Cisco UCS S3260 Storage Server with IBM BigInsights

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Cisco Validated Design
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Executive Summary

Digital transformation in today’s world is accelerating data generation by massive numbers. And with all this data generated organizations are transforming how the business activities, processes, and models leverage this information to get actionable insights from their data. Data storage with retrieval on demand for processing is required for customers. Customers need to achieve the lowest cost for storage, easy access to data while keeping the costs of operation low.

The Cisco® UCS S3260 Storage Server is specifically designed to address this challenge. This next-generation high-density storage system 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 modular design of the Cisco UCS S3260 Storage Server protects the company’s 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.

IBM BigInsights for Apache Hadoop is a platform for the analysis and visualization of Internet-scale data volumes. BigInsights is powered by Apache Hadoop, an open source distributed computing platform. BigInsights helps organizations quickly build and deploy custom analytics and workloads to capture insights from big data that can then be integrated into existing databases, data warehouses, and business intelligence infrastructures.

The Cisco UCS S3260 Storage Server for Big Data and Analytics with IBM BigInsights is a tested and dependable deployment model for enterprise quality Hadoop based systems. This system is designed with easy storage, rapid access, operational excellence and security empowerment in mind.
Solution Overview

Enormous amount of information is 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 IBM Big Insights 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.
- Provides advanced analytics built on Hadoop technology to meet big data analysis requirements.
- Integrates with IBM and other information solutions to help enhance data manipulation and management tasks.

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.

Audience

This document describes the architecture and deployment procedures of IBM BigInsights for Apache Hadoop (16 data nodes with 3 master/management nodes) based on Cisco UCS Integrated Infrastructure for Big Data. The intended audience of this document includes, but is not limited to sales engineers, field consultants, professional services, IT managers, partner engineering and customers who want to deploy IBM BigInsights for Apache Hadoop on the Cisco UCS Integrated Infrastructure for Big Data.
Solution Overview

Solution Summary

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 with Cisco UCS C240 M4 servers for management. This architecture is specifically designed for performance and linear scalability for big data workloads.

The configuration using Cisco UCS S3260 Storage Servers as data nodes and Cisco UCS C240 M4 rack servers as management nodes is shown in Table 1. This configuration supports the massive scalability that big data enterprise deployments demand. This architecture can scale to thousands of servers with Cisco Nexus 9000 Series Switches.

Table 1 lists the Configuration Details of the Cisco UCS S3260 Storage Server Configuration.

Table 1  Cisco UCS S3260 Storage Server Configuration Details

<table>
<thead>
<tr>
<th>Cisco UCS S3260 Storage Server Data Nodes</th>
<th>Cisco UCS C240 M4 Management Nodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connectivity: 2 Cisco UCS 6332 Fabric Interconnects</td>
<td></td>
</tr>
<tr>
<td>8 Cisco UCS S3260 Storage Servers, each with two nodes, each node with:</td>
<td>3 Cisco UCS C240 M4 Rack Servers each with:</td>
</tr>
<tr>
<td>• 2 Intel Xeon® processor E5-2680 v4 CPUs (14 cores on each CPU)</td>
<td>• 2 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 12-Gbps 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>• 24 x 8-TB 7,200-rpm LFF SAS drives (3.07 petabytes [PB] total)</td>
<td>• 8 x 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>• 2 x 480-GB 6-Gbps 2.5-inch enterprise value SATA SSD drives for boot</td>
<td>• 2 x 240-GB 6-Gbps 2.5-inch enterprise value SATA SSD drives for boot</td>
</tr>
</tbody>
</table>

Scaling/Performance Options

Depending on the storage and performance requirements, any of the following HDDs can be used with an optional expansion to 24 drives per node. Table 2 lists the Hard Drives and their Expansion Storage Values.

Table 2  Hard Drives with Storage and Expansion Storage Values

<table>
<thead>
<tr>
<th>HDD</th>
<th>Total Storage (24 drives)</th>
<th>Expansion (with 28 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>HDD</td>
<td>Total Storage (24 drives)</td>
<td>Expansion (with 28 drives)</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------------------------</td>
<td>---------------------------</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>

**Data Storage for Big Data Processing**

Companies have realized the power of big data and are now collecting more data than ever before. They need to get value from this data, often in real-time. Sensors, IoT devices, social network data and online transactions are just a few examples. They are all generating data continuously, 24x7. This data needs to be captured, stored, monitored and processed quickly in order to make informed, data-driven decisions in real-time.

In addition, real-time streaming data needs to be sent to the company's enterprise-wide data store where it can be used for traditional analysis and reporting, data discovery and as input to sophisticated machine-learning algorithms.

The next section details the relevant reference architectures for meeting these real world challenges.

**Reference Architecture**

Figure 1 shows the base configuration of a high-availability cluster. It is comprised of 16 data nodes using Cisco UCS S3260 Storage Servers and 3 management nodes using Cisco UCS C240 M4 rack servers.
Note: This CVD describes the installation process of IBM BigInsights 4.2 for a cluster (3 management nodes for high-availability + 16 data nodes).

Table 3  **Components for a BigInsights 19 Node Cluster**

<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>Big Insights Nodes</td>
<td>3 x Cisco UCS C240 M4 Rack Server</td>
</tr>
<tr>
<td></td>
<td>8 x Cisco UCS S3260 Storage Servers</td>
</tr>
<tr>
<td></td>
<td>Hadoop NameNode/Secondary NameNode and Resource Manager and Data Nodes.</td>
</tr>
<tr>
<td></td>
<td>Spark Executors are collocated on a Data Node.</td>
</tr>
<tr>
<td></td>
<td>*Please refer to the Service Assignment section for specific service assignment and configuration details.</td>
</tr>
</tbody>
</table>
Reference Architecture

Cisco UCS S3260 Storage Server with IBM BigInsights

This solution is based on the Cisco Unified Computing System (Cisco UCS) infrastructure using Cisco UCS 6300 Series Fabric Interconnects, Cisco UCS S3260 Storage Servers, and Cisco UCS C240 M4 Rack Servers. This architecture is specifically designed for performance and linear scalability for big data workloads and is built using the following components:

Cisco UCS S3260 Storage Servers

The Cisco UCS S3260 Storage Server 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 a 4-GB cache and a host bus adapter (HBA) controller. For each server, there are two internal solid-state-disk (SSD) drives for booting.
The Cisco UCS S3260 Storage Server chassis has 56 top-load LFF HDDs with a maximum capacity of 10 TB per HDD and can be mixed with up to 24 SSDs with maximum capacity of 3.2 TB per SSD.

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 6300 Series Fabric Interconnects**

Cisco UCS 6300 Series Fabric Interconnects 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 alarms and send notifications about the health of the entire cluster.
Cisco UCS C-Series Rack Mount Servers

Cisco UCS C-Series Rack Mount Servers are based on the Intel Xeon® E5-2600 v3 and 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 servers provide 24 DIMM (PCIe) 3.0 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 internal drives are supported in the Performance-optimized option, or twelve Large Form Factor (LFF) disk drives option 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 1227 (VICs), are 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 5   Cisco UCS C220 M4 Rack Server (Small Form Factor Disk Drive Model)
Cisco UCS Virtual Interface Cards (VICs)

Cisco UCS Virtual Interface Cards (VICs) are unique to Cisco. Cisco UCS Virtual Interface Cards incorporate next-generation converged network adapter (CNA) technology from Cisco, and offer dual 10-Gbps ports designed for use with Cisco UCS C-Series Rack-Mount Servers. Optimized for virtualized networking, these cards deliver high performance and bandwidth utilization, and support up to 256 virtual devices. The Cisco UCS Virtual Interface Card (VIC) 1227 is a dual-port, enhanced Small Form-Factor Pluggable (SFP+), 10 Gigabit Ethernet, and Fiber Channel over Ethernet (FCoE)-capable, PCI Express (PCIe) modular LAN on motherboard (mLOM) adapter. It is designed exclusively for the M4 generation of Cisco UCS C-Series Rack Servers and the C3160 dense storage servers.

The Cisco UCS Virtual Interface Card 1387 (Figure 7) 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 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), 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 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 case Cisco UCS Manager will automatically detect the failed drives and replace with one of the available hot spare drives, rebuild it and make it available to use within the Chassis.
IBM BigInsights for Apache Hadoop: A complete Hadoop Platform

With IBM BigInsights 4.2 (Figure 9), IBM provides the full range of analytics for Hadoop, Spark and SQL over an open and flexible platform. This platform combines batch processing, SQL, streaming and complex analytics seamlessly for any application to handle a wide range of data processing scenarios.

Figure 9  IBM BigInsights
IBM BigInsights, built on IBM IOP, is designed with analytics, operational excellence and security empowerment in mind.

IBM BigInsights with Apache Hadoop at the core:

- Provides advanced analytics built on Hadoop technology (IBM BigInsights Data Scientist module) to meet big data analysis requirements.
- Designed for performance and usability (IBM BigInsights Analyst module) through performance optimized capabilities, visualization, rich developer tools and powerful analytic functions.
- Delivers management, security and reliability features (IBM Enterprise Management module) to support large-scale deployments and help speed time to value.
- Integrates with IBM and other information solutions to help enhance data manipulation and management tasks.

IBM BigInsights with Apache Hadoop provides a scalable, flexible, integrated platform that makes it easy to manage rapidly increasing volumes and varieties of data in any enterprise. Industry-leading IBM BigInsights with Apache Hadoop products and solutions enable to deploy and manage Apache Hadoop and related projects, manipulate and analyze data, and keep that data secure and protected.

IBM IOP

IBM Open Platform (IOP) with Apache Hadoop and Apache Spark is IBM’s big data platform. IOP is built on 100% open source Apache Ecosystem components. It is designed for flexible and efficient analytics and operations.

Key features of IBM Open Platform with Apache Hadoop include:

- Ambari operational framework for provisioning, managing & monitoring Apache Hadoop clusters.
- Native support for rolling upgrades for Hadoop services.
- Support for long-running applications within YARN:
  - Higher cluster utilization.
  - Lower operational costs.
  - Reduced data motion.

Integration with Apache Spark

IBM IOP includes integration with Apache Spark 1.6.1. The benefits include fast processing from the Spark core, near real-time analytics with Spark streaming, built-in machine learning libraries that are highly extensible using Spark MLib, querying of unstructured data and more value from free-form text analytics with Spark SQL, and graph computation/graph analytics with Spark GraphX.
IBM BigSQL

IBM BigSQL is the ultimate platform for RDBMS off-load and consolidation, featuring standard compliant SQL, as well as support many vendor specific extensions.

It is faster and easier to offload old data from existing enterprise data warehouses or data marts to free up capacity while preserving most of the familiar SQL from those platforms. BigSQL's SQL engine for Hadoop can work with Hive, HBase, and Spark concurrently for best in class analytic capabilities.

As with any RDBMS, performance is a critical factor, and this is certainly the case for BigSQL. One of the most significant improvements in Big SQL 4.2 is improved out-of-the-box performance, including more partitioning capabilities, better default execution plans.

Key Features of IBM BigSQL include:

- Easy installation/administration via Apache Ambari.
- Improved performance with concurrent query processing/partition options/optimized default configurations.
- Statistics collection and measurement.
- Enhanced security via Impersonation support to allow a service user to securely access data in Hadoop on behalf of another user.
- Metadata Integration: automatic synchronization of Big SQL metadata with Hive.
- Resource Management: More optimal distribution of resources for high demand (enterprise) environments.
- BigSQL disaster recovery:
  - Support for Online backup of BigSQL metastore + data (local tables) and offline restore on remote DR site.
  - Regular backup/restored configured to meet user's recovery window requirements.

IBM Text Analytics

IBM Text Analytics is a powerful system for extracting structured information from unstructured and semi-structured text by defining rules to create extractors. It includes an all-new powerful web-based Visual Text Analytics Framework allowing developers to easily build high-quality applications that can process text in multiple written languages and derive insights from large amounts of native textual data in various formats.

Cisco UCS Integrated Infrastructure for Big Data and Analytics offers several configurations to meet a variety of computing and storage requirements.
BigSheets

BigSheets turns Do It Yourself Analytics into a reality for analysts by going beyond structured database management into unstructured data management. Seeing the whole picture will help all levels of business make better decisions.

BigSheets provides a web-based, spreadsheet-style view into collections of files in Hadoop. Users can perform data transformations, filtering and visualizations at massive scale. No coding is required because BigSheets translates the spreadsheet actions into MapReduce to leverage the computational resources of the Hadoop cluster. This helps analysts discover value in data quickly and easily.

BigSheets is an extension of the mashup paradigm that:

- Integrates gigabytes, terabytes, or petabytes of unstructured data from web-based repositories.
- Collects a wide range of unstructured web data stemming from user-defined seed URLs.
- Extracts and enriches data using the unstructured information management architecture selected (LanguageWare, OpenCalais, etc.).
- Lets users explore and visualize this data in specific, user defined contexts (such as ManyEyes).

Some of BigSheets benefits include:

- Provides business users with a new approach to keep pace with data escalation. By taking the structure to the data, this helps mine petabytes of data without additional storage requirements.
- BigSheets provides business users with a new approach that allows them to break down data into consumable, situation-specific frames of reference. This enables organizations to translate untapped, unstructured, and often unknown web data into actionable intelligence.
- Leverage all the compute resources of the Hadoop cluster to drive insights and visualizations with BigSheets right on the cluster—no extraction required.

Big R

The IBM BigInsights Data Scientist module includes Big R. Big R enables data scientists to run native R functions to explore, visualize, transform, and model big data right from within the R environment. Data scientists can run scalable machine learning algorithms with a wide class of algorithms and growing R-like syntax for new algorithms & customize existing algorithms. BigInsights for Apache Hadoop running Big R can use the entire cluster memory, spill to disk and run thousands of models in parallel.

Big R provides a new processing engine, and enables automatic tuning of machine learning performance over massive data sets in Hadoop clusters. Big R can be used for comprehensive data analysis, hiding some of the complexity of manually writing MapReduce jobs.

Benefits of Big R include:
Technology Overview

- End-to-end integration with open source R.
- Transparent execution on Hadoop.
- Seamless access to rich and scalable machine learning algorithms provided in Big R.
- Text analytics to extract meaningful information from unstructured data.

Enterprise Management

The IBM BigInsights Enterprise Management module provides a comprehensive web-based interface included in BigInsights that simplifies cluster management, service management, job management and file management. Administrators and users can share the same interface, launching applications and viewing a variety of configurable reports and dashboards.

Built-in Security

IBM IOP now supports Apache Ranger. It provides a centralized security platform for managing authorization, access control, auditing and data protection. Another new feature in Big SQL 4.2 is the support of Impersonation. Impersonation is the ability to allow a service user to securely access data in Hadoop on behalf of another user. In Big SQL, impersonation can be enabled at the global level to enable impersonation of connected users for actions on Hadoop tables.
Solution Design

Requirements

This CVD describes architecture and deployment procedures for IBM BigInsights (4.2.0) on eight Cisco UCS S3260 Storage Server chassis each with two C3X60 M4 server nodes as Hadoop data nodes, and three Cisco UCS C240 M4 as Hadoop Management nodes. The solution goes into detail configuring IOP 4.2 on the infrastructure.

The cluster configuration consists of the following:

- Two Cisco UCS 6332 Fabric Interconnects
- Three Cisco UCS C240 M4 servers
- Eight Cisco UCS S3260 Storage Server Chassis (2 Server nodes on each chassis)
- 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 C240M4 Servers. Each chassis is connected to two vertical PDUs for redundancy; thereby, ensuring availability during power source failure.

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

<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 C240M4 Rack Server</td>
</tr>
<tr>
<td>37</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>Cisco UCS C240M4 Rack Server</td>
</tr>
<tr>
<td>35</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Cisco UCS C240M4 Rack Server</td>
</tr>
<tr>
<td>33</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Cisco UCS S3260 Storage Server</td>
</tr>
<tr>
<td>31</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>
## Port Configuration on Fabric Interconnects

<table>
<thead>
<tr>
<th>Port Type</th>
<th>Port Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network</td>
<td>32</td>
</tr>
<tr>
<td>Server</td>
<td>1 to 19</td>
</tr>
</tbody>
</table>

## 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 10 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 10 Fabric Topology for Cisco UCS S3260 Storage Server with UCSC-C3K-M4SRB server blades

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

Figure 10 depicts the connectivity between Cisco UCS S3260 Storage Server chassis and Cisco UCS 6300 Fabric Interconnects. Each chassis has two C3x60 M4 server nodes. Each link in the figure represents a 40 Gigabit Ethernet link from the Cisco UCS S3260 Storage Server chassis connecting to a Fabric Interconnect. Every chassis is connected to both Fabric Interconnects represented with dual links.

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 10). 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. The Fabric Topology for the Cisco UCS C240 M4 Rack Server is shown in Figure 11.
Cisco UCS S3260 Storage Server Scaling with Cisco Application Centric Infrastructure (ACI)

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 Interconnects which are interconnected through the 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, two Nexus 9332PQ as the leaf switches, and three APIC-L1 as an APIC appliance.
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 5 below.
Table 5  **Spine to Leaf Connectivity**

<table>
<thead>
<tr>
<th>Spine</th>
<th>Line Card Pair</th>
<th>Ports Used</th>
<th>POD</th>
<th>Chassis</th>
<th>Leaf</th>
</tr>
</thead>
<tbody>
<tr>
<td>N9508_A</td>
<td>Line Card 1</td>
<td>1-2</td>
<td></td>
<td></td>
<td>9332_1A</td>
</tr>
<tr>
<td></td>
<td>Line Card 1</td>
<td>3-4</td>
<td>1</td>
<td>70</td>
<td>9332_1B</td>
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<td></td>
<td>Line Card 1</td>
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<td>9332_2A</td>
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<td></td>
<td>Line Card 1</td>
<td>7-8</td>
<td>2</td>
<td>154</td>
<td>9332_2B</td>
</tr>
<tr>
<td></td>
<td>Line Card 1</td>
<td>9-10</td>
<td></td>
<td></td>
<td>9332_3A</td>
</tr>
<tr>
<td></td>
<td>Line Card 1</td>
<td>11-12</td>
<td>3</td>
<td>238</td>
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<td>13-14</td>
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<td>4</td>
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</tr>
<tr>
<td></td>
<td>Line Card 1</td>
<td>17-18</td>
<td>5</td>
<td></td>
<td>9332_5A</td>
</tr>
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<td></td>
<td>Line Card 1</td>
<td>19-20</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>...</td>
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<td>....</td>
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<td>Line Card 1</td>
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<td>9</td>
<td>742</td>
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<tr>
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<td>1-2</td>
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<td></td>
<td></td>
<td>9332_64A</td>
</tr>
<tr>
<td>Line Card 8</td>
<td>3-4</td>
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<td>64</td>
<td>5362</td>
<td>9332_64B</td>
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<td>Line Card 8</td>
<td>1-2</td>
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<tr>
<td>Line Card 8</td>
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<td>5446</td>
<td>9332_65B</td>
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<td></td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td>9332_67A</td>
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<tr>
<td>Line Card 8</td>
<td>3-4</td>
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<td>67</td>
<td>5614</td>
<td>9332_67B</td>
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<td></td>
<td></td>
<td></td>
<td>9332_68A</td>
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<tr>
<td>Line Card 8</td>
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<td>68</td>
<td>5698</td>
<td>9332_68B</td>
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<tr>
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<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Line Card 8</td>
<td>9-10</td>
<td></td>
<td></td>
<td></td>
<td>9332_72A</td>
</tr>
<tr>
<td>Line Card 8</td>
<td>11-12</td>
<td></td>
<td>72</td>
<td>6034</td>
<td>9332_72B</td>
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</tbody>
</table>
| N9508_B | Line Card 1 | 1-2  | 1  | 70  | 9332_1A  
|         | Line Card 1 | 3-4  | 1  | 70  | 9332_1B  
|         | Line Card 1 | 5-6  | 2  | 154 | 9332_2A  
|         | Line Card 1 | 7-8  | 2  | 154 | 9332_2B  
|         | Line Card 1 | 9-10 | 3  | 238 | 9332_3A  
|         | Line Card 1 | 11-12| 3  | 238 | 9332_3B  
|         | Line Card 1 | 13-14| 4  | 322 | 9332_4A  
|         | Line Card 1 | 15-16| 4  | 322 | 9332_4B  
|         | Line Card 1 | 17-18| 5  | 406 | 9332_5A  
|         | Line Card 1 | 19-20| 5  | 406 | 9332_5B  
|         |            |      |    |     | ...      
|         |            |      |    |     | ...      
|         |            |      |    |     | ...      
|         | Line Card 8| 1-2  | 9  | 742 | 9332_6A  
|         | Line Card 8| 3-4  | 9  | 742 | 9332_6B  
|         | Line Card 8| 1-2  | 64 | 5362| 9332_7A  
|         | Line Card 8| 3-4  | 64 | 5362| 9332_7B  
|         | Line Card 8| 1-2  | 65 | 5446| 9332_8A  
|         | Line Card 8| 3-4  | 65 | 5446| 9332_8B  
|         | Line Card 8| 1-2  | 66 | 5530| 9332_9A  
|         | Line Card 8| 3-4  | 66 | 5530| 9332_9B  
|         | Line Card 8| 1-2  | 67 | 5614| 9332_10A 
|         | Line Card 8| 3-4  | 67 | 5614| 9332_10B 
|         | Line Card 8| 5-6  | 68 | 5698| 9332_11A 
|         | Line Card 8| 7-8  | 68 | 5698| 9332_11B 
|         |            |      |    |     | ...      
|         |            |      |    |     | ...      
|         |            |      |    |     | ...      
|         | Line Card 8| 9-10 | 72 | 6034| 9332_12A 
|         | Line Card 8| 11-12| 72 | 6034| 9332_12B |
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 software distributions required versions are listed below.

IBM BigInsights with Apache Hadoop


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

The software versions tested and validated in this document are shown in Table 7.

<table>
<thead>
<tr>
<th>Layer</th>
<th>Component</th>
<th>Version or Release</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compute (Chassis)</td>
<td>Board Controller</td>
<td>1.0.14</td>
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<tr>
<td></td>
<td>Chassis Management Controller</td>
<td>2.0(13a54)</td>
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<tr>
<td></td>
<td>Shared Adapter</td>
<td>4.1(2a)</td>
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<tr>
<td></td>
<td>SAS Expander</td>
<td>04.08.01.B073</td>
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<tr>
<td>System IO Controller</td>
<td>BIOS</td>
<td>C3x60M4.2.0.13c</td>
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<tr>
<td></td>
<td>Board Controller</td>
<td>2.0</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>CIMC Controller</td>
<td>2.0(13e)</td>
</tr>
<tr>
<td>Network</td>
<td>Cisco UCS 6332</td>
<td>3.1(2b)</td>
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<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>
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<tr>
<td>Storage</td>
<td>Storage Controller SAS</td>
<td>29.00.1-0042</td>
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<td></td>
<td>LSI MegaRAID SAS 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>
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<td></td>
<td>Cisco UCS Manager</td>
<td>3.1(2b)</td>
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<td></td>
<td>Big Insights</td>
<td>4.2</td>
</tr>
</tbody>
</table>

Note: The latest drivers can be downloaded from the link below:
https://software.cisco.com/download/release.html?mdfid=283862063&flowid=25886&softwareid=283853158&release=1.5.7d&relind=AVAILABLE&rellifecycle=&reltype=latest

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 Cisco UCS Manager using virtual IP address of using the web browser.
- Launch Cisco UCS Manager.
- Enable server, uplink and appliance ports.
- Start discovery process.
- Create pools and polices for service profile template.
- Create Service Profile template and 64 Service profiles.
- Associate Service Profiles to servers.
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.


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 12)

Figure 12  Cisco UCS Manager Login Screen
Adding a Block of IP Addresses for KVM Access

To create a block of KVM IP addresses for server access in the Cisco UCS environment, complete the following steps, as shown in Figure 13:

1. Select the LAN tab at the top of the left window.
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 14).
6. Click OK to create the IP block.

7. Click OK in the message box.

Enabling Uplink Ports

To enable uplinks ports, complete the following steps, as shown in Figure 15:

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


3. Expand the Unconfigured Ethernet Ports section.

4. Select port 1 that is connected to the uplink switch, right-click, then select Reconfigure > Configure as Uplink Port.

5. Select Show Interface and select 10GB for Uplink Connection.

6. A pop-up window appears to confirm the selection. Click Yes then OK to continue.


8. Expand the Unconfigured Ethernet Ports section.

9. Select port number 1, which is connected to the uplink switch, right-click, then select Reconfigure > Configure as Uplink Port.

10. Select Show Interface and select 10GB for Uplink Connection.

11. A pop-up window appears to confirm the selection. Click Yes then OK to continue.
Configuring VLANs

VLANs are configured as in shown in Table 8.

Table 8  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 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, as shown in Figure 16:

1. Select the LAN tab in the left pane in the Cisco 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.
5. Enter vlan76 for the VLAN Name. (Figure 17)

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 (Figure 18).


3. Click the Ethernet Ports section.

4. Select all the ports that are connected to the Servers right-click them, and select Reconfig-ure > Configure as a Server Port.

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 18** Enabling Server Ports

<table>
<thead>
<tr>
<th>Slot</th>
<th>App Port ID</th>
<th>Port ID</th>
<th>MAC</th>
<th>Role</th>
<th>Type</th>
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<td>1</td>
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<td>0</td>
<td>2</td>
<td>CC-46:06:83:16:12</td>
<td>Disable</td>
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<td>0</td>
<td>3</td>
<td>CC-46:06:83:16:16</td>
<td>Configure as Server Port</td>
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<tr>
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<td>4</td>
<td>CC-46:06:83:16:1A</td>
<td>Configure as Uplink Port</td>
<td></td>
</tr>
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<td>0</td>
<td>5</td>
<td>CC-46:06:83:16:1E</td>
<td>Configure as FC/E UpLink Port</td>
<td></td>
</tr>
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<td>0</td>
<td>6</td>
<td>CC-46:06:83:16:20</td>
<td>Configure as FC/E Storage Port</td>
<td></td>
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<td>7</td>
<td>CC-46:06:83:16:26</td>
<td>Configure as Appliance Port</td>
<td></td>
</tr>
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<td>0</td>
<td>8</td>
<td>CC-46:06:83:16:3A</td>
<td>Unconfigure</td>
<td></td>
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<td>0</td>
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<td>CC-46:06:83:16:3E</td>
<td>Unconfigure FC/E Uplink Port</td>
<td></td>
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<td>1</td>
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<td>0</td>
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<td>Unconfigure FC/E Storage Port</td>
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<td>12</td>
<td>CC-46:06:83:16:3A</td>
<td>Unconfigure Appliance Port</td>
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<td>CB/H4L</td>
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<td>Physical</td>
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<td>Physical</td>
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<td>Physical</td>
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<td>Physical</td>
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<td>Physical</td>
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<td>Physical</td>
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<td>Physical</td>
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<td>Physical</td>
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<td>Physical</td>
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<td>Physical</td>
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<td>CC-46:06:83:16:3E</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 19).
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 20)
5. In the Add Slots to Policy window (Figure 21), 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 22)
Creating Chassis Firmware Package Policy

1. Right click on the Chassis Firmware Packages and click “Create Chassis Firmware Packages”. (Figure 23)
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 25).

![Chassis Profile Templates](image)

**Figure 25** Chassis Profile Templates

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

Figure 31  Associate Chassis Profiles

3. Select “Chassis Profile Chassis 1” and click “OK”. (Figure 32)
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 33)
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 34)

2. In the Create Disk Policy window, configure the following parameters and click OK. (Figure 35)
   a. Name = “Boot_SSD”
   b. RAID Level = RAID 1 Mirrored
c. Disk Group Configuration = Automatic

d. Number of Drives = 2

e. Drive Type = SSD

f. Use Remaining Disks = checked

g. Strip Size = 64 KB

h. Access Policy = Platform Default

i. Read Policy = Read Ahead

j. Write Cache Policy = Always Write Back

k. IO Policy and Drive Cache = Platform Default

Figure 35  Create Disk Group Policy
3. Click on the Storage tab. Right click on Storage Profile and click Create Storage Profile. (Figure 36)

Figure 36  Create Storage Profile

4. Enter “Boot_SSD” in the name field. Under Local LUNs click “+” to add local lun. (Figure 37)

Figure 37  Create Storage Profile

5. In the Create Local LUN window, enter the name “Boot_SSD”. (Figure 38)
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 (Figure 39):

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.

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 40).

10. Specify a size of the MAC address pool, which is sufficient to support the available server resources.

11. Click OK.

**Figure 39** Creating a MAC Pool

**Figure 40** Specifying First MAC Address and Size

12. Click Finish (Figure 41).
13. When the message box displays, click **OK** (Figure 42).

### 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. A server can be manually assigned to a server pool, or server pool policies and server pool policy qualifications can be used 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 Cisco UCS Manager GUI.
2. Select **Pools > root**.
3. Right-click the **Server Pools**.
4. Select **Create Server Pool**.
5. Enter the 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.

**Figure 43** Unified Computing System/Set Name and Description

8. Select all the Cisco UCS C240M4SX servers 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.
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 Cisco UCS Manager GUI.
2. Select Policies > root.
3. Right-click Host Firmware Packages.
4. Select Create Host Firmware Package (Figure 45).
5. Enter the required Host Firmware package name (ucs).
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 45  Create Host Firmware Package**

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 Cisco UCS Manager GUI (Figure 46).

2. Select Policies > root.


4. Select Create QoS Policy.
5. Enter **Platinum** as the name of the policy.

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 (Figure 47).
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 Cisco UCSM GUI.
2. Select LAN Cloud > QoS System Class (Figure 48).
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 48 QoS System Class
Creating the Local Disk Configuration Policy

To create a 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 Cisco UCS Manager GUI.
2. Go to Policies > root.
3. Right-click Local Disk Config Policies.
4. Select Create Local Disk Configuration Policy.
5. Enter ucs as the local disk configuration policy name (Figure 49).
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.
Creating 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 Cisco UCS Manager GUI.
2. Select Policies > root.
4. Select Create BIOS Policy.
5. Enter the preferred BIOS policy name (ucs).

6. Change the BIOS settings as shown below.

7. Changes only need to be made in the Processor (Error! Reference source not found.) and RAS Memory settings (Figure 51).
Unified Computing System Manager

Processor

- Processor C7 Report: disabled
- Processor CMC: enabled
- CPU Performance: enterprise
- Max Variable MTRR Setting: auto-max
- Local X2 APIC: x皇
- Power Technology: performance
- Energy Performance: performance
- Frequency Floor Overrides: disabled
- P-STATE Coordinator: hw-all
- DRAM Clock Throttling: performance
- Channel Interleaving: Platform Default
- Rank Interleaving: Platform Default
- Demand Scrub: disabled
- Patrol Scrub: disabled
- Altitude: Package C State Limit: auto
- CPU Hardware Power Management: disabled
- Energy Performance Tuning: platform
- Workload Configuration: balanced

< Prev  Next >  Finish  Cancel
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 Cisco UCS Manager GUI.
2. Select Policies > root.
3. Right-click the Boot Policies.
4. Select Create Boot Policy (Figure 52).
5. Enter `ucs` for 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. *(Error! Reference source not found.)*

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.

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 Cisco UCS Manager GUI.
2. Select Policies > root.
3. Right-click the Power Control Policies (Figure 55).
4. Select Create Power Control Policy.
5. Enter `ucs` for the Power Control policy name (Figure 56).

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.
Creating a Service Profile Template

To create a Service Profile Template, complete the following steps:

1. Select the **Servers** tab in the left pane in the Cisco UCSM GUI.
2. Right-click **Service Profile Templates** (Figure 57).
3. Select **Create Service Profile Template**.

**Figure 56** Create Power Control Policy

**Figure 57** Service Profile Template
The Create Service Profile Template window appears.

To identify the service profile template, complete the following steps (Figure 58):

4. Name the service profile template *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 58** Identify Service Profile Template

---

**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 59)

2. Click *Next* to continue to the next section.
4. Go to the Local Disk Configuration Policy tab, and select \texttt{ucs} for the Local Storage. Figure 60. Click \texttt{Next} to continue to the next section
5. 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 set at the default (Figure 61).

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 (Figure 62). Name the vNIC eth0.

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 VLAN19 check box for VLANs and select the Native VLAN radio button.

8. Select MTU size 9000.

9. Select the adapter policy Linux.

10. Select the QoS Policy Platinum.

11. Keep the Network Control Policy set to Default.
12. Click **OK**.

**Figure 62  Create vNIC**
13. Click **Next** to continue with SAN Connectivity (Figure 63).

14. Select no vHBAs for How would you like to configure SAN Connectivity? (Figure 64)
15. Click **Next** to continue with Zoning (Figure 65).
16. Click Next to continue with vNIC/vHBA placement. (Figure 66)
17. Click **Next** to configure vMedia Policy.

**Configuring the vMedia Policy for the Template**

1. Click **Next** once the vMedia Policy window appears to go to the next section.
Configuring Server Boot Order for the Template

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

1. Select ucs in the Boot Policy name field. (Figure 68)
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 OK.
5. Click Next to continue to the next section.
6. In the Maintenance Policy window, apply the maintenance policy (Figure 69).

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 (Figure 70), to assign the servers to the pool, complete the following steps:

1. Select UCS for the Pool Assignment field.

2. Select the power state to be Up.


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 71), 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 Cisco UCS Manager GUI.

6. Go to **Service Profile Templates > root**.

7. Right-click **Service Profile Templates ucs**.

8. Select **Create Service Profiles From Template**. (Figure 72)
Association of the Service Profiles will take place automatically. Click OK. (Figure 73)

The final Cisco UCS Manager window is shown below in Figure 74.
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 75)

3. In the Clone Name, enter UCS-C240 and from the Org drop down list choose UCS-C240 and click OK. (Figure 76)
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 77)

6. In the Pool Assignment drop down list choose Management and click OK.

Figure 77  Associate with Server Pool
7. In the right window select the Storage tab and click Modify Storage Profile. (Figure 78)

Figure 78  Modify Storage Profile

8. From the Storage profile drop down list choose No Storage Profile and click OK. (Figure 79)
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 80)
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 81)
In the Create Service Profiles from Template screen: (Figure 82)

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
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 83.
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 83  KVM Console

6. Click the Activate Virtual Devices found in the Virtual Media tab. (Figure 84)
7. In the KVM window (Figure 85), 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 86), and click Continue.

**Figure 86  Select Language Window**
18. Select Date and time as shown in Figure 87.

**Figure 87**  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 88.
A Caution symbol appears next to Installation Destination as shown in Figure 89 above.

21. This opens the Installation Destination window displaying the boot disks. This is shown in Figure 90 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 91.

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 92).
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 93 below.
28. Change the Device type to RAID and RAID level to RAID1 (Redundancy) and click on Update Settings.
Figure 94  Manual Partitioning/Swap

- Click + to add the / partition. The size can be left empty so it uses the remaining capacity and click Add Mountpoint. (Figure 95).
29. In the next window (Figure 96), change the Device type to RAID and RAID level to RAID1 (Redundancy). Click Update Settings.
30. Click Done to go back to the main screen and continue the Installation.

The Installation screen opens (Figure 97).

31. Click on Software Selection.
The Software Selection screen opens (Figure 98).

32. Select Infrastructure Server and select the Add-Ons as noted below. Click Done.
The Installation Summary window returns (Figure 99).

33. Click on Network and Hostname.
Configure Hostname and Networking for the Host (Figure 100).

34. Type in the hostname as shown below.
35. Click on Configure to open the Network Connectivity window (Figure 101).

36. Click on IPV4Settings.
37. Change the Method to Manual and click Add. Figure 102 shows the Add Details pop up window.

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

40. Update the hostname and turn Ethernet ON. Click Done to return to the main menu. The Installation Summary window opens (Figure 103).

41. Click Begin Installation in the main menu.
Figure 103  Installation Summary Window

A new window opens (Figure 104).

42. Select Root Password in the User Settings.

Figure 104  Select Root Password
43. On the next screen (Figure 105), enter the Root Password and click done.

**Figure 105** Enter the Root Password

A progress window will open (Figure 106).

**Figure 106** Progress Bar

44. Once the installation is complete reboot the system.

45. Repeat steps 1 to 43 to install Red Hat Enterprise Linux 7.2 on other Management Nodes.
Installing Red Hat Enterprise Linux 7.2 on 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 107)
5. In the KVM window, select the Virtual Media tab.
6. Click the Activate Virtual Devices found in the Virtual Media tab. (Figure 108)

7. In the KVM window, select the Virtual Media tab and click the Map CD/DVD. (Figure 109)

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 110)
Figure 110  Select the rhel-server

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 111)

17. Select language of installation and click Continue. (Figure 112)
18. Select Date and Time, (Figure 113) which pops up another window as shown below in Figure 114.

**Figure 113** Date and Time
19. Select the location on the map, set the time and click Done.

20. Click on Installation Destination. (Figure 115)
21. This opens a new window with the boot disks. Make the selection, and choose I will configure partitioning. Click Done. (Figure 116)
22. This opens the new window for creating the partitions. (Figure 117) 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.
Figure 117 Add a New Mount Point

24. Click on the + sign to create the swap partition of size 2048 MB as shown below. (Figure 118)
25. Click + to add the / partition. The size can be left empty so it uses the remaining capacity and click Add Mountpoint. (Figure 119)
26. Select /boot partition and change the Device Type to Standard Partition and the file system to ext4. (Figure 120)

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 121)
Figure 121 Software Selection

31. Select Infrastructure Server and select the Add-Ons as noted below. Click Done. (Figure 122)
Figure 122 Infrastructure Server

32. Click on Network and Hostname and configure Hostname and Networking for the Host. (Figure 123)
33. Type in the hostname as shown below. (Figure 124)
34. Click on Configure to open the Network Connectivity window. Click on Ethernet. (Figure 125)

**Figure 125 Add Ethernet**

35. Click on IPv4 Settings and change the Method to Manual and click Add to enter the IP Address, Netmask and Gateway details. (Figure 126)
Figure 126 Add IP Details

36. Enter the desired IP address, Netmask and Gateway and click Save. (Figure 127)

Figure 127 Manual IP Address Entry

37. Click Save, update the hostname and turn Ethernet ON. Click Done to return to the main
38. Click Begin Installation in the main menu. (Figure 128)

**Figure 128** Begin Installation

39. Select Root Password in the User Settings. (Figure 129)
40. Enter the Root Password and click done. (Figure 130)

The Installation Progress window displays the process. (Figure 131)
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 9.

<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>Hostname</td>
<td>eth0</td>
</tr>
<tr>
<td>----------</td>
<td>----------</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>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>
Post OS Install Configuration

Choose one of the nodes of the cluster or a separate node as the Admin Node for management such as 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 clustershell (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).

2. 

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

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

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

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

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

9. Create a file under `/ssh/` and enter the following lines

   ```
   vi ~/.ssh/config
   ServerAliveInterval 99
   StrictHostKeyChecking no
   ```

10. 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 (`rhel1`) and other nodes as follows:

2. On Admin Node (`rhel1`)

   ```
   #vi /etc/hosts
   127.0.0.1 localhost localhost.localdomain localhost4 \
   localhost4.localdomain4 ::1 localhost localhost.localdomain localhost6 \
   localhost6.localdomain6
   172.16.46.11 rhel1
   172.16.46.12 rhel2
   172.16.46.13 rhel3
   172.16.46.14 rhel4
   172.16.46.15 rhel5
   172.16.46.16 rhel6
   172.16.46.17 rhel7
   172.16.46.18 rhel8
   172.16.46.19 rhel9
   ```
Creating a Red Hat Enterprise Linux (RHEL) 7.2 Local Repo

To create a repository using 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. Copy the contents of the Red Hat DVD to `/var/www/html/rhelrepo`

3. Alternatively, if access to a Red Hat ISO Image is available, copy the ISO file to rhel1.

4. And login back to rhel1 and create the mount directory.

   `# scp rhel-server-7.2-x86_64-dvd.iso rhel1:/root/
   # 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`

6. Now on rhel1 create a `.repo` file to enable the use of the yum command.

   `# vi /var/www/html/rhelrepo/rheliso.repo`
[rhel7.2]
name=Red Hat Enterprise Linux 7.2
baseurl=http://10.4.1.31/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.

9. 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.

---

Note: This step is needed to install software on Admin Node (rhel1) using the repo (such as httpd, createrepo, etc.)

# 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

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

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

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 ClusterShell (clush) and install it on `rhel1`. ClusterShell is available from EPEL (Extra Packages for Enterprise Linux) repository.

```bash
# scp clustershell-1.7-1.el7.noarch.rpm rhel1:/root/
```

2. Login to `rhel1` and install cluster shell.
3. #yum -y install clustershell-1.71.el7.noarch.rpm

![yum installation output]

4. 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.

5. For 64 node cluster as in our CVD, set groups file as follows,

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

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


Note: ClusterShell will not work if not ssh to the machine earlier (as it must be in the known_hosts file), for instance, as in the case below for rhel<host>.
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.

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

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

   ```sh
   #vi /etc/httpd/conf/httpd.conf
   ServerName 172.16.46.11
   ```

3. Start httpd

   ```sh
   #service httpd start
   #chkconfig httpd on
   ```

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.

   ```sh
   ```

2. Copy the /etc/hosts file to all nodes.

3. ```sh
   #clush -w rhel[2-19] -c /etc/hosts --dest=/etc/hosts
   ```

4. Purge the yum caches after this
Post OS Install Configuration

```
#clush -a -B yum clean all
#clush -a -B yum repolist
```

**Note:** While the suggested configuration is to disable SELinux as shown below, 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 repos files.

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

## Configure 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 if setting up dnsmasq on the Admin node. If not 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 the 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 to 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:


7. 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.

8. 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).

9. 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"
```

10. 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"
```

```
filename: /lib/modules/2.6.32-573.el6.x86_64/kernel/vmlinux extra/enic/enic.ko
version: 2.3.0.30
```
11. 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 the 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"
```

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
```

Note: Installing an internal NTP server keeps the cluster synchronized even when an outside NTP server is inaccessible.
Post OS Install Configuration

1. driftfile /var/lib/ntp/drift
2. restrict 127.0.0.1
3. restrict -6 ::1
4. includefile /etc/ntp/crypto/pw
5. keys /etc/ntp/keys

4. 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
   ```

5. Display:

   ```plaintext
   ntp.conf
   ntp.conf
   ntp.conf
   ntp.conf
   ntp.conf
   ntp.conf
   ntp.conf
   ntp.conf
   ntp.conf
   ntp.conf
   ntp.conf
   ntp.conf
   ntp.conf
   ntp.conf
   ntp.conf
   ntp.conf
   ntp.conf
   ntp.conf
   ntp.conf
   ```

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

6. Run the following script 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"
   ```

7. 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. One of the following commands should be used to confirm that the service is properly configured:

```
#clush -B -a rsyslogd -v
#clush -B -a service rsyslog status
```
### 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. This value should be set 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:

   ```bash
   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:

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

3. Check that the `/etc/pam.d/su` file contains the following settings:

   ```bash
   #%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.

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.

SELinux can be disabled by editing `/etc/selinux/config` and changing the SELINUX line to SELINUX=disabled. The following command will disable SELINUX on all nodes:

```
#clush -a -b "sed -i 's/SELINUX=enforcing/SELINUX=disabled/g' /etc/selinux/config"
```

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

Reboot the machine, if needed for SELinux to be disabled incase it does not take effect. It can checked using

```
#clush -a -b sestatus
```

Set TCP Retries

Adjusting the tcp_retries parameter for the system network enables faster detection of failed nodes. Given the advanced networking features of Cisco 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 the default sysctl file `/etc/sysctl.conf` by running.
Disabling the Linux Firewall

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

```bash
#clush -a -b "firewall-cmd --zone=public --add-port=80/tcp --permanent"
#clush -a -b "firewall-cmd --reload"
#clush -a -b "systemctl stop firewalld.service"
#clush -a -b "systemctl disable firewalld.service"
```

Disable Swapping

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

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

1. The commands above must be run for every reboot, so copy these commands to `/etc/rc.local` so they are executed automatically for every reboot.

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 file to each node:

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

4. Append the content of file `thp_disable` to `/etc/rc.local`:
Disable IPv6 Defaults

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

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

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

Configuring Data Drives on Name Node and Other Management Nodes

This section describes steps to configure non-OS disk drives as RAID1 using StorCli commands as described below. All the drives are going to be part of a single RAID1 volume. This volume can be used for staging any client data to be loaded to HDFS. This volume won’t be used for HDFS data.

1. From the website download storcli:
   

2. Extract the zip file and copy storcli-1.14.12-1.noarch.rpm from the Linux directory.

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

   ```bash
   #scp storcli-1.14.12-1.noarch.rpm rhell:/root/
   ```

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

   ```bash
   #clush -a -b -c /root/storcli-1.14.12-1.noarch.rpm --dest=/root/
   ```

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

   ```bash
   #clush -a -b "rpm -ivh storcli-1.14.12-1.noarch.rpm"
   ```

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

   ```bash
   #cd /opt/MegaRAID/storcli/
   #cp storcli64 /root/
   ```
7. Copy `storcli64` to all the nodes using the following commands:

```bash
#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.

```bash
# vi /root/raid1.sh
./storcli64 -cfgldadd
```

The script above requires enclosure ID as a parameter.

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

```bash
#!/usr/bin/env bash
./storcli64 pdlist -a0 | grep Enc | grep ^v 252 | awk '{print $4}' | sort | uniq -c | awk '{print $2}'
#chmod 755 raid1.sh
```

10. Run the MegaCli script as follows:

```bash
#!/usr/bin/env bash
./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
```

---

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

---

### Configuring Data Drives on Data Nodes

This section describes steps to configure non-OS disk drives as individual RAID0 volumes using StorCli commands as described below. These volumes are going to be used for HDFS Data.

1. Issue the following command from the admin node to create the virtual drives with individual RAID 0 configurations on all the data nodes.

```bash
#clush -w rhel[3-64] -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
Post OS Install Configuration

Note: The command above will not override existing configurations. To clear and reconfigure existing configurations refer to the Embedded MegaRAID Software Users Guide available at 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 Datanode. OS boot partition is going to be skipped. All drives are going to be 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.

# vi /root/driveconf.sh
#!/bin/bash
#disks_count=`lsblk -id | grep sd | wc -l`
#if [ $disks_count -eq 24 ]; then
  # echo "Found 24 disks"
#else
  # echo "Found $disks_count disks. Expecting 24. Exiting.."
  # exit 1
#fi
[[ "-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
  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. Run the following command to copy driveconf.sh to all the nodes:

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

4. Run the following command from the admin node to run the script across all data nodes:

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

5. Run the following from the admin node to list the partitions and mount points:

```
# 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 partition is to be deleted and run fdisk to delete 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).

```
# 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 Integrated Infrastructure 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 ${NC}"
clush -a -B "cat /proc/meminfo | grep -i ^memt | uniq"
echo ""
echo ""
echo -e "${green}Number of Dimms ${NC}"
clush -a -B "echo -n 'DIMM slots: '; dmidecode |grep -c \ '^[[:space:]]*Locator:'"
clush -a -B "echo -n 'DIMM count is: '; dmidecode | grep \\Size\ | grep -c "MB"
clush -a -B " dmidecode | awk '/Memory Device$/,/^$/ {print}' |\grep -e '^Mem' -e Size: -e Speed: -e Part | sort -u | grep -v -e 'NO \ DIMM' -e 'No Module Installed' -e Unknown"
echo ""
echo ""
# probe for cpu info #
echo -e "${green}CPU ${NC}"
clush -a -B "grep '^model name' /proc/cpuinfo | sort -u"
echo ""
clush -a -B `which lscpu` | grep -v -e op-mode -e ^Vendor -e family -e Model: -e Stepping: -e BogoMIPS -e Virtual -e ^Byte -e '^NUMA node(s)'"
echo ""
echo ""
# probe for nic info #
echo "${green}NIC ${NC}"
clush -a -B "ls /sys/class/net | grep ^enp | \xargs -l `which ethtool` | grep -e ^Settings -e Speed"
echo ""
clush -a -B `which lspci` | grep -i ether"
echo ""
echo ""
# probe for disk info #
echo "${green}Storage ${NC}"
clush -a -B "echo 'Storage Controller: '; `which lspci` | grep -i -e \raid -e storage -e lsi"
echo ""
clush -a -B "dmesg | grep -i raid | grep -i scsi"
echo ""
clush -a -B "lsblk -id | awk '{print $1,$4}'|sort | nl"
echo ""
echo ""
echo "${green} ================ Software ================ ${NC}""e
clush -a -B "cat /etc/*release | uniq"
echo ""
echo ""
echo "${green}Linux Release ${NC}"
clush -a -B "cat /etc/*release | uniq"
echo ""
echo ""
echo "$\{green\} Linux Release $\{NC\}"
clush -a -B "cat /etc/*release | uniq"
echo ""
echo ""
echo "$\{green\} Linux Version $\{NC\}"
clush -a -B "uname -srvm | fmt"
```
post_os_install

    Post OS Install Configuration

    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 ${NC}"
    clush -a -B "echo -n 'SElinux status: '; grep ^SELINUX= /etc/selinux/config 2>&1"
    echo ""
    echo ""
    clush -a -B "echo -n 'CPUspeed Service: '; cpupower frequency-info \ status 2>&1"
    # clush -a -B "echo -n 'CPUspeed Service: '; `which chkconfig` --list \
    # cpuspeed 2>&1"
    echo ""
    echo ""
    echo -e "${green}Java Version${NC}"
    clush -a -B 'java -version 2>&1; echo JAVA_HOME is ${JAVA_HOME:-Not Defined!}'
    echo ""
    echo ""
    echo -e "${green}Hostname LookUp${NC}"
    clush -a -B " ip addr show"
    echo ""
    echo ""
    echo -e "${green}Open File Limit${NC}"
    clush -a -B 'echo -n "Open file limit(should be >32K): "; ulimit -n'
    # MapR related RPMs
```
```bash
clush -a -B 'rpm -qa | grep -i nfs | sort'

clush -a -B 'rpm -qa | grep -i nfs | sort'
clush -a -B 'echo Missing RPMs: ; for each in make patch redhat-lsb
irqbalance syslinux hdparm sdparm dmidecode nc; do rpm -q $each | grep "is not installed"; done'
clush -a -B "ls -d /opt/mapr/* | head"
# mapr login for hadoop
clush -a -B 'echo "mapr login for Hadoop "; getent passwd mapr'
clush -a -B 'echo "Root login "; getent passwd root'
exit
```

**NOTE: Please install pciutils if not installed, to run the script correctly.**

2. Change permissions to executable.

```bash
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.

```bash
#./cluster_verification.sh
```
Installing IBM BigInsights

IBM BigInsights provides the power of open source, IBM innovations and rich developer tools – and puts the full range of analytics for Hadoop, Spark, and SQL into the hands of big data analytics teams. IBM Open Platform (IOP) with Apache Spark and Apache Hadoop is IBM’s big data platform.

Pre-Requisites for IOP Installation

The IBM Open Platform with Apache Spark and Apache Hadoop uses the repository-based Ambari installer.

To download the IBM Open Platform rpm package file go to: http://www.ibm.com/support/docview.wss?uid=swg24042361

An IBM ID is required for the download.

Additional components from BigInsights like BigSQL, BigSheets etc. can also be downloaded at this site.

1. Log on to the admin server rhel1 and run the following command to install the nc package:

   # clush -a -b yum install -y nc

2. Copy the downloaded rpm for IOP from the download site to the admin node:

   # scp iop-4.2.0.0-1.el7.x86_64.rpm rhel1:/root

3. Install the rpm file on the admin node:

   # yum install iop-4.2.0.0-1.el7.x86_64.rpm

4. From a host connected to the internet, download the required IBM repository files and transfer to the admin node:

   # mkdir -p /tmp/IBM
#cd /tmp/IBM/

5. To download the Ambri repo go to:

```
#wget http://ibm-open-platform.ibm.com/repos/Ambri/rhel/7/x86_64/2.2.x/GA/2.2.0/ambari-2.2.0.el7.x86_64.tar.gz
```

6. Download the IOP repo at:

```
#wget http://ibm-open-platform.ibm.com/repos/IOP/rhel/7/x86_64/4.2.x/GA/4.2.0.0/iop-4.2.0.0.el7.x86_64.tar.gz
```

7. Download the IOP-UTILS repo at:

```
#wget http://ibm-open-platform.ibm.com/repos/IOP-UTILS/rhel/7/x86_64/1.2/iop-utils-1.2.0.0.el7.x86_64.tar.gz
```

8. Copy the repository directory to the admin node:

```
#scp -r /tmp/IBM/ rhel1:/var/www/html /repos
```

9. Extract the files login to rhel1:

```
#cd /var/www/html/repos
#tar -zxvf ambari-2.2.0.el7.x86_64.tar.gz
#tar -zxvf iop-4.2.0.0.el7.x86_64.tar.gz
```
11. Update the ambari.repo file to use the local repository set up above.

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

[BI_AMBARI-2.2.0]
name=ambari-2.2.0
baseurl=http://172.16.46.11/repos/Ambari/RHEL7/x86_64/2.2.0/
enabled=1
gpgcheck=0

12. Update the baseurl with the webserver's address where the local repo is available as shown above.

13. Clean the yum cache on all nodes so that the right packages from the remote repository are seen by the local yum.

# clush -a -b yum clean all

14. Install the Ambari server on the admin management node, using the following command:

# yum install ambari-server

15. Update the value for the baseurl in the file below:
Installing IBM BigInsights

/var/lib/ambari-server/resources/stacks/BigInsights/4.2/repos/repoinfo.xml

with the urls for the local repository as shown below:

#vi /var/lib/ambari-server/resources/stacks/BigInsights/4.2/repos/repoinfo.xml

<reposinfo>
  <mainrepoid>IOP-4.2</mainrepoid>
  <os family="redhat7">
    <repo>
      <baseurl>http://10.4.1.31/repos/IOP/RHEL7/x86_64/4.2.0.0/</baseurl>
      <repoid>IOP-4.2</repoid>
      <reponame>IOP</reponame>
    </repo>
    <repo>
      <baseurl>http://10.4.1.31/repos/IOP-UTILS/rhel/7/x86_64/1.2/</baseurl>
      <repoid>IOP-UTILS-1.2</repoid>
      <reponame>IOP-UTILS</reponame>
    </repo>
  </os>
</reposinfo>

16. Edit the file /etc/ambari-server/conf/ambari.properties to update the JDK location from the IOP-UTILS repository as shown below:

#vi /etc/ambari-server/conf/ambari.properties
openjdk1.8.url=http://172.16.46.11/repos/IOP-UTILS/rhel/7/x86_64/1.2/openjdk/jdk-1.8.0.tar.gz

Set Up the Ambari server

1. Run the following command and accept the default settings:

#ambari-server setup
Installing IBM BigInsights

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

2. Start the Ambari server, using the following command:

   ```bash
   # ambari-server start
   ```

3. Ensure that the postgresql service, which is used by Ambari, starts automatically on reboot.

4. Run the following command on the admin node:

   ```bash
   # systemctl start postgresql.service
   # systemctl enable postgresql.service
   ```

Ambari Server Components Set up

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

2. Point the browser to [http:// 172.16.46.11:8080](http://172.16.46.11:8080).

3. Log in to the Ambari Server using the default username/password: admin/admin. This can be changed at a later period of time. (Figure 132)
Once logged in, the “Welcome to Apache Ambari” window appears. (Figure 133)

Creating a Cluster

To create a cluster, complete the following steps.

1. Click the Launch Install Wizard button.
2. On the Get started page type “Cisco_BI42” as the name for the cluster in the text box. Click the Next button. (Figure 134)

Figure 134 Get Started Window

Select a Stack

1. On the following screen, select the BigInsights 4.2 stack. (Figure 135)

2. Expand “Advanced Repository Options” to check that it is pointed to the local repository on the admin node.

Figure 135 Select a Stack

IOP Installation

In order to build up the cluster, the install wizard needs to know general information about how the cluster has 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.

1. Use the Target Hosts text box to enter the list of host names, one per line. Ranges inside brackets can be used to indicate larger sets of hosts. (Figure 136)

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.

![Figure 136 Ambari Install Options](image)

4. Click on register and confirm to continue with the installation.

**Confirm Hosts**

This screen ensures 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. (Figure 137)

If any host was selected in error, it can be removed by selecting the appropriate checkboxes and clicking the grey Remove Selected button.

1. To remove a single host, click the small white Remove button in the Action column. When the lists of hosts are confirmed, click Next.
Host checks (all hosts are in order).

Choose Services

IOP is made up of a number of components.

1. Select All to preselect all items. (Figure 138)

2. When done, click Next.
**Figure 138 Choose Services**

### Choose Services

Choose which services you want to install on your cluster.

<table>
<thead>
<tr>
<th>Service</th>
<th>Version</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDFS</td>
<td>2.7.2</td>
<td>Apache Hadoop Distributed File System</td>
</tr>
<tr>
<td>YARN + MapReduce2</td>
<td>2.7.2</td>
<td>Apache Hadoop NextGen MapReduce (YARN)</td>
</tr>
<tr>
<td>Hive</td>
<td>1.2.1</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>1.2.0</td>
<td>Non-relational distributed database and centralized service for configuration management &amp; synchronization</td>
</tr>
<tr>
<td>Pig</td>
<td>0.15.0</td>
<td>Scripting platform for analyzing large datasets</td>
</tr>
<tr>
<td>Sqoop</td>
<td>1.4.6</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</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 ExtUS Library</td>
</tr>
<tr>
<td>ZooKeeper</td>
<td>3.4.6</td>
<td>Centralized service which provides highly reliable distributed coordination</td>
</tr>
<tr>
<td>Flume</td>
<td>1.6.0</td>
<td>A distributed service for collecting, aggregating, and moving large amounts of streaming data into HDFS</td>
</tr>
<tr>
<td>Titan</td>
<td>1.0.0</td>
<td>Titan is a scalable graph database optimized for storing and querying graphs containing hundreds of billions of vertices and edges distributed across a multi-machine cluster.</td>
</tr>
<tr>
<td>Ambari Metrics</td>
<td>0.1.0</td>
<td>A system for metrics collection that provides storage and retrieval capability for metrics collected from the cluster</td>
</tr>
<tr>
<td>Kafka</td>
<td>0.9.0.1</td>
<td>A high-throughput distributed messaging system</td>
</tr>
<tr>
<td>Knox</td>
<td>0.7.0</td>
<td>Provides a single point of authentication and access for Apache Hadoop services in a cluster</td>
</tr>
<tr>
<td>Slider</td>
<td>0.90.2</td>
<td>A framework for deploying, managing and monitoring existing distributed applications on YARN</td>
</tr>
<tr>
<td>Solr</td>
<td>5.5.0</td>
<td>Solr is the popular, blazing fast open source enterprise search platform from the Apache Lucene project</td>
</tr>
<tr>
<td>Spark</td>
<td>1.6.1</td>
<td>Apache Spark is a fast and general engine for large-scale data processing</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. 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 139)
Reconfigure the service assignments to match the values in Table 10.

<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>HistoryServer</td>
<td>rhel1</td>
</tr>
<tr>
<td>App Timeline Server</td>
<td>rhel2</td>
</tr>
<tr>
<td>ResourceManager</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>rhel2</td>
</tr>
<tr>
<td>Oozie Server</td>
<td>rhel1</td>
</tr>
<tr>
<td>Zookeeper</td>
<td>rhel1, rhel2, rhel3</td>
</tr>
<tr>
<td>Spark History Server</td>
<td>rhel1</td>
</tr>
<tr>
<td>Kafka Broker</td>
<td>rhel3</td>
</tr>
<tr>
<td>Knox Gateway</td>
<td>rhel1</td>
</tr>
<tr>
<td>Metrics Collector</td>
<td>rhel1</td>
</tr>
</tbody>
</table>

There is one broker by default, add more based on requirements.
Figure 139 Assign Masters

Click the Next button.

Assign Slaves and Clients

The Ambari install wizard attempts to assign the slave components (DataNodes, NFSGateway, NodeManager, RegionServers, Flume, Spark Thrift Server and Client) to appropriate hosts in the cluster. Reconfigure the service assignment to match the example shown in Figure 140 and Table 11 below:

1. Assign DataNode, NodeManager, RegionServer, and Flume on nodes rhel3- rhel64.
2. Assign Client to all nodes.

3. Click the Next button.

Table 11 Assign Client Services and Hosts

<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>rhel4-rhel19</td>
</tr>
<tr>
<td>RegionServer</td>
<td>rhel4-rhel19</td>
</tr>
<tr>
<td>Flume</td>
<td>rhel4-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 140 Assign Slaves and Clients

Customize Services

This section describes 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, memory and service level settings for each component and service level tuning.

**HDFS**

In Ambari, choose the HDFS Service tab and use the “Search” box on top to filter for the properties mentioned in the table to update their values to those shown in Table 13.

**YARN**

1. In Ambari, choose the YARN Service from the tab and use the “Search” box on top to filter for the properties mentioned in Table 12 below to update their values.

2. Update the following YARN configurations:

<table>
<thead>
<tr>
<th>Table 12 YARN Configuration Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property Name</td>
</tr>
<tr>
<td>ResourceManager Java heap size</td>
</tr>
<tr>
<td>NodeManager Java heap size</td>
</tr>
<tr>
<td>yarn.nodemanager.resource.memory-mb</td>
</tr>
<tr>
<td>YARN Java heap size</td>
</tr>
<tr>
<td>yarn.scheduler.minimum-allocation-mb</td>
</tr>
<tr>
<td>yarn.scheduler.maximum-allocation-mb</td>
</tr>
</tbody>
</table>

**HDFS JVM Settings**

1. Update the HDFS configurations in Ambari as shown in Table 13.

<table>
<thead>
<tr>
<th>Table 13 HDFS Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property Name</td>
</tr>
<tr>
<td>NameNode Java Heap Size</td>
</tr>
<tr>
<td>Hadoop maximum Java heap size</td>
</tr>
<tr>
<td>DataNode maximum Java heap size</td>
</tr>
<tr>
<td>DataNode Volumes Failure Toleration</td>
</tr>
</tbody>
</table>

**MapReduce2**

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

2. Update the following MapReduce 2 configurations:
### Table 14 MapReduce 2 Values

<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>Sort allocation memory (mapreduce.task.sort.io.mb)</td>
<td>1638</td>
</tr>
<tr>
<td>yarn.app.mapreduce.am.resource.mb</td>
<td>4096</td>
</tr>
<tr>
<td>mapreduce.map.java.opts -Xmx3276m</td>
<td>-</td>
</tr>
<tr>
<td>mapreduce.reduce.java.opts -Xmx6552m</td>
<td>-</td>
</tr>
<tr>
<td>yarn.app.mapreduce.am.command-opts -Xmx6552m</td>
<td>-</td>
</tr>
</tbody>
</table>

### Hive

Choose Hive Service from the tab (Figure 141) and select the Advanced tab and make the changes below:

1. **Select New MySQL Database**
   - Database Name: hive
   - Database Username: hive
2. **Enter the Hive database password as per organizational policy.**

**Figure 141 Customize Hive Services**
HBase

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

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 HBase is not running, keep the default value of 1024 for the Java Heap size for HBase RegionServers and HBase Master.

Oozie

Similarly, under the Oozie tab (Figure 142), change the default log location by finding the Log Dir property and modifying the /var prefix to /data/disk1.

1. Select New Derby Database

2. Name the database oozie

3. Name the username oozie
Knox

Choose Knox Service from the tab (Figure 143) and expand the Knox gateway tab and make the changes below:

1. Enter the Knox Master Secret password as per organizational policy.
**Figure 143** Customize Knox Services

The assignments that have been made are displayed. Check to ensure everything is correct before clicking on Deploy button. If any changes are to be made, use the left navigation bar to return to the appropriate screen. (Figure 144)

**Figure 144** Review Set Up
The progress of the install is shown on the screen. 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.

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

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

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

4. To see a larger version of the log contents, click the **Open** icon. 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. (Figure 145)

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

### Summary of Install Process

The Summary page shows a summary of the accomplished tasks. Click **Complete**.

**Figure 145 Progress Screen**
The Summary page shows a summary of the accomplished tasks. (Figure 146)

Click Complete to finish the installation.

**Figure 146 Summary Screen**

Enabling High Availability

The idea behind providing High Availability is to ensure the availability of all critical services:

- Without any SLA violations
- Planned or scheduled outages
- Mask unplanned outages (crashes, etc.)

HDFS High Availability

The HDFS HA feature provides the option of running two NameNodes in the same cluster. These NameNodes are referred to as: the Active and the Standby. The Standby NameNode, allowing a fast failover to a new NameNode during a graceful administrator-initiated failover for the purpose of planned maintenance or in the event of machine crashes (unplanned outage).

To setup NameNode high availability, complete the following steps:

1. From the Ambari dashboard, click HDFS Service (Figure 147).

2. Select Service Actions > Enable NameNode HA.
The Enable NameNode HA wizard (0) opens the Enable HA NameNode Wizard. (Figure 148)

3. On the Select Hosts page, select which hosts to use for additional NameNodes and JournalNodes. (Figure 149)
4. On the Review page (Figure 150), confirm the selections. To change any values, click **Back**, to continue, click **Next**.
5. Create a checkpoint on the NameNode with some manual steps on the Linux server (rhel1). (Figure 151)

6. Log in to the current NameNode host.

7. Run the following command to put the NameNode into safe mode.
8. Create the checkpoint.

9. Return to the Ambari web interface. When Ambari detects success, click Next. (Figure 152)

![Create a Check Point on the NameNode](image)

**Figure 152** Create a Check Point on the NameNode

10. See the progress bars on the Configure Components page, as the wizard configures the components. When all the configuration steps are complete, click Next. (Figure 153)
11. Initialize the JournalNodes with the manual step below (Figure 154)

12. Log in to the current NameNode host.

13. Run the following command to initialize the JournalNodes:

```
sudo su hdfs -l -c "hdfs namenode -initializeSharedEdits"
```
14. Return to the Ambari web interface. When Ambari detects success, click Next. (Figure 155)

![Figure 155 JournalNodes Initialized](image)

15. On the start Components page (Figure 156), the wizard starts the Zookeeper servers and the NameNode. Once done, click Next.

![Figure 156 Start Components](image)

To initialize NameNode HA Metadata, complete the following steps at the NameNode host (rhel1) (Figure 157):

1. Initialize the metadata for NameNode (automatic failover):
sudo su hdfs -l -c 'hdfs zkfc -formatZK'

2. Login to the additional NameNode host (rhel4):

3. Run the following command to initialize the metadata for the additional NameNode:

   sudo su -l hdfs -c 'hdfs namenode -bootstrapStandby'

4. Return to the Ambari web Interface. Click **Next**, when Ambari detects success.

   **Figure 157** Initialize NameNode HA

   **Enable NameNode HA Wizard**

5. When complete click **Done**.

On the Finalize HA setup page (Figure 158), the user can see the progress bars as the wizard completes the High Availability setup.
6. Once the setup is complete, the Ambari web interface will reload. Please confirm to see if any services need to be restarted. (Figure 158)

Setting Up Resource Manager (Yarn) High Availability

The process of setting up High Availability for Yarn, sets up a standby resource manager so that if active resource manager goes down, standby takes over and Yarn can continue to function.

Note: At least three Zookeeper servers must be running.

1. From the Ambari web interface, click on the Yarn service (Figure 160).
This will open the Resource Manager HA setup wizard (Figure 161):

Figure 161  HA Wizard

Enable ResourceManager HA Wizard

2. From the Select Hosts page, choose the host for Additional Resource Manager (Figure 162).
Proceed to the Review screen (Figure 163).

The Configure Components screen (Figure 164) shows the progress bars as the Additional Resource Manager is being deployed.
Once complete, the Ambari web interface reloads and informs the user to restart the required services. The active and standby ResourceManagers show they are successfully restarted.

![Configuration Components](image)

Note: Below are the steps for installing BigSQL. This was done separately so the user may notice a difference in the number of nodes, but all the above steps still apply.

**BigSQL Installation**

**How to Acquire BigInsights Value-added Services**

For complete download information (including part numbers and SKUs), go to:


In the context of this document, the user will obtain “biginsights_4.2.0.0.el7.x86_64.bin” from the Passport Advantage portal. This file is used to deploy BigInsights 4.2 over Redhat Enterprise Linux 7.

When the user runs the bin file, they will be prompted with the option to download the RPM packages. Then the user may proceed to download the RPMs tar-ball.
Prechecks and Preconditions

It is important to take care of the following precheck criteria before starting with the BigSQL installation on the cluster. To take care of the prechecks and preconditions, complete the following steps:

1. Install KornShell (KSH):

   ![Image of KornShell installation]

   Note: It is important that KSH be installed on all the nodes.

2. Disable requiretty: open the file /etc/sudoers and comment out the line “default requiretty”

   ```bash
   visudo -f /etc/sudoers
   ```

   ![Image of sudoers file modification]

   The changes shown above need to be made on all the nodes that will be part of the BigSQL installation.

3. The storage subsystem should have disks of sector size 512 Bytes.

   ![Image of storage configuration]

   # Storage
   # CmdAlias STORAGE = /bin/fsck, /bin/sfck, /bin/ntfsck, /bin/ntfsmax, /bin/ntfsprobe, /bin/mount, /bin/umount
   # Delegating permissions
   # CmdAlias DELEGATION = /usr/bin/sudo, /bin/chown, /bin/renice, /bin/chgrp
   # Processes
   # CmdAlias PROCESSES = /bin/ps, /bin/kill, /sbin/kill, /usr/bin/killall
   # Drivers
   # CmdAlias DRIVERS = /sbin/modprobe
   # Defaults specification
   # Disable "mount -v" because it will show the password in clear.
   # You have to run "mount -t NAME".
   # defaults requiretty
   # If not to run if unable to disable echo on the tty, this setting should also be

---

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Important Caveat/Note: The storage disks on the nodes being used for the BigSQL installation should have the sector size of 512 bytes. Otherwise, the user will receive the error "SQLCODE-902".

4. All the server nodes should have Fully Qualified Domain Names, example, rhel1.cisco.com.

To install BigSQL complete the following steps:

1. Untar the downloaded BigInsights 4.2 package. The “BigInsights-Valuepacks” appears.

```bash
[root@rhel1 BigInsights-Valuepacks]# ll
```

2. Create the folder:

   ```
   /var/www/html/repos/valueadds
   ```

3. Copy the downloaded RPMs to this folder.

   ```
   # cp /root/BigInsights-Valuepacks/RHEL7/x86_64/4.2.0.0/* /var/www/html/repos/valueadds/
   ```


   ```
   [root@rhel1 valueadds]# ls
   ```
5. Run "yum install BigInsights-IOP-1.2.0.0-4.2.el7.x86_64.rpm"

6. Check for BIGINSIGHTS-VALUEPACK-1.2.0.0.repo under /etc/yum.repos.d

7. Update /var/lib/ambari-server/resources/stacks/BigInsights/4.2/repos/repoinfo.xml file to include:

   <repo>
   <baseurl>http://172.16.51.11/repos/valueadds</baseurl>
   <reponame>BIGINSIGHTS-VALUEPACK-1.2.0.0</reponame>

   </repo>

8. Restart the Ambari server, to reflect the new services to be installed.
9. Issue the command:

```
service ambari-server restart.
```

Once the Ambari server has restarted, the user can see the new services on the web interface.

10. Login to the Ambari server again. (Figure 165)

**Figure 165** Ambari Login Screen

11. Proceed to install the BigSQL service.

12. From the Actions tab, choose “Add Service”, (Figure 166).
13. From the “Add Service Wizard”, choose “BigInsights BigSQL” service and click Next. (Figure 167)

14. Choose the node on which to install the BigSQL head, (rhe1.cisco.com in this installation example). (Figure 168)
15. Click Next.

16. Proceed to choose nodes to assign BigSQL worker nodes. (Figure 169)

(Figures 168 and 169: Diagrams of Assign Masters and Assign Slaves and Clients screens)

17. After selecting the worker nodes, click Next.

The user will be prompted to customize the service and set up the environment. Any issues and open items will be pointed out now.
For e.g. Bigsql_user_password is missing here and the user will be prompted to enter the password. (Figure 170)

**Figure 170** Customize Services

18. Once the password is set, click Next. (Figure 171)

**Figure 171** Add Passwords
If prompted to make configuration changes based on Ambari recommendations, make the appropriate changes or click “proceed anyway”, (Figure 172).

Figure 172 Configuration Confirmation Screen

19. Confirm the head node and worker nodes.

20. Click “Deploy” on the review screen.

21. Click “Deploy” to start the install process. (Figure 173)

Figure 173 Review Configuration

Add Service Wizard

22. Click “Deploy” to start the install process.
23. Install progress is shown in Figure 174 and Figure 175.
24. Check and track progress through the log file under `/tmp/bigsql/logs/`:

```
[root@rhel logs]$ tail -f bigsql-setup-2016-07-13_08.44.45.1956.log 
Setup is complete with rc: 0. Log file can be found at /tmp/rhel.cisco.com-bigsql-setup-2016-07-13_08.44.45.1956.log.
```

25. Once complete, the installation will show success. (Figure 176)
After the successful installation, the user will be prompted for the warning to restart other services for the BigSQL service to work properly. (Figure 177)

26. Click “Complete” to go back to the Ambari screen with the BigSQL service successfully installed and some services requiring a restart. (Figure 178)
27. Restart all services Hive, Hbase etc.

Once all services are restarted, the Ambari Service will display the installation details. (Figure 180)
Figure 180  Installation Details
Bill of Materials

This section provides the BOM for the 16 nodes. See Table 16 Bill of Materials for the Cisco UCS Fabric Interconnect 6332, Table 17 Bill of Materials for the Cisco UCS C240M4 Rack Server, Table 18 for the Cisco UCS S3260 Storage Server Base Rack, Table 19 Bill of Materials for Cisco UCS S3260 Storage Server Capacity Rack, and Table 20 for software components.

Table 16 Bill of Materials for Cisco UCS Fabric Interconnect 6332

<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 w/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-RPDU6</td>
<td>UC PLUS 24X7X4 Cisco RP208- 30-U-X Single Phase PDU 2x (Country Specific)</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 17 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></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 18  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>UCSS-S3260</td>
<td>Cisco UCS S3260 Base Chassis w/4x, 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>UCS-C3K-HD4TB</td>
<td>UCS C3000 4TB NL- SAS 7200 RPM 12Gb HDD w Carrier- Top Load</td>
<td>48</td>
</tr>
<tr>
<td>UCSC-C3160- BEZEL</td>
<td>Cisco UCS C3160 System Bezel</td>
<td>8</td>
</tr>
<tr>
<td>UCSC-C3X60- RAIL</td>
<td>UCS C3X60 Rack Rails Kit</td>
<td>8</td>
</tr>
</tbody>
</table>
### 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>Code</td>
<td>Description</td>
<td>Quantity</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>UCSC-C3160-BEZEL</td>
<td>Cisco UCS C3160 System Bezel</td>
<td>8</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>UCSC-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>UCSC-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-C3X60-42HD8</td>
<td>UCS C3X60 3 rows of 8TB NL-SAS7200 RPM SAS-3 (42Total) 336TB</td>
<td>8</td>
</tr>
<tr>
<td>UCSC-C3X60-HD8TB</td>
<td>UCS C3X60 8TB NL-SAS 7.2K Helium HDD with HDD Carrier</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>UCSC-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>Red Hat Enterprise Linux</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>RHEL-2S2V-3A</td>
<td>Red Hat Enterprise Linux</td>
</tr>
<tr>
<td>CON-ISV1-EL2S2V3A</td>
<td>3 year Support for Red Hat Enterprise Linux</td>
</tr>
</tbody>
</table>
About the Authors

Rajesh Shroff, Big Data Solutions Architect, Data Center Solutions Group, Cisco Systems, Inc. Rajesh is a big data infrastructure and performance engineer, with focus on solutions and emerging trends in big data and analytics.

Acknowledgements

- Chinmayi Narasimhadevara, Big Data Software Engineer, Data Center Solutions Group, Cisco Systems, Inc.
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