Enterprise Data Lake with Cisco UCS S3260 Storage Server and Hortonworks Data Platform

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Executive Summary

Data is being generated on an unprecedented scale. More data is being collected more quickly and stored longer than ever before. Traditional transactional data is being supplemented with data from high-speed, real-time streaming systems, and then stored for long periods of time both for archival and regulatory purposes. Business Data Lakes centered around Hadoop-based storage are becoming common. Once there is ability to store and load these different types of datasets the next step is to gain business value by processing, analyzing gaining insights and taking action on data.

The Cisco® UCS S3260 Storage Server is the latest addition to the highly successful Cisco Unified Computing System™ (Cisco UCS®) reference architecture for big data. This server provides up to 600 terabytes (TB) in only four rack units (4RU), providing the best dollar-per-terabyte value while delivering superior computing performance and a balanced core-to-spindle ratio. The Cisco® UCS S3260 Storage Server provides superior performance at a lower total cost. Fewer servers mean less rack space, fewer OS and software licenses, and less networking equipment to purchase and maintain, and lower power and cooling costs. The Cisco UCS S3260 Storage Server is specifically designed to process huge volumes of data with high performance.

The modular design of the Cisco® UCS S3260 Storage Server protects your long-term technology investment. The computing, storage, and network components can be upgraded independently as technology advances. There is no need to replace the entire server; simply upgrade an individual component.

It complements Cisco UCS Integrated Infrastructure for Big Data and Analytics, a highly scalable architecture for big data systems that includes computing, storage, and networking resources fully managed through Cisco UCS Manager and linearly scalable to thousands of nodes using Cisco Nexus® 9000 Series Switches and the Cisco Application Centric Infrastructure (Cisco ACI™) platform.

The Cisco UCS S3260 Storage Server for Big Data and Analytics with Hortonworks Data Platform is a tested, reliable method for big data systems. Together, they power the next generation architecture for taking full advantage of the power of data to accelerate decision-making and innovation.
Solution Overview

Introduction

Massive amounts of information and data are being generated every second. Big Data is not just some abstract concept but it has become a priority for many organizations. This solution unlocks the value of big data while maximizing existing investments.

Apache Hadoop is the most popular big data framework. The technology is evolving rapidly to enable decisions while working large volumes of data. A solution that can work effectively to enable processing of multiple petabytes of data to get actionable insights is needed.

The Cisco UCS S3260 Storage Server is specifically designed to address this with its modular design and unique capabilities. It is designed with the flexibility to handle both high-capacity and high-performance workloads.

Solution

This solution is a simple and linearly scalable architecture that provides data processing on Hortonworks Data Platform that enables data processing with a centrally managed automated Hadoop deployment, providing all the benefits of the Cisco Unified Computing System (UCS).

Some of the features of this solution include:

- Infrastructure for both big data and large scale analytics
- Simplified infrastructure management via the Cisco UCS Manager
- Architectural scalability - linear scaling based on network, storage and compute requirements.
- Usage of Hortonworks Data Platform (HDP) for comprehensive cluster monitoring and management

This solution is based on the Cisco Unified Computing System (Cisco UCS) infrastructure using Cisco UCS 6300 Series Fabric Interconnects, and Cisco UCS S3260 Storage Servers. This architecture is specifically designed to power data processing on dense compute and storage servers for big data deployments.

Audience

This document describes the architecture and deployment procedures for Hortonworks Data Platform (HDP) on an Enterprise data lake using 8 Cisco UCS S3260 Storage Servers with two C3x60 M4 server nodes each as worker nodes, and 3 Cisco UCS C240 M4 Rack Servers as master nodes. The intended audience for this document includes, but is not limited to, sales engineers, field consultants, professional services, IT managers, partner engineering, and customers who want to deploy Hortonworks Data Platform (HDP) on the Cisco Unified Computing System (UCS) using Cisco UCS S3260 Storage Servers.
Solution Overview

Solution Summary

This CVD describes in detail the process for installing Hortonworks 2.5.0 including the configuration details of the cluster.

The configuration using Cisco UCS S3260 Storage Servers as data nodes and Cisco UCS C240 M4 Rack Servers as management nodes, is shown in Error! Reference source not found. This configuration supports the massive scalability that big data enterprise deployments demand.

Table 1  Reference Architecture Configuration Details

<table>
<thead>
<tr>
<th>Connectivity: Two Cisco UCS 6332 Fabric Interconnects</th>
<th>Three Cisco UCS C240 M4 Rack Servers each with:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eight Cisco UCS S3260 Storage Server Chassis, each with two C3x60 M4 server nodes, each server node with:</td>
<td></td>
</tr>
<tr>
<td>• Two Intel Xeon processor E5-2680 v4 CPUs (14 cores on each CPU)</td>
<td>• Two Intel Xeon processor E5-2680 v4 CPUs (14 cores on each CPU)</td>
</tr>
<tr>
<td>• 256 GB of memory</td>
<td>• 256 GB of memory</td>
</tr>
<tr>
<td>• Cisco UCS-C3K-M4RAID  SAS Modular RAID Controller with 4-GB FBWC</td>
<td>• Cisco 12-Gbps SAS Modular RAID Controller with 2-GB FBWC</td>
</tr>
<tr>
<td>• Twenty-four 4-TB 7,200-rpm LFF SAS drives (96 terabytes [TB])</td>
<td>• Twelve 1.2-TB 10,000-rpm SFF SAS drives</td>
</tr>
<tr>
<td>• Cisco UCS VIC 1387 (with 2 x 40 Gigabit Ethernet QSFP ports)</td>
<td>• Cisco UCS VIC 1387 (with 2 x 40 Gigabit Ethernet QSFP ports)</td>
</tr>
<tr>
<td>• Two 480-GB 6-Gbps 2.5-inch enterprise value SATA SSD drives for boot</td>
<td>• Two 240-GB 6-Gbps 2.5-inch enterprise value SATA SSD drives for boot</td>
</tr>
</tbody>
</table>

Scaling/Performance Options

The server supports upto 28 LFF disk drives of various capacities. The base reference configuration consists of 24 LFF drives each with 4 TB capacity. The storage capacities can be extended as shown in Table 2 below.

Table 2  Disk Drive Options

<table>
<thead>
<tr>
<th>HDD Type</th>
<th>Capacity with 24 disk drives</th>
<th>Capacity with 28 disk drives</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 TB 7200 rpm LFF SAS drives</td>
<td>1.54 PetaBytes</td>
<td>1.8 PetaBytes</td>
</tr>
<tr>
<td>6 TB 7200 rpm LFF SAS drives</td>
<td>2.38 PetaBytes</td>
<td>2.68 PetaBytes</td>
</tr>
<tr>
<td>8 TB 7200 rpm LFF SAS drives</td>
<td>3.07 PetaBytes</td>
<td>3.58 PetaBytes</td>
</tr>
<tr>
<td>10 TB 7200 rpm LFF SAS drives</td>
<td>3.84 PetaBytes</td>
<td>4.48 PetaBytes</td>
</tr>
</tbody>
</table>
Reference Architecture

Figure 1 shows the base configuration of the enterprise data lake cluster. It is comprised of 16 data nodes (worker nodes) using 8 Cisco UCS S3260 Storage Servers and 3 management nodes (master nodes) using Cisco UCS C240 M4 Rack Servers.

![Figure 1 Reference Architecture](image)

Note: This CVD describes the installation process of HDP 2.5.0 for a 16 node cluster (with three management nodes).

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connectivity</td>
<td>2 x Cisco UCS 6332 32-Port Fabric Interconnects</td>
</tr>
<tr>
<td>HDP Nodes</td>
<td>8 x Cisco UCS S3260 Storage Servers</td>
</tr>
<tr>
<td></td>
<td>3 x Cisco UCS C240 M4 Rack Servers</td>
</tr>
<tr>
<td></td>
<td>Hadoop NameNode/Secondary NameNode and Resource Manager and Data Nodes.</td>
</tr>
</tbody>
</table>
Spark Executors are collocated on a Data Node.
*Please refer to the Service Assignment section for specific service assignment and configuration details.

Cisco UCS S3260 Storage Server for Big Data and Analytics with HDP

This solution is based on the Cisco Unified Computing System (Cisco UCS) infrastructure using Cisco UCS 6300 Series Fabric Interconnects, and Cisco UCS S3260 Storage Servers. This architecture is specifically designed for high performance and linear scalability for big data workloads and is built using the following components:

Cisco UCS S3260 Storage Server

The Cisco UCS S3260 Storage Server (Figure 2) is a high-density modular storage server designed to deliver efficient, industry-leading storage for data-intensive workloads. The Cisco UCS S3260 Storage Server is a modular chassis with dual server nodes (two servers per chassis) and up to 60 large-form-factor (LFF) drives in a 4RU form factor. The server uses dual Intel® Xeon® Processor E5-2600 v4 Series CPUs and supports up to 512 GB of main memory and a range of hard-disk-drive (HDD) options. It comes with a pass-through controller or a RAID card with 4 GB cache and host bus adapter (HBA) controller, and up to two internal solid-state-disk (SSD) drives for boot, as shown in Figure 3.

Figure 2  Cisco UCS S3260 Storage Server
The Cisco UCS S3260 Storage Server chassis has 56 top-load LFF HDDs option as shown above with a maximum capacity of 4 TB per HDD (supports 4TB, 6TB, 8TB and 10TB) and can be mixed with up to 28 SSDs.

**Figure 3**  Cisco UCS S3260 Storage Server Chassis - Back view, showing Two Servers

The modular Cisco UCS S3260 Storage Server chassis offers flexibility with more computing, storage, and PCIe expansion on the second slot in the chassis. This second slot can be used for:

- An additional server node
- Four additional LFF HDDs with up to 10 TB capacity per HDD
- New PCIe expansion tray with up to two x8 half-height, half-width PCIe slots that can use any industry-standard PCIe card including Fibre Channel and Ethernet cards.

The Cisco UCS S3260 Storage Server Chassis includes a Cisco UCS Virtual Interface Card (VIC) 1300 platform chip onboard the system I/O controller, offering high-performance bandwidth with dual-port 40 Gigabit Ethernet and FCoE interfaces per system I/O controller.

**Cisco UCS C240 M4 Rack Server**

Cisco UCS C240 M4 High-Density Rack Server (Small Form Factor Disk Drive Model), are enterprise-class systems that support a wide range of computing, I/O, and storage-capacity demands in compact designs. Cisco UCS C-Series Rack-Mount Servers are based on the Intel Xeon® E5-2600 v4 series processor family that delivers the best combination of performance, flexibility, and efficiency gains, with 12-Gbps SAS throughput. The Cisco UCS C240 M4 Rack Servers provide 24 DIMMs slots and can support up to 1.5 TB of main memory, (128 or 256 GB is typical for Big Data applications). It can support a range of disk drive and SSD options; twenty-four Small Form Factor (SFF) disk drives plus two (optional) internal SATA boot drives, for a total of 26 drives, are supported in the Performance Optimized option. Twelve Large Form Factor (LFF) disk drives, plus two (optional) internal SATA boot drives, for a total of 14 internal drives, are supported in the Capacity Optimized option, along with 2x1 Gigabit Ethernet embedded LAN-on-motherboard (LOM) ports. Cisco UCS Virtual Interface Cards 1387 (VICs), designed for the M4 generation of Cisco UCS C-Series Rack Servers, are optimized for high-
bandwidth and low-latency cluster connectivity, with support for up to 256 virtual devices, that are configured on demand through Cisco UCS Manager. Figure 4 shows the Cisco UCS C240 M4 Rack Server.

**Figure 4** Cisco UCS C240 M4 Rack Server

![Cisco UCS C240 M4 Rack Server](image)

**Figure 5** Back View of Cisco UCS C240 M4 Rack Server

![Back View of Cisco UCS C240 M4 Rack Server](image)

**Cisco UCS VIC 1387**

Cisco UCS Virtual Interface Cards (VICs) are unique to Cisco. The Cisco UCS VIC 1387 incorporates next-generation converged network adapter (CNA) technology from Cisco, and offers dual 40-Gbps ports designed for use with Cisco UCS Rack-Mount Servers. Optimized for virtualized networking, this card delivers high performance and bandwidth utilization, and supports up to 256 virtual devices.

The Cisco UCS VIC 1387 (Figure 6) offers dual-port, Enhanced Quad, Small Form-Factor Pluggable (QSFP) 40 Gigabit Ethernet and Fiber Channel over Ethernet (FCoE), in a modular-LAN-on-motherboard (mLOM) form factor. The mLOM slot can be used to install a Cisco VIC without consuming a PCIe slot providing greater I/O expandability.
Cisco UCS 6300 Series Fabric Interconnects

Cisco UCS 6300 Series Fabric Interconnects as shown in Figure 7, provide high-bandwidth, low-latency connectivity for servers, with Cisco UCS Manager providing integrated, unified management for all connected devices. The Cisco UCS 6300 Series Fabric Interconnects are a core part of Cisco UCS, providing low-latency, lossless 40 Gigabit Ethernet, Fibre Channel over Ethernet (FCoE), and Fibre Channel functions with management capabilities for systems 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 Manager enables rapid and consistent server configuration using service profiles and automates 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 alerts and send notifications about the health of the entire cluster.

Figure 6 Cisco UCS VIC 1387

Figure 7 Cisco UCS 6332 32-Port Fabric Interconnect
Cisco UCS Manager

Cisco UCS Manager resides within the Cisco UCS 6300 Series Fabric Interconnect. 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), as shown in Figure 8, 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 the process takes minutes instead of days. This simplification allows IT departments to shift their focus from constant maintenance to strategic business initiatives.

The new Cisco UCS Manager has smart capabilities such as predictive drive failure and rebuild. With the integration with Cisco UCS S3260 Storage Server, Cisco UCS Manager can be configured to have hot spare drives in case of any drive failure. In such a case, Cisco UCS Manager will automatically detect the failed drives and replace it with one of the available hot spare drives, rebuild it and make it available to use within the Chassis.

Figure 8  Cisco UCS Manager

Hortonworks (HDP 2.5.0)

The Hortonworks Data Platform (HDP) delivers essential capabilities in a completely open, integrated and tested platform that is ready for enterprise usage. With Hadoop YARN at its core, HDP provides flexible enterprise data processing across a range of data processing engines, paired with comprehensive enterprise capabilities for governance, security and operations.
All the integration of the entire solution is thoroughly tested and fully documented. By taking the guesswork out of building out a Hadoop deployment, HDP gives a streamlined path to success in solving real business problems.

HDP for Data Access

With YARN at its foundation, HDP provides a range of processing engines that allow users to interact with data in multiple and parallel ways, without the need to stand up individual clusters for each data set/application. Some applications require batch while others require interactive SQL or low-latency access with NoSQL. Other applications require search, streaming or in-memory analytics. Apache Solr, Storm and Spark fulfill those needs respectively.

To function as a true data platform, the YARN-based architecture of HDP enables the widest possible range of access methods to coexist within the same cluster avoiding unnecessary and costly data silos.

As shown in Figure 9, HDP Enterprise natively provides for the following data access types:

- **Batch** – Apache MapReduce has served as the default Hadoop processing engine for years. It is tested and relied upon by many existing applications.
- **Interactive SQL Query** – Apache Hive™ is the de facto standard for SQL interactions at petabyte scale within Hadoop. Hive delivers interactive and batch SQL querying across the broadest set of SQL semantics.
- **Search** – HDP integrates Apache Solr to provide high-speed indexing and sub-second search times across all your HDFS data.
- **Scripting** – Apache Pig is a scripting language for Hadoop that can run on MapReduce or Apache Tez, allowing you to aggregate, join and sort data.
- **Low-latency access via NoSQL** – Apache HBase provides extremely fast access to data as a columnar format, NoSQL database. Apache Accumulo also provides high-performance storage and retrieval, but with fine-grained access control to the data.
- **Streaming** – Apache Storm processes streams of data in real time and can analyze and take action on data as it flows into HDFS.

**Figure 9** YARN
HDP Cluster Operations

HDP delivers a comprehensive set of completely open operational capabilities that provide both visibilities into cluster health as well as the ability to manage, monitor and configure resources.

- Apache Ambari – is a completely open framework to provision, manage and monitor Apache Hadoop clusters. It provides a simple, elegant UI that allows you to image a Hadoop cluster.
- Apache Oozie - provides a critical scheduling capability to organize and schedule jobs within Enterprise Hadoop across all data access points.

Apache Spark

Traditional servers are not designed to support the massive scalability, performance and efficiency requirements of big data solutions. These outdated and siloed computing solutions are difficult to integrate with network and storage resources, and are time-consuming to deploy and expensive to operate. The Cisco Unified Computing System takes a different approach, combining computing, networking, storage access and management capabilities into a unified, fabric-based architecture that is optimized for big data workloads.

Apache Spark enhances the existing big data environments by adding new capabilities to Hadoop or other big data deployments. The platform unifies a broad range of capabilities—batch processing, real-time stream processing, advanced analytic capabilities, and interactive exploration—that can intelligently optimize applications.

Spark provides programmers with an application interface centered on a data structure called the resilient distributed dataset (RDD), a read-only set of data items distributed over a cluster of machines that is maintained in a fault-tolerant way.

Figure 10  Apache Spark Libraries

As shown in Figure 10 above, Apache Spark has a number of libraries:

- Apache Spark SQL/DataFrame API for querying structured data inside Spark programs.
- Apache Spark streaming offers Spark’s core API enabling real-time processing of streaming data, including web server log files, social media, and messaging queues.
- MLLib to take advantage of machine-learning algorithms and accelerate application performance across clusters.

Spark can access diverse data sources including HDFS, Cassandra, HBase, and S3. Spark with YARN is an optimal way to schedule and run Spark jobs on a Hadoop cluster alongside a variety of other data processing frameworks, leveraging existing clusters using queue-based placement policies, and enabling security by running on Kerberos enabled clusters.

Some common use cases that are popular in the field with Apache Spark are shown in Table 4.

<table>
<thead>
<tr>
<th>Table 4</th>
<th>Apache Spark Use Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insurance</td>
<td>Optimize claims reimbursement processes by using Spark’s machine learning capabilities to process and analyze all claims.</td>
</tr>
<tr>
<td>Healthcare</td>
<td>Build a Patient Care System using Spark Core, Streaming and SQL.</td>
</tr>
<tr>
<td>Retail</td>
<td>Use Spark to analyze point-of-sale data and coupon usage.</td>
</tr>
<tr>
<td>Internet</td>
<td>Use Spark’s ML capability to identify fake profiles and enhance product matches to show their customers.</td>
</tr>
<tr>
<td>Banking</td>
<td>Use a machine learning model to predict the profile of retail banking customers for certain financial products.</td>
</tr>
<tr>
<td>Government</td>
<td>Analyze spending across geography, time and category.</td>
</tr>
<tr>
<td>Scientific Research</td>
<td>Analyze earthquake events by time, depth and geography to predict future events.</td>
</tr>
<tr>
<td>Investment Banking</td>
<td>Analyze intra-day stock prices to predict future price movements.</td>
</tr>
<tr>
<td>Geospatial Analysis</td>
<td>Analyze Uber trips by time and geography to predict future demand and pricing.</td>
</tr>
<tr>
<td>Twitter Sentiment Analysis</td>
<td>Analyze large volumes of Tweets to determine positive, negative or neutral sentiment for specific organizations and products.</td>
</tr>
<tr>
<td>Airlines</td>
<td>Build a model for predicting airline travel delays.</td>
</tr>
<tr>
<td>Devices</td>
<td>Predict likelihood of a building exceeding threshold temperatures.</td>
</tr>
</tbody>
</table>
Solution Design

Requirements

This CVD describes the architecture and deployment procedures to install Hortonworks (HDP 2.5.0) on eight Cisco UCS S3260 Storage Servers each with two C3x60 M4 server nodes each as Hadoop data nodes, and three Cisco UCS C240 M4 Rack servers as Hadoop Management nodes for Big Data and Analytics. The solution goes into detail configuring HDP 2.5.0 on the infrastructure.

The cluster configuration consists of the following:

- Two Cisco UCS 6332 Fabric Interconnects
- Three Cisco UCS C240 M4 Rack Servers
- Eight Cisco UCS S3260 Storage Servers with two C3x60 M4 server nodes each
- One Cisco R42610 standard racks
- Two Vertical Power distribution units (PDUs) (Country Specific)

Rack and PDU Configuration

Each rack consists of two vertical PDUs. The rack consists of two Cisco UCS 6332 Fabric Interconnects, eight Cisco UCS S3260 Storage Servers with two C3x60 M4 server nodes each and three Cisco UCS C240 M4 Rack Servers. Each chassis is connected to two vertical PDUs for redundancy; ensuring availability during power source failure.

Note: Please contact your Cisco representative for country specific information.

Table 5 Rack Configuration

<table>
<thead>
<tr>
<th>Position</th>
<th>Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td>Cisco UCS FI 6332</td>
</tr>
<tr>
<td>41</td>
<td>Cisco UCS FI 6332</td>
</tr>
<tr>
<td>40</td>
<td>Unused</td>
</tr>
<tr>
<td>39</td>
<td>Unused</td>
</tr>
<tr>
<td>38</td>
<td>Cisco UCS C240 M4 Rack Server</td>
</tr>
<tr>
<td>37</td>
<td>Cisco UCS C240 M4 Rack Server</td>
</tr>
<tr>
<td>36</td>
<td>Cisco UCS C240 M4 Rack Server</td>
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<td>33</td>
<td>Cisco UCS C240 M4 Rack Server</td>
</tr>
<tr>
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<td>Cisco UCS S3260 Storage Server</td>
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Port Configuration on Fabric Interconnects

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Server Configuration and Cabling for UCS S3260 Storage Server

The Cisco UCS S3260 Storage Server Chassis is equipped with two C3x60 M4 server nodes each and four 480 GB SATA SSDs. Each server node is equipped with two Intel Xeon® E5-2680 v4 processors, 256 GB of memory and a Cisco UCS-C3K-M4RAID SAS Modular RAID Controller with 4-GB FBWC.

Figure 11 illustrates the port connectivity between the Fabric Interconnect, and Cisco UCS S3260 Storage Server Chassis. Eight Cisco UCS S3260 Storage Server Chassis are used in single rack configurations.
Figure 11  Fabric Topology for Cisco UCS S3260 Storage Server with UCSC- C3K- M4 SRB server blades

For more information on physical connectivity illustrations and cluster setup, see:

Figure 11 depicts a connectivity between Cisco UCS S3260 Storage Server chassis and Cisco UCS 6300 Fabric Interconnect. Each chassis has two C3x60 M4 server nodes. Each link in the figure represents a 40 Gigabit Ethernet link from Cisco UCS S3260 Storage Server chassis connecting to a Fabric Interconnect. Every chassis is connected to both Fabric Interconnects represented with dual link.

Since each chassis will have two server nodes, the top server node works with the left SIOC and the bottom server node works with right SIOC (as show in Figure 12). Similarly, for the boot drives, the top two SSD slots are assigned for server node 1 and the bottom two SSD slots are assigned for server node 2.

Server Configuration and Cabling for Cisco UCS C240 M4 Rack Server

Each Cisco UCS C240M4 Rack Server is equipped with two Intel Xeon® E5- 2680 v4 processors, 256 GB of memory and a Cisco 12- Gbps SAS Modular RAID Controller with 2- GB FBWC.
**Figure 12** Fabric Topology for Cisco UCS C240 M4 Rack Server

![Cisco UCS S3260 Storage Server Scaling with Cisco Application Centric Infrastructure (ACI)](image)

The system architecture includes the Cisco UCS S3260 Storage Server chassis, each Fabric Interconnect domain can have 12 chassis under a single pair of Fabric Interconnect which are interconnected through Cisco Application Centric Infrastructure (ACI) Fabric.

The ACI Fabric consists of three major components: the Application Policy Infrastructure Controller (APIC), spine switches, and leaf switches. These three components handle both the application of network policy and the delivery of packets.

The system architecture can be scaled up linearly and consists of 1 domain (1 pair of FIs) connecting to ACI having two Nexus 9508 switches acting as a Spine and two Nexus 9332PQ as the leaf switches and three APIC-L1 as an APIC appliance.
ACI Scaling Diagram

The following explains the system architecture for the base rack:

- The 8 Cisco UCS S3260 Storage Server chassis are rack mounted and connected to a pair of Fabric Interconnect representing a domain through 40GE link (4x40GE link to a pair of FI)
- Multiple such domains can be connected to a pair of ACI leaf switches. Here 40GE x 4 links from each FI are connected to leaf switches. This is done through a virtual port-channel of 2 links connected to each of the Nexus 9332.
- Nexus 9332 receives the 4x40GE from each pair of Fabric Interconnect as a vPC (Virtual Port-Channel), i.e., 2 ports coming from each single FI as an uplink to the leaf. There are 2 vPC for the 1 domain in each of 9332 connecting to a single pair of FIs.
- Each leaf is connected to each Spine via 2 x 40 Gig connectivity cables.
- The three APIC's are connected to two leaves (Nexus 9332) via 10 gig SFP cable.

Six UCS domains can be connected to a pair of Leaf switches, this will accommodate up to 70 Cisco UCS S3260 Storage Servers.

- 1 pair of FI can connect up to 12 chassis
- 1 pair of Leaf switch can connect up to 6 pair of FI
- 1 Pair of Line card can connect up to 9 pair of leaf switches.

Further scaling can be done based on the requirement and is explained in Table 6 below.
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<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 7**  Leaf to Fabric Interconnect Connectivity.
Based on the system architecture above, only 6 UCS FI Domains can be connected to the first pair of leaf switches due to the port restrictions, as the leaf switch needs to connect three APIC Appliances, providing the scalability up to 70 chassis (10 chassis and 3 management nodes for the first domain and 12 chassis in each additional FI Domain). Each additional leaf pair can have up to 7 UCS FI Domain, providing the scalability up to 84 chassis (12 chassis in each FI Domain). The Cisco UCS S3260 Storage Server can be scaled up to 742 chassis with just a pair of line cards on the Nexus 9508 spine switch. Nexus 9508 can have up to 8 linecards, and with all 8 linecards being used for scaling can connect up to 6034 chassis providing a massive storage solution for the industry.

The architecture above has 4 unused ports in each FI, these ports can either be used as an uplink to Leaf switches or can be connected to external appliances. Most Hadoop distributions require more than
3 management nodes in case the data nodes exceed more than 100. In that case these unused ports can be used to connect additional management nodes.

If the scaling is performed beyond the pair of leaf switches, it is recommended to connect APIC in three different leaf switches for maximum redundancy.

Note: This example shows a sample scaling capability using ACI a production implementation might vary based on the customer’s network throughput requirements. Please reach out to a Cisco representative for your specific requirements.

Software Distributions and Versions

The required software distribution versions are listed below.

Hortonworks (HDP 2.5.0)

The Hortonworks Distribution for Apache Hadoop version used is 2.5.0. For more information visit http://www.hortonworks.com

Red Hat Enterprise Linux (RHEL)

The operating system supported is Red Hat Enterprise Linux 7.2. For more information visit http://www.redhat.com.

Software Versions

Table 8 The software version Software Versions

<table>
<thead>
<tr>
<th>Layer</th>
<th>Component</th>
<th>Version or Release</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compute (Chassis)</td>
<td>BIOS</td>
<td>C3x60M4.2.0.13c</td>
</tr>
<tr>
<td>System IO Controller</td>
<td>Board Controller</td>
<td>1.0.14</td>
</tr>
<tr>
<td></td>
<td>Chassis Management Controller</td>
<td>2.0(13aS4)</td>
</tr>
<tr>
<td></td>
<td>Shared Adapter</td>
<td>4.1(2a)</td>
</tr>
<tr>
<td></td>
<td>SAS Expander</td>
<td>04.08.01.B073</td>
</tr>
<tr>
<td>Compute (Server Nodes)</td>
<td>BIOS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Board Controller</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>CIMC Controller</td>
<td>2.0(13e)</td>
</tr>
<tr>
<td>Network</td>
<td>Cisco UCS 6332</td>
<td>3.1(2b)</td>
</tr>
<tr>
<td></td>
<td>Kernel</td>
<td>5.0(3)N2(3.12b)</td>
</tr>
<tr>
<td></td>
<td>Driver</td>
<td>2.3.0.30</td>
</tr>
<tr>
<td>Storage</td>
<td>Storage Controller SAS</td>
<td>29.00.1-0042</td>
</tr>
<tr>
<td></td>
<td>Driver</td>
<td>06.810.10.00</td>
</tr>
<tr>
<td>Software</td>
<td>Red Hat Enterprise Linux Server</td>
<td>7.2 (x86_64)</td>
</tr>
<tr>
<td></td>
<td>Cisco UCS Manager</td>
<td>3.1(2b)</td>
</tr>
<tr>
<td>Layer</td>
<td>Component</td>
<td>Version or Release</td>
</tr>
<tr>
<td>-------</td>
<td>----------------</td>
<td>-------------------</td>
</tr>
<tr>
<td></td>
<td>Hortonworks (HDP)</td>
<td>2.5.0</td>
</tr>
</tbody>
</table>

The latest drivers can be downloaded from the link below:

Note: The Latest Supported RAID controller Driver is already included with the RHEL 7.2 operating system.

Fabric Configuration

This section provides details for configuring a fully redundant, highly available Cisco UCS 6332 fabric configuration.

- Initial setup of the Fabric Interconnect A and B.
- Connect to UCS Manager using virtual IP address of using the web browser.
- Launch UCS Manager.
- Enable server, uplink and appliance ports.
- Start discovery process.
- Create pools and polices for service profile template.
- Create chassis and storage profile.
- Create Service Profile template and 16 Service profiles.
- Associate Service Profiles to servers.

Performing Initial Setup of Cisco UCS 6332 Fabric Interconnects

This section describes the initial setup of the Cisco UCS 6332 Fabric Interconnects A and B.

Configure Fabric Interconnect A

1. Connect to the console port on the first Cisco UCS 6332 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.


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 6332 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 Cisco UCS 6300 Series Fabric Interconnect, see:
Logging Into Cisco UCS Manager

To login to Cisco UCS Manager, complete the following steps:

1. Open a Web browser and navigate to the Cisco UCS 6332 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. (Figure 13)

Adding a 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. Select the LAN tab at the top of the left window, Figure 14.
3. Right-click IP Pool ext-mgmt.
4. Select Create Block of IPv4 Addresses.
5. Enter the starting IP address of the block and number of IPs needed, as well as the subnet and gateway information. (Figure 15)

6. Click OK to create the IP block.

7. Click OK in the message box.

**Enabling Uplink Port**

To enable uplinks ports, complete the following steps:

1. Select the Equipment tab on the top left of the window.

3. Click Ethernet Ports section.

4. Select port 32 that are connected to the uplink switch, right-click, and then select Configure as Uplink Port. (Figure 16)


6. Click Ethernet Ports section.

7. Select port 32 that is connected to the uplink switch, right-click, and then select Configure as Uplink Port.

**Figure 16  Enabling Uplink Ports**

<table>
<thead>
<tr>
<th>VLAN</th>
<th>NIC Port</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLAN76</td>
<td>Eth0</td>
<td>Management &amp; Data Traffic</td>
</tr>
</tbody>
</table>

Configuring VLAN

VLANs are configured as in shown in Table 9.

**Table 9  VLAN Configurations**

<table>
<thead>
<tr>
<th>VLAN</th>
<th>NIC Port</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLAN76</td>
<td>Eth0</td>
<td>Management &amp; Data Traffic</td>
</tr>
</tbody>
</table>

The NIC will carry both the management and the data traffic from VLAN76. A single vNIC is used in this configuration and the Fabric Failover feature in Fabric Interconnects will take care of any physical port down issues. It will be a seamless transition from an application perspective.
To configure VLANs in the Cisco UCS Manager GUI, complete the following steps:

1. Select the **LAN** tab in the left pane in the UCSM GUI.
2. Select LAN > LAN Cloud > VLANs.
3. Right-click the **VLANs** under the root organization.
4. Select **Create VLANs** to create the VLAN. (Figure 17)

**Figure 17** Creating a VLAN

5. Enter **vlan76** for the **VLAN Name**. (Figure 18)
6. Keep multicast policy as **<not set>**.
7. Select **Common/Global** for vlan76.
8. Enter **76** in the **VLAN IDs** field for the Create VLAN IDs.
9. Click **OK** and then, click **Finish**.
10. Click **OK** in the success message box.
11. Click OK and then, click Finish.

Enabling Server Ports

To enable server ports, complete the following steps:

1. Select the Equipment tab on the top left of the window.

2. Select Equipment > Fabric Interconnects > Fabric Interconnect A (primary) > Fixed Module

3. Click the Ethernet Ports section.

4. Select all the ports that are connected to the Servers right-click them, and select Configure as a Server Port. (In this case it is ports 1-19). (Figure 19)

6. Click Ethernet Ports section.

7. Select all the ports that are connected to the Servers right-click them, and select **Configure as a Server Port** (In this case it is ports 1-19).

**Figure 19** Enabling Server Ports

<table>
<thead>
<tr>
<th>Slot</th>
<th>Root Port ID</th>
<th>Port ID</th>
<th>MAC</th>
<th>If Mode</th>
<th>If Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>C046:00:01:16:06</td>
<td>Enable</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>2</td>
<td>C046:00:01:16:12</td>
<td>Disable</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>3</td>
<td>C046:00:01:16:06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>4</td>
<td>C046:00:01:16:1A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>5</td>
<td>C046:00:01:16:1E</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>6</td>
<td>C046:00:01:16:22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>7</td>
<td>C046:00:01:16:26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>8</td>
<td>C046:00:01:16:2A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>9</td>
<td>C046:00:01:16:2E</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>10</td>
<td>C046:00:01:16:02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>11</td>
<td>C046:00:01:16:06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>12</td>
<td>C046:00:01:16:0A</td>
<td></td>
<td></td>
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<tr>
<td>0</td>
<td>0</td>
<td>13</td>
<td>C046:00:01:16:1E</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>14</td>
<td>C046:00:01:16:0F</td>
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<td></td>
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<tr>
<td>0</td>
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<td>C046:00:01:16:14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>16</td>
<td>C046:00:01:16:19</td>
<td></td>
<td></td>
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<tr>
<td>0</td>
<td>0</td>
<td>17</td>
<td>C046:00:01:16:0B</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>0</td>
<td>18</td>
<td>C046:00:01:16:4C</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>0</td>
<td>19</td>
<td>C046:00:01:16:0E</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
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<td>C046:00:01:16:4F</td>
<td></td>
<td></td>
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<td>C046:00:01:16:08</td>
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</tr>
<tr>
<td>0</td>
<td>0</td>
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<td>C046:00:01:16:9C</td>
<td>Unconfigured</td>
<td>Physical</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>23</td>
<td>C046:00:01:16:06</td>
<td>Unconfigured</td>
<td>Physical</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>24</td>
<td>C046:00:01:16:04</td>
<td>Unconfigured</td>
<td>Physical</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>25</td>
<td>C046:00:01:16:6B</td>
<td>Unconfigured</td>
<td>Physical</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>26</td>
<td>C046:00:01:16:0C</td>
<td>Unconfigured</td>
<td>Physical</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>27</td>
<td>C046:00:01:16:70</td>
<td>Unconfigured</td>
<td>Physical</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>28</td>
<td>C046:00:01:16:71</td>
<td>Unconfigured</td>
<td>Physical</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>29</td>
<td>C046:00:01:16:72</td>
<td>Unconfigured</td>
<td>Physical</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>30</td>
<td>C046:00:01:16:73</td>
<td>Unconfigured</td>
<td>Physical</td>
</tr>
</tbody>
</table>

**Creating Chassis Profile**

Chassis profile is required to assign the number of drives to the particular server nodes and also to upgrade the chassis firmware.

**Creating Disk Zoning Policy**

1. Click the Chassis tab on UCS Manager on the top left menu (Figure 20).

2. Expand Policies → Root → Disk Zoning Policies

4. On Create Disk Zoning Policy windows enter the Name UCS and click “+” to create the Disk Zoning. (Figure 21)
In the Add Slots to Policy window (Figure 22), select the “Dedicated” radio button. From the server drop down list choose “1”, from the controller drop down list choose “1”, in the slot range enter 1-24 and click “OK”.
6. Click “+” again and in Add Slots to Policy window, select the “Dedicated” radio button. From the server drop down list choose “2”, from the controller drop down list choose “1”, in the slot range enter 29-52 and click “OK”. (Figure 23)
Creating Chassis Firmware Package Policy

1. Right click on the Chassis Firmware Packages and click “Create Chassis Firmware Packages”. (Figure 24)
2. In Create Chassis Firmware Package window enter UCS as the Name. (Figure 25)

3. From the Chassis Packages drop down list choose the appropriate package and click OK.

Creating Chassis Profiles from Template

1. Under Chassis Profile Template, right click and click “Create Chassis Profile Templates” (Figure 26).
2. Enter the Name “UCS” and select “Updating Template” as the type, and click Next and Next again. (Figure 27)
3. From the Chassis Firmware Package drop down list choose UCS and click Next. (Figure 28)
4. From the Disk Zoning Policy drop down list choose UCS and click Finish. (Figure 29)
5. Right click on the Chassis Profiles and click “Create Chassis Profile from Templates” (Figure 30).
6. Enter Chassis as the Naming Prefix, the Number of Instances is “8” and from the Chassis Profile Template drop down list choose “Chassis Profile Template UCS” and click OK. (Figure 31)

**Figure 30** Create Chassis Profile from Templates

**Figure 31** Chassis Profile Template UCS
Associating Chassis Profiles to Individual Chassis

1. On the Cisco UCS Manager UI select the Equipment tab. Under Equipment expand Chassis.

2. Select the Chassis and click Associate Chassis Profile. (Figure 32)

Figure 32  Associate Chassis Profiles

3. Select “Chassis Profile Chassis 1” and click “OK”. (Figure 33)
4. Repeat steps 2 and 3 for the rest of the chassis.

5. Once the chassis profile is associated, only 24 disks will be assigned to each server node.

6. To verify that, go to Equipment → Chassis → 1 → Server 1. Click on the Inventory → Storage → Disks. Expand Storage controller SAS 1. (Figure 34)
Creating a Storage Profile for Boot Drives

1. Go to Storage and expand Storage → Storage Policies. Right click on Disk Group Policies and click Create Disk Group Policies. (Figure 35)

2. In the Create Disk Policy window, configure the following parameters and click OK. (Figure 36)
   a. Name = “Boot_SSD”
   b. RAID Level = RAID 1 Mirrored
   c. Disk Group Configuration=Automatic
   d. Number of Drives=2
Solution Design

- Drive Type = SSD
- Use Remaining Disks = checked
- Strip Size = 64 KB
- Access Policy = Platform Default
- Read Policy = Read Ahead
- Write Cache Policy = Always Write Back
- IO Policy and Drive Cache = Platform Default

**Figure 36** Create Disk Group Policy

3. Click on the Storage tab. Right click on Storage Profile and click Create Storage Profile. (Figure 37)
4. Enter “Boot_SSD” in the name field. Under Local LUNs click “+” to add local lun. (Figure 38)

5. In the Create Local LUN window, enter the name “Boot_SSD”. (Figure 39)

6. Check the “Expand to Available” checkbox to use all available space.

7. Under Select Disk Group Configuration drop down list choose “Boot_SSD” created earlier and click “OK” and “OK” again to complete the configuration.
Creating Pools for Service Profile Templates

Creating MAC Address Pools

To create MAC address pools, complete the following steps:

1. Select the LAN tab on the left of the window.
2. Select Pools > root.
3. Right-click MAC Pools under the root organization.
4. Select Create MAC Pool to create the MAC address pool. Enter ucs for the name of the MAC pool. (Figure 40)
5. (Optional) Enter a description of the MAC pool.
6. Select Assignment Order Sequential.
7. Click Next.
8. Click Add.
9. Specify a starting MAC address. (Figure 41)
10. Specify a size of the MAC address pool, which is sufficient to support the available server resources.
11. Click **OK**.

**Figure 40** Define Name and Description of MAC Pool

**Figure 41** Specify first MAC Address and Size

12. Click **Finish**. (Figure 42)
13. When the message box displays, click OK.

Creating a 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.

To configure the server pool within the Cisco UCS Manager GUI, complete the following steps:

1. Select the Servers tab in the left pane in the UCS Manager GUI.

2. Select Pools > root.

3. Right-click the Server Pools.

4. Select Create Server Pool.

5. Enter your required name ucs for the Server Pool in the name text box. (Figure 43)

6. (Optional) enter a description for the organization.
7. Click Next > to add the servers.

8. Select all the Cisco UCS S3260 Storage Server to be added to the server pool that was previously created (ucs), then Click >> to add them to the pool. (Figure 44)

9. Click Finish.

10. Click OK and then click Finish.
11. Repeat steps 1 through 7 to create another server pool named Management.

12. Select three Cisco UCS C240 M4 Rack Servers to be added to the server pool named Management, then Click >> to add them to the pool. (Figure 45)
13. Click Finish.

14. Click OK and then click Finish

Creating Policies for Service Profile Templates

Creating Host Firmware Package Policy

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

To create a firmware management policy for a given server configuration using the Cisco UCS Manager GUI, complete the following steps:

1. Select the Servers tab in the left pane in the UCS Manager GUI.

2. Select Policies > root.

3. Right-click Host Firmware Packages.

4. Select Create Host Firmware Package.
5. Enter the required Host Firmware package name (ucs). (Figure 46)

6. Select Simple radio button to configure the Host Firmware package.

7. Select the appropriate Rack package that has been installed.

8. Click OK to complete creating the management firmware package

9. Click OK.

**Figure 46  Create Host Firmware Package Screen**

Creating QoS Policies

To create the QoS policy for a given server configuration using the Cisco UCS Manager GUI, complete the following steps:

**Platinum Policy**

1. Select the LAN tab in the left pane in the UCS Manager GUI.

2. Select Policies > root.

4. Select Create QoS Policy. (Figure 47)

**Figure 47** QoS Policies

5. Enter Platinum as the name of the policy. (Figure 48)

6. Select Platinum from the drop down menu.

7. Keep the Burst (Bytes) field set to default (10240).

8. Keep the Rate (Kbps) field set to default (line-rate).

9. Keep Host Control radio button set to default (none).

10. Once the pop-up window appears, click OK to complete the creation of the Policy.
Setting Jumbo Frames

To set Jumbo frames and enable QoS, complete the following steps:

1. Select the **LAN** tab in the left pane in the UCSM GUI.
2. Select **LAN Cloud > QoS System Class**. (Figure 49)
3. In the right pane, select the **General** tab
4. In the **Platinum** row, enter 9216 for MTU.
5. Check the **Enabled** check box next to **Platinum**.
6. In the **Best Effort** row, select **none** for weight.
7. In the **Fiber Channel** row, select **none** for weight.
8. Click **Save Changes**.
9. Click **OK**.

**Figure 49  LAN General**
Creating the Local Disk Configuration Policy

To create the local disk configuration policy in the Cisco UCS Manager GUI, complete the following steps:

1. Select the Servers tab on the left pane in the UCS Manager GUI.
2. Go to Policies > root.
3. Right-click Local Disk Configuration Policies.
4. Select Create Local Disk Configuration Policy.
5. Enter ucs as the local disk configuration policy name. (Figure 50)
6. Change the Mode to Any Configuration. Check 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 50  Create Local Disk Configuration Policy
Creating a Server BIOS Policy

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

To create a server BIOS policy using the Cisco UCS Manager GUI, complete the following steps:

1. Select the Servers tab in the left pane in the UCS Manager GUI.
2. Select Policies > root.
4. Select Create BIOS Policy.
5. Enter your preferred BIOS policy name (ucs).
6. Change the BIOS settings as shown in the following figures.
7. The only changes that need to be made are in the Processor (Figure 51) and RAS Memory settings (Figure 52).
Figure 51 Processor

Unified Computing System Manager

Processor

- Turbo Boost: Disabled
- Enhanced Intel Speedstep: Disabled
- Hyper Threading: Enabled
- Core Multi Processing: All
- Execute Disable Bit: Disabled
- Virtualization Technology (VT): Disabled
- Hardware Prefetcher: Disabled
- Adjacent Cache Line Prefetcher: Disabled
- DCU Streamer Prefetcher: Disabled
- DCUI P Prefetcher: Disabled
- Direct Cache Access: Disabled
- Processor C State: Disabled
- Processor C1E: Disabled
- Processor C3 Report: Disabled
- Processor C6 Report: Disabled
Unified Computing System Manager

Processor

- Processor C7 Report: [ ] disabled [ ] enabled
- Processor CMCI: [ ] enabled [ ] disabled [ ] Platform Default
- CPU Performance: [ ] enterprise [ ] Platform Default
- Max Variable MTRR Settings: [ ] auto-[ ] [ ] [ ] [ ] [ ] [ ] Platform Default
- Local X2APIC: [ ] x2apic [ ] auto [ ] Platform Default
- Power Technology: [ ] performance [ ] Platform Default
- Energy Performance: [ ] performance [ ] Platform Default
- Frequency Floor Override: [ ] disabled [ ] enabled [ ] Platform Default
- P-STATE Coordination: [ ] ove [ ] [ ] [ ] [ ] [ ] [ ] Platform Default
- DEAM Clock Throttling: [ ] performance [ ] Platform Default
- Channel Interleaving: [ ] Platform Default
- Rank Interleaving: [ ] Platform Default
- Demand Scrub: [ ] disabled [ ] enabled [ ] Platform Default
- Patrol Scrub: [ ] disabled [ ] enabled [ ] Platform Default
- Altitude: Package C State Limits: [ ] auto [ ] [ ] [ ] [ ] [ ] [ ] Platform Default
- CPU Hardware Power Management: [ ] disabled [ ] [ ] [ ] [ ] [ ] Platform Default
- Energy Performance Tuning: [ ] os [ ] bios [ ] Platform Default
- Workload Configuration: [ ] balanced [ ] [ ] [ ] Platform Default
Creating the Boot Policy

To create boot policies within the Cisco UCS Manager GUI, complete the following steps:

1. Select the Servers tab in the left pane in the UCS Manager GUI.
2. Select Policies > root.
3. Right-click the Boot Policies.
4. Select Create Boot Policy. (Figure 53)
5. Enter `ucs` as the boot policy name.

6. (Optional) enter a description for the boot policy.

7. Keep the Reboot on Boot Order Change check box unchecked.

8. Keep Enforce vNIC/vHBA/iSCSI Name check box checked.


10. Expand Local Devices and select Add Local Lun.

11. In the Add Local LUN Image Path window, select Primary and enter the Name “Boot_SSD” that was created earlier during storage profile creation step. (Figure 54)

Note: The LUN name must match with the LUN name created earlier.
12. Expand Local Devices > Add CD/DVD and select Add Local CD/DVD. (Figure 55)

13. Expand vNICs and select Add LAN Boot and enter eth0.

14. Click OK to add the Boot Policy.

15. Click OK.

Creating Power Control Policy

To create Power Control policies within the Cisco UCS Manager GUI, complete the following steps:

1. Select the Servers tab in the left pane in the UCS Manager GUI.
2. Select Policies > root.
3. Right-click the Power Control Policies. (Figure 56)
4. Select Create Power Control Policy.
5. Enter ucs as the Power Control policy name. (Figure 57)

6. (Optional) enter a description for the boot policy.

7. Select Performance for Fan Speed Policy.

8. Select No cap for Power Capping selection.

9. Click OK to create the Power Control Policy.

10. Click OK.
To create a Service Profile Template, complete the following steps:

1. Select the Servers tab in the left pane in the UCSM GUI.
2. Right-click Service Profile Templates.
3. Select Create Service Profile Template. (Figure 58)
The Create Service Profile Template window appears. (Figure 59)

To identify the service profile template, complete the following steps:

4. Name the service profile template as ucs. Select the Updating Template radio button.
5. In the UUID section, select Hardware Default as the UUID pool.
6. Click Next to continue to the next section.

**Figure 59  Identify Service Profile Template**

![Create Service Profile Template Window](image)

**Configuring the Storage Provisioning for the Template**

To configure storage policies, complete the following steps:

1. Go to Storage Profile Policy tab, and select Boot_SSD from the drop down list. (Figure 60)
7. Go to the Local Disk Configuration Policy tab, and select ucs for the Local Storage. (Figure 61)

8. Click Next to continue to the next section.
9. Click Next once the Networking window appears, then to go to the next section.

Configuring Network Settings for the Template

1. Keep the **Dynamic vNIC Connection Policy** field at the default. (Figure 62)

2. Select the **Expert** radio button for the option, "How would you like to configure LAN connectivity?"

3. Click **Add** to add a vNIC to the template.
4. The Create vNIC window displays. Name the vNIC eth0. (Figure 63)

5. Select ucs in the Mac Address Assignment pool.

6. Select the Fabric A radio button and check the Enable failover check box for the Fabric ID.

7. Check the VLAN76 check box for VLANs and select the Native VLAN radio button.

8. Select MTU size as 9000.

9. Select adapter policy as Linux.

10. Select QoS Policy as Platinum.

11. Keep the Network Control Policy as Default.

12. Click OK.
Figure 63  Create vNIC

- Name: eth0
- MAC Address Assignment: LVC/20/20
- Fabric ID: Fabric A, Fabric B
- VLAN in LAN cloud will take precedence over the Appliance Cloud when there is a name clash.
- MTU: 9000
- Warning: Make sure that the MTU has the same value in the QoS System Class corresponding to the Egress priority of the selected QoS Policy.
- Pin Group: <not set>

Operational Parameters

- Adaptor Performance Profile
  - Adaptor Policy: Linux
  - QoS Policy: Platinum
  - Network Control Policy: Default

- Connection Policies
  - Dynamic vNIC
  - uNIC
  - VMQ
  - Dynamic vNIC Connection Policy: <not set>
13. Click Next to continue with SAN Connectivity. (Figure 64)

14. Select no vHBAs for How would you like to configure SAN Connectivity? (Figure 65)
15. Click **Next** to continue with Zoning. (Figure 66)
16. Click **Next** to continue with vNIC/vHBA placement. (Figure 67)
17. Click Next to configure vMedia Policy.

Configuring the vMedia Policy for the Template

1. Click Next. When the vMedia Policy window appears, to go to the next section. (Figure 68)
Configuring Server Boot Order for the Template

To set the boot order for the servers, complete the following steps:

1. Select \texttt{ucs} in the Boot Policy name field. (Figure 69)

2. Review to make sure that all of the boot devices were created and identified.

3. Verify that the boot devices are in the correct boot sequence.

4. Click \texttt{OK}.

5. Click \texttt{Next} to continue to the next section.
6. In the Maintenance Policy window, apply the maintenance policy. (Figure 70)

7. Keep the Maintenance policy at no policy used by default. Click Next to continue to the next section.
Configuring Server Assignment for the Template

In the Server Assignment window, to assign the servers to the pool, complete the following steps:

1. Select **ucs** for the Pool Assignment field. (Figure 71)

2. Select the power state to be **Up**.

3. Keep the Server Pool Qualification field set to **<not set>**.

4. Check the Restrict Migration check box.

5. Select **ucs** in Host Firmware Package.
Configuring Operational Policies for the Template

In the Operational Policies Window (Figure 72), complete the following steps:

1. **Select ucs in the BIOS Policy field.**

2. **Select ucs in the Power Control Policy field.**
3. Click Finish to create the Service Profile template.

4. Click OK in the pop-up window to proceed.

5. Select the Servers tab in the left pane of the UCS Manager GUI. (Figure 73)

6. Go to Service Profile Templates > root.

7. Right-click Service Profile Templates ucs.

8. Select Create Service Profiles From Template.
The Create Service Profiles from Template window appears. (Figure 74)

9. Click OK.

Association of the Service Profiles will take place automatically.

The final Cisco UCS Manager window is shown in below.
Creating Service Profile Templates for Hadoop Management Nodes

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.

To configure an organization within the Cisco UCS Manager GUI, complete the following steps:

1. Click on Servers tab, go to Service Profile Template → root.
2. Right click on root and select Create Organization from the options.
3. Enter UCS-C240 as the name for the organization.
4. Click Ok.

Cloning the Template for Hadoop Management Nodes

1. Click on Servers tab, go to Service Profile Template → root.
2. Right click on the existing template UCS and click Create a Clone. (Figure 76)
3. In the Clone Name, enter UCS-C240 and from the Org drop down list choose UCS-C240 and click OK. (Figure 77)

**Figure 77** Create a Clone

4. Go to root → Sub-Organization → UCS-C240 and select the Service Template UCS-C240.

5. In the right window general tab click Associate with Server pool. (Figure 78)

6. In the Pool Assignment drop down list choose Management and click OK.
7. In the right window select the Storage tab and click Modify Storage Profile. (Figure 79)
8. From the Storage profile drop down list choose No Storage Profile and click OK. (Figure 80)
9. Select the Boot Order tab and click Modify Boot Policy.

10. From the Boot Policy drop down list choose Default and click OK. (Figure 81)

**Figure 81** Modify Boot Policy

---

**Creating Service Profile from Template**

1. Go to Servers → Service Profiles → root → Sub-Organization → UCS-C240.

2. Right click and select Create Service Profiles from Template. (Figure 82)
In the Create Service Profiles from Template screen: (Figure 83)

3. Naming Prefix enter MGMT-

4. Name Suffix Starting Number 1

5. Number of Instances 3

6. Service Profile Template UCS-C240 and click OK.

The service profile will be applied to the three Management UCS-C240 M4 Rack Server nodes.

Installing Red Hat Enterprise Linux 7.2 on Management Nodes

The following section provides detailed procedures for installing Red Hat Enterprise Linux 7.2 using Software RAID (OS based Mirroring) on Cisco UCS C240 M4 Rack Servers. There are multiple ways to
install the Red Hat Linux operating system. The installation procedure described in this deployment guide uses KVM console and virtual media from Cisco UCS Manager.

Note: This requires RHEL 7.2 DVD/ISO for the installation.

To install the Red Hat Linux 7.2 operating system, complete the following steps:

1. Log in to the Cisco UCS 6332 Fabric Interconnect and launch the Cisco UCS Manager application.

2. Select the Equipment tab as shown in Figure 84.

3. In the navigation pane expand Rack-Mounts and then Servers.

4. Right click on the server and select KVM Console.

5. In the KVM window, select the Virtual Media tab.

Figure 84  KVM Console

6. Click the Activate Virtual Devices found in the Virtual Media tab. (Figure 85)
7. In the KVM window (Figure 86), select the Virtual Media tab and click the Map CD/DVD.


   **Note:** The Red Hat Enterprise Linux 7.2 DVD is assumed to be on the client machine.

9. Click Open to add the image to the list of virtual media.
10. In the KVM window, select the KVM tab to monitor during boot.

11. In the KVM window, select the Macros > Static Macros > Ctrl-Alt-Del button in the upper left corner.

12. Click OK.

13. Click OK to reboot the system.

14. On reboot, the machine detects the presence of the Red Hat Enterprise Linux Server 7.2 install media.

15. Select the Install or Upgrade an Existing System.
16. Skip the Media test and start the installation.

17. Select language of installation (Figure 87), and click Continue.

**Figure 87  Select Language Window**
18. Select Date and time as shown in Figure 88.

**Figure 88**  Date and Time Window

19. Select the location on the map, set the time and click **Done**.
20. Click on Installation Destination, shown above in Figure 89.
A Caution symbol appears next to Installation Destination as shown in Figure 90 above.

21. This opens the Installation Destination window displaying the boot disks. This is shown in Figure 91 below.

22. Make the selection, and choose "I will configure partitioning." Click Done.
This opens the new window for creating the partitions, as shown in Figure 92.

23. Click on the + sign to add a new partition as shown below, boot partition of size 2048 MB.
24. Click Add Mount Point to add the partition.

The screen refreshes to show the added Mount Point (Figure 93).
25. Change the Device type to RAID and make sure the RAID Level is RAID1 (Redundancy).

26. Click on Update Settings to save the changes.

27. Click on the + sign to create the swap partition of size 2048 MB as shown in Figure 94 below.
28. Change the Device type to RAID and RAID level to RAID1 (Redundancy) and click on Update Settings.
29. Click + to add the / partition. The size can be left empty so it uses the remaining capacity and click Add Mountpoint. (Figure 96).
30. In the next window (Figure 97), change the Device type to RAID and RAID level to RAID1 (Redundancy). Click Update Settings.
31. Click Done to go back to the main screen and continue the Installation.

The Installation screen opens (Figure 98).

32. Click on Software Selection.
The Software Selection screen opens (Figure 99).

33. Select Infrastructure Server and select the Add-Ons as noted below. Click Done.
The Installation Summary window returns (Figure 100).

34. Click on Network and Hostname.
Configure Hostname and Networking for the Host (Figure 101).

35. Type in the hostname as shown below.
36. Click on Configure to open the Network Connectivity window (Figure 102).

37. Click on IPV4Settings.
38. Change the Method to Manual and click Add. Figure 103 shows the Add Details pop up window.

39. Enter the IP Address, Netmask and Gateway details. Click Add after each addition.
40. Click Save.

41. Update the hostname and turn Ethernet ON. Click Done to return to the main menu.

The Installation Summary window opens (Figure 104).

42. Click Begin Installation in the main menu.
A new window opens (Figure 105).

43. Select Root Password in the User Settings.

44. On the next screen (Figure 106), enter the Root Password and click done.
Figure 106  Enter the Root Password

A progress window will open (Figure 107).

Figure 107  Progress Bar

45. Once the installation is complete reboot the system.

46. Repeat steps 1 to 45 to install Red Hat Enterprise Linux 7.2 on other Management Nodes.
Note: The OS installation and configuration of the nodes that is mentioned above can be automated through PXE boot or third party tools.

Installing Red Hat Enterprise Linux 7.2 on Data Nodes

The following section provides detailed procedures for installing Red Hat Enterprise Linux 7.2 on Cisco UCS S3260 Storage Servers. There are multiple ways to install the Red Hat Linux operating system. The installation procedure described in this deployment guide uses KVM console and virtual media from Cisco UCS Manager.

Note: This requires RHEL 7.2 DVD/ISO for the installation

To install the Red Hat Linux 7.2 operating system, complete the following steps:

1. Log in to the Cisco UCS 6332 Fabric Interconnect and launch the Cisco UCS Manager application.

2. Select the Equipment tab.

3. In the navigation pane expand Chassis and then Servers.

4. Right click on the server and select KVM Console. (Figure 108)

5. In the KVM window, select the Virtual Media tab.

Figure 108 KVM Console
6. Click the **Activate Virtual Devices** found in the **Virtual Media tab**. (Figure 109)

**Figure 109 Activate Virtual Devices**

![Image of virtual devices panel](image)

No Signal

7. In the KVM window, select the **Virtual Media tab** and click the **Map CD/DVD**. (Figure 110)

**Figure 110 Map CD/DVD**

![Image of KVM window with map CD/DVD](image)

8. Browse to the **Red Hat Enterprise Linux Server 7.2 installer ISO image file**.

9. **Note**: The **Red Hat Enterprise Linux 7.2 DVD** is assumed to be on the client machine.

9. Click **Open** to add the image to the list of virtual media. (Figure 111)
10. In the KVM window, select the KVM tab to monitor during boot.

11. In the KVM window, select the Macros > Static Macros > Ctrl-Alt-Del button in the upper left corner.

12. Click OK.

13. Click OK to reboot the system.

14. On reboot, the machine detects the presence of the Red Hat Enterprise Linux Server 7.2 install media.

15. Select the Install or Upgrade an Existing System.
16. Skip the Media test and start the installation. (Figure 112)

17. Select language of installation and click Continue. (Figure 113)
18. Select Date and Time, (Figure 114) which pops up another window as shown below in Figure 115.

**Figure 114** Date and Time
19. Select the location on the map, set the time and click **Done**.

20. Click on Installation Destination. (Figure 116)
21. This opens a new window with the boot disks. Make the selection, and choose I will configure partitioning. Click Done. (Figure 117)
22. This opens the new window for creating the partitions. (Figure 118) Click on the + sign to add a new partition as shown below, boot partition of size 2048 MB.

23. Click Add MountPoint to add the partition.
24. Click on the + sign to create the swap partition of size 2048 MB as shown below. (Figure 119)
Figure 119 Add a New Mount Point

25. Click + to add the / partition. The size can be left empty so it uses the remaining capacity and click Add Mountpoint. (Figure 120)
Figure 120 Add a swap

26. Select `/boot` partition and change the Device Type to Standard Partition and the file system to ext4. (Figure 121)

27. Select “/” partition and change the Device Type to Standard Partition and the file system to ext4.

28. Select “swap” partition and change the Device Type to Standard Partition.
29. Click Done to go back to the main screen and continue the Installation.

30. Click on Software Selection. (Figure 122)
Figure 122 Software Selection

31. Select Infrastructure Server and select the Add-Ons as noted below. Click Done. (Figure 123)
32. Click on Network and Hostname and configure Hostname and Networking for the Host. (Figure 124)
33. Type in the hostname as shown below. (Figure 125)
34. Click on Configure to open the Network Connectivity window. Click on Ethernet. (Figure 126)
35. Click on IPv4 Settings and change the Method to Manual and click Add to enter the IP Address, Netmask and Gateway details. (Figure 127)

**Figure 127 Add IP Details**

36. Enter the desired IP address, Netmask and Gateway and click Save. (Figure 128)

**Figure 128 Manual IP Address Entry**
37. Click Save, update the hostname and turn Ethernet ON. Click Done to return to the main menu.

38. Click Begin Installation in the main menu. (Figure 129)

**Figure 129** Begin Installation

39. Select Root Password in the User Settings. (Figure 130)
40. Enter the Root Password and click done. (Figure 131)

The Installation Progress window displays the process. (Figure 132)
41. Once the installation is complete reboot the system.

42. Repeat steps 1 to 40 to install Red Hat Enterprise Linux 7.2 on rest of the Data Nodes.

⚠️ Note: The OS installation and configuration of the nodes that is mentioned above can be automated through PXE boot or third party tools.

The hostnames and their corresponding IP addresses are shown in Table 1.

<table>
<thead>
<tr>
<th>Hostname</th>
<th>eth0</th>
</tr>
</thead>
<tbody>
<tr>
<td>rhel1</td>
<td>172.16.46.11</td>
</tr>
<tr>
<td>rhel2</td>
<td>172.16.46.12</td>
</tr>
<tr>
<td>rhel3</td>
<td>172.16.46.13</td>
</tr>
<tr>
<td>rhel4</td>
<td>172.16.46.14</td>
</tr>
<tr>
<td>rhel1</td>
<td>172.16.46.15</td>
</tr>
<tr>
<td>rhel6</td>
<td>172.16.46.16</td>
</tr>
<tr>
<td>rhel7</td>
<td>172.16.46.17</td>
</tr>
<tr>
<td>rhel8</td>
<td>172.16.46.18</td>
</tr>
<tr>
<td>Hostname</td>
<td>eth0</td>
</tr>
<tr>
<td>----------</td>
<td>-----------</td>
</tr>
<tr>
<td>rhel9</td>
<td>172.16.46.19</td>
</tr>
<tr>
<td>rhel10</td>
<td>172.16.46.20</td>
</tr>
<tr>
<td>rhel11</td>
<td>172.16.46.21</td>
</tr>
<tr>
<td>rhel12</td>
<td>172.16.46.22</td>
</tr>
<tr>
<td>rhel13</td>
<td>172.16.46.23</td>
</tr>
<tr>
<td>rhel14</td>
<td>172.16.46.24</td>
</tr>
<tr>
<td>rhel15</td>
<td>172.16.46.25</td>
</tr>
<tr>
<td>rhel16</td>
<td>172.16.46.26</td>
</tr>
<tr>
<td>rhel17</td>
<td>172.16.46.27</td>
</tr>
<tr>
<td>rhel18</td>
<td>172.16.46.28</td>
</tr>
<tr>
<td>rhel19</td>
<td>172.16.46.29</td>
</tr>
</tbody>
</table>
Choose one of the nodes of the cluster or a separate node as the Admin Node for management such as CDH installation, cluster parallel shell, creating a local Red Hat repo and others. In this document, we use rhel1 for this purpose.

Setting Up Password-less Login

To manage all of the clusters nodes from the admin node, password-less login needs to be setup. It assists in automating common tasks with clush (a cluster wide parallel shell), and shell-scripts without having to use passwords.

Once Red Hat Linux is installed across all the nodes in the cluster, follow the steps below in order to enable password-less login across all the nodes.

1. Login to the Admin Node (rhel1).

   #ssh 172.16.46.11

2. Run the ssh-keygen command to create both public and private keys on the admin node.

   ![ssh-keygen output]

   1. Download sshpass to the node connected to the internet and copy it to the admin node (rhel1) using the command

      wget ftp://195.220.108.108/linux/dag/redhat/el6/en/x86_64/dag/RPMS/sshpass-1.05-1.el6.rf.x86_64.rpm

      scp sshpass-1.05-1.el6.x86_64.rpm rhel1:/root/

   2. Log in to the admin node and Install the rpm using the command
yum -y install sshpass-1.05-1.el6.x86_64.rpm

3. Create a file under ~/.ssh/config and enter the following lines

vi ~/.ssh/config

ServerAliveInterval 99
StrictHostKeyChecking no

4. Then run the following command from the admin 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_keys.

    #for IP in {11..29}; do echo -n "$IP -> "; sshpass -p secret123 ssh-copy-id -i ~/.ssh/id_rsa.pub 172.16.46.$IP; done

Configuring /etc/hosts

Setup /etc/hosts on the Admin node; this is a pre-configuration to setup DNS as shown in the next
section.

To create the host file on the admin node, complete the following steps:

1. Populate the host file with IP addresses and corresponding hostnames on the Admin node
    (rhe1) and other nodes as follows:

2. On Admin Node (rhe1)

    #vi /etc/hosts

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

    172.16.46.11 rhe1
    172.16.46.12 rhe12
    172.16.46.13 rhe13
    172.16.46.14 rhe14
    172.16.46.15 rhe15
    172.16.46.16 rhe16
    172.16.46.17 rhe17
    172.16.46.18 rhe18
    172.16.46.19 rhe19
    172.16.46.20 rhe110
Creating a Red Hat Enterprise Linux (RHEL) 7.2 Local Repo

To create a repository using the RHEL DVD or ISO on the admin node (in this deployment rhel1 is used for this purpose), create a directory with all the required RPMs, run the `createrepo` command and then publish the resulting repository.

1. Log on to rhel1. Create a directory that would contain the repository.
   ```
   mkdir -p /var/www/html/rhelrepo
   ```

2. Create the mount directory for redhat iso.
   ```
   #mkdir -p /mnt/rheliso
   #mount -t iso9660 -o loop /root/rhel-server-7.2-x86_64-dvd.iso /mnt/rheliso/
   ```

   ```
   #cp -r /mnt/rheliso/* /var/www/html/rhelrepo
   ```

4. Now create a .repo file to enable the use of the yum command.
   ```
   #vi /var/www/html/rhelrepo/rheliso.repo
   ```

   [root@rhel1 ~]# mkdir -p /var/www/html/rhelrepo
   [root@rhel1 ~]# mkdir -p /mnt/rheliso
   [root@rhel1 ~]# mount -t iso9660 -o loop /root/rhel-server-7.2-x86_64-dvd.iso /mnt/rheliso/
   mount: /dev(loop0) is write-protected, mounting read-only
   [root@rhel1 ~]# cp -r /mnt/rheliso/* /var/www/html/rhelrepo

   [rhe17.2]
   name=Red Hat Enterprise Linux 7.2
   baseurl=http://172.16.46.11/rhelrepo
gpgcheck=0
enabled=1


   #cp /var/www/html/rhelrepo/rheliso.repo /etc/yum.repos.d/

Note: Based on this repo file yum requires httpd to be running on rhel1 for other nodes to access the repository.

6. To make use of repository files on rhel1 without httpd, edit the baseurl of repo file /etc/yum.repos.d/rheliso.repo to point repository location in the file system.

   #vi /etc/yum.repos.d/rheliso.repo

   [rhel7.2]
   name=Red Hat Enterprise Linux 7.2
   baseurl=file:///var/www/html/rhelrepo
   gpgcheck=0
   enabled=1

Creating the Red Hat Repository Database

   To create a Red Hat Repository Database, complete the following steps:

   1. Install the createrepo package on admin node (rhel1). Use it to regenerate the repository database(s) for the local copy of the RHEL DVD contents.

      #yum -y install createrepo
2. Run createrepo on the RHEL repository to create the repo database on admin node.

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

```
[rhel@rhelrepo # createrepo .
Spawning worker 0 with 3763 pkgs
Workers Finished
Gathering worker results

Saving Primary metadata
Saving file lists metadata
Saving other metadata
Generating sqlite DBs
Sqlite DBs complete
```
Setting up ClusterShell

ClusterShell (or clush) is the cluster-wide shell that runs commands on several hosts in parallel.

1. From the system connected to the Internet download Cluster shell (clush) and copy and install it on rhel1. Cluster shell is available from EPEL (Extra Packages for Enterprise Linux) repository.

   # wget
   ftp://ftp.pbone.net/mirror/ftp.sourceforge.net/pub/sourceforge/c/cl/clustershell/1.7/clustershell-1.7.1.el7.noarch.rpm

   #scp clustershell-1.7.1.el7.noarch.rpm rhel1:/root/

2. Login to rhel1 and install cluster shell.

   #yum -y install clustershell-1.7.1.el7.noarch.rpm
3. Edit /etc/clustershell/groups.d/local.cfg file to include hostnames for all the nodes of the cluster. This set of hosts is taken when running clush with the ‘a’ option.

4. For a 19 node cluster as in our CVD, set groups file as follows:

```
#vi /etc/clustershell/groups.d/local.cfg
```

```
# ClusterShell groups config local.cfg
# Replace /etc/clustershell/groups
# Note: file auto-loaded unless /etc/clustershell/groups is present
# See also groups.d/cluster.yaml.example for an example of multiple sources single flat file setup using YAML syntax.
# Feel free to edit to fit your needs.
all: rhel[1-19]
```

```
all: rhel[1-19]
```


---

**Installing httpd**

Setting up RHEL repo on the admin node requires httpd. To set up RHEL repository on the admin node, complete the following steps:

1. Install httpd on the admin node to host repositories.

   The Red Hat Repository is hosted using HTTP on the admin node, this machine is accessible by all the hosts in the cluster.

   ```
   #yum -y install httpd
   ```

2. Add ServerName and make the necessary changes to the server configuration file.

   ```
   #vi /etc/httpd/conf/httpd.conf
   ServerName 172.16.46.11:80
   ```

3. Start httpd:

   ```
   #service httpd start
   ```
Disabling the Linux Firewall

The default Linux firewall settings are far too restrictive for any Hadoop deployment. Since the UCS Big Data deployment will be in its own isolated network there is no need for that additional firewall.

```
#clush -a -b "service firewalld stop"
#clush -a -b "systemctl disable firewalld"
```

Disabling SELinux

SELinux must be disabled during the install procedure and cluster setup. SELinux can be enabled after installation and while the cluster is running.

1. To disable SELinux, edit `/etc/selinux/config` and change the `SELINUX` line to:
   ```
   SELINUX=disabled.
   ```

2. To disable `SELINUX` on all nodes, use the following command:
   ```
   #clush -a -b "sed -i 's/SELINUX=enforcing/SELINUX=disabled/g' /etc/selinux/config"
   #clush -a -b "setenforce 0"
   ```

   **Note:** The command above may fail if SELinux is already disabled.

3. Reboot the machine to disable SELinux, if does not take effect. Check it using:
   ```
   #clush -a -b sestatus
   ```

Set Up all Nodes to Use the RHEL Repository

**Note:** Based on this repo file yum requires httpd to be running on rhel1 for other nodes to access the repository.

1. Copy the rheliso.repo to all the nodes of the cluster.
   ```
   ```

2. Copy the /etc/hosts file to all nodes.
   ```
   #clush -w rhel[2-19] -c /etc/hosts --dest=/etc/hosts
   ```
3. Purge the yum caches.
   
   #clush -a -B yum clean all
   #clush -a -B yum repolist

   ~
   Note: While the suggested configuration is to disable SELinux, if for any reason SELinux needs to be enabled on the cluster, run the following to make sure that httpd is able to read the Yum repofiles.

   #chcon -R -t httpd_sys_content_t /var/www/html/

Configuring DNS

This section details setting up DNS using dnsmasq as an example based on the /etc/hosts configuration setup in the earlier section.

To create the host file across all the nodes in the cluster, complete the following steps:

1. Disable Network manager on all nodes.
   
   #clush -a -b service NetworkManager stop
   #clush -a -b chkconfig NetworkManager off

2. Update /etc/resolv.conf file to point to Admin Node.
   
   #vi /etc/resolv.conf

   nameserver 172.16.46.11

   ~
   Note: This step is needed to set up dnsmasq on the Admin node. Otherwise this file should be updated with the correct nameserver.

   ~
   Note: Alternatively, #systemctl start NetworkManager.service can be used to start the service. #systemctl stop NetworkManager.service can be used to stop the service. Use #systemctl disable NetworkManager.service to stop a service from being automatically started at boot time.

3. Install and Start dnsmasq on Admin node.

   #service dnsmasq start
   #chkconfig dnsmasq on

4. Deploy /etc/resolv.conf from the admin node (rhel1) to all the nodes via the following clush command:
Post OS Install Configuration

#clush -a -B -c /etc/resolv.conf

Note: A clush copy without - dest copies to the same directory location as the source- file directory.

5. Ensure DNS is working fine by running the following command on Admin node and any data

    node

    [root@rhel2 ~]# nslookup rhel1
    Server: 172.16.46.11
    Address: 172.16.46.11#53
    Name: rhel1
    Address: 172.16.46.11

Note: yum install -y bind-utils will need to be run for nslookup utility to run.

Upgrading the Cisco Network Driver for VIC1387

The latest Cisco Network driver is required for performance and updates. To download the latest drivers go to the link below:


1. In the ISO image, the required driver kmod-enic-2.3.0.30-rhel7u2.el7.x86_64.rpm can be located at \Network\Cisco\VIC\RHEL\RHEL7.2.

2. From a node connected to the Internet, download, extract and transfer kmod-enic-2.3.0.30-rhel7u2.el7.x86_64.rpm to rhel1 (admin node).

3. Install the rpm on all nodes of the cluster using the following clush commands. For this example the rpm is assumed to be in present working directory of rhel1.

    [root@rhel1 ~]# clush -a -b -c kmod-enic-2.3.0.30-rhel7u2.el7.x86_64.rpm
    [root@rhel1 ~]# clush -a -b "rpm -ivh kmod-enic-2.3.0.30-rhel7u2.el7.x86_64.rpm"

4. Ensure that the above installed version of kmod-enic driver is being used on all nodes by running the command "modinfo enic" on all nodes

    [root@rhel1 ~]# clush -a -B "modinfo enic | head -5"

    [root@rhel1 ~]# modinfo enic
    filename: /lib/modules/2.6.32-573.el6.x86_64/extra/enic/enic.ko
    version: 2.3.0.30
5. Also it is recommended to download the kmod-megaraid driver for higher performance, the RPM can be found in the same package at \
Storage\LSI\Cisco_Storage_12G_SAS_RAID_controller\RHEL\RHEL7.2

Installing xfsprogs

From the admin node rhel1 run the command below to Install xfsprogs on all the nodes for xfs filesystem.

#clush -a -B yum -y install xfsprogs

NTP Configuration

The Network Time Protocol (NTP) is used to synchronize the time of all the nodes within the cluster. The Network Time Protocol daemon (ntpd) sets and maintains the system time of day in synchronism with the timeserver located in the admin node (rhel1). Configuring NTP is critical for any Hadoop Cluster. If server clocks in the cluster drift out of sync, serious problems will occur with HBase and other services.

#clush -a -b "yum -y install ntp"

Note: Installing an internal NTP server keeps your cluster synchronized even when an outside NTP server is inaccessible.

1. Configure /etc/ntp.conf on the admin node only with the following contents:

   # vi /etc/ntp.conf
   
   driftfile /var/lib/ntp/drift
   
   restrict 127.0.0.1
   
   restrict -6 ::1
   
   server 127.127.1.0
   
   fudge 127.127.1.0 stratum 10
   
   includefile /etc/ntp/crypto/pw
   
   keys /etc/ntp/keys

2. Create /root/ntp.conf on the admin node and copy it to all nodes

   # vi /root/ntp.conf
   
   server 172.16.46.11
driftfile /var/lib/ntp/drift
restrict 127.0.0.1
restrict -6 ::1
includefile /etc/ntp/crypto/pw
keys /etc/ntp/keys

3. Copy ntp.conf file from the admin node to /etc of all the nodes by executing the following command in the admin node (rhel1)

```bash
# for SERVER in {12..29}; do scp /root/ntp.conf 172.16.46.$SERVER:/etc/ntp.conf; done
```

Note: Instead of the above for loop, this could be run as a clush command with "-w" option.

```bash
#clush -w rhel[2-19] -b -c /root/ntp.conf --dest=/etc
```

4. Run the following to synchronize the time and restart NTP daemon on all nodes.

```bash
#clush -a -b "service ntpd stop"
#clush -a -b "ntpddate rhel1"
#clush -a -b "service ntpd start"
```

5. Ensure restart of NTP daemon across reboots

```bash
#clush -a -b "systemctl enable ntpd"
```

**Enabling Syslog**

Syslog must be enabled on each node to preserve logs regarding killed processes or failed jobs. Modern versions such as syslog-ng and rsyslog are possible, making it more difficult to be sure that a syslog daemon is present.
To confirm that the service is properly configured, use one of the following commands:

#clush -B -a rsyslogd -v
#clush -B -a service rsyslog status

[root@rhell ~]# clush -B -a rsyslogd -v
rsyslogd 7.4.7, compiled with:

FEATURE_REGEXP: Yes
FEATURE_LARGEFILE: No
GSSAPI Kerberos 5 support: Yes
FEATURE_DEBUG (debug build, slow code): No
32bit Atomic operations supported: Yes
64bit Atomic operations supported: Yes
Runtime Instrumentation (slow code): No
uuid support: Yes

See [http://www.rsyslog.com](http://www.rsyslog.com) for more information.

**Setting ulimit**

On each node, `ulimit -n` specifies the number of inodes that can be opened simultaneously. With the default value of 1024, the system appears to be out of disk space and shows no inodes available. Set the value to 64000 on every node.

Higher values are unlikely to result in an appreciable performance gain.

1. For setting the ulimit on Redhat, edit `/etc/security/limits.conf` on admin node rhel1 and add the following lines:

   root soft nofile 64000
   root hard nofile 64000

   [root@rhell ~]# cat /etc/security/limits.conf | grep 64000
   root soft nofile 64000
   root hard nofile 64000

2. Copy the `/etc/security/limits.conf` file from admin node (rhel1) to all the nodes using the following command.

   #clush -a -b -c /etc/security/limits.conf --dest=/etc/security/

   [root@rhell ~]# clush -a -b -c /etc/security/limits.conf --dest=/etc/security/

3. Check that the `/etc/pam.d/su` file contains the following settings:
#%PAM-1.0

auth sufficient pam_rootOK.so

# Uncomment the following line to implicitly trust users in the "wheel" group.
#auth sufficient pam_wheel.so trust use_uid

# Uncomment the following line to require a user to be in the "wheel" group.
#auth required pam_wheel.so use_uid

auth include system-auth

account sufficient pam_succeed_if.so uid = 0 use_uid quiet

account include system-auth

password include system-auth

session include system-auth

session optional pam_xauth.so

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

Set TCP Retries

Adjust the tcp_retries parameter for the system network to enable faster detection of failed nodes. Given the advanced networking features of UCS, this is a safe and recommended change (failures observed at the operating system layer are most likely serious rather than transitory). On each node, setting the number of TCP retries to 5 can help detect unreachable nodes with less latency.

1. Edit the file /etc/sysctl.conf and on admin node rhel1 add the following lines:

   ```
   net.ipv4.tcp_retries2=5
   ```

2. Copy the /etc/sysctl.conf file from admin node (rhel1) to all the nodes using the following command:

   ```
   #clush -a -b -c /etc/sysctl.conf --dest=/etc/
   ```

3. Load the settings from default sysctl file /etc/sysctl.conf by running.

   ```
   #clush -B -a sysctl -p
   ```

   [root@rhel ~]# clush -B -a sysctl -p

   net.ipv4.tcp_retries2 = 5

   rhel[1-16] (16)
Post OS Install Configuration

Disable Swapping

1. To reduce Swapping, run the following on all nodes. The variable `vm.swappiness` defines how often swap should be used, 60 is the default.

   ```bash
   #clush -a -b " echo 'vm.swappiness=1' >> /etc/sysctl.conf"
   ``

2. Load the settings from default sysctl file `/etc/sysctl.conf`.

   ```bash
   #clush -a -b "sysctl -p"
   ``

Disable Transparent Huge Pages

Disabling Transparent Huge Pages (THP) reduces elevated CPU usage caused by THP.

1. To run the following commands for every reboot, copy these commands to `/etc/rc.local` so they are executed automatically for every reboot.

   ```bash
   #clush -a -b "echo never > /sys/kernel/mm/transparent_hugepage/enabled"
   #clush -a -b "echo never > /sys/kernel/mm/transparent_hugepage/defrag"
   ``

2. On the Admin node, run the following commands:

   ```bash
   #rm -f /root/thp_disable
   #echo "echo never > /sys/kernel/mm/transparent_hugepage/enabled" >> /root/thp_disable
   #echo "echo never > /sys/kernel/mm/transparent_hugepage/defrag " >> /root/thp_disable
   ``

3. Copy the following file to each node:

   ```bash
   #clush -a -b -c /root/thp_disable
   ``

4. Append the content of the file `thp_disable` to `/etc/rc.local`.

   ```bash
   #clush -a -b "cat /root/thp_disable >> /etc/rc.local"
   ``

Disable IPv6 Defaults

5. Disable IPv6 as the addresses used are IPv4.

   ```bash
   #clush -a -b "echo 'net.ipv6.conf.all.disable_ipv6 = 1' >> /etc/sysctl.conf"
   #clush -a -b "echo 'net.ipv6.conf.default.disable_ipv6 = 1' >> /etc/sysctl.conf"
   ```
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#clush -a -b "echo 'net.ipv6.conf.lo.disable_ipv6 = 1' >> /etc/sysctl.conf"

6. Load the settings from the default sysctl file /etc/sysctl.conf.

#clush -a -b "sysctl -p"

[root@rhel ~]# clush -a -b sysctl -p
----------------------
rhel[1-19] (19)
net.ipv4.tcp_retries2 = 5
vm.swappiness = 1
net.ipv6.conf.all.disable_ipv6 = 1
net.ipv6.conf.default.disable_ipv6 = 1
net.ipv6.conf.lo.disable_ipv6 = 1

Configuring RAID1 on Hadoop Management Nodes

Configure non-OS disk drives as RAID1 using StorCli commands as described below. The first four disk drives are going to be part of a single RAID1 volume. This volume will be used for HDFS Metadata. This section describes in detail the RAID configuration of disk drives for HDFS Name Node Metadata.

1. To download storcli go to: [http://docs.avagotech.com/docs/1.19.04_StorCLI.zip](http://docs.avagotech.com/docs/1.19.04_StorCLI.zip)

2. Extract the zip file and copy storcli-1.19.04-1.noarch.rpm from the linux directory.

3. Download storcli and its dependencies and transfer to Admin node.

   #scp storcli-1.19.04-1.noarch.rpm rhel1:/root/

4. Copy storcli rpm to all the nodes using the following commands:

   #clush -a -b -c /root/storcli-1.19.04-1.noarch.rpm --dest=/root/

5. Run the following command to install storcli on all the nodes

   #clush -a -b "rpm -ivh storcli-1.19.04-1.noarch.rpm"

6. Run the below command to copy storcli64 to root directory.

   #cd /opt/MegaRAID/storcli/

   #cp storcli64 /root/

   [root@rhel ~]# cd /opt/MegaRAID/storcli/
   [root@rhel storcli]# ls
   storcli64

7. Copy storcli64 to all the nodes:
#clush -a -b -c /root/storcli64 --dest=/root/

8. Run the following script as root user on rhel1 to rhel3 to create the virtual drives for the management nodes.

#vi /root/raid1.sh

./storcli64 -cfgldadd r1[$1:1,$1:2,$1:3,$1:4] wb ra nocachedbadbbu strpsz1024 -a0

The script above requires Enclosure ID as a parameter.

9. Run the following command to get the enclosure id.

`. /storcli64 pdlist -a0 | grep Enc | grep -v 252 | awk '{print $4}' | sort | uniq -c | awk '{print $2}'`

#chmod 755 raid1.sh

10. Run MegaCli script as follows:/

`. /raid1.sh <EnclosureID> obtained by running the command above

WB: Write back
RA: Read Ahead

NoCachedBadBBU: Do not write cache when the BBU is bad.
Strpsz1024: Strip Size of 1024K

Configuring the Virtual Drive (RAID10) for DB Filesystem on Hadoop Management Node

This section describes configuring the remaining 8 disk drives as a RAID10 DB file system with read-ahead cache enabled and write cache enabled while battery is present.

1. Create a script named raid10.sh on the admin node and copy it over to all Master/Management Nodes.

`vi /root/raid10.sh`

2. Paste the following contents into the file and save it.

`/opt/MegaRAID/storcli/storcli64 /c0 add vd type=raid10 drives=$1:5-12 pdperarray=4 WB ra direct Strip=1024`

(Please add/remove drives based on your configuration).

Note: Do not execute this script on the Data Nodes.
Note: This script must be executed manually on each of the Management nodes. The script takes the EnclosureID as Input, which would be different on different Management servers.

3. Change the mode to include execution privileges.

   chmod +x /root/raid10.sh

4. Copy the script over to all the Management nodes.

5. The script above requires enclosure ID as a parameter. Run the following command to get EnclosureID on each Management node.

   /opt/MegaRAID/storcli/storcli64 pdlist -a0 | grep Enc | grep -v 252 | awk '{print $4}' | sort | uniq -c | awk '{print $2}'

6. Run the script to create a single RAID10 volume as follows:

   ./raid10.sh <EnclosureID>

Note: The command above will not override any existing configuration. To clear and reconfigure existing configurations refer to Embedded MegaRAID Software Users Guide available at [www.lsi.com](http://www.lsi.com).

Configuring Data Drives on Data Nodes

Configure non-OS disk drives as individual RAID0 volumes using the StorCli command as described below. These volumes will be used for HDFS Data.

7. To create virtual drives with individual RAID 0 configurations on all the data nodes, from the admin node, issue the following command:

   #clush -w rhel[4-19] -B ./storcli64 -cfgeachdskraid0 WB RA direct NoCachedBadBBU strpsz1024 -a0

   WB: Write back
   RA: Read Ahead

   NoCachedBadBBU: Do not write cache when the BBU is bad.
   Strpsz1024: Strip Size of 1024K

Note: The command above will not override existing configurations. To clear and reconfigure existing configurations refer to Embedded MegaRAID Software Users Guide available at [www.lsi.com](http://www.lsi.com).
Configuring the Filesystem for NameNodes and DataNodes

The following script will format and mount the available volumes on each node whether it is a NameNode or a Data node. The OS boot partition is skipped. All drives are mounted based on their UUID as /data/disk1, /data/disk2, and so on.

1. On the Admin node, create a file containing the following script.

2. To create partition tables and file systems on the local disks supplied to each of the nodes, run the following script as the root user on each node.

---

Note: The script assumes there are no partitions already existing on the data volumes. If there are partitions, delete them before running the script. This process is documented in the "Note" section at the end of the section.

---

```bash
#vi /root/driveconf.sh
#!/bin/bash

[[ "-x" == "$(1)" ]] && set -x && set -v && shift 1
count=1
for X in /sys/class/scsi_host/host?/scan
  do
echo '- - -' > ${X}
done
for X in /dev/sd?
  do
  list+=$(echo $X " ")
done
for X in /dev/sd??
  do
  list+=$(echo $X " ")
done
for X in $list
  do
    echo "========"
    echo $X
    echo "========"
    if [[ -b "$X" && `/sbin/parted -s "$X" print quit|/bin/grep -c boot` -ne 0 ]]
      then
        echo "$X bootable - skipping."
        continue
    else
      Y=${X##*/}1
      echo "Formatting and Mounting Drive => $X"
```
/sbin/mkfs.xfs -f $(X) 
(( $? )) && continue

# Identify UUID
UUID=`blkid $(X) | cut -d " " -f2 | cut -d "=" -f2 | sed 's/"//g'`
/bin/mkdir -p /data/disk${count}
(( $? )) && continue

echo "UUID of $(X) = ${UUID}, mounting $(X) using UUID on /data/disk${count}"
/bin/mount -t xfs -o inode64,noatime,nobarrier -U ${UUID} /data/disk${count}
(( $? )) && continue

echo "UUID=${UUID} /data/disk${count} xfs inode64,noatime,nobarrier 0 0" >> /etc/fstab
((count++))
fi
done

3. Copy driveconf.sh to all the nodes with the following command:

   #chmod 755 /root/driveconf.sh
   #clush -a -B -c /root/driveconf.sh

4. From the admin node run the following script across all data nodes:

   #clush -a -B /root/driveconf.sh

5. To list the partitions and mount points, run the following from the admin node

   #clush -a -B df -h
   #clush -a -B mount
   #clush -a -B cat /etc/fstab

Note: In case there is a need to delete any partitions, it can be done so using the following.

6. Run the mount command (‘mount’) to identify which drive is mounted to which device /dev/sd<?>

7. umount the drive for which the partition is to be deleted, and run fdisk to delete it as shown below.

   Note: Care should be taken not to delete the OS partition as this will wipe out the OS.

   #mount
   #umount /data/disk1 ➔ (disk1 shown as example)
   #({echo d; echo w;} | sudo fdisk /dev/sd<?)}
Cluster Verification

This section describes the steps to create the script `cluster_verification.sh` that helps to verify the CPU, memory, NIC, and storage adapter settings across the cluster on all nodes. This script also checks additional prerequisites such as NTP status, SELinux status, ulimit settings, JAVA_HOME settings and JDK version, IP address and hostname resolution, Linux version and firewall settings.

1. Create the script `cluster_verification.sh` as shown, on the Admin node (rhel1).

   ```bash
   #vi cluster_verification.sh
   #!/bin/bash
   #shopt -s expand_aliases,
   # Setting Color codes
   green='\e[0;32m'
   red='\e[0;31m'
   NC='\e[0m' # No Color
   echo -e "\${green} === Cisco UCS C3260 Storage Server for Big Data and Analytics \ Cluster Verification === \${NC}\"
   echo ""
   echo ""
   echo -e "\${green} ==== System Information ==== \${NC}\"
   echo ""
   echo ""
   echo -e "\${green}System \${NC}\"
   clush -a -B " `which dmidecode` | grep -A2 '^System Information'"'
   echo ""
   echo ""
   echo -e "\${green}BIOS \${NC}\"
   clush -a -B " `which dmidecode` | grep -A3 '^BIOS I'"'
   echo ""
   echo ""
   echo -e "\${green}Memory \${NC}\"
   clush -a -B "cat /proc/meminfo | grep -i ^memt | uniq"
   ```
echo ""

# probe for cpu info #

# probe for nic info #

# probe for disk info #
```bash
echo ""
clush -a -B "dmesg | grep -i raid | grep -i scsi"
echo ""
clush -a -B "lsblk -id | awk '{print $1,$4}'\|sort \| nl"
echo ""
echo ""
echo -e "${green} ================ Software ================ ${NC}"
echo ""
echo ""
echo -e "${green}Linux Release ${NC}" 
clush -a -B "cat /etc/*release \| uniq"
echo ""
echo ""
echo -e "${green}Linux Version ${NC}" 
clush -a -B "uname -srvm \| fmt"
echo ""
echo ""
echo -e "${green}Date ${NC}" 
clush -a -B date 
echo ""
echo ""
echo -e "${green}NTP Status ${NC}" 
clush -a -B "ntpstat 2>&1 \| head -1"
echo ""
echo ""
echo -e "${green}SELINUX ${NC}" 
clush -a -B "echo -n 'SElinux status: '; grep ^SELINUX= \!/etc/selinux/config 2>&1"
echo ""
```
change permissions to executable.

```
chmod 755 cluster_verification.sh
```

3. Run the Cluster Verification tool from the admin node. This can be run before starting Hadoop to identify any discrepancies in Post OS Configuration between the servers or during troubleshooting of any cluster / Hadoop issues.

```
#./cluster_verification.sh
```
Installing HDP 2.5

HDP is an enterprise grade, hardened Hadoop distribution. HDP combines Apache Hadoop and its related projects into a single tested and certified package. HPD 2.5 components are depicted in Figure 133 below. The following section goes in to detail on how to install HDP 2.5 on the cluster.

Figure 133 HDP Components

Pre-Requisites for HDP

This section details the pre-requisites for HDP Installation such as setting up of HDP Repositories.

Hortonworks Repo

1. From a host connected to the Internet, download the Hortonworks repositories as shown below and transfer to the admin node.

   mkdir -p /tmp/Hortonworks
   cd /tmp/Hortonworks/

2. Download the Hortonworks HDP Repo:

   wget http://public-repo-1.hortonworks.com/HDP/centos7/2.x/uploads/2.5.0.0/HDP-2.5.0.0-centos7-rpm.tar.gz
3. Download Hortonworks HDP-Utils Repo:

   `wget http://public-repo-1.hortonworks.com/HDP-UTILS-1.1.0.21/repos/centos7/HDP-UTILS-1.1.0.21-centos7.tar.gz`

4. Download Ambari Repo:

   `wget http://public-repo-1.hortonworks.com/ambari/centos7/2.x/updates/2.4.0.1/AMBARI-2.4.0.1-centos7.tar.gz`

5. Copy the repository directory to the admin node:

   `scp -r /tmp/Hortonworks/ rhel1:/var/www/html`

6. Login to rhel1.

7. Extract the files:

   `cd /var/www/html/Hortonworks`

   `tar -zxvf HDP-2.5.0.0-centos7-rpm.tar.gz`

   `tar -zxvf HDP-UTILS-1.1.0.21-centos7.tar.gz`

   `tar -zxvf AMBARI-2.4.0.1-centos7.tar.gz`

8. Create the `hdp.repo` file with following contents:

   `vi /etc/yum.repos.d/hdp.repo`
[HDP-2.5.0.0]
name= Hortonworks Data Platform Version - HDP-2.5.0.0
baseurl= http://rhel1/Hortonworks/HDP/centos7
gpgcheck=0
enabled=1
priority=1

[HDP-UTILS-1.1.0.20]
name=Hortonworks Data Platform Utils Version - HDP-UTILS-1.1.0.21
baseurl= http://rhel1/Hortonworks/HDP-UTILS-1.1.0.21/repos/centos7
gpgcheck=0
enabled=1
priority=1

[root@rhel1 ~]# vi /etc/yum.repos.d/hdp.repo
[root@rhel1 ~]# cat /etc/yum.repos.d/hdp.repo
[HDP-2.5.0.0]
name= Hortonworks Data Platform Version - HDP-2.5.0.0
baseurl= http://rhel1/Hortonworks/HDP/centos7

gpgcheck=0
enabled=1
priority=1

[HDP-UTILS-1.1.0.21]
name=Hortonworks Data Platform Utils Version - HDP-UTILS-1.1.0.21
baseurl= http://rhel1/Hortonworks/HDP-UTILS-1.1.0.21/repos/centos7

9. Create the Ambari repo file with following contents:

vi /etc/yum.repos.d/ambari.repo
[ambari-2.4.0.1-1]
name=ambari-2.4.0.1-1
baseurl=http://rhel1/Hortonworks/AMBARI-2.4.0.1/centos7/2.4.0.1-1

gpgcheck=0
enabled=1
priority=1

[root@rhel1 ~]# vi /etc/yum.repos.d/ambari.repo
[root@rhel1 ~]# cat /etc/yum.repos.d/ambari.repo
[ambari-2.4.0.1-1]
name=ambari-2.4.0.1-1
tbaseurl=http://rhel1/Hortonworks/AMBARI-2.4.0.1/centos7/2.4.0.1-1
gpgcheck=0
enabled=1
priority=1

10. From the admin node copy the repo files to /etc/yum.repos.d/ of all the nodes of the cluster.

    clush -a -b -c /etc/yum.repos.d/hdp.repo --dest=/etc/yum.repos.d/
    clush -a -b -c /etc/yum.repos.d/ambari.repo --dest=/etc/yum.repos.d/

HDP Installation

To install HDP, complete the following the steps:

Install and Setup Ambari Server on rhel1

    yum -y install ambari-server
**Post OS Install Configuration**

**External Database PostgreSQL Installation**

The PostgreSQL database will be used by Ambari, Hive and Oozie services.

In this installation `rhel1` will host the Hive, Oozie and Ambari services.

1. Login to `rhel1` and perform the following steps.
   
   ```bash
   yum -y install postgresql-*
   ```

   ```bash
   [root@rhel1 ~]# yum -y install postgresql-*
   ```

   `postgsql-setup initdb`

   `/bin/systemctl start postgresql.service`

   `systemctl enable postgresql`
2. Update these files on rhel1 in the location chosen to install the databases for Hive, Oozie and Ambari, using the host ip addresses.

```
vi /var/lib/pgsql/data/pg_hba.conf
```
vi /var/lib/pgsql/data/postgresql.conf

search for listen_address and replace with (*)

3. Issue the following command to verify postgres has been installed correctly.

   sudo -u postgres psql

   http://docs.hortonworks.com/HDPDocuments/Ambari-2.2.2.0/bk_ambari_reference_guide/content/_using_ambari_with_postgresql.html
Ambari

To set up PostgreSQL to be used with Ambari, complete the following steps:

1. Connect to PostgreSQL database admin utility using
   
   ```sh
sudo -u postgres psql
   ```

2. Create the Ambari database.
   
   ```sql
   CREATE DATABASE ambari;
   ```

3. Create a user for Ambari with password “Cisco_123”.
   
   ```sql
   CREATE USER ambari WITH PASSWORD 'Cisco_123';
   ```

4. Grant all privileges on the Ambari database to the Ambari user
   
   ```sql
   GRANT ALL PRIVILEGES ON DATABASE ambari TO ambari;
   ```

5. Connect to Ambari database
   
   ```sql
   \connect ambari
   ```

6. Create the Ambari schema authorization to Ambari user.
   
   ```sql
   CREATE SCHEMA ambari AUTHORIZATION ambari;
   ```

7. Change the Ambari schema owner to Ambari user.
   
   ```sql
   ALTER SCHEMA ambari OWNER TO ambari;
   ```

8. Alter the Ambari role, set search_path to ‘ambari’, ‘public’.
   
   ```sql
   ALTER ROLE ambari SET search_path to 'ambari','public';
   ```

9. Log out using \q
10. Please enter the password.

11. To Load the Ambari Server database schema, find the `Ambari-DDL-Postgres-CREATE.sql` file in the `/var/lib/ambari-server/resources/` directory of the Ambari Server host after you have installed Ambari Server.

   ```bash
   cd /var/lib/ambari-server/resources/
   psql -U ambari -h rhel1 -d ambari
   ``

12. Enter the password ‘Cisco_123’

   ```bash
   \connect ambari
   ```
13. Check the table is created by running `\dt` command.

14. Log out with `\q`.

**Hive**

To set up PostgreSQL to be used with Hive, complete the following steps:

1. Connect to PostgreSQL database admin utility using

   
   ```bash
   sudo -u postgres psql
   ```
2. Create the Hive database.

    CREATE DATABASE hive;

3. Create a hive user with the password "Cisco_123".

    CREATE USER hive WITH PASSWORD 'Cisco_123';

4. Grant all privileges on the Hive database to the hive user

    GRANT ALL PRIVILEGES ON DATABASE hive TO hive;

5. Log out using \q

```
[root@rhell ~]# sudo -u postgres psql
Could not change directory to "/root"
psql (9.2.13)
Type "help" for help.

postgres=# CREATE DATABASE hive;
CREATE DATABASE
postgres=# CREATE USER hive WITH PASSWORD 'Cisco_123';
CREATE ROLE
postgres=# GRANT ALL PRIVILEGES ON DATABASE hive TO hive;
GRANT
```

Oozie

To set up PostgreSQL to be used with Oozie, complete the following steps:

1. Connect to PostgreSQL database admin utility using

    sudo -u postgres psql

2. Create the Oozie database.

    CREATE DATABASE oozie;

3. Create a user for Oozie and grant it permissions.

4. Create a Oozie user with the password "Cisco_123".

    CREATE USER oozie WITH PASSWORD 'Cisco_123';

5. Grant all privileges on the Oozie database to the Oozie user

    GRANT ALL PRIVILEGES ON DATABASE oozie TO oozie;
6. **Log out using \q**

7. **Connect to the admin node (rhel1) and run the commands described below.**

   ```bash
   yum -y install postgresql-jdbc*
   ambari-server setup --jdbc-db=postgres --jdbc-driver=/usr/share/java/postgresql-jdbc.jar
   ```

---

**Downgrade Snappy on All Nodes**

To downgrade snappy on all data nodes, run the following command from admin node:

```bash
clush -a -b yum -y downgrade snappy
```

**Setting Up the Ambari Server on the Admin Node (rhel1)**

```bash
ambari-server setup -j ${JAVA_HOME}
```

---

Note: Enter the advanced database configuration option - Yes and choose option 4 for the existing PostgreSQL Database selection.
1. Starting the Ambari Server

   `ambari-server start`
Log into the Ambari Server

Once the Ambari service has been started, access the Ambari Install Wizard through the browser.

1. Point the browser to [http://<ip_address_for_rhel1>:8080](http://<ip_address_for_rhel1>:8080).

2. The Ambari Login screen will open (Figure 134).

3. Log in to the Ambari Server using the default username/password: admin/admin. This can be changed at a later period of time.
Once logged in, the “Welcome to Apache Ambari” window appears (Figure 135).

Creating a Cluster

To create a cluster, complete the following steps:

1. Click the button under “Create a Cluster” to launch the install wizard as shown in Figure 135 above.

2. On the “Get Started” page (Figure 136) type “Cisco_HDP” as the name for the cluster.
3. Click Next.

**Figure 136 Creating a Cluster**

Select a Version

1. In the next screen (Figure 137), select the HDP 2.5 stack.

2. Select “Use Local Repository”.

3. Select the RedHat 7 checkbox.

4. Provide the base URL’s for the operating systems

5. Update the Redhat 7 HDP-2.5.0.0 URL to [http://rhel1/Hortonworks/HDP/centos7](http://rhel1/Hortonworks/HDP/centos7)

6. Update the Redhat 7 HDP-UTILS-1.1.0.21 URL to [http://rhel1/Hortonworks/HDP-UTILS-1.1.0.21/repos/centos7](http://rhel1/Hortonworks/HDP-UTILS-1.1.0.21/repos/centos7)

7. Select a Version. (Figure 137)
Figure 137 Select Version

![Select Version](image.png)

Note: Make sure there are no trailing spaces after the URLs.

**HDP Installation**

To build up the cluster, the install wizard needs to know general information about how the cluster is to be set up. This requires providing the Fully Qualified Domain Name (FQDN) of each of the hosts. The wizard also needs to access the private key file that was created in **Set Up Password-less SSH**. It uses these to locate all the hosts in the system and to access and interact with them securely.

Figure 138 below shows the install wizard window.

1. Use the **Target Hosts** text box to enter the list of host names, one per line. Ranges inside brackets can also be used to indicate larger sets of hosts.

2. Select the option **Provide your SSH Private Key** in the Ambari cluster install wizard.

3. Copy the contents of the file `/root/.ssh/id_rsa` on `rhel1` and paste it in the text area provided by the Ambari cluster install wizard.
Note: Make sure there is no extra white space after the text.

![](image)

```bash
[root@hell ~]# cat /root/.ssh/id_rsa
-----BEGIN RSA PRIVATE KEY-----
MIIEQIBAAKCAQEAYdDIoRSg4mBZfzBz0/g0M2iYT2h0vrxIXxA/u/wFthFrewUdgP
2eiV/QtdK7meqehqgmsNmb1Crf0m6SxVExW2cGoAx75hZwUDRs3Qlvk66jYUmDW
BKq5TmUmKFD7tknKskg5N+YH5sPCoNlLz/Wq0c1h22o7tiCmXrxrEnFgS1JY74/Db
A0BeWuNaJAOvppP06cL6PG/WK0OpEDuNcuwe5pCrv5tko+g2eByF5oeC56Ya67
n80HpjLXV0MNv23SNWv13cswbqlDr3r3at66YReVmmr/P1rKMe192tqzqlmH2MBqG
wljRTfJjygWggp5g77Nq8Gf87m7x4V60mzv4vmmzrBIywKCAQEAg4+UEI+o2PjKVCUX
2h+XEvNUCJC3KoNEYBx2n7KxckYas/80LW6BlpYROUB3X2YV6hBwUL+JDMK
hrGNMALqyDjtHUI0yX/9H1mLDYTe9k81vPY2g8zqvHnJ+3Jis192Dspc01xBRqX
wnpofjAm1CDx5Wxyp4MZYX9HyvCcmhePefobLys6gLoxd84eHW1y6b0xUl1d7hsq
pck+xpdFW1sHYTvckTuCtUIAezF+4+uBT5FpHiD7FwzzvBXXA65ABuezv9gg2/II
PekIkRwbosiniFbBU1Z0SUlu/gsao6m8g9qTarJL1V8zhy6K31LE5c0CKj12L2NRX2
5cEX6WKBgqD9ClKc0Uf1rQWH5cLTdźU8wztIrk4N9q1b2LohfHu2fLuiA3Ref
y1L9MjE3A5Mnn9pcRxMmCXPp4t9iuLh3+i3csr1TzFm14Wt+Fipa9sh+3J22Hkgm
pCquaAedcFRR4oP3/yYqg95gieSC9s5oZsEv3ovhdvNUnk1Mb9vwi3WBqQDKQiyTi
Yyu21owsYkZ7YjmJrkRUFaH4CktnyJy1M3hSwFPm2Jd4BQmQoDaXtr2tW4Si+i4
t8M8X6sHCHySqwRtL0tYzniulwntULJ2QFqSeg1NoveCkx3L0iUze18Fl30H
AebJ0j/QL3SF+FHMOKCnWtAJOV/xlDbDjseQKBgGEPFm8uxVF3N2g3YvqtMY0
97KtsU3eX52x0ad1VPht5Ts6mo1k0vO6TEE+8c4W1f2Xj5j+v2Xnhb+bojBj30/Dwc
G0gBrqbrKksac5ILL135+QqtwEPB4hiQnUkvnVVFpIPQAs65S3YxCd7KH1ynpq
blNQFkWd2QElvYdDKuRlAOgM56R/EXlAATvfB5gdbj0n4V316g97K3dVnS18hSm
rkC7ADoTnz2x5N31L08гаEFtw9zKpqpFx+ztFIn0MFMmY1Y9EpynnJ05/1aDCtOroWu
sc383bu/5RNkWx2z+s9szUyUdxT2cyJq6tLkgTqyUpxoVo/cccEwA5LBE725
xnsGc7yABFEmESDB16p9mmi1Rl+qMc1h4Hw+FmHmncE/y80QL/MoAYoHBlTn8cWvU
1-sjubWBGxUv9GMxP5xeU6ySh8h091vijp/1kpnCNZ7C6+/uI6Fy+slzXTr
t5P/AhOCvUKnHRFPjFxxQy5gNkarsyVu6S9Qlun18N2IhEgw1g==
-----END RSA PRIVATE KEY-----
```

4. Click the **Register and Confirm** button to continue.
Hostname Pattern Expressions

1. Click OK on the Host Name Pattern Expressions popup (Figure 139).
Confirm Hosts

Figure 140 shows the Confirm Hosts screen. This helps ensure that Ambari has located the correct hosts for the cluster and checks those hosts to make sure they have the correct directories, packages, and processes to continue the install.

1. If any host was selected in error, remove it by selecting the appropriate checkboxes and clicking the grey **Remove Selected** button.

2. To remove a single host, click the small white **Remove** button in the Action column.

3. When the list of hosts is confirmed, click **Next**.
Choose Services

HDP is made up of a number of components. See [Understand the Basics](#) for more information. The services are listed in Figure 141 below.

1. Select all to preselect all items.

2. When you have made your selections, click Next.
Figure 141 Choose Services

![Choose Services](image)

<table>
<thead>
<tr>
<th>Service</th>
<th>Version</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDFS</td>
<td>2.7.1.2.5</td>
<td>Apache Hadoop Distributed File System</td>
</tr>
<tr>
<td>YARN + MapReduce2</td>
<td>2.7.1.2.5</td>
<td>Apache Hadoop NextGen MapReduce (YARN)</td>
</tr>
<tr>
<td>Tez</td>
<td>0.7.0.2.5</td>
<td>Tez is the next generation Hadoop Query Processing framework written on top of YARN.</td>
</tr>
<tr>
<td>Hive</td>
<td>1.2.1.2.5</td>
<td>Data warehouse system for ad-hoc queries &amp; analysis of large datasets and table &amp; storage management service</td>
</tr>
<tr>
<td>HBase</td>
<td>1.1.2.2.5</td>
<td>A Non-relational distributed database, plus Phoenix, a high performance SQL layer for low latency applications.</td>
</tr>
<tr>
<td>Pig</td>
<td>0.16.0.2.5</td>
<td>Scripting platform for analyzing large datasets</td>
</tr>
<tr>
<td>Sqoop</td>
<td>1.4.5.2.5</td>
<td>Tool for transferring bulk data between Apache Hadoop and structured data stores such as relational databases</td>
</tr>
<tr>
<td>Oozie</td>
<td>4.2.0.2.5</td>
<td>System for workflow coordination and execution of Apache Hadoop jobs. This also includes the installation of the optional Oozie Web Console which relies on and will install the EXTLIB Library.</td>
</tr>
<tr>
<td>ZooKeeper</td>
<td>3.4.6.2.5</td>
<td>Centralized service which provides highly reliable distributed coordination</td>
</tr>
<tr>
<td>Falcon</td>
<td>0.10.0.2.5</td>
<td>Data management and processing platform</td>
</tr>
<tr>
<td>Storm</td>
<td>1.0.1.2.5</td>
<td>Apache Hadoop Streaming processing framework</td>
</tr>
<tr>
<td>Flume</td>
<td>1.5.2.2.5</td>
<td>A distributed service for collecting, aggregating, and moving large amounts of streaming data into HDFS</td>
</tr>
<tr>
<td>Accumulo</td>
<td>1.7.0.2.5</td>
<td>Robust, scalable, high performance distributed key/value store.</td>
</tr>
</tbody>
</table>
Assign Masters

The Ambari install wizard attempts to assign the master nodes for various services that have been selected to appropriate hosts in the cluster, as shown in Figure 142. The right column shows the current service assignments by host, with the hostname and its number of CPU cores and amount of RAM indicated.
Figure 142 Assign Masters

Assign master components to hosts you want to run them on.
- HiveServer2 and WebHCatServer will be hosted on the same host.
3. Reconfigure the service assignments to match Table 10 shown below.

<table>
<thead>
<tr>
<th>Service Name</th>
<th>Host</th>
</tr>
</thead>
<tbody>
<tr>
<td>NameNode</td>
<td>rhel1</td>
</tr>
<tr>
<td>SNameNode</td>
<td>rhel2</td>
</tr>
<tr>
<td>History Server</td>
<td>rhel2</td>
</tr>
<tr>
<td>App Timeline Server</td>
<td>rhel2</td>
</tr>
<tr>
<td>Resource Manager</td>
<td>rhel2</td>
</tr>
<tr>
<td>Hive Metastore</td>
<td>rhel1</td>
</tr>
<tr>
<td>WebHCat Server</td>
<td>rhel1</td>
</tr>
<tr>
<td>HiveServer2</td>
<td>rhel1</td>
</tr>
<tr>
<td>HBase Master</td>
<td>rhel3</td>
</tr>
<tr>
<td>Oozie Server</td>
<td>rhel1</td>
</tr>
<tr>
<td>Zookeeper</td>
<td>rhel1, rhel2, rhel3</td>
</tr>
<tr>
<td>Falcon Server</td>
<td>rhel3</td>
</tr>
<tr>
<td>DRPC Server</td>
<td>rhel2</td>
</tr>
<tr>
<td>Nimbus</td>
<td>rhel2</td>
</tr>
<tr>
<td>Storm UI Server</td>
<td>rhel2</td>
</tr>
<tr>
<td>Accumulo Master</td>
<td>rhel1</td>
</tr>
<tr>
<td>Accumulo Monitor</td>
<td>rhel1</td>
</tr>
<tr>
<td>Accumulo Tracer</td>
<td>rhel1</td>
</tr>
<tr>
<td>Accumulo GC</td>
<td>rhel1</td>
</tr>
<tr>
<td>Infra Solr Instance</td>
<td>rhel1</td>
</tr>
<tr>
<td>Grafana</td>
<td>rhel1</td>
</tr>
<tr>
<td>Kafka Broker</td>
<td>rhel1</td>
</tr>
<tr>
<td>Accumulo GC</td>
<td>rhel1</td>
</tr>
<tr>
<td>Atlas Metadata Server</td>
<td>rhel1</td>
</tr>
<tr>
<td>Knox Gateway</td>
<td>rhel1</td>
</tr>
<tr>
<td>Metrics Collector</td>
<td>rhel3</td>
</tr>
<tr>
<td>Activity Explorer</td>
<td>rhel1</td>
</tr>
<tr>
<td>HST server</td>
<td>rhel1</td>
</tr>
<tr>
<td>Activity Analyser</td>
<td>rhel1</td>
</tr>
<tr>
<td>Spark history server</td>
<td>rhel2</td>
</tr>
</tbody>
</table>
Note: On a small cluster (<16 nodes), consolidate all master services to run on a single node. For large clusters (> 64 nodes), deploy master services across 3 nodes.

4. Click Next.

Assign Slaves and Clients

The Ambari install wizard attempts to assign the slave components (DataNodes, NFSGateway, NodeManager, RegionServers, Phoenix Query Server, Supervisor, Flume, Accumulo TServer, Spark Thrift Server and Client) to appropriate hosts in the cluster as shown in Figure 143.

1. Reconfigure the service assignment to match the values shown in Table 11 below:

2. Assign DataNode, NodeManager, RegionServer, Supervisor and Flume on nodes rhel3- rhel19.

3. Assign Client to all nodes.

4. Click the Next button.

<table>
<thead>
<tr>
<th>Client Service Name</th>
<th>Host</th>
</tr>
</thead>
<tbody>
<tr>
<td>DataNode</td>
<td>Rhel4- rhel19</td>
</tr>
<tr>
<td>NFSGateway</td>
<td>rhel1</td>
</tr>
<tr>
<td>NodeManager</td>
<td>rhel3- rhel19</td>
</tr>
<tr>
<td>RegionServer</td>
<td>rhel3- rhel19</td>
</tr>
<tr>
<td>Phoenix Query Server</td>
<td>rhel1</td>
</tr>
<tr>
<td>Supervisor</td>
<td>rhel3- rhel19</td>
</tr>
<tr>
<td>Flume</td>
<td>rhel3- rhel19</td>
</tr>
<tr>
<td>Accumulo TServer</td>
<td>rhel3- rhel19</td>
</tr>
<tr>
<td>Spark Thrift Server</td>
<td>rhel1</td>
</tr>
<tr>
<td>Client</td>
<td>All nodes, rhel1- rhel19</td>
</tr>
</tbody>
</table>
Figure 143 Assign Slaves and Clients

Assign Slaves and Clients

Assign slave and client components to hosts you want to run them on.

Hosts that are assigned master components are shown with an asterisk (*).

"Client" will install HDFS Client, YARN Client, MapReduce2 Client, Tez Client, HCat Client, Hive Client, HBase Client, Pig Client, Sqoop Client, Oozie Client, ZooKeeper Client, Falcon Client, Accumulo Client, HBase Client, Infracost Client, Atlas Metadata Client, Spark Client, Mahout Client and Slidr Client.

---

Assign Slaves and Clients

Assign slave and client components to hosts you want to run them on.

Hosts that are assigned master components are shown with an asterisk (*).

"Client" will install HDFS Client, YARN Client, MapReduce2 Client, Tez Client, HCat Client, Hive Client, HBase Client, Pig Client, Sqoop Client, Oozie Client, ZooKeeper Client, Falcon Client, Accumulo Client, HBase Client, Infracost Client, Atlas Metadata Client, Spark Client, Mahout Client and Slidr Client.

---

Assign Slaves and Clients

Assign slave and client components to hosts you want to run them on.

Hosts that are assigned master components are shown with an asterisk (*).

"Client" will install HDFS Client, YARN Client, MapReduce2 Client, Tez Client, HCat Client, Hive Client, HBase Client, Pig Client, Sqoop Client, Oozie Client, ZooKeeper Client, Falcon Client, Accumulo Client, HBase Client, Infracost Client, Atlas Metadata Client, Spark Client, Mahout Client and Slidr Client.
Customize Services

This section as shown in Figure 144 displays the tabs that manage configuration settings for Hadoop components. The wizard attempts to set reasonable defaults for each of the options here, but this can be modified to meet specific requirements. The following sections provide configuration guidance that should be refined to meet specific use case requirements.

The following changes are to be made:

- Memory and service level settings for each component and service level tuning.
- Customize the log locations of all the components to ensure growing logs do not cause the SSDs to run out of space.

HDFS

1. In Ambari, choose the HDFS Service tab. (Figure 144) and use the “Search” box on top to filter for the properties mentioned in Table 12 and update their values.

Figure 144  HDFS

### HDFS JVM Settings

1. Update the following HDFS configurations in Ambari.

<table>
<thead>
<tr>
<th>Property Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NameNode Java Heap Size</td>
<td>4096</td>
</tr>
</tbody>
</table>

185
Hadoop maximum Java heap size | 4096
---|---
DataNode maximum Java heap size | 4096
Datanode Volumes Failure Tolerance | 3

YARN

In Ambari, choose the YARN Service from the tab as shown in Table 13, and use the “Search” box on top to filter for the properties mentioned in Figure 145 below to update their values.

Update the following YARN configurations.

Table 13 YARN Configuration Values

<table>
<thead>
<tr>
<th>Property Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ResourceManager Java heap size</td>
<td>4096</td>
</tr>
<tr>
<td>NodeManager Java heap size</td>
<td>2048</td>
</tr>
<tr>
<td>yarn.nodemanager.resource.memory-mb</td>
<td>184320</td>
</tr>
<tr>
<td>YARN Java heap size</td>
<td>4096</td>
</tr>
<tr>
<td>yarn.scheduler.minimum-allocation-mb</td>
<td>4096</td>
</tr>
<tr>
<td>yarn.scheduler.maximum-allocation-mb</td>
<td>184320</td>
</tr>
</tbody>
</table>

**Figure 145** Customize Services Screen

**MapReduce2**

Figure 146 shows the MapReduce2 Tab.
1. In Ambari, choose the MapReduce Service tab and use the “Search” box on top to filter for the properties mentioned in Table 14 and update their values.

2. Update the following MapReduce configurations.

**Table 14 MapReduce Configurations**

<table>
<thead>
<tr>
<th>Property Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default virtual memory for a job's map-task</td>
<td>4096</td>
</tr>
<tr>
<td>Default virtual memory for a job's reduce-task</td>
<td>8192</td>
</tr>
<tr>
<td>Map-side sort buffer memory</td>
<td>1638</td>
</tr>
<tr>
<td>yarn.app.mapreduce.am.resource.mb</td>
<td>4096</td>
</tr>
<tr>
<td>mapreduce.map.java.opts</td>
<td>- Xmx3276m</td>
</tr>
<tr>
<td>mapreduce.reduce.java.opts</td>
<td>- Xmx6552m</td>
</tr>
<tr>
<td>yarn.app.mapreduce.am.command-opts</td>
<td>- Xmx6552m</td>
</tr>
</tbody>
</table>

**Tez**

No changes are required.
Hive

1. Choose Hive Service from the tab, as shown in Figure 147.

2. Select the advanced tab and make the changes below:

3. Select Existing PostgreSQL Database.

4. Database Name hive.

5. Database Username hive.

6. Enter the Hive database password as per organizational policy.

7. Database password Cisco_123.

8. Please test connection.

**Figure 147 Hive Tab**
HBase

In Ambari, choose HBase Service from the tab (Figure 148) and use the “Search” box on top to filter for the properties mentioned in Table 15 to update their values.

1. Update the following HBase configurations:

<table>
<thead>
<tr>
<th>Property Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBase Master Maximum Java Heap Size</td>
<td>4096</td>
</tr>
<tr>
<td>HBase RegionServers Maximum Java Heap Size</td>
<td>16384</td>
</tr>
</tbody>
</table>

Note: If you are not running HBase, keep the default value of 1024 for Java Heap size for HBase RegionServers and HBase Master

Figure 148  HBase

Pig

No changes are required.
Sqoop

No changes are required.

Figure 149 Scoop Services

Oozie

Similarly, under the Oozie tab, (Figure 150), change the default log location by finding the Log Dir property and modifying the /var prefix to /data/disk1.

1. Select Existing PostgreSQL Database.

2. Database Name oozie.

3. Database Username oozie. Enter the oozie database password as per organizational policy.

4. Database password is Cisco_123.

5. Please test the connection.
Figure 150  Oozie Tab

Zookeeper
No changes required

Falcon
No changes required
**Post OS Install Configuration**

**Storm**

No changes required

**Flume**

No changes required

**Accumulo**

Choose Accumulo Service from the tab and expand the General tab and make the changes below:

1. Enter the Accumulo root password as per organizational policy. (Figure 152)

2. Enter the Accumulo instance Secret password as per organizational policy.
Figure 152  Accumulo
Ambari Infra

**Figure 153 Ambari Infra**

Ambari Metrics

1. Choose the Ambari Metrics Service, (Figure 154), from the tab and expand the general tab and make the changes below:

2. Enter the Grafana Admin password as per organizational policy.
Atlas

Under the Atlas tab, (Figure 155), change the default log location by finding the Log Dir property and modifying the /var prefix to /data/disk1.
**Figure 155** Atlas Tab

<table>
<thead>
<tr>
<th>CLUSTER INSTALL WIZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Get Started</td>
</tr>
<tr>
<td>Select Version</td>
</tr>
<tr>
<td>Install Options</td>
</tr>
<tr>
<td>Confirm Hosts</td>
</tr>
<tr>
<td>Choose Services</td>
</tr>
<tr>
<td>Assign Masters</td>
</tr>
<tr>
<td>Assign Slaves and Clients</td>
</tr>
<tr>
<td>Customize Services</td>
</tr>
<tr>
<td>Review</td>
</tr>
<tr>
<td>Install, Start and Test</td>
</tr>
<tr>
<td>Summary</td>
</tr>
</tbody>
</table>

### Kafka

1. Under the Kafka tab (**Error! Reference source not found.**), No change required.
Knox

1. Choose Knox Service, (Figure 156), from the tab and expand the Knox gateway tab and make the changes below:

2. Enter the Knox Master Secret password as per organizational policy.

3. For Knox, change the gateway port to 8444 to ensure no conflicts with local HTTP server.
Figure 156  Knox Service

SmartSense

Figure 157 shows the SmartSense tab. This requires the Hortonworks support subscription. Subscribers can populate the properties below.
Spark

1. Select the Spark tab, (Figure 158), change the default log location by finding the Log Dir property and modifying the `/var` prefix to `/data/disk1`. 
Zeppelin Notebook
No changes required

Mahout
No changes are required.

**Figure 159 Mahout Tab**

![Customize Services](image)

**Slider**
No changes are required.

**Misc**
No changes are required.

**Review**
The assignments that have been made are displayed, (Figure 160). Check to ensure everything is correct before clicking on the Deploy button. If any changes are to be made, use the left navigation bar to return to the appropriate screen.

**Deploy**
1. Once the review is complete, click the **Deploy** button.
The progress of the install is shown on the screen as shown in Figure 161. Each component is installed and started and a simple test is run on the component. The next screen displays the overall status of the install in the progress bar at the top of the screen and a host-by-host status in the main section.

2. To see specific information on what tasks have been completed per host, click the link in the **Message** column for the appropriate host.

3. In the **Tasks** pop-up, click the individual task to see the related log files.

4. Select filter conditions by using the **Show** dropdown list.

5. To see a larger version of the log contents, click the **Open** icon or to copy the contents to the clipboard, use the **Copy** icon.

   Depending on which components are installing, the entire process may take 10 or more minutes.

6. When successfully installed and started the service appears, click Next.

Figure 161 displays the install progress screen.
Summary of the Installation Process

Figure 162 shows a summary of the accomplished tasks.

Click Complete.
Figure 162 Summary Screen
This section provides the BOM for the 16 nodes. See **Error! Reference source not found.** for Bill of Materials for the Cisco UCS Fabric Interconnect, Table 16 Bill of Materials for Cisco UCS C240M4 Rack Server, Table 17 for the Cisco UCS S3260 Storage Server Base Rack, Table 18 Bill of Materials for Cisco UCS S3260 Storage Server Capacity Rack, Table 20 for software components.

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCS- FI-6332UP-UPG</td>
<td>UCS 6332UP 2RU Fabric Int/No PSU/48 UP/18p LIC</td>
<td>2</td>
</tr>
<tr>
<td>CON- SNT- FI6332UP</td>
<td>SMARTNET 8X5XNBD UCS 6332UP 2RU Fabric Int/2 PSU/4 Fans</td>
<td>2</td>
</tr>
<tr>
<td>SFP- H40GB-CU3M</td>
<td>40GBASE-CU SFP+Cable 3 Meter</td>
<td>8</td>
</tr>
<tr>
<td>UCS- ACC-6296UP</td>
<td>UCS 6296UP Chassis Accessory Kit</td>
<td>2</td>
</tr>
<tr>
<td>UCS- PSU-6296UP-AC</td>
<td>UCS 6296UP Power Supply/100-240VAC</td>
<td>4</td>
</tr>
<tr>
<td>N10- MGT014</td>
<td>UCS Manager v3.1</td>
<td>2</td>
</tr>
<tr>
<td>UCS- L-6200-10G-C</td>
<td>2rd Gen FI License to connect C-direct only</td>
<td>62</td>
</tr>
<tr>
<td>UCS- BLKE-6200</td>
<td>UCS 6200 Series Expansion Module Blank</td>
<td>6</td>
</tr>
<tr>
<td>UCS- FAN-6296UP</td>
<td>UCS 6296UP Fan Module</td>
<td>8</td>
</tr>
<tr>
<td>CAB- N5K6A-NA</td>
<td>Power Cord 200/240V 6A North America</td>
<td>4</td>
</tr>
<tr>
<td>UCS- FI-E16UP</td>
<td>UCS 6200 16-port Expansion module/16 UP/8p LIC</td>
<td>4</td>
</tr>
<tr>
<td>RACK- UCS2</td>
<td>Cisco R42610 standard rack with side panels</td>
<td>1</td>
</tr>
<tr>
<td>RP208-30-1P-U-2=</td>
<td>Cisco RP208-30-U-2 Single Phase PDU 20x C13 4x C19 (Country Specific)</td>
<td>2</td>
</tr>
<tr>
<td>CON- UCW3-RPDUX</td>
<td>UC PLUS 24X7X4 Cisco RP208-30-U-X Single Phase PDU 2x (Country Specific)</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 16  Bill of Materials for Cisco UCS C240M4 Rack Server
<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCSC-C240-M4SX</td>
<td>UCS C240 M4 SFF 24 HD w/o CPU, memory, HD, PCIe, PS, rail kit w/expander</td>
<td>3</td>
</tr>
<tr>
<td>UCSC-MRAID12G</td>
<td>Cisco 12G SAS Modular Raid Controller</td>
<td>3</td>
</tr>
<tr>
<td>UCSC-MRAID12G-2GB</td>
<td>Cisco 12Gbps SAS 2GB FBWC Cache module (Raid 0/1/5/6)</td>
<td>3</td>
</tr>
<tr>
<td>UCSC-MLOM-CSC-02</td>
<td>Cisco UCS VIC1387 VIC MLOM - Dual Port 40Gb Ethernet QSFP ports</td>
<td>3</td>
</tr>
<tr>
<td>CAB-9K12A-NA</td>
<td>Power Cord 125VAC 13A NEMA 5-15 Plug North America</td>
<td>6</td>
</tr>
<tr>
<td>UCSC-PSU2V2-1200W</td>
<td>1200W/800W V2 AC Power Supply for 2U C-Series Servers</td>
<td>6</td>
</tr>
<tr>
<td>UCSC-RAILB-M4</td>
<td>Ball Bearing Rail Kit for C240 M4 rack servers</td>
<td>3</td>
</tr>
<tr>
<td>UCSC-HS-C240M4</td>
<td>Heat Sink for UCS C240 M4 Rack Server</td>
<td>6</td>
</tr>
<tr>
<td>UCSC-SCCBL240</td>
<td>Supercap cable 250mm</td>
<td>3</td>
</tr>
<tr>
<td>UCS-CPU-E52680E</td>
<td>2.40 GHz E5- 2680 v4/120W 14C/35MB Cache/DDR4 2400MHz</td>
<td>6</td>
</tr>
<tr>
<td>UCS-MR-1X161RV-A</td>
<td>16GB DDR4- 2400-MHz RDIMM/PC4- 19200/single rank/x4/1.2v</td>
<td>48</td>
</tr>
<tr>
<td>UCS-HD18TB10KS4K</td>
<td>1.2 TB 12G SAS 10K rpm SFF HDD (4K)</td>
<td>36</td>
</tr>
<tr>
<td>UCS-SD240GBKS4-EB</td>
<td>240 GB 2.5 inch Enterprise Value 6G SATA SSD (BOOT)</td>
<td>6</td>
</tr>
<tr>
<td>UCSC-PCI-1C-240M4</td>
<td>Right PCI Riser Bd (Riser 1) 2onbl SATA bootdrvs+ 2PCI slts</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 17: Bill of Materials for Cisco UCS S3260 Storage Server Base Rack
<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCSC-PSU1-1050W</td>
<td>UCS C3X60 1050W Power Supply Unit</td>
<td>32</td>
</tr>
<tr>
<td>UCSC-C3K-M4SRB</td>
<td>UCS C3000 M4 Server Node for Intel E5-2600 v4</td>
<td>8</td>
</tr>
<tr>
<td>UCS-CPU-E52680E</td>
<td>2.40 GHz E5-2680 v4/120W 14C/35MB Cache/DDR4 2400MHz</td>
<td>16</td>
</tr>
<tr>
<td>UCS-MR-1X322RV-A</td>
<td>32GB DDR4-2400-MHz RDIMM/PC4-19200/dual rank/x4/1.2v</td>
<td>64</td>
</tr>
<tr>
<td>UCS-C3K-M4RAID</td>
<td>Cisco UCS C3000 RAID Controller M4 Server w 4G RAID Cache</td>
<td>8</td>
</tr>
<tr>
<td>UCSC-HS-C3X60</td>
<td>Cisco UCS C3X60 Server Node CPU Heatsink</td>
<td>16</td>
</tr>
<tr>
<td>UCSC-C3K-M4SRB</td>
<td>UCS C3000 M4 Server Node for Intel E5-2600 v4</td>
<td>8</td>
</tr>
<tr>
<td>UCS-CPU-E52680E</td>
<td>2.40 GHz E5-2680 v4/120W 14C/35MB Cache/DDR4 2400MHz</td>
<td>16</td>
</tr>
<tr>
<td>UCS-MR-1X322RV-A</td>
<td>32GB DDR4-2400-MHz RDIMM/PC4-19200/dual rank/x4/1.2v</td>
<td>64</td>
</tr>
<tr>
<td>UCS-C3K-M4RAID</td>
<td>Cisco UCS C3000 RAID Controller M4 Server w 4G RAID Cache</td>
<td>8</td>
</tr>
<tr>
<td>UCSC-HS-C3X60</td>
<td>Cisco UCS C3X60 Server Node CPU Heatsink</td>
<td>16</td>
</tr>
<tr>
<td>UCS-S3260-42HD4</td>
<td>Cisco UCS C3X60 Three row of drives containing 42 x 4TB (Tot</td>
<td>8</td>
</tr>
<tr>
<td>UCS-C3K-HD4TB</td>
<td>UCS C3000 4TB NL-SAS 7200 RPM 12Gb HDD w Carrier- Top Load</td>
<td>336</td>
</tr>
<tr>
<td>UCSC-C3260-SIOC</td>
<td>Cisco UCS C3260 System IO Controller with VIC 1300 incl.</td>
<td>8</td>
</tr>
<tr>
<td>UCSC-C3260-SIOC</td>
<td>Cisco UCS C3260 System IO Controller with VIC 1300 incl.</td>
<td>8</td>
</tr>
<tr>
<td>UCS-C3X60-G2SD48</td>
<td>UCSC C3X60 480GB Boot SSD (Gen 2)</td>
<td>32</td>
</tr>
</tbody>
</table>

**Table 18 Bill of Materials for Cisco UCS S3260 Storage Server Capacity Rack**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCSC-C3260</td>
<td>Cisco UCS C3260 Base Chassis w/4x PSU, SSD, Railkit</td>
<td>8</td>
</tr>
<tr>
<td>CAB-C13-C14-2M</td>
<td>Power Cord Jumper, C13-C14 Connectors, 2 Meter Length</td>
<td>32</td>
</tr>
<tr>
<td>UCSC-C3X60-HD8TB</td>
<td>UCSC 3X60 8TB NL-SAS 7.2K Helium HDD with HDD Carrier</td>
<td>48</td>
</tr>
<tr>
<td>UCSC-C3160-BEZEL</td>
<td>Cisco UCS C3160 System Bezel</td>
<td>8</td>
</tr>
<tr>
<td>Part Number</td>
<td>Description</td>
<td>Quantity</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------</td>
<td>----------</td>
</tr>
<tr>
<td>UCSC-C3X60-RAIL</td>
<td>UCS C3X60 Rack Rails Kit</td>
<td>8</td>
</tr>
<tr>
<td>UCSC-PSU1-1050W</td>
<td>UCS C3X60 1050W Power Supply Unit</td>
<td>32</td>
</tr>
<tr>
<td>UCSC-C3K-M4SRB</td>
<td>UCS C3000 M4 Server Node for Intel E5-2600 v4</td>
<td>8</td>
</tr>
<tr>
<td>UCS-CPU-E52680E</td>
<td>2.40 GHz E5-2680 v4/120W 14C/35MB Cache/DDR4 2400MHz</td>
<td>16</td>
</tr>
<tr>
<td>UCS-MR-1X322RV-A</td>
<td>32GB DDR4-2400-MHz RDIMM/PC4-19200/dual rank/x4/1.2v</td>
<td>64</td>
</tr>
<tr>
<td>UCS-C3K-M4RAID</td>
<td>Cisco UCS C3000 RAID Controller M4 Server w 4G RAID Cache</td>
<td>8</td>
</tr>
<tr>
<td>UCS-HS-C3X60</td>
<td>Cisco UCS C3X60 Server Node CPU Heatsink</td>
<td>16</td>
</tr>
<tr>
<td>UCS-C3K-M4SRB</td>
<td>UCS C3000 M4 Server Node for Intel E5-2600 v4</td>
<td>8</td>
</tr>
<tr>
<td>UCS-CPU-E52680E</td>
<td>2.40 GHz E5-2680 v4/120W 14C/35MB Cache/DDR4 2400MHz</td>
<td>16</td>
</tr>
<tr>
<td>UCS-MR-1X322RV-A</td>
<td>32GB DDR4-2400-MHz RDIMM/PC4-19200/dual rank/x4/1.2v</td>
<td>64</td>
</tr>
<tr>
<td>UCS-C3K-M4RAID</td>
<td>Cisco UCS C3000 RAID Controller M4 Server w 4G RAID Cache</td>
<td>8</td>
</tr>
<tr>
<td>UCS-HS-C3X60</td>
<td>Cisco UCS C3X60 Server Node CPU Heatsink</td>
<td>16</td>
</tr>
<tr>
<td>UCS-C3X60-42HD8</td>
<td>UCS C3X60 3 rows of 8TB NL-SAS7200 RPM SAS-3 (42Total) 336TB</td>
<td>8</td>
</tr>
<tr>
<td>UCS-C3X60-HD8TB</td>
<td>UCSC 3X60 8TB NL-SAS 7.2K Helium HDD with HDD Carrier</td>
<td>336</td>
</tr>
<tr>
<td>UCS-C3260-SIOC</td>
<td>Cisco UCS C3260 System IO Controller with VIC 1300 incl.</td>
<td>8</td>
</tr>
<tr>
<td>UCS-C3260-SIOC</td>
<td>Cisco UCS C3260 System IO Controller with VIC 1300 incl.</td>
<td>8</td>
</tr>
<tr>
<td>UCS-C3X60-G2SD48</td>
<td>UCSC C3X60 480GB Boot SSD (Gen 2)</td>
<td>32</td>
</tr>
</tbody>
</table>

Note: Both Cisco UCS S3260 Storage Server Basic Rack and Cisco UCS S3260 Storage Server Capacity Rack Bundle comes with 24 x 4TB Disk Drives, supports up to 28 x 6TB, 8TB and 10TB Disk drives also.

<table>
<thead>
<tr>
<th>Table 19 Red Hat Enterprise Linux License</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Hat Enterprise Linux</td>
<td></td>
</tr>
</tbody>
</table>

207
<table>
<thead>
<tr>
<th>Item Code</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>RHEL-2S2V-3A</td>
<td>Red Hat Enterprise Linux</td>
<td>19</td>
</tr>
<tr>
<td>CON-ISV1-EL2S2V3A</td>
<td>3 year Support for Red Hat Enterprise Linux</td>
<td>19</td>
</tr>
</tbody>
</table>

Table 20 Hortonworks Software

| Hortonworks Software edition needed for this CVD |
|----------------|-----------------------------------------------|
| Hortonworks 2.5 | UCS-BD-CEDHC-BZ= 19                        |
| Hortonworks 2.5 | UCS-BD-CEDHC-GD= 19                        |

SKUS for Hortonworks Subscription

<table>
<thead>
<tr>
<th>Cisco PID (TOP level)</th>
<th>Cisco Subscription PID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCS-BD-HDP-JSS=</td>
<td>UCS-BD-HDP-JSS-6M</td>
<td>HDP Data Platform J umpstart Subscription - Up to 16 Nodes – 1 Business Day Response - 6 Months - sold to new customers only - max. Qty. to buy 1 SKU per customer</td>
</tr>
<tr>
<td>UCS-BD-HDP-ENT-ND=</td>
<td>UCS-BD-ENT-ND-1Y</td>
<td>HDP Enterprise Subscription - 4 Nodes - 24x7 Sev 1 Response - min of 3 SKUs required for new customers</td>
</tr>
<tr>
<td>UCS-BD-HDP-ENT-ND=</td>
<td>UCS-BD-ENT-ND-2Y</td>
<td>HDP Enterprise Subscription - 4 Nodes - 24x7 Sev 1 Response - min of 3 SKUs required for new customers</td>
</tr>
<tr>
<td>UCS-BD-HDP-ENT-ND=</td>
<td>UCS-BD-ENT-ND-3Y</td>
<td>HDP Enterprise Subscription - 4 Nodes - 24x7 Sev 1 Response - min of 3 SKUs required for new customers</td>
</tr>
<tr>
<td>UCS-BD-HDP-EPL-ND=</td>
<td>UCS-BD-EPL-ND-1Y</td>
<td>HDP Enterprise Plus Subscription - 4 Nodes - 24x7 Sev 1 Response - min of 3 SKUs required for new customers</td>
</tr>
<tr>
<td>UCS-BD-HDP-EPL-ND=</td>
<td>UCS-BD-EPL-ND-2Y</td>
<td>HDP Enterprise Plus Subscription - 4 Nodes - 24x7 Sev 1 Response - min of 3 SKUs required for new customers</td>
</tr>
<tr>
<td>UCS-BD-HDP-EPL-ND=</td>
<td>UCS-BD-EPL-ND-3Y</td>
<td>HDP Enterprise Plus Subscription - 4 Nodes - 24x7 Sev 1 Response - min of 3 SKUs required for new customers</td>
</tr>
</tbody>
</table>
About the Authors

Manan Trivedi is a Big Data Solutions Architect in the Data Center Solutions Group, Cisco Systems Inc. Manan is part of the Big Data solution engineering team focusing on big data infrastructure and performance.

Ali Bajwa, Principal Partner Solutions Engineer, Technology Alliances Team, Hortonworks, Inc. Ali is a Senior Partner Solutions Engineer at Hortonworks and works as part of the Technology Alliances team. His focus is to evangelize and assist partners integrate with Hortonworks Data Platform.

Acknowledgements

- Karthik Kulkarni, Big Data Solutions Architect, Data Center Solutions Group, Cisco Systems Inc.
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