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

Design and deploy an SAP HANA solution based on standalone Cisco UCS C-Series M5 rack servers with Red Hat Enterprise Linux 7.6 for SAP Applications

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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 cannot 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 M5 rack server 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 C-Series M5 rack-mount server provides a robust platform for SAP HANA workloads in a single node.

Solution overview

This section introduces the solution discussed in this document.

Introduction

The Cisco UCS C480 M5 Rack Server supports the SAP HANA scale-up solution with prevalidated, ready-to-deploy infrastructure. Solution configuration and validation requires less time and is less complex than with a traditional data center deployment. The reference architecture discussed in this document demonstrates the resiliency and ease of deployment of an SAP HANA solution.

SAP HANA is SAP's implementation of in-memory database (IMDB) 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. SAP HANA 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.

SAP HANA Tailored Datacenter Integration (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. SAP HANA TDI enables organizations to run multiple SAP HANA production systems on a shared infrastructure. It also enables customers to run SAP application servers and an 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.

What's new in this release?

Design and deploy a SAP HANA scale-up solution based on the standalone Cisco UCS C480 M5 Rack Server with Red Hat Enterprise Linux (RHEL) 7.6 for SAP Applications.

Solution summary

This section briefly describes the components of the solution.

Cisco UCS C480 M5 Rack Server

The Cisco Scale-Up Solution for SAP HANA uses 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

Item	Description	
CPU specifications	2.70-GHz Intel® Xeon® Platinum 8280L processor: Quantity 2 or 4	
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)	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) • 128-GB DDR4: Quantity 48 (6 TB)
Hard-disk drive (HDD) type and quantity	Any of the following: • 1.8-TB 10,000-rpm SAS drive: Quantity 20 • 3.8-TB solid-state disk (SSD): Quantity 8 • 3.8-TB SSD: Quantity 3 (up to 1.5-TB memory configurations)	
BIOS	C480M5.4.0.4b.0.0407190307	
Cisco Integrated Management Controller (IMC) firmware	4.0(4b)	
LSI MegaRAID controller	Cisco 12-Gbps SAS modular RAID controller	
Network card	Cisco UCS Virtual Interface Card (VIC) 1385: Quantity 1 • 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
Any of the following: • 20 x 1.8-TB SAS HDD • 8 x 3.8-TB SSD • 3 x 3.8-TB SSD	Any of the following: • RAID 50 • RAID 5 • RAID 5	Operating system	Ext3
		Data file system	XFS
		Log file system	XFS
		SAP HANA shared file system	XFS

Cisco UCS C240 M5 Rack Server

The Cisco Scale-Up Solution for SAP HANA can also 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

Item	Description
CPU specifications	2.70-GHz Intel Xeon Platinum 8280L processor: 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	Any of the following: • 1.8-TB 10,000-rpm SAS drive: Quantity 20 • 3.8-TB SSD: Quantity 8 • 3.8-TB SSD: Quantity 8 • 3.8-TB SSD: Quantity 3 (for up to 1.5-TB memory configurations)
BIOS	C480M5.4.0.4b.0.0407190307
Cisco IMC firmware	4.0(4b)
Network card	Cisco UCS VIC 1385: Quantity 1 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
Any of the following: • 20 x 1.8-TB SAS HDD • 8 x 3.8-TB SSD • 3 x 3.8-TB SSD	Any of the following: • RAID 50 • RAID 5 • RAID 5	Operating system	Ext3
		Data file system	XFS
		Log file system	XFS
		SAP HANA shared file system	XFS

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

Item	Description
CPU specifications	2.70-GHz Intel Xeon Platinum 8280L processor: 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	Any of the following: • 3.8-TB SSD: Quantity 8 • 3.8-TB SSD: Quantity 3 (for up to 1.5-TB memory configurations)
BIOS	C480M5.4.0.4b.0.0407190307
Cisco IMC firmware	4.0(4b)
Network card	Cisco UCS VIC 1385: Quantity 1 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
Any of the following: • 8 x 3.8-TB SSD • 3 x 3.8-TB SSD	Any of the following: • RAID 5 • RAID 5	Operating system	Ext3
		Data file system	XFS
		Log file system	XFS
		SAP HANA shared file system	XFS

Infrastructure overview

The Cisco Scale-Up Solution for SAP HANA uses the Cisco UCS M5 generation of Cisco UCS C-Series Rack Servers.

Cisco UCS C480 M5 Rack Server

The Cisco UCS C480 M5 Rack Server (Figure 1) can be deployed as a standalone server 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.

The C480 M5 is a storage- and I/O-optimized enterprise-class rack server that delivers industry-leading performance for:

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

It delivers outstanding levels of expandability and performance for standalone or 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 M5 offers these capabilities:

- Latest Intel Xeon Scalable processors with up to 28 cores per socket and support for two- or four-processor configurations
- 2933-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 UCS 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 customers' TCO and increase their business agility.

In response to ever-increasing computing and data-intensive real-time workloads, the enterprise-class 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 SSDs than the previous generation of servers. These improvements deliver significant performance and efficiency gains that will improve your application performance. The C240 M5 delivers outstanding storage expandability with exceptional performance, with:

- 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 a 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 bootup
- 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 (SMB) 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 customers' TCO and increase their 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 than the previous generation of servers. These improvements deliver significant performance and efficiency gains that will improve your application performance. The C220 M5 server delivers outstanding levels of expandability and performance in a compact package, with:

- 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 of 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
- 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
- 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
- SMB 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 at 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, see https://www.sap.com/dmc/exp/2014-09-02-hana-hardware/enEN/appliances.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 layouts and the storage sizes required to install and operate 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

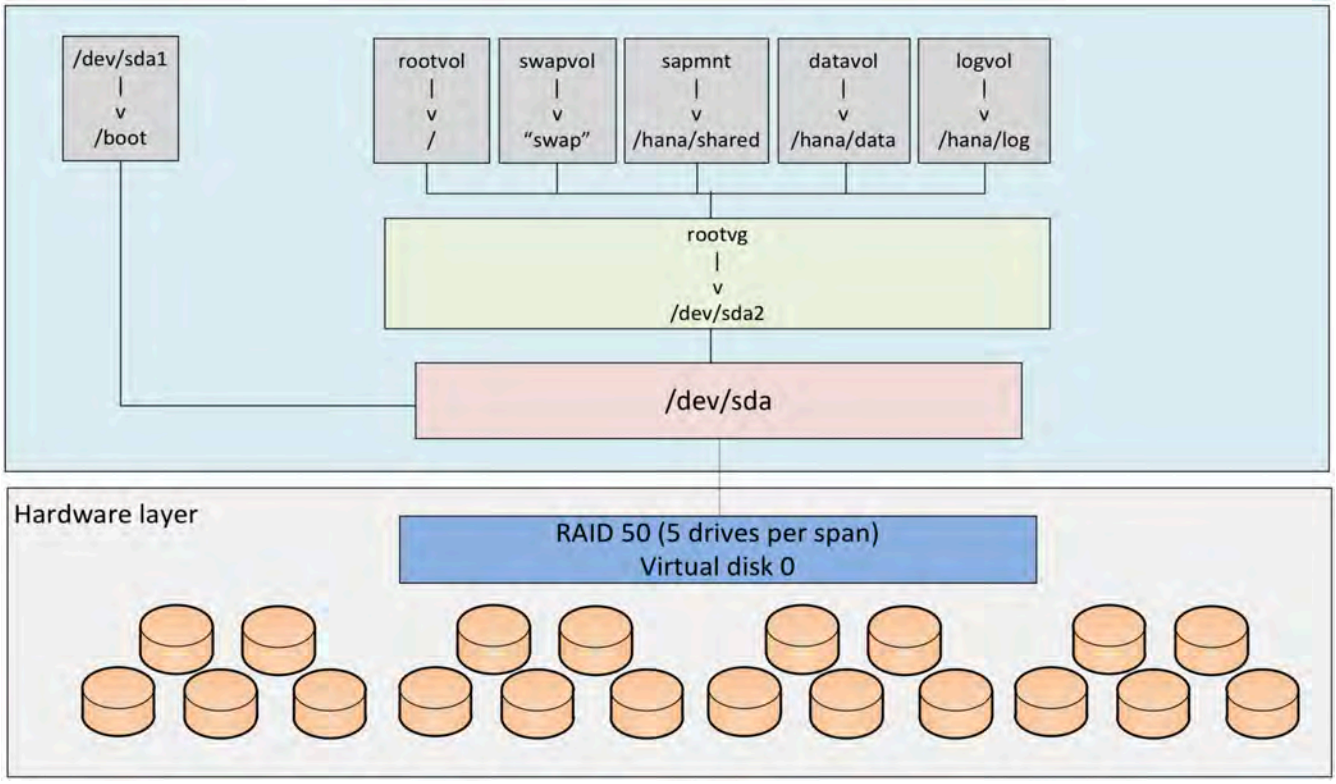


Figure 5. Proposed disk layout with partition mapping with 8 SSD drives

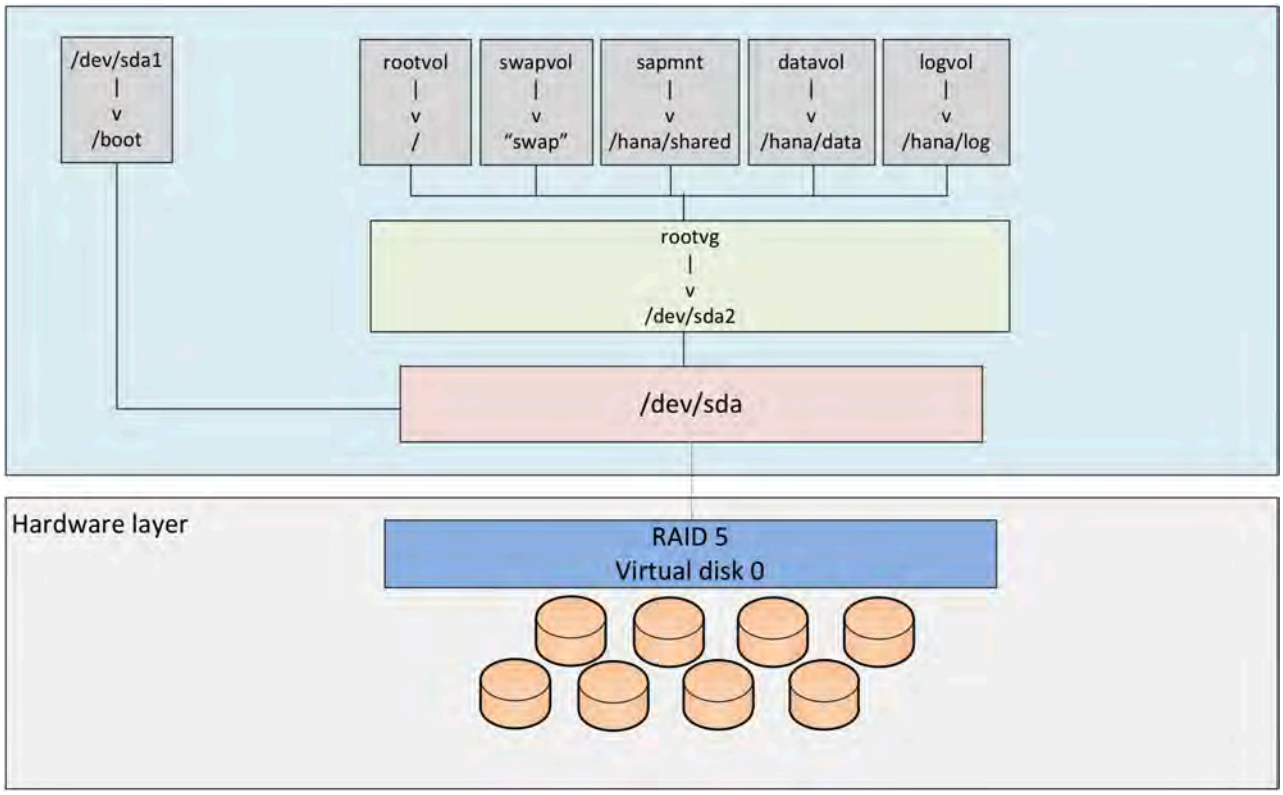
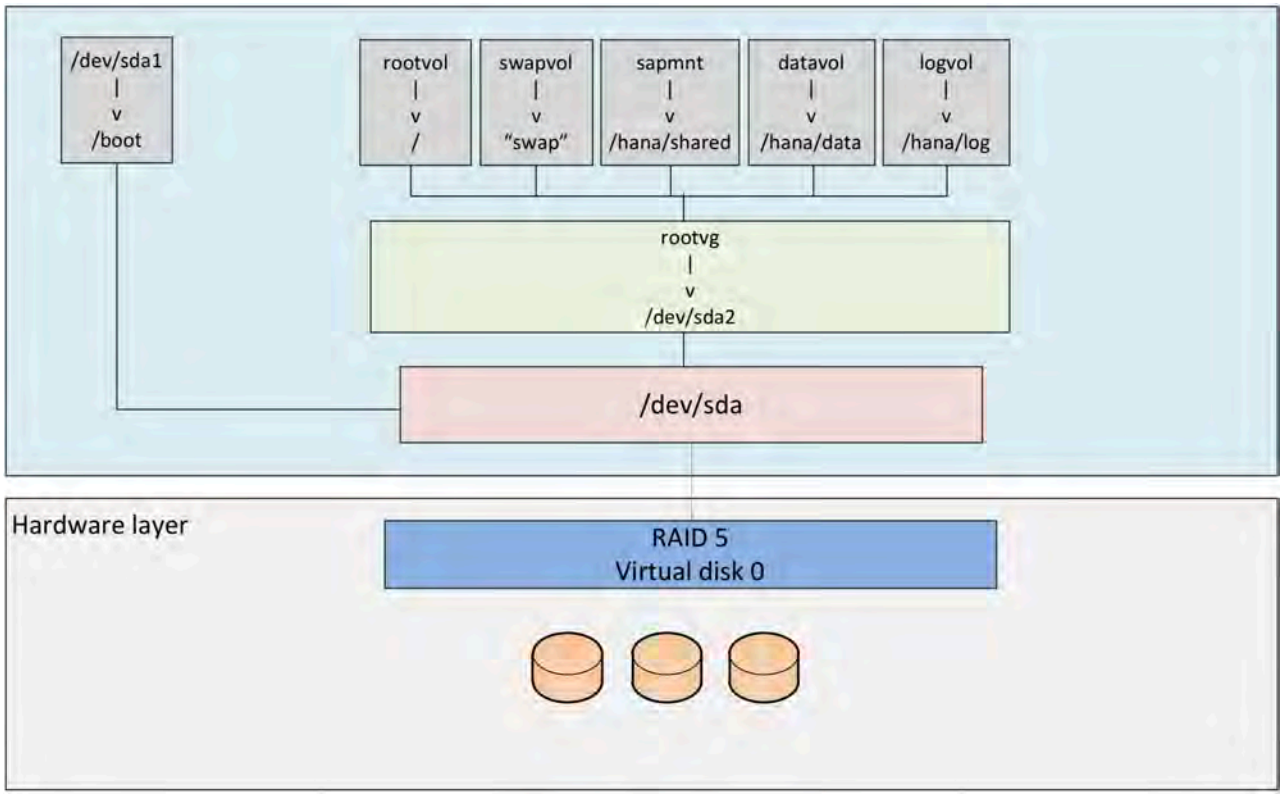


Figure 6. Proposed disk layout with partition mapping with 3 SSD drives (up to 1.5-TB memory configurations)



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

Note: For solutions based on the Intel Xeon Platinum processor, the size of the log volume (/hana/log) must be as follows:

- Half of the server memory for systems of 256 GB of memory or less
- Minimum of 512 GB for systems with 512 GB of memory or more

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 7.6 for SAP.

Deployment hardware and software

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. You can complete this table using your specific site variables and use it 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

This section discusses how to prepare the SAP HANA scale-up node for the SAP HANA installation.

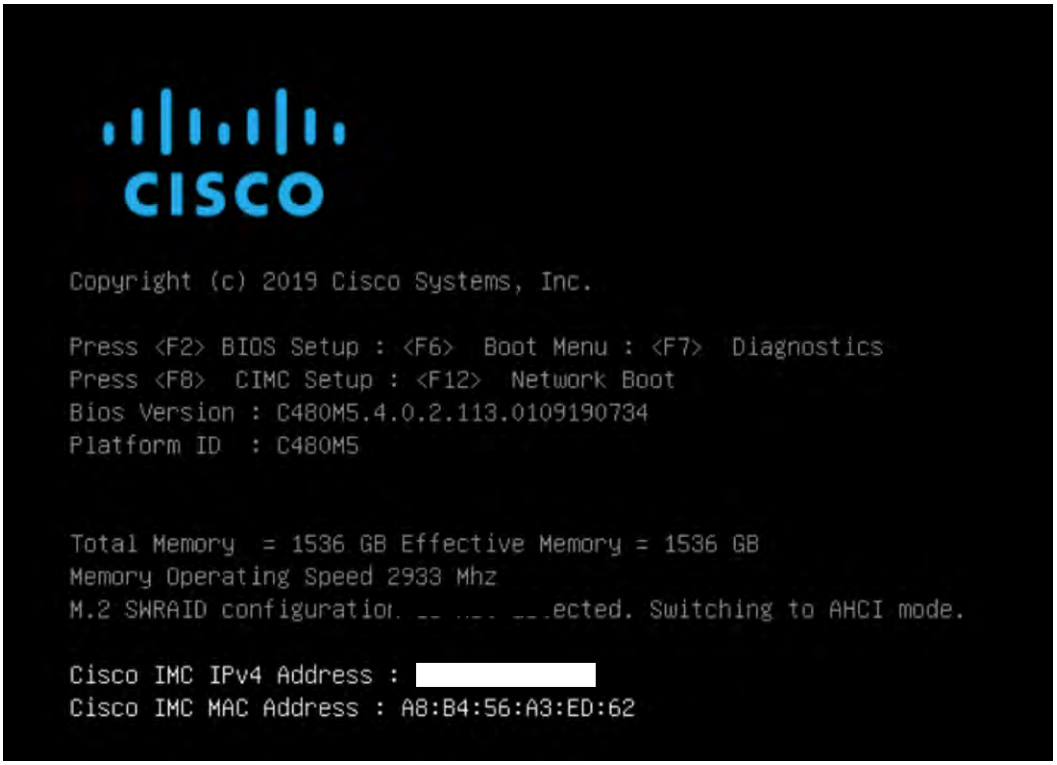
Configuring the Cisco Integrated Management Controller

To configure the on-board IMC, you should connect a keyboard, video, and mouse (KVM) switch to the server.

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

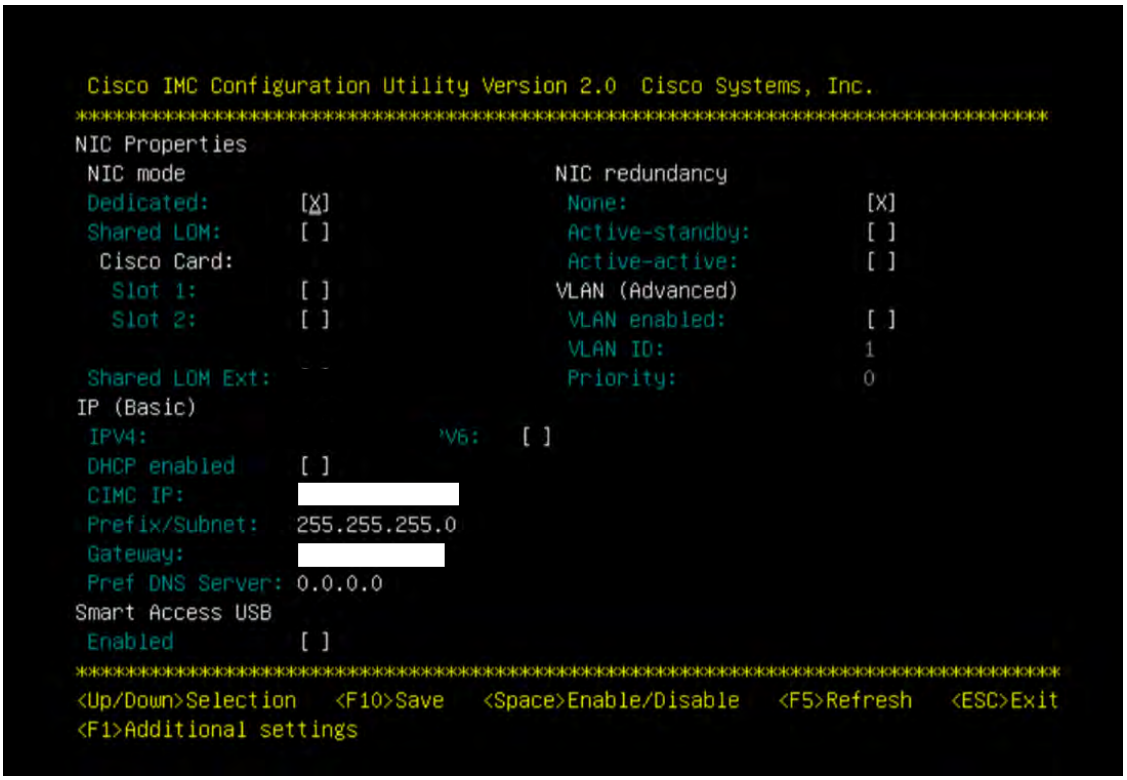
Figure 7. BIOS POST screen

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>> for the IPv4 settings of the IMC. Select None for network interface card (NIC) redundancy.
4. Press F10 to save 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).

Figure 10. Cisco IMC login screen

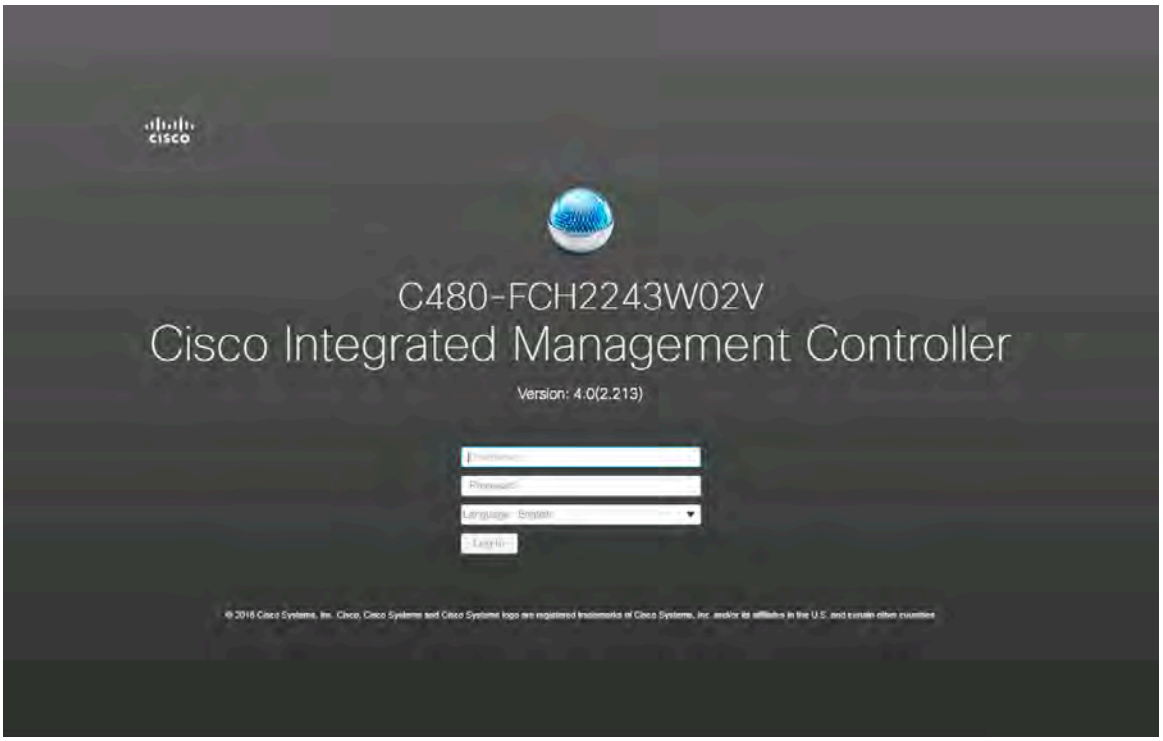
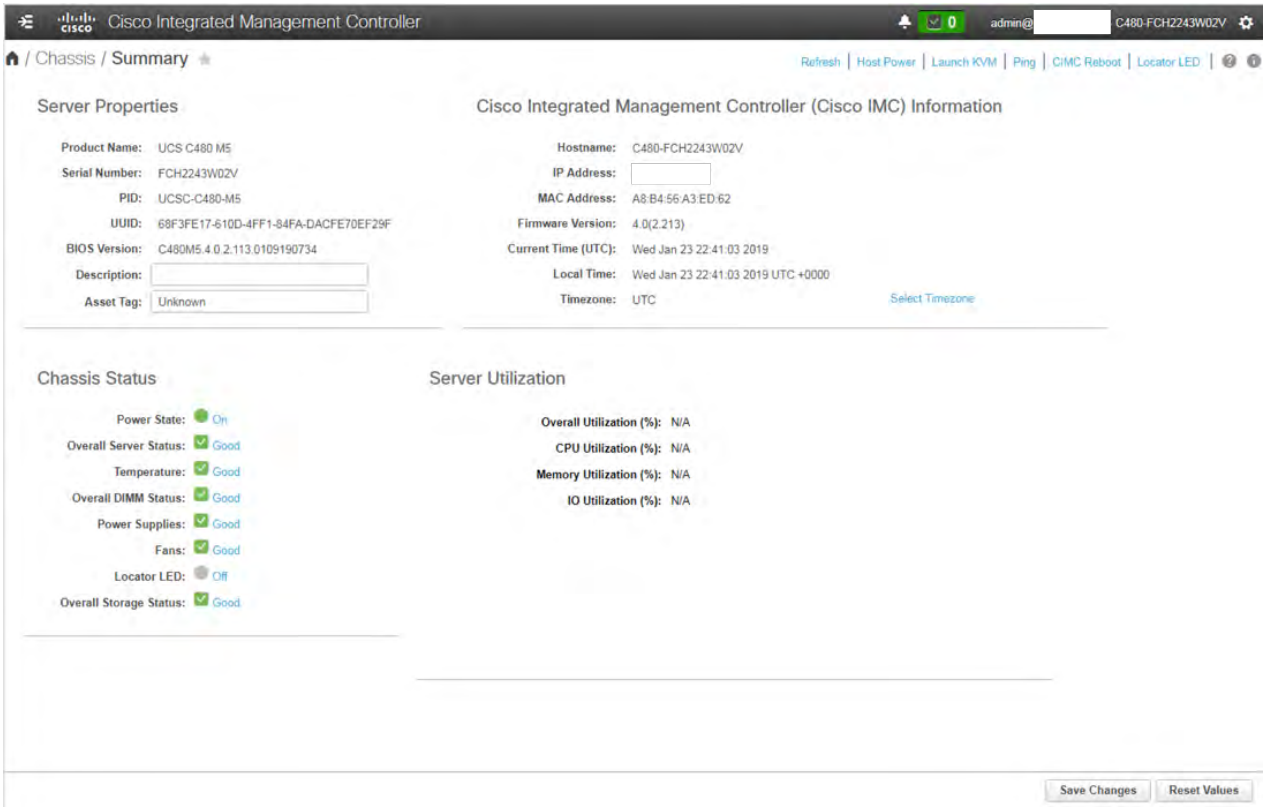


Figure 11 shows the results.

Figure 11. Cisco IMC summary screen



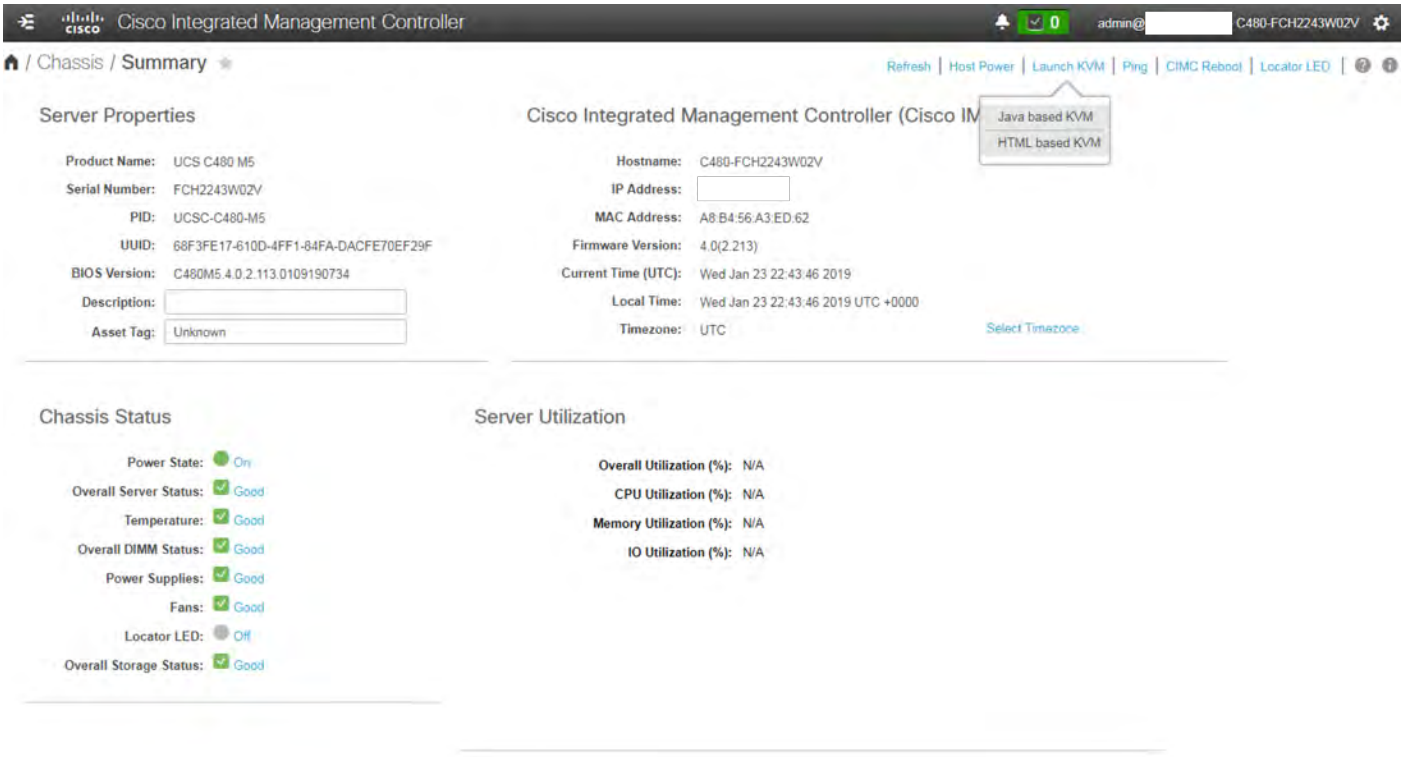
Launching the KVM console

You next need to launch the KVM console and map the RHEL 7.6 for SAP DVD ISO file for the installation.

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

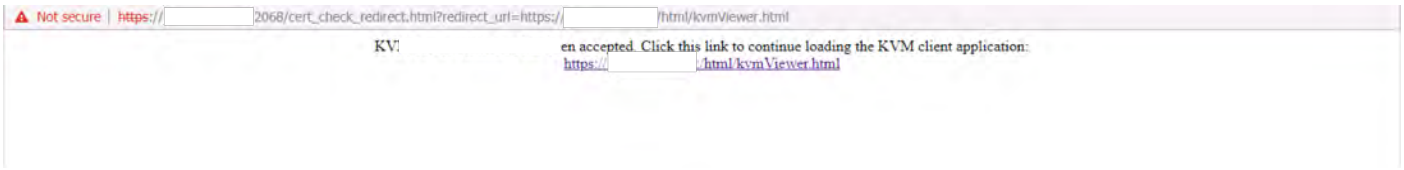
Starting with Cisco IMC Release 3.0, two options are available for launching the KVM: one using the Java console and another using the browser-based HTML KVM console. In this example, the HTML KVM console has been used.

Figure 12. Cisco IMC home screen



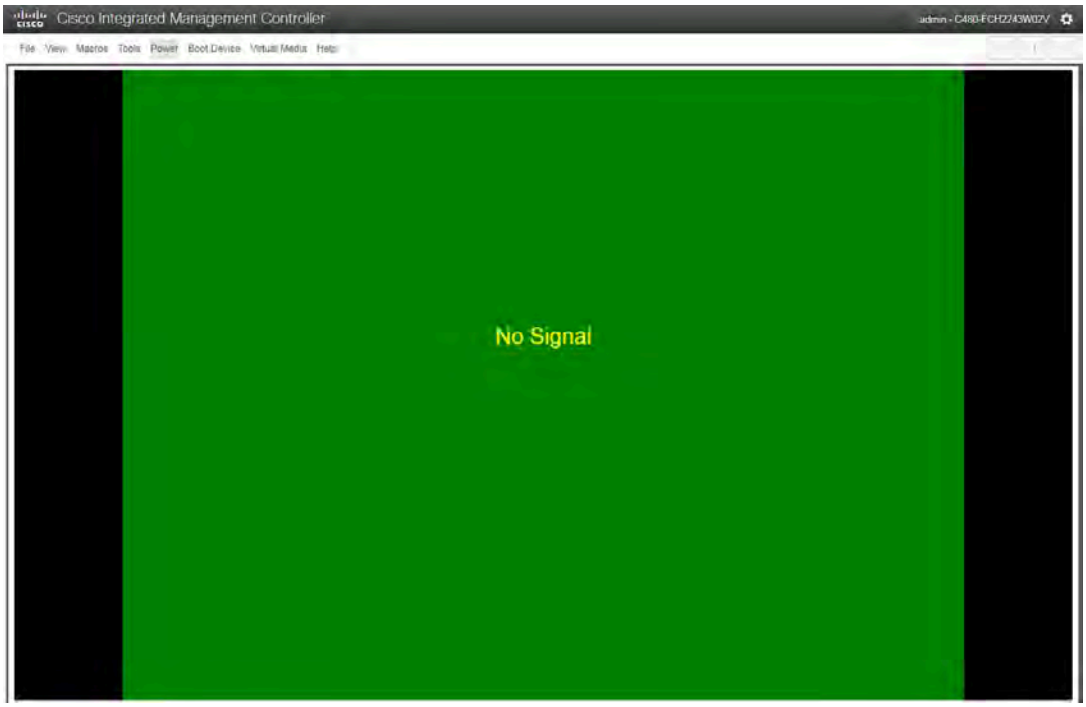
2. After you select the HTML-based console, a certificate confirmation window appears. Click the provided hyperlink to continue (Figure 13).

Figure 13. Click the hyperlink to load the KVM application



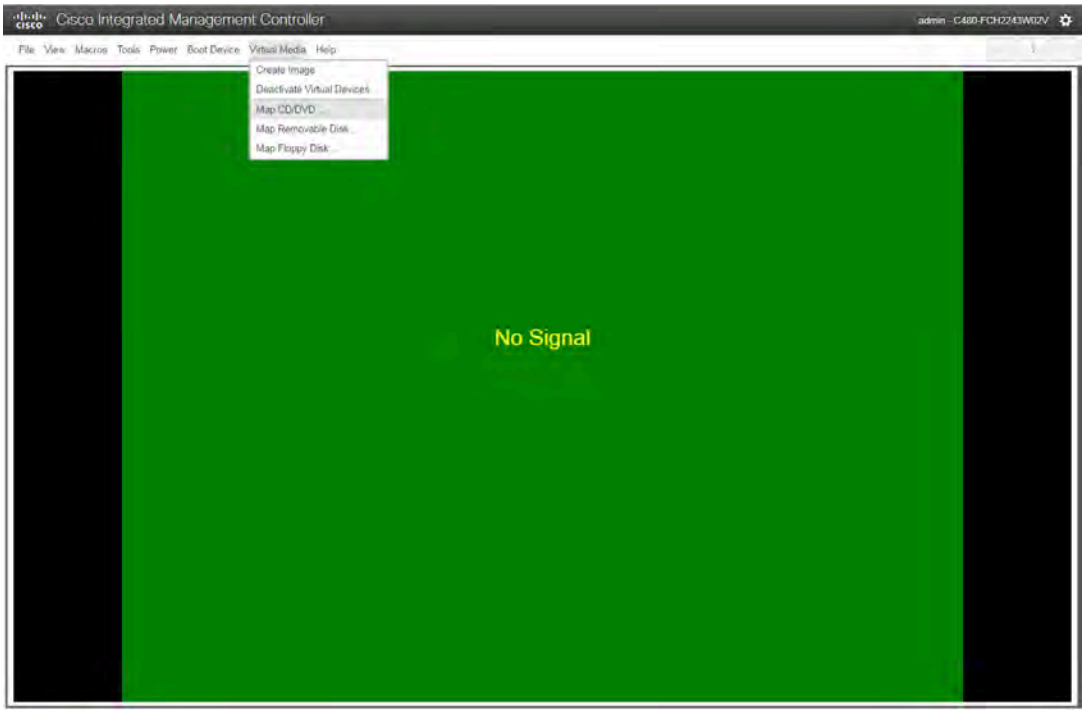
The KVM window will appear (Figure 14).

Figure 14. KVM window



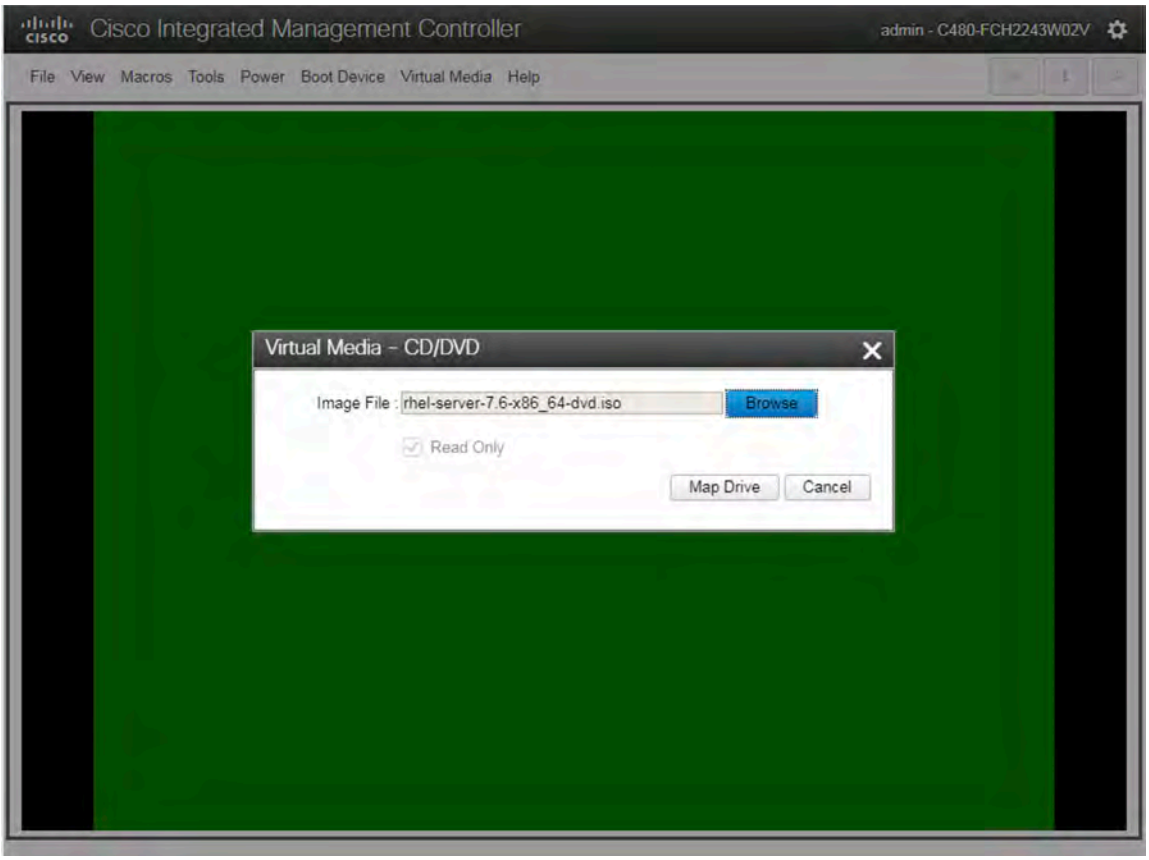
3. In the menu bar at the top of the KVM window, choose Virtual Media > Activate Virtual Devices > Map CD/DVD (Figure 15).

Figure 15. Beginning the CD/DVD mapping process



4. Browse for the RHEL 7.6 for SAP DVD ISO file and click Map Drive (Figure 16).

Figure 16. Click Map Drive

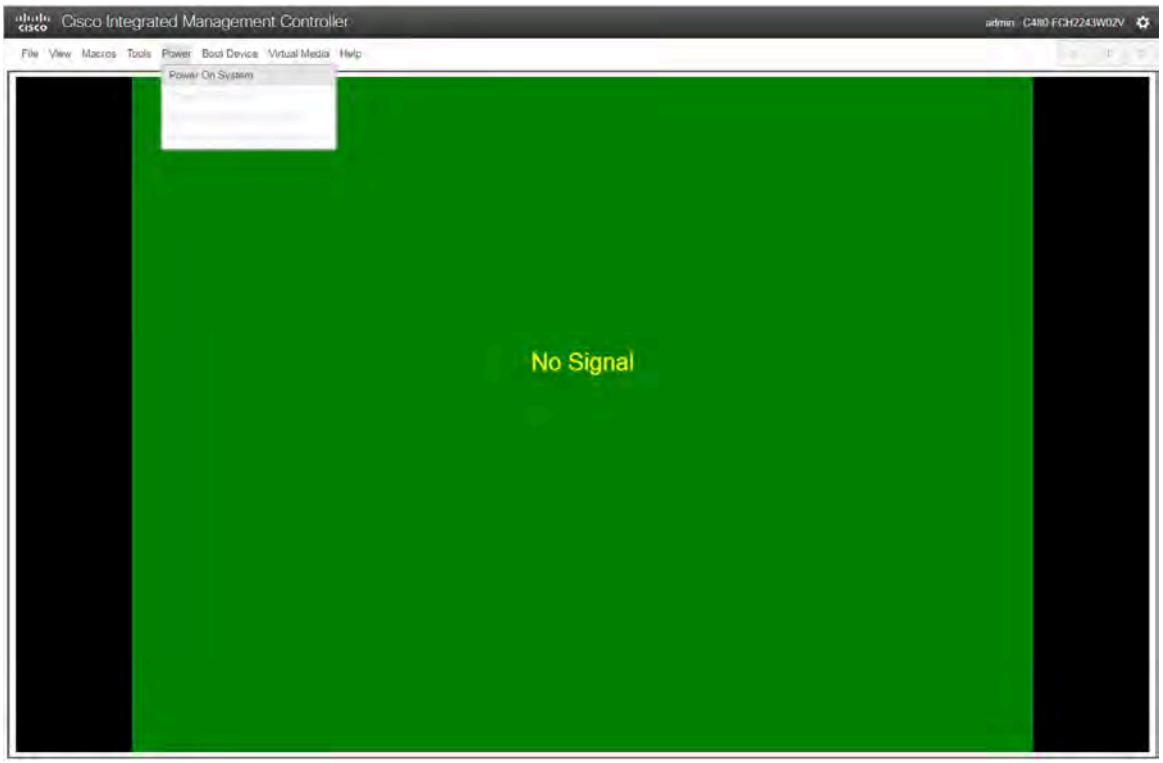


Configuring BIOS settings

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

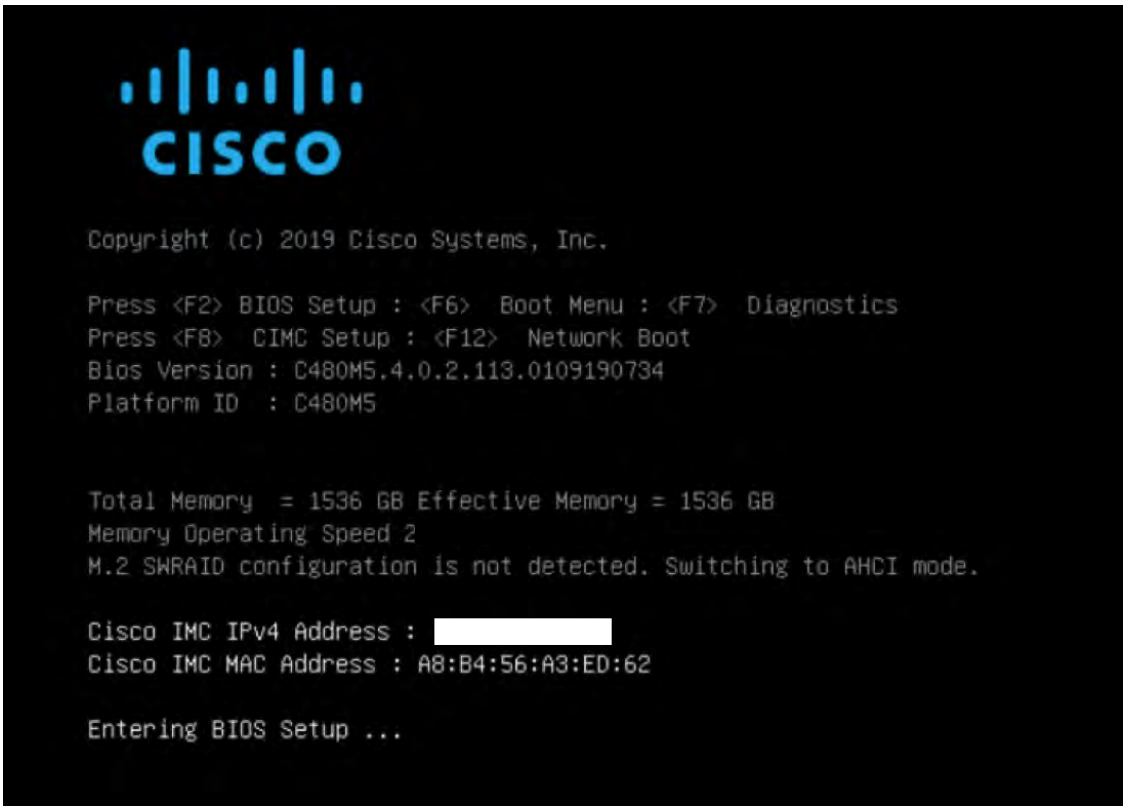
1. From the menu bar at the top of the KVM window, choose Power > Power on System (Figure 17).

Figure 17. Power on the system



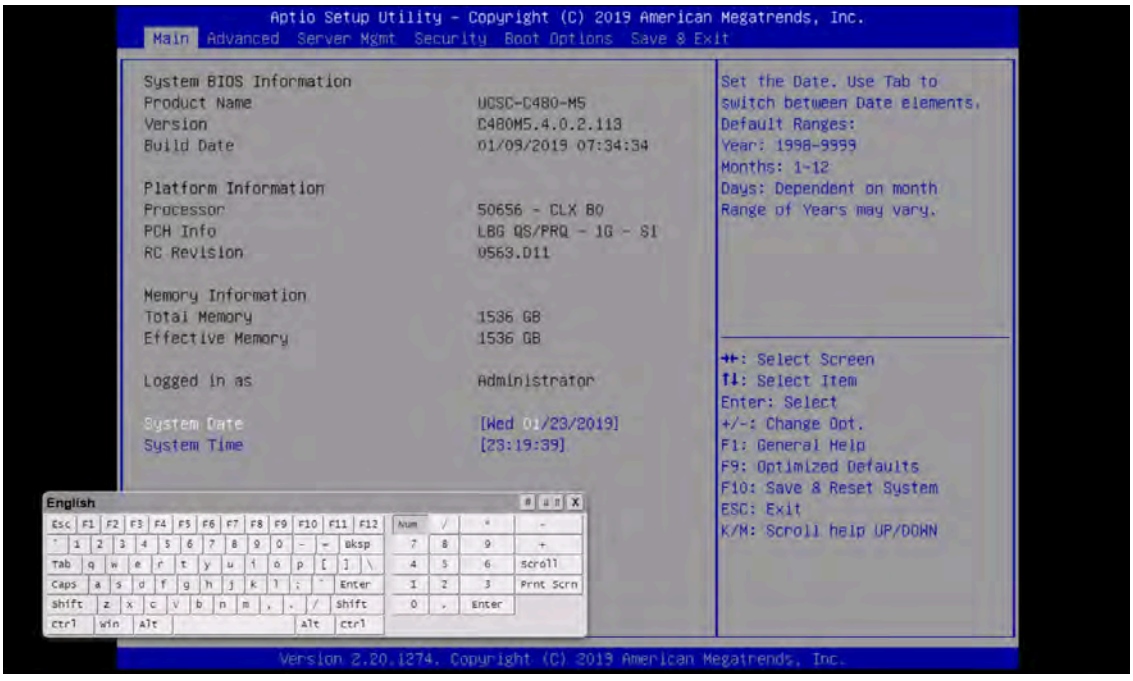
2. After the server has booted, press F2 to enter the BIOS menu (Figure 18).

Figure 18. Press F2



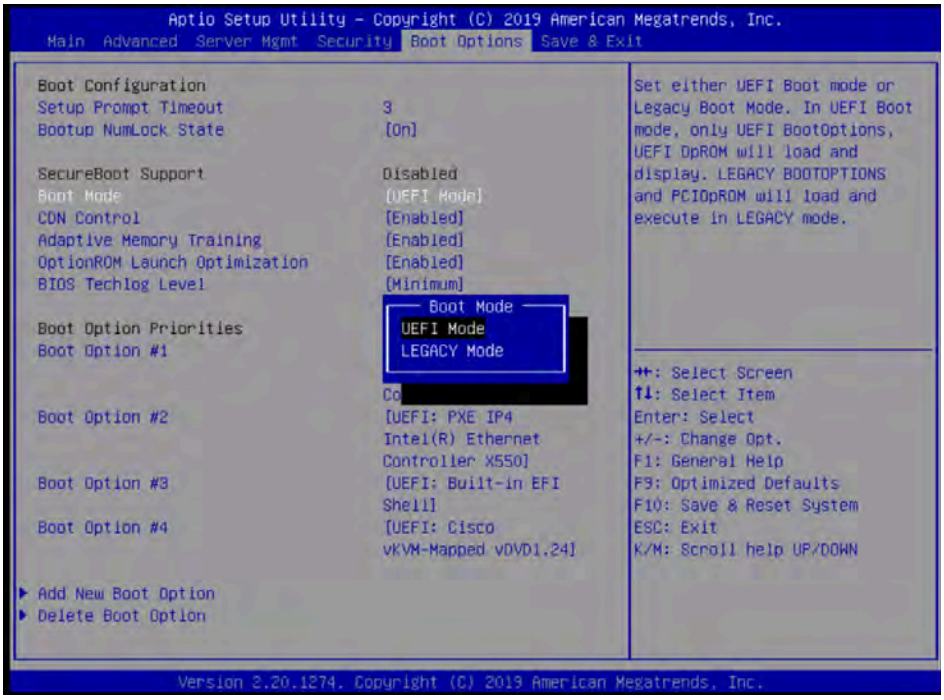
3. For a better keyboard experience, from the View menu select the on-screen keyboard (Figure 19).

Figure 19. On-screen keyboard



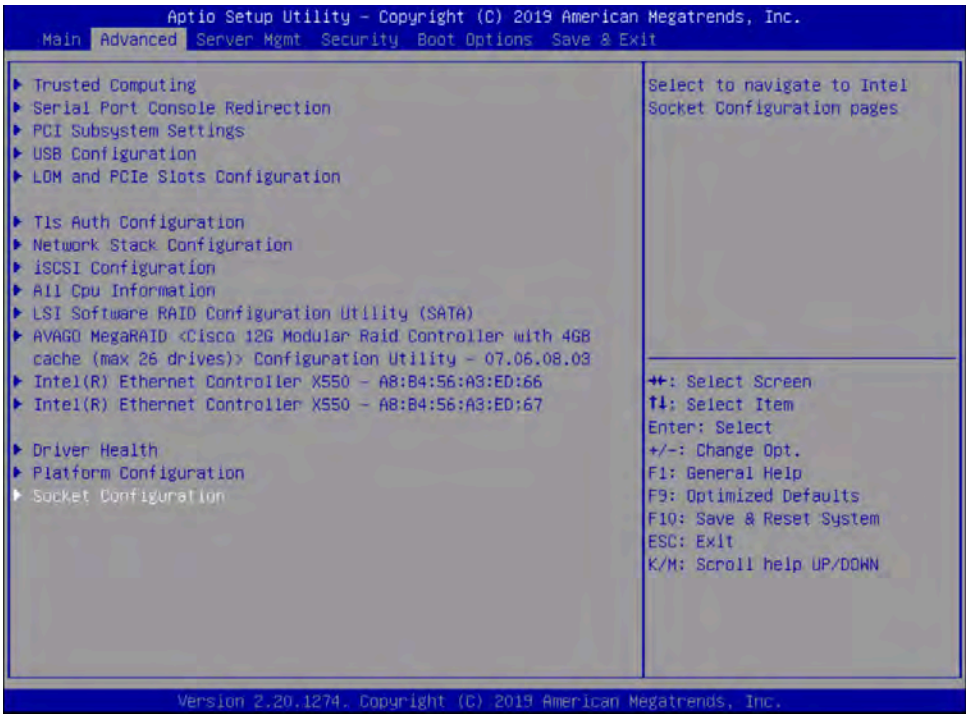
4. From the BIOS menu, choose Boot Options > Boot Mode > UEFI Mode (Figure 20). This setting selects the Unified Extensible Firmware Interface (UEFI).

Figure 20. Choose UEFI Mode



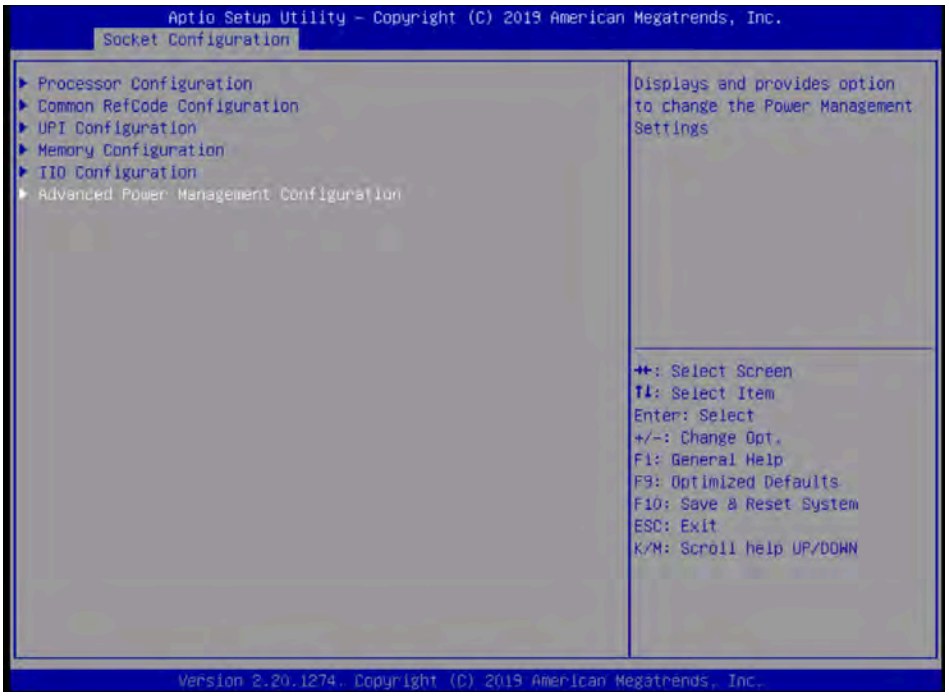
5. Disable the C-states of the CPU as recommended in the SAP for HANA requirements. From the BIOS menu, choose Advanced > Socket Configuration (Figure 21).

Figure 21. Choose Socket Configuration



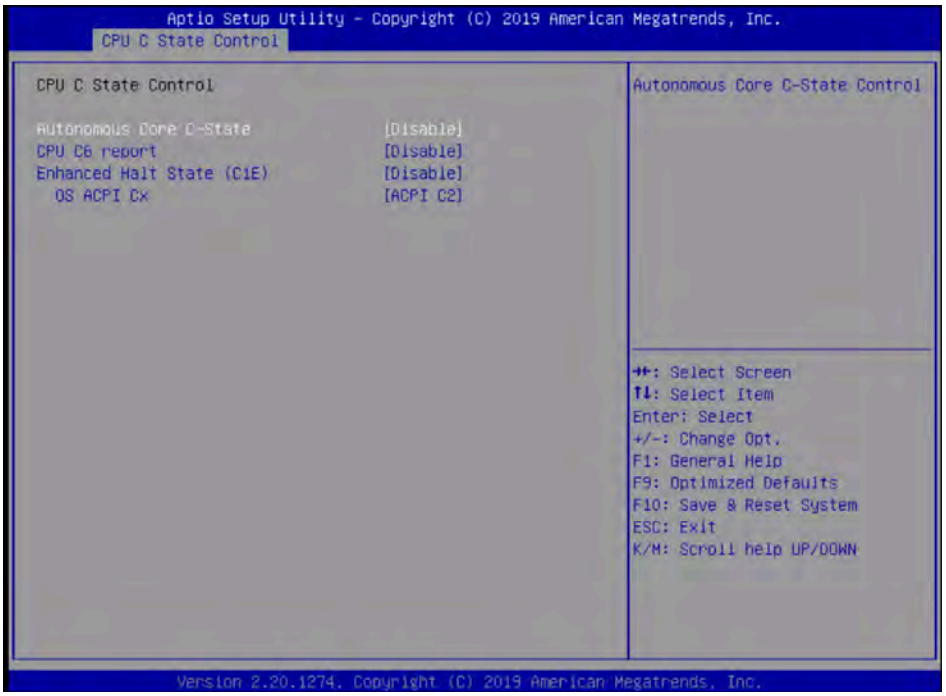
6. Choose Advanced Power Management Configuration (Figure 22).

Figure 22. Choose Advanced Power Management Configuration



7. Choose CPU C State control and then 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.

Configuring RAID

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

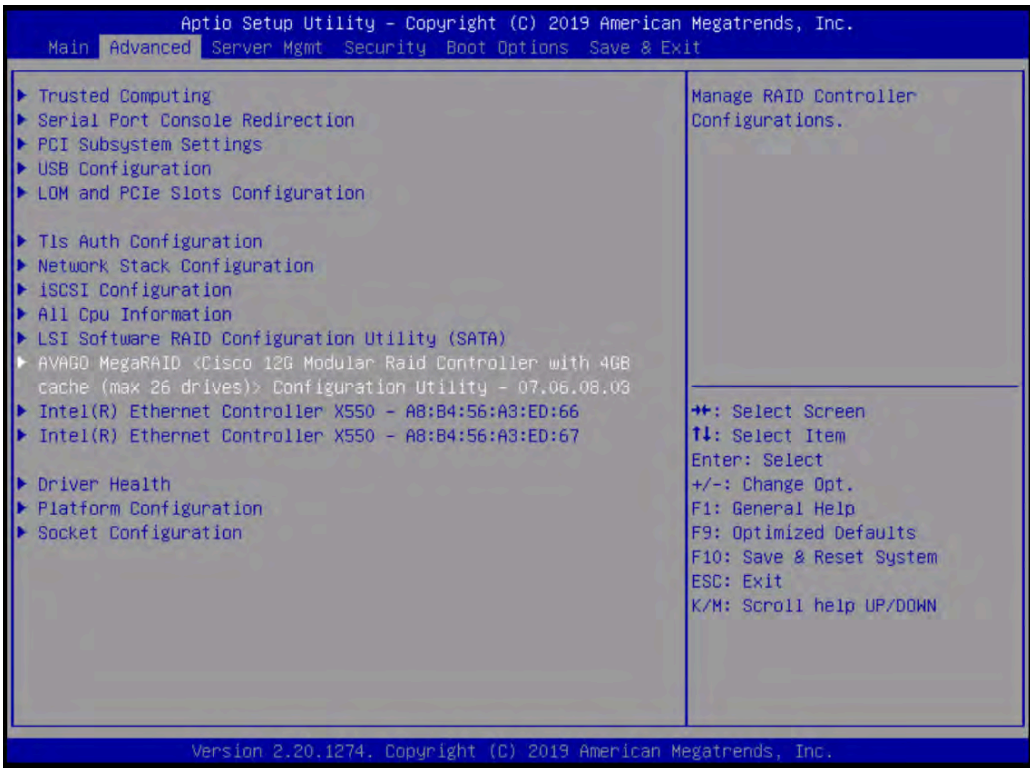
RAID settings	RAID 50	RAD 5
Stripe size	256	256 (8 SSDs or 20 SAS drives) 128 (3 SSDs)
Read policy	Read ahead	Read ahead
Write policy	Write back	Write back
I/O policy	Cached	Default

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

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.

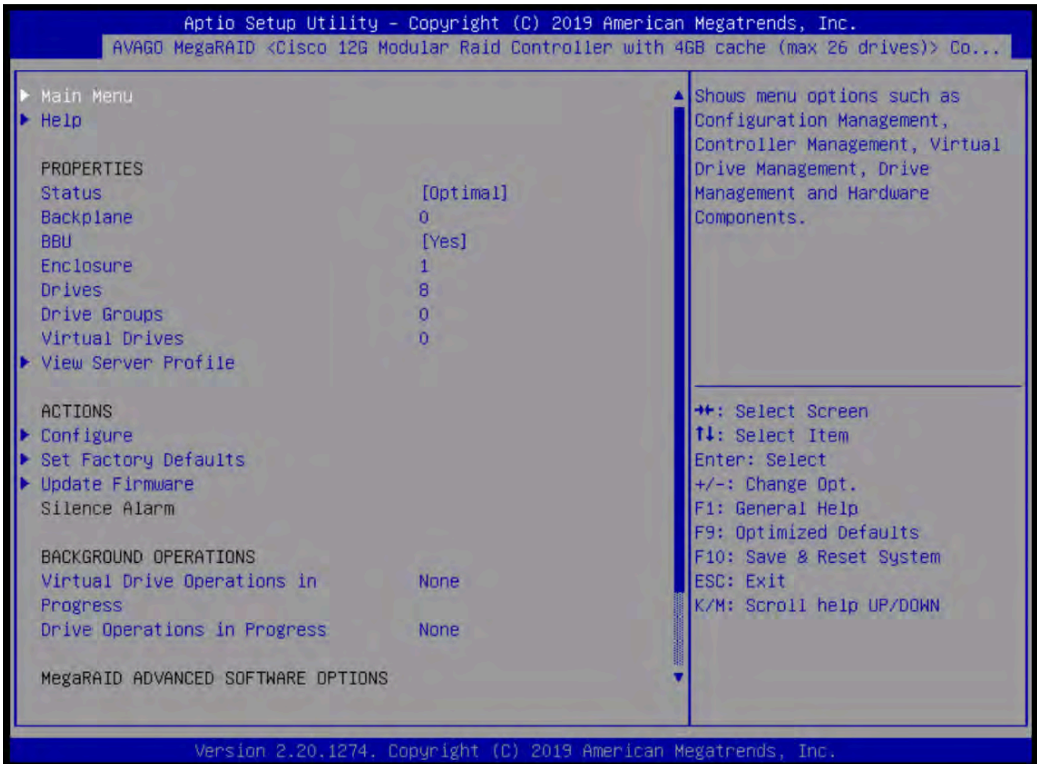
1. Boot the server and press F2 to enter the BIOS menu.
2. Navigate to Advanced and select the Avago MegaRAID utility to proceed with the RAID configuration (Figure 24).

Figure 24. Select Avago MegaRAID



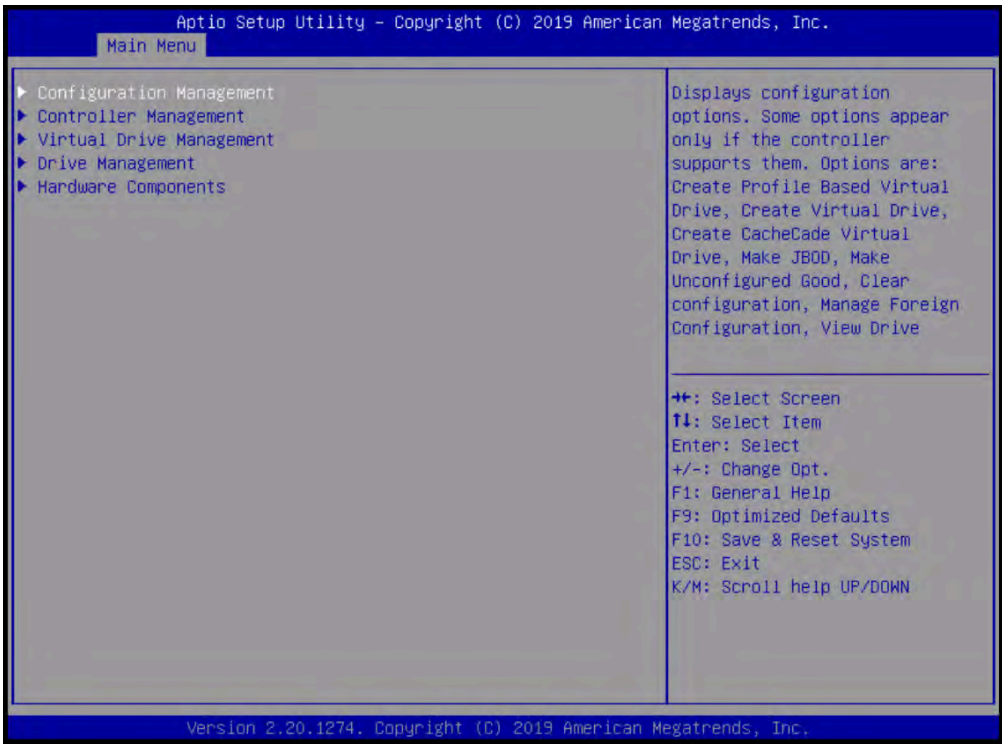
3. Choose Main Menu (Figure 25).

Figure 25. Choose Main Menu



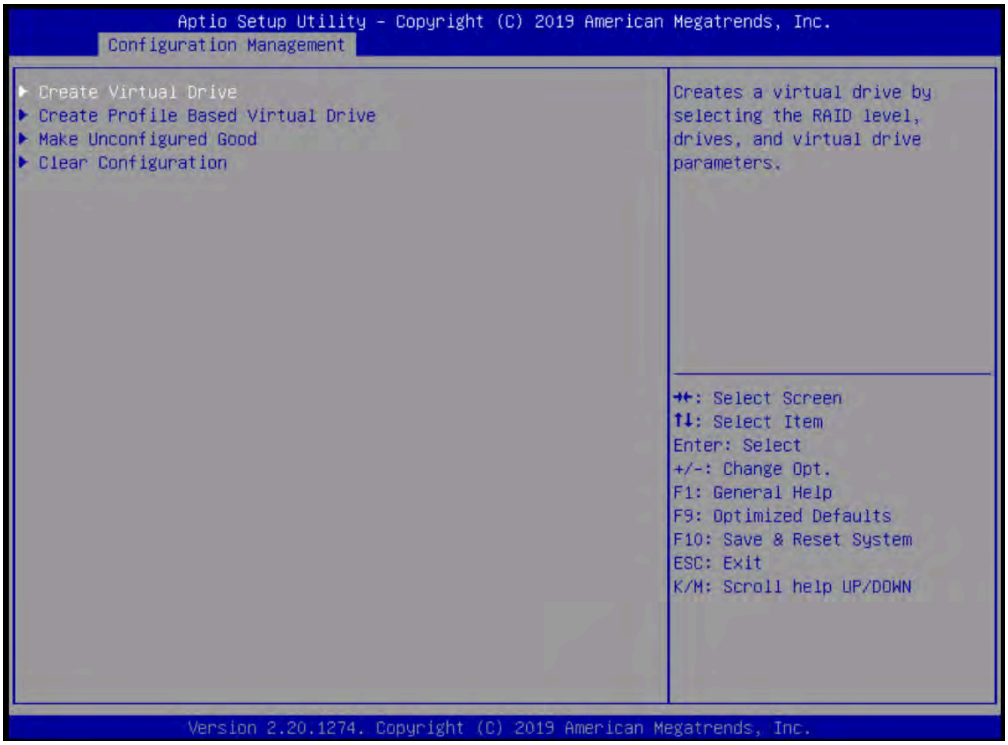
4. Choose Configuration Management (Figure 26).

Figure 26. Choose Configuration Management



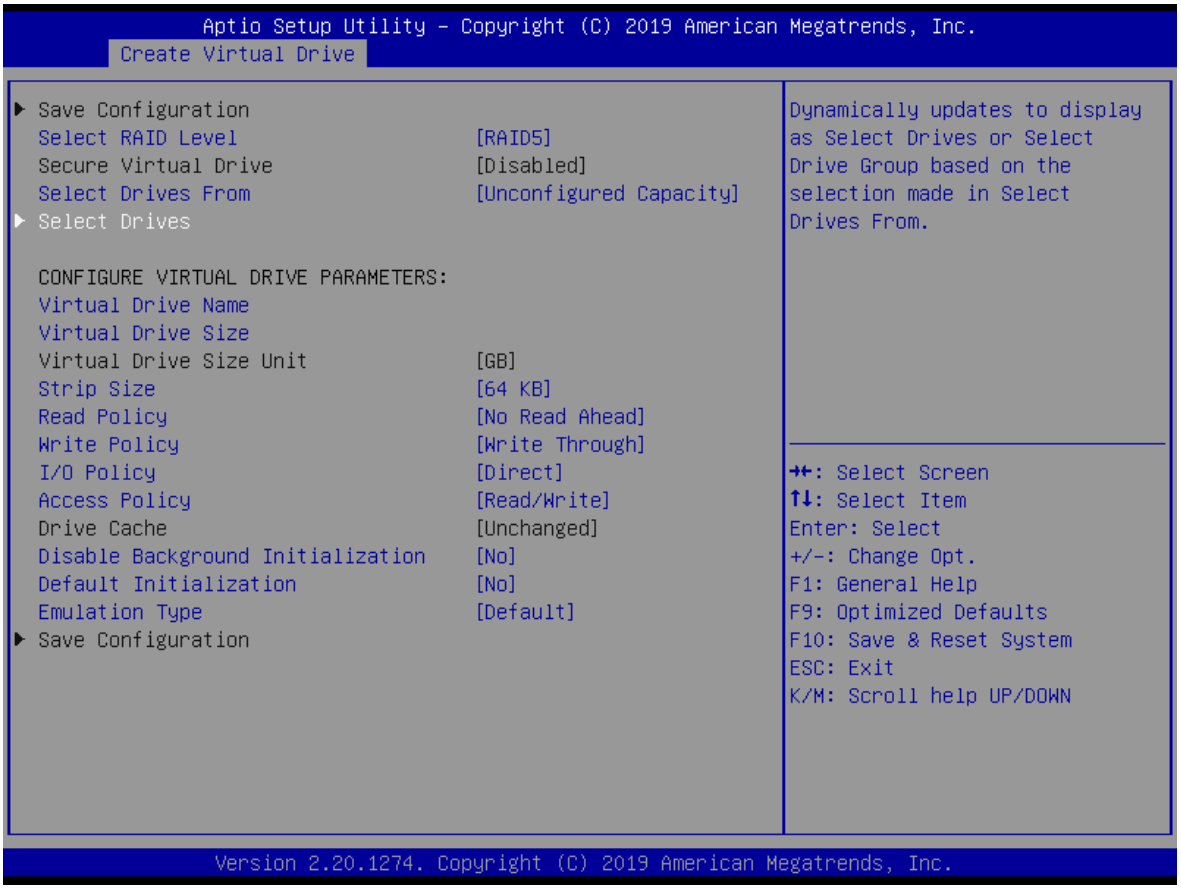
5. Choose Create Virtual Drive (Figure 27).

Figure 27. Choose Create Virtual Drive



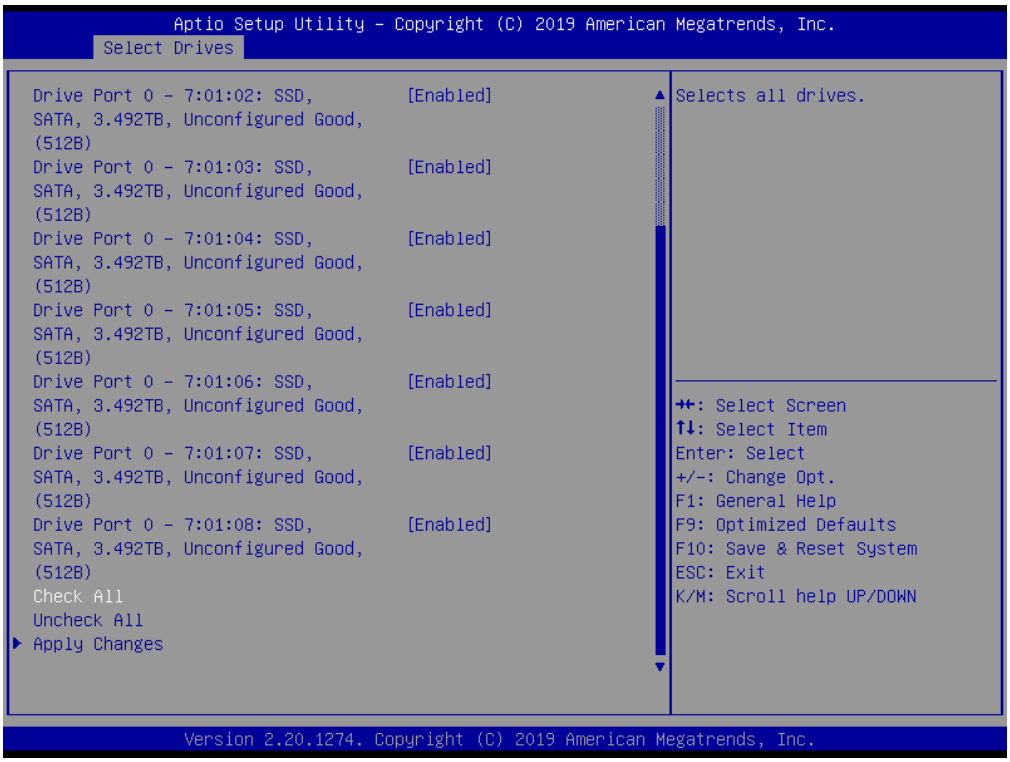
6. Choose the following options to create a RAID 50 or RAID 5 virtual drive. With 20 disks, add five spans.
   a. For RAID Level, choose RAID 50 or RAID 5. [[SHOULD THE FIGURE SHOW RAID 50 SELECTED?]]
   b. Choose Select Drives (Figure 28).

Figure 28. Choose RAID options



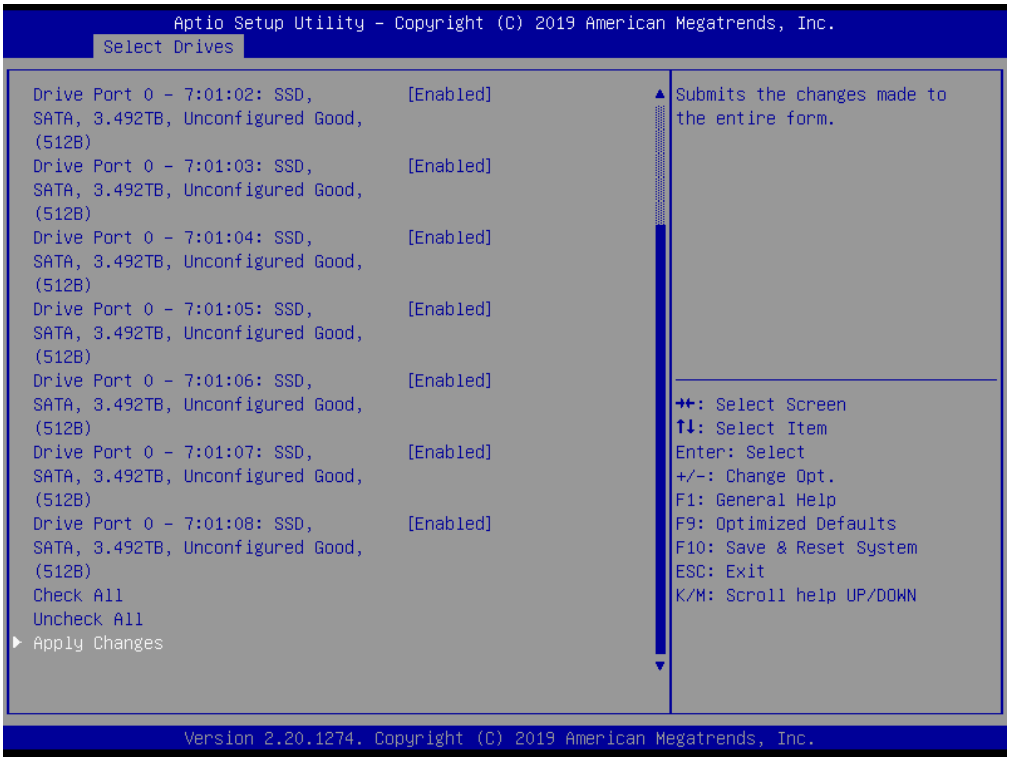
   c. Choose Select Drives and then select the eight SSDs by choosing Enabled as shown in Figure 29.

Figure 29. Choose Enabled



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

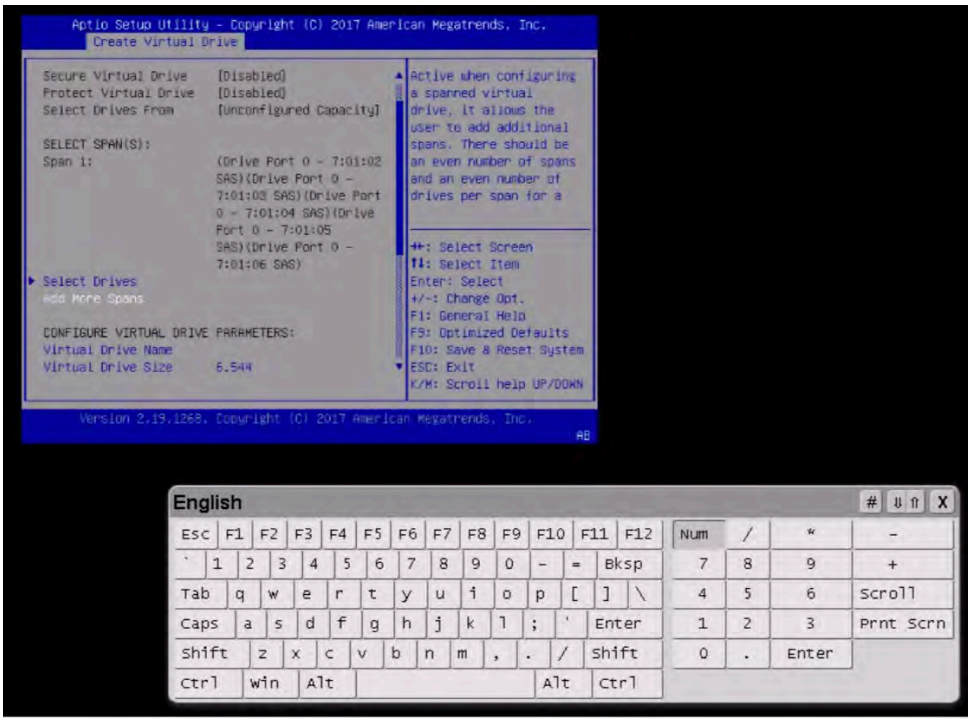
Figure 30. Apply the changes



e. Choose OK in the confirmation window.

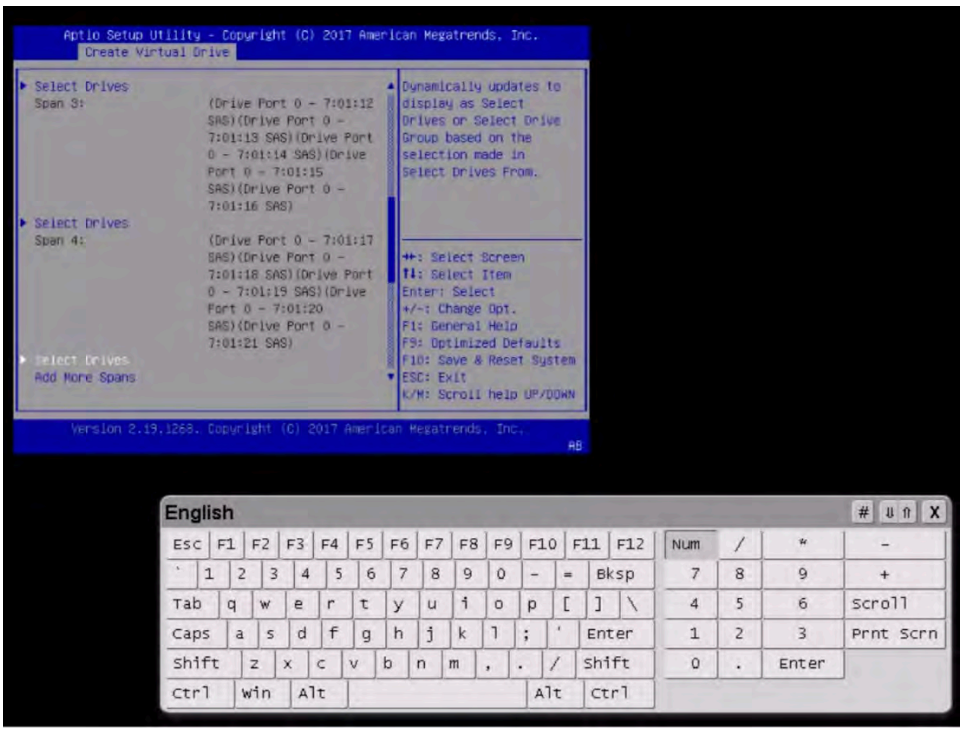
7. Add four more spans using the same process as in step 6 when configuring RAID 50 (Figure 31).

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. Verify that 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>>.

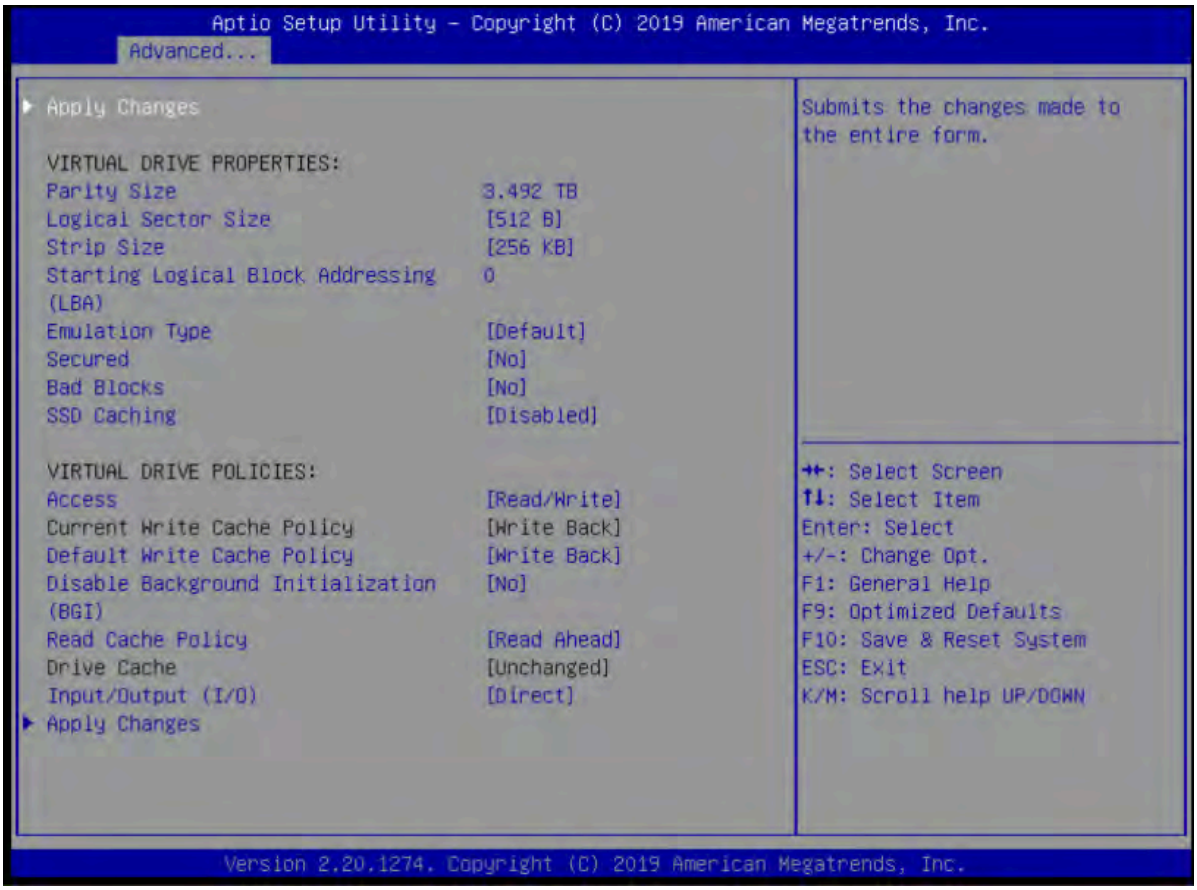
   b. For Strip Size, choose 256 KB.

   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.

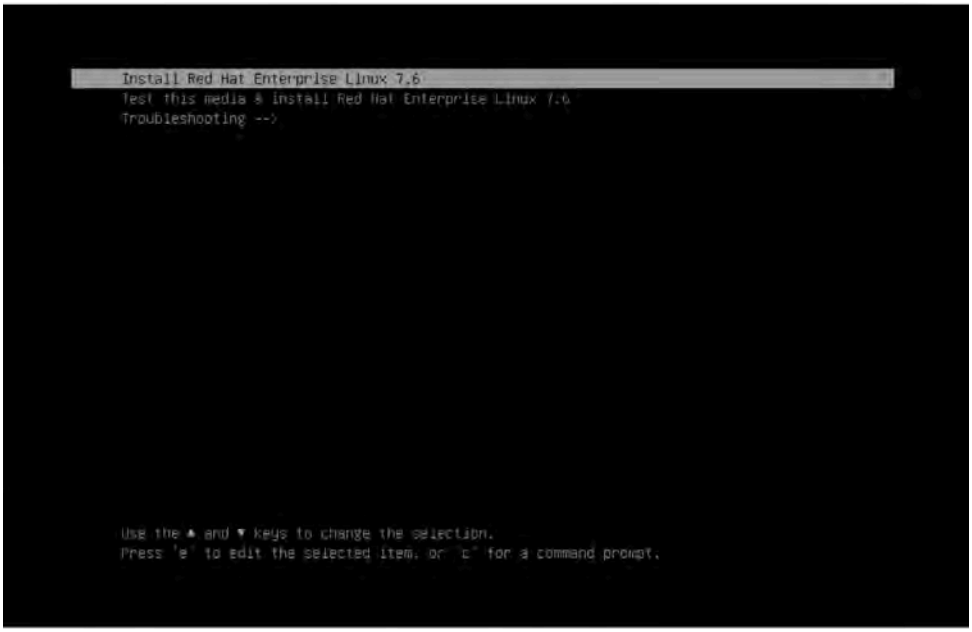
11. Wait for the initialization process for VD0 to complete, which may take several minutes.
12. Press Esc and choose OK to exit the RAID configuration utility.
13. Press Ctrl+Alt+Del to reboot the server.

Installing the operating system

This section shows the installation procedure for RHEL 7.6 for SAP on local drives.

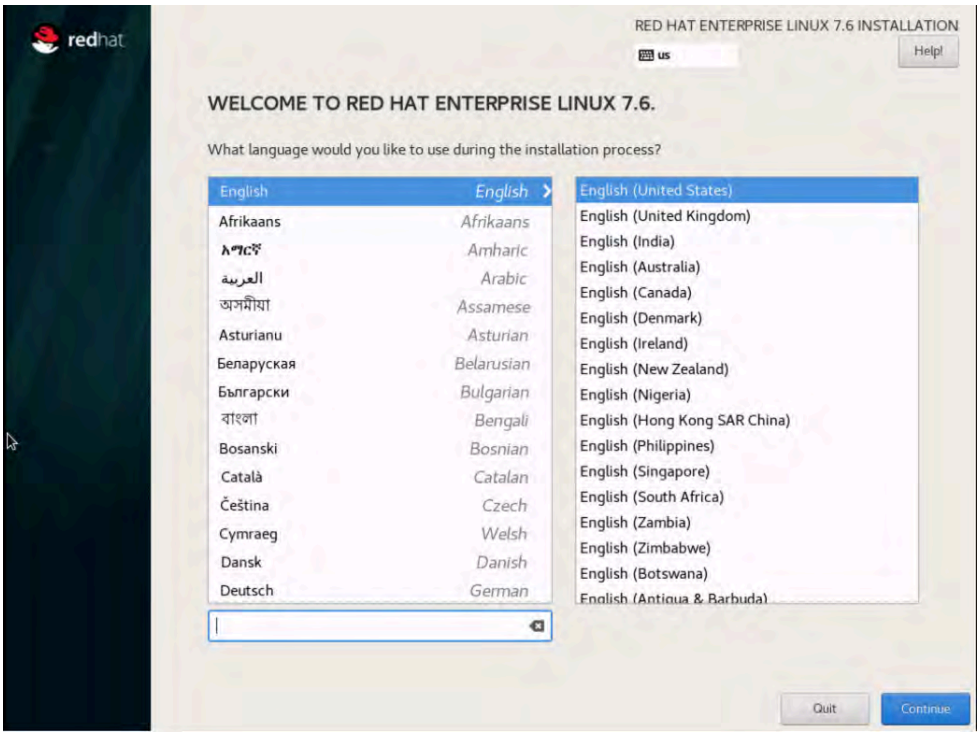
1. Follow the steps in the section “Launching the KVM console” to mount and boot the ISO image (Figure 34).

Figure 34. Booting to the ISO image



2. Select the language and keyboard layout you want to use (Figure 35).

Figure 35. Select your preferred language and keyboard layout

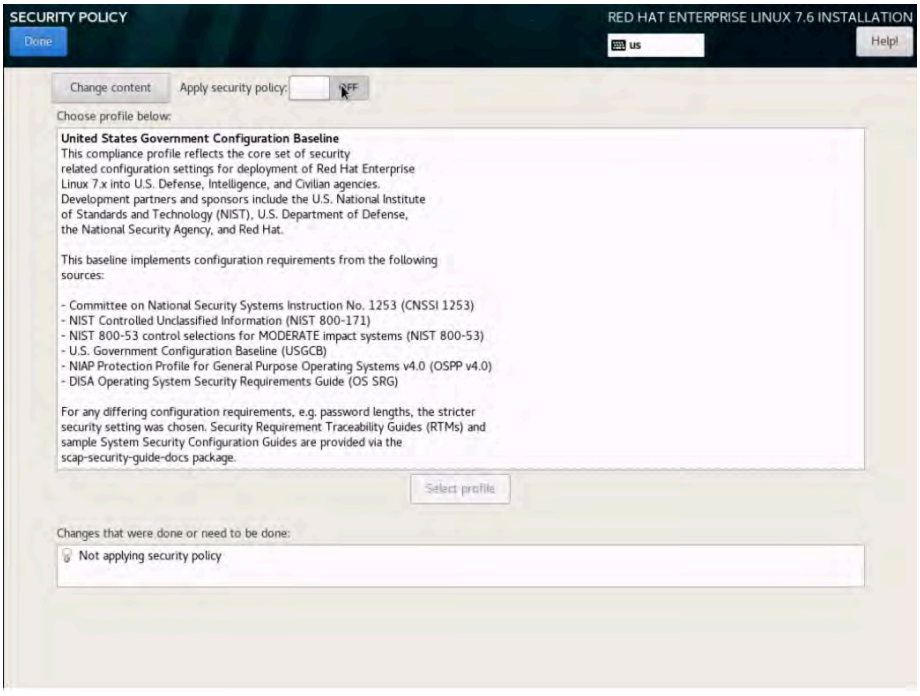


3. Click Continue. The central installation summary page appears. Here you need to configure various features.
4. Choose Localization > Date & Time. Choose the appropriate region and city (Figure 36). You will configure the Network Time Protocol (NTP) later. Click Done.

Figure 36. Setting the date and time

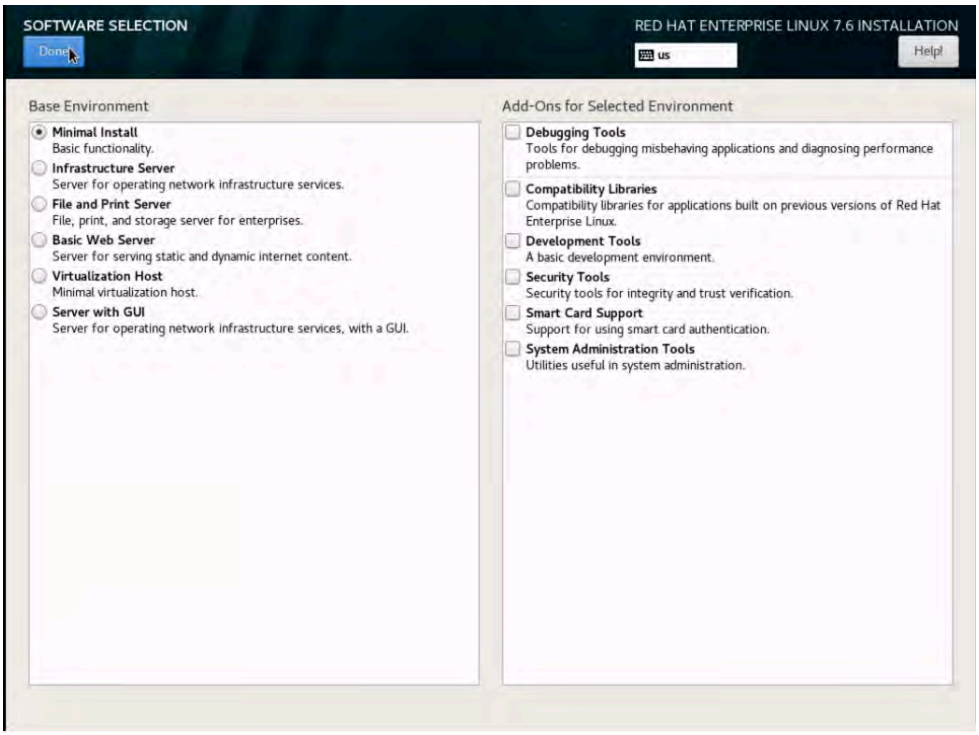
5. Choose Security > Security Policy. Turn off the security policy (Figure 37).

Figure 37. Setting security policy



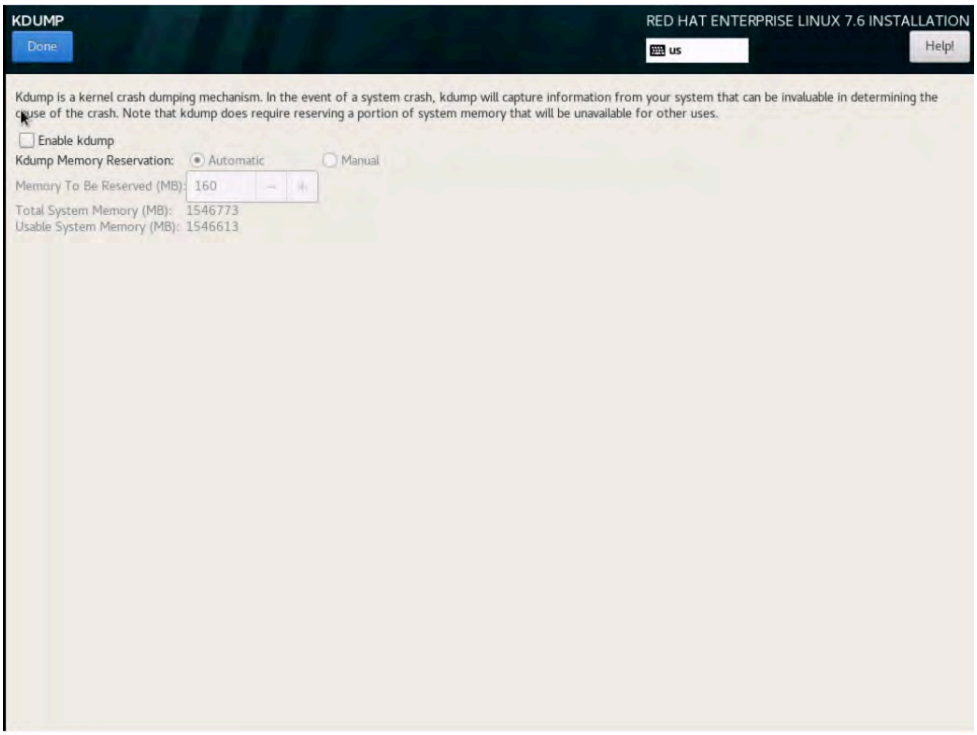
6. Select Software Selection. Retain the default selection: Minimal Install (Figure 38).

Figure 38. Software Selection page



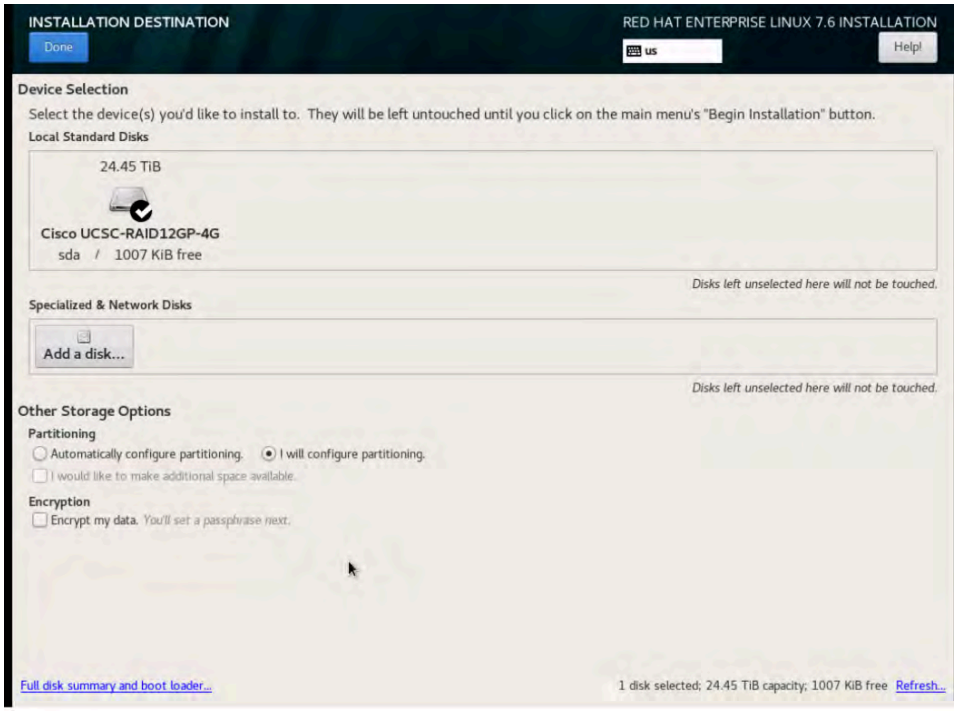
7. Select KDUMP. Deselect the Enable Kdump option to disable it (Figure 39).

Figure 39. Disabling Kdump



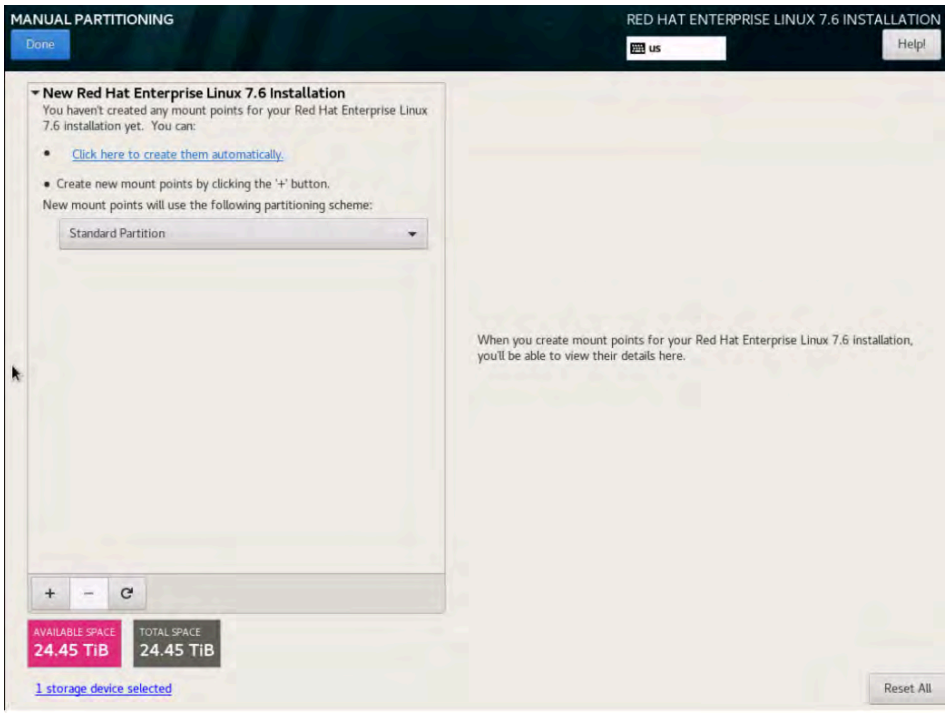
8. Choose System > Installation Destination. Under the other storage options, select the option to manually configure the disk partition layout: “I will configure partition.” (Figure 40).

Figure 40. Installation Destination page



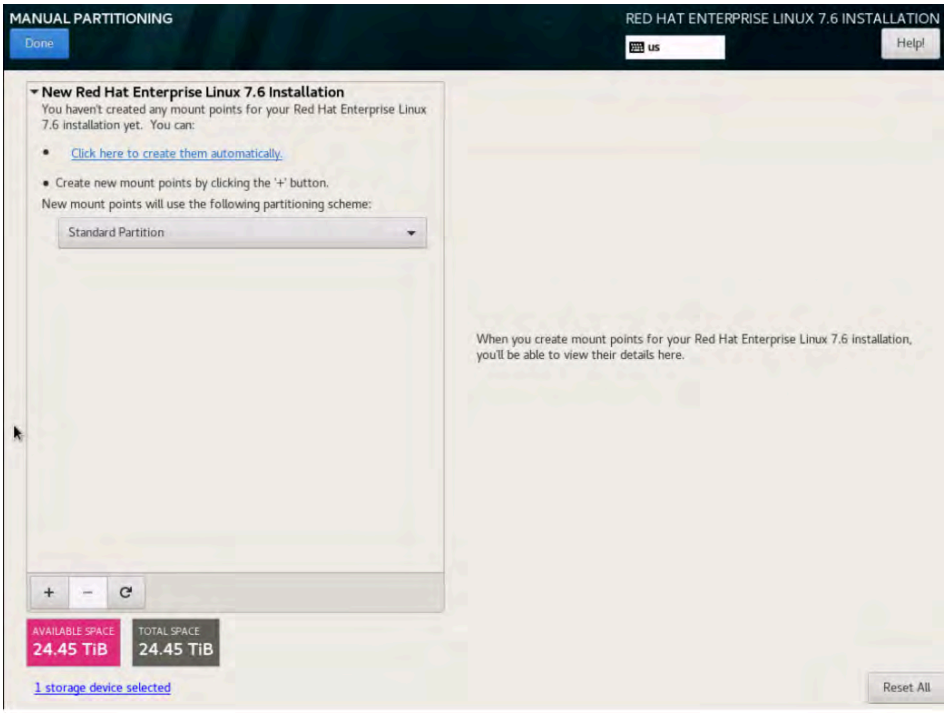
9. Click Done. The Manual Partitioning page appears (Figure 41).

Figure 41. Manual Partitioning page



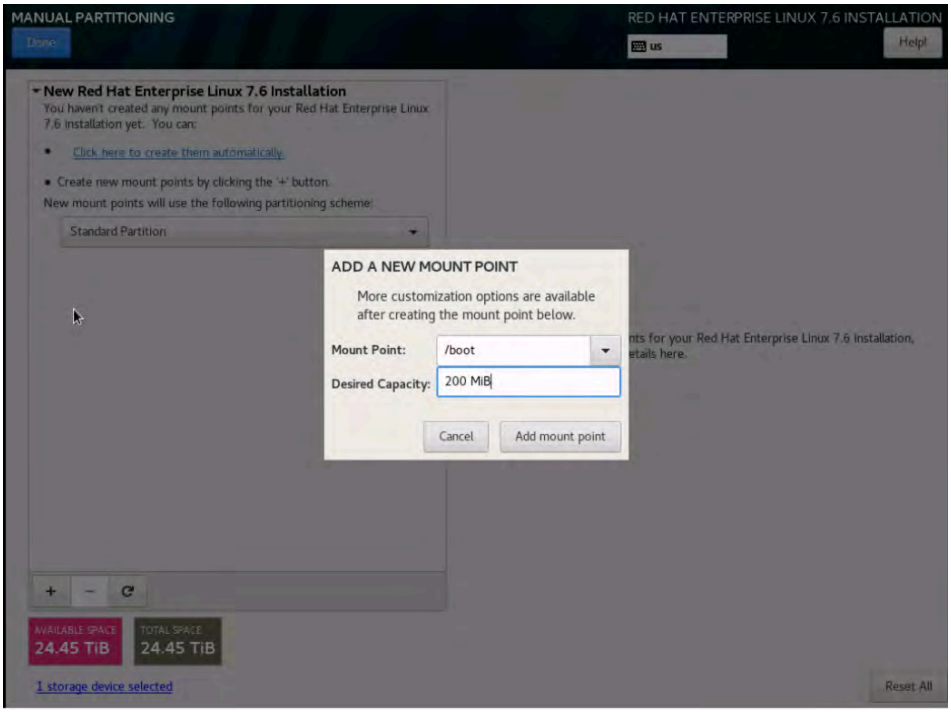
10. You will first create the /boot partition with the standard partition scheme. Change the default partition scheme from Logical Volume Manager (LVM) to Standard Partition (Figure 42).

Figure 42. Choosing the Standard Partition type



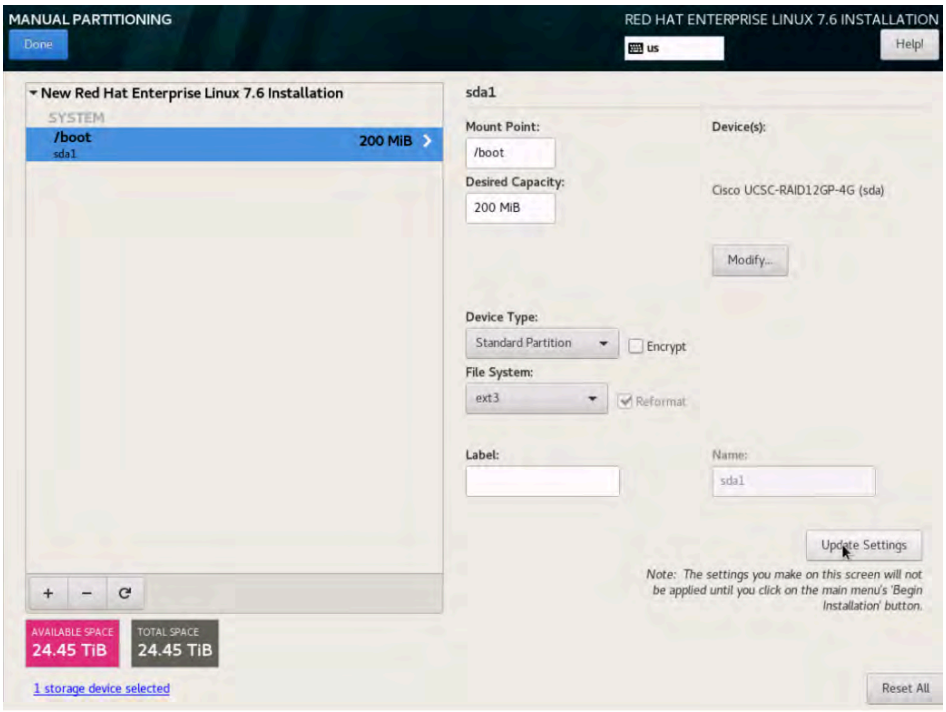
11. Click the + button and create a /boot partition with a size of 200 MiB. Then click “Add mount point” (Figure 43).

Figure 43. Entering mount-point and capacity information



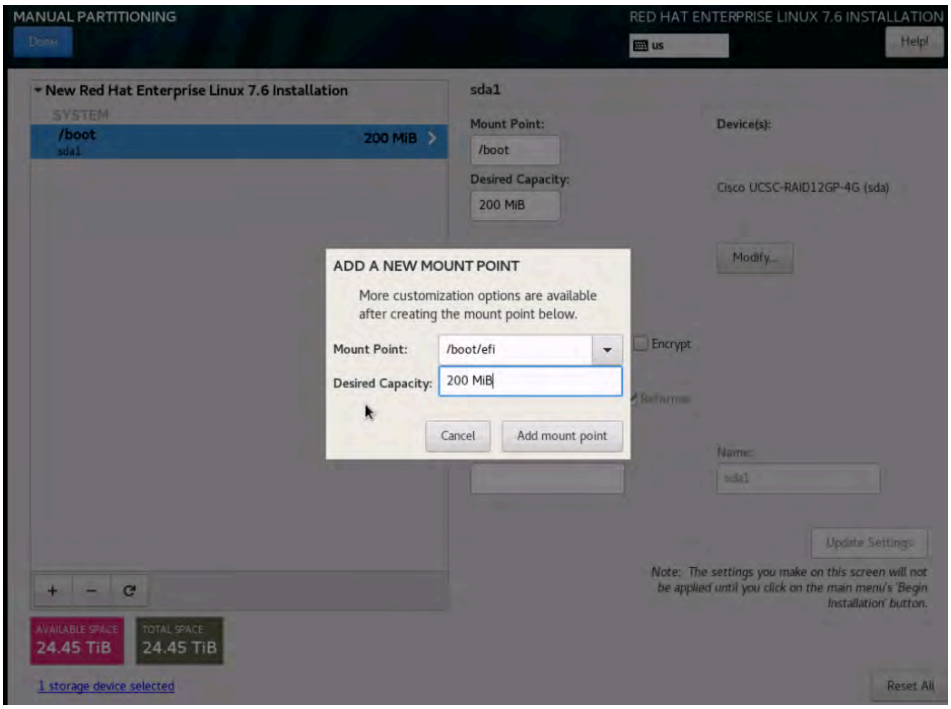
12. Change the file system from the default XFS to ext3 (Figure 44).

Figure 44. Changing the file system type to ext3



13. Create a /boot/efi partition of 200 MiB. Click the + button, choose /boot/efi as the mount point, enter **200 MiB** as the desired capacity, and click “Add mount point” (Figure 45).

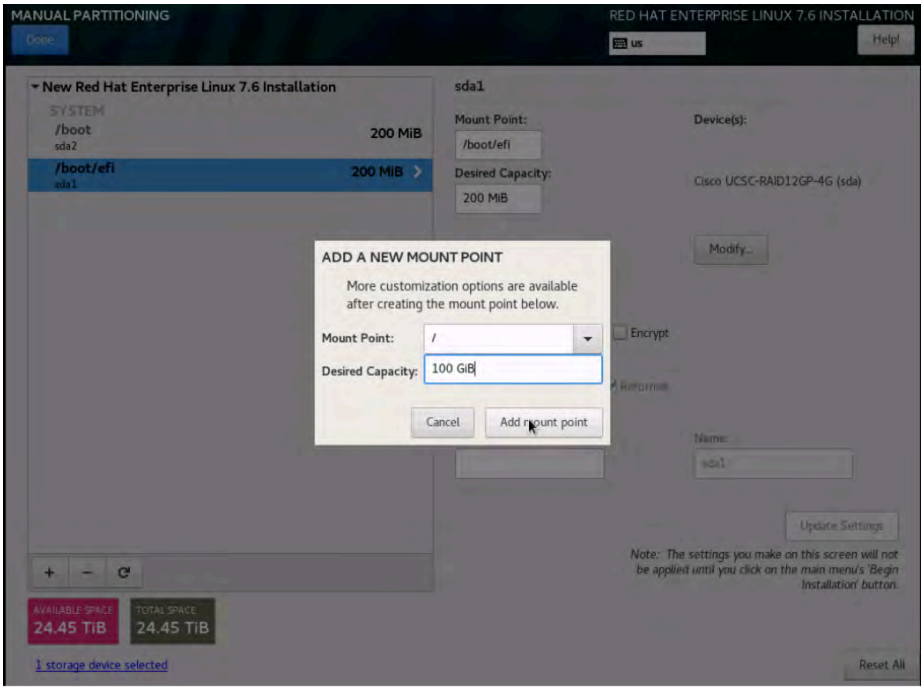
Figure 45. Creating the EFI boot partition



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 SAP HANA system-related volumes.

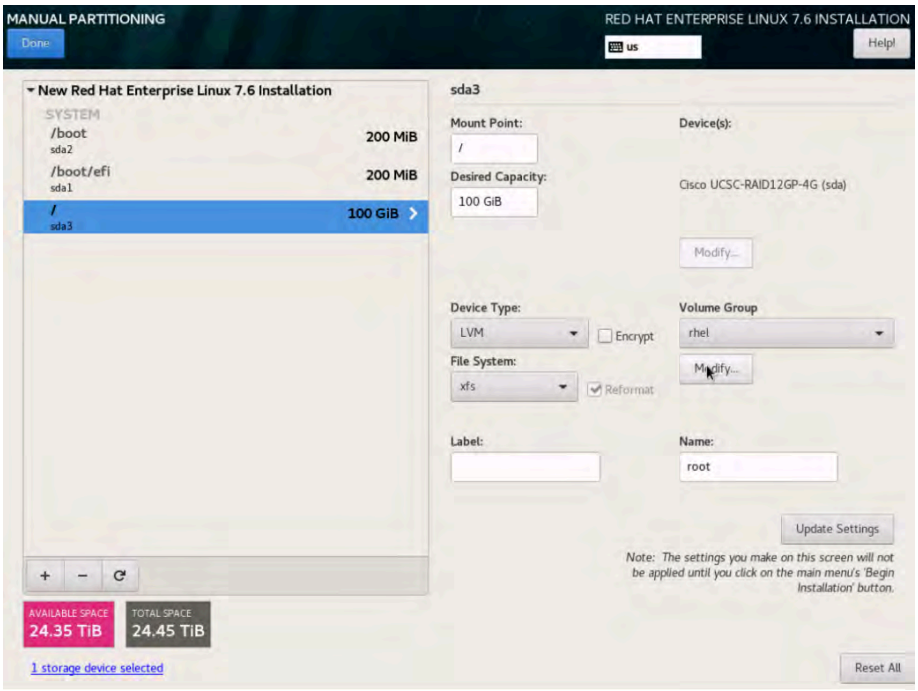
14. Click the + button, select "/" as the mount point, enter **100 GiB** as the desired capacity, and click "Add mount point" (Figure 46).

Figure 46. Creating the root file system with 100 GiB



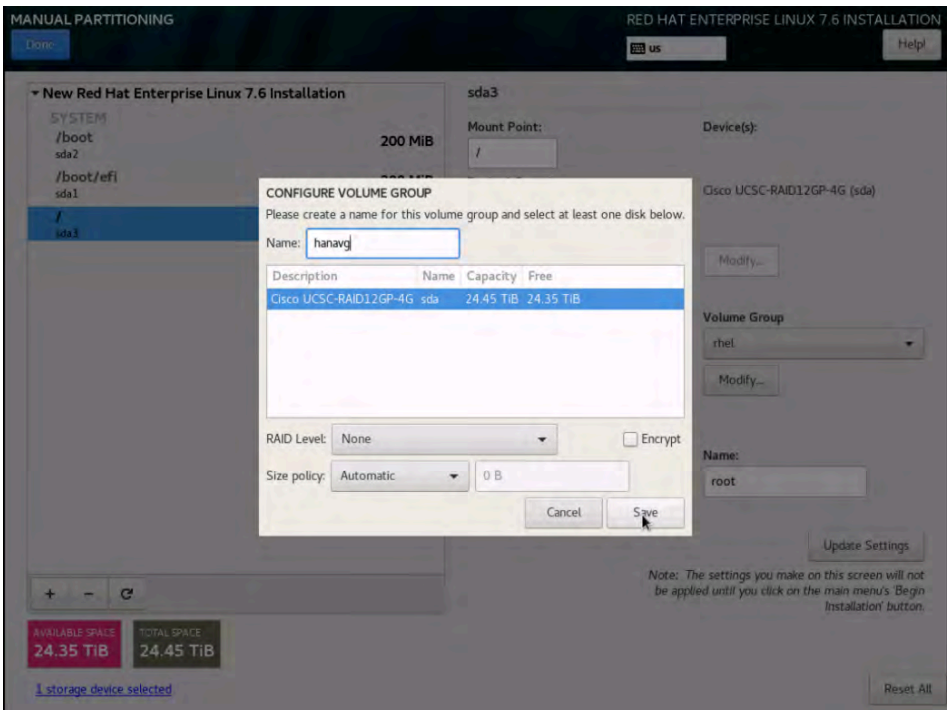
15. Click Modify to change the device type (Figure 47).

Figure 47. Preparing to change the device type to LVM



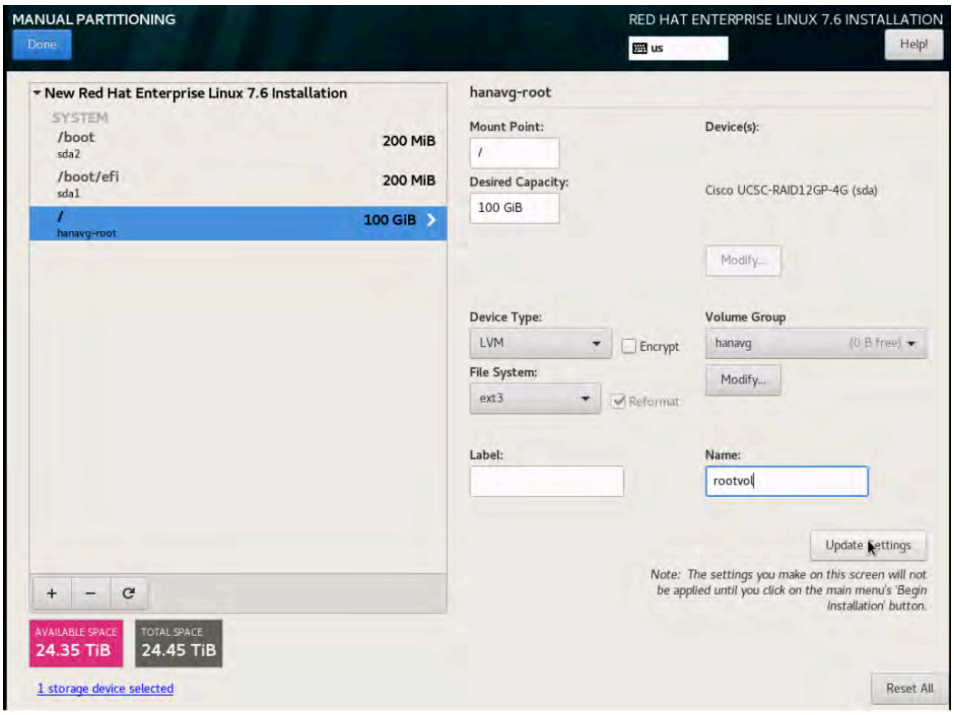
16. Change the device type from Standard Partition to LVM.
17. Change the name of the volume group from the default rhel to **hanavg** (Figure 48). Then click Save.

Figure 48. Configuring the volume group



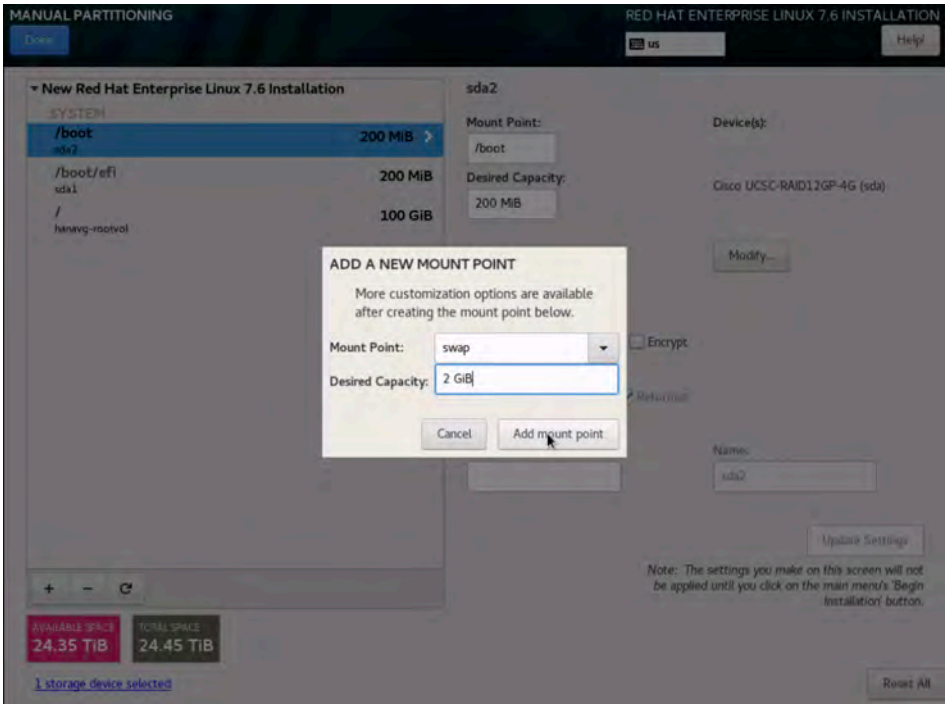
18. Change the file system type to ext3 and change the name to **rootvol**. Click Update Settings (Figure 49).

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



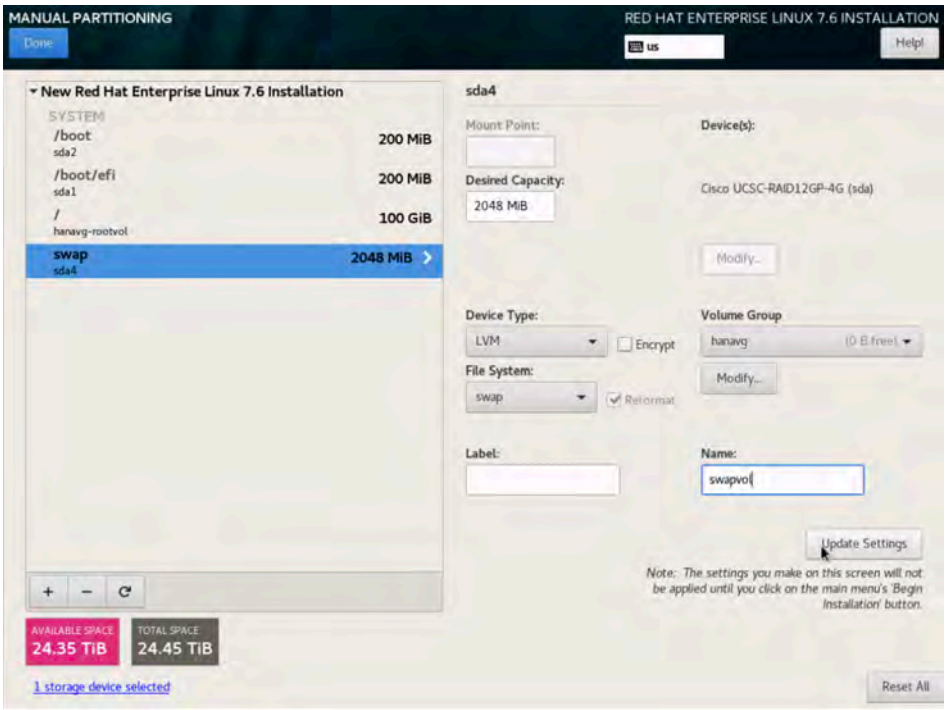
19. You will now create a 2 GiB swap volume. Click the + button, choose swap as the mount point, enter **2 GiB** as the desired capacity, and click “Add mount point” (Figure 50).

Figure 50. Creating a swap volume



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

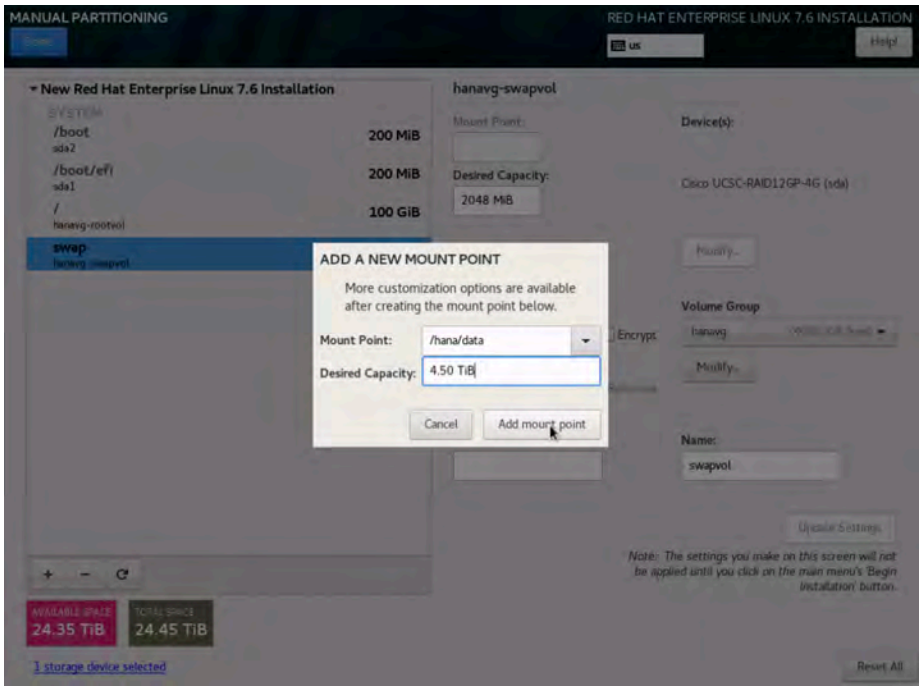
Figure 51. Updating swap volume properties



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

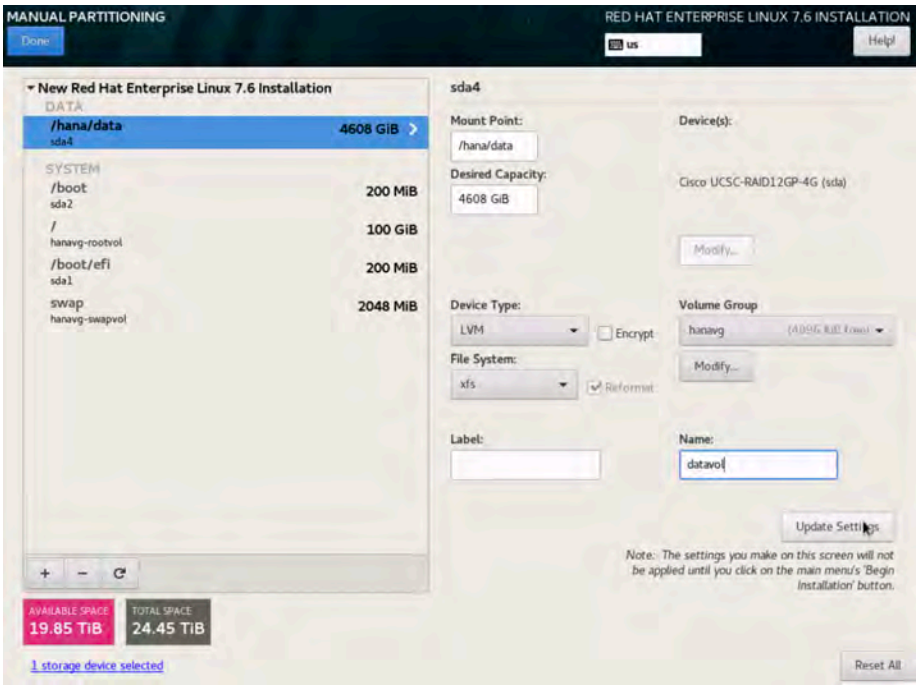
    a. Click the + button, choose /hana/data as the mount point and 4.5 TiB as the desired capacity, and click "Add mount point" (Figure 52).

Figure 52. Creating the /hana/data logical volume



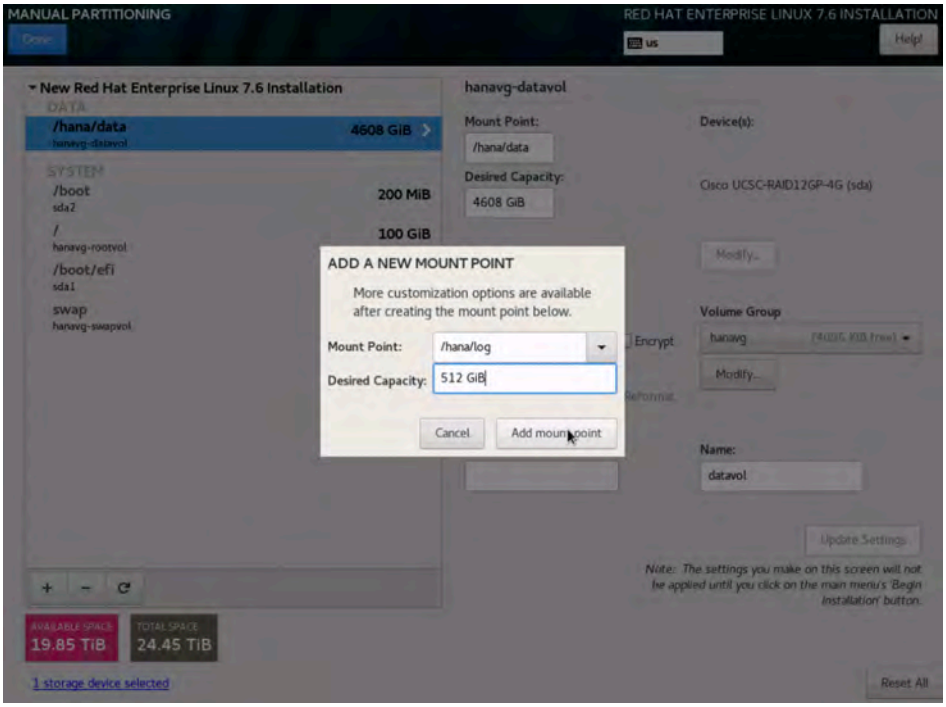
    b. Change the device type to LVM, verify that hanavg is selected as the volume group, and change the name to **datavol** (Figure 53).

Figure 53. Updating /hana/data logical volume properties



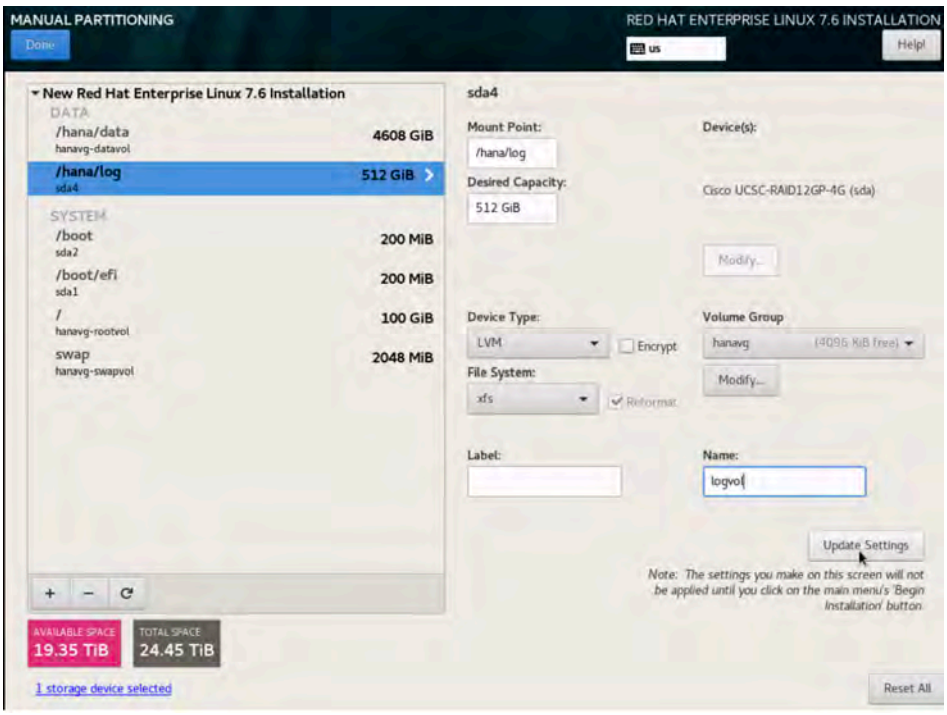
c. Click the + button, choose /hana/log as the mount point and 512 GiB as the desired capacity, and click “Add mount point” (Figure 54).

Figure 54. Creating the /hana/log logical volume



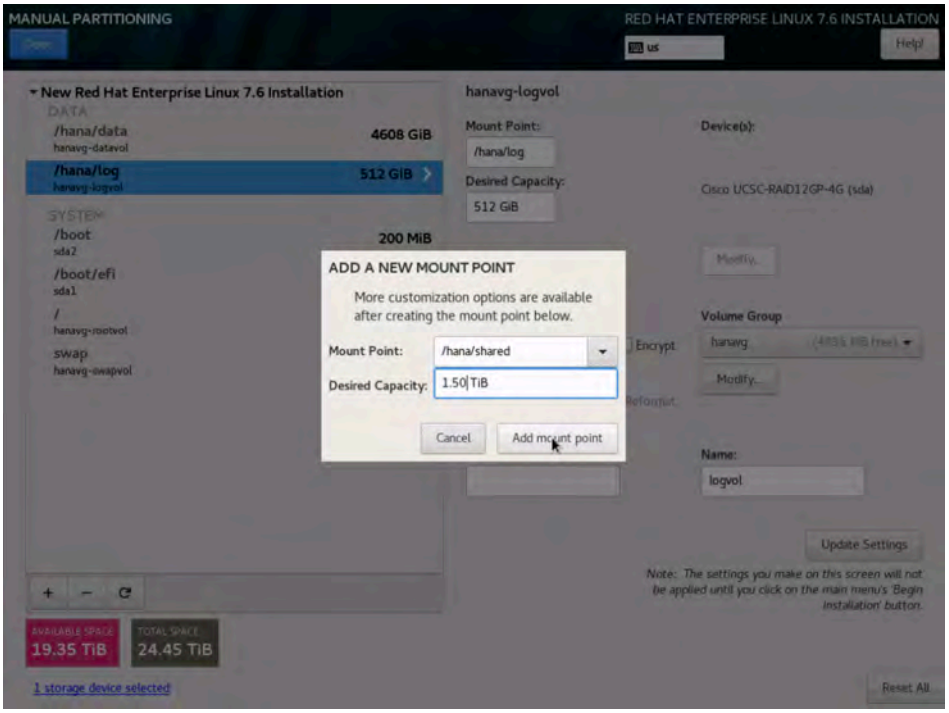
d. Change the device type to LVM, verify that hanavg is selected as the volume group, and change the name to **logvol** (Figure 55).

Figure 55. Updating /hana/log logical volume properties



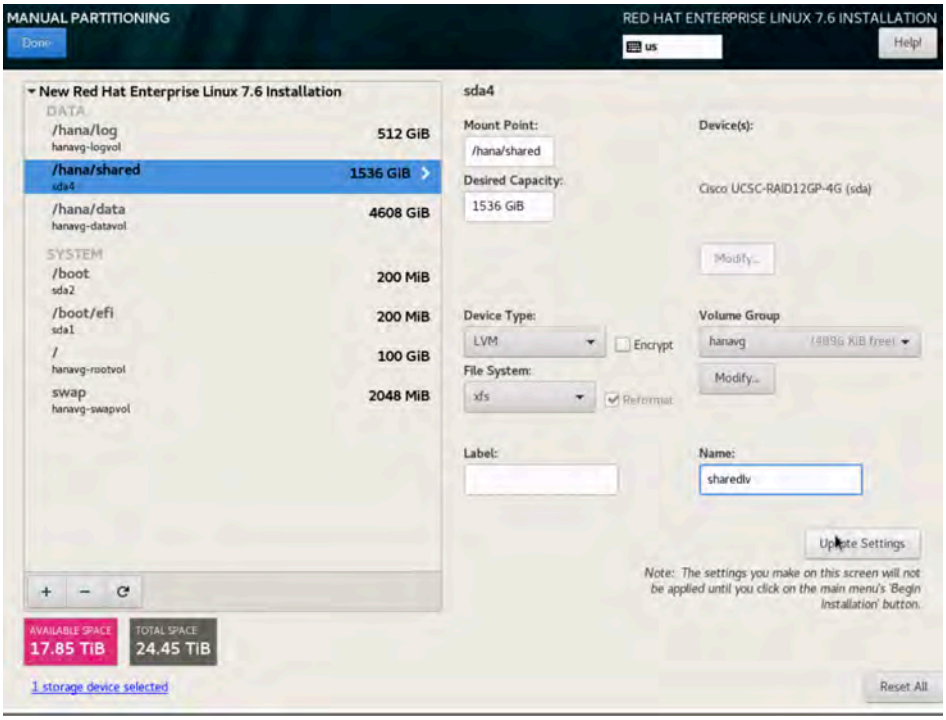
e. Click the + button, choose /hana/shared as the mount point and 1.5 TiB as the desired capacity, and click “Add mount point” (Figure 56).

Figure 56. Creating the /hana/shared logical volume



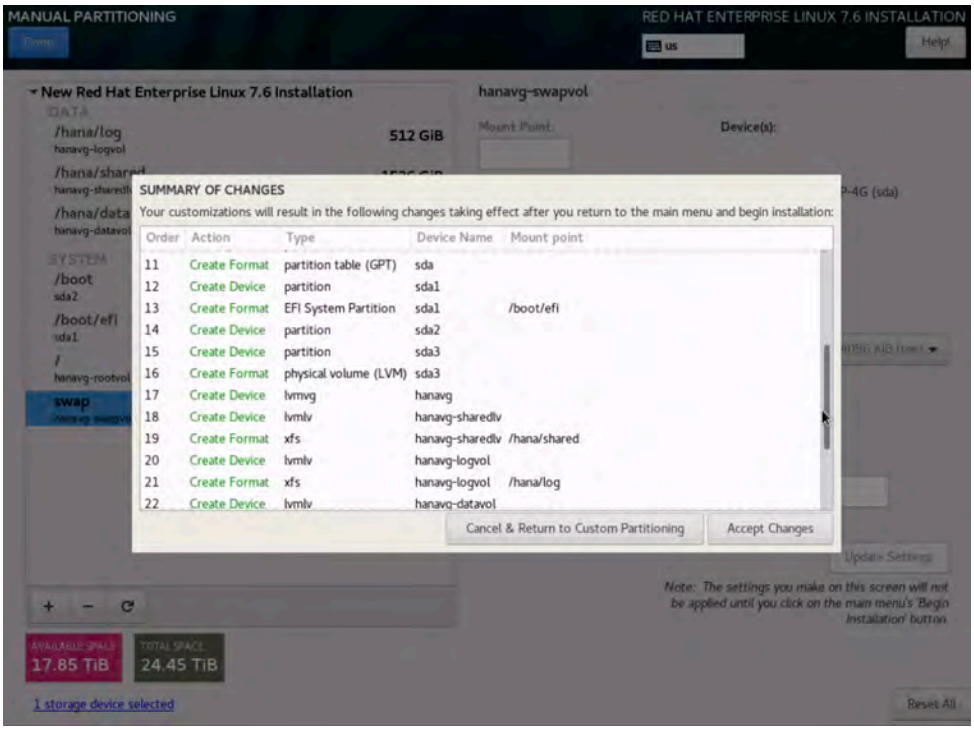
f. Change the device type to LVM, verify that hanavg is selected as the volume group, and change the name to **sharedlv**. Click Update Settings (Figure 57).

Figure 57. Updating /hana/shared logical volume properties



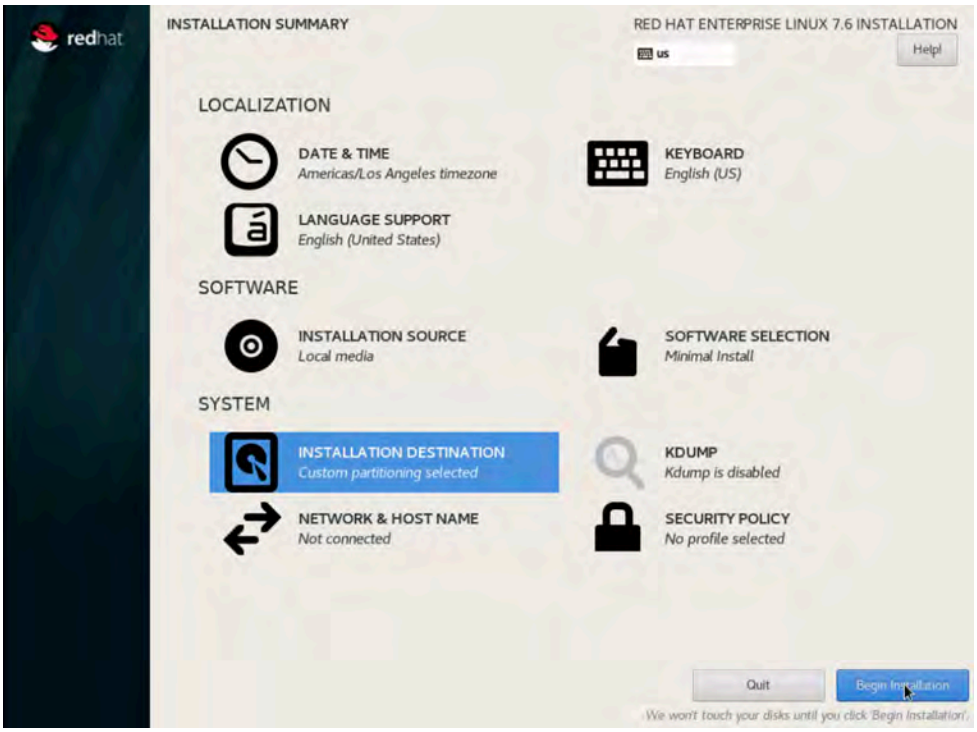
22. Click Done. A summary of changes appears. Click Accept Changes (Figure 58).

Figure 58. Summary of changes for manual partition configuration



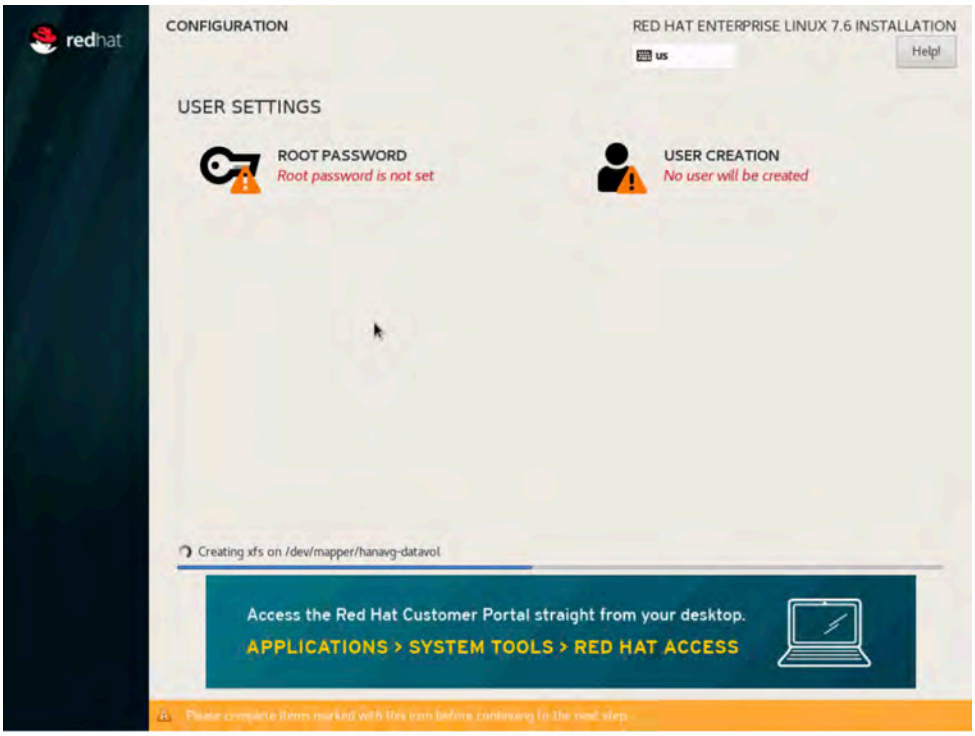
23. On the Installation Summary page that appears, click Begin Installation (Figure 59).

Figure 59. Beginning the installation



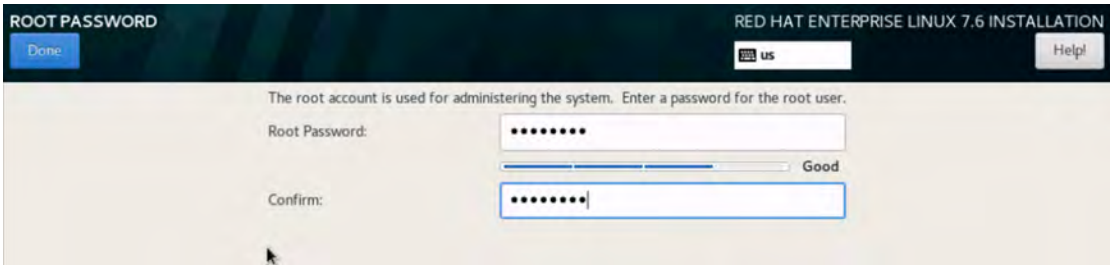
24. As the installation progress, set the root password (Figure 60).

Figure 60. Setting the root password



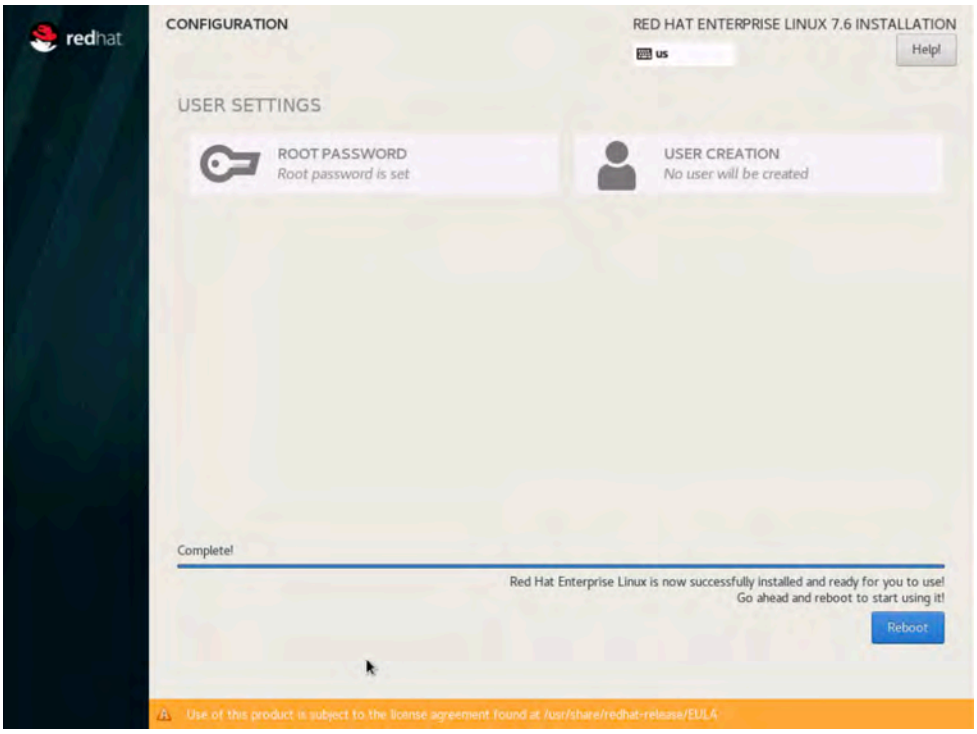
25. Enter and confirm the root password (Figure 61).

Figure 61. Entering and confirming the root user password



26. After the installation is complete, click Reboot (Figure 62).

Figure 62. Finishing the installation



Post-installation OS configuration

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

Customizing the host name

You can customize 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 host name and IP address of the system (Figure 63).

Figure 63. . Sample hosts file

```
[root@localhost network-scripts]# more /etc/hosts
127.0.0.1   localhost localhost.localdomain localhost4 localhost4.localdomain4
::1         localhost localhost.localdomain localhost6 localhost6.localdomain6
173.36.215.51   cishana01.ciscolab.local       cishana01
```

3. Verify that the host name is set 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@localhost network-scripts]# hostname
ciscohana01.ciscolab.local
[root@localhost network-scripts]# hostname -s
ciscohana01
[root@localhost network-scripts]# hostname -f
ciscohana01.ciscolab.local
[root@localhost network-scripts]# hostname -d
ciscolab.local
```

Configuring the network

The Cisco UCS C480 M5 server comes with a pair of Cisco VIC 1455 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@localhost ~]# ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    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: eno5: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN group default qlen 1000
    link/ether 00:b7:71:ff:83:7b brd ff:ff:ff:ff:ff:ff
3: eno6: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN group default qlen 1000
    link/ether 00:b7:71:ff:83:7c brd ff:ff:ff:ff:ff:ff
4: eno7: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN group default qlen 1000
    link/ether 00:b7:71:7e:02:2e brd ff:ff:ff:ff:ff:ff
5: eno8: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN group default qlen 1000
    link/ether 00:b7:71:7e:02:2f brd ff:ff:ff:ff:ff:ff
6: enp53s0f0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP group default qlen 1000
    link/ether a8:b4:56:a3:ed:66 brd ff:ff:ff:ff:ff:ff
7: enp53s0f1: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN group default qlen 1000
    link/ether a8:b4:56:a3:ed:67 brd ff:ff:ff:ff:ff:ff
```

In RHEL 7.0, **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, eno5, 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-active network names.
3. You can disable IPv6 support at this time because this solution uses IPv4. You 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@ciscohana01 ~]# 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@localhost ~]# grub2-mkconfig -o /boot/efi/EFI/redhat/grub.cfg
Generating grub configuration file ...
Found linux image: /boot/vmlinuz-3.10.0-957.el7.x86_64
Found initrd image: /boot/initramfs-3.10.0-957.el7.x86_64.img
Found linux image: /boot/vmlinuz-0-rescue-68a4f0e19736474aa07e1e9c1dc7679e
Found initrd image: /boot/initramfs-0-rescue-68a4f0e19736474aa07e1e9c1dc7679e.img
done
```

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

```
# reboot
```

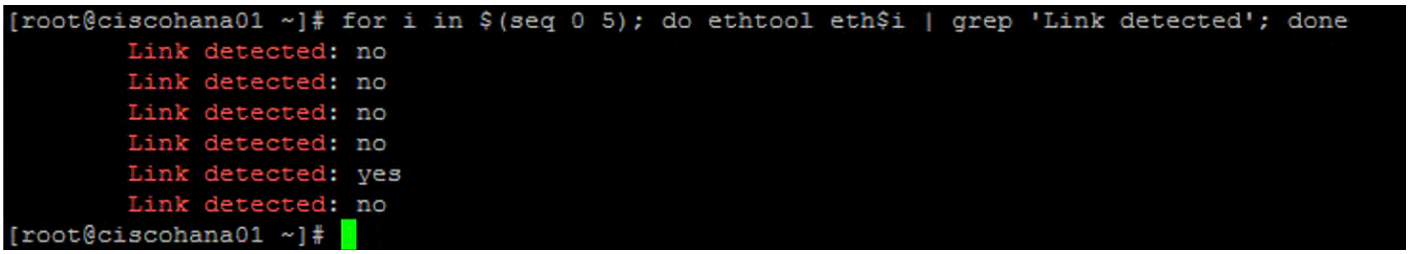
6. After the reboot, use the KVM console to log in to the installed system as the user **root** with password **<<var_sys_root_pw>>**.
7. Run the **ip addr** command to see the interfaces in the traditional kernel-native ethX nomenclature (Figure 68).

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

```
[root@localhost ~]# ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    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 group default qlen 1000
    link/ether 00:b7:71:ff:83:7b brd ff:ff:ff:ff:ff:ff
3: eth1: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN group default qlen 1000
    link/ether 00:b7:71:ff:83:7c brd ff:ff:ff:ff:ff:ff
4: eth2: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN group default qlen 1000
    link/ether 00:b7:71:7e:02:2e brd ff:ff:ff:ff:ff:ff
5: eth3: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN group default qlen 1000
    link/ether 00:b7:71:7e:02:2f brd ff:ff:ff:ff:ff:ff
6: eth4: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP group default qlen 1000
    link/ether a8:b4:56:a3:ed:66 brd ff:ff:ff:ff:ff:ff
7: eth5: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc mq state DOWN group default qlen 1000
    link/ether a8:b4:56:a3:ed:67 brd ff:ff:ff:ff:ff:ff
```

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

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



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 post 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 eth4 as shown in this example:

```
# cd /etc/sysconfig/network-scripts
# vi ifcfg-eth4
DEVICE=eth4
Type=Ethernet
ONBOOT=yes
BOOTPROTO=static
IPV6INIT=no
USERCTL=no
NM_CONTROLLED=no
IPADDR=<<var_mgmt_ip_address>>
NETMASK=<<var_mgmt_ip_mask>>
```

11. Add the default gateway:

```
# vi /etc/sysconfig/network
NETWORKING=yes
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
nameserver <<IP of DNS server 1>>
nameserver <<IP of DNS server 2>>
```

Configuring bonding for high availability (optional)

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 1455 adapters installed in the server as well as the onboard 1-Gbps interface.

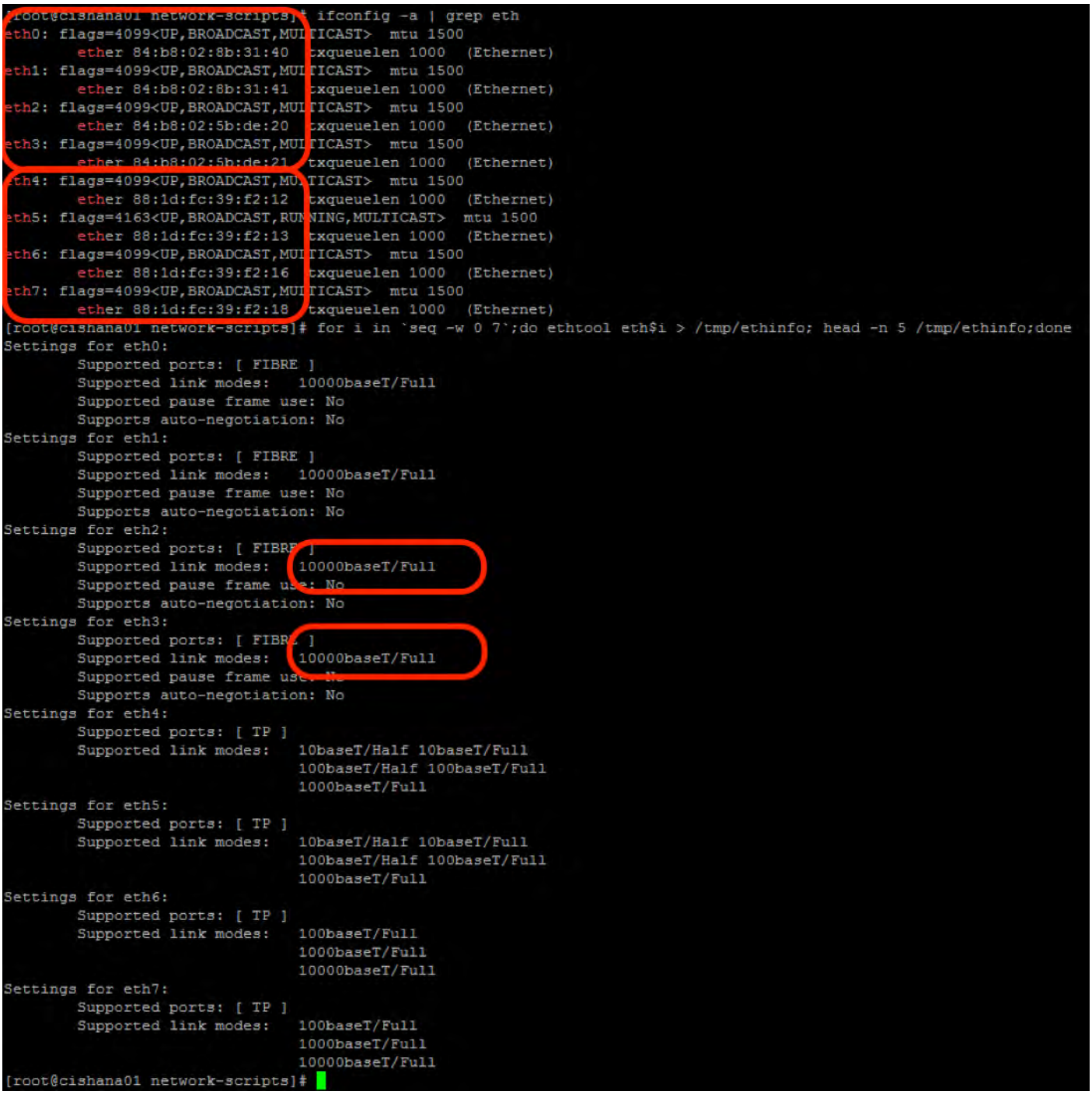
A bond configured with two 1-Gbps ports can be used for the administration, management, and access networks, and a bond configured with two ports, using one port from each dual-port VIC, can be used for a backup network. Additional interfaces can be configured on the VICs based on needs.

In the example in Figure 70, the **ethtool** output for the interfaces showing Fibre Channel support and 10-Gbps indicates that eth0 through eth4 are VIC ports. In addition, a close observation of their MAC addresses reveals that eth0 and eth1 and that eth2 and eth3 are ports on the same VICs (in both cases, the last octet of the MAC address differs).

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

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

Figure 70. Identifying 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
IP ADDR=<<var_mgmt_ip_address>>
NETMASK=<<var_mgmt_nw_netmask>>
```

```
ONBOOT=yes
HOTPLUG=no
BOOTPROTO=none
USERCTL=no
BONDING_OPTS=”million=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/ifcfg-eth5 BOOTPROTO='none'

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:

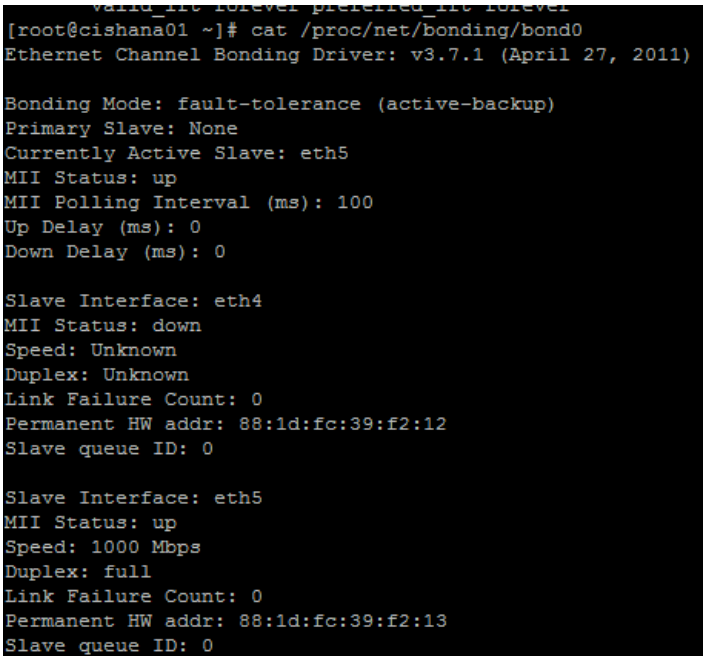
systemctl restart network.service

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

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

Figure 71 shows sample output.

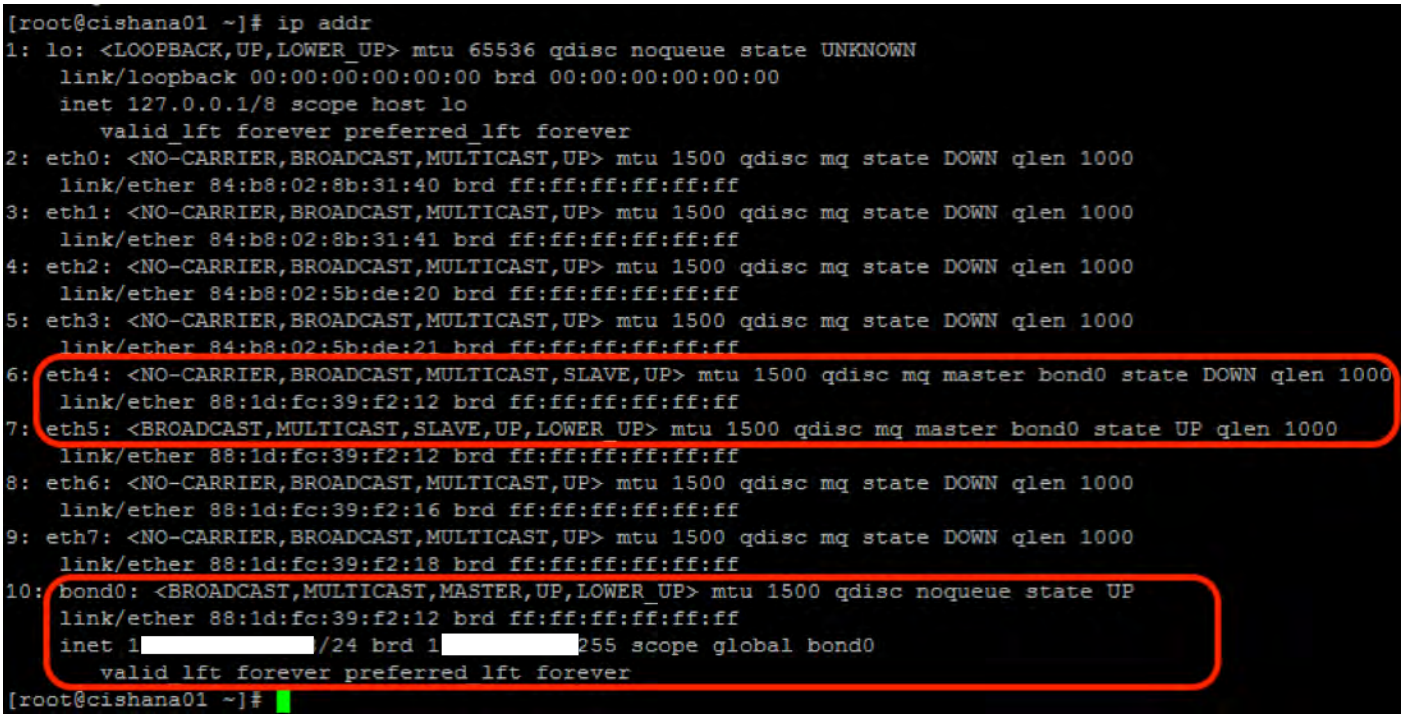
Figure 71. Sample bond0 configuration test output



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
IP ADDR=<<var_mgmt_ip_address>>
NETMASK=<<var_mgmt_nw_netmask>>
ONBOOT=yes
HOTPLUG=no
BOOTPROTO=none
USERCTL=no
BONDING_OPTS="million=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 does not include any update information. Before you can 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 to which the subscription is attached, use the following command:

   ```
   #yum repolist
   ```

   Update only the OS kernel and firmware packages to the latest release that appeared in RHEL 7.6. Set the release version to 7.6.

   ```
   #subscription-manager release –set=7.6
   ```

3. Apply the latest update for RHEL 7.6. Typically, the kernel is updated as well.

   ```
   #yum -y update
   ```

4. Reboot the system to 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 help 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. Run the following commands to install tuned-profiles for SAP HANA:

```
#subscription-manager repos --enable="rhel-sap-hana-for-rhel-7-server-rpms" --enable="rhel-7-server-rpms"
# 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
# sytemctl disable chronyd.service
```

a. Edit the /etc/ntp.conf file 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 daemon (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

Use the following process to optimize the use of HANA database (HDB) with RHEL 7.6 for SAP.

1. Apply the SAP Notes settings as instructed. See SAP Note 2292690: SAP HANA DB: Recommended OS settings for RHEL 7.
2. Optionally, remove old kernels after the OS update:

```
Package-cleanup --oldkernels --count=1
```

3. Reboot the server after applying the SAP Notes

```
#reboot
```

The information from SAP Note 2292690 mentioned is shown here and is current at the time of publishing this document. For the latest updates, please see the SAP Notes.

To customize the RHEL 7.6 System for HANA Servers, follow these steps:

Turn off autoNUMA balancing

Add "kernel.numa_balancing = 0" to /etc/sysctl.d/sap_hana.conf (please create this file if it does not already exist) and reconfigure the kernel by running

```
# sysctl -p /etc/sysctl.d/sap_hana.conf
```

Additionally the "numad" daemon must be disabled:

```
# systemctl stop numad
# systemctl disable numad
```

Disable transparent hugepages and configure C-States for lower latency

Edit /etc/default/grub, search for the line starting with “GRUB_CMDLINE_LINUX”: and append the following

```
transparent_hugepage=never processor.max_cstate=1 intel_idle.max_cstate=1
```

Energy Performance Bias, CPU frequency/Voltage scaling and Kernel samepage merging (KSM).

Add the following commands to a script executed on system boot, such as /etc/rc.d/boot.local:

```
cpupower frequency-set -g performance
```

```
Add the following commands to a script executed on system boot, such as /etc/init.d/boot.local:
cpupower set -b 0
echo 0 > /sys/kernel/mm/ksm/run

Activate tuned and Enable tuned profile
systemctl enable tuned
tuned-adm profile sap-hana

Reboot the OS issuing reboot command
```

To optimize the network configuration, apply the settings by referring to SAP Note 2382421: Optimizing the network configuration on HANA and OS level.

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 SAP HANA Server Installation Guide. All other SAP HANA administration documentation is available at SAP HANA Administration Guide.

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 SAP Notes and Knowledge base.

SAP HANA 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 2519630: Check whether power save mode is active
- 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 BW on HANA: Sizing the SAP HANA database
- SAP Note 1793345: Sizing for Suite on HANA

- SAP Note 2399079: Elimination of hdbparam in HANA 2
- SAP Note 2186744: FAQ: SAP HANA parameters

Linux notes

- SAP Note 2292690: SAP HANA DB: Recommended OS settings for RHEL 7
- SAP Note 2235581: SAP HANA: Supported operating systems
- SAP Note 2009879: SAP HANA guidelines for the RHEL operating system
- SAP Note 1731000: Non-recommended configuration changes
- SAP Note 1557506: Linux paging improvements
- SAP Note 1740136: SAP HANA: Wrong mount option may lead to corrupt persistency
- SAP Note 2382421: Optimizing the network configuration on HANA and OS level

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

Performing an SAP HANA post-installation checkup

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

Commands for checking SAP HANA services

```
bwladm@cishana01:/usr/sap/BWL/HDB00> /usr/sap/hostctrl/exe//sapcontrol -nr 00 -function
GetProcessList
19.02.2019 11:29:27
GetProcessList
OK
name, description, dispstatus, textstatus, starttime, elapsedtime, pid
hdbdaemon, HDB Daemon, GREEN, Running, 2019 02 13 08:51:49, 866:37:38, 41691
hdbcompileserver, HDB Compileserver, GREEN, Running, 2019 02 13 08:51:56, 866:37:31, 41837
hdbindexserver, HDB Indexserver, GREEN, Running, 2019 02 13 08:52:00, 866:37:27, 41863
hdbnameserver, HDB Nameserver, GREEN, Running, 2019 02 13 08:51:50, 866:37:37, 41711
hdbpreprocessor, HDB Preprocessor, GREEN, Running, 2019 02 13 08:51:56, 866:37:31, 41839
hdbwebdispatcher, HDB Web Dispatcher, GREEN, Running, 2019 02 13 08:53:11, 866:36:16, 42431
hdbxsengine, HDB XSEngine, GREEN, Running, 2019 02 13 08:52:00, 866:37:27, 41865
bwladm@cishana01-bwl:/usr/sap/BWL/HDB00>
```

Commands for checking SAP HANA database information

```
bwladm@cishana01:/usr/sap/BWL/HDB00> HDB info
USER            PID      PPID    %CPU     VSZ      RSS    COMMAND
bwladm      59578  59577    0.0     108472  1944   -sh
bwladm      59663  59578    0.0     114080  2020   \_ /bin/sh /usr/sap/BWL/HDB00/HDB info
bwladm      59692  59663    0.0     118048  1596   \_ ps fx -U bwladm -o
user,pid,ppid,pcpu,vsz,rss,args
       bwladm      41683          1    0.0     22188    1640   sapstart
pf=/hana/shared/BWL/profile/BWL_HDB00_cishana01-bwl
bwladm      41691  41683    0.0     582888  290988 \_ /usr/sap/BWL/HDB00/cishana01-
bwl/trace/hdb.sapBWL_HDB00 -d -nw -f /usr/sap/BWL/HDB00/cishana01-bwl/daemon.ini
bwladm      41711  41691    0.3     54292416 2058900  \_hdbnameserver
bwladm      41837   41691   0.1     4278472   1243356   \_hdbcompileserver
bwladm      41839   41691   0.2     11773976 8262724    \_hdbpreprocessor
bwladm      41863   41691   6.2     22143172 18184604  \_hdbindexserver
bwladm      41865   41691   0.5     8802064    2446612   \_hdbxsengine
bwladm      42431   41691   0.1     4352988   823220     \_hdbwebdispatcher
bwladm.     41607          1   0.0      497576     23232
/usr/sap/BWL/HDB00/exe/sapstartsrv
pf=/hana/shared/BWL/profile/BWL_HDB00_cishana01-bwl -D -u bwladm
bwladm@cishana01-bwl:/usr/sap/BWL/HDB00>
```

Tuning the SAP HANA performance parameters

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

Table 13. Tuning parameters

Parameters	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

Performing maintenance operations

SAP HANA operation and maintenance procedures 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: HAN, Status: Error
cishana01:~ #
```

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

```
cishana01:~ # /usr/sap/hostctrl/exe/saphostctrl -function ListInstances
 Inst Info : HAN - 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


19.02.2019 14:54:45
GetProcessList
OK
name, description, dispstatus, textstatus, starttime, elapsedtime, pid
hdbdaemon, HDB Daemon, GREEN, Running, 2019 02 15 11:57:45, 98:57:00, 8545
hdbnameserver, HDB Nameserver, GREEN, Running, 2019 02 15 12:05:27, 98:49:18, 11579
hdbpreprocessor, HDB Preprocessor, GREEN, Running, 2019 02 15 12:05:27, 98:49:18, 11580
hdbindexserver, HDB Indexserver, GREEN, Running, 2019 02 15 12:05:27, 98:49:18, 11581
hdbstatisticsserver, HDB Statisticsserver, GREEN, Running, 2019 02 15 12:05:27, 98:49:18,
11582
hdbxsengine, HDB XSEngine, GREEN, Running, 2019 02 15 12:05:27, 98:49:18, 11583
sapwebdisp_hdb, SAP WebDispatcher, GREEN, Running, 2019 02 15 12:05:27, 98:49:18, 11584
hdbcompileserver, HDB Compileserver, GREEN, Running, 2019 02 15 12:05:27, 98:49:18, 115
```

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


19.07.2019 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.

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 SAP HANA Master Guide for update procedures for SAP HANA.

For more information

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

For information about 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 in 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 in 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	<IP address>
<<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	<Gateway IP>
<<var_raid50_vd_name>> or <<var_raid5_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	
<<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	<Management IP>
<<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	<Management GW IP>
<<var_mgmt_netmask_prefix>>	Netmask prefix in CIDR notation	24

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