



Red Hat Enterprise Linux 9

Interactively installing RHEL from installation media

Installing RHEL on a local system using the graphical installer

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Abstract

You can install RHEL by using the graphical installer on one system at a time. Use this method to install RHEL on one or a few systems if you prefer the graphical interface. The installation source can be an installation media, an ISO file, or the Red Hat content delivery network (CDN).

Table of Contents

PROVIDING FEEDBACK ON RED HAT DOCUMENTATION	5
PART I. PREPARING THE RHEL INSTALLATION	6
CHAPTER 1. SYSTEM REQUIREMENTS AND SUPPORTED ARCHITECTURES	7
1.1. SUPPORTED INSTALLATION TARGETS	7
1.2. DISK AND MEMORY REQUIREMENTS	7
1.3. GRAPHICS DISPLAY RESOLUTION REQUIREMENTS	8
1.4. UEFI SECURE BOOT AND BETA RELEASE REQUIREMENTS	8
CHAPTER 2. THE VALUE OF REGISTERING YOUR RHEL SYSTEM TO RED HAT	10
CHAPTER 3. CUSTOMIZING THE INSTALLATION MEDIA	11
CHAPTER 4. CREATING A BOOTABLE INSTALLATION MEDIUM FOR RHEL	12
4.1. INSTALLATION BOOT MEDIA OPTIONS	12
4.2. CREATING A BOOTABLE DVD	12
4.3. CREATING A BOOTABLE USB DEVICE ON LINUX	12
4.4. CREATING A BOOTABLE USB DEVICE ON WINDOWS	14
4.5. CREATING A BOOTABLE USB DEVICE ON MACOS	14
CHAPTER 5. PREPARING A SYSTEM WITH UEFI SECURE BOOT ENABLED TO INSTALL AND BOOT RHEL BETA RELEASES	17
5.1. UEFI SECURE BOOT AND RHEL BETA RELEASES	17
5.2. ADDING A BETA PUBLIC KEY FOR UEFI SECURE BOOT	17
5.3. REMOVING A BETA PUBLIC KEY	18
PART II. MANUALLY INSTALLING RED HAT ENTERPRISE LINUX	19
CHAPTER 6. CREATING A KERNEL-BASED VIRTUAL MACHINE AND BOOTING THE INSTALLATION ISO IN THE VM	20
CHAPTER 7. BOOTING THE INSTALLATION MEDIA	21
CHAPTER 8. OPTIONAL: CUSTOMIZING BOOT OPTIONS	23
8.1. BOOT MENU	23
8.2. TYPES OF BOOT OPTIONS	24
8.3. EDITING THE BOOT: PROMPT IN BIOS	25
8.4. EDITING PREDEFINED BOOT OPTIONS USING THE > PROMPT	25
8.5. EDITING THE GRUB2 MENU FOR THE UEFI-BASED SYSTEMS	25
8.6. UPDATING DRIVERS DURING INSTALLATION	26
8.6.1. Overview	26
8.6.2. Types of driver update	26
8.6.3. Preparing a driver update	27
8.6.4. Performing an automatic driver update	28
8.6.5. Performing an assisted driver update	28
8.6.6. Performing a manual driver update	29
8.6.7. Disabling a driver	29
CHAPTER 9. CONSOLES AND LOGGING DURING INSTALLATION	31
CHAPTER 10. CUSTOMIZING THE SYSTEM IN THE INSTALLER	32
10.1. CONFIGURING THE STORAGE DEVICES	32
10.1.1. Configuring installation destination	32
10.1.2. Special cases during installation destination configuration	34

10.1.3. Configuring boot loader	35
10.1.4. Storage device selection	36
10.1.5. Filtering storage devices	36
10.1.6. Using advanced storage options	37
10.1.6.1. Discovering and starting an iSCSI session	37
10.1.6.2. Configuring FCoE parameters	39
10.1.6.3. Configuring DASD storage devices	40
10.1.6.4. Configuring FCP devices	40
10.1.7. Installing to an NVDIMM device	41
10.1.7.1. Criteria for using an NVDIMM device as an installation target	41
10.1.7.2. Configuring an NVDIMM device using the graphical installation mode	42
10.2. CONFIGURING THE ROOT USER AND CREATING LOCAL ACCOUNTS	43
10.2.1. Configuring a root password	43
10.2.2. Creating a user account	44
10.2.3. Editing advanced user settings	44
10.3. CONFIGURING MANUAL PARTITIONING	45
10.3.1. Recommended partitioning scheme	46
10.3.2. Supported hardware storage	48
10.3.3. Starting manual partitioning	49
10.3.4. Supported file systems	50
10.3.5. Adding a mount point file system	51
10.3.6. Configuring storage for a mount point file system	52
10.3.7. Customizing a mount point file system	52
10.3.8. Preserving the /home directory	54
10.3.9. Creating a software RAID during the installation	55
10.3.10. Creating an LVM logical volume	56
10.3.11. Configuring an LVM logical volume	57
10.3.12. Advice on partitions	59
10.4. SELECTING THE BASE ENVIRONMENT AND ADDITIONAL SOFTWARE	60
10.5. OPTIONAL: CONFIGURING THE NETWORK AND HOST NAME	63
10.5.1. Adding a virtual network interface	64
10.5.2. Editing network interface configuration	65
10.5.3. Enabling or Disabling the Interface Connection	65
10.5.4. Setting up Static IPv4 or IPv6 Settings	66
10.5.5. Configuring Routes	66
10.6. OPTIONAL: CONFIGURING LOCALIZATION OPTIONS	67
10.7. OPTIONAL: CONFIGURING LANGUAGE AND LOCATION SETTINGS	68
10.8. OPTIONAL: SUBSCRIBING THE SYSTEM AND ACTIVATING RED HAT INSIGHTS	69
10.9. OPTIONAL: USING NETWORK-BASED REPOSITORIES FOR THE INSTALLATION	70
10.10. OPTIONAL: CONFIGURING KDUMP KERNEL CRASH-DUMPING MECHANISM	72
10.11. OPTIONAL: SELECTING A SECURITY PROFILE	72
10.11.1. About security policy	73
10.11.2. Configuring a security profile	73
10.11.3. Profiles not compatible with Server with GUI	74
10.11.4. Deploying baseline-compliant RHEL systems using Kickstart	74
10.11.5. Additional resources	75
CHAPTER 11. COMPLETING INITIAL SETUP	76
PART III. POST-INSTALLATION TASKS	78
CHAPTER 12. REGISTERING RHEL BY USING SUBSCRIPTION MANAGER	79
12.1. REGISTERING RHEL 9 USING THE INSTALLER GUI	79
12.2. REGISTRATION ASSISTANT	79

12.3. REGISTERING YOUR SYSTEM USING THE COMMAND LINE	79
CHAPTER 13. CONFIGURING SYSTEM PURPOSE USING THE SUBSCRIPTION-MANAGER COMMAND-LINE TOOL	81
CHAPTER 14. SECURING YOUR SYSTEM	84
CHAPTER 15. CHANGING A SUBSCRIPTION SERVICE	85
15.1. UNREGISTERING FROM SUBSCRIPTION MANAGEMENT SERVER	85
15.1.1. Unregistering using command line	85
15.1.2. Unregistering using Subscription Manager user interface	85
15.2. UNREGISTERING FROM SATELLITE SERVER	86
PART IV. APPENDICES	87
APPENDIX A. TOOLS AND TIPS FOR TROUBLESHOOTING AND BUG REPORTING	88
A.1. DRACUT	88
A.2. USING INSTALLATION LOG FILES	88
A.2.1. Creating pre-installation log files	88
A.2.2. Transferring installation log files to a USB drive	89
A.2.3. Transferring installation log files over the network	90
A.3. DETECTING MEMORY FAULTS USING THE MEMTEST86 APPLICATION	91
A.3.1. Running Memtest86	91
A.4. VERIFYING BOOT MEDIA	92
A.5. CONSOLES AND LOGGING DURING INSTALLATION	92
A.6. SAVING SCREENSHOTS	93
A.7. DISPLAY SETTINGS AND DEVICE DRIVERS	93
APPENDIX B. TROUBLESHOOTING	95
B.1. RESUMING AN INTERRUPTED DOWNLOAD ATTEMPT	95
B.2. DISKS ARE NOT DETECTED	95
B.3. CANNOT BOOT WITH A RAID CARD	96
B.4. GRAPHICAL BOOT SEQUENCE IS NOT RESPONDING	96
B.5. X SERVER FAILS AFTER LOG IN	97
B.6. RAM IS NOT RECOGNIZED	97
B.7. SYSTEM IS DISPLAYING SIGNAL 11 ERRORS	98
B.8. UNABLE TO IPL FROM NETWORK STORAGE SPACE ON IBM POWER SYSTEMS	99
B.9. USING XDMCP	99
B.10. USING RESCUE MODE	100
B.10.1. Booting into rescue mode	101
B.10.2. Using an SOS report in rescue mode	102
B.10.3. Reinstalling the GRUB2 boot loader	103
B.10.4. Using dnf to add or remove a driver	104
B.10.4.1. Adding a driver using dnf	104
B.10.4.2. Removing a driver using dnf	105
B.11. IP= BOOT OPTION RETURNS AN ERROR	106
B.12. CANNOT BOOT INTO THE GRAPHICAL INSTALLATION ON ILO OR IDRAC DEVICES	106
B.13. ROOTFS IMAGE IS NOT INITRAMFS	107

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PART I. PREPARING THE RHEL INSTALLATION

Before installing Red Hat Enterprise Linux (RHEL), ensure that your system meets the necessary hardware and architecture requirements. Additionally, you may want to optimize your installation experience by customizing the installation media or creating a bootable medium tailored to your environment. Registration of your RHEL system to Red Hat provides access to updates and support, which can enhance the system's stability and security. Special attention may also be needed for systems using UEFI Secure Boot, particularly when installing or booting RHEL beta releases.

CHAPTER 1. SYSTEM REQUIREMENTS AND SUPPORTED ARCHITECTURES

Red Hat Enterprise Linux 9 delivers a stable, secure, consistent foundation across hybrid cloud deployments with the tools needed to deliver workloads faster with less effort. You can deploy RHEL as a guest on supported hypervisors and Cloud provider environments as well as on physical infrastructure, so your applications can take advantage of innovations in the leading hardware architecture platforms.

Review the guidelines provided for system, hardware, security, memory, and RAID before installing.

If you want to use your system as a virtualization host, review the [necessary hardware requirements for virtualization](#).

Red Hat Enterprise Linux supports the following architectures:

- AMD and Intel 64-bit architectures
- The 64-bit ARM architecture
- IBM Power Systems, Little Endian
- 64-bit IBM Z architectures

1.1. SUPPORTED INSTALLATION TARGETS

An installation target is a storage device that stores Red Hat Enterprise Linux and boots the system. Red Hat Enterprise Linux supports the following installation targets for AMD64, Intel 64, and 64-bit ARM systems:

- Storage connected by a standard internal interface, such as SCSI, SATA, or SAS
- BIOS/firmware RAID devices
- NVDIMM devices in sector mode on the Intel64 and AMD64 architectures, supported by the **nd_pmem** driver.
- Fibre Channel Host Bus Adapters and multipath devices. Some can require vendor-provided drivers.
- Xen block devices on Intel processors in Xen virtual machines.
- VirtIO block devices on Intel processors in KVM virtual machines.

Red Hat does not support installation to USB drives or SD memory cards. For information about support for third-party virtualization technologies, see the [Red Hat Hardware Compatibility List](#).

1.2. DISK AND MEMORY REQUIREMENTS

If several operating systems are installed, it is important that you verify that the allocated disk space is separate from the disk space required by Red Hat Enterprise Linux. In some cases, it is important to dedicate specific partitions to Red Hat Enterprise Linux, for example, for AMD64, Intel 64, and 64-bit ARM, at least two partitions (**/** and **swap**) must be dedicated to RHEL and for IBM Power Systems servers, at least three partitions (**/**, **swap**, and a **PReP** boot partition) must be dedicated to RHEL.

Additionally, you must have a minimum of 10 GiB of available disk space. To install Red Hat Enterprise Linux, you must have a minimum of 10 GiB of space in either unpartitioned disk space or in partitions that can be deleted.

For more information, see [Partitioning reference](#) for more information.

Table 1.1. Minimum RAM requirements

Installation type	Minimum RAM
Local media installation (USB, DVD)	<ul style="list-style-type: none"> 1.5 GiB for aarch64, s390x and x86_64 architectures 3 GiB for ppc64le architecture
NFS network installation	<ul style="list-style-type: none"> 1.5 GiB for aarch64, s390x and x86_64 architectures 3 GiB for ppc64le architecture
HTTP, HTTPS or FTP network installation	<ul style="list-style-type: none"> 3 GiB for s390x and x86_64 architectures 4 GiB for aarch64 and ppc64le architectures

It is possible to complete the installation with less memory than the minimum requirements. The exact requirements depend on your environment and installation path. Test various configurations to determine the minimum required RAM for your environment. Installing Red Hat Enterprise Linux using a Kickstart file has the same minimum RAM requirements as a standard installation. However, additional RAM may be required if your Kickstart file includes commands that require additional memory, or write data to the RAM disk. For more information, see the [Automatically installing RHEL](#) document.

1.3. GRAPHICS DISPLAY RESOLUTION REQUIREMENTS

Your system must have the following minimum resolution to ensure a smooth and error-free installation of Red Hat Enterprise Linux.

Table 1.2. Display resolution

Product version	Resolution
Red Hat Enterprise Linux 9	<p>Minimum: 800 x 600</p> <p>Recommended: 1026 x 768</p>

1.4. UEFI SECURE BOOT AND BETA RELEASE REQUIREMENTS

If you plan to install a Beta release of Red Hat Enterprise Linux, on systems having UEFI Secure Boot enabled, then first disable the UEFI Secure Boot option and then begin the installation.

UEFI Secure Boot requires that the operating system kernel is signed with a recognized private key, which the system's firmware verifies using the corresponding public key. For Red Hat Enterprise Linux Beta releases, the kernel is signed with a Red Hat Beta-specific public key, which the system fails to recognize by default. As a result, the system fails to even boot the installation media.

Additional resources

- For information about installing RHEL on IBM, see [IBM installation documentation](#)
- [Security hardening](#)
- [Composing a customized RHEL system image](#)
- [Red Hat ecosystem catalog](#)
- [RHEL technology capabilities and limits](#)

CHAPTER 2. THE VALUE OF REGISTERING YOUR RHEL SYSTEM TO RED HAT

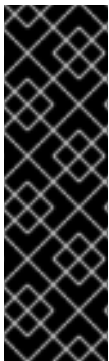
Registration establishes an authorized connection between your system and Red Hat. Red Hat issues the registered system, whether a physical or virtual machine, a certificate that identifies and authenticates the system so that it can receive protected content, software updates, security patches, support, and managed services from Red Hat.

With a valid subscription, you can register a Red Hat Enterprise Linux (RHEL) system in the following ways:

- During the installation process, using an installer graphical user interface (GUI) or text user interface (TUI)
- After installation, using the command line interface (CLI)
- Automatically, during or after installation, using a kickstart script or an activation key.

The specific steps to register your system depend on the version of RHEL that you are using and the registration method that you choose.

Registering your system to Red Hat enables features and capabilities that you can use to manage your system and report data. For example, a registered system is authorized to access protected content repositories for subscribed products through the Red Hat Content Delivery Network (CDN) or a Red Hat Satellite Server. These content repositories contain Red Hat software packages and updates that are available only to customers with an active subscription. These packages and updates include security patches, bug fixes, and new features for RHEL and other Red Hat products.



IMPORTANT

The entitlement-based subscription model is deprecated and will be retired in the future. Simple content access is now the default subscription model. It provides an improved subscription experience that eliminates the need to attach a subscription to a system before you can access Red Hat subscription content on that system. If your Red Hat account uses the entitlement-based subscription model, contact your Red hat account team, for example, a technical account manager (TAM) or solution architect (SA) to prepare for migration to simple content access. For more information, see [Transition of subscription services to the hybrid cloud](#).

CHAPTER 3. CUSTOMIZING THE INSTALLATION MEDIA

For details, see [Composing a customized RHEL system image](#).

CHAPTER 4. CREATING A BOOTABLE INSTALLATION MEDIUM FOR RHEL

You can download the ISO file from the [Customer Portal](#) to prepare the bootable physical installation medium, such as a USB or DVD. Starting with RHEL 8, Red Hat no longer provides separate variants for **Server** and **Workstation**. **Red Hat Enterprise Linux for x86_64** includes both **Server** and **Workstation** capabilities. The distinction between **Server** and **Workstation** is managed through the System Purpose Role during the installation or configuration process.

After downloading an ISO file from the Customer Portal, create a bootable physical installation medium, such as a USB or DVD to continue the installation process.

For secure environment cases where USB drives are prohibited, consider using the Image Builder to create and deploy reference images. This method ensures compliance with security policies while maintaining system integrity. For more details, refer to the [Image builder documentation](#).

4.1. INSTALLATION BOOT MEDIA OPTIONS

There are several options available to boot the Red Hat Enterprise Linux installation program.

Full installation DVD or USB flash drive

Create a full installation DVD or USB flash drive using the **DVD ISO** image. The DVD or USB flash drive can be used as a boot device and as an installation source for installing software packages.

Minimal installation DVD, CD, or USB flash drive

Create a minimal installation CD, DVD, or USB flash drive using the **Boot ISO** image, which contains only the minimum files necessary to boot the system and start the installation program. If you are not using the Content Delivery Network (CDN) to download the required software packages, the **Boot ISO** image requires an installation source that contains the required software packages.

4.2. CREATING A BOOTABLE DVD

You can create a bootable installation DVD by using a burning software and a DVD burner. The exact steps to produce a DVD from an ISO image file vary greatly, depending on the operating system and disc burning software installed. Consult your system's burning software documentation for the exact steps to burn a DVD from an ISO image file.



WARNING

You can create a bootable DVD using either the DVD ISO image (full install) or the Boot ISO image (minimal install). However, the DVD ISO image is larger than 4.7 GB, and as a result, it might not fit on a single or dual-layer DVD. Check the size of the DVD ISO image file before you proceed. Use a USB flash drive when using the DVD ISO image to create bootable installation media. For the environment cases where USB drives are prohibited, see [Image builder documentation](#).

4.3. CREATING A BOOTABLE USB DEVICE ON LINUX

You can create a bootable USB device which you can then use to install Red Hat Enterprise Linux on other machines. This procedure overwrites the existing data on the USB drive without any warning. Back up any data or use an empty flash drive. A bootable USB drive cannot be used for storing data.

Prerequisites

- You have downloaded the full installation DVD ISO or minimal installation Boot ISO image from the [Product Downloads](#) page.
- You have a USB flash drive with enough capacity for the ISO image. The required size varies, but the recommended USB size is 8 GB.

Procedure

1. Connect the USB flash drive to the system.
2. Open a terminal window and display a log of recent events.

```
$ dmesg|tail
```

Messages resulting from the attached USB flash drive are displayed at the bottom of the log. Record the name of the connected device.

3. Log in as a root user:

```
$ su -
```

Enter your root password when prompted.

4. Find the device node assigned to the drive. In this example, the drive name is **sdd**.

```
# dmesg|tail
[288954.686557] usb 2-1.8: New USB device strings: Mfr=0, Product=1, SerialNumber=2
[288954.686559] usb 2-1.8: Product: USB Storage
[288954.686562] usb 2-1.8: SerialNumber: 000000009225
[288954.712590] usb-storage 2-1.8:1.0: USB Mass Storage device detected
[288954.712687] scsi host6: usb-storage 2-1.8:1.0
[288954.712809] usbcore: registered new interface driver usb-storage
[288954.716682] usbcore: registered new interface driver uas
[288955.717140] scsi 6:0:0:0: Direct-Access    Generic STORAGE DEVICE  9228 PQ: 0
ANSI: 0
[288955.717745] sd 6:0:0:0: Attached scsi generic sg4 type 0
[288961.876382] sd 6:0:0:0: sdd Attached SCSI removable disk
```

5. If the inserted USB device mounts automatically, unmount it before continuing with the next steps. For unmounting, use the **umount** command. For more information, see [Unmounting a file system with umount](#).
6. Write the ISO image directly to the USB device:

```
# dd if=/image_directory/image.iso of=/dev/device
```

- Replace `/image_directory/image.iso` with the full path to the ISO image file that you downloaded,

- Replace *device* with the device name that you retrieved with the **dmesg** command. In this example, the full path to the ISO image is **/home/testuser/Downloads/rhel-9-x86_64-boot.iso**, and the device name is **sdd**:

```
# dd if=/home/testuser/Downloads/rhel-9-x86_64-boot.iso of=/dev/sdd
```

Partition names are usually device names with a numerical suffix. For example, **sdd** is a device name, and **sdd1** is the name of a partition on the device **sdd**.

7. Wait for the **dd** command to finish writing the image to the device. Run the **sync** command to synchronize cached writes to the device. The data transfer is complete when the **#** prompt appears. When you see the prompt, log out of the root account and unplug the USB drive. The USB drive is now ready to use as a boot device.

4.4. CREATING A BOOTABLE USB DEVICE ON WINDOWS

You can create a bootable USB device on a Windows system with various tools. You can use Fedora Media Writer, available for download at <https://github.com/FedoraQt/MediaWriter/releases>. Fedora Media Writer is a community product and is not supported by Red Hat. You can report any issues with the tool at <https://github.com/FedoraQt/MediaWriter/issues>.

Creating a bootable drive overwrites existing data on the USB drive without any warning. Back up any data or use an empty flash drive. A bootable USB drive cannot be used for storing data.

Prerequisites

- You have downloaded the full installation DVD ISO or minimal installation Boot ISO image from the [Product Downloads](#) page.
- You have a USB flash drive with enough capacity for the ISO image. The required size varies.

Procedure

1. Download and install Fedora Media Writer from <https://github.com/FedoraQt/MediaWriter/releases>.
2. Connect the USB flash drive to the system.
3. Open Fedora Media Writer.
4. From the main window, click **Custom Image** and select the previously downloaded Red Hat Enterprise Linux ISO image.
5. From the **Write Custom Image** window, select the drive that you want to use.
6. Click **Write to disk**. The boot media creation process starts. Do not unplug the drive until the operation completes. The operation may take several minutes, depending on the size of the ISO image, and the write speed of the USB drive.
7. When the operation completes, unmount the USB drive. The USB drive is now ready to be used as a boot device.

4.5. CREATING A BOOTABLE USB DEVICE ON MACOS

You can create a bootable USB device which you can then use to install Red Hat Enterprise Linux on

other machines. Creating a bootable USB drive overwrites any data previously stored on the USB drive without any warning. Back up any data or use an empty flash drive. A bootable USB drive cannot be used for storing data.

Prerequisites

- You have downloaded the full installation DVD ISO or minimal installation Boot ISO image from the [Product Downloads](#) page.
- You have a USB flash drive with enough capacity for the ISO image. The required size varies.

Procedure

1. Connect the USB flash drive to the system.
2. Identify the device path with the **diskutil list** command. The device path has the format of **/dev/disknumber**, where **number** is the number of the disk. The disks are numbered starting at zero (0). Typically, **disk0** is the OS X recovery disk, and **disk1** is the main OS X installation. In the following example, the USB device is **disk2**:

```
$ diskutil list
/dev/disk0
#:              TYPE NAME              SIZE      IDENTIFIER
0:      GUID_partition_scheme          *500.3 GB   disk0
1:              EFI EFI                209.7 MB   disk0s1
2:      Apple_CoreStorage              400.0 GB   disk0s2
3:      Apple_Boot Recovery HD         650.0 MB   disk0s3
4:      Apple_CoreStorage              98.8 GB   disk0s4
5:      Apple_Boot Recovery HD         650.0 MB   disk0s5
/dev/disk1
#:              TYPE NAME              SIZE      IDENTIFIER
0:      Apple_HFS YosemiteHD          *399.6 GB   disk1
Logical Volume on disk0s1
8A142795-8036-48DF-9FC5-84506DFBB7B2
Unlocked Encrypted
/dev/disk2
#:              TYPE NAME              SIZE      IDENTIFIER
0:      FDisk_partition_scheme          *8.1 GB    disk2
1:      Windows_NTFS SanDisk USB       8.1 GB     disk2s1
```

3. Identify your USB flash drive by comparing the NAME, TYPE and SIZE columns to your flash drive. For example, the NAME should be the title of the flash drive icon in the **Finder** tool. You can also compare these values to those in the information panel of the flash drive.
4. Unmount the flash drive's filesystem volumes:

```
$ diskutil unmountDisk /dev/disknumber
Unmount of all volumes on disknumber was successful
```

When the command completes, the icon for the flash drive disappears from your desktop. If the icon does not disappear, you may have selected the wrong disk. Attempting to unmount the system disk accidentally returns a **failed to unmount** error.

5. Write the ISO image to the flash drive:

```
# sudo dd if=/path/to/image.iso of=/dev/rdisknumber
```

macOS provides both a block (**/dev/disk***) and character device (**/dev/rdisk***) file for each storage device. Writing an image to the **/dev/rdisknumber** character device is faster than writing to the **/dev/disknumber** block device.

For example, to write the **/Users/user_name/Downloads/rhel-9-x86_64-boot.iso** file to the **/dev/rdisk2** device, enter the following command:

```
# sudo dd if=/Users/user_name/Downloads/rhel-9-x86_64-boot.iso of=/dev/rdisk2
```

6. Wait for the **dd** command to finish writing the image to the device. The data transfer is complete when the **#** prompt appears. When the prompt is displayed, log out of the root account and unplug the USB drive. The USB drive is now ready to be used as a boot device.

Additional resources

- [Configuring System Purpose](#)
- [ISO for RHEL 8/9 Server or Workstation](#)

CHAPTER 5. PREPARING A SYSTEM WITH UEFI SECURE BOOT ENABLED TO INSTALL AND BOOT RHEL BETA RELEASES

To enhance the security of your operating system, use the UEFI Secure Boot feature for signature verification when booting a Red Hat Enterprise Linux Beta release on systems having UEFI Secure Boot enabled.

5.1. UEFI SECURE BOOT AND RHEL BETA RELEASES

UEFI Secure Boot requires that the operating system kernel is signed with a recognized private key. UEFI Secure Boot then verifies the signature using the corresponding public key.

For Red Hat Enterprise Linux Beta releases, the kernel is signed with a Red Hat Beta-specific private key. UEFI Secure Boot attempts to verify the signature using the corresponding public key, but because the hardware does not recognize the Beta private key, Red Hat Enterprise Linux Beta release system fails to boot. Therefore, to use UEFI Secure Boot with a Beta release, add the Red Hat Beta public key to your system using the Machine Owner Key (MOK) facility.

5.2. ADDING A BETA PUBLIC KEY FOR UEFI SECURE BOOT

This section contains information about how to add a Red Hat Enterprise Linux Beta public key for UEFI Secure Boot.

Prerequisites

- The UEFI Secure Boot is disabled on the system.
- The Red Hat Enterprise Linux Beta release is installed, and Secure Boot is disabled even after system reboot.
- You are logged in to the system, and the tasks in the **Initial Setup** window are complete.

Procedure

1. Begin to enroll the Red Hat Beta public key in the system's Machine Owner Key (MOK) list:

```
# mokutil --import /usr/share/doc/kernel-keys/$(uname -r)/kernel-signing-ca.cer
```

\$(uname -r) is replaced by the kernel version - for example, **4.18.0-80.el8.x86_64**.

2. Enter a password when prompted.
3. Reboot the system and press any key to continue the startup. The Shim UEFI key management utility starts during the system startup.
4. Select **Enroll MOK**.
5. Select **Continue**.
6. Select **Yes** and enter the password. The key is imported into the system's firmware.
7. Select **Reboot**.

8. Enable Secure Boot on the system.

5.3. REMOVING A BETA PUBLIC KEY

If you plan to remove the Red Hat Enterprise Linux Beta release, and install a Red Hat Enterprise Linux General Availability (GA) release, or a different operating system, then remove the Beta public key.

The procedure describes how to remove a Beta public key.

Procedure

1. Begin to remove the Red Hat Beta public key from the system's Machine Owner Key (MOK) list:

```
# mokutil --reset
```

2. Enter a password when prompted.
3. Reboot the system and press any key to continue the startup. The Shim UEFI key management utility starts during the system startup.
4. Select **Reset MOK**.
5. Select **Continue**.
6. Select **Yes** and enter the password that you had specified in step 2. The key is removed from the system's firmware.
7. Select **Reboot**.

PART II. MANUALLY INSTALLING RED HAT ENTERPRISE LINUX

Setting up a machine for installing Red Hat Enterprise Linux (RHEL) involves several key steps, from booting the installation media to configuring system options. Once the installation ISO is booted in the VM, there are opportunities to modify boot settings and monitor installation processes through various consoles and logs. Customizing the system during installation ensures that it is tailored to specific needs, and the initial setup process finalizes the configuration for first-time use.

CHAPTER 6. CREATING A KERNEL-BASED VIRTUAL MACHINE AND BOOTING THE INSTALLATION ISO IN THE VM

This section describes how to create a kernel-based virtual machine (KVM) and starting the Red Hat Enterprise Linux installation.

Prerequisites

- On the IBM Z platform, the KVM host runs Red Hat Enterprise Linux installed in LPAR mode. See [Installing in an LPAR](#).

Procedure

- Create virtual machine with the instance of Red Hat Enterprise Linux as a KVM guest operating system, use the following **virt-install** command on the KVM host:

```
$ virt-install --name=<guest_name> --disk size=<disksize_in_GB> --memory=
<memory_size_in_MB> --cdrom <filepath_to_iso> --graphics vnc
```

Additional resources

- **virt-install** man page on your system
- [Creating virtual machines by using the command-line interface](#)

CHAPTER 7. BOOTING THE INSTALLATION MEDIA

You can boot the Red Hat Enterprise Linux installation using a USB, CD, or DVD. The following steps are generic. Consult your hardware manufacturer's documentation for specific instructions.

You can register RHEL using the Red Hat Content Delivery Network (CDN). CDN is a geographically distributed series of web servers. These servers provide, for example, packages and updates to RHEL hosts with a valid subscription.

During the installation, registering and installing RHEL from the CDN offers following benefits:

- Utilizing the latest packages for an up-to-date system immediately after installation and
- Integrated support for connecting to Red Hat Insights and enabling System Purpose.

Prerequisite

- You have created bootable installation media (USB, CD or DVD).

Procedure

1. Power off the system to which you are installing Red Hat Enterprise Linux.
2. Disconnect any drives from the system.
3. Power on the system.
4. Insert the bootable installation media (USB, DVD, or CD).
5. Power off the system but do not remove the boot media.
6. Power on the system.
7. You might need to press a specific key or combination of keys to boot from the media or configure the Basic Input/Output System (BIOS) of your system to boot from the media. For more information, see the documentation that came with your system.
8. The **Red Hat Enterprise Linux boot** window opens and displays information about a variety of available boot options.
9. Use the arrow keys on your keyboard to select the boot option that you require, and press **Enter** to select the boot option. The **Welcome to Red Hat Enterprise Linux** window opens and you can install Red Hat Enterprise Linux using the graphical user interface.
The installation program automatically begins if no action is performed in the boot window within 60 seconds.
10. Optional: Edit the available boot options:
 - a. **UEFI-based systems:** Press **E** to enter edit mode. Change the predefined command line to add or remove boot options. Press **Enter** to confirm your choice.
 - b. **BIOS-based systems:** Press the **Tab** key on your keyboard to enter edit mode. Change the predefined command line to add or remove boot options. Press **Enter** to confirm your choice.

Additional Resources

- [Customizing the system in the installer](#)
- [Boot options reference](#)

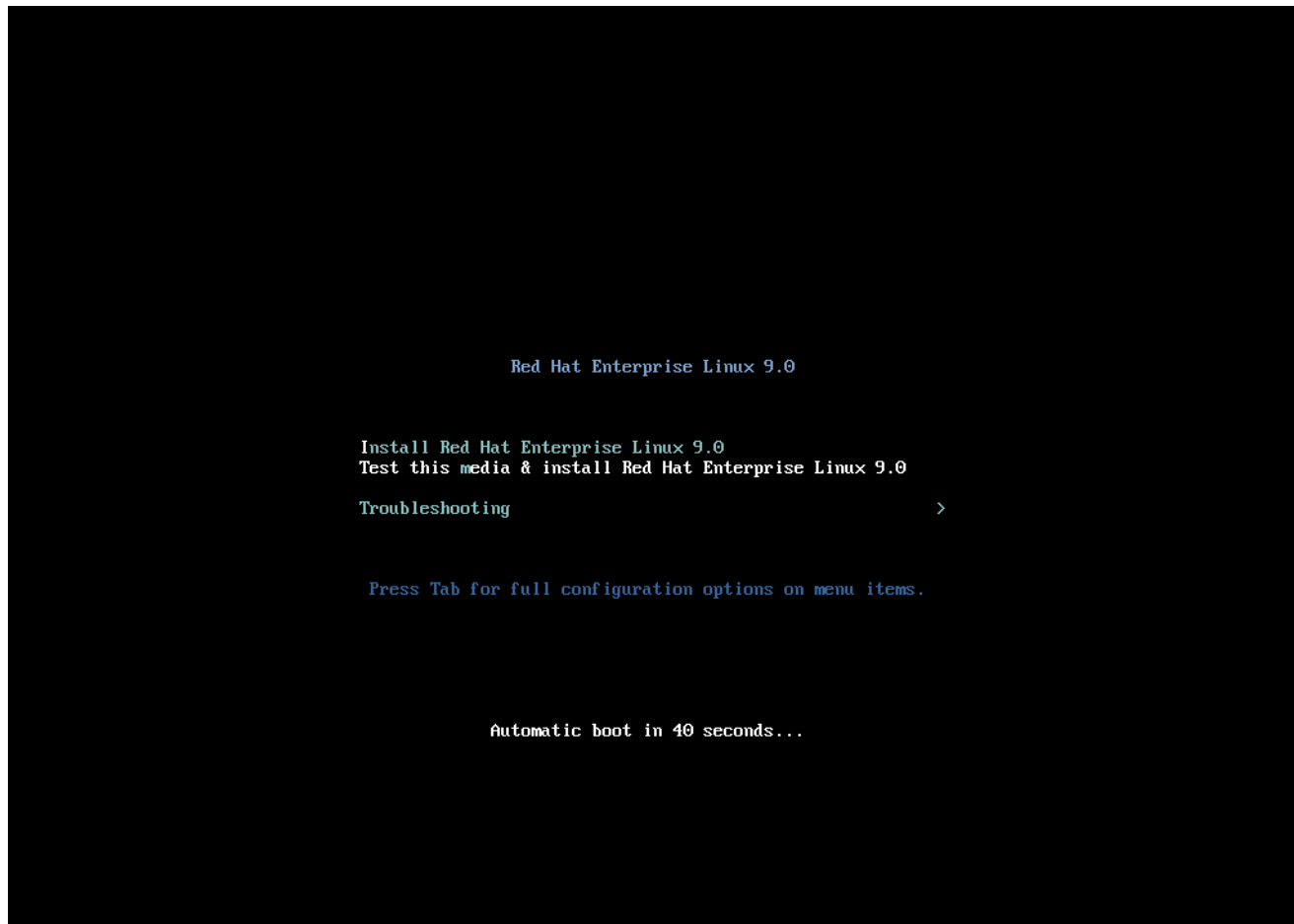
CHAPTER 8. OPTIONAL: CUSTOMIZING BOOT OPTIONS

Based on installation environment, you can edit the boot options to further customize them.

8.1. BOOT MENU

The Red Hat Enterprise Linux boot menu is displayed using **GRand Unified Bootloader version 2** (GRUB2) when your system has completed loading the boot media.

Figure 8.1. Red Hat Enterprise Linux boot menu



The boot menu provides several options in addition to launching the installation program. If you do not make a selection within 60 seconds, the default boot option (highlighted in white) is run. To select a different option, use the arrow keys on your keyboard to make your selection and press the **Enter** key.

You can customize boot options for a particular menu entry:

- **On BIOS-based systems:** Press the **Tab** key and add custom boot options to the command line. You can also access the **boot:** prompt by pressing the **Esc** key but no required boot options are preset. In this scenario, you must always specify the Linux option before using any other boot options.
- **On UEFI-based systems:** Press the **e** key and add custom boot options to the command line. When ready press **Ctrl+X** to boot the modified option.

Table 8.1. Boot menu options

Boot menu option	Description
Install Red Hat Enterprise Linux 9	Use this option to install Red Hat Enterprise Linux using the graphical installation program.
Test this media & install Red Hat Enterprise Linux 9	Use this option to check the integrity of the installation media.
Troubleshooting >	Use this option to resolve various installation issues. Press Enter to display its contents.

Table 8.2. Troubleshooting options

Troubleshooting option	Description
Troubleshooting > Install Red Hat Enterprise Linux 9 in basic graphics mode	Use this option to install Red Hat Enterprise Linux in graphical mode even if the installation program is unable to load the correct driver for your video card. If your screen is distorted when using the Install Red Hat Enterprise Linux 9 option, restart your system and use this option. For more information, see Cannot boot into graphical installation
Troubleshooting > Rescue a Red Hat Enterprise Linux system	Use this option to repair any issues that prevent you from booting. For more information, see Using a rescue mode .
Troubleshooting > Run a memory test	Use this option to run a memory test on your system. Press Enter to display its contents. For more information, see memtest86 .
Troubleshooting > Boot from local drive	Use this option to boot the system from the first installed disk. If you booted this disk accidentally, use this option to boot from the disk immediately without starting the installation program.

8.2. TYPES OF BOOT OPTIONS

The two types of boot options are those with an equals "=" sign, and those without an equals "=" sign. Boot options are appended to the boot command line and you can append multiple options separated by space. Boot options that are specific to the installation program always start with **inst**.

Options with an equals "=" sign

You must specify a value for boot options that use the = symbol. For example, the **inst.vncpassword=** option must contain a value, in this example, a password. The correct syntax for this example is **inst.vncpassword=password**.

Options without an equals "=" sign

This boot option does not accept any values or parameters. For example, the **rd.live.check** option forces the installation program to verify the installation media before starting the installation. If this

boot option is present, the installation program performs the verification and if the boot option is not present, the verification is skipped.

8.3. EDITING THE BOOT: PROMPT IN BIOS

When using the **boot:** prompt, the first option must always specify the installation program image file that you want to load. In most cases, you can specify the image using the keyword. You can specify additional options according to your requirements.

Prerequisites

- You have created bootable installation media (USB, CD or DVD).
- You have booted the installation from the media, and the installation boot menu is open.

Procedure

1. With the boot menu open, press the **Esc** key on your keyboard.
2. The **boot:** prompt is now accessible.
3. Press the **Tab** key on your keyboard to display the help commands.
4. Press the **Enter** key on your keyboard to start the installation with your options. To return from the **boot:** prompt to the boot menu, restart the system and boot from the installation media again.

The **boot:** prompt also accepts **dracut** kernel options. A list of options is available in the **dracut.cmdline(7)** man page.

8.4. EDITING PREDEFINED BOOT OPTIONS USING THE > PROMPT

In BIOS-based AMD64 and Intel 64 systems, you can use the > prompt to edit predefined boot options. To display a full set of options, select **Test this media and install RHEL 9** from the boot menu.

Prerequisites

- You have created bootable installation media (USB, CD or DVD).
- You have booted the installation from the media, and the installation boot menu is open.

Procedure

1. From the boot menu, select an option and press the **Tab** key on your keyboard. The > prompt is accessible and displays the available options.
2. Append the options that you require to the > prompt.
3. Press **Enter** to start the installation.
4. Press **Esc** to cancel editing and return to the boot menu.

8.5. EDITING THE GRUB2 MENU FOR THE UEFI-BASED SYSTEMS

The GRUB2 menu is available on UEFI-based AMD64, Intel 64, and 64-bit ARM systems.

Prerequisites

- You have created bootable installation media (USB, CD or DVD).
- You have booted the installation from the media, and the installation boot menu is open.

Procedure

1. From the boot menu window, select the required option and press **e**.
2. On UEFI systems, the kernel command line starts with **linuxefi**. Move the cursor to the end of the **linuxefi** kernel command line.
3. Edit the parameters as required. For example, to configure one or more network interfaces, add the **ip=** parameter at the end of the **linuxefi** kernel command line, followed by the required value.
4. When you finish editing, press **Ctrl+X** to start the installation using the specified options.

8.6. UPDATING DRIVERS DURING INSTALLATION

You can update drivers during the Red Hat Enterprise Linux installation process. Updating drivers is completely optional. Do not perform a driver update unless it is necessary. Ensure you have been notified by Red Hat, your hardware vendor, or a trusted third-party vendor that a driver update is required during Red Hat Enterprise Linux installation.

8.6.1. Overview

Red Hat Enterprise Linux supports drivers for many hardware devices but some newly-released drivers may not be supported. A driver update should only be performed if an unsupported driver prevents the installation from completing. Updating drivers during installation is typically only required to support a particular configuration. For example, installing drivers for a storage adapter card that provides access to your system's storage devices.



WARNING

Driver update disks may disable conflicting kernel drivers. In rare cases, unloading a kernel module may cause installation errors.

8.6.2. Types of driver update

Red Hat, your hardware vendor, or a trusted third party provides the driver update as an ISO image file. Once you receive the ISO image file, choose the type of driver update.

Types of driver update

Automatic

In this driver update method; a storage device (including a CD, DVD, or USB flash drive) labeled **OEMDRV** is physically connected to the system. If the **OEMDRV** storage device is present when the installation starts, it is treated as a driver update disk, and the installation program automatically

loads its drivers.

Assisted

The installation program prompts you to locate a driver update. You can use any local storage device with a label other than **OEMDRV**. The **inst.dd** boot option is specified when starting the installation. If you use this option without any parameters, the installation program displays all of the storage devices connected to the system, and prompts you to select a device that contains a driver update.

Manual

Manually specify a path to a driver update image or an RPM package. You can use any local storage device with a label other than **OEMDRV**, or a network location accessible from the installation system. The **inst.dd=location** boot option is specified when starting the installation, where *location* is the path to a driver update disk or ISO image. When you specify this option, the installation program attempts to load any driver updates found at the specified location. With manual driver updates, you can specify local storage devices, or a network location (HTTP, HTTPS or FTP server). You can use both **inst.dd=location** and **inst.dd** simultaneously, where *location* is the path to a driver update disk or ISO image. In this scenario, the installation program attempts to load any available driver updates from the location and also prompts you to select a device that contains the driver update.

Limitations

On UEFI systems with the Secure Boot technology enabled, all drivers must be signed with a valid certificate. Red Hat drivers are signed by one of Red Hat's private keys and authenticated by its corresponding public key in the kernel. If you load additional, separate drivers, verify that they are signed.

8.6.3. Preparing a driver update

This procedure describes how to prepare a driver update on a CD and DVD.

Prerequisites

- You have received the driver update ISO image from Red Hat, your hardware vendor, or a trusted third-party vendor.
- You have burned the driver update ISO image to a CD or DVD.



WARNING

If only a single ISO image file ending in **.iso** is available on the CD or DVD, the burn process has not been successful. See your system's burning software documentation for instructions on how to burn ISO images to a CD or DVD.

Procedure

1. Insert the driver update CD or DVD into your system's CD/DVD drive, and browse it using the system's file manager tool.
2. Verify that a single file **rhdd3** is available. **rhdd3** is a signature file that contains the driver description and a directory named **rpms**, which contains the RPM packages with the actual drivers for various architectures.

8.6.4. Performing an automatic driver update

This procedure describes how to perform an automatic driver update during installation.

Prerequisites

- You have placed the driver update image on a standard disk partition with an **OEMDRV** label or burnt the **OEMDRV** driver update image to a CD or DVD. Advanced storage, such as RAID or LVM volumes, may not be accessible during the driver update process.
- You have connected a block device with an **OEMDRV** volume label to your system, or inserted the prepared CD or DVD into your system's CD/DVD drive before starting the installation process.

Procedure

- When you complete the prerequisite steps, the drivers load automatically when the installation program starts and installs during the system's installation process.

8.6.5. Performing an assisted driver update

This procedure describes how to perform an assisted driver update during installation.

Prerequisites

- You have connected a block device without an **OEMDRV** volume label to your system and copied the driver disk image to this device, or you have prepared a driver update CD or DVD and inserted it into your system's CD or DVD drive before starting the installation process.



NOTE

If you burned an ISO image file to a CD or DVD but it does not have the **OEMDRV** volume label, you can use the **inst.dd** option with no arguments. The installation program provides an option to scan and select drivers from the CD or DVD. In this scenario, the installation program does not prompt you to select a driver update ISO image. Another scenario is to use the CD or DVD with the **inst.dd=location** boot option; this allows the installation program to automatically scan the CD or DVD for driver updates. For more information, see [Performing a manual driver update](#).

Procedure

1. From the boot menu window, press the **Tab** key on your keyboard to display the boot command line.
2. Append the **inst.dd** boot option to the command line and press **Enter** to execute the boot process.
3. From the menu, select a local disk partition or a CD or DVD device. The installation program scans for ISO files, or driver update RPM packages.
4. Optional: Select the driver update ISO file.
This step is not required if the selected device or partition contains driver update RPM packages rather than an ISO image file, for example, an optical drive containing a driver update CD or DVD.

5. Select the required drivers.
 - a. Use the number keys on your keyboard to toggle the driver selection.
 - b. Press **c** to install the selected driver. The selected driver is loaded and the installation process starts.

8.6.6. Performing a manual driver update

This procedure describes how to perform a manual driver update during installation.

Prerequisites

- You have placed the driver update ISO image file on a USB flash drive or a web server and connected it to your computer.

Procedure

1. From the boot menu window, press the **Tab** key on your keyboard to display the boot command line.
2. Append the **inst.dd=location** boot option to the command line, where location is a path to the driver update. Typically, the image file is located on a web server, for example, `http://server.example.com/dd.iso`, or on a USB flash drive, for example, `/dev/sdb1`. It is also possible to specify an RPM package containing the driver update, for example `http://server.example.com/dd.rpm`.
3. Press **Enter** to execute the boot process. The drivers available at the specified location are automatically loaded and the installation process starts.

Additional resources

- [The **inst.dd** boot option](#)

8.6.7. Disabling a driver

This procedure describes how to disable a malfunctioning driver.

Prerequisites

- You have booted the installation program boot menu.

Procedure

1. From the boot menu, press the **Tab** key on your keyboard to display the boot command line.
2. Append the **modprobe.blacklist=driver_name** boot option to the command line.
Replace *driver_name* with the name of the driver or drivers you want to disable, for example:

```
modprobe.blacklist=ahci
```

Drivers disabled using the **modprobe.blacklist=** boot option remain disabled on the installed system and appear in the `/etc/modprobe.d/anaconda-blacklist.conf` file.

3. Press **Enter** to execute the boot process.

CHAPTER 9. CONSOLES AND LOGGING DURING INSTALLATION

The Red Hat Enterprise Linux installer uses the **tmux** terminal multiplexer to display and control several windows in addition to the main interface. Each of these windows serve a different purpose; they display several different logs, which can be used to troubleshoot issues during the installation process. One of the windows provides an interactive shell prompt with **root** privileges, unless this prompt was specifically disabled using a boot option or a Kickstart command.

The terminal multiplexer is running in virtual console 1. To switch from the actual installation environment to **tmux**, press **Ctrl+Alt+F1**. To go back to the main installation interface which runs in virtual console 6, press **Ctrl+Alt+F6**. During the text mode installation, start in virtual console 1 (**tmux**), and switching to console 6 will open a shell prompt instead of a graphical interface.

The console running **tmux** has five available windows; their contents are described in the following table, along with keyboard shortcuts. Note that the keyboard shortcuts are two-part: first press **Ctrl+b**, then release both keys, and press the number key for the window you want to use.

You can also use **Ctrl+b n**, **Alt+ Tab**, and **Ctrl+b p** to switch to the next or previous **tmux** window, respectively.

Table 9.1. Available tmux windows

Shortcut	Contents
Ctrl+b 1	Main installation program window. Contains text-based prompts (during text mode installation or if you use VNC direct mode), and also some debugging information.
Ctrl+b 2	Interactive shell prompt with root privileges.
Ctrl+b 3	Installation log; displays messages stored in /tmp/anaconda.log .
Ctrl+b 4	Storage log; displays messages related to storage devices and configuration, stored in /tmp/storage.log .
Ctrl+b 5	Program log; displays messages from utilities executed during the installation process, stored in /tmp/program.log .

CHAPTER 10. CUSTOMIZING THE SYSTEM IN THE INSTALLER

During the customization phase of the installation, you must perform certain configuration tasks to enable the installation of Red Hat Enterprise Linux. These tasks include:

- Configuring the storage and assign mount points.
- Selecting a base environment with software to be installed.
- Setting a password for the root user or create a local user.

Optionally, you can further customize the system, for example, by configuring system settings and connecting the host to a network.

10.1. CONFIGURING THE STORAGE DEVICES

You can install Red Hat Enterprise Linux on a large variety of storage devices. You can configure basic, locally accessible, storage devices in the **Installation Destination** window. Basic storage devices directly connected to the local system, such as disks and solid-state drives, are displayed in the **Local Standard Disks** section of the window. On 64-bit IBM Z, this section contains activated Direct Access Storage Devices (DASDs).



WARNING

A known issue prevents DASDs configured as HyperPAV aliases from being automatically attached to the system after the installation is complete. These storage devices are available during the installation, but are not immediately accessible after you finish installing and reboot. To attach HyperPAV alias devices, add them manually to the `/etc/dasd.conf` configuration file of the system.

10.1.1. Configuring installation destination

You can use the **Installation Destination** window to configure the storage options, for example, the disks that you want to use as the installation target for your Red Hat Enterprise Linux installation. You must select at least one disk.

Prerequisites

- The **Installation Summary** window is open.
- Ensure to back up your data if you plan to use a disk that already contains data. For example, if you want to shrink an existing Microsoft Windows partition and install Red Hat Enterprise Linux as a second system, or if you are upgrading a previous release of Red Hat Enterprise Linux. Manipulating partitions always carries a risk. For example, if the process is interrupted or fails for any reason data on the disk can be lost.

Procedure

1. From the **Installation Summary** window, click **Installation Destination**. Perform the following operations in the **Installation Destination** window opens:

- a. From the **Local Standard Disks** section, select the storage device that you require; a white check mark indicates your selection. Disks without a white check mark are not used during the installation process; they are ignored if you choose automatic partitioning, and they are not available in manual partitioning.
The **Local Standard Disks** shows all locally available storage devices, for example, SATA, IDE and SCSI disks, USB flash and external disks. Any storage devices connected after the installation program has started are not detected. If you use a removable drive to install Red Hat Enterprise Linux, your system is unusable if you remove the device.
- b. Optional: Click the **Refresh** link in the lower right-hand side of the window if you want to configure additional local storage devices to connect new disks. The **Rescan Disks** dialog box opens.
 - i. Click **Rescan Disks** and wait until the scanning process completes.
All storage changes that you make during the installation are lost when you click **Rescan Disks**.
 - ii. Click **OK** to return to the **Installation Destination** window. All detected disks including any new ones are displayed under the **Local Standard Disks** section.
2. Optional: Click **Add a disk...** to add a specialized storage device.
The **Storage Device Selection** window opens and lists all storage devices that the installation program has access to.
3. Optional: Under **Storage Configuration**, select the **Automatic** radio button for automatic partitioning.
You can also configure custom partitioning. For more details, see [Configuring manual partitioning](#).
4. Optional: Select **I would like to make additional space available** to reclaim space from an existing partitioning layout. For example, if a disk you want to use already has a different operating system and you want to make this system's partitions smaller to allow more room for Red Hat Enterprise Linux.
5. Optional: Select **Encrypt my data** to encrypt all partitions except the ones needed to boot the system (such as **/boot**) using *Linux Unified Key Setup* (LUKS). Encrypting your disk to add an extra layer of security.
 - a. Click **Done**. The **Disk Encryption Passphrase** dialog box opens.
 - i. Type your passphrase in the **Passphrase** and **Confirm** fields.
 - ii. Click **Save Passphrase** to complete disk encryption.



WARNING

If you lose the LUKS passphrase, any encrypted partitions and their data is completely inaccessible. There is no way to recover a lost passphrase. However, if you perform a Kickstart installation, you can save encryption passphrases and create backup encryption passphrases during the installation. For more information, see the [Automatically installing RHEL](#) document.

6. Optional: Click the **Full disk summary and bootloader** link in the lower left-hand side of the window to select which storage device contains the boot loader. For more information, see [Configuring boot loader](#).
In most cases it is sufficient to leave the boot loader in the default location. Some configurations, for example, systems that require chain loading from another boot loader require the boot drive to be specified manually.
7. Click **Done**.
8. Optional: The **Reclaim Disk Space** dialog box appears if you selected **automatic partitioning** and the **I would like to make additional space available** option, or if there is not enough free space on the selected disks to install Red Hat Enterprise Linux. It lists all configured disk devices and all partitions on those devices. The dialog box displays information about the minimal disk space the system needs for an installation with the currently selected package set and how much space you have reclaimed. To start the reclaiming process:
 - a. Review the displayed list of available storage devices. The **Reclaimable Space** column shows how much space can be reclaimed from each entry.
 - b. Select a disk or partition to reclaim space.
 - c. Use the **Shrink** button to use free space on a partition while preserving the existing data.
 - d. Use the **Delete** button to delete that partition or all partitions on a selected disk including existing data.
 - e. Use the **Delete all** button to delete all existing partitions on all disks including existing data and make this space available to install Red Hat Enterprise Linux.
 - f. Click **Reclaim space** to apply the changes and return to graphical installations.
No disk changes are made until you click **Begin Installation** on the **Installation Summary** window. The **Reclaim Space** dialog only marks partitions for resizing or deletion; no action is performed.

Additional resources

- [How to use dm-crypt on IBM Z, LinuxONE and with the PAES cipher](#)

10.1.2. Special cases during installation destination configuration

Following are some special cases to consider when you are configuring installation destinations:

- Some BIOS types do not support booting from a RAID card. In these instances, the **/boot** partition must be created on a partition outside of the RAID array, such as on a separate disk. It is necessary to use an internal disk for partition creation with problematic RAID cards. A **/boot** partition is also necessary for software RAID setups. If you choose to partition your system automatically, you should manually edit your **/boot** partition.
- To configure the Red Hat Enterprise Linux boot loader to *chain load* from a different boot loader, you must specify the boot drive manually by clicking the **Full disk summary and bootloader** link from the **Installation Destination** window.
- When you install Red Hat Enterprise Linux on a system with both multipath and non-multipath storage devices, the automatic partitioning layout in the installation program creates volume groups that contain a mix of multipath and non-multipath devices. This defeats the purpose of

multipath storage. Select either multipath or non-multipath devices on the **Installation Destination** window. Alternatively, proceed to manual partitioning.

10.1.3. Configuring boot loader

Red Hat Enterprise Linux uses GRand Unified Bootloader version 2 (**GRUB2**) as the boot loader for AMD64 and Intel 64, IBM Power Systems, and ARM. For 64-bit IBM Z, the **zipl** boot loader is used.

The boot loader is the first program that runs when the system starts and is responsible for loading and transferring control to an operating system. **GRUB2** can boot any compatible operating system (including Microsoft Windows) and can also use chain loading to transfer control to other boot loaders for unsupported operating systems.



WARNING

Installing **GRUB2** may overwrite your existing boot loader.

If an operating system is already installed, the Red Hat Enterprise Linux installation program attempts to automatically detect and configure the boot loader to start the other operating system. If the boot loader is not detected, you can manually configure any additional operating systems after you finish the installation.

If you are installing a Red Hat Enterprise Linux system with more than one disk, you might want to manually specify the disk where you want to install the boot loader.

Procedure

1. From the **Installation Destination** window, click the **Full disk summary and bootloader** link. The **Selected Disks** dialog box opens.
The boot loader is installed on the device of your choice, or on a UEFI system; the **EFI system partition** is created on the target device during guided partitioning.
2. To change the boot device, select a device from the list and click **Set as Boot Device**. You can set only one device as the boot device.
3. To disable a new boot loader installation, select the device currently marked for boot and click **Do not install boot loader**. This ensures **GRUB2** is not installed on any device.



WARNING

If you choose not to install a boot loader, you cannot boot the system directly and you must use another boot method, such as a standalone commercial boot loader application. Use this option only if you have another way to boot your system.

The boot loader may also require a special partition to be created, depending on if your system uses

BIOS or UEFI firmware, or if the boot drive has a *GUID Partition Table* (GPT) or a **Master Boot Record** (MBR, also known as **msdos**) label. If you use automatic partitioning, the installation program creates the partition.

10.1.4. Storage device selection

The storage device selection window lists all storage devices that the installation program can access. Depending on your system and available hardware, some tabs might not be displayed. The devices are grouped under the following tabs:

Multipath Devices

Storage devices accessible through more than one path, such as through multiple SCSI controllers or Fiber Channel ports on the same system. The installation program only detects multipath storage devices with serial numbers that are 16 or 32 characters long.

Other SAN Devices

Devices available on a Storage Area Network (SAN).

Firmware RAID

Storage devices attached to a firmware RAID controller.

NVDIMM Devices

Under specific circumstances, Red Hat Enterprise Linux 9 can boot and run from (NVDIMM) devices in sector mode on the Intel 64 and AMD64 architectures.

System z Devices

Storage devices, or Logical Units (LUNs), attached through the zSeries Linux FCP (Fiber Channel Protocol) driver.

10.1.5. Filtering storage devices

In the storage device selection window you can filter storage devices either by their World Wide Identifier (WWID) or by the port, target, or logical unit number (LUN).

Prerequisite

- The **Installation Summary** window is open.

Procedure

1. From the **Installation Summary** window, click **Installation Destination**. The **Installation Destination** window opens, listing all available drives.
2. Under the **Specialized & Network Disks** section, click **Add a disk...** The storage devices selection window opens.
3. Click the **Search by** tab to search by port, target, LUN, or WWID. Searching by WWID or LUN requires additional values in the corresponding input text fields.
4. Select the option that you require from the **Search** drop-down menu.
5. Click **Find** to start the search. Each device is presented on a separate row with a corresponding check box.
6. Select the check box to enable the device that you require during the installation process. Later in the installation process you can choose to install Red Hat Enterprise Linux on any of the

selected devices, and you can choose to mount any of the other selected devices as part of the installed system automatically. Selected devices are not automatically erased by the installation process and selecting a device does not put the data stored on the device at risk.



NOTE

You can add devices to the system after installation by modifying the `/etc/fstab` file.

7. Click **Done** to return to the **Installation Destination** window.

Any storage devices that you do not select are hidden from the installation program entirely. To chain load the boot loader from a different boot loader, select all the devices present.

10.1.6. Using advanced storage options

To use an advanced storage device, you can configure an iSCSI (SCSI over TCP/IP) target or FCoE (Fibre Channel over Ethernet) SAN (Storage Area Network).

To use iSCSI storage devices for the installation, the installation program must be able to discover them as iSCSI targets and be able to create an iSCSI session to access them. Each of these steps might require a user name and password for Challenge Handshake Authentication Protocol (CHAP) authentication. Additionally, you can configure an iSCSI target to authenticate the iSCSI initiator on the system to which the target is attached (reverse CHAP), both for discovery and for the session. Used together, CHAP and reverse CHAP are called mutual CHAP or two-way CHAP. Mutual CHAP provides the greatest level of security for iSCSI connections, particularly if the user name and password are different for CHAP authentication and reverse CHAP authentication.

Repeat the iSCSI discovery and iSCSI login steps to add all required iSCSI storage. You cannot change the name of the iSCSI initiator after you attempt discovery for the first time. To change the iSCSI initiator name, you must restart the installation.

10.1.6.1. Discovering and starting an iSCSI session

The Red Hat Enterprise Linux installer can discover and log in to iSCSI disks in two ways:

iSCSI Boot Firmware Table (iBFT)

When the installer starts, it checks if the BIOS or add-on boot ROMs of the system support iBFT. It is a BIOS extension for systems that can boot from iSCSI. If the BIOS supports iBFT, the installer reads the iSCSI target information for the configured boot disk from the BIOS and logs in to this target, making it available as an installation target. To automatically connect to an iSCSI target, activate a network device for accessing the target. To do so, use **ip=ibft** boot option. For more information, see [Network boot options](#).

Discover and add iSCSI targets manually

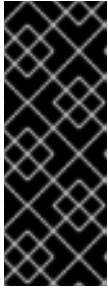
You can discover and start an iSCSI session to identify available iSCSI targets (network storage devices) in the installer's graphical user interface.

Prerequisites

- The **Installation Summary** window is open.

Procedure

1. From the **Installation Summary** window, click **Installation Destination**. The **Installation Destination** window opens, listing all available drives.
2. Under the **Specialized & Network Disks** section, click **Add a disk....** The storage devices selection window opens.
3. Click **Add iSCSI target...** The **Add iSCSI Storage Target** window opens.



IMPORTANT

You cannot place the **/boot** partition on iSCSI targets that you have manually added using this method - an iSCSI target containing a **/boot** partition must be configured for use with iBFT. However, in instances where the installed system is expected to boot from iSCSI with iBFT configuration provided by a method other than firmware iBFT, for example using iPXE, you can remove the **/boot** partition restriction using the **inst.nonibftiscsiboot** installer boot option.

4. Enter the IP address of the iSCSI target in the **Target IP Address** field.
5. Type a name in the **iSCSI Initiator Name** field for the iSCSI initiator in iSCSI qualified name (IQN) format. A valid IQN entry contains the following information:
 - The string **iqn.** (note the period).
 - A date code that specifies the year and month in which your organization's Internet domain or subdomain name was registered, represented as four digits for the year, a dash, and two digits for the month, followed by a period. For example, represent September 2010 as **2010-09**.
 - Your organization's Internet domain or subdomain name, presented in reverse order with the top-level domain first. For example, represent the subdomain **storage.example.com** as **com.example.storage**.
 - A colon followed by a string that uniquely identifies this particular iSCSI initiator within your domain or subdomain. For example, **:diskarrays-sn-a8675309**.

A complete IQN is as follows: **iqn.2010-09.storage.example.com:diskarrays-sn-a8675309**. The installation program prepopulates the **iSCSI Initiator Name** field with a name in this format to help you with the structure. For more information about IQNs, see 3.2.6. *iSCSI Names in RFC 3720 - Internet Small Computer Systems Interface (iSCSI)* available from tools.ietf.org and 1. *iSCSI Names and Addresses in RFC 3721 - Internet Small Computer Systems Interface (iSCSI) Naming and Discovery* available from tools.ietf.org.
6. Select the **Discovery Authentication Type** drop-down menu to specify the type of authentication to use for iSCSI discovery. The following options are available:
 - No credentials
 - CHAP pair
 - CHAP pair and a reverse pair
7. Do one of the following:
 - a. If you selected **CHAP pair** as the authentication type, enter the user name and password for the iSCSI target in the **CHAP Username** and **CHAP Password** fields.
 - b. If you selected **CHAP pair and a reverse pair** as the authentication type, enter the user

name and password for the iSCSI target in the **CHAP Username** and **CHAP Password** field, and the user name and password for the iSCSI initiator in the **Reverse CHAP Username** and **Reverse CHAP Password** fields.

8. Optional: Select the **Bind targets to network interfaces** check box.
9. Click **Start Discovery**.
The installation program attempts to discover an iSCSI target based on the information provided. If discovery succeeds, the **Add iSCSI Storage Target** window displays a list of all iSCSI nodes discovered on the target.
10. Select the check boxes for the node that you want to use for installation.
The **Node login authentication type** menu contains the same options as the **Discovery Authentication Type** menu. However, if you need credentials for discovery authentication, use the same credentials to log in to a discovered node.
11. Click the additional **Use the credentials from discovery** drop-down menu. When you provide the proper credentials, the **Log In** button becomes available.
12. Click **Log In** to initiate an iSCSI session.

While the installer uses **iscsiadm** to find and log into iSCSI targets, **iscsiadm** automatically stores any information about these targets in the **iscsiadm** iSCSI database. The installer then copies this database to the installed system and marks any iSCSI targets that are not used for root partition, so that the system automatically logs in to them when it starts. If the root partition is placed on an iSCSI target, **initrd** logs into this target and the installer does not include this target in start up scripts to avoid multiple attempts to log into the same target.

10.1.6.2. Configuring FCoE parameters

You can discover the FCoE (Fibre Channel over Ethernet) devices from the **Installation Destination** window by configuring the FCoE parameters accordingly.

Prerequisite

- The **Installation Summary** window is open.

Procedure

1. From the **Installation Summary** window, click **Installation Destination**. The **Installation Destination** window opens, listing all available drives.
2. Under the **Specialized & Network Disks** section, click **Add a disk...** The storage devices selection window opens.
3. Click **Add FCoE SAN...** A dialog box opens for you to configure network interfaces for discovering FCoE storage devices.
4. Select a network interface that is connected to an FCoE switch in the **NIC** drop-down menu.
5. Click **Add FCoE disk(s)** to scan the network for SAN devices.
6. Select the required check boxes:
 - **Use DCB:** *Data Center Bridging* (DCB) is a set of enhancements to the Ethernet protocols designed to increase the efficiency of Ethernet connections in storage networks and

clusters. Select the check box to enable or disable the installation program's awareness of DCB. Enable this option only for network interfaces that require a host-based DCBX client. For configurations on interfaces that use a hardware DCBX client, disable the check box.

- **Use auto vlan:** *Auto VLAN* is enabled by default and indicates whether VLAN discovery should be performed. If this check box is enabled, then the FIP (FCoE Initiation Protocol) VLAN discovery protocol runs on the Ethernet interface when the link configuration has been validated. If they are not already configured, network interfaces for any discovered FCoE VLANs are automatically created and FCoE instances are created on the VLAN interfaces.
7. Discovered FCoE devices are displayed under the **Other SAN Devices** tab in the **Installation Destination** window.

10.1.6.3. Configuring DASD storage devices

You can discover and configure the DASD storage devices from the **Installation Destination** window.

Prerequisite

- The **Installation Summary** window is open.

Procedure

1. From the **Installation Summary** window, click **Installation Destination**. The **Installation Destination** window opens, listing all available drives.
2. Under the **Specialized & Network Disks** section, click **Add a disk....** The storage devices selection window opens.
3. Click **Add DASD**. The **Add DASD Storage Target** dialog box opens and prompts you to specify a device number, such as **0.0.0204**, and attach additional DASDs that were not detected when the installation started.
4. Type the device number of the DASD that you want to attach in the **Device number** field.
5. Click **Start Discovery**.
If a DASD with the specified device number is found and if it is not already attached, the dialog box closes and the newly-discovered drives appear in the list of drives. You can then select the check boxes for the required devices and click **Done**. The new DASDs are available for selection, marked as **DASD device 0.0.xxxx** in the **Local Standard Disks** section of the **Installation Destination** window.

If you entered an invalid device number, or if the DASD with the specified device number is already attached to the system, an error message appears in the dialog box, explaining the error and prompting you to try again with a different device number.

10.1.6.4. Configuring FCP devices

FCP devices enable 64-bit IBM Z to use SCSI devices rather than, or in addition to, Direct Access Storage Device (DASD) devices. FCP devices provide a switched fabric topology that enables 64-bit IBM Z systems to use SCSI LUNs as disk devices in addition to traditional DASD devices.

Prerequisites

- The **Installation Summary** window is open.
- For an FCP-only installation, you have removed the **DASD=** option from the CMS configuration file or the **rd.dasd=** option from the parameter file to indicate that no DASD is present.

Procedure

1. From the **Installation Summary** window, click **Installation Destination**. The **Installation Destination** window opens, listing all available drives.
2. Under the **Specialized & Network Disks** section, click **Add a disk...**. The storage devices selection window opens.
3. Click **Add ZFCP LUN**. The **Add zFCP Storage Target** dialog box opens allowing you to add a FCP (Fibre Channel Protocol) storage device.
64-bit IBM Z requires that you enter any FCP device manually so that the installation program can activate FCP LUNs. You can enter FCP devices either in the graphical installation, or as a unique parameter entry in the parameter or CMS configuration file. The values that you enter must be unique to each site that you configure.
4. Type the 4 digit hexadecimal device number in the **Device number** field.
5. When installing RHEL-9.0 or older releases or if the **zFCP** device is not configured in NPIV mode, or when **auto LUN** scanning is disabled by the **zfcplib.allow_lun_scan=0** kernel module parameter, provide the following values:
 - a. Type the 16 digit hexadecimal World Wide Port Number (WWPN) in the **WWPN** field.
 - b. Type the 16 digit hexadecimal FCP LUN identifier in the **LUN** field.
6. Click **Start Discovery** to connect to the FCP device.

The newly-added devices are displayed in the **System z Devices** tab of the **Installation Destination** window.

Use only lower-case letters in hex values. If you enter an incorrect value and click **Start Discovery**, the installation program displays a warning. You can edit the configuration information and retry the discovery attempt. For more information about these values, consult the hardware documentation and check with your system administrator.

10.1.7. Installing to an NVDIMM device

Non-Volatile Dual In-line Memory Module (NVDIMM) devices combine the performance of RAM with disk-like data persistence when no power is supplied. Under specific circumstances, Red Hat Enterprise Linux 9 can boot and run from NVDIMM devices.

10.1.7.1. Criteria for using an NVDIMM device as an installation target

You can install Red Hat Enterprise Linux 9 to Non-Volatile Dual In-line Memory Module (NVDIMM) devices in sector mode on the Intel 64 and AMD64 architectures, supported by the **nd_pmem** driver.

Conditions for using an NVDIMM device as storage

To use an NVDIMM device as storage, the following conditions must be satisfied:

- The architecture of the system is Intel 64 or AMD64.

- The NVDIMM device is configured to sector mode. The installation program can reconfigure NVDIMM devices to this mode.
- The NVDIMM device must be supported by the **nd_pmem** driver.

Conditions for booting from an NVDIMM Device

Booting from an NVDIMM device is possible under the following conditions:

- All conditions for using the NVDIMM device as storage are satisfied.
- The system uses UEFI.
- The NVDIMM device must be supported by firmware available on the system, or by an UEFI driver. The UEFI driver may be loaded from an option ROM of the device itself.
- The NVDIMM device must be made available under a namespace.

Utilize the high performance of NVDIMM devices during booting, place the **/boot** and **/boot/efi** directories on the device. The Execute-in-place (XIP) feature of NVDIMM devices is not supported during booting and the kernel is loaded into conventional memory.

10.1.7.2. Configuring an NVDIMM device using the graphical installation mode

A Non-Volatile Dual In-line Memory Module (NVDIMM) device must be properly configured for use by Red Hat Enterprise Linux 9 using the graphical installation.



WARNING

Reconfiguration of a NVDIMM device process destroys any data stored on the device.

Prerequisites

- A NVDIMM device is present on the system and satisfies all the other conditions for usage as an installation target.
- The installation has booted and the **Installation Summary** window is open.

Procedure

1. From the **Installation Summary** window, click **Installation Destination**. The **Installation Destination** window opens, listing all available drives.
2. Under the **Specialized & Network Disks** section, click **Add a disk....** The storage devices selection window opens.
3. Click the **NVDIMM Devices** tab.
4. To reconfigure a device, select it from the list.
If a device is not listed, it is not in sector mode.

5. Click **Reconfigure NVDIMM...**. A reconfiguration dialog opens.
6. Enter the sector size that you require and click **Start Reconfiguration**.
The supported sector sizes are 512 and 4096 bytes.
7. When reconfiguration completes click **OK**.
8. Select the device check box.
9. Click **Done** to return to the **Installation Destination** window.
The NVDIMM device that you reconfigured is displayed in the **Specialized & Network Disks** section.
10. Click **Done** to return to the **Installation Summary** window.

The NVDIMM device is now available for you to select as an installation target. Additionally, if the device meets the requirements for booting, you can set the device as a boot device.

10.2. CONFIGURING THE ROOT USER AND CREATING LOCAL ACCOUNTS

10.2.1. Configuring a root password

You must configure a **root** password to finish the installation process and to log in to the administrator (also known as superuser or root) account that is used for system administration tasks. These tasks include installing and updating software packages and changing system-wide configuration such as network and firewall settings, storage options, and adding or modifying users, groups and file permissions.

To gain root privileges to the installed systems, you can either use a root account or create a user account with administrative privileges (member of the wheel group). The **root** account is always created during the installation. Switch to the administrator account only when you need to perform a task that requires administrator access.



WARNING

The **root** account has complete control over the system. If unauthorized personnel gain access to the account, they can access or delete users' personal files.

Procedure

1. From the **Installation Summary** window, select **User Settings > Root Password**. The **Root Password** window opens.
2. Type your password in the **Root Password** field.
The requirements for creating a strong root password are:
 - *Must* be at least eight characters long
 - May contain numbers, letters (upper and lower case) and symbols

- Is case-sensitive
3. Type the same password in the **Confirm** field.
 4. Optional: Select the **Lock root account** option to disable the root access to the system.
 5. Optional: Select the **Allow root SSH login with password** option to enable SSH access (with password) to this system as a root user. By default the password-based SSH root access is disabled.
 6. Click **Done** to confirm your root password and return to the **Installation Summary** window. If you proceeded with a weak password, you must click **Done** twice.

10.2.2. Creating a user account

Create a user account to finish the installation. If you do not create a user account, you must log in to the system as **root** directly, which is **not** recommended.

Procedure

1. On the **Installation Summary** window, select **User Settings > User Creation**. The **Create User** window opens.
2. Type the user account name in to the **Full name** field, for example: John Smith.
3. Type the username in to the **User name** field, for example: jsmith.
The **User name** is used to log in from a command line; if you install a graphical environment, then your graphical login manager uses the **Full name**.
4. Select the **Make this user administrator** check box if the user requires administrative rights (the installation program adds the user to the **wheel** group).
An administrator user can use the **sudo** command to perform tasks that are only available to **root** using the user password, instead of the **root** password. This may be more convenient, but it can also cause a security risk.
5. Select the **Require a password to use this account** check box.
If you give administrator privileges to a user, ensure the account is password protected. Never give a user administrator privileges without assigning a password to the account.
6. Type a password into the **Password** field.
7. Type the same password into the **Confirm password** field.
8. Click **Done** to apply the changes and return to the **Installation Summary** window.

10.2.3. Editing advanced user settings

This procedure describes how to edit the default settings for the user account in the **Advanced User Configuration** dialog box.

Procedure

1. On the **Create User** window, click **Advanced**.
2. Edit the details in the **Home directory** field, if required. The field is populated by default with **/home/username**.

3. In the **User and Groups IDs** section you can:
 - a. Select the **Specify a user ID manually** check box and use **+** or **-** to enter the required value. The default value is 1000. User IDs (UIDs) 0-999 are reserved by the system so they cannot be assigned to a user.
 - b. Select the **Specify a group ID manually** check box and use **+** or **-** to enter the required value. The default group name is the same as the user name, and the default Group ID (GID) is 1000. GIDs 0-999 are reserved by the system so they can not be assigned to a user group.
4. Specify additional groups as a comma-separated list in the **Group Membership** field. Groups that do not already exist are created; you can specify custom GIDs for additional groups in parentheses. If you do not specify a custom GID for a new group, the new group receives a GID automatically. The user account created always has one default group membership (the user's default group with an ID set in the **Specify a group ID manually** field).
5. Click **Save Changes** to apply the updates and return to the **Create User** window.

10.3. CONFIGURING MANUAL PARTITIONING

You can use manual partitioning to configure your disk partitions and mount points and define the file system that Red Hat Enterprise Linux is installed on. Before installation, you should consider whether you want to use partitioned or unpartitioned disk devices. For more information about the advantages and disadvantages to using partitioning on LUNs, either directly or with LVM, see the article at <https://access.redhat.com/solutions/163853>.

You have different partitioning and storage options available, including **Standard Partitions**, **LVM**, and **LVM thin provisioning**. These options provide various benefits and configurations for managing your system's storage effectively.

Standard partition

A standard partition contains a file system or swap space. Standard partitions are most commonly used for **/boot** and the **BIOS Boot** and **EFI System partitions**. You can use the LVM logical volumes in most other uses.

LVM

Choosing **LVM** (or Logical Volume Management) as the device type creates an LVM logical volume. LVM improves performance when using physical disks, and it allows for advanced setups such as using multiple physical disks for one mount point, and setting up software RAID for increased performance, reliability, or both.

LVM thin provisioning

Using thin provisioning, you can manage a storage pool of free space, known as a thin pool, which can be allocated to an arbitrary number of devices when needed by applications. You can dynamically expand the pool when needed for cost-effective allocation of storage space.

An installation of Red Hat Enterprise Linux requires a minimum of one partition but use at least the following partitions or volumes: **/**, **/home**, **/boot**, and **swap**. You can also create additional partitions and volumes as you require.

To prevent data loss it is recommended that you back up your data before proceeding. If you are upgrading or creating a dual-boot system, you should back up any data you want to keep on your storage devices.

10.3.1. Recommended partitioning scheme

Create separate file systems at the following mount points. However, if required, you can also create the file systems at **/usr**, **/var**, and **/tmp** mount points.

- **/boot**
- **/** (root)
- **/home**
- **swap**
- **/boot/efi**
- **PRoP**

This partition scheme is recommended for bare metal deployments and it does not apply to virtual and cloud deployments.

/boot partition - recommended size at least 1 GiB

The partition mounted on **/boot** contains the operating system kernel, which allows your system to boot Red Hat Enterprise Linux 9, along with files used during the bootstrap process. Due to the limitations of most firmwares, create a small partition to hold these. In most scenarios, a 1 GiB boot partition is adequate. Unlike other mount points, using an LVM volume for **/boot** is not possible - **/boot** must be located on a separate disk partition.

If you have a RAID card, be aware that some BIOS types do not support booting from the RAID card. In such a case, the **/boot** partition must be created on a partition outside of the RAID array, such as on a separate disk.



WARNING

- Normally, the **/boot** partition is created automatically by the installation program. However, if the **/** (root) partition is larger than 2 TiB and (U)EFI is used for booting, you need to create a separate **/boot** partition that is smaller than 2 TiB to boot the machine successfully.
- Ensure the **/boot** partition is located within the first 2 TB of the disk while manual partitioning. Placing the **/boot** partition beyond the 2 TB boundary might result in a successful installation, but the system fails to boot because BIOS cannot read the **/boot** partition beyond this limit.

root - recommended size of 10 GiB

This is where **/**, or the root directory, is located. The root directory is the top-level of the directory structure. By default, all files are written to this file system unless a different file system is mounted in the path being written to, for example, **/boot** or **/home**.

While a 5 GiB root file system allows you to install a minimal installation, it is recommended to allocate at least 10 GiB so that you can install as many package groups as you want.

Do not confuse the `/` directory with the `/root` directory. The `/root` directory is the home directory of the root user. The `/root` directory is sometimes referred to as *slash root* to distinguish it from the root directory.

/home - recommended size at least 1 GiB

To store user data separately from system data, create a dedicated file system for the `/home` directory. Base the file system size on the amount of data that is stored locally, number of users, and so on. You can upgrade or reinstall Red Hat Enterprise Linux 9 without erasing user data files. If you select automatic partitioning, it is recommended to have at least 55 GiB of disk space available for the installation, to ensure that the `/home` file system is created.

swap partition - recommended size at least 1 GiB

Swap file systems support virtual memory; data is written to a swap file system when there is not enough RAM to store the data your system is processing. Swap size is a function of system memory workload, not total system memory and therefore is not equal to the total system memory size. It is important to analyze what applications a system will be running and the load those applications will serve in order to determine the system memory workload. Application providers and developers can provide guidance.

When the system runs out of swap space, the kernel terminates processes as the system RAM memory is exhausted. Configuring too much swap space results in storage devices being allocated but idle and is a poor use of resources. Too much swap space can also hide memory leaks. The maximum size for a swap partition and other additional information can be found in the **mkswap(8)** manual page.

The following table provides the recommended size of a swap partition depending on the amount of RAM in your system and if you want sufficient memory for your system to hibernate. If you let the installation program partition your system automatically, the swap partition size is established using these guidelines. Automatic partitioning setup assumes hibernation is not in use. The maximum size of the swap partition is limited to 10 percent of the total size of the disk, and the installation program cannot create swap partitions more than 1TiB. To set up enough swap space to allow for hibernation, or if you want to set the swap partition size to more than 10 percent of the system's storage space, or more than 1TiB, you must edit the partitioning layout manually.

Table 10.1. Recommended system swap space

Amount of RAM in the system	Recommended swap space	Recommended swap space if allowing for hibernation
Less than 2 GiB	2 times the amount of RAM	3 times the amount of RAM
2 GiB - 8 GiB	Equal to the amount of RAM	2 times the amount of RAM
8 GiB - 64 GiB	4 GiB to 0.5 times the amount of RAM	1.5 times the amount of RAM
More than 64 GiB	Workload dependent (at least 4GiB)	Hibernation not recommended

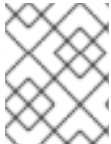
/boot/efi partition - recommended size of 200 MiB

UEFI-based AMD64, Intel 64, and 64-bit ARM require a 200 MiB EFI system partition. The recommended minimum size is 200 MiB, the default size is 600 MiB, and the maximum size is 600 MiB. BIOS systems do not require an EFI system partition.

At the border between each range, for example, a system with 2 GiB, 8 GiB, or 64 GiB of system RAM, discretion can be exercised with regard to chosen swap space and hibernation support. If your system resources allow for it, increasing the swap space can lead to better performance.

Distributing swap space over multiple storage devices – particularly on systems with fast drives, controllers and interfaces – also improves swap space performance.

Many systems have more partitions and volumes than the minimum required. Choose partitions based on your particular system needs. If you are unsure about configuring partitions, accept the automatic default partition layout provided by the installation program.



NOTE

Only assign storage capacity to those partitions you require immediately. You can allocate free space at any time, to meet needs as they occur.

PRéP boot partition - recommended size of 4 to 8 MiB

When installing Red Hat Enterprise Linux on IBM Power System servers, the first partition of the disk should include a **PRéP** boot partition. This contains the GRUB2 boot loader, which allows other IBM Power Systems servers to boot Red Hat Enterprise Linux.

10.3.2. Supported hardware storage

It is important to understand how storage technologies are configured and how support for them may have changed between major versions of Red Hat Enterprise Linux.

Hardware RAID

Any RAID functions provided by the mainboard of your computer, or attached controller cards, need to be configured before you begin the installation process. Each active RAID array appears as one drive within Red Hat Enterprise Linux.

Software RAID

On systems with more than one disk, you can use the Red Hat Enterprise Linux installation program to operate several of the drives as a Linux software RAID array. With a software RAID array, RAID functions are controlled by the operating system rather than the dedicated hardware.



NOTE

When a pre-existing RAID array's member devices are all unpartitioned disks/drives, the installation program treats the array as a disk and there is no method to remove the array.

USB Disks

You can connect and configure external USB storage after installation. Most devices are recognized by the kernel, but some devices may not be recognized. If it is not a requirement to configure these disks during installation, disconnect them to avoid potential problems.

NVDIMM devices

To use a Non-Volatile Dual In-line Memory Module (NVDIMM) device as storage, the following conditions must be satisfied:

- The architecture of the system is Intel 64 or AMD64.

- The device is configured to sector mode. Anaconda can reconfigure NVDIMM devices to this mode.
- The device must be supported by the `nd_pmem` driver.

Booting from an NVDIMM device is possible under the following additional conditions:

- The system uses UEFI.
- The device must be supported by firmware available on the system, or by a UEFI driver. The UEFI driver may be loaded from an option ROM of the device itself.
- The device must be made available under a namespace.

To take advantage of the high performance of NVDIMM devices during booting, place the **/boot** and **/boot/efi** directories on the device.



NOTE

The Execute-in-place (XIP) feature of NVDIMM devices is not supported during booting and the kernel is loaded into conventional memory.

Considerations for Intel BIOS RAID Sets

Red Hat Enterprise Linux uses **mdraid** for installing on Intel BIOS RAID sets. These sets are automatically detected during the boot process and their device node paths can change across several booting processes. Replace device node paths (such as **/dev/sda**) with file system labels or device UUIDs. You can find the file system labels and device UUIDs using the **blkid** command.

10.3.3. Starting manual partitioning

You can partition the disks based on your requirements by using manual partitioning.

Prerequisites

- The **Installation Summary** screen is open.
- All disks are available to the installation program.

Procedure

1. Select disks for installation:
 - a. Click **Installation Destination** to open the **Installation Destination** window.
 - b. Select the disks that you require for installation by clicking the corresponding icon. A selected disk has a check-mark displayed on it.
 - c. Under **Storage Configuration**, select the **Custom** radio-button.
 - d. Optional: To enable storage encryption with LUKS, select the **Encrypt my data** check box.
 - e. Click **Done**.
2. If you selected to encrypt the storage, a dialog box for entering a disk encryption passphrase opens. Type in the LUKS passphrase:

- a. Enter the passphrase in the two text fields. To switch keyboard layout, use the keyboard icon.



WARNING

In the dialog box for entering the passphrase, you cannot change the keyboard layout. Select the English keyboard layout to enter the passphrase in the installation program.

- b. Click **Save Passphrase**. The **Manual Partitioning** window opens.
3. Detected mount points are listed in the left-hand pane. The mount points are organized by detected operating system installations. As a result, some file systems may be displayed multiple times if a partition is shared among several installations.
 - a. Select the mount points in the left pane; the options that can be customized are displayed in the right pane.
 - b. Optional: If your system contains existing file systems, ensure that enough space is available for the installation. To remove any partitions, select them in the list and click the - button. The dialog has a check box that you can use to remove all other partitions used by the system to which the deleted partition belongs.
 - c. Optional: If there are no existing partitions and you want to create a set of partitions as a starting point, select your preferred partitioning scheme from the left pane (default for Red Hat Enterprise Linux is LVM) and click the **Click here to create them automatically** link.



NOTE

A **/boot** partition, a **/** (root) volume, and a **swap** volume proportionate to the size of the available storage are created and listed in the left pane. These are the file systems for a typical installation, but you can add additional file systems and mount points.

- d. Click **Done** to confirm any changes and return to the **Installation Summary** window.

10.3.4. Supported file systems

When configuring manual partitioning, you can optimize performance, ensure compatibility, and effectively manage disk space by utilizing the various file systems and partition types available in Red Hat Enterprise Linux.

xfs

XFS is a highly scalable, high-performance file system that supports file systems up to 16 exabytes (approximately 16 million terabytes), files up to 8 exabytes (approximately 8 million terabytes), and directory structures containing tens of millions of entries. **XFS** also supports metadata journaling, which facilitates quicker crash recovery. The maximum supported size of a single XFS file system is 500 TB. **XFS** is the default file system on Red Hat Enterprise Linux. The XFS filesystem cannot be shrunk to get free space.

ext4

The **ext4** file system is based on the **ext3** file system and features a number of improvements. These include support for larger file systems and larger files, faster and more efficient allocation of disk space, no limit on the number of subdirectories within a directory, faster file system checking, and more robust journaling. The maximum supported size of a single **ext4** file system is 50 TB.

ext3

The **ext3** file system is based on the **ext2** file system and has one main advantage – journaling. Using a journaling file system reduces the time spent recovering a file system after it terminates unexpectedly, as there is no need to check the file system for metadata consistency by running the `fsck` utility every time.

ext2

An **ext2** file system supports standard Unix file types, including regular files, directories, or symbolic links. It provides the ability to assign long file names, up to 255 characters.

swap

Swap partitions are used to support virtual memory. In other words, data is written to a swap partition when there is not enough RAM to store the data your system is processing.

vfat

The **VFAT** file system is a Linux file system that is compatible with Microsoft Windows long file names on the FAT file system.



NOTE

Support for **VFAT** file system is not available for Linux system partitions. For example, `/`, `/var`, `/usr` and so on.

BIOS Boot

A very small partition required for booting from a device with a GUID partition table (GPT) on BIOS systems and UEFI systems in BIOS compatibility mode.

EFI System Partition

A small partition required for booting a device with a GUID partition table (GPT) on a UEFI system.

PReP

This small boot partition is located on the first partition of the disk. The **PReP** boot partition contains the GRUB2 boot loader, which allows other IBM Power Systems servers to boot Red Hat Enterprise Linux.

10.3.5. Adding a mount point file system

You can add multiple mount point file systems. You can use any of the file systems and partition types available, such as XFS, ext4, ext3, ext2, swap, VFAT, and specific partitions like BIOS Boot, EFI System Partition, and PRPreP to effectively configure your system's storage.

Prerequisites

- You have planned your partitions.
- Ensure you haven't specified mount points at paths with symbolic links, such as `/var/mail`, `/usr/tmp`, `/lib`, `/sbin`, `/lib64`, and `/bin`. The payload, including RPM packages, depends on creating symbolic links to specific directories.

Procedure

1. Click **+** to create a new mount point file system. The **Add a New Mount Point** dialog opens.
2. Select one of the preset paths from the **Mount Point** drop-down menu or type your own; for example, select **/** for the root partition or **/boot** for the boot partition.
3. Enter the size of the file system in to the **Desired Capacity** field; for example, **2GiB**.
If you do not specify a value in **Desired Capacity**, or if you specify a size bigger than available space, then all remaining free space is used.
4. Click **Add mount point** to create the partition and return to the **Manual Partitioning** window.

10.3.6. Configuring storage for a mount point file system

You can set the partitioning scheme for each mount point that was created manually. The available options are **Standard Partition**, **LVM**, and **LVM Thin Provisioning**. Btrfs support has been removed in Red Hat Enterprise Linux 9.



NOTE

The **/boot** partition is always located on a standard partition, regardless of the value selected.

Procedure

1. To change the devices that a single non-LVM mount point should be located on, select the required mount point from the left-hand pane.
2. Under the **Device(s)** heading, click **Modify....** The **Configure Mount Point** dialog opens.
3. Select one or more devices and click **Select** to confirm your selection and return to the **Manual Partitioning** window.
4. Click **Update Settings** to apply the changes.
5. In the lower left-hand side of the **Manual Partitioning** window, click the **storage device selected** link to open the **Selected Disks** dialog and review disk information.
6. Optional: Click the **Rescan** button (circular arrow button) to refresh all local disks and partitions; this is only required after performing advanced partition configuration outside the installation program. Clicking the **Rescan Disks** button resets all configuration changes made in the installation program.

10.3.7. Customizing a mount point file system

You can customize a partition or volume if you want to set specific settings. If **/usr** or **/var** is partitioned separately from the rest of the root volume, the boot process becomes much more complex as these directories contain critical components. In some situations, such as when these directories are placed on an iSCSI drive or an FCoE location, the system is unable to boot, or hangs with a **Device is busy** error when powering off or rebooting.

This limitation only applies to **/usr** or **/var**, not to directories below them. For example, a separate partition for **/var/www** works successfully.

Procedure

1. From the left pane, select the mount point.

Figure 10.1. Customizing Partitions

MANUAL PARTITIONING

RED HAT ENTERPRISE LINUX 9.0 INSTALLATION

Done us Help!

▼ New Red Hat Enterprise Linux 9.0 Installation

SYSTEM

Mount Point	Size
/boot	1024 MiB
/	17 GiB
swap	2 GiB

rhel-root

Mount Point: /

Device(s): 0x1af4 (vda)

Desired Capacity: 17 GiB

Device Type: LVM

File System: xfs

Volume Group: rhel

Label:

Name: root

Update Settings

Note: The settings you make on this screen will not be applied until you click on the main menu's 'Begin Installation' button.

Discard All Changes

AVAILABLE SPACE: 1023 KiB

TOTAL SPACE: 20 GiB

1 storage device selected

2. From the right-hand pane, you can customize the following options:
 - a. Enter the file system mount point into the **Mount Point** field. For example, if a file system is the root file system, enter `/`; enter `/boot` for the `/boot` file system, and so on. For a swap file system, do not set the mount point as setting the file system type to **swap** is sufficient.
 - b. Enter the size of the file system in the **Desired Capacity** field. You can use common size units such as KiB or GiB. The default is MiB if you do not set any other unit.
 - c. Select the device type that you require from the drop-down **Device Type** menu: **Standard Partition**, **LVM**, or **LVM Thin Provisioning**.



NOTE

RAID is available only if two or more disks are selected for partitioning. If you choose **RAID**, you can also set the **RAID Level**. Similarly, if you select **LVM**, you can specify the **Volume Group**.

- d. Select the **Encrypt** check box to encrypt the partition or volume. You must set a password later in the installation program. The **LUKS Version** drop-down menu is displayed.
- e. Select the LUKS version that you require from the drop-down menu.

- f. Select the appropriate file system type for this partition or volume from the **File system** drop-down menu.



NOTE

Support for **VFAT** file system is not available for Linux system partitions. For example, **/**, **/var**, **/usr**, and so on.

- g. Select the **Reformat** check box to format an existing partition, or clear the **Reformat** check box to retain your data. The newly-created partitions and volumes must be reformatted, and the check box cannot be cleared.
 - h. Type a label for the partition in the **Label** field. Use labels to easily recognize and address individual partitions.
 - i. Type a name in the **Name** field. The standard partitions are named automatically when they are created and you cannot edit the names of standard partitions. For example, you cannot edit the **/boot** name **sda1**.
3. Click **Update Settings** to apply your changes and if required, select another partition to customize. Changes are not applied until you click **Begin Installation** from the **Installation Summary** window.
 4. Optional: Click **Reset All** to discard your partition changes.
 5. Click **Done** when you have created and customized all file systems and mount points. If you choose to encrypt a file system, you are prompted to create a passphrase.
A **Summary of Changes** dialog box opens, displaying a summary of all storage actions for the installation program.
 6. Click **Accept Changes** to apply the changes and return to the **Installation Summary** window.

10.3.8. Preserving the **/home** directory

In a Red Hat Enterprise Linux 9 graphical installation, you can preserve the **/home** directory that was used on your RHEL 8 system. Preserving **/home** is only possible if the **/home** directory is located on a separate **/home** partition on your RHEL 8 system.

Preserving the **/home** directory that includes various configuration settings, makes it possible that the GNOME Shell environment on the new Red Hat Enterprise Linux 9 system is set in the same way as it was on your RHEL 8 system. Note that this applies only for users on Red Hat Enterprise Linux 9 with the same user name and ID as on the previous RHEL 8 system.

Prerequisites

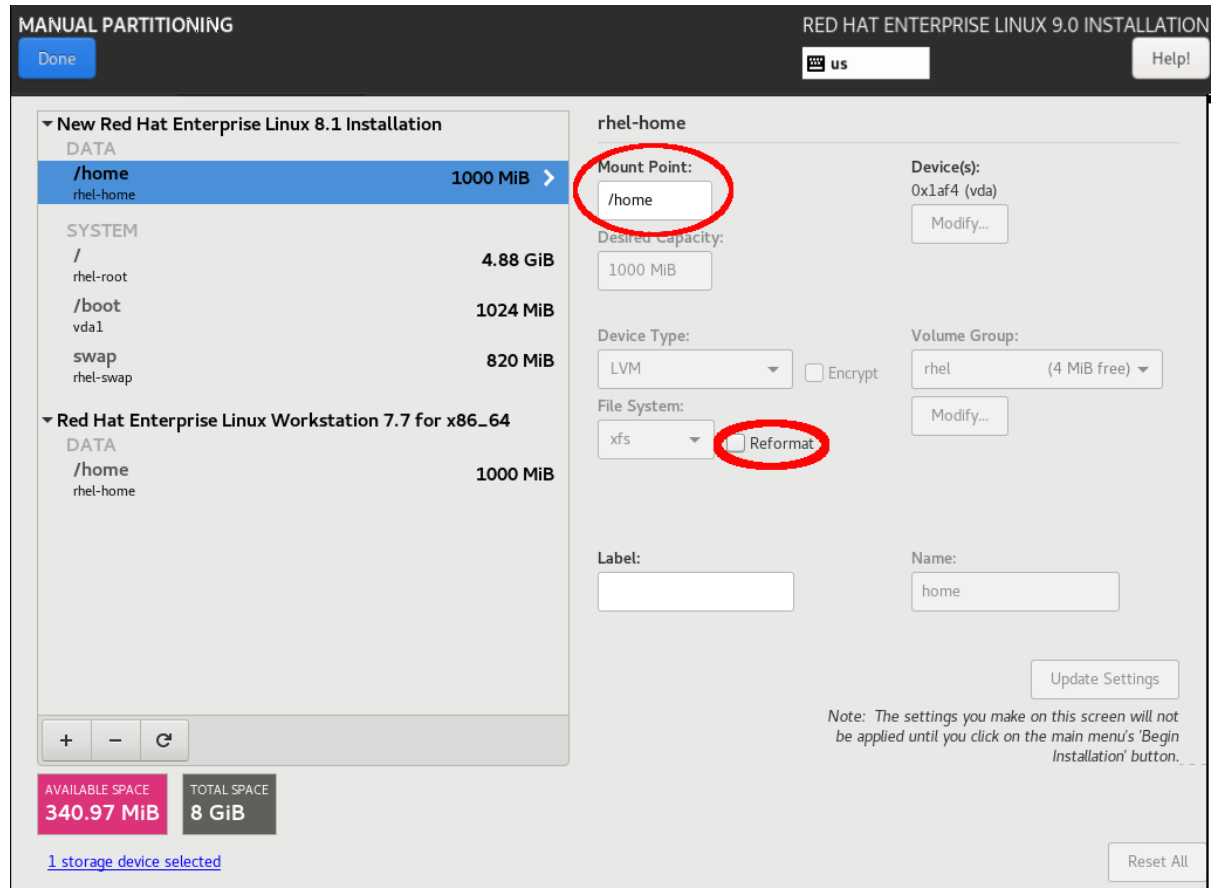
- You have RHEL 8 installed on your computer.
- The **/home** directory is located on a separate **/home** partition on your RHEL 8 system.
- The Red Hat Enterprise Linux 9 **Installation Summary** window is open.

Procedure

1. Click **Installation Destination** to open the **Installation Destination** window.

2. Under **Storage Configuration**, select the **Custom** radio button. Click **Done**.
3. Click **Done**, the **Manual Partitioning** window opens.
4. Choose the **/home** partition, fill in **/home** under **Mount Point:** and clear the **Reformat** check box.

Figure 10.2. Ensuring that **/home** is not formatted



5. Optional: You can also customize various aspects of the **/home** partition required for your Red Hat Enterprise Linux 9 system as described in [Customizing a mount point file system](#). However, to preserve **/home** from your RHEL 8 system, it is necessary to clear the **Reformat** check box.
6. After you customized all partitions according to your requirements, click **Done**. The **Summary of changes** dialog box opens.
7. Verify that the **Summary of changes** dialog box does not show any change for **/home**. This means that the **/home** partition is preserved.
8. Click **Accept Changes** to apply the changes, and return to the **Installation Summary** window.

10.3.9. Creating a software RAID during the installation

Redundant Arrays of Independent Disks (RAID) devices are constructed from multiple storage devices that are arranged to provide increased performance and, in some configurations, greater fault tolerance. A RAID device is created in one step and disks are added or removed as necessary. You can configure one RAID partition for each physical disk in your system, so that the number of disks available to the installation program determines the levels of RAID device available. For example, if your system has two disks, you cannot create a **RAID 10** device, as it requires a minimum of three separate disks. To optimize

your system's storage performance and reliability, RHEL supports software **RAID 0**, **RAID 1**, **RAID 4**, **RAID 5**, **RAID 6**, and **RAID 10** types with LVM and LVM Thin Provisioning to set up storage on the installed system.



NOTE

On 64-bit IBM Z, the storage subsystem uses RAID transparently. You do not have to configure software RAID manually.

Prerequisites

- You have selected two or more disks for installation before RAID configuration options are visible. Depending on the RAID type you want to create, at least two disks are required.
- You have created a mount point. By configuring a mount point, you can configure the RAID device.
- You have selected the **Custom** radio button on the **Installation Destination** window.

Procedure

1. From the left pane of the **Manual Partitioning** window, select the required partition.
2. Under the **Device(s)** section, click **Modify**. The **Configure Mount Point** dialog box opens.
3. Select the disks that you want to include in the RAID device and click **Select**.
4. Click the **Device Type** drop-down menu and select **RAID**.
5. Click the **File System** drop-down menu and select your preferred file system type.
6. Click the **RAID Level** drop-down menu and select your preferred level of RAID.
7. Click **Update Settings** to save your changes.
8. Click **Done** to apply the settings to return to the **Installation Summary** window.

Additional resources

- [Creating a RAID LV with DM integrity](#)
- [Managing RAID](#)

10.3.10. Creating an LVM logical volume

Logical Volume Management (LVM) presents a simple logical view of underlying physical storage space, such as disks or LUNs. Partitions on physical storage are represented as physical volumes that you can group together into volume groups. You can divide each volume group into multiple logical volumes, each of which is analogous to a standard disk partition. Therefore, LVM logical volumes function as partitions that can span multiple physical disks.



IMPORTANT

- LVM configuration is available only in the graphical installation program. During text-mode installation, LVM configuration is not available.
- To create an LVM configuration, press **Ctrl+Alt+F2** to use a shell prompt in a different virtual console. You can run **vgcreate** and **lv** commands in this shell. To return to the text-mode installation, press **Ctrl+Alt+F1**.

Procedure

1. From the **Manual Partitioning** window, create a new mount point by using any of the following options:
 - Use the **Click here to create them automatically** option or click the **+** button.
 - Select Mount Point from the drop-down list or enter manually.
 - Enter the size of the file system in to the **Desired Capacity** field; for example, 70 GiB for **/**, 1 GiB for **/boot**.
Note: Skip this step to use the existing mount point.
2. Select the mount point.
3. Select **LVM** in the drop-down menu. The **Volume Group** drop-down menu is displayed with the newly-created volume group name.



NOTE

You cannot specify the size of the volume group's physical extents in the configuration dialog. The size is always set to the default value of 4 MiB. If you want to create a volume group with different physical extents, you must create it manually by switching to an interactive shell and using the **vgcreate** command, or use a Kickstart file with the **volgroup --pesize=size** command. For more information about Kickstart, see the [Automatically installing RHEL](#).

4. Click **Done** to return to the **Installation Summary** window.

Additional resources

- [Configuring and managing logical volumes](#)

10.3.11. Configuring an LVM logical volume

You can configure a newly-created LVM logical volume based on your requirements.

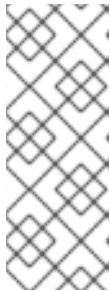


WARNING

Placing the **/boot** partition on an LVM volume is not supported.

Procedure

- From the **Manual Partitioning** window, create a mount point by using any of the following options:
 - Use the **Click here to create them automatically** option or click the **+** button.
 - Select Mount Point from the drop-down list or enter manually.
 - Enter the size of the file system in to the **Desired Capacity** field; for example, 70 GiB for `/`, 1 GiB for `/boot`.
Note: Skip this step to use the existing mount point.
- Select the mount point.
- Click the **Device Type** drop-down menu and select **LVM**. The **Volume Group** drop-down menu is displayed with the newly-created volume group name.
- Click **Modify** to configure the newly-created volume group. The **Configure Volume Group** dialog box opens.



NOTE

You cannot specify the size of the volume group's physical extents in the configuration dialog. The size is always set to the default value of 4 MiB. If you want to create a volume group with different physical extents, you must create it manually by switching to an interactive shell and using the **vgcreate** command, or use a Kickstart file with the **volgroup --pesize=size** command. For more information, see the [Automatically installing RHEL](#) document.

- Optional: From the **RAID Level** drop-down menu, select the RAID level that you require. The available RAID levels are the same as with actual RAID devices.
- Select the **Encrypt** check box to mark the volume group for encryption.
- From the **Size policy** drop-down menu, select any of the following size policies for the volume group:
The available policy options are:

Automatic

The size of the volume group is set automatically so that it is large enough to contain the configured logical volumes. This is optimal if you do not need free space within the volume group.

As large as possible

The volume group is created with maximum size, regardless of the size of the configured logical volumes it contains. This is optimal if you plan to keep most of your data on LVM and later need to increase the size of some existing logical volumes, or if you need to create additional logical volumes within this group.

Fixed

You can set an exact size of the volume group. Any configured logical volumes must then fit within this fixed size. This is useful if you know exactly how large you need the volume group to be.

- Click **Save** to apply the settings and return to the **Manual Partitioning** window.

9. Click **Update Settings** to save your changes.
10. Click **Done** to return to the **Installation Summary** window.

10.3.12. Advice on partitions

There is no best way to partition every system; the optimal setup depends on how you plan to use the system being installed. However, the following tips may help you find the optimal layout for your needs:

- Create partitions that have specific requirements first, for example, if a particular partition must be on a specific disk.
- Consider encrypting any partitions and volumes which might contain sensitive data. Encryption prevents unauthorized people from accessing the data on the partitions, even if they have access to the physical storage device. In most cases, you should at least encrypt the **/home** partition, which contains user data.
- In some cases, creating separate mount points for directories other than **/**, **/boot** and **/home** may be useful; for example, on a server running a **MySQL** database, having a separate mount point for **/var/lib/mysql** allows you to preserve the database during a re-installation without having to restore it from backup afterward. However, having unnecessary separate mount points will make storage administration more difficult.
- Some special restrictions apply to certain directories with regards on which partitioning layouts can they be placed. Notably, the **/boot** directory must always be on a physical partition (not on an LVM volume).
- If you are new to Linux, consider reviewing the [Linux Filesystem Hierarchy Standard](#) for information about various system directories and their contents.
- Each kernel requires approximately: 60MiB (initrd 34MiB, 11MiB vmlinuz, and 5MiB System.map)
- For rescue mode: 100MiB (initrd 76MiB, 11MiB vmlinuz, and 5MiB System map)
- When **kdump** is enabled in system it will take approximately another 40MiB (another initrd with 33MiB)
The default partition size of 1 GiB for **/boot** should suffice for most common use cases. However, increase the size of this partition if you are planning on retaining multiple kernel releases or errata kernels.
- The **/var** directory holds content for a number of applications, including the Apache web server, and is used by the DNF package manager to temporarily store downloaded package updates. Make sure that the partition or volume containing **/var** has at least 5 GiB.
- The **/usr** directory holds the majority of software on a typical Red Hat Enterprise Linux installation. The partition or volume containing this directory should therefore be at least 5 GiB for minimal installations, and at least 10 GiB for installations with a graphical environment.
- If **/usr** or **/var** is partitioned separately from the rest of the root volume, the boot process becomes much more complex because these directories contain boot-critical components. In some situations, such as when these directories are placed on an iSCSI drive or an FCoE location, the system may either be unable to boot, or it may hang with a **Device is busy** error when powering off or rebooting.
This limitation only applies to **/usr** or **/var**, not to directories under them. For example, a separate partition for **/var/www** works without issues.



IMPORTANT

Some security policies require the separation of **/usr** and **/var**, even though it makes administration more complex.

- Consider leaving a portion of the space in an LVM volume group unallocated. This unallocated space gives you flexibility if your space requirements change but you do not wish to remove data from other volumes. You can also select the **LVM Thin Provisioning** device type for the partition to have the unused space handled automatically by the volume.
- The size of an XFS file system cannot be reduced – if you need to make a partition or volume with this file system smaller, you must back up your data, destroy the file system, and create a new, smaller one in its place. Therefore, if you plan to alter your partitioning layout later, you should use the ext4 file system instead.
- Use Logical Volume Management (LVM) if you anticipate expanding your storage by adding more disks or expanding virtual machine disks after the installation. With LVM, you can create physical volumes on the new drives, and then assign them to any volume group and logical volume as you see fit – for example, you can easily expand your system's **/home** (or any other directory residing on a logical volume).
- Creating a BIOS Boot partition or an EFI System Partition may be necessary, depending on your system's firmware, boot drive size, and boot drive disk label. Note that you cannot create a BIOS Boot or EFI System Partition in graphical installation if your system does **not** require one – in that case, they are hidden from the menu.

Additional resources

- [How to use dm-crypt on IBM Z, LinuxONE and with the PAES cipher](#)

10.4. SELECTING THE BASE ENVIRONMENT AND ADDITIONAL SOFTWARE

Use the **Software Selection** window to select the software packages that you require. The packages are organized by Base Environment and Additional Software.

- **Base Environment** contains predefined packages. You can select only one base environment, for example, Server with GUI (default), Server, Minimal Install, Workstation, Custom operating system, Virtualization Host. The availability is dependent on the installation ISO image that is used as the installation source.
- **Additional Software for Selected Environment** contains additional software packages for the base environment. You can select multiple software packages.

Use a predefined environment and additional software to customize your system. However, in a standard installation, you cannot select individual packages to install. To view the packages contained in a specific environment, see the ***repository/repodata/*-comps-repository.architecture.xml*** file on your installation source media (DVD, CD, USB). The XML file contains details of the packages installed as part of a base environment. Available environments are marked by the **<environment>** tag, and additional software packages are marked by the **<group>** tag.

If you are unsure about which packages to install, select the **Minimal Install** base environment. Minimal install installs a basic version of Red Hat Enterprise Linux with only a minimal amount of additional software. After the system finishes installing and you log in for the first time, you can use the **DNF**

package manager to install additional software. For more information about **DNF** package manager, see the [Configuring basic system settings](#) document.



NOTE

- Use the **dnf group list** command from any RHEL 9 system to view the list of packages being installed on the system as a part of software selection. For more information, see [Configuring basic system settings](#).
- If you need to control which packages are installed, you can use a Kickstart file and define the packages in the **%packages** section.
- By default, RHEL 9 does not install the Tuned package. You can manually install the Tuned package using the **dnf install tuned** command. For more information, see the [Automatically installing RHEL](#) document.

Prerequisites

- You have configured the installation source.
- The installation program has downloaded package metadata.
- The **Installation Summary** window is open.

Procedure

1. From the **Installation Summary** window, click **Software Selection**. The **Software Selection** window opens.
2. From the **Base Environment** pane, select a base environment. You can select only one base environment, for example, Server with GUI (default), Server, Minimal Install, Workstation, Custom Operating System, Virtualization Host. By default, the **Server with GUI** base environment is selected.

Figure 10.3. Red Hat Enterprise Linux Software Selection

SOFTWARE SELECTION RED HAT ENTERPRISE LINUX 9.0 INSTALLATION

[Done](#) us [Help!](#)

Base Environment

- ☒ **Server with GUI**
An integrated, easy-to-manage server with a graphical interface.
- ☐ **Server**
An integrated, easy-to-manage server.
- ☐ **Minimal Install**
Basic functionality.
- ☐ **Workstation**
Workstation is a user-friendly desktop system for laptops and PCs.
- ☐ **Custom Operating System**
Basic building block for a custom RHEL system.
- ☐ **Virtualization Host**
Minimal virtualization host.

Additional software for Selected Environment

- ☐ **Debugging Tools**
Tools for debugging misbehaving applications and diagnosing performance problems.
- ☐ **DNS Name Server**
This package group allows you to run a DNS name server (BIND) on the system.
- ☐ **File and Storage Server**
CIFS, SMB, NFS, iSCSI, iSER, and iSNS network storage server.
- ☐ **FTP Server**
These tools allow you to run an FTP server on the system.
- ☐ **Guest Agents**
Agents used when running under a hypervisor.
- ☐ **InfiniBand Support**
Software designed for supporting clustering, grid connectivity, and low-latency, high bandwidth storage using RDMA-based InfiniBand, iWARP, RoCE, and OPA fabrics.
- ☐ **Mail Server**
These packages allow you to configure an IMAP or SMTP mail server.
- ☐ **Network File System Client**
Enables the system to attach to network storage.
- ☐ **Network Servers**
These packages include network-based servers such as DHCP, Kerberos and NIS.
- ☐ **Performance Tools**
Tools for diagnosing system and application-level performance problems.
- ☐ **Remote Desktop Clients**
- ☐ **Remote Management for Linux**
Remote management interface for Red Hat Enterprise Linux.
- ☐ **Windows File Server**
This package group allows you to share files between Linux and MS Windows(tm) systems.
- ☐ **Virtualization Client**
Clients for installing and managing virtualization instances.
- ☐ **Virtualization Hypervisor**
Smallest possible virtualization host installation.
- ☐ **Virtualization Tools**
Tools for offline virtual image management.
- ☐ **Basic Web Server**
These tools allow you to run a Web server on the system.
- ☐ **Local iBMC Compatibility**

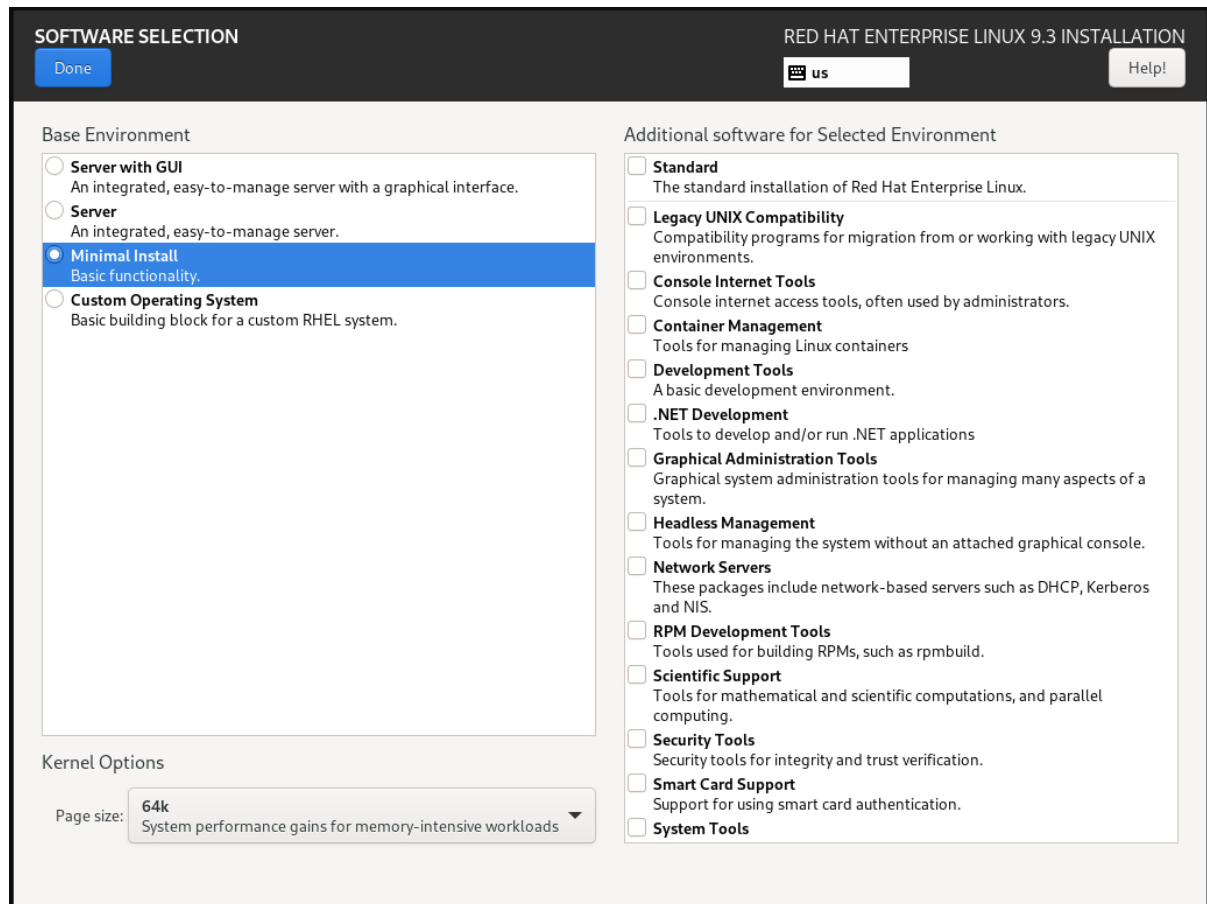
- Optional: For installations on ARM based systems, select desired **Page size** from **Kernel Options**.

By default, it selects Kernel with a **4k** page size.



WARNING

If you want to use the Kernel with **64k** page size, ensure you select **Minimal Install** under **Base Environment** to use this option. You can install additional software after you login to the system for the first time post installation using the **DNF** package manager.



4. From the **Additional Software for Selected Environment** pane, select one or more options.
5. Click **Done** to apply the settings and return to graphical installations.

Additional resources

- [The 4k and 64k page size Kernel Options](#)

10.5. OPTIONAL: CONFIGURING THE NETWORK AND HOST NAME

Use the **Network and Host name** window to configure network interfaces. Options that you select here are available both during the installation for tasks such as downloading packages from a remote location, and on the installed system.

Follow the steps in this procedure to configure your network and host name.

Procedure

1. From the **Installation Summary** window, click **Network and Host Name**.
2. From the list in the left-hand pane, select an interface. The details are displayed in the right-hand pane.
3. Toggle the **ON/OFF** switch to enable or disable the selected interface.
You cannot add or remove interfaces manually.
4. Click **+** to add a virtual network interface, which can be either: Team (deprecated), Bond, Bridge, or VLAN.

5. Click **-** to remove a virtual interface.
6. Click **Configure** to change settings such as IP addresses, DNS servers, or routing configuration for an existing interface (both virtual and physical).
7. Type a host name for your system in the **Host Name** field.

The host name can either be a fully qualified domain name (FQDN) in the format **hostname.domainname**, or a short host name without the domain. Many networks have a Dynamic Host Configuration Protocol (DHCP) service that automatically supplies connected systems with a domain name. To allow the DHCP service to assign the domain name to this system, specify only the short host name.

Host names can only contain alphanumeric characters and **-** or **..**. Host name should be equal to or less than 64 characters. Host names cannot start or end with **-** and **..**. To be compliant with DNS, each part of a FQDN should be equal to or less than 63 characters and the FQDN total length, including dots, should not exceed 255 characters.

The value **localhost** means that no specific static host name for the target system is configured, and the actual host name of the installed system is configured during the processing of the network configuration, for example, by NetworkManager using DHCP or DNS.

When using static IP and host name configuration, it depends on the planned system use case whether to use a short name or FQDN. Red Hat Identity Management configures FQDN during provisioning but some 3rd party software products may require short name. In either case, to ensure availability of both forms in all situations, add an entry for the host in **/etc/hosts** in the format **IP FQDN short-alias**.

8. Click **Apply** to apply the host name to the installer environment.
9. Alternatively, in the **Network and Hostname** window, you can choose the Wireless option. Click **Select network** in the right-hand pane to select your wifi connection, enter the password if required, and click **Done**.

Additional resources

- For more information about network device naming standards, see [Configuring and managing networking](#).

10.5.1. Adding a virtual network interface

You can add a virtual network interface.

Procedure

1. From the **Network & Host name** window, click the **+** button to add a virtual network interface. The **Add a device** dialog opens.
2. Select one of the four available types of virtual interfaces:
 - **Bond**: NIC (*Network Interface Controller*) Bonding, a method to bind multiple physical network interfaces together into a single bonded channel.
 - **Bridge**: Represents NIC Bridging, a method to connect multiple separate networks into one aggregate network.

- **Team:** NIC Teaming, a new implementation to aggregate links, designed to provide a small kernel driver to implement the fast handling of packet flows, and various applications to do everything else in user space.
NIC teaming is deprecated in Red Hat Enterprise Linux 9. Consider using the network bonding driver as an alternative. For details, see [Configuring a network bond](#).
 - **Vlan** (*Virtual LAN*): A method to create multiple distinct broadcast domains which are mutually isolated.
3. Select the interface type and click **Add**. An editing interface dialog box opens, allowing you to edit any available settings for your chosen interface type.
For more information, see [Editing network interface](#).
 4. Click **Save** to confirm the virtual interface settings and return to the **Network & Host name** window.
 5. Optional: To change the settings of a virtual interface, select the interface and click **Configure**.

10.5.2. Editing network interface configuration

You can edit the configuration of a typical wired connection used during installation. Configuration of other types of networks is broadly similar, although the specific configuration parameters might be different.



NOTE

On 64-bit IBM Z, you cannot add a new connection as the network subchannels need to be grouped and set online beforehand, and this is currently done only in the booting phase.

Procedure

- To configure a network connection manually, select the interface from the **Network and Host name** window and click **Configure**.
An editing dialog specific to the selected interface opens.

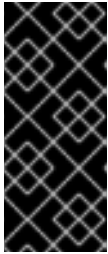
The options present depend on the connection type – the available options are slightly different depending on whether the connection type is a physical interface (wired or wireless network interface controller) or a virtual interface (Bond, Bridge, Team (deprecated), or Vlan) that was previously configured in [Adding a virtual interface](#).

10.5.3. Enabling or Disabling the Interface Connection

You can enable or disable specific interface connections.

Procedure

1. Click the **General** tab.
2. Select the **Connect automatically with priority** check box to enable connection by default.
Keep the default priority setting at **0**.
3. Optional: Enable or disable all users on the system from connecting to this network by using the **All users may connect to this network** option. If you disable this option, only **root** will be able to connect to this network.



IMPORTANT

When enabled on a wired connection, the system automatically connects during startup or reboot. On a wireless connection, the interface attempts to connect to any known wireless networks in range. For further information about NetworkManager, including the **nm-connection-editor** tool, see the [Configuring and managing networking](#) document.

4. Click **Save** to apply the changes and return to the **Network and Host name** window.
It is not possible to only allow a specific user other than **root** to use this interface, as no other users are created at this point during the installation. If you need a connection for a different user, you must configure it after the installation.

10.5.4. Setting up Static IPv4 or IPv6 Settings

By default, both IPv4 and IPv6 are set to automatic configuration depending on current network settings. This means that addresses such as the local IP address, DNS address, and other settings are detected automatically when the interface connects to a network. In many cases, this is sufficient, but you can also provide static configuration in the **IPv4 Settings** and **IPv6 Settings** tabs. Complete the following steps to configure IPv4 or IPv6 settings:

Procedure

1. To set static network configuration, navigate to one of the IPv Settings tabs and from the **Method** drop-down menu, select a method other than **Automatic**, for example, **Manual**. The **Addresses** pane is enabled.
2. Optional: In the **IPv6 Settings** tab, you can also set the method to **Ignore** to disable IPv6 on this interface.
3. Click **Add** and enter your address settings.
4. Type the IP addresses in the **Additional DNS servers** field; it accepts one or more IP addresses of DNS servers, for example, **10.0.0.1,10.0.0.8**.
5. Select the **Require IPvX addressing for this connection to complete** check box.
Selecting this option in the **IPv4 Settings** or **IPv6 Settings** tabs allow this connection only if IPv4 or IPv6 was successful. If this option remains disabled for both IPv4 and IPv6, the interface is able to connect if configuration succeeds on either IP protocol.
6. Click **Save** to apply the changes and return to the **Network & Host name** window.

10.5.5. Configuring Routes

You can control the access of specific connections by configuring routes.

Procedure

1. In the **IPv4 Settings** and **IPv6 Settings** tabs, click **Routes** to configure routing settings for a specific IP protocol on an interface. An editing routes dialog specific to the interface opens.
2. Click **Add** to add a route.
3. Select the **Ignore automatically obtained routes** check box to configure at least one static route and to disable all routes not specifically configured.

4. Select the **Use this connection only for resources on its network** check box to prevent the connection from becoming the default route.
This option can be selected even if you did not configure any static routes. This route is used only to access certain resources, such as intranet pages that require a local or VPN connection. Another (default) route is used for publicly available resources. Unlike the additional routes configured, this setting is transferred to the installed system. This option is useful only when you configure more than one interface.
5. Click **OK** to save your settings and return to the editing routes dialog that is specific to the interface.
6. Click **Save** to apply the settings and return to the **Network and Host Name** window.

10.6. OPTIONAL: CONFIGURING LOCALIZATION OPTIONS

You can configure your keyboard, language support, and time and date settings.



IMPORTANT

If you use a layout that cannot accept Latin characters, such as **Russian**, add the **English (United States)** layout and configure a keyboard combination to switch between the two layouts. If you select a layout that does not have Latin characters, you might be unable to enter a valid **root** password and user credentials later in the installation process. This might prevent you from completing the installation.

Procedure

1. Configure keyboard settings:
 - a. From the **Installation Summary** window, click **Keyboard**.
The default layout depends on the option selected in [Installing RHEL using Anaconda](#).
 - b. Click **+** to open the **Add a Keyboard Layout** window and change to a different layout.
 - c. Select a layout by browsing the list or use the **Search** field.
 - d. Select the required layout and click **Add**. The new layout appears under the default layout.
 - e. Click **Options** to optionally configure a keyboard switch that you can use to cycle between available layouts. The **Layout Switching Options** window opens.
 - f. To configure key combinations for switching, select one or more key combinations and click **OK** to confirm your selection.
 - g. Optional: When you select a layout, click the **Keyboard** button to open a new dialog box displaying a visual representation of the selected layout.
 - h. Click **Done** to apply the settings and return to graphical installations
2. Configure language settings:
 - a. From the **Installation Summary** window, click **Language Support**. The **Language Support** window opens. The left pane lists the available language groups. If at least one language from a group is configured, a check mark is displayed and the supported language is highlighted.

- b. From the left pane, click a group to select additional languages, and from the right pane, select regional options. Repeat this process for languages that you require.
 - c. Click **Done** to apply the settings and return to graphical installations.
3. Configure time and date settings:
 - a. From the **Installation Summary** window, click **Time & Date**. The **Time & Date** window opens.

The list of cities and regions come from the Time Zone Database (**tzdata**) public domain that is maintained by the Internet Assigned Numbers Authority (IANA). Red Hat can not add cities or regions to this database. You can find more information at the [IANA official website](#).
 - b. From the **Region** drop-down menu, select a region. Select **Etc** as your region to configure a time zone relative to Greenwich Mean Time (GMT) without setting your location to a specific region.
 - c. From the **City** drop-down menu, select the city, or the city closest to your location in the same time zone.
 - d. Toggle the **Network Time** switch to enable or disable network time synchronization using the Network Time Protocol (NTP).

Enabling the Network Time switch keeps your system time correct as long as the system can access the internet. By default, one NTP pool is configured.
 - e. Optional: Use the **gear wheel** button next to the **Network Time** switch to add a new NTP, or disable or remove the default options.
 - f. Click **Done** to apply the settings and return to graphical installations.

Disabling the network time synchronization activates controls at the bottom of the page to set time and date manually.

10.7. OPTIONAL: CONFIGURING LANGUAGE AND LOCATION SETTINGS

The installation program uses the language that you selected during installation.

Prerequisites

- You have created installation media. For more information, see [Creating a bootable installation medium for RHEL](#).
- You have specified an installation source if you are using the Boot ISO image file.
- You have booted the installation. For more information, see [Booting the installer](#).

Procedure

1. From the left-hand pane of the **Welcome to Red Hat Enterprise Linux** window, select a language. Alternatively, type your preferred language into the **Search** field.



NOTE

A language is pre-selected by default. If network access is configured, that is, if you booted from a network server instead of local media, the pre-selected language is determined by the automatic location detection feature of the **GeoIP** module. If you used the **inst.lang=** option on the boot command line or in your PXE server configuration, then the language that you define with the boot option is selected.

2. From the right-hand pane of the **Welcome to Red Hat Enterprise Linux** window, select a location specific to your region.
3. Click **Continue** to proceed to the graphical installations window.
4. If you are installing a pre-release version of Red Hat Enterprise Linux, a warning message is displayed about the pre-release status of the installation media.
 - a. To continue with the installation, click **I want to proceed**, or
 - b. To quit the installation and reboot the system, click **I want to exit**.

Additional resources

- [Configuring localization settings](#)

10.8. OPTIONAL: SUBSCRIBING THE SYSTEM AND ACTIVATING RED HAT INSIGHTS

Red Hat Insights is a Software-as-a-Service (SaaS) offering that provides continuous, in-depth analysis of registered Red Hat-based systems to proactively identify threats to security, performance and stability across physical, virtual and cloud environments, and container deployments. By [registering](#) your RHEL system in Red Hat Insights, you gain access to predictive analytics, security alerts, and performance optimization tools, enabling you to maintain a secure, efficient, and stable IT environment.

You can register to Red Hat by using either your Red Hat account or your activation key details. You can connect your system to Red Hat Insights by using the **Connect to Red Hat** option.

Procedure

1. From the **Installation Summary** screen, under **Software**, click **Connect to Red Hat**
2. Select **Account** or **Activation Key**.
 - a. If you select **Account**, enter your Red Hat Customer Portal username and password details.
 - b. If you select **Activation Key**, enter your organization ID and activation key.
You can enter more than one activation key, separated by a comma, as long as the activation keys are registered to your subscription.
3. Select the **Set System Purpose** check box.
 - If the account has Simple content access mode enabled, setting the system purpose values is still important for accurate reporting of consumption in the subscription services.

- If your account is in the entitlement mode, system purpose enables the entitlement server to determine and automatically attach the most appropriate subscription to satisfy the intended use of the Red Hat Enterprise Linux 9 system.
4. Select the required **Role**, **SLA**, and **Usage** from the corresponding drop-down lists.
 5. The **Connect to Red Hat Insights** check box is enabled by default. Clear the check box if you do not want to connect to Red Hat Insights.
 6. Optional: Expand **Options**.
 - a. Select the **Use HTTP proxy** check box if your network environment only allows external Internet access or access to content servers through an HTTP proxy. Clear the **Use HTTP proxy** check box if an HTTP proxy is not used.
 - b. If you are running Satellite Server or performing internal testing, select the **Satellite URL** and **Custom base URL** check boxes and enter the required details.



IMPORTANT

- RHEL 9 is supported only with Satellite 6.11 or later. Check the version prior registering the system.
- The **Satellite URL** field does not require the HTTP protocol, for example **nameofhost.com**. However, the **Custom base URL** field requires the HTTP protocol.
- To change the **Custom base URL** after registration, you must unregister, provide the new details, and then re-register.

7. Click **Register** to register the system. When the system is successfully registered and subscriptions are attached, the **Connect to Red Hat** window displays the attached subscription details.
Depending on the amount of subscriptions, the registration and attachment process might take up to a minute to complete.
8. Click **Done** to return to the **Installation Summary** window.
A *Registered* message is displayed under **Connect to Red Hat**

Additional resources

- [About Red Hat Insights](#)

10.9. OPTIONAL: USING NETWORK-BASED REPOSITORIES FOR THE INSTALLATION

You can configure an installation source from either auto-detected installation media, Red Hat CDN, or the network. When the **Installation Summary** window first opens, the installation program attempts to configure an installation source based on the type of media that was used to boot the system. The full Red Hat Enterprise Linux Server DVD configures the source as local media.

Prerequisites

- You have downloaded the full installation DVD ISO or minimal installation Boot ISO image from the [Product Downloads](#) page.

- You have created bootable installation media.
- The **Installation Summary** window is open.

Procedure

1. From the **Installation Summary** window, click **Installation Source**. The **Installation Source** window opens.
 - a. Review the **Auto-detected installation media** section to verify the details. This option is selected by default if you started the installation program from media containing an installation source, for example, a DVD.
 - b. Click **Verify** to check the media integrity.
 - c. Review the **Additional repositories** section and note that the **AppStream** check box is selected by default.
The BaseOS and AppStream repositories are installed as part of the full installation image. Do not disable the AppStream repository check box if you want a full Red Hat Enterprise Linux 9 installation.
2. Optional: Select the **Red Hat CDN** option to register your system, attach RHEL subscriptions, and install RHEL from the Red Hat Content Delivery Network (CDN).
3. Optional: Select the **On the network** option to download and install packages from a network location instead of local media. This option is available only when a network connection is active. See [Configuring network and host name options](#) for information about how to configure network connections in the GUI.



NOTE

If you do not want to download and install additional repositories from a network location, proceed to [Configuring software selection](#).

- a. Select the **On the network** drop-down menu to specify the protocol for downloading packages. This setting depends on the server that you want to use.
- b. Type the server address (without the protocol) into the address field. If you choose NFS, a second input field opens where you can specify custom **NFS mount options**. This field accepts options listed in the **nfs(5)** man page on your system.
- c. When selecting an NFS installation source, specify the address with a colon (:) character separating the host name from the path. For example, **server.example.com:/path/to/directory**.
The following steps are optional and are only required if you use a proxy for network access.
- d. Click **Proxy setup...** to configure a proxy for an HTTP or HTTPS source.
- e. Select the **Enable HTTP proxy** check box and type the URL into the **Proxy Host** field.
- f. Select the **Use Authentication** check box if the proxy server requires authentication.
- g. Type in your user name and password.
- h. Click **OK** to finish the configuration and exit the **Proxy Setup...** dialog box.

**NOTE**

If your HTTP or HTTPS URL refers to a repository mirror, select the required option from the **URL type** drop-down list. All environments and additional software packages are available for selection when you finish configuring the sources.

4. Click **+** to add a repository.
5. Click **-** to delete a repository.
6. Click the **arrow** icon to revert the current entries to the setting when you opened the **Installation Source** window.
7. To activate or deactivate a repository, click the check box in the **Enabled** column for each entry in the list.
You can name and configure your additional repository in the same way as the primary repository on the network.
8. Click **Done** to apply the settings and return to the **Installation Summary** window.

10.10. OPTIONAL: CONFIGURING KDUMP KERNEL CRASH-DUMPING MECHANISM

Kdump is a kernel crash-dumping mechanism. In the event of a system crash, **Kdump** captures the contents of the system memory at the moment of failure. This captured memory can be analyzed to find the cause of the crash. If **Kdump** is enabled, it must have a small portion of the system's memory (RAM) reserved to itself. This reserved memory is not accessible to the main kernel.

Procedure

1. From the **Installation Summary** window, click **Kdump**. The **Kdump** window opens.
2. Select the **Enable kdump** check box.
3. Select either the **Automatic** or **Manual** memory reservation setting.
4. If you select **Manual**, enter the amount of memory (in megabytes) that you want to reserve in the **Memory to be reserved** field using the **+** and **-** buttons. The **Usable System Memory** readout below the reservation input field shows how much memory is accessible to your main system after reserving the amount of RAM that you select.
5. Click **Done** to apply the settings and return to graphical installations.

The amount of memory that you reserve is determined by your system architecture (AMD64 and Intel 64 have different requirements than IBM Power) as well as the total amount of system memory. In most cases, automatic reservation is satisfactory.

Additional settings, such as the location where kernel crash dumps will be saved, can only be configured after the installation using either the **system-config-kdump** graphical interface, or manually in the **/etc/kdump.conf** configuration file.

10.11. OPTIONAL: SELECTING A SECURITY PROFILE

You can apply security policy during your Red Hat Enterprise Linux 9 installation and configure it to use on your system before the first boot.

10.11.1. About security policy

The Red Hat Enterprise Linux includes OpenSCAP suite to enable automated configuration of the system in alignment with a particular security policy. The policy is implemented using the Security Content Automation Protocol (SCAP) standard. The packages are available in the AppStream repository. However, by default, the installation and post-installation process does not enforce any policies and therefore does not involve any checks unless specifically configured.

Applying a security policy is not a mandatory feature of the installation program. If you apply a security policy to the system, it is installed using restrictions defined in the profile that you selected. The **openscap-scanner** and **scap-security-guide** packages are added to your package selection, providing a preinstalled tool for compliance and vulnerability scanning.

When you select a security policy, the Anaconda GUI installer requires the configuration to adhere to the policy's requirements. There might be conflicting package selections, as well as separate partitions defined. Only after all the requirements are met, you can start the installation.

At the end of the installation process, the selected OPenSCAP security policy automatically hardens the system and scans it to verify compliance, saving the scan results to the **/root/openscap_data** directory on the installed system.

By default, the installer uses the content of the **scap-security-guide** package bundled in the installation image. You can also load external content from an HTTP, HTTPS, or FTP server.

10.11.2. Configuring a security profile

You can configure a security policy from the **Installation Summary** window.

Prerequisite

- The **Installation Summary** window is open.

Procedure

1. From the **Installation Summary** window, click **Security Profile**. The **Security Profile** window opens.
2. To enable security policies on the system, toggle the **Apply security policy** switch to **ON**.
3. Select one of the profiles listed in the top pane.
4. Click **Select profile**.
Profile changes that you must apply before installation appear in the bottom pane.
5. Click **Change content** to use a custom profile.
A separate window opens allowing you to enter a URL for valid security content.
 - a. Click **Fetch** to retrieve the URL.
You can load custom profiles from an **HTTP**, **HTTPS**, or **FTP** server. Use the full address of the content including the protocol, such as **http://**. A network connection must be active before you can load a custom profile. The installation program detects the content type automatically.

- b. Click **Use SCAP Security Guide** to return to the **Security Profile** window.
6. Click **Done** to apply the settings and return to the **Installation Summary** window.

10.11.3. Profiles not compatible with Server with GUI

Certain security profiles provided as part of the **SCAP Security Guide** are not compatible with the extended package set included in the **Server with GUI** base environment. Therefore, do not select **Server with GUI** when installing systems compliant with one of the following profiles:

Table 10.2. Profiles not compatible with Server with GUI

Profile name	Profile ID	Justification	Notes
[DRAFT] CIS Red Hat Enterprise Linux 9 Benchmark for Level 2 – Server	xccdf_org.ssgproject.content_profile_cis	Packages xorg-x11-server-Xorg , xorg-x11-server-common , xorg-x11-server-utils , and xorg-x11-server-Xwayland are part of the Server with GUI package set, but the policy requires their removal.	
[DRAFT] CIS Red Hat Enterprise Linux 9 Benchmark for Level 1 – Server	xccdf_org.ssgproject.content_profile_cis_server_l1	Packages xorg-x11-server-Xorg , xorg-x11-server-common , xorg-x11-server-utils , and xorg-x11-server-Xwayland are part of the Server with GUI package set, but the policy requires their removal.	
DISA STIG for Red Hat Enterprise Linux 9	xccdf_org.ssgproject.content_profile_stig	Packages xorg-x11-server-Xorg , xorg-x11-server-common , xorg-x11-server-utils , and xorg-x11-server-Xwayland are part of the Server with GUI package set, but the policy requires their removal.	To install a RHEL system as a Server with GUI aligned with DISA STIG, you can use the DISA STIG with GUI profile BZ#1648162

10.11.4. Deploying baseline-compliant RHEL systems using Kickstart

You can deploy RHEL systems that are aligned with a specific baseline. This example uses Protection Profile for General Purpose Operating System (OSPP).

Prerequisites

- The **scap-security-guide** package is installed on your RHEL 9 system.

Procedure

1. Open the `/usr/share/scap-security-guide/kickstart/ssg-rhel9-ospp-ks.cfg` Kickstart file in an editor of your choice.
2. Update the partitioning scheme to fit your configuration requirements. For OSPP compliance, the separate partitions for **/boot**, **/home**, **/var**, **/tmp**, **/var/log**, **/var/tmp**, and **/var/log/audit** must be preserved, and you can only change the size of the partitions.
3. Start a Kickstart installation as described in [Performing an automated installation using Kickstart](#).



IMPORTANT

Passwords in Kickstart files are not checked for OSPP requirements.

Verification

- To check the current status of the system after installation is complete, reboot the system and start a new scan:

```
# oscap xccdf eval --profile ospp --report eval_postinstall_report.html
/usr/share/xml/scap/ssg/content/ssg-rhel9-ds.xml
```

Additional resources

- [OSCAP Anaconda Add-on](#)
- [Kickstart commands and options reference: %addon org_fedora_oscap](#)

10.11.5. Additional resources

- **scap-security-guide(8)** – The manual page for the **scap-security-guide** project contains information about SCAP security profiles, including examples on how to utilize the provided benchmarks using the OpenSCAP utility.
- Red Hat Enterprise Linux security compliance information is available in the [Security hardening](#) document.

CHAPTER 11. COMPLETING INITIAL SETUP

This section contains information about how to complete initial setup on a Red Hat Enterprise Linux 9 system. If you have selected the **Server with GUI** base environment during installation, the **Initial Setup** window opens the first time you reboot your system after the installation process is complete. If you have registered and installed RHEL from the CDN, the Subscription Manager option displays a note that all installed products are covered by valid entitlements.

The information displayed in the **Initial Setup** window might vary depending on what was configured during installation. At a minimum, the **Licensing** and **Subscription Manager** options are displayed.

Prerequisites

- You have completed the graphical installation.
- You have an active, non-evaluation Red Hat Enterprise Linux subscription.

Procedure

1. From the **Initial Setup** window, select **Licensing Information**.
The **License Agreement** window opens and displays the licensing terms for Red Hat Enterprise Linux.
2. Review the license agreement and select the **I accept the license agreement** checkbox.
You must accept the license agreement to proceed. Exiting **Initial Setup** without accepting license agreement causes a system restart. When the restart process is complete, you are prompted to accept the license agreement again.
3. Click **Done** to apply the settings and return to the **Initial Setup** window.
4. Optional: Click **Finish Configuration**, if you did not configure network settings earlier as you cannot register your system immediately.
Red Hat Enterprise Linux 9 starts and you can login, activate access to the network, and register your system. See [Subscription manager post installation](#) for more information.

If you have configured network settings, as described in [Network hostname](#), you can register your system immediately, as shown in the following steps.

5. From the **Initial Setup** window, select **Subscription Manager**.
6. The **Subscription Manager** graphical interface opens and displays the option you are going to register, which is: **subscription.rhsm.redhat.com**.
7. Click **Next**.
8. Enter your **Login** and **Password** details and click **Register**.
9. Confirm the Subscription details and click **Attach**. You must receive the following confirmation message: **Registration with Red Hat Subscription Management is Done!**
10. Click **Done**. The **Initial Setup** window opens.
11. Click **Finish Configuration**. The login window opens.
12. Configure your system. See the [Configuring basic system settings](#) document for more information.

Methods to register RHEL

Depending on your requirements, there are five methods to register your system:

- Using the Red Hat Content Delivery Network (CDN) to register your system, attach RHEL subscriptions, and install Red Hat Enterprise Linux.
- During installation using **Initial Setup**.
- After installation using the command line.
- After installation using the Subscription Manager user interface.
- After installation using Registration Assistant. Registration Assistant is designed to help you choose the most suitable registration option for your Red Hat Enterprise Linux environment. See <https://access.redhat.com/labs/registrationassistant/> for more information.

PART III. POST-INSTALLATION TASKS

Managing subscriptions and securing a Red Hat Enterprise Linux (RHEL) system are essential steps for maintaining system compliance and functionality. Registering RHEL ensures access to software updates and services. Additionally, setting a system purpose aligns the system's usage with the appropriate subscriptions, while adjusting security settings helps safeguard critical infrastructure. When needed, subscription services can be updated or changed to meet evolving system requirements.

CHAPTER 12. REGISTERING RHEL BY USING SUBSCRIPTION MANAGER

Post-installation, you must register your system to get continuous updates.

12.1. REGISTERING RHEL 9 USING THE INSTALLER GUI

You can register a Red Hat Enterprise Linux 9 by using the RHEL installer GUI.

Prerequisites

- You have a valid user account on the Red Hat Customer Portal. See the [Create a Red Hat Login page](#).
- You have a valid Activation Key and Organization id.

Procedure

1. From the **Installation Summary** screen, under **Software**, click **Connect to Red Hat**
2. Authenticate your Red Hat account using the **Account** or **Activation Key** option.
3. Optional: In the **Set System Purpose** field select the **Role**, **SLA**, and **Usage** attribute that you want to set from the drop-down menu.
At this point, your Red Hat Enterprise Linux 9 system has been successfully registered.

12.2. REGISTRATION ASSISTANT

Registration Assistant is designed to help you choose the most suitable registration option for your Red Hat Enterprise Linux environment.

Additional resources

- For assistance with using a username and password to register RHEL with the Subscription Manager client, see the [RHEL registration assistant](#) on the Customer Portal.
- For assistance with registering your RHEL system to Red Hat Insights, see the [Insights registration assistant](#) on the Hybrid Cloud Console.

12.3. REGISTERING YOUR SYSTEM USING THE COMMAND LINE

You can register your Red Hat Enterprise Linux 9 subscription by using the command line.

For an improved and simplified experience registering your hosts to Red Hat, use remote host configuration (RHC). The RHC client registers your system to Red Hat making your system ready for Insights data collection and enabling direct issue remediation from Insights for Red Hat Enterprise Linux. For more information, see [RHC registration](#).

Prerequisites

- You have an active, non-evaluation Red Hat Enterprise Linux subscription.
- Your Red Hat subscription status is verified.

- You have not previously received a Red Hat Enterprise Linux 9 subscription.
- You have successfully installed Red Hat Enterprise Linux 9 and logged into the system as root.

Procedure

1. Open a terminal window as a root user.
2. Register your Red Hat Enterprise Linux system by using the activation key:

```
# subscription-manager register --activationkey=<activation_key_name> --  
org=<organization_ID>
```

When the system is successfully registered, an output similar to the following is displayed:

```
The system has been registered with id:  
62edc0f8-855b-4184-b1b8-72a9dc793b96
```

Additional resources

- [Using an activation key to register a system with Red Hat Subscription Manager](#)
- [Getting Started with RHEL System Registration](#)

CHAPTER 13. CONFIGURING SYSTEM PURPOSE USING THE SUBSCRIPTION-MANAGER COMMAND-LINE TOOL

System purpose is a feature of the Red Hat Enterprise Linux installation to help RHEL customers get the benefit of our subscription experience and services offered in the Red Hat Hybrid Cloud Console, a dashboard-based, Software-as-a-Service (SaaS) application that enables you to view subscription usage in your Red Hat account.

You can configure system purpose attributes either on the activation keys or by using the subscription manager tool.

Prerequisites

- You have installed and registered your Red Hat Enterprise Linux 9 system, but system purpose is not configured.
- You are logged in as a **root** user.



NOTE

In the entitlement mode, if your system is registered but has subscriptions that do not satisfy the required purpose, you can run the **subscription-manager remove --all** command to remove attached subscriptions. You can then use the command-line subscription-manager syspurpose {role, usage, service-level} tools to set the required purpose attributes, and lastly run **subscription-manager attach --auto** to re-entitle the system with considerations for the updated attributes. Whereas, in the SCA enabled account, you can directly update the system purpose details post registration without making an update to the subscriptions in the system.

Procedure

1. From a terminal window, run the following command to set the intended role of the system:

```
# subscription-manager syspurpose role --set "VALUE"
```

Replace **VALUE** with the role that you want to assign:

- **Red Hat Enterprise Linux Server**
- **Red Hat Enterprise Linux Workstation**
- **Red Hat Enterprise Linux Compute Node**

For example:

```
# subscription-manager syspurpose role --set "Red Hat Enterprise Linux Server"
```

- a. Optional: Before setting a value, see the available roles supported by the subscriptions for your organization:

```
# subscription-manager syspurpose role --list
```

- b. Optional: Run the following command to unset the role:

```
# subscription-manager syspurpose role --unset
```

2. Run the following command to set the intended Service Level Agreement (SLA) of the system:

```
# subscription-manager syspurpose service-level --set "VALUE"
```

Replace **VALUE** with the SLA that you want to assign:

- **Premium**
- **Standard**
- **Self-Support**

For example:

```
# subscription-manager syspurpose service-level --set "Standard"
```

- a. Optional: Before setting a value, see the available service-levels supported by the subscriptions for your organization:

```
# subscription-manager syspurpose service-level --list
```

- b. Optional: Run the following command to unset the SLA:

```
# subscription-manager syspurpose service-level --unset
```

3. Run the following command to set the intended usage of the system:

```
# subscription-manager syspurpose usage --set "VALUE"
```

Replace **VALUE** with the usage that you want to assign:

- **Production**
- **Disaster Recovery**
- **Development/Test**

For example:

```
# subscription-manager syspurpose usage --set "Production"
```

- a. Optional: Before setting a value, see the available usages supported by the subscriptions for your organization:

```
# subscription-manager syspurpose usage --list
```

- b. Optional: Run the following command to unset the usage:

```
# subscription-manager syspurpose usage --unset
```

4. Run the following command to show the current system purpose properties:

```
# subscription-manager syspurpose --show
```

- a. Optional: For more detailed syntax information run the following command to access the **subscription-manager** man page and browse to the SYSPURPOSE OPTIONS:

```
# man subscription-manager
```

Verification

- To verify the system's subscription status in a system registered with an account having entitlement mode enabled:

```
# subscription-manager status
+-----+
System Status Details
+-----+
Overall Status: Current

System Purpose Status: Matched
```

- An overall status **Current** means that all of the installed products are covered by the subscription(s) attached and entitlements to access their content set repositories has been granted.
- A system purpose status **Matched** means that all of the system purpose attributes (role, usage, service-level) that were set on the system are satisfied by the subscription(s) attached.
- When the status information is not ideal, additional information is displayed to help the system administrator decide what corrections to make to the attached subscriptions to cover the installed products and intended system purpose.
- To verify the system's subscription status in a system registered with an account having SCA mode enabled:

```
# subscription-manager status
+-----+
System Status Details
+-----+
Overall Status: Disabled
Content Access Mode is set to Simple Content Access. This host has access to content,
regardless of subscription status.
System Purpose Status: Disabled
```

- In SCA mode, subscriptions are no longer required to be attached to individual systems. Hence, both the overall status and system purpose status are displayed as Disabled . However, the technical, business, and operational use cases supplied by system purpose attributes are important to the subscriptions service. Without these attributes, the subscriptions service data is less accurate.

Additional resources

- To learn more about the subscriptions service, see the [Getting Started with the Subscriptions Service guide](#).

CHAPTER 14. SECURING YOUR SYSTEM

You must secure your Red Hat Enterprise Linux system after completing the installation process.

Prerequisites

- You have completed the graphical installation.

Procedure

1. To update your system, run the following command as root:

```
# dnf update
```

2. Even though the firewall service, **firewalld**, is automatically enabled with the installation of Red Hat Enterprise Linux, there are scenarios where it might be explicitly disabled, for example in a Kickstart configuration. In that scenario, you re-enable the firewall.
To start **firewalld**, run the following commands as root:

```
# systemctl start firewalld  
# systemctl enable firewalld
```

3. To enhance security, disable services that you do not need. For example, if your system has no printers installed, disable the cups service using the following command:

```
# systemctl mask cups
```

To review active services, run the following command:

```
$ systemctl list-units | grep service
```


CHAPTER 15. CHANGING A SUBSCRIPTION SERVICE

To manage the subscriptions, you can register a RHEL system with either Red Hat Subscription Management Server or Red Hat Satellite Server. If required, you can change the subscription service at a later point. To change the subscription service under which you are registered, unregister the system from the current service and then register it with a new service.

To receive the system updates, register your system with either of the management server.

This section contains information about how to unregister your RHEL system from the Red Hat Subscription Management Server and Red Hat Satellite Server.

Prerequisites

You have registered your system with any one of the following:

- Red Hat Subscription Management Server
- Red Hat Satellite Server version 6.11

To receive the system updates, register your system with either of the management server.

15.1. UNREGISTERING FROM SUBSCRIPTION MANAGEMENT SERVER

This section contains information about how to unregister a RHEL system from Red Hat Subscription Management Server, using a command line and the Subscription Manager user interface.

15.1.1. Unregistering using command line

Use the **unregister** command to unregister a RHEL system from Red Hat Subscription Management Server.

Procedure

1. Run the unregister command as a root user, without any additional parameters.

```
# subscription-manager unregister
```

2. When prompted, provide a root password.

The system is unregistered from the Subscription Management Server, and the status 'The system is currently not registered' is displayed with the **Register** button enabled.

To continue uninterrupted services, re-register the system with either of the management services. If you do not register the system with a management service, you may fail to receive the system updates. For more information about registering a system, see [Registering your system using the command line](#).

Additional resources

- [Using and Configuring Red Hat Subscription Manager](#)

15.1.2. Unregistering using Subscription Manager user interface

This section contains information about how to unregister a RHEL system from Red Hat Subscription Management Server, using Subscription Manager user interface.

Procedure

1. Log in to your system.
2. From the top left-hand side of the window, click **Activities**.
3. From the menu options, click the **Show Applications** icon.
4. Click the **Red Hat Subscription Manager** icon, or enter **Red Hat Subscription Manager** in the search.
5. Enter your administrator password in the **Authentication Required** dialog box. The **Subscriptions** window appears and displays the current status of Subscriptions, System Purpose, and installed products. Unregistered products display a red X. Authentication is required to perform privileged tasks on the system.
6. Click the **Unregister** button.

The system is unregistered from the Subscription Management Server, and the status 'The system is currently not registered' is displayed with the **Register** button enabled.

To continue uninterrupted services, re-register the system with either of the management services. If you do not register the system with a management service, you may fail to receive the system updates. For more information about registering a system, see [Registering your system using the Subscription Manager User Interface](#).

Additional resources

- [Using and Configuring Red Hat Subscription Manager](#)

15.2. UNREGISTERING FROM SATELLITE SERVER

To unregister a Red Hat Enterprise Linux system from Satellite Server, remove the system from Satellite Server.

For more information, see [Removing a Host from Red Hat Satellite](#) .

PART IV. APPENDICES

Tools and techniques to help identify, analyze, and address potential problems. It also covers best practices for reporting bugs, ensuring that issues are clearly communicated for prompt resolution.

APPENDIX A. TOOLS AND TIPS FOR TROUBLESHOOTING AND BUG REPORTING

The troubleshooting information in the following sections might be helpful when diagnosing issues at the start of the installation process. The following sections are for all supported architectures. However, if an issue is for a particular architecture, it is specified at the start of the section.

A.1. DRACUT

Dracut is a tool that manages the **initramfs** image during the Linux operating system boot process. The **dracut** emergency shell is an interactive mode that can be initiated while the **initramfs** image is loaded. You can run basic troubleshooting commands from the **dracut** emergency shell. For more information, see the **Troubleshooting** section of the **dracut** man page on your system.

A.2. USING INSTALLATION LOG FILES

For debugging purposes, the installation program logs installation actions in files that are located in the **/tmp** directory. These log files are listed in the following table.

Table A.1. Log files generated during the installation

Log file	Contents
/tmp/anaconda.log	General messages.
/tmp/program.log	All external programs run during the installation.
/tmp/storage.log	Extensive storage module information.
/tmp/packaging.log	dnf and rpm package installation messages.
/tmp/dbus.log	Information about the dbus session that is used for installation program modules.
/tmp/sensitive-info.log	Configuration information that is not part of other logs and not copied to the installed system.
/tmp/syslog	Hardware-related system messages. This file contains messages from other Anaconda files.

If the installation fails, the messages are consolidated into **/tmp/anaconda-tb-identifier**, where identifier is a random string. After a successful installation, these files are copied to the installed system under the directory **/var/log/anaconda/**. However, if the installation is unsuccessful, or if the **inst.nosave=all** or **inst.nosave=logs** options are used when booting the installation system, these logs only exist in the installation program's RAM disk. This means that the logs are not saved permanently and are lost when the system is powered down. To store them permanently, copy the files to another system on the network or copy them to a mounted storage device such as a USB flash drive.

A.2.1. Creating pre-installation log files

Use this procedure to set the **inst.debug** option to create log files before the installation process starts. These log files contain, for example, the current storage configuration.

Prerequisites

- The Red Hat Enterprise Linux boot menu is open.

Procedure

1. Select the **Install Red Hat Enterprise Linux** option from the boot menu.
2. Press the **Tab** key on BIOS-based systems or the **e** key on UEFI-based systems to edit the selected boot options.
3. Append **inst.debug** to the options. For example:

```
vmlinuz ... inst.debug
```

4. Press the **Enter** key on your keyboard. The system stores the pre-installation log files in the **/tmp/pre-anaconda-logs/** directory before the installation program starts.
5. To access the log files, switch to the console.
6. Change to the **/tmp/pre-anaconda-logs/** directory:

```
# cd /tmp/pre-anaconda-logs/
```

Additional resources

- [Boot options reference](#)
- [Console logging during installation](#)

A.2.2. Transferring installation log files to a USB drive

Use this procedure to transfer installation log files to a USB drive.

Prerequisites

- You have backed up data from the USB drive.
- You are logged into a root account and you have access to the installation program's temporary file system.

Procedure

1. Press **Ctrl + Alt + F2** to access a shell prompt on the system you are installing.
2. Connect a USB flash drive to the system and run the **dmesg** command:

```
# dmesg
```

A log detailing all recent events is displayed. At the end of this log, a set of messages is displayed. For example:

```
[ 170.171135] sd 5:0:0:0: [sdb] Attached SCSI removable disk
```

3. Note the name of the connected device. In the above example, it is **sdb**.
4. Navigate to the **/mnt** directory and create a new directory that serves as the mount target for the USB drive. This example uses the name **usb**:

```
# mkdir usb
```

5. Mount the USB flash drive onto the newly created directory. In most cases, you do not want to mount the whole drive, but a partition on it. Do not use the name **sdb**, use the name of the partition you want to write the log files to. In this example, the name **sdb1** is used:

```
# mount /dev/sdb1 /mnt/usb
```

6. Verify that you mounted the correct device and partition by accessing it and listing its contents:

```
# cd /mnt/usb
```

```
# ls
```

7. Copy the log files to the mounted device.

```
# cp /tmp/*log /mnt/usb
```

8. Unmount the USB flash drive. If you receive an error message that the target is busy, change your working directory to outside the mount (for example, /).

```
# umount /mnt/usb
```

A.2.3. Transferring installation log files over the network

Use this procedure to transfer installation log files over the network.

Prerequisites

- You are logged into a root account and you have access to the installation program's temporary file system.

Procedure

1. Press **Ctrl + Alt + F2** to access a shell prompt on the system you are installing.
2. Switch to the **/tmp** directory where the log files are located:

```
# cd /tmp
```

3. Copy the log files onto another system on the network using the **scp** command:

```
# scp *log user@address:path
```

- a. Replace **user** with a valid user name on the target system, **address** with the target system's address or host name, and **path** with the path to the directory where you want to save the log files. For example, if you want to log in as **john** on a system with an IP address of 192.168.0.122 and place the log files into the **/home/john/logs/** directory on that system, the command is as follows:

```
# scp *log john@192.168.0.122:/home/john/logs/
```

When connecting to the target system for the first time, the SSH client asks you to confirm that the fingerprint of the remote system is correct and that you want to continue:

```
The authenticity of host '192.168.0.122 (192.168.0.122)' can't be established.  
ECDSA key fingerprint is a4:60:76:eb:b2:d0:aa:23:af:3d:59:5c:de:bb:c4:42.  
Are you sure you want to continue connecting (yes/no)?
```

- b. Type **yes** and press **Enter** to continue. Provide a valid password when prompted. The files are transferred to the specified directory on the target system.

A.3. DETECTING MEMORY FAULTS USING THE MEMTEST86 APPLICATION

Faults in memory (RAM) modules can cause your system to fail unpredictably. In certain situations, memory faults might only cause errors with particular combinations of software. For this reason, you should test your system's memory before you install Red Hat Enterprise Linux.

Red Hat Enterprise Linux includes the **Memtest86+** memory testing application for BIOS systems only. Support for UEFI systems is currently unavailable.

A.3.1. Running Memtest86

Use this procedure to run the **Memtest86** application to test your system's memory for faults before you install Red Hat Enterprise Linux.

Prerequisites

- You have accessed the Red Hat Enterprise Linux boot menu.

Procedure

1. From the Red Hat Enterprise Linux boot menu, select **Troubleshooting > Run a memory test**. The **Memtest86** application window is displayed and testing begins immediately. By default, **Memtest86** performs ten tests in every pass. After the first pass is complete, a message is displayed in the lower part of the window informing you of the current status. Another pass starts automatically.
If **Memtest86+** detects an error, the error is displayed in the central pane of the window and is highlighted in red. The message includes detailed information such as which test detected a problem, the memory location that is failing, and others. In most cases, a single successful pass of all 10 tests is sufficient to verify that your RAM is in good condition. In rare circumstances, however, errors that went undetected during the first pass might appear on subsequent passes. To perform a thorough test on important systems, run the tests overnight or for a few days to complete multiple passes.

The amount of time it takes to complete a single full pass of **Memtest86+** varies depending on your system's configuration, notably the RAM size and speed. For example, on a system with 2 GiB of DDR2 memory at 667 MHz, a single pass takes 20 minutes to complete.

- Optional: Follow the on-screen instructions to access the **Configuration** window and specify a different configuration.
- To halt the tests and reboot your computer, press the **Esc** key at any time.

Additional resources

- [How to use Memtest86](#)

A.4. VERIFYING BOOT MEDIA

Verifying ISO images helps to avoid problems that are sometimes encountered during installation. These sources include DVD and ISO images stored on a disk or NFS server. Use this procedure to test the integrity of an ISO-based installation source before using it to install Red Hat Enterprise Linux.

Prerequisites

- You have accessed the Red Hat Enterprise Linux boot menu.

Procedure

- From the boot menu, select **Test this media & install Red Hat Enterprise Linux 9** to test the boot media.
- The boot process tests the media and highlights any issues.
- Optional: You can start the verification process by appending **rd.live.check** to the boot command line.

A.5. CONSOLES AND LOGGING DURING INSTALLATION

The Red Hat Enterprise Linux installer uses the **tmux** terminal multiplexer to display and control several windows in addition to the main interface. Each of these windows serve a different purpose; they display several different logs, which can be used to troubleshoot issues during the installation process. One of the windows provides an interactive shell prompt with **root** privileges, unless this prompt was specifically disabled using a boot option or a Kickstart command.

The terminal multiplexer is running in virtual console 1. To switch from the actual installation environment to **tmux**, press **Ctrl+Alt+F1**. To go back to the main installation interface which runs in virtual console 6, press **Ctrl+Alt+F6**. During the text mode installation, start in virtual console 1 (**tmux**), and switching to console 6 will open a shell prompt instead of a graphical interface.

The console running **tmux** has five available windows; their contents are described in the following table, along with keyboard shortcuts. Note that the keyboard shortcuts are two-part: first press **Ctrl+b**, then release both keys, and press the number key for the window you want to use.

You can also use **Ctrl+b n**, **Alt+ Tab**, and **Ctrl+b p** to switch to the next or previous **tmux** window, respectively.

Table A.2. Available tmux windows

Shortcut	Contents
Ctrl+b 1	Main installation program window. Contains text-based prompts (during text mode installation or if you use VNC direct mode), and also some debugging information.
Ctrl+b 2	Interactive shell prompt with root privileges.
Ctrl+b 3	Installation log; displays messages stored in /tmp/anaconda.log .
Ctrl+b 4	Storage log; displays messages related to storage devices and configuration, stored in /tmp/storage.log .
Ctrl+b 5	Program log; displays messages from utilities executed during the installation process, stored in /tmp/program.log .

A.6. SAVING SCREENSHOTS

You can press **Shift+Print Screen** at any time during the graphical installation to capture the current screen. The screenshots are saved to **/tmp/anaconda-screenshots**.

A.7. DISPLAY SETTINGS AND DEVICE DRIVERS

Some video cards have trouble booting into the Red Hat Enterprise Linux graphical installation program. If the installation program does not run using its default settings, it attempts to run in a lower resolution mode. If that fails, the installation program attempts to run in text mode.

There are several possible solutions to resolve display issues, most of which involve specifying custom boot options:

For more information, see [Console boot options](#).

Table A.3. Solutions

Solution	Description
Use the text mode	You can attempt to perform the installation using the text mode. For details, refer to Installing RHEL in text mode .
Specify the display resolution manually	If the installation program fails to detect your screen resolution, you can override the automatic detection and specify it manually. To do this, append the inst.resolution=x option at the boot menu, where x is your display's resolution, for example, 1024x768.

Solution	Description
Use an alternate video driver	You can attempt to specify a custom video driver, overriding the installation program's automatic detection. To specify a driver, use the inst.xdriver=x option, where x is the device driver you want to use (for example, nouveau)*.
Perform the installation using VNC	If the above options fail, you can use a separate system to access the graphical installation over the network, using the Virtual Network Computing (VNC) protocol. For details on installing using VNC, see the Preparing a remote installation by using VNC .

- If specifying a custom video driver solves your problem, you should report it as a bug in [Jira](#). The installation program should be able to detect your hardware automatically and use the appropriate driver without intervention.

APPENDIX B. TROUBLESHOOTING

The troubleshooting information in the following sections might be helpful when diagnosing issues after the installation process. The following sections are for all supported architectures. However, if an issue is for a particular architecture, it is specified at the start of the section.

B.1. RESUMING AN INTERRUPTED DOWNLOAD ATTEMPT

You can resume an interrupted download using the **curl** command.

Prerequisite

- You have navigated to the **Product Downloads** section of the Red Hat Customer Portal at <https://access.redhat.com/downloads>, and selected the required variant, version, and architecture.
- You have right-clicked on the required ISO file, and selected **Copy Link Location** to copy the URL of the ISO image file to your clipboard.

Procedure

1. Download the ISO image from the new link. Add the **--continue-at -** option to automatically resume the download:

```
$ curl --output directory-path/filename.iso 'new_copied_link_location' --continue-at -
```

2. Use a checksum utility such as **sha256sum** to verify the integrity of the image file after the download finishes:

```
$ sha256sum rhel-x.x-x86_64-dvd.iso
85a...46c rhel-x.x-x86_64-dvd.iso
```

Compare the output with reference checksums provided on the Red Hat Enterprise Linux **Product Download** web page.

Example B.1. Resuming an interrupted download attempt

The following is an example of a **curl** command for a partially downloaded ISO image:

```
$ curl --output _rhel-x.x-x86_64-dvd.iso
'https://access.cdn.redhat.com//content/origin/files/sha256/85/85a...46c/rhel-x.x-x86_64-dvd.iso?_auth=141...963' --continue-at -
```

B.2. DISKS ARE NOT DETECTED

If the installation program cannot find a writable storage device to install to, it returns the following error message in the **Installation Destination** window: **No disks detected. Please shut down the computer, connect at least one disk, and restart to complete installation.**

Check the following items:

- Your system has at least one storage device attached.

- If your system uses a hardware RAID controller; verify that the controller is properly configured and working as expected. See your controller's documentation for instructions.
- If you are installing into one or more iSCSI devices and there is no local storage present on the system, verify that all required LUNs are presented to the appropriate Host Bus Adapter (HBA).

If the error message is still displayed after rebooting the system and starting the installation process, the installation program failed to detect the storage. In many cases the error message is a result of attempting to install on an iSCSI device that is not recognized by the installation program.

In this scenario, you must perform a driver update before starting the installation. Check your hardware vendor's website to determine if a driver update is available. For more general information about driver updates, see the [Updating drivers during installation](#).

You can also consult the Red Hat Hardware Compatibility List, available at <https://access.redhat.com/ecosystem/search/#/category/Server>.

B.3. CANNOT BOOT WITH A RAID CARD

If you cannot boot your system after the installation, you might need to reinstall and repartition your system's storage. Some BIOS types do not support booting from RAID cards. After you finish the installation and reboot the system for the first time, a text-based screen displays the boot loader prompt (for example, **grub>**) and a flashing cursor might be displayed. If this is the case, you must repartition your system and move your **/boot** partition and the boot loader outside of the RAID array. The **/boot** partition and the boot loader must be on the same drive. Once these changes have been made, you should be able to finish your installation and boot the system properly.

B.4. GRAPHICAL BOOT SEQUENCE IS NOT RESPONDING

When rebooting your system for the first time after installation, the system might be unresponsive during the graphical boot sequence. If this occurs, a reset is required. In this scenario, the boot loader menu is displayed successfully, but selecting any entry and attempting to boot the system results in a halt. This usually indicates that there is a problem with the graphical boot sequence. To resolve the issue, you must disable the graphical boot by temporarily altering the setting at boot time before changing it permanently.

Procedure: Disabling the graphical boot temporarily

1. Start your system and wait until the boot loader menu is displayed. If you set your boot timeout period to **0**, press the **Esc** key to access it.
2. From the boot loader menu, use your cursor keys to highlight the entry you want to boot. Press the **Tab** key on BIOS-based systems or the **e** key on UEFI-based systems to edit the selected entry options.
3. In the list of options, find the kernel line - that is, the line beginning with the keyword **linux**. On this line, locate and delete **rhgb**.
4. Press **F10** or **Ctrl+X** to boot your system with the edited options.

If the system started successfully, you can log in normally. However, if you do not disable graphical boot permanently, you must perform this procedure every time the system boots.

Procedure: Disabling the graphical boot permanently

1. Log in to the root account on your system.
2. Use the grubby tool to find the default GRUB2 kernel:

```
# grubby --default-kernel
/boot/vmlinuz-4.18.0-94.el8.x86_64
```

3. Use the grubby tool to remove the **rhgb** boot option from the default kernel in your GRUB2 configuration. For example:

```
# grubby --remove-args="rhgb" --update-kernel /boot/vmlinuz-4.18.0-94.el8.x86_64
```

4. Reboot the system. The graphical boot sequence is no longer used. If you want to enable the graphical boot sequence, follow the same procedure, replacing the **--remove-args="rhgb"** parameter with the **--args="rhgb"** parameter. This restores the **rhgb** boot option to the default kernel in your GRUB2 configuration.

B.5. X SERVER FAILS AFTER LOG IN

An X server is a program in the X Window System that runs on local machines, that is, the computers used directly by users. X server handles all access to the graphics cards, display screens and input devices, typically a keyboard and mouse on those computers. The X Window System, often referred to as X, is a complete, cross-platform and free client-server system for managing GUIs on single computers and on networks of computers. The client-server model is an architecture that divides the work between two separate but linked applications, referred to as clients and servers.*

If X server crashes after login, one or more of the file systems might be full. To troubleshoot the issue, execute the following command:

```
$ df -h
```

The output verifies which partition is full - in most cases, the problem is on the **/home** partition. The following is a sample output of the **df** command:

Filesystem	Size	Used	Avail	Use%	Mounted on
devtmpfs	396M	0	396M	0%	/dev
tmpfs	411M	0	411M	0%	/dev/shm
tmpfs	411M	6.7M	405M	2%	/run
tmpfs	411M	0	411M	0%	/sys/fs/cgroup
/dev/mapper/rhel-root	17G	4.1G	13G	25%	/
/dev/sda1	1014M	173M	842M	17%	/boot
tmpfs	83M	20K	83M	1%	/run/user/42
tmpfs	83M	84K	83M	1%	/run/user/1000
/dev/dm-4	90G	90G	0	100%	/home

In the example, you can see that the **/home** partition is full, which causes the failure. Remove any unwanted files. After you free up some disk space, start X using the **startx** command. For additional information about **df** and an explanation of the options available, such as the **-h** option used in this example, see the **df(1)** man page on your system.

*Source: http://www.linfo.org/x_server.html

B.6. RAM IS NOT RECOGNIZED

In some scenarios, the kernel does not recognize all memory (RAM), which causes the system to use less memory than is installed. If the total amount of memory that your system reports does not match your expectations, it is likely that at least one of your memory modules is faulty. On BIOS-based systems, you can use the **Memtest86+** utility to test your system's memory.

Some hardware configurations have part of the system's RAM reserved, and as a result, it is unavailable to the system. Some laptop computers with integrated graphics cards reserve a portion of memory for the GPU. For example, a laptop with 4 GiB of RAM and an integrated Intel graphics card shows roughly 3.7 GiB of available memory. Additionally, the **kdump** crash kernel dumping mechanism, which is enabled by default on most Red Hat Enterprise Linux systems, reserves some memory for the secondary kernel used in case of a primary kernel failure. This reserved memory is not displayed as available.

Use this procedure to manually set the amount of memory.

Procedure

1. Check the amount of memory that your system currently reports in MiB:

```
$ free -m
```

2. Reboot your system and wait until the boot loader menu is displayed.
If your boot timeout period is set to **0**, press the **Esc** key to access the menu.
3. From the boot loader menu, use your cursor keys to highlight the entry you want to boot, and press the **Tab** key on BIOS-based systems or the **e** key on UEFI-based systems to edit the selected entry options.
4. In the list of options, find the kernel line: that is, the line beginning with the keyword **linux**. Append the following option to the end of this line:

```
mem=xxM
```

5. Replace **xx** with the amount of RAM you have in MiB.
6. Press **F10** or **Ctrl+X** to boot your system with the edited options.
7. Wait for the system to boot, log in, and open a command line.
8. Check the amount of memory that your system reports in MiB:

```
$ free -m
```

9. If the total amount of RAM displayed by the command now matches your expectations, make the change permanent:

```
# grubby --update-kernel=ALL --args="mem=xxM"
```

B.7. SYSTEM IS DISPLAYING SIGNAL 11 ERRORS

A signal 11 error, commonly known as a segmentation fault means that a program accessed a memory location that it was not assigned. A signal 11 error can occur due to a bug in one of the software programs that are installed, or faulty hardware. If you receive a signal 11 error during the installation process, verify that you are using the most recent installation images and prompt the installation program to verify them to ensure they are not corrupt.

For more information, see [Verifying Boot media](#).

Faulty installation media (such as an improperly burned or scratched optical disk) are a common cause of signal 11 errors. Verify the integrity of the installation media before every installation. For information about obtaining the most recent installation media, refer to [Product Downloads](#) page.

To perform a media check before the installation starts, append the **rd.live.check** boot option at the boot menu. If you performed a media check without any errors and you still have issues with segmentation faults, it usually indicates that your system encountered a hardware error. In this scenario, the problem is most likely in the system's memory (RAM). This can be a problem even if you previously used a different operating system on the same computer without any errors.



NOTE

For AMD and Intel 64-bit and 64-bit ARM architectures: On BIOS-based systems, you can use the **Memtest86+** memory testing module included on the installation media to perform a thorough test of your system's memory. For more information, see [Detecting memory faults using the Memtest86 application](#).

Other possible causes are beyond this document's scope. Consult your hardware manufacturer's documentation and also see the Red Hat Hardware Compatibility List, available online at <https://access.redhat.com/ecosystem/search/#/category/Server>.

B.8. UNABLE TO IPL FROM NETWORK STORAGE SPACE ON IBM POWER SYSTEMS

If you experience difficulties when trying to IPL from Network Storage Space (*NWSSTG), it is most likely due to a missing PReP partition. In this scenario, you must reinstall the system and create this partition during the partitioning phase or in the Kickstart file.

B.9. USING XDMCP

There are scenarios where you have installed the X Window System and want to log in to your Red Hat Enterprise Linux system using a graphical login manager. Use this procedure to enable the X Display Manager Control Protocol (XDMCP) and remotely log in to a desktop environment from any X-compatible client, such as a network-connected workstation or X11 terminal.



NOTE

XDMCP is not supported by the Wayland protocol.

Procedure

1. Open the **/etc/gdm/custom.conf** configuration file in a plain text editor such as **vi** or **nano**.
2. In the **custom.conf** file, locate the section starting with **[xdmcp]**. In this section, add the following line:

```
Enable=true
```

3. If you are using XDMCP, ensure that **WaylandEnable=false** is present in the **/etc/gdm/custom.conf** file.

4. Save the file and exit the text editor.
5. Restart the X Window System. To do this, either reboot the system, or restart the GNOME Display Manager using the following command as root:

```
# systemctl restart gdm.service
```



WARNING

Restarting the **gdm** service terminates all currently running GNOME sessions of all desktop users who are logged in. This might result in users losing unsaved data.

1. Wait for the login prompt and log in using your user name and password. The X Window System is now configured for XDMCP. You can connect to it from another workstation (client) by starting a remote X session using the X command on the client workstation. For example:

```
$ X :1 -query address
```

2. Replace **address** with the host name of the remote X11 server. The command connects to the remote X11 server using XDMCP and displays the remote graphical login screen on display :1 of the X11 server system (usually accessible by pressing **Ctrl-Alt-F8**). You can also access remote desktop sessions using a nested X11 server, which opens the remote desktop as a window in your current X11 session. You can use Xnest to open a remote desktop nested in a local X11 session. For example, run Xnest using the following command, replacing address with the host name of the remote X11 server:

```
$ Xnest :1 -query address
```

Additional resources

- [X Window System documentation](#)

B.10. USING RESCUE MODE

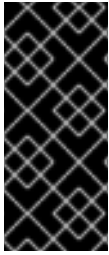
The installation program's rescue mode is a minimal Linux environment that can be booted from the Red Hat Enterprise Linux DVD or other boot media. It contains command-line utilities for repairing a wide variety of issues. Rescue mode can be accessed from the **Troubleshooting** menu of the boot menu. In this mode, you can mount file systems as read-only, blacklist or add a driver provided on a driver disc, install or upgrade system packages, or manage partitions.



NOTE

The installation program's rescue mode is different from rescue mode (an equivalent to single-user mode) and emergency mode, which are provided as parts of the **systemd** system and service manager.

To boot into rescue mode, you must be able to boot the system using one of the Red Hat Enterprise Linux boot media, such as a minimal boot disc or USB drive, or a full installation DVD.



IMPORTANT

Advanced storage, such as iSCSI or zFCP devices, must be configured either using **dracut** boot options such as **rd.zfcp=** or **root=iscsi: options**, or in the CMS configuration file on 64-bit IBM Z. It is not possible to configure these storage devices interactively after booting into rescue mode. For information about **dracut** boot options, see the **dracut.cmdline(7)** man page on your system.

B.10.1. Booting into rescue mode

This procedure describes how to boot into rescue mode.

Procedure

1. Boot the system from either minimal boot media, or a full installation DVD or USB drive, and wait for the boot menu to be displayed.
2. From the boot menu, either select **Troubleshooting > Rescue a Red Hat Enterprise Linux system** option, or append the **inst.rescue** option to the boot command line. To enter the boot command line, press the **Tab** key on BIOS-based systems or the **e** key on UEFI-based systems.
3. Optional: If your system requires a third-party driver provided on a driver disc to boot, append the **inst.dd=driver_name** to the boot command line:

```
inst.rescue inst.dd=driver_name
```

4. Optional: If a driver that is part of the Red Hat Enterprise Linux distribution prevents the system from booting, append the **modprobe.blacklist=** option to the boot command line:

```
inst.rescue modprobe.blacklist=driver_name
```

5. Press **Enter** (BIOS-based systems) or **Ctrl+X** (UEFI-based systems) to boot the modified option. Wait until the following message is displayed:

The rescue environment will now attempt to find your Linux installation and mount it under the directory: **/mnt/sysroot/**. You can then make any changes required to your system. Choose 1 to proceed with this step. You can choose to mount your file systems read-only instead of read-write by choosing 2. If for some reason this process does not work choose 3 to skip directly to a shell.

- 1) Continue
- 2) Read-only mount
- 3) Skip to shell
- 4) Quit (Reboot)

If you select 1, the installation program attempts to mount your file system under the directory **/mnt/sysroot/**. You are notified if it fails to mount a partition. If you select 2, it attempts to mount your file system under the directory **/mnt/sysroot/**, but in read-only mode. If you select 3, your file system is not mounted.

For the system root, the installer supports two mount points **/mnt/sysimage** and **/mnt/sysroot**.

The **/mnt/sysroot** path is used to mount **/** of the target system. Usually, the physical root and the system root are the same, so **/mnt/sysroot** is attached to the same file system as **/mnt/sysimage**. The only exceptions are rpm-ostree systems, where the system root changes based on the deployment. Then, **/mnt/sysroot** is attached to a subdirectory of **/mnt/sysimage**. Use **/mnt/sysroot** for chroot.

6. Select **1** to continue. Once your system is in rescue mode, a prompt appears on VC (virtual console) 1 and VC 2. Use the **Ctrl+Alt+F1** key combination to access VC 1 and **Ctrl+Alt+F2** to access VC 2:

```
sh-4.2#
```

7. Even if your file system is mounted, the default root partition while in rescue mode is a temporary root partition, not the root partition of the file system used during normal user mode (**multi-user.target** or **graphical.target**). If you selected to mount your file system and it mounted successfully, you can change the root partition of the rescue mode environment to the root partition of your file system by executing the following command:

```
sh-4.2# chroot /mnt/sysroot
```

This is useful if you need to run commands, such as **rpm**, that require your root partition to be mounted as **/**. To exit the chroot environment, type **exit** to return to the prompt.

8. If you selected **3**, you can still try to mount a partition or LVM2 logical volume manually inside rescue mode by creating a directory, such as **/directory/**, and typing the following command:

```
sh-4.2# mount -t xfs /dev/mapper/VolGroup00-LogVol02 /directory
```

In the above command, **/directory/** is the directory that you created and **/dev/mapper/VolGroup00-LogVol02** is the LVM2 logical volume you want to mount. If the partition is a different type than XFS, replace the **xfs** string with the correct type (such as **ext4**).

9. If you do not know the names of all physical partitions, use the following command to list them:

```
sh-4.2# fdisk -l
```

If you do not know the names of all LVM2 physical volumes, volume groups, or logical volumes, use the **pvdisplay**, **vgdisplay** or **lvdisplay** commands.

B.10.2. Using an SOS report in rescue mode

The **sosreport** command-line utility collects configuration and diagnostic information, such as the running kernel version, loaded modules, and system and service configuration files from the system. The utility output is stored in a tar archive in the **/var/tmp/** directory. The **sosreport** utility is useful for analyzing system errors and troubleshooting. Use this procedure to capture an **sosreport** output in rescue mode.

Prerequisites

- You have booted into rescue mode.
- You have mounted the installed system **/ (root)** partition in read-write mode.
- You have contacted Red Hat Support about your case and received a case number.

Procedure

1. Change the root directory to the **/mnt/sysroot/** directory:

```
sh-4.2# chroot /mnt/sysroot/
```

2. Execute **sosreport** to generate an archive with system configuration and diagnostic information:

```
sh-4.2# sosreport
```

sosreport prompts you to enter your name and the case number you received from Red Hat Support. Use only letters and numbers because adding any of the following characters or spaces could render the report unusable: `# % & { } \ < > * ? / $ ~ ' " : @ + ` | =`

3. Optional: If you want to transfer the generated archive to a new location using the network, it is necessary to have a network interface configured. In this scenario, use the dynamic IP addressing as no other steps required. However, when using static addressing, enter the following command to assign an IP address (for example 10.13.153.64/23) to a network interface, for example dev eth0:

```
bash-4.2# ip addr add 10.13.153.64/23 dev eth0
```

4. Exit the chroot environment:

```
sh-4.2# exit
```

5. Store the generated archive in a new location, from where it can be easily accessible:

```
sh-4.2# cp /mnt/sysroot/var/tmp/sosreport new_location
```

6. For transferring the archive through the network, use the **scp** utility:

```
sh-4.2# scp /mnt/sysroot/var/tmp/sosreport username@hostname:sosreport
```

Additional resources

- [What is an sosreport and how to create one in Red Hat Enterprise Linux?](#)
- [How to generate sosreport from the rescue environment](#)
- [How do I make sosreport write to an alternative location?](#)
- [Sosreport fails. What data should I provide in its place?](#)

B.10.3. Reinstalling the GRUB2 boot loader

In some scenarios, the GRUB2 boot loader is mistakenly deleted, corrupted, or replaced by other operating systems. Use this procedure to reinstall GRUB2 on the master boot record (MBR) on AMD64 and Intel 64 systems with BIOS.

Prerequisites

- You have booted into rescue mode.
- You have mounted the installed system / **(root)** partition in read-write mode.
- You have mounted the **/boot** mount point in read-write mode.

Procedure

1. Change the root partition:

```
sh-4.2# chroot /mnt/sysroot/
```

2. Reinstall the GRUB2 boot loader, where the **install_device** block device was installed:

```
sh-4.2# /sbin/grub2-install install_device
```

IMPORTANT

Running the **grub2-install** command could lead to the machine being unbootable if all the following conditions apply:

- The system is an AMD64 or Intel 64 with Extensible Firmware Interface (EFI).
- Secure Boot is enabled.

After you run the **grub2-install** command, you cannot boot the AMD64 or Intel 64 systems that have Extensible Firmware Interface (EFI) and Secure Boot enabled. This issue occurs because the **grub2-install** command installs an unsigned GRUB2 image that boots directly instead of using the shim application. When the system boots, the shim application validates the image signature, which when not found fails to boot the system.

3. Reboot the system.

B.10.4. Using dnf to add or remove a driver

Missing or malfunctioning drivers cause problems when booting the system. Rescue mode provides an environment in which you can add or remove a driver even when the system fails to boot. Wherever possible, use the dnf package manager to remove malfunctioning drivers or to add updated or missing drivers.

IMPORTANT

When you install a driver from a driver disc, the driver disc updates all **initramfs** images on the system to use this driver. If a problem with a driver prevents a system from booting, you cannot rely on booting the system from another **initramfs** image.

B.10.4.1. Adding a driver using dnf

Use this procedure to add a driver.

Prerequisites

- You have booted into rescue mode.
- You have mounted the installed system in read-write mode.

Procedure

1. Make the RPM package that contains the driver available. For example, mount a CD or USB flash drive and copy the RPM package to a location of your choice under **/mnt/sysroot/**, for example: **/mnt/sysroot/root/drivers/**.
2. Change the root directory to **/mnt/sysroot/**:

```
sh-4.2# chroot /mnt/sysroot/
```

3. Use the **dnf install** command to install the driver package. For example, run the following command to install the **xorg-x11-drv-wacom** driver package from **/root/drivers/**:

```
sh-4.2# dnf install /root/drivers/xorg-x11-drv-wacom-0.23.0-6.el7.x86_64.rpm
```



NOTE

The **/root/drivers/** directory in this chroot environment is the **/mnt/sysroot/root/drivers/** directory in the original rescue environment.

4. Exit the chroot environment:

```
sh-4.2# exit
```

B.10.4.2. Removing a driver using dnf

Use this procedure to remove a driver.

Prerequisites

- You have booted into rescue mode.
- You have mounted the installed system in read-write mode.

Procedure

1. Change the root directory to the **/mnt/sysroot/** directory:

```
sh-4.2# chroot /mnt/sysroot/
```

2. Use the **dnf remove** command to remove the driver package. For example, to remove the **xorg-x11-drv-wacom** driver package, run:

```
sh-4.2# dnf remove xorg-x11-drv-wacom
```

3. Exit the chroot environment:

```
sh-4.2# exit
```

If you cannot remove a malfunctioning driver for some reason, you can instead blocklist the driver so that it does not load at boot time.

4. When you have finished adding and removing drivers, reboot the system.

B.11. IP= BOOT OPTION RETURNS AN ERROR

Using the **ip=** boot option format **ip=[ip address]** for example, **ip=192.168.1.1** returns the error message **Fatal for argument 'ip=[insert ip here]'\n sorry, unknown value [ip address] refusing to continue.**

In previous releases of Red Hat Enterprise Linux, the boot option format was:

```
ip=192.168.1.15 netmask=255.255.255.0 gateway=192.168.1.254 nameserver=192.168.1.250
hostname=myhost1
```

However, in Red Hat Enterprise Linux 9, the boot option format is:

```
ip=192.168.1.15::192.168.1.254:255.255.255.0:myhost1::none: nameserver=192.168.1.250
```

To resolve the issue, use the format: **ip=ip::gateway:netmask:hostname:interface:none** where:

- **ip** specifies the client ip address. You can specify IPv6 addresses in square brackets, for example, **[2001:DB8::1]**.
- **gateway** is the default gateway. IPv6 addresses are also accepted.
- **netmask** is the netmask to be used. This can be either a full netmask, for example, 255.255.255.0, or a prefix, for example, **64**.
- **hostname** is the host name of the client system. This parameter is optional.

Additional resources

- [Network boot options](#)

B.12. CANNOT BOOT INTO THE GRAPHICAL INSTALLATION ON ILO OR IDRAC DEVICES

The graphical installer for a remote ISO installation on iLO or iDRAC devices may not be available due to a slow internet connection. To proceed with the installation in this case, you can choose one of the following methods:

1. Avoid the timeout. To do so:
 - a. Press the **Tab** key in case of BIOS usage, or the **e** key in case of UEFI usage when booting from an installation media. That will allow you to modify the kernel command line arguments.
 - b. To proceed with the installation, append the **rd.live.ram=1** and press **Enter** in case of BIOS usage, or **Ctrl+x** in case of UEFI usage.
This might take longer time to load the installation program.

2. Another option to extend the loading time for the graphical installer is to set the **inst.xtimeout** kernel argument in seconds.

```
inst.xtimeout=N
```

3. You can install the system in text mode. For more details, see [Installing RHEL8 in text mode](#).
4. In the remote management console, such as iLO or iDRAC, instead of a local media source, use the direct URL to the installation ISO file from the [Download center](#) on the Red Hat Customer Portal. You must be logged in to access this section.

B.13. ROOTFS IMAGE IS NOT INITRAMFS

If you get the following message on the console during booting the installer, the transfer of the installer **initrd.img** might have had errors:

```
[...] rootfs image is not initramfs
```

To resolve this issue, download **initrd** again or run the **sha256sum** with **initrd.img** and compare it with the checksum stored in the **.treeinfo** file on the installation medium, for example,

```
$ sha256sum dvd/images/pxeboot/initrd.img
fdb1a70321c06e25a1ed6bf3d8779371b768d5972078eb72b2c78c925067b5d8
dvd/images/pxeboot/initrd.img
```

To view the checksum in **.treeinfo**:

```
$ grep sha256 dvd/.treeinfo
images/efiboot.img =
sha256:d357d5063b96226d643c41c9025529554a422acb43a4394e4ebcaa779cc7a917
images/install.img =
sha256:8c0323572f7fc04e34dd81c97d008a2ddfc2cfc525aef8c31459e21bf3397514
images/pxeboot/initrd.img =
sha256:fdb1a70321c06e25a1ed6bf3d8779371b768d5972078eb72b2c78c925067b5d8
images/pxeboot/vmlinuz =
sha256:b9510ea4212220e85351cbb7f2ebc2b1b0804a6d40ccb93307c165e16d1095db
```

Despite having correct **initrd.img**, if you get the following kernel messages during booting the installer, often a boot parameter is missing or mis-spelled, and the installer could not load **stage2**, typically referred to by the **inst.repo=** parameter, providing the full installer initial ramdisk for its in-memory root file system:

```
[...] No filesystem could mount root, tried:
[...] Kernel panic - not syncing: VFS: Unable to mount root fs on unknown-block(1,0)
[...] CPU: 0 PID: 1 Comm: swapper/0 Not tainted 5.14.0-55.el9.s390x #1
[...] ...
[...] Call Trace:
[...] ([<...>] show_trace+0x.../0x...)
[...] [<...>] show_stack+0x.../0x...
[...] [<...>] panic+0x.../0x...
[...] [<...>] mount_block_root+0x.../0x...
[...] [<...>] prepare_namespace+0x.../0x...
[...] [<...>] kernel_init_freeable+0x.../0x...
```

```
[ ...] [<...>] kernel_init+0x.../0x...  
[ ...] [<...>] kernel_thread_starter+0x.../0x...  
[ ...] [<...>] kernel_thread_starter+0x.../0x...
```

To resolve this issue, check

- if the installation source specified is correct on the kernel command line (**inst.repo=**) or in the kickstart file
- the network configuration is specified on the kernel command line (if the installation source is specified as network)
- the network installation source is accessible from another system