides on high-performance SSDs. In these configurations, a read cache implemented with SSDs could become a bottleneck and prevent the system from using the aggregate bandwidth of the entire set of SSDs.

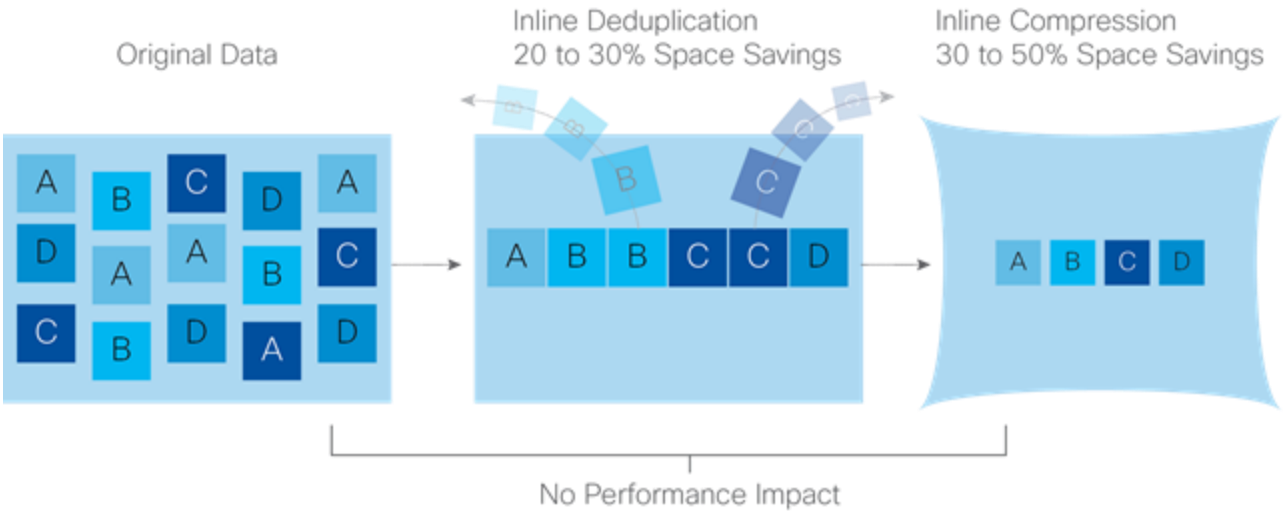
Data Optimization

The Cisco HyperFlex HX Data Platform provides finely detailed inline deduplication and variable block inline compression that is always on for objects in the cache (SSD and memory) and capacity (SSD or HDD) layers. Unlike other solutions, which require you to turn off these features to maintain performance, the deduplication and compression capabilities in the Cisco data platform are designed to sustain and enhance performance and significantly reduce physical storage capacity requirements.

Data Deduplication

Data deduplication is used on all storage in the cluster, including memory and SSD drives. Based on a patent-pending Top-K Majority algorithm, the platform uses conclusions from empirical research that show that most data, when sliced into small data blocks, has significant deduplication potential based on a minority of the data blocks. By fingerprinting and indexing just these frequently used blocks, high rates of deduplication can be achieved with only a small amount of memory, which is a high-value resource in cluster nodes (Figure 14).

Figure 14 Cisco HyperFlex HX Data Platform Optimizes Data Storage with No Performance Impact



Inline Compression

The Cisco HyperFlex HX Data Platform uses high-performance inline compression on data sets to save storage capacity. Although other products offer compression capabilities, many negatively affect performance. In contrast, the Cisco data platform uses CPU-offload instructions to reduce the performance impact of compression operations. In addition, the log-structured distributed-objects layer has no effect on modifications (write operations) to previously compressed data. Instead, incoming modifications are compressed and written to a new location, and the existing (old) data is marked for deletion, unless the data needs to be retained in a snapshot.

The data that is being modified does not need to be read prior to the write operation. This feature avoids typical read-modify-write penalties and significantly improves write performance.

Log-Structured Distributed Objects

In the Cisco HyperFlex HX Data Platform, the log-structured distributed-object store layer groups and compresses data that filters through the deduplication engine into self-addressable objects. These objects are written to disk in a log-structured, sequential manner. All incoming I/O—including random I/O—is written sequentially to both the

caching (SSD and memory) and persistent (SSD or HDD) tiers. The objects are distributed across all nodes in the cluster to make uniform use of storage capacity.

By using a sequential layout, the platform helps increase flash-memory endurance. Because read-modify-write operations are not used, there is little or no performance impact of compression, snapshot operations, and cloning on overall performance.

Data blocks are compressed into objects and sequentially laid out in fixed-size segments, which in turn are sequentially laid out in a log-structured manner (Figure 15). Each compressed object in the log-structured segment is uniquely addressable using a key, with each key fingerprinted and stored with a checksum to provide high levels of data integrity. In addition, the chronological writing of objects helps the platform quickly recover from media or node failures by rewriting only the data that came into the system after it was truncated due to a failure.

Figure 15 Cisco HyperFlex HX Data Platform Optimizes Data Storage with No Performance Impact

Encryption

Securely encrypted storage optionally encrypts both the caching and persistent layers of the data platform. Integrated with enterprise key management software, or with passphrase-protected keys, encrypting data at rest helps you comply with HIPAA, PCI-DSS, FISMA, and SOX regulations. The platform itself is hardened to Federal Information Processing Standard (FIPS) 140-1 and the encrypted drives with key management comply with the FIPS 140-2 standard.

Data Services

The Cisco HyperFlex HX Data Platform provides a scalable implementation of space-efficient data services, including thin provisioning, space reclamation, pointer-based snapshots, and clones, without affecting performance.

Thin Provisioning

The platform makes efficient use of storage by eliminating the need to forecast, purchase, and install disk capacity that may remain unused for a long time. Virtual data containers can present any amount of logical space to applications, whereas the amount of physical storage space that is needed is determined by the data that is written. You can expand storage on existing nodes and expand your cluster by adding more storage-intensive nodes as your business requirements dictate, eliminating the need to purchase large amounts of storage before you need it.

Snapshots

The Cisco HyperFlex HX Data Platform uses metadata-based, zero-copy snapshots to facilitate backup operations and remote replication: critical capabilities in enterprises that require always-on data availability. Space-efficient snapshots allow you to perform frequent online data backups without worrying about the consumption of physical storage capacity. Data can be moved offline or restored from these snapshots instantaneously.

- **Fast snapshot updates**: When modified-data is contained in a snapshot, it is written to a new location, and the metadata is updated, without the need for read-modify-write operations.

- **Rapid snapshot deletions**: You can quickly delete snapshots. The platform simply deletes a small amount of metadata that is located on an SSD, rather than performing a long consolidation process as needed by solutions that use a delta-disk technique.
- **Highly specific snapshots**: With the Cisco HyperFlex HX Data Platform, you can take snapshots on an individual file basis. In virtual environments, these files map to drives in a virtual machine. This flexible specificity allows you to apply different snapshot policies on different virtual machines.

Many basic backup applications, read the entire dataset, or the changed blocks since the last backup at a rate that is usually as fast as the storage, or the operating system can handle. This can cause performance implications since HyperFlex is built on Cisco UCS with 10GbE which could result in multiple gigabytes per second of backup throughput. These basic backup applications, such as Windows Server Backup, should be scheduled during off-peak hours, particularly the initial backup if the application lacks some form of change block tracking.

Full featured backup applications, such as Veeam Backup and Replication v9.5, have the ability to limit the amount of throughput the backup application can consume which can protect latency sensitive applications during the production hours. With the release of v9.5 update 2, Veeam is the first partner to integrate HX native snapshots into the product. HX Native snapshots do not suffer the performance penalty of delta-disk snapshots, and do not require heavy disk IO impacting consolidation during snapshot deletion.

Particularly important for SQL administrators is the Veeam Explorer for SQL which can provide transaction level recovery within the Microsoft VSS framework. The three ways Veeam Explorer for SQL Server works to restore SQL Server databases include; from the backup restore point, from a log replay to a point in time, and from a log replay to a specific transaction – all without taking the VM or SQL Server offline.

Fast, Space-Efficient Clones

In the Cisco HyperFlex HX Data Platform, clones are writable snapshots that can be used to rapidly provision items such as virtual desktops and applications for test and development environments. These fast, space-efficient clones rapidly replicate storage volumes so that virtual machines can be replicated through just metadata operations, with actual data copying performed only for write operations. With this approach, hundreds of clones can be created and deleted in minutes. Compared to full-copy methods, this approach can save a significant amount of time, increase IT agility, and improve IT productivity.

Clones are deduplicated when they are created. When clones start diverging from one another, data that is common between them is shared, with only unique data occupying new storage space. The deduplication engine eliminates data duplicates in the diverged clones to further reduce the clone's storage footprint.

Data Replication and Availability

In the Cisco HyperFlex HX Data Platform, the log-structured distributed-object layer replicates incoming data, improving data availability. Based on policies that you set, data that is written to the write cache is synchronously replicated to one or two other SSD drives located in different nodes before the write operation is acknowledged to the application. This approach allows incoming writes to be acknowledged quickly while protecting data from SSD or node failures. If an SSD or node fails, the replica is quickly re-created on other SSD drives or nodes using the available copies of the data.

The log-structured distributed-object layer also replicates data that is moved from the write cache to the capacity layer. This replicated data is likewise protected from SSD or node failures. With two replicas, or a total of three data copies, the cluster can survive uncorrelated failures of two SSD drives or two nodes without the risk of data loss. Uncorrelated failures are failures that occur on different physical nodes. Failures that occur on the same node affect the same copy of data and are treated as a single failure. For example, if one disk in a node fails and subsequently another disk on the same node fails, these correlated failures count as one failure in the system. In this case, the cluster could withstand another uncorrelated failure on a different node. See the Cisco HyperFlex HX Data Platform system administrator's guide for a complete list of fault-tolerant configurations and settings.

If a problem occurs in the Cisco HyperFlex HX controller software, data requests from the applications residing in that node are automatically routed to other controllers in the cluster. This same capability can be used to upgrade or perform maintenance on the controller software on a rolling basis without affecting the availability of the cluster

or data. This self-healing capability is one of the reasons that the Cisco HyperFlex HX Data Platform is well suited for production applications.

In addition, native replication transfers consistent cluster data to local or remote clusters. With native replication, you can snapshot and store point-in-time copies of your environment in local or remote environments for backup and disaster recovery purposes.

Data Rebalancing

A distributed file system requires a robust data rebalancing capability. In the Cisco HyperFlex HX Data Platform, no overhead is associated with metadata access, and rebalancing is extremely efficient. Rebalancing is a non-disruptive online process that occurs in both the caching and persistent layers, and data is moved at a fine level of specificity to improve the use of storage capacity. The platform automatically rebalances existing data when nodes and drives are added or removed or when they fail. When a new node is added to the cluster, its capacity and performance is made available to new and existing data. The rebalancing engine distributes existing data to the new node and helps ensure that all nodes in the cluster are used uniformly from capacity and performance perspectives. If a node fails or is removed from the cluster, the rebalancing engine rebuilds and distributes copies of the data from the failed or removed node to available nodes in the clusters.

Online Upgrades

Cisco HyperFlex HX-Series systems and the HX Data Platform support online upgrades so that you can expand and update your environment without business disruption. You can easily expand your physical resources; add processing capacity; and download and install BIOS, driver, hypervisor, firmware, and Cisco UCS Manager updates, enhancements, and bug fixes.

Cisco Nexus 93108YCPX Switches

The Cisco Nexus 93180YC-EX Switch has 48 1/10/25G-Gbps Small Form Pluggable Plus (SFP+) ports and 6 40/100-Gbps Quad SFP+ (QSFP+) uplink ports. All ports are line rate, delivering 3.6 Tbps of throughput in a 1-rack-unit (1RU) form factor.

Architectural Flexibility

- Includes top-of-rack, fabric extender aggregation, or middle-of-row fiber-based server access connectivity for traditional and leaf-spine architectures
- Includes leaf node support for Cisco ACI architecture
- Increase scale and simplify management through Cisco Nexus 2000 Fabric Extender support

Feature-Rich

- Enhanced Cisco NX-OS Software is designed for performance, resiliency, scalability, manageability, and programmability
- ACI-ready infrastructure helps users take advantage of automated policy-based systems management
- Virtual extensible LAN (VXLAN) routing provides network services
- Rich traffic flow telemetry with line-rate data collection
- Real-time buffer utilization per port and per queue, for monitoring traffic micro-bursts and application traffic patterns

Real-Time Visibility and Telemetry

- Cisco Tetration Analytics Platform support with built-in hardware sensors for rich traffic flow telemetry and line-rate data collection
- Cisco Nexus Data Broker support for network traffic monitoring and analysis
- Real-time buffer utilization per port and per queue, for monitor traffic micro-bursts and application traffic patterns

Highly Available and Efficient Design

- High-performance, non-blocking architecture
- Easily deployed into either a hot-aisle and cold-aisle configuration
- Redundant, hot-swappable power supplies and fan trays

Simplified Operations

- Pre-boot execution environment (PXE) and Power-On Auto Provisioning (POAP) support allows for simplified software upgrades and configuration file installation
- Automate and configure switches with DevOps tools like Puppet, Chef, and Ansible
- An intelligent API offers switch management through remote procedure calls (RPCs, JSON, or XML) over a HTTP/HTTPS infrastructure
- Python scripting gives programmatic access to the switch command-line interface (CLI)
- Includes hot and cold patching, and online diagnostics

Investment Protection

- A Cisco 40-Gb bidirectional transceiver allows for reuse of an existing 10 Gigabit Ethernet multimode cabling plant for 40 Gigabit Ethernet
- Support for 10-Gb and 25-Gb access connectivity and 40-Gb and 100-Gb uplinks facilitate data centers migrating switching infrastructure to faster speeds
- 1.44 Tbps of bandwidth in a 1 RU form factor
- 48 fixed 1/10-Gbps SFP+ ports
- 6 fixed 40-Gbps QSFP+ for uplink connectivity that can be turned into 10 Gb ports through a QSFP to SFP or SFP+ Adapter (QSA)
- Latency of 1 to 2 microseconds
- Front-to-back or back-to-front airflow configurations
- 1+1 redundant hot-swappable 80 Plus Platinum-certified power supplies
- Hot swappable 2+1 redundant fan tray

Figure 16 Cisco Nexus 93108YC Switch

Microsoft Hyper-V 2016

Hyper-V is Microsoft's hardware virtualization product. It lets you create and run a software version of a computer, called a virtual machine. Each virtual machine acts like a complete computer, running an operating system and programs. When you need computing resources, virtual machines give you more flexibility, help save time and money, and are a more efficient way to use hardware than just running one operating system on physical hardware.

Hyper-V runs each virtual machine in its own isolated space, which means you can run more than one virtual machine on the same hardware at the same time. You might want to do this to avoid problems such as a crash affecting the other workloads, or to give different people, groups or services access to different systems.

Microsoft System Center 2016

This document does not cover the steps to install Microsoft System Center Operations Manager (SCOM) and Virtual Machine Manager (SCVMM). Follow the Microsoft guidelines to install SCOM and SCVMM 2016:

- SCOM: https://docs.microsoft.com/en-us/system-center/scom/deploy-overview
- SCVMM: https://docs.microsoft.com/en-us/system-center/vmm/install-console

Citrix XenApp™ and XenDesktop™ 7.16

Enterprise IT organizations are tasked with the challenge of provisioning Microsoft Windows apps and desktops while managing cost, centralizing control, and enforcing corporate security policy. Deploying Windows apps to users in any location, regardless of the device type and available network bandwidth, enables a mobile workforce that can improve productivity. With Citrix XenDesktop 7.16, IT can effectively control app and desktop provisioning while securing data assets and lowering capital and operating expenses.

The XenDesktop 7.16 release offers these benefits:

- **Comprehensive virtual desktop delivery for any use case**. The XenDesktop 7.16 release incorporates the full power of XenApp, delivering full desktops or just applications to users. Administrators can deploy both XenApp published applications and desktops (to maximize IT control at low cost) or personalized VDI desktops (with simplified image management) from the same management console. Citrix XenDesktop 7.16 leverages common policies and cohesive tools to govern both infrastructure resources and user access.
- **Simplified support and choice of BYO (Bring Your Own) devices**. XenDesktop 7.16 brings thousands of corporate Microsoft Windows-based applications to mobile devices with a native-touch experience and optimized performance. HDX technologies create a “high definition” user experience, even for graphics intensive design and engineering applications.

- **Lower cost and complexity of application and desktop management**. XenDesktop 7.16 helps IT organizations take advantage of agile and cost-effective cloud offerings, allowing the virtualized infrastructure to flex and meet seasonal demands or the need for sudden capacity changes. IT organizations can deploy XenDesktop application and desktop workloads to private or public clouds.

- **Protection of sensitive information through centralization**. XenDesktop decreases the risk of corporate data loss, enabling access while securing intellectual property and centralizing applications since assets reside in the datacenter.

- **Virtual Delivery Agent improvements.** Universal print server and driver enhancements and support for the HDX 3D Pro graphics acceleration for Windows 10 are key additions in XenDesktop 7.16

- **Improved high-definition user experience.** XenDesktop 7.16 continues the evolutionary display protocol leadership with enhanced Thinwire display remoting protocol and Framehawk support for HDX 3D Pro.

Citrix XenApp and XenDesktop are application and desktop virtualization solutions built on a unified architecture so they're simple to manage and flexible enough to meet the needs of all your organization's users. XenApp and XenDesktop have a common set of management tools that simplify and automate IT tasks. You use the same architecture and management tools to manage public, private, and hybrid cloud deployments as you do for on premises deployments.

Citrix XenApp delivers:

- XenApp published apps, also known as server-based hosted applications: These are applications hosted from Microsoft Windows servers to any type of device, including Windows PCs, Macs, smartphones, and tablets. Some XenApp editions include technologies that further optimize the experience of using Windows applications on a mobile device by automatically translating native mobile-device display, navigation, and controls to Windows applications; enhancing performance over mobile networks; and enabling developers to optimize any custom Windows application for any mobile environment.

- XenApp published desktops, also known as server-hosted desktops: These are inexpensive, locked-down Windows virtual desktops hosted from Windows server operating systems. They are well suited for users, such as call center employees, who perform a standard set of tasks.

- Virtual machine–hosted apps: These are applications hosted from machines running Windows desktop operating systems for applications that can’t be hosted in a server environment.

- Windows applications delivered with Microsoft App-V: These applications use the same management tools that you use for the rest of your XenApp deployment.

- Citrix XenDesktop: Includes significant enhancements to help customers deliver Windows apps and desktops as mobile services while addressing management complexity and associated costs. Enhancements in this release include:

- Unified product architecture for XenApp and XenDesktop: The FlexCast Management Architecture (FMA). This release supplies a single set of administrative interfaces to deliver both hosted-shared applications (RDS) and complete virtual desktops (VDI). Unlike earlier releases that separately provisioned Citrix XenApp and XenDesktop farms, the XenDesktop 7.16 release allows administrators to deploy a single infrastructure and use a consistent set of tools to manage mixed application and desktop workloads.

- Support for extending deployments to the cloud. This release provides the ability for hybrid cloud provisioning from Microsoft Azure, Amazon Web Services (AWS) or any Cloud Platform-powered public or private cloud. Cloud deployments are configured, managed, and monitored through the same administrative consoles as deployments on traditional on-premises infrastructure.

Citrix XenDesktop delivers:

- VDI desktops: These virtual desktops each run a Microsoft Windows desktop operating system rather than running in a shared, server-based environment. They can provide users with their own desktops that they can fully personalize.
- Hosted physical desktops: This solution is well suited for providing secure access powerful physical machines, such as blade servers, from within your data center.
- Remote PC access: This solution allows users to log in to their physical Windows PC from anywhere over a secure XenDesktop connection.
- Server VDI: This solution is designed to provide hosted desktops in multitenant, cloud environments.
- Capabilities that allow users to continue to use their virtual desktops: These capabilities let users continue to work while not connected to your network.

This product release includes the following new and enhanced features:

Some XenDesktop editions include the features available in XenApp.

Zones

Deployments that span widely-dispersed locations connected by a WAN can face challenges due to network latency and reliability. Configuring zones can help users in remote regions connect to local resources without forcing connections to traverse large segments of the WAN. Using zones allows effective Site management from a single Citrix Studio console, Citrix Director, and the Site database. This saves the costs of deploying, staffing, licensing, and maintaining additional Sites containing separate databases in remote locations.

Zones can be helpful in deployments of all sizes. You can use zones to keep applications and desktops closer to end users, which improves performance.

For more information, see the Zones article.

Improved Database Flow and Configuration

When you configure the databases during Site creation, you can now specify separate locations for the Site, Logging, and Monitoring databases. Later, you can specify different locations for all three databases. In previous releases, all three databases were created at the same address, and you could not specify a different address for the Site database later.

You can now add more Delivery Controllers when you create a Site, as well as later. In previous releases, you could add more Controllers only after you created the Site.

For more information, see the Databases and Controllers articles.

Application Limits

Configure application limits to help manage application use. For example, you can use application limits to manage the number of users accessing an application simultaneously. Similarly, application limits can be used to manage the number of simultaneous instances of resource-intensive applications, this can help maintain server performance and prevent deterioration in service.

For more information, see the Manage applications article.

Multiple Notifications before Machine Updates or Scheduled Restarts

You can now choose to repeat a notification message that is sent to affected machines before the following types of actions begin:

- Updating machines in a Machine Catalog using a new master image
- Restarting machines in a Delivery Group according to a configured schedule

If you indicate that the first message should be sent to each affected machine 15 minutes before the update or restart begins, you can also specify that the message be repeated every five minutes until the update/restart begins.

For more information, see the Manage Machine Catalogs and Manage machines in Delivery Groups articles.

API Support for Managing Session Roaming

By default, sessions roam between client devices with the user. When the user launches a session and then moves to another device, the same session is used and applications are available on both devices. The applications follow, regardless of the device or whether current sessions exist. Similarly, printers and other resources assigned to the application follow.

You can now use the PowerShell SDK to tailor session roaming. This was an experimental feature in the previous release.

For more information, see the Sessions article.

API Support for Provisioning VMs from Hypervisor Templates

When using the PowerShell SDK to create or update a Machine Catalog, you can now select a template from other hypervisor connections. This is in addition to the currently-available choices of VM images and snapshots.

Support for New and Additional Platforms

See the System requirements article for full support information. Information about support for third-party product versions is updated periodically.

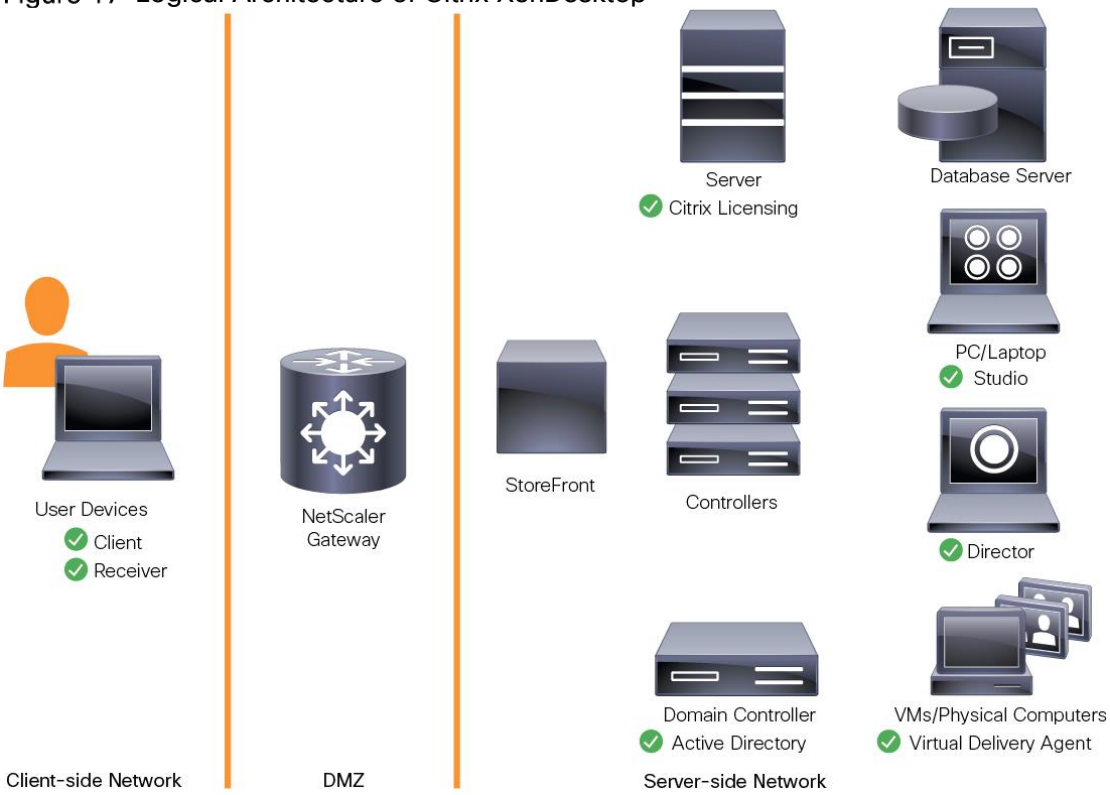
By default, SQL Server 2012 Express SP2 is installed when you install the Delivery Controller. SP1 is no longer installed.

The component installers now automatically deploy newer Microsoft Visual C++ runtime versions: 32-bit and 64-bit Microsoft Visual C++ 2013, 2010 SP1, and 2008 SP1. Visual C++ 2005 is no longer deployed.

You can install Studio or VDAs for Windows Desktop OS on machines running Windows 10.

You can create connections to Microsoft Azure virtualization resources.

Figure 17 Logical Architecture of Citrix XenDesktop



Citrix Provisioning Services 7.16

Most enterprises struggle to keep up with the proliferation and management of computers in their environments. Each computer, whether it is a desktop PC, a server in a data center, or a kiosk-type device, must be managed as an individual entity. The benefits of distributed processing come at the cost of distributed management. It costs time and money to set up, update, support, and ultimately decommission each computer. The initial cost of the machine is often dwarfed by operating costs.

Citrix PVS takes a very different approach from traditional imaging solutions by fundamentally changing the relationship between hardware and the software that runs on it. By streaming a single shared disk image (vDisk) rather than copying images to individual machines, PVS enables organizations to reduce the number of disk images that they manage, even as the number of machines continues to grow, simultaneously providing the efficiency of centralized management and the benefits of distributed processing.

In addition, because machines are streaming disk data dynamically and in real time from a single shared image, machine image consistency is essentially ensured. At the same time, the configuration, applications, and even the OS of large pools of machines can be completed changed in the time it takes the machines to reboot.

Using PVS, any vDisk can be configured in standard-image mode. A vDisk in standard-image mode allows many computers to boot from it simultaneously, greatly reducing the number of images that must be maintained and the amount of storage that is required. The vDisk is in read-only format, and the image cannot be changed by target devices.

Benefits for Citrix XenApp and Other Server Farm Administrators

If you manage a pool of servers that work as a farm, such as Citrix XenApp servers or web servers, maintaining a uniform patch level on your servers can be difficult and time consuming. With traditional imaging solutions, you start with a clean golden master image, but as soon as a server is built with the master image, you must patch that individual server along with all the other individual servers. Rolling out patches to individual servers in your farm is

not only inefficient, but the results can also be unreliable. Patches often fail on an individual server, and you may not realize you have a problem until users start complaining or the server has an outage. After that happens, getting the server resynchronized with the rest of the farm can be challenging, and sometimes a full reimaging of the machine is required.

With Citrix PVS, patch management for server farms is simple and reliable. You start by managing your golden image, and you continue to manage that single golden image. All patching is performed in one place and then streamed to your servers when they boot. Server build consistency is assured because all your servers use a single shared copy of the disk image. If a server becomes corrupted, simply reboot it, and it is instantly back to the known good state of your master image. Upgrades are extremely fast to implement. After you have your updated image ready for production, you simply assign the new image version to the servers and reboot them. You can deploy the new image to any number of servers in the time it takes them to reboot. Just as important, rollback can be performed in the same way, so problems with new images do not need to take your servers or your users out of commission for an extended period of time.

Benefits for Desktop Administrators

Because Citrix PVS is part of Citrix XenDesktop, desktop administrators can use PVS's streaming technology to simplify, consolidate, and reduce the costs of both physical and virtual desktop delivery. Many organizations are beginning to explore desktop virtualization. Although virtualization addresses many of IT's needs for consolidation and simplified management, deploying it also requires deployment of supporting infrastructure. Without PVS, storage costs can make desktop virtualization too costly for the IT budget. However, with PVS, IT can reduce the amount of storage required for VDI by as much as 90 percent. And with a single image to manage instead of hundreds or thousands of desktops, PVS significantly reduces the cost, effort, and complexity for desktop administration.

Different types of workers across the enterprise need different types of desktops. Some require simplicity and standardization, and others require high performance and personalization. XenDesktop can meet these requirements in a single solution using Citrix FlexCast delivery technology. With FlexCast, IT can deliver every type of virtual desktop, each specifically tailored to meet the performance, security, and flexibility requirements of each individual user.

Not all desktops applications can be supported by virtual desktops. For these scenarios, IT can still reap the benefits of consolidation and single-image management. Desktop images are stored and managed centrally in the data center and streamed to physical desktops on demand. This model works particularly well for standardized desktops such as those in lab and training environments and call centers and thin-client devices used to access virtual desktops.

Citrix Provisioning Services Solution

Citrix PVS streaming technology allows computers to be provisioned and re-provisioned in real time from a single shared disk image. With this approach, administrators can completely eliminate the need to manage and patch individual systems. Instead, all image management is performed on the master image. The local hard drive of each system can be used for runtime data caching or, in some scenarios, removed from the system entirely, which reduces power use, system failure rate, and security risk.

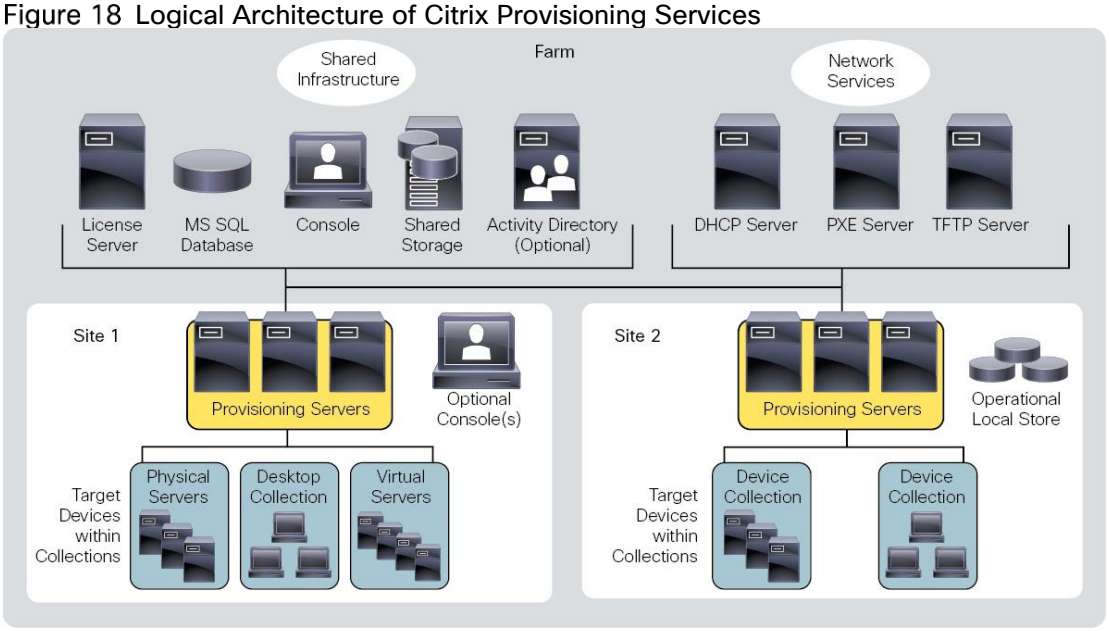
The PVS solution's infrastructure is based on software-streaming technology. After PVS components are installed and configured, a vDisk is created from a device's hard drive by taking a snapshot of the OS and application image and then storing that image as a vDisk file on the network. A device used for this process is referred to as a master target device. The devices that use the vDisks are called target devices. vDisks can exist on a PVS, file share, or in larger deployments, on a storage system with which PVS can communicate (iSCSI, SAN, network-attached storage [NAS], and Common Internet File System [CIFS]). vDisks can be assigned to a single target device in private-image mode, or to multiple target devices in standard-image mode.

Citrix Provisioning Services Infrastructure

The Citrix PVS infrastructure design directly relates to administrative roles within a PVS farm. The PVS administrator role determines which components that administrator can manage or view in the console.

A PVS farm contains several components. Figure 18 provides a high-level view of a basic PVS infrastructure and shows how PVS components might appear within that implementation.

Figure 18 Logical Architecture of Citrix Provisioning Services



The following new features are available with Provisioning Services 7.16:

- Linux streaming
- XenServer proxy using PVS-Accelerator

Architecture and Design of Citrix XenDesktop on Cisco Unified Computing System and Cisco HyperFlex Storage Design Fundamentals

There are many reasons to consider a virtual desktop solution such as an ever growing and diverse base of user devices, complexity in management of traditional desktops, security, and even Bring Your Own Computer (BYOC) to work programs. The first step in designing a virtual desktop solution is to understand the user community and the type of tasks that are required to successfully execute their role. The following user classifications are provided:

- Knowledge Workers today do not just work in their offices all day – they attend meetings, visit branch offices, work from home, and even coffee shops. These anywhere workers expect access to all of their same applications and data wherever they are.
- External Contractors are increasingly part of your everyday business. They need access to certain portions of your applications and data, yet administrators still have little control over the devices they use and the locations they work from. Consequently, IT is stuck making trade-offs on the cost of providing these workers a device vs. the security risk of allowing them access from their own devices.
- Task Workers perform a set of well-defined tasks. These workers access a small set of applications and have limited requirements from their PCs. However, since these workers are interacting with your customers, partners, and employees, they have access to your most critical data.

- Mobile Workers need access to their virtual desktop from everywhere, regardless of their ability to connect to a network. In addition, these workers expect the ability to personalize their PCs, by installing their own applications and storing their own data, such as photos and music, on these devices.
- Shared Workstation users are often found in state-of-the-art universities and business computer labs, conference rooms or training centers. Shared workstation environments have the constant requirement to re-provision desktops with the latest operating systems and applications as the needs of the organization change, tops the list.

After the user classifications have been identified and the business requirements for each user classification have been defined, it becomes essential to evaluate the types of virtual desktops that are needed based on user requirements. There are essentially five potential desktops environments for each user:

- Traditional PC: A traditional PC is what typically constituted a desktop environment; physical device with a locally installed operating system.
- Hosted Shared Desktop: A hosted, server-based desktop is a desktop where the user interacts through a delivery protocol. With hosted, server-based desktops, a single installed instance of a server operating system, such as Microsoft Windows Server 2012, is shared by multiple users simultaneously. Each user receives a desktop "session" and works in an isolated memory space. Changes made by one user could impact the other users.
- Hosted Virtual Desktop: A hosted virtual desktop is a virtual desktop running either on virtualization layer (ESX) or on bare metal hardware. The user does not work with and sit in front of the desktop, but instead the user interacts through a delivery protocol.
- Published Applications: Published applications run entirely on the Microsoft Session Hosts and the user interacts through a delivery protocol. With published applications, a single installed instance of an application, such as Microsoft, is shared by multiple users simultaneously. Each user receives an application "session" and works in an isolated memory space.
- Streamed Applications: Streamed desktops and applications run entirely on the user‘s local client device and are sent from a server on demand. The user interacts with the application or desktop directly but the resources may only available while they are connected to the network.
- Local Virtual Desktop: A local virtual desktop is a desktop running entirely on the user‘s local device and continues to operate when disconnected from the network. In this case, the user’s local device is used as a type 1 hypervisor and is synced with the data center when the device is connected to the network.

For the purposes of the validation represented in this document, both XenDesktop Virtual Desktops and XenApp Hosted Shared Desktop server sessions were validated. Each of the sections provides some fundamental design decisions for this environment.

Understanding Applications and Data

When the desktop user groups and sub-groups have been identified, the next task is to catalog group application and data requirements. This can be one of the most time-consuming processes in the VDI planning exercise, but is essential for the VDI project’s success. If the applications and data are not identified and co-located, performance will be negatively affected.

The process of analyzing the variety of application and data pairs for an organization will likely be complicated by the inclusion cloud applications, like SalesForce.com. This application and data analysis is beyond the scope of this Cisco Validated Design, but should not be omitted from the planning process. There are a variety of third party tools available to assist organizations with this crucial exercise.

Project Planning and Solution Sizing Sample Questions

Now that user groups, their applications, and their data requirements are understood, some key project and solution sizing questions may be considered.

General project questions should be addressed at the outset, including:

- Has a VDI pilot plan been created based on the business analysis of the desktop groups, applications, and data?
- Is there infrastructure and budget in place to run the pilot program?
- Are the required skill sets to execute the VDI project available? Can we hire or contract for them?
- Do we have end user experience performance metrics identified for each desktop sub-group?
- How will we measure success or failure?
- What is the future implication of success or failure?

Below is a short, non-exhaustive list of sizing questions that should be addressed for each user sub-group:

- What is the desktop OS planned? Windows 7, Windows 8, or Windows 10?
- 32-bit or 64-bit desktop OS?
- How many virtual desktops will be deployed in the pilot? In production? All Windows 7/8/10?
- How much memory per target desktop group desktop?
- Are there any rich media, Flash, or graphics-intensive workloads?
- What is the end point graphics processing capability?
- Will Citrix XenApp for Remote Desktop Server Hosted Sessions used?
- What is the hypervisor for the solution?
- What is the storage configuration in the existing environment?
- Are there sufficient IOPS available for the write-intensive VDI workload?
- Will there be storage dedicated and tuned for VDI service?
- Is there a voice component to the desktop?
- Is anti-virus a part of the image?
- Is user profile management (for example, non-roaming profile based) part of the solution?
- What is the fault tolerance, failover, disaster recovery plan?
- Are there additional desktop sub-group specific questions?

Citrix XenDesktop Design Fundamentals

An ever growing and diverse base of user devices, complexity in management of traditional desktops, security, and even Bring Your Own (BYO) device to work programs are prime reasons for moving to a virtual desktop solution.

Citrix XenDesktop 7.16 integrates Hosted Shared and VDI desktop virtualization technologies into a unified architecture that enables a scalable, simple, efficient, and manageable solution for delivering Windows applications and desktops as a service.

Users can select applications from an easy-to-use “store” that is accessible from tablets, smartphones, PCs, Macs, and thin clients. XenDesktop delivers a native touch-optimized experience with HDX high-definition performance, even over mobile networks.

Machine Catalogs

Collections of identical Virtual Machines (VMs) or physical computers are managed as a single entity called a Machine Catalog. In this CVD, VM provisioning relies on Citrix Provisioning Services to make sure that the machines in the catalog are consistent. In this CVD, machines in the Machine Catalog are configured to run either a Windows Server OS (for RDS hosted shared desktops) or a Windows Desktop OS (for hosted pooled VDI desktops).

Delivery Groups

To deliver desktops and applications to users, you create a Machine Catalog and then allocate machines from the catalog to users by creating Delivery Groups. Delivery Groups provide desktops, applications, or a combination of desktops and applications to users. Creating a Delivery Group is a flexible way of allocating machines and applications to users. In a Delivery Group, you can:

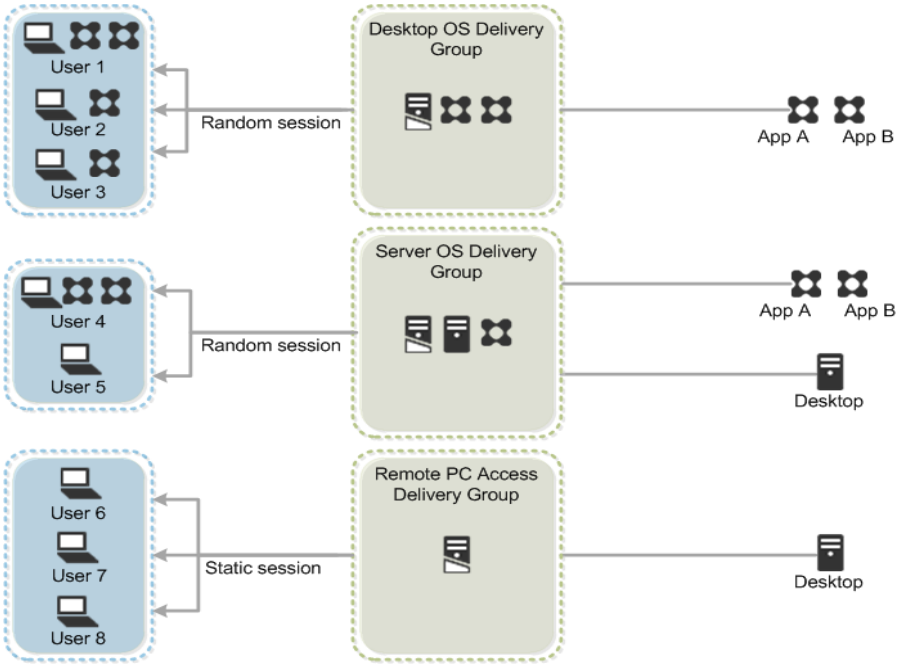
- Use machines from multiple catalogs
- Allocate a user to multiple machines
- Allocate multiple users to one machine

As part of the creation process, you specify the following Delivery Group properties:

- Users, groups, and applications allocated to Delivery Groups
- Desktop settings to match users' needs
- Desktop power management options

Figure 19 illustrates how users access desktops and applications through machine catalogs and delivery groups.

Figure 19 Access Desktops and Applications through Machine Catalogs and Delivery Groups



Example XenDesktop Deployments

Two examples of typical XenDesktop deployments are:

- A distributed components configuration
- A multiple site configuration

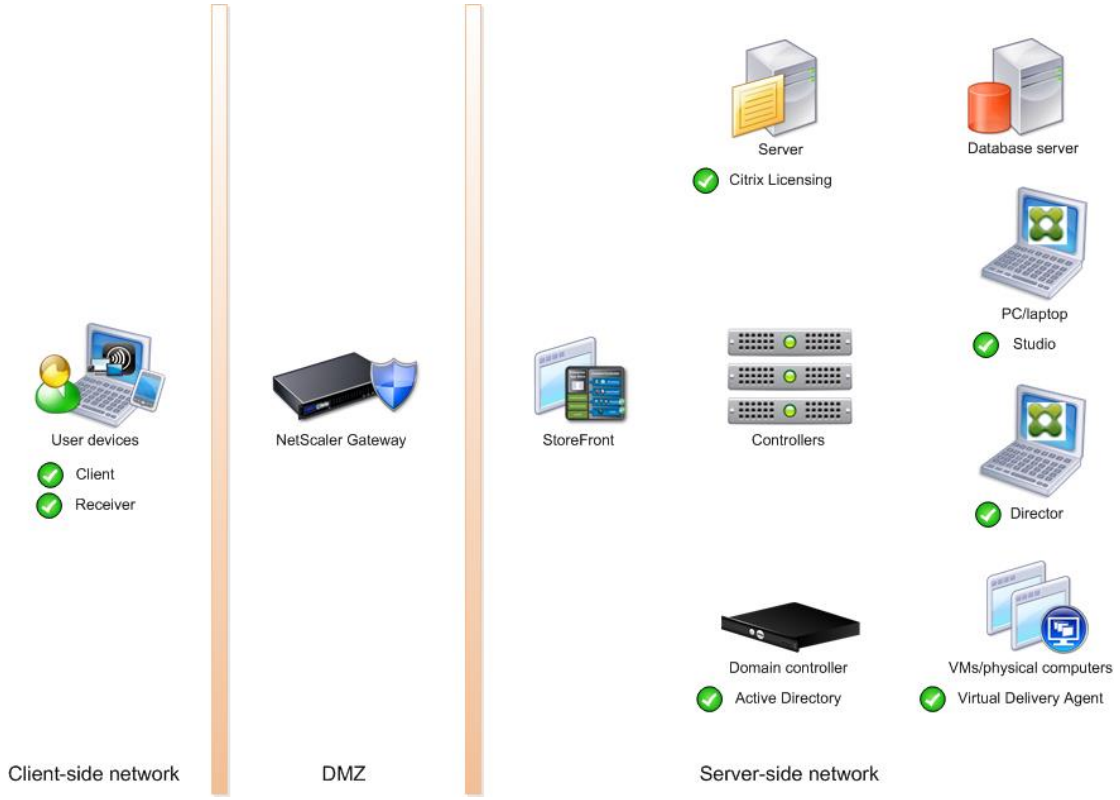
Since XenApp and XenDesktop 7.16 are based on a unified architecture, combined they can deliver a combination of Hosted Shared Desktops (HSDs, using a Server OS machine) and Hosted Virtual Desktops (HVDs, using a Desktop OS).

Distributed Components Configuration

You can distribute the components of your deployment among a greater number of servers, or provide greater scalability and failover by increasing the number of controllers in your site. You can install management consoles on separate computers to manage the deployment remotely. A distributed deployment is necessary for an infrastructure based on remote access through NetScaler Gateway (formerly called Access Gateway).

Figure 20 shows an example of a distributed components configuration. A simplified version of this configuration is often deployed for an initial proof-of-concept (POC) deployment. The CVD described in this document deploys Citrix XenDesktop in a configuration that resembles this distributed components configuration shown. Two Cisco C220 rack servers host the required infrastructure services (AD, DNS, DHCP, Profile, SQL, Citrix XenDesktop management, and StoreFront servers).

Figure 20 Example of a Distributed Components Configuration

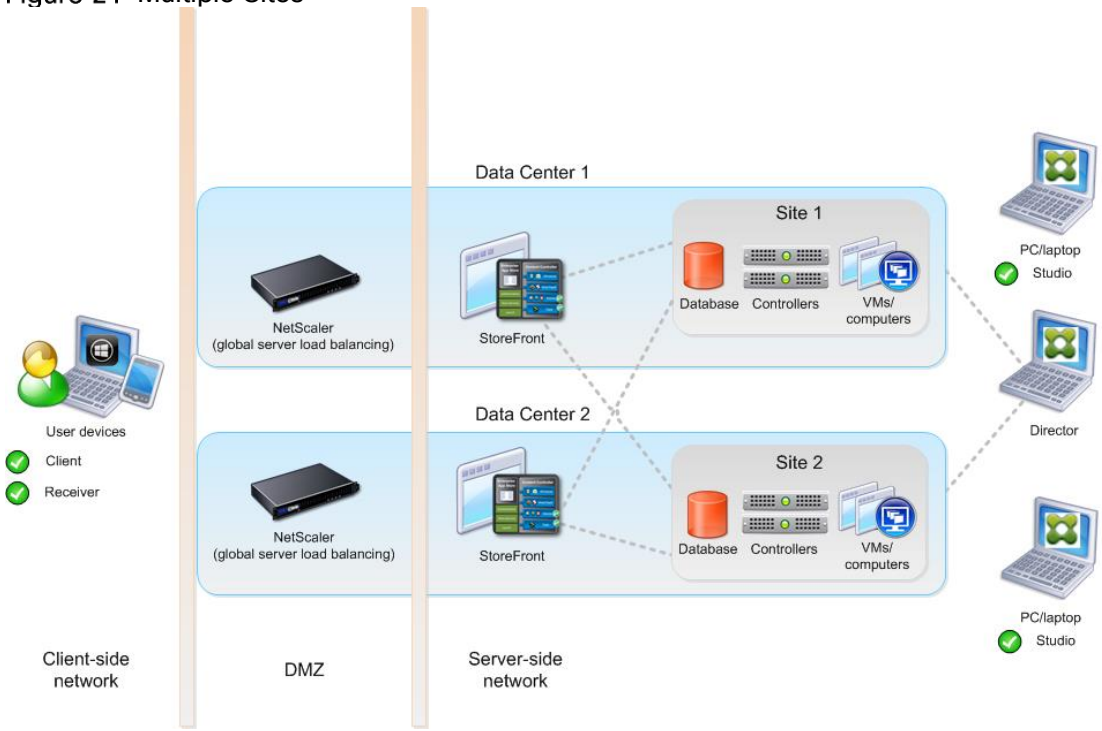


Multiple Site Configuration

If you have multiple regional sites, you can use Citrix NetScaler to direct user connections to the most appropriate site and StoreFront to deliver desktops and applications to users.

In Figure 21 depicting multiple sites, a site was created in two data centers. Having two sites globally, rather than just one, minimizes the amount of unnecessary WAN traffic.

Figure 21 Multiple Sites



You can use StoreFront to aggregate resources from multiple sites to provide users with a single point of access with NetScaler. A separate Studio console is required to manage each site; sites cannot be managed as a single entity. You can use Director to support users across sites.

Citrix NetScaler accelerates application performance, load balances servers, increases security, and optimizes the user experience. In this example, two NetScalers are used to provide a high availability configuration. The NetScalers are configured for Global Server Load Balancing and positioned in the DMZ to provide a multi-site, fault-tolerant solution.

Citrix Cloud Services

Easily deliver the Citrix portfolio of products as a service. Citrix Cloud services simplify the delivery and management of Citrix technologies extending existing on-premises software deployments and creating hybrid workspace services.

- Fast: Deploy apps and desktops, or complete secure digital workspaces in hours, not weeks.
- Adaptable: Choose to deploy on any cloud or virtual infrastructure — or a hybrid of both.
- Secure: Keep all proprietary information for your apps, desktops and data under your control.
- Simple: Implement a fully-integrated Citrix portfolio via a single-management plane to simplify administration

Designing a XenDesktop Environment for a Mixed Workload

With Citrix XenDesktop 7.16, the method you choose to provide applications or desktops to users depends on the types of applications and desktops you are hosting and available system resources, as well as the types of users and user experience you want to provide.

Server OS machines	**You want**: Inexpensive server-based delivery to minimize the cost of delivering applications to a large number of users, while providing a secure, high-definition user experience. **Your users**: Perform well-defined tasks and do not require personalization or offline access to applications. Users may include task workers such as call center operators and retail workers, or users that share workstations. **Application types**: Any application.
Desktop OS machines	**You want**: A client-based application delivery solution that is secure, provides centralized management, and supports a large number of users per host server (or hypervisor), while providing users with applications that display seamlessly in high-definition. **Your users**: Are internal, external contractors, third-party collaborators, and other provisional team members. Users do not require off-line access to hosted applications. **Application types**: Applications that might not work well with other applications or might interact with the operating system, such as .NET framework. These types of applications are ideal for hosting on virtual machines. Applications running on older operating systems such as Windows XP or Windows Vista, and older architectures, such as 32-bit or 16-bit. By isolating each application on its own virtual machine, if one machine fails, it does not impact other users.
Remote PC Access	**You want:** Employees with secure remote access to a physical computer without using a VPN. For example, the user may be accessing their physical desktop PC from home or through a public WIFI hotspot. Depending upon the location, you may want to restrict the ability to print or copy and paste outside of the desktop. This method enables BYO device support without migrating desktop images into the datacenter. Your users: Employees or contractors that have the option to work from home, but need access to specific software or data on their corporate desktops to perform their jobs remotely. Host: The same as Desktop OS machines. Application types: Applications that are delivered from an office computer and display seamlessly in high definition on the remote user's device.

Deployment Hardware and Software

Physical Components

Table 1 HyperFlex System Components

Component	Hardware Required
Fabric Interconnects	Two Cisco UCS 6332 Fabric Interconnects, or Two Cisco UCS 6332-16UP Fabric Interconnects
Servers	Eight Cisco HyperFlex HXAF220c-M5SX All-Flash rack servers

For complete server specifications 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-M5SX Spec Sheet:

https://www.cisco.com/c/dam/en/us/products/collateral/hyperconverged-infrastructure/hyperflex-hx-series/hxaf-220c-m5-specsheet.pdf

Table 2 lists the hardware component options for the HXAF220c-M5SX server model.

Table 2 HXAF220c-M5SX Server Options

HXAF220c-M5SX options		Hardware Required
Processors		A pair of Intel Xeon Processor Scalable Family CPUs (6140 Gold)
Memory		768GB of total memory using 64 GB DDR4 2666 MHz 1.2v modules
Disk Controller		Cisco 12Gbps Modular SAS HBA
SSDs	Standard	One 240 GB 2.5 Inch Enterprise Value 6G SATA SSD One 400 GB 2.5 Inch Enterprise Performance 12G SAS SSD Six to eight 3.8 TB 2.5 Inch Enterprise Value 6G SATA SSDs, or six to eight 960 GB 2.5 Inch Enterprise Value 6G SATA SSDs
Network		Cisco UCS VIC1387 VIC MLOM
Boot Device		One 240 GB M.2 form factor SATA SSD
microSD Card		One 32GB microSD card for local host utilities storage

HXAF220c-M5SX options	Hardware Required
Optional	Cisco QSA module to convert 40 GbE QSFP+ to 10 GbE SFP+

Software Components

Table 3 lists the software components and the versions required for the Cisco HyperFlex system for Microsoft Hyper-V.

Table 3 Software Components

Component	Software Required
Hypervisor	Hyper-V - Microsoft Windows Server 2016 Datacenter Note: Microsoft Windows Server with Hyper-V will NOT be installed in Cisco Factory. Customers need to bring their own Windows Server ISO image that needs to be installed at deployment site
Active Directory	A Windows 2012 or later domain and forest functionality level with AD integrated DNS server.
Management Server	Windows 10 or Windows Server 2016 with PowerShell and RSAT tools installed. System Center VMM 2016 Windows Admin Center (Optional)
Cisco HyperFlex Data Platform	Cisco HyperFlex HX Data Platform Installer for Microsoft Hyper-V 3.0(1c) - Cisco-HX-Data-Platform-Installer-v3.0.1c-29681-hyperv.vhdx.zip
Microsoft Windows Server 2016 System Preparation Script	Cisco HyperFlex Data Platform System Preparation Script for Microsoft Windows Server 2016 with Cisco Drivers - HXInstall-HyperV-DatacenterCore-v3.0.1c-29681.img, or Cisco HyperFlex Data Platform System Preparation Script for Microsoft Windows Server 2016 Desktop Experience with Cisco Drivers - HXInstall-HyperV-DatacenterDE-v3.0.1c-29681.img
Ready Clone PowerShell Script	Cisco HyperFlex Data Platform Hyper-V ReadyClone PowerShell Script HxClone-HyperV-v3.0.1c-29681.ps1
Cisco UCS Firmware	Cisco UCS Infrastructure software, Cisco UCS B-Series and C-Series bundles, revision 3.2(3g) or later.

Licensing

Cisco HyperFlex systems must be properly licensed using Cisco Smart Licensing, which is a cloud-based software licensing management solution used to automate many manual, time consuming and error prone licensing tasks. Cisco HyperFlex 2.5 and later communicate with the Cisco Smart Software Manager (CSSM) online service via a Cisco Smart Account, to check out or assign available licenses from the account to the Cisco HyperFlex cluster resources. Communications can be direct via the internet, they can be configured to communicate via a proxy server, or they can communicate with an internal Cisco Smart Software Manager satellite server, which caches

and periodically synchronizes licensing data. In a small number of highly secure environments, systems can be provisioned with a Permanent License Reservation (PLR) which does not need to communicate with CSSM. Contact your Cisco sales representative or partner to discuss if your security requirements will necessitate use of these permanent licenses. New HyperFlex cluster installations will operate for 90 days without licensing as an evaluation period, thereafter the system will generate alarms and operate in a non-compliant mode. Systems without compliant licensing will not be entitled to technical support.

For more information about the Cisco Smart Software Manager satellite server, see: https://www.cisco.com/c/en/us/buy/smart-accounts/software-manager-satellite.html

Beginning with Cisco HyperFlex 3.0, licensing of the system requires one license per node - Standard license.

Table 4 lists the licensing editions and the features available with each type of license.

Table 4 HyperFlex System License Editions

HyperFlex Licensing Edition	Standard
Features Available	8 Converged Nodes standard cluster with Fabric Interconnects (Compute-only nodes not supported) All Cisco UCS M5 with SFF server models Replication Factor 3 10 GbE or 40 GbE Ethernet

Considerations

Version Control

The software revisions listed in Table 3 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 make sure that the system is not being modified into an unsupported configuration.

Microsoft Windows Active Directory

The Microsoft Windows Active Directory 2012 or later is required due to the requirement Cisco HyperFlex for Microsoft Hyper-V. The Active Directory with integrated DNS server must be installed and operational prior to the installation of the Cisco HyperFlex HX Data Platform software.

This document does not cover the installation and configuration of Microsoft Windows Active Directory and DNS server.

Scale

Cisco HyperFlex for Microsoft Hyper-V standard clusters currently scale from a minimum of 3 to a maximum of 8 Cisco HX-series converged nodes with small form factor (SFF) disks per cluster. A converged node is a member of the cluster which provides storage resources to the HX Distributed Filesystem. Once the maximum size of a single 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 management host with PowerShell and RSAT tools installed.

At the time of the publication of this document, Cisco HyperFlex for Microsoft Hyper-V does not support the following: Adding compute-only nodes to a cluster or expanding an existing cluster and Cisco UCS M4 server models and LFF disks are not supported

Table 5 lists the minimum and maximum scale for various installations of the Cisco HyperFlex system with Microsoft Hyper-V:

Table 5 HyperFlex Cluster Scale

Cluster Type	Minimum Converged Nodes Required	Maximum Converged Nodes Allowed	Maximum Compute-only Nodes Allowed
Standard with SFF disks	3	8	Not supported

Capacity

Overall usable cluster capacity is based on a number of factors. The number of nodes in the cluster, the number and size of the capacity layer disks, and the replication factor of the HyperFlex HX Data Platform, all affect the cluster capacity.

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 percent.

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

Table 6 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 listed in Table 7

Table 7 IEC Unit Values (binary prefix)

Value	Symbol	Name
1024 bytes	KiB	Kibibyte
1024 KiB	MiB	Mebibyte

Value	Symbol	Name
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 Connect GUI when viewing cluster capacity, allocation and consumption, and also within most operating systems.

Table 8 lists a set of HyperFlex HX Data Platform cluster usable capacity values, using binary prefix, for an array of cluster configurations. These values provide an example of the capacity calculations, 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.

Table 8 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-M5SX	8	3.8 TB	8	102.8 TiB	68.6 TiB
		960 GB	8	25.7 TiB	17.1 TiB
HXAF240c-M5SX (Not used in this solution)	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

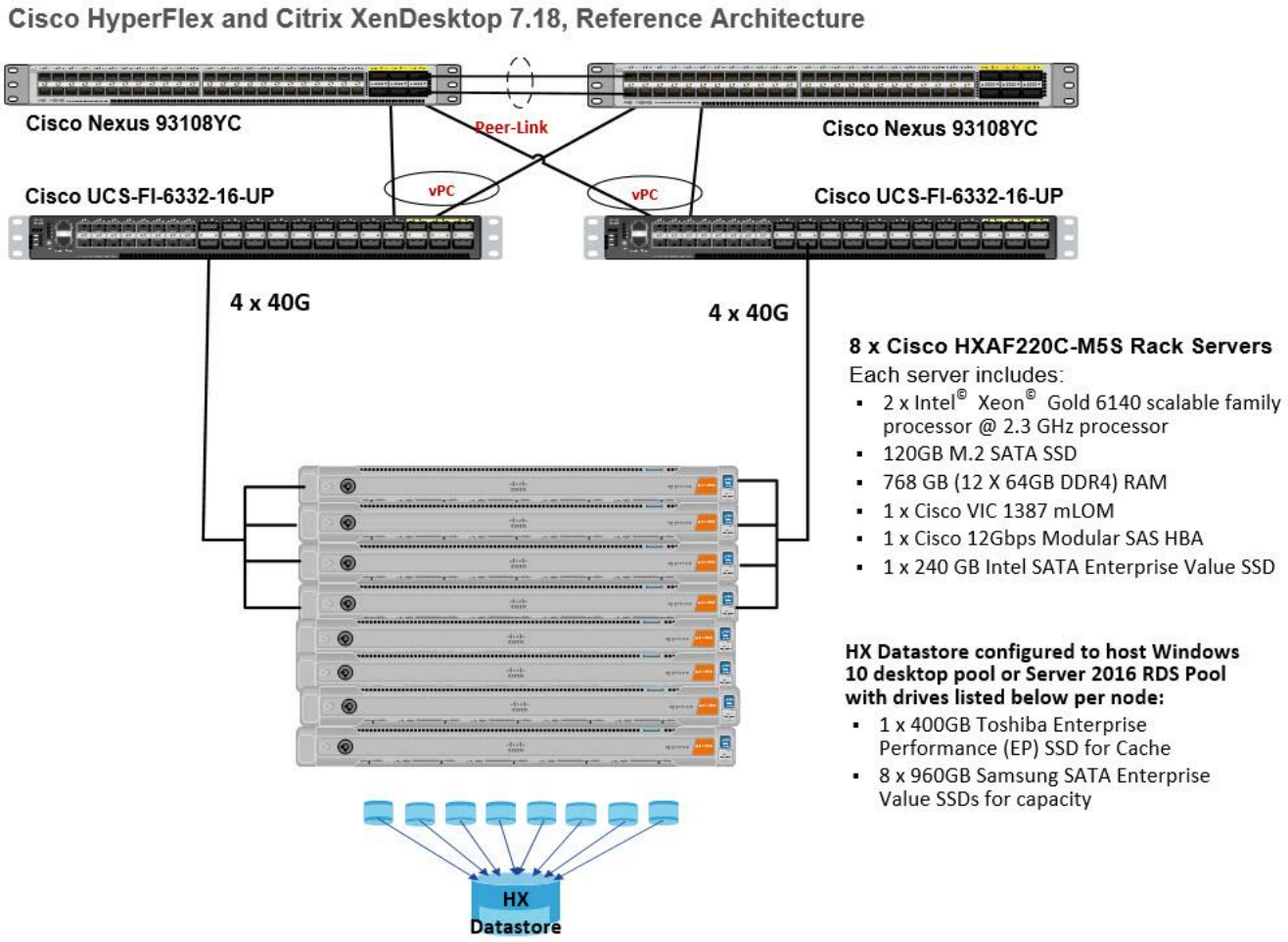
Calculations are based on the number of nodes, the number of capacity disks per node, and the size of the capacity disks. Table 8 is not a comprehensive list of all capacities and models available.

Physical Topology

Topology Overview

The Cisco HyperFlex for Microsoft Hyper-V system is composed of a pair of Cisco UCS Fabric Interconnects along with up to 8 HX-Series rack-mount servers as converged nodes per cluster. 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. Upstream network connections, also referred to as “northbound” network connections are made from the Fabric Interconnects to the customer data center network at the time of installation.

Figure 22 HyperFlex Standard Cluster Topology



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

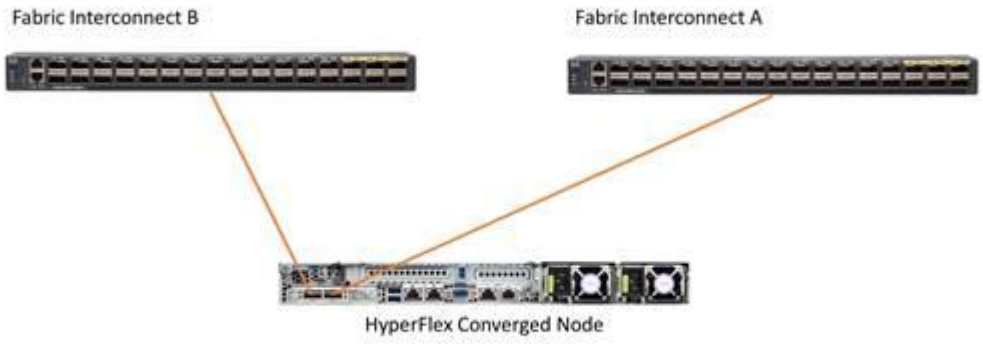
The HX-Series converged servers are connected directly to the Cisco UCS Fabric Interconnects in Direct Connect mode. This option enables Cisco UCS Manager to manage the HX-Series Rack-Mount Servers using a single cable for both management traffic and data traffic. Cisco HyperFlex M5 generation servers can be configured only with the Cisco VIC 1387 card. 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 23). 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.

Various combinations of physical connectivity between the Cisco HX-series servers and the Fabric Interconnects are possible, but only specific combinations are supported. For example, use of the Cisco QSA module to convert a 40 GbE QSFP+ port into a 10 GbE SFP+ port is allowed for M5 generation servers in order to configure M5 generation servers along with model 6248 or 6296 Fabric Interconnects. Table 9 lists the possible connections, and which of these methods is supported.

Table 9 Supported Physical Connectivity

Fabric Interconnect Model	6248	6296	6332		6332-16UP		
Port Type	10GbE	10GbE	40GbE	10GbE Breakout	40GbE	10GbE Breakout	10GbE onboard
M5 with VIC 1387	✗	✗	✓	✗	✓	✗	✗
M5 with VIC 1387 + QSA	✓	✓	✗	✗	✗	✗	✗

Figure 23 HX-Series Server Connectivity



Logical Architecture

The logical architecture of this solution is designed to support up to 1250 Hosted Virtual Microsoft Windows 10 Desktops users or 1600 RDS users within an eight node Cisco UCS HXAF220c- HyperFlex cluster, which provides physical redundancy for each workload type.

Figure 24 Logical Architecture Design

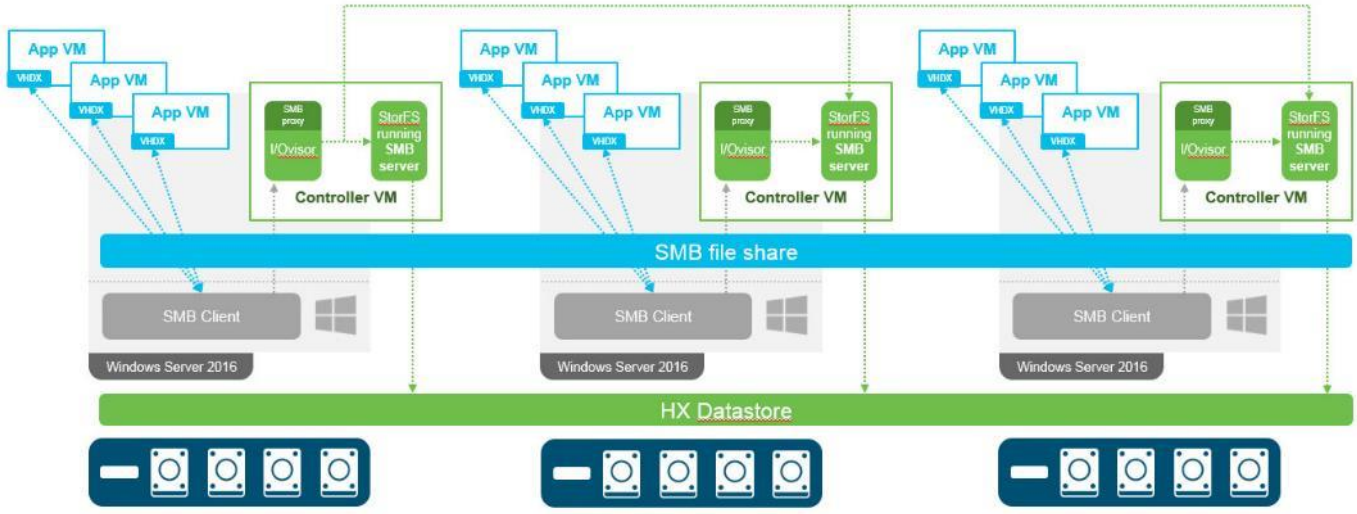


Table 3 lists the software revisions for this solution.

This document is intended to allow you to fully configure your environment. In this process, various steps require you to insert customer-specific naming conventions, IP addresses, and VLAN schemes, as well as to record appropriate MAC addresses. Table 10 through Table 23 lists the information you need to configure your environment.

Design Elements

Installing 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 Windows Server 2016 on the HyperFlex hosts, and also performs significant portions of the 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

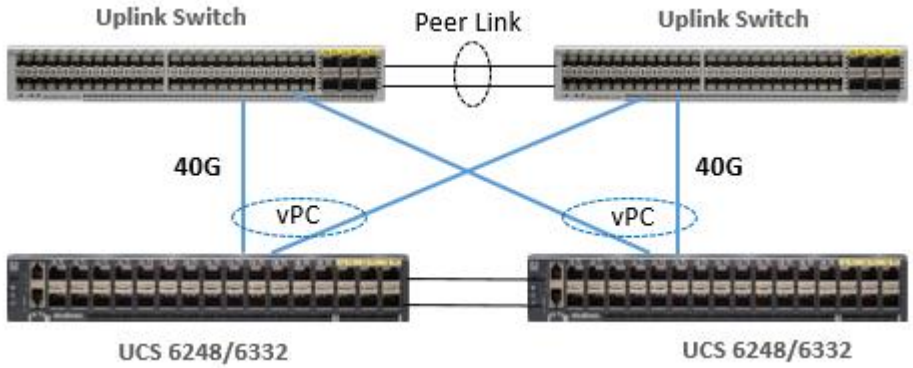
upstream Cisco switches using the virtual port channel (vPC) feature. Using vPC uplinks allows all uplinks to be active passing data, plus protects against any individual link failure, and the failure of an upstream switch. Other uplink configurations can be redundant, but spanning-tree protocol loop 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 section detail the uplink connectivity option used for this solution.

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 25 Connectivity with vPC



VLANs

The VLAN configuration recommended for the environment includes a total of seven VLANs as outlined in Table 10 .

Table 10 VLANs Configured in this Study

VLAN Name	VLAN ID	VLAN Purpose
Default	1	Native VLAN
Hx-in-Band-Mgmt	30	VLAN for in-band management interfaces
Infra-Mgmt	32	VLAN for Virtual Infrastructure
Hx-storage-data	101	VLAN for HyperFlex Storage
Hx-livemigration	33	VLAN for Hyper-V Live Migration
Vm-network	34	VLAN for VDI Traffic
OOB-Mgmt	132	VLAN for out-of-band management interfaces

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 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. 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, particularly when cable or port failures would cause storage traffic to traverse the northbound Cisco UCS uplink switches.

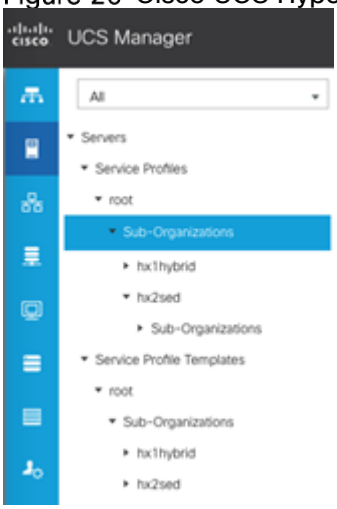
Cisco UCS Design

This section describes 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 new 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, which prevents problems from overlapping settings across policies and pools. This arrangement also allows for organizational control using Role-Based Access Control (RBAC) and administrative locales within Cisco UCS Manager 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 26 Cisco UCS HyperFlex Sub-Organization



Cisco UCS LAN Policies

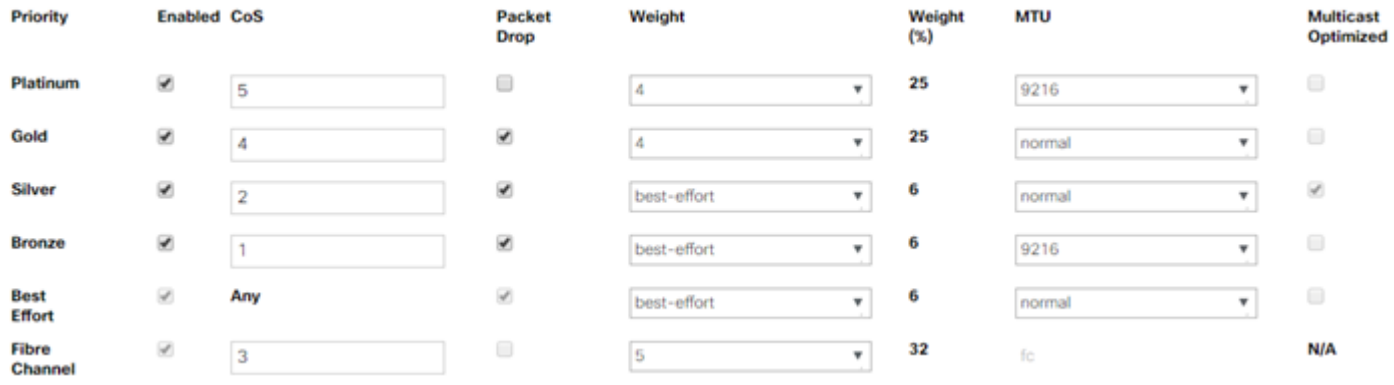
QoS System Classes

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. Table 11 and Figure 27 list the QoS System Class settings configured for HyperFlex.

Table 11 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
Best Effort	Yes	Any	Yes	Best-effort	Normal	No
Fibre Channel	Yes	3	No	5	FC	N/A

Figure 27 QoS System Classes



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. Table 12 details the QoS Policies configured for HyperFlex, and their default assignment to the vNIC templates created:

Table 12 HyperFlex QoS Policies

Policy	Priority	Burst	Rate	Host Control	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
Bronze	Bronze	10240	Line-rate	None	hv-livemigrate-a hv- livemigrate -b
Best Effort	Best Effort	10240	Line-rate	None	N/A

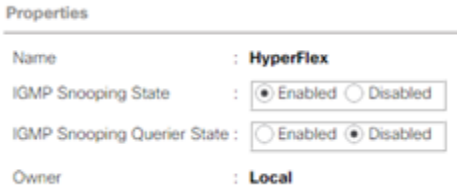
Multicast Policy

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. Table 13 and Figure 28 details the Multicast Policy configured for HyperFlex:

Table 13 Multicast Policy

Name	IGMP Snooping State	IGMP Snooping Queries State
HyperFlex	Enabled	Disabled

Figure 28 Multicast Policy



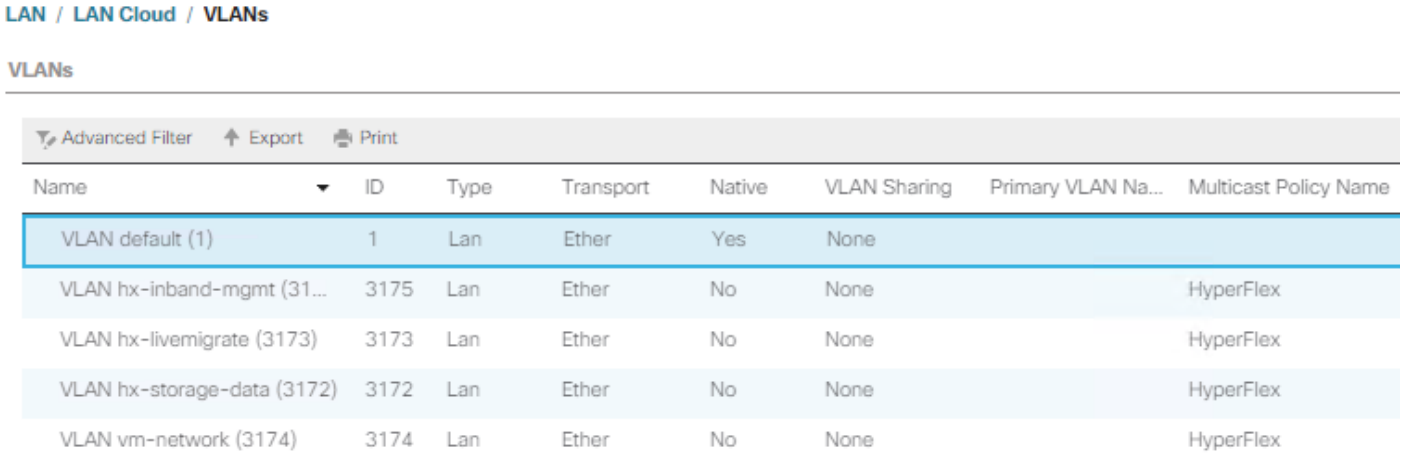
VLANs

VLANs are created by the HyperFlex installer to support a base HyperFlex system, with a VLAN for live migrate, 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). Table 14 and Figure 29 list the VLANs configured for HyperFlex.

Table 14 Cisco UCS VLANs

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

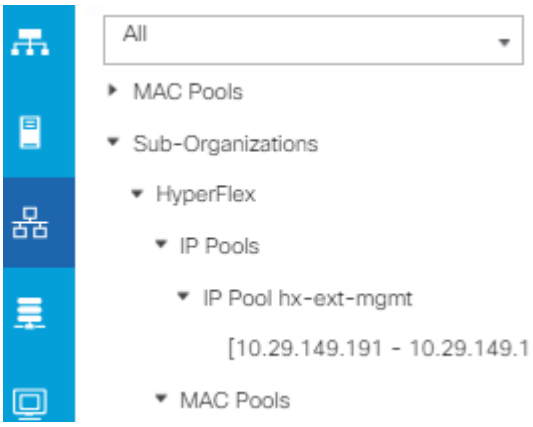
Figure 29 Cisco UCS VLANs



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.

Figure 30 Management IP Address Pool



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 (for example, 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.

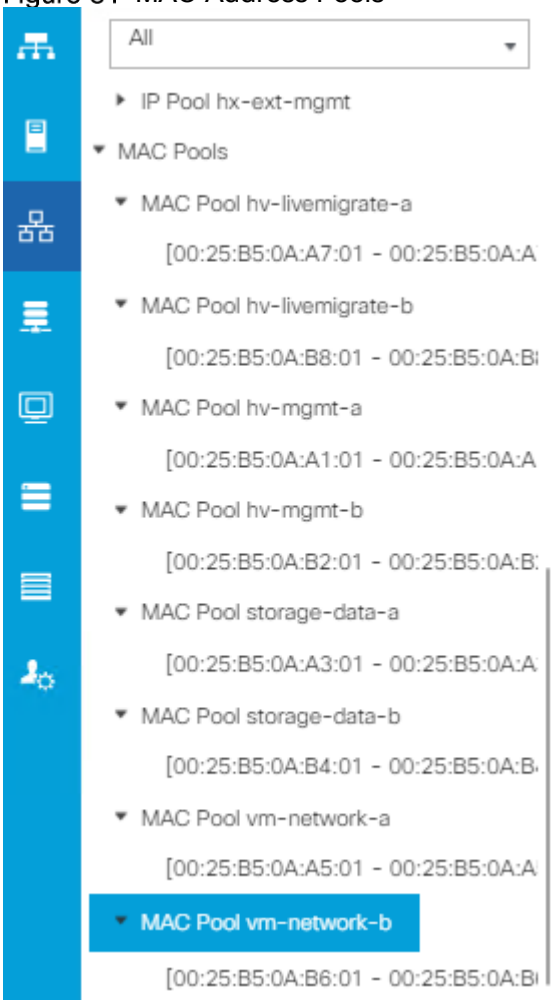
Table 15 list the MAC Address Pools configured for HyperFlex and their default assignment to the vNIC templates created.

Table 15 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-livemigrate-a	00:25:B5:<xx>:A7:01	100	Sequential	hv-livemigrate-a
hv-livemigrate-b	00:25:B5:<xx>:B8:01	100	Sequential	hv-livemigrate-b
storage-data-a	00:25:B5:<xx>:A3:01	100	Sequential	storage-data-a
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

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

Figure 31 MAC Address Pools



Network Control Policies

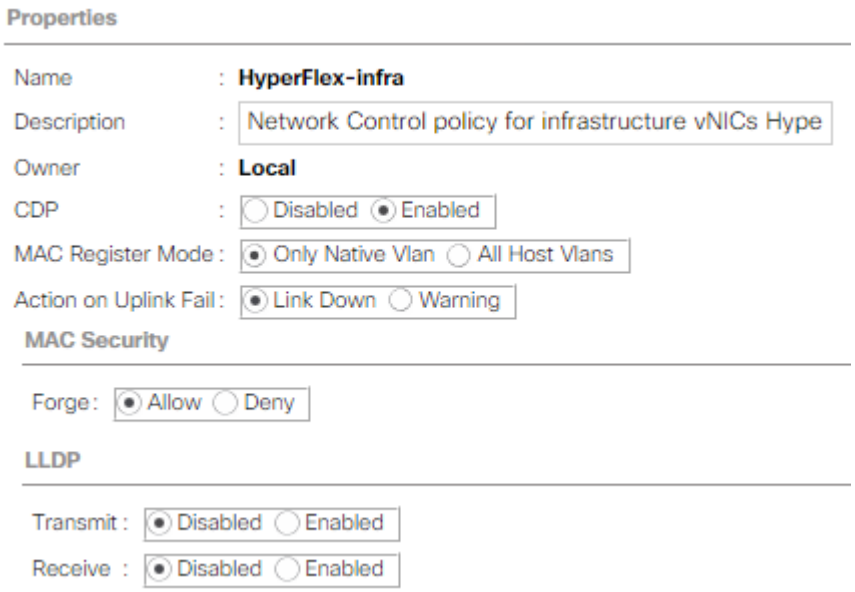
Cisco UCS Network Control Policies control various aspects of the behavior of vNICs defined in the Cisco UCS Service Profiles. Settings controlled include enablement of Cisco Discovery Protocol (CDP), MAC address registration, MAC address forging, and the action taken on the vNIC status if the Cisco 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. Table 16 details the Network Control Policies configured for HyperFlex, and their default assignment to the vNIC templates created:

Table 16 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-livemigrate-a hv-livemigrate-b storage-data-a

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

Figure 32 Network Control Policy



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 list the initial settings in each of the vNIC templates created by the HyperFlex installer:

Table 17 vNIC Template hv-mgmt-a/b

vNIC Template Name:	hv-mgmt-a	hv-mgmt-b	storage-data-a	storage-data-b	hv-livemigrate-a	hv-livemigrate-b	vm-network-a	vm-network-b
Setting	Value	Value	Value	Value	Value	Value	Value	Value
Fabric ID	A	B	A	B	A	B	A	B

Fabric Failover	Disabled	Disabled	Disabled	Disabled	Disabled	Disabled	Disabled	Disabled
Target	Adapter	Adapter	Adapter	Adapter	Adapter	Adapter	Adapter	Adapter
Type	Updating Template	Updating Template	Updating Template	Updating Template	Updating Template	Updating Template	Updating Template	Updating Template
MTU	1500	1500	9000	9000	9000	9000	1500	1500
MAC Pool	hv-mgmt-a	hv-mgmt-b	storage-data-a	storage-data-b	hv-livemigrate-a	hv-livemigrate-b	vm-network-a	vm-network-b
QoS Policy	silver	silver	platinum	platinum	bronze	bronze	gold	gold
Network Control Policy	HyperFlex-infra	HyperFlex-infra	HyperFlex-infra	HyperFlex-infra	HyperFlex-infra	HyperFlex-infra	HyperFlex-vm	HyperFlex-vm
VLANs	<<hx-inband-mgmt>>	<<hx-inband-mgmt>>	<<hx-storage-data>>	<<hx-storage-data>>	<<hx-livemigrate>>	<<hx-livemigrate>>	<<vm-network>>	<<vm-network>>
Native VLAN	No	No	No	No	No	No	No	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. Table 18 lists the LAN Connectivity Policy configured for HyperFlex.

Table 18 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-livemigrate-a	hv-livemigrate-a	
		hv-livemigrate-b	hv-livemigrate-b	
		storage-data-a	storage-data-a	
		storage-data-b	storage-data-b	

Policy Name	Use vNIC Template	vNIC Name	vNIC Template Used	Adapter Policy
		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 named “HyperFlex” configured for HyperFlex.

Figure 33 Cisco UCS Adapter Policy Resources

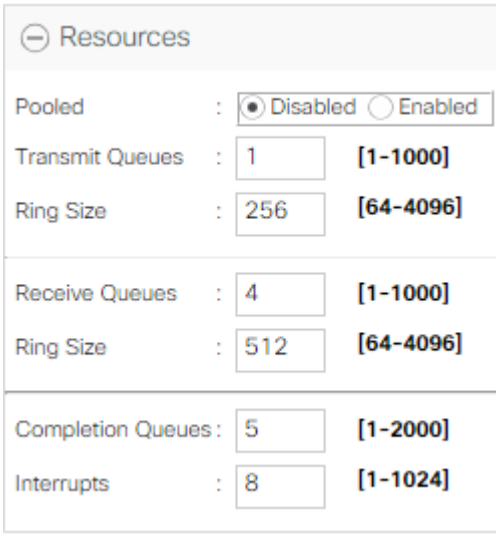
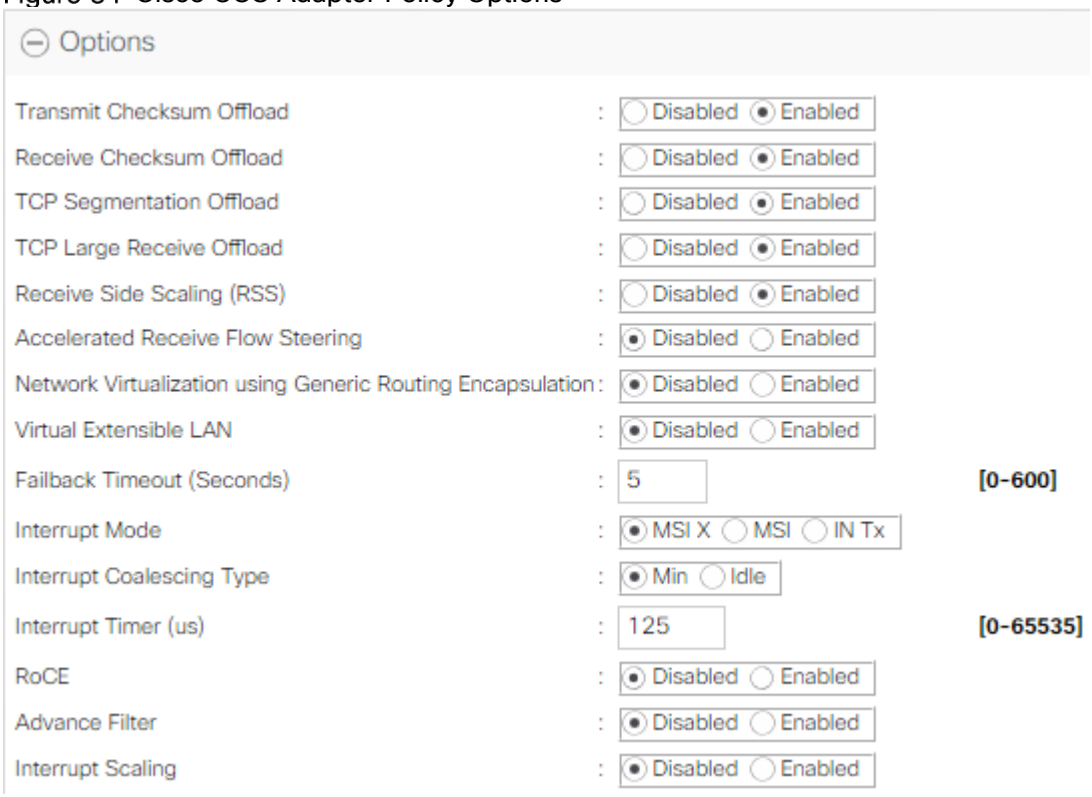


Figure 34 Cisco UCS Adapter Policy Options



BIOS Policies

Cisco HX-Series M5 generation servers no longer use pre-defined BIOS setting defaults derived from Cisco UCS Manager, instead the servers have default BIOS tokens set from the factory. The current default token settings can be viewed at the following website: https://www.cisco.com/c/en/us/td/docs/unified_computing/ucs/ucs-manager/Reference-Docs/Server-BIOS-Tokens/3-2/b_UCS_BIOS_Tokens.html

A BIOS policy, named “HyperFlex-m5” is created by the HyperFlex installer to modify the setting of M5 generation servers. The settings modified are as follows:

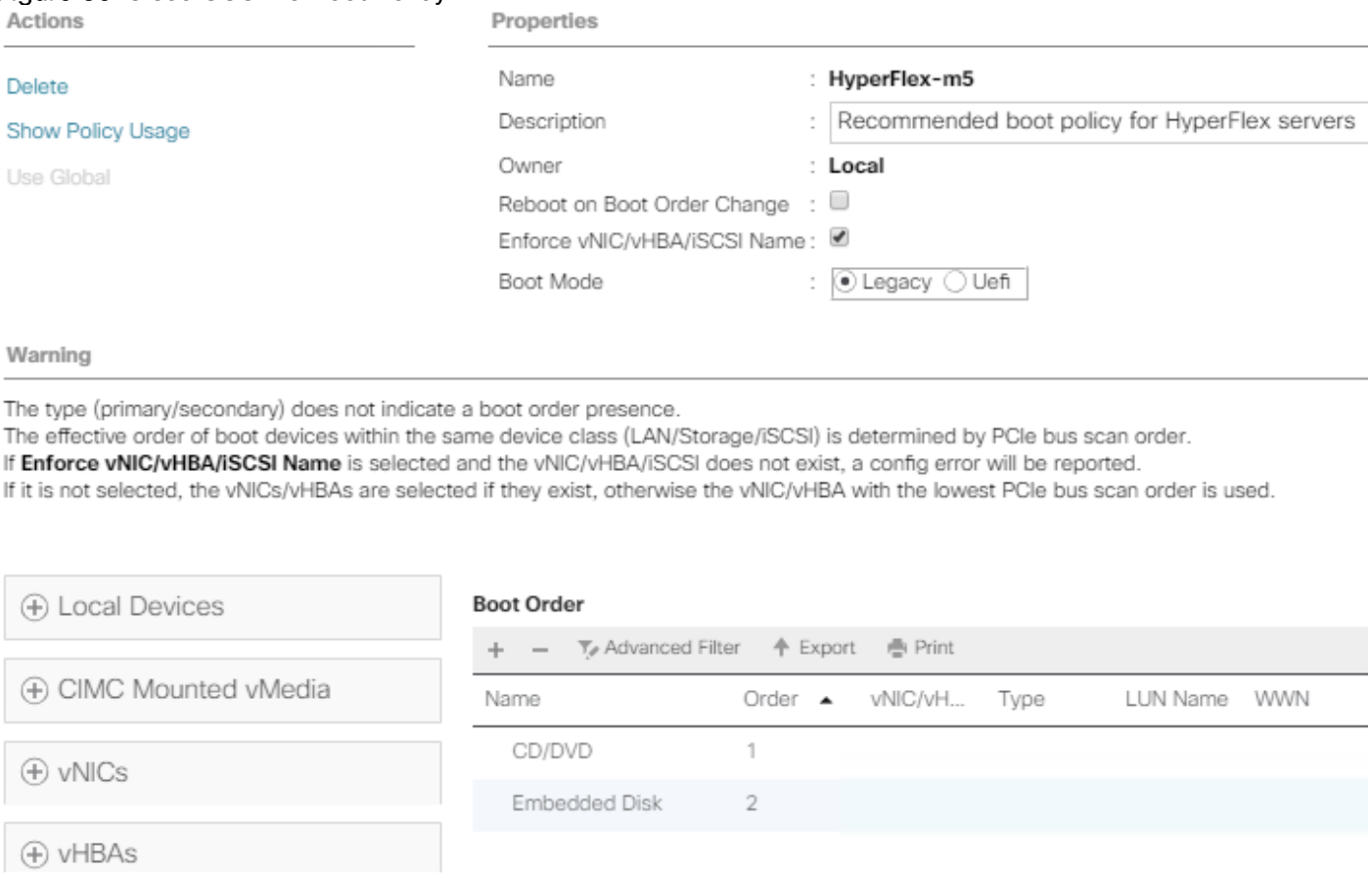
- System altitude is set to “Auto”
- CPU performance is set to “HPC”
- Processor C1E state is set to “Disabled”
- Power Technology is set to “Performance”
- Energy Performance is set to “Performance”
- Serial Port A is enabled
- Console Redirection is set to Serial Port A

Boot Policies

Cisco UCS Boot Policies define the boot devices used by rack-mount servers, and the order that they are attempted to boot from. Cisco HX-Series M5 generation rack-mount servers have their Hyper-V hypervisors installed to an internal M.2 SSD boot drive, therefore they require a unique boot policy defining that the servers should boot from that location. The HyperFlex installer configures a boot policy named “HyperFlex-m5” specifying boot from the M.2 SSDs, referred to as “Embedded Disk” which is used by the HyperFlex M5 converged nodes, and should not be modified.

Figure 35 details the HyperFlex Boot Policies for Cisco HX-Series M5 generation rack-mount servers.

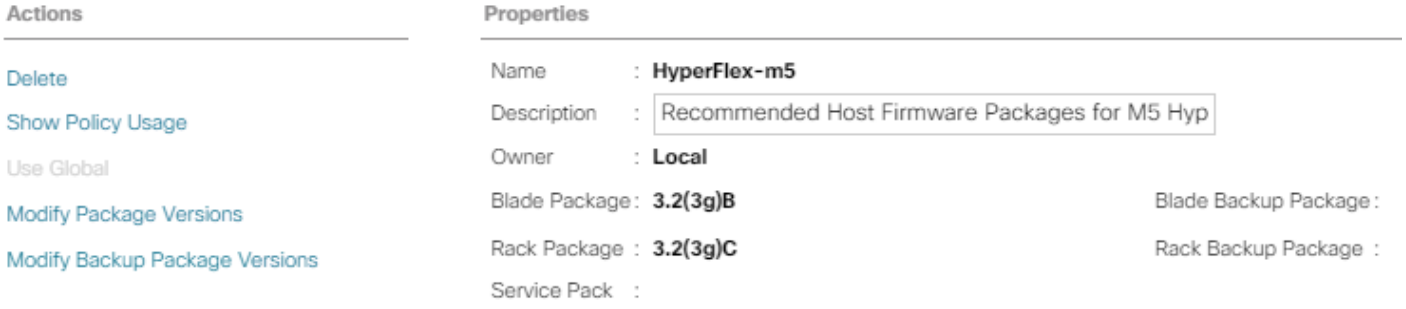
Figure 35 Cisco UCS M5 Boot Policy



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 Packages named “HyperFlex-m5” which use 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. Figure 36 shows the Host Firmware Package configured by the HyperFlex installer for Cisco HX-Series M5 generation rack-mount servers.

Figure 36 Cisco UCS M5 Host Firmware Package

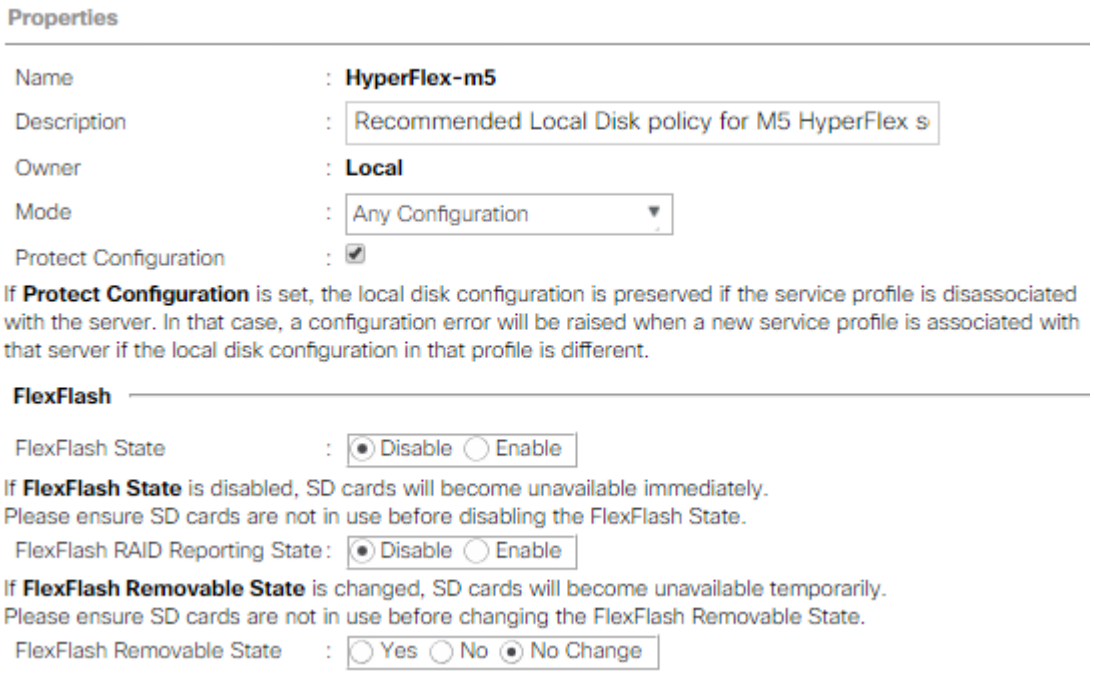


Local Disk Configuration Policies

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 a Local Disk Configuration Policies, named "HyperFlex-m5" which allows any local disk configuration. The policy named "HyperFlex-m5" is used by the service profile template named "hx-nodes-m5", which is for the HyperFlex M5 generation converged servers, and should not be modified.

Figure 37 details the Local Disk Configuration Policies configured by the HyperFlex installer.

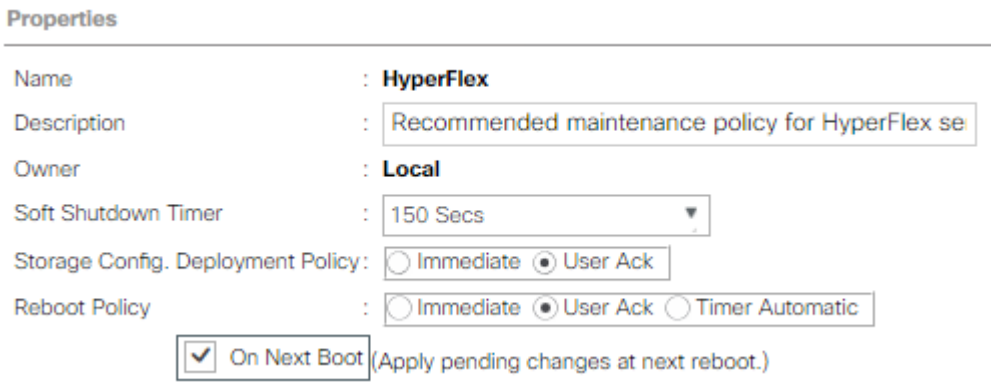
Figure 37 Cisco UCS M5 Local Disk Configuration Policy



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. Figure 38 details the Maintenance Policy configured by the HyperFlex installer:

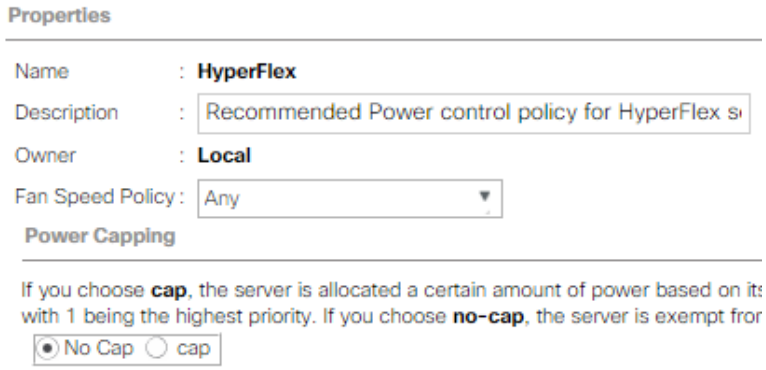
Figure 38 Cisco UCS Maintenance Policy



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. Figure 39 details the Power Control Policy configured by the HyperFlex installer.

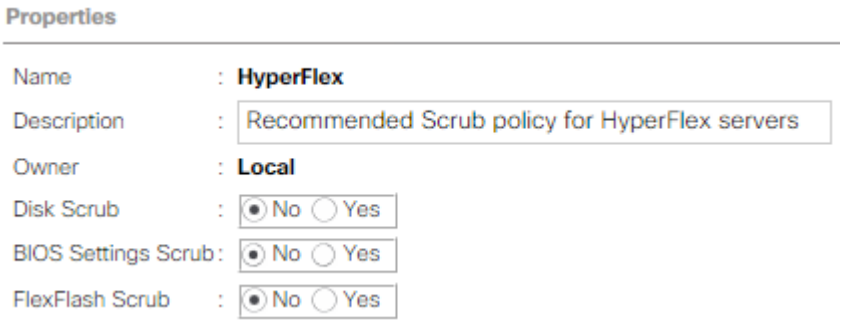
Figure 39 Cisco UCS Power Control Policy



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. Figure 40 details the Scrub Policy configured by the HyperFlex installer.

Figure 40 Cisco UCS Scrub Policy



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 a service profile templates, named “hx-nodes-m5”. The following tables list the service profile template configured by the HyperFlex installer.

Table 19 Cisco UCS Service Profile Template Settings and Values

Service Profile Template Name:	hx-nodes-m5
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-m5
LAN Connectivity Policy	HyperFlex
Boot Policy	HyperFlex-m5
BIOS Policy	HyperFlex-m5
Firmware Policy	HyperFlex-m5
Power Control Policy	HyperFlex
Scrub Policy	HyperFlex
Serial over LAN Policy	HyperFlex

Service Profile Template Name:	hx-nodes-m5
Setting	Value
vMedia Policy	Not defined

Virtual Networking Design

The Cisco HyperFlex system has a pre-defined virtual network design at the Hyper-V 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 UCS service profile. The vSwitches created are:

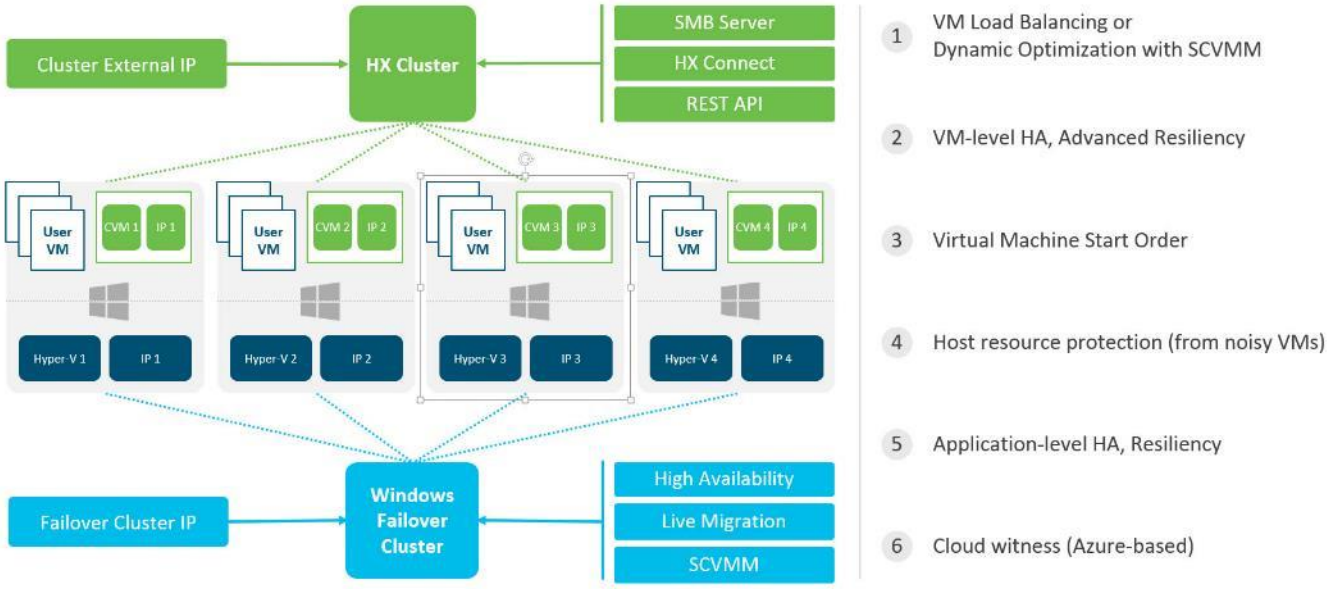
- **vswitch-hx-inband-mgmt**: This is the default vSwitch0 which is renamed by the Hyper-V kickstart file as part of the automated installation. The default vmkernel port, vmk0, is configured in the standard Management Network port group. The switch has two uplinks, active on fabric A and standby on 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. The VLAN is not a Native VLAN as assigned to the vNIC template, and therefore assigned in Hyper-V/Hyper-V
- **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 required. 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 template, and therefore assigned in Hyper-V/Hyper-V
- **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 VLAN is not a Native VLAN as assigned to the vNIC template, and therefore assigned in Hyper-V/Hyper-V
- **live-migration**: 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 required. The VLAN is not a Native VLAN as assigned to the vNIC template, and therefore assigned in Hyper-V/Hyper-V

The following tables and figures help give more details into the Hyper-V virtual networking design as built by the HyperFlex installer:

Table 20 Table Hyper-V Host Virtual Switch Configuration

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
vswitch-hx-storage-data	Storage Controller Data Network Storage Hypervisor Data Network	vmnic3	vmnic2	hx-storage-data	yes
vswitch-hx-vm-network	none	vmnic4,vmnic5	none	vm-network	no
Live-migration	none	vmnic6	vmnic7	33	yes

Figure 41 SCVMM Network Design



Storage Platform Controller Virtual Machines

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 Hyper-V agent, which is similar in concept to that of a Linux or Windows service. Hyper-V agents are tied to a specific host, they start and stop along with the Hyper-V hypervisor, and the system is not considered to be online and ready until both the hypervisor and the agents have started. Each Hyper-V hypervisor host has a single Hyper-V agent deployed, which is the controller VM for that node, and it cannot be moved or migrated to another host. The collective Hyper-V agents are managed via a Hyper-V agency in the Hyper-V 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 Hyper-V agents to the agency, therefore the Hyper-V hypervisors nor SCVMM 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 a plugin installed to the SCVMM server or appliance managing the Hyper-V cluster. The plugin communicates directly with the controller VMs to display the information requested.

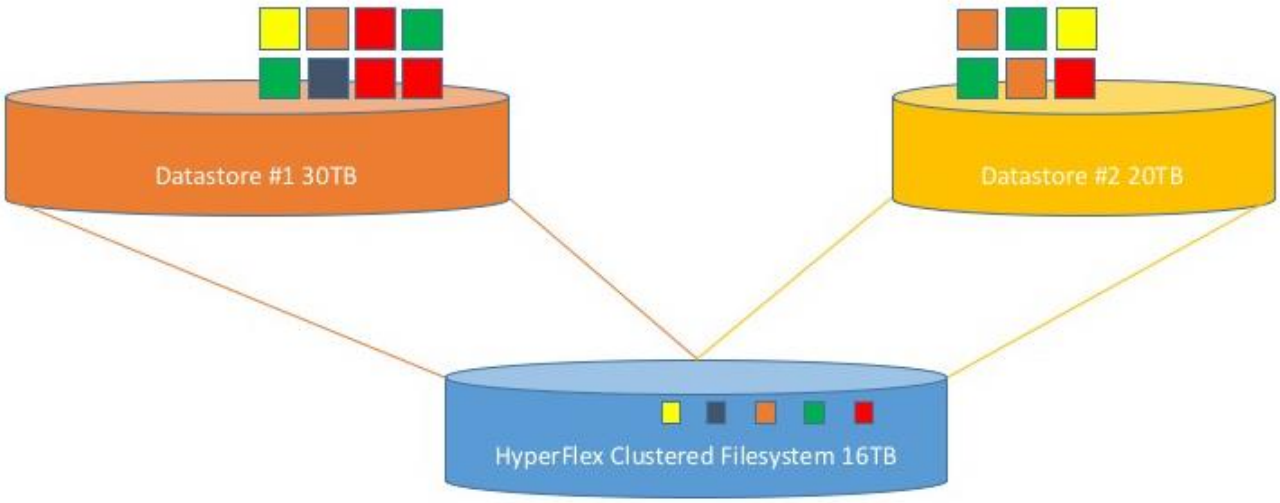
Controller VM Locations

The physical storage location of the controller VM is similar between the Cisco HXAF220c-M5S and HXAF240c-M5SX model servers. The storage controller VM is operationally no different from any other typical virtual machines in a Hyper-V 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 SR-IOV. The configuration details of the models are described in the following subsections.

Cisco HyperFlex Datastores

The new HyperFlex cluster has no default datastores configured for virtual machine storage, therefore the datastores must be created using the HyperFlex Connect GUI. Overall space consumption in the HyperFlex clustered filesystem is optimized by the default deduplication and compression features.

Figure 42 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 Hyper-V hypervisor host are being heavily consumed by the guest VMs. Table 21 details the CPU resource reservation of the storage controller VMs.

Table 21 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 Hyper-V hypervisor host are being heavily consumed by the guest VMs.

Table 22 lists the memory resource reservation of the storage controller VMs.

Table 22 Controller VM Memory Reservations

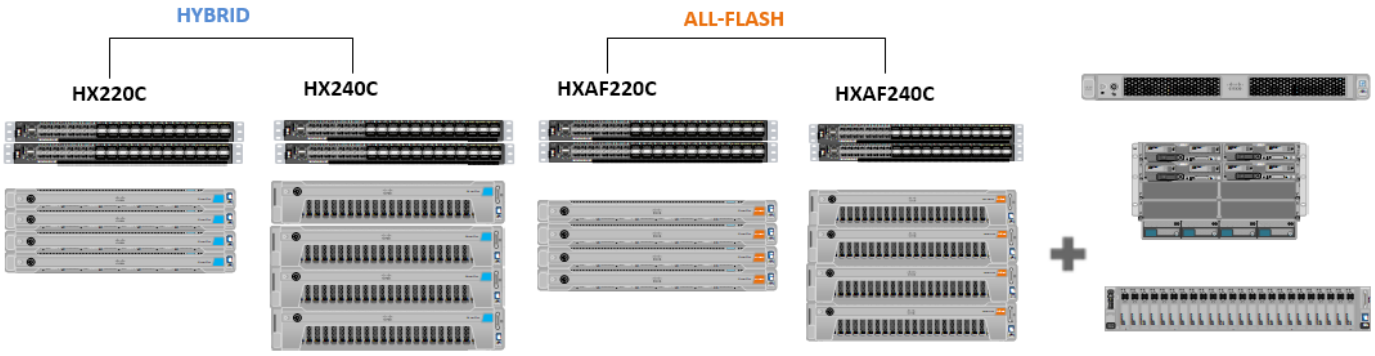
Server Model	Amount of Guest Memory	Reserve All Guest Memory
HX220c-M5 HXAF220c-M5	48 GB	Yes
HX240c-M5SX HXAF240c-M5SX	72 GB	Yes

The Cisco UCS compute-only nodes have a lightweight storage controller VM; it is configured with only 1 vCPU and 512 MB of memory reservation.

Solution Configuration

This section details the configuration and tuning that was performed on the individual components to produce a complete, validated solution. Figure 43 illustrates the configuration topology for this solution.

Figure 43 Configuration Topology for Scalable Citrix XenDesktop 7.16 Workload with HyperFlex



Cisco UCS Compute Platform

The following subsections detail the physical connectivity configuration of the Citrix XenDesktop environment.

Physical Infrastructure

Solution Cabling

The information in this section is provided as a reference for cabling the physical equipment in this Cisco Validated Design environment. To simplify cabling requirements, the tables include both local and remote device and port locations.

The tables in this section list the details for the prescribed and supported configuration.

This document assumes that out-of-band management ports are plugged into an existing management infrastructure at the deployment site. These interfaces will be used in various configuration steps.

Be sure to follow the cabling directions in this section. Failure to do so will result in necessary changes to the deployment procedures that follow because specific port locations are mentioned.

Figure 44 shows a cabling diagram for a Citrix XenDesktop configuration using the Cisco Nexus 9000 and Cisco UCS Fabric Interconnect.

Table 23 Cisco Nexus 93108YC-Cabling Information

Local Device	Local Port	Connection	Remote Device	Remote Port
Cisco Nexus 93108YC A	Eth1/1	10GbE	Cisco Nexus 93108YC B	Eth1/1
	Eth1/2	10GbE	Cisco Nexus 93108YC B	Eth1/2
	Eth1/3	10GbE	Cisco UCS fabric interconnect A	Eth1/13

Local Device	Local Port	Connection	Remote Device	Remote Port
	Eth1/4	10GbE	Cisco UCS fabric interconnect A	Eth1/14
	Eth1/5	10GbE	Cisco UCS fabric interconnect B	Eth1/13
	Eth1/6	10GbE	Cisco UCS fabric interconnect B	Eth1/14
	Eth1/25	10GbE	Infra-host-01	Port01
	Eth1/26	10GbE	Infra-host-02	Port01
	Eth1/27	10GbE	Launcher-host-01	Port01
	Eth1/28	10GbE	Launcher-host-02	Port01
	Eth1/29	10GbE	Launcher-host-03	Port01
	Eth1/30	10GbE	Launcher-host-04	Port01
	MGMT0	GbE	GbE management switch	Any

For devices requiring GbE connectivity, use the GbE Copper SFP+s (GLC-T=).

Table 24 Cisco Nexus 93108YC-B Cabling Information

Local Device	Local Port	Connection	Remote Device	Remote Port
Cisco Nexus 93108YC B	Eth1/1	10GbE	Cisco Nexus 93108YC A	Eth1/1
	Eth1/2	10GbE	Cisco Nexus 93108YC A	Eth1/2
	Eth1/3	10GbE	Cisco UCS fabric interconnect A	Eth1/15
	Eth1/4	10GbE	Cisco UCS fabric interconnect A	Eth1/16
	Eth1/5	10GbE	Cisco UCS fabric interconnect B	Eth1/15
	Eth1/6	40GbE	Cisco UCS fabric interconnect B	Eth1/16
	Eth1/25	10GbE	Infra-host-01	Port02
	Eth1/26	10GbE	Infra-host-02	Port02
	Eth1/27	10GbE	Launcher-host-01	Port02
	Eth1/28	10GbE	Launcher-host-02	Port02
	Eth1/29	10GbE	Launcher-host-03	Port02
	Eth1/30	10GbE	Launcher-host-04	Port02

Local Device	Local Port	Connection	Remote Device	Remote Port
	MGMT0	GbE	GbE management switch	Any

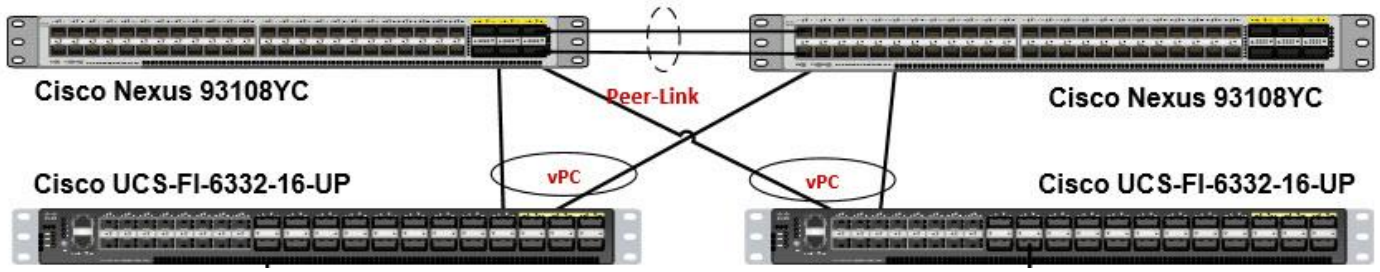
Table 25 Cisco UCS Fabric Interconnect A Cabling Information

Local Device	Local Port	Connection	Remote Device	Remote Port
Cisco UCS fabric interconnect A	Eth1/13	10GbE	Cisco Nexus 93108YC A	Eth1/3
	Eth1/14	10GbE	Cisco Nexus 93108YC A	Eth1/4
	Eth1/15	10GbE	Cisco Nexus 93108YC B	Eth1/5
	Eth1/16	10 GbE	Cisco Nexus 93108YC B	Eth 1/6
	MGMT0	GbE	GbE management switch	Any
	L1	GbE	Cisco UCS fabric interconnect B	L1
	L2	GbE	Cisco UCS fabric interconnect B	L2

Table 26 Cisco UCS Fabric Interconnect B Cabling Information

Local Device	Local Port	Connection	Remote Device	Remote Port
Cisco UCS fabric interconnect B	Eth1/13	10GbE	Cisco Nexus 93108YC B	Eth1/3
	Eth1/14	10GbE	Cisco Nexus 93108YC B	Eth1/4
	Eth1/15	10GbE	Cisco Nexus 93108YC A	Eth1/5
	Eth1/16	10GbE	Cisco Nexus 93108YC A	Eth 1/6
	MGMT0	GbE	GbE management switch	Any
	L1	GbE	Cisco UCS fabric interconnect A	L1
	L2	GbE	Cisco UCS fabric interconnect A	L2

Figure 44 Cable Connectivity Between Cisco Nexus 93108YC A and B to Cisco UCS 6248 Fabric A and B



Cisco Unified Computing System Configuration

This section describes the steps to initialize and configure the Cisco UCS Fabric Interconnects and how 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:  HXHV-FI-A
  Physical Switch Mgmt0 IP address : 10.29.149.203
  Physical Switch Mgmt0 IPv4 netmask : 255.255.255.0
  IPv4 address of the default gateway : 10.29.149.1
  Cluster IPv4 address : 10.29.149.205
  Configure the DNS Server IP address? (yes/no) [n]: yes
    DNS IP address : 10.29.149.222
  Configure the default domain name? (yes/no) [n]: yes
    Default domain name : hxhvdom.local
```

```
  Join centralized management environment (UCS Central)? (yes/no) [n]: no
  Following configurations will be applied:
    Switch Fabric=A
    System Name=HXHV-FI-A
    Enforced Strong Password=no
    Physical Switch Mgmt0 IP Address=10.29.149.203
    Physical Switch Mgmt0 IP Netmask=255.255.255.0
    Default Gateway=10.29.149.1
    Ipv6 value=0
    DNS Server=10.29.149.222
    Domain Name=hx.lab.cisco.com
    Cluster Enabled=yes
    Cluster IP Address=10.29.149.205
    NOTE: Cluster IP will be configured only after both Fabric Interconnects are ini-
tialized
 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 inter-
connect will be added to the cluster. Continue (y/n) ? y
  Enter the admin password of the peer Fabric interconnect:
```

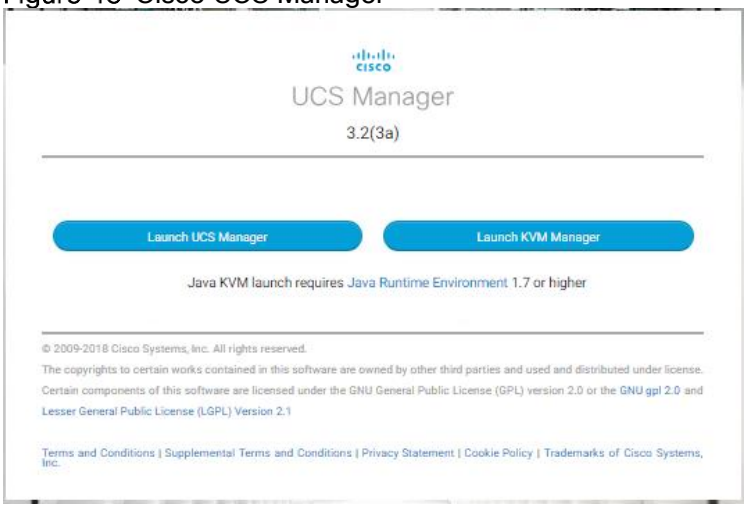
```
    Connecting to peer Fabric interconnect... done
    Retrieving config from peer Fabric interconnect... done
    Peer Fabric interconnect Mgmt0 IPv4 Address: 10.29.149.204
    Peer Fabric interconnect Mgmt0 IPv4 Netmask: 255.255.255.0
    Cluster IPv4 address          : 10.29.149.205
    Peer FI is IPv4 Cluster enabled. Please Provide Local Fabric Interconnect Mgmt0
IPv4 Address
  Physical Switch Mgmt0 IP address : 10.29.149.204
  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 and complete the following steps:

1. Open a web browser and navigate to the Cisco UCS Manager Cluster IP address, for example https://10.29.149.205

Figure 45 Cisco UCS Manager



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 3.2(3a). 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:

https://www.cisco.com/c/en/us/td/docs/unified_computing/ucs/ucs-manager/GUI-User-Guides/Firmware-Mgmt/3-2/b_UCSM_GUI_Firmware_Management_Guide_3_2.html

NTP

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

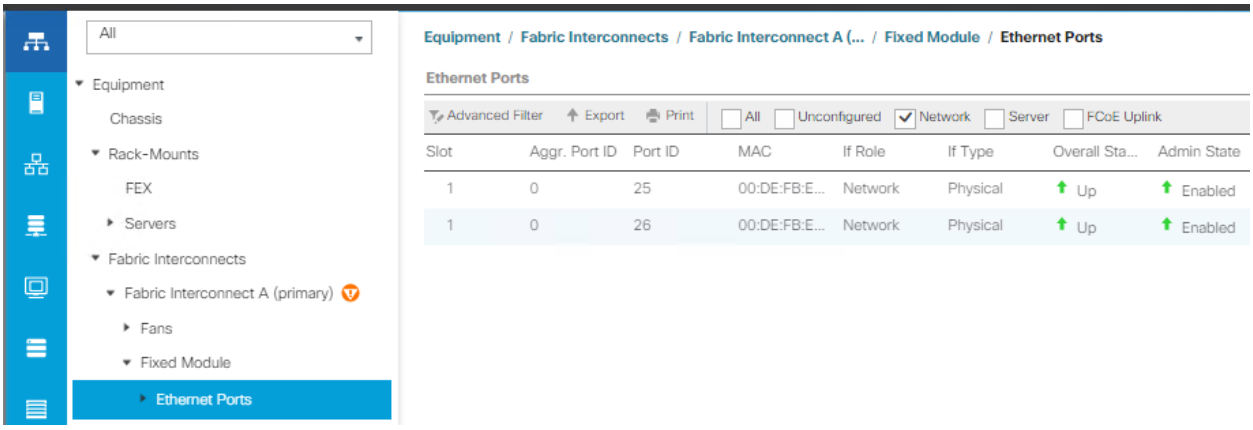
1. In Cisco UCS Manager, click the Admin button on the left-hand side.
2. In the navigation pane, select All > Time Zone Management, and click the carat next to Time Zone Management to expand it.
3. Click Timezone.
4. In the Properties pane, select the appropriate time zone in the Time Zone menu.
5. 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.

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.”

Figure 46 Uplinks Ports

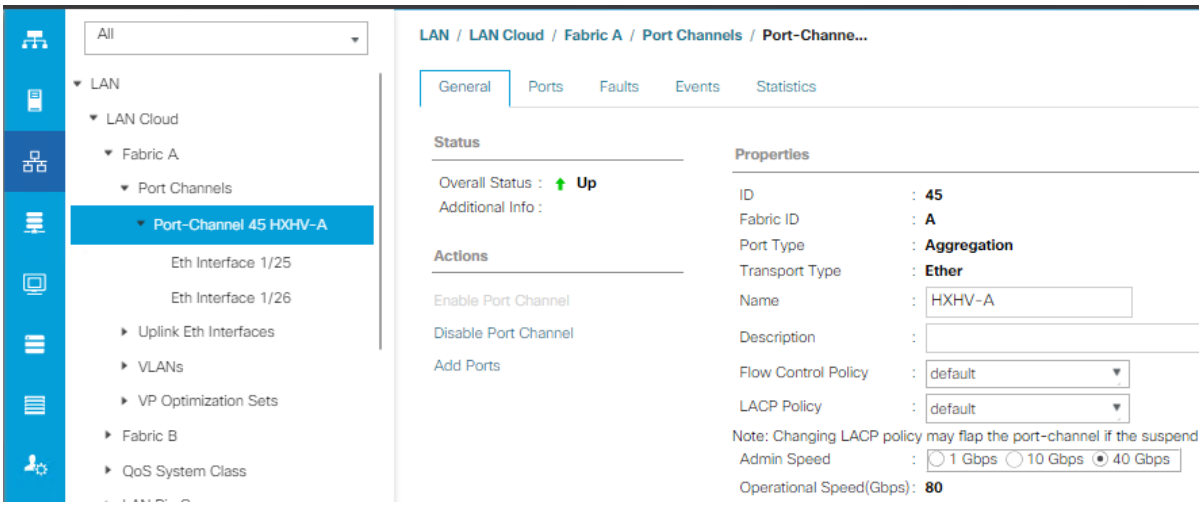


Uplink Port Channels

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.

Figure 47 Uplink Port Channels



Server Ports

The Ethernet ports of a Cisco UCS Fabric Interconnect connected to the rack-mount servers must be defined as server ports. When a server port is activated, the connected server or chassis will begin the discovery process shortly afterwards. Rack-mount servers 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.

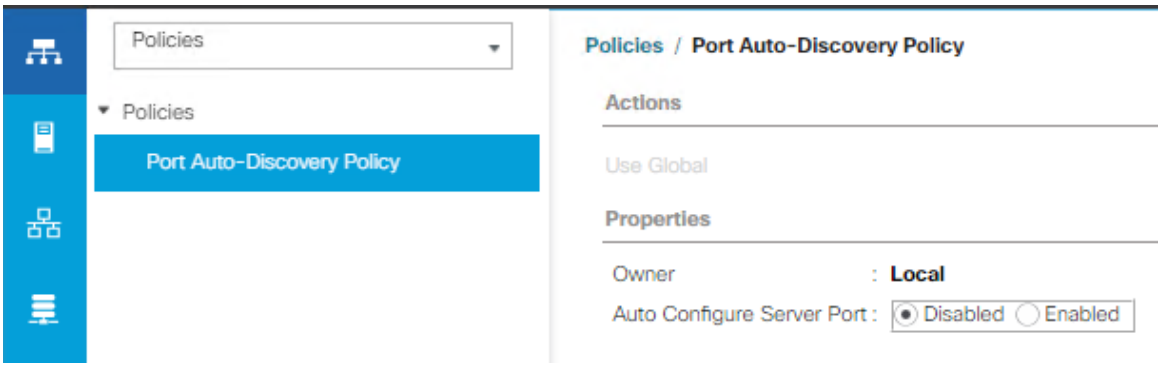
Auto Configuration

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 is connected to them. The firmware on the rack-mount servers 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.

Figure 48 Port Auto-Discovery Policy



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 pair of server ports, until all rack-mount servers and chassis appear in the order desired in the Equipment tab.

Server Discovery

As previously described, when 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.

Deploying HX Data Platform Installer on Hyper-V Infrastructure

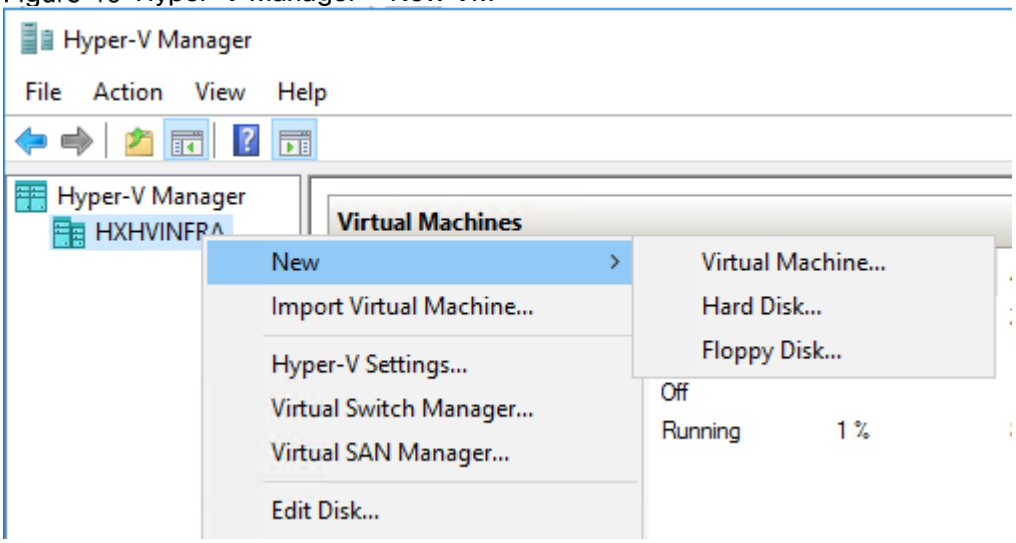
To deploy HX Data Platform Installer using **Microsoft Hyper-V Manager** to create a HX Data Platform Installer virtual machine, complete the following steps:

1. Locate and download the HX Data Platform Installer.vhdx zipped file (for example, Cisco-HX-Data-Platform-Installer-v3.0.1c-29681-hyperv.vhdx) from the Cisco Software Downloads site.
2. Extract the zipped folder to your local computer and copy the `.vhdx` file to the Hyper-V host where you want to host the HX Data Platform Installer. For example,

   ```
   \\hyp-v-host01\....\HX-Installer\ Cisco-HX-Data-Platform-Installer-v3.0.1c-29681-hyperv.vhdx
   ```

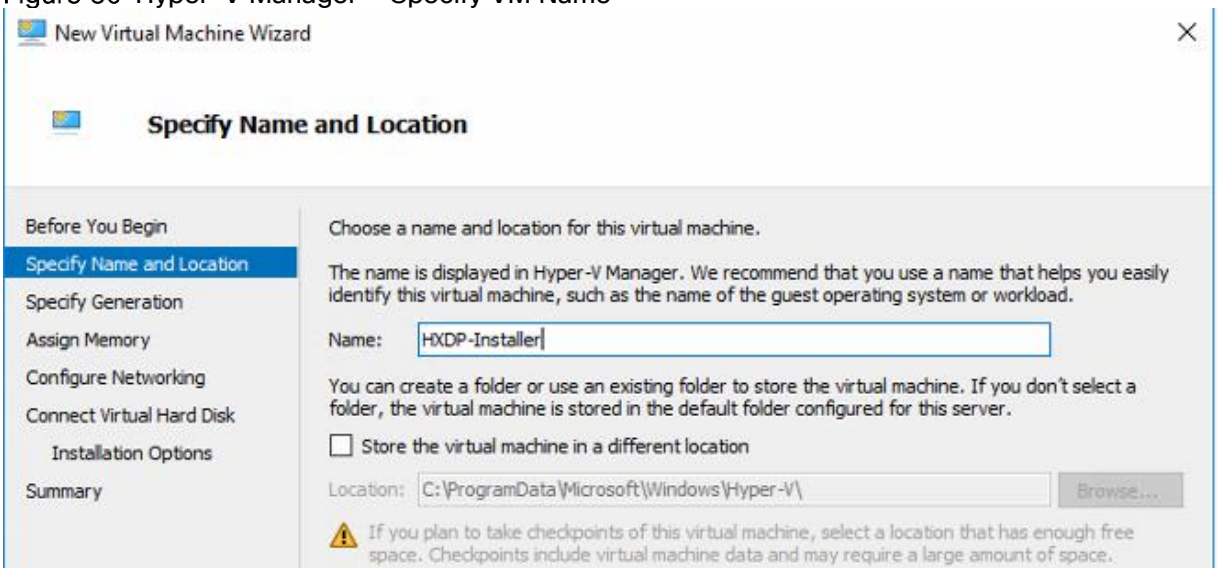
3. In Hyper-V Manager, navigate to one of the Hyper-V servers.
4. Select the Hyper-V server, and right-click and select **New** > **Create a virtual machine**. The Hyper-V Manager New Virtual Machine Wizard displays.

Figure 49 Hyper-V Manager – New VM



5. In the Before you Begin page, click Next.
6. In the **Specify Name and Location** page, enter a name and location for the virtual machine where the virtual machine configuration files will be stored. Click **Next**.

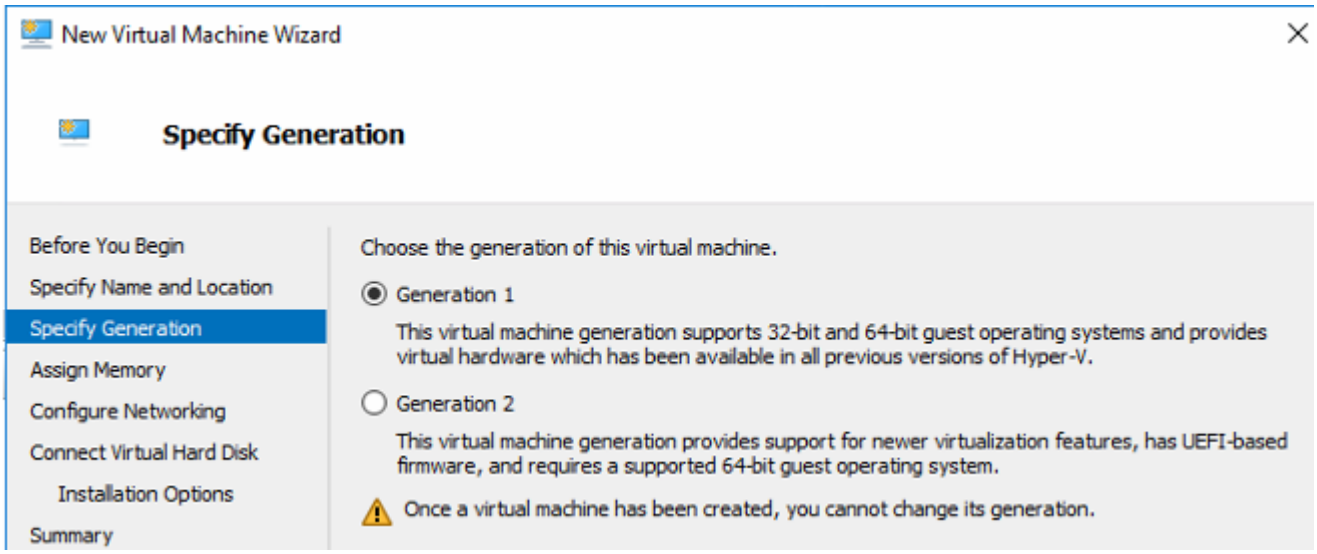
Figure 50 Hyper-V Manager – Specify VM Name



As a best practice, store the VM together with the `.vhdx` file.

7. In the Specify Generation page, select Generation 1. Click Next.

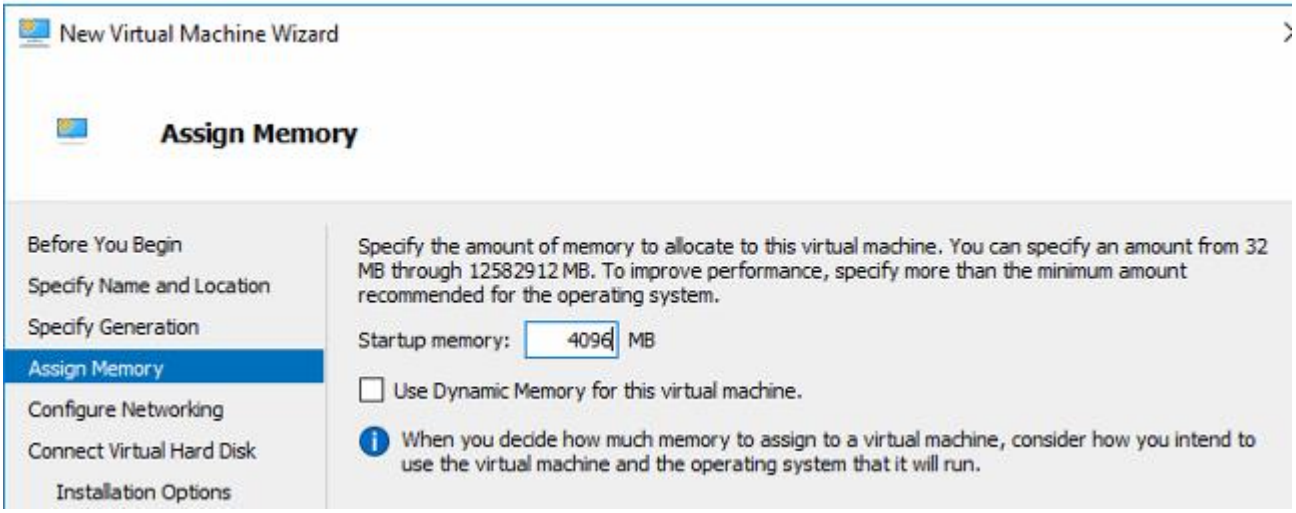
Figure 51 Hyper-V Manger – Specify VM Generation



If you select Generation 2, the VM may not boot.

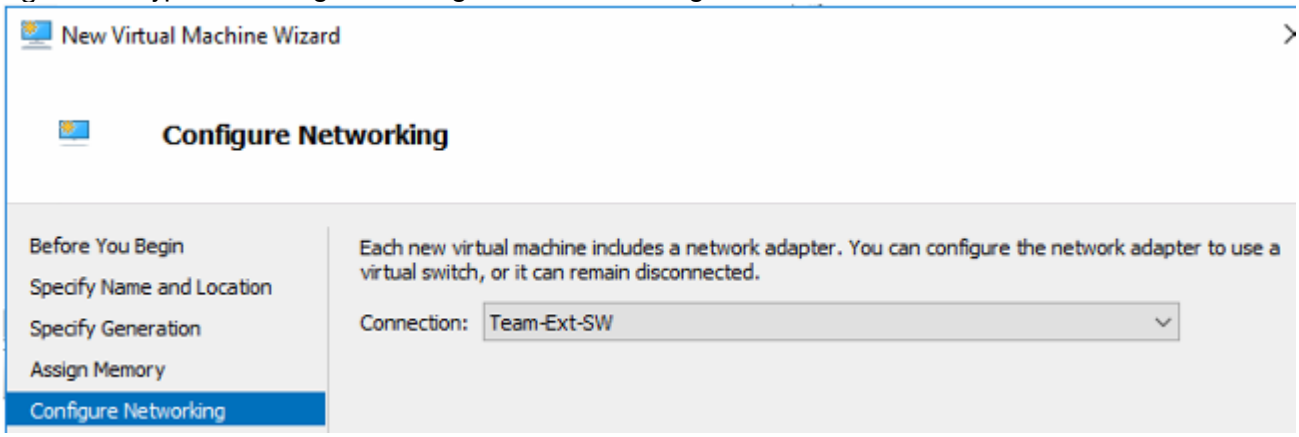
8. In the **Assign Memory** page, set the startup memory value to 4096 MB. Click **Next**.

Figure 52 Hyper-V Manager – Assign VM Memory



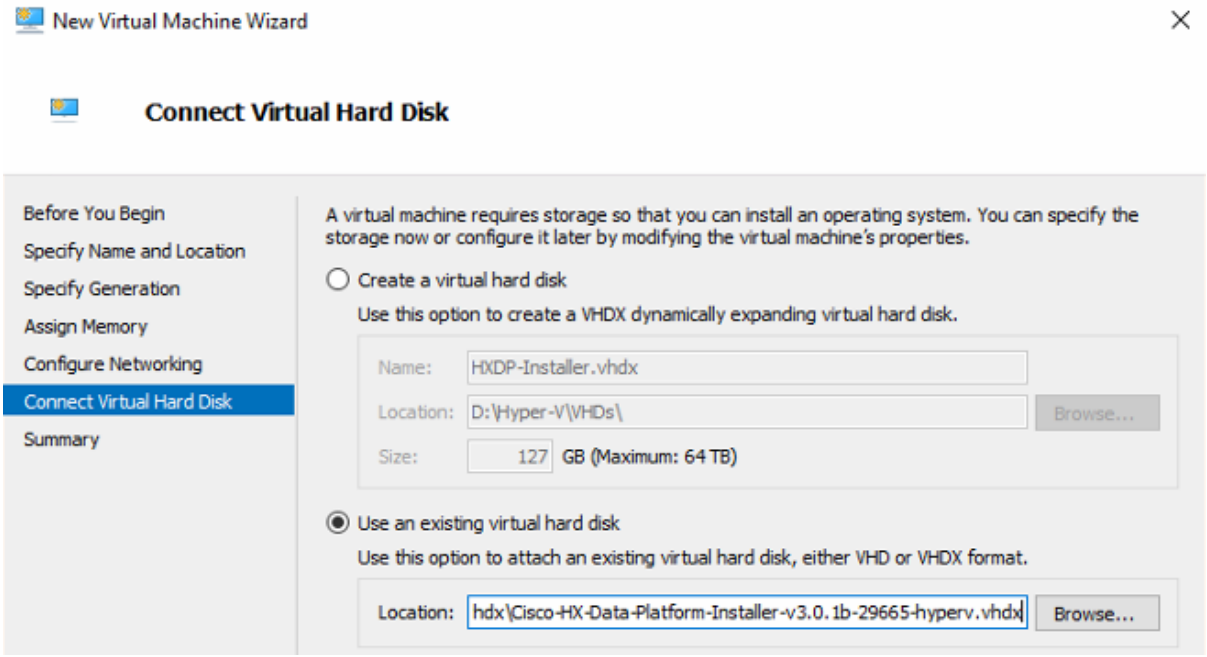
9. In the **Configure Networking** page, select a network connection for the virtual machine to use from a list of existing virtual switches. Click **Next**.

Figure 53 Hyper-V Manager – Configure VM Networking



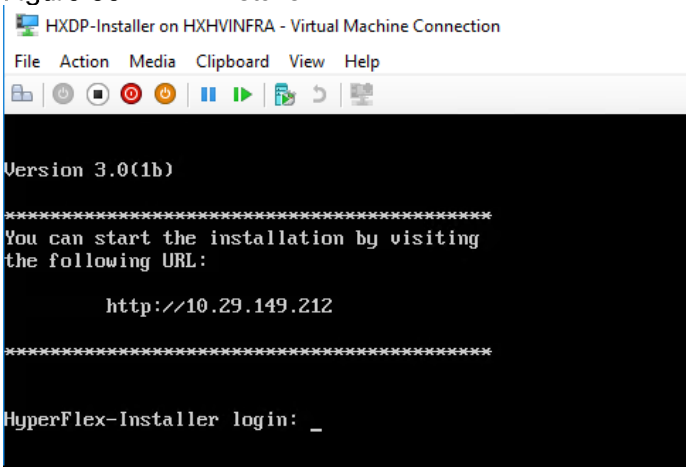
10. In the **Connect Virtual Hard Disk** page, select **Use an existing virtual hard disk**, and browse to the folder on your Hyper-V host that contains the `.vhdx` file. Click **Next**.

Figure 54 Hyper-V Manager - Connect Virtual Hard Disk



11. In the **Summary** page, verify that the list of options displayed are correct. Click **Finish**.
12. After the VM is created, power it ON, and launch the GUI.
13. Right-click the VM and choose Connect.
14. Choose Action > Start (Ctrl+S).
15. When the VM is booted, make a note of the URL (IP address of the VM). You will need this information in the following steps in the installation.

Figure 55 HXDP Installer



Assign a Static IP Address to the HX Data Platform Installer VM

During a default installation of the VM, the HX Installer will try and automatically obtain an IP address using DHCP. To make sure that you have the same IP address at every boot, you can assign a static IP address on the VM.

To configure your network interface (/etc/network/interfaces) with a static IP address. Make sure you change the relevant settings to suit your network and complete the following steps:

1. Log in to your Installer machine via the Hyper-V Console.
2. Open the /etc/network/interfaces file and add the following lines to the file:

```
auto eth0 # eth0 interface

iface eth0 inet static # configures static IP for the eth0 interface

address XX.XX.XX.XX # Static IP address for the installer VM

netmask 255.255.0.0 # netmask for the Static IP address

gateway XX.XX.X.X # gateway for the Static IP address

metric 100

dns-nameservers XX.XX.X.XXX #DNS name servers used by the HX installer

dns-search <DNS_Search_Name>.local # DNS search domain name used by the installer
```

3. Save the file.
4. Reboot the VM for changes to take effect.
5. Verify the settings as shown in the following figures.

Figure 56 Show Interfaces

```
root@HyperFlex-Installer:~# ifconfig
eth0      Link encap:Ethernet  HWaddr 00:15:5d:fc:33:0e
          inet addr:10.104.252.48  Bcast:10.104.252.255  Mask:255.255.255.0
          inet6 addr: fe80::215:5dff:fefc:330e/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:9880615 errors:0 dropped:3 overruns:0 frame:0
          TX packets:1102137 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:915866025 (915.8 MB)  TX bytes:12398400970 (12.3 GB)
```

Figure 57 Routing Table

```
root@HyperFlex-Installer:~# route -n
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
0.0.0.0         10.104.252.1    0.0.0.0         UG    0      0        0 eth0
10.104.252.0    0.0.0.0         255.255.255.0   U     0      0        0 eth0
239.255.255.253 0.0.0.0         255.255.255.255 UH    0      0        0 eth0
```

Figure 58 /etc/resolv.conf file for Nameserver and Search Domain

```
root@HyperFlex-Installer:~# cat /etc/resolv.conf
# Dynamic resolv.conf(5) file for glibc resolver(3) generated by resolvconf(8)
#     DO NOT EDIT THIS FILE BY HAND -- YOUR CHANGES WILL BE OVERWRITTEN
nameserver 10.29.149.222
search HXHVDOM.LOCAL
```

HyperFlex Installation

The HyperFlex installer will guide you through the process of setting up your cluster. The Windows OS is not factory installed and requires the customer to provide a media for the installation. The HyperFlex installation for Microsoft Hyper-V is completed in two phases using the customized version of the HX installation workflow:

- In the phase one, only ‘Run UCS Configuration” workflow is executed to prepare and install Windows OS, and
- In phase two, the remaining three workflows (Hypervisor Configuration, HX Deploy Software and Create HX Cluster) are executed to complete the deployment of HX Cluster.

HyperFlex Installation – Phase 1

This phase of the HyperFlex installation will guide you through the process of configuring Cisco UCS Manager using HyperFlex installer and installation of Windows OS on the HX nodes. The following high-level steps are covered in this phase of the installation:

- Configure Cisco UCS Manager using HX Installer
- Configure Cisco UCS vMedia and Boot Policies
- Install Microsoft Windows Server 2016 OS
- Undo vMedia and Boot Policy Changes

Configure Cisco UCS Manager using HX Installer

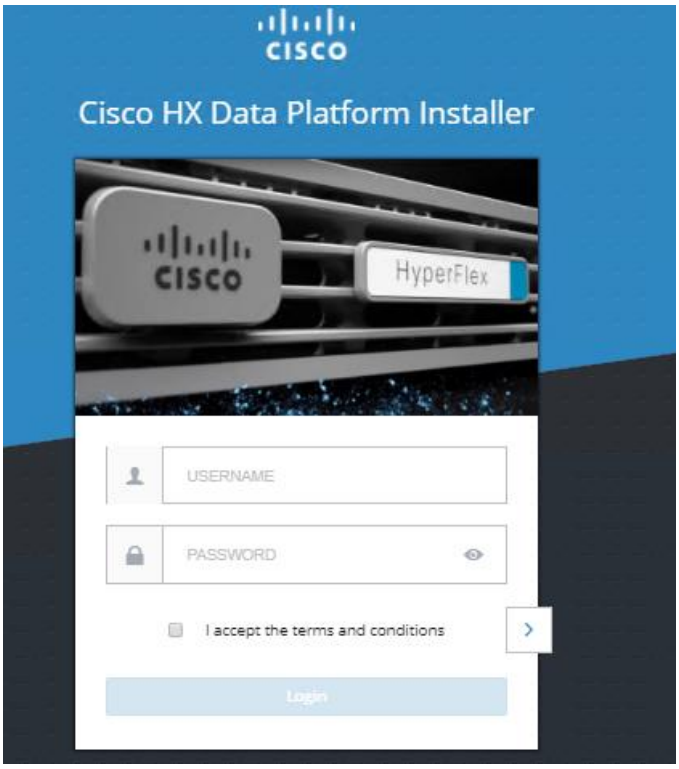
To configure Cisco UCS Manager using HX Installer, complete the following steps:

1. Launch HX Data Platform Installer - In a browser, enter the URL for the VM where HX Data Platform Installer was installed.
2. Use the credentials: username: root, password: Cisco123

IMPORTANT! Systems ship with a default password of `Cisco123` that must be changed during installation; you cannot continue installation unless you specify a new user supplied password.

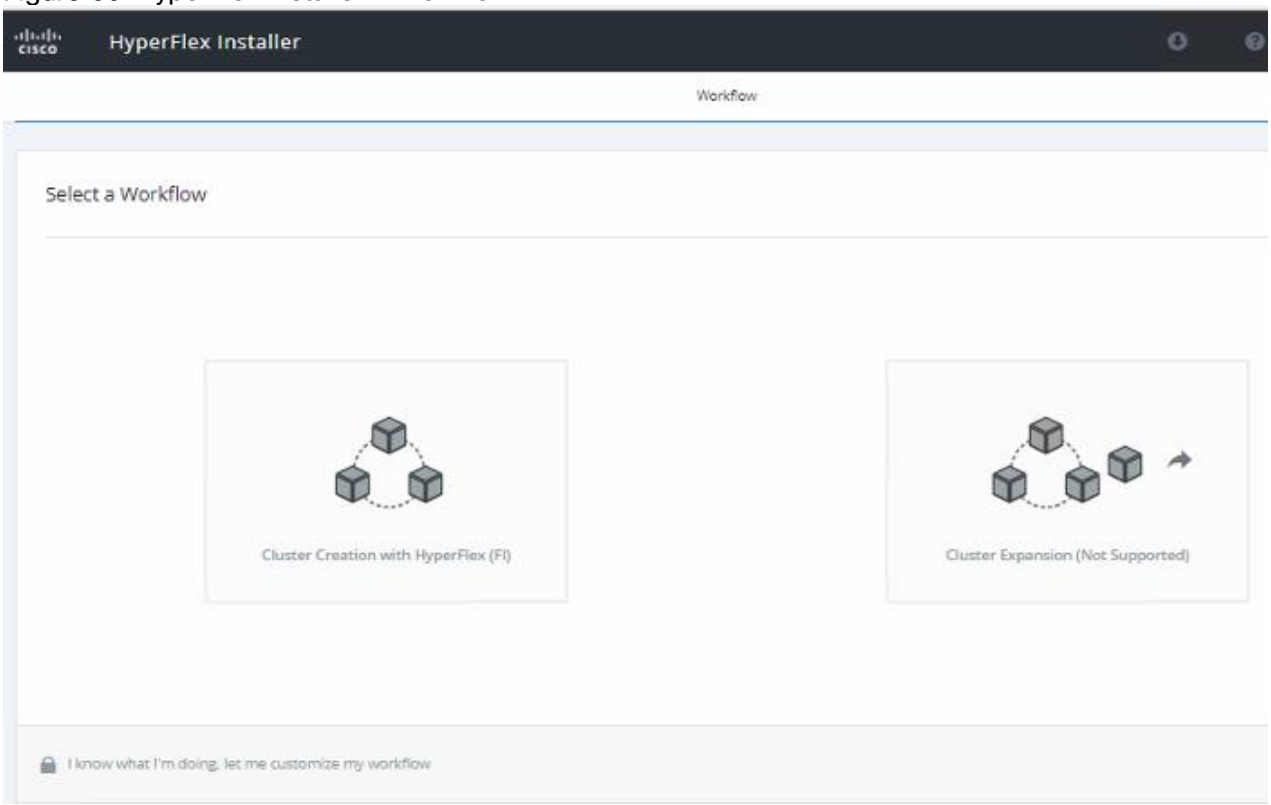
3. Read the EULA. Click I accept the terms and conditions.
4. Verify the product version listed in the lower right corner is correct. This version must be 3.0(1c) or later. Enter the credentials and Click Login.

Figure 59 Cisco HX Data Platform Installer Login Page



5. From the HX Data Platform Installer Workflow page, select I know what I'm doing, let me customize my workflow.

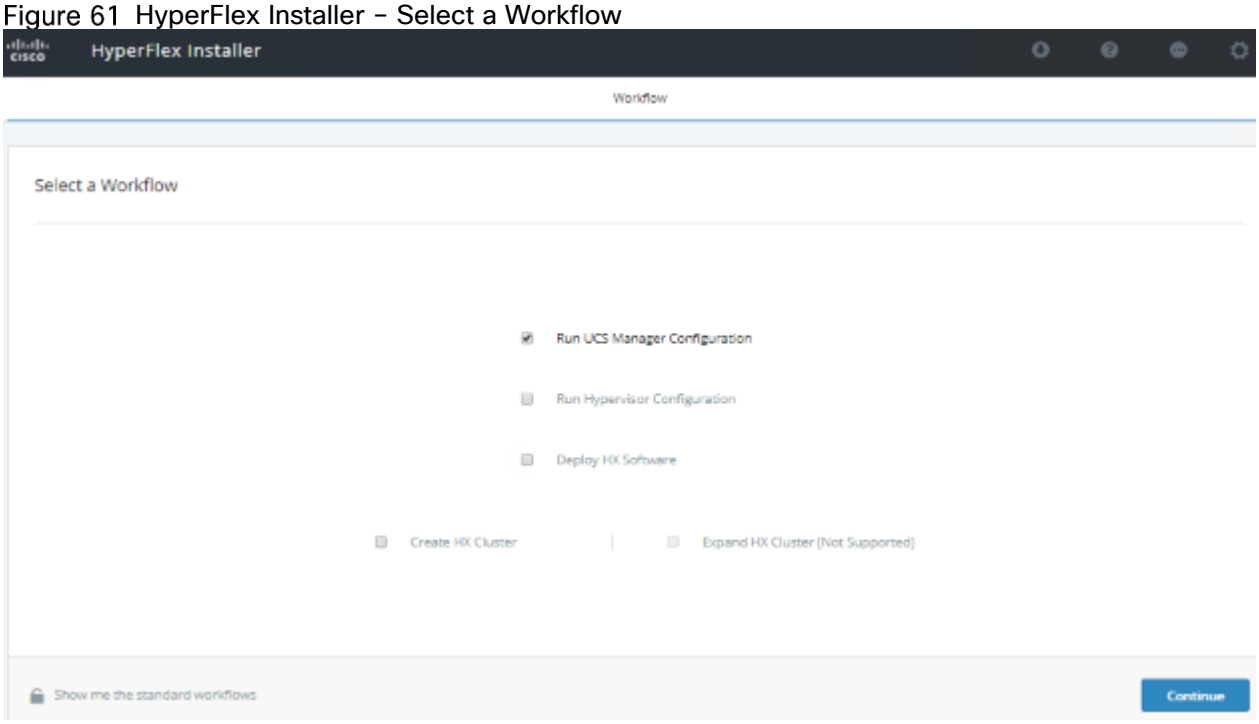
Figure 60 HyperFlex Installer – Workflow



6. On the next screen, click Run UCS Manager Configuration and then click Continue.

Do not choose any other workflow options.

Figure 61 HyperFlex Installer – Select a Workflow



7. Click Confirm in the popup that displays.
8. Enter the UCS Manager credentials.

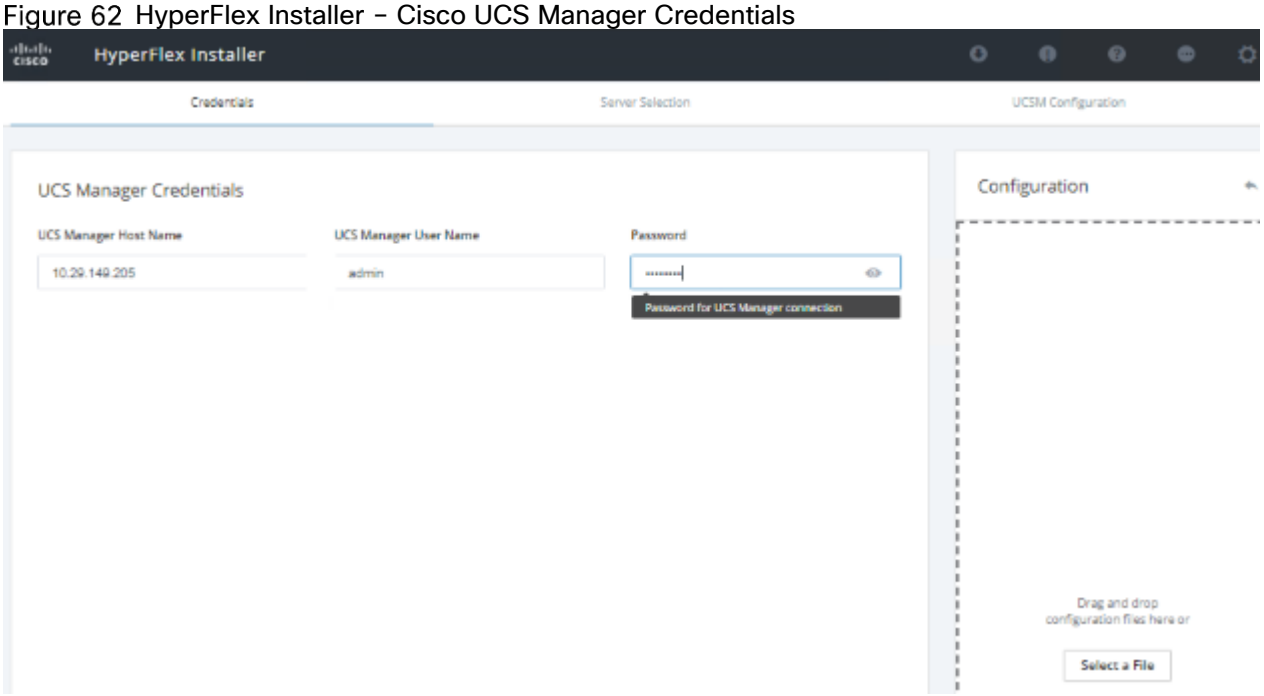
The right side of the page is unused. Further in the setup process a configuration JSON is saved, so in subsequent installations the JSON file can be imported to add the data quickly.

9. Click Confirm and Proceed to bypass the warning. Complete the following fields for Cisco UCS Manager:

Table 27 Cisco UCS Manager Details

Field	Description
Cisco UCS Manager Host Name	FQDN or the VIP address of Cisco UCS Manager
Cisco UCS Manager User Name and Password	Administrator user and password or an user with Cisco UCS Manager admin rights

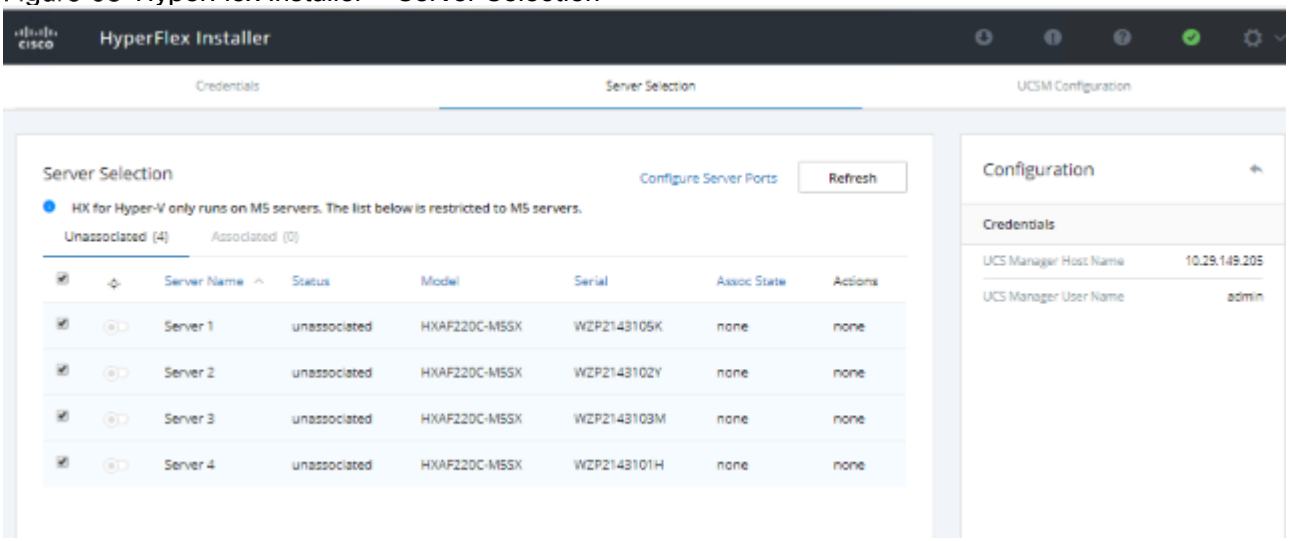
Figure 62 HyperFlex Installer – Cisco UCS Manager Credentials



10. Click Continue.

The installer connects to Cisco UCS Manager and queries for available servers. The configuration pane is populated as the installer progresses. You can at any time save the JSON file so you can re-use it for subsequent installations. This feature works on all the different workflows in the installer. After the query finishes a screen displays showing the available servers.

Figure 63 HyperFlex Installer – Server Selection



11. Choose all the servers that you want to install in the cluster and click **Continue**.

HyperFlex for Hyper-V only supports M5 Servers.

12. In the VLAN Configuration section, enter the details as shown in the following screenshot.

13. HyperFlex needs to have at least 4 VLANs to function; each VLAN needs to be on different IP subnets and extended from the fabric interconnects to the connecting uplink switches, to make sure that traffic can flow from Primary Fabric Interconnect (Fabric A) to Subordinate Fabric Interconnect (Fabric B).

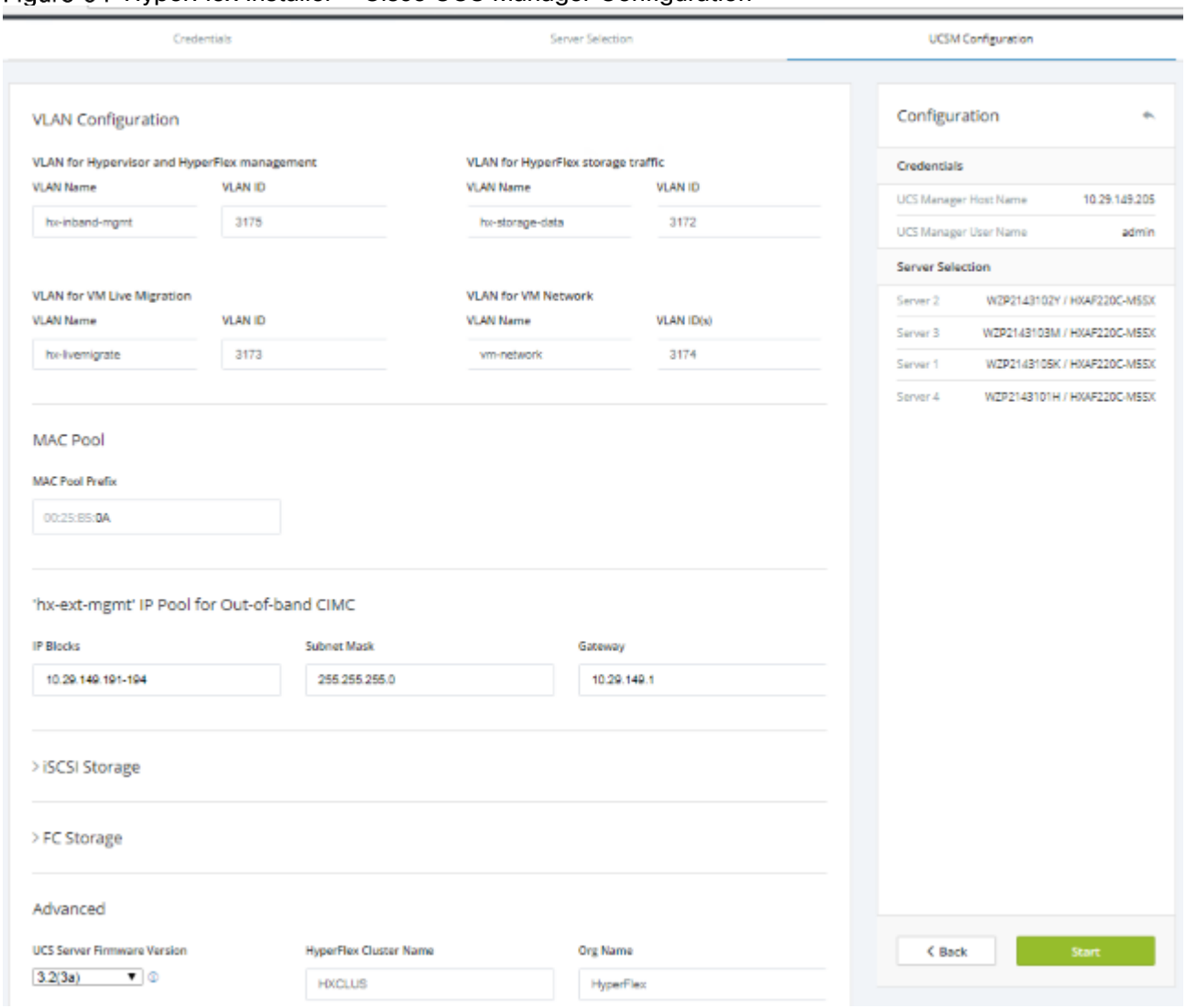
Do not use vlan 1 as it is not best practice and can cause issues with disjoint layer 2.

vm-network can be multiple VLANs added as a comma separated list.

Renaming the 4 core networks is not supported.

Figure 64 shows the various fields in the VLAN Configuration pane where you need to enter values.

Figure 64 HyperFlex Installer – Cisco UCS Manager Configuration



14. In the MAC Pool and 'hx-ext-mgmt' IP Pool for Out-of-band CIMC sections, enter the details as shown below.

The Out-Of-Band network needs to be on the same subnet as the Cisco UCS Manager.

You can add multiple blocks of addresses as a comma separated line.

iSCSI Storage and FC Storage are used for adding external storage to the HyperFlex cluster.

> iSCSI Storage and FC Storage are currently not supported for Cisco HyperFlex with Microsoft Hyper-V.

15. Use the details from the table below to complete the fields in the Advanced section.

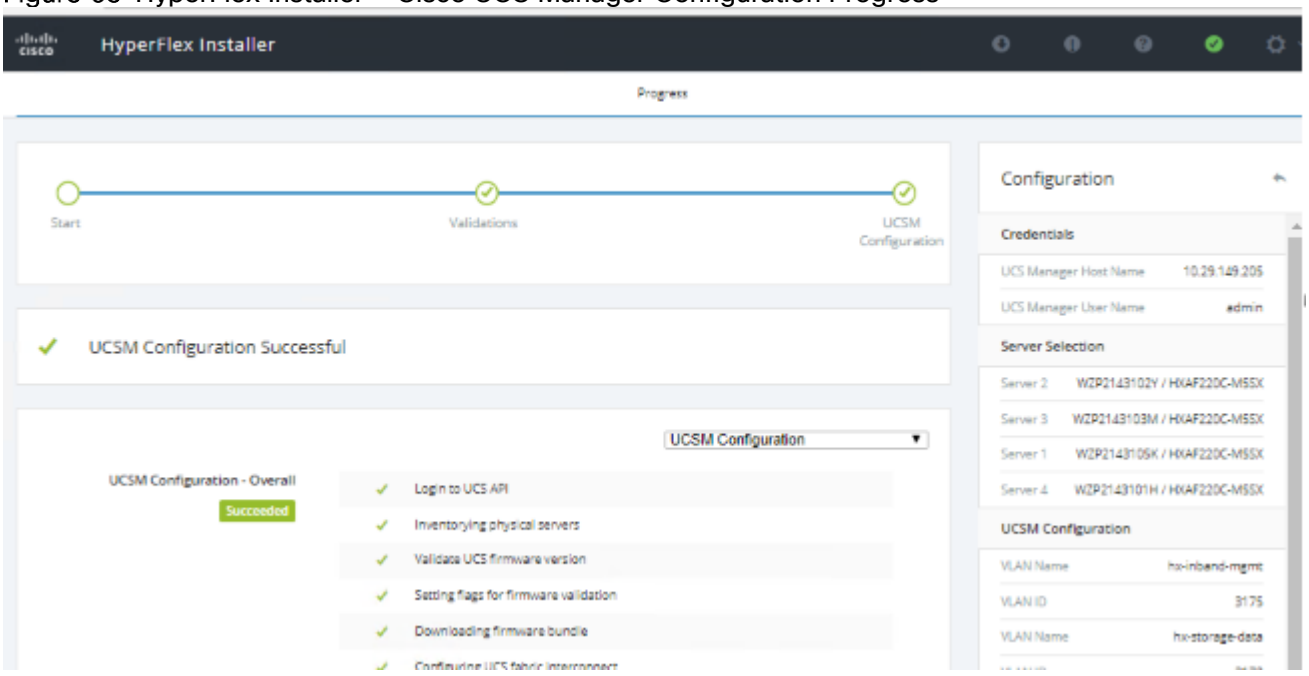
> The Cisco UCS B and C packages must exist on the Fabric interconnect otherwise the installation will fail. If the right version is not available in the drop-down list, then upload it to Cisco UCS Manager before continuing.

> The supported version for HyperFlex Hyper-V is 3.2(3e).

16. Click Start. The installer validates your input and then begins configuring Cisco UCS Manager.

When the HX Data Platform Installer is finished, then you are ready to proceed to next step of installing the Windows OS.

Figure 65 HyperFlex Installer – Cisco UCS Manager Configuration Progress



Configure Cisco UCS vMedia and Boot Policies

By using a Cisco UCS vMedia policy, the Windows Server 2016 media ISO file and Cisco HyperFlex Driver image 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

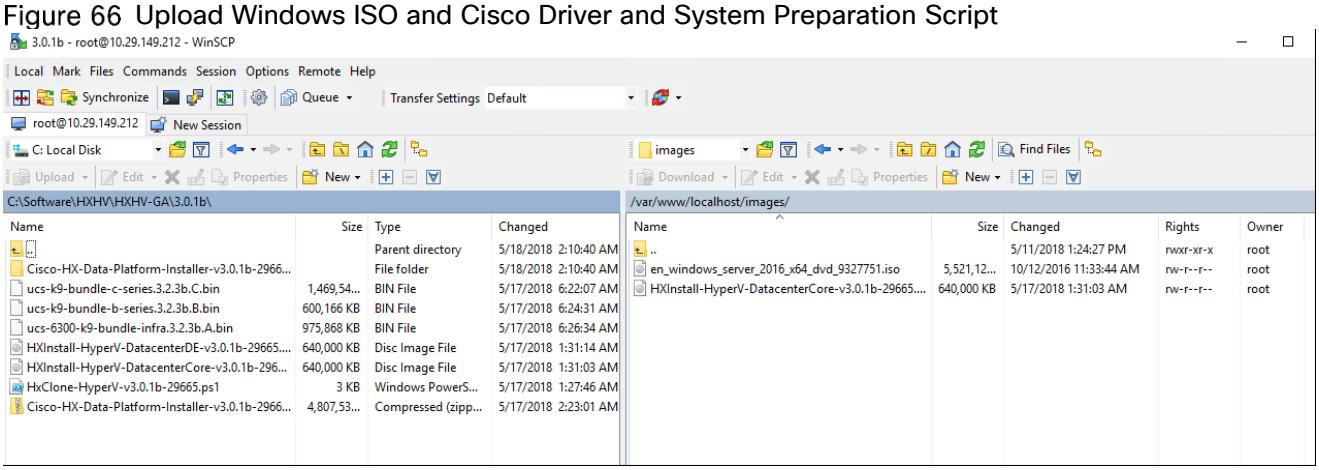
will automatically boot from the remotely mounted vMedia file, installing and configuring Windows Server 2016 on the HX nodes.

WARNING! While vMedia policies are very efficient for installing multiple servers, using vMedia policies as described could lead to an accidental reinstall of Windows 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 Windows 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 ***Windows Server 2016 iso and*** Cisco HyperFlex Driver image files to the HX Installer VM via SCP or SFTP, placing it in the folder /var/www/localhost/images/ as shown below.

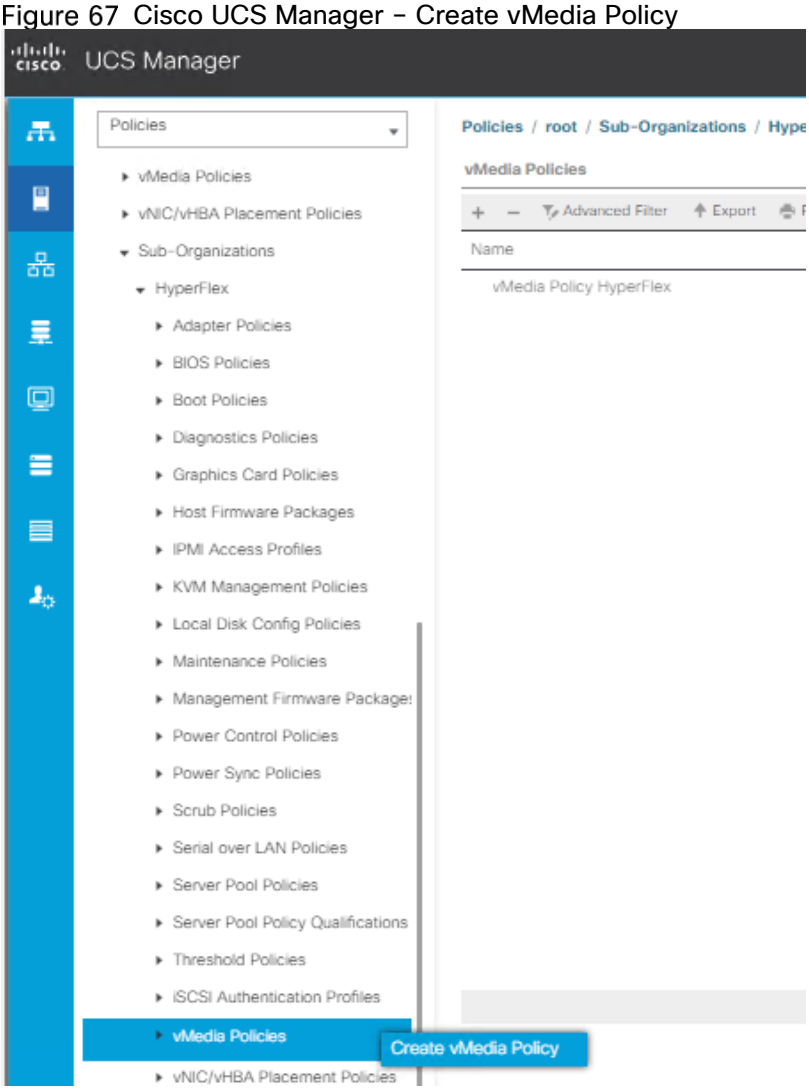
Figure 66 Upload Windows ISO and Cisco Driver and System Preparation Script



Make sure network connectivity exists between the file share and all server management IPs.

2. Configure the vMedia and Boot policies using Cisco UCS Manager to mount the above images
3. Launch Cisco UCS Manager by accessing the Cisco UCS Manager IP address in a browser of your choice.
4. Click Launch UCS Manager and log in with administrator username and the password you used at the beginning of the installation.
5. In the left navigation pane, click Servers.
6. Expand Servers > Policies > root > Sub-Organizations > hx-cluster_name>vMedia Policies to view the list of vMedia Policies.

Figure 67 Cisco UCS Manager – Create vMedia Policy



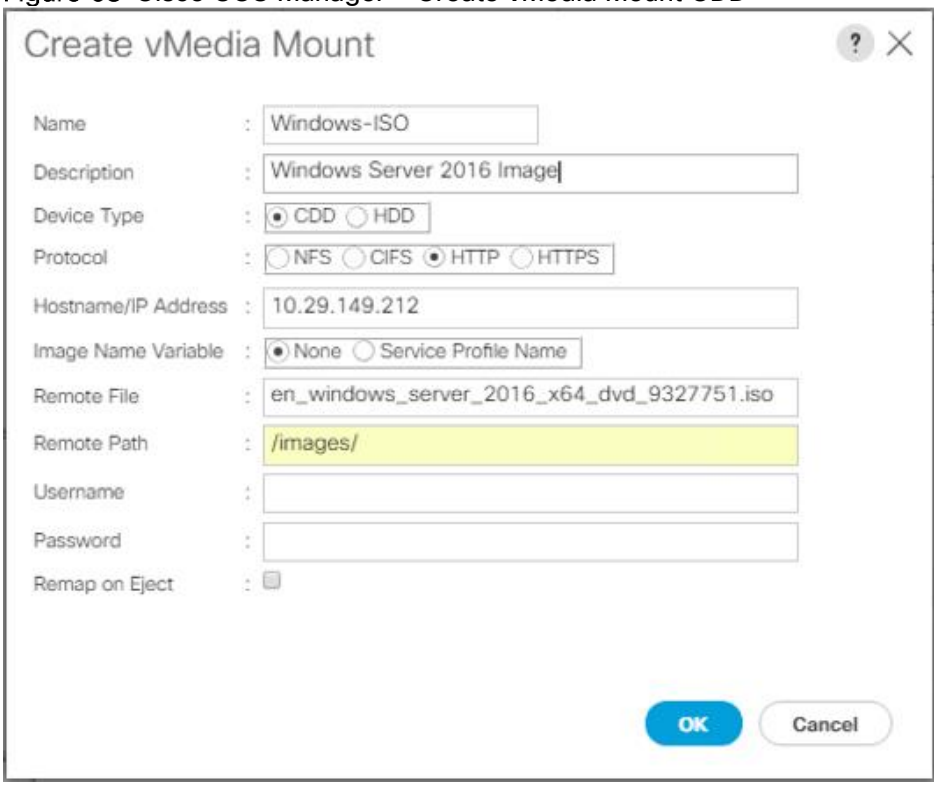
7. Double-click vMedia Policy HyperFlex.
8. In the properties for vMedia Policy HyperFlex, click Create vMedia Mount to add the mount points.
9. In the Create vMedia Mount dialog box, complete the following fields:

Table 28 Create vMedia Mount Details

Field Name	Action	Example Value
Name	Name for the mount point.	Windows -ISO
Description	Can be used for more information.	
Device Type	Type of image that you want to mount	CDD
Protocol	The protocol used for accessing the share where the ISO files are located.	HTTP
Hostname/IP Address	IP address or FQDN of the server hosting the images.	10.29.149.212

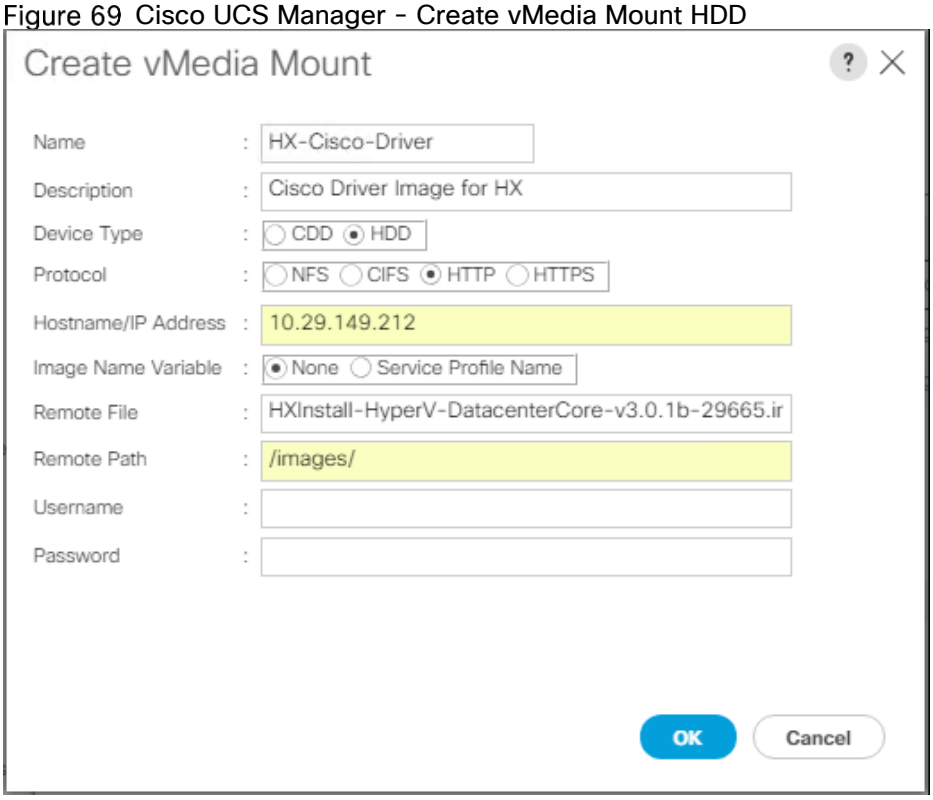
Field Name	Action	Example Value
Image Name Variable	This value is not used in HyperFlex installation.	None
Remote File	The filename of the ISO file that you want to mount.	
Remote Path	The path on the remote server to where the file resides	
Username	If you use CIFS or NFS a username might be necessary	
Password	If you use CIFS or NFS a password might be necessary	

Figure 68 Cisco UCS Manager – Create vMedia Mount CDD



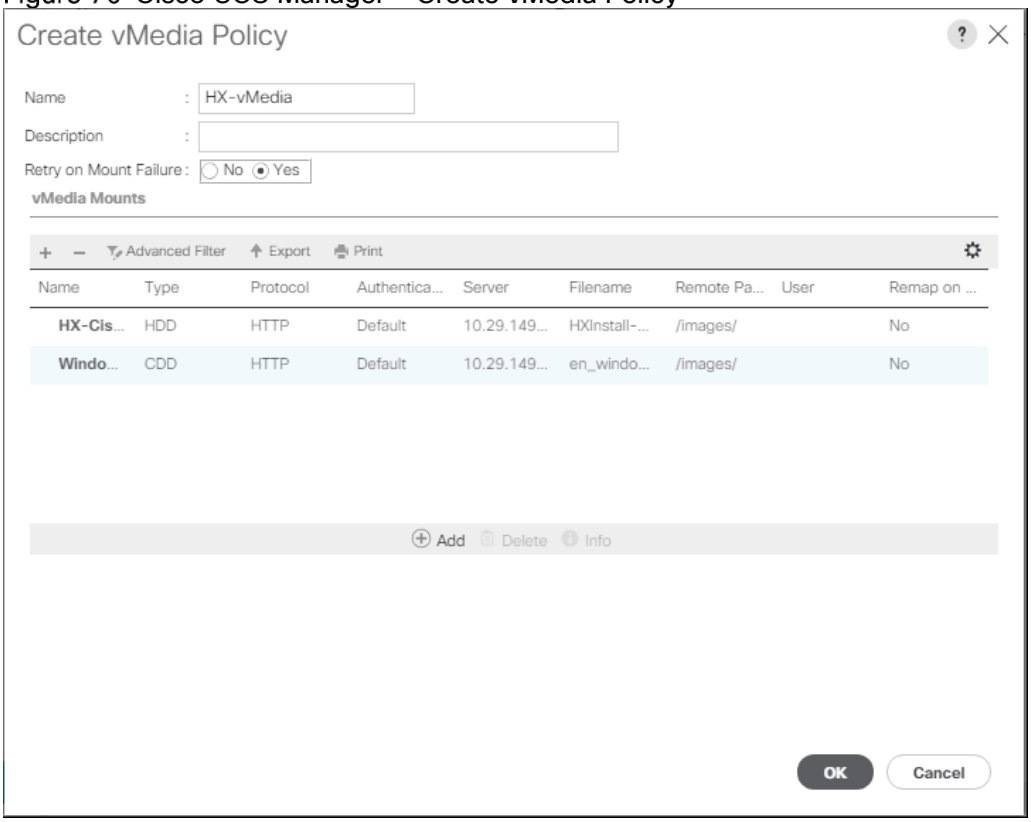
10. Click Save Changes and click OK.
11. Click OK. When you click OK, you are returned to the vMedia policy and will see the information that you submitted.
12. Repeat steps 5 and 6 but change the type to HDD and the filename to the Cisco HyperFlex driver image.

Figure 69 Cisco UCS Manager – Create vMedia Mount HDD



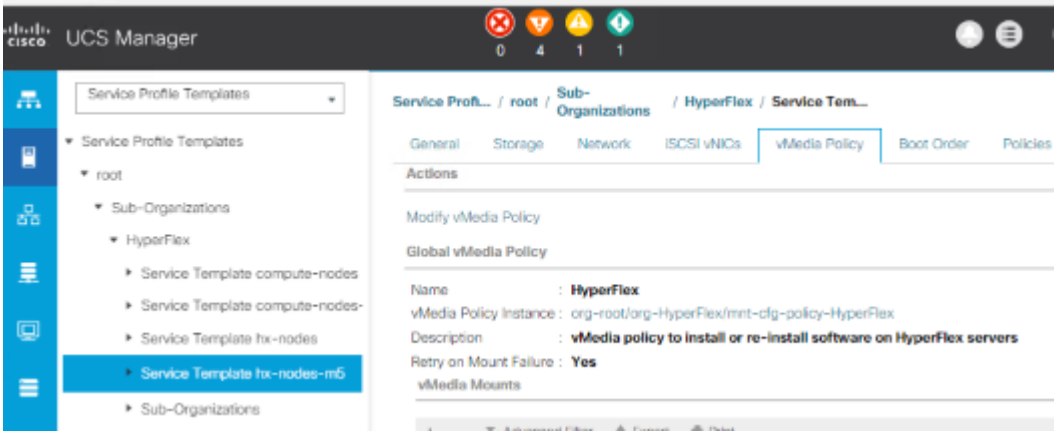
13. On completion, the following screen displays:

Figure 70 Cisco UCS Manager – Create vMedia Policy



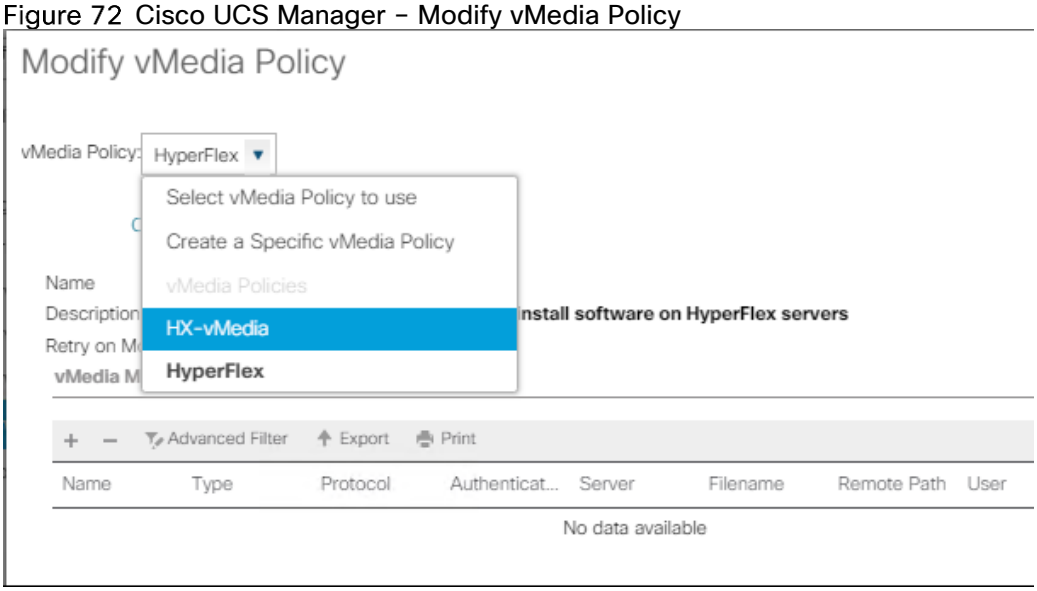
14. In the left navigation pane, select Servers > Service Profile Templates > root > Sub-Organizations > `hx-cluster_name` > Service Template `hx-nodes_name` (example:`hx-nodes-m5`).

Figure 71 Cisco UCS Manager – Service Template



15. Choose the HyperFlex vMedia Policy from the drop-down list and click OK twice.

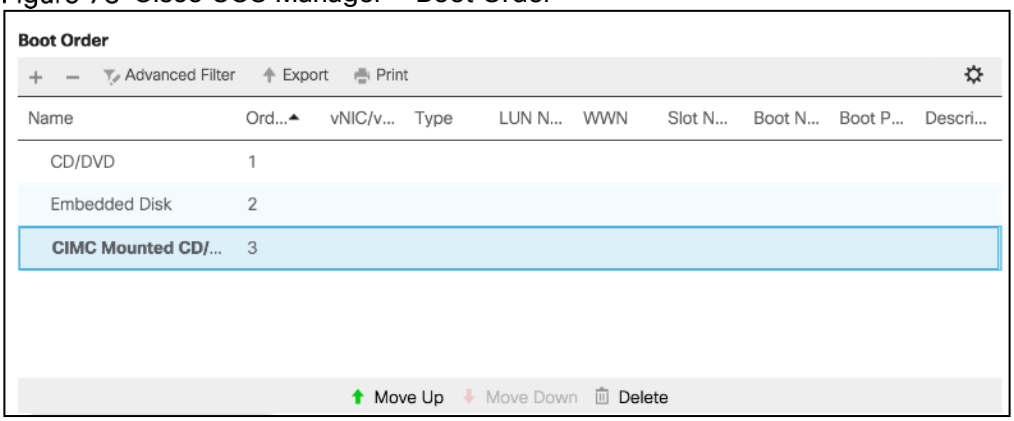
Figure 72 Cisco UCS Manager – Modify vMedia Policy



The vMedia policy is assigned to the HyperFlex Template during the Cisco UCS Manager phase of the HyperFlex deployment.

16. Select Servers > Policies > root > Sub-Organizations > `hx-cluster_name` > Boot Policies Boot Policy HyperFlex-m5.
17. In the configuration pane, click CIMC Mounted vMedia. Click Add CIMC Mounted CD/DVD to add this to the boot order.
18. Select the CIMC Mounted CD/DVD entry in the list and move it to the top of the boot order by pressing the Move Up button.

Figure 73 Cisco UCS Manager – Boot Order

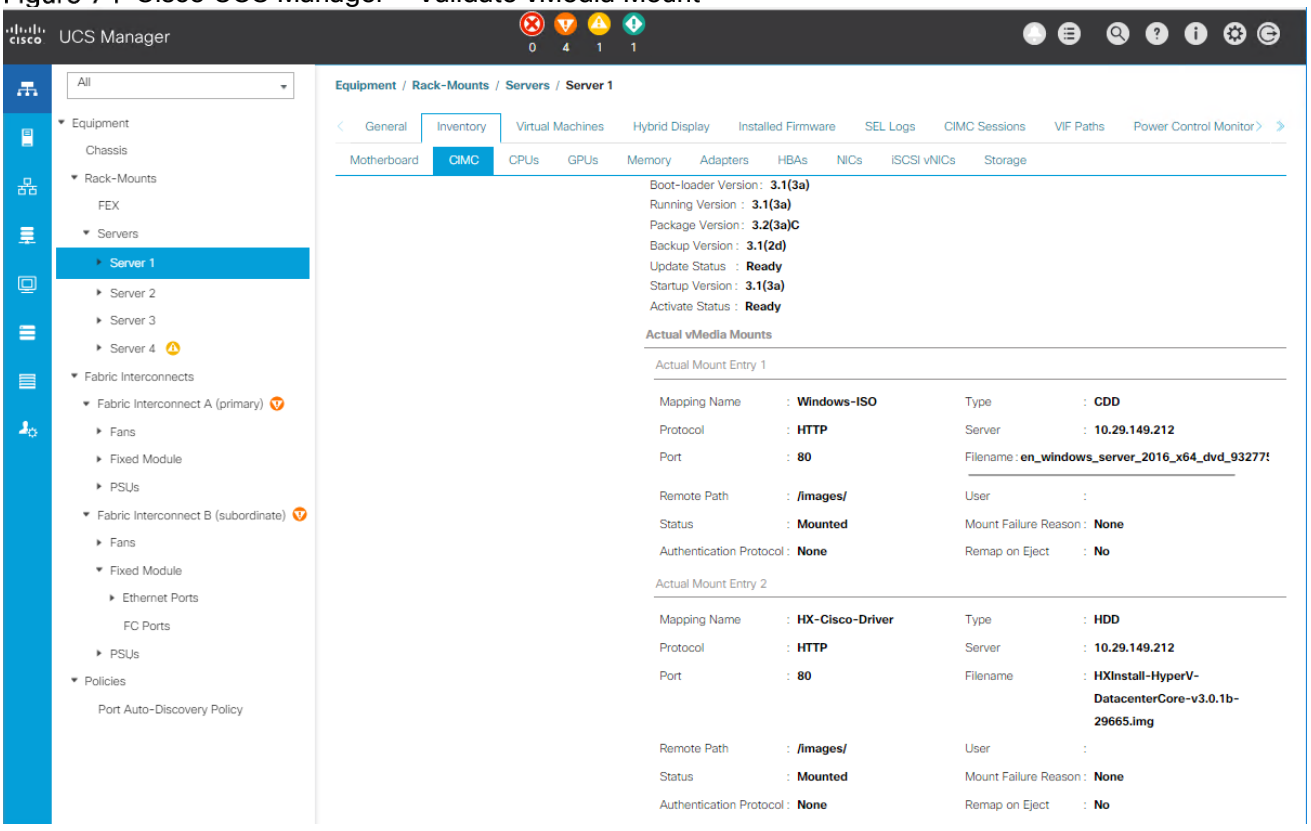


19. Click Save Changes and click OK. The boot policy is saved.

To verify the images are mounted correctly, complete the following steps:

1. On the Equipment tab, select one of the servers.
2. Click Inventory > CIMC, scroll down and make sure for the mount entry #1(OS image) and mount entry #2 (Cisco HyperFlex driver image) the status is Mounted and there are no failures.

Figure 74 Cisco UCS Manager – Validate vMedia Mount



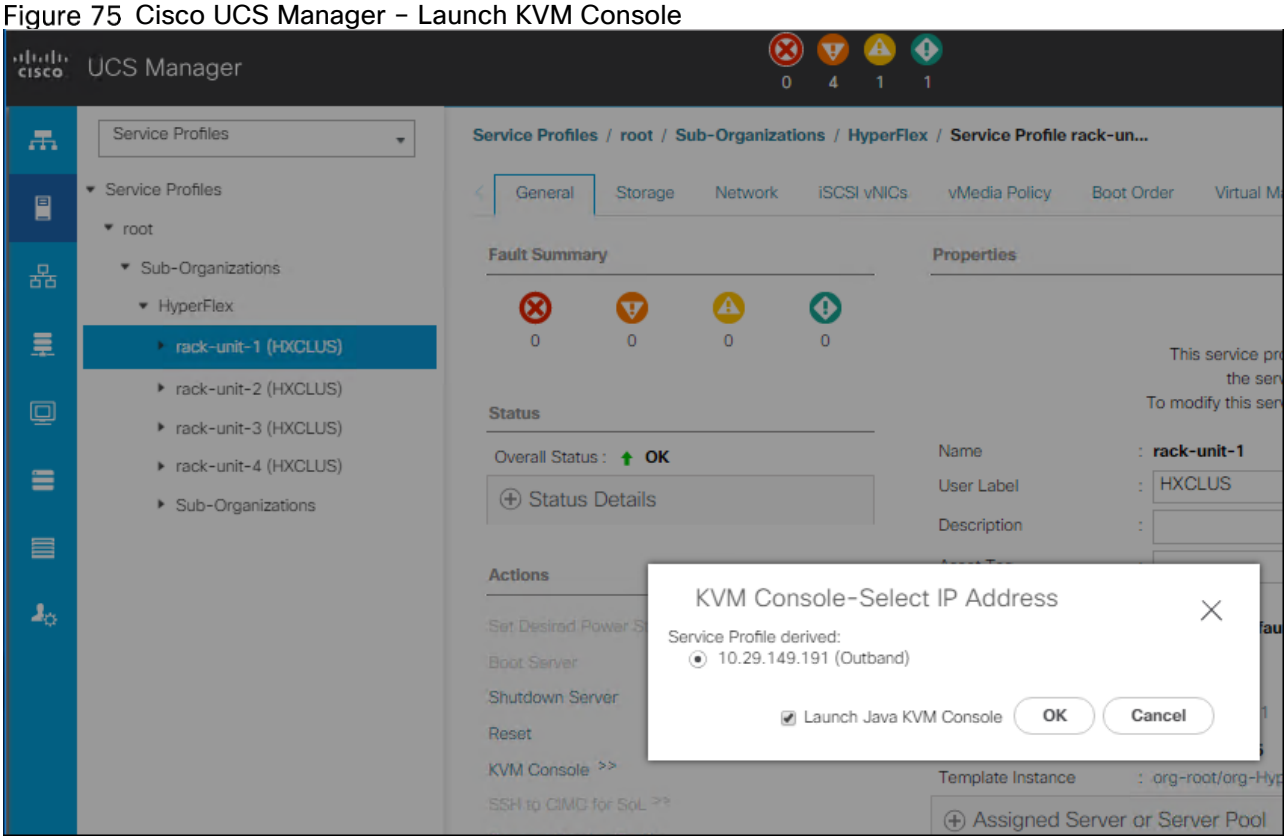
Install Microsoft Windows Server 2016 OS

In the menu bar, click Servers and choose the first HyperFlex service profile.

1. Click the General tab and choose Actions > KVM Console.

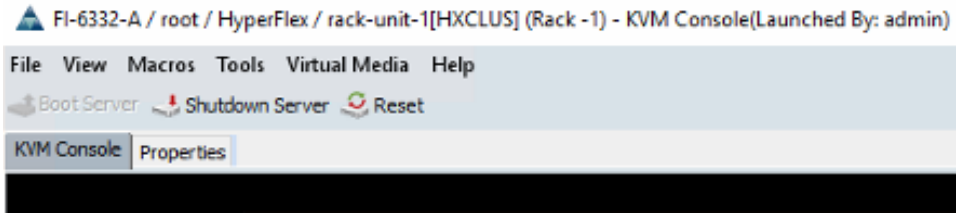
The KVM console will try to open in a new browser. Be aware of any pop-up blockers. Allow the Pop-Ups and re-open the KVM.

Figure 75 Cisco UCS Manager – Launch KVM Console



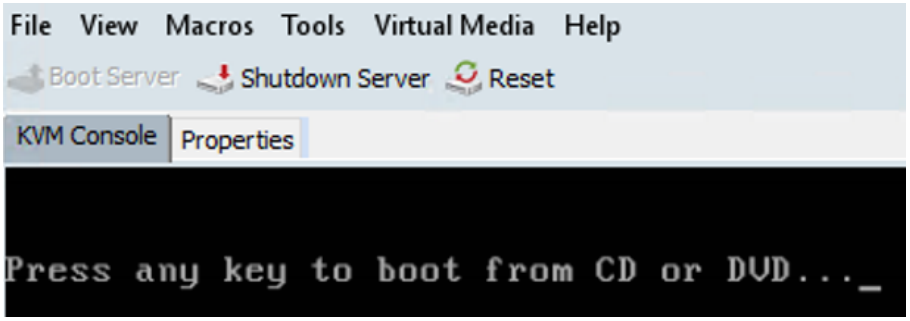
2. Reboot the server. In the KVM console choose Server Actions and press Reset.

Figure 76 Cisco UCS Manager – Server KVM Console



3. Choose Power Cycle.
4. When the server is rebooting, remember to press any key to start the Windows installation.

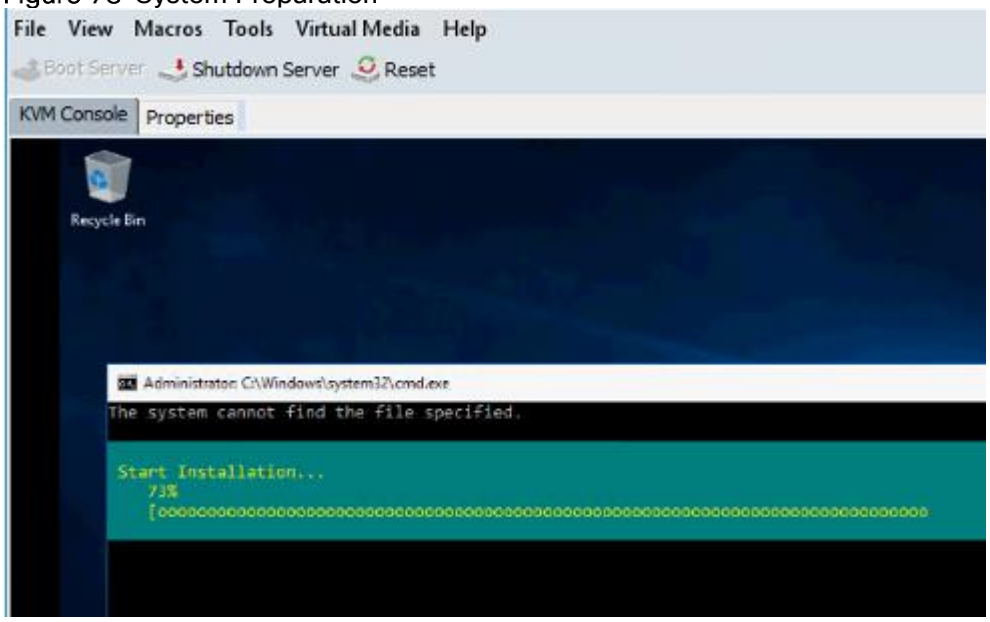
Figure 77 Cisco UCS Manager – KVM Console Server Boot



If you miss pressing any key, the server will display in the windows installation or an error page displays stating no OS is installed.

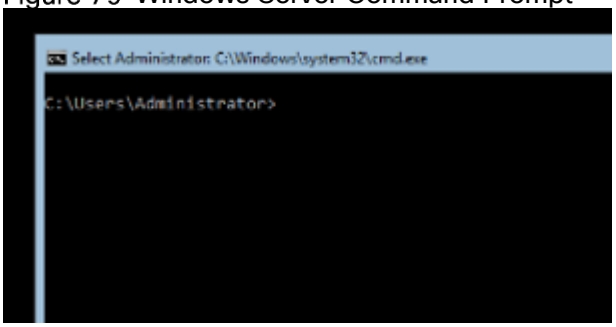
5. When the Windows installation is complete, you will see some tasks running as shown in the below and the host will reboot a few times. Allow some time for the system preparation to complete.

Figure 78 System Preparation



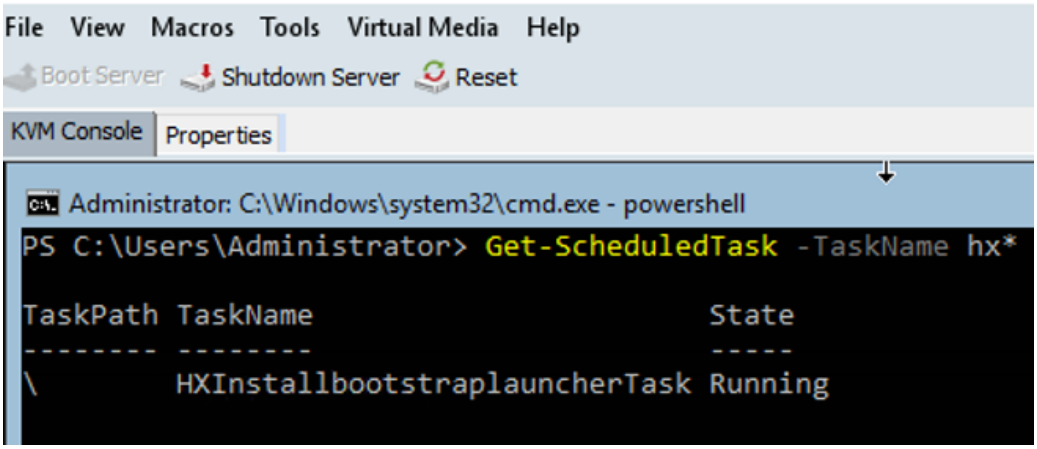
6. The installation is complete when a clean command prompt with no activity is displayed as shown below.

Figure 79 Windows Server Command Prompt



7. Repeat these steps on all the HX nodes in the cluster and verify the below task is running as shown in below. The ‘HXInstallbootstraplauncherTask’ in running state is an indication of successful installation Windows OS and system preparation.

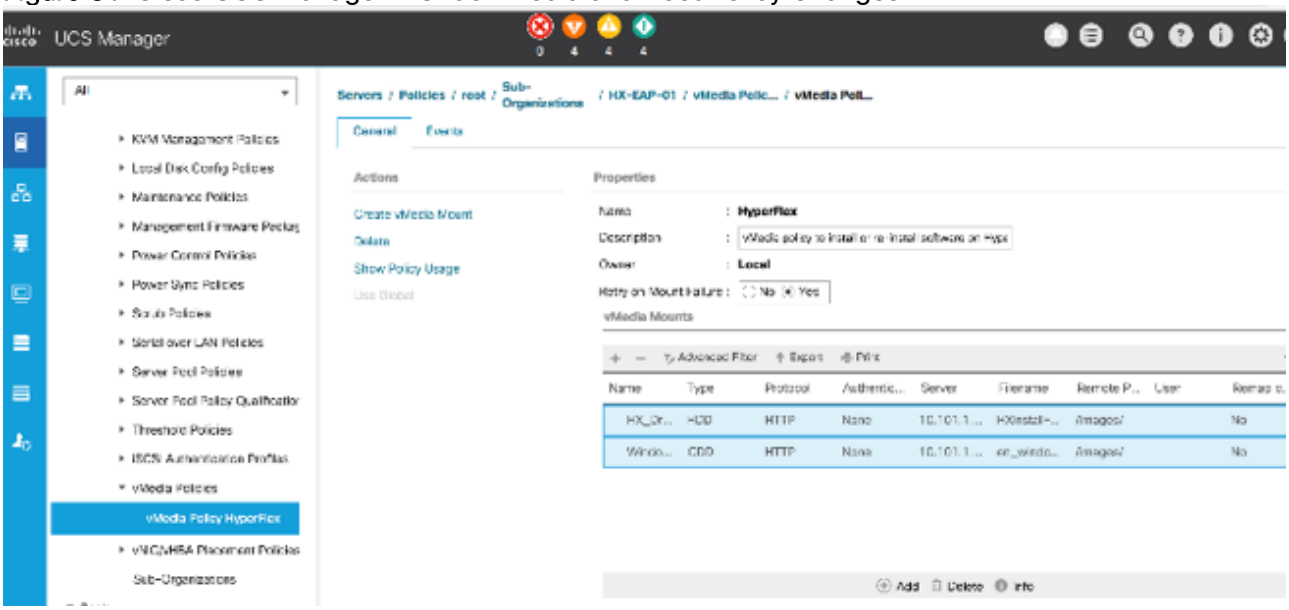
Figure 80 Validate Windows Server Installation Completion



Undo vMedia and Boot Policy Changes

1. When 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: In Cisco UCS Manager select Servers > Polices > Root > Sub-Organizations > `HX-Cluster_name` > vMedia polices
2. Click the vMedia Policy HyperFlex. Click the mount points one at a time and delete both of them. Accept the changes.

Figure 81 Cisco UCS Manager – Undo vMedia and Boot Policy Changes



3. Go to the boot policy by selecting Servers > Polices > Root > Sub-Organizations > `HX-Cluster_name` > boot polices > Boot Policy HyperFlex-m5.
4. Select the CIMC mounted CD/DVD, click Delete and accept the changes.

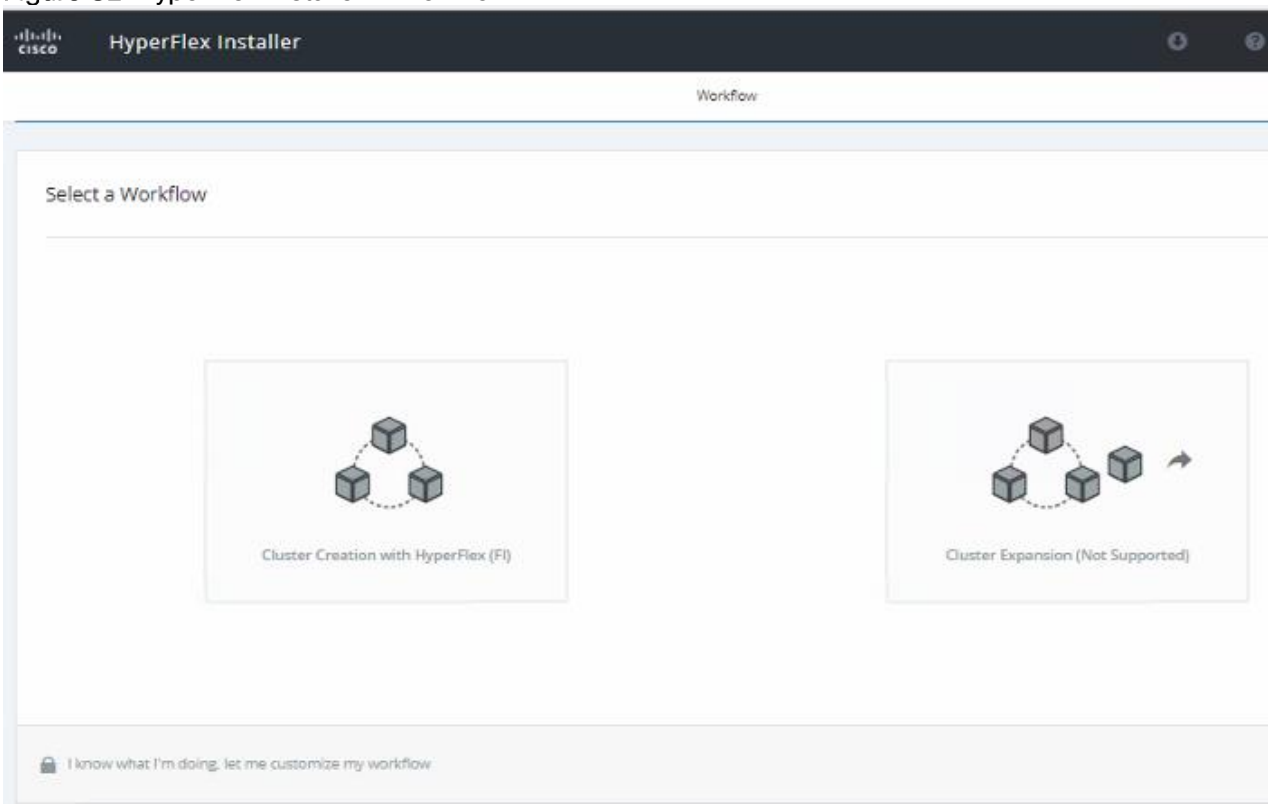
HyperFlex Installation – Phase 2

After installing Windows OS, use the customized workflow of HX installer and select the remaining three options: Run Hypervisor Configuration, HX Deploy Software, and Create HX Cluster to continue and complete the deployment of HyperFlex Cluster.

To deploy HX cluster, complete the following steps:

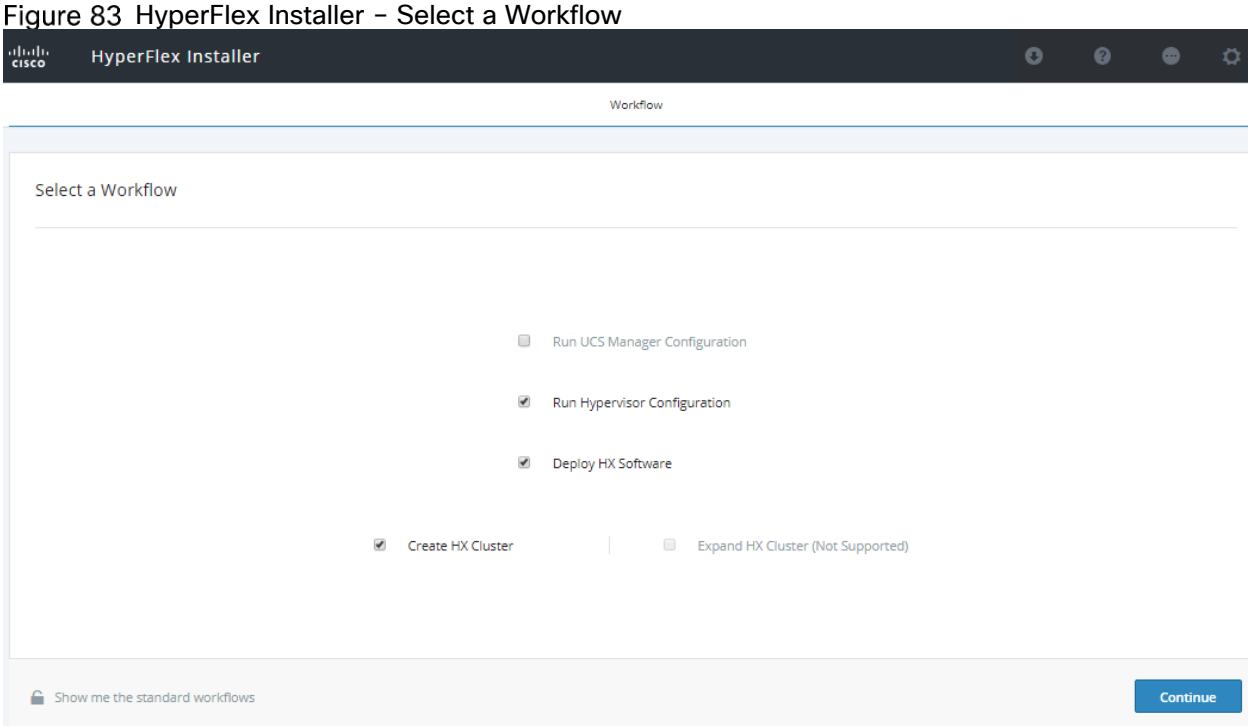
1. Open the HX Data Platform Installer and log in.
2. You might need to “start over” since the previous workflow was finished. Click the gear icon in the top right corner and select Start Over.
3. In the main menu, select I know what I'm doing, let me customize my workflow. In the Warning dialog box, click Confirm and Proceed.

Figure 82 HyperFlex Installer – Workflow



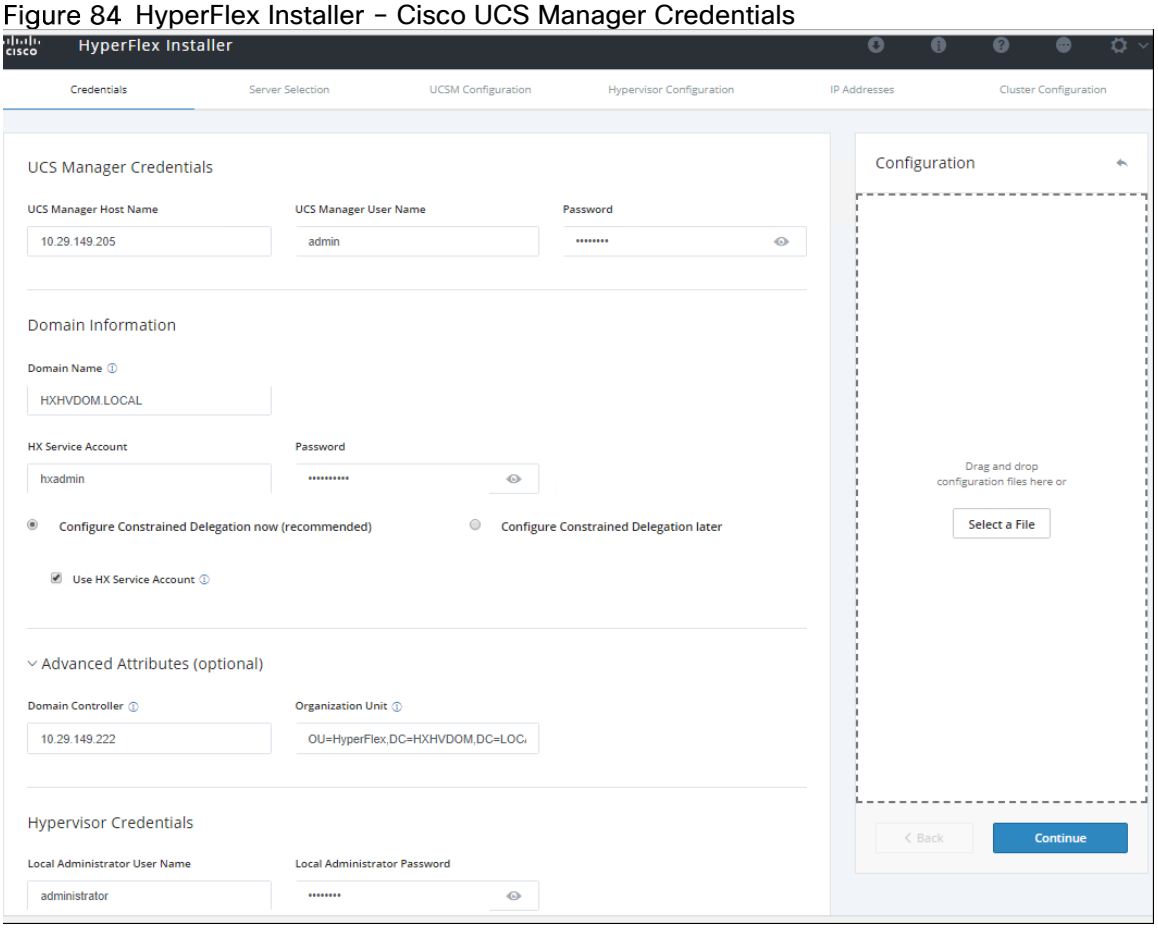
4. Select Run Hypervisor Configuration, Deploy HX Software and Create HX Cluster and click Continue.

Figure 83 HyperFlex Installer – Select a Workflow



5. Enter the information for the Cisco UCS Manager, Domain Information, and Hypervisor Credentials. Optionally, you can import a JSON file that has the configuration information, except for the appropriate passwords.

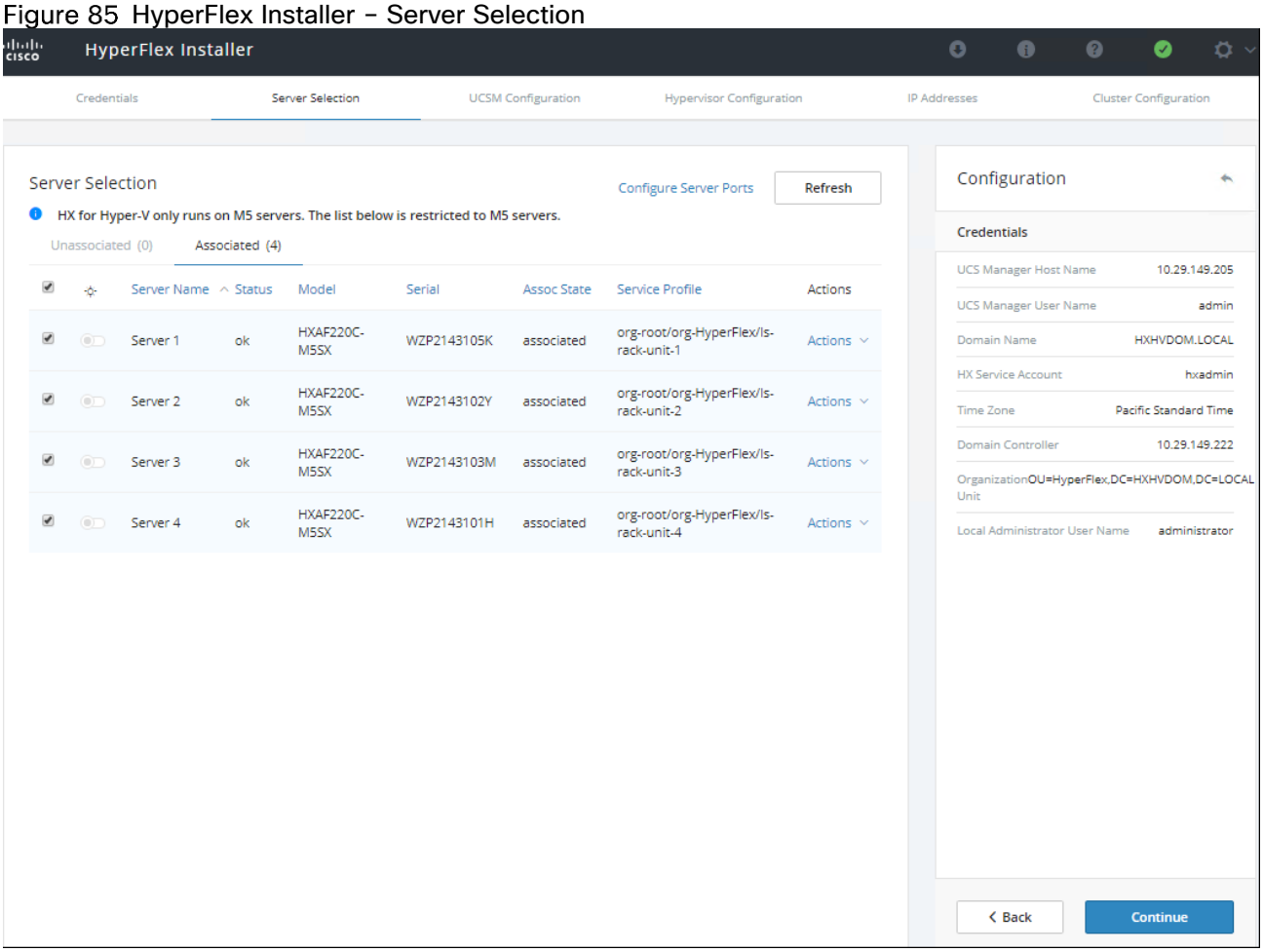
Figure 84 HyperFlex Installer – Cisco UCS Manager Credentials



6. Click Continue
7. 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.

Using this option of enabling server ports within HX installer, limits fine control of server order sequence, which is possible in manual configuration. 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.

Figure 85 HyperFlex Installer – Server Selection



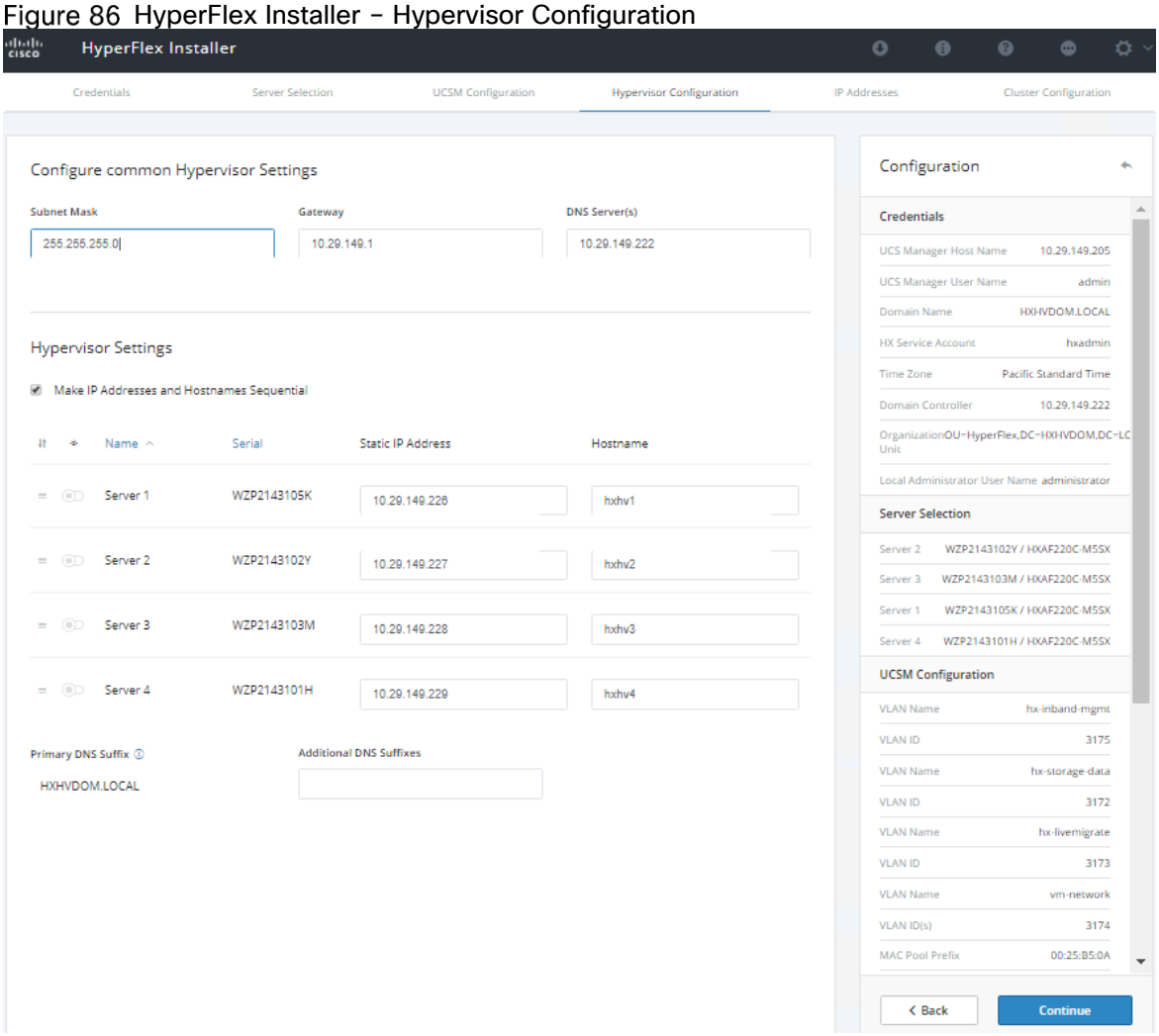
8. In the Cisco UCS Manager Configuration section, enter the network information as you have done in the **Error! Reference source not found.** section and make sure the data is the same. Click Continue.

When deploying a second or any additional clusters, you must put them into a different sub-org, use a different MAC Pool prefix, a unique pool of IP addresses for the CIMC interfaces, 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.

9. In the Hypervisor Configuration section, enter the subnet mask, gateway, 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 Hyper-V host systems as their management IP addresses. Click Continue.

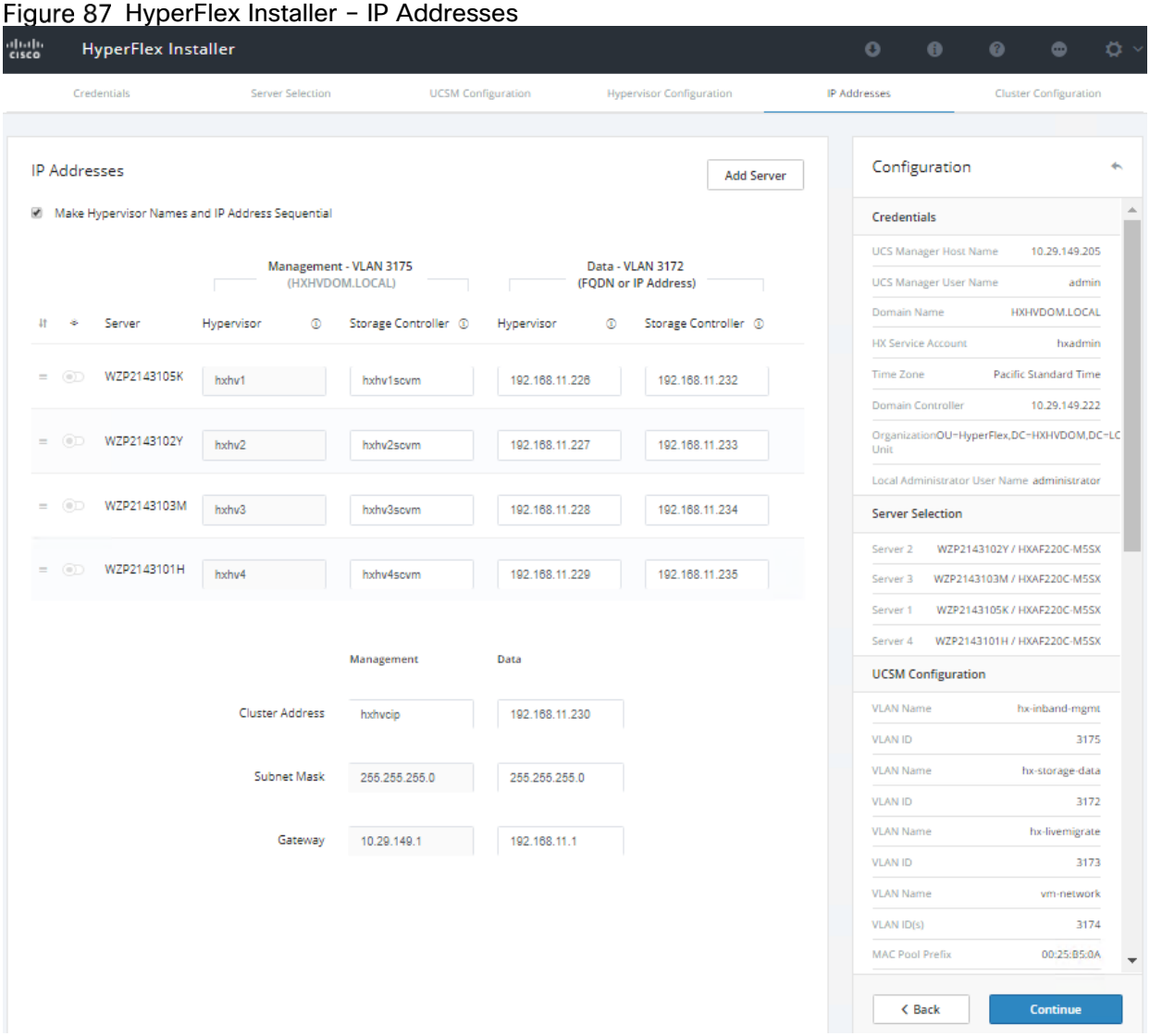
If you leave the checkbox Make IP Addresses and Hostnames Sequential as checked then the installer will automatically fill the rest of the servers sequentially.

Figure 86 HyperFlex Installer – Hypervisor Configuration



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

Figure 87 HyperFlex Installer – IP Addresses

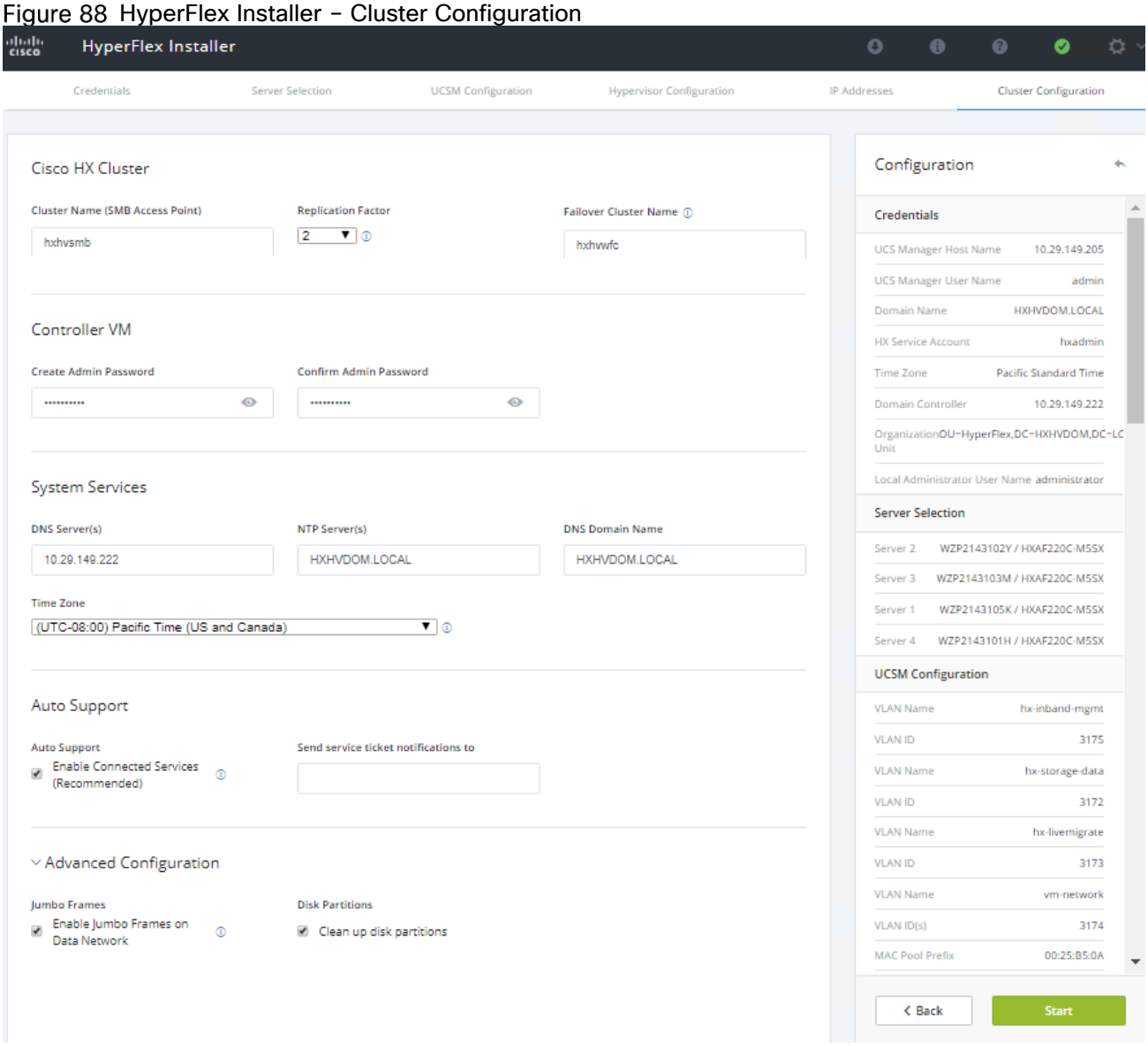


A default gateway is not required for the data network, as those interfaces normally will not communicate with any other hosts or networks, and the subnet can be non-routable.

11. Enter the HX Cluster Name and Replication Factor setting.
12. Enter the Password that will be assigned to the Controller VMs.
13. Enter the System Services information for DNS, NTP, and Time Zone. Make sure to use the Active Directory domain name for NTP.
14. Enable Connected Services in order to enable management via Cisco Intersight, and enter the email address to receive service ticket alerts, then scroll down.
15. Under Advanced Configuration, validate that VDI is not checked (applicable to hybrid nodes only). Jumbo Frames should be enabled to ensure the best performance, unless the upstream network is not capable of being configured to transmit jumbo frames. It is not necessary to select Clean up disk partitions for a new cluster installation, but an installation using previously used converged nodes should have the option checked.
16. Click Start.

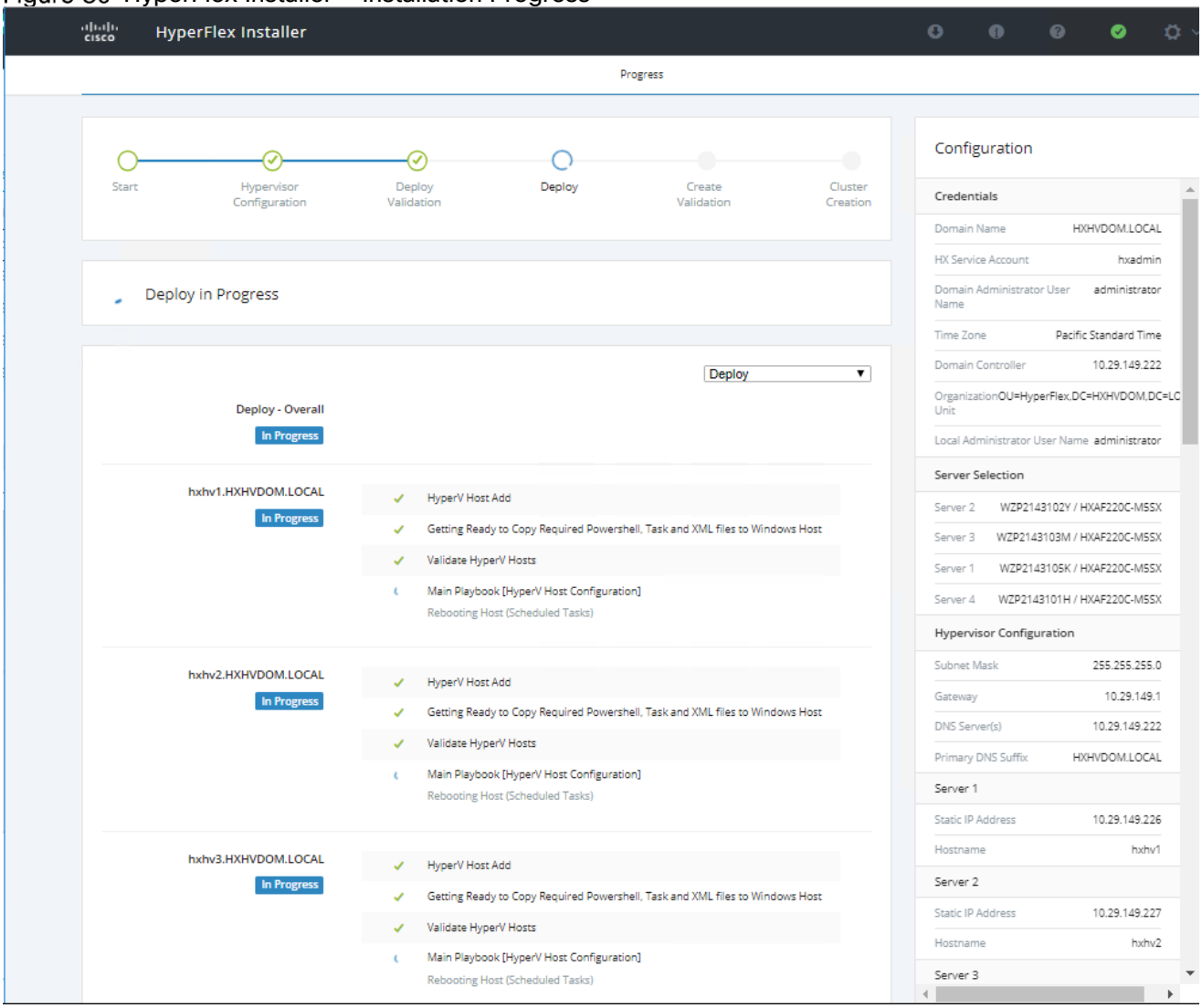
17. Validation of the configuration will now start. If there are warnings, you can review them and click “Skip Validation” if the warnings are acceptable. If there are no warnings, the installer will automatically continue on to the configuration process.

Figure 88 HyperFlex Installer – Cluster Configuration



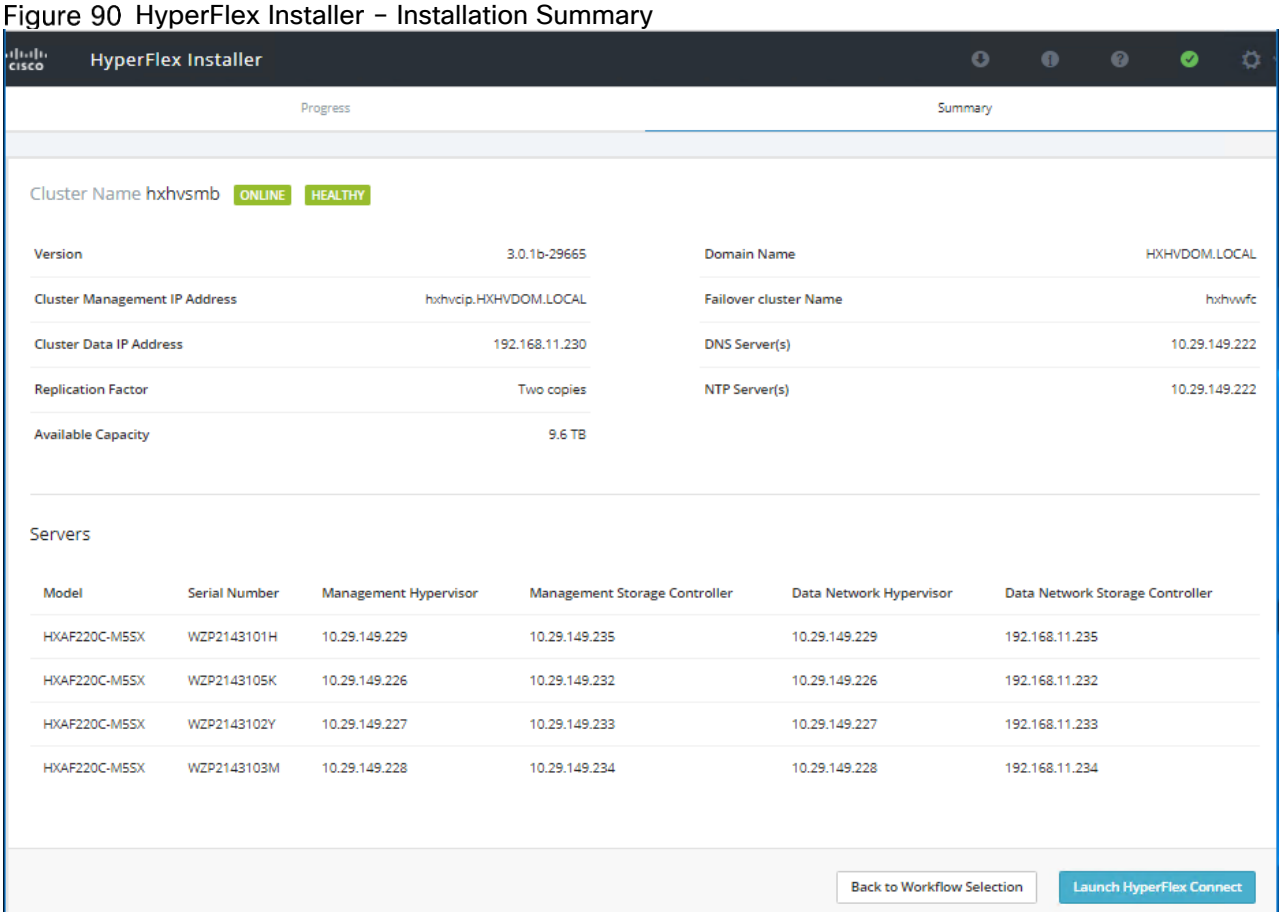
18. After the pre-installation validations, the HX installer will proceed to complete the deployment and perform all the steps listed at the top of the screen along with their status.

Figure 89 HyperFlex Installer – Installation Progress



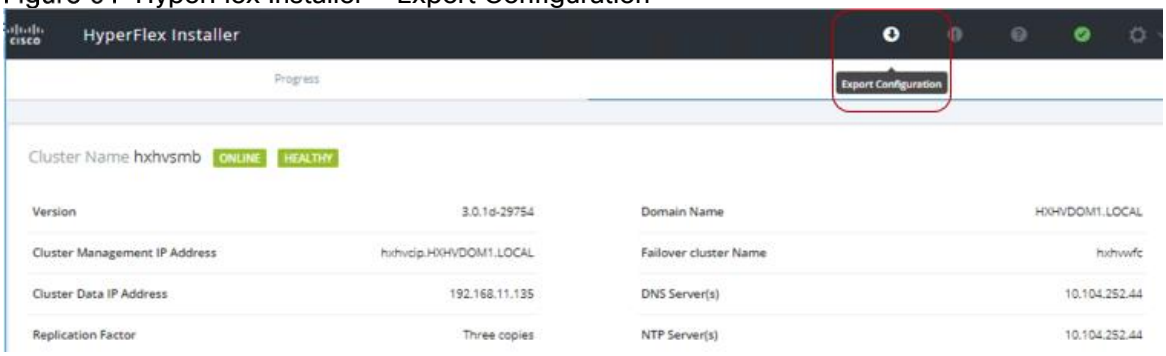
19. Review the Summary screen after the install completes by selecting Summary on the top right of the window.

Figure 90 HyperFlex Installer – Installation Summary



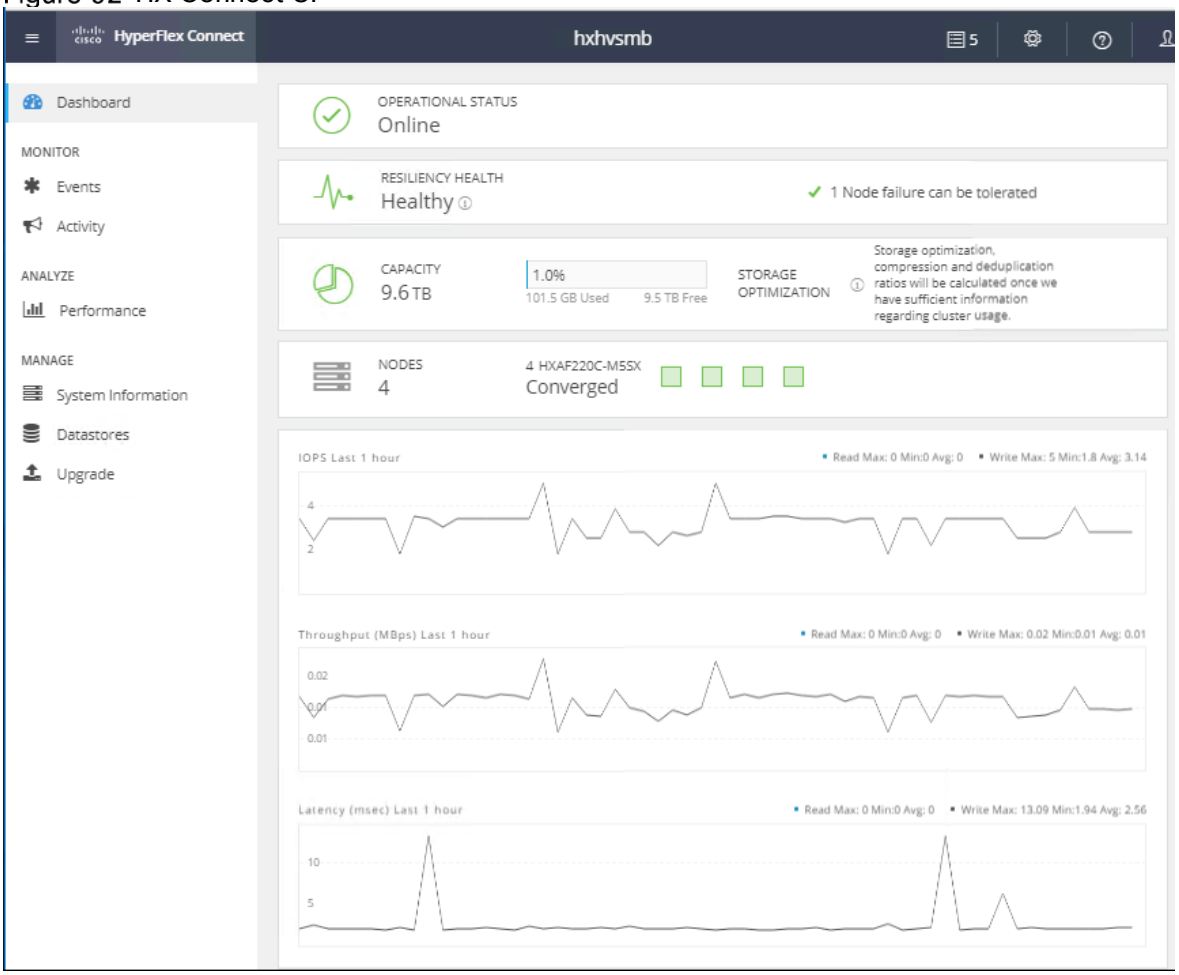
20. After the install completes, you may export the cluster configuration by clicking the downward arrow icon in the top right of the screen. Click OK to save the configuration to a JSON file. This file can be imported to save time if you need to rebuild the same cluster in the future, and stored as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

Figure 91 HyperFlex Installer – Export Configuration



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

Figure 92 HX Connect UI



Post Installation Tasks

Create Datastores

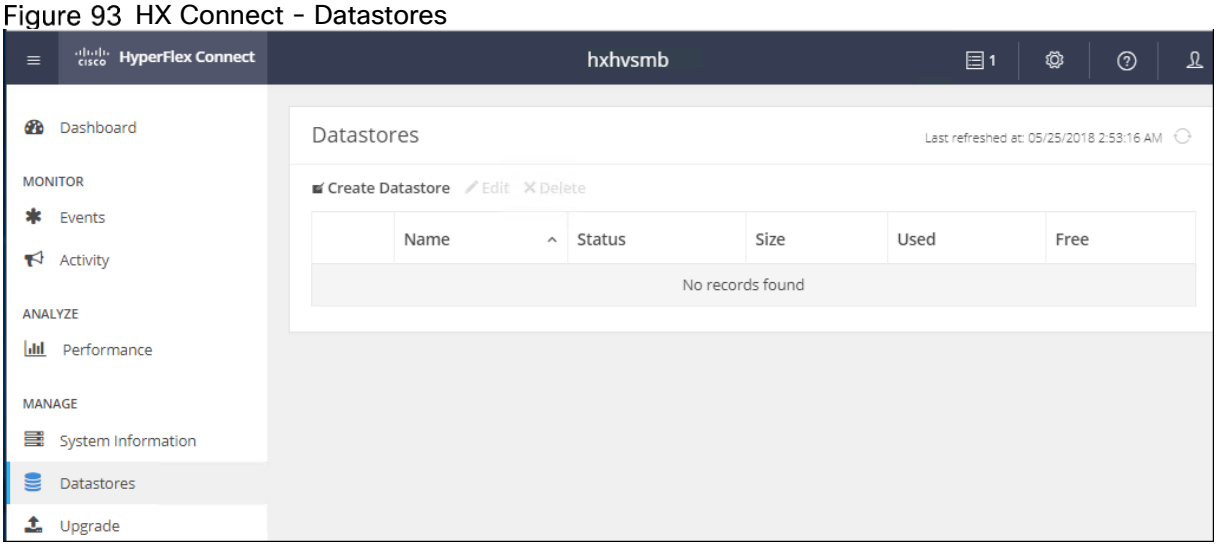
You need to create a datastore to store the virtual machines. This task can be completed by using the HyperFlex Connect HTML management webpage. The Datastores created using HX Connect creates a SMB share which the HyperFlex Hyper-V nodes can use it to store virtual machine files.

To configure a new datastore via the HyperFlex Connect webpage, complete the following steps:

Cisco recommends 8K block size for best performance and as few datastores as possible for ease of management.

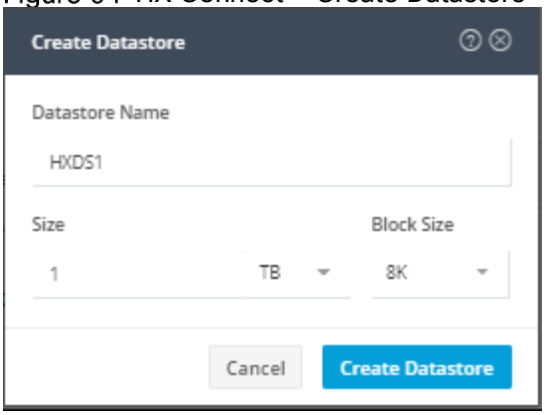
1. Use a web browser to open the HX cluster IP management URL.
2. Enter the credentials.
3. Click Login.
4. Click Datastores in the left pane and click Create Datastore.

Figure 93 HX Connect – Datastores



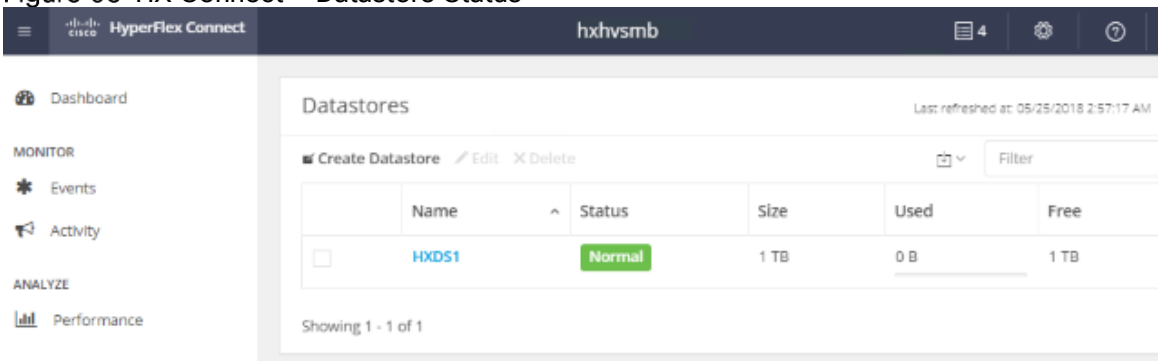
5. In the popup, enter the Datastore Name and size. For most applications, leave the Block Size at the default of 8K. Only dedicated Virtual Desktop Infrastructure (VDI) environments should choose the 4K Block Size option.

Figure 94 HX Connect – Create Datastore



6. Click Create Datastore.

Figure 95 HX Connect – Datastore Status



Constrained Delegation (Optional)

Windows provides a safer form of delegation that could be used by services. When it is configured, constrained delegation restricts the services to which the specified server can act on the behalf of a user. In other words. Constrained Delegation gives granular control over impersonation. When the remote management requests are

made to the Hyper-V hosts, it needs to make those requests to the storage on behalf of the caller. This is allowed if that host is trusted for delegation for the CIFS service principal of HX Storage.

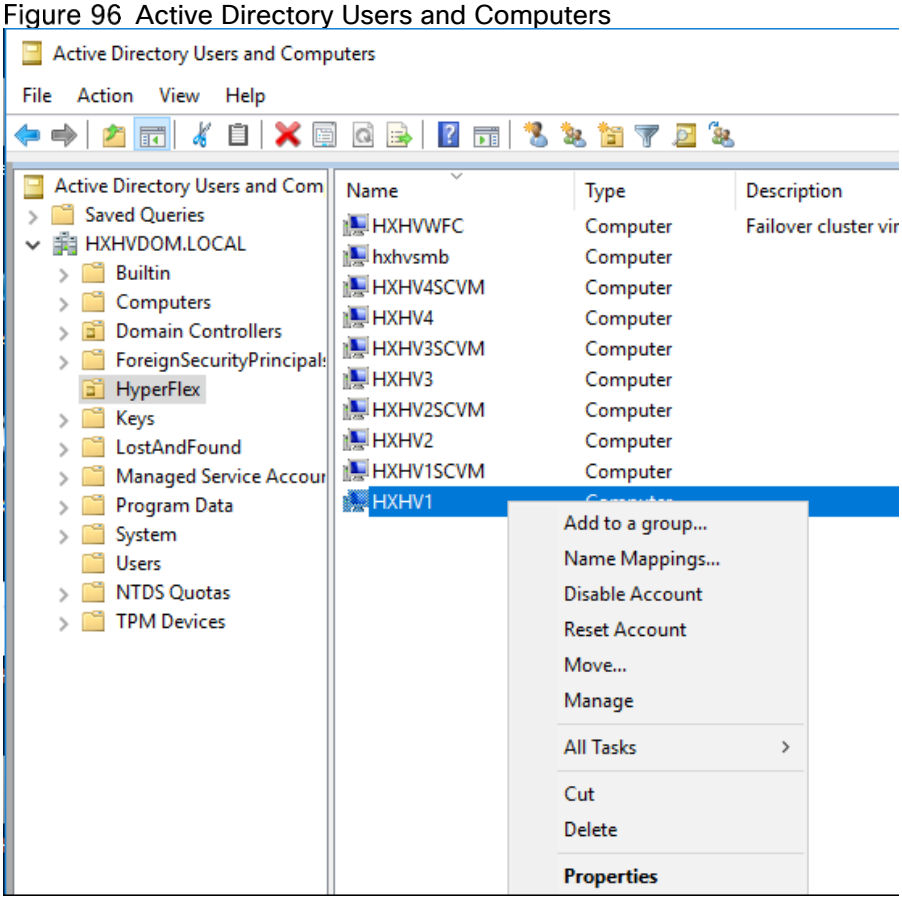
Constrained Delegation requires that the option for the security setting User Account Control: Behavior of the elevation prompt for Administrators in Admin Approval Mode is set to Elevate without Prompting. This will prevent the global AD policy from overriding policy on HX OU.

This step must be performed only if Constrained Delegation was not configured during initial installation. It is recommended that you perform this procedure using the HX Installer and not as part of post-installation.

To configure Constrained Delegation using the domain administrator, complete the following steps on each Hyper-V host in the HX Cluster and also on management hosts (with RSAT tools from where you want to remotely perform administrator tasks):

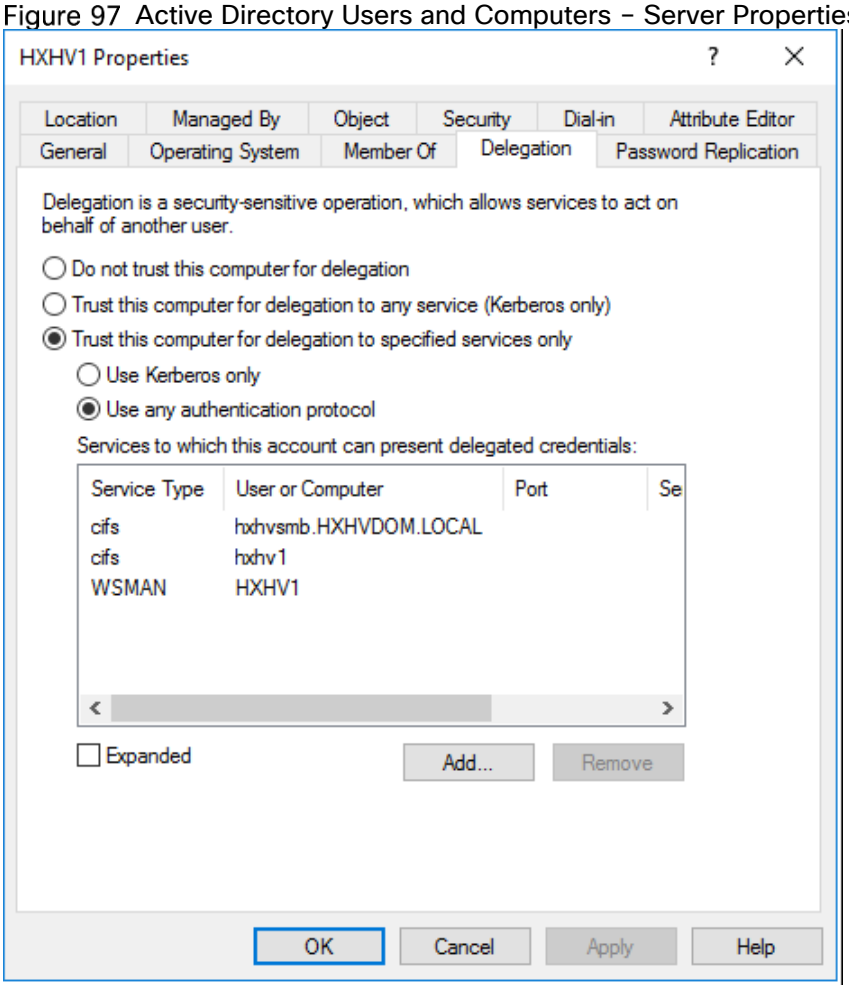
1. Open the Active Directory Users and Computers snap-in. (From Server Manager, select the server if it is not selected, click Tools >> Active Directory Users and Computers).
2. From the navigation pane in Active Directory Users and Computers, select the domain and double-click the Computers folder.
3. From the Computers folder, right-click the computer account of the source server and then click Properties.

Figure 96 Active Directory Users and Computers



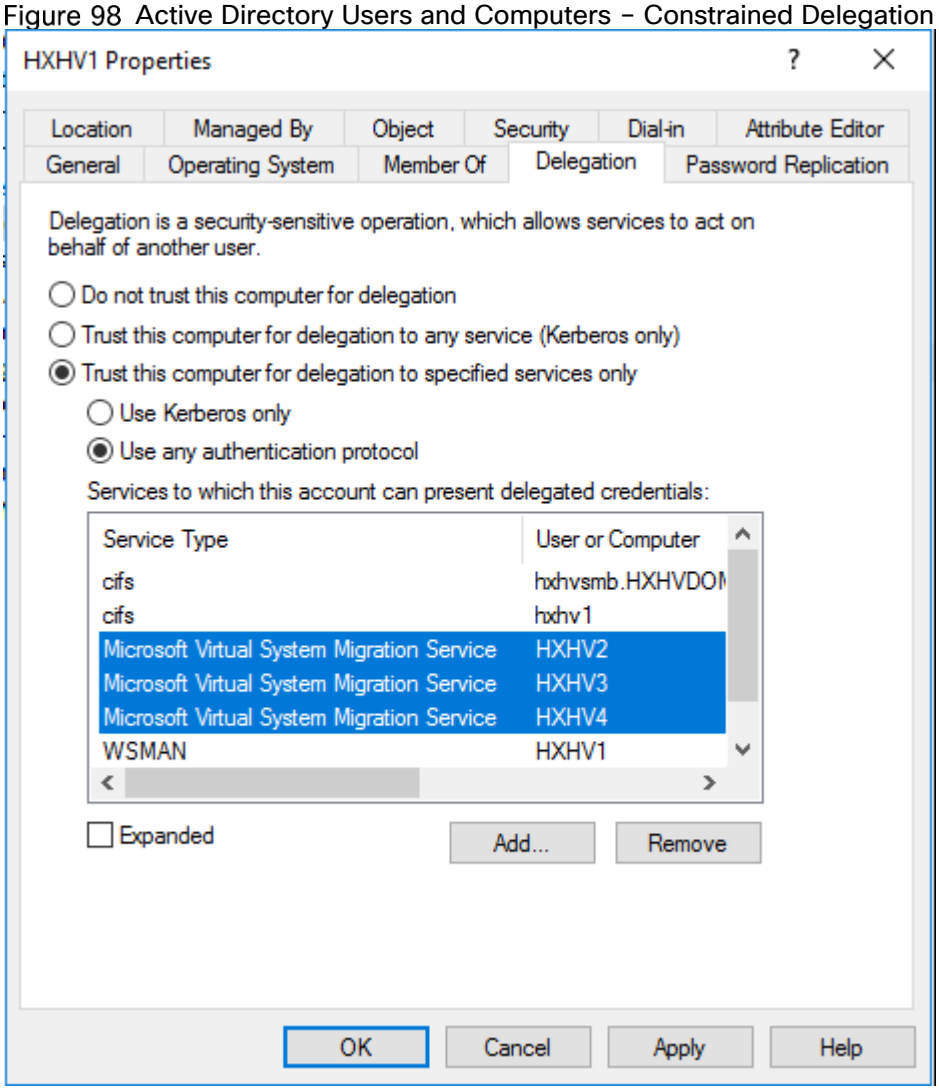
4. From the Properties tab, click the Delegation tab.
5. On the delegation tab, select Trust this computer for delegation to the specified services only and then select Use any authentication protocol.

Figure 97 Active Directory Users and Computers – Server Properties



6. Click Add.
7. From Add Services, click Users or Computers.
8. From Select Users or Computers, type the name of the destination server.
9. Click Check Names to verify it and then click OK.
10. From Add Services, in the list of available services, do the following and then click OK:
    a. To move virtual machine storage, select **cifs**. This is required if you want to move the storage along with the virtual machine, as well as if you want to move only a virtual machine's storage. If the server is configured to use SMB storage for Hyper-V, this should already be selected.
    b. To move virtual machines, select Microsoft Virtual System Migration Service.

Figure 98 Active Directory Users and Computers – Constrained Delegation



11. On the Delegation tab of the Properties dialog box, verify that the services you selected in the previous step are listed as the services to which the destination computer can present delegated credentials. Click OK.

From the Computers folder, select the computer account of the destination server and repeat the process. In the Select Users or Computers dialog box, be sure to specify the name of the source server.

Post HyperFlex Cluster Installation for Hyper-V 2016

The HyperFlex installer configures all components of the environment from the UCS policies to the Hyper-V networking. In order to manage the environment from SCVMM for the purpose of VDI, you must perform some post-installation steps to allow Citrix XenDesktop to use the environment.

This section detail the steps to prepare the environment for VDI use.

Microsoft System Center Virtual Machine Manager 2016

The Hyper-V Cluster created by the HyperFlex Installer can also be managed using the Microsoft System Center Virtual Manager. At the time of the publishing this document, there is no HX plug-in or SMI-S integration with the HX Storage. However, the Hyper-V Cluster can still be managed using the SCVMM without these features.

Installing Microsoft SCVMM is beyond the scope of this document. The following steps cover the basic procedure to add the HyperFlex Hyper-V Cluster to SCVMM and configure storage for managing.

Create Run-As Account for Managing the Hyper-V Cluster

A Run As account is a container for a set of stored credentials. In VMM a Run As account can be provided for any process that requires credentials. Administrators and Delegated Administrators can create Run As accounts. For this deployment, a Run As account should be created for adding Hyper-V hosts and clusters.

To create a Run As account, complete the following steps:

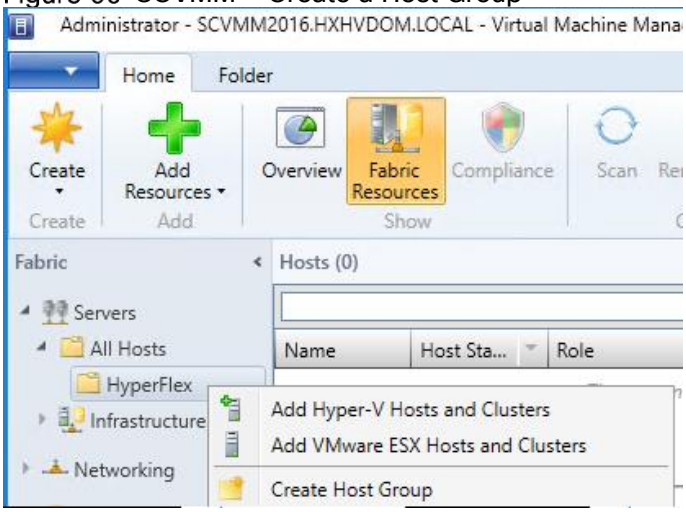
1. Click Settings and in Create click Create Run As Account.
2. In Create Run As Account specify name and optional description to identify the credentials in VMM.
3. In User name and Password specify the credentials. The credentials can be a valid Active Directory user or group account, or local credentials.
4. Clear Validate domain credentials if it is not required and click OK to create the Run As account.

Manage Servers and Clusters

To add the HyperFlex Hyper-V Cluster to the SCVMM, complete the following steps:

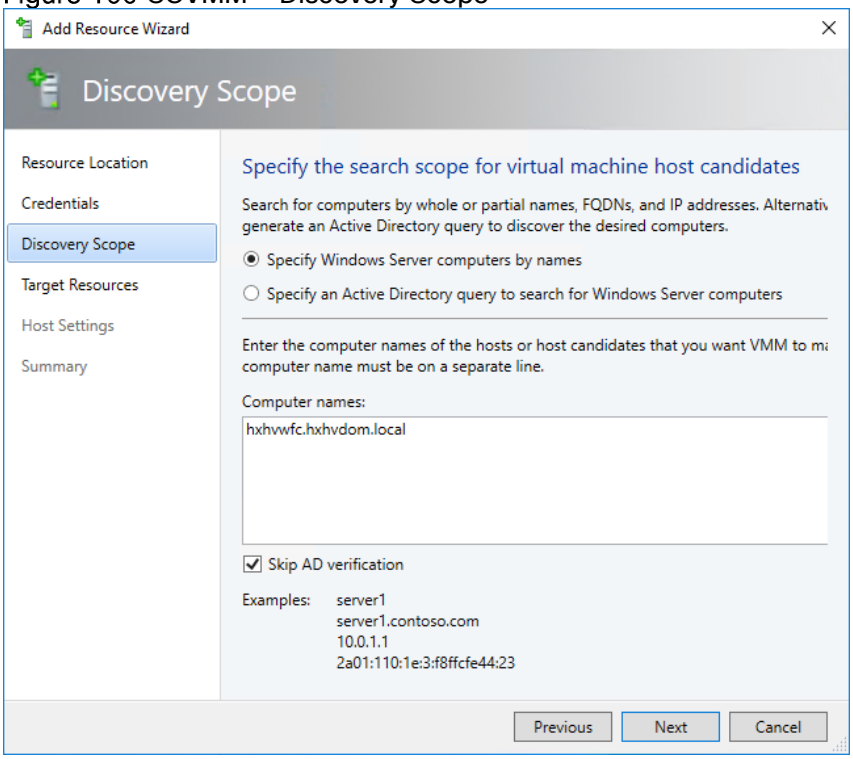
1. Open the SCVMM administrator Console and click on Fabric > Servers > All Hosts.
2. Right-click All Hosts and Create a folder for the HyperFlex Hyper-V Cluster.
3. Right-click the newly created folder and click on Add Hyper-V Hosts and Clusters.

Figure 99 SCVMM – Create a Host Group



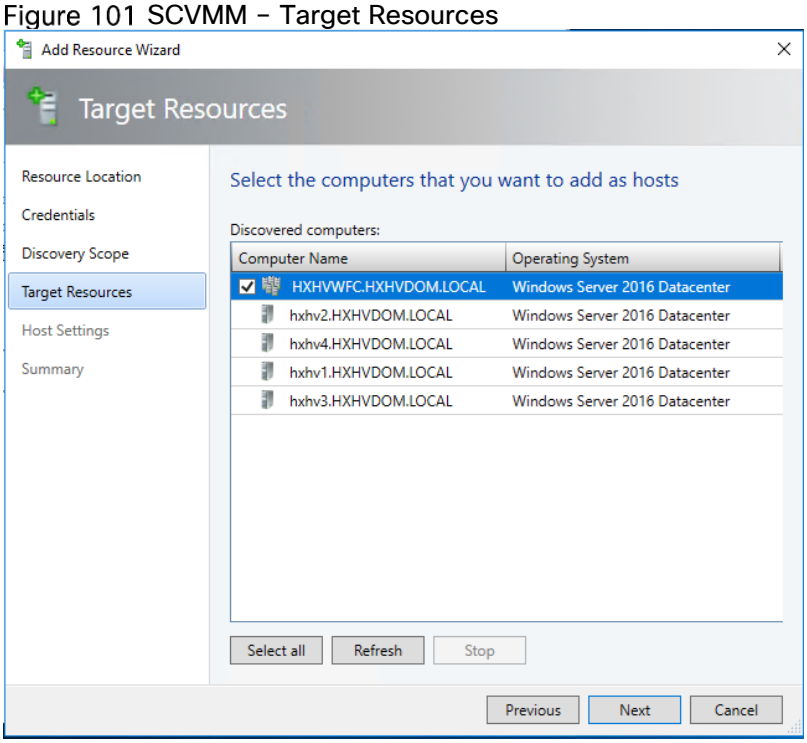
4. In the Credentials section, select Use an existing Run As account and select the account created in the previous section.
5. In the Discovery scope, enter the FQDN of HyperFlex Hyper-V Cluster as shown below.

Figure 100 SCVMM – Discovery Scope



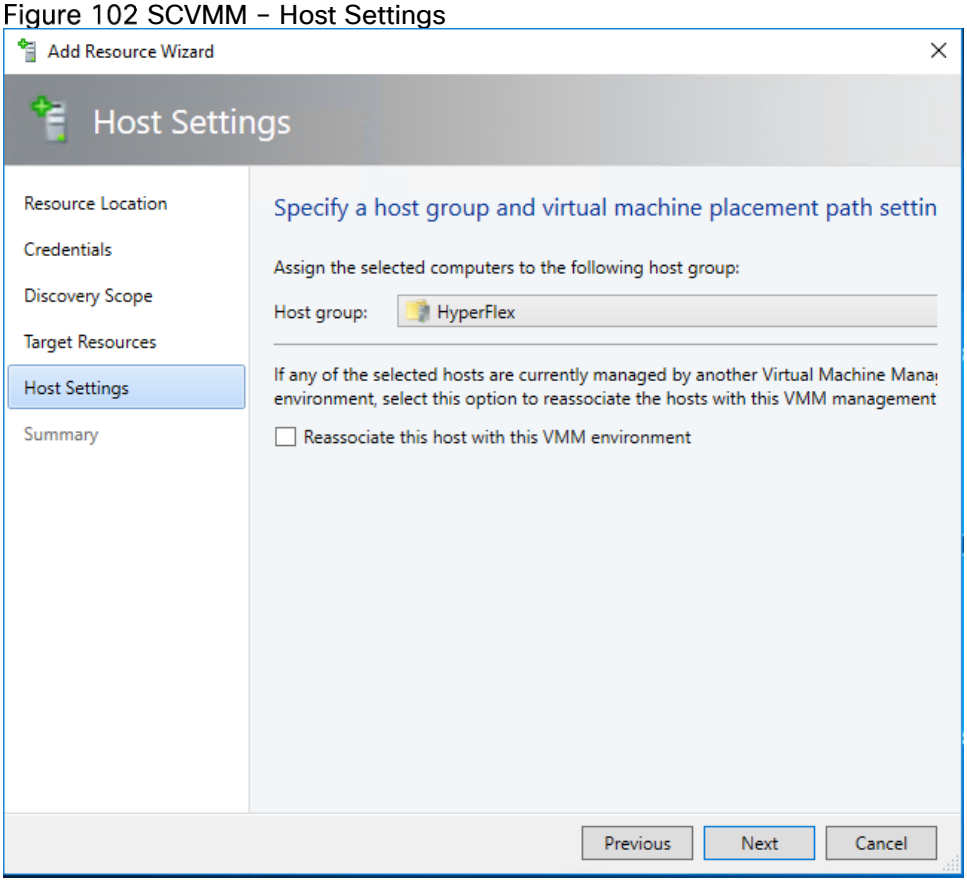
6. In the Target Resources page, select all the discovered hosts and click Next.

Figure 101 SCVMM – Target Resources



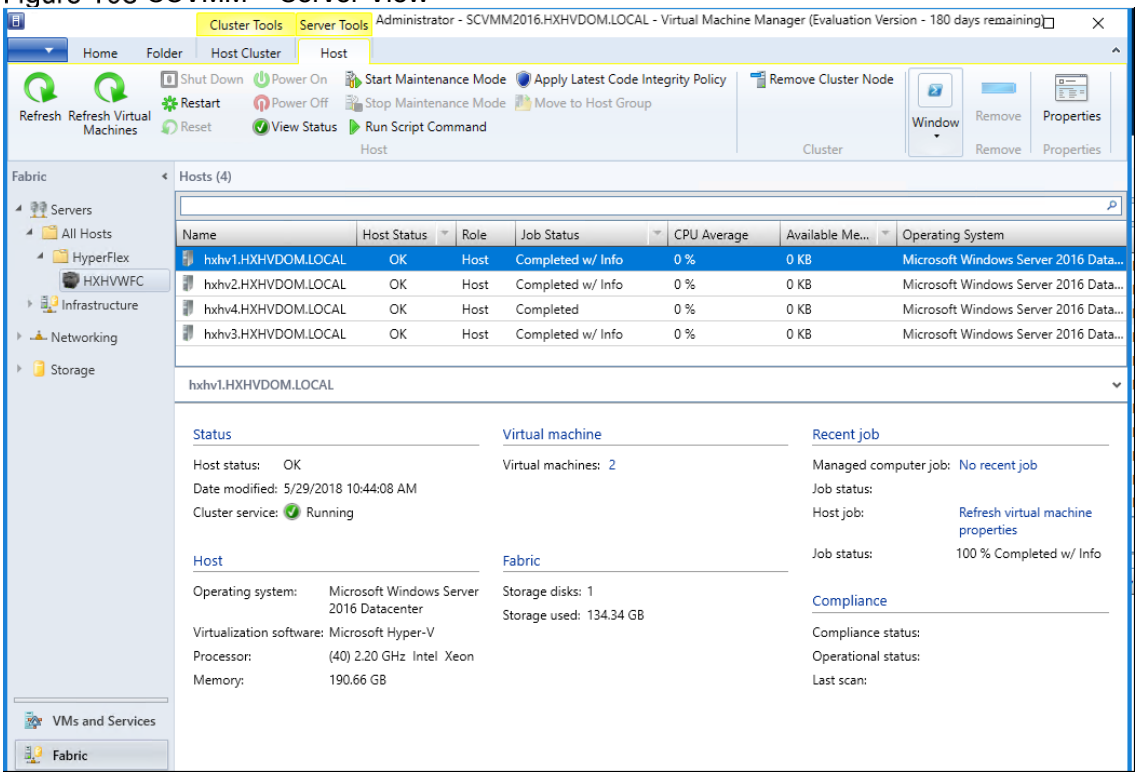
7. In the Host Settings page, select the appropriate Host group and click Next.

Figure 102 SCVMM – Host Settings



8. In the summary page, confirm the settings and click Finish.

Figure 103 SCVMM – Server View



Networking

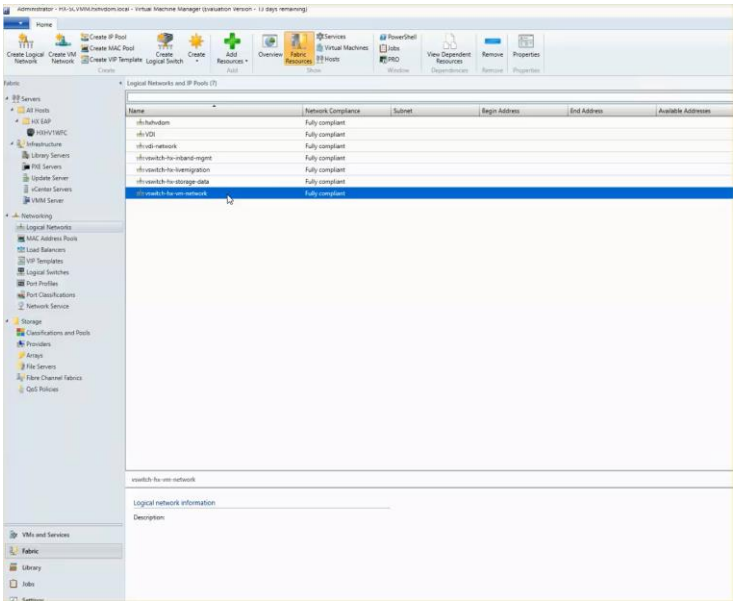
Network switches and interfaces are created by the HyperFlex installer. A network team is created for the Management, Storage, VM Network and Live Migration networks specified during the installer.

When the teams are created, the Network Sites must be created and added to the logical networks created by the installer.

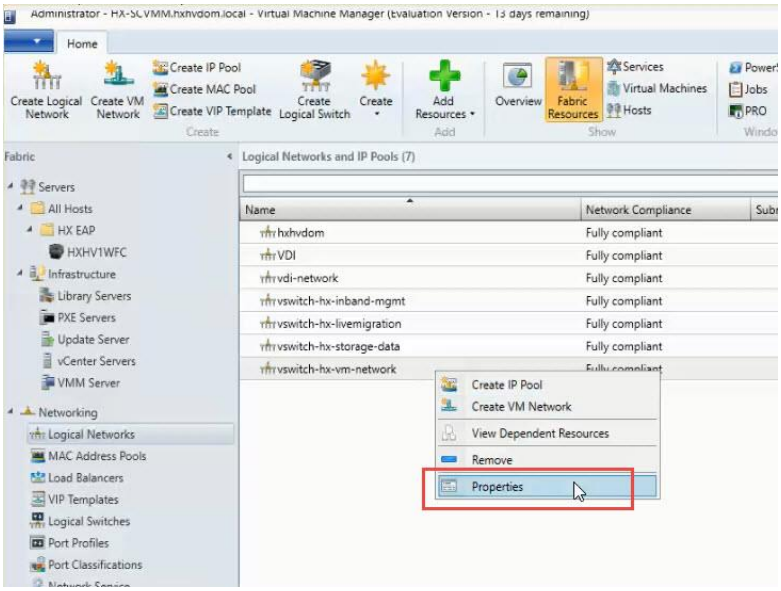
To create the Network Sites, complete the following steps:

1. Under Fabric > Networking > Logical Networks, find the Logical Network created by the installer.

   In this example, it is 'vswitch-hx-vm-network'.

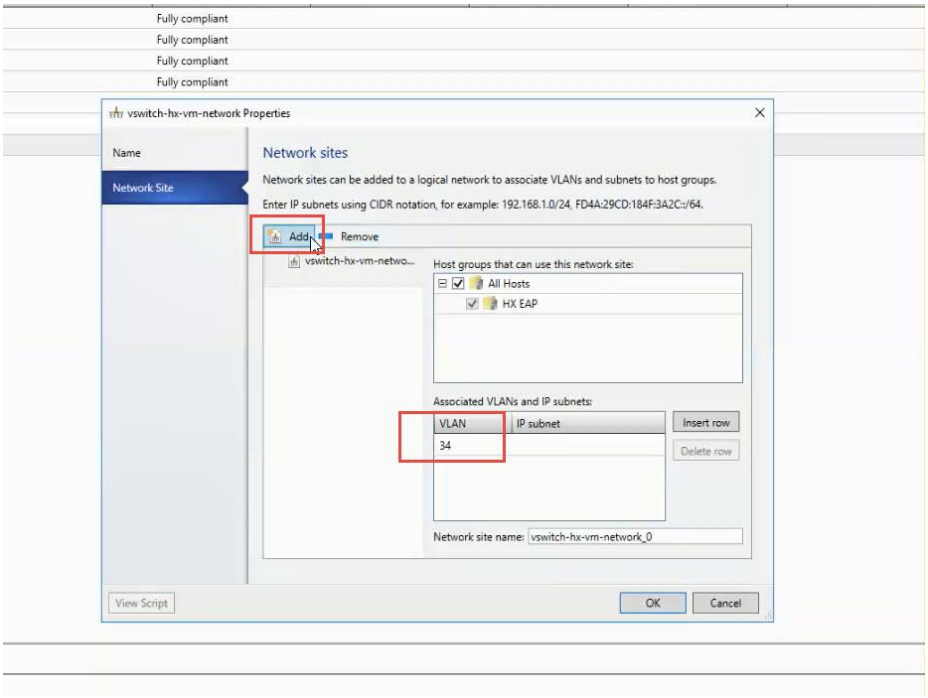


2. Right-click and select ‘Properties’ of the logical network.

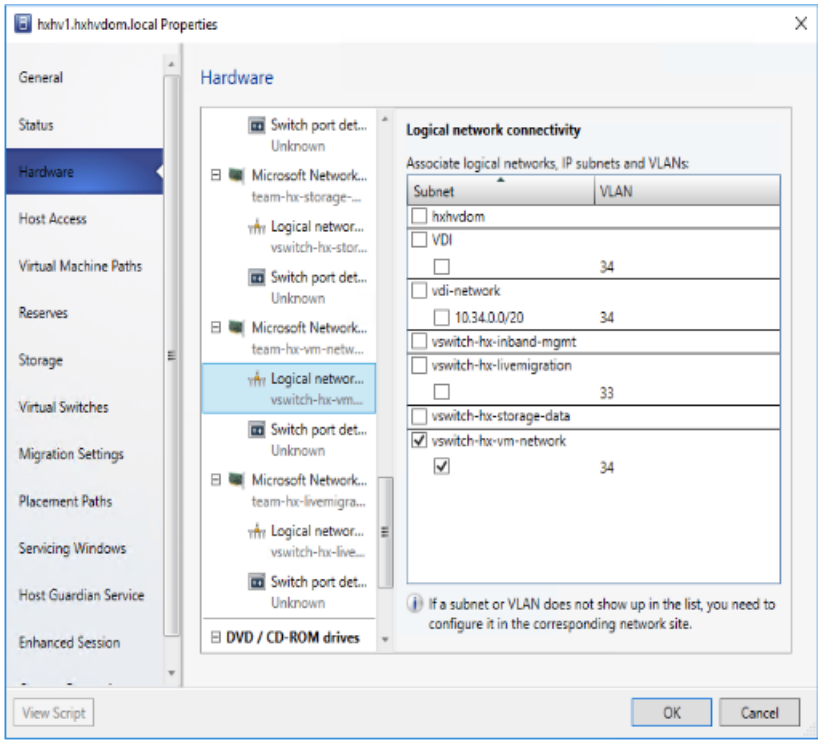


3. Under Network Site, add a site so a VLAN can be specified on the Logical Network.

In this example VLAN 34 was used for the VM network and VLAN 33 was used for Live Migration



4. When the network site is created, make sure each host in the cluster has the proper VLAN checked in its properties. This can be found under the properties of each host, under Hardware -> and scroll to the 'team-hx-vm-network'



Assign IP Addresses to Live Migration and VM Network Interfaces

To assign a static IP address to Live Migration and Network Interfaces, log into each Hyper-V node and execute the following commands in PowerShell, complete the following steps:

1. Use the following PowerShell command to check if there is vSwitch created for Live Migration network on Hyper-V hosts by the HX installer.

   Get-VMSwitch

Figure 104 PowerShell – Get VMSwitch

```
[hxhv1]: PS C:\Users\Administrator.HXHVDOM\Documents> Get-VMSwitch

Name                      SwitchType NetAdapterInterfaceDescription
----                      ---------- ------------------------------
vswitch-hx-livemigration  External   Microsoft Network Adapter Multiplexor Driver #4
vswitch-hx-storage-data   External   Microsoft Network Adapter Multiplexor Driver #2
vswitch-hx-vm-network     External   Microsoft Network Adapter Multiplexor Driver #3
vswitch-hx-inband-mgmt    External   Microsoft Network Adapter Multiplexor Driver
```

2. Remove the vSwitch named ‘vswitch-hx-livemigration’ using the following PowerShell command.

   Remove-VMSwitch -Name 'vswitch-hx-livemigration'

Figure 105 PowerShell – Remove VMSwitch

```
[hxhv1]: PS C:\Users\Administrator.HXHVDOM\Documents> Remove-VMSwitch -Name vswitch-hx-livemigration

[hxhv1]: PS C:\Users\Administrator.HXHVDOM\Documents> Get-VMSwitch

Name                    SwitchType NetAdapterInterfaceDescription
----                    ---------- ------------------------------
vswitch-hx-storage-data External   Microsoft Network Adapter Multiplexor Driver #2
vswitch-hx-vm-network   External   Microsoft Network Adapter Multiplexor Driver #3
vswitch-hx-inband-mgmt  External   Microsoft Network Adapter Multiplexor Driver
```

3. Assign a static IP address to the teamed interface named “team-hx-livemigration” using the following PowerShell command

   New-NetIPAddress -ifAlias "team-hx-livemigration" -IPAddress 192.168.73.127 -PrefixLength 24

Figure 106 PowerShell – Assign Static IP

```
[hxhv1]: PS C:\Users\Administrator.HXHVDOM\Documents> New-NetIPAddress -ifAlias "team-hx-livemigration" -IPAddress 192.168.73.21 -PrefixLength 24


IPAddress         : 192.168.73.21
InterfaceIndex    : 7
InterfaceAlias    : team-hx-livemigration
AddressFamily     : IPv4
Type              : Unicast
PrefixLength      : 24
PrefixOrigin      : Manual
SuffixOrigin      : Manual
AddressState      : Tentative
ValidLifetime     : Infinite ([TimeSpan]::MaxValue)
PreferredLifetime : Infinite ([TimeSpan]::MaxValue)
SkipAsSource      : False
PolicyStore       : ActiveStore

IPAddress         : 192.168.73.21
InterfaceIndex    : 7
InterfaceAlias    : team-hx-livemigration
AddressFamily     : IPv4
Type              : Unicast
PrefixLength      : 24
PrefixOrigin      : Manual
SuffixOrigin      : Manual
AddressState      : Invalid
ValidLifetime     : Infinite ([TimeSpan]::MaxValue)
PreferredLifetime : Infinite ([TimeSpan]::MaxValue)
SkipAsSource      : False
PolicyStore       : PersistentStore
```

4. This step is optional. If there is a requirement for the Hyper-V host also to communicate on VM network, then assign a static IP address to “team-hx-livemigration” using the following PowerShell command.

   New-NetIPAddress –ifAlias "vswitch-hx-vm-network" -IPAddress 192.168.74.21 -PrefixLength 24

Rename the Cluster Network in Windows Failover Cluster – Optional

To rename the default cluster network names assigned during cluster creation to more meaningful names, execute the following PowerShell commands from any one HyperFlex Hyper-V host:

1. Execute the "*Get-ClusterNetwork*" and "*Get-ClusterNetworkInterface*" as shown below to view information on the cluster network.

Figure 107 PowerShell – Get Cluster Network

```
Administrator: C:\Windows\system32\cmd.exe - powershell
PS C:\Users\Administrator.HXHVDOM> Get-ClusterNetwork

Name              State Metric             Role
----              ----- ------             ----
Cluster Network 1    Up  69760 ClusterAndClient
Cluster Network 3    Up  69761 ClusterAndClient
Cluster Network 4    Up  29761          Cluster
Cluster Network 5    Up  29762          Cluster


PS C:\Users\Administrator.HXHVDOM> Get-ClusterNetworkInterface

Name                            Node  Network           State
----                            ----  -------           -----
hxhv1 - vswitch-hx-inband-mgmt    hxhv1 Cluster Network 1    Up
hxhv2 - vswitch-hx-inband-mgmt    hxhv2 Cluster Network 1    Up
hxhv3 - vswitch-hx-inband-mgmt    hxhv3 Cluster Network 1    Up
hxhv4 - vswitch-hx-inband-mgmt    hxhv4 Cluster Network 1    Up
hxhv1 - vswitch-hx-storage-data   hxhv1 Cluster Network 3    Up
hxhv2 - vswitch-hx-storage-data   hxhv2 Cluster Network 3    Up
hxhv3 - vswitch-hx-storage-data   hxhv3 Cluster Network 3    Up
hxhv4 - vswitch-hx-storage-data   hxhv4 Cluster Network 3    Up
hxhv1 - vswitch-hx-vm-network     hxhv1 Cluster Network 4    Up
hxhv2 - vswitch-hx-vm-network     hxhv2 Cluster Network 4    Up
hxhv3 - vswitch-hx-vm-network     hxhv3 Cluster Network 4    Up
hxhv4 - vswitch-hx-vm-network     hxhv4 Cluster Network 4    Up
hxhv1 - team-hx-livemigration (1) hxhv1 Cluster Network 5    Up
hxhv2 - team-hx-livemigration (1) hxhv2 Cluster Network 5    Up
hxhv3 - team-hx-livemigration (1) hxhv3 Cluster Network 5    Up
hxhv4 - team-hx-livemigration (1) hxhv4 Cluster Network 5    Up
```

2. Execute the below PowerShell command to rename the cluster networks.

```
Get-ClusterNetwork | Where-Object {$_.Address -eq "10.29.149.0"}).Name = "hx-inband-mgmt"
(Get-ClusterNetwork | Where-Object {$_.Address -eq "192.168.11.0"}).Name = "hx-storage-data"
(Get-ClusterNetwork | Where-Object {$_.Address -eq "192.168.73.0"}).Name = "LiveMigration"
(Get-ClusterNetwork | Where-Object {$_.Address -eq "172.18.0.0"}).Name = "vm-network"
```

Figure 108 PowerShell – Rename the Cluster Network

```
[hxhv1]: PS C:\Users\Administrator.HXHVDOM\Documents> (Get-ClusterNetwork | Where-Object {$_.Address -eq "10.29.149.0"}).Name = "hx-inband-mgmt
(Get-ClusterNetwork | Where-Object {$_.Address -eq "192.168.11.0"}).Name = "hx-storage-data"
(Get-ClusterNetwork | Where-Object {$_.Address -eq "192.168.73.0"}).Name = "LiveMigration"
(Get-ClusterNetwork | Where-Object {$_.Address -eq "172.18.0.0"}).Name = "vm-network"
```

Configure the Windows Failover Cluster Network Roles

Cluster networks are automatically configured during the cluster creation. To manually configure the cluster network roles based on their type of function, execute the following PowerShell commands on any one HyperFlex Hyper-V host:

Execute the following PowerShell commands to configure the cluster networks roles:

(Get-ClusterNetwork -Name "hx-inband-mgmt").Role = 3
(Get-ClusterNetwork -Name "hx-storage-data").Role = 0
(Get-ClusterNetwork -Name "LiveMigration").Role = 1
(Get-ClusterNetwork -Name "vm-network").Role = 0

Figure 109 PowerShell – Configure Cluster Network Roles

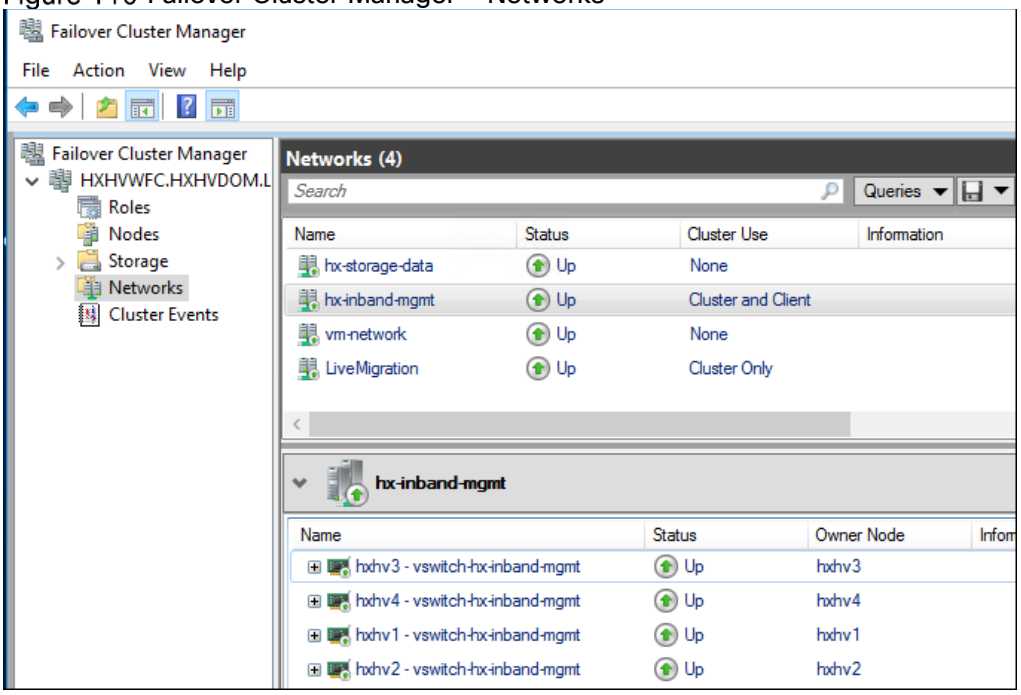
```
[hxhv1]: PS C:\Users\Administrator.HXHVDOM\Documents> (Get-ClusterNetwork -Name "hx-inband-mgmt").Role = 3
(Get-ClusterNetwork -Name "hx-storage-data").Role = 0
(Get-ClusterNetwork -Name "LiveMigration").Role = 1
(Get-ClusterNetwork -Name "vm-network").Role = 0
```

Role = 0 to disable cluster communication

Role = 1 to enable only cluster communication

Role = 3 to enable both cluster & client communication

Figure 110 Failover Cluster Manager – Networks



Configure the Windows Failover Cluster Network for Live Migration

To make sure that you are using the appropriate cluster network for Live Migration traffic configure the Live Migration settings by completing the following steps:

Execute the PowerShell command shown below to configure the cluster network for live migration traffic:

Get-ClusterResourceType -Name "Virtual Machine" | Set-ClusterParameter -Name MigrationExcludeNetworks -Value ([String]::Join(";",(Get-ClusterNetwork | Where-Object {$_.Name -ne "LiveMigration"}).ID))

Figure 111 PowerShell – Configure Live Migration Network

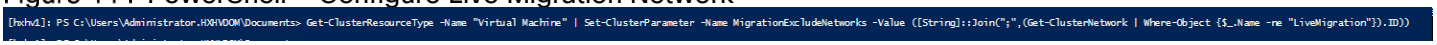
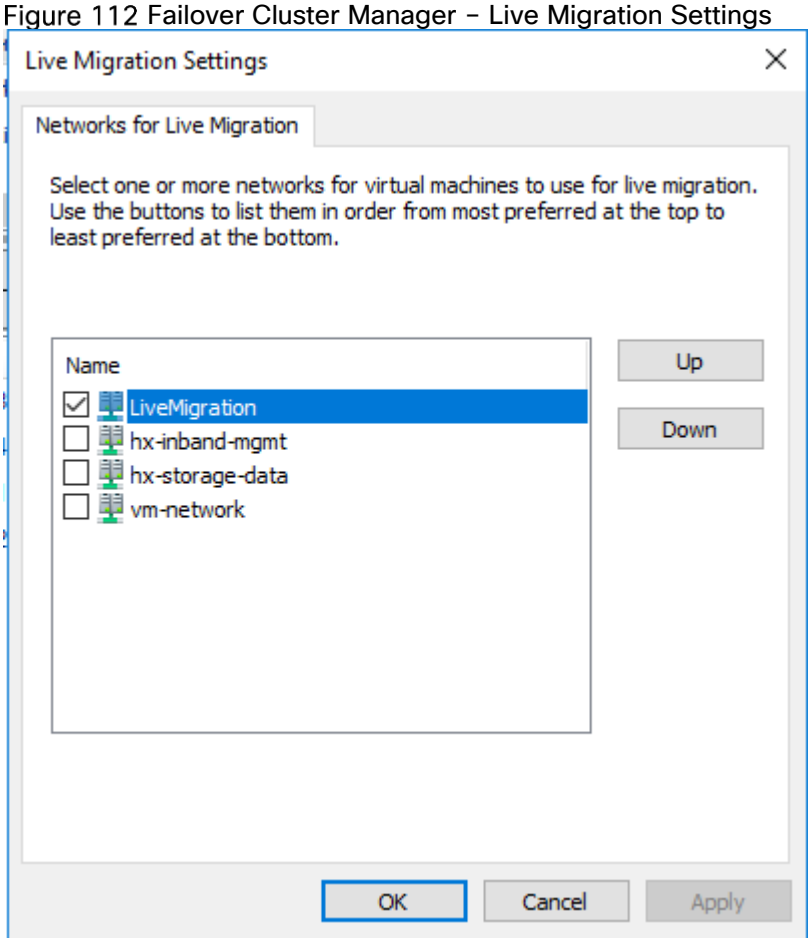


Figure 112 Failover Cluster Manager – Live Migration Settings

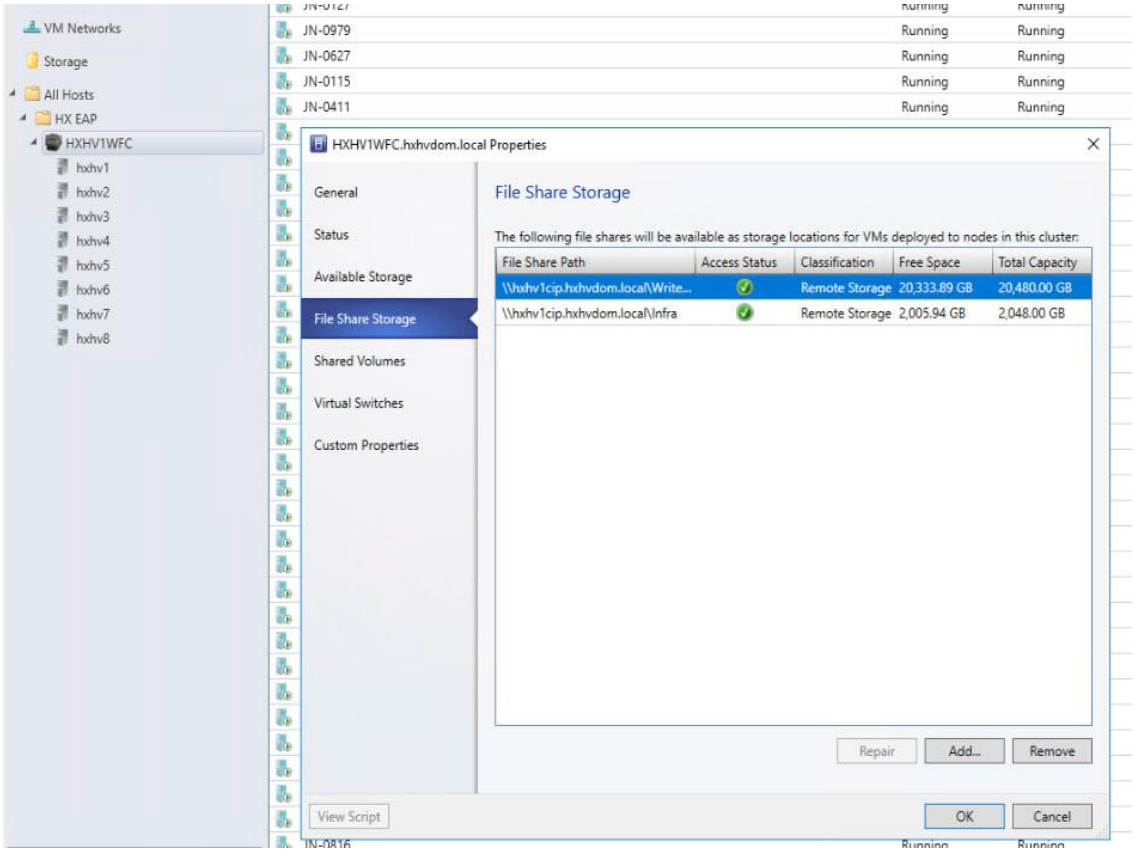


Storage

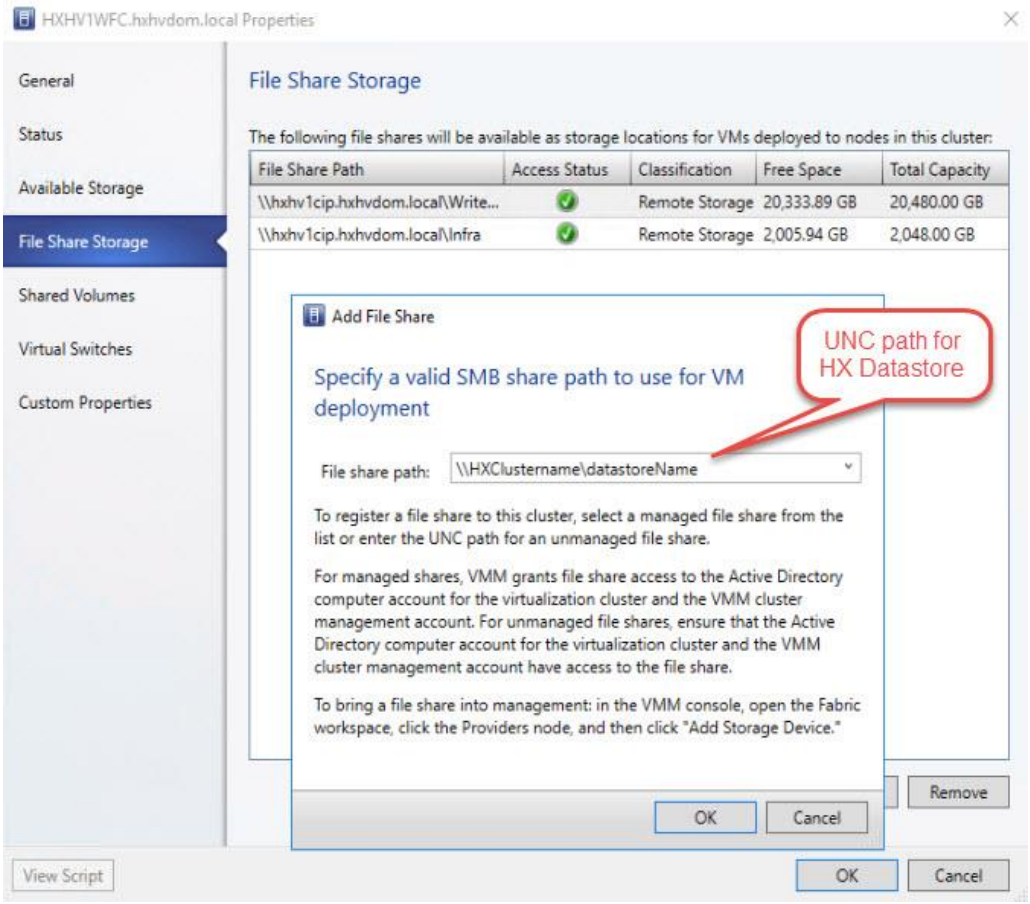
The data stores created in the HyperFlex Connect interface, creates an SMB share to use to place Virtual Machines. The naming convention is '\\hxClustername\DatastoreName'.

To add the HX Datastores to the HX cluster, complete the following steps:

1. Right-click the Cluster 'HXHV1WFC', select Properties and click 'File Share Storage'.



2. Click Add to specify the UNC path for the datastore.


HXHV1WFC.hxhvdom.local Properties
General
Status
Available Storage
File Share Storage
Shared Volumes
Virtual Switches
Custom Properties
File Share Storage
The following file shares will be available as storage locations for VMs deployed to nodes in this cluster:
File Share Path
Access Status
Classification
Free Space
Total Capacity
\\hxhv1cip.hxhvdom.local\Write...
Remote Storage
20,333.89 GB
20,480.00 GB
\\hxhv1cip.hxhvdom.local\Infra
Remote Storage
2,005.94 GB
2,048.00 GB
Add File Share
Specify a valid SMB share path to use for VM deployment
UNC path for HX Datastore
File share path:
\\HXClustername\datastoreName
To register a file share to this cluster, select a managed file share from the list or enter the UNC path for an unmanaged file share.
For managed shares, VMM grants file share access to the Active Directory computer account for the virtualization cluster and the VMM cluster management account. For unmanaged file shares, ensure that the Active Directory computer account for the virtualization cluster and the VMM cluster management account have access to the file share.
To bring a file share into management: in the VMM console, open the Fabric workspace, click the Providers node, and then click "Add Storage Device."
OK
Cancel
Remove
View Script
OK
Cancel

3. Click OK.

Build the Virtual Machines and Environment for Workload Testing

Software Infrastructure Configuration

This section details how to configure the software infrastructure components that comprise this solution.

Install and configure the infrastructure virtual machines by following the process provided in Table 29

Table 29 Test Infrastructure Virtual Machine Configuration

Configuration	Citrix XenDesktop Controllers Virtual Machines	Citrix Profile Servers Virtual Machines
Operating System	Microsoft Windows Server 2016	Microsoft Windows Server 2016
Virtual CPU amount	6	8
Memory amount	8 GB	8 GB
Network	VMNIC	Network
Disk-1 (OS) size and location	40 GB	Disk-1 (OS) size and location
Disk-2 size and location	–	
Configuration	Microsoft Active Directory DC's Virtual Machines	
Operating system	Microsoft Windows Server 2016	Operating system
Virtual CPU amount	4	
Memory amount	4 GB	
Network	VMNIC	
Disk size and location	40 GB	
Configuration	Microsoft SQL Server Virtual Machine	Citrix StoreFront Virtual Machine
Operating system	Microsoft Windows Server 2016	Operating system
Virtual CPU amount	4	4
Memory amount	16 GB	8 GB
Network	VMNIC	Network
Disk-1 (OS) size and location	40 GB	Disk-1 (OS) size and location
Disk-2 size and location	200 GB Infra-DS volume	Disk-2 size and location
Configuration	Citrix License Server Virtual Machine	NetScaler VPX Appliance Virtual Machine
Operating system	Microsoft Windows Server 2016	NS11.1 52.13.nc
Virtual CPU amount	4	2
Memory amount	4 GB	2 GB
Network	VMNIC	Network

Disk size and location	40 GB	20 GB

Prepare the Master Images

This section details how to create the golden (or master) images for the environment. VMs for the master images must first be installed with the software components needed to build the golden images. For this CVD, the images contain the basics needed to run the Login VSI workload.

To prepare the master VMs for the Hosted Virtual Desktops (HVDs) and Hosted Shared Desktops (HSDs), there are three major steps to complete when the base virtual machine has been created:

- Installing OS
- Installing application software
- Installing the Virtual Delivery Agents (VDAs)

The master image HVD and HSD VMs were configured as listed in Table 30 :

Table 30 HVD and HSD Configurations

Configuration	HVDI Virtual Machines	HSD Virtual Machines
Operating system	Microsoft Windows 10 64-bit	Microsoft Windows Server 2016
Virtual CPU amount	2	8
Memory amount	4.0 GB (reserved)	24 GB (reserved)
Network	VMNIC vm-network	VMNIC vm-network
Citrix PVS vDisk size and location	24 GB WriteCache Volume	40 GB WriteCache Volume
Citrix PVS write cache Disk size	6 GB	24 GB
Additional software used for testing	Microsoft Office 2016 Login VSI 4.1.32 (Knowledge Worker Workload)	Microsoft Office 2016 Login VSI 4.1.32 (Knowledge Worker Workload)

Install and Configure XenDesktop Delivery Controller, Citrix Licensing, and StoreFront

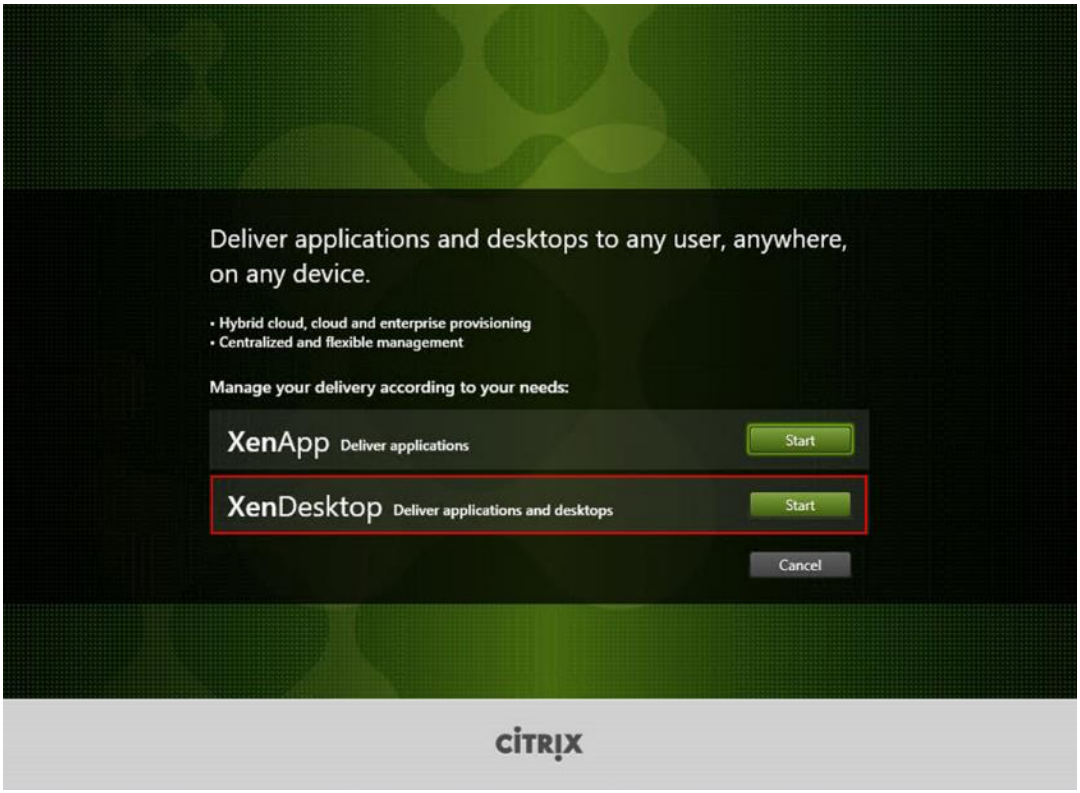
This section details the installation of the core components of the XenDesktop/XenApp 7.16 system. This CVD provides the process to install two XenDesktop Delivery Controllers to support hosted shared desktops (HSD), non-persistent virtual desktops (VDI), and persistent virtual desktops (VDI).

The process of installing the XenDesktop Delivery Controller also installs other key XenDesktop software components, including Studio, which is used to create and manage infrastructure components, and Director, which is used to monitor performance and troubleshoot problems.

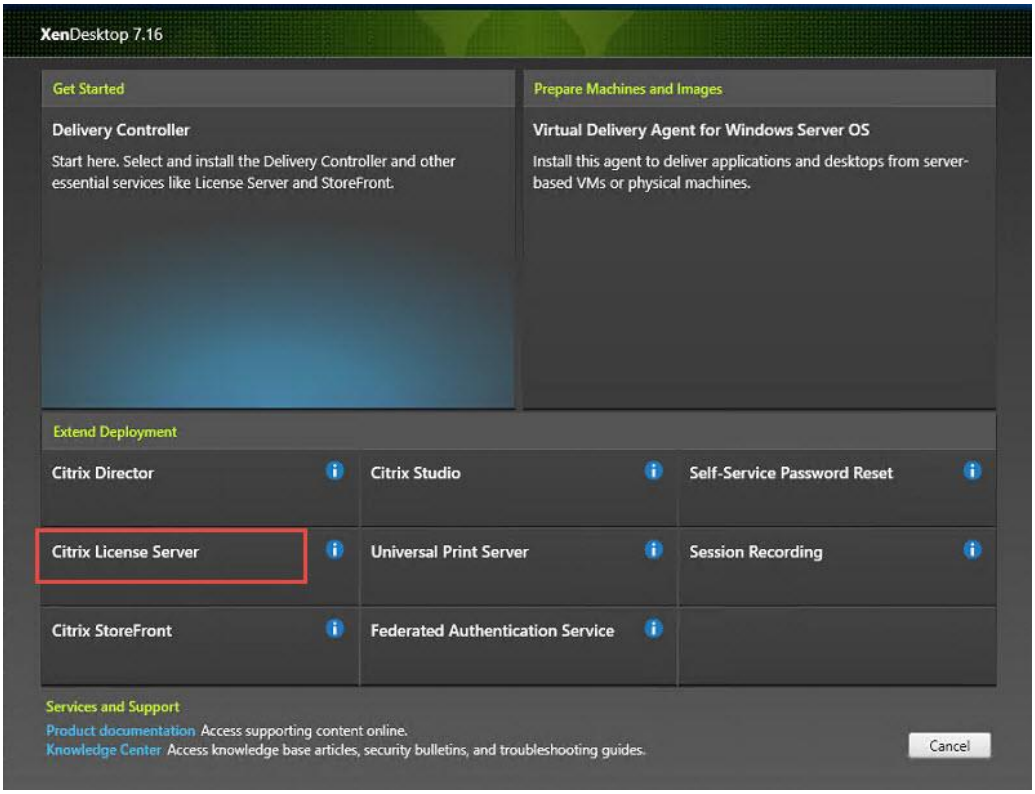
Install Citrix License Server

To install the Citrix License Server, complete the following steps:

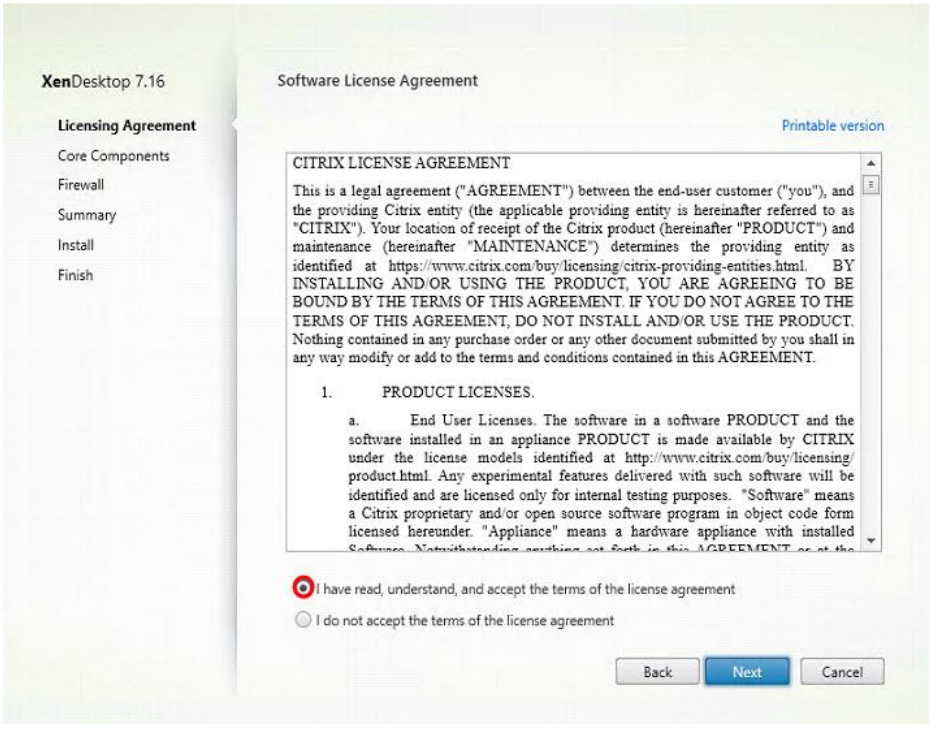
1. To begin the installation, connect to the first Citrix License server and launch the installer from the Citrix XenDesktop 7.16 ISO.
2. Click Start.



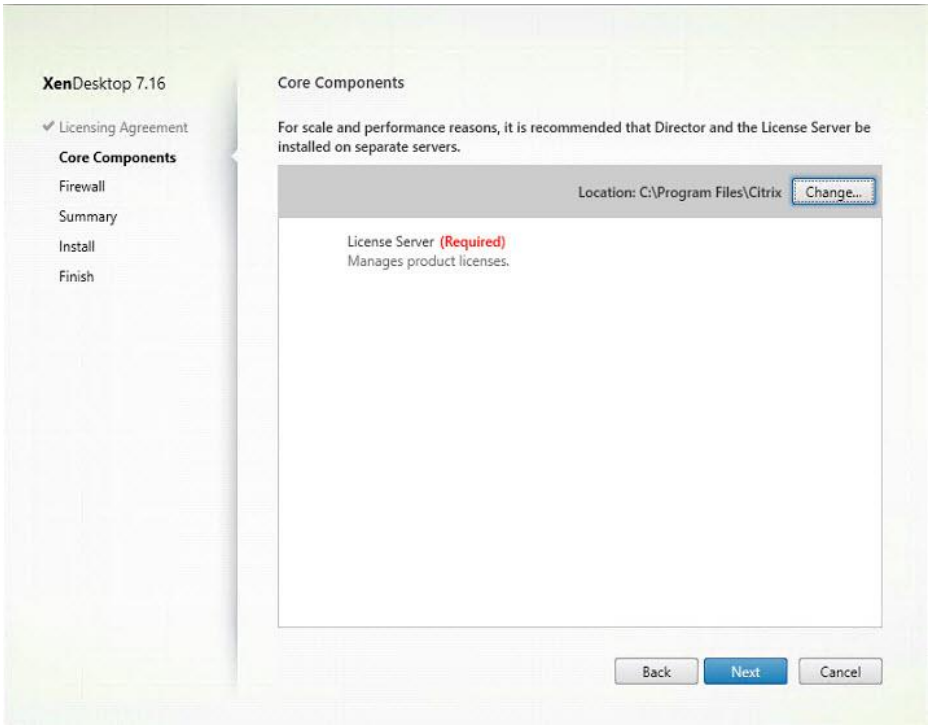
3. Click “Extend Deployment – Citrix License Server.”



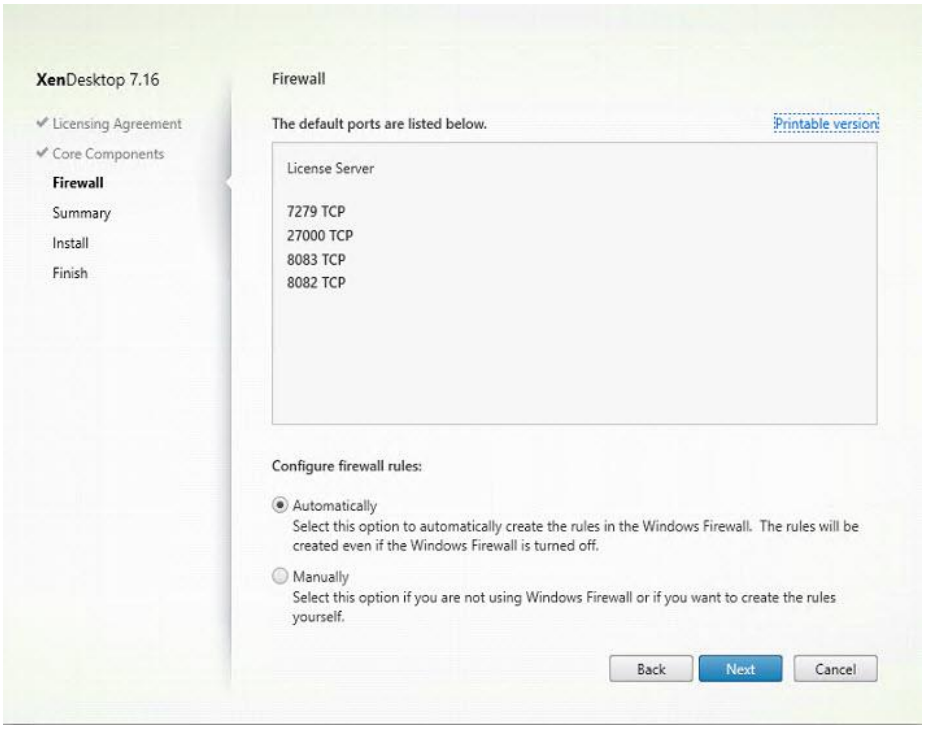
4. Read the Citrix License Agreement.
5. If acceptable, indicate your acceptance of the license by selecting the “I have read, understand, and accept the terms of the license agreement” radio button.
6. Click Next.



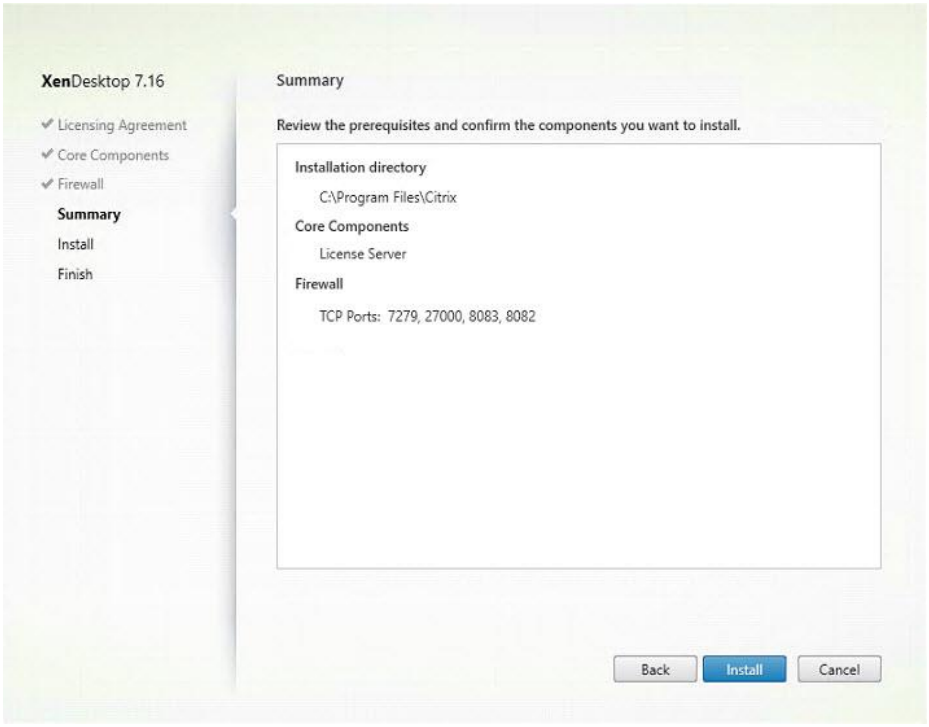
7. Click Next.



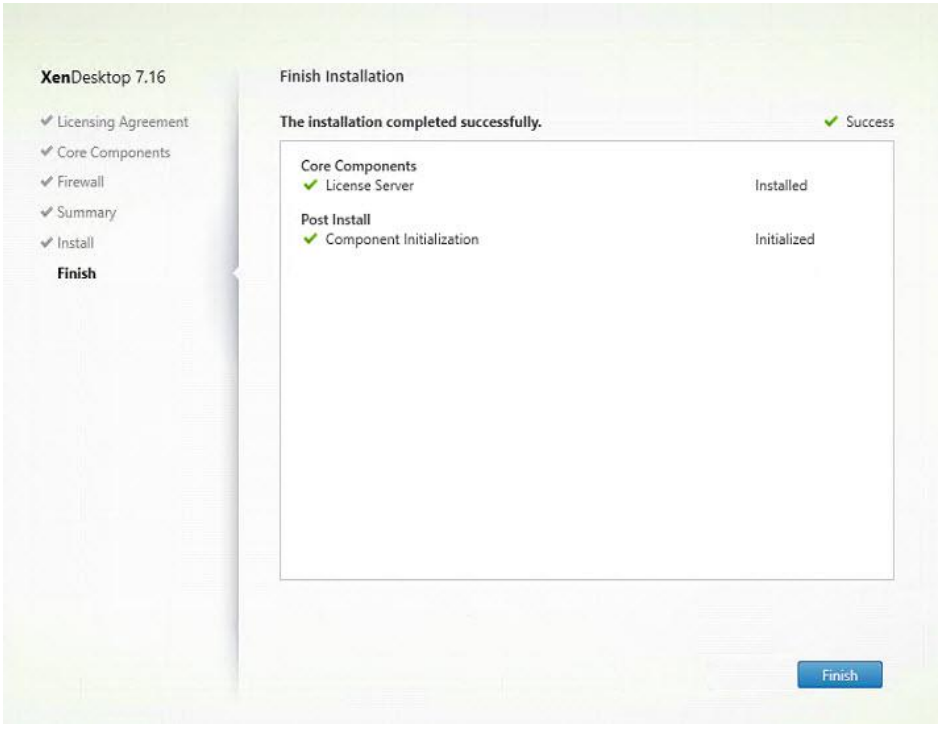
8. Select the default ports and automatically configured firewall rules.
9. Click Next.



10. Click Install.



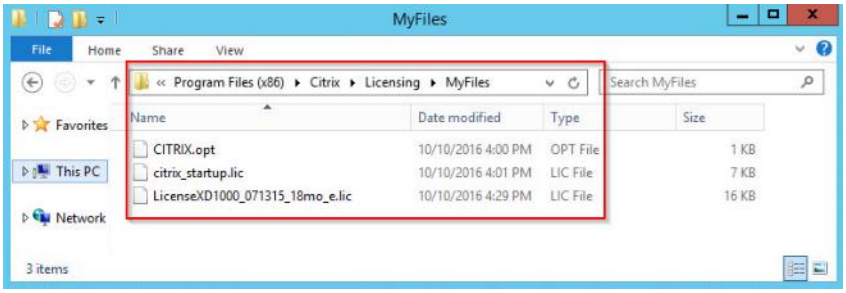
11. Click Finish to complete the installation.



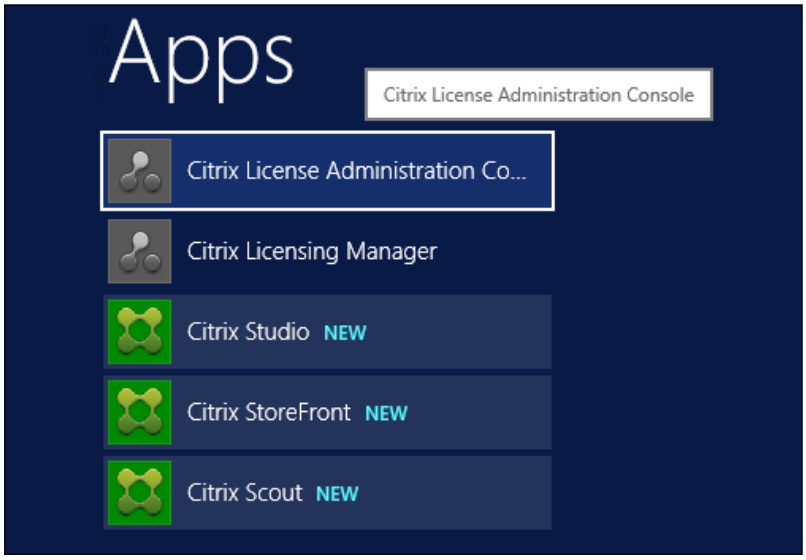
Install Citrix Licenses

To install the Citrix Licenses, complete the following steps:

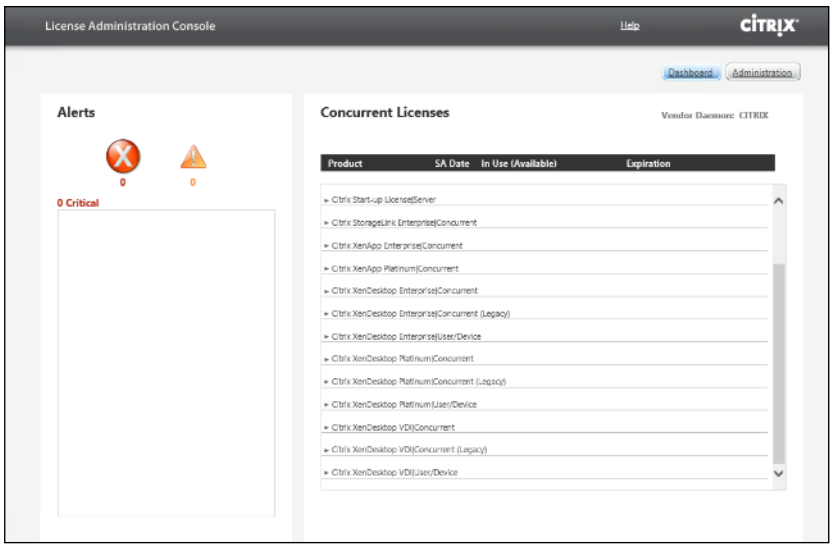
1. Copy the license files to the default location (C:\Program Files (x86)\Citrix\Licensing\ MyFiles) on the license server.



2. Restart the server or Citrix licensing services so that the licenses are activated.
3. Run the application Citrix License Administration Console.



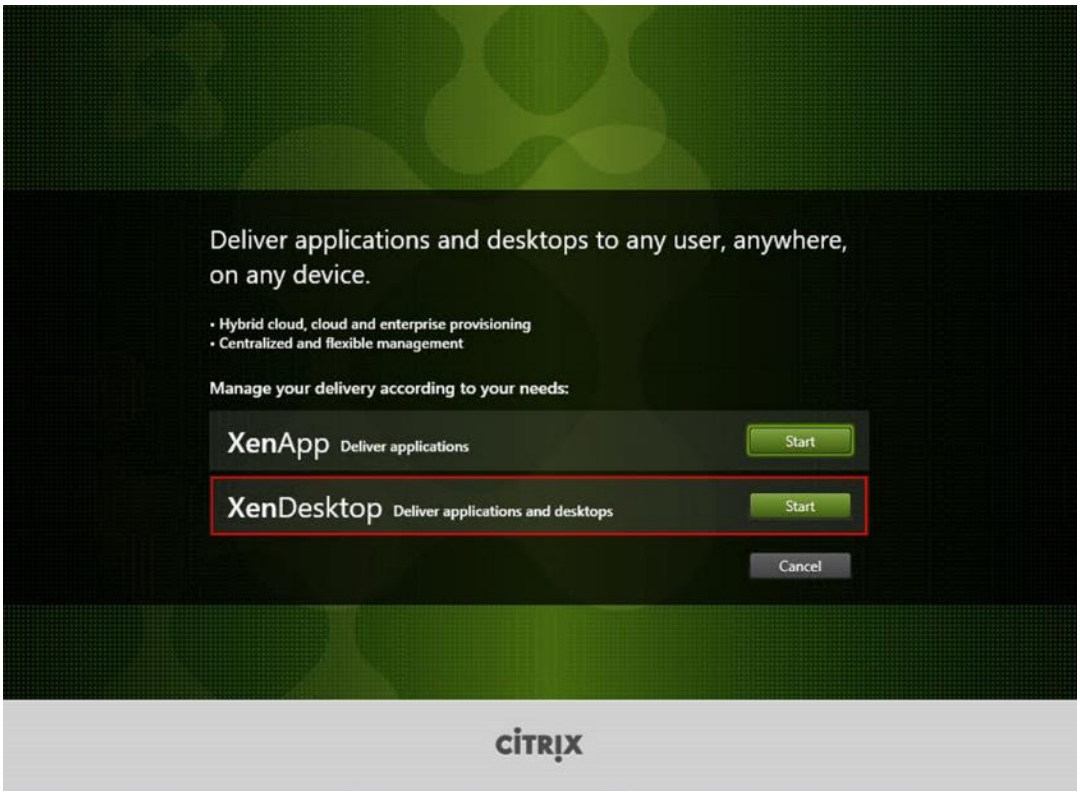
4. Confirm that the license files have been read and enabled correctly.



Install XenDesktop

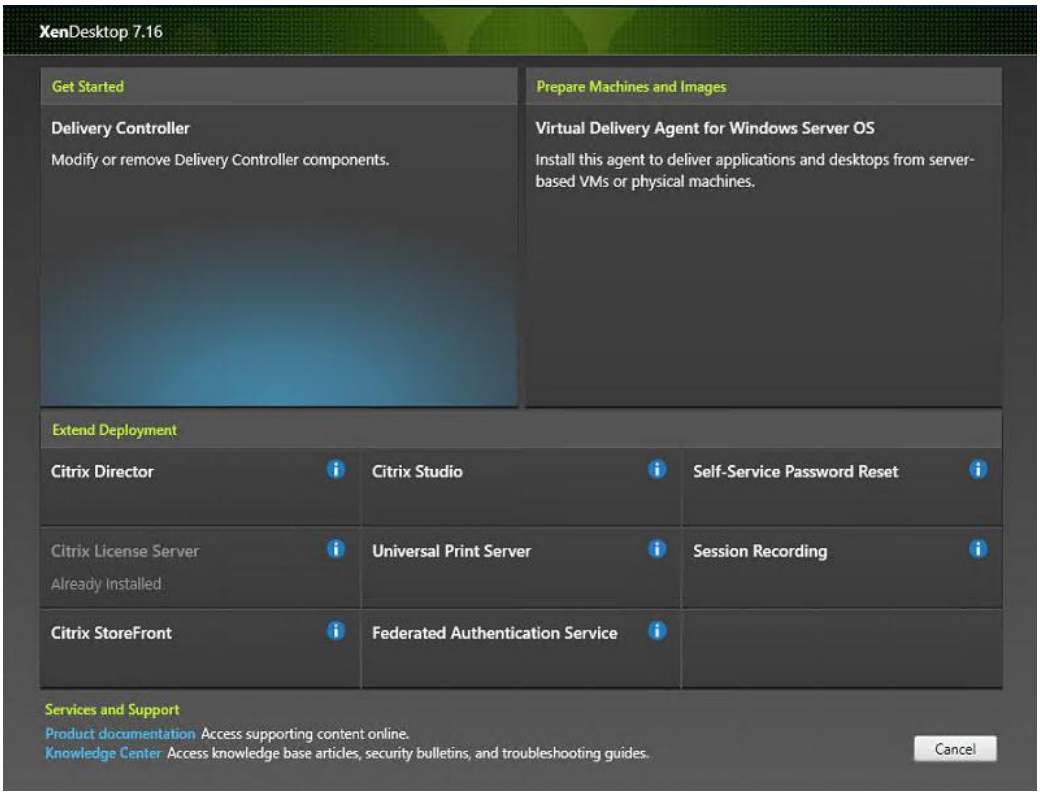
To install XenDesktop, complete the following steps:

1. To begin the installation, connect to the first XenDesktop server and launch the installer from the Citrix XenDesktop 7.16 ISO.
2. Click Start.

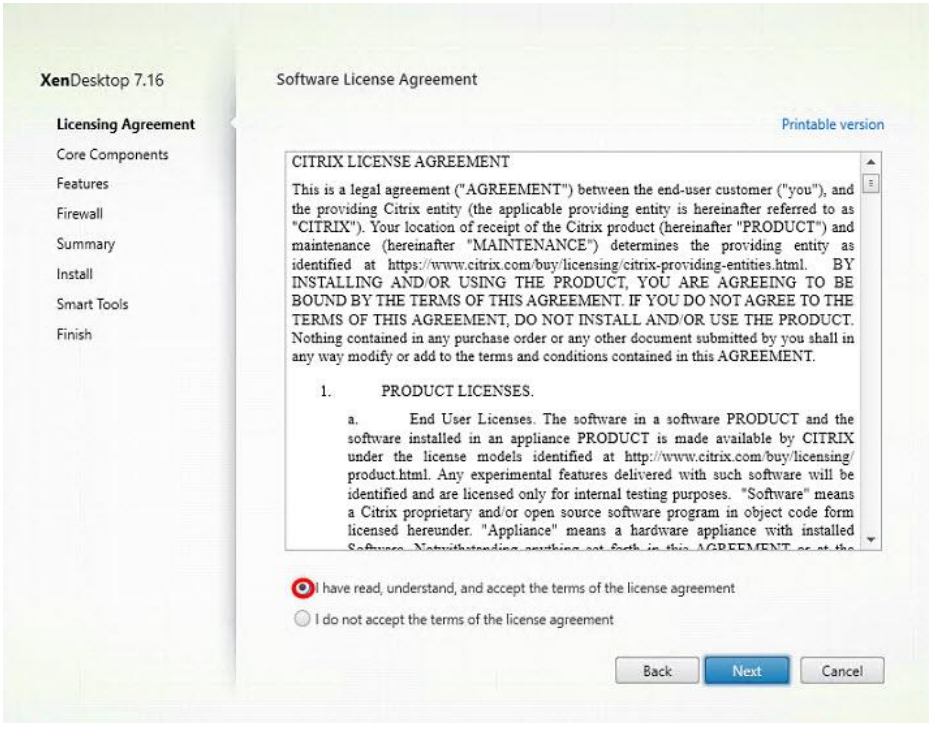


The installation wizard presents a menu with three subsections.

3. Click “Get Started - Delivery Controller.”



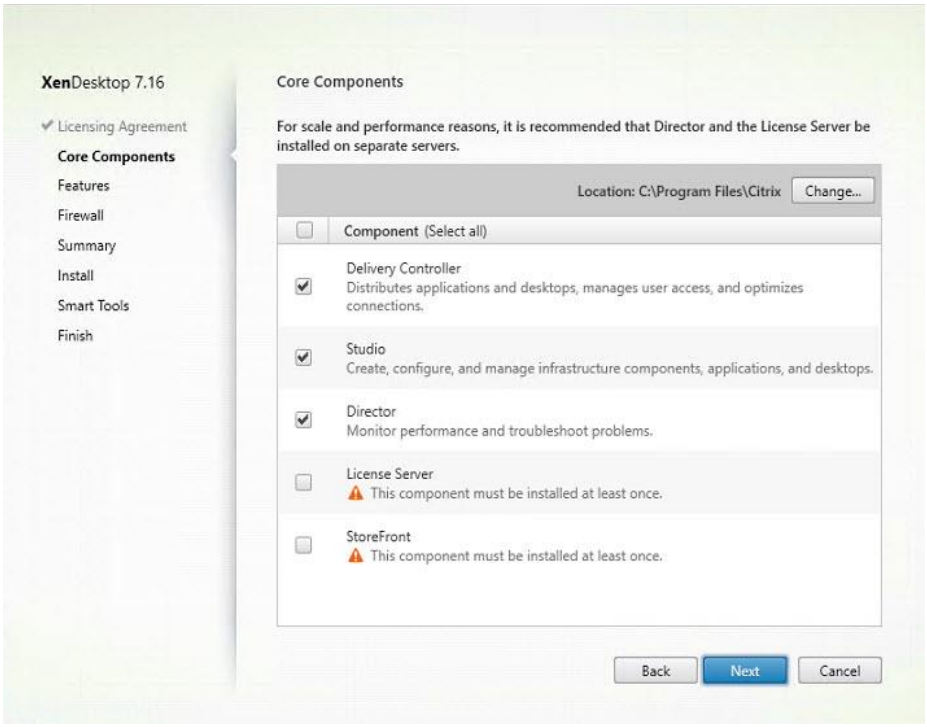
4. Read the Citrix License Agreement.
5. If acceptable, indicate your acceptance of the license by selecting the “I have read, understand, and accept the terms of the license agreement” radio button.
6. Click Next.



7. Select the components to be installed on the first Delivery Controller Server:

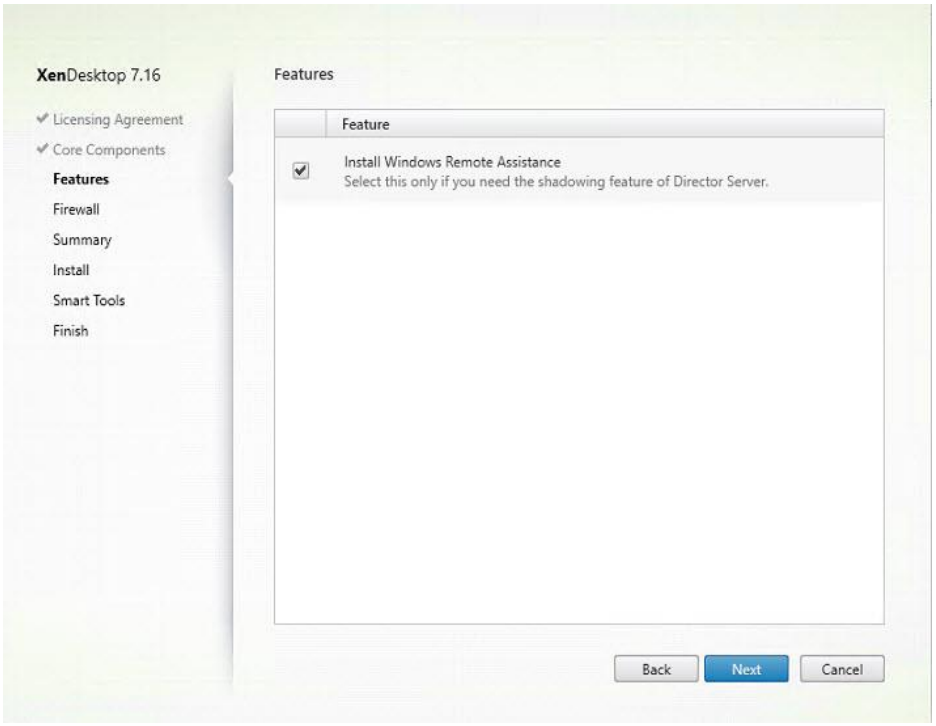
a. Delivery Controller
b. Studio
c. Director

8. Click Next.

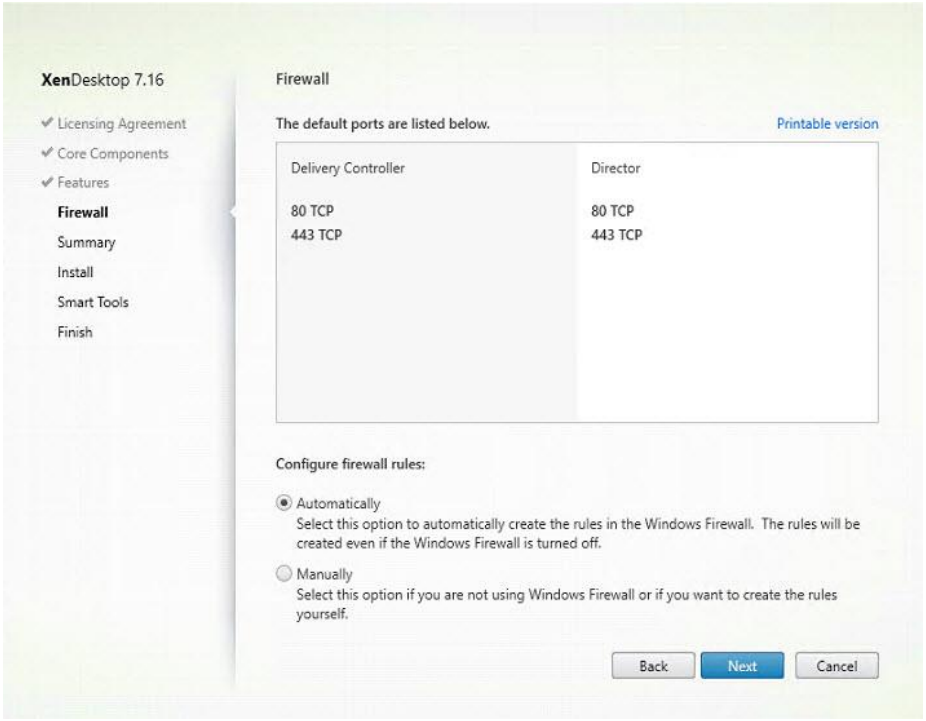


Dedicated StoreFront and License servers should be implemented for large scale deployments.

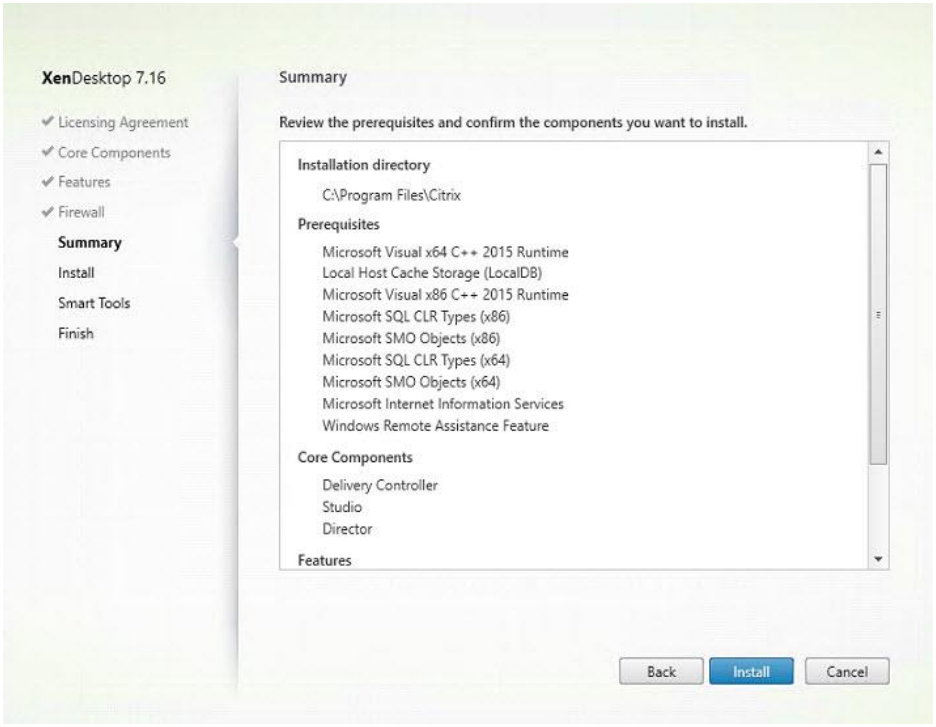
9. Since a SQL Server will be used to Store the Database, leave “Install Microsoft SQL Server 2012 SP1 Express” unchecked.
10. Click Next.



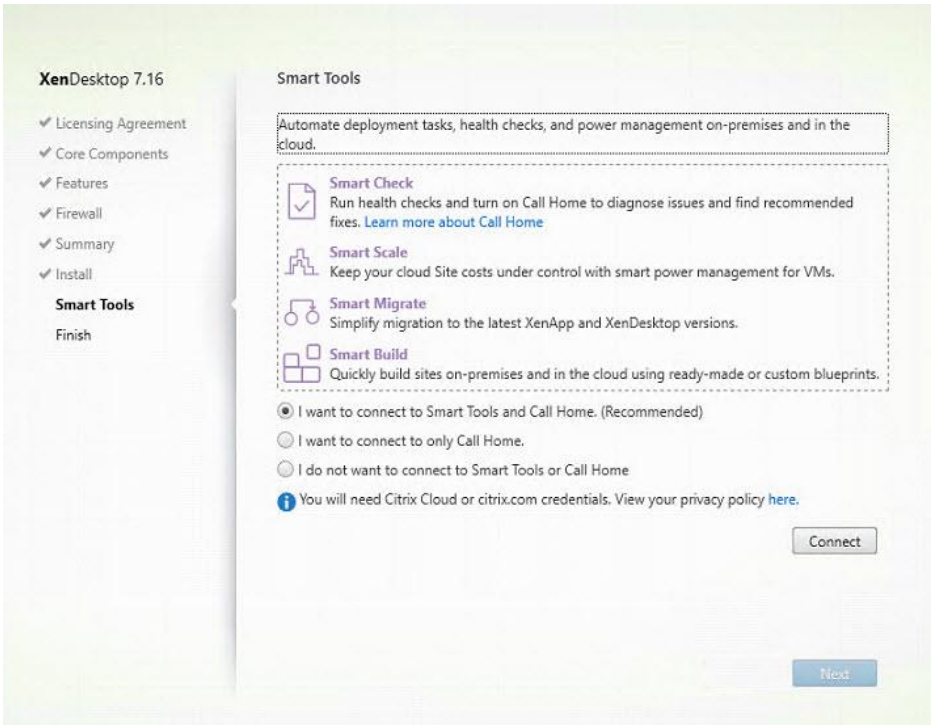
11. Select the default ports and automatically configured firewall rules.
12. Click Next.



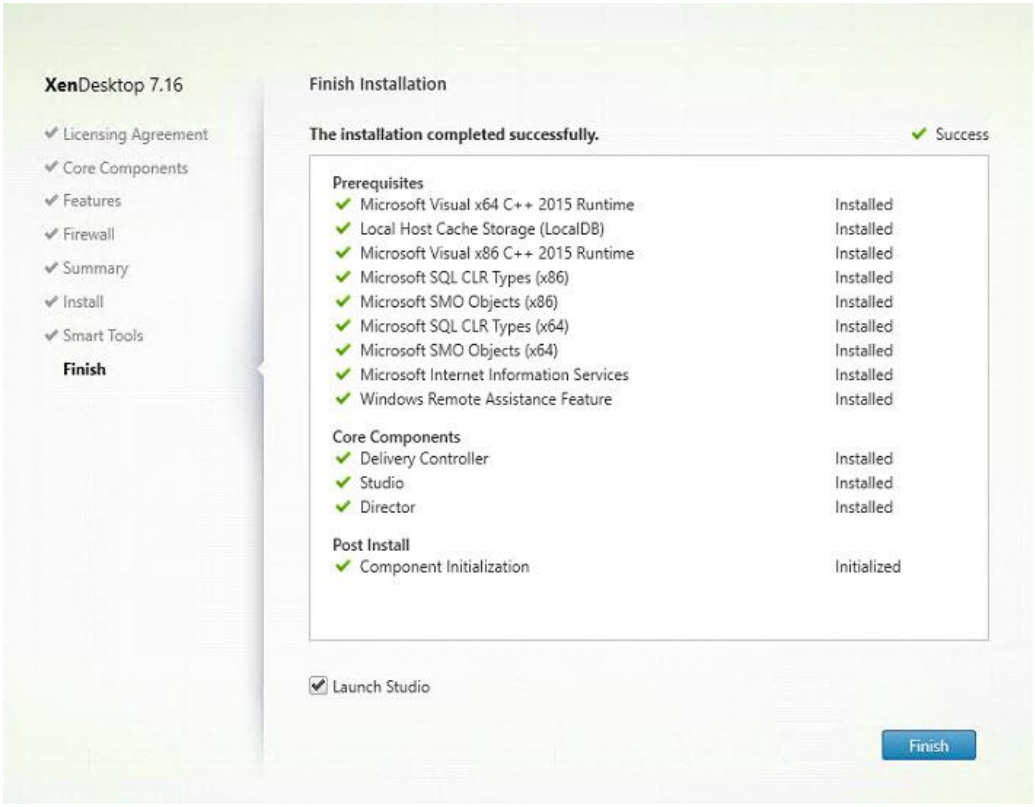
13. Click Install to begin the installation.



14. (Optional) Click the Call Home participation.
15. Click Next.



16. Click Finish to complete the installation.
17. (Optional) Check Launch Studio to launch Citrix Studio Console.



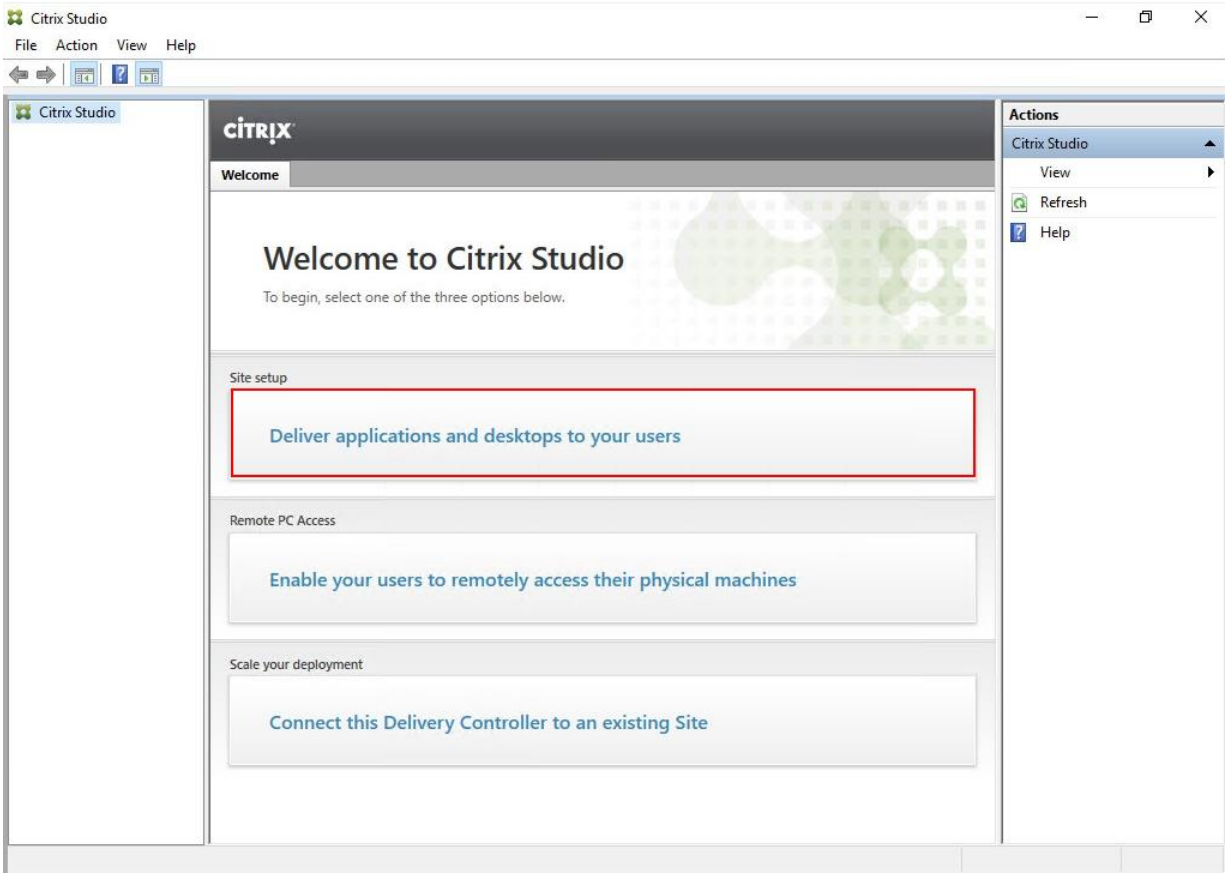
Configure the XenDesktop Site

Citrix Studio is a management console that allows you to create and manage infrastructure and resources to deliver desktops and applications. Replacing Desktop Studio from earlier releases, it provides wizards to set up your environment, create workloads to host applications and desktops, and assign applications and desktops to users.

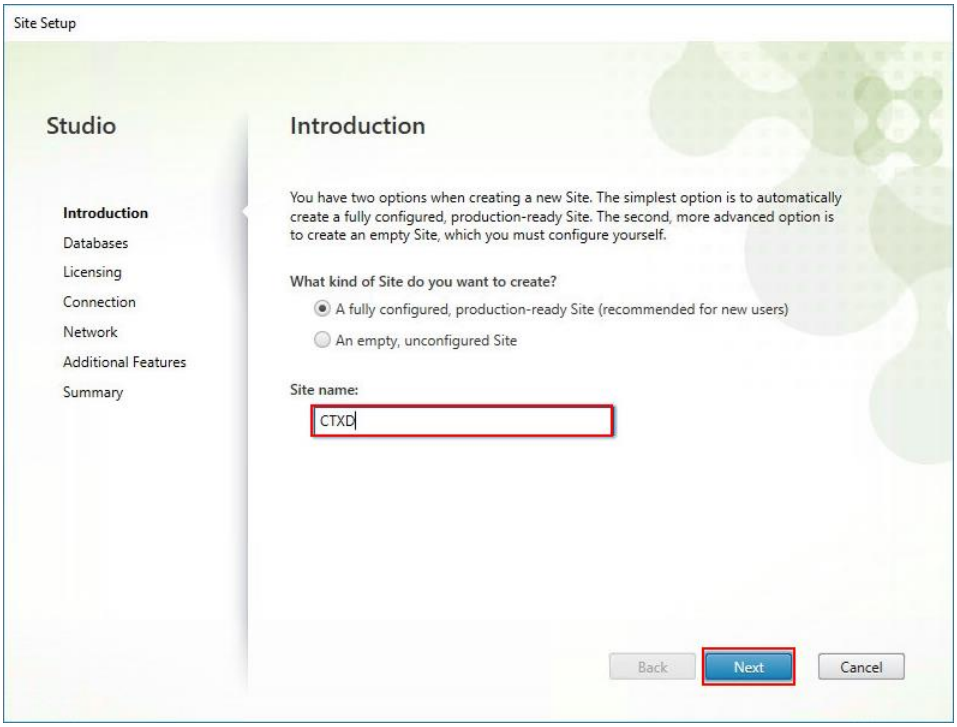
Citrix Studio launches automatically after the XenDesktop Delivery Controller installation, or if necessary, it can be launched manually. Citrix Studio is used to create a Site, which is the core XenDesktop 7.16 environment consisting of the Delivery Controller and the Database.

To configure XenDesktop, complete the following steps:

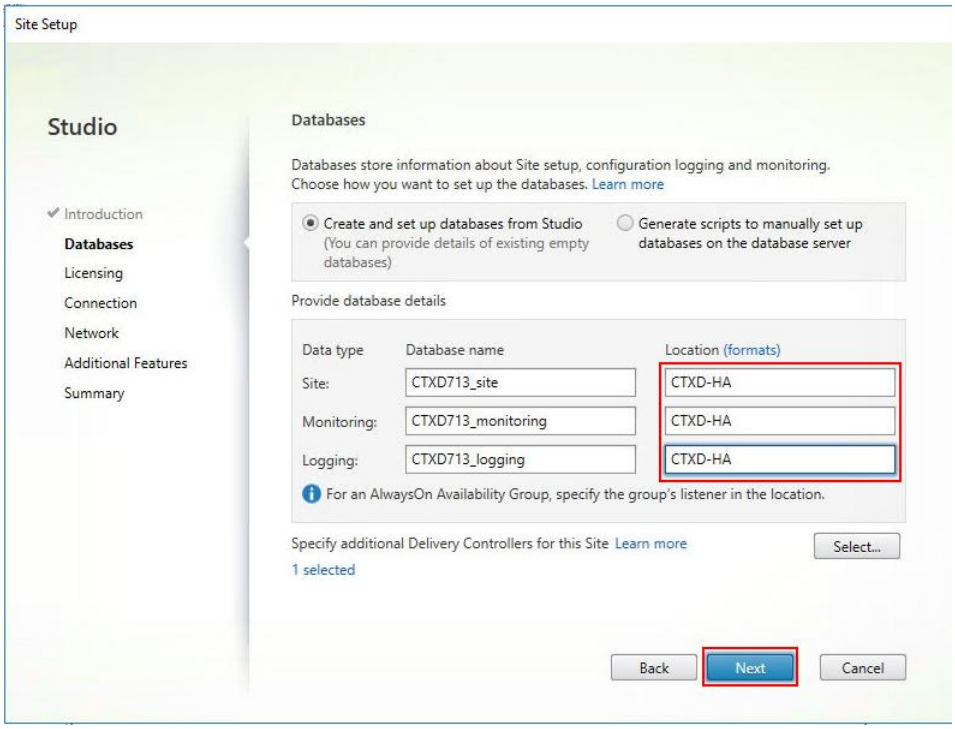
1. From Citrix Studio, click the Deliver applications and desktops to your users button.



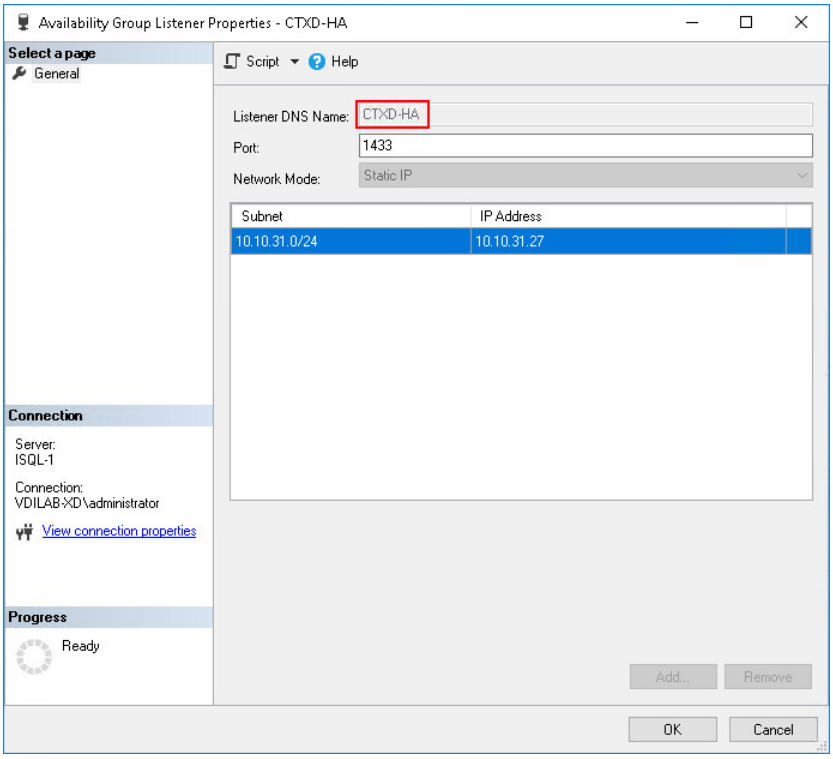
2. Select the “A fully configured, production-ready Site” radio button.
3. Enter a site name.
4. Click Next.



5. Provide the Database Server Locations for each data type and click Next.



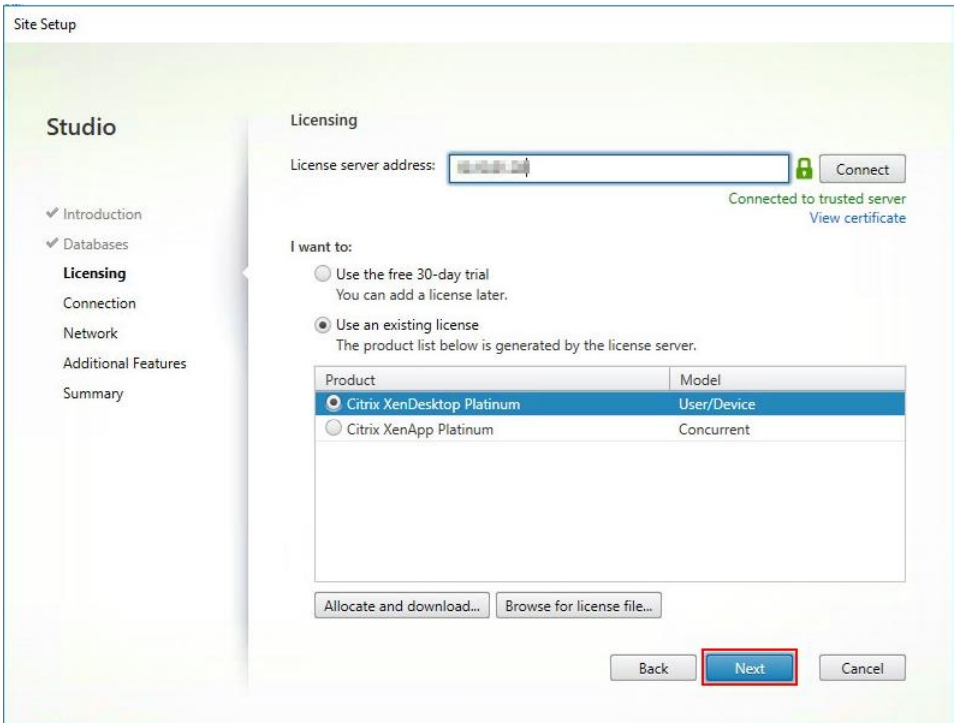
6. For an AlwaysOn Availability Group, use the group's listener DNS name.



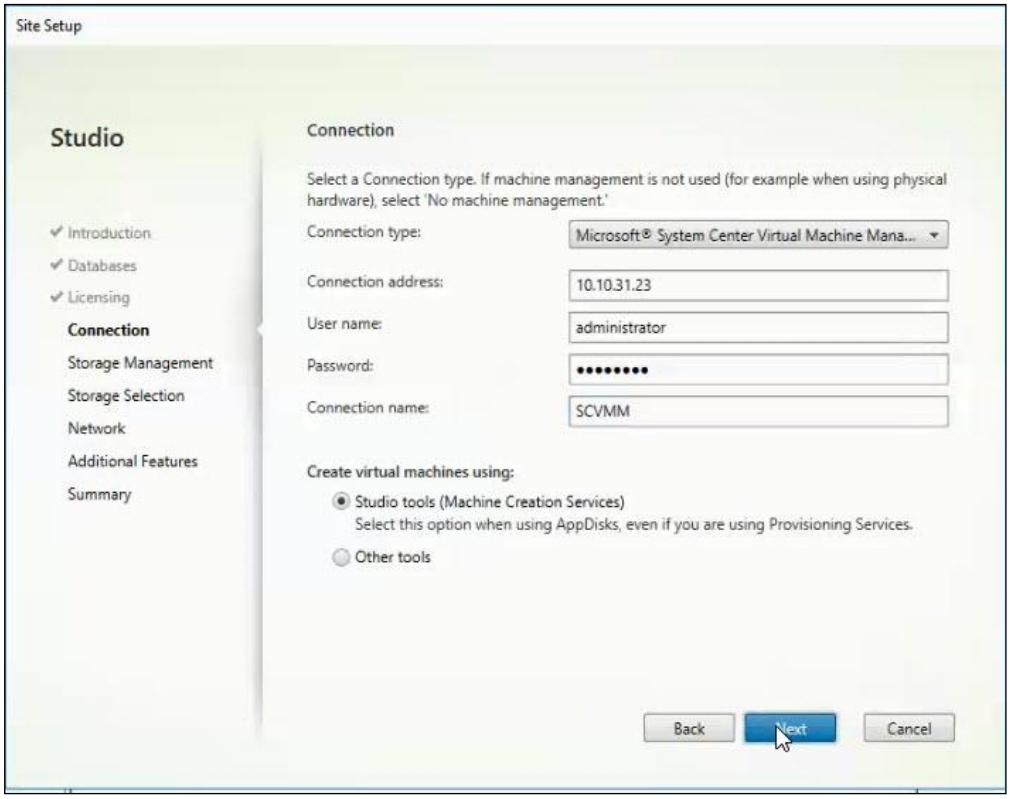
7. Provide the FQDN of the license server.
8. Click Connect to validate and retrieve any licenses from the server.

If no licenses are available, you can use the 30-day free trial or activate a license file.

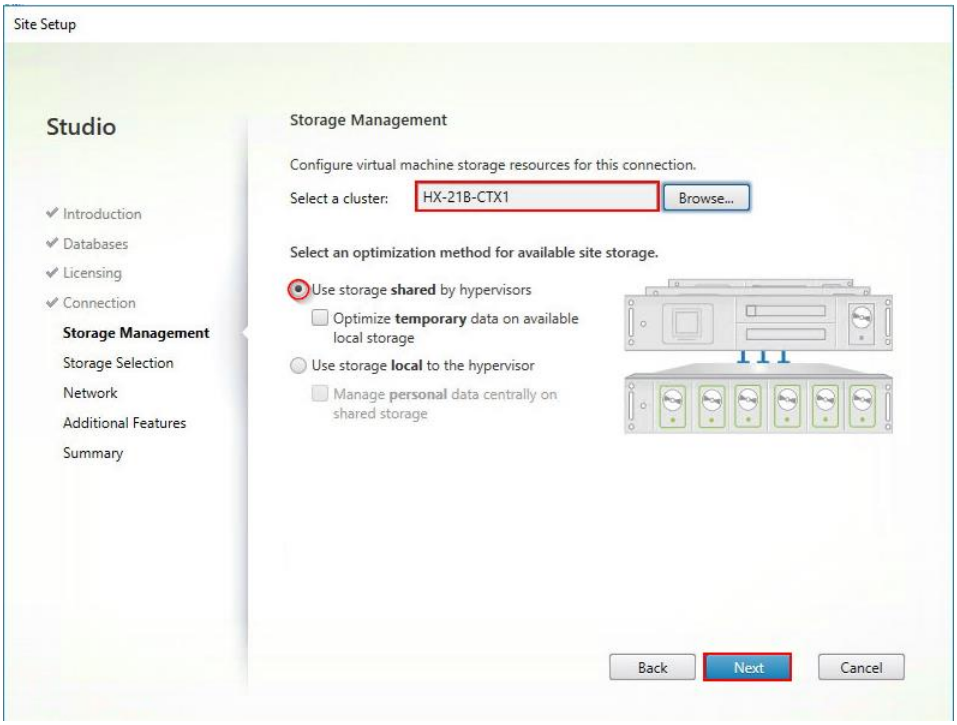
9. Select the appropriate product edition using the license radio button.
10. Click Next.



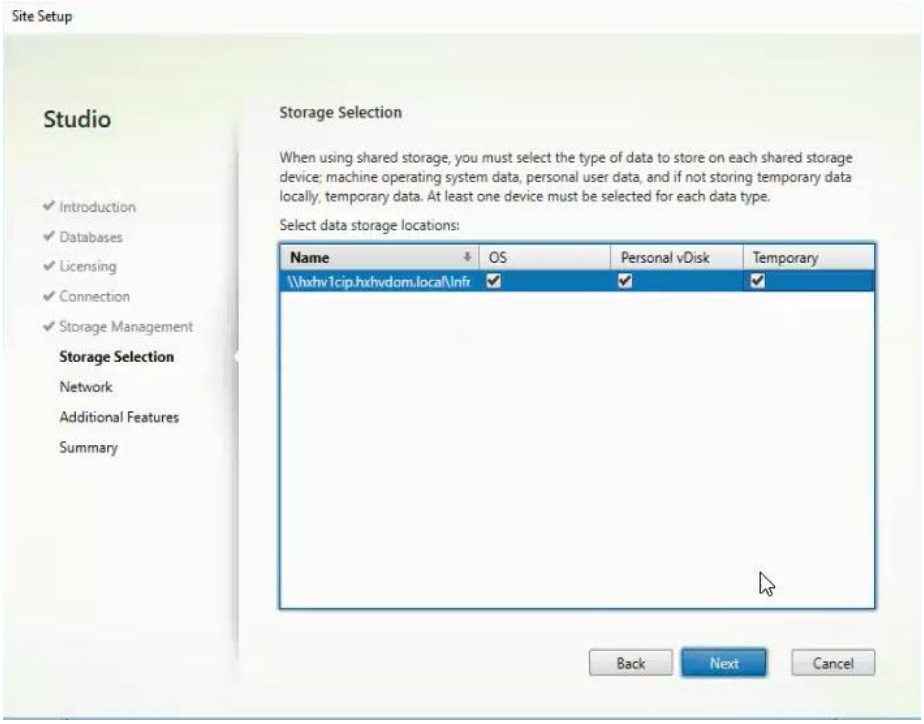
11. Select the Connection type of System Center Virtual Machine Manager.
12. Enter the FQDN of the SCVMM server (in Server_FQDN/sdk format).
13. Enter the username (in domain\username format) for the Hyper-V account.
14. Provide the password for the Domain Admin account.
15. Provide a connection name.
16. Select the Other tools radio button.



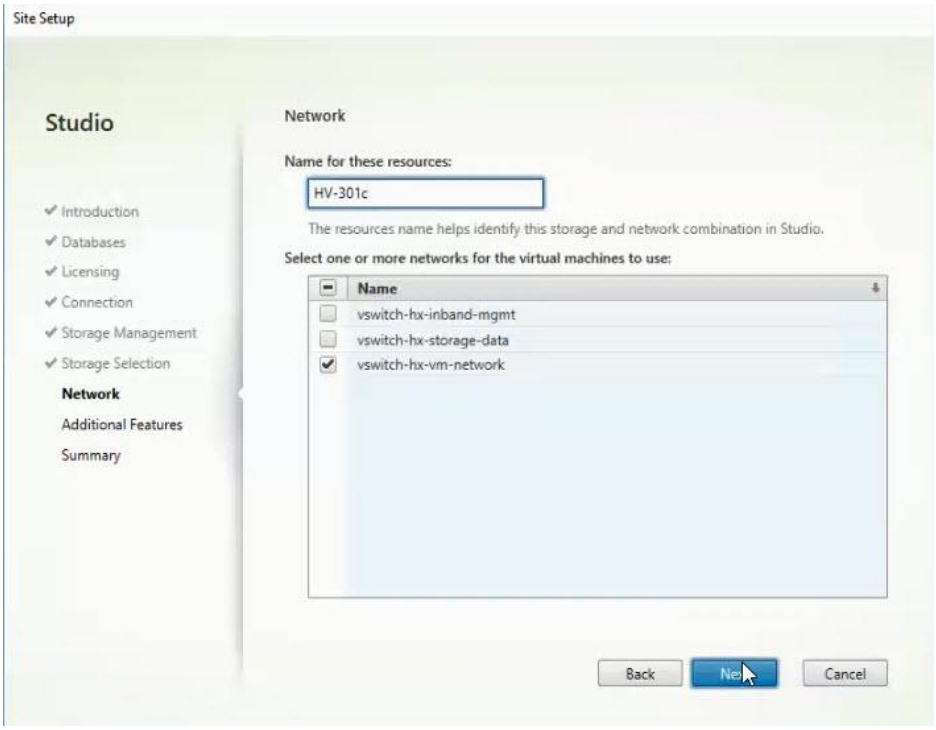
17. Click Next.
18. Select HyperFlex Cluster that will be used by this connection.
19. Check Studio Tools radio button required to support desktop provisioning task by this connection.
20. Click Next.



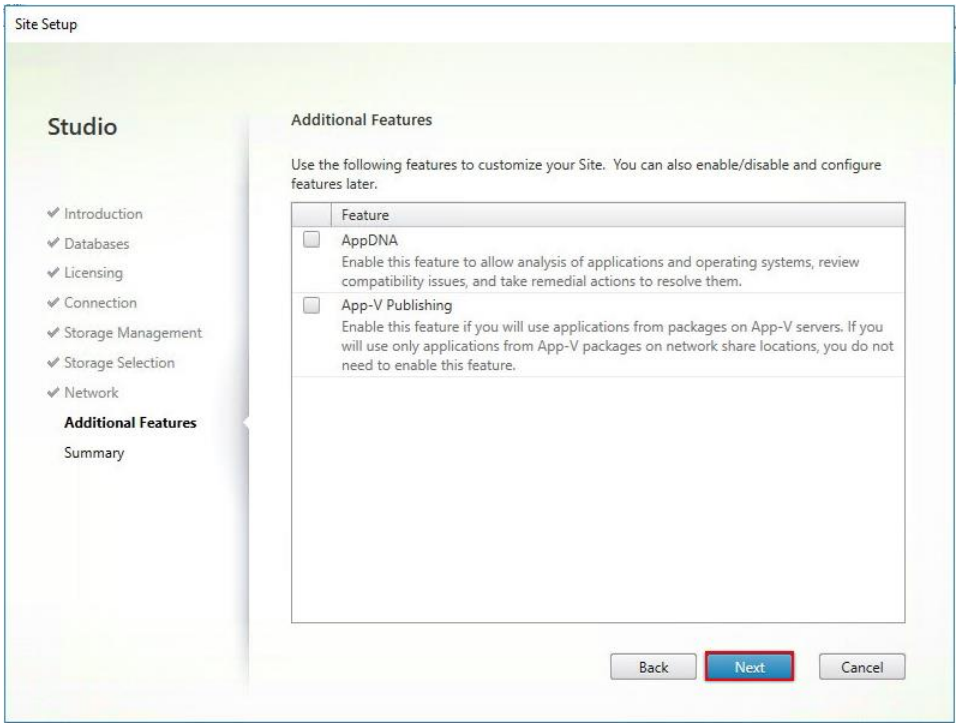
21. Make Storage selection to be used by this connection.
22. Click Next.



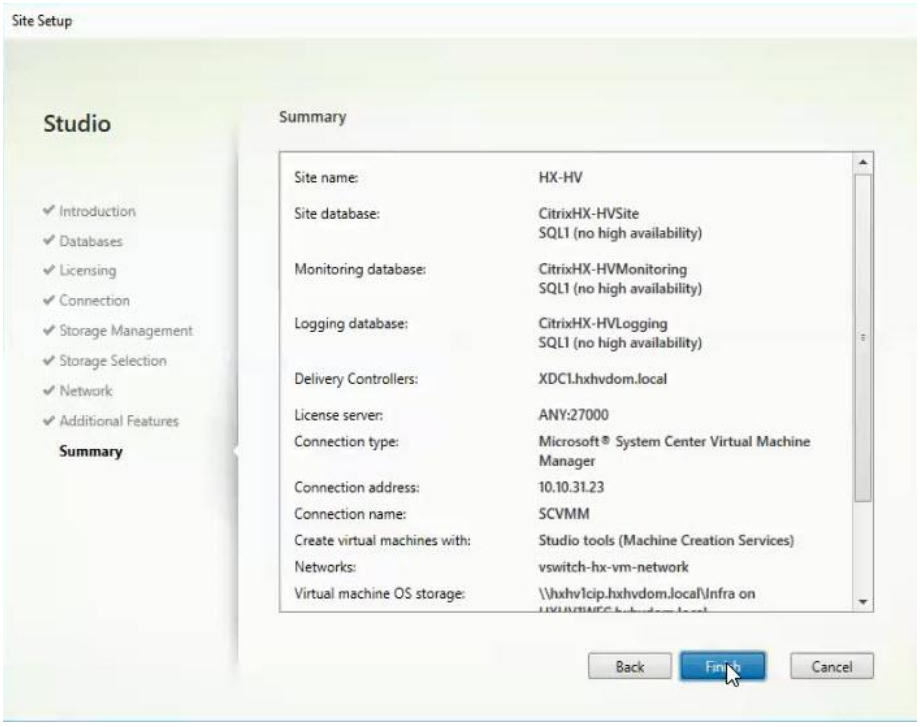
23. Make Network selection to be used by this connection.
24. Click Next.



25. Select Additional features.
26. Click Next.



27. Review Site configuration Summary and click Finish.

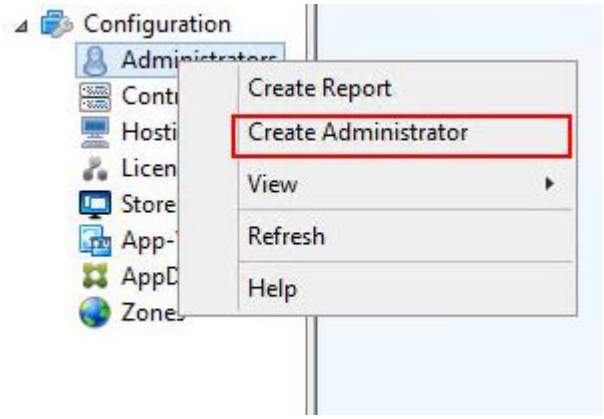


Configure the XenDesktop Site Administrators

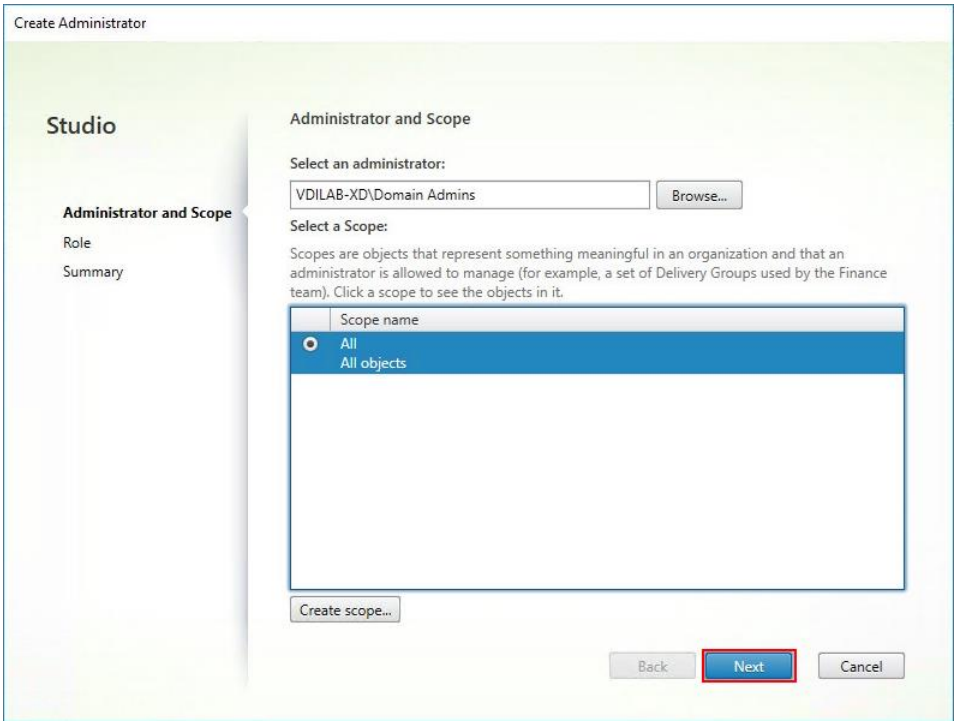
To configure the XenDesktop site administrators, complete the following steps:

1. Connect to the XenDesktop server and open Citrix Studio Management console.

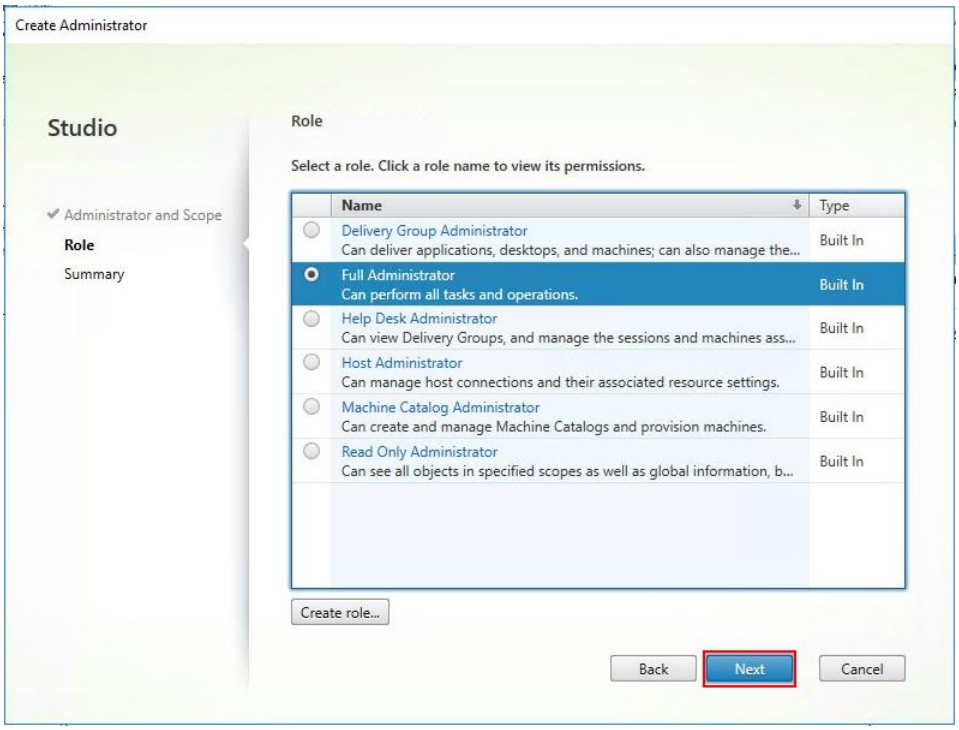
2. From the Configuration menu, right-click Administrator and select Create Administrator from the drop-down list.



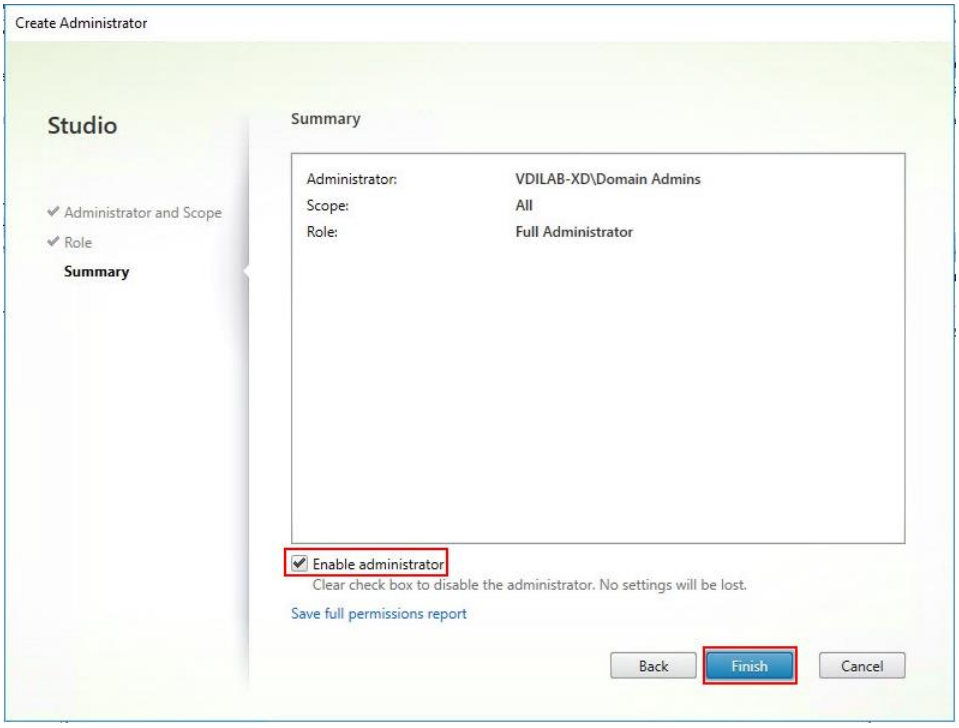
3. Select/Create appropriate scope and click Next.



4. Choose an appropriate Role.



5. Review the Summary, check Enable administrator, and click Finish.



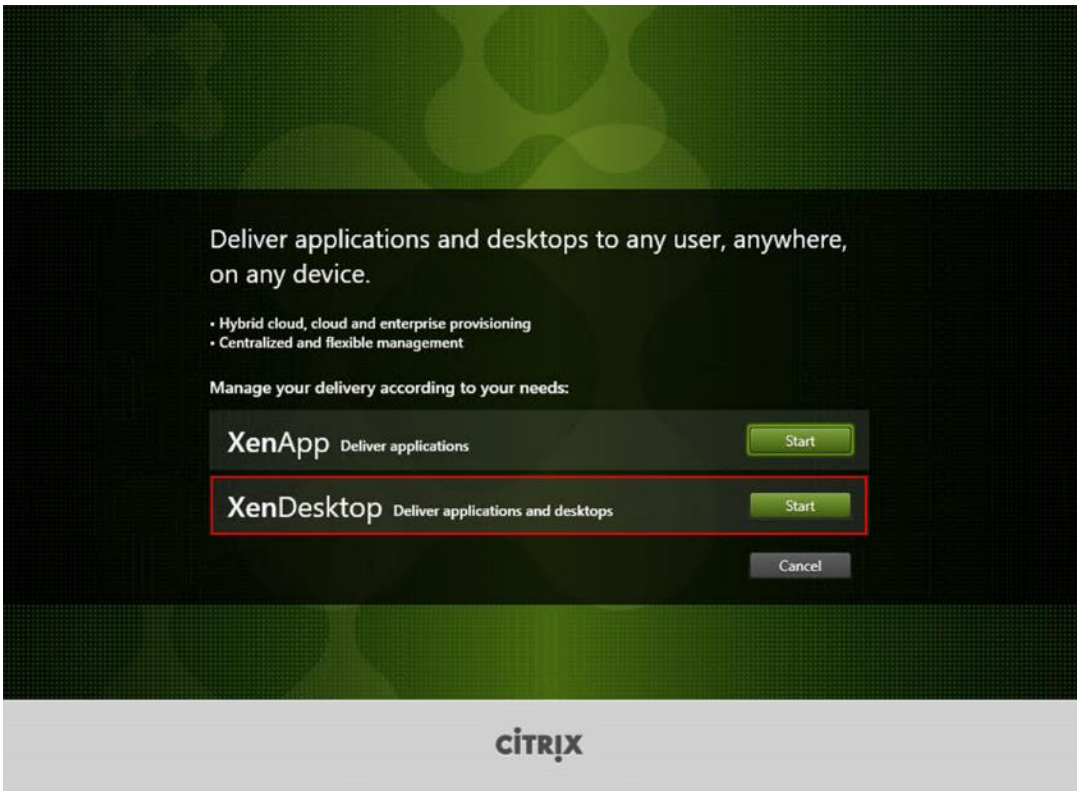
Configure Additional XenDesktop Controller

After the first controller is completely configured and the Site is operational, you can add additional controllers.

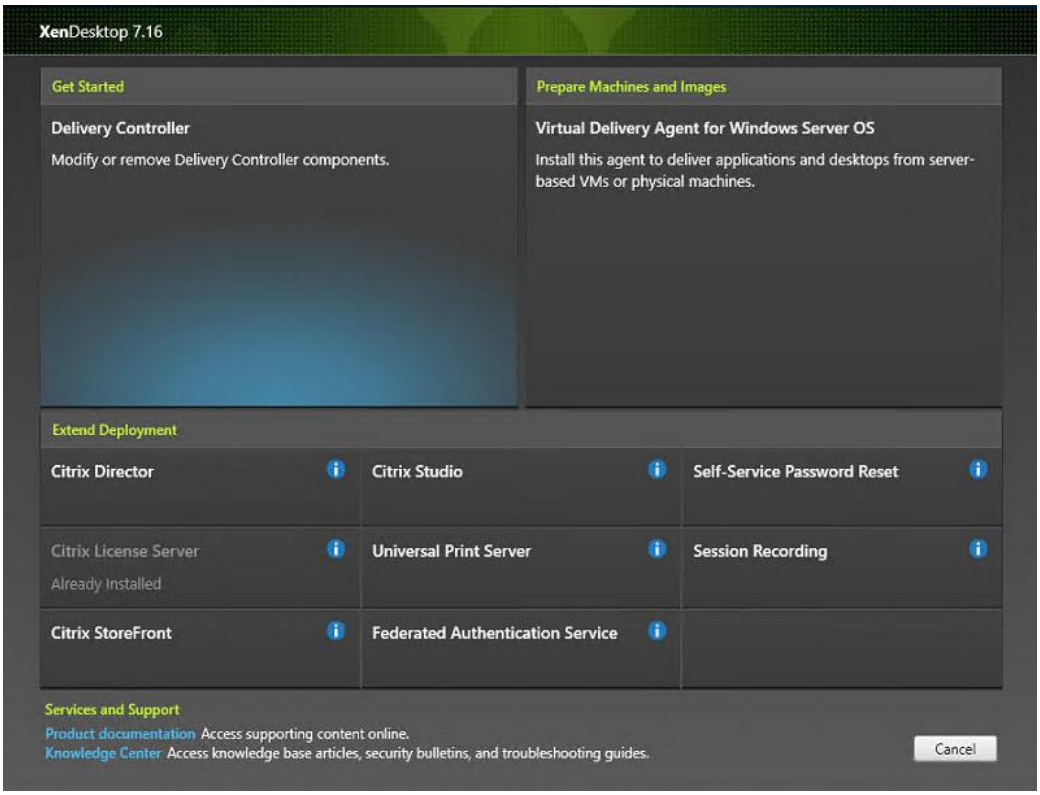
In this CVD, we created two Delivery Controllers.

To configure additional XenDesktop controllers, complete the following steps:

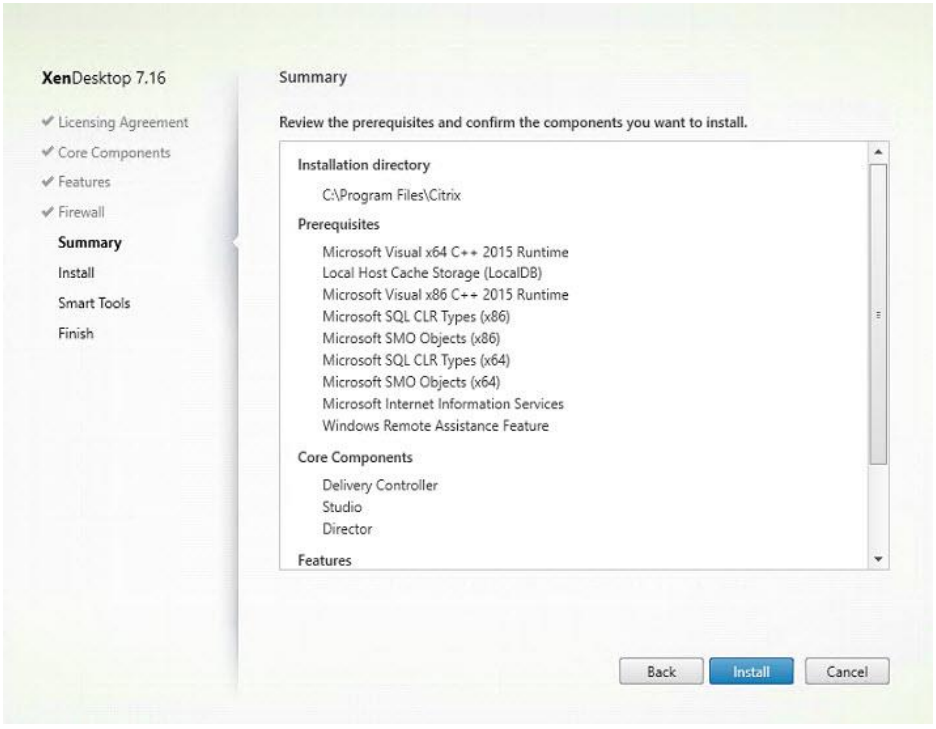
1. To begin the installation of the second Delivery Controller, connect to the second XenDesktop server and launch the installer from the Citrix XenDesktop 7.16 ISO.
2. Click Start.



3. Click Delivery Controller.

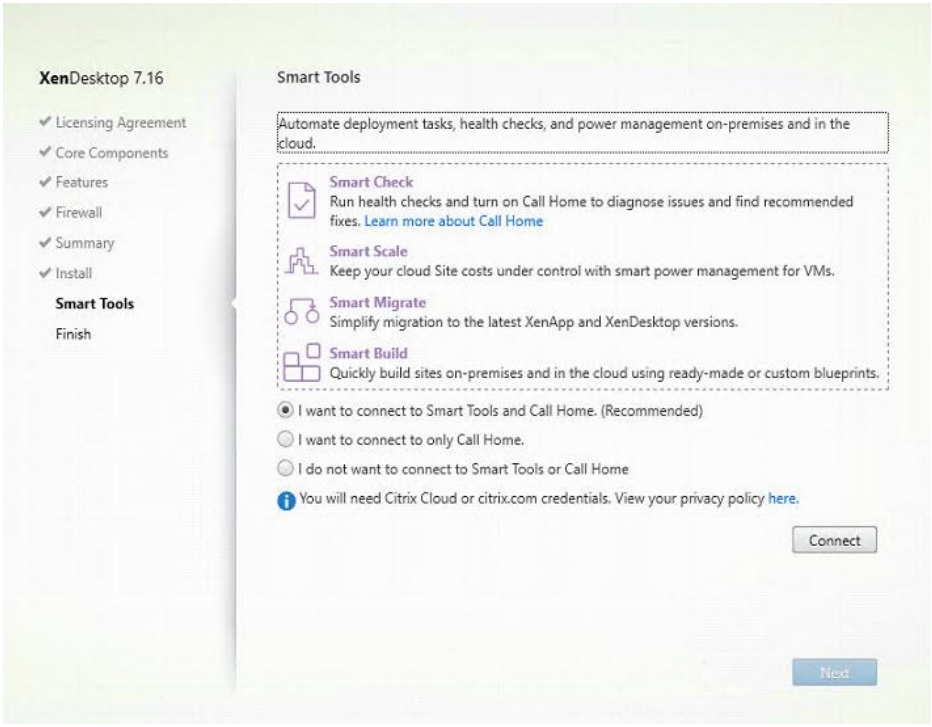


4. Repeat the same steps used to install the first Delivery Controller, including the step of importing an SSL certificate for HTTPS between the controller and Hyper-V.
5. Review the Summary configuration.
6. Click Install.

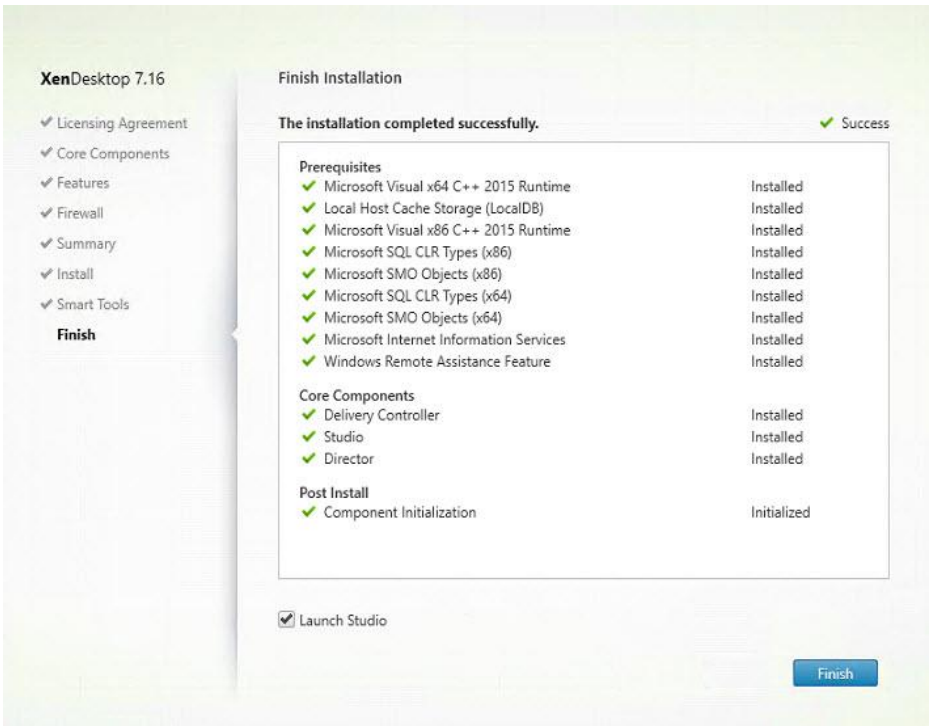


7. (Optional) Click the “I want to participate in Call Home.”

8. Click Next.



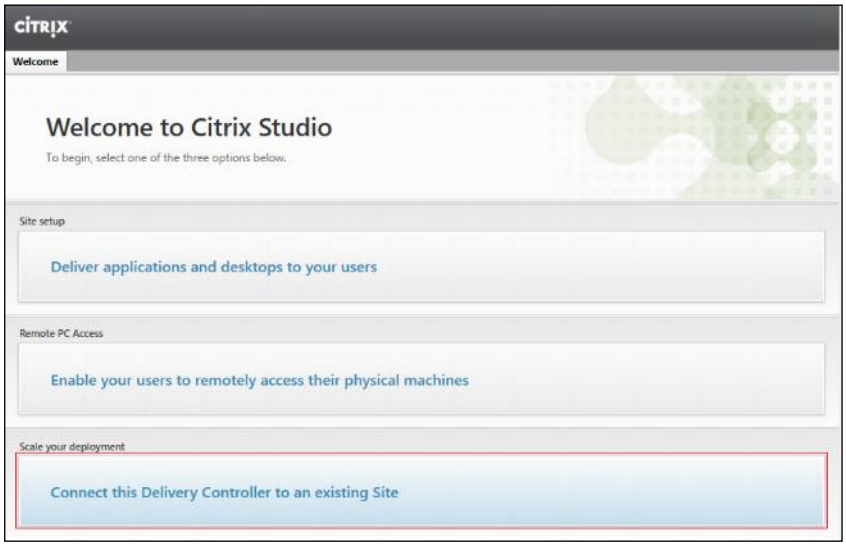
9. Verify the components installed successfully.
10. Click Finish.



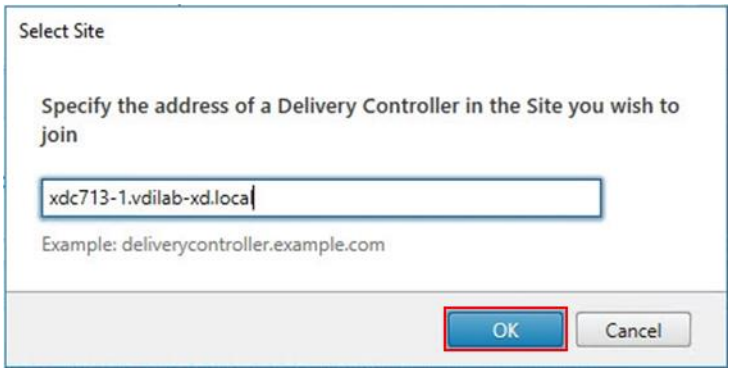
Add the Second Delivery Controller to the XenDesktop Site

To add the second Delivery Controller to the XenDesktop Site, complete the following steps:

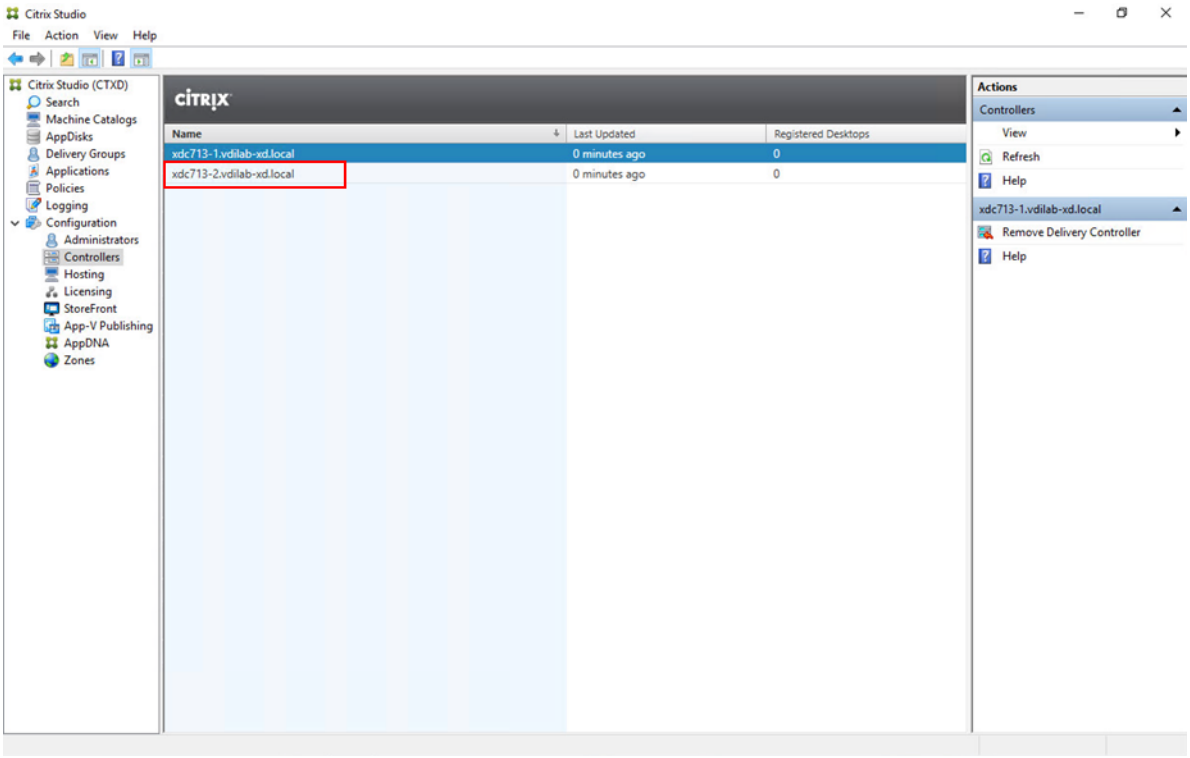
1. In Desktop Studio click the “Connect this Delivery Controller to an existing Site” button.



2. Enter the FQDN of the first delivery controller.
3. Click OK.



4. Click Yes to allow the database to be updated with this controller’s information automatically.
5. When complete, test the site configuration and verify the Delivery Controller has been added to the list of Controllers.



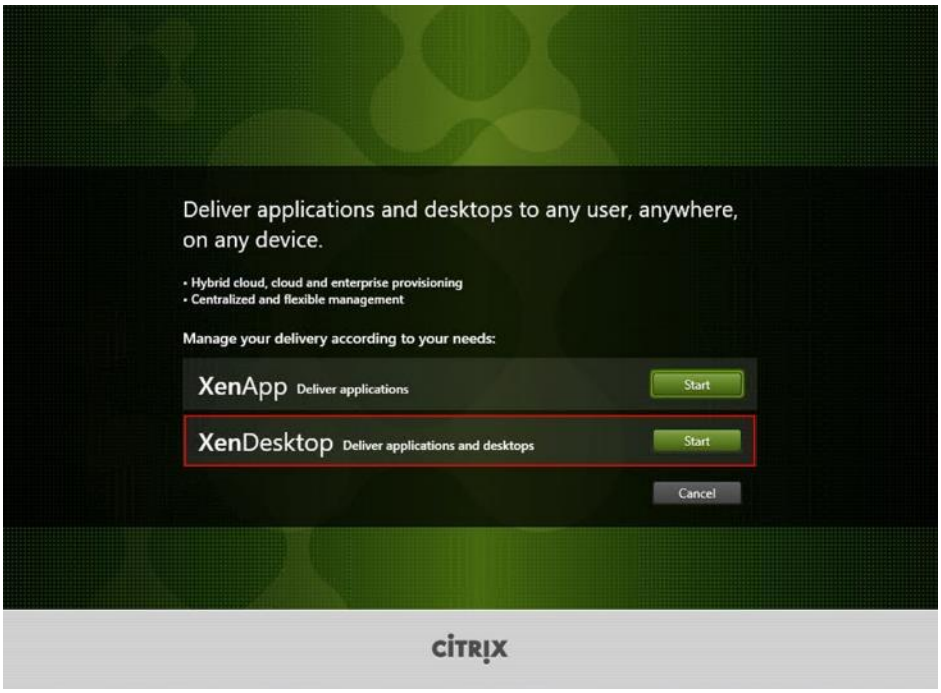
Install and Configure StoreFront

Citrix StoreFront stores aggregate desktops and applications from XenDesktop sites, making resources readily available to users.

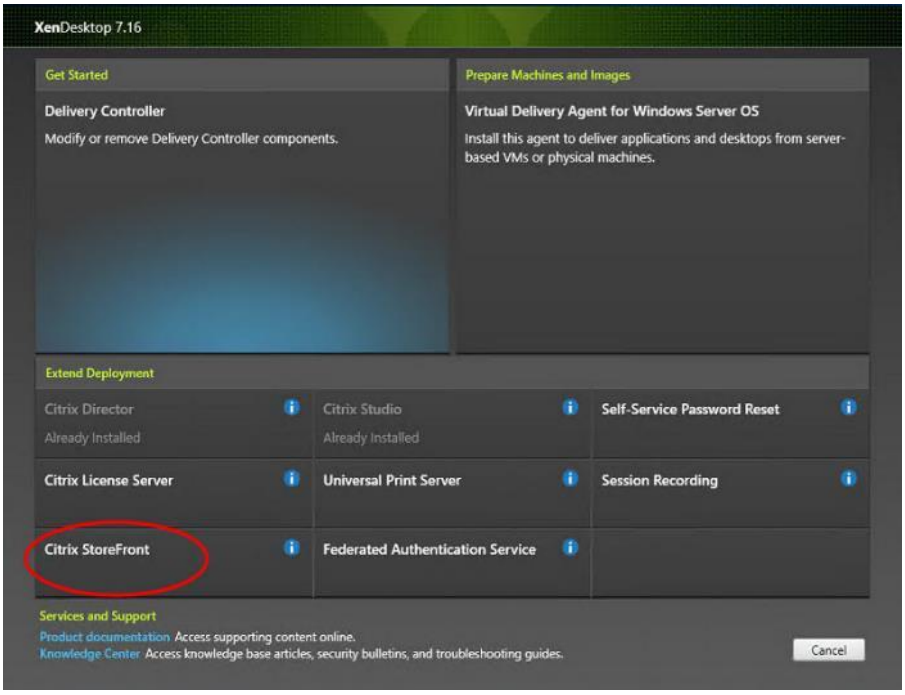
In this CVD, we created two StoreFront servers on dedicated virtual machines.

To install and configure StoreFront, complete the following steps:

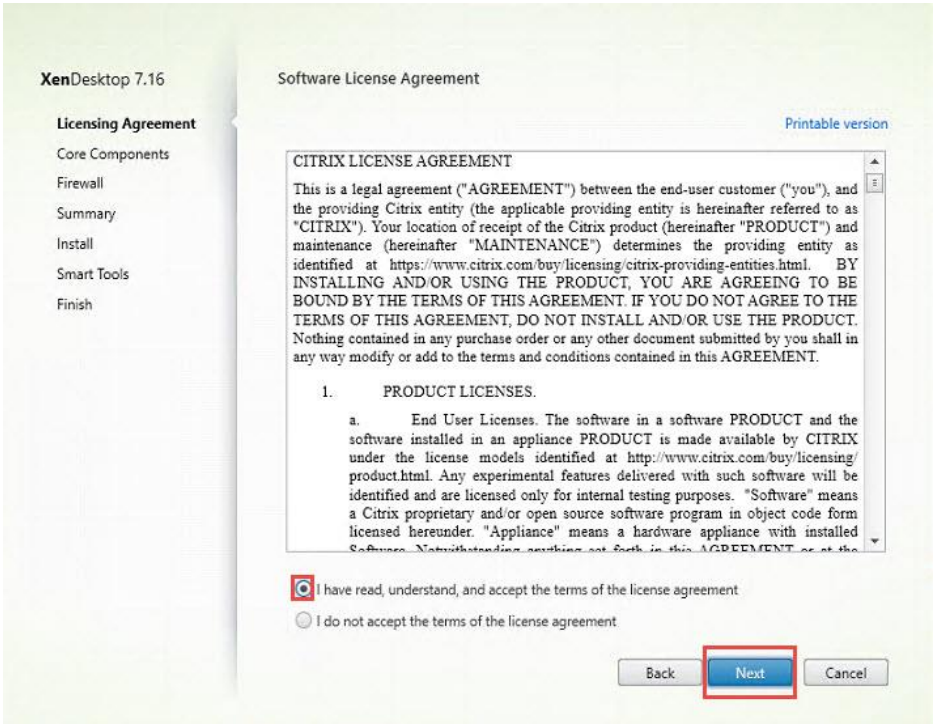
1. To begin the installation of the StoreFront, connect to the first StoreFront server and launch the installer from the Citrix XenDesktop 7.16 ISO.
2. Click Start.



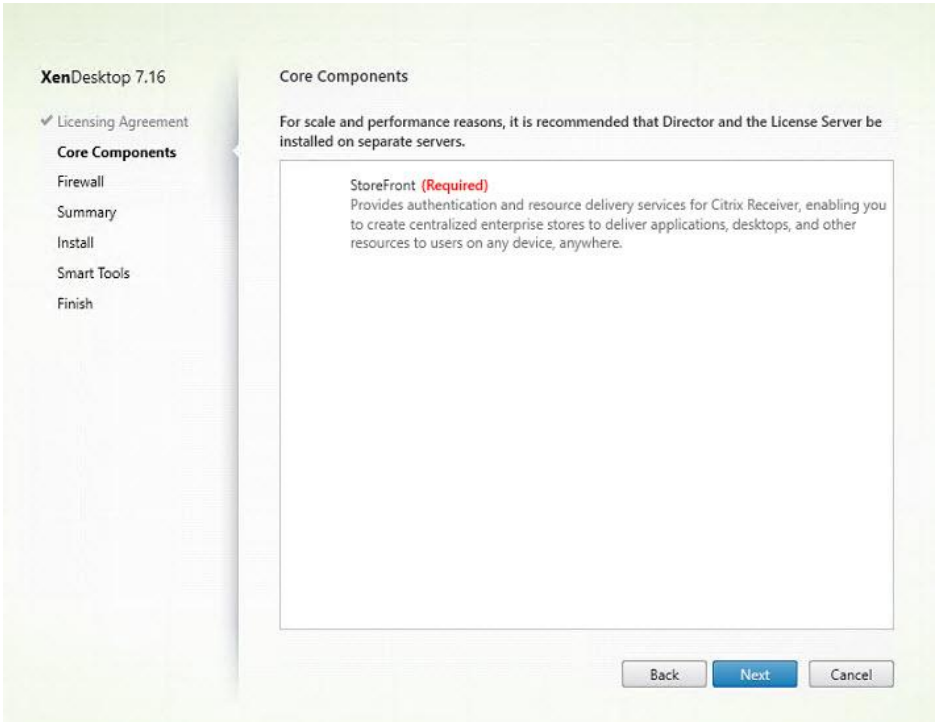
3. Click Extend Deployment Citrix StoreFront.



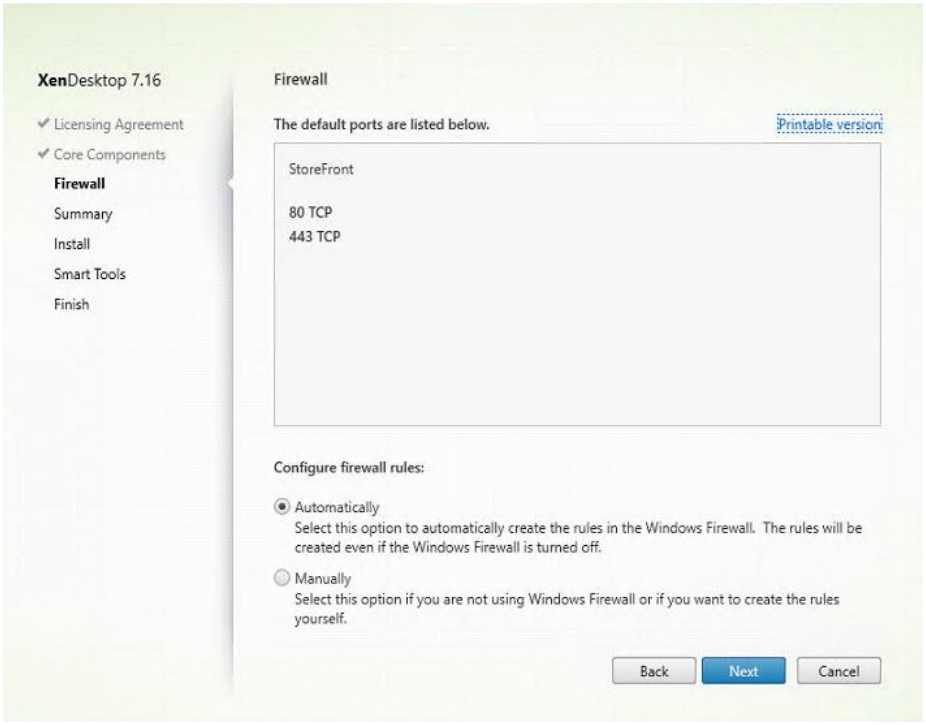
4. If acceptable, indicate your acceptance of the license by selecting the “I have read, understand, and accept the terms of the license agreement” radio button.
5. Click Next.



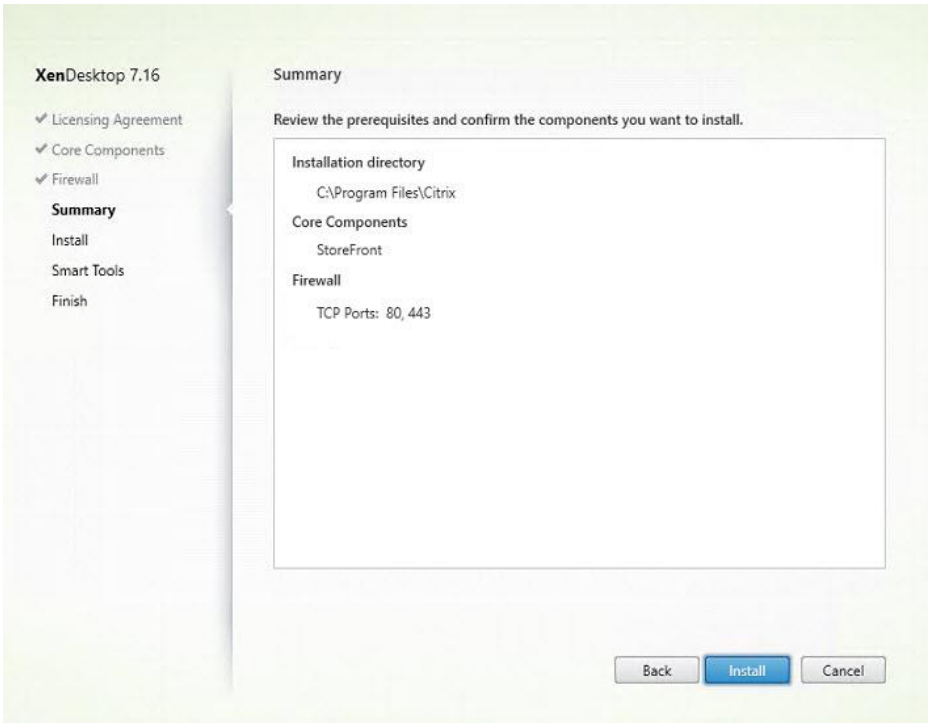
6. Click Next.



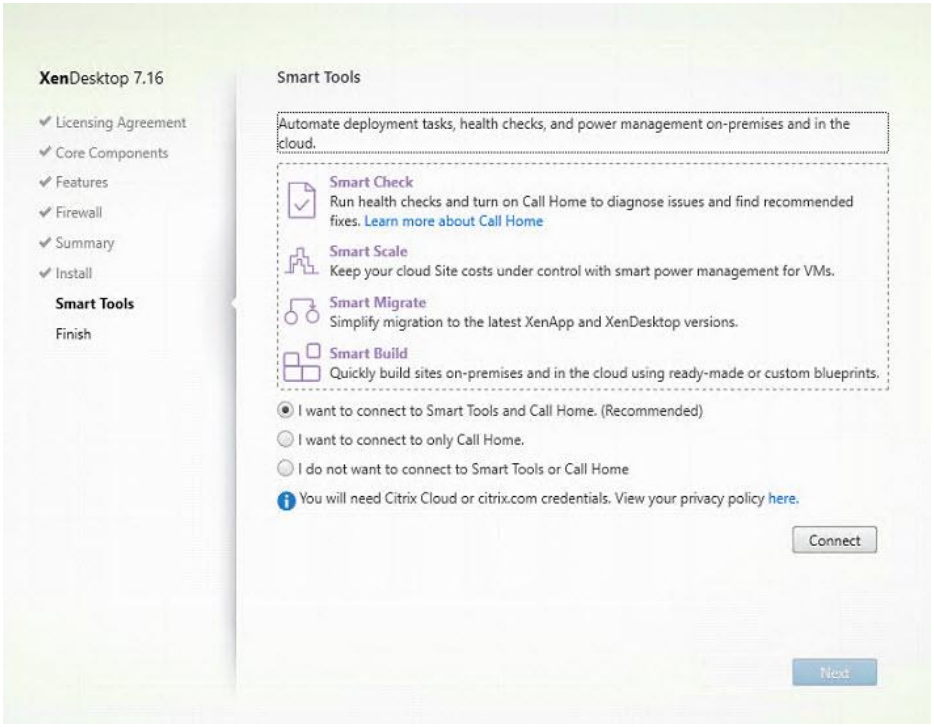
7. Select the default ports and automatically configured firewall rules.
8. Click Next.



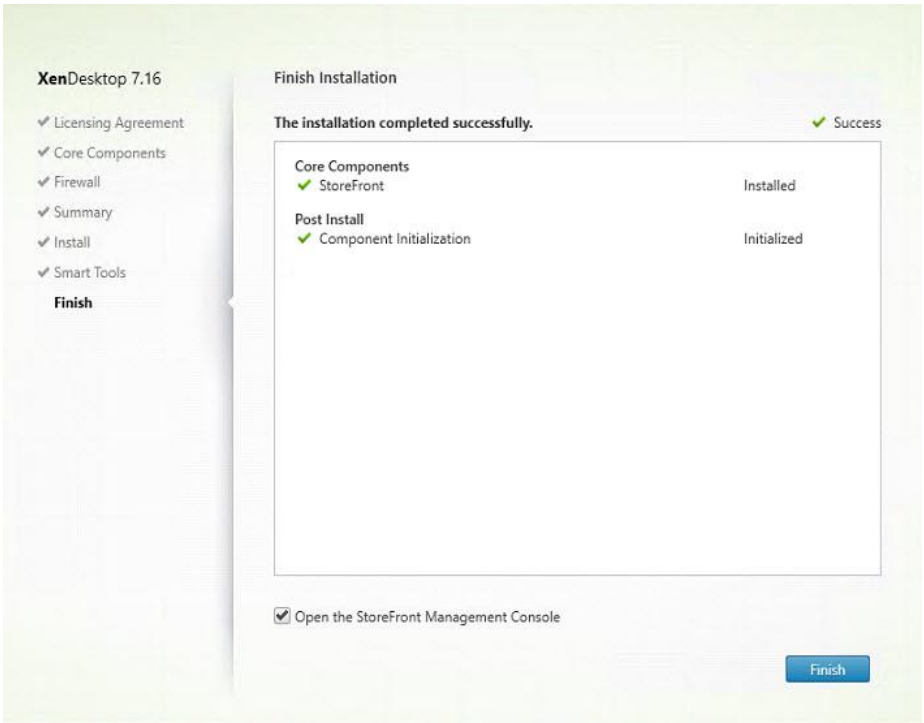
9. Click Install.



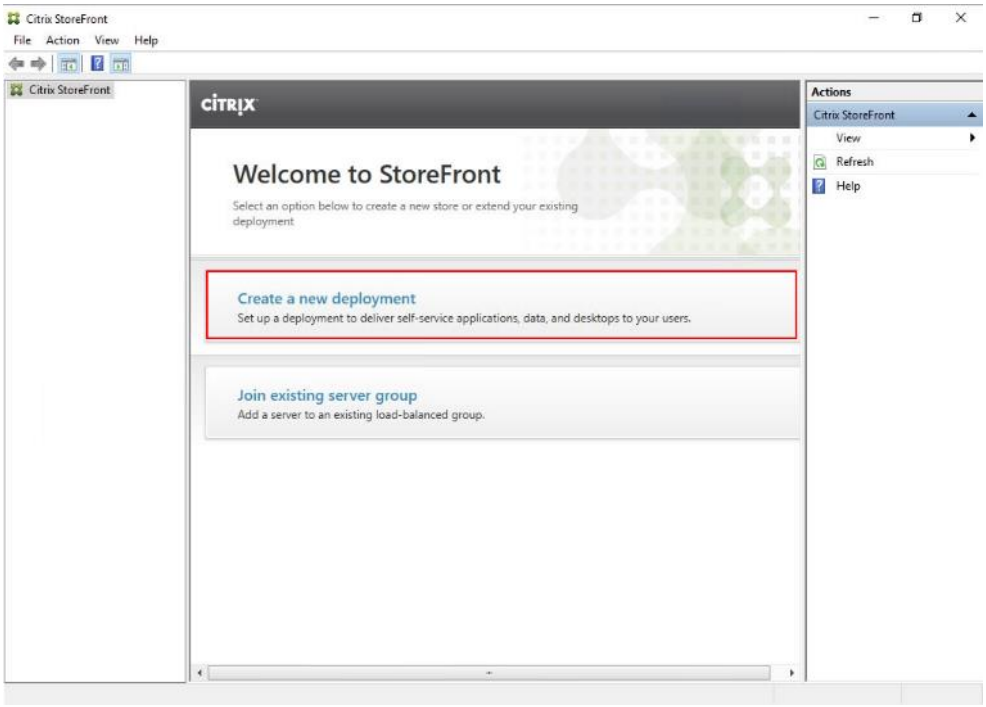
10. (Optional) Click “I want to participate in Call Home.”
11. Click Next.



12. Check “Open the StoreFront Management Console.”
13. Click Finish.

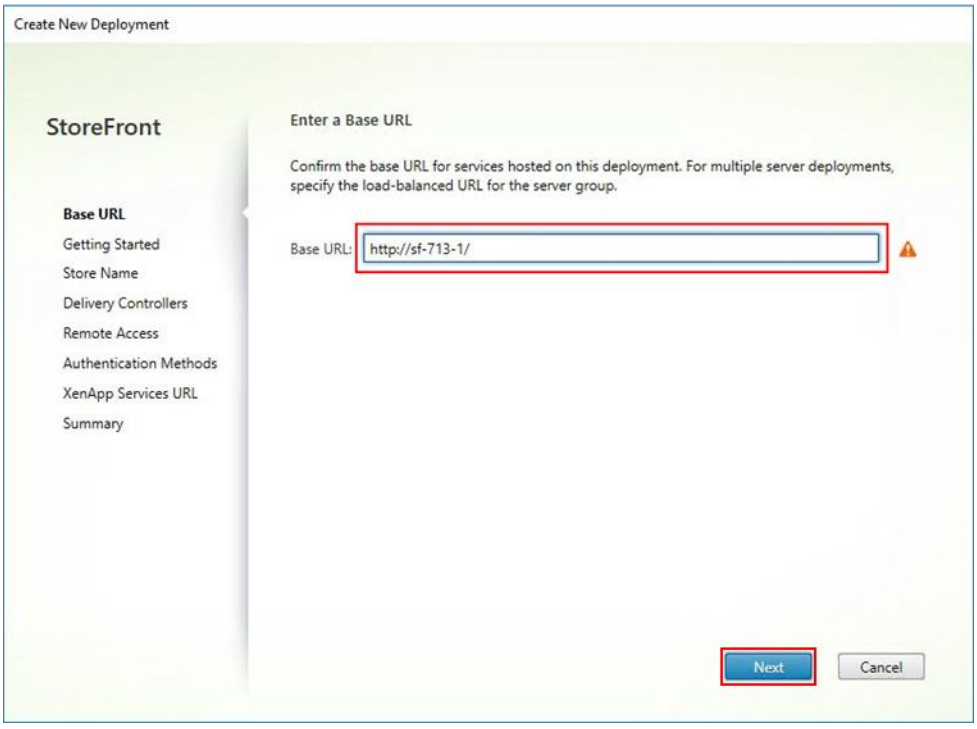


14. Click Create a new deployment.

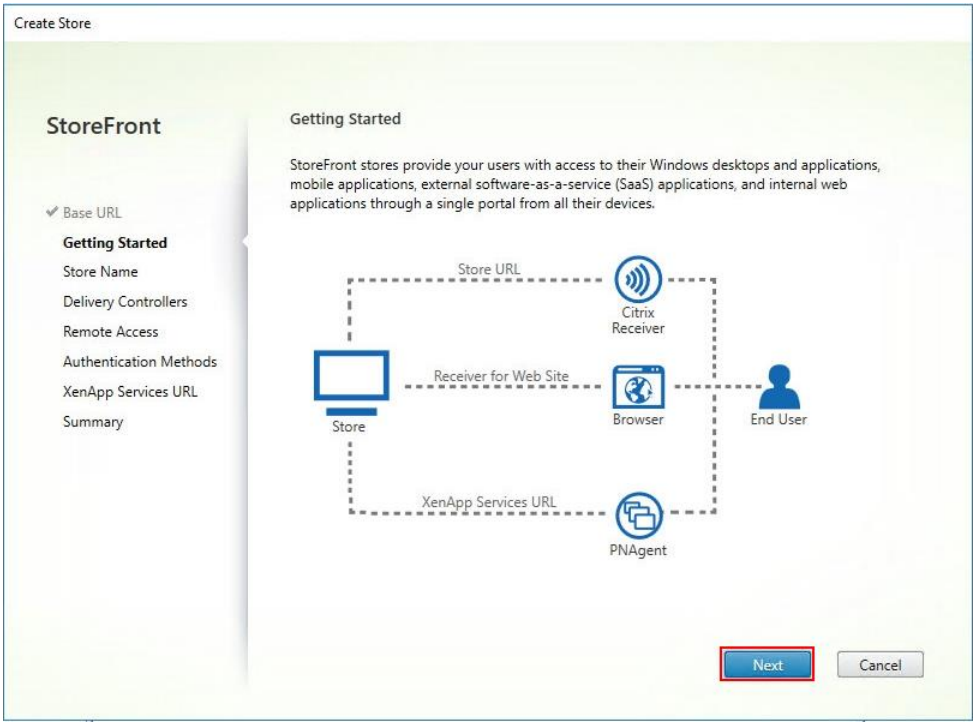


15. Specify the URL of the StoreFront server and click Next.

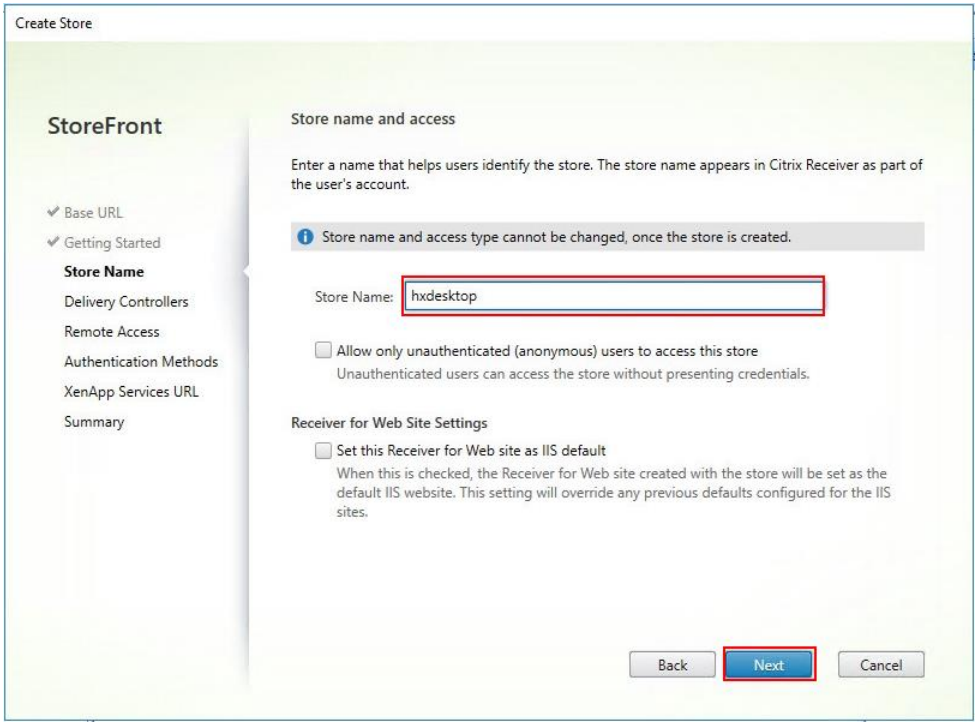
For a multiple server deployment use the load balancing environment in the Base URL box.



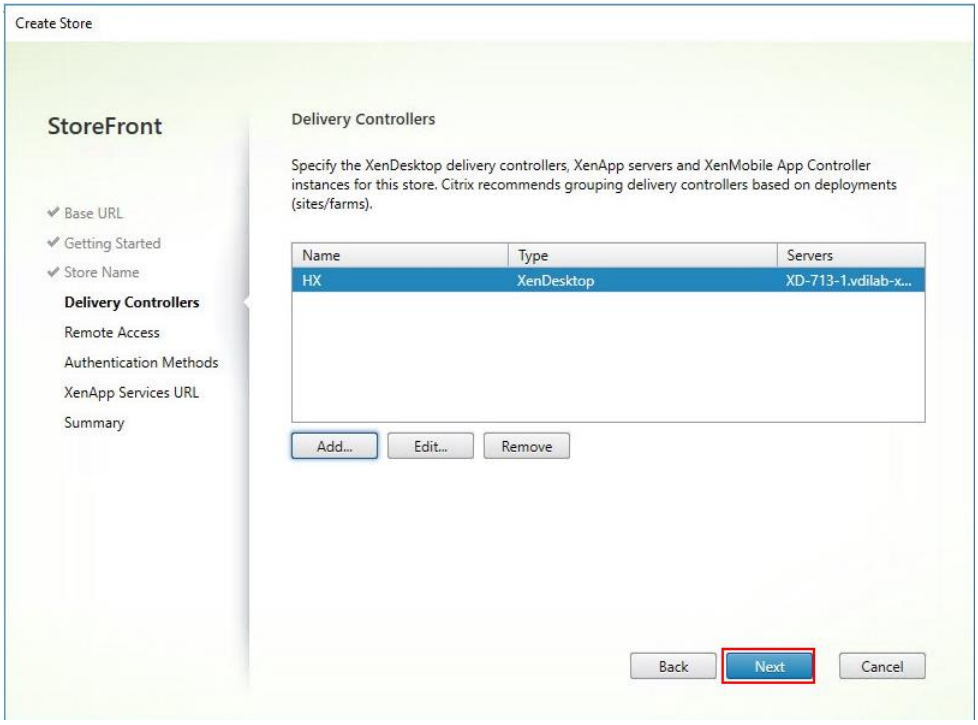
16. Click Next.



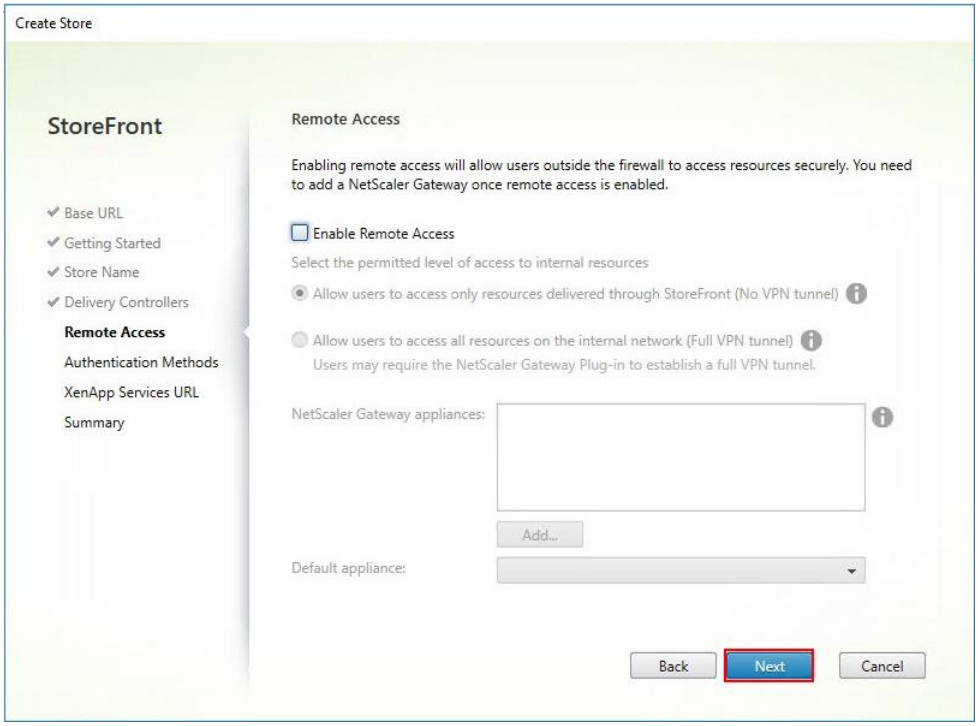
17. Specify a name for your store and click Next.



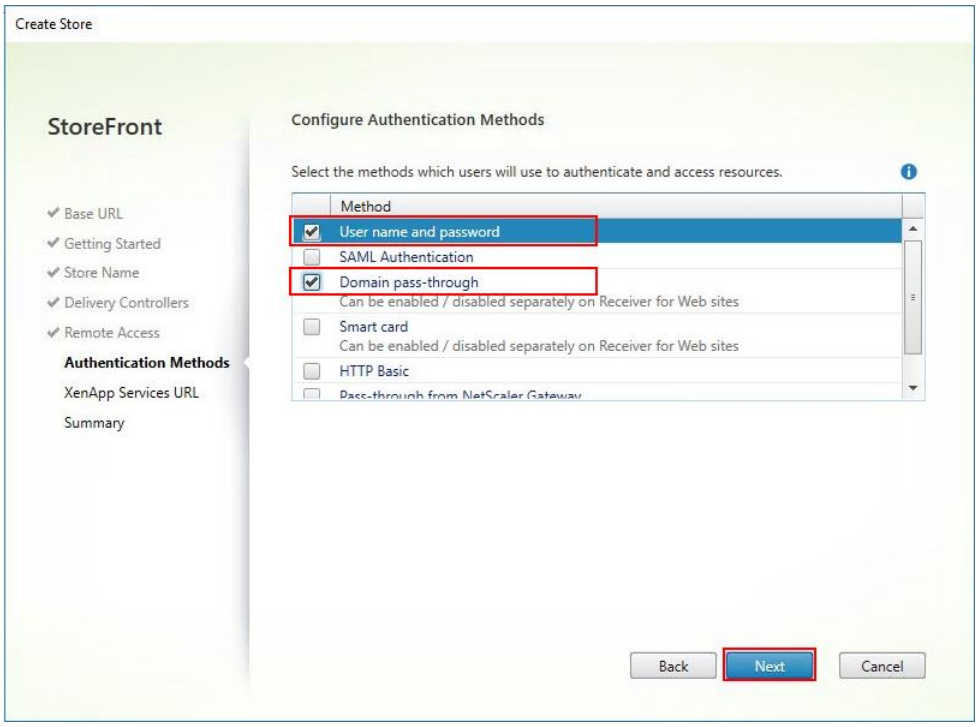
18. Add the required Delivery Controllers to the store and click Next.



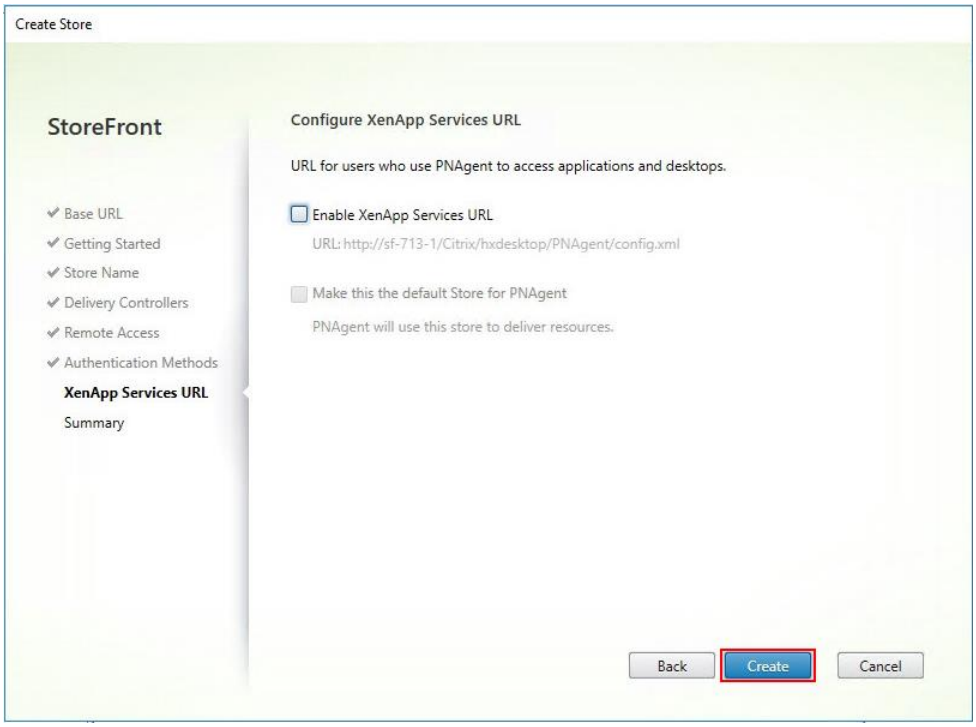
19. Specify how connecting users can access the resources, in this environment only local users on the internal network are able to access the store, and click Next.



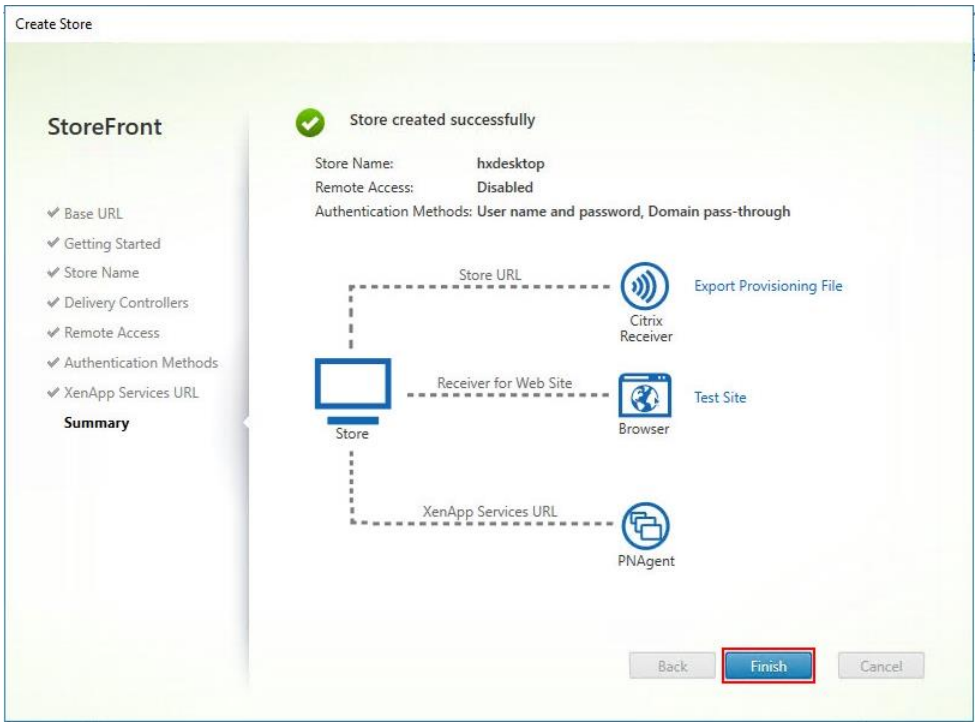
20. On the “Authentication Methods” page, select the methods your users will use to authenticate to the store and click Next. You can select from the following methods:



21. Username and password: Users enter their credentials and are authenticated when they access their stores.
22. Domain pass-through: Users authenticate to their domain-joined Windows computers and their credentials are used to log them on automatically when they access their stores.
23. Configure the XenApp Service URL for users who use PNAgent to access the applications and desktops and click Create.



24. After creating the store click Finish.

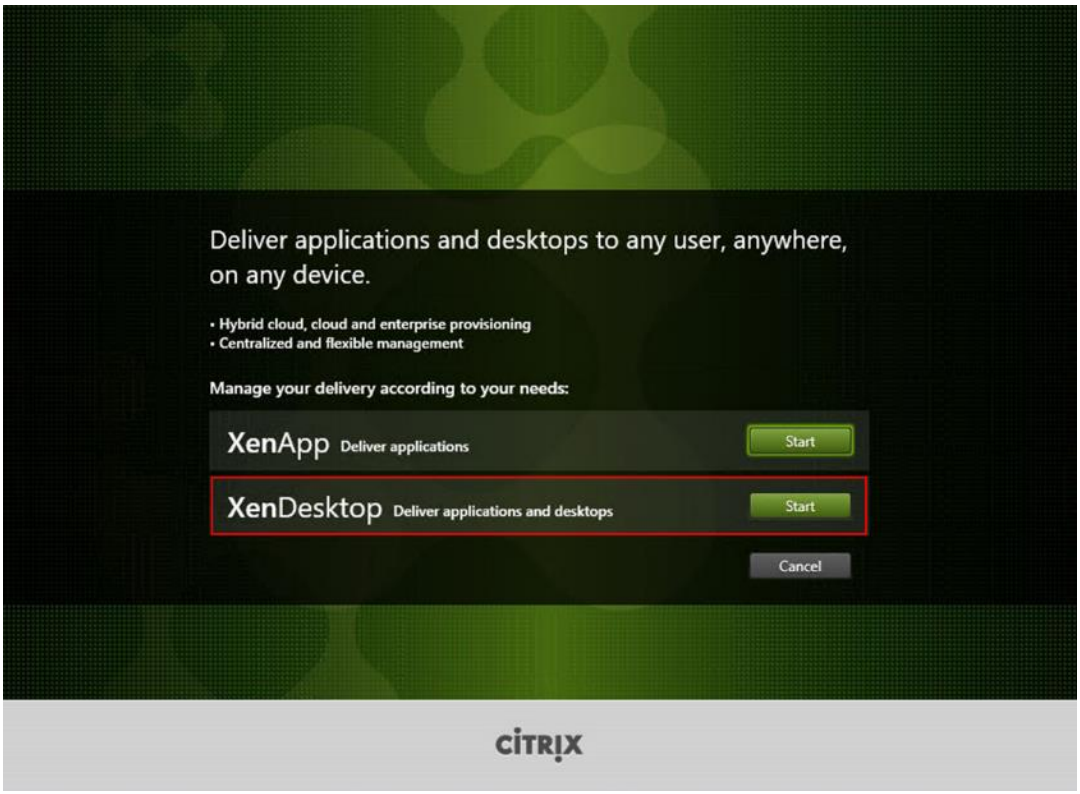


Additional StoreFront Configuration

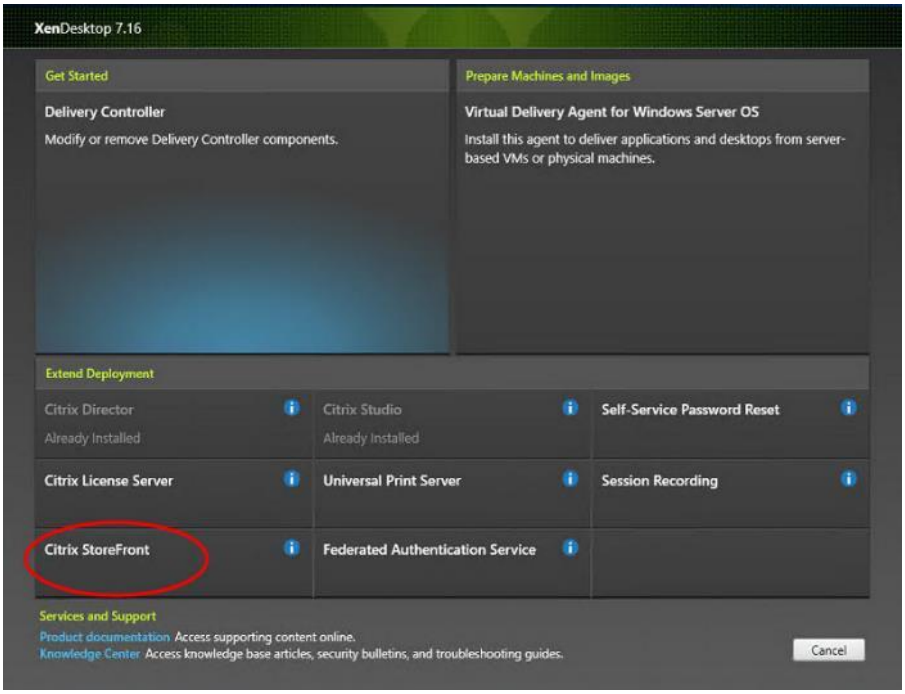
After the first StoreFront server is completely configured and the Store is operational, you can add additional servers.

To configure additional StoreFront server, complete the following steps:

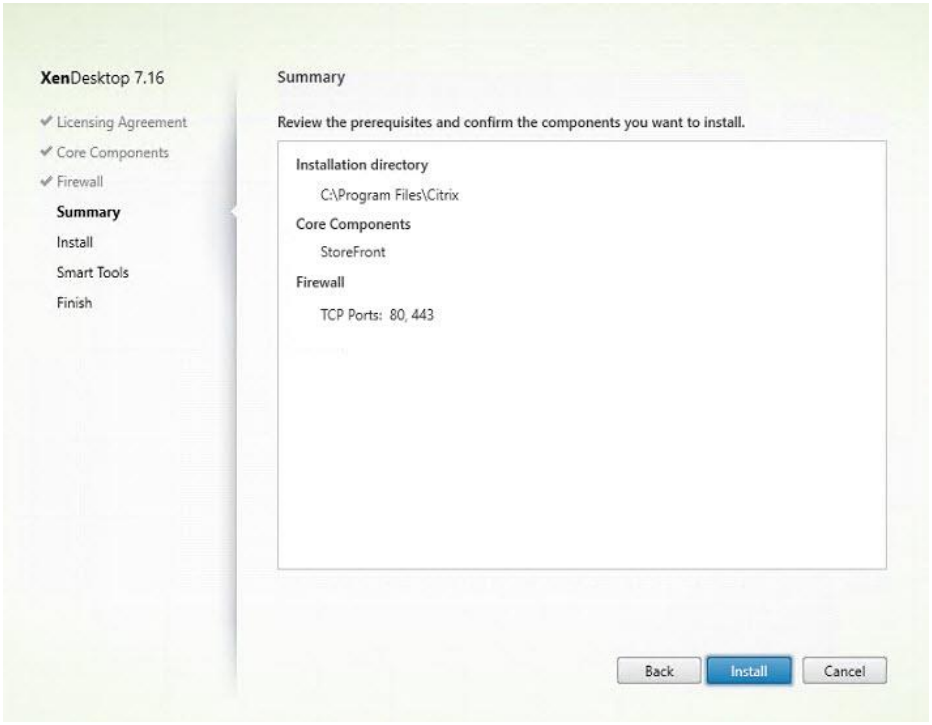
1. To begin the installation of the second StoreFront, connect to the second StoreFront server and launch the installer from the Citrix XenDesktop 7.16 ISO.
2. Click Start.



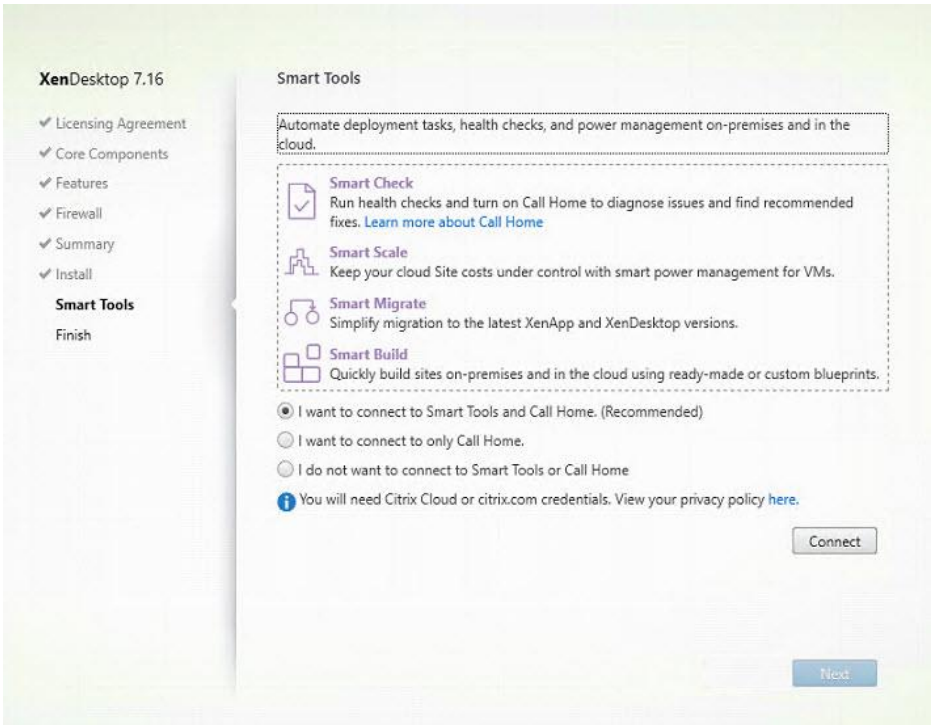
3. Click Extended Deployment Citrix StoreFront.



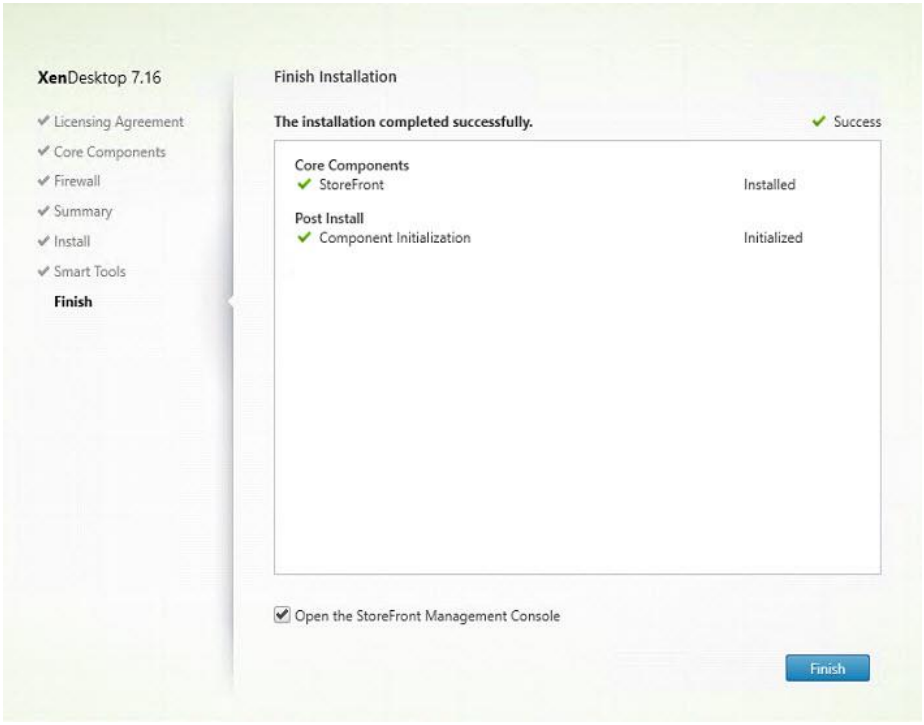
4. Repeat the same steps used to install the first StoreFront.
5. Review the Summary configuration.
6. Click Install.



7. (Optional) Click “I want to participate in Call Home.”
8. Click Next.

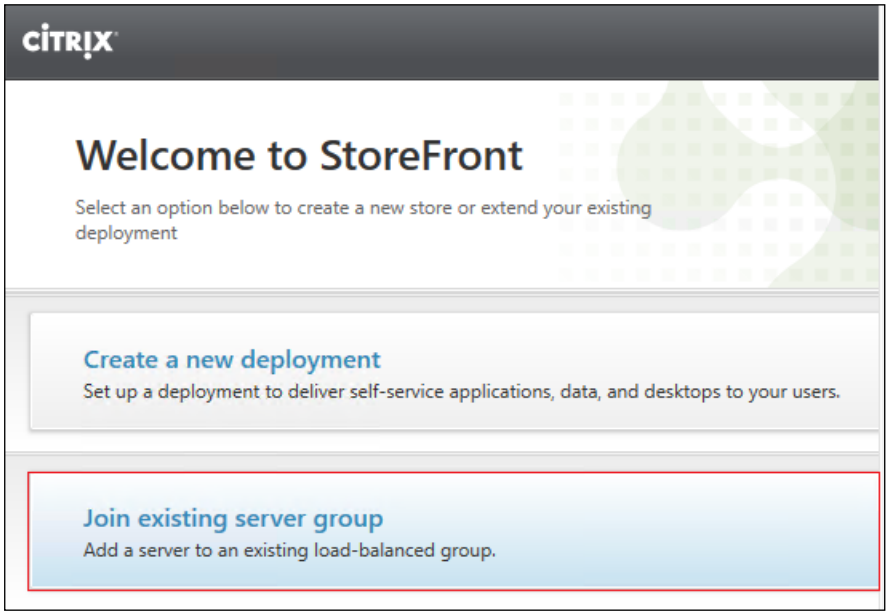


9. Check “Open the StoreFront Management Console."
10. Click Finish.

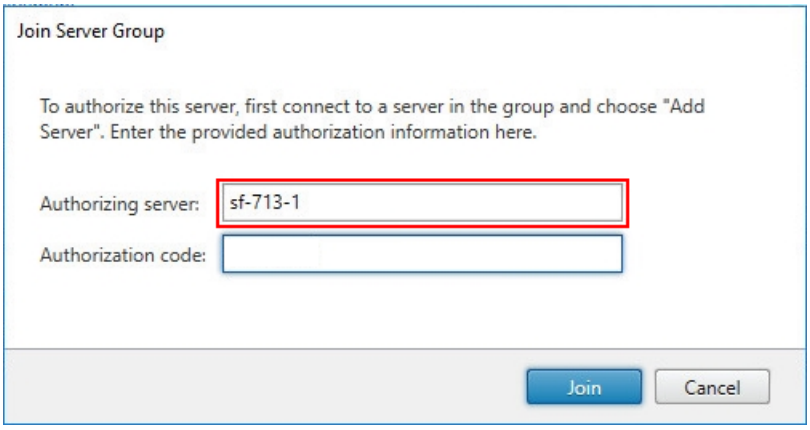


To configure the second StoreFront if used, complete the following steps:

1. From the StoreFront Console on the second server select “Join existing server group.”

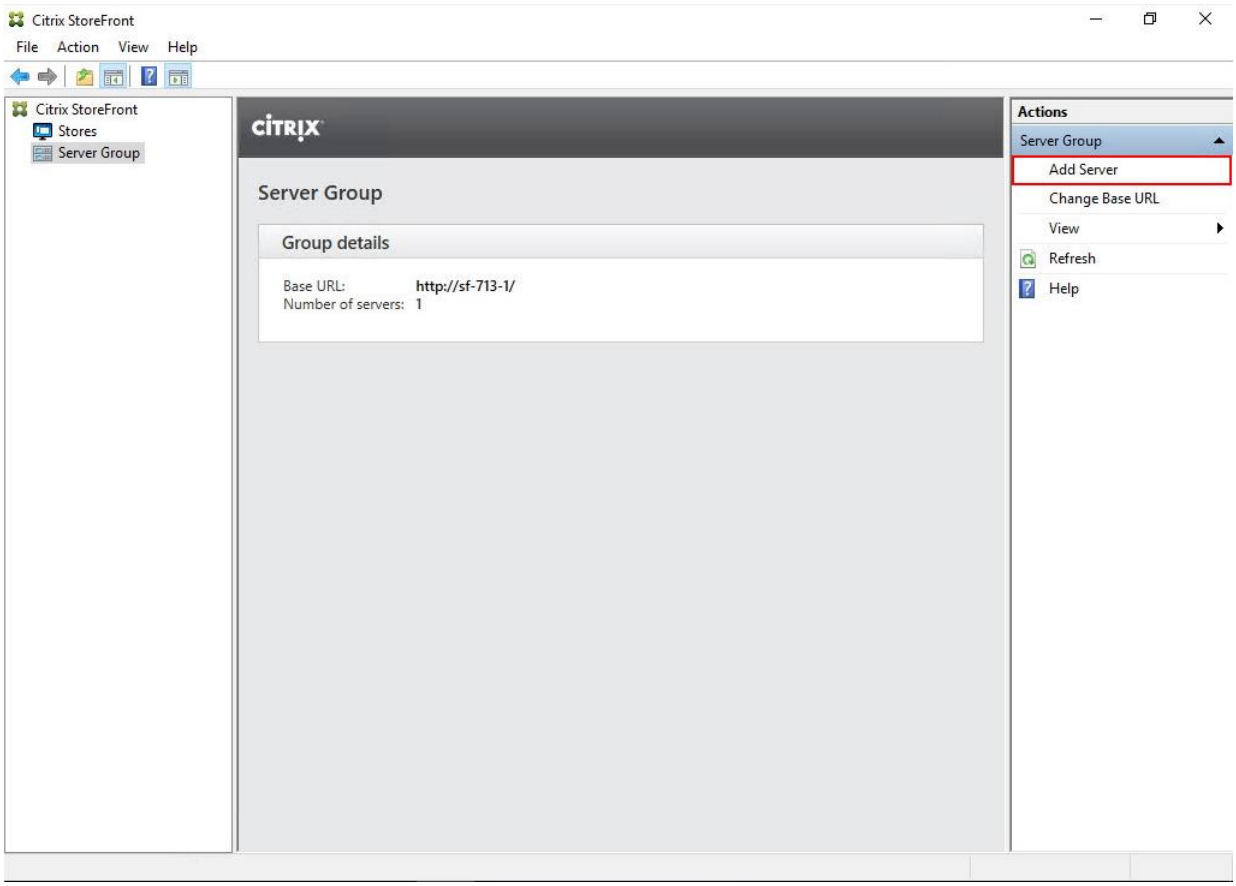


2. In the Join Server Group dialog, enter the name of the first Storefront server.

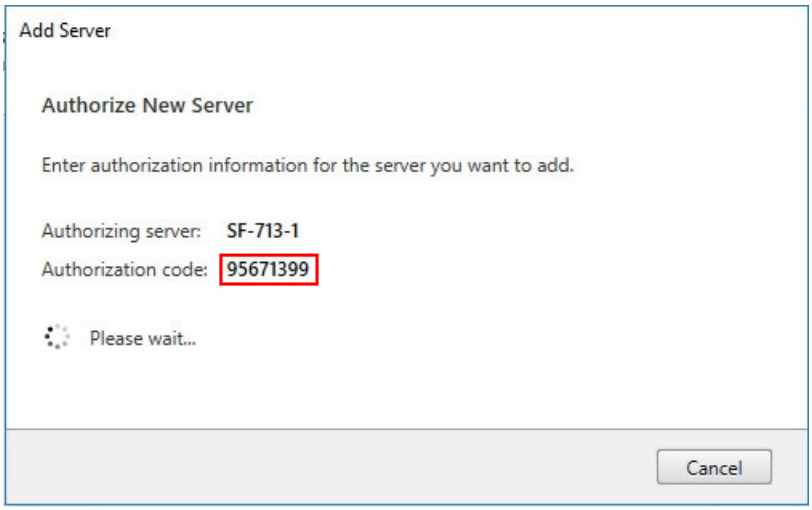


3. Before the additional StoreFront server can join the server group, you must connect to the first Storefront server, add the second server, and obtain the required authorization information.
4. Connect to the first StoreFront server.
5. Using the StoreFront menu on the left, you can scroll through the StoreFront management options.
6. Select Server Group from the menu.

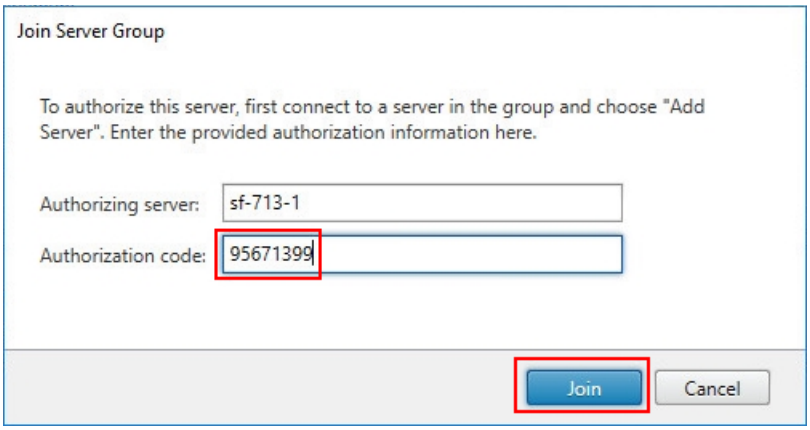
7. To add the second server and generate the authorization information that allows the additional StoreFront server to join the server group, select Add Server.



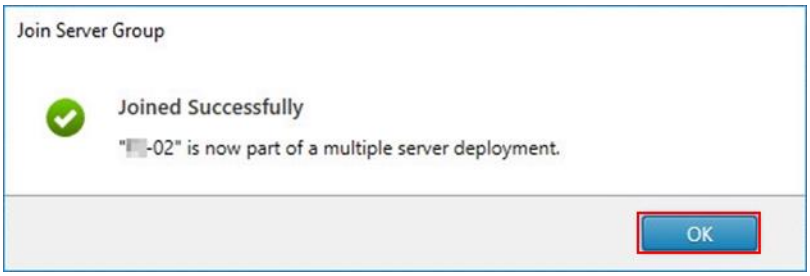
8. Copy the Authorization code from the Add Server dialog.



9. Connect to the second Storefront server and paste the Authorization code into the Join Server Group dialog.
10. Click Join.



11. A message appears when the second server has joined successfully.
12. Click OK.



The second StoreFront is now in the Server Group.

Install the Citrix Provisioning Services Target Device Software

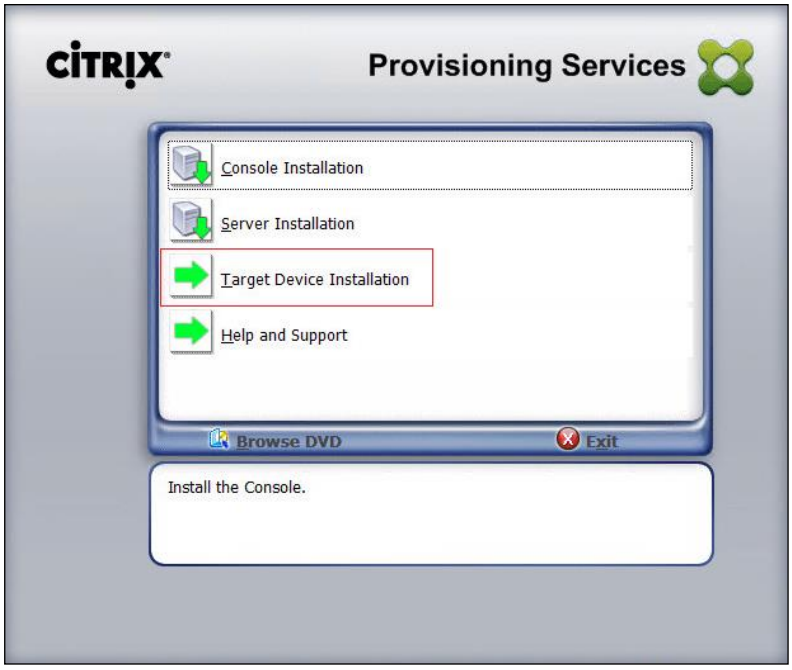
For non-persistent Windows 10 virtual desktops and Server 2016 XenApp virtual machines, Citrix Provisioning Services (PVS) is used for deployment. The Master Target Device refers to the target device from which a hard disk image is built and stored on a vDisk. Provisioning Services then streams the contents of the vDisk created to

other target devices. This procedure installs the PVS Target Device software that is used to build the RDS and VDI golden images.

To install the Citrix Provisioning Server Target Device software, complete the following steps:

The instructions below outline the installation procedure to configure a vDisk for VDI desktops. When you have completed these installation steps, repeat the procedure to configure a vDisk for RDS.

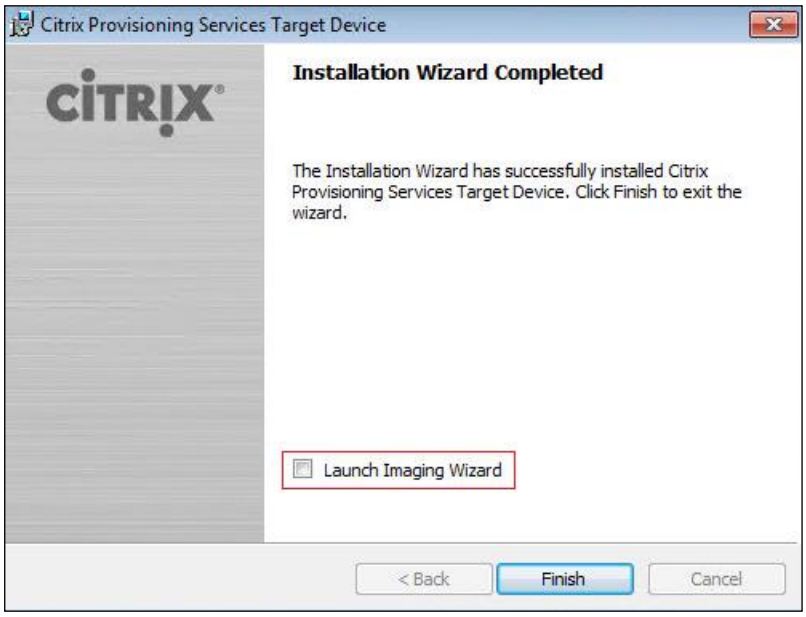
1. On the Window 10 Master Target Device, launch the PVS installer from the Provisioning Services 7.16 ISO.
2. Click the Target Device Installation button.



The installation wizard will check to resolve dependencies and then begin the PVS target device installation process.

3. Click **Next**.

4. Confirm the installation settings and click **Install**.
5. Deselect the checkbox to launch the **Imaging Wizard** and click **Finish**.



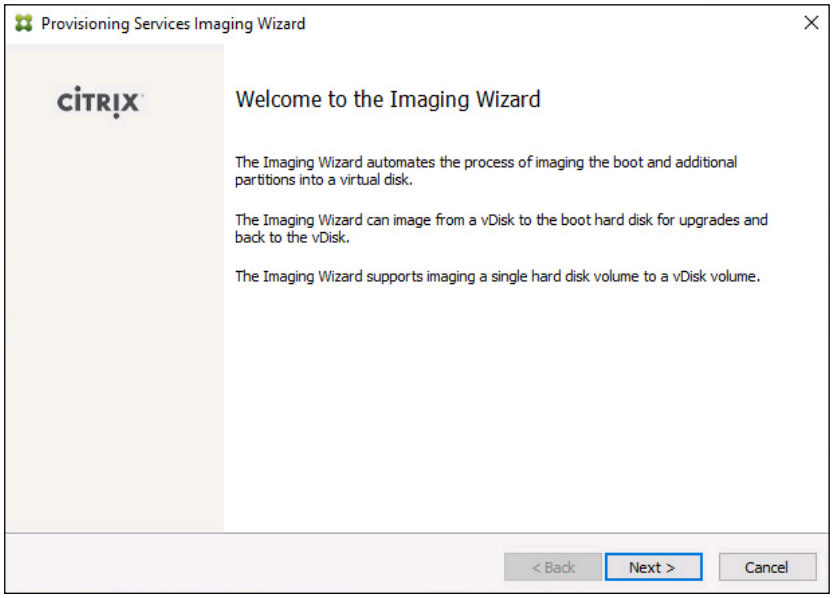
6. Reboot the machine.

Create Citrix Provisioning Services vDisks

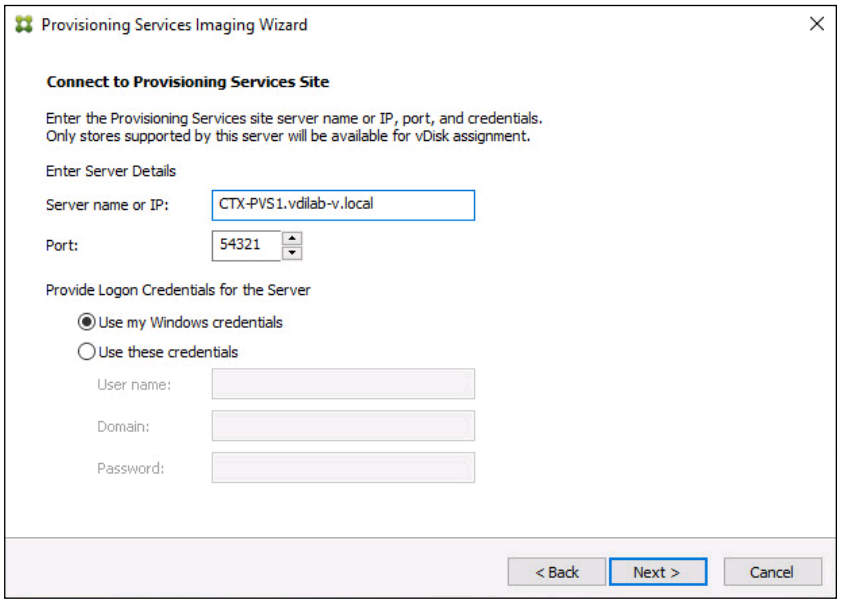
The PVS Imaging Wizard automatically creates a base vDisk image from the master target device. To create the Citrix Provisioning Server vDisks, complete the following steps:

The instructions below describe the process of creating a vDisk for VDI desktops. When you have completed these steps, repeat the procedure to build a vDisk for RDS.

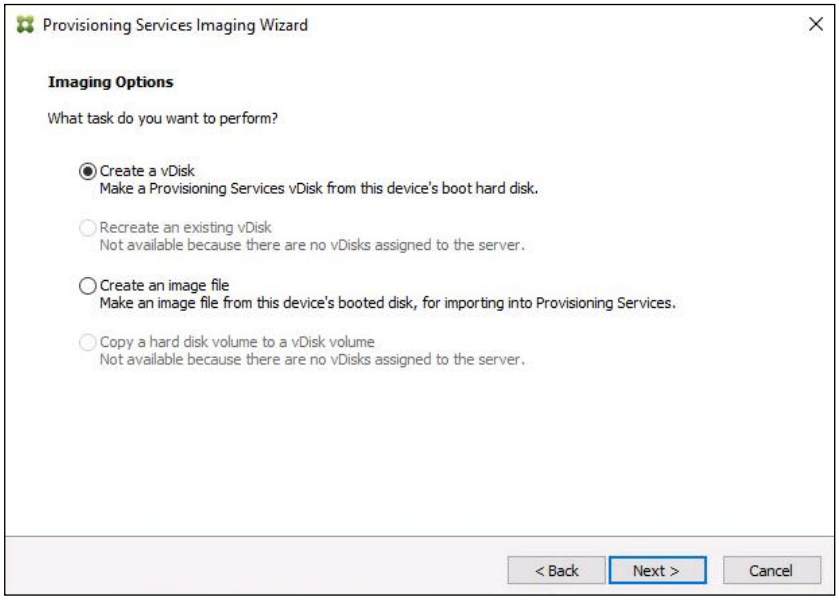
1. The PVS Imaging Wizard's Welcome page appears.
2. Click **Next.**



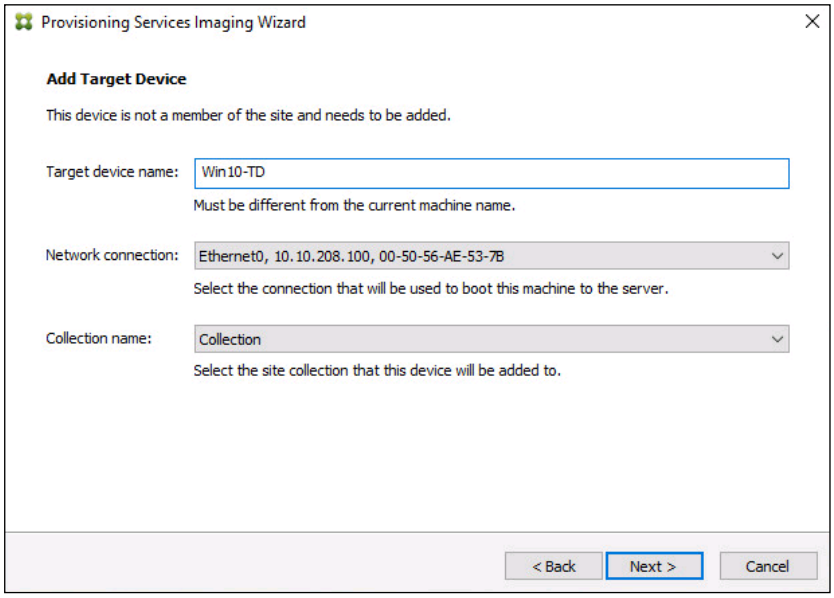
3. The **Connect to Farm** page appears. Enter the name or IP address of a Provisioning Server within the farm to connect to and the port to use to make that connection.
4. Use the Windows credentials (default) or enter different credentials.
5. Click **Next.**



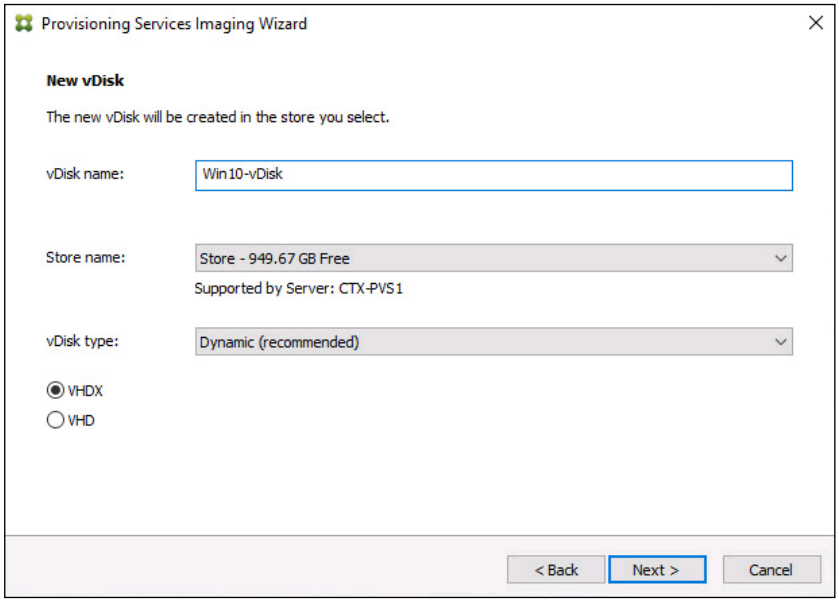
6. Select Create new vDisk.
7. Click **Next.**



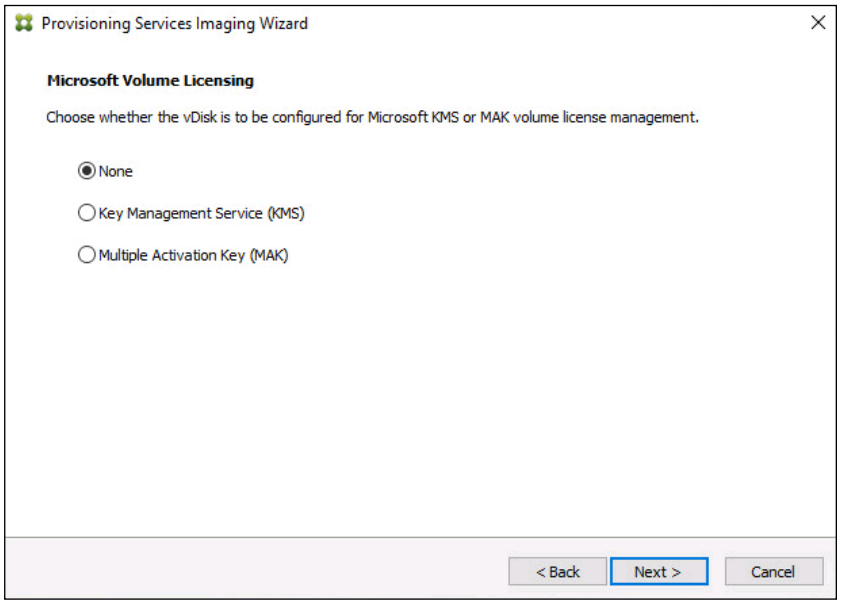
8. The **Add Target Device** page appears.
9. Select the **Target Device Name**, the **MAC** address associated with one of the NICs that was selected when the target device software was installed on the master target device, and the **Collection** to which you are adding the device.
10. Click **Next.**



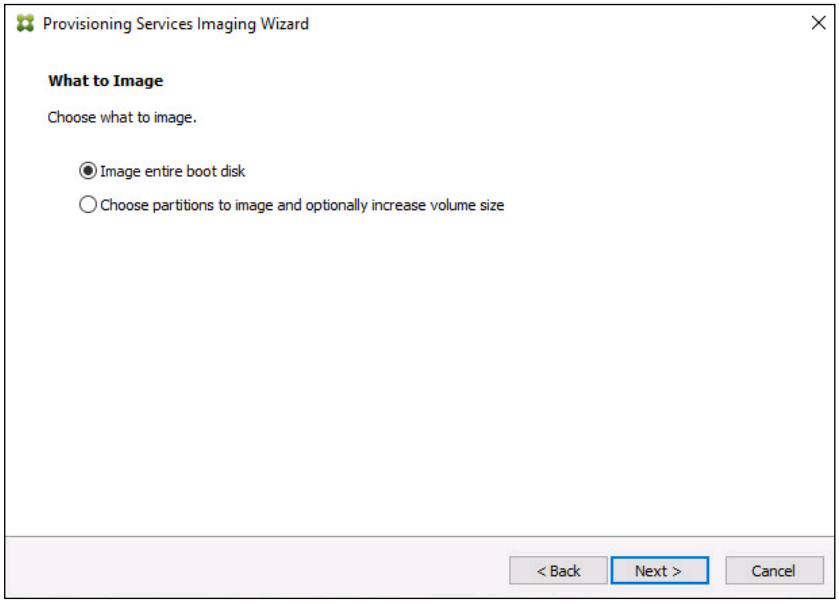
11. The **New vDisk** dialog displays. Enter the name of the vDisk.
12. Select the **Store** where the vDisk will reside. Select the **vDisk type**, either Fixed or Dynamic, from the drop-down menu. (This CVD used Dynamic rather than Fixed vDisks.)
13. Click **Next.**



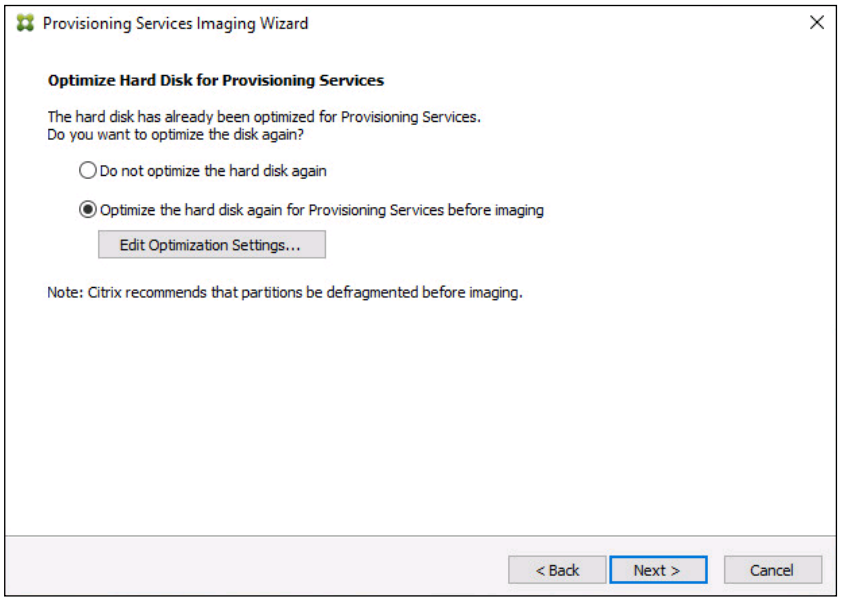
14. On the **Microsoft Volume Licensing** page, select the volume license option to use for target devices. For this CVD, volume licensing is not used, so the None button is selected.
15. Click **Next.**



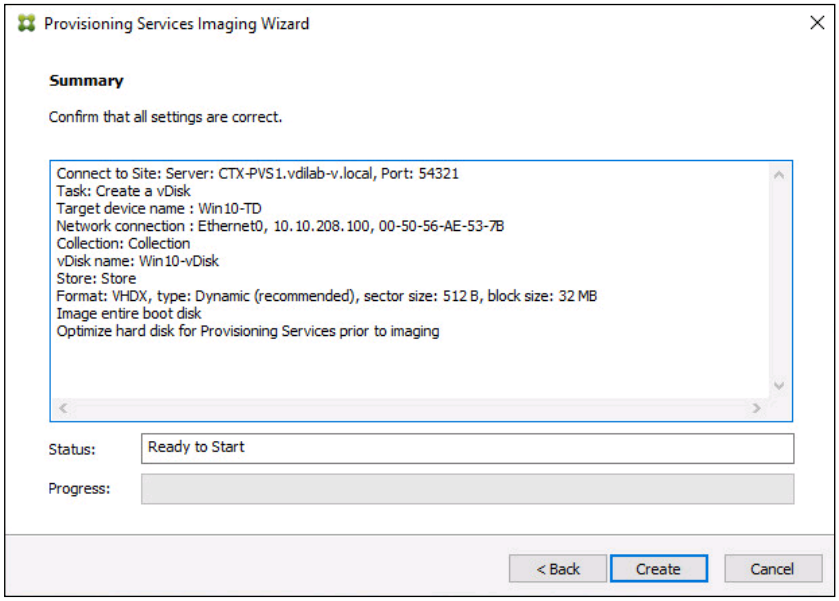
16. Select **Image entire boot disk** on the Configure Image Volumes page.
17. Click **Next.**



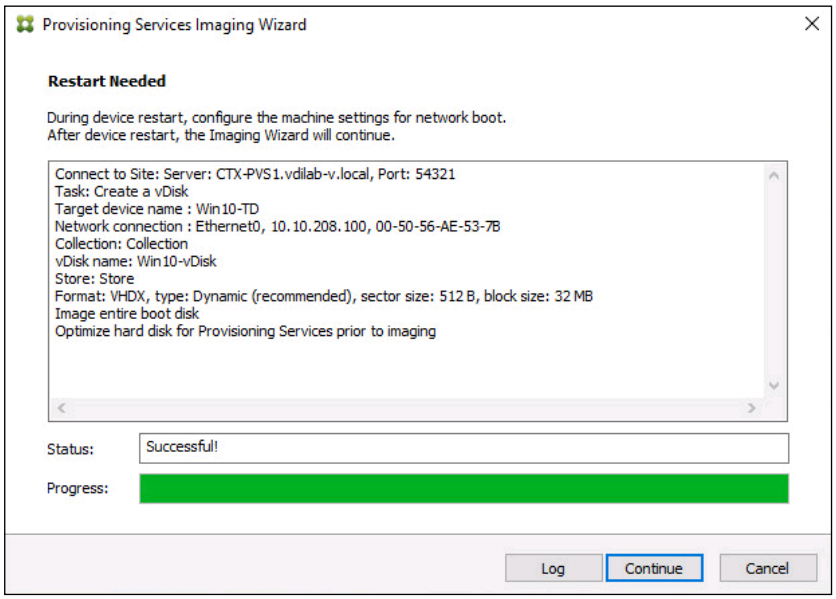
18. Select Optimize for hard disk again for Provisioning Services before imaging on the Optimize Hard Disk for Provisioning Services.
19. Click **Next.**



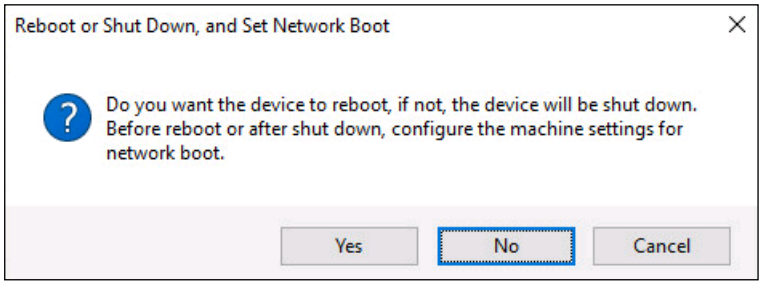
20. Select **Create** on the Summary page.



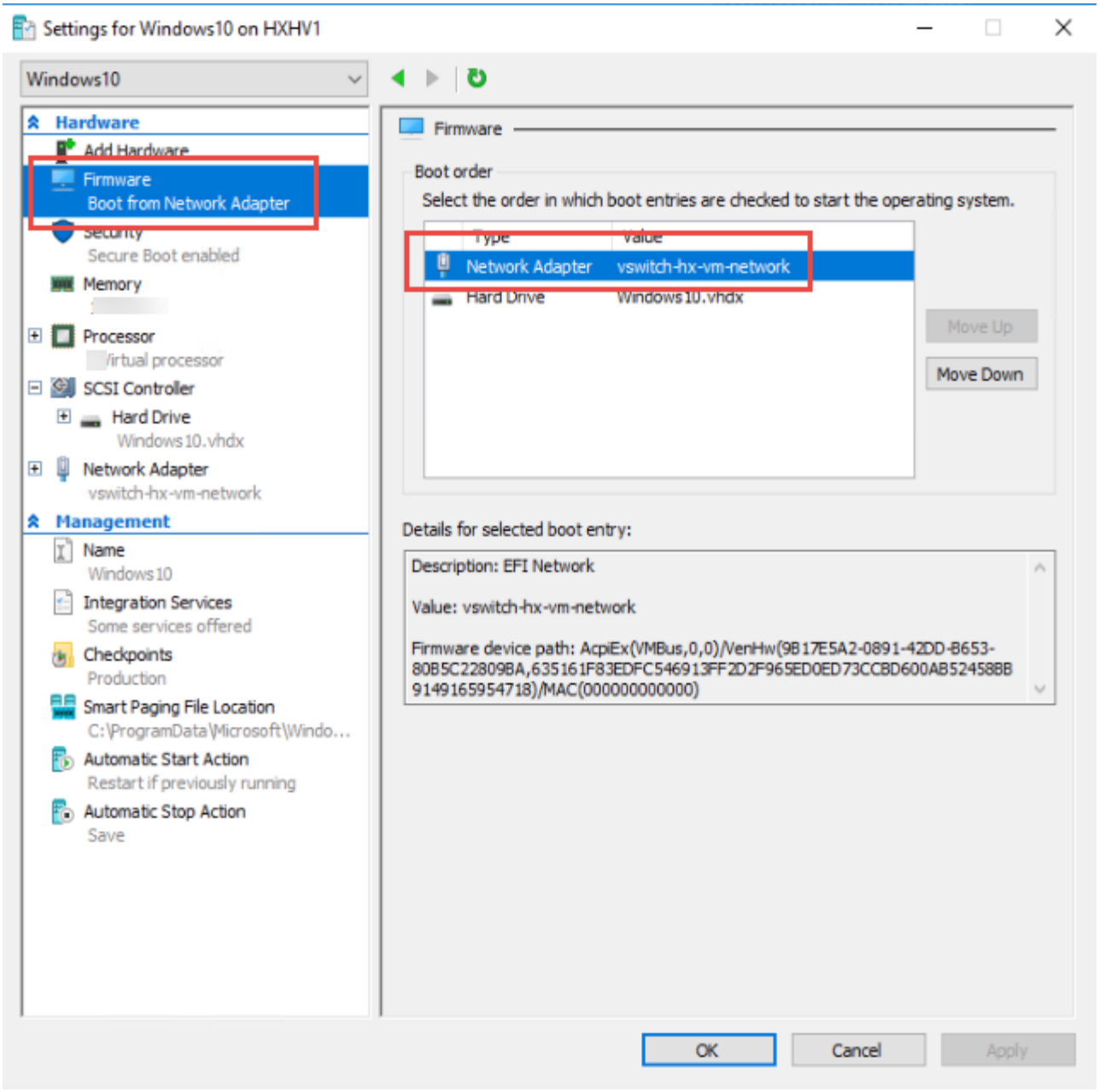
21. Review the configuration and click **Continue.**



22. When prompted, click **No** to shut down the machine.



23. Edit the VM settings and select **Boot from Network Adapter** under Boot Order.



24. Restart Virtual Machine.

After restarting the VM, log into the VDI or RDS master target. The PVS imaging process begins, copying the contents of the C: drive to the PVS vDisk located on the server.

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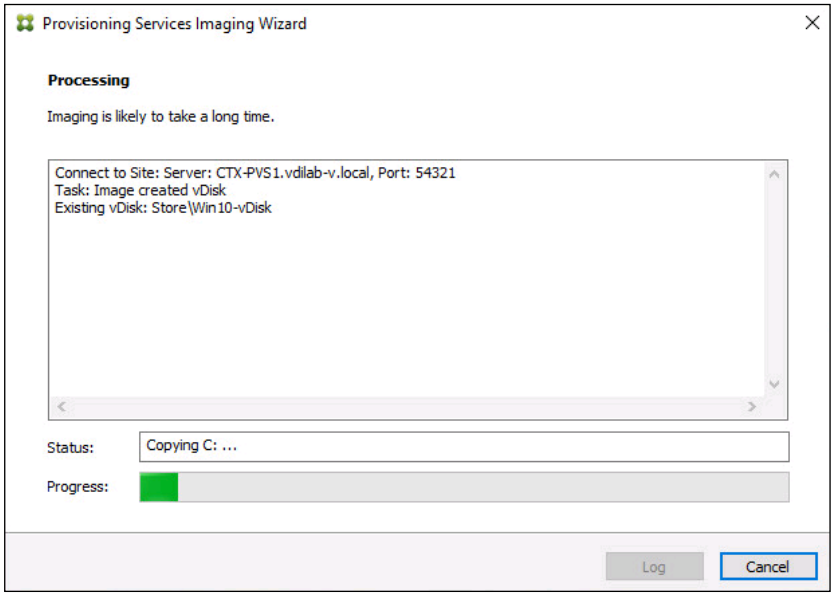
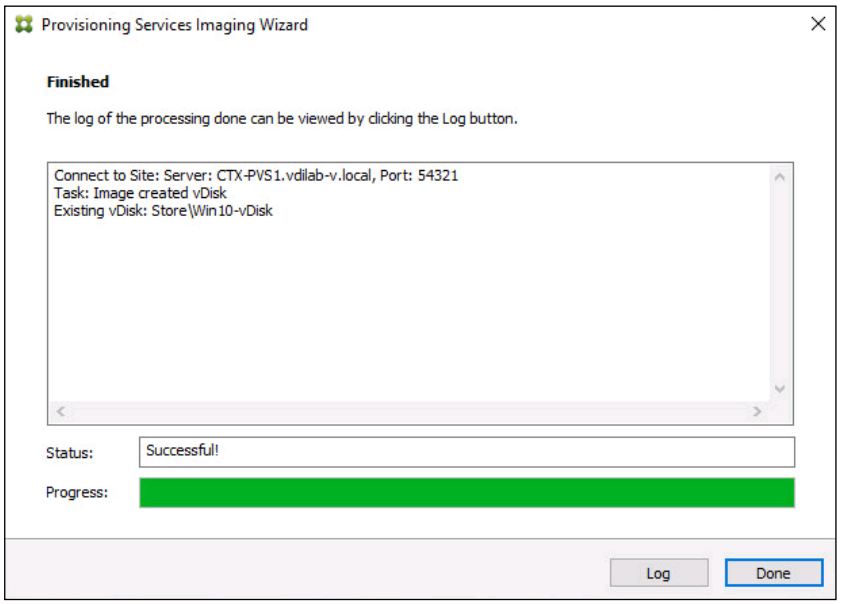
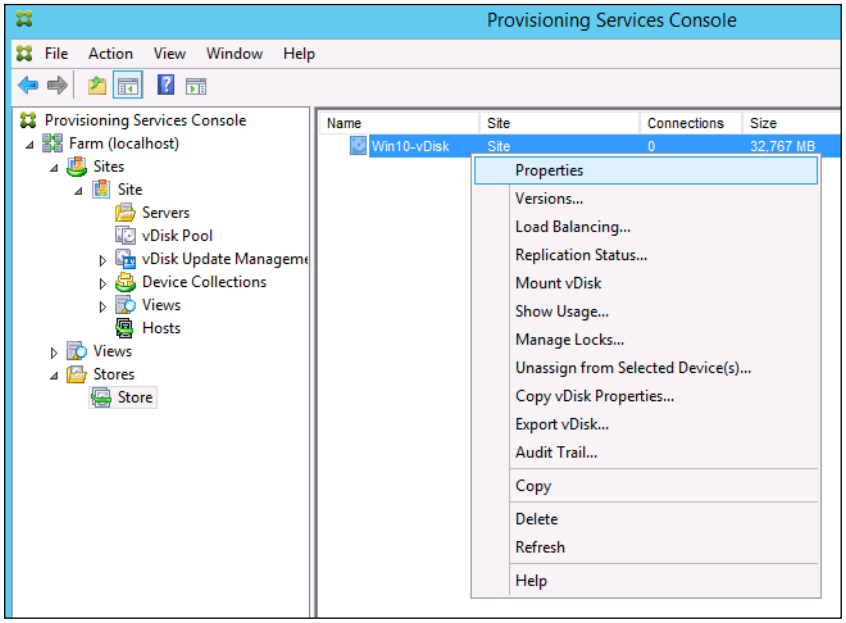
25. If prompted to Restart select **Restart Later**.



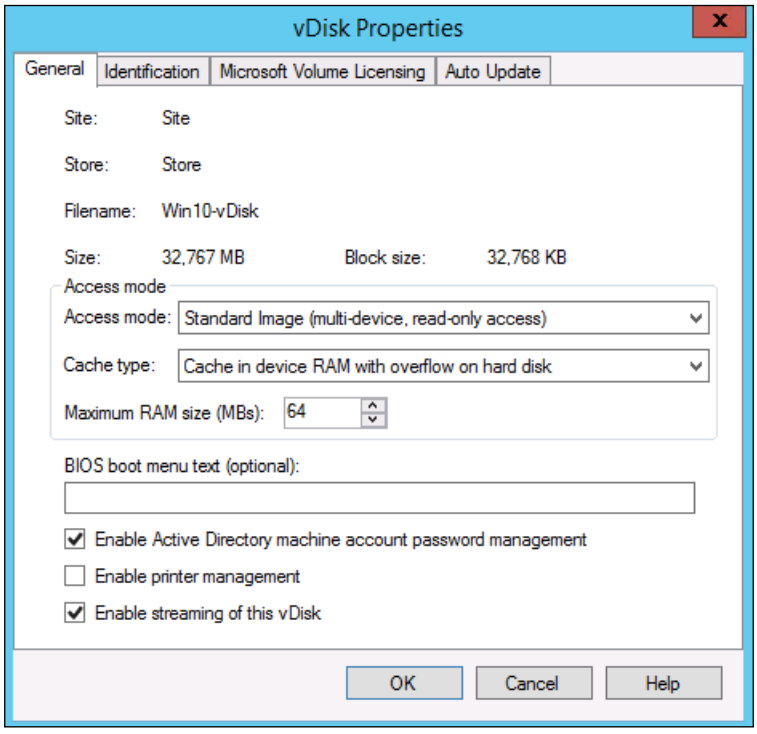
26. A message is displayed when the conversion is complete, click **Done**.



27. Shutdown the VM used as the VDI or RDS master target.
28. Connect to the PVS server and validate that the vDisk image is available in the Store.
29. Right-click the newly created vDisk and select **Properties**.



30. On the vDisk Properties dialog, change Access mode to “Standard Image (multi-device, read-only access)”.
31. Set the Cache Type to “Cache in device RAM with overflow on hard disk.”
32. Set Maximum RAM size (MBs): 256 for VDI and set 1024 MB for RDS vDisk.



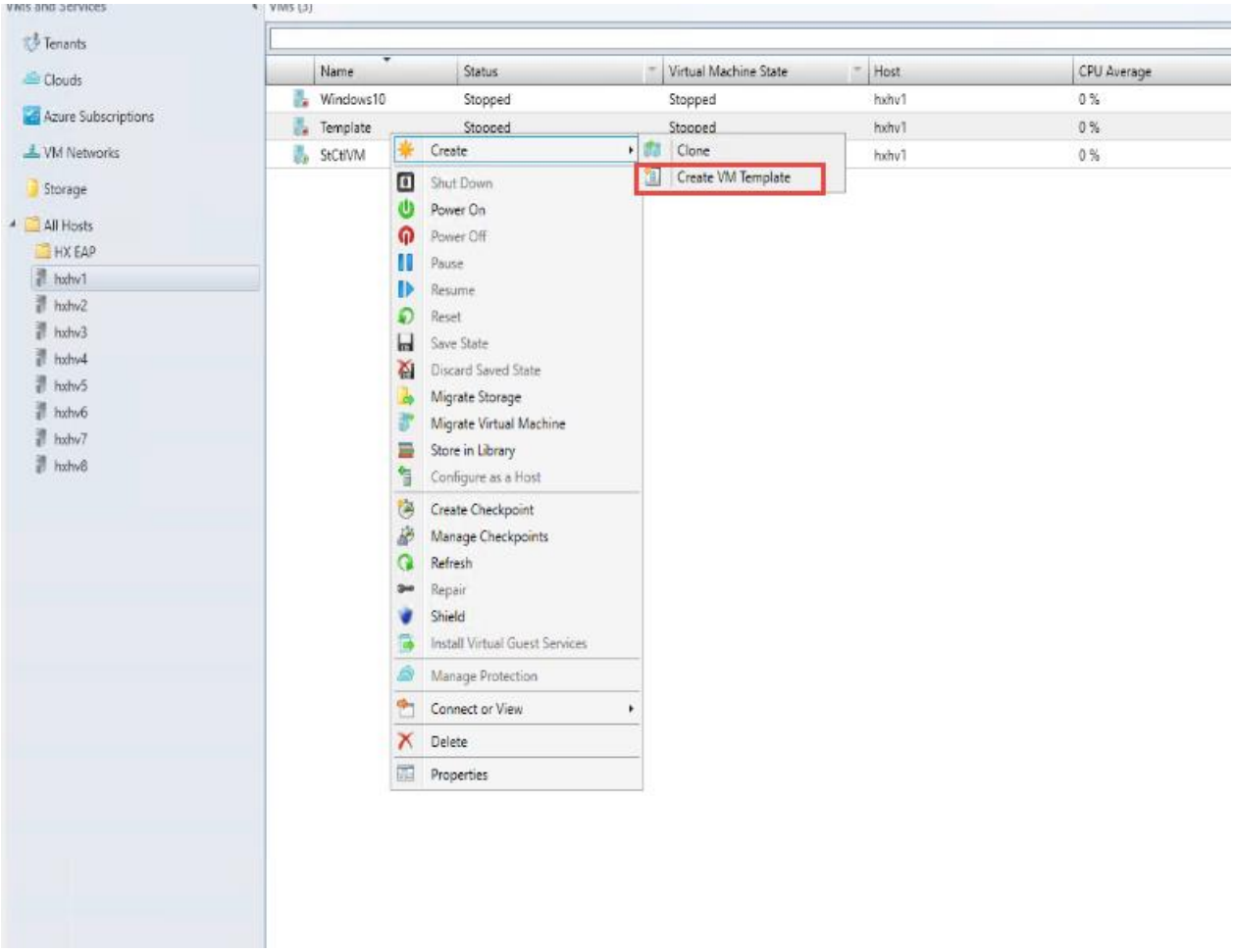
33. Click **OK.**

Repeat this procedure to create vDisks for both the Hosted VDI Desktops (using the Windows 10 OS image) and the Hosted Shared Desktops (using the Windows Server 2016 image).

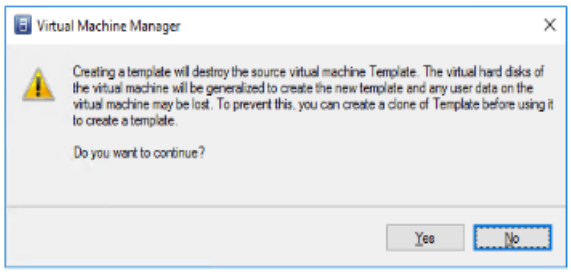
Provision Virtual Desktop Machines

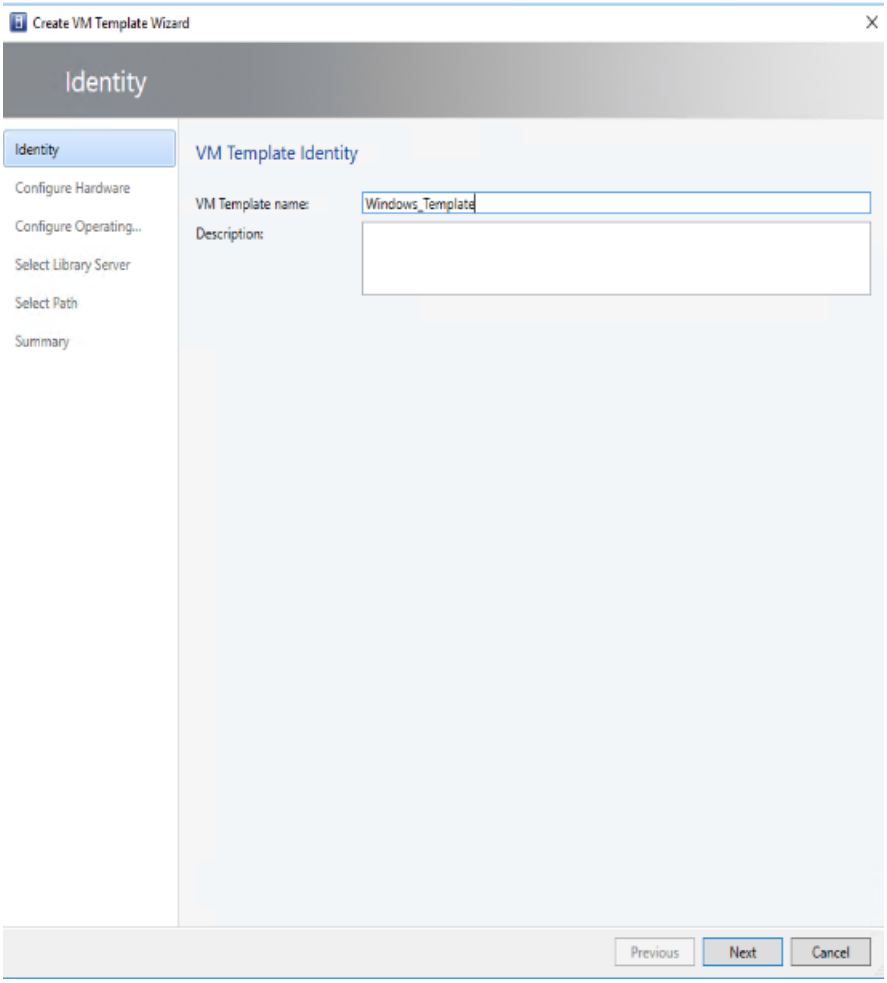
To create VDI and RDS machines, complete the following steps:

1. Select the Master Target Device VM from the SCVMM Client.
2. Right-click the VM and select Create -> Create VM Template.
3. Name the cloned ‘Template’.
4. Select the cluster and datastore where the first phase of provisioning will occur.

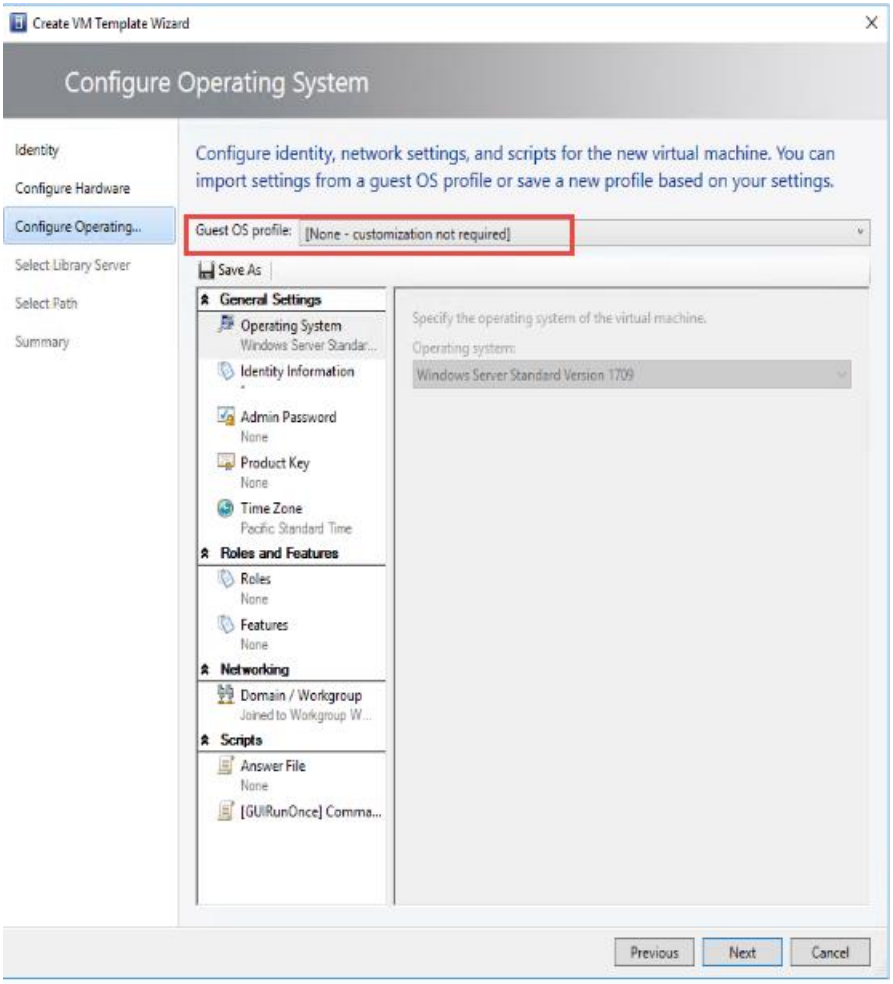


5. Click Yes to the warning that your machine will be destroyed by the Template process.

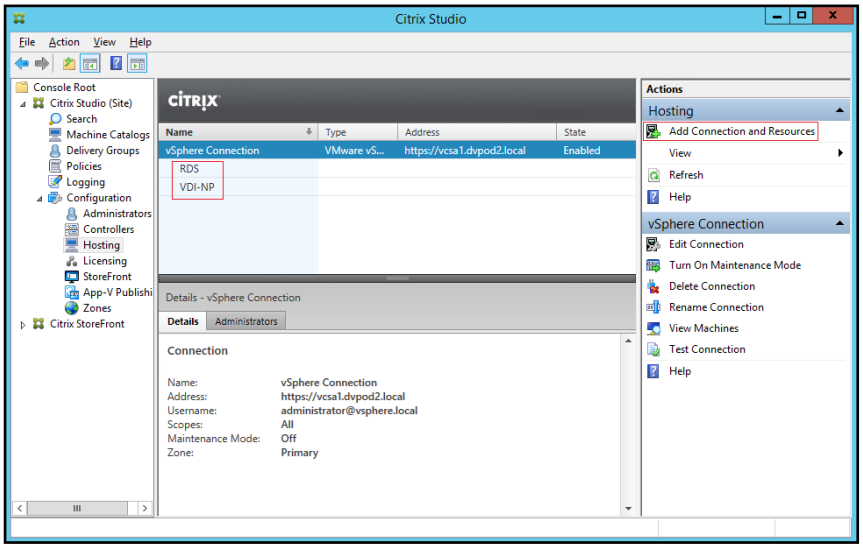



Create VM Template Wizard
Identity
Identity
Configure Hardware
Configure Operating...
Select Library Server
Select Path
Summary
VM Template Identity
VM Template name:
Windows_Template
Description:
Previous
Next
Cancel

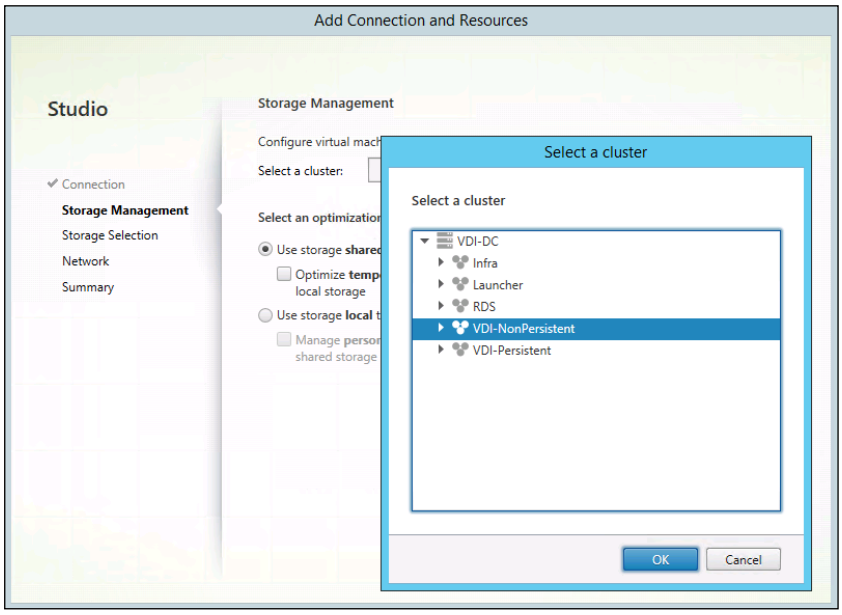
6. Click Next.



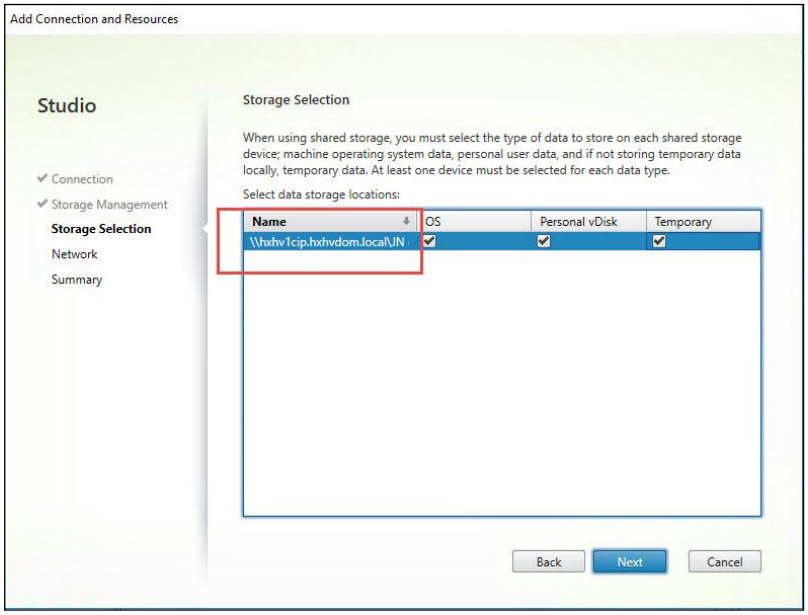
7. Under ‘Configure Operating System’, ensure that customization is disabled.
8. Click Next through the remaining screens
9. Click Finish to create the template
10. From Citrix Studio on the Desktop Controller, select Hosting and Add Connection and Resources.
11. Select Use an existing Connection and click Next.
12. Correspond the name of the resource with desktop machine clusters.



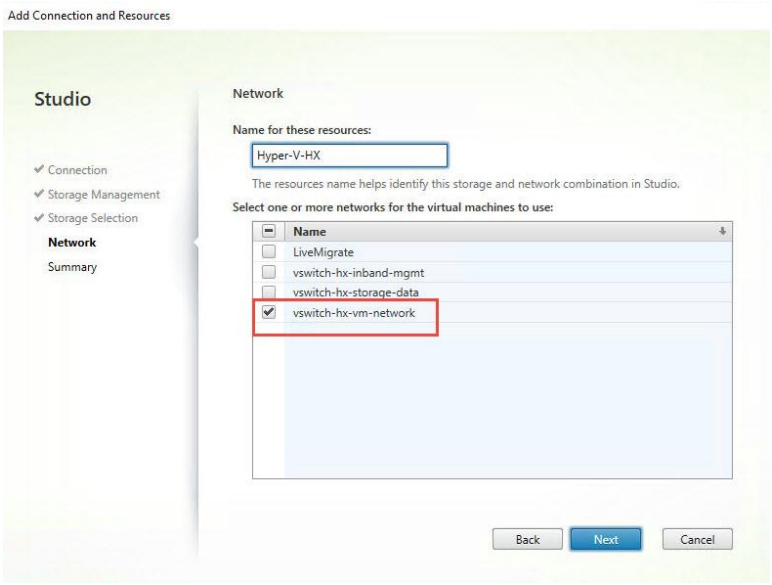
13. Browse and select the Hyper-V cluster for desktop provisioning and use the default storage method Use storage shared by hypervisors.

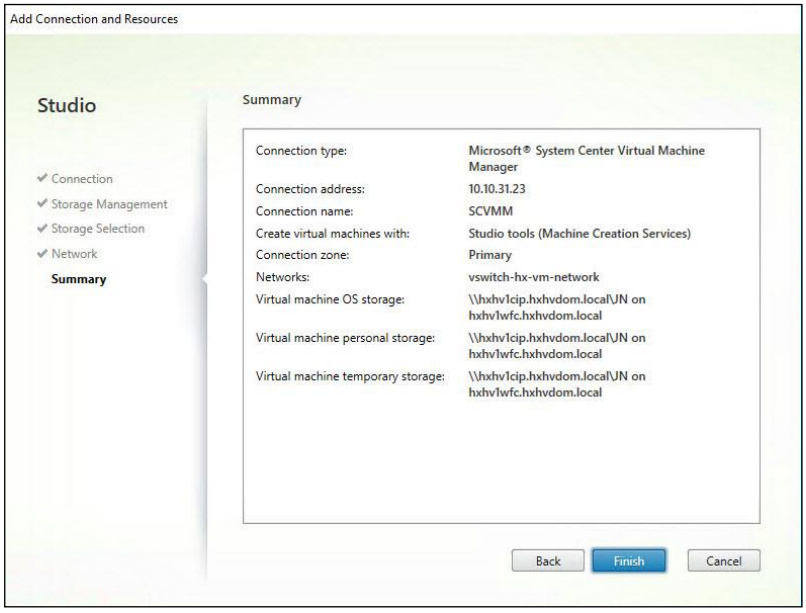


14. Select the data storage location for the corresponding resource.



15. Select the VDI networks for the desktop machines and click Next.



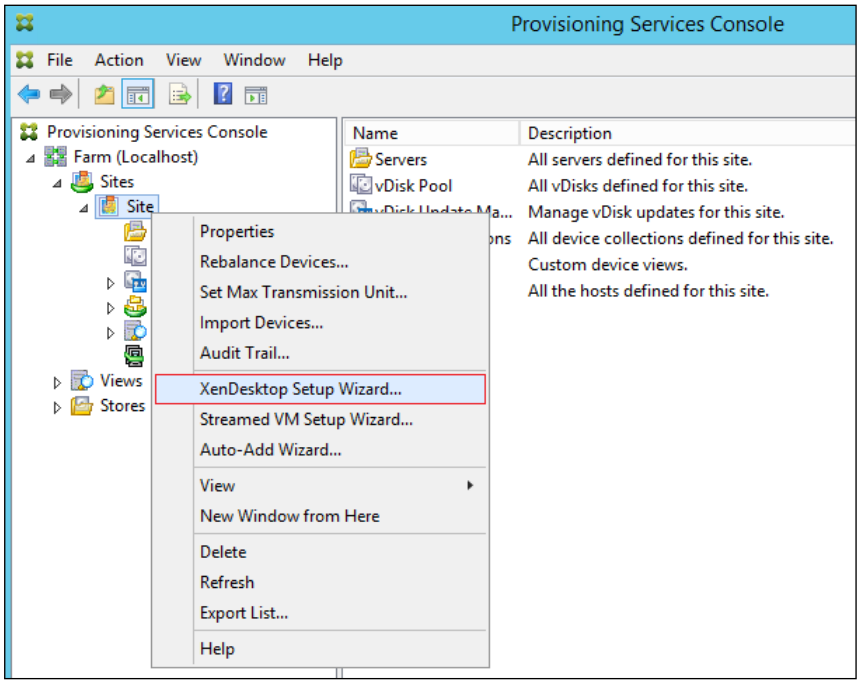


16. Click Finish.

Return to these settings to alter the datastore selection for each set of provisioned desktop machines.

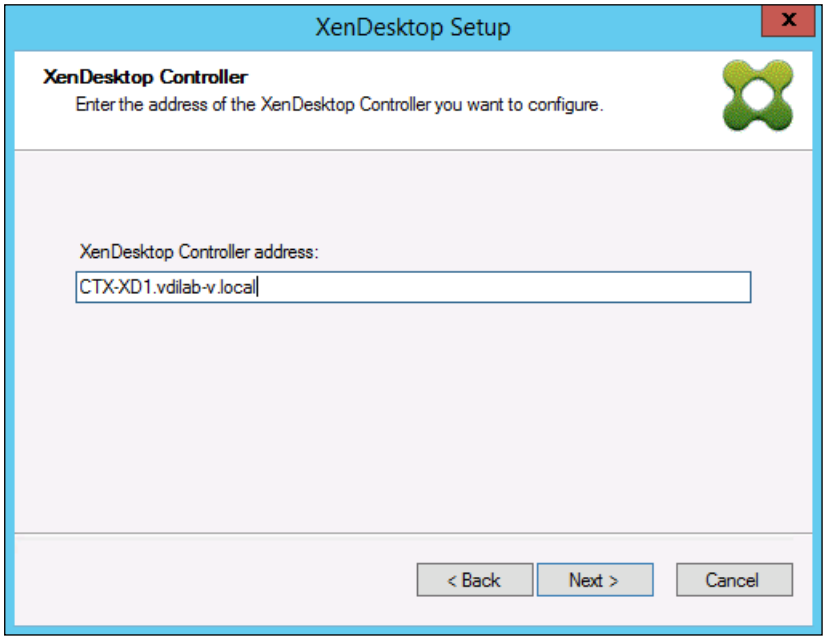
Provision Desktop Machines from Citrix Provisioning Services Console

1. Start the XenDesktop Setup Wizard from the Provisioning Services Console.
2. Right-click the Site.
3. Choose XenDesktop Setup Wizard… from the context menu.

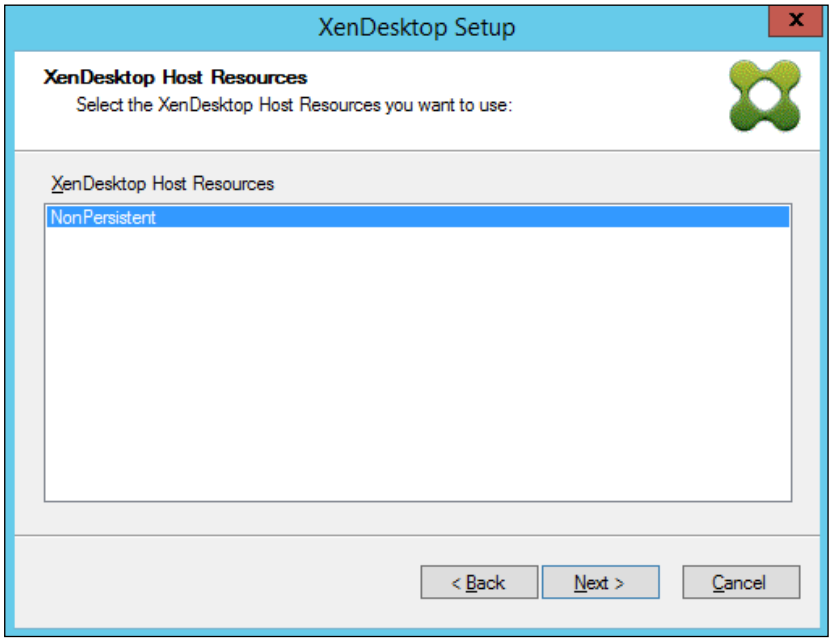


4. Click Next.

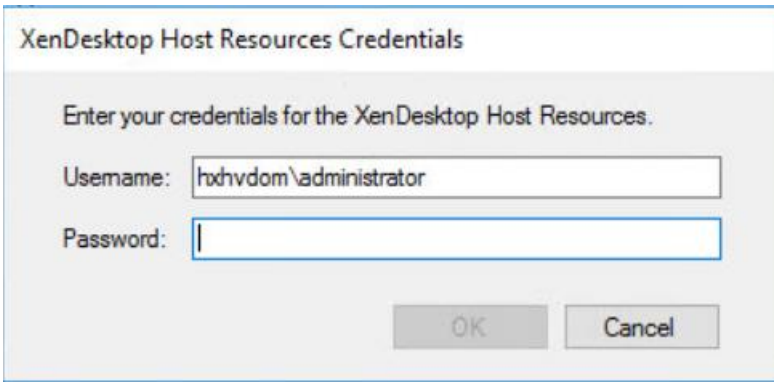
5. Enter the XenDesktop Controller address that will be used for the wizard operations.
6. Click Next.



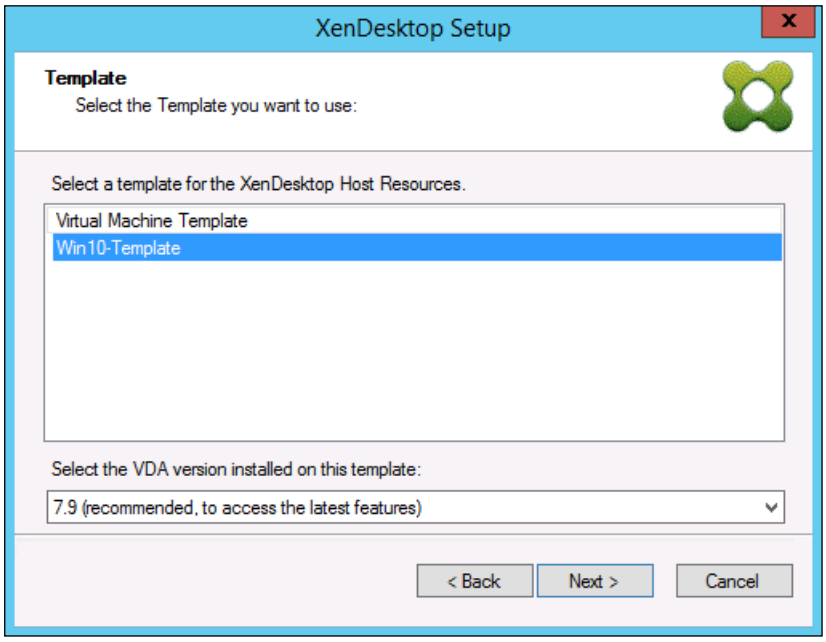
7. Select the Host Resources on which the virtual machines will be created.
8. Click Next.



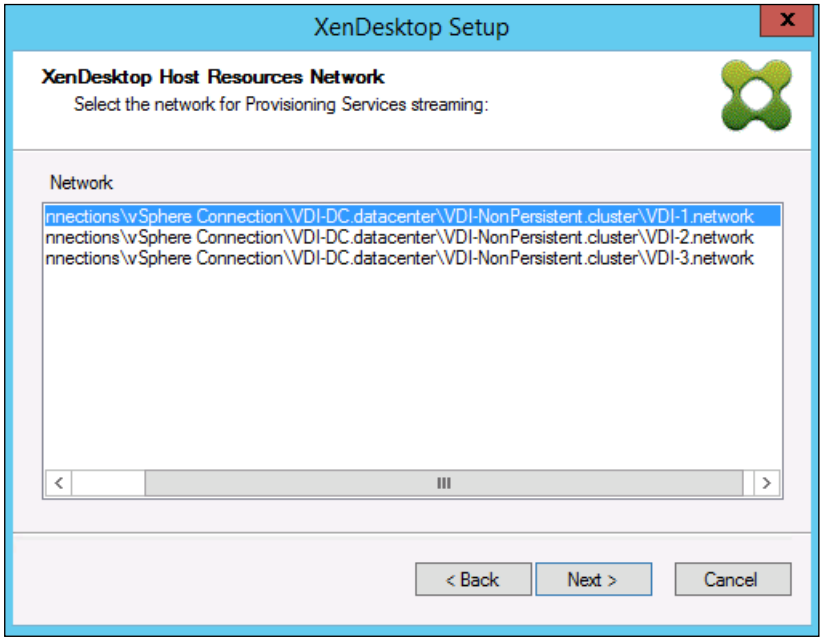
9. Provide the Host Resources Credentials (Username and Password) to the XenDesktop controller when prompted.
10. Click OK.



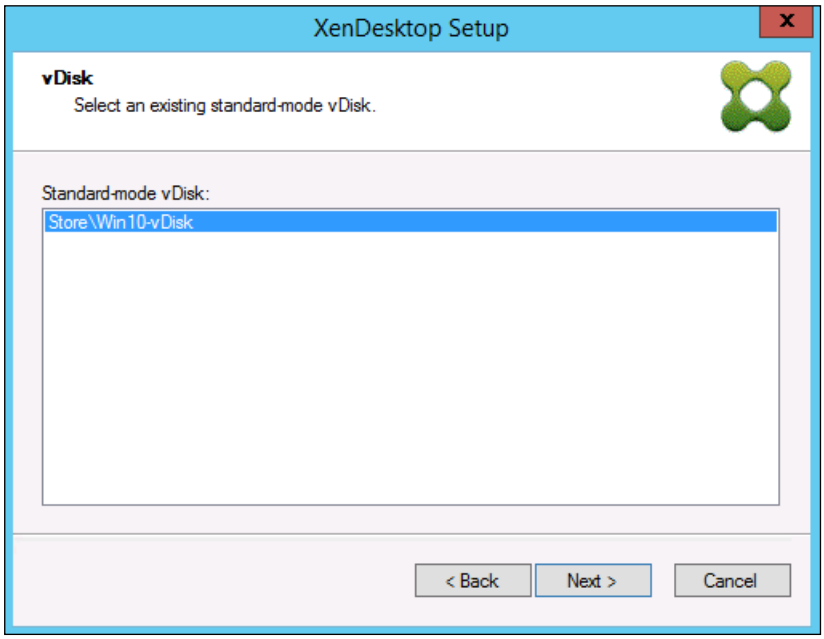
11. Select the Template created earlier.
12. Click Next.



13. Select the network that will be used for the provisioned virtual machines.



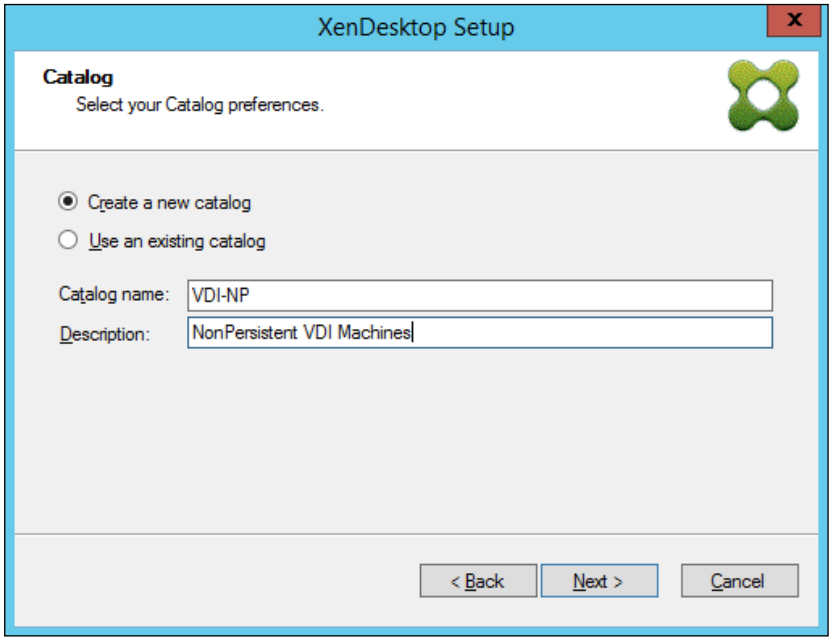
14. Select the vDisk that will be used to stream virtual machines.
15. Click Next.



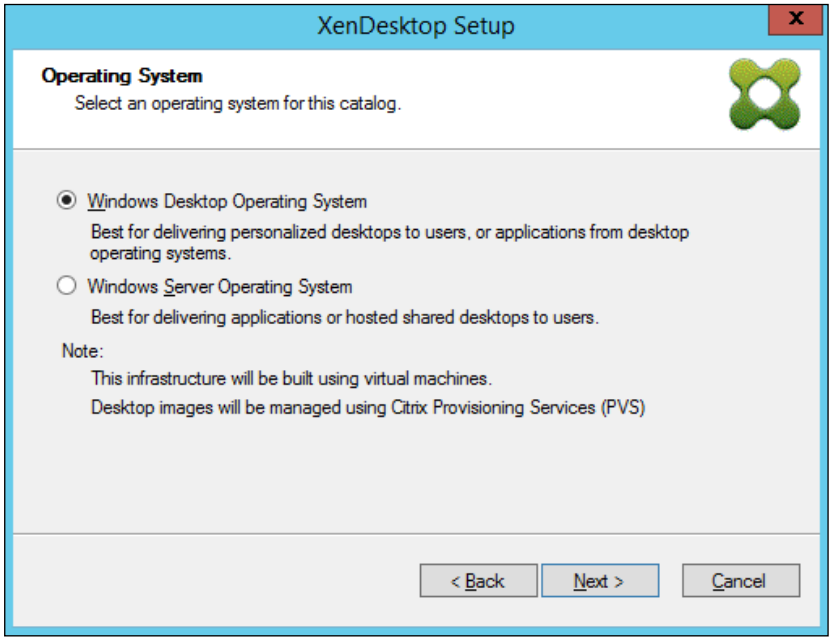
16. Select “Create a new catalog.”

> The catalog name is also used as the collection name in the PVS site.

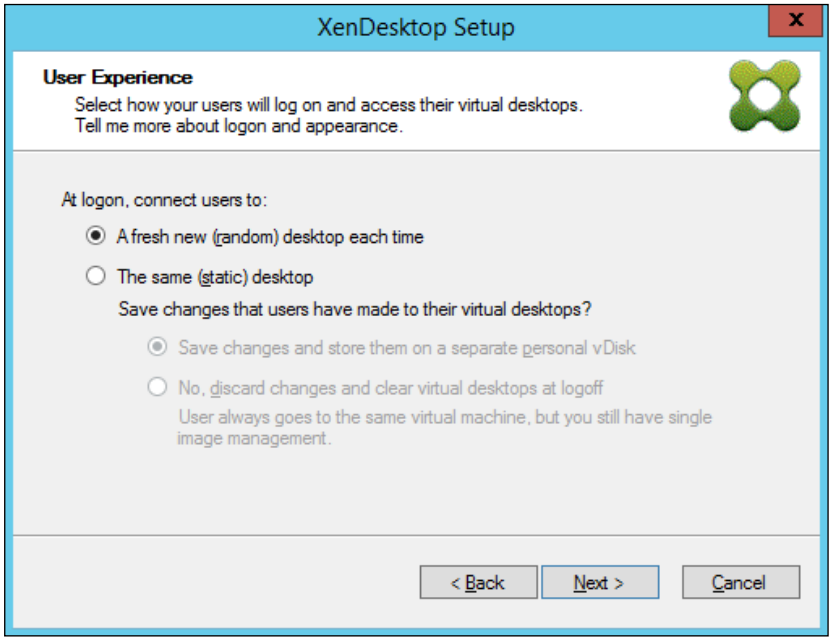
17. Click Next.



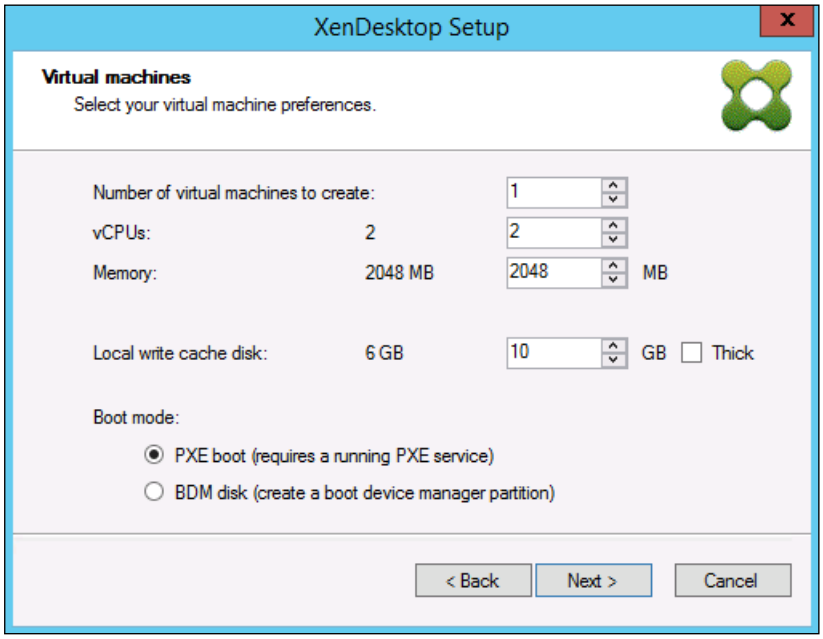
18. On the Operating System dialog, specify the operating system for the catalog. Specify Windows Desktop Operating System for VDI and Windows Server Operating System for RDS.
19. Click Next.



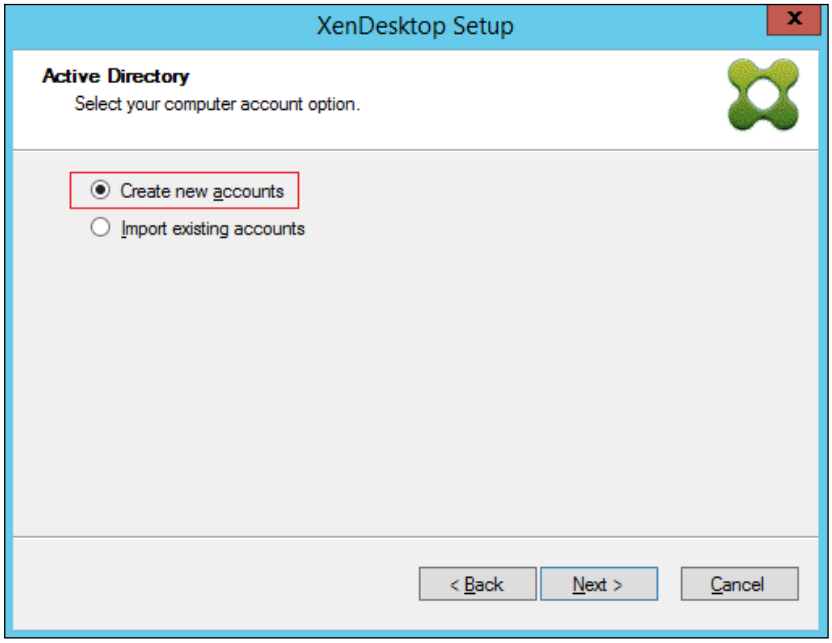
20. If you specified a Windows Desktop OS for VDIs, a User Experience dialog appears. Specify that the user will connect to “A fresh new (random) desktop each time.”
21. Click Next.



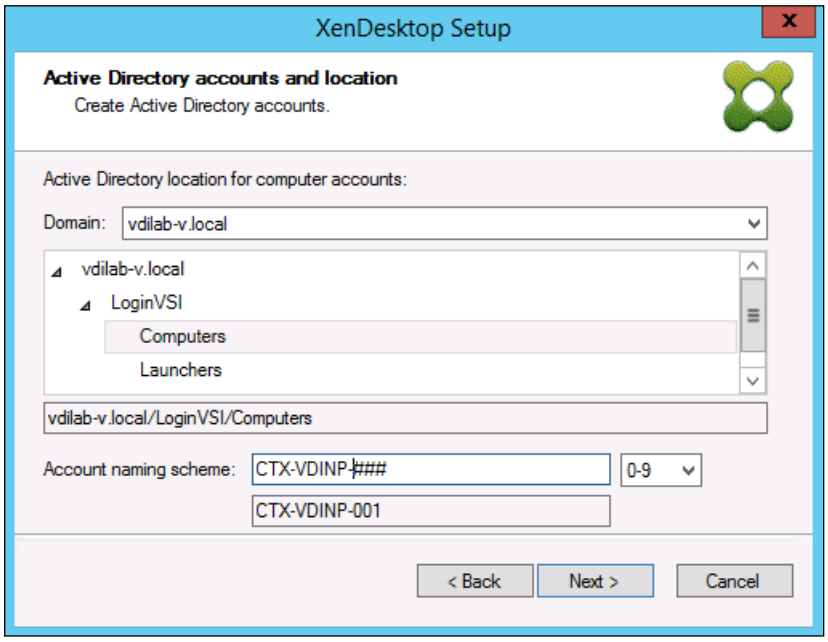
22. On the Virtual machines dialog, specify:
    a. The number of VMs to create.
    b. Number of vCPUs for the VM (2 for VDI, 8 for RDS)
    c. The amount of memory for the VM (4GB for VDI, 24GB for RDS)
    d. The write-cache disk size (10GB for VDI, 30GB for RDS)
    e. PXE boot as the Boot Mode
23. Click Next.



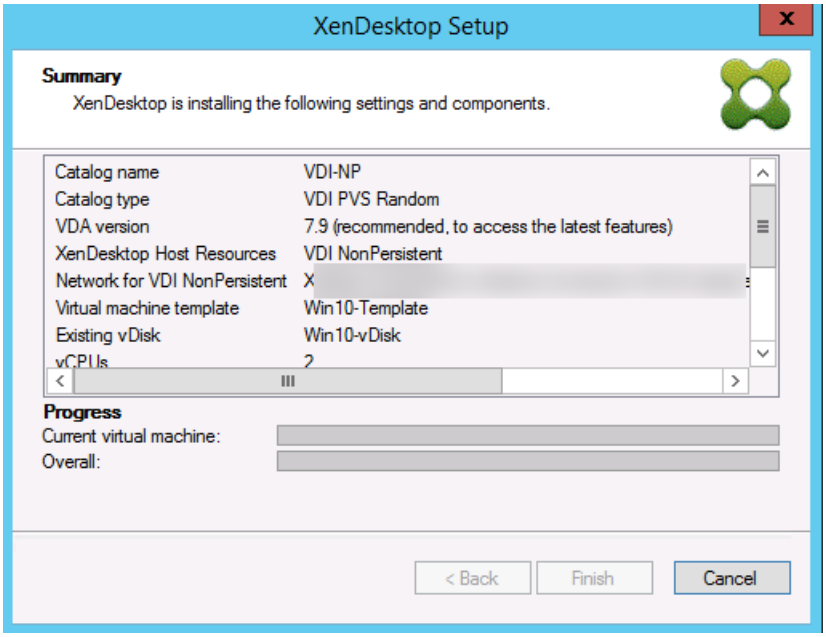
24. Select the Create new accounts radio button.
25. Click Next.



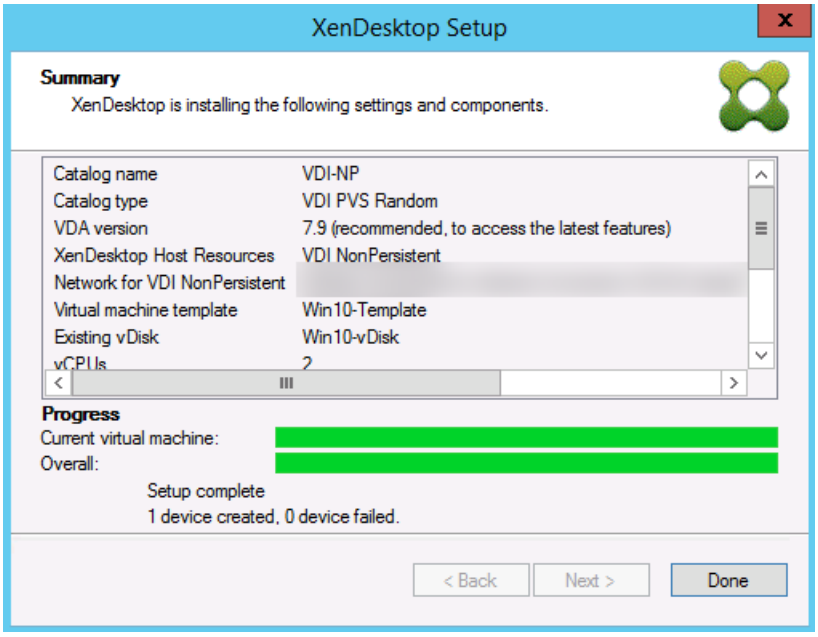
26. Specify the Active Directory Accounts and Location. This is where the wizard should create the computer accounts.
27. Provide the Account naming scheme. An example name is shown in the text box below the name scheme selection location.
28. Click Next.



29. Click Finish to begin the virtual machine creation.

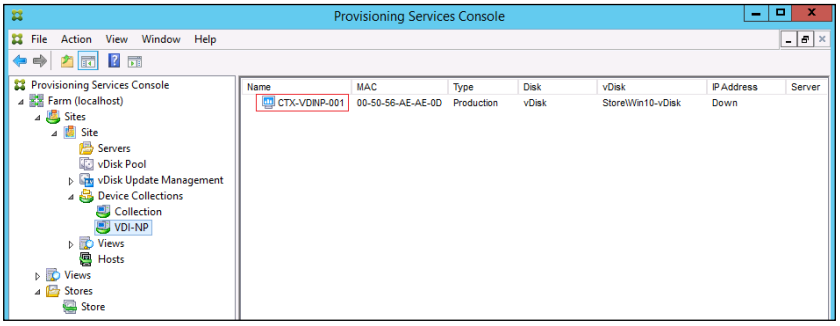


30. When the wizard is done provisioning the virtual machines, click Done.

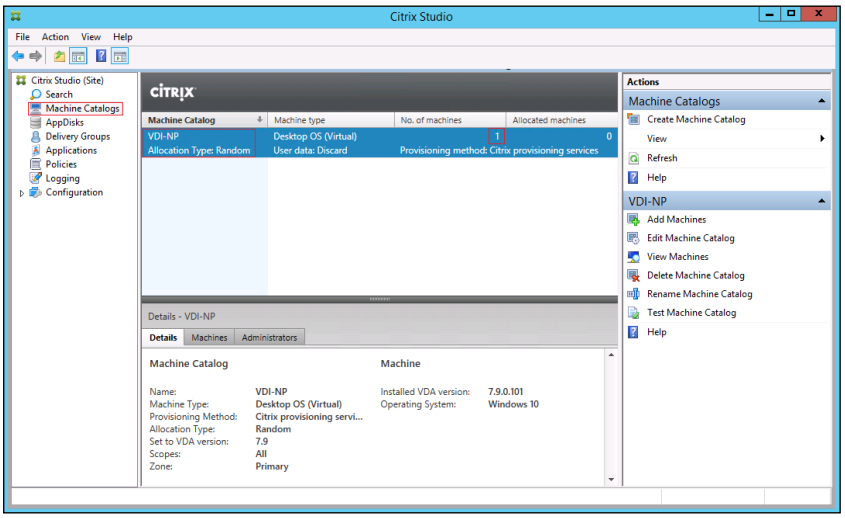


Provisioning process takes ~10 seconds per machine.

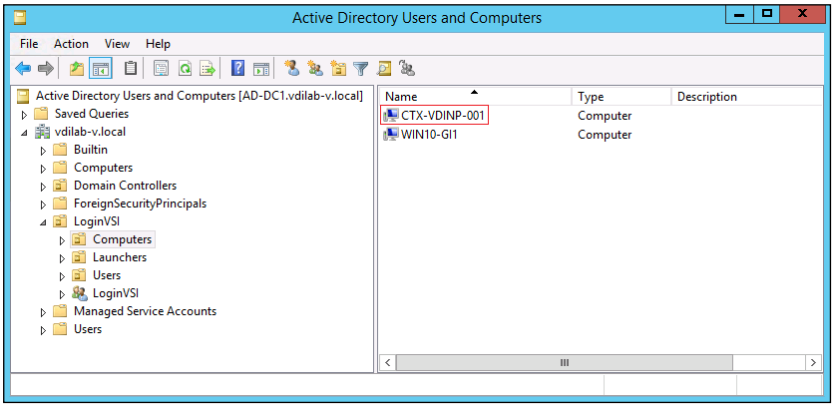
31. Verify the desktop machines were successfully created in the following locations:
    a. PVS1 > Provisioning Services Console > Farm > Site > Device Collections > VDI-NP > CTX-VDI-001



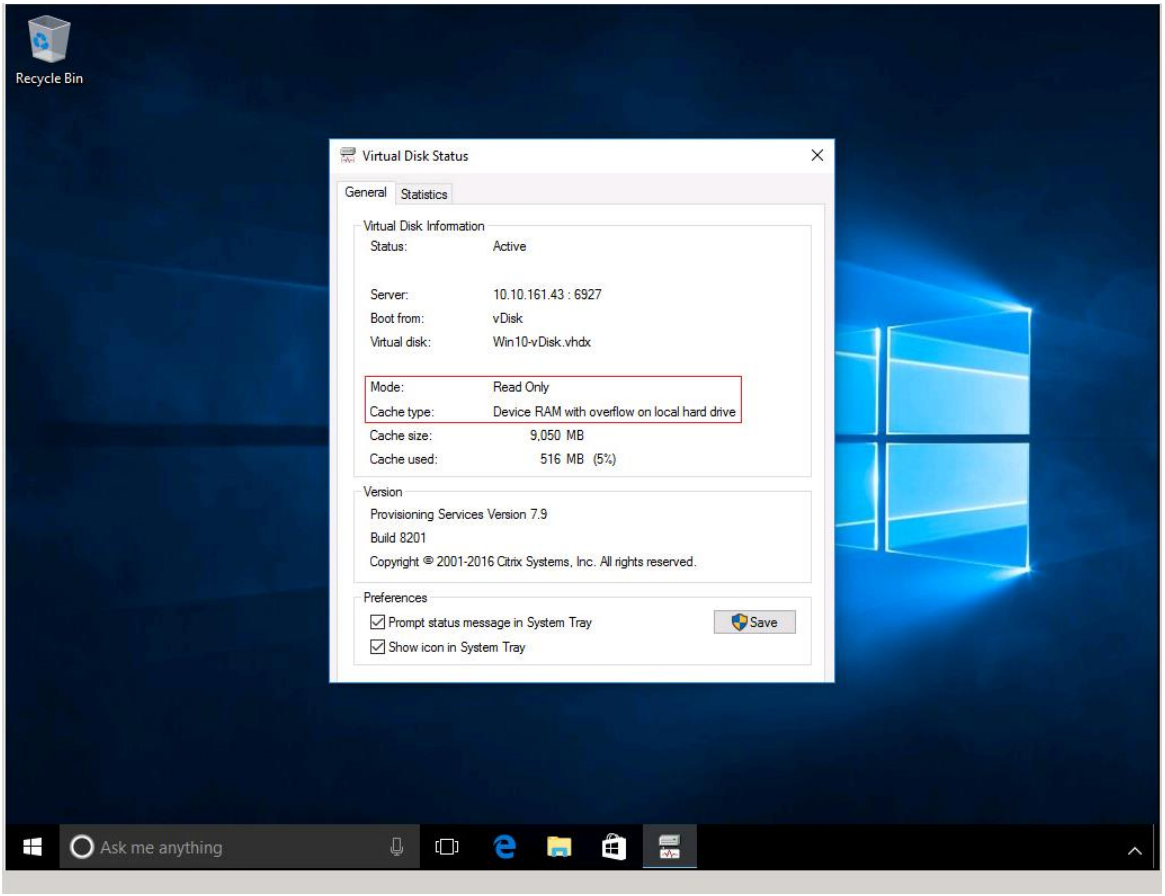
b. CTX-XD1 > Citrix Studio > Machine Catalogs > VDI-NP



c. AD-DC1 > Active Directory Users and Computers > dvpod2.local > Computers > CTX-VDI-001



32. Logon to newly provisioned desktop machine, using the Virtual Disk Status verify the image mode is set to Ready Only and the cache type as Device Ram with overflow on local hard drive.



Install XenDesktop Virtual Desktop Agents

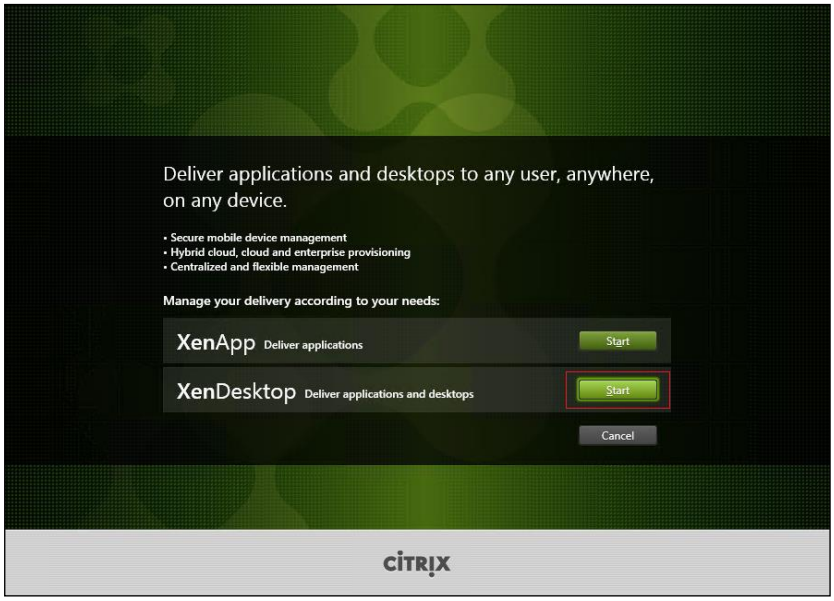
Virtual Delivery Agents (VDAs) are installed on the server and workstation operating systems, and enable connections for desktops and apps. The following procedure was used to install VDAs for both HVD and HSD environments.

By default, when you install the Virtual Delivery Agent, Citrix User Profile Management is installed silently on master images.

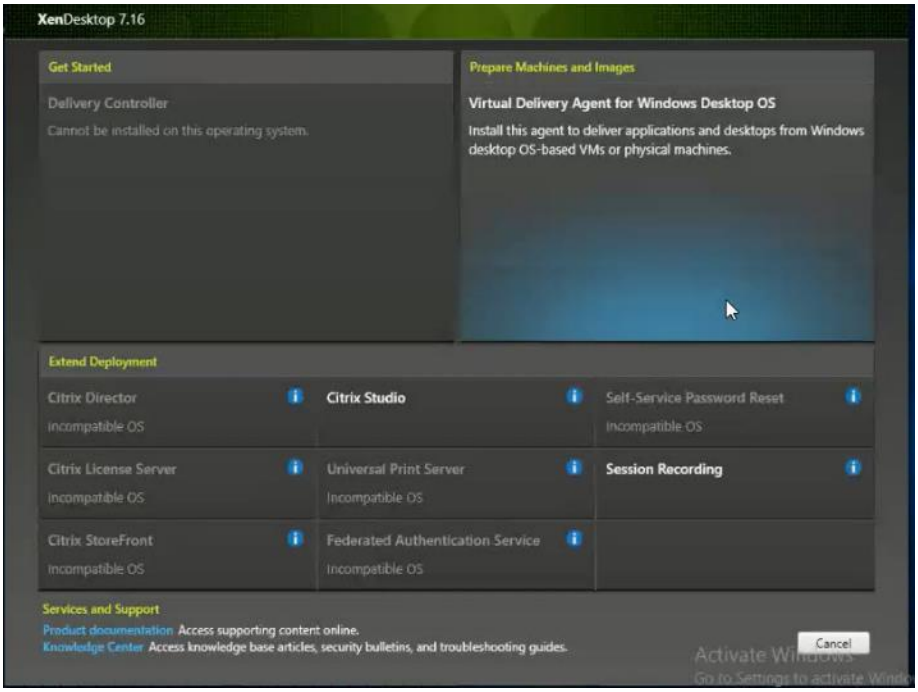
Using profile management as a profile solution is optional but was used for this CVD and is described in a subsequent section.

To install XenDesktop Virtual Desktop Agents, complete the following steps:

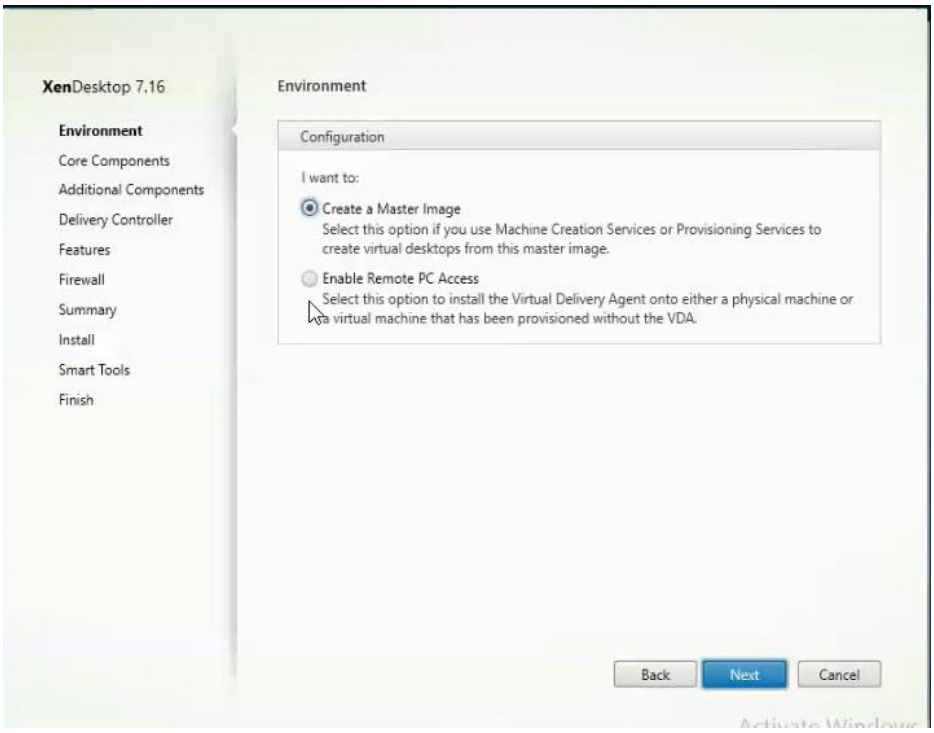
1. Launch the XenDesktop installer from the XenDesktop 7.16 ISO.
2. Click Start on the Welcome Screen.



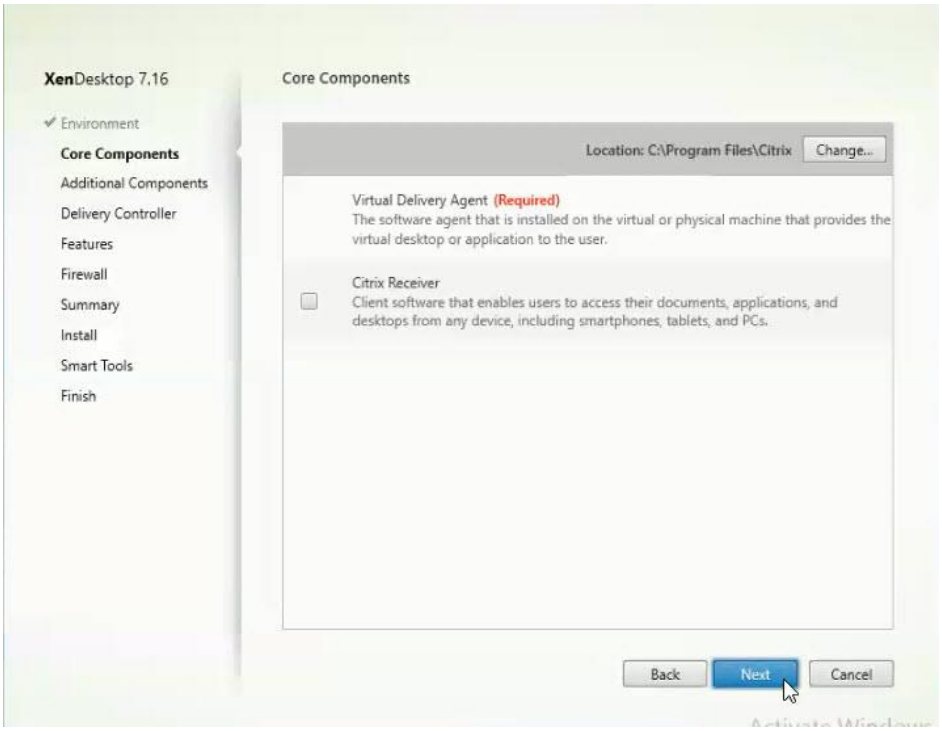
3. To install the VDA for the Hosted Virtual Desktops (VDI), select Virtual Delivery Agent for Windows Desktop OS. After the VDA is installed for Hosted Virtual Desktops, repeat the procedure to install the VDA for Hosted Shared Desktops (RDS). In this case, select Virtual Delivery Agent for Windows Server OS and follow the same basic steps.



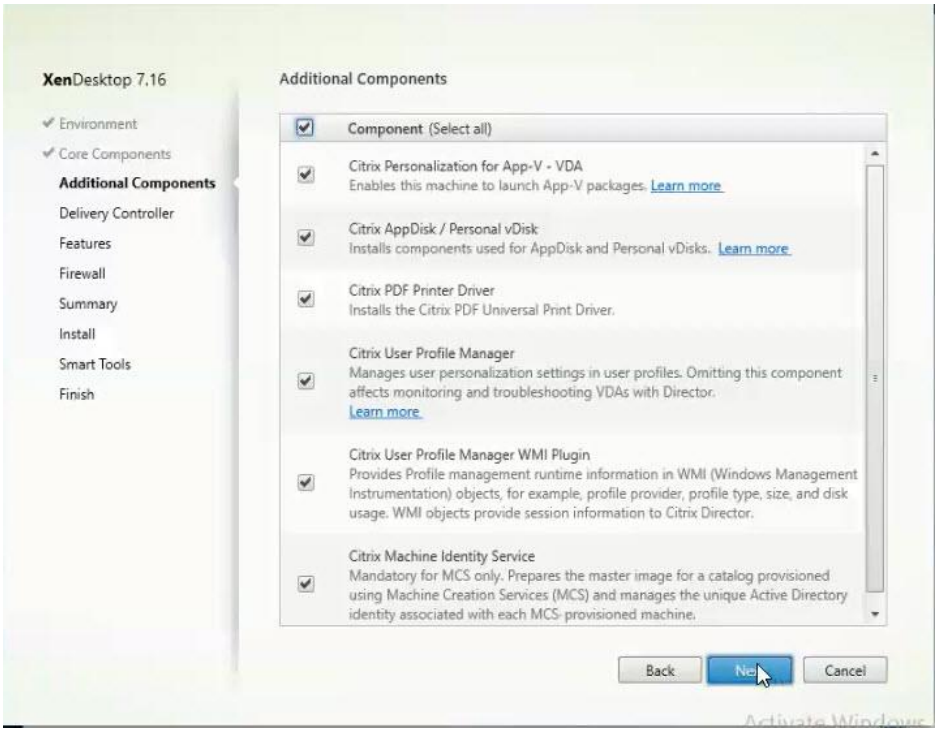
4. Select “Create a Master Image.”
5. Click Next.



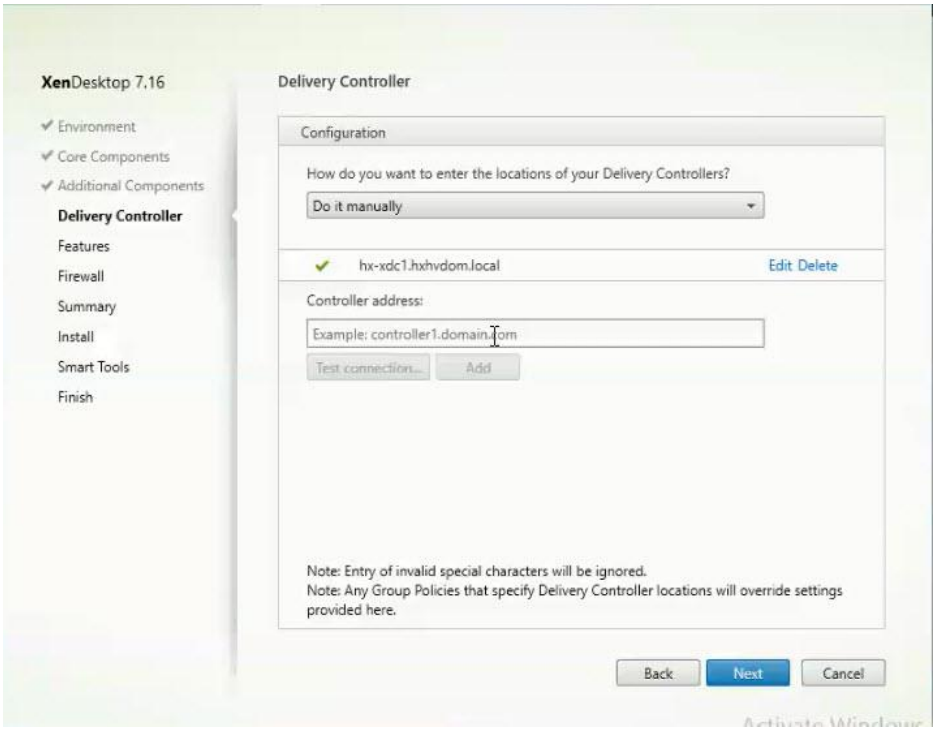
6. Optional: Select Citrix Receiver.
7. Click Next.



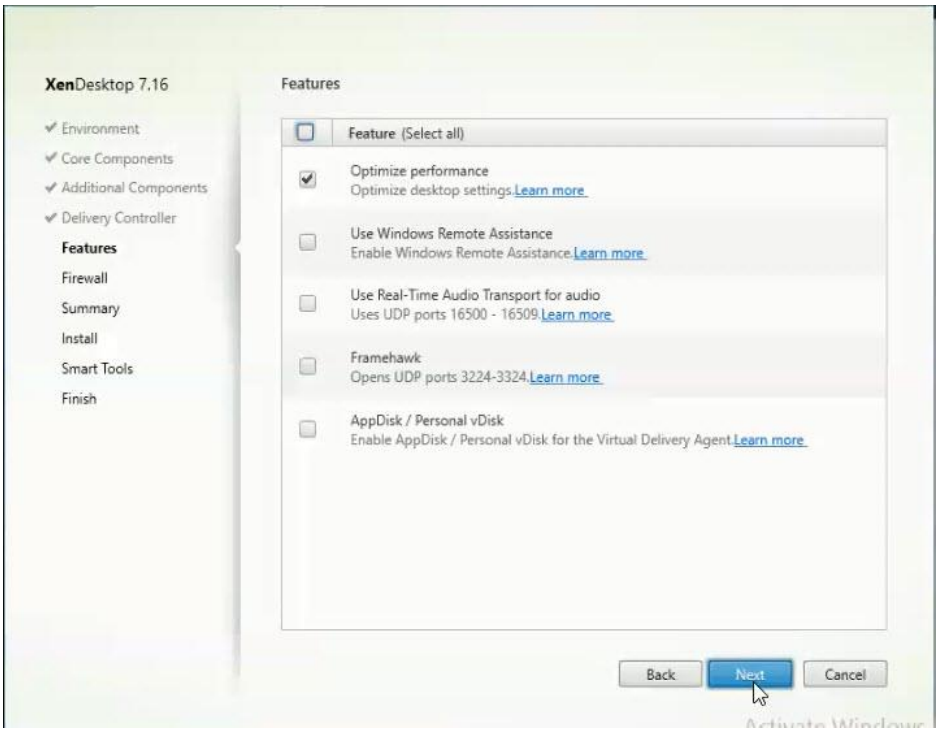
8. Click Next.



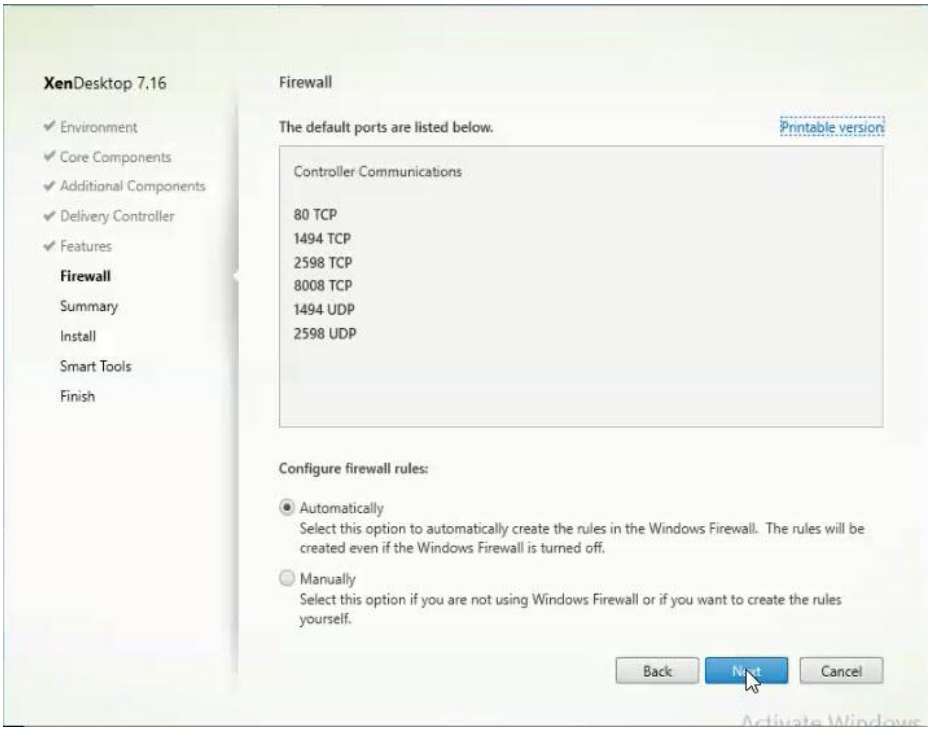
9. Select “Do it manually” and specify the FQDN of the Delivery Controllers.
10. Click Next.



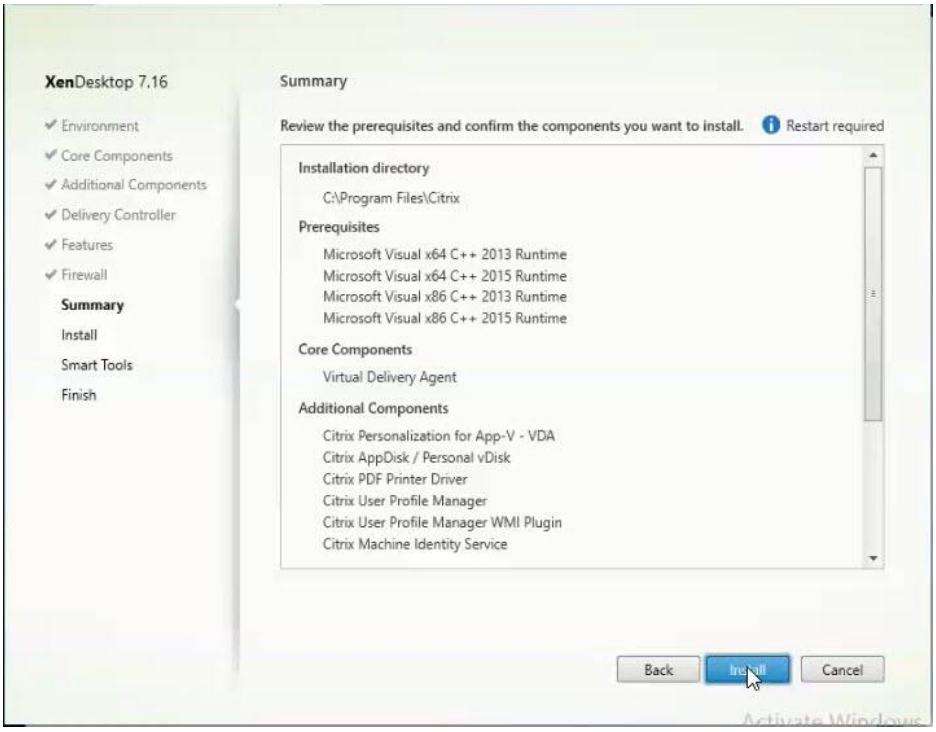
11. Accept the default features.
12. Click Next.



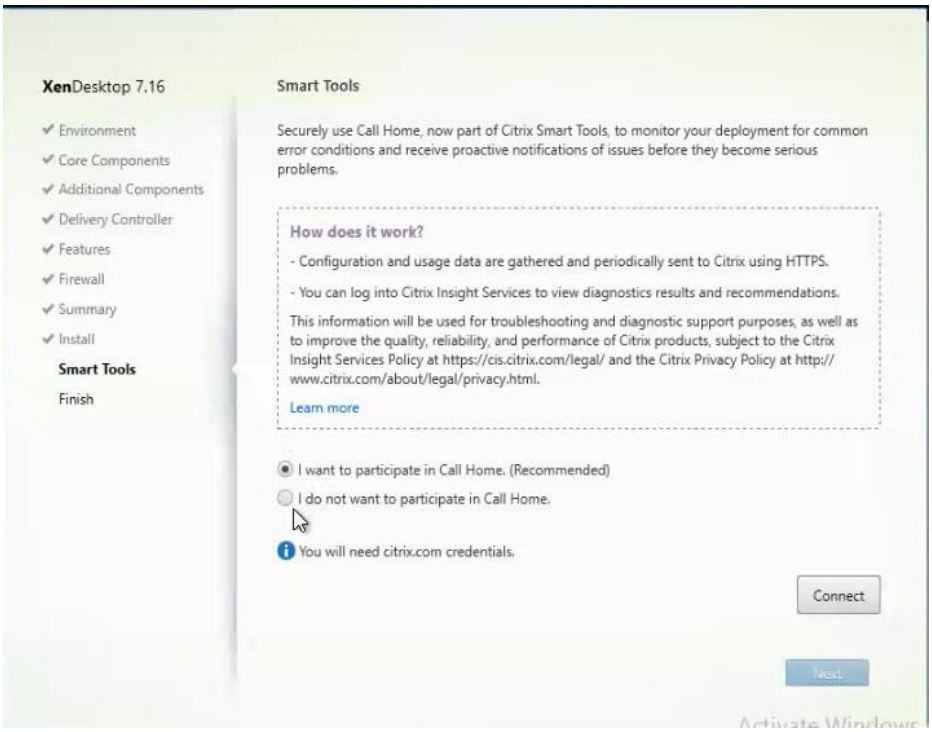
13. Allow the firewall rules to be configured automatically.
14. Click Next.



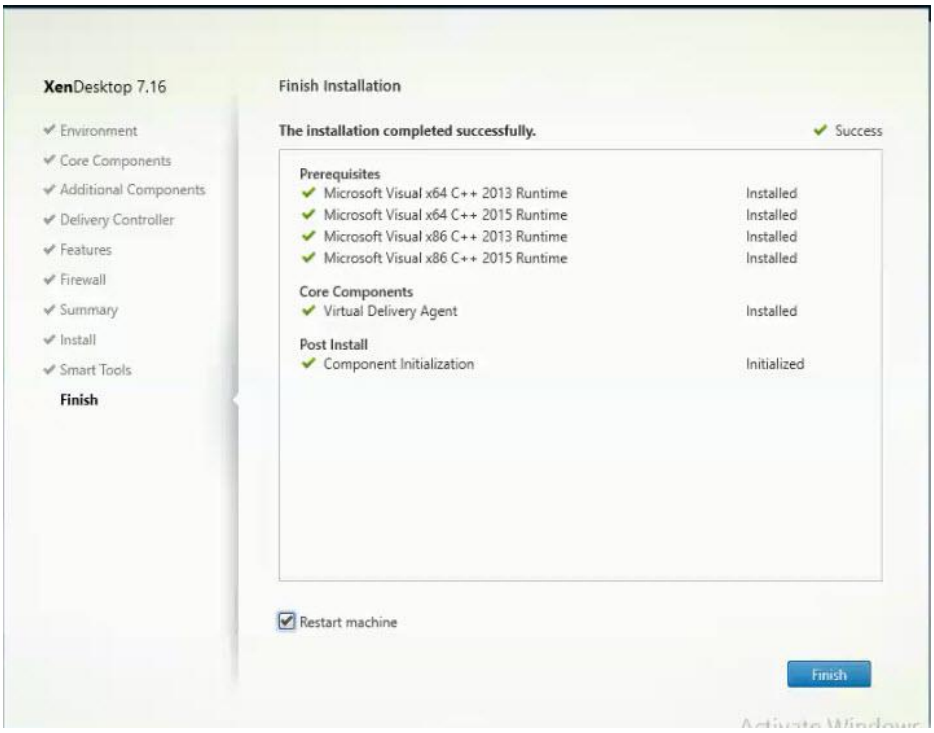
15. Verify the Summary and click Install.



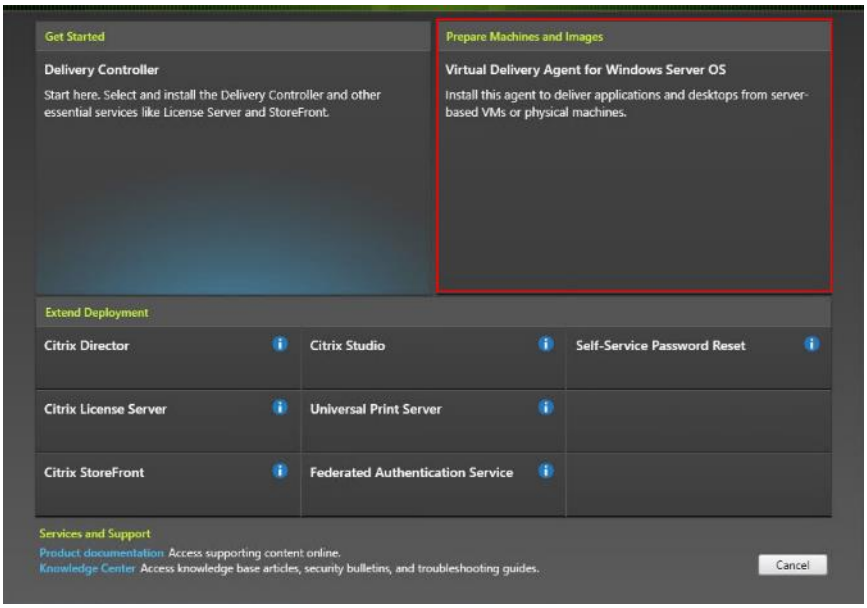
16. (Optional) Select Call Home participation.



17. (Optional) check “Restart Machine.”
18. Click Finish.



19. Repeat the procedure so that VDAs are installed for both HVD (using the Windows 10 OS image) and the HSD desktops (using the Windows Server 2016 image).
20. Select an appropriate workflow for the HSD desktop.



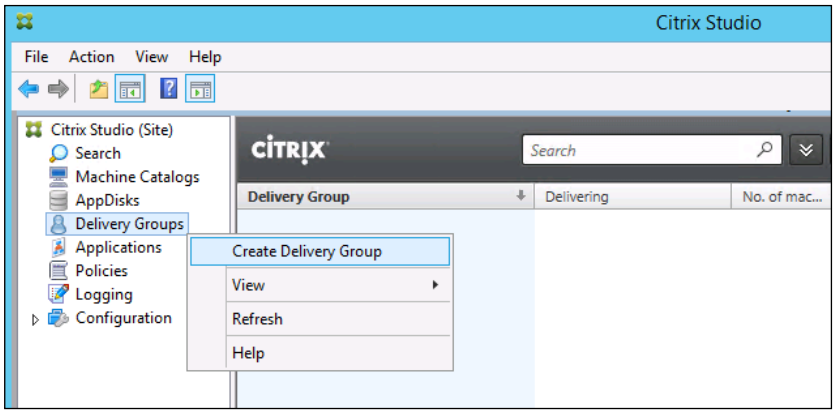
Create Delivery Groups

Delivery Groups are collections of machines that control access to desktops and applications. With Delivery Groups, you can specify which users and groups can access which desktops and applications.

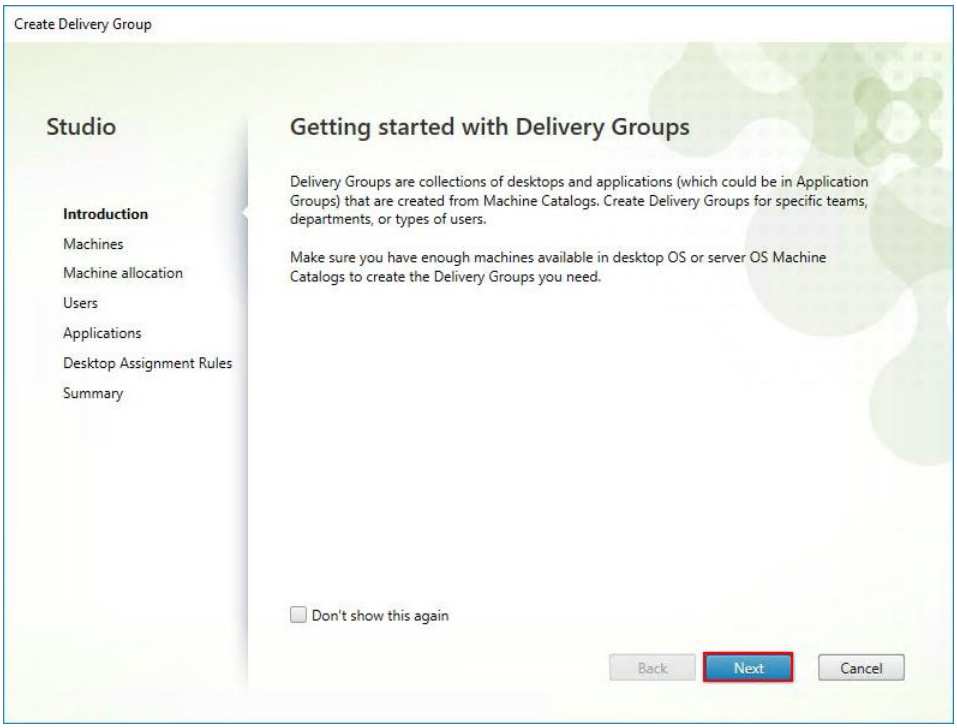
To create delivery groups, complete the following steps:

The instructions below outline the steps to create a Delivery Group for VDI desktops. When you have completed these steps, repeat the procedure to a Delivery Group for HVD desktops.

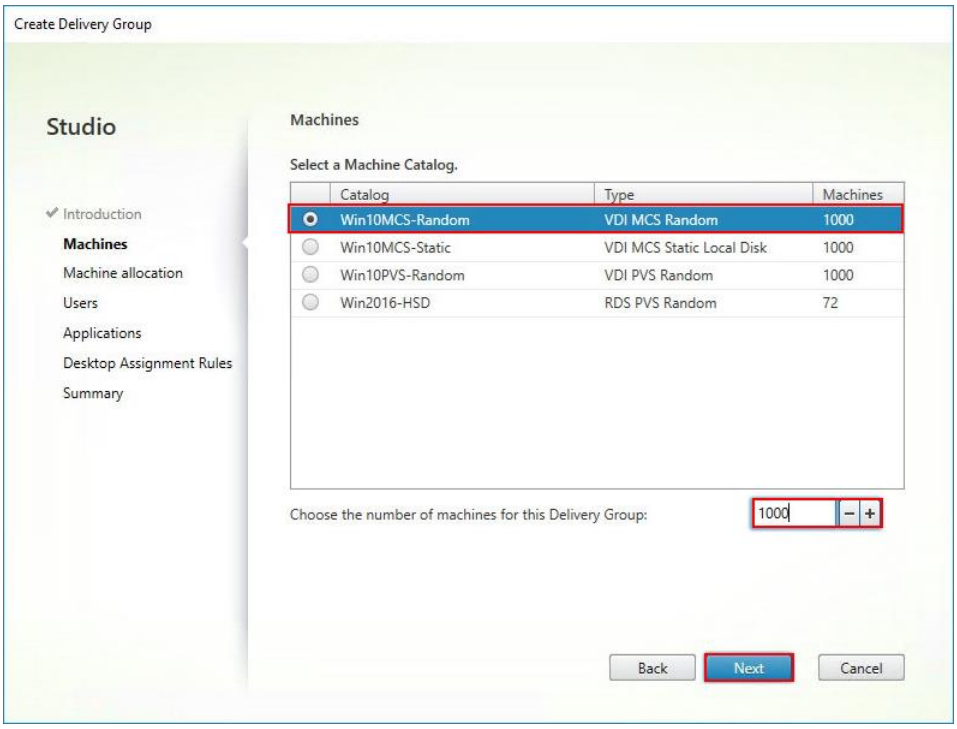
1. Connect to a XenDesktop server and launch Citrix Studio.
2. Choose Create Delivery Group from the drop-down list.



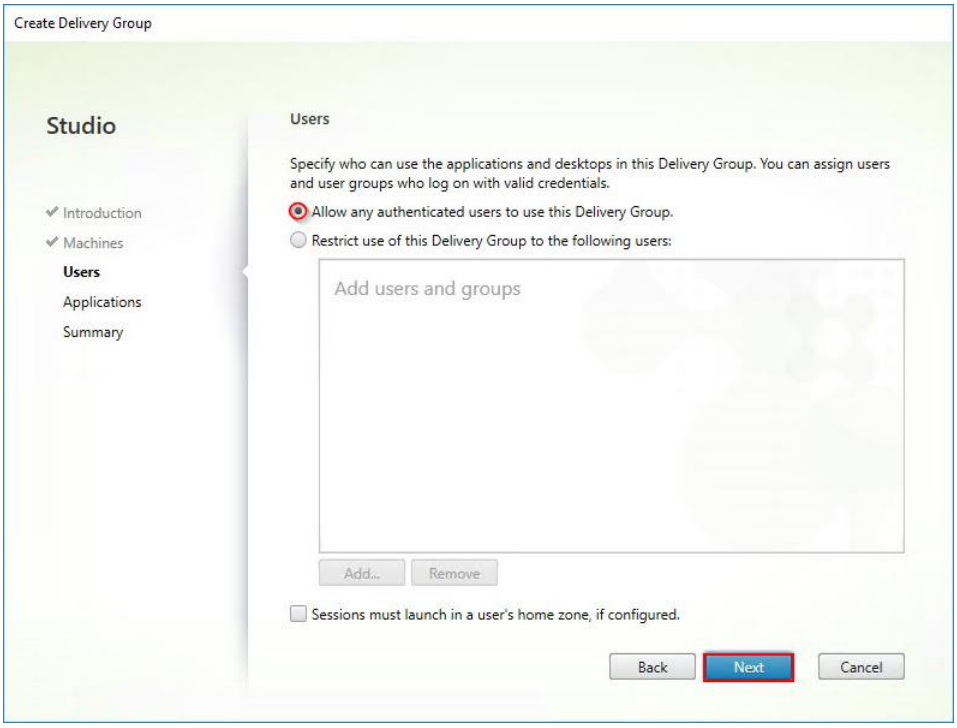
3. Click Next.



4. Select Machine catalog.
5. Provide the number of machines to be added to the delivery Group.
6. Click Next.

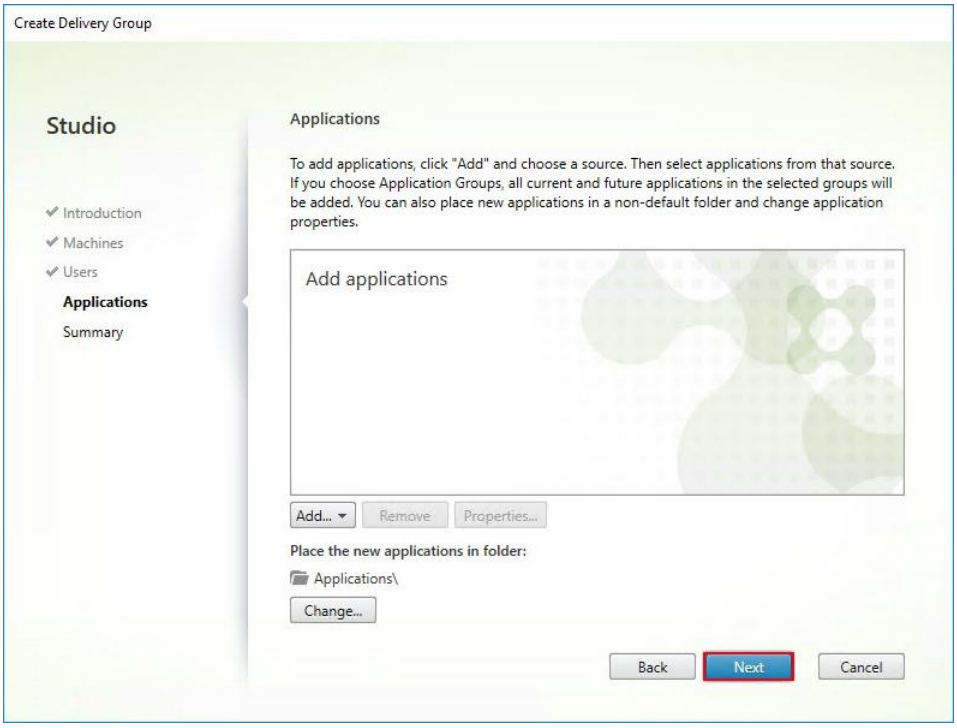


7. To make the Delivery Group accessible, you must add users, select Allow any authenticated users to use this Delivery Group.
8. Click Next.

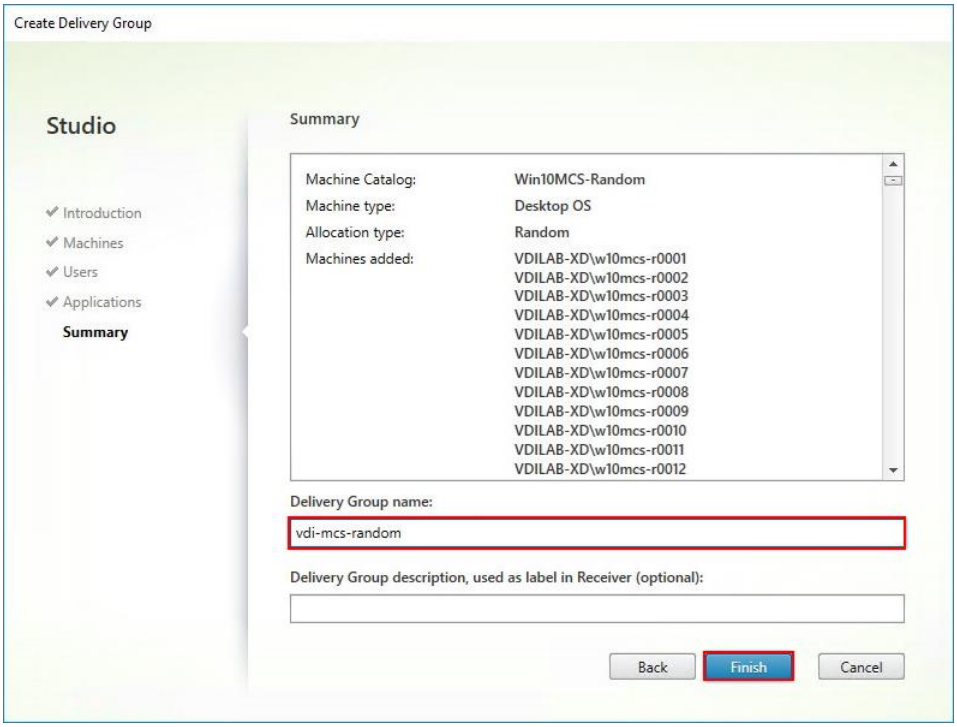


User assignment can be updated any time after Delivery group creation by accessing Delivery group properties in Desktop Studio.

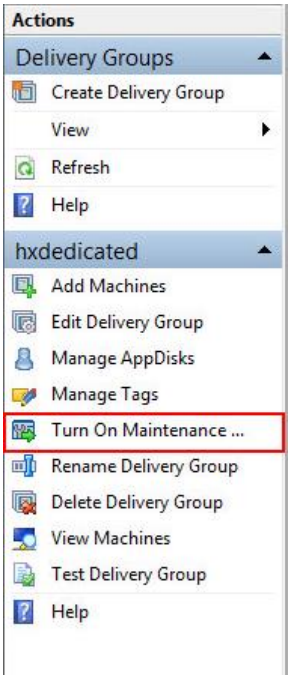
9. (Optional) specify Applications catalog will deliver.
10. Click Next.



11. On the Summary dialog, review the configuration. Enter a Delivery Group name and a Display name (for example, HVD or HSD).
12. Click Finish.



13. Citrix Studio lists the created Delivery Groups and the type, number of machines created, sessions, and applications for each group in the Delivery Groups tab. Select Delivery Group and in Action List, select “Turn on Maintenance Mode.”



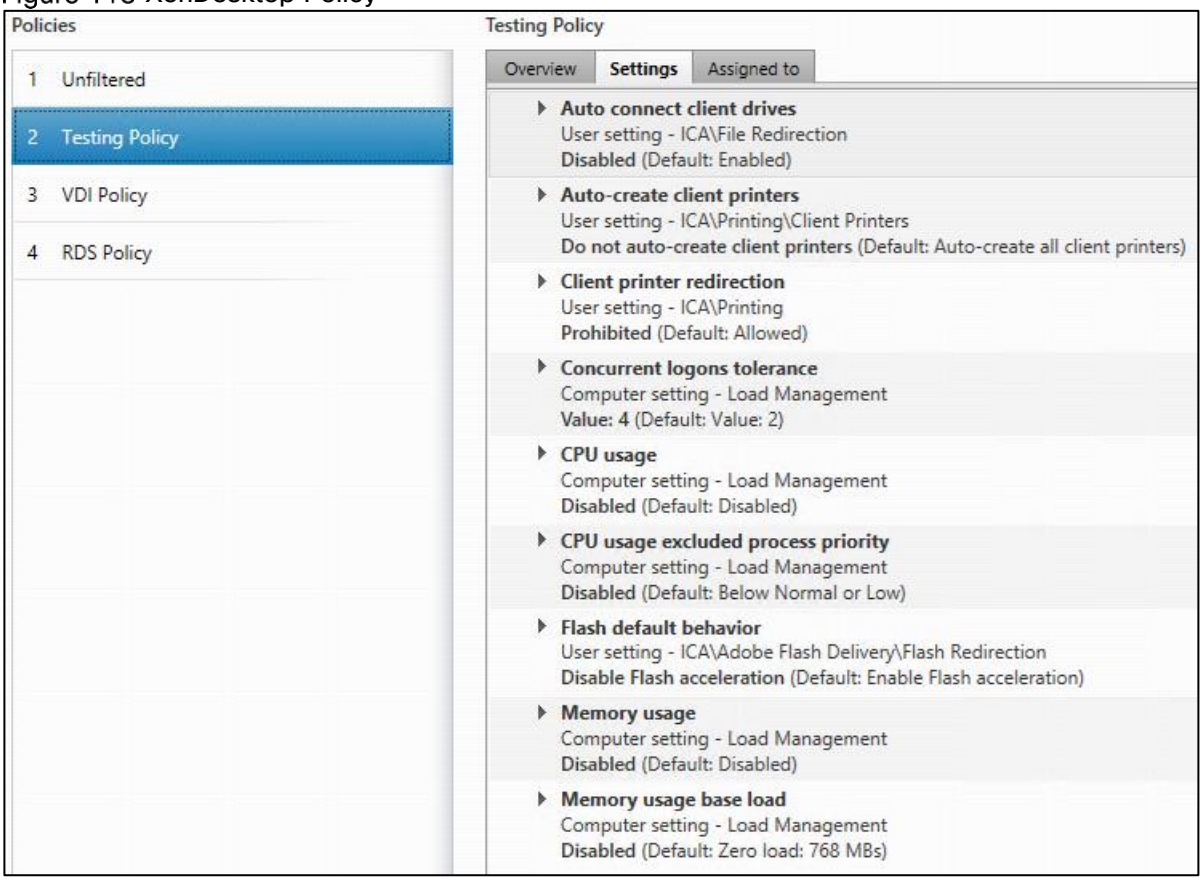
Citrix XenDesktop Policies and Profile Management

Policies and profiles allow the Citrix XenDesktop environment to be easily and efficiently customized.

Configure Citrix XenDesktop Policies

Citrix XenDesktop policies control user access and session environments, and are the most efficient method of controlling connection, security, and bandwidth settings. You can create policies for specific groups of users, devices, or connection types with each policy. Policies can contain multiple settings and are typically defined through Citrix Studio. (The Windows Group Policy Management Console can also be used if the network environment includes Microsoft Active Directory and permissions are set for managing Group Policy Objects). Figure 113 shows policies for Login VSI testing in this CVD.

Figure 113 XenDesktop Policy



Configuring User Profile Management

Profile management provides an easy, reliable, and high-performance way to manage user personalization settings in virtualized or physical Windows environments. It requires minimal infrastructure and administration, and provides users with fast logons and logoffs. A Windows user profile is a collection of folders, files, registry settings, and configuration settings that define the environment for a user who logs on with a particular user account. These settings may be customizable by the user, depending on the administrative configuration. Examples of settings that can be customized are:

- Desktop settings such as wallpaper and screen saver
- Shortcuts and Start menu setting
- Internet Explorer Favorites and Home Page
- Microsoft Outlook signature
- Printers

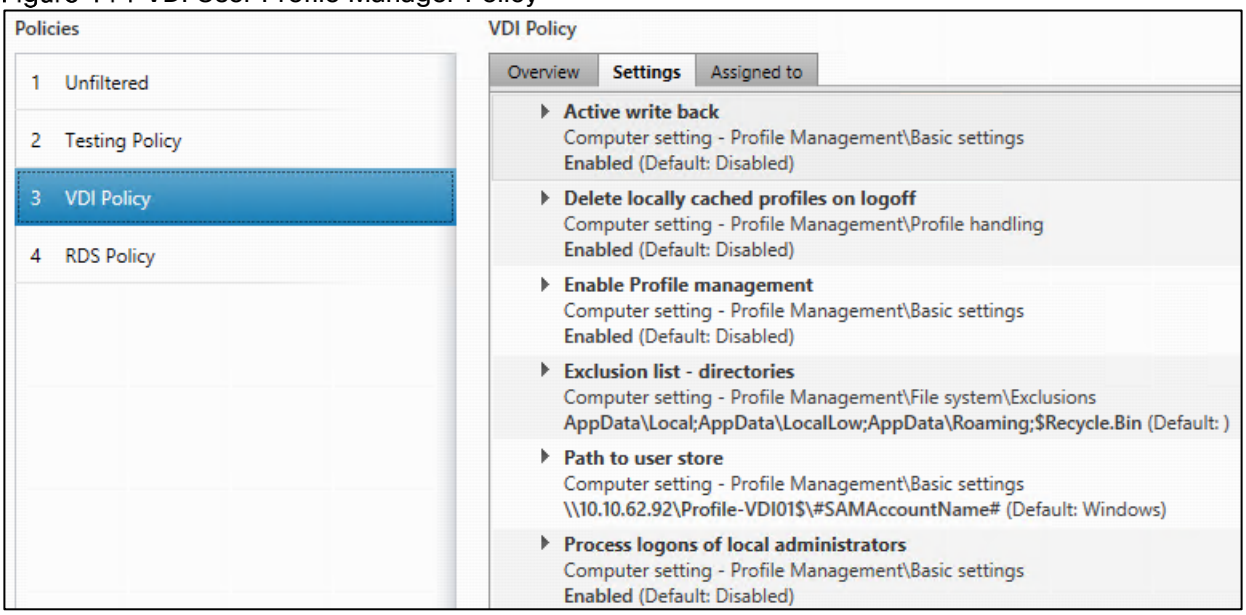
Some user settings and data can be redirected by means of folder redirection. However, if folder redirection is not used these settings are stored within the user profile.

The first stage in planning a profile management deployment is to decide on a set of policy settings that together form a suitable configuration for your environment and users. The automatic configuration feature simplifies some of this decision-making for XenDesktop deployments. Screenshots of the User Profile Management interfaces that establish policies for this CVD's RDS and VDI users (for testing purposes) are shown below.

Basic profile management policy settings are documented here:

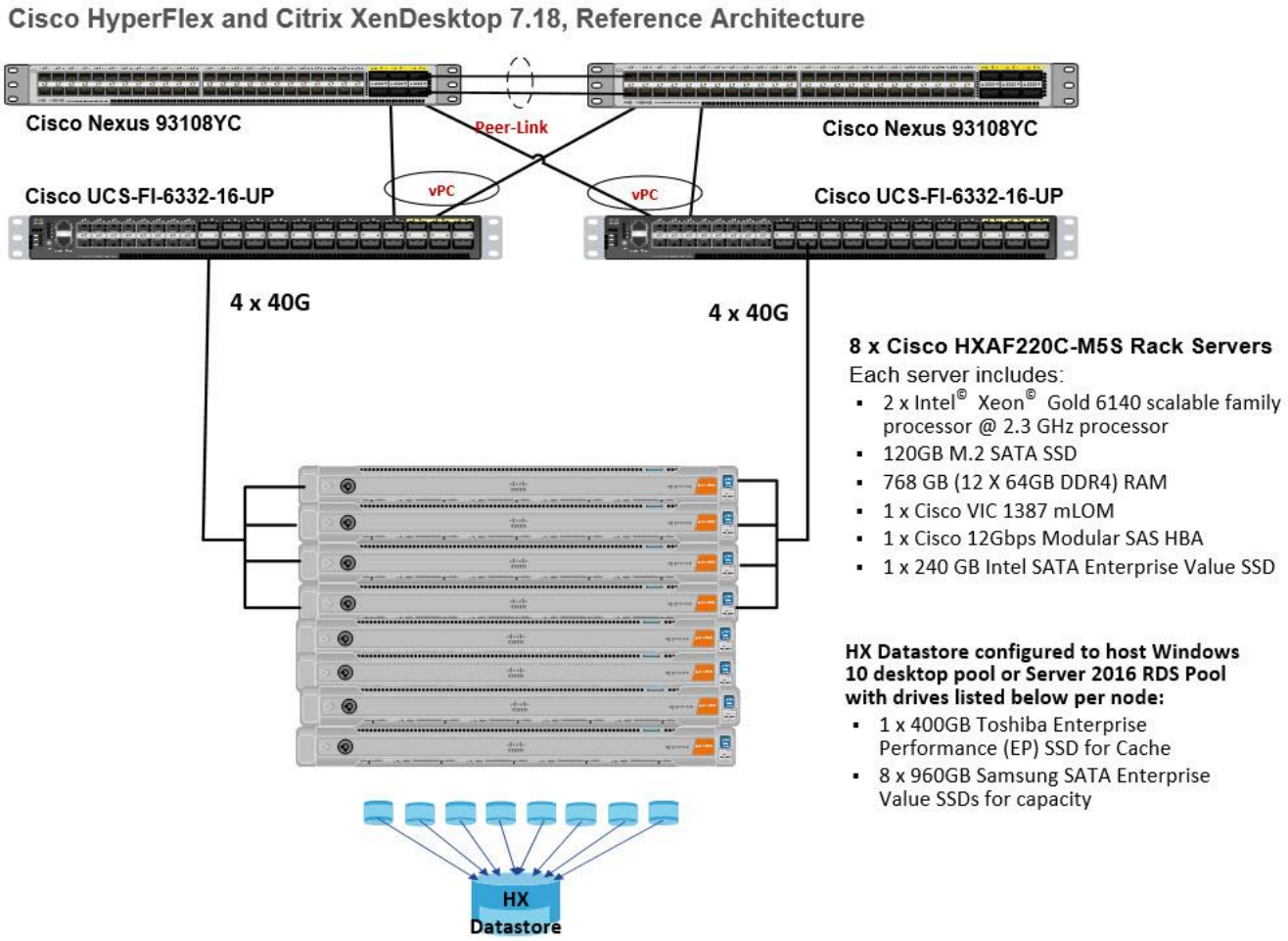
http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-11.html

Figure 114 VDI User Profile Manager Policy



Test Setup and Configurations

In this project, we tested a single Cisco HyperFlex cluster running four Cisco UCS HXAF220C-M5SX Rack Servers in a single Cisco UCS domain. This solution is tested to illustrate linear scalability for each workload studied.



Hardware Components:

- 2 x Cisco UCS 6332-16UP Fabric Interconnects
- 2 x Cisco Nexus 93108YCPX Access Switches
- 8 x Cisco UCS HXAF220c-M5SX Rack Servers (2 Intel Xeon Gold 6140 scalable family processor at 2.3 GHz, with 768 GB of memory per server [32 GB x 24 DIMMs at 2666 MHz])
- Cisco VIC 1387 mLOM
- 12G modular SAS HBA Controller
- 240GB M.2 SATA SSD drive (Boot and HyperFlex Data Platform controller VM)
- 240GB 2.5” 6G SATA SSD drive (Housekeeping)

- 400GB 2.5” 6G SAS SSD drive (Cache)
- 8 x 960GB 2.5” SATA SSD drive (Capacity)
- 1 x 32GB mSD card (Upgrades temporary cache)

Software Components:

- Cisco UCS firmware 3.2(3e)
- Cisco HyperFlex Data Platform 3.0.1c
- Microsoft Hyper-V 2016
- Citrix XenDesktop 7.16
- Citrix User Profile Management
- Microsoft SQL Server 2016
- Microsoft Windows 10
- Microsoft Windows 2016
- Microsoft Office 2016
- Login VSI 4.1.25.6

Testing Methodology and Success Criteria

All validation testing was conducted on-site within the Cisco labs in San Jose, California.

The testing results focused on the entire process of the virtual desktop lifecycle by capturing metrics during the desktop boot-up, user logon and virtual desktop acquisition (also referred to as ramp-up,) user workload execution (also referred to as steady state), and user logoff for the Hosted Shared Desktop Session under test.

Test metrics were gathered from the virtual desktop, storage, and load generation software to assess the overall success of an individual test cycle. Each test cycle was not considered passing unless all of the planned test users completed the ramp-up and steady state phases (described below) and unless all metrics were within the permissible thresholds as noted as success criteria.

Three successfully completed test cycles were conducted for each hardware configuration and results were found to be relatively consistent from one test to the next.

You can obtain additional information and a free test license from http://www.loginvsi.com.

Testing Procedure

The following protocol was used for each test cycle in this study to insure consistent results.

Pre-Test Setup for Testing

All machines were shut down utilizing the Citrix XenDesktop 7.16 Administrator Console.

All Launchers for the test were shut down. They were then restarted in groups of 10 each minute until the required number of launchers was running with the Login VSI Agent at a “waiting for test to start” state.

Test Run Protocol

To simulate severe, real-world environments, Cisco requires the log-on and start-work sequence, known as Ramp Up, to complete in 48 minutes. Additionally, we require all sessions started, whether 60 single server users or 4000 full scale test users to become active within two minutes after the last session is launched.

In addition, Cisco requires that the Login VSI Benchmark method is used for all single server and scale testing. This assures that our tests represent real-world scenarios. For each of the three consecutive runs on single server tests, the same process was followed. Complete the following steps:

1. Time 0:00:00 Start esxtop Logging on the following systems:
   - Infrastructure and VDI Host Blades used in test run
   - All Infrastructure VMs used in test run (AD, SQL, View Connection brokers, image mgmt., etc.)
2. Time 0:00:10 Start Storage Partner Performance Logging on Storage System.
3. Time 0:05: Boot RDS Machines using Citrix XenDesktop 7.16 Administrator Console.
4. Time 0:06 First machines boot.
5. Time 0:35 Single Server or Scale target number of RDS Servers registered on XD.

No more than 60 Minutes of rest time is allowed after the last desktop is registered and available on Citrix XenDesktop 7.16 Administrator Console dashboard. Typically a 20–30 minute rest period for Windows 10 desktops and 10 minutes for RDS VMs is sufficient.

6. Time 1:35 Start Login VSI 4.1.5 Knowledge Worker Benchmark Mode Test, setting auto-logoff time at 900 seconds, with Single Server or Scale target number of desktop VMs utilizing sufficient number of Launchers (at 20-25 sessions/Launcher).
7. Time 2:23 Single Server or Scale target number of desktop VMs desktops launched (48 minute benchmark launch rate).
8. Time 2:25 All launched sessions must become active.

All sessions launched must become active for a valid test run within this window.

9. Time 2:40 Login VSI Test Ends (based on Auto Logoff 900 Second period designated above).
10. Time 2:55 All active sessions logged off.
11. All sessions launched and active must be logged off for a valid test run. The Citrix XenDesktop 7.16 Administrator Dashboard must show that all desktops have been returned to the registered/available state as evidence of this condition being met.
12. Time 2:57 All logging terminated; Test complete.
13. Time 3:15 Copy all log files off to archive; Set virtual desktops to maintenance mode through broker; Shutdown all Windows 7 machines.
14. Time 3:30 Reboot all hypervisors.
15. Time 3:45 Ready for new test sequence.

Success Criteria

Our “pass” criteria for this testing is as follows: Cisco will run tests at a session count levels that effectively utilize the server capacity measured by CPU, memory, storage and network utilization. We use Login VSI version 4.1.25 to launch Knowledge Worker workload sessions. The number of launched sessions must equal active sessions within two minutes of the last session launched in a test as observed on the VSI Management console.

The Citrix XenDesktop Studio will be monitored throughout the steady state to make sure of the following:

- All running sessions report In Use throughout the steady state
- No sessions move to unregistered, unavailable or available state at any time during steady state

Within 20 minutes of the end of the test, all sessions on all launchers must have logged out automatically and the Login VSI Agent must have shut down. Cisco's tolerance for Stuck Sessions is 0.5 percent (half of one percent.) If the Stuck Session count exceeds that value, we identify it as a test failure condition.

Cisco requires three consecutive runs with results within +/-1 percent variability to pass the Cisco Validated Design performance criteria. For white papers written by partners, two consecutive runs within +/-1 percent variability are accepted. (All test data from partner run testing must be supplied along with proposed white paper.)

We will publish Cisco Validated Designs with our recommended workload following the process above and will note that we did not reach a VSImax dynamic in our testing.

The purpose of this testing is to provide the data needed to validate Citrix XenDesktop 7.16 Hosted Shared Desktop with Citrix XenDesktop 7.16 Composer provisioning using Microsoft Windows Server 2016 sessions on Cisco UCS HXAF220c-M4S, Cisco UCS 220 M4 and Cisco UCS B200 M4 servers.

The information contained in this section provides data points that a customer may reference in designing their own implementations. These validation results are an example of what is possible under the specific environment conditions outlined here and do not represent the full characterization of Citrix and Microsoft products.

Four test sequences, each containing three consecutive test runs generating the same result, were performed to establish system performance and linear scalability.

VSImax 4.1.x Description

The philosophy behind Login VSI is different to conventional benchmarks. In general, most system benchmarks are steady state benchmarks. These benchmarks execute one or multiple processes, and the measured execution time is the outcome of the test. Simply put: the faster the execution time or the bigger the throughput, the faster the system is according to the benchmark.

Login VSI is different in approach. Login VSI is not primarily designed to be a steady state benchmark (however, if needed, Login VSI can act like one). Login VSI was designed to perform benchmarks for SBC or VDI workloads through system saturation. Login VSI loads the system with simulated user workloads using well known desktop applications like Microsoft Office, Internet Explorer and Adobe PDF reader. By gradually increasing the amount of simulated users, the system will eventually be saturated. Once the system is saturated, the response time of the applications will increase significantly. This latency in application response times show a clear indication whether the system is (close to being) overloaded. As a result, by nearly overloading a system it is possible to find out what is its true maximum user capacity.

After a test is performed, the response times can be analyzed to calculate the maximum active session/desktop capacity. Within Login VSI this is calculated as VSImax. When the system is coming closer to its saturation point, response times will rise. When reviewing the average response time it will be clear the response times escalate at saturation point.

This VSImax is the "Virtual Session Index (VSI)". With Virtual Desktop Infrastructure (VDI) and Terminal Services (RDS) workloads this is valid and useful information. This index simplifies comparisons and makes it possible to understand the true impact of configuration changes on hypervisor host or guest level.

Server-Side Response Time Measurements

It is important to understand why specific Login VSI design choices have been made. An important design choice is to execute the workload directly on the target system within the session instead of using remote sessions. The scripts simulating the workloads are performed by an engine that executes workload scripts on every target system, and are initiated at logon within the simulated user's desktop session context.

An alternative to the Login VSI method would be to generate user actions client side through the remoting protocol. These methods are always specific to a product and vendor dependent. More importantly, some protocols simply do not have a method to script user actions client side.

For Login VSI the choice has been made to execute the scripts completely server side. This is the only practical and platform independent solutions, for a benchmark like Login VSI.

Calculating VSImax v4.1.x

The simulated desktop workload is scripted in a 48-minute loop when a simulated Login VSI user is logged on, performing generic Office worker activities. After the loop is finished it will restart automatically. Within each loop the response times of sixteen specific operations are measured in a regular interval: sixteen times in within each loop. The response times of these five operations are used to determine VSImax.

The five operations from which the response times are measured are:

- Notepad File Open (NFO)

  Loading and initiating VSINotepad.exe and opening the openfile dialog. This operation is handled by the OS and by the VSINotepad.exe itself through execution. This operation seems almost instant from an end-user's point of view.

- Notepad Start Load (NSLD)

  Loading and initiating VSINotepad.exe and opening a file. This operation is also handled by the OS and by the VSINotepad.exe itself through execution. This operation seems almost instant from an end-user's point of view.

- Zip High Compression (ZHC)

  This action copy's a random file and compresses it (with 7zip) with high compression enabled. The compression will very briefly spike CPU and disk IO.

- Zip Low Compression (ZLC)

  This action copy's a random file and compresses it (with 7zip) with low compression enabled. The compression will very briefly disk IO and creates some load on the CPU.

- CPU

  Calculates a large array of random data and spikes the CPU for a short period of time.

  These measured operations within Login VSI do hit considerably different subsystems such as CPU (user and kernel), Memory, Disk, the OS in general, the application itself, print, GDI, etc. These operations are specifically short by nature. When such operations become consistently long: the system is saturated because of excessive queuing on any kind of resource. As a result, the average response times will then escalate. This effect is clearly visible to end-users. If such operations consistently consume multiple seconds the user will regard the system as slow and unresponsive.

Figure 115 Sample of a VSI Max Response Time Graph, Representing a Normal Test

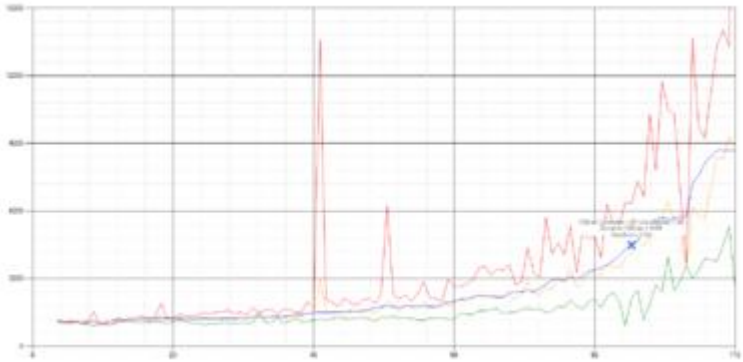
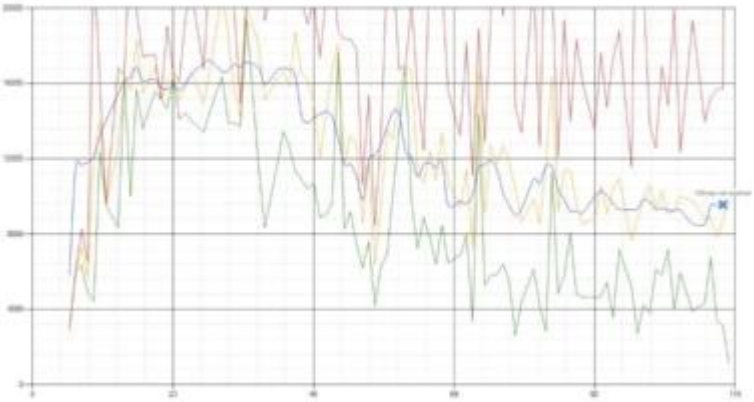


Figure 116 Sample of a VSI Test Response Time Graph with a Clear Performance Issue



When the test is finished, VSImax can be calculated. When the system is not saturated, and it could complete the full test without exceeding the average response time latency threshold, VSImax is not reached and the amount of sessions ran successfully.

The response times are very different per measurement type, for instance Zip with compression can be around 2800 ms, while the Zip action without compression can only take 75ms. This response time of these actions are weighted before they are added to the total. This ensures that each activity has an equal impact on the total response time.

In comparison to previous VSImax models, this weighting much better represent system performance. All actions have very similar weight in the VSImax total. The following weighting of the response times are applied.

The following actions are part of the VSImax v4.1 calculation and are weighted as follows (US notation):

- Notepad File Open (NFO): 0.75
- Notepad Start Load (NSLD): 0.2
- Zip High Compression (ZHC): 0.125
- Zip Low Compression (ZLC): 0.2
- CPU: 0.75

This weighting is applied on the baseline and normal Login VSI response times.

With the introduction of Login VSI 4.1 we also created a new method to calculate the base phase of an environment. With the new workloads (Taskworker, Powerworker, etc.) enabling 'base phase' for a more reliable

baseline has become obsolete. The calculation is explained below. In total 15 lowest VSI response time samples are taken from the entire test, the lowest 2 samples are removed and the 13 remaining samples are averaged. The result is the Baseline. The calculation is as follows:

- Take the lowest 15 samples of the complete test
- From those 15 samples remove the lowest 2
- Average the 13 results that are left is the baseline

The VSImax average response time in Login VSI 4.1.x is calculated on the amount of active users that are logged on the system.

Always a 5 Login VSI response time samples are averaged + 40 percent of the amount of “active” sessions. For example, if the active sessions is 60, then latest 5 + 24 (=40 percent of 60) = 31 response time measurement are used for the average calculation.

To remove noise (accidental spikes) from the calculation, the top 5 percent and bottom 5 percent of the VSI response time samples are removed from the average calculation, with a minimum of 1 top and 1 bottom sample. As a result, with 60 active users, the last 31 VSI response time sample are taken. From those 31 samples the top 2 samples are removed and lowest 2 results are removed (5 percent of 31 = 1.55, rounded to 2). At 60 users the average is then calculated over the 27 remaining results.

VSImax v4.1.x is reached when the VSIbase + a 1000 ms latency threshold is not reached by the average VSI response time result. Depending on the tested system, VSImax response time can grow 2 - 3x the baseline average. In end-user computing, a 3x increase in response time in comparison to the baseline is typically regarded as the maximum performance degradation to be considered acceptable.

In VSImax v4.1.x this latency threshold is fixed to 1000ms, this allows better and fairer comparisons between two different systems, especially when they have different baseline results. Ultimately, in VSImax v4.1.x, the performance of the system is not decided by the total average response time, but by the latency is has under load. For all systems, this is now 1000ms (weighted).

The threshold for the total response time is: average weighted baseline response time + 1000ms.

When the system has a weighted baseline response time average of 1500ms, the maximum average response time may not be greater than 2500ms (1500+1000). If the average baseline is 3000 the maximum average response time may not be greater than 4000ms (3000+1000).

When the threshold is not exceeded by the average VSI response time during the test, VSImax is not hit and the amount of sessions ran successfully. This approach is fundamentally different in comparison to previous VSImax methods, as it was always required to saturate the system beyond VSImax threshold.

Lastly, VSImax v4.1.x is now always reported with the average baseline VSI response time result. For example: “The VSImax v4.1 was 125 with a baseline of 1526ms”. This helps considerably in the comparison of systems and gives a more complete understanding of the system. The baseline performance helps to understand the best performance the system can give to an individual user. VSImax indicates what the total user capacity is for the system. These two are not automatically connected and related:

When a server with a very fast dual core CPU, running at 3.6 GHZ, is compared to a 10 core CPU, running at 2,26 GHZ, the dual core machine will give and individual user better performance than the 10 core machine. This is indicated by the baseline VSI response time. The lower this score is, the better performance an individual user can expect.

However, the server with the slower 10 core CPU will easily have a larger capacity than the faster dual core system. This is indicated by VSImax v4.1.x, and the higher VSImax is, the larger overall user capacity can be expected.

With Login VSI 4.1.x a new VSImax method is introduced: VSImax v4.1. This methodology gives much better insight in system performance and scales to extremely large systems.

Test Results

Boot Storms

A key performance metric for desktop virtualization environments is the ability to boot the virtual machines quickly and efficiently to minimize user wait time for their desktop.

As part of Cisco's virtual desktop test protocol, we shut down each virtual machine at the conclusion of a benchmark test. When we run a new test, we cold boot all 450 desktops and measure the time it takes for the 450th virtual machine to register as available in the XenDesktop Administrator console.

The Cisco HyperFlex HXAF220c-M5SX based All-Flash cluster running Data Platform version 3.0.1c software can accomplish this task in **5 minutes**.

Recommended Maximum Workload and Configuration Guidelines

Eight Node Cisco HXAF220c-M5S Rack Server and HyperFlex All-Flash Cluster

For Citrix XenApp RDS Hosted Shared Desktop and Hosted Virtual Desktop use case, the recommended maximum workload was determined based on both Login VSI Knowledge Worker workload end user experience measures and HXAF220c-M5SX server operating parameters.

This recommended maximum workload approach allows you to determine the server N+1 fault tolerance load the blade can successfully support in the event of a server outage for maintenance or upgrade.

Our recommendation is that the Login VSI Average Response and VSI Index Average should not exceed the Baseline plus 2000 milliseconds to insure that end-user experience is outstanding. Additionally, during steady state, the processor utilization should average no more than 90-95 percent.

Memory should never be oversubscribed for Desktop Virtualization workloads.

Callouts have been added throughout the data charts to indicate each phase of testing.

Test Phase	Description
Boot	Start all RDS and/or VDI virtual machines at the same time.
Login	The Login VSI phase of test is where sessions are launched and start executing the workload over a 48 minutes duration.
Steady state	The steady state phase is where all users are logged in and performing various workload tasks such as using Microsoft Office, Web browsing, PDF printing, playing videos, and compressing files.
Logoff	Sessions finish executing the Login VSI workload and logoff.

Eight Node Cisco HXAF220c-M5S Rack Server and HyperFlex All-Flash Cluster

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Boot	Start all RDS and/or VDI virtual machines at the same time.
Login	The Login VSI phase of test is where sessions are launched and start executing the workload over a 48 minutes duration.
Steady state	The steady state phase is where all users are logged in and performing various workload tasks such as using Microsoft Office, Web browsing, PDF printing, playing videos, and compressing files.
Logoff	Sessions finish executing the Login VSI workload and logoff.

The recommended maximum workload for a Cisco HyperFlex cluster configured on Cisco HXAF220c-M5SX with Intel Xeon Gold 6140 scalable family processors and 768GB of RAM for Windows 10 desktops is 1250 users with Office 2016 virtual desktops respectively.

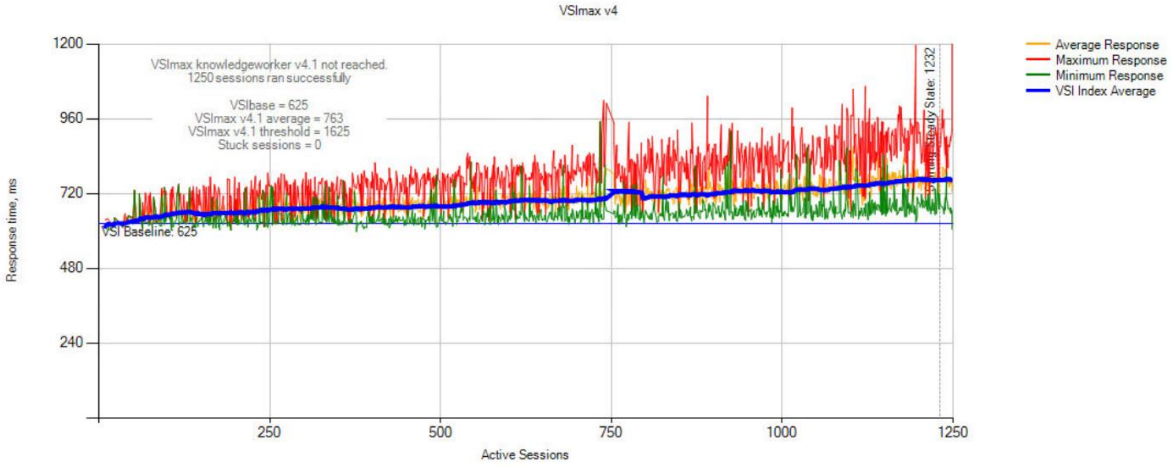
1250 Windows 10 Citrix PVS Non-Persistent Testing on Eight Node Cisco HyperFlex Cluster

Pooled desktops with 1250 Windows 10 VMs hosting 1250 User Sessions on four HXAF220c-M5SX HyperFlex cluster.

Test result highlights include:

- 0.625 second baseline response time
- 0.763 second average response time with 1250 desktops running
- Average CPU utilization of 55 percent during steady state
- Average of 500 GB of RAM used out of 768 GB available
- 3500 peak I/O operations per second (IOPS) per cluster at steady state
- 250MBps peak throughput per cluster at steady state

Figure 117 Login VSI Analyzer Chart for 1250 Windows 10 Citrix PVS Non-persistent Virtual Desktops



1250-01

Successfully completed Login VSI test with **1250** **knowledgeworker** sessions. VSImax (system saturation) was not reached. All Login VSI users completed the test.

Test result review

1250 sessions were configured to be launched in **2880** seconds.

In total **0** sessions failed during the test:

- **0** sessions was/were not successfully launched
- **0** launched sessions failed to become active
- **1250** sessions were active during the test
- **0** sessions got stuck during the test (before VSImax threshold)

With **1250** sessions the maximum capacity VSImax (v4.1) **knowledgeworker** was not reached with a Login VSI baseline performance score of **625**

Login VSI index average score is **674** lower than threshold. It might be possible to launch more sessions in this configuration.

Baseline performance of **625** is: **Very good**

PASS

LoginVSI Results
VSI Baseline: 625ms
VSI Average: 763ms
VSI Threshold: 1625ms
Stuck Sessions: 0

VSI Baseline	Performance
0-799	Very Good
800-1299	Good
1200-1999	Reasonable
2000-9999	Bad

Figure 118 Three Consecutive Login VSI Analyzer Chart for 1250 Windows 10 Citrix PVS Non-persistent Virtual Desktops

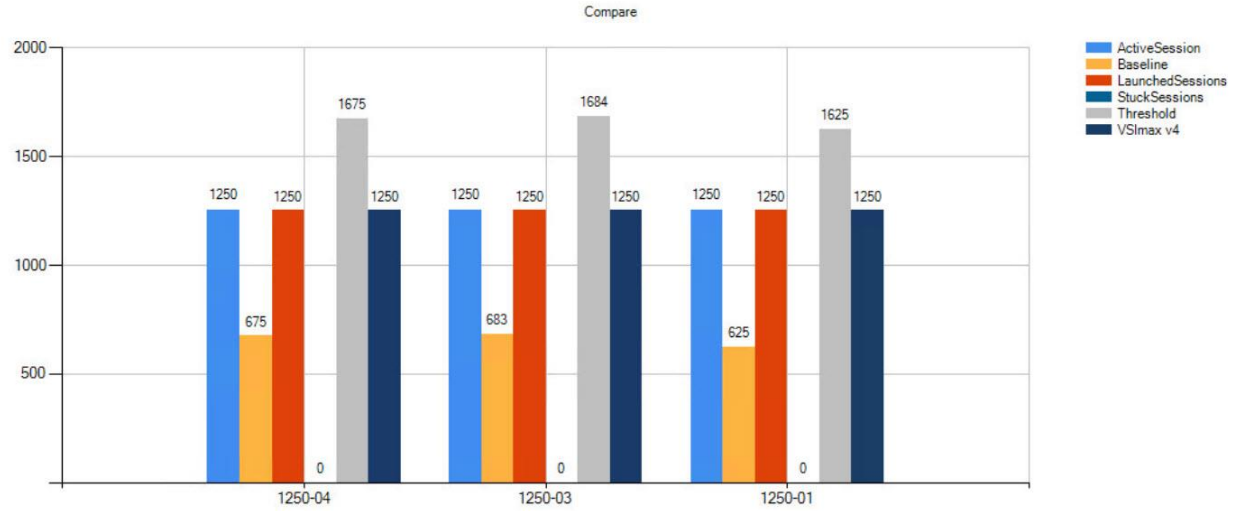
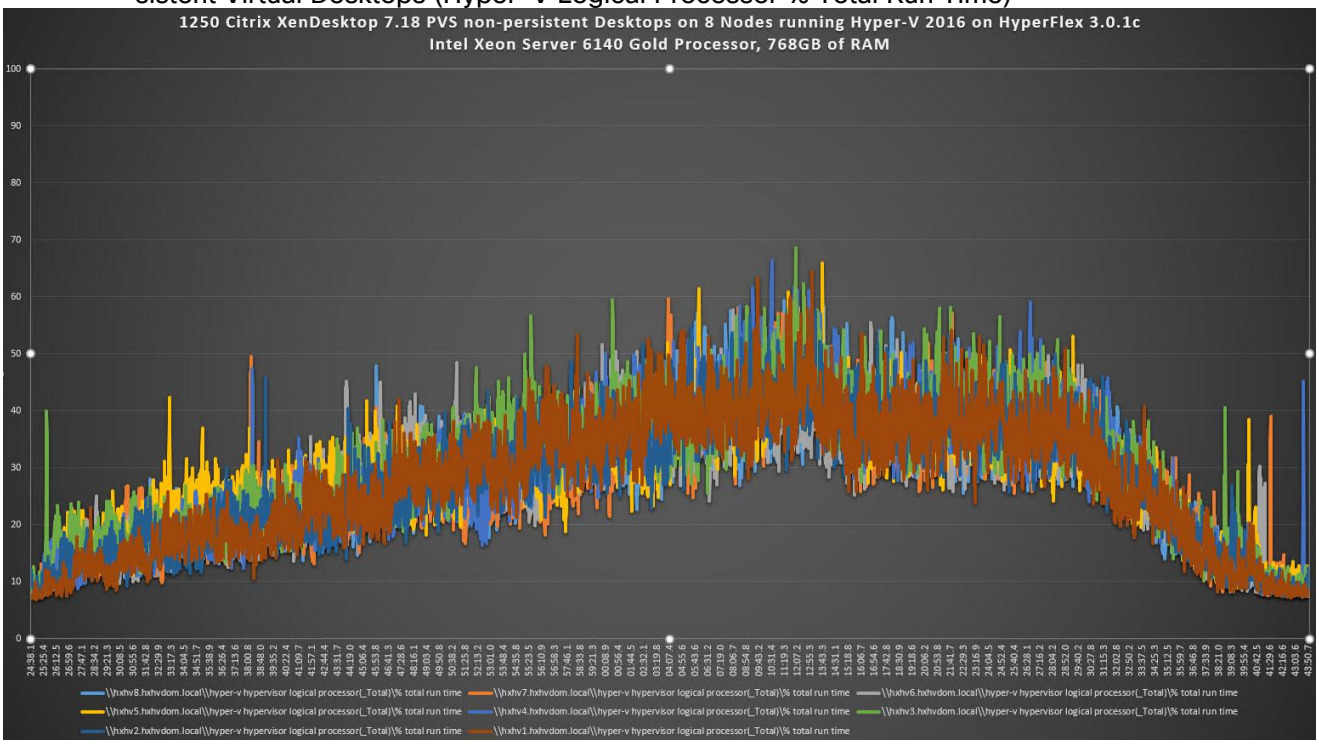


Figure 119 Sample 8x Hyper-V Hosts CPU Core Utilization Running 1250 Windows 10 Citrix PVS Non-persistent Virtual Desktops (Hyper-V Logical Processor % Total Run Time)



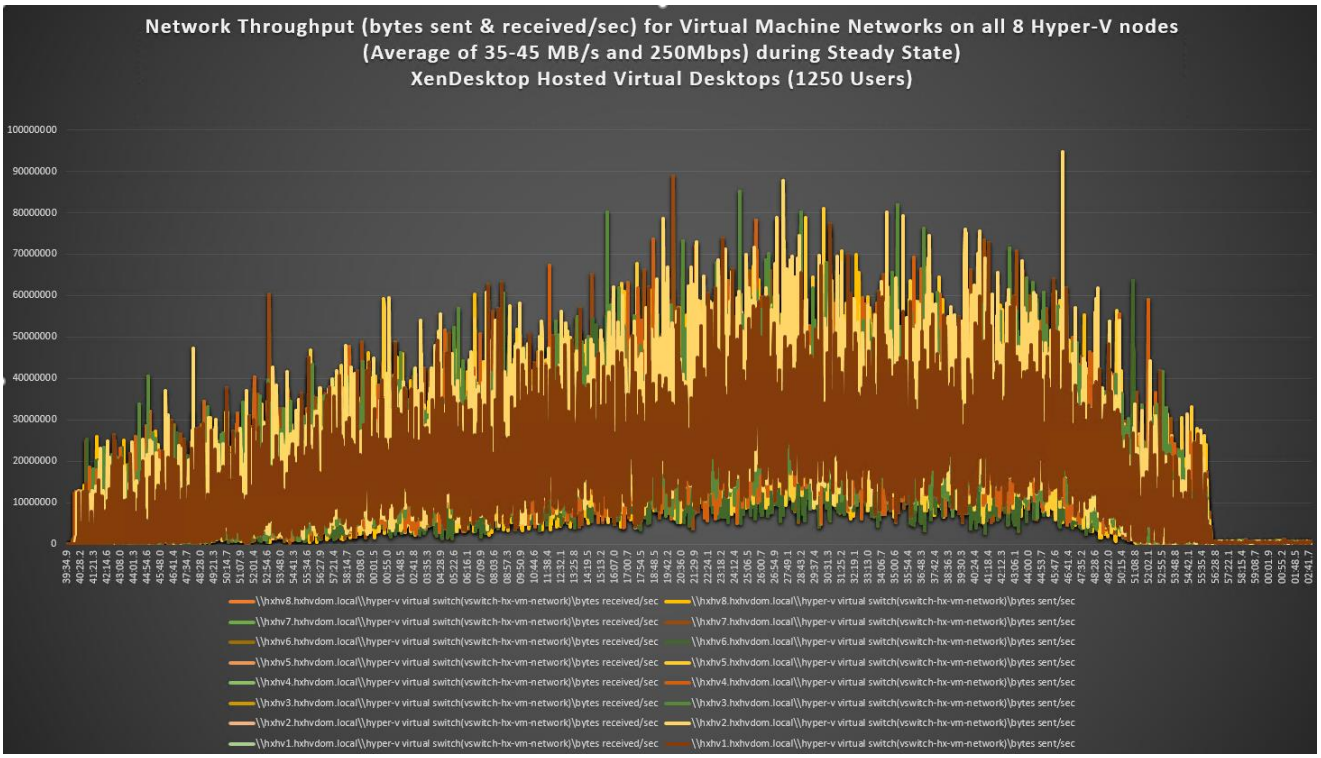
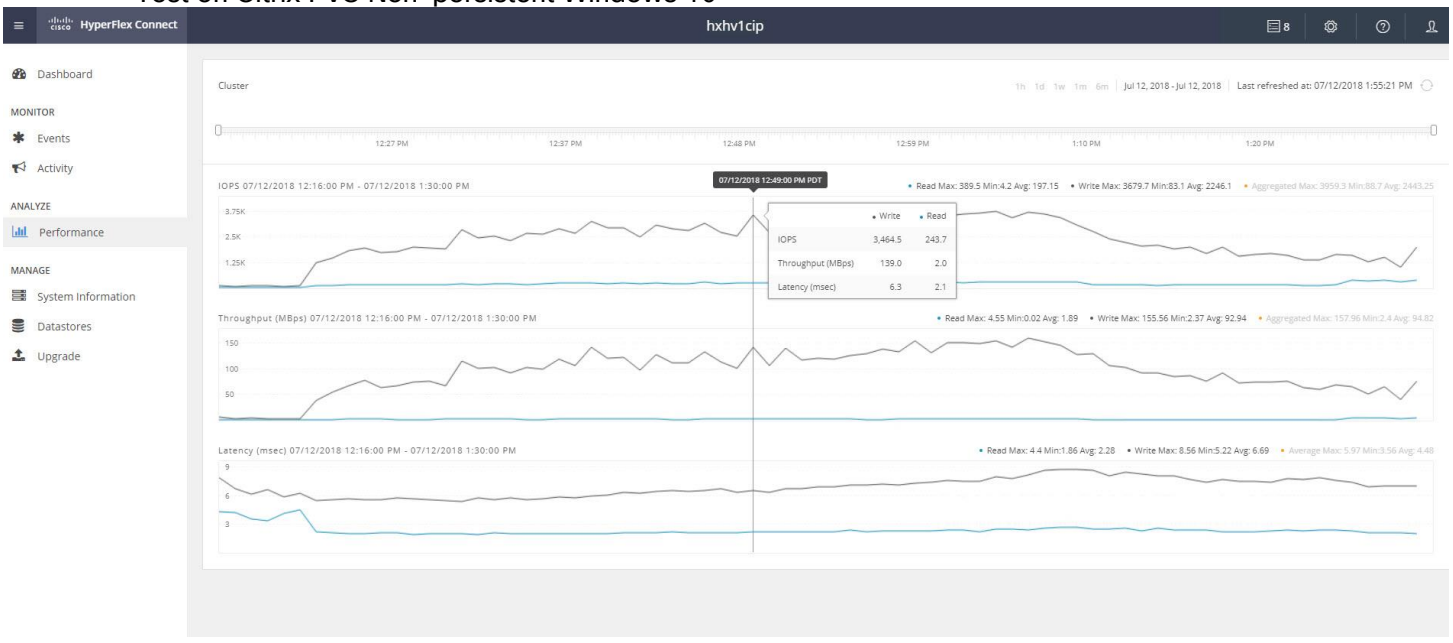


Figure 120 HyperFlex Cluster UI Performance Chart for Knowledge Worker Workload Running 1250 User Test on Citrix PVS Non-persistent Windows 10



The recommended maximum workload for a Cisco HyperFlex cluster configured on Cisco HXAF220c-M5SX with Intel Xeon Gold 6140 scalable family processors and 768GB of RAM for Windows Server 2016 Hosted Sessions is 1250 sessions with Office 2016 virtual desktops respectively.

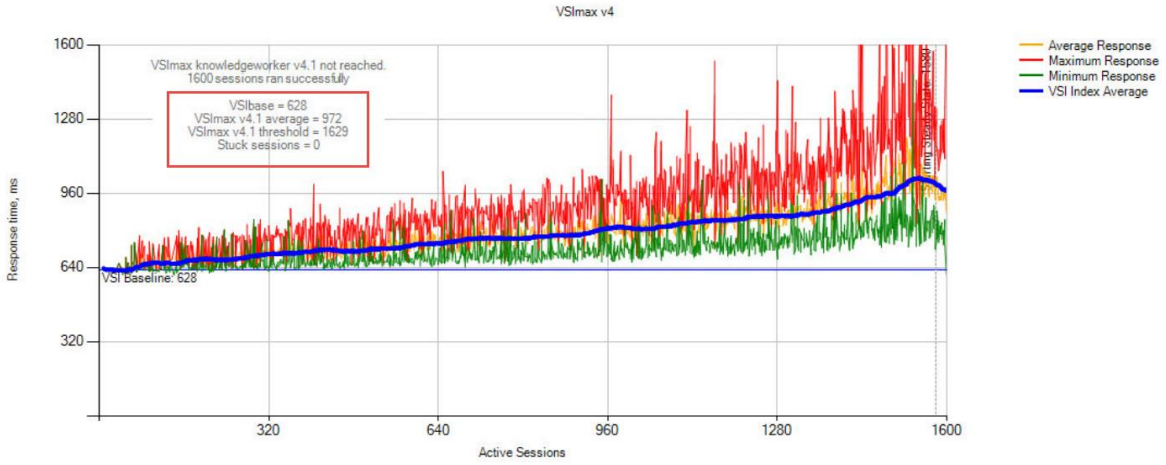
1600 Windows 2016 Citrix PVS Non-Persistent HSD Testing on Eight Node Cisco HyperFlex Cluster

Pooled hosted shared desktops with 1600 User Sessions on four HXAF220c-M5SX HyperFlex cluster.

Test result highlights include:

- 0.676 second baseline response time
- 0.839 second average response time with 450 desktops running
- Average CPU utilization of 45 percent during steady state
- Average of 320 GB of RAM used out of 768 GB available
- 3500 peak I/O operations per second (IOPS) per cluster at steady state
- 80MBps peak throughput per cluster at steady state

Figure 121 Login VSI Analyzer Chart for 1600 Windows 2016 Citrix PVS Non-persistent HSD



XA-1600-01

Successfully completed Login VSI test with **1600** **knowledgeworker** sessions. VSImax (system saturation) was not reached. All Login VSI users completed the test.

Test result review

1600 sessions were configured to be launched in **2880** seconds.

In total **0** sessions failed during the test:

- **0** sessions was/were not successfully launched
- **0** launched sessions failed to become active
- **1600** sessions were active during the test
- **0** sessions got stuck during the test (before VSImax threshold)

With **1600** sessions the maximum capacity VSImax (v4.1) **knowledgeworker** was not reached with a Login VSI baseline performance score of **628**

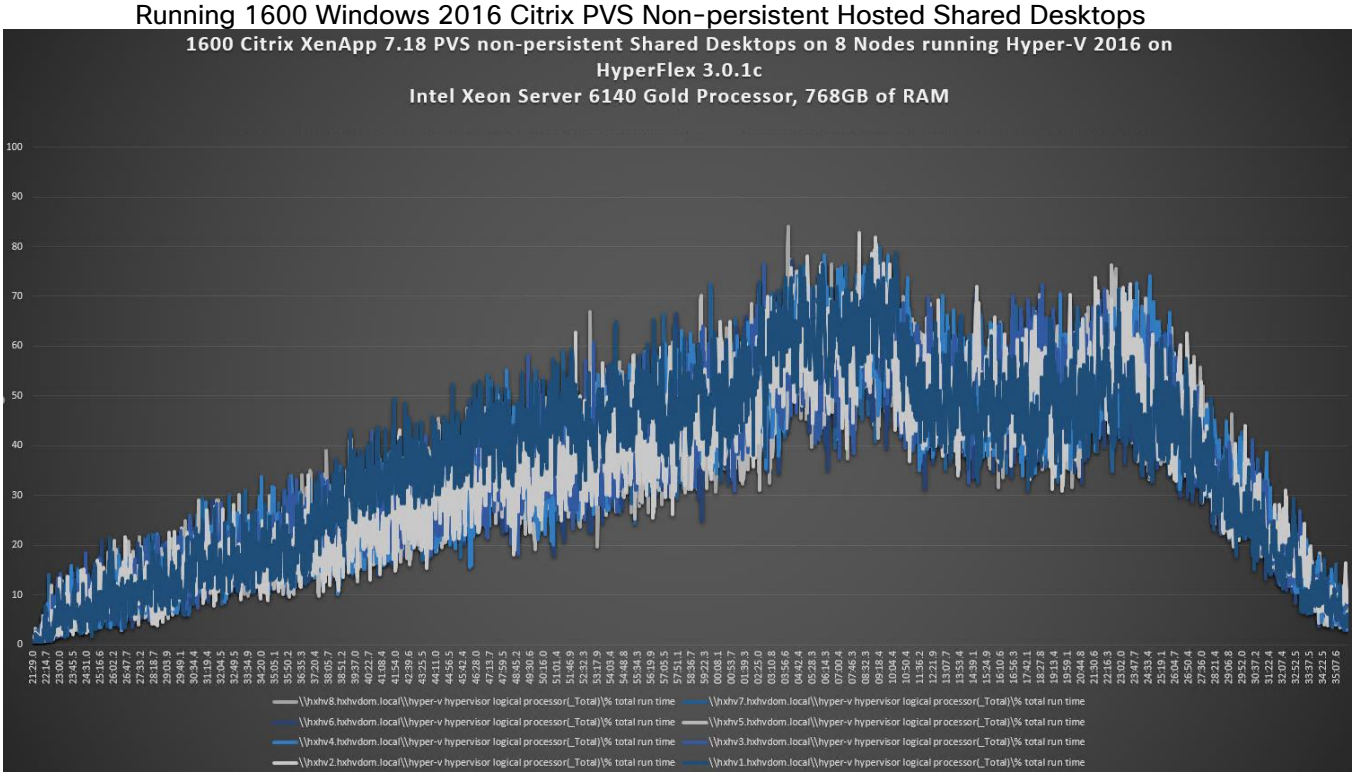
Baseline performance of **628** is: **Very good**

PASS

LoginVSI Results
VSI Baseline: 628ms
VSI Average: 972ms
VSI Threshold: 1629ms
Stuck Sessions: 0

VSI Baseline	Performance
0-799	Very Good
800-1299	Good
1200-1999	Reasonable
2000-9999	Bad

Figure 122 Performance Chart for 8x Hyper-V Hosts CPU Hyper-V Logical Processor (%Total_Run_Time) Running 1600 Windows 2016 Citrix PVS Non-persistent Hosted Shared Desktops



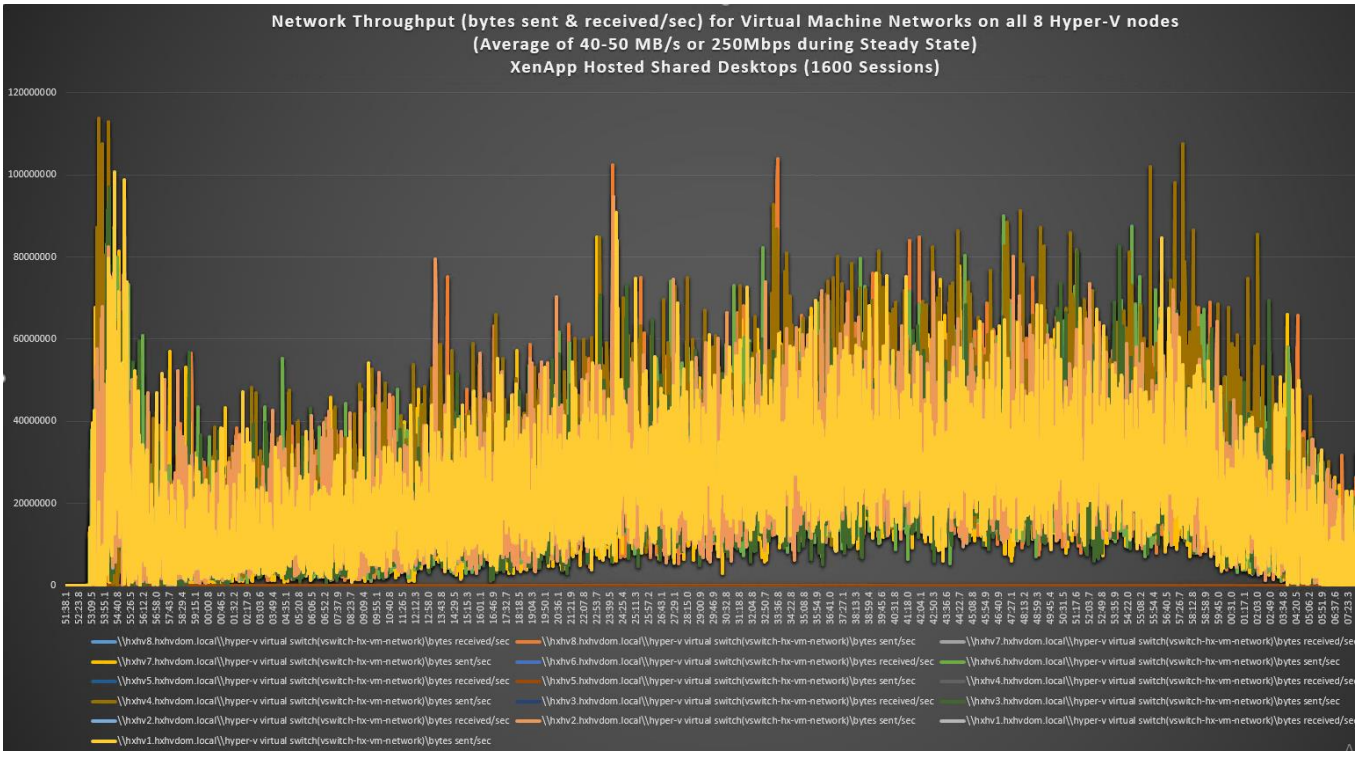
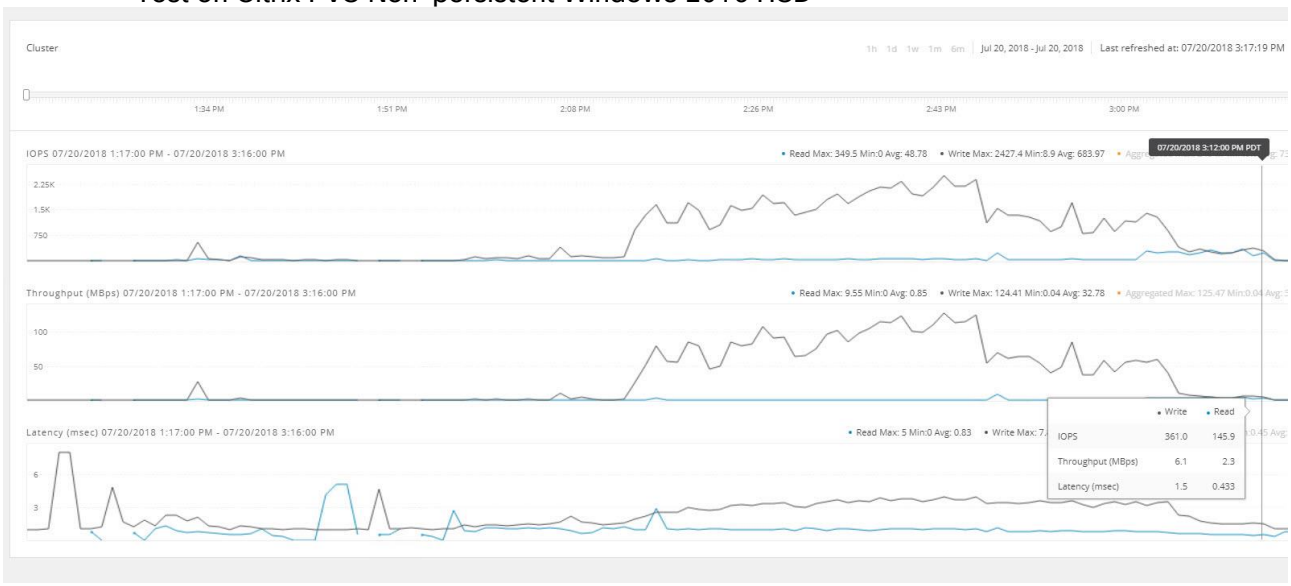


Figure 123 HyperFlex Cluster UI Performance Chart for Knowledge Worker Workload Running 1600 User Test on Citrix PVS Non-persistent Windows 2016 HSD



Summary

This Cisco HyperFlex solution addresses urgent needs of IT by delivering a platform that is cost effective and simple to deploy and manage. The architecture and approach used provides for a flexible and high-performance system with a familiar and consistent management model from Cisco. In addition, the solution offers numerous enterprise-class data management features to deliver the next-generation hyper-converged system.

Only Cisco offers the flexibility to add compute only nodes to a true hyper-converged cluster for compute intensive workloads like desktop virtualization. This translates to lower cost for the customer, since no hyper-convergence licensing is required for those nodes.

Delivering responsive, resilient, high-performance Citrix XenDesktop provisioned Microsoft Windows 10 Virtual Machines and Microsoft Windows Server for hosted Apps or desktops has many advantages for desktop virtualization administrators.

The solution if fully capable of supporting graphics accelerated workloads. Each Cisco HyperFlex HXAF240c M5 node and each Cisco UCS C240 M5 server can support up to two NVIDIA M10 or P40 cards. The Cisco UCS B200 M5 server supports up to two NVIDIA P6 cards for high density, high performance graphics workload support. See our Cisco Graphics White Paper for our fifth generation servers with NVIDIA GPUs and software for details on how to integrate this capability with Citrix XenDesktop.

Virtual desktop end-user experience, as measured by the Login VSI tool in benchmark mode, is outstanding with Intel Xeon scalable family processors and Cisco 2666Mhz memory. In fact, we have set a new industry standard in performance for Desktop Virtualization on a hyper-converged platform.

About the Authors

Jeff Nichols, Technical Marketing Engineer, Desktop Virtualization and Graphics Solutions, Cisco Systems, Inc.

Jeff Nichols is a Cisco Unified Computing System architect, focusing on Virtual Desktop and Application solutions with extensive experience with Microsoft ESX/Hyper-V, XenDesktop, XenApp and Microsoft Remote Desktop Services. He has expert product knowledge in application, desktop and server virtualization across all three major hypervisor platforms and supporting infrastructures including but not limited to Windows Active Directory and Group Policies, User Profiles, DNS, DHCP and major storage platforms.

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- Sanjeev Naldurgkar, Technical Marketing Engineer, Cisco UCS Datacenter Solutions Group, Cisco Systems, Inc**.**

Appendix A – Cisco Nexus 93108YC Switch Configuration

Switch A Configuration

```
!Command: show running-config

version 7.0(3)I2(2d)
switchname XXXXXXXXXXX
class-map type network-qos class-fcoe
match qos-group 1
class-map type network-qos class-all-flood
match qos-group 2
class-map type network-qos class-ip-multicast
match qos-group 2
vdc XXXXXXXXXX id 1
  limit-resource vlan minimum 16 maximum 4094
  limit-resource vrf minimum 2 maximum 4096
  limit-resource port-channel minimum 0 maximum 511
  limit-resource u4route-mem minimum 248 maximum 248
  limit-resource u6route-mem minimum 96 maximum 96
  limit-resource m4route-mem minimum 58 maximum 58
  limit-resource m6route-mem minimum 8 maximum 8

feature telnet
cfs eth distribute

feature interface-vlan
feature hsrp
feature lacp
feature dhcp
feature vpc
feature lldp
clock protocol ntp vdc 1
```

```
no password strength-check
username admin password 5 $1$MSJwTJtn$Bo0IrVnESUVxLcbRHg86j1  role network-admin
ip domain-lookup
no service unsupported-transceiver
class-map type qos match-all class-fcoe
policy-map type qos jumbo
  class class-default
    set qos-group 0
copp profile strict
snmp-server user admin network-admin auth md5 0x71d6a9cf1ea007cd3166e91a6f3807e5
 priv 0x71d6a9cf1ea007cd3166e91a6f3807e5 localizedkey
rmon event 1 log trap public description FATAL(1) owner PMON@FATAL
rmon event 2 log trap public description CRITICAL(2) owner PMON@CRITICAL
rmon event 3 log trap public description ERROR(3) owner PMON@ERROR
rmon event 4 log trap public description WARNING(4) owner PMON@WARNING

rmon event 5 log trap public description INFORMATION(5) owner PMON@INFO
ntp server 10.10.50.2
ntp peer 10.10.50.3
ntp server 171.68.38.66 use-vrf management
ntp logging
ntp master 8


vlan 1,50-54
vlan 50
  name InBand-Mgmt-C1
vlan 51
  name Infra-Mgmt-C1
vlan 52
  name StorageIP-C1
vlan 53
  name LiveMigration-C1
```

```
vlan 54
  name VM-Data-C1


service dhcp
ip dhcp relay
ip dhcp relay information option
ipv6 dhcp relay
vrf context management
  ip route 0.0.0.0/0 10.29.132.1
vpc domain 50
  role priority 1000
  peer-keepalive destination 10.29.132.20 source 10.29.132.19



interface Vlan1
  no shutdown
  ip address 10.29.132.2/24

interface Vlan50
  no shutdown
  ip address 10.10.50.2/24
  hsrp version 2
  hsrp 50
    preempt
    priority 110
    ip 10.10.50.1

  ip dhcp relay address 10.10.51.21
  ip dhcp relay address 10.10.51.22

interface Vlan51
  no shutdown
```

```
  ip address 10.10.51.2/24
  hsrp version 2
  hsrp 51
    preempt
    priority 110
    ip 10.10.51.1

interface Vlan52
  no shutdown
  ip address 10.10.52.2/24
  hsrp version 2
  hsrp 52
    preempt
    priority 110
    ip 10.10.52.1

interface Vlan53
  no shutdown

  ip address 10.10.53.2/24
  hsrp version 2
  hsrp 53
    preempt
    priority 110
    ip 10.10.53.1

interface Vlan54
  no shutdown
  ip address 10.54.0.2/20
  hsrp version 2
  hsrp 54
    preempt
    priority 110
```

```
    ip 10.54.0.1
  ip dhcp relay address 10.10.51.21
  ip dhcp relay address 10.10.51.22

interface port-channel10
  description vPC-PeerLink
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  spanning-tree port type network

  service-policy type qos input jumbo
  vpc peer-link

interface port-channel11
  description FI-Uplink-K22
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  spanning-tree port type edge trunk
  mtu 9216
  service-policy type qos input jumbo
  vpc 11

interface port-channel12
  description FI-Uplink-K22
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  spanning-tree port type edge trunk
  mtu 9216
  service-policy type qos input jumbo
  vpc 12

interface Ethernet1/1
  switchport mode trunk
```

```
  switchport trunk allowed vlan 1,50-54
  channel-group 10 mode active

interface Ethernet1/2
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  channel-group 10 mode active

interface Ethernet1/3
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  channel-group 10 mode active

interface Ethernet1/4
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  channel-group 10 mode active

interface Ethernet1/5
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  mtu 9216
  channel-group 11 mode active

interface Ethernet1/6
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  mtu 9216
  channel-group 11 mode active

interface Ethernet1/7
  switchport mode trunk
```

```
  switchport trunk allowed vlan 1,50-54
  mtu 9216
  channel-group 12 mode active

interface Ethernet1/8
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  mtu 9216
  channel-group 12 mode active

interface Ethernet1/9

interface Ethernet1/10

interface Ethernet1/11

interface Ethernet1/12

interface Ethernet1/13

interface Ethernet1/14

interface Ethernet1/15

interface Ethernet1/16

interface Ethernet1/17

interface Ethernet1/18

interface Ethernet1/19

interface Ethernet1/20
```

```
interface Ethernet1/21

interface Ethernet1/22

interface Ethernet1/23

interface Ethernet1/24

interface Ethernet1/25
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  spanning-tree port type edge trunk

interface Ethernet1/26
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  spanning-tree port type edge trunk

interface Ethernet1/27
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  spanning-tree port type edge trunk

interface Ethernet1/28
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54

  spanning-tree port type edge trunk

interface Ethernet1/29
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
```

```
  spanning-tree port type edge trunk

interface Ethernet1/30
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  spanning-tree port type edge trunk

interface Ethernet1/31
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  spanning-tree port type edge trunk

interface Ethernet1/32
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  spanning-tree port type edge trunk

interface Ethernet1/33

interface Ethernet1/34

interface Ethernet1/35

interface Ethernet1/36

interface Ethernet1/37

interface Ethernet1/38

interface Ethernet1/39

interface Ethernet1/40
```

```
interface Ethernet1/41

interface Ethernet1/42

interface Ethernet1/43

interface Ethernet1/44


interface Ethernet1/45

interface Ethernet1/46

interface Ethernet1/47

interface Ethernet1/48

interface Ethernet1/49

interface Ethernet1/50

interface Ethernet1/51

interface Ethernet1/52

interface Ethernet1/53

interface Ethernet1/54

interface mgmt0
  vrf member management
  ip address 10.29.132.19/24
```

```
clock timezone PST -8 0
clock summer-time PDT 2 Sunday March 02:00 1 Sunday November 02:00 60
line console
line vty
boot nxos bootflash:/nxos.7.0.3.I2.2d.bin
```

Switch B Configuration

```
!Command: show running-config
!Time: Fri Dec 15 17:18:36 2017

version 7.0(3)I2(2d)
switchname XXXXXXXXXX
class-map type network-qos class-fcoe
match qos-group 1
class-map type network-qos class-all-flood
match qos-group 2
class-map type network-qos class-ip-multicast
match qos-group 2
vdc XXXXXXXXXX id 1
  limit-resource vlan minimum 16 maximum 4094
  limit-resource vrf minimum 2 maximum 4096
  limit-resource port-channel minimum 0 maximum 511
  limit-resource u4route-mem minimum 248 maximum 248
  limit-resource u6route-mem minimum 96 maximum 96
  limit-resource m4route-mem minimum 58 maximum 58
  limit-resource m6route-mem minimum 8 maximum 8

feature telnet
cfs eth distribute

feature interface-vlan
feature hsrp
feature lacp
```

```
feature dhcp
feature vpc
feature lldp
clock protocol ntp vdc 1

no password strength-check
username admin password 5 $1$jEwHqUvM$gpOec2hramkyX09KD3/Dn.  role network-admin
ip domain-lookup
no service unsupported-transceiver
class-map type qos match-all class-fcoe
policy-map type qos jumbo
  class class-default
    set qos-group 0
copp profile strict
snmp-server user admin network-admin auth md5 0x9046c100ce1f4ecdd74ef2f92c4e83f9
 priv 0x9046c100ce1f4ecdd74ef2f92c4e83f9 localizedkey
rmon event 1 log trap public description FATAL(1) owner PMON@FATAL
rmon event 2 log trap public description CRITICAL(2) owner PMON@CRITICAL
rmon event 3 log trap public description ERROR(3) owner PMON@ERROR
rmon event 4 log trap public description WARNING(4) owner PMON@WARNING

rmon event 5 log trap public description INFORMATION(5) owner PMON@INFO
ntp peer 10.10.50.2
ntp server 10.10.50.3
ntp server 171.68.38.66 use-vrf management
ntp logging
ntp master 8

vlan 1,50-54
vlan 50
  name InBand-Mgmt-C1
vlan 51
  name Infra-Mgmt-C1
```

```
vlan 52
  name StorageIP-C1
vlan 53
  name LiveMigration-C1
vlan 54
  name VM-Data-C1


service dhcp
ip dhcp relay
ip dhcp relay information option
ipv6 dhcp relay
vrf context management
  ip route 0.0.0.0/0 10.29.132.1
vpc domain 50
  role priority 2000
  peer-keepalive destination 10.29.132.19 source 10.29.132.20


interface Vlan1
  no shutdown
  ip address 10.29.132.3/24

interface Vlan50
  no shutdown
  ip address 10.10.50.3/24
  hsrp version 2
  hsrp 50
    preempt
    priority 110
    ip 10.10.50.1

  ip dhcp relay address 10.10.51.21
```

```
  ip dhcp relay address 10.10.51.22

interface Vlan51
  no shutdown
  ip address 10.10.51.3/24
  hsrp version 2
  hsrp 51
    preempt
    priority 110
    ip 10.10.51.1

interface Vlan52
  no shutdown
  ip address 10.10.52.3/24
  hsrp version 2
  hsrp 52
    preempt
    priority 110
    ip 10.10.52.1

interface Vlan53
  no shutdown
  ip address 10.10.53.3/24
  hsrp version 2
  hsrp 53
    preempt
    priority 110
    ip 10.10.53.1

interface Vlan54
  no shutdown
  ip address 10.54.0.3/20
```

```
  hsrp version 2
  hsrp 54
    preempt
    priority 110
    ip 10.54.0.1
  ip dhcp relay address 10.10.51.21
  ip dhcp relay address 10.10.51.22

interface port-channel10
  description vPC-PeerLink
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  spanning-tree port type network

  service-policy type qos input jumbo
  vpc peer-link

interface port-channel11
  description FI-Uplink-K22
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  spanning-tree port type edge trunk
  mtu 9216
  service-policy type qos input jumbo
  vpc 11

interface port-channel12
  description FI-Uplink-K22
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  spanning-tree port type edge trunk
  mtu 9216
  service-policy type qos input jumbo
```

```
  vpc 12

interface Ethernet1/1
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  channel-group 10 mode active

interface Ethernet1/2
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  channel-group 10 mode active

interface Ethernet1/3
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  channel-group 10 mode active

interface Ethernet1/4
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  channel-group 10 mode active

interface Ethernet1/5
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  mtu 9216
  channel-group 11 mode active

interface Ethernet1/6
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  mtu 9216
  channel-group 11 mode active
```

```
interface Ethernet1/7
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  mtu 9216
  channel-group 12 mode active

interface Ethernet1/8
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  mtu 9216
  channel-group 12 mode active

interface Ethernet1/9

interface Ethernet1/10

interface Ethernet1/11

interface Ethernet1/12

interface Ethernet1/13

interface Ethernet1/14

interface Ethernet1/15

interface Ethernet1/16

interface Ethernet1/17

interface Ethernet1/18
```

```
interface Ethernet1/19

interface Ethernet1/20

interface Ethernet1/21

interface Ethernet1/22

interface Ethernet1/23

interface Ethernet1/24

interface Ethernet1/25
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  spanning-tree port type edge trunk

interface Ethernet1/26
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  spanning-tree port type edge trunk

interface Ethernet1/27
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  spanning-tree port type edge trunk

interface Ethernet1/28
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54

  spanning-tree port type edge trunk
```

```
interface Ethernet1/29
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  spanning-tree port type edge trunk

interface Ethernet1/30
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  spanning-tree port type edge trunk

interface Ethernet1/31
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  spanning-tree port type edge trunk

interface Ethernet1/32
  switchport mode trunk
  switchport trunk allowed vlan 1,50-54
  spanning-tree port type edge trunk

interface Ethernet1/33

interface Ethernet1/34

interface Ethernet1/35

interface Ethernet1/36

interface Ethernet1/37

interface Ethernet1/38
```

```
interface Ethernet1/39

interface Ethernet1/40

interface Ethernet1/41

interface Ethernet1/42

interface Ethernet1/43

interface Ethernet1/44


interface Ethernet1/45

interface Ethernet1/46

interface Ethernet1/47

interface Ethernet1/48
  switchport access vlan 50

interface Ethernet1/49

interface Ethernet1/50

interface Ethernet1/51

interface Ethernet1/52

interface Ethernet1/53
```

```
interface Ethernet1/54


interface mgmt0
  vrf member management

  ip address 10.29.132.20/24
clock timezone PST -8 0
clock summer-time PDT 2 Sunday March 02:00 1 Sunday November 02:00 60
line console
line vty
boot nxos bootflash:/nxos.7.0.3.I2.2d.bin
```