Red Hat Enterprise Linux 9

Automatically installing RHEL

Deploying RHEL on one or more systems from a predefined configuration

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Abstract

You can automate the RHEL installation by using Kickstart. Use this method to deploy the same RHEL configuration on many systems. Kickstart installs RHEL based on the parameters that you specify in a configuration file. The installation source can be an installation media, an ISO file, the Red Hat content delivery network (CDN), or a server in your local network.

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PART I. PREPARING THE RHEL INSTALLATION

Essential steps for preparing a RHEL installation environment addresses system requirements, supported architectures, and offers customization options for installation media. Additionally, it covers methods for creating bootable installation media, setting up network-based repositories, and configuring UEFI HTTP or PXE installation sources. Guidance is also included for systems using UEFI Secure Boot and for installing RHEL on 64-bit IBM Z architecture.

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)	• 1.5 GiB for aarch64, s390x and x86_64 architectures • 3 GiB for ppc64le architecture
NFS network installation	• 1.5 GiB for aarch64, s390x and x86_64 architectures • 3 GiB for ppc64le architecture
HTTP, HTTPS or FTP network installation	• 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	**Minimum**: 800 x 600 **Recommended**: 1026 x 768

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 firware 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

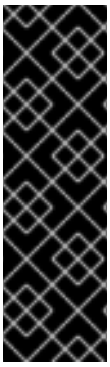
Registration establishes an authorized connection between your system and Red Hat. Red Hat issues the registered system, whether a physical or virtual machine, a certificate that identifies and authenticates the system so that it can receive protected content, software updates, security patches, support,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

You must prepare repositories to install RHEL from your network system.

5.1. PORTS FOR NETWORK-BASED INSTALLATION

The following table lists the ports that must be open on the server for providing the files for each type of network-based installation.

Table 5.1. Ports for network-based installation

Protocol used	Ports to open
HTTP	80
HTTPS	443
FTP	21
NFS	2049, 111, 20048
TFTP	69

Additional resources

- Securing networks

5.2. CREATING AN INSTALLATION SOURCE ON AN NFS SERVER

You can use this installation method to install multiple systems from a single source, without having to connect to physical media.

Prerequisites

- You have an administrator-level access to a server with Red Hat Enterprise Linux 9, and this server is on the same network as the system to be installed.
- You have downloaded the full installation DVD ISO from the Product Downloads page.
- You have created a bootable CD, DVD, or USB device from the image file.
- You have verified that your firewall allows the system you are installing to access the remote installation source. For more information, see Ports for network-based installation .

IMPORTANT

Ensure that you use different paths in **inst.ks** and **inst.repo**. When using NFS to host the installation source, you cannot use the same nfs share to host the Kickstart.

Procedure

1. Install the **nfs-utils** package:

```
# dnf install nfs-utils
```

2. Copy the DVD ISO image to a directory on the NFS server.
3. Open the **/etc/exports** file using a text editor and add a line with the following syntax:

```
/exported_directory/ clients
```

- Replace */exported_directory/* with the full path to the directory with the ISO image.
- Replace *clients* with one of the following:
  - The host name or IP address of the target system
  - The subnetwork that all target systems can use to access the ISO image
  - To allow any system with network access to the NFS server to use the ISO image, the asterisk sign (*)

  See the **exports(5)** man page for detailed information about the format of this field.

  For example, a basic configuration that makes the **/rhel9-install/** directory available as read-only to all clients is:

```
/rhel9-install *
```

4. Save the **/etc/exports** file and exit the text editor.
5. Start the nfs service:

```
# systemctl start nfs-server.service
```

If the service was running before you changed the **/etc/exports** file, reload the NFS server configuration:

```
# systemctl reload nfs-server.service
```

The ISO image is now accessible over NFS and ready to be used as an installation source.

When configuring the installation source, use **nfs:** as the protocol, the server host name or IP address, the colon sign **(:)**, and the directory holding the ISO image. For example, if the server host name is **myserver.example.com** and you have saved the ISO image in **/rhel9-install/**, specify **nfs:myserver.example.com:/rhel9-install/** as the installation source.

5.3. CREATING AN INSTALLATION SOURCE USING HTTP OR HTTPS

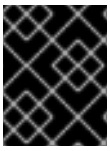
You can create an installation source for a network-based installation using an installation tree, which is a directory containing extracted contents of the DVD ISO image and a valid **.treeinfo** file. The installation source is accessed over HTTP or HTTPS.

Prerequisites

- You have an administrator-level access to a server with Red Hat Enterprise Linux 9, and this server is on the same network as the system to be installed.
- You have downloaded the full installation DVD ISO from the Product Downloads page.
- You have created a bootable CD, DVD, or USB device from the image file.
- You have verified that your firewall allows the system you are installing to access the remote installation source. For more information, see Ports for network-based installation .
- The **httpd** package is installed.
- The **mod_ssl** package is installed, if you use the **https** installation source.

WARNING

If your Apache web server configuration enables SSL security, prefer to enable the TLSv1.3 protocol. By default, TLSv1.2 (LEGACY) is enabled.



IMPORTANT

If you use an HTTPS server with a self-signed certificate, you must boot the installation program with the **noverifyssl** option.

Procedure

1. Copy the DVD ISO image to the HTTP(S) server.
2. Create a suitable directory for mounting the DVD ISO image, for example:

```
# mkdir /mnt/rhel9-install/
```

3. Mount the DVD ISO image to the directory:

```
# mount -o loop,ro -t iso9660 /image_directory/image.iso /mnt/rhel9-install/
```

   Replace */image_directory/image.iso* with the path to the DVD ISO image.

4. Copy the files from the mounted image to the HTTP(S) server root.

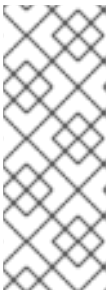
```
# cp -r /mnt/rhel9-install/ /var/www/html/
```

   This command creates the **/var/www/html/rhel9-install/** directory with the content of the image. Note that some other copying methods might skip the **.treeinfo** file which is required for a valid installation source. Entering the **cp** command for entire directories as shown in this procedure copies **.treeinfo** correctly.

5. Start the **httpd** service:

```
# systemctl start httpd.service
```

The installation tree is now accessible and ready to be used as the installation source.



NOTE

When configuring the installation source, use **http://** or **https://** as the protocol, the server host name or IP address, and the directory that contains the files from the ISO image, relative to the HTTP server root. For example, if you use HTTP, the server host name is **myserver.example.com**, and you have copied the files from the image to **/var/www/html/rhel9-install/**, specify **http://myserver.example.com/rhel9-install/** as the installation source.

Additional resources

- Deploying different types of servers

5.4. CREATING AN INSTALLATION SOURCE USING FTP

You can create an installation source for a network-based installation using an installation tree, which is a directory containing extracted contents of the DVD ISO image and a valid **.treeinfo** file. The installation source is accessed over FTP.

Prerequisites

- You have an administrator-level access to a server with Red Hat Enterprise Linux 9, and this server is on the same network as the system to be installed.
- You have downloaded the full installation DVD ISO from the Product Downloads page.
- You have created a bootable CD, DVD, or USB device from the image file.
- You have verified that your firewall allows the system you are installing to access the remote installation source. For more information, see Ports for network-based installation .
- The **vsftpd** package is installed.

Procedure

1. Open and edit the **/etc/vsftpd/vsftpd.conf** configuration file in a text editor.
   a. Change the line **anonymous_enable=NO** to **anonymous_enable=YES**
   b. Change the line **write_enable=YES** to **write_enable=NO**.
   c. Add lines **pasv_min_port=<*min_port*>** and **pasv_max_port=<*max_port*>**. Replace <*min_port*> and <*max_port*> with the port number range used by FTP server in passive mode, for example, **10021** and **10031**.
   This step might be necessary in network environments featuring various firewall/NAT setups.
   d. Optional: Add custom changes to your configuration. For available options, see the **vsftpd.conf(5)** man page. This procedure assumes that default options are used.

WARNING

If you configured SSL/TLS security in your **vsftpd.conf** file, ensure that you enable only the TLSv1 protocol, and disable SSLv2 and SSLv3. This is due to the POODLE SSL vulnerability (CVE-2014-3566). See https://access.redhat.com/solutions/1234773 for details.

2. Configure the server firewall.

   a. Enable the firewall:

   ```
   # systemctl enable firewalld
   ```

   b. Start the firewall:

   ```
   # systemctl start firewalld
   ```

   c. Configure the firewall to allow the FTP port and port range from the previous step:

   ```
   # firewall-cmd --add-port min_port-max_port/tcp --permanent
   # firewall-cmd --add-service ftp --permanent
   ```

   Replace <*min_port*> and <*max_port*> with the port numbers you entered into the **/etc/vsftpd/vsftpd.conf** configuration file.

   d. Reload the firewall to apply the new rules:

   ```
   # firewall-cmd --reload
   ```

3. Copy the DVD ISO image to the FTP server.

4. Create a suitable directory for mounting the DVD ISO image, for example:

   ```
   # mkdir /mnt/rhel9-install
   ```

5. Mount the DVD ISO image to the directory:

   ```
   # mount -o loop,ro -t iso9660 /image-directory/image.iso /mnt/rhel9-install
   ```

   Replace ***/image-directory/image.iso*** with the path to the DVD ISO image.

6. Copy the files from the mounted image to the FTP server root:

   ```
   # mkdir /var/ftp/rhel9-install
   # cp -r /mnt/rhel9-install/ /var/ftp/
   ```

   This command creates the **/var/ftp/rhel9-install/** directory with the content of the image. Some copying methods can skip the **.treeinfo** file which is required for a valid installation source. Entering the **cp** command for whole directories as shown in this procedure will copy **.treeinfo**

correctly.

7. Make sure that the correct SELinux context and access mode is set on the copied content:

```
# restorecon -r /var/ftp/rhel9-install
# find /var/ftp/rhel9-install -type f -exec chmod 444 {} \;
# find /var/ftp/rhel9-install -type d -exec chmod 755 {} \;
```

8. Start the **vsftpd** service:

```
# systemctl start vsftpd.service
```

If the service was running before you changed the **/etc/vsftpd/vsftpd.conf** file, restart the service to load the edited file:

```
# systemctl restart vsftpd.service
```

Enable the **vsftpd** service to start during the boot process:

```
# systemctl enable vsftpd
```

The installation tree is now accessible and ready to be used as the installation source.

When configuring the installation source, use **ftp://** as the protocol, the server host name or IP address, and the directory in which you have stored the files from the ISO image, relative to the FTP server root. For example, if the server host name is **myserver.example.com** and you have copied the files from the image to **/var/ftp/rhel9-install/**, specify **ftp://myserver.example.com/rhel9-install/** as the installation source.

CHAPTER 6. PREPARING A UEFI HTTP INSTALLATION SOURCE

As an administrator of a server on a local network, you can configure an HTTP server to enable HTTP boot and network installation for other systems on your network.

6.1. NETWORK INSTALL OVERVIEW

A network installation allows you to install Red Hat Enterprise Linux to a system that has access to an installation server. At a minimum, two systems are required for a network installation:

Server

A system running a DHCP server, an HTTP, HTTPS, FTP, or NFS server, and in the PXE boot case, a TFTP server. Although each server can run on a different physical system, the procedures in this section assume a single system is running all servers.

Client

The system to which you are installing Red Hat Enterprise Linux. Once installation starts, the client queries the DHCP server, receives the boot files from the HTTP or TFTP server, and downloads the installation image from the HTTP, HTTPS, FTP or NFS server. Unlike other installation methods, the client does not require any physical boot media for the installation to start.

To boot a client from the network, enable network boot in the firmware or in a quick boot menu on the client. On some hardware, the option to boot from a network might be disabled, or not available.

The workflow steps to prepare to install Red Hat Enterprise Linux from a network using HTTP or PXE are as follows:

Procedure

1. Export the installation ISO image or the installation tree to an NFS, HTTPS, HTTP, or FTP server.
2. Configure the HTTP or TFTP server and DHCP server, and start the HTTP or TFTP service on the server.
3. Boot the client and start the installation.

You can choose between the following network boot protocols:

HTTP

Red Hat recommends using HTTP boot if your client UEFI supports it. HTTP boot is usually more reliable.

PXE (TFTP)

PXE boot is more widely supported by client systems, but sending the boot files over this protocol might be slow and result in timeout failures.

Additional resources

- Preparing network based repositories
- Red Hat Satellite product documentation

6.2. CONFIGURING THE DHCPV4 SERVER FOR NETWORK BOOT

Enable the DHCP version 4 (DHCPv4) service on your server, so that it can provide network boot functionality.

Prerequisites

- You are preparing network installation over the IPv4 protocol.
  For IPv6, see Configuring the DHCPv6 server for network boot instead.
- Find the network addresses of the server.
  In the following examples, the server has a network card with this configuration:

  IPv4 address

  192.168.124.2/24

  IPv4 gateway

  192.168.124.1

Procedure

1. Install the DHCP server:

```
dnf install dhcp-server
```

2. Set up a DHCPv4 server. Enter the following configuration in the **/etc/dhcp/dhcpd.conf** file. Replace the addresses to match your network card.

```
option architecture-type code 93 = unsigned integer 16;

subnet 192.168.124.0 netmask 255.255.255.0 {
  option routers 192.168.124.1;
  option domain-name-servers 192.168.124.1;
  range 192.168.124.100 192.168.124.200;
  class "pxeclients" {
    match if substring (option vendor-class-identifier, 0, 9) = "PXEClient";
    next-server 192.168.124.2;
          if option architecture-type = 00:07 {
            filename "redhat/EFI/BOOT/BOOTX64.EFI";
          }
          else {
            filename "pxelinux/pxelinux.0";
          }
  }
  class "httpclients" {
    match if substring (option vendor-class-identifier, 0, 10) = "HTTPClient";
    option vendor-class-identifier "HTTPClient";
    filename "http://192.168.124.2/redhat/EFI/BOOT/BOOTX64.EFI";
  }
}
```

3. Start the DHCPv4 service:

```
# systemctl enable --now dhcpd
```

6.3. CONFIGURING THE DHCPV6 SERVER FOR NETWORK BOOT

Enable the DHCP version 6 (DHCPv4) service on your server, so that it can provide network boot functionality.

Prerequisites

- You are preparing network installation over the IPv6 protocol.
  For IPv4, see Configuring the DHCPv4 server for network boot instead.
- Find the network addresses of the server.
  In the following examples, the server has a network card with this configuration:

  IPv6 address

  fd33:eb1b:9b36::2/64

  IPv6 gateway

  fd33:eb1b:9b36::1

Procedure

1. Install the DHCP server:

```
dnf install dhcp-server
```

2. Set up a DHCPv6 server. Enter the following configuration in the **/etc/dhcp/dhcpd6.conf** file. Replace the addresses to match your network card.

```
option dhcp6.bootfile-url code 59 = string;
option dhcp6.vendor-class code 16 = {integer 32, integer 16, string};

subnet6 fd33:eb1b:9b36::/64 {
        range6 fd33:eb1b:9b36::64 fd33:eb1b:9b36::c8;

        class "PXEClient" {
                match substring (option dhcp6.vendor-class, 6, 9);
        }

        subclass "PXEClient" "PXEClient" {
                option dhcp6.bootfile-url
"tftp://[fd33:eb1b:9b36::2]/redhat/EFI/BOOT/BOOTX64.EFI";
        }

        class "HTTPClient" {
                match substring (option dhcp6.vendor-class, 6, 10);
        }

        subclass "HTTPClient" "HTTPClient" {
                option dhcp6.bootfile-url
"http://[fd33:eb1b:9b36::2]/redhat/EFI/BOOT/BOOTX64.EFI";
                option dhcp6.vendor-class 0 10 "HTTPClient";
        }
}
```

3. Start the DHCPv6 service:

```
# systemctl enable --now dhcpd6
```

4. If DHCPv6 packets are dropped by the RP filter in the firewall, check its log. If the log contains the **rpfilter_DROP** entry, disable the filter using the following configuration in the **/etc/firewalld/firewalld.conf** file:

```
IPv6_rpfilter=no
```

6.4. CONFIGURING THE HTTP SERVER FOR HTTP BOOT

You must install and enable the **httpd** service on your server so that the server can provide HTTP boot resources on your network.

Prerequisites

- Find the network addresses of the server.
  In the following examples, the server has a network card with the **192.168.124.2** IPv4 address.

Procedure

1. Install the HTTP server:

```
# dnf install httpd
```

2. Create the **/var/www/html/redhat/** directory:

```
# mkdir -p /var/www/html/redhat/
```

3. Download the RHEL DVD ISO file. See All Red Hat Enterprise Linux Downloads .

4. Create a mount point for the ISO file:

```
# mkdir -p /var/www/html/redhat/iso/
```

5. Mount the ISO file:

```
# mount -o loop,ro -t iso9660 path-to-RHEL-DVD.iso /var/www/html/redhat/iso
```

6. Copy the boot loader, kernel, and **initramfs** from the mounted ISO file into your HTML directory:

```
# cp -r /var/www/html/redhat/iso/images /var/www/html/redhat/
# cp -r /var/www/html/redhat/iso/EFI /var/www/html/redhat/
```

7. Make the boot loader configuration editable:

```
# chmod 644 /var/www/html/redhat/EFI/BOOT/grub.cfg
```

8. Edit the **/var/www/html/redhat/EFI/BOOT/grub.cfg** file and replace its content with the following:

```
set default="1"

function load_video {
  insmod efi_gop
  insmod efi_uga
  insmod video_bochs
  insmod video_cirrus
  insmod all_video
}

load_video
set gfxpayload=keep
insmod gzio
insmod part_gpt
insmod ext2

set timeout=60
# END /etc/grub.d/00_header #

search --no-floppy --set=root -l 'RHEL-9-3-0-BaseOS-x86_64'

# BEGIN /etc/grub.d/10_linux #
menuentry 'Install Red Hat Enterprise Linux 9.3' --class fedora --class gnu-linux --class gnu --
class os {
    linuxefi ../../images/pxeboot/vmlinuz inst.repo=http://192.168.124.2/redhat/iso quiet
    initrdefi ../../images/pxeboot/initrd.img
}
menuentry 'Test this media & install Red Hat Enterprise Linux 9.3' --class fedora --class gnu-
linux --class gnu --class os {
    linuxefi ../../images/pxeboot/vmlinuz inst.repo=http://192.168.124.2/redhat/iso quiet
    initrdefi ../../images/pxeboot/initrd.img
}
submenu 'Troubleshooting -->' {
    menuentry 'Install Red Hat Enterprise Linux 9.3 in text mode' --class fedora --class gnu-
linux --class gnu --class os {
     linuxefi ../../images/pxeboot/vmlinuz inst.repo=http://192.168.124.2/redhat/iso inst.text
quiet
     initrdefi ../../images/pxeboot/initrd.img
    }
    menuentry 'Rescue a Red Hat Enterprise Linux system' --class fedora --class gnu-linux --
class gnu --class os {
     linuxefi ../../images/pxeboot/vmlinuz inst.repo=http://192.168.124.2/redhat/iso inst.rescue
quiet
     initrdefi ../../images/pxeboot/initrd.img
    }
}
```

In this file, replace the following strings:

RHEL-9-3-0-BaseOS-x86_64 **and** ***Red Hat Enterprise Linux 9.3***

Edit the version number to match the version of RHEL that you downloaded.

192.168.124.2

Replace with the IP address to your server.

9. Make the EFI boot file executable:

```
# chmod 755 /var/www/html/redhat/EFI/BOOT/BOOTX64.EFI
```

10. Open ports in the firewall to allow HTTP (80), DHCP (67, 68) and DHCPv6 (546, 547) traffic:

```
# firewall-cmd --zone public \
        --add-port={80/tcp,67/udp,68/udp,546/udp,547/udp}
```

This command enables temporary access until the next server reboot.

11. Optional: To enable permanent access, add the **--permanent** option to the command.
12. Reload firewall rules:

```
# firewall-cmd --reload
```

13. Start the HTTP server:

```
# systemctl enable --now httpd
```

14. Make the **html** directory and its content readable and executable:

```
# chmod -cR u=rwX,g=rX,o=rX /var/www/html
```

15. Restore the SELinux context of the **html** directory:

```
# restorecon -FvvR /var/www/html
```

CHAPTER 7. PREPARING A PXE INSTALLATION SOURCE

You must configure TFTP and DHCP on a PXE server to enable PXE boot and network installation.

7.1. NETWORK INSTALL OVERVIEW

A network installation allows you to install Red Hat Enterprise Linux to a system that has access to an installation server. At a minimum, two systems are required for a network installation:

Server

A system running a DHCP server, an HTTP, HTTPS, FTP, or NFS server, and in the PXE boot case, a TFTP server. Although each server can run on a different physical system, the procedures in this section assume a single system is running all servers.

Client

The system to which you are installing Red Hat Enterprise Linux. Once installation starts, the client queries the DHCP server, receives the boot files from the HTTP or TFTP server, and downloads the installation image from the HTTP, HTTPS, FTP or NFS server. Unlike other installation methods, the client does not require any physical boot media for the installation to start.

To boot a client from the network, enable network boot in the firmware or in a quick boot menu on the client. On some hardware, the option to boot from a network might be disabled, or not available.

The workflow steps to prepare to install Red Hat Enterprise Linux from a network using HTTP or PXE are as follows:

Procedure

1. Export the installation ISO image or the installation tree to an NFS, HTTPS, HTTP, or FTP server.
2. Configure the HTTP or TFTP server and DHCP server, and start the HTTP or TFTP service on the server.
3. Boot the client and start the installation.

You can choose between the following network boot protocols:

HTTP

Red Hat recommends using HTTP boot if your client UEFI supports it. HTTP boot is usually more reliable.

PXE (TFTP)

PXE boot is more widely supported by client systems, but sending the boot files over this protocol might be slow and result in timeout failures.

Additional resources

- Preparing network based repositories
- Red Hat Satellite product documentation

7.2. CONFIGURING THE DHCPV4 SERVER FOR NETWORK BOOT

Enable the DHCP version 4 (DHCPv4) service on your server, so that it can provide network boot functionality.

Prerequisites

- You are preparing network installation over the IPv4 protocol.
  For IPv6, see Configuring the DHCPv6 server for network boot instead.
- Find the network addresses of the server.
  In the following examples, the server has a network card with this configuration:

  IPv4 address

  192.168.124.2/24

  IPv4 gateway

  192.168.124.1

Procedure

1. Install the DHCP server:

```
dnf install dhcp-server
```

2. Set up a DHCPv4 server. Enter the following configuration in the **/etc/dhcp/dhcpd.conf** file. Replace the addresses to match your network card.

```
option architecture-type code 93 = unsigned integer 16;

subnet 192.168.124.0 netmask 255.255.255.0 {
  option routers 192.168.124.1;
  option domain-name-servers 192.168.124.1;
  range 192.168.124.100 192.168.124.200;
  class "pxeclients" {
    match if substring (option vendor-class-identifier, 0, 9) = "PXEClient";
    next-server 192.168.124.2;
          if option architecture-type = 00:07 {
            filename "redhat/EFI/BOOT/BOOTX64.EFI";
          }
          else {
            filename "pxelinux/pxelinux.0";
          }
  }
  class "httpclients" {
    match if substring (option vendor-class-identifier, 0, 10) = "HTTPClient";
    option vendor-class-identifier "HTTPClient";
    filename "http://192.168.124.2/redhat/EFI/BOOT/BOOTX64.EFI";
  }
}
```

3. Start the DHCPv4 service:

```
# systemctl enable --now dhcpd
```

7.3. CONFIGURING THE DHCPV6 SERVER FOR NETWORK BOOT

Enable the DHCP version 6 (DHCPv4) service on your server, so that it can provide network boot functionality.

Prerequisites

- You are preparing network installation over the IPv6 protocol.
  For IPv4, see Configuring the DHCPv4 server for network boot instead.
- Find the network addresses of the server.
  In the following examples, the server has a network card with this configuration:

  IPv6 address

  fd33:eb1b:9b36::2/64

  IPv6 gateway

  fd33:eb1b:9b36::1

Procedure

1. Install the DHCP server:

```
dnf install dhcp-server
```

2. Set up a DHCPv6 server. Enter the following configuration in the **/etc/dhcp/dhcpd6.conf** file. Replace the addresses to match your network card.

```
option dhcp6.bootfile-url code 59 = string;
option dhcp6.vendor-class code 16 = {integer 32, integer 16, string};

subnet6 fd33:eb1b:9b36::/64 {
        range6 fd33:eb1b:9b36::64 fd33:eb1b:9b36::c8;

        class "PXEClient" {
                match substring (option dhcp6.vendor-class, 6, 9);
        }

        subclass "PXEClient" "PXEClient" {
                option dhcp6.bootfile-url
"tftp://[fd33:eb1b:9b36::2]/redhat/EFI/BOOT/BOOTX64.EFI";
        }

        class "HTTPClient" {
                match substring (option dhcp6.vendor-class, 6, 10);
        }

        subclass "HTTPClient" "HTTPClient" {
                option dhcp6.bootfile-url
"http://[fd33:eb1b:9b36::2]/redhat/EFI/BOOT/BOOTX64.EFI";
                option dhcp6.vendor-class 0 10 "HTTPClient";
        }
}
```

3. Start the DHCPv6 service:

```
# systemctl enable --now dhcpd6
```

4. If DHCPv6 packets are dropped by the RP filter in the firewall, check its log. If the log contains the **rpfilter_DROP** entry, disable the filter using the following configuration in the **/etc/firewalld/firewalld.conf** file:

```
IPv6_rpfilter=no
```

7.4. CONFIGURING A TFTP SERVER FOR BIOS-BASED CLIENTS

You must configure a TFTP server and DHCP server and start the TFTP service on the PXE server for BIOS-based AMD and Intel 64-bit systems.

Procedure

1. As root, install the following package.

```
# dnf install tftp-server
```

2. Allow incoming connections to the **tftp service** in the firewall:

```
# firewall-cmd --add-service=tftp
```

This command enables temporary access until the next server reboot.

3. optional: To enable permanent access, add the **--permanent** option to the command. Depending on the location of the installation ISO file, you might have to allow incoming connections for HTTP or other services.

4. Access the **pxelinux.0** file from the **SYSLINUX** package in the DVD ISO image file, where *my_local_directory* is the name of the directory that you create:

```
# mount -t iso9660 /path_to_image/name_of_image.iso /mount_point -o loop,ro
```

```
# cp -pr /mount_point/AppStream/Packages/syslinux-tftpboot-version-architecture.rpm
/my_local_directory
```

```
# umount /mount_point
```

5. Extract the package:

```
# rpm2cpio syslinux-tftpboot-version-architecture.rpm | cpio -dimv
```

6. Create a **pxelinux**/ directory in **tftpboot**/ and copy all the files from the directory into the **pxelinux**/ directory:

```
# mkdir /var/lib/tftpboot/pxelinux
```

```
# cp /my_local_directory/tftpboot/* /var/lib/tftpboot/pxelinux
```

7. Create the directory **pxelinux.cfg**/ in the **pxelinux**/ directory:

```
# mkdir /var/lib/tftpboot/pxelinux/pxelinux.cfg
```

8. Create a configuration file named **default** and add it to the **pxelinux.cfg/** directory as shown in the following example:

```
default vesamenu.c32
prompt 1
timeout 600

display boot.msg

label linux
  menu label ^Install system
  menu default
  kernel images/RHEL-9/vmlinuz
  append initrd=images/RHEL-9/initrd.img ip=dhcp inst.repo=http://192.168.124.2/RHEL-
9/x86_64/iso-contents-root/
label vesa
  menu label Install system with ^basic video driver
  kernel images/RHEL-9/vmlinuz
  append initrd=images/RHEL-9/initrd.img ip=dhcp inst.xdriver=vesa nomodeset
inst.repo=http://192.168.124.2/RHEL-9/x86_64/iso-contents-root/
label rescue
  menu label ^Rescue installed system
  kernel images/RHEL-9/vmlinuz
  append initrd=images/RHEL-9/initrd.img inst.rescue
  inst.repo=http:///192.168.124.2/RHEL-8/x86_64/iso-contents-root/
label local
  menu label Boot from ^local drive
  localboot 0xffff
```

- The installation program cannot boot without its runtime image. Use the **inst.stage2** boot option to specify location of the image. Alternatively, you can use the **inst.repo=** option to specify the image as well as the installation source.
- The installation source location used with **inst.repo** must contain a valid **.treeinfo** file.
- When you select the RHEL9 installation DVD as the installation source, the **.treeinfo** file points to the BaseOS and the AppStream repositories. You can use a single **inst.repo** option to load both repositories.

9. Create a subdirectory to store the boot image files in the **/var/lib/tftpboot/** directory, and copy the boot image files to the directory. In this example, the directory is **/var/lib/tftpboot/pxelinux/images/RHEL-9/**:

```
# mkdir -p /var/lib/tftpboot/pxelinux/images/RHEL-9/
# cp /path_to_x86_64_images/pxeboot/{vmlinuz,initrd.img}
/var/lib/tftpboot/pxelinux/images/RHEL-9/
```

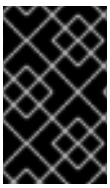
10. Start and enable the **tftp.socket** service:

```
# systemctl enable --now tftp.socket
```

The PXE boot server is now ready to serve PXE clients. You can start the client, which is the system to which you are installing Red Hat Enterprise Linux, select **PXE Boot** when prompted to specify a boot source, and start the network installation.

7.5. CONFIGURING A TFTP SERVER FOR UEFI-BASED CLIENTS

You must configure a TFTP server and DHCP server and start the TFTP service on the PXE server for UEFI-based AMD64, Intel 64, and 64-bit ARM systems.



IMPORTANT

Red Hat Enterprise Linux 9 UEFI PXE boot supports a lowercase file format for a MAC-based grub menu file. For example, the MAC address file format for grub2 is **grub.cfg-01-aa-bb-cc-dd-ee-ff**

Procedure

1. As root, install the following package.

```
# dnf install tftp-server
```

2. Allow incoming connections to the **tftp service** in the firewall:

```
# firewall-cmd --add-service=tftp
```

   This command enables temporary access until the next server reboot.

3. Optional: To enable permanent access, add the **--permanent** option to the command. Depending on the location of the installation ISO file, you might have to allow incoming connections for HTTP or other services.

4. Access the EFI boot image files from the DVD ISO image:

```
# mount -t iso9660 /path_to_image/name_of_image.iso /mount_point -o loop,ro
```

5. Copy the EFI boot images from the DVD ISO image:

```
# mkdir /var/lib/tftpboot/redhat
# cp -r /mount_point/EFI /var/lib/tftpboot/redhat/
# umount /mount_point
```

6. Fix the permissions of the copied files:

```
# chmod -R 755 /var/lib/tftpboot/redhat/
```

7. Replace the content of **/var/lib/tftpboot/redhat/EFI/BOOT/grub.cfg** with the following example:

```
set timeout=60
menuentry 'RHEL 9' {
  linux images/RHEL-9/vmlinuz ip=dhcp inst.repo=http://192.168.124.2/RHEL-9/x86_64/iso-
```

```
contents-root/
  initrd images/RHEL-9/initrd.img
}
```

- The installation program cannot boot without its runtime image. Use the **inst.stage2** boot option to specify location of the image. Alternatively, you can use the **inst.repo=** option to specify the image as well as the installation source.
- The installation source location used with **inst.repo** must contain a valid **.treeinfo** file.
- When you select the RHEL9 installation DVD as the installation source, the **.treeinfo** file points to the BaseOS and the AppStream repositories. You can use a single **inst.repo** option to load both repositories.

8. Create a subdirectory to store the boot image files in the **/var/lib/tftpboot/** directory, and copy the boot image files to the directory. In this example, the directory is **/var/lib/tftpboot/images/RHEL-9/**:

```
# mkdir -p /var/lib/tftpboot/images/RHEL-9/
# cp /path_to_x86_64_images/pxeboot/{vmlinuz,initrd.img}/var/lib/tftpboot/images/RHEL-9/
```

9. Start and enable the **tftp.socket** service:

```
# systemctl enable --now tftp.socket
```

The PXE boot server is now ready to serve PXE clients. You can start the client, which is the system to which you are installing Red Hat Enterprise Linux, select **PXE Boot** when prompted to specify a boot source, and start the network installation.

Additional resources

- Using the Shim Program

7.6. CONFIGURING A NETWORK SERVER FOR IBM POWER SYSTEMS

You can configure a network boot server for IBM Power systems by using GRUB2.

Procedure

1. As root, install the following packages:

```
# dnf install tftp-server dhcp-server
```

2. Allow incoming connections to the **tftp** service in the firewall:

```
# firewall-cmd --add-service=tftp
```

This command enables temporary access until the next server reboot.

3. Optional: To enable permanent access, add the **--permanent** option to the command. Depending on the location of the installation ISO file, you might have to allow incoming connections for HTTP or other services.

4. Create a GRUB2 network boot directory inside the TFTP root:

```
# grub2-mknetdir --net-directory=/var/lib/tftpboot
Netboot directory for powerpc-ieee1275 created. Configure your DHCP server to point to
/boot/grub2/powerpc-ieee1275/core.elf
```

The command output informs you of the file name that needs to be configured in your DHCP configuration, described in this procedure.

a. If the PXE server runs on an x86 machine, the **grub2-ppc64-modules** must be installed before creating a **GRUB2** network boot directory inside the tftp root:

```
# dnf install grub2-ppc64-modules
```

5. Create a GRUB2 configuration file: **/var/lib/tftpboot/boot/grub2/grub.cfg** as shown in the following example:

```
set default=0
set timeout=5

echo -e "\nWelcome to the Red Hat Enterprise Linux 9 installer!\n\n"

menuentry 'Red Hat Enterprise Linux 9' {
  linux grub2-ppc64/vmlinuz ro ip=dhcp inst.repo=http://192.168.124.2/RHEL-9/x86_64/iso-
contents-root/
  initrd grub2-ppc64/initrd.img
}
```

- The installation program cannot boot without its runtime image. Use the **inst.stage2** boot option to specify location of the image. Alternatively, you can use the **inst.repo=** option to specify the image as well as the installation source.
- The installation source location used with **inst.repo** must contain a valid **.treeinfo** file.
- When you select the RHEL8 installation DVD as the installation source, the **.treeinfo** file points to the BaseOS and the AppStream repositories. You can use a single **inst.repo** option to load both repositories.

6. Mount the DVD ISO image using the command:

```
# mount -t iso9660 /path_to_image/name_of_iso/ /mount_point -o loop,ro
```

7. Create a directory and copy the **initrd.img** and **vmlinuz** files from DVD ISO image into it, for example:

```
# cp /mount_point/ppc/ppc64/{initrd.img,vmlinuz} /var/lib/tftpboot/grub2-ppc64/
```

8. Configure your DHCP server to use the boot images packaged with **GRUB2** as shown in the following example. If you already have a DHCP server configured, then perform this step on the DHCP server.

```
subnet 192.168.0.1 netmask 255.255.255.0 {
  allow bootp;
  option routers 192.168.0.5;
  group { #BOOTP POWER clients
    filename "boot/grub2/powerpc-ieee1275/core.elf";
```

```
    host client1 {
    hardware ethernet 01:23:45:67:89:ab;
    fixed-address 192.168.0.112;
    }
  }
}
```

9. Adjust the sample parameters **subnet**, **netmask**, **routers**, **fixed-address** and **hardware ethernet** to fit your network configuration. The **file name** parameter; this is the file name that was outputted by the **grub2-mknetdir** command earlier in this procedure.

10. On the DHCP server, start and enable the **dhcpd** service. If you have configured a DHCP server on the localhost, then start and enable the **dhcpd** service on the localhost.

```
# systemctl enable --now dhcpd
```

11. Start and enable the **tftp.socket** service:

```
# systemctl enable --now tftp.socket
```

The PXE boot server is now ready to serve PXE clients. You can start the client, which is the system to which you are installing Red Hat Enterprise Linux, select **PXE Boot** when prompted to specify a boot source, and start the network installation.

CHAPTER 8. 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.

8.1. 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.

8.2. 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.

8.3. 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**.

CHAPTER 9. PREPARING A RHEL INSTALLATION ON 64-BIT IBM Z

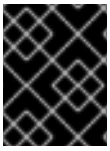
This section describes how to install Red Hat Enterprise Linux on the 64-bit IBM Z architecture.

9.1. PLANNING FOR INSTALLATION ON 64-BIT IBM Z

Red Hat Enterprise Linux 9 runs on IBM z14 or IBM LinuxONE II systems, or later.

The installation process assumes that you are familiar with the 64-bit IBM Z and can set up *logical partitions* (LPARs) and z/VM guest virtual machines.

For installation of Red Hat Enterprise Linux on 64-bit IBM Z, Red Hat supports Direct Access Storage Device (DASD), SCSI disk devices attached over Fiber Channel Protocol (FCP), and **virtio-blk** and **virtio-scsi** devices. When using FCP devices, Red Hat recommends using them in multipath configuration for better reliability.



IMPORTANT

DASDs are disks that allow a maximum of three partitions per device. For example, **dasda** can have partitions **dasda1**, **dasda2**, and **dasda3**.

Pre-installation decisions

- Whether the operating system is to be run on an LPAR, KVM, or as a z/VM guest operating system.
- If swap space is needed, and how much. Although it is recommended to assign enough memory to a z/VM guest virtual machine and let z/VM do the necessary swapping, there are cases where the amount of required RAM is hard to predict. Such instances should be examined on a case-by-case basis.
- Network configuration. Red Hat Enterprise Linux 9 for 64-bit IBM Z supports the following network devices:
  - Real and virtual *Open Systems Adapter* (OSA)
  - Real and virtual HiperSockets
  - *LAN channel station* (LCS) for real OSA
  - **virtio-net** devices
- Ensure you select machine type as ***ESA*** for your z/VM VMs, because selecting any other machine types might prevent RHEL from installing. See the IBM documentation.

Disk space

You will need to calculate and allocate sufficient disk space on DASDs or SCSI disks.

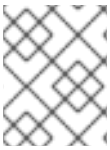
- A minimum of 10 GiB is needed for a server installation, 20 GiB if you want to install all packages.
- Disk space is also required for any application data. After the installation, you can add or delete more DASD or SCSI disk partitions.

- The disk space used by the newly installed Red Hat Enterprise Linux system (the Linux instance) must be separate from the disk space used by other operating systems you have installed on your system.

RAM

Ensure that your system has sufficient RAM available:

- Minimum 1.5 GiB when installing from NFS.
- Minimum 3 GiB when installing from an HTTP or FTP installation source.
- When installing in text mode, 1GiB is sufficient only if you are using an NFS installation source.
- Red Hat recommends 2 GiB for the installed Linux instance. However, 1GiB is sufficient on a properly tuned system.



NOTE

When initializing swap space on a Fixed Block Architecture (FBA) DASD using the **SWAPGEN** utility, the **FBAPART** option must be used.

Additional resources

- For additional information about 64-bit IBM Z, see https://www.ibm.com/it-infrastructure/z.
- For additional information about using secure boot with Linux on IBM Z, see Secure boot for Linux on IBM Z.
- For installation instructions on IBM Power Servers, refer to *IBM installation documentation*.
- To see if your system is supported for installing RHEL, refer to https://catalog.redhat.com and https://access.redhat.com/articles/rhel-limits.

9.2. OVERVIEW OF INSTALLATION PROCESS ON 64-BIT IBM Z SERVERS

You can install Red Hat Enterprise Linux on 64-bit IBM Z interactively or in unattended mode. Installation on 64-bit IBM Z differs from other architectures as it is typically performed over a network, and not from local media. The installation consists of three phases:

1. Booting the installation
   - Connect to the mainframe
   - Customize the boot parameters
   - Perform an initial program load (IPL), or boot from the media containing the installation program
2. Connecting to the installation system
   - From a local machine, connect to the remote 64-bit IBM Z system using SSH, and start the installation program using Virtual Network Computing (VNC)
3. Completing the installation using the RHEL installation program

9.3. BOOT MEDIA FOR INSTALLING RHEL ON 64-BIT IBM Z SERVERS

After establishing a connection with the mainframe, you need to perform an initial program load (IPL), or boot, from the medium containing the installation program. This document describes the most common methods of installing Red Hat Enterprise Linux on 64-bit IBM Z. In general, any method may be used to boot the Linux installation system, which consists of a kernel (**kernel.img**) and initial RAM disk (**initrd.img**) with parameters in the **generic.prm** file supplemented by user defined parameters. Additionally, a **generic.ins** file is loaded which determines file names and memory addresses for the initrd, kernel and **generic.prm**.

The Linux installation system is also called the *installation program* in this book.

The control point from where you can start the IPL process depends on the environment where your Linux is to run. If your Linux is to run as a z/VM guest operating system, the control point is the *control program* (CP) of the hosting z/VM. If your Linux is to run in LPAR mode, the control point is the mainframe's *Support Element* (SE) or an attached 64-bit IBM Z *Hardware Management Console* (HMC).

You can use the following boot media only if Linux is to run as a guest operating system under z/VM:

- z/VM reader

You can use the following boot media only if Linux is to run in LPAR mode:

- SE or HMC through a remote FTP server
- SE or HMC DVD

You can use the following boot media for both z/VM and LPAR:

- DASD
- SCSI disk device that is attached through an FCP channel

If you use DASD or an FCP-attached SCSI disk device as boot media, you must have a configured **zipl** boot loader.

9.4. CUSTOMIZING BOOT PARAMETERS

Before the installation can begin, you must configure some mandatory boot parameters. When installing through z/VM, these parameters must be configured before you boot into the **generic.prm** file. When installing on an LPAR, the **rd.cmdline** parameter is set to **ask** by default, meaning that you will be given a prompt on which you can enter these boot parameters. In both cases, the required parameters are the same.

All network configuration can either be specified by using a parameter file, or at the prompt.

Installation source

An installation source must always be configured.

Use the **inst.repo** option to specify the package source for the installation.

Network devices

Network configuration must be provided if network access will be required during the installation. If you plan to perform an unattended (Kickstart-based) installation by using only local media such as a disk, network configuration can be omitted.

ip=

Use the **ip=** option for basic network configuration, and other options as required.

rd.znet=

Also use the **rd.znet=** kernel option, which takes a network protocol type, a comma delimited list of sub-channels, and, optionally, comma delimited **sysfs** parameter and value pairs. This parameter can be specified multiple times to activate multiple network devices.
For example:

```
rd.znet=qeth,0.0.0600,0.0.0601,0.0.0602,layer2=1,portname=<name>
```

When specifying multiple **rd.znet** boot options, only the last one is passed on to the kernel command line of the installed system. This does not affect the networking of the system since all network devices configured during installation are properly activated and configured at boot.

The qeth device driver assigns the same interface name for Ethernet and Hipersockets devices: **enc*<device number>***. The bus ID is composed of the channel subsystem ID, subchannel set ID, and device number, separated by dots; the device number is the last part of the bus ID, without leading zeroes and dots. For example, the interface name will be **enca00** for a device with the bus ID **0.0.0a00**.

Storage devices

At least one storage device must always be configured for text mode installations.
The **rd.dasd=** option takes a Direct Access Storage Device (DASD) adapter device bus identifier. For multiple DASDs, specify the parameter multiple times, or use a comma separated list of bus IDs. To specify a range of DASDs, specify the first and the last bus ID.

For example:

```
rd.dasd=0.0.0200 rd.dasd=0.0.0202(ro),0.0.0203(ro:failfast),0.0.0205-0.0.0207
```

The **rd.zfcp=** option takes a SCSI over FCP (zFCP) adapter device bus identifier, a target world wide port name (WWPN), and an FCP LUN, then activates one path to a SCSI disk. This parameter needs to be specified at least twice to activate multiple paths to the same disk. This parameter can be specified multiple times to activate multiple disks, each with multiple paths. Since 9, a target world wide port name (WWPN) and an FCP LUN have to be provided only if the **zFCP** device is not configured in NPIV mode or when **auto LUN** scanning is disabled by the **zfcp.allow_lun_scan=0** kernel module parameter. It provides access to all SCSI devices found in the storage area network attached to the FCP device with the specified bus ID. This parameter needs to be specified at least twice to activate multiple paths to the same disks.

```
rd.zfcp=0.0.4000,0x5005076300C213e9,0x5022000000000000
rd.zfcp=0.0.4000
```

Kickstart options

If you are using a Kickstart file to perform an automatic installation, you must always specify the location of the Kickstart file using the **inst.ks=** option. For an unattended, fully automatic Kickstart installation, the **inst.cmdline** option is also useful.

An example customized **generic.prm** file containing all mandatory parameters look similar to the following example:

Example 9.1. Customized generic.prm file

```
ro ramdisk_size=40000 cio_ignore=all,!condev
inst.repo=http://example.com/path/to/repository
rd.znet=qeth,0.0.0600,0.0.0601,0.0.0602,layer2=1,portno=0,portname=foo
ip=192.168.17.115::192.168.17.254:24:foobar.systemz.example.com:enc600:none
nameserver=192.168.17.1
rd.dasd=0.0.0200 rd.dasd=0.0.0202
rd.zfcp=0.0.4000,0x5005076300c213e9,0x5022000000000000
rd.zfcp=0.0.5000,0x5005076300dab3e9,0x5022000000000000
inst.ks=http://example.com/path/to/kickstart
```

Some installation methods also require a file with a mapping of the location of installation data in the file system of the HMC DVD or FTP server and the memory locations where the data is to be copied.

The file is typically named **generic.ins**, and contains file names for the initial RAM disk, kernel image, and parameter file (**generic.prm**) and a memory location for each file. An example **generic.ins** will look similar to the following example:

Example 9.2. Sample generic.ins file

```
images/kernel.img 0x00000000
images/initrd.img 0x02000000
images/genericdvd.prm 0x00010480
images/initrd.addrsize 0x00010408
```

A valid **generic.ins** file is provided by Red Hat along with all other files required to boot the installer. Modify this file only if you want to, for example, load a different kernel version than default.

Additional resources

- Installation source boot options

9.5. PARAMETERS AND CONFIGURATION FILES ON 64-BIT IBM Z

This section contains information about the parameters and configuration files on 64-bit IBM Z.

9.5.1. Required configuration file parameters on 64-bit IBM Z

Several parameters are required and must be included in the parameter file. These parameters are also provided in the file **generic.prm** in directory **images/** of the installation DVD.

- **ro**
  Mounts the root file system, which is a RAM disk, read-only.

- **ramdisk_size=*size***
  Modifies the memory size reserved for the RAM disk to ensure that the Red Hat Enterprise Linux installation program fits within it. For example: **ramdisk_size=40000**.

The **generic.prm** file also contains the additional parameter **cio_ignore=all,!condev**. This setting speeds up boot and device detection on systems with many devices. The installation program transparently handles the activation of ignored devices.

9.5.2. 64-bit IBM Z/VM configuration file

Under z/VM, you can use a configuration file on a CMS-formatted disk. The purpose of the CMS configuration file is to save space in the parameter file by moving the parameters that configure the initial network setup, the DASD, and the FCP specification out of the parameter file.

Each line of the CMS configuration file contains a single variable and its associated value, in the following shell-style syntax: ***variable=value***.

You must also add the **CMSDASD** and **CMSCONFFILE** parameters to the parameter file. These parameters point the installation program to the configuration file:

CMSDASD=*cmsdasd_address*

Where *cmsdasd_address* is the device number of a CMS-formatted disk that contains the configuration file. This is usually the CMS user's **A** disk.
For example: **CMSDASD=191**

CMSCONFFILE=*configuration_file*

Where *configuration_file* is the name of the configuration file. **This value must be specified in lower case.** It is specified in a Linux file name format: ***CMS_file_name.CMS_file_type***.
The CMS file **REDHAT CONF** is specified as **redhat.conf**. The CMS file name and the file type can each be from one to eight characters that follow the CMS conventions.

For example: **CMSCONFFILE=redhat.conf**

9.5.3. Installation network, DASD and FCP parameters on 64-bit IBM Z

These parameters can be used to automatically set up the preliminary network, and can be defined in the CMS configuration file. These parameters are the only parameters that can also be used in a CMS configuration file. All other parameters in other sections must be specified in the parameter file.

NETTYPE="*type*"

Where *type* must be one of the following: **qeth**, **lcs**, or **ctc**. The default is **qeth**.
Choose **lcs** for:

- OSA-Express features

Choose **qeth** for:

- OSA-Express features
- HiperSockets
- Virtual connections on z/VM, including VSWTICH and Guest LAN

SUBCHANNELS="*device_bus_IDs*"

Where *device_bus_IDs* is a comma-separated list of two or three device bus IDs. The IDs must be specified in lowercase.
Provides required device bus IDs for the various network interfaces:

```
qeth: SUBCHANNELS="read_device_bus_id,write_device_bus_id,data_device_bus_id"
lcs or ctc: SUBCHANNELS="read_device_bus_id,write_device_bus_id"
```

For example (a sample qeth SUBCHANNEL statement):

```
SUBCHANNELS="0.0.f5f0,0.0.f5f1,0.0.f5f2"
```

PORTNAME="*osa_portname*" PORTNAME="*lcs_portnumber*"

This variable supports OSA devices operating in qdio mode or in non-qdio mode.
When using qdio mode (**NETTYPE="qeth"**), *osa_portname* is the portname specified on the OSA device when operating in qeth mode.

When using non-qdio mode (**NETTYPE="lcs"**), *lcs_portnumber* is used to pass the relative port number as a decimal integer in the range of 0 through 15.

PORTNO="*portnumber*"

You can add either **PORTNO="0"** (to use port 0) or **PORTNO="1"** (to use port 1 of OSA features with two ports per CHPID) to the CMS configuration file to avoid being prompted for the mode.

LAYER2="*value*"

Where *value* can be **0** or **1**.
Use **LAYER2="0"** to operate an OSA or HiperSockets device in layer 3 mode (**NETTYPE="qeth"**).
Use **LAYER2="1"** for layer 2 mode. For virtual network devices under z/VM this setting must match the definition of the GuestLAN or VSWITCH to which the device is coupled.

To use network services that operate on layer 2 (the Data Link Layer or its MAC sublayer) such as DHCP, layer 2 mode is a good choice.

The qeth device driver default for OSA devices is now layer 2 mode. To continue using the previous default of layer 3 mode, set **LAYER2="0"** explicitly.

VSWITCH="*value*"

Where *value* can be **0** or **1**.
Specify **VSWITCH="1"** when connecting to a z/VM VSWITCH or GuestLAN, or **VSWITCH="0"** (or nothing at all) when using directly attached real OSA or directly attached real HiperSockets.

MACADDR="*MAC_address*"

If you specify **LAYER2="1"** and **VSWITCH="0"**, you can optionally use this parameter to specify a MAC address. Linux requires six colon-separated octets as pairs lower case hex digits - for example, **MACADDR=62:a3:18:e7:bc:5f**. This is different from the notation used by z/VM.
If you specify **LAYER2="1"** and **VSWITCH="1"**, you must not specify the **MACADDR**, because z/VM assigns a unique MAC address to virtual network devices in layer 2 mode.

CTCPROT="*value*"

Where *value* can be **0**, **1**, or **3**.
Specifies the CTC protocol for **NETTYPE="ctc"**. The default is **0**.

HOSTNAME="*string*"

Where *string* is the host name of the newly-installed Linux instance.

IPADDR="*IP*"

Where *IP* is the IP address of the new Linux instance.

NETMASK="*netmask*"

Where *netmask* is the netmask.
The netmask supports the syntax of a prefix integer (from 1 to 32) as specified in IPv4 *classless interdomain routing* (CIDR). For example, you can specify **24** instead of **255.255.255.0**, or **20** instead of **255.255.240.0**.

GATEWAY="*gw*"

Where *gw* is the gateway IP address for this network device.

MTU="*mtu*"

Where *mtu* is the *Maximum Transmission Unit* (MTU) for this network device.

DNS="*server1:server2:additional_server_terms:serverN*"

Where "*server1:server2:additional_server_terms:serverN*" is a list of DNS servers, separated by colons. For example:

```
DNS="10.1.2.3:10.3.2.1"
```

SEARCHDNS="*domain1:domain2:additional_dns_terms:domainN*"

Where "*domain1:domain2:additional_dns_terms:domainN*" is a list of the search domains, separated by colons. For example:

```
SEARCHDNS="subdomain.domain:domain"
```

You only need to specify **SEARCHDNS=** if you specify the **DNS=** parameter.

DASD=

Defines the DASD or range of DASDs to configure for the installation.
The installation program supports a comma-separated list of device bus IDs, or ranges of device bus IDs with the optional attributes **ro**, **diag**, **erplog**, and **failfast**. Optionally, you can abbreviate device bus IDs to device numbers with leading zeros stripped. Any optional attributes should be separated by colons and enclosed in parentheses. Optional attributes follow a device bus ID or a range of device bus IDs.

The only supported global option is **autodetect**. This does not support the specification of non-existent DASDs to reserve kernel device names for later addition of DASDs. Use persistent DASD device names such as **/dev/disk/by-path/name** to enable transparent addition of disks later. Other global options such as **probeonly**, **nopav**, or **nofcx** are not supported by the installation program.

Only specify those DASDs that need to be installed on your system. All unformatted DASDs specified here must be formatted after a confirmation later on in the installation program.

Add any data DASDs that are not needed for the root file system or the **/boot** partition after installation.

For example:

```
DASD="eb1c,0.0.a000-0.0.a003,eb10-eb14(diag),0.0.ab1c(ro:diag)"
```

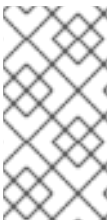
FCP_*n*="*device_bus_ID* [*WWPN FCP_LUN*]"

For FCP-only environments, remove the **DASD=** option from the CMS configuration file to indicate no DASD is present.

```
FCP_n="device_bus_ID [WWPN FCP_LUN]"
```

Where:

- *n* is typically an integer value (for example **FCP_1** or **FCP_2**) but could be any string with alphabetic or numeric characters or underscores.
- *device_bus_ID* specifies the device bus ID of the FCP device representing the *host bus adapter* (HBA) (for example **0.0.fc00** for device fc00).
- *WWPN* is the world wide port name used for routing (often in conjunction with multipathing) and is as a 16-digit hex value (for example **0x50050763050b073d**).
- *FCP_LUN* refers to the storage logical unit identifier and is specified as a 16-digit hexadecimal value padded with zeroes to the right (for example **0x4020400100000000**).



NOTE

A target world wide port name (WWPN) and an FCP_LUN have to be provided if the **zFCP** device is not configured in NPIV mode, when auto LUN scanning is disabled by the **zfcp.allow_lun_scan=0** kernel module parameter or when installing RHEL-9.0 or older releases. Otherwise only the **device_bus_ID** value is mandatory.

- These variables can be used on systems with FCP devices to activate FCP LUNs such as SCSI disks. Additional FCP LUNs can be activated during the installation interactively or by means of a Kickstart file. An example value looks similar to the following:

```
FCP_1="0.0.fc00 0x50050763050b073d 0x4020400100000000"
FCP_2="0.0.4000"
```

Each of the values used in the FCP parameters (for example **FCP_1** or **FCP_2**) are site-specific and are normally supplied by the FCP storage administrator.

9.5.4. Parameters for kickstart installations on 64-bit IBM Z

The following parameters can be defined in a parameter file but do not work in a CMS configuration file.

inst.ks=*URL*

References a Kickstart file, which usually resides on the network for Linux installations on 64-bit IBM Z. Replace *URL* with the full path including the file name of the Kickstart file. This parameter activates automatic installation with Kickstart.

inst.cmdline

This requires installation with a Kickstart file that answers all questions, because the installation program does not support interactive user input in cmdline mode. Ensure that your Kickstart file contains all required parameters before you use the **inst.cmdline** option. If a required command is missing, the installation will fail.

9.5.5. Miscellaneous parameters on 64-bit IBM Z

The following parameters can be defined in a parameter file but do not work in a CMS configuration file.

rd.live.check

Turns on testing of an ISO-based installation source; for example, when using **inst.repo=** with an ISO on local disk or mounted with NFS.

inst.nompath

Disables support for multipath devices.

inst.proxy=[*protocol*://][*username*[:*password*]@]*host*[:*port*]

Specify a proxy to use with installation over HTTP, HTTPS or FTP.

inst.rescue

Boot into a rescue system running from a RAM disk that can be used to fix and restore an installed system.

inst.stage2=*URL*

Specifies a path to a tree containing **install.img**, not to the **install.img** directly. Otherwise, follows the same syntax as **inst.repo=**. If **inst.stage2** is specified, it typically takes precedence over other methods of finding **install.img**. However, if **Anaconda** finds **install.img** on local media, the **inst.stage2** URL will be ignored.
If **inst.stage2** is not specified and **install.img** cannot be found locally, **Anaconda** looks to the location given by **inst.repo=** or **method=**.

If only **inst.stage2=** is given without **inst.repo=** or **method=**, **Anaconda** uses whatever repos the installed system would have enabled by default for installation.

Use the option multiple times to specify multiple HTTP, HTTPS or FTP sources. The HTTP, HTTPS or FTP paths are then tried sequentially until one succeeds:

```
inst.stage2=http://hostname/path_to_install_tree/
inst.stage2=http://hostname/path_to_install_tree/
inst.stage2=http://hostname/path_to_install_tree/
```

inst.syslog=*IP/hostname*[:*port*]

Sends log messages to a remote syslog server.

The boot parameters described here are the most useful for installations and trouble shooting on 64-bit IBM Z, but only a subset of those that influence the installation program.

9.5.6. Sample parameter file and CMS configuration file on 64-bit IBM Z

To change the parameter file, begin by extending the shipped **generic.prm** file.

Example of **generic.prm** file:

```
ro ramdisk_size=40000 cio_ignore=all,!condev
CMSDASD="191" CMSCONFFILE="redhat.conf"
inst.vnc
inst.repo=http://example.com/path/to/dvd-contents
```

Example of **redhat.conf** file configuring a QETH network device (pointed to by **CMSCONFFILE** in **generic.prm**):

```
NETTYPE="qeth"
SUBCHANNELS="0.0.0600,0.0.0601,0.0.0602"
PORTNAME="FOOBAR"
PORTNO="0"
```

```
LAYER2="1"
MACADDR="02:00:be:3a:01:f3"
HOSTNAME="foobar.systemz.example.com"
IPADDR="192.168.17.115"
NETMASK="255.255.255.0"
GATEWAY="192.168.17.254"
DNS="192.168.17.1"
SEARCHDNS="systemz.example.com:example.com"
DASD="200-203"
```

9.5.7. Using parameter and configuration files on 64-bit IBM Z

The 64-bit IBM Z architecture can use a customized parameter file to pass boot parameters to the kernel and the installation program.

You need to change the parameter file if you want to:

- Install unattended with Kickstart.
- Choose non-default installation settings that are not accessible through the installation program's interactive user interface, such as rescue mode.

The parameter file can be used to set up networking non-interactively before the installation program (**Anaconda**) starts.

The kernel parameter file is limited to 895 characters plus an end-of-line character. The parameter file can be variable or fixed record format. Fixed record format increases the file size by padding each line up to the record length. Should you encounter problems with the installation program not recognizing all specified parameters in LPAR environments, you can try to put all parameters in one single line or start and end each line with a space character.

The parameter file contains kernel parameters, such as **ro**, and parameters for the installation process, such as **vncpassword=test** or **vnc**.

9.6. PREPARING AN INSTALLATION IN A Z/VM GUEST VIRTUAL MACHINE

Use the **x3270** or **c3270** terminal emulator, to log in to z/VM from other Linux systems, or use the IBM 3270 terminal emulator on the 64-bit IBM Z Hardware Management Console (HMC). If you are running Microsoft Windows operating system, there are several options available, and can be found through an internet search. A free native Windows port of **c3270** called **wc3270** also exists.

Ensure you select machine type as ***ESA*** for your z/VM VMs, because selecting any other machine types might prevent installing RHEL. See the IBM documentation.

Procedure

1. Log on to the z/VM guest virtual machine chosen for the Linux installation.
2. optional: If your 3270 connection is interrupted and you cannot log in again because the previous session is still active, you can replace the old session with a new one by entering the following command on the z/VM logon screen:

```
logon user here
```

+ Replace *user* with the name of the z/VM guest virtual machine. Depending on whether an external security manager, for example RACF, is used, the logon command might vary.

1. If you are not already running **CMS** (single-user operating system shipped with z/VM) in your guest, boot it now by entering the command:

```
cp ipl cms
```

2. Be sure not to use CMS disks such as your A disk (often device number 0191) as installation targets. To find out which disks are in use by CMS, use the following query:

```
query disk
```

3. You can use the following CP (z/VM Control Program, which is the z/VM hypervisor) query commands to find out about the device configuration of your z/VM guest virtual machine:

   a. Query the available main memory, which is called *storage* in 64-bit IBM Z terminology. Your guest should have at least 1 GiB of main memory.

```
cp query virtual storage
```

   b. Query available network devices by type:

   osa
   OSA - CHPID type OSD, real or virtual (VSWITCH or GuestLAN), both in QDIO mode

   hsi
   HiperSockets - CHPID type IQD, real or virtual (GuestLAN type Hipers)

   lcs
   LCS - CHPID type OSE

   For example, to query all of the network device types mentioned above, run:

```
cp query virtual osa
```

   c. Query available DASDs. Only those that are flagged **RW** for read-write mode can be used as installation targets:

```
cp query virtual dasd
```

   d. Query available FCP devices (vHBAs):

```
cp query virtual fcp
```

PART II. INSTALLING RHEL FULLY AND SEMI-AUTOMATED

Automating the RHEL installation process is the key purpose of kickstart installations. It covers how to create and configure Kickstart files, integrate them with UEFI HTTP or PXE sources, and make them accessible for semi-automated installations. Additionally, it provides guidance on initiating Kickstart installations to streamline system deployment.

CHAPTER 10. AUTOMATED INSTALLATION WORKFLOW

Kickstart installations can be performed using a local DVD, a local disk, or a NFS, FTP, HTTP, or HTTPS server. This section provides a high level overview of Kickstart usage.

1. Create a Kickstart file. You can write it by hand, copy a Kickstart file saved after a manual installation, or use an online generator tool to create the file, and edit it afterward. See Creating Kickstart files.

2. Make the Kickstart file available to the installation program on removable media, a disk or a network location using an HTTP(S), FTP, or NFS server. See Adding the Kickstart file to a UEFI HTTP or PXE installation source or Making Kickstart files available to the RHEL installer .

3. Create the boot medium which will be used to begin the installation.

4. Make the installation source available to the installation program. See Creating installation sources for Kickstart installations.

5. Start the installation using the boot medium and the Kickstart file. See Starting Kickstart installations.

If the Kickstart file contains all mandatory commands and sections, the installation finishes automatically. If one or more of these mandatory parts are missing, or if an error occurs, the installation requires manual intervention to finish.

CHAPTER 11. CREATING KICKSTART FILES

You can create a Kickstart file using the following methods:

- Use the online Kickstart configuration tool.
- Copy the Kickstart file created as a result of a manual installation.
- Write the entire Kickstart file manually.
- Convert the Red Hat Enterprise Linux 8 Kickstart file for Red Hat Enterprise Linux 9 installation. For more information about the conversion tool, see Kickstart generator lab .
- In case of virtual and cloud environment, create a custom system image, using Image Builder.

Some highly specific installation options can be configured only by manual editing of the Kickstart file.

11.1. CREATING A KICKSTART FILE WITH THE KICKSTART CONFIGURATION TOOL

Users with a Red Hat Customer Portal account can use the Kickstart Generator tool in the Customer Portal Labs to generate Kickstart files online. This tool will walk you through the basic configuration and enables you to download the resulting Kickstart file.

Prerequisites

- You have a Red Hat Customer Portal account and an active Red Hat subscription.

Procedure

1. Open the Kickstart generator lab information page at https://access.redhat.com/labsinfo/kickstartconfig.
2. Click the **Go to Application** button to the left of heading and wait for the next page to load.
3. Select **Red Hat Enterprise Linux 9** in the drop-down menu and wait for the page to update.
4. Describe the system to be installed using the fields in the form.
   You can use the links on the left side of the form to quickly navigate between sections of the form.
5. To download the generated Kickstart file, click the red **Download** button at the top of the page. Your web browser saves the file.
6. Install the **pykickstart** package.

   ```
   # dnf install pykickstart
   ```

7. Run **ksvalidator** on your Kickstart file.

   ```
   $ ksvalidator -v RHEL9 /path/to/kickstart.ks
   ```

   Replace */path/to/kickstart.ks* with the path to the Kickstart file you want to verify.

The validation tool cannot guarantee the installation will be successful. It ensures only that the syntax is correct and that the file does not include deprecated options. It does not attempt to validate the **%pre**, **%post** and **%packages** sections of the Kickstart file.

11.2. CREATING A KICKSTART FILE BY PERFORMING A MANUAL INSTALLATION

The recommended approach to creating Kickstart files is to use the file created by a manual installation of Red Hat Enterprise Linux. After an installation completes, all choices made during the installation are saved into a Kickstart file named **anaconda-ks.cfg**, located in the **/root/** directory on the installed system. You can use this file to reproduce the installation in the same way as before. Alternatively, copy this file, make any changes you need, and use the resulting configuration file for further installations.

Procedure

1. Install RHEL. For more details, see Interactively installing RHEL from installation media . During the installation, create a user with administrator privileges.
2. Finish the installation and reboot into the installed system.
3. Log into the system with the administrator account.
4. Copy the file **/root/anaconda-ks.cfg** to a location of your choice. The file contains information about users and passwords.
   - To display the file contents in terminal:

     ```
     # cat /root/anaconda-ks.cfg
     ```

     You can copy the output and save to another file of your choice.
   - To copy the file to another location, use the file manager. Remember to change permissions on the copy, so that the file can be read by non-root users.
5. Install the **pykickstart** package.

   ```
   # dnf install pykickstart
   ```
6. Run **ksvalidator** on your Kickstart file.

   ```
   $ ksvalidator -v RHEL9 /path/to/kickstart.ks
   ```

   Replace */path/to/kickstart.ks* with the path to the Kickstart file you want to verify.

IMPORTANT

The validation tool cannot guarantee the installation will be successful. It ensures only that the syntax is correct and that the file does not include deprecated options. It does not attempt to validate the **%pre**, **%post** and **%packages** sections of the Kickstart file.

11.3. CONVERTING A KICKSTART FILE FROM PREVIOUS RHEL INSTALLATION

You can use the Kickstart Converter tool to convert a RHEL 7 Kickstart file for use in a RHEL 8 or 9 installation or convert a RHEL 8 Kickstart file for use it in RHEL 9. For more information about the tool and how to use it to convert a RHEL Kickstart file, see https://access.redhat.com/labs/kickstartconvert/.

Procedure

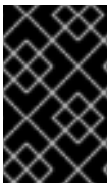
- After you prepare your kickstart file, install the **pykickstart** package.

```
# dnf install pykickstart
```

- Run **ksvalidator** on your Kickstart file.

```
$ ksvalidator -v RHEL9 /path/to/kickstart.ks
```

  Replace */path/to/kickstart.ks* with the path to the Kickstart file you want to verify.



IMPORTANT

The validation tool cannot guarantee the installation will be successful. It ensures only that the syntax is correct and that the file does not include deprecated options. It does not attempt to validate the **%pre**, **%post** and **%packages** sections of the Kickstart file.

11.4. CREATING A CUSTOM IMAGE USING IMAGE BUILDER

You can use Red Hat Image Builder to create a customized system image for virtual and cloud deployments.

For more information about creating customized images, using Image Builder, see the *Composing a customized RHEL system image* document.

CHAPTER 12. ADDING THE KICKSTART FILE TO A UEFI HTTP OR PXE INSTALLATION SOURCE

After your Kickstart file is ready, you can make it available for the installation on the destination system.

12.1. PORTS FOR NETWORK-BASED INSTALLATION

The following table lists the ports that must be open on the server for providing the files for each type of network-based installation.

Table 12.1. Ports for network-based installation

Protocol used	Ports to open
HTTP	80
HTTPS	443
FTP	21
NFS	2049, 111, 20048
TFTP	69

Additional resources

- Securing networks

12.2. SHARING THE INSTALLATION FILES ON AN NFS SERVER

You can store the Kickstart script file on an NFS server. Storing it on an NFS server enables you to install multiple systems from a single source without having to use physical media for the Kickstart file.

Prerequisites

- You have an administrator-level access to a server with Red Hat Enterprise Linux 9 on the local network.
- The system to be installed can connect to the server.
- The firewall on the server allows connections from the system you are installing to. See Ports for Network based Installation for more information.

IMPORTANT

Ensure that you use different paths in **inst.ks** and **inst.repo**. When using NFS to host the Kickstart, you cannot use the same nfs share to host the installation source.

Procedure

1. Install the **nfs-utils** package by running the following command as root:

```
# dnf install nfs-utils
```

2. Copy the Kickstart file to a directory on the NFS server.
3. Open the **/etc/exports** file using a text editor and add a line with the following syntax:

```
/exported_directory/ clients
```

Replace */exported_directory/* with the full path to the directory holding the Kickstart file. Instead of *clients*, use the host name or IP address of the computer that is to be installed from this NFS server, the subnetwork from which all computers are to have access the ISO image, or the asterisk sign (*) if you want to allow any computer with network access to the NFS server to use the ISO image. See the *exports(5)* man page for detailed information about the format of this field. A basic configuration that makes the **/rhel9-install/** directory available as read-only to all clients is:

```
/rhel9-install *
```

4. Save the **/etc/exports** file and exit the text editor.
5. Start the nfs service:

```
# systemctl start nfs-server.service
```

If the service was running before you changed the **/etc/exports** file, enter the following command, in order for the running NFS server to reload its configuration:

```
# systemctl reload nfs-server.service
```

The Kickstart file is now accessible over NFS and ready to be used for installation.

NOTE

When specifying the Kickstart source, use **nfs:** as the protocol, the server's host name or IP address, the colon sign (**:**), and the path inside directory holding the file. For example, if the server's host name is **myserver.example.com** and you have saved the file in **/rhel9-install/my-ks.cfg**, specify **inst.ks=nfs:myserver.example.com:/rhel9-install/my-ks.cfg** as the installation source boot option.

Additional resources

- Preparing a remote installation by using VNC

12.3. SHARING THE INSTALLATION FILES ON AN HTTP OR HTTPS SERVER

You can store the Kickstart script file on an HTTP or HTTPS server. Storing the Kickstart file on an HTTP or HTTPS server enables you to install multiple systems from a single source without having to use physical media for the Kickstart file.

Prerequisites

- You have an administrator-level access to a server with Red Hat Enterprise Linux 9 on the local network.
- The system to be installed can connect to the server.
- The firewall on the server allows connections from the system you are installing to. See Ports for Network based Installation for more information.

Procedure

1. To store the Kickstart file on an HTTP, install the **httpd** package:

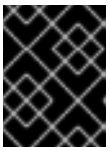
```
# dnf install httpd
```

   To store the Kickstart file on an HTTPS, install **httpd** and **mod_ssl** packages:

```
# dnf install httpd mod_ssl
```

WARNING

If your Apache web server configuration enables SSL security, verify that you only enable the TLSv1 protocol, and disable SSLv2 and SSLv3. This is due to the POODLE SSL vulnerability (CVE-2014-3566). See https://access.redhat.com/solutions/1232413 for details.



IMPORTANT

If you use an HTTPS server with a self-signed certificate, you must boot the installation program with the **inst.noverifyssl** option.

2. Copy the Kickstart file to the HTTP(S) server into a subdirectory of the **/var/www/html/** directory.
3. Start the httpd service:

```
# systemctl start httpd.service
```

   The Kickstart file is now accessible and ready to be used for installation.

   When specifying the location of the Kickstart file, use **http://** or **https://** as the protocol, the server's host name or IP address, and the path of the Kickstart file, relative to the HTTP server root. For example, if you are using HTTP, the server's host name is **myserver.example.com**, and you have copied the Kickstart file as **/var/www/html/rhel9-install/my-ks.cfg**, specify **http://myserver.example.com/rhel9-install/my-ks.cfg** as the file location.

Additional resources

- Deploying Web Servers and Proxies

- Configuring and using Database Servers

12.4. SHARING THE INSTALLATION FILES ON AN FTP SERVER

You can store the Kickstart script file on an FTP server. Storing the script on an FTP server enables you to install multiple systems from a single source without having to use physical media for the Kickstart file.

Prerequisites

- You have an administrator-level access to a server with Red Hat Enterprise Linux 9 on the local network.
- The system to be installed can connect to the server.
- The firewall on the server allows connections from the system you are installing to. For moer information, Ports for Network based Installation .

Procedure

1. Install the **vsftpd** package by running the following command as root:

```
# dnf install vsftpd
```

2. Open and edit the **/etc/vsftpd/vsftpd.conf** configuration file in a text editor.
   a. Change the line **anonymous_enable=NO** to **anonymous_enable=YES**
   b. Change the line **write_enable=YES** to **write_enable=NO**.
   c. Add lines **pasv_min_port=*min_port*** and **pasv_max_port=*max_port***. Replace ***min_port*** and ***max_port*** with the port number range used by FTP server in passive mode, for example, **10021** and **10031**.
   This step can be necessary in network environments featuring various firewall/NAT setups.
   d. Optional: add custom changes to your configuration. For available options, see the **vsftpd.conf(5)** man page. This procedure assumes that default options are used.

WARNING

If you configured SSL/TLS security in your **vsftpd.conf** file, ensure that you enable only the TLSv1 protocol, and disable SSLv2 and SSLv3. This is due to the POODLE SSL vulnerability (CVE-2014-3566). See https://access.redhat.com/solutions/1234773 for details.

3. Configure the server firewall.
   a. Enable the firewall:

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

b. Enable in your firewall the FTP port and port range from previous step:

```
# firewall-cmd --add-port min_port-max_port/tcp --permanent
# firewall-cmd --add-service ftp --permanent
# firewall-cmd --reload
```

Replace *min_port-max_port* with the port numbers you entered into the **/etc/vsftpd/vsftpd.conf** configuration file.

4. Copy the Kickstart file to the FTP server into the **/var/ftp/** directory or its subdirectory.

5. Make sure that the correct SELinux context and access mode is set on the file:

```
# restorecon -r /var/ftp/your-kickstart-file.ks
# chmod 444 /var/ftp/your-kickstart-file.ks
```

6. Start the **vsftpd** service:

```
# systemctl start vsftpd.service
```

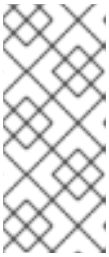
If the service was running before you changed the **/etc/vsftpd/vsftpd.conf** file, restart the service to load the edited file:

```
# systemctl restart vsftpd.service
```

Enable the **vsftpd** service to start during the boot process:

```
# systemctl enable vsftpd
```

The Kickstart file is now accessible and ready to be used for installations by systems on the same network.



NOTE

When configuring the installation source, use **ftp://** as the protocol, the server's host name or IP address, and the path of the Kickstart file, relative to the FTP server root. For example, if the server's host name is **myserver.example.com** and you have copied the file to **/var/ftp/my-ks.cfg**, specify **ftp://myserver.example.com/my-ks.cfg** as the installation source.

CHAPTER 13. SEMI-AUTOMATED INSTALLATIONS: MAKING KICKSTART FILES AVAILABLE TO THE RHEL INSTALLER

After your Kickstart file is ready, you can make it available to for installation on the destination system.

13.1. SHARING THE INSTALLATION FILES ON A LOCAL VOLUME

This procedure describes how to store the Kickstart script file on a volume on the system to be installed. This method enables you to bypass the need for another system.

Prerequisites

- You have a drive that can be moved to the machine to be installed, such as a USB stick.
- The drive contains a partition that can be read by the installation program. The supported types are **ext2**, **ext3**, **ext4**, **xfs**, and **fat**.
- The drive is connected to the system and its volumes are mounted.

Procedure

1. List volume information and note the UUID of the volume to which you want to copy the Kickstart file.

```
# lsblk -l -p -o name,rm,ro,hotplug,size,type,mountpoint,uuid
```

2. Navigate to the file system on the volume.
3. Copy the Kickstart file to this file system.
4. Make a note of the string to use later with the **inst.ks=** option. This string is in the form **hd:UUID=*volume-UUID*:*path/to/kickstart-file.cfg***. Note that the path is relative to the file system root, not to the / root of file system hierarchy. Replace *volume-UUID* with the UUID you noted earlier.
5. Unmount all drive volumes:

```
# umount /dev/xyz ...
```

   Add all the volumes to the command, separated by spaces.

13.2. SHARING THE INSTALLATION FILES ON A LOCAL VOLUME FOR AUTOMATIC LOADING

A specially named Kickstart file can be present in the root of a specially named volume on the system to be installed. This lets you bypass the need for another system, and makes the installation program load the file automatically.

Prerequisites

- You have a drive that can be moved to the machine to be installed, such as a USB stick.

- The drive contains a partition that can be read by the installation program. The supported types are **ext2**, **ext3**, **ext4**, **xfs**, and **fat**.
- The drive is connected to the system and its volumes are mounted.

Procedure

1. List volume information to which you want to copy the Kickstart file.

```
# lsblk -l -p
```

2. Navigate to the file system on the volume.
3. Copy the Kickstart file into the root of this file system.
4. Rename the Kickstart file to **ks.cfg**.
5. Rename the volume as **OEMDRV**:
   - For **ext2**, **ext3**, and **ext4** file systems:

```
# e2label /dev/xyz OEMDRV
```

   - For the XFS file system:

```
# xfs_admin -L OEMDRV /dev/xyz
```

   Replace */dev/xyz* with the path to the volume's block device.
6. Unmount all drive volumes:

```
# umount /dev/xyz ...
```

   Add all the volumes to the command, separated by spaces.

CHAPTER 14. STARTING KICKSTART INSTALLATIONS

You can start Kickstart installations in multiple ways:

- Automatically by editing the boot options in PXE boot.
- Automatically by providing the file on a volume with specific name.

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.

14.1. STARTING A KICKSTART INSTALLATION AUTOMATICALLY USING PXE

AMD64, Intel 64, and 64-bit ARM systems and IBM Power Systems servers have the ability to boot using a PXE server. When you configure the PXE server, you can add the boot option into the boot loader configuration file, which in turn lets you start the installation automatically. Using this approach, it is possible to automate the installation completely, including the boot process.

This procedure is intended as a general reference; detailed steps differ based on your system's architecture, and not all options are available on all architectures (for example, you cannot use PXE boot on 64-bit IBM Z).

Prerequisites

- You have a Kickstart file ready in a location accessible from the system to be installed.
- You have a PXE server that can be used to boot the system and begin the installation.

Procedure

1. Open the boot loader configuration file on your PXE server, and add the **inst.ks=** boot option to the appropriate line. The name of the file and its syntax depends on your system's architecture and hardware:
   - On AMD64 and Intel 64 systems with BIOS, the file name can be either default or based on your system's IP address. In this case, add the **inst.ks=** option to the append line in the installation entry. A sample append line in the configuration file looks similar to the following:

     ```
     append initrd=initrd.img inst.ks=http://10.32.5.1/mnt/archive/RHEL-9/9.x/x86_64/kickstarts/ks.cfg
     ```

   - On systems using the GRUB2 boot loader (AMD64, Intel 64, and 64-bit ARM systems with UEFI firmware and IBM Power Systems servers), the file name will be **grub.cfg**. In this file, append the **inst.ks=** option to the kernel line in the installation entry. A sample kernel line in the configuration file will look similar to the following:

```
kernel vmlinuz inst.ks=http://10.32.5.1/mnt/archive/RHEL-9/9.x/x86_64/kickstarts/ks.cfg
```

2. Boot the installation from the network server.
   The installation begins now, using the installation options specified in the Kickstart file. If the Kickstart file is valid and contains all required commands, the installation is completely automated.

NOTE

If you have installed a Red Hat Enterprise Linux Beta release, on systems having UEFI Secure Boot enabled, then add the Beta public key to the system's Machine Owner Key (MOK) list.

Additional resources

- For information about setting up a PXE server, see Preparing a PXE installation source

14.2. STARTING A KICKSTART INSTALLATION AUTOMATICALLY USING A LOCAL VOLUME

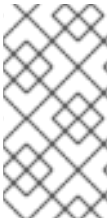
You can start a Kickstart installation by putting a Kickstart file with a specific name on a specifically labelled storage volume.

Prerequisites

- You have a volume prepared with label **OEMDRV** and the Kickstart file present in its root as **ks.cfg**.
- A drive containing this volume is available on the system as the installation program boots.

Procedure

1. Boot the system using a local media (a CD, DVD, or a USB flash drive).
2. At the boot prompt, specify the required boot options.
   a. If a required repository is in a network location, you may need to configure the network using the **ip=** option. The installer tries to configure all network devices using the DHCP protocol by default without this option.
   b. In order to access a software source from which necessary packages will be installed, you may need to add the **inst.repo=** option. If you do not specify this option, you must specify the installation source in the Kickstart file.
      For more information about installation sources, see Kickstart commands for installation program configuration and flow control.
3. Start the installation by confirming your added boot options.
   The installation begins now, and the Kickstart file is automatically detected and used to start an automated Kickstart installation.



NOTE

If you have installed a Red Hat Enterprise Linux Beta release, on systems having UEFI Secure Boot enabled, then add the Beta public key to the system's Machine Owner Key (MOK) list. For more information about UEFI Secure Boot and Red Hat Enterprise Linux Beta releases, see the UEFI Secure Boot and Beta release requirements.

14.3. BOOTING THE INSTALLATION ON IBM Z TO INSTALL RHEL IN AN LPAR

14.3.1. Booting the RHEL installation from an FTP server to install in an IBM Z LPAR

Use this procedure when installing Red Hat Enterprise Linux into an LPAR using an FTP server.

Procedure

1. Log in on the IBM Z Hardware Management Console (HMC) or the Support Element (SE) as a user with sufficient privileges to install a new operating system to an LPAR. The **SYSPROG** user is recommended.
2. On the **Systems** tab, select the mainframe you want to work with, then on the **Partitions** tab select the LPAR to which you wish to install.
3. At the bottom of the screen, under **Daily**, find **Operating System Messages**. Double-click **Operating System Messages** to show the text console on which Linux boot messages will appear.
4. Double-click **Load from Removable Media or Server**.
5. In the dialog box that follows, select **FTP Server**, and enter the following information:
   - **Host Computer** - Host name or IP address of the FTP server you want to install from, for example **ftp.redhat.com**
   - **User ID** - Your user name on the FTP server. Or, specify anonymous.
   - **Password** - Your password. Use your email address if you are logging in as anonymous.
   - **File location (optional)** - Directory on the FTP server holding the Red Hat Enterprise Linux for IBM Z, for example **/rhel/s390x/**.
6. Click **Continue**.
7. In the dialog that follows, keep the default selection of **generic.ins** and click **Continue**.

14.3.2. Booting the RHEL installation from a prepared DASD to install in an IBM Z LPAR

Use this procedure when installing Red Hat Enterprise Linux into an LPAR using an already prepared DASD.

Procedure

1. Log in on the IBM Z Hardware Management Console (HMC) or the Support Element (SE) as a user with sufficient privileges to install a new operating system to an LPAR. The **SYSPROG** user is recommended.
2. On the **Systems** tab, select the mainframe you want to work with, then on the **Partitions** tab select the LPAR to which you wish to install.
3. At the bottom of the screen, under **Daily**, find **Operating System Messages**. Double-click **Operating System Messages** to show the text console on which Linux boot messages will appear.
4. Double-click **Load**.
5. In the dialog box that follows, select **Normal** as the **Load type**.
6. As Load **address**, fill in the device number of the DASD.
7. As **Load parameter**, fill in the number corresponding to the **zipl** boot menu entry that you prepared for booting the Red Hat Enterprise Linux installation program.
8. Click the **OK** button.

14.3.3. Booting the RHEL installation from an FCP-attached SCSI disk to install in an IBM Z LPAR

Use this procedure when installing Red Hat Enterprise Linux into an LPAR using an already prepared FCP attached SCSI disk.

Procedure

1. Log in on the IBM Z Hardware Management Console (HMC) or the Support Element (SE) as a user with sufficient privileges to install a new operating system to an LPAR. The **SYSPROG** user is recommended.
2. On the **Systems** tab, select the mainframe you want to work with, then on the **Partitions** tab select the LPAR to which you wish to install.
3. At the bottom of the screen, under **Daily**, find **Operating System Messages**. Double-click **Operating System Messages** to show the text console on which Linux boot messages will appear.
4. Double-click **Load**.
5. In the dialog box that follows, select **SCSI** as the **Load type**.
6. As **Load address**, fill in the device number of the FCP channel connected with the SCSI disk.
7. As **World wide port name**, fill in the WWPN of the storage system containing the disk as a 16-digit hexadecimal number.
8. As **Logical unit number**, fill in the LUN of the disk as a 16-digit hexadecimal number.
9. As **Boot program selector**, fill in the number corresponding to the **zipl** boot menu entry that you prepared for booting the Red Hat Enterprise Linux installation program.
10. Leave the **Boot record logical block address** as **0** and the **Operating system specific load parameters** empty.

11. Click the **OK** button.

14.4. BOOTING THE INSTALLATION ON IBM Z TO INSTALL RHEL IN Z/VM

When installing under z/VM, you can boot from:

- The z/VM virtual reader
- A DASD or an FCP-attached SCSI disk prepared with the **zipl** boot loader

14.4.1. Booting the RHEL installation by using the z/VM Reader

Perform the following steps to boot from the z/VM reader:

Procedure

1. If necessary, add the device containing the z/VM TCP/IP tools to your CMS disk list. For example:

   ```
   cp link tcpmaint 592 592
   acc 592 fm
   ```

   Replace *fm* with any **FILEMODE** letter.

2. Execute the command:

   ```
   ftp host
   ```

   Where **host** is the host name or IP address of the FTP server that hosts the boot images (**kernel.img** and **initrd.img**).

3. Log in and execute the following commands. Use the **(repl** option if you are overwriting existing **kernel.img**, **initrd.img**, **generic.prm**, or **redhat.exec** files:

   ```
   cd /location/of/install-tree/images/
   ascii
   get generic.prm (repl
   get redhat.exec (repl
   locsite fix 80
   binary
   get kernel.img (repl
   get initrd.img (repl
   quit
   ```

4. Optional: Check whether the files were transferred correctly by using the CMS command **filelist** to show the received files and their format. It is important that **kernel.img** and **initrd.img** have a fixed record length format denoted by F in the Format column and a record length of 80 in the Lrecl column. For example:

   ```
   VMUSER FILELIST A0 V 169 Trunc=169 Size=6 Line=1 Col=1 Alt=0
   Cmd Filename Filetype Fm Format Lrecl Records Blocks Date Time
   REDHAT EXEC  B1 V 22 1  1 4/15/10 9:30:40
   ```

```
GENERIC PRM  B1 V 44 1 1 4/15/10 9:30:32
INITRD IMG  B1 F 80 118545 2316 4/15/10 9:30:25
KERNEL IMG  B1 F 80 74541 912 4/15/10 9:30:17
```

Press **PF3** to quit filelist and return to the CMS prompt.

5. Customize boot parameters in **generic.prm** as necessary. For details, see Customizing boot parameters.
   Another way to configure storage and network devices is by using a CMS configuration file. In such a case, add the ***CMSDASD=*** and ***CMSCONFFILE=*** parameters to **generic.prm**. See IBM Z/VM configuration file for more details.

6. Finally, execute the REXX script redhat.exec to boot the installation program:

```
redhat
```

14.4.2. Booting the RHEL installation by using a prepared DASD

Perform the following steps to use a Prepared DASD:

Procedure

- Boot from the prepared DASD and select the **zipl** boot menu entry referring to the Red Hat Enterprise Linux installation program. Use a command of the following form:

```
cp ipl DASD_device_number loadparm boot_entry_number
```

Replace *DASD_device_number* with the device number of the boot device, and *boot_entry_number* with the **zipl** configuration menu for this device. For example:

```
cp ipl eb1c loadparm 0
```

14.4.3. Booting the RHEL installation by using a prepared FCP attached SCSI Disk

Perform the following steps to boot from a prepared FCP-attached SCSI disk:

Procedure

1. Configure the SCSI boot loader of z/VM to access the prepared SCSI disk in the FCP Storage Area Network. Select the prepared **zipl** boot menu entry referring to the Red Hat Enterprise Linux installation program. Use a command of the following form:

```
cp set loaddev portname WWPN lun LUN bootprog boot_entry_number
```

Replace *WWPN* with the World Wide Port Name of the storage system and *LUN* with the Logical Unit Number of the disk. The 16-digit hexadecimal numbers must be split into two pairs of eight digits each. For example:

```
cp set loaddev portname 50050763 050b073d lun 40204011 00000000 bootprog 0
```

2. Optional: Confirm your settings with the command:

```
query loaddev
```

3. Boot the FCP device connected with the storage system containing the disk with the following command:

```
cp ipl FCP_device
```

For example:

```
cp ipl fc00
```

14.5. 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 14.1. 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**.

PART III. POST-INSTALLATION TASKS

It is essential to manage and secure RHEL systems across different platforms. It includes instructions for registering systems, configuring the system purpose. It also provides details on installing a 64k kernel on ARM and modifying subscription services to maintain system configuration and security.

CHAPTER 15. REGISTERING RHEL BY USING SUBSCRIPTION MANAGER

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

15.1. 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.

15.2. 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.

15.3. 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 16. 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 17. CONFIGURING A LINUX INSTANCE ON 64-BIT IBM Z

This section describes most of the common tasks for installing Red Hat Enterprise Linux on 64-bit IBM Z.

17.1. ADDING DASDS

Direct Access Storage Devices (DASDs) are a type of storage commonly used with 64-bit IBM Z. For more information, see Working with DASDs in the IBM Knowledge Center. The following example is how to set a DASD online, format it, and make the change persistent.

Verify that the device is attached or linked to the Linux system if running under z/VM.

```
CP ATTACH EB1C TO *
```

To link a mini disk to which you have access, run the following commands:

```
CP LINK RHEL7X 4B2E 4B2E MR
DASD 4B2E LINKED R/W
```

17.2. DYNAMICALLY SETTING DASDS ONLINE

This section contains information about setting a DASD online.

Procedure

1. Use the **cio_ignore** utility to remove the DASD from the list of ignored devices and make it visible to Linux:

   ```
   # cio_ignore -r device_number
   ```

   Replace *device_number* with the device number of the DASD. For example:

   ```
   # cio_ignore -r 4b2e
   ```

2. Set the device online. Use a command of the following form:

   ```
   # chccwdev -e device_number
   ```

   Replace *device_number* with the device number of the DASD. For example:

   ```
   # chccwdev -e 4b2e
   ```

   As an alternative, you can set the device online using sysfs attributes:

   a. Use the **cd** command to change to the /sys/ directory that represents that volume:

      ```
      # cd /sys/bus/ccw/drivers/dasd-eckd/0.0.4b2e/
      # ls -l
      total 0
      ```

```
-r--r--r--  1 root root 4096 Aug 25 17:04 availability
-rw-r--r--  1 root root 4096 Aug 25 17:04 cmb_enable
-r--r--r--  1 root root 4096 Aug 25 17:04 cutype
-rw-r--r--  1 root root 4096 Aug 25 17:04 detach_state
-r--r--r--  1 root root 4096 Aug 25 17:04 devtype
-r--r--r--  1 root root 4096 Aug 25 17:04 discipline
-rw-r--r--  1 root root 4096 Aug 25 17:04 online
-rw-r--r--  1 root root 4096 Aug 25 17:04 readonly
-rw-r--r--  1 root root 4096 Aug 25 17:04 use_diag
```

b. Check to see if the device is already online:

```
# cat online
0
```

c. If it is not online, enter the following command to bring it online:

```
# echo 1 > online
# cat online
1
```

3. Verify which block devnode it is being accessed as:

```
# ls -l
total 0
-r--r--r--  1 root root 4096 Aug 25 17:04 availability
lrwxrwxrwx  1 root root    0 Aug 25 17:07 block -> ../../../../block/dasdb
-rw-r--r--  1 root root 4096 Aug 25 17:04 cmb_enable
-r--r--r--  1 root root 4096 Aug 25 17:04 cutype
-rw-r--r--  1 root root 4096 Aug 25 17:04 detach_state
-r--r--r--  1 root root 4096 Aug 25 17:04 devtype
-r--r--r--  1 root root 4096 Aug 25 17:04 discipline
-rw-r--r--  1 root root    0 Aug 25 17:04 online
-rw-r--r--  1 root root 4096 Aug 25 17:04 readonly
-rw-r--r--  1 root root 4096 Aug 25 17:04 use_diag
```

As shown in this example, device 4B2E is being accessed as /dev/dasdb.

These instructions set a DASD online for the current session, but this is not persistent across reboots.

For instructions on how to set a DASD online persistently, see Persistently setting DASDs online. When you work with DASDs, use the persistent device symbolic links under **/dev/disk/by-path/**.

17.3. PREPARING A NEW DASD WITH LOW-LEVEL FORMATTING

Once the disk is online, change back to the **/root** directory and low-level format the device. This is only required once for a DASD during its entire lifetime:

```
# cd /root
# dasdfmt -b 4096 -d cdl -p /dev/disk/by-path/ccw-0.0.4b2e
Drive Geometry: 10017 Cylinders * 15 Heads =  150255 Tracks

I am going to format the device /dev/disk/by-path/ccw-0.0.4b2e in the following way:
Device number of device : 0x4b2e
```

```
Labelling device        : yes
Disk label              : VOL1
Disk identifier         : 0X4B2E
Extent start (trk no)   : 0
Extent end (trk no)     : 150254
Compatible Disk Layout  : yes
Blocksize               : 4096

--->> ATTENTION! <<---
All data of that device will be lost.
Type "yes" to continue, no will leave the disk untouched: yes
cyl    97 of  3338 |#----------------------------------------------|   2%
```

When the progress bar reaches the end and the format is complete, **dasdfmt** prints the following output:

```
Rereading the partition table...
Exiting...
```

Now, use **fdasd** to partition the DASD. You can create up to three partitions on a DASD. In our example here, we create one partition spanning the whole disk:

```
# fdasd -a /dev/disk/by-path/ccw-0.0.4b2e
reading volume label ..: VOL1
reading vtoc .........: ok

auto-creating one partition for the whole disk...
writing volume label...
writing VTOC...
rereading partition table...
```

After a (low-level formatted) DASD is online, it can be used like any other disk under Linux. For example, you can create file systems, LVM physical volumes, or swap space on its partitions, for example **/dev/disk/by-path/ccw-0.0.4b2e-part1**. Never use the full DASD device (**dev/dasdb**) for anything but the commands **dasdfmt** and **fdasd**. If you want to use the entire DASD, create one partition spanning the entire drive as in the **fdasd** example above.

To add additional disks later without breaking existing disk entries in, for example, **/etc/fstab**, use the persistent device symbolic links under **/dev/disk/by-path/**.

17.4. PERSISTENTLY SETTING DASDS ONLINE

The above instructions described how to activate DASDs dynamically in a running system. However, such changes are not persistent and do not survive a reboot. Making changes to the DASD configuration persistent in your Linux system depends on whether the DASDs belong to the root file system. Those DASDs required for the root file system need to be activated very early during the boot process by the **initramfs** to be able to mount the root file system.

The **cio_ignore** commands are handled transparently for persistent device configurations and you do not need to free devices from the ignore list manually.

17.5. DASDS THAT ARE PART OF THE ROOT FILE SYSTEM

The file you have to modify to add DASDs that are part of the root file system has changed in Red Hat Enterprise Linux 9. Instead of editing the **/etc/zipl.conf** file, the new file to be edited, and its location, may be found by running the following commands:

```
# machine_id=$(cat /etc/machine-id)
# kernel_version=$(uname -r)
# ls /boot/loader/entries/$machine_id-$kernel_version.conf
```

There is one boot option to activate DASDs early in the boot process: **rd.dasd=**. This option takes a Direct Access Storage Device (DASD) adapter device bus identifier. For multiple DASDs, specify the parameter multiple times, or use a comma separated list of bus IDs. To specify a range of DASDs, specify the first and the last bus ID. Below is an example of the **/boot/loader/entries/4ab74e52867b4f998e73e06cf23fd761-4.18.0-80.el8.s390x.conf** file for a system that uses physical volumes on partitions of two DASDs for an LVM volume group **vg_devel1** that contains a logical volume **lv_root** for the root file system.

```
title Red Hat Enterprise Linux (4.18.0-80.el8.s390x) 8.0 (Ootpa)
version 4.18.0-80.el8.s390x
linux /boot/vmlinuz-4.18.0-80.el8.s390x
initrd /boot/initramfs-4.18.0-80.el8.s390x.img
options root=/dev/mapper/vg_devel1-lv_root crashkernel=auto rd.dasd=0.0.0200 rd.dasd=0.0.0207
rd.lvm.lv=vg_devel1/lv_root rd.lvm.lv=vg_devel1/lv_swap cio_ignore=all,!condev
rd.znet=qeth,0.0.0a00,0.0.0a01,0.0.0a02,layer2=1,portno=0
id rhel-20181027190514-4.18.0-80.el8.s390x
grub_users $grub_users
grub_arg --unrestricted
grub_class kernel
```

To add another physical volume on a partition of a third DASD with device bus ID **0.0.202b**. To do this, add **rd.dasd=0.0.202b** to the parameters line of your boot kernel in **/boot/loader/entries/4ab74e52867b4f998e73e06cf23fd761-4.18.0-32.el8.s390x.conf**:

```
title Red Hat Enterprise Linux (4.18.0-80.el8.s390x) 8.0 (Ootpa)
version 4.18.0-80.el8.s390x
linux /boot/vmlinuz-4.18.0-80.el8.s390x
initrd /boot/initramfs-4.18.0-80.el8.s390x.img
options root=/dev/mapper/vg_devel1-lv_root crashkernel=auto rd.dasd=0.0.0200 rd.dasd=0.0.0207
rd.dasd=0.0.202b rd.lvm.lv=vg_devel1/lv_root rd.lvm.lv=vg_devel1/lv_swap cio_ignore=all,!condev
rd.znet=qeth,0.0.0a00,0.0.0a01,0.0.0a02,layer2=1,portno=0
id rhel-20181027190514-4.18.0-80.el8.s390x
grub_users $grub_users
grub_arg --unrestricted
grub_class kernel
```

WARNING

Make sure the length of the kernel command line in the configuration file does not exceed 896 bytes. Otherwise, the boot loader cannot be saved, and the installation fails.

Run **zipl** to apply the changes of the configuration file for the next IPL:

```
# zipl -V
Using config file '/etc/zipl.conf'
Using BLS config file '/boot/loader/entries/4ab74e52867b4f998e73e06cf23fd761-4.18.0-
80.el8.s390x.conf'
Target device information
  Device.....: 5e:00
  Partition.....: 5e:01
  Device name.....: dasda
  Device driver name.....: dasd
  DASD device number.....: 0201
  Type.....: disk partition
  Disk layout.....: ECKD/compatible disk layout
  Geometry - heads.....: 15
  Geometry - sectors.....: 12
  Geometry - cylinders.....: 13356
  Geometry - start.....: 24
  File system block size.....: 4096
  Physical block size.....: 4096
  Device size in physical blocks..: 262152
Building bootmap in '/boot'
Building menu 'zipl-automatic-menu'
Adding #1: IPL section '4.18.0-80.el8.s390x' (default)
  initial ramdisk...: /boot/initramfs-4.18.0-80.el8.s390x.img
  kernel image.....: /boot/vmlinuz-4.18.0-80.el8.s390x
  kernel parmline...: 'root=/dev/mapper/vg_devel1-lv_root crashkernel=auto rd.dasd=0.0.0200
rd.dasd=0.0.0207 rd.dasd=0.0.202b rd.lvm.lv=vg_devel1/lv_root rd.lvm.lv=vg_devel1/lv_swap
cio_ignore=all,!condev rd.znet=qeth,0.0.0a00,0.0.0a01,0.0.0a02,layer2=1,portno=0'
  component address:
    kernel image....: 0x00010000-0x0049afff
    parmline.....: 0x0049b000-0x0049bfff
    initial ramdisk.: 0x004a0000-0x01a26fff
    internal loader.: 0x0000a000-0x0000cfff
Preparing boot menu
  Interactive prompt.....: enabled
  Menu timeout.....: 5 seconds
  Default configuration...: '4.18.0-80.el8.s390x'
Preparing boot device: dasda (0201).
Syncing disks...
Done.
```

17.6. DASDS THAT ARE NOT PART OF THE ROOT FILE SYSTEM

Direct Access Storage Devices (DASDs) that are not part of the root file system, that is, *data disks*, are persistently configured in the **/etc/dasd.conf** file. This file contains one DASD per line, where each line begins with the DASD's bus ID.

When adding a DASD to the **/etc/dasd.conf** file, use key-value pairs to specify the options for each entry. Separate the key and its value with an equal (=) sign. When adding multiple options, use a space or a tab to separate each option.

Example /etc/dasd.conf file

```
0.0.0207
0.0.0200 use_diag=1 readonly=1
```

Changes to the **/etc/dasd.conf** file take effect after a system reboot or after a new DASD is dynamically added by changing the system's I/O configuration (that is, the DASD is attached under z/VM).

Alternatively, to activate a DASD that you have added to the **/etc/dasd.conf** file, complete the following steps:

1. Remove the DASD from the list of ignored devices and make it visible using the **cio_ignore** utility:

   ```
   # cio_ignore -r device_number
   ```

   where ***device_number*** is the DASD device number.

   For example, if the device number is **021a**, run:

   ```
   # cio_ignore -r 021a
   ```

2. Activate the DASD by writing to the device's **uevent** attribute:

   ```
   # echo add > /sys/bus/ccw/devices/dasd-bus-ID/uevent
   ```

   where ***dasd-bus-ID*** is the DASD's bus ID.

   For example, if the bus ID is **0.0.021a**, run:

   ```
   # echo add > /sys/bus/ccw/devices/0.0.021a/uevent
   ```

17.7. FCP LUNS THAT ARE PART OF THE ROOT FILE SYSTEM

The only file you have to modify for adding FCP LUNs that are part of the root file system has changed in Red Hat Enterprise Linux 9. Instead of editing the **/etc/zipl.conf** file, the new file to be edited, and its location, may be found by running the following commands:

```
# machine_id=$(cat /etc/machine-id)
# kernel_version=$(uname -r)
# ls /boot/loader/entries/$machine_id-$kernel_version.conf
```

Red Hat Enterprise Linux provides a parameter to activate FCP LUNs early in the boot process: **rd.zfcp=**. The value is a comma-separated list containing the FCP device bus ID, the target WWPN as 16 digit hexadecimal number prefixed with **0x**, and the FCP LUN prefixed with 0x and padded with zeroes to the right to have 16 hexadecimal digits.

The WWPN and FCP LUN values are only necessary if the **zFCP** device is not configured in NPIV mode, when auto LUN scanning is disabled by the **zfcp.allow_lun_scan=0** kernel module parameter or when installing RHEL-9.0 or older releases. Otherwise they can be omitted, for example, **rd.zfcp=0.0.4000**. Below is an example of the **/boot/loader/entries/4ab74e52867b4f998e73e06cf23fd761-5.14.0-55.el9.s390x.conf** file for a system that uses a physical volume on a partition of an FCP-attached SCSI disk, with two paths, for an LVM volume group **vg_devel1** that contains a logical volume **lv_root** for the root file system.

```
title Red Hat Enterprise Linux (5.14.0-55.el9.s390x) 9.0 (Plow)
version 5.14.0-55.el9.s390x
linux /boot/vmlinuz-5.14.0-55.el9.s390x
initrd /boot/initramfs-5.14.0-55.el9.s390x.img
options root=/dev/mapper/vg_devel1-lv_root crashkernel=auto
rd.zfcp=0.0.fc00,0x5105074308c212e9,0x401040a000000000
rd.zfcp=0.0.fcd0,0x5105074308c2aee9,0x401040a000000000 rd.lvm.lv=vg_devel1/lv_root
rd.lvm.lv=vg_devel1/lv_swap cio_ignore=all,!condev
rd.znet=qeth,0.0.0a00,0.0.0a01,0.0.0a02,layer2=1,portno=0
id rhel-20181027190514-5.14.0-55.el9.s390x
grub_users $grub_users
grub_arg --unrestricted
grub_class kernel
```

1. To add another physical volume on a partition of a second FCP-attached SCSI disk with FCP LUN **0x401040a300000000** using the same two paths as the already existing physical volume, add **rd.zfcp=0.0.fc00,0x5105074308c212e9,0x401040a300000000** and **rd.zfcp=0.0.fcd0,0x5105074308c2aee9,0x401040a300000000** to the parameters line of your boot kernel in **/boot/loader/entries/4ab74e52867b4f998e73e06cf23fd761-5.14.0-55.el9.s390x.conf**. For example:

```
title Red Hat Enterprise Linux (5.14.0-55.el9.s390x) 9.0 (Plow)
version 5.14.0-55.el9.s390x
linux /boot/vmlinuz-5.14.0-55.el9.s390x
initrd /boot/initramfs-5.14.0-55.el9.s390x.img
options root=/dev/mapper/vg_devel1-lv_root crashkernel=auto
rd.zfcp=0.0.fc00,0x5105074308c212e9,0x401040a000000000
rd.zfcp=0.0.fcd0,0x5105074308c2aee9,0x401040a000000000
rd.zfcp=0.0.fc00,0x5105074308c212e9,0x401040a300000000
rd.zfcp=0.0.fcd0,0x5105074308c2aee9,0x401040a300000000 rd.lvm.lv=vg_devel1/lv_root
rd.lvm.lv=vg_devel1/lv_swap cio_ignore=all,!condev
rd.znet=qeth,0.0.0a00,0.0.0a01,0.0.0a02,layer2=1,portno=0
id rhel-20181027190514-5.14.0-55.el9.s390x
grub_users $grub_users
grub_arg --unrestricted
grub_class kernel
```

WARNING

Make sure the length of the kernel command line in the configuration file does not exceed 896 bytes. Otherwise, the boot loader cannot be saved, and the installation fails.

- Run **dracut -f** to update the initial RAM disk of your target kernel.
- Run **zipl** to apply the changes of the configuration file for the next IPL:

```
# zipl -V
Using config file '/etc/zipl.conf'
Using BLS config file '/boot/loader/entries/4ab74e52867b4f998e73e06cf23fd761-5.14.0-
```

```
55.el9.s390x.conf'
Run /lib/s390-tools/zipl_helper.device-mapper /boot
Target device information
Device.....: fd:00
Partition.....: fd:01
Device name.....: dm-0
Device driver name.....: device-mapper
Type.....: disk partition
Disk layout.....: SCSI disk layout
Geometry - start.....: 2048
File system block size.....: 4096
Physical block size.....: 512
Device size in physical blocks..: 10074112
Building bootmap in '/boot/'
Building menu 'zipl-automatic-menu'
Adding #1: IPL section '5.14.0-55.el9.s390x' (default)
kernel image.....: /boot/vmlinuz-5.14.0-55.el9.s390x
kernel parmline...: 'root=/dev/mapper/vg_devel1-lv_root crashkernel=auto
rd.zfcp=0.0.fc00,0x5105074308c212e9,0x401040a000000000
rd.zfcp=0.0.fcd0,0x5105074308c2aee9,0x401040a000000000
rd.zfcp=0.0.fc00,0x5105074308c212e9,0x401040a300000000
rd.zfcp=0.0.fcd0,0x5105074308c2aee9,0x401040a300000000 rd.lvm.lv=vg_devel1/lv_root
rd.lvm.lv=vg_devel1/lv_swap cio_ignore=all,!condev
rd.znet=qeth,0.0.0a00,0.0.0a01,0.0.0a02,layer2=1,portno=0'
initial ramdisk...: /boot/initramfs-5.14.0-55.el9.s390x.img component address:
kernel image....: 0x00010000-0x007a21ff
parmline.....: 0x00001000-0x000011ff
initial ramdisk.: 0x02000000-0x028f63ff
internal loader.: 0x0000a000-0x0000a3ff
Preparing boot device: dm-0.
Detected SCSI PCBIOS disk layout.
Writing SCSI master boot record.
Syncing disks...
Done.
```

17.8. FCP LUNS THAT ARE NOT PART OF THE ROOT FILE SYSTEM

FCP LUNs that are not part of the root file system, such as data disks, are persistently configured in the file **/etc/zfcp.conf**. It contains one FCP LUN per line. Each line contains the device bus ID of the FCP adapter, the target WWPN as 16 digit hexadecimal number prefixed with **0x**, and the FCP LUN prefixed with **0x** and padded with zeroes to the right to have 16 hexadecimal digits, separated by a space or tab.

The WWPN and FCP LUN values are only necessary if the **zFCP** device is not configured in NPIV mode, when **auto LUN** scanning is disabled by the **zfcp.allow_lun_scan=0** kernel module parameter or when installing RHEL-9.0 or older releases. Otherwise they can be omitted and only the device bus ID is mandatory.

Entries in **/etc/zfcp.conf** are activated and configured by udev when an FCP adapter is added to the system. At boot time, all FCP adapters visible to the system are added and trigger **udev**.

Example content of **/etc/zfcp.conf**:

```
0.0.fc00 0x5105074308c212e9 0x401040a000000000
0.0.fc00 0x5105074308c212e9 0x401040a100000000
0.0.fc00 0x5105074308c212e9 0x401040a300000000
```

```
0.0.fcd0 0x5105074308c2aee9 0x401040a000000000
0.0.fcd0 0x5105074308c2aee9 0x401040a100000000
0.0.fcd0 0x5105074308c2aee9 0x401040a300000000
0.0.4000
0.0.5000
```

Modifications of **/etc/zfcp.conf** only become effective after a reboot of the system or after the dynamic addition of a new FCP channel by changing the system's I/O configuration (for example, a channel is attached under z/VM). Alternatively, you can trigger the activation of a new entry in **/etc/zfcp.conf** for an FCP adapter which was previously not active, by executing the following commands:

1. Use the **zfcp_cio_free** utility to remove the FCP adapters from the list of ignored devices and make them visible to Linux:

```
# zfcp_cio_free
```

2. To apply the additions from **/etc/zfcp.conf** to the running system, issue:

```
# zfcpconf.sh
```

17.9. ADDING A QETH DEVICE

The **qeth** network device driver supports 64-bit IBM Z OSA-Express features in QDIO mode, HiperSockets, z/VM guest LAN, and z/VM VSWITCH.

For more information about the qeth device driver naming scheme, see Customizing boot parameters.

17.10. DYNAMICALLY ADDING A QETH DEVICE

This section contains information about how to add a **qeth** device dynamically.

Procedure

1. Determine whether the **qeth** device driver modules are loaded. The following example shows loaded **qeth** modules:

```
# lsmod | grep qeth
qeth_l3               69632  0
qeth_l2               49152  1
qeth                 131072  2 qeth_l3,qeth_l2
qdio                  65536  3 qeth,qeth_l3,qeth_l2
ccwgroup              20480  1 qeth
```

If the output of the **lsmod** command shows that the **qeth** modules are not loaded, run the **modprobe** command to load them:

```
# modprobe qeth
```

2. Use the **cio_ignore** utility to remove the network channels from the list of ignored devices and make them visible to Linux:

```
# cio_ignore -r read_device_bus_id,write_device_bus_id,data_device_bus_id
```

Replace *read_device_bus_id*,*write_device_bus_id*,*data_device_bus_id* with the three device bus IDs representing a network device. For example, if the *read_device_bus_id* is **0.0.f500**, the *write_device_bus_id* is **0.0.f501**, and the *data_device_bus_id* is **0.0.f502**:

```
# cio_ignore -r 0.0.f500,0.0.f501,0.0.f502
```

3. Use the **znetconf** utility to sense and list candidate configurations for network devices:

```
# znetconf -u
Scanning for network devices...
Device IDs                Type    Card Type      CHPID Drv.
------------------------------------------------------------
0.0.f500,0.0.f501,0.0.f502 1731/01 OSA (QDIO)       00 qeth
0.0.f503,0.0.f504,0.0.f505 1731/01 OSA (QDIO)       01 qeth
0.0.0400,0.0.0401,0.0.0402 1731/05 HiperSockets     02 qeth
```

4. Select the configuration you want to work with and use **znetconf** to apply the configuration and to bring the configured group device online as network device.

```
# znetconf -a f500
Scanning for network devices...
Successfully configured device 0.0.f500 (encf500)
```

5. Optional: You can also pass arguments that are configured on the group device before it is set online:

```
# znetconf -a f500 -o portname=myname
Scanning for network devices...
Successfully configured device 0.0.f500 (encf500)
```

Now you can continue to configure the **encf500** network interface.

Alternatively, you can use **sysfs** attributes to set the device online as follows:

1. Create a **qeth** group device:

```
# echo read_device_bus_id,write_device_bus_id,data_device_bus_id >
/sys/bus/ccwgroup/drivers/qeth/group
```

For example:

```
# echo 0.0.f500,0.0.f501,0.0.f502 > /sys/bus/ccwgroup/drivers/qeth/group
```

2. Next, verify that the **qeth** group device was created properly by looking for the read channel:

```
# ls /sys/bus/ccwgroup/drivers/qeth/0.0.f500
```

You can optionally set additional parameters and features, depending on the way you are setting up your system and the features you require, such as:

- **portno**
- **layer2**

- **portname**

3. Bring the device online by writing **1** to the online **sysfs** attribute:

```
# echo 1 > /sys/bus/ccwgroup/drivers/qeth/0.0.f500/online
```

4. Then verify the state of the device:

```
# cat /sys/bus/ccwgroup/drivers/qeth/0.0.f500/online
1
```

A return value of **1** indicates that the device is online, while a return value **0** indicates that the device is offline.

5. Find the interface name that was assigned to the device:

```
# cat /sys/bus/ccwgroup/drivers/qeth/0.0.f500/if_name
encf500
```

Now you can continue to configure the **encf500** network interface.

The following command from the **s390utils** package shows the most important settings of your **qeth** device:

```
# lsqeth encf500
Device name                    : encf500
------------------------------------------------
card_type               : OSD_1000
cdev0                   : 0.0.f500
cdev1                   : 0.0.f501
cdev2                   : 0.0.f502
chpid                   : 76
online                  : 1
portname                : OSAPORT
portno                  : 0
state                   : UP (LAN ONLINE)
priority_queueing       : always queue 0
buffer_count            : 16
layer2                  : 1
isolation               : none
```

17.11. PERSISTENTLY ADDING A QETH DEVICE

To make a new **qeth** device persistent, create a configuration file for the new interface. The network interface configuration files are placed in the **/etc/NetworkManager/system-connections/** directory.

The network configuration files use the naming convention *device*.nmconnection, where *device* is the value found in the interface-name file in the *qeth* group device that was created earlier, for example *enc9a0*. The *cio_ignore* commands are handled transparently for persistent device configurations and you do not need to free devices from the ignore list manually.

If a configuration file for another device of the same type already exists, copy it to the new name and edit it:

```
# cd /etc/NetworkManager/system-connections/
# cp enc9a0.nmconnection enc600.nmconnection
```

To learn IDs of your network devices, use the *lsqeth* utility:

```
# lsqeth -p
devices                  CHPID interface        cardtype       port chksum prio-q'ing rtr4 rtr6 lay'2 cnt
------------------------ ----- ---------------- -------------- ---- ------ ---------- ---- ---- ----- -----
0.0.09a0/0.0.09a1/0.0.09a2 x00   enc9a0    Virt.NIC QDIO  0    sw     always_q_2 n/a  n/a  1     64
0.0.0600/0.0.0601/0.0.0602 x00   enc600    Virt.NIC QDIO  0    sw     always_q_2 n/a  n/a  1     64
```

If you do not have a similar device defined, create a new file. Use this example:

```
[connection]
type=ethernet
interface-name=enc600

[ipv4]
address1=10.12.20.136/24,10.12.20.1
dns=10.12.20.53;
method=manual

[ethernet]
mac-address=00:53:00:8f:fa:66
```

Edit the new *enc600.nmconnection* file as follows:

1. Ensure the new connection file is owned by **root:root**:

   ```
   # chown root:root /etc/NetworkManager/system-connections/enc600.nmconnection
   ```

2. Add more details in this file or modify these parameters based on your connection requirements.

3. Save the file.

4. Reload the connection profile:

   ```
   # nmcli connection reload
   ```

5. To view complete details of the connection newly added, enter:

   ```
   # nmcli connection show enc600
   ```

Changes to the *enc600.nmconnection* file become effective after either rebooting the system, dynamic addition of new network device channels by changing the system's I/O configuration (for example, attaching under z/VM), or reloading network connections. Alternatively, you can trigger the activation of *enc600.nmconnection* for network channels, which were previously not active yet, by executing the following commands:

1. Use the **cio_ignore** utility to remove the network channels from the list of ignored devices and make them visible to Linux:

   ```
   # cio_ignore -r read_device_bus_id,write_device_bus_id,data_device_bus_id
   ```

Replace *read_device_bus_id*, *write_device_bus_id*, *data_device_bus_id* with the three device bus IDs representing a network device. For example, if the *read_device_bus_id* is **0.0.0600**, the *write_device_bus_id* is **0.0.0601**, and the *data_device_bus_id* is **0.0.0602**:

```
#  cio_ignore -r 0.0.0600,0.0.0601,0.0.0602
```

2. To trigger the uevent that activates the change, issue:

```
# echo add > /sys/bus/ccw/devices/read-channel/uevent
```

For example:

```
# echo add > /sys/bus/ccw/devices/0.0.0600/uevent
```

3. Check the status of the network device:

```
# lsqeth
```

4. If the default route information has changed, you must also update the *ipaddress1* parameters in both the **[ipv4]** and **[ipv6]** sections of the **/etc/NetworkManager/system-connections/<profile_name>.nmconnection** file accordingly:

```
[ipv4]
address1=10.12.20.136/24,10.12.20.1
[ipv6]
address1=2001:db8:1::1,2001:db8:1::fffe
```

5. Now start the new interface:

```
# nmcli connection up enc600
```

6. Check the status of the interface:

```
# ip addr show enc600
3: enc600:  <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state
UP group default qlen 1000
link/ether 3c:97:0e:51:38:17 brd ff:ff:ff:ff:ff:ff
10.12.20.136/24 brd 10.12.20.1 scope global dynamic enc600
valid_lft 81487sec preferred_lft 81487sec
inet6 1574:12:5:1185:3e97:eff:fe51:3817/64 scope global noprefixroute dynamic
valid_lft 2591994sec preferred_lft 604794sec
inet6 fe45::a455:eff:d078:3847/64 scope link
valid_lft forever preferred_lft forever
```

7. Check the routing for the new interface:

```
# ip route
default via 10.12.20.136 dev enc600 proto dhcp src
```

8. Verify your changes by using the **ping** utility to ping the gateway or another host on the subnet of the new device:

```
# ping -c 1 10.12.20.136
PING 10.12.20.136 (10.12.20.136) 56(84) bytes of data.
64 bytes from 10.12.20.136: icmp_seq=0 ttl=63 time=8.07 ms
```

9. If the default route information has changed, you must also update **/etc/sysconfig/network** accordingly.

Additional resources

- **nm-settings-keyfile** man page on your system

17.12. CONFIGURING AN 64-BIT IBM Z NETWORK DEVICE FOR NETWORK ROOT FILE SYSTEM

To add a network device that is required to access the root file system, you only have to change the boot options. The boot options can be in a parameter file, however, the **/etc/zipl.conf** file no longer contains specifications of the boot records. The file that needs to be modified can be located using the following commands:

```
# machine_id=$(cat /etc/machine-id)
# kernel_version=$(uname -r)
# ls /boot/loader/entries/$machine_id-$kernel_version.conf
```

Dracut, the **mkinitrd** successor that provides the functionality in the initramfs that in turn replaces **initrd**, provides a boot parameter to activate network devices on 64-bit IBM Z early in the boot process: **rd.znet=**.

As input, this parameter takes a comma-separated list of the **NETTYPE** (qeth, lcs, ctc), two (lcs, ctc) or three (qeth) device bus IDs, and optional additional parameters consisting of key-value pairs corresponding to network device sysfs attributes. This parameter configures and activates the 64-bit IBM Z network hardware. The configuration of IP addresses and other network specifics works the same as for other platforms. See the **dracut** documentation for more details.

The **cio_ignore** commands for the network channels are handled transparently on boot.

Example boot options for a root file system accessed over the network through NFS:

```
root=10.16.105.196:/nfs/nfs_root cio_ignore=all,!condev
rd.znet=qeth,0.0.0a00,0.0.0a01,0.0.0a02,layer2=1,portno=0,portname=OSAPORT
ip=10.16.105.197:10.16.105.196:10.16.111.254:255.255.248.0:nfs-server.subdomain.domain:enc9a0:n
one rd_NO_LUKS rd_NO_LVM rd_NO_MD rd_NO_DM LANG=en_US.UTF-8
SYSFONT=latarcyrheb-sun16 KEYTABLE=us
```

CHAPTER 18. 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
```

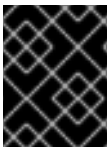
To review active services, run the following command:

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

CHAPTER 19. INSTALLING KERNEL-64K ON ARM USING THE COMMAND LINE

By default, RHEL 9 is distributed with a kernel supporting a 4k page size. This 4k kernel is sufficient for efficient memory usage in smaller environments or small cloud instances where the usage of a 64k page kernel is not practical due to space, power, and cost constraints.

If you have already installed RHEL with the default kernel (supporting 4k page size), you can install **kernel-64k** post installation using the command line.



IMPORTANT

It is not recommended to move between 4k and 64k page size kernels after the initial boot without reinstallation of the OS.

Procedure

1. Open the terminal as the root user, and enter:

```
# dnf -y install kernel-64k
```

2. To set the **kernel-64k** as default, enter:

```
# k=$(echo /boot/vmlinuz*64k)
# grubby --set-default=$k \
        --update-kernel=$k \
        --args="crashkernel=2G-:640M"
```

3. Set the system boot order to use RHEL as the default option.

   a. Obtain the current boot order. For example:

```
# efibootmgr
BootCurrent: 0000
Timeout: 5 seconds
BootOrder: 0003,0004,0001,0000,0002,0005
Boot0000\* Red Hat Enterprise Linux
```

   b. Set the boot order to prioritize RHEL. For example, for the output in the previous step, use the following command:

```
# efibootmgr -o 0000,0001,0002,0003,0004,0005
```

4. Reboot the system:

```
# reboot
```

5. Optional: After reboot, remove the 4k kernel:

```
# dnf erase kernel
```

Keeping both versions accidentally can make the 4k kernel default when you update the kernel in future using the **yum update** command.

Verification

- To verify the page size, open the terminal and run the following command as any user:

```
$ getconf PAGESIZE
65536
```

The output **65536** indicates that the 64k kernel is in use.

- To verify swap is enabled, enter:

```
$ free
              total        used        free      shared  buff/cache   available
Mem:       35756352     3677184    34774848       25792      237120    32079168
Swap:       6504384           0     6504384
```

The total and free columns are non-zero, which indicates the swap is enabled successfully.

CHAPTER 20. 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.

20.1. 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.

20.1.1. 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*

20.1.2. 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*

20.2. 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

A comprehensive reference for the Kickstart script file format and its commands. It covers various Kickstart options related to installation program configuration, system and network setup, storage handling, and specific addons included with the RHEL installation program. Additionally, it details commands relevant for system recovery, offering an essential guide for automating and customizing RHEL installations. Changes to Kickstart commands are also documented to keep users informed of updates.

APPENDIX A. KICKSTART SCRIPT FILE FORMAT REFERENCE

This reference describes in detail the kickstart file format.

A.1. KICKSTART FILE FORMAT

Kickstart scripts are plain text files that contain keywords recognized by the installation program, which serve as directions for the installation. Any text editor able to save files as ASCII text, such as **Gedit** or **vim** on Linux systems or **Notepad** on Windows systems, can be used to create and edit Kickstart files. The file name of your Kickstart configuration does not matter; however, it is recommended to use a simple name as you will need to specify this name later in other configuration files or dialogs.

Commands

Commands are keywords that serve as directions for installation. Each command must be on a single line. Commands can take options. Specifying commands and options is similar to using Linux commands in shell.

Sections

Certain special commands that begin with the percent **%** character start a section. Interpretation of commands in sections is different from commands placed outside sections. Every section must be finished with **%end** command.

Section types

The available sections are:

- **Add-on sections**. These sections use the **%addon *addon_name*** command.
- **Package selection sections**. Starts with **%packages**. Use it to list packages for installation, including indirect means such as package groups or modules.
- **Script sections**. These start with **%pre**, **%pre-install**, **%post**, and **%onerror**. These sections are not required.

Command section

The command section is a term used for the commands in the Kickstart file that are not part of any script section or **%packages** section.

Script section count and ordering

All sections except the command section are optional and can be present multiple times. When a particular type of script section is to be evaluated, all sections of that type present in the Kickstart are evaluated in order of appearance: two **%post** sections are evaluated one after another, in the order as they appear. However, you do not have to specify the various types of script sections in any order: it does not matter if there are **%post** sections before **%pre** sections.

Comments

Kickstart comments are lines starting with the hash **#** character. These lines are ignored by the installation program.

Items that are not required can be omitted. Omitting any required item results in the installation program changing to the interactive mode so that the user can provide an answer to the related item, just as during a regular interactive installation. It is also possible to declare the kickstart script as non-interactive with the **cmdline** command. In non-interactive mode, any missing answer aborts the installation process.

NOTE

If user interaction is needed during kickstart installation in text or graphical mode, enter only the windows where updates are mandatory to complete the installation. Entering spokes might lead to resetting the kickstart configuration. Resetting of the configuration applies specifically to the kickstart commands related to storage after entering the Installation Destination window.

A.2. PACKAGE SELECTION IN KICKSTART

Kickstart uses sections started by the **%packages** command for selecting packages to install. You can install packages, groups, environments, module streams, and module profiles this way.

A.2.1. Package selection section

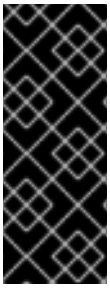
Use the **%packages** command to begin a Kickstart section which describes the software packages to be installed. The **%packages** section must end with the **%end** command.

You can specify packages by environment, group, module stream, module profile, or by their package names. Several environments and groups that contain related packages are defined. See the ***repository*/repodata/*-comps-*repository.architecture*.xml** file on the Red Hat Enterprise Linux 9 Installation DVD for a list of environments and groups.

The ***-comps-*repository.architecture*.xml** file contains a structure describing available environments (marked by the **<environment>** tag) and groups (the **<group>** tag). Each entry has an ID, user visibility value, name, description, and package list. If the group is selected for installation, the packages marked **mandatory** in the package list are always installed, the packages marked **default** are installed if they are not specifically excluded elsewhere, and the packages marked **optional** must be specifically included elsewhere even when the group is selected.

You can specify a package group or environment using either its ID (the **<id>** tag) or name (the **<name>** tag).

If you are not sure what package should be installed, Red Hat recommends you to select the **Minimal Install** environment. **Minimal Install** provides only the packages which are essential for running Red Hat Enterprise Linux 9. This will substantially reduce the chance of the system being affected by a vulnerability. If necessary, additional packages can be added later after the installation. For more details on **Minimal Install**, see the Installing the Minimum Amount of Packages Required section of the *Security Hardening* document. The **Initial Setup** can not run after a system is installed from a Kickstart file unless a desktop environment and the X Window System were included in the installation and graphical login was enabled.



IMPORTANT

To install a 32-bit package on a 64-bit system:

- specify the **--multilib** option for the **%packages** section
- append the package name with the 32-bit architecture for which the package was built; for example, **glibc.i686**

A.2.2. Package selection commands

These commands can be used within the **%packages** section of a Kickstart file.

Specifying an environment

Specify an entire environment to be installed as a line starting with the **@^** symbols:

```
%packages
@^Infrastructure Server
%end
```

This installs all packages which are part of the **Infrastructure Server** environment. All available environments are described in the ***repository*/repodata/*-comps-*repository.architecture*.xml** file on the Red Hat Enterprise Linux 9 Installation DVD.

Only a single environment should be specified in the Kickstart file. If more environments are specified, only the last specified environment is used.

Specifying groups

Specify groups, one entry to a line, starting with an **@** symbol, and then the full group name or group id as given in the ***-comps-*repository.architecture*.xml** file. For example:

```
%packages
@X Window System
@Desktop
@Sound and Video
%end
```

The **Core** group is always selected – it is not necessary to specify it in the **%packages** section.

Specifying individual packages

Specify individual packages by name, one entry to a line. You can use the asterisk character (*) as a wildcard in package names. For example:

```
%packages
sqlite
curl
aspell
docbook*
%end
```

The **docbook*** entry includes the packages **docbook-dtds** and **docbook-style** that match the pattern represented with the wildcard.

Specifying profiles of module streams

Specify profiles for module streams, one entry to a line, using the syntax for profiles:

```
%packages
@module:stream/profile
%end
```

This installs all packages listed in the specified profile of the module stream.

- When a module has a default stream specified, you can leave it out. When the default stream is not specified, you must specify it.

- When a module stream has a default profile specified, you can leave it out. When the default profile is not specified, you must specify it.
- Installing a module multiple times with different streams is not possible.
- Installing multiple profiles of the same module and stream is possible.

Modules and groups use the same syntax starting with the @ symbol. When a module and a package group exist with the same name, the module takes precedence.

In Red Hat Enterprise Linux 9, modules are present only in the AppStream repository. To list available modules, use the **dnf module list** command on an installed Red Hat Enterprise Linux 9 system.

It is also possible to enable module streams using the **module** Kickstart command and then install packages contained in the module stream by naming them directly.

Excluding environments, groups, or packages

Use a leading dash (**-**) to specify packages or groups to exclude from the installation. For example:

```
%packages
-@Graphical Administration Tools
-autofs
-ipa*compat
%end
```

IMPORTANT

Installing all available packages using only * in a Kickstart file is not supported.

You can change the default behavior of the **%packages** section by using several options. Some options work for the entire package selection, others are used with only specific groups.

Additional resources

- Managing Software with the DNF Tool

A.2.3. Common package selection options

The following options are available for the **%packages** sections. To use an option, append it to the start of the package selection section. For example:

```
%packages --multilib --ignoremissing
```

--default

Install the default set of packages. This corresponds to the package set which would be installed if no other selections were made in the **Package Selection** screen during an interactive installation.

--excludedocs

Do not install any documentation contained within packages. In most cases, this excludes any files normally installed in the **/usr/share/doc** directory, but the specific files to be excluded depend on individual packages.

--ignoremissing

Ignore any packages, groups, module streams, module profiles, and environments missing in the installation source, instead of halting the installation to ask if the installation should be aborted or continued.

--inst-langs

Specify a list of languages to install. This is different from package group level selections. This option does not describe which package groups should be installed; instead, it sets RPM macros controlling which translation files from individual packages should be installed.

--multilib

Configure the installed system for multilib packages, to allow installing 32-bit packages on a 64-bit system, and install packages specified in this section as such.
Normally, on an AMD64 and Intel 64 system, you can install only the x86_64 and the noarch packages. However, with the --multilib option, you can automatically install the 32-bit AMD and the i686 Intel system packages available, if any.

This only applies to packages explicitly specified in the **%packages** section. Packages which are only being installed as dependencies without being specified in the Kickstart file are only installed in architecture versions in which they are needed, even if they are available for more architectures.

User can configure Anaconda to install packages in **multilib** mode during the installation of the system. Use one of the following options to enable **multilib** mode:

1. Configure Kickstart file with the following lines:

```
%packages --multilib --default
%end
```

2. Add the inst.multilib boot option during booting the installation image.

--nocore

Disables installation of the **@Core** package group which is otherwise always installed by default. Disabling the **@Core** package group with **--nocore** should be only used for creating lightweight containers; installing a desktop or server system with **--nocore** will result in an unusable system.

NOTES

- Using **-@Core** to exclude packages in the **@Core** package group does not work. The only way to exclude the **@Core** package group is with the **--nocore** option.
- The **@Core** package group is defined as a minimal set of packages needed for installing a working system. It is not related in any way to core packages as defined in the Package Manifest and Scope of Coverage Details.

--exclude-weakdeps

Disables installation of packages from weak dependencies. These are packages linked to the selected package set by Recommends and Supplements flags. By default weak dependencies will be installed.

--retries=

Sets the number of times DNF will attempt to download packages (retries). The default value is 10. This option only applies during the installation, and will not affect DNF configuration on the installed system.

--timeout=

Sets the DNF timeout in seconds. The default value is 30. This option only applies during the installation, and will not affect DNF configuration on the installed system.

A.2.4. Options for specific package groups

The options in this list only apply to a single package group. Instead of using them at the **%packages** command in the Kickstart file, append them to the group name. For example:

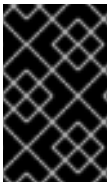
```
%packages
@Graphical Administration Tools --optional
%end
```

--nodefaults

Only install the group's mandatory packages, not the default selections.

--optional

Install packages marked as optional in the group definition in the ***-comps-*repository*.*architecture*.xml** file, in addition to installing the default selections.
Some package groups, such as **Scientific Support**, do not have any mandatory or default packages specified - only optional packages. In this case the **--optional** option must always be used, otherwise no packages from this group will be installed.



IMPORTANT

The **--nodefaults** and **--optional** options cannot be used together. You can install only mandatory packages during the installation using **--nodefaults** and install the optional packages on the installed system post installation.

A.2.5. Installing Kernel-64k on ARM using Kickstart

RHEL offers the ARM64 hardware architecture to support workloads that require large physical memory configuration for optimal performance. Such large memory configuration requires the use of a large MMU page size (64k).

While installing RHEL 9, you can select the **kernel-64k** package to install RHEL with kernel supporting 64k page size.

Procedure

- In the **%packages** section of the kickstart file, add the following list of packages:

```
%packages
kernel-64k
-kmod-kvdo
-vdo
-kernel
%end
```

Verification

- To verify the page size, after installation is completed and the system is rebooted, open the terminal and run:

```
$ getconf PAGESIZE
65536
```

  The output **65536** indicates that the 64k kernel is in use.

- To verify that the swap partition is enabled, enter:

```
$ free
              total        used        free      shared  buff/cache   available
Mem:       35756352     3677184    34774848       25792      237120    32079168
Swap:       6504384           0     6504384
```

The total and free columns are non-zero, which indicates the swap is enabled successfully.

A.3. SCRIPTS IN KICKSTART FILE

A kickstart file can include the following scripts:

- **%pre**
- **%pre-install**
- **%post**

This section provides the following details about the scripts:

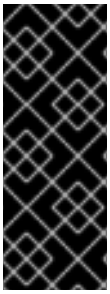
- Execution time
- Types of commands that can be included in the script
- Purpose of the script
- Script options

A.3.1. %pre script

The **%pre** scripts are run on the system immediately after the Kickstart file has been loaded, but before it is completely parsed and installation begins. Each of these sections must start with **%pre** and end with **%end**.

The **%pre** script can be used for activation and configuration of networking and storage devices. It is also possible to run scripts, using interpreters available in the installation environment. Adding a **%pre** script can be useful if you have networking and storage that needs special configuration before proceeding with the installation, or have a script that, for example, sets up additional logging parameters or environment variables.

Debugging problems with **%pre** scripts can be difficult, so it is recommended only to use a **%pre** script when necessary.

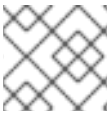


IMPORTANT

The **%pre** section of Kickstart is executed at the stage of installation which happens after the installer image (**inst.stage2**) is fetched: it means **after** root switches to the installer environment (the installer image) and **after** the **Anaconda** installer itself starts. Then the configuration in **%pre** is applied and can be used to fetch packages from installation repositories configured, for example, by URL in Kickstart. However, it **cannot** be used to configure network to fetch the image (**inst.stage2**) from network.

Commands related to networking, storage, and file systems are available to use in the **%pre** script, in addition to most of the utilities in the installation environment **/sbin** and **/bin** directories.

You can access the network in the **%pre** section. However, the name service has not been configured at this point, so only IP addresses work, not URLs.



NOTE

The pre script does not run in the chroot environment.

A.3.1.1. %pre script section options

The following options can be used to change the behavior of pre-installation scripts. To use an option, append it to the **%pre** line at the beginning of the script. For example:

```
%pre --interpreter=/usr/libexec/platform-python
-- Python script omitted --
%end
```

--interpreter=

Allows you to specify a different scripting language, such as Python. Any scripting language available on the system can be used; in most cases, these are **/usr/bin/sh**, **/usr/bin/bash**, and **/usr/libexec/platform-python**.
Note that the **platform-python** interpreter uses Python version 3.6. You must change your Python scripts from previous RHEL versions for the new path and version. Additionally, **platform-python** is meant for system tools: Use the **python36** package outside the installation environment. For more details about Python in Red Hat Enterprise Linux, see\ Introduction to Python in *Installing and using dynamic programming languages*.

--erroronfail

Displays an error and halts the installation if the script fails. The error message will direct you to where the cause of the failure is logged. The installed system might get into an unstable and unbootable state. You can use the **inst.nokill** option to debug the script.

--log=

Logs the script's output into the specified log file. For example:

```
%pre --log=/tmp/ks-pre.log
```

A.3.2. %pre-install script

The commands in the **pre-install** script are run after the following tasks are complete:

- System is partitioned
- Filesystems are created and mounted under /mnt/sysroot
- Network has been configured according to any boot options and kickstart commands

Each of the **%pre-install** sections must start with **%pre-install** and end with **%end**.

The **%pre-install** scripts can be used to modify the installation, and to add users and groups with guaranteed IDs before package installation.

It is recommended to use the **%post** scripts for any modifications required in the installation. Use the **%pre-install** script only if the **%post** script falls short for the required modifications.

The **pre-install** script does not run in chroot environment.

A.3.2.1. %pre-install script section options

The following options can be used to change the behavior of **pre-install** scripts. To use an option, append it to the **%pre-install** line at the beginning of the script. For example:

```
%pre-install --interpreter=/usr/libexec/platform-python
-- Python script omitted --
%end
```

You can have multiple **%pre-install** sections, with same or different interpreters. They are evaluated in their order of appearance in the Kickstart file.

--interpreter=

Allows you to specify a different scripting language, such as Python. Any scripting language available on the system can be used; in most cases, these are **/usr/bin/sh**, **/usr/bin/bash**, and **/usr/libexec/platform-python**.
The **platform-python** interpreter uses Python version 3.6. You must change your Python scripts from previous RHEL versions for the new path and version. Additionally, **platform-python** is meant for system tools: Use the **python36** package outside the installation environment. For more details about Python in Red Hat Enterprise Linux, see Introduction to Python in *Installing and using dynamic programming languages*.

--erroronfail

Displays an error and halts the installation if the script fails. The error message will direct you to where the cause of the failure is logged. The installed system might get into an unstable and unbootable state. You can use the **inst.nokill** option to debug the script.

--log=

Logs the script's output into the specified log file. For example:

```
%pre-install --log=/mnt/sysroot/root/ks-pre.log
```

A.3.3. %post script

The %post script is a post-installation script that is run after the installation is complete, but before the system is rebooted for the first time. You can use this section to run tasks such as system subscription.

You have the option of adding commands to run on the system once the installation is complete, but before the system is rebooted for the first time. This section must start with **%post** and end with **%end**.

The **%post** section is useful for functions such as installing additional software or configuring an additional name server. The post-install script is run in a **chroot** environment, therefore, performing tasks such as copying scripts or RPM packages from the installation media do not work by default. You can change this behavior using the **--nochroot** option as described below. Then the **%post** script will run in the installation environment, not in **chroot** on the installed target system.

Because post-install script runs in a **chroot** environment, most **systemctl** commands will refuse to perform any action.

During execution of the **%post** section, the installation media must be still inserted.

A.3.3.1. %post script section options

The following options can be used to change the behavior of post-installation scripts. To use an option, append it to the **%post** line at the beginning of the script. For example:

```
%post --interpreter=/usr/libexec/platform-python
-- Python script omitted --
%end
```

--interpreter=

Allows you to specify a different scripting language, such as Python. For example:

```
%post --interpreter=/usr/libexec/platform-python
```

Any scripting language available on the system can be used; in most cases, these are **/usr/bin/sh**, **/usr/bin/bash**, and **/usr/libexec/platform-python**.

The **platform-python** interpreter uses Python version 3.6. You must change your Python scripts from previous RHEL versions for the new path and version. Additionally, **platform-python** is meant for system tools: Use the **python36** package outside the installation environment. For more details about Python in Red Hat Enterprise Linux, see Introduction to Python in *Installing and using dynamic programming languages*.

--nochroot

Allows you to specify commands that you would like to run outside of the chroot environment. The following example copies the file /etc/resolv.conf to the file system that was just installed.

```
%post --nochroot
cp /etc/resolv.conf /mnt/sysroot/etc/resolv.conf
%end
```

--erroronfail

Displays an error and halts the installation if the script fails. The error message will direct you to where the cause of the failure is logged. The installed system might get into an unstable and unbootable state. You can use the **inst.nokill** option to debug the script.

--log=

Logs the script's output into the specified log file. The path of the log file must take into account whether or not you use the **--nochroot** option. For example, without **--nochroot**:

```
%post --log=/root/ks-post.log
```

and with **--nochroot**:

```
%post --nochroot --log=/mnt/sysroot/root/ks-post.log
```

A.3.3.2. Example: Mounting NFS in a post-install script

This example of a **%post** section mounts an NFS share and executes a script named **runme** located at **/usr/new-machines/** on the share. The NFS file locking is not supported while in Kickstart mode, therefore the **-o nolock** option is required.

```
# Start of the %post section with logging into /root/ks-post.log
%post --log=/root/ks-post.log

# Mount an NFS share
mkdir /mnt/temp
mount -o nolock 10.10.0.2:/usr/new-machines /mnt/temp
openvt -s -w -- /mnt/temp/runme
umount /mnt/temp

# End of the %post section
%end
```

A.4. KICKSTART ERROR HANDLING SECTION

Starting with Red Hat Enterprise Linux 7, Kickstart installations run custom scripts when any fatal error encounters in the installation program. Example scenarios include an error in a package that has been requested for installation, VNC fails to start if specified in the configuration, or an error while scanning storage devices. In case of such events, installation aborts. To analyze these events, the installation program runs all **%onerror** scripts chronologically as provided in the Kickstart file. In the event of traceback, you can run the **%onerror** scripts.

Each **%onerror** script is required to end with **%end**.

You can enforce the error handler for any error by using **inst.cmdline** to make every error a fatal error.

Error handling sections accept the following options:

--erroronfail

Displays an error and halts the installation if the script fails. The error message will direct you to where the cause of the failure is logged. The installed system might get into an unstable and unbootable state. You can use the **inst.nokill** option to debug the script.

--interpreter=

Allows you to specify a different scripting language, such as Python. For example:

```
%onerror --interpreter=/usr/libexec/platform-python
```

Any scripting language available on the system can be used; in most cases, these are **/usr/bin/sh**, **/usr/bin/bash**, and **/usr/libexec/platform-python**.

The **platform-python** interpreter uses Python version 3.6. You must change your Python scripts

from previous RHEL versions for the new path and version. Additionally, **platform-python** is meant for system tools: Use the **python36** package outside the installation environment. For more details about Python in Red Hat Enterprise Linux, see Introduction to Python in *Installing and using dynamic programming languages*.

--log=

Logs the script's output into the specified log file.

A.5. KICKSTART ADD-ON SECTIONS

Starting with Red Hat Enterprise Linux 7, Kickstart installations support add-ons. These add-ons can expand the basic Kickstart (and Anaconda) functionality in many ways.

To use an add-on in your Kickstart file, use the **%addon *addon_name options*** command, and finish the command with an **%end** statement, similar to pre-installation and post-installation script sections. For example, if you want to use the Kdump add-on, which is distributed with Anaconda by default, use the following commands:

```
%addon com_redhat_kdump --enable --reserve-mb=auto
%end
```

The **%addon** command does not include any options of its own - all options are dependent on the actual add-on.

APPENDIX B. KICKSTART COMMANDS AND OPTIONS REFERENCE

This reference is a complete list of all Kickstart commands supported by the Red Hat Enterprise Linux installation program program. The commands are sorted alphabetically in a few broad categories. If a command can fall under multiple categories, it is listed in all of them.

B.1. KICKSTART CHANGES

The following sections describe the changes in Kickstart commands and options in Red Hat Enterprise Linux 9.

B.1.1. auth or authconfig is deprecated in RHEL 8

The **auth** or **authconfig** Kickstart command is deprecated in Red Hat Enterprise Linux 8 because the **authconfig** tool and package have been removed.

Similarly to **authconfig** commands issued on command line, **authconfig** commands in Kickstart scripts now use the **authselect-compat** tool to run the new **authselect** tool. For a description of this compatibility layer and its known issues, see the manual page **authselect-migration(7)**. The installation program will automatically detect use of the deprecated commands and install on the system the **authselect-compat** package to provide the compatibility layer.

B.1.2. Using Kickstart files from previous RHEL releases

If you are using Kickstart files from previous RHEL releases, see the *Repositories* section of the *Considerations in adopting RHEL 8* document for more information about the Red Hat Enterprise Linux 8 BaseOS and AppStream repositories.

B.1.3. Deprecated Kickstart commands and options

The following Kickstart commands and options have been deprecated in 9.

- **timezone --ntpservers** - use the **timesource** command instead
- **timezone --nontp**
- **logging --level**
- **%packages --excludeWeakdeps** - use **--exclude-weakdeps** instead
- **%packages --instLangs** - use **--inst-langs** instead
- **%anaconda**
- **pwpolicy** - use the Anaconda configuration files instead
- **syspurpose** - use **subscription-manager syspurpose** instead
- **nvdimm**

Where only specific options are listed, the base command and its other options are still available and not deprecated. Using the deprecated commands in Kickstart files prints a warning in the logs. You can turn the deprecated command warnings into errors with the **inst.ksstrict** boot option.

B.1.4. Removed Kickstart commands and options

The following Kickstart commands and options have been completely removed in 9. Using them in Kickstart files will cause an error.

- **device**
- **deviceprobe**
- **dmraid**
- **install** - use the subcommands or methods directly as commands
- **multipath**
- **bootloader --upgrade**
- **ignoredisk --interactive**
- **partition --active**
- **harddrive --biospart**
- **autostep**

Where only specific options and values are listed, the base command and its other options are still available and not removed.

B.2. KICKSTART COMMANDS FOR INSTALLATION PROGRAM CONFIGURATION AND FLOW CONTROL

The Kickstart commands in this list control the mode and course of installation, and what happens at its end.

B.2.1. cdrom

The **cdrom** Kickstart command is optional. It performs the installation from the first optical drive on the system. Use this command only once.

Syntax

```
cdrom
```

Notes

- This command has no options.
- To actually run the installation, you must specify one of **cdrom**, **harddrive**, **hmc**, **nfs**, **liveimg**, **ostreesetup**, **rhsm**, or **url** unless the **inst.repo** option is specified on the kernel command line.

B.2.2. cmdline

The **cmdline** Kickstart command is optional. It performs the installation in a completely non-interactive command line mode. Any prompt for interaction halts the installation. Use this command only once.

Syntax

```
cmdline
```

Notes

- For a fully automatic installation, you must either specify one of the available modes (**graphical**, **text**, or **cmdline**) in the Kickstart file, or you must use the **console=** boot option. If no mode is specified, the system will use graphical mode if possible, or prompt you to choose from VNC and text mode.
- This command has no options.
- This mode is useful on 64-bit IBM Z systems with the x3270 terminal.

B.2.3. driverdisk

The **driverdisk** Kickstart command is optional. Use it to provide additional drivers to the installation program.

Driver disks can be used during Kickstart installations to provide additional drivers not included by default. You must copy the driver disks contents to the root directory of a partition on the system's disk. Then, you must use the **driverdisk** command to specify that the installation program should look for a driver disk and its location. Use this command only once.

Syntax

```
driverdisk [partition|--source=url|--biospart=biospart]
```

Options

You must specify the location of driver disk in one way out of these:

- *partition* - Partition containing the driver disk. The partition must be specified as a full path (for example, **/dev/sdb1**), *not* just the partition name (for example, **sdb1**).
- **--source=** - URL for the driver disk. Examples include:

```
driverdisk --source=ftp://path/to/dd.img
driverdisk --source=http://path/to/dd.img
driverdisk --source=nfs:host:/path/to/dd.img
```

- **--biospart=** - BIOS partition containing the driver disk (for example, **82p2**).

Notes

Driver disks can also be loaded from a local disk or a similar device instead of being loaded over the network or from **initrd**. Follow this procedure:

1. Load the driver disk on a disk drive, a USB or any similar device.
2. Set the label, for example, *DD*, to this device.
3. Add the following line to your Kickstart file:

```
driverdisk LABEL=DD:/e1000.rpm
```

Replace *DD* with a specific label and replace *e1000.rpm* with a specific name. Use anything supported by the **inst.repo** command instead of *LABEL* to specify your disk drive.

B.2.4. eula

The **eula** Kickstart command is optional. Use this option to accept the End User License Agreement (EULA) without user interaction. Specifying this option prevents Initial Setup from prompting you to accept the license agreement after you finish the installation and reboot the system for the first time. Use this command only once.

Syntax

```
eula [--agreed]
```

Options

- **--agreed** (required) - Accept the EULA. This option must always be used, otherwise the **eula** command is meaningless.

B.2.5. firstboot

The **firstboot** Kickstart command is optional. It determines whether the **Initial Setup** application starts the first time the system is booted. If enabled, the **initial-setup** package must be installed. If not specified, this option is disabled by default. Use this command only once.

Syntax

```
firstboot OPTIONS
```

Options

- **--enable** or **--enabled** - Initial Setup is started the first time the system boots.
- **--disable** or **--disabled** - Initial Setup is not started the first time the system boots.
- **--reconfig** - Enable the Initial Setup to start at boot time in reconfiguration mode. This mode enables the root password, time & date, and networking & host name configuration options in addition to the default ones.

B.2.6. graphical

The **graphical** Kickstart command is optional. It performs the installation in graphical mode. This is the default. Use this command only once.

Syntax

```
graphical [--non-interactive]
```

Options

- **--non-interactive** - Performs the installation in a completely non-interactive mode. This mode will terminate the installation when user interaction is required.

Note

- For a fully automatic installation, you must either specify one of the available modes (**graphical**, **text**, or **cmdline**) in the Kickstart file, or you must use the **console=** boot option. If no mode is specified, the system will use graphical mode if possible, or prompt you to choose from VNC and text mode.

B.2.7. halt

The **halt** Kickstart command is optional.

Halt the system after the installation has successfully completed. This is similar to a manual installation, where Anaconda displays a message and waits for the user to press a key before rebooting. During a Kickstart installation, if no completion method is specified, this option is used as the default. Use this command only once.

Syntax

```
halt
```

Notes

- The **halt** command is equivalent to the **shutdown -H** command. For more details, see the *shutdown(8)* man page on your system.
- For other completion methods, see the **poweroff**, **reboot**, and **shutdown** commands.
- This command has no options.

B.2.8. harddrive

The **harddrive** Kickstart command is optional. It performs the installation from a Red Hat installation tree or full installation ISO image on a local drive. The drive must be formatted with a file system the installation program can mount: **ext2**, **ext3**, **ext4**, **vfat**, or **xfs**. Use this command only once.

Syntax

```
harddrive OPTIONS
```

Options

- **--partition=** - Partition to install from (such as **sdb2**).
- **--dir=** - Directory containing the ***variant*** directory of the installation tree, or the ISO image of the full installation DVD.

Example

```
harddrive --partition=hdb2 --dir=/tmp/install-tree
```

Notes

Notes

- Previously, the **harddrive** command had to be used together with the **install** command. The **install** command has been deprecated and **harddrive** can be used on its own, because it implies **install**.
- To actually run the installation, you must specify one of **cdrom**, **harddrive**, **hmc**, **nfs**, **liveimg**, **ostreesetup**, **rhsm**, or **url** unless the **inst.repo** option is specified on the kernel command line.

B.2.9. liveimg

The **liveimg** Kickstart command is optional. It performs the installation from a disk image instead of packages. Use this command only once.

Syntax

```
liveimg --url=SOURCE [OPTIONS]
```

Mandatory options

- **--url=** - The location to install from. Supported protocols are **HTTP**, **HTTPS**, **FTP**, and **file**.

Optional options

- **--url=** - The location to install from. Supported protocols are **HTTP**, **HTTPS**, **FTP**, and **file**.
- **--proxy=** - Specify an **HTTP**, **HTTPS** or **FTP** proxy to use while performing the installation.
- **--checksum=** - An optional argument with the **SHA256** checksum of the image file, used for verification.
- **--noverifyssl** - Disable SSL verification when connecting to an **HTTPS** server.

Example

```
liveimg --url=file:///images/install/squashfs.img --
checksum=03825f567f17705100de3308a20354b4d81ac9d8bed4bb4692b2381045e56197 --
noverifyssl
```

Notes

- The image can be the **squashfs.img** file from a live ISO image, a compressed tar file (**.tar**, **.tbz**, **.tgz**, **.txz**, **.tar.bz2**, **.tar.gz**, or **.tar.xz**.), or any file system that the installation media can mount. Supported file systems are **ext2**, **ext3**, **ext4**, **vfat**, and **xfs**.
- When using the **liveimg** installation mode with a driver disk, drivers on the disk will not automatically be included in the installed system. If necessary, these drivers should be installed manually, or in the **%post** section of a kickstart script.
- To actually run the installation, you must specify one of **cdrom**, **harddrive**, **hmc**, **nfs**, **liveimg**, **ostreesetup**, **rhsm**, or **url** unless the **inst.repo** option is specified on the kernel command line.

B.2.10. logging

The **logging** Kickstart command is optional. It controls the error logging of Anaconda during installation. It has no effect on the installed system. Use this command only once.

Logging is supported over TCP only. For remote logging, ensure that the port number that you specify in **--port=** option is open on the remote server. The default port is 514.

Syntax

```
logging OPTIONS
```

Optional options

- **--host=** - Send logging information to the given remote host, which must be running a syslogd process configured to accept remote logging.
- **--port=** - If the remote syslogd process uses a port other than the default, set it using this option.

B.2.11. mediacheck

The **mediacheck** Kickstart command is optional. This command forces the installation program to perform a media check before starting the installation. This command requires that installations be attended, so it is disabled by default. Use this command only once.

Syntax

```
mediacheck
```

Notes

- This Kickstart command is equivalent to the **rd.live.check** boot option.
- This command has no options.

B.2.12. nfs

The **nfs** Kickstart command is optional. It performs the installation from a specified NFS server. Use this command only once.

Syntax

```
nfs OPTIONS
```

Options

- **--server=** - Server from which to install (host name or IP).
- **--dir=** - Directory containing the ***variant*** directory of the installation tree.
- **--opts=** - Mount options to use for mounting the NFS export. (optional)

Example

```
nfs --server=nfsserver.example.com --dir=/tmp/install-tree
```

Notes

- To actually run the installation, you must specify one of **cdrom**, **harddrive**, **hmc**, **nfs**, **liveimg**, **ostreesetup**, **rhsm**, or **url** unless the **inst.repo** option is specified on the kernel command line.

B.2.13. ostreesetup

The **ostreesetup** Kickstart command is optional. It is used to set up OStree-based installations. Use this command only once.

Syntax

```
ostreesetup --osname=OSNAME [--remote=REMOTE] --url=URL --ref=REF [--nogpg]
```

Mandatory options:

- **--osname=*OSNAME*** - Management root for OS installation.
- **--url=*URL*** - URL of the repository to install from.
- **--ref=*REF*** - Name of the branch from the repository to be used for installation.

Optional options:

- **--remote=*REMOTE*** - A remote repository location.
- **--nogpg** - Disable GPG key verification.

Note

- For more information about the OStree tools, see the upstream documentation: https://ostreedev.github.io/ostree/

B.2.14. ostreecontainer

The **ostreecontainer** Kickstart command is optional. Use this command for OSTree installations from your custom containers.

IMPORTANT

The **ostreecontainer** is provided as a Technology Preview only. Technology Preview features are not supported with Red Hat production Service Level Agreements (SLAs), might not be functionally complete, and Red Hat does not recommend using them for production. These previews provide early access to upcoming product features, enabling customers to test functionality and provide feedback during the development process.

See Technology Preview Features Support Scope on the Red Hat Customer Portal for information about the support scope for Technology Preview features.

Syntax

-

```
ostreecontainer [--stateroot STATEROOT] --url URL [--transport TRANSPORT] [--remote REMOTE]
[--no-signature-verification]
```

Note: The **ostreecontainer** option cannot be used with the **ostreesetup** command.

Options:

- **--no-signature-verification**: Use this option to disable verification by using an ostree remote.
- **--stateroot**: Name of the state directory, also known as "osname". Default value is **default**.
- **--url**: Name of the container image for the registry transport. For example, **quay.io/exampleos/foo:latest**.
- **--transport**: The transport, for example, registry, oci, oci-archive. The default value is **registry**.
- **--remote**: Name of the OSTree remote used for GPG signature verification. Generally not needed, and does not work with layered images.

B.2.15. poweroff

The **poweroff** Kickstart command is optional. It shuts down and powers off the system after the installation has successfully completed. Normally during a manual installation, Anaconda displays a message and waits for the user to press a key before rebooting. Use this command only once.

Syntax

```
poweroff
```

Notes

- The **poweroff** option is equivalent to the **shutdown -P** command. For more details, see the *shutdown(8)* man page on your system.
- For other completion methods, see the **halt**, **reboot**, and **shutdown** Kickstart commands. The **halt** option is the default completion method if no other methods are explicitly specified in the Kickstart file.
- The **poweroff** command is highly dependent on the system hardware in use. Specifically, certain hardware components such as the BIOS, APM (advanced power management), and ACPI (advanced configuration and power interface) must be able to interact with the system kernel. Consult your hardware documentation for more information about you system's APM/ACPI abilities.
- This command has no options.

B.2.16. reboot

The **reboot** Kickstart command is optional. It instructs the installation program to reboot after the installation is successfully completed (no arguments). Normally, Kickstart displays a message and waits for the user to press a key before rebooting. Use this command only once.

Syntax

```
reboot OPTIONS
```

Options

- **--eject** - Attempt to eject the bootable media (DVD, USB, or other media) before rebooting.
- **--kexec** - Uses the **kexec** system call instead of performing a full reboot, which immediately loads the installed system into memory, bypassing the hardware initialization normally performed by the BIOS or firmware.

IMPORTANT

This option is deprecated and available as a Technology Preview only. For information about Red Hat scope of support for Technology Preview features, see the Technology Preview Features Support Scope document.

When **kexec** is used, device registers (which would normally be cleared during a full system reboot) might stay filled with data, which could potentially create issues for some device drivers.

Notes

- Use of the **reboot** option *might* result in an endless installation loop, depending on the installation media and method.
- The **reboot** option is equivalent to the **shutdown -r** command. For more details, see the *shutdown(8)* man page on your system.
- Specify **reboot** to automate installation fully when installing in command line mode on 64-bit IBM Z.
- For other completion methods, see the **halt**, **poweroff**, and **shutdown** Kickstart options. The **halt** option is the default completion method if no other methods are explicitly specified in the Kickstart file.

B.2.17. rhsm

The **rhsm** Kickstart command is optional. It instructs the installation program to register and install RHEL from the CDN. Use this command only once.

The **rhsm** Kickstart command removes the requirement of using custom **%post** scripts when registering the system.

Options

- **--organization=** - Uses the organization id to register and install RHEL from the CDN.
- **--activation-key=** - Uses the activation key to register and install RHEL from the CDN. Option can be used multiple times, once per activation key, as long as the activation keys used are registered to your subscription.
- **--connect-to-insights** - Connects the target system to Red Hat Insights.
- **--proxy=** - Sets the HTTP proxy.

- **--server-hostname=** - Sets the Satellite instance hostname for registration.
- To switch the installation source repository to the CDN by using the **rhsm** Kickstart command, you must meet the following conditions:
  - On the kernel command line, you have used **inst.stage2=*<URL>*** to fetch the installation image but have not specified an installation source using **inst.repo=**.
  - In the Kickstart file, you have not specified an installation source by using the **url**, **cdrom**, **harddrive**, **liveimg**, **nfs** and **ostree** setup commands.
- An installation source URL specified using a boot option or included in a Kickstart file takes precedence over the CDN, even if the Kickstart file contains the **rhsm** command with valid credentials. The system is registered, but it is installed from the URL installation source. This ensures that earlier installation processes operate as normal.

B.2.18. shutdown

The **shutdown** Kickstart command is optional. It shuts down the system after the installation has successfully completed. Use this command only once.

Syntax

```
shutdown
```

Notes

- The **shutdown** Kickstart option is equivalent to the **shutdown** command. For more details, see the *shutdown(8)* man page on your system.
- For other completion methods, see the **halt**, **poweroff**, and **reboot** Kickstart options. The **halt** option is the default completion method if no other methods are explicitly specified in the Kickstart file.
- This command has no options.

B.2.19. sshpw

The **sshpw** Kickstart command is optional.

During the installation, you can interact with the installation program and monitor its progress over an **SSH** connection. Use the **sshpw** command to create temporary accounts through which to log on. Each instance of the command creates a separate account that exists only in the installation environment. These accounts are not transferred to the installed system.

Syntax

```
sshpw --username=name [OPTIONS] password
```

Mandatory options

- **--username**=*name* - Provides the name of the user. This option is required.
- *password* - The password to use for the user. This option is required.

Optional options

- **--iscrypted** - If this option is present, the password argument is assumed to already be encrypted. This option is mutually exclusive with **--plaintext**. To create an encrypted password, you can use Python:

```
$ python3 -c 'import crypt,getpass;pw=getpass.getpass();print(crypt.crypt(pw) if
(pw==getpass.getpass("Confirm: ")) else exit())'
```

  This generates a sha512 crypt-compatible hash of your password using a random salt.

- **--plaintext** - If this option is present, the password argument is assumed to be in plain text. This option is mutually exclusive with **--iscrypted**

- **--lock** - If this option is present, this account is locked by default. This means that the user will not be able to log in from the console.

- **--sshkey** - If this is option is present, then the *<password>* string is interpreted as an ssh key value.

Notes

- By default, the **ssh** server is not started during the installation. To make **ssh** available during the installation, boot the system with the kernel boot option **inst.sshd**.

- If you want to disable root **ssh** access, while allowing another user **ssh** access, use the following:

```
sshpw --username=example_username example_password --plaintext
sshpw --username=root example_password --lock
```

- To simply disable root **ssh** access, use the following:

```
sshpw --username=root example_password --lock
```

B.2.20. text

The **text** Kickstart command is optional. It performs the Kickstart installation in text mode. Kickstart installations are performed in graphical mode by default. Use this command only once.

Syntax

```
text [--non-interactive]
```

Options

- **--non-interactive** - Performs the installation in a completely non-interactive mode. This mode will terminate the installation when user interaction is required.

Notes

- Note that for a fully automatic installation, you must either specify one of the available modes (**graphical**, **text**, or **cmdline**) in the Kickstart file, or you must use the **console=** boot option. If no mode is specified, the system will use graphical mode if possible, or prompt you to choose from VNC and text mode.

B.2.21. url

The **url** Kickstart command is optional. It is used to install from an installation tree image on a remote server by using the FTP, HTTP, or HTTPS protocol. You can only specify one URL. Use this command only once.

You must specify one of the **--url**, **--metalink** or **--mirrorlist** options.

Syntax

```
url --url=FROM [OPTIONS]
```

Options

- **--url=*FROM*** - Specifies the **HTTP**, **HTTPS**, **FTP**, or **file** location to install from.
- **--mirrorlist=** - Specifies the mirror URL to install from.
- **--proxy=** - Specifies an **HTTP**, **HTTPS**, or **FTP** proxy to use during the installation.
- **--noverifyssl** - Disables SSL verification when connecting to an **HTTPS** server.
- **--metalink=*URL*** - Specifies the metalink URL to install from. Variable substitution is done for **$releasever** and **$basearch** in the *URL*.

Examples

- To install from a HTTP server:

```
url --url=http://server/path
```

- To install from a FTP server:

```
url --url=ftp://username:password@server/path
```

Notes

- To actually run the installation, you must specify one of **cdrom**, **harddrive**, **hmc**, **nfs**, **liveimg**, **ostreesetup**, **rhsm**, or **url** unless the **inst.repo** option is specified on the kernel command line.

B.2.22. vnc

The **vnc** Kickstart command is optional. It allows the graphical installation to be viewed remotely through VNC.

This method is usually preferred over text mode, as there are some size and language limitations in text installations. With no additional options, this command starts a VNC server on the installation system with no password and displays the details required to connect to it. Use this command only once.

Syntax

```
vnc [--host=host_name] [--port=port] [--password=password]
```

Options

Options

--host=

Connect to the VNC viewer process listening on the given host name.

--port=

Provide a port that the remote VNC viewer process is listening on. If not provided, Anaconda uses the VNC default port of 5900.

--password=

Set a password which must be provided to connect to the VNC session. This is optional, but recommended.

Additional resources

- Preparing to install from the network using PXE

B.2.23. hmc

The hmc kickstart command is optional. Use it to install from an installation medium by using SE/HMC on IBM Z. This command does not have any options.

Syntax

```
hmc
```

B.2.24. %include

The **%include** Kickstart command is optional.

Use the **%include** command to include the contents of another file in the Kickstart file as if the contents were at the location of the **%include** command in the Kickstart file.

This inclusion is evaluated only after the **%pre** script sections and can thus be used to include files generated by scripts in the **%pre** sections. To include files before evaluation of **%pre** sections, use the **%ksappend** command.

Syntax

```
%include path/to/file
```

B.2.25. %ksappend

The **%ksappend** Kickstart command is optional.

Use the **%ksappend** command to include the contents of another file in the Kickstart file as if the contents were at the location of the **%ksappend** command in the Kickstart file.

This inclusion is evaluated before the **%pre** script sections, unlike inclusion with the **%include** command.

Syntax

```
%ksappend path/to/file
```

B.3. KICKSTART COMMANDS FOR SYSTEM CONFIGURATION

The Kickstart commands in this list configure further details on the resulting system such as users, repositories, or services.

B.3.1. auth or authconfig (deprecated)

IMPORTANT

Use the new **authselect** command instead of the deprecated **auth** or **authconfig** Kickstart command. **auth** and **authconfig** are available only for limited backwards compatibility.

The **auth** or **authconfig** Kickstart command is optional. It sets up the authentication options for the system using the **authconfig** tool, which can also be run on the command line after the installation finishes. Use this command only once.

Syntax

```
authconfig [OPTIONS]
```

Notes

- Previously, the **auth** or **authconfig** Kickstart commands called the **authconfig** tool. This tool has been deprecated in Red Hat Enterprise Linux 8. These Kickstart commands now use the **authselect-compat** tool to call the new **authselect** tool. For a description of the compatibility layer and its known issues, see the manual page *authselect-migration(7)*. The installation program will automatically detect use of the deprecated commands and install on the system the **authselect-compat** package to provide the compatibility layer.
- Passwords are shadowed by default.
- When using OpenLDAP with the **SSL** protocol for security, make sure that the **SSLv2** and **SSLv3** protocols are disabled in the server configuration. This is due to the POODLE SSL vulnerability (CVE-2014-3566). See https://access.redhat.com/solutions/1234843 for details.

B.3.2. authselect

The **authselect** Kickstart command is optional. It sets up the authentication options for the system using the **authselect** command, which can also be run on the command line after the installation finishes. Use this command only once.

Syntax

```
authselect [OPTIONS]
```

Notes

- This command passes all options to the **authselect** command. Refer to the *authselect(8)* manual page and the **authselect --help** command for more details.
- This command replaces the deprecated **auth** or **authconfig** commands deprecated in Red Hat Enterprise Linux 8 together with the **authconfig** tool.

- Passwords are shadowed by default.
- When using OpenLDAP with the **SSL** protocol for security, make sure that the **SSLv2** and **SSLv3** protocols are disabled in the server configuration. This is due to the POODLE SSL vulnerability (CVE-2014-3566). See https://access.redhat.com/solutions/1234843 for details.

B.3.3. firewall

The **firewall** Kickstart command is optional. It specifies the firewall configuration for the installed system.

Syntax

```
firewall --enabled|--disabled [incoming] [OPTIONS]
```

Mandatory options

- **--enabled** or **--enable** - Reject incoming connections that are not in response to outbound requests, such as DNS replies or DHCP requests. If access to services running on this machine is needed, you can choose to allow specific services through the firewall.
- **--disabled** or **--disable** - Do not configure any iptables rules.

Optional options

- **--trust** - Listing a device here, such as **em1**, allows all traffic coming to and from that device to go through the firewall. To list more than one device, use the option more times, such as **--trust em1 --trust em2**. Do not use a comma-separated format such as **--trust em1, em2**.
- **--remove-service** - Do not allow services through the firewall.
- *incoming* - Replace with one or more of the following to allow the specified services through the firewall.
  - **--ssh**
  - **--smtp**
  - **--http**
  - **--ftp**
- **--port=** - You can specify that ports be allowed through the firewall using the port:protocol format. For example, to allow IMAP access through your firewall, specify **imap:tcp**. Numeric ports can also be specified explicitly; for example, to allow UDP packets on port 1234 through, specify **1234:udp**. To specify multiple ports, separate them by commas.
- **--service=** - This option provides a higher-level way to allow services through the firewall. Some services (like **cups**, **avahi**, and so on.) require multiple ports to be open or other special configuration in order for the service to work. You can specify each individual port with the **--port** option, or specify **--service=** and open them all at once.
  Valid options are anything recognized by the **firewall-offline-cmd** program in the **firewalld** package. If the **firewalld** service is running, **firewall-cmd --get-services** provides a list of known service names.

- **--use-system-defaults** - Do not configure the firewall at all. This option instructs anaconda to do nothing and allows the system to rely on the defaults that were provided with the package or ostree. If this option is used with other options then all other options will be ignored.

B.3.4. group

The **group** Kickstart command is optional. It creates a new user group on the system.

```
group --name=name [--gid=gid]
```

Mandatory options

- **--name=** - Provides the name of the group.

Optional options

- **--gid=** - The group's GID. If not provided, defaults to the next available non-system GID.

Notes

- If a group with the given name or GID already exists, this command fails.
- The **user** command can be used to create a new group for the newly created user.

B.3.5. keyboard (required)

The **keyboard** Kickstart command is required. It sets one or more available keyboard layouts for the system. Use this command only once.

Syntax

```
keyboard --vckeymap|--xlayouts OPTIONS
```

Options

- **--vckeymap=** - Specify a **VConsole** keymap which should be used. Valid names correspond to the list of files in the **/usr/lib/kbd/keymaps/xkb/** directory, without the **.map.gz** extension.
- **--xlayouts=** - Specify a list of X layouts that should be used as a comma-separated list without spaces. Accepts values in the same format as **setxkbmap(1)**, either in the ***layout*** format (such as **cz**), or in the ***layout* (*variant*)** format (such as **cz (qwerty)**).
  All available layouts can be viewed on the **xkeyboard-config(7)** man page under **Layouts**.
- **--switch=** - Specify a list of layout-switching options (shortcuts for switching between multiple keyboard layouts). Multiple options must be separated by commas without spaces. Accepts values in the same format as **setxkbmap(1)**.
  Available switching options can be viewed on the **xkeyboard-config(7)** man page under **Options**.

Notes

- Either the **--vckeymap=** or the **--xlayouts=** option must be used.

Example

The following example sets up two keyboard layouts (**English (US)** and **Czech (qwerty)**) using the **--xlayouts=** option, and allows to switch between them using **Alt**+**Shift**:

```
keyboard --xlayouts=us,'cz (qwerty)' --switch=grp:alt_shift_toggle
```

B.3.6. lang (required)

The **lang** Kickstart command is required. It sets the language to use during installation and the default language to use on the installed system. Use this command only once.

Syntax

```
lang language [--addsupport=language,...]
```

Mandatory options

- ***language*** - Install support for this language and set it as system default.

Optional options

- **--addsupport=** - Add support for additional languages. Takes the form of comma-separated list without spaces. For example:

  ```
  lang en_US --addsupport=cs_CZ,de_DE,en_UK
  ```

Notes

- The **locale -a | grep _** or **localectl list-locales | grep _** commands return a list of supported locales.
- Certain languages (for example, Chinese, Japanese, Korean, and Indic languages) are not supported during text-mode installation. If you specify one of these languages with the **lang** command, the installation process continues in English, but the installed system uses your selection as its default language.

Example

To set the language to English, the Kickstart file should contain the following line:

```
lang en_US
```

B.3.7. module

The **module** Kickstart command is optional. Use this command to enable a package module stream within kickstart script.

Syntax

```
module --name=NAME [--stream=STREAM]
```

Mandatory options

--name=

Specifies the name of the module to enable. Replace *NAME* with the actual name.

Optional options

--stream=

Specifies the name of the module stream to enable. Replace *STREAM* with the actual name. You do not need to specify this option for modules with a default stream defined. For modules without a default stream, this option is mandatory and leaving it out results in an error. Enabling a module multiple times with different streams is not possible.

Notes

- Using a combination of this command and the **%packages** section allows you to install packages provided by the enabled module and stream combination, without specifying the module and stream explicitly. Modules must be enabled before package installation. After enabling a module with the **module** command, you can install the packages enabled by this module by listing them in the **%packages** section.
- A single **module** command can enable only a single module and stream combination. To enable multiple modules, use multiple **module** commands. Enabling a module multiple times with different streams is not possible.
- In Red Hat Enterprise Linux 9, modules are present only in the AppStream repository. To list available modules, use the **dnf module list** command on an installed Red Hat Enterprise Linux 9 system with a valid subscription.

Additional resources

- Managing Software with the DNF Tool

B.3.8. repo

The **repo** Kickstart command is optional. It configures additional dnf repositories that can be used as sources for package installation. You can add multiple **repo** lines.

Syntax

```
repo --name=repoid [--baseurl=url|--mirrorlist=url|--metalink=url] [OPTIONS]
```

Mandatory options

- **--name=** - The repository id. This option is required. If a repository has a name which conflicts with another previously added repository, it is ignored. Because the installation program uses a list of preset repositories, this means that you cannot add repositories with the same names as the preset ones.

URL options

These options are mutually exclusive and optional. The variables that can be used in dnf repository configuration files are not supported here. You can use the strings **$releasever** and **$basearch** which are replaced by the respective values in the URL.

- **--baseurl=** - The URL to the repository.
- **--mirrorlist=** - The URL pointing at a list of mirrors for the repository.
- **--metalink=** - The URL with metalink for the repository.

Optional options

- **--install** - Save the provided repository configuration on the installed system in the **/etc/yum.repos.d/** directory. Without using this option, a repository configured in a Kickstart file will only be available during the installation process, not on the installed system.
- **--cost=** - An integer value to assign a cost to this repository. If multiple repositories provide the same packages, this number is used to prioritize which repository will be used before another. Repositories with a lower cost take priority over repositories with higher cost.
- **--excludepkgs=** - A comma-separated list of package names that must *not* be pulled from this repository. This is useful if multiple repositories provide the same package and you want to make sure it comes from a particular repository. Both full package names (such as **publican**) and globs (such as **gnome-***) are accepted.
- **--includepkgs=** - A comma-separated list of package names and globs that are allowed to be pulled from this repository. Any other packages provided by the repository will be ignored. This is useful if you want to install just a single package or set of packages from a repository while excluding all other packages the repository provides.
- **--proxy=[*protocol*://][*username*[:*password*]@]*host*[:*port*]** - Specify an HTTP/HTTPS/FTP proxy to use just for this repository. This setting does not affect any other repositories, nor how the **install.img** is fetched on HTTP installations.
- **--noverifyssl** - Disable SSL verification when connecting to an **HTTPS** server.

Note

- Repositories used for installation must be stable. The installation can fail if a repository is modified before the installation concludes.

B.3.9. rootpw (required)

The **rootpw** Kickstart command is required. It sets the system's root password to the *password* argument. Use this command only once.

Syntax

```
rootpw [--iscrypted|--plaintext] [--lock] password
```

Mandatory options

- *password* - Password specification. Either plain text or encrypted string. See **--iscrypted** and **--plaintext** below.

Options

- **--iscrypted** - If this option is present, the password argument is assumed to already be encrypted. This option is mutually exclusive with **--plaintext**. To create an encrypted password, you can use python:

  ```
  $ python -c 'import crypt,getpass;pw=getpass.getpass();print(crypt.crypt(pw) if
  (pw==getpass.getpass("Confirm: ")) else exit())'
  ```

  This generates a sha512 crypt-compatible hash of your password using a random salt.

- **--plaintext** - If this option is present, the password argument is assumed to be in plain text. This option is mutually exclusive with **--iscrypted**.

- **--lock** - If this option is present, the root account is locked by default. This means that the root user will not be able to log in from the console. This option will also disable the **Root Password** screens in both the graphical and text-based manual installation.

- **--allow-ssh** - If this option is present, the root user can login to the system using SSH with a password. This option is available in RHEL 9.1 and later only.

Add the following line to the kickstart file during the kickstart installation method to enable **password-based SSH root logins**. The option **--allow-ssh** is not available in RHEL 9.0.

```
%post
echo "PermitRootLogin yes" > /etc/ssh/sshd_config.d/01-permitrootlogin.conf
%end
```

B.3.10. selinux

The **selinux** Kickstart command is optional. It sets the state of SELinux on the installed system. The default SELinux policy is **enforcing**. Use this command only once.

Syntax

```
selinux [--disabled|--enforcing|--permissive]
```

Options

--enforcing

Enables SELinux with the default targeted policy being **enforcing**.

--permissive

Outputs warnings based on the SELinux policy, but does not actually enforce the policy.

--disabled

Disables SELinux completely on the system.

Additional resources

- Using SElinux

B.3.11. services

The **services** Kickstart command is optional. It modifies the default set of services that will run under the default systemd target. The list of disabled services is processed before the list of enabled services. Therefore, if a service appears on both lists, it will be enabled.

Syntax

```
services [--disabled=list] [--enabled=list]
```

Options

- **--disabled=** - Disable the services given in the comma separated list.
- **--enabled=** - Enable the services given in the comma separated list.

Notes

- When using the **services** element to enable **systemd** services, ensure you include packages containing the specified service file in the **%packages** section.
- Multiple services should be included separated by comma, without any spaces. For example, to disable four services, enter:

  ```
  services --disabled=auditd,cups,smartd,nfslock
  ```

  If you include any spaces, Kickstart enables or disables only the services up to the first space. For example:

  ```
  services --disabled=auditd, cups, smartd, nfslock
  ```

  That disables only the **auditd** service. To disable all four services, this entry must include no spaces.

B.3.12. skipx

The **skipx** Kickstart command is optional. If present, X is not configured on the installed system.

If you install a display manager among your package selection options, this package creates an X configuration, and the installed system defaults to **graphical.target**. That overrides the effect of the **skipx** option. Use this command only once.

Syntax

```
skipx
```

Notes

- This command has no options.

B.3.13. sshkey

The **sshkey** Kickstart command is optional. It adds a SSH key to the **authorized_keys** file of the specified user on the installed system.

Syntax

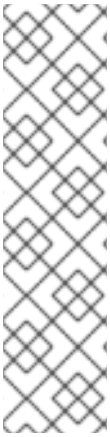
```
sshkey --username=user "ssh_key"
```

Mandatory options

- **--username=** - The user for which the key will be installed.
- *ssh_key* - The complete SSH key fingerprint. It must be wrapped with quotes.

B.3.14. syspurpose

The **syspurpose** Kickstart command is optional. Use it to set the system purpose which describes how the system will be used after installation. This information helps apply the correct subscription entitlement to the system. Use this command only once.



NOTE

Red Hat Enterprise Linux 9.0 and later enables you to manage and display system purpose attributes with a single module by making the **role**, **service-level**, **usage**, and **addons** subcommands available under one **subscription-manager syspurpose** module. Previously, system administrators used one of four standalone **syspurpose** commands to manage each attribute. This standalone **syspurpose** command is deprecated starting with RHEL 9.0 and is planned to be removed in post RHEL 9. Red Hat will provide bug fixes and support for this feature during the current release lifecycle, but this feature will no longer receive enhancements. Starting with RHEL 9, the single **subscription-manager syspurpose** command and its associated subcommands is the only way to use system purpose.

Syntax

```
syspurpose [OPTIONS]
```

Options

- **--role=** - Set the intended system role. Available values are:
  - Red Hat Enterprise Linux Server
  - Red Hat Enterprise Linux Workstation
  - Red Hat Enterprise Linux Compute Node
- **--sla=** - Set the Service Level Agreement. Available values are:
  - Premium
  - Standard
  - Self-Support
- **--usage=** - The intended usage of the system. Available values are:
  - Production

- Disaster Recovery
- Development/Test

- **--addon=** - Specifies additional layered products or features. You can use this option multiple times.

Notes

- Enter the values with spaces and enclose them in double quotes:

```
syspurpose --role="Red Hat Enterprise Linux Server"
```

- While it is strongly recommended that you configure System Purpose, it is an optional feature of the Red Hat Enterprise Linux installation program.

B.3.15. timezone (required)

The **timezone** Kickstart command is required. It sets the system time zone. Use this command only once.

Syntax

```
timezone timezone [OPTIONS]
```

Mandatory options

- *timezone* - the time zone to set for the system.

Optional options

- **--utc** - If present, the system assumes the hardware clock is set to UTC (Greenwich Mean) time.
- **--nontp** - Disable the NTP service automatic starting. This option is deprecated.
- **--ntpservers=** - Specify a list of NTP servers to be used as a comma-separated list without spaces. This option is deprecated, use the **timesource** command instead.

Note

In Red Hat Enterprise Linux 9, time zone names are validated using the **pytz.all_timezones** list, provided by the **pytz** package. In previous releases, the names were validated against **pytz.common_timezones**, which is a subset of the currently used list. Note that the graphical and text mode interfaces still use the more restricted **pytz.common_timezones** list; you must use a Kickstart file to use additional time zone definitions.

B.3.16. timesource (optional)

The **timesource** kickstart command is optional. Use it to set NTP, NTS servers, and pools that provide time data, as well as control whether NTP services are enabled or disabled on the system.

Syntax

```
timesource [--ntp-server NTP_SERVER | --ntp-pool NTP_POOL | --ntp-disable] [--nts]
```

Mandatory options

It is mandatory to specify one of the following options when you use the **timesource** command:

- **--ntp-server** - adds one NTP server as a time source. This option can be added only once to a single command in order to add a one NTP time source server. To add multiple sources, add multiple timesource commands each with a single --ntp-server or --ntp-pool option each time. For example, to add multiple sources for *Europe* timezone

```
timezone Europe
timesource --ntp-server 0.rhel.pool.ntp.org
timesource --ntp-server 1.rhel.pool.ntp.org
timesource --ntp-server 2.rhel.pool.ntp.org
```

- **--ntp-pool** - adds a NTP server pool as a time source. This option can be added only once to add a single NTP time source pool. Repeat the timesource command to add multiple sources.
- **--ntp-disable** - disables NTP time sources for the installed system.

Optional options

- **--nts** - the server or pool added with this command uses the NTS protocol. Note that this option can be added even with --ntp-disable, but it has no effect.

Notes

- The **--ntpservers** option from the **timezone** command is deprecated. Red Hat recommends using this new option for expressive capabilities of the **timesource** command.
- Only **timesource** command can mark servers and pools as using **NTS** instead of plain **NTP** protocol.

B.3.17. user

The **user** Kickstart command is optional. It creates a new user on the system.

Syntax

```
user --name=username [OPTIONS]
```

Mandatory options

- **--name=** - Provides the name of the user. This option is required.

Optional options

- **--gecos=** - Provides the GECOS information for the user. This is a string of various system-specific fields separated by a comma. It is frequently used to specify the user's full name, office number, and so on. See the **passwd(5)** man page for more details.
- **--groups=** - In addition to the default group, a comma separated list of group names the user should belong to. The groups must exist before the user account is created. See the **group** command.

- **--homedir=** - The home directory for the user. If not provided, this defaults to /**home**/***username***.
- **--lock** - If this option is present, this account is locked by default. This means that the user will not be able to log in from the console. This option will also disable the **Create User** screens in both the graphical and text-based manual installation.
- **--password=** - The new user's password. If not provided, the account will be locked by default.
- **--iscrypted** - If this option is present, the password argument is assumed to already be encrypted. This option is mutually exclusive with **--plaintext**. To create an encrypted password, you can use python:

```
$ python -c 'import crypt,getpass;pw=getpass.getpass();print(crypt.crypt(pw) if
(pw==getpass.getpass("Confirm: ")) else exit())'
```

  This generates a sha512 crypt-compatible hash of your password using a random salt.
- **--plaintext** - If this option is present, the password argument is assumed to be in plain text. This option is mutually exclusive with **--iscrypted**
- **--shell=** - The user's login shell. If not provided, the system default is used.
- **--uid=** - The user's UID (User ID). If not provided, this defaults to the next available non-system UID.
- **--gid=** - The GID (Group ID) to be used for the user's group. If not provided, this defaults to the next available non-system group ID.

Notes

- Consider using the **--uid** and **--gid** options to set IDs of regular users and their default groups at range starting at **5000** instead of **1000**. That is because the range reserved for system users and groups, **0**-**999**, might increase in the future and thus overlap with IDs of regular users.
- Files and directories are created with various permissions, dictated by the application used to create the file or directory. For example, the **mkdir** command creates directories with all permissions enabled. However, applications are prevented from granting certain permissions to newly created files, as specified by the **user file-creation mask** setting.
  The **user file-creation mask** can be controlled with the **umask** command. The default setting of the **user file-creation mask** for new users is defined by the **UMASK** variable in the /**etc**/**login.defs** configuration file on the installed system. If unset, it defaults to **022**. This means that by default when an application creates a file, it is prevented from granting write permission to users other than the owner of the file. However, this can be overridden by other settings or scripts.

B.3.18. xconfig

The **xconfig** Kickstart command is optional. It configures the X Window System. Use this command only once.

Syntax

```
xconfig [--startxonboot]
```

Options

Options

- **--startxonboot** - Use a graphical login on the installed system.

Notes

- Because Red Hat Enterprise Linux 9 does not include the KDE Desktop Environment, do not use the **--defaultdesktop=** documented in upstream.

B.4. KICKSTART COMMANDS FOR NETWORK CONFIGURATION

The Kickstart commands in this list let you configure networking on the system.

B.4.1. network (optional)

Use the optional **network** Kickstart command to configure network information for the target system and activate the network devices in the installation environment. The device specified in the first **network** command is activated automatically. You can also explicitly require a device to be activated using the **--activate** option.

WARNING

Re-configuration of already active network devices that are in use by the running installer may lead to an installation failure or freeze. In such a case, avoid re-configuration of network devices used to access the installer runtime image (*stage2*) over NFS.

Syntax

```
network OPTIONS
```

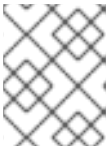
Options

- **--activate** - activate this device in the installation environment.
  If you use the **--activate** option on a device that has already been activated (for example, an interface you configured with boot options so that the system could retrieve the Kickstart file) the device is reactivated to use the details specified in the Kickstart file.

  Use the **--nodefroute** option to prevent the device from using the default route.

- **--no-activate** - do not activate this device in the installation environment.
  By default, Anaconda activates the first network device in the Kickstart file regardless of the **--activate** option. You can disable the default setting by using the **--no-activate** option.

- **--bootproto=** - One of **dhcp**, **bootp**, **ibft**, or **static**. The default option is **dhcp**; the **dhcp** and **bootp** options are treated the same. To disable **ipv4** configuration of the device, use **--noipv4** option.



NOTE

This option configures ipv4 configuration of the device. For ipv6 configuration use **--ipv6** and **--ipv6gateway** options.

The DHCP method uses a DHCP server system to obtain its networking configuration. The BOOTP method is similar, requiring a BOOTP server to supply the networking configuration. To direct a system to use DHCP:

```
network --bootproto=dhcp
```

To direct a machine to use BOOTP to obtain its networking configuration, use the following line in the Kickstart file:

```
network --bootproto=bootp
```

To direct a machine to use the configuration specified in iBFT, use:

```
network --bootproto=ibft
```

The **static** method requires that you specify at least the IP address and netmask in the Kickstart file. This information is static and is used during and after the installation.

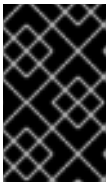
All static networking configuration information must be specified on *one* line; you cannot wrap lines using a backslash (\) as you can on a command line.

```
network --bootproto=static --ip=10.0.2.15 --netmask=255.255.255.0 --gateway=10.0.2.254 --
nameserver=10.0.2.1
```

You can also configure multiple nameservers at the same time. To do so, use the **--nameserver=** option once, and specify each of their IP addresses, separated by commas:

```
network --bootproto=static --ip=10.0.2.15 --netmask=255.255.255.0 --gateway=10.0.2.254 --
nameserver=192.168.2.1,192.168.3.1
```

- **--device=** - specifies the device to be configured (and eventually activated in Anaconda) with the **network** command.
  If the **--device=** option is missing on the *first* use of the **network** command, the value of the **inst.ks.device=** Anaconda boot option is used, if available. This is considered deprecated behavior; in most cases, you should always specify a **--device=** for every **network** command.



IMPORTANT

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.

The behavior of any subsequent **network** command in the same Kickstart file is unspecified if its **--device=** option is missing. Verify you specify this option for any **network** command beyond the first.

You can specify a device to be activated in any of the following ways:

- the device name of the interface, for example, **em1**
- the MAC address of the interface, for example, **01:23:45:67:89:ab**
- the keyword **link**, which specifies the first interface with its link in the **up** state
- the keyword **bootif**, which uses the MAC address that pxelinux set in the **BOOTIF** variable. Set **IPAPPEND 2** in your **pxelinux.cfg** file to have pxelinux set the **BOOTIF** variable.

For example:

```
network --bootproto=dhcp --device=em1
```

- **--ipv4-dns-search**/**--ipv6-dns-search** - Set the DNS search domains manually. You must use these options together with **--device** options and mirror their respective NetworkManager properties, for example:

```
network --device ens3 --ipv4-dns-search domain1.example.com,domain2.example.com
```

- **--ipv4-ignore-auto-dns**/**--ipv6-ignore-auto-dns** - Set to ignore the DNS settings from DHCP. You must use these options together with **--device** options and these options do not require any arguments.
- **--ip=** - IP address of the device.
- **--ipv6=** - IPv6 address of the device, in the form of *address*[/*prefix length*] - for example, **3ffe:ffff:0:1::1**/**128**. If *prefix* is omitted, **64** is used. You can also use **auto** for automatic configuration, or **dhcp** for DHCPv6-only configuration (no router advertisements).
- **--gateway=** - Default gateway as a single IPv4 address.
- **--ipv6gateway=** - Default gateway as a single IPv6 address.
- **--nodefroute** - Prevents the interface being set as the default route. Use this option when you activate additional devices with the **--activate=** option, for example, a NIC on a separate subnet for an iSCSI target.
- **--nameserver=** - DNS name server, as an IP address. To specify more than one name server, use this option once, and separate each IP address with a comma.
- **--netmask=** - Network mask for the installed system.
- **--hostname=** - Used to configure the target system's host name. 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 machine, specify only the short host name.
  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**.

  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.

If you only want to configure the target system's host name, use the **--hostname** option in the **network** command and do not include any other option.

If you provide additional options when configuring the host name, the **network** command configures a device using the options specified. If you do not specify which device to configure using the **--device** option, the default **--device link** value is used. Additionally, if you do not specify the protocol using the **--bootproto** option, the device is configured to use DHCP by default.

- **--ethtool=** - Specifies additional low-level settings for the network device which will be passed to the ethtool program.
- **--onboot=** - Whether or not to enable the device at boot time.
- **--dhcpclass=** - The DHCP class.
- **--mtu=** - The MTU of the device.
- **--noipv4** - Disable IPv4 on this device.
- **--noipv6** - Disable IPv6 on this device.
- **--bondslaves=** - When this option is used, the bond device specified by the **--device=** option is created using secondary devices defined in the **--bondslaves=** option. For example:

```
network --device=bond0 --bondslaves=em1,em2
```

The above command creates a bond device named **bond0** using the **em1** and **em2** interfaces as its secondary devices.

- **--bondopts=** - a list of optional parameters for a bonded interface, which is specified using the **--bondslaves=** and **--device=** options. Options in this list must be separated by commas (",") or semicolons (";"). If an option itself contains a comma, use a semicolon to separate the options. For example:

```
network --bondopts=mode=active-backup,balance-rr;primary=eth1
```

IMPORTANT

The **--bondopts=mode=** parameter only supports full mode names such as **balance-rr** or **broadcast**, not their numerical representations such as **0** or **3**. For the list of available and supported modes, see the Configuring and Managing Networking Guide.

- **--vlanid=** - Specifies virtual LAN (VLAN) ID number (802.1q tag) for the device created using the device specified in **--device=** as a parent. For example, **network --device=em1 --vlanid=171** creates a virtual LAN device **em1.171**.
- **--interfacename=** - Specify a custom interface name for a virtual LAN device. This option should be used when the default name generated by the **--vlanid=** option is not desirable. This option must be used along with **--vlanid=**. For example:

```
network --device=em1 --vlanid=171 --interfacename=vlan171
```

The above command creates a virtual LAN interface named **vlan171** on the **em1** device with an ID of **171**.

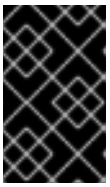
The interface name can be arbitrary (for example, **my-vlan**), but in specific cases, the following conventions must be followed:

- If the name contains a dot (**.**), it must take the form of ***NAME.ID***. The *NAME* is arbitrary, but the *ID* must be the VLAN ID. For example: **em1.171** or **my-vlan.171**.
- Names starting with **vlan** must take the form of **vlan*ID*** - for example, **vlan171**.

- **--teamslaves=** - Team device specified by the **--device=** option will be created using secondary devices specified in this option. Secondary devices are separated by commas. A secondary device can be followed by its configuration, which is a single-quoted JSON string with double quotes escaped by the \ character. For example:

```
network --teamslaves="p3p1'{\"prio\": -10, \"sticky\": true}',p3p2'{\"prio\": 100}'"
```

See also the **--teamconfig=** option.

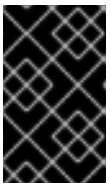


IMPORTANT

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.

- **--teamconfig=** - Double-quoted team device configuration which is a JSON string with double quotes escaped by the \ character. The device name is specified by **--device=** option and its secondary devices and their configuration by **--teamslaves=** option. For example:

```
network --device team0 --activate --bootproto static --ip=10.34.102.222 --
netmask=255.255.255.0 --gateway=10.34.102.254 --nameserver=10.34.39.2 --
teamslaves="p3p1'{\"prio\": -10, \"sticky\": true}',p3p2'{\"prio\": 100}'" --teamconfig="
{\"runner\": {\"name\": \"activebackup\"}}"
```



IMPORTANT

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.

- **--bridgeslaves=** - When this option is used, the network bridge with device name specified using the **--device=** option will be created and devices defined in the **--bridgeslaves=** option will be added to the bridge. For example:

```
network --device=bridge0 --bridgeslaves=em1
```

- **--bridgeopts=** - An optional comma-separated list of parameters for the bridged interface. Available values are **stp**, **priority**, **forward-delay**, **hello-time**, **max-age**, and **ageing-time**. For information about these parameters, see the *bridge setting* table in the **nm-settings(5)** man page or at Network Configuration Setting Specification.
Also see the Configuring and managing networking document for general information about network bridging.

- **--bindto=mac** - Bind the device configuration file on the installed system to the device MAC address (**HWADDR**) instead of the default binding to the interface name (**DEVICE**). This option is independent of the **--device=** option - **--bindto=mac** will be applied even if the same **network** command also specifies a device name, **link**, or **bootif**.

Notes

- The **ethN** device names such as **eth0** are no longer available in Red Hat Enterprise Linux due to changes in the naming scheme. For more information about the device naming scheme, see the upstream document Predictable Network Interface Names .
- If you used a Kickstart option or a boot option to specify an installation repository on a network, but no network is available at the start of the installation, the installation program displays the **Network Configuration** window to set up a network connection prior to displaying the **Installation Summary** window. For more details, see Configuring network and host name options.

B.4.2. realm

The **realm** Kickstart command is optional. Use it to join an Active Directory or IPA domain. For more information about this command, see the **join** section of the **realm(8)** man page on your system.

Syntax

```
realm join [OPTIONS] domain
```

Mandatory options

- ***domain*** - The domain to join.

Options

- **--computer-ou=OU=** - Provide the distinguished name of an organizational unit in order to create the computer account. The exact format of the distinguished name depends on the client software and membership software. The root DSE portion of the distinguished name can usually be left out.
- **--no-password** - Join automatically without a password.
- **--one-time-password=** - Join using a one-time password. This is not possible with all types of realm.
- **--client-software=** - Only join realms which can run this client software. Valid values include **sssd** and **winbind**. Not all realms support all values. By default, the client software is chosen automatically.
- **--server-software=** - Only join realms which can run this server software. Possible values include **active-directory** or **freeipa**.
- **--membership-software=** - Use this software when joining the realm. Valid values include **samba** and **adcli**. Not all realms support all values. By default, the membership software is chosen automatically.

B.5. KICKSTART COMMANDS FOR HANDLING STORAGE

The Kickstart commands in this section configure aspects of storage such as devices, disks, partitions, LVM, and filesystems.

IMPORTANT

The **sdX** (or **/dev/sdX**) format does not guarantee consistent device names across reboots, which can complicate the usage of some Kickstart commands. When a command requires a device node name, you can use any item from **/dev/disk** as an alternative. For example, instead of using the following device name:

part / --fstype=xfs --onpart=sda1

You can use an entry similar to one of the following:

part / --fstype=xfs --onpart=/dev/disk/by-path/pci-0000:00:05.0-scsi-0:0:0:0-part1

part / --fstype=xfs --onpart=/dev/disk/by-id/ata-ST3160815AS_6RA0C882-part1

By using this approach, the command always targets the same storage device. This is especially useful in large storage environments. To explore the available device names on the system, you can use the **ls -lR /dev/disk** command during the interactive installation. For more information about different ways to consistently refer to storage devices, see Overview of persistent naming attributes.

B.5.1. ignoredisk

The **ignoredisk** Kickstart command is optional. It causes the installation program to ignore the specified disks.

This is useful if you use automatic partitioning and want to be sure that some disks are ignored. For example, without **ignoredisk**, attempting to deploy on a SAN-cluster the Kickstart would fail, as the installation program detects passive paths to the SAN that return no partition table. Use this command only once.

Syntax

```
ignoredisk --drives=drive1,drive2,... | --only-use=drive
```

Options

- **--drives=*driveN*,...** - Replace *driveN* with one of **sda**, **sdb**,..., **hda**,... and so on.
- **--only-use=*driveN*,...** - Specifies a list of disks for the installation program to use. All other disks are ignored. For example, to use disk **sda** during installation and ignore all other disks:

  ```
  ignoredisk --only-use=sda
  ```

  To include a multipath device that does not use LVM:

  ```
  ignoredisk --only-use=disk/by-id/dm-uuid-mpath-2416CD96995134CA5D787F00A5AA11017
  ```

  To include a multipath device that uses LVM:

  ```
  ignoredisk --only-use==/dev/disk/by-id/dm-uuid-mpath-
  ```

```
bootloader --location=mbr
```

You must specify only one of the **--drives** or **--only-use**.

Notes

- To ignore a multipath device that does not use logical volume management (LVM), use the format **disk/by-id/dm-uuid-mpath-*WWID***, where *WWID* is the world-wide identifier for the device. For example, to ignore a disk with WWID **2416CD96995134CA5D787F00A5AA11017**, use:

  ```
  ignoredisk --drives=disk/by-id/dm-uuid-mpath-2416CD96995134CA5D787F00A5AA11017
  ```

- Never specify multipath devices by device names like **mpatha**. Device names such as this are not specific to a particular disk. The disk named **/dev/mpatha** during installation might not be the one that you expect it to be. Therefore, the **clearpart** command could target the wrong disk.

- The **sdX** (or **/dev/sdX**) format does not guarantee consistent device names across reboots, which can complicate the usage of some Kickstart commands. When a command requires a device node name, you can use any item from **/dev/disk** as an alternative. For example, instead of using the following device name:

  ```
  part / --fstype=xfs --onpart=sda1
  ```

  You can use an entry similar to one of the following:

  ```
  part / --fstype=xfs --onpart=/dev/disk/by-path/pci-0000:00:05.0-scsi-0:0:0:0-part1

  part / --fstype=xfs --onpart=/dev/disk/by-id/ata-ST3160815AS_6RA0C882-part1
  ```

  By using this approach, the command always targets the same storage device. This is especially useful in large storage environments. To explore the available device names on the system, you can use the **ls -lR /dev/disk** command during the interactive installation. For more information about different ways to consistently refer to storage devices, see Overview of persistent naming attributes.

B.5.2. clearpart

The **clearpart** Kickstart command is optional. It removes partitions from the system, prior to creation of new partitions. By default, no partitions are removed. Use this command only once.

Syntax

```
clearpart OPTIONS
```

Options

- **--all** - Erases all partitions from the system.
  This option will erase all disks which can be reached by the installation program, including any attached network storage. Use this option with caution.

  You can prevent **clearpart** from wiping storage you want to preserve by using the **--drives=** option and specifying only the drives you want to clear, by attaching network storage later (for

example, in the **%post** section of the Kickstart file), or by blocklisting the kernel modules used to access network storage.

- **--drives=** - Specifies which drives to clear partitions from. For example, the following clears all the partitions on the first two drives on the primary IDE controller:

```
clearpart --drives=hda,hdb --all
```

To clear a multipath device, use the format **disk/by-id/scsi-*WWID***, where *WWID* is the world-wide identifier for the device. For example, to clear a disk with WWID **58095BEC5510947BE8C0360F604351918**, use:

```
clearpart --drives=disk/by-id/scsi-58095BEC5510947BE8C0360F604351918
```

This format is preferable for all multipath devices, but if errors arise, multipath devices that do not use logical volume management (LVM) can also be cleared using the format **disk/by-id/dm-uuid-mpath-*WWID***, where *WWID* is the world-wide identifier for the device. For example, to clear a disk with WWID **2416CD96995134CA5D787F00A5AA11017**, use:

```
clearpart --drives=disk/by-id/dm-uuid-mpath-2416CD96995134CA5D787F00A5AA11017
```

Never specify multipath devices by device names like **mpatha**. Device names such as this are not specific to a particular disk. The disk named **/dev/mpatha** during installation might not be the one that you expect it to be. Therefore, the **clearpart** command could target the wrong disk.

- **--initlabel** - Initializes a disk (or disks) by creating a default disk label for all disks in their respective architecture that have been designated for formatting (for example, msdos for x86). Because **--initlabel** can see all disks, it is important to ensure only those drives that are to be formatted are connected. Disks cleared by **clearpart** will have the label created even in case the **--initlabel** is not used.

```
clearpart --initlabel --drives=names_of_disks
```

For example:

```
clearpart --initlabel --drives=dasda,dasdb,dasdc
```

- **--list=** - Specifies which partitions to clear. This option overrides the **--all** and **--linux** options if used. Can be used across different drives. For example:

```
clearpart --list=sda2,sda3,sdb1
```

- **--disklabel=*LABEL*** - Set the default disklabel to use. Only disklabels supported for the platform will be accepted. For example, on the 64-bit Intel and AMD architectures, the **msdos** and **gpt** disklabels are accepted, but **dasd** is not accepted.

- **--linux** - Erases all Linux partitions.

- **--none** (default) - Do not remove any partitions.

- **--cdl** - Reformat any LDL DASDs to CDL format.

Notes

- The **sdX** (or **/dev/sdX**) format does not guarantee consistent device names across reboots, which can complicate the usage of some Kickstart commands. When a command requires a device node name, you can use any item from **/dev/disk** as an alternative. For example, instead of using the following device name:

```
part / --fstype=xfs --onpart=sda1
```

  You can use an entry similar to one of the following:

```
part / --fstype=xfs --onpart=/dev/disk/by-path/pci-0000:00:05.0-scsi-0:0:0:0-part1

part / --fstype=xfs --onpart=/dev/disk/by-id/ata-ST3160815AS_6RA0C882-part1
```

  By using this approach, the command always targets the same storage device. This is especially useful in large storage environments. To explore the available device names on the system, you can use the **ls -lR /dev/disk** command during the interactive installation. For more information about different ways to consistently refer to storage devices, see Overview of persistent naming attributes.

- If the **clearpart** command is used, then the **part --onpart** command cannot be used on a logical partition.

B.5.3. zerombr

The **zerombr** Kickstart command is optional. The **zerombr** initializes any invalid partition tables that are found on disks and destroys all of the contents of disks with invalid partition tables. This command is required when performing an installation on an 64-bit IBM Z system with unformatted Direct Access Storage Device (DASD) disks, otherwise the unformatted disks are not formatted and used during the installation. Use this command only once.

Syntax

```
zerombr
```

Notes

- On 64-bit IBM Z, if **zerombr** is specified, any Direct Access Storage Device (DASD) visible to the installation program which is not already low-level formatted is automatically low-level formatted with dasdfmt. The command also prevents user choice during interactive installations.

- If **zerombr** is not specified and there is at least one unformatted DASD visible to the installation program, a non-interactive Kickstart installation exits unsuccessfully.

- If **zerombr** is not specified and there is at least one unformatted DASD visible to the installation program, an interactive installation exits if the user does not agree to format all visible and unformatted DASDs. To circumvent this, only activate those DASDs that you will use during installation. You can always add more DASDs after installation is complete.

- This command has no options.

B.5.4. bootloader

The **bootloader** Kickstart command is required. It specifies how the boot loader should be installed. Use this command only once.

Syntax

```
bootloader [OPTIONS]
```

Options

- **--append=** - Specifies additional kernel parameters. To specify multiple parameters, separate them with spaces. For example:

  ```
  bootloader --location=mbr --append="hdd=ide-scsi ide=nodma"
  ```

  The **rhgb** and **quiet** parameters are automatically added when the **plymouth** package is installed, even if you do not specify them here or do not use the **--append=** command at all. To disable this behavior, explicitly disallow installation of **plymouth**:

  ```
  %packages
  -plymouth
  %end
  ```

  This option is useful for disabling mechanisms which were implemented to mitigate the Meltdown and Spectre speculative execution vulnerabilities found in most modern processors (CVE-2017-5754, CVE-2017-5753, and CVE-2017-5715). In some cases, these mechanisms may be unnecessary, and keeping them enabled causes decreased performance with no improvement in security. To disable these mechanisms, add the options to do so into your Kickstart file - for example, **bootloader --append="nopti noibrs noibpb"** on AMD64/Intel 64 systems.

  WARNING

  Ensure your system is not at risk of attack before disabling any of the vulnerability mitigation mechanisms. See the Red Hat vulnerability response article for information about the Meltdown and Spectre vulnerabilities.

- **--boot-drive=** - Specifies which drive the boot loader should be written to, and therefore which drive the computer will boot from. If you use a multipath device as the boot drive, specify the device using its disk/by-id/dm-uuid-mpath-WWID name.

  IMPORTANT

  The **--boot-drive=** option is currently being ignored in Red Hat Enterprise Linux installations on 64-bit IBM Z systems using the **zipl** boot loader. When **zipl** is installed, it determines the boot drive on its own.

- **--leavebootorder** - This option is applicable for Power and UEFI systems. The installation program adds Red Hat Enterprise Linux 9 to the list of the installed systems in UEFI. It does not

add the installed system to the boot order. All existing boot entries as well as their order are preserved.

- **--driveorder=** - Specifies which drive is first in the BIOS boot order. For example:

```
bootloader --driveorder=sda,hda
```

- **--location=** - Specifies where the boot record is written. Valid values are the following:
  - **mbr** - The default option. Depends on whether the drive uses the Master Boot Record (MBR) or GUID Partition Table (GPT) scheme:
    On a GPT-formatted disk, this option installs stage 1.5 of the boot loader into the BIOS boot partition.

    On an MBR-formatted disk, stage 1.5 is installed into the empty space between the MBR and the first partition.
  - **partition** - Install the boot loader on the first sector of the partition containing the kernel.
  - **none** - Do not install the boot loader.

  In most cases, this option does not need to be specified.

- **--nombr** - Do not install the boot loader to the MBR.

- **--password=** - If using GRUB2, sets the boot loader password to the one specified with this option. This should be used to restrict access to the GRUB2 shell, where arbitrary kernel options can be passed.
  If a password is specified, GRUB2 also asks for a user name. The user name is always **root**.

- **--iscrypted** - Normally, when you specify a boot loader password using the **--password=** option, it is stored in the Kickstart file in plain text. If you want to encrypt the password, use this option and an encrypted password.
  To generate an encrypted password, use the **grub2-mkpasswd-pbkdf2** command, enter the password you want to use, and copy the command's output (the hash starting with **grub.pbkdf2**) into the Kickstart file. An example **bootloader** Kickstart entry with an encrypted password looks similar to the following:

```
bootloader --iscrypted --
password=grub.pbkdf2.sha512.10000.5520C6C9832F3AC3D149AC0B24BE69E2D4FB0DBE
EDBD29CA1D30A044DE2645C4C7A291E585D4DC43F8A4D82479F8B95CA4BA4381F8550
510B75E8E0BB2938990.C688B6F0EF935701FF9BD1A8EC7FE5BD2333799C98F28420C5
CC8F1A2A233DE22C83705BB614EA17F3FDFDF4AC2161CEA3384E56EB38A2E39102F53
34C47405E
```

- **--timeout=** - Specifies the amount of time the boot loader waits before booting the default option (in seconds).

- **--default=** - Sets the default boot image in the boot loader configuration.

- **--extlinux** - Use the extlinux boot loader instead of GRUB2. This option only works on systems supported by extlinux.

- **--disabled** - This option is a stronger version of **--location=none**. While **--location=none** simply disables boot loader installation, **--disabled** disables boot loader installation and also disables installation of the package containing the boot loader, thus saving space.

Notes

- Red Hat recommends setting up a boot loader password on every system. An unprotected boot loader can allow a potential attacker to modify the system's boot options and gain unauthorized access to the system.
- In some cases, a special partition is required to install the boot loader on AMD64, Intel 64, and 64-bit ARM systems. The type and size of this partition depends on whether the disk you are installing the boot loader to uses the Master Boot Record (MBR) or a GUID Partition Table (GPT) schema. For more information, see the Configuring boot loader section.
- The **sdX** (or **/dev/sdX**) format does not guarantee consistent device names across reboots, which can complicate the usage of some Kickstart commands. When a command requires a device node name, you can use any item from **/dev/disk** as an alternative. For example, instead of using the following device name:

```
part / --fstype=xfs --onpart=sda1
```

  You can use an entry similar to one of the following:

```
part / --fstype=xfs --onpart=/dev/disk/by-path/pci-0000:00:05.0-scsi-0:0:0:0-part1

part / --fstype=xfs --onpart=/dev/disk/by-id/ata-ST3160815AS_6RA0C882-part1
```

  By using this approach, the command always targets the same storage device. This is especially useful in large storage environments. To explore the available device names on the system, you can use the **ls -lR /dev/disk** command during the interactive installation. For more information about different ways to consistently refer to storage devices, see Overview of persistent naming attributes.

B.5.5. autopart

The **autopart** Kickstart command is optional. It automatically creates partitions.

The automatically created partitions are: a root (/) partition (1 GiB or larger), a **swap** partition, and an appropriate **/boot** partition for the architecture. On large enough drives (50 GiB and larger), this also creates a **/home** partition. Use this command only once.

Syntax

```
autopart OPTIONS
```

Options

- **--type=** - Selects one of the predefined automatic partitioning schemes you want to use. Accepts the following values:
  - **lvm**: The LVM partitioning scheme.
  - **plain**: Regular partitions with no LVM.
  - **thinp**: The LVM Thin Provisioning partitioning scheme.
- **--fstype=** - Selects one of the available file system types. The available values are **ext2**, **ext3**, **ext4**, **xfs**, and **vfat**. The default file system is **xfs**.

- **--nohome** - Disables automatic creation of the **/home** partition.
- **--nolvm** - Do not use LVM for automatic partitioning. This option is equal to **--type=plain**.
- **--noboot** - Do not create a **/boot** partition.
- **--noswap** - Do not create a swap partition.
- **--encrypted** - Encrypts all partitions with Linux Unified Key Setup (LUKS). This is equivalent to checking the **Encrypt partitions** check box on the initial partitioning screen during a manual graphical installation.

NOTE

When encrypting one or more partitions, Anaconda attempts to gather 256 bits of entropy to ensure the partitions are encrypted securely. Gathering entropy can take some time - the process will stop after a maximum of 10 minutes, regardless of whether sufficient entropy has been gathered.

The process can be sped up by interacting with the installation system (typing on the keyboard or moving the mouse). If you are installing in a virtual machine, you can also attach a **virtio-rng** device (a virtual random number generator) to the guest.

- **--luks-version=*LUKS_VERSION*** - Specifies which version of LUKS format should be used to encrypt the filesystem. This option is only meaningful if **--encrypted** is specified.
- **--passphrase=** - Provides a default system-wide passphrase for all encrypted devices.
- **--escrowcert=*URL_of_X.509_certificate*** - Stores data encryption keys of all encrypted volumes as files in **/root**, encrypted using the X.509 certificate from the URL specified with *URL_of_X.509_certificate*. The keys are stored as a separate file for each encrypted volume. This option is only meaningful if **--encrypted** is specified.
- **--backuppassphrase** - Adds a randomly-generated passphrase to each encrypted volume. Store these passphrases in separate files in **/root**, encrypted using the X.509 certificate specified with **--escrowcert**. This option is only meaningful if **--escrowcert** is specified.
- **--cipher=** - Specifies the type of encryption to use if the Anaconda default **aes-xts-plain64** is not satisfactory. You must use this option together with the **--encrypted** option; by itself it has no effect. Available types of encryption are listed in the Security hardening document, but Red Hat strongly recommends using either **aes-xts-plain64** or **aes-cbc-essiv:sha256**.
- **--pbkdf=*PBKDF*** - Sets Password-Based Key Derivation Function (PBKDF) algorithm for LUKS keyslot. See also the man page *cryptsetup(8)*. This option is only meaningful if **--encrypted** is specified.
- **--pbkdf-memory=*PBKDF_MEMORY*** - Sets the memory cost for PBKDF. See also the man page *cryptsetup(8)*. This option is only meaningful if **--encrypted** is specified.
- **--pbkdf-time=*PBKDF_TIME*** - Sets the number of milliseconds to spend with PBKDF passphrase processing. See also **--iter-time** in the man page *cryptsetup(8)*. This option is only meaningful if **--encrypted** is specified, and is mutually exclusive with **--pbkdf-iterations**.
- **--pbkdf-iterations=*PBKDF_ITERATIONS*** - Sets the number of iterations directly and avoids PBKDF benchmark. See also **--pbkdf-force-iterations** in the man page *cryptsetup(8)*. This

option is only meaningful if **--encrypted** is specified, and is mutually exclusive with **--pbkdf-time**.

Notes

- The **autopart** option cannot be used together with the **part**/**partition**, **raid**, **logvol**, or **volgroup** options in the same Kickstart file.
- The **autopart** command is not mandatory, but you must include it if there are no **part** or **mount** commands in your Kickstart script.
- It is recommended to use the **autopart --nohome** Kickstart option when installing on a single FBA DASD of the CMS type. This ensures that the installation program does not create a separate /**home** partition. The installation then proceeds successfully.
- 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, you can save encryption passphrases with the **--escrowcert** and create backup encryption passphrases with the **--backuppassphrase** options.
- Ensure that the disk sector sizes are consistent when using **autopart**, **autopart --type=lvm**, or **autopart=thinp**.

B.5.6. reqpart

The **reqpart** Kickstart command is optional. It automatically creates partitions required by your hardware platform. These include a /**boot**/**efi** partition for systems with UEFI firmware, a **biosboot** partition for systems with BIOS firmware and GPT, and a **PRePBoot** partition for IBM Power Systems. Use this command only once.

Syntax

```
reqpart [--add-boot]
```

Options

- **--add-boot** - Creates a separate /**boot** partition in addition to the platform-specific partition created by the base command.

Note

- This command cannot be used together with **autopart**, because **autopart** does everything the **reqpart** command does and, in addition, creates other partitions or logical volumes such as / and **swap**. In contrast with **autopart**, this command only creates platform-specific partitions and leaves the rest of the drive empty, allowing you to create a custom layout.

B.5.7. part or partition

The **part** or **partition** Kickstart command is required. It creates a partition on the system.

Syntax

```
part|partition mntpoint [OPTIONS]
```

Options

- *mntpoint* - Where the partition is mounted. The value must be of one of the following forms:
  - /***path***
    For example, /, /**usr**, /**home**
  - **swap**
    The partition is used as swap space.

    To determine the size of the swap partition automatically, use the **--recommended** option:

    ```
    swap --recommended
    ```

    The size assigned will be effective but not precisely calibrated for your system.

    To determine the size of the swap partition automatically but also allow extra space for your system to hibernate, use the **--hibernation** option:

    ```
    swap --hibernation
    ```

    The size assigned will be equivalent to the swap space assigned by **--recommended** plus the amount of RAM on your system. For the swap sizes assigned by these commands, see Recommended Partitioning Scheme for AMD64, Intel 64, and 64-bit ARM systems.
  - **raid.*id***
    The partition is used for software RAID (see **raid**).
  - **pv.*id***
    The partition is used for LVM (see **logvol**).
  - **biosboot**
    The partition will be used for a BIOS Boot partition. A 1 MiB BIOS boot partition is necessary on BIOS-based AMD64 and Intel 64 systems using a GUID Partition Table (GPT); the boot loader will be installed into it. It is not necessary on UEFI systems. See also the **bootloader** command.
  - **/boot/efi**
    An EFI System Partition. A 50 MiB EFI partition is necessary on UEFI-based AMD64, Intel 64, and 64-bit ARM; the recommended size is 200 MiB. It is not necessary on BIOS systems. See also the **bootloader** command.
- **--size=** - The minimum partition size in MiB. Specify an integer value here such as **500** (do not include the unit). Installation fails if size specified is too small. Set the **--size** value as the minimum amount of space you require. For size recommendations, see Recommended Partitioning Scheme.
- **--grow** - Specifies the partition to grow to fill available space (if any), or up to the maximum size setting, if one is specified. If you use **--grow=** without setting **--maxsize=** on a swap partition, Anaconda limits the maximum size of the swap partition. For systems that have less than 2 GiB of physical memory, the imposed limit is twice the amount of physical memory. For systems with more than 2 GiB, the imposed limit is the size of physical memory plus 2GiB.
- **--maxsize=** - The maximum partition size in MiB when the partition is set to grow. Specify an integer value here such as **500** (do not include the unit).

- **--noformat** - Specifies that the partition should not be formatted, for use with the **--onpart** command.

- **--onpart=** or **--usepart=** - Specifies the device on which to place the partition. Uses an existing blank device and format it to the new specified type. For example:

```
partition /home --onpart=hda1
```

  puts **/home** on **/dev/hda1**.

  These options can also add a partition to a logical volume. For example:

```
partition pv.1 --onpart=hda2
```

  The device must already exist on the system; the **--onpart** option will not create it.

  It is also possible to specify an entire drive, rather than a partition, in which case Anaconda will format and use the drive without creating a partition table. However, installation of GRUB2 is not supported on a device formatted in this way, and must be placed on a drive with a partition table.

```
partition pv.1 --onpart=hdb
```

- **--ondisk=** or **--ondrive=** - Creates a partition (specified by the **part** command) on an existing disk.This command always creates a partition. Forces the partition to be created on a particular disk. For example, **--ondisk=sdb** puts the partition on the second SCSI disk on the system.
  To specify a multipath device that does not use logical volume management (LVM), use the format **disk/by-id/dm-uuid-mpath-*WWID***, where *WWID* is the world-wide identifier for the device. For example, to specify a disk with WWID **2416CD96995134CA5D787F00A5AA11017**, use:

```
part / --fstype=xfs --grow --asprimary --size=8192 --ondisk=disk/by-id/dm-uuid-mpath-
2416CD96995134CA5D787F00A5AA11017
```

WARNING

Never specify multipath devices by device names like **mpatha**. Device names such as this are not specific to a particular disk. The disk named **/dev/mpatha** during installation might not be the one that you expect it to be. Therefore, the **part** command could target the wrong disk.

- **--asprimary** - Forces the partition to be allocated as a *primary* partition. If the partition cannot be allocated as primary (usually due to too many primary partitions being already allocated), the partitioning process fails. This option only makes sense when the disk uses a Master Boot Record (MBR); for GUID Partition Table (GPT)-labeled disks this option has no meaning.

- **--fsprofile=** - Specifies a usage type to be passed to the program that makes a filesystem on this partition. A usage type defines a variety of tuning parameters to be used when making a filesystem. For this option to work, the filesystem must support the concept of usage types and

there must be a configuration file that lists valid types. For **ext2**, **ext3**, **ext4**, this configuration file is **/etc/mke2fs.conf**.

- **--mkfsoptions=** - Specifies additional parameters to be passed to the program that makes a filesystem on this partition. This is similar to **--fsprofile** but works for all filesystems, not just the ones that support the profile concept. No processing is done on the list of arguments, so they must be supplied in a format that can be passed directly to the mkfs program. This means multiple options should be comma-separated or surrounded by double quotes, depending on the filesystem. For example,

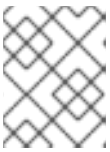
```
part /opt/foo1 --size=512 --fstype=ext4 --mkfsoptions="-O
^has_journal,^flex_bg,^metadata_csum"

part /opt/foo2 --size=512 --fstype=xfs --mkfsoptions="-m bigtime=0,finobt=0"
```

For details, see the man pages of the filesystems you are creating. For example, **mkfs.ext4** or **mkfs.xfs**.

- **--fstype=** - Sets the file system type for the partition. Valid values are **xfs**, **ext2**, **ext3**, **ext4**, **swap**, **vfat**, **efi** and **biosboot**.

- **--fsoptions** - Specifies a free form string of options to be used when mounting the filesystem. This string will be copied into the **/etc/fstab** file of the installed system and should be enclosed in quotes.



NOTE

In the EFI system partition (**/boot/efi**), anaconda hard codes the value and ignores the users specified **--fsoptions** values.

- **--label=** - assign a label to an individual partition.

- **--recommended** - Determine the size of the partition automatically. For details about the recommended scheme, see Recommended Partitioning Scheme for AMD64, Intel 64, and 64-bit ARM. This option can only be used for partitions which result in a file system such as the **/boot** partition and **swap** space. It cannot be used to create LVM physical volumes or RAID members.

- **--onbiosdisk** - Forces the partition to be created on a particular disk as discovered by the BIOS.

- **--encrypted** - Specifies that this partition should be encrypted with Linux Unified Key Setup (LUKS), using the passphrase provided in the **--passphrase** option. If you do not specify a passphrase, Anaconda uses the default, system-wide passphrase set with the **autopart --passphrase** command, or stops the installation and prompts you to provide a passphrase if no default is set.

NOTE

When encrypting one or more partitions, Anaconda attempts to gather 256 bits of entropy to ensure the partitions are encrypted securely. Gathering entropy can take some time - the process will stop after a maximum of 10 minutes, regardless of whether sufficient entropy has been gathered.

The process can be sped up by interacting with the installation system (typing on the keyboard or moving the mouse). If you are installing in a virtual machine, you can also attach a **virtio-rng** device (a virtual random number generator) to the guest.

- **--luks-version=*LUKS_VERSION*** - Specifies which version of LUKS format should be used to encrypt the filesystem. This option is only meaningful if **--encrypted** is specified.
- **--passphrase=** - Specifies the passphrase to use when encrypting this partition. You must use this option together with the **--encrypted** option; by itself it has no effect.
- **--cipher=** - Specifies the type of encryption to use if the Anaconda default **aes-xts-plain64** is not satisfactory. You must use this option together with the **--encrypted** option; by itself it has no effect. Available types of encryption are listed in the Security hardening document, but Red Hat strongly recommends using either **aes-xts-plain64** or **aes-cbc-essiv:sha256**.
- **--escrowcert=*URL_of_X.509_certificate*** - Store data encryption keys of all encrypted partitions as files in /**root**, encrypted using the X.509 certificate from the URL specified with *URL_of_X.509_certificate*. The keys are stored as a separate file for each encrypted partition. This option is only meaningful if **--encrypted** is specified.
- **--backuppassphrase** - Add a randomly-generated passphrase to each encrypted partition. Store these passphrases in separate files in /**root**, encrypted using the X.509 certificate specified with **--escrowcert**. This option is only meaningful if **--escrowcert** is specified.
- **--pbkdf=*PBKDF*** - Sets Password-Based Key Derivation Function (PBKDF) algorithm for LUKS keyslot. See also the man page *cryptsetup(8)*. This option is only meaningful if **--encrypted** is specified.
- **--pbkdf-memory=*PBKDF_MEMORY*** - Sets the memory cost for PBKDF. See also the man page *cryptsetup(8)*. This option is only meaningful if **--encrypted** is specified.
- **--pbkdf-time=*PBKDF_TIME*** - Sets the number of milliseconds to spend with PBKDF passphrase processing. See also **--iter-time** in the man page *cryptsetup(8)*. This option is only meaningful if **--encrypted** is specified, and is mutually exclusive with **--pbkdf-iterations**.
- **--pbkdf-iterations=*PBKDF_ITERATIONS*** - Sets the number of iterations directly and avoids PBKDF benchmark. See also **--pbkdf-force-iterations** in the man page *cryptsetup(8)*. This option is only meaningful if **--encrypted** is specified, and is mutually exclusive with **--pbkdf-time**.
- **--resize=** - Resize an existing partition. When using this option, specify the target size (in MiB) using the **--size=** option and the target partition using the **--onpart=** option.

Notes

- The **part** command is not mandatory, but you must include either **part**, **autopart** or **mount** in your Kickstart script.

- If partitioning fails for any reason, diagnostic messages appear on virtual console 3.
- All partitions created are formatted as part of the installation process unless **--noformat** and **--onpart** are used.
- The **sdX** (or /**dev**/**sdX**) format does not guarantee consistent device names across reboots, which can complicate the usage of some Kickstart commands. When a command requires a device node name, you can use any item from /**dev**/**disk** as an alternative. For example, instead of using the following device name:

```
part / --fstype=xfs --onpart=sda1
```

  You can use an entry similar to one of the following:

```
part / --fstype=xfs --onpart=/dev/disk/by-path/pci-0000:00:05.0-scsi-0:0:0:0-part1

part / --fstype=xfs --onpart=/dev/disk/by-id/ata-ST3160815AS_6RA0C882-part1
```

  By using this approach, the command always targets the same storage device. This is especially useful in large storage environments. To explore the available device names on the system, you can use the **ls -lR /dev/disk** command during the interactive installation. For more information about different ways to consistently refer to storage devices, see Overview of persistent naming attributes.

- 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, you can save encryption passphrases with the **--escrowcert** and create backup encryption passphrases with the **--backuppassphrase** options.

B.5.8. raid

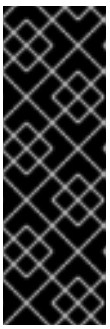
The **raid** Kickstart command is optional. It assembles a software RAID device.

Syntax

```
raid mntpoint --level=level --device=device-name partitions*
```

Options

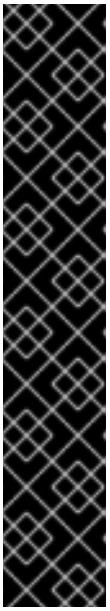
- *mntpoint* - Location where the RAID file system is mounted. If it is /, the RAID level must be 1 unless a boot partition (/**boot**) is present. If a boot partition is present, the /**boot** partition must be level 1 and the root (/) partition can be any of the available types. The *partitions** (which denotes that multiple partitions can be listed) lists the RAID identifiers to add to the RAID array.



IMPORTANT

  - On IBM Power Systems, if a RAID device has been prepared and has not been reformatted during the installation, ensure that the RAID metadata version is **0.90** or **1.0** if you intend to put the /**boot** and PReP partitions on the RAID device. The **mdadm** metadata versions **1.1** and **1.2** are not supported for the /**boot** and PReP partitions.
  - The **PReP** Boot partitions are not required on PowerNV systems.

- **--level=** - RAID level to use (0, 1, 4, 5, 6, or 10).
- **--device=** - Name of the RAID device to use - for example, **--device=root**.



IMPORTANT

Do not use **mdraid** names in the form of **md0** - these names are not guaranteed to be persistent. Instead, use meaningful names such as **root** or **swap**. Using meaningful names creates a symbolic link from /**dev**/**md**/***name*** to whichever /**dev**/**md*X*** node is assigned to the array.

If you have an old (v0.90 metadata) array that you cannot assign a name to, you can specify the array by a filesystem label or UUID. For example, **--device=LABEL=root** or **--device=UUID=93348e56-4631-d0f0-6f5b-45c47f570b88**.

You can use the UUID of the file system on the RAID device or UUID of the RAID device itself. The UUID of the RAID device should be in the **8-4-4-4-12** format. UUID reported by mdadm is in the **8:8:8:8** format which needs to be changed. For example **93348e56:4631d0f0:6f5b45c4:7f570b88** should be changed to **93348e56-4631-d0f0-6f5b-45c47f570b88**.

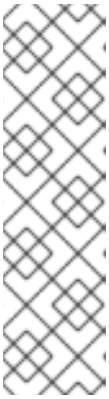
- **--chunksize=** - Sets the chunk size of a RAID storage in KiB. In certain situations, using a different chunk size than the default (**512 Kib**) can improve the performance of the RAID.
- **--spares=** - Specifies the number of spare drives allocated for the RAID array. Spare drives are used to rebuild the array in case of drive failure.
- **--fsprofile=** - Specifies a usage type to be passed to the program that makes a filesystem on this partition. A usage type defines a variety of tuning parameters to be used when making a filesystem. For this option to work, the filesystem must support the concept of usage types and there must be a configuration file that lists valid types. For ext2, ext3, and ext4, this configuration file is /**etc**/**mke2fs.conf**.
- **--fstype=** - Sets the file system type for the RAID array. Valid values are **xfs**, **ext2**, **ext3**, **ext4**, **swap**, and **vfat**.
- **--fsoptions=** - Specifies a free form string of options to be used when mounting the filesystem. This string will be copied into the /**etc**/**fstab** file of the installed system and should be enclosed in quotes. In the EFI system partition (/**boot**/**efi**), anaconda hard codes the value and ignores the users specified **--fsoptions** values.
- **--mkfsoptions=** - Specifies additional parameters to be passed to the program that makes a filesystem on this partition. No processing is done on the list of arguments, so they must be supplied in a format that can be passed directly to the mkfs program. This means multiple options should be comma-separated or surrounded by double quotes, depending on the filesystem. For example,

```
part /opt/foo1 --size=512 --fstype=ext4 --mkfsoptions="-O
^has_journal,^flex_bg,^metadata_csum"

part /opt/foo2 --size=512 --fstype=xfs --mkfsoptions="-m bigtime=0,finobt=0"
```

For details, see the man pages of the filesystems you are creating. For example, **mkfs.ext4** or **mkfs.xfs**.

- **--label=** - Specify the label to give to the filesystem to be made. If the given label is already in use by another filesystem, a new label will be created.
- **--noformat** - Use an existing RAID device and do not format the RAID array.
- **--useexisting** - Use an existing RAID device and reformat it.
- **--encrypted** - Specifies that this RAID device should be encrypted with Linux Unified Key Setup (LUKS), using the passphrase provided in the **--passphrase** option. If you do not specify a passphrase, Anaconda uses the default, system-wide passphrase set with the **autopart --passphrase** command, or stops the installation and prompts you to provide a passphrase if no default is set.



NOTE

When encrypting one or more partitions, Anaconda attempts to gather 256 bits of entropy to ensure the partitions are encrypted securely. Gathering entropy can take some time - the process will stop after a maximum of 10 minutes, regardless of whether sufficient entropy has been gathered.

The process can be sped up by interacting with the installation system (typing on the keyboard or moving the mouse). If you are installing in a virtual machine, you can also attach a **virtio-rng** device (a virtual random number generator) to the guest.

- **--luks-version=*LUKS_VERSION*** - Specifies which version of LUKS format should be used to encrypt the filesystem. This option is only meaningful if **--encrypted** is specified.
- **--cipher=** - Specifies the type of encryption to use if the Anaconda default **aes-xts-plain64** is not satisfactory. You must use this option together with the **--encrypted** option; by itself it has no effect. Available types of encryption are listed in the Security hardening document, but Red Hat strongly recommends using either **aes-xts-plain64** or **aes-cbc-essiv:sha256**.
- **--passphrase=** - Specifies the passphrase to use when encrypting this RAID device. You must use this option together with the **--encrypted** option; by itself it has no effect.
- **--escrowcert=*URL_of_X.509_certificate*** - Store the data encryption key for this device in a file in /**root**, encrypted using the X.509 certificate from the URL specified with *URL_of_X.509_certificate*. This option is only meaningful if **--encrypted** is specified.
- **--backuppassphrase** - Add a randomly-generated passphrase to this device. Store the passphrase in a file in /**root**, encrypted using the X.509 certificate specified with **--escrowcert**. This option is only meaningful if **--escrowcert** is specified.
- **--pbkdf=*PBKDF*** - Sets Password-Based Key Derivation Function (PBKDF) algorithm for LUKS keyslot. See also the man page *cryptsetup(8)*. This option is only meaningful if **--encrypted** is specified.
- **--pbkdf-memory=*PBKDF_MEMORY*** - Sets the memory cost for PBKDF. See also the man page *cryptsetup(8)*. This option is only meaningful if **--encrypted** is specified.
- **--pbkdf-time=*PBKDF_TIME*** - Sets the number of milliseconds to spend with PBKDF passphrase processing. See also **--iter-time** in the man page *cryptsetup(8)*. This option is only meaningful if **--encrypted** is specified, and is mutually exclusive with **--pbkdf-iterations**.
- **--pbkdf-iterations=*PBKDF_ITERATIONS*** - Sets the number of iterations directly and avoids

PBKDF benchmark. See also **--pbkdf-force-iterations** in the man page *cryptsetup(8)*. This option is only meaningful if **--encrypted** is specified, and is mutually exclusive with **--pbkdf-time**.

Example

The following example shows how to create a RAID level 1 partition for /, and a RAID level 5 for **/home**, assuming there are three SCSI disks on the system. It also creates three swap partitions, one on each drive.

```
part raid.01 --size=6000 --ondisk=sda
part raid.02 --size=6000 --ondisk=sdb
part raid.03 --size=6000 --ondisk=sdc
part swap --size=512 --ondisk=sda
part swap --size=512 --ondisk=sdb
part swap --size=512 --ondisk=sdc
part raid.11 --size=1 --grow --ondisk=sda
part raid.12 --size=1 --grow --ondisk=sdb
part raid.13 --size=1 --grow --ondisk=sdc
raid / --level=1 --device=rhel8-root --label=rhel8-root raid.01 raid.02 raid.03
raid /home --level=5 --device=rhel8-home --label=rhel8-home raid.11 raid.12 raid.13
```

Note

- 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, you can save encryption passphrases with the **--escrowcert** and create backup encryption passphrases with the **--backuppassphrase** options.

B.5.9. volgroup

The **volgroup** Kickstart command is optional. It creates a Logical Volume Management (LVM) group.

Syntax

```
volgroup name [OPTIONS] [partition*]
```

Mandatory options

- *name* - Name of the new volume group.

Options

- *partition* - Physical volume partitions to use as backing storage for the volume group.
- **--noformat** - Use an existing volume group and do not format it.
- **--useexisting** - Use an existing volume group and reformat it. If you use this option, do not specify a *partition*. For example:

  ```
  volgroup rhel00 --useexisting --noformat
  ```

- **--pesize=** - Set the size of the volume group's physical extents in KiB. The default value is 4096 (4 MiB), and the minimum value is 1024 (1 MiB).

- **--reserved-space=** - Specify an amount of space to leave unused in a volume group in MiB. Applicable only to newly created volume groups.
- **--reserved-percent=** - Specify a percentage of total volume group space to leave unused. Applicable only to newly created volume groups.

Notes

- Create the partition first, then create the logical volume group, and then create the logical volume. For example:

```
part pv.01 --size 10000
volgroup my_volgrp pv.01
logvol / --vgname=my_volgrp --size=2000 --name=root
```

- Do not use the dash (**-**) character in logical volume and volume group names when installing Red Hat Enterprise Linux using Kickstart. If this character is used, the installation finishes normally, but the /**dev**/**mapper**/ directory will list these volumes and volume groups with every dash doubled. For example, a volume group named **volgrp-01** containing a logical volume named **logvol-01** will be listed as /**dev**/**mapper**/**volgrp--01-logvol--01**.
  This limitation only applies to newly created logical volume and volume group names. If you are reusing existing ones using the **--noformat** option, their names will not be changed.

B.5.10. logvol

The **logvol** Kickstart command is optional. It creates a logical volume for Logical Volume Management (LVM).

Syntax

```
logvol mntpoint --vgname=name --name=name [OPTIONS]
```

Mandatory options

mntpoint

The mount point where the partition is mounted. Must be of one of the following forms:

- /***path***
  For example, / or /**home**
- **swap**
  The partition is used as swap space.

  To determine the size of the swap partition automatically, use the **--recommended** option:

  ```
  swap --recommended
  ```

  To determine the size of the swap partition automatically and also allow extra space for your system to hibernate, use the **--hibernation** option:

  ```
  swap --hibernation
  ```

The size assigned will be equivalent to the swap space assigned by **--recommended** plus the amount of RAM on your system. For the swap sizes assigned by these commands, see Recommended Partitioning Scheme for AMD64, Intel 64, and 64-bit ARM systems.

--vgname=*name*

Name of the volume group.

--name=*name*

Name of the logical volume.

Optional options

--noformat

Use an existing logical volume and do not format it.

--useexisting

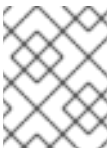
Use an existing logical volume and reformat it.

--fstype=

Sets the file system type for the logical volume. Valid values are **xfs**, **ext2**, **ext3**, **ext4**, **swap**, and **vfat**.

--fsoptions=

Specifies a free form string of options to be used when mounting the filesystem. This string will be copied into the **/etc/fstab** file of the installed system and should be enclosed in quotes.



NOTE

In the EFI system partition (**/boot/efi**), anaconda hard codes the value and ignores the users specified **--fsoptions** values.

--mkfsoptions=

Specifies additional parameters to be passed to the program that makes a filesystem on this partition. No processing is done on the list of arguments, so they must be supplied in a format that can be passed directly to the mkfs program. This means multiple options should be comma-separated or surrounded by double quotes, depending on the filesystem. For example,

```
part /opt/foo1 --size=512 --fstype=ext4 --mkfsoptions="-O
^has_journal,^flex_bg,^metadata_csum"

part /opt/foo2 --size=512 --fstype=xfs --mkfsoptions="-m bigtime=0,finobt=0"
```

For details, see the man pages of the filesystems you are creating. For example, **mkfs.ext4** or **mkfs.xfs**.

--fsprofile=

Specifies a usage type to be passed to the program that makes a filesystem on this partition. A usage type defines a variety of tuning parameters to be used when making a filesystem. For this option to work, the filesystem must support the concept of usage types and there must be a configuration file that lists valid types. For **ext2**, **ext3**, and **ext4**, this configuration file is **/etc/mke2fs.conf**.

--label=

Sets a label for the logical volume.

--grow

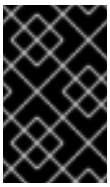
Extends the logical volume to occupy the available space (if any), or up to the maximum size specified, if any. The option must be used only if you have pre-allocated a minimum storage space in the disk image, and would want the volume to grow and occupy the available space. In a physical environment, this is an one-time-action. However, in a virtual environment, the volume size increases as and when the virtual machine writes any data to the virtual disk.

--size=

The size of the logical volume in MiB. This option cannot be used together with the **--percent=** option.

--percent=

The size of the logical volume, as a percentage of the free space in the volume group after any statically-sized logical volumes are taken into account. This option cannot be used together with the **--size=** option.



IMPORTANT

When creating a new logical volume, you must either specify its size statically using the **--size=** option, or as a percentage of remaining free space using the **--percent=** option. You cannot use both of these options on the same logical volume.

--maxsize=

The maximum size in MiB when the logical volume is set to grow. Specify an integer value here such as **500** (do not include the unit).

--recommended

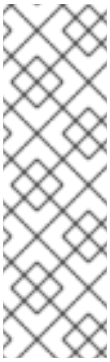
Use this option when creating a logical volume to determine the size of this volume automatically, based on your system's hardware. For details about the recommended scheme, see Recommended Partitioning Scheme for AMD64, Intel 64, and 64-bit ARM systems.

--resize

Resize a logical volume. If you use this option, you must also specify **--useexisting** and **--size**.

--encrypted

Specifies that this logical volume should be encrypted with Linux Unified Key Setup (LUKS), using the passphrase provided in the **--passphrase=** option. If you do not specify a passphrase, the installation program uses the default, system-wide passphrase set with the **autopart --passphrase** command, or stops the installation and prompts you to provide a passphrase if no default is set.



NOTE

When encrypting one or more partitions, Anaconda attempts to gather 256 bits of entropy to ensure the partitions are encrypted securely. Gathering entropy can take some time - the process will stop after a maximum of 10 minutes, regardless of whether sufficient entropy has been gathered.

The process can be sped up by interacting with the installation system (typing on the keyboard or moving the mouse). If you are installing in a virtual machine, you can also attach a **virtio-rng** device (a virtual random number generator) to the guest.

--passphrase=

Specifies the passphrase to use when encrypting this logical volume. You must use this option together with the **--encrypted** option; it has no effect by itself.

--cipher=

Specifies the type of encryption to use if the Anaconda default **aes-xts-plain64** is not satisfactory. You must use this option together with the **--encrypted** option; by itself it has no effect. Available types of encryption are listed in the Security hardening document, but Red Hat strongly recommends using either **aes-xts-plain64** or **aes-cbc-essiv:sha256**.

--escrowcert=*URL_of_X.509_certificate*

Store data encryption keys of all encrypted volumes as files in **/root**, encrypted using the X.509 certificate from the URL specified with *URL_of_X.509_certificate*. The keys are stored as a separate file for each encrypted volume. This option is only meaningful if **--encrypted** is specified.

--luks-version=*LUKS_VERSION*

Specifies which version of LUKS format should be used to encrypt the filesystem. This option is only meaningful if **--encrypted** is specified.

--backuppassphrase

Add a randomly-generated passphrase to each encrypted volume. Store these passphrases in separate files in **/root**, encrypted using the X.509 certificate specified with **--escrowcert**. This option is only meaningful if **--escrowcert** is specified.

--pbkdf=*PBKDF*

Sets Password-Based Key Derivation Function (PBKDF) algorithm for LUKS keyslot. See also the man page *cryptsetup(8)*. This option is only meaningful if **--encrypted** is specified.

--pbkdf-memory=*PBKDF_MEMORY*

Sets the memory cost for PBKDF. See also the man page *cryptsetup(8)*. This option is only meaningful if **--encrypted** is specified.

--pbkdf-time=*PBKDF_TIME*

Sets the number of milliseconds to spend with PBKDF passphrase processing. See also **--iter-time** in the man page *cryptsetup(8)*. This option is only meaningful if **--encrypted** is specified, and is mutually exclusive with **--pbkdf-iterations**.

--pbkdf-iterations=*PBKDF_ITERATIONS*

Sets the number of iterations directly and avoids PBKDF benchmark. See also **--pbkdf-force-iterations** in the man page *cryptsetup(8)*. This option is only meaningful if **--encrypted** is specified, and is mutually exclusive with **--pbkdf-time**.

--thinpool

Creates a thin pool logical volume. (Use a mount point of **none**)

--metadatasize=*size*

Specify the metadata area size (in MiB) for a new thin pool device.

--chunksize=*size*

Specify the chunk size (in KiB) for a new thin pool device.

--thin

Create a thin logical volume. (Requires use of **--poolname**)

--poolname=*name*

Specify the name of the thin pool in which to create a thin logical volume. Requires the **--thin** option.

--profile=*name*

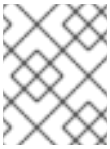
Specify the configuration profile name to use with thin logical volumes. If used, the name will also be included in the metadata for the given logical volume. By default, the available profiles are **default** and **thin-performance** and are defined in the **/etc/lvm/profile/** directory. See the **lvm(8)** man page for additional information.

--cachepvs=

A comma-separated list of physical volumes which should be used as a cache for this volume.

--cachemode=

Specify which mode should be used to cache this logical volume - either **writeback** or **writethrough**.



NOTE

For more information about cached logical volumes and their modes, see the **lvmcache(7)** man page on your system.

--cachesize=

Size of cache attached to the logical volume, specified in MiB. This option requires the **--cachepvs=** option.

Notes

- Do not use the dash (**-**) character in logical volume and volume group names when installing Red Hat Enterprise Linux using Kickstart. If this character is used, the installation finishes normally, but the **/dev/mapper/** directory will list these volumes and volume groups with every dash doubled. For example, a volume group named **volgrp-01** containing a logical volume named **logvol-01** will be listed as **/dev/mapper/volgrp—01-logvol—01**.
  This limitation only applies to newly created logical volume and volume group names. If you are reusing existing ones using the **--noformat** option, their names will not be changed.

- 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, you can save encryption passphrases with the **--escrowcert** and create backup encryption passphrases with the **--backuppassphrase** options.

Examples

- Create the partition first, create the logical volume group, and then create the logical volume:

```
part pv.01 --size 3000
volgroup myvg pv.01
logvol / --vgname=myvg --size=2000 --name=rootvol
```

- Create the partition first, create the logical volume group, and then create the logical volume to occupy 90% of the remaining space in the volume group:

```
part pv.01 --size 1 --grow
volgroup myvg pv.01
logvol / --vgname=myvg --name=rootvol --percent=90
```

Additional resources

- Configuring and managing logical volumes

B.5.11. snapshot

The **snapshot** Kickstart command is optional. Use it to create LVM thin volume snapshots during the installation process. This enables you to back up a logical volume before or after the installation.

To create multiple snapshots, add the **snaphost** Kickstart command multiple times.

Syntax

```
snapshot vg_name/lv_name --name=snapshot_name --when=pre-install|post-install
```

Options

- ***vg_name*/*lv_name*** – Sets the name of the volume group and logical volume to create the snapshot from.
- **--name=*snapshot_name*** – Sets the name of the snapshot. This name must be unique within the volume group.
- **--when=*pre-install*|*post-install*** – Sets if the snapshot is created before the installation begins or after the installation is completed.

B.5.12. mount

The **mount** Kickstart command is optional. It assigns a mount point to an existing block device, and optionally reformats it to a given format.

Syntax

```
mount [OPTIONS] device mountpoint
```

Mandatory options:

- ***device*** – The block device to mount.
- ***mountpoint*** – Where to mount the ***device***. It must be a valid mount point, such as / or /**usr**, or **none** if the device is unmountable (for example **swap**).

Optional options:

- **--reformat=** – Specifies a new format (such as **ext4**) to which the device should be reformatted.
- **--mkfsoptions=** – Specifies additional options to be passed to the command which creates the new file system specified in **--reformat=**. The list of options provided here is not processed, so they must be specified in a format that can be passed directly to the **mkfs** program. The list of options should be either comma-separated or surrounded by double quotes, depending on the file system. See the **mkfs** man page for the file system you want to create (for example **mkfs.ext4(8)** or **mkfs.xfs(8)**) for specific details.
- **--mountoptions=** – Specifies a free form string that contains options to be used when mounting the file system. The string will be copied to the /**etc**/**fstab** file on the installed system and should be enclosed in double quotes. See the **mount(8)** man page for a full list of mount options, and **fstab(5)** for basics.

Notes

- Unlike most other storage configuration commands in Kickstart, **mount** does not require you to describe the entire storage configuration in the Kickstart file. You only need to ensure that the described block device exists on the system. However, if you want to *create* the storage stack with all the devices mounted, you must use other commands such as **part** to do so.

- You can not use **mount** together with other storage-related commands such as **part**, **logvol**, or **autopart** in the same Kickstart file.

B.5.13. zipl

The **zipl** Kickstart command is optional. It specifies the ZIPL configuration for 64-bit IBM Z. Use this command only once.

Options

- **--secure-boot** - Enables secure boot if it is supported by the installing system.

NOTE

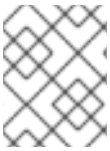
When installed on a system that is later than IBM z14, the installed system cannot be booted from an IBM z14 or earlier model.

- **--force-secure-boot** - Enables secure boot unconditionally.

NOTE

Installation is not supported on IBM z14 and earlier models.

- **--no-secure-boot** - Disables secure boot.



NOTE

Secure Boot is not supported on IBM z14 and earlier models. Use **--no-secure-boot** if you intend to boot the installed system on IBM z14 and earlier models.

B.5.14. fcoe

The **fcoe** Kickstart command is optional. It specifies which FCoE devices should be activated automatically in addition to those discovered by Enhanced Disk Drive Services (EDD).

Syntax

```
fcoe --nic=name [OPTIONS]
```

Options

- **--nic=** (required) - The name of the device to be activated.
- **--dcb=** - Establish Data Center Bridging (DCB) settings.
- **--autovlan** - Discover VLANs automatically. This option is enabled by default.

B.5.15. iscsi

The **iscsi** Kickstart command is optional. It specifies additional iSCSI storage to be attached during installation.

Syntax

```
iscsi --ipaddr=address [OPTIONS]
```

Mandatory options

- **--ipaddr=** (required) - the IP address of the target to connect to.

Optional options

- **--port=** (required) - the port number. If not present, **--port=3260** is used automatically by default.
- **--target=** - the target IQN (iSCSI Qualified Name).
- **--iface=** - bind the connection to a specific network interface instead of using the default one determined by the network layer. Once used, it must be specified in all instances of the **iscsi** command in the entire Kickstart file.
- **--user=** - the user name required to authenticate with the target
- **--password=** - the password that corresponds with the user name specified for the target
- **--reverse-user=** - the user name required to authenticate with the initiator from a target that uses reverse CHAP authentication
- **--reverse-password=** - the password that corresponds with the user name specified for the initiator

Notes

- If you use the **iscsi** command, you must also assign a name to the iSCSI node, using the **iscsiname** command. The **iscsiname** command must appear before the **iscsi** command in the Kickstart file.
- Wherever possible, configure iSCSI storage in the system BIOS or firmware (iBFT for Intel systems) rather than use the **iscsi** command. Anaconda automatically detects and uses disks configured in BIOS or firmware and no special configuration is necessary in the Kickstart file.
- If you must use the **iscsi** command, ensure that networking is activated at the beginning of the installation, and that the **iscsi** command appears in the Kickstart file *before* you refer to iSCSI disks with commands such as **clearpart** or **ignoredisk**.

B.5.16. iscsiname

The **iscsiname** Kickstart command is optional. It assigns a name to an iSCSI node specified by the **iscsi** command. Use this command only once.

Syntax

```
iscsiname iqname
```

Options

- ***iqname*** - Name to assign to the iSCSI node.

Note

- If you use the **iscsi** command in your Kickstart file, you must specify **iscsiname** *earlier* in the Kickstart file.

B.5.17. nvdimm

The **nvdimm** Kickstart command is optional. It performs an action on Non-Volatile Dual In-line Memory Module (NVDIMM) devices. By default, NVDIMM devices are ignored by the installation program. You must use the **nvdimm** command to enable installation on these devices.

This Kickstart command is deprecated.

Syntax

```
nvdimm action [OPTIONS]
```

Actions

- **reconfigure** - Reconfigure a specific NVDIMM device into a given mode. Additionally, the specified device is implicitly marked as to be used, so a subsequent **nvdimm use** command for the same device is redundant. This action uses the following format:

  ```
  nvdimm reconfigure [--namespace=NAMESPACE] [--mode=MODE] [--
  sectorsize=SECTORSIZE]
  ```

  - **--namespace=** - The device specification by namespace. For example:

    ```
    nvdimm reconfigure --namespace=namespace0.0 --mode=sector --sectorsize=512
    ```

  - **--mode=** - The mode specification. Currently, only the value **sector** is available.

  - **--sectorsize=** - Size of a sector for sector mode. For example:

    ```
    nvdimm reconfigure --namespace=namespace0.0 --mode=sector --sectorsize=512
    ```

    The supported sector sizes are 512 and 4096 bytes.

- **use** - Specify a NVDIMM device as a target for installation. The device must be already configured to the sector mode by the **nvdimm reconfigure** command. This action uses the following format:

  ```
  nvdimm use [--namespace=NAMESPACE|--blockdevs=DEVICES]
  ```

  - **--namespace=** - Specifies the device by namespace. For example:

    ```
    nvdimm use --namespace=namespace0.0
    ```

  - **--blockdevs=** - Specifies a comma-separated list of block devices corresponding to the NVDIMM devices to be used. The asterisk * wildcard is supported. For example:

```
nvdimm use --blockdevs=pmem0s,pmem1s
nvdimm use --blockdevs=pmem*
```

B.5.18. zfcp

The **zfcp** Kickstart command is optional. It defines a Fibre channel device.

This option only applies on 64-bit IBM Z.

Syntax

```
zfcp --devnum=devnum [--wwpn=wwpn --fcplun=lun]
```

Options

- **--devnum=** - The device number (zFCP adapter device bus ID).
- **--wwpn=** - The device's World Wide Port Name (WWPN). Takes the form of a 16-digit number, preceded by **0x**.
- **--fcplun=** - The device's Logical Unit Number (LUN). Takes the form of a 16-digit number, preceded by **0x**.

NOTE

It is sufficient to specify an FCP device bus ID if automatic LUN scanning is available and when installing 9 or later releases. Otherwise all three parameters are required. Automatic LUN scanning is available for FCP devices operating in NPIV mode if it is not disabled through the **zfcp.allow_lun_scan** module parameter (enabled by default). It provides access to all SCSI devices found in the storage area network attached to the FCP device with the specified bus ID.

Example

```
zfcp --devnum=0.0.4000 --wwpn=0x5005076300C213e9 --fcplun=0x5022000000000000
zfcp --devnum=0.0.4000
```

B.6. KICKSTART COMMANDS FOR ADDONS SUPPLIED WITH THE RHEL INSTALLATION PROGRAM

The Kickstart commands in this section are related to add-ons supplied by default with the Red Hat Enterprise Linux installation program: Kdump and OpenSCAP.

B.6.1. %addon com_redhat_kdump

The **%addon com_redhat_kdump** Kickstart command is optional. This command configures the kdump kernel crash dumping mechanism.

Syntax

```
%addon com_redhat_kdump [OPTIONS]
%end
```

NOTE

The syntax for this command is unusual because it is an add-on rather than a built-in Kickstart command.

Notes

Kdump is a kernel crash dumping mechanism that allows you to save the contents of the system's memory for later analysis. It relies on **kexec**, which can be used to boot a Linux kernel from the context of another kernel without rebooting the system, and preserve the contents of the first kernel's memory that would otherwise be lost.

In case of a system crash, **kexec** boots into a second kernel (a capture kernel). This capture kernel resides in a reserved part of the system memory. Kdump then captures the contents of the crashed kernel's memory (a crash dump) and saves it to a specified location. The location cannot be configured using this Kickstart command; it must be configured after the installation by editing the **/etc/kdump.conf** configuration file.

For more information about Kdump, see the Installing kdump.

Options

- **--enable** - Enable kdump on the installed system.
- **--disable** - Disable kdump on the installed system.
- **--reserve-mb=** - The amount of memory you want to reserve for kdump, in MiB. For example:

  ```
  %addon com_redhat_kdump --enable --reserve-mb=128
  %end
  ```

  You can also specify **auto** instead of a numeric value. In that case, the installation program will determine the amount of memory automatically based on the criteria described in the Memory requirements for kdump section of the *Managing, monitoring and updating the kernel* document.

  If you enable kdump and do not specify a **--reserve-mb=** option, the value **auto** will be used.

- **--enablefadump** - Enable firmware-assisted dumping on systems which allow it (notably, IBM Power Systems servers).

B.6.2. %addon com_redhat_oscap

The **%addon com_redhat_oscap** Kickstart command is optional.

The OpenSCAP installation program add-on is used to apply SCAP (Security Content Automation Protocol) content - security policies - on the installed system. This add-on has been enabled by default since Red Hat Enterprise Linux 7.2. When enabled, the packages necessary to provide this functionality will automatically be installed. However, by default, no policies are enforced, meaning that no checks are performed during or after installation unless specifically configured.

IMPORTANT

Applying a security policy is not necessary on all systems. This command should only be used when a specific policy is mandated by your organization rules or government regulations.

Unlike most other commands, this add-on does not accept regular options, but uses key-value pairs in the body of the **%addon** definition instead. These pairs are whitespace-agnostic. Values can be optionally enclosed in single quotes (') or double quotes (").

Syntax

```
%addon com_redhat_oscap
key = value
%end
```

Keys

The following keys are recognized by the add-on:

content-type

Type of the security content. Possible values are **datastream**, **archive**, **rpm**, and **scap-security-guide**.
If the **content-type** is **scap-security-guide**, the add-on will use content provided by the **scap-security-guide** package, which is present on the boot media. This means that all other keys except **profile** will have no effect.

content-url

Location of the security content. The content must be accessible using HTTP, HTTPS, or FTP; local storage is currently not supported. A network connection must be available to reach content definitions in a remote location.

datastream-id

ID of the data stream referenced in the **content-url** value. Used only if **content-type** is **datastream**.

xccdf-id

ID of the benchmark you want to use.

content-path

Path to the datastream or the XCCDF file which should be used, given as a relative path in the archive.

profile

ID of the profile to be applied. Use **default** to apply the default profile.

fingerprint

A MD5, SHA1 or SHA2 checksum of the content referenced by **content-url**.

tailoring-path

Path to a tailoring file which should be used, given as a relative path in the archive.

Examples

- The following is an example **%addon com_redhat_oscap** section which uses content from the **scap-security-guide** on the installation media:

  Example B.1. Sample OpenSCAP Add-on Definition Using SCAP Security Guide

```
%addon com_redhat_oscap
content-type = scap-security-guide
profile = xccdf_org.ssgproject.content_profile_pci-dss
%end
```

- The following is a more complex example which loads a custom profile from a web server:

Example B.2. Sample OpenSCAP Add-on Definition Using a Datastream

```
%addon com_redhat_oscap
content-type = datastream
content-url = http://www.example.com/scap/testing_ds.xml
datastream-id = scap_example.com_datastream_testing
xccdf-id = scap_example.com_cref_xccdf.xml
profile =  xccdf_example.com_profile_my_profile
fingerprint = 240f2f18222faa98856c3b4fc50c4195
%end
```

Additional resources

- Security Hardening
- OpenSCAP installation program add-on
- OpenSCAP Portal

B.7. COMMANDS USED IN ANACONDA

The **pwpolicy** command is an Anaconda UI specific command that can be used only in the **%anaconda** section of the kickstart file.

B.7.1. pwpolicy (deprecated)

The **pwpolicy** Kickstart command is optional. Use this command to enforce a custom password policy during installation. The policy requires you to create passwords for the root, users, or the luks user accounts. The factors such as password length and strength decide the validity of a password.

Syntax

```
pwpolicy name [--minlen=length] [--minquality=quality] [--strict|--notstrict] [--emptyok|--notempty] [--changesok|--nochanges]
```

Mandatory options

- *name* - Replace with either **root**, **user** or **luks** to enforce the policy for the **root** password, user passwords, or LUKS passphrase, respectively.

Optional options

- **--minlen=** - Sets the minimum allowed password length, in characters. The default is **6**.

- **--minquality=** - Sets the minimum allowed password quality as defined by the **libpwquality** library. The default value is **1**.
- **--strict** - Enables strict password enforcement. Passwords which do not meet the requirements specified in **--minquality=** and **--minlen=** will not be accepted. This option is disabled by default.
- **--notstrict** - Passwords which do *not* meet the minimum quality requirements specified by the **--minquality=** and **-minlen=** options will be allowed, after **Done** is clicked twice in the GUI. For text mode interface, a similar mechanism is used.
- **--emptyok** - Allows the use of empty passwords. Enabled by default for user passwords.
- **--notempty** - Disallows the use of empty passwords. Enabled by default for the root password and the LUKS passphrase.
- **--changesok** - Allows changing the password in the user interface, even if the Kickstart file already specifies a password. Disabled by default.
- **--nochanges** - Disallows changing passwords which are already set in the Kickstart file. Enabled by default.

Notes

- The **pwpolicy** command is an Anaconda-UI specific command that can be used only in the **%anaconda** section of the kickstart file.
- The **libpwquality** library is used to check minimum password requirements (length and quality). You can use the **pwscore** and **pwmake** commands provided by the **libpwquality** package to check the quality score of a password, or to create a random password with a given score. See the **pwscore(1)** and **pwmake(1)** man page for details about these commands.

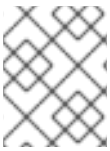
B.8. KICKSTART COMMANDS FOR SYSTEM RECOVERY

The Kickstart command in this section repairs an installed system.

B.8.1. rescue

The **rescue** Kickstart command is optional. It provides a shell environment with root privileges and a set of system management tools to repair the installation and to troubleshoot the issues like:

- Mount file systems as read-only
- Blocklist or add a driver provided on a driver disc
- Install or upgrade system packages
- Manage partitions



NOTE

The Kickstart rescue mode is different from the rescue mode and emergency mode, which are provided as part of the systemd and service manager.

The **rescue** command does not modify the system on its own. It only sets up the rescue environment by mounting the system under /mnt/sysimage in a read-write mode. You can choose not to mount the system, or to mount it in read-only mode. Use this command only once.

Syntax

```
rescue [--nomount|--romount]
```

Options

- **--nomount** or **--romount** - Controls how the installed system is mounted in the rescue environment. By default, the installation program finds your system and mount it in read-write mode, telling you where it has performed this mount. You can optionally select to not mount anything (the **--nomount** option) or mount in read-only mode (the **--romount** option). Only one of these two options can be used.

Notes

To run a rescue mode, make a copy of the Kickstart file, and include the **rescue** command in it.

Using the **rescue** command causes the installer to perform the following steps:

1. Run the **%pre** script.
2. Set up environment for rescue mode.
   The following kickstart commands take effect:
   a. updates
   b. sshpw
   c. logging
   d. lang
   e. network
3. Set up advanced storage environment.
   The following kickstart commands take effect:
   a. fcoe
   b. iscsi
   c. iscsiname
   d. nvdimm
   e. zfcp
4. Mount the system

   ```
   rescue [--nomount|--romount]
   ```

5. Run %post script
   This step is run only if the installed system is mounted in read-write mode.

6. Start shell
7. Reboot system