Cisco UCS Integrated Infrastructure for Big Data with Splunk Enterprise

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Executive Summary

Traditional tools for managing and monitoring IT infrastructures are out of step with the constant change happening in today’s data centers. When problems arise, finding the root cause or gaining visibility across the infrastructure to pro-actively identify and prevent outages is nearly impossible. Virtualization and cloud infrastructures introduce additional complexity, resulting in an environment that is more challenging to control and manage.

Splunk software reliably collects and indexes machine data, from a single source to tens of thousands of sources, all in real time. Organizations typically start with Splunk to solve a specific problem, and then expand from there to address a broad range of use cases, such as application troubleshooting, IT infrastructure monitoring, security, business analytics, Internet of Things, and many others. As operational analytics become increasingly critical to day-to-day decision-making and Splunk deployments expand to terabytes of data, a high-performance, highly scalable infrastructure is critical to ensuring rapid and predictable delivery of insights. Cisco UCS’s ability to expand to thousands of servers allows the Splunk deployments to scale horizontally while continuously delivering exceptional performance.

The Cisco Validated Design (CVD) for Splunk Enterprise describes the architecture and deployment procedures for Splunk Enterprise on a Distributed High Performance reference architecture based on Cisco UCS Integrated Infrastructure for Big Data (see Distributed Splunk Reference Architecture Solution Brief). The configuration consists of eight (8) Cisco UCS C240 M4 rack servers as indexers, three (3) Cisco C220 M4 rack servers as search heads and two (2) Cisco C220 M4 rack servers to perform administrative functions, along with one (1) archival node (Cisco UCS S3260 storage server) for frozen data.
This CVD describes architecture and deployment procedures for Splunk Enterprise using eight (8) Cisco UCS C240 M4 rack servers as indexers, three (3) Cisco UCS C220 M4 rack servers as search heads, and two (2) Cisco UCS C220 M4 rack servers to perform administrative functions, along with 1 archival server for frozen data (Cisco UCS S3260 storage server). This architecture is based on the Cisco UCS Integrated Infrastructure for Big Data with Splunk. The reference architecture named Distributed Deployment with High Capacity consists of 16 indexers for storage, of which 8 are considered for this CVD as well as an additional archival server for attached storage. The solution goes into detail configuring distributed search on Splunk Enterprise platform along with the Archival node (Cisco UCS S3260 storage server with one server blade). Figure 1 shows the architecture for the Splunk Enterprise deployment.

Figure 1 Clustered Distributed Search Deployment Architecture of Splunk Enterprise

Audience

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 Splunk Enterprise on Cisco UCS Integrated Infrastructure for Big Data.

Purpose of the Document

This CVD offers a dependable deployment model for Splunk Enterprise which can be implemented rapidly and customized to meet Splunk requirements. The configuration detailed in the document can be extended to larger clusters. In this CVD, eight Splunk Indexers provide capacity to index up to 2.4 TB of data per day. This configuration can scale to index hundreds of terabytes to petabytes of data every 24 hours, delivering real-time search results and meeting Splunk application demands with seamless data integration and analytics to multiple users across the globe.
Technology Overview

The Cisco UCS solution for Splunk Enterprise is based on Cisco UCS Integrated Infrastructure for Big Data and Analytics, a highly scalable architecture designed to meet a variety of scale-out application demands with seamless data integration and management integration capabilities built using the following components:

Cisco UCS 6200 Series Fabric Interconnects

Cisco UCS 6200 Series Fabric Interconnects provide high-bandwidth, low-latency connectivity for servers, with integrated, unified management provided for all connected devices by Cisco UCS Manager. Deployed in redundant pairs, Cisco Fabric Interconnects offer the full active-active redundancy, performance, and exceptional scalability needed to support the large number of nodes that are typical in clusters serving big data applications. Cisco UCS Manager enables rapid and consistent server configuration using service profiles, automating ongoing system maintenance activities such as firmware updates across the entire cluster as a single operation. Cisco UCS Manager also offers advanced monitoring with options to raise alarms and send notifications about the health of the entire cluster. The Cisco UCS 6296UP 96-Port Fabric Interconnect is shown in Figure 2.

Figure 2 Cisco UCS 6296UP 96-Port Fabric Interconnect

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. Figure 3 shows the Cisco UCS 6332 UP-Port Fabric Interconnect.
Figure 3  Cisco UCS 6332 UP 32-Port Fabric Interconnect

Note: This Cisco Validated Design is built using second generation Fabric Interconnects (Cisco UCS 6296, as shown above in Figure 3), but the Cisco UCS 6332 can be used as well.

Cisco UCS C-Series Rack Mount Servers

Cisco UCS C-Series Rack Mount C220 M4 High-Density Rack servers (Small Form Factor Disk Drive Model) and Cisco UCS C240 M4 High-Density Rack servers (Small Form Factor Disk Drive Model) are enterprise-class systems that support a wide range of computing, I/O, and storage-capacity demands in compact designs. Cisco UCS C-Series Rack-Mount Servers are based on the Intel Xeon® E5-2600 v4 product family with 12-Gbps SAS throughput, delivering significant performance and efficiency gains over the previous generation of servers. The servers use dual Intel Xeon® processor E5-2600 v4 series CPUs and support up to 768 GB of main memory (128 or 256 GB is typical for big data applications) and a range of disk drive and SSD options. The Performance-optimized option supports 24 Small Form Factor (SFF) disk drives. The Capacity-optimized option supports 12 Large Form Factor (LFF) disk drives, along with 4 Gigabit Ethernet LAN-on-motherboard (LOM) ports. Cisco UCS virtual interface cards 1227 (VICs) designed for the M4 generation of Cisco UCS C-Series Rack Servers are optimized for high-bandwidth and low-latency cluster connectivity, with support for up to 256 virtual devices that are configured on demand through Cisco UCS Manager. The Cisco UCS C220 M4 Rack Server is shown in Figure 5 and Cisco UCS 240 M4 Rack Server is shown in Figure 5.

Figure 4  Cisco UCS C220 M4 Rack Server
Cisco UCS S3260 Storage Server

Cisco UCS S3260 Storage Server is an advanced, modular rack server with extremely high storage density. Based on the Intel Xeon® processor E5-2600 v4 series, it offers up to 560 TB of local storage in a compact 4-rack-unit (4RU) form factor. With its individually hot-swappable hard-disk drives, and its built-in enterprise-class Redundant Array of Independent Disks (RAID) redundancy, the Cisco UCS S3260 Storage Server helps you achieve the highest levels of data availability. The Cisco UCS S3260 Storage Server is ideal for Snapshots, active archiving, compliance, media storage, and distributed file systems for scenarios in which high storage capacity is important. Cisco UCS virtual interface cards 1300 (VICs) designed for the M4 generation of Cisco UCS C-Series Rack Servers and Cisco UCS S3260 Storage Server 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. The Cisco UCS S3260 Storage Server is shown in Figure 6
Cisco UCS Virtual Interface Cards (VICs)

Cisco UCS Virtual Interface Cards (VICs), unique to Cisco, 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. Cisco VIC 1227 provide dual 10 Gigabit Ethemet. The Cisco VIC 1387 can also be used in conjunction with 3rd generation Cisco UCS Fabric Interconnects 6332 for taking advantage of 40 Gigabit Ethernet connectivity. The System IO Controller (SIOC) with VIC1300 on S3260 can work as dual 40 Gigabit Ethernet or dual 10 Gigabit Ethernet ports (with appropriate QSFP to SFP+ convertors). Figure 7 displays the Cisco UCS VIC 1227.
Figure 7  Cisco UCS VIC 1227

Figure 8  displays the Cisco UCS VIC 1387.
Figure 8  Cisco UCS VIC 1387
Solution Design

Cisco UCS Manager

Cisco UCS Manager resides within the Cisco UCS 6200 Series Fabric Interconnects. It makes the system self-aware and self-integrating, managing all of the system components as a single logical entity. Cisco UCS Manager can be accessed through an intuitive graphical user interface (GUI), a command-line interface (CLI), or an XML application-programming interface (API). Cisco UCS Manager uses service profiles to define the personality, configuration, and connectivity of all resources within Cisco UCS, radically simplifying provisioning of resources so that the process takes minutes instead of days. This simplification allows IT departments to shift their focus from constant maintenance to strategic business initiatives.

Figure 9  Cisco UCS Manager

Splunk for Big Data Analytics

All your IT applications, systems, and technology infrastructure generate data every millisecond of every day. This machine data is one of the fastest growing, most complex areas of big data. It is also one of the most valuable, containing a definitive record of user transactions, customer behavior, sensor activity, machine behavior, security threats, fraudulent activity, and more.

Splunk Enterprise provides a holistic way to organize and extract real-time insights from massive amounts of machine data from virtually any source. This includes data from websites, business applications, social media platforms, app servers, hypervisors, sensors, traditional databases, and open source data stores. Splunk Enterprise scales to collect and index tens of terabytes of data per day, across multi-geography, multi-datacenter, and hybrid cloud infrastructures.
Key Features of Splunk Enterprise

Splunk Enterprise provides an end-to-end, real-time solution for machine data, delivering the following core capabilities:

- Universal collection and indexing of machine data, from virtually any source
- Powerful search processing language (SPL) to search and analyze real-time and historical data
- Real-time monitoring for patterns and thresholds; real-time alerts when specific conditions arise
- Powerful reporting and analysis
- Custom dashboards and views for different roles
- Resilience and horizontal scalability
- Granular role-based security and access controls
- Support for multi-tenancy and flexible, distributed deployments on-premises or in the cloud
- Robust, flexible platform for big data apps
Deployment Hardware and Software

Architecture

Reference Architecture for the Splunk Enterprise deployment is shown in Table 1.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Cisco UCS Reference Architecture for Splunk Enterprise (with Archival Nodes)</th>
</tr>
</thead>
</table>
| **Indexer** | 8 Cisco UCS C240 M4 Rack Servers, each with:  
• 2 Intel Xeon® processor E5-2680 v4 CPUs (28 cores)  
• 256 GB of memory  
• Cisco 12-Gbps SAS modular RAID controller with  
  2-GB flash-backed write cache  
• Cisco UCS VIC 1227  
• 24 1.8-TB 10K SFF SAS drives in a RAID10 configuration  
• 2 120-GB (or 240-GB) SSDs for the operating system |
| **Search head** | 3 Cisco UCS C220 M4 Rack Servers, each with:  
• 2 Intel Xeon® processor E5-2680 v4 CPUs (28 cores)  
• 256 GB of memory  
• Cisco 12-Gbps SAS modular RAID controller with  
  2-GB flash-backed write cache  
• Cisco UCS VIC 1227  
• 2 600-GB 10K SFF SAS drives |
| **Administration and master nodes** | 2 Cisco UCS C220 M4 Rack Servers, each with:  
• 2 Intel Xeon® processor E5-2620 v4  
• 128 GB of memory  
• Cisco 12-Gbps SAS modular RAID controller with 2-GB flash-backed write cache  
• Cisco UCS VIC 1227  
• 2 600-GB 10K SFF SAS drives |
| **Archival Storage (Frozen data)** | 1 Cisco UCS S3260 Storage Server with:  
• 2 Intel Xeon® processor E5-2620 v4 CPUs (16 cores)  
• 256 GB of memory  
• Cisco 12-Gbps SAS modular RAID controller with  
  4-GB flash-backed write cache  
• Cisco UCS VIC 1227  
• 2 600-GB 10K SFF SAS drives  
• 60 X 4TB 7200 RPM drives |
| **Networking** | 2 Cisco UCS 6296UP 96-Port Fabric Interconnects |
| **Recommended indexing capacity** | Up to 2.4 TB per day |
| **Retention capability** | 2.4 TB per day with 3 month retention |
| **Recommended indexing capacity with replication** | Up to 1 TB per day |
| **Total storage capacity** | 172 TB |
| **Servers** | 14 |
| **Rack space** | 29 RU |

Rack and PDU Configuration

The rack consists of two vertical power distribution units (PDU), two Cisco UCS 6296UP Fabric Interconnects, eight Cisco UCS C240 M4 servers, five Cisco UCS C220 M4 servers, and one Cisco UCS
S3260 storage server. All the devices are connected to each of the vertical PDUs for redundancy, thereby ensuring availability during power source failure.

Table 2 describes the rack configuration used in this CVD.

<table>
<thead>
<tr>
<th>Cisco 42 RU Rack</th>
<th>Master Rack</th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td>Cisco UCS FI 6296UP</td>
</tr>
<tr>
<td>41</td>
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<tr>
<td>40</td>
<td>Cisco UCS FI 6296UP</td>
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<tr>
<td>39</td>
<td></td>
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<tr>
<td>38</td>
<td>Cisco UCS C220 M4</td>
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<tr>
<td>37</td>
<td>Cisco UCS C220 M4</td>
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<tr>
<td>36</td>
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<td>35</td>
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<tr>
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<td>Cisco 42 RU Rack</td>
<td>Master Rack</td>
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<td>18</td>
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<tr>
<td>5</td>
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<tr>
<td>4</td>
<td>Cisco UCS S3260 Storage Server</td>
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<tr>
<td>3</td>
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<tr>
<td>2</td>
<td></td>
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<tr>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

**Port Configuration on Fabric Interconnects**

Table 3 shows the network connectivity configurations used for developing this CVD.

**Table 3** Port Types and Port Numbers

<table>
<thead>
<tr>
<th>Port Type</th>
<th>Description</th>
<th>Port Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network</td>
<td>Uplink port</td>
<td>1</td>
</tr>
<tr>
<td>Server</td>
<td>Cisco UCS C220 M4 Servers</td>
<td>4 to 8</td>
</tr>
<tr>
<td>Server</td>
<td>Cisco UCS C240 M4 Servers</td>
<td>9 to 16</td>
</tr>
<tr>
<td>Server</td>
<td>Cisco S3260 Storage Server</td>
<td>17</td>
</tr>
</tbody>
</table>
Configuration and Cabling for Cisco UCS C240 M4 Rack Servers

The Cisco UCS C240 M4 rack server is equipped with Intel Xeon® E5-2680 v4 processors, 256 GB of memory, Cisco UCS Virtual Interface Card 1227, Cisco 12-Gbps SAS Modular Raid Controller with 2-GB FBWC, twenty-four 1.8-TB 10K SFF SAS drives, and two 120-GB SATA SSD for Boot.

All eight servers of this category are directly connected to the ports on the Cisco UCS FI 6296 Fabric Interconnects as shown below. These ports are configured as server ports in the Cisco UCS Manager.

Figure 10 illustrates the port connectivity between the Fabric Interconnect and Cisco UCS C240 M4 server. Eight Cisco UCS C240 M4 servers are used as indexers in this rack configuration.

Figure 10  Fabric Topology for Cisco UCS C240 M4 Rack Server

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Configuration and Cabling for Cisco UCS C220 M4 Rack Servers

This solution makes use of five C220 M4 rack servers that are configured with two different classes of CPUs.

- The servers that function as the search heads are equipped with Intel Xeon® E5-2680 v4 processors, 256 GB of memory, Cisco UCS Virtual Interface Card 1227, Cisco 12-Gbps SAS Modular Raid Controller with 2-GB FBWC, and 2 600 GB 10K SFF SAS drives.
The servers that function as the admin nodes are equipped with Intel Xeon® E5-2620 v4 processors, 128 GB of memory, Cisco UCS Virtual Interface Card 1227, Cisco 12-Gbps SAS Modular Raid Controller with 2-GB FBWC, and 2 600 GB 10K SFF SAS drives.

All five servers of this category are directly connected to the ports on the Cisco UCS Fabric Interconnects 6296 Fabric Interconnects as shown below. These ports are configured as server ports in the UCS Manager.

Figure 11 illustrates the port connectivity between the Fabric Interconnect and Cisco UCS C220 M4 servers. Five Cisco UCS C220 M4 servers are used in the rack configuration.

**Figure 11  Fabric Topology for Cisco UCS C220 M4 Rack Server**

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**Configuration and Cabling for the Cisco UCS S3260 Storage Server**

The Cisco UCS S3260 Storage Server is equipped with two Intel Xeon® E5-2680 v4 processors, 256 GB of memory, one SIOC containing Cisco UCS 1300 series Virtual Interface Card, Cisco 12-Gbps SAS Modular Raid Controller with 4-GB FBWC, 60 6-TB 7.2K LFF SAS drives, and two 120-GB SATA SSD for Boot.

The servers of this category are all directly connected to the ports on the Cisco UCS FI6296 Fabric Interconnects as shown below. These ports are configured as server ports in the UCS Manager.

Figure 12 illustrates the port connectivity between the Fabric Interconnect and Cisco UCS S3260 Storage Server as a server port. One Cisco UCS S3260 storage server is used in master rack configurations.
The SIOC card has two 40 Gigabit Ethernet ports. In order to connect these ports to the Cisco UCS Fabric Interconnect 6296, we will need make use of the QSFP-to-SFP+ converters per port (PID: CVR-QSFP-SFP10G).

For more information on physical connectivity and single-wire management, go to:

For more information on physical connectivity illustrations and cluster setup, go to:
Rack Appearance

Figure 13 shows the single rack configuration containing five Cisco C220 M4 servers and eight Cisco UCS C240 M4 servers, along with one Cisco UCS S3260 storage server as an archival server. Each server is connected to each Fabric Interconnect by means of a dedicated (that is directly) 10 Gigabit Ethernet link. Individual server connectivity diagrams can be seen above.

Figure 13  Splunk Distributed Search with Indexer and Search Head Clustering Configuration

Note: 2.4 TB/day is computed based on the indexer’s capability of indexing 300 Gigabytes per day for core IT operational analytics use cases.
Software Distributions and Versions

The software versions tested and validated in this document are shown in Table 4

Table 4  Software Versions

<table>
<thead>
<tr>
<th>Layer</th>
<th>Component</th>
<th>Version or Release</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compute</td>
<td>Cisco UCS C240 M4</td>
<td>C240M4.2.0.13d</td>
</tr>
<tr>
<td></td>
<td>Cisco UCS C220 M4</td>
<td>C220M4.2.0.13d</td>
</tr>
<tr>
<td></td>
<td>Cisco UCS S3260</td>
<td>S3260M4.2.0.13c</td>
</tr>
<tr>
<td>Network</td>
<td>Cisco UCS 6296UP</td>
<td>UCS 3.1(2b) A</td>
</tr>
<tr>
<td></td>
<td>Cisco UCS VIC1227 Firmware</td>
<td>4.1 (2d)</td>
</tr>
<tr>
<td></td>
<td>Cisco UCS VIC1227 Driver</td>
<td>2.3.0.20</td>
</tr>
<tr>
<td>Storage</td>
<td>LSI SAS 3108</td>
<td>24.12.1-0049</td>
</tr>
<tr>
<td>Software</td>
<td>Red Hat Enterprise Linux Server</td>
<td>6.8 (x86_64)</td>
</tr>
<tr>
<td></td>
<td>Cisco UCS Manager</td>
<td>3.1 (2b)</td>
</tr>
<tr>
<td></td>
<td>Splunk Enterprise</td>
<td>6.4.3</td>
</tr>
</tbody>
</table>

To learn more about Splunk Enterprise, visit: [http://www.splunk.com](http://www.splunk.com).

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.
The latest supported RAID controller driver is already included with the RHEL 6.8 operating system. Broadwell CPUs, that is E5-2600 v4 processors, are supported from Cisco UCS firmware 3.1(2b) onward.

Fabric Configuration

To configure a fully redundant, highly available Cisco UCS 6296 Fabric Interconnect configuration, complete the following steps:

1. Initial setup of Fabric Interconnect A and B.
2. Connect to UCS Manager with the virtual IP address using a web browser.
3. Launch UCS Manager.
4. Enable server, uplink, and appliance ports.
5. Start discovery process.
6. Create pools and policies for the Service Profile template.
7. Create Service Profile template and 13 Service Profiles.
8. Associate Service Profiles to servers.
Performing Initial Setup of Cisco UCS 6296 Fabric Interconnects

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

Configure Fabric Interconnect A

1. Connect to the console port on the first Cisco UCS 6296 Fabric Interconnect.

2. At the prompt to enter the configuration method, enter console to continue.

3. If asked to either perform a new setup or restore from backup, enter setup to continue.

4. Enter y to continue to set up a new Fabric Interconnect.

5. Enter y to enforce strong passwords.

6. Enter the password for the admin user.

7. Enter the same password again to confirm the password for the admin user.

8. When asked if this Fabric Interconnect is part of a cluster, answer y to continue.


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. When asked to Join centralized management environment (UCS Central)?, select No.

---

Note: UCS Central extends the policy-based functions and concepts of Cisco UCS Manager across multiple Cisco UCS domains in one or more physical locations. If you are using multiple UCS domains, select Yes for this question.
20. Review the settings that were printed to the console, and if they are correct, answer yes to save the configuration.

21. Wait for the login prompt to make sure the configuration has been saved.

Configure Fabric Interconnect B

1. Connect to the console port on the second Cisco UCS 6296 Fabric Interconnect.

2. When prompted to enter the configuration method, enter console to continue.

3. The installer detects the presence of the partner Fabric Interconnect and adds this Fabric Interconnect to the cluster. Enter y to continue the installation.

4. Enter the admin password that was configured for the first Fabric Interconnect.

5. Enter the Mgmt0 IPv4 address.

6. Answer yes to save the configuration.

7. Wait for the login prompt to confirm that the configuration has been saved.

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

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 6296 Fabric Interconnect cluster address.

2. Click the Launch link to download the Cisco UCS Manager software.

3. If prompted to accept security certificates, accept as necessary.

4. When prompted, enter admin for the user name and enter the administrative password.

5. Click Login to log in to the Cisco UCS Manager.

Upgrading UCSM Software to Version 3.1(2b)

This document assumes the use of UCS 3.1(2b). Refer to Cisco UCS 3.1 Release. Upgrade the Cisco UCS Manager software and UCS 6296 Fabric Interconnect software to version 3.1(2b). Also, make sure the UCS C-Series version 3.1(2b) software bundles are installed on the Fabric Interconnects.
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:

1. Select the **LAN** tab at the top of the left window.
2. **Select** Pools > IP Pools > IP Pool ext-mgmt.
3. **Right-click** IP Pool ext-mgmt.
4. **Select** Create Block of IPv4 Addresses as shown in Figure 14

**Figure 14** Adding Block of IPv4 Addresses for KVM Access: Part 1

5. Enter the starting IP address of the block and number of IPs needed, as well as the subnet and gateway information as shown in Figure 15
6. **Click** **OK** to create the IP block.
7. **Click** **OK** in the message box.
Enabling Uplink Ports

To enable uplink ports, complete the following steps:

1. Select the Equipment tab on the top left of the window.
3. Expand the Ethernet Ports section.
4. Select Port 1 (which is connected to the uplink switch), right-click, then select Reconfigure > Configure as Uplink Port, as shown in Figure 16.
5. Select Show Interface and select 10GB for Uplink Connection.
6. A pop-up window appears, asking to confirm your selection. Click Yes, then click OK to continue.
8. Expand the Ethernet Ports section.
9. Select Port 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, asking to confirm your selection. Click Yes, then click OK to continue.
Configuring VLANs

VLANs are configured as shown in Table 5

Table 5  VLAN Configurations

<table>
<thead>
<tr>
<th>VLAN</th>
<th>Fabric</th>
<th>NIC Port</th>
<th>Function</th>
<th>Failover</th>
</tr>
</thead>
<tbody>
<tr>
<td>default(VLAN1)</td>
<td>A</td>
<td>eth0</td>
<td>Management, User connectivity, Data Ingestion</td>
<td>Fabric Failover to B</td>
</tr>
<tr>
<td>vlan11_DATA1</td>
<td>B</td>
<td>eth1</td>
<td>Data Replication</td>
<td>Fabric Failover to A</td>
</tr>
</tbody>
</table>

Both VLANs must be trunked to the upstream distribution switch connecting the Fabric Interconnects. For this deployment, default VLAN1 is configured for management access (installing and configuring OS, clustershell commands, setup NTP, user connectivity, etc) and for Splunk data ingestion from the forwarders. VLAN vlan11_DATA1 will be used for the replication traffic between the indexers. This enables Splunk to take advantage of the UCS dual 10Gigabit Ethernet (10GigE) links to isolate the inter-server traffic (that is index replication) from the ingress traffic (data ingestion from forwarders) on separate 10GigE links.

Note: We are using default VLAN1 for management traffic.

To configure the VLANs in the Cisco UCS Manager GUI, complete the following steps:

1. Select the LAN tab in the left pane in the UCS Manager GUI.
2. Select LAN > VLANs.
3. Right-click the VLANs under the root organization.
4. Select Create VLANs to create the VLAN, as shown in Figure 17
5. Enter vlan11_DATA1 for the VLAN Name, as shown in Figure 18.

6. Click the Common/Global radio button for vlan11_DATA1.

7. Enter 11 in the VLAN IDs field.

8. Click OK and then, click Finish.

9. Click OK in the success message box.
Figure 19 shows the created VLANs.

Figure 19 List of VLANs

Enabling Server Ports

These steps provide details for enabling server ports:

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


3. Expand the Ethernet Ports section, as shown in Figure 20

4. Select all the ports that are connected to the servers (including the S3260), right-click them, and select Reconfigure > Configure as a Server Port.

5. A pop-up window appears to confirm your selection. Click Yes, then OK to continue.


7. Expand the Ethernet Ports section.

8. Select all the ports that are connected to the servers (including the S3260), right-click them, and select Reconfigure > Configure as a Server Port.

9. A pop-up window appears, asking to confirm your selection. Click Yes then OK to continue.
Creating a Storage Profile for Boot Drives

1. Go to the Storage tab and expand Storage → Storage Policies.

2. Right click on Disk Group Policies and click Create Disk Group Policies as shown in Figure 21

3. In the Create Disk Policy window, configure the following parameters and click OK, as shown in Figure 22
   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 = Write Back Good Bbu

k. IO Policy = Platform Default

l. Drive Cache = Disable

Figure 22 Create Disk Group Policy

4. In the Storage tab, right click on Storage Profile, and click Create Storage Profile as shown in Figure 23
5. Enter “Boot_SSD” in the name field. Under Local LUNs click “+” to add local LUN, as shown in Figure 24.

6. In the Create Local LUN window, enter the name Boot_SSD, as shown in Figure 25.

7. Check the Expand to Available checkbox to use all available space.
8. Under the Select Disk Group Configuration drop down list, choose Boot_SSD, which was created earlier.

9. Click OK and OK again to complete the configuration.

Figure 25  Create Local LUN

Creating Pools for Service Profile Templates

Creating an Organization

Organizations are used as a means to arrange and restrict access to various groups within the IT organization, thereby enabling multi-tenancy of the compute resources. This document does not assume the use of organizations; however, the necessary steps are provided for future reference. If you create an organization, you can choose it instead of root in the remaining instructions of this document (for example, step 2 of the next section, Creating MAC Address Pools).

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

1. Click New on the top left corner in the right pane in the UCS Manager GUI.

2. Select Create Organization from the options.

3. Enter a name for the organization.

4. (Optional) Enter a description for the organization.

5. Click OK.

6. Click OK in the success message box.
Creating MAC Address Pools

To create MAC address pools, complete the following steps:

1. Select the LAN tab on the left of the window.
2. Select Pools > root.
3. Right-click MAC Pools under the root organization.
4. Select Create MAC Pool to create the MAC address pool as shown in Figure 26.
5. Enter the MAC Pool name, which is ucs.
6. (Optional) Enter a description of the MAC pool.
7. Select the Assignment Order to be Sequential.
8. Click Next.
9. Click Add.
10. Specify a starting MAC address.

Figure 26 Creating MAC Pool Window

11. Specify a size of the MAC address pool, which is sufficient to support the available server resources, as shown in Figure 27.
12. Click OK.
Figure 27  Specifying First MAC Address and Size

13. Click Finish as shown in Figure 28

Figure 28  Adding MAC Addresses

14. When the message box displays, click OK, as shown in Figure 29

Figure 29  Confirming Newly Added MAC Pool

Creating Server Pools

A server pool contains a set of servers. These servers typically share the same characteristics. Those characteristics can be their location in the chassis, or an attribute such as server type, amount of memory, local storage, type of CPU, or local drive configuration. You can manually assign a server to a server pool, or use server pool policies and server pool policy qualifications to automate the assignment. Follow these steps to configure the server pool within the Cisco UCS Manager GUI:
1. Select the **Servers** tab in the left pane in the UCS Manager GUI.

2. Select **Pools > root**.

3. Right-click **Server Pools**.

4. Select **Create Server Pool**.

5. Enter the server pool name, which is **ucs**, as shown in Figure 30.

6. (Optional) Enter a description for the server pool.

7. Click **Next** to add the servers.

**Figure 30 Setting Name and Description of Server Pool**

8. Select all the Cisco UCS C240 M4 and all five Cisco UCS C220 M4 servers to be added to the server pool and then click >> to add them to the pool, as shown in Figure 31.

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, ROM, and storage controller properties as applicable.

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

1. Select the `Servers` tab in the left pane in the UCS Manager GUI.
2. Select `Policies` > `root`.
3. Right-click `Host Firmware Packages`.
4. Select `Create Host Firmware Package`.
5. Enter the host firmware package name, which is `ucs_FW_3.1_2b_C`, as shown in Figure 32. Name the Host Firmware Package appropriately to include the actual firmware version and package.
6. Click the 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 32  Creating 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 UCS Manager GUI.

2. Select Policies > root.
3. Right-click **QoS Policies**.

4. Select **Create QoS Policy**.

5. Enter **Platinum** as the name of the policy, as shown in Figure 33.

6. Select **Platinum** from the drop down menu.

7. Keep the **Burst (Bytes)** field as default (10240).

8. Keep the **Rate (Kbps)** field as default (line-rate).

9. Keep **Host Control** radio button as default (none).

10. Once the pop-up window appears, click **OK** to complete the creation of the policy.

![Creating Platinum QoS Policy](image)

**Figure 33**  
**Creating Platinum QoS Policy**

**Setting Jumbo Frames**

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

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

2. Select **LAN Cloud > QoS System Class**, as shown in Figure 34.

3. In the right pane, select the **General** tab.

4. In the **Platinum** row, enter **9000** for MTU.

5. Check the **Enabled** check box next to **Platinum**.

6. In the **Best Effort** row, select **best-effort** for weight.

7. In the **Fiber Channel** row, select **none** for weight.

8. Click **Save Changes**.
9. Click **OK**.

**Figure 34** Setting Jumbo Frames

Creating Local Disk Configuration Policy

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

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

2. Go to **Policies > root**.

3. Right-click **Local Disk Config Policies**.

4. Select **Create Local Disk Configuration Policy**.

5. Enter the local disk configuration policy name, which is **ucs**, as shown in Figure 35.

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 done manually and is often error-prone. By creating a BIOS policy and assigning the policy to a server or group of servers, you can enable transparency within the BIOS settings configuration.

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

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

1. Select the Servers tab in the left pane in the UCS Manager GUI.
2. Select Policies > root.
3. **Right-click** **BIOS Policies**.

4. **Select** **Create BIOS Policy**.

5. **Enter** *ucs* **for the BIOS policy name**, as shown in Figure 36.

6. **Change** the BIOS settings to match the following figures:

---

**Figure 36**  
**Creating Server BIOS Policy – Main Screen**

![BIOS Policy Configuration Screen]

---

*Note: The image shows the BIOS policy configuration screen with options such as Name, Description, Reboot on BIOS Settings Changes, Quiet Boot, etc.*
Figure 37   Creating Server BIOS Policy for Processor
7. Click **Finish** to complete creating the BIOS policy.

8. Click **OK**.

**Creating Boot Policy**

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

1. Select the **Servers** tab in the left pane in the UCS Manager GUI, as shown in Figure 40
2. Select Policies > root.

3. Right-click the Boot Policies.

4. Select Create Boot Policy.

**Figure 40 Creating Boot Policy Part 1**

5. Enter `ucs` for the boot policy name, as shown in Figure 41.

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

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

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

9. Keep Boot Mode as the default (Legacy).

10. Expand Local Devices > Add CD/DVD and select Add CD/DVD.

11. Expand Local Devices and select Add Local Disk.

12. Expand vNICs and select Add LAN Boot and enter `eth0`.

13. Click OK to add the boot policy.

14. Click OK.
Creating Power Control Policy

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

1. Select the Servers tab in the left pane in the UCS Manager GUI, as shown in Figure 42.

2. Select Policies > root.


4. Select Create Power Control Policy.
5. Enter ucs for the power control policy name, as shown in Figure 43.

6. (Optional) Enter a description for the power control policy.

7. Select No cap for the Power Capping selection.

8. Click OK to create the power control policy.

9. Click OK.
Creating a Maintenance Policy

To create a maintenance policy, complete the following steps:

1. Select the Servers tab in the left pane in the UCS Manager GUI, as shown in Figure 44

2. Select Policies > root.


4. Select Create Maintenance Policy.
5. Enter the maintenance policy name: `user_ack`.

6. Select User Ack as the Reboot Policy by clicking on it.

7. Click OK to create the maintenance policy.

8. Click OK.
Creating Chassis Profiles for Cisco UCS S3260 Storage Servers

A chassis profile is required for discovering the Cisco UCS S3260 server nodes. To create a chassis profile, complete the following steps:

- Create Disk zoning policy to discover and allocate the hard disk drives per server node.
- Assign chassis firmware policy
- Create a chassis profile template.
- Create and associate a chassis profile with the Cisco UCS S3260 storage server chassis.

Note: In this solution, all 60 drives of the chassis are allocated to one server node.

Creating Disk Zoning Policy

1. Click the Chassis tab on the top of the left navigation pane in UCS Manager.
2. Expand Policies -> Root -> Disk Zoning Policies, as shown in Figure 46.
3. Right-click on Disk Zoning Policies and click Create Disk Zoning Policy.

Figure 46 Chassis Profile Screen

4. In the Create Disk Zoning Policy window, enter the Name UCS and click “+” to add the disk zoning information, as shown in Figure 47.
5. In the **Add Slots to Policy** window, select the **Dedicated** radio button.

6. From the **Server** drop down list choose “1”.

7. From the **Controller** drop down list, choose “1”.

8. For the **Slot Range** field, enter 1-60 and click **OK**.
9. Click **OK** to finish creating the disk zoning policy.

Note: In this configuration, a single server is used, which holds 60 drives. In a two-server configuration, there would only be room for 56 drives, with each server assigned to 28 drives.

Creating Chassis Firmware Package Policy

1. In the **Chassis** tab, expand **Chassis > Policies > Root**.

2. Right click on **Chassis Firmware Packages** and click **Create Chassis Firmware Packages**, as shown in Figure 49.

![Chassis Firmware Packages](image)

3. In the **Create Chassis Firmware Package** window, enter **UCS** as the Name.

4. From the **Chassis Packages** drop down list, choose the appropriate package (must be 3.1(2b) or above) and click **OK**.
Creating a Chassis Profile Template

1. Under Chassis Profile Template, right-click and click Create Chassis Profile Template, as shown in Figure 51

2. Enter **UCS** for the Name, Select **Updating Template** for Type,
3. Click Next and Next again.

4. Expand the Chassis Firmware Package section. From the Chassis Firmware Package drop down list choose UCS and click Next, as shown in Figure 53.
5. From the Disk Zoning Policy drop down list, choose UCS and click Finish. Click OK at the success message. See Figure 54
6. Right-click on **Chassis Profiles** and click **Create Chassis Profile from Templates** (not to be confused with the option to create multiple chassis profiles). See Figure 55.
7. The Create Chassis Profile From Template window will appear. For Name, enter Chassis.

8. Enter a description (optional).

9. From the Chassis Profile Template drop down list, choose UCS. Click OK. See Figure 56

Figure 56  Create Chassis Profile from Template

10. Click OK on the success dialog box.

Associating Chassis Profile to Individual Chassis

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

2. Select the chassis and click Associate Chassis Profile, as shown in Figure 57
3. Select Chassis Profile Chassis and click OK, as shown in Figure 58.
4. Once the chassis profile is associated, all 60 disks will be assigned to the server node, as shown in Figure 59

![Storage Controller SAS 1](image)

**Figure 59** Storage Controller SAS 1

**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 UCS Manager GUI.**
2. **Right-click Service Profile Templates.**
3. **Select Create Service Profile Template, as shown in Figure 60**

![Creating Service Profile Template](image)

**Figure 60** Creating Service Profile Template

The Create Service Profile Template window appears.

4. **Enterucs for the service profile template name, as shown in Figure 61**
5. **Click the Updating Template radio button.**
6. **In the UUID section, select Hardware Default as the UUID Assignment.**
7. **Click Next to continue to the next section.**
Configuring the Storage Policy for the Template

To configure storage policies for the template, complete the following steps:

1. Click on the Local Disk Configuration Policy tab.
2. Select ucs for the local disk configuration policy, as shown in Figure 62
3. Click Next to continue to the next section.
Configuring Network Settings for the Template

To configure the network settings for the template, complete the following steps:

1. Keep the Dynamic vNIC Connection Policy field set to default, as shown in Figure 63

2. Click the Expert radio button for the option, How would you like to configure LAN connectivity?
3. Click Add to add a vNIC to the template.

4. The Create vNIC window displays. Name the vNIC eth0, as shown in Figure 64.

5. Select ucs in the Mac Address Assignment pool.

6. For Fabric ID, click the Fabric A radio button and check the Enable failover check box.

7. Check the default check box for VLANs and click the Native VLAN radio button.

8. Set MTU size to 9000.


10. In the Connection Policies section, keep the Connection Policies set at Dynamic vNIC. Keep the Dynamic vNIC Connection Policy as <not set>.

11. Click OK.
12. Click Add to add the second vNIC to the template.

13. The Create vNIC window appears. Name the vNIC eth1, as shown in Figure 65
14. Select **ucs** in the Mac Address Assignment pool.

15. Click the Fabric B radio button and check the Enable failover check box for the Fabric ID.

16. Check the **vlan11_DATA1** check box for VLANs, and click the Native VLAN radio button.

17. Set **MTU size** as **9000**.

18. In the **Adapter Performance Profile section**, set **Adapter Policy** as **Linux**. Set **QoS Policy** as **Platinum**. Set **Network Control Policy** as **Default**.

19. In the **Connection Policies section**, keep the **Connection Policies** as **Dynamic vNIC**. Keep the **Dynamic vNIC Connection Policy** as **<not set>**.

20. Click **OK**.
Configuring SAN Connectivity for the Template

To configure SAN connectivity, complete the following steps:

1. **For How would you like to configure SAN connectivity?, select no vHBAs, as shown in Figure 66**
2. Click **Next** to go to the next section.

3. Zoning information is not specified. Click **Next** to go to the next section.

**Figure 66** Configuring Network Settings for the Template

![Configuring Network Settings for the Template](image)

**Configuring vNIC/vHBA Placement Policy for the Template**

To configure the vNIC/vHBA placement policy, complete the following steps:

1. Keep the default option for the **Select Placement** field, as shown in Figure 67.

2. Select **eth0** and **eth1** and assign the vNICs in the following order: eth0, eth1.

3. Review to make sure that both vNICs were assigned in the appropriate order.

4. Click **Next** to continue to the next section.
Configuring vMedia Policy for the Template

1. Skip the vMedia policy, as shown in Figure 68. Click Next 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, as shown in Figure 69
2. Review to make sure that all of the boot devices were created and identified.
3. Verify that the boot devices are in the correct boot sequence.
4. Click **OK**.
5. Click **Next** to continue to the next section.

![Configure Boot Policy](image)

**Figure 69** Configure Boot Policy

Configuring the Maintenance Policy for the Template

To configure the maintenance policy, complete the following steps:

1. Select **user_ack** at the **Maintenance Policy** field, as shown in Figure 70
2. Click **Next** to continue to the next section.
Configuring Server Assignment for the Template

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

1. **Select ucs for the Pool Assignment field**, as shown in Figure 71
2. **Keep the Server Pool Qualification field at default.**
3. **Expand the Firmware Management section.**
4. **For the Host Firmware Package**, select **ucs_FW_3_1_2b_C** from the drop-down list.
Configuring Operational Policies for the Template

In the Operational Policies Window, complete the following steps:

1. In the BIOS Configuration section, select ucs in the BIOS Policy field, as shown in Figure 72.


3. Click Finish to create the service profile template.

4. Click OK in the pop-up window to proceed.
Creating a Service Profile Template for the S3260 Storage Server

The server in the Cisco UCS S3260 needs a separate service profile template. Copy the service profile template that was just created and then add a storage profile and boot policy.

1. Select the Servers tab in the navigation pane.
2. Go to Servers > Service Profile Templates > root.
3. Right-click Service Profile Templates ucs.
4. Select Create a Clone, Figure 73
5. Enter **S3260** for the Clone Name and select **root** for the organization, as shown in Figure 74.

6. Select the new service template in the navigation pane.

7. Select the **Storage** and **Storage Profiles** tabs, as shown in Figure 75.
8. Click on **Modify Storage Profile**.

9. Click on the **Storage Profile Policy** tab.

10. Choose **Boot SSD** for the **Storage Profile**, as shown in Figure 76
11. Click **OK** to finish modifying the storage profile. Click **OK** on the success dialog box.

12. Click on the **Boot Order** tab, as shown in Figure 77
13. The current boot policy is ucs. Click on Modify Boot Policy to change it.

14. Click Create Boot Policy.

15. Enter LUN for the name.
16. Expand **Local Devices** and select **Add Local LUN**.

**Figure 79**  
**Add Local LUN Image Path**

17. In the **Add Local LUN Image Path** window, select **Primary**, enter a **LUN Name**, and click **OK**.

18. After creating the new boot policy, select it in the **Modify Boot Policy** screen and click **OK**.
Creating Service Profiles from Template

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

2. Go to Service Profile Templates > root, as shown in Figure 80.

3. Right-click Service Profile Templates ucs.

4. Select Create Service Profiles From Template.

Figure 80: Creating Service Profiles from Template

5. In the Create Service Profile from Template window enter the following:
   a. In the field Naming Prefix, enter ucs, as shown in Figure 81.
   b. In the field Enter Name Suffix Starting Number, enter 1.
   c. In the field Number of Instances, enter 13.

80
Figure 81    Selecting Name and Total number of Service Profiles

![Create Service Profiles From Template](image)

- **Naming Prefix:** rack
- **Name Suffix Starting Number:** 0
- **Number of Instances:** 0

OK  Cancel

---

Note: Association of the Service Profiles will take place automatically.

---

6. Repeat the above steps to create a service profile from the S3260 Service Profile Template. Use the parameters in Figure 82

Figure 82    Selecting Name and Total number of Service Profiles for S3260

![Create Service Profiles From Template](image)

- **Naming Prefix:** storage
- **Name Suffix Starting Number:** 1
- **Number of Instances:** 1

OK  Cancel

---

**Identifying the Servers**

1. In the **Equipment Tab**, select **Rack-Mounts** for the **Filter**, and click on **Servers**. In the right pane all thirteen servers are displayed along with their details, as shown in Figure 83
2. (Optional) Double click on an individual server instance and enter an appropriate text string (name or role) in the User Label as shown below in Figure 84. This could be helpful in identifying the server’s application-specific roles.

Figure 84 (Optional) Using the User Label Field to Identify the Application Specific Roles
Installing Red Hat Enterprise Linux 6.8 on C220 M4 Systems

The search heads and the admin nodes are C220 M4 servers. These servers should be populated with a minimum of 2 identical hard disk drives. The procedures documented in this section are applicable for all servers performing the admin and the search head functions.

Note: This requires RHEL 6.8 DVD/ISO for the installation.

Creating a Virtual Drive Using Cisco 12G SAS RAID Controller Utility

To create a virtual drive using Cisco 12G SAS RAID Controller Utility, complete the following steps:

1. Log in to the Cisco UCS 6296 Fabric Interconnect and launch the Cisco UCS Manager application.

2. Select the Equipment tab.

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

4. Right-click on the C220 server that will serve as the admin1 node and select KVM Console, as shown in Figure 85
5. In the KVM window, select Macros > Static Macros > Ctrl-Alt-Del, as shown in Figure 86
6. Wait for the initial server configurations and POST to complete. Press Ctrl-R when the next screen appears as in Figure 87. This will take you to the configuration utility for the controller.

Figure 87  Open MegaRAID Configuration Utility

7. In the Cisco 12G SAS Modular Raid Controller BIOS Configuration Utility, use the arrow keys to highlight the Cisco 12G SAS Modular Raid controller line item.

8. Press F2 to open up the sub-menu. Select Create Virtual Drive, as shown in Figure 88.
9. In the Create New VD dialog box, highlight the RAID Level field, and press Enter to select RAID-1.

10. Select the drives.

11. Press Enter on the Advanced button.

12. In the Create Virtual Drive-Advanced dialog box, select 128KB as the Strip Size, as shown in Figure 89.

13. Select Read Ahead as the Read Policy.

14. Select Write Back with BBU as the Write Policy.

15. Select Direct as the I/O Policy.

Figure 89   Advanced Settings for Creating a Virtual Drive

16. Check the Initialize check box.

17. Select OK and press the Enter key.
18. In the Create Virtual Drive-Advanced window, press **OK** to continue.

19. In the **Create New VD** dialog box, review the configuration and press **OK** to create the virtual drive, as shown in Figure 91

![Figure 91: Review the Virtual Drive Configuration](image)

20. Press **Ctrl-N** twice to reach the **Ctrl Mgmt** tab, as shown in Figure 92

21. Use the Tab key to navigate to the **Boot device** field. Press Enter to choose VD0 as the boot device.

22. Use the Tab key to select **Apply** to save the changes.
23. Press the **Esc** key and select **OK** to exit out of this utility.

24. Use the **Macro** menu to send a **Ctrl-Alt-Del** macro to reboot the server.

### Installing the Operating System

1. In the KVM console, select **Virtual Media > Activate Virtual Devices**, as shown in Figure 93.

2. Select **Virtual Media > Map CD/DVD**.
3. In the Virtual Media - Map CD/DVD dialog box, click on Browse button to choose the RHEL 6.8 Operating System ISO image file.

4. Click Map Device.

5. Select Macros > Static Macros > Ctrl-Alt-Del option to reboot the server.

6. On reboot, the machine detects the presence of the Red Hat Enterprise Linux Server 6.8 install media.

7. Select Install or upgrade an existing system, as shown in Figure 95
8. Skip the media test and start the installation.

9. Click Next.

10. Select the language of installation and click Next. See Figure 96
11. Select the Keyboard for installation and click Next. See Figure 97
12. Select Basic Storage Devices and click Next. See Figure 98

**Figure 98**  RHEL Installation: Select Storage Devices

- **Basic Storage Devices**
  - Installs or upgrades basic types of storage devices. If you're not sure which option is right for you, start with this one.
- **Specialized Storage Devices**
  - Installs or upgrades for specialized devices such as Storage Area Networks (SANs). This option will allow you to add FCU/FC/S/FCP data and filter out devices the installer should ignore.

13. Provide Hostname and click the Configure Network button on the bottom left to configure networking for the host, as shown in the figures below.
Figure 102  RHEL Installation: Configure IPv4 Settings for eth 1

Figure 103  RHEL Installation: Select Region

14. In the type of Installation, select Create Custom Layout, as shown in Figure 104
15. Click Create. Create three partitions as follows, to be assigned to /boot, swap, and / respectively.

Note: This partition layout customization is optional but highly recommended. As the Splunk software will be installed on the root partition under /data/disk1, it is recommended to allocate and ensure that sufficient storage is available to the / partition.
16. Set the Mount Point as /boot, specify the size to be 2048 MB, and select Fixed size under Additional Size Options. Click OK.

![RHEL Installation: Add Partition Part 1](image1)

17. Create another standard partition with a fixed size of 512 MB for the swap partition by selecting File System Type as swap.

![RHEL Installation: Add Partition Part 2](image2)
18. Create the third standard partition with Mount Point set to / and select the Fill to maximum allowable size in the Additional Size Options.

![Add Partition](image)

19. Click Next to continue.

![Select Disk](image)

20. Continue with the RHEL Installation as shown below.
21. Once the installation is complete, reboot the system.

22. Repeat steps 1 to 21 to install Red Hat Enterprise Linux 6.8 on the four other Cisco C220 M4 servers serving as search heads and admin nodes. Assign the host names as follows: admin2 for the other Cisco C220 M4 admin server, and sh1, sh2, sh3 for the three Cisco C220 M4 search head servers. Assign the respective IP addresses to these servers by referring to Table 6.

Installing Red Hat Enterprise Linux 6.8 using Software RAID on C240 M4 Systems

To install Red Hat Enterprise Linux 6.8 using Software RAID (OS based Mirroring) on Cisco UCS C240 M4 servers complete the following steps:

Note: The installation procedure described in this deployment guide uses KVM Console and virtual media from Cisco UCS Manager.

Note: RHEL 6.8 DVD/ISO is required for the installation.

1. Log in to the Cisco UCS 6296 Fabric Interconnect and launch the Cisco UCS Manager application.
2. Select the **Equipment** tab.

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

4. Right click on the server and select **KVM Console**, as shown in Figure 111

![Opening the KVM Console](image)

**Figure 111** Opening the KVM Console

5. In the KVM window, select the **Virtual Media** tab, as shown in Figure 112

6. Click **Activate Virtual Devices** found in **Virtual Media** tab.

![KVM Console: Active Virtual Devices](image)

**Figure 112** KVM Console: Active Virtual Devices
7. In the KVM window, select the Virtual Media tab and click Map CD/DVD, as shown in Figure 113

![KVM Console: Map CD/DVD](image)

8. Browse to the Red Hat Enterprise Linux Server 6.8 installer ISO image file, as shown in Figure 114

⚠️ Note: The Red Hat Enterprise Linux 6.8 DVD is assumed to be on the client machine.

9. Click Open to add the image to the list of virtual media.

![Browse for Red Hat Enterprise Linux ISO Image](image)

10. In the KVM window, select the KVM tab to monitor during boot.
11. In the KVM window, select **Macros > Static Macros > Ctrl-Alt-Del** 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 6.8 install media.

15. **Select** **Install or upgrade an existing system.**

**Figure 115** RHEL Installation

16. Skip the Media test and start the installation.

17. **Click** **Next**.

18. **Select** language of installation and **click** **Next. See Figure 116**
19. Select the desired keyboard for the installation. See Figure 117

20. Select Basic Storage Devices and click Next. See Figure 118
21. **Provide Hostname**, as shown in Figure 120

22. **Click the Configure Network button** on the bottom left to configure networking for the host, see Table 7.
Figure 120  RHEL Installation: Enter Host Name

Figure 121  RHEL Installation: Configure Network Settings
Figure 122  RHEL Installation: Configure IPv4 Settings for eth1

Figure 123  RHEL Installation: Select Region
23. Choose Create Custom Layout for Installation type.

24. To create two software RAID 1 partitions for boot and / (root) partitions, complete the following steps:
24. Choose free volume and click on Create and choose RAID Partition, as shown in Figure 126.

**Figure 126**  RHEL Installation: RAID Configuration

25. Choose Software RAID for File System Type and set Size for Boot volume.

**Figure 127**  RHEL Installation: Set Boot Volume and Select File System Type
26. Do the same for the other free volume.

Figure 128  RHEL Installation: RAID Configuration
27. Create RAID partitions for root (/) partition on both the devices and use the rest of the available space by selecting Fill to maximum allowable size.

Figure 129  RHEL Installation: RAID Configuration Add Partition

Figure 130  RHEL Installation: RAID Configuration: Create Storage
The steps above created 2 boot and 2 root (/) partitions. To create RAID1 Devices complete the following steps.

28. Choose one of the boot partitions and click on Create.

29. Choose RAID Device, as shown in Figure 133
30. Choose /boot as the mount point.

31. In RAID members, choose all the boot partitions created above to create a software RAID 1 for boot, as shown in Figure 134.
32. Repeat for / partitions created above choosing both members with mount point as “/”.

Figure 135  RHEL Installation: RAID Configuration- Create Storage

Figure 136  RHEL Installation: RAID Configuration- Make RAID Device
33. Click Next.
34. Select **Default Settings** and click **Next.**
35. Continue with the RHEL Installation as shown below.

Figure 141  Installation: RAID Configuration

36. Once the installation is complete, reboot the system.

37. Repeat steps 1 to 36 to install Red Hat Enterprise Linux 6.8 on the other seven Cisco C240 M4 servers that is idx2 – idx8. The hostnames and their corresponding IP addresses are shown in Table 6

The table below shows how the hosts are assigned with their host names. Within the UCS domain, the eth0 network (that is 10.29.160.X subnet) over Fabric A is used as the primary network for all Splunk related data traffic except the replication traffic. The Splunk index replication-related data traffic will be configured to use eth1 over Fabric B.

For example, the host names associated with the various interfaces of an indexer that is idx1 are as follows:

- eth0:
  - Used to ingest the data streaming in from forwarders, and for traffic between the search head and indexers.
  - Used for management traffic such as SSH, Web UI, NTP sync.
  - Hostname is idx1.
  - Configured with Platinum QOS policy.
• eth1:
  — Used by the indexers to replicate indexes across each other.
  — Hostname is idx-rep.
  — Configured with Platinum QOS policy.

<table>
<thead>
<tr>
<th>Hostname</th>
<th>eth0 Management Network, Data Ingestion</th>
<th>eth1 Data Replication Hostname: &lt;hostname&gt;-rep</th>
</tr>
</thead>
<tbody>
<tr>
<td>admin1</td>
<td>10.29.160.101</td>
<td>192.168.11.101</td>
</tr>
<tr>
<td>admin2</td>
<td>10.29.160.102</td>
<td>192.168.11.102</td>
</tr>
<tr>
<td>idx1</td>
<td>10.29.160.103</td>
<td>192.168.11.103</td>
</tr>
<tr>
<td>Idx2</td>
<td>10.29.160.104</td>
<td>192.168.11.104</td>
</tr>
<tr>
<td>idx3</td>
<td>10.29.160.105</td>
<td>192.168.11.105</td>
</tr>
<tr>
<td>idx4</td>
<td>10.29.160.106</td>
<td>192.168.11.106</td>
</tr>
<tr>
<td>idx5</td>
<td>10.29.160.107</td>
<td>192.168.11.107</td>
</tr>
<tr>
<td>idx6</td>
<td>10.29.160.108</td>
<td>192.168.11.108</td>
</tr>
<tr>
<td>idx7</td>
<td>10.29.160.109</td>
<td>192.168.11.109</td>
</tr>
<tr>
<td>idx8</td>
<td>10.29.160.110</td>
<td>192.168.11.110</td>
</tr>
<tr>
<td>sh1</td>
<td>10.29.160.111</td>
<td>192.168.11.111</td>
</tr>
<tr>
<td>sh2</td>
<td>10.29.160.112</td>
<td>192.168.11.112</td>
</tr>
<tr>
<td>sh3</td>
<td>10.29.160.113</td>
<td>192.168.11.113</td>
</tr>
<tr>
<td>storage1</td>
<td>10.29.160.114</td>
<td>192.168.11.114</td>
</tr>
</tbody>
</table>

Installing Red Hat Enterprise Linux 6.8 on the S3260

There are multiple methods 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 6.8 DVD/ISO for the installation.

1. Log in to the Cisco UCS 6296 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.

5. Follow the directions in the section "Installing the Operation System" under "Installing Red Hat Enterprise Linux 6.8 on C220 M4 Systems."
Post OS Install Configuration

Choose one of the admin nodes of the cluster for management such as installation, cluster parallel shell, creating a local Red Hat repo, and others. In this document, we use admin1 for this purpose.

Configuring /etc/hosts

To configure /etc/hosts on the admin node, complete the following steps:

1. Login to the admin node (admin1).
   
   ```
   ssh 10.29.160.101
   ```

2. Populate the host file with IP addresses and corresponding hostnames. We will later copy this over to the other nodes.

On the Admin Node (admin1)

```bash
vi /etc/hosts
```

```
127.0.0.1   localhost localhost.localdomain localhost4 localhost4.localdomain4 ::1   localhost localhost.localdomain localhost6 localhost6.localdomain6
10.29.160.101   admin1
192.168.11.101   admin1-rep
10.29.160.102   admin2
192.168.11.102   admin2-rep
10.29.160.103   idx1
192.168.11.103   idx1-rep
10.29.160.104   idx2
192.168.11.104   idx2-rep
10.29.160.105   idx3
192.168.11.105   idx3-rep
10.29.160.106   idx4
192.168.11.106   idx4-rep
10.29.160.107   idx5
192.168.11.107   idx5-rep
10.29.160.108   idx6
```
192.168.11.108 idx6-rep
10.29.160.109 idx7
192.168.11.109 idx7-rep
10.29.160.110 idx8
192.168.11.110 idx8-rep
10.29.160.111 sh1
192.168.11.111 sh1-rep
10.29.160.112 sh2
192.168.11.112 sh2-rep
10.29.160.113 sh3
192.168.11.113 sh3-rep
10.29.160.114 storage1

Setting Up Password-less Login

To manage all of the cluster’s nodes from the admin node, set up password-less login. It assists in automating common tasks with ClusterShell, a cluster-wide parallel shell command utility, and shell scripts without having to use passwords.

Once Red Hat Linux is installed across all the nodes in the cluster, to enable password-less login across all the nodes, complete the following steps:

1. Login to the admin node (admin1). For example: ssh 10.29.160.101

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

[root@admin1 ~]# ssh-keygen
Generating public/private rsa key pair.
Enter file in which to save the key (/root/.ssh/id_rsa):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /root/.ssh/id_rsa.
Your public key has been saved in /root/.ssh/id_rsa.pub.
The key fingerprint is:
42:4e:45:1b:0f:1d:a5:7b:4c:0a:59:13:12:3b:bc:93 root@admin1
The key's randomart image is:

[119]
3. Then run the following script 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`.

```bash
for host in admin1 admin2 idx1 idx2 idx3 idx4 idx5 idx6 idx7 idx8 sh1 sh2 sh3 storage1; do echo -n "$host -> "; ssh-copy-id -i ~/.ssh/id_rsa.pub $host; done
```

4. Enter yes at the prompt Are you sure you want to continue connecting (yes/no)? Enter the password of the remote host.

Note: The admin node's `/etc/hosts` should be copied over to all thirteen other servers by using the cluster shell command after it is installed. See the next section, Setting Up ClusterShell.

### Setting Up ClusterShell

ClusterShell (or clush) is a cluster-wide shell to run commands on several hosts in parallel. It is available from the EPEL (Extra Packages for Enterprise Linux) repository.

To download ClusterShell and install it on admin1, complete the following steps:

1. Download `clustershell` and copy it to the root folder of admin1.

   ```bash
   wget http://dl.fedoraproject.org/pub/epel/6/x86_64/clustershell-1.7.2-1.el6.noarch.rpm
   scp clustershell-1.7.2-1.el6.noarch.rpm admin1:/root/
   ```

2. Login to admin1 and install `cluster shell`.

   ```bash
   yum -y install clustershell-1.7.2-1.el6.noarch.rpm
   ```

3. Edit the `/etc/clustershell/groups` file to include hostnames for all the nodes of the cluster. Create four special groups besides the group that takes all the hosts of the cluster. These groups help target the cluster wide commands to a specific set of nodes grouped by their role in the Splunk deployment.

   ```bash
   vi /etc/clustershell/groups
   ```

4. Copy and paste the content below and save the groups file.

   ```bash
   admins: admin[1-2]
   indexers: idx[1-8]
   searchheads: sh[1-3]
   storage: storage1
   all-splunk: admin[1-2],sh[1-3],idx[1-8]
   ```
all: admin[1-2],sh[1-3],idx[1-8],storage

[root@admin1 ~]# cat /etc/clustershell/groups
admins: admin[1-2]
indexors: idx[1-8]
searchheads: sh[1-3]
storage: storage
all-splunk: admin[1-2],sh[1-3],idx[1-8]
all: admin[1-2],sh[1-3],idx[1-8],storage

For more information and documentation on ClusterShell, visit https://github.com/cea-hpc/clustershell/wiki/UserAndProgrammingGuide.

When the IP address or different hostname that is idx1 or 10.29.160.103 is used to configure the /etc/clustershell/groups file, ClusterShell will not work until a manual SSH session is initiated to the machine by using that IP or hostname (as it needs to be in the known_hosts file), for instance, as in the case below for idx1 and 10.29.160.103.

[root@admin1 ~]# ssh 10.29.160.103
The authenticity of host '10.29.160.103 (10.29.160.103)' can't be established.
Are you sure you want to continue connecting (yes/no)? yes

5. From the admin node, that is admin1, copy over the /etc/hosts file to all the other servers.

clush -a -B -x admin1 -c /etc/hosts

[root@admin1 ~]# clush -a -B -x admin1 -c /etc/hosts

Creating Red Hat Enterprise Linux (RHEL) 6.8 Local Repo

To create a repository using RHEL DVD or ISO on the admin node (in this deployment, admin1 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 admin1. 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 you have access to a Red Hat ISO Image, copy the ISO file to admin1.

scp rhel-server-6.8-x86_64-dvd.iso admin1:/root/

Note: Make sure the Red Hat ISO file is located in your present working directory. Use the IP address of the admin node instead of the hostname admin1 if hostnames have not been configured on this computer.


mkdir -p /mnt/rheliso
mount -t iso9660 -o loop /root/rhel-server-6.8-x86_64-dvd.iso /mnt/rheliso/


   cp -r /mnt/rheliso/* /var/www/html/rhrepro

   [root@admin-1 ~]# mkdir -p /var/www/html/rhrepro
   [root@admin-1 ~]# mkdir -p /mnt/rheliso
   [root@admin-1 ~]# mount -t iso9660 -o loop /root/rhel-server-6.8-x86_64-dvd.iso /mnt/rheliso/
   [root@admin-1 ~]# cp -r /mnt/rheliso/* /var/www/html/rhrepro

6. On admin1, create a .repo file to enable the use of the yum command.

   vi /var/www/html/rhrepro/rheliso.repo

   [rhel6.8]

   name=Red Hat Enterprise Linux 6.8
   baseurl=http://10.29.160.101/rhrepro
   gpgcheck=0
   enabled=1

7. Now copy the rheliso.repo file from /var/www/html/rhrepro to /etc/yum.repos.d on admin1

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

   ![Note: Based on this repo file, yum requires httpd to be running on admin1 for other nodes to access the repository.]

8. Copy the rheliso.repo to all the nodes of the cluster.

   clush -a -b -c /etc/yum.repos.d/rheliso.repo

   [root@admin1 ~]# clush -a -b -c /etc/yum.repos.d/rheliso.repo

9. To make use of repository files on admin1 without httpd, edit the baseurl of repo file
    /etc/yum.repos.d/rheliso.repo to point to the repository location in the file system.

   ![Note: This step is needed to install software on admin node (admin1) using the repo (such as httpd, createrepo, etc)]

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

   [rhel6.8]

   name=Red Hat Enterprise Linux 6.8

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baseurl=file:///var/www/html/rhelrepo
gpgcheck=0
enabled=1

Creating the Red Hat Repository Database

1. Install the `createrepo` package on admin node (admin1). Use it to generate the repository database(s) for the local copy of the RHEL DVD contents.

   ```
   yum -y install createrepo
   ```

2. Run createrepo on the RHEL repository to create the repo database on admin node:

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

3. Finally, purge the yum caches after httpd is installed (steps outlined in the next section, “Installing httpd”)

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Installing httpd

Setting up RHEL repo on the admin node requires httpd. This section describes the process of setting one up:

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

The Red Hat repository is hosted using HTTP on the admin node. This machine is accessible by all the hosts in the cluster.

   ```
yum -y install httpd
   **

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

   ```
   vi /etc/httpd/conf/httpd.conf
   ServerName 10.29.160.101:80
   **

   ```
   [root@admin ~]# grep ServerName /etc/httpd/conf/httpd.conf
   # ServerName gives the name and port that the server uses to identify itself.
   #ServerName www.example.com:80
   ServerName 10.29.160.101:80
   **

3. **Start** httpd.

   ```
   service httpd start
   **
   chkconfig httpd on
   **

4. **Purge the yum caches after httpd is installed (the last step in the previous section, “Creating the Red Hat Repository Database”).**

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

   ```
   [root@admin-1 ~]# clush -a -B yum clean all
   admin-[1-2],index-[1-8],xb-[1-2] (12)
   Loaded plugins: product-id, search-disabled-repos, security, subscription-manager
   This system is not registered to Red Hat Subscription Management. You can use subscription-manager to register.
   Cleaning repos: RHEL6.8
   Cleaning up Everything
   [root@admin-1 ~]# clush -a -B yum repolist
   admin-[1-2],index-[1-8],xb-[1-2] (12)
   Loaded plugins: product-id, search-disabled-repos, security, subscription-manager
   This system is not registered to Red Hat Subscription Management. You can use subscription-manager to register.
   repo id   repo name  status
   RHEL6.8   RHEL6.8    3,997
   repolist: 3,997
   [root@admin-1 ~]# ```
Note: While the suggested configuration is to disable SELinux as shown below, if for any reason SELinux needs to be enabled on the cluster, then make sure to run the following command to make sure that httpd is able to read the yum repofiles: `chcon -R -t httpd_sys_content_t /var/www/html/`.

Verify Cisco Network Driver for VIC1227

Ensure that the correct version of the kmod-enic driver is being used on all nodes:

```
clush -a -B "modinfo enic | head -5"
```

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

admin[1-2],idx[1-8],sh[1-3],storage1 (14)

filename: /lib/modules/2.6.32-431.el6.x86_64/kernel/extra/enic/enic.ko
version: 2.1.1.66
license: GPL v2
author: Scott Feldman <scofeldm@cisco.com>
description: Cisco VIC Ethernet NIC Driver
```

Disabling SELinux

Security-Enhanced Linux (SELinux) must be disabled during the install procedure and cluster setup. SELinux can be enabled after installation and while the cluster is running.

1. To disable SELinux, edit `/etc/selinux/config` and change the `SELINUX` line to `SELINUX=disabled`. The following command will disable SELinux on all nodes.

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

```
[root@admin ~]# clush -a -b "sed -i 's/SELINUX=enforcing/SELINUX=disabled/g' /etc/selinux/config"
[root@admin ~]# clush -a -b cat /etc/selinux/config

admin[1-2],idx[1-8],sh[1-3],storage1 (14)

# This file controls the state of SELinux on the system.
# SELINUX= can take one of these three values:
# enforcing - SELinux security policy is enforced.
# permissive - SELinux prints warnings instead of enforcing.
# disabled - No SELinux policy is loaded.
SELINUX=disabled

clush -a -b "setenforce 0"
```

Note: The command above may fail if SELinux is already disabled.
2. Reboot the machine, if needed, for SELinux to be disabled in case it does not take effect. It can be checked using:

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

**Disabling the Linux Firewall**

The default Linux firewall settings are far too restrictive for any application deployment. Since the Cisco UCS Big Data deployment will be in its own isolated network, the firewall service can be disabled.

```
clush -a -b "service iptables stop"

clush -a -b "chkconfig iptables off"
```

```
[root@admin1 ~]# clush -a -b service iptables stop

admin[1-2],idx[1-8],sh[1-3],storagel (14)

iptables: Setting chains to policy ACCEPT: filter [ OK ]
iptables: Flushing firewall rules: [ OK ]
iptables: Unloading modules: [ OK ]
[root@admin1 ~]# clush -a -b chkconfig iptables off
```

Note: The user could re-configure the IP tables' settings in order to match the requirements of his/her particular deployment and turn the service back on. Consult Splunk documentation to determine the appropriate IP tables' settings.

**Installing xfsprogs**

The xfsprogs package contains administration and debugging tools for the XFS file system. To install xfsprogs on all nodes, complete the following steps:

1. From the admin node admin1, run the command below to install xfsprogs on all the nodes for xfs filesystem.

```
clush -a -B yum -y install xfsprogs
```
NTP Configuration

The Network Time Protocol (NTP) is used to synchronize the time of all the nodes within the cluster. The Network Time Protocol daemon (ntpd) sets and maintains the system time of day in synchronism with the timeserver located in the admin node (admin1). Configuring NTP is critical for any clustered application. Installing an internal NTP server keeps the cluster synchronized even when an outside NTP server is inaccessible.

1. **Configure** `/etc/ntp.conf` on the admin node 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** `/tmp/ntp.conf` on the admin node and copy it to all nodes.

   ```
   vi /tmp/ntp.conf
   ```
server 10.29.160.101

driftfile /var/lib/ntp/drift

restrict 127.0.0.1

restrict -6 ::1

includefile /etc/ntp/crypto/pw

keys /etc/ntp/keys

3. Copy /tmp/ntp.conf from the admin node to /etc/ntp.conf of all the other nodes by executing the following command in the admin node (admin1).

clush -a -B -x admin1 -c /tmp/ntp.conf --dest=/etc/ntp.conf

[root@admin1 ~]# clush -a -B -x admin1 -c /tmp/ntp.conf --dest=/etc/ntp.conf
[root@admin1 ~]# clush -a -B cat /etc/ntp.conf

4. Start the NTP service on the admin node (admin1).

service ntpd start

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

clush -a -B "yum install -y ntpdate"

clush -a -b -x admin1 "service ntpd stop"

clush -a -b -x admin1 "ntpd 10.29.160.101"

clush -a -b "service ntpd start"


clush -a -b "chkconfig ntpd on"
Enabling Syslog

To preserve logs regarding killed processes or failed job, enable Syslog on each node. Versions such as syslog-ng and rsyslog are used, making it more difficult to be sure that a syslog daemon is present.

To confirm that the service is properly configured, run the following commands:

```
clush -B -a rsyslogd -v
```

```
[root@admin1 ~]# clush -B -a rsyslogd -v

rsyslogd 5.8.10, compiled with:
  FEATURE_REGEXP: Yes
  FEATURE_LARGEFILE: No
  GSSAPI Kerberos 5 support: Yes
  FEATURE_DEBUG (debug build, slow code): No
  32bit Atomic operations supported: Yes
  64bit Atomic operations supported: Yes
  Runtime Instrumentation (slow code): No

See http://www.rsyslog.com for more information.
```

```
[root@admin1 ~]#
```

```
clush -B -a service rsyslog status
```

Setting Ulimit

In Linux, the ‘nofile’ property in /etc/security/limits.conf defines the number of i-nodes that can be opened simultaneously. With the default value of 1024, the system may appear to be out of disk space and would show no i-nodes are available. This value should be set to 64000 on every node for users root and splunk.

⚠️ Note: When the Splunk Enterprise software is installed, a service user account by name “splunk” gets created automatically. Since all Splunk related operations are performed as user “splunk”, its ulimits need to be increased as well. Higher values are unlikely to result in an appreciable performance gain.

1. Set the "nofile" properties of root and splunk users to 64000 by editing the
   /etc/security/limits.conf on the admin node. Add the following lines to this file.

   ```
   root soft nofile 64000
   root hard nofile 64000
   splunk soft nofile 64000
   splunk hard nofile 64000
   ```
2. Now, copy the `/etc/security/limits.conf` file from admin node (admin1) to all the nodes using the following command.

```
clush -a -B -c /etc/security/limits.conf
clush -a -B grep 64000 /etc/security/limits.conf
```

3. Verify the ulimit settings by running the following command. The command should report 64000.

```
clush -B -a ulimit -n
```

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

---

### Set TCP Retries

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

1. Edit the file `/etc/sysctl.conf` on admin1 and add the following line:

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

2. Copy the `/etc/sysctl.conf` file from the admin node (admin1) to all the other nodes using the following command:

```
clush -a -b -c /etc/sysctl.conf
```

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

```
clush -B -a sysctl -p
```
Configure VM Swapping

`vm.swappiness`, with a value from 0 to 100, controls the degree to which the system swaps. A high value prioritizes system performance, aggressively swapping processes out of physical memory when they are not active. A low value avoids swapping processes out of physical memory for as long as possible. In order to reduce swapping, run the following on all nodes. The default value is 60.

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

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 the default `sysctl` file `/etc/sysctl.conf`.

```bash
clush -a -B "sysctl -p"
```

Disable Transparent Huge Pages

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

1. From the admin node, run the following commands:

```bash
clush -a -b "echo never > /sys/kernel/mm/redhat_transparent_hugepage/defrag"
```

2. Run the commands above every time the Linux system starts up. Add these commands to `/etc/rc.local`, so they are executed automatically upon every reboot.

3. From the admin node, run the following commands:

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

4. Copy the file over to all the nodes.

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

5. Append the content of file `thp_disable` to `/etc/rc.local`. 
Installing the LSI StorCLI Utility on All Indexers and Archival Nodes

This section describes the steps to configure non-OS disk drives as RAID10 using the StorCLI command. All the drives are going to be part of a single RAID10 volume. From the website below, download StorCLI: http://docs.avagotech.com/docs/1.19.04_StorCLI.zip

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

2. Download storcli and its dependencies and transfer to the admin node.

   scp storcli-1.19.04-1.noarch.rpm admin1:/tmp/

3. Copy storcli rpm to all the indexers and storage node(s) using the following commands:

   clush -a -b -X searchheads,admins -c /tmp/storcli-1.19.04-1.noarch.rpm

4. Run the below command to install storcli all the indexers and storage node(s).

   clush -a -b -X searchheads,admins rpm -ivh /tmp/storcli-1.19.04-1.noarch.rpm

Configuring the Virtual Drive on the Indexers

1. Create a script by name raid10.sh on the admin node and copy it over to all indexers.

   vi /root/raid10.sh

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

   /opt/MegaRAID/storcli/storcli64 /c0 add vd type=raid10 drives=$1:1-24 pdperarray=12 WB ra direct Strip=128

   Note: Do not execute this script on the admin or search head nodes. This script is meant only for the indexers.

   Note: This script needs to be executed on each of the indexer nodes manually. This is because the script takes the EnclosureID as input, which would generally be different on different indexer servers.

3. Change the mode to include execution privileges.

   chmod +x /root/raid10.sh

4. Copy the script over to all the indexers.

   clush --group=indexers -c /root/raid10.sh
5. The script above requires enclosure ID as a parameter. Run the following command to get EnclosureID on each indexer by launching an SSH session onto that indexer.

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

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

```
./raid10.sh <EnclosureID> # obtained by running the command above
```

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

```
[root@admin1 -]# ssh idx1
Last login: Thu Apr  9 04:04:38 2015 from admin1
[root@idx1 ~]#
[root@idx1 ~]# /opt/MegaRAID/storcli/storcli64 pdlist -a0 | grep Enc | grep -v 252 | awk '{print $4}' | sort | uniq -c | awk '{print $2}'
0
[root@idx1 ~]# ./raid10.sh 0
Controller = 0
Status = Success
Description = Add WD Succeeded
```

Note: The above figure shows the procedure for creating virtual drive on one indexer. This process needs to be performed on all eight indexers individually.

### Configuring the XFS File System

The following script will format and mount the RAID10 volume (virtual drive) that was created in the previous section. It looks at all available volumes on the indexers, but will skip OS/boot related volumes. The RAID10 volume will be mounted based on its UUID as /data/disk1. This script assumes a strip size of 128K and one RAID10 volume with 12 physical drives in each span.

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

1. On the admin node, create a file containing the following script.
Note: The script assumes there are no partitions already existing on the data volumes. If there are partitions, then they have to be deleted first before running this script. This process is documented in the Note at the end of the section.

```bash
vi /root/driveconf-idx.sh

#!/bin/bash
[[ "-x" == "$(1)" ]] && set -x && set -v && shift 1
count=1
for devX in /sys/class/scsi_host/host?/scan
do
echo '- - -' > ${devX}
done
for devD in $(lsblk | grep disk | cut -c1-3)
do
echo /dev/$devD
devX=/dev/$devD
devX=/dev/$devD
if [[ -b ${devX} && `/sbin/parted -s ${devX} print quit|/bin/grep -c boot` -ne 0 ]]
then
echo "${devX} bootable - skipping."
continue
else
echo ${devX}
echo "Setting up Drive => ${devX}"
/sbin/mkfs.xfs -f ${devX}
(( $? )) && continue
UUID=`blkid ${devX} | cut -d " " -f2 | cut -d "=" -f2 | sed 's/"//g'

echo "UUID of ${devX} = ${UUID}, mounting ${devX} as UUID on
/data/disk${count}"
/bin/mkdir -p /data/disk${count}
(( $? )) && continue
/bin/mount -t xfs -o allofsize=128m,inode64,noatime,nobarrier,nodiratime -U
${UUID} /data/disk${count}
(( $? )) && continue
echo "UUID=${UUID} /data/disk${count} xfs
allocsize=128m,inode64,noatime,nobarrier,nodiratime 0 0" >> /etc/fstab
((count++))
fi
done

2. Run the following command to copy driveconf-idx.sh to all the indexers.

```bash
chmod 755 /root/driveconf-idx.sh
clush --group=indexers -B -c /root/driveconf-idx.sh
```
3. Run the following command from the admin node to run the script across all data nodes.

   clush --group=indexers -B /root/driveconf-idx.sh

4. Run the following from the admin node to list the partitions and mount points to ensure that the drive `/data/disk1` is mounted properly.

   clush --group=indexers -B df -h
   clush --group=indexers -B mount
   clush --group=indexers -B cat /etc/fstab

---

Note: If there is a need to delete any partitions; it can be done using the following: Run command ‘mount’ to identify which drive is mounted to which device: `/dev/sd<?>`. Unmount the drive for the partition to be deleted and run fdisk to delete it as shown below. Be careful not to delete the OS partition as this will wipe out the installed OS.

   mount
   umount /data/disk1 # <- disk1 shown as example
   (echo d; echo w;) | sudo fdisk /dev/sd<?>

---

Configuring Data Drives on Archival Nodes

This section describes steps to configure non-OS disk drives as 4 RAID6 volumes each with 15 drives using the StorCLI command as described below. These volumes shall be shared as NFS exports and will be used for archiving frozen data.

1. In the node admin1, create a shell script with the StorCLI commands to create four RAID6 volumes with 15 drives in each volume.

   vi /root/raid6.sh
   /opt/MegaRAID/storcli/storcli64 /c0 add vd type=raid6 drives=$1:1-15 WB ra direct Strip=1024
   /opt/MegaRAID/storcli/storcli64 /c0 add vd type=raid6 drives=$1:16-30 WB ra direct Strip=1024
   /opt/MegaRAID/storcli/storcli64 /c0 add vd type=raid6 drives=$1:31-45 WB ra direct Strip=1024
   /opt/MegaRAID/storcli/storcli64 /c0 add vd type=raid6 drives=$1:46-60 WB ra direct Strip=1024

2. Copy over this script to all the storage nodes.

   clush --group=storage -B -c /root/raid6.sh
3. Log onto each of the storage servers as user root.

Note: This document covers the procedure for creating the RAID volumes on only one storage server. If there are multiple storage nodes required in the solution, this process needs to be repeated on all the storage nodes individually.

4. Use the following command to add execute permissions to the shell script.

```bash
chmod +x ./raid6.sh
```

5. Execute the following command to get the enclosure ID of the controller.

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

6. Execute the shell script with the EnclosureID obtained in the previous step.

```bash
/raid6.sh <EnclosureID>
```

7. Verify the virtual drives created by using the following command.

```bash
lsblk
```

```bash
[root@storage1 ~]# /opt/MegaRAID/storcli/storcli64 pdlist -a0 | grep Enc | grep -v 252 | awk '{print $4}' | sort | uniq -c | awk '{print $2}'
65
```

```bash
[root@storage1 ~]# ./raid6.sh 65
Controller = 0
Status - Success
Description = Add VD Succeeded
```

```bash
Controller = 0
Status - Success
Description = Add VD Succeeded
```

```bash
Controller = 0
Status - Success
Description = Add VD Succeeded
```

```bash
Controller = 0
Status - Success
Description = Add VD Succeeded
```

Note: The procedure above will not override existing configurations. To clear and reconfigure existing configurations refer to Embedded MegaRAID Software Users Guide available at www.lsi.com.
Configuring the XFS File System

The following script will format and mount the available volumes on each archival node. OS boot partitions are skipped. All drives shall 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.

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.

```
#!/bin/bash
[[ "-x" == "${1}" ]] && set -x && set -v && shift 1
count=1
for devX in /sys/class/scsi_host/host?/scan
do
echo '---' > ${devX}
done
for devD in $(lsblk | grep disk | cut -c1-3)
do
echo /dev/$devD
devX=/dev/$devD
if [[ -b $devX ]]
then
    echo "$devX bootable - skipping."
    continue
else
    echo "$devX Setting up Drive => $devX"
    /sbin/mkfs.xfs -f $devX
    (( $? )) && continue
    #Identify UUID
    UUID=`blkid $devX | cut -d " " -f2 | cut -d "=" -f2 | sed 's/"//g'`
    echo "UUID of $devX = $UUID, mounting $devX as UUID on
```

Note: The script assumes there are no partitions already existing on the data volumes. If there are partitions, then they have to be deleted first before running this script. This process is documented in the note at the end of the section.

2. Create a file named “driveconf-arch.sh” and copy-paste the following contents.

vi driveconf-arch.sh

Note: Copy and paste the content below into the script file.
/data/disk$\{count\}"
/bin/mkdir -p /data/disk$\{count\}
(( $? )) && continue
/bin/mount -t xfs -o allocsize=128m,inode64,noatime,nobarrier,nodiratime -U $\{UUID\} /data/disk$\{count\}
(( $? )) && continue
echo "UUID=$\{UUID\} /data/disk$\{count\} xfs allocsize=128m,inode64,noatime,nobarrier,nodiratime 0 0" >> /etc/fstab
((count++))
fi
done

3. Copy the `driveconf-arch.sh` script file to all the Storage nodes.

```bash
clush --group=storage -B -c /root/driveconf-arch.sh
```

4. Execute the script from the admin node targeting all the storage nodes.

```bash
clush --group=storage -B /root/driveconf-arch.sh
```

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

```bash
clush --group=storage -B df -h
clush --group=storage -B mount
clush --group=storage -B cat /etc/fstab
```

```
[root@admin1 ~]# clush --group=storage -B df -h

Filesystem  Size  Used  Avail  Use% Mounted on
/dev/md1    109G  2.0G  107G   2% /
tmpfs       127G  0   127G   0% /dev/shm
/dev/md0    2.0G  64M  1.9G   4% /boot
/dev/sdc1   48T  34M  48T   1% /data/disk1
/dev/sdd1   48T  34M  48T   1% /data/disk2
/dev/sde1   48T  34M  48T   1% /data/disk3
/dev/sdf1   48T  34M  48T   1% /data/disk4
[root@admin1 ~]#
[root@admin1 ~]# clush --group=storage -B mount

```

```
[root@admin1 ~]#
```

```
```
Note: To delete any of the partitions, run the ‘mount’ command to identify which drive is mounted to which device. Unmount the drive with the Cluster Verification partition to be deleted and run `fdisk` to delete it as shown below. Be careful not to delete the OS partition as this will wipe out the installed OS.
Cluster Verification

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

1. Create the `cluster_verification.sh` script as follows on the admin node (admin1):

```bash
vi cluster_verification.sh
#!/bin/bash
shopt -s expand_aliases
# Setting Color codes
green='\e[0;32m'
red='\e[0;31m'
NC='\e[0m' # No Color
echo -e "{green} === Cisco UCS Integrated Infrastructure for Big Data \ Cluster Verification === {NC}"
```
```bash
echo ""'n'
echo ""'n'
echo -e "{green} ==== System Information ==== {NC}"
```
```bash
echo ""
echo ""
echo ""
echo -e "$\{green\} System $\{NC\}"
```
```bash
clush -a -B " `which dmidecode` | grep -A2 '^System Information'"`
echo ""'n'
echo ""'n'
echo -e "$\{green\}BIOS $\{NC\}"
```
```bash
clush -a -B " `which dmidecode` | grep -A3 '^BIOS I'"'
echo ""'n'
```
```bash
```
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: '; `which dmidecode` | grep -c \
  '\^[[:space:]]*Locator:'" 

clush -a -B "echo -n 'DIMM count is: '; `which dmidecode` | grep "Size"| grep -c "MB"

clush -a -B " `which 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 -e ^Vendor -e family -e \n  Model: -e Stepping: -e BogoMIPS -e Virtual -e ^Byte -e '^[NUMA node(s)]""

echo ""

echo ""

# probe for nic info #

echo -e "${green}NIC ${NC}"

clush -a -B "`which ifconfig` | egrep '(^e|^p)' | awk '{print $1}' | xargs -1 \n  `which ethtool` | grep -e ^Settings -e Speed"

echo ""

clush -a -B "`which lspci` | grep -i ether"
echo ""
echo ""
# probe for disk info #
echo -e "${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 -e "${green} ================ Software ======================= ${NC}"
```

```
echo -e "${green} Linux Release ${NC}"
clush -a -B "cat /etc/*release | uniq"
```

```
echo -e "${green} Linux Version ${NC}"
clush -a -B "uname -srvm | fmt"
```

```
echo -e "${green} Date ${NC}"
clush -a -B date
```

```
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 "" 

echo -e "${green}IPTables ${NC}"

clush -a -B "`which chkconfig` --list iptables 2>&1"

echo ""

clush -a -B " `which service` iptables status 2>&1 | head -10"

echo ""

echo "" 

echo -e "${green}Transparent Huge Pages ${NC}"

clush -a -B " cat /sys/kernel/mm/*transparent_hugepage/enabled"

echo ""

echo "" 

echo -e "${green}CPU Speed${NC}"

clush -a -B "echo -n 'CPUspeed Service: '; `which service` cpuspeed status 2>&1"

clush -a -B "echo -n 'CPUspeed Service: '; `which chkconfig` --list cpuspeed 2>&1"

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'
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 Splunk Enterprise software to identify any discrepancies in post-OS configuration among the servers.

```bash
./cluster_verification.sh
```
Splunk Architecture and Terminology

Splunk comes packaged as an ‘all-in-one’ distribution. The single file can be configured to function as one or all of the following components (Splunk’s Universal Forwarder is a separate package). In a distributed deployment, installations follow a 3-tier approach, as shown in Figure 142.

Figure 142  Splunk Components

Splunk Components

- Searching and Reporting (Search Head)
- Indexing and Search Services (Indexer)
- Data Collection and Forwarding (Forwarder)
- Data Governor (Cluster Master)
- Distributed Management (Deployment Server)

- **Search Head**: A Splunk Enterprise instance that handles search management functions in a distributed search environment, directing search requests to a set of search peers and then merging the results back to the user. A Splunk Enterprise instance can function as both a search head and a search peer. If it does only searching (and not any indexing), it is usually referred to as a dedicated search head. Search head clusters are groups of search heads that coordinate their activities.

- **Indexer**: A Splunk Enterprise instance that indexes data, transforming raw data into events and placing the results into an index. It also searches the indexed data in response to search requests. The indexer also frequently performs the other fundamental Splunk Enterprise functions: data input and search management. In larger deployments, forwarders handle data input, and forward the data to the indexer for indexing. Similarly, although indexers always perform searches across their own data, in larger deployments, a specialized Splunk Enterprise instance, called a search head, handles search management and coordinates searches across multiple indexers.

- **Universal Forwarder**: A small-footprint version of a forwarder, a Splunk Enterprise instance that forwards data to another Splunk server or a third-party system without parsing.

- **Heavy Forwarder**: A fully functional Splunk instance that is configured to send data to the indexing tier. The heavy forwarder performs Splunk’s parsing phase before forwarding the data.
• **Cluster Master (Master Node):** The indexer cluster node that regulates the functioning of an indexer cluster.

• **Deployment Server:** A Splunk Enterprise instance that acts as a centralized configuration manager, grouping together and collectively managing any number of Splunk Enterprise instances. Instances that are remotely configured by deployment servers are called deployment clients. The deployment server downloads updated content, such as configuration files and apps, to deployment clients. Units of such content are known as deployment apps.

• **Deployer (not pictured):** A Splunk Enterprise instance that distributes apps and certain other configuration updates to search head cluster members.

• **License Master (not pictured):** A license master controls one or more license slaves. From the license master, you can define stacks and pools, add licensing capacity, and manage license slaves.

• **Distributed Management Console (not pictured):** The distributed management console lets you view detailed performance information about your Splunk Enterprise deployment. The topics in this chapter describe the available dashboards and alerts.

In this distributed configuration, indexers and search heads are configured in a clustered mode. Splunk Enterprise supports clustering for both search heads and indexers.

• A search head cluster is a group of interchangeable and highly available search heads. By increasing concurrent user capacity and by eliminating single point of failure, search head clusters reduce the total cost of ownership.

• Indexer clusters are made up of groups of Splunk Enterprise indexers configured to replicate peer data so that the indexes of the system become highly available. By maintaining multiple, identical copies of indexes, clusters prevent data loss while promoting data availability for searching.

• An archival node is configured to host the frozen data generated by the indexers. (See the sections NFS Configurations, for Splunk Frozen Data Storage, and Configuring Archival of Data from Cold to Frozen)

For more information, please refer to [Splunk Documentation](https://www.splunk.com).

**Splunk Services and Processes**

A Splunk Enterprise server installs a process on your host, splunkd.

Splunkd is a distributed C/C++ server that accesses, processes and indexes streaming IT data. It also handles search requests. splunkd processes and indexes your data by streaming it through a series of pipelines, each made up of a series of processors.

• **Pipelines** are single threads inside the splunkd process, each configured with a single snippet of XML.

• **Processors** are individual, reusable C or C++ functions that act on the stream of IT data passing through a pipeline. Pipelines can pass data to one another through queues. Splunkd supports a command-line interface for searching and viewing results.
• Splunkd also provides the Splunk Web user interface. It allows users to search and navigate data stored by Splunk servers and to manage your Splunk deployment through a web interface. It communicates with your web browser through Representational State Transfer (REST).

• Splunkd runs administration and management services on port 8089 with SSL/HTTPS turned on by default.

• It also runs a web server on port 8000 with SSL/HTTPS turned off by default.

Planning the Installation

In this CVD, three (3) clustered Search Heads, eight (8) clustered indexers, a deployment server, a deployer, a distributed management console, a master node, and a license master are configured.

Installation order will be as follows:

• Splunk Installation

• Configure License Master

• Configure Master Node

• Configure Indexing Cluster

• Configure Deployer

• Configure Search Head Cluster

• Configure Distribution Management Console

• Configure Archival of frozen data

• Configure Deployment Server

• Install universal forwarder

• Verify Installation

• Post Install Clean up

It is highly recommended that assigned hostnames match their corresponding function, for example a search head may be ‘splksrch1.domain.com’ or an indexer may be idx1.domain.com. Throughout this document, instructions are provided and examples include the use of hostnames. Your deployment may or may not use the same hostnames. Use Table 7 to plan and track assigned roles and hostnames/IP addresses:

<table>
<thead>
<tr>
<th>CVD Hostname</th>
<th>Function / Model</th>
<th>Hostname</th>
<th>IP</th>
</tr>
</thead>
<tbody>
<tr>
<td>sh1</td>
<td>Search Head 1 C220 M4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sh2</td>
<td>Search Head 2 C220 M4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CVD Hostname</td>
<td>Function / Model</td>
<td>Hostname</td>
<td>IP</td>
</tr>
<tr>
<td>-------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>----------</td>
<td>------</td>
</tr>
<tr>
<td>sh3</td>
<td>Search Head 3 C220 M4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>idx1</td>
<td>Indexer 1 C240 M4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>idx2</td>
<td>Indexer 2 C240 M4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>idx3</td>
<td>Indexer 3 C240 M4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>idx4</td>
<td>Indexer 4 C240 M4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>idx5</td>
<td>Indexer 4 C240 M4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>idx6</td>
<td>Indexer 4 C240 M4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>idx7</td>
<td>Indexer 4 C240 M4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>idx8</td>
<td>Indexer 4 C240 M4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>admin1</td>
<td>Admin Box 1 (Master Node, License Master, Distributed Management Console, Deployer) C220 M4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>admin2</td>
<td>Admin Box 2 Deployment Server C220 M4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>storage1</td>
<td>S3260</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The IP addresses and hostnames used in this CVD can be found in Table 7.

Installing Splunk

The Splunk Enterprise software is a single software package that can be configured to function in a specific role. Installation of Splunk across all nodes will be the same, with no specific parameters required; configuration changes will be required for each respective component. As such, a simple installation across every server will be the base to build this architecture.

1. From a host connected to internet, download Splunk Enterprise software from the splunk.com website. Copy it over to the server admin1.

```bash
[root@admin1 ~]# ls splunk*
splunk-6.4.1-debde650d26e-linux-2.6-x86_64.rpm
```
2. Copy Splunk software over to all the nodes (2 admins, 3 search heads, and 8 indexers) but the storage nodes.

   clush -a -X storage -c ./splunk-6.4.1-debde650d26e-linux-2.6-x86_64.rpm --dest=/tmp

3. Modify the permissions on the Splunk Enterprise RPM file to include execution privileges.

   clush -a -X storage chmod +x /tmp/splunk-6.4.1-debde650d26e-linux-2.6-x86_64.rpm

4. Create a directory tree “/data/disk1” on the search heads and admin nodes.

   clush --group=admins,searchheads mkdir -p /data/disk1

---

Note: The indexers already have a similar directory that is /data/disk1 which serves as the mount point for the RAID10 volume we created in the earlier sections. This step will make the directory structure uniform across all nodes where Splunk Enterprise is installed.

---

5. Install Splunk Enterprise in the directory /data/disk1 of the indexers, search heads and admin nodes.

   clush -a -X storage -B rpm -ivh --prefix=/data/disk1 /tmp/splunk-6.4.1-debde650d26e-linux-2.6-x86_64.rpm

   This step installs Splunk Enterprise and creates a user named splunk.

---

Note: When Splunk Enterprise is installed by means of the RPM package as mentioned above, the installation tool automatically creates a user named splunk and group named splunk.

---

6. Setup the environment variable:

   clush --group=all-splunk "echo SPLUNK_HOME=/data/disk1/splunk >> /etc/environment"
[root@admin1 ~]# clush --group=all-splunk -B "echo SPLUNK_HOME=/data/disk1/splunk >> /etc/environment"

7. Log off and log back in to the server admin1.

8. Use the ClusterShell utility command to verify if the environment variable has been setup correctly.

   clush --group=all-splunk -B echo $SPLUNK_HOME

   [root@admin1 ~]# clush --group=all-splunk -B echo $SPLUNK_HOME

   admin[1-2],idx[1-8],sh[1-3] (13)
   /data/disk1/splunk

9. Verify the ownership of the SPLUNK_HOME directory and its contents. All of these files should belong to splunk user and splunk group.

   clush --group=all-splunk -B ls -l $SPLUNK_HOME

   clush --group=all-splunk -B ls -l $SPLUNK_HOME/bin/splunk

   [root@admin1 ~]# clush --group=all-splunk -B ls -l $SPLUNK_HOME/bin/splunk

   admin2,idx[1,3,5-8],sh[1-3] (10)
   -r-xr-xr-x 1 splunk splunk 356592 Feb 18 15:41 /data/disk1/splunk/bin/splunk
   admin1,idx[2,4] (3)
   -r-xr-xr-x 1 splunk splunk 356592 Feb 18 15:41 /data/disk1/splunk/bin/splunk

---

**Setting Up Login for Splunk User**

As mentioned above, the ‘splunk’ user is created without a password. This section describes the procedure to assign a password and configure the password-less login for that user account.

This facilitates the usage of ClusterShell commands.

   1. From the admin node ‘admin1’, assign the password for the user ‘splunk’ on all the Splunk indexers, search heads and admin servers.

      clush --group=all-splunk -B "echo cisco123 | passwd splunk --stdin"

      [root@admin1 ~]# clush --group=all-splunk -B "echo cisco123 | passwd splunk --stdin"

      Changing password for user splunk.
      passwd: all authentication tokens updated successfully.

---

Note: In this example, we are using a command line method with clear-text password for the sake of simplification. It is recommended to setup a strong password and set the password manually on each server individually to match the target datacenter’s security practices.
2. Log onto the admin node as user splunk using the password selected in the above step.

3. Run the `ssh-keygen` command to create both public and private keys on the admin node for the user 'splunk'.

```
login as: splunk
splunk@10.29.160.101's password:
Last login: Mon Apr 13 12:20:14 2015 from 10.29.160.220
[splunk@admin1 ~]$ ssh-keygen
Generating public/private rsa key pair.
Enter file in which to save the key (/data/disk1/splunk/.ssh/id_rsa):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /data/disk1/splunk/.ssh/id_rsa.
Your public key has been saved in /data/disk1/splunk/.ssh/id_rsa.pub.
The key fingerprint is:
f1:2d:02:5e:67:23:99:e7:c0:ab:be:7c:3f:f1:de:4a splunk@admin1
The key's randomart image is:
    _oooooo------+-
   o   o o    o  o
   . s s  o  s
   . . . . .
   . . . . .
   . + . . .
   . . . . .
   . . . . .
    [... RSA 2048]----+
      [splunk@admin1 ~]$ [splunk@admin1 ~]$
```

4. Run the following script from the admin node to copy the public key id_rsa.pub to all the Splunk servers that is, indexers, search heads and admins of the cluster. `ssh-copy-id` appends the keys to the remote-host's .ssh/authorized_key.

```
for host in admin1 admin2 idx1 idx2 idx3 idx4 idx5 idx6 idx7 idx8 sh1 sh2 sh3; do echo -n "$host -> "; ssh-copy-id -i ~/.ssh/id_rsa.pub $host; done
```

5. Enter `yes` for, "Are you sure you want to continue connecting (yes/no):" Enter the password of the remote host.

6. Verify the password-less login by entering the following command. The output should display the hostnames of all splunk servers.

```
clush --group=all-splunk hostname
```
Starting the Splunk Enterprise Cluster

1. Log onto the admin node as user "splunk"

2. Start the Splunk Enterprise services.

   clush --group=all-splunk $SPLUNK_HOME/bin/splunk start --accept-license

3. Verify the status of the Splunk Enterprise services.

   clush --group=all-splunk $SPLUNK_HOME/bin/splunk status
Logging in for the First Time

When logging in for the first time, the default password is ‘changeme’. The GUI then prompts for the user to change the admin password. This can be completed by logging on to the GUI via every instance:

Log into the admin1 instance. The URL will point to the default port of ‘8000’. For example http://admin1:8000.

Note: If you have not added these servers to DNS, you will need to use the IP address, for example, http://10.29.160.101:8000/

Figure 143   Splunk Sign-in Page

In this CVD the password for the Splunk Administrator is set to ‘cisco123’ (the same as the OS ‘splunk’ user). You will need to perform this action once on every node via the GUI.

Creating User Accounts

Splunk RPM packages automatically create the user ‘splunk’ with the home directory of the original installation (for example: /data/disk1/splunk). If an alternative user is created, repeat the instructions under the previous section, “Setting Up Login for Splunk User”.

Note: The splunk user is installed without a password. A password should be assigned to the user splunk across all the nodes.

Throughout this CVD, the user ‘splunk’ is used to run all Splunk processes. If there is a requirement to run Splunk as a different user, perform the following:

1. Export /data/disk1/splunk as $SPLUNK_HOME, add it to the PATH
2. Home Directory for new users should be Splunk installation directory (/data/disk1/splunk/)
3. Stop all Splunk processes
4. Chown -R user:usergroup

$SPLUNK_HOME/*

5. Change or sudo to new user

6. Start all splunk processes

$SPLUNK_HOME/bin/splunk start

7. When the CVD refers to the user ‘splunk’, substitute the alternate user.

Initializing Splunk on Boot

Log onto the admin server ‘admin1’ as root user.

From the command line, launch the following command:

```
clush --group=all-splunk $SPLUNK_HOME/bin/splunk enable boot-start -user splunk
```

This will initialize splunk running as user ‘splunk’ if any server is rebooted. If the splunk user account is not ‘splunk’, change the -user reference accordingly.

```
[root@admin1 ~]# clush --group=all-splunk -B $SPLUNK_HOME/bin/splunk enable boot-start -user splunk
----------
admin[1-2], idx[1-8], sh[1-3] (13)
----------
Init script installed at /etc/init.d/splunk.
Init script is configured to run at boot.
```

Default Ports

The following are the default ports that are used by Splunk software on every node. For more information please refer to Splunk Documentation.

<table>
<thead>
<tr>
<th>Function</th>
<th>Default Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management Port</td>
<td>8089</td>
</tr>
<tr>
<td>Web Interface</td>
<td>8000</td>
</tr>
</tbody>
</table>

NFS Configurations for Splunk Frozen Data Storage

Create the User Splunk in the Storage Servers

1. From the node admin1, execute the following command to check the user splunk’s user and group identification info.
sudo -u splunk id

2. Take a note of the uid and gid fields output from the command output.

Note: In this case, the splunk user has been created with UID=500 and GID=500.

3. Create a group named splunk and user named splunk with matching IDs on all the storage nodes.

clush --group=storage -B groupadd --gid=500 splunk

clush --group=storage -B useradd --gid=500 --uid=500 splunk

Note: The user splunk gets created without a password. If necessary use the passwd command to assign a password to this user.

NFS Server Setup on Archival Nodes

This section describes the procedures to configure the NFS server on the storage servers. As described in the section "Configuring Data Drives on Archival Nodes using CIMC" each archival node consists of four volumes. They are mounted locally on the archival node that is, hostname storage1, as /data/disk1, /data/disk2, /data/disk3 and /data/disk4. In each of these volumes a directory tree is created as /splunk/frzn[<indexer1-hostname>, <indexer2-hostname>, ...]. The indexer-specific directory under /data/disk[1-4]/splunk/frzn/ is then assigned to the respective indexer, resulting in one or more indexers getting assigned to a volume on the archival nodes depending on the number of indexers and number of storage nodes available in the particular Splunk deployment.

Use the following tables as a guideline to map a volume on a given storage node to one or more indexers. For more information about how Splunk stores and manages the frozen data, see "Configuring Archival of Data From Cold to Frozen."

To configure NFS server on the storage servers, complete the following steps:

Scenario A

4 Indexers, 6 Indexers, 8 Indexers (or) 16 Indexers with only One Storage Node.

In this scenario, since there is only a single storage node, a sub-directory is created in each of the volumes and assigned to an indexer. The location of the indexer specific sub-directory is determined by the ratio between the numbers of storage nodes and indexers.

Table 9 shows the sample scenarios. There is no hard and fast rule about how to perform this mapping; it can be changed as needed for the particular deployment.
Table 9  Scenario A: Storage Volume Scalability and Mapping Options with One Storage Node

<table>
<thead>
<tr>
<th>Volume #</th>
<th>Volume Name</th>
<th>1 Storage Node</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>4 indexers</td>
</tr>
<tr>
<td>1</td>
<td>/data/disk1</td>
<td>idx1</td>
</tr>
<tr>
<td>2</td>
<td>/data/disk2</td>
<td>idx2</td>
</tr>
<tr>
<td>3</td>
<td>/data/disk3</td>
<td>idx3</td>
</tr>
<tr>
<td>4</td>
<td>/data/disk4</td>
<td>idx4</td>
</tr>
</tbody>
</table>

Scenario B

8 Indexers (or) 16 Indexers with Two Storage Nodes.

The following table shows the mapping of eight or sixteen indexers across two storage nodes.

Table 10  Scenario B: Storage Volume Scalability and Mapping Options with Two Storage Nodes

<table>
<thead>
<tr>
<th>Volume #</th>
<th>Volume Name</th>
<th>8 Indexers</th>
<th>16 Indexers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Storage node #1</td>
<td>Storage node #2</td>
</tr>
<tr>
<td>1</td>
<td>/data/disk1</td>
<td>idx1</td>
<td>idx5</td>
</tr>
<tr>
<td>2</td>
<td>/data/disk2</td>
<td>idx2</td>
<td>idx6</td>
</tr>
<tr>
<td>3</td>
<td>/data/disk3</td>
<td>idx3</td>
<td>idx7</td>
</tr>
<tr>
<td>4</td>
<td>/data/disk4</td>
<td>idx4</td>
<td>idx8</td>
</tr>
</tbody>
</table>

The script provided in this section creates two sub-directories per disk volume thereby mapping two indexers to a disk volume.

1. Install the NFS tools on the storage servers.

   clush --group=storage -B yum install -y nfs-*

   [root@admin ~]# clush --group=storage -B yum install -y nfs-*

   Loaded plugins: product-id, security, subscription-manager
   This system is not registered to Red Hat Subscription Management. You can use subscription-manager to register.
   Setting up Install Process
   Package nfs-utils-lib-1.1.5-6.el6.x86_64 already installed and latest version
   Package l:nfs-utils-1.2.3-39.el6.x86_64 already installed and latest version
   Nothing to do

2. Create a file by name nfs_server_setup.sh.

   vi /root/nfs_server_setup.sh
3. Copy and paste the following contents and save the file.

```
#!/bin/bash
## Setup NFS Server for Splunk Frozen storage and setup exports
## Stop the NFS Service
service nfs stop
service rpcbind stop
indexer=1
## Create the NFS Export directories and prepare the /etc/exports file
for diskName in disk1 disk2 disk3 disk4
  do
    echo /data/$diskName
    mkdir -p /data/$diskName/splunk/frzn
    ## Exported for Frozen Data from Splunk cluster
    ## Create the root directory for each indexer by their hostnames.
    ## Each volume is dedicated for two indexers.
    mkdir -p /data/$diskName/splunk/frzn/idx$indexer
    ((indexer++))
    mkdir -p /data/$diskName/splunk/frzn/idx$indexer
    ((indexer++))
    chown -R splunk:splunk /data/$diskName/*
    ## Add the directory paths to the NFS Exports file.
    echo "/data/$diskName/splunk/frzn 192.168.11.0/24(rw,sync)" >> /etc/exports
  done
## Start the NFS Service in the proper order
service rpcbind start
service nfs start
exit 0
```

Note: This script creates the necessary directories to accommodate eight indexers in the four RAID6 volumes and configures them to be NFS exports. In a deployment scenario where the number of indexers and storage nodes are different from what is described in this CVD, the script will need to be modified accordingly.

4. Change the mode to make it into an executable script.

`chmod +x /root/nfs_server_setup.sh`

5. Copy over the script nfs_server_setup.sh to all the storage nodes.

`clush --group=storage -B -c /root/nfs_server_setup.sh`

6. Execute the nfs_server_setup.sh script on all the storage nodes.

`clush --group=storage -B /root/nfs_server_setup.sh`
Note: During the shutdown of NFS, daemons may show errors if they weren’t previously running. It is normal.

Note: This document assumes that there is only one storage/archival node. The script can be easily modified to accommodate another storage node and to distribute frozen data generated by the indexers between the storage nodes.

7. Check the availability of the mount points from the server admin1.

    `showmount -e storagel`

    

    ```bash
    [root@admin ~]# showmount -e storagel
    Export list for storagel:
    /data/disk4/splunk/frzn 192.168.11.0/24
    /data/disk3/splunk/frzn 192.168.11.0/24
    /data/disk2/splunk/frzn 192.168.11.0/24
    /data/disk1/splunk/frzn 192.168.11.0/24
    ```

Note: Even though eight partitions have been exported from the storage node, this solution makes use of only the exports named as /data/disk[1-4]/splunk/frzn. Refer to Splunk. For more information how Splunk indexer stores indexes and the aging policy go to:


**NFS Client Configurations on the Indexers**

This section describes the procedures to configure NFS clients on the indexer servers. One mount point on the server will be shared between two indexers. But the indexers shall be configured to make use of their own respective root directory mounted in their own file system as /data/frzn_data. It is a recommended best practice to perform “hard” NFS mount without attribute caching.

To configure NFS clients on the indexer servers, complete the following steps:
1. Install the NFS tools on all the indexers.

   `clush --group=indexers -B yum install -y nfs-*`

2. Create a file by name nfs_client_setup.sh.

   `vi /root/nfs_client_setup.sh`

3. Copy and paste the following contents and save the file.

   ```bash
   #!/bin/bash
   ## NFS Clientside configurations for the Indexers
   ## Create a temporary script directory for holding auto generated scripts.
   CISCO_SCRIPT_DIR=/root/cisco/scripts
   mkdir -p $CISCO_SCRIPT_DIR
   rm -rf $CISCO_SCRIPT_DIR/*
   clush --group=indexers -B mkdir -p $CISCO_SCRIPT_DIR
   clush --group=indexers -B rm -rf $CISCO_SCRIPT_DIR/*
   ## Create the mount points on the indexers
   clush --group=indexers -B mkdir -p /mnt/frzn
   ## Create the RAID6 volume to indexer-set map.
   declare -A diskMap=( [disk1]=idx1,idx2 [disk2]=idx3,idx4 [disk3]=idx5,idx6
   ```
FRZN_LINK_NAME="frzn_data"
for K in "${!diskMap[@]}"
do
echo $K --- ${diskMap[$K]}
  
  optParam="nolock,tcp,rw,hard,intr,timeo=600,retrans=2,rsize=131072,wsize=131072"
  fstabEntry="storage1:/data/$K/splunk/frzn /mnt/frzn nfs $optParam"
  mountParam="-t nfs storage1:/data/$K/splunk/frzn /mnt/frzn -o $optParam"
  echo "mount $mountParam" > $CISCO_SCRIPT_DIR/mount_script_$K.sh
  echo "echo $fstabEntry >> /etc/fstab" >> $CISCO_SCRIPT_DIR/mount_script_$K.sh
  chmod +x $CISCO_SCRIPT_DIR/mount_script_$K.sh
  clush -w ${diskMap[$K]} -B -c $CISCO_SCRIPT_DIR/mount_script_$K.sh
done

4. Change the mode to make it into an executable script.

chmod +x /root/nfs_client_setup.sh

5. Execute the script:

./nfs_client_setup.sh

[root@admin ~]# ./nfs_client_setup.sh
disk4 --- idx7,idx8
disk1 --- idx1,idx2
disk3 --- idx5,idx6
disk2 --- idx3,idx4

-------------
idx[1-8] (8)
-------------
removing old mapping /data/frzn_data

Note: If the mount point on the indexers that is, /mnt/frzn was previously used, it needs to be un-mounted prior to executing the above script. In such a case, use the command

clush --group=indexers -B umount /mnt/frzn
6. Verify the NFS setup in all the indexers.

    clush --group=indexers -B "mount -l | grep splunk"

    clush --group=indexers -B ls -l /data

```
[root@admin ~]# clush --group=indexers -B "mount -l | grep splunk"

    storagel:/data/disk1/splunk/active on /mnt/frzn type nfs (rw,nolock,tcp,hard,intr,t imeo=600,retrans=2,rsize=131072,wsize=131072,vers=4,addr=192.168.11.114,client.addr= 192.168.11.103)

    storagel:/data/disk1/splunk/active on /mnt/frzn type nfs (rw,nolock,tcp,hard,intr,t imeo=600,retrans=2,rsize=131072,wsize=131072,vers=4,addr=192.168.11.114,client.addr= 192.168.11.104)

    storagel:/data/disk2/splunk/active on /mnt/frzn type nfs (rw,nolock,tcp,hard,intr,t imeo=600,retrans=2,rsize=131072,wsize=131072,vers=4,addr=192.168.11.114,client.addr= 192.168.11.105)

    storagel:/data/disk2/splunk/active on /mnt/frzn type nfs (rw,nolock,tcp,hard,intr,t imeo=600,retrans=2,rsize=131072,wsize=131072,vers=4,addr=192.168.11.114,client.addr= 192.168.11.106)

    storagel:/data/disk3/splunk/active on /mnt/frzn type nfs (rw,nolock,tcp,hard,intr,t imeo=600,retrans=2,rsize=131072,wsize=131072,vers=4,addr=192.168.11.114,client.addr= 192.168.11.107)

    storagel:/data/disk3/splunk/active on /mnt/frzn type nfs (rw,nolock,tcp,hard,intr,t imeo=600,retrans=2,rsize=131072,wsize=131072,vers=4,addr=192.168.11.114,client.addr= 192.168.11.108)

    storagel:/data/disk4/splunk/active on /mnt/frzn type nfs (rw,nolock,tcp,hard,intr,t imeo=600,retrans=2,rsize=131072,wsize=131072,vers=4,addr=192.168.11.114,client.addr= 192.168.11.109)

    storagel:/data/disk4/splunk/active on /mnt/frzn type nfs (rw,nolock,tcp,hard,intr,t imeo=600,retrans=2,rsize=131072,wsize=131072,vers=4,addr=192.168.11.114,client.addr= 192.168.11.110)
```
Configuring the Splunk Enterprise Cluster

Configuring Splunk Enterprise Licenses

The servers in the Splunk Enterprise infrastructure that performs indexing must be licensed. Any Splunk instance can be configured to perform the role of license master. In this CVD, the admin node (admin1) is configured to be the license master and all the other Splunk instances are configured as license slaves.

Setting Up License Master

Configure the server admin1 as the central license master by following the procedures detailed below.
1. Log onto the server admin1 as user admin.

2. Navigate to the licensing screen by clicking on Settings → Licensing, as shown in Figure 144

![Figure 144 Splunk Enterprise Page](image)

3. Click on Change License Group.

4. Click on the Enterprise License radio button, as shown in Figure 145

![Figure 145 Change License Group](image)

5. Click on Save.

6. In the Add new license dialog, click on Choose File to select your license file.

7. Click Install to install the license.
8. Click on Restart now.

9. Click OK to restart Splunk to complete the license installation.

10. Log back in to Splunk. If “Are you sure you want to restart Splunk” is still visible, click Cancel.

For more information about Splunk Enterprise licensing, please refer to Splunk Documentation.

Configure the Indexers, Search Heads, and Admin Nodes as License Slaves

Configure all the other Splunk instances to be the license slaves to the Splunk license master, that is, admin1. This can be performed by following one of the two methods described below.

The first and preferred method is to use the ClusterShell command (clsh) to configure all the Splunk instances to be license slaves to the license master in admin1. The second (optional) method is to configure each node as a license slave individually by accessing the respective Web UI.
Configure all the License Slaves at Once Using CLI (Clush)

1. From the admin node (admin1) as user ‘splunk’ execute the command:

   clush --group=all-splunk -x admin1 -B $SPLUNK_HOME/bin/splunk edit licenser-localslave -master_uri https://admin1:8089 -auth admin:cisco123

   ![clush output]

   The licenser-localslave object has been edited.

2. Next issue the command:

   clush --group=all-splunk -x admin1 $SPLUNK_HOME/bin/splunk restart

   ![clush output]

   This will restart all nodes except for admin1 and storage1 nodes.

3. During restart, you will receive confirmation that the instances are running as license-slaves.

   ![Restart output]

4. Proceed to ‘Verifying License-Slave Relationships’.

(Optional) Configure License Slaves Individually Using the Web Interface

1. Log onto an indexer server that is, idx1 as user admin. (for example, https://idx1:8000)

2. Navigate to the licensing screen by clicking on Settings → Licensing, as shown in Figure 148

3. Click on the button Change to slave.
4. In the Change master association dialog, click on **Designate a different Splunk instance as the master license server** radio button, as shown in Figure 149

5. Enter the Master license server URI in the format `https://<IP-or-hostname>:8089`. (for example, `https://admin1:8089`)

   Note: The port 8089 is the management port chosen while the server admin1 was provisioned as the master node.

6. Click **Save**.
Repeat the steps above to configure all eight indexers, all three search heads, and the second admin node (admin2), to become license slaves to the license master on the server admin1.

Verifying License-Slave Relationships

To confirm the license configurations, complete the following steps:

1. Go to the master node’s Splunk GUI, and navigate to Settings > Licensing.

2. At the bottom of this screen, click All indexer Details to view the license slaves, as shown in Figure 151
Figure 151  Verifying Indexer Details

**Local server information**

<table>
<thead>
<tr>
<th>Indexer name</th>
<th>admin1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume used today</td>
<td>0 MB</td>
</tr>
<tr>
<td>Warning count</td>
<td>0</td>
</tr>
<tr>
<td>Debug information</td>
<td>All license details</td>
</tr>
<tr>
<td></td>
<td>All indexer details</td>
</tr>
</tbody>
</table>

There should be thirteen license slaves listed: eight indexers, three search heads, and two admin nodes.

Figure 152  Indexer Details

<table>
<thead>
<tr>
<th>Indexers connected to: admin1 (13)</th>
</tr>
</thead>
</table>

1. idx2

<table>
<thead>
<tr>
<th>active_pool_names</th>
<th>auto_generated_pool_enterprise</th>
</tr>
</thead>
<tbody>
<tr>
<td>added_usage_parsing_warnings</td>
<td>None</td>
</tr>
<tr>
<td>label</td>
<td>idx2</td>
</tr>
<tr>
<td>pool_names</td>
<td>auto_generated_pool_download_trial</td>
</tr>
<tr>
<td></td>
<td>auto_generated_pool_enterprise</td>
</tr>
<tr>
<td></td>
<td>auto_generated_pool_forwarder</td>
</tr>
<tr>
<td></td>
<td>auto_generated_pool_free</td>
</tr>
<tr>
<td>stack_names</td>
<td>download-trial</td>
</tr>
<tr>
<td></td>
<td>enterprise</td>
</tr>
<tr>
<td></td>
<td>forwarder</td>
</tr>
<tr>
<td></td>
<td>free</td>
</tr>
<tr>
<td>warning_count</td>
<td>0</td>
</tr>
</tbody>
</table>

2. idx8

<table>
<thead>
<tr>
<th>active_pool_names</th>
<th>auto_generated_pool_enterprise</th>
</tr>
</thead>
<tbody>
<tr>
<td>added_usage_parsing_warnings</td>
<td>None</td>
</tr>
<tr>
<td>label</td>
<td>idx8</td>
</tr>
<tr>
<td>pool_names</td>
<td>auto_generated_pool_download_trial</td>
</tr>
<tr>
<td></td>
<td>auto_generated_pool_enterprise</td>
</tr>
<tr>
<td></td>
<td>auto_generated_pool_forwarder</td>
</tr>
<tr>
<td></td>
<td>auto_generated_pool_free</td>
</tr>
<tr>
<td>stack_names</td>
<td>download-trial</td>
</tr>
<tr>
<td></td>
<td>enterprise</td>
</tr>
<tr>
<td></td>
<td>forwarder</td>
</tr>
<tr>
<td></td>
<td>free</td>
</tr>
<tr>
<td>warning_count</td>
<td>0</td>
</tr>
</tbody>
</table>

3. idx1

| active_pool_names | auto_generated_pool_enterprise |

---

Note: The License Master counts all the license slaves as Splunk Indexer instances in spite of the actual roles the instances have been configured to perform.
Configuring the Master Node (aka: Cluster Master)

To start, configure the admin node admin1 as the Indexer Cluster master.

1. Using your browser, go to the master node (admin1) http://hostname-or-IP:8000/ (for example, https://admin1:8000/)

2. Click on the Settings > Indexer Clustering, as shown in Figure 153

Figure 153   Indexer Clustering

3. Click Enable Indexer Clustering, as shown in Figure 154

Figure 154   Enable Indexer Clustering

4. Click the Master Node radio button, then click Next. See Figure 155
5. Set the Replication Factor field to 2, and the Search Factor field to 2.

6. Set up a Security Key; in this installation ‘splunk+cisco’ was used as the security key.

7. Click Enable Master Node.

Figure 156 Master Node Configuration
Note: Replication and search factors vary by deployment. The replication factor indicates the number of copies to be maintained on the indexers. The search factor indicates how many of those copies will return search results. In the configuration above, one indexer could be down and searches will still return all results. If the configuration needs to be more resilient, the replication factor may be increased, but this will also increase disk consumption. Consult the documentation for more information. [http://docs.splunk.com/Documentation/Splunk/6.4.1/Indexer/Thereplicationfactor](http://docs.splunk.com/Documentation/Splunk/6.4.1/Indexer/Thereplicationfactor)

Note: Make sure to apply a Security key.

8. Click on Go to Server Controls to proceed with restarting Splunk as indicated.

Figure 157  Restart Splunk to Make the Master Node Active

You must restart Splunk for the master node to become active. You can restart Splunk from Server Controls.

Restart Splunk  

[Start button]

[Stop button]

[Restart button]

[Reboot button]

[Power button]

9. Restart Successful message appears. Click OK to go back to the Login screen.

10. Log back in as the “admin” user.

11. Return to Settings > Indexer Clustering.

A message appears indicating that the necessary number of peers must join the cluster. For a replication factor of 2, Splunk Enterprise needs a minimum of 2 peers. See Figure 158
Configure Indexing Peers

Configure all the Splunk instances to be the Indexing Peers to the Master Node, admin1. This can be performed by following one of the two methods described below.

The first and preferred method is to use ClusterShell command (clush) to configure all the C240 M4 servers to be indexing peers to the cluster master in admin1. The second (optional) method is to configure each C240 M4 server as an indexing peer individually by accessing the respective Web UI.

Configuring Indexer Clusters

An indexer cluster is a group of Splunk Enterprise instances, or nodes, that, working in concert, provide a redundant indexing and searching capability. The parts of an indexer cluster are:

- A single master node to manage the cluster
- A number of peer nodes to index and maintain multiple copies of the data and to search the data.
- One or more search heads to coordinate searches across the set of peer nodes

The Splunk Enterprise indexers of an indexer cluster are configured to replicate each other’s data, so that the system keeps multiple copies of all data. This process is known as index replication. The number of copies is controlled by a parameter known as the replication factor. By maintaining multiple, identical copies of Splunk Enterprise data, clusters prevent data loss while promoting data availability for searching.

Indexer clusters feature automatic failover from one indexer to the next. This means that, if one or more indexers fail, incoming data continues to get indexed and indexed data continues to be searchable.

For more information, please refer to Splunk Documentation.

Configure All Indexing Peers Using CLI (Clush)

1. From the admin1 box, as the ‘splunk’ user, issue the command:
clush --group=indexers $SPLUNK_HOME/bin/splunk edit cluster-config -mode slave
-master_uri https://admin1:8089 -replication_port 8080 -secret splunk+cisco -auth admin:cisco123

[clush@admin1 ~]$ clush --group=indexers $SPLUNK_HOME/bin/splunk edit cluster-config -mode slave -master_uri https://admin1:8089 -replication_port 8080 -secret splunk+cisco -auth admin:cisco123
idx4: The cluster-config property has been edited.
idx2: The cluster-config property has been edited.
idx6: The cluster-config property has been edited.
idx8: The cluster-config property has been edited.
idx7: The cluster-config property has been edited.
idx5: The cluster-config property has been edited.
idx3: The cluster-config property has been edited.
idx1: The cluster-config property has been edited.

2. After editing the cluster configuration, the affected boxes must be restarted.

clush --group=indexers $SPLUNK_HOME/bin/splunk restart

3. After all the splunk process in peer nodes are restarted, check the Master node’s (admin1) web UI. The Master node must report number of available peers, as shown in Figure 159

Figure 159  Available Peers in the Master Node

<table>
<thead>
<tr>
<th>Peer Name</th>
<th>Fully Searchable</th>
<th>Shards</th>
<th>Buckets</th>
</tr>
</thead>
<tbody>
<tr>
<td>idx8</td>
<td>Yes</td>
<td>119</td>
<td></td>
</tr>
<tr>
<td>idx7</td>
<td>Yes</td>
<td>119</td>
<td></td>
</tr>
<tr>
<td>idx6</td>
<td>Yes</td>
<td>93</td>
<td></td>
</tr>
<tr>
<td>idx5</td>
<td>Yes</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>idx3</td>
<td>Yes</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td>idx2</td>
<td>Yes</td>
<td>111</td>
<td></td>
</tr>
<tr>
<td>idx1</td>
<td>Yes</td>
<td>145</td>
<td></td>
</tr>
<tr>
<td>idx4</td>
<td>Yes</td>
<td>79</td>
<td></td>
</tr>
</tbody>
</table>

4. Proceed to Setting Dedicated Replication Address.

Note: Once the indexers are added to the cluster, it is not advised to use the command ' '$SPLUNK_HOME/bin/splunk restart' on individual indexers. For further information, see: http://docs.splunk.com/Documentation/Splunk/latest/Indexer/RearrangingPeers
Configure Indexing Peers Individually Using the Web Interface (Optional)

Note: This is an optional method that may be followed to configure each indexer manually through the Splunk Web-UI. The preferred method is to perform the configuration via CLI as shown in the previous section. See “Configure All Indexing Peers Using CLI (clush)” procedure on page 212.

To enable an indexer as a peer node, complete the following steps:

1. Go to an Indexer node’s Splunk Web-UI - http://idx1:8000/
2. Login as “admin” user with password “cisco123”.
3. Click Settings in the upper right corner of Splunk Web.
4. In the Distributed environment group, click Indexer Clustering.

5. Select Enable indexer clustering.
6. Select Peer node and click Next. See Figure 162

7. Complete entries for the following fields:
   a. Master IP address or Hostname. Enter the master's IP address or hostname. For example: https://admin1
   b. Master port. Enter the master's management port. For example: 8089.
   c. Peer replication port. This is the port on which the peer receives replicated data streamed from the other peers. You can specify any available, unused port for this purpose. This port must be different from the management or receiving ports.
d. Security key. This is the key that authenticates communication between the master and the peers and search heads. The key must be the same across all cluster instances. If the master has a security key, you must enter it here.

8. Click Enable peer node, as shown in Figure 163

![Peer Node Configuration](image)

9. The message appears: "You must restart Splunk for the peer node to become active."

![Restart Splunk](image)
10. Click **Go to Server Controls**. This will take you to the **Settings** page where you can initiate the restart.

Note: The figures below show the Splunk restart process on indexer idx1 (that is, 10.29.160.103).
11. After the peer node restarts, check the Master node’s web UI. The Master node must report number of available peers.

12. Repeat this process for all the cluster’s peer nodes (indexers). When complete, the screen should report 8 indexers as reflected in figure above.

Note: Once the indexers are added to the cluster, it is not advised to use the command `$SPLUNK_HOME/bin/splunk restart` on individual indexers. For further information, see: [http://docs.splunk.com/Documentation/Splunk/latest/Indexer/Rerstartthecluster](http://docs.splunk.com/Documentation/Splunk/latest/Indexer/Rerstartthecluster)
Setting Dedicated Replication Address

Splunk Enterprise provides a way to make use of a dedicated network interface for index replication data traffic that happens between the indexers in Splunk Enterprise Indexer cluster. In this CVD, the eth2 with an IP address in the range 192.168.12.0/24 is utilized for this purpose. This feature is configured in the server.conf file on each Splunk Enterprise indexer instance by setting the `register_replication_address` property. This property can be configured with an IP address or a resolvable hostname.

1. SSH to idx1.

2. As the splunk user, edit the file `$SPLUNK_HOME/etc/system/local/server.conf`

3. Under the section `[clustering]`, include the line:

   ```
   register_replication_address=idx1-rep
   ```

   ![Example Configuration](image)

   Note: It is important to make sure that the host name that is, idx1-rep or IP address used when setting the `register_replication_address` field is local to the server on which the server.conf resides. The value entered must reflect the replication address of the local server that is, idx1-rep.

4. Save the file.

5. Repeat this across all indexers (idx1-8).

6. SSH to the master node, admin1.

7. As user ‘splunk’ issue the command:

   ```
   $SPLUNK_HOME/bin/splunk rolling-restart cluster-peers
   ```

Verify Cluster Configuration

1. Navigate to the master node’s web GUI (for example, `https://admin1:8000`).

2. Select Settings -> Index Clustering.

3. All eight (8) indexers should appear as searchable.
Configure Receiving on the Peer Nodes

In order for the indexers (aka peer nodes) to receive data from the forwarders, the inputs.conf file of all the indexers needs to be configured with a stanza to enable the TCP port 9997. This is done by editing a special purpose app’s inputs.conf file in the cluster master, that is, admin1, as follows.

1. On the command line of the master node (admin1), navigate to

   `$SPLUNK_HOME/etc/master-apps/_cluster/local`

2. Create and edit the file ‘inputs.conf’ with the following content:

   ```
   [splunktcp://9997]
   connection_host = ip
   ```

   ```
   [splunk@admin1 local]$ pwd
   /data/disk1/splunk/etc/master-apps/_cluster/local
   [splunk@admin1 local]$ vi inputs.conf
   ```

   ```
   [splunktcp://9997]
   connection_host = ip
   ```

   Note: If this configuration uses DNS, edit ‘connection_host = dns’.
3. Navigate to the `admin1` web interface via browser.

4. Navigate to `Settings > Distributed Environment > Indexer Clustering`.

Figure 169  Indexer Clustering

5. Select `Edit > Distribute Configuration Bundle`.

Figure 170  Indexer Clustering: Distribute Configuration Bundle

6. Select `Distribute Configuration Bundle`.
7. Acknowledge the warning, and push changes.

8. Once Push is complete, the GUI should reflect a successful push.

Configure Master to Forward All its Data to the Indexer Layer

It is a best practice to forward all master node internal data to the indexer (peer node) layer. This has several advantages:

It enables diagnostics for the master node if it goes down. The data leading up to the failure is accumulated on the indexers, where a search head can later access it.

The preferred approach is to forward the data directly to the indexers, without indexing separately on the master. You do this by configuring the master as a forwarder. These are the main steps:

- Make sure that all necessary indexes exist on the indexers. This is normally the case, unless you have created custom indexes on the master node. Since _audit and _internal exist on indexers as well as the master, there is no need to create separate versions of those indexes to hold the corresponding master data.
- Configure the master as a forwarder. Create an outputs.conf file on the master node that configures it for load-balanced forwarding across the set of peer nodes. The indexing function on the master must also be turned off, so that the master does not retain the data locally as well as forward it to the peers.

In the cluster master node admin1, perform the following:

1. Create ‘outputs.conf’ file in the master node at $SPLUNK_HOME/etc/system/local directory

   ```bash
   [splunk@admin1 root]$ cd $SPLUNK_HOME/etc/system/local/
   [splunk@admin1 local]$ vi outputs.conf
   ```

2. Create an outputs.conf file with the following content:

   ```bash
   #Turn off indexing on the master
   [indexAndForward]
   index = false

   [tcpout]
   defaultGroup = search_peers
   forwardedindex.filter.disable = true
   indexAndForward = false

   [tcpout:search_peers]
   autoLB = true
   ```

   Note: It may be advantageous for scalability to use the “indexer discovery” feature instead of statically assigning indexers to forward to.

3. Restart Splunk ($SPLUNK_HOME/bin/splunk restart)
Configure Search Head Clustering

A search head cluster is a group of Splunk Enterprise search heads that serves as a central resource for searching. The members of a search head cluster are essentially interchangeable. You can run the same searches, view the same dashboards, and access the same search results from any member of the cluster.

Note: In order to take full advantage of the search head cluster (also described in Splunk Architecture & Terminology), you must utilize a virtual or physical load balancer according to the enterprise’s standards. Due to variability, the operator is suggested to use their own discretion in installing and configuring this. Further notes for configuration are provided under “Configuring Search Head Load-Balancing”.

Add Search Heads to Master Node

A Splunk Enterprise instance can be configured as a search head via the Indexer clustering feature.

1. Log onto one of the search heads as user admin.

2. Navigate to Settings > Indexer Clustering.

3. Click Enable Indexer Clustering.
4. In the **Enable Clustering** dialog box, click on **Search head node**.

5. Click **Next**.

6. Enter the hostname of the master node including the the Master port number (default: 8089) in the format https://<hostname_or_IP>. (For example, [https://admin1:8089](https://admin1:8089)) See Figure 176

7. Enter the same security key that was used while configuring the master node for example, `splunk+Cisco`.

8. Click **Enable search head node**.
9. Click **Go to server controls** to view the Server controls screen and to restart Splunk.

10. Repeat the above steps to configure all three servers with hostnames sh1, sh2 and sh3 to be search heads.

11. Verify the search head cluster members in the master node, by navigating to **Setting > Indexer clustering**.

12. Click the **Search Heads** tab, as shown in Figure 177
Configure the Deployer

A Splunk Enterprise instance that distributes apps and certain other configuration updates to search head cluster members is referred to as a ‘Deployer’. Any Splunk Enterprise instance can be configured to act as the Deployer. In this solution the admin1 is selected to serve this function as well.

Note: Do not locate deployer functionality on a search head cluster member. The deployer must be a separate instance from any cluster member, as it is used to manage the configurations for the cluster members.

1. Open an SSH session to admin1.
2. Navigate to:
   
   `$SPLUNK_HOME/etc/system/local/`

3. As the user ‘splunk’, edit server.conf to include the following:
   
   ```
   [shclustering]
   pass4SymmKey = `<your_secret_key>` (for example, splunk+cisco)
   ```
4. Restart the admin1 instance ($SPLUNK_HOME/bin/splunk restart)

Configure Search Head Cluster Members

1. As the user ‘splunk’, Enter the following commands to make this search head join the search head cluster. Change the mgmt._uri per respective Search Head


2. Restart Splunk Search Head after the command is issued

$SPLUNK_HOME/bin/splunk restart
[splunk@sh1 ~] $ $SPLUNK_HOME/bin/splunk init shcluster-config -auth admin:cisco123 -mgmt_url https://sh1:8089 -replication_port 18081 -replication_factor 2 -conf_deploy_fetch_url https://admin:8089 -secret splunk-cisco

Search head clustering has been initialized on this node.
You need to restart the splunk server (splunkd) for your changes to take effect.

[splunk@sh1 ~] $ $SPLUNK_HOME/bin/splunk restart
Stopping splunkd...
Shutting down. Please wait, as this may take a few minutes.

Stopping splunk helpers... [ OK ]

Done.

Splunk> Be an IT superhero. Go home early.

Checking prerequisites...
  Checking http port [8000]: open
  Checking mgmt port [8089]: open
  Checking appserver port [127.0.0.1:8065]: open
  Checking kvsstore port [8191]: open
  Checking configuration... Done
  Checking critical directories... Done
  Checking indexes... Done
  Validating: _audit _blocks _signature _internal _introspection _thefishbucket _history
  Done

Bypassing local license checks since this instance is configured with a remote license master.

  Checking filesystem compatibility... Done
  Checking conf files for problems... Done
  Checking replication_port port [18081]: open

All preliminary checks passed.

Starting splunk server daemon (splunkd)...

Done [ OK ]

If you got stuck, we're here to help.
Look for answers here: http://docs.splunk.com

The Splunk web interface is at http://sh1:8000

3. Repeat the above steps for all search heads.

Elect a Search Head Captain

A search head cluster consists of a group of search heads that share configurations, job scheduling, and search artifacts. The search heads are known as the cluster members.

One cluster member has the role of captain, which means that it coordinates job scheduling and replication activities among all the members. It also serves as a search head like any other member, running search jobs, serving results, and so on. Over time, the role of captain can shift among the cluster members.

The following illustration shows a small search head cluster, consisting of three members:
A search head cluster uses a dynamic captain. This means that the member serving as captain can change over the life of the cluster. Any member has the ability to function as captain. When necessary, the cluster holds an election, which can result in a new member taking over the role of captain.

The procedure described in this section helps bootstrap the election process.

1. Log into any search head as user splunk.

2. Start the search head caption election bootstrap process by using the following command as the splunk user.

```
```

Note: The search head captain election process can be started from any of the search head cluster members.

**Configure Search Heads to Forward their Data to the Indexer Layer**

It is a best practice to forward all search head internal data to the search peer (indexer) layer. This has several advantages:
- It enables diagnostics for the search head if it goes down. The data leading up to the failure is accumulated on the indexers, where another search head can later access it.

- By forwarding the results of summary index searches to the indexer level, all search heads have access to them. Otherwise, they are only available to the search head that generates them.

The recommended approach is to forward the data directly to the indexers, without indexing separately on the search head. You do this by configuring the search head as a forwarder by creating an `outputs.conf` file on the search head that configures the search head for load-balanced forwarding across the set of search peers (indexers). The indexing on the search head, so that the search head does not both retain the data locally as well as forward it to the search peers.

1. Using the CLI, as the `splunk` user on `admin1`, navigate to `$SPLUNK_HOME/etc/shcluster/apps`.
2. Create the directory ‘outputs’ and ‘outputs/local’.
3. Navigate to the newly created ‘local’ directory.
4. Within the `$SPLUNK_HOME/etc/shcluster/apps/outputs/local/` directory, create the file `outputs.conf` with the following content in Step 5.

```bash
mkdir -p outputs/local

cd outputs/local

vi outputs.conf

5. Copy and paste the following contents.

```bash
# Turn off indexing on the master

[indexAndForward]

index = false

[tcpout]

defaultGroup = search_peers

forwardedindex.filter.disable = true

indexAndForward = false [tcpout:search_peers]


autoLB = true
```

Note: It may be advantageous for scalability to use the "indexer discovery" feature instead of statically assigning indexers to forward to.
6. Execute the ‘apply shcluster-bundle’ command:

```bash
$SPLUNK_HOME/bin/splunk apply shcluster-bundle -target https://sh1:8089 -auth admin:cisco123
```

```
[splunk@admin local]$ $SPLUNK_HOME/bin/splunk apply shcluster-bundle -target https://sh1:8089 -auth admin:cisco123
Warning: Depending on the configuration changes being pushed, this command might initiate a rolling restart of the cluster members. Please refer to the documentation for the details. Do you wish to continue? [y/n]: y
Bundle has been pushed successfully to all the cluster members.
```

```
[splunk@admin local]$
```

7. Acknowledge the warning. A message pop-up will notify that the bundle has been pushed successfully.

Configure Search Head Load-Balancing

As described above in the introductory note about search head clustering, it is useful to utilize a load balancer to take advantage of the search head cluster.

1. Designate a common URL for use throughout the enterprise (For example, https://splunk.domain.com)


---

Note: Explicit instructions for configuring the designated load balancer will differ by vendor, but the functionality and load balancing direction is the same.

---

Verify Search Head Clustering:

3. SSH to any search head.

4. As the ‘splunk’ user, issue the command ‘$SPLUNK_HOME/bin/splunk show shcluster-status -auth <username>:<password>’.

```bash
$SPLUNK_HOME/bin/splunk show shcluster-status -auth admin:cisco123
```
5. Alternatively, run `$SPLUNK_HOME/bin/splunk list shcluster-members -auth admin:cisco123` to view the various members.

`$SPLUNK_HOME/bin/splunk list shcluster-members -auth admin:cisco123`
Navigate to the directory $SPLUNK_HOME/etc/apps/outputs/default/ on any search head. List the directory, outputs.conf will be listed, verifying that it has been pushed by the Deployer.
ls -l

```
[splunk@sh2 default]$ pwd
/data/disk1/splunk/etc/apps/outputs/default
[splunk@sh2 default]$ ls -l
total 8
-rw-------. 1 splunk splunk 77 Apr 10 10:13 app.conf
-rw-r--r--. 1 splunk splunk 296 Apr 10 10:13 outputs.conf
```

Note: This app will not appear under ‘apps’ within the GUI, but will appear under ‘Apps >Manage Apps’

## Configuring the Distributed Management Console

The distributed management console is a special purpose pre-packaged app that comes with Splunk Enterprise providing detailed performance information about the Splunk Enterprise deployment.

This section describes the procedure to configure the Distributed Management Console for this deployment. It is installed on the admin node, that is, admin1. Please refer to [Splunk Documentation](https://docs.splunk.com) for learning about other installation options.

1. **Navigate to the Splunk Web Interface on admin1 (https://admin1:8000/).**

2. **Click Settings > Distributed Management Console.**

3. **Select Distributed Management Console**

4. **In the Distributed Management Console app, click Settings > General Setup, as shown in Figure 179**
5. Click the Distributed mode. Click Continue through the warning (make sure this is on admin1). This should show all the eight indexers as remote instances. See Figure 180

6. Select Edit on the admin1 box. The server must change roles to function properly. See Figure 181
7. Select only ‘License Master’ and ‘Cluster Master’.

![Edit Server Roles](image)

8. Click **Save**.

9. Click the **Apply Changes** button at the top right.

10. Confirm that changes have been saved successfully.

**Configure Search Heads in Distributed Management Console**

In the previous section the Distributed Management Console (DMC) was configured to manage the indexers and the master node. This section provides the procedure to configure DMC to monitor the search heads.

1. Navigate to the Master Node (admin1) via the GUI.

2. Open **Settings -> Distributed Environment -> Distributed search.**
3. Select **Search Peers**, as shown in Figure 184

**Figure 184  Search Peers**

**Distributed search**

Perform a search across multiple Splunk indexers.

**Distributed search setup**

**Search peers**

4. Select **New**.

**Figure 185  Selecting New Peers**

Showing 1-11 of 11 items

<table>
<thead>
<tr>
<th>Peer</th>
<th>Splunk server name</th>
</tr>
</thead>
<tbody>
<tr>
<td>idx1.rep:8089</td>
<td>idx1</td>
</tr>
<tr>
<td>idx2.rep:8089</td>
<td>idx2</td>
</tr>
<tr>
<td>idx3.rep:8089</td>
<td>idx3</td>
</tr>
<tr>
<td>idx4.rep:8089</td>
<td>idx4</td>
</tr>
<tr>
<td>idx5.rep:8089</td>
<td>idx5</td>
</tr>
</tbody>
</table>
5. Add a search Peer.

[Peer] - Enter the hostname or IP of one of your search heads

[Remote username] - use ‘admin’

[Remote password] - the password to the Splunk admin account on the search head

6. Repeat this process for the other two search heads.

7. On the Master Node (admin1), navigate to Settings > Distributed Management Console.

8. In the Distributed Management Console app, click Settings > General Setup, as shown in Figure 187

9. The three newly added search heads should be listed under ‘remote instances’ as ‘new’.

10. Select Edit within the table next to the instance name, and ensure that the server roles are ‘Search Head’ and ‘KV Store’, as shown in Figure 188
11. Confirm changes and roles.

12. Ensure that the Master Node (admin1) does not have the role of ‘search head’.

13. Click Apply Changes, as shown in Figure 189

14. Click Overview.

15. DMC should now display “Search Heads” within the overview, as shown in Figure 191

Configuring Archive of Data from Cold to Frozen

As the indexer indexes the incoming data, it creates two types of files:
• The raw data in compressed form (rawdata files)
• Indexes that point to the raw data, plus some metadata (index files)

Together, these files constitute the Splunk Enterprise index. The files reside in sets of directories organized by age. Some directories contain newly indexed data; others contain previously indexed data. The number of such directories can grow quite large, depending on how much data you’re indexing.

In short, each of the index directories is known as a bucket.

• An "index" contains compressed raw data and associated index files.
• An index resides across many age-designated index directories.
• An index directory is called a bucket.

A bucket moves through several stages as it ages:

• hot
• warm
• cold
• frozen
• thawed

As buckets age, they "roll" from one stage to the next. As data is indexed, it goes into a hot bucket. Hot buckets are both searchable and actively being written to. An index can have several hot buckets open at a time.

When certain conditions occur (for example, the hot bucket reaches a certain size or splunkd gets restarted), the hot bucket becomes a warm bucket ("rolls to warm"), and a new hot bucket is created in its place. Warm buckets are searchable, but are not actively written to. There are many warm buckets.

Once further conditions are met (for example, the index reaches some maximum number of warm buckets), the indexer begins to roll the warm buckets to cold, based on their age. It always selects the oldest warm bucket to roll to cold. Buckets continue to roll to cold as they age in this manner. After a set period of time, cold buckets roll to frozen, at which point they are either archived or deleted. By editing attributes in indexes.conf, the bucket aging policy can be specified, which determines when a bucket moves from one stage to the next.

If the frozen data has been archived, it can later be thawed. Thawed data is available for searches. If archival of specific sets of data is required, each additional index that is added will require the stanza:

coldToFrozenDir = <directory of frozen data>

Each index that is added will require this stanza to be appended. In the section Verifying Master and Peer Replication, an index will be created for the purposes of testing. Different configurations will apply to indexes as the Splunk installation matures.

For testing purposes only, an index will be pushed from the master node (admin1) in the verification stage of this CVD by applying the following stanza:

[archival]

coldToFrozenDir = /path/to/frozen
More information regarding archival can be found in the documentation

Configuring the Deployment Server

In this section, the server admin2 is configured to function as the Deployment server, and procedure to push a sample “Splunk App” from the Deployment Server to a Universal Forwarder on a test server (not part of this CVD).

Any Splunk instance can act as a Deployment Server that assists in maintaining and deploying apps. In particular, the Deployment Server acts as a central manager for Universal Forwarders deployed throughout the enterprise.

Any configuration to be pushed to remote instances will be hosted under $SPLUNK_HOME/etc/deployment-apps/.

In the following section, a Universal Forwarder will be installed on a machine separate from the servers that make up the Splunk Enterprise platform of this CVD. The only requirement for this is it must be reachable via the same network to which the Indexers are connected to.

Once the machine is connected to the network with connectivity to the UCS platform, follow the steps below.

>Note: In this documentation, it is assumed that the machine with Universal Forwarder is reachable via 192.168.11.0/24 network (in other words via NIC eth1 of the Cisco UCS servers). This would require the respective VLANs configured appropriately to provide appropriate connectivity between the Cisco UCS infrastructure on which Splunk platform is built and the server with a universal forwarder.

>Note: The Deployment Server is installed by default when Splunk Enterprise is deployed. In this CVD, the admin2 box will function as the designated Deployment Server.

Installing a Universal Forwarder on a Test Server


2. Install the package as detailed in the documentation for the appropriate operating system of the Universal Forwarder host.

Register Universal Forwarder with the Deployment Server

1. Via the command line, access the system hosting the Universal Forwarder.

2. Navigate to the $SPLUNK_HOME/etc/system/local directory.

3. Create and edit the file ‘deploymentclient.conf’ with the following content
clientName = the name or identifier of the host system

targetUri = the hostname/IP and port of the Deployment Server (For example, admin2:8089)

4. As the user 'splunk' restart the Universal Forwarder ($SPLUNK_HOME/bin/splunk restart)

Configure an App within the Deployment Server

1. In a browser, navigate to the Splunk instance’s Web Interface of server admin2.(that is, https://admin2:8000/)

2. Select Settings -> Distributed Environment -> Forwarder Management.

3. Notice the record of the Universal Forwarder communicating with the Deployment Server (this step may take up to five minutes due to polling cycle). See Figure 192

Figure 192    Forwarder Management: Communication with the Deployment Server

4. Using the command line, navigate to the Deployment Server, admin2.

5. Navigate to $SPLUNK_HOME/etc/deployment-apps/

6. Create the directory appTest.

7. Within appTest create the directory local.

```
[root@admin2 ~]# cd $SPLUNK_HOME/etc/deployment-apps
[root@admin2 deployment-apps]# mkdir appTest
[root@admin2 deployment-apps]# cd appTest
[root@admin2 appTest]# mkdir local
[root@admin2 appTest]# cd local
[root@admin2 local]# vi app.conf
```
8. Create the file ‘app.conf’ and include the following contents:

```
[tcpout]
defaultGroup = search_peers
[tcpout:search_peers]
autoLB = true
forceTimebasedAutoLB = true
```

9. As the splunk user, execute the command to reload the deployment server:

```
$SPLUNK_HOME/bin/splunk reload deploy-server
```

![](image)

Note: The login step could be bypassed by appending “auth admin:cisco” to the command line.

10. Navigate to the Web GUI on admin2 (http://admin2:8000) and navigate to Settings > Forwarder Management. Click Apps.

![](image)

11. Zero apps have been deployed. Click Server Class.
12. **Click** Create One and give it the name **TestForwarder**.

![Create Server Class](image)

**Figure 194** Create Server Class

13. **Figure 195** presents options for adding apps and clients. **Click** Add Apps.

![Add Apps to New Server Class](image)

**Figure 195** Add Apps to New Server Class

14. **Click** **appTest** in the Unselected Apps section to move it to Selected Apps section, as shown in **Figure 196**

![Select Apps](image)

**Figure 196** Select Apps

15. **Click** the **Save** button in the upper right.

16. The next screen will show the apps listed under Apps.

17. **Click** the **Add Clients** button, as shown in **Figure 197**
18. Within the **Edit Clients** screen, add the hostname of the forwarder to the whitelist. In this instance, the forwarder used is named `fwd1`. See Figure 198.

19. Click **Save**.

20. Go back to the **Forwarder Management** screen. (Select **Settings** -> **Distributed Environment** -> **Forwarder Management**).

21. On the forwarder box, navigate to `$SPLUNK_HOME/etc/apps`. List the directory to view the newly deployed app.
Installation Verification

The purpose of this verification is to ensure connectivity between the indexers, search heads, license master, master node, and the distributed management console.

Verifying from DMC

1. Log into the Master Node (admin1).

2. Navigate to Settings > Indexer Clustering.

3. Verify that all search heads and indexers are listed. See Figure 200

![Figure 200 Verify Search Heads and Indexers](image)

4. Navigate to Settings > Distributed Management Console.

5. The overview page should display similar results (8 Indexers, 3 Search Heads, 1 Cluster Master, 1 License Master, 3 KV stores).
6. Navigate to **Settings > General Setup**.

7. Ensure that the Master Node (admin1) is not attributed with the role of ‘search head’. If so, edit the role to only reflect License Master and Cluster Master, as shown in Figure 202.

### Verifying Master and Peer Replication

The purpose of this test is to ensure that indexes are distributed across each peer. By creating an index for testing, as well as a small retention time-frame, we will force the instance to push data into the archival directory.

1. SSH into the master node (admin1) as the ‘splunk’ user.

2. Navigate to `$SPLUNK_HOME/etc/master-apps/_cluster/local/

3. Create and edit the file ‘indexes.conf’

   ```bash
   [splunk@admin1 ~] $ cd $SPLUNK_HOME/etc/master-apps/_cluster/local
   [splunk@admin1 local]$ vi indexes.conf
   ```

4. Add the following stanzas:

   ```
   ### TESTING PURPOSES ONLY ###
   [archival]
   repFactor = auto
   ```
homePath = $SPLUNK_DB/archival/db

coldPath = $SPLUNK_DB/archival/colddb

thawedPath = $SPLUNK_DB/archival/thaweddb

maxDataSize = 1024

coldToFrozenDir = /data/frzn_data/archival/frzn

### TESTING PURPOSES ONLY ###
[archival]
repFactor = auto
homePath = $SPLUNK_DB/archival/db
coldPath = $SPLUNK_DB/archival/colddb
thawedPath = $SPLUNK_DB/archival/thaweddb
maxDataSize = 1024
frozenTimePeriodInSecs = 3600
coldToFrozenDir = /data/frzn_data/archival/frzn

---

Note: This test index configuration make use of the frozen data path that was created in the earlier section. See NFS Configurations for the Splunk Frozen Data Storage. Save the file

---


6. Navigate to Settings -> Distributed Environment -> Indexer Clustering, as shown in Figure 203
7. Click **Edit > Distribute Configuration Bundle.**

8. Click **Distribute Configuration Bundle.**
Figure 205  Distribute Configuration Bundle

Distribute Configuration Bundle
Distribute the configuration bundle from the master to the peers. Learn More ▶

Back to Master Node
Distribute Configuration Bundle

Last Push: ✓ Successful

3/24/2015, 3:31:25 PM
Bundle ID 675C59B77A47B3296FB0E75B1D750

9. A pop-up window will appear. Select Push Changes, as shown in Figure 206

Figure 206  Push Changes by Restarting the Peers

Distribute Configuration Bundle
Some configuration changes might require a restart of all peers. Would you like to push the changes? Learn More ▶

Cancel
Push Changes

10. Verify that the push was successful.

Figure 207  Details of the Last Push

Last Push: ✓ Successful
4/6/2015, 2:30:25 PM
Bundle ID 7AD6211B37846DC07D745847C8597CE

11. SSH to any indexer as the ‘splunk’ user.

12. Navigate to the directory ‘$SPLUNK_HOME/etc/slave-apps/_cluster/local/’

13. Verify that the new ‘indexes.conf’ file exists.
Verifying Data Replication

Next, verify that data is distributed across indexer nodes and is replicated across ‘live’ nodes when an indexer is down. In order to verify that the indexers are replicating data, the indexers must have a sample set of data to work with.

Any random syslog or file in which each line is a new event is acceptable. It is suggested that syslog data be used for verification due to the known and expected format. The recommended file size is at minimum ~250MB or 1 million events. If a file is not available for testing, one may be found here. Alternatively, you may use a random syslog generator.

Default throughput of universal forwarders is 256KBps. This may be increased by editing the “maxKBps” stanza in $SPLUNK_HOME/etc/system/local/limits.conf. Consult the documentation for more information. When testing, larger max KBps rates may be used (this configuration tested with 10240) but this may not be suitable for all environments depending upon network infrastructure.

Previously a universal forwarder was configured in the section Configure the Universal Forwarder. It must be accessible from the same network which UCS is attached to.

Once the new system is available, follow the steps below:

1. From a command line interface on the universal forwarder system, enter the following command:

   ```bash
   /opt/splunkforwarder/bin/splunk add oneshot -source ./your_test_file.log -sourcetype syslog -index archival -auth admin:your_admin_password
   ```

Note: The $SPLUNK_HOME on universal forwarder may be set to /opt/splunkforwarder to avoid the warning seen in the screenshot above.
2. Screen will echo 'Oneshot 'your_test_file.log' added.

3. Note the time that this step was executed.

Note: The time that this export was executed will be used to verify data transport to the archival node.

4. Issue the same command, but alter the stanza from “-index archival” to “-index main”. One dataset will be within two indexes.

5. Navigate to the DMC and your Master Node (admin1) in your browser by going to Settings -> Distributed Management Console.


Figure 208 Select Indexing Performance Deployment

Note that the DMC reflects indexing rates and data passing through the system.
7. Navigate to any of the search heads in your browser.
8. Click on Searching and Reporting.
9. In the Splunk search bar, enter the following search: `index="archival" | stats count by splunk_server`
10. Note the indexer(s).
11. In the Splunk search bar, enter the following search: `index="main" | stats count by splunk_server`
12. Change the time range picker to ‘All time’.
13. Change the search mode to ‘fast mode’.
14. Click on ‘search’ (magnifying glass).
15. Change view to ‘Visualization’ and set the chart type to ‘Column’. Note the distribution of data across each of the indexers. Figure 210
16. Change the view to ‘Statistics’. Note the number of events per indexer, as well as the Total number of events, visible in the panel as well as the event summary under the search bar. See Figure 211

Figure 211  Splunk Server Versus Count: Statistics

<table>
<thead>
<tr>
<th>splunk_server</th>
<th>count</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>idx1</td>
<td>652672</td>
<td>652672</td>
</tr>
<tr>
<td>idx3</td>
<td>59511</td>
<td>59511</td>
</tr>
<tr>
<td>idx4</td>
<td>31417</td>
<td>31417</td>
</tr>
<tr>
<td>Total</td>
<td>1000000</td>
<td>1000000</td>
</tr>
</tbody>
</table>

17. Write down or take a screenshot of the totals per indexer for reference later.

18. Use shell access to navigate to one of the indexers which reported data.

19. Approximately 5 minutes after sending data to the indexers, proceed to step 24.

20. Issue the command ‘$SPLUNK_HOME/bin/splunk offline’.

21. Return to the browser and run the same search again. See Figure 212
Note: Jot down the distribution of events and the total. The event count from this search and the previous (step 18) should be the same. Bring your indexer back up ($SPLUNK_HOME/bin/splunk start).

While one indexer is down, this step has verified that the indexed data has been replicated and that the search results are consistent, even when an indexer is not functioning.

If the test does not present data across the indexers, the most common reasons for failure are listed below:

- The universal forwarder does not have the appropriate configurations listed in ‘outputs.conf’
- There are network connectivity issues between the Universal Forwarder and the assigned receiving port on the indexers
- The dataset was large and has not finished replication to other indexers in the allotted amount of time

Verifying Transfer of Frozen Buckets to Archival Storage

In the previous test, the time that a ‘oneshot’ to the index ‘archival’ was performed was noted (Step 8). In this configuration, this setting is for one hour. For more information on frozen data, see Configuring Archival of Data From Cold to Frozen.

Note: This is NOT a recommended setting, but simply for quick testing of archival transfer. You cannot verify the archival of frozen data until one hour has passed from the time of indexing.

1. As the ‘splunk’ user, SSH to the indexer which reported data ("verifying data replication: step 11") 2. Navigate to /data/frzn_data/archival/frzn
2. Issue the command:

    ls -la

This displays the ‘frozen’ bucket(s) that have been moved.

Note: If the selected indexer did not receive data, frozen buckets will not be present.

---

Post-Test Cleanup

Removing Test Data

To remove the data indexed during the test, complete the following steps:

1. Stop the Splunk service on the admin node. As the splunk user on admin1, issue the command:

    $SPLUNK_HOME/bin/splunk stop

2. Stop all indexers:

    clush --group=indexers $SPLUNK_HOME/bin/splunk stop

3. SSH to each indexer (idx1–idx8). As the splunk user, issue the command

    $SPLUNK_HOME/bin/splunk clean eventdata -index main

Note: Alternatively, the clush command could be used to delete the indexes from all the peers at once by applying the force parameter ‘-f’, that is, clush --group=indexers

$SPLUNK_HOME/bin/splunk clean eventdata -index main -f. Use this command with extreme caution as this action can’t be undone.

4. Confirm the cleaning of events on every indexer!!

5. Start the master node (admin1) as splunk user:

    $SPLUNK_HOME/bin/splunk start

6. Start indexing peers as user ‘splunk’
clush --group=indexers $SPLUNK_HOME/bin/splunk start

Removing Test Indexes

1. As user ‘splunk’, SSH into the master node (admin1)

2. Navigate to $SPLUNK_HOME/etc/master-apps/_cluster/local/

3. Remove the indexes.conf file. This file contains the ‘archival’ index and is not needed beyond testing.

```
[splunk@admin1 local]$ pwd
/data/disk1/splunk/etc/master-apps/_cluster/local
[splunk@admin1 local]$ ls -la
```
```
total 20
drwxr-xr-x 2 splunk splunk 4096 Apr 18 12:57 .
drwxr-xr-x 4 splunk splunk 4096 Apr 18 10:33 ..
-rw-rw-r-- 1 splunk splunk 9 Apr 18 12:57 indexes.conf
-rw-rw-r-- 1 splunk splunk 41 Apr 18 12:10 inputs.conf
-r--r--r-- 1 splunk splunk 231 Feb 18 15:01 README
[splunk@admin1 local]$ rm indexes.conf
```
```
[splunk@admin1 local]$ ls -la
```
```
total 16
drwxr-xr-x 2 splunk splunk 4096 Apr 18 12:58 .
drwxr-xr-x 4 splunk splunk 4096 Apr 18 10:33 ..
-rw-rw-r-- 1 splunk splunk 41 Apr 18 12:10 inputs.conf
-r--r--r-- 1 splunk splunk 231 Feb 18 15:01 README
```

4. Using your browser, navigate to the master node web interface (admin1).

5. Select Settings > Indexer Clustering > Edit > Distribute Configuration Bundle, as shown in Figure 213

**Figure 213** Select Distribute Configuration Bundle

```
Node Type
Master Node Configuration
Distribute Configuration Bundle
Disable Indexer Clustering
```

6. Click Distribute Configuration Bundle, as shown in Figure 214
7. Click Push Changes. This will remove the `indexes.conf` file which was created for testing purposes.

Removing the Universal Forwarder

1. Navigate to the host system of the Universal Forwarder
2. Stop the Universal Forwarder (`$SPLUNK_HOME/bin/splunk stop`)
3. Remove or uninstall the Universal Forwarder (actions will vary per OS)

Remove Deployment Server App

1. Via the CLI of the Deployment Server, navigate to `$SPLUNK_HOME/etc/deployment-apps`
2. Remove the directory ‘outputTest’.
   ```
   rm -r outputTest/
   ``
3. Reload the deployment Server.
   ```
   `$SPLUNK_HOME/bin/splunk reload deploy-server`
5. Select Settings > Forwarder Management.
6. Under the tab Server Classes, click Edit > Delete.

The Splunk Enterprise installation is now in a ‘clean’ state, with no test data or forwarders.

Hardening the Splunk Installation

Taking the proper steps to secure Splunk Enterprise reduces its attack surface and mitigates the risk and impact of most vulnerabilities. We highly recommend you harden and tune the environment to your standards, so long as they do not overwrite configurations described within this document.
Turn Off Web Servers

Web connectivity should be limited to only those instances that require it. Web services should run on:

- Search Heads
- Distributed Management Console
- License Master

Web servers are not required to run on:

- Indexers

To disable web servers:

1. SSH into the instance of each indexer
2. As the ‘splunk’ user, issue the command `$SPLUNK_HOME/bin/splunk disable webserver -auth <username>:<password>`.
3. SSH into the master node (admin1)
4. Restart the indexing tier with the command:

```
$SPLUNK_HOME/bin/splunk rolling-restart cluster-peers
```

For up-to-date information regarding hardening the Splunk environment, visit ‘Securing Splunk Enterprise’
The Universal Forwarder

There are several methods to consider for collecting data into Splunk, otherwise referred to as ‘onboarding’. Techniques include syslog forwarding, remote-polling techniques such as SNMP and WMI, writing of application logs to shared storage; batch uploads, and dedicated agents. Each of these approaches comes with limitations, and in many cases with additional costs for licensing or for computing overhead.

Optimal collection of data combines several factors: it has minimal overhead, supports myriad data sources including data that is not in log files, is securely transmitted, works with low bandwidth, sends in real time, and has scalable & robust delivery support. There should be centralized management of what’s being collected.

To meet these goals, Splunk recommends the use of the Splunk Universal Forwarder (UF) on every server where this is possible. The Universal Forwarder is a centrally managed, lightweight tool for collecting and forwarding data to your Indexers, and it is available for installation on nearly all standard operating systems: Linux, Windows, OSX AIX, HP-UX, Solaris, FreeBSD, even Raspberry Pi.

Advantages of the Splunk Universal Forwarder

The use of the Universal Forwarder allows a platform-agnostic approach to managing data collection from your environment.

Here is how the Splunk UF meets each of the goals:

**Minimal Overhead:** The Splunk Universal Forwarder is a lightweight software package; its sole purpose is to collect and forward data. Unlike heavyweight agents, it does not analyze data locally for lowest local overhead.

**Data sources:** Like most other options, the UF can collect data from local syslog files (*NIX) and Event Logs (Windows). The Splunk UF can also read from virtually any local file source so long as it is in ASCII format. The UF can also collect data that does not exist on disk at all:

- For all data being forwarded, the UF provides meta-data for all data sources, including: hostname & time zone (per OS), source (typically the full file path), sourcetype, and routing information of destination indexes in Splunk.

- Each Universal forwarder can call shell, Python, or PowerShell scripts to monitor OS- and application-level usage; one example is to monitor and report on open network ports.

- Splunk Stream Forwarder can be configured to listen on network interfaces and collect protocol level data directly off the network stream. This is particularly useful when application logs lack the details necessary for your monitoring or analytics needs.

- The Splunk UF can listen on UDP or TCP ports directly, allowing applications to send application logs directly and avoid Disk I/O concerns. The UF routes this directly to the Indexers, removing the need to have compression / routing logic at the application layer.
Secure, low bandwidth: After collecting the raw data, Splunk uses data compression and optional SSL compression when sending the data to the Splunk indexers. SSL overhead is minimized by keeping TCP sessions open for set periods of time.

Real time: With the UF, Splunk can monitor and analyze data in near real time. As events are generated (for example, appended to a logfile), they are immediately forwarded to indexers, where they are typically available for analysis within a second or so of initial generation.

Data Delivery: The UF is designed with high availability and guaranteed delivery in mind. Delivery is over TCP rather than UDP, ensuring that the UF “knows” if the data was received or not. Every UF can be configured with one or more indexers as targets, automatically spreading the load of collected data across the indexers. When one or more indexers are off-line, the UF will automatically find an indexer that is available. If all indexers are unavailable, The UF keeps track of last data sent - when an indexer becomes available, data transmission from where it left off.

Management: Splunk offers central management of the configuration of Universal Forwarders. Each UF connects to the Deployment server on a scheduled basis to check for new configurations, the Deployment server offers granular control over classes of systems that will collect any given data source. A Splunk administrator can change collection configurations and roll this out within minutes.

What About Systems Where the Splunk Universal Forwarder is Not Supported?

Networking and Storage gear, virtual appliances, and other “non-OS” devices are a vital part of any company’s environment, and should be monitored for performance and reliability. When the Splunk Universal Forwarder cannot be installed locally, here are a few recommended options to consider.

IPFIX/NetFlow: Most networking equipment (physical or virtual) supports either IPFIX, NetFlow, sfow or jflow for pushing out performance or security data. Systems sending on these protocols are called “exporters". IPFIX and *Flow are binary protocols and cannot be sent directly to Splunk. Recommended approaches (select one):

- Have the exporters send their data to a system running the Splunk Universal Forwarder with the NetFlow or IPFIX TAs. These TAs translate the protocol from binary to ASCII.

- Have the exporters send their data to a 3rd party NetFlow/IPFIX parser, such as the NetFlow Integrator by NetFlow Logic. These systems accept binary data in, convert the data to syslog, and send out over the network. Install a Splunk UF on the same system, listening for network data streamed out of the middleware.

SNMP (polling): SNMP provides a valuable method for remotely collecting information from devices without a “normal" OS, such as network switches and routers, and on hardware management ports of physical server hardware. Recommended approaches (select one):

- Set up a Splunk heavy forwarder with the SNMP modular input app. The app will poll SNMP data and store it directly in Splunk. Details are in the app’s documentation. (Simply install on the Splunk search head for smaller deployments.)

- On any system where a Splunk UF could be installed, use an SNMP polling agent to collect data as necessary, and output the results to a log file. The UF can then collect the output files in the same manner as any other log file. The SNMP polling agent might be a commercial tool for this purpose, or something as simple as the ‘snmpwalk’ command running from a script.
**SNMP (traps):** SNMP traps are sent on alert conditions, typically by network devices. Recommended approaches (select one):

- Set SNMP devices to send their traps to a system running Splunk Universal Forwarder and the Splunk for Stream app. Configure Stream to listen for the SNMP protocol, forwarding whichever SNMP data is required.

- Set SNMP devices to send their traps to a system capable of running an SNMP daemon and a Splunk UF. Configure the SNMP daemon to log traps to a file, configure the UF to read the logs.

- **Syslog Forwarding:** Many devices, virtual appliances, and bare-metal hypervisors offer the ability to send critical information via Syslog. (Linux and UNIX family OSes do to – but those systems support UF installation.) Recommended approach:
  
  - Configure a system that runs a supported syslog server to listen for syslog data. (“syslog-ng” and “rsyslog” are excellent free options for Linux systems.)
  
  - Configure the log servers to store logs in host-specific folders.
  
  - When possible, configure syslog senders to use TCP rather than UDP. This ensures that critical data will not be dropped.

- Install the Splunk Universal Forwarder or heavy forwarder on the system, and configure it to monitor the log files. Tell Splunk to extract the hostnames from the file paths. (Heavy forwarder is necessary for certain syslog streams, such as ESXi data.) Install additional TAs as recommended by documentation, depending on syslog data sources.

- Optionally, create two syslog collection systems – and put them behind a load balancer. Have the syslog sources send to the load balancer via TCP. This ensures that if a single syslog server is down, the data will still continue coming to Splunk in real time.

**Proprietary APIs:** There are a large number of computing infrastructure components that only provide the full set of information when polled through API calls. These include network, storage, power system controllers, and other devices. A few specific examples include VMware vCenter servers, NetApp OnTap filers, Checkpoint firewalls. Because these systems provide a piece of the overall infrastructure picture for performance and security, bringing this data into Splunk is important for many Splunk customers. There are many approaches available, here is a recommended methodology for getting this data in:

> **Note:** Do not use the “find more apps” function within the Splunk UI.

- Check on splunkbase.splunk.com for an app that is designed to handle the technology. For example, search for “cisco”.

- If an app exists – read the documentation for that app.

- If an app does not exist on Splunkbase, simply perform an Internet search for “Splunk” and the technology.
● If all else fails, contact Splunk support to ask for suggestions.

Additional Terminology

When onboarding data, Splunk provides a number of apps and add-ons via splunkbase.splunk.com. It is imperative that the Splunk administrator is familiar with the following terms:

**Apps**: An application that runs on Splunk Enterprise and typically addresses several use cases. An app typically contains both components of a Technology add-on and a Search add-on. An app contains one or more views. An app can include various Splunk Enterprise knowledge objects such as reports, lookups, scripted inputs, and modular inputs. An app sometimes depends on one or more add-ons for specific functionality. Examples of apps are the Splunk Enterprise Search app, the Splunk on Splunk app, and the Splunk Enterprise Security app.

**Technology Add-on (TA)**: A technology add-on is a Splunk app that extracts knowledge from IT data so that it can be processed by Splunk, as well as other apps that leverage the Common Information Model (CIM). The technology add-on may pull data into Splunk or simply map data that is already coming in. Technology add-ons may conflict with or duplicate other Splunk apps that are already pulling in the same sort of data if they disagree on the source type. The difference between a technology add-on and another Splunk app is compliance with the Common Information Model. Technology add-ons typically reside on the universal forwarder or on the indexing tier.

**Search Add-on (SA)**: A search add-on is a Splunk app that contains pre-built dashboards, searches, look-ups, forms, and various search components. The difference between a search add-on and a technology add-on is that SAs are primarily focused on visualizing data. Search add-ons exist on the search head(s).

**Common Information Model (CIM)**: The Common Information Model Add-on is based on the idea that you can break down most log files into two components:

- fields
- event category tags

With these two components a knowledge manager can set up their log files in a way that makes them easy to process by Splunk and which normalizes noncompliant log files and forces them to follow a similar schema. The Common Information Model details the standard fields and event category tags that Splunk uses when it processes most IT data.

The Common Information Model is an overlay function and does not normalize or overwrite the raw data, it categorizes various fields into corresponding categories.

Recommended Apps and Add-ons for Data Collection

Here are the most commonly deployed add-ons, and what they collect.

You will find these add-ons at [https://splunkbase.splunk.com](https://splunkbase.splunk.com); for each, you will also see a complete description as well as the documentation on how to install them. For some, these add-ons on installed to the forwarders, in some cases they are installed to the indexers, or to both.

**Splunk Technical Add-on for Cisco UCS**: Splunk’s first (and only) supported integration for server environments provides real-time operational visibility across multiple Cisco UCS domains and enables
our joint customers to identify & resolve problems faster, proactively monitor systems & infrastructure, track key performance indicators & understand trends & patterns of activity & behavior.

The app grabs UCS faults, events, performance statistics such as temperature, power and network throughput from one or more Cisco UCS Managers to:

- Deliver real time and historical visibility centrally across your entire UCS deployment
- Provide analytics such as available capacity, trending of faults over time, tracking of power & cooling costs.
- Correlate UCS performance, fault and events data with user, application, and hypervisor data to analyze, prevent and fix problems across broad infrastructure or application environments.

**Splunk Add-on for Unix and Linux:** This add-on includes predefined inputs to collect data from *NIX systems, and maps to normalize the data to the Common Information Model. It provides easy collection from standard system log directories (such as /var/log), and excludes collection of common binary files. Examples are provided for monitoring the contents of specific files, such as /etc/hosts. Scripted inputs are included to monitor a variety of OS performance and network data points.

**Splunk App for Stream:** This provides a scalable and easy-to-configure solution to capture real-time streaming wire data from anywhere in your datacenter through protocol-level inspection. Stream data is useful for IT Ops, DevOps, and Security use cases. The Stream forwarder can run directly on endpoint servers – no need for SPAN/TAP ports; this is particularly useful in public cloud environments where SPAN/TAP are not an option. Capture only the relevant wire data for analytics, through filters and aggregation rules. Manage wire data volumes with fine-grained precision by selecting or deselecting protocols and associated attributes within the App interface.

**Splunk DB Connect 2:** Enrich your data results by accessing the data stored in your database servers. Splunk can access your structured data on-demand, for providing supplemental information, or on a monitoring basis where Splunk indexes the new data in selected tables. Use the Outputs function to export Splunk results into your legacy database.

**Splunk Support for Active Directory / Idapsec:** Enrich your data results by reading data stored in your LDAP directory servers, including Active Directory. Use cases include mapping host names to additional information, mapping user names to HR information, or accessing asset management information stored in LDAP.

**Splunk add-on for Microsoft Windows:** This add-on includes predefined inputs to collect data from Windows systems, and maps to normalize the data to the Common Information Model. Supported data includes performance data, event logs, commonly used log files, and Windows Registry content. Scripted inputs are included to monitor open Network ports and installed applications.

**Splunk App for Windows Infrastructure:** The Splunk App for Windows Infrastructure provides examples of pre-built data inputs, searches, reports, and dashboards for Windows server and desktop management. You can monitor, manage, and troubleshoot Windows operating systems, including Active Directory elements, all from one place. The App also contains dashboards needed to monitor your Active Directory environment and allows for correlation opportunities from the Active Directory data back to the Operating System.

For a complete list of all Splunk supported apps go to: https://splunkbase.splunk.com/apps/#/order/latest/author/splunk.
Conclusion

Splunk Enterprise delivers operational visibility and digital intelligence by monitoring all machine generated data and making it accessible, usable and valuable across the organization. Cisco UCS Integrated Infrastructure for Big Data with its compute, storage, connectivity, and unified management features, streamlines the deployment and offers dependable, scalable integrated infrastructure that delivers predictable performance and high-availability for your Splunk Enterprise platform with a lower TCO.

The configuration detailed in the document can be extended to clusters of various sizes depending on application demands. Up to 80 servers (4 racks) can be supported with no additional switching in a single UCS domain without any network over-subscription. Scaling beyond 4 racks (80 servers) can be implemented by interconnecting multiple UCS domains using Nexus 6000/7000 Series switches, scalable to thousands of servers and to hundreds of petabytes storage, and managed from a single pane using UCS Central.
Table 11 provides the BOM for a 13 node Splunk Enterprise cluster plus 1 Cisco UCS S3260 Storage Server as an archival node. Table 11

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco UCS C220 M4 Rack Server configuration for Splunk search heads</td>
<td></td>
<td></td>
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<tr>
<td>UCSC-C220-M4S</td>
<td>UCS C220 M4 SFF w/o CPU, mem, HD, PCIe, PSU, rail kit</td>
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</tr>
<tr>
<td>CON-OSP-C220M4S</td>
<td>SNTC-24X7X4OS UCS C220 M4 SFF w/o CPU, mem, HD</td>
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<tr>
<td>UCSC-MLOM-CSC-02</td>
<td>Cisco UCS VIC1227 VIC MLOM - Dual Port 10Gb SFP+</td>
<td>3</td>
</tr>
<tr>
<td>UCSC-RAILB-M4</td>
<td>Ball Bearing Rail Kit for C220 M4 and C240 M4 rack servers</td>
<td>3</td>
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<tr>
<td>UCSC-PSU1-770W</td>
<td>770W AC Hot-Plug Power Supply for 1U C-Series Rack Server</td>
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<tr>
<td>UCSC-SCCBL220</td>
<td>Supercap cable 950mm</td>
<td>3</td>
</tr>
<tr>
<td>N20-BBLKD</td>
<td>UCS 2.5 inch HDD blanking panel</td>
<td>18</td>
</tr>
<tr>
<td>UCSC-HS-C220M4</td>
<td>Heat sink for UCS C220 M4 rack servers</td>
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<tr>
<td>UCSC-MRAID12G</td>
<td>Cisco 12G SAS Modular Raid Controller</td>
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<tr>
<td>UCSC-MRAID12G-2GB</td>
<td>Cisco 12Gbps SAS 2GB FBWC Cache module (Raid 0/1/5/6)</td>
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<td>C1UCS-OPT-OUT</td>
<td>Cisco ONE Data Center Compute Opt Out Option</td>
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Cisco UCS C240 M4 Rack Server configuration for Splunk indexers
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<td>Heat sink for UCS C240 M4 rack servers</td>
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<td>UCSC-MRAID12G-2GB</td>
<td>Cisco 12Gbps SAS 2GB FBWC Cache module (Raid 0/1/5/6)</td>
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<td>Cisco ONE Data Center Compute Opt Out Option</td>
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Cisco UCS C220 M4 Rack Server configuration for Splunk admin nodes

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<tr>
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<td>UCSC-HS-C220M4</td>
<td>Heat sink for UCS C220 M4 rack servers</td>
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<td>UCSC-MRAID12G</td>
<td>Cisco 12G SAS Modular Raid Controller</td>
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<td>UCSC-MRAID12G-2GB</td>
<td>Cisco 12Gbps SAS 2GB FBWC Cache module (Raid 0/1/5/6)</td>
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228
<table>
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<tr>
<td>UCSC-SCCBL220</td>
<td>Supercap cable 950mm</td>
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<td>N20-BBLKD</td>
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<td>UCS-M4-V4-LBL</td>
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**Cisco UCS S3260 Storage Server configuration for Splunk archival node**

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<td>SNTC-24X7X4OS Cisco UCS S3260 Base Chassis w/4x PSU, 2x120GB</td>
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<tr>
<td>CAB-N5K6A-NA</td>
<td>Power Cord, 200/240V 6A North America</td>
<td>4</td>
</tr>
<tr>
<td>UCSC-C3160-BEZEL</td>
<td>Cisco UCS C3160 System Bezel</td>
<td>1</td>
</tr>
<tr>
<td>UCSC-C3X60-SBLKP</td>
<td>UCS C3x60 SIoC blanking plate</td>
<td>1</td>
</tr>
<tr>
<td>UCSC-C3X60-RAIL</td>
<td>UCS C3X60 Rack Rails Kit</td>
<td>1</td>
</tr>
<tr>
<td>UCSC-PSU1-1050W</td>
<td>UCS C3X60 1050W Power Supply Unit</td>
<td>4</td>
</tr>
<tr>
<td>Part Number</td>
<td>Description</td>
<td>Quantity</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>N20-BBLKD-7MM</td>
<td>UCS 7MM SSD Blank Filler</td>
<td>3</td>
</tr>
<tr>
<td>UCS-C3K-M4SRB</td>
<td>UCS C3000 M4 Server Node for Intel E5-2600 v4</td>
<td>1</td>
</tr>
<tr>
<td>UCS-CPU-E52620E</td>
<td>2.10 GHz E5-2620 v4/85W 8C/20MB Cache/DDR4 2133MHz</td>
<td>2</td>
</tr>
<tr>
<td>UCS-MR-1X322RV-A</td>
<td>32GB DDR4-2400-MHz RDIMM/PC4-19200/dual rank/x4/1.2v</td>
<td>8</td>
</tr>
<tr>
<td>UCS-C3K-M4RAID</td>
<td>Cisco UCS C3000 RAID Controller M4 Server w 4G RAID Cache</td>
<td>1</td>
</tr>
<tr>
<td>UCSC-HS-C3X60</td>
<td>Cisco UCS C3X60 Server Node CPU Heatsink</td>
<td>2</td>
</tr>
<tr>
<td>UCSC-S3260-SIOC</td>
<td>Cisco UCS S3260 System IO Controller with VIC 1300 incl.</td>
<td>1</td>
</tr>
<tr>
<td>UCSC-C3X60-EX32T</td>
<td>UCS C3X60 Expander with 4x 8TB 7200RPM NL-SAS Drives</td>
<td>1</td>
</tr>
<tr>
<td>UCSC-C3X60-8TBRR</td>
<td>UCSC 3X60 8TB NL-SAS 7.2K Helium HDD rear with HDD Carrier</td>
<td>4</td>
</tr>
<tr>
<td>UCS-C3X60-G2SD12</td>
<td>UCSC C3X60 120GB Boot SSD (Gen 2)</td>
<td>1</td>
</tr>
<tr>
<td>UCSC-C3X60-56HD8</td>
<td>UCS C3X60 4 rows of 8TB NL-SAS7200 RPM SAS-3 (56Total) 448TB</td>
<td>1</td>
</tr>
<tr>
<td>UCSC-C3X60-HD8TB</td>
<td>UCSC 3X60 8TB NL-SAS 7.2KHelium HDD with HDD Carrier</td>
<td>56</td>
</tr>
<tr>
<td>RHEL-2S2V-3A=</td>
<td>Red Hat Enterprise Linux (1-2 CPU,1-2 VN); 3-Yr Support Req</td>
<td>1</td>
</tr>
<tr>
<td>CON-ISV1-EL2S2V3A</td>
<td>ISV 24X7 RHEL Server 2Socket-OR-2Virtual; ANNUAL List Price</td>
<td>1</td>
</tr>
<tr>
<td>UCS-RHEL-TERMS</td>
<td>Acceptance of Terms, Standalone RHEL License for UCS Servers</td>
<td>1</td>
</tr>
<tr>
<td>SFP-H10GB-CU5M=</td>
<td>10GBASE-CU SFP+ Cable 5 Meter</td>
<td>36</td>
</tr>
</tbody>
</table>
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Appendix A

Provisioning a Splunk Cluster with UCSDE

An alternative to manually deploying a Splunk cluster as outlined in this CVD is to deploy it through Cisco UCS Director Express. Cisco UCS Director Express for Big Data provides a single-touch solution that automates Hadoop deployment on the Cisco UCS Common Platform Architecture (CPA) for Big Data infrastructure. It also provides a single management pane across both physical infrastructure and Hadoop software. All elements of the infrastructure are handled automatically with little user input.

The steps outlined in this section assume that you have the Fabric Interconnects configured according to the Fabric Configuration section and have enabled the server and uplink ports. The servers have undergone the discovery process and all necessary devices have assigned IP addresses on the management network.

Requirements

- Two virtual machines (VM) on an ESXi server to use for UCS Director Express (UCSDE) and the Baremetal Agent (BMA)
- UCSDE minimum requirements: 4 vCPUs, 12GB RAM, 100GB thick-provisioned storage
- BMA minimum requirements: 2 vCPUs, 3GB RAM, 40GB thick-provisioned storage

Note: Reserve 4000 MHz and 12GB RAM for the UCSDE VM and 2000 MHz and 3GB RAM for the Baremetal Agent VM.

- Three separate networks for Management, PXE, and Splunk index replication traffic. The PXE network should not have any other PXE/DHCP server present.
- Red Hat 6.x ISO file
- UCS Director Express software, available from the Cisco.com download site for UCS Director
  - CUCSD_Express_3.0.0.0.0_GA.zip
  - CUCSD_BMA_6.0.0.0_VMWARE_GA.zip
- Any necessary patches
- clustershell-1.7-1.el6.noarch.rpm (available at http://dl.fedoraproject.org/pub/epel/6/x86_64/clustershell-1.7-1.el6.noarch.rpm)
- Splunk software and license

Creating MAC Address Pools

Create three MAC address pools for the three server roles. To create MAC address pools, complete the following steps:
1. Select the LAN tab of the navigation pane (the left pane in the UCS Manager GUI).

2. Select Pools > root. If you created an organization, you may select that under Sub-O rganizations instead of root.

3. Right-click MAC Pools under the root organization.

4. Select Create MAC Pool to create the MAC address pool.

5. Enter the MAC Pool name in the Name field. Here we will name them Mgmt, Data1, and Data2.

6. (Optional) Enter a description of the MAC pool.

7. Select Assignment Order to be Sequential.

Creating MAC Pool Window

Figure 215  Add MAC Address

8. Click Next.

9. Click Add.

10. Specify a starting MAC address, such that the three MAC address pools will not overlap.

11. Specify a size of the MAC address pool which is sufficient to support the available server resources, as shown in Figure 216.
Specifying First MAC Address and Size

12. Click OK.

13. Click Finish.

14. When the message box displays, click OK.

15. Repeat the above steps to create the other two MAC address pools.

Creating Server Pools

Create server pools for the indexers, search heads, and administrative nodes. Follow these steps to configure the server pool within the Cisco UCS Manager GUI:

1. In the navigation pane of UCS Manager, click the Servers tab.

2. Expand Pools > root. If you created an organization, you may select that under Sub-O rganizations instead of root.

3. Right-click Server Pools.

4. Select Create Server Pool.
5. Enter the server pool name, which is indexer (the other server pools will be named search and admin).

6. (Optional) Enter a description for the server pool.

7. Click **Next** to add the servers.

**Figure 218** Naming a Server Pool

8. For the indexer pool, select the 8 Cisco UCS C240 M4 servers to be added to the server pool. For the search pool, select 3 Cisco UCS C200 M4 servers. For the admin pool, select 2 Cisco UCS C200 M4 servers. Click **>>** to add them to the pool.

9. Click **Finish**.
10. The *Create Server Pools* dialog box confirms that the server pool was successfully created. Click OK.

11. Repeat the steps above two more times to create the search and admin server pools.

Note: Though we support any type of servers, the 1RU servers are the appropriate ones for the search-head and admin pools.

Table 12 shows a summary of the server pool names and their corresponding server types.

<table>
<thead>
<tr>
<th>Server Pool Name</th>
<th>Role</th>
<th>Server Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indexer</td>
<td>Indexer</td>
<td>Cisco C240 M4</td>
</tr>
<tr>
<td>Search</td>
<td>Search Head</td>
<td>Cisco C220 M4</td>
</tr>
<tr>
<td>Admin</td>
<td>Administration Node</td>
<td>Cisco C220 M4</td>
</tr>
</tbody>
</table>
Communication Settings

Web session limits are used by Cisco UCS Manager to restrict the number of web sessions (both GUI and XML) that are permitted access to the system at any one time. We will set the possible number of concurrent HTTP and HTTPS sessions allowed for all users within the system to the maximum of 256.

1. In the navigation pane, click the Admin tab.

2. Select Communication Management in the Filter drop-down menu.


4. In the Web Session Limits section, change the Maximum Sessions to 256. (Figure 220)

Figure 220 Setting the Number of Maximum Sessions

QOS System Class

We will make the Platinum system class available for assigning custom settings and policies.

1. In the navigation pane, click the LAN tab.

2. Expand LAN > LAN Cloud.

3. Click the QOS System Class node.

4. In the General tab, check the Enabled box for Platinum and set its MTU to 9000.

5. Click Save Changes.

Figure 221 Platinum System Class Settings
UCS Director Express Deployment and Configuration

These are instructions for installing UCS Director Express with the vSphere Client.

1. Unzip CUCSD_Express_3_0_0_0_GA.zip.

2. In the vSphere Client, select the desired host machine and then select File > Deploy OVF Template…

3. Browse to the location of the folder created in step 1.

4. Select the ovf file and click Open.

5. Click Next to go to OVF Template Details.

6. Confirm the details and click Next to go to End User License Agreement.

7. Read and accept the agreement. Then click Next to go to Name and Location.

8. Specify a unique name for the virtual machine. Click Next to go to Storage.

9. Select a storage location for the virtual machine files. Click Next to go to Disk Format.
Figure 222  Storage for Virtual Machine Files

10. Keep the default option of **Thick Provision Lazy Zeroed**. Click **Next** to go to **Network Mapping**.

11. Select the management network from the **Destination Networks** drop-down menu and click **Next**.
12. Confirm the settings, check **Power on after deployment**, and click **Finish**.

These are instructions for configuring UCS Director Express after installing and powering it on.

13. In the left navigation pane, select the UCSDE VM.

14. Click on the **Console tab**.

15. Read the End User License Agreement and enter yes to agree to the terms. When the installation is complete, you will see this screen:
16. Use the arrow keys to navigate to Login and press Enter.

17. Login as “shelladmin” with the password “changeme”

18. From the shell menu, select 1 to change the default password. Enter the new password and confirm it.

19. From the shell menu, select 14 to configure the network interface.

20. Enter $ to configure a static IP address.

21. Enter eth0.

22. Enter a to use IPv4.

23. Enter y to confirm that you would like to configure the eth0 interface with a static IP address.
24. Enter the desired networking details on the management network for UCSDE. If you will not be using a DNS server, you can leave them blank. You will be prompted to confirm your choice.

25. Press **Return** to return to the menu.

26. From the shell menu, select **10** to ping an IP address. We will check to see if we can ping the gateway IP address.

27. Enter **v4** to indicate that you will be pinging an IPv4 address.

28. Enter the gateway IP address.
Figure 226  Pinging Default Gateway

20) Shutdown Appliance
21) Reboot Appliance
22) Manage Root Access
23) Login as Root
24) Configure Multi Node Setup (Advanced Deployment)
25) Clean-up Patch Files
26) Collect logs from a Node
27) Collect Diagnostics
28) Quit

SELECT> 10

Do you want to run ping/ping6 [v4/v6] ? : v4
Enter IP Address : 10.1.1.1
PING 10.1.1.1 (10.1.1.1) 56(84) bytes of data.
64 bytes from 10.1.1.1: icmp_seq=1 ttl=255 time=4.54 ms
64 bytes from 10.1.1.1: icmp_seq=2 ttl=255 time=1.71 ms
64 bytes from 10.1.1.1: icmp_seq=3 ttl=255 time=0.443 ms
64 bytes from 10.1.1.1: icmp_seq=4 ttl=255 time=0.490 ms
64 bytes from 10.1.1.1: icmp_seq=5 ttl=255 time=0.456 ms

--- 10.1.1.1 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4003ms
rtt min/avg/max/mdev = 0.443/1.520/4.542/1.503 ms
Press return to continue...

29. Press Return to return to the menu.

30. Enter 28 to quit the shell menu. You will see a message saying that your VM is now accessible at the IP address you specified.

Baremetal Agent Deployment and Configuration

To install the baremetal agent with the vSphere Client, complete the following steps:

1. Unzip CUCSD_BMA_6_0_0_0_VMWARE_GA.zip.

2. In the vSphere Client, select the host machine that contains the UCSDE VM.
3. Select File > Deploy OVF Template…

4. Browse to the location of the unzipped files in step 1.

5. Select the ovf file and click Open. Click Next to go to OVF Template Details.

6. Confirm the details and click Next to go to End User License Agreement.

7. Read and accept the agreement. Click Next to go to Name and Location.

8. Specify a unique name and location for the virtual machine. Click Next to go to Storage.

9. Select a storage location for the virtual machine files. Click Next to go to Disk Format.

10. Keep the default option of Thick Provision Lazy Zeroed. Click Next to go to Network Mapping.

![Disk Format Configuration]

11. Destination Networks is a drop-down menu. For Network 1, select the management network. For Network 2, select the PXE network. Click Next.

12. Confirm the settings, check Power on after deployment, and click Finish.

13. Click on the Console tab.
14. After loading, there will be an End User License Agreement to read and accept.

15. Use the arrow keys to navigate to **Login** and press **Enter**.

16. Login as the user “root” with the default password “pxeboot”.

17. Type this command to configure the BMA network interface:

   `/opt/vmware/share/vami/vami_config_net`

   **Figure 228  Network Configuration for BMA**

```bash
localhost.localdomain login: root
Password:
[root@localhost ~]# /opt/vmware/share/vami/vami_config_net
Main Menu
0)  Show Current Configuration (scroll with Shift-PgUp/PgDown)
1)  Exit this program
2)  Default Gateway
3)  Hostname
4)  DNS
5)  Proxy Server
6)  IP Address Allocation for eth0
7)  IP Address Allocation for eth1
Enter a menu number [0-7]: 6
```

18. In the main menu, enter **6** to configure the IP address for eth0.

19. Enter **y** to confirm you want to configure an IPv4 address for eth0.

20. Enter **n** to use a static IP address instead of DHCP.

21. Enter the IP address and netmask when prompted.

22. Enter **y** to confirm. You will be returned to the main menu after the network parameters are successfully changed.

23. Enter **7** to configure the IP address for eth1.

245
24. Enter y to confirm.

25. Enter n to use a static IP address.

26. Enter the IP address and netmask when prompted.

27. Enter y to confirm.

**Figure 229  Configuring IP address for eth1**

Configure an IPv4 address for eth1? y/n [n]: y
Use a DHCPv4 Server instead of a static IPv4 address? y/n [n]: n
IPv4 Address [i]: 192.168.12.42
Netmask [i]: 255.255.255.0
IPv4 Address: 192.168.12.42
Netmask: 255.255.255.0

Is this correct? y/n [y]: y

Reconfiguring eth1...
Determining if ip address 192.168.12.42 is already in use for device eth1...
wami_login: no process killed
Network parameters successfully changed to requested values

**Main Menu**

0) Show Current Configuration (scroll with Shift-PgUp/PgDown)
1) Exit this program
2) Default Gateway
3) Hostname
4) DNS
5) Proxy Server
6) IP Address Allocation for eth0
7) IP Address Allocation for eth1
Enter a menu number [0]: _

---

Add Licenses to UCSDE

To add licenses to UCSDE, complete the following steps:

1. In a web browser, go to the UCSDE IP address.

2. Login as admin with a password of admin.
3. Change the password, as shown in Figure 231

4. Use the Guided Setup for Initial System Configuration to upload the license, select a locale, configure an SMTP mail server, configure your email address, and/or set up NTP and DNS servers.
Alternatively, you can upload and configure the license with the following steps:

1. **Navigate to** Administration > License.

2. **Click** Upload and browse to the license file.
3. Click Submit.

After uploading the license, enable the Big Data personality to unlock certain menu options.

4. Navigate to Administration > License.

5. Select the license and click on Manage Personalities.

6. In the Personality Configuration window, select Big Data only.

7. Click Submit.

   
   a. Login to the UCSDE console as ‘shelladmin’
   b. In the Shell Menu, select 3 to stop services.
   c. Select 2 to confirm that the services have stopped.
   d. Select 4 to start services.
   e. Select 2 to confirm that the services have restarted successfully.

9. Re-login to UCSDE.

Building the Software Catalog

Cisco UCSDE uses a catalog of installed software when it deploys a cluster. For this Splunk cluster, Red Hat Enterprise Linux 6.8 and Splunk are installed, other Hadoop distributions and versions can also be used. Have the RHEL ISO in the BMA VM.

1. Go to Solutions > Big Data > Settings.

2. Select the Software Catalogs tab.

3. Click Add.

4. In the Create Software Catalogs dialog box, select the target BMA.

5. Check the Restart BMA Services checkbox.

6. In the Linux OS Upload section, enter RHEL6.8 for the Catalog Name (the name can not have any spaces).

7. From the Upload Type drop-down menu, select Path to ISO in BMA.

8. Specify the location of the ISO file.

9. Click Submit.
10. After some time, click Refresh and see RHEL6.8 in the software catalog. Figure 235 below shows the software catalog sorted by the Missing Packages column so that RHEL6.8 will be the first entry.
Put software files in specific folders for UCSDE to find.

- In the Software Catalogs tab, see the files for a particular Hadoop distribution in the Required Packages column.
- The Available Packages column shows which files UCSDE already has.

11. The Missing Packages column shows which files it still needs.

- The Required Packages list is maintained in the HadoopDistributionRPM.txt file located in the BMA's /opt/cnsaroot/bigdata_templates/common_templates directory. It may be necessary sometimes to change these requirements (for example, if you are using a newer version of a required utility file). Please note that the file names are case-sensitive.

```
[root@localhost ~]# cd /opt/cnsaroot/bigdata_templates/common_templates/
[root@localhost common_templates]# vi HadoopDistributionRPM.txt
```

For Splunk 6.4.0, there are several missing files. Some files, such as clustershell, are used by many distributions and can be placed in the /opt/cnsaroot/bd-sw-rep directory in the BMA VM. Files that are specific to a particular distribution should be placed in the appropriate subfolder in the /opt/cnsaroot/bd-sw-rep directory.

1. **Copy the following files to** /opt/cnsaroot/bd-sw-rep:

   - clustershell-1.7-1.el6.noarch.rpm
   - libyaml-0.1.3-4.el6_6.x86_64.rpm
   - PyYAML-3.10-3.1.el6.x86_64.rpm

2. **Copy these Splunk files to** /opt/cnsaroot/bd-sw-rep/splunk-6.4.0:

   - splunk-6.4.0-f2c836328108-linux-2.6-x86_64.rpm
   - splunk.license

3. In the Software Catalogs tab in UCSDE, click Refresh and confirm that there are no longer any files in the Missing Packages column of the Splunk distribution.

To use a version of Splunk that does not already have a software catalog, complete the following steps, (Splunk 6.4.3 is used in this example, but this can be adapted for any version):

4. **Copy the following files to** /opt/cnsaroot/bd-sw-rep:

   - clustershell-1.7-1.el6.noarch.rpm
   - libyaml-0.1.3-4.el6_6.x86_64.rpm
   - PyYAML-3.10-3.1.el6.x86_64.rpm
5. Create a folder called splunk-6.4.3 containing the files splunk-6.4.3-b03109c2bad4-linux-2.6-x86_64.rpm and splunk.license.

6. Zip that folder in a file called splunk-6.4.3.zip.

7. In UCSDE, go to Solutions > Big Data > Settings.

8. Click the Software Catalogs tab.

9. Click Add.

10. In the Create Software Catalogs window, click the Upload... button.

11. In the File Upload window, click the link to upload the zip file you created in Step 2.

12. When the upload completes, click Submit.

Figure 236 Uploading the Splunk Zip File

13. In the Big Data Software Upload section, enter splunk-6.4.3 for the Catalog Name.

14. Keep the Upload Type set to Desktop File and note that your zip file shows up as the uploaded file.
15. Click Submit.

16. Click OK.

17. After some time, the splunk-6.4.3 software catalog will be created. There will be a splunk-6.4.3 subdirectory in /opt/cnsaroot/bd-sw-rep and splunk-6.4.3 will show up in the Software Catalogs list in UCSDE. Confirm that there are no missing packages.

Creating IP Pools

Create IP pools for the Splunk cluster. While provisioning the cluster, these pools will be associated with the NICs. UCSD Express workflow will assign IP addresses to the NICs from their respective IP pools. There will be one pool for management and two pools for data.

1. In UCS Director, navigate to Solutions > Big Data > Settings.

2. Click on the Big Data IP Pools tab.
3. Click the Add button.

4. Enter the IP Pool Name. We will be creating three pools (one for each vNIC interface): MGMT, DATA1, and DATA2.

5. (Optional) Enter a description for the IP pool.

6. Keep the Assignment Order as Default.

Figure 238   Creating and Naming an IP Pool

7. Click Next.

8. Click the Add button (designated with the + symbol) to add an entry to the list of IPv4 blocks.

9. Enter the IP address range, subnet mask, and default gateway.

10. Click Submit.
11. Verify the details in the table and click Submit to create the IP pool.

12. Repeat the above steps to create two more pools.

Creating an Instant Splunk Cluster

When creating a Splunk cluster, UCSDE will automatically associate the servers with a service profile, install Red Hat Enterprise Linux and Splunk, and assign roles to the servers.

To create a Splunk cluster, complete the following steps:

1. Go to Solutions > Big Data > Containers.

2. Select the Cluster Deploy Templates tab.

3. Click on Instant Splunk Cluster Creation.

4. In the Instant Splunk Cluster Creation dialog box, complete the fields as shown in Table 13.

<table>
<thead>
<tr>
<th>Table 13</th>
<th>Splunk Cluster Fields</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Name</td>
<td>Description</td>
</tr>
<tr>
<td>Big Data Account Name</td>
<td>The name of the Big Data account</td>
</tr>
<tr>
<td>UCSM Policy Name Prefix</td>
<td>The UCSM Policy Name prefix is used in naming the service profile template</td>
</tr>
<tr>
<td>SSH (root) Password Confirm SSH Password</td>
<td>The SSH root password. The SSH username pertains to the root user.</td>
</tr>
<tr>
<td>Splunk Manager Password Confirm Splunk Manager Password</td>
<td>The management console password</td>
</tr>
<tr>
<td>OS Version</td>
<td>Choose the operating system to be installed on the servers in this cluster.</td>
</tr>
<tr>
<td>Splunk Distribution Version</td>
<td>Choose the Splunk Enterprise version to be used for this cluster.</td>
</tr>
<tr>
<td>Field Name</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Multi-UCSM</td>
<td>Check the Multi-UCSM check box if you use multiple UCSM accounts. In this design, we are leaving this unchecked.</td>
</tr>
<tr>
<td>UCS Manager Account</td>
<td>Choose the Cisco UCS Manager account for this cluster.</td>
</tr>
<tr>
<td>Organization</td>
<td>Choose the organization in which the servers for this cluster are located. If you did not create an organization, this will be root.</td>
</tr>
<tr>
<td>UCS SP Template</td>
<td>This is not a mandatory field. Leave this blank; UCSDE will create a service profile template for you.</td>
</tr>
<tr>
<td>PXE VLAN ID</td>
<td>Enter the PXE VLAN ID.</td>
</tr>
</tbody>
</table>

Figure 240  Instant Splunk Cluster Creation Window

5. Enter 2 for the **Replication Factor**.

6. Enter 2 for the **Search Factor**.

7. In the **Splunk Server Roles** section, edit each role (click the role and then click the pencil icon) to specify the number of nodes for that role, the host name prefix, and the server pool. Recall that we created three separate server pools for these roles. There will be 8 indexers, 3 search heads, and 2 admin nodes, as shown in Figure 241

If using Cisco C240 M4 servers for the indexers, check the box for “SSD Boot Drives Available for OS” when editing the server roles for indexers.
Figure 241  Indexer Values
8. In the vNIC Template section, edit each vNIC to configure it with the appropriate IP pool. If no service profile template was specified in step 4, specify the MAC address pool and VLAN for each vNIC, as shown in Figure 243.
9. Click Submit.

10. Monitor the workflow by going to Organization > Service Requests. Click on the workflow and then click View Details to bring up the Service Request window. See Figure 245

Figure 245 Service Requests

11. Certain steps may require approval, as shown in Figure 246 Go to Organizations > My Approvals to approve.
The Multi-UCSM Splunk Cluster workflow should trigger the Single UCSM Server Configuration workflow. In turn, the Single UCSM Server Configuration workflow should trigger multiple baremetal node workflows. These workflows will appear in the service requests list like in the screenshot as shown in Figure 247.

If a service request fails, retry the request. Or rollback the multi-node request to restore the system to the state before the workflow was executed. This will allow changes to be made before reattempting the
request. To do this, select the UCS CPA Multi-UCSM Splunk Cluster WF and then click Rollback Request. The rollback may have to be approved, as shown in Figure 248.

Figure 248  Approvals

12. Deployment is finished when all workflows have a status of Complete.

Figure 249  Workflow Status

13. To view information about this cluster go to Solution > Big Data > Accounts, Select the Splunk Accounts tab, then select the account (as specified in the field Big Data Account Name), and click View Details.
14. Open the Splunk Distributed Management Console on the admin1 node by selecting the account in the Splunk Accounts tab and clicking Launch Splunk DMC.

15. Login with the user admin and password specified in Splunk Manager Password created for the cluster.

**Figure 250** Splunk Distributed Management Console

Perform further verification by following the steps in the sections Configuring the Deployment Server and onward.