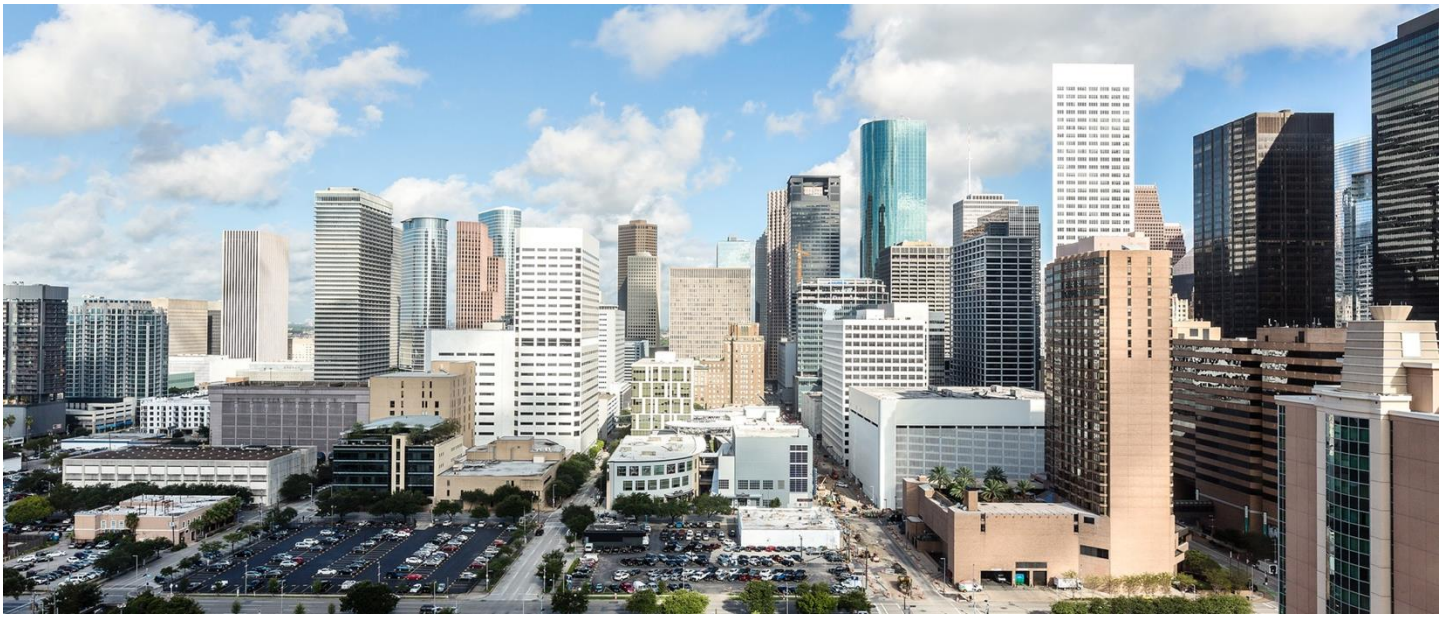
Cisco UCS Scale-Up Solution for SAP HANA on Cisco UCS M5 Rack Servers with Red Hat Enterprise Linux for SAP HANA



Design and deploy a SAP HANA single-node solution based on standalone Cisco UCS M5 rack servers with Red Hat Enterprise Linux for SAP HANA 7.3

April 2018

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Executive Summary

Organizations in every industry are generating and using more data than ever before: from customer transactions and supplier delivery information to real-time user-consumption statistics. Without reliable infrastructure that can store, process, and analyze big data sets in real time, companies are unable to use this information to their advantage. The Cisco® Scale-Up Solution for SAP HANA with the Cisco Unified Computing System™ (Cisco UCS®) using the Cisco UCS C480, C240, and C220 M5 Rack Servers helps companies more easily harness information and make better business decisions that let them stay ahead of the competition. Our solutions help improve access to all your data to accelerate business decision making with policy-based, simplified management; lower deployment risk; and reduced total cost of ownership (TCO). Our innovations help enable you to unlock the intelligence in your data and interpret it with a new dimension of context and insight to help you gain a sustainable, competitive business advantage.

The Cisco solution for SAP HANA with the Cisco UCS M5 rack-mount servers provides a robust platform for SAP HANA workloads in a single node. This document focuses on the Cisco UCS C480 server.

Solution Overview

Introduction

The Cisco UCS M5 rack server scale-up solution provides a prevalidated, ready-to-deploy infrastructure, reducing the time and complexity involved in configuring and validating a traditional data center deployment. The reference architecture detailed in this document highlights the resiliency and ease of deployment of an SAP HANA solution.

SAP HANA is SAP's implementation of in-memory database technology. The SAP HANA database takes advantage of the low-cost main memory (RAM), faster access, and data-processing capabilities of multicore processors to provide better performance for analytical and transactional applications. SAP HANA offers a multiple-engine query-processing environment that supports relational data (with both row- and column-oriented physical representations in a hybrid engine) as well as graph and text processing for semistructured and unstructured data management within the same system. As an appliance, the SAP HANA solution combines software components from SAP optimized for certified hardware. However, this solution has a preconfigured hardware setup and preinstalled software package that is dedicated to SAP HANA. In 2013, SAP introduced the SAP HANA Tailored Datacenter Integration (TDI) option. TDI offers a more open and flexible way to integrate SAP HANA into the data center by reusing existing enterprise storage hardware, thereby reducing hardware costs. With the introduction of SAP HANA TDI for shared infrastructure, the Cisco UCS Integrated Infrastructure solution provides the advantages of an integrated computing, storage, and network stack and the programmability of Cisco UCS. The TDI option enables organizations to run multiple SAP HANA production systems on a shared infrastructure. It also enables customers to run SAP application servers and the SAP HANA database hosted on the same infrastructure.

For more information about SAP HANA, see the SAP help portal: http://help.sap.com/hana/.

Audience

The intended audience for this document includes sales engineers, field consultants, professional services staff, IT managers, partner engineers, and customers deploying the Cisco solution for SAP HANA. External references are provided wherever applicable, but readers are expected to be familiar with the technology, infrastructure, and database security policies of the customer installation.

Purpose of this document

This document describes the steps required to deploy and configure a Cisco data center solution for SAP HANA. This document showcases one of the variants of Cisco's solution for SAP HANA. Although readers of this document are expected to have sufficient knowledge to install and configure the products used, configuration details that are important to the deployment of this solution are provided in this document.

Solution summary: Cisco UCS C480 M5 Rack Server

The Cisco Scale-Up Solution for SAP HANA can be deployed on the Cisco UCS C480 M5 Rack Server. Tables 1, 2, and 3 summarize the server specifications and show proposed disk configurations for the SAP HANA use case.

Table 1. Overview of Cisco UCS C480 M5 Rack Server configuration

CPU specification	2.50-GHz Intel® Xeon® processor 8180 Platinum CPU Quantity: 2 or 4	
Possible memory configurations	**Analytics**	**SAP Business Suite on SAP HANA (SoH)**
	• 16-GB DDR4: Quantity 12 (192 GB) • 32-GB DDR4: Quantity 12 (384 GB) • 32-GB DDR4: Quantity 24 (768 GB) • 64-GB DDR4: Quantity 24 (1.5 TB) • 128-GB DDR4: Quantity 24 (3 TB)	• 16-GB DDR4: Quantity 12 (192 GB) • 32-GB DDR4: Quantity 12 (384 GB) • 32-GB DDR4: Quantity 24 (768 GB) • 64-GB DDR4: Quantity 24 (1.5 TB) • 128-GB DDR4: Quantity 24 (3 TB) • 128-GB DDR4: Quantity 48 (6 TB)
Hard-disk drive (HDD) type and quantity	• 1.8-TB 10,000-rpm SAS drives: Quantity 20 • 3.8-TB SSD: Quantity 8 • 3.8-TB SSD: Quantity 3 (for up to 1.5-TB memory configurations)	
BIOS	Release C480M5.3.1.0.248.0518171057	
Cisco Integrated Management Controller (IMC) firmware	Release 3.1(0.213)	
LSI MegaRAID controller	Cisco 12-Gbps SAS modular RAID controller	
Network card	Cisco UCS Virtual Interface Card (VIC) 1385: Quantity 2 For 10-Gbps connectivity: • Onboard Intel 1 Gigabit Ethernet controller: Quantity 2 • Onboard Intel 10BASE-T Ethernet controller: Quantity 2	
Power supply	Redundant power supplies: Quantity 4	

Table 2. Cisco UCS C480 M5 proposed disk layout

Disk	Disk type	Drive group	RAID level	Virtual drive
Slot (1 through 20)	SAS HDD	DG0	50	VD0
Slot (1 through 8)	SSD	DG0	5	VD0
Slot (1 through 3); up to 1.5 TB of RAM	SSD	DG0	5	VD0

Table 3. Cisco UCS C480 M5 proposed disk configuration

Drives used	RAID type	Used for	File system
• 20 x 1.8-TB SAS HDD • 8 x 3.8-TB SSD • 3 x 3.8-TB SSD	• RAID 50 • RAID 5 • RAID 5	Operating system	ext3
		Data file system	XFS
		Log file system	XFS
		HANA shared file system	XFS

Solution summary: Cisco UCS C240 M5 Rack Server

The Cisco Scale-Up Solution for SAP HANA can be deployed on the Cisco UCS C240 M5 Rack Server. Tables 4, 5, and 6 summarize the server specifications and show proposed disk configurations for the SAP HANA use case.

Table 4. Overview of Cisco UCS C240 M5 Rack Server configuration

CPU specification	2.50-GHz Intel® Xeon® processor 8180 Platinum CPU Quantity: 2
Possible memory configurations	**Analytics** • 16-GB DDR4: Quantity 12 (192 GB) • 32-GB DDR4: Quantity 12 (384 GB) • 32-GB DDR4: Quantity 24 (768 GB) • 64-GB DDR4: Quantity 24 (1.5 TB) • 128-GB DDR4: Quantity 24 (3 TB)
HDD type and quantity	• 1.8-TB 10,000-rpm SAS drives: Quantity 20 • 3.8-TB SSD: Quantity 8 • 3.8-TB SSD: Quantity 3 (for up to 1.5-TB memory configurations)
BIOS	Release C480M5.3.1.0.248.0518171057
Cisco IMC firmware	Release 3.1(1d)
Network card	Cisco UCS VIC 1385: Quantity 2 For 10-Gbps connectivity: • Onboard Intel 1 Gigabit Ethernet controller: Quantity 2 • Onboard Intel 10BASE-T Ethernet controller: Quantity 2
Power supply	Redundant power supplies: Quantity 2

Table 5. Cisco UCS C240 M5 proposed disk layout

Disk	Disk type	Drive group	RAID level	Virtual drive
Slot (1 through 20)	SAS HDD	DG0	50	VD0
Slot (1 through 8)	SSD	DG0	5	VD0
Slot (1 through 3); up to 1.5 TB of RAM	SSD	DG0	5	VD0

Table 6. Cisco UCS C240 M5 proposed disk configuration

Drives used	RAID type	Used for	File system
• 20 x 1.8-TB SAS HDD • 8 x 3.8-TB SSD • 3 x 3.8-TB SSD	• RAID 50 • RAID 5 • RAID 5	Operating system	ext3
		Data file system	XFS
		Log file system	XFS
		HANA shared file system	XFS

Solution summary: Cisco UCS C220 M5 Rack Server

The Cisco Scale-Up Solution for SAP HANA can also be deployed on the Cisco UCS C220 M5 Rack Server. Tables 7, 8, and 9 summarize the server specifications and show proposed disk configurations for the SAP HANA use case.

Table 7. Overview of Cisco UCS C220 M5 Rack Server configuration

CPU specification	2.50-GHz Intel® Xeon® processor 8180 Platinum CPU Quantity: 2
Possible memory configurations	**Analytics** • 16-GB DDR4: Quantity 12 (192 GB) • 32-GB DDR4: Quantity 12 (384 GB) • 32-GB DDR4: Quantity 24 (768 GB) • 64-GB DDR4: Quantity 24 (1.5 TB) • 128-GB DDR4: Quantity 24 (3 TB)
HDD type and quantity	• 3.8 TB SSD: Quantity 8 • 3.8 TB SSD: Quantity 3 (for up to 1.5-TB memory configurations)
BIOS	Release C480M5.3.1.0.248.0518171057
Cisco IMC firmware	Release 3.1(1d)
Network card	Cisco UCS VIC 1385: Quantity 2 For 10-Gbps connectivity: • Onboard Intel 1 Gigabit Ethernet controller: Quantity 2 • Onboard Intel 10BASE-T Ethernet controller: Quantity 2
Power supply	Redundant power supplies: Quantity 2

Table 8. Cisco UCS C220 M5 proposed disk layout

Disk	Disk type	Drive group	RAID level	Virtual drive
Slot (1 through 8)	SSD	DG0	5	VD0
Slot (1 through 3); up to 1.5 TB of RAM	SSD	DG0	5	VD0

Table 9. Cisco UCS C220 M5 proposed disk configuration

Drives used	RAID type	Used for	File system
• 8 x 3.8-TB SSD • 3 x 3.8-TB SSD	• RAID 5 • RAID 5	Operating system	ext3
		Data file system	XFS
		Log file system	XFS
		HANA shared file system	XFS

Infrastructure overview

Cisco UCS C480 M5 Rack Server

C480 M5 servers can be deployed as standalone servers or in a Cisco UCS managed environment. When used in combination with Cisco UCS Manager, the C480 M5 brings the power and automation of unified computing to enterprise applications, including Cisco SingleConnect technology, drastically reducing switching and cabling requirements. Cisco UCS Manager uses service profiles, templates, and policy-based management to enable rapid deployment and help ensure deployment consistency. It also enables end-to-end server visibility, management, and control in both virtualized and bare-metal environments.

Use cases include the following:

- In-memory databases
- Big data analytics
- Virtualization and virtual desktop infrastructure (VDI) workloads
- Bare-metal applications

The Cisco UCS C480 M5 Rack Server (Figure 1) is a storage- and I/O-optimized enterprise-class rack server that delivers industry-leading performance for in-memory databases, big data analytics, virtualization, VDI, and bare-metal applications. The C480 M5 delivers outstanding levels of expandability and performance for standalone and Cisco UCS managed environments in a 4-rack-unit (4RU) form-factor. And because of its modular design, you pay for only what you need. The C480 R5 offers these capabilities:

- Latest Intel Xeon Scalable processors with up to 28 cores per socket and support for two- or four-processor configurations
- 2666-MHz DDR4 memory and 48 DIMM slots for up to 6 TB of total memory
- 12 PCI Express (PCIe) 3.0 slots
- Six x8 full-height, full-length slots
- Six x16 full-height, full-length slots
- Flexible storage options with support up to 32 small-form-factor (SFF) 2.5-inch SAS, SATA, and PCIe Non-Volatile Memory Express (NVMe) disk drives
- Cisco 12-Gbps SAS modular RAID controller in a dedicated slot
- Internal Secure Digital (SD) and M.2 boot options
- Dual embedded 10 Gigabit Ethernet LAN-on-motherboard (LOM) ports

Figure 1. Cisco C480 M5 Rack Server

Cisco UCS C240 M5 Rack Server

The Cisco UCS C240 M5 Rack Server (Figure 2) is a 2-socket, 2RU rack server offering industry-leading performance and expandability. It supports a wide range of storage and I/O-intensive infrastructure workloads, from big data and analytics to collaboration. Cisco UCS C-Series Rack Servers can be deployed as standalone servers or as part of a Cisco UCS managed environment to take advantage of Cisco's standards-based unified computing innovations that help reduce TCO and increase business agility.

In response to ever-increasing computing and data-intensive real-time workloads, the enterprise-class Cisco UCS C240 M5 server extends the capabilities of the Cisco UCS portfolio in a 2RU form factor. It incorporates the Intel Xeon Scalable processors, supporting up to 20 percent more cores per socket, twice the memory capacity, and five times more NVMe PCIe solid-state disks (SSDs) compared to the previous generation of servers. These improvements deliver significant performance and efficiency gains that will improve your application performance. The C240 M5 delivers outstanding levels of storage expandability with exceptional performance, with:

- The latest Intel Xeon Scalable CPUs, with up to 28 cores per socket
- Up to 24 DDR4 DIMMs for improved performance
- Intel 3D XPoint-ready support, with built-in support for next-generation nonvolatile memory technology
- Up to 26 hot-swappable SFF 2.5-inch drives, including 2 rear hot-swappable SFF drives (up to 10 support NVMe PCIe SSDs on the NVMe-optimized chassis version), or 12 large-form-factor (LFF) 3.5-inch drives plus 2 rear hot-swappable SFF drives
- Support for 12-Gbps SAS modular RAID controller in a dedicated slot, leaving the remaining PCIe Generation 3.0 slots available for other expansion cards
- Modular LOM (mLOM) slot that can be used to install a Cisco UCS VIC without consuming a PCIe slot, supporting dual 10- or 40-Gbps network connectivity
- Dual embedded Intel x550 10GBASE-T LOM ports
- Modular M.2 or SD cards that can be used for boot

High performance for data-intensive applications

The Cisco UCS C240 M5 Rack Server is well-suited for a wide range of enterprise workloads, including:

- Big data and analytics
- Collaboration
- Small and medium-sized business databases
- Virtualization and consolidation
- Storage servers
- High-performance appliances

C240 M5 servers can be deployed as standalone servers or in a Cisco UCS managed environment. When used in combination with Cisco UCS Manager, the C240 M5 brings the power and automation of unified computing to enterprise applications, including Cisco SingleConnect technology, drastically reducing switching and cabling requirements.

Cisco UCS Manager uses service profiles, templates, and policy-based management to enable rapid deployment and help ensure deployment consistency. If also enables end-to-end server visibility, management, and control in both virtualized and bare-metal environments.

Figure 2. Cisco UCS C240 M5 Rack Server

Cisco UCS C220 M5 Rack Server

The Cisco UCS C220 M5 Rack Server (Figure 3) is among the most versatile general-purpose enterprise infrastructure and application servers in the industry. It is a high-density 2-socket rack server that delivers industry-leading performance and efficiency for a wide range of workloads, including virtualization, collaboration, and bare-metal applications. The Cisco UCS C-Series Rack Servers can be deployed as standalone servers or as part of Cisco UCS to take advantage of Cisco's standards-based unified computing innovations that help reduce TCO and increase business agility.

The Cisco UCS C220 M5 server extends the capabilities of the Cisco UCS portfolio in a 1RU form factor. It incorporates the Intel Xeon Scalable processors, supporting up to 20 percent more cores per socket, twice the memory capacity, 20 percent greater storage density, and five times more PCIe NVMe SSDs compared to the previous generation of servers. These improvements deliver significant performance and efficiency gains that will improve your application performance. The C220 M5 delivers outstanding levels of expandability and performance in a compact package, with:

- The latest Intel Xeon Scalable CPUs, with up to 28 cores per socket
- Up to 24 DDR4 DIMMs for improved performance
- Intel 3D XPoint-ready support, with built-in support for next-generation nonvolatile memory technology
- Up to 10 SFF 2.5-inch drives or 4 LFF 3.5-inch drives (77 TB storage capacity with all NVMe PCIe SSDs)
- Support for a 12-Gbps SAS modular RAID controller in a dedicated slot, leaving the remaining PCIe Generation 3.0 slots available for other expansion cards
- An mLOM slot that can be used to install a Cisco UCS VIC without consuming a PCIe slot, supporting dual 10- and 40-Gbps network connectivity
- Dual embedded Intel x550 10GBASE-T LOM ports

High performance for data-intensive applications

The Cisco UCS C220 M5 rack server is well-suited for a wide range of enterprise workloads, including:

- Big data and analytics
- Collaboration
- Small and medium-sized business databases
- Virtualization and consolidation
- Storage servers
- High-performance appliances

C220 M5 servers can be deployed as standalone servers or in a Cisco UCS managed environment. When used in combination with Cisco UCS Manager, the C220 M5 brings the power and automation of unified computing to enterprise applications, including Cisco SingleConnect technology, drastically reducing switching and cabling requirements.

Cisco UCS Manager uses service profiles, templates, and policy-based management to enable rapid deployment and help ensure deployment consistency. If also enables end-to-end server visibility, management, and control in both virtualized and bare-metal environments.

Figure 3. Cisco UCS C220 M5 Rack Server

Solution design

This section describes the SAP HANA system requirements defined by SAP and the architecture of the Cisco UCS solution for SAP HANA.

SAP HANA system

An SAP HANA scale-up system on a single server is the simplest of the SAP HANA installation types. You can run an SAP HANA system entirely on one host and then scale the system up as needed. All data and processes are located on the same server and can be accessed locally. For this option the network must have least one 1 Gigabit Ethernet access network and one 10 Gigabit Ethernet storage network.

Hardware requirements for the SAP HANA database

SAP defines hardware and software requirements for running SAP HANA systems. For the latest information about the CPU and memory configurations supported for SAP HANA, please refer to https://global.sap.com/community/ebook/2014-09-02-hana-hardware/enEN/index.html.

Note: This document does not cover the updated information published by SAP. Additional information is available at http://saphana.com/.

File system layout

Figures 4, 5, and 6 show the file system layout and the required storage sizes for installing and operating SAP HANA. When installing SAP HANA on a host, specify the mount point for the installation binaries (/hana/shared/<sid>), data files (/hana/data/<sid>), and log files (/hana/log/<sid>), where sid is the instance identifier of the SAP HANA installation.

Figure 4. Proposed disk layout with partition mapping with 20 SAS drives

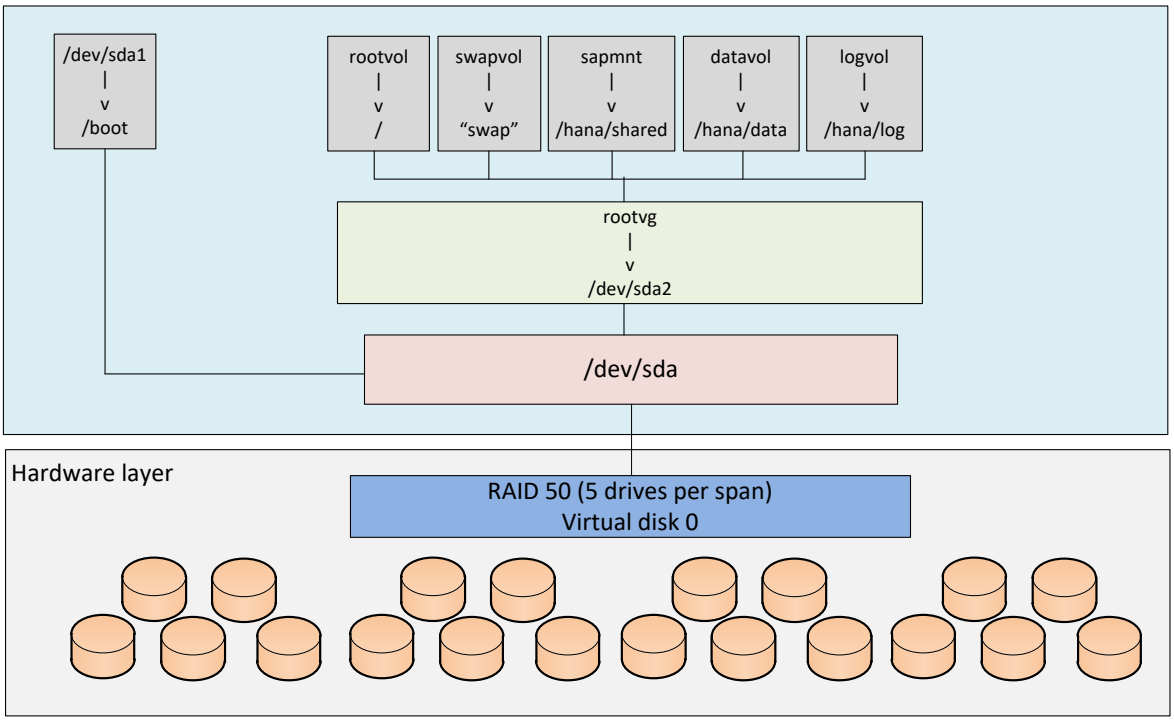


Figure 5. Proposed disk layout with partition mapping with eight SSD drives

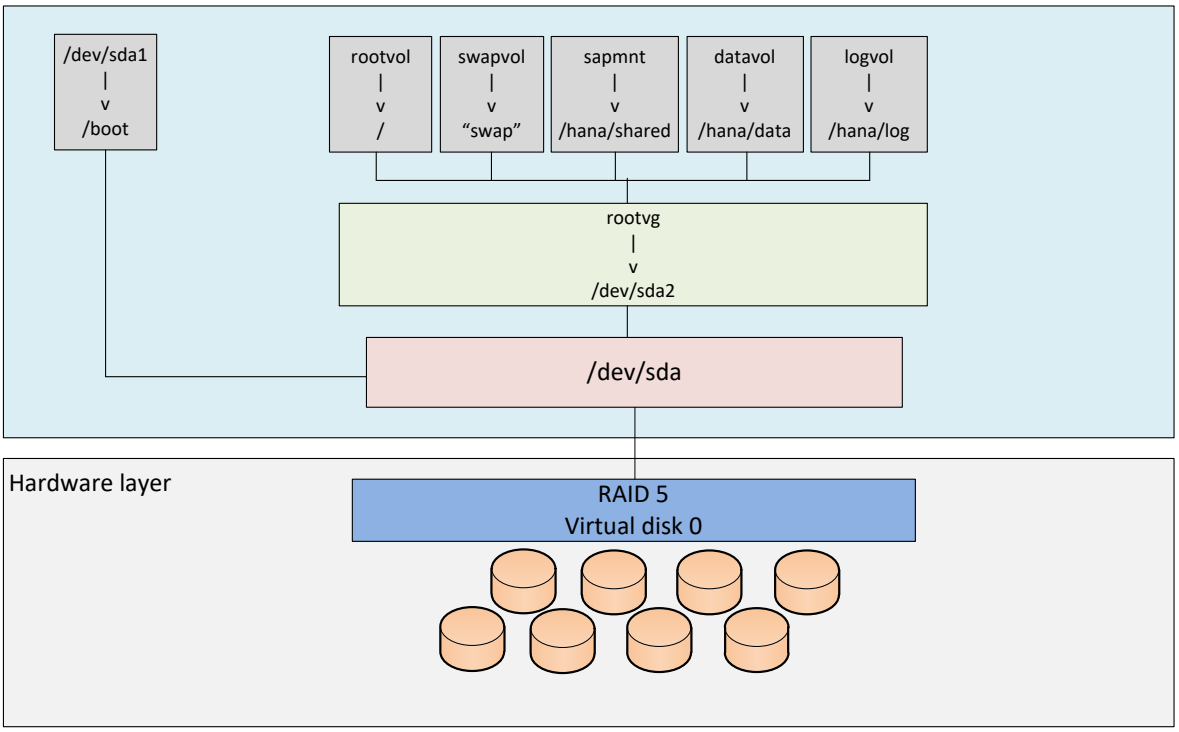
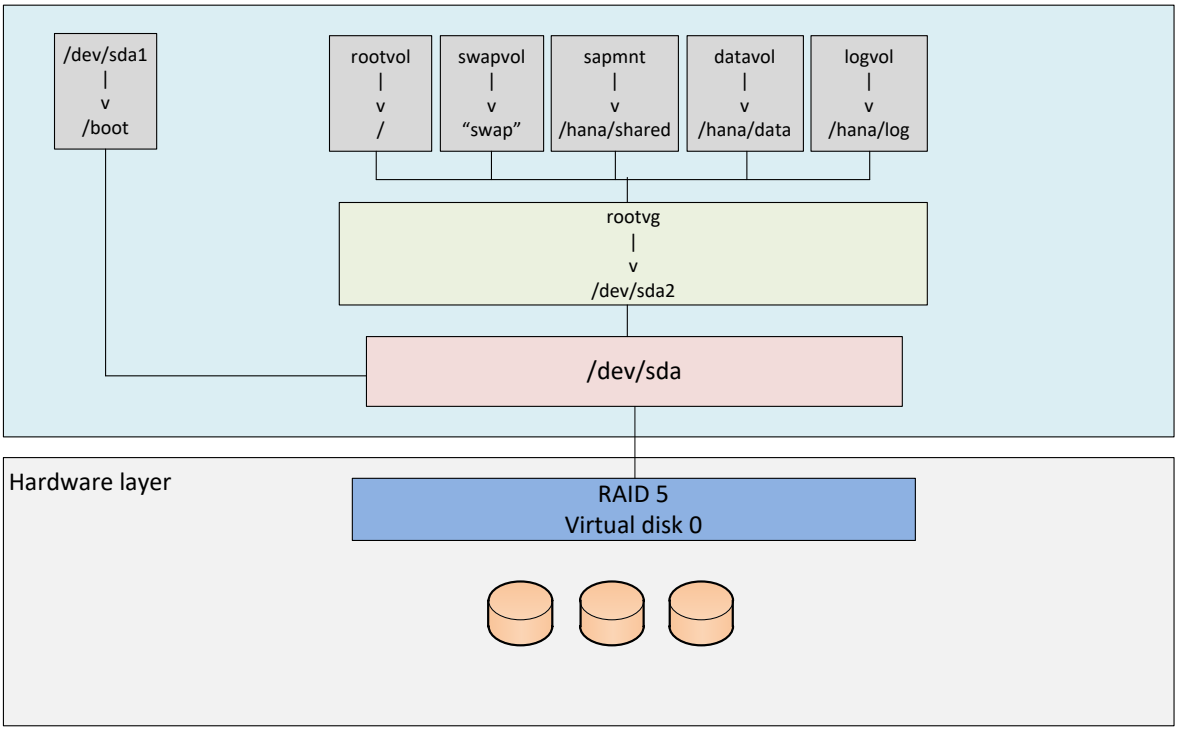


Figure 6. Proposed disk layout with partition mapping with three SSD drives (configurations with up to 1.5 TB of memory)



The storage size for the file system is based on the amount of memory on the SAP HANA host.

The following list shows sample file system sizes for a single-node system with 3 TB of memory:

- /hana/shared: 1 x memory (3 TB)
- /hana/data: 3 x memory (9 TB)
- /hana/log: 1 x memory (512 GB)*

* For solutions based on the Intel Xeon processor Platinum CPU, the size of the log volume must be as follows:

  - Half of the server memory for systems ≤ 256 GB of memory
  - Minimum of 512 GB for systems with ≥ 512 GB of memory

Operating system

SAP HANA supports the following operating systems:

- SUSE Linux Enterprise Server (SLES) for SAP applications
- Red Hat Enterprise Linux (RHEL) for SAP applications

Note: This document provides installation steps for RHEL for SAP Applications 7.3.

Deployment hardware and software

Configuration guidelines

This section is intended to enable you to fully configure the customer environment. In this process, various steps require you to insert customer-specific naming conventions, IP addresses, and VLAN schemes, as well as to record appropriate MAC addresses. Table 10 lists the configuration variables that are used throughout this document. This table can be completed based on the specific site variables and used in implementing the configuration steps presented in this document.

Table 10. Configuration variables

Variable	Description	Customer implementation value
<<var_cimc_ip_address>>	Cisco UCS C480 M5 server's IMC IP address	
<<var_cimc_ip_netmask>>	Cisco UCS C480 M5 server's IMC network netmask	
<<var_cimc_gateway_ip>>	Cisco UCS C480 M5 server's IMC network gateway IP address	
<<var_raid50_vd_name>>	Name for virtual drive VD0 during RAID configuration	
<<var_hostname.domain>>	SAP HANA node's fully qualified domain name (FQDN)	
<<var_sys_root-pw>>	SAP HANA node's root password	
<<var_lvm_vg_name>>	SAP HANA node's OS logical volume management (LVM) volume group name	
<<var_mgmt_ip_address>>	SAP HANA node's management and administration IP address	
<<var_mgmt_nw_netmask>>	SAP HANA node's management network netmask	
<<var_mgmt_gateway_ip>>	Cisco UCS C480 M5 server's management and administrative network gateway IP address	
<<var_mgmt_netmask_prefix>>	Netmask prefix in Classless Inter-Domain Routing (CIDR) notation	

Preparing the SAP HANA scale-up node

Configuring the Cisco Integrated Management Controller

To configure the on-board Cisco IMC, first connect a KVM switch to the server.

1. After everything is connected, turn on the power to the server (Figures 7 and 8).

Figure 7. BIOS POST screen

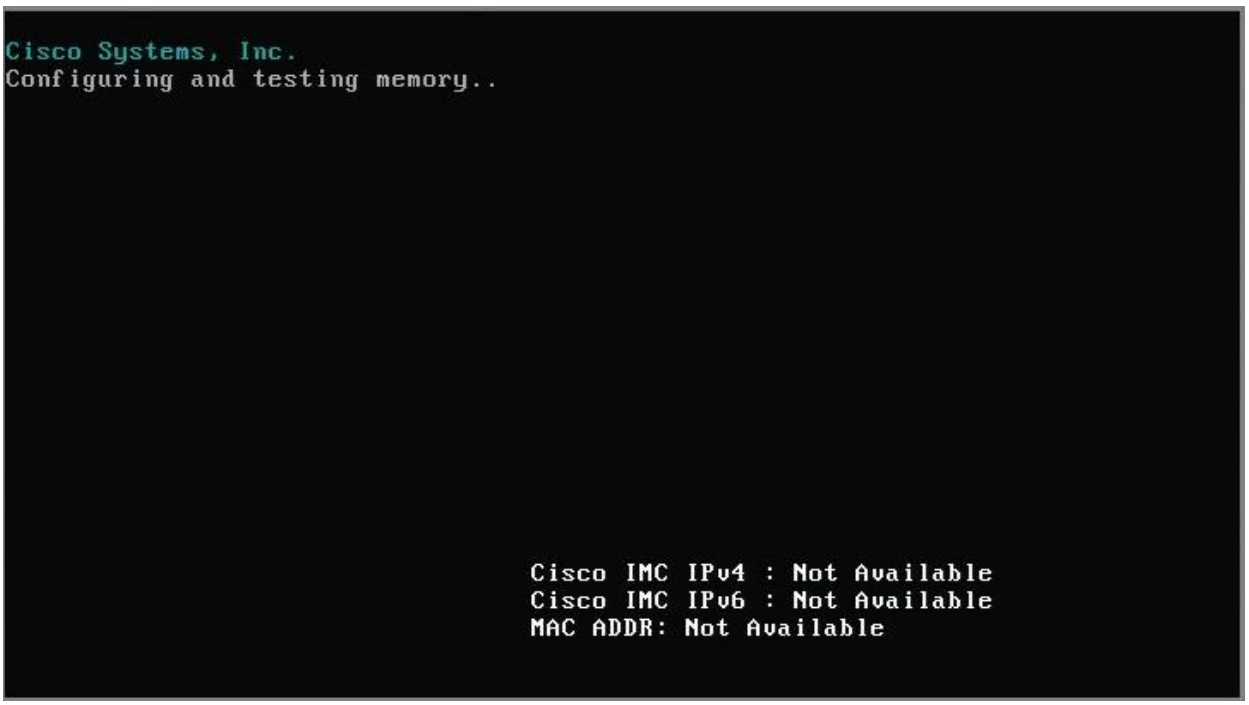
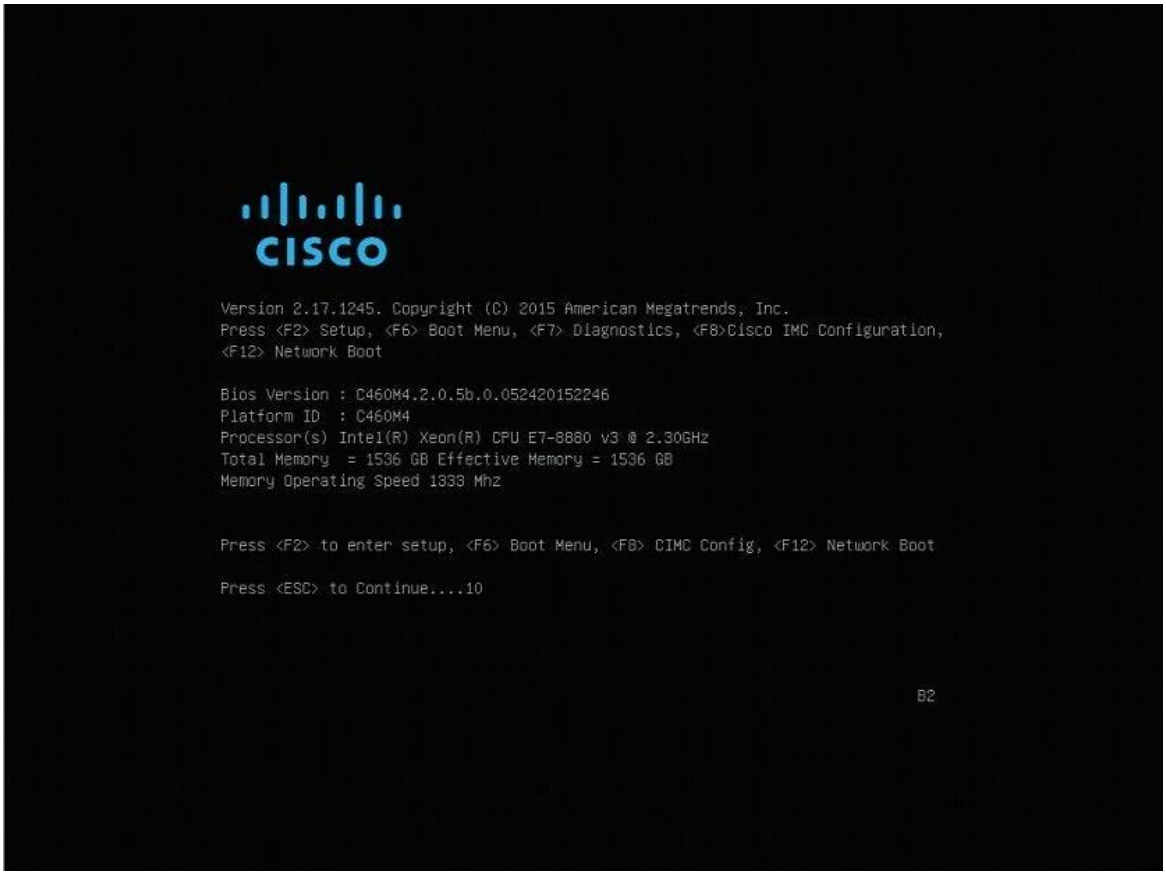
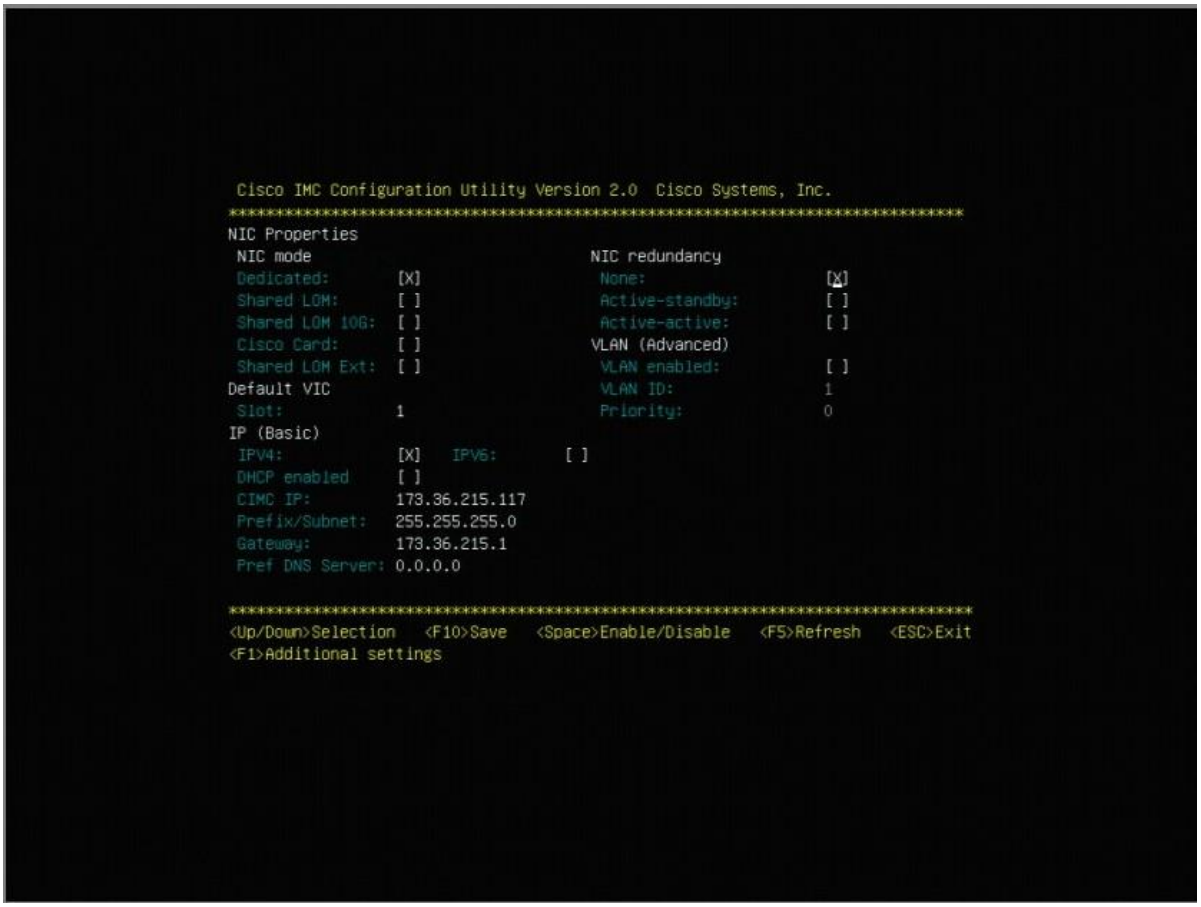


Figure 8. BIOS post screen (continued)



2. Press F8 to display the IMC configuration (Figure 9)

Figure 9. Cisco UCS C480 IMC configuration view (local display)



3. Use the console network IP address **<<var_cimc_ip_address>>**, netmask **<<var_cimc_ip_netmask>>**, and gateway **<<var_cimc_gateway_ip>>** for the IPv4 settings of the IMC. Select None for NIC redundancy.
4. Press F10 to save the configuration and exit the utility.
5. Open a web browser on a computer on the same network with Java and Adobe Flash installed.
6. Enter the IMC IP address of the Cisco UCS C480 M5 server: **http://<<var_cimc_ip_address>>**.
7. Enter the login credentials as updated in the IMC configuration. The default user name and password are **admin** and **password**.

Figure 10. Cisco IMC login screen

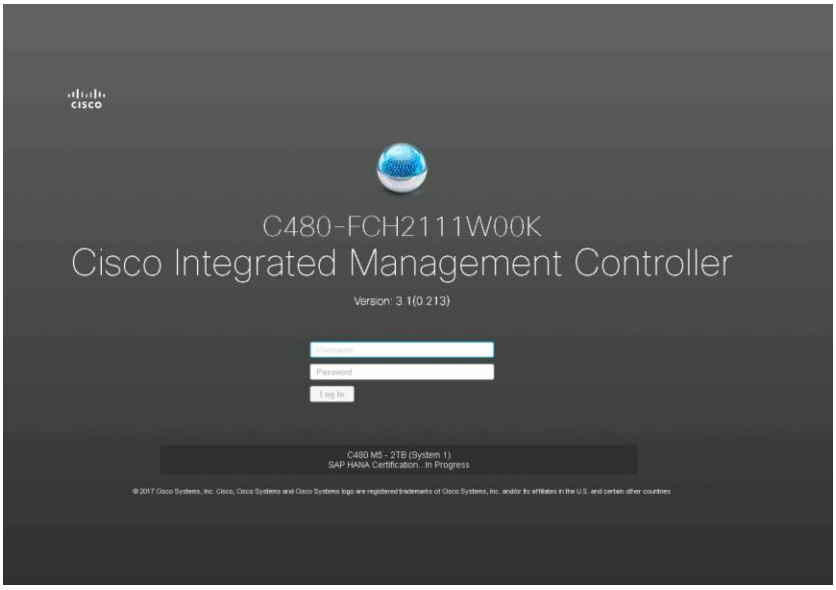
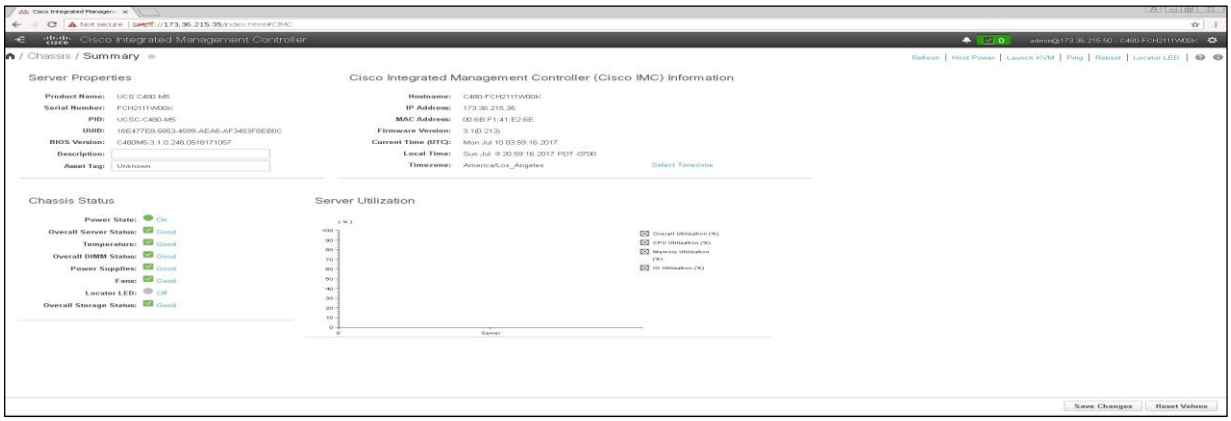


Figure 11. Cisco IMC summary screen



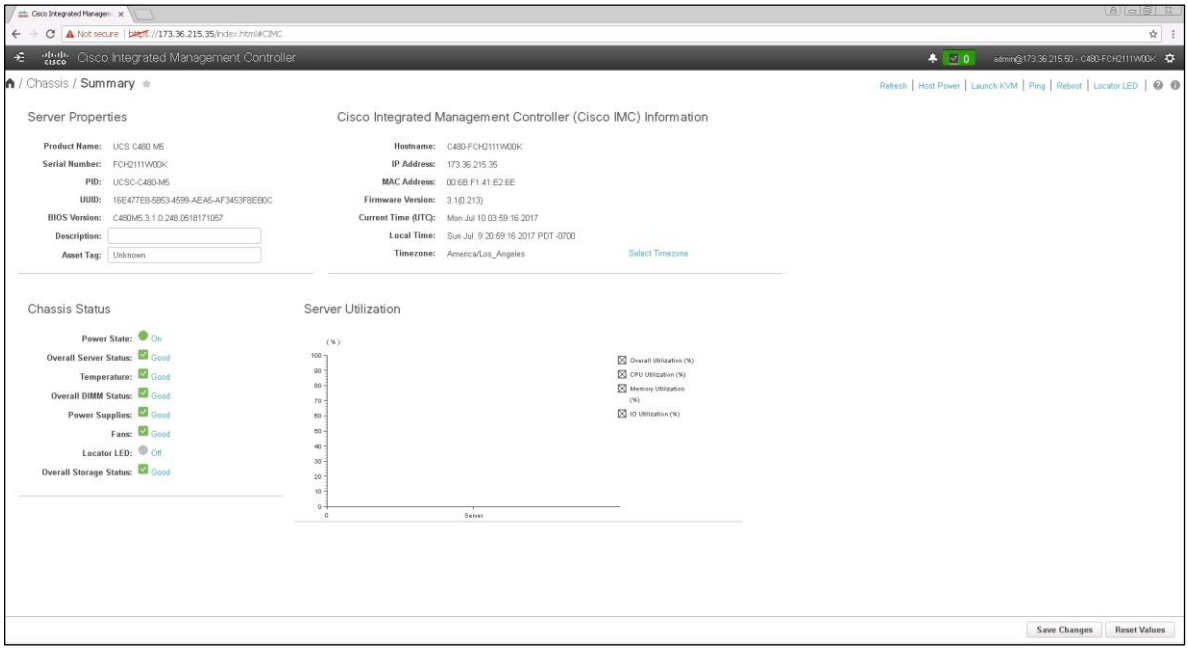
Launching the KVM console

You next need to launch the KVM console and map the RHEL 7.3 DVD ISO file for the installation.

1. Click Launch KVM in the top-left corner of the IMC homepage (Figure 12).

   Starting the IMC Release 3.0, two options are available for launching the KVM: one using the Java console and other using the browser-based HTML KVM console. In this example, the HTML KVM console has been used.

Figure 12. Cisco IMC homescreen

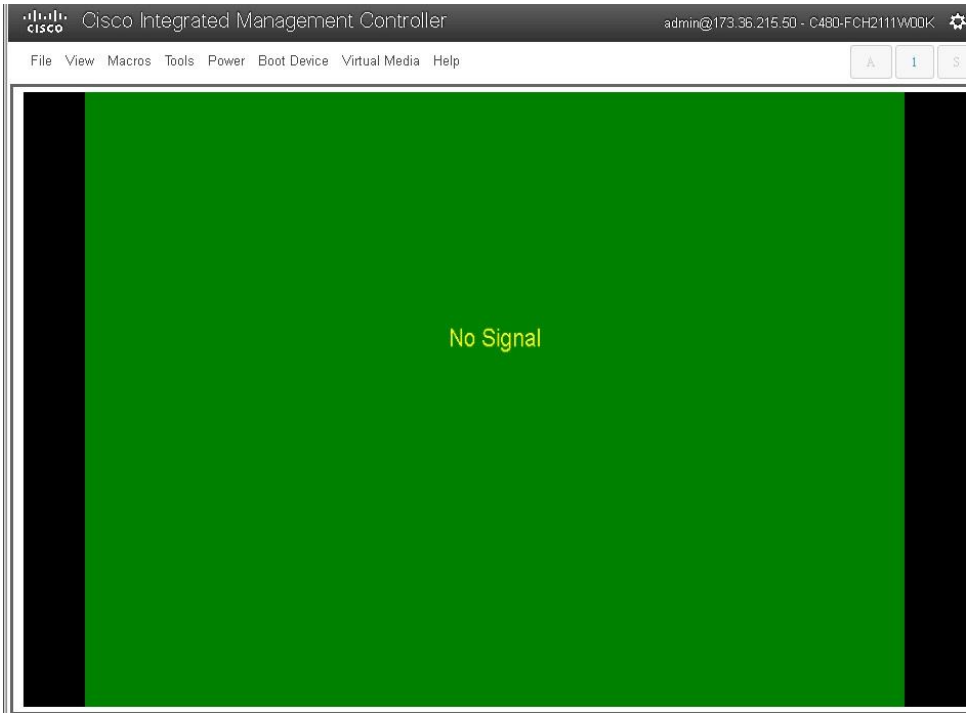


2. After you select the HTML-based console, a certificate confirmation window appears. Click the provided hyperlink to continue (Figure 13).

Figure 13. Click the hyperlink to load the KVM application

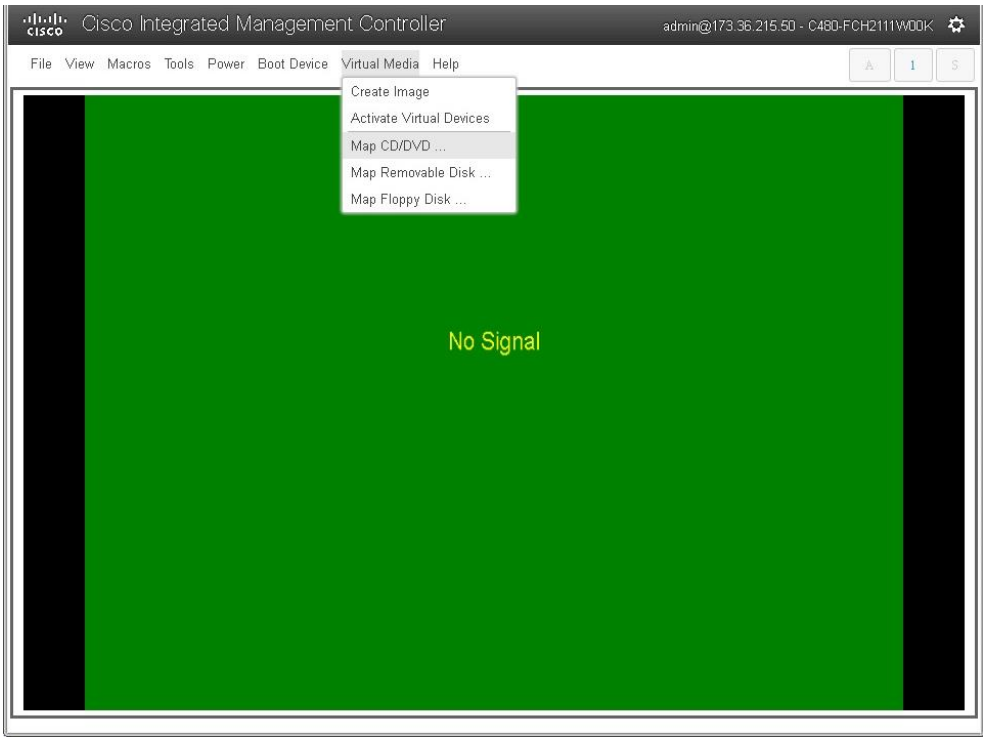
The KVM window will appear (Figure 14).

Figure 14. KVM window



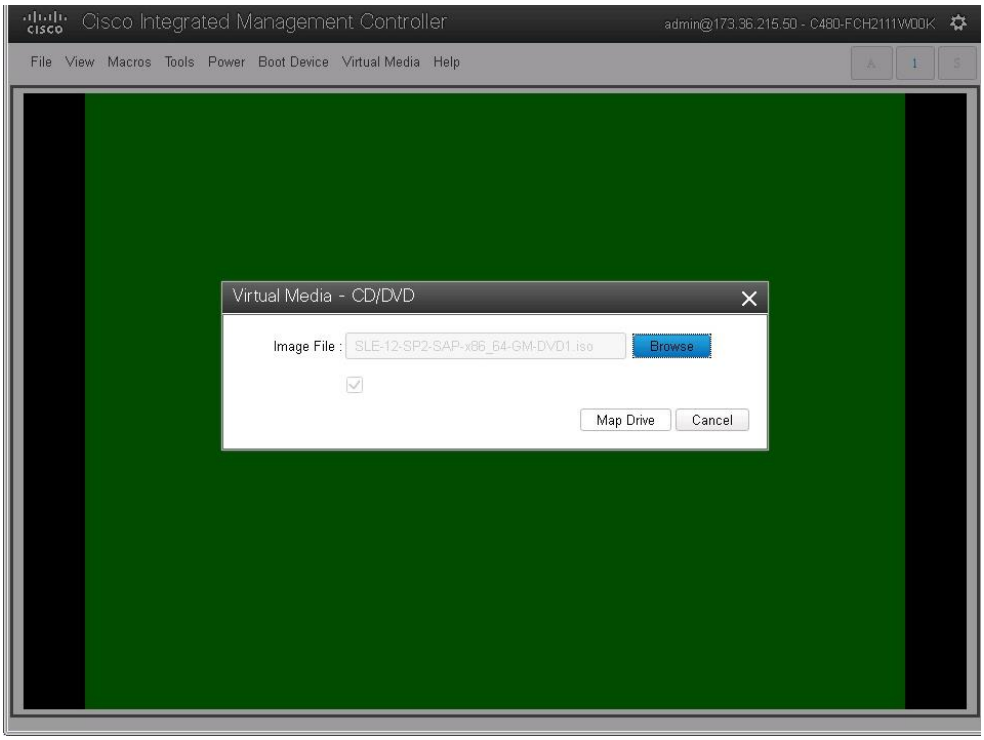
3. In the menu bar at the top of the KVM window, choose Virtual Media > Activate Virtual Devices > Map CD/DVD (Figure 15).

Figure 15. Beginning the CD/DVD mapping process



4. Browse for the SLES 12 for SAP SP2 DVD ISO file and click Map Drive (Figure 16).

Figure 16. Click Map Drive

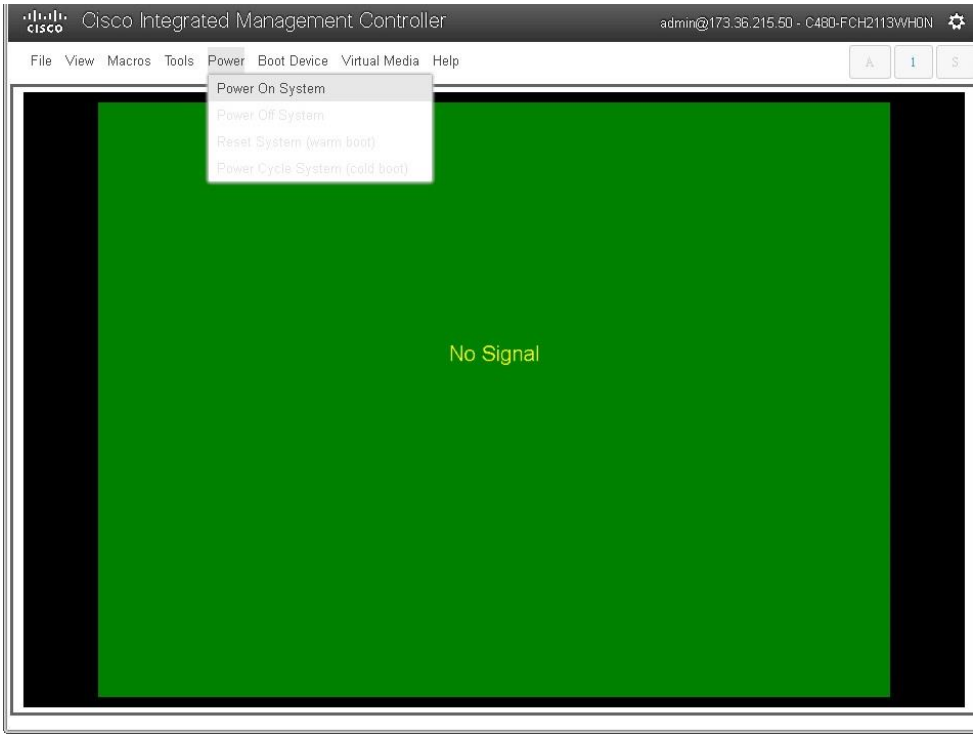


Configuring BIOS settings

You need to power on the server and configure some BIOS settings before proceeding with the RAID configuration.

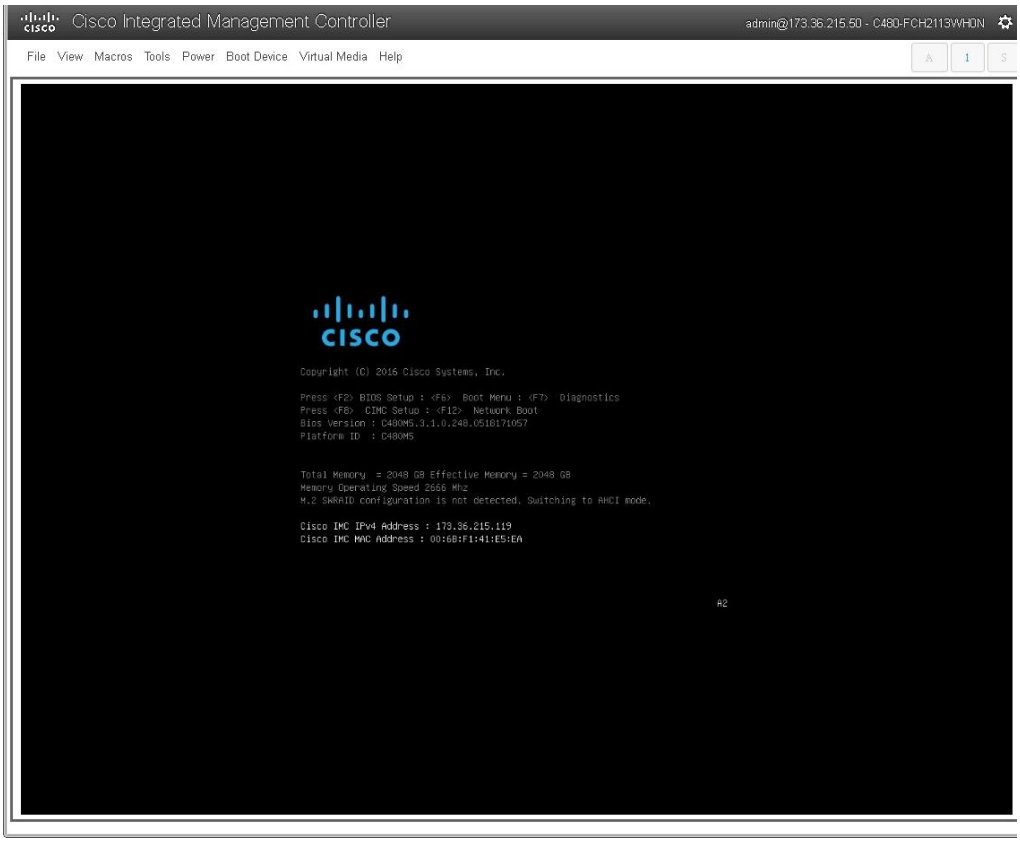
1. From the menu bar at the top of the KVM window, choose Power > Power On System (Figure 17).

Figure 17. Powering on the system



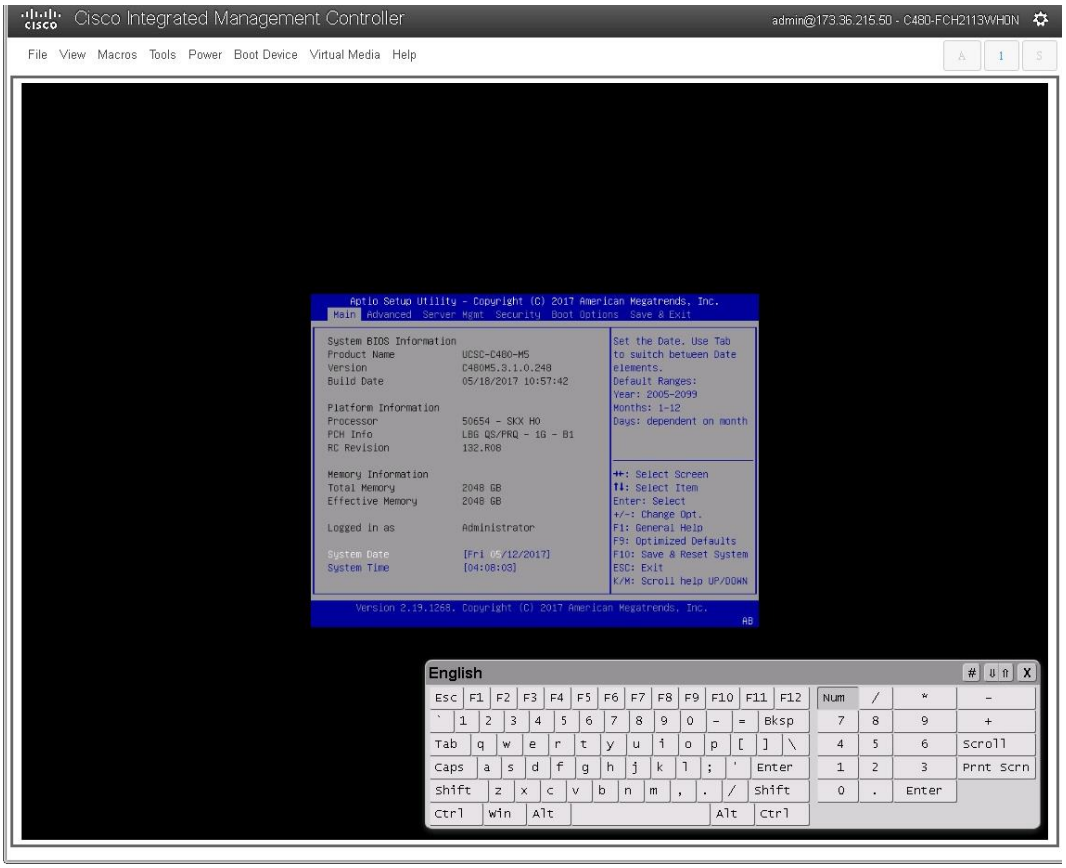
2. After the server has booted, press F2 to enter the BIOS menu (Figure 18).

Figure 18. Press F2



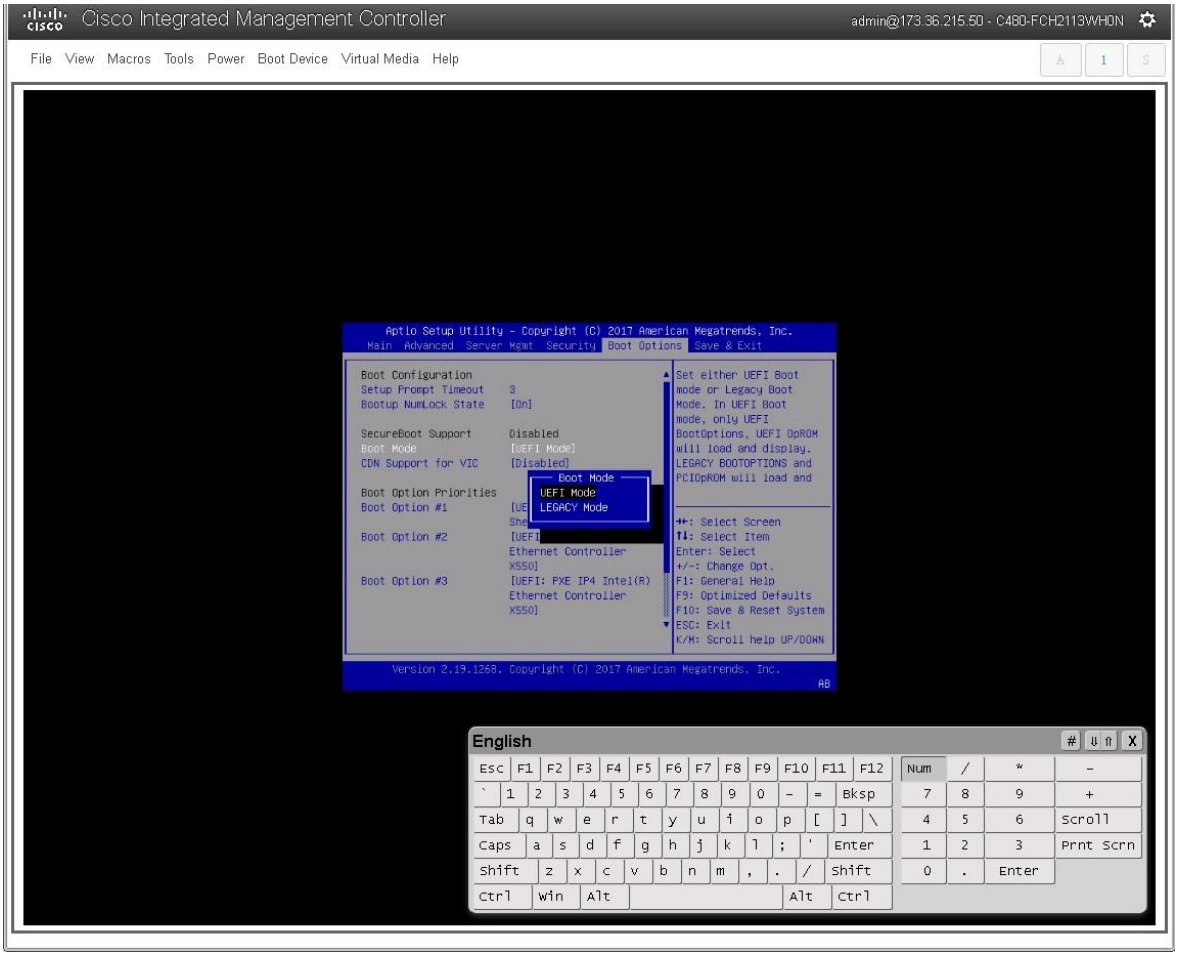
3. For a better keyboard experience, from the View menu select the on-screen keyboard (Figure 19).

Figure 19. On-screen keyboard



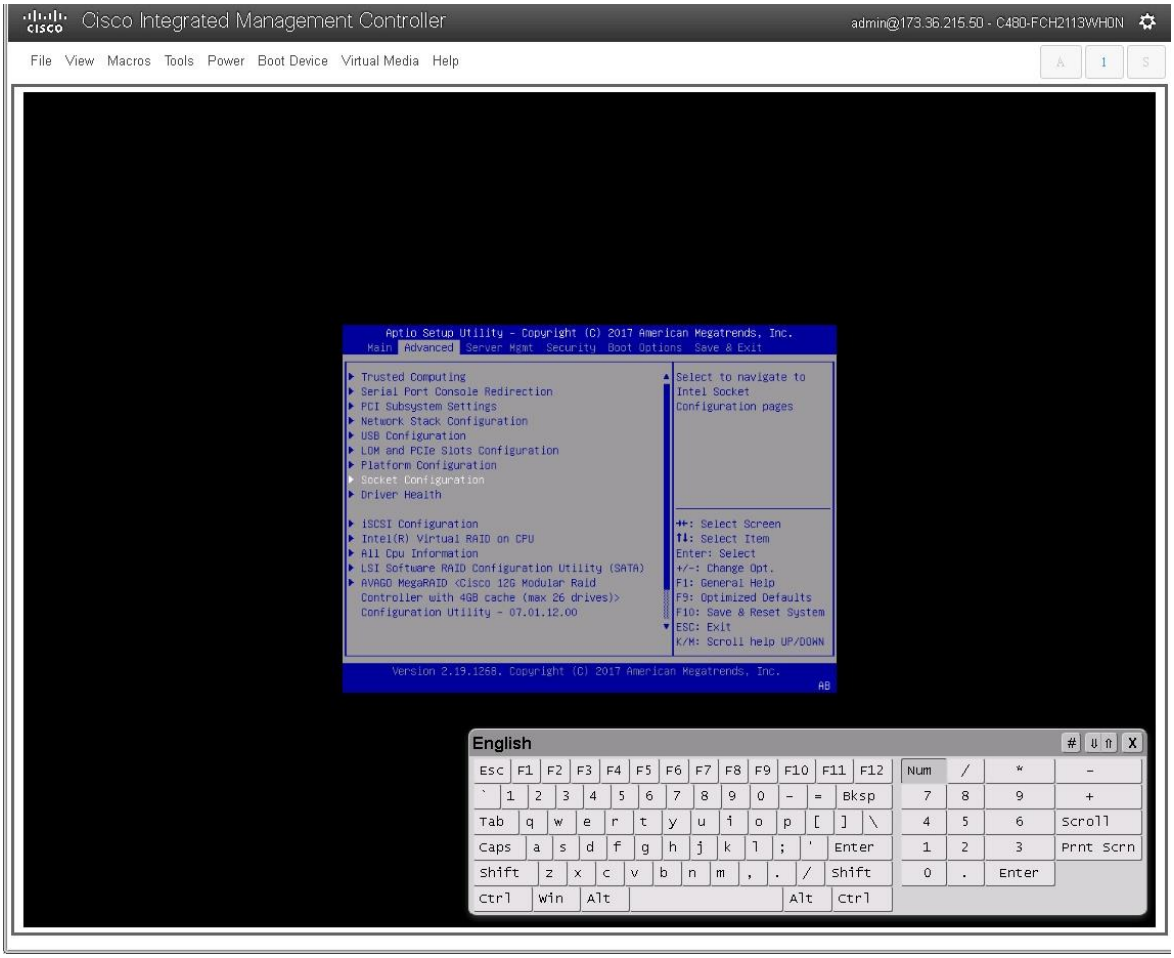
4. From the BIOS menu, choose Boot Options > Boot Mode > UEFI Mode (Figure 20). This setting selects the Unified Extensible Firmware Interface (UEFI).

Figure 20. Choose UEFI Mode



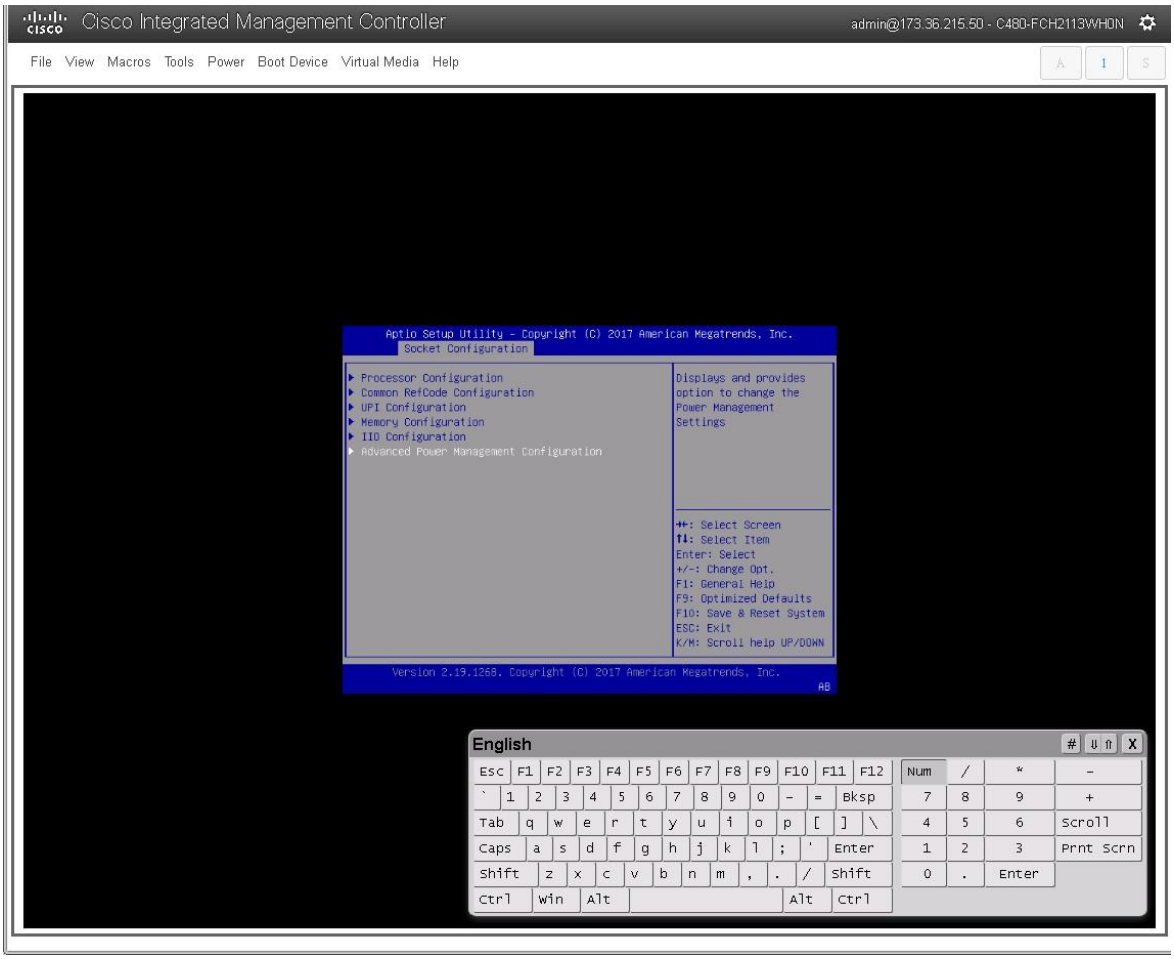
5. Disable the C-states of the CPU as recommended in the SAP for HANA requirements. From the BIOS menu, choose Advanced > Socket Configuration (Figure 21).

Figure 21. Choose Socket Configuration



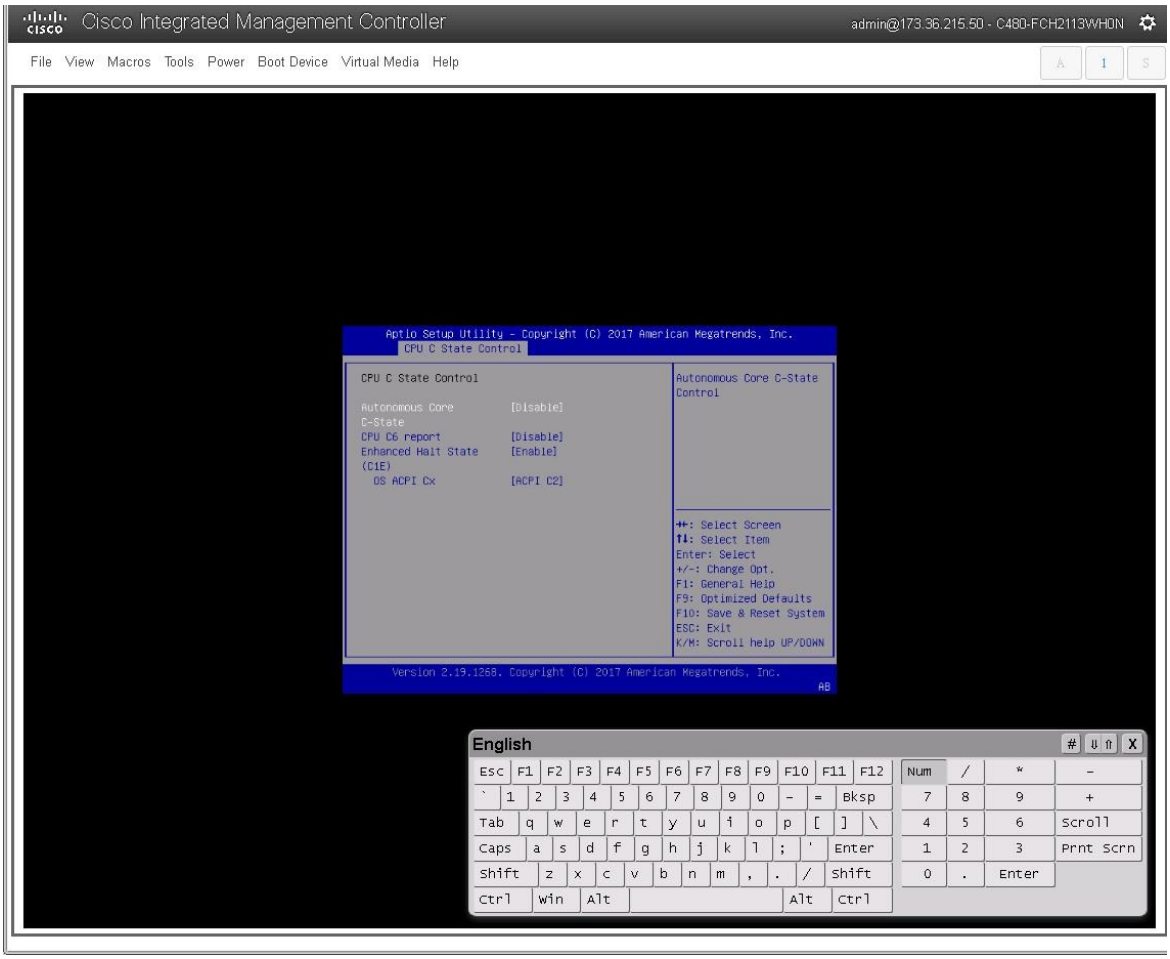
6. Choose Advanced Power Management Configuration (Figure 22).

Figure 22. Choose Advanced Power Management Configuration



7. Disable the C-states as shown in Figure 23.

Figure 23. Disabling C-states



8. After disabling the C-states, press F10 and save the BIOS settings.

Rebooting the server to implement BIOS changes

To make the boot options and CPU C-states take effect, reboot the server.

You are now ready to configure RAID.

RAID options

This document covers all scale-up solutions with 2- and 4-socket configurations of the Cisco UCS M5 platform.

Table 11 lists the RAID options and the available platforms.

Table 11. RAID options

Platform	SAS (20 drives)	SSD (3 or 8 drives)
Cisco UCS C480	RAID 50	RAID 5
Cisco UCS C240	RAID 50	RAID 5
Cisco UCS C220	–	RAID 5

Table 12 lists the settings that you need to configure when you create the virtual drives.

Table 12. RAID settings

RAID settings	RAID 50	RAID 5
Stripe size	256	128
Read policy	Read ahead	Read ahead
Write policy	Write back	Write back
I/O policy	Cached	Default

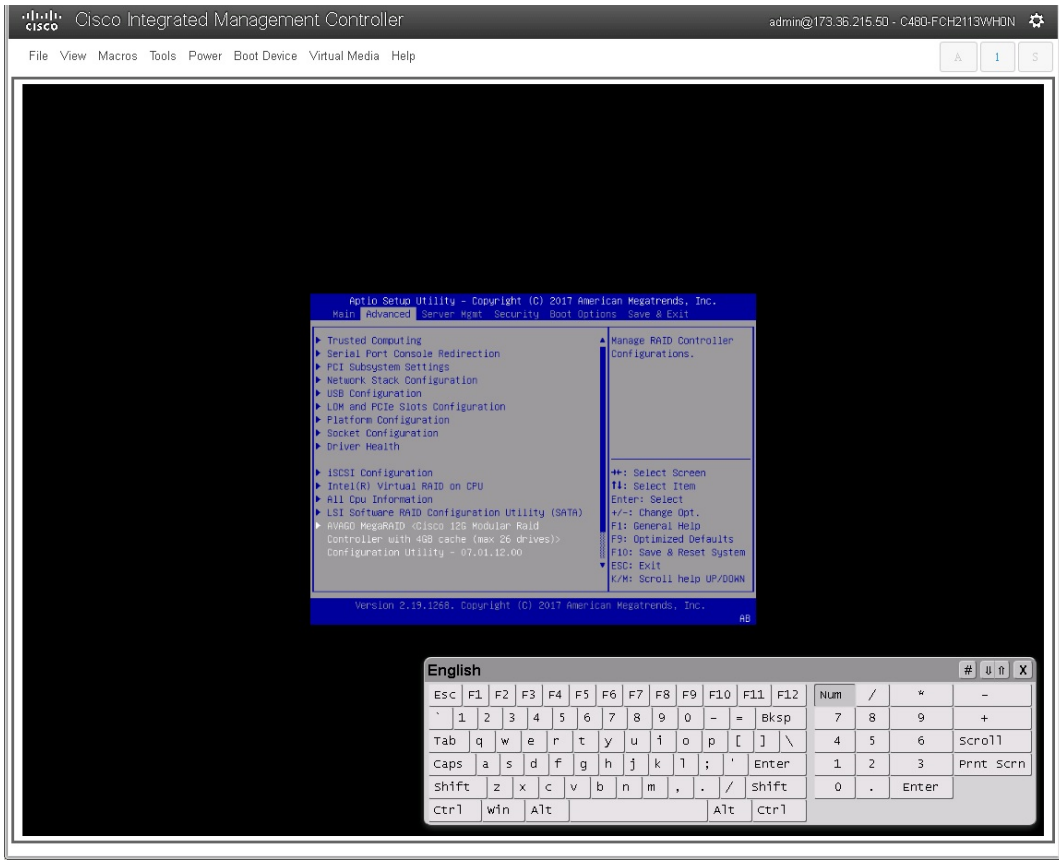
Configuring RAID

The following procedure shows the RAID 50 configuration with SAS drives on the Cisco UCS C480 M5 server used for SAP HANA.

Note: The RAID settings described here apply only to a configuration using 20 SAS drives with RAID 50. Refer to Table 12 for the RAID options for SSD drives with RAID 5 settings. The same procedure applies to the creation of RAID 5 virtual drives with SSD-based options except that the number of drives will be three or eight and the RAID level will be RAID 5.

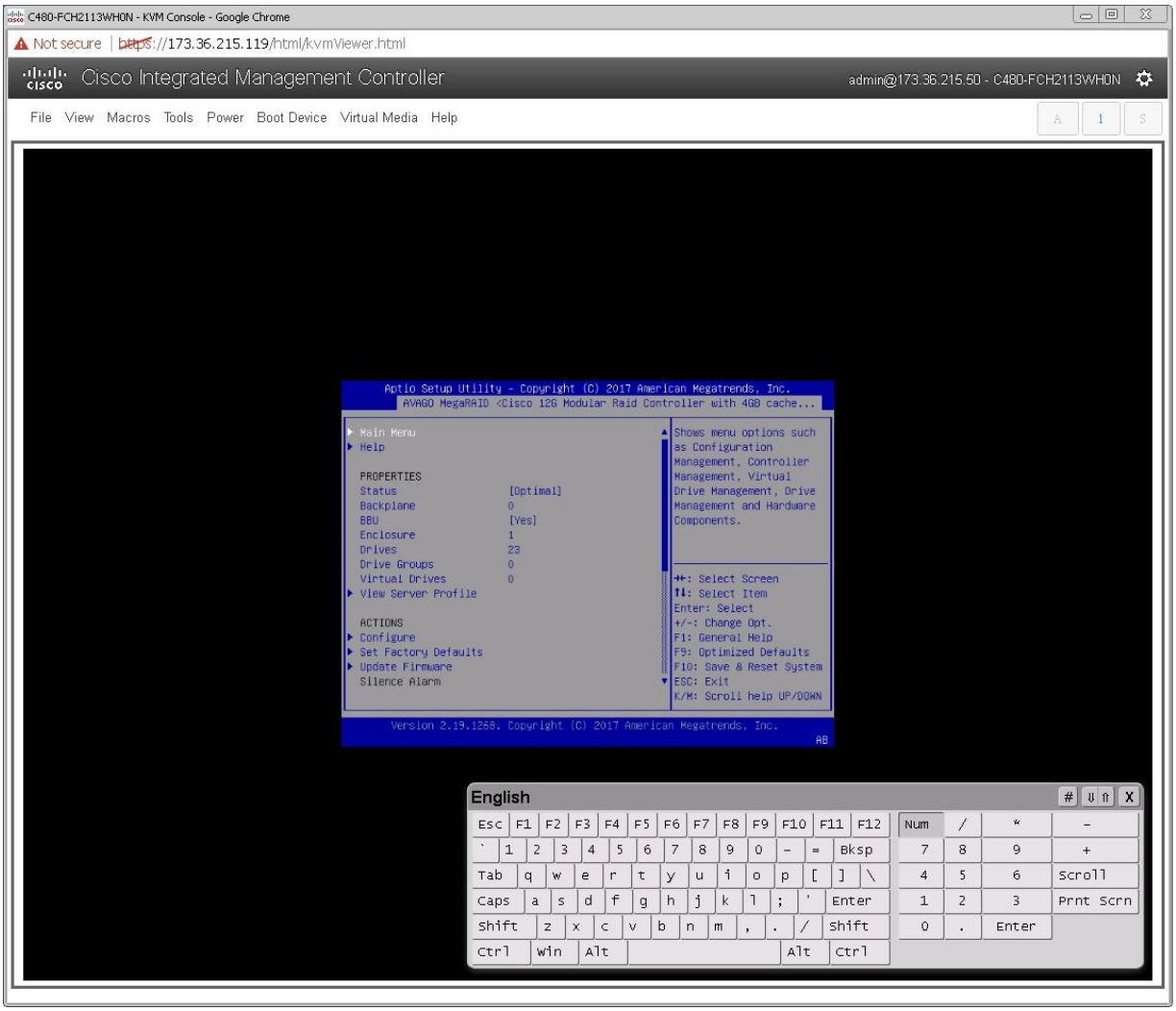
1. Boot the server and press F2 to enter the BIOS menu.
2. Select the Avago MegaRAID Utility to proceed with the RAID configuration (Figure 24).

Figure 24. Select Avago MegaRAID



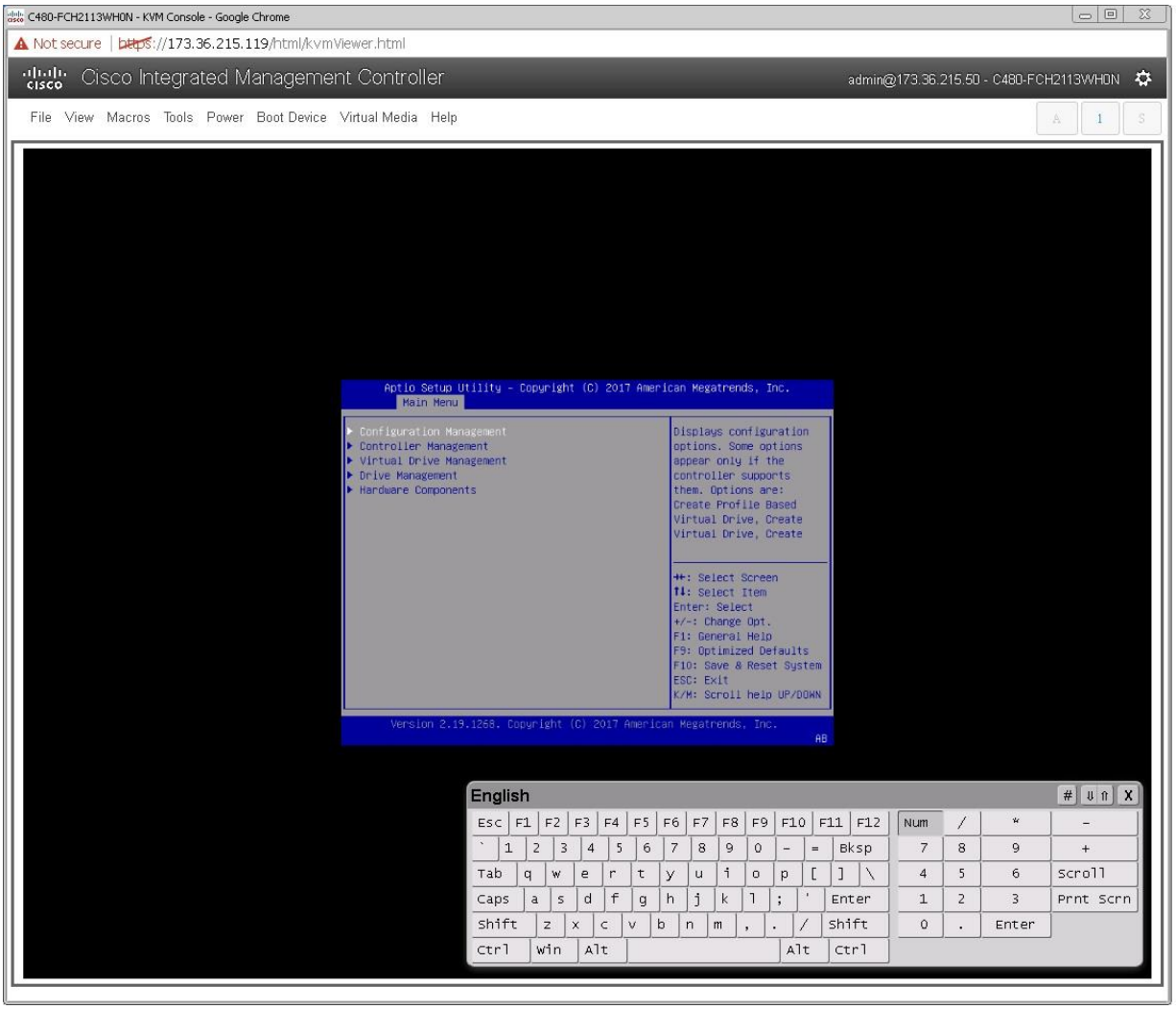
3. Choose Main Menu (Figure 25).

Figure 25. Choose Main Menu



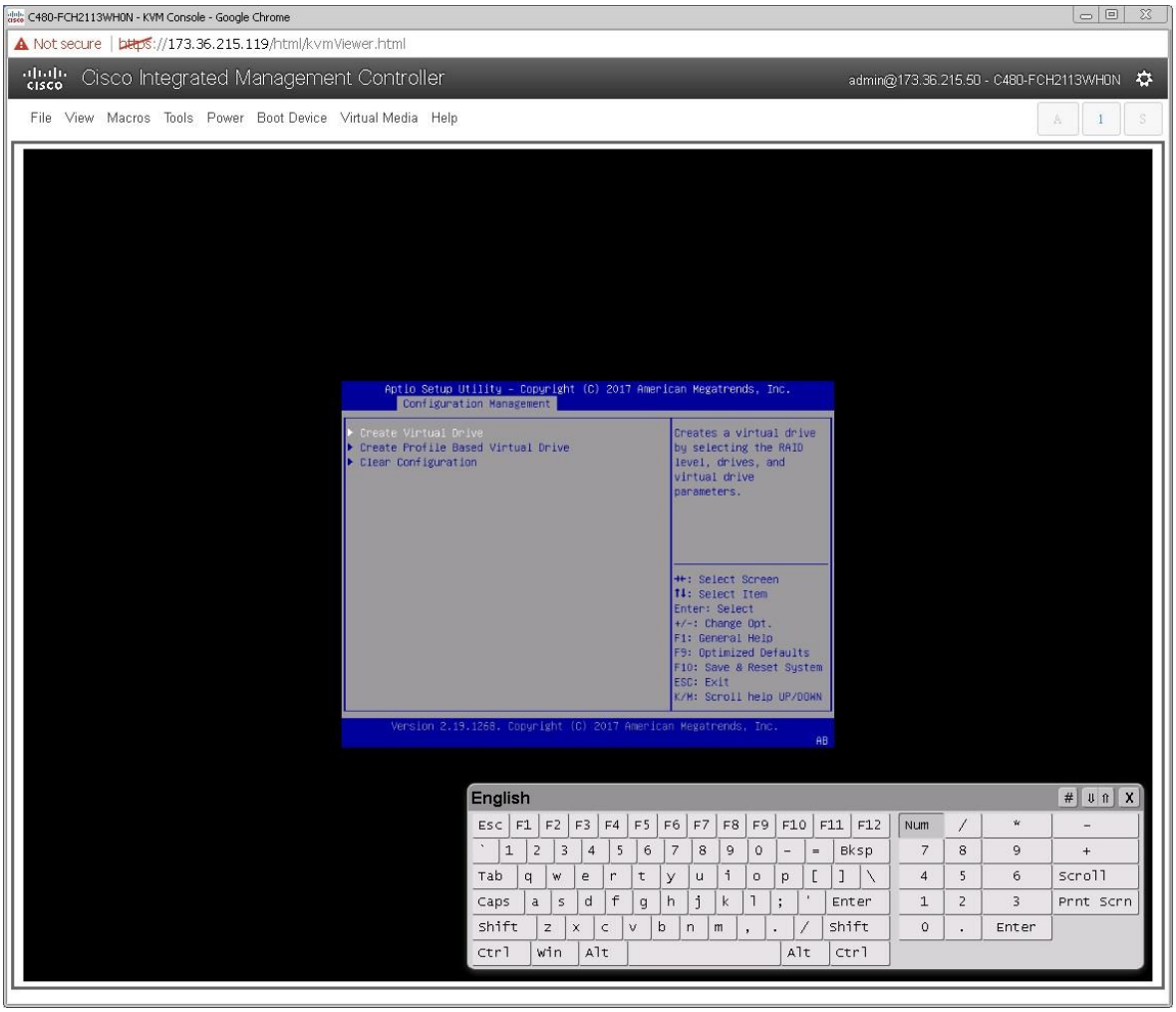
4. Choose Configuration Management (Figure 26).

Figure 26. Choose Configuration Management



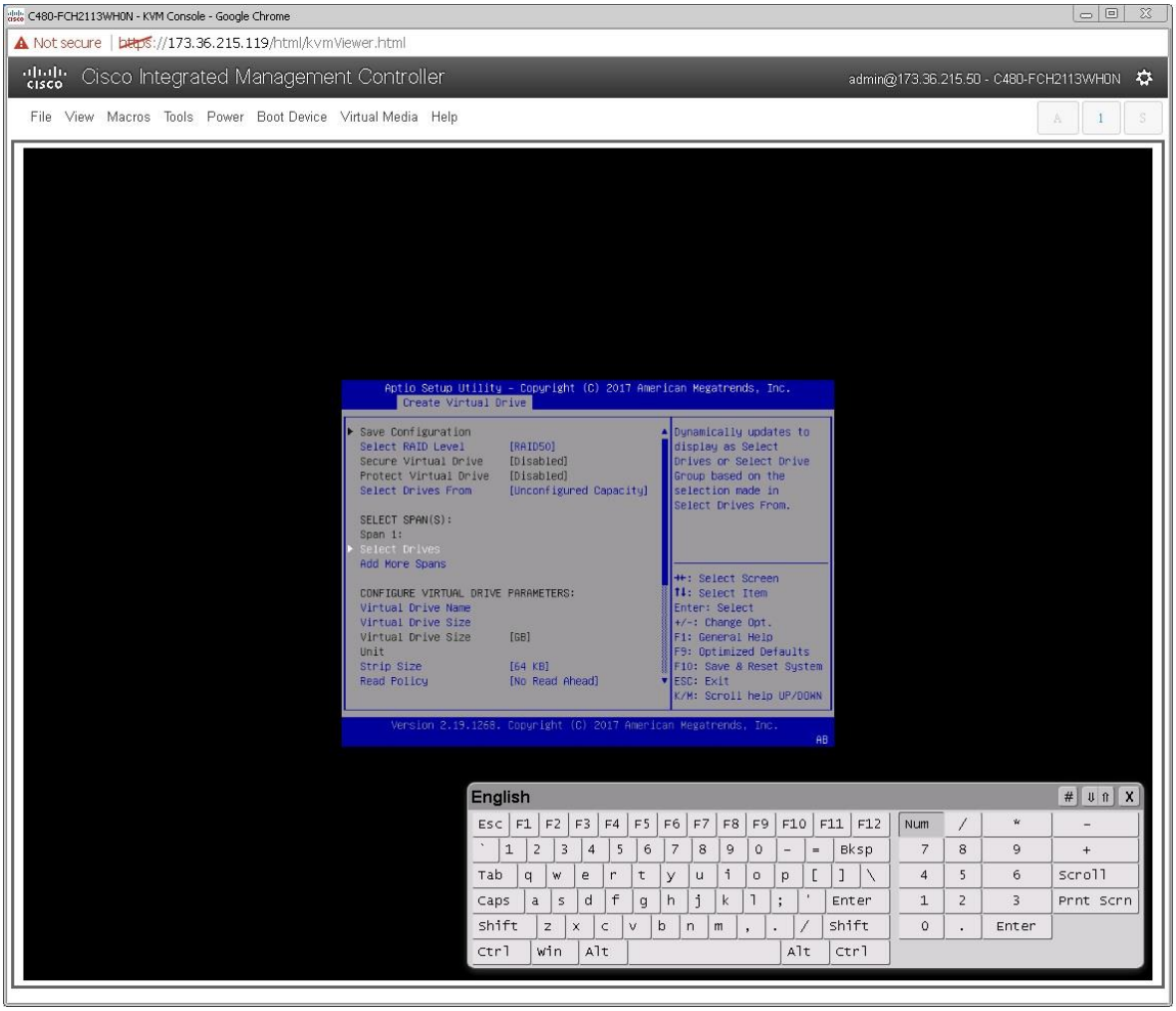
5. Choose Create Virtual Drive (Figure 27).

Figure 27. MegaRAID Configuration Utility: Create Virtual Drive



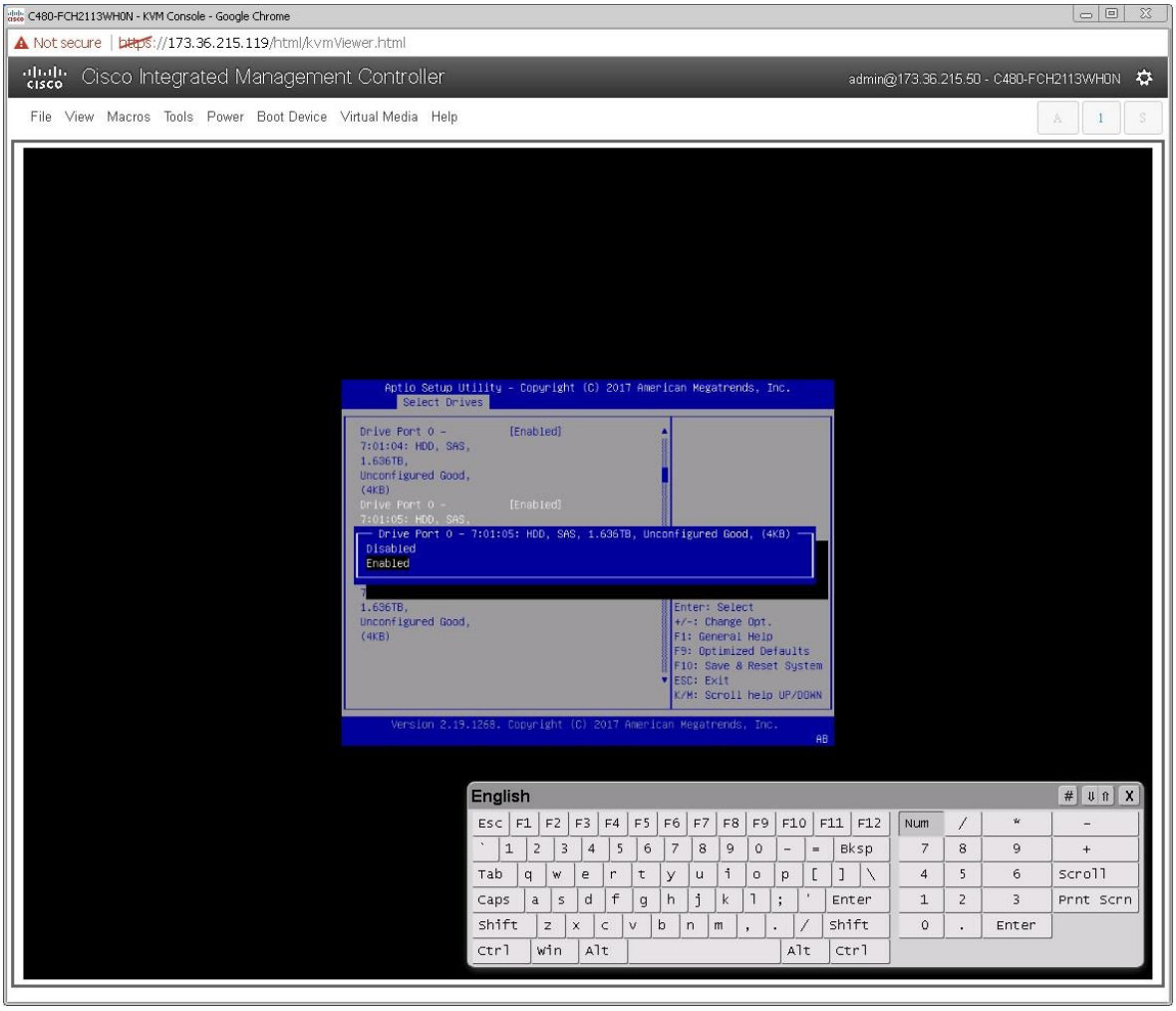
6. Choose the following options to create a RAID 50 virtual drive with 20 disks and five spans:
   a. For RAID Level, choose RAID50.
   b. Choose Select Drives (Figure 28).

Figure 28. Choosing RAID options



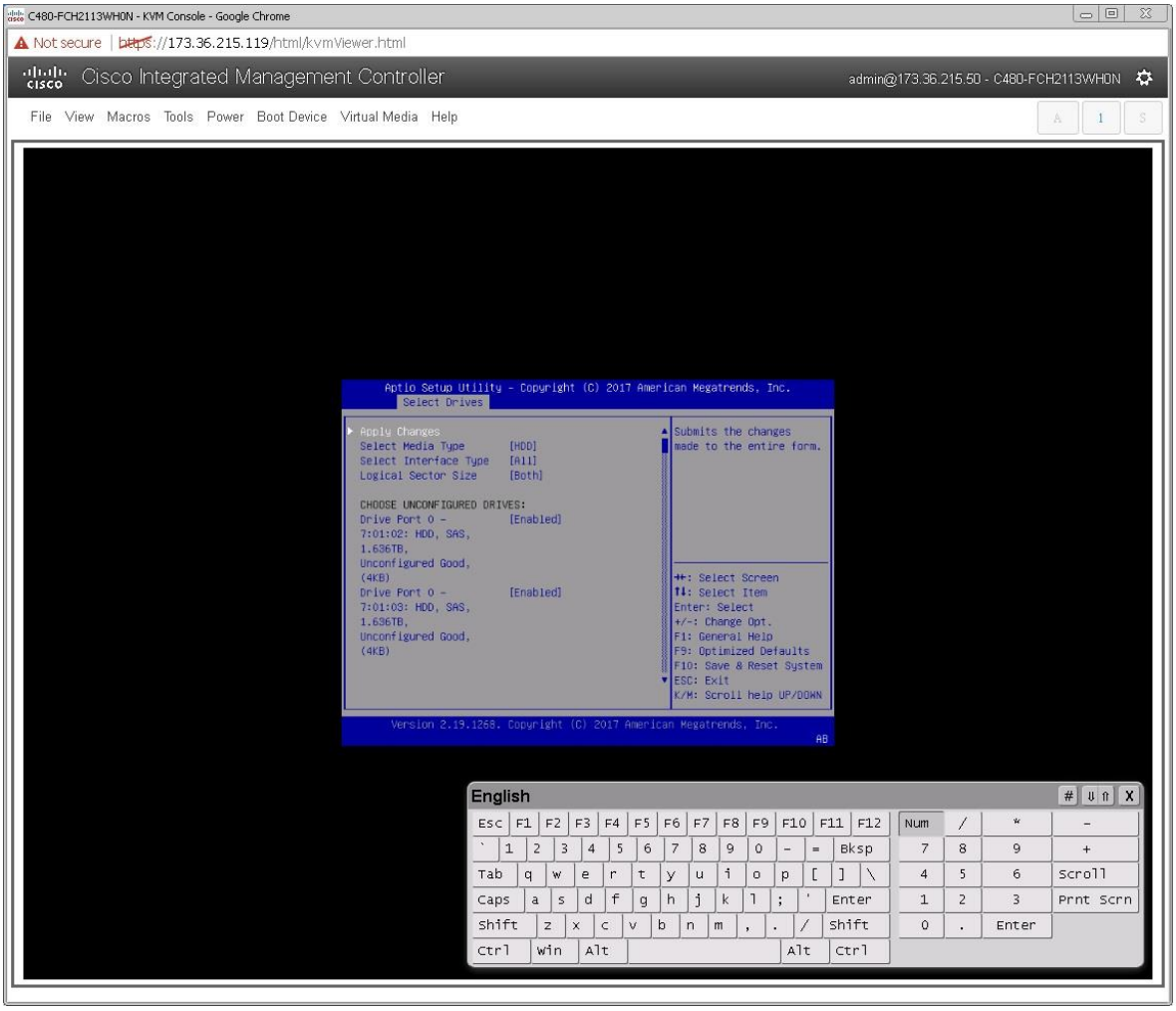
c. Select the first five disks by choosing Enabled as shown in Figure 29.

Figure 29. Choose Enabled



d. Scroll up or down and on the Select Drives screen, choose Apply Changes (Figure 30).

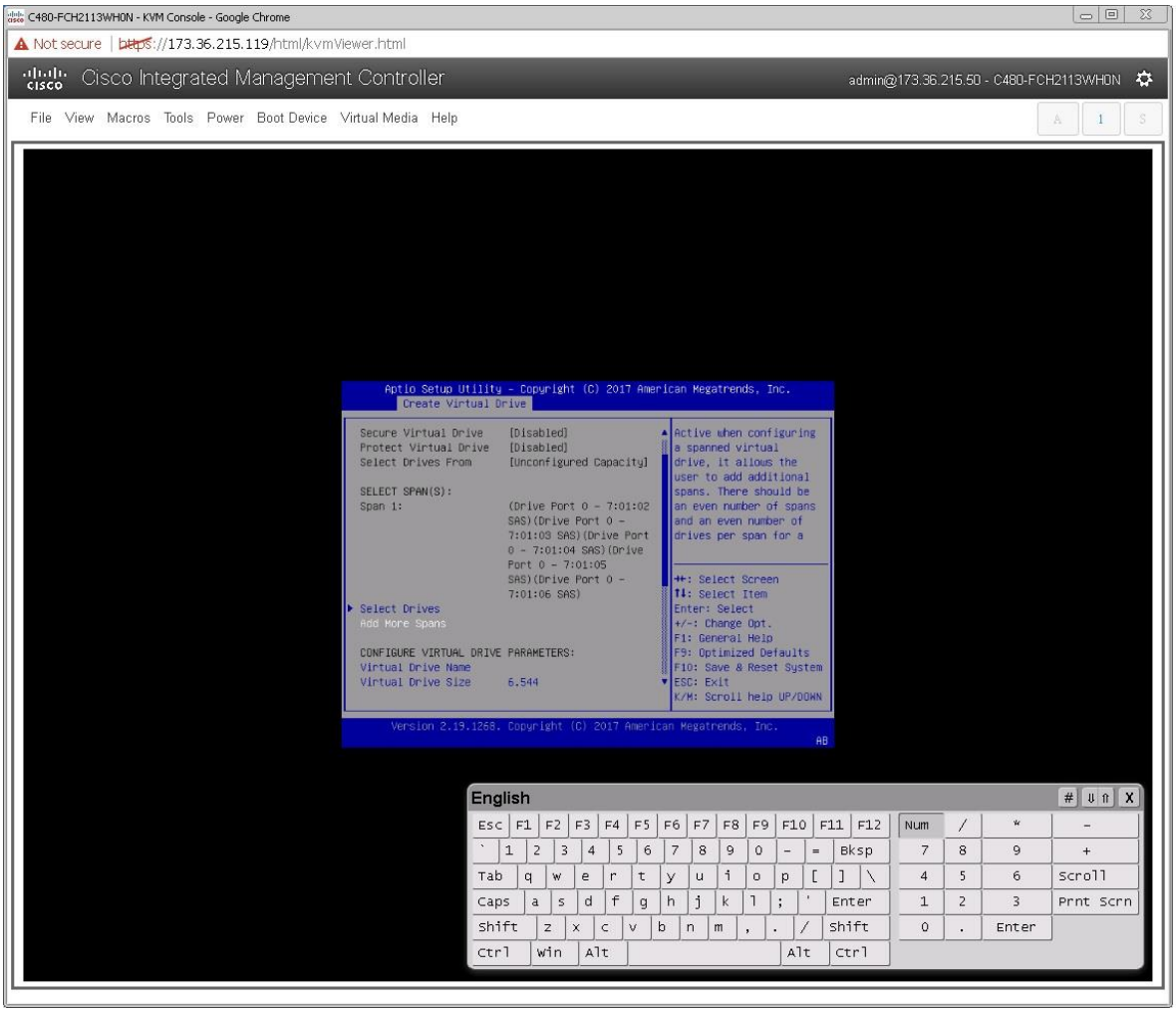
Figure 30. Apply the changes



e. Choose OK in the confirmation window.

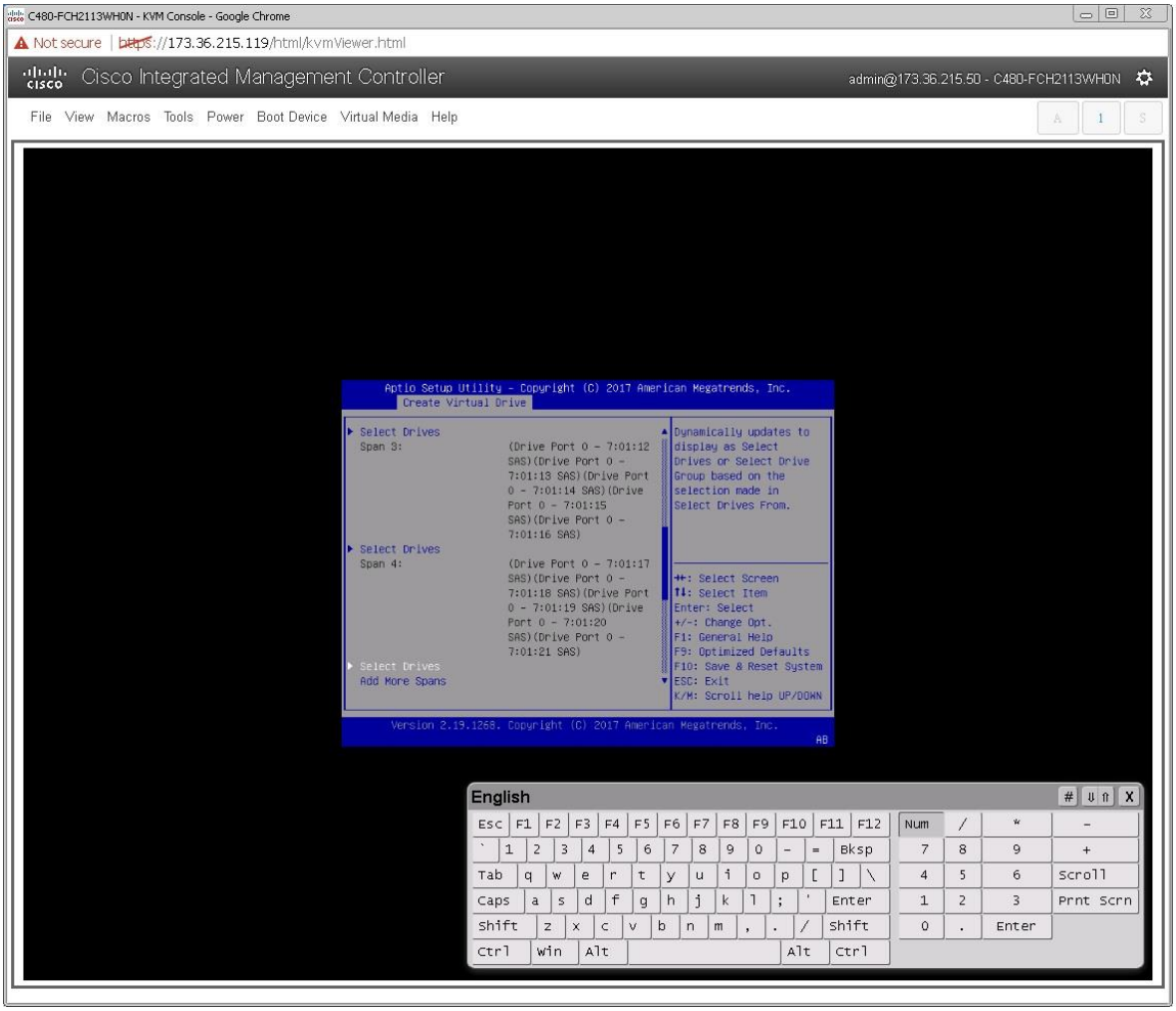
7. Add four more spans using the same process as in step 6 (Figure 31).

Figure 31. Add more spans



8. After repeating the steps to add spans and drives, verify that four spans with five drives per span have been added (Figure 32).

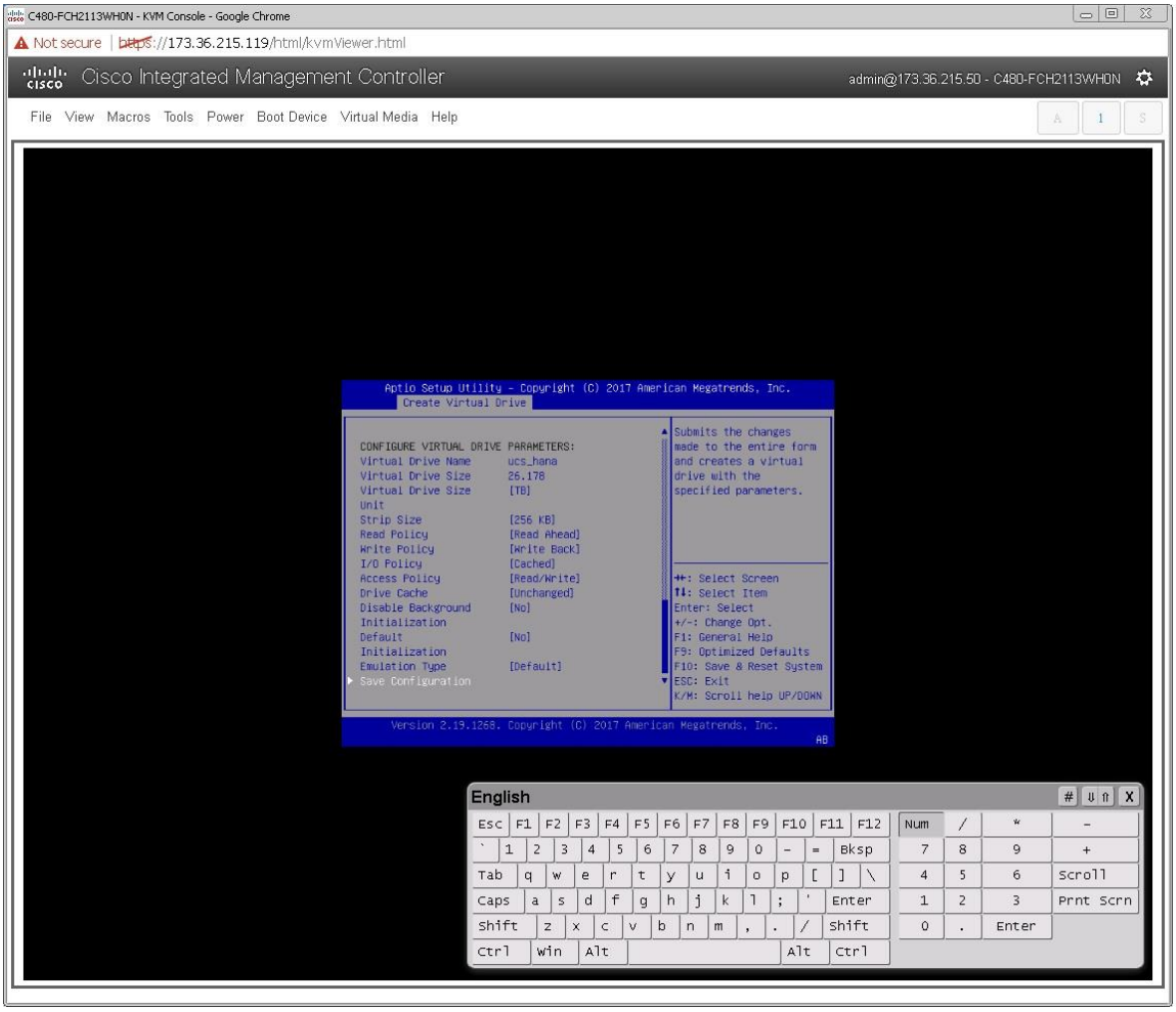
Figure 32. Verifying that the spans and drives have been added



9. Configure the virtual drive parameters as shown in Figure 33.
   a. Name the virtual drive **<<var_raid50_vd_name>>**.
   b. For Strip Size, choose 256KB.
   c. For Read Policy, choose Read Ahead.
   d. For Write Policy, choose Write Back.

When you are done, choose Save Configuration and press Enter.

Figure 33. Virtual drive parameters



10. In the next window, the utility will ask for confirmation. Choose OK to proceed.

Note: The RAID settings described here apply only to a configuration using 20 SAS drives with RAID 50. Refer to Table 12 for the RAID options for SSD drives with RAID 5 settings.

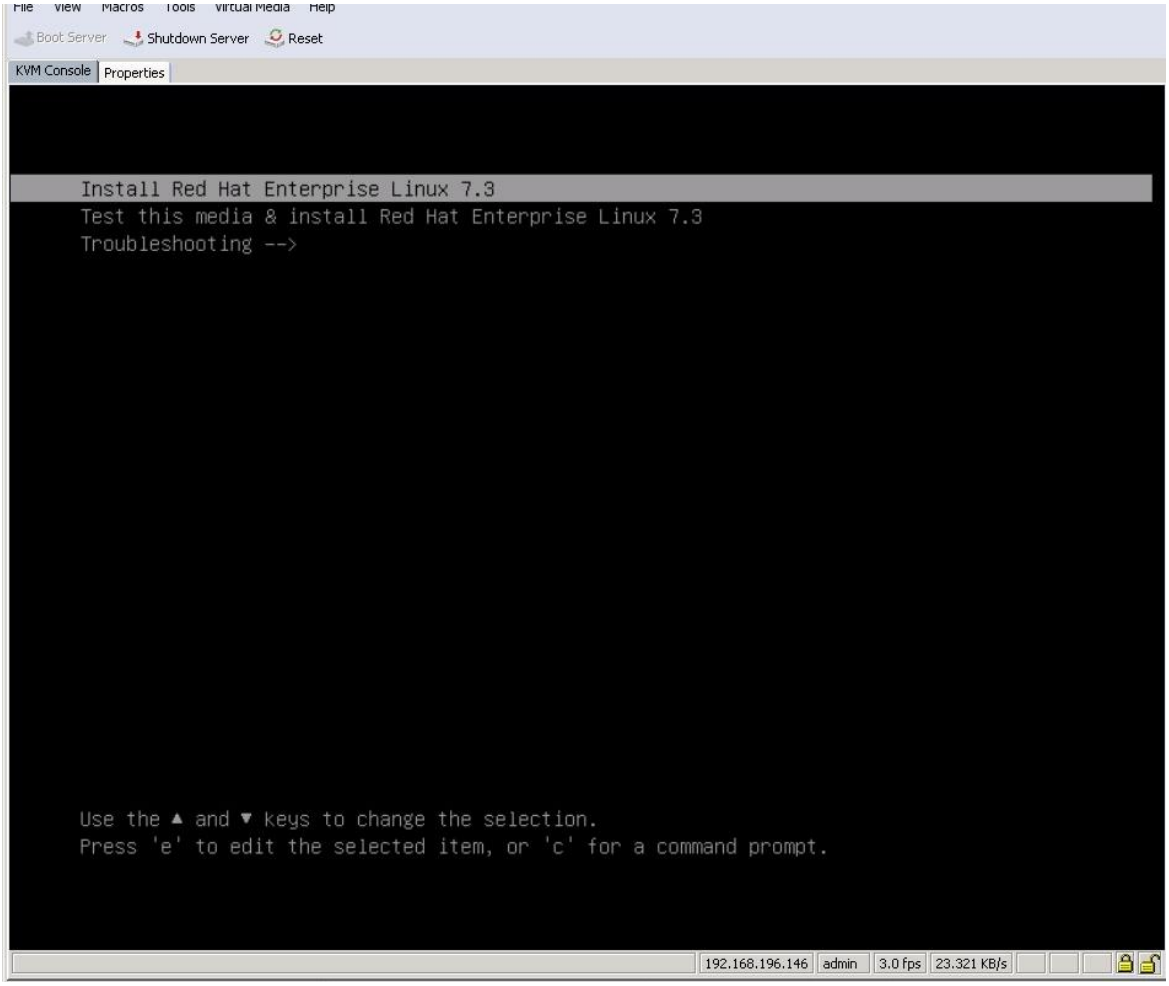
11. Wait for the initialization process for VD0 to complete, which may take several minutes.
12. Press Esc and choose OK to exit the RAID configuration utility.
13. Press Ctrl+Alt+Del to reboot the server.

Installing the operating system

The following procedure shows the RHEL 7.3 operating system installation on local drives.

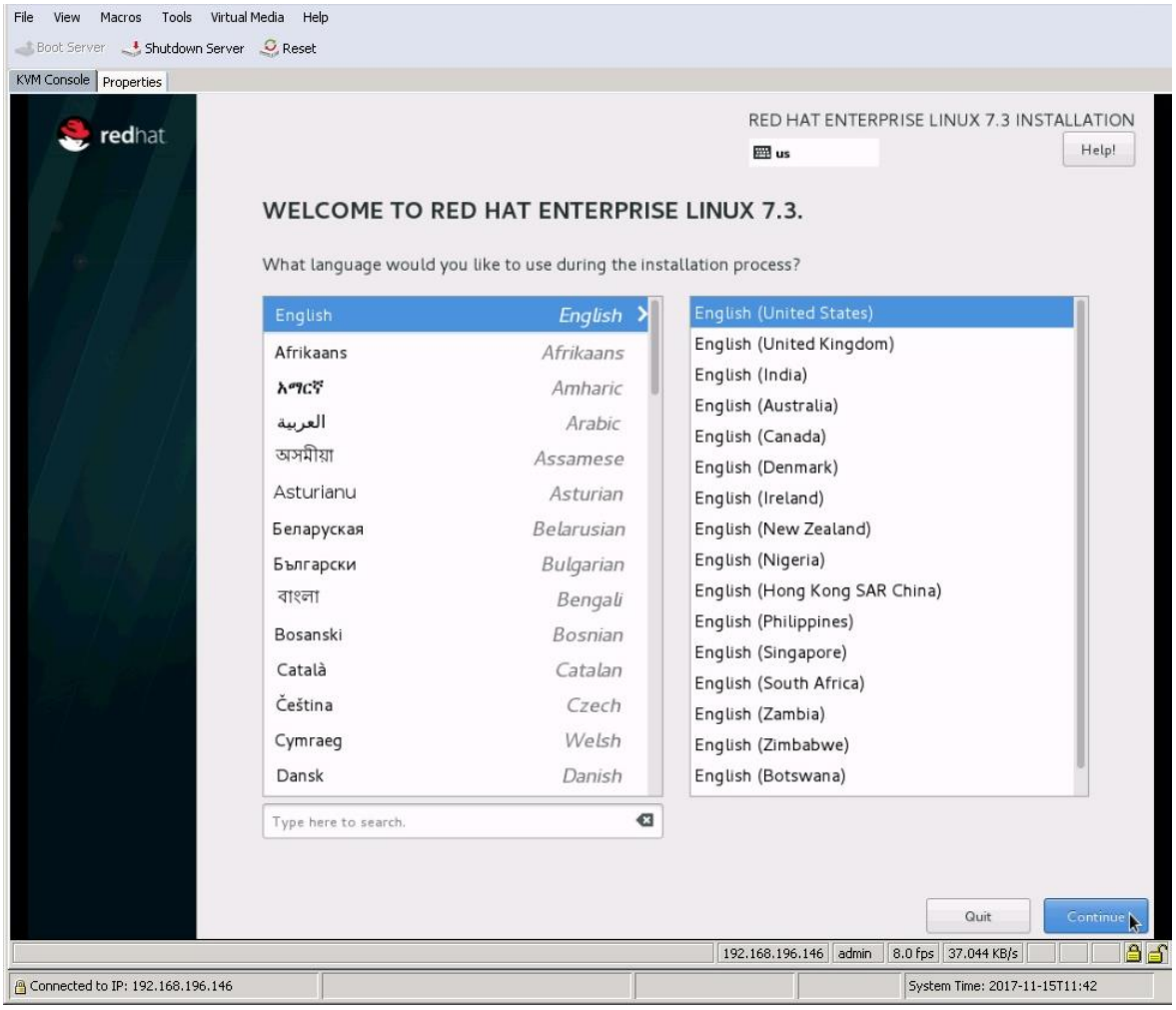
1. On the CIMC page, click Launch KVM Server.
2. Click KVM Console.
3. After the KVM console is launched, click Boot Server.
4. Choose Virtual Media > Activate Virtual Devices.
   a. For Unencrypted Virtual Media Session, select Accept this Session and then click Apply.
   b. Click Virtual Media and choose Map CD/DVD.
   c. Click Browse to navigate to the ISO media location.
   d. Click Map Device.
5. On the initial screen, select Install Red hat Enterprise Linux 7.2 to begin the installation process (Figure 34).

Figure 34. Beginning the installation process



6. Select the language and keyboard layout you want of choice (Figure 35).

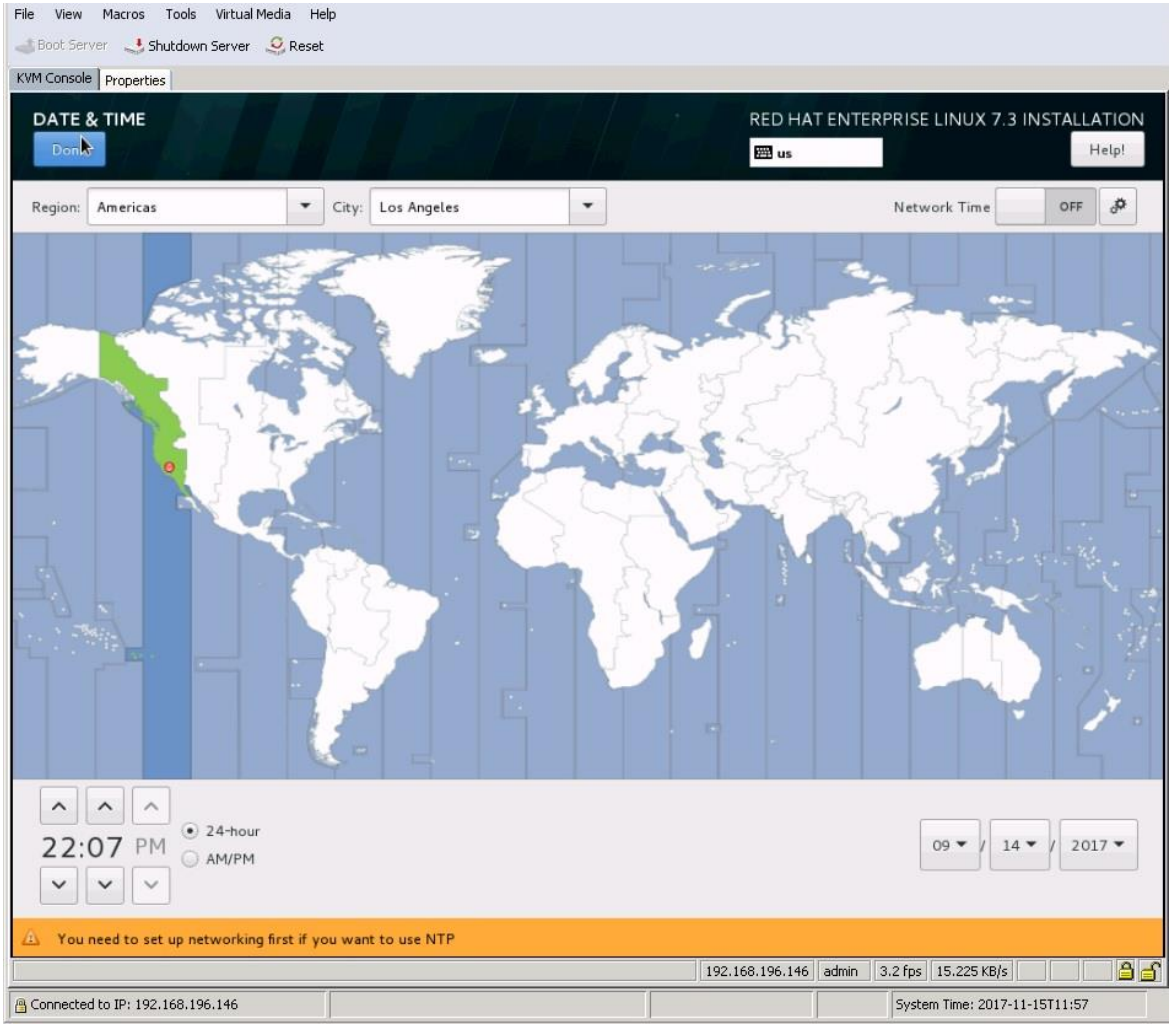
Figure 35. Selecting the language and keyboard layout



7. Click Continue. The central Installation Summary page appears. Here, you need to configure various features.

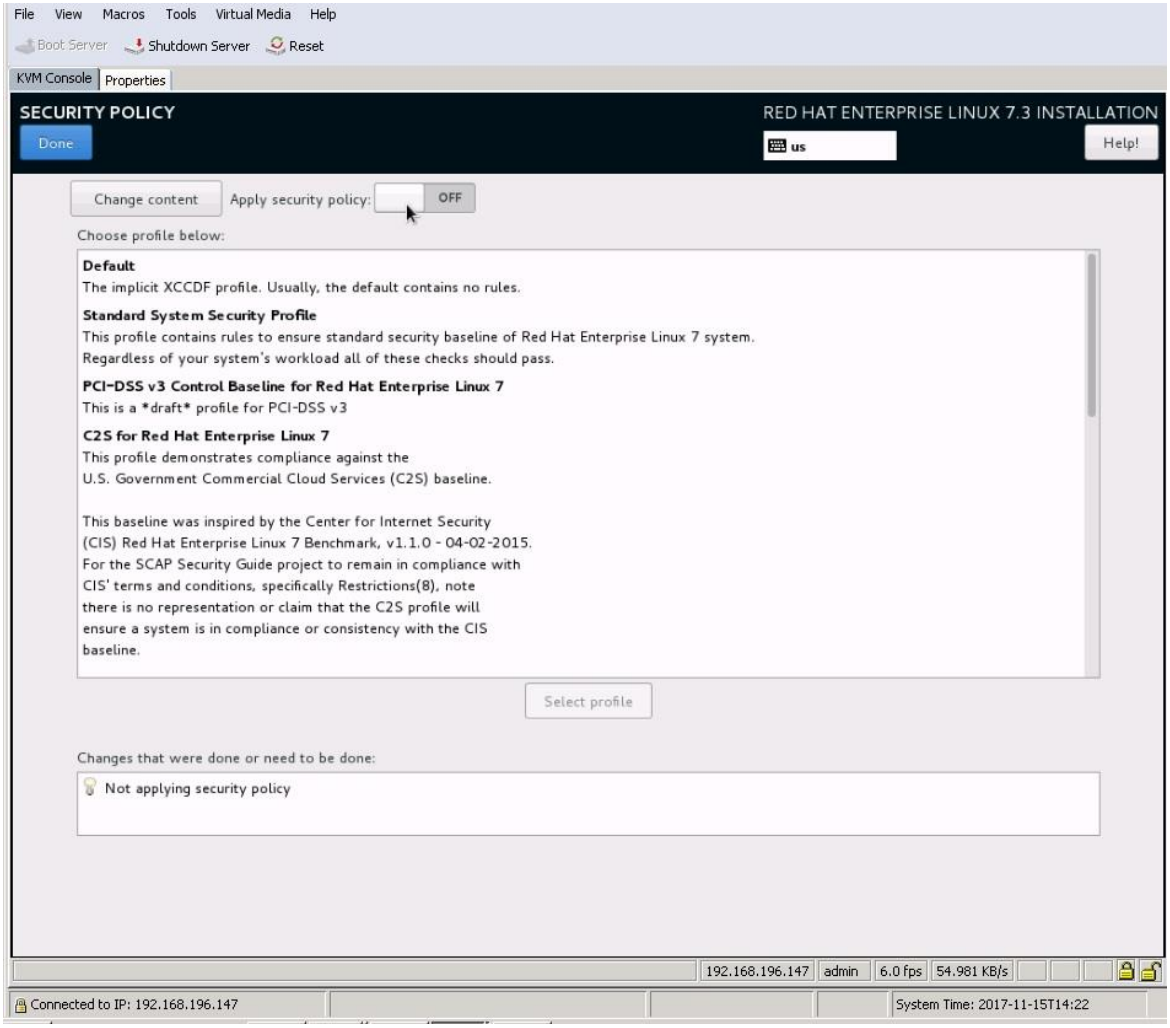
   Choose Localization > Date & Time. Choose the appropriate region and city (Figure 36). You will configure the Network Time Protocol (NTP) later. Click Done.

Figure 36. Setting the date and time



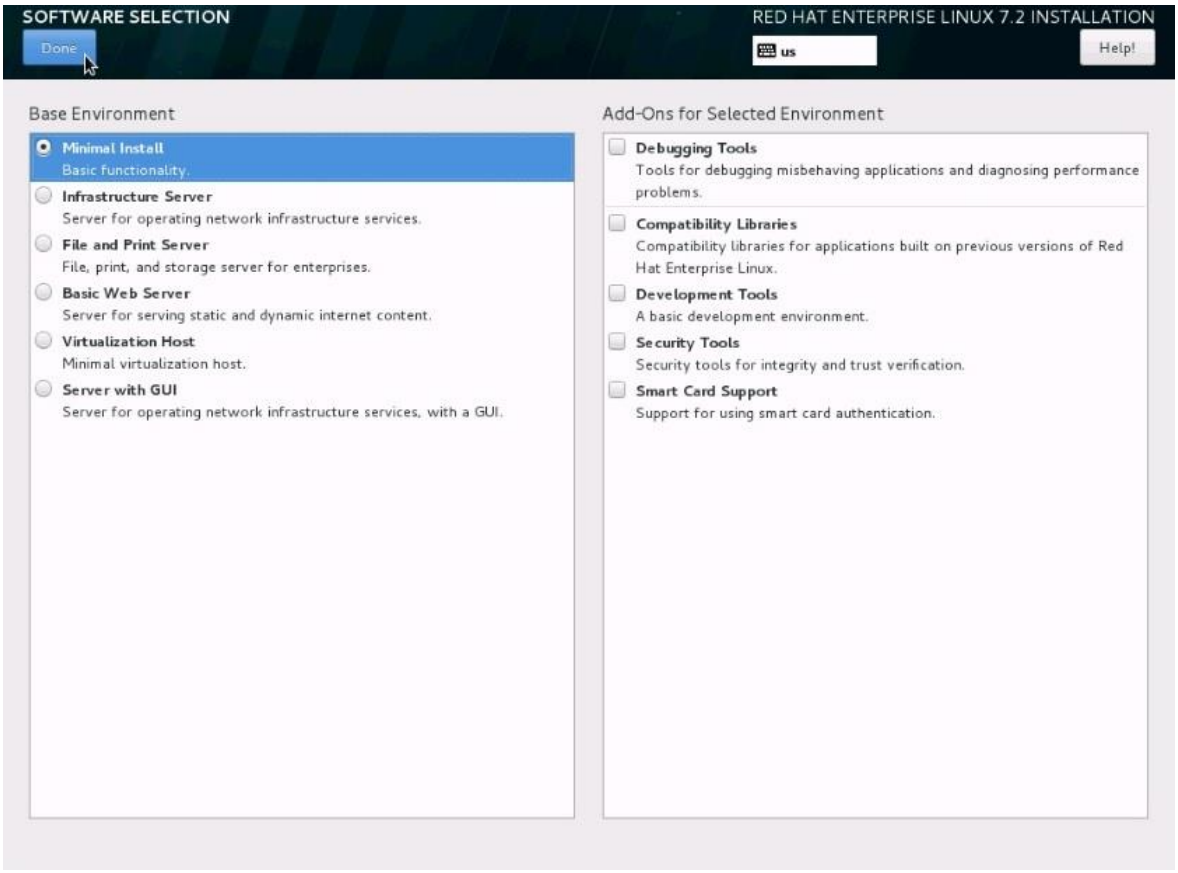
8. Choose Security > Security Policy. Turn off the security policy (Figure 37).

Figure 37. Setting security policy



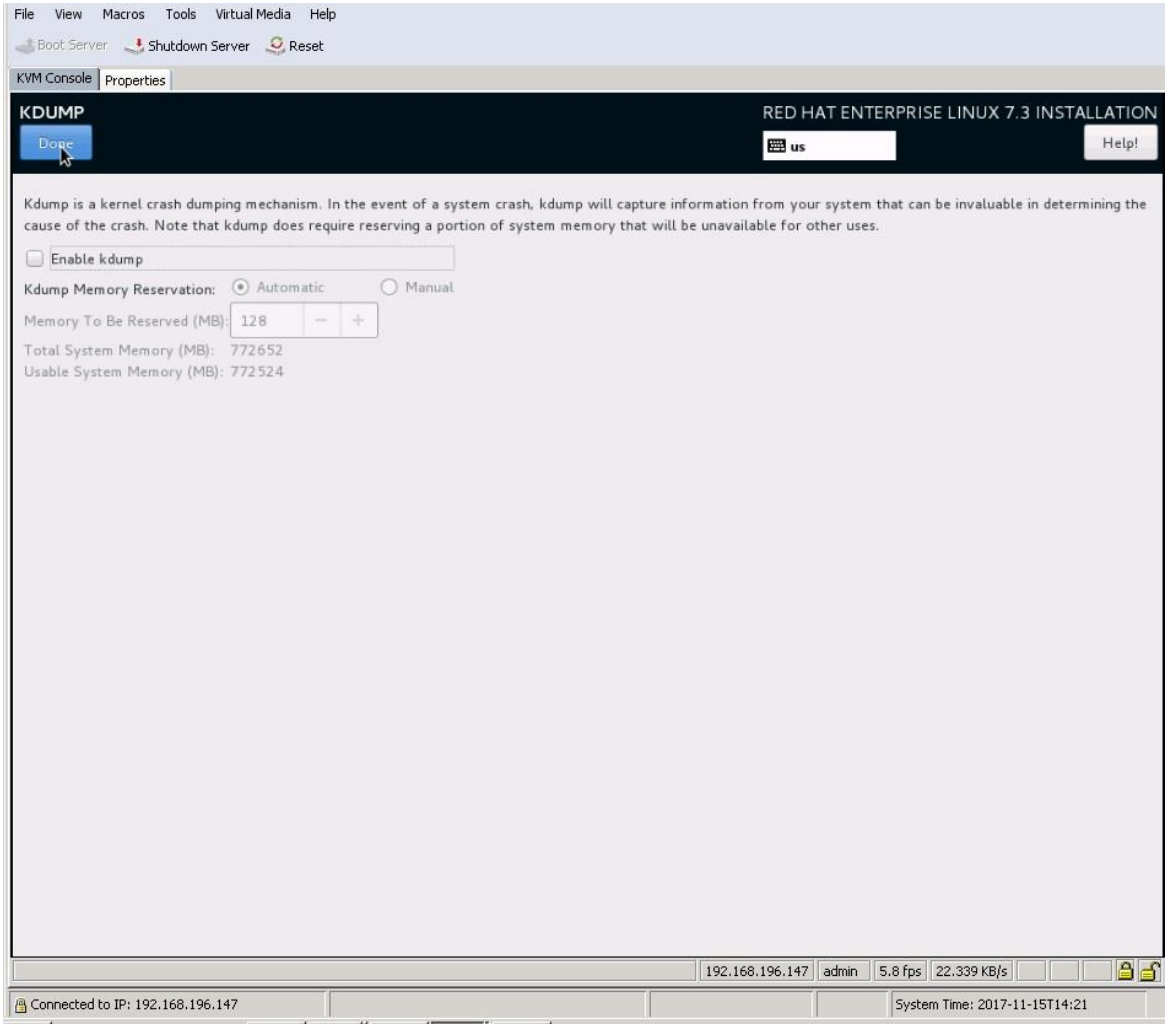
9. Select Software Selection. Retain the default selection: Minimal Install (Figure 38).

Figure 38. Software Selection page



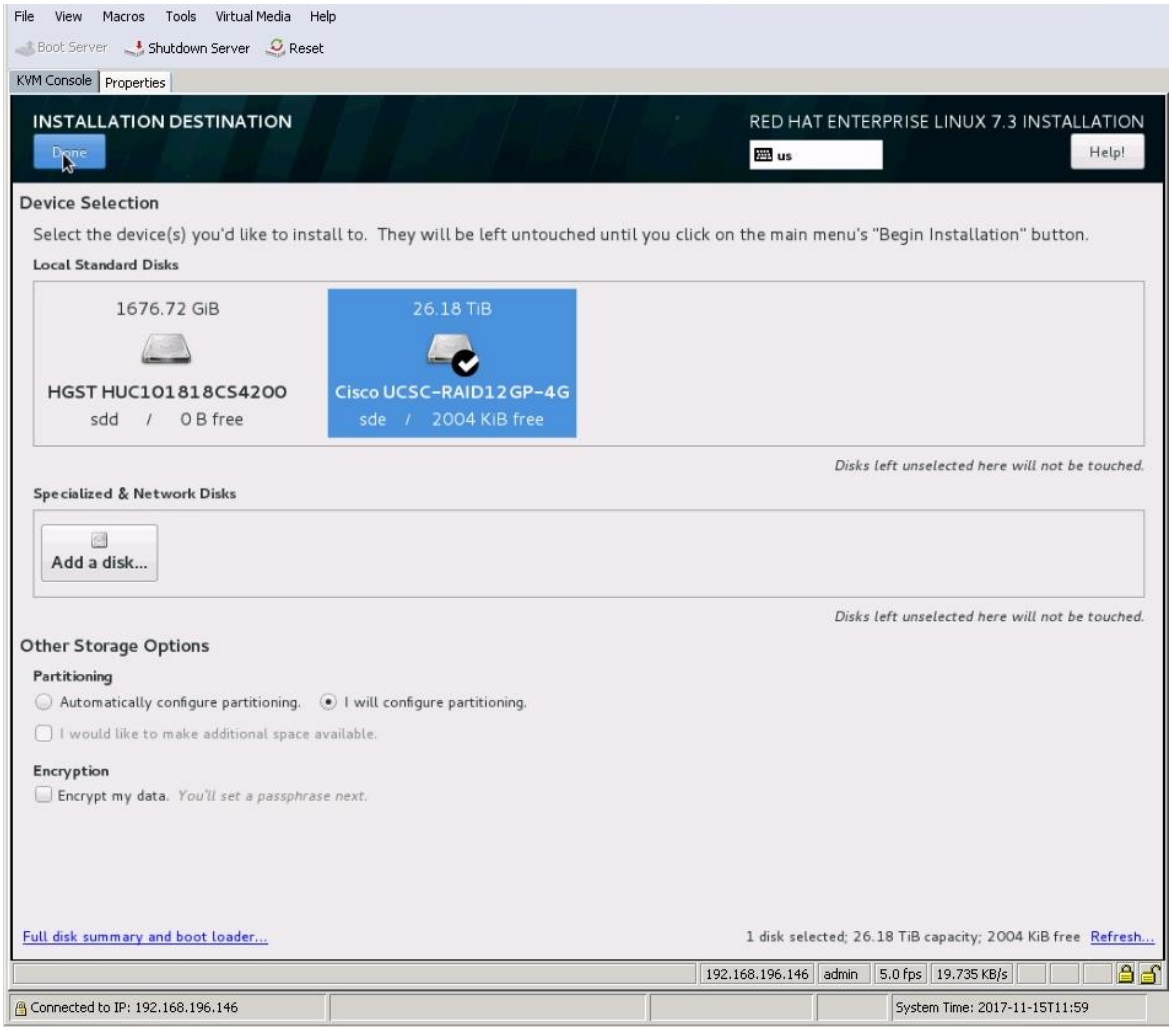
10. Select KDUMP. Deselect the Enable Kdump option to disable it (Figure 39).

Figure 39. Disabling Kdump



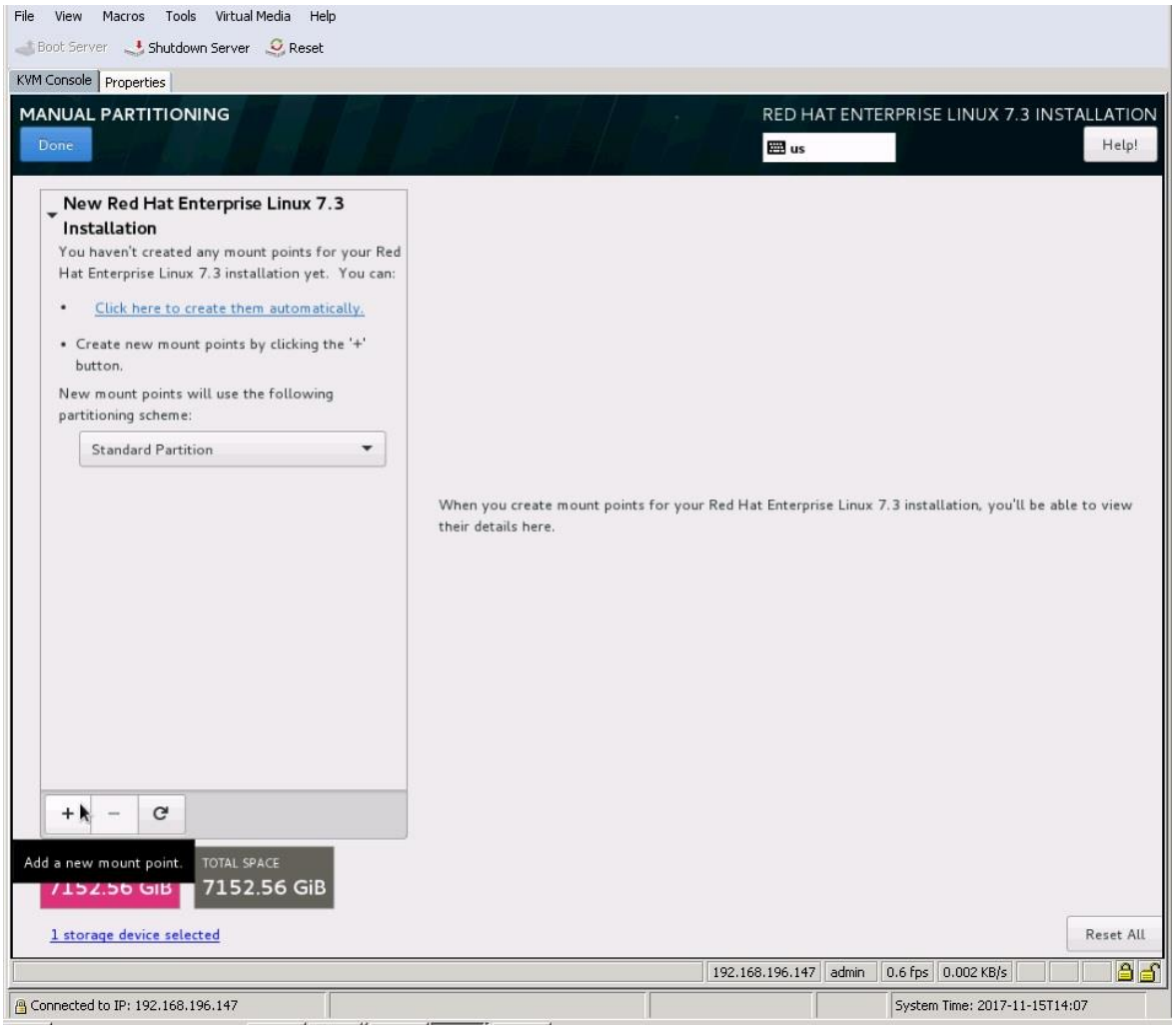
11. Choose System > Installation Destination. Under the other storage options, select the option to manually configure the disk partition layout: “I will configure partition.” (Figure 40).

Figure 40. Installation Settings landing page



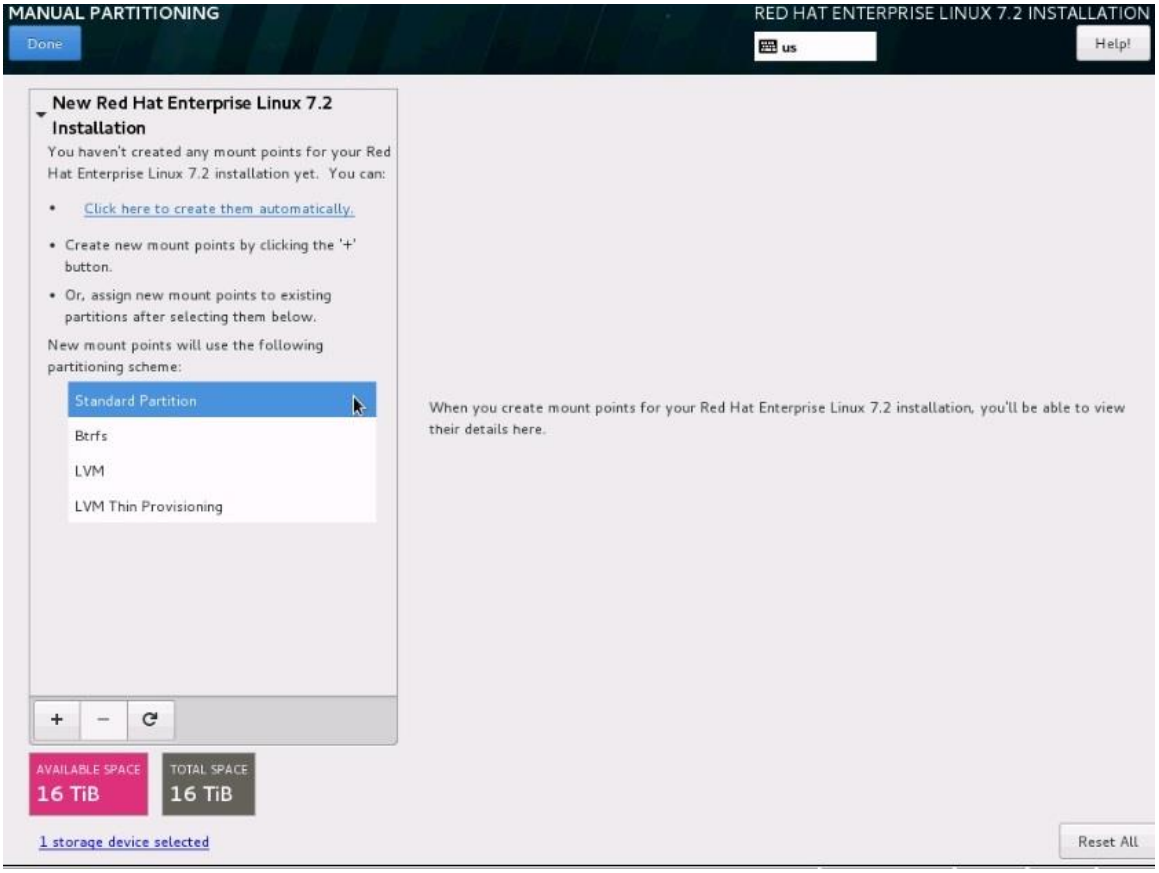
12. Click Done. The Manual Partitioning page appears (Figure 41).

Figure 41. Manual Partitioning page



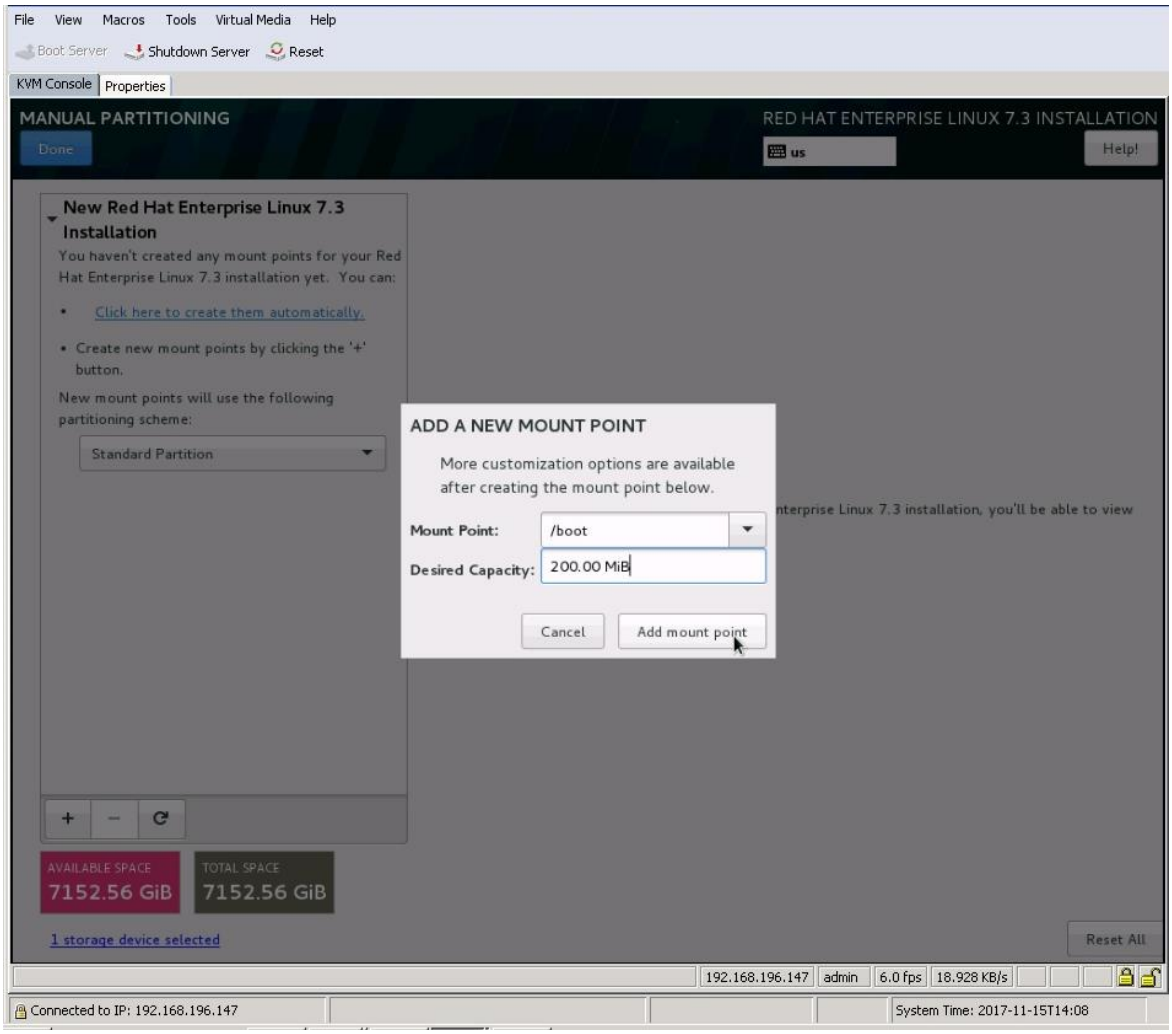
13. You will first create /boot partition with standard partition scheme. Change the default partition scheme from Logical Volume Manager (LVM) to Standard Partition (Figure 42).

Figure 42. Choosing the Standard Partition type



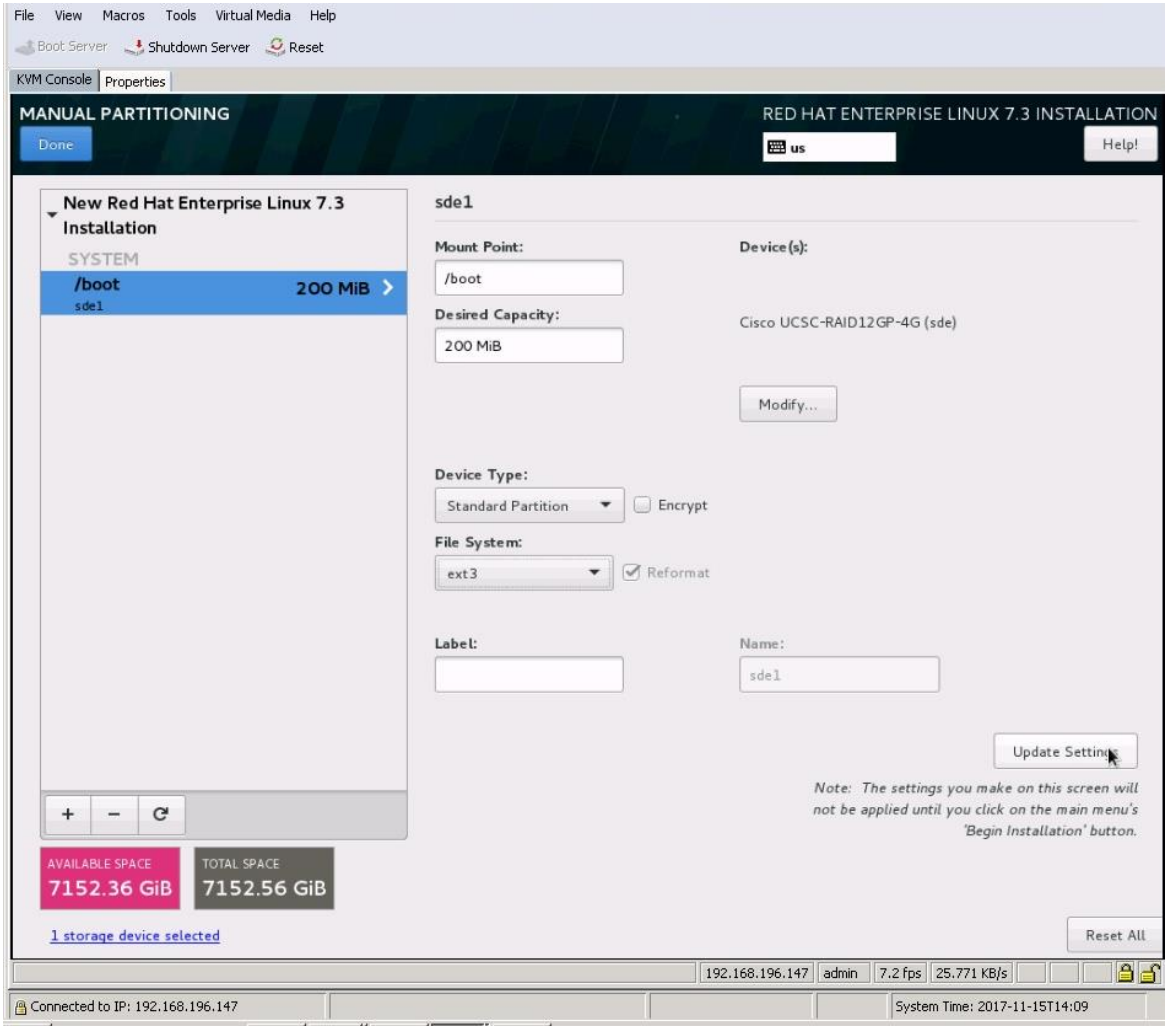
14. Click the + button and create a /boot partition with a size of 200 MiB. Then Click “Add mount point” (Figure 43).

Figure 43. Entering mount point and capacity information



15. Change the file system type from the default XFS to ext3 (Figure 44).

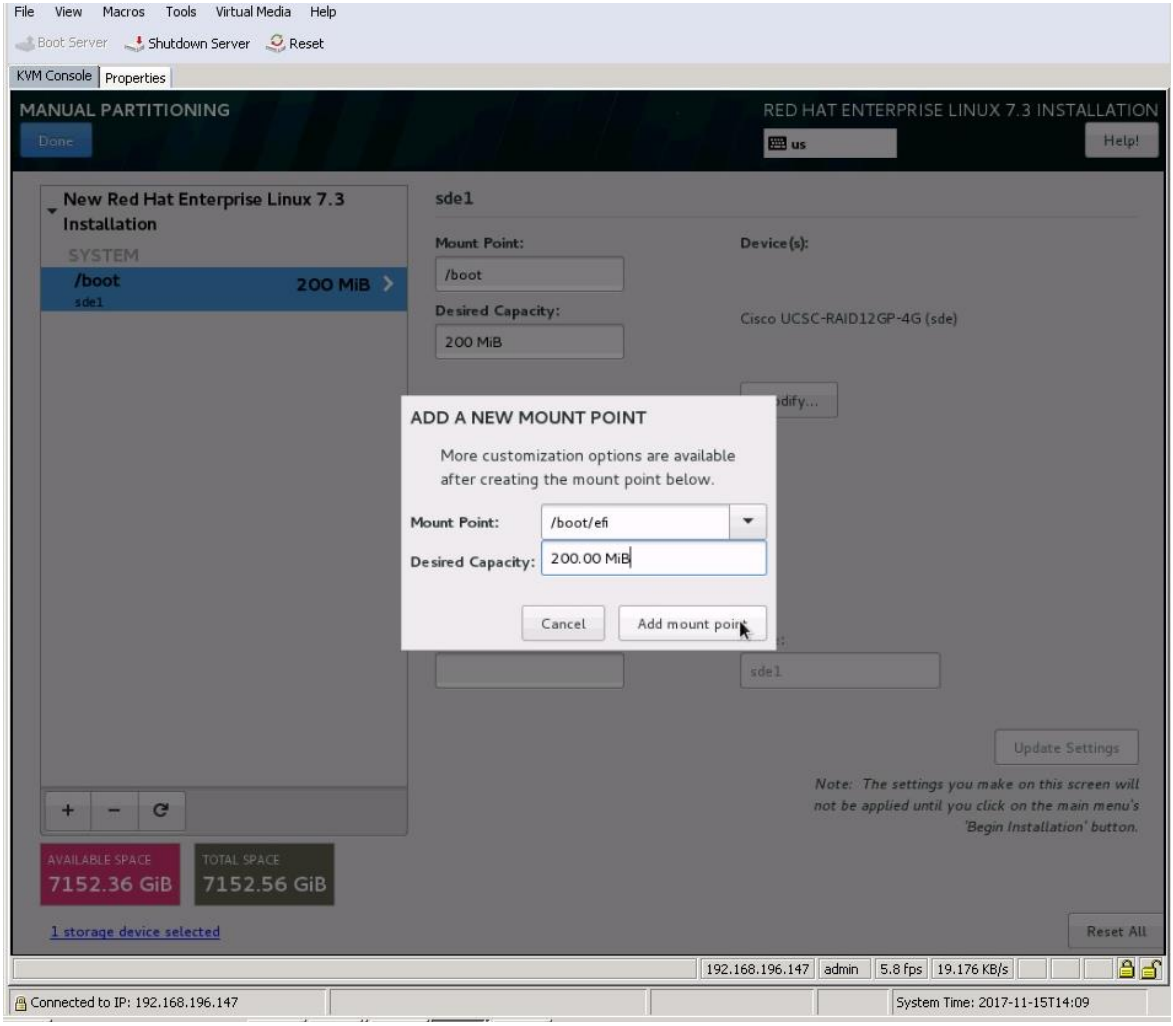
Figure 44. Modifying the file system type



16. Create /boot/efi partition of 200MiB

    Click the + button, select /boot/efi for the mount point, enter 200 MiB as the desired capacity, and click “Add mount point” (Figure 45).

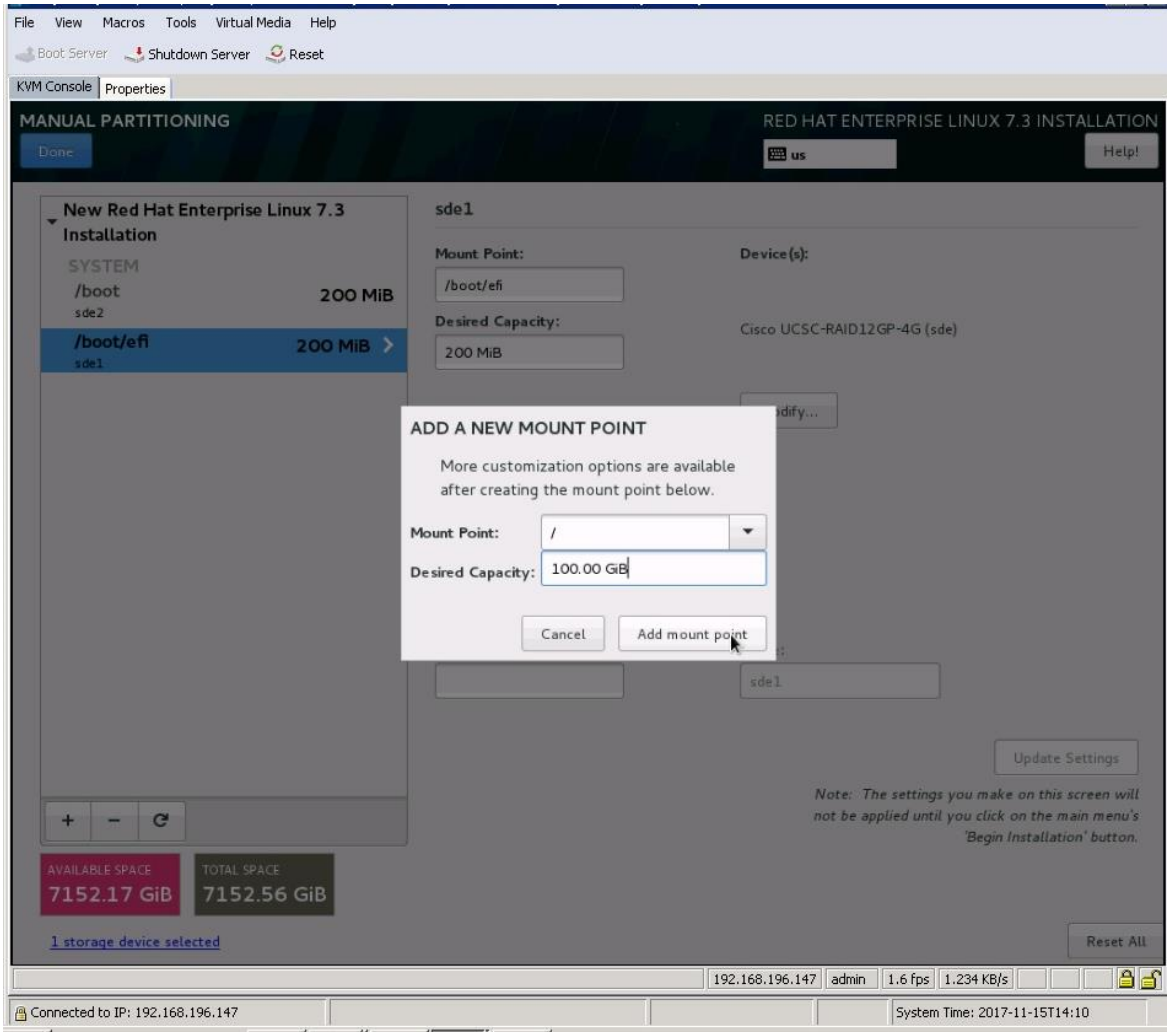
Figure 45. Creating the EFI boot partition



After you define the /boot and /boot/efi partitions, you will assign the remaining disk space to the LVM as a volume group (VG) and then carve out a root volume, swap volume, and HANA system–related volumes.

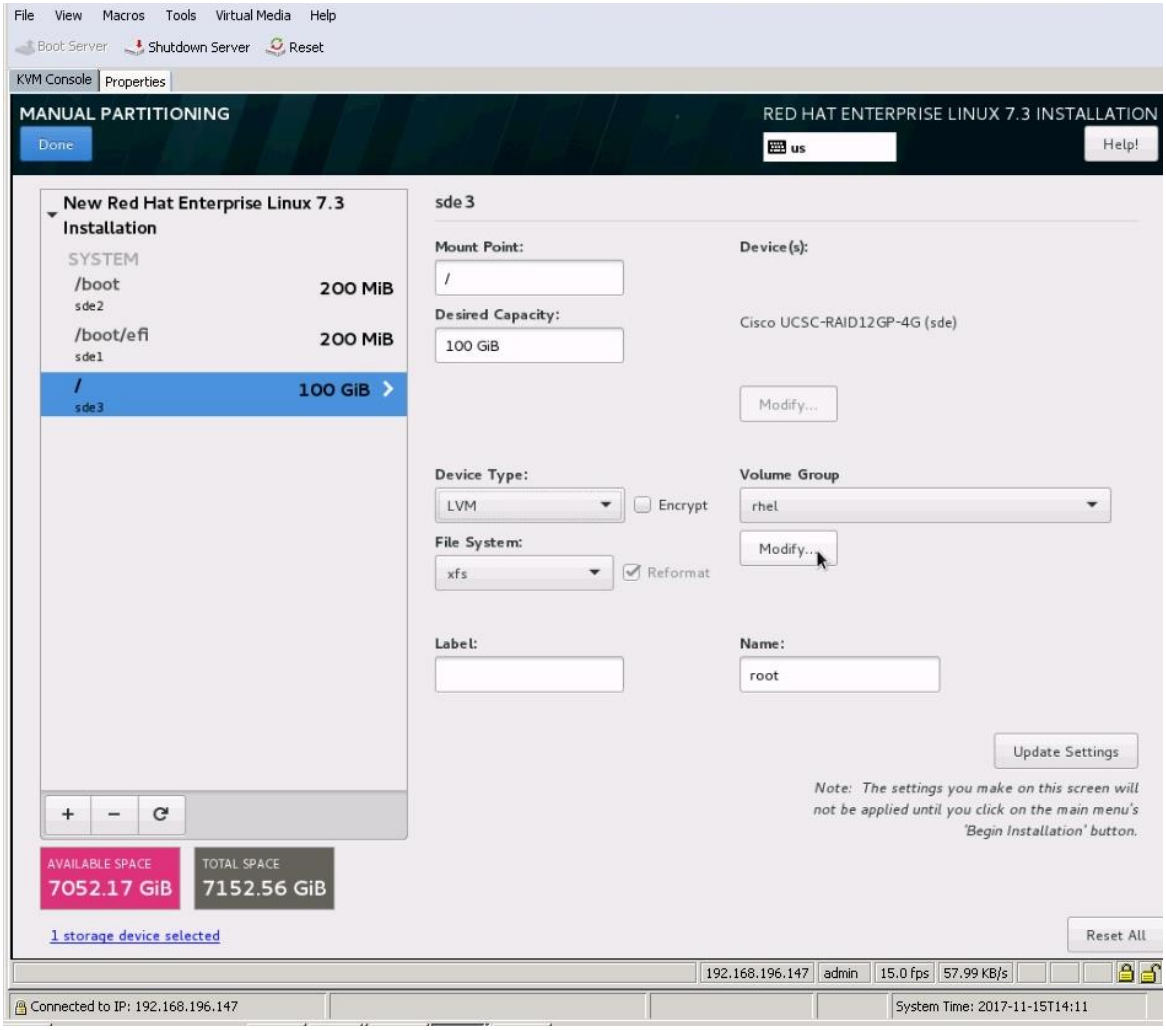
Click the + button, select "/" for the mount point, enter 100 GiB as the desired capacity, and click "Add mount point" (Figure 46).

Figure 46. Creating the root file system with 100 GB



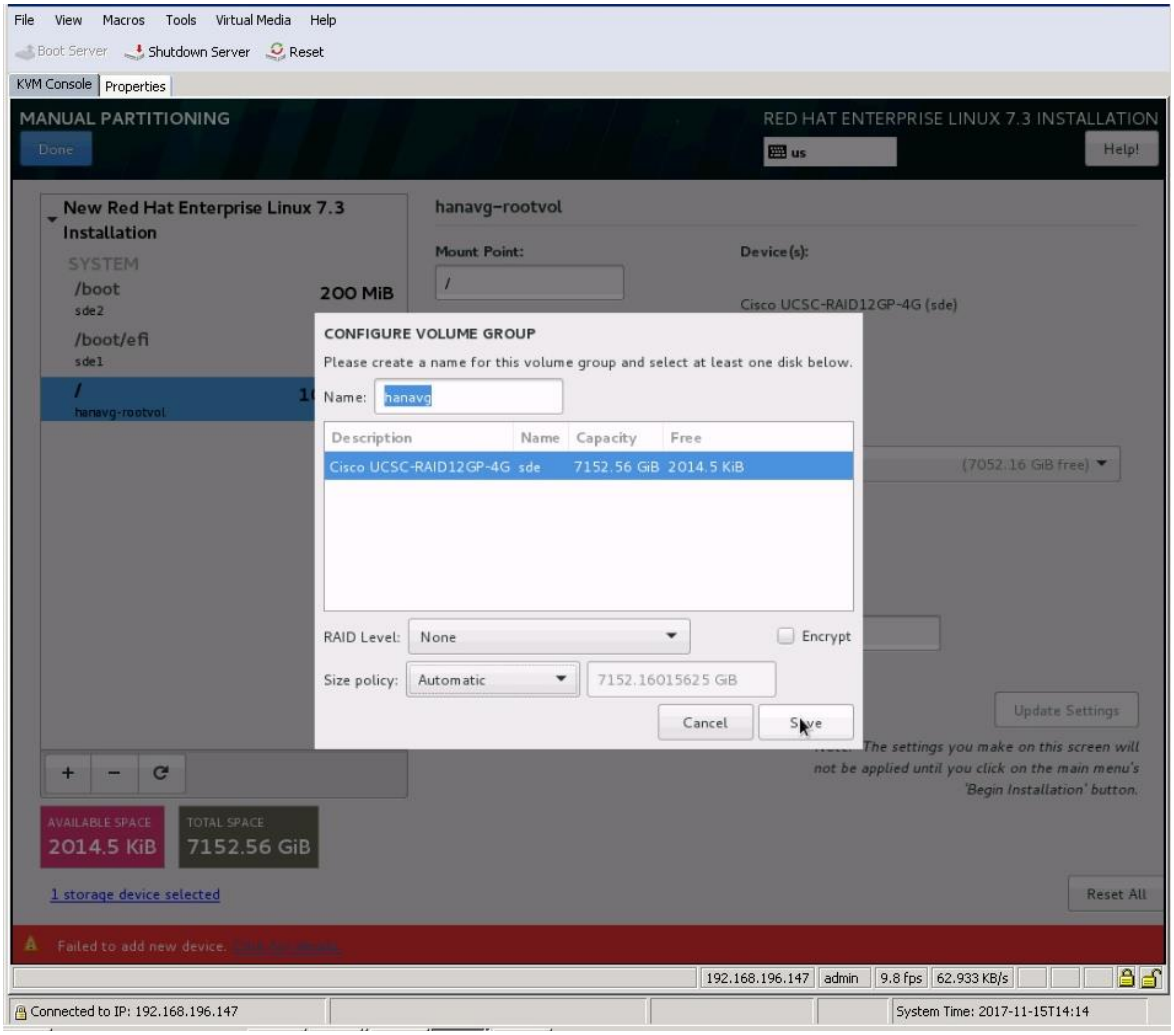
17. Click Modify to change the device type (Figure 47).

Figure 47. Preparing to change the device type to LVM



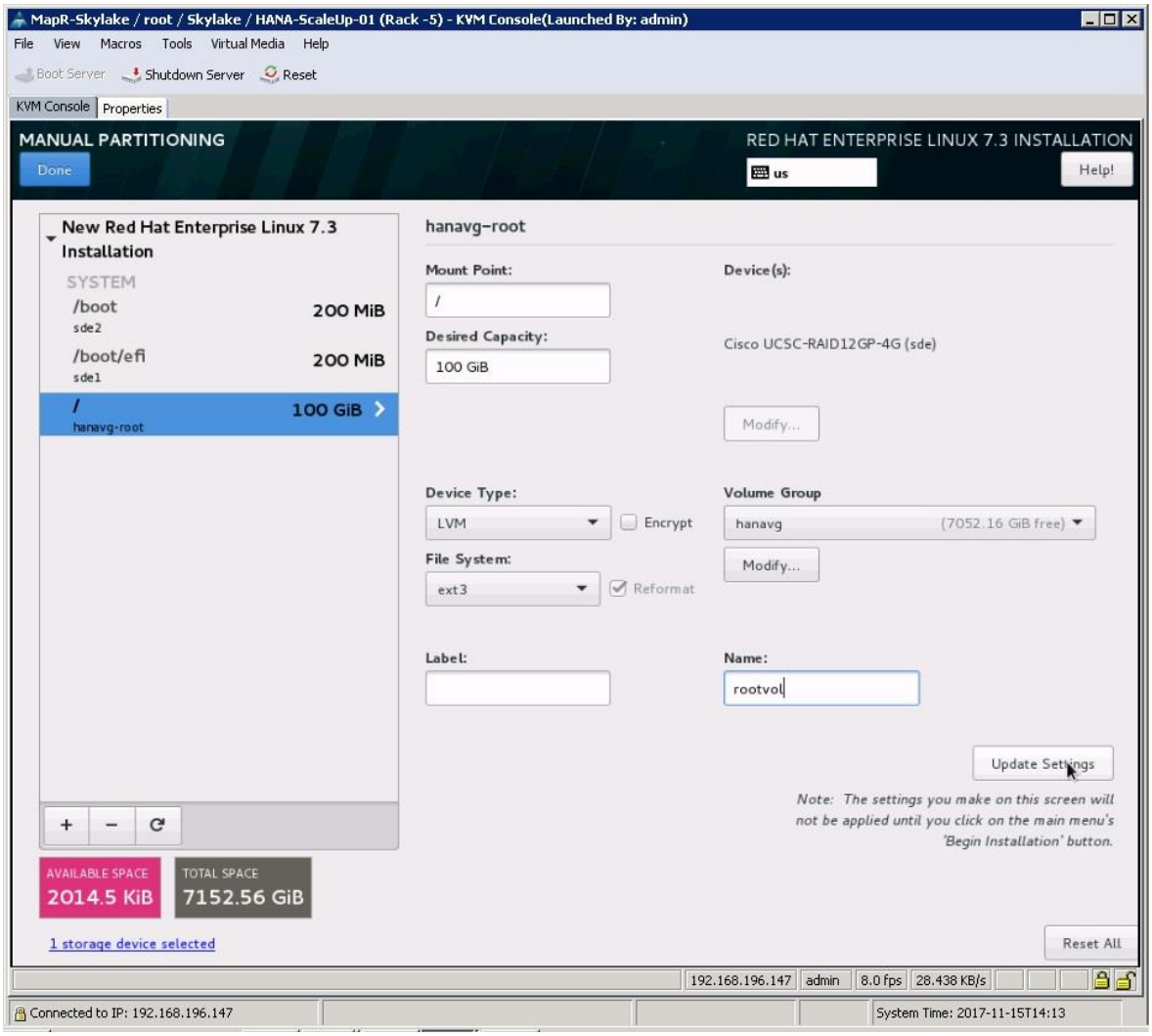
18. Change the device type from Standard Partition to LVM.
19. Change the name of the volume group from the default rhel to **hanavg** (Figure 48) Then click Save.

Figure 48. Configuring the volume group



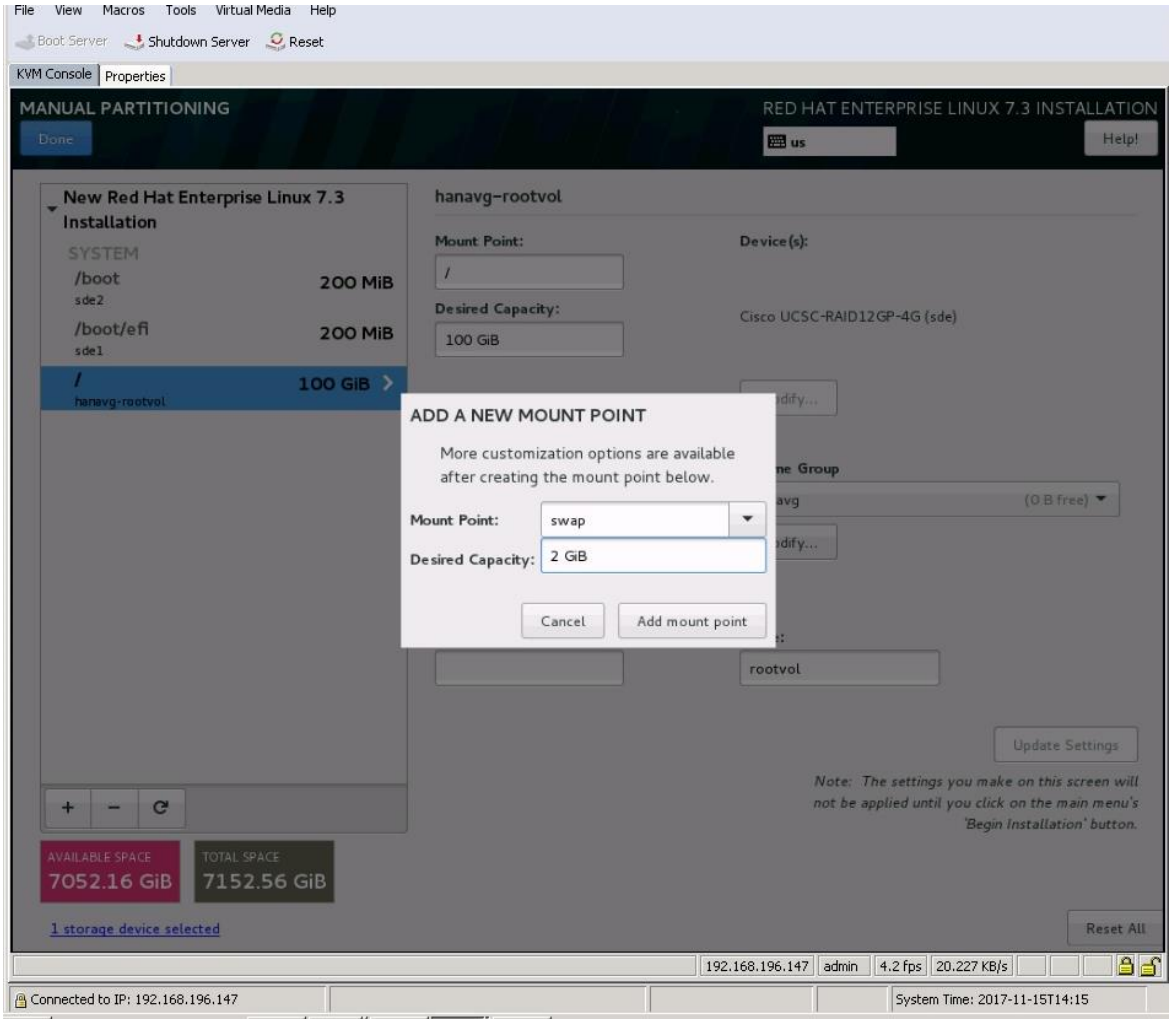
20. Change the file system type to ext3 and change the name to **rootvol**. Click Update Settings (Figure 49).

Figure 49. Updating the file system type and volume group name



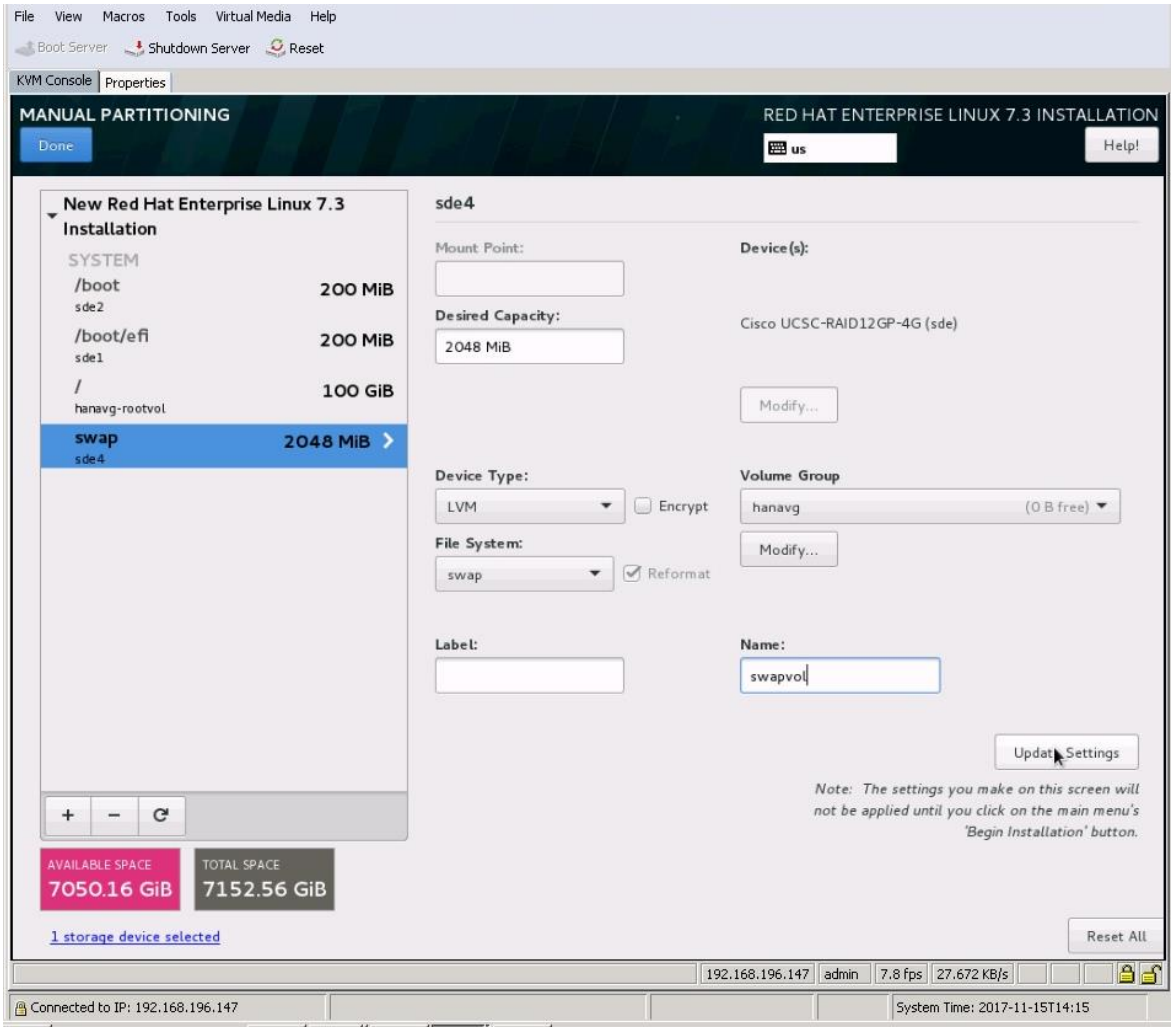
You will now create a 2 GiB swap volume. Click the + button, select swap for the mount point, enter 2 GiB as the desired capacity, and click “Add mount point” (Figure 50).

Figure 50. Creating a swap volume



21. Change the device type to LVM, verify that hanavg is selected as the volume group, and change the name to **swapvol** (Figure 51).

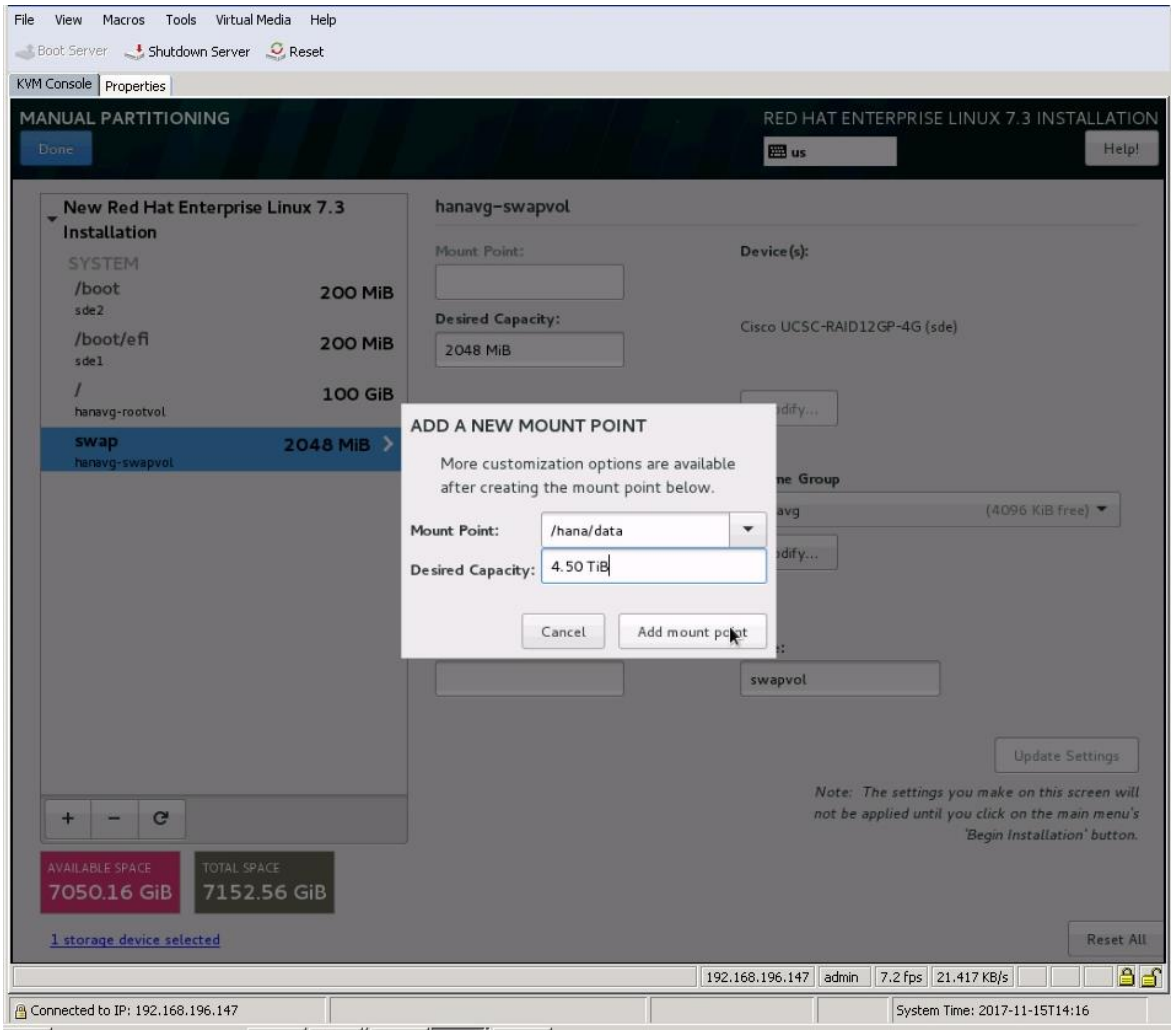
Figure 51. Updating swap volume properties



22. Next you will create the SAP HANA system's data, log, and shared volumes.

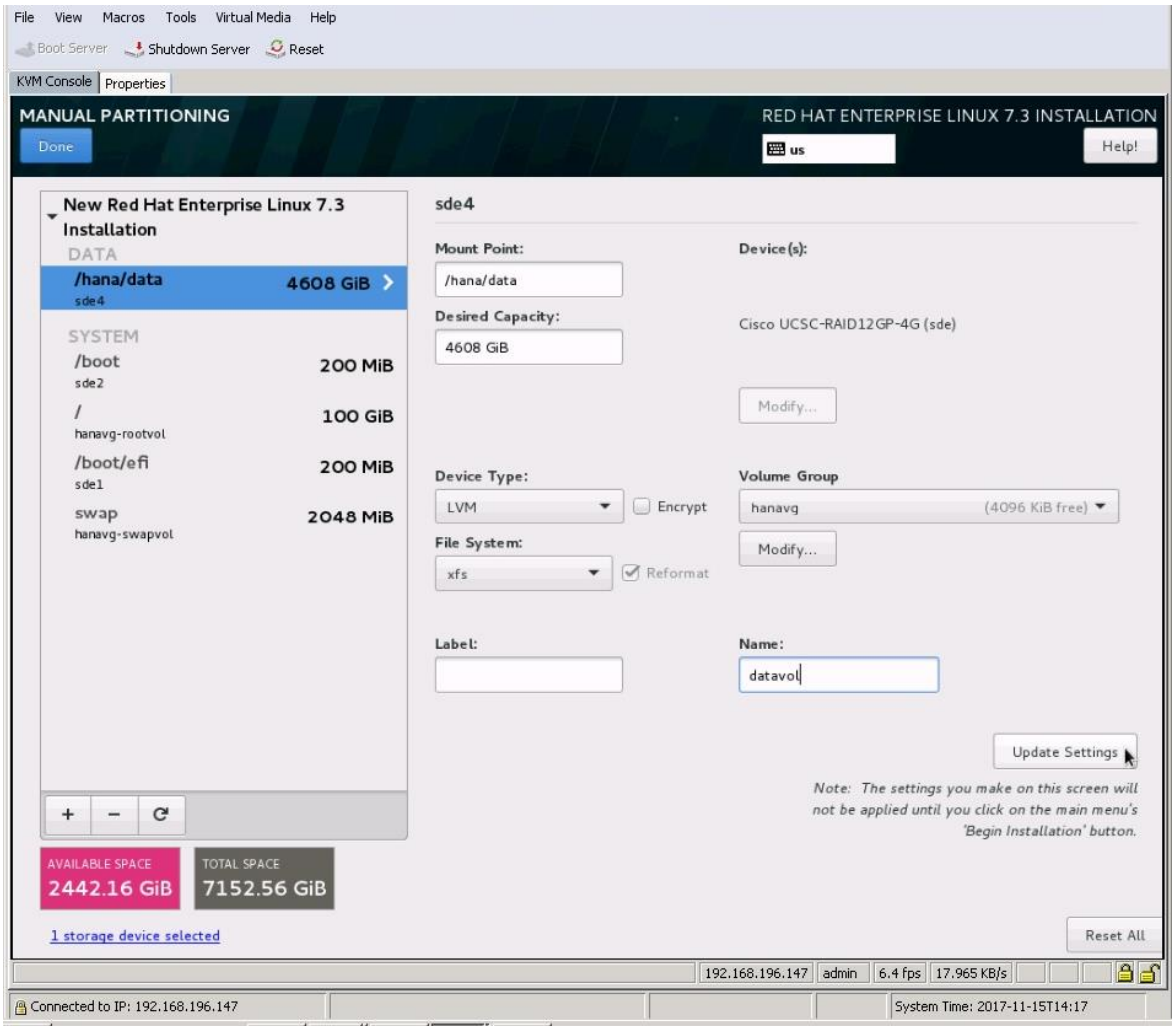
    a. Click the + button, select /hana/data as the mount point and 4.5 TiB as the desired capacity, and click "Add mount point" (Figure 52).

Figure 52. Creating the /hana/data logical volume



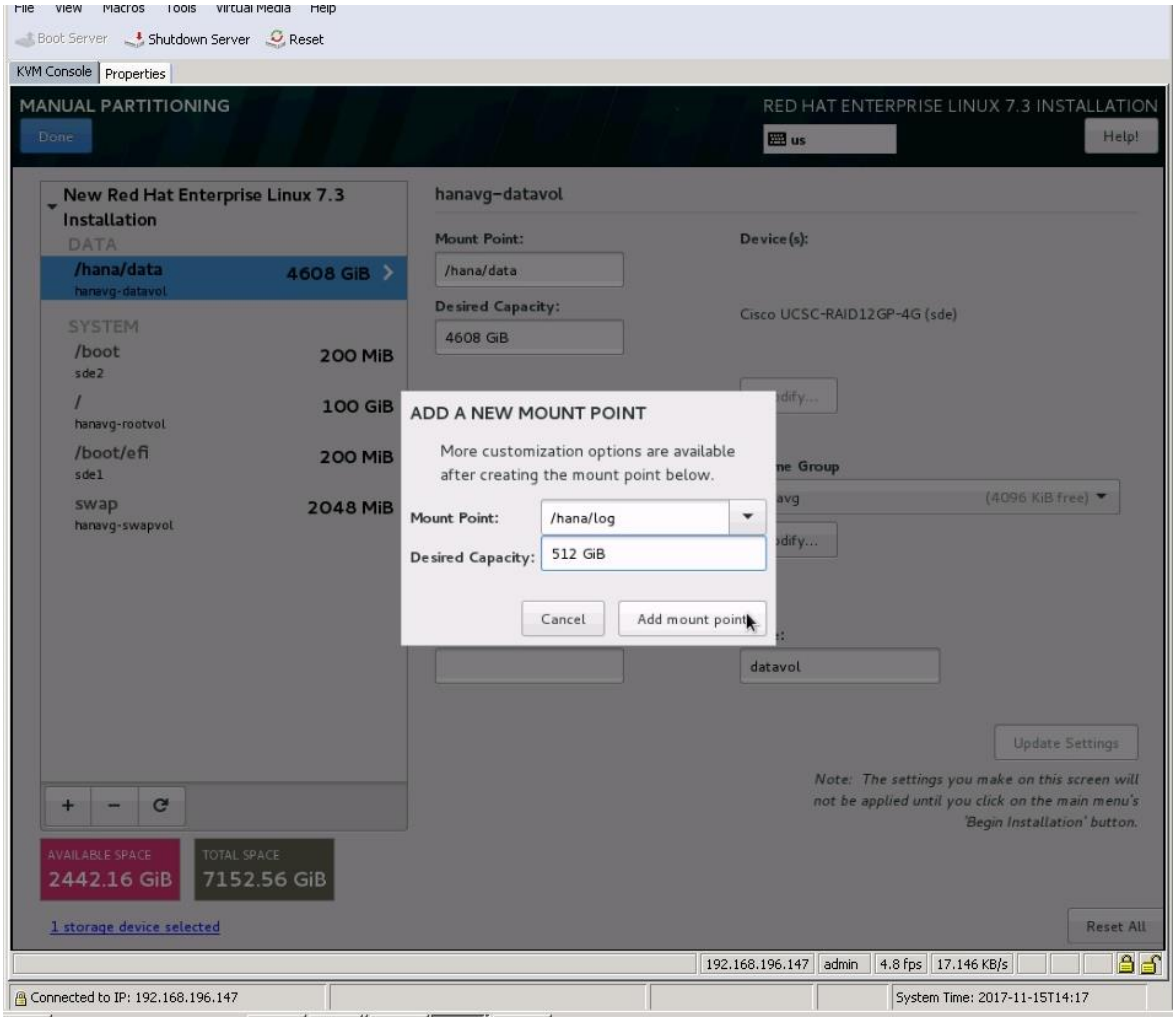
b. Change the device type to LVM, verify that hanavg is selected as the volume group, and change the name to **datavol** (Figure 53).

Figure 53. Updating /hana/data logical volume properties



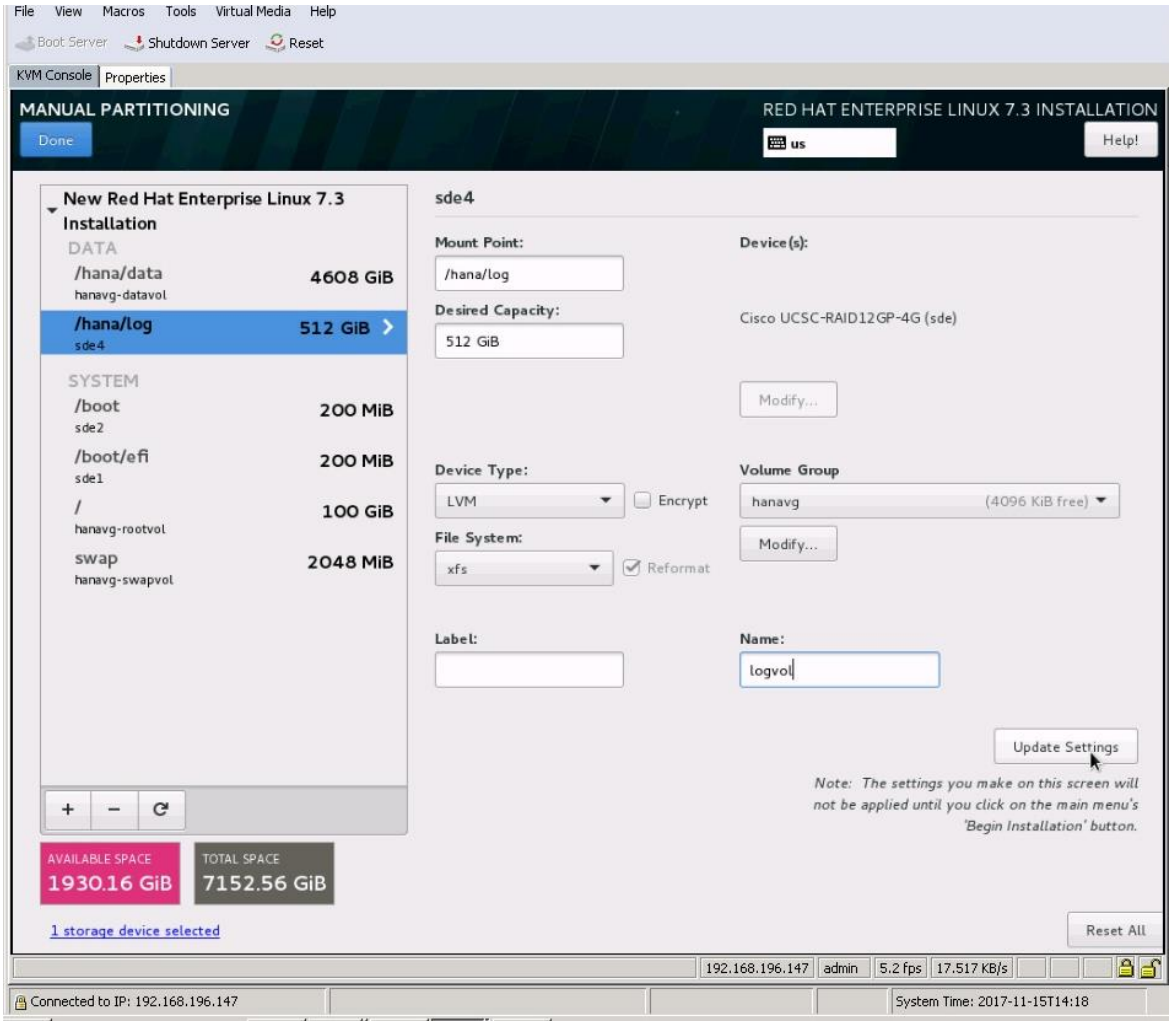
c. Click the + button, select /hana/log as the mount point and 512 GiB as the desired capacity, and click “Add mount point” (Figure 54).

Figure 54. Creating the /hana/log logical volume



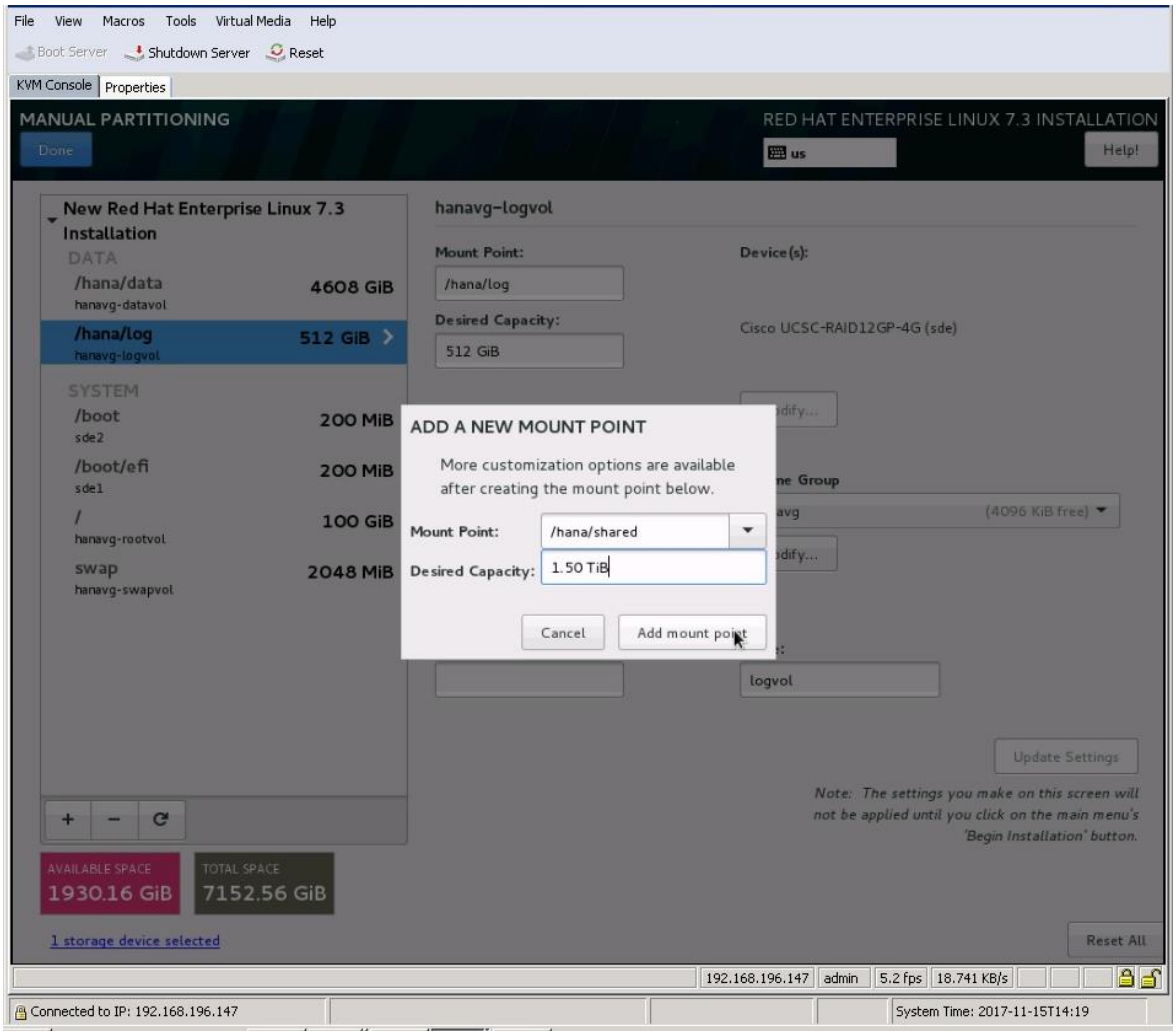
d. Change the device type to LVM, verify that hanavg is selected as the volume group, and change the name to **loglv** (Figure 55).

Figure 55. Updating the /hana/log logical volume properties



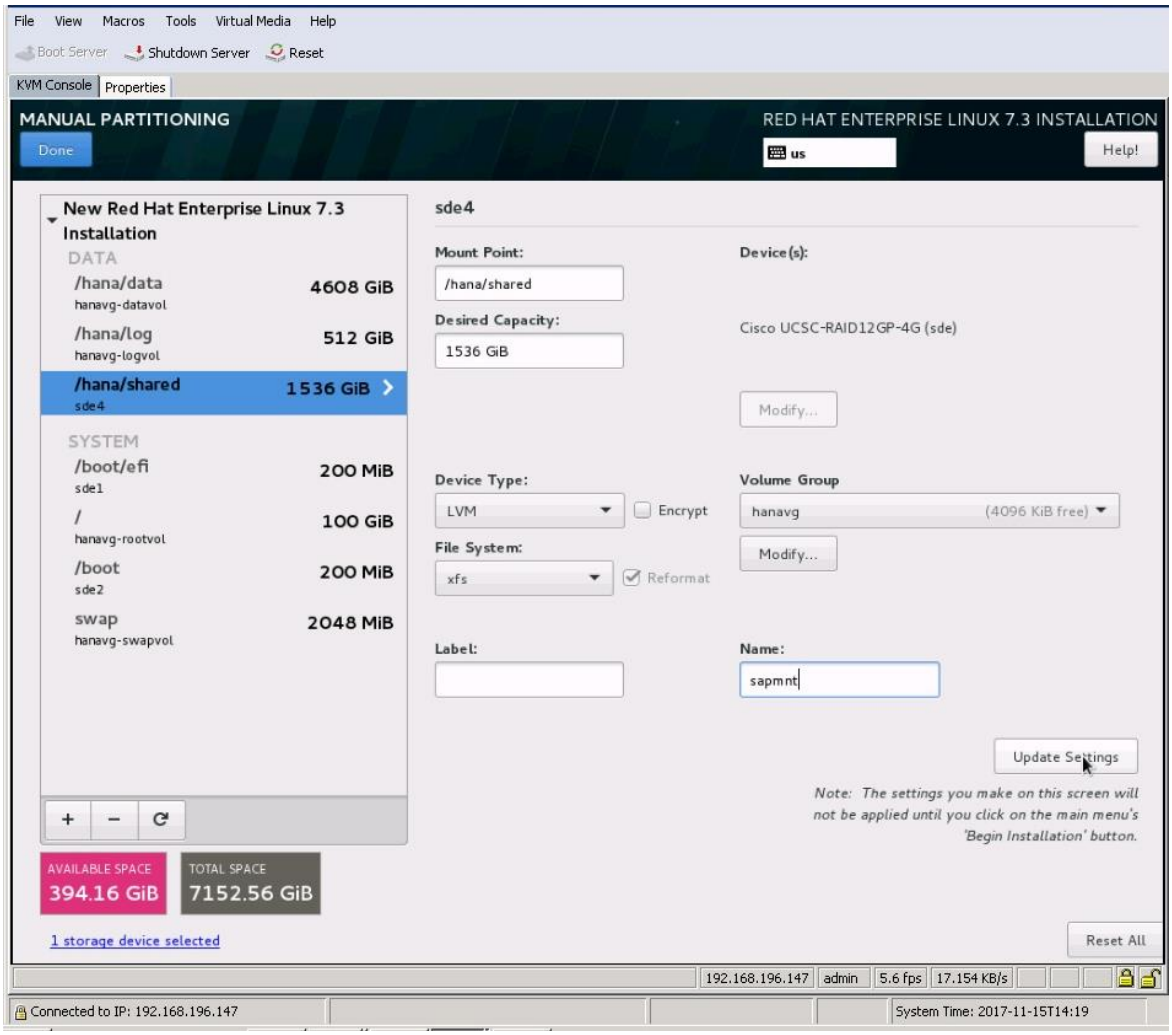
e. Click the + button, select /hana/shared as the mount point and 1.5 TiB as the desired capacity, and click “Add mount point” (Figure 56).

Figure 56. Creating the /hana/shared logical volume



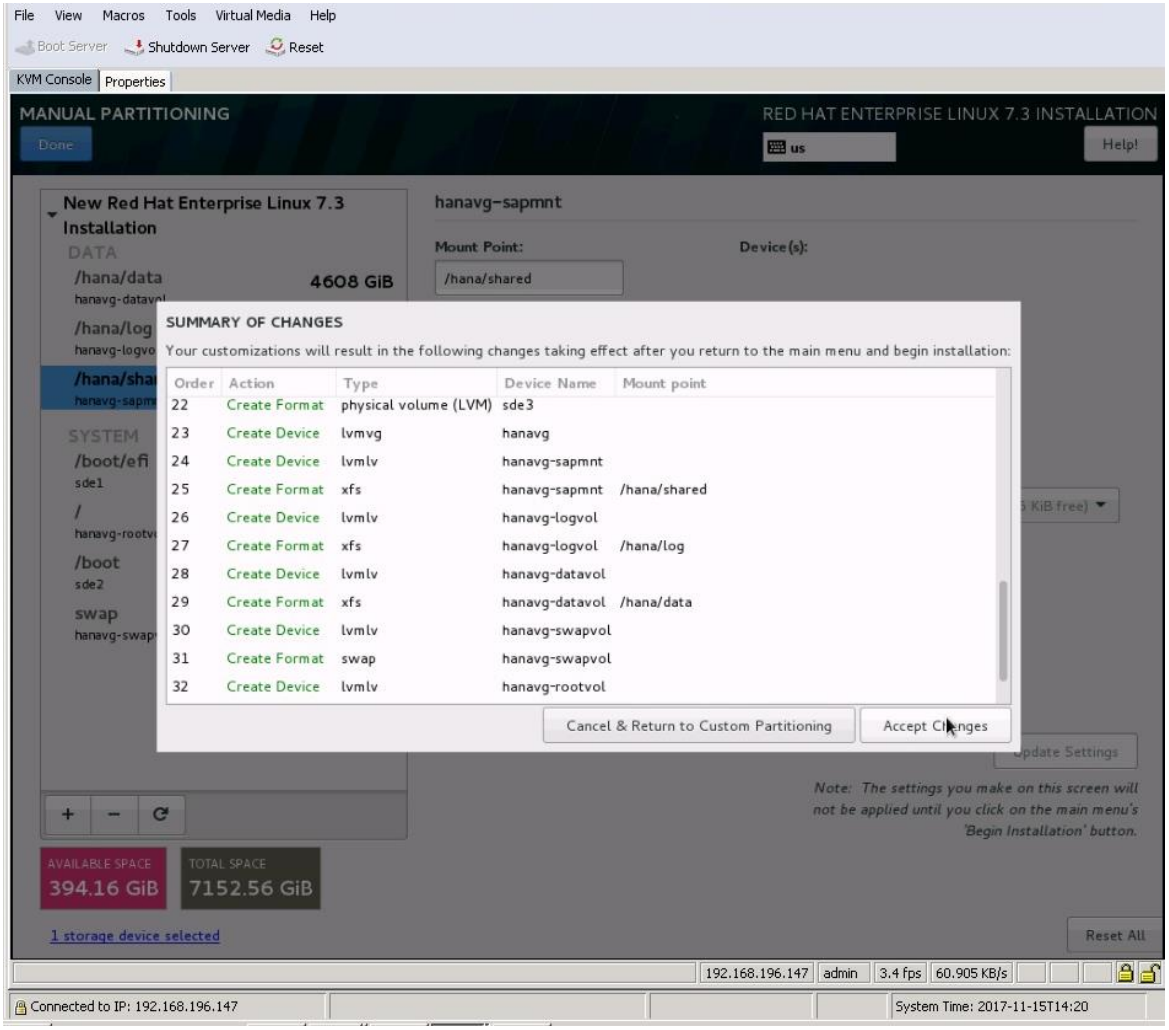
f. Change the device type to LVM, verify that hanavg is selected as the volume group, and change the name to **sharedlv**. Click Update Settings (Figure 57).

Figure 57. Updating the /hana/shared logical volume properties



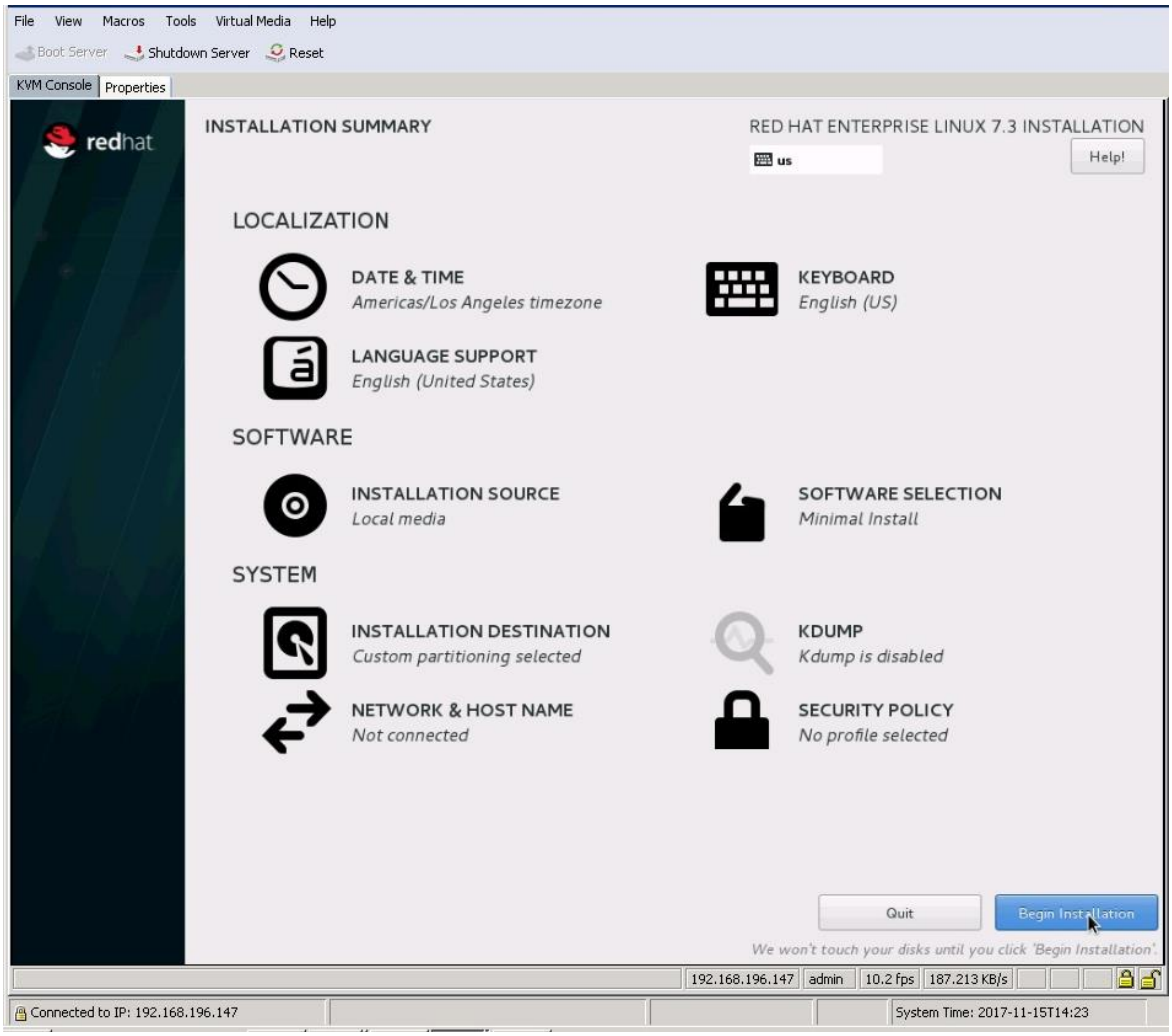
23. Click Done. A summary of the changes will appear. Click Accept Changes (Figure 58).

Figure 58. Summary of changes for manual partition configurations



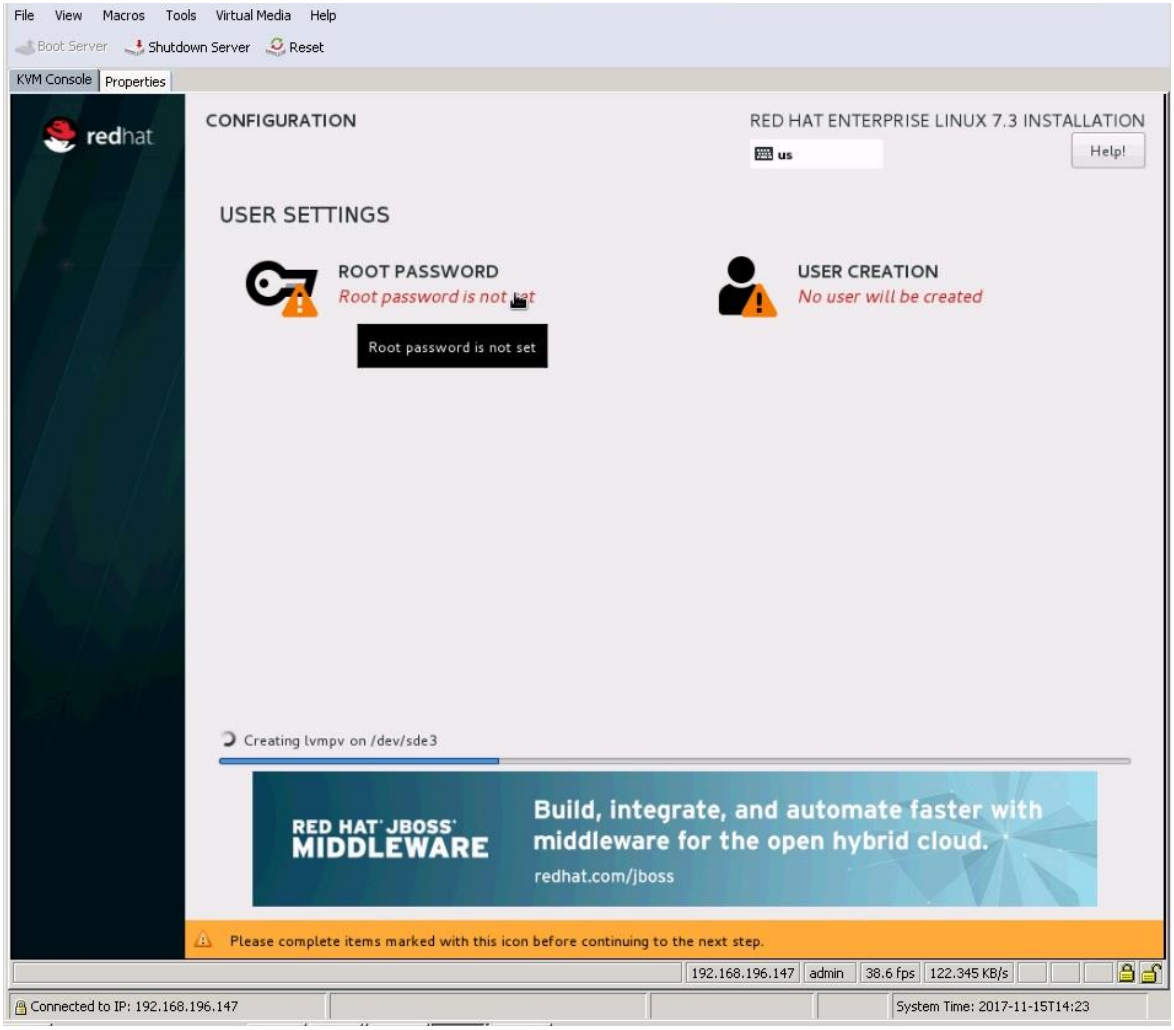
24. On the Installation Summary page that appears, click Begin Installation (Figure 59).

Figure 59. Beginning the installation



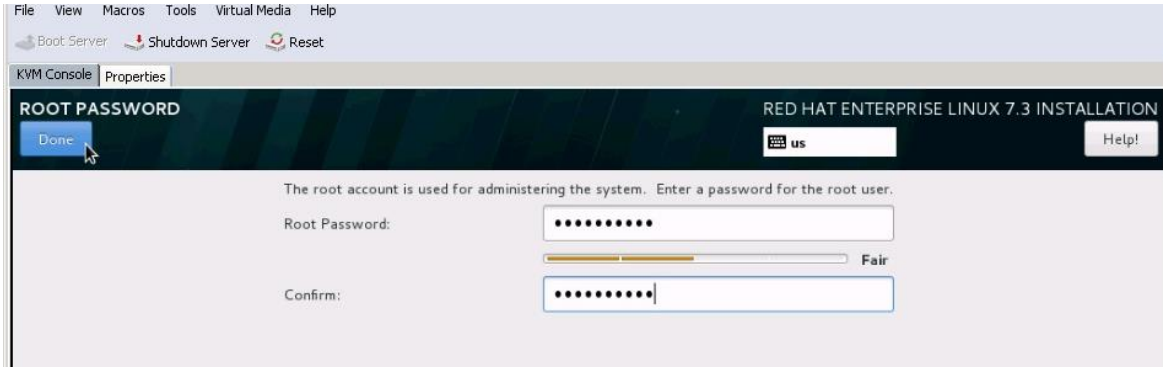
25. As the installation progresses, set the root password (Figure 60).

Figure 60. Setting the root password



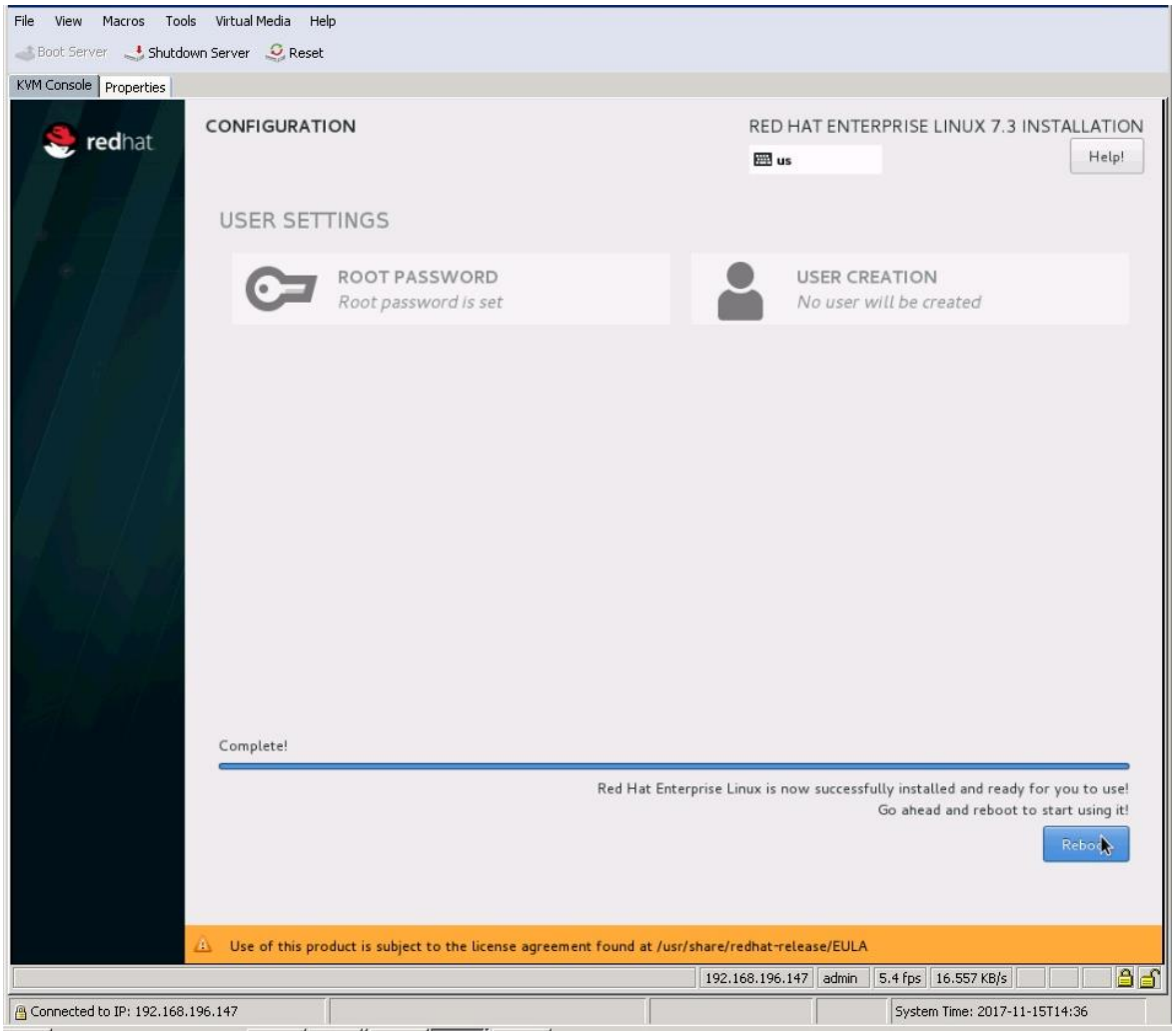
26. Enter and confirm the root password

Figure 61. Entering and confirming the root user password



27. The installation completes. Click Reboot (Figure 62).

Figure 62. Finishing the configuration



Performing post-installation OS customization

Follow the steps presented here to customize the server in preparation for SAP HANA installation.

Customizing the host name

1. Use the KVM console to log in to the installed system as the user **root** with the password **<<var_sys_root-pw>>**.
2. Update the /etc/hosts file with an entry matching the hostname and IP address of the system (Figure 63).

Figure 63. Sample hosts file

```
[root@cishana01 ~]# more /etc/hosts
127.0.0.1   localhost localhost.localdomain localhost4 localhost4.localdomain4
::1         localhost localhost.localdomain localhost6 localhost6.localdomain6
173.36.215.118  cishana01.custdom.local cishana01
[root@cishana01 ~]#
```

3. Verify that the set host name is displayed correctly.

   The operating system must be configured so that the short name of the server is displayed with the command **hostname -s**, and the fully qualified host name is displayed with the command **hostname -f**. Figure 64 shows sample output.

Figure 64. Sample **hostname** command output

```
[root@cishana01 ~]# hostname
cishana01.custdon.local
[root@cishana01 ~]# hostname -s
cishana01
[root@cishana01 ~]# hostname -f
cishana01.custdon.local
[root@cishana01 ~]# hostname -d
custdon.local
```

Configuring the network

The Cisco UCS C460 M4 server comes with a pair of Cisco UCS VIC 1225 adapters. In addition to the administration and management networks, you can optionally have networks for backup, client access, etc. You can configure additional networks based on customer-specific requirements and use cases.

1. To display an overview of the Ethernet interface configuration, use the **ip addr** command. Figure 65 shows sample output.

Figure 65. Sample **ip addr** command output

```
[root@cishana01 ~]# ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: enp72s0: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN qlen 1000
    link/ether 84:b8:02:8b:31:40 brd ff:ff:ff:ff:ff:ff
3: enp73s0: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN qlen 1000
    link/ether 84:b8:02:8b:31:41 brd ff:ff:ff:ff:ff:ff
4: enp135s0: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN qlen 1000
    link/ether 84:b8:02:5b:de:20 brd ff:ff:ff:ff:ff:ff
5: enp136s0: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN qlen 1000
    link/ether 84:b8:02:5b:de:21 brd ff:ff:ff:ff:ff:ff
6: enp65s0f0: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN qlen 1000
    link/ether 88:1d:fc:39:f2:12 brd ff:ff:ff:ff:ff:ff
7: enp65s0f1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP qlen 1000
    link/ether 88:1d:fc:39:f2:13 brd ff:ff:ff:ff:ff:ff
    inet 173.36.215.118/24 brd 173.36.215.255 scope global enp65s0f1
       valid_lft forever preferred_lft forever
    inet6 fe80::8a1d:fcff:fe39:f213/64 scope link
       valid_lft forever preferred_lft forever
8: enp80s0f0: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN qlen 1000
    link/ether 88:1d:fc:39:f2:16 brd ff:ff:ff:ff:ff:ff
9: enp80s0f1: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN qlen 1000
    link/ether 88:1d:fc:39:f2:18 brd ff:ff:ff:ff:ff:ff
[root@cishana01 ~]#
```

In RHEL 7, systemd and udev support a number of different naming schemes. By default, fixed names are assigned based on firmware, topology, and location information: for instance, enp72s0, as shown in Figure 66.

With this naming convention, names stay fixed even if hardware is added or removed. However, the names are often more difficult to read than traditional kernel-native ethX names: for instance, eth0.

Another method for naming network interfaces, biosdevnames, is also available with the installation.

2. Configure the boot parameters **net.ifnames=0 biosdevname=0** to disable both approaches to use the original kernel-native network names.
3. Also, you can disable IPv6 support at this time because this solution uses IPv4. You can accomplish this by appending **ipv6.disable=1** to **GRUB_CMDLINE_LINUX** as shown in Figure 66.

Figure 66. Sample grub file with CMDLINE parameter additions

```
[root@cishana01 ~]# vi /etc/default/grub
GRUB_TIMEOUT=5
GRUB_DISTRIBUTOR="$(sed 's, release .*$,,g' /etc/system-release)"
GRUB_DEFAULT=saved
GRUB_DISABLE_SUBMENU=true
GRUB_TERMINAL_OUTPUT="console"
GRUB_CMDLINE_LINUX="rd.lvm.lv=hanavg/rootvol rd.lvm.lv=hanavg/swapvol rhgb quiet net.ifnames=0 biosdevname=0 ipv6.disable=1"
GRUB_DISABLE_RECOVERY="true"
```

4. Run the **grub2-mkconfig** command to regenerate the grub.cfg file (Figure 67):

```
# grub2-mkconfig -o /boot/grub2/grub.cfg
```

Figure 67. Updating the grub configuration

```
[root@cishana01 ~]# grub2-mkconfig -o /boot/grub2/grub.cfg
Generating grub configuration file ...
Found linux image: /boot/vmlinuz-3.10.0-327.28.3.el7.x86_64
Found initrd image: /boot/initramfs-3.10.0-327.28.3.el7.x86_64.img
Found linux image: /boot/vmlinuz-3.10.0-327.el7.x86_64
Found initrd image: /boot/initramfs-3.10.0-327.el7.x86_64.img
Found linux image: /boot/vmlinuz-0-rescue-2bee164fc0474586a395513638954a08
Found initrd image: /boot/initramfs-0-rescue-2bee164fc0474586a395513638954a08.img
done
[root@cishana01 ~]#
```

5. Reboot the system to make the changes take effect:

```
# reboot
```

6. After the reboot, use the KVM console to log in to the installed system as the user **root** with the password **<<var_sys_root-pw>>**.

7. Run the **ip addr** command to see the interfaces in the traditional kernel-native ethX nomenclature (Figure 68).

Figure 68. Checking the interface status with the **ip addr** command

```
[root@cishana01 network-scripts]# ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
2: eth0: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN qlen 1000
    link/ether 84:b8:02:8b:31:40 brd ff:ff:ff:ff:ff:ff
3: eth1: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN qlen 1000
    link/ether 84:b8:02:8b:31:41 brd ff:ff:ff:ff:ff:ff
4: eth2: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN qlen 1000
    link/ether 84:b8:02:5b:de:20 brd ff:ff:ff:ff:ff:ff
5: eth3: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN qlen 1000
    link/ether 84:b8:02:5b:de:21 brd ff:ff:ff:ff:ff:ff
6: eth4: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN qlen 1000
    link/ether 88:1d:fc:39:f2:12 brd ff:ff:ff:ff:ff:ff
7: eth5: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP qlen 1000
    link/ether 88:1d:fc:39:f2:13 brd ff:ff:ff:ff:ff:ff
8: eth6: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN qlen 1000
    link/ether 88:1d:fc:39:f2:16 brd ff:ff:ff:ff:ff:ff
9: eth7: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN qlen 1000
    link/ether 88:1d:fc:39:f2:18 brd ff:ff:ff:ff:ff:ff
[root@cishana01 network-scripts]#
```

8. A close observation of the output reveals that the previous IP address setting was lost due to the changes in the interface naming you just implemented. You will have to again find the interface that has the uplink connectivity. Check the link status using the **ethtool** command to ascertain the interface that is connected to the management network (Figure 69).

Figure 69. Using the **ethtool** command to check the link status

```
[root@cishana01 network-scripts]# for i in `seq -w 0 7`; do ethtool eth$i | grep 'Link detected';done
        Link detected: no
        Link detected: no
        Link detected: no
        Link detected: no
        Link detected: no
        Link detected: yes
        Link detected: no
        Link detected: no
[root@cishana01 network-scripts]#
```

9. Assign **<<var_mgmt_ip_address>>** as the IP address and enter **<<var_mgmt_ip_mask>>** as the subnet mask for the available interface (eth5 in the example in Figure 70). You can use this configuration temporarily until you port this interface to a high-availability bond device and create another interface with Cisco VIC 10-Gbps ports.
10. Go to the network configuration directory and create a configuration for eth5 as shown in the following example:

```
#cd /etc/sysconfig/network-scripts

#vi ifcfg-eth5

DEVICE=eth5

TYPE=Ethernet

ONBOOT=yes

BOOTPROTO=static

IPV6INIT=no
```

```
USERCTL=no
NM_CONTROLLED=no
IPADDR=<<var_mgmt_ip_addr>>
NETMASK=<<var_mgmt_nw_netmask>>
```

11. Add the default gateway:

```
#vi /etc/sysconfig/network
NETWORKING=yes
HOSTNAME=<<var_hostname.domain>>
GATEWAY=<<var_mgmt_gateway_ip>>
```

Configuring the network time

Be sure that the time on all components used for SAP HANA is synchronized. Use the same NTP configuration on all systems:

```
#vi /etc/ntp.conf
   …..
   server <NTP-SERVER1 IP>
   server <NTP-SERVER2 IP>

#service ntpd stop
#ntpdate ntp.example.com
#service ntpd start
#chkconfig ntpd on
#chkconfig ntpdate on
```

Configuring the Domain Name System

Configure the Domain Name System (DNS) based on the local requirements.

A sample configuration is shown here. Add the DNS IP address if it is required to access the Internet.

```
#vi /etc/resolv.conf

DNS1=<<IP of DNS Server1>>
DNS2=<<IP of DNS Server2>>
DOMAIN= <<Domain_name>>
```

Configuring bonds for high availability

To configure a bond for high availability, first view the Ethernet interfaces available in the system.

By examining the hardware and MAC addresses of the interfaces using the **ifconfig** command and the properties using ethtool, you can clearly differentiate the interfaces for the two dual-port Cisco UCS VIC 1385 adapters installed in the server as well as the onboard 1-Gbps interface (Figure 70).

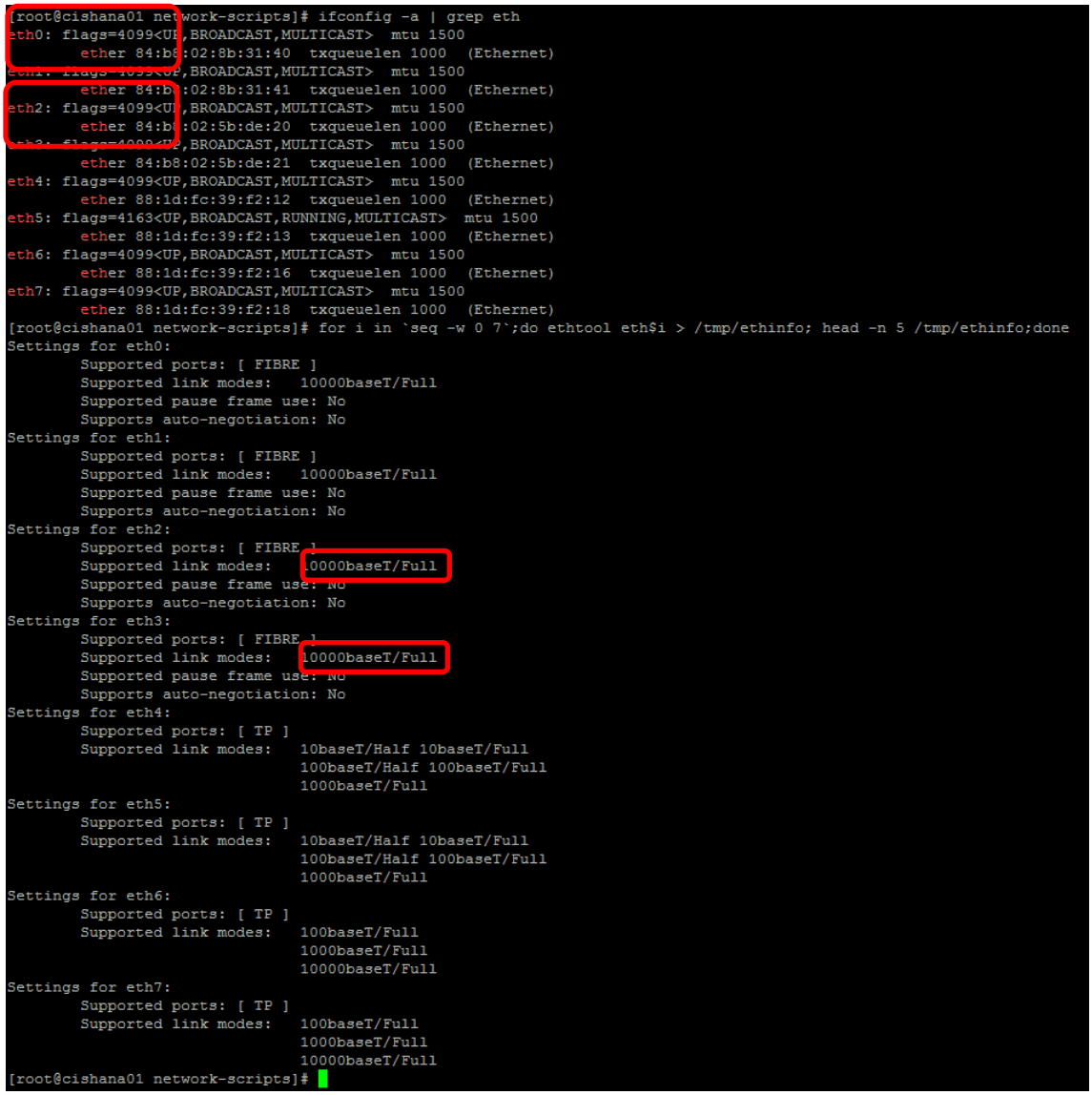
A bond configured with two 1-Gbps ports can be used for the administration, management, and access networks, and a bond configured with two ports, using one port from each dual-port VIC, can be used for a backup network. Additional interfaces can be configured on the VICs based on needs.

In the example in Figure 66, the ethtool output for the interfaces showing Fibre Channel support and 10-Gbps indicates that eth0 through eth3 are VIC ports. In addition, a close observation of their MAC addresses reveals that eth4 and eth5 and that eth6 and eth7 are ports on the same VICs (in both cases, the last octet of the MAC address differs).

So for high availability, eth2 and eth3 is one possible slave pair for creating a 10-Gbps bond device.

In this section, you will manually create at least one bond interfaces.

Figure 70. Determining VIC ports and their supported link modes



1. Create 1-Gbps bond device **ifcfg-bond0** with eth0 and eth1 as slaves.
   a. Create a **bond0** configuration file:

```
# vi /etc/sysconfig/network-scripts/ifcfg-bond0

DEVICE=bond0

IPADDR=<<var_mgmt_ip_address>>

NETMASK=<<var_mgmt_nw_netmask>>

ONBOOT=yes

HOTPLUG=no

BOOTPROTO=none
```

```
USERCTL=no
BONDING_OPTS="miimon=100 mode=1"
NM_CONTROLLED=no
```

b. Modify the eth4 and eth5 configuration files:

```
# vi /etc/sysconfig/network-scripts/ifcfg-eth4
DEVICE=eth4
BOOTPROTO=none
ONBOOT=yes
HOTPLUG=no
MASTER=bond0
SLAVE=yes
USERCTL=no
NM_CONTROLLED=no

# vi /etc/sysconfig/network-scripts/ifcfg-eth5
DEVICE=eth5
BOOTPROTO=none
ONBOOT=yes
HOTPLUG=no
MASTER=bond0
SLAVE=yes
USERCTL=no
NM_CONTROLLED=no
```

c. Test the configuration.

Restart the network service to bring up the bond0 interface. Then enter the following command:

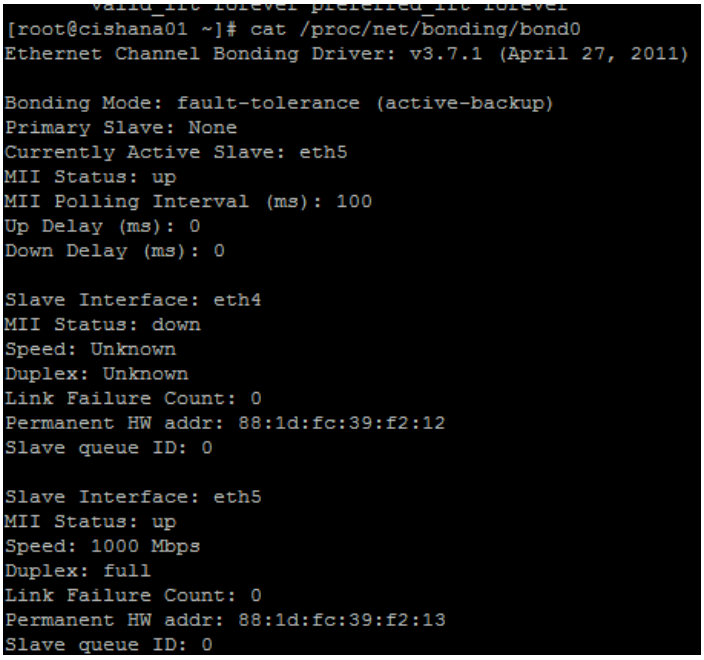
```
# systemctl restart network.service
```

To query the current status of the Linux kernel bounding driver, enter the following command:

```
# cat /proc/net/bonding/bond0
```

Figure 71 shows sample output.

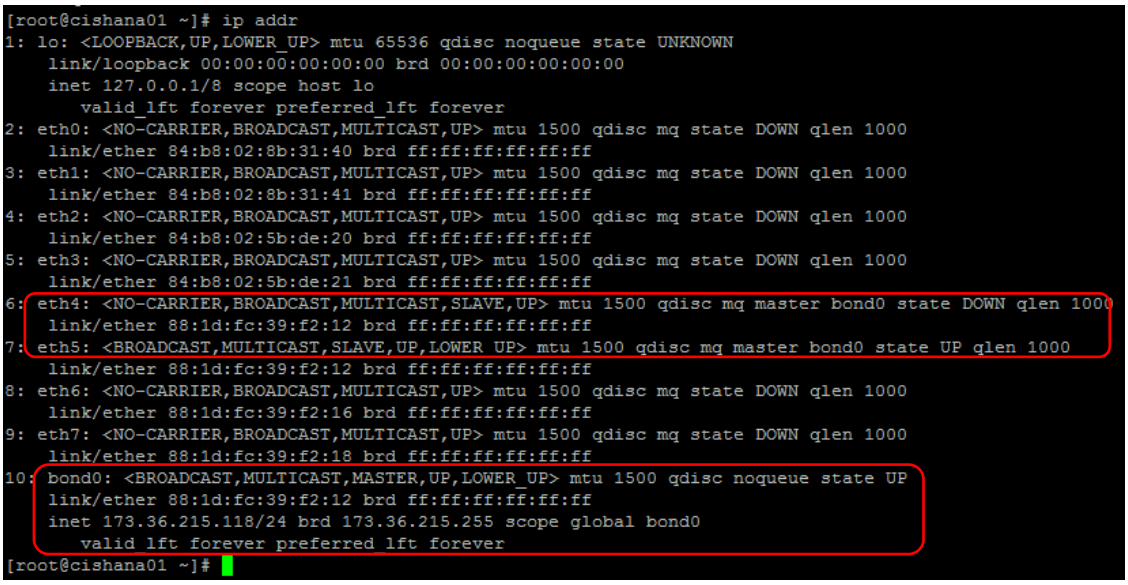
Figure 71. Sample bond configuration status output



d. Verify the status of interfaces with the **ip addr** command (Figure 72):

```
# ip addr
```

Figure 72. Verifying the bond interface status with the ip addr command



2. Create 10-Gbps bond device **ifcfg-bond1** with eth0 and eth2 as slaves.
   a. Create a **bond1** configuration file:

```
# vi /etc/sysconfig/network-scripts/ifcfg-bond1
DEVICE=bond1
IPADDR=<<ip_address_customer_usecase>>
NETMASK=<<subnet_mask>>
ONBOOT=yes
HOTPLUG=no
BOOTPROTO=none
USERCTL=no
BONDING_OPTS="miimon=100 mode=1"
NM_CONTROLLED=no
```

   b. Modify the eth0 and eth2 configuration files:

```
# vi /etc/sysconfig/network-scripts/ifcfg-eth0
DEVICE=eth0
BOOTPROTO=none
ONBOOT=yes
HOTPLUG=no
MASTER=bond1
SLAVE=yes
USERCTL=no
NM_CONTROLLED=no

# vi /etc/sysconfig/network-scripts/ifcfg-eth2
DEVICE=eth2
BOOTPROTO=none
ONBOOT=yes
HOTPLUG=no
MASTER=bond1
SLAVE=yes
USERCTL=no
NM_CONTROLLED=no
```

c. Test the configuration.

Restart the networking service to bring up the bond0 interface. Enter the following command:

```
# systemctl restart network.service
```

To query the current status of Linux kernel bounding driver, enter the following command:

```
# cat /proc/net/bonding/bond1
```

Updating the Red Hat system and customizing the OS for SAP HANA

Before you can customize the OS for SAP HANA, you need to update the Red Hat system.

1. Update the Red Hat repository.

   To patch the system, you must first update the repository. Note that the installed system doesn't include any update information. To patch the Red Hat system, the system must be registered and attached to a valid subscription. The following code will register the installation and update the repository information:

   ```
   #subscription-manager register --auto-attach
   Username: <<username>>
   Password: <<password>>
   ```

2. To list the repositories subscribed to, use the following command:

   ```
   #yum repolist
   ```

   Update only the OS kernel and firmware packages to the latest release that appeared in RHEL 7.3. Set the release version to 7.3:

   ```
   #subscription-manager release –set=7.3
   ```

3. Apply the latest updates for RHEL 7.3. Typically, the kernel is updated as well.

   ```
   #yum -y update
   ```

4. Reboot the machine and use the new kernel.

5. Install the base package group:

   ```
   #yum -y groupinstall base
   ```

6. Install dependencies in accordance with the SAP HANA Server Installation and Update Guide. Install the numactl package if the benchmark HWCCT is to be used.

   ```
   #yum install gtk2 libicu xulrunner sudo tcsh libssh2 expect cairo graphviz iptraf-ng krb5-
   workstation krb5-libs libpng12 nfs-utils lm_sensors rsyslog openssl PackageKit-gtk3-module
   libcanberra-gtk2 libtool-ltdl xorg-x11-xauth numactl xfsprogs net-tools bind-utils screen
   compat-sap-c++-6 compat-sap-c++-5
   ```

7. Disable SELinux.

   To ensure that SELinux is fully disabled, modify the file /etc/selinux/config:

   ```
   # sed -i 's/\(SELINUX=enforcing\|SELINUX=permissive\)/SELINUX=disabled/g' /etc/selinux/config
   ```

   For compatibility reasons, four symbolic links are required:

   ```
   #ln -s /usr/lib64/libssl.so.0.9.8e /usr/lib64/libssl.so.0.9.8
   #ln -s /usr/lib64/libssl.so.1.0.1e /usr/lib64/libssl.so.1.0.1
   #ln -s /usr/lib64/libcrypto.so.0.9.8e /usr/lib64/libcrypto.so.0.9.8
   #ln -s /usr/lib64/libcrypto.so.1.0.1e /usr/lib64/libcrypto.so.1.0.1
   ```

8. Configure **tuned** to use the profile **sap-hana**:

   ```
   # yum install tuned-profiles-sap-hana tuned
   # systemctl start tuned
   # systemctl enable tuned
   # tuned-adm profile sap-hana
   ```

9. Disable the abort and crash dump features:

   ```
   # systemctl disable abrtd
   # systemctl disable abrt-ccpp
   # systemctl stop abrtd
   # systemctl stop abrt-ccpp
   ```

   a. Disable core file creation. To disable core dumps for all users, open /etc/security/limits.conf and add the following lines:

   ```
   * soft core 0
   * hard core 0
   ```

   b. Enable the sapsys group to create an unlimited number of processes:

   ```
   echo "@sapsys soft nproc unlimited" > /etc/security/limits.d/99-sapsys.conf
   ```

10. To avoid problems with the firewall during SAP HANA installation, you can disable the firewall completely with the following commands:

    ```
    # systemctl stop firewalld
    # systemctl disable firewalld
    ```

11. Configure the network time and date.

    Make sure that NTP and its utilities are installed and that **chrony** is disabled:

    ```
    # yum -y install ntp ntpdate
    # systemctl stop ntpd.service
    # systemctl stop chronyd.service
    ```

```
# systemctl disable chronyd.service
```

a. Edit /etc/ntp.conf and make sure that the server lines reflect your NTP servers:

```
# grep ^server /etc/ntp.conf
server ntp.example.com
server ntp1.example.com
server ntp2.example.com
```

b. Force an update to the current time:

```
# ntpdate ntp.example.com
```

c. Enable and start the NTP and date (NTPD) service:

```
# systemctl enable ntpd.service
# systemctl start ntpd.service
# systemctl restart systemd-timedated.service
```

d. Double-check that the NTP service is enabled:

```
# systemctl list-unit-files | grep ntp
ntpd.service enabled
ntpdate.service disabled
```

e. The **ntpdate** script adjusts the time according to the NTP server every time the system comes up. This process occurs before the regular NTP service is started and helps ensure an exact system time even if the time deviation is too large to be compensated for by the NTP service.

```
# echo ntp.example.com >> /etc/ntp/step-tickers
# systemctl enable ntpdate.service
```

Tuning the OS for SAP HANA– Adapting SAP Notes

To optimize the use of HANA database (HDB) with SLES for SAP 12 SP2,

12. Apply the following SAP Notes settings as instructed.
    2292690–SAP HANA DB: Recommended OS settings for RHEL 7
13. Optionally, remove old kernels after the OS update:

    ```
    package-cleanup --oldkernels --count=1
    ```

14. Reboot the server after applying the SAP notes

    ```
    # reboot
    ```

Installing SAP HANA

Use the official SAP documentation, which describes the installation process with and without the SAP unified installer.

For the SAP HANA installation documentation, see the SAP HANA Server Installation Guide.

All other SAP installation and administration documentation is available at http://service.sap.com/instguides.

Important SAP Notes

Read the following SAP Notes before you start the installation. These SAP Notes contain the latest information about the installation, as well as corrections to the installation documentation.

The latest SAP Notes can be found at: https://service.sap.com/notes.

SAP HANA in-memory database (IMDB) notes

SAP Note 1514967: SAP HANA: Central note

SAP Note 2298750: SAP HANA Platform SPS 12 release note

SAP Note 1523337: SAP HANA database: Central note

SAP Note 2000003: FAQ: SAP HANA

SAP Note 2380257: SAP HANA 2.0 release notes

SAP Note 1780950: Connection problems due to host name resolution

SAP Note 1755396: Released disaster tolerant (DT) solutions for SAP HANA with disk replication

SAP Note 1890444: HANA system slow due to CPU power save mode

SAP Note 1681092: Support for multiple SAP HANA databases on a single SAP HANA appliance

SAP Note 1514966: SAP HANA: Sizing the SAP HANA database

SAP Note 1637145: SAP Business Warehouse (BW) on HANA: Sizing the SAP HANA database

SAP Note 1793345: Sizing for Suite on HANA

Linux notes

SAP Note 2205917: SAP HANA DB: Recommended OS settings for SLES 12 and SLES for SAP Applications 12

SAP Note 2235581: SAP HANA: Supported operating systems

SAP Note 1944799: SAP HANA guidelines for the SLES operating system

SAP Note 1731000: Nonrecommended configuration changes

SAP Note 1557506: Linux paging improvements

SAP Note 1726839: SAP HANA database: Potential crash when using XFS file system

SAP Note 1740136: SAP HANA: Wrong mount option may lead to corrupt persistency

SAP Note 1829651: Time-zone settings in SAP HANA scale-out landscapes

Third-party software notes

SAP Note 1730928: Using external software in an SAP HANA appliance

SAP Note 1730929: Using external tools in an SAP HANA appliance

SAP Note 1730930: Using antivirus software in an SAP HANA appliance

SAP Note 1730932: Using backup tools with Backint for SAP HANA

SAP HANA virtualization notes

SAP Note 1788665: SAP HANA running on VMware vSphere virtual machines

SAP HANA post-installation checkup

For an SAP HANA system installed with <SID> set to **SKL** and the system number <nr> set to **00**, log in as **<sid>adm** i.e **skladm** and run the commands presented here.

Checking the SAP HANA services

```
skladm@cishana01:/usr/sap/SKL/HDB00> /usr/sap/hostctrl/exe//sapcontrol -nr 00 -function
GetProcessList


19.05.2016 11:29:27
GetProcessList
OK
name, description, dispstatus, textstatus, starttime, elapsedtime, pid
hdbdaemon, HDB Daemon, GREEN, Running, 2016 04 13 08:51:49, 866:37:38, 41691
hdbcompileserver, HDB Compileserver, GREEN, Running, 2016 04 13 08:51:56, 866:37:31, 41837
hdbindexserver, HDB Indexserver, GREEN, Running, 2016 04 13 08:52:00, 866:37:27, 41863
hdbnameserver, HDB Nameserver, GREEN, Running, 2016 04 13 08:51:50, 866:37:37, 41711
hdbpreprocessor, HDB Preprocessor, GREEN, Running, 2016 04 13 08:51:56, 866:37:31, 41839
hdbwebdispatcher, HDB Web Dispatcher, GREEN, Running, 2016 04 13 08:53:11, 866:36:16, 42431
hdbxsengine, HDB XSEngine, GREEN, Running, 2016 04 13 08:52:00, 866:37:27, 41865
skladm@cishana01-bwl:/usr/sap/SKL/HDB00>
```

Checking the HANA database information

```
skladm@cishana01:/usr/sap/SKL/HDB00> HDB info
USER         PID    PPID %CPU    VSZ   RSS COMMAND
skladm     59578   59577  0.0 108472  1944 -sh
skladm     59663   59578  0.0 114080  2020  \_ /bin/sh /usr/sap/SKL/HDB00/HDB info
skladm     59692   59663  0.0 118048  1596      \_ ps fx -U skladm -o user,pid,ppid,pcpu,vsz,rss,args
skladm     41683       1  0.0  22188  1640 sapstart pf=/hana/shared/SKL/profile/SKL_HDB00_cishana01-
bwl
skladm     41691   41683  0.0 582888 290988  \_ /usr/sap/SKL/HDB00/cishana01-
bwl/trace/hdb.sapSKL_HDB00 -d -nw -f /usr/sap/SKL/HDB00/cishana01-bwl/daemon.ini
skladm     41711   41691  0.3 54292416 2058900      \_ hdbnameserver
skladm     41837   41691  0.1 4278472 1243356      \_ hdbcompileserver
skladm     41839   41691  0.2 11773976 8262724      \_ hdbpreprocessor
skladm     41863   41691  6.2 22143172 18184604      \_ hdbindexserver
skladm     41865   41691  0.5 8802064 2446612      \_ hdbxsengine
skladm     42431   41691  0.1 4352988 823220      \_ hdbwebdispatcher
skladm     41607       1  0.0 497576 23232 /usr/sap/SKL/HDB00/exe/sapstartsrv
pf=/hana/shared/SKL/profile/SKL_HDB00_cishana01-bwl -D -u skladm
skladm@cishana01-bwl:/usr/sap/SKL/HDB00>
```

Tuning the SAP HANA performance parameters

After SAP HANA is installed, tune the parameters as explained in the following SAP Notes and shown in Table 13.

Table 13. SAP HANA performance tuning parameters

Parameters and file system	Data file system	Log file system
max_parallel_io_requests	256	Default
async_read_submit	On	On
async_write_submit_blocks	All	All
async_write_submit_active	Auto	On

SAP Note 2399079: Elimination of hdbparam in HANA 2

SAP Note 2186744: FAQ: SAP HANA parameters

SAP HANA operation and maintenance

SAP HANA operation and maintenance processes are described in detail in many related SAP documents. For a complete list of the documentation available, see http://help.sap.com/hana.

This document summarizes only a few important operation and maintenance procedures. Most of the procedures described in this document are command-line interface (CLI) procedures and are independent of any GUI requiring an X terminal or other GUI front end (Microsoft Windows PC, Linux desktop, etc.). CLI procedures can be started using the KVM or any Secure Shell (SSH) tool such as PuTTY (for Windows) or Terminal (for Mac OS), or any Linux terminal window to connect to the SAP HANA database system (the appliance).

Monitoring SAP HANA

Three easy CLI methods are available to check the running SAP HANA database.

saphostagent

1. Start a shell and connect to the SAP HANA system as the root user.

```
cishana01:~ # /usr/sap/hostctrl/exe/saphostctrl -function ListDatabases
Instance name: HDB00, Hostname: cishana01, Vendor: HDB, Type: hdb, Release: 1.00.60.0379371
  Database name: SKL, Status: Error
cishana01:~ #
```

2. Get a list of installed HANA instances or databases.

```
cishana01:~ # /usr/sap/hostctrl/exe/saphostctrl -function ListInstances
 Inst Info : SKL - 00 - cishana01 - 740, patch 17, changelist 1413428
cishana01:~ #
```

3. Using this information (system ID [SID] and system number), you can use **sapcontrol** to gather more information about the running HANA database.

sapcontrol

1. In a shell, use the **sapcontrol** function **GetProcessList** to display a list of running HANA OS processes.

```
cishana01:~ # /usr/sap/hostctrl/exe/sapcontrol -nr 00 -function GetProcessList

19.07.3016 14:54:45
GetProcessList
OK
name, description, dispstatus, textstatus, starttime, elapsedtime, pid
hdbdaemon, HDB Daemon, GREEN, Running, 2016 07 15 11:57:45, 98:57:00, 8545
hdbnameserver, HDB Nameserver, GREEN, Running, 2016 07 15 12:05:27, 98:49:18, 11579
hdbpreprocessor, HDB Preprocessor, GREEN, Running, 2013 08 15 12:05:27, 98:49:18, 11580
hdbindexserver, HDB Indexserver, GREEN, Running, 2016 07 15 12:05:27, 98:49:18, 11581
hdbstatisticsserver, HDB Statisticsserver, GREEN, Running, 2016 07 15 12:05:27, 98:49:18, 11582
hdbxsengine, HDB XSEngine, GREEN, Running, 2016 07 15 12:05:27, 98:49:18, 11583
sapwebdisp_hdb, SAP WebDispatcher, GREEN, Running, 2016 07 15 12:05:27, 98:49:18, 11584
hdbcompileserver, HDB Compileserver, GREEN, Running, 2016 07 15 12:05:27, 98:49:18, 11585
```

You see processes such as **hdbdaemon**, **hdbnameserver**, and **hdbindexserver** that belong to a running HANA database.

2. You can also get a system instance list, which is more useful for a scale-out appliance.

```
cishana01:~ # /usr/sap/hostctrl/exe/sapcontrol -nr 00 -function GetSystemInstanceList

19.07.3016 15:03:12
GetSystemInstanceList
OK
hostname, instanceNr, httpPort, httpsPort, startPriority, features, dispstatus
cishana01, 0, 50013, 0, 0.3, HDB, GREEN
```

HDB info

Another important tool is the **HDB** command, which needs to be issued by the <SID>adm user: the OS user who owns the HANA database.

As the root user on the HANA appliance, enter the following command:

```
cishana01:~ # su - hanadm
```

```
cishana01:/usr/sap/HAN/HDB00> HDB info
USER       PID  PPID %CPU    VSZ   RSS COMMAND
hanadm   61208 61207  1.6  13840  2696 -sh
hanadm   61293 61208  0.0  11484  1632  \_ /bin/sh /usr/sap/HAN/HDB00/HDB info
hanadm   61316 61293  0.0   4904   872      \_ ps fx -U hanadm -o user,pid,ppid,pcpu,vsz,rss,args
hanadm    8532     1  0.0  20048  1468 sapstart pf=/hana/shared/HAN/profile/HAN_HDB00_cishana01
hanadm    8545  8532  1.5 811036 290140  \_ /usr/sap/HAN/HDB00/cishana01/trace/hdb.sapHAN_HDB00 -d
-nw -f /usr/sap/HAN/HDB00/cis
hanadm   11579  8545  6.6 16616748 1789920      \_ hdbnameserver
hanadm   11580  8545  1.5 5675392 371984      \_ hdbpreprocessor
hanadm   11581  8545 10.9 18908436 6632128      \_ hdbindexserver
hanadm   11582  8545  8.7 17928872 3833184      \_ hdbstatisticsserver
hanadm   11583  8545  7.4 17946280 1872380      \_ hdbxsengine
hanadm   11584  8545  0.0 203396 16000      \_ sapwebdisp_hdb
pf=/usr/sap/HAN/HDB00/cishana01/wdisp/sapwebdisp.pfl -f /usr/sap/H
hanadm   11585  8545  1.5 15941688 475708      \_ hdbcompileserver
hanadm    8368     1  0.0 216268 75072 /usr/sap/HAN/HDB00/exe/sapstartsrv
pf=/hana/shared/HAN/profile/HAN_HDB00_cishana01 -D -u
```

This command produces output similar to that from the **sapcontrol GetProcessList** function, with a bit more information about the process hierarchy.

Starting and stopping SAP HANA

Before you stop the SAP HANA appliance, you must be able to stop and start the HANA database. You can use the commands shown here.

sapcontrol

You can use the **sapcontrol** functions **StartSystem** and **StopSystem** to start and stop a HANA database.

Stop the system with the **StopSystem** function.

```
cishana01:~ # /usr/sap/hostctrl/exe/sapcontrol -nr 00 -function StopSystem HDB

19.07.3016 15:05:35
StopSystem
OK
```

Use the following command to verify that the database has stopped.

```
cishana01:~ # /usr/sap/hostctrl/exe/sapcontrol -nr 00 -function GetSystemInstanceList

19.07.3016 15:05:58
GetSystemInstanceList
OK
hostname, instanceNr, httpPort, httpsPort, startPriority, features, dispstatus
cishana01, 0, 50013, 0, 0.3, HDB, YELLOW
```

Wait for the status to be **GRAY**.

```
cishana01:~ # /usr/sap/hostctrl/exe/sapcontrol -nr 00 -function GetSystemInstanceList

19.07.3016 15:07:52
GetSystemInstanceList
OK
hostname, instanceNr, httpPort, httpsPort, startPriority, features, dispstatus
cishana01, 0, 50013, 0, 0.3, HDB, GRAY
```

You can also use the **HDB info** command.

```
cishana01:~ # su -l hanadm
cishana01:/usr/sap/HAN/HDB00> HDB info
USER       PID  PPID %CPU    VSZ   RSS COMMAND
hanadm   61477 61476  2.0  13840  2692 -sh
hanadm   61562 61477  0.0  11484  1632  \_ /bin/sh /usr/sap/HAN/HDB00/HDB info
hanadm   61585 61562  0.0   4904   872      \_ ps fx -U hanadm -o user,pid,ppid,pcpu,vsz,rss,args
hanadm    8368     1  0.0 216784 75220 /usr/sap/HAN/HDB00/exe/sapstartsrv
pf=/hana/shared/HAN/profile/HAN_HDB00_cishana01 -D -u
cishana01:/usr/sap/HAN/HDB00>
```

You can start the database again with the **sapcontrol** command **StartSystem** function.

```
cishana01:~ # /usr/sap/hostctrl/exe/sapcontrol -nr 00 -function StartSystem HDB
19.07.3016 15:08:48
StartSystem
OK
```

To check the system status, use the **sapcontrol** command **GetSystemInstanceList** function. Wait for the status to be **GREEN**.

```
cishana01:~ # /usr/sap/hostctrl/exe/sapcontrol -nr 00 -function GetSystemInstanceList

19.07.3016 15:10:19
GetSystemInstanceList
OK
hostname, instanceNr, httpPort, httpsPort, startPriority, features, dispstatus
cishana01, 0, 50013, 0, 0.3, HDB, GREEN
```

HDB

You can use the **HDB start** and **stop** commands to stop and start the HANA database.

Use **HDB stop** to stop the database.

```
cishana01:~ # su - hanadm
cishana01:/usr/sap/HAN/HDB00> HDB stop
hdbdaemon will wait maximal 300 seconds for NewDB services finishing.
Stopping instance using: /usr/sap/HAN/SYS/exe/hdb/sapcontrol -prot NI_HTTP -nr 00 -function
StopWait 400 2



19.07.2016 19:10:37
Stop
OK
```

In contrast to **sapcontrol**, this command waits until the database is stopped or started.

```
cishana01:/usr/sap/HAN/HDB00> HDB start



StartService
Impromptu CCC initialization by 'rscpCInit'.
  See SAP note 1266393.
OK
OK
Starting instance using: /usr/sap/HAN/SYS/exe/hdb/sapcontrol -prot NI_HTTP -nr 00 -function
StartWait 2700 2



19.07.2016 19:11:20
Start
OK
```

Downloading revisions

To download revisions, you need to connect to the service marketplace and select the software download area to search for available patches.

Refer to http://help.sap.com/hana/SAP_HANA_Master_Update_Guide_en.pdf for update procedures for SAP HANA.

For more information

For more information about SAP HANA, see https://hana.sap.com/abouthana.html.

For a list of certified and supported SAP HANA hardware, see https://global.sap.com/community/ebook/2014-09-02-hana-hardware/enEN/index.html.

Appendix: Solution variables used for this document

Before starting the configuration process, you need to collect some specific configuration information. Table 14 provides information to help you assemble the required network and host address, numbering, and naming information. This worksheet can also be used as a "leave behind" document for future reference.

Table 14. Solution variables used for this document

Variable	Description	Value used in the lab for this document
<<var_cimc_ip_address>>	Cisco UCS C480 M5 server's IMC IP address	173.36.215.117
<<var_cimc_ip_netmask>>	Cisco UCS C480 M5 server's IMC network netmask	255.255.255.0
<<var_cimc_gateway_ip>>	Cisco UCS C480 M5 server's IMC network gateway IP address	173.36.215.1
<<var_raid50_vd_name>>	Name for virtual drive VD0 during RAID configuration	ucs_hana
<<var_hostname.domain>>	SAP HANA node FQDN	cishana01.custdom.local
<<var_sys_root-pw>>	SAP HANA node's root password	Saphana1!
<<var_lvm_vg_name>>	SAP HANA node's OS LVM volume group name	hanavg
<<var_mgmt_ip_address>>	SAP HANA node's management and administration IP address	173.36.215.118
<<var_mgmt_nw_netmask>>	SAP HANA node's management network netmask	255.255.255.0
<<var_mgmt_gateway_ip>>	Cisco UCS C480 M5 server's management and administration network gateway IP address	173.36.215.1
<<var_mgmt_netmask_prefix>>	Netmask prefix in CIDR notation	24

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