Big Data with Cisco UCS and EMC Isilon: Building a 60 Node Hadoop Cluster

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Cisco Validated Design

Building Architectures to Solve Business Problems

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Introduction

Hadoop has evolved into a significant modern day data platform for processing and extracting valuable insights from massive volume of variety of data gathered by the mainstream enterprises. It offers the fastest path for businesses to take advantages of the hidden value in big data technology while maximizing the benefits of their existing database investments.

In this Cisco Validated Design (CVD), we address the above critical challenge faced in scaling up, scaling down and scaling out the Hadoop clusters to meet the customers' ever-changing requirements by implementing Virtualized Hadoop solution. The design presented in this document offers a modular, scalable and integrated architecture that can be easily deployed, minimizing the downtime. The Virtualized Hadoop solution is implemented using Cisco UCS, EMC® Isilon® and VMware vSphere® Big Data Extension (BDE) combination. In this solution we have used Cloudera's CDH5 enterprise distribution.

Audience

This document describes the architecture, deployment procedures of building a Virtualized Hadoop solution using Cisco UCS B200 M3 blade servers and EMC Isilon scale-out NAS and vSphere Big Data Extensions. The intended audience include, but not limited to, sales engineers, field consultants, professional services, IT managers, partner engineering and customers who want to deploy a Virtualized Hadoop solution in their data centers.

The Building Blocks

Figure 1 illustrates the building blocks of this Virtualized Hadoop solution. The hardware components consist of Cisco UCS B-Series blade servers, Cisco UCS Fabric Interconnects and EMC Isilon S-Series nodes along with the intra-cluster communication infrastructure (backplane).

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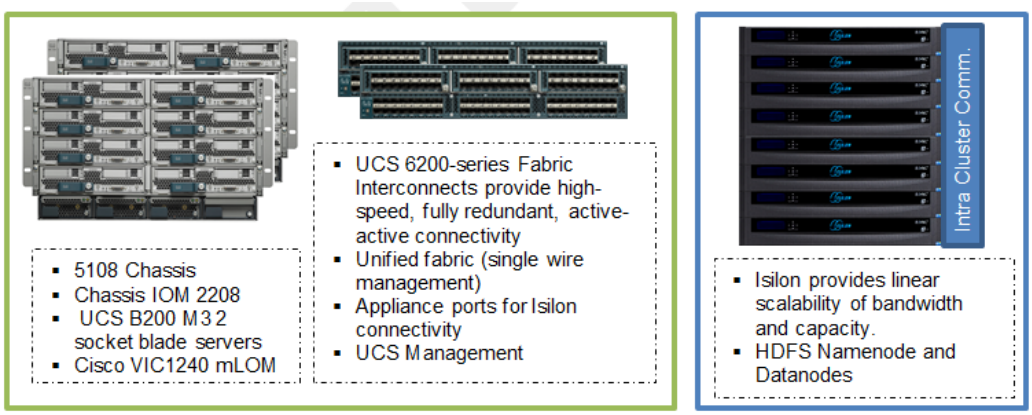
Cisco Unified Computing System provides the compute, network, and storage access components in this solution. EMC Isilon scale-out NAS runs NameNode and DataNode services providing direct HDFS access to the compute nodes. The combination of EMC Isilon and Cisco UCS provides industry-leading platform for Hadoop based applications. This Hadoop solution uses the Cloudera Enterprise (CDH) which is a 100% open-source distribution of Apache Hadoop. The Hadoop Cluster deployment and management are performed by the VMware's vSphere Big Data Extensions (BDE).

Figure 1 Building Blocks of Cisco Unified Computing System



We have VMware's vSphere Big Data Extensions (version 2.1), vSphere ESXi 5.5, vCenter-Server Appliance 5.5 and CDH 5.1.3 on RedHat Enterprise Linux (RHEL 6.4) as software components for creating this Virtualized Hadoop solution.

Cisco UCS Compute and Network Components

The Cisco UCS provides a highly scalable architecture designed to meet a variety of scale-out application demands with seamless data integration and management integration capabilities built using the following components:

- **Cisco UCS 6200 Series Fabric Interconnects—**This provide high-bandwidth, low-latency connectivity for servers, with integrated, unified management provided for all connected devices by Cisco UCS Manager. Deployed in redundant pairs, Cisco fabric interconnects offer the full active-active redundancy, performance, and exceptional scalability needed to support the large number of nodes that are typical in clusters serving big data applications. Cisco UCS Manger enables rapid and consistent server configuration using service profiles, automating ongoing system maintenance activities such as firmware updates across the entire cluster as a single operation. Cisco UCS Manager also offers advanced monitoring with options to raise alarms and send notifications about the health of the entire cluster.
- **Cisco UCS 2200 Series Fabric Extender IO-Modules**—This extends the network into each chassis, acting as remote line cards for fabric interconnects and providing highly scalable and extremely cost-effective connectivity for a large number of servers.
- **Cisco UCS B-Series Blade Servers**—Cisco UCS B200 M3 Blade Servers are 2-socket servers based on Intel Xeon E-2600 v2 series processors and supporting up to 768 GB of main memory and 2 Small Form Factor (SFF) SAS/SATA/SSD disks, along with VIC 1240 mLOM (modular LAN on Motherboard) delivering 4 X 10Gbps bandwidth per blade server.

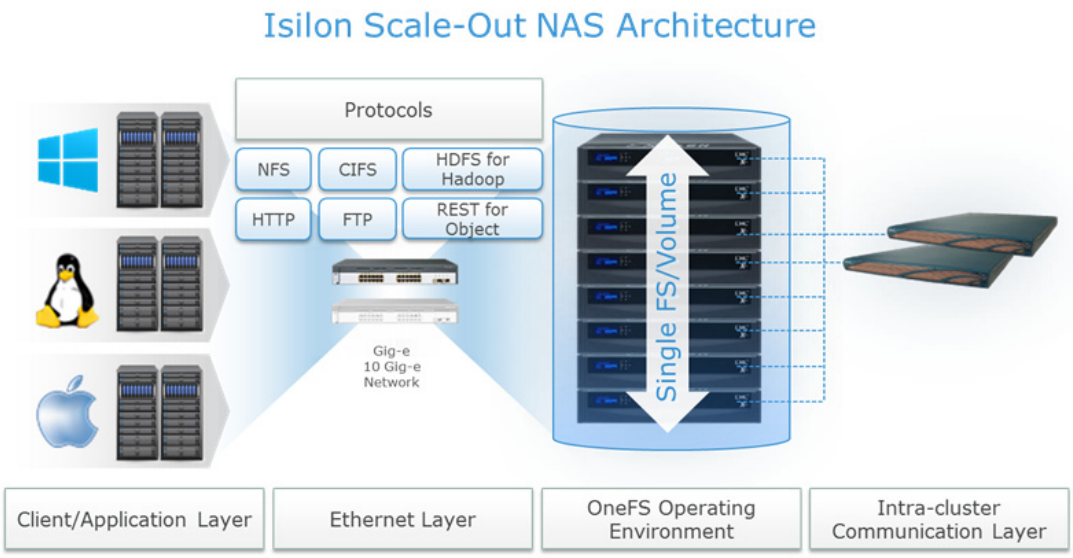
- **Cisco UCS Virtual Interface Cards (VIC)—**This is unique to Cisco, Cisco UCS Virtual Interface Cards incorporate next-generation converged network adapter (CNA) technology from Cisco, and offer 4 X 10-Gbps ports designed for use with Cisco UCS B-Series Servers. Optimized for Virtualized networking, these cards deliver high performance and bandwidth utilization and support up to 256 virtual devices.
- **Cisco UCS Manager—**The Cisco UCS Manager resides within the Cisco UCS 6200 Series Fabric Interconnects. It makes the system self-aware and self-integrating, managing all of the system components as a single logical entity. Cisco UCS Manager can be accessed through an intuitive graphical user interface (GUI), a command-line interface (CLI), or an XML application-programming interface (API). Cisco UCS Manager uses service profiles to define the personality, configuration, and connectivity of all resources within Cisco UCS, radically simplifying provisioning of resources so that the process takes minutes instead of days. This simplification allows IT departments to shift their focus from constant maintenance to strategic business initiatives.

Scale-Out Architecture With EMC Isilon

The EMC Isilon scale-out network-attached storage (NAS) cluster provides direct access to Hadoop File System (HDFS) for the big data applications.

- Isilon scale-out NAS is a fully distributed system that consists of nodes of modular hardware arranged in a cluster.
- The distributed Isilon OneFS operating system combines the memory, I/O, CPUs, and disks of the nodes into a cohesive storage unit to present a global namespace as a single file system.
- The nodes work together as peers in a shared-nothing hardware architecture with no single point of failure.
- Every node adds capacity, performance, and resiliency to the storage cluster and each node acts as a Hadoop namenode and datanode.
- The namenode daemon is a distributed process that runs on all the nodes of the Isilon Cluster. A compute client can connect to any node in the cluster to access namenode services.
- As nodes are added, the file system expands dynamically and redistributes data, eliminating the work of partitioning disks and creating volumes.

Figure 2 Isilon Scale-Out NAS Architecture



Solution Overview

This Cisco Validated Design (CVD) describes the process of building a Virtualized Hadoop solution using Cisco UCS B-Series servers, a S200 EMC Isilon cluster and VMware vCenter Server along with its Big Data Extensions.

The infrastructure consists of the following components:

- Two Cisco UCS 6296UP Fabric Interconnects
- Two Cisco UCS 5108 Chassis each with two Cisco UCS 2208 Fabric Extenders (IO Modules)
- 16 Cisco UCS B200 M3 Half-Width blade servers (8 per chassis) with VIC 1240
- 8 EMC Isilon S200 nodes along with 2 Infiniband switches
- One Cisco R42610 standard rack
- Two Vertical Power distribution units (PDUs) (Country Specific)

Cisco Unified Computing System (UCS)

Cisco UCS a set of pre-integrated data center components that comprises blade servers, adapters, fabric-interconnects, and fabric-extenders that are integrated under a common embedded management system. This approach results in far fewer system components and much better manageability, operational efficiencies, and flexibility than comparable data center platforms.

The Cisco UCS is designed from the ground up to be programmable and self-integrating. A server's entire hardware stack, ranging from server firmware and settings to network profiles, is configured through model-based management. With Cisco virtual interface cards, even the number and type of I/O interfaces is programmed dynamically, making every server ready to power any workload at any time.

With model-based management, administrators manipulate a model of a desired system configuration, associate a model's service profile with hardware resources and the system configures itself to match the model. This automation speeds provisioning and workload migration with accurate and rapid scalability. The result is increased IT staff productivity, improved compliance, and reduced risk of failures due to inconsistent configurations.

Cisco Fabric Extender technology reduces the number of system components to purchase, configure, manage, and maintain by condensing three network layers into one. It eliminates both blade server and hypervisor-based switches by connecting fabric interconnect ports directly to individual blade servers and virtual machines. Virtual networks are now managed exactly as physical networks are, but with massive scalability. This represents a radical simplification over traditional systems, reducing capital and operating costs while increasing business agility, simplifying and speeding deployment, and improving performance.

Cisco Fabric Interconnect

Cisco UCS Fabric Interconnects creates a unified network fabric throughout the Cisco UCS. They provide uniform access to both networks and storage, eliminating the barriers to deploying a fully virtualized environment based on a flexible, programmable pool of resources.

Cisco Fabric Interconnects comprise a family of line-rate, low-latency, lossless 10-GE, Cisco Data Center Ethernet, and FCoE interconnect switches. Based on the same switching technology as the Cisco Nexus 5000 Series, Cisco UCS 6000 Series Fabric Interconnects provide the additional features and management capabilities that make them the central nervous system of Cisco UCS.

The Cisco UCS Manager software runs inside the Cisco UCS Fabric Interconnects. The Cisco UCS 6000 Series Fabric Interconnects expand the UCS networking portfolio and offer higher capacity, higher port density, and lower power consumption. These interconnects provide the management and communication backbone for the Cisco UCS B-Series Blades and Cisco UCS Blade Server Chassis.

All chassis and all blades that are attached to the Fabric Interconnects are part of a single, highly available management domain. By supporting unified fabric, the Cisco UCS 6200 Series provides the flexibility to support LAN and SAN connectivity for all blades within its domain right at configuration time. Typically deployed in redundant pairs, the Cisco UCS Fabric Interconnect provides uniform access to both networks and storage, facilitating a fully virtualized environment.

The Cisco UCS Fabric Interconnect family is currently comprised of the Cisco 6100 Series and Cisco 6200 Series of Fabric Interconnects.

Cisco UCS 6296UP 96-Port Fabric Interconnect

The Cisco UCS 6296UP 96-Port Fabric Interconnect is a 2RU 10 Gigabyte Ethernet, FCoE and native Fiber Channel switch offering up to 1920-Gbps throughput and up to 96 ports. The switch has 48 1/10-Gbps fixed Ethernet, FCoE and Fiber Channel ports and three expansion slots. Each expansion module slot could house an 6200 Series expansion module.

The Cisco UCS 6200 Series supports expansion module that can be used to increase the number of 10 Gigabit Ethernet, FCoE and FC ports. This unified port module provides up to 16 ports that can be configured for 10 GigabitEthernet Ethernet, FCoE and/or 1/2/4/8-Gbps native Fiber Channel using the SFP or SFP+ interface for transparent connectivity with existing Fiber Channel networks.

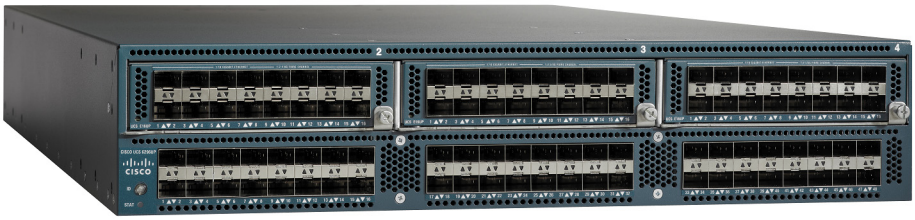
The Fabric Interconnects come with a GUI-based software to manage the entire UCS infrastructure called UCS-Manager.

Cisco UCS Manager offers the following features and benefits:

- A unified embedded management interface that integrates server, network, and storage access

- Policy and model-based management, with service profiles, that improves agility and reduces risk
- Auto-discovery to detect, inventory, manage, and provision system components that are added or changed
- A comprehensive open XML API, which facilitates integration with third-party systems management tools
- Role-based administration that builds on existing skills and supports collaboration across disciplines

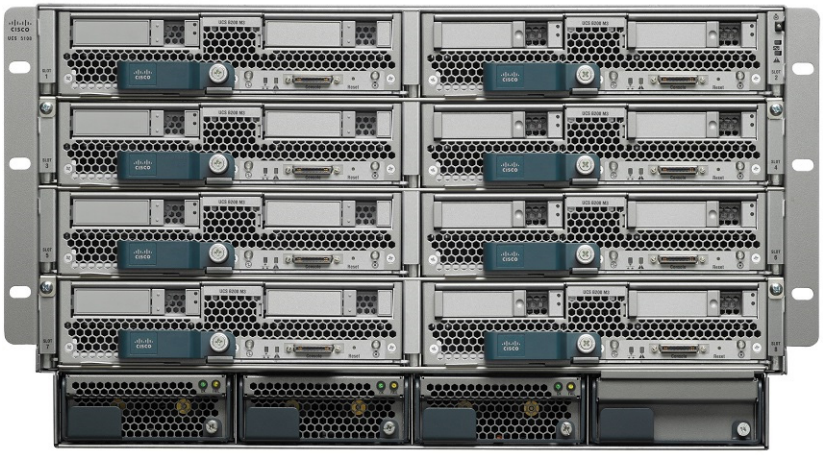
Figure 3 Cisco UCS 6296UP Fabric Interconnect



Cisco UCS Chassis

The Cisco UCS 5108 Series Blade Server Chassis is a 6 RU blade chassis that will accept up to eight half-width Cisco UCS B-Series Blade Servers or up to four full-width Cisco UCS B-Series Blade Servers, or a combination of the two. The UCS 5108 Series Blade Server Chassis can accept four redundant power supplies with automatic load-sharing and failover and two Cisco UCS (either 2100 or 2200 series) Fabric Extenders. The chassis is managed by Cisco UCS Chassis Management Controllers, which are mounted in the Cisco UCS Fabric Extenders and work in conjunction with the Cisco UCS Manager to control the chassis and its components.

Figure 4 UCS 5108 Chassis Populated With Eight B200 M3 Half-Width Servers



A single UCS managed domain can scale to up to 40 individual chassis and 320 blade servers. At this time Cisco supports up to 20 individual chassis and 160 blade servers.

Basing the I/O infrastructure on a 10-Gbps unified network fabric allows the Cisco UCS to have a streamlined chassis with a simple yet comprehensive set of I/O options. The result is a chassis that has only five basic components:

- The physical chassis with passive mid-plane and active environmental monitoring circuitry

- Four power supply bays with power entry in the rear, and hot-swappable power supply units accessible from the front panel
- Eight hot-swappable fan trays, each with two fans
- Two fabric extender slots accessible from the back panel
- Eight blade server slots accessible from the front panel

Cisco UCS 2200 Series IO Module

The Cisco UCS 2100/2200 Series FEX multiplexes and forwards all traffic from blade servers in a chassis to a parent Cisco UCS Fabric Interconnect over from 10-Gbps unified fabric links. All traffic, even traffic between blades on the same chassis, or VMs on the same blade, is forwarded to the parent interconnect, where network profiles are managed efficiently and effectively by the Fabric Interconnect. At the core of the Cisco UCS Fabric Extender are ASIC processors developed by Cisco that multiplex all traffic.

Up to two fabric extenders can be placed in a blade chassis. In this solution we have used the IO-Module 2208.

UCS 2208 has thirty-two 10GBASE-KR connections to the blade chassis mid-plane, with one connection per fabric extender for each of the chassis' eight half slots. This gives each half-slot blade server access to each of two 4x10-Gbps unified fabric-based networks via SFP+ sockets for both throughput and redundancy. It has 8 ports connecting up the fabric interconnect.

Figure 5 Cisco UCS 2208 Fabric Extender Module

Cisco UCS B200 M3 Blade Server

Cisco UCS B200 M3 is a third generation half-slot, two-socket Blade Server. The Cisco UCS B200 M3 harnesses the power of the latest Intel Xeon processor E5-2600 v2 product family, with up to 768 GB of RAM (using 32GB DIMMs), two optional SAS/SATA/SSD disk drives, and up to dual 4x 10 GigabitEthernet Ethernet throughput, utilizing our VIC 1240 LAN on motherboard (LOM) design. The Cisco UCS B200 M3 further extends the capabilities of Cisco UCS by delivering new levels of manageability, performance, energy efficiency, reliability, security, and I/O bandwidth for enterprise-class virtualization and other mainstream data center workloads.

In addition, customers who initially purchased Cisco UCS B200M3 blade servers with Intel E5-2600 v2 series processors, can field upgrade their blades to the second generation E5-2600 v2 processors, providing increased processor capacity and providing investment protection

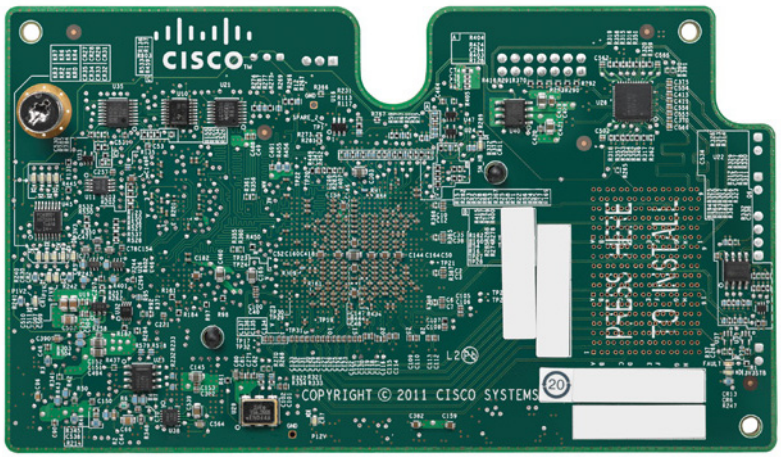
Figure 6 Cisco UCS B200 M3 Server

UCS VIC1240 Converged Network adapter

A Cisco® innovation, the Cisco UCS Virtual Interface Card (VIC) 1240 is a 4-port 10 Gigabyte Ethernet, Fiber Channel over Ethernet (FCoE)-capable modular LAN on motherboard (mLOM) designed exclusively for the M3 generation of Cisco UCS B-Series Blade Servers. When used in combination with an optional Port Expander, the Cisco UCS VIC 1240 capabilities can be expanded to eight ports of 10 GigabitEthernet.

The Cisco UCS VIC 1240 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). In addition, the Cisco UCS VIC 1240 supports Cisco Data Center Virtual Machine Fabric Extender (VM-FEX) technology, which extends the Cisco UCS fabric interconnect ports to virtual machines, simplifying server virtualization deployment.

Figure 7 Cisco UCS VIC 1240 Converged Network Adapter



EMC Isilon Scale-Out NAS for Virtualized Hadoop Clusters

EMC Isilon is a scale-out network-attached storage (NAS) platform provides Hadoop clients with direct access to big data through a Hadoop Distributed File System (HDFS) interface. Powered by the distributed EMC Isilon OneFS operating system, an EMC Isilon cluster delivers a scalable pool of storage with a global namespace.

Hadoop compute clients access the data stored in an Isilon cluster by connecting to any of the nodes over HDFS. Every node in the cluster can act as a namenode and a datanode. Each node of the Isilon cluster adds to the Isilon cluster's capacity and throughput. For Hadoop applications, the Isilon scale-out distributed architecture minimizes the bottlenecks, rapidly serves big data, and optimizes performance for MapReduce jobs.

EMC Isilon cluster can be used as a storage platform that can be used to store data using the existing workflows of an enterprise using standard protocols such as, SMB, HTTP, FTP, REST and NFS as well as HDFS. Regardless of the protocol that was used to store the data on an Isilon cluster (for example, SMB or NFS), the analysis can be performed via HDFS, using Hadoop compute grid. Thus, it avoids the need for setting up a separate HDFS file system and loading the data into it with HDFS copy operations or specialized Hadoop connectors.

An Isilon cluster simplifies data management while cost-effectively maximizing the value of data. Using HDFS as an over-the-wire protocol, you can deploy a powerful, efficient, and flexible data storage and analytics ecosystem. In addition to native integration with HDFS, EMC Isilon storage easily scales to support massively large Hadoop analytics projects. Isilon scale-out NAS also offers great simplicity; efficiency, flexibility, and reliability that you need to maximize the value of your Hadoop data storage and analytics workflow investment. Combine the power of VMware vSphere Big Data Extensions with Isilon scale-out NAS to achieve a comprehensive big data storage and analytics solution that delivers superior value.

EMC's Isilon scale-out network attached storage (NAS) for various Big Data storage needs. OneFS is the operating system as well as the underlying distributed file system that runs on multiple nodes that form the EMC Isilon scale-out NAS. OneFS is designed to scale not just in terms of machines, but also in human terms — allowing large-scale systems to be managed with a fraction of the personnel required for traditional storage systems. OneFS eliminates complexity and incorporates self-healing and self-managing functionality that dramatically reduces the burden of storage management. OneFS also incorporates parallelism at a very deep level of the OS, such that every key system service is distributed across multiple units of hardware. This allows OneFS to scale in virtually every dimension as the infrastructure is expanded, ensuring that what works today will continue to work as the dataset grows and workflows change.

Figure 8 EMC Isilon S200 Node

Apache Hadoop

Apache Hadoop is an open source, batch data processing system for enormous amounts of data. Hadoop runs as a platform that provides cost-effective, scalable infrastructure for building Big Data analytic applications. All Hadoop Clusters contain a distributed filesystem called the Hadoop Distributed Filesystem (HDFS), and a computation layer called MapReduce.

Virtualizing Hadoop Clusters

Hadoop is an open source software project that enables the distributed processing of large data sets across clusters of commodity servers. It is designed to scale up from a single server to thousands of machines. Hadoop clusters can be dynamically scaled up and down based on the available resources and the required services levels. Performance service levels vary widely for processing, from a few minutes to multiple days. Hadoop has emerged as a tool of choice for big data analytics, and virtualizing Hadoop brings many benefits, including:

- **Rapid provisioning**—From the creation of virtual Hadoop nodes to starting up the Hadoop services on the cluster, much of the Hadoop cluster deployment can be automated, requiring little expertise on the user's part. Virtual Hadoop clusters can be rapidly deployed and configured as needed.
- **High availability**—Reliability is critical for certain mission-critical uses of Hadoop. HA protection can be provided through the virtualization platform to protect the single points of failure (SPOF) in the Hadoop system, such as the NameNode for HDFS.
- **Elasticity**—Hadoop capacity can be scaled up and down on demand in a virtual environment, thus allowing the same physical infrastructure to be shared among Hadoop and other applications. This consolidation of workloads results in more efficient resource utilization and reduced costs.
- **Multi-tenancy**—Different tenants running Hadoop can be isolated in separate VMs, providing stronger VM-grade resource and security isolation. With virtualization, mixed workloads that include non-Hadoop applications can run alongside Hadoop on the same physical cluster.

HDFS and Isilon OneFS

Hadoop works by abstracting from an application the heavy lifting of parallelizing, scheduling and running a job against a large data set. In Hadoop, a user writes a client application that submits one or more jobs. The job contains a map function and a reduce function. The MapReduce framework handles breaking the job into tasks, scheduling tasks to run on machines, and monitoring the tasks. A job processes an input dataset specified by the user and creates an output job one as well. These input and output datasets are one or more files on the Hadoop distributed file system also known as HDFS.

HDFS has three main services: Namenode, Secondary Namenode, and Datanode. The Datanode service is responsible for storing and retrieving blocks. The Namenode stores the filesystem metadata. Clients connect to the Namenode to perform filesystem operations. The third HDFS service is called the secondary Namenode and performs internal housekeeping for the Namenode. Despite its name, the secondary Namenode is not a backup for the Namenode and performs a completely different function. The sole native method of access to HDFS is its Java API. All other access methods are built on top of this API and by definition, can expose only as much functionality as it.

EMC Isilon OneFS implements the essential NameNode and DataNode services on an Isilon cluster by means of a free HDFS license. With EMC Isilon providing HDFS services over the wire through the high-speed 10GigE links, the compute nodes could simply perform the MapReduce tasks for handling all major Hadoop workloads and applications.

VMware vSphere Big Data Extensions

VMware vSphere Big Data Extensions (BDE) is a vApp deployed on a vCenter Server. It helps with the Virtualized Hadoop Cluster deployment and provisioning. It also helps with centralized management of Hadoop clusters VMs via VMware vCenter Server. It allows the user to scale-up/down/out as per the changing needs of the organization, while providing a central place from which to manage and monitor

your Hadoop VMs. It comes with vSphere Web-Client based GUI interface, and a powerful Serengeti CLI shell that can be accessed via the management-server of the BDE. This provides a range of tools to help you optimize cluster performance and utilization.

The BDE vApp consists of two VMs.

1. BDE Management Server VM
2. Hadoop-Template VM

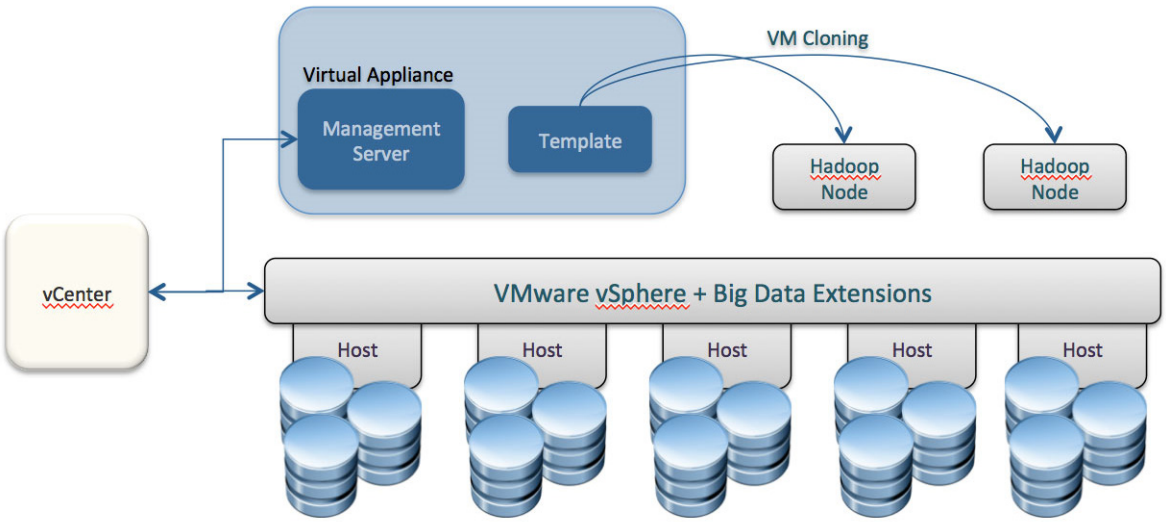
Note We will be building a custom VM template based on RHEL 6.4 and use it as the Hadoop-Template VM.

VMware vSphere Big Data Extensions (BDE) is integrated with vCenter to facilitate rapid deployment of VM clusters and for provisioning Hadoop on them. The following is the list of key features of the VMware vSphere Big Data Extensions (BDE).

- Deploy clusters with HDFS, MapReduce2, YARN, HBase, Pig, and Hive Server
- Automate the deployment and scaling of Hadoop clusters Hadoop cluster as a service
- Enable self-service provision of Hadoop clusters in the private cloud with vCloud Automation Center
- Elastic Scaling and Multi-tenancy
- Elastically scale compute and data separately
- Preserve data locality to improve performance
- Architectural Flexibility, and platform flexibility with support from major Hadoop distributions
- Choose from hybrid, local storage, and shared storage options
- High Availability though vSphere Clusters

Note This document describes how to use BDE to create the VM cluster with just the basic services, and subsequently use Cloudera Manager to provision Hadoop, thus leveraging two leading edge software platforms to build this scalable and flexible virtualized Hadoop solution.

Figure 9 Creating Hadoop Cluster Using VMware vSphere Big Data Extensions



Cloudera Enterprise CDH 5.2

Cloudera Manager, an end to end management application, is used to install and configure CDH. During

CDH Installation, Cloudera Manager's Wizard will help to install Hadoop services on all nodes using the following procedure:

- Discovery of the cluster VMs
- Configure the Cloudera parcel or package repositories
- Install Hadoop, Cloudera Manager Agent (CMA) and Impala on all the cluster nodes
- Install the Oracle JDK if it is not already installed across all the cluster nodes
- Assign various services to nodes
- Start the Hadoop service

With Cloudera Manager, you can easily deploy and centrally operate the complete Big Data stack. The application automates the installation process, reducing deployment time from weeks to minutes; gives you a cluster-wide, real-time view of nodes and services running; provides a single, central console to enact configuration changes across your cluster; and incorporates a full range of reporting and diagnostic tools to help you optimize performance and utilization.

Key Capabilities of Cloudera Manager

- Manage: Easily deploy, configure and operate a data hub with centralized, intuitive administration for all services, hosts and workflows.
- Monitor: Maintain a central view of all activity in the cluster through heatmaps, proactive health checks and alerts.
- Diagnose: Easily diagnose and resolve issues with operational reports and dashboards, events, intuitive log viewing and search, audit trails and integration with Cloudera Support.
- Integrate: Integrate Cloudera Manager with existing enterprise monitoring tools through SNMP, SMTP and a comprehensive API.

Cloudera Enterprise CDH 5 (5.1.3)

CDH (Cloudera’s Distribution Including Apache Hadoop) is a complete distribution of Apache Hadoop. CDH is open source and it offers batch processing, interactive SQL, and interactive search as well as enterprise-grade continuous availability. CDH delivers the core elements of Hadoop—scalable storage and distributed computing—as well as all of the necessary enterprise capabilities such as security, high availability and integration with a broad range of hardware and software solutions.

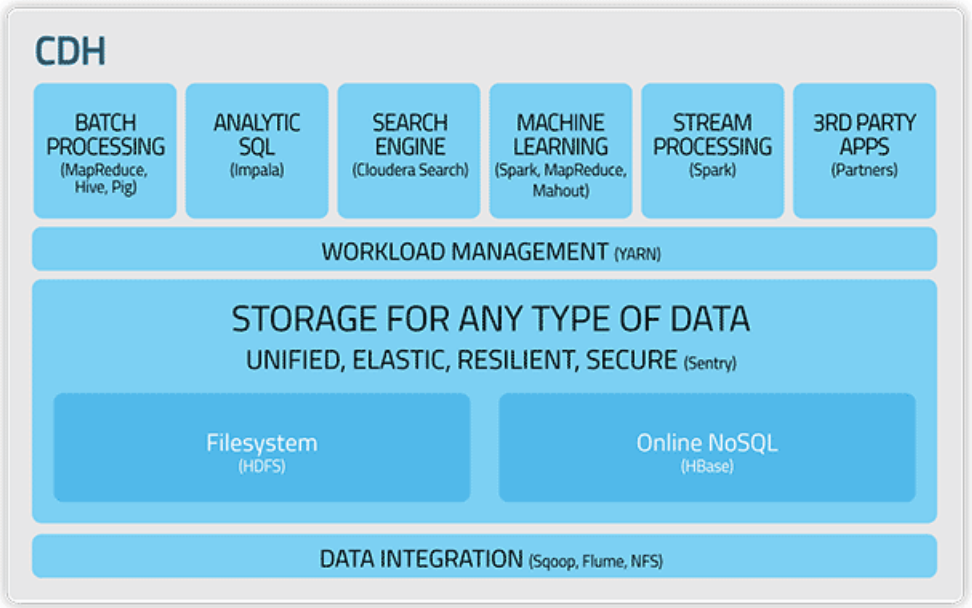
Cloudera Enterprise provides a comprehensive platform for designing and managing solutions that cross the boundaries of traditional and Big Data platforms. By providing easy-to-use tools and familiar design concepts for both traditional and Big Data platforms, Cloudera empowers organizations to leverage existing IT skillsets to build Big Data solutions.

Some of the key features of CDH include:

- Flexibility— Store any type of data and prosecute it with an array of different computation frameworks including batch processing, interactive SQL, free text search, machine learning and statistical computation.
- Integration—Get up and running quickly on a complete, packaged, Hadoop platform.
- Security—Process and control sensitive data and facilitate multi-tenancy.

- Scalability and Extensible—Enable a broad range of applications and scale them with your business.
- Highly Available—Run mission-critical workloads with confidence.
- Open—Benefit from rapid innovation without proprietary vendor lock-in.
- Compatible—Extend and leverage existing IT investments.

Figure 10 CDH Architecture



For more information on Cloudera, visit: www.cloudera.com.

Solution Architecture

Network Architecture

This solution makes use of two 5108 UCS Chassis, each with two 2208 IO-Modules for connectivity with UCS Fabric Interconnects. The Chassis' are populated with eight B200 M3 half-width blade servers.

The B200 M3 blade servers are equipped with two Intel Xeon E5-2660 v2 processors, 256 GB of DDR3 1866MHz memory, Cisco UCS Virtual Interface Card 1240 mLOM, onboard Cisco LSI MegaRAID SAS 2004 CV-8i storage controller and 2 x 1TB 7.2K SATA disk drives.

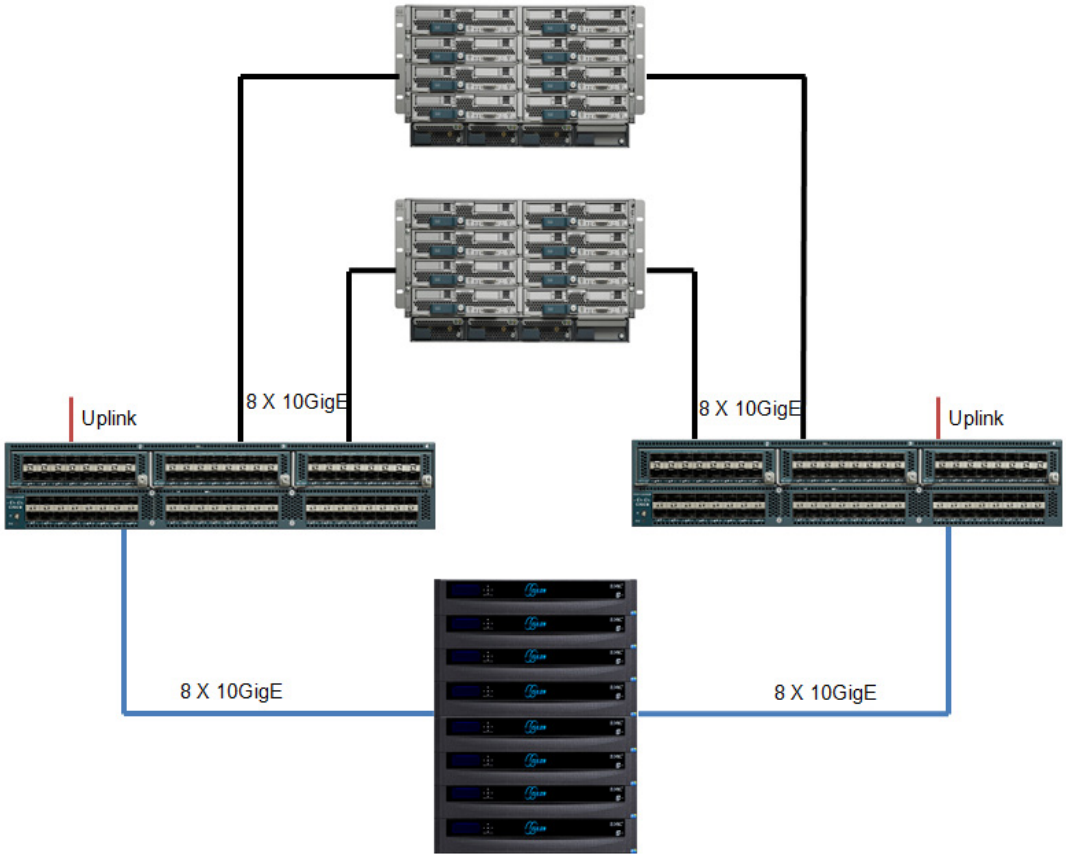
Physical Networking

Figure 11 illustrates the network connectivity between the UCS 5108 Chassis', Isilon cluster and the redundant 6296 Fabric Interconnects.

Each of the two FEX/IO-Modules on the 5108 Chassis' are connected to their respective Fabric-Interconnects using eight Twin-Ax Cables. IO-Module A is connected to Fabric-Interconnect A and IO-Module B is connected to the Fabric-Interconnect B. The eight nodes of the Isilon S-series cluster

are connected to the Fabric Interconnects directly without going through any of the switches. The ports on the Fabric-Interconnect are configured as Appliance Ports. The port 10GigE-1 of each Isilon S200 node is connected to an appliance port on FI-A, and 10GigE-2 is connected to an appliance port on FI-B.

Figure 11 Physical Network Topology



VM Networking

The VM level networking is performed by using vSphere standard switches by using the vNICs defined in the UCS service-profiles. There are 6 vNICs created per server – refer to Table 1. These vNICs are grouped as follows.

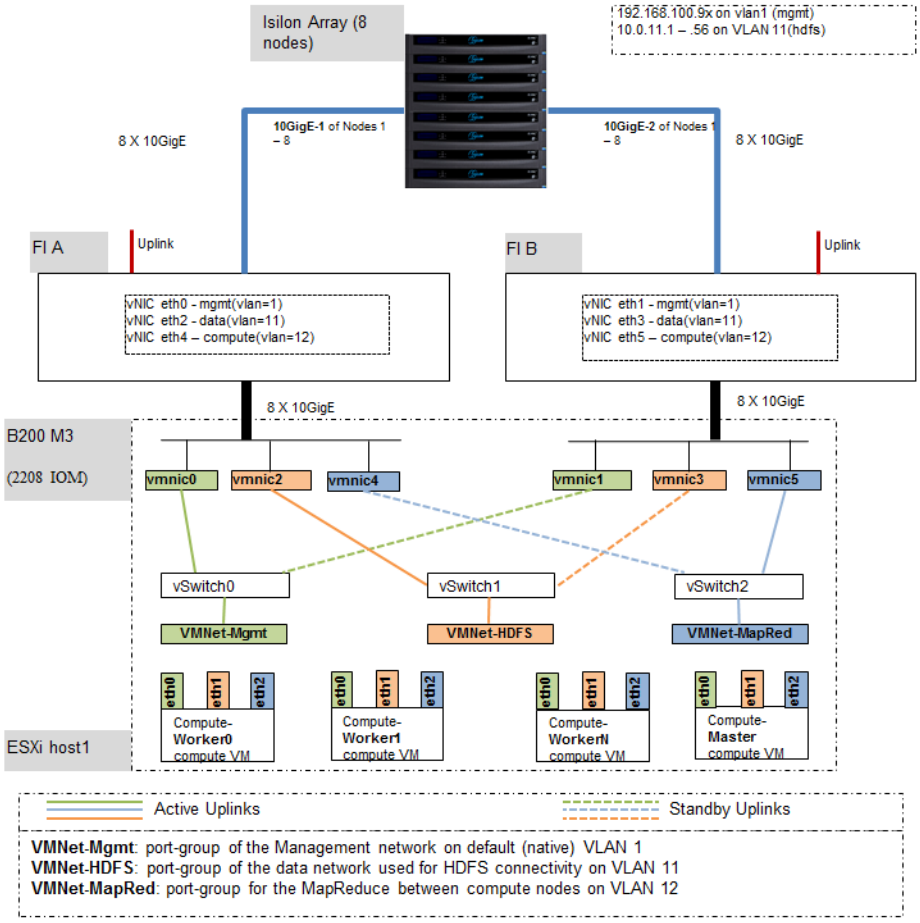
These vNICs act as the uplink ports of the vSphere standard vSwitches in each of the server blades. For more information, see "Configuring Virtual Networking" section on page 93.

Table 1 Defining vNIC in UCS Service-Profiles

VLAN	VLAN ID	vNICs	vSwitch	Portgroup
Management	1 (default)	eth0(vmnic0), eth1(vmnic1)	vSwitch0	VMNet-Mgmt
Data	11	eth2(vmnic2), eth3(vmnic3)	vSwitch1	VMNet-HDFS
Compute	12	eth4(vmnic4), eth5(vmnic5)	vSwitch1	VMNet-MapRed

Figure 12 shows the VM network architecture. The VM port-groups are color-coded to indicate the connectivity between the network adapters of the VMs, the VM port-groups and the VM uplinks of the vSwitches. The standby uplinks are shown in dotted lines.

Figure 12 VM-Networking Topology



Software Infrastructure

This document talks about the method to create a self-contained infrastructure for Virtualized Hadoop that can be used to provision multiple Hadoop clusters and scaling them to satisfy the needs of today's enterprise customers.

This Virtualized Hadoop solution is built with the following software components:

- Cisco UCS Manager for provisioning the UCS blades
- Isilon OneFS for providing HDFS services
- vSphere ESXi Hypervisors running on all 16 blade servers
- vCenter Server appliance
- vSphere Big Data Extensions vApp for virtualized Hadoop deployment
- RHEL6.4-based Custom OS- VM template to be used with the BDE vApp
- RHEL6.4-based Admin-VM that runs DHCP, DNS, NTP services. It also hosts RHEL and Hadoop distribution repositories.
- Cloudera Distribution for Apache Hadoop (CDH 5.1.34)
- Cloudera Manager (CM 5.2.0)

In the following sections, we will see how to install and configure each one of these software infrastructure components for building the Virtualized Hadoop solution.

vSphere Clusters and Distributed Resource Scheduler (DRS)

VMware vSphere Big Data Extensions requires the compute resources be managed in the form of vSphere clusters for building a Virtualized Hadoop solution. Thus, the compute resources i.e. ESXi hosts of this solution were managed by grouping them as vSphere clusters.

VMware vSphere clusters allow you to:

- Provide highly available resources to your workloads.
- Balance workloads for optimal performance.
- Scale and manage computing resources without service disruption.

Balancing Compute Capacity Using vSphere Distributed Resource Scheduler (DRS)

The computing capacity is balanced in the cluster to deliver optimized performance for hosts and virtual machines.

VMware vSphere Distributed Resource Scheduler (DRS) is a feature included in the vSphere Enterprise and Enterprise Plus editions. Using DRS, you can:

- Improve service levels by guaranteeing appropriate resources to virtual machines.
- Deploy new capacity (i.e. adding a new ESXi-host) to a cluster without service disruption.
- Migrating virtual machines automatically during maintenance without service disruption (requires vSphere vMotion).
- Monitor and manage more infrastructures per system administrator.

The DRS manages various stages of VM deployment such as:

- Initial VM placement—When a VM is powered on in a cluster, DRS could place it on an appropriate host or generates a recommendation, depending on the automation level you choose. In this solution, BDE makes use of this feature for placing Hadoop cluster VMs.
- Automated load-balancing—DRS spread the virtual machine workloads across vSphere hosts inside a cluster and constantly available resources for you. Depending on the automation levels chosen, DRS could migrate the VMs other hosts within the cluster to maximize performance (requires vSphere vMotion).

Note Since, we did not enable vMotion in this solution, we disabled the application-monitoring and migration features in the cluster.

- Cluster Maintenance—DRS speeds up the VMware vSphere Update Manager remediation process by determining the optimum number of hosts that can enter maintenance mode simultaneously, based on current cluster conditions and demands.

We created and made use of two compute resource clusters in this solution. Hereafter, we will be referring to them as DRS-cluster.

- Admin DRS-cluster—consists of the ESXi hosts in which the administrative VMs (vSphere vCenter Server, vSphere Big Data Extensions vApp, Admin-VM) are placed.
- Hadoop DRS-cluster— consists of ESXi hosts in which the Hadoop Cluster VMs are placed by using BDE.

In this solution, we kept only one ESXi host in the Admin DRS-cluster and the other fifteen ESXi hosts were put in the Hadoop DRS-cluster. However, one could easily add more compute resources to this pool to match the deployment needs.

Managing Resources In BDE

In order to provision Virtualized Hadoop, BDE requires three types of resources.

1. Compute resource pool – maps to the Hadoop DRS-cluster we discussed in the previous section.
2. Network resources – these are pointers to the actual vSphere port-groups defined in the ESXi vSwitches.
3. Datastore pool – a pool of datastore pools utilized for placing the VM hard-drives for the Hadoop VMs.

The "Configuring Datastores and Network Resources in Big Data Extensions" section on page 170 shows the creation of the network and datastore resources in BDE.

Time Synchronization

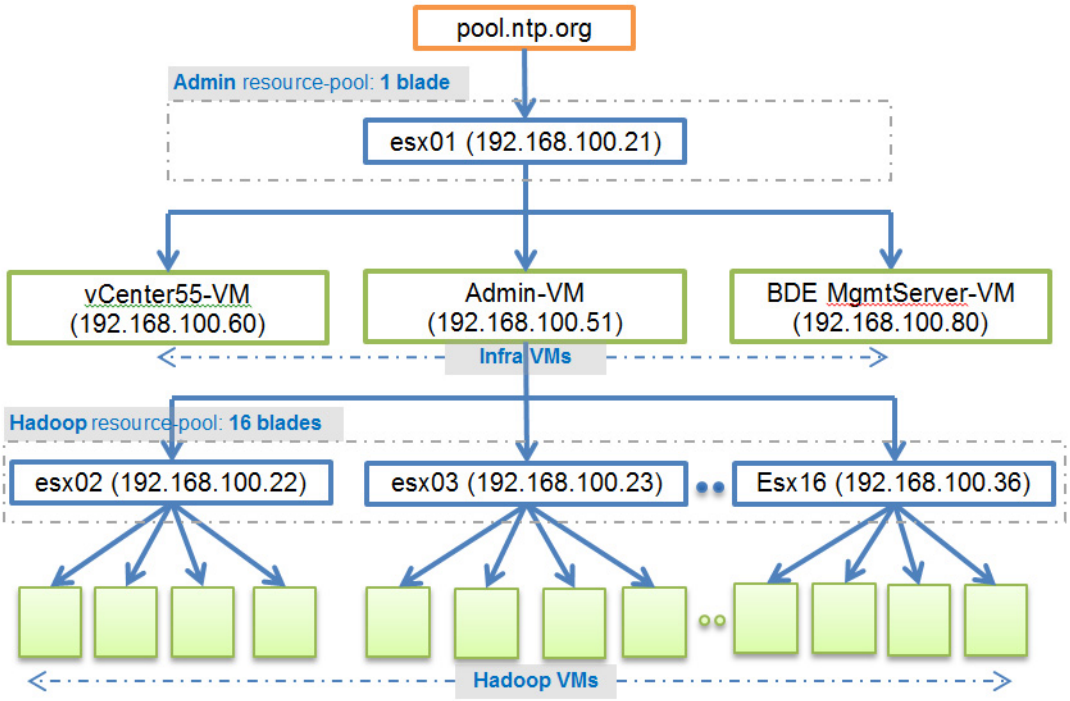
The Virtualized Hadoop provisioning requires the Clock of all the ESXi hosts and VMs to be synchronized with each other. In order to achieve this synchronization, we follow a hierarchical approach in which only one of the 16 blades synchronizes its time with the well-known NTP-servers at pool.ntp.org.

This ESXi host will be made to be part of the Admin vSphere Distributed Resource Scheduler (DRS) resource-pool. The Admin-VM will be created on this host. The Admin-VM will be synchronizing it's time with its host ESXi.

All the other 15 ESXi hosts that are to be part of the Hadoop DRS-cluster shall synchronize their clock to the Admin-VM's NTP-server.

The Hadoop-Cluster VMs themselves will synchronize their clock to their respective ESXi host. By following the hierarchical approach shown below, the timing is synchronized and maintained across the entire cluster.

Figure 13 NTP Synchronization Scheme



Rack and PDU Configuration

The rack consist of two Cisco UCS 6296UP Fabric-Interconnects, two Cisco UCS 5108 Chassis each containing eight Cisco UCS B200 M3 Servers, and an eight node S200 Isilon cluster with two Infiniband switches. All these devices are powered by two vertical PDUs for redundancy; thereby, ensuring availability during power source failure. Each of the two 2208 IO-Modules (Fabric Extenders) of the 5108 chassis are connected to one Fabric-Interconnect by means of 8 TWIN-AX cables respectively.

Table 2 Rack Configuration

Cisco 42U Rack	Master Rack	Expansion Rack
42	Cisco UCS FI 6296UP	-
41		-
40	Cisco UCS FI 6296UP	-
39		-

Table 2 Rack Configuration

Cisco 42U Rack	Master Rack	Expansion Rack
38	-	-
37	-	-
36	-	-
35	-	-
34	-	-
33	-	-
32	-	-
31	-	-
30	IB Switch	-
29		-
28	Isilon S200	Isilon S200
27		
26	Isilon S200	Isilon S200
25		
24	Isilon S200	Isilon S200
23		
22	Isilon S200	Isilon S200
21		
20	Isilon S200	Isilon S200
19		
18	Isilon S200	Isilon S200
17		
16	Isilon S200	Isilon S200
15		
14	Isilon S200	Isilon S200
13		
12	Cisco UCS 5108 Blade Server Chassis	Cisco UCS 5108 Blade Server Chassis
11		
10		
9		
8		
7		

Table 2 Rack Configuration

Cisco 42U Rack	Master Rack	Expansion Rack
6	Cisco UCS 5108 Blade Server Chassis	Cisco UCS 5108 Blade Server Chassis
5		
4		
3		
2		
1		

Note Please contact your Cisco or EMC representatives for country specific information.

Figure 14 and Figure 15 show the physical view (front) of the master and expansion rack.

Figure 14 Master Rack Configuration

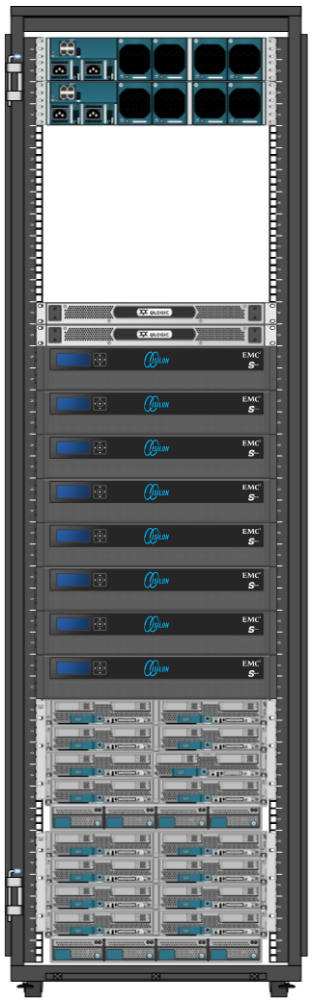


Figure 15 Expansion Rack Configuration

Software Version information

Infrastructure: Cisco UCS

The Cisco UCS version 2.2(1c) has been used to build this solution.

Table 3 Infrastructure Software: Cisco UCS

Layer	Component	Version or Release
Compute	Cisco UCS B200 M3	2.2 (1c) 11.0 (Board Controller)

Layer	Component	Version or Release
Network	Cisco UCS 6296UP	2.2(1c)
	Cisco UCS VIC1240 Firmware	2.2(1c)
	Cisco UCS IOM 2208	2.2(1c)
Management		2.2(1c)

Note You can download the latest drivers from the following location: http://software.cisco.com/download/release.html?mdfid=284296254&flowid=31743&softwareid=283853158&release=1.5.1&relind=AVAILABLE&rellifecycle=&reltype=latest

Infrastructure: EMC Isilon S-Series Cluster

Table 4 Infrastructure Software: EMC Isilon S-Series

Name	Version
OneFS	7.2.0.0

Software Components

Table 5 Hypervisor, OS and Hadoop

Table 0-1

Software Component	Version	Information
VMware vSphere Hypervisor	5.5 update 1	http://www.vmware.com/
vCenter Server	5.5	
VMware vSphere Big Data Extensions	2.1	
Red Hat Enterprise Linux	6.4(x86_64)	http://www.redhat.com/
Cloudera Manager	5.2.0	http://www.cloudera.com/
Cloudera Enterprise (CDH)	5.1.3	

Unified Fabric Configuration

This section provides details for configuring a fully redundant, highly available Cisco UCS 6296 fabric configuration.

Initial setup of the Fabric Interconnect A and B

1. Connect to IP address of Fabric Interconnect A using web browser.
2. Launch UCS Manager.
3. Edit the chassis discovery policy.
4. Enable server and uplink ports.
5. Enable Appliance ports for Isilon connectivity
6. Create pools and polices for service profile template.
7. Create Service Profile template and 16 Service profiles.
8. Start server discovery process.
9. Associate to server.

Performing Initial Setup of Cisco UCS 6296 Fabric Interconnects

This section describes the steps to perform initial setup of the Cisco UCS 6296 Fabric Interconnects A and B.

Configure Fabric Interconnect A

1. Connect to the console port on the first Cisco UCS 6296 Fabric Interconnect.
2. At the prompt to enter the configuration method, enter console to continue.
3. If asked to either perform a new setup or restore from backup, enter setup to continue.
4. Enter y to continue to set up a new Fabric Interconnect.
5. Enter y to enforce strong passwords.
6. Enter the password for the admin user.
7. Enter the same password again to confirm the password for the admin user.
8. When asked if this fabric interconnect is part of a cluster, answer y to continue.
9. Enter A for the switch fabric.
10. Enter the cluster name for the system name.
11. Enter the Mgmt0 IPv4 address.
12. Enter the Mgmt0 IPv4 netmask.
13. Enter the IPv4 address of the default gateway.
14. Enter the cluster IPv4 address.
15. To configure DNS, answer y.
16. Enter the DNS IPv4 address.
17. Answer y to set up the default domain name.

18. Enter the default domain name.
19. Review the settings that were printed to the console, and if they are correct, answer yes to save the configuration.
20. Wait for the login prompt to make sure the configuration has been saved.

Configure Fabric Interconnect B

1. Connect to the console port on the second Cisco UCS 6296 Fabric Interconnect.
2. When prompted to enter the configuration method, enter console to continue.
3. The installer detects the presence of the partner Fabric Interconnect and adds this fabric interconnect to the cluster. Enter y to continue the installation.
4. Enter the admin password that was configured for the first Fabric Interconnect.
5. Enter the Mgmt0 IPv4 address.
6. Answer yes to save the configuration.
7. Wait for the login prompt to confirm that the configuration has been saved.

For more information on configuring Cisco UCS 6200 Series Fabric Interconnect, see:

http://www.cisco.com/c/en/us/td/docs/unified_computing/ucs/sw/gui/config/guide/2-2/b_UCSM_GUI_Configuration_Guide_2_2.html

Logging Into Cisco UCS Manager

Follow these steps to login to Cisco UCS Manager:

1. Open a Web browser and navigate to the Cisco UCS 6296 Fabric Interconnect cluster address.
2. Click the Launch link to download the Cisco UCS Manager software.
3. If prompted to accept security certificates, accept as necessary.
4. When prompted, enter admin for the username and enter the administrative password.
5. Click **Login** to log in to the Cisco UCS Manager.

Upgrading UCSM Software to Version 2.2(1c)

In this section, we will document the process of upgrading the UCS firmware to the version UCS 2.2(1c). If your current UCS firmware version is 2.1, please refer to Upgrading between Cisco UCS 2.x Releases to upgrade the Cisco UCS Manager to identify and upgrade your UCS firmware. Please do make sure that the UCS B-Series version 2.2(1c) software bundles is installed on the Fabric Interconnects.

UCS Configurations

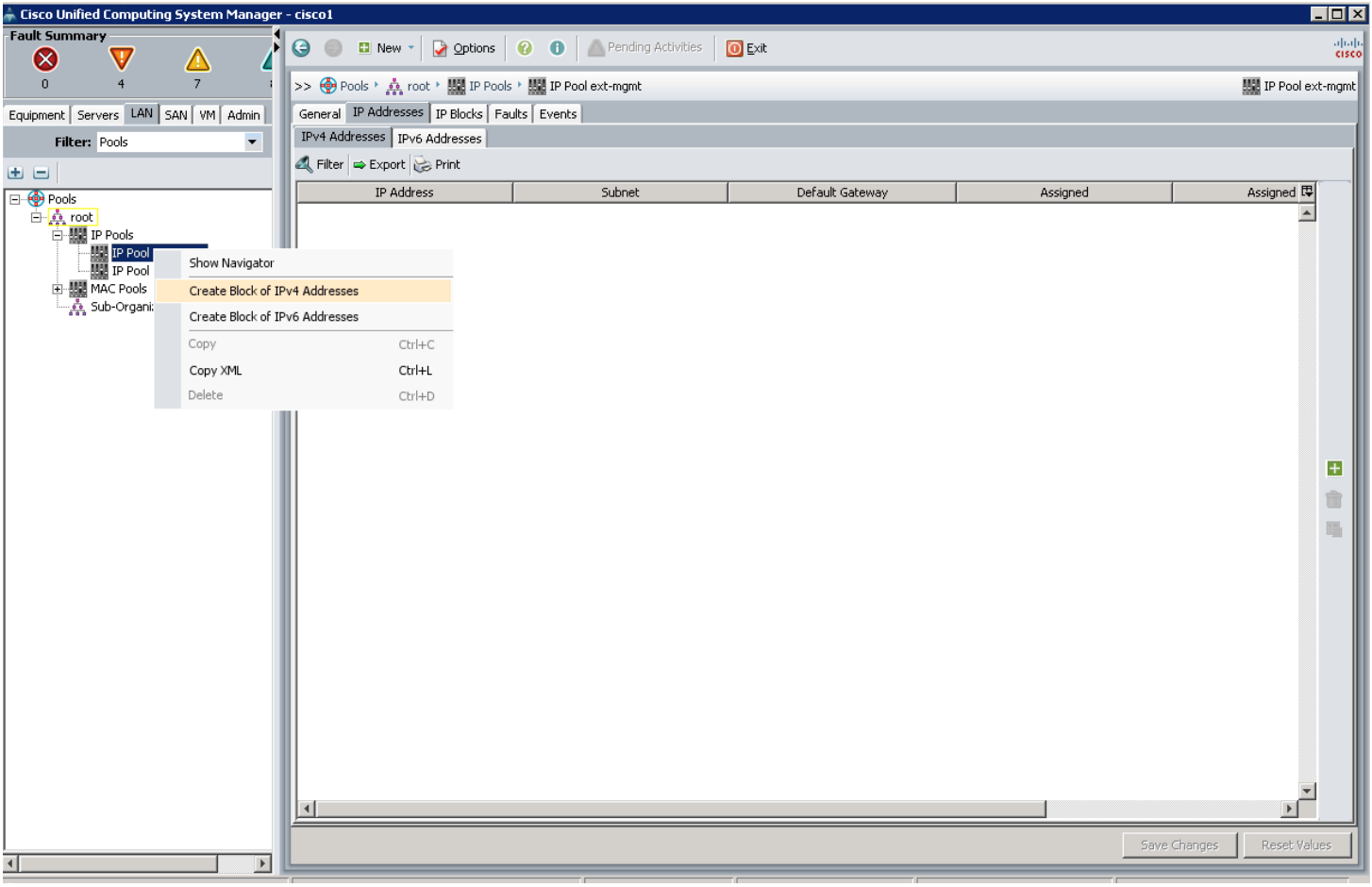
Adding Block of IP Addresses for KVM Access

These steps provide details for creating a block of KVM IP addresses for server access in the Cisco UCS environment.

1. Choose the **LAN** tab at the top of the left window.

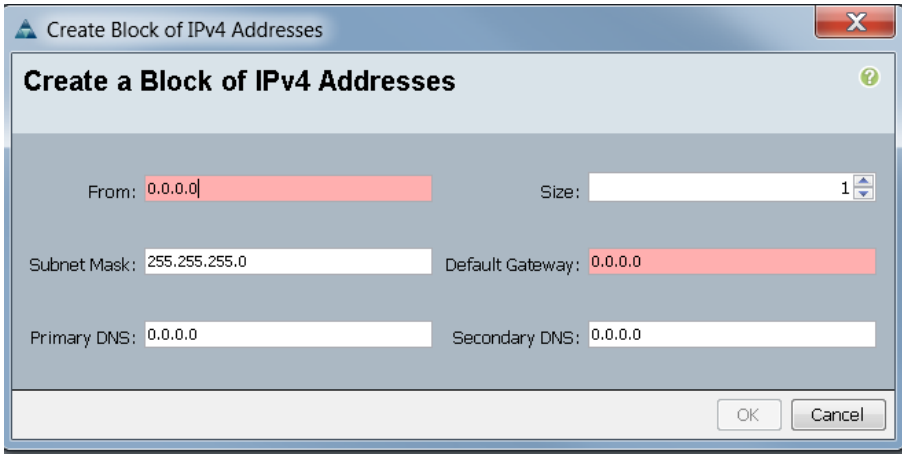
2. Choose **Pools** > **IpPools** > **IP Pool ext-mgmt.**
3. Right-click **IP Pool ext-mgmt**
4. Choose **Create Block of IPv4 Addresses.**

Figure 16 Adding Block of IPv4 Addresses for KVM Access Part 1



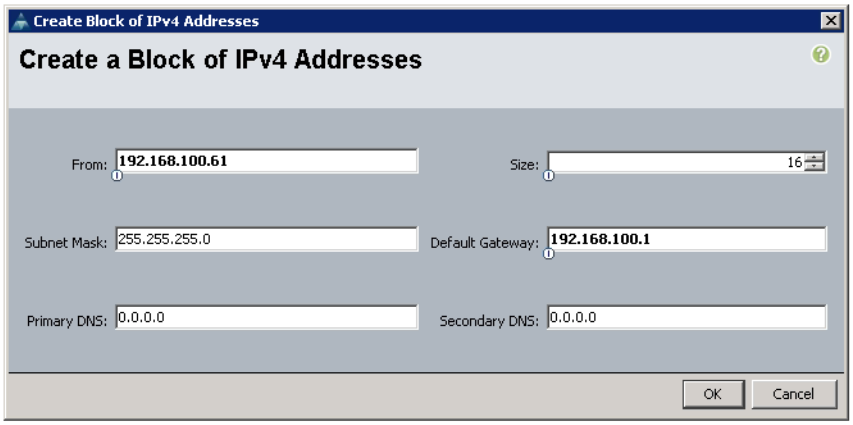
5. Enter the starting IP address of the block and number of IPs needed, as well as the subnet and gateway information.

Figure 17 Adding Block of IPv4 Addresses for KVM Access Part 2



6. Click **OK** to create the IP block.
7. Click **OK** in the message box.

Figure 18 Adding Block of IPv4 Addresses for KVM Access Part 3

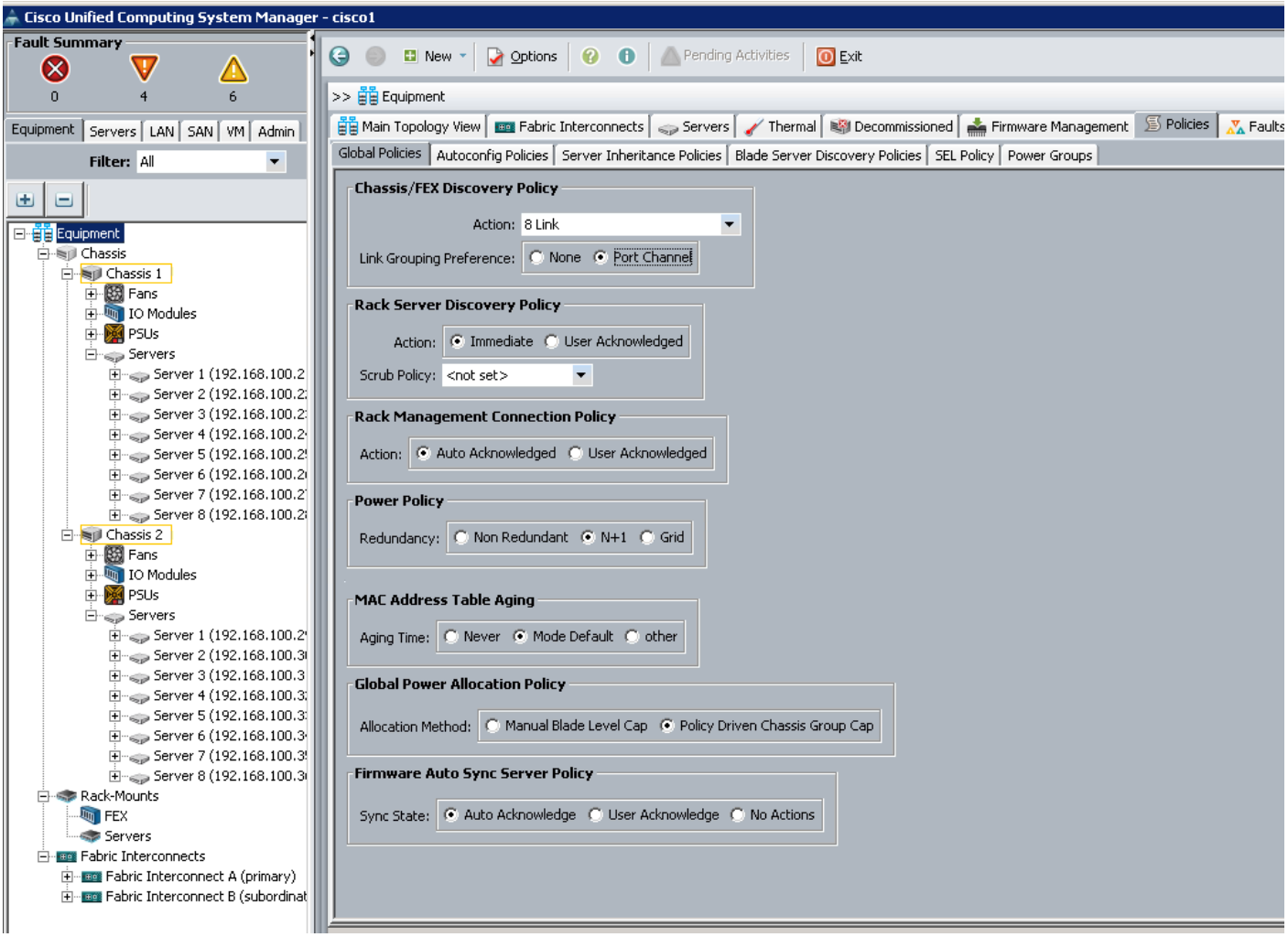


Editing Chassis/FEX Discovery Policy

These steps provide details for modifying the chassis discovery policy. Setting the discovery policy now will simplify the addition of future B-Series UCS Chassis and additional Fabric Extenders for further C-Series connectivity.

1. Navigate to the **Equipment** tab in the left pane.
2. In the right pane, click the **Policies** tab.
3. Under **Global Policies,** change the Chassis/FEX Discovery Policy to 8-link.
4. Set the **Port Channel** radio-button.
5. Click **Save Changes** in the bottom right hand corner.
6. Click **OK**.

Figure 19 Chassis/FEX Discovery Policy



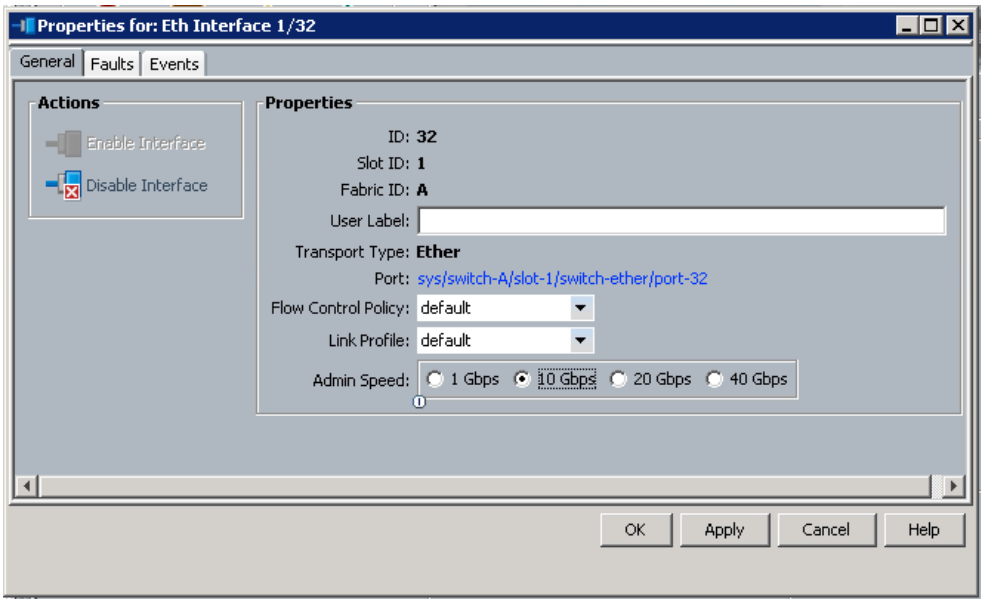
Enabling Server Ports and Uplink Ports

These steps provide details for enabling server and uplinks ports.

1. Choose the **Equipment** tab on the top left of the window.
2. Choose **Equipment** > **Fabric Interconnects** > **Fabric Interconnect A (primary)** > **Fixed Module**.
3. Expand the **Unconfigured Ethernet Ports** section.
4. Choose all the ports that are connected to the Cisco UCS 5108 Chassis (8 per IO-Module), right-click them, and choose **Reconfigure** > **Configure as a Server Port.**
5. Choose ports 31 and 32 that are connected to the uplink switch, right-click, then choose **Reconfigure** > **Configure as Uplink Port**.
6. Choose **Show Interface** and choose**10GB** for Uplink Connection.
7. A pop-up window appears to confirm your selection. Click **Yes** then **OK** to continue.
8. Choose **Equipment** > **Fabric Interconnects** > **Fabric Interconnect B (subordinate)** > **Fixed** Module.

9. Expand the **UnConfigured Ethernet Ports** section.
10. Choose all the ports that are connected to the Cisco UCS 5108 Chassis(8 per IO-Module), right-click them, and choose Reconfigure > Configure as Server Port.
11. A prompt displays asking if this is what you want to do. Click **Yes** then **OK** to continue.
12. Choose ports 31 and 32, which are connected to the uplink switch, right-click, then choose **Reconfigure** > **Configure as Uplink Port**.
13. Choose **Show Interface** and choose **10GB** for Uplink Connection.
14. A pop-up window appears to confirm your selection. Click **Yes** then **OK** to continue.

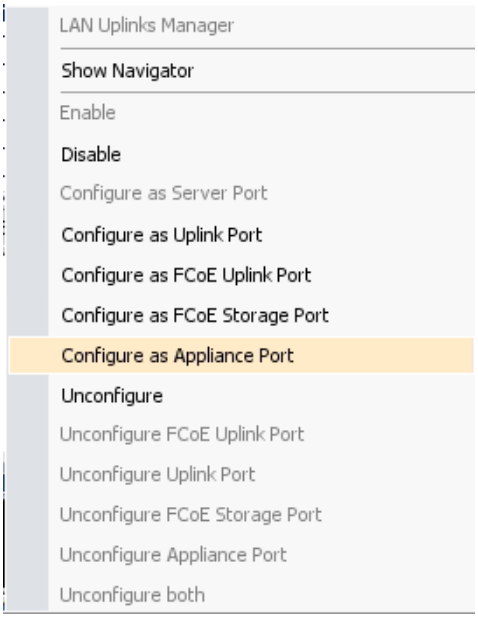
Figure 20 Enabling Uplink Ports



Configuring Appliance Ports for Isilon Connectivity

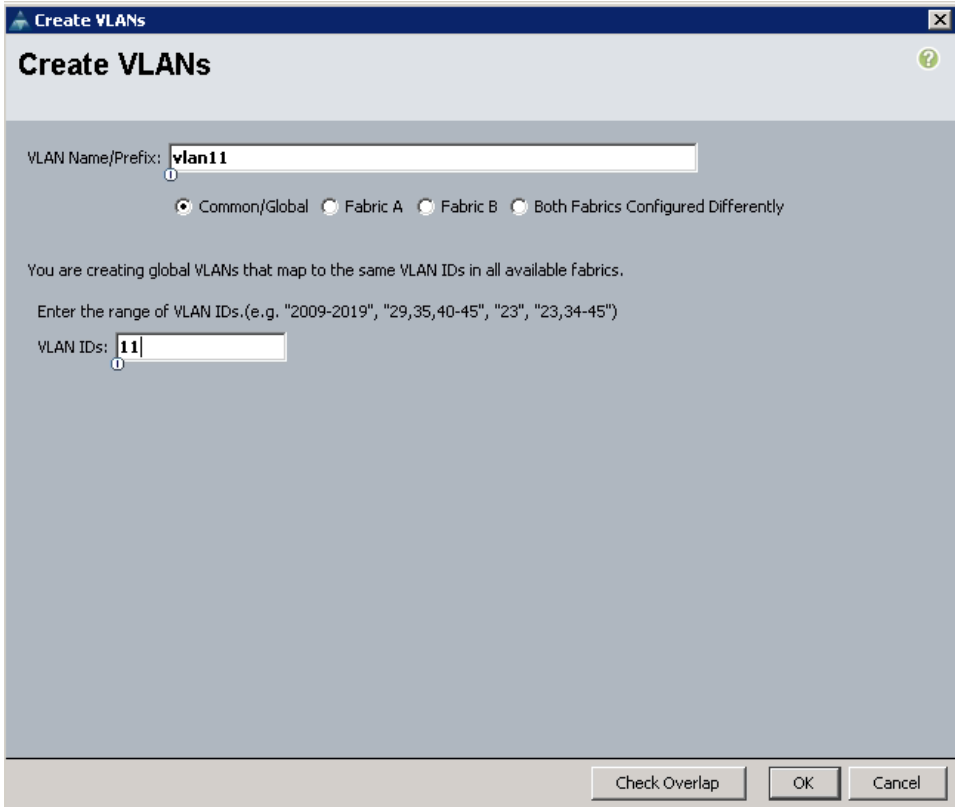
1. Click to **Expand** the Fabric-Interconnect A under Equipments in the **Equipment** tab.
2. Click to Expand the Fixed-Module > Ethernet Ports
3. Choose the list of ports connected to the Isilon Array, and Right-Click and choose “Configure as Appliance Port” menu item.

Figure 21 Configuring a Port as Appliance Port



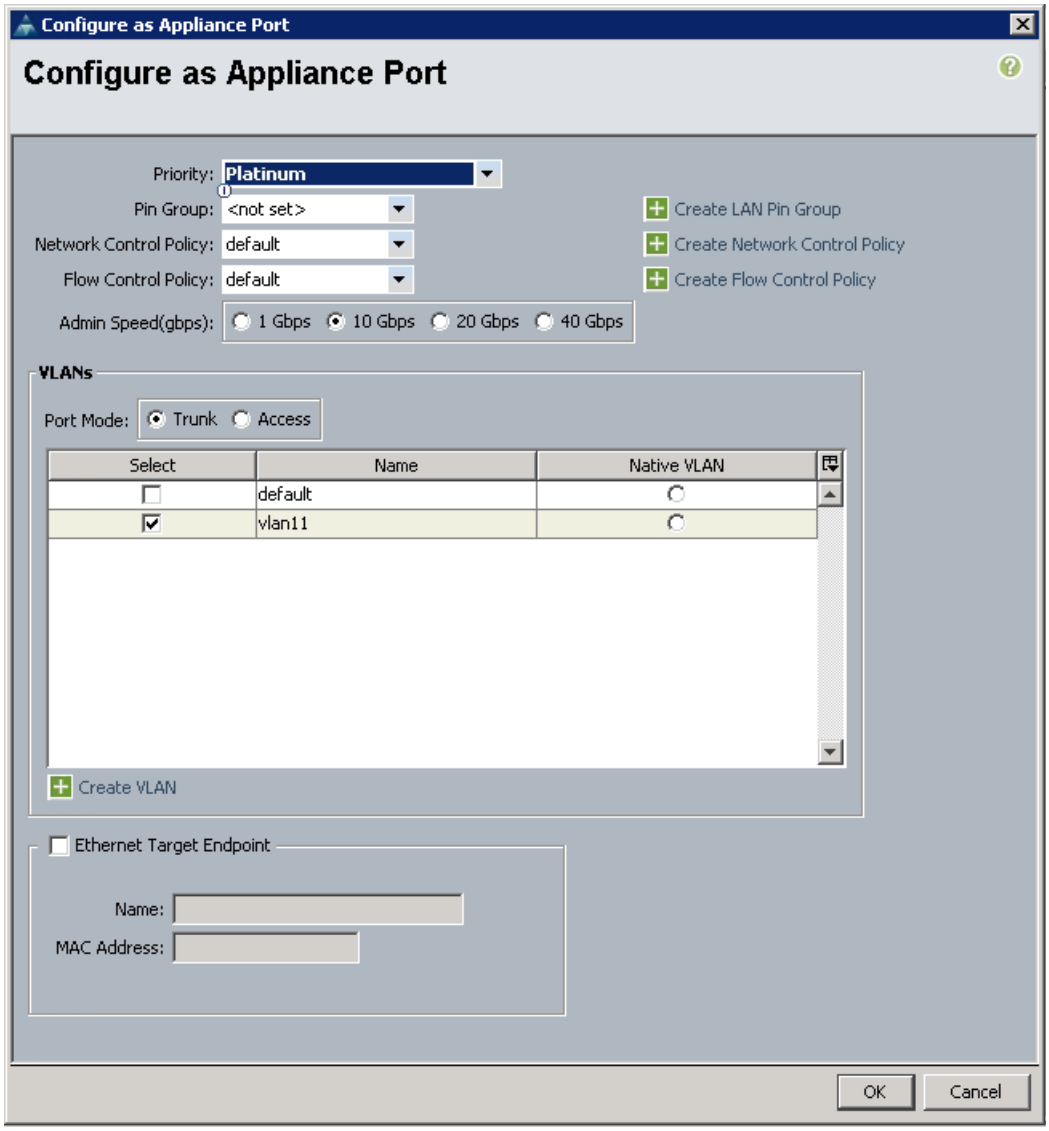
4. Click **Yes** to accept the Configure As Appliance Port confirmation message.
5. Choose "**Platinum**" in the **Priority** field
6. In the VLANs section, click the **Trunk** radio button.
7. Click **Create a VLAN**
8. In the **Create VLANs** dialog box, enter the Name as vlan11, Check **Common/Global** option, and set the VLAN IDs as 11, and Click **OK** to continue.

Figure 22 Creating a VLAN for Appliance port



9. Leave the default entry unselected.
10. In the **Priority** field choose **Platinum**.
11. Check to choose the **vlan11** option and click **OK** to continue.

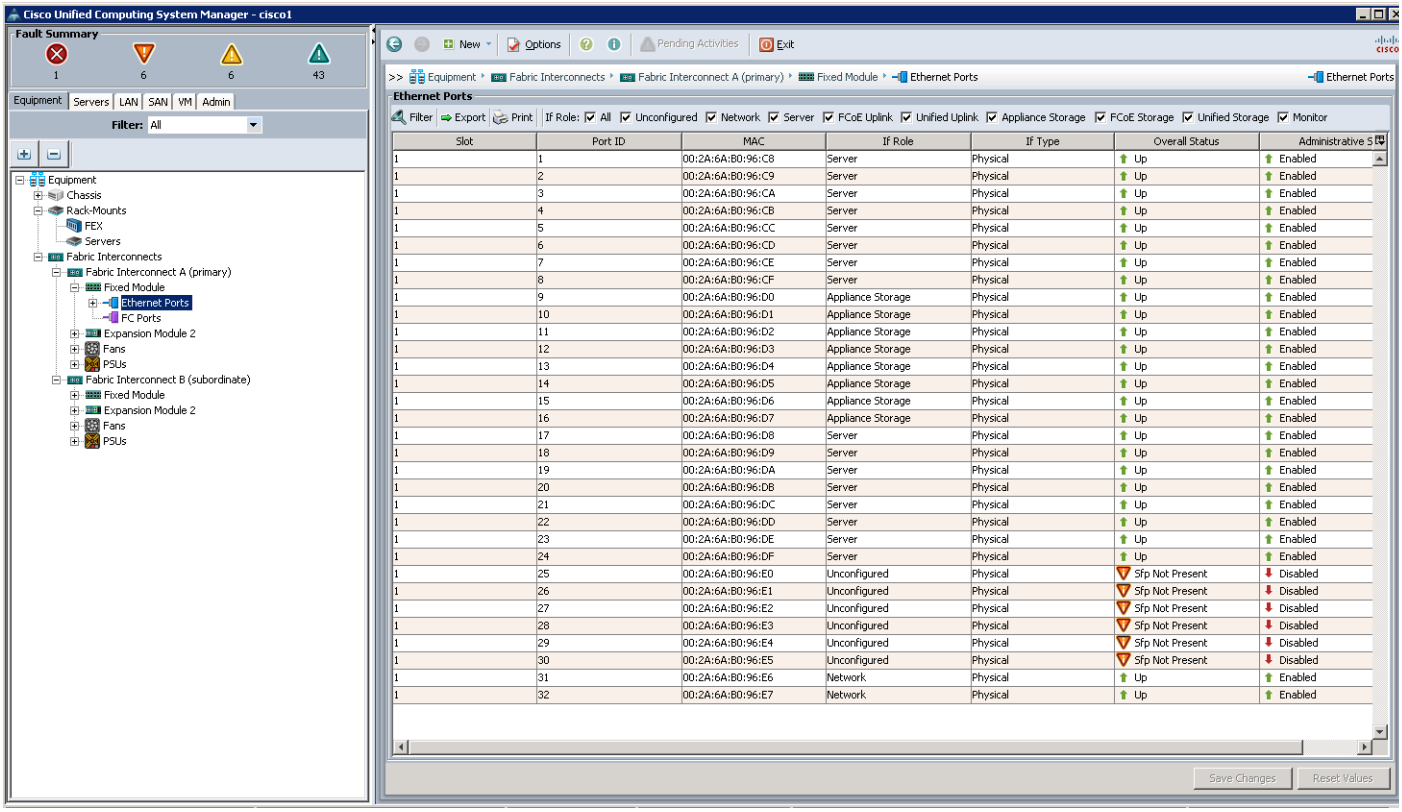
Figure 23 Appliance Port configuration



12. Perform these steps on all the other 7 ports on Fabric-Interconnect A and all the 8 ports on Fabric Interconnect B that are connected to the Isilon Array.

Figure 24 shows the configurations of all the ports configured in the Fabric Interconnect.

Figure 24 Showing Appliance, Server and Uplink Ports



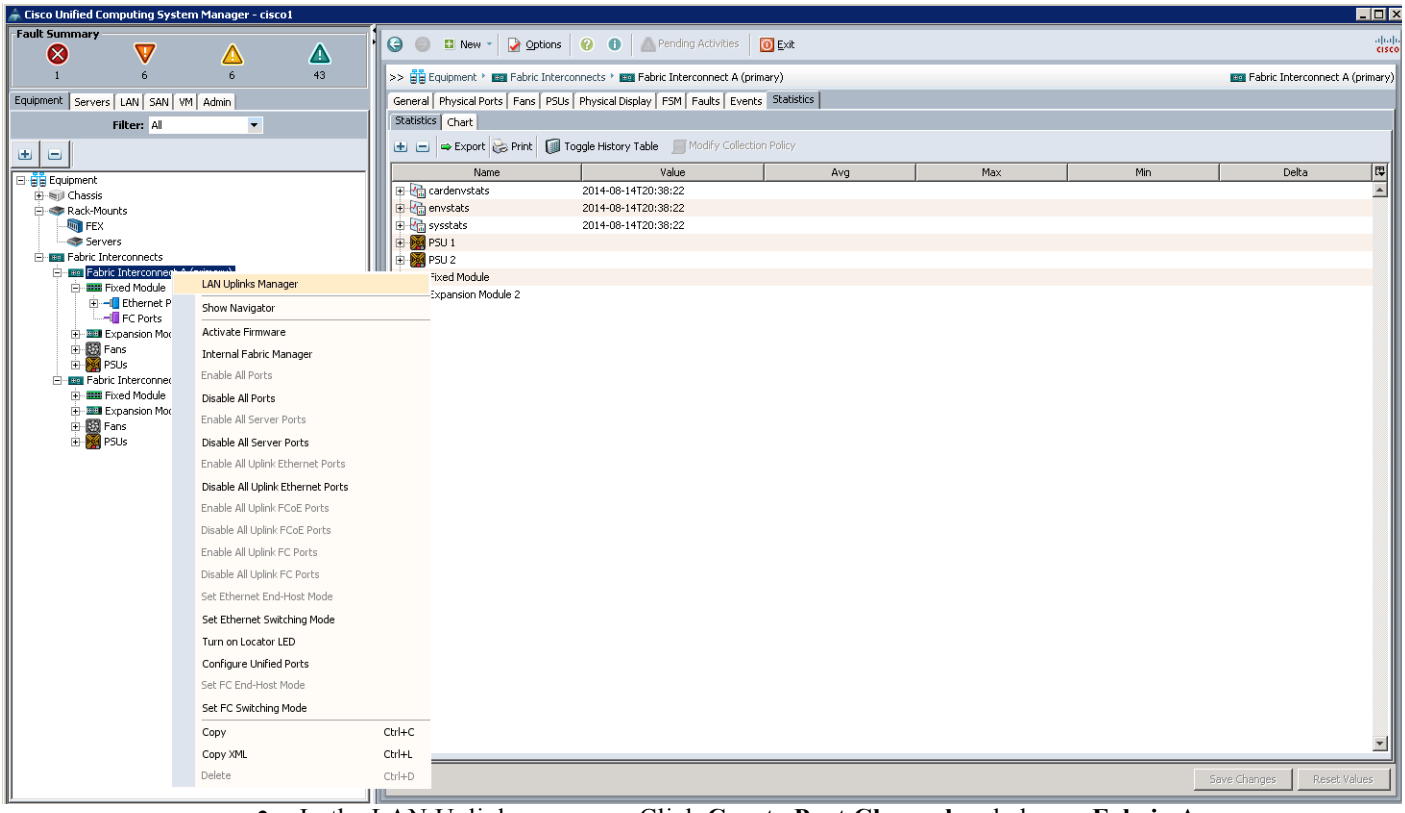
Creating Uplink Port-Channel

In this section we shall walk through the procedure to combine the two uplink ports (port 31 and 32) into a port-channel for achieving better uplink throughput and making the connectivity fault-tolerant. The upstream switches to which the uplink ports are connected, need to be configured appropriately.

Note The configuration of the upstream switches is not discussed in this document.

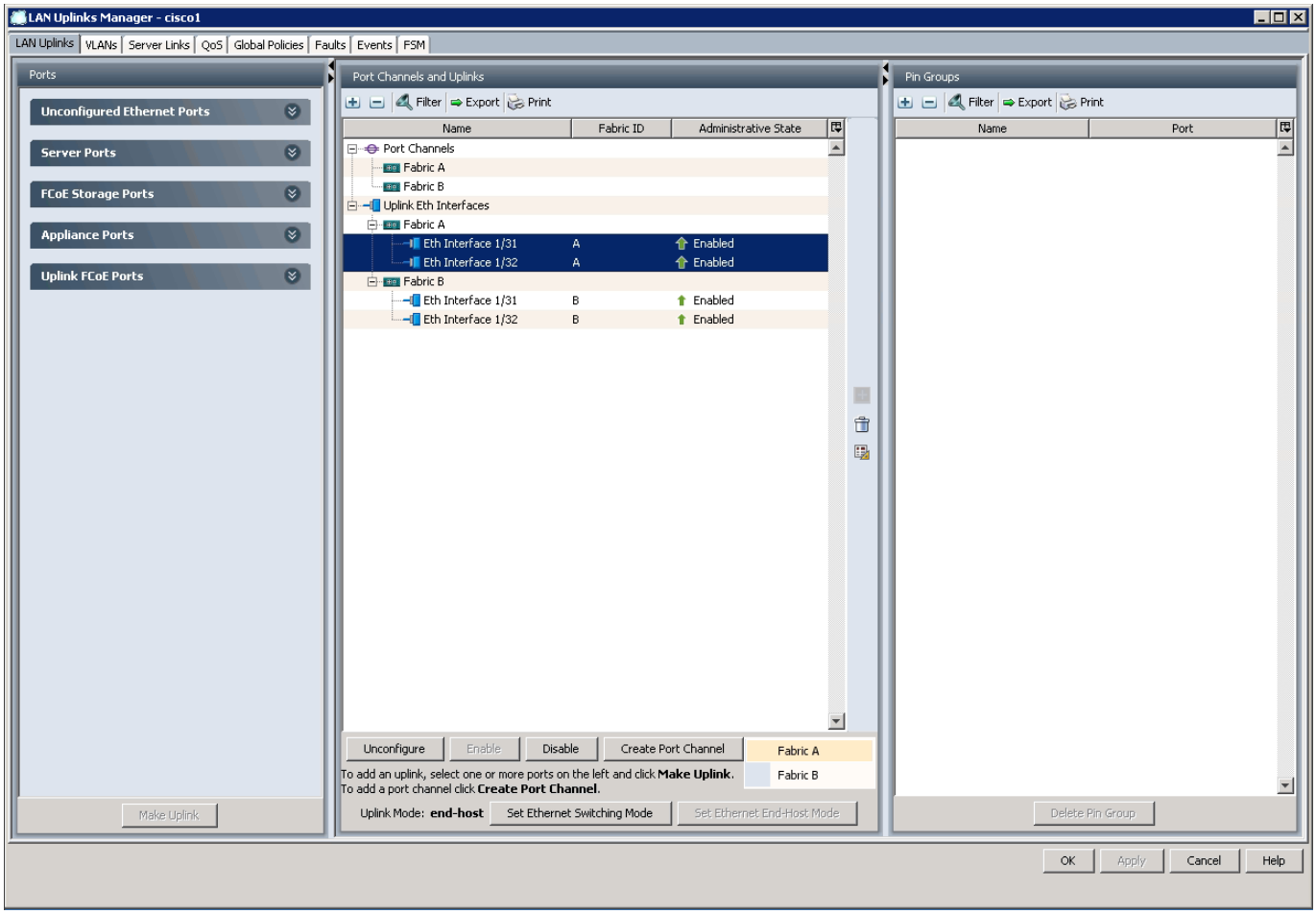
1. Right-click the **Fabric Interconnect A** and choose **LAN Uplinks Manager**.

Figure 25 LAN Uplinks Manager Configuration



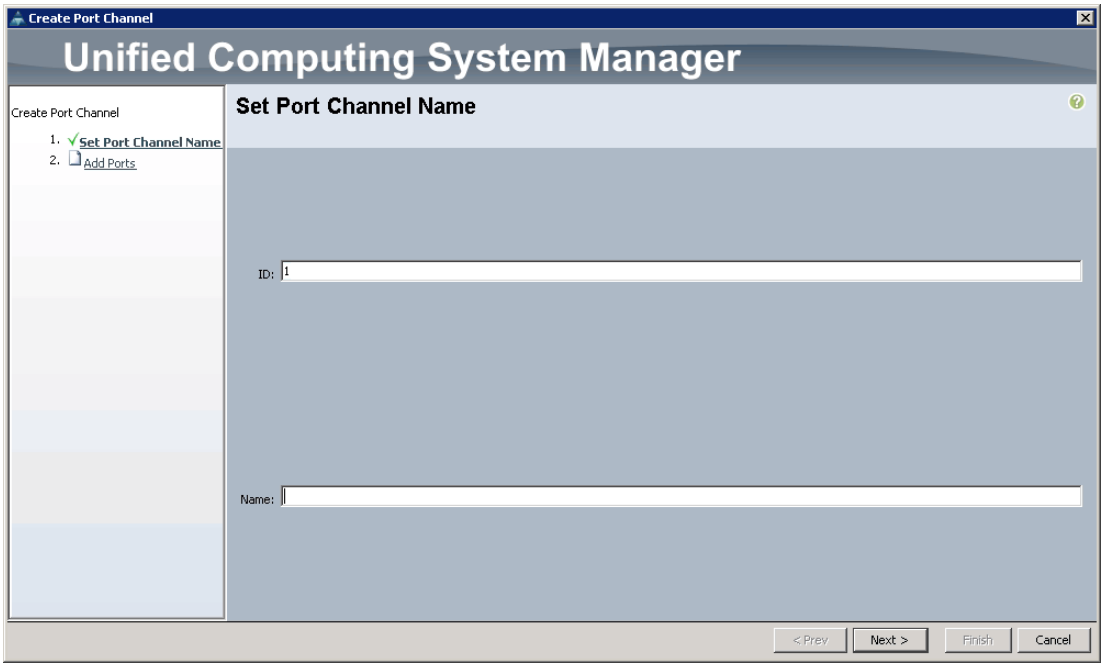
2. In the LAN Uplinks manager, Click **Create Port Channel** and choose **Fabric A**.

Figure 26 Creating an Uplink Port-Channel on Fabric A



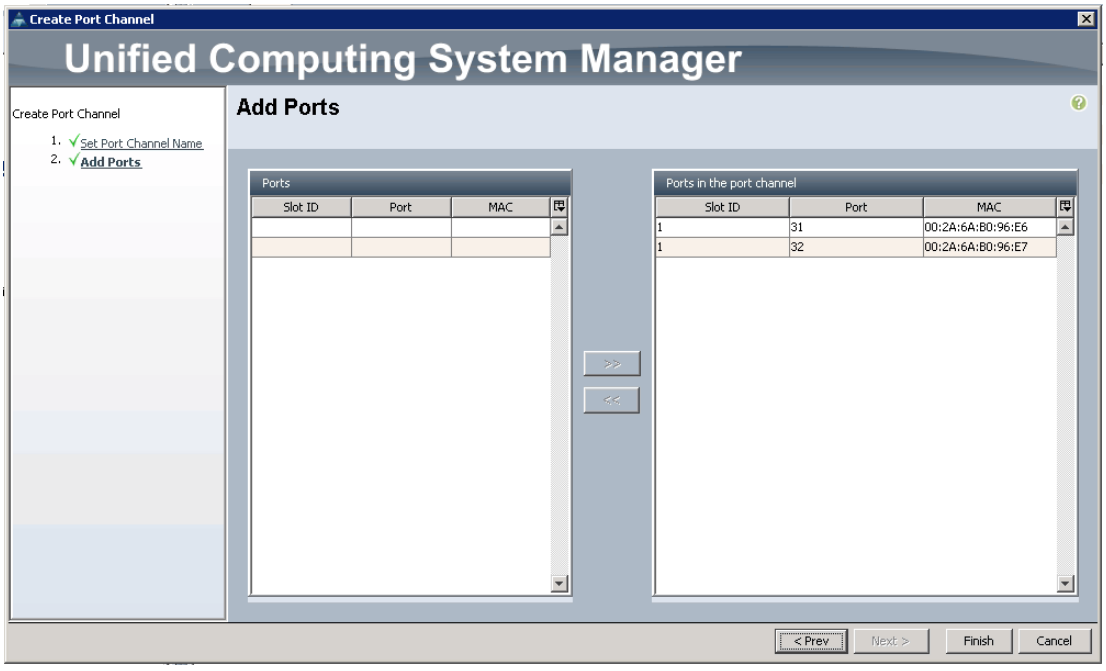
3. Enter the Port-Channel ID, optionally specify a name, and Click **Next**.

Figure 27 Creating Port Channel – Assign an ID



4. Choose both ports 31 and 32 and click >> to add them to the port-channel, and click **Finish**.

Figure 28 Adding the Uplink Ports 31 and 32 to Port-Channel



5. Repeat the steps on Fabric Interconnect B by creating a port-channel (ID=2) of the uplink ports 31 and 32.

Note The upstream switches will need to be configured to match these Port-Channel configurations in order to establish the proper connectivity upstream.

Creating Pools for Service Profile Templates

This section provides information on creating various pools for Service Profile Templates.

Creating an Organization

Organizations are used as a means to arrange and restrict access to various groups within the IT organization, thereby enabling multi-tenancy of the compute resources. This document does not assume the use of Organizations; however the necessary steps are provided for future reference.

Follow these steps to configure an organization within the Cisco UCS Manager GUI:

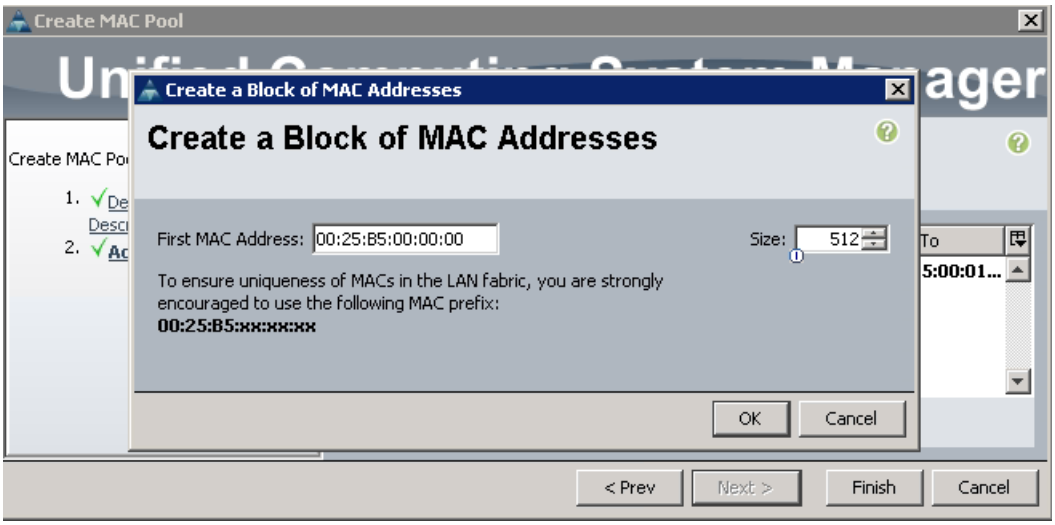
1. Click **New** on the top left corner in the right pane in the UCS Manager GUI.
2. Choose **Create Organization** from the options
3. Enter a name for the organization.
4. (Optional) Enter a description for the organization.
5. Click **OK**.
6. Click **OK** in the success message box.

Creating MAC Address Pools

Follow these steps to create MAC address pools:

1. Choose the **LAN** tab on the left of the window.
2. Choose **Pools** > **root**.
3. Right-click MAC Pools under the root organization.
4. Choose **Create MAC Pool** option to create the MAC address pool. Enter “mac_pool1” for the name of the MAC pool.
5. (Optional) Enter a description of the MAC pool.
6. Click **Next**.
7. Click **Add**.
8. Specify a starting MAC address.
9. Specify a size of the MAC address pool, which is sufficient to support the available server resources.
10. Click **OK**.

Figure 29 Specifying First MAC Address and Size



11. Click **Finish**.

Figure 30 Adding MAC Addresses

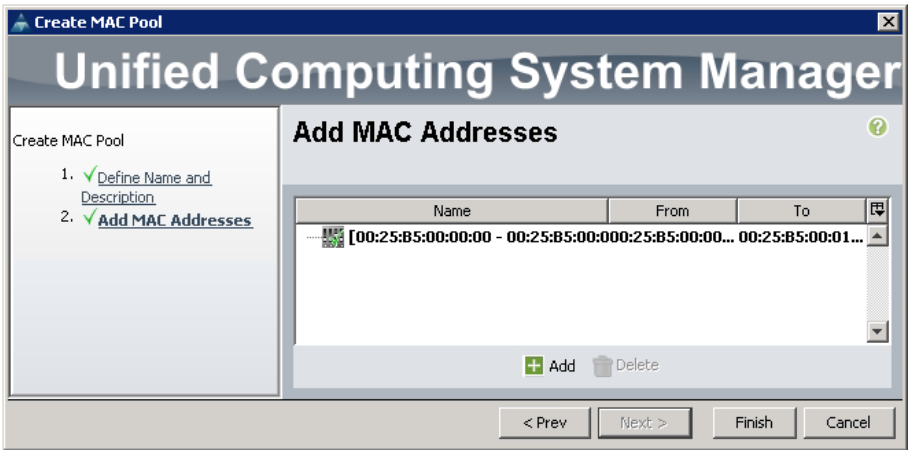
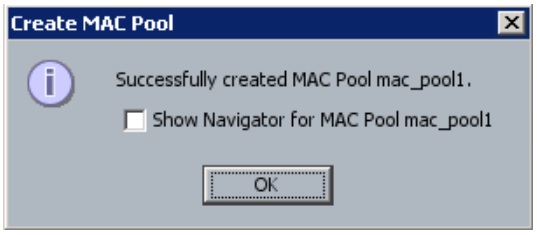


Figure 31 Confirming Newly added MAC Pool



Configuring VLANs

VLANs are configured as in shown in Table 6.

Table 6 VLAN Configurations

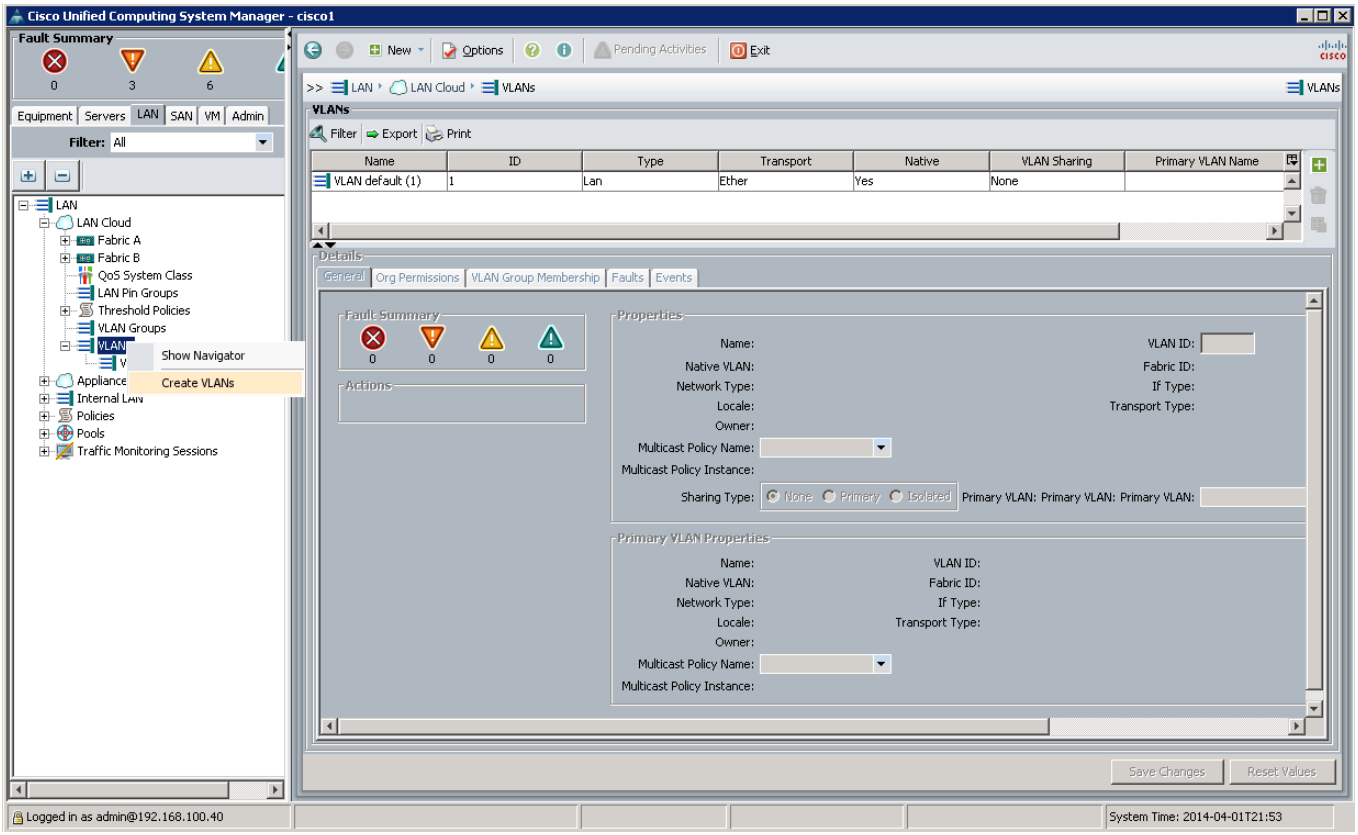
VLAN	Fabric	Purpose
default (VLAN 1)	A,B	Management
vlan11_data (VLAN 11)	A,B	Used for HDFS and NFS access related network traffic between UCS and Isilon Array.
vlan12_compute (VLAN 12)	A,B	Used for network traffic between compute nodes (Map-Reduce traffic)

All of the VLANs created need to be trunked to the upstream distribution switch connecting the fabric interconnects.

Follow these steps to configure VLANs in the Cisco UCS Manager GUI:

1. Choose **LAN** tab in the left pane in the UCSM GUI.
2. Choose **LAN** > **LAN Cloud** > **VLANs.**
3. Right-click the **VLANs**.
4. Choose **Create VLANs** option to create the VLAN.

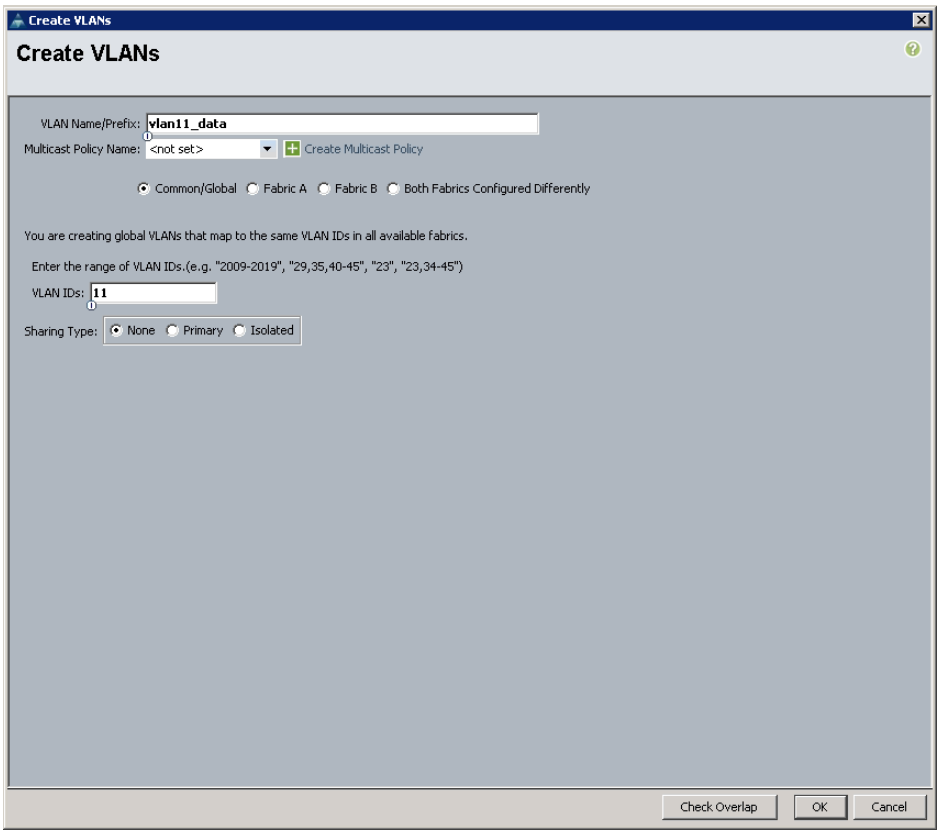
Figure 32 Creating VLAN



5. Choose the **LAN** tab in the left pane again

6. Choose **LAN** > **VLANs**.
7. Right-click the **VLANs** under the root organization.
8. Choose **Create VLANs** option to create the VLAN.
9. Enter vlan11_data for the VLAN Name.
10. Choose Common/Global for the vlan11_data.
11. Enter 11 in **VLAN IDs** field.
12. Click **OK** and then, click **Finish**.
13. Click **OK** in the success message box.

Figure 33 Creating VLAN to Communicate Between Compute Nodes and Isilon Cluster



Repeat the same steps for creating another VLAN called vlan12_compute and set the VLAN ID as 12.

Creating Server Pool

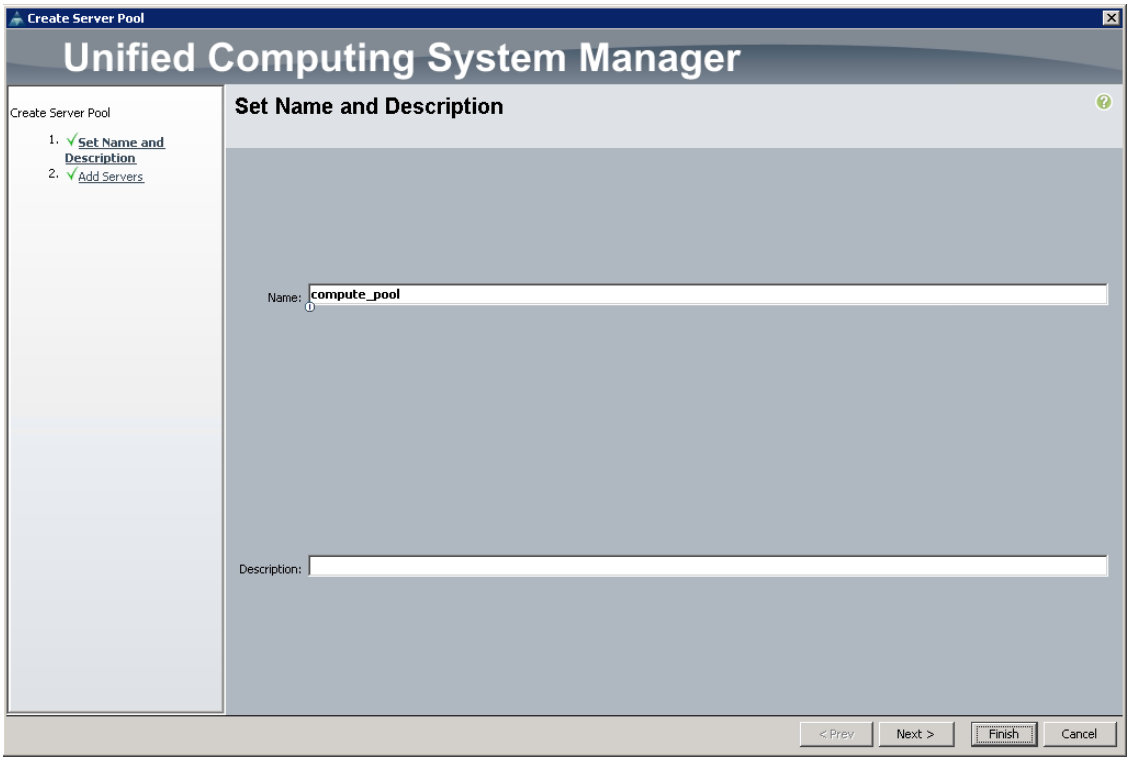
A server pool contains a set of servers. These servers typically share the same characteristics. Those characteristics can be their location in the chassis, or an attribute such as server type, amount of memory, local storage, type of CPU, or local drive configuration. You can manually assign a server to a server pool, or use server pool policies and server pool policy qualifications to automate the assignment

Follow these steps to configure the server pool within the Cisco UCS Manager GUI:

1. Choose the **Servers** tab in the left pane in the UCS Manager GUI.

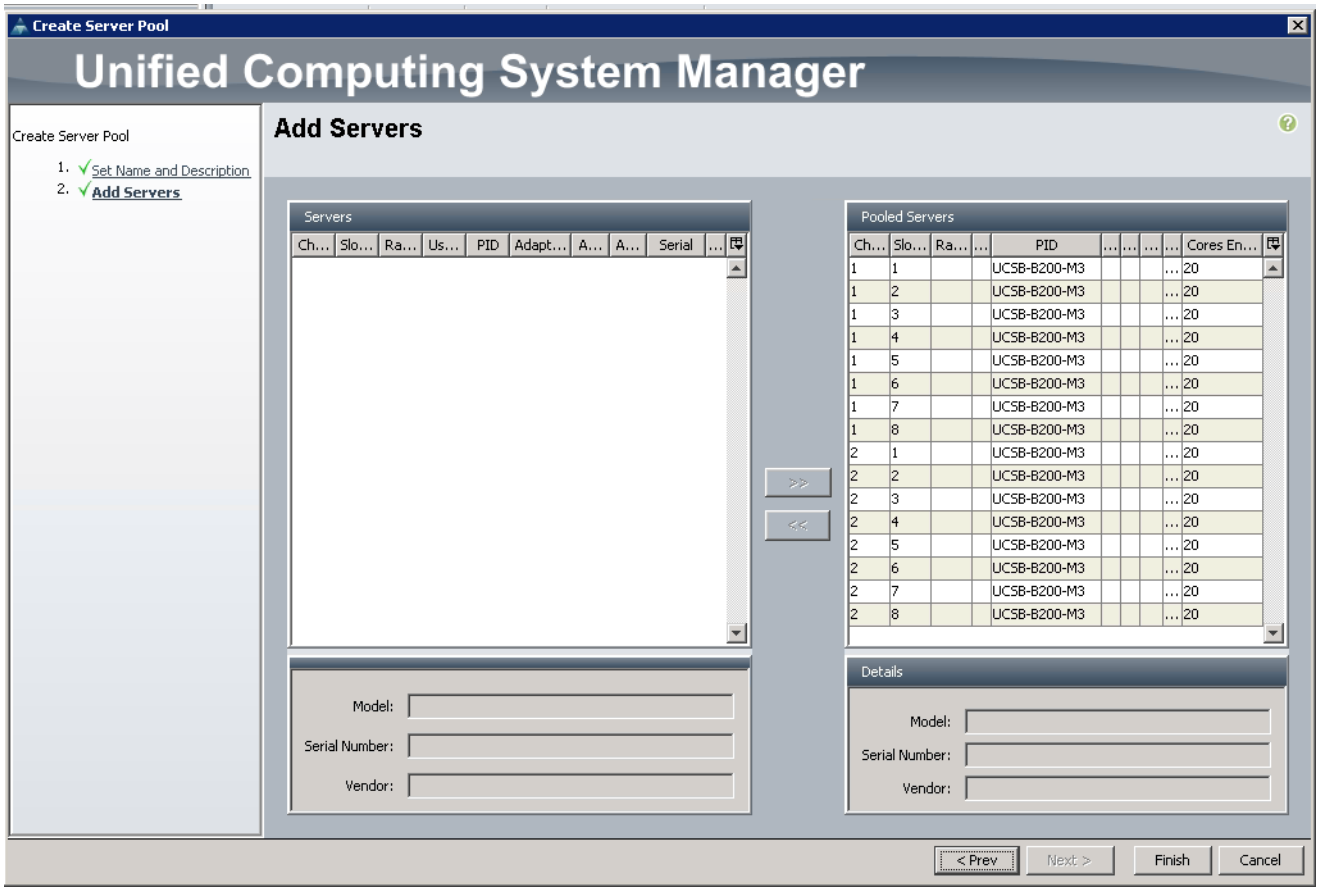
2. Choose **Pools** > **root**.
3. Right-click the **Server Pools**.
4. Choose **Create Server Pool**.
5. Enter the name compute_pool for the Server Pool in the name text box.
6. (Optional) enter a description for the organization
7. Click **Next** to add servers.

Figure 34 Entering Name and Description of the Server Pool



8. Choose all the Cisco UCS B200 M3 servers to the server pool you previously then Click >> to add them to the pool.
9. Click **Finish**.
10. Click **OK** when the message box appears.

Figure 35 Adding Servers to the Server Pool



Creating Policies for Service Profile Templates

This section provides information on creating various policies for Service Profile Templates.

Creating Host Firmware Package Policy

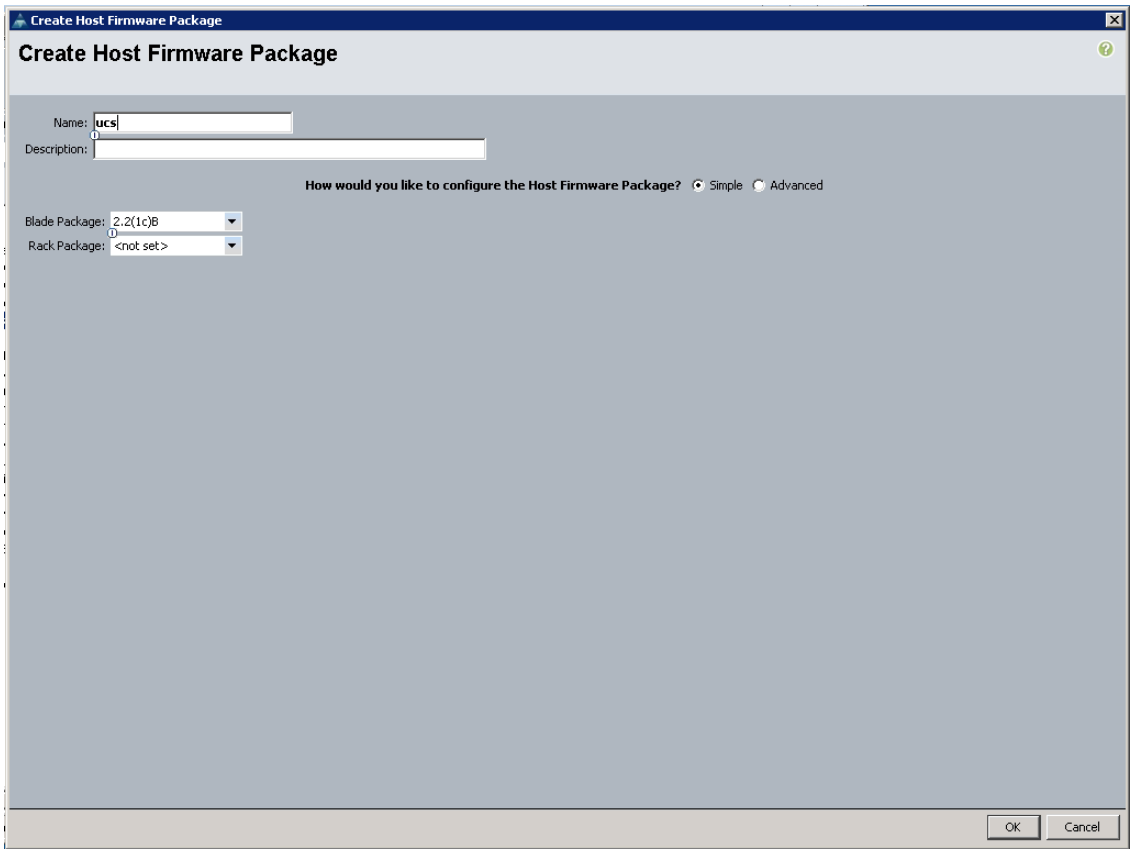
Firmware management policies allow the administrator to choose the corresponding packages for a given server configuration. These include adapters, BIOS, board controllers, FC adapters, HBA options, ROM and storage controller properties as applicable.

Follow these steps to create a firmware management policy for a given server configuration using the Cisco UCS Manager GUI:

1. Choose the **Servers** tab in the left pane in the UCS Manager GUI.
2. Choose **Policies** > **root**.
3. Right-click Host Firmware Packages.
4. Choose **Create Host Firmware Package** option
5. Enter your required Host Firmware package name UCS.
6. Click the **Simple** radio button to configure the Host Firmware package.

7. Choose the appropriate Blade package that you have.
8. Click **OK** to complete creating the management firmware package.
9. Click **OK**.

Figure 36 Creating Host Firmware Package



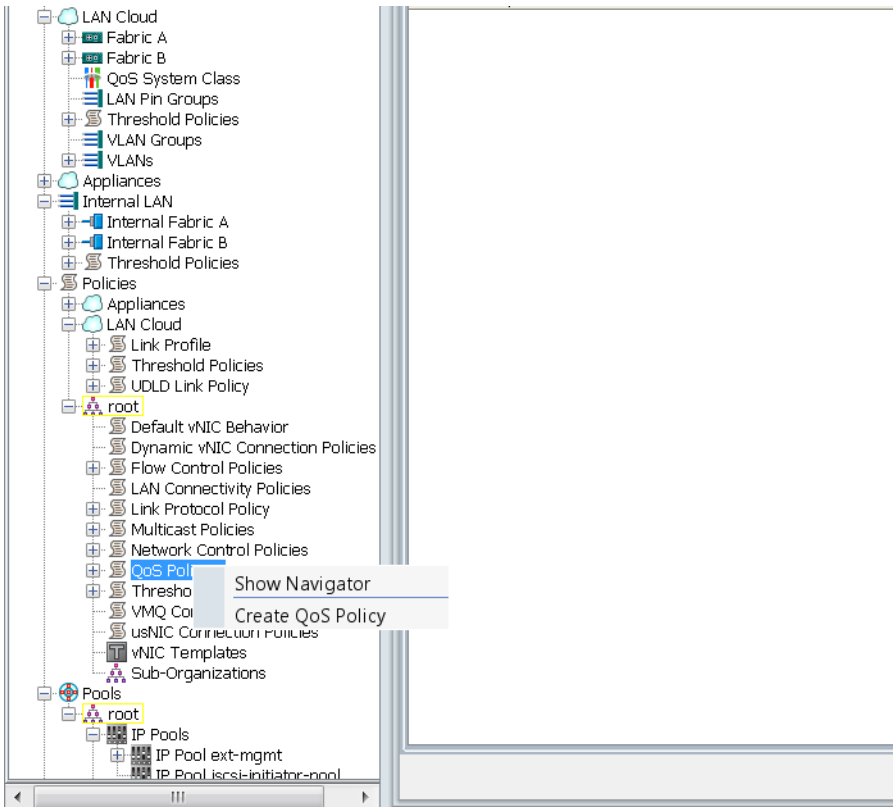
Creating QoS Policies

Follow these steps to create the QoS policy for a given server configuration using the Cisco UCS Manager GUI:

Best Effort Policy

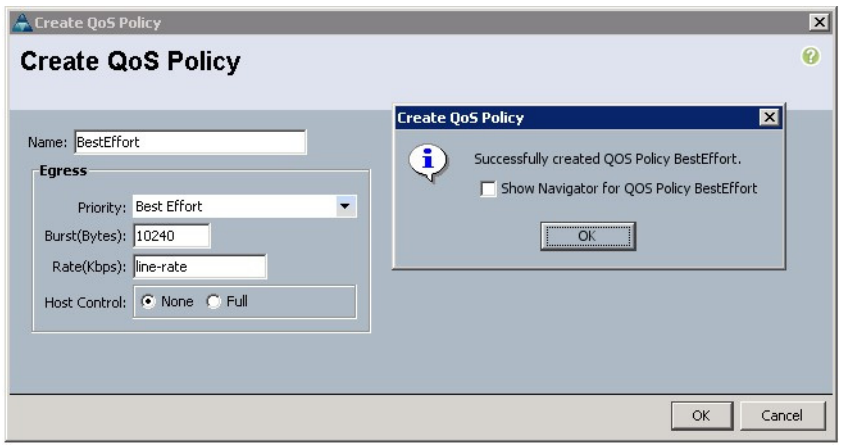
1. Choose the **LAN** tab in the left pane in the UCS Manager GUI.
2. Choose **Policies** > **root**.
3. Right-click **QoS Policies.**
4. Choose **Create QoS Policy.**

Figure 37 Creating QoS Policy



5. Type BestEffort as the name of the policy.
6. Choose **BestEffort** from the drop down menu.
7. Keep the Burst(Bytes) field as default (10240).
8. Keep the Rate(Kbps) field as default (line-rate).
9. Click the **Host Control** radio button as default (none).
10. Once the pop-up window appears, click **OK** to complete the creation of the Policy.

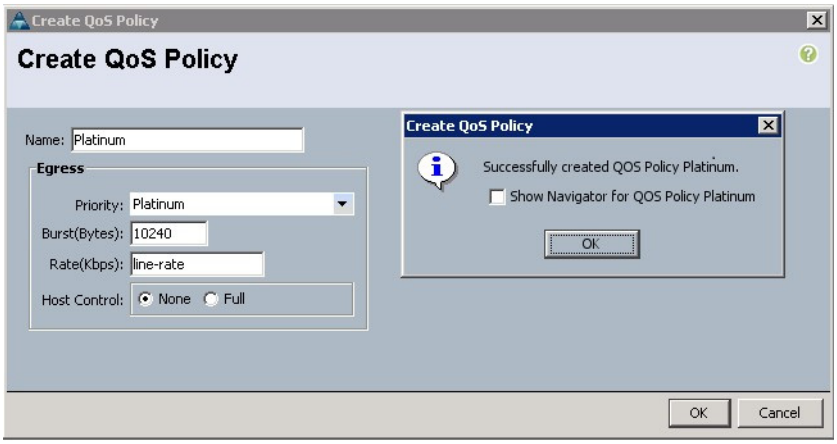
Figure 38 Creating BestEffort QoS Policy



Platinum Policy

1. Choose the **LAN** tab in the left pane in the UCSM GUI.
2. Choose **Policies** > **root**.
3. Right-click **QoS Policies**.
4. Choose **Create QoS Policy**.
5. Type Platinum as the name of the policy.
6. Choose **Platinum** from the drop down menu.
7. Keep the Burst (Bytes) field as default (10240).
8. Keep the Rate (Kbps) field as default (line-rate).
9. Click the **Host Control** radio button as default (none).
10. Once the pop-up window appears, click **OK** to complete the creation of the Policy.

Figure 39 Creating Platinum QoS Policy

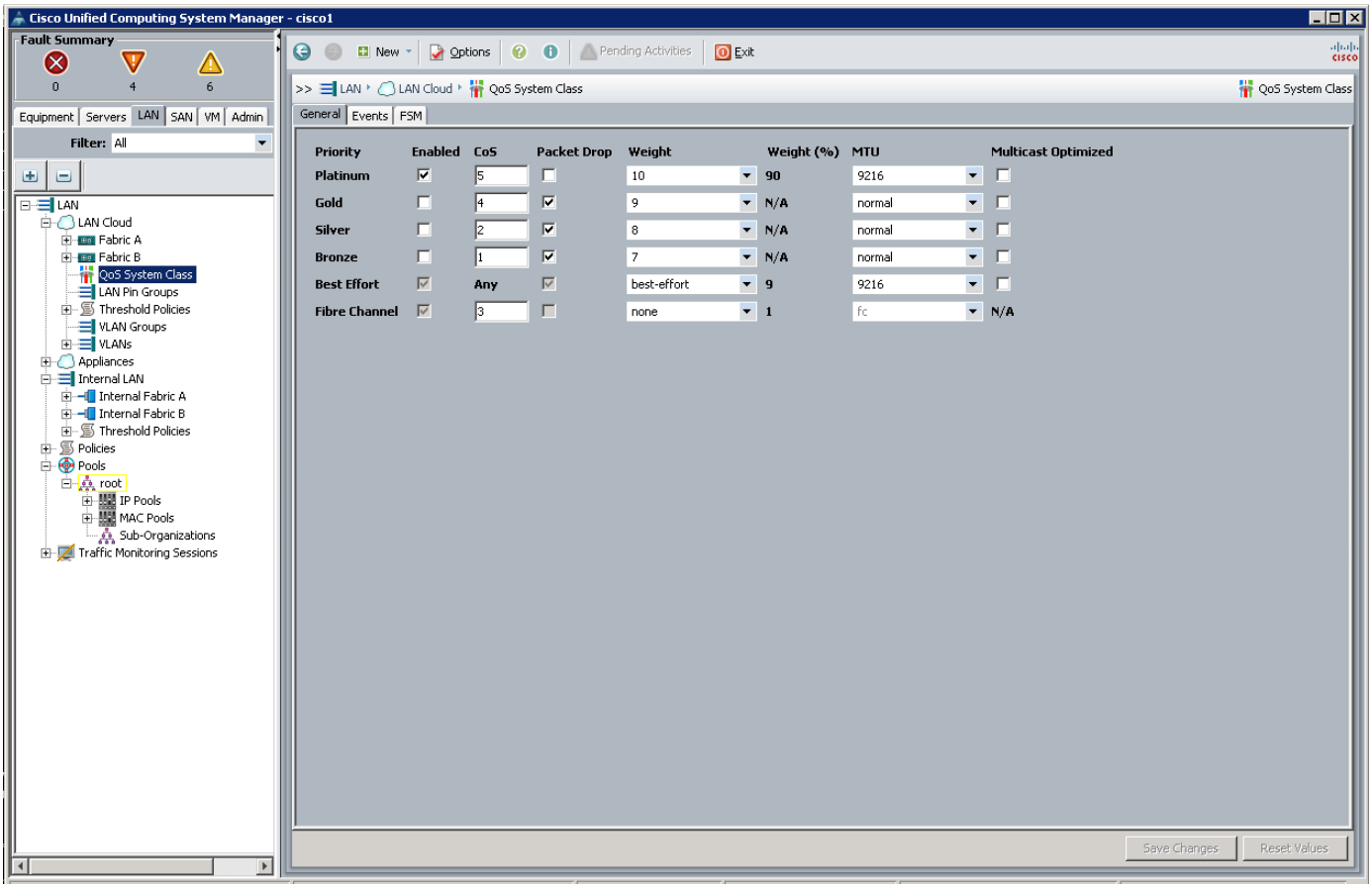


Setting Jumbo Frames

Follow these steps for setting Jumbo frames and enabling QoS:

1. Choose the **LAN** tab in the left pane in the UCSM GUI.
2. Choose **LAN Cloud** and choose **QoS** tab in the right pane of the UCSM GUI.
3. In the **Platinum** row, enter 9216 for MTU.
4. Check the **Enabled** option next to Platinum.
5. In the Best Effort row, choose best-effort for weight, and enter 9216 for MTU.
6. In the Fiber Channel row, choose **none** for weight.
7. Click **Save Changes**.
8. Click **OK**.

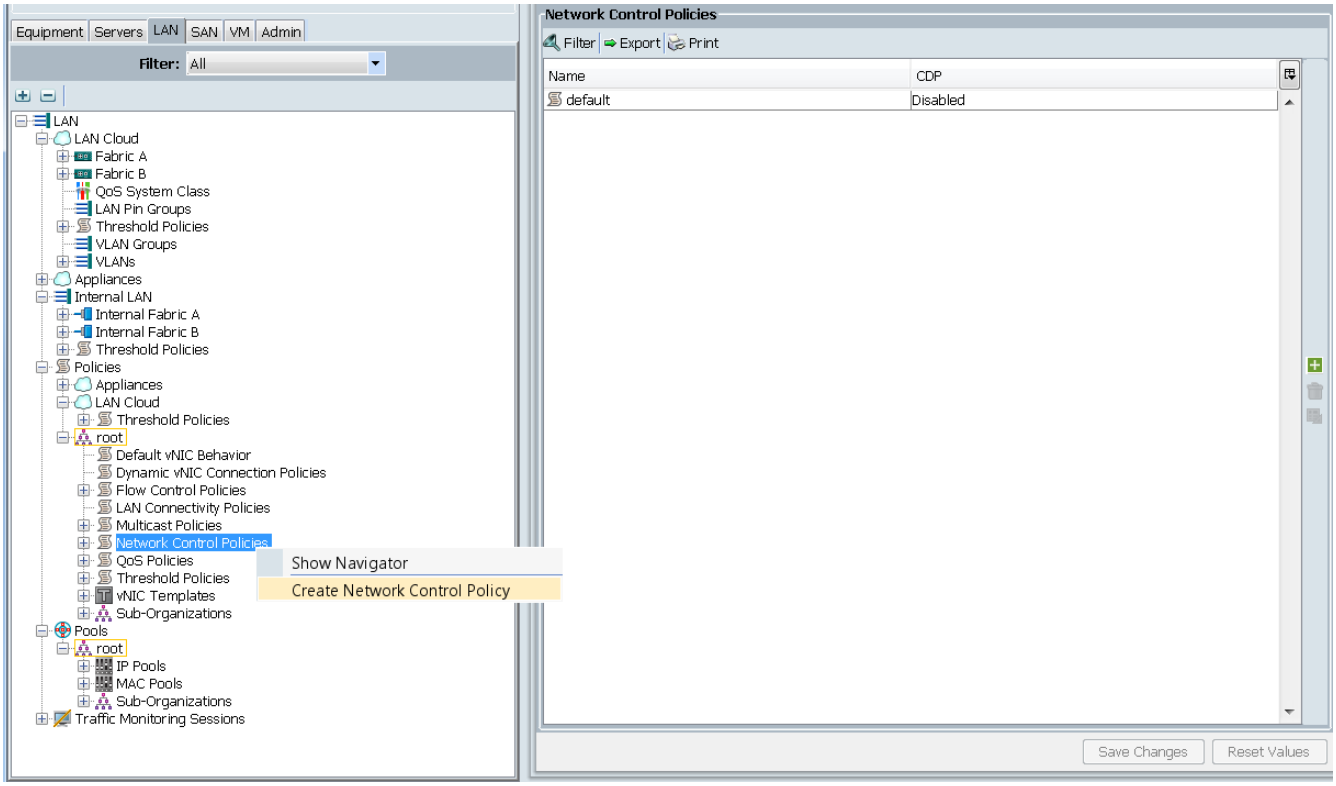
Figure 40 Setting Jumbo Frames



Creating Network Control Policy for Enabling Cisco Discovery Protocol

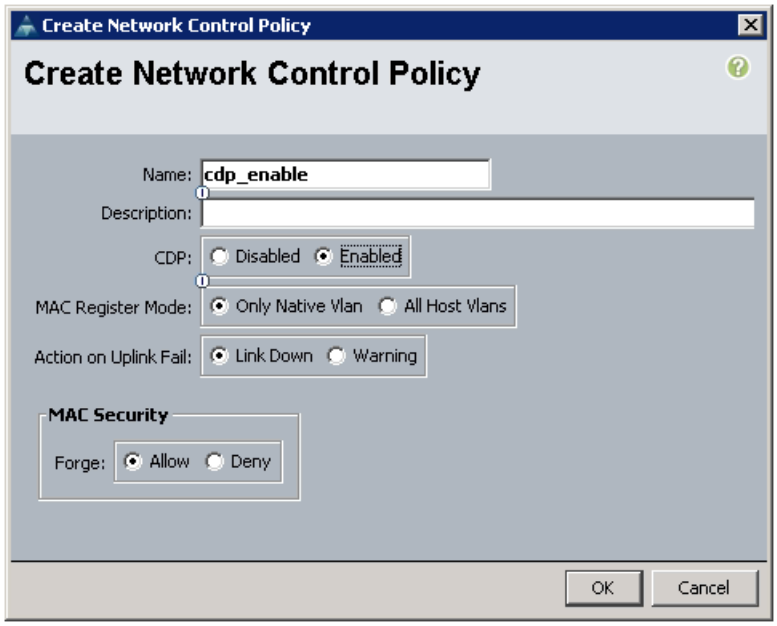
1. Choose the **LAN** tab in the left pane in the UCS Manager GUI.
2. Choose **Policies** > **root**.
3. Right-click **Network Control Policies**.
4. Choose **Create Network Control Policy**.

Figure 41 Creating Network Control Policy to Enable CDP in ESXi vSwitches



5. In the dialog box, enter the name cdp_enable as the name of the policy.
6. On **CDP** field, Click **Enabled** option to enable CDP.
7. Click **OK** to finish creating the Network Control Policy.

Figure 42 Network Control Policy creation with CDP enabled.

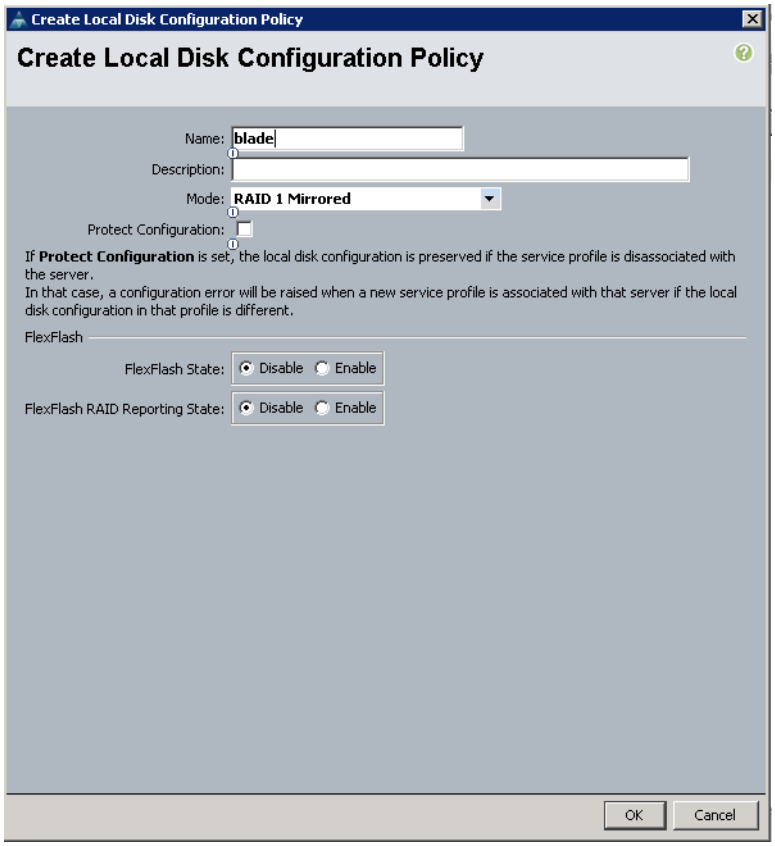


Creating Local Disk Configuration Policy

Follow these steps to create local disk configuration in the Cisco UCS Manager GUI:

1. Choose the **Servers** tab on the left pane in the UCS Manager GUI.
2. Go to **Policies** > **root**.
3. Right-click **Local Disk Config Policies**.
4. Choose **Create Local Disk Configuration Policy**.
5. Enter blade as the local disk configuration policy name.
6. Change the Mode to RAID 1 Mirrored. Uncheck the Protect Configuration box.
7. Keep the FlexFlash State field as default (Disable).
8. Keep the FlexFlash RAID Reporting State field as default (Disable).
9. Click **OK** to complete the creation of the **Local Disk Configuration Policy**.
10. Click **OK**.

Figure 43 Configuring Local Disk Policy



Creating Server BIOS Policy

The BIOS policy feature in Cisco UCS automates the BIOS configuration process. The traditional method of setting the BIOS is done manually and is often error-prone. By creating a BIOS policy and assigning the policy to a server or group of servers, you can enable transparency within the BIOS settings configuration.

Note BIOS settings can have a significant performance impact, depending on the workload and the applications. The BIOS settings listed in this section is for configurations optimized for best performance which can be adjusted based on the application, performance and energy efficiency requirements.

Follow these steps to create a server BIOS policy using the Cisco UCS Manager GUI:

1. Choose the **Servers** tab in the left pane in the UCS Manager GUI.
2. Choose **Policies** > **root**.
3. Right-click **BIOS Policies**.
4. Choose Create BIOS Policy.
5. Type the preferred BIOS policy name (ucs).
6. Change the BIOS settings as show in the below images.

Figure 44 Creating Server BIOS Policy

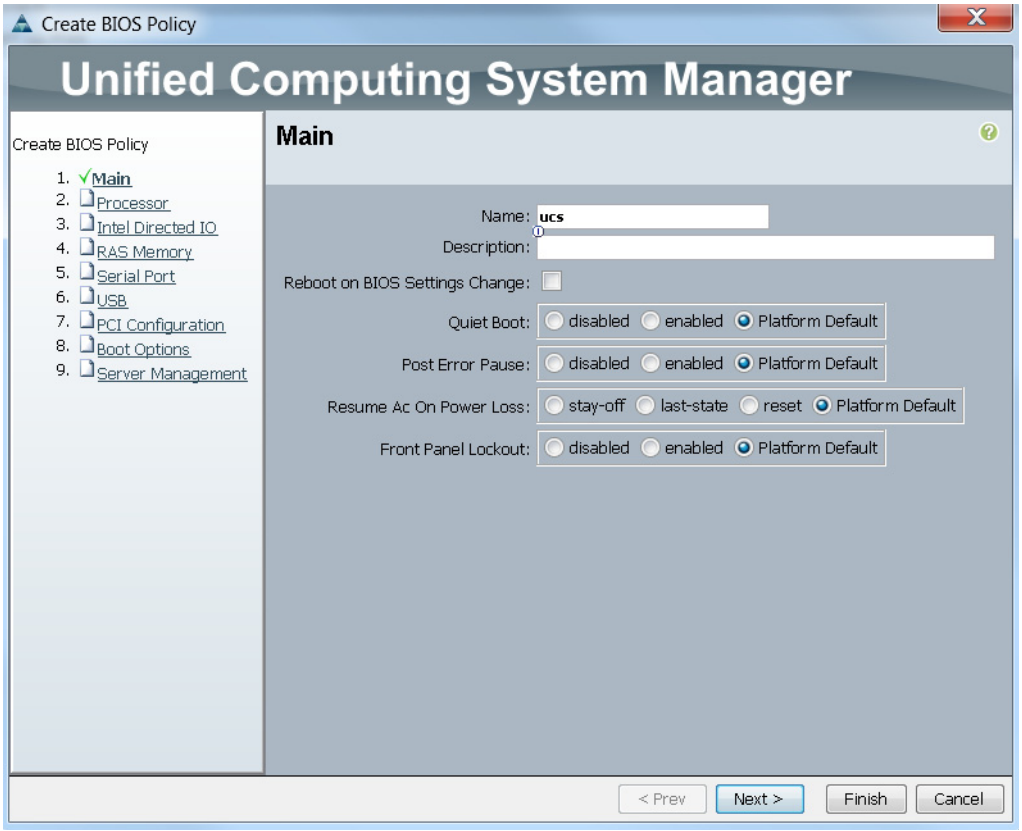


Figure 45 Creating Server BIOS Policy for Processor

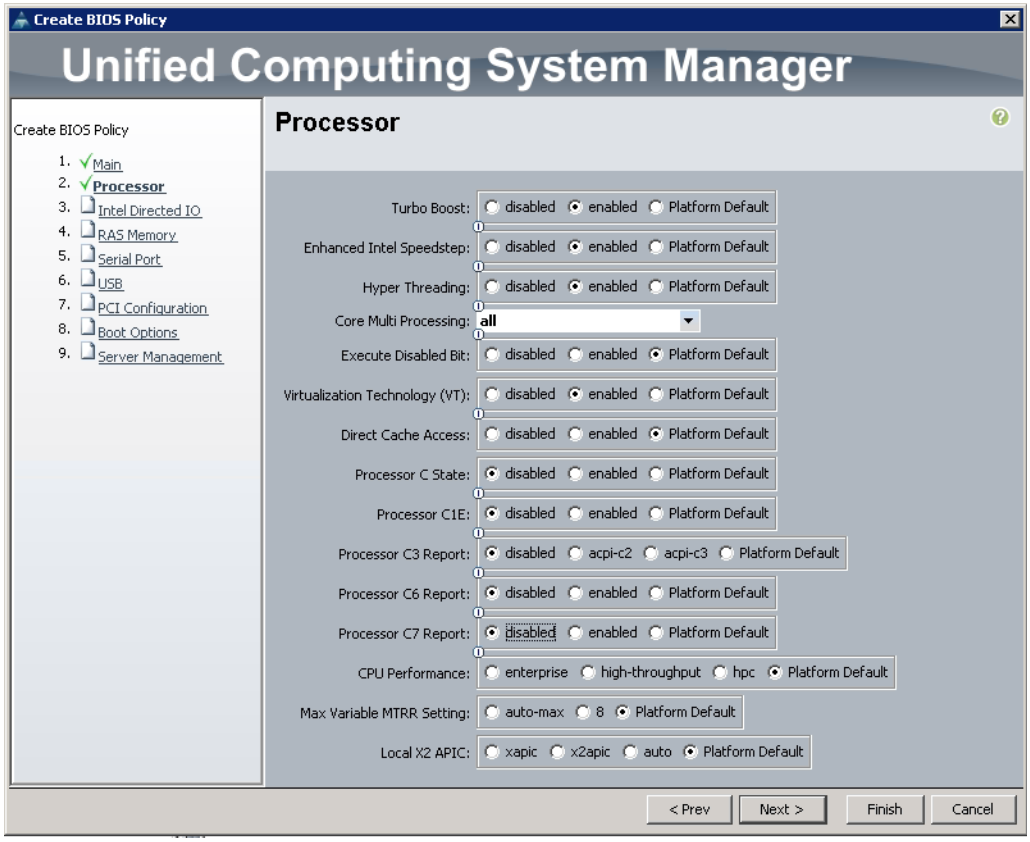


Figure 46 Creating Server BIOS Policy for Intel Directed IO

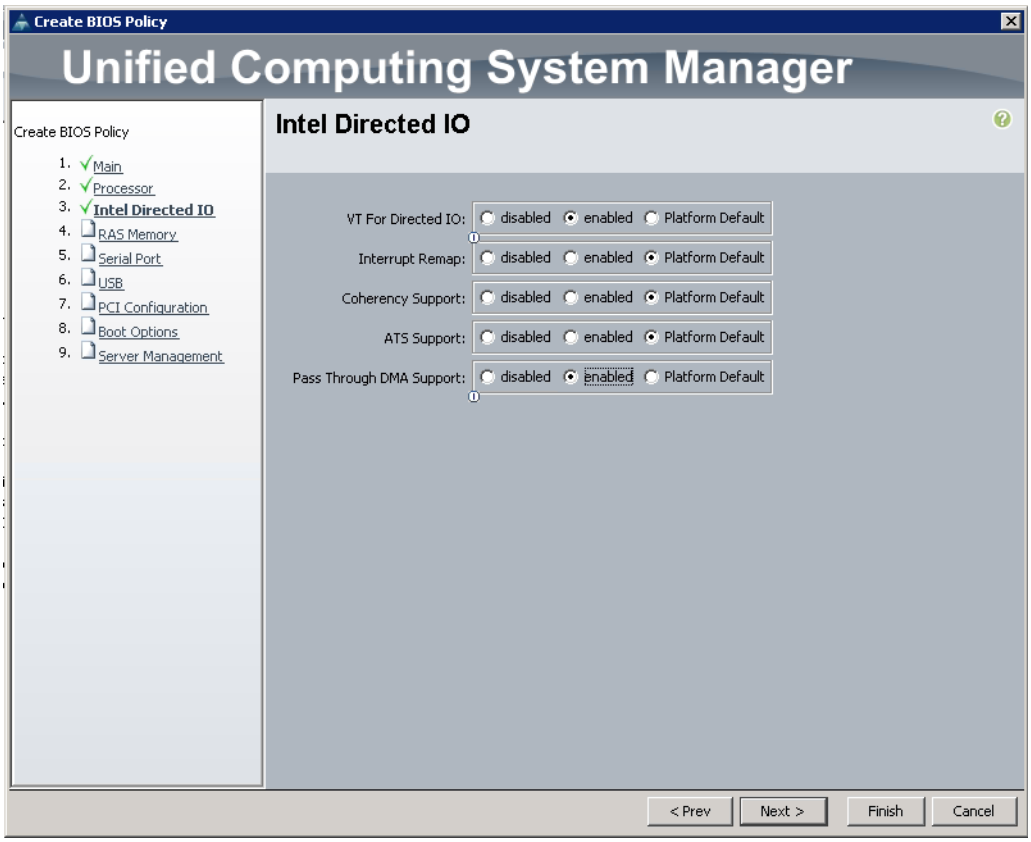
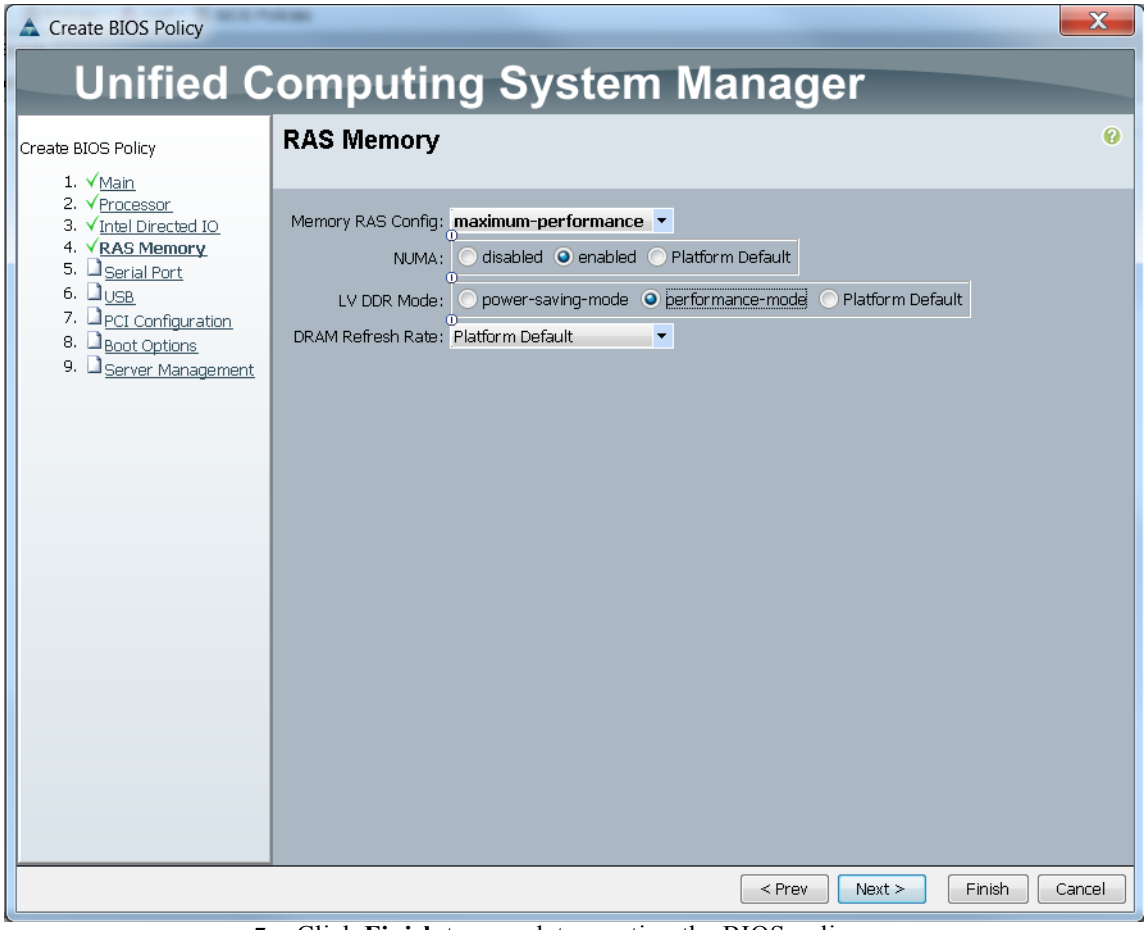


Figure 47 Creating Server BIOS Policy for Memory



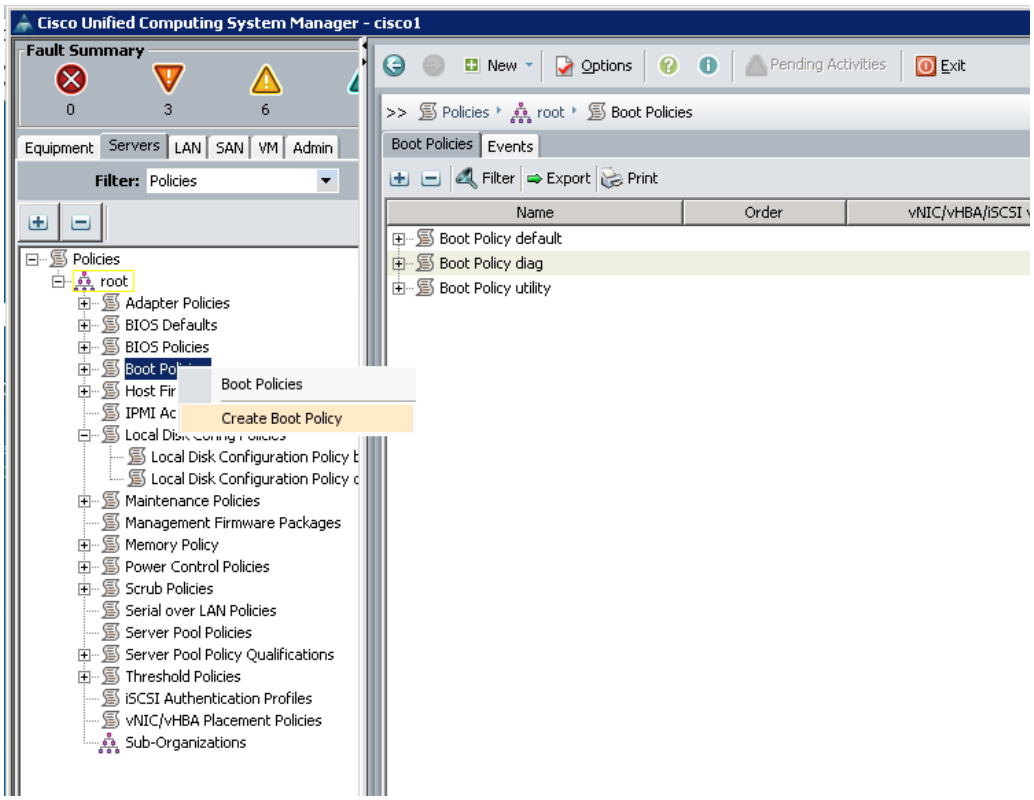
7. Click **Finish** to complete creating the BIOS policy.
8. Click **OK**.

Creating Boot Policy

Follow these steps to create boot policies within the Cisco UCS Manager GUI:

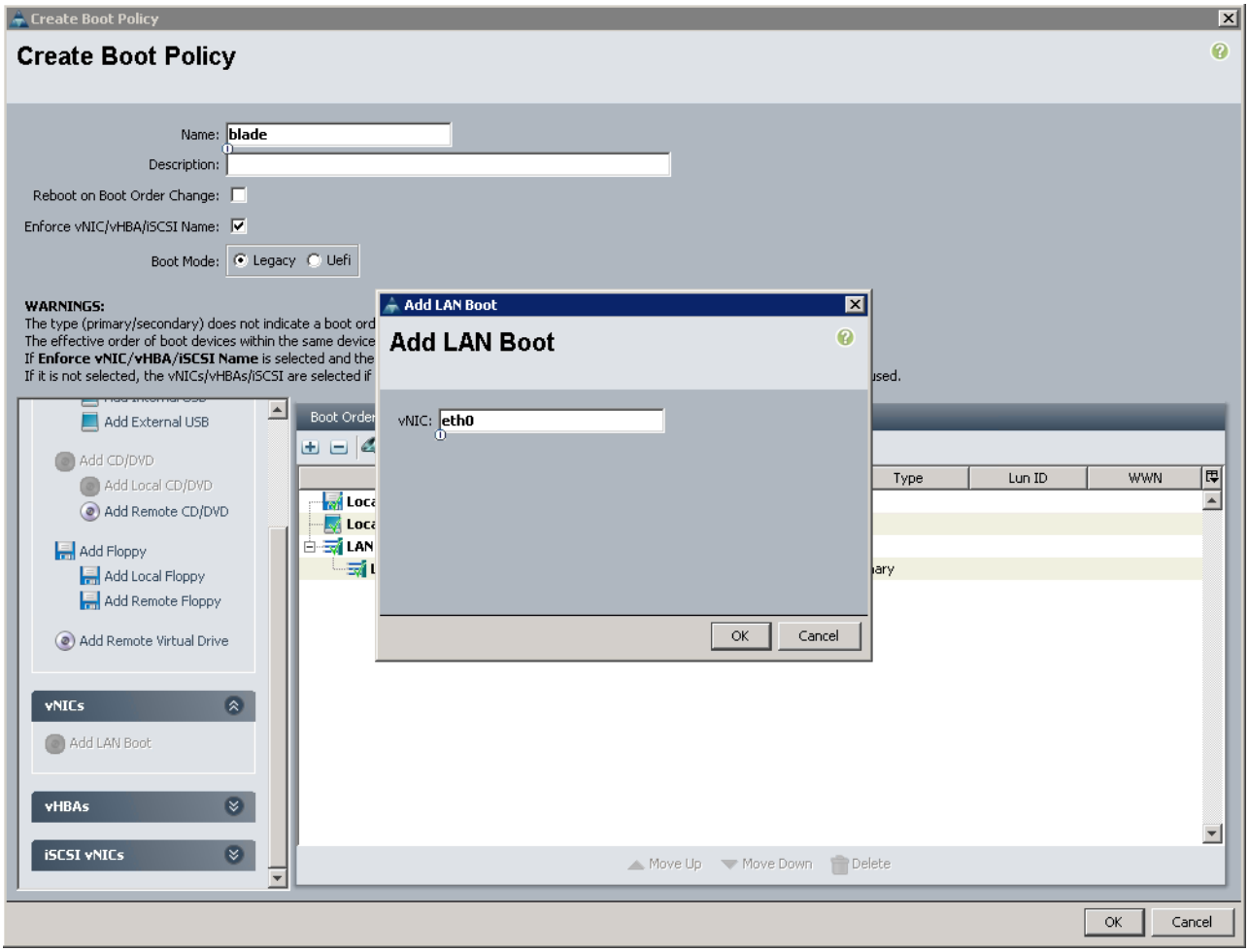
1. Choose the **Servers** tab in the left pane in the UCS Manager GUI.
2. Choose **Policies** > **root**.
3. Right-click the **Boot Policies**.
4. Choose **Create Boot Policy**

Figure 48 Creating Boot Policy Part 1



5. Enter blade as the boot policy name.
6. (Optional) enter a description for the boot policy.
7. Keep the **Reboot on Boot Order Change** option unchecked.
8. Keep **Enforce vNIC/vHBA/iSCSI Name** option checked.
9. Keep **Boot Mode Default** (Legacy).
10. Expand Local Devices > Add CD/DVD and choose **Add Local CD/DVD**.
11. Expand Local Devices > Add Local Disk and choose **Add Local LUN**.
12. Expand vNICs and choose Add LAN Boot and enter eth0.
13. Click **OK** to add the Boot Policy.
14. Click **OK**.

Figure 49 Creating Boot Policy Part 2

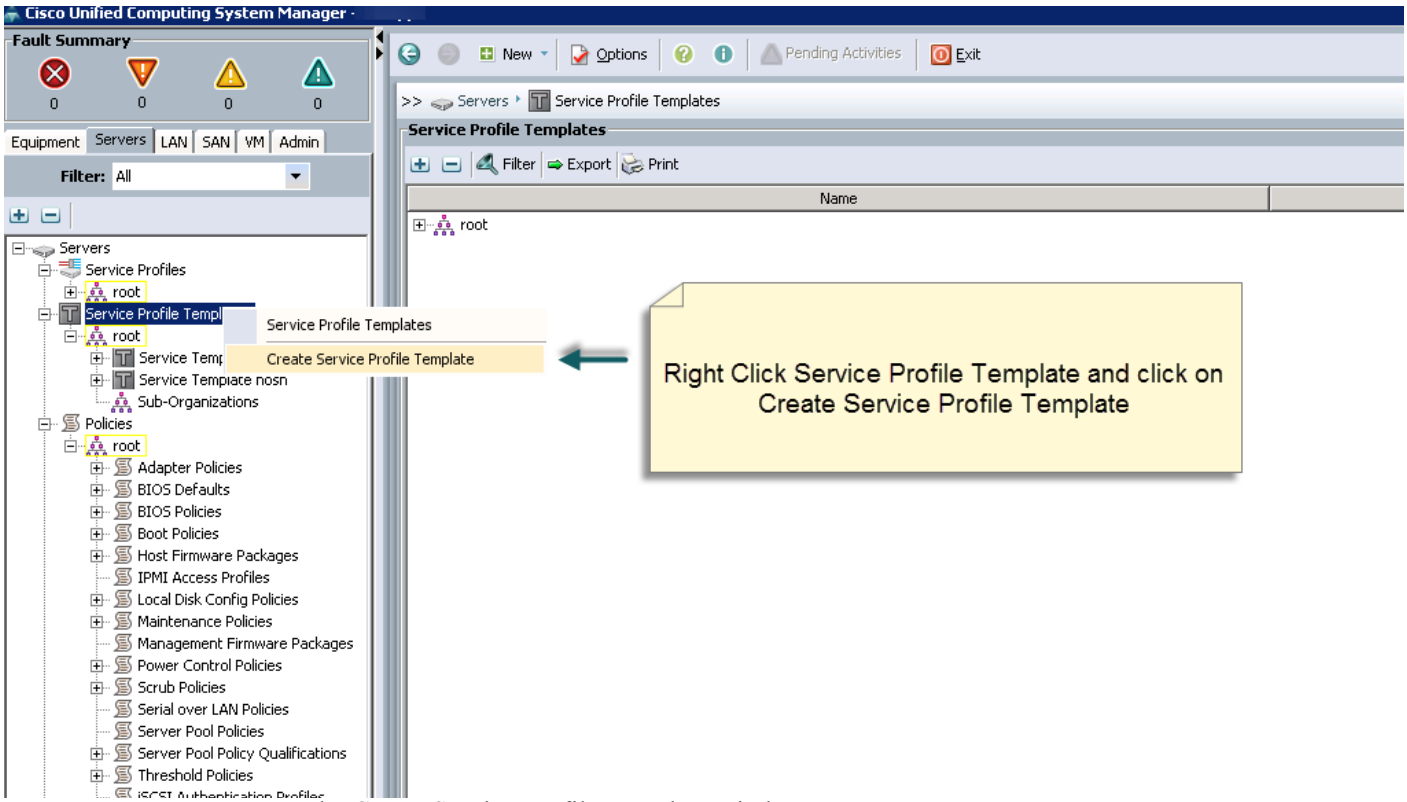


Creating Service Profile Template

To create a service profile template, follow these steps:

1. Choose the **Servers** tab in the left pane in the UCSM GUI.
2. Right-click **Service Profile Templates**.
3. Choose **Create Service Profile Template**.

Figure 50 Creating Service Profile Template

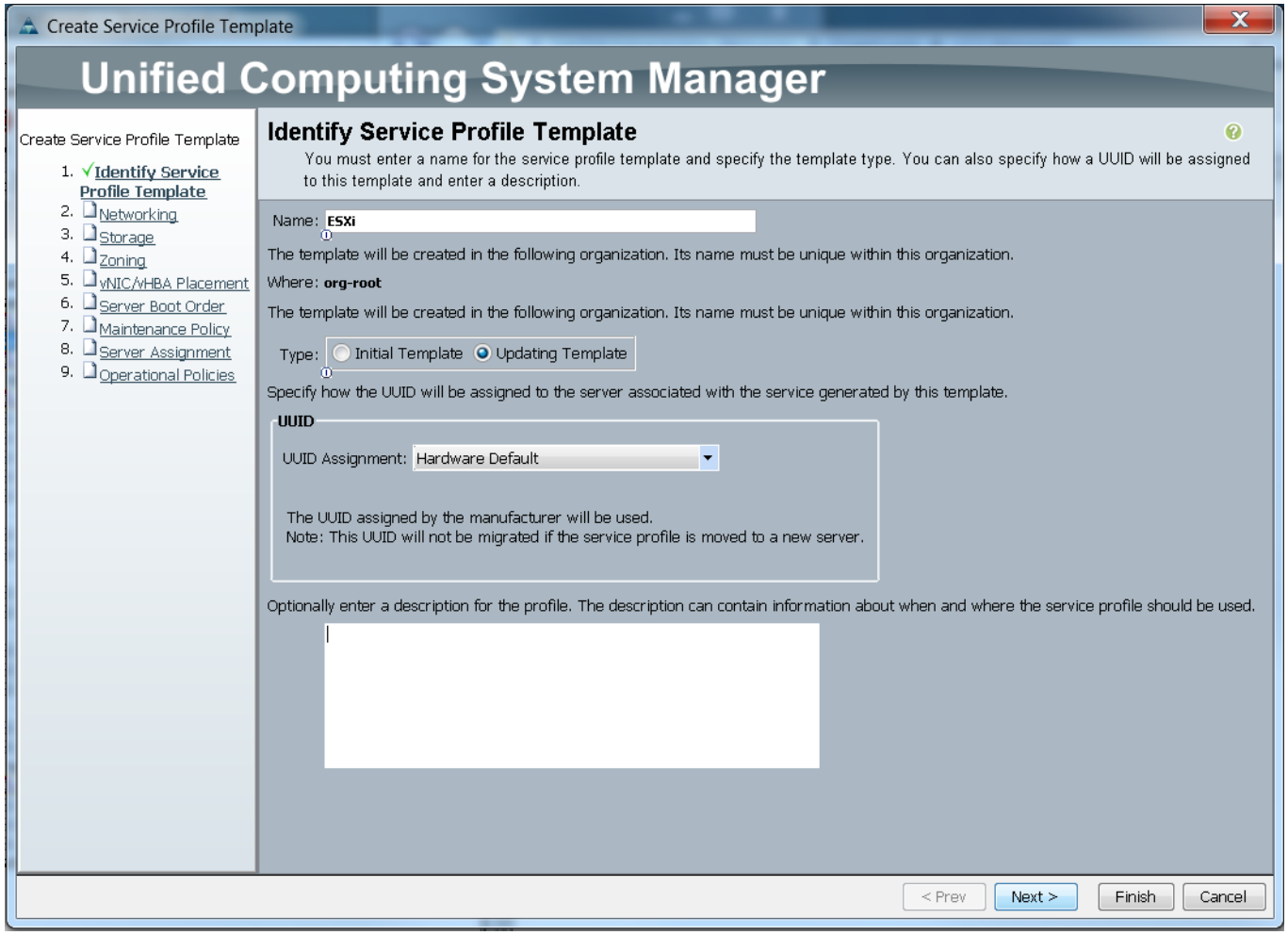


4. The Create Service Profile Template window appears.

These steps below provide a detailed configuration procedure to identify the service profile template:

1. Name the service profile template as **ESXi**. Choose the **Updating Template** option.
2. In the UUID section, choose Hardware Default as the **UUID** pool.
3. Click **Next** to continue.

Figure 51 Identify Service Profile Template



Configuring Network Settings for Template

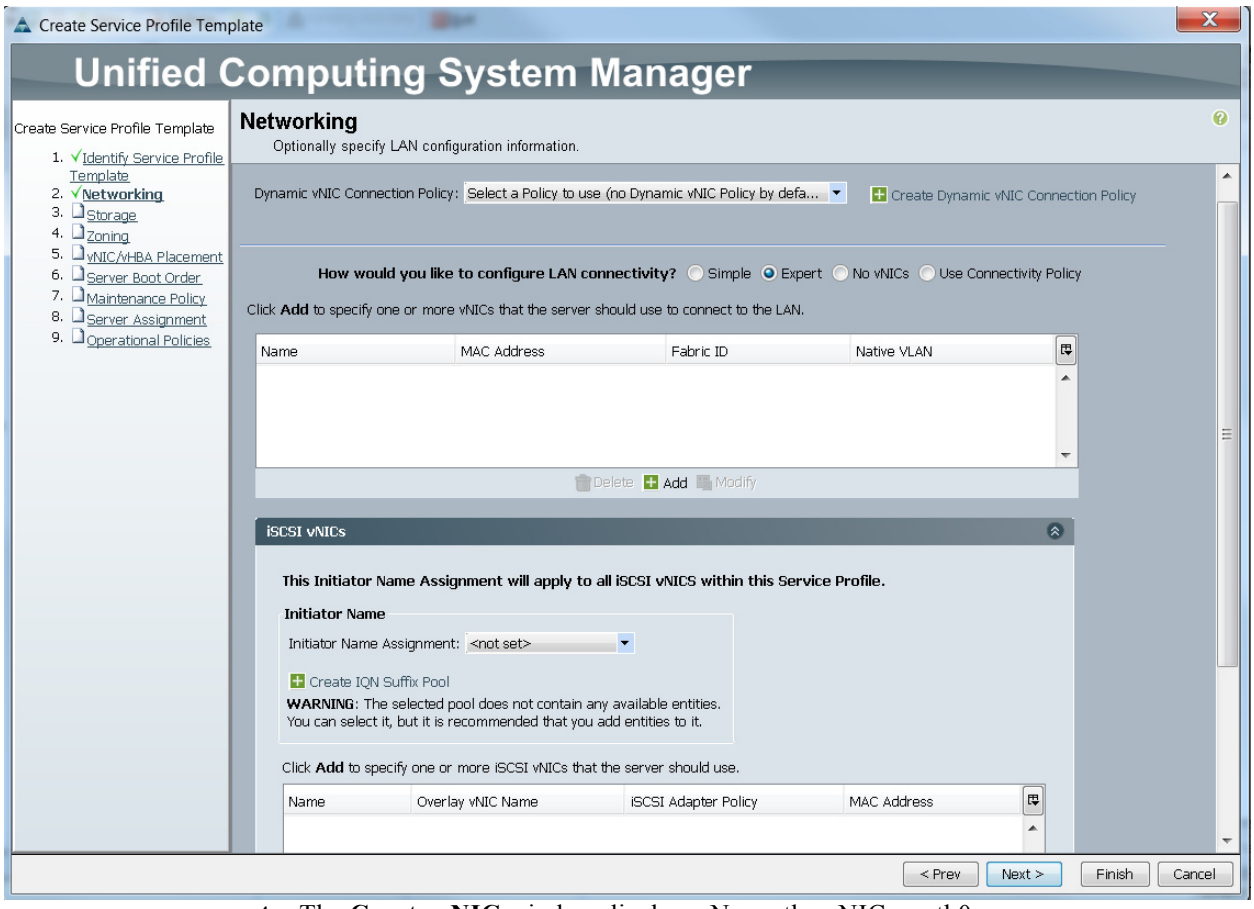
In this solution, we create six vNICs as shown below, with three vNICs on each fabric interconnect. They are created in pairs i.e. eth0 on Fabric A, and eth1 on Fabric-B, and so on. The hardware failover is disabled the failover logic is handled at the vSwitches that would be created in the in the VMware vSphere ESXi hypervisor.

Table 7 vNICs in the Service Profile Template

VLAN	Fabric	NIC Port	Function	Failover
default	A	eth0	Management, User connectivity and Used for the inter-compute node traffic	None
default	B	eth1	Used for the inter-compute node traffic and for Used for the inter-compute node traffic	None
vlan11_data	A	eth2	Network connectivity between the server and the Isilon Cluster	None
vlan11_data	B	eth3	Network connectivity between the server and the Isilon Cluster	None
vlan12_compute	A	eth4	For Map-Reduce traffic between the Server Blades	None
vlan12_compute	B	eth5	For Map-Reduce traffic between the Server Blades	None

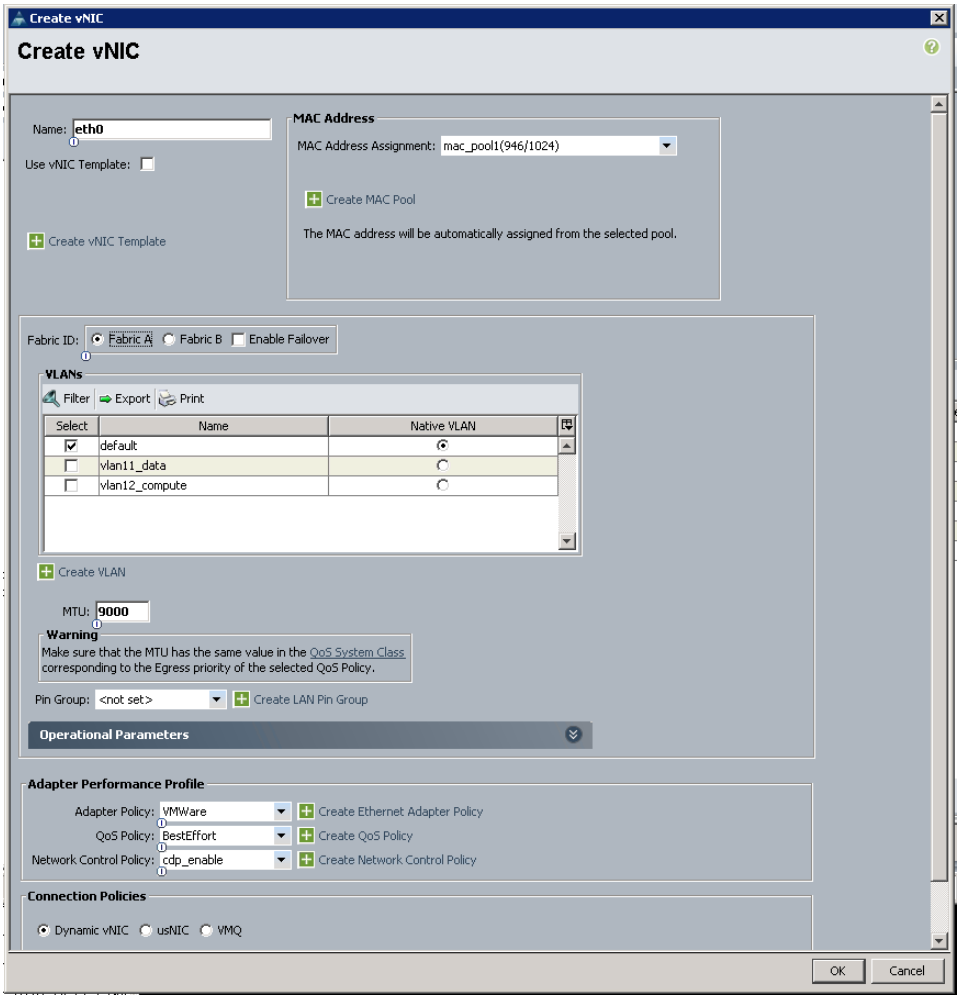
1. Keep the Dynamic vNIC Connection Policy field at the default.
2. Choose **Expert** option for the option how would you like to configure LAN connectivity?
3. Click **Add to add a vNIC** to the template.

Figure 52 Configuring Network Settings for the Template



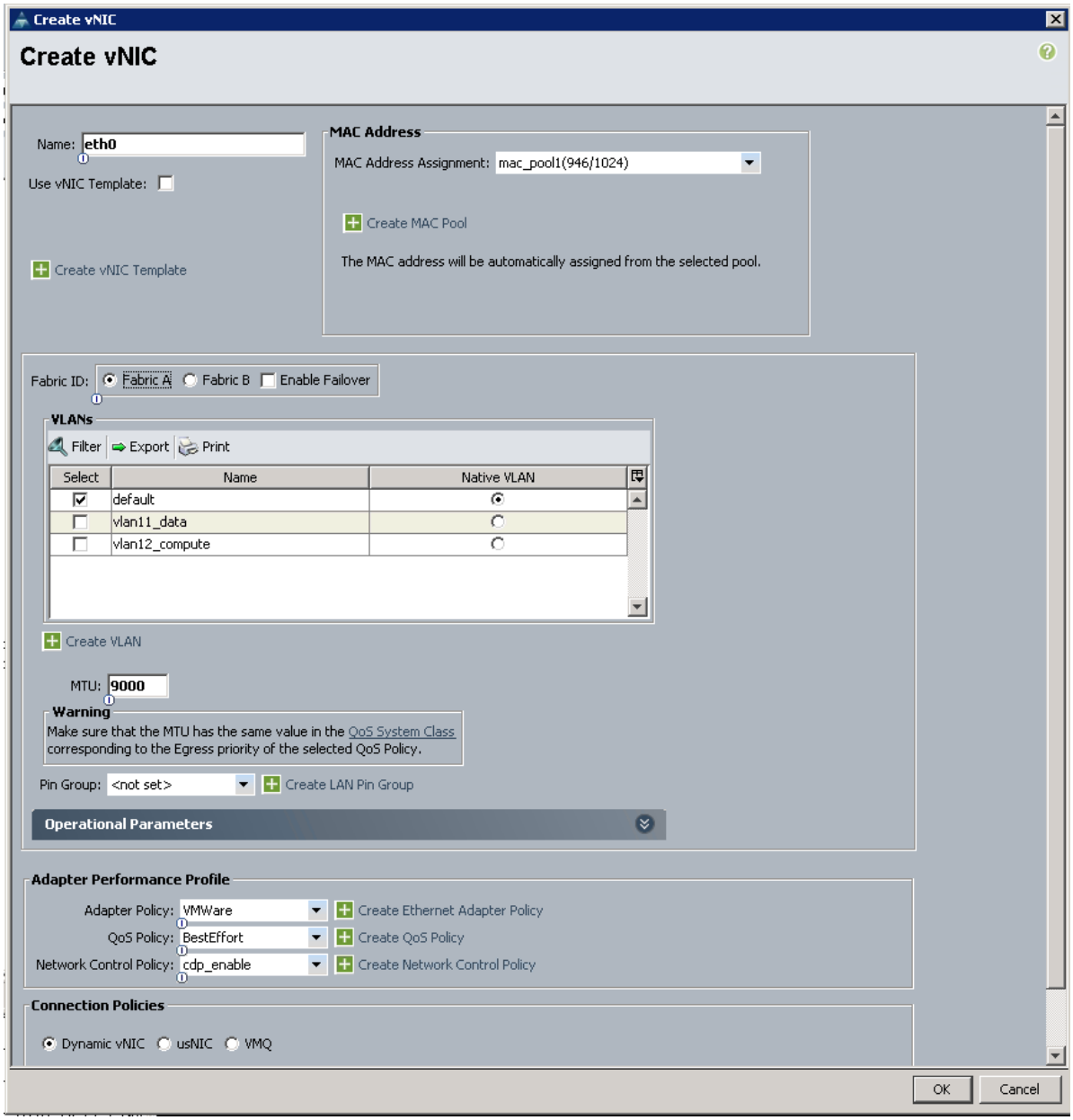
4. The **Create vNIC** window displays. Name the vNIC as eth0.
5. Choose **mac_pool1** in the Mac Address Assignment pool.
6. In the **Fabric ID** field check the Fabric A checkbox to activate the option.
7. Check the default check box for VLANs and choose the Native VLAN checkbox.
8. Choose MTU size as 9000.
9. Choose adapter policy as VMware.
10. Choose QoS Policy as **BestEffort**.
11. Keep the Network Control Policy as cdp_enable.
12. Keep the Connection Policies as Dynamic vNIC.
13. Keep the Dynamic vNIC Connection Policy as <not set>.
14. Click **OK**.

Figure 53 Configuring vNIC eth0 For Management Traffic on Default VLAN (Fabric A)



15. The **Create vNIC** window appears. Name the vNIC eth1.
16. Choose mac_pool1 in the Mac Address Assignment pool.
17. In the **Fabric ID** field choose the **Fabric B** checkbox.
18. Check the **default** check box for VLANs and choose the **Native VLAN** option.
19. Choose MTU size as **9000.**
20. Choose adapter policy as **VMware.**
21. Choose QoS Policy as **BestEffort**.
22. Keep the Network Control Policy as **cdp_enable**.
23. Keep the Connection Policies as **Dynamic vNIC**.
24. Keep the Dynamic vNIC Connection Policy as **not set.**
25. Click **OK**.

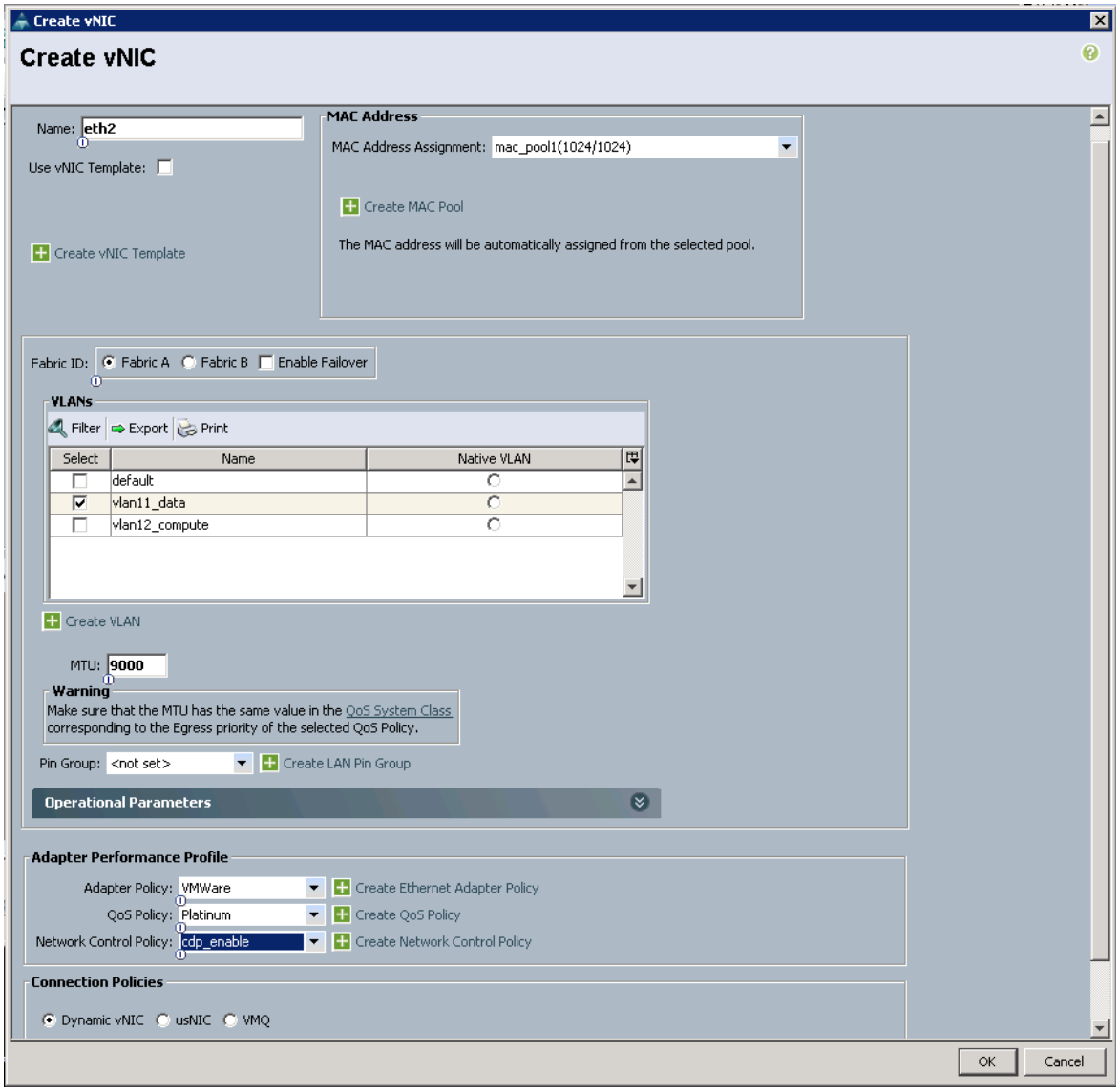
Figure 54 Configuring vNIC eth1 For Management Traffic on Default VLAN (Fabric B)



26. The Create vNIC window appears. Name the vNIC eth2.
27. Choose mac_pool1 in the Mac Address Assignment pool.
28. In the Fabric ID field, click the **Fabric A** radio button.
29. Check the **vlan11_data** check box for VLANs.
30. Choose MTU size as **9000.**
31. Choose Adapter policy as **VMware**.
32. Choose QoS Policy as **Platinum**.
33. Keep the Network Control Policy as **cdp_enable**.
34. Keep the Connection Policies as **Dynamic vNIC**.

35. Keep the Dynamic vNIC Connection Policy as **not set**.
36. Click **OK**.

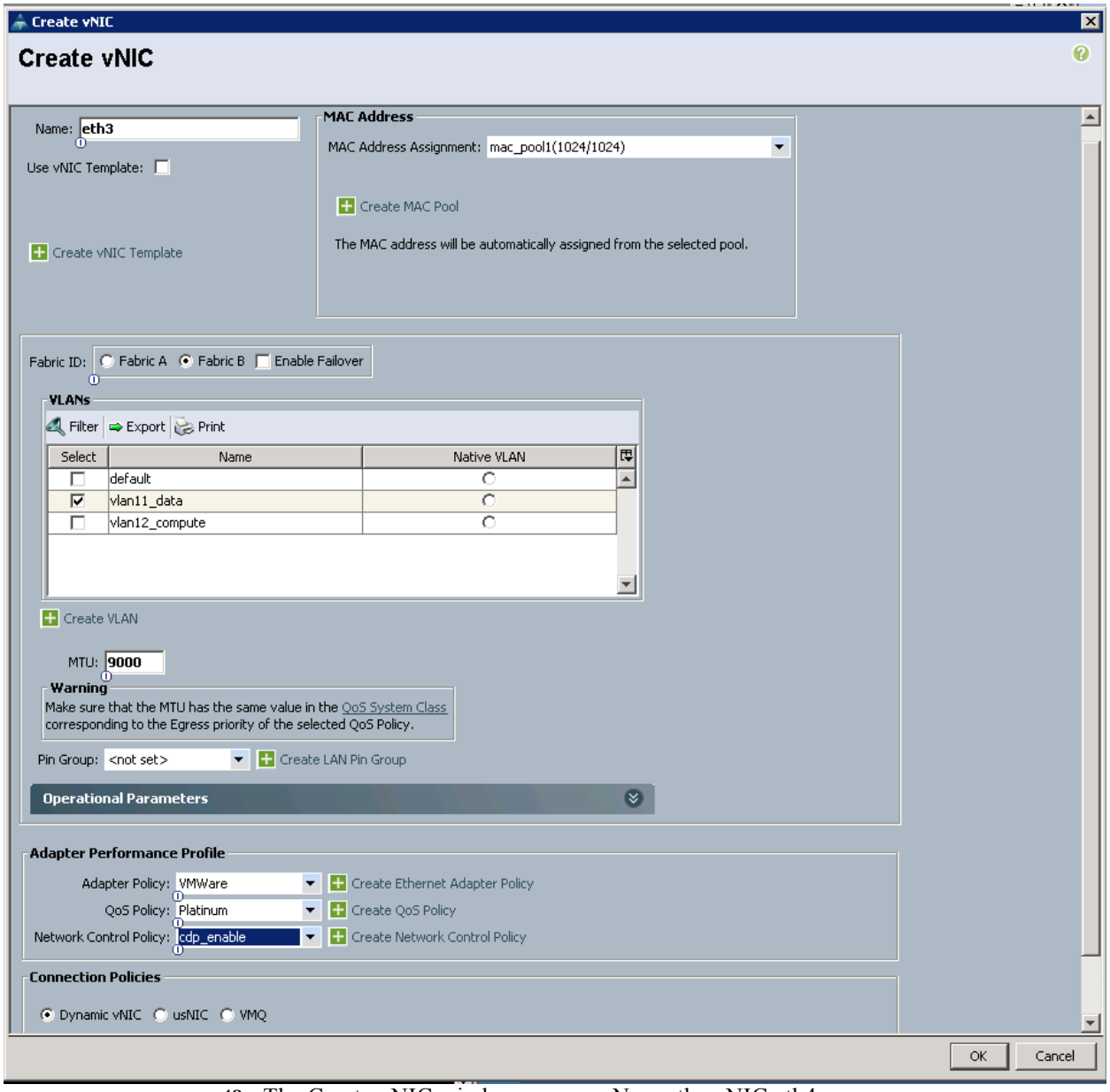
Figure 55 Configuring vNIC eth2 For vlan11_data on Fabric A



37. The Create vNIC window appears. Name the vNIC eth3.
38. Choose mac_pool1 in the Mac Address Assignment pool.
39. In the Fabric ID field click the **Fabric B** radio button.
40. Check the **vlan11_data** check box for VLANs.
41. Choose MTU size as **9000.**
42. Choose Adapter policy as **VMware**.
43. Choose QoS Policy as **Platinum**.
44. Keep the Network Control Policy as **cdp_enable**.

45. Keep the Connection Policies as **Dynamic vNIC**.
46. Keep the Dynamic vNIC Connection Policy as **not set**.
47. Click **OK**.

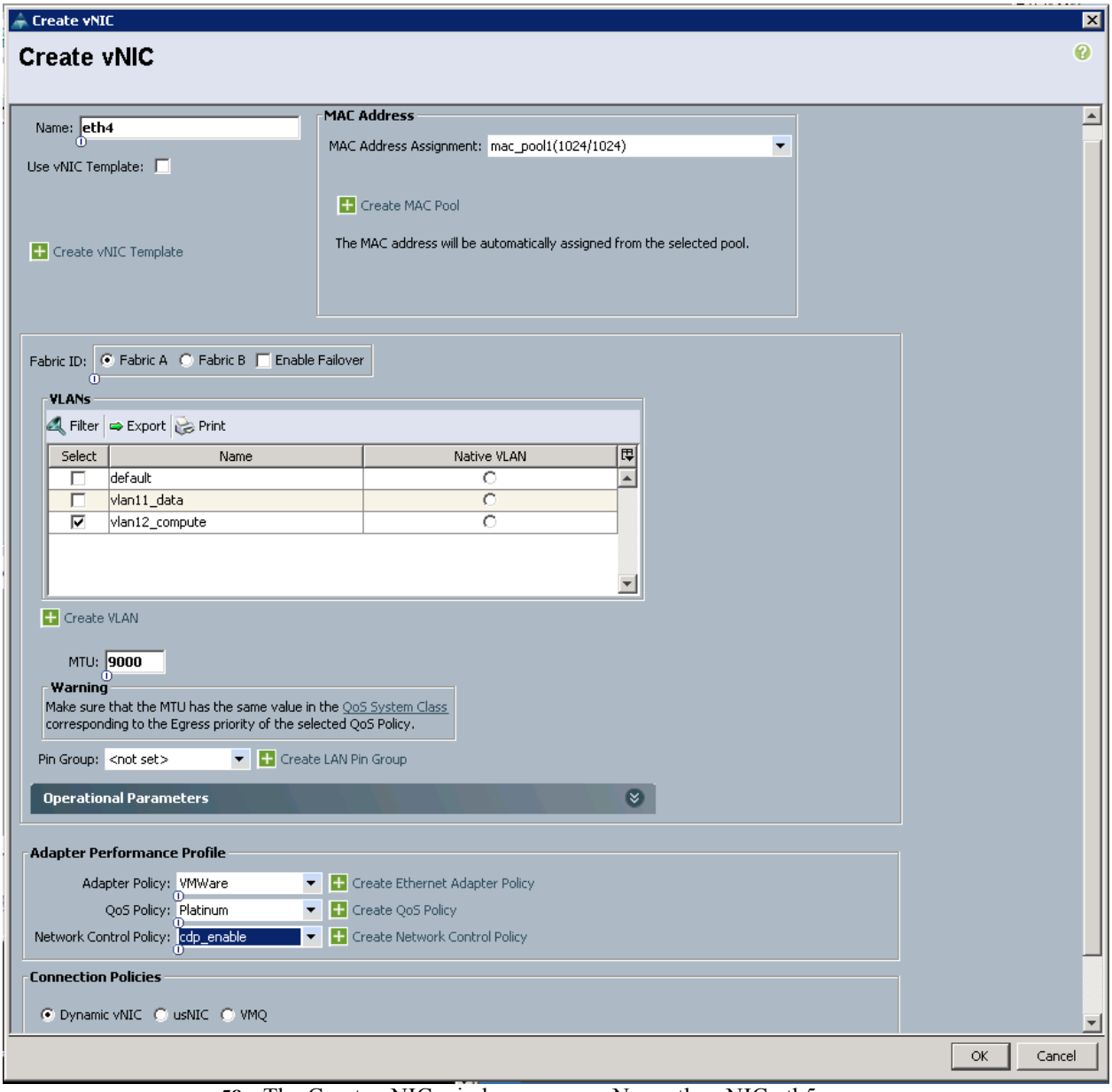
Figure 56 Configuring vNIC eth3 For vlan11_data on Fabric B



48. The Create vNIC window appears. Name the vNIC eth4.
49. Choose mac_pool1 in the Mac Address Assignment pool.
50. In the Fabric ID field click the **Fabric A** radio button.
51. Check the **vlan12_compute** check box for VLANs
52. Choose MTU size as **9000**
53. Choose Adapter policy as **VMware**.

54. Choose QoS Policy as **Platinum**.
55. Keep the Network Control Policy as **cdp_enable**.
56. Keep the Connection Policies as **Dynamic vNIC**.
57. Keep the Dynamic vNIC Connection Policy as **not set**.

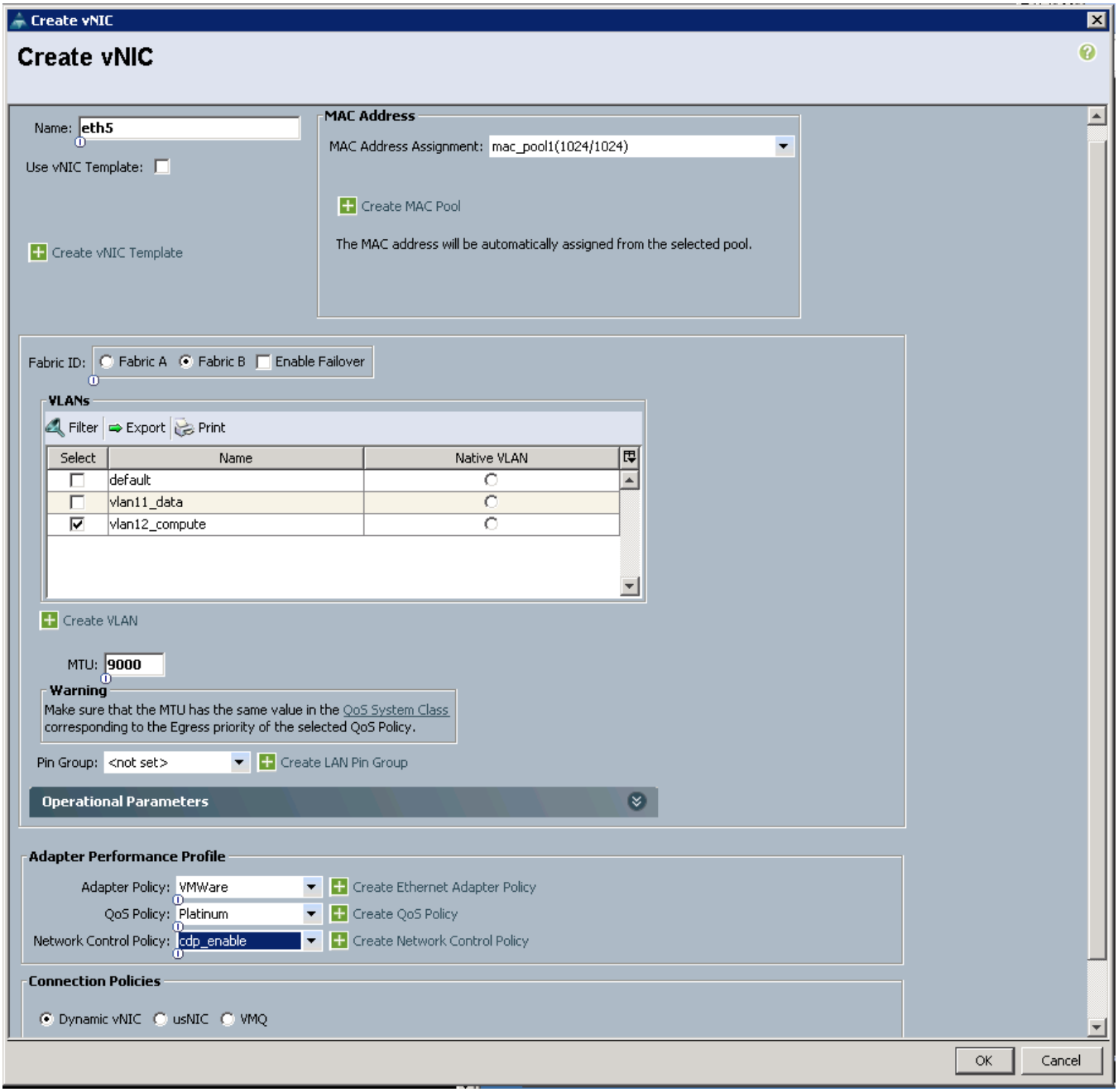
Figure 57 Configuring vNIC eth4 For vlan12_compute on Fabric A



58. The Create vNIC window appears. Name the vNIC eth5.
59. Choose mac_pool1 in the Mac Address Assignment pool.
60. In the Fabric ID field click the **Fabric B** radio button.
61. Check the **vlan12_compute** check box for VLANs.
62. Choose MTU size as **9000.**

63. Choose Adapter policy as **VMware**.
64. Choose QoS Policy as **Platinum**.
65. Keep the Network Control Policy as **cdp_enable.**
66. Keep the Connection Policies as **Dynamic vNIC**.
67. Keep the Dynamic vNIC Connection Policy as <not set>.

Figure 58 Configuring vNIC eth5 for vlan12_compute on Fabric B

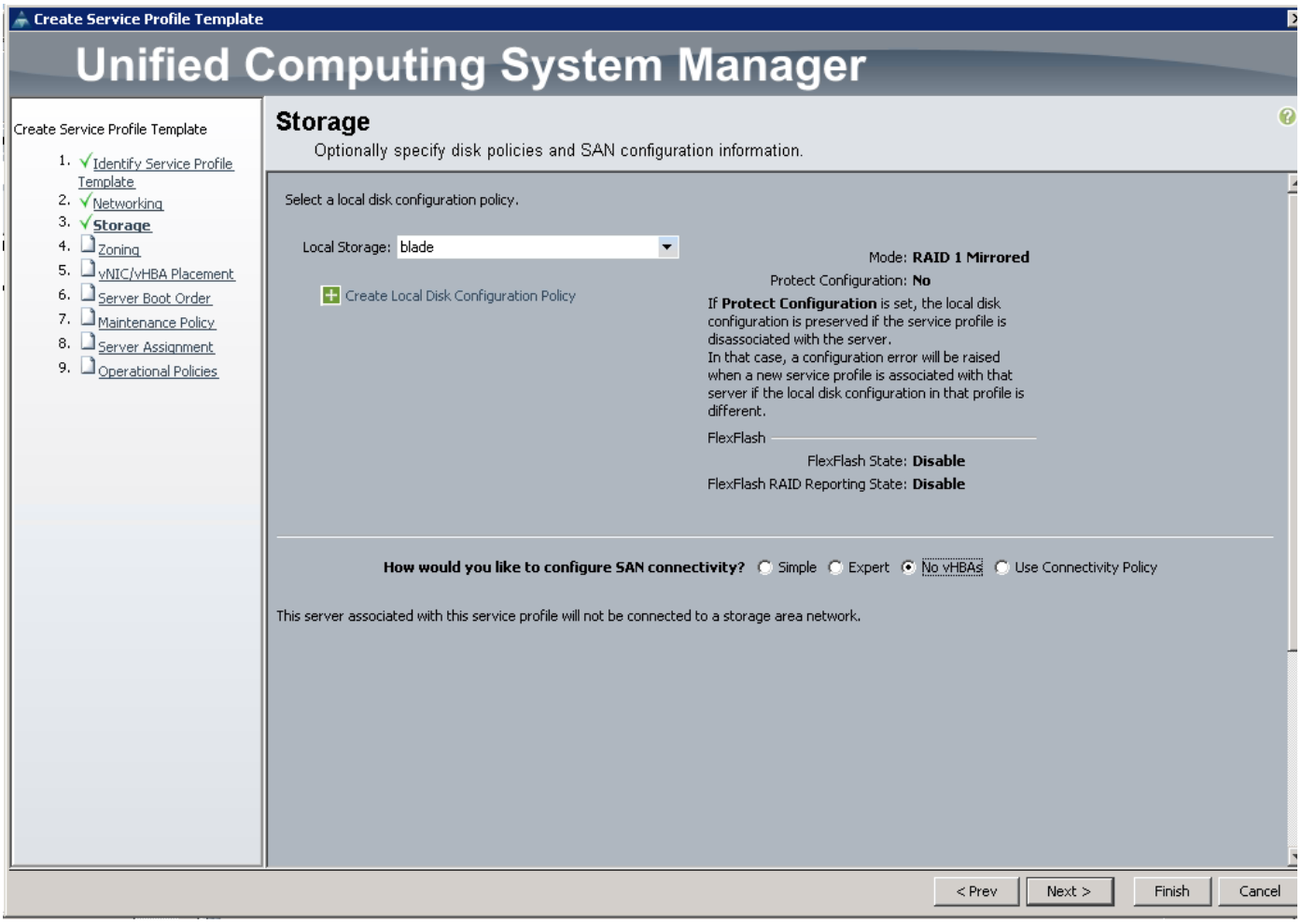


Configuring Storage Policy for Template

Follow these steps to configure storage policies:

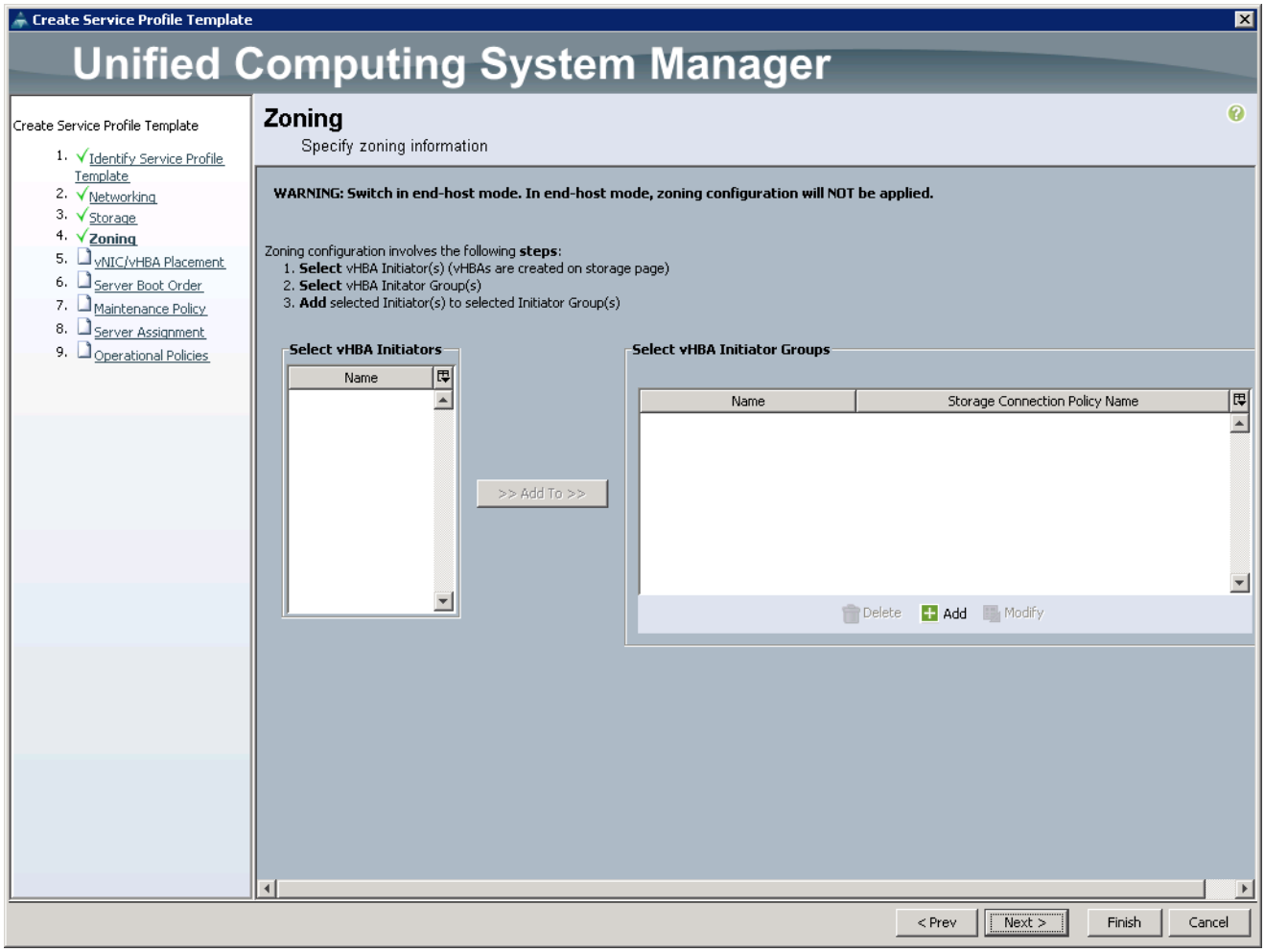
1. Choose **blade** for the local disk configuration policy.
2. Choose the **No vHBAs** option for How would you like to configure SAN connectivity.
3. Click **Next** to continue to the next section.

Figure 59 Configuring Storage



4. Click **Next** once the zoning window appears to go to the next section.

Figure 60 Configure Zoning

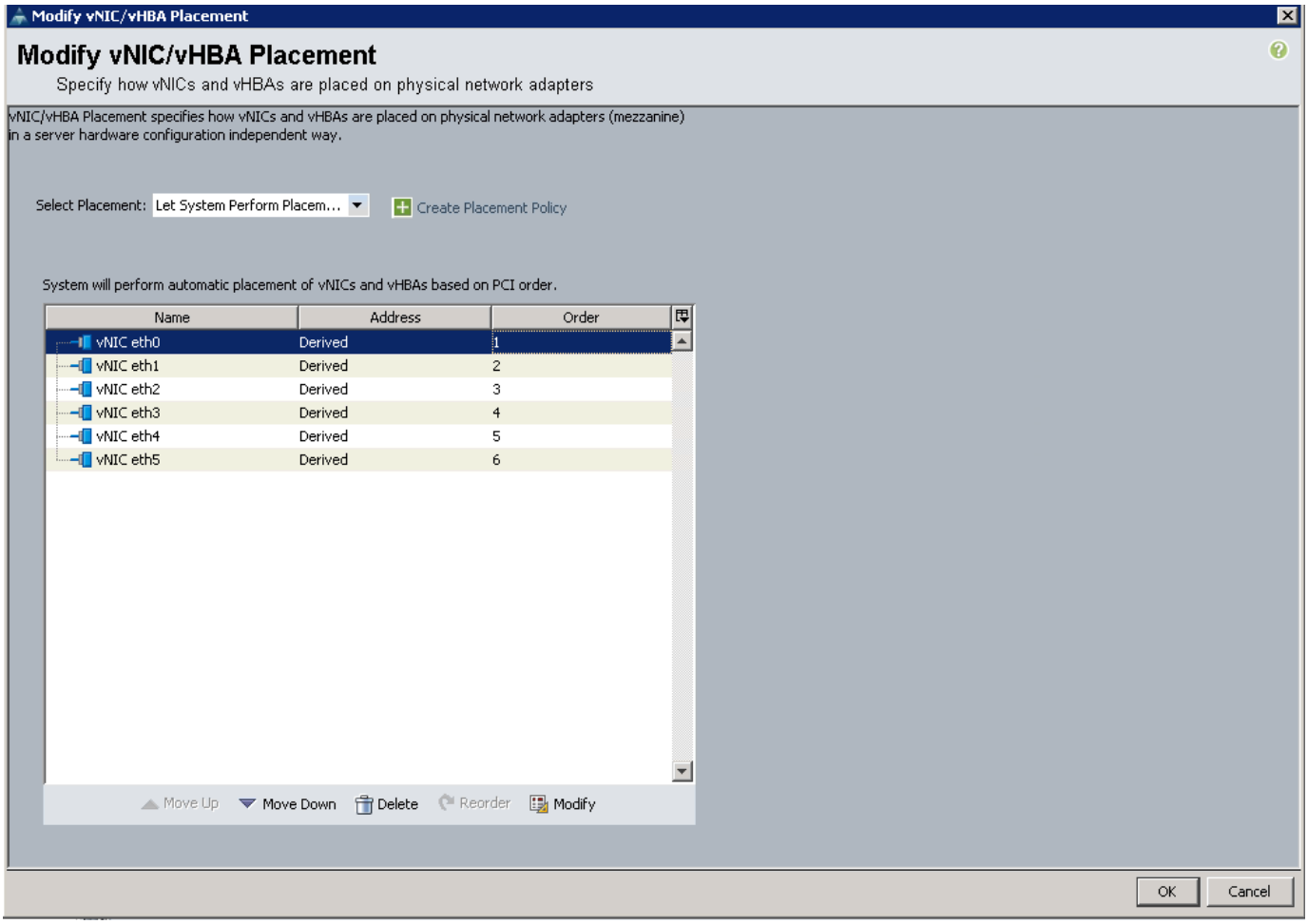


Configuring vNIC/vHBA Placement for Template

Follow these steps to configure vNIC/vHBA placement policy:

1. Choose the **Let System Perform Placement** option for the **Select Placement** field.
2. Choose eth0, eth1, eth2, eth3, eth4 and eth5 assign the vNICs in the following order:
   - eth0
   - eth1
   - eth2
   - eth3
   - eth4
   - eth5
3. Review to make sure that all of the vNICs were assigned in the appropriate order.
4. Click **Next** to continue to the next section.

Figure 61 vNIC/vHBA Placement

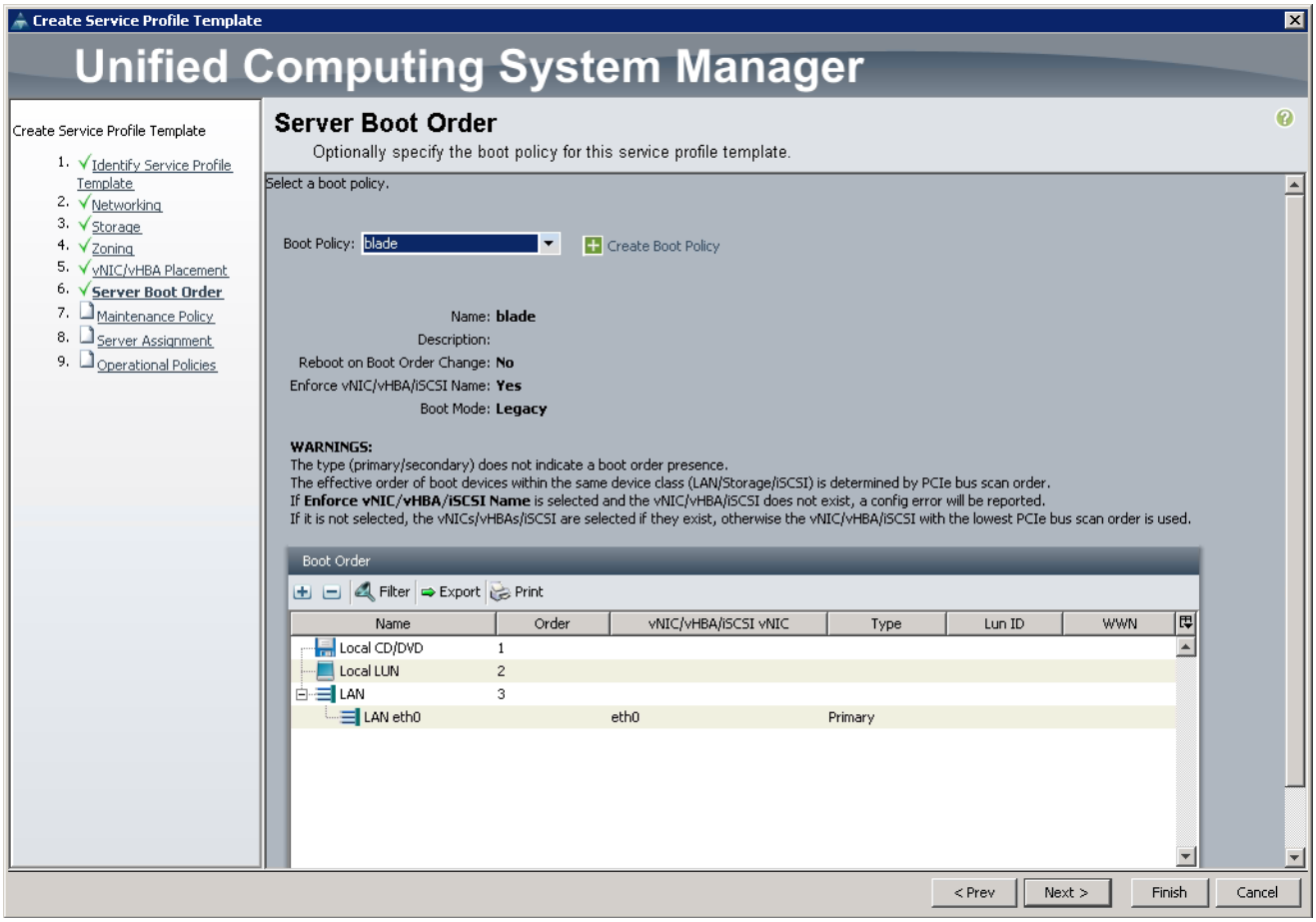


Configuring Server Boot Order for Template

Follow these steps to set the boot order for servers:

1. Choose the blade in the Boot Policy name field.
2. Check the **Enforce vNIC/vHBA/iSCSI Name** check box.
3. Review to make sure that all of the boot devices were created and identified.
4. Verify that the boot devices are in the correct boot sequence.
5. Click **OK**.
6. Click **Next** to continue to the next section.

Figure 62 Creating Boot Policy



In the Maintenance Policy window, follow these steps to apply the maintenance policy:

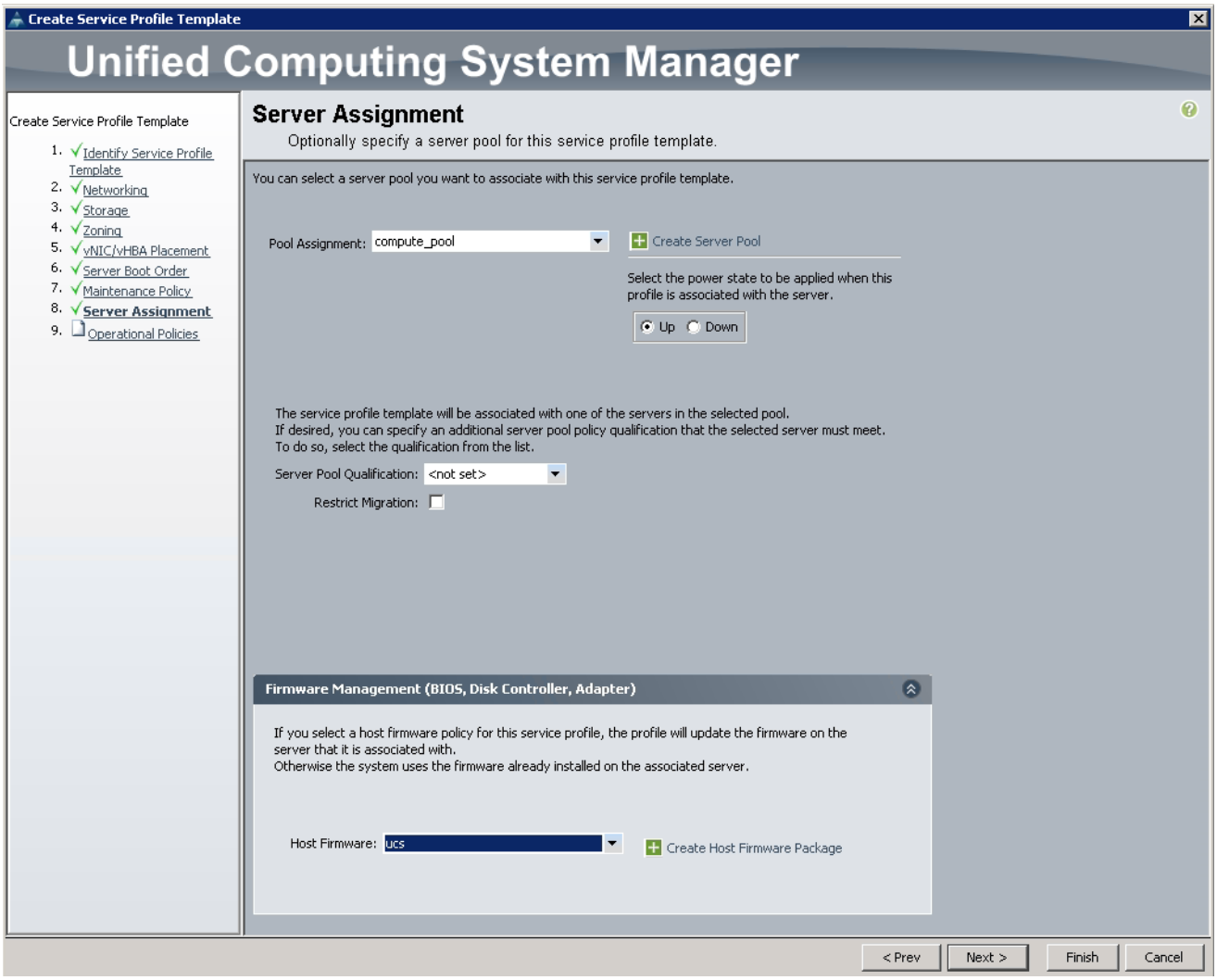
1. Keep the Maintenance policy at no policy used by default.
2. Click **Next** to continue to the next section.

Configuring Server Assignment for Template

In the Server Assignment window, follow these steps to assign the servers to the pool:

1. Choose **compute_pool** for the Pool Assignment field.
2. Keep the Server Pool Qualification field at default not set.
3. Choose ucs in Host Firmware Package.

Figure 63 Server Assignment

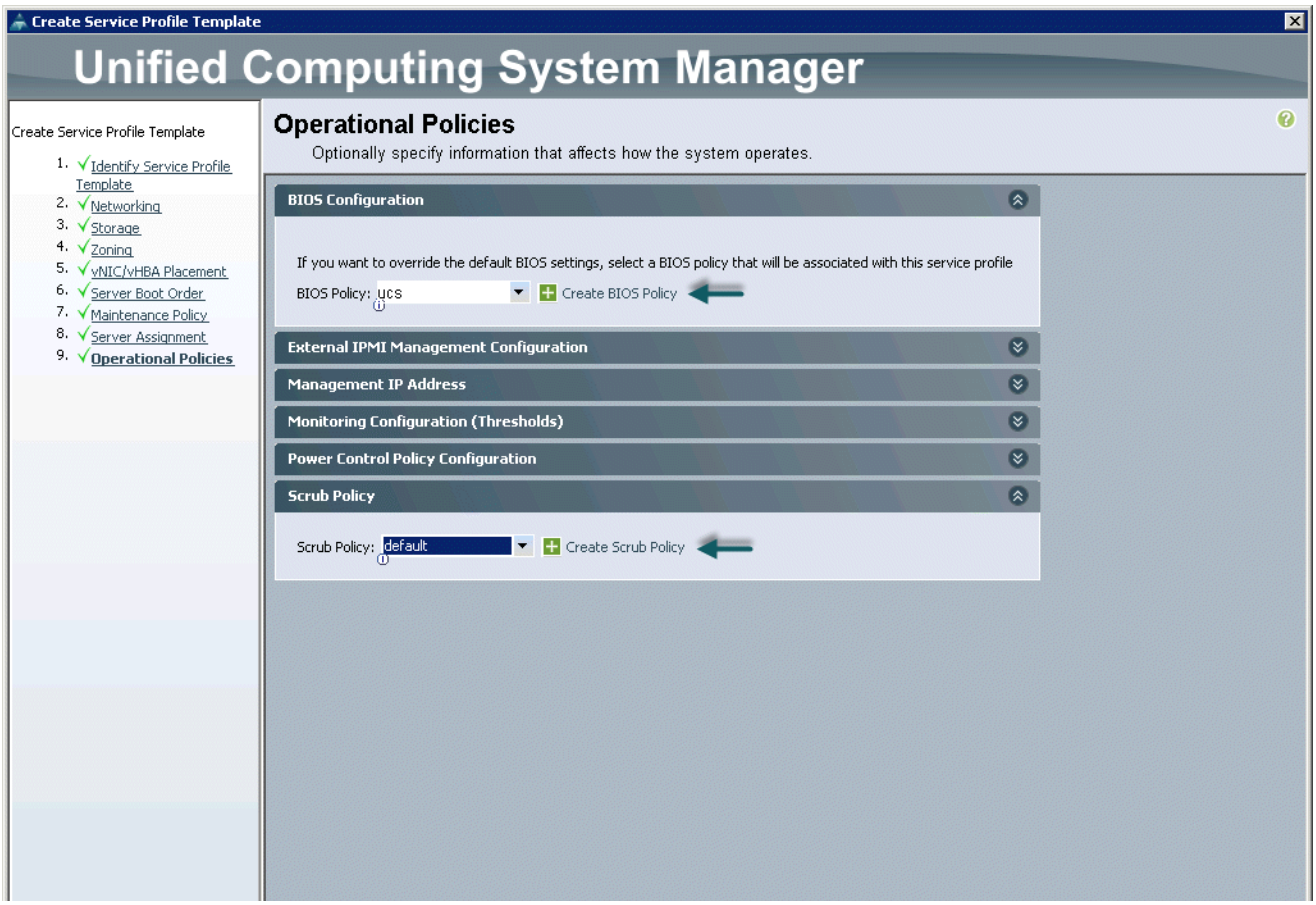


Configuring Operational Policies for Template

In the Operational Policies window, follow these steps:

1. Choose ucs in the BIOS Policy field.
2. Click **Finish** to create the Service Profile template.
3. Click **OK** in the pop-up window to proceed.

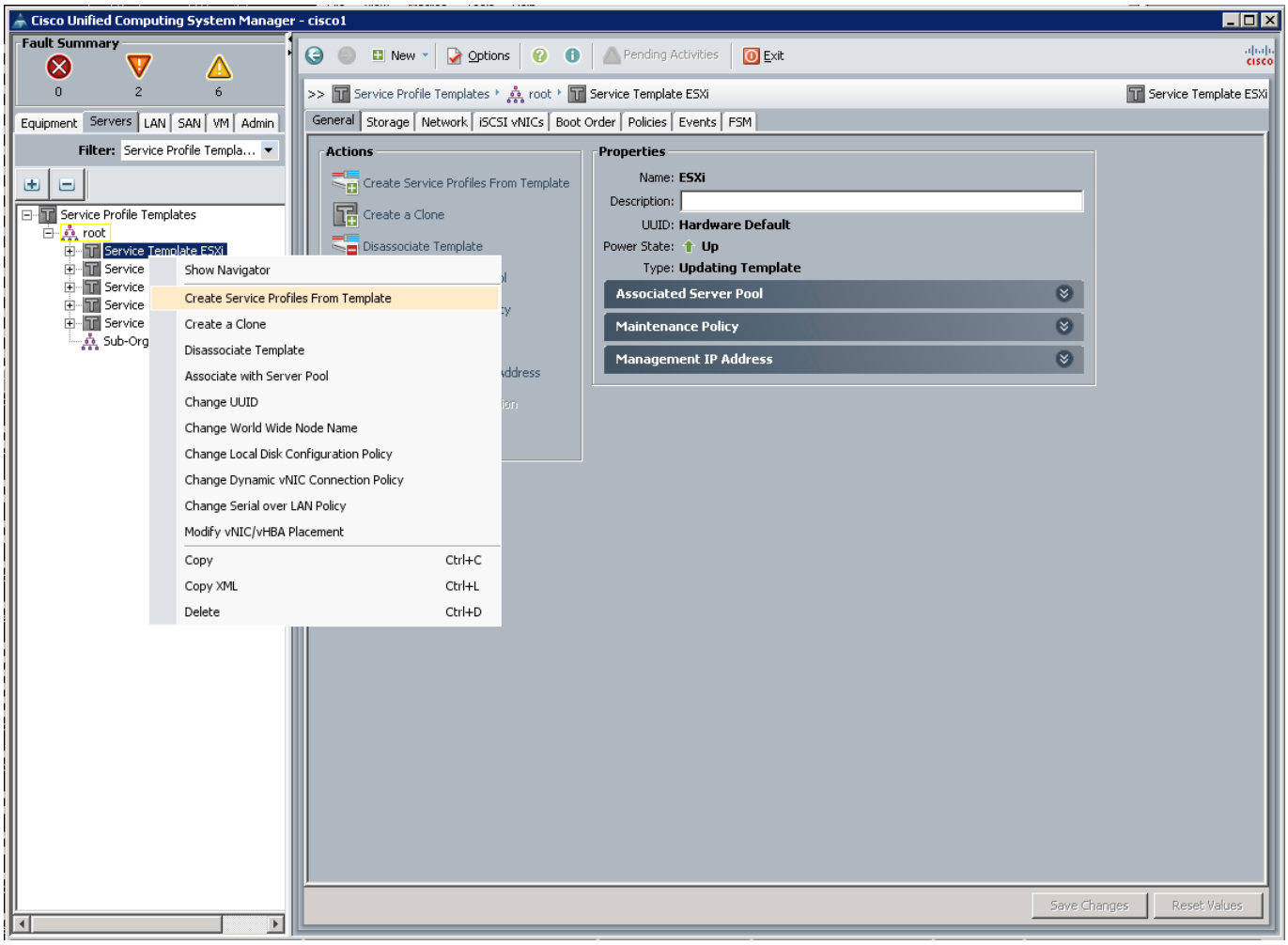
Figure 64 Selecting BIOS Policy



Choose the **Servers** tab in the left pane of the UCS Manager GUI.

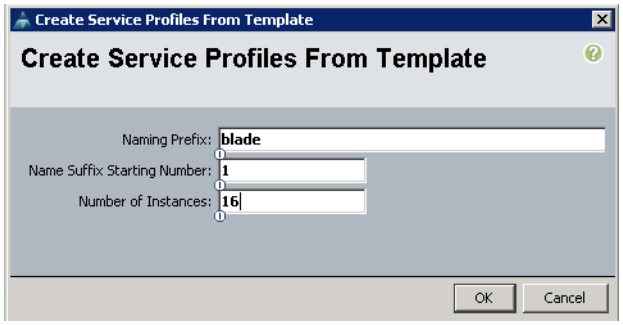
1. Go to **Service Profile Templates** > **root**.
2. Right-click Service Profile Templates ESXi.
3. Choose **Create Service Profiles** from **Template**.

Figure 65 Creating Service Profiles from Template



4. The **Create Service Profile** from **Template** window appears.

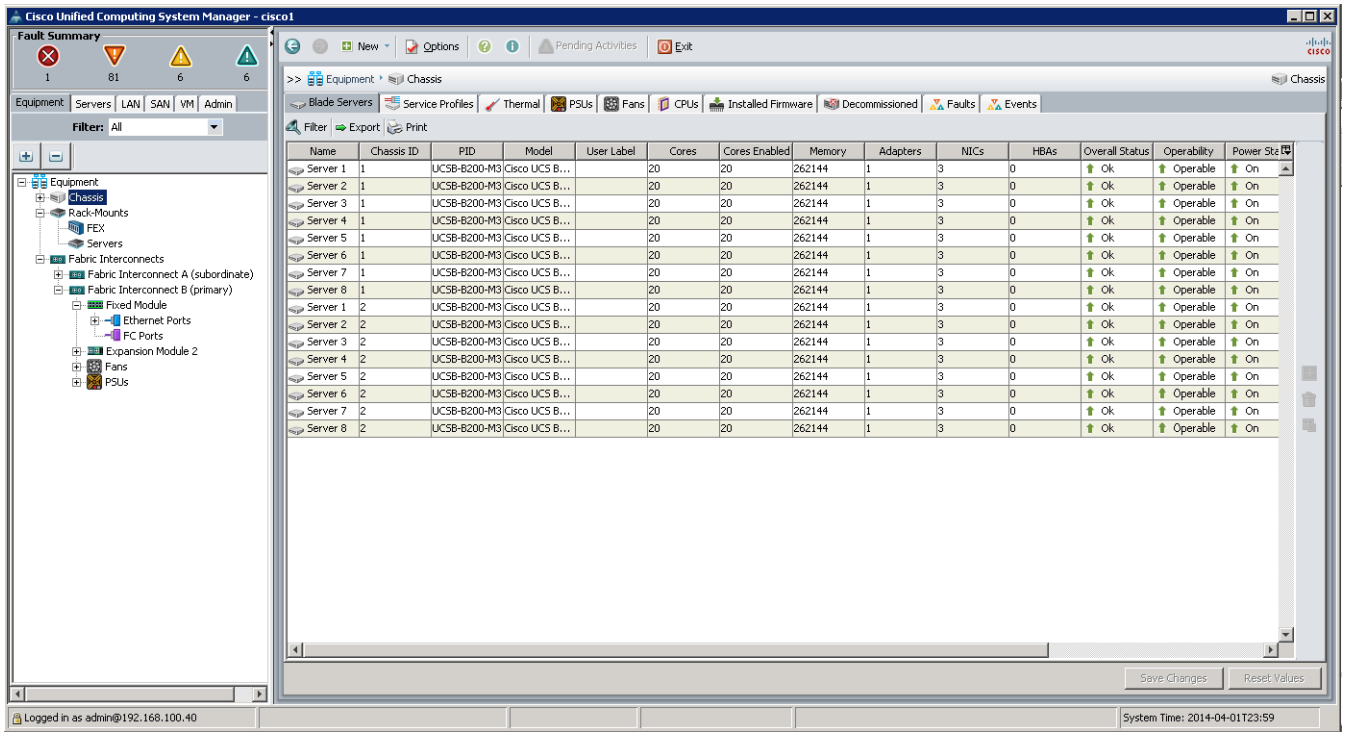
Figure 66 Selecting Name and Total number of Service Profiles



UCS Manager will then discover the servers. Association of the Service Profiles will take place automatically.

The Final Cisco UCS Manager window is shown in Figure 67.

Figure 67 UCS Manager Showing all Nodes



5. Install and Configure VMware's Hypervisor vSphere ESXi 5.5

Install and Configure VMware's Hypervisor vSphere ESXi 5.5

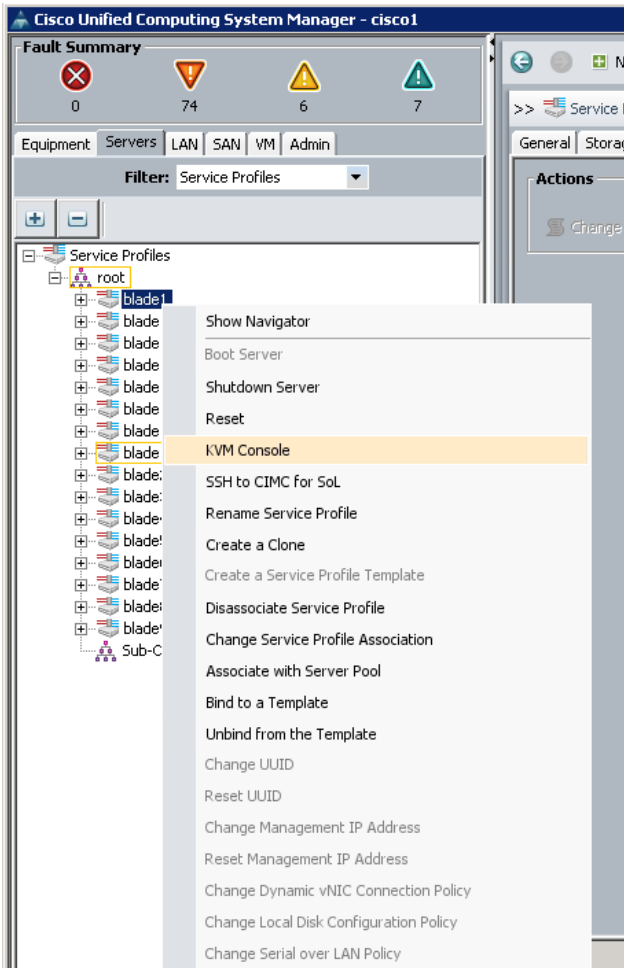
This section details on installing VMware's vSphere ESXi Hypervisor version 5.5.

Booting From VMware vSphere ESXi 5.5 ISO

Choose the **Equipments** tab in the left pane of the UCS Manager GUI.

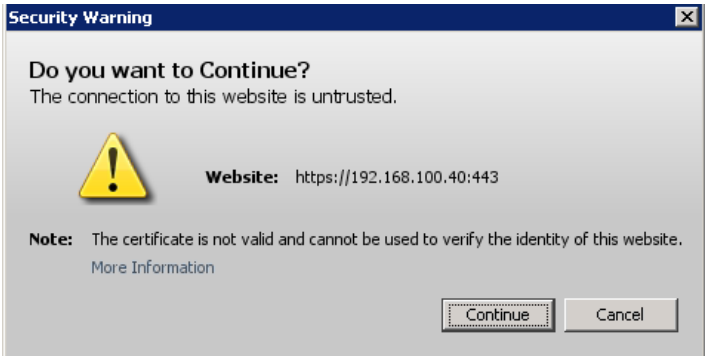
1. Go to Service **Profiles** > **root**.
2. Right-click profile blade1.
3. Choose **KVM Console**.

Figure 68 Opening the KVM Console of a Server



4. Ignore any security warnings that may pop up as below by clicking **Continue**.

Figure 69 Security Warning While Opening KVM Console.

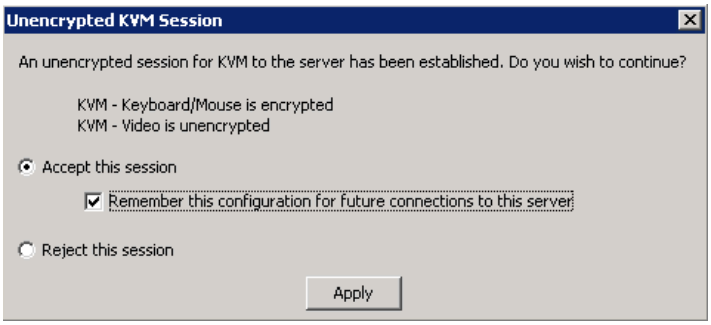


At this point the necessary client program will get downloaded from the UCSM and will report the following Unencrypted KVM Session warning message.

5. Click the **Accept this session** radio button and check the Remember this configuration for future connections to this server.
6. Click **Apply**.

7. And Click **Accept** to accept the certificate installation.

Figure 70 Unencrypted KVM Session Warning While Opening KVM Console.



This will bring up the KVM-window.

8. In the KVM-window click **Virtual-Media** tab, click the **Accept this session** radio button and Check the Remember this configuration for future connections to this server

Figure 71 Unencrypted Virtual Media Session Warning While Entering the Virtual Media Session Tab

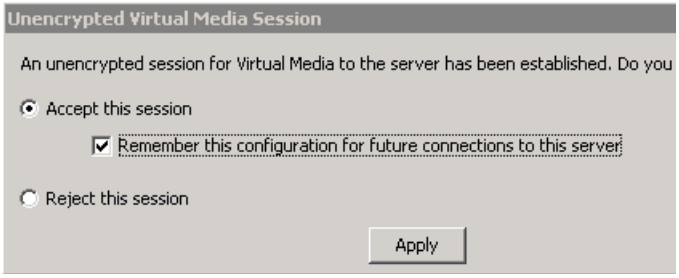
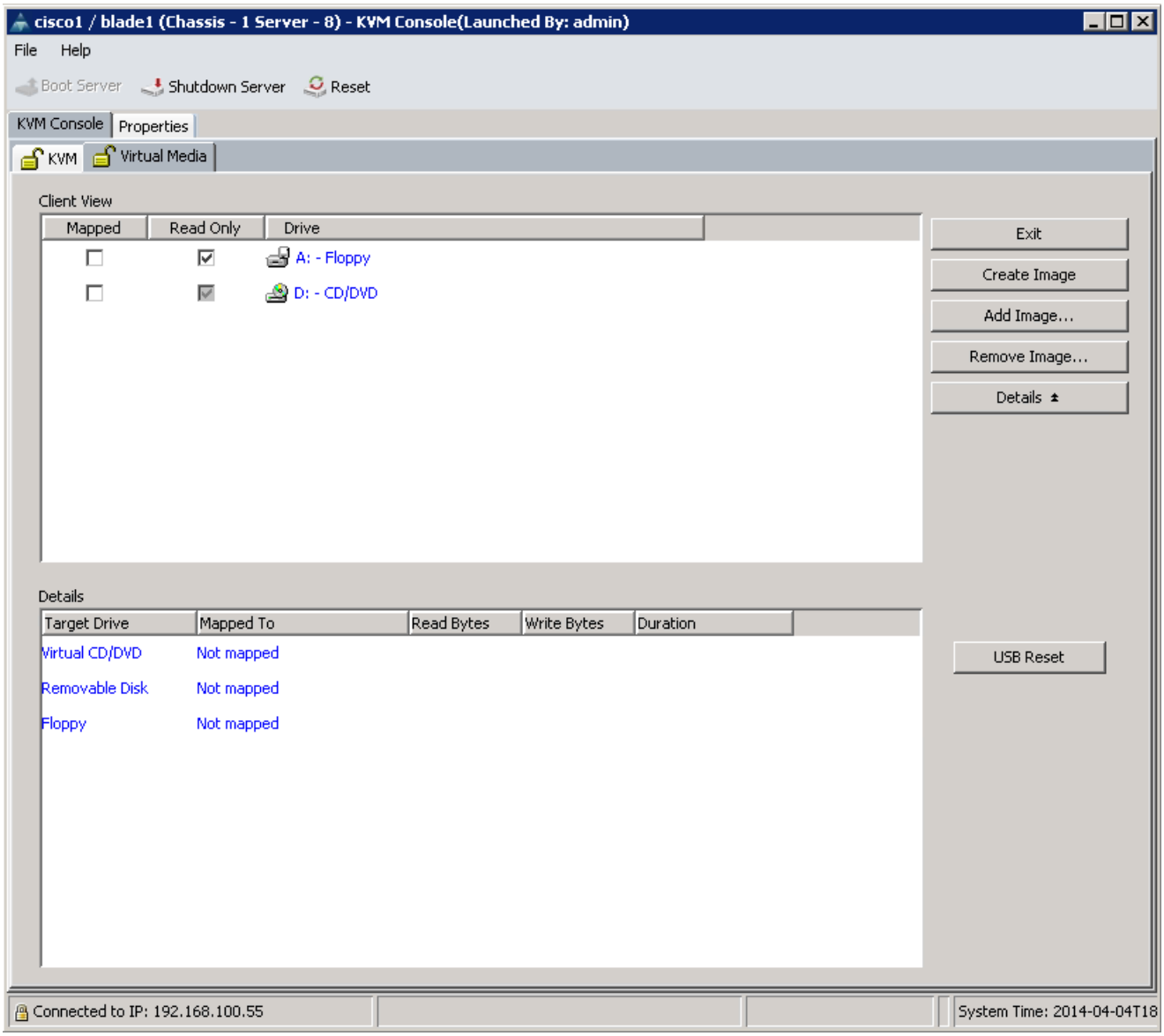
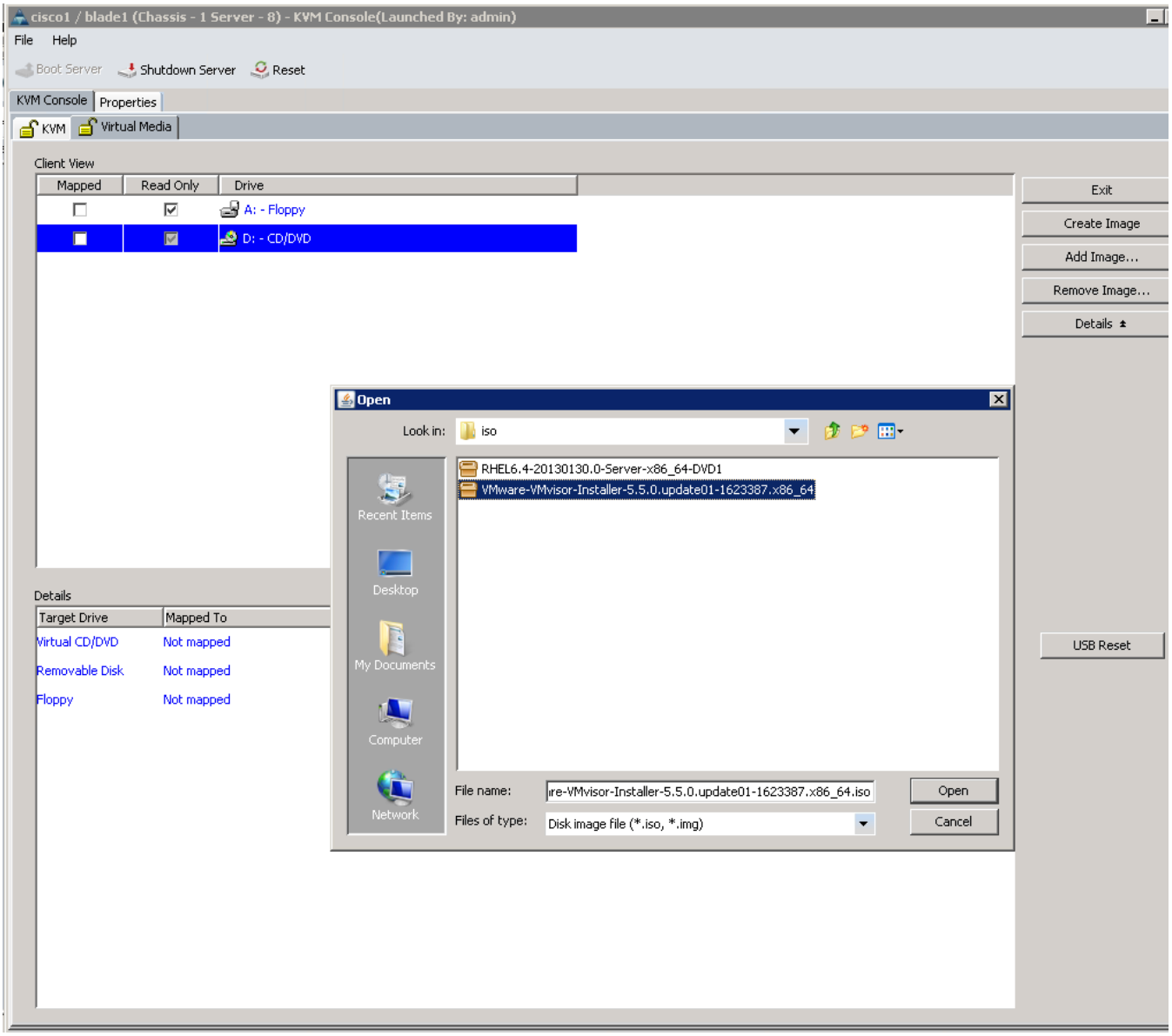


Figure 72 Virtual Media Tab



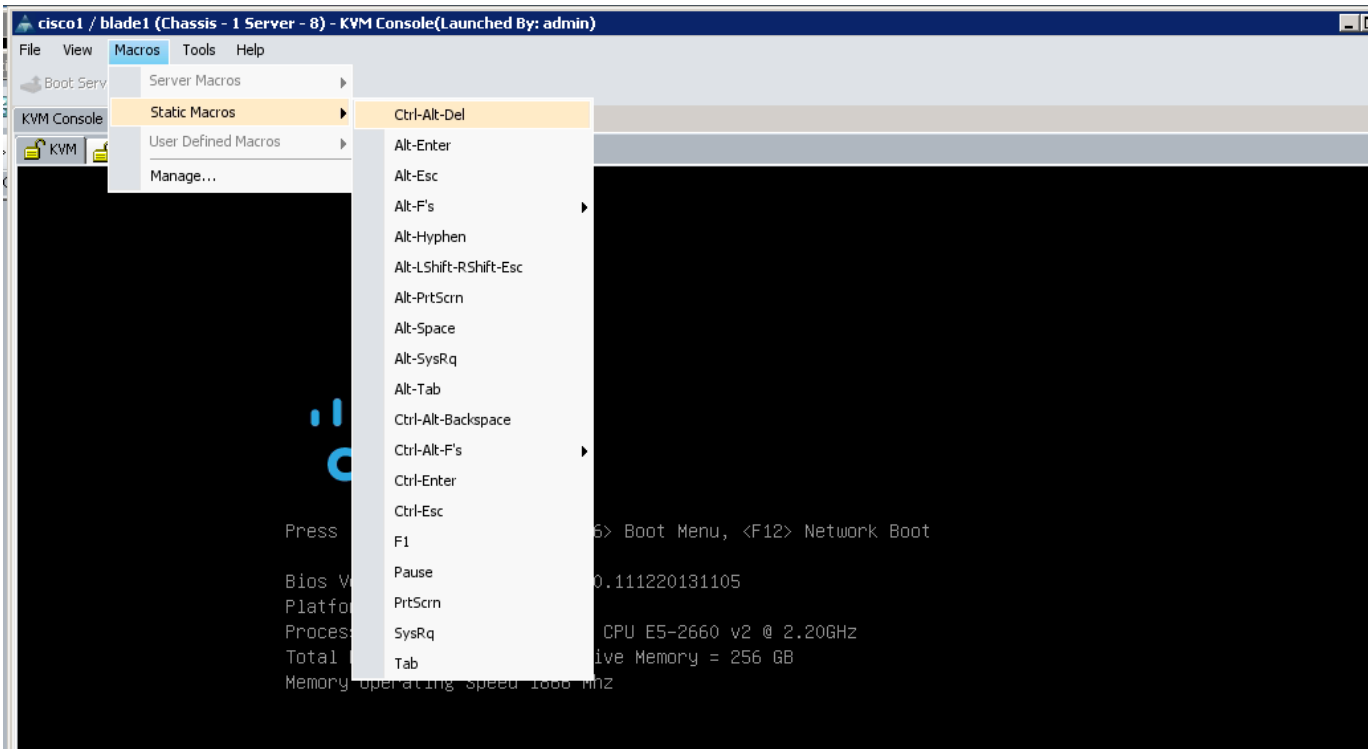
9. In the **Virtual Media** tab, click **Add Image.**
10. Choose the VMware-VMVisor-Installer-5.5.0-updateX-<nnnnn>.x86_64.iso image.

Figure 73 Mounting the VMware Hypervisor ISO image



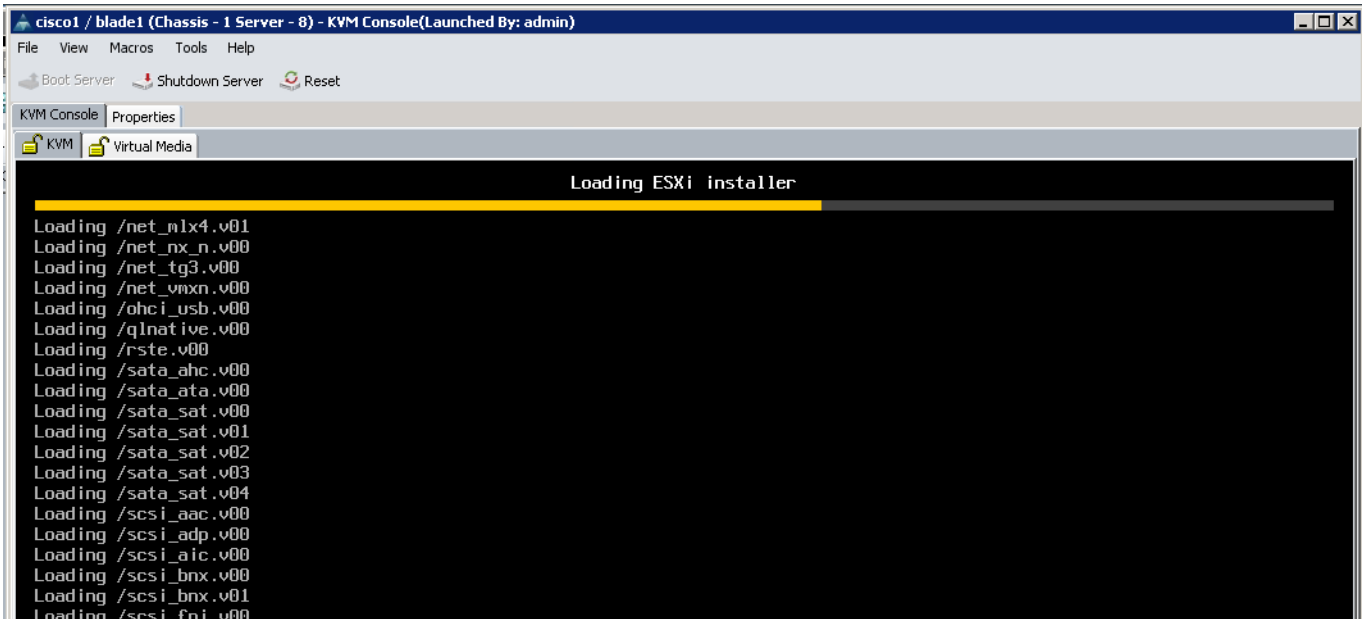
11. Click **Open**.
12. Check the **Mapped** check box.
13. Click the **KVM** tab back again and use the Macro menu item to send <Ctrl-Alt-Del> command to the KVM session.

Figure 74 Macro Sending Ctrl-Alt-Del Command to Server



This reboots the blade-server and after several seconds, the VMware Hypervisor starts loading

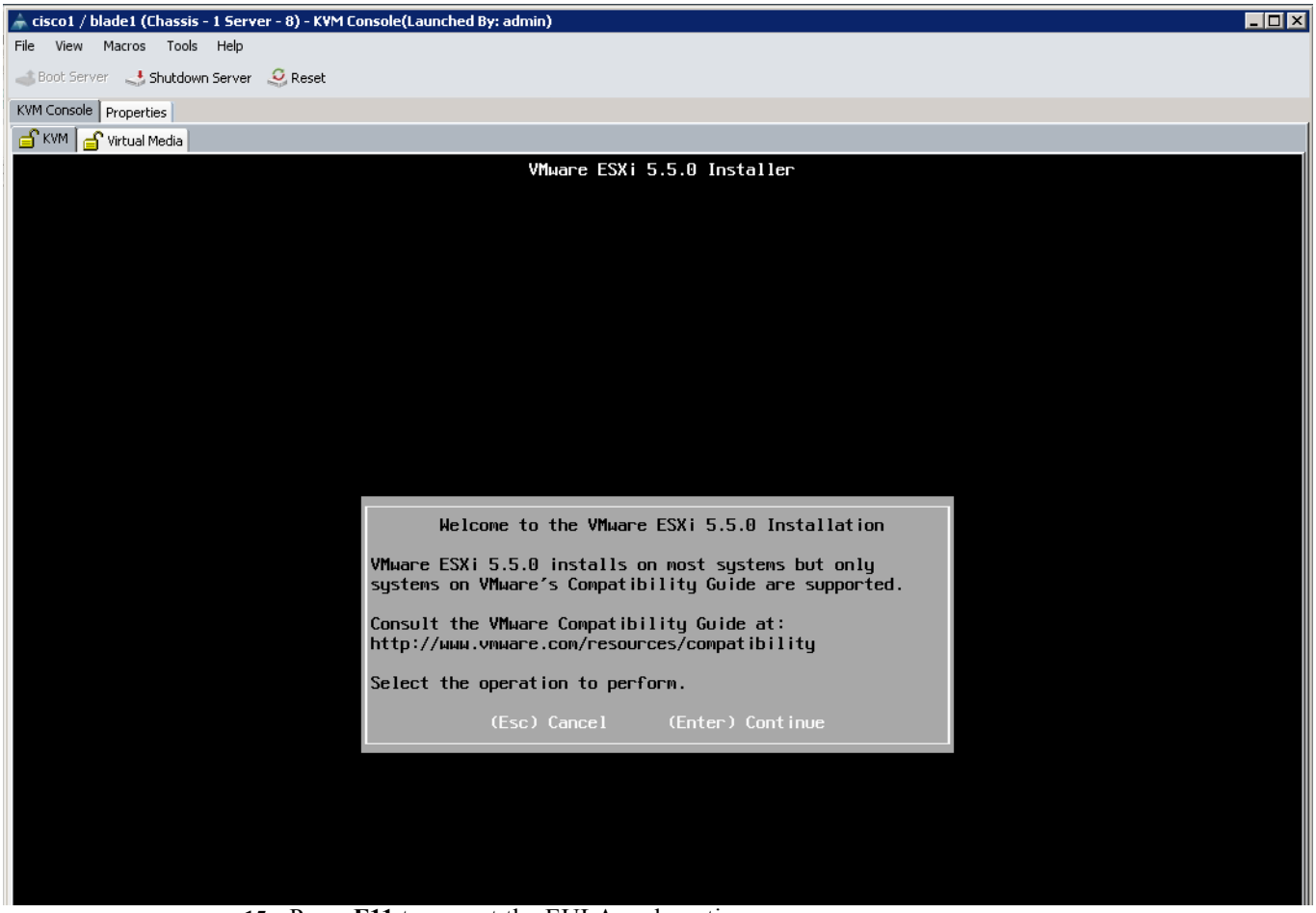
Figure 75 VMware Hypervisor Installation Screen 1



After a few short minutes, the following screen will show up waiting for user-input.

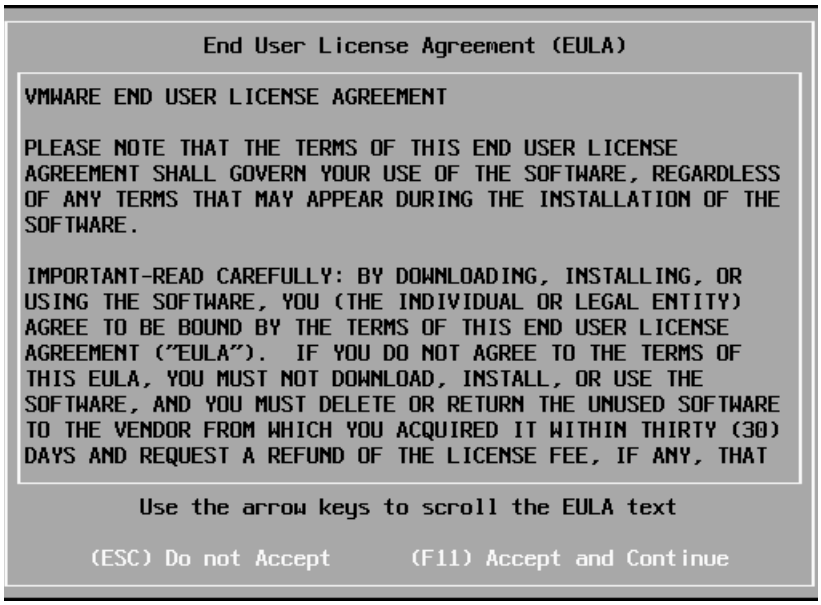
14. Press **Enter** to continue.

Figure 76 VMware Installation Screen 2



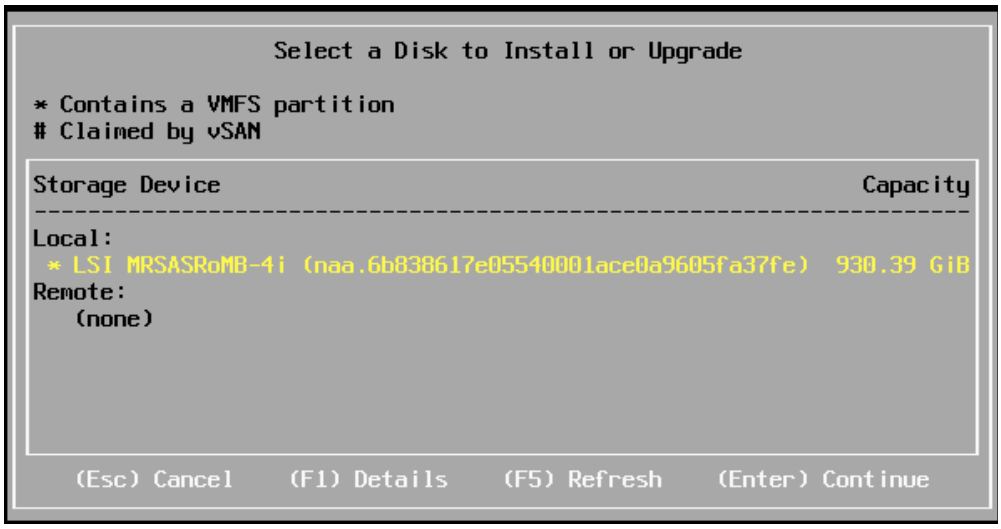
15. Press **F11** to accept the EULA and continue.

Figure 77 VMware Installation Screen 3 - EULA



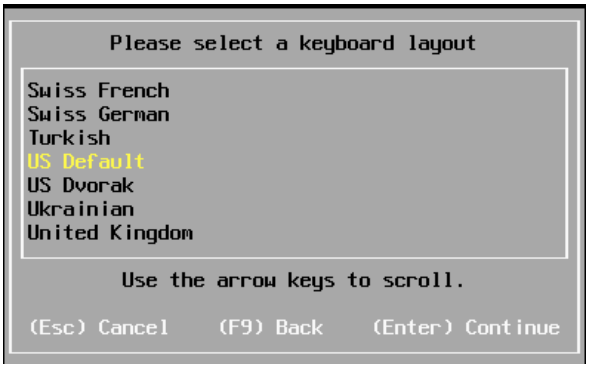
16. Review the available local storage information, choose the device using arrow keys and Press **Enter** to continue.

Figure 78 VMware Installation Screen 4 – Selecting the Disk to Install



17. Choose the keyboard US-Default using arrow keys and Press **Enter** to continue.

Figure 79 VMware Installation Screen 5 – Selecting the Keyboard Type



18. Type in your preferred strong root password, confirm and Press **Enter** to continue.

Figure 80 VMware Installation Screen 6 – Root Password Entry

19. Confirm the installation in the next screen by pressing <F11> to proceed with the installation.

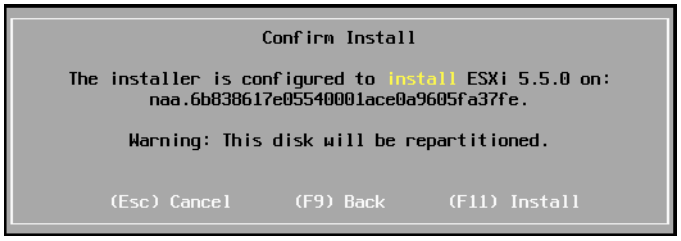
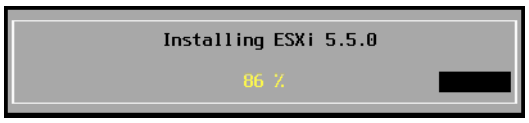


Figure 81 VMware Installation Screen 7 – Confirm Install

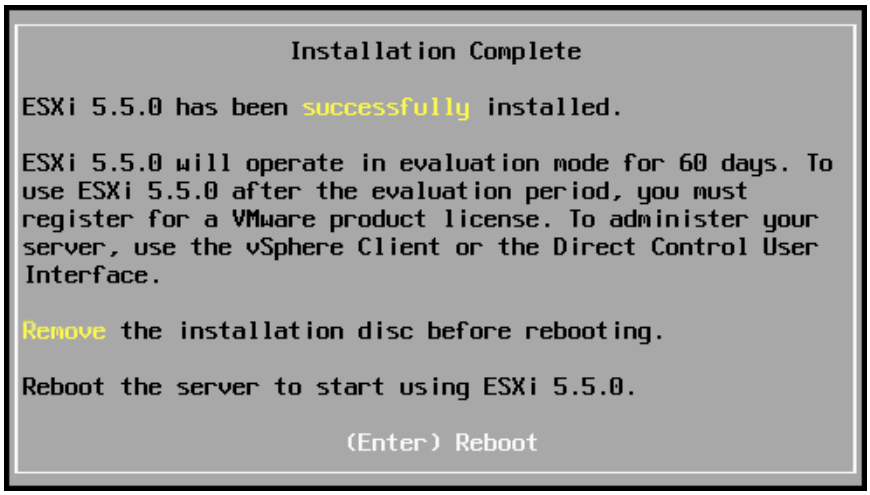
Now the installer will start installing the Hypervisor ESXi as shown below:

Figure 82 Installation Status



Once complete you will be presented with the following screen

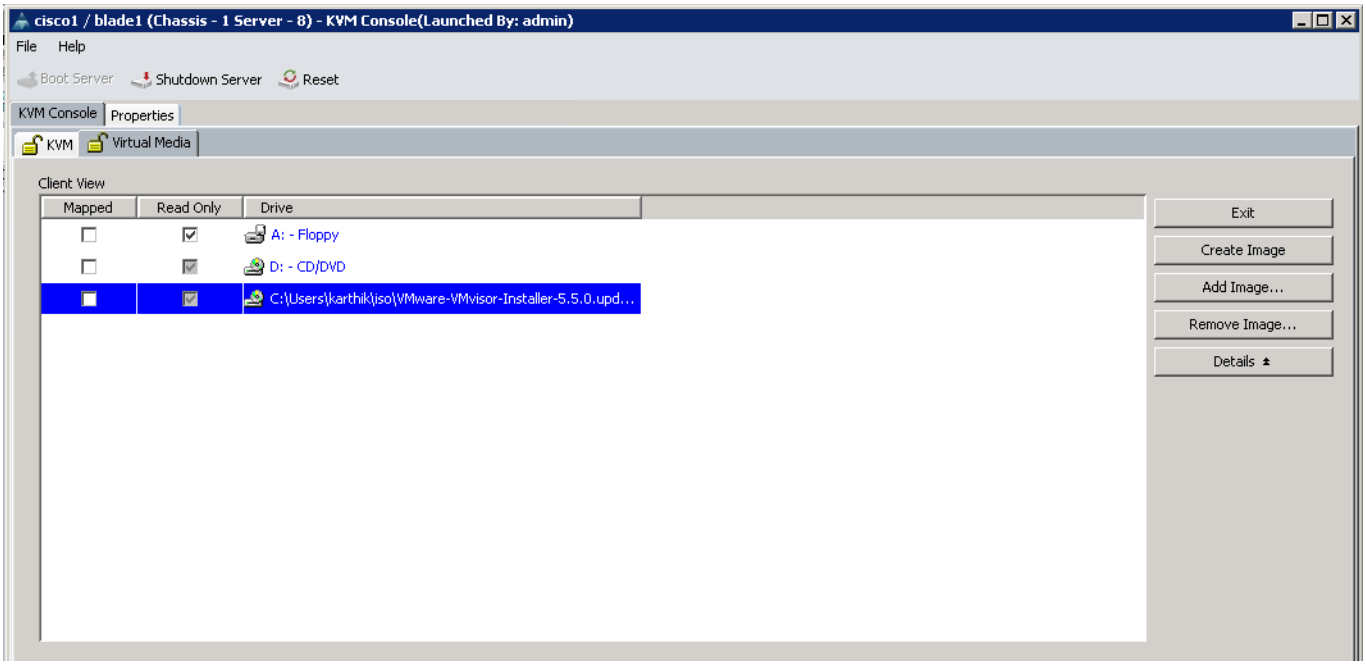
Figure 83 VMware Installation Completed



As a part of the reboot process, the **Mapped** check box in the **Virtual Media** tab will automatically get unchecked.

20. (Optionally) you may remove the installation Media manually by clicking on the **Virtual Media** tab and uncheck the **Mapped** check box and ignore the warning if any; and remove the image by clicking **Remove Image.**

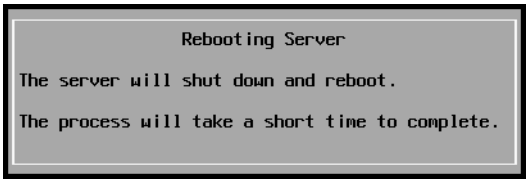
Figure 84 VMware Installation Screen 8 – Removing the Install Media



21. Return to the KVM by clicking on the **KVM** tab, and Press **Enter** to reboot.

You will be greeted with the following message, indicating you to wait a few moments for the ESXi to boot.

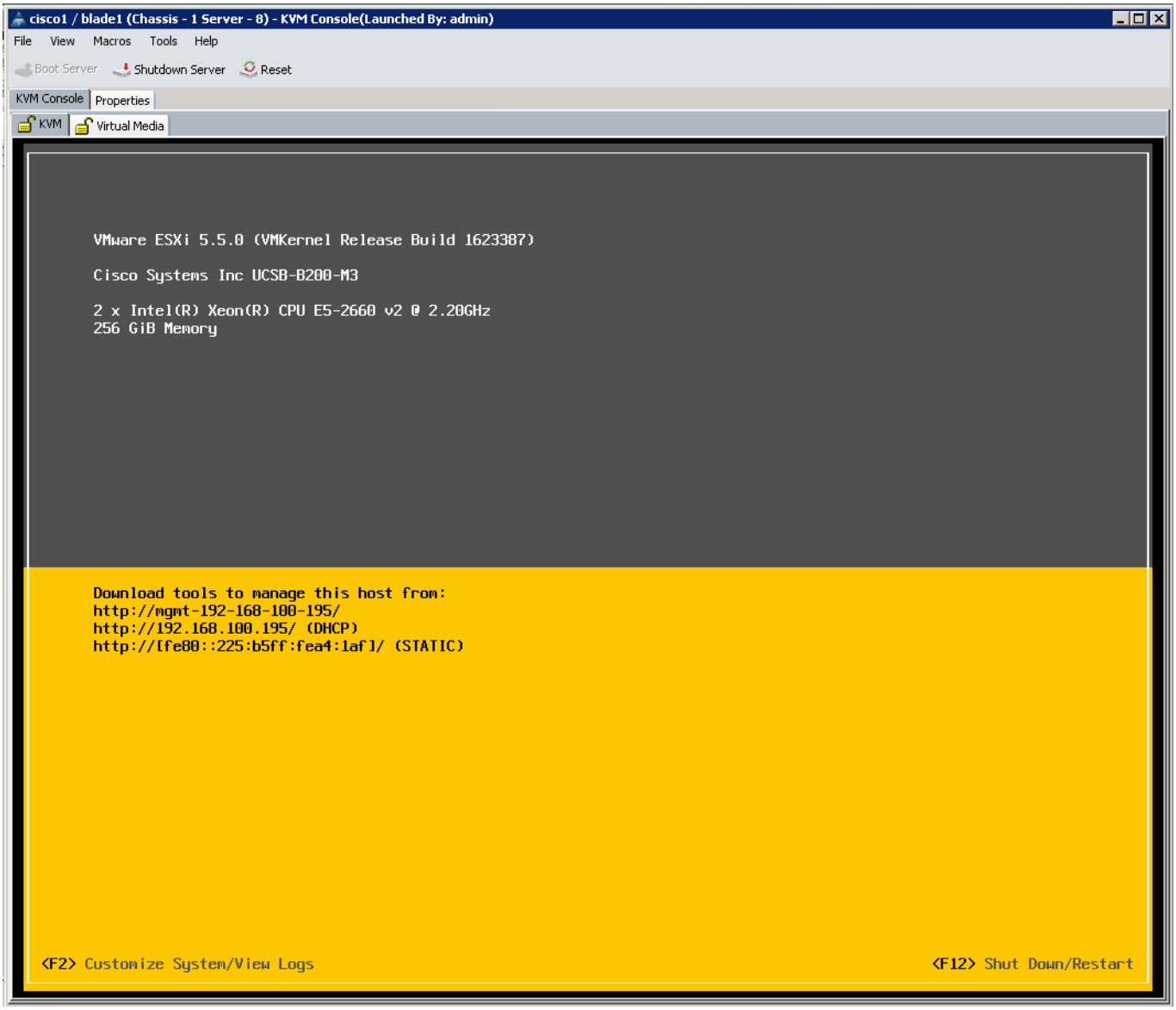
Figure 85 VMware Installation Screen 9 – Reboot in Progress.



Configuring VMware Hypervisor ESXi

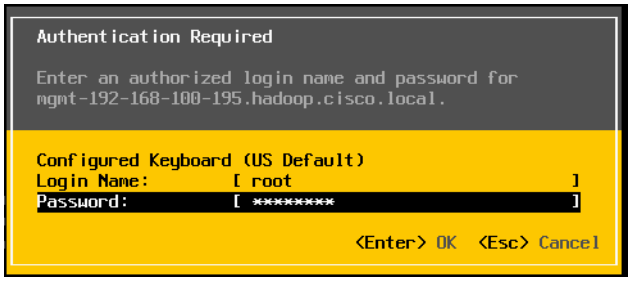
Once the VMware Hypervisor ESXi boots up, you will be presented with the following screen.

Figure 86 VMware Hypervisor Startup Screen



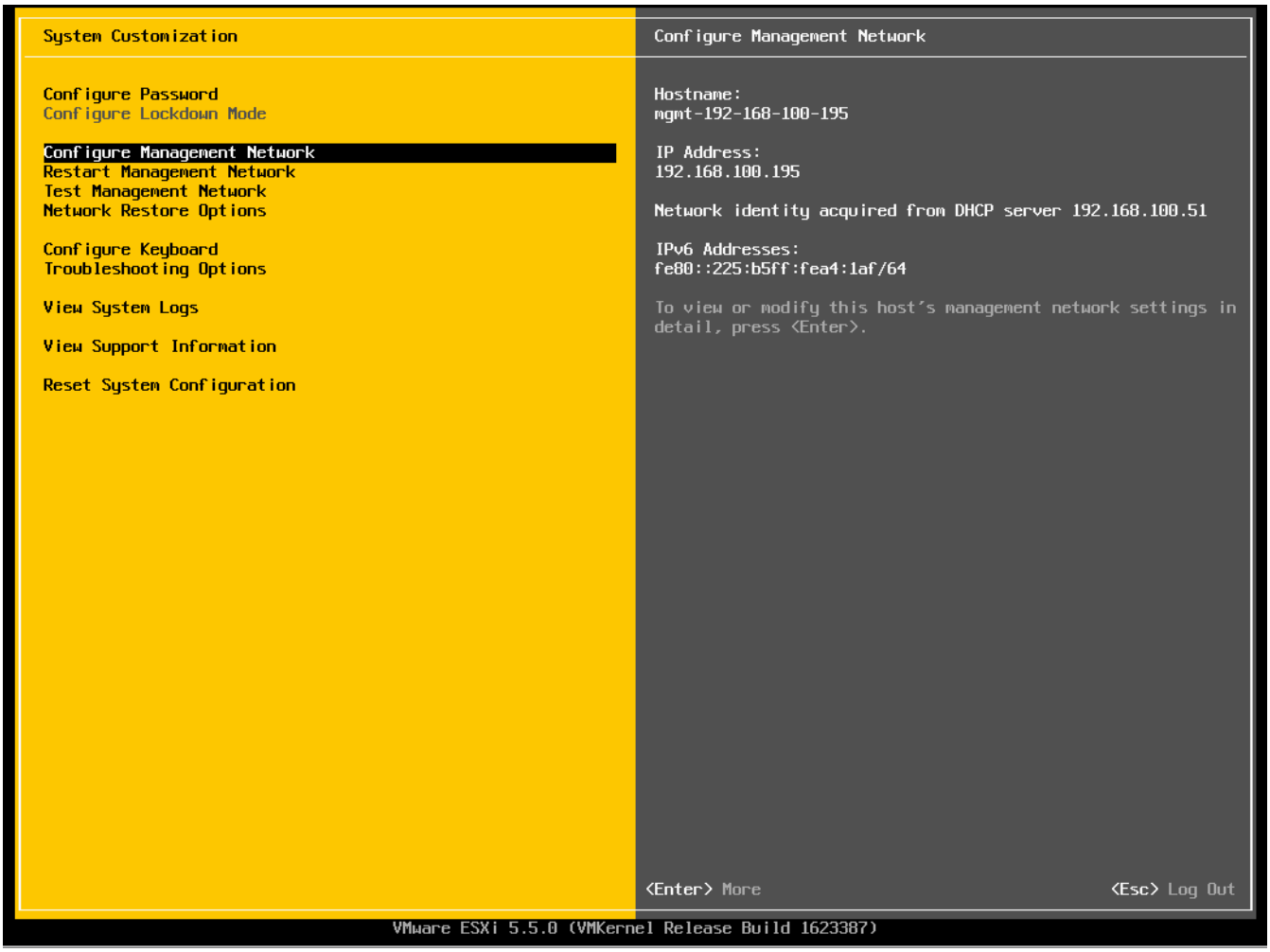
1. Press **F2** to customize the installation.
2. Enter the root password and Press **Enter** to proceed.

Figure 87 VMware Hypervisor configuration - Entering the Login Credentials



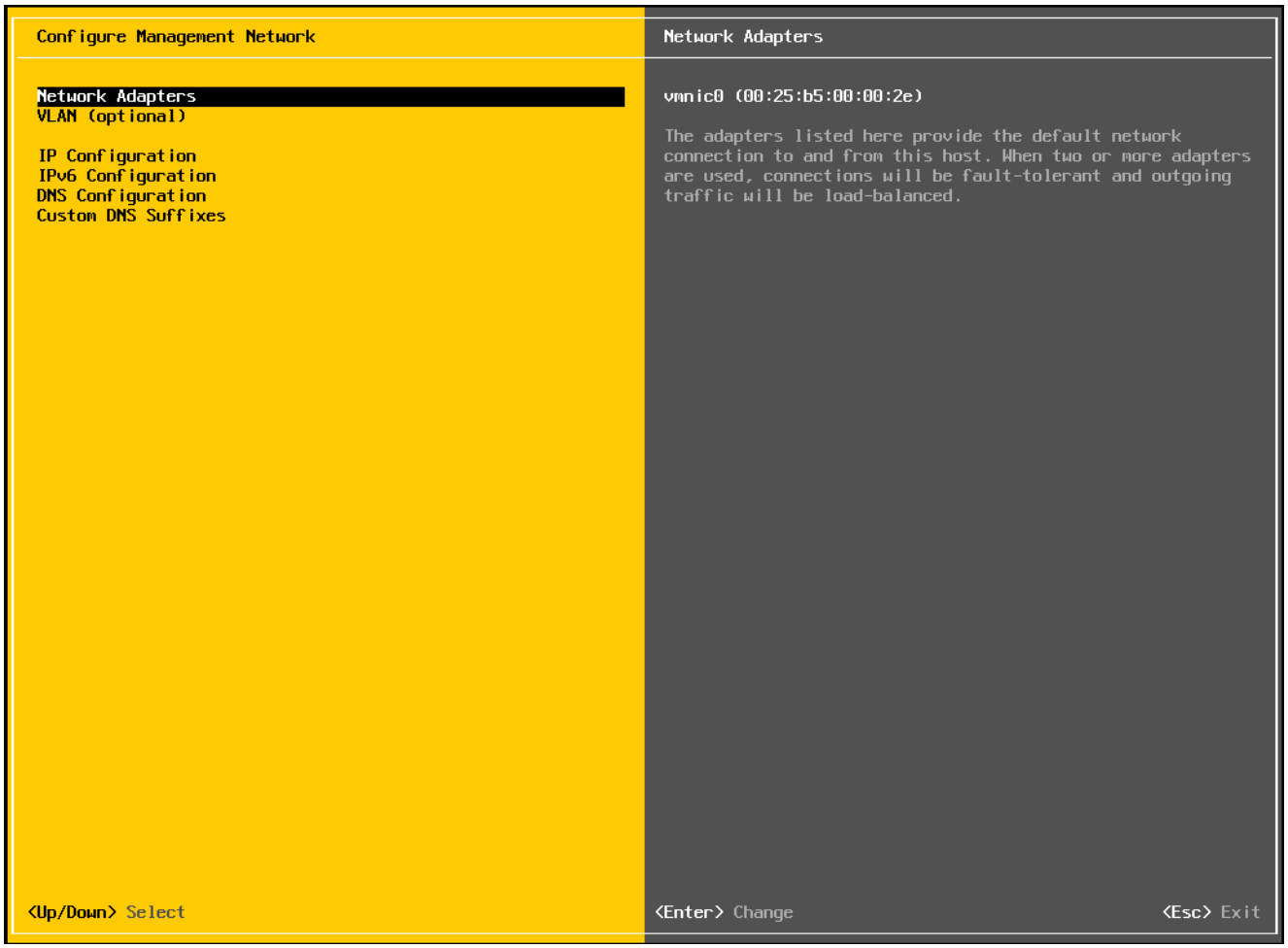
3. Once logged in successfully, press **F2** again to proceed.
4. In the next screen use the Arrow Keys to choose **Configure Management Network** option and Press **Enter** to choose it.

Figure 88 VMware Hypervisor Configuration – Configuring the Management Network



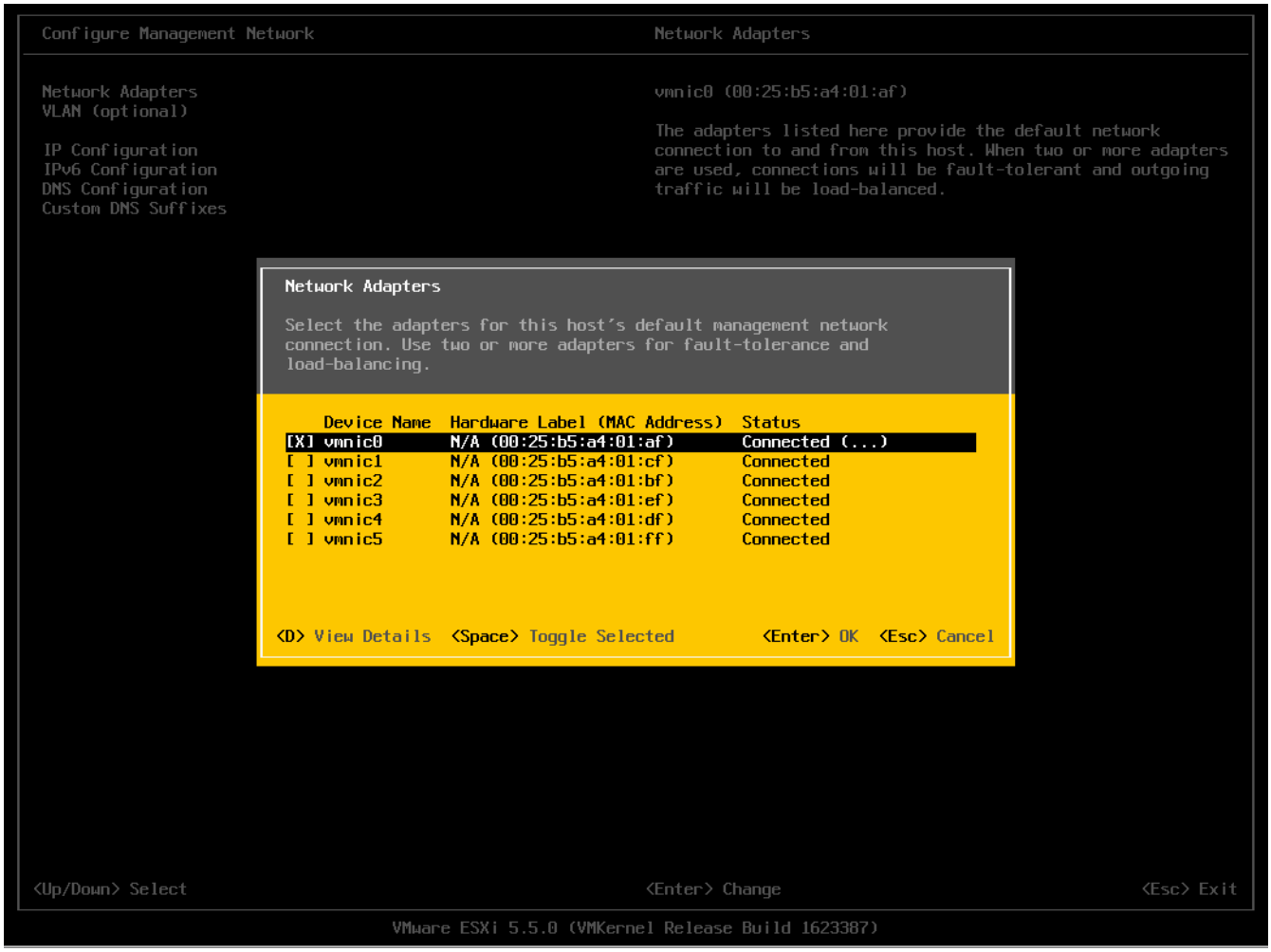
5. In the next screen use the Arrow Keys to choose Network Adapters option and Press **Enter**.

Figure 89 VMware Hypervisor Configuration – Configuring the Network Adapters



Upon pressing **Enter** key you are presented with the list of vmnics that were configured in your service profile template. In our case, we configured 6 vNICs in our Service-Profile Template; they show up here as vmnic0 through vmnic5.

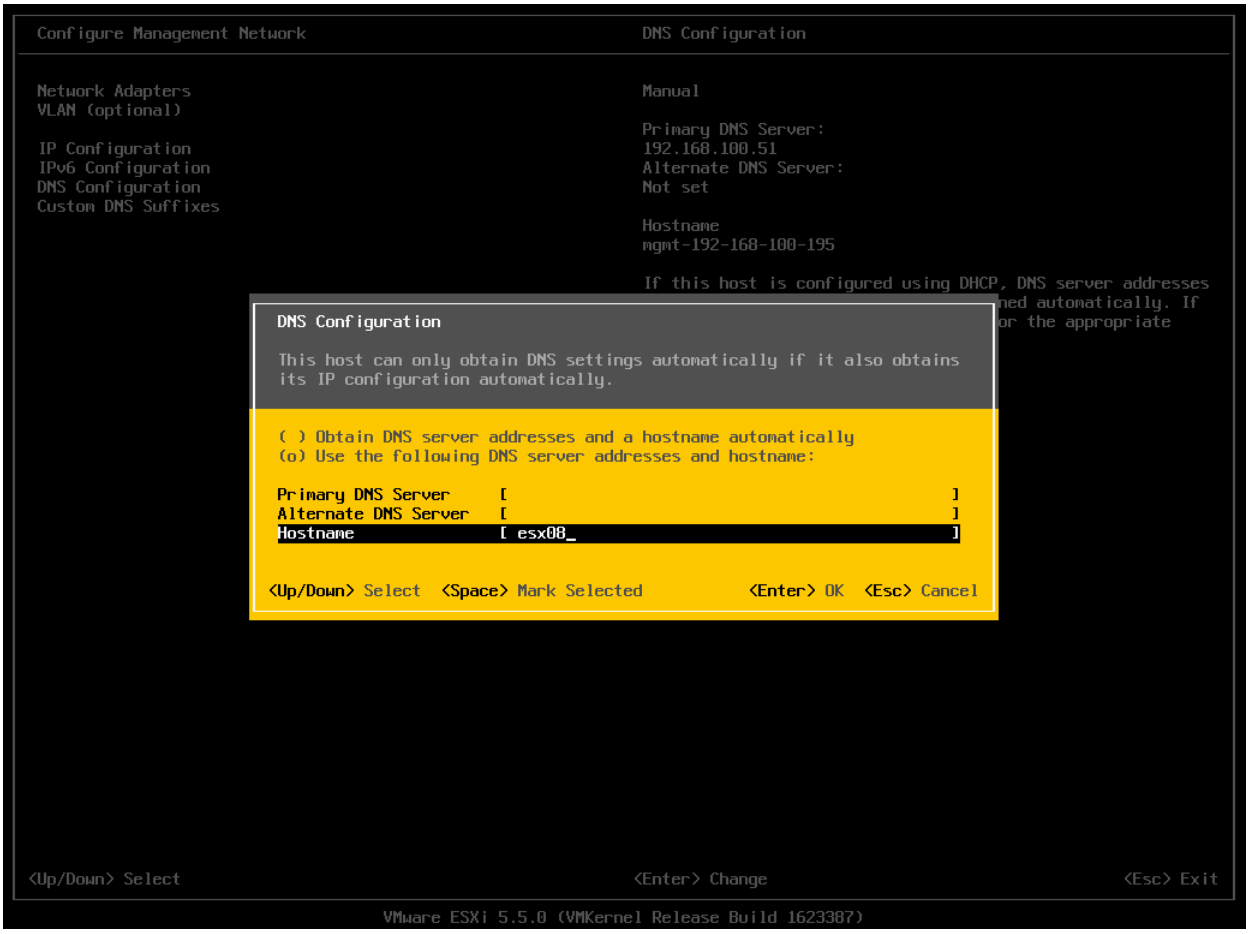
Figure 90 Verifying vmnics and Selecting vmnic0 (Management Network)



In this screen, make sure that only the vmnic that's associated with the Management Network is checked. In this case, we have had only the vmnic0 selected – this inherently assumes that, the Fabric-A is Active. If necessary, open the UCS-Manager GUI and identify the correct vmnic by matching its MAC address with that of the vNIC in the Service-Profile of the blade.

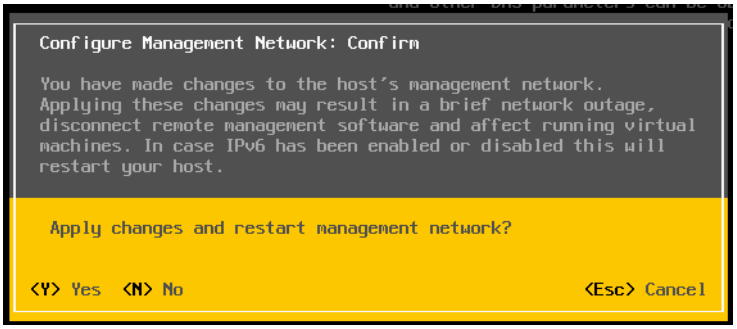
6. In the next screen use the Arrow Keys to choose **IP Configuration** option.
7. Press **Enter** to edit the IP-Address info.
8. Use the Arrow key to highlight the Set static IP address and network configuration: and press the <Space> bar to choose that option.
9. Enter your Static-IPv4 address in the IP-Address field. In this case, we used 192.168.100.28.
10. Enter the relevant Subnet Mask field. In this case, we used 255.255.255.0.
11. Enter the appropriate Default Gateway. In this case, we used 192.168.100.1.
12. Press **Enter** to accept the changes made.

Figure 91 VMware Hypervisor Configuration - Entering the IP-Address for the Management Network



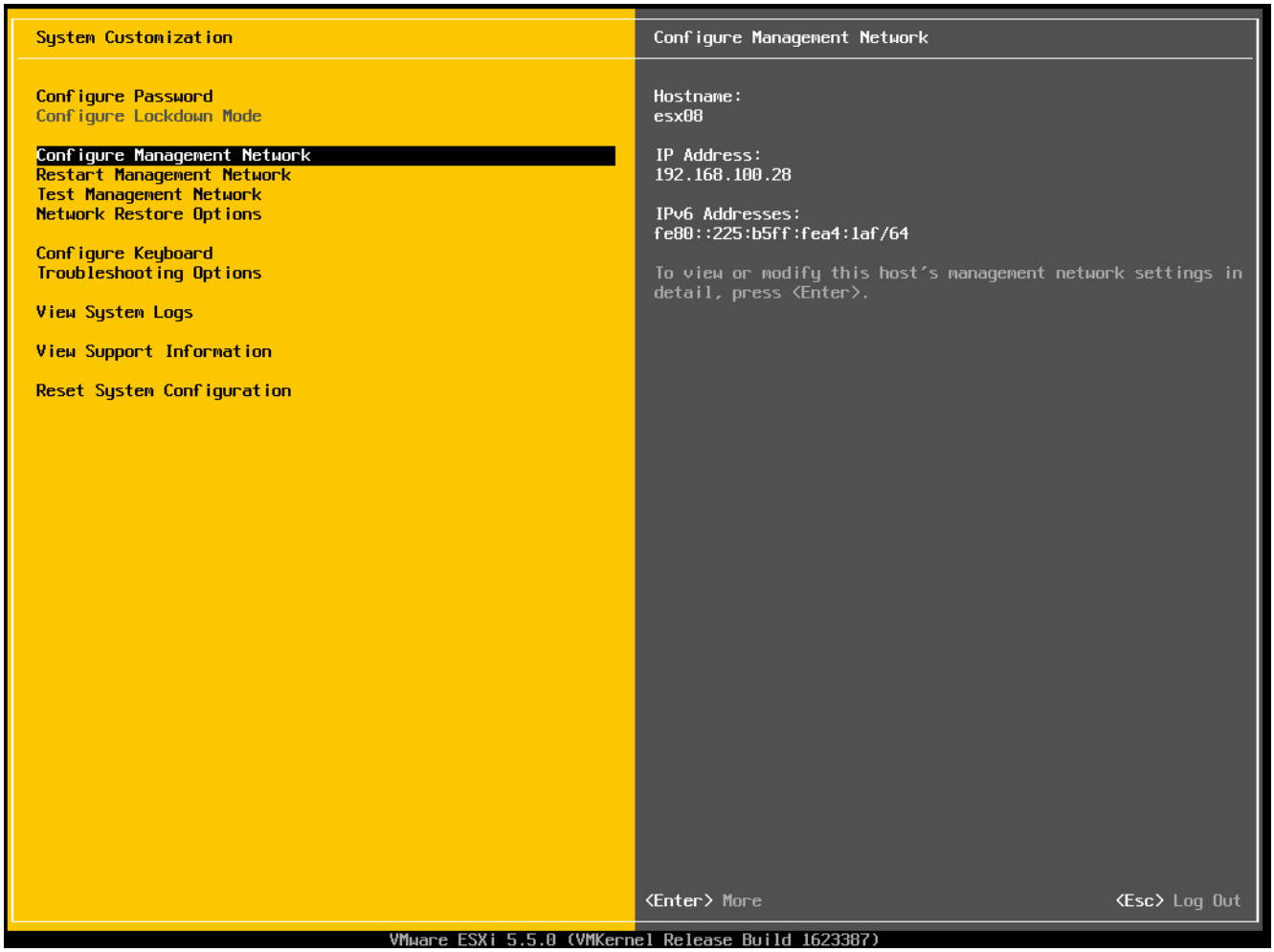
13. Now use the ARROW keys to choose the DNS Configuration option.
14. Remove the DNS IP address, since we don't intend to use the DNS-name resolution for the ESXi hosts.
15. Enter the name "esx08", and press **Enter** to accept the changes.
16. Now press **ESC** to exit out of this screen. Since, we changed some configuration, VMware Hypervisor will respond with alert message asking for confirmation to apply the changes.
17. Press the key <Y> to Accept the changes and Restart the Management Network.

Figure 92 VMware Hypervisor Configuration – Applying Changes and Restarting Management Network



18. Once the Management Network gets restarted, review the screen to make sure the IP-address is configured correctly.

Figure 93 VMware Hypervisor Configuration – Management Network Configuration.

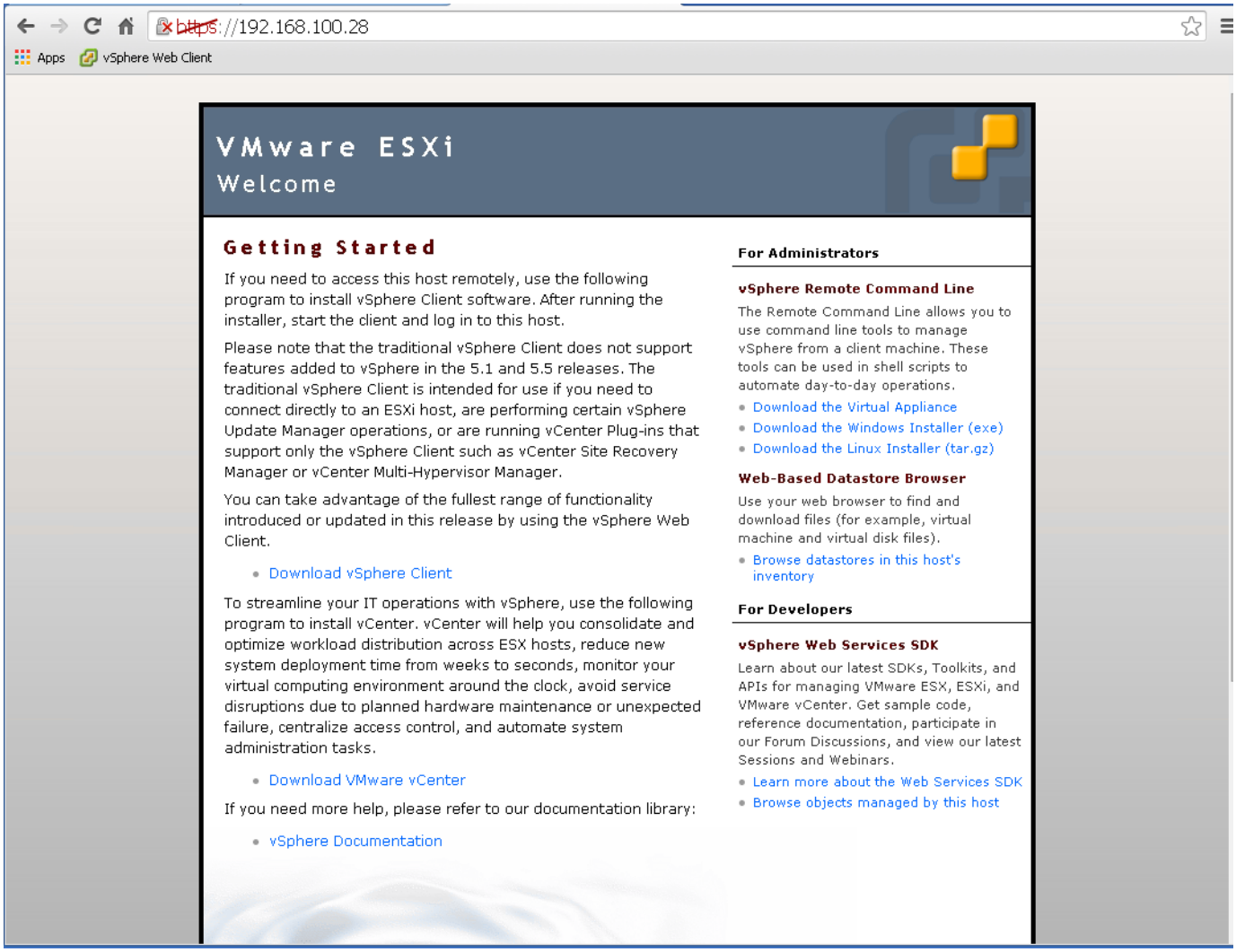


19. Press **ESC** to logout of that screen.

Verifying Management Network of Hypervisor

Open a terminal or a command window on your client computer and ping the IP-address 192.168.100.20 that you just used to provision the Management Network of the VMware ESXi Hypervisor. Optionally, you may also open a web-browser to visit the URL https://192.168.100.28/.

Figure 94 Verifying the Management Network Configuration in the ESXi



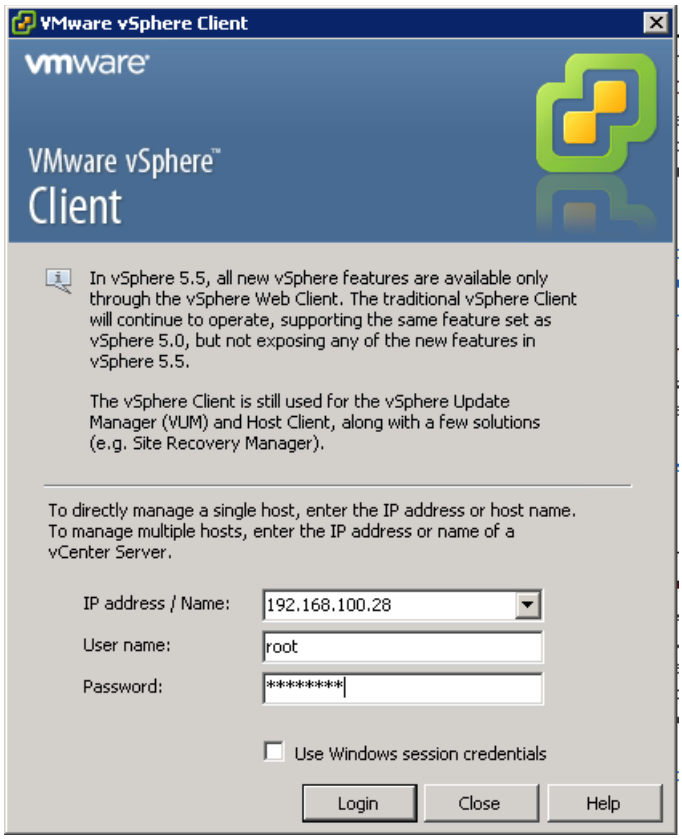
Configuring Virtual Networking

Each of the server blades consists of 6 vNIC interfaces as defined by the UCS-Manager. So, in the ESXi there shall be 6 vmnics. This can be seen via the vSphere native client, Figure 95 show an ESXi host's network adapters. The Client software shall be downloaded by clicking on the link shown in the home page of the ESXi. Please refer to the Figure 94.

It is recommended to install the vSphere Remote Command Line client to your workstation as well. We could make use of some of the vSphere command-line tools to configure the VM Networks necessary for the solution.

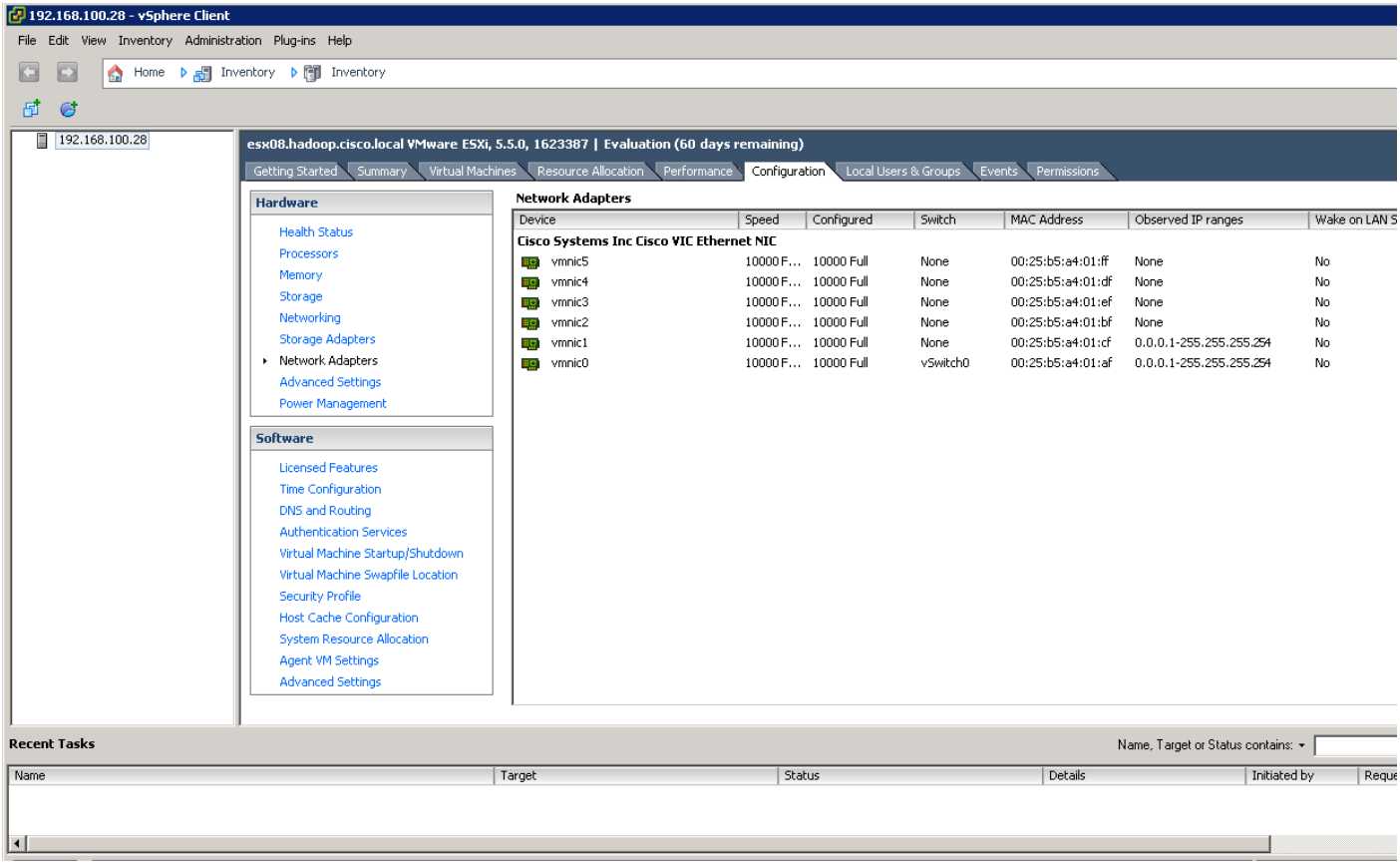
1. Launch the vSphere Native client and log on using the username root and its password.

Figure 95 Logging into ESXi Host Using vSphere Client



2. Click the Hypervisor's name or IP-address on the Navigation pane, and choose the **Configuration** tab on the right.
3. In the **Hardware** sub-section, click **Network Adapters**.

Figure 96 Viewing Network Adapters of ESXi Host



4. Out of these vmnics, vmnic0-1, vmnic2-3, vmnic4-5 form pairs sharing similar characteristics. They map to their respective vNICs defined in the UCS-Manager. This solution uses standard vSphere vSwitches for VM-networking.

Note The VM-networks could also be created by using VMware Distributed Virtual Switch or Cisco Nexus 1000v.

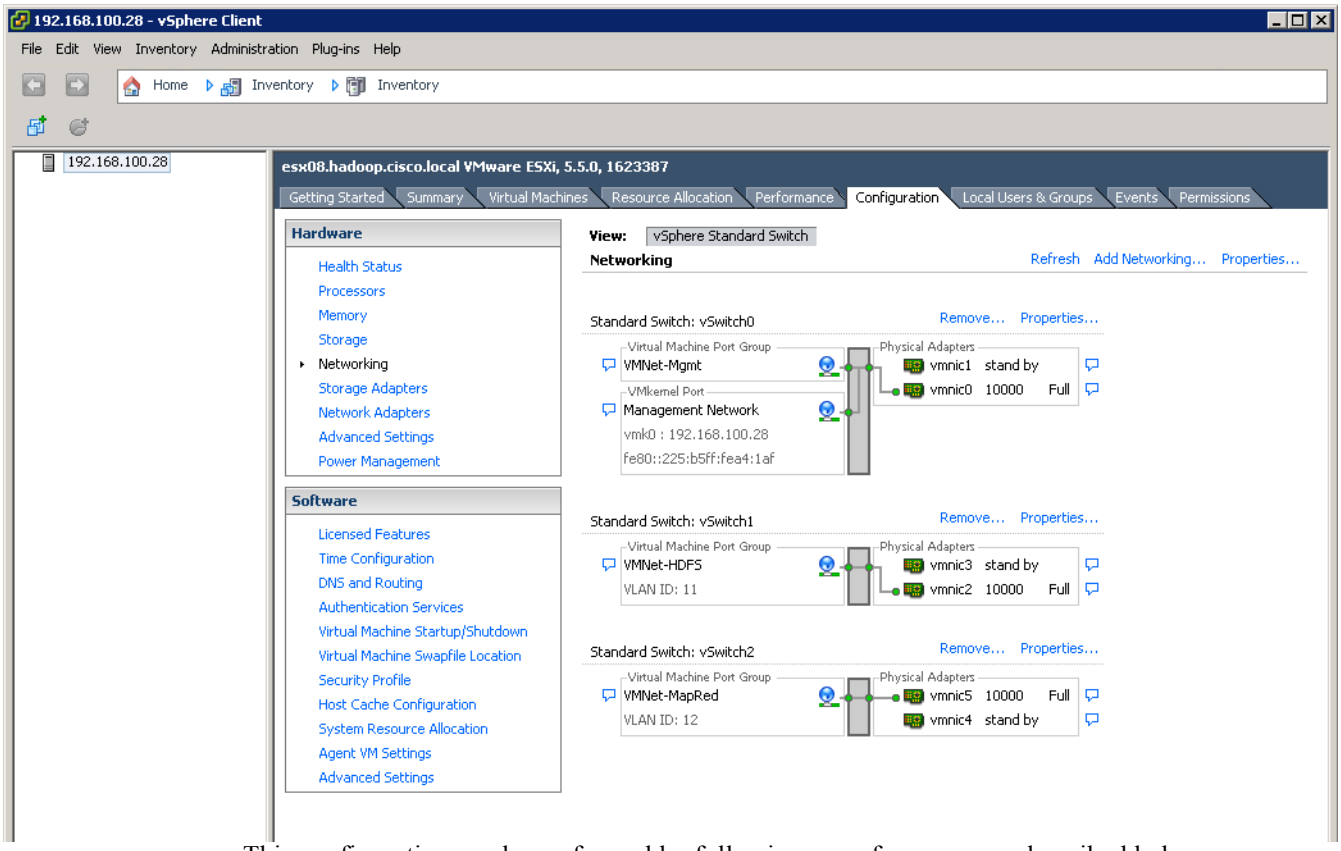
In this solution, we created three vSwitches (vSwitch0, vSwitch1 and vSwitch2) by using Table 8 for reference. In each of the vSwitches, we made use of the Active/Standby NIC-teaming policy. There were no vMotion-related configurations used in this solution. Table 8 show the network mappings between the VM networks, vmnics and UCS vNICs.

Table 8 vSphere ESXi to UCS-M Network Mappings

VMware Port Group Name	Switch Name	MTU	vmnic#	UCS vNIC	Fabric Reference	Active/ Standby
VMNet-Mgmt	vSwitch0	9000	vmnic0	eth0	FI A	Active
VMNet-Mgmt	vSwitch0	9000	vmnic1	eth1	FI B	Standby
VMNet-HDFS	vSwitch1	9000	vmnic2	eth2	FI A	Active
VMNet-HDFS	vSwitch1	9000	vmnic2	eth3	FI B	Standby
VMNet-MapRed	vSwitch2	9000	vmnic3	eth4	FI A	Standhy
VMNet-MapRed	vSwitch2	9000	vmnic4	eth5	FI B	Active

An ESXi host with fully configured network will look as in Figure 97.

Figure 97 vSphere Standard vSwitch Network Configurations



This configuration can be performed by following one of many ways described below.

1. Manual creation of standard vSwitches and their associated vmnics and port-groups using the vSphere Client.
2. Using the "esxcli" and other remote command-line tools to create via the command line.

In this solution, we used the following esxcli commands to configure the vSwitches and subsequently using the vSphere Native Client to verify that the network configuration has been created as expected. Command line client may be installed by visiting the ESXi-host's IP-address using a web-browser i.e. https://192.168.100.28/.

Table 9 Configuring vSwitches

Command Information	vSwitch	Command Syntax
Creating a new Port-Group VMNet-Mgmt	vSwitch0	`esxcli -s 192.168.100.28 -u root -p Cisco123 network vswitch standard portgroup add --portgroup-name=VMNet-Mgmt --vswitch-name=vSwitch0`
Adding the uplink interfaces i.e. vmnic1	vSwitch0	`sxcli -s 192.168.100.28 -u root -p Cisco123 network vswitch standard uplink add --vswitch-name=vSwitch0 --uplink-name=vmnic1`
Set the vmnic0 as Active-Uplink, and vmnic1 as Standby-Uplink	vSwitch0	`esxcli -s 192.168.100.28 -u root -p Cisco123 network vswitch standard policy failover set --vswitch-name=vSwitch0 --active-uplinks=vmnic0 --standby-uplinks=vmnic1`

Table 9 Configuring vSwitches

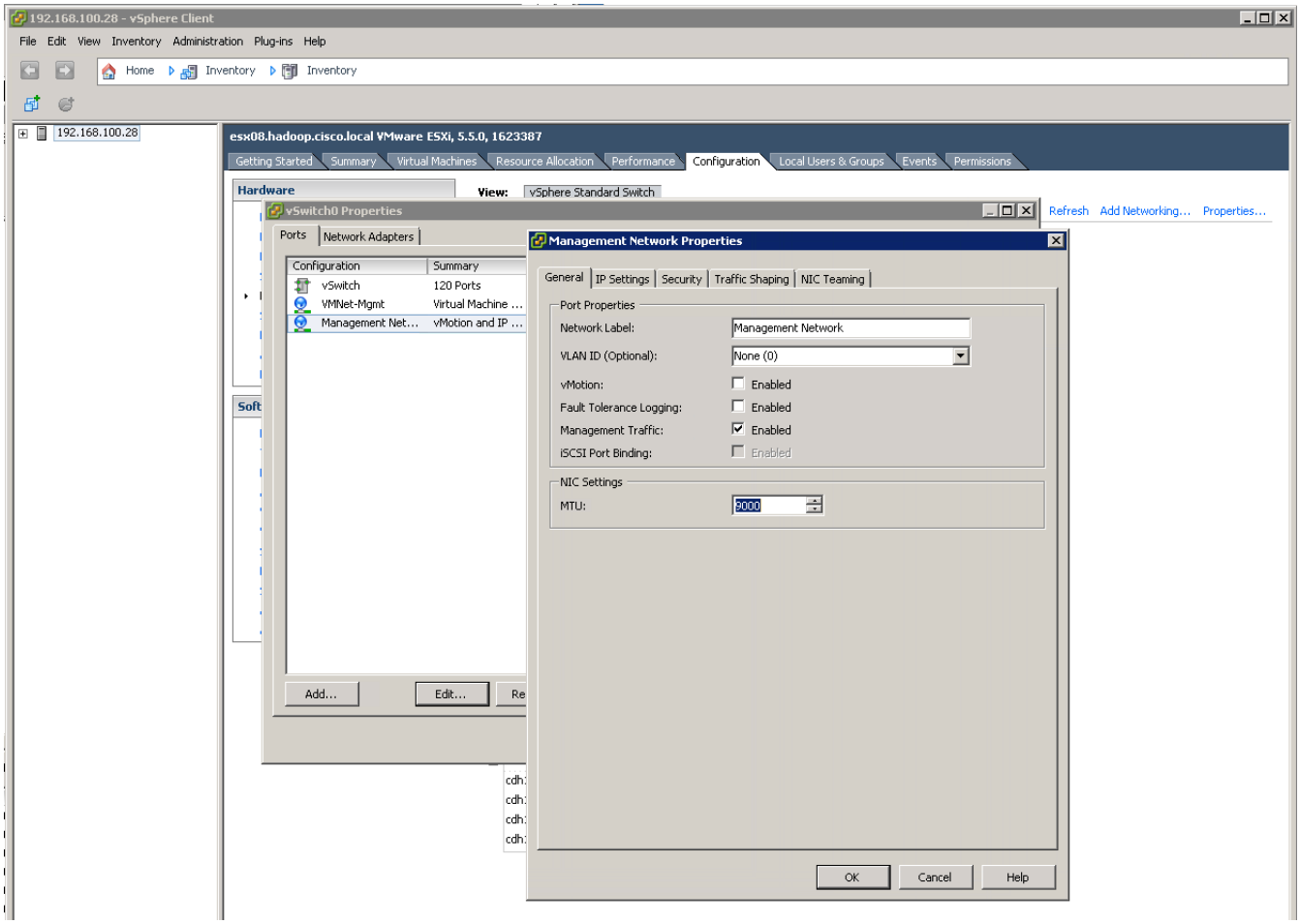
Command Information	vSwitch	Command Syntax
Set MTU to 9000	vSwitch0	`esxcli -s 192.168.100.28 -u root -p Cisco123 network vswitch standard set --vswitch-name=vSwitch0 -m 9000`
Creating a new vSwitch for HDFS	vSwitch1	`esxcli -s 192.168.100.28 -u root -p Cisco123 network vswitch standard add --vswitch-name=vSwitch1`
Creating a new Port-Group VMNet-HDFS	vSwitch1	`esxcli -s 192.168.100.28 -u root -p Cisco123 network vswitch standard portgroup add --portgroup-name=VMNet-HDFS --vswitch-name=vSwitch1`
Adding the uplink interfaces i.e. vmnic2, vmnic3	vSwitch0	`esxcli -s 192.168.100.28 -u root -p Cisco123 network vswitch standard uplink add --vswitch-name=vSwitch1 --uplink-name=vmnic2` `esxcli -s 192.168.100.28 -u root -p Cisco123 network vswitch standard uplink add --vswitch-name=vSwitch1 --uplink-name=vmnic3`
Set the vmnic2 as Active-Uplink, and vmnic3 as Standby- gUplink	vSwitch1	`esxcli -s 192.168.100.28 -u root -p Cisco123 network vswitch standard policy failover set --vswitch-name=vSwitch1 --active-uplinks=vmnic2 --standby-uplinks=vmnic3`
Set MTU to 9000	vSwitch1	`esxcli -s 192.168.100.28 -u root -p Cisco123 network vswitch standard set --vswitch-name=vSwitch1 -m 9000`
Creating a new vSwitch for MapReduce	vSwitch2	`esxcli -s 192.168.100.28 -u root -p Cisco123 network vswitch standard add --vswitch-name=vSwitch2`
Creating a new Port-Group VMNet-MapRed	vSwitch2	`esxcli -s 192.168.100.28 -u root -p Cisco123 network vswitch standard portgroup add --portgroup-name=VMNet-MapRed --vswitch-name=vSwitch2` `esxcli -s 192.168.100.28 -u root -p Cisco123 network vswitch standard portgroup set --portgroup-name=VMNet-MapRed --vlan-id 12`
Adding the uplink interfaces i.e. vmnic4, vmnic5	vSwitch2	`esxcli -s 192.168.100.28 -u root -p Cisco123 network vswitch standard uplink add --vswitch-name=vSwitch2 --uplink-name=vmnic4` `esxcli -s 192.168.100.28 -u root -p Cisco123 network vswitch standard uplink add --vswitch-name=vSwitch2 --uplink-name=vmnic5`
Set the vmnic5 as Active-Uplink, and vmnic4 as Standby-Uplink	vSwitch2	`esxcli -s 192.168.100.28 -u root -p Cisco123 network vswitch standard policy failover set --vswitch-name=vSwitch2 --active-uplinks=vmnic5 --standby-uplinks=vmnic4`
Set MTU to 9000	vSwitch2	`esxcli -s 192.168.100.28 -u root -p Cisco123 network vswitch standard set --vswitch-name=vSwitch2 -m 9000`

Note Copy the contents of the 3rd column into a text file and modify the IP-address in order to configure each ESXi host.

Configuring MTU to 9000 Management Network of vSwitch0

The above script would make all configurations except one that's necessary for this solution. The MTU of the Management Network port group of vSwitch0 needs to be set manually. It can be as shown below:

Figure 98 Setting MTU Value of "Management Network to 9000



Installing VMware ESXi and configuring remaining 15 servers

Now that one server is configured, we continue on to configure the install VMware Hypervisor and configure the VM Networking as per the last two sections.

The static-IP addresses that we used for configuring the Management vmnics of the VMware Hypervisor ESXi instances while building this solution are as follows:

Table 10 Static-IP address range used for configuring management network of VMware ESXi

Servers	Static IPv4 Address Range
16 blade servers	192.168.100.21 – 192.168.100.36 (Netmask: 255.255.255.0)

VMware vCenter Server

This section provides information on installing the VMware vCenter Server and the vSphere client software packages. There are two ways to install the vCenter Server.

1. Install vCenter Server on a Windows Server i.e. server with Windows Server 2008R2.
2. Install vCenter Server as an appliance.

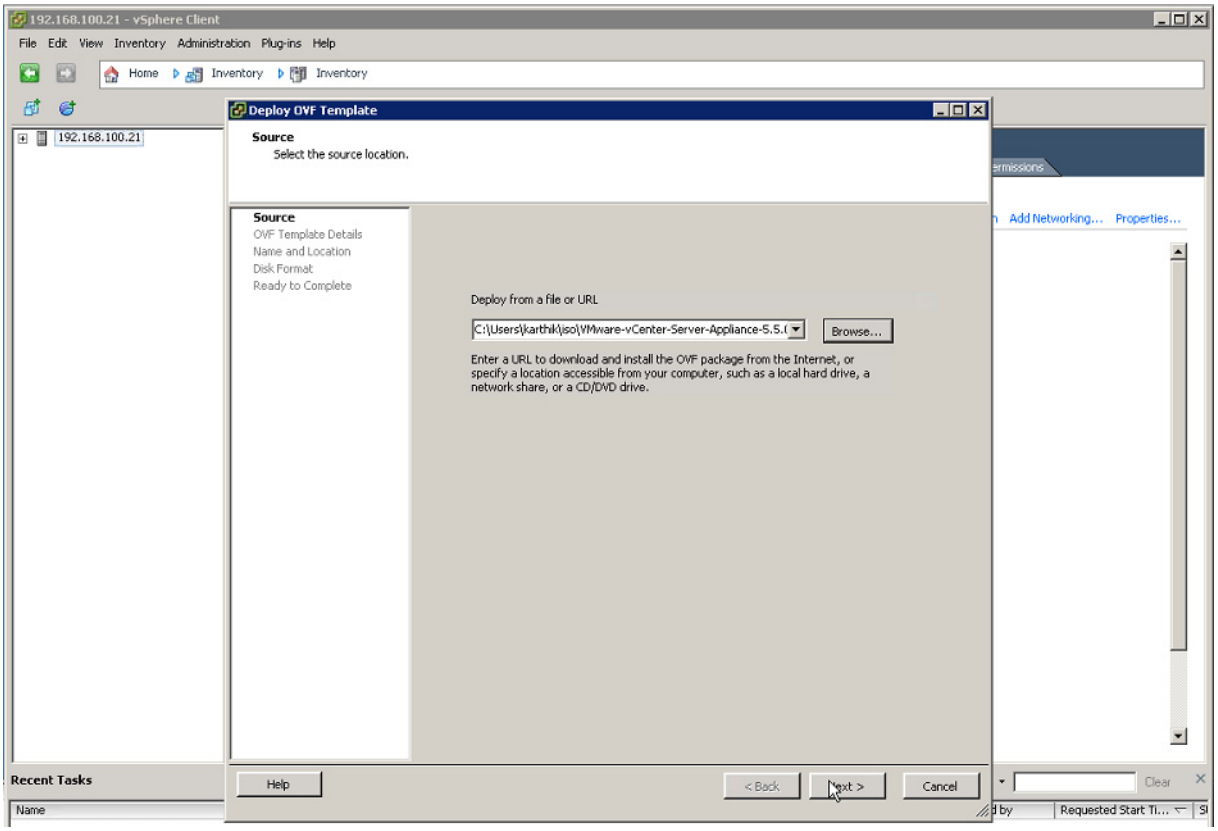
While building out this solution, we went with Option 2—installed the vCenter Virtual-Appliance 5.5 on a server in the Admin DRS-cluster.

In this solution we used both the Native vSphere-Client and vSphere Web-Client. Please note that, as mentioned in the pre-requisites in 14.1, vSphere Web-Client is a requirement for installing Big-Data-Extensions. The vCenter Server Appliance comes pre-packaged with vSphere Web-Client, so no other installation is required.

Installing the vCenter Server Virtual Appliance

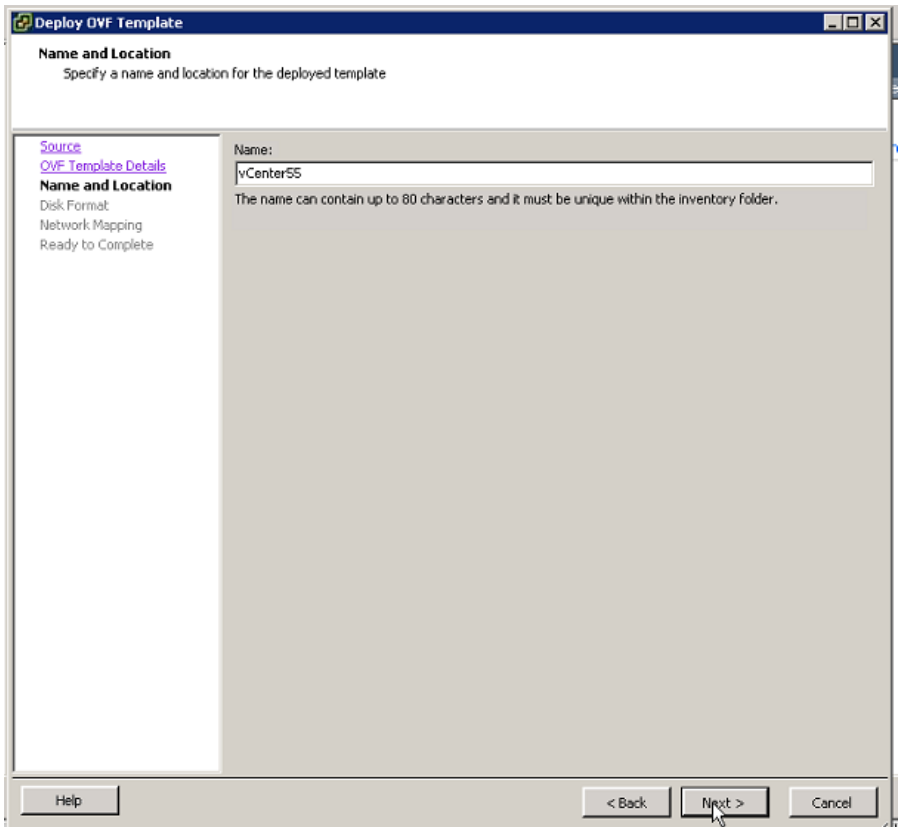
1. Download vCenter Server Virtual Appliance ISO file from the vmware website http://www.vmware.com/downloads.
2. Using the vSphere Native client, log into ESXi host 192.168.100.21.
3. From the **File** menu choose **Deploy OVF Template** option.
4. Choose the VMware-vCenter-Server-Appliance OVF file by using the <Browse> button. Click **Next**.

Figure 99 Choosing vCenter-Server Virtual Appliance OVF File



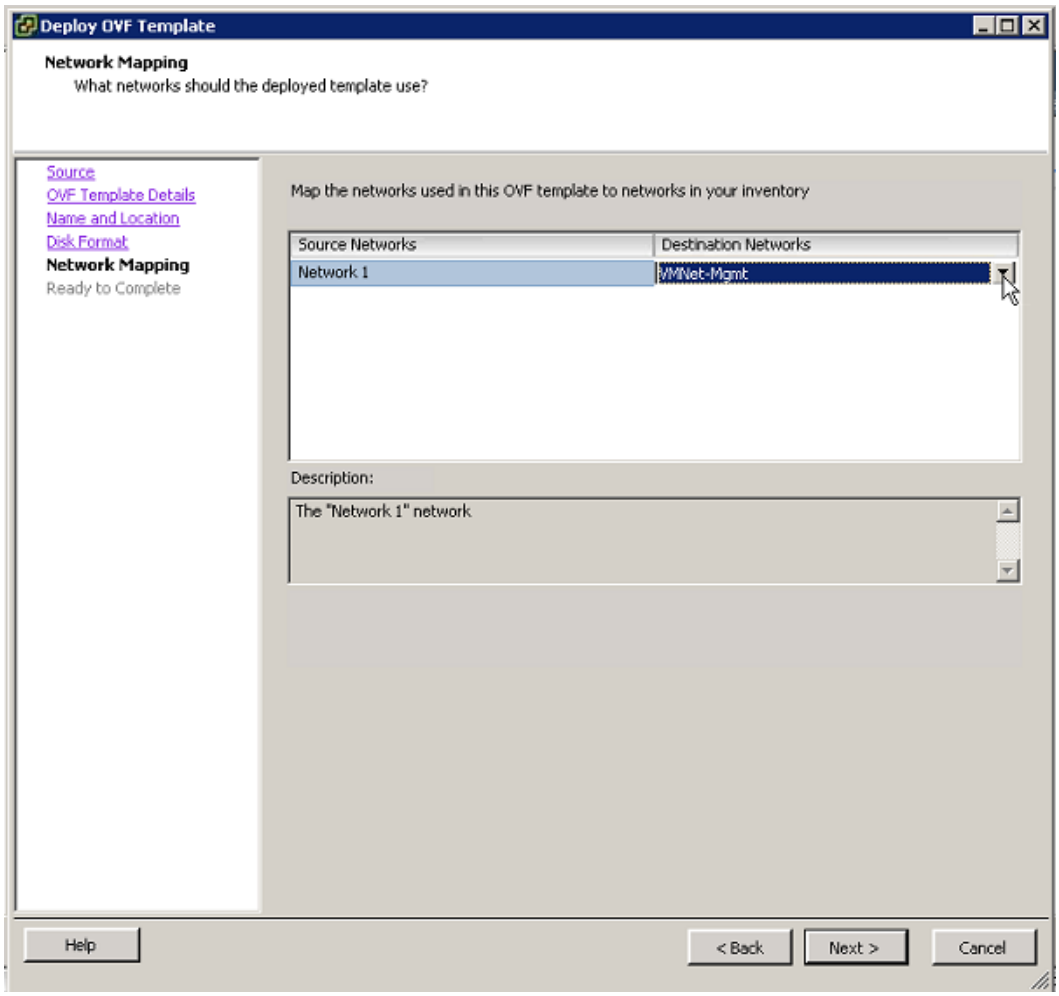
5. Accept the EULA, and name the VM as “vCenter55”.

Figure 100 Naming vCenter-Server Appliance



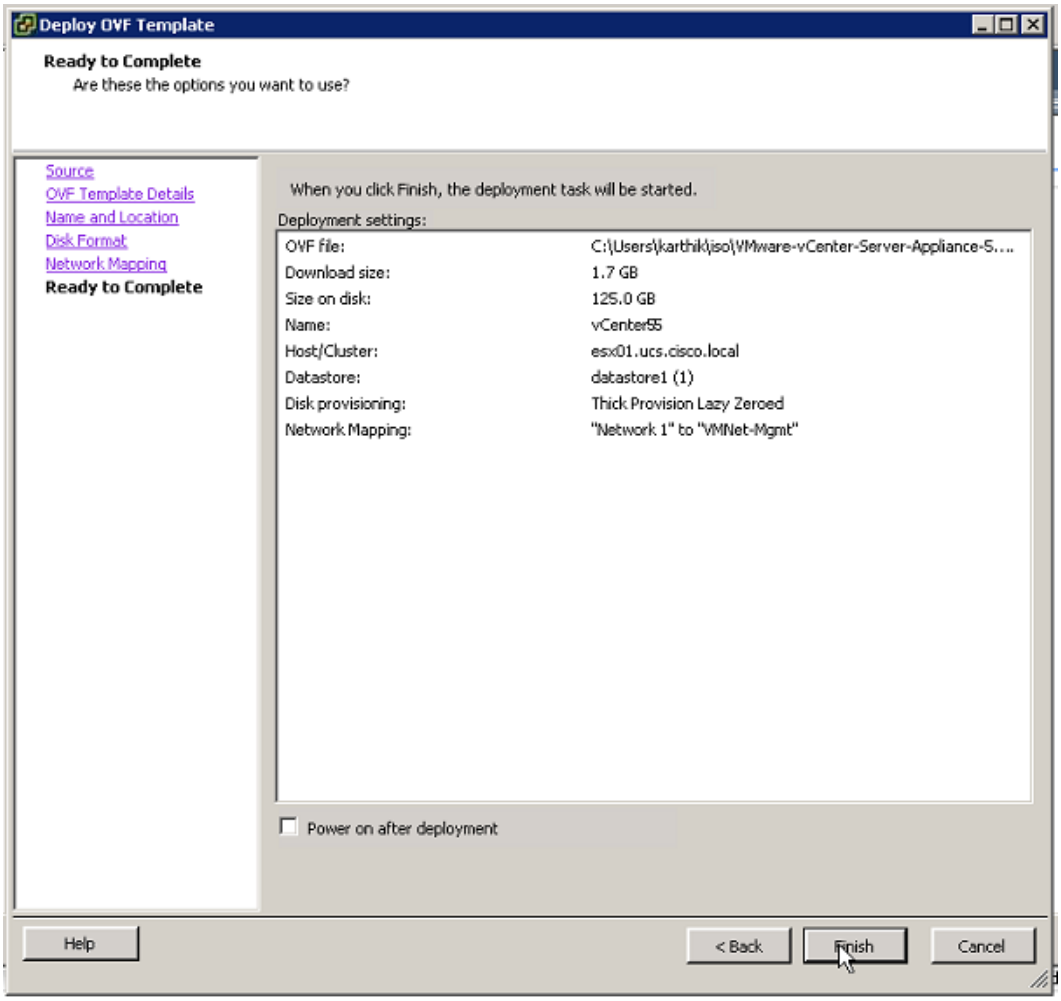
6. Accept the Default storage configurations.
7. Choose the Network port-group as **VMNet-Mgmt**. Click **Next**.

Figure 101 Selecting Correct vSphere Port-Group for Management Network



8. Review the details in the next Screen, and Click **Finish** to begin the deployment.

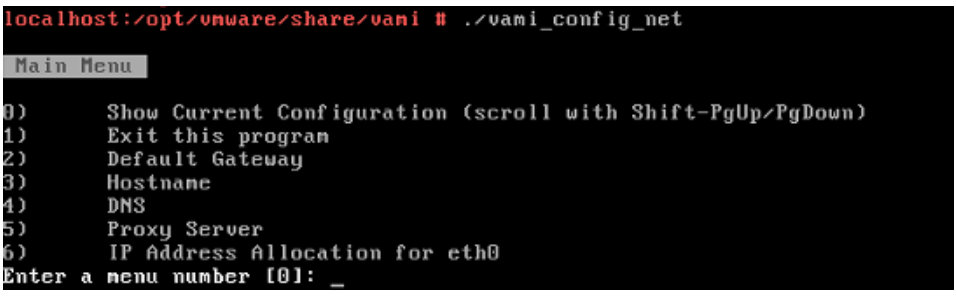
Figure 102 Reviewing Changes in Deployment Settings



Now the installation of the vCenter-Server appliance begins.

9. Now open the vCenter Server Virtual Appliance's console in the vSphere client, and click power-on.
10. Log onto the vCenter-Server Virtual Appliance by using the default credentials "root/vmware".
11. Run the script "./vami_config_net" from the directory "/opt/vmware/share/vami".

Figure 103 Configuring vCenter-Server Appliance VM's Network Interface



12. Choose the options displayed one at a time to input the following details:

Table 11 vCenter Virtual Appliance's Network Settings

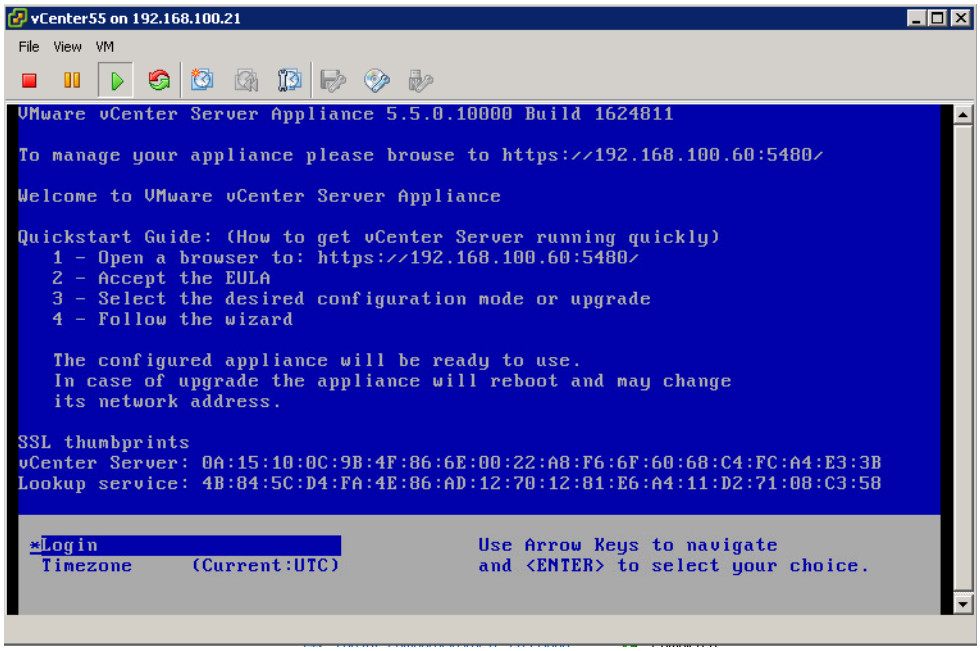
Option #	Information
2) Default Gateway	192.168.100.1
3) Hostname	vc55.hadoop.cisco.local
4) DNS	192.168.100.51 (IP address of the Admin-VM)
6) IP Address/Mask1	192.168.100.60/255.255.255.0

Note After completing the configurations detailed in "VMware vCenter Server" section on page 100 and "Creating and Configuring the Admin-VM" section on page 114, it is recommended that the vCenter-Server VM is restarted via its admin web-UI at https://192.168.100.60:5480.

Configuring vCenter-Server Virtual Appliance

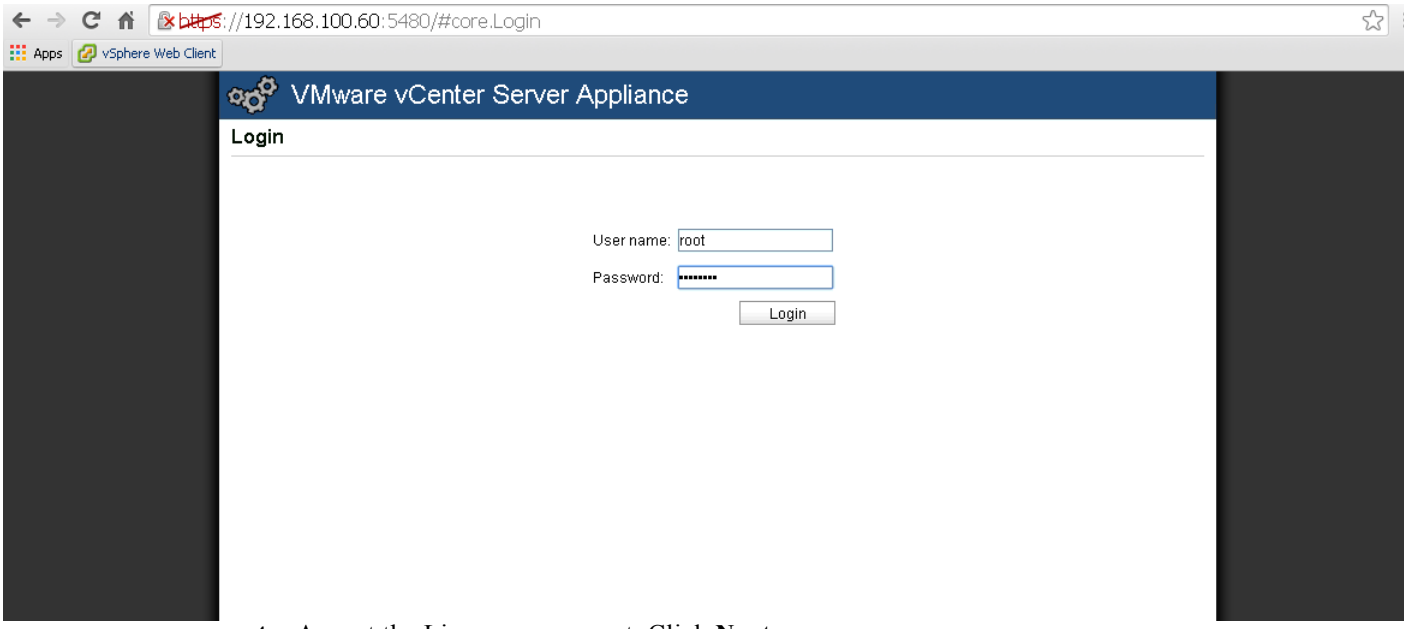
1. Subsequently press 1 to exit the program. It would return to the console that looks like this.

Figure 104 vCenter-Server Virtual Appliance's Console



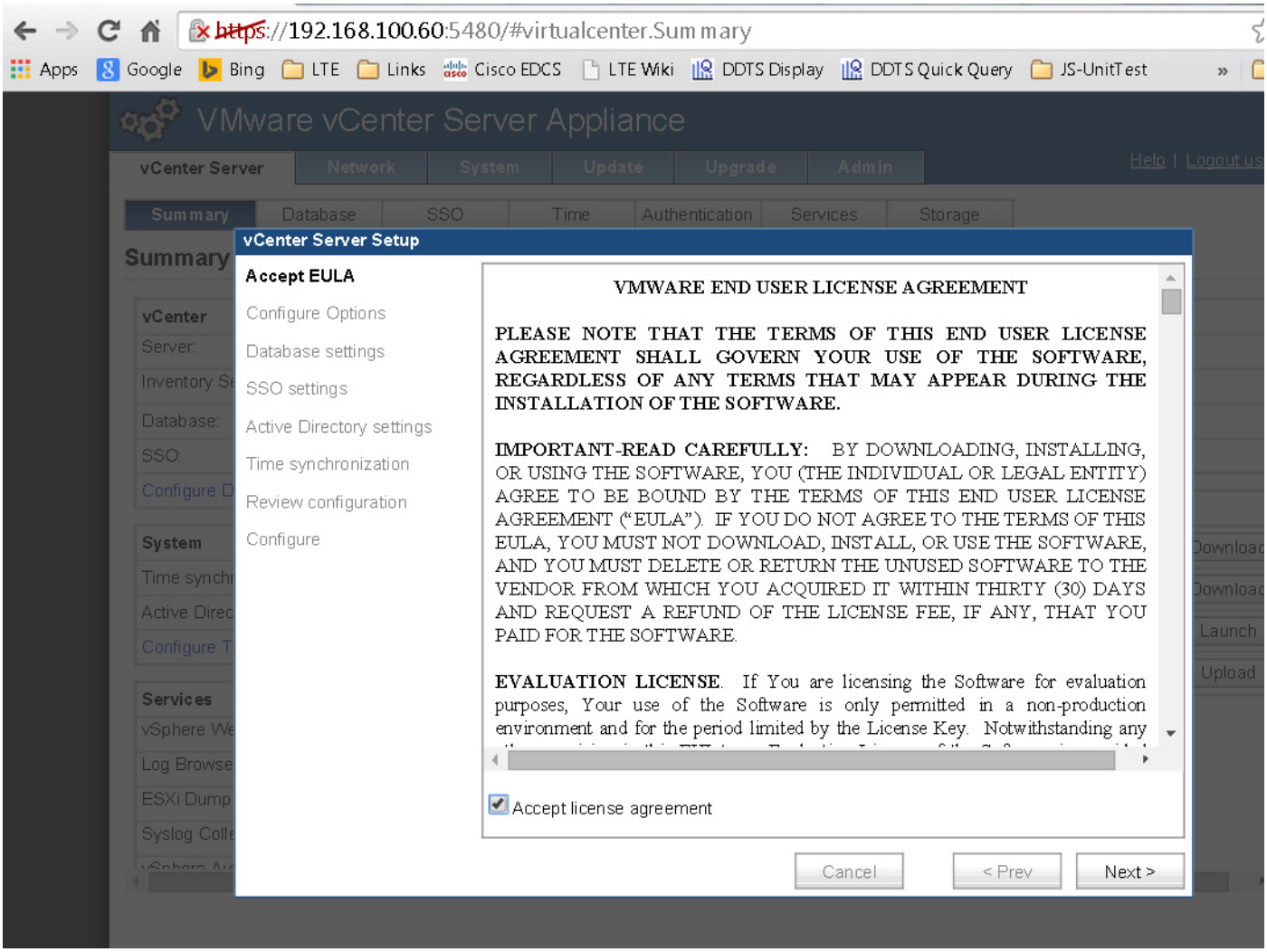
2. Now open a web-browser to open the URL: https://192.168.100.60:5480
3. Login with the default credentials Username: "root", Password: vmware"

Figure 105 Logging into vCenter-Server Admin Web User Interface



4. Accept the License agreement. Click **Next**.

Figure 106 Accepting EULA in vCenter-Server Admin User Interface

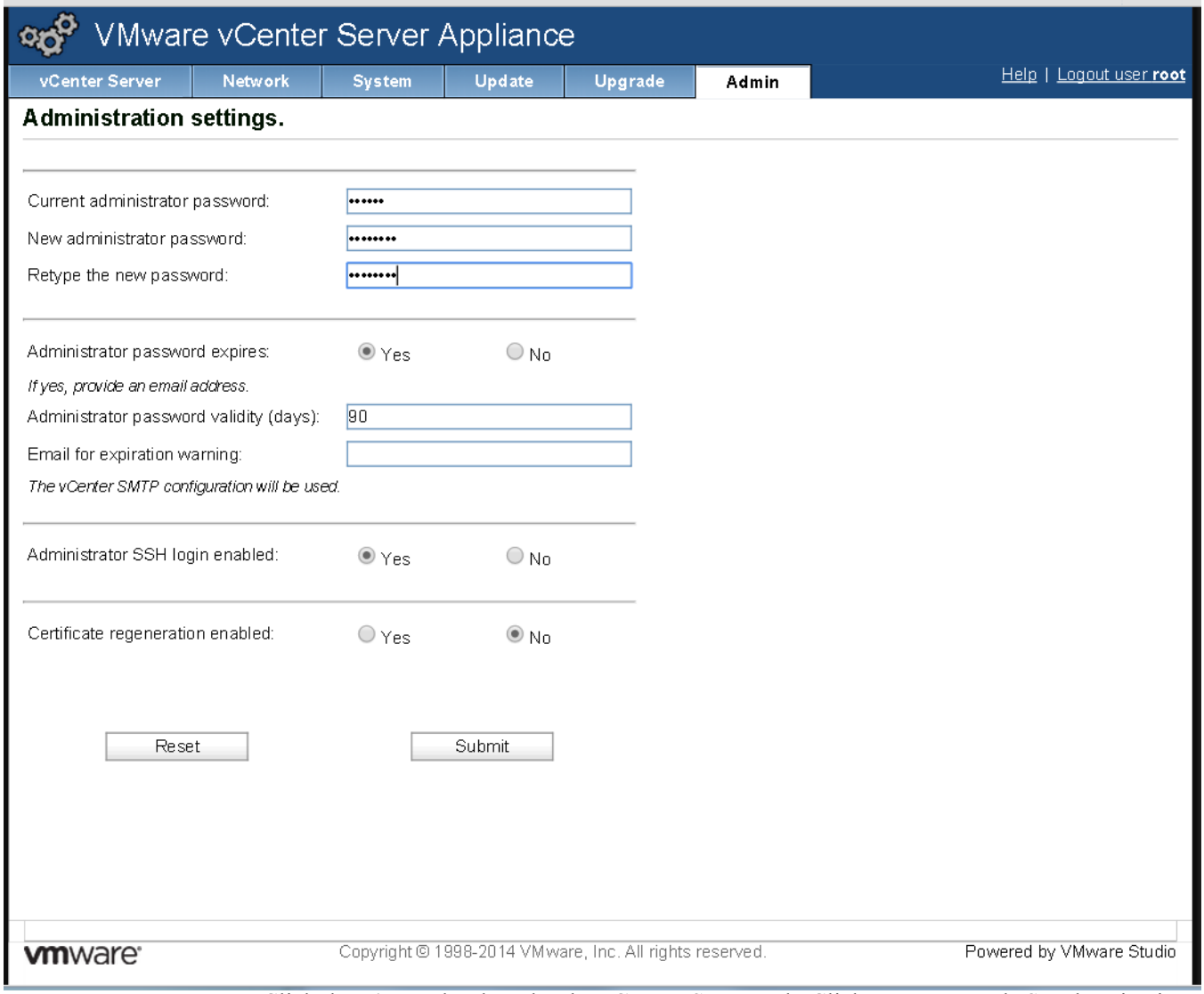


5. In the next screen, click **Cancel** to go to the dashboard.

Note we will resume the setup wizard after reviewing the FQDN and IP-settings.

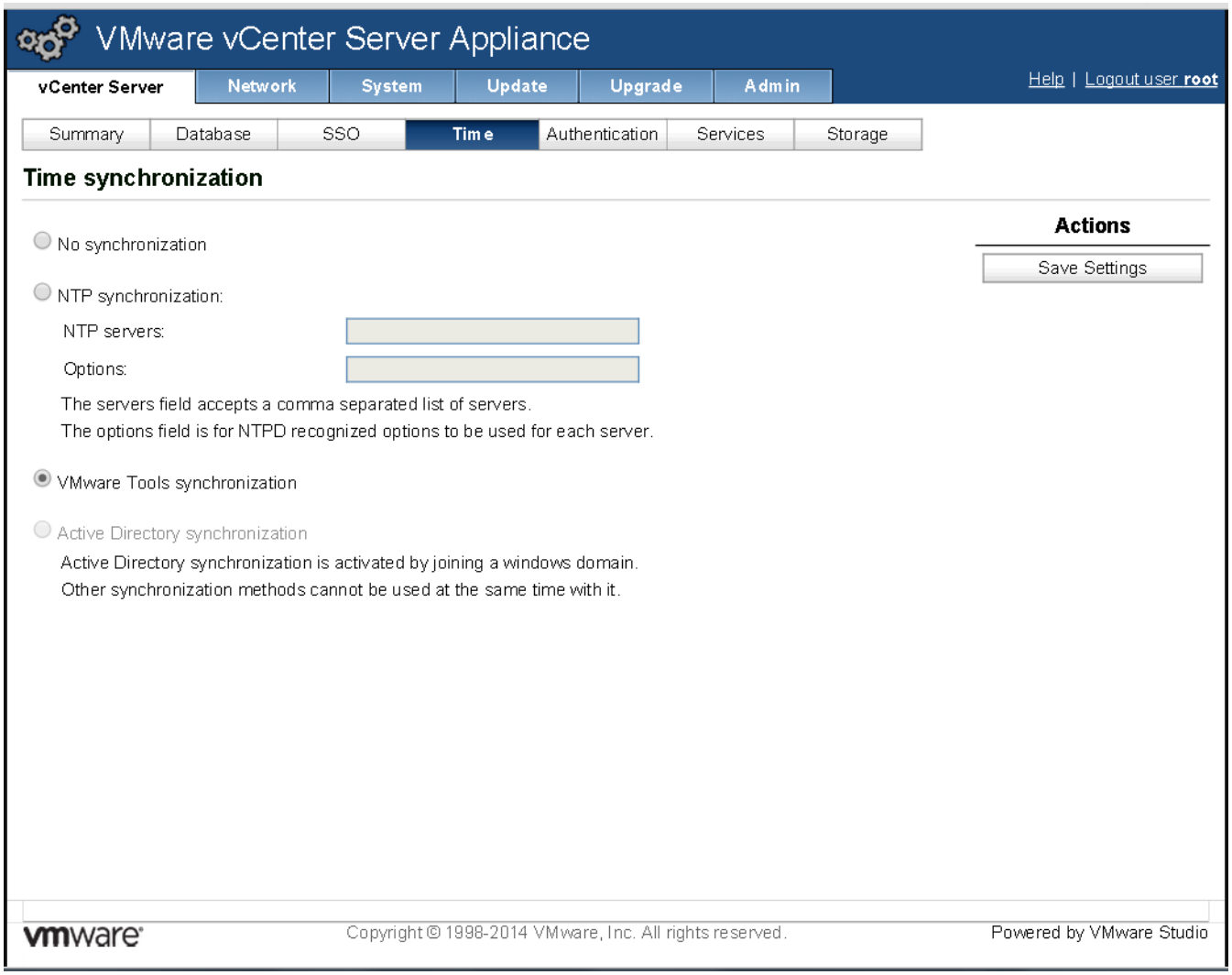
6. Change the admin password in the Admin tab page and click **Submit**.

Figure 107 vCenter-Server: Change the Admin Password



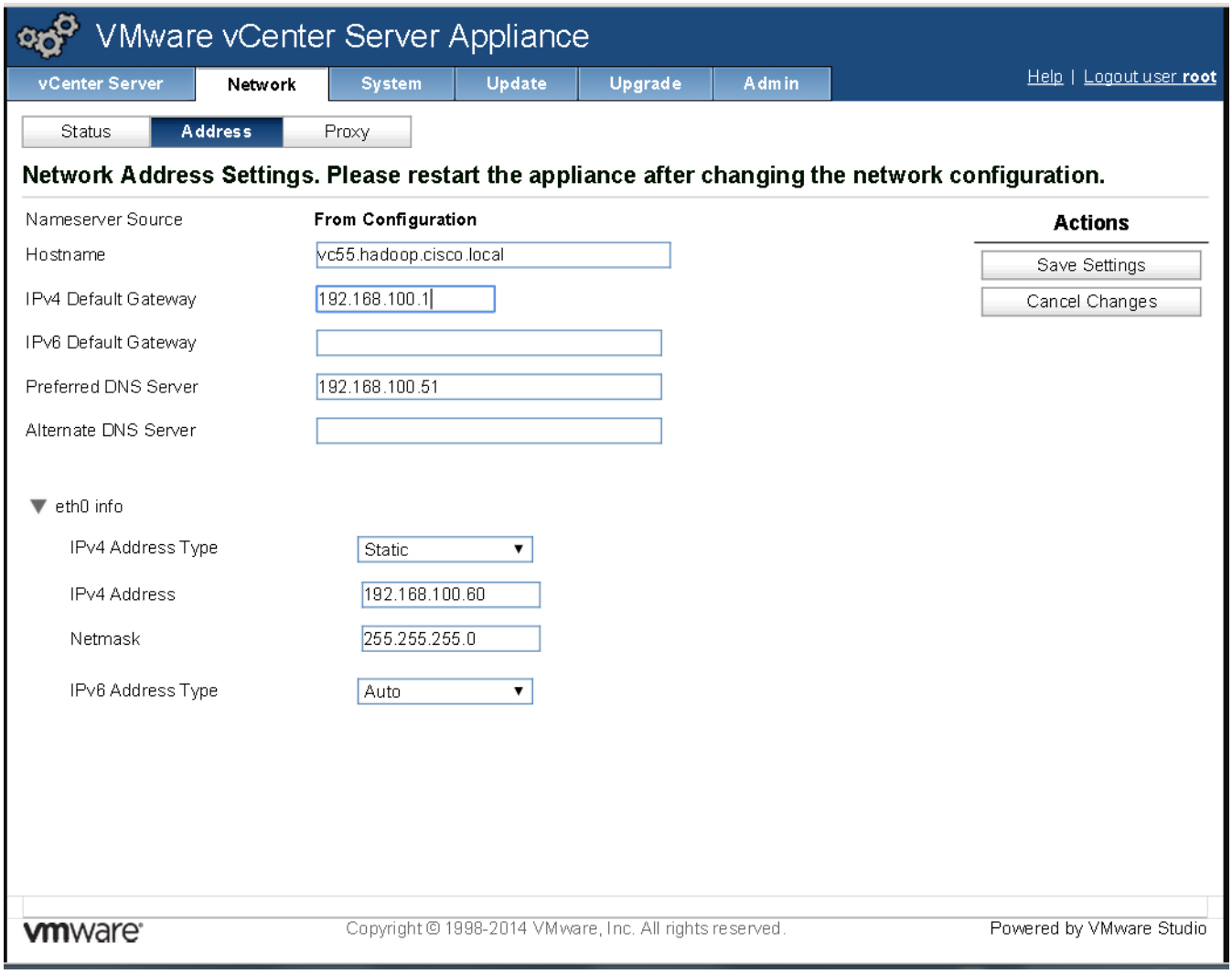
7. Click the **Time** sub-tab under the **vCenter Server** tab. Click VMware Tools Synchronization radio-button and click Save Settings. This will synchronize the time of the vCenter Server Appliance VM with its host ESXi (IP: 192.168.100.21).

Figure 108 Choosing VMware Tools Synchronization for Time



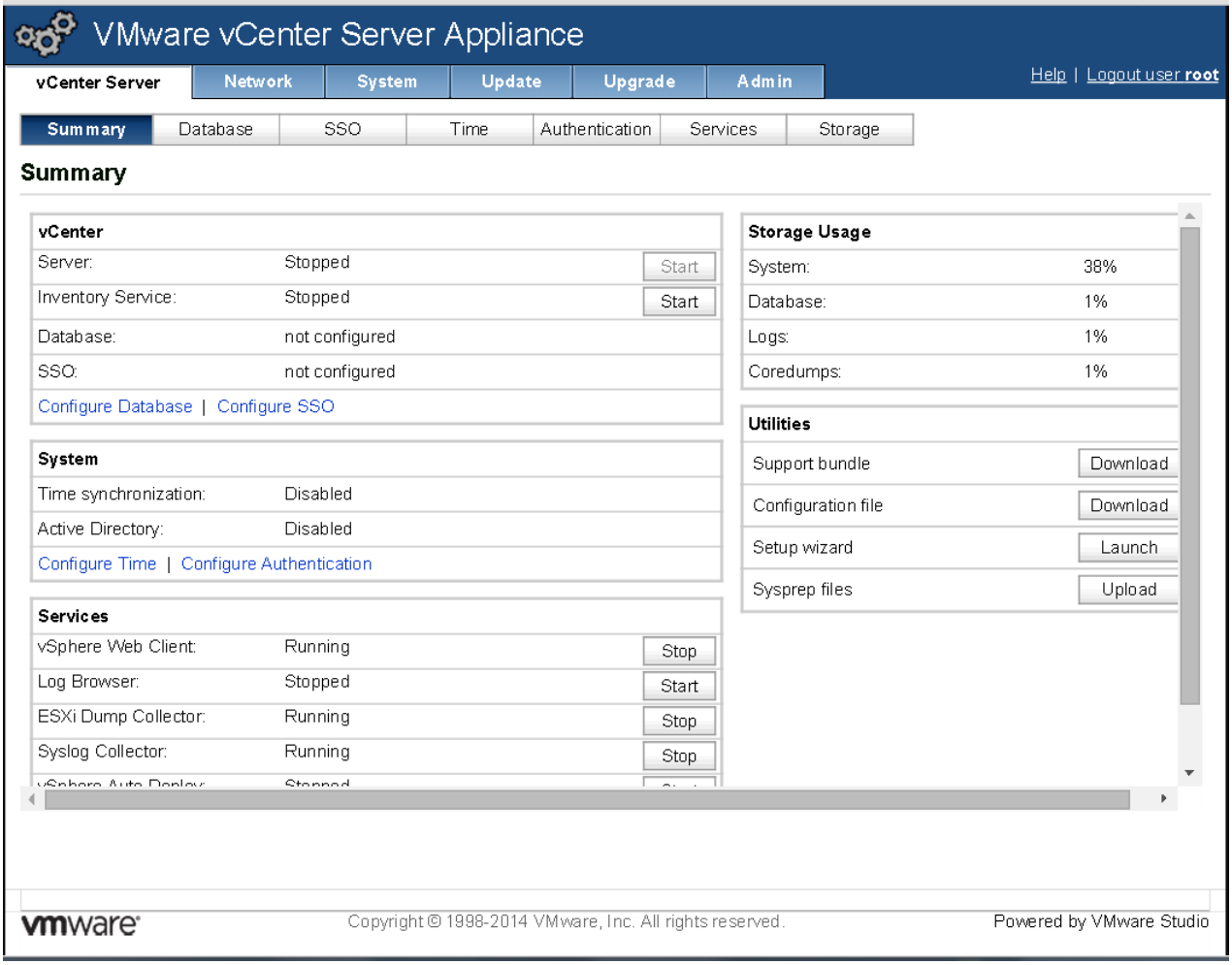
8. Click the **Network** tab, and choose the **Address** sub-tab. Verify the IP-address and the hostname are set correctly. If not, update them as specified in Table 10, and Click **Save Settings**.

Figure 109 Setting FQDN of vCenter-Server



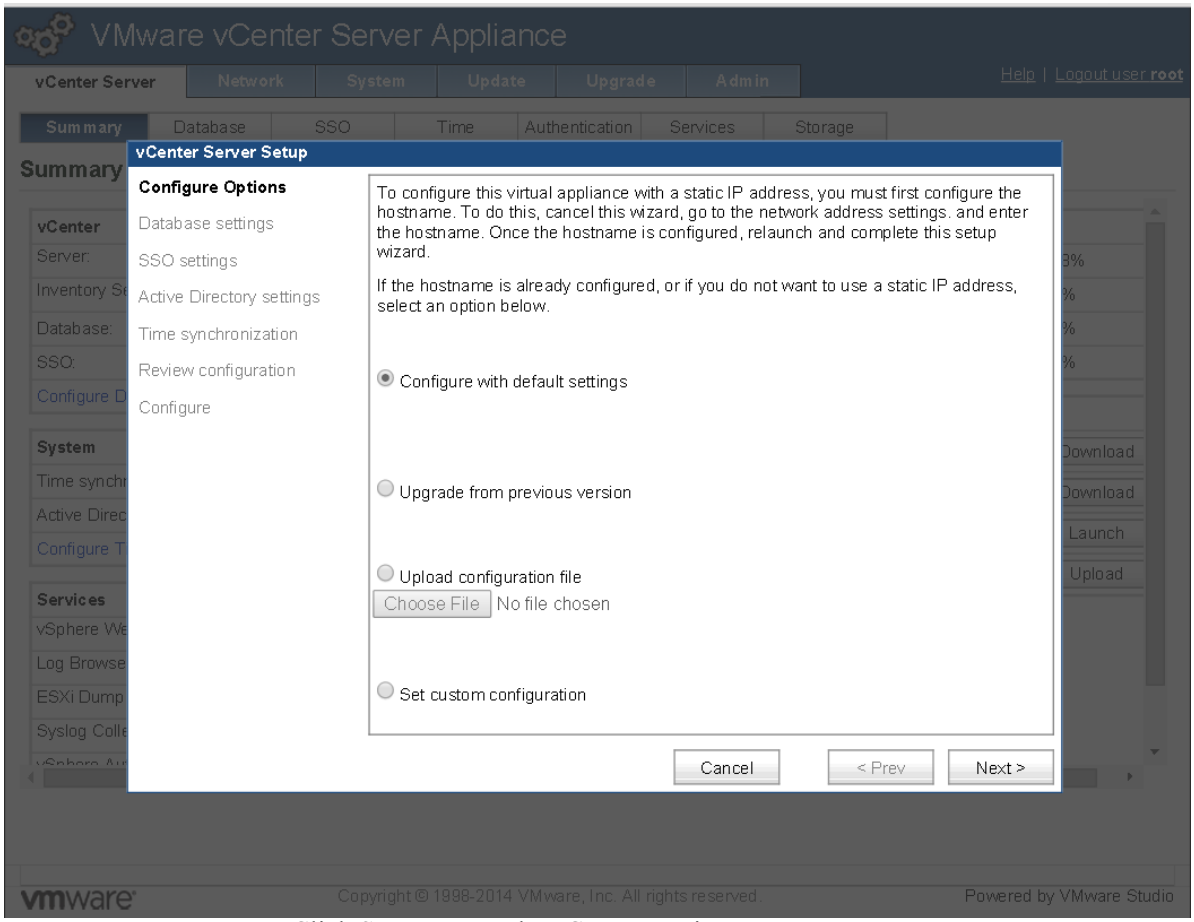
9. If the change was made, click “Logout user root” link. And, <Refresh> key of the browser.
10. Log back into the **VMware vCenter Virtual Appliance**.
11. Click **Launch** in the Utilities section of the Summary screen to launch the Setup Wizard.

Figure 110 vCenter-Server Virtual Appliance's Summary Dashboard



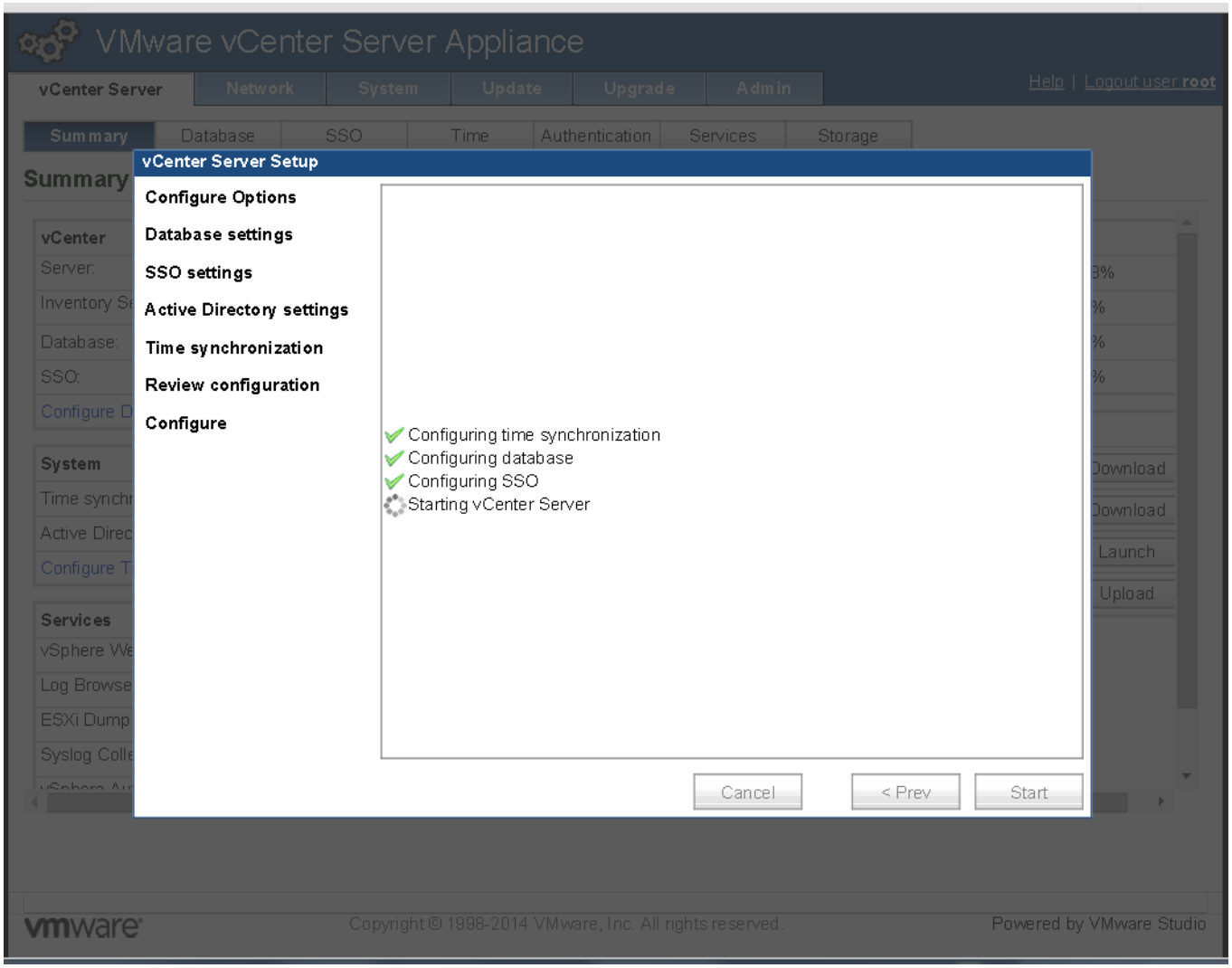
12. Click **Configure with default settings** option. Click **Next**.

Figure 111 vCenter-Server: Choose Default settings



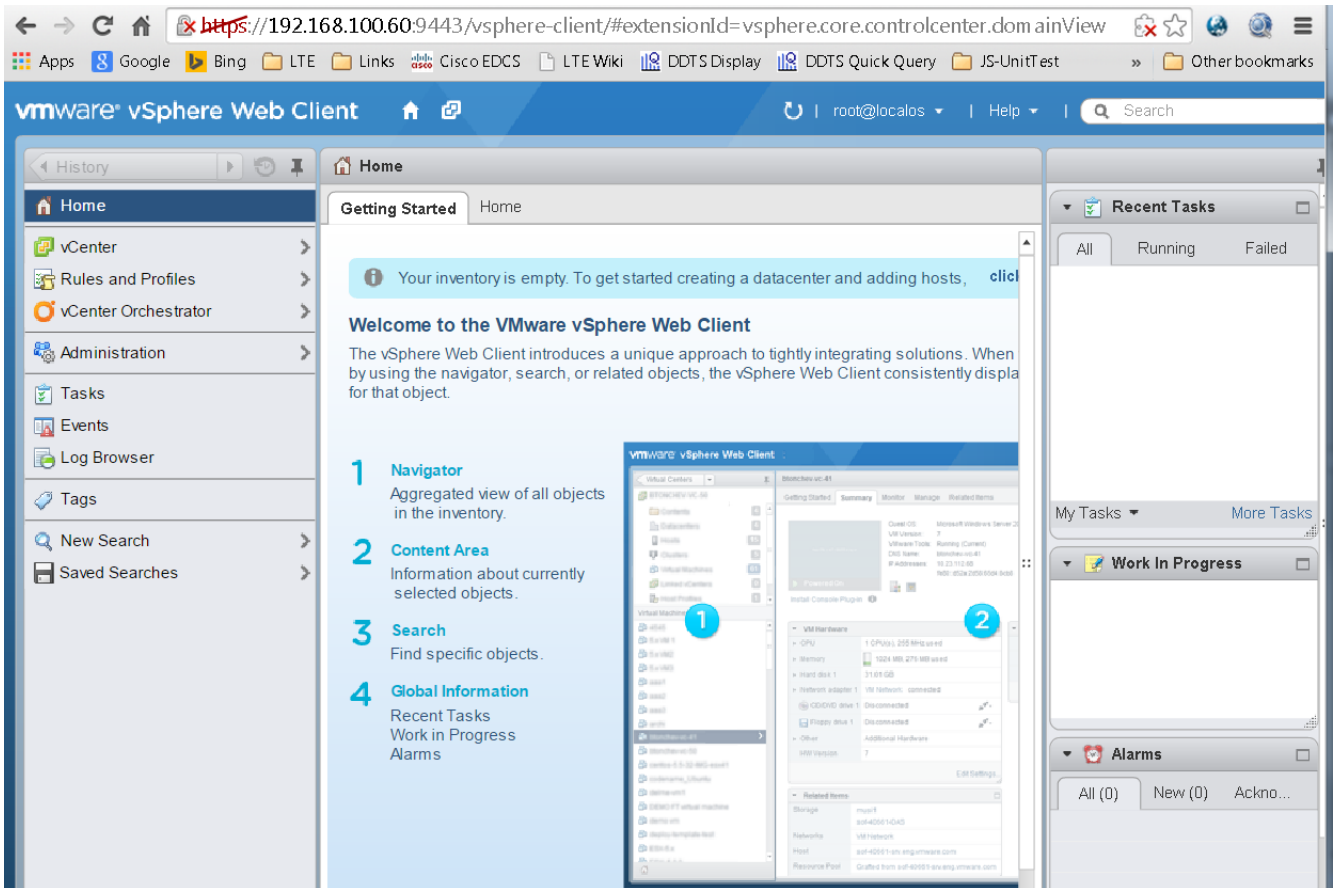
13. Click **Start** to start the vCenter services.

Figure 112 Starting vCenter Server Service



14. Click **Summary** tab of the **vCenter Server dashboard** tab.
15. Verify that all the services in are running state. i.e. vCenter Server, Inventory Service, WebClient etc.
16. Now use a browser to open the URL https://192.168.100.60:9443/vsphere-client/.
17. Log on as user root using the newly assigned password.

Figure 113 Logging into vCenter-Server Using VMware vSphere Web Client.



Creating and Configuring the Admin-VM

In this section, we will walk through the process of creating an Admin-VM instance. The admin-VM is a RHEL6.4 based VM that plays critical role in the solution. This consists of the following services:

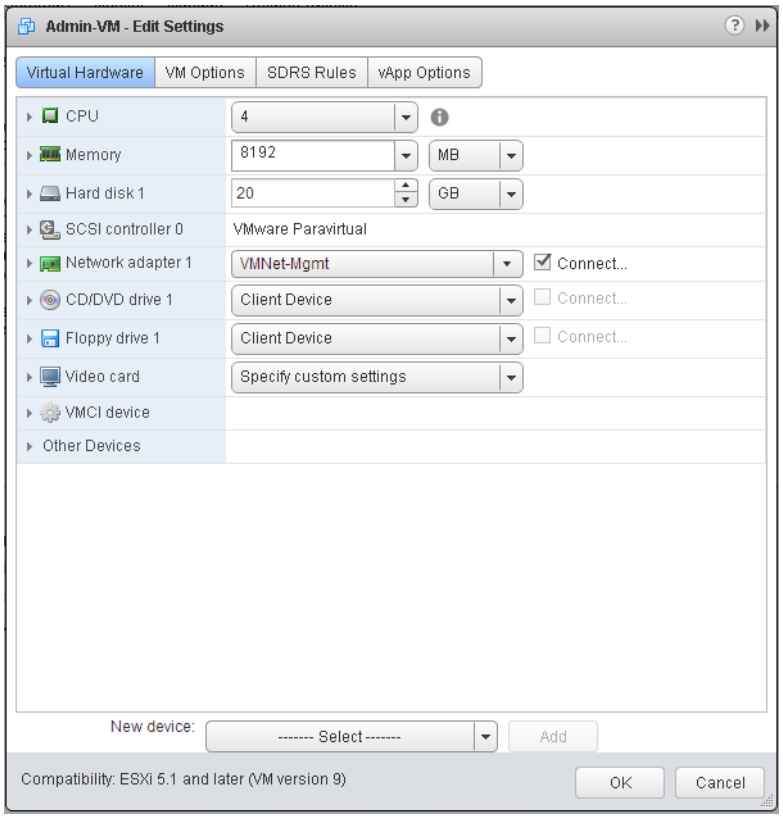
- DNS-Server
- DHCP-Server
- NTP-Server (Local)
- Cloudera and RHEL Repositories

This VM is kept on the ESXi host 192.168.100.21 of the Admin resource-pool.

Creating Admin-VM

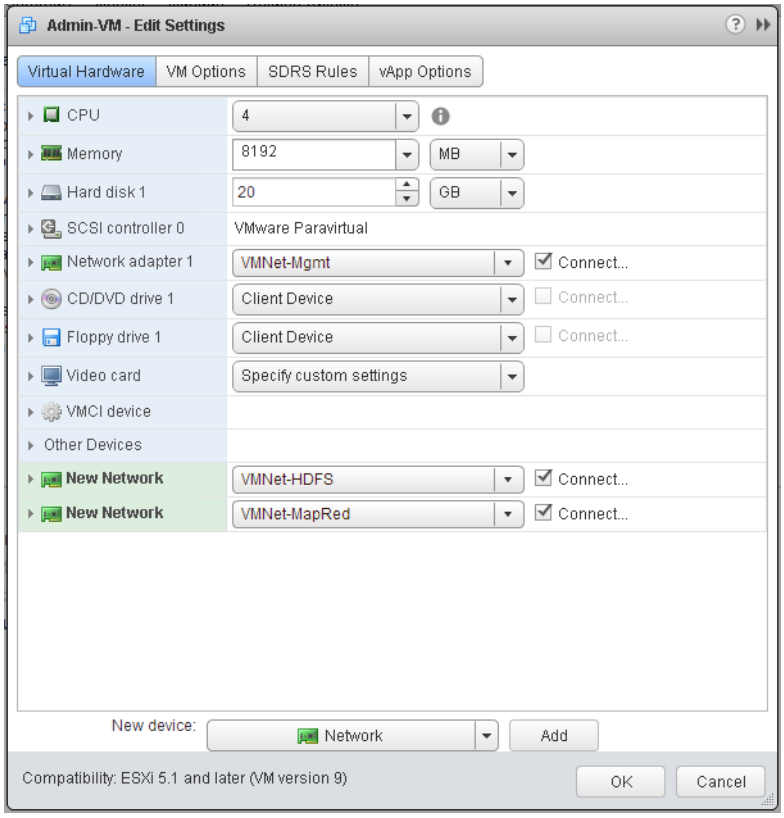
1. Create a VM in the ESXi host 192.168.100.21 in the Admin DRS-cluster. Name this VM as "Admin-VM".
2. Click **Edit-Settings** on this VM, and Assign the Network Adapter to the VMNet-Mgmt port-group.

Figure 114 Creating Admin-VM



3. Add two additional Network adapters and assign them to VMNet-HDFS and VMNet-MapRed port-groups respectively.

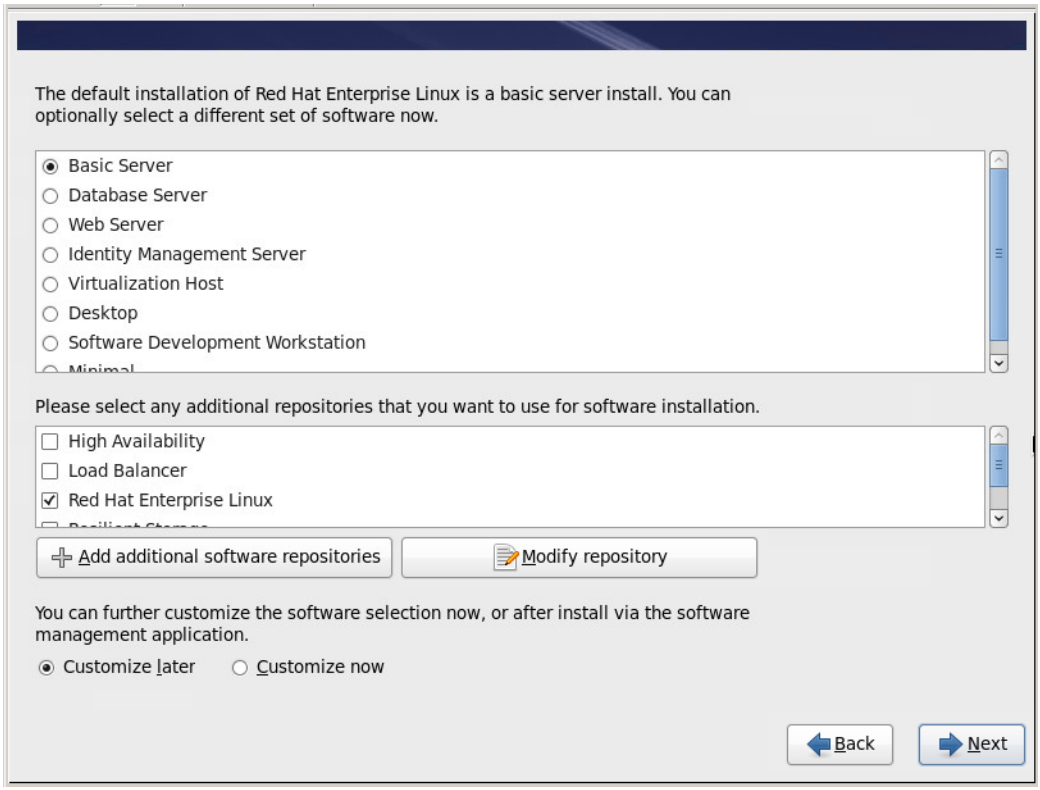
Figure 115 Admin-VM Settings: Add the additional Network Interfaces for the HDFS and MapRed



4. Install RHEL6.4 as described in "Installing RHEL6.4 in VM" section on page 180. While following those instructions, please choose **Basic Server** instead of minimal installation of RedHat Linux for the Admin-VM.

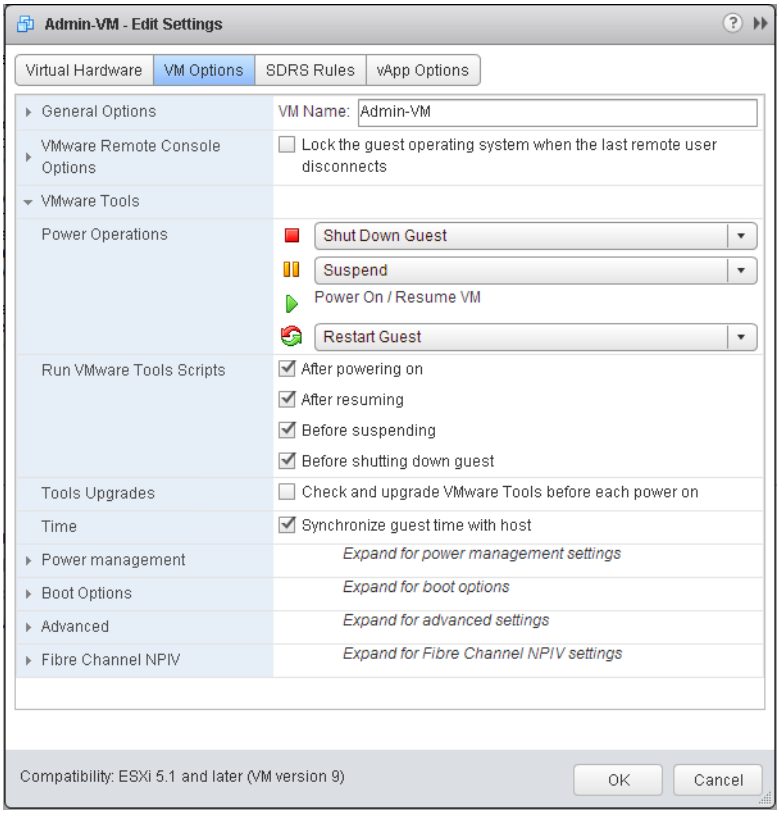
Note After the Admin-VM's RHEL6.4 Basic Server installation is complete, continue at step#5 below.

Figure 116 Installing RedHat Enterprise Linux (RHEL 6.4)



5. Power-On the VM.
6. Right-click the VM option to edit settings on the vSphere Web-Client.
7. Click the **VM Options** tab, and expand the "VMware Tools" section.
8. In the Time field, click the Synchronize guest time with host check box. Click **OK** to accept the changes.

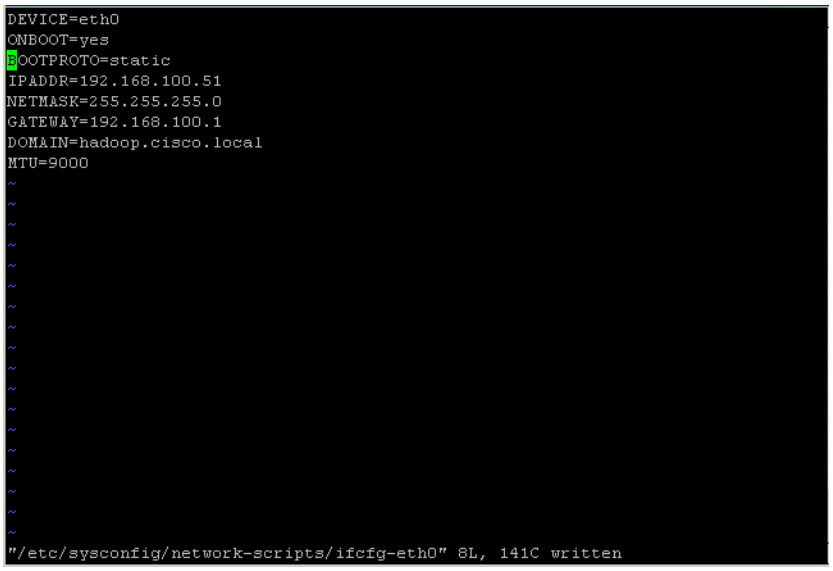
Figure 117 Choosing VM Time to be synchronized With Host ESXi



9. Log into the VM as “root” user.
10. Edit the Interface configuration file “/etc/sysconfig/network-scripts/ifcfg-eth0” file to assign the static IP address as follows.

```
DEVICE=eth0
ONBOOT=yes
BOOTPROTO=static
IPADDR=192.168.100.51
NETMASK=255.255.255.0
GATEWAY=192.168.100.1
DOMAIN=hadoop.cisco.local
MTU=9000
```

Figure 118 Configuring IP-address for Management Network Interface eth0



11. Similarly, Edit the Interface configuration file "/etc/sysconfig/network-scripts/ifcfg-eth1" file to assign the static IP address as follows.

```
DEVICE=eth1
ONBOOT=yes
BOOTPROTO=static
IPADDR=10.0.11.57
NETMASK=255.255.255.0
DOMAIN=hadoop.cisco.local
MTU=9000
```

12. And, edit the Interface configuration file "/etc/sysconfig/network-scripts/ifcfg-eth2" file to assign the static IP address as follows.

```
DEVICE=eth2
ONBOOT=yes
BOOTPROTO=static
IPADDR=10.0.12.57
NETMASK=255.255.255.0
DOMAIN=hadoop.cisco.local
MTU=9000
```

13. Restart the network by using the command "service network restart".

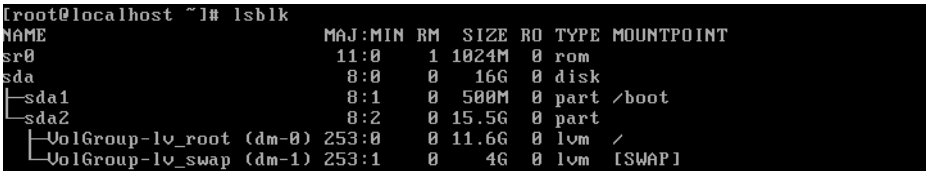
```
service network restart
```

Setting up RHEL Repository

Copy the contents of the RHEL6.4 ISO mounted to the VM from the previous steps as follows:

1. Use the command "lsblk" to detect the DVD drive device name. In this case, it is "sr0".

Figure 119 Admin-VM: Naming CD/DVD Device



2. Now mount the device “/dev/sr0” to a new mount point “/mnt/dvd”.
3. Create a RHEL Repo directory at “/var/www/html/rhelrepo”.
4. Copy the contents of the RHEL6.4 ISO DVD to the newly created directory “/var/www/html/rhelrepo”.
5. Now unmounts the device by using the command “umount /mnt/dvd”.

```
mkdir -p /mnt/dvd
mount -t iso9660 -o ro /dev/sr0 /mnt/dvd
mkdir -p /var/www/html/rhelrepo
cp -r /mnt/dvd/* /var/www/html/rhelrepo
umount /mnt/dvd
```

Figure 120 Admin-VM: Copying the RHEL RPMs

```
[root@localhost ~]# mount -t iso9660 -o ro /dev/sr0 /mnt/dvd
[root@localhost ~]# mkdir -p /var/www/html/rhelrepo
[root@localhost ~]# cp -r /mnt/dvd/* /var/www/html/rhelrepo/
[root@localhost ~]# ls /var/www/html/rhelrepo/
EULA              README                    RELEASE-NOTES-pt-BR.html
EULA_de           RELEASE-NOTES-as-IN.html  RELEASE-NOTES-ru-RU.html
EULA_en           RELEASE-NOTES-bn-IN.html  RELEASE-NOTES-si-LK.html
EULA_es           RELEASE-NOTES-de-DE.html  RELEASE-NOTES-ta-IN.html
EULA_fr           RELEASE-NOTES-en-US.html  RELEASE-NOTES-te-IN.html
EULA_it           RELEASE-NOTES-es-ES.html  RELEASE-NOTES-zh-CN.html
EULA_ja           RELEASE-NOTES-fr-FR.html  RELEASE-NOTES-zh-TW.html
EULA_ko           RELEASE-NOTES-gu-IN.html  repodata
EULA_pt           RELEASE-NOTES-hi-IN.html  ResilientStorage
EULA_zh           RELEASE-NOTES-it-IT.html  RPM-GPG-KEY-redhat-beta
GPL               RELEASE-NOTES-ja-JP.html  RPM-GPG-KEY-redhat-release
HighAvailability  RELEASE-NOTES-kn-IN.html  ScalableFileSystem
images            RELEASE-NOTES-ko-KR.html  Server
isolinux          RELEASE-NOTES-ml-IN.html  TRANS.TBL
LoadBalancer      RELEASE-NOTES-mr-IN.html
media.repo        RELEASE-NOTES-or-IN.html
```

6. Create a repo file in “/etc/yum.repos.d/rheliso.repo” with the following contents.

```
[rhel6.4]
name=Red Hat Enterprise Linux 6.4
baseurl=file:///var/www/html/rhelrepo
gpgcheck=0
enabled=1
```

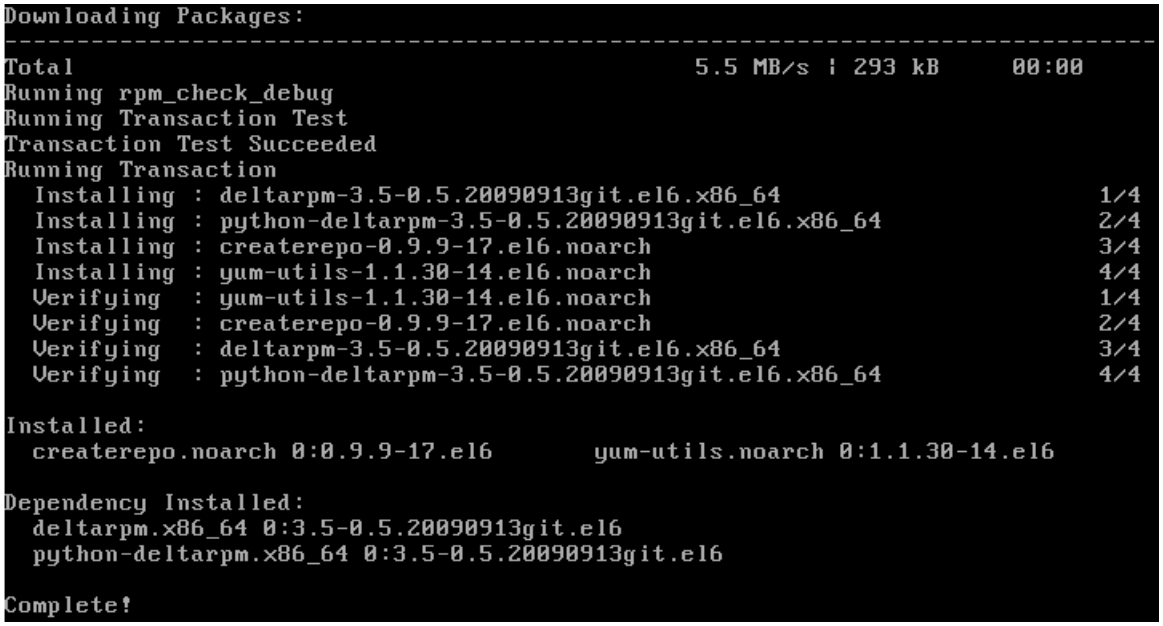
Figure 121 Admin-VM: Setting up Yum Repository Configurations for RHEL6.4 Repository

```
[rhel6.4]
name=Red Hat Enterprise Linux 6.4
baseurl=file:///var/www/html/rhelrepo
gpgcheck=0
enabled=1
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
"/etc/yum.repos.d/rheliso.repo" 5L, 103C
```

7. Install the “createrepo” and “yum-utils” packages.

```
yum install createrepo yum-utils
```

Figure 122 Installing Yum Tools



8. Run “createrepo command in the directory “/var/www/html/rhelrepo”.

```
cd /var/www/html/rhelrepo
createrepo .
```

9. Now the RHEL repository is ready. You may optionally create a repo file “/etc/yum.repos.d/rheliso.repo” with the following repository contents to the RHEL6.4-Template so that all the VMs of the Hadoop-Cluster automatically get access to a local RHEL-repository.

```
[rhel6.4]
name=Red Hat Enterprise Linux 6.4
baseurl= http://192.168.100.51/rhelrepo
gpgcheck=0
enabled=1
```

Assign Hostname Admin-VM

The Admin-VM’s Management IP-address is 192.168.100.51. Assign a hostname (FQDN) for this VM. We used the name “admin-vm.hadoop.cisco.com”. Use the command “hostname” to set the FQDN.

```
hostname admin-vm.hadoop.cisco.local
```

Figure 123 Assigning Hostname

Setting up the Cloudera Manager 5.2 Repository and CDH 5.1.3 Parcels

This section describes the procedure to download the RPMs, Cloudera-Manager Installer and configure the Cloudera Manager 5.2 repository in the Admin-VM.

Creating a Cloudera Manager Repository in the Admin-VM

In order to create a YUM repo for the Cloudera Manager, we need to download the Cloudera Manager RPMS and the associated GPG-Key that are found here:

http://archive.cloudera.com/cm5/redhat/6/x86_64/cm/5.2.0

http://archive-primary.cloudera.com/cm5/redhat/6/x86_64/cm/RPM-GPG-KEY-cloudera

In our solution, we will be setting up the Admin-VM as the Cloudera Manager YUM repo server. Cloudera Manager RPMs and Cloudera Manager Installer RPM shall be downloaded from a host connected to the internet, and transferred over to the Admin-VM.

From a host connected to the internet, download the Cloudera Manager RPMs and repodata as shown below using "reposync" utility and transfer them to the Admin-VM.

1. In the Admin-VM, create the Cloudera Manager specific directories under "/var/www/html" and copy over the contents of "cloudera-cdh5" directory downloaded in the previous step.

In Admin-VM:

```
mkdir -p /var/www/html/cm/5/
mkdir -p /var/www/html/cm/installer
mkdir -p /var/www/html/cdh/5.1.3/parcels
```

Figure 124 Creating the CM Repository and CDH 5.1.3 Parcel Folders

```
[root@admin-vm ~]# mkdir -p /var/www/html/cm/5/
[root@admin-vm ~]# mkdir -p /var/www/html/cm/installer
[root@admin-vm ~]# mkdir -p /var/www/html/cdh/5.1.3/parcels
```

2. Download the Cloudera Manager's repo file "cloudera-manager.repo" from the Cloudera archives.

```
mkdir -p /tmp/cloudera-mgr
cd /tmp/cloudera-mgr
wget http://archive.cloudera.com/cm5/redhat/6/x86_64/cm/cloudera-manager.repo
```

Figure 125 Downloading the cloudera-mgr.repo File

```
[root@localhost ~]# mkdir -p /tmp/cloudera-mgr
[root@localhost ~]# cd !$
cd /tmp/cloudera-mgr
[root@localhost cloudera-mgr]#
[root@localhost cloudera-mgr]# wget http://archive.cloudera.com/cm5/redhat/6/x86_64/cm/c
loudera-manager.repo
--2014-12-04 11:59:00--  http://archive.cloudera.com/cm5/redhat/6/x86_64/cm/cloudera-man
ager.repo
Resolving archive.cloudera.com... 54.192.118.235, 54.230.119.55, 54.239.132.74, ...
Connecting to archive.cloudera.com|54.192.118.235|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 289
Saving to: "cloudera-manager.repo"

100%[======================================>] 289         --.-K/s   in 0s

2014-12-04 11:59:00 (40.7 MB/s) - "cloudera-manager.repo" saved [289/289]
```

3. Edit the cloudera-manager.repo file that we just downloaded to make sure that it is referring to repository of Cloudera Manager version 5.2.0. After editing file will look as below.

```
[cloudera-manager]
# Packages for Cloudera Manager, Version 5, on RedHat 6 x86_64
name=Cloudera Manager
baseurl=http://archive.cloudera.com/cm5/redhat/6/x86_64/cm/5.2.0/
gpgkey = http://archive.cloudera.com/cm5/redhat/6/x86_64/cm/RPM-GPG-KEY-cloudera
gpgcheck = 1
```

Figure 126 Updating the cloudera-manager.repo File to Point to the Correct Version of Cloudera Manager

```
[root@localhost cloudera-mgr]# cat ./cloudera-manager.repo
[cloudera-manager]
# Packages for Cloudera Manager, Version 5, on RedHat or CentOS 6 x86_64

name=Cloudera Manager
baseurl=http://archive.cloudera.com/cm5/redhat/6/x86_64/cm/5.2.0/
gpgkey = http://archive.cloudera.com/cm5/redhat/6/x86_64/cm/RPM-GPG-KEY-cloudera
gpgcheck = 1
```

4. Copy the “cloudera-manager.repo” file to “/etc/yum.repos.d” folder, and download the Cloudera Manager repository using the reposync command. This would create a directory called “cloudera-manager” in the current directory.

```
cp cloudera-manager.repo /etc/yum.repos.d
reposync --repoid=cloudera-manager
```

Figure 127 Cloudera Manager reposync in Progress

```
[root@localhost cloudera-mgr]# cp ./cloudera-manager.repo /etc/yum.repos.d/
[root@localhost cloudera-mgr]# reposync --repoid=cloudera-manager
cloudera-manager                                                | 951 B     00:00
cloudera-manager/primary                                        | 4.1 kB     00:00
[cloudera-manager: 1     of 7     ] Downloading RPMS/x86_64/cloudera-manager-agent-5.2.0
-1.cm520.p0.60.el6.x86_64.rpm
cloudera-manager-agent-5.2.0-1.cm520.p0.60.el6.x86_64.rpm        | 3.8 MB     00:01
[cloudera-manager: 2     of 7     ] Downloading RPMS/x86_64/cloudera-manager-daemons-5.2
.0-1.cm520.p0.60.el6.x86_64.rpm
cloudera-manager-daemons-5 (30%) 45% [=======         ]  11 MB/s | 188 MB     00:20 ETA
```

5. Download the Cloudera Manager installer binary

```
wget http://archive.cloudera.com/cm5/installer/5.2.0/cloudera-manager-installer.bin
```

Figure 128 Download the Cloudera Manager Installer

```
[root@localhost cloudera-mgr]# wget http://archive.cloudera.com/cm5/installer/5.2.0/clou
dera-manager-installer.bin
--2014-12-04 12:50:41--  http://archive.cloudera.com/cm5/installer/5.2.0/cloudera-manage
r-installer.bin
Resolving archive.cloudera.com... 54.230.117.156, 54.230.118.214, 54.192.118.236, ...
Connecting to archive.cloudera.com|54.230.117.156|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 514202 (502K) [application/octet-stream]
Saving to: “cloudera-manager-installer.bin”

100%[=============================================>] 514,202      830K/s   in 0.6s

2014-12-04 12:50:42 (830 KB/s) - “cloudera-manager-installer.bin” saved [514202/514202]
```

6. Copy the contents of the directory “/tmp/cloudera-mgr/cloudera-manager” over to the directory “/var/www/html/cm/5” in the Admin-VM.

```
scp -r cloudera-manager/* admin-vm:/var/www/html/cm/5
```

Figure 129 Copying the Cloudera-manager RPMs over to the Admin-VM

```
[root@localhost cloudera-mgr]# scp -r cloudera-manager/* admin-vm:/var/www/html/cm/5
cloudera-manager-server-5.2.0-1.cm520.p0.60.el6.x86_6 100% 7792     7.6KB/s   00:00
oracle-j2sdk1.7-1.7.0+update67-1.x86_64.rpm           100%  135MB 135.5MB/s   00:01
enterprise-debuginfo-5.2.0-1.cm520.p0.60.el6.x86_64.r 100%  672KB 672.0KB/s   00:00
jdk-6u31-linux-amd64.rpm                              100%   68MB  67.9MB/s   00:01
cloudera-manager-agent-5.2.0-1.cm520.p0.60.el6.x86_64 100% 3860KB   3.8MB/s   00:00
cloudera-manager-daemons-5.2.0-1.cm520.p0.60.el6.x86_  27%  113MB 113.4MB/s   00:02 ETA
```

7. In the Admin-VM, create the local Cloudera Manager repository by using the "createrepo" command as follows.

```
In Admin-VM:
cd /var/www/html/cm/5
createrepo .
```

Figure 130 Admin-VM: Creating the Local Cloudera Manager Repository

```
[root@admin-vm ~]# cd /var/www/html/cm/5
[root@admin-vm 5]# ls
RPMS
[root@admin-vm 5]# createrepo .
Spawning worker 0 with 7 pkgs
Workers Finished
Gathering worker results

Saving Primary metadata
Saving file lists metadata
Saving other metadata
Generating sqlite DBs
Sqlite DBs complete
[root@admin-vm 5]# ls
repodata  RPMS
```

8. Create a new local repo file in the same directory by name "cloudera-manager.repo". Add the following contents and save the file.

```
[cloudera-manager]
# Packages for Cloudera Manager, Version 5, on RedHat 6 x86_64
name=Cloudera Manager
baseurl=http://192.168.100.51/cm/5/
enabled=1
gpgcheck=0
```

Figure 131 Admin-VM: Creating the Cloudera Manager Repository Configuration File

```
[root@admin-vm 5]# pwd
/var/www/html/cm/5
[root@admin-vm 5]# cat ./cloudera-manager.repo
[cloudera-manager]
# Packages for Cloudera Manager, Version 5, on RedHat 6 x86_64
name=Cloudera Manager
baseurl=http://192.168.100.51/cm/5/
enabled=1
gpgcheck=0
```

9. Copy the cloudera-manager-installer.bin over to the directory "/var/www/html/cm/installer" in the Admin-VM.

```
scp cloudera-manager-installer.bin admin-vm:/var/www/html/cm/installer
```

Figure 132 Copying Over the cloudera-manager-installer.bin to the Admin-VM

```
[root@localhost cloudera-mgr]# scp cloudera-manager-installer.bin admin-vm:/var/www/html
/cm/installer
cloudera-manager-installer.bin                        100%  502KB 502.2KB/s   00:00
```

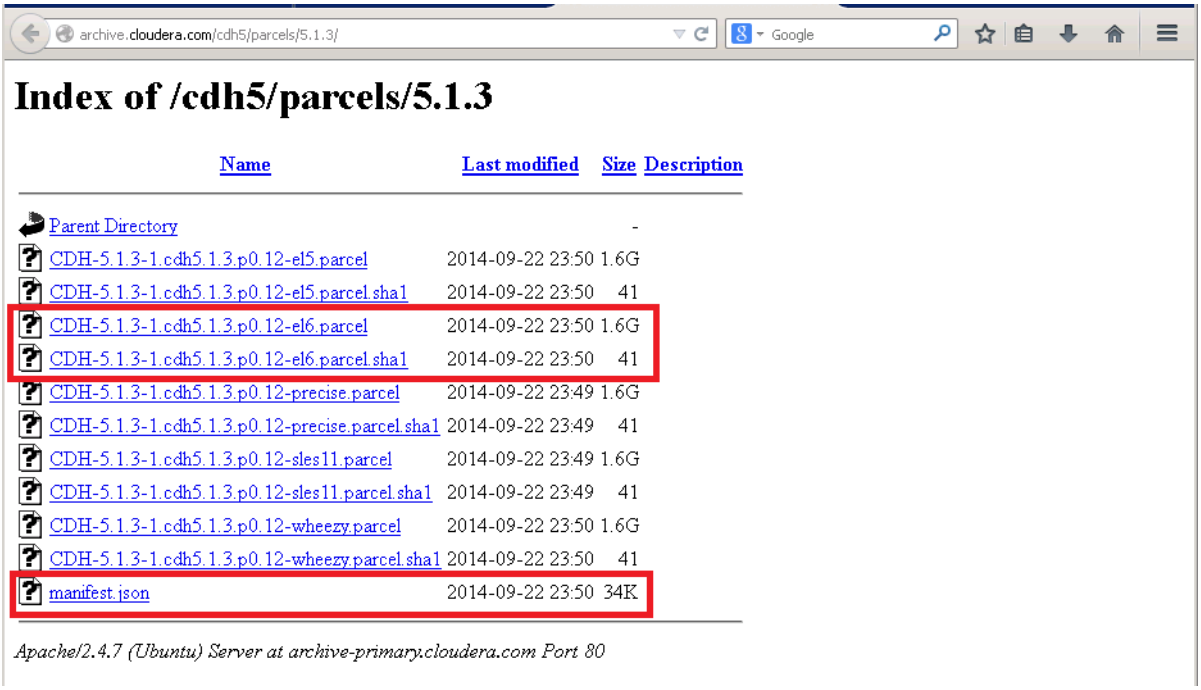
Setup the Local Parcels for CDH 5.1.3

1. From a host that's connected the internet, download the appropriate CDH 5.1.3 parcels that are meant for RHEL6.x from the URL: http://archive.cloudera.com/cdh5/parcels/5.1.3/ and place them in the directory "/var/www/html/cdh/5.1.3/parcels" of the Admin-VM.

   The following screenshot shows the files relevant for RHEL6.x Linux. They are,

   CDH-5.1.3-1.cdh5.1.3.p0.12-el6.parcel, CDH-5.1.3-1.cdh5.1.3.p0.12-el6.parcel.sha1 and manifest.json.

Figure 133 CDH 5.1.3 Parcels from Cloudera Archives



2. In the Admin-VM, edit the manifest.json file located at "/var/www/html/cdh/5.1.3/parcels/" directory, and keep only the parcel definition that's meant for RHEL6.x Linux distributions. Please refer to the below table for the actual content. You may copy paste the below content into your manifest.json file.

```
{
    "lastUpdated": 14114297570000,
    "parcels": [
        {
            "parcelName": "CDH-5.1.3-1.cdh5.1.3.p0.12-el6.parcel",
            "components": [
                {
                    "pkg_version": "0.7.0+cdh5.1.3+0",
                    "pkg_release": "1.cdh5.1.3.p0.12",
                    "name": "bigtop-tomcat",
                    "version": "6.0.37-cdh5.1.3"
                },
                {
                    "pkg_version": "0.10.0+cdh5.1.3+18",
                    "pkg_release": "1.cdh5.1.3.p0.10",
                    "name": "crunch",
                    "version": "0.10.0-cdh5.1.3"
                },
```

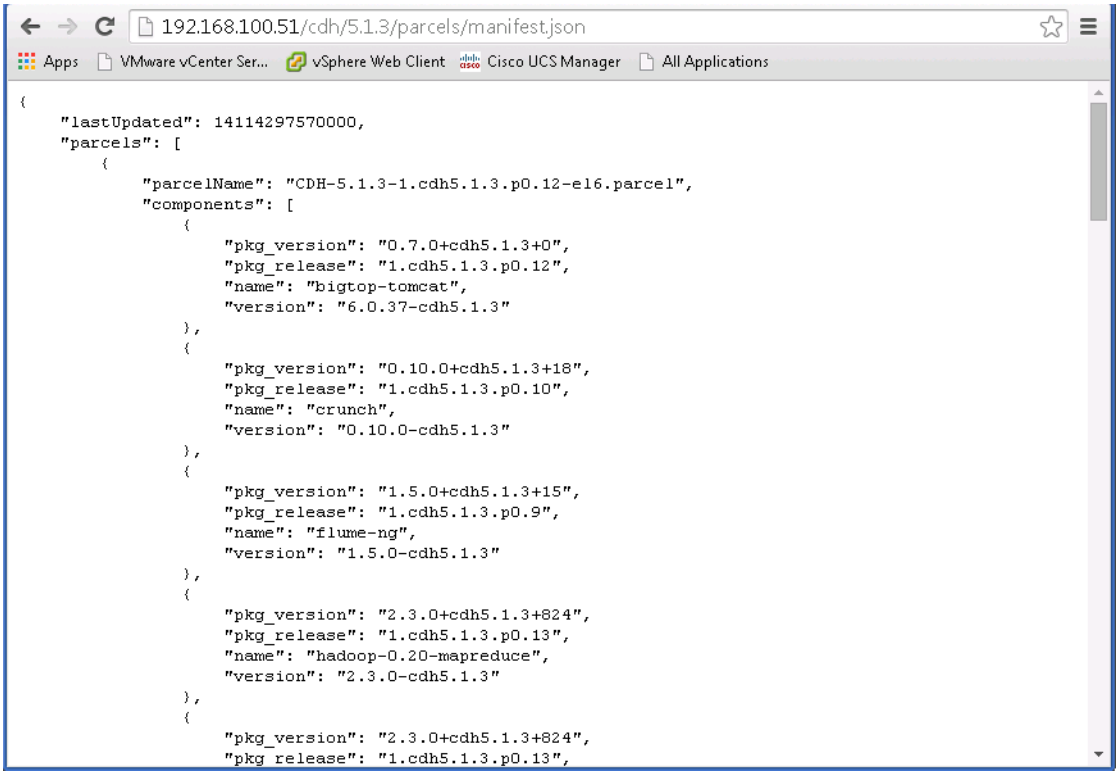
```
{
    "pkg_version": "1.5.0+cdh5.1.3+15",
    "pkg_release": "1.cdh5.1.3.p0.9",
    "name": "flume-ng",
    "version": "1.5.0-cdh5.1.3"
},
{
    "pkg_version": "2.3.0+cdh5.1.3+824",
    "pkg_release": "1.cdh5.1.3.p0.13",
    "name": "hadoop-0.20-mapreduce",
    "version": "2.3.0-cdh5.1.3"
},
{
    "pkg_version": "2.3.0+cdh5.1.3+824",
    "pkg_release": "1.cdh5.1.3.p0.13",
    "name": "hadoop-hdfs",
    "version": "2.3.0-cdh5.1.3"
},
{
    "pkg_version": "2.3.0+cdh5.1.3+824",
    "pkg_release": "1.cdh5.1.3.p0.13",
    "name": "hadoop-httpfs",
    "version": "2.3.0-cdh5.1.3"
},
{
    "pkg_version": "2.3.0+cdh5.1.3+824",
    "pkg_release": "1.cdh5.1.3.p0.13",
    "name": "hadoop-mapreduce",
    "version": "2.3.0-cdh5.1.3"
},
{
    "pkg_version": "2.3.0+cdh5.1.3+824",
    "pkg_release": "1.cdh5.1.3.p0.13",
    "name": "hadoop-yarn",
    "version": "2.3.0-cdh5.1.3"
},
{
    "pkg_version": "2.3.0+cdh5.1.3+824",
    "pkg_release": "1.cdh5.1.3.p0.13",
    "name": "hadoop",
    "version": "2.3.0-cdh5.1.3"
},
{
    "pkg_version": "1.5+cdh5.1.3+16",
    "pkg_release": "1.cdh5.1.3.p0.9",
    "name": "hbase-solr",
    "version": "1.5-cdh5.1.3"
},
{
    "pkg_version": "0.98.1+cdh5.1.3+82",
    "pkg_release": "1.cdh5.1.3.p0.12",
    "name": "hbase",
    "version": "0.98.1-cdh5.1.3"
},
{
    "pkg_version": "0.12.0+cdh5.1.3+381",
    "pkg_release": "1.cdh5.1.3.p0.11",
    "name": "hive-hcatalog",
    "version": "0.12.0-cdh5.1.3"
},
{
    "pkg_version": "0.12.0+cdh5.1.3+381",
    "pkg_release": "1.cdh5.1.3.p0.11",
    "name": "hive",
```

```
    "version": "0.12.0-cdh5.1.3"
},
{
    "pkg_version": "3.6.0+cdh5.1.3+108",
    "pkg_release": "1.cdh5.1.3.p0.9",
    "name": "hue",
    "version": "3.6.0-cdh5.1.3"
},
{
    "pkg_version": "1.4.2+cdh5.1.3+0",
    "pkg_release": "1.cdh5.1.3.p0.14",
    "name": "impala",
    "version": "1.4.2-cdh5.1.3"
},
{
    "pkg_version": "0.10.0+cdh5.1.3+124",
    "pkg_release": "1.cdh5.1.3.p0.9",
    "name": "kite",
    "version": "0.10.0-cdh5.1.3"
},
{
    "pkg_version": "1.0.0+cdh5.1.3+0",
    "pkg_release": "1.cdh5.1.3.p0.12",
    "name": "llama",
    "version": "1.0.0-cdh5.1.3"
},
{
    "pkg_version": "0.9+cdh5.1.3+15",
    "pkg_release": "1.cdh5.1.3.p0.13",
    "name": "mahout",
    "version": "0.9-cdh5.1.3"
},
{
    "pkg_version": "4.0.0+cdh5.1.3+255",
    "pkg_release": "1.cdh5.1.3.p0.9",
    "name": "oozie",
    "version": "4.0.0-cdh5.1.3"
},
{
    "pkg_version": "1.2.5+cdh5.1.3+138",
    "pkg_release": "1.cdh5.1.3.p0.11",
    "name": "parquet",
    "version": "1.2.5-cdh5.1.3"
},
{
    "pkg_version": "0.12.0+cdh5.1.3+37",
    "pkg_release": "1.cdh5.1.3.p0.10",
    "name": "pig",
    "version": "0.12.0-cdh5.1.3"
},
{
    "pkg_version": "1.3.0+cdh5.1.3+162",
    "pkg_release": "1.cdh5.1.3.p0.9",
    "name": "sentry",
    "version": "1.3.0-cdh5.1.3"
},
{
    "pkg_version": "4.4.0+cdh5.1.3+235",
    "pkg_release": "1.cdh5.1.3.p0.10",
    "name": "solr",
    "version": "4.4.0-cdh5.1.3"
},
{
    "pkg_version": "1.0.0+cdh5.1.3+45",
```

```
                "pkg_release": "1.cdh5.1.3.p0.10",
                "name": "spark",
                "version": "1.0.0-cdh5.1.3"
            },
            {
                "pkg_version": "1.4.4+cdh5.1.3+59",
                "pkg_release": "1.cdh5.1.3.p0.9",
                "name": "sqoop",
                "version": "1.4.4-cdh5.1.3"
            },
            {
                "pkg_version": "1.99.3+cdh5.1.3+30",
                "pkg_release": "1.cdh5.1.3.p0.9",
                "name": "sqoop2",
                "version": "1.99.3-cdh5.1.3"
            },
            {
                "pkg_version": "0.9.0+cdh5.1.3+13",
                "pkg_release": "1.cdh5.1.3.p0.9",
                "name": "whirr",
                "version": "0.9.0-cdh5.1.3"
            },
            {
                "pkg_version": "3.4.5+cdh5.1.3+33",
                "pkg_release": "1.cdh5.1.3.p0.14",
                "name": "zookeeper",
                "version": "3.4.5-cdh5.1.3"
            }
        ],
        "replaces": "IMPALA, SOLR, SPARK",
        "hash": "d884302c9f9aad2a57db9187dda1244d5c19749e\n"
    }
  ]
}
```

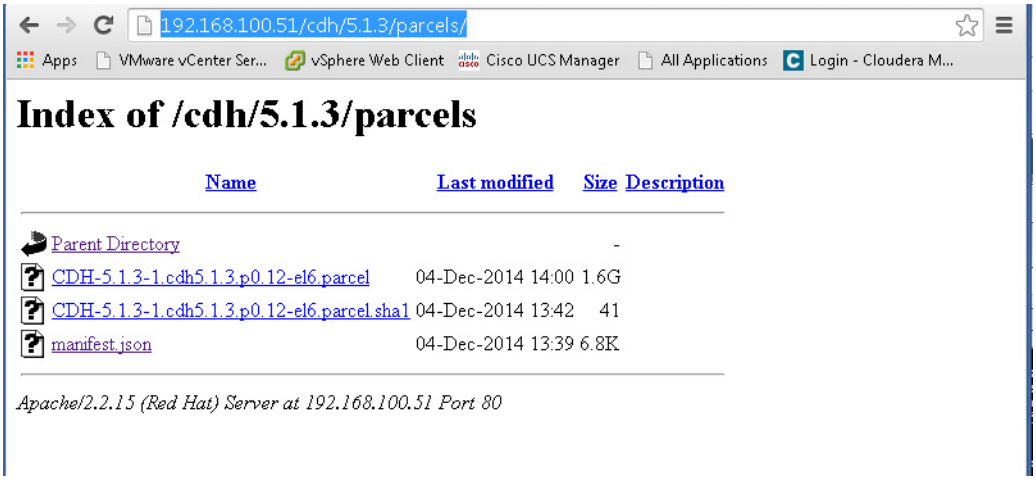

3. Verify that the manifest.jso file is accessible by visiting the URL http://192.168.100.51/cdh/5.1.3/parcels/manifest.json

Figure 134 Admin-VM's CDH 5.1.3 Parcels Manifest File Containing only the RHEL6.x Parcel



4. Viewing the Parcels via the Web Browser.

Figure 135 Accessing the CDH 5.1.3 Parcels manifest.json File via a Web Browser



Installing Lightweight DNS Server dnsmasq Service

In this section, we will walk through the procedure to install a lightweight DNS Server called "dnsmasq". The RPM for this can be obtained from the RHEL repository that is setup locally in the Admin-VM. The "dnsmasq" service makes use of the Linux's "/etc/hosts" file for resolving hostnames to IP-address and vice-versa. Advanced configurations can be specified in the "/etc/dnsmasq.conf" file.

1. Log into the Admin-VM
2. Install the service "dnsmasq" by using the command:

```
yum install dnsmasq
```

3. Edit the "/etc/hosts" file to create the Host entries for important VMs of this solution by using Table 12 as reference.

Table 12 Admin-VM: "/etc/hosts" file configurations for the dnsmasq service

VM	IP Address	FQDN
vCenter Server	192.168.100.60	vc55.hadoop.cisco.local
BDE2.1 "Serengeti" Management-Server	192.168.100.81	bdemgr21.hadoop.cisco.local
Admin-VM	192.168.100.51	admin-vm.hadoop.cisco.local
CMBD	192.168.100.90	cmdb.hadoop.cisco.local

Add the following text to the /etc/hosts file.

```
192.168.100.81 bdemgr21.hadoop.cisco.local
192.168.100.51 admin-vm.hadoop.cisco.local
192.168.100.60 vc55.hadoop.cisco.local
192.168.100.90 cmdb.hadoop.cisco.local
```

Figure 136 Admin-VM: "/etc/hosts" File Configurations for the dnsmasq Service

```
127.0.0.1   localhost localhost.localdomain localhost4 localhost4.localdomain4
::1         localhost localhost.localdomain localhost6 localhost6.localdomain6

192.168.100.81 bdemgr21.hadoop.cisco.local
192.168.100.51 admin-vm.hadoop.cisco.local
192.168.100.60 vc55.hadoop.cisco.local
192.168.100.90 cmdb.hadoop.cisco.local
```

4. Start the dnsmasq service, and make the dnsmasq service start automatically upon system reboot.

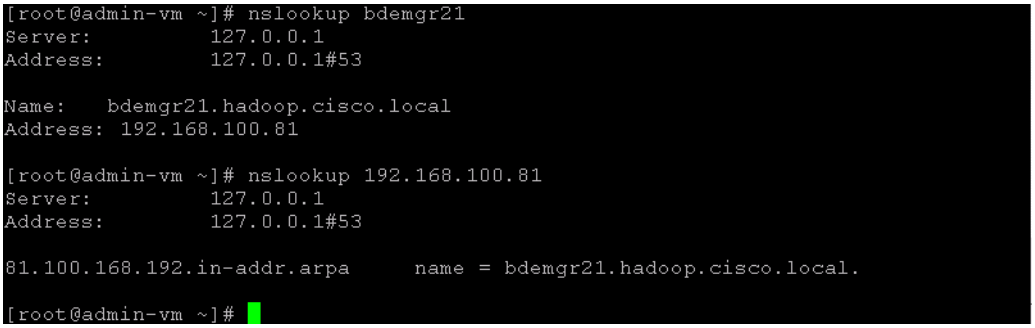
```
service dnsmasq restart
chkconfig dnsmasq on
```

Figure 137 Admin-VM: Restarting the dnsmasq Service

```
[root@admin-vm ~]# service dnsmasq restart
Shutting down dnsmasq:                                     [  OK  ]
Starting dnsmasq:                                          [  OK  ]
[root@admin-vm ~]#
```

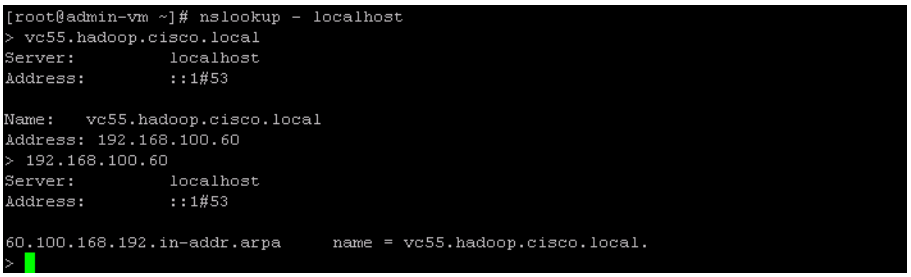
5. Verify if the name lookup works correctly by using the nslookup commands.

Figure 138 Admin-VM: Verifying the dnsmasq Service



6. Perform nslookup to make sure the name resolution works correctly for the vCenter-Server

Figure 139 Admin-VM: Verify Another Server's IP and Name Resolution



Configure the VM Name Resolutions

In this section, we will configure "dnsmasq" service to act as our DHCP server. We will also configure it to delegate all the DNS-requests made to resolve the sub-domain "isic.hadoop.cisco.local" to the Isilon OneFS' SmartConnect Service IP "10.0.11.251" on vlan 11 (via the port-group VMNet-HDFS). This step can be verified only after Isilon cluster is fully configured for HDFS access.

The BDE assign IP-addresses to the Hadoop-VMs by means of one of two methods.

- Static IP-pool configured in the BDE vApp's network resources. This need to be done per network interface.
- Dynamic IP-address allocation using DHCP.

We would be making use of Static IP-pool method for allocating and assigning IP-address to the VM cluster, and configure dnsmasq.conf file to provide appropriate IP to FQDN name resolutions.

Cloudera Hadoop distribution requires a full name resolution support in order for it to work correctly.

1. Log onto the Admin-VM.
2. Edit the file "/etc/dnsmasq.conf", clear its contents and add the following. You may want to keep a copy of the old dnsmasq.conf file for reference. You could do that by renaming the file dnsmasq.conf as dnsmasq.conf.old, and create a new file "dnsmasq.conf" in "/etc" directory and add the following contents.

Admin-VM: dnsmasq.conf containing DHCP configurations

```
# Configuration file for dnsmasq.

# Format is one option per line, legal options are the same
# as the long options legal on the command line. See
```

```
# "/usr/sbin/dnsmasq --help" or "man 8 dnsmasq" for details.

# Interface configurations on which dnsmasq will listen on for DNS requests.
interface=eth0
interface=eth1
interface=eth2
# If you want dnsmasq to provide only DNS service on an interface,
# configure it as shown above, and then use the following line to
# disable DHCP on it.
no-dhcp-interface=eth0
no-dhcp-interface=eth1
no-dhcp-interface=eth2

# Configuring 'addn-hosts' that points to "/etc/vm_hosts" file. This file will
# consist of hostname to IP-address mappings for all the VMs.
addn-hosts=/etc/vm_hosts

# Set this (and domain: see below) if you want to have a domain
# automatically added to simple names in a hosts-file.
expand-hosts

# Add other name servers here, with domain specs if they are for
# non-public domains.
## Add the "isic" subdomain delegation pointing to Isilon's
##  SmartConnect Service IP.
server=/isic.hadoop.cisco.local/10.0.11.251

# Set the domain for dnsmasq.
domain=hadoop.cisco.local
```

3. Copy the following script into a file "/tmp/gen_hostnames.sh" on the Admin-VM and execute it to generate the file "/etc/vm_hosts" referenced in the previous step.

Admin-VM: Script to generate the Hostnames for the VMs

4. Copy the following script into a file "/tmp/gen_hostnames.sh" on the Admin-VM and execute it to generate the file "/etc/vm_hosts" referenced in the previous step.

```
#!/bin/bash
mapred_subnet="10.0.12."
mgmt_subnet="192.168.100."
hdfs_subnet="10.0.11."
ipx="X"

hostname_prefix="rhel"
mgmt_suffix="-m"
hdfs_suffix="-h"

echo "#Generated for the dnsmasq name resolution by the CVD script: gen_hostnames.sh - on
$(date)"

# Generating hostnames for the MapRed Subnet
echo "# VM Hostnames in the MapRed Subnet:$mapred_subnet$ipx"
for (( ip=101; ip<=200; ip++ ))
do
        echo "$mapred_subnet$ip $hostname_prefix$ip"
done

# Generating hostnames for the HDFS Subnet
echo "# VM Hostnames in the HDFS Subnet:$hdfs_subnet$ipx"
for (( ip=101; ip<=200; ip++ ))
do
    echo "$hdfs_subnet$ip $hdfs_hostname_prefix$ip"
done
```

```
# Generating hostnames for the HDFS Subnet
echo "# VM Hostnames in the HDFS Subnet:$hdfs_subnet$ipx"
for (( ip=101; ip<=200; ip++ ))
do
        echo "$hdfs_subnet$ip $hostname_prefix$ip$hdfs_suffix"
done
```

The generated hostnames shall be as per the below sample for all the 100 IP addresses in each subnet.

Table 13 Admin-VM: DNS Name to IP-address Mapping

Network	Hostname	IP Address
VMNet-Mgmt	rhel101-m	192.168.100.101
VMNet-HDFS	rhel101-h	10.0.11.101
VMNet-MapRed	rhel101	10.0.12.101

Figure 140 Admin-VM: Viewing the Hostnames of the VMs

```
[root@admin-vm ~]# /tmp/gen_hostnames.sh > /etc/vm_hosts
[root@admin-vm ~]# grep rhel101 /etc/vm_hosts
10.0.12.101 rhel101
192.168.100.101 rhel101-m
10.0.11.101 rhel101-h
[root@admin-vm ~]#
[root@admin-vm ~]# grep rhel160 /etc/vm_hosts
10.0.12.160 rhel160
192.168.100.160 rhel160-m
10.0.11.160 rhel160-h
[root@admin-vm ~]#
```

5. Restart the dnsmasq service.

Figure 141 Admin-VM: Restarting the dnsmasq Service to Apply the DNS Name Server Configurations

```
[root@admin-vm ~]# service dnsmasq restart
Shutting down dnsmasq:                                     [  OK  ]
Starting dnsmasq:                                          [  OK  ]
```

6. Perform a forward and reverse lookup of some IP-addresses to make sure that the FQDN to IP mapping works in both directions flawlessly.

Figure 142 Admin-VM: Verifying Name Resolution

```
[root@admin-vm ~]# nslookup 192.168.100.160
Server:         127.0.0.1
Address:        127.0.0.1#53

160.100.168.192.in-addr.arpa    name = rhel160-m.hadoop.cisco.local.

[root@admin-vm ~]#
[root@admin-vm ~]# nslookup rhel160
Server:         127.0.0.1
Address:        127.0.0.1#53

Name:   rhel160.hadoop.cisco.local
Address: 10.0.12.160
```

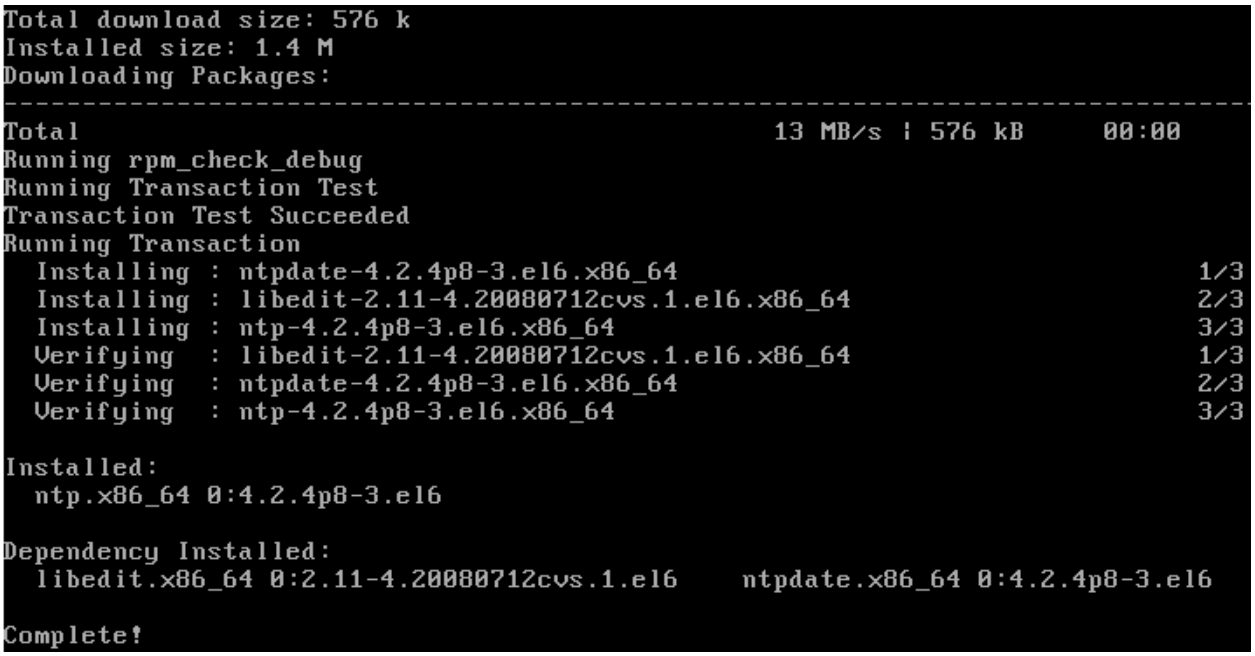
Configure NTP Server

As mentioned before, it is very important to have a proper time-synchronization across all the components of this solution. In this section, we will configure the Admin-VM as the local NTP-server. All 15 ESXi hosts of the "Hadoop" DRS-cluster mentioned in "Creating Server DRS-Clusters" section on page 140 (192.168.100.22 – 192.168.100.36) shall sync to the Admin-VM's NTP-server.

1. Install the NTP service using the command "yum install ntp".

```
yum install -y ntp
```

Figure 143 Admin-VM: Installing NTP Service



2. Edit the file "/etc/ntp.conf", clear its contents, and add the contents of the following table. Since, this VM will be automatically synchronized to the clock of its ESXi-host (192.168.100.21), we do not need to synchronize the Admin-VM's clock any external server. Ref 12.1.

Admin-VM: Basic NTP-Service configurations8.Start the NTP service

```
# Permit all access over the loopback interface.  This could
# be tightened as well, but to do so would effect some of
# the administrative functions.
restrict 127.0.0.1

# Hosts on local network are less restricted.
restrict 192.168.100.0 mask 255.255.255.0 nomodify notrap

# Undisciplined Local Clock. This is a fake driver intended for backup
# and when no outside source of synchronized time is available.
server  127.127.1.0     # local clock
fudge   127.127.1.0 stratum 10
```

Figure 144 Admin-VM: Starting NTP Service

```
[root@localhost ~]# service ntpd start
Starting ntpd:                                             [  OK  ]
```

3. Use the “chkconfig” command to ensure that the ntpd starts up automatically every time upon Admin-VM reboot.

```
chkconfig ntpd on
```

Configuring Hadoop Datacenter in vCenter server

Creating Datacenter in vCenter-server

Launch the VMware Web-Client to connect to the newly installed VMware Web-Client by visiting https://192.168.100.60:9443/vsphere-client/.

1. In the Web-Client GUI, enter the user-name and password to log onto the vCenter Server.

Figure 145 Web-Client Login Screen

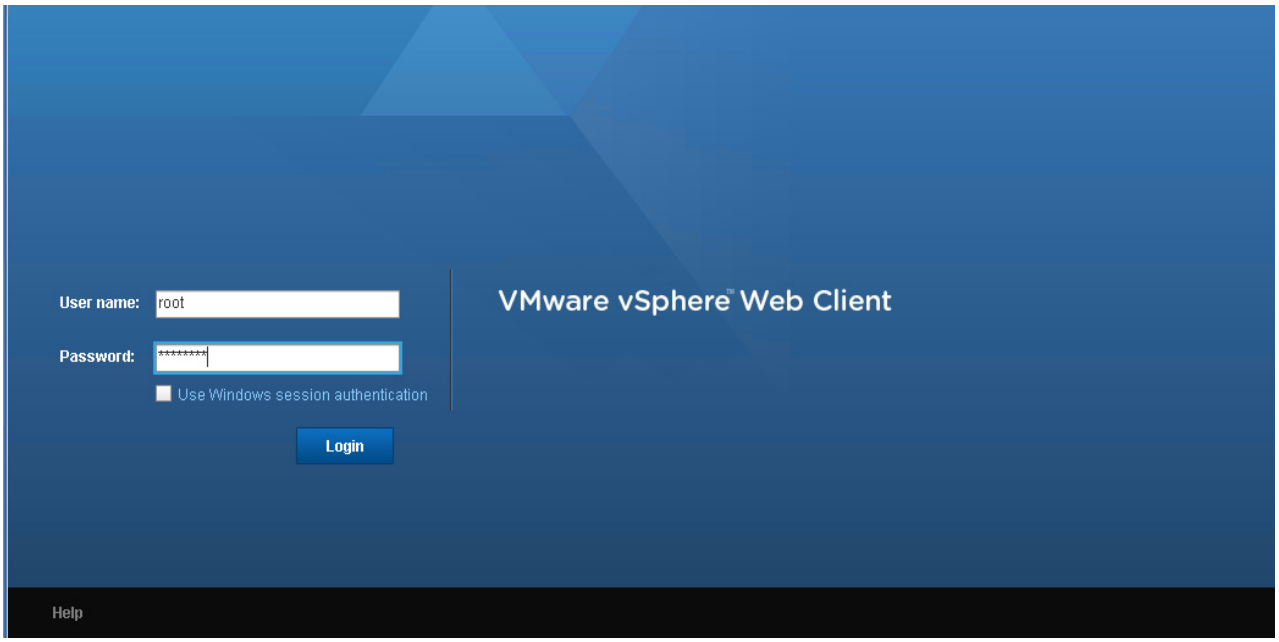
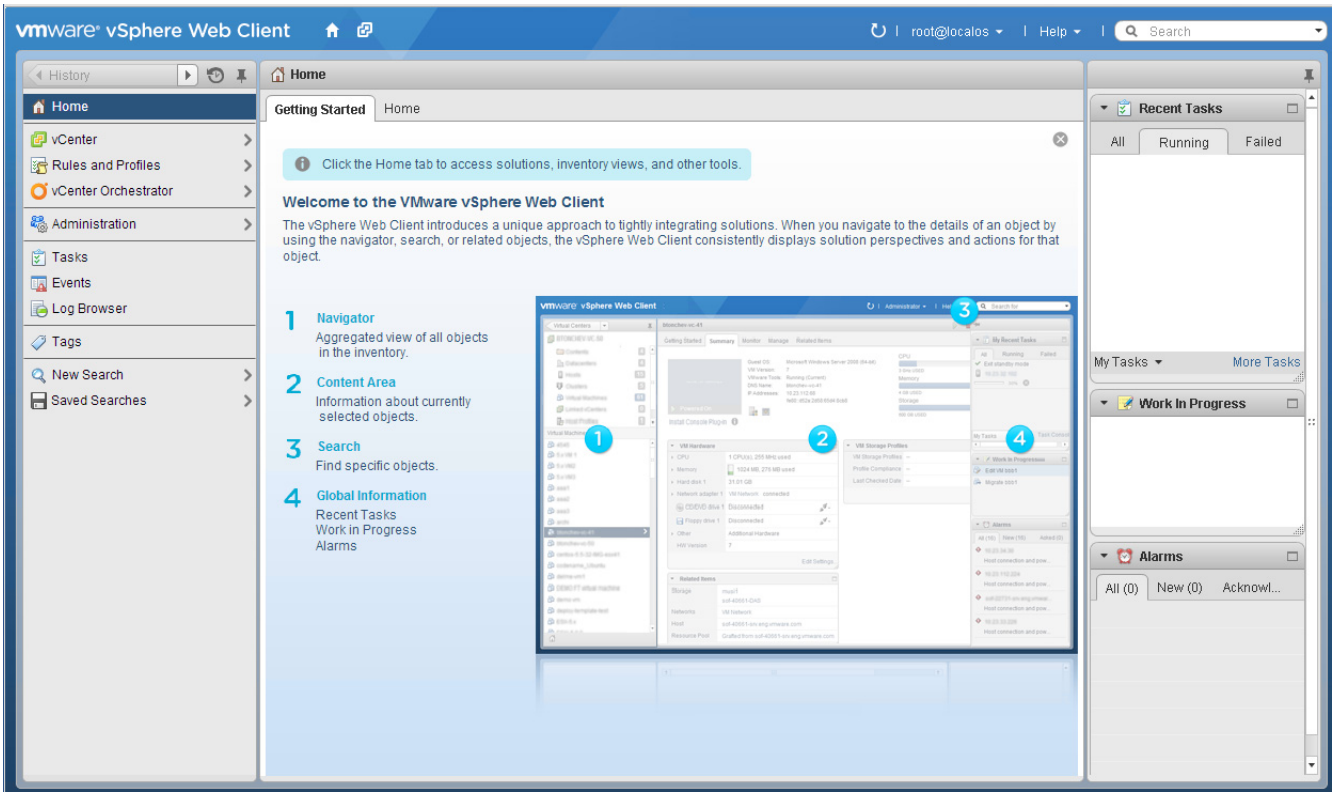
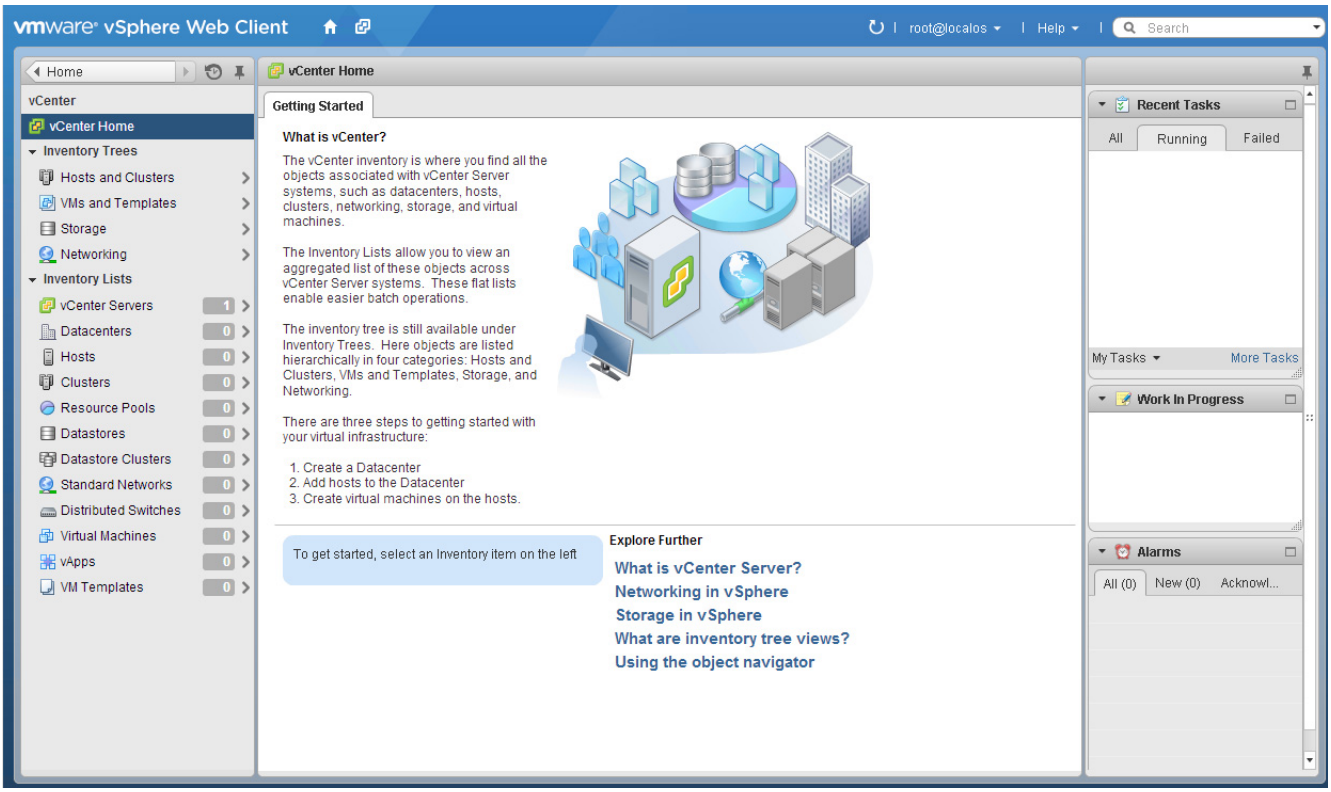


Figure 146 vSphere Web-Client vCenter Home-screen



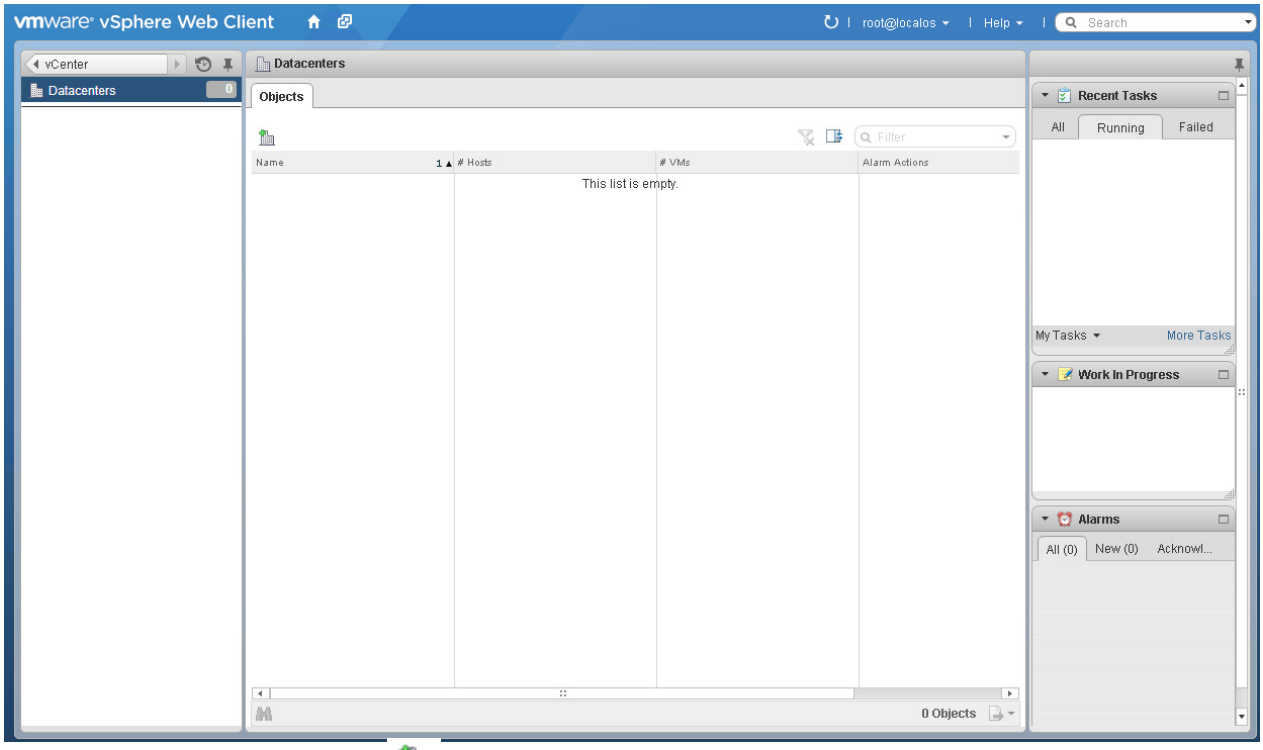
2. From the home screen click **vCenter** on the navigation pane on the left side.

Figure 147 Navigating to the vCenter Home Screen



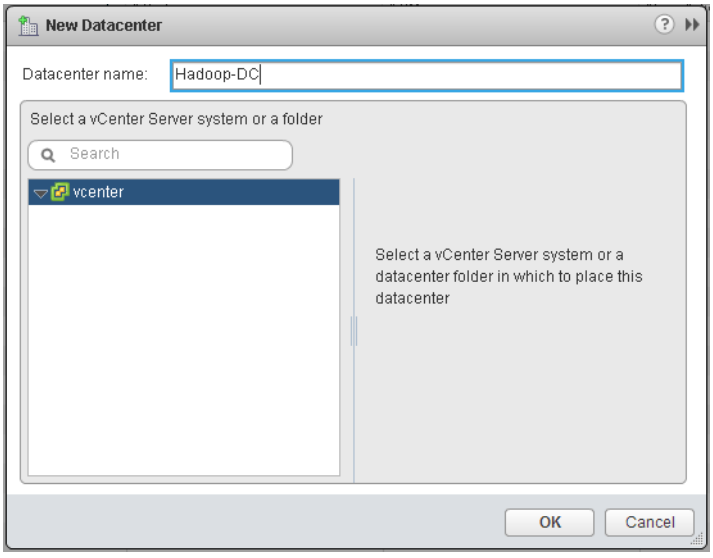
3. Click **Datacenters** under the **Inventory Lists**

Figure 148 vCenter Server - Data Center Dashboard Screen



4. Click the  to start the creation of a vSphere Datacenter.

Figure 149 Selecting the vCenter Server Instance



5. Enter a name for the Datacenter, choose the vCenter server instance and click **OK**. We have named the datacenter as Hadoop-DC in the below example.

Figure 150 Creating a Data Center in the vSphere Web Client

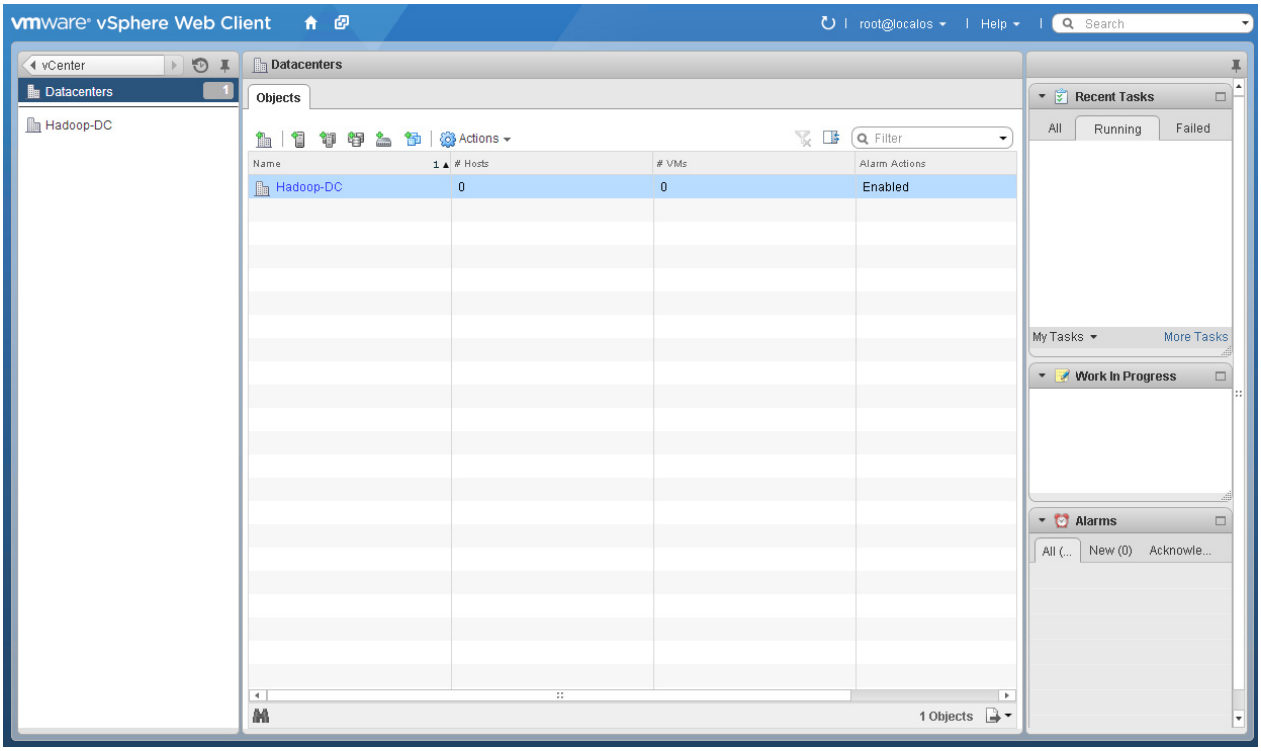
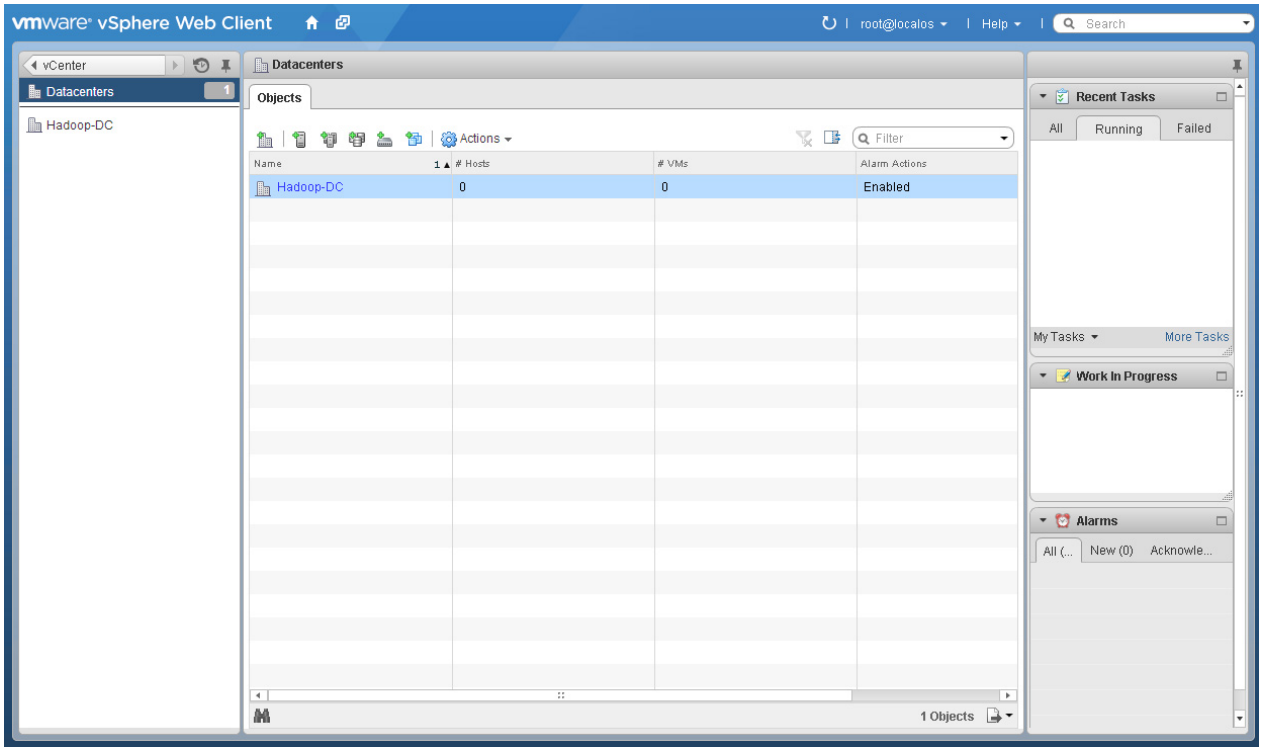


Figure 151 Data Center Successfully Created in the vCenter Server



Creating Server DRS-Clusters

In this section, we will create two DRS (Dynamic Resource Scheduling) clusters. Those pools shall be named as “Admin” and “Hadoop”.

Admin DRS-cluster shall consist of one vSphere ESXi host that contain the VMs used for creating this Virtualized Hadoop solution. The following VMs and BDE-vApp shall be created in this resource pool:

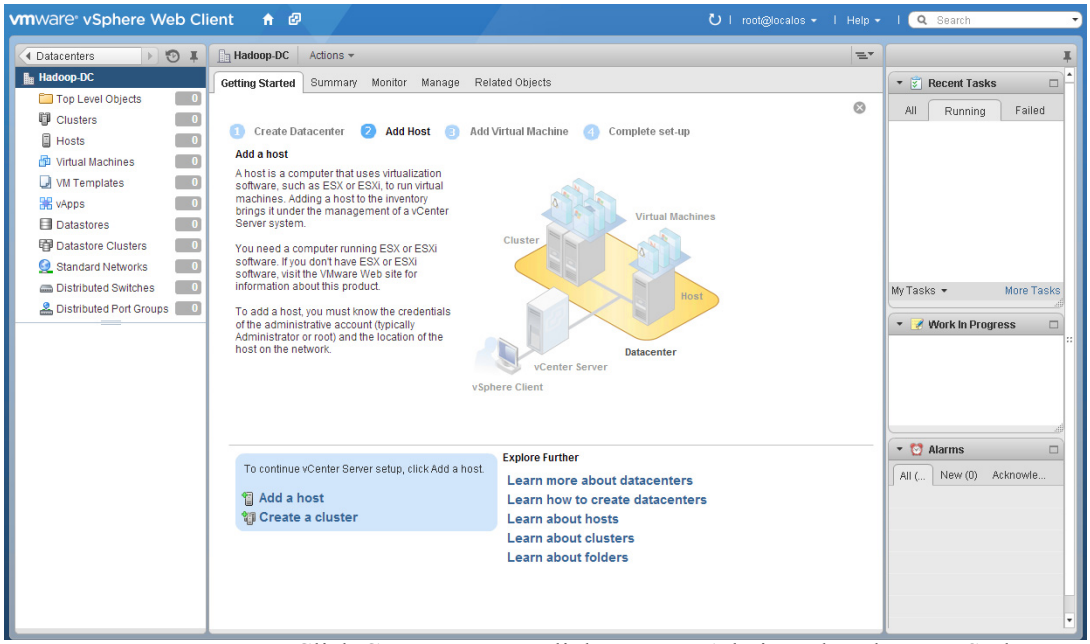
- vCenter Virtual-Appliance 5.5
- Admin VM that acts as the NTP, DNS and DHCP servers for this solution.
- BDE 2.1 vApp.
- RHEL6.4 custom VM-template built for the BDE2.1

Hadoop DRS-cluster shall consist of all the other 15 vSphere ESXi hosts that will be used to provision the Compute-Only Hadoop cluster.

To begin with, we shall navigate to the datacenter screen that is shown in Figure 152.

1. Click the newly created datacenter “Hadoop-DC.

Figure 152 Data Center “Hadoop-DC”



2. Click **Create a cluster** link to create Admin and Hadoop DRS-clusters. In each of the pools, enable the DRS by clicking on the **Turn On** check box.

Figure 153 Creating DRS-Clusters Admin

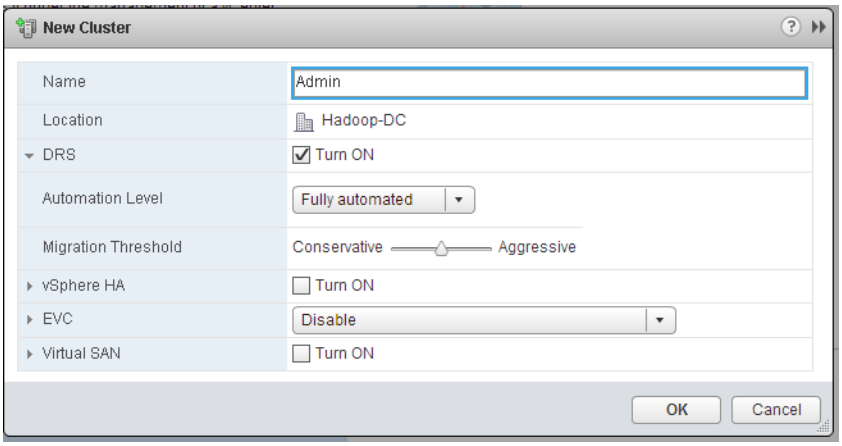
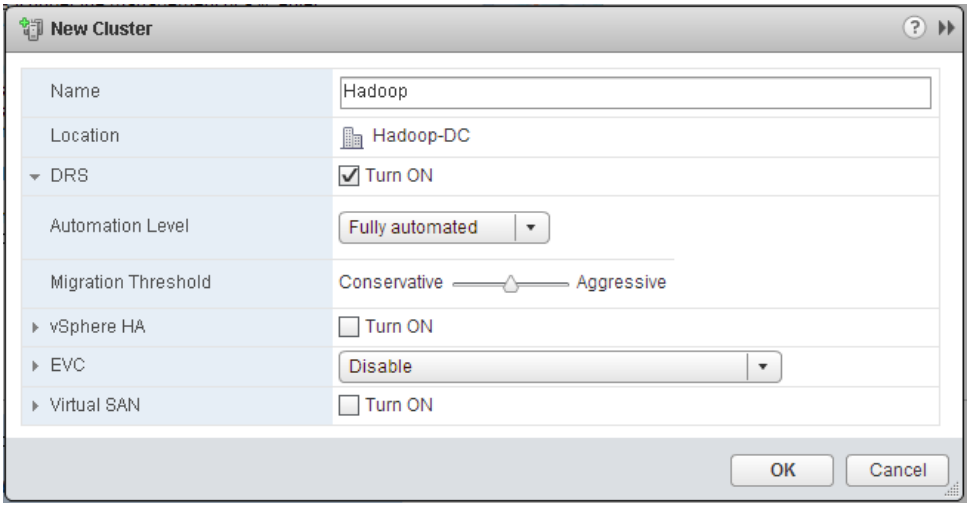


Figure 154 Creating DRS-Clusters Hadoop



Adding ESXi hosts to DRS-clusters of Datacenter Hadoop

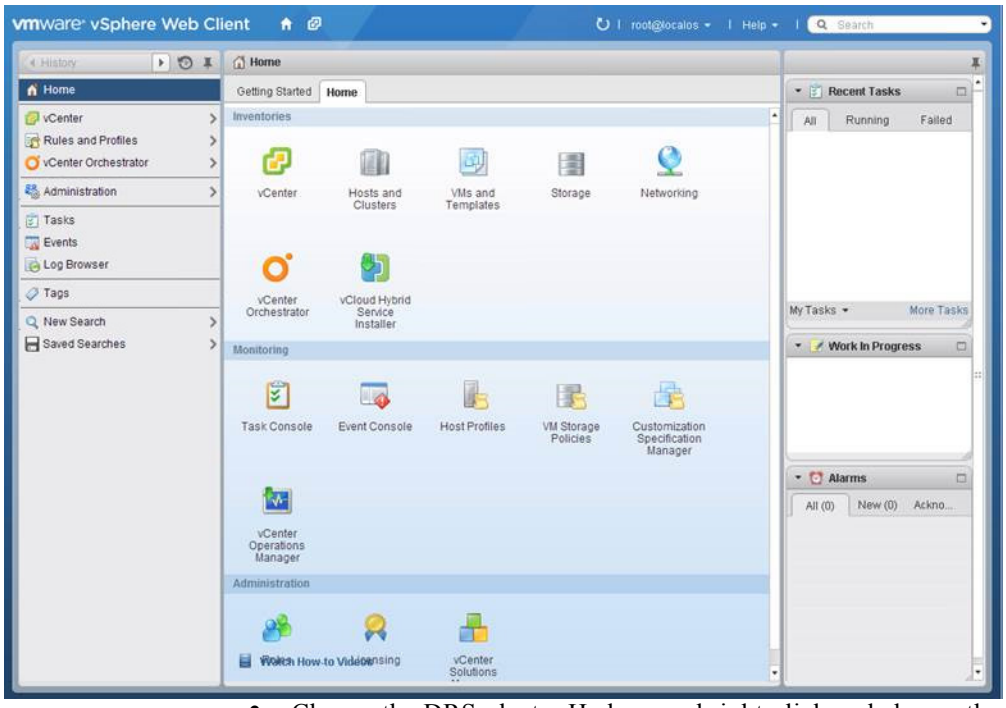
In this section we will walk through the process of adding one ESXi Host (IP: 192.168.100.28) to the DRS-cluster Hadoop. Subsequently, the user of this document is expected to add the rest of the hosts to appropriate DRS-clusters based on Table 14.

Table 14 DRS Cluster Configuration

DRS Cluster	ESXi Host IP Address
Admin	192.168.100.21 (1 ESXi host)
Hadoop	192.168.100.22 to 192.168.100.36 (15 ESXi hosts)

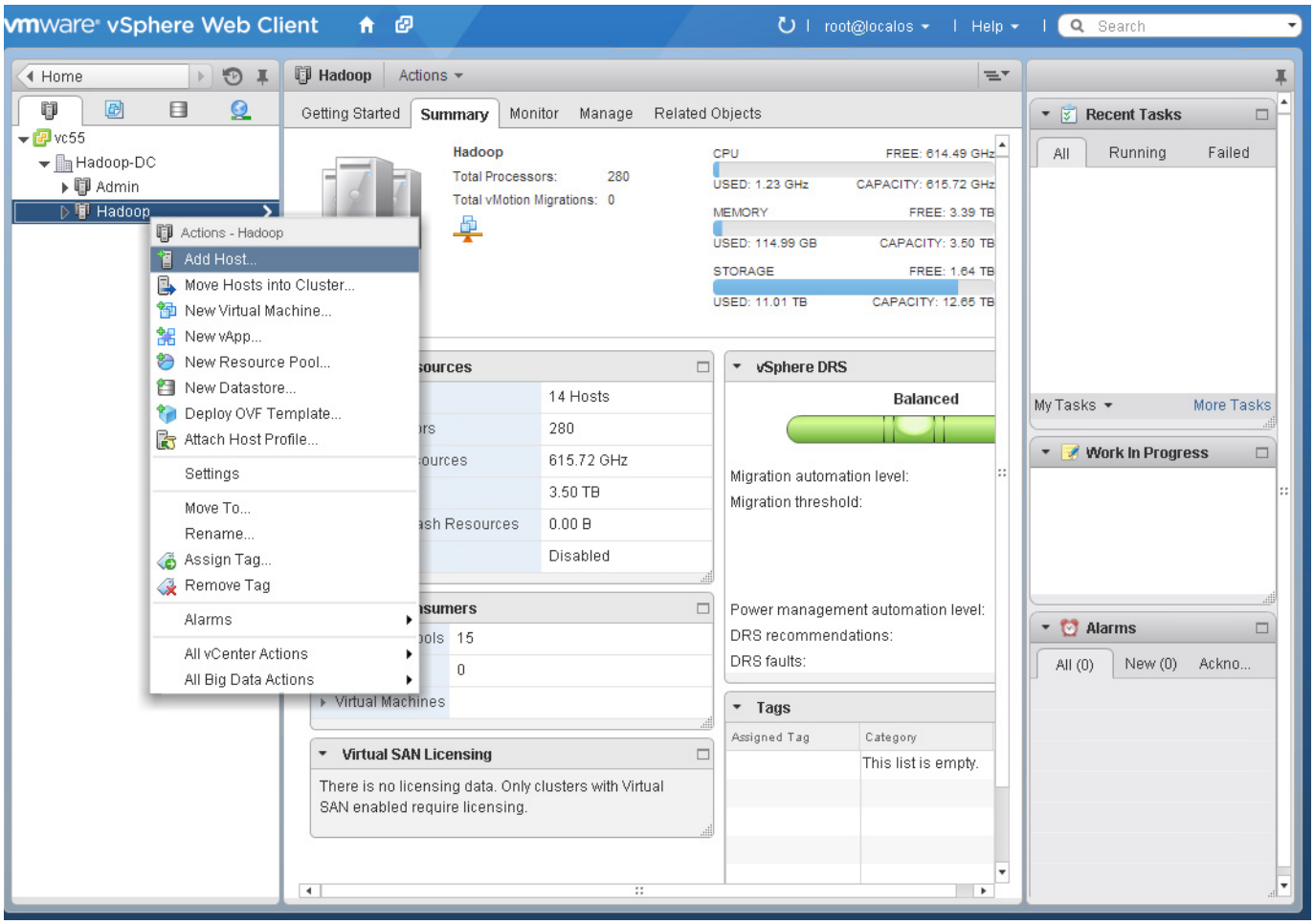
1. From the home page of the vSphere Web Client, click **Hosts and Clusters** icon.

Figure 155 vCenter Server Home Screen



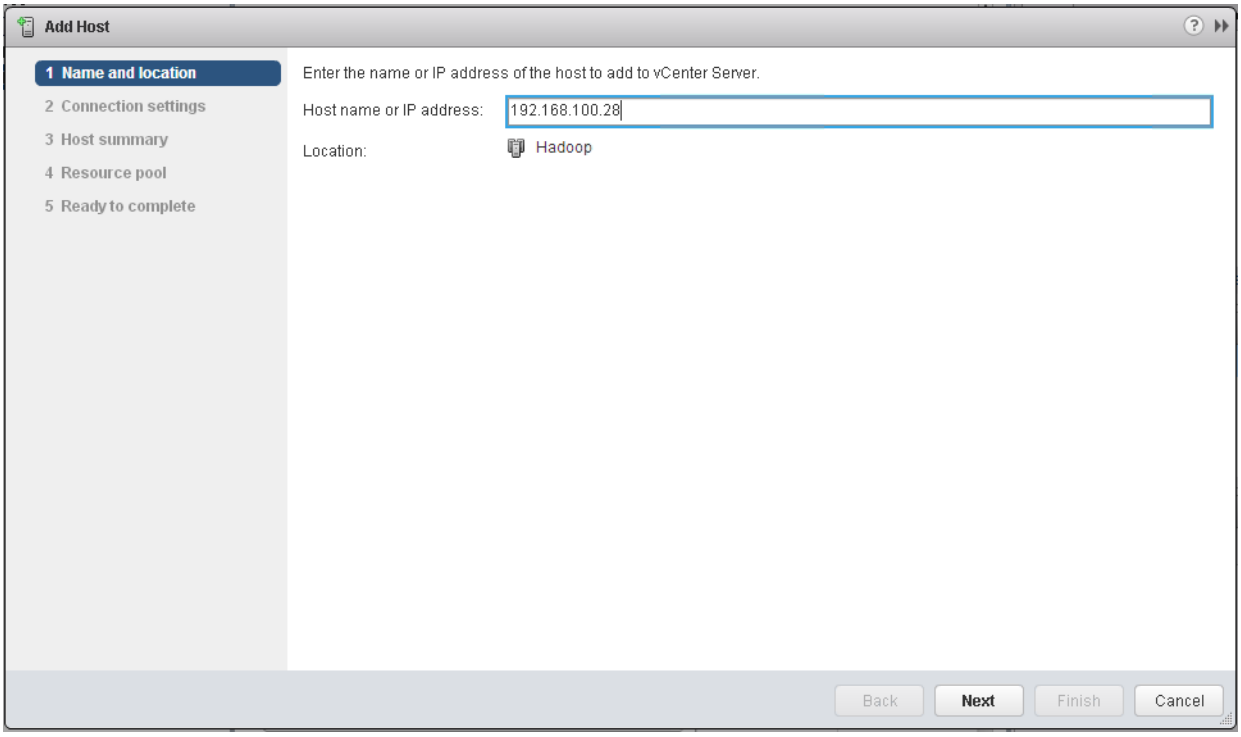
2. Choose the DRS-cluster Hadoop and right-click and choose the **Add Hos**t option.

Figure 156 Adding ESXi Host to DRS-Cluster "Hadoop"



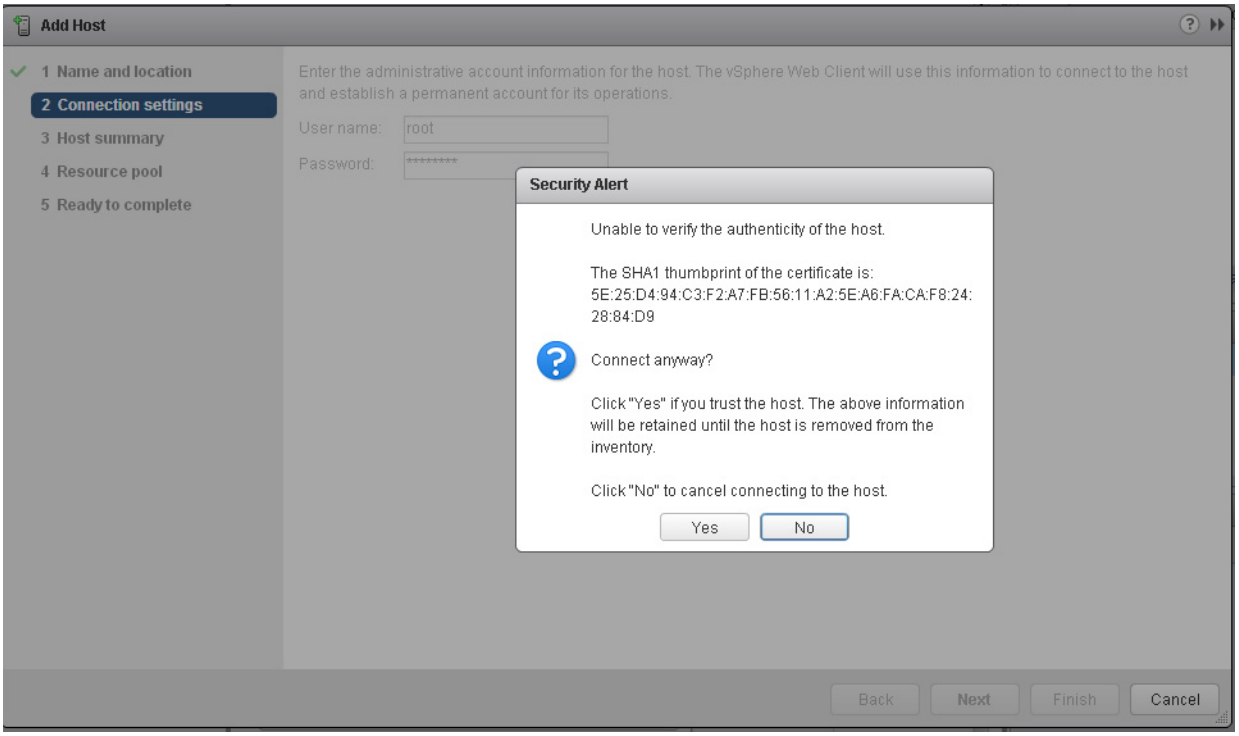
3. Enter the IP-address of the ESXi-host that needs to be added to the DRS-cluster, 192.168.100.28, and Click **Next**.

Figure 157 Entering the IP-Address of ESXi Host Added to the DRS-Cluster "Hadoop"



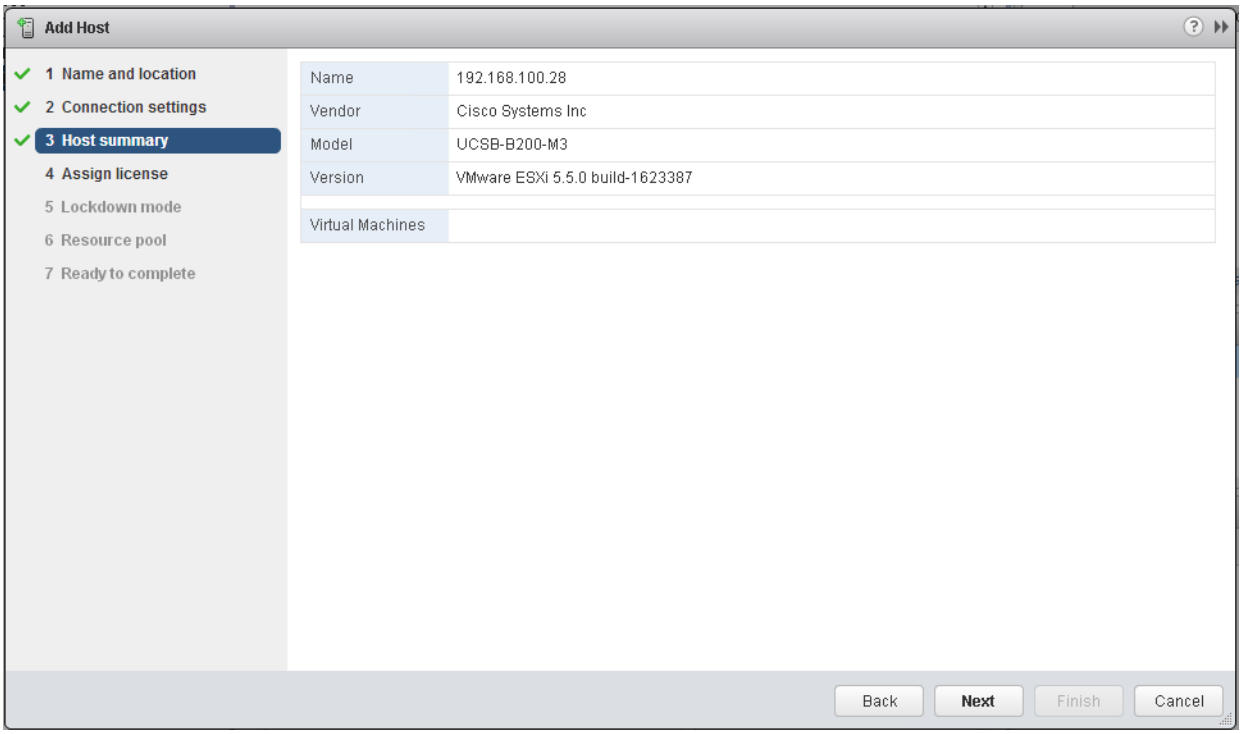
4. Enter the username root and the password. Click **Next**.

Figure 158 Entering the Credentials of the ESXi Host



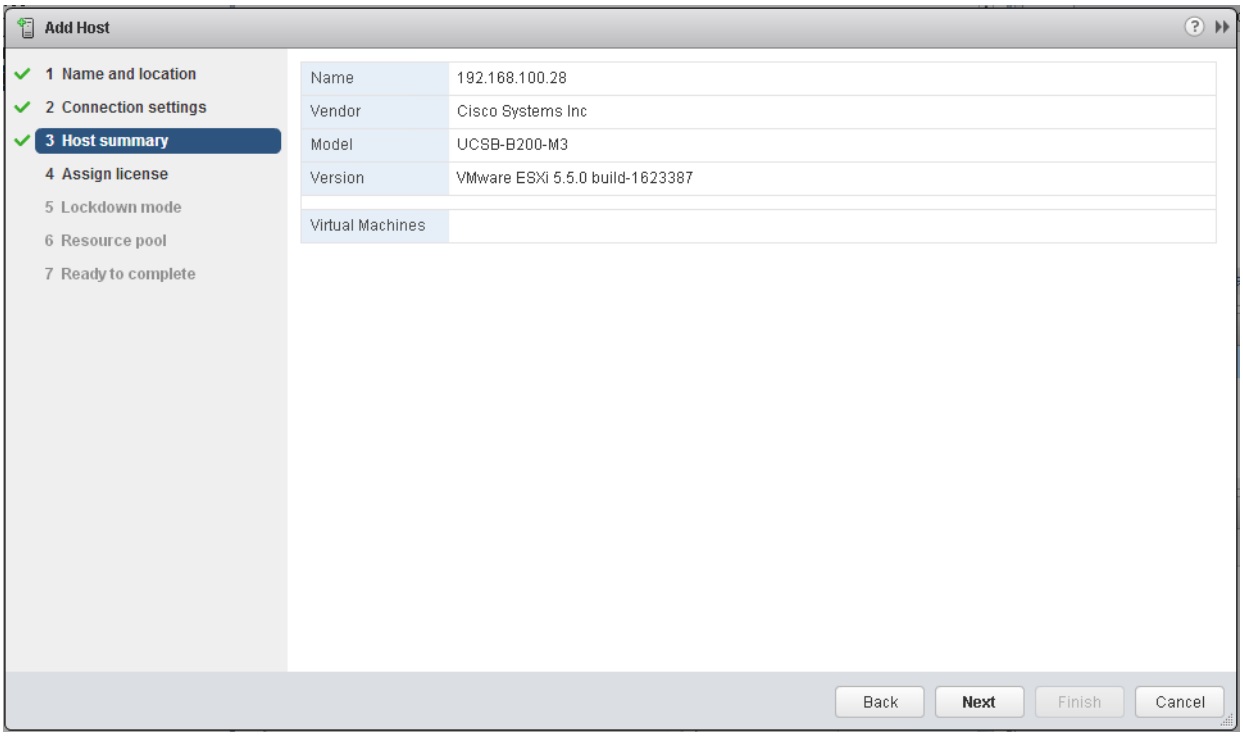
5. Accept the Warning in the next page.

Figure 159 Accept the Warning Message



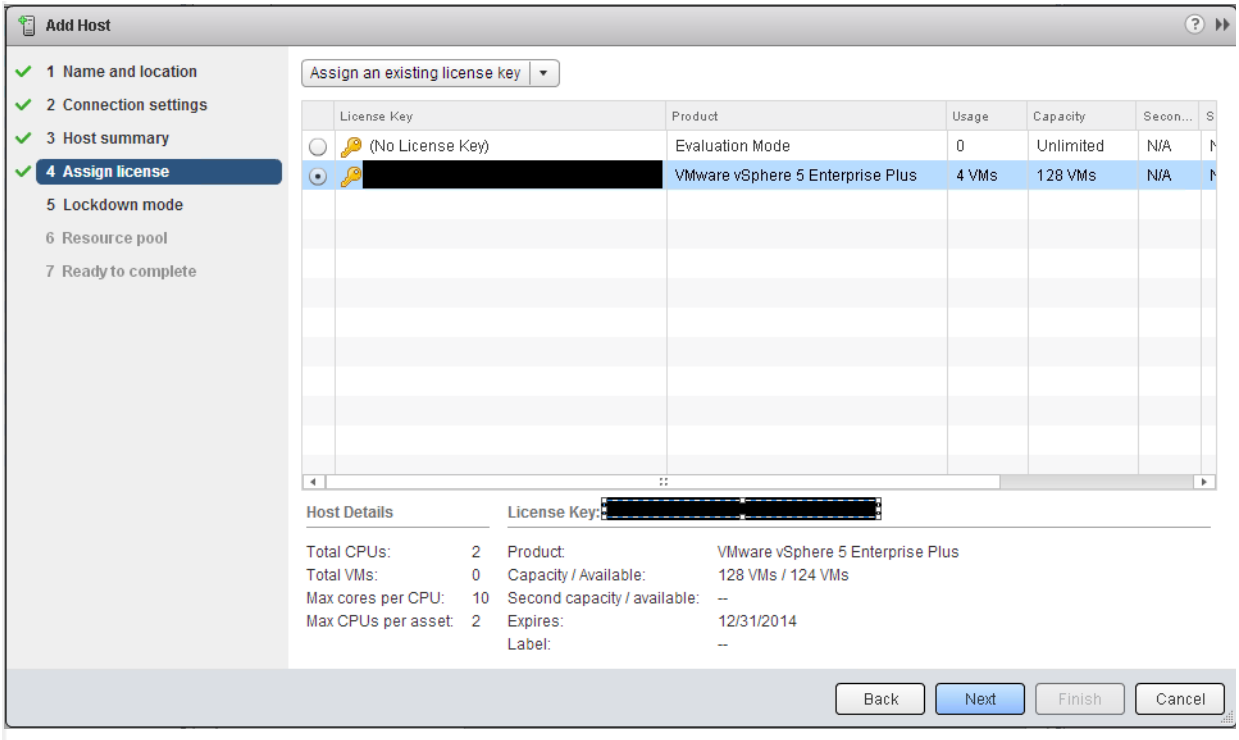
6. Review the host summary and click **Next**

Figure 160 Review the Host Summary



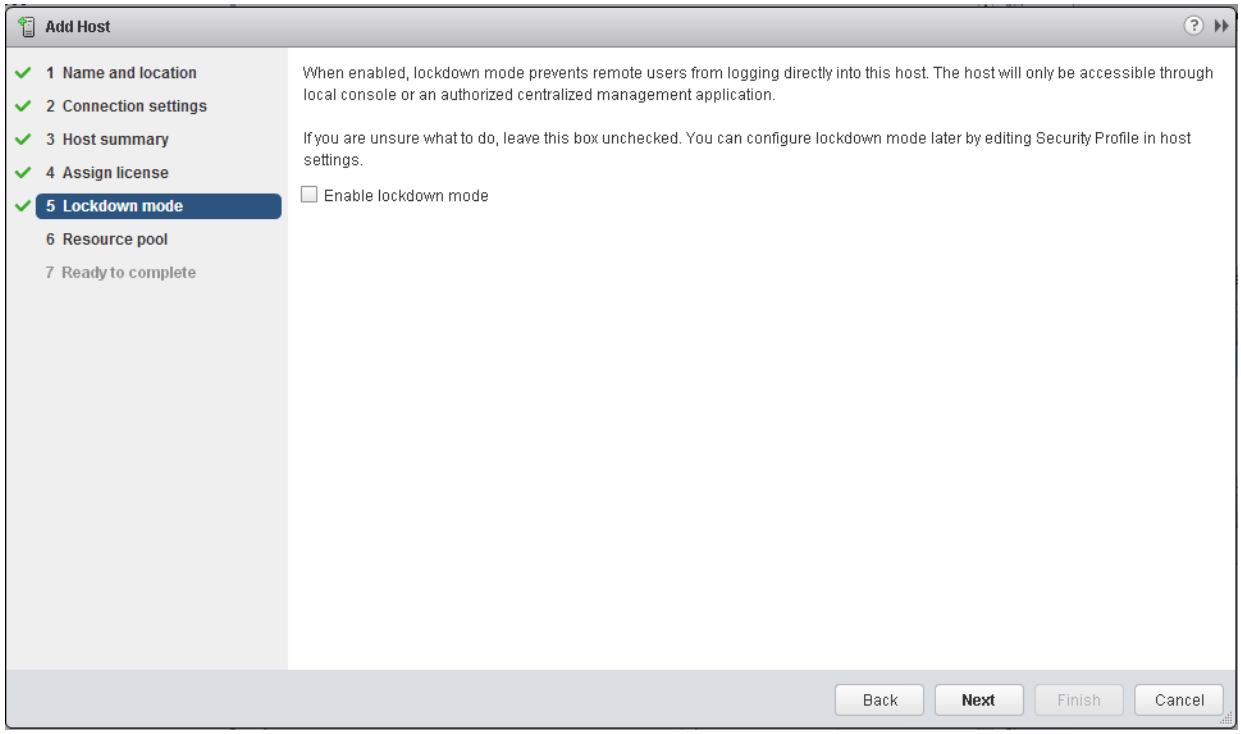
7. Assign the License “VMware vSphere 5 Enterprise Plus” and Click **Next**

Figure 161 Assign the License key



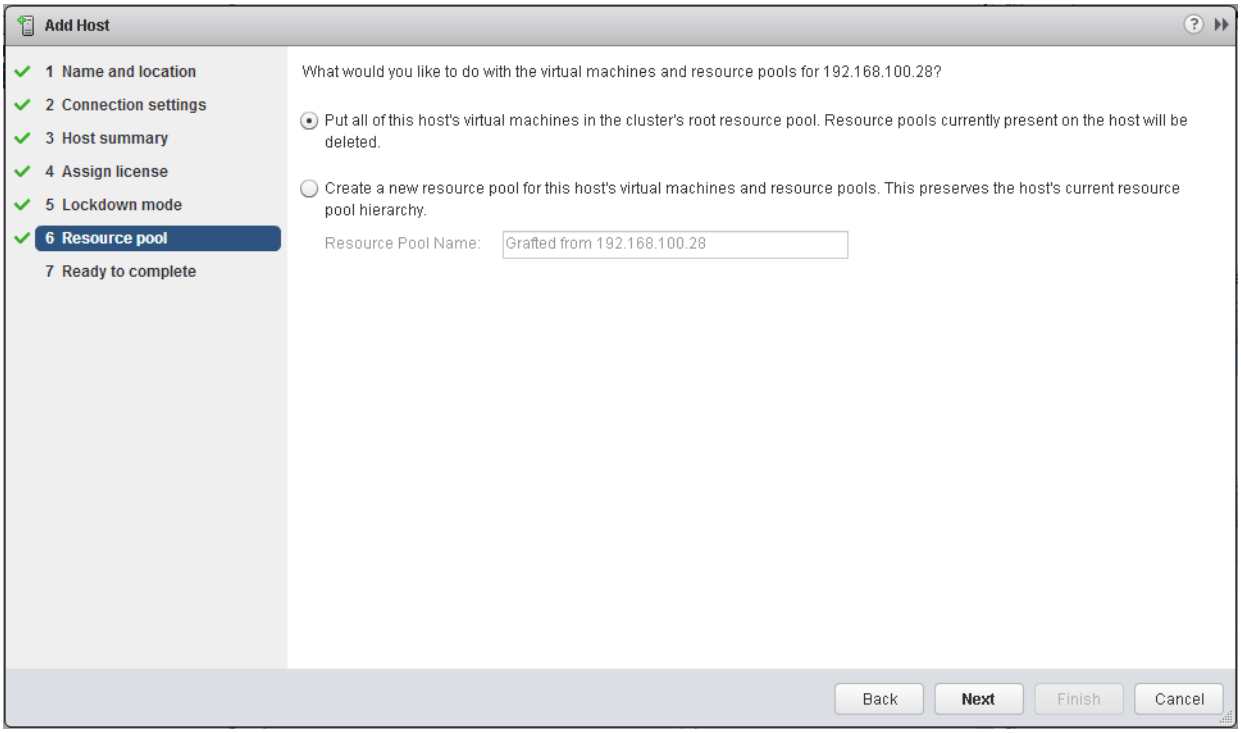
8. Leave the check box Enable Lockdown mode unchecked and click **Next**.

Figure 162 Lockdown Mode is Left Unchecked



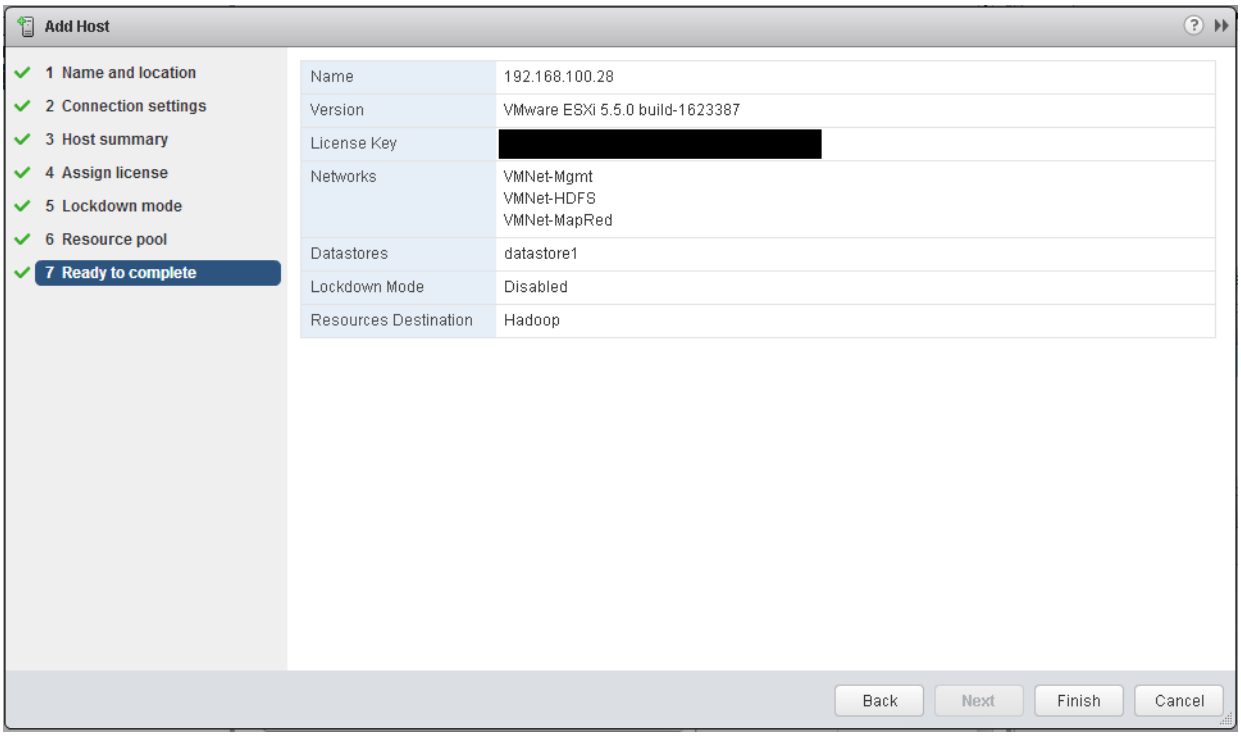
9. In the "Resource Pool" section, choose the radio-button "Put all of this host's virtual machines and resource pools for 192.168.100.21 and click **Finish** to complete adding the ESXi host to the newly created resource pool Hadoop.

Figure 163 Option to Place Existing in a Different Cluster



10. Review the details of the ESXi host and license info that's newly being added, and Click **Finish** to complete adding the ESXi host 192.168.100.28 to the DRS-cluster Hadoop.

Figure 164 Adding ESXi Host to DRS-cluster "Hadoop"

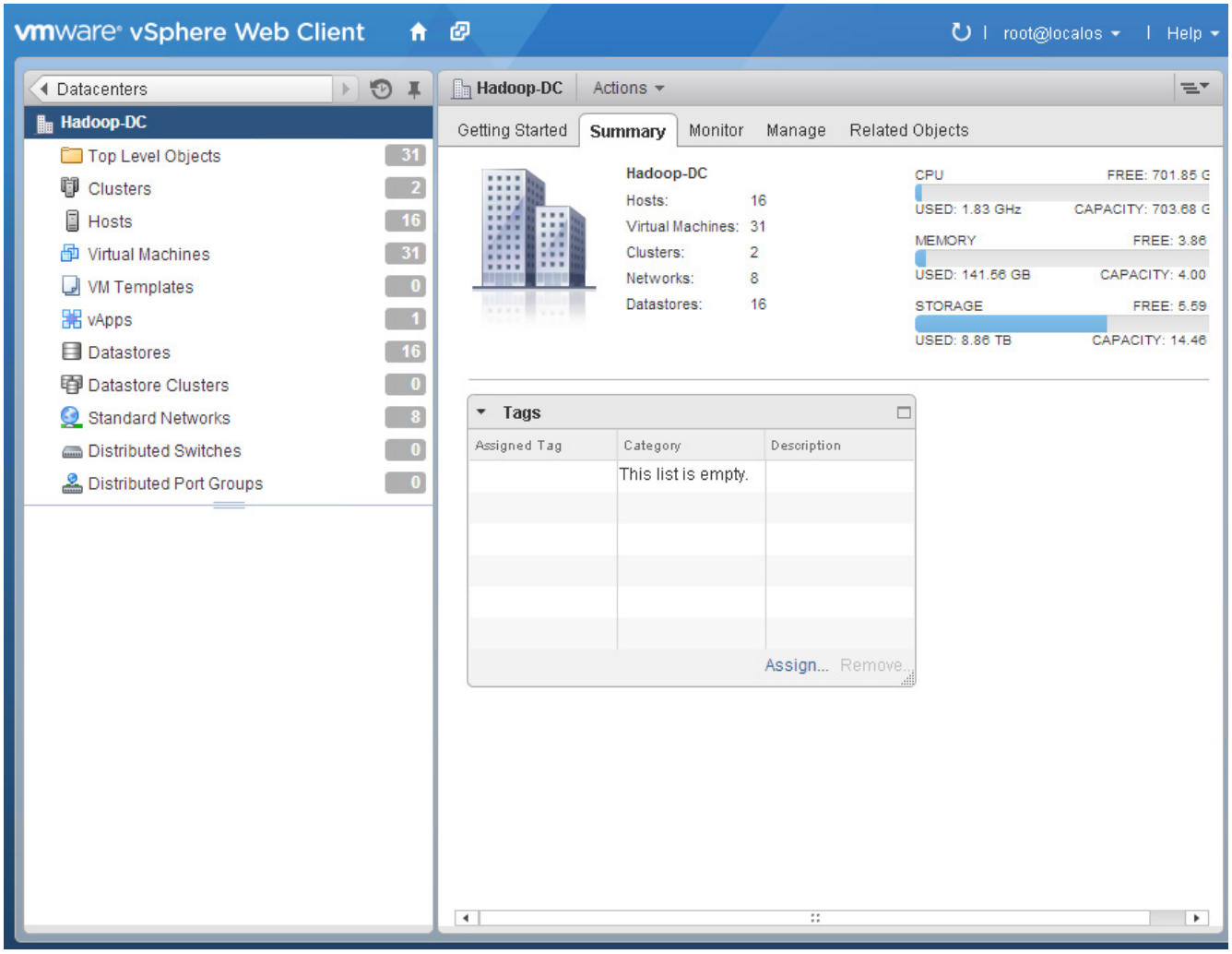


11. Verify that the newly added host by checking the Hadoop DRS-cluster.

Note This process needs to be repeated for adding all the remaining 15-ESXi hosts to the resource pool "Hadoop". See Table 9 for the IP-addresses of the ESXi-hosts.

12. Once all the hosts have been added to the Resource Pool, go to the summary page datacenter Hadoop-DC to verify the available number of resources as shown below.

Figure 165 Summary of Resources in the Data Center Hadoop-DC



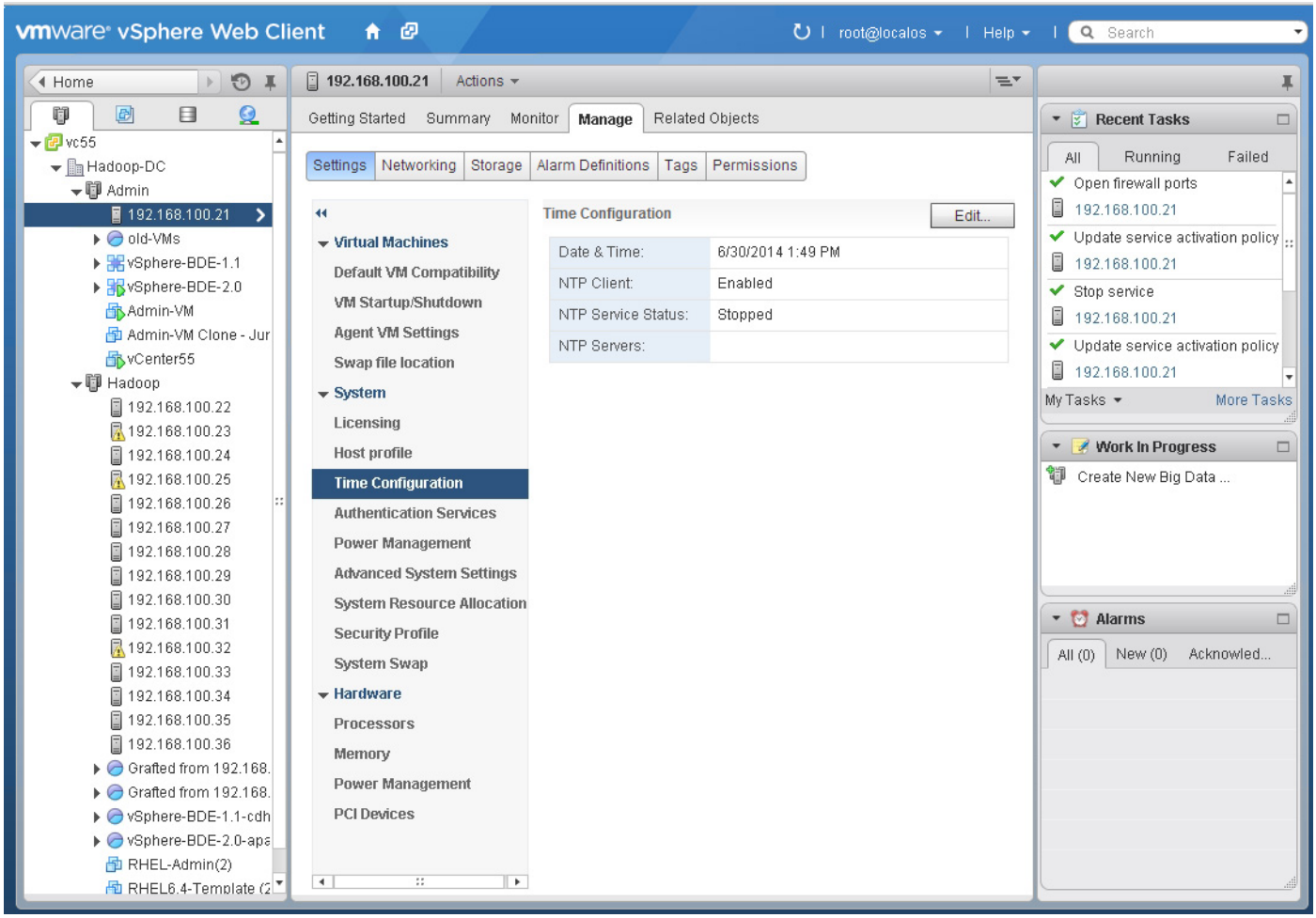
Enable Network Time Protocol on vSphere ESXi hosts

Synchronizing Time of ESXi Host 192.168.100.21 with NTP Server

1. In the vSphere Web-Client navigate to the Datacenter "Hadoop-DC" and choose the "Hosts" to view the list of hosts in the lower part of the Navigation Pane.

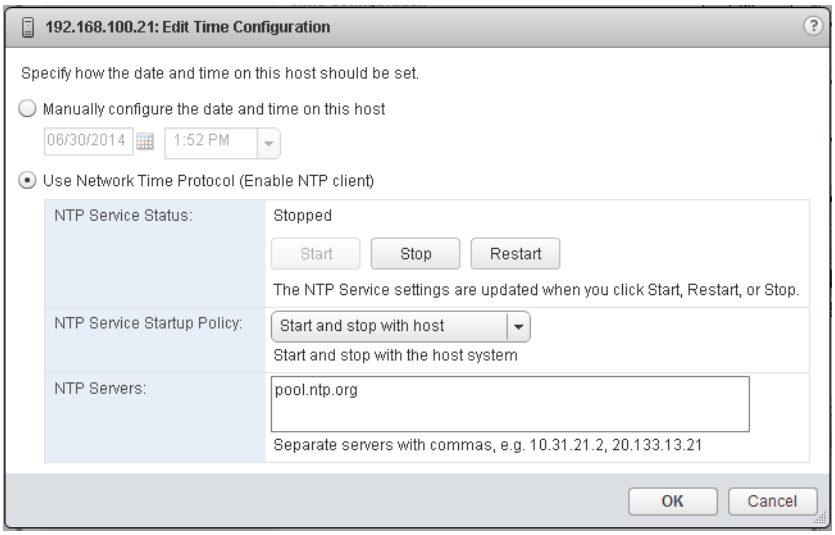
2. Click the hosts in the lower part of the Navigation Pane, and in the middle work pane choose the **Manage** tab, and within it, **Settings** sub-tab.
3. Under the **Settings** tab, choose **System** > **Time Configuration**.

Figure 166 Configuring NTP on the vSphere ESXi Host



4. On the right hand side, click **Edit** to edit the time configuration.
5. Click **Use Network Time Protocol (Enable NTP client)** radio button.
6. Choose the option Start and stop with host in **NTP Service Startup Policy** option.
7. Enter the NTP-server information as pool.ntp.org in the NTP Servers option.
8. Click **Start** to start the NTP client.
9. Press **OK** to complete.

Figure 167 Starting NTP-Client of the ESXi Host in Admin DRS-cluster



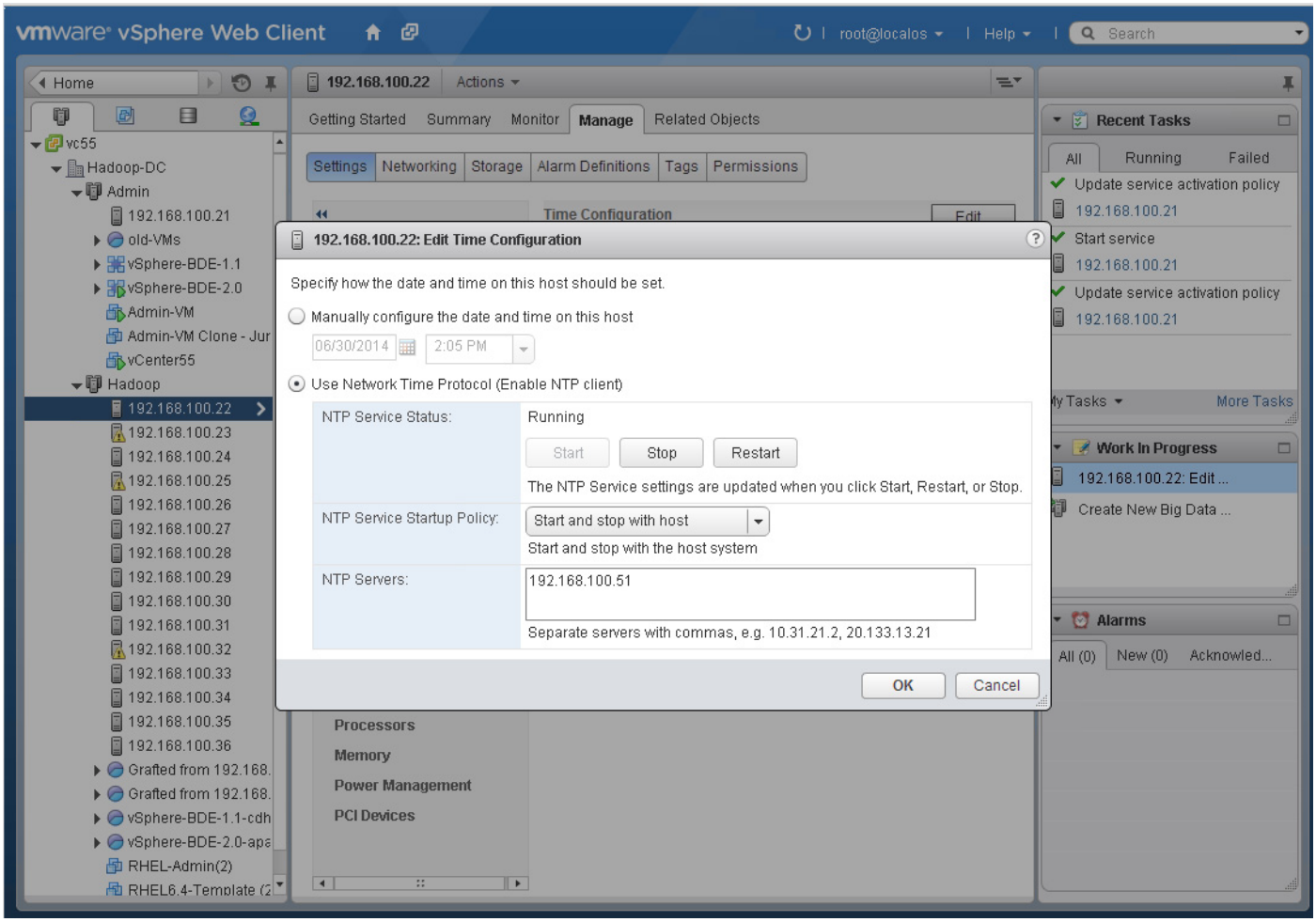
Synchronizing Time of ESXi-hosts (192.168.100.22 – 36) to Admin-VM

The 15 ESXi hosts of the Hadoop DRS-cluster shall be configured to synchronize their time with the local NTP-server that's configured in the Admin-VM (192.168.100.51).

Using vCenter Web Client, perform the following steps on all the 15 ESXi hosts of the Hadoop DRS-cluster.

1. Navigate to the Datacenter "Hadoop-DC" and choose the "Hosts" to view the list of hosts in the lower part of the Navigation Pane.
2. C lick the hosts in the lower part of the Navigation Pane, and in the middle Work pane choose the **Manage** tab, and within it, **Settings** sub-tab.
3. Under the **Settings** tab, choose **System** > **Time Configuration**.
4. On the right hand side, click **Edit** to edit the time configuration.
5. Click the **Use Network Time Protocol (Enable NTP client)** radio-button.
6. Choose the option Start and stop with host in NTP Service Startup Policy option.
7. Add the NTP-server information as pool.ntp.org in the NTP Servers option.
8. Click **Start** button to start the NTP client.
9. Press **OK** to complete.

Figure 168 Configuring the NTP-client ESXi Hosts of the Hadoop DRS-cluster to Sync with Admin-VM



vSphere Big Data Extension 2.1 configurations

Pre-Requisites

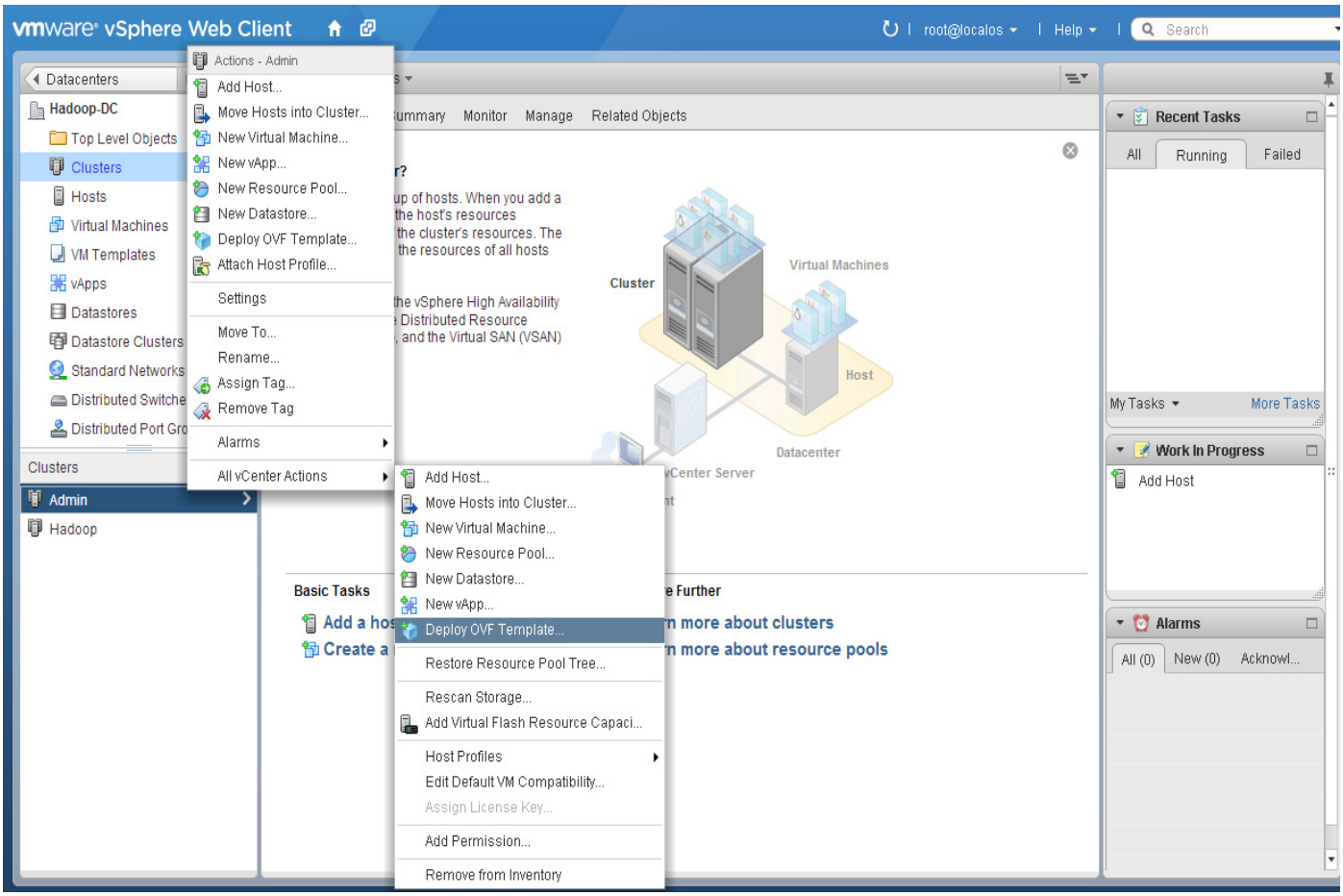
The vSphere Web Client is necessary for installing and configuring the Big Data Extension (BDE) vApp on the vCenter Server. In this section, we will discuss the details on how to install BDE2.0 using vSphere Web Client.

Installing VMware vSphere Big Data Extensions 2.1 using VMware vSphere Web Client

1. Download the latest Big Data Extension 2.1 OVA file from www.vmware.com/downloads. It does not require any licenses.
2. Log onto the vCenter Server using VMware vSphere WebClient.

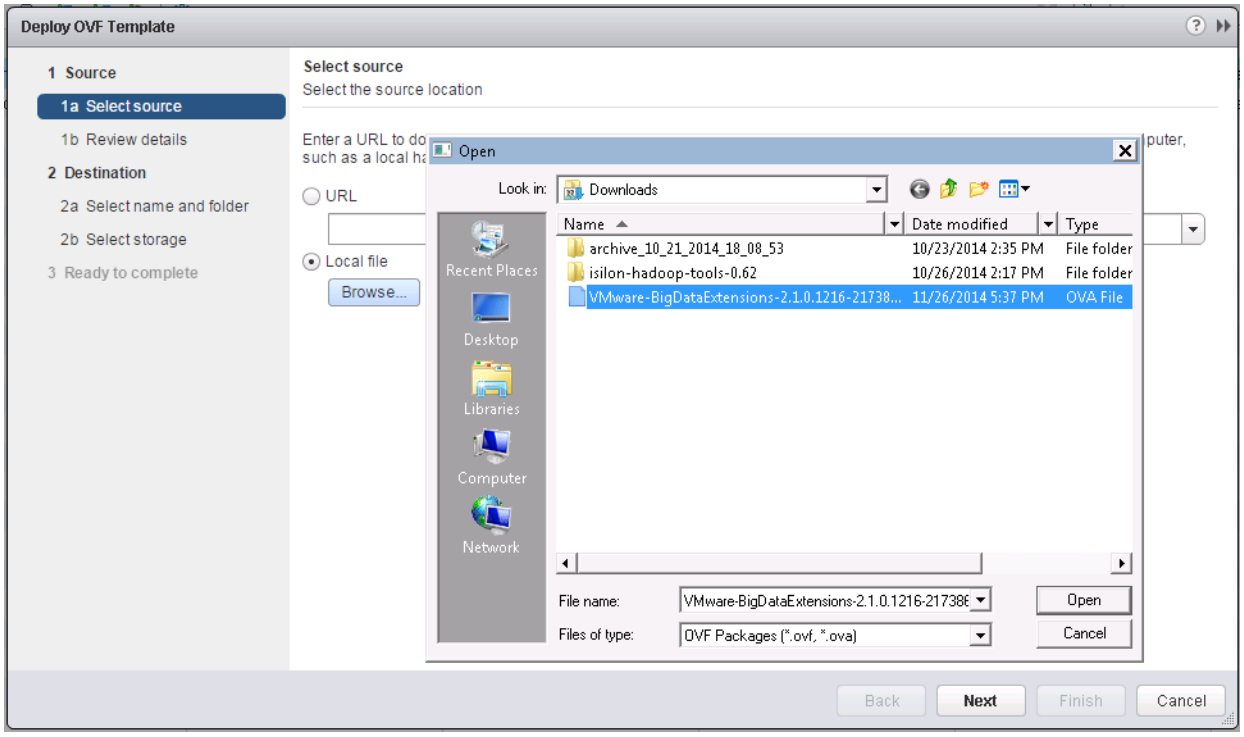
3. Navigate to the Hadoop-DC datacenter, choose Admin DRS resource pool, and right-click to get the context-menu.
4. In the context-menu, choose **All vCenter Actions Deploy OVF Template** option.

Figure 169 Deploy vSphere BDE 2.0 vApp OVF-Template in the Admin DRS-Cluster



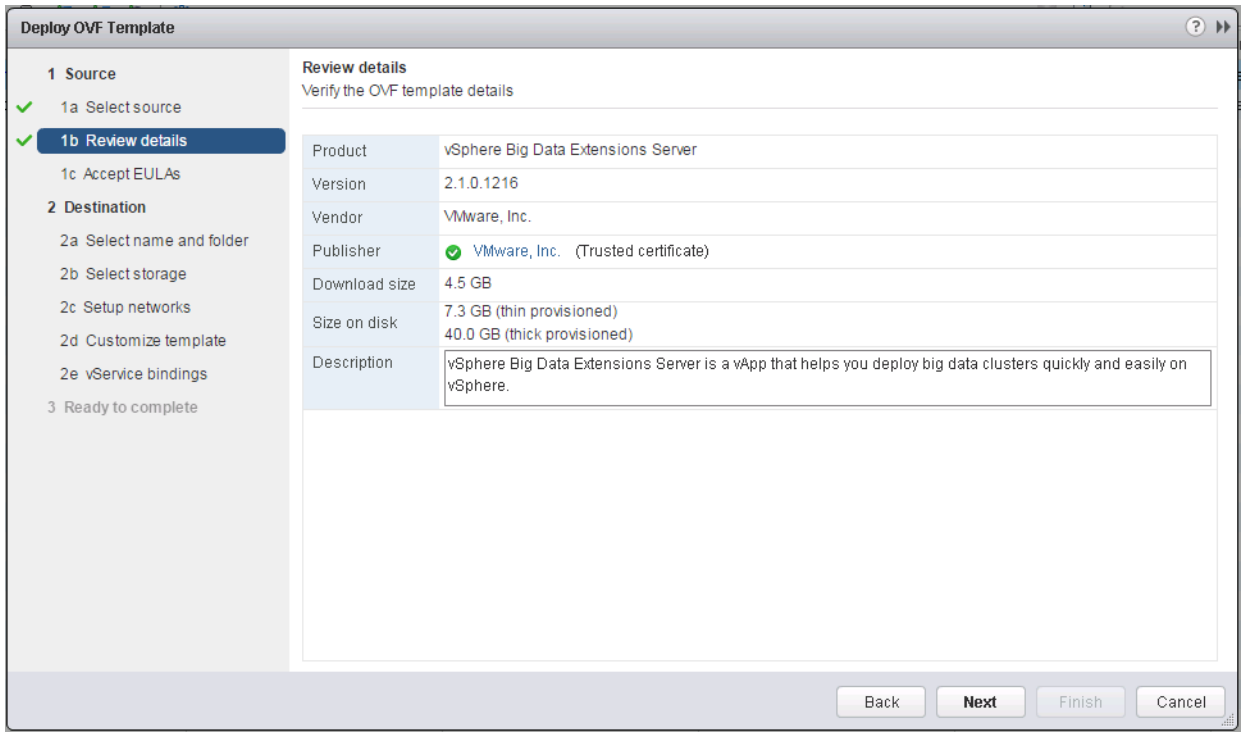
5. In the Deploy OVF Template dialog box. click the **Local file** radio button and click **Browse** to browse and choose the “VMware-BigDataExtension-2.1.0…ova” file, and Click **Next**.

Figure 170 Deploying BDE vApp: Choose the vSphere BDE 2.1's OVF File



6. Review the details of the vSphere BDE 2.1 vApp, and Click **Next**.

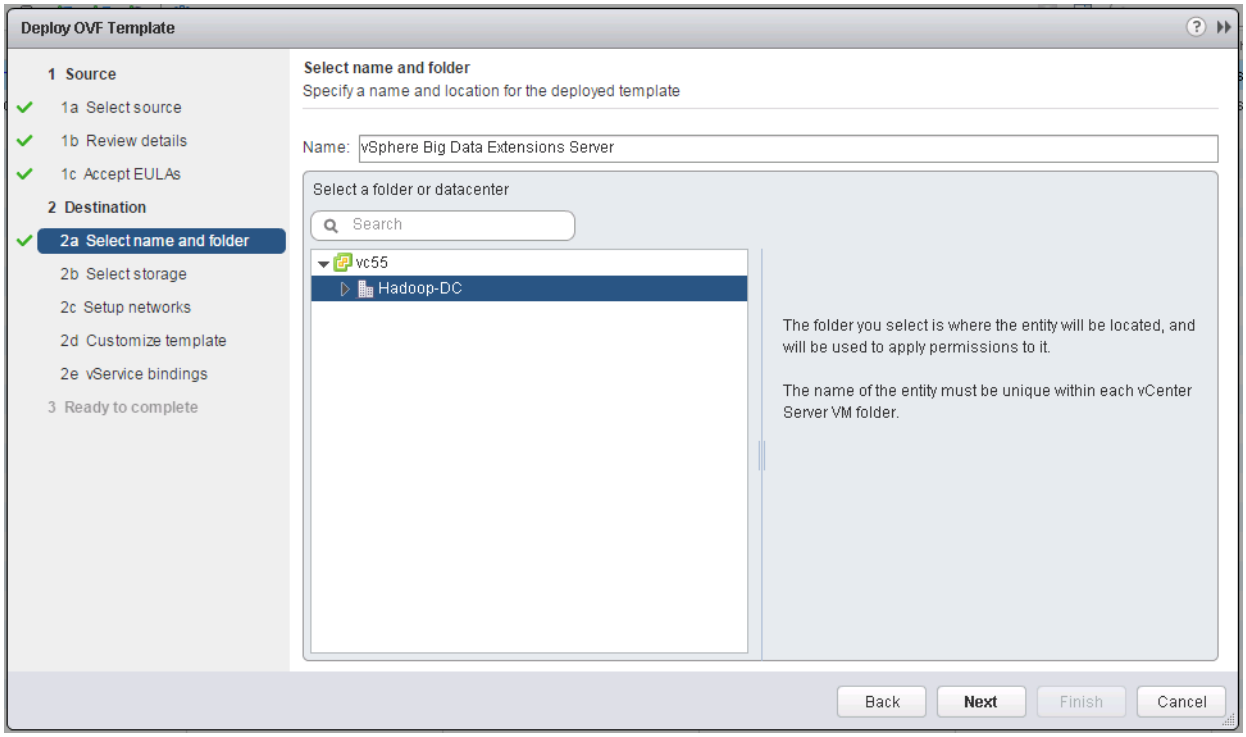
Figure 171 Deploying BDE vApp: Review the Details of the vApp



7. Review and Click **Accept** to accept the End-User License Agreement. Click **Next**.

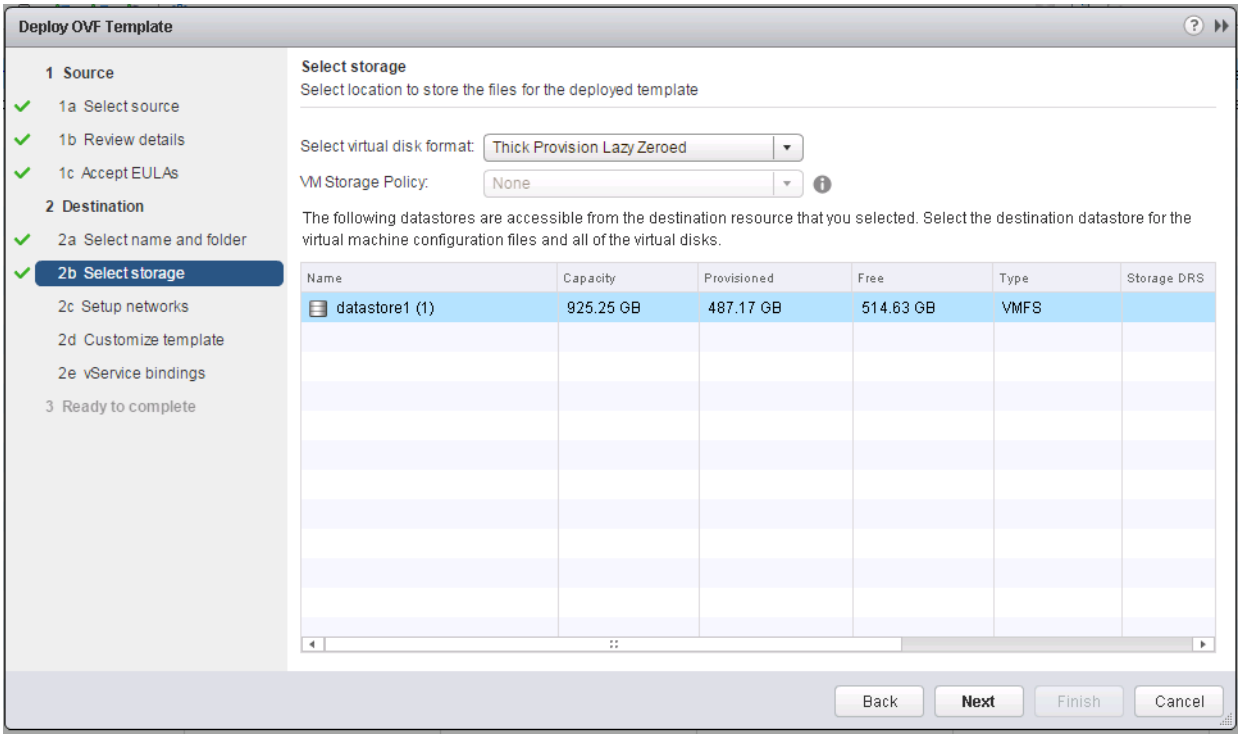
8. Click **Hadoop-DC** to choose the datacenter and specify a name for the vApp, and. Click **Next**.

Figure 172 Deploying BDE vApp: Choosing Data Center and vApp Name



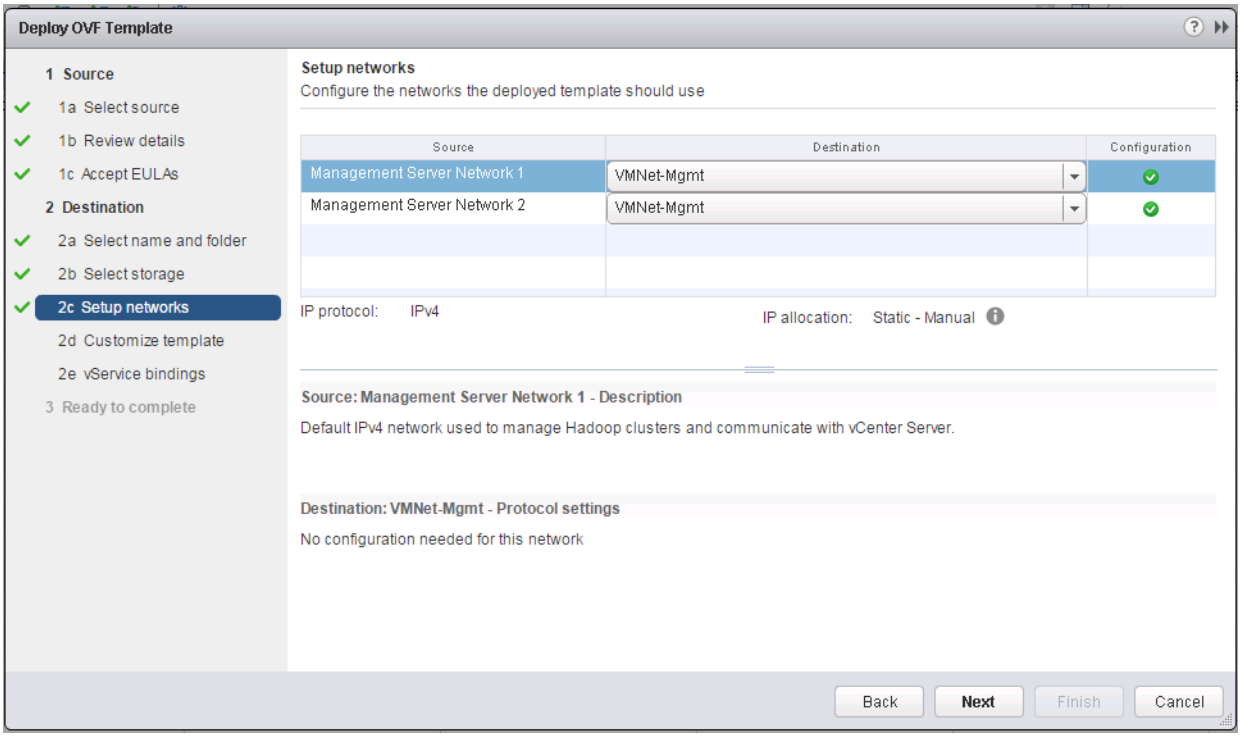
9. Choose the datastore on which the BDE2.1 vApp could be installed. Click **Next**

Figure 173 Deploying vSphere BDE vApp: Choose the Datastore and Virtual-Disk Format



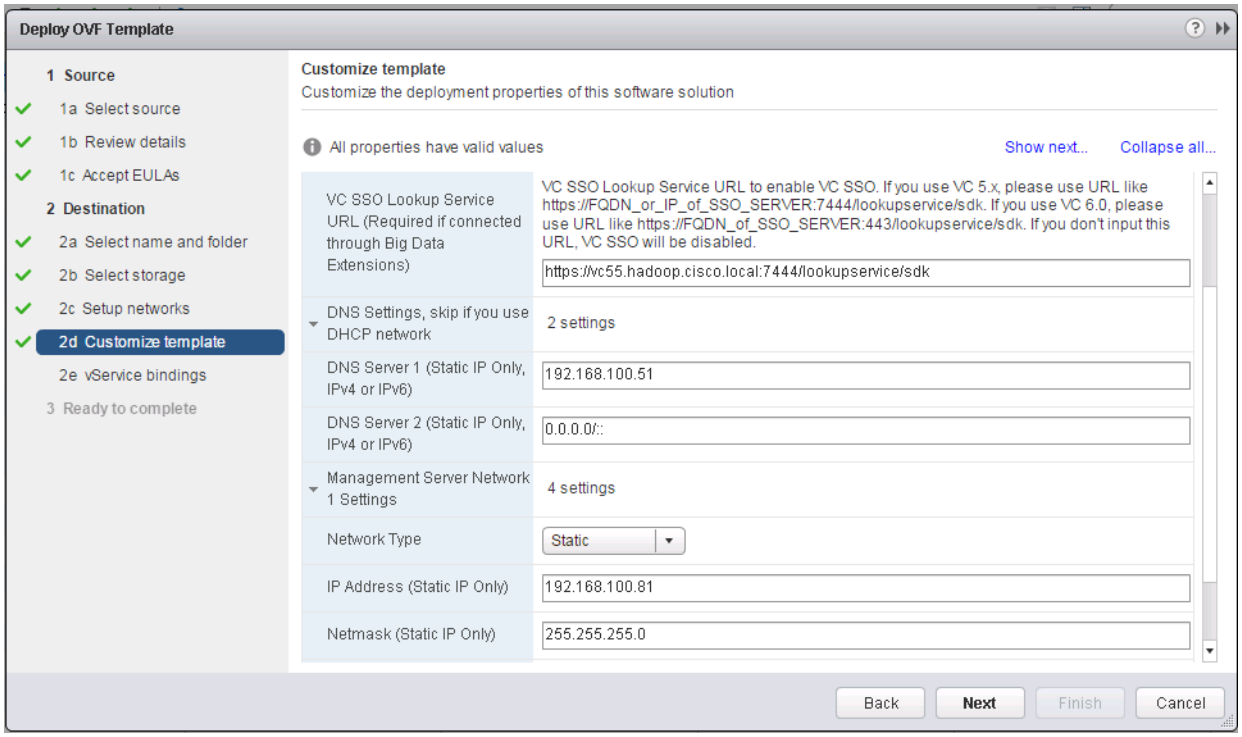
10. Choose Management Network profile for the vApp, and Click **Next**.

Figure 174 Deploying vSphere BDE vApp: Choose the Management Network Port-Group



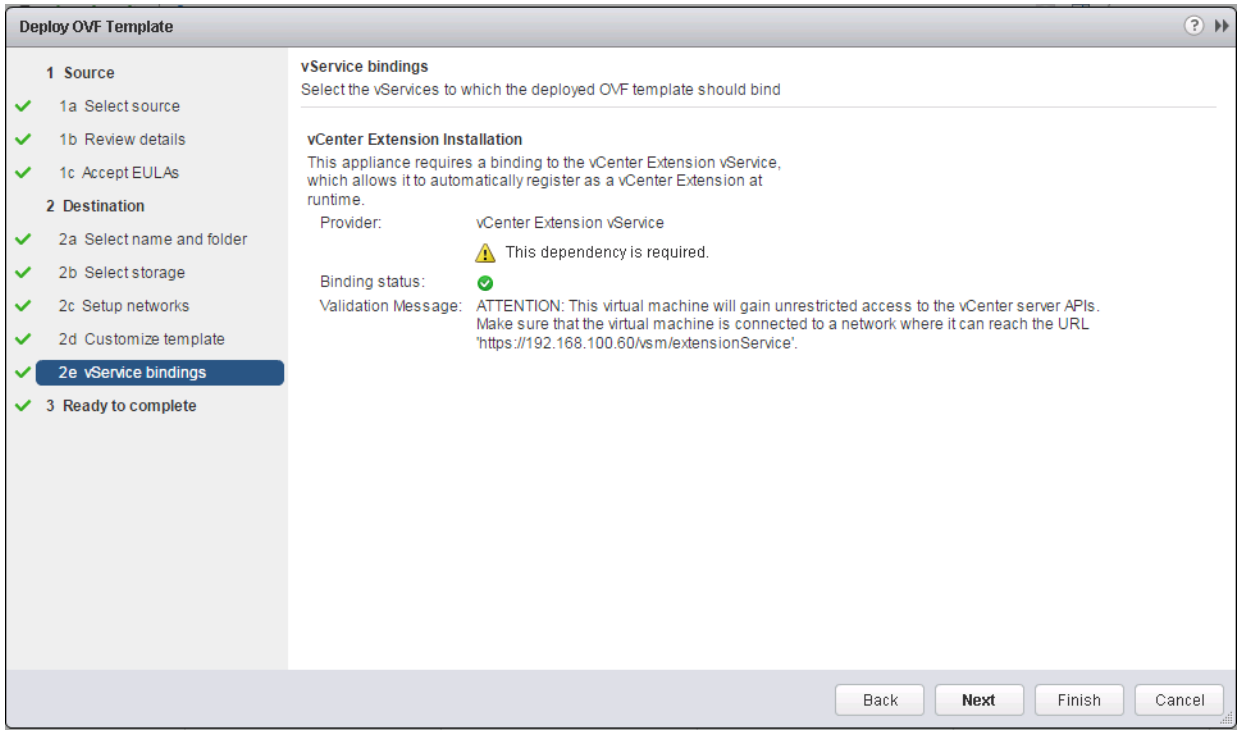
11. Check the **Initialize Resources** check box. With this setting, the BDE vApp will automatically create the network and datastore resources for the vApp. Please note that, we will be able to edit these BDE resources manually.
12. Specify the FQDN of the vCenter-server in the VC SSO Lookup-Service URL section. In our case, the URL is https://vc55.hadoop.cisco.local:7444/lookupservice/sdk
13. Enter the DNS and Static-IP address for the Management network. Click **Next**

Figure 175 Deploying vSphere BDE vApp: Assign the Static IP-Address to the Management-Server



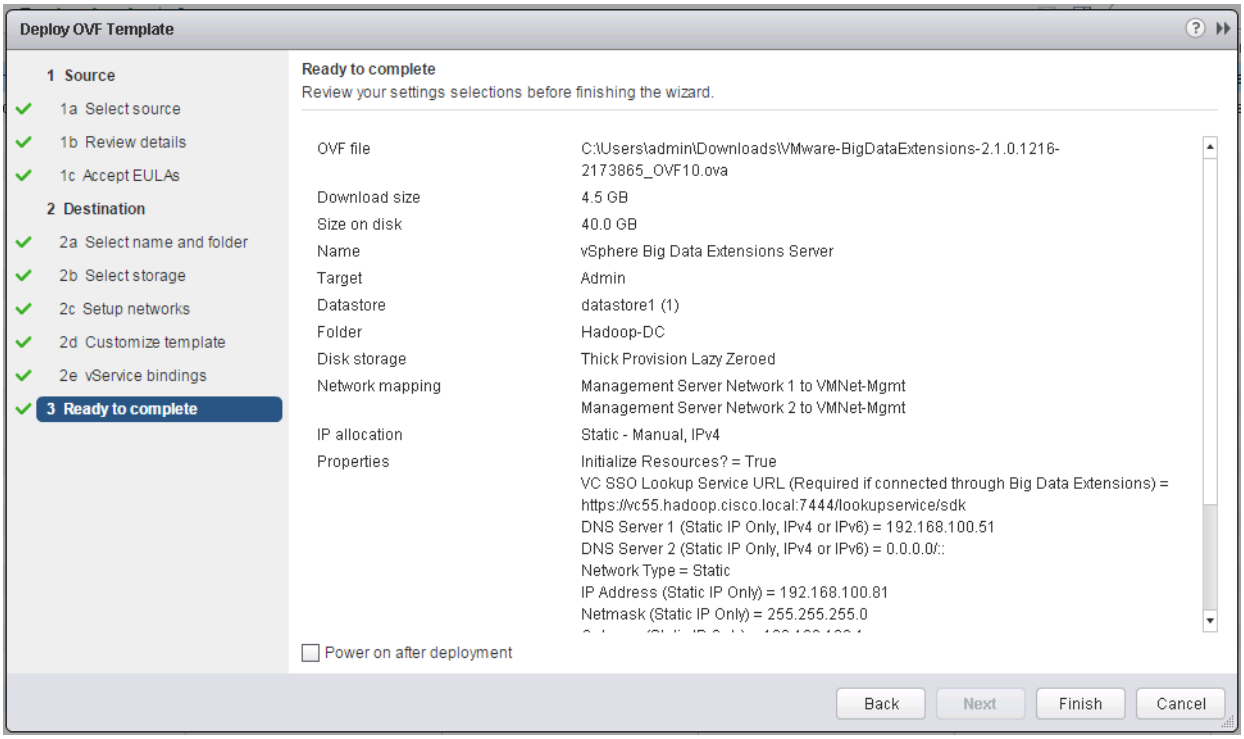
14. Review the warning network access for the vApp. This BDE2.1 vApp requires unrestricted access to the vCenter Extension Service access. So, please make sure the network-port-profile (port-group) assigned in the previous screen will allow access to the vCenter's extension service URL. Click **Next**.

Figure 176 Deploying vSphere BDE vApp: Review the vCenter Extension Service Binding Status



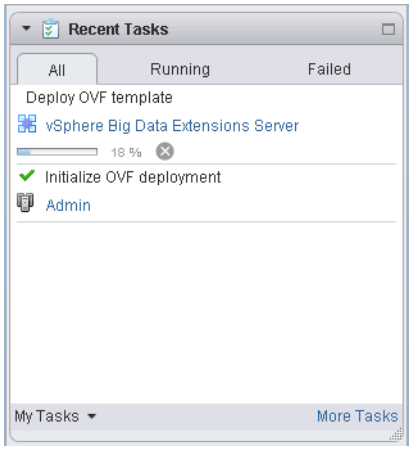
15. Review the details of the settings you provided for this vApp, and Click **Finish** to start the installation process.

Figure 177 Deploying vSphere BDE vApp: Review the Settings



16. You may monitor the progress of the installation of the vApp in the “Recent Tasks” column of the vSphere WebClient.

Figure 178 Deploying vSphere BDE vApp: Showing BDE vApp Deployment Progress Bar



17. Once the installation completes, view “/etc/hosts” file of the Admin-VM to make sure that, there is an entry for the BDE management-server with the correct IP address – 192.168.100.81. See “Installing Lightweight DNS Server dnsmasq Service” section on page 130.
18. Make sure the FQDN is resolvable in the network. From another server/VM in the network perform the nslookup command to check the name resolution. In our case, the FQDN “bdemgr21.hadoop.cisco.local” resolves to the IP 192.168.100.81.

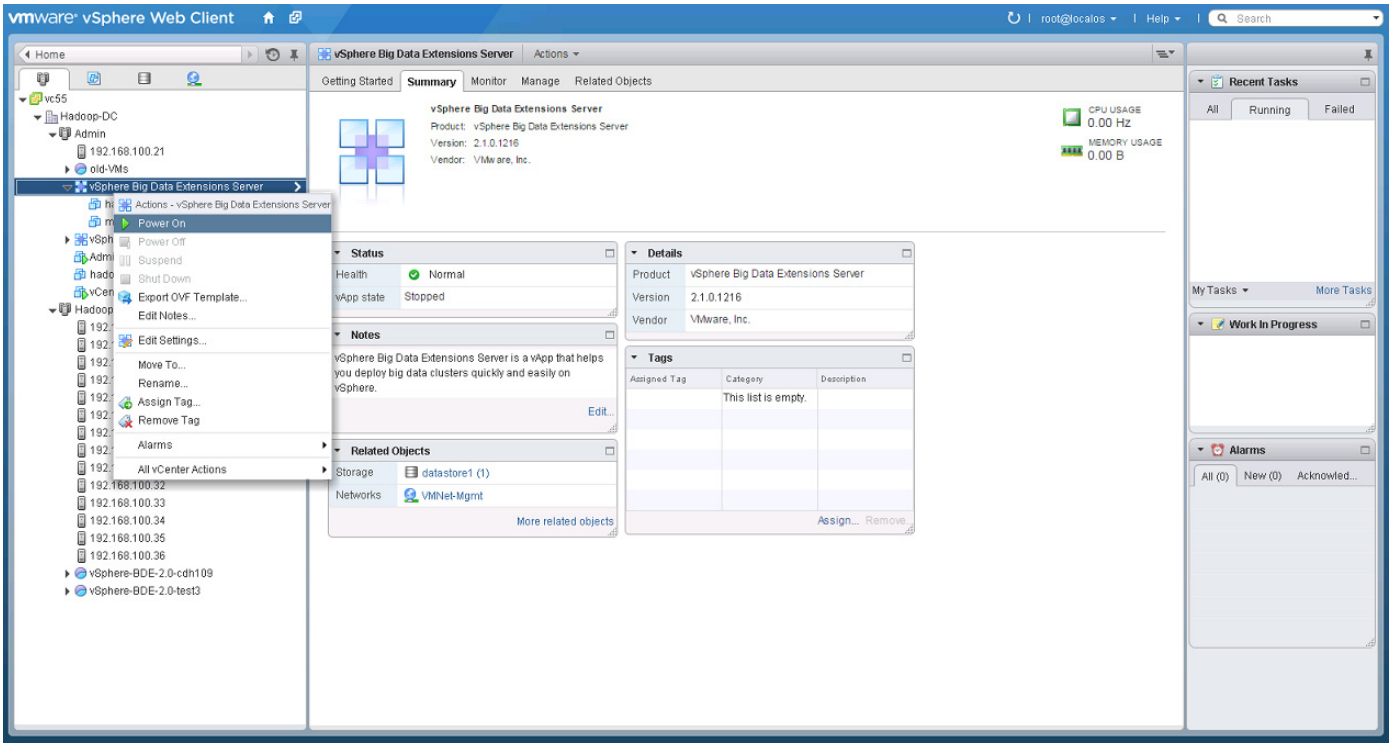
Figure 179 Deploying vSphere BDE vApp: Verifying the BDE vApp FQDN Name Resolutions

```
[root@admin-vm ~]# nslookup bdemgr21
Server:         127.0.0.1
Address:        127.0.0.1#53

Name:   bdemgr21.hadoop.cisco.local
Address: 192.168.100.81

[root@admin-vm ~]# nslookup 192.168.100.81
Server:         127.0.0.1
Address:        127.0.0.1#53

81.100.168.192.in-addr.arpa     name = bdemgr21.hadoop.cisco.local.

[root@admin-vm ~]#
```

Configuring VMware vSphere Big Data Extensions 2.1

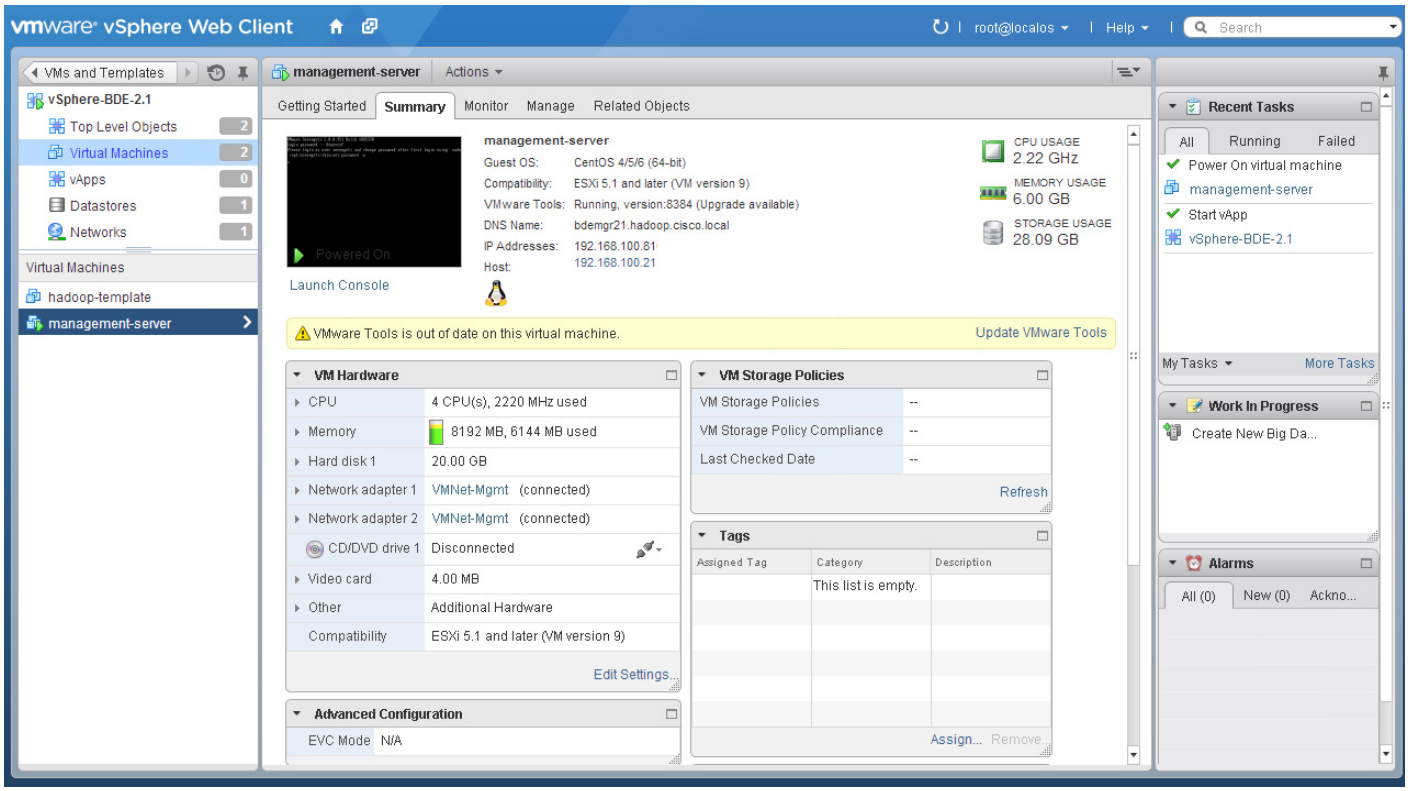
1. Power on the Big Data Extensions (BDE) 2.1 vApp by right-clicking the vApp and choosing **Power On** option.

Figure 180 BDE vApp: Powering On



2. Once the vSphere BDE Server vApp gets powered on, select and expand the vApp, click the **VMs**, and choose **management-server VM** in the list of VMs, and review the IP-address assigned in the middle-pane to make sure that the IP-address that was provided in the previous step is indeed the IP-address assigned to the management-server.

Figure 181 DE vApp: Verify the IP-Address of the Management-Server

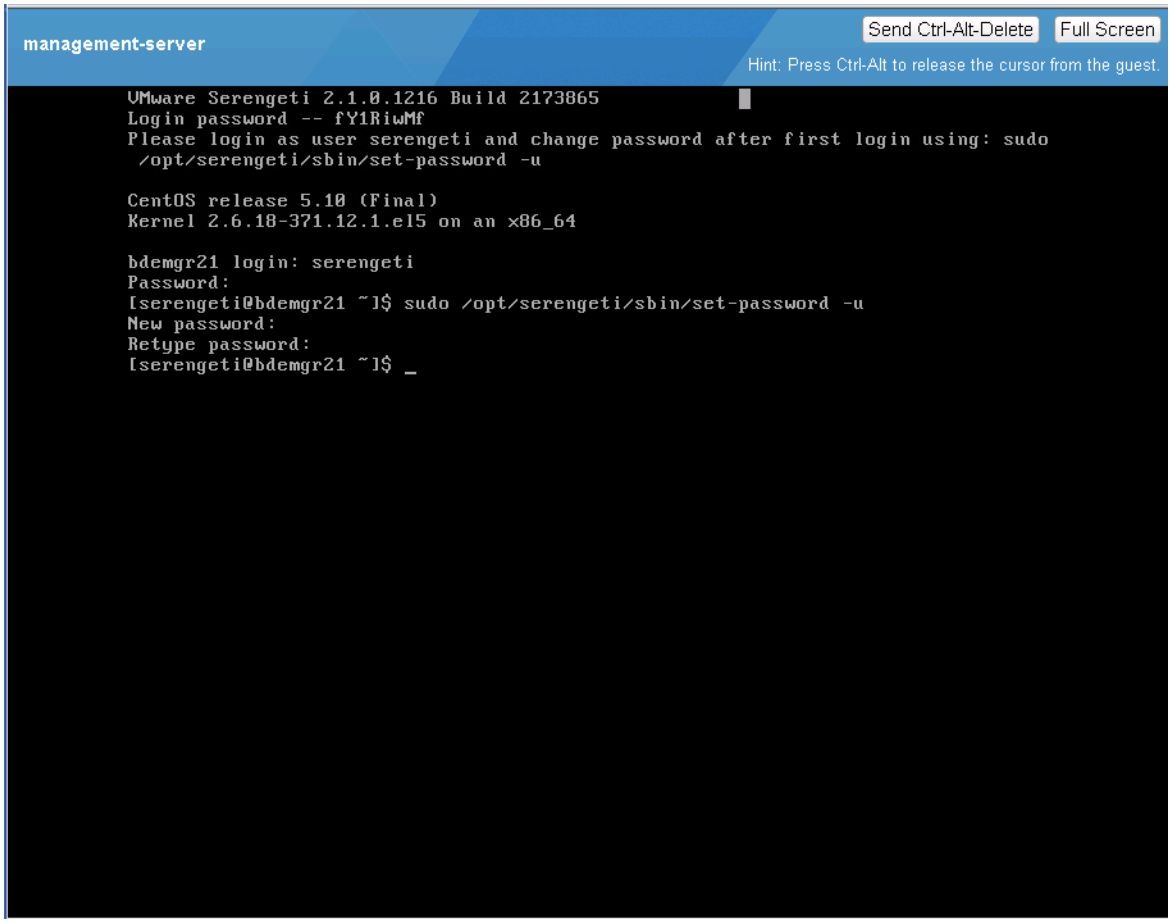


Note When the BDE vApp is powered-on, only the management-server VM is powered on automatically, the Hadoop Template virtual machine, i.e. “hadoop-template”, remains powered off. Big Data Extensions clones this template VM for creating Hadoop cluster VMs. Do not start or stop this virtual machine without good reason!

3. Click the Console to launch the console. Log-onto the management-server as a user “serengeti” and use the password displayed on the top of the Console. And use the command displayed to assign your preferred password.

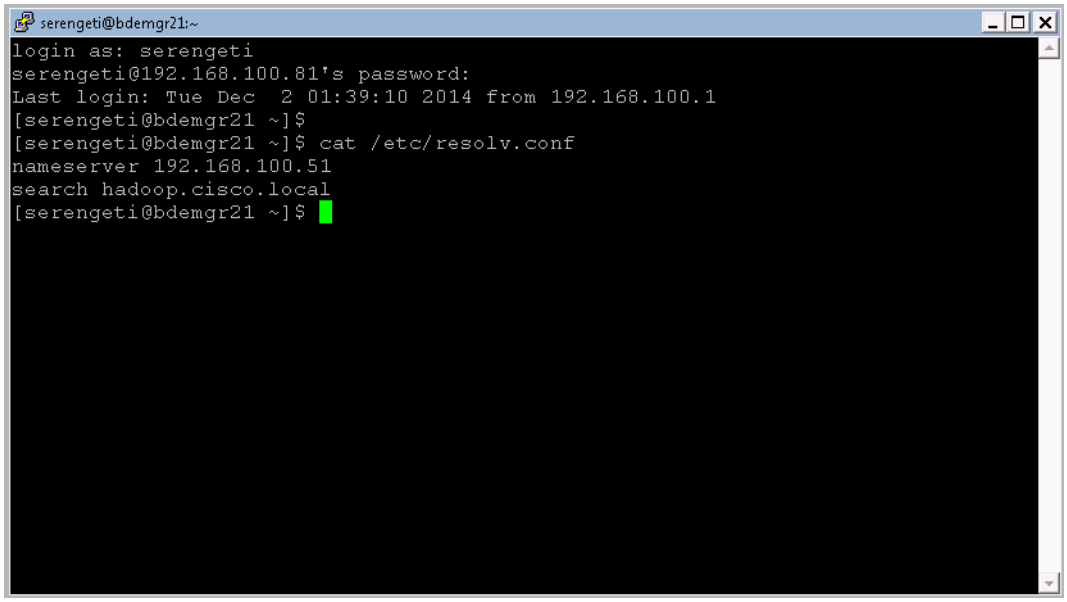
```
sudo /opt/serengeti/sbin/set-password -u
```

Figure 182 BDE vApp: Setting the Password Through the VM console



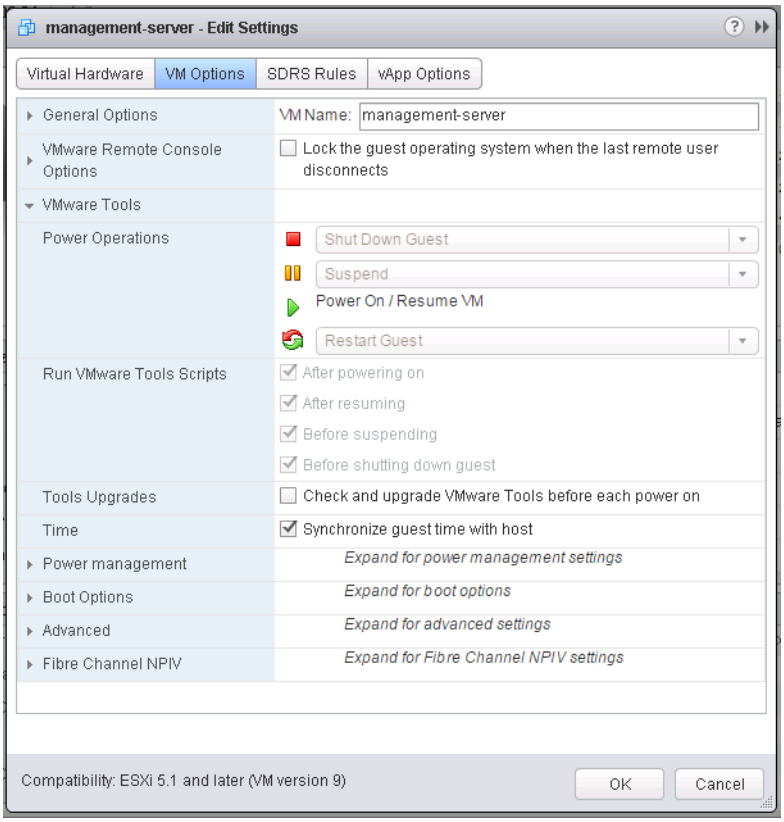
4. Now use putty to open an SSH-session of the BDE 2.1 Management-Server. Login as user “serengeti” and use the password you chose in the previous step.
5. Verify the Nameserver is set to our Admin-VM (admin-vm.hadoop.cisco.com: 192.168.100.51) by viewing the file “/etc/resolv.conf”

Figure 183 BDE vApp: Verifying the Name-Server Configurations



6. Configure the Time source by editing the settings of the management-server and the hadoop-template VMs of the BDE2.1 vApp. This is done by right-clicking on the management-server and selecting “Edit Settings” menu item. In the “Edit Settings” dialog-box, choose the **VM-Options** tab and expand **VMware Tools** > **Time** check the **Synchronize guest time with host** checkbox to Enable it. Click **OK** to accept the changes.

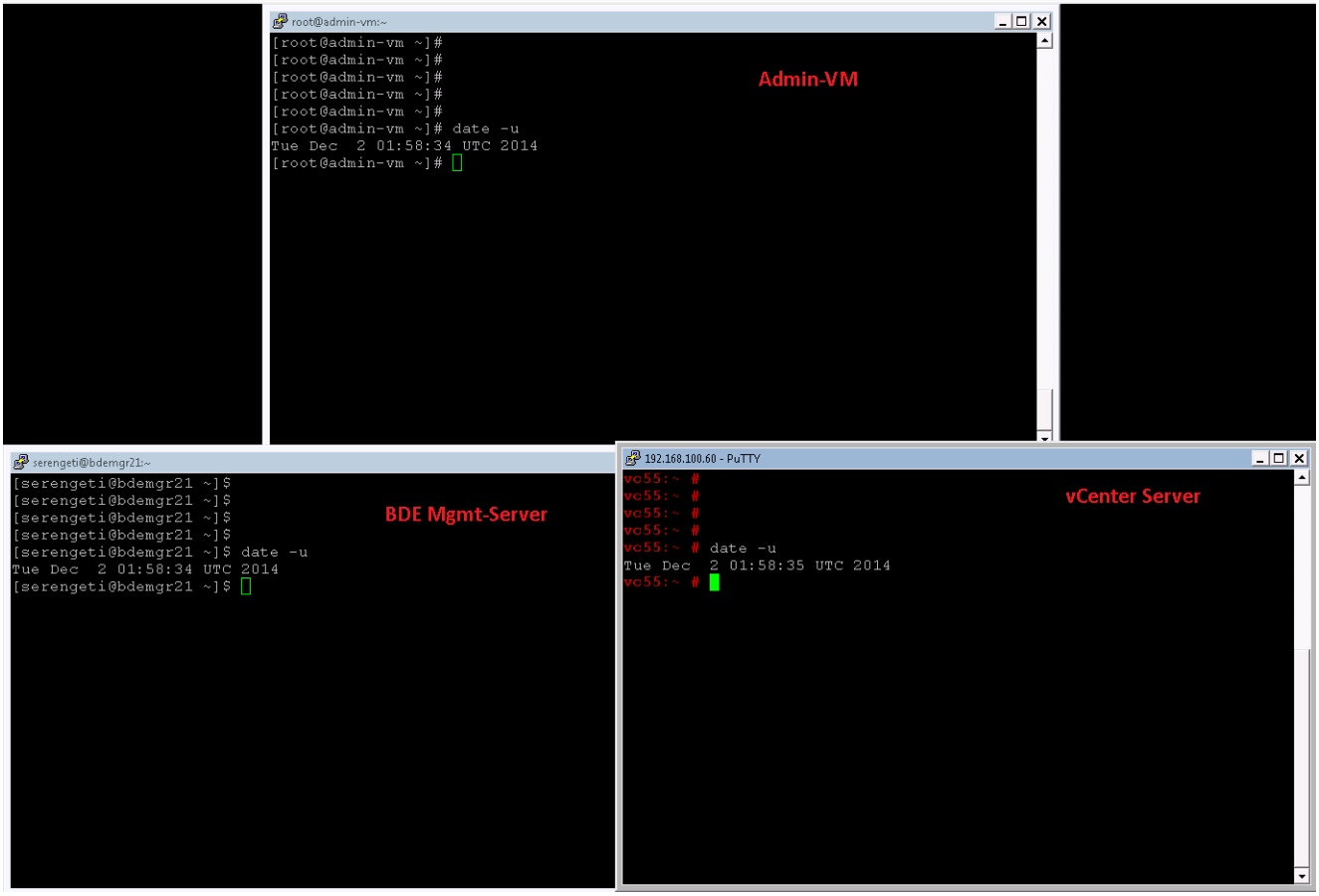
Figure 184 BDE vApp: Synchronizing the Time with the ESXi-host



Verifying Time Synchronization in Three VMs

1. Run the date command in all the important VMs (vCenter, Admin-VM and the BDE Management-Server). As shown below, the times should be in Sync.

Figure 185 Verifying If Time is synchronized in All Three VMs



Installing the vSphere Big Data Extensions Plugin into the vSphere Web-Client

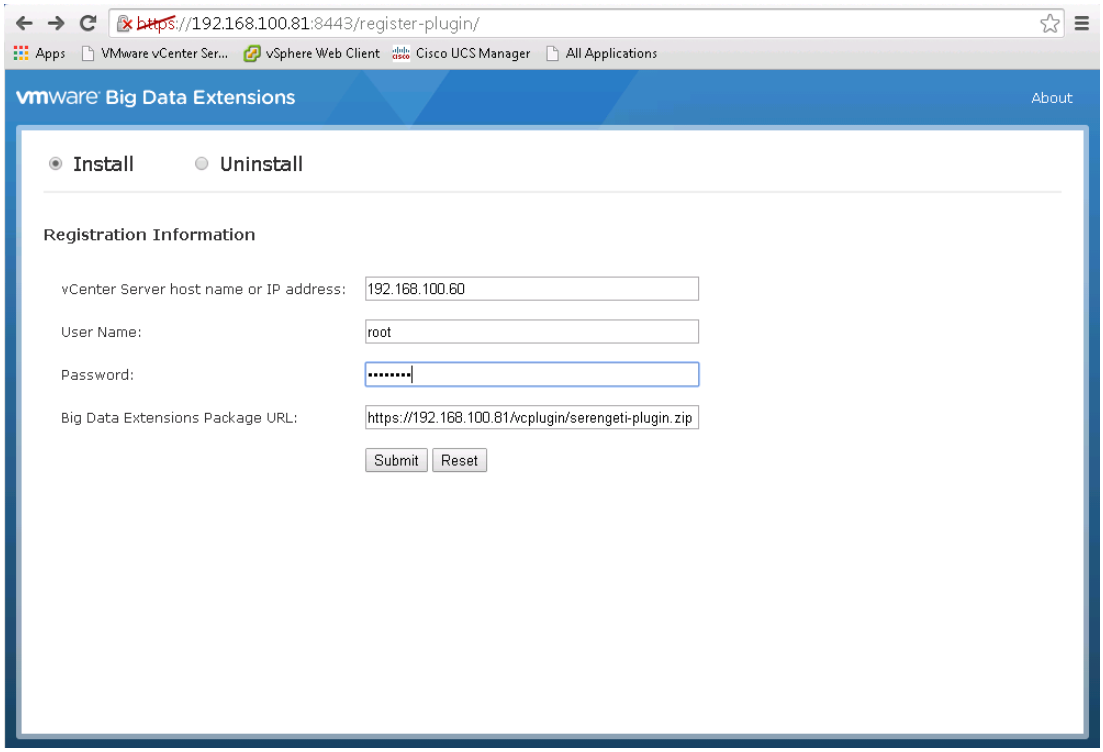
In order to use the Big-Data Extensions with the vCenter Server, you must to register the Big-Data Extensions plugin in the vSphere Web-Client that is used to access the vCenter Server hosting the Big-Data Extension vApp.

Note Please make sure that the system clock of the all the ESXi host that's hosting the Big Data Extensions vApp is synchronized with that of the computers/VMs hosting the Admin VM (192.168.100.51).

1. Using a web-browser go to the BDE Management-Server's Plugin registration URL at https://192.168.100.81:8443/register-plugin.
2. Click the Install radio button, enter the FQDN (or) the IP-address of the vCenter-Server, Username, Password. Click **Submit** to install the Plugin.

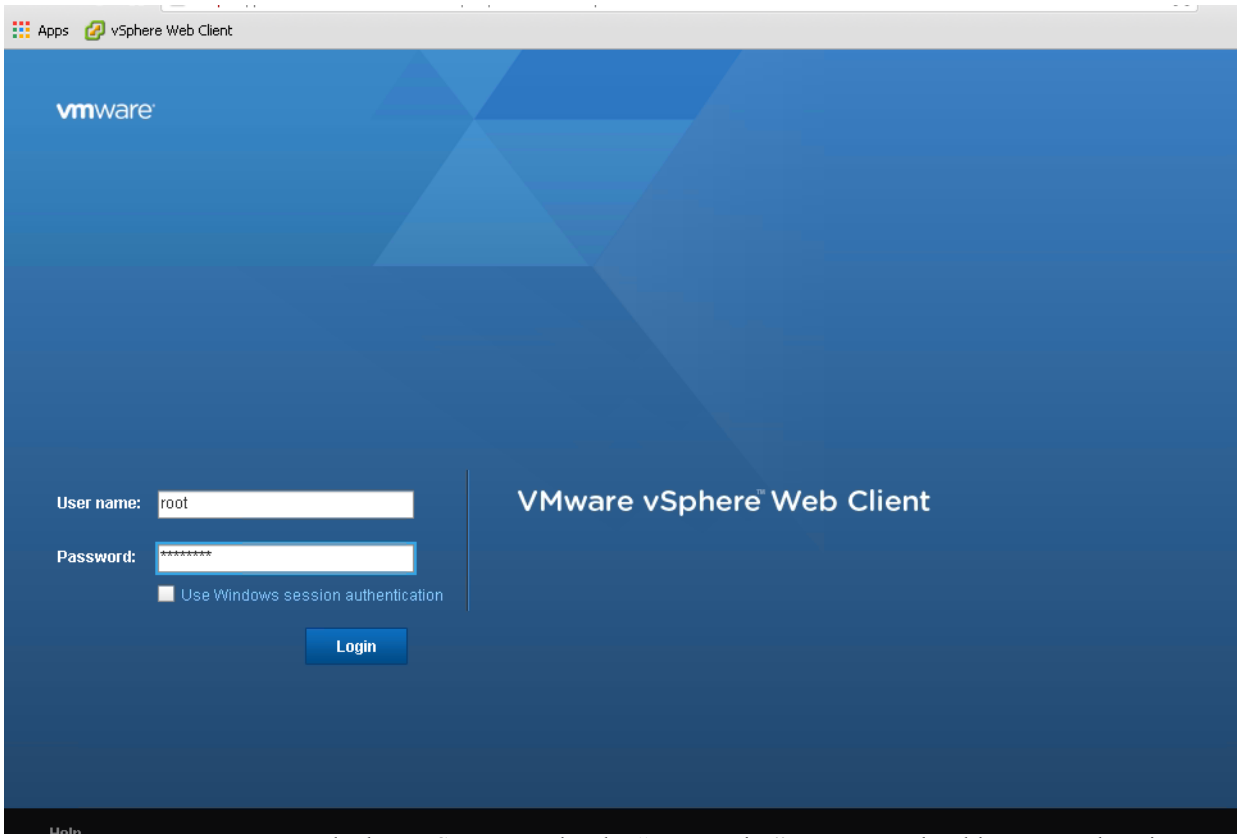
Note If this vCenter was ever used with older (1.1) version of the BDE, Make sure it's plugin is disconnected from its management-server, uninstall the BDE1.1 plugin and subsequently install the BDE2.1 plugin. If Static-IP addresses are used for BDE management-server, please use a different IP than the IP used for BDE1.1 management-server.

Figure 186 BDE vApp: Installing the Big Data Extensions Plugin into the vCenter Web Client



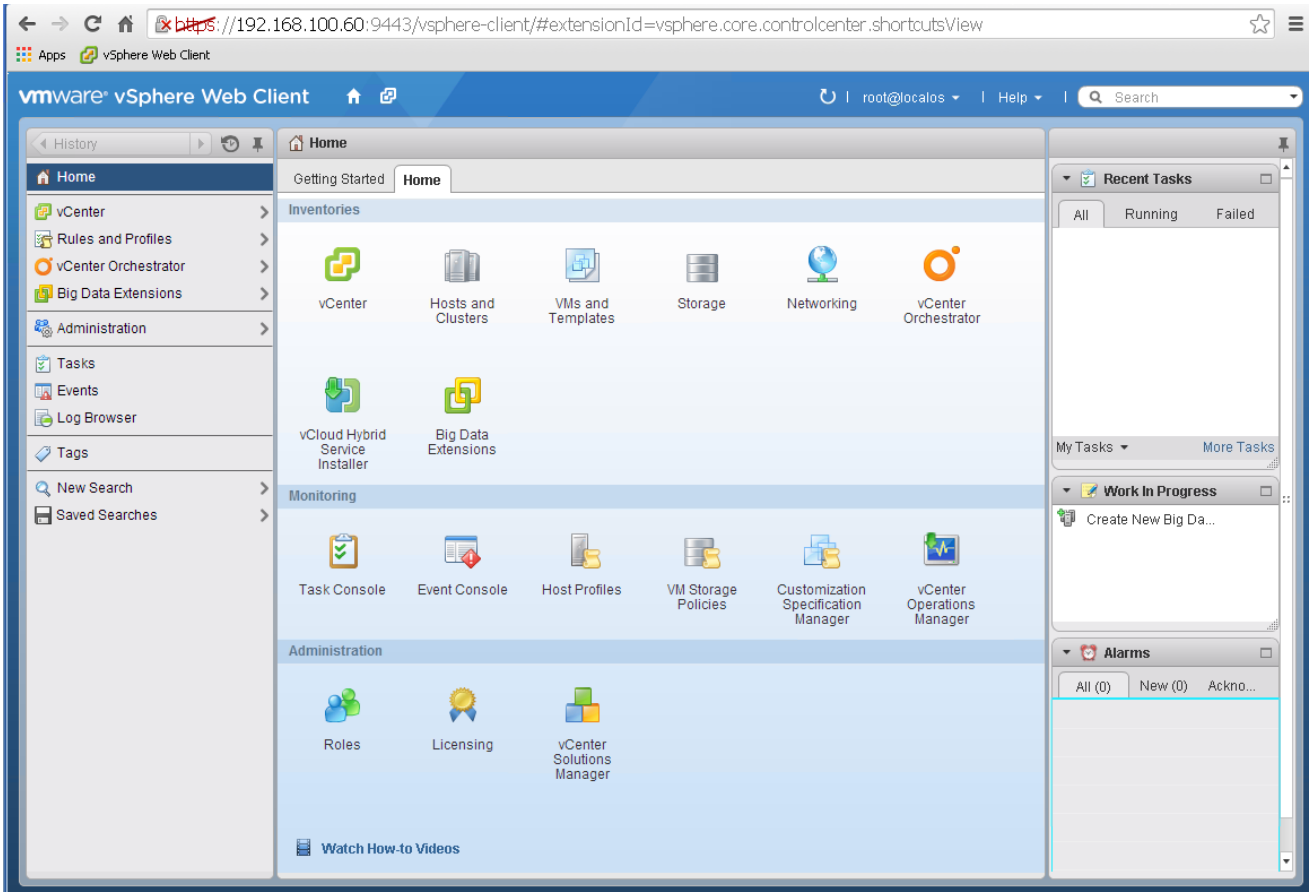
3. Once the installation is successful, it should display the following message: "Installation successful! Big Data Extensions Server is now available through the vSphere Web Client."
4. Now, log-off from the vSphere Web Client
5. Press the **Refresh** button or Refresh Hot-Key of your Web-Browser.
6. Now log back into the vSphere Web Client.

Figure 187 Logging into vSphere Web-Client after Installing vSphere Big Data Extensions Plugin



7. In the home Screen, under the “Inventories” pane, you should now see the Big Data Extensions Plugin.

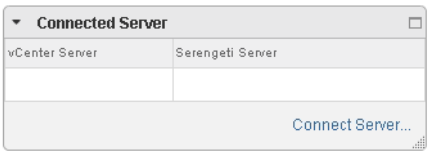
Figure 188 vSphere Web Client Screen Showing Installed "Big Data Extensions" Plugin in Inventories pane



Connecting the BDE Plugin with BDE Management Server

1. From the home page, click **Big Data Extensions** icon in the Inventories pane. This will bring up the **Big Data Extensions** screen as shown below.
2. Click **Connect Server** Link in the Big Data Extensions screen.

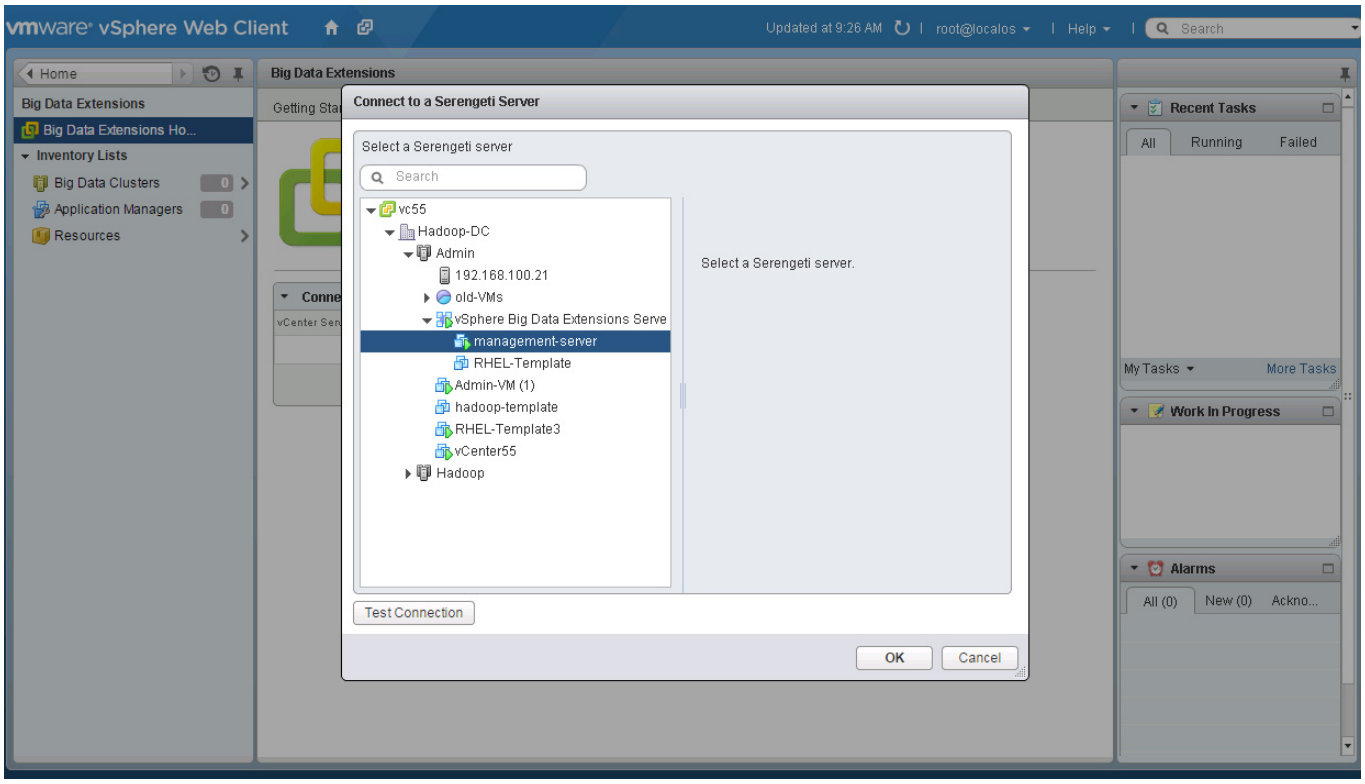
Figure 189 BDE vApp: Connecting the BDE Plugin



3. In the resulting "Connect to a Serengeti Server" dialog box, perform the following steps:
4. Click Datacenter "Hadoop-DC".
5. Click DRS-cluster "Admin".
6. Click the appropriate BDE vApp instance, in our case, "vSphere Big Data Extensions Server"
7. Click the VM "management-server".

Note vCenter supports multiple BDE vApps to be present in the same datacenter of the vCenter. But, the BDE-Plugin in the vSphere Web-Client should be connected to only one BDE vApp's Serengeti server i.e. management-server VM.

Figure 190 BDE vApp: Connecting the BDE Plugin with the BDE Management-Server

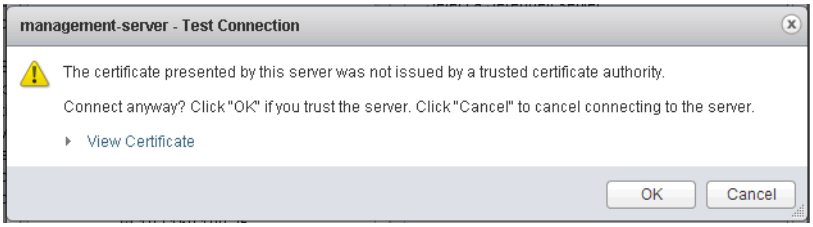


8. Press **OK** to complete the connection.

Note Optionally, you may also test the connection by clicking the <Test Connection> button, before actually connecting to the Serengeti Server.

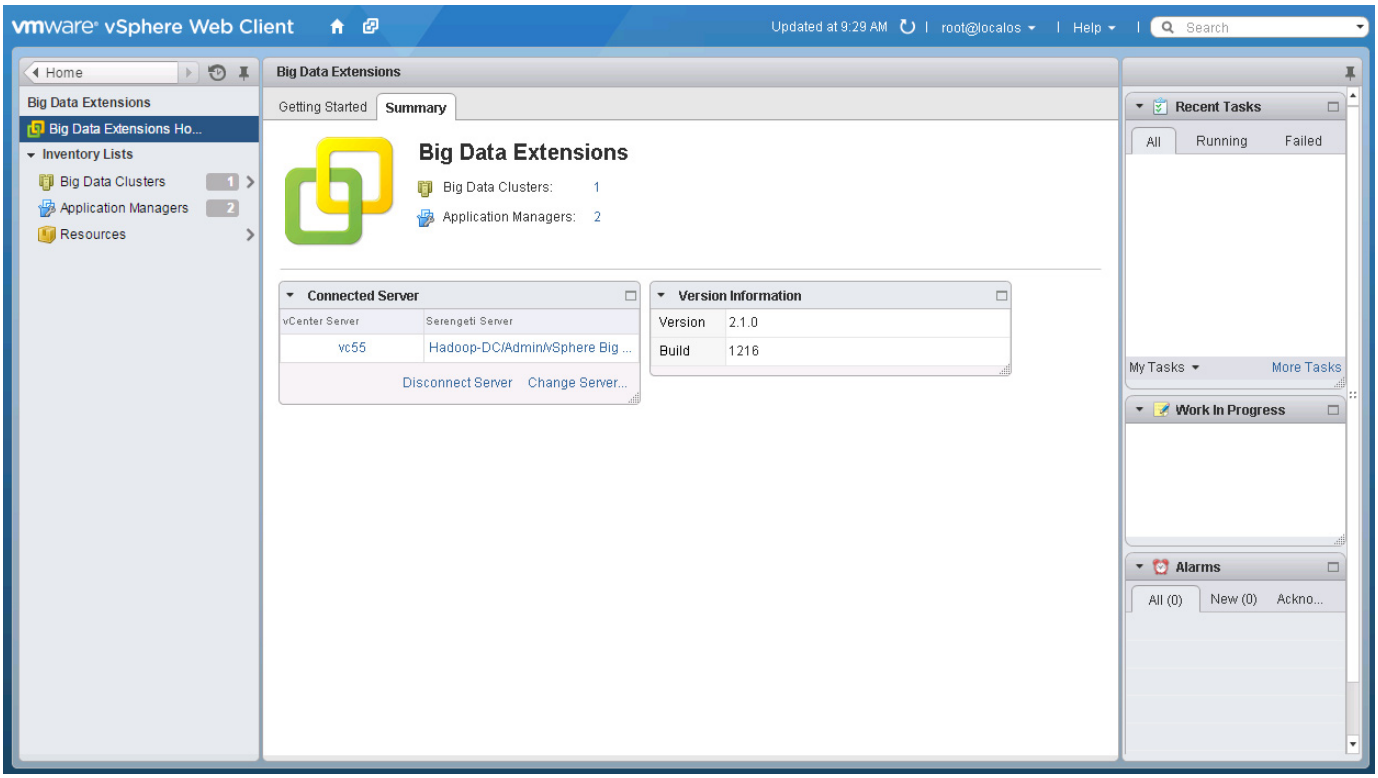
9. Choose to accept the Certificate warning that pops-up during the test to proceed.

Figure 191 BDE vApp: BDE Plugin to Management Server Connection Test



10. Once successfully connected, the Big Data Extensions screen would look like the below screen.

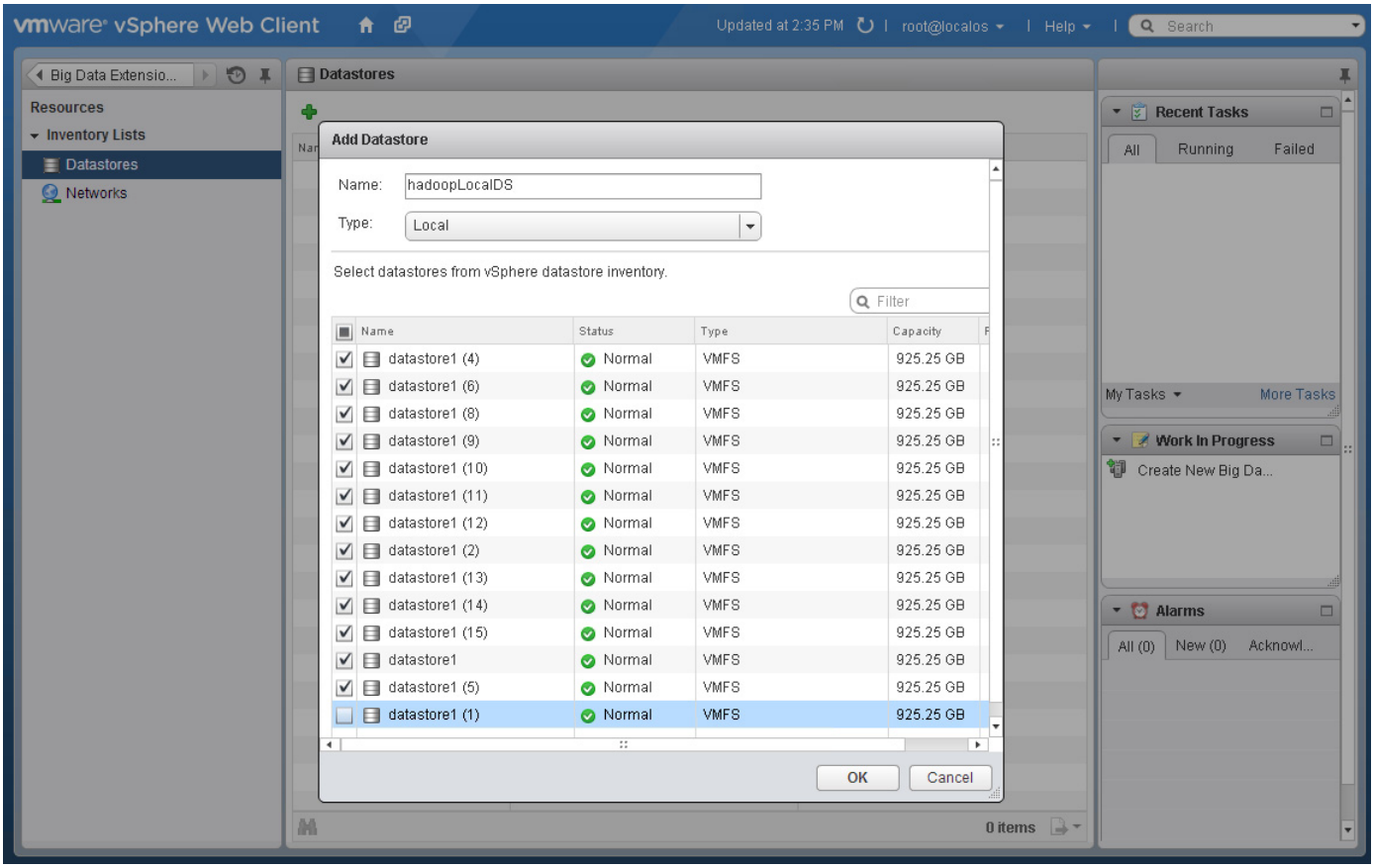
Figure 192 BDE vApp: Big Data Extensions Plugin is Connected with the Serengeti (BDE) Management-Server



Configuring Datastores and Network Resources in Big Data Extensions

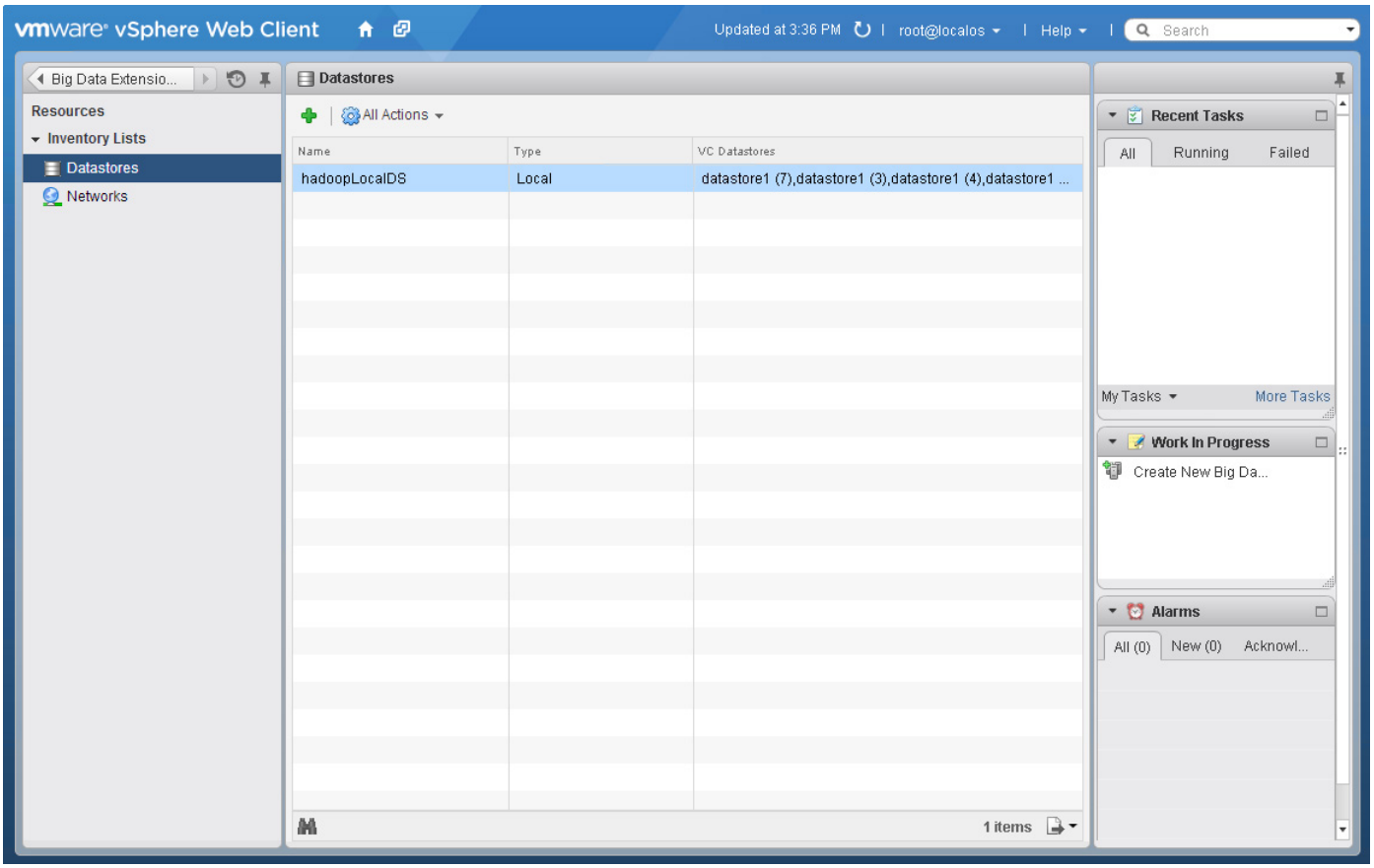
1. In the BDE home screen (Figure 193), click the Resources.
2. Click the “Datastores” under “Inventory Lists”.
3. In the Middle-pane, click + to create a datastore resource-pool.
4. Give a name **hadoopLocalDS**.
5. Change the Type field drop-down box, choose **Local**.
6. Choose all the datastores that belong to the Hadoop DRS-cluster. In other words, choose all but the datastore that belongs to the Admin DRS-cluster. In our case, datastore1 (1) belonged to the only ESXi host that is part of the Admin DRS-cluster, so we left that one datastore unchecked.
7. Press **OK** to continue.

Figure 193 Creating the Local Datastore Resource Pool



8. The below screen shows the successfully created datastore resource pool.

Figure 194 Successfully Creating Datastore Resource Pool



9. Click **Networks** under Inventory Lists.

The following steps show how to create the BDE network resource for one of the 3 network port-groups found in the vSphere ESXi hosts of the datacenter "Hadoop-DC". Please follow the instructions carefully to create all the 3 network resources. Table 15 serves as the BDE resource to ESXi VM Port-Group mapping to be created.

Table 15 BDE Resources Name and Port Group Name

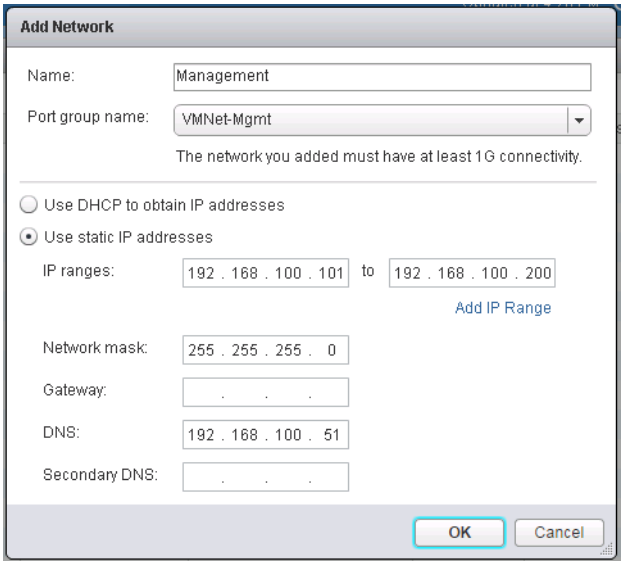
BDE Resource Name	vSphere ESXi VM Port-Group Name	IP Address Range	DNS IP
Management	VMNet-Mgmt	192.168.100.101 – 200	192.168.100.51
Storage	VMNet-HDFS	10.0.11.101 – 200	192.168.100.51
MapRed	VMNet-MapRed	10.0.12.101 – 200	192.168.100.51

Note If you see more than 3 vSphere Network port-groups, you may cancel and delete any unwanted and unused vSphere port-groups. After that, resume the creation of the Network resources in BDE as described here (optional).

10. In the Middle-pane, click + to create the Network Resources.

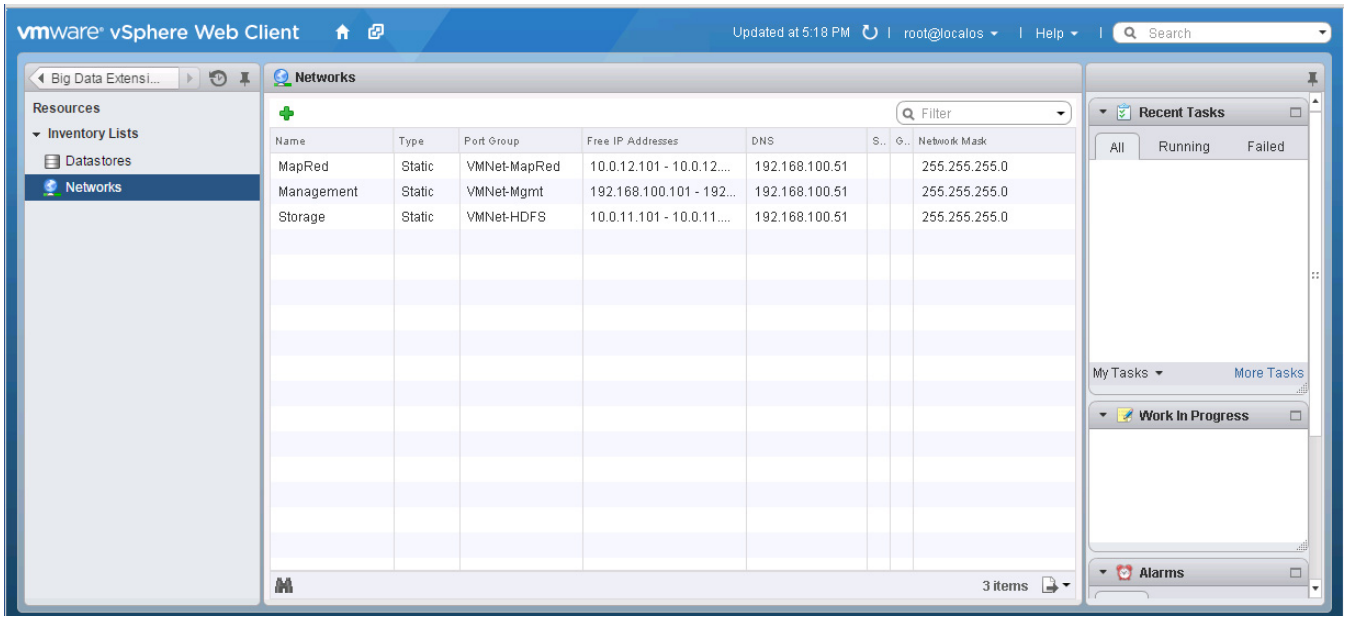
11. Enter the Name “Management”.
12. In the Port group, click to open the drop-down list box, and choose the port group “VMNet-Mgmt”.
13. Select the radio button “Use Static IP addresses” option.
14. In “IP Ranges” enter the IP address range as per the table above i.e. 192.168.100.101 to 192.168.100.200.
15. Enter the network mask: 255.255.255.0.
16. Enter the DNS IP: 192.168.100.51.
17. Press **OK** to complete the creation of the resource “Management” for the management network.

Figure 195 Creating BDE Network Resource and Binding to vSphere Port-Group



18. Repeat the above steps for other two network resources as per Table 15.
19. Once all the three network resources have been created, the resulting screen will appear as below.

Figure 196 BDE Network Resources Created Successfully



Installing RPMs in Yum Repository through Serengeti Management-Server

1. Download the following RPM files from the internet and copy it over to the Serengeti management-server's "/tmp" directory.

- http://mirror.centos.org/centos/6/os/x86_64/Packages/mailx-12.4-7.el6.x86_64.rpm
- http://mirror.centos.org/centos/6/os/x86_64/Packages/wsdl4j-1.5.2-7.8.el6.noarch.rpm

2. Log onto the management-server as the user "serengeti"
3. Copy over these RPM files from "/tmp" directory to "/opt/serengeti/www/yum/repos/centos/6/base/RPMS/".
4. Create a repo by running the command "createrepo" in the "base" directory.

```
cp /tmp/*.rpm /opt/serengeti/www/yum/repos/centos/6/base/RPMS/
cd /opt/serengeti/www/yum/repos/centos/6/base/
createrepo /opt/serengeti/www/yum/repos/centos/6/base/
```

Figure 197 Setting up Additional RPMs in Serengeti Server's yum Repository

```
[serengeti@bdemgr21 ~]$ ls /tmp/*.rpm
/tmp/mailx-12.4-7.el6.x86_64.rpm  /tmp/wsdl4j-1.5.2-7.8.el6.noarch.rpm
[serengeti@bdemgr21 ~]$
[serengeti@bdemgr21 ~]$ cp /tmp/*.rpm /opt/serengeti/www/yum/repos/centos/6/base/RPMS/
[serengeti@bdemgr21 ~]$
[serengeti@bdemgr21 ~]$ createrepo /opt/serengeti/www/yum/repos/centos/6/base/
169/169 - RPMS/redhat-lsb-core-4.0-7.el6.centos.x86_64.rpm
Saving Primary metadata
Saving file lists metadata
Saving other metadata
[serengeti@bdemgr21 ~]$ ls -l /opt/serengeti/www/yum/repos/centos/6/base/
total 16
drwxrwxr-x 2 serengeti serengeti  4096 Dec  2 23:57 repodata
drwxr-xr-x 2 serengeti serengeti 12288 Dec  2 23:56 RPMS
[serengeti@bdemgr21 ~]$
```

Creating RedHat Linux 6.4 VM Template

In this section we will create a brand new RedHat Linux 6.4 VM template for creating our Big-Data clusters. We will cover the following.

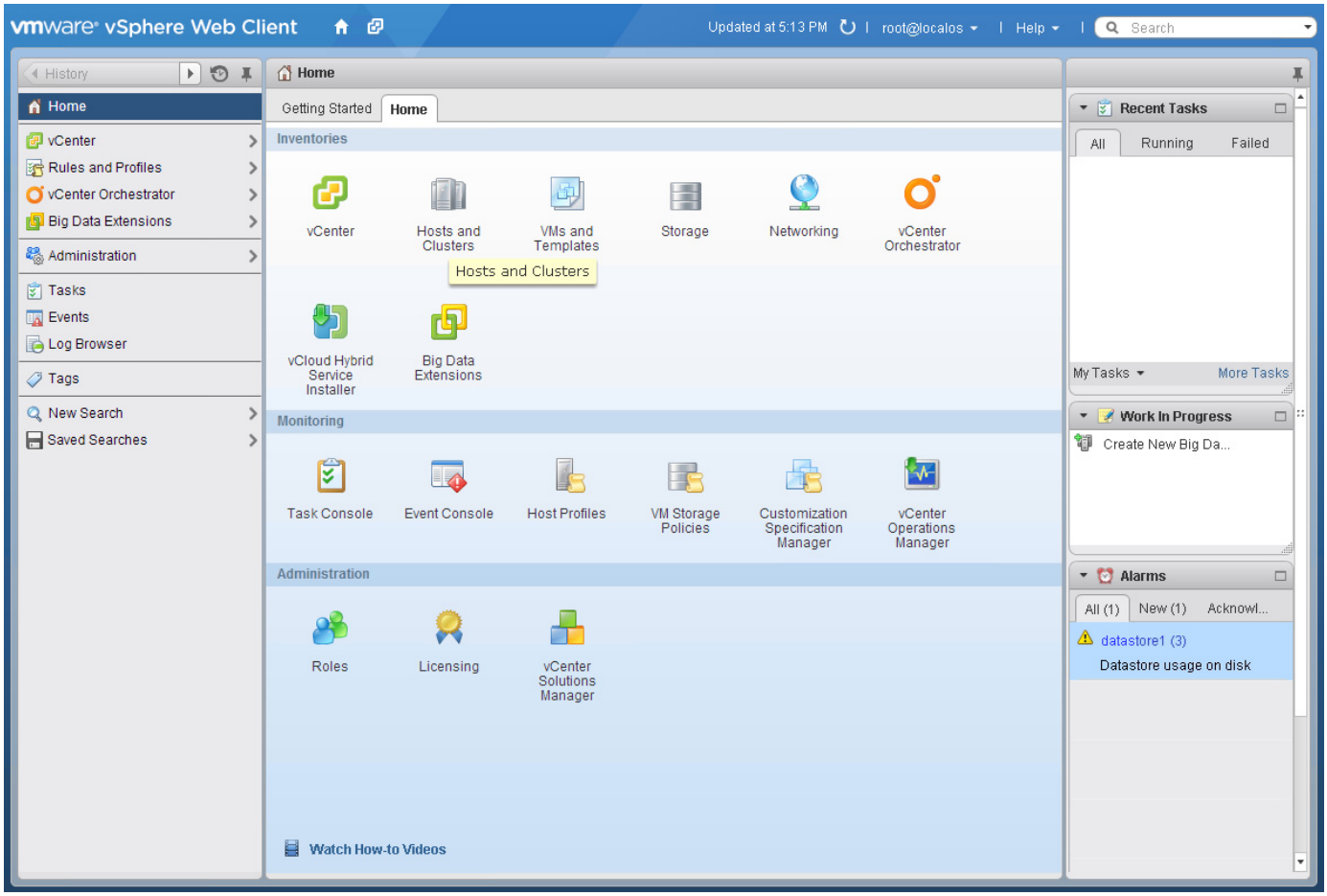
1. Create a VM.
2. Install RHEL6.4.
3. Configure the OS with necessary software components.

Creating a VM

From the vSphere Web Client, choose the resource pool Blades under the Datacenter “Hadoop-DC”, and create a VM as follows:

1. Download the RHEL6.4 ISO from www.redhat.com and upload it to the ESXi host’s (192.168.100.21) datastore.
2. On the Home screen click the “Hosts and Clusters” under inventory screen.

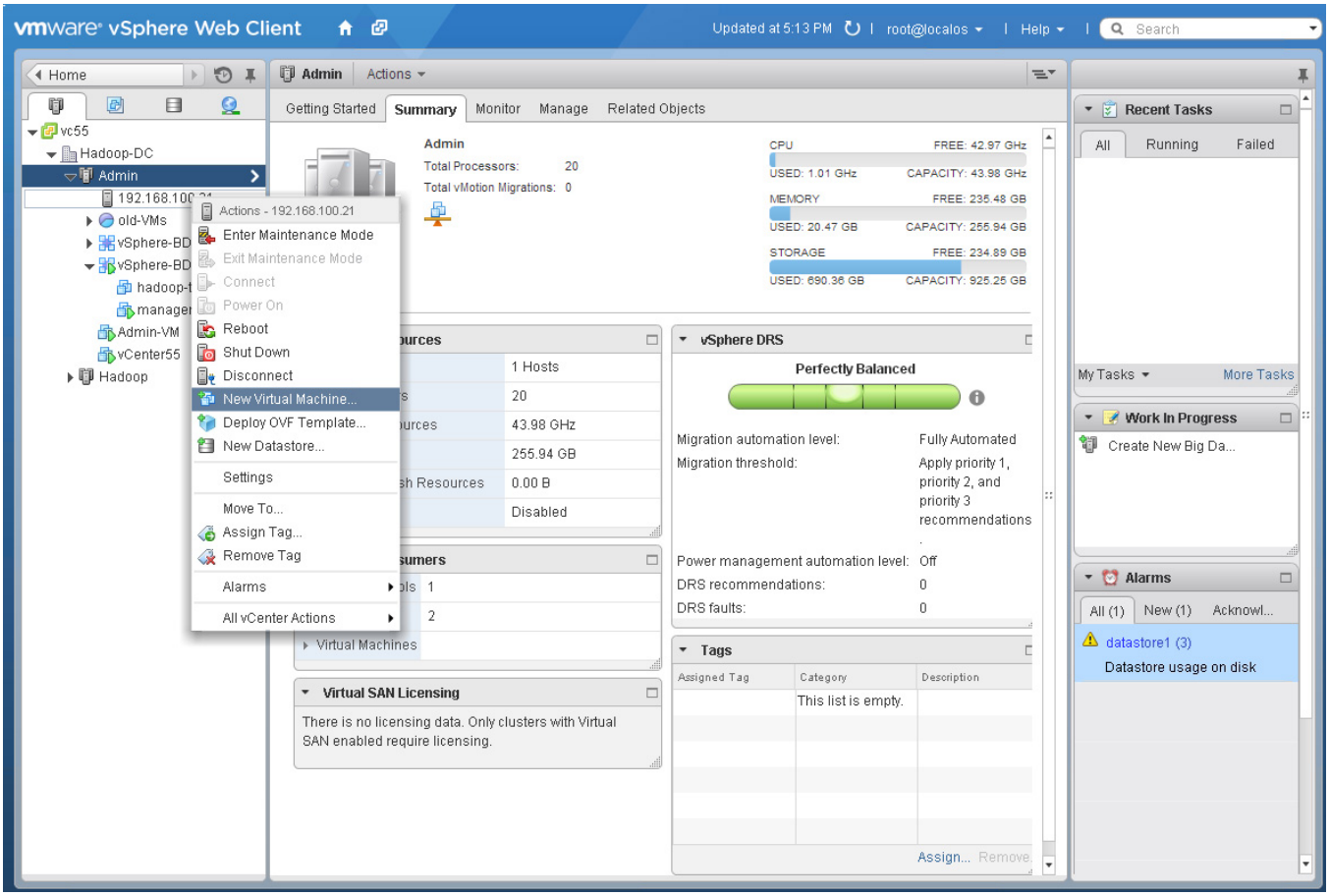
Figure 198 vSphere Web Client Home Dashboard



3. In the Next screen, click the datacenter “Hadoop-DC”.
4. Click “Admin” Cluster to expand the cluster.

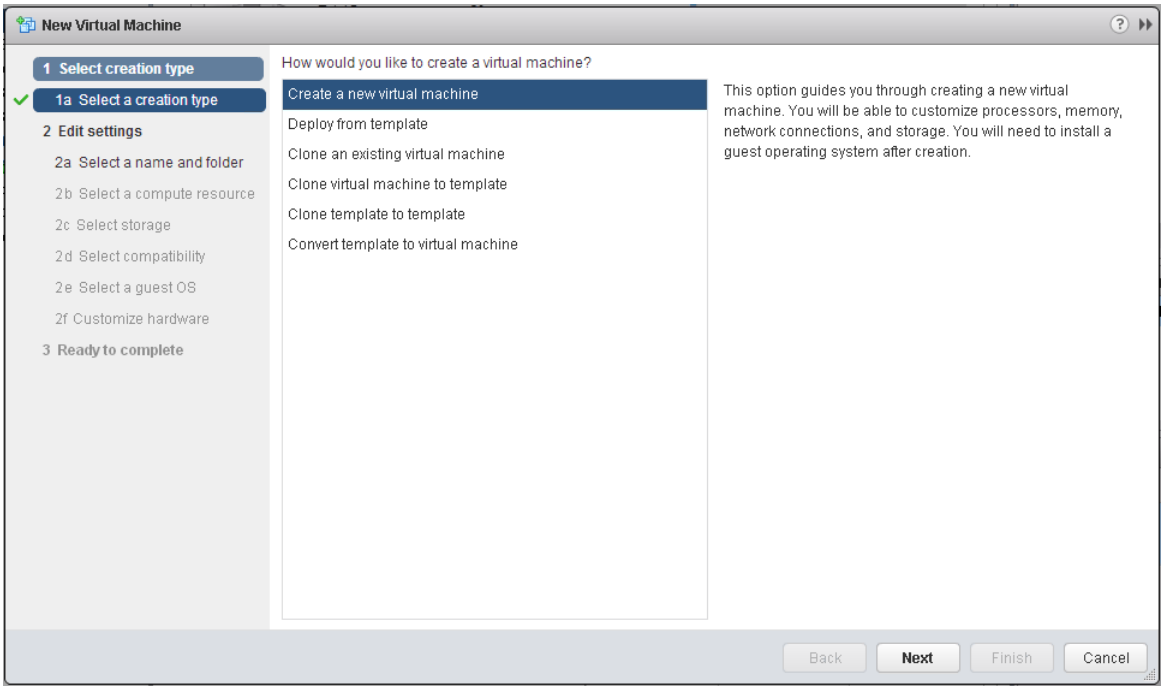
5. Right-click the host “192.168.100.21” and choose the menu-item “New Virtual Machine…”.

Figure 199 RHEL-Template: Creating Virtual Machine



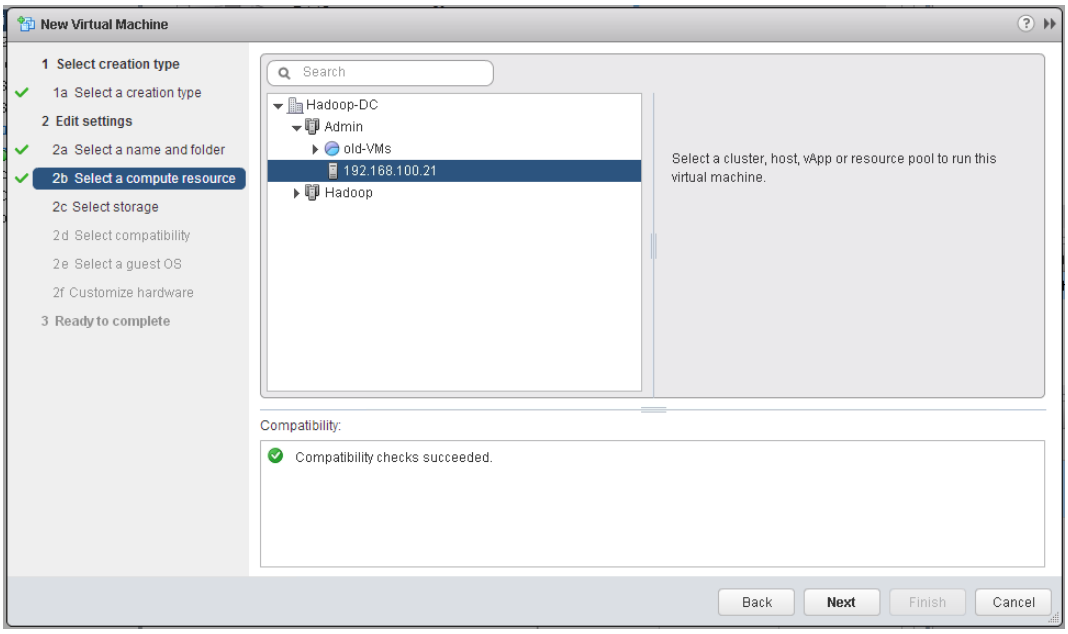
6. In the **New Virtual Machine** dialog box, choose **Create a new virtual machine** and Click **Next**.

Figure 200 RHEL-Template: Selecting the Type of the Virtual Machine



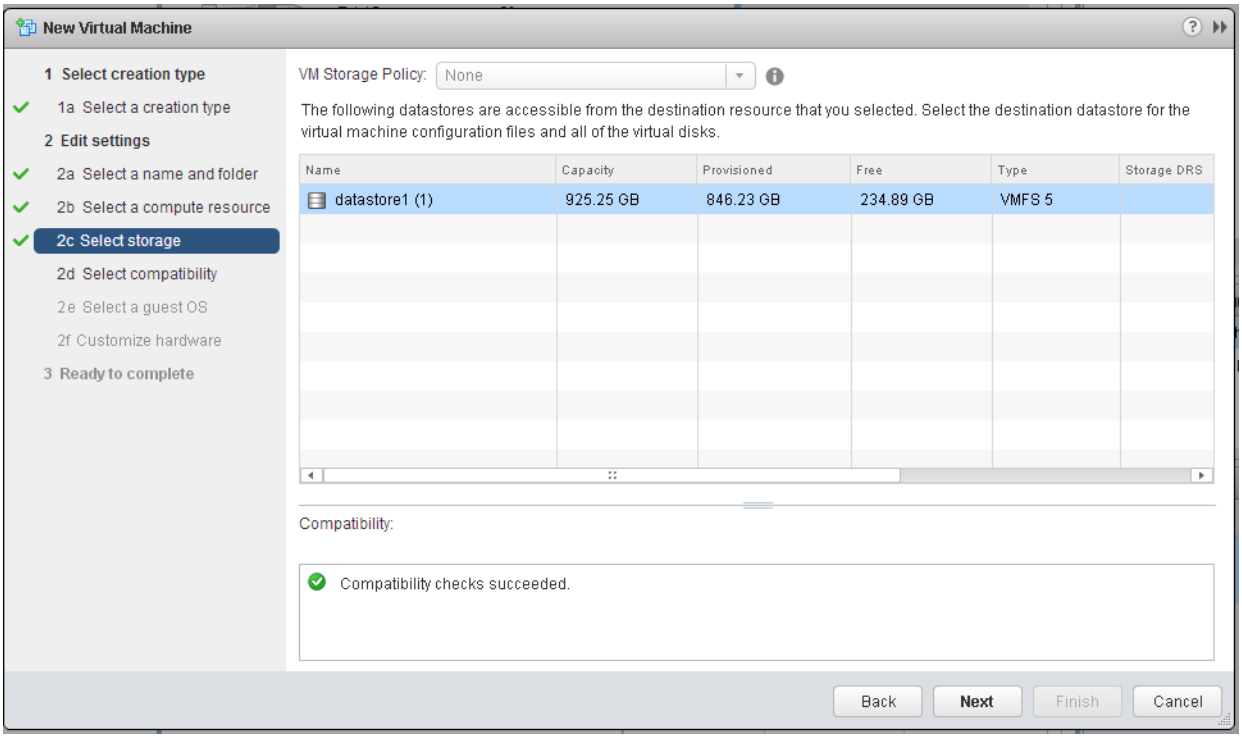
7. Give the name “RHEL6.4_Template”
8. Choose the Datacenter “Hadoop-DC” as the name of the data center, and Click **Next**.
9. Select the target ESXi host “192.168.100.21” of Admin DRS cluster, and click **Next**.

Figure 201 RHEL-Template: Select the Compute Resource



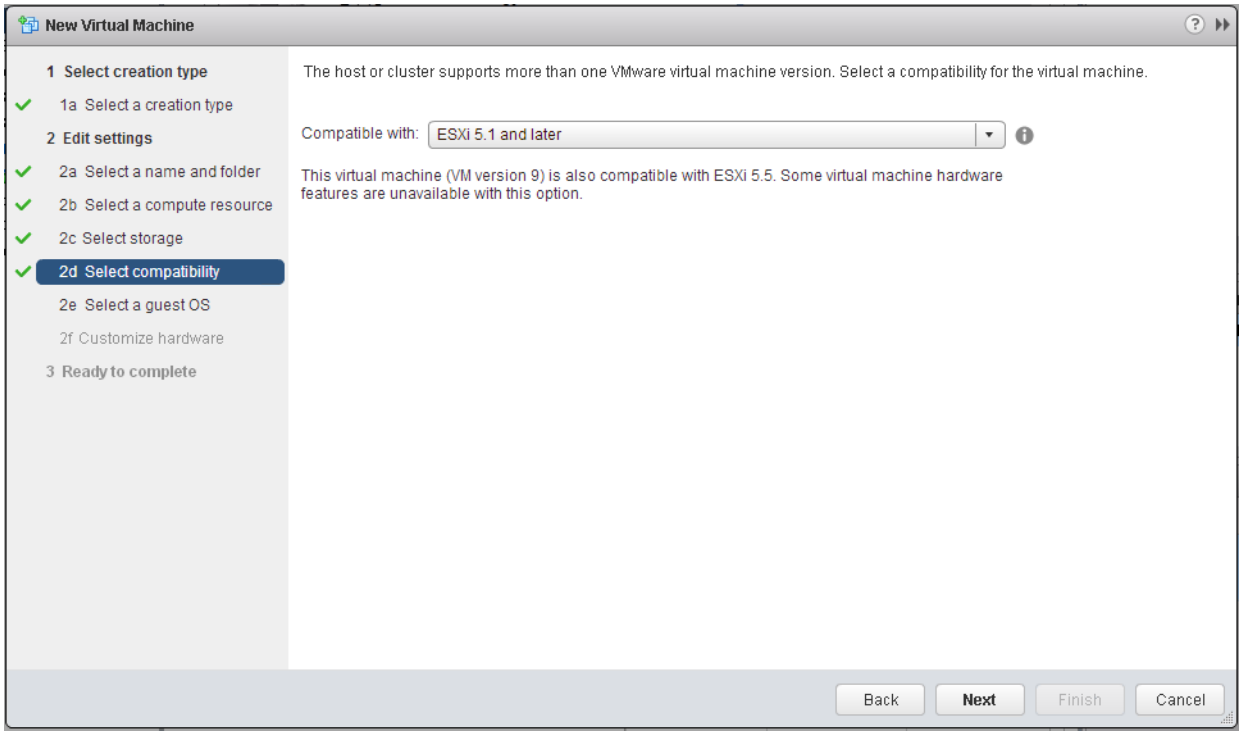
10. Choose the datastore, and Click **Next**.

Figure 202 RHEL-Template: Selecting Datastore to Host New VM



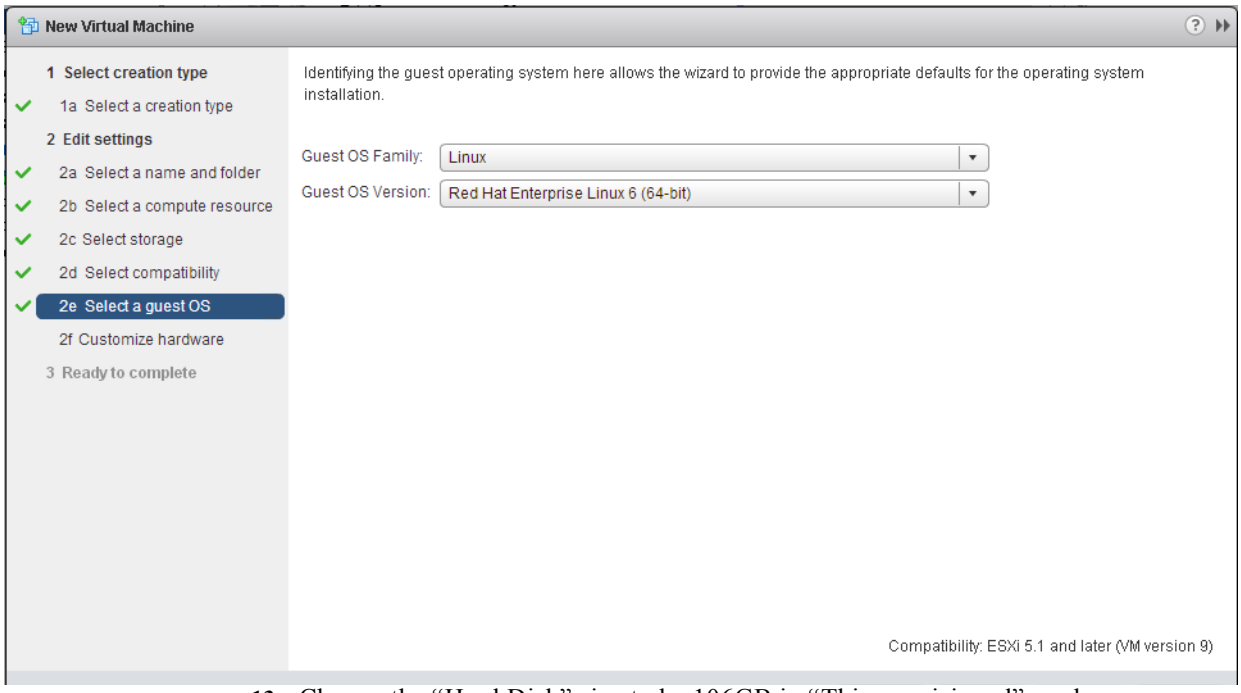
11. Choose the virtual machine compatibility to be the latest version available.

Figure 203 RHEL-Template: Choose the VM Compatibility



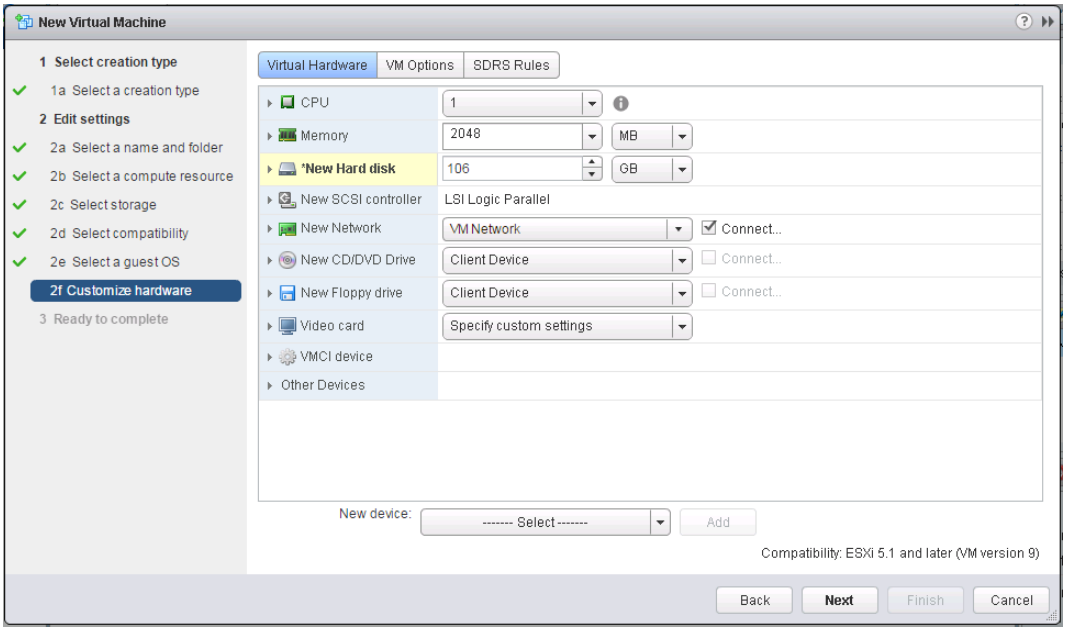
12. Choose the Guest OS Type to be “Linux” and Version to be “Red Hat Enterprise Linux 6 (64-bit)”. Click **Next**.

Figure 204 RHEL-Template: Choose the Guest OS Family and Version



13. Change the “Hard Disk” size to be 106GB in “Thin provisioned” mode.

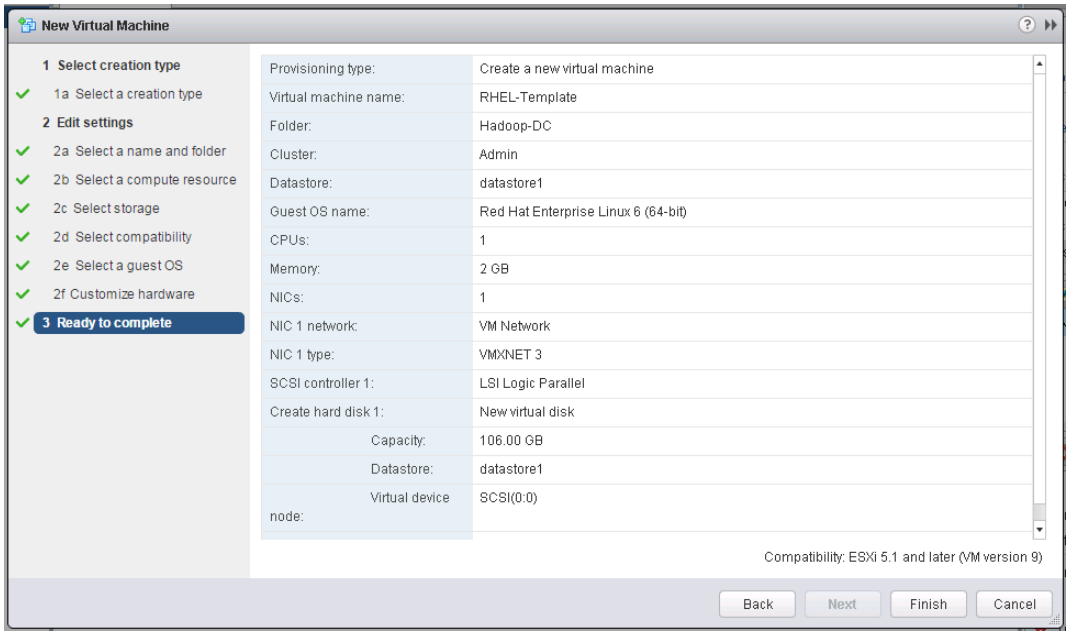
Figure 205 RHEL-Template: Customize the Hard Disk Size



Note Cloudera recommends a larger hard disk size i.e. (more than 100 GB in size) so that there is more available space for the log in the root partition. Such a hard disk built right into the template result in longer VM cluster creation times. It may also be required to create a smaller cluster first i.e. create cluster of size 45 VMs first and then use BDE's scale-out function to grow to the target size of 60 VMs.

14. Change Network to port-group "VMNet-Mgmt".
15. Mount the RHEL6.4 ISO from the datastore onto the CD/DVD Drive and make sure it is "Connect At Power On" is checked. click **Next**.
16. Choose the SCSI controller type to be LSI Logic Parallel
17. Review the VM details and click **Finish**.

Figure 206 RHEL-Template: Verify the Settings

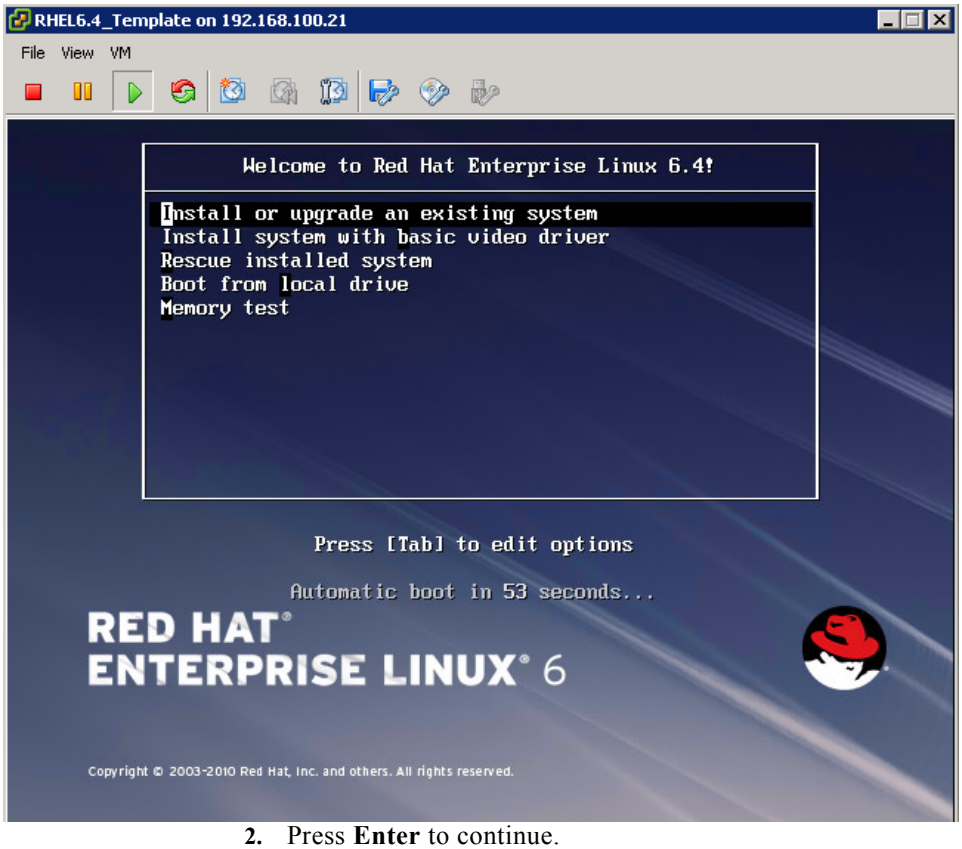


Installing RHEL6.4 in VM

In this document, we made use vSphere native client instead of the vSphere Web Client. But, the same can be performed using the vSphere Web Client.

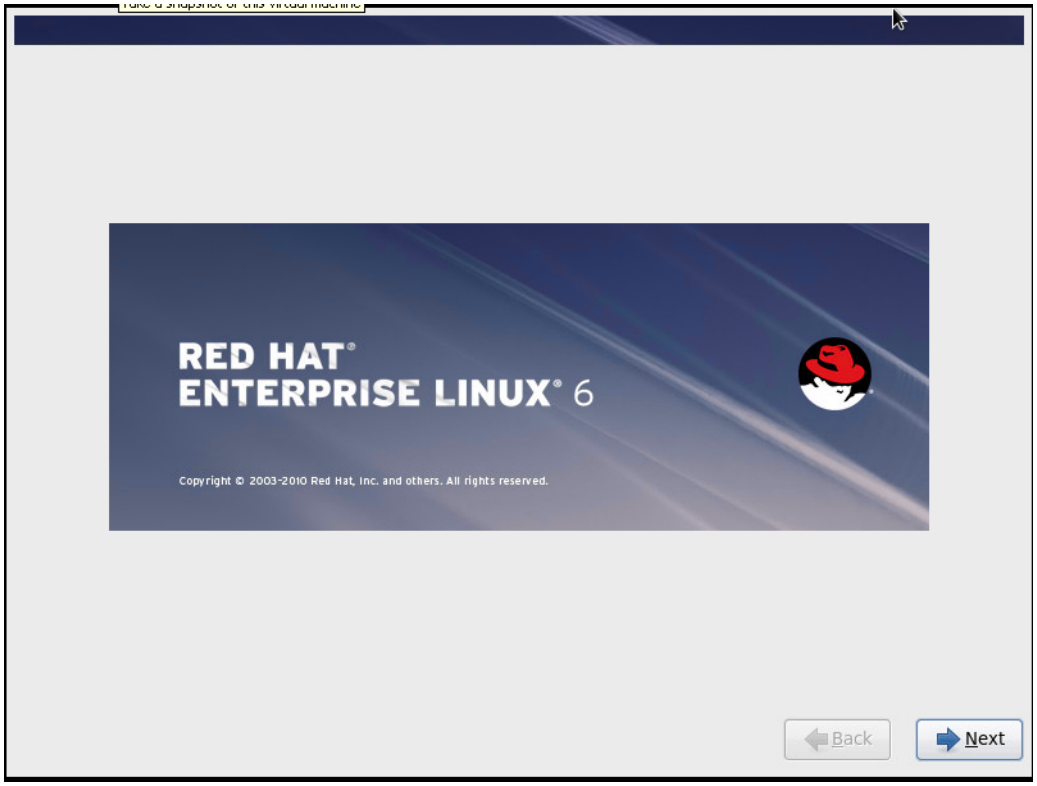
1. Power-On the Newly Created VM "RHEL6.4_Template" under the Admin cluster.

Figure 207 RHEL-Template: RedHat 6.4 Enterprise Linux Installed



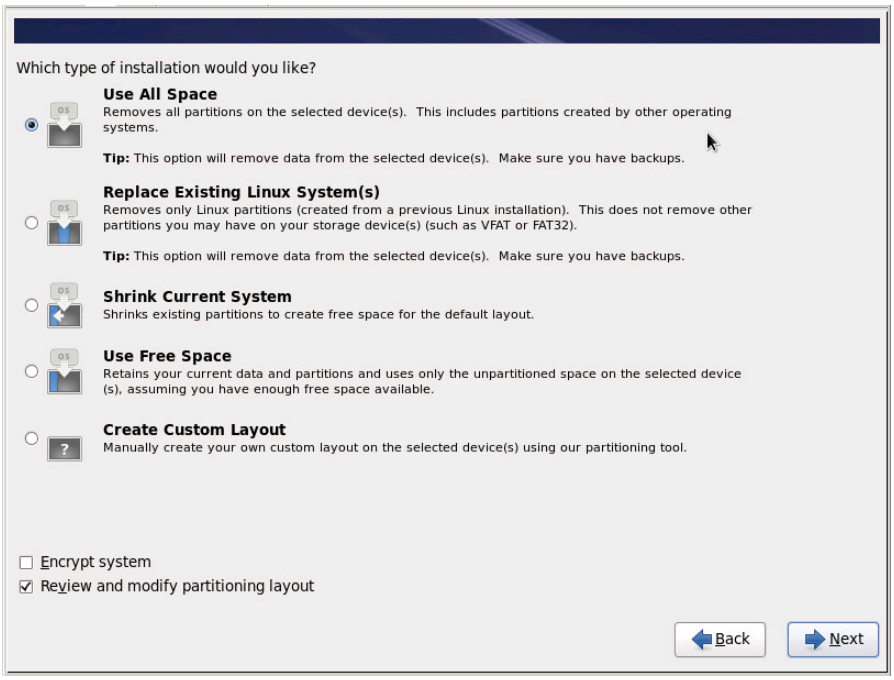
2. Press **Enter** to continue.

Figure 208 RHEL-Template: Installation Welcome Screen



3. In the next screens, choose the Language and Keyboard layouts.
4. Choose the basic storage disk, and choose to discard the data in the VMware virtual disk.
5. Retain the name of the computer as “localhost.localdomain” and click **Next** to continue.
6. Choose the timezone and root-password.
7. Click the **Use All Space** installation type radio button, and check the **Review and modify partitioning layout** checkbox. Click **Next**.

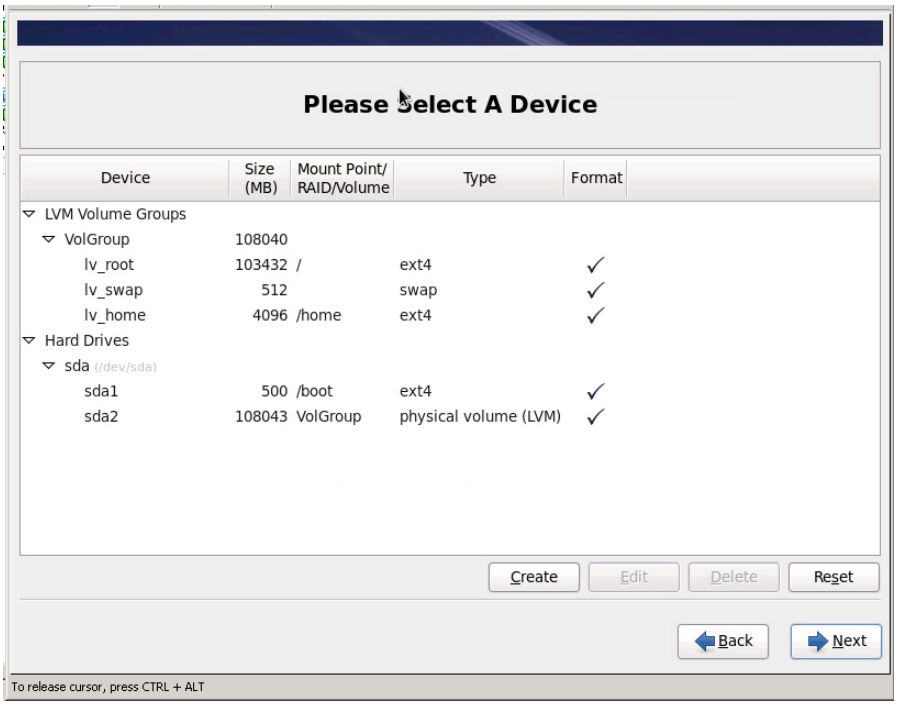
Figure 209 RHEL-Template: Choosing Installation Type



8. Edit the lv_swap partition to reduce the size of the swap area to 512 MB, reduce the size of lv_home partition to 4 GB (4096 MB) and make the lv_root partition larger to make use of all the rest of the space i.e. 103432 MB.

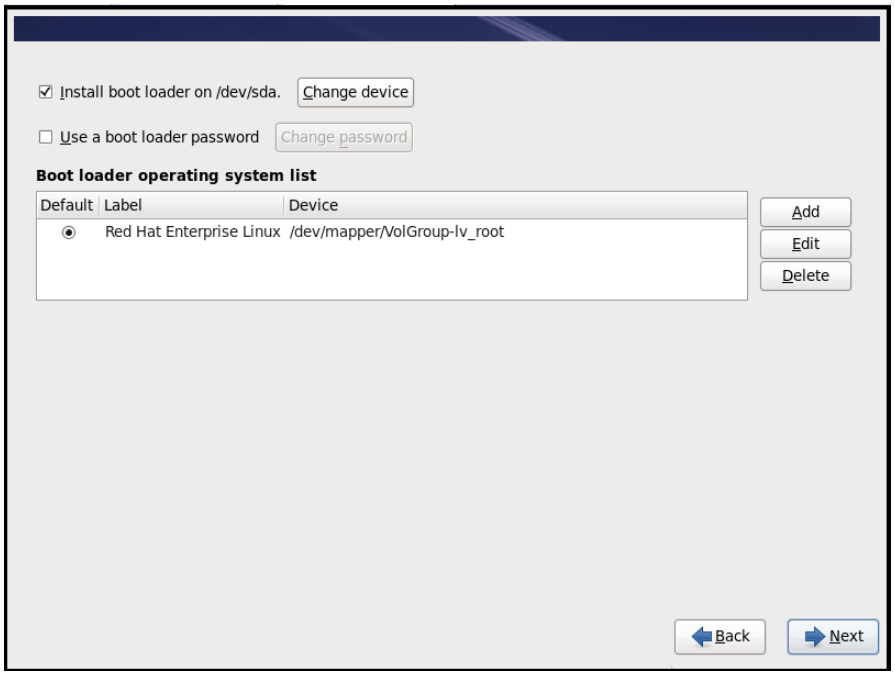
Note This step ensures that there is enough space available for the Hadoop logs on the root partition.

Figure 210 RHEL-Template: Custom Partition Layout



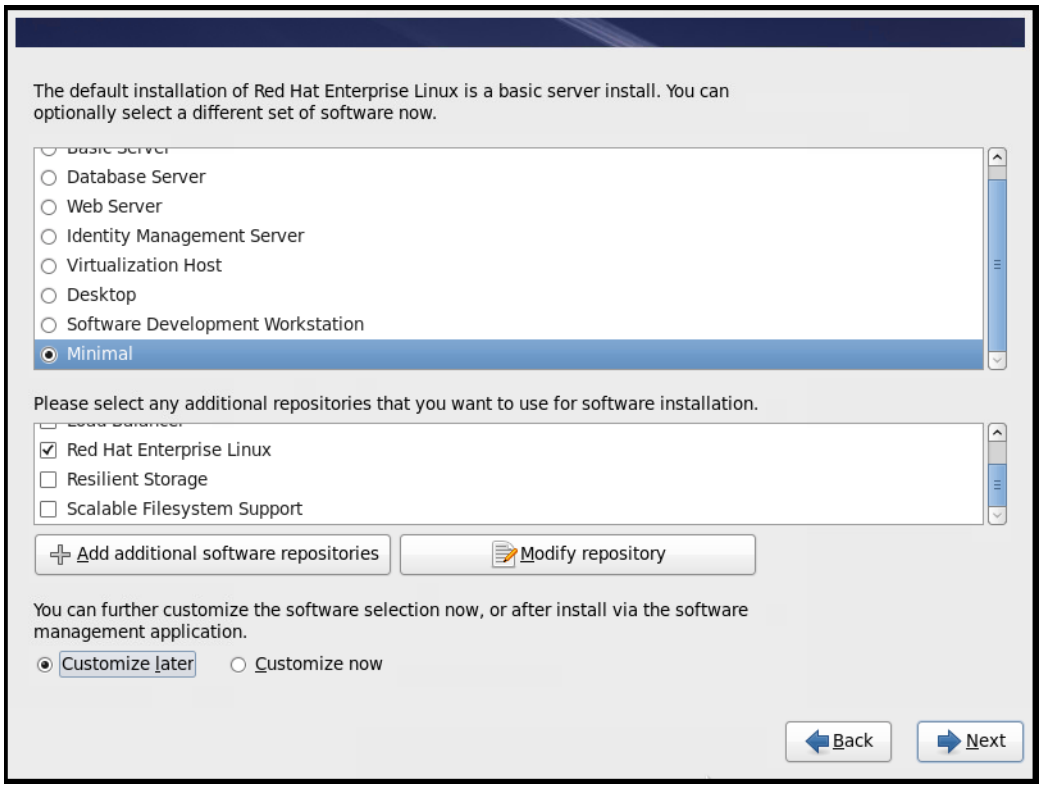
9. In the next step, choose the option to write the changes to disk, and click Next to continue.
10. Retain the selection on /dev/mapper/VolGroup-lv_root partion in the Boot loader operating system list.

Figure 211 RHEL-Template: Boot Loader Installation Option



11. Choose the “Minimal installation” option for starting the installation.

Figure 212 RHEL-Template: Choose Minimal Installation



12. Installation begins after this step.

Figure 213 RHEL-Template: RedHat 6.4 Installation in Progress

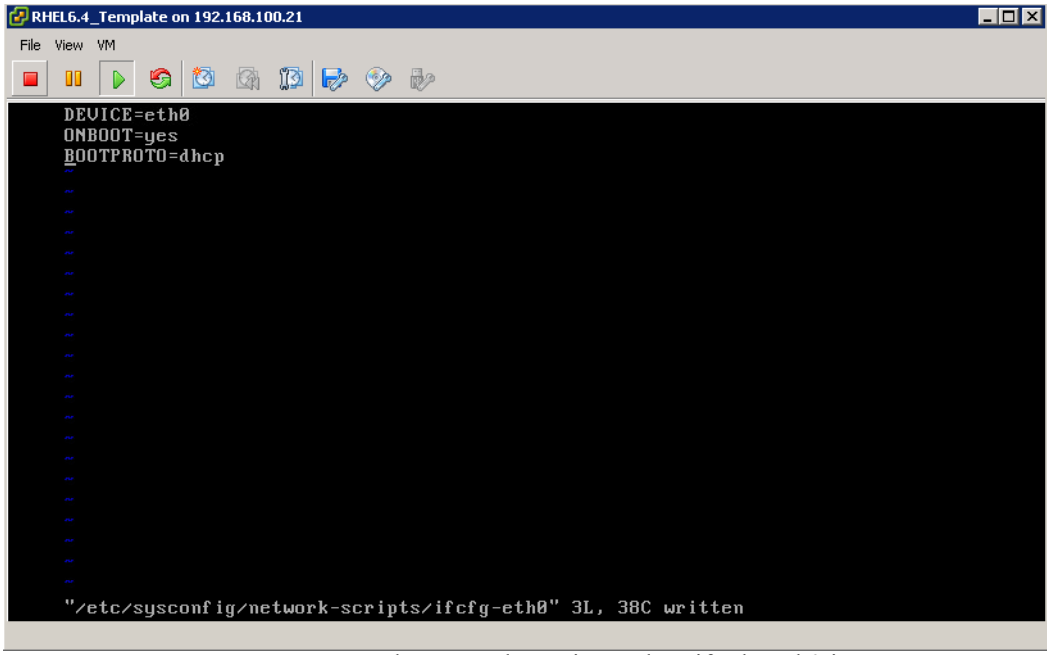
Once the Installation completes, reboot the VM.

Network Configurations

1. Login to the newly created VM.
2. Edit the file "/etc/sysconfig/network-scripts/ifcfg-eth0" and make it fetch an IP-address dynamically upon boot-up from a DHCP-server in the network. This IP-address shall be in the management subnet that is reachable from the vCenter Server, and Big Data Extensions Management-Server. i.e. 192.168.100.x subnet. Keep the following lines in the file and remove the rest.

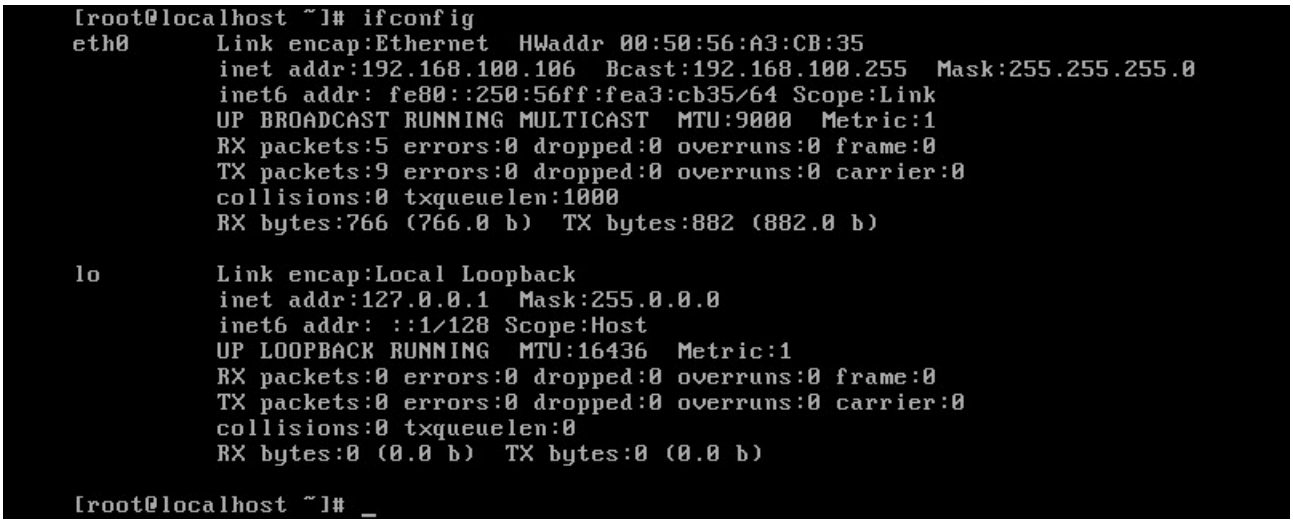
```
DEVICE=eth0
ONBOOT=yes
BOOTPROTO=dhcp
```

Figure 214 RHEL-Template: Management Network Configurations



3. Restart the network service and verify the eth0 is up.

Figure 215 RHEL-Template: Verify the Network Interfaces



Note This step assumes that there is a DHCP server present in this network. The same thing can be accomplished by assigning a Static-IP address to the Template VM. If you are using Static-IP address for "eth0", please make sure you restore it back to "dhcp" as the last step before shutting down this VM.

Installing Necessary Software Components

1. We need to install perl and nfs-utils from the RHEL-Install media. For this, we will configure the RHEL-Template to make use of the RHEL-repository from the Admin-VM.
2. Create a file named "rheliso.repo" in the directory "/etc/yum.repos.d", and add the following contents.

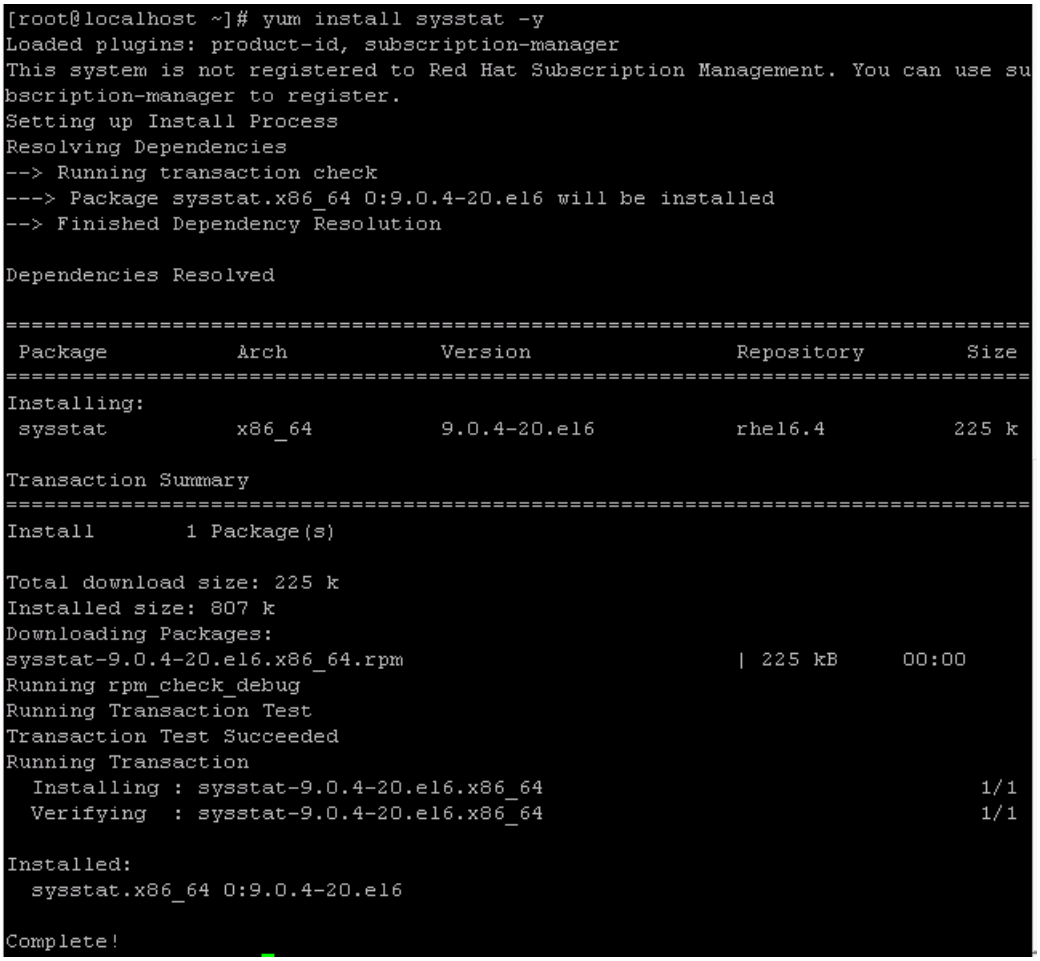
```
[rhel6.4]
name=Red Hat Enterprise Linux 6.4
baseurl=http://192.168.100.51/rhelrepo
gpgcheck=0
enabled=1
```

Figure 216 RHEL-Template: Adding Repository File for RHEL ISO in Yum Repositories Folder

3. Install the RHEL sysstat package for taking advantage of the useful tools that comes with it such as "iostat", "mpstat" using the following command.

```
yum install sysstat -y
```

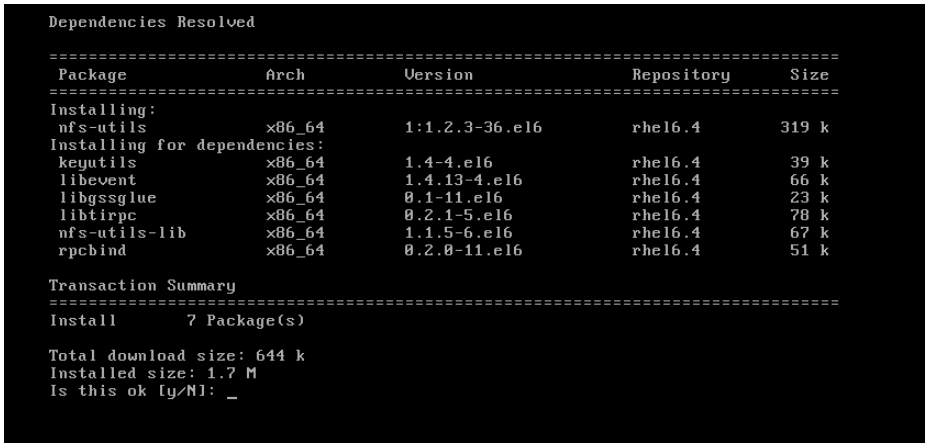
Figure 217 Installing "sysstat" Package.



4. Install NFS-Utils – useful for mounting Isilon's NFS, by entering the command

```
yum install -y mount.nfs
```

Figure 218 Install the NFS-Utilities



5. Create an entry into the "/etc/fstab" for mounting the Isilon NFS export.

```
echo "hdfs.isic.hadoop.cisco.local:/ifs/zone1/nfs/cluster1 /mnt/isilon_nfs nfs
nolock,nfsvers=3,tcp,rw,hard,intr,timeo=600,retrans=2,rsize=131072,wsize=524288" >>
/etc/fstab
```

Figure 219 Verify the NFS-mount Entry in the "/etc/fstab"

```
[root@localhost ~]# cat /etc/fstab

#
# /etc/fstab
# Created by anaconda on Wed Dec  3 21:30:13 2014
#
# Accessible filesystems, by reference, are maintained under '/dev/disk'
# See man pages fstab(5), findfs(8), mount(8) and/or blkid(8) for more info
#
/dev/mapper/VolGroup-lv_root /                       ext4    defaults        1 1
UUID=d3fd2336-7cfb-465f-a1c6-055c49e882d3 /boot                   ext4    defaul
ts          1 2
/dev/mapper/VolGroup-lv_swap swap                    swap    defaults        0 0
tmpfs                   /dev/shm                tmpfs   defaults        0 0
devpts                  /dev/pts                devpts  gid=5,mode=620  0 0
sysfs                   /sys                    sysfs   defaults        0 0
proc                    /proc                   proc    defaults        0 0
hdfs.isic.hadoop.cisco.local:/ifs/zone1/nfs/cluster1 /mnt/isilon_nfs nfs nolock,
nfsvers=3,tcp,rw,hard,intr,timeo=600,retrans=2,rsize=131072,wsize=524288
[root@localhost ~]#
```

6. Install Perl by using the command

```
yum install -y perl
```

Figure 220 RHEL-Template: Install Perl

```
Installed:
  perl.x86_64 4:5.10.1-129.el6

Dependency Installed:
  perl-Module-Pluggable.x86_64 1:3.90-129.el6
  perl-Pod-Escapes.x86_64 1:1.04-129.el6
  perl-Pod-Simple.x86_64 1:3.13-129.el6
  perl-libs.x86_64 4:5.10.1-129.el6
  perl-version.x86_64 3:0.77-129.el6

Complete!
```

By default Linux sets the limit on the number of inodes that can be opened simultaneously with a default value of 1024. This usually is not sufficient for Hadoop applications. Such a low number could make the system appears to be out of disk space and shows no inodes available. This value should be set to 64000 in the RHEL-template so that, all this configuration gets applied to all the VMs automatically. At the same time, increase the number of processes limit for the root user to 32768. The default value is 1024.

7. For setting ulimit on Redhat, edit /etc/security/limits.conf and add the following lines:

```
root soft nofile 64000
root hard nofile 64000
root hard nproc 32768
root soft nproc 32768
```

Figure 221 Edit /etc/security/limits.conf

```
#        - locks - max number of file locks the user can hold
#        - sigpending - max number of pending signals
#        - msgqueue - max memory used by POSIX message queues (bytes)
#        - nice - max nice priority allowed to raise to values: [-20, 19]
#        - rtprio - max realtime priority
#
#<domain>      <type>  <item>         <value>
#

#*               soft    core            0
#*               hard    rss             10000
#@student        hard    nproc           20
#@faculty        soft    nproc           20
#@faculty        hard    nproc           50
#ftp             hard    nproc           0
#@student        -       maxlogins       4
root soft nofile 64000
root hard nofile 64000
root hard nproc 32768
root soft nproc 32768

-

# End of file
"/etc/security/limits.conf" 56L, 1917C written
```

Note "ulimit" values are applied only on a new shell, running the command on a node on an earlier instance of a shell will show old value.

8. Open a new SSH-session using a terminal Emulator and use the following command to verify the "ulimits"

```
ulimit -n
ulimit -u
```

Figure 222 Verifying the "ulimits" Configuration

```
[root@localhost ~]# ulimit -a
core file size          (blocks, -c) 0
data seg size           (kbytes, -d) unlimited
scheduling priority             (-e) 0
file size               (blocks, -f) unlimited
pending signals                 (-i) 14874
max locked memory       (kbytes, -l) 64
max memory size         (kbytes, -m) unlimited
open files                      (-n) 64000
pipe size            (512 bytes, -p) 8
POSIX message queues     (bytes, -q) 819200
real-time priority              (-r) 0
stack size              (kbytes, -s) 10240
cpu time               (seconds, -t) unlimited
max user processes              (-u) 32768
virtual memory          (kbytes, -v) unlimited
file locks                      (-x) unlimited
[root@localhost ~]# ulimit -n
64000
```

9. Unmount the Media by using the command.

```
umount /media
```

10. Download the latest version of Oracle Java Development Kit Release 1.7 onto the /root/ directory.

Note It is important that, the JAVA version installed in the template matches that of the "Serengeti" management-server of the BDE.

Figure 223 RHEL-Template: Verify the JDK Installation Package

```
[root@localhost ~]# ls
anaconda-ks.cfg  install.log  install.log.syslog  jdk-7u60-linux-x64.rpm
```

11. And install the JDK with the following command.

```
rpm -Uvh ./jdk-7u60-linux-x64.rpm
```

12. Remove the JDK file.

```
rm -f ./jdk-7u60-linux-x64.rpm
```

Figure 224 RHEL-Template: Installing Java Development Kit

```
[root@localhost ~]# rpm -Uvh ./jdk-7u60-linux-x64.rpm
Preparing...                ########################################### [100%]
   1:jdk                    ########################################### [100%]
Unpacking JAR files...
        rt.jar...
        jsse.jar...
        charsets.jar...
        tools.jar...
        localedata.jar...
        jfxrt.jar...
[root@localhost ~]# rm -f jdk-7u60-linux-x64.rpm
[root@localhost ~]#
```

13. Use the following command to verify the Java version. Add the string "JAVA_HOME=/usr/java/default" to the file "/etc/environment" by using the echo command.

14. Verify the contents of the file "/etc/environment".

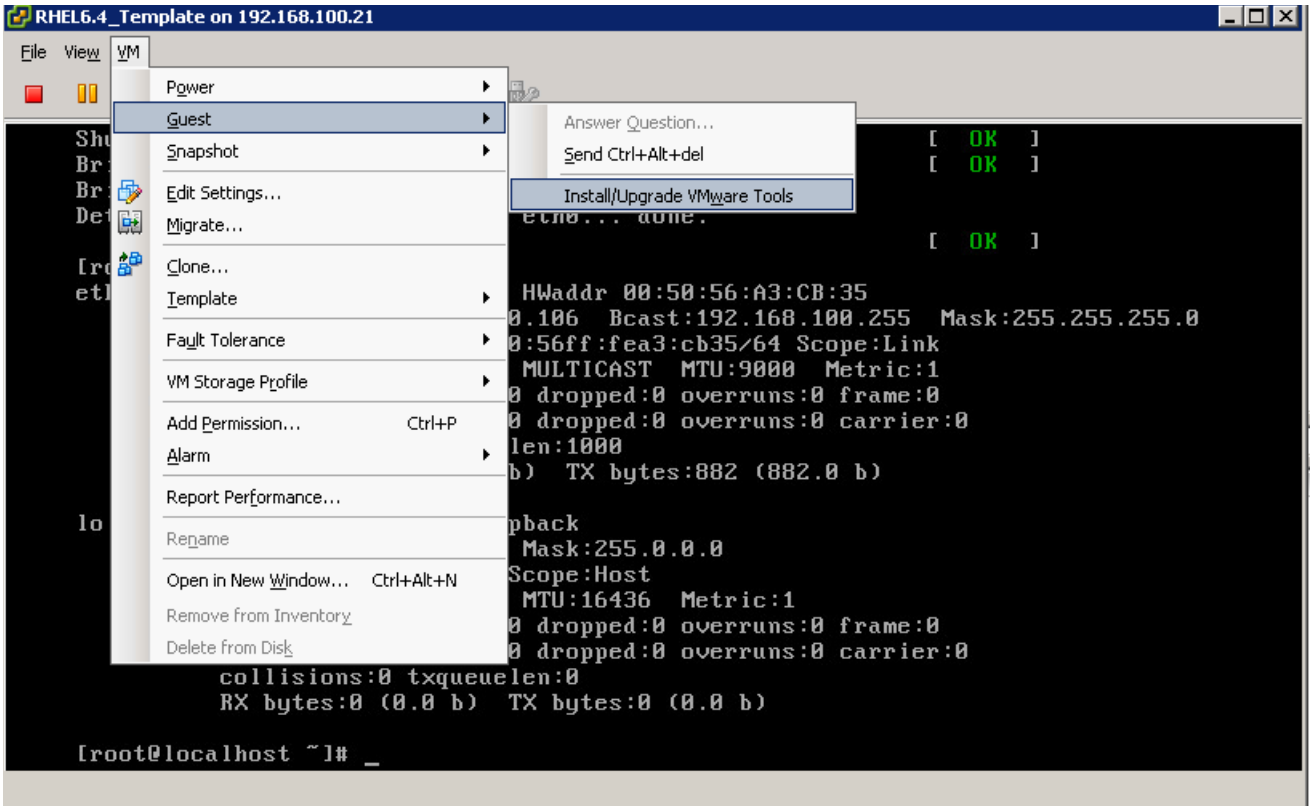
```
java –version
echo "JAVA_HOME=/usr/java/default" > /etc/environment
cat /etc/environment
```

Figure 225 RHEL-Template: Verifying the Java Installation and set the JAVA_HOME Environment Variable

```
[root@localhost ~]# java -version
java version "1.7.0_60"
Java(TM) SE Runtime Environment (build 1.7.0_60-b19)
Java HotSpot(TM) 64-Bit Server VM (build 24.60-b09, mixed mode)
[root@localhost ~]# echo "JAVA_HOME=/usr/java/default" > /etc/environment
[root@localhost ~]# cat /etc/environment
JAVA_HOME=/usr/java/default
[root@localhost ~]#
```

We now proceed to install the VMware tools. From the VMware Console, Mount the VMware tools to the CD/DVD-drive by using the menu-item VM > Guest > Install/Upgrade VMware Tools.

Figure 226 RHEL-Template: Mounting the VMware Tools ISO



15. From the Console mount the drive to a new folder called "/media" by using the command:

```
mount -t iso9660 -o ro /dev/sr0 /media
```

Figure 227 RHEL-Template: Mounting VMware Tools ISO from CD/DVD Drive

```
[root@localhost ~]# mount -t iso9660 -o ro /dev/sr0 /media
```

16. Copy the VMware-Tools-X.Y.Z-(nnnn).tar.gz to the "/tmp" folder and untar that file using the following command.

```
tar xf VMware-Tools-X.Y.Z-(nnnn).tar.gz
```

Figure 228 RHEL-Template: VMware Tools

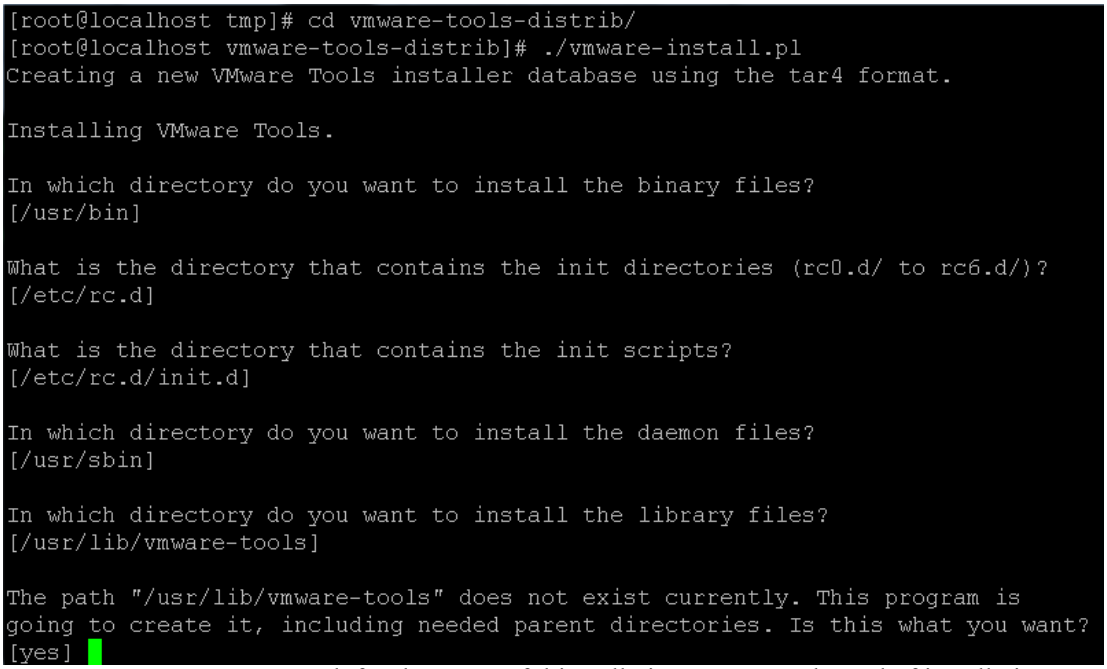
```
[root@localhost tmp]# ls
hsperfdata_root  VMwareTools-9.0.10-1481436.tar.gz  yum.log
[root@localhost tmp]# tar xf VMwareTools-9.0.10-1481436.tar.gz
[root@localhost tmp]# ls
hsperfdata_root                 vmware-tools-distrib
VMwareTools-9.0.10-1481436.tar.gz  yum.log
```

17. Now change the directory to "/tmp/vmware-tools-distrib" folder (assuming you had untarred the archive in the "/tmp" folder), and execute the following command to install the VMware Tools.

18. At the prompts accept the defaults.

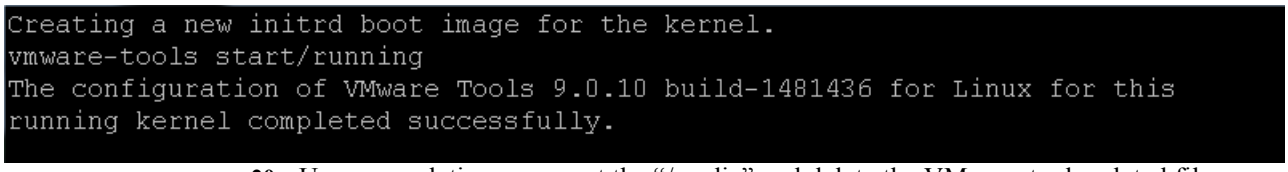
```
cd /tmp/vmware-tools-distrib/
./vmware-install.pl
```

Figure 229 RHEL-Template: Executing the VMware Tools Installation Script



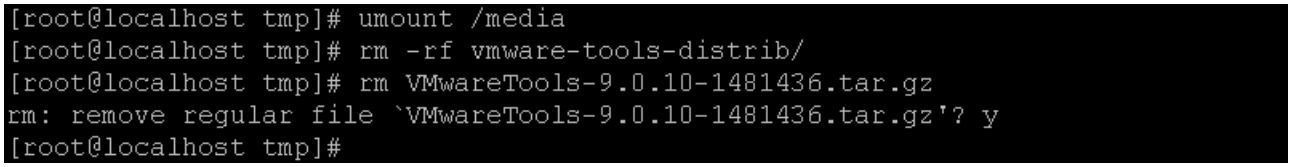
19. Look for the successful installation prompt at the end of installation.

Figure 230 RHEL-Template: VMware Tools Successfully Installed



20. Upon completion, unmount the "/media" and delete the VMware tools related files.

Figure 231 RHEL-Template: Delete the VMware Tools Related files and vmware-tools-distrib Directory



Downloading and Installing Custom Scripts from BDE management-server

In this section, we will be downloading custom scripts from the BDE management-server and installing it in the template.

Note This procedure requires the VM to have access to the internet and RHEL repository.

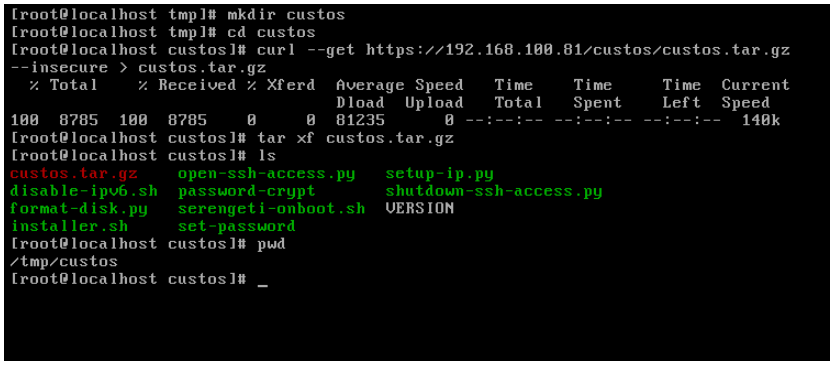
1. Create a director called custos under "/tmp"
2. Download and install the custom scripts from the BDE2.1 management-server i.e. 192.168.100.81.

```
mkdir -p /tmp/custos
cd /tmp/custos
curl --get https://192.168.100.80/custos/custos.tar.gz --insecure > custos.tar.gz
```

3. Extract the contents of the file using the command:

```
tar xf custos.tar.gz
```

Figure 232 RHEL-Template: Downloading the Custom OS Scripts for Customizing the RHEL6.4 Template VM

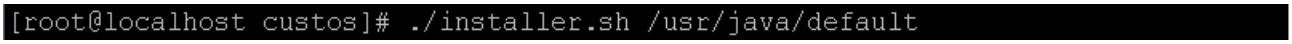


Note Before executing the Custom OS scripts, please make sure that the RHEL-repository is available either via the Admin-VM's repository(preferred) or via the locally mounted DVD/CDROM.

4. Install the "custos" parts by running the script "installer.sh" with the parameter of the location of the JDK i.e. the folder that JAVA_HOME environment variable is set to. Use this command.

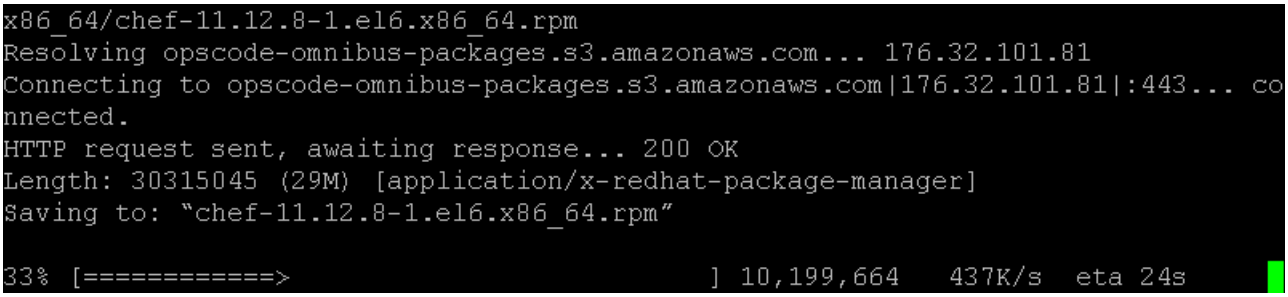
```
./installer.sh /usr/java/default
```

Figure 233 RHEL-Template: Installing the Serengeti Custom-OS Packages



This script installs a number of software-packages including Chef that's used for automated provisioning of the Hadoop-VMs, it will also fetch several components from the Install media. This step requires internet connection.

Figure 234 RHEL-Template: Installing Chef Packages Using Custom-OS Scripts



Once the following message appears, please check all the messages to review if any of the installation failed, if it did, re-run the install script. If you do not have internet connectivity, you may need download some of these packages and install them manually.

Figure 235 RHEL-Template: Completion of the Custom-OS Scripts Execution

5. Unmount the RHEL6.4 Installation media. And, remove the custom OS scripts.

```
umount /media
```

Figure 236 RHEL-Template: Removing the Custom-OS Script Files

6. Remove the /etc/udev/rules.d/70-persistent-net.rules file to avoid increasing the “eth”-number of the interface while creating the VMs. This must be done before powering down the VM.

```
rm /etc/udev/rules.d/70-persistent-net.rules
```

Figure 237 RHEL-Template: Deleting the 70-persistent-net.rules

7. Turn off the Firewall, and verify that the firewall service has been stopped by issuing the following commands:

```
service iptables stop
chkconfig iptables off
```

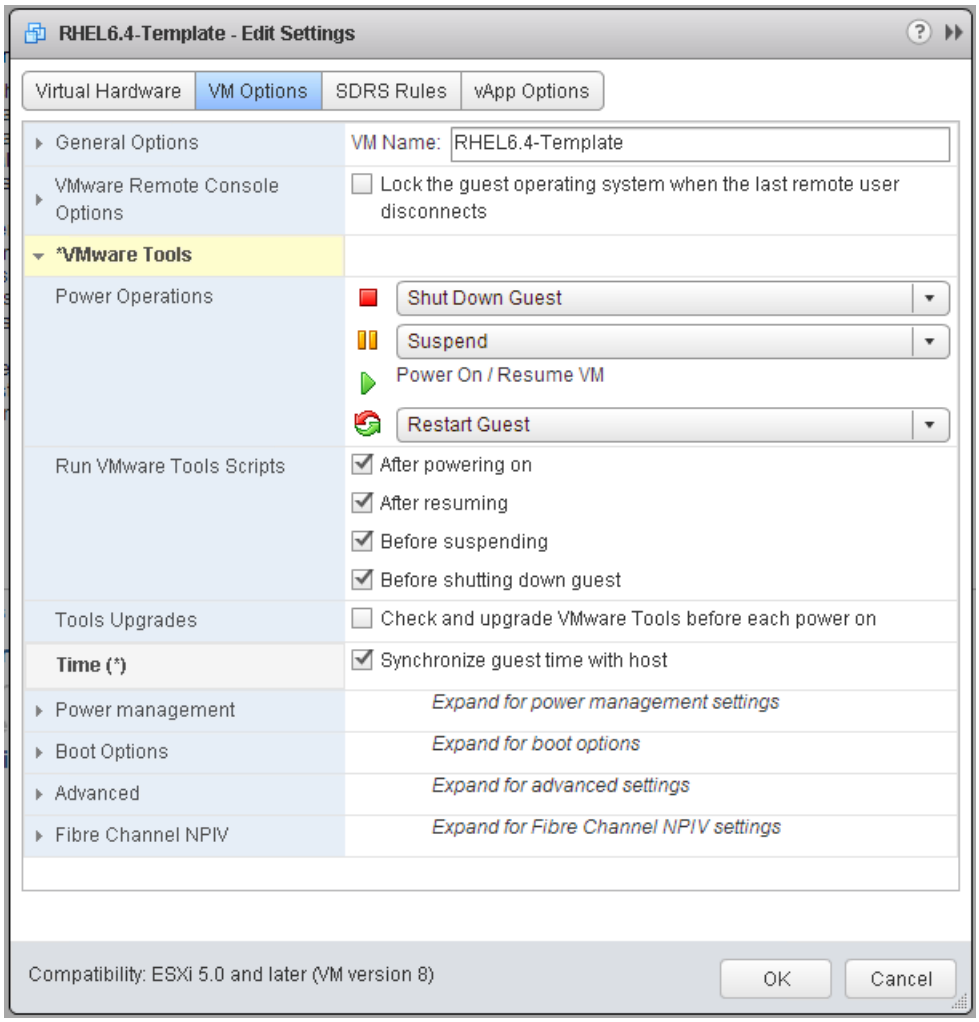
Figure 238 RHEL-Template: Disable the Firewall

8. Disable SELinux by setting the value “Disabled” to the variable SELINUX in the config file “/etc/selinux/config.

Note If you had created any snapshots on this VM during the course of the installation, delete them now.

9. Using vSphere Web-Client, edit the Settings of this VM, and click **VM-Options** tab.
10. Click VMware Tools to expand the options list, and check the checkbox to Synchronize guest time with host i.e. ESXi.
11. On the Virtual Hardware Tab, uncheck the **Connected** checkbox to disconnect the mounted ISO from the virtual CD/DVD device.

Figure 239 RHEL-Template: Setting VM Time to be Synchronized with ESXi Host



Fix up the "/root/.ssh" ownership in the "/opt/serengeti/sbin/open_ssh_access.py"

While creating a hadoop cluster, we make use of password-less SSH to perform some global operations across the cluster of VMs. For this purpose, we will be creating the public and private-keys and distribute them across the entire cluster of VMs (60 to be exact).

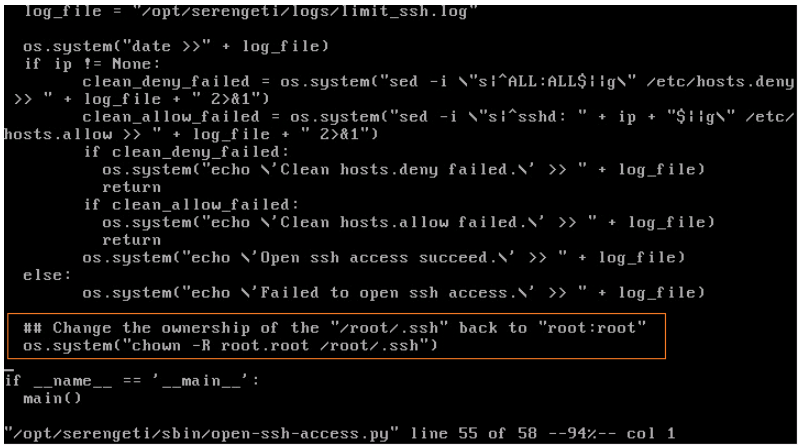
During the VM bootstrap process, the serengeti server limits the SSH access to the VMs to the user "serengeti". Once the bootstrapping process completes, the SSH access is opened to all automatically. However, there is one residual configuration that prevents the functionality of the Password-Less SSH setup. In this section, we install an one-liner fix in the "/opt/serengeti/sbin/open-ssh-access.py" script. TBD: Add VMWare Ticket.

1. Open the file "/opt/serengeti/sbin/open-ssh-access.py" using vi or other editor.
2. Add the following lines before the "if __name__ == '__main__'" code block.

```
## Change the ownership of the "/root/.ssh" back to "root:root"
os.system("chown -R root.root /root/.ssh")
```

Note While copy-pasting the above content, please make sure there is no space in front of these lines, and there are exactly 2 spaces in front of them.

Figure 240 Edit the "open-ssh-access.py" to Return ".ssh" directory to the User



Note If you had assigned a static IP-address to the "eth0" device, please remove the IPADDR entry, and change the BOOTPROTO field of the "/etc/sysconfig/ifcfg-eth0" back to "static" now.

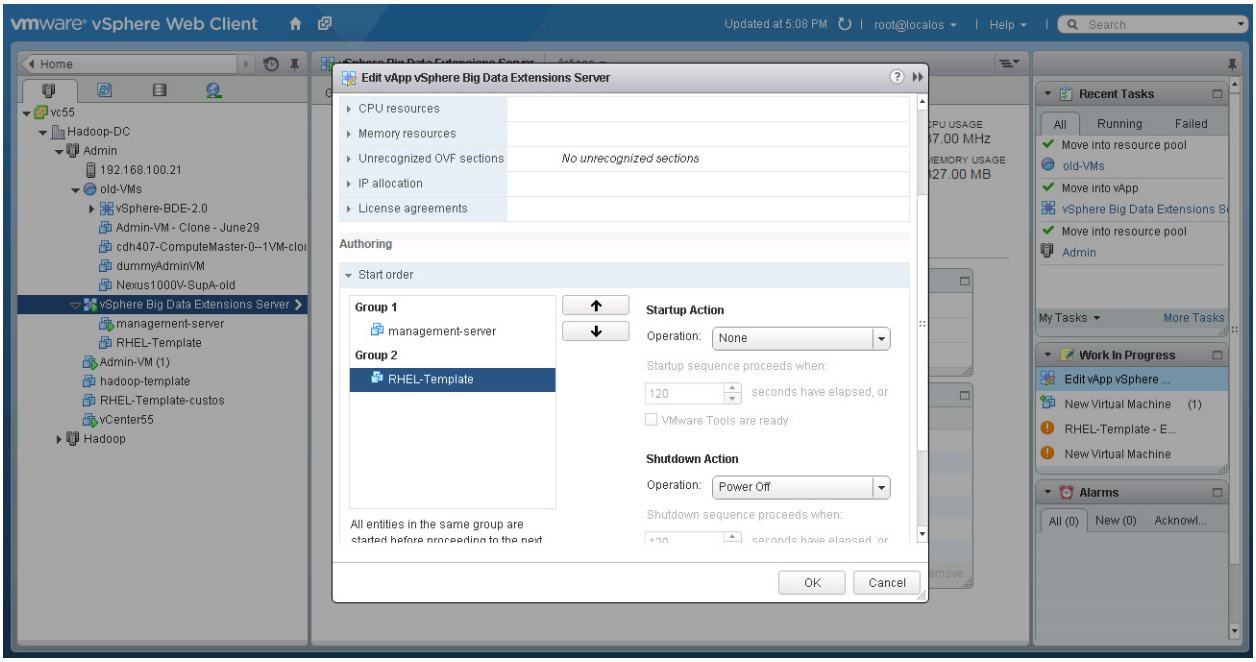
3. RHEL-Template configuration is now complete. Shutdown the VM.

Replacing Hadoop-Template in vSphere Big Data Extensions Server vApp

Now, replace the original Hadoop Template virtual machine of the BDE vApp with the custom RHEL-Template VM by performing the following steps in the vSphere Web Client.

1. Drag and move the original Hadoop Template virtual machine out of the vApp.
2. Drag the new RHEL-Template virtual machine that you just created into the vApp.
3. Click on the "vSphere Big Data Extensions Server" vApp, and select "Edit Settings".
4. In Start Order section under "Group 2", make sure that the RHEL-Template's "Startup Action" should be set to "None" as shown below.
5. As a result the vSphere Big Data Extensions Server vApp consists of 3 VMs now.
6. Now move the old "hadoop-template" out of the vSphere Big Data Extensions Server vApp. It can be moved to any host, but, moving it simply into the same ESXi host makes the transfer to get done faster. Simply drag the "hadoop-template" and drop it into BDE vApp to move it to the same ESXi host for faster migration of the VM.

Figure 241 Verifying the Startup Action of RHEL-Template is set to "None"



7. Finally, log onto the management-server as user "serengeti", and restart the TomCat service by using the command:

```
sudo service tomcat restart
```

Figure 242 RHEL-Template: Restarting the Tomcat Server After Replacing the Hadoop-Template VM

```
[serengeti@bdemgr21 ~]$ service tomcat restart
Thu Dec 4 01:54:18 UTC 2014 tomcat: Stopping Tomcat
Using CATALINA_BASE:   /opt/serengeti/tomcat6
Using CATALINA_HOME:   /opt/serengeti/tomcat6
Using CATALINA_TMPDIR: /opt/serengeti/tomcat6/temp
Using JRE_HOME:        /usr
Using CLASSPATH:       /opt/serengeti/tomcat6/bin/bootstrap.jar
Using CATALINA_PID:    /var/tmp/catalina.pid
Thu Dec 4 01:54:24 UTC 2014 tomcat: no need to remove stale /var/tmp/catalina.pi
d
Thu Dec 4 01:54:24 UTC 2014 tomcat: Stop ok
Thu Dec 4 01:54:24 UTC 2014 tomcat: Starting Tomcat
Thu Dec 4 01:54:24 UTC 2014 tomcat: no need to remove stale /var/tmp/catalina.pi
d
Using CATALINA_BASE:   /opt/serengeti/tomcat6
Using CATALINA_HOME:   /opt/serengeti/tomcat6
Using CATALINA_TMPDIR: /opt/serengeti/tomcat6/temp
Using JRE_HOME:        /usr
Using CLASSPATH:       /opt/serengeti/tomcat6/bin/bootstrap.jar
Using CATALINA_PID:    /var/tmp/catalina.pid
[serengeti@bdemgr21 ~]$
```

Note It is important to remember to always log onto the management-server as the user "serengeti".

Now, the BDE vApp is ready to make use of the RHEL6.4-Template VM as its "Hadoop" VM-template.

Modifying RHEL-Template After Initial Creation

If you power ON your RHEL-Template VM in order to perform any changes to it; such as, install additional packages or OS-configuration changes, you must perform the following before powering it down and using it for deploying the Hadoop clusters. If you fail to perform these steps, it will result in your new configuration not being applied to your Hadoop Cluster.

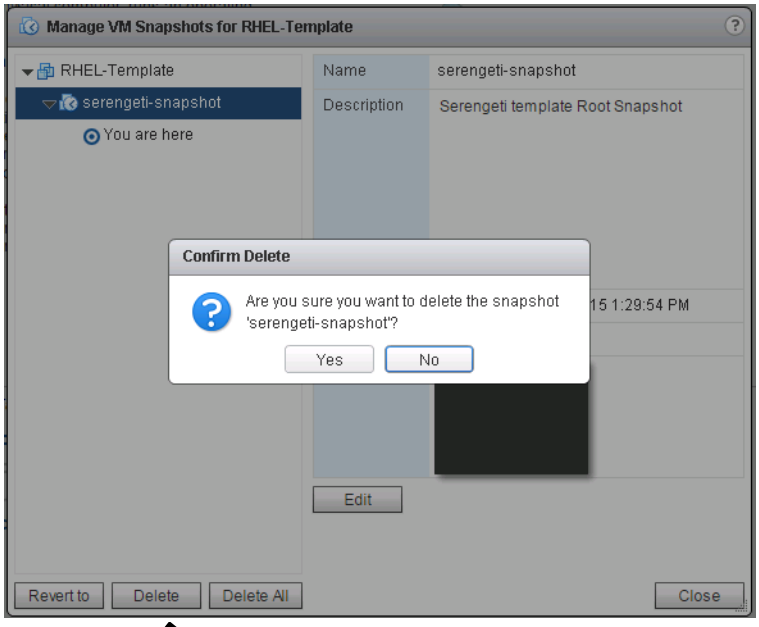
1. Delete the "/etc/udev/rules.d/70-persistent-net.rules file again before powering down and using it for deploying the VM cluster.

```
rm /etc/udev/rules.d/70-persistent-net.rules
```

2. Delete any snapshots that were created either by you or by BDE management-server. As shown below:

Note When the RHEL-Template is deployed in BDE and used for creating a Hadoop-Cluster, the BDE management-server will create a snapshot called "serengeti-snapshot" automatically. This snapshot must also be removed by the user, if the RHEL-Template gets powered ON by the user for the reasons mentioned in this section above.

Figure 243 Deleting the Serengeti-snapshot



Note You need to follow the procedures in this section, only if you power ON the RHEL-Template VM when it is already part of the BDE vAPP. If you always manage the BDE vApp through the vSphere Web-Client and never turn on the RHEL-Template VM, the above steps are not required.

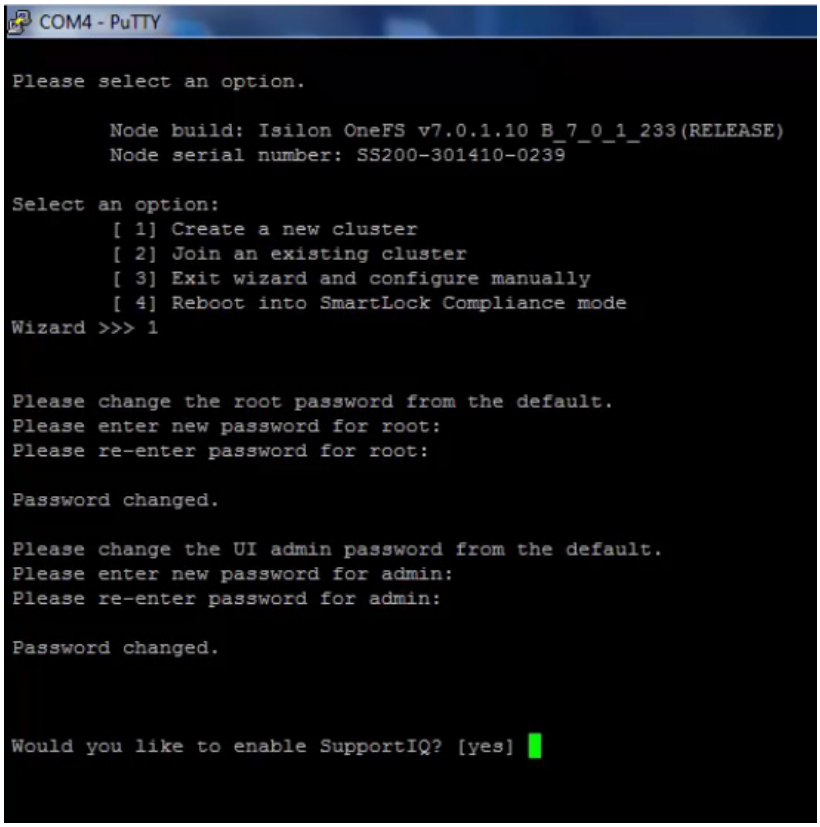
Isilon Configurations

In this section, we will bring up the Isilon Cluster consisting of eight S200 nodes with the version of OneFS that came pre-installed. Subsequently in "Upgrading the OneFS to Latest Version Supporting CDH5" section on page 209, we will upgrade the OneFS to the required version, which is OneFS 7.2.0.

Provisioning the Isilon Node (S200)

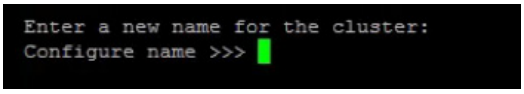
1. Connect a NULL modem cable to the serial port on the back of the S200 and connect the other end to a computer.
2. Open a PuTTY or any other Terminal Emulator session on that COM port.
3. In the initial screen enter the password for the “root” user and UI “admin” user account.

Figure 244 Isilon configurations: Password Configuration for admin and root Users.



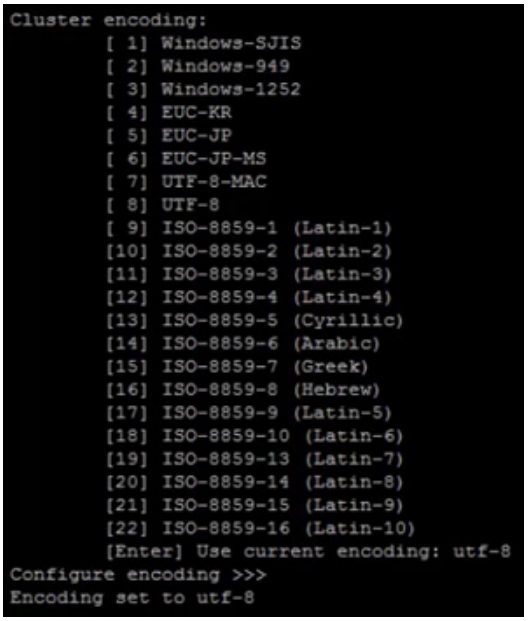
4. Hit Enter to enable the SupportIQ option and configure the Admin Username, Email and phone number.
5. Choose the name of the cluster.
6. We used the string “ISIC”,

Figure 245 Isilon Configurations: Name the Cluster



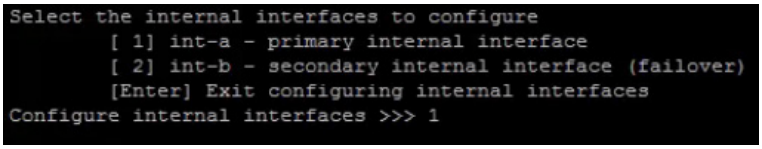
7. Accept UTF-8 encoding for the cluster by pressing ENTER key.

Figure 246 Isilon Configurations: Select the UTF-8 Encoding



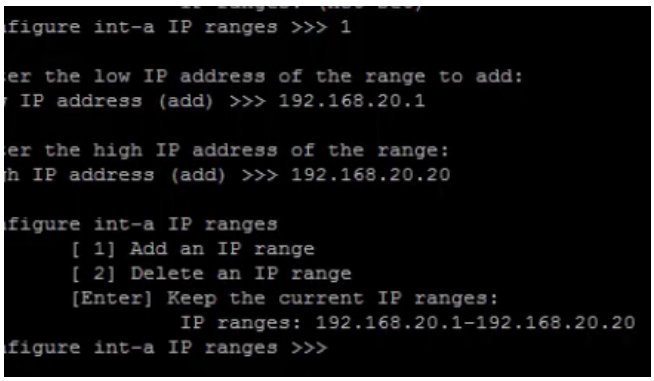
8. Next we need to configure the IP-address for the various network interfaces.
9. We first configure the IP-addresses for the internal-networks (Infiniband networks).

Figure 247 Isilon Configurations: Configure the Internal Interface int-a



10. Configure the IP-address range for the interface “int-a”. Since, our cluster will consist of 8 S200 Isilon nodes; we need a minimum of 8 IP-addresses. These are internal IP-addresses not known outside of the Isilons.
11. Enter Low IP-address as 192.168.20.1 and high IP-address as 192.168.20.20 as shown below.

Figure 248 Isilon Configurations: IP-address Ranges for the Interface int-a



12. Enter the subnet mask as 255.255.255.0

Figure 249 isilon Configurations: Netmask for Interface int-a

```
Configure interface int-a:
        [ 1] Configure netmask
        [ 2] Configure int-a IP ranges
        [Enter] Keep the current configuration:
                    Netmask: (not set)
                 IP ranges: (not set)
Configure interface int-a >>> 1

Enter a new netmask
Configure int-a netmask >>> 255.255.255.0
```

13. Then, configure the IP-addresses and subnet-mask for the other internal interface int-b, and the failover-IP address ranges.

Note The int-b is the secondary (backup) Infiniband-network which takes over in the case of a failure in the primary network. Please refer to Isilon documentation for details on the significance of the Failover-IP configurations.

Figure 250 Isilon Configurations: IP-address Configurations for Interface int-b

```
Configure interface int-b (failover):
        [ 1] Configure netmask
        [ 2] Configure int-b IP ranges
        [ 3] Configure failover IP ranges
        [ 4] Disable failover
        [Enter] Keep the current configuration:
                    Netmask: 255.255.255.0
                 IP ranges: 192.168.30.1-192.168.30.20
        Failover IP ranges: 192.168.40.1-192.168.40.20
                  Failover: enabled
```

14. Press enter to exit the internal network configuration dialog and choose option 2 to enter the 10-Gig external interface configuration dialog.

Figure 251 Isilon Configurations: External 10-GigE Interface Configuration

```
Select the internal interfaces to configure
        [ 1] int-a - primary internal interface
        [ 2] int-b - secondary internal interface (failover)
        [Enter] Exit configuring internal interfaces
Configure internal interfaces >>>

Configure external subnet
        [ 1] ext-1 - External interface
        [ 2] 10gige-1 - External interface
        [Enter] Exit configuring external network.
Configure external subnet >>> 2

Configure interface 10gige-1:
        [ 1] Configure netmask
        [ 2] Configure MTU
        [ 3] Configure 10gige-1 IP ranges
        [Enter] Keep the current configuration:
                    Netmask: (not set)
                        MTU: 1500
                 IP ranges: (not set)
Configure interface 10gige-1 >>>
```

15. Configure the IP-address range, subnet mask and the default-gateway

Figure 252 Isilon Configurations: Default Gateway

```
Configure interface 10gige-1 >>> 1

Enter a new netmask
Configure 10gige-1 netmask >>> 255.255.255.0

Configure interface 10gige-1:
        [ 1] Configure netmask
        [ 2] Configure MTU
        [ 3] Configure 10gige-1 IP ranges
        [Enter] Keep the current configuration:
                  Netmask: 255.255.255.0
                      MTU: 1500
                IP ranges: (not set)
Configure interface 10gige-1 >>> 3

Configure external IP ranges
        [ 1] Add an IP range
        [ 2] Delete an IP range
        [Enter] Keep the current IP ranges:
                IP ranges: (not set)
Configure 10gige-1 IP ranges >>> 1

Enter the low IP address of the range to add:
Low IP address (add) >>> 192.168.100.90

Enter the high IP address of the range:
High IP address (add) >>> 192.168.100.99

Configure external IP ranges
        [ 1] Add an IP range
        [ 2] Delete an IP range
        [Enter] Keep the current IP ranges:
                IP ranges: 192.168.100.90-192.168.100.99
Configure 10gige-1 IP ranges >>>

Configure interface 10gige-1:
        [ 1] Configure netmask
        [ 2] Configure MTU
        [ 3] Configure 10gige-1 IP ranges
        [Enter] Keep the current configuration:
                  Netmask: 255.255.255.0
                      MTU: 1500
                IP ranges: 192.168.100.90-192.168.100.99
Configure interface 10gige-1 >>>

Enter default gateway:
Configure default gateway >>> 192.168.100.1
```

Note The MTU configured here is used for management traffic only. For HDFS traffic a larger MTU to allow jumbo frames will be configured through the OneFS-WebGUI interface.

16. Configure the SmartConnect Zone name and Service IP-addresses.

Note This is the address that will be configured in the DNS-server for HDFS connectivity to Isilon Cluster. subnet0 here will load-balance the request from the servers across the range of external IP-addresses that we provided above.

Figure 253 Isilon Configurations: SmartConnect Service IP

```
Configure SmartConnect settings
        [ 1] SmartConnect zone name
        [ 2] SmartConnect service IP
        [Enter] Keep the current SmartConnect settings:
        SmartConnect zone name: (not set)
         SmartConnect service IP: (not set)
Configure SmartConnect settings >>> 1

Enter SmartConnect zone name
SmartConnect zone name >>> subnet0.isic.hadoop.cisco.local

Configure SmartConnect settings
        [ 1] SmartConnect zone name
        [ 2] SmartConnect service IP
        [Enter] Keep the current SmartConnect settings:
        SmartConnect zone name: subnet0.isic.hadoop.cisco.local
         SmartConnect service IP: (not set)
Configure SmartConnect settings >>> 2

Enter SmartConnect service IP
SmartConnect service IP >>> 192.168.100.45
```

17. Next, Configure the DNS server (if any). In our solution, we didn't configure the Isilon with any DNS server.
18. Modify the Cluster Date/Time, and Cluster Join mode

Figure 254 Modifying the Cluster Date and Time

```
Configure cluster date and time
        [ 1] Configure time zone
        [ 2] Configure day and time
        [Enter] Keep the current date and time: 2014/04/14 21:30:47 UTC.
Configure date >>>

Configure cluster join mode
        [ 1] Manual
        [ 2] Secure
        [Enter] Keep the current join mode: Manual
Configure join mode >>>
Join mode set to Manual.
```

19. In the subsequent screen you will presented with the complete configuration that you have chosen to apply to the Isilon node. Type "yes" to accept the changes and press **Enter** to continue.

Figure 255 Isilon Configurations: Verify the Configurations

```
Enter SmartConnect service IP
SmartConnect service IP >>> 192.168.100.45

Cluster name           : (not set) -> ISIC
Encoding               : (not set) -> utf-8
int-a                  : enabled -> enabled
int-a netmask          : (not set) -> 255.255.255.0
int-a IP ranges        : (not set) -> { 192.168.20.1-192.168.20.20 }
int-b                  : disabled -> enabled
int-b netmask          : (not set) -> 255.255.255.0
int-b IP ranges        : (not set) -> { 192.168.30.1-192.168.30.20 }
lpbk                   : disabled -> enabled
lpbk netmask           : (not set) -> 255.255.255.0
lpbk IP ranges         : (not set) -> { 192.168.40.1-192.168.40.20 }
10gige-1 netmask       : (not set) -> 255.255.255.0
10gige-1 IP range      : (not set) -> { 192.168.100.90-192.168.100.99 }
10gige-1 gateway       : (not set) -> 192.168.100.1
SmartConnect zone name : (not set) -> subnet0.isic.hadoop.cisco.local
SmartConnect service IP: (not set) -> 192.168.100.45

Do you wish to commit these changes? [yes]
Commit changes? >>> yes
```

After about 15-20 minutes, the first node should become functional.

Testing Connectivity

Once the configuration gets applied, you are prompted with a login screen in the Isilon CLI console. Login as user “root” and use the following ping command to test the management network connectivity.

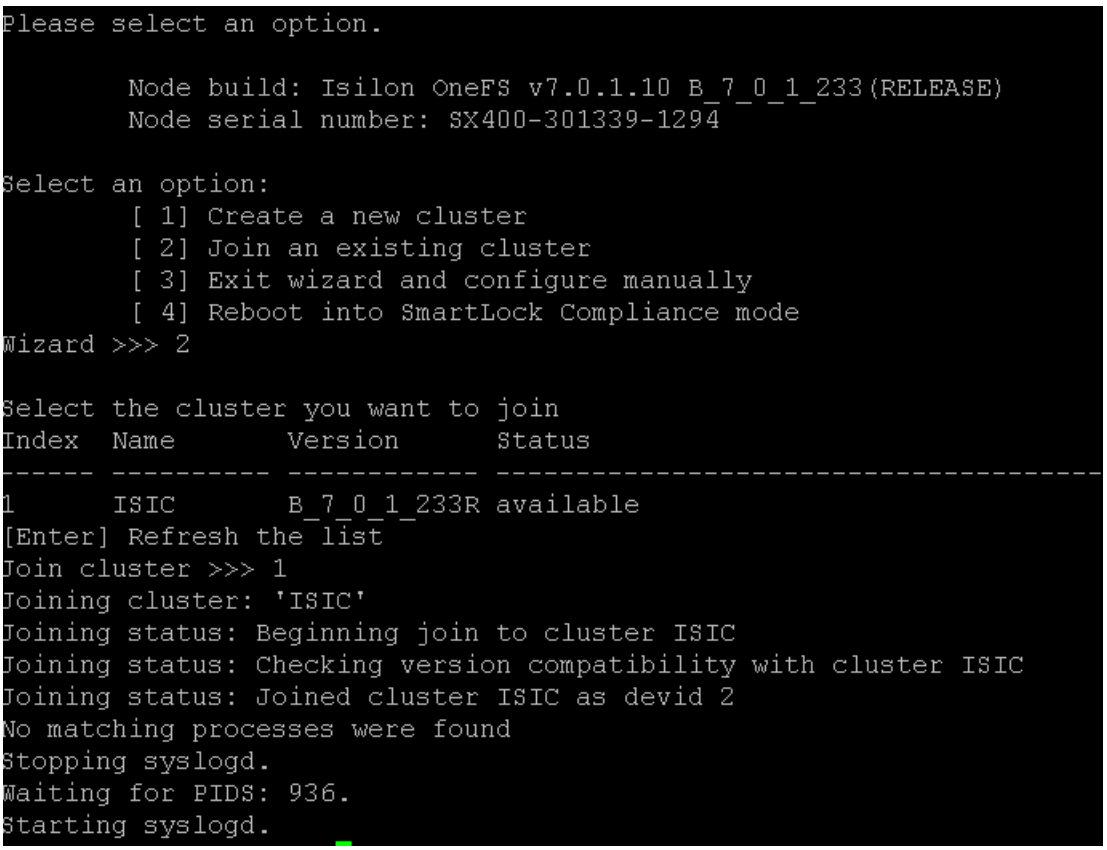
```
ping 192.168.100.51
```

Note 192.168.100.51 is Admin-VM’s management IP-address.

Adding Seven S200 Nodes to Cluster

1. Power on the 2nd-Isilon node and connect the serial cable to it.

Figure 256 Isilon configurations: Joining 2nd Isilon node in Cluster



2. Now the second node begins communicating with the first and runs appropriate scripts to join the cluster. Once the script completes, login to the second node using root user and enter the command, and review the status of the cluster.

```
isi status -q
```

Figure 257 Isilon configurations: Two Isilon nodes Are Up

```
<isi_rc> Completed script isi_firmware_versions
<isi_rc> Completed isi_rc_parallel

Isilon OneFS/amd64 (Hadoop-2) (ttyd0)

login: root
Password:
Copyright (c) 2001-2012 EMC Corporation. All Rights Reserved.
Copyright (c) 1992-2011 The FreeBSD Project.
Copyright (c) 1979, 1980, 1983, 1986, 1988, 1989, 1991, 1992, 1993, 1994
        The Regents of the University of California. All rights reserved.

Isilon OneFS v7.0.1.10
ISIC-2# isi status -q
Cluster Name: ISIC
Cluster Health:     [  OK ]
Cluster Storage:  HDD                 SSD
Size:             23T (24T Raw)       735G (735G Raw)
VHS Size:         1.2T
Used:             78M (< 1%)          992K (< 1%)
Avail:            23T (> 99%)         735G (> 99%)

                  Health  Throughput (bps)  HDD Storage      SSD Storage
ID |IP Address     |DASR |  In   Out  Total| Used / Size     |Used / Size
------------------+-----+-----+-----+-----+----------------+----------------
  1|192.168.100.90 |  OK | 2.7K| 590K| 592K|  57M/  11T(< 1%)| 736K/ 367G(< 1%
  2|192.168.100.91 |  OK |  59K| 1.8M| 1.9M|  21M/  11T(< 1%)| 256K/ 367G(< 1%
------------------+-----+-----+-----+-----+----------------+----------------
Cluster Totals:          |  62K| 2.4M| 2.5M|  78M/  23T(< 1%)| 992K/ 735G(< 1%

    Health Fields: D = Down, A = Attention, S = Smartfailed, R = Read-Only
ISIC-2#
```

Note The nodes may go through a reboot at times while the other nodes join.

3. Repeat the above process for the rest of the 6 nodes for creating the complete cluster. Check the status using the same command.

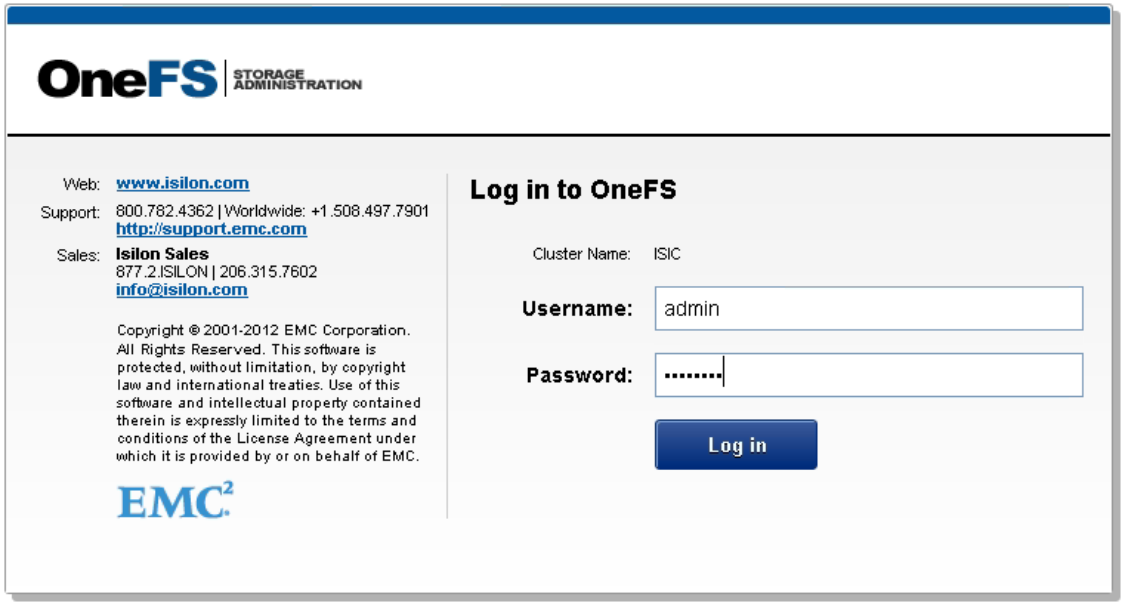
Figure 258 Isilon Configurations: Isilon Cluster in Ready State

```
ISIC-2# isi status -q
Cluster Name: ISIC
Cluster Health:     [  OK ]
Cluster Storage:  HDD                 SSD
Size:             94T (95T Raw)       2.9T (2.9T Raw)
VHS Size:         1.3T
Used:             829M (< 1%)         9.6M (< 1%)
Avail:            94T (> 99%)         2.9T (> 99%)

                  Health  Throughput (bps)  HDD Storage      SSD Storage
ID |IP Address     |DASR |  In   Out  Total| Used / Size     |Used / Size
------------------+-----+-----+-----+-----+-----------------+----------------
  1|192.168.100.90 | OK  | 667K|    0| 667K| 142M/  12T(< 1%)| 1.5M/ 367G(< 1%)
  2|192.168.100.91 | OK  |    0|    0|    0| 127M/  12T(< 1%)| 1.5M/ 367G(< 1%)
  3|192.168.100.92 | OK  |    0| 480K| 480K| 121M/  12T(< 1%)| 1.6M/ 367G(< 1%)
  4|192.168.100.93 | OK  |    0| 107K| 107K| 117M/  12T(< 1%)| 1.3M/ 367G(< 1%)
  5|192.168.100.94 | OK  |    0| 192K| 192K| 103M/  12T(< 1%)| 1.3M/ 367G(< 1%)
  6|192.168.100.95 | OK  |    0| 240K| 240K| 109M/  12T(< 1%)| 1.1M/ 367G(< 1%)
  7|192.168.100.96 | OK  |    0| 240K| 240K|  98M/  12T(< 1%)| 1.1M/ 367G(< 1%)
  8|192.168.100.97 | OK  |  60K| 262K| 323K|  12M/  12T(< 1%)| 112K/ 367G(< 1%)
------------------+-----+-----+-----+-----+-----------------+----------------
Cluster Totals:           | 727K| 1.5M| 2.2M| 829M/  94T(< 1%)| 9.6M/ 2.9T(< 1%)

     Health Fields: D = Down, A = Attention, S = Smartfailed, R = Read-Only
```

Logging Into Isilon OneFS Web-UI

1. Log into the Isilon Cluster as user “admin”.

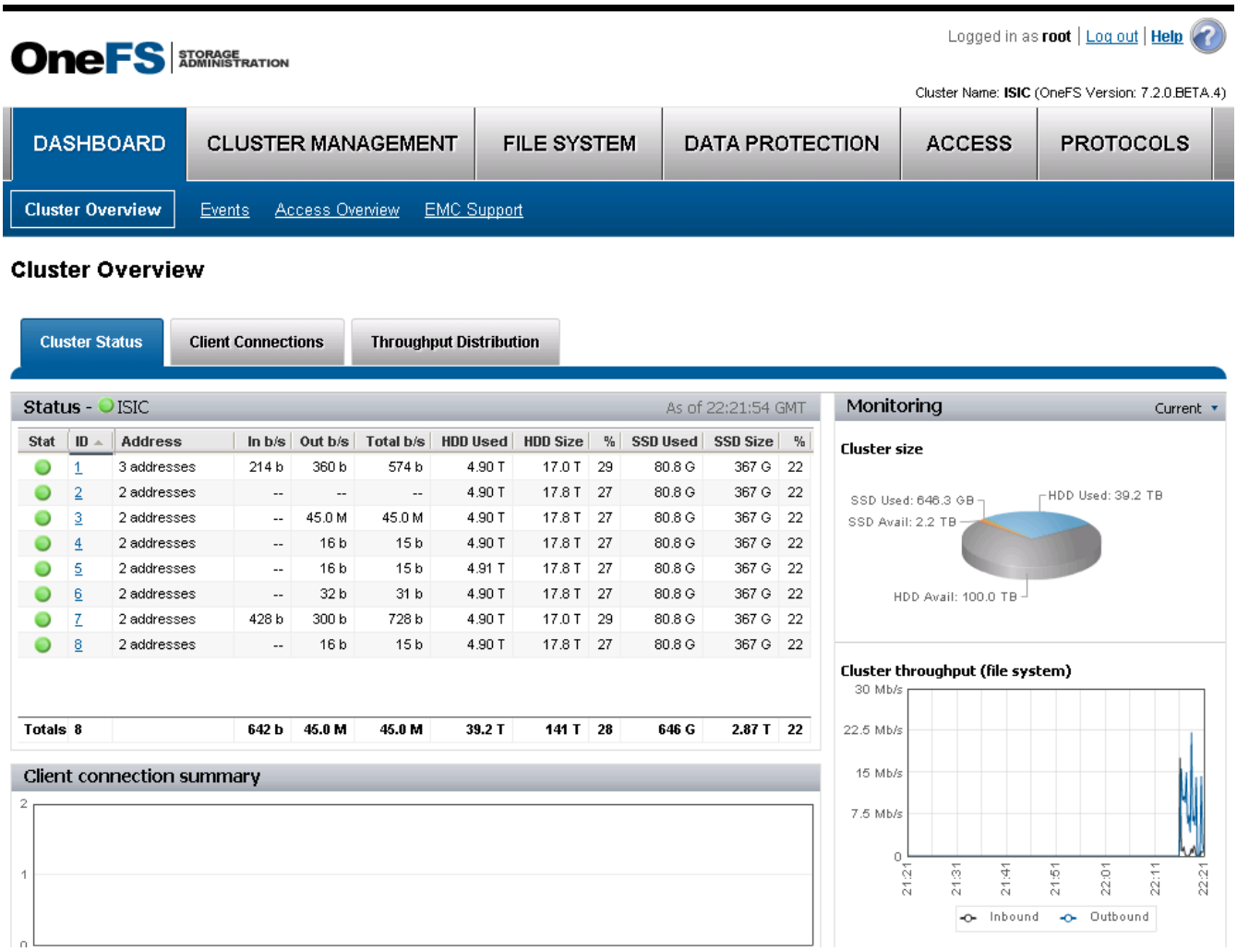
Figure 259 Isilon OneFS: Logging into Isilon OneFS Cluster Management WebUI.



This takes you to the dashboard as shown below.

Note You could also login as “root” user.

Figure 260 Isilon OneFS: Cluster Overview Screen



Upgrading the OneFS to Latest Version Supporting CDH5

The OneFS must be upgraded to the version 7.2.0 or beyond that supports the Compute-Only clusters using Cloudera Distribution of Hadoop (CDH5).

In this section, we will review how to perform the upgrade from an older version to 7.2.0.0 image.

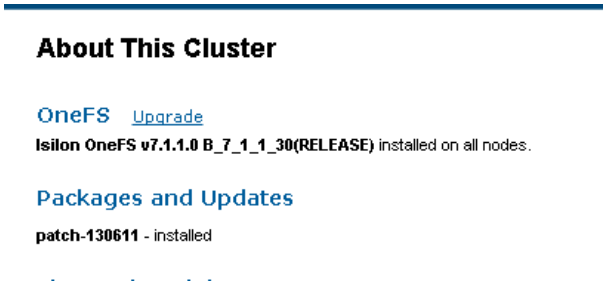
1. Place the OneFS tar file /ifs folder of Isilon cluster by using standard “scp” commands.

Figure 261 Isilon Configurations: OneFS Archive Uploaded to the "/ifs" Folder

```
ISIC-1# ls -l /ifs
total 185631
drwxrwxr-x    19 root  wheel       1515 Oct  7 10:17 .ifsvar
dr-xr-xr-x     2 root  wheel          0 Jun 12 01:00 .snapshot
-rw-r--r--     1 root  wheel  165667249 Oct 24 21:48 OneFS_v7.2.0.BETA.4_Install.tar.gz
-rw-r--r--     1 root  wheel       1032 Jun 12 01:00 README.txt
drwxrwxrwx     5 root  wheel        118 Sep 12 20:19 data
drwxrwxr-x    13 root  wheel        318 Oct 10 10:56 home
drwxr-xr-x     4 root  wheel         47 Sep 12 23:53 isic
drwx------ +   2 root  wheel        139 Sep 12 21:15 onefs
```

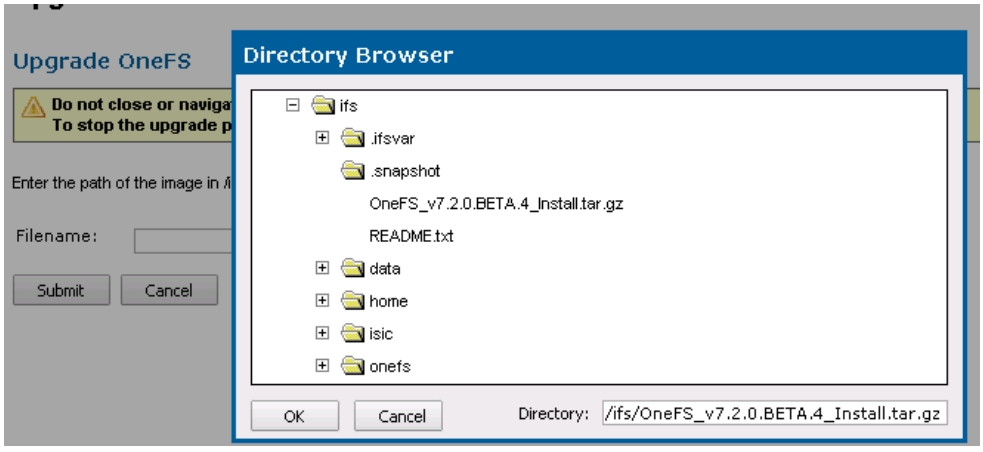
2. Log into OneFS Web-UI as root or admin user.
3. Click Help at the top-right corner and choose "About this cluster".
4. Click the Upgrade link under "About This Cluster"

Figure 262 Isilon Configurations: Upgrade Option in OneFS



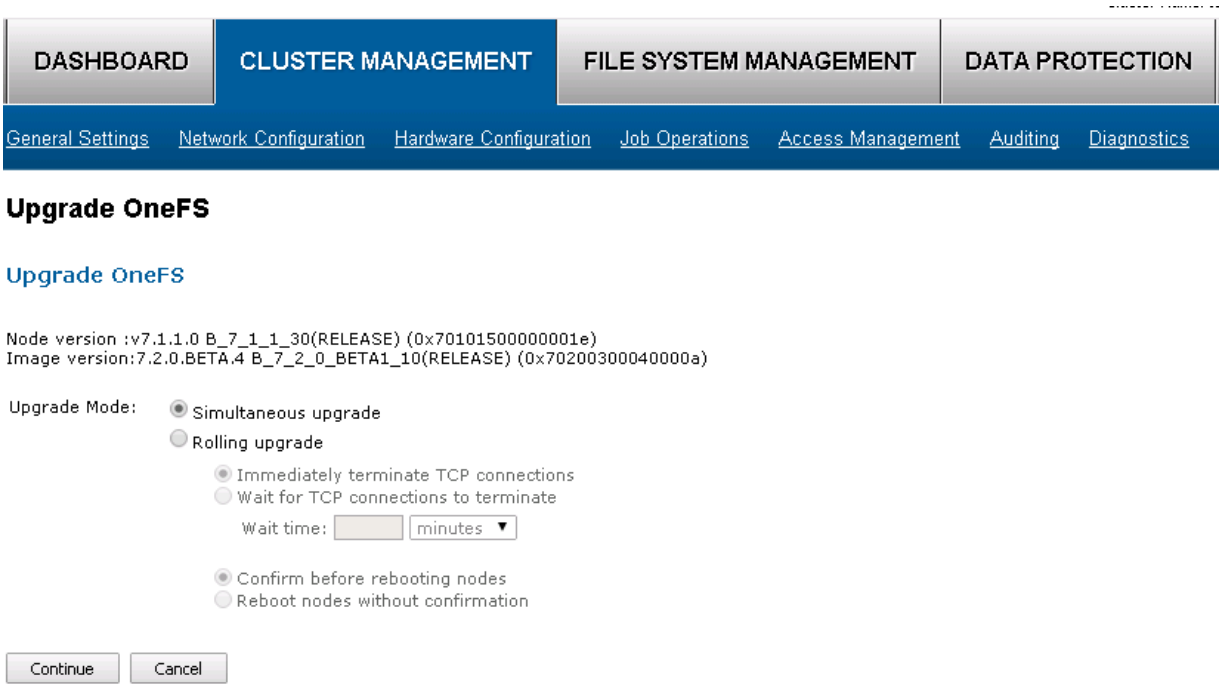
5. Click **Browse** to choose the new OneFS archive file.
6. Click **Submit**

Figure 263 Isilon Configurations: Upgrading OneFS



7. Click **Simultaneous Upgrade** radio button in the Upgrade Mode and click **Continue**.

Figure 264 Isilon Configurations: Upgrading OneFS Simultaneously in All Nodes



8. After several minutes, once the upgrade is complete. click **Yes** to reboot the Cluster.

Figure 265 Completing Isilon Upgrade

9. Log back onto the Console to verify the version of OneFS by using the command:

```
isi version
```

Figure 266 Verifying the OneFS Upgrade

```
ISIC-1# isi version
Isilon OneFS v7.2.0.BETA.4 B_7_2_0_BETA1_10(RELEASE): 0x70200300040000A:Tue Sep 23 03:48:5
4 GMT 2014    root@fastbuild-03.west.isilon.com:/build/mnt/obj/build/mnt/src/sys/IQ.amd64.
release   clang version 3.3 (tags/RELEASE_33/final)
```

Creating New Zone for HDFS Access

Access zones on OneFS are a way to choose a distinct configuration for the OneFS cluster based on the IP address that the client connects to. For HDFS, this configuration includes authentication methods, HDFS root path, and authentication providers (AD, LDAP, local, etc.). By default, OneFS includes a single access zone called System.

If you will only have a single Hadoop cluster connecting to your Isilon cluster, then you can use the System access zone with no additional configuration. However, to have more than one Hadoop cluster connect to your Isilon cluster, it is best to have each Hadoop cluster connect to a separate OneFS access zone. This will allow OneFS to present each Hadoop cluster with its own HDFS namespace and an independent set of users.

For more information, see Security and Compliance for Scale-out Hadoop Data Lakes.

In this section, we will create a new access-zone called “zone1”, and we will configure it for HDFS access.

1. Create a sub-directory under “/ifs” which will act as the root-directory for the zone “zone1”

```
mkdir -p /ifs/zone1
```

2. Create a new Zone by name “zone1”

```
isi zone zones create --name zone1 --path /ifs/zone1
```

3. Verify the successful creation of the zone by using the command

```
isi zone zones list”
```

Figure 267 Creating New Access Zone “Zone1” for HDFS Access.

```
ISIC-1# mkdir -p /ifs/zone1
ISIC-1# isi zone zones create --name zone1 --path /ifs/zone1
ISIC-1# isi zone zones list
Name   Path
----------------------
System /ifs
mini2  /ifs/isic/mini2
zone1  /ifs/zone1
----------------------
Total: 3
ISIC-1#
```

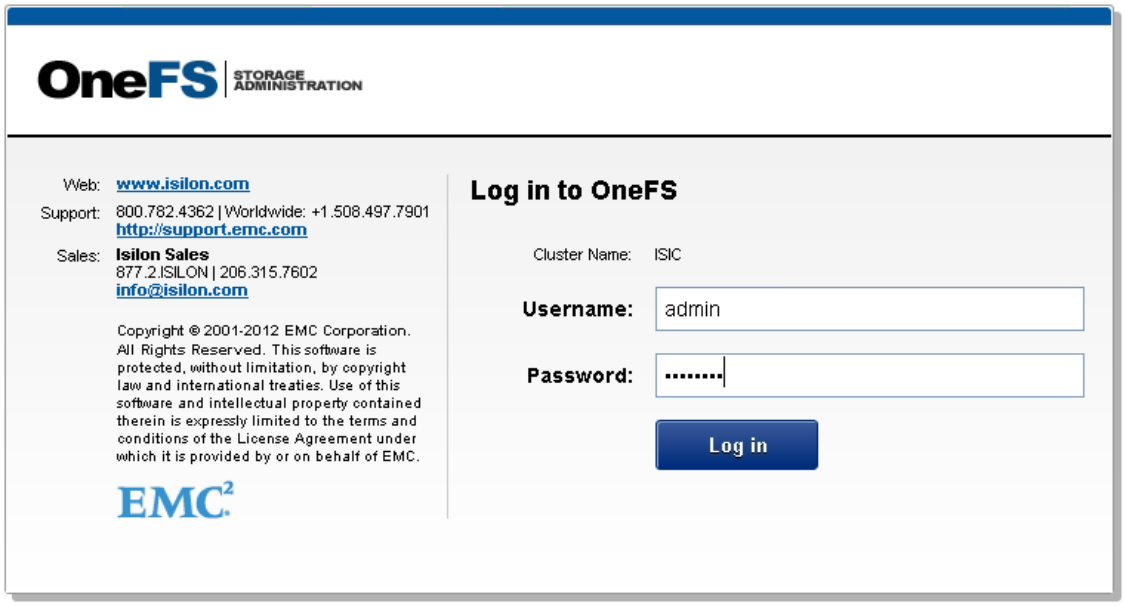
Configuring OneFS cluster for HDFS access

Configuring NTP Settings

It is important to have all the components of the Hadoop cluster to be synchronized to the same time-source. In this section we will walk through the method to configure OneFS’s NTP settings to synchronize the Isilon cluster’s time to Admin-VM.

1. Log onto the Isilon Cluster as user “admin” or “root”.

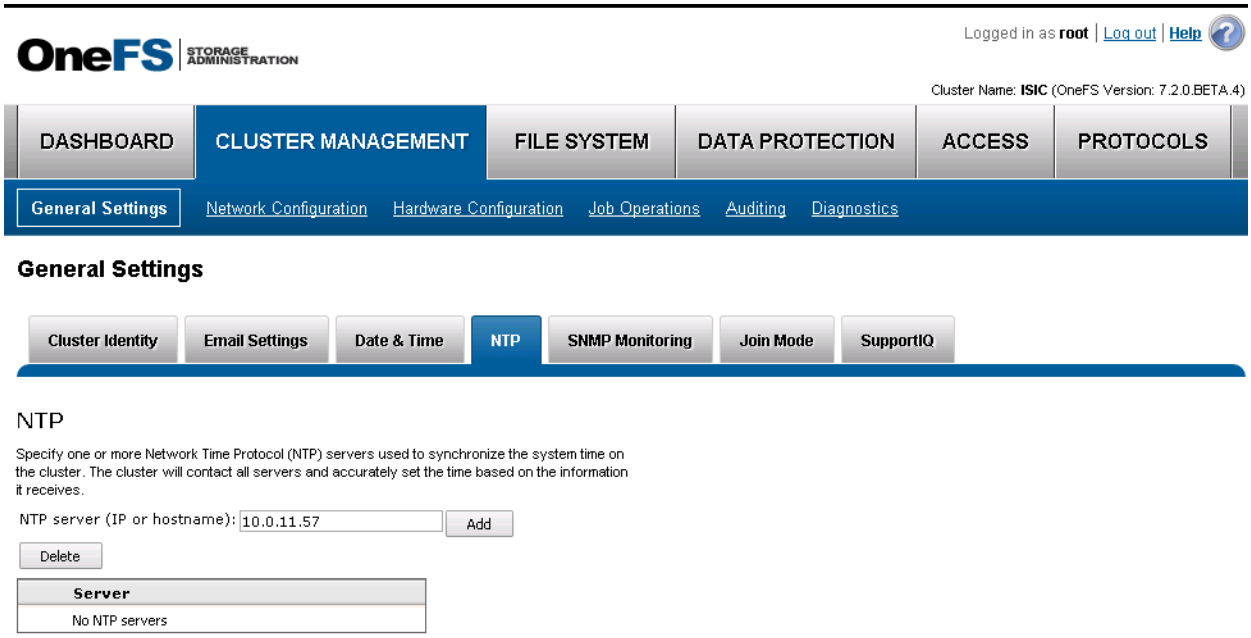
Figure 268 Isilon OneFS: Logging into Isilon OneFS Cluster Management WebUI.



Note You could also login as “root” user.

2. Under the Cluster Management, choose **NTP** tab under the General Settings.
3. Add the IP-address of the Admin-VM i.e. 10.0.11.57 and click **Add**.

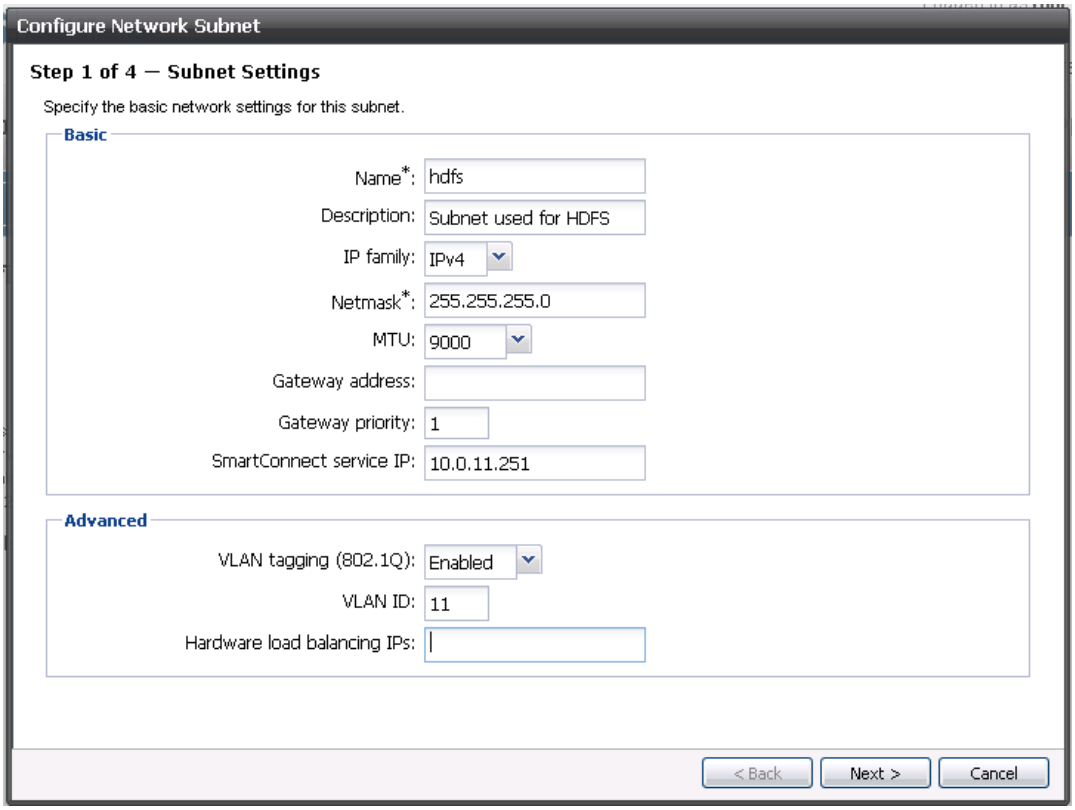
Figure 269 Configuring NTP in OneFS



Creating New IP-Pool for HDFS Connectivity In Isilon

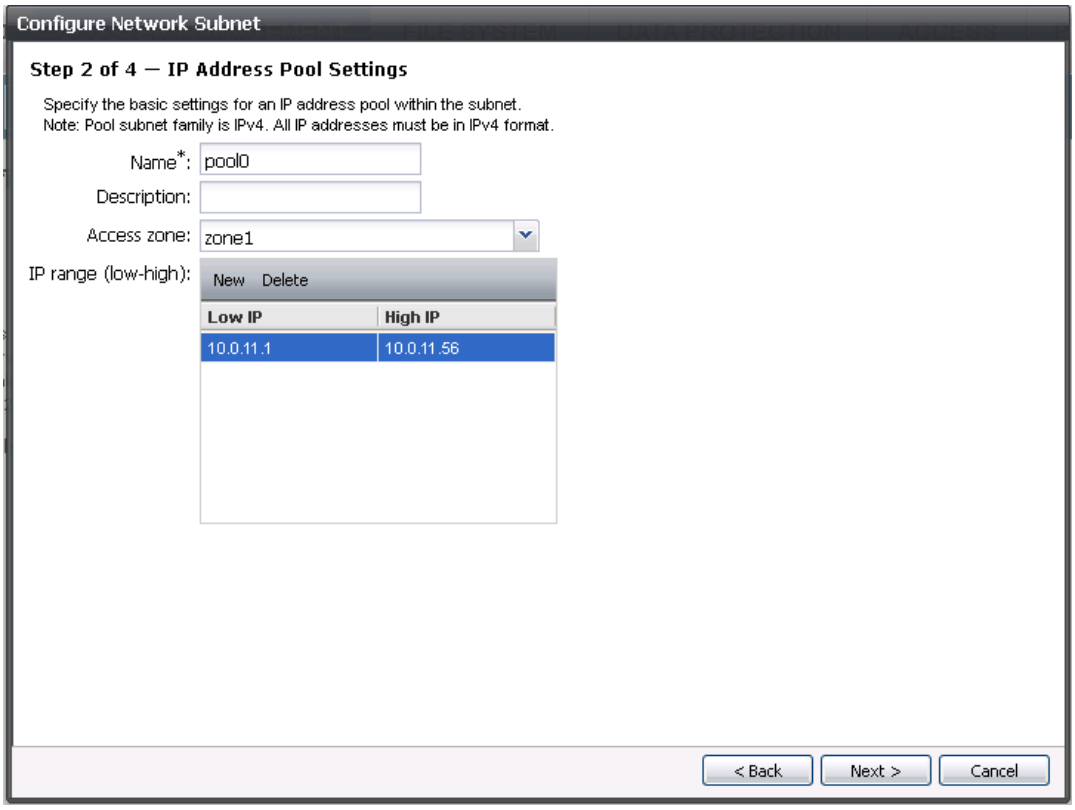
1. Log onto the Web-UI
2. Navigate to **Cluster Mangement** > **Network Configuration** and click **Add Subnet**.
3. Enter the name as hdfs.
4. Enter 255.255.255.0 in the Netmask field.
5. Enter MTU as 9000
6. Assign a Smart-Connect Service-IP 10.0.11.251
7. Enable the VLAN tagging.
8. Enter the VLAN-ID: 11
9. Click **Next** to Continue.

Figure 270 Isilon OneFS: Adding New Subnet Pool for HDFS-Interface



10. In step-2, enter pool name as “pool0” and
11. Enter the IP-address range.(10.0.11.1 – 10.0.11.56),
12. Choose “zone1” Access zone from the drop-down box.
13. Click **Next** to continue

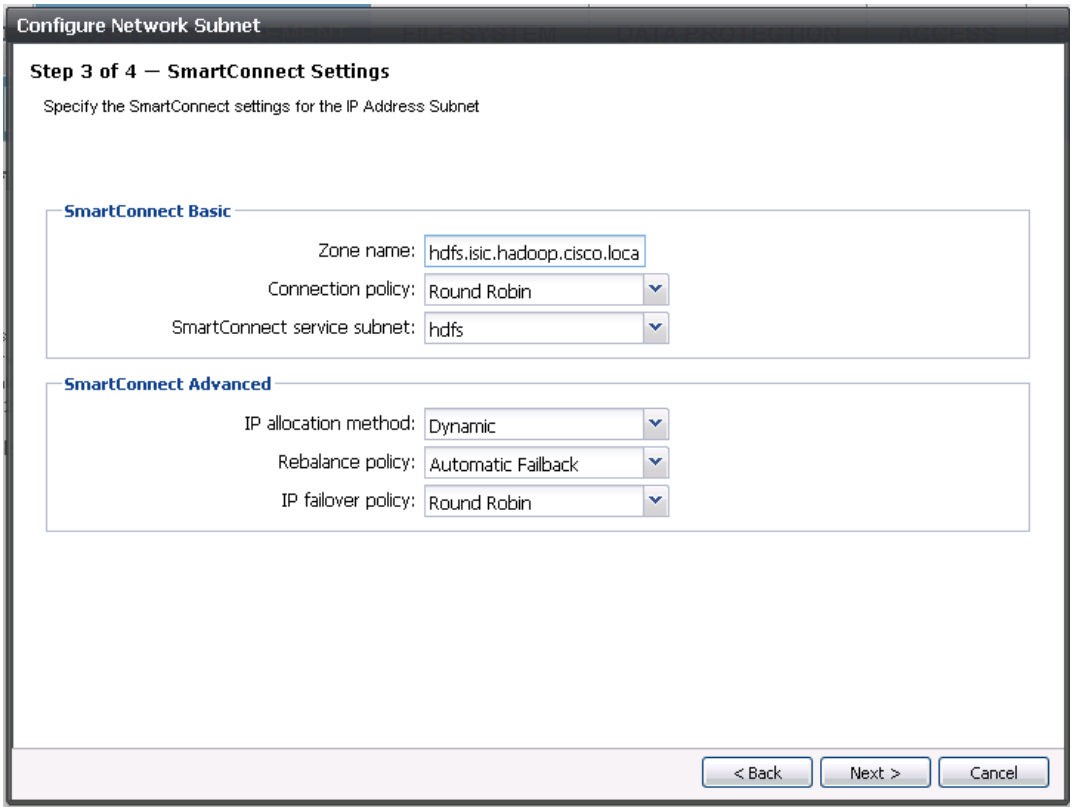
Figure 271 Isilon OneFS: IP Address Range for HDFS-Interface



14. Assign the zone name (FQDN) i.e. hdfs.isic.hadoop.cisco.local. All requests HDFS-requests will be using this Zone FQDN.
15. Enter the SmartConnect service subnet as “hdfs”.
16. Choose the “IP Allocation Method” to be “Dynamic”.

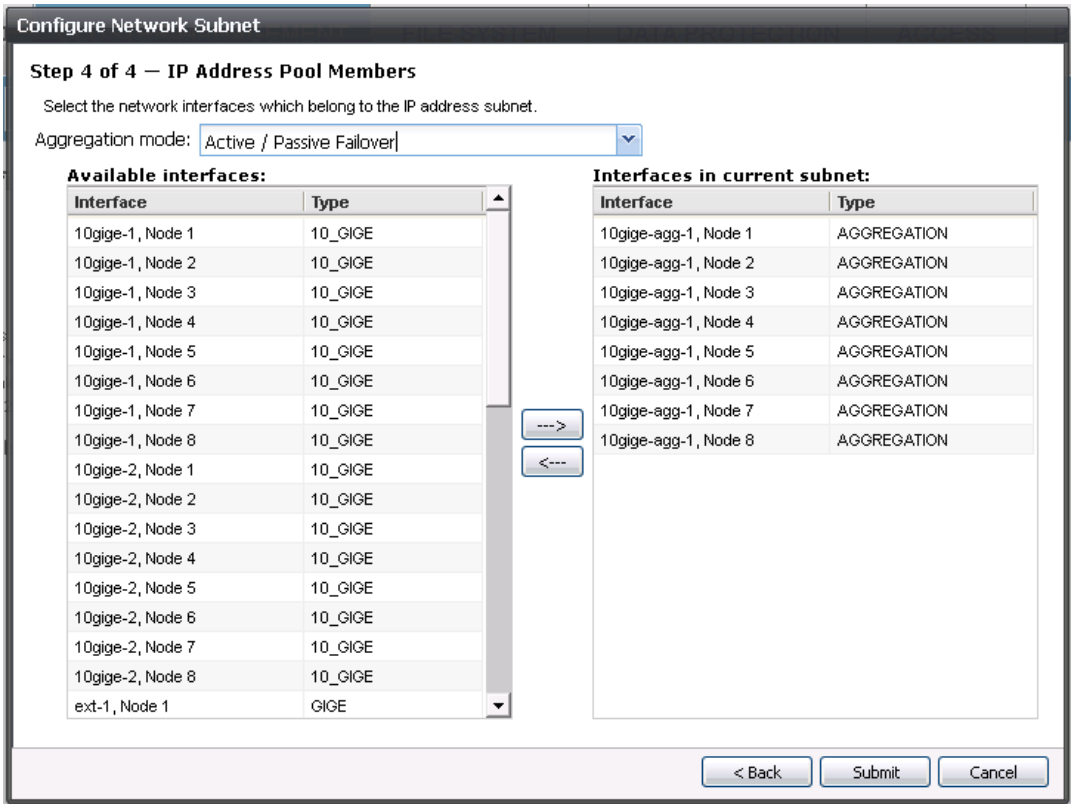
Note Use of “Dynamic” IP Allocation Method requires additional “SmartConnect Advanced” License. Please refer to “Bill of Materials” section on page 278.

Figure 272 Isilon OneFS: SmartConnect Settings Configuration



17. Set Aggregation Mode to be **Active/Passive Failover** type.
18. Under the "Available interfaces" column, choose all the interfaces that matches the pattern "10gige-agg-*" and click ---> to add them to the "Interfaces in current subnet" column.
19. Click **Submit**.

Figure 273 Isilon OneFS: Adding the 10gige-agg- Interfaces to the Pool0*



Configuring Isilon for HDFS

1. Verify the HDFS License is installed in your Isilon Cluster using the command “isi license”.

Figure 274 Verifying Isilon Licenses

```
ISIC-1# isi license
Module                   License Status    Configuration     Expiration Date
------                   --------------    -------------     ---------------
CloudPools               Inactive          Not Configured
HDFS                     Evaluation        Not Configured    December  9, 2014
InsightIQ                Evaluation        Not Configured    December  9, 2014
Isilon for vCenter       Evaluation        Not Configured    December  9, 2014
MobileIQ                 Inactive          Not Configured
SmartConnect Advanced    Evaluation        Configured        December  9, 2014
SmartDedupe              Evaluation        Not Configured    December  9, 2014
SmartLock                Evaluation        Not Configured    December  9, 2014
SmartPools               Evaluation        Not Configured    December  9, 2014
SmartQuotas              Evaluation        Not Configured    December  9, 2014
SnapshotIQ               Evaluation        Not Configured    December  9, 2014
Swift                    Inactive          Not Configured
SyncIQ                   Evaluation        Not Configured    December  9, 2014
iSCSI                    Inactive          Not Configured
ISIC-1#
```

2. Download the latest version of Isilon Hadoop tools and from the GitHub page https://github.com/claudiofahey/isilon-hadoop-tools/releases and copy it over to the Isilon cluster under a directory scripts directory under “/ifs”. This tool-kit consists of several useful scripts, the relevant scripts were kept under “/ifs/scripts/onefs” directory in the Isilon cluster as shown below.

Note The relevant scripts from the GitHub project can be found in the Appendix.

Figure 275 Isilon Hadoop Helper Scripts

```
ISIC-1# ls -l /ifs/scripts/onefs
total 77
-rwxr-xr-x    1 root  wheel   966 Oct 26 21:28 isilon_create_cdh_users_for_nfs.sh
-rwxr-xr-x    1 root  wheel  6660 Oct 26 21:27 isilon_create_directories.sh
-rwxr-xr-x    1 root  wheel  6458 Oct 26 21:27 isilon_create_users.sh
ISIC-1#
```

3. Create the HDFS root directory.
4. Create a logical rack for HDFS using the following commands:

```
isi hdfs racks create /rack0 -client-ip-ranges 0.0.0.0-255.255.255.255
isi hdfs racks modify /rack0 -add-ip-pools hdfs:pool0
```

Figure 276 Configuring the HDFS Rack

```
ISIC-1# isi hdfs racks create /rack0 --client-ip-ranges 0.0.0.0-255.255.255.255
ISIC-1# isi hdfs racks modify /rack0 --add-ip-pools hdfs:pool0
ISIC-1#
ISIC-1# isi hdfs racks list -v
           Name: /rack0
Client IP Ranges: 0.0.0.0-255.255.255.255
        IP Pools: hdfs:pool0
ISIC-1#
```

Creating Hadoop users and setting directory permissions for HDFS access

Since, we are using the Isilon only for HDFS storage by the Hadoop VMs, the user- IDs and group-IDs of the Hadoop-users do not need to match between that of the Hadoop-VMs and the Isilon OneFS. This is due to the fact that the HDFS wire protocol only refers to users and groups by their names, and never their numeric IDs.

In contrast, the NFS wire protocol refers to users and groups by their numeric IDs. Although NFS is rarely used in traditional Hadoop environments, the high-performance, enterprise-class, and POSIX-compatible NFS functionality of Isilon makes NFS a compelling protocol for certain workflows. It is highly recommended to maintain consistent names and numeric IDs for all users and groups on Isilon and your Hadoop servers. In a multi-tenant environment with multiple Hadoop clusters, numeric IDs for users in different clusters should be distinct.

The Hadoop VMs shall make use of these user names to perform the MapReduce jobs. Here, we enable unrestricted access to the Hadoop root directory on Isilon. The administrator must re-configure directory access privileges appropriately to restrict any unauthorized access before entering the production phase.

In this solution, we are making use of the “zone” zone of the Isilon OneFS for HDFS. If you prefer to configure HDFS in a different access zone, then change the parameter “zone1” with the zone name of your choice in the below commands.

1. Log onto the Isilon-cluster by using SSH
2. Enter the command “isi zone zones list” to list the zones and their access paths

```
isi zone zones list
```

Figure 277 Isilon Access Zones

```
ISIC-1# isi zone zones list
Name   Path
----------------------
System /ifs
mini2  /ifs/isic/mini2
zone1  /ifs/zone1
----------------------
Total: 3
```

3. Now create a new Hadoop root-directory under "/ifs" as follows:

```
mkdir -p /ifs/zone1/hadoop
```

4. Configure the newly created directory as the HDFS root-directory of "zone1" zone.

```
isi zone zones modify zone1 --hdfs-root-directory /ifs/zone1/hadoop
```

5. Increase the HDFS Service's Thread count.

```
isi hdfs settings modify --server-threads 256
```

6. Configure the HDFS block-size used for reading from Isilon.

```
isi hdfs settings modify --default-block-size 512M.
```

7. Disable the HDFS checksum. This checksum is never stored in the Isilon, since Isilon performs its own advanced checksum calculations, it is safe to disable the HDFS checksum here, and it might also help increase Isilon performance.

```
isi hdfs settings modify --default-checksum-type=none
```

Figure 278 Initial HDFS Configuration in OneFS

```
ISIC-1# mkdir -p /ifs/zone1/hadoop
ISIC-1# isi zone zones modify zone1 --hdfs-root-directory /ifs/zone1/hadoop
ISIC-1# isi hdfs settings modify --server-threads=256
ISIC-1# isi hdfs settings modify --default-block-size=512M
ISIC-1# isi hdfs settings modify --default-checksum-type=none
ISIC-1#
ISIC-1# isi hdfs settings view
   Default Block Size: 512M
Default Checksum Type: none
     Server Log Level: warning
       Server Threads: 256
ISIC-1#
ISIC-1#
```

8. Now execute the script from Isilon-Hadoop toolkit "isilon_create_users.sh" via "bash" for creating the users necessary to make the HDFS accessible to the users of the CDH5 Hadoop cluster

Note Refer to the script "Isilon_create_users.sh" in "Script for Creating Hadoop Users on Isilon OneFS" section on page 284

```
bash /ifs/scripts/onefs/isilon_create_users.sh --dist cdh --startgid 501 --startuid 501
--zone zone1
```

Figure 279 Creating the CDH-Specific Users in Zone1

```
ISIC-1# bash /ifs/scripts/onefs/isilon_create_users.sh --dist cdh --startgid 501
 --startuid 501 --zone zone1
Info: Hadoop distribution:  cdh
Info: groups will start at GID 501
Info: users will start at UID 501
Info: will put users in zone:  zone1
Info: HDFS root:  /ifs/zone1/hadoop
SUCCESS -- Hadoop users created successfully!
Done!
```

9. Now create the appropriate directories for those users using the script “isilon_create_directories.sh” via bash.

Note Refer to the script “isilon_create_directories.sh” in “Script for Creating Hadoop User Directories on Isilon OneFS” section on page 288.

```
bash /ifs/scripts/onefs/isilon_create_directories.sh --dist cdh --fixperm --zone zone1
```

Figure 280 Creating User-Directories in Isilon Cluster

```
ISIC-1# bash /ifs/scripts/onefs/isilon_create_directories.sh --dist cdh --fixper
m --zone zone1
Info: Hadoop distribution:  cdh
Info: will fix permissions and owners on existing directories
Info: will use users in zone:  zone1
Info: Access Zone ID is 3
Info: HDFS root dir is /ifs/zone1/hadoop
################################################################################
##
## Creates Hadoop directory structure on Isilon system HDFS.
################################################################################
##
DEBUG: specs dirname /; perm 755; owner hdfs; group hadoop
DEBUG: specs dirname /hbase; perm 755; owner hbase; group hbase
DEBUG: specs dirname /solr; perm 775; owner solr; group solr
DEBUG: specs dirname /tmp; perm 1777; owner hdfs; group supergroup
DEBUG: specs dirname /tmp/logs; perm 1777; owner mapred; group hadoop
DEBUG: specs dirname /user; perm 755; owner hdfs; group supergroup
DEBUG: specs dirname /user/history; perm 777; owner mapred; group hadoop
DEBUG: specs dirname /user/hive; perm 775; owner hive; group hive
DEBUG: specs dirname /user/hive/warehouse; perm 1777; owner hive; group hive
DEBUG: specs dirname /user/hue; perm 755; owner hue; group hue
DEBUG: specs dirname /user/hue/.cloudera_manager_hive_metastore_canary; perm 777
; owner hue; group hue
DEBUG: specs dirname /user/impala; perm 775; owner impala; group impala
DEBUG: specs dirname /user/oozie; perm 775; owner oozie; group oozie
DEBUG: specs dirname /user/spark; perm 755; owner spark; group spark
DEBUG: specs dirname /user/spark/applicationHistory; perm 1777; owner spark; gro
up spark
DEBUG: specs dirname /user/sqoop2; perm 775; owner sqoop2; group sqoop
SUCCESS -- Hadoop admin directory structure exists and has correct ownership and
 permissions
Done!
```

10. Map the hdfs user to the Isilon superuser. This will allow the hdfs user to show (change ownership of) all files. Subsequently, disable and enable the Isilon HDFS services using the commands given below to flush any user-privileges cached in memory.

```
isi zone zones modify --user-mapping-rules="hdfs=>root" --zone zone1
isi services isi_hdfs_d disable
isi services isi_hdfs_d enable
```

Figure 281 Mapping the hdfs User to “root” Privileges.

```
ISIC-1# isi zone zones modify --user-mapping-rules="hdfs=>root" --zone zone1
ISIC-1#
ISIC-1#
ISIC-1# isi services isi_hdfs_d disable
The service 'isi_hdfs_d' has been disabled.
ISIC-1# isi services isi_hdfs_d enable
The service 'isi_hdfs_d' has been enabled.
ISIC-1#
```

Verifying DNS-Request Delegations to Isilon Sub-Domain

The VMware Big Data Extensions require all entities to be addressable by means of fully qualified domain names (FQDN) for all HDFS traffic. This is also for all the Namenode and Datanode resolutions. In the previous step, we configured the FQDN "subnet0.isic.hadoop.cisco.local" which will be the common FQDN for all HDFS name-nodes and data-nodes. This name must be configured to resolve to an IP-address of the SmartConnect Service-IP address of Isilon node in the network (VLAN) assigned to carry the HDFS traffic between Hadoop Cluster VMs and the Isilon nodes.

In "Creating Admin-VM" section on page 114, we configured the Admin-VM (192.168.100.51 – admin-vm.hadoop.cisco.local) to forward all requests to "isic.hadoop.cisco.local" sub-domain to the HDFS SmartConnect Service IP i.e. 10.0.11.251.

We shall verify if they work correctly by using nslookup command repeatedly to access the "hdfs" subnet that we created in the previous steps.

```
nslookup hdfs.isic.hadoop.cisco.local
```

Figure 282 Isilon OneFS: Verifying Isilon DNS Subdomain Delegations

```
[root@admin-vm ~]# nslookup hdfs.isic.hadoop.cisco.local
Server:         127.0.0.1
Address:        127.0.0.1#53

Name:   hdfs.isic.hadoop.cisco.local
Address: 10.0.11.15

[root@admin-vm ~]# nslookup hdfs.isic.hadoop.cisco.local
Server:         127.0.0.1
Address:        127.0.0.1#53

Name:   hdfs.isic.hadoop.cisco.local
Address: 10.0.11.16

[root@admin-vm ~]# nslookup hdfs.isic.hadoop.cisco.local
Server:         127.0.0.1
Address:        127.0.0.1#53

Name:   hdfs.isic.hadoop.cisco.local
Address: 10.0.11.17

[root@admin-vm ~]#
```

The above step confirms that, the DNS lookup delegation is working correctly for the "isic.hadoop.cisco.local" sub-domain; and the Isilon OneFS SmartConnect Dynamic IP-allocation is working as provisioned.

Create an NFS export on OneFS for MapReduce Shuffle

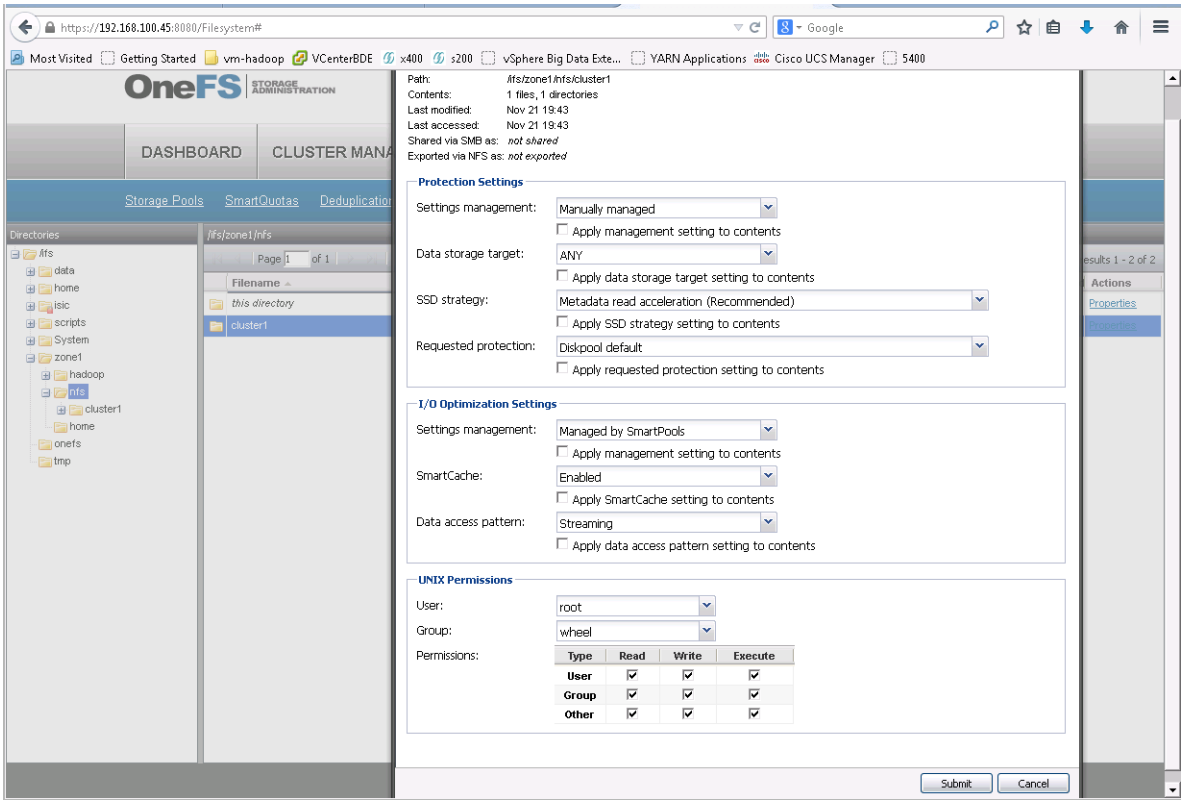
This section describes the procedure to create an NFS export on the Isilon Cluster via OneFS WebUI, and make it available to the Hadoop Cluster. We will be re-using the same SmartConnect IP-pool that was created in the previous section. This NFS export will be used by the Hadoop-VMs as a temporary space for the MapReduce shuffle operations.

1. Log onto the OneFS Web-UI as user "admin" or "root".
2. Click the **File System** tab and click the menu item **File System Explorer**.
3. Create the following set of directories under "/ifs/zone1".
   a. Select the "zone1" in the navigating pane, and click **Add Directory** to create a directory "nfs" under "/ifs/zone1".

b. Select the “nfs” in the navigating pane; then create a directory “cluster1” under “/ifs/zone1/nfs” by clicking the **Add Directory**.

4. Now click on the properties hyperlink on the directory entry “cluster1”.
5. At the bottom of the properties dialog box, in the section “UNIX Permissions”, check all the boxes to enable the “root” user with complete “Read”, “Write”, “Execute” privileges.
6. Click **Submit** to complete the settings.

Figure 283 Create the NFS Directories and Setup Permissions



7. Click the **Protocols** tab, and select the Unix Sharing (NFS) menu.
8. Click on the Current Access Zone drop-down list and select the new zone that we created in the previous section as “zone1”
9. At the right hand side of this page, click + **Add an NFS Export**.
10. In the fields Clients, Allow Read-Write Clients, and Root clients enter the HDFS-IP subnet i.e. 10.0.11.0/24.
11. In Directory Paths field enter the path to the directory that we created above i.e. /ifs/zone1/nfs/cluster1.
12. Check the checkbox **Enable mount access to subdirectories**.
13. Click **Save** to complete the NFS Export configuration.

Figure 284 Create an NFS Export

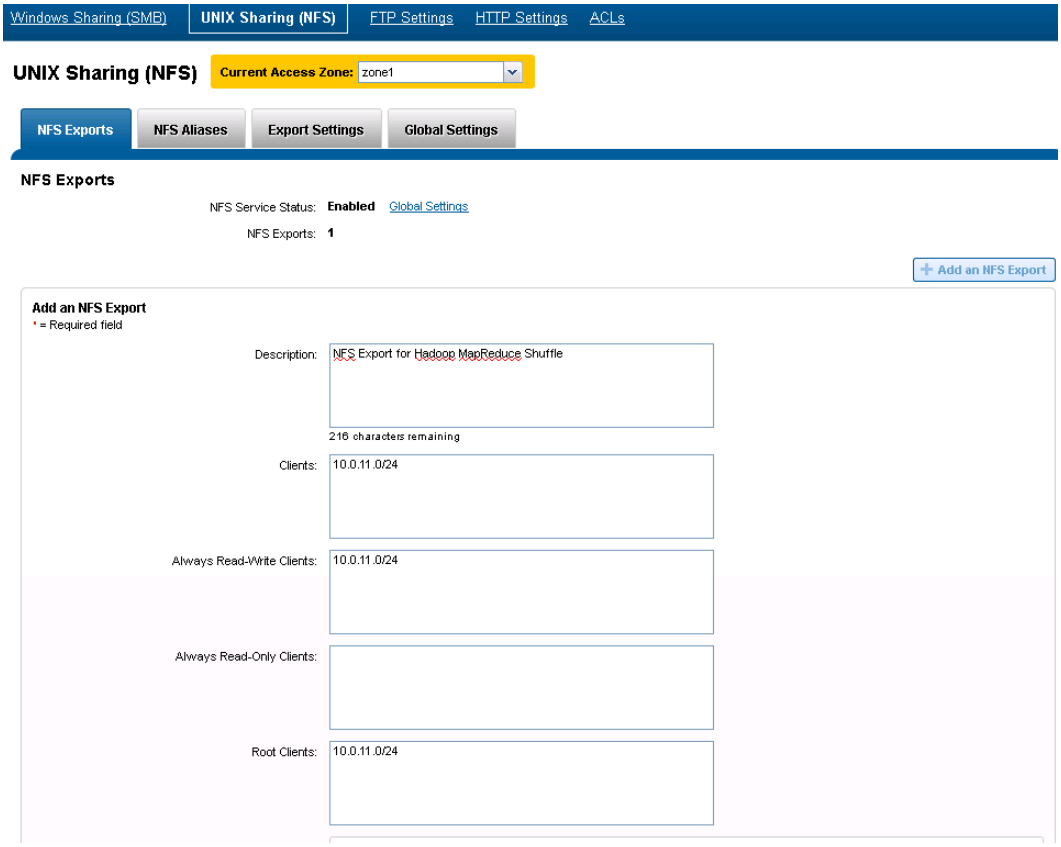


Figure 285 NFS Export in Isilon Zone

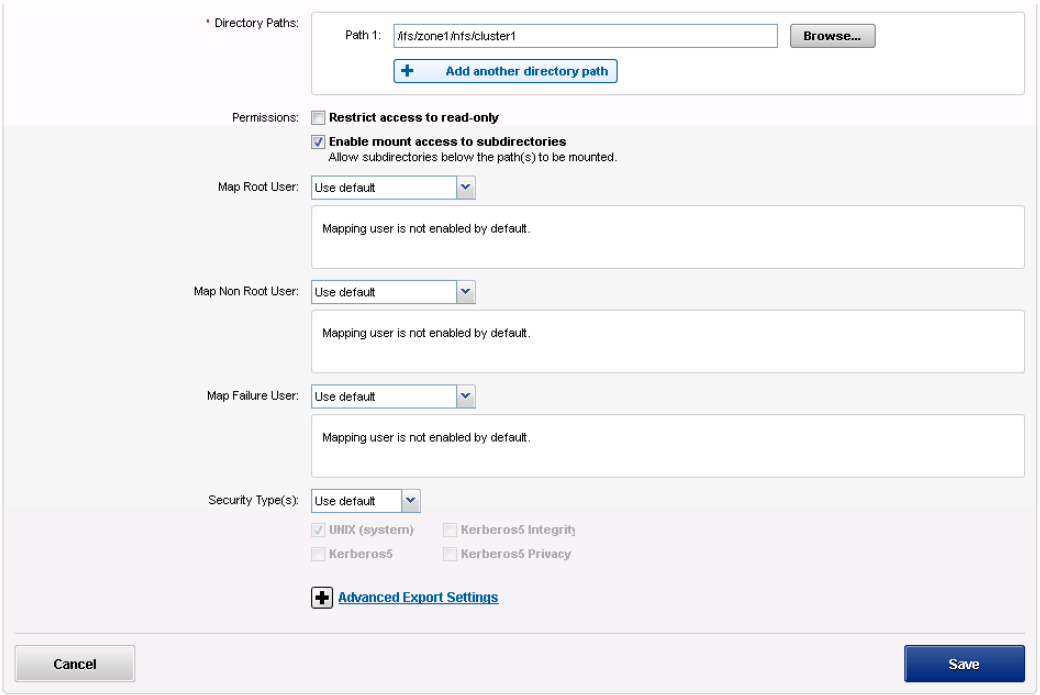
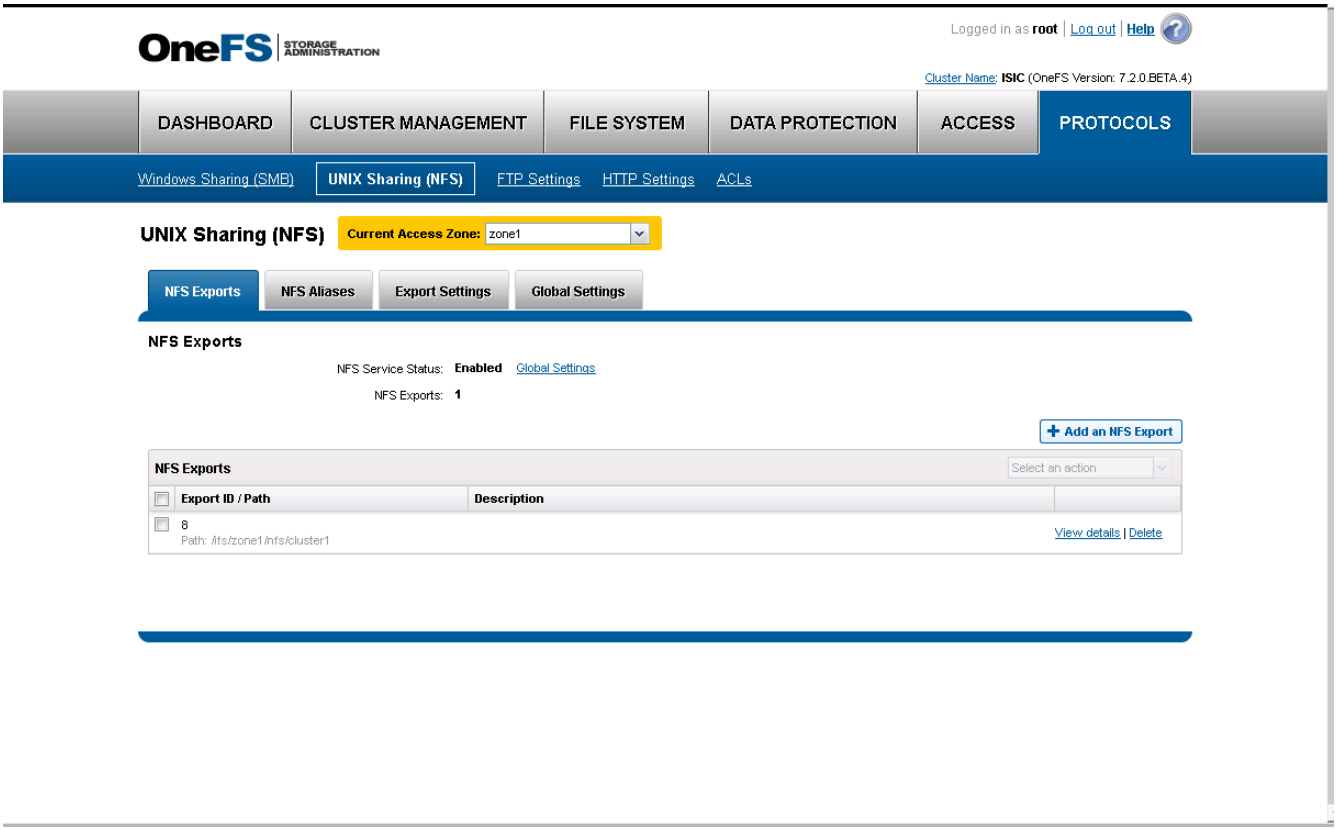


Figure 286 Created NFS Export on Isilon



Create a Database Server

This solution makes use of Cloudera Manager for creating a 60-node Hadoop cluster. For any cluster larger than a few nodes, Cloudera Manager requires an external database server for managing number of its databases.

For this, we will create a new VM on the Admin DRS cluster. We will install RHEL6.4 and install and configure MySQL or PostgreSQL DB.

Required Databases

The Cloudera Manager Server, Activity Monitor, Reports Manager, Hive Metastore, Sentry Server, Cloudera Navigator Audit Server, and Cloudera Navigator Metadata Server all require databases. The type of data contained in the databases and their estimated sizes are as follows:

- Cloudera Manager - Contains all the information about services you have configured and their role assignments, all configuration history, commands, users, and running processes. This relatively small database (<100 MB) is the most important to back up.
- Activity Monitor - Contains information about past activities. In large clusters, this database can grow large. Configuring an Activity Monitor database is only necessary if a MapReduce service is deployed.
- Reports Manager - Tracks disk utilization and processing activities over time. Medium-sized.
- Hive Metastore - Contains Hive metadata. Relatively small.

- Sentry Server - Contains authorization metadata. Relatively small.
- Cloudera Navigator Audit Server - Contains auditing information. In large clusters, this database can grow large.
- Cloudera Navigator Metadata Server - Contains authorization, policies, and audit report metadata. Relatively small.

Create a new VM

1. Create a new VM in the Admin DRS cluster (on 192.168.100.21) with the following characteristics.

   NAME: CMDB

   Guest OS: RHEL6.4

   CPU: 4 or 8

   Memory: 64 GB

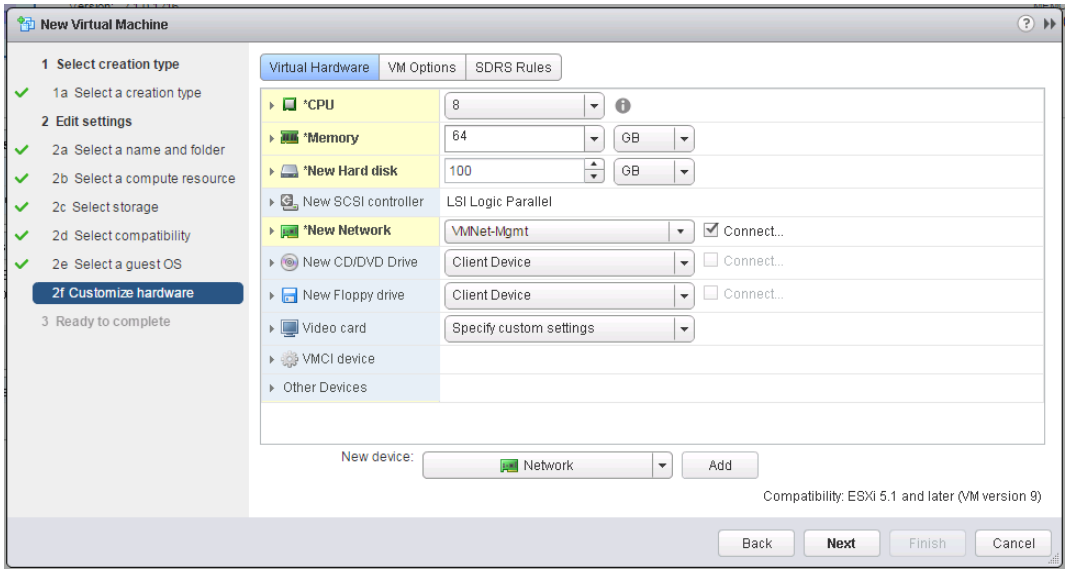
   Hard Disk: 100 GB

   SCSI Controller: LSI Logic Parallel

   CD/DVD

   Network Card 1: VMNet-Mgmt

Figure 287 Create New VM



2. Configure the network interface eth0 with the IP address 192.168.100.90.
3. Set the hostname as “cmdb.hadoop.cisco.local” by editing the “/etc/sysconfig/network” file.

Follow the documentation on Cloudera’s website for installing the PostgreSQL or MySQL database services:
http://www.cloudera.com/content/cloudera/en/documentation/core/v5-2-x/topics/cm_ig_extrnl_pstgrs.html

(or)
http://www.cloudera.com/content/cloudera/en/documentation/core/v5-2-x/topics/cm_ig_mysql.html

Configuring the External Database

The database that we just created in this section needs to be configured with the script from the Cloudera-Manager VM. Since, the Cloudera Manager will be installed in the next section, the preparation steps are performed as a part of bringing up Cloudera Manager. See "Preparing Cloudera Manager Server External Database" section on page 252.

Building a Virtualized Hadoop Cluster

In this section we will discuss how to go about creating a 60-node (4 VMs per blade server) VM Cluster using the Big Data Extensions and subsequently use Cloudera Manager to provision Hadoop as a two-step process.

First, we will create the 60 VM Cluster each with 8 vCPUs, 74 GB of storage(64 from VM Template) and 60 GB of memory using the Big Data Extensions plugin via the vSphere Web Client. Once the VMs have been created, we will use the Cloudera Manager to provision the 60-Node Hadoop cluster and configure it to make use of the Isilon services for HDFS. We will also make use of the NFS export on Isilon as YARN(MR2) intermediate file storage space.

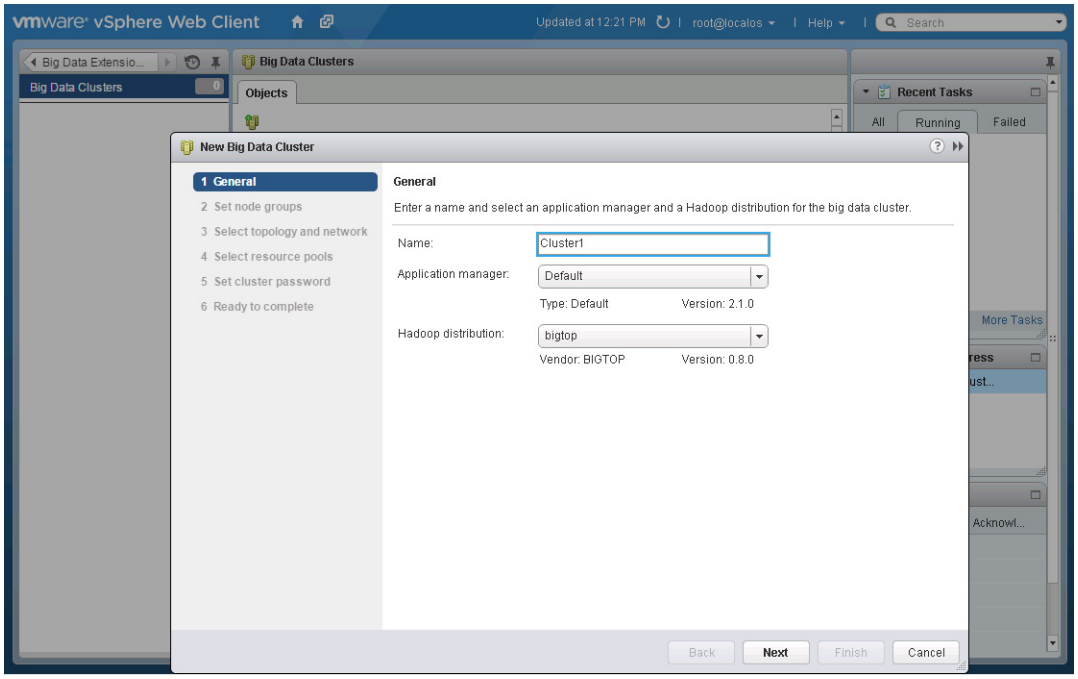
Creating VM Cluster using BDE

Basic VM Cluster Creation using vSphere Big Data Extensions

1. Log onto the vCenter by using the vSphere Web Client and navigate to the Big-Data Extensions Plugin.
2. Click + under **Objects** to open the "Create New Big Data Cluster" dialog.
3. Enter a Name for the Cluster.
4. Leave the Application Manager as Default.
5. Ignore the Hadoop distribution field.
6. Click **Next** to continue.

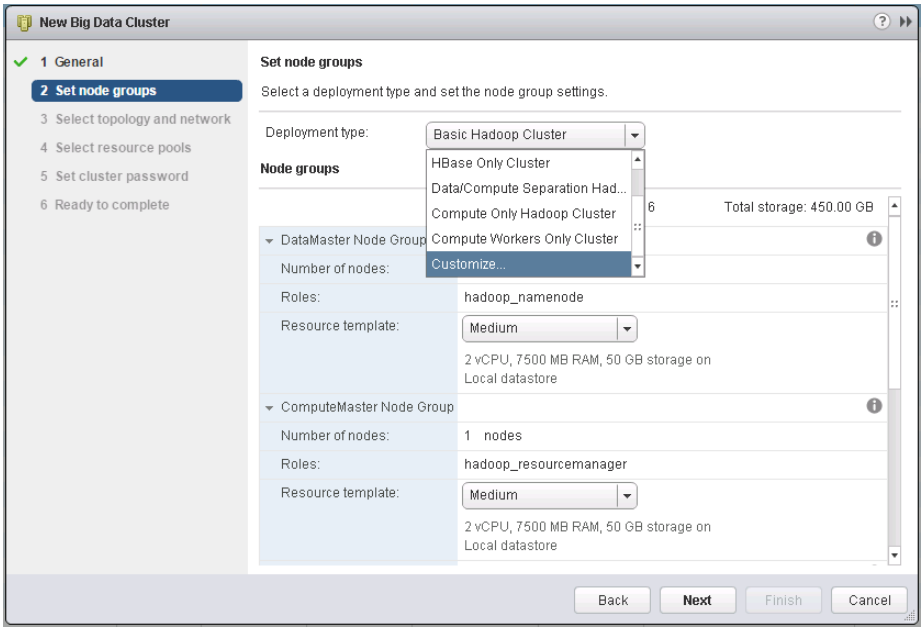
Note This is because; at first, we will be creating only a basic VM cluster without Hadoop.

Figure 288 VM Cluster Creation with Basic Services



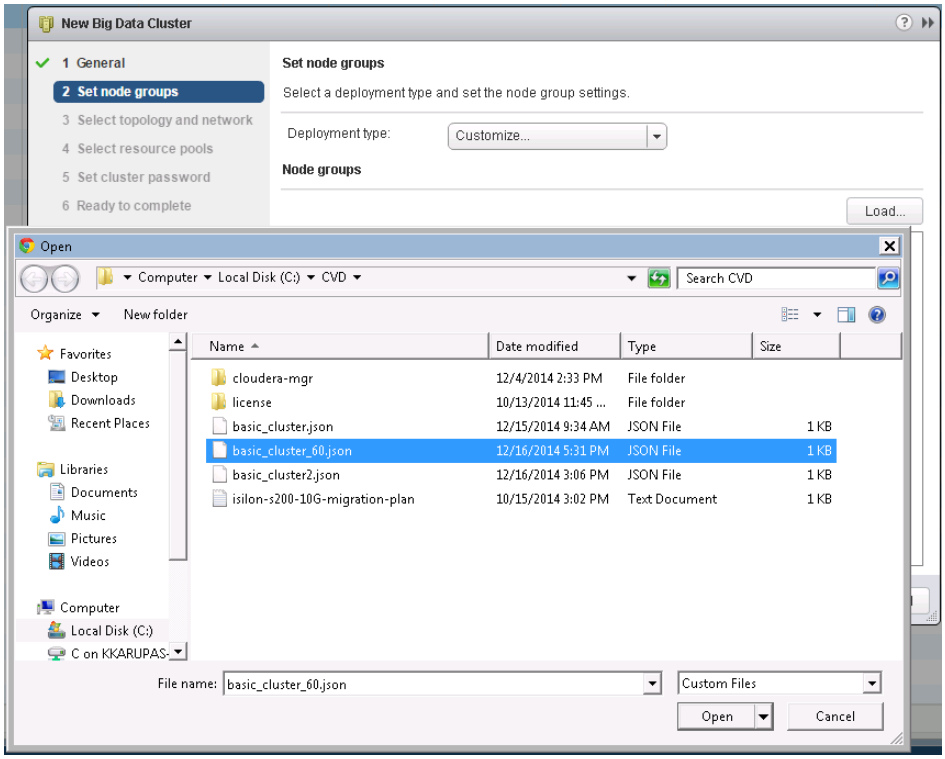
7. In the next screen, click on the Deployment Type drop-down box and select "Customize…" option as shown below.

Figure 289 Customizing the Deployment Type



8. Click **Load** and using the dialog box, select the "basic_cluster_60.json" file, and click **Open**.

Figure 290 Using the Basic VM Cluster Specification File



The content of the cluster specification file "basic_cluster_60.json" is given below for reference. All the VMs will be created with just the "basic" server roles. Please note that, in this solution, we do not differentiate between the nodeGroup "master" v/s "worker". All the 60 VMs are configured with identical parameters. Since the datastore is kept on the local hard drives of the blade servers, we set the "haFlag" to "off" state. For more information on the cluster specifications, please refer to the VMWare's documentation at http://pubs.vmware.com/bde-2/index.jsp#com.vmware.bigdataextensions.commandline.doc/GUID-3E6A391A-85DB-4771-94D6-1CFCDC469380.html.

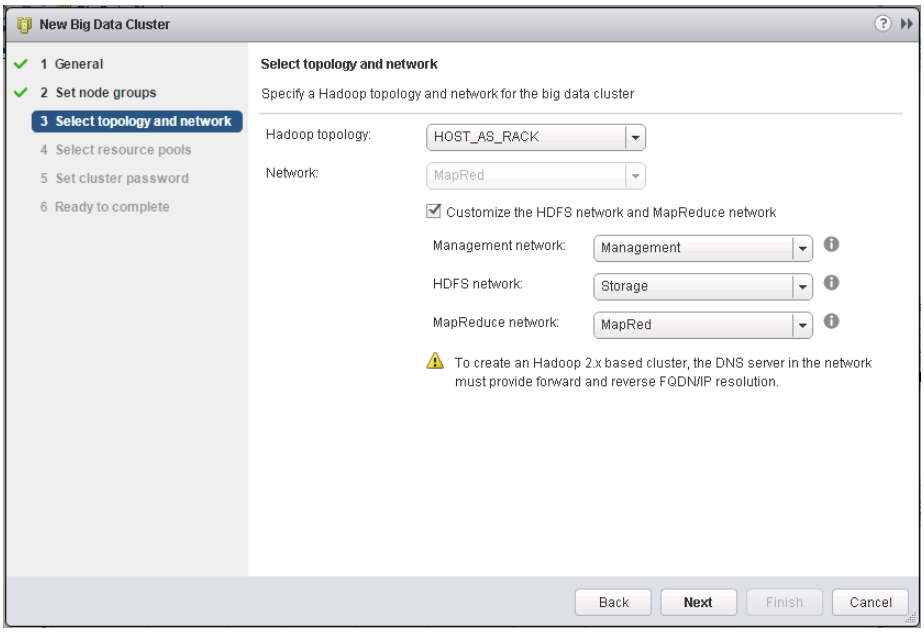
basic_cluster_60.json file contains the specification for the VMs

```
{
  "nodeGroups":[
    {
      "name": "master",
      "roles": [
      "basic"
      ],
      "instanceNum": 1,
      "cpuNum": 8,
      "memCapacityMB": 61440,
      "storage": {
        "type": "LOCAL",
        "sizeGB": 10
      },
      "haFlag": "off"
    },
    {
      "name": "worker",
      "roles": [
      "basic"
      ],
```

```
      "instanceNum": 59,
      "cpuNum": 8,
      "memCapacityMB": 61440,
      "storage": {
        "type": "LOCAL",
        "sizeGB": 10
      },
      "haFlag": "off"
    }
  ]
}
```

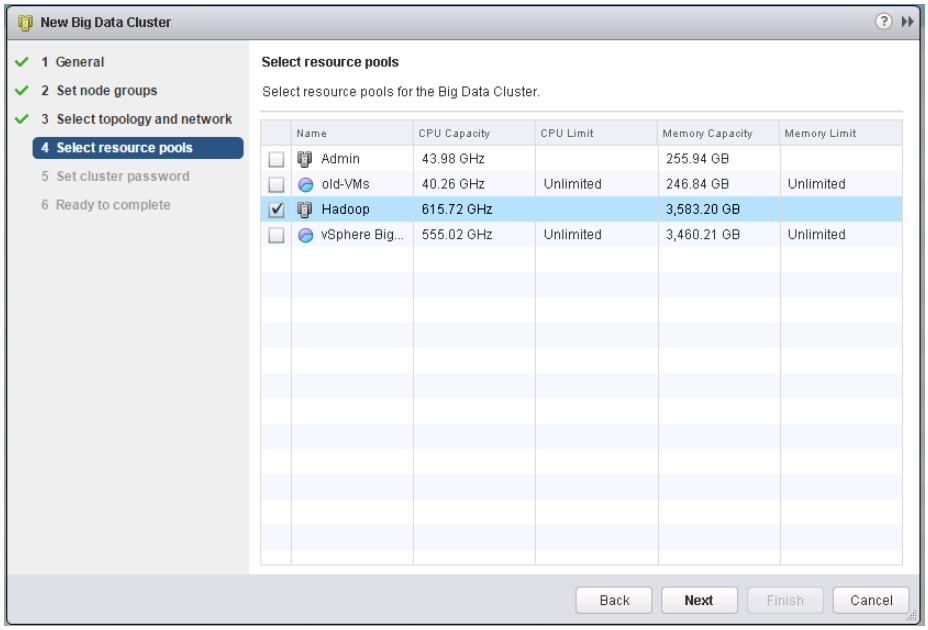
9. Click **Next** to continue.
10. In the next screen, Leave the Hadoop topology at its default HOST_AS_RACK
11. Check the **Customize HDFS network and MapReduce network** check box.
12. In the Management network drop-down box, select Management.
13. In the HDFS network select Storage.
14. In the MapReduce network select MapRed.
15. Click **Next** to Continue.

Figure 291 Create Big Data Cluster: Select Topology and Network



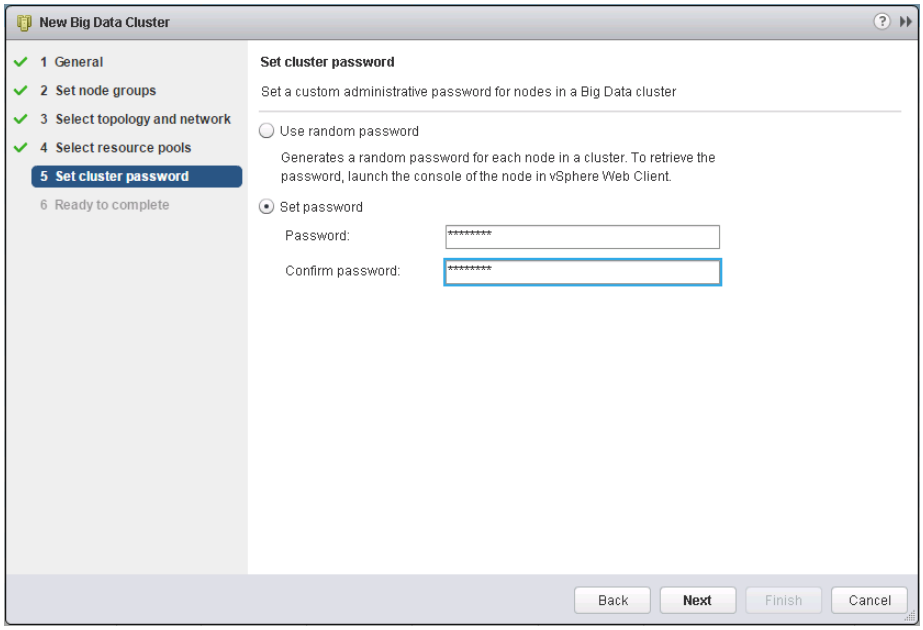
16. Check the check box against **Hadoop** for selecting resource pools for big data cluster.
17. Click **Next** to continue.

Figure 292 Create Big Data Cluster: Select Resource Pools



18. Click on the Set password radio-button and an appropriate password for the cluster nodes.
19. Click **Next** to continue.

Figure 293 Create Big Data Cluster: Set Cluster Password



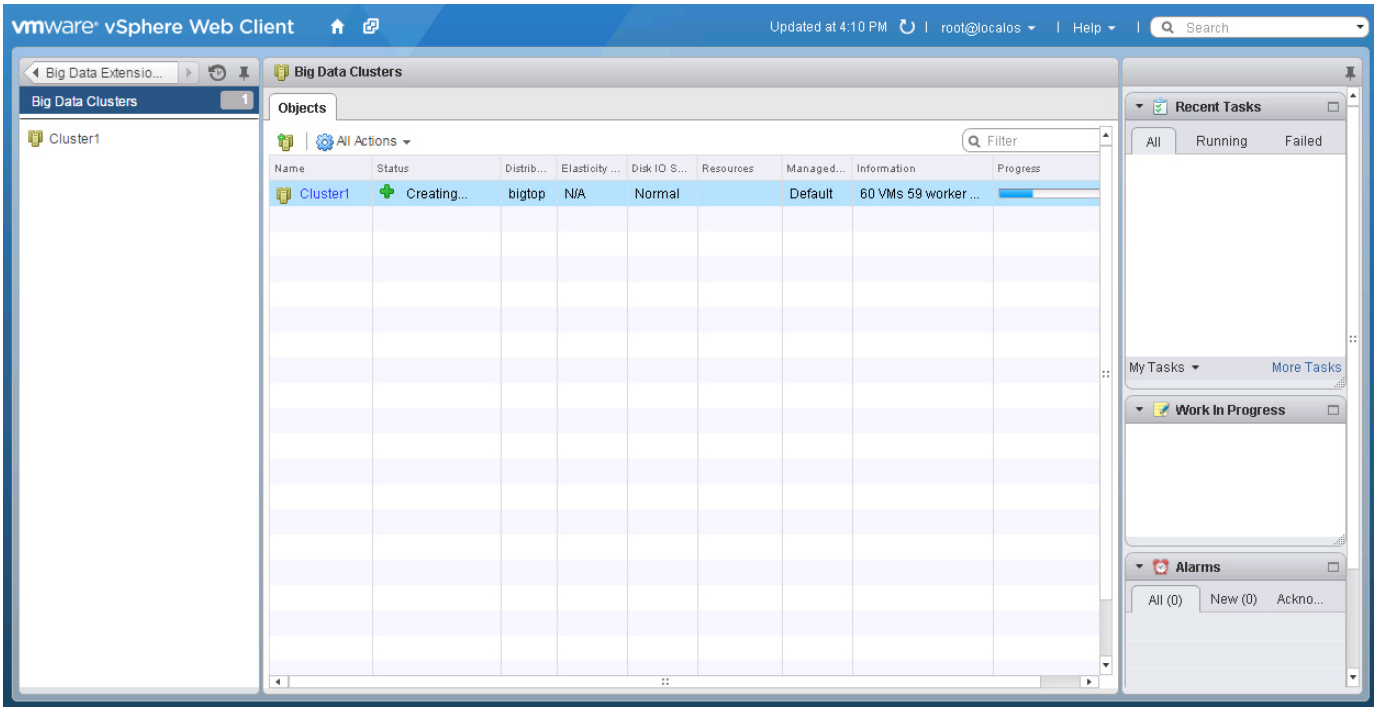
Note If the password is not set, each one of the Hadoop-VMs will get a randomly assigned password that can be obtained only by accessing its VM-Console via vSphere client.

20. In the next screen, verify the settings and click <Finish> to initiate the cluster creation.

Note If BDE reports shortage of resources for creating the 60 VMs, modify the cluster specification file to create 3 VMs per physical compute blade to start with, i.e. 45 VMs (1 Master + 44 Workers) and then use the BDE's Scale-Out function to grow number of workers from 44 to 59 VMs, thus creating the 60 VM cluster.

21. Once the Big Data Cluster begins, you will see the following screen with the progress bar.

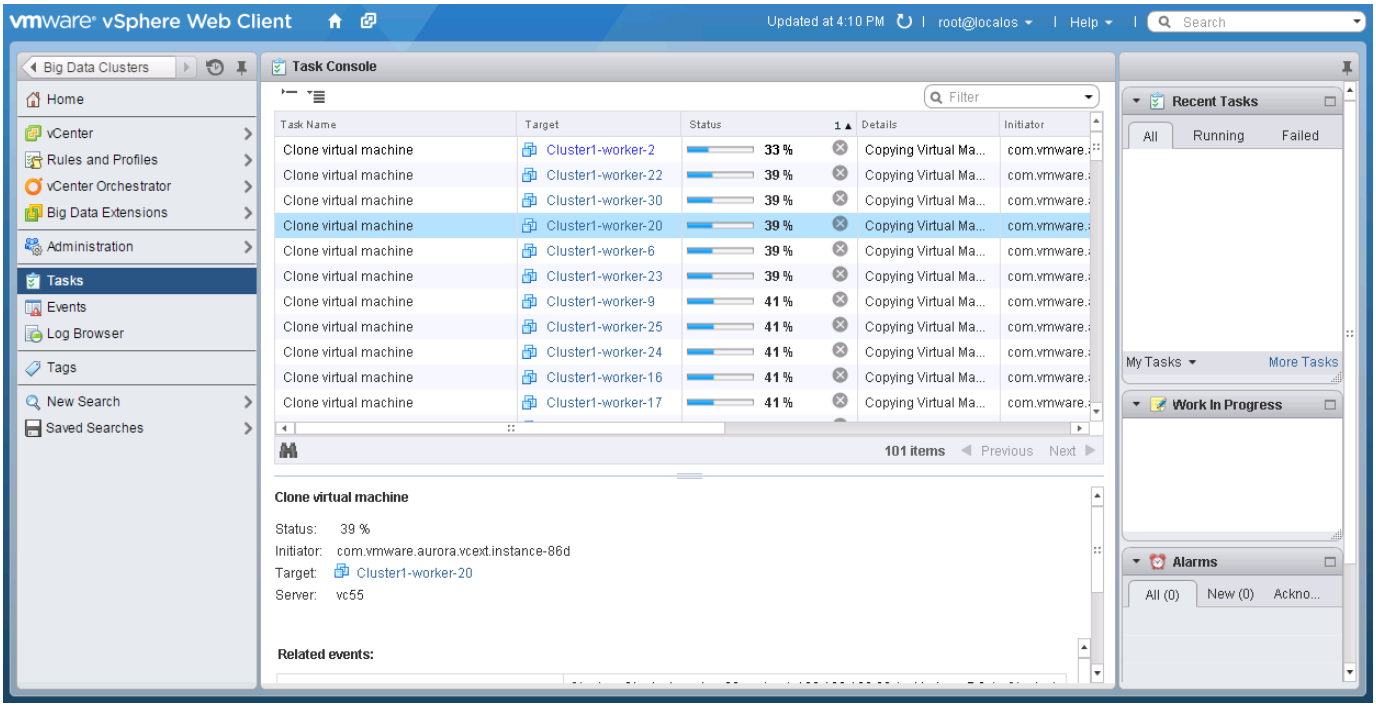
Figure 294 Big Data Cluster Creation in Progress



Note

- The detailed status of the individual VMs could be seen by clicking on the link Cluster1.
- The actual VM cloning process can be monitored by clicking on the "More Tasks" link in the Recent Tasks pane at the right hand side.

Figure 295 Cloning in Progress



The VMs are created evenly across all the 15 servers of the Hadoop DRS cluster. The BDE makes the replication process faster by cloning the VMs recursively as shown above. Once the cluster creation is complete, the "Status" field will change to Running, and the status of individual VMs will be "Service Ready" as shown below.

Figure 296 VM Cluster Creation Compete

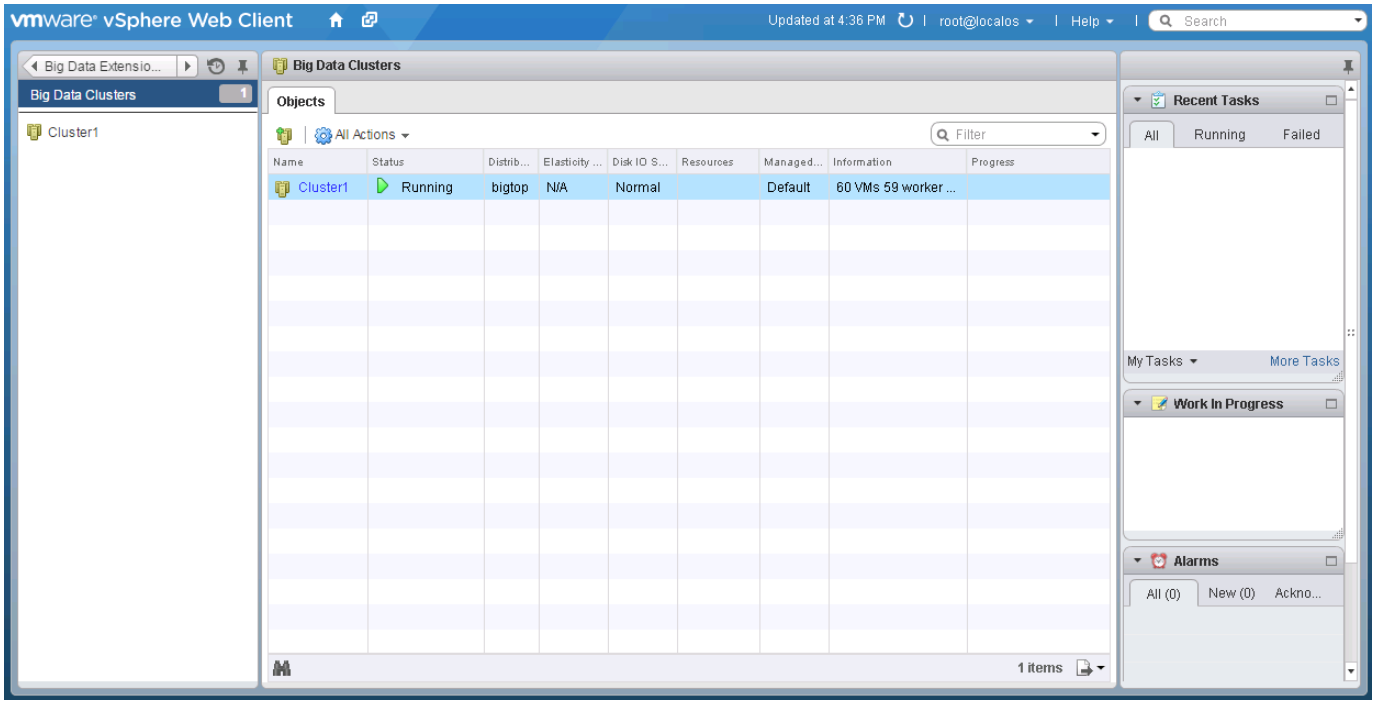
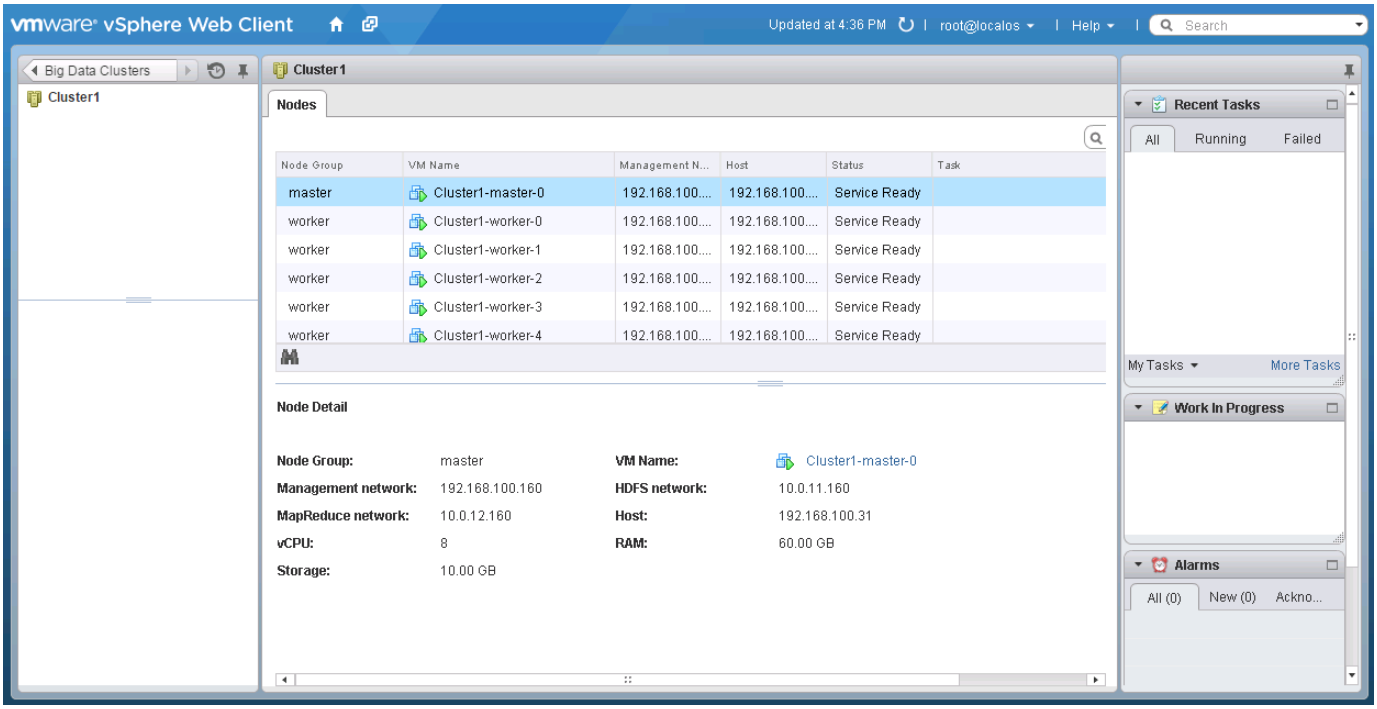


Figure 297 VM Cluster Ready: Showing Master VM's Resource Details



Make a note of the master node's IP-addresses. In this particular case, the master node's IP addresses are as follows:

Table 16 Master Node IP Addresses

Network Name	IP Address
Management network	192.168.100.160
HDFS network	10.0.11.160
MapReduce network	10.0.12.160

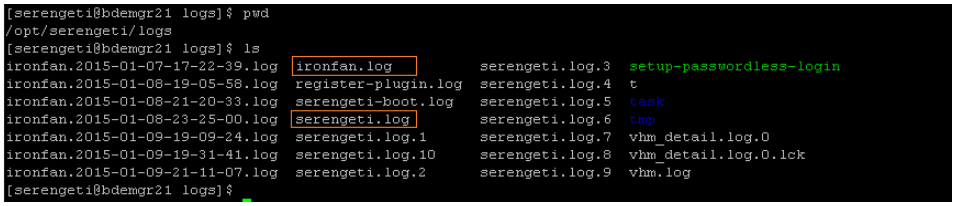
We will be using these IP-addresses to prepare the VM cluster for deploying the Cloudera Hadoop cluster.

Monitoring the Cluster Creation Process from the BDE management-server

The cluster creation process could be monitored by looking at the tasks ongoing in the vCenter Server. The Big-Data-Extensions activities can be viewed by monitoring the logs in the Serengeti Management server of the Big Data Extension vApp.

1. Open a SSH session to “management server”.
2. Change the directory to “/opt/serengeti/logs”.
3. List the directory.

Figure 298 Serengeti (BDE) Log Files in the BDE management-server



4. The highlighted files are of interest for Big-Data cluster creation and management.
5. The file “serengeti.log” contains the infrastructure creation such as the cloning of the template VM into the “Worker” or the “Compute-Master” nodes.
6. Once the infrastructure has been created, the Chef-framework is used to perform the actual service provisioning. This activity can be monitored by looking into the file ironfan.log.

   The following figure shows sample Serengeti log by monitoring the contents of the file “/opt/serengeti/logs/serengeti.log” in the BDE management-server VM.

Figure 299 Monitoring the Cluster Creation by Monitoring serengeti.log File

```
[serengeti@bdemgr21 serengeti]$ tail -f /opt/serengeti/logs/serengeti.log
[2015-01-13T20:33:02.617+0000] INFO  VcEventListener| com.vmware.aurora.vc.VcTaskMgr: task: ManagedObjectReference: type = T
ask, value = task-24656, serverGuid = null progress: 26
[2015-01-13T20:33:02.672+0000] INFO  VcEventListener| com.vmware.aurora.vc.VcTaskMgr: task: ManagedObjectReference: type = T
ask, value = task-24656, serverGuid = null progress: 27
[2015-01-13T20:33:02.872+0000] INFO  VcEventListener| com.vmware.aurora.vc.VcTaskMgr: task: ManagedObjectReference: type = T
ask, value = task-24656, serverGuid = null progress: 30
[2015-01-13T20:33:03.142+0000] INFO  VcEventListener| com.vmware.aurora.vc.VcTaskMgr: task: ManagedObjectReference: type = T
ask, value = task-24656, serverGuid = null progress: 33
[2015-01-13T20:34:17.153+0000] INFO  VcEventListener| com.vmware.aurora.vc.VcTaskMgr: task: ManagedObjectReference: type = T
ask, value = task-24656, serverGuid = null progress: 34
[2015-01-13T20:34:44.286+0000] INFO  VcEventListener| com.vmware.aurora.vc.VcTaskMgr: task: ManagedObjectReference: type = T
ask, value = task-24656, serverGuid = null progress: 35
[2015-01-13T20:34:56.423+0000] INFO  VcEventListener| com.vmware.aurora.vc.VcTaskMgr: task: ManagedObjectReference: type = T
ask, value = task-24656, serverGuid = null progress: 36
[2015-01-13T20:35:27.173+0000] INFO  VcEventListener| com.vmware.aurora.vc.VcTaskMgr: task: ManagedObjectReference: type = T
ask, value = task-24656, serverGuid = null progress: 37
[2015-01-13T20:35:57.180+0000] INFO  VcEventListener| com.vmware.aurora.vc.VcTaskMgr: task: ManagedObjectReference: type = T
ask, value = task-24656, serverGuid = null progress: 38
[2015-01-13T20:36:34.912+0000] INFO  VcEventListener| com.vmware.aurora.vc.VcTaskMgr: task: ManagedObjectReference: type = T
ask, value = task-24656, serverGuid = null progress: 39
```

7. Once the VM creation is complete and IP-address gets assigned, the BDE will invoke the chef-client to finalize the VM configurations such as password-less login etc. This process can be observed by viewing the log file "/opt/serengeti/logs/ironfan.log".

Figure 300 Ironfan.log Sample Output

```
[serengeti@bdemgr21 logs]$ tail -f /opt/serengeti/logs/ironfan.log
  | Cluster1-worker-53 |            | VM Ready |        |       | 192.168.100.154 | 192.168.100.154 |            | -           |
  | Cluster1-worker-54 |            | VM Ready |        |       | 192.168.100.155 | 192.168.100.155 |            | -           |
  | Cluster1-worker-55 |            | VM Ready |        |       | 192.168.100.156 | 192.168.100.156 |            | -           |
  | Cluster1-worker-56 |            | VM Ready |        |       | 192.168.100.157 | 192.168.100.157 |            | -           |
  | Cluster1-worker-57 |            | VM Ready |        |       | 192.168.100.158 | 192.168.100.158 |            | -           |
  | Cluster1-worker-58 |            | VM Ready |        |       | 192.168.100.159 | 192.168.100.159 |            | -           |
  +--------------------+------------+----------+--------+-------+-----------------+-----------------+------------+-------------+
[2015-01-14T00:29:39.404+0000] INFO: ============= Ironfan Knife CLI exited with status code 0 =============
[2015-01-14T00:29:39.405+0000] DEBUG: get operation progress for cluster Cluster1 ...
[2015-01-14T00:29:39.734+0000] DEBUG: progress: <Software::Mgmt::Thrift::OperationStatus finished:true, succeed:true, progress:100,
total:60, success:60, failure:0, running:0>
```

Post BDE Cluster Configurations

Although VMWare BDE is designed to provision the complete Big Data cluster, in this solution we use BDE only for managing the bare VM cluster. Subsequently we make use of Cloudera Manager to provision the Hadoop cluster. By following this method we get the benefits of both the software components.

In this section we will walk through the procedure to create Password-less login for the root-user and install the post-BDE provisioning scripts that perform the following:

1. Disable REDHAT transparent huge pages.
2. Disable Defrag.
3. Set VM Swappiness value to 0.
4. Mount a host specific directory on Isilon NFS. This directory will be used by YARN.
5. Change the hostname of individual VMs to be same as the FQDN that's mapped to the IP address in the MapRed Subnet. The HOSTNAME parameter each VM's "/etc/host/network" file is configured with the FQDN of the Management network (i.e. rhel101-m.hadoop.cisco.com). The script we create in this section will modify the HOSTNAME to point to the FQDN of the IP (i.e. rhel101.hadoop.cisco.com) in the MapRed Network (which is used by Cloudera manager to provision the cluster).

Setup Password-less Login

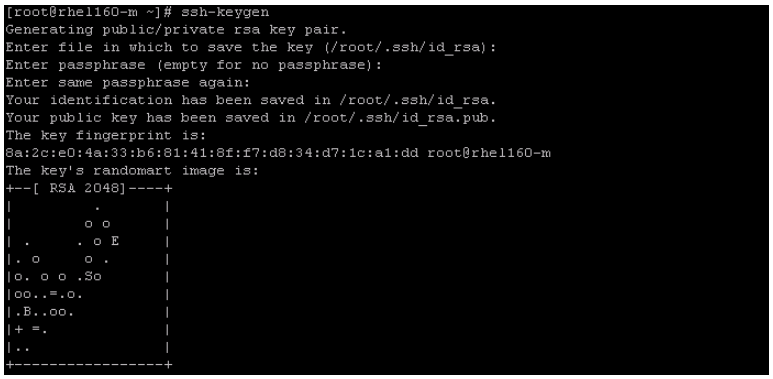
1. Using SSH onto the Compute-Master VM as the user root, and enter the ifconfig command as follows:

   ```
   ssh 192.168.100.160
   ```

2. Generate the RSA public and private keys using the ssh-keygen command.

   ```
   ssh-keygen
   ```

Figure 301 SSH Key Generation

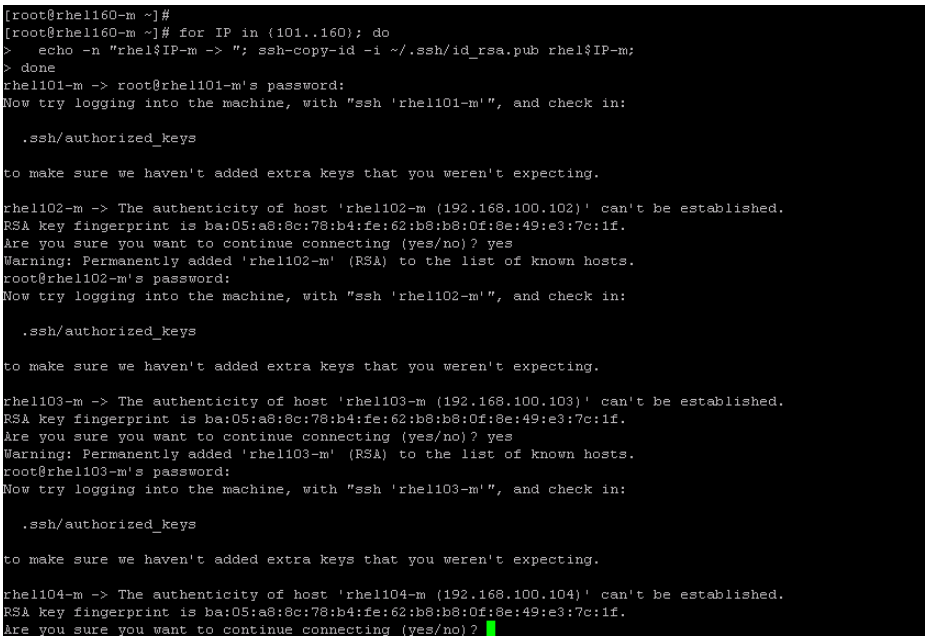


3. Run the following script from the Master node to copy the public key id_rsa.pub to all the nodes of the cluster. ssh-copy-id appends the keys to the remote-host's .ssh/authorized_key.

   ```
   for IP in {101..160}; do
     echo -n "rhel$IP-m -> "; ssh-copy-id -i ~/.ssh/id_rsa.pub rhel$IP-m;
   done
   ```

4. Enter yes for Are you sure you want to continue connecting (yes/no)?
5. Enter the root password of the cluster.

Figure 302 Copy Over the public-key to all the VMs



Note The steps 4 and 5 will be repeated for 60 times.

Installing and Configuring the Parallel SSH Shell

Parallel SSH is used to run commands on several hosts at the same time. It takes a file of hostnames and a bunch of common SSH parameters, and executes the given command in parallel on the nodes specified.

1. From the system that is connected to the Internet, download pssh.

   ```
   wget https://parallel-ssh.googlecode.com/files/pssh-2.3.1.tar.gz
   ```

Figure 303 Download Parallel SSH

2. Copy over the file pssh-2.3.1.tar.gz to the master node (i.e. 192.168.100.108).
3. Extract the contents of the file, and install pssh using the below commands.

   ```
   tar zxf pssh-2.3.1.tar.gz
   cd pss-2.3.1
   python setup.py install
   ```

Figure 304 Installing Parallel SSH

```
[root@rhel160-m ~]# tar zxf pssh-2.3.1.tar.gz
[root@rhel160-m ~]# cd pssh-2.3.1
[root@rhel160-m pssh-2.3.1]# python setup.py install
running install
running build
running build_py
creating build
creating build/lib
creating build/lib/psshlib
copying psshlib/cli.py -> build/lib/psshlib
copying psshlib/version.py -> build/lib/psshlib
copying psshlib/psshutil.py -> build/lib/psshlib
copying psshlib/manager.py -> build/lib/psshlib
copying psshlib/askpass_client.py -> build/lib/psshlib
copying psshlib/task.py -> build/lib/psshlib
copying psshlib/askpass_server.py -> build/lib/psshlib
copying psshlib/__init__.py -> build/lib/psshlib
copying psshlib/color.py -> build/lib/psshlib
running build_scripts
creating build/scripts-2.6
copying and adjusting bin/pssh -> build/scripts-2.6
copying and adjusting bin/pnuke -> build/scripts-2.6
copying and adjusting bin/prsync -> build/scripts-2.6
copying and adjusting bin/pslurp -> build/scripts-2.6
copying and adjusting bin/pscp -> build/scripts-2.6
copying and adjusting bin/pssh-askpass -> build/scripts-2.6
changing mode of build/scripts-2.6/pssh from 644 to 755
changing mode of build/scripts-2.6/pnuke from 644 to 755
changing mode of build/scripts-2.6/prsync from 644 to 755
changing mode of build/scripts-2.6/pslurp from 644 to 755
changing mode of build/scripts-2.6/pscp from 644 to 755
changing mode of build/scripts-2.6/pssh-askpass from 644 to 755
running install_lib
```

4. Create a text file containing the list of Worker hosts of the VM Cluster. In the above example, the IP address of the Master node is 192.168.100.160. And the Worker VMs have their IPs assigned from [192.168.100–101–159].

```
vi /root/worker-nodes
# This file contains ip address of all nodes of the cluster
#used by parallel-shell (pssh). For Details man pssh

192.168.100.101
192.168.100.102
192.168.100.103
192.168.100.104
192.168.100.105
192.168.100.106
192.168.100.107
192.168.100.108
192.168.100.109
192.168.100.110
192.168.100.111
192.168.100.112
192.168.100.113
192.168.100.114
…
192.168.100.153
192.168.100.154
192.168.100.155
192.168.100.156
192.168.100.157
192.168.100.158
192.168.100.159
```

Note Here we are using the IP addresses that belong to the Management Network. The same can be accomplished by using the IP addresses of the other networks as well.

5. Create a text file named as “all-nodes” containing the list of IP addresses of all the VMs of this VM cluster (Master VM + all Worker VMs). Thus, the IP address list would contain one IP per line in the range from 192.168.100.101 to 192.168.100.160].

Installing Cluster Shell

1. From the system connected to the Internet download Cluster shell (clush) and install it on rhel1. Cluster shell is available from EPEL (Extra Packages for EnterpriseLinux) repository.

```
wget http://dl.fedoraproject.org/pub/epel//6/x86_64/clustershell-1.6-1.el6.noarch.rpm
scp clustershell-1.6-1.el6.noarch.rpm rhel160:/root/
```

2. Log onto the master VM i.e. 192.168.100.160 (or) rhel160 to install cluster-shell.

```
rpm -ivh /root/ clustershell-1.6-1.el6.noarch.rpm
```

3. Edit /etc/clustershell/groups file to include hostnames for all the nodes of the cluster. In this solution we have 60VMs, so add the following entries to it.

```
all: rhel[101-160]-m
workers: rhel[101-159]-m
```

Setup /etc/rc.local Init Script for Initializing the Node with for Hadoop Use

From the previous section take a note of the Mgmt-IP address of the Compute-Master VM.

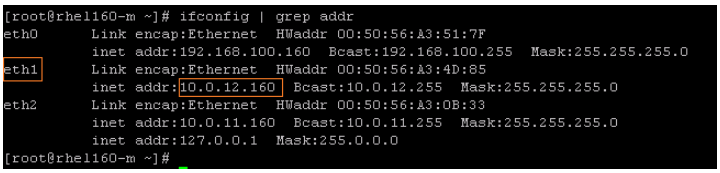
1. Using SSH log onto the Master VM as the user root, and enter the ifconfig command as follows:

```
ssh 192.168.100.160
ifconfig | grep addr
```

2. Take a note of the device name that’s associated with the MapReduce subnet i.e. 10.0.12.x.

Note This is necessary because, the VMWare BDE the device assignment to the network resource may be different between BDE clusters.

Figure 305 Identifying the Interface Associated with the MapReduce Network



3. Create a new directory “/opt/cisco” and create a new file by name “hadoop_node_init.sh” and paste the following contents.

```
#!/bin/sh
###
### Cisco Hadoop Node Init Script for the VM-cluster provisioned by VMWare BDE 2.1
###
## Disable RedHat Transparent Huge-Pages and Defrag flags.
## Set the vm.swappiness to 0.
echo never > /sys/kernel/mm/redhat_transparent_hugepage/enabled
echo never > /sys/kernel/mm/redhat_transparent_hugepage/defrag
sysctl -w vm.swappiness=0

## Update the hostname to reflect the DNS name of the IP of MapRed interface
```

```
## This part of the script is copied from VMWare Big Data Extensions 2.1
##  Administrator's and User's Guide - Page 125
##
## Please make sure that the NIC device name "eth1" below is the one
##  that's associated with the MapReduce Network. If not, change that
##  parameter appropriately to eth0 or eth2.
sleep 30
ETHIP=`/sbin/ifconfig eth1 | grep "inet addr" | awk '{print $2}' | sed 's/addr://'`
FQDN=$ETHIP
RET=`/bin/ipcalc --silent --hostname $ETHIP`
if [ "$?" = "0" ]; then
FQDN=`echo $RET | awk -F= '{print $2}'`
fi
echo "set hostname to ${FQDN}"
`hostname ${FQDN}`
sed -i s/^HOSTNAME=.*/HOSTNAME="$FQDN"/ /etc/sysconfig/network

## Fix the MTU
## When the BDE used with Static-IPs, it sets MTU value to be 1500 by default.
## In this solution the NICs are capable of Jumbo MTUs.
##
ip link set dev eth0 mtu 9000
ip link set dev eth1 mtu 9000
ip link set dev eth2 mtu 9000

## Mount the Isilon NFS directory
mount -a
ISILON_NFS=/mnt/isilon_nfs
rm -f /DATA/nfs1
mkdir -p $ISILON_NFS/hadoop-local-data/$FQDN
chmod 777 $ISILON_NFS/hadoop-local-data/$FQDN
mkdir –p /DATA
ln -s -f $ISILON_NFS/hadoop-local-data/$FQDN /DATA/nfs1
```

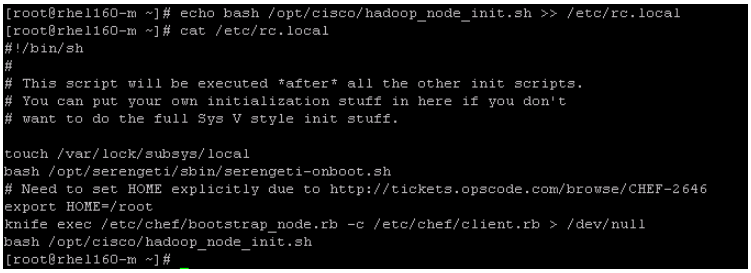
Figure 306 Cisco Hadoop Node Initialization Script

```
#!/bin/sh
###
### Cisco Hadoop Node Init Script for the VM-cluster provisioned by VMWare BDE 2
.1
###
## Disable RedHat Transparent Huge-Pages and Defrag flags.
## Set the vm.swappiness to 0.
echo never > /sys/kernel/mm/redhat_transparent_hugepage/enabled
echo never > /sys/kernel/mm/redhat_transparent_hugepage/defrag
sysctl -w vm.swappiness=0
## Update the hostname to reflect the DNS name of the IP of MapRed interface
## This part of the script is copied from VMWare Big Data Extensions 2.1
## Administrator's and User's Guide - Page 125
##
## Please make sure that the NIC device name "eth1" below is the one
## that's associated with the MapReduce Network. If not, change that
## parameter appropriately to eth0 or eth2.
sleep 30

ETHIP=`/sbin/ifconfig eth1 | grep "inet addr" | awk '{print $2}' | sed 's/addr:/
/'`
FQDN=$ETHIP
RET=`/bin/ipcalc --silent --hostname $ETHIP`
if [ "$?" = "0" ]; then
FQDN=`echo $RET | awk -F= '{print $2}'`
fi
echo "set hostname to ${FQDN}"
`hostname ${FQDN}`
sed -i s/^HOSTNAME=.*/HOSTNAME="$FQDN"/ /etc/sysconfig/network
## Fix the MTU
## When the BDE used with Static-IPs, it sets MTU value to be 1500 by default.
## In this solution the NICs are capable of Jumbo MTUs.
##
ip link set dev eth0 mtu 9000
ip link set dev eth1 mtu 9000
ip link set dev eth2 mtu 9000
## Mount the Isilon NFS directory
mount -a
ISILON_NFS=/mnt/isilon_nfs
rm -f /DATA/nfs1
mkdir -p $ISILON_NFS/hadoop-local-data/$FQDN
chmod 777 $ISILON_NFS/hadoop-local-data/$FQDN
mkdir -p /DATA
ln -s -f $ISILON_NFS/hadoop-local-data/$FQDN /DATA/nfs1
~
~
~
~
~
"hadoop_node_init.sh" line 1 of 42 --2%-- col 1
```

4. Add an entry to the Linux Init-Script "/etc/rc.local" so that, the "hadoop_node_init.sh" script is invoked every time the node gets rebooted.

```
echo bash /opt/cisco/hadoop_node_init.sh >> /etc/rc.local
```

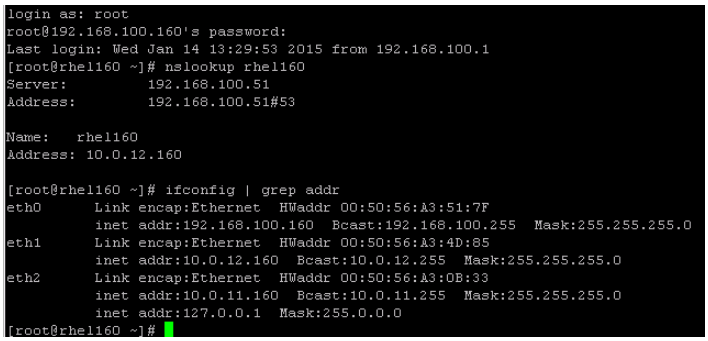
Figure 307 Modify the Script



```
[root@rhel160-m ~]# echo bash /opt/cisco/hadoop_node_init.sh >> /etc/rc.local
[root@rhel160-m ~]# cat /etc/rc.local
#!/bin/sh
#
# This script will be executed *after* all the other init scripts.
# You can put your own initialization stuff in here if you don't
# want to do the full Sys V style init stuff.

touch /var/lock/subsys/local
bash /opt/serengeti/sbin/serengeti-onboot.sh
# Need to set HOME explicitly due to http://tickets.opscode.com/browse/CHEF-2646
export HOME=/root
knife exec /etc/chef/bootstrap_node.rb -c /etc/chef/client.rb > /dev/null
bash /opt/cisco/hadoop_node_init.sh
[root@rhel160-m ~]#
```

5. Reboot the Master VM to apply the configurations. And, log back into the VM using ssh.
6. Verify the hostname after the reboot, it will now use the hostname of the MapReduce (10.0.12.x) network.

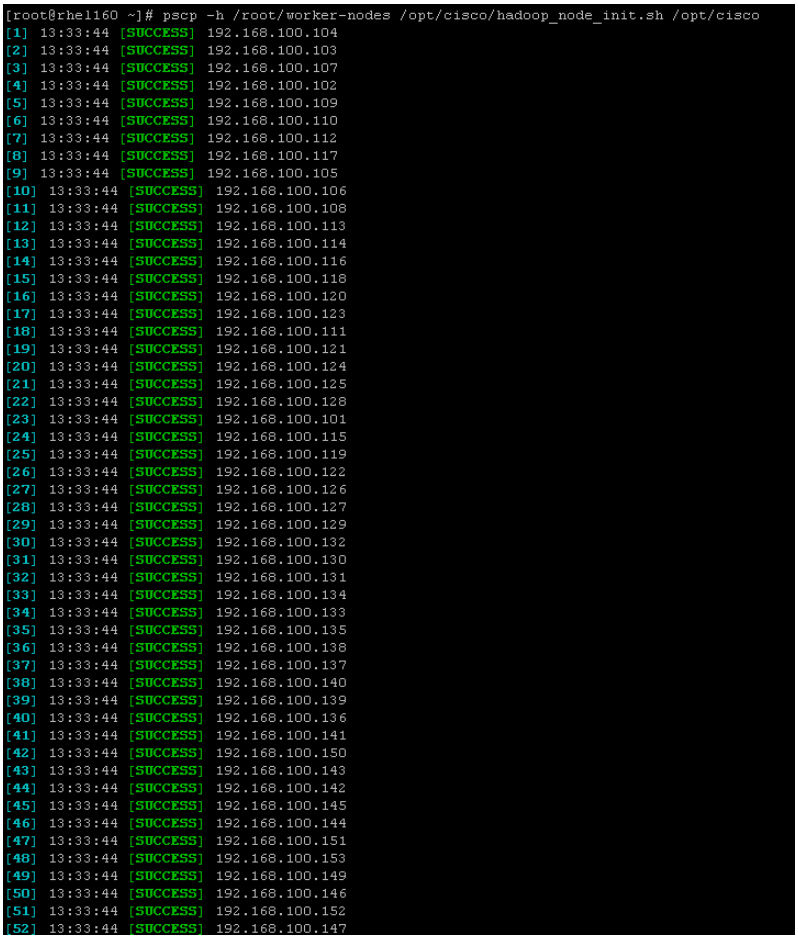
Figure 308 Verify the Hostname of MapReduce Network



7. Now copy over this script onto all the 59 Worker VMs.

```
pssh -h /root/worker-nodes mkdir -p /opt/cisco
pscp -h /root/worker-nodes /opt/cisco/hadoop_node_init.sh /opt/cisco
```

Figure 309 Copy Script Over to all the 59 Worker VMs



8. Invoke the “hadoop_node_init.sh” script on all the 59 worker VMs.

```
pssh -h /root/worker-nodes "echo bash /opt/cisco/hadoop_node_init.sh >> /etc/rc.local
```

9. Verify if the hadoop_node_init.sh script is copied over to all 60 VMs.

```
clush -a -B ls -l /opt/cisco/hadoop_node_init.sh
clush -a -B cat /opt/cisco/hadoop_node_init.sh
```

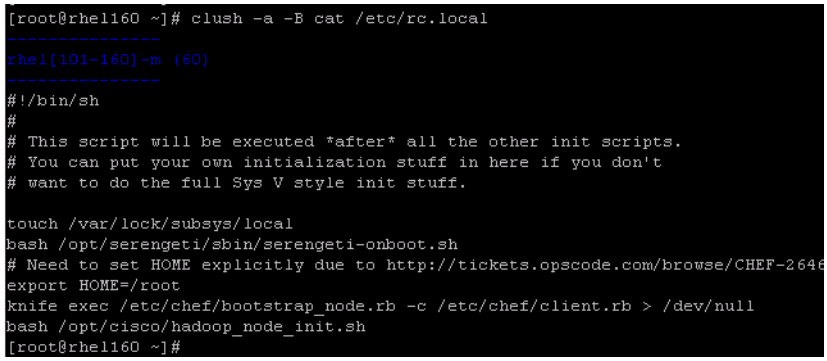
Figure 310 Verify the Copied Script on all the Nodes

```
[root@rhel160 ~]# clush -a -B ls -l /opt/cisco/hadoop_node_init.sh
---------------
rhel[101-160]-m (60)
---------------
-rw-r--r-- 1 root root 1551 Feb 24 11:41 /opt/cisco/hadoop_node_init.sh
[root@rhel160 ~]# clush -a -B cat /opt/cisco/hadoop_node_init.sh
---------------
rhel[101-160]-m (60)
---------------
#!/bin/sh
###
### Cisco Hadoop Node Init Script for the VM-cluster provisioned by VMWare BDE 2
.1
###
## Disable RedHat Transparent Huge-Pages and Defrag flags.
## Set the vm.swappiness to 0.
echo never > /sys/kernel/mm/redhat_transparent_hugepage/enabled
echo never > /sys/kernel/mm/redhat_transparent_hugepage/defrag
sysctl -w vm.swappiness=0
## Update the hostname to reflect the DNS name of the IP of MapRed interface
## This part of the script is copied from VMWare Big Data Extensions 2.1
## Administrator's and User's Guide - Page 125
##
## Please make sure that the NIC device name "eth1" below is the one
## that's associated with the MapReduce Network. If not, change that
## parameter appropriately to eth0 or eth2.
sleep 30

ETHIP=`/sbin/ifconfig eth0 | grep "inet addr" | awk '{print $2}' | sed 's/addr:/
/'`
FQDN=$ETHIP
RET=`/bin/ipcalc --silent --hostname $ETHIP`
if [ "$?" = "0" ]; then
FQDN=`echo $RET | awk -F= '{print $2}'`
fi
echo "set hostname to ${FQDN}"
`hostname ${FQDN}`
sed -i s/^HOSTNAME=.*/HOSTNAME="$FQDN"/ /etc/sysconfig/network
## Fix the MTU
## When the BDE used with Static-IPs, it sets MTU value to be 1500 by default.
## In this solution the NICs are capable of Jumbo MTUs.
##
ip link set dev eth0 mtu 9000
ip link set dev eth1 mtu 9000
ip link set dev eth2 mtu 9000
## Mount the Isilon NFS directory
mount -a
ISILON_NFS=/mnt/isilon_nfs
rm -f /DATA/nfs1
mkdir -p $ISILON_NFS/hadoop-local-data/$FQDN
chmod 777 $ISILON_NFS/hadoop-local-data/$FQDN
mkdir -p /DATA
ln -s -f $ISILON_NFS/hadoop-local-data/$FQDN /DATA/nfs1
[root@rhel160 ~]#
```

10. Verify that the "/etc/rc.local" files are same across the entire VM cluster.

```
clush -a -B cat /etc/rc.local
```

Figure 311 Verify the Files Across VM Cluster



Restarting the Cluster Manually to Apply the changes

Once the Hadoop node initialization scripts have been installed on all the VMs, we need to reboot them in order to apply the configurations.

1. Using SSH onto the Master VM as the user root, and enter the ifconfig command as follows:

   ```
   ssh 192.168.100.160
   ```

2. Enter the command to reboot all the worker nodes.

   ```
   pssh -h /root/worker-nodes reboot
   ```

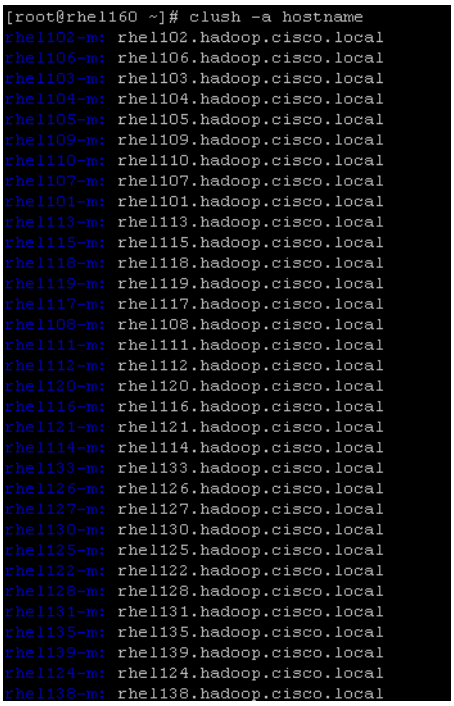
3. Now reboot the Master node as well.

   ```
   reboot
   ```

4. Once the master node is back up, log back in and use cluster-shell command to verify the status of all the hosts. Part of the output is shown below.

   ```
   clush -a hostname
   ```

Figure 312 Verify all the Hosts' Status



At this point, the actual hostnames of each individual VMs have been mapped to the Map-Reduce subnet (10.0.12.x).

Installing and configuring the Cloudera Manager 5.2.0 in the Master VM

In this section, we will see how to install Cloudera Manager 5.2.0 in the Master VM. As mentioned above, the Master VM's IP-addresses are as follows:

Table 17 Master VM's IP Addresses

NIC	Port Group	Address
eth0	VMNet-Mgmt	192.168.100.160
eth1	VMNet-MapRed	10.0.12.160
eth2	VMNet-HDFS	10.0.11.160

Note The actual port-group/IP-address to NIC may vary.

1. Setup the RHEL yum repository in this Master VM, by adding the following content into a new file at "/etc/yum.repos.d/rheliso.repo".

```
[rhel6.4]
name=Red Hat Enterprise Linux 6.4
baseurl=http://192.168.100.51/rhelrepo
gpgcheck=0
enabled=1
```

Figure 313 Cloudera-Manager VM: Create RHEL YUM Repository File

```
[root@rhel160 ~]# cat /etc/yum.repos.d/rheliso.repo
[rhel6.4]
name=Red Hat Enterprise Linux 6.4
baseurl=http://192.168.100.51/rhelrepo
gpgcheck=0
enabled=1
```

Note Since this VM is created from our custom RHEL-Template VM, the RHEL yum-repo should be already present under "/etc/yum.repos.d".

2. Setup the Cloudera Manager yum repository, by adding the following content into a new file at "/etc/yum.repos.d/cloudera-manager.repo".

```
 [cloudera-manager]
# Packages for Cloudera Manager, Version 5, on RedHat 6 x86_64
name=Cloudera Manager
baseurl=http://192.168.100.51/cm/5/
enabled=1
gpgcheck=0
```

Figure 314 Cloudera-Manager VM: Create the Cloudera-Manager YUM Repository File

```
[cloudera-manager]
# Packages for Cloudera Manager, Version 5, on RedHat 6 x86_64
name=Cloudera Manager
baseurl=http://192.168.100.51/cm/5/
enabled=1
gpgcheck=0
~
~
~
~
~
~
~
~
~
~
~
"/etc/yum.repos.d/cloudera-manager.repo" line 1 of 7 --14%-- col 1
```

3. Download the Cloudera Manager installer binary file from the Admin-VM by using the command:

```
wget http://192.168.100.51/cm/installer/cloudera-manager-installer.bin
```

Figure 315 Downloading the Cloudera Manager Installer Binary File into the Cloudera-Manager VM

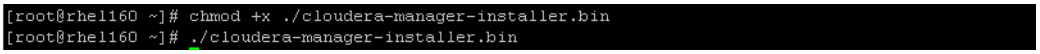
```
[root@rhel160 ~]# wget http://192.168.100.51/cm/installer/cloudera-manager-installer.bin
--2015-01-13 17:59:48--  http://192.168.100.51/cm/installer/cloudera-manager-installer.bin
Connecting to 192.168.100.51:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 514202 (502K) [application/octet-stream]
Saving to: `cloudera-manager-installer.bin'

100%[======================================================>] 514,202     --.-K/s   in 0.002s

2015-01-13 17:59:48 (213 MB/s) - `cloudera-manager-installer.bin' saved [514202/514202]
```

Installing the Cloudera Manager

1. Change the mode of the Cloudera Manager Installer binary file, cloudera-manager-installer.bin, to include execute permissions, and execute it.

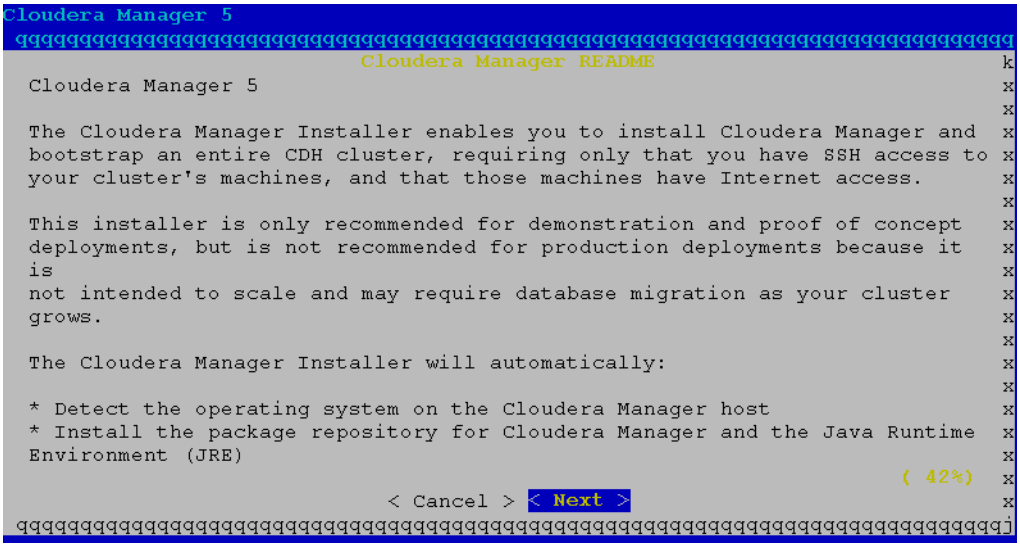
```
chmod +x cloudera-manager-installer.bin
./cloudera-manager-installer.bin
```

Figure 316 Execute the Cloudera Manager Installer Binary



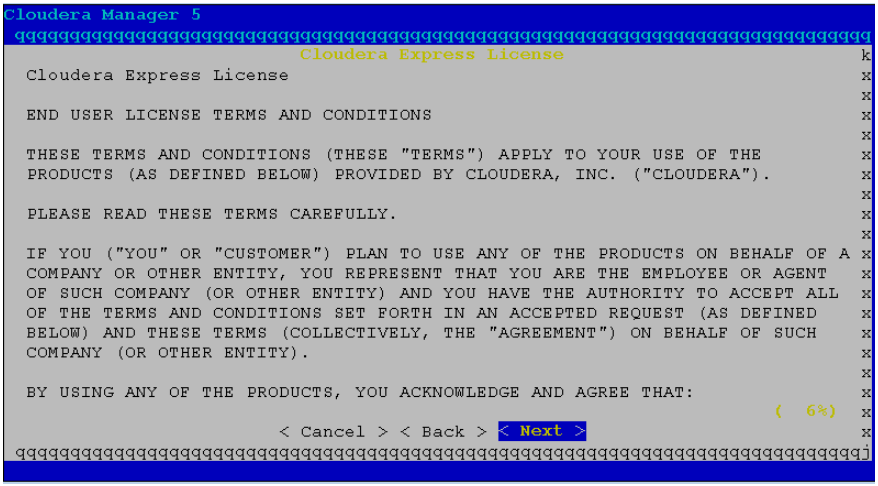
2. The screen displays the Cloudera-Manager Installation screen with basic information about the Installer. Review the information and select **Next** to continue.

Figure 317 About Cloudera Manager 5



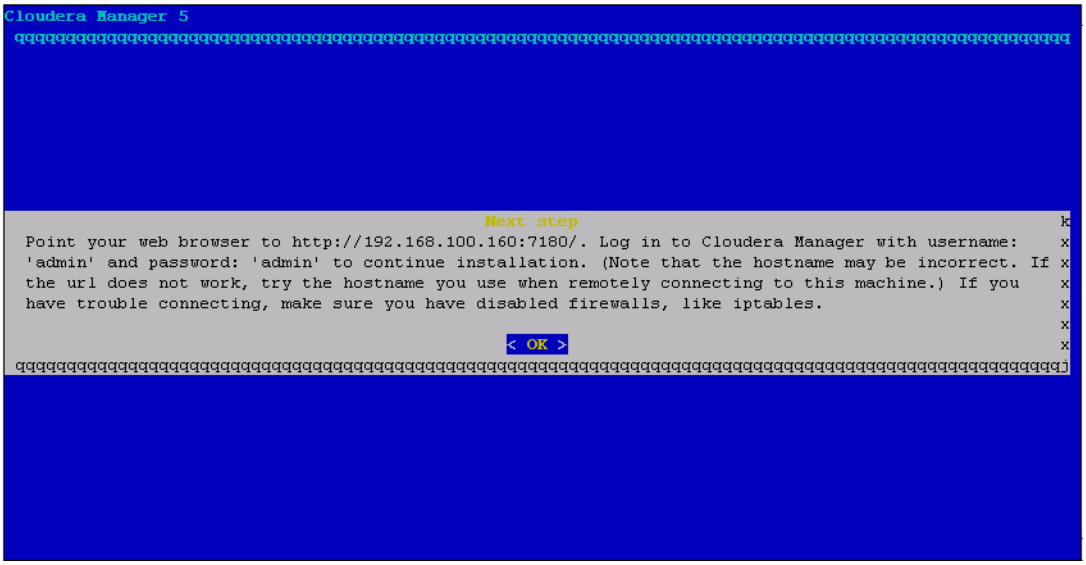
3. Review the End User License Agreement page and select **Next** to continue.

Figure 318 Cloudera Express License: License Agreement Page



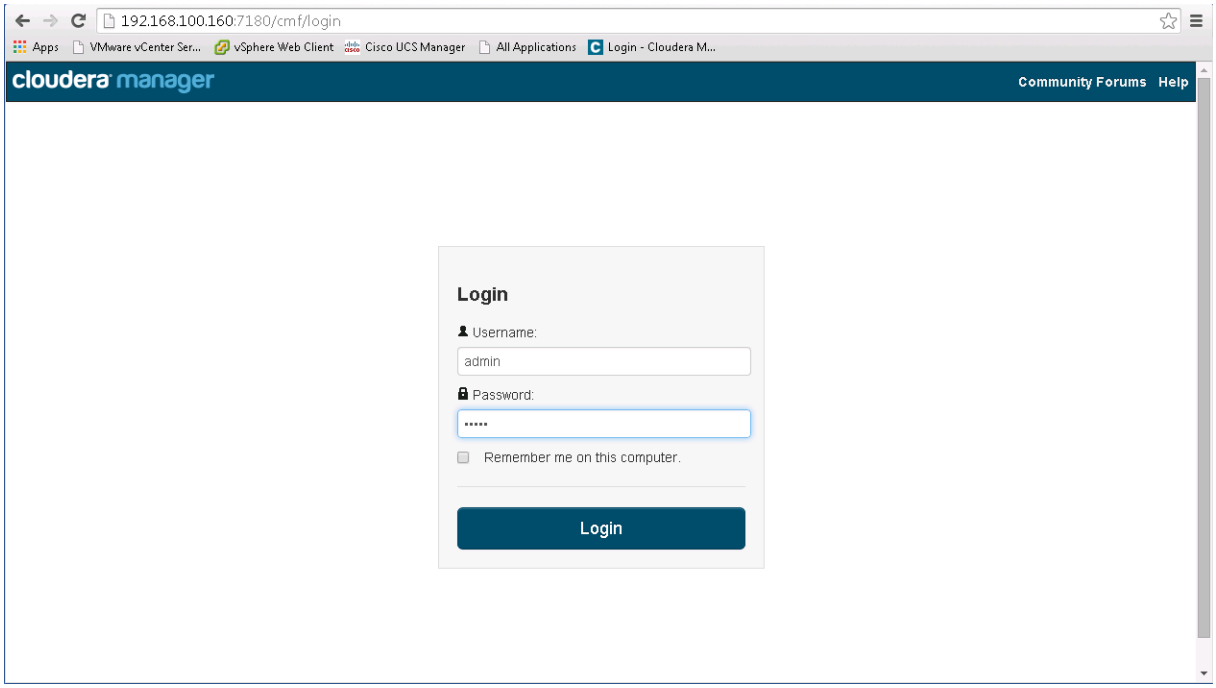
4. Select **Yes** to continue; also accept the Oracle JDK installation agreement to continue onto Cloudera Manager Installation.
5. Once the Cloudera-Manager installation is complete, the installer prompts the following message with the URL to access the Cloudera-Manager.

Figure 319 URL for Logging into Cloudera Manager



6. Save the URL displayed i.e. http://192.168.100.160:7180. Use this URL to access the Cloudera Manager using your web browser. Press <OK> to complete the installation.
7. Now verify the Cloudera Manager is accessible via the web-browser by visiting the URL:http://192.168.100.160:7180.
8. Login as admin user with the default password “admin”.

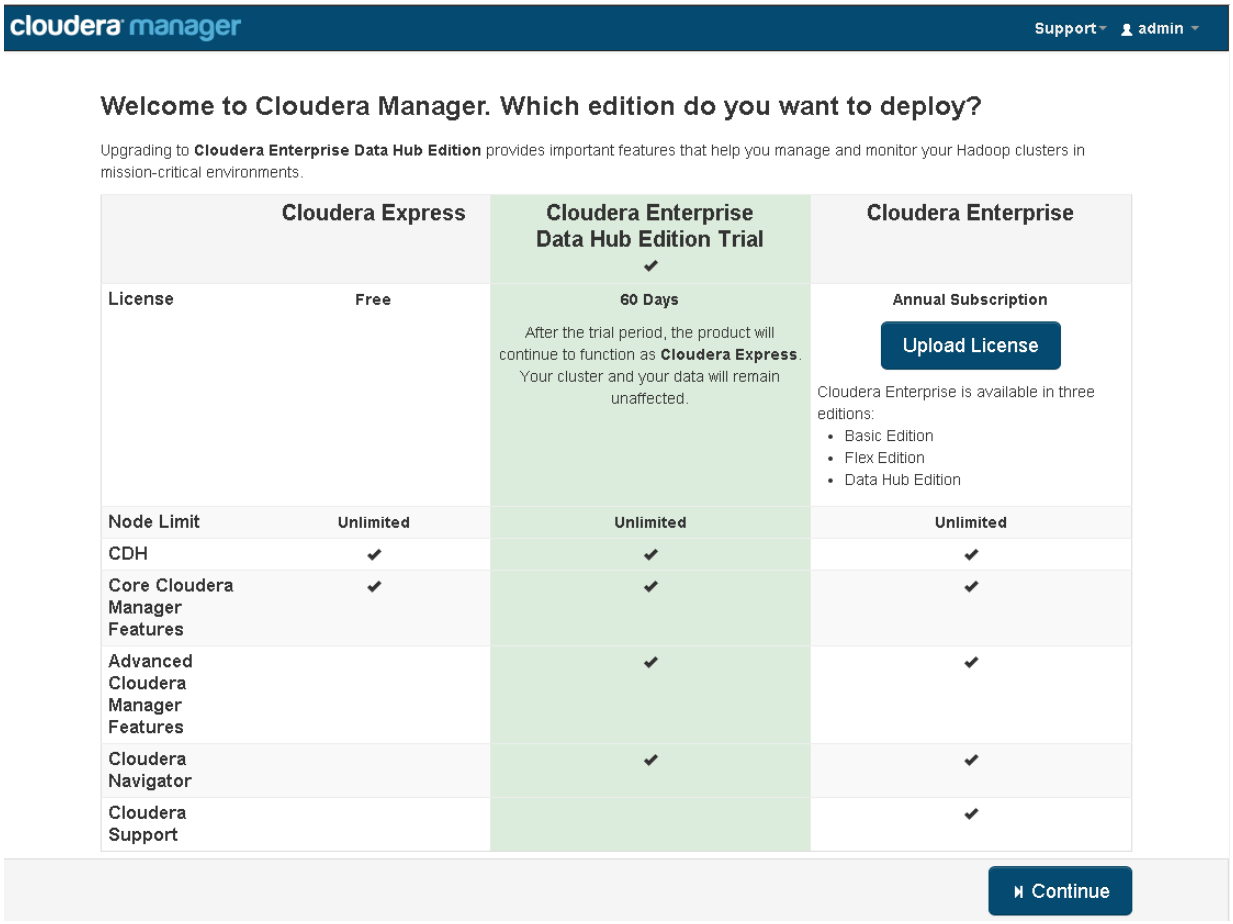
Figure 320 Accessing the Cloudera Manager Web-UI



Edit the Cloudera Enterprise Parcel Settings to Use the CDH 5.1.3 Parcels

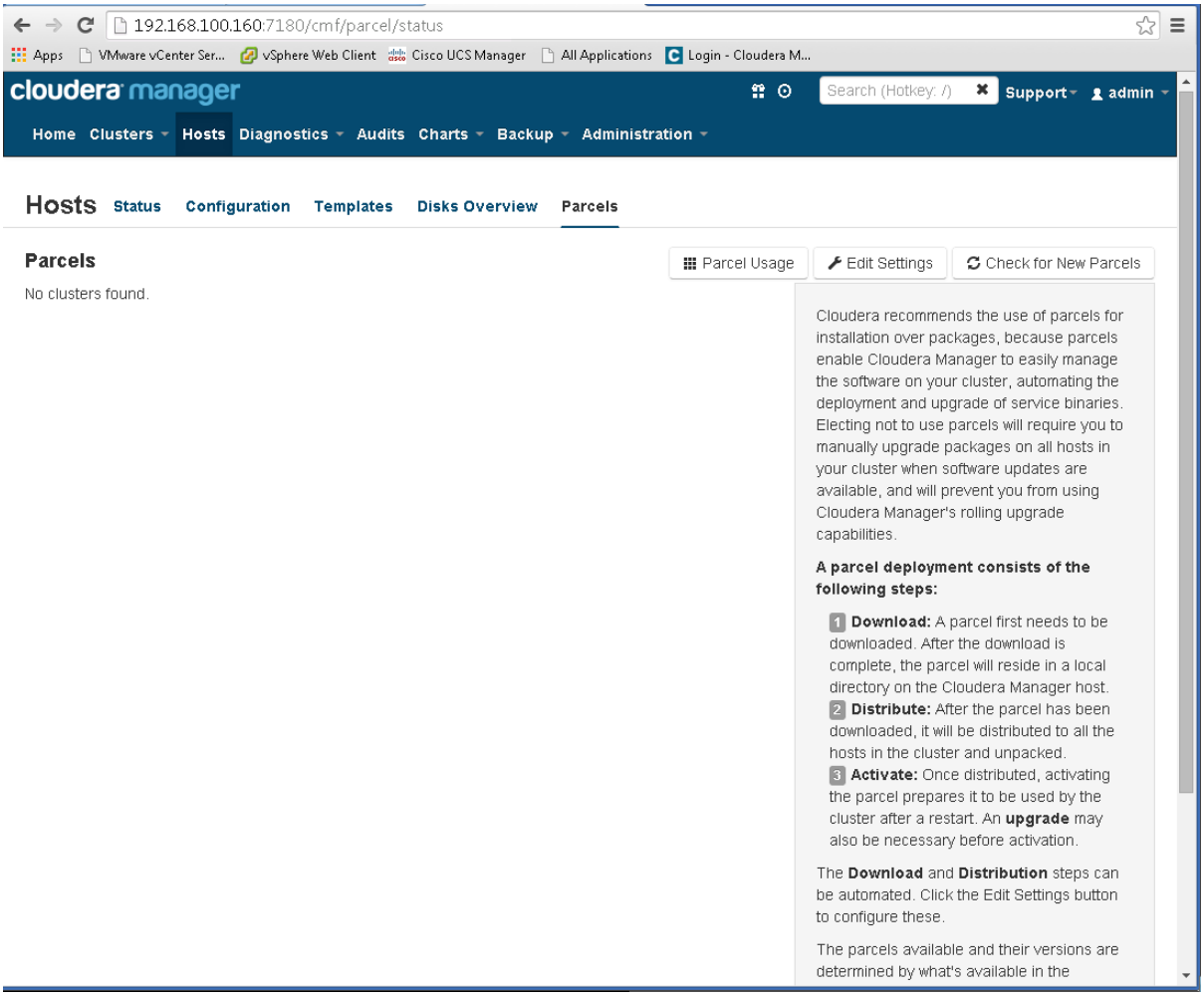
1. Log into the Cloudera Manager using the admin credentials (Username admin, default password is "admin")
2. Click **Upload License** to continue.

Figure 321 Select the License File



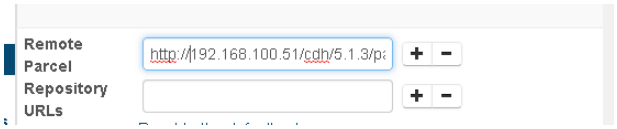
3. Browse for the License Text file, and click **Upload**.
4. Click **Continue**.
5. At this point, open another tab in the same browser window and visit the URL: http://192.168.100.160:7180/cmf/parcel/status for modifying the parcel settings.

Figure 322 Edit the Parcel Settings



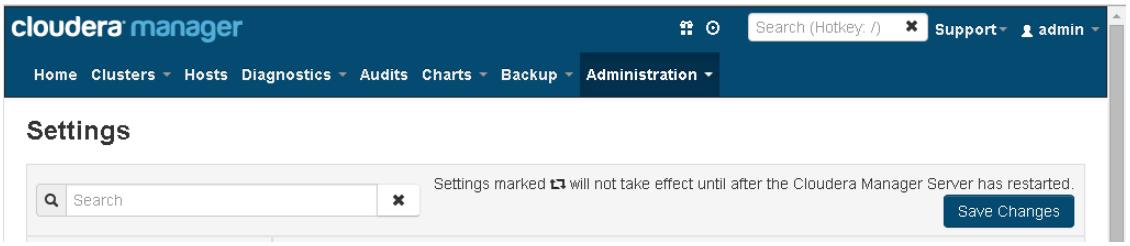
6. Click **Edit Settings** on this page:
7. Click **-** to remove all the remote repository URLs, and add the URL to the location where we kept the CDH 5.1.3 parcels i.e. http://192.168.100.51/cdh/5.1.3/parcels/

Figure 323 Change the Parcel URLs



8. Click **Save Changes** to finish the configuration.

Figure 324 Save the Parcel Settings



At this point, Cloudera Manager is almost ready. The VMs are also ready to be configured to form the Hadoop cluster.

The only remaining activity is to prepare the Cloudera Manager's external database.

Preparing Cloudera Manager Server External Database

Configure the Cloudera Manager to use the external database. Follow the instructions on http://www.cloudera.com/content/cloudera/en/documentation/core/v5-2-x/topics/cm_ig_installing_configuring_dbs.html#cmig_topic_5_2_unique_1 to configure database VM (CMDB, IP: 192.168.100.90) with the script scm_prepare_database.sh that can be found at "/usr/share/cmf/shema" directory of the Master VM(rhel160, IP: 192.168.100.160).

Create the Hadoop Cluster Using Cloudera Manager

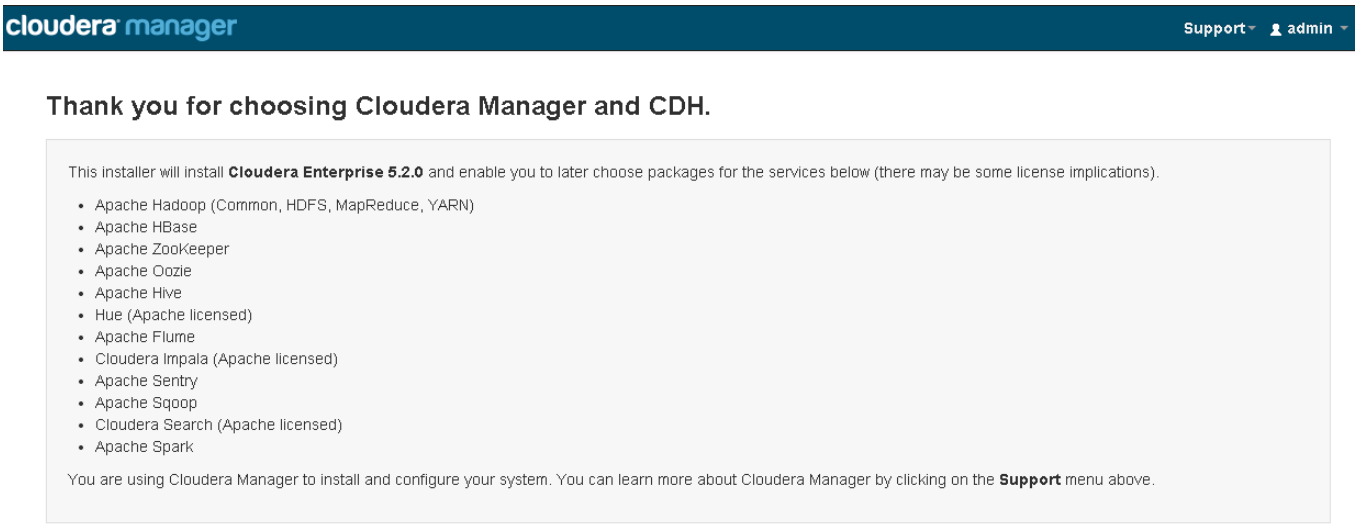
In this section we will see how to provision the Hadoop cluster on the VMs that we created in the above section using Cloudera Manager.

Adding the New Cluster in Cloudera Manager

In order to create the Hadoop cluster, we will make use of the hostnames of all the 60 VMs.

1. Launch Cloudera Manager Web application, on the home page, and click **Add Cluster**. Click **Continue**.

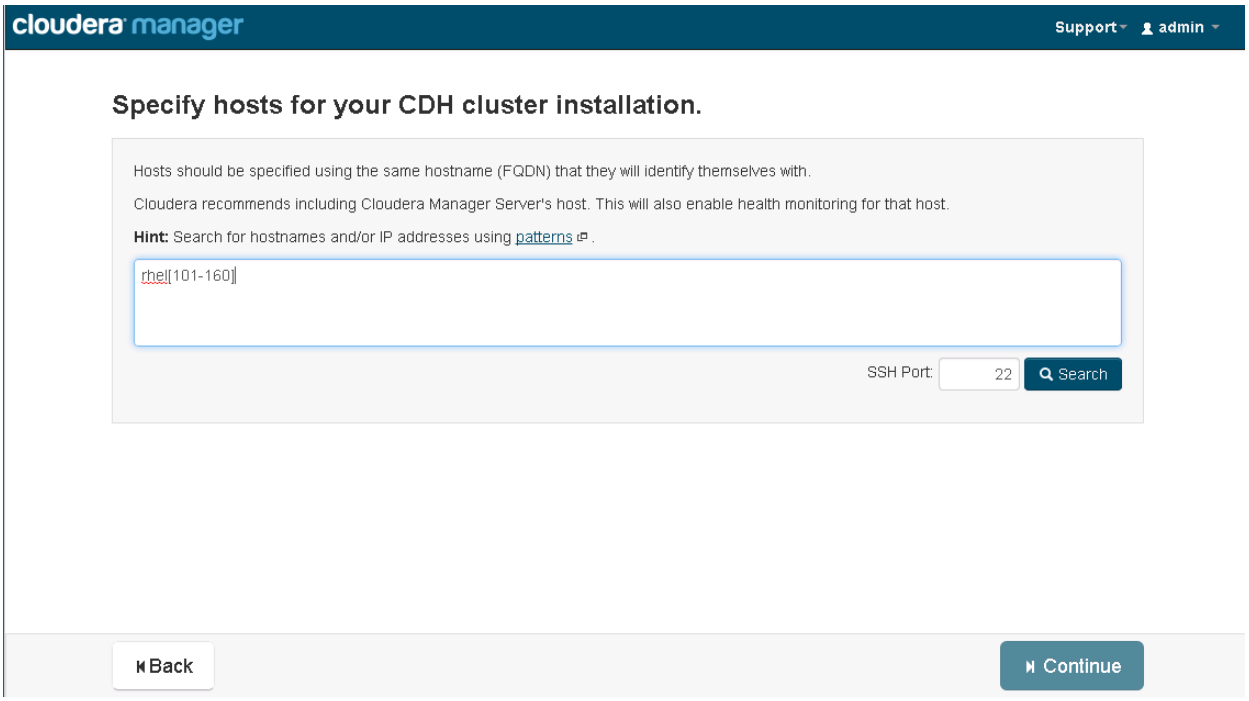
Figure 325 List of Services Available in Cloudera Enterprise 5.2.0



2. In the next screen, enter the hostname range as shown below. Click **Search**.

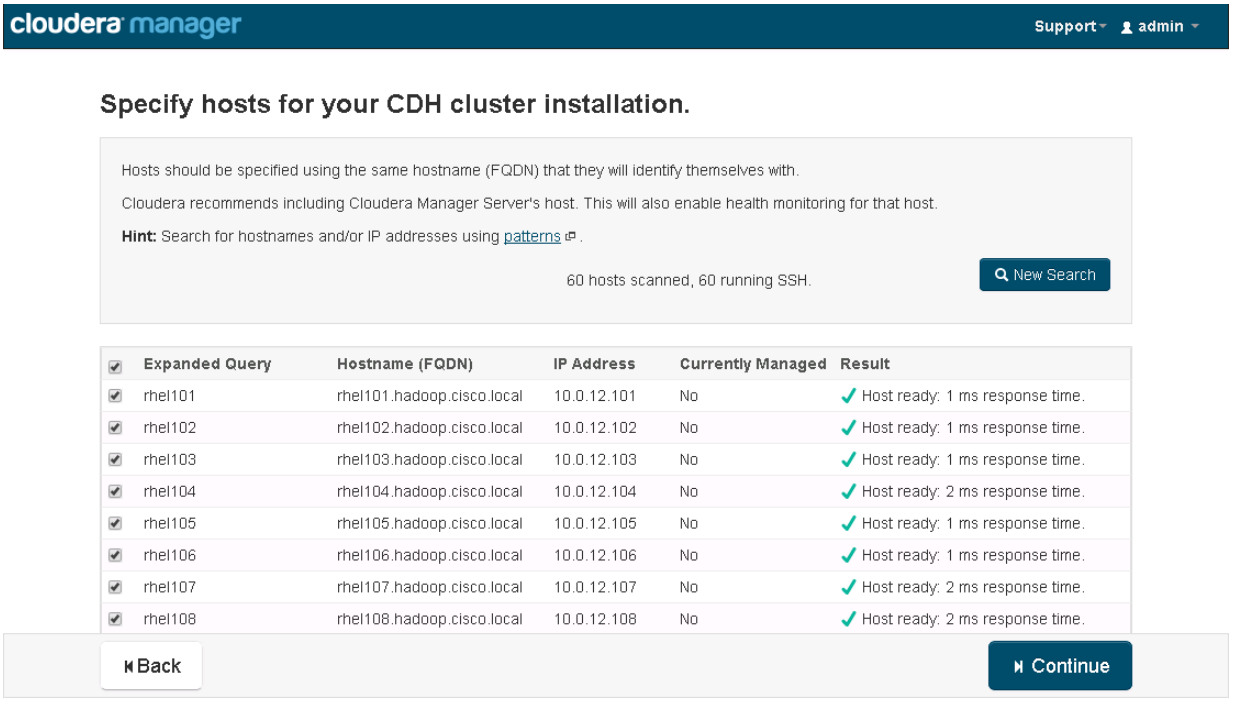
```
rhel[101-160]
```

Figure 326 Search the IP Addresses of the VMs



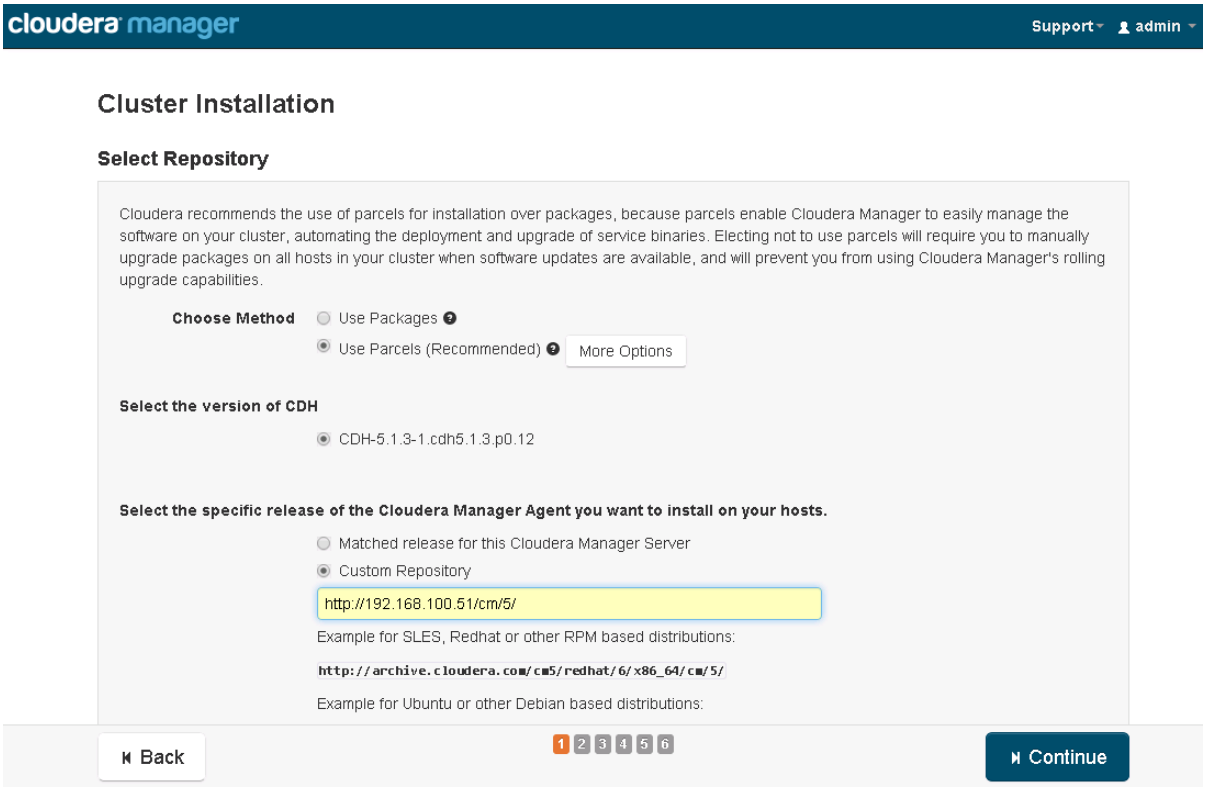
3. Cloudera Manager discovers the nodes and display IP addresses and FQDNs. Click **Continue**.

Figure 327 View the Resolved FQDNs of the IP Addresses



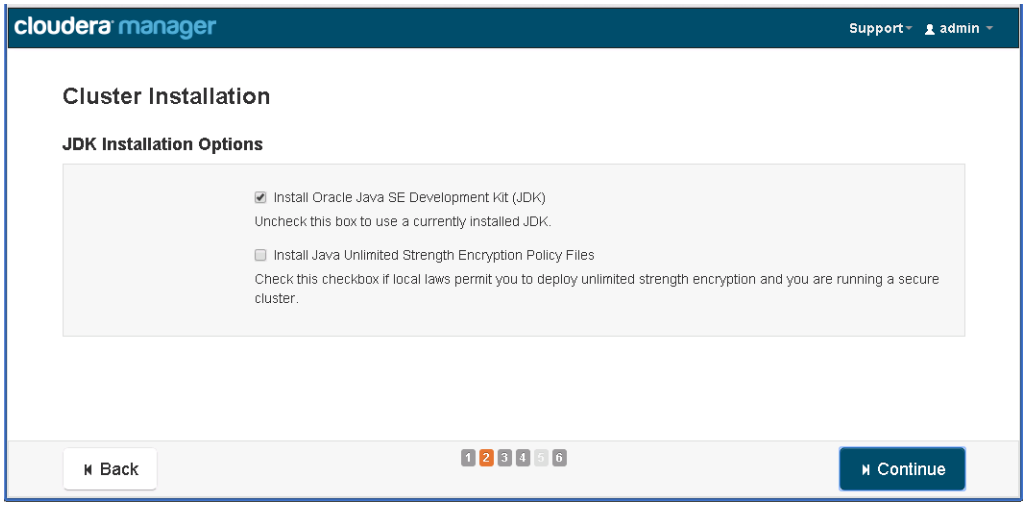
4. Click **Continue** to move to the next step.
5. In the Cluster Installation screen, select the **Use Parcels** as the method of installation.
6. Select the CDH version as CDH-5.1.3.x
7. Select the Cloudera Manager repository by clicking on “Custom Repository”, and enter repository URL (Admin-VM): http://192.168.100.51/cm/5.
8. Click **Continue**.

Figure 328 Specify the Custom Repository for the Cloudera Manager



9. Check the Install Oracle Java SE Development Kit (JDK) checkbox, Click **Continue**.

Figure 329 JDK Install Option

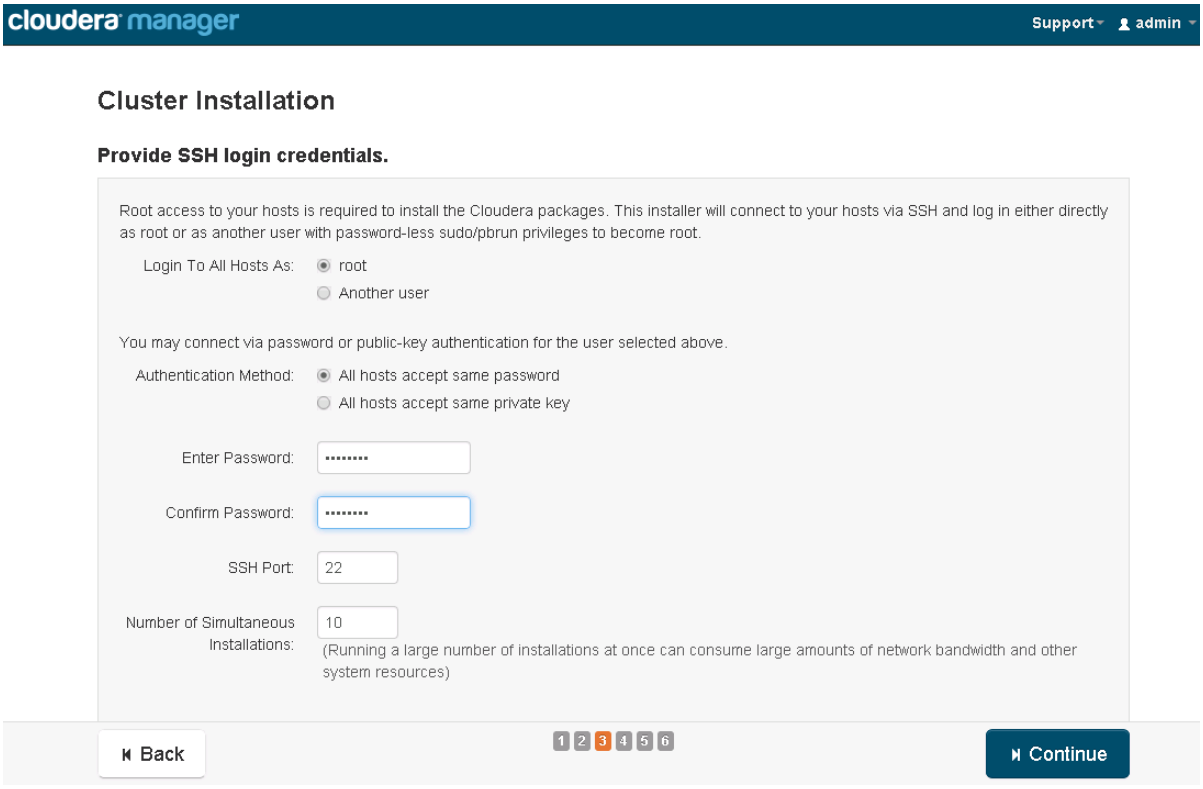


Note Even though the RHEL-Template already contains an appropriate JDK, it is preferable to install the JDK that comes pre-packaged with the Cloudera Enterprise.

10. In the next screen, select root radio button for the option for "Login To All Hosts As"

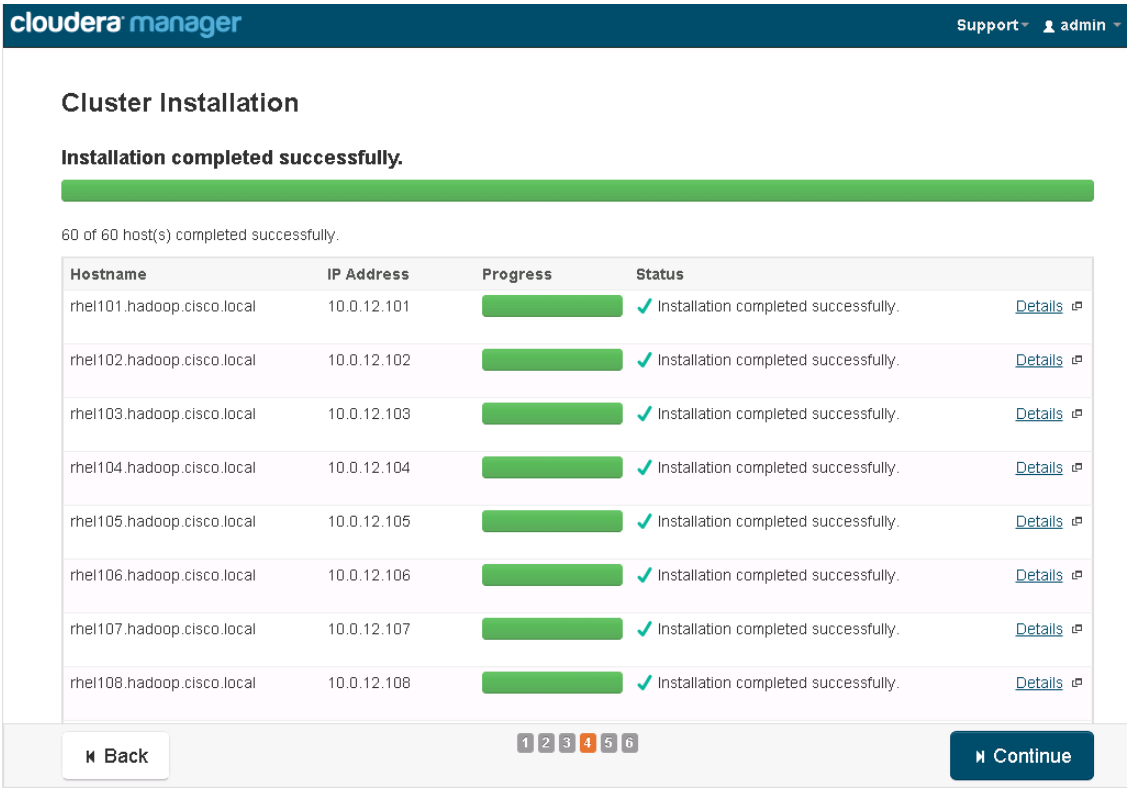
11. Select “All hosts accept same password” radio button for the option “Authentication Method”.
12. Subsequently, enter the password and confirm it by re-typing it.
13. Click **Continue**.

Figure 330 User and Credentials Settings



14. Observe the installation, once it is complete, Click **Continue**.

Figure 331 Cloudera Manager Agent Installation is Complete

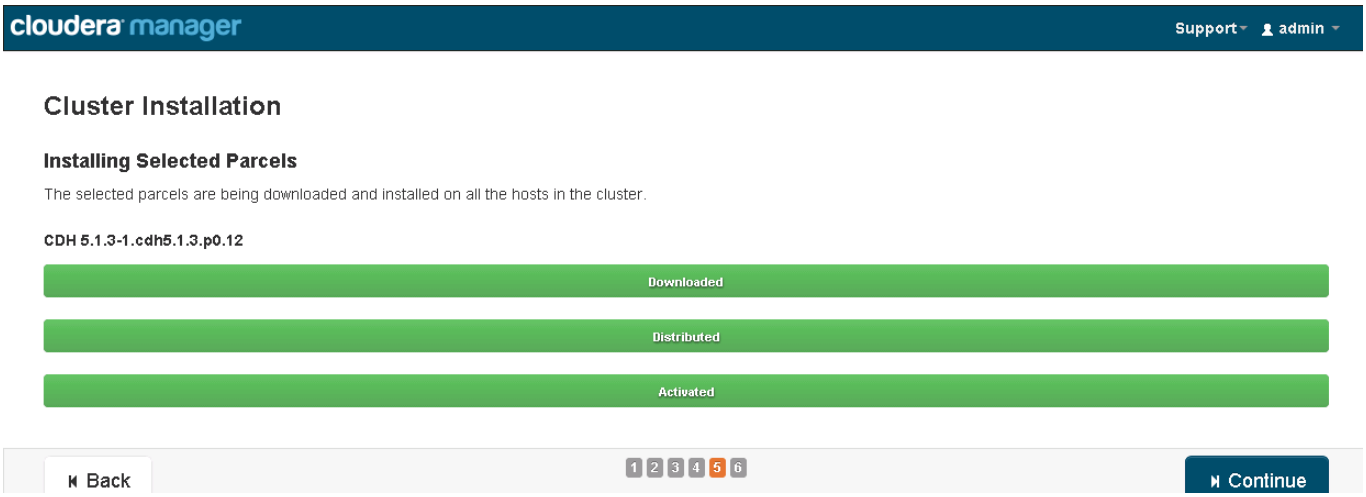


15. Cloudera Manager will start distributing the CDH parcels to all the VMs.

Note This step will take about 10 to 20 minutes to complete.

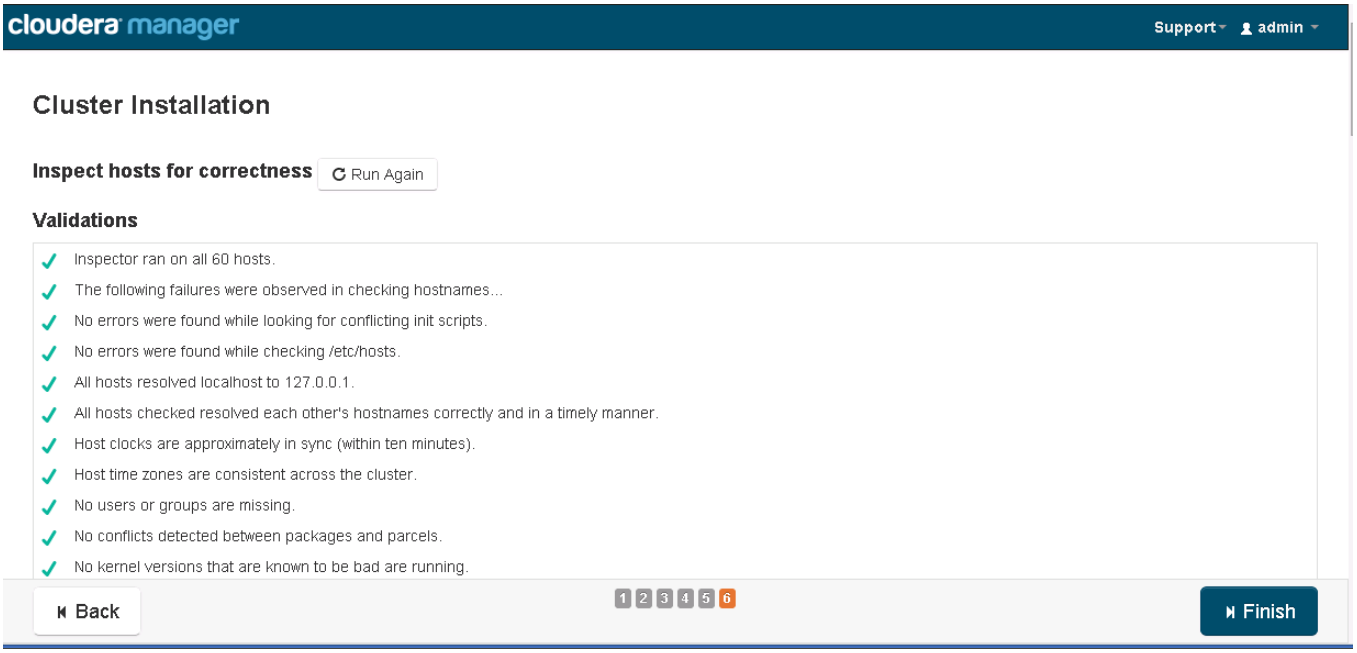
16. Once the CDH distribution is complete, Click **Continue**.

Figure 332 Installing the CDH 5.1.3 on All the 60 VMs



17. Final Host verification will now take place, after it completes, Click **Finish**.

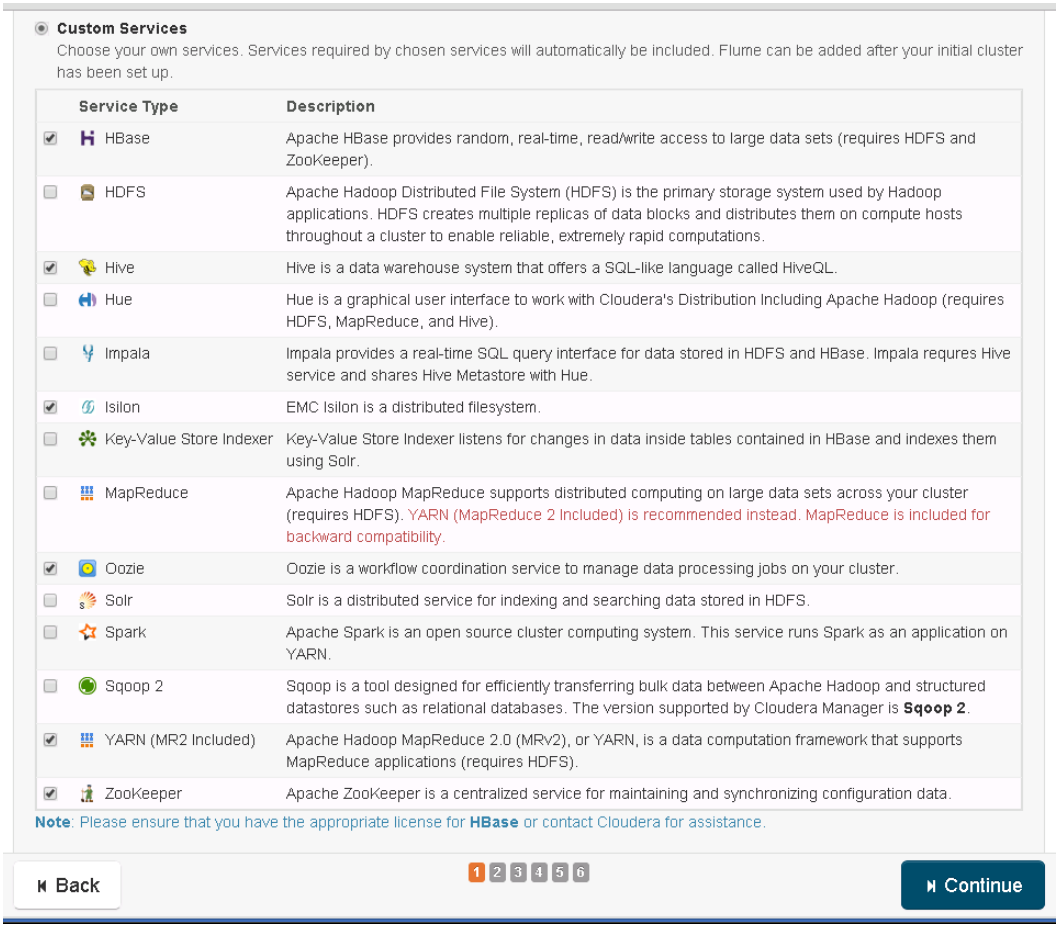
Figure 333 Cluster Host Verification



18. In the next screen, click the Custom Services radio button, and choose the following services and Click **Continue**.
    - HBase
    - Hive
    - Isilon
    - Oozie
    - YARN (MR2 included)
    - Zookeeper

Note Make sure not to select HDFS. We will use Isilon for the HDFS services. The other services can be added easily at any time using the Cloudera Manager.

Figure 334 Custom Role Assignments



In the next step, we will be choosing the service roles of the different roles. rhel101 and rhel160 will be used purely for administrative purposes, and we will use rhel102 – rhel159 to be host the YARN Node Manager service.

19. Configure the cluster role assignments as per this table.

Table 18 Cluster Roles

Service Name	Host
Resource Manager	rhel101
History Server	rhel101
Cloudera Management Services • Alert publisher • Activity Monitor • Event Server • Host Monitor • Reports manager • Service Monitor	rhel101
Node Manager	rhel102 – rhel159

Table 18 Cluster Roles

Service Name	Host
Isilon Service	rhel101 – rhel103
Hive Metastore Server	rhel101
Hive2	rhel160
HBase Master	rhel101
HBase Rest Server	rhel101
HBase Region Server	rhel102 – rhel159
Zookeeper	rhel101, rhel102, rhel160
Oozie Server	rhel160

Note The above table contains the mandatory services such as Cloudera Management Services, YARN and Isilon, and some important services that are commonly used. Additional services can be added to this cluster using Cloudera Manager at any point in time. Consider using the VMs rhel101 and rhel160 for hosting key services. While provisioning a new service that requires more than two hosts, plan to use rhel101, rhel160, rhel102, rhel103 and so on. This model distributes the services across various physical blades, thus improving the fault tolerance and availability.

Figure 335 Cluster Setup Showing HBase, YARN, Isilon and Oozie services

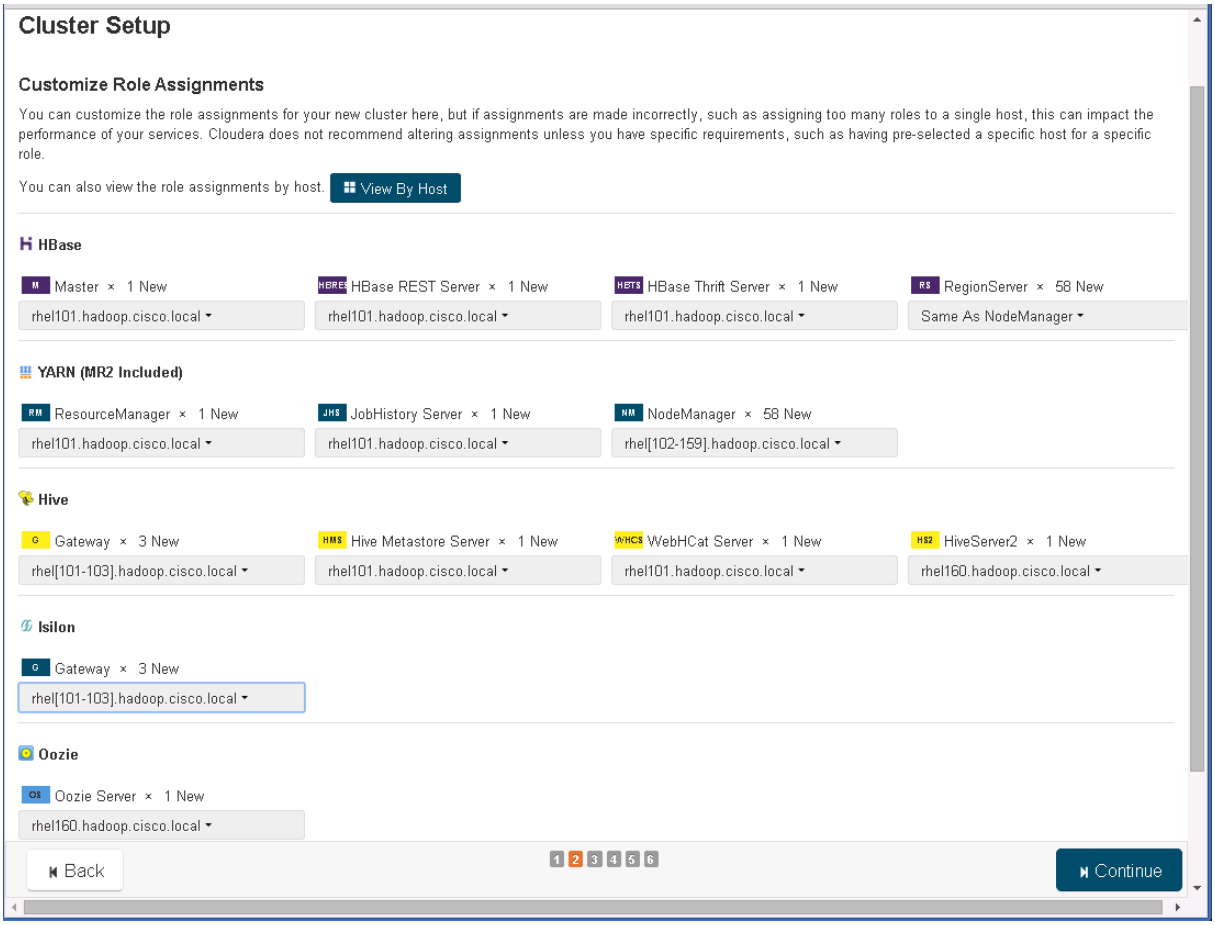
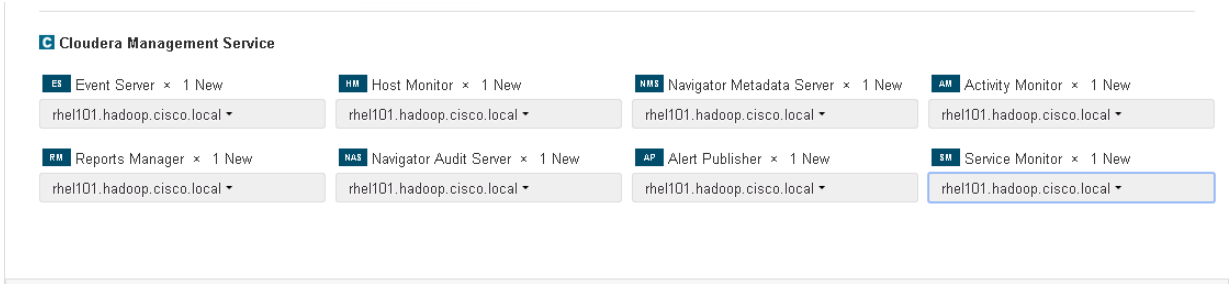


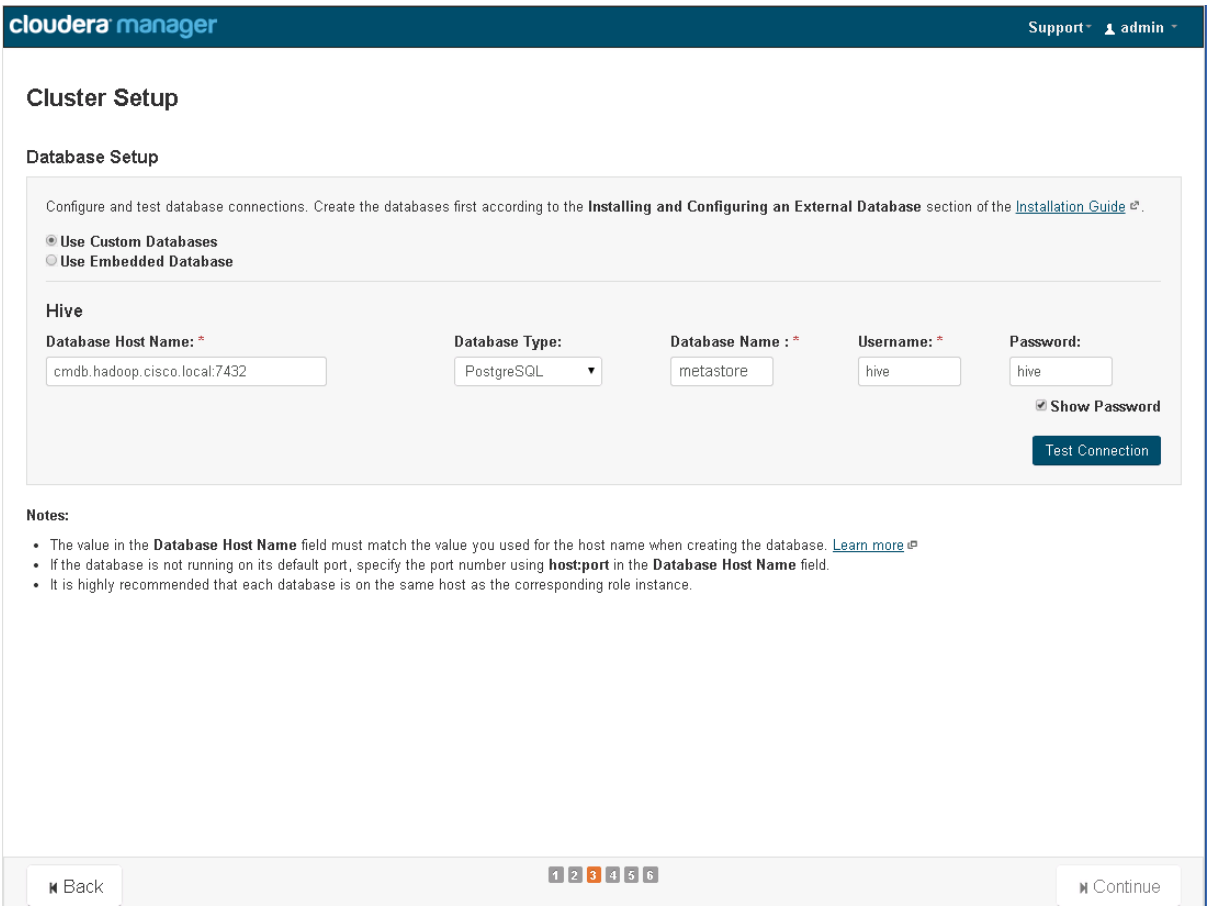
Figure 336 Assigning Cloudera Management Roles to the Individual Hosts



20. In the next screen, choose the Custom Database option, and enter the database hostname as “cmdb.hadoop.cisco.local:7432, Database Type as PostgreSQL and enter the user name hive role and the respective password as per your configuration in section 16.
21. Click **Test Connection**. Once it completes, Click **Continue**.

Note This step requires that the external database has been already setup in a VM.

Figure 337 External Database Details



22. After the database setup is complete, in the subsequent screen, enter the following data.
    - Default File System URI: hdfs://hdfs.isic.hadoop.cisco.local:8020
    - WebHDFS URL: http://hdfs.isic.hadoop.cisco.local:8082/webhdfs/v1
    - In the Nodemanager Local Directory List filed, set yarn.nodemanager.local-dirs settings to "/DATA/nfs1/yarn/nm". Make sure there is one such entry per Node Manager group. Also, in each group, remove the extra entries that points to the "/mnt/scsi-<UUID>/yarn/nm in each group by clicking on the button with "-".

Figure 338 Cluster Configuration – Islion, YARN and Other Services

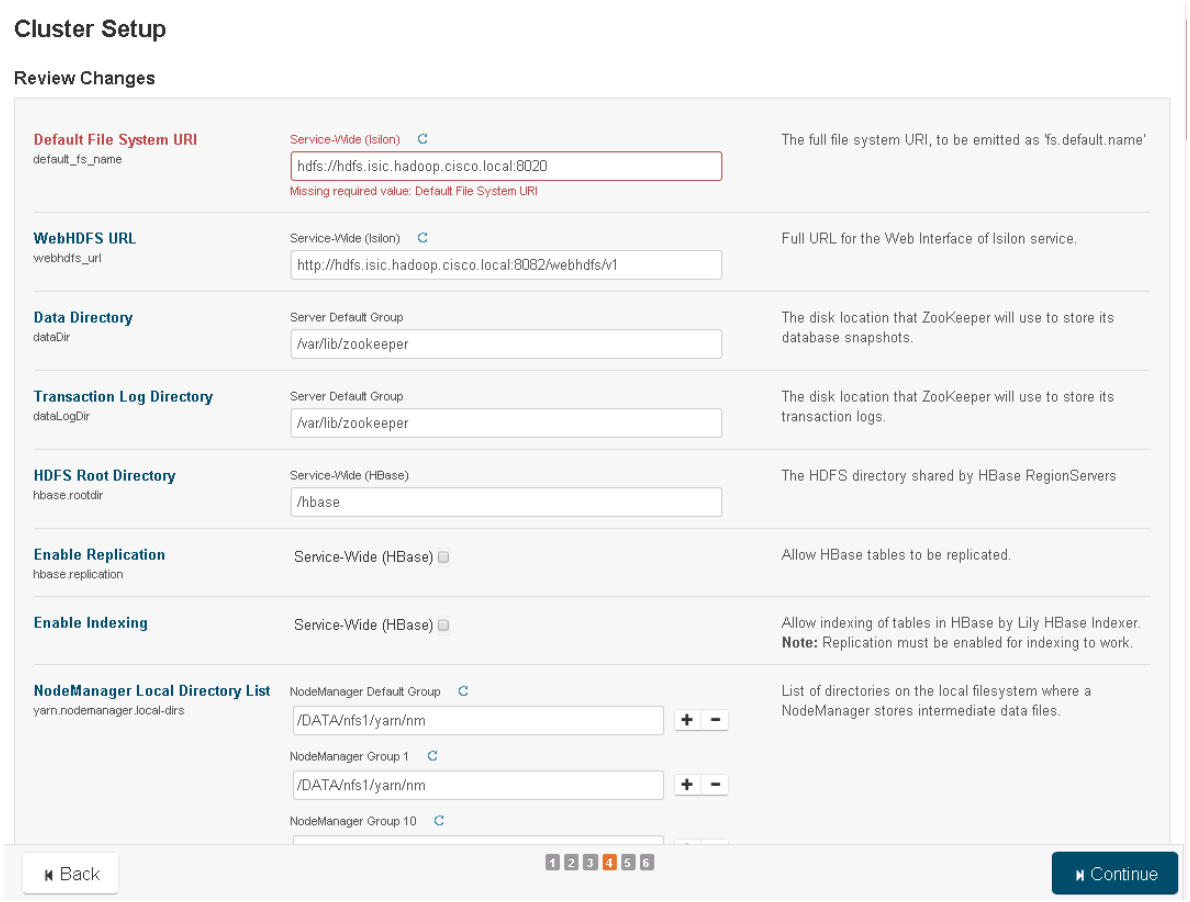
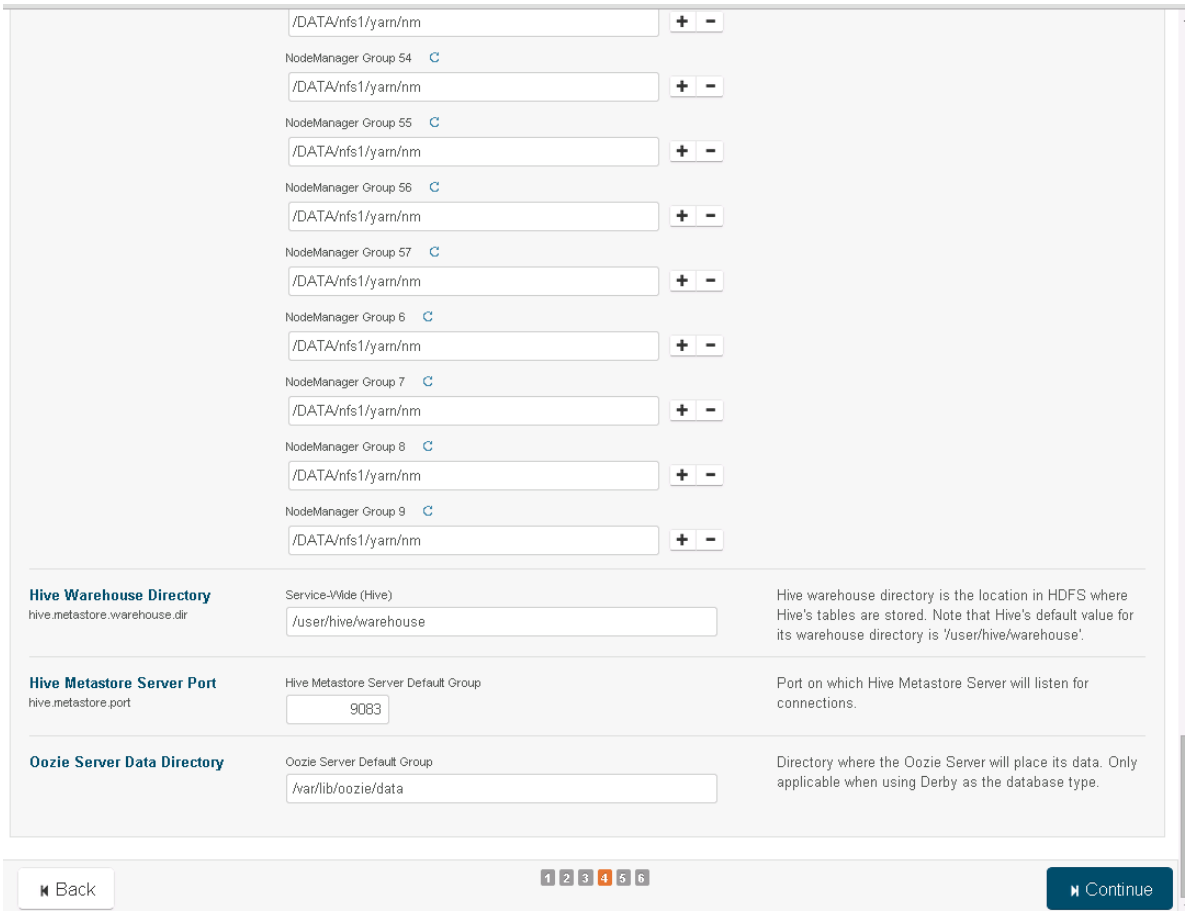


Figure 339 Cluster Configuration – YARN Local-Directory Setup, Hive and Oozie Setup

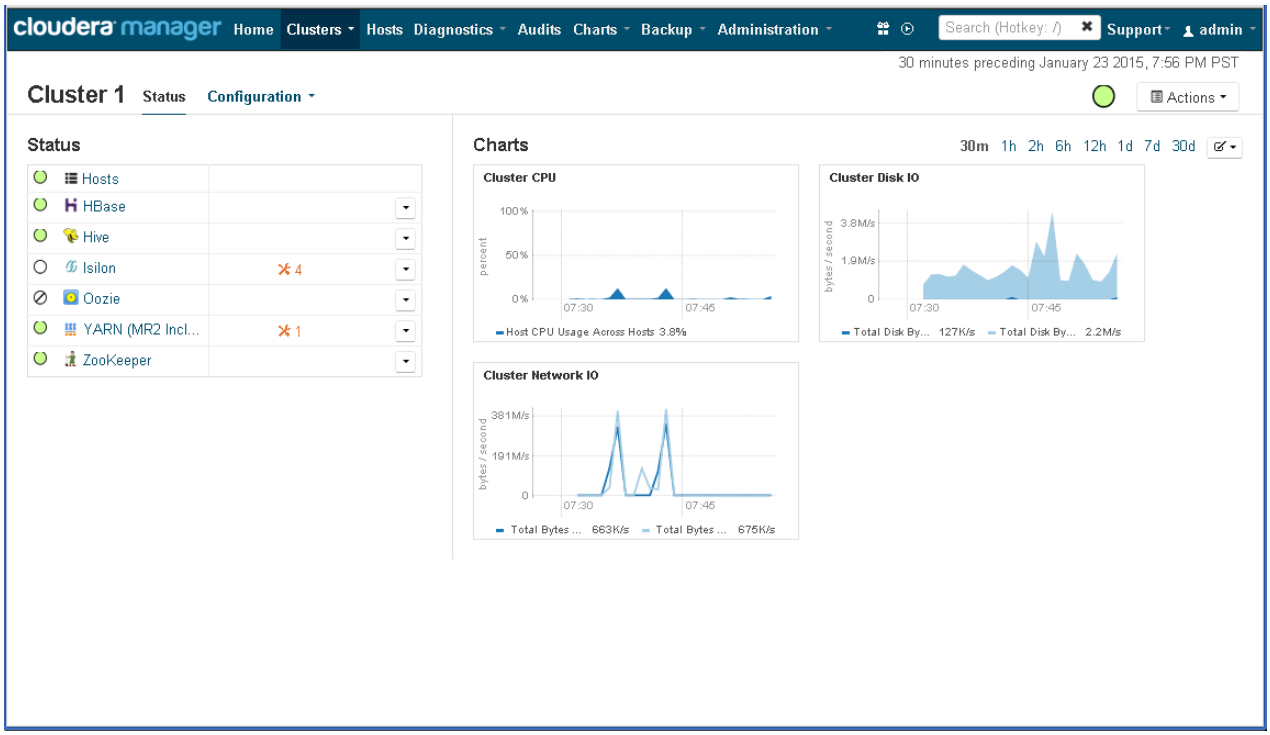


23. Click **Continue** to proceed with the Cluster Setup.
24. Once the cluster setup is complete, click **Finish**.

Cluster Creation is Complete

The cluster has been successfully provisioned and is ready to accept MapReduce jobs.

Figure 340 Successful Creation of a New Cluster



You may notice a few warnings against the Isilon and YARN services. They can be safely ignored. You may also use the Cloudera Manager to disable those warnings.

The following are the warnings that can be viewed by clicking on the orange icon.

Isilon Warning

The warning “HDFS Trash is disabled. Deleted files will be unrecoverable” indicates that while using Isilon as the HDFS backend, the option “dfs_client_use_trash” is disabled. It is possible to use Cloudera Manager to enable this option. If enabled, the trash is not automatically emptied.

Figure 341 Isilon Warning: HDFS Trash Option

YARN Configuration Warning

This warning indicates that the YARN setting “mapred_submit_replication” is not set to proper value and it indicates number of data nodes is 0. This warning must be simply ignored. Please do not make any changes suggested by the Cloudera Manager. Making any change to the variable may make your cluster unable to perform map-reduce jobs.

Figure 342 YARN Configuration Warning

This completes the basic configuration of the Hadoop cluster.

Configure the YARN(MR2) Service Settings

Using Cloudera Manager, configure the YARN (MR2 Included) service settings to the below recommended settings.

Table 19 YARN (MR2) Settings

Parameter	**Value**	**Description**
mapreduce.map.memory.mb	4096	Memory used by the YARN container for running a map task
mapreduce.map.java.opts	-Xmx3328m	Maximum memory allocated to the JVM performing the map task. This value should be less than that of the parameter: mapreduce.map.memory.mb.
mapreduce.map.memory.mb	6144	Memory used by the YARN container for running a reduce task.
mapreduce.map.java.opts	-Xmx5376m	Maximum memory allocated to the JVM performing the reduce task. This value should be less than that of the parameter: mapreduce.reduce.memory.mb.
mapreduce.task.io.sort.mb	1024	The total amount of buffer memory to use while sorting files, in megabytes.
mapreduce.task.timeout	900000	The number of milliseconds before a task will be terminated. Default value is 10min (600000 ms). This change is optional.

Table 19 YARN (MR2) Settings

Parameter	Value	Description
yarn.log-aggregation-enable	true	Whether to enable log aggregation. Log aggregation collects each container's logs and moves these logs onto a file-system, for e.g. HDFS, after the application completes. Users can configure the "yarn.nodemanager.remote-app-log-dir" and "yarn.nodemanager.remote-app-log-dir-suffix" properties to determine where these logs are moved to. Users can access the logs via the Application Timeline Server.
yarn.scheduler.minimum-allocation-mb	4096	The minimum allocation for every container request at the RM, in MBs. Memory requests lower than this won't take effect, and the specified value will get allocated at minimum.
yarn.scheduler.maximum-allocation-mb	53248	The maximum allocation for every container request at the RM, in MBs. Memory requests higher than this won't take effect, and will get capped to this value.
yarn.nodemanager.resource.memory-mb	53248	Amount of physical memory, in MB, that can be allocated for containers. This parameter determines the number of containers created per VM.
yarn.nodemanager.local-dirs	/DATA/nfs1	Node manager intermediate directory space on Isilon NFS.
yarn.nodemanager.resource.cpu-vcores	8	Number of CPU cores that can be allocated for containers.
yarn.scheduler.maximum-allocation-vcores	8	The maximum allocation for every container request at the RM, in terms of virtual CPU cores. Requests higher than this won't take effect, and will get capped to this value.
yarn.app.mapreduce.am.resource.cpu-vcores	1	The number of virtual CPU cores the MR AppMaster needs.

Table 19 YARN (MR2) Settings

Parameter	**Value**	**Description**
yarn.app.mapreduce.am.resource.mb	3072	The amount of memory the MR AppMaster needs.
yarn.app.mapreduce.am.command-opts	-Xmx2304m	Java opts for the MR App Master processes.

VM cluster configurations post Hadoop Cluster creation

Once the Hadoop Cluster is created, we need to make sure that the hadoop cluster comes back up every time the VMs are rebooted. In order to achieve this repeatable state, we need to make some adjustments to the VM startup sequence.

Cloudera Manager installs its agent on every VM that becomes part of the Hadoop cluster. This agent, cloudera-scm-agent, starts up before the BDE performs its boot-up initialization sequence. The hadoop_init_script.sh invocation step that we inserted in the "/etc/rc.local" in the previous sections requires that the Cloudera Manager Agent starts after the BDE initializations are complete. In order to accomplish this, the cloudera-scm-agent startup needs to be delayed until after the BDE initialization sequence is complete.

Note This procedure in section must be executed only after the Cloudera Hadoop Cluster has been provisioned successfully.

From the previous section take a note of the Mgmt-IP address of the Compute-Master VM.

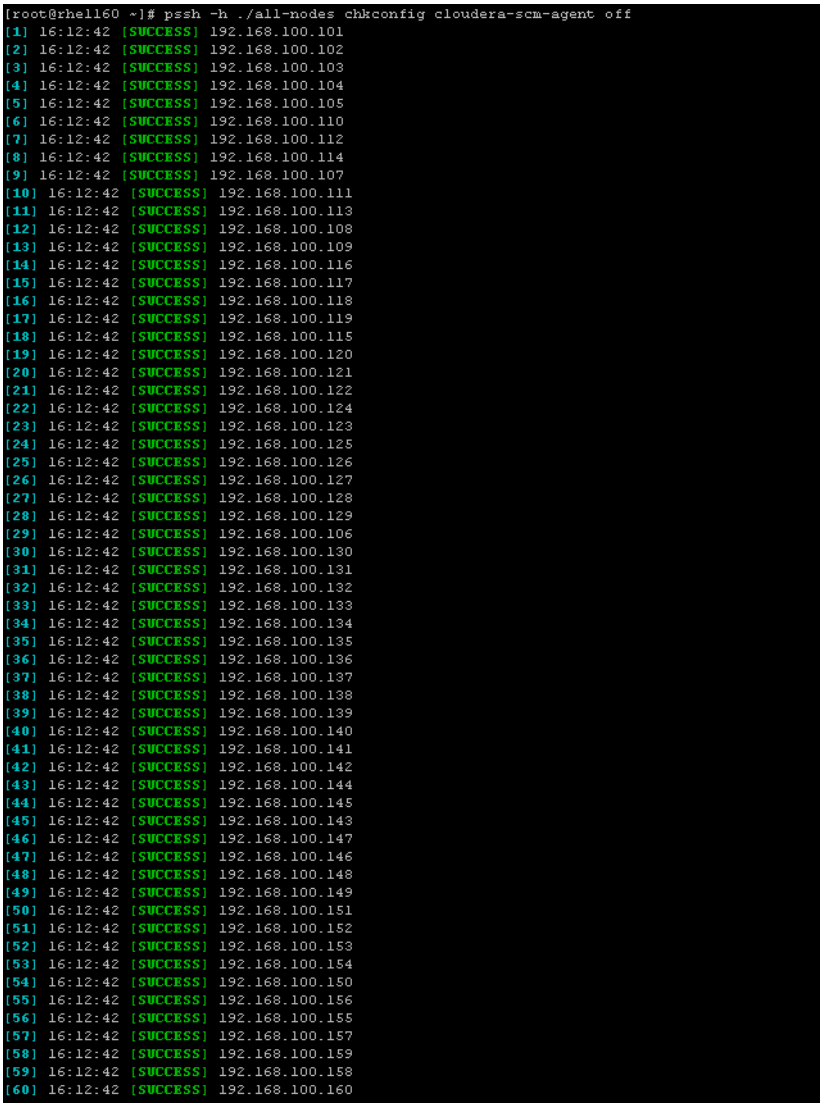
1. Using SSH log onto the Master VM as the user root.

   ```
   ssh 192.168.100.160
   ```

2. Disable the automatic startup of the Cloudera Manager Agent in all the VMs by entering the following command.

   ```
   pssh -h /root/all-nodes chkconfig cloudera-scm-agent off
   ```

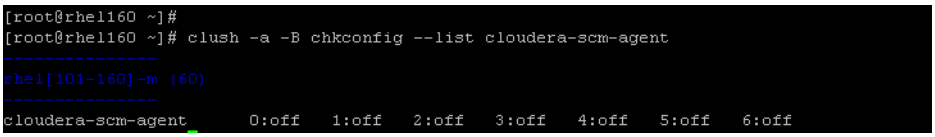
Figure 343 Disabling Automatic Cloudera Manager Agent Startup



3. Verify that the chkconfig setup is turned OFF for Cloudera Manager Agent.

```
clush -a -B chkconfig --list cloudera-scm-agent
```

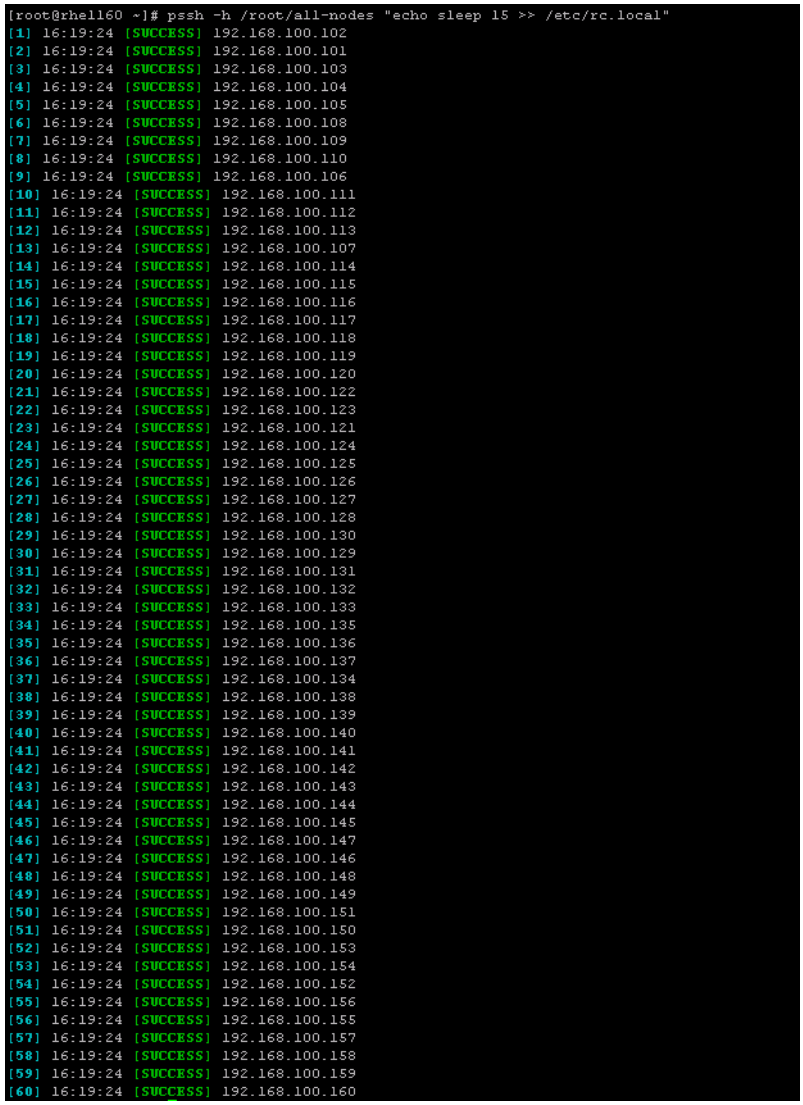
Figure 344 Turnoff Check Configuration



4. Introduce a delay of 15 seconds into initialization script "/etc/rc.local" of all VMs.

```
pssh -h /root/all-nodes "echo sleep 15 >> /etc/rc.local"
```

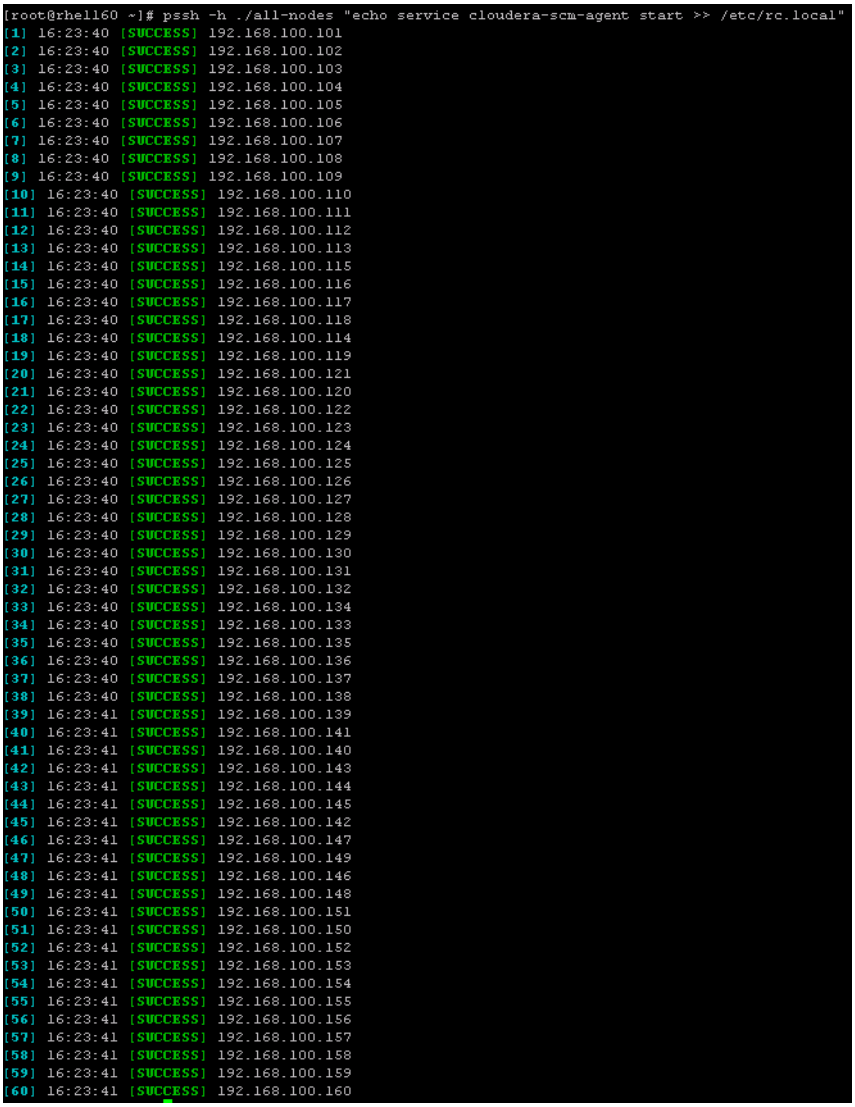
Figure 345 Set a Delay of 15 secs



5. Insert a command to start the Cloudera Manager Agent at the end of Linux system initialization in all the VMs by using the following commands.

```
pssh -h /root/all-nodes "echo service cloudera-scm-agent start >> /etc/rc.local"
```

Figure 346 Start Cloudera Manager Agent



6. Use the Cluster Shell command to verify if the "/etc/rc.local" script contents in all the 60 VMs.

```
clush -a -B cat /etc/rc.local
```

Figure 347 Verify Script Contents Through Cluster Shell Command

```
[root@rhel160 ~]# clush -a -B cat /etc/rc.local
---------------
rhel[101-160]-m (60)
---------------
#!/bin/sh
#
# This script will be executed *after* all the other init scripts.
# You can put your own initialization stuff in here if you don't
# want to do the full Sys V style init stuff.

touch /var/lock/subsys/local
bash /opt/serengeti/sbin/serengeti-onboot.sh
# Need to set HOME explicitly due to http://tickets.opscode.com/browse/CHEF-2646
export HOME=/root
knife exec /etc/chef/bootstrap_node.rb -c /etc/chef/client.rb > /dev/null
bash /opt/cisco/hadoop_node_init.sh
sleep 15
service cloudera-scm-agent start
```

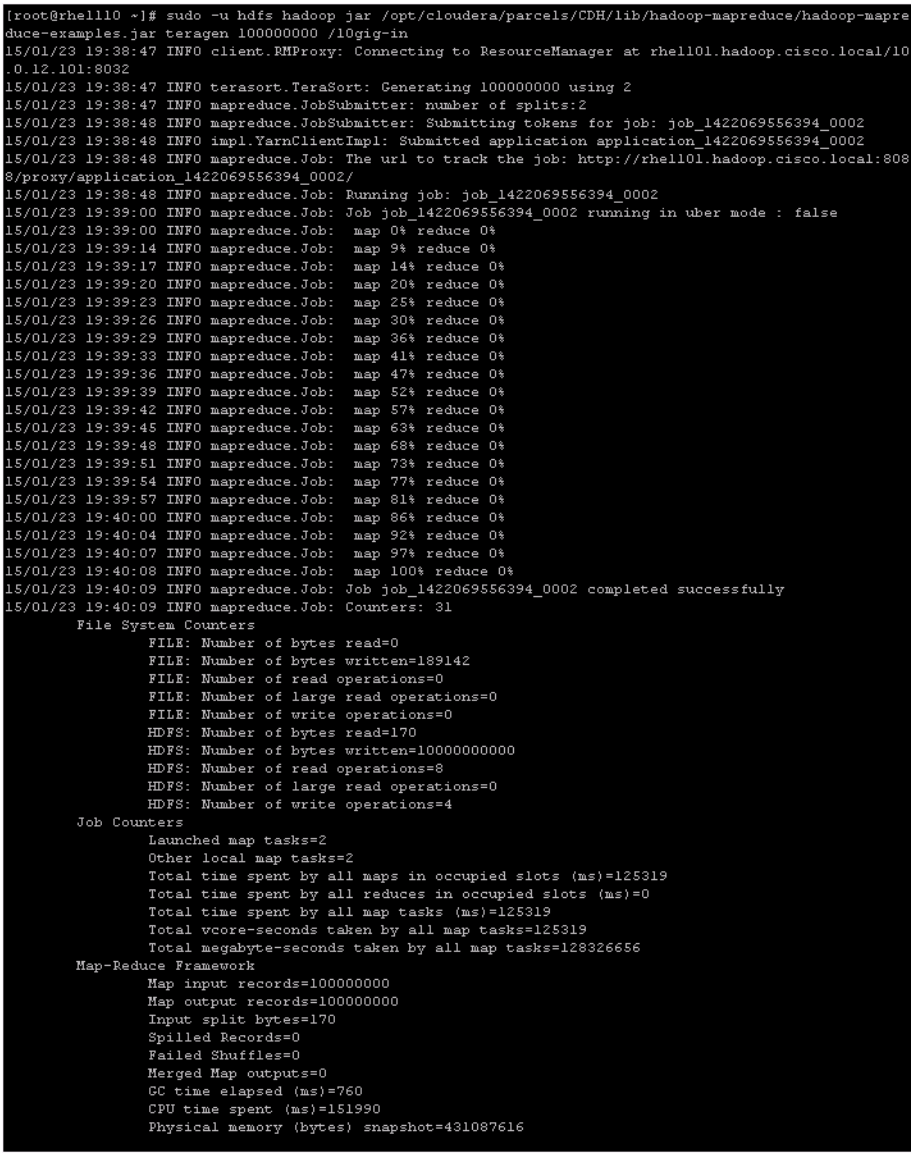
Smoke Test

From the master VM (192.168.100.160 or host: rhel160-m), ssh into one of the nodes with Node-Manager.

1. On this node, execute run a few map-reduce jobs using the hadoop-examples java package, by using the following command.

```
sudo –u hdfs hadoop jar
/opt/cloudera/parcels/CDH/lib/hadoop-mapreduce/hadoop-mapreduce-examples.jar pi 10 100
sudo -u hdfs hadoop jar
/opt/cloudera/parcels/CDH/lib/hadoop-mapreduce/hadoop-mapreduce-examples.jar teragen
100000000 /10gig-in
```

Figure 348 Running a Sample Map-Reduce Job – Teragen




```
sudo -u hdfs hadoop jar
/opt/cloudera/parcels/CDH/lib/hadoop-mapreduce/hadoop-mapreduce-examples.jar terasort
/10gig-in /10gig-out
```

Figure 349 Running a Sample Map-Reduce Job – Terasort

```
[root@rhel110 ~]# sudo -u hdfs hadoop jar /opt/cloudera/parcels/CDH/lib/hadoop-mapreduce/hadoop-mapre
duce-examples.jar terasort /10gig-in /10gig-out
15/01/23 19:41:22 INFO terasort.TeraSort: starting
15/01/23 19:41:23 INFO input.FileInputFormat: Total input paths to process : 2
Spent 189ms computing base-splits.
Spent 4ms computing TeraScheduler splits.
Computing input splits took 194ms
Sampling 10 splits of 20
Making 232 from 100000 sampled records
Computing parititions took 551ms
Spent 750ms computing partitions.
15/01/23 19:41:24 INFO client.RMProxy: Connecting to ResourceManager at rhel101.hadoop.cisco.local/10
.0.12.101:8032
15/01/23 19:41:25 INFO mapreduce.JobSubmitter: number of splits:20
15/01/23 19:41:25 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1422069556394_0003
15/01/23 19:41:25 INFO impl.YarnClientImpl: Submitted application application_1422069556394_0003
15/01/23 19:41:25 INFO mapreduce.Job: The url to track the job: http://rhel101.hadoop.cisco.local:808
8/proxy/application_1422069556394_0003/
15/01/23 19:41:25 INFO mapreduce.Job: Running job: job_1422069556394_0003
15/01/23 19:41:37 INFO mapreduce.Job: Job job_1422069556394_0003 running in uber mode : false
15/01/23 19:41:37 INFO mapreduce.Job:  map 0% reduce 0%
15/01/23 19:41:50 INFO mapreduce.Job:  map 32% reduce 0%
15/01/23 19:41:51 INFO mapreduce.Job:  map 35% reduce 0%
15/01/23 19:41:53 INFO mapreduce.Job:  map 47% reduce 0%
15/01/23 19:41:56 INFO mapreduce.Job:  map 55% reduce 0%
15/01/23 19:41:59 INFO mapreduce.Job:  map 56% reduce 0%
15/01/23 19:42:02 INFO mapreduce.Job:  map 70% reduce 0%
15/01/23 19:42:08 INFO mapreduce.Job:  map 74% reduce 0%
15/01/23 19:42:11 INFO mapreduce.Job:  map 84% reduce 0%
15/01/23 19:42:14 INFO mapreduce.Job:  map 94% reduce 0%
15/01/23 19:42:17 INFO mapreduce.Job:  map 100% reduce 0%
15/01/23 19:42:32 INFO mapreduce.Job:  map 100% reduce 2%
15/01/23 19:42:33 INFO mapreduce.Job:  map 100% reduce 9%
15/01/23 19:42:34 INFO mapreduce.Job:  map 100% reduce 13%
15/01/23 19:42:35 INFO mapreduce.Job:  map 100% reduce 14%
15/01/23 19:42:37 INFO mapreduce.Job:  map 100% reduce 62%
15/01/23 19:42:38 INFO mapreduce.Job:  map 100% reduce 72%
15/01/23 19:42:39 INFO mapreduce.Job:  map 100% reduce 75%
15/01/23 19:42:40 INFO mapreduce.Job:  map 100% reduce 81%
15/01/23 19:42:41 INFO mapreduce.Job:  map 100% reduce 83%
15/01/23 19:42:42 INFO mapreduce.Job:  map 100% reduce 96%
15/01/23 19:42:43 INFO mapreduce.Job:  map 100% reduce 100%
15/01/23 19:42:49 INFO mapreduce.Job: Job job_1422069556394_0003 completed successfully
15/01/23 19:42:49 INFO mapreduce.Job: Counters: 49
        File System Counters
                FILE: Number of bytes read=9110712097
                FILE: Number of bytes written=13190552313
                FILE: Number of read operations=0
                FILE: Number of large read operations=0
                FILE: Number of write operations=0
                HDFS: Number of bytes read=10000002540
                HDFS: Number of bytes written=10000000000
                HDFS: Number of read operations=756
                HDFS: Number of large read operations=0
                HDFS: Number of write operations=464
        Job Counters
                Launched map tasks=20
                Launched reduce tasks=232
                Rack-local map tasks=20
                Total time spent by all maps in occupied slots (ms)=706300
                Total time spent by all reduces in occupied slots (ms)=3193495
                Total time spent by all map tasks (ms)=706300
                Total time spent by all reduce tasks (ms)=3193495
```

Hadoop Cluster Administration

An organization implementing a Hadoop solution, may want to grow the Hadoop cluster by adding more VMs to it or by simply adding more memory/CPUs to the existing VMs. Such changes can be performed by means of the BDE plugin in the vSphere Web Client or via Serengeti CLI.

Whenever such changes are made to the underlying VM Cluster, the Hadoop cluster state will get disturbed temporarily. The following procedure describes how to gracefully make changes to the Hadoop cluster The table below shows actual the procedure that must be carried out for the type of change performed.

VMWare BDE provides multiple ways to resize the VM Cluster. The VM Cluster can be scaled up/down, scale out. The VM Cluster can be simply powered down or up. The following table captures the steps that need to be performed to administer the Hadoop cluster properly.

Table 20 Steps for Administering Hadoop Cluster

VM Cluster Change performed in BDE	Action that must be performed to the Hadoop Cluster
Cluster shutdown	N/A

Cluster startup	1. Wait until the BDE reports the cluster state as RUNNING.
	2. Log onto the Master VM using SSH (IP: 192.168.100.160, Hostname: rhel160), and issue a manual reboot command.
	3. Once the Master VM is back up, log back in to confirm that the hostname is set back to "rhel160".
	4. and issue a "parallel-SSH" reboot command to all the Worker VMs.
	`pssh –h /root/worker-nodes reboot`
	5. Wait for about 3-5 minutes for all the Worker-VMs to come back up.
	6. From the Master VM execute a cluster-shell command to read the hostname of all the VMs. All VMs should display the hostname in this format.
	`"rhel[101-160].hadoop.cisco.local"`
	`clush -a hostname`
	`clush -a -B hostname`
	7. From Cloudera Manager UI, make sure all the services up and running properly, and restart any service if at all necessary.

Cluster Scale-Up/Scale-Down to change the amount of Master VM's Compute or Memory resources.	1. Upon the completion of the BDE change, log onto the Master VM using SSH (IP: 192.168.100.160, Hostname: rhel160), and issue a manual reboot command. 2. Once the Master VM is back up, log back in to confirm that the hostname is set back to "rhel160". 3. From Cloudera Manager UI, make sure all the services up and running properly, and restart any service if at all necessary.

Cluster Scale-Up/Scale-Down to change the amount of Worker VMs' Compute or Memory resources.	1. Upon the completion of the BDE change, log onto the Master VM using SSH (IP: 192.168.100.160, Hostname: rhel160), and issue a "parallel-SSH" reboot command to all the Worker VMs.
	`pssh –h /root/all-nodes reboot`
	2. Wait for about 3-5 minutes for all VMs (Master and all Workers) to come back up.
	3. From the Master VM execute a cluster-shell command to read the hostname of all the VMs. All VMs should display the hostname in this format "rhel[101-160].hadoop.cisco.local"
	`clush -a hostname`
	`clush -a -B hostname`
	4. From Cloudera Manager UI, make sure all the services up and running properly, and restart any service if at all necessary.

Table 20 Steps for Administering Hadoop Cluster

VM Cluster Change performed in BDE	Action that must be performed to the Hadoop Cluster

Add a new Worker VM to the VM Cluster by using the Scale-Out function in BDE.	For example, let's assume we added new VM with IP addresses:192.168.100.161, 10.0.11.161 and 10.0.12.161 with a Management network assigned hostname "rhel161-vm".
	1. Upon the completion of the BDE change, log onto the Master VM using SSH (IP: 192.168.100.160, Hostname: rhel160).
	2. Copy over the RSA public-key file from the Master VM to the new VM by using the following command:
	`ssh-copy-id –i /root/.ssh/id_rsa.pub rhel161-m`
	3. Log onto the new worker VM(rhel161-vm), and create a new directory called "/opt/cisco" in the new Worker VM
	`ssh rhel161-m`
	`mkdir -p /opt/cisco`
	`exit`
	4. From the new Master VM(rhel160-m), copy over the hadoop_node_init.sh script from the master VM local directory "/opt/cisco" to the corresponding directory in the new Worker VM (rhel161-m).
	`scp /opt/cisco/hadoop_node_init.sh rhel161-m:/opt/cisco`
	5. Invoke the hadoop_init_script.sh from the "/etc/rc.local" file of the new Worker-VM.
	`ssh rhel161-m`
	`echo bash /opt/cisco/hadoop_node_init_sh >> /etc/rc.local`
	6. Verify all the above changes have been done properly.
	7. Reboot the new Worker VM (rhel161-m).
	8. In the Master VM, Add the Management IP-address of the new Worker VM (192.168.100.161) to the:"/root/worker-nodes" file.
	`echo 192.168.100.161 >> /root/worker-nodes`
	`echo 192.168.100.161 >> /root/all-nodes`
	9. In the Master VM, edit the "/etc/cluster-shell/groups" to make the group entries to be as follows:
	`all: rhel[101-161]-m`
	`workers: rhel[101-159,161]-m`
	10. Once the new Worker VM is back up, log back in to check the hostname. It should show "rhel161.hadoop.cisco.local".
	11. You may also verify the hostname or any other parameters from the Master VM, by using the "clush –a" command.
	`clush -a hostname`
	`or`
	`clush -a -B hostname`
	12. Use Cloudera Manager UI to add service roles to the new Worker VM.

Table 20 Steps for Administering Hadoop Cluster

VM Cluster Change performed in BDE	Action that must be performed to the Hadoop Cluster

	13. After the new VM (i.e. rhel161-m: 192.168.100.161) has been added to the Hadoop cluster, perform the Post-VM configuration steps on this VM. See (refer to the new section Change102).
	14. Log onto the VM using SSH to 192.168.100.161.
	15. Disable the automatic startup of the Cloudera Manager Agent in all the VMs by entering the following command:
	`chkconfig cloudera-scm-agent off`
	16. Introduce a delay of 15 seconds into initialization script "/etc/rc.local" of all VMs.
	`echo sleep 15 >> /etc/rc.local`
	17. Insert a command to start the Cloudera Manager Agent at the end of Linux system initialization by using the following command.
	`echo service cloudera-scm-agent start >> /etc/rc.local`
	Now the VM has been fully provisioned to serve as a Hadoop node.

Conclusion

Hadoop has become the leading data processing and cost-effective analytics platform of recent times. The Cisco UCS and Isilon Scale-Out NAS along with VMware's vSphere Big Data Extensions offer a flexible and scalable service-oriented model for enterprise Hadoop cluster deployments (Virtualized Hadoop) with an outlook to meet the growing needs. Virtualized Hadoop offers elasticity, flexibility, and multi-tenancy, which makes it an excellent platform for voluminous data processing. Cisco UCS along with VMware vSphere Big Data Extensions and Cloudera Manager make it easy to deploy and scale the Hadoop clusters to meet the changing needs of today's enterprise customers. Cisco UCS and EMC Isilon's scale-out architecture paves the way to achieve the Business Data Lake architecture by separating data from compute. In this architecture, the data can be analyzed by various compute node setup as per the analytics logic.

The configuration detailed in the document can be extended to clusters of various sizes depending on the application demands. Up to 48 servers (6 Chassis populated with Cisco UCS B200 M3 Blade Servers) and 24 Node S200 Cluster can be supported with no additional switching in a single Cisco UCS domain. Scaling beyond 48 servers can be accomplished by interconnecting multiple Cisco UCS domains using Nexus 5000/7000/9000 Series switches, and getting managed in a single pane using UCS Central.

Disclaimer

This solution has not been tested with Kerberos enabled. Although Kerberos is supported by Cloudera Manager for securing Hadoop clusters, this document does not address the procedures required to provision it. Please refer to the relevant Kerberos configuration documentations of Cloudera Manager and EMC Isilon for further details about how to incorporate Kerberos to secure this Hadoop deployment.

Table 21 Kerberos References

Cloudera Kerberos configuration	http://www.cloudera.com/content/cloudera/en/documentation/core/v5-2-x/topics/cm_sg_authentication.html
EMC Isilon best practices for Hadoop Data Storage (section: Securing HDFS Connections with Kerberos)	http://www.emc.com/collateral/white-paper/h12877-wp-emc-isilon-hadoop-best-practices.pdf

Bill of Materials

This section provides the Bill of Materials (BOM) for Cisco UCS and EMC Isilon hardware and the software that were used to build this solution.

Note Table 23 and Table 25 provide the modified BOM with newer hardware specifications that is, with UCS B200 M4 blade servers and EMC Isilon S210 Scale-Out NAS respectively.

Table 22 Bill of Materials for UCS with B200 M3 Blade Servers (as specified in this document)

SKU	Description	Quantity	
		Master Rack	Expansion Rack
UCS-FI-6296UP-UPG	UCS 6296UP 2RU Fabric Int/No PSU/48 UP/ 18p LIC	2	-
CON-3SNTP-FI6296UP	3YR SMARTNET 24X7X4 UCS 6296UP 2RU Fabric Int/2 PSU/4 Fans	2	-
UCS-ACC-6296UP	UCS 6296UP Chassis Accessory Kit	2	-
SFP-H10GB-CU3M	10GBASE-CU SFP+ Cable 3 Meter	48	48
UCS-PSU-6296UP-AC	UCS 6296UP Power Supply/100-240VAC	4	-
CAB-C13-C14-2M	Power Cord Jumper, C13-C14 Connectors, 2 Meter Length	4	-
N10-MGT012	UCS Manager v2.2	2	-
UCS-LIC-10GE	UCS 6200 Series ONLY Fabric Int 1PORT 1/10GE/FC-port license	20	48
UCS-FAN-6296UP	UCS 6296UP Fan Module	8	-

Table 22 Bill of Materials for UCS with B200 M3 Blade Servers (as specified in this document)

SKU	Description	Quantity	
		Master Rack	Expansion Rack
UCS-BLKE-6200	UCS 6200 Series Expansion Module Blank	6	-
N20-C6508-UPG	UCS 5108 Blade Server AC Chassis/0 PSU/8 fans/0 fabric extender	2	2
CON-3SNTP-2C6508	3YR SMARTNET 24X7X4 5108 Blade Server Chassis	2	2
N20-FAN5	Fan module for UCS 5108	16	16
N20-CAK	Accessory kit for UCS 5108 Blade Server Chassis	2	2
N01-UAC1	Single phase AC power module for UCS 5108	2	2
UCSB-5108-PKG-HW	UCS 5108 Packaging for chassis with half width blades.	2	2
N20-CBLKB1	Blade slot blanking panel for UCS 5108/single slot	16	16
UCS-IOM-2208XP	UCS 2208XP I/O Module (8 External, 32 Internal 10Gb Ports)	4	4
CAB-C19-CBN	Cabinet Jumper Power Cord, 250 VAC 16A, C20-C19 Connectors	8	8
N20-FW012	UCS Blade Server Chassis FW Package 2.2	2	2
UCSB-PSU-2500ACDV	2500W Platinum AC Hot Plug Power Supply - DV	8	8
UCSB-B200M3-U	UCS B200 M3 Blade Server w/o CPU, memory, HDD, mLOM/mezz (UPG)	16	16
CON-3OSP-B200M3-U	3YR SMARTNET24X7X4OS UCS B200 M3 Blade Se	16	16
UCS-CPU-E52660B	2.20 GHz E5-2660 v2/95W 10C/25MB Cache/DDR3 1866MHz	32	32
UCS-MR-1X162RZ-A	16GB DDR3-1866-MHz RDIMM/PC3-14900/dual rank/x4/1.5v	256	256

Table 22 Bill of Materials for UCS with B200 M3 Blade Servers (as specified in this document)

SKU	Description	Quantity	
		Master Rack	Expansion Rack
A03-D1TBSATA	1TB 6Gb SATA 7.2K RPM SFF HDD/hot plug/drive sled mounted	32	32
UCSB-MLOM-40G-01	Cisco UCS VIC 1240 modular LOM for M3 blade servers	16	16
UCSB-HS-01-EP	CPU Heat Sink for UCS B200 M3 and B420 M3	32	32
VMW-VS5-ENTP-3A	VMware vSphere 5 Enterprise Plus (1 CPU), 3yr support required	32	32
CON-ISV1-VS5ENTP3A	ISV 24X7 VMware vSphere 5 EPlus for 1 P, 3 yr, RQD	32	32
RHEL-2S-1G-3A	Rhel/2 Socket/1 Guest/3yr services required	62	64
CON-ISV1-RH2S4G3A	ISV 24X7 Rhel/2 Socket/1 guest, list price is annual.	62	64
VMW-VC5-STD-3A=	VMware vCenter 5 Server Standard, 3 yr support required.	1	-
CON-ISV1-VC5STD3A	ISV 24X7 VMware vCenter Server Standard, list price is annual	1	-
UCS-VMW-TERMS	Acceptance of Terms, Standalone VMW license for UCS Servers	1	

The following table consist of the Bill of materials for UCS with the latest B200 M4 blade servers. See: http://www.cisco.com/c/en/us/products/collateral/servers-unified-computing/ucs-b200-m4-blade-server/datasheet-c78-732434.pdf

Table 23 Bill of Materials for UCS with B200 M4 Blade Servers

SKU	Description	Quantity	
		Master Rack	Expansion Rack
UCS-FI-6296UP-UPG	UCS 6296UP 2RU Fabric Int/No PSU/48 UP/ 18p LIC	2	-
CON-3SNTP-FI6296UP	3YR SMARTNET 24X7X4 UCS 6296UP 2RU Fabrc Int/2 PSU/4 Fans	2	-

Table 23 Bill of Materials for UCS with B200 M4 Blade Servers

SKU	Description	Quantity	
		Master Rack	Expansion Rack
UCS-ACC-6296UP	UCS 6296UP Chassis Accessory Kit	2	-
SFP-H10GB-CU3M	10GBASE-CU SFP+ Cable 3 Meter	48	48
UCS-PSU-6296UP-AC	UCS 6296UP Power Supply/100-240VAC	4	-
CAB-C13-C14-2M	Power Cord Jumper, C13-C14 Connectors, 2 Meter Length	4	-
N10-MGT012	UCS Manager v2.2	2	-
UCS-LIC-10GE	UCS 6200 Series ONLY Fabric Int 1PORT 1/10GE/FC-port license	20	48
UCS-FAN-6296UP	UCS 6296UP Fan Module	8	-
UCS-BLKE-6200	UCS 6200 Series Expansion Module Blank	6	-
N20-C6508-UPG	UCS 5108 Blade Server AC Chassis/0 PSU/8 fans/0 fabric extender	2	2
CON-SNTP-2C6508	3YR SMARTNET 24X7X4 5108 Blade Server Chassis	2	2
N20-FAN5	Fan module for UCS 5108	16	16
N20-CAK	Accessory kit for UCS 5108 Blade Server Chassis	2	2
N01-UAC1	Single phase AC power module for UCS 5108	2	2
UCSB-5108-PKG-HW	UCS 5108 Packaging for chassis with half width blades.	2	2
N20-CBLKB1	Blade slot blanking panel for UCS 5108/single slot	16	16
UCS-IOM-2208XP	UCS 2208XP I/O Module (8 External, 32 Internal 10Gb Ports)	4	4
CAB-C19-CBN	Cabinet Jumper Power Cord, 250 VAC 16A, C20-C19 Connectors	8	8
N20-FW012	UCS Blade Server Chassis FW Package 2.2	2	2

Table 23 Bill of Materials for UCS with B200 M4 Blade Servers

SKU	Description	Quantity	
		Master Rack	Expansion Rack
UCSB-PSU-2500ACDV	2500W Platinum AC Hot Plug Power Supply - DV	8	8
VMW-VC5-STD-3A=	VMware vCenter 5 Server Standard, 3 yr support required	1	-
CON-ISV1-VC5STD3A	ISV 24X7 VMware vCenterServer Standard, List Price is ANNUAL	1	-
UCS-VMW-TERMS	Acceptance of Terms, Standalone VMW License for UCS Servers	1	-
UCSB-B200-M4-U	UCS B200 M4 w/o CPU, mem, drive bays, HDD, mezz (UPG)	16	16
CON-3SNTP-B200M4U	3YR SMARTNET 24X7X4UCS B200 M4 w/o CPU,m,dr b, HDD,m (UPG)	16	16
UCS-MR-1X162RU-A	16GB DDR4-2133-MHz RDIMM/PC4-17000/dual rank/x4/1.2v	256	256
UCS-HD12T10KS2-E	1.2 TB 6G SAS 10K rpm SFF HDD	32	32
UCSB-MLOM-40G-03	Cisco UCS VIC 1340 modular LOM for blade servers	16	16
VMW-VS5-ENTP-3A	VMware vSphere 5 Enterprise Plus (1 CPU),3yr Support Required	32	32
CON-ISV1-VS5ENTP3A	ISV 24X7 VMware vSphere 5 EPlus for 1 P,3 Yr,RQD	32	32
UCSB-HS-EP-M4-F	CPU Heat Sink for UCS B200 M4 Socket 1 (Front)	16	16
UCSB-HS-EP-M4-R	CPU Heat Sink for UCS B200 M4 Socket 2 (Rear)	16	16
UCSB-MRAID12G	Cisco FlexStorage 12G SAS RAID controller with Drive bays	16	16
UCS-CPU-E52670D	2.30 GHz E5-2670 v3/120W 12C/30MB Cache/DDR4 2133MHz	32	32

Table 23 Bill of Materials for UCS with B200 M4 Blade Servers

SKU	Description	Quantity	
		Master Rack	Expansion Rack
RHEL-2S-1G-3A	Rhel/2 Socket/1 Guest/3yr services required	62	64
CON-ISV1-RH2S4G3A	ISV 24X7 Rhel/2 Socket/1 guest, list price is annual	62	64

Table 24 and Table 25 provide the Bill of Materials (BOM) for Isilon Scale-Out NAS.

Table 24 Bill of Materials for Isilon S200 Scale-Out NAS (as specified in this document)

SKU	Description	Quantity	
		Master Rack	Expansion Rack
S200-SAS-S32	S200-19.8T+400G SSD/96G/2x10GE SFP+2x1GE	8	8
851-0209	Cable, IB, QSFP-CX4, 3M	16	16
800-0012	PWRCRD, 2, IEC320 C14-C13, 208V universal	16	16
851-0151	Switch IB QDR 48 Port 2PS 10U -120	2	-
PSINST-ESRS	zero dollar ESRS install	1	1
PS-BAS-INIS2U	Isilon 2U Installation Base	1	1
M-PREHWI-001	Premium hardware support	1	1
M-PRESWI-001	Premium software support	1	1
200-0262	SmartConnect Advanced (Software)	8	8
	HDFS licenses (included)	1	-

The following table consist of the Bill of materials for EMC Isilon S210 Scale-out NAS. See: http://www.emc.com/collateral/hardware/specification-sheet/h10690-ss-isilon-s-series.pdf

Table 25 Bill of Materials for Isilon S210 Scale-Out NAS

SKU	Description	Quantity	
		Master Rack	Expansion Rack
S210-SAS-S11	S210-13.8TB+800GB SSD/256G/2x10GE+2x1GE	8	8
851-0209	Cable, IB, QSFP-CX4, 3M	16	16
800-0012	PWRCRD, 2, IEC320 C14-C13, 208V universal	16	16

Table 25 Bill of Materials for Isilon S210 Scale-Out NAS

SKU	Description	Quantity	
		Master Rack	Expansion Rack
851-0151	Switch IB QDR 48 Port 2PS 10U -120	2	-
PSINST-ESRS	zero dollar ESRS install	1	1
PS-BAS-INIS2U	Isilon 2U Installation Base	1	1
M-PREHWI-001	Premium hardware support	1	1
M-PRESWI-001	Premium software support	1	1
200-0262	SmartConnect Advanced (Software)	8	8
	HDFS licenses (included)	1	-

Table 26 provides the BOM for Cloudera Enterprise License.

Table 26 Bill of Materials for Cloudera Enterprise License

SKU	Description	Master Rack	Expansion Rack
UCS-BD-CEDN=	Cloudera Enterprise	60 instances	64 instances

Appendix

Script for Creating Hadoop Users on Isilon OneFS

```
### The script has been copied from Github page:
https://github.com/claudiofahey/isilon-hadoop-tools/releases on 10/26/2014.
#!/bin/bash
################################################################################
##  Script to create Hadoop users on Isilon.
##  Must be run on Isilon system as root.
################################################################################

if [ -z "$BASH_VERSION" ] ; then
   # probably using zsh...
   echo "Script not run from bash -- reinvoking under bash"
   bash "$0"
   exit $?
fi

declare -a ERRORLIST=()

DIST=""
STARTUID=1000
STARTGID=1000
ZONE="System"

#set -x
```

```
function banner() {
   echo
"##############################################################################################"
   echo "## $*"
   echo
"##############################################################################################"
}

function usage() {
   echo "$0 --dist <cdh|hwx|phd> --startgid <GID>] [--startuid <UID>] [--zone <ZONE>]"
   exit 1
}

function fatal() {
   echo "FATAL:  $*"
   exit 1
}

function warn() {
   echo "ERROR:  $*"
   ERRORLIST[${#ERRORLIST[@]}]="$*"
}

function addError() {
   ERRORLIST+=("$*")
}

function yesno() {
   [ -n "$1" ] && myPrompt=">>> $1 (y/n)? "
   [ -n "$1" ] || myPrompt=">>> Please enter yes/no: "
   read -rp "$myPrompt" yn
   [ "z${yn:0:1}" = "zy" -o "z${yn:0:1}" = "zY" ] && return 0
#   exit "DEBUG:  returning false from function yesno"
   return 1
}

function uidInUse() {
   isi auth users view --uid $1 --zone $2 > /dev/null 2>&1
}

function userExists() {
   isi auth users view $1 --zone $2 > /dev/null 2>&1
}

function groupExists() {
   isi auth groups view $1 --zone $2 > /dev/null 2>&1
}

function gidInUse() {
   isi auth groups view --gid $1 --zone $2 > /dev/null 2>&1
}

function getUidFromUser() {
   local uid
   uid=$(isi auth users view $1 --zone $2 | awk '/^ *UID:/ {print $2}')
   echo $uid
}

function getUserFromUid() {
   local user
   user=$(isi auth users view --uid $1 --zone $2 | head -1 | awk '/^ *Name:/ {print $2}')
   echo $user
}
```

```
function getGidFromGroup() {
   local gid
   gid=$(isi auth groups view $1 --zone $2 | awk '/^ *GID:/ {print $2}')
   echo $gid
}

function getGroupFromGid() {
   local group
   group=$(isi auth groups view --gid $1 --zone $2 | head -1 | awk '/^ *Name:/ {print
$2}')
   echo $group
}

function getHdfsRoot() {
    local hdfsroot
    hdfsroot=$(isi zone zones view $1 | grep "HDFS Root Directory:" | cut -f2 -d :)
    echo $hdfsroot
}

### MAIN   main()

if [ "`uname`" != "Isilon OneFS" ]; then
   fatal "Script must be run on Isilon cluster as root."
fi

if [ "$USER" != "root" ] ; then
   fatal "Script must be run as root user."
fi

# Parse Command-Line Args
# Allow user to specify what functions to check
while [ "z$1" != "z" ] ; do
    # echo "DEBUG:  Arg loop processing arg $1"
    case "$1" in
      "--dist")
             shift
             DIST="$1"
             echo "Info: Hadoop distribution:  $DIST"
             ;;
      "--startuid")
             shift
             STARTUID="$1"
             echo "Info: users will start at UID $STARTUID"
             ;;
      "--startgid")
             shift
             STARTGID="$1"
             echo "Info: groups will start at GID $STARTGID"
             ;;
      "--zone")
             shift
             ZONE="$1"
             echo "Info: will put users in zone:  $ZONE"
             ;;
      *)
             echo "ERROR -- unknown arg $1"
             usage
             ;;
    esac
    shift;
done

case "$DIST" in
```

```
    "cdh")
        SUPER_USERS="hdfs mapred yarn"
        SUPER_GROUPS="hadoop supergroup"
        REQUIRED_USERS="$SUPER_USERS flume hbase hive hue impala oozie sample solr spark
sqoop2"
        REQUIRED_GROUPS="$REQUIRED_USERS $SUPER_GROUPS sqoop"
        ;;
    "hwx")
        # See
http://docs.hortonworks.com/HDPDocuments/Ambari-1.6.0.0/bk_ambari_reference/content/Defini
ng-service-users-groups-2x.html
        SUPER_USERS="hdfs mapred yarn hbase storm falcon"
        SUPER_GROUPS="hadoop"
        REQUIRED_USERS="$SUPER_USERS tez hive hcat oozie zookeeper ambari-qa"
        REQUIRED_GROUPS="$REQUIRED_USERS $SUPER_GROUPS"
        ;;
    "phd")
        SUPER_USERS="hdfs mapred hbase gpadmin hive yarn"
        SUPER_GROUPS="hadoop"
        REQUIRED_USERS="$SUPER_USERS"
        REQUIRED_GROUPS="$REQUIRED_USERS $SUPER_GROUPS"
        ;;
    *)
        echo "ERROR -- Invalid Hadoop distribution"
        usage
        ;;
esac

HDFSROOT=$(getHdfsRoot $ZONE)
echo "Info: HDFS root:  $HDFSROOT"

# set -x
gid=$STARTGID
for group in $REQUIRED_GROUPS; do
    # echo "DEBUG:  GID=$gid"
    if groupExists $group $ZONE ; then
       gid=$(getGidFromGroup $group $ZONE)
       addError "Group $group already exists at gid $gid in zone $ZONE"
    elif gidInUse $gid $ZONE ; then
       group=$(getGroupFromGid $gid $ZONE)
       addError "GID $gid already in use by group $group in zone $ZONE"
    else
       isi auth groups create $group --gid $gid --zone $ZONE
       [ $? -ne 0 ] && addError "Could not create group $group with gid $gid in zone
$ZONE"
    fi
    gid=$(( $gid + 1 ))
done
# set +x

uid=$STARTUID
for user in $REQUIRED_USERS; do
    # echo "DEBUG:  UID=$uid"
    if userExists $user $ZONE ; then
       uid=$(getUidFromUser $user $ZONE)
       addError "User $user already exists at uid $uid in zone $ZONE"
    elif uidInUse $uid $ZONE ; then
       user=$(getUserFromUid $uid $ZONE)
       addError "UID $uid already in use by user $user in zone $ZONE"
    else
       isi auth users create $user --uid $uid --primary-group $user --zone $ZONE
--provider local --home-directory $HDFSROOT/user/$user
       [ $? -ne 0 ] && addError "Could not create user $user with uid $uid in zone $ZONE"
    fi
```

```
    uid=$(( $uid + 1 ))
done

for user in $SUPER_USERS; do
    for group in $SUPER_GROUPS; do
       isi auth groups modify $group --add-user $user --zone $ZONE
       [ $? -ne 0 ] && addError "Could not add user $user to $group group in zone $ZONE"
       done
done

# Special cases
case "$DIST" in
    "cdh")
        isi auth groups modify sqoop --add-user sqoop2 --zone $ZONE
        [ $? -ne 0 ] && addError "Could not add user sqoop2 to sqoop group in zone $ZONE"
        ;;
esac

### Deliver Results
if [ "${#ERRORLIST[@]}" != "0" ] ; then
   echo "ERRORS FOUND:"
   i=0
   while [ $i -lt ${#ERRORLIST[@]} ]; do
      echo "*  ERROR:  ${ERRORLIST[$i]}"
      i=$(( $i + 1 ))
   done
   fatal "ERRORS FOUND making Hadoop users in zone $ZONE -- please fix before continuing"
   exit 1
else
   echo "SUCCESS -- Hadoop users created successfully!"
fi

echo "Done!"
```

Script for Creating Hadoop User Directories on Isilon OneFS

```
### The script has been copied from Github page:
https://github.com/claudiofahey/isilon-hadoop-tools/releases on 10/26/2014.

#!/bin/bash
##############################################################################
##  Script to create Hadoop directory structure on Isilon.
##  Must be run on Isilon system.
##############################################################################

if [ -z "$BASH_VERSION" ] ; then
   # probably using zsh...
   echo "Script not run from bash -- reinvoking under bash"
   bash "$0"
   exit $?
fi

declare -a ERRORLIST=()

DIST=""
FIXPERM="n"
ZONE="System"

#set -x

function banner() {
```

```
   echo
"##############################################################################################"
   echo "## $*"
   echo
"##############################################################################################"
}

function usage() {
   echo "$0 --dist <cdh|hwx|phd> [--zone <ZONE>] [--fixperm]"
   exit 1
}

function fatal() {
   echo "FATAL:  $*"
   exit 1
}

function warn() {
   echo "ERROR:  $*"
   ERRORLIST[${#ERRORLIST[@]}]="$*"
}

function yesno() {
   [ -n "$1" ] && myPrompt=">>> $1 (y/n)? "
   [ -n "$1" ] || myPrompt=">>> Please enter yes/no: "
   read -rp "$myPrompt" yn
   [ "z${yn:0:1}" = "zy" -o "z${yn:0:1}" = "zY" ] && return 0
#   exit "DEBUG:  returning false from function yesno"
   return 1
}

function makedir() {
   if [ "z$1" == "z" ] ; then
      echo "ERROR -- function makedir needs directory as an argument"
   else
      mkdir $1
   fi
}

function fixperm() {
   if [ "z$1" == "z" ] ; then
      echo "ERROR -- function fixperm needs directory owner group perm as an argument"
   else
      isi_run -z $ZONEID chown $2 $1
      isi_run -z $ZONEID chown :$3 $1
      isi_run -z $ZONEID chmod $4 $1
   fi
}

function getHdfsRoot() {
    local hdfsroot
    hdfsroot=$(isi zone zones view $1 | grep "HDFS Root Directory:" | cut -f2 -d :)
    echo $hdfsroot
}

function getAccessZoneId() {
    local zoneid
    hdfsroot=$(isi zone zones view $1 | grep "Zone ID:" | cut -f2 -d :)
    echo $hdfsroot
}

if [ "`uname`" != "Isilon OneFS" ]; then
   fatal "Script must be run on Isilon cluster as root."
fi
```

```
if [ "$USER" != "root" ] ; then
   fatal "Script must be run as root user."
fi

# Parse Command-Line Args
# Allow user to specify what functions to check
while [ "z$1" != "z" ] ; do
    # echo "DEBUG:  Arg loop processing arg $1"
    case "$1" in
      "--dist")
             shift
             DIST="$1"
             echo "Info: Hadoop distribution:  $DIST"
             ;;
      "--zone")
             shift
             ZONE="$1"
             echo "Info: will use users in zone:  $ZONE"
             ;;
      "--fixperm")
             echo "Info: will fix permissions and owners on existing directories"
             FIXPERM="y"
             ;;
      *)     echo "ERROR -- unknown arg $1"
             usage
             ;;
    esac
    shift;
done

declare -a dirList

case "$DIST" in
    "cdh")
        # Format is: dirname#perm#owner#group
        dirList=(\
            "/#755#hdfs#hadoop" \
            "/hbase#755#hbase#hbase" \
            "/solr#775#solr#solr" \
            "/tmp#1777#hdfs#supergroup" \
            "/tmp/logs#1777#mapred#hadoop" \
            "/user#755#hdfs#supergroup" \
            "/user/history#777#mapred#hadoop" \
            "/user/hive#775#hive#hive" \
            "/user/hive/warehouse#1777#hive#hive" \
            "/user/hue#755#hue#hue" \
            "/user/hue/.cloudera_manager_hive_metastore_canary#777#hue#hue" \
            "/user/impala#775#impala#impala" \
            "/user/oozie#775#oozie#oozie" \
            "/user/spark#755#spark#spark" \
            "/user/spark/applicationHistory#1777#spark#spark" \
            "/user/sqoop2#775#sqoop2#sqoop" \
        )
        ;;
    "hwx")
        # Format is: dirname#perm#owner#group
        dirList=(\
            "/#755#hdfs#hadoop" \
            "/tmp#1777#hdfs#hdfs" \
            "/user#755#hdfs#hdfs" \
            "/user/ambari-qa#770#ambari-qa#hdfs" \
            "/user/hcat#755#hcat#hdfs" \
            "/user/hive#700#hive#hdfs" \
```

```
            "/user/oozie#775#oozie#hdfs" \
        )
        ;;
    "phd")
        # Format is: dirname#perm#owner#group
        dirList=(\
            "/#755#hdfs#hadoop" \
            "/apps#755#hdfs#hadoop#" \
            "/apps/hbase#755#hdfs#hadoop" \
            "/apps/hbase/data#775#hbase#hadoop" \
            "/apps/hbase/staging#711#hbase#hadoop" \
            "/hawq_data#770#gpadmin#hadoop"
            "/hive#755#hdfs#hadoop" \
            "/hive/gphd#755#hdfs#hadoop" \
            "/hive/gphd/warehouse#1777#hive#hadoop" \
            "/mapred#755#mapred#hadoop" \
            "/mapred/system#700#mapred#hadoop" \
            "/tmp#777#hdfs#hadoop" \
            "/tmp/gphdtmp#777#hdfs#hadoop" \
            "/user#777#hdfs#hadoop" \
            "/user/history#777#mapred#hadoop" \
            "/user/history/done#777#mapred#hadoop" \
            "/user/history/done_intermediate#1777#mapred#hadoop" \
            "/yarn#755#hdfs#hadoop" \
            "/yarn/apps#777#mapred#hadoop" \
        )
        ;;
    *)
        echo "ERROR -- Invalid Hadoop distribution"
        usage
        ;;
esac

ZONEID=$(getAccessZoneId $ZONE)
echo "Info: Access Zone ID is $ZONEID"

HDFSROOT=$(getHdfsRoot $ZONE)
echo "Info: HDFS root dir is $HDFSROOT"

if [ ! -d $HDFSROOT ] ; then
   fatal "HDFS root $HDFSROOT does not exist!"
fi

# MAIN

banner "Creates Hadoop directory structure on Isilon system HDFS."

prefix=0
# Cycle through directory entries comparing owner, group, perm
# Sample output from "ls -dl"  command below
# drwxrwxrwx    8 hdfs  hadoop  1024 Aug 26 03:01 /tmp

for direntry in ${dirList[*]}; do
   read -a specs <<<"$(echo $direntry | sed 's/#/ /g')"
   echo "DEBUG: specs dirname ${specs[0]}; perm ${specs[1]}; owner ${specs[2]}; group
${specs[3]}"
   ifspath=$HDFSROOT${specs[0]}
   # echo "DEBUG:  ifspath = $ifspath"

   #  Get info about directory
   if [ ! -d $ifspath ] ; then
      # echo "DEBUG:  making directory $ifspath"
      makedir $ifspath
      fixperm $ifspath ${specs[2]} ${specs[3]} ${specs[1]}
```

```
   elif [ "$FIXPERM" == "y" ] ; then
      # echo "DEBUG:  fixing directory perm $ifspath"
      fixperm $ifspath ${specs[2]} ${specs[3]} ${specs[1]}
   else
      warn "Directory $ifspath exists but no --fixperm not specified"
   fi

done

if [ "${#ERRORLIST[@]}" != "0" ] ; then
   echo "ERRORS FOUND:"
   i=0
   while [ $i -lt ${#ERRORLIST[@]} ]; do
      echo "ERROR:  ${ERRORLIST[$i]}"
      i=$(($i + 1))
   done
   fatal "ERRORS FOUND making Hadoop admin directory structure -- please fix before
continuing"
   exit 1
else
   echo "SUCCESS -- Hadoop admin directory structure exists and has correct ownership and
permissions"
fi

echo "Done!"
```