

Installation Procedure for CERN CentOS 7

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1 Introduction

This guide will present a quick tutorial on installing the CERN Community ENTERprise Operating System 7 (CC7), which is the standard operating system (OS) for use with CMS software (SW). First, I will briefly discuss the CC7 OS. Then, I will provide an overview of preparing the installation media on a USB drive (using MacOS), and then I will provide the installation procedure of CC7.

2 CERN CentOS 7

The CentOS operating system is (almost) a facsimile of the Red Hat Enterprise Linux (RHEL). The primary difference is that RHEL is available for purchase¹, while CentOS is free (both have open source code and are binary compatible). CentOS was originally forked from the RHEL project in 2004, and has gone through eight major releases since then. Although the latest major release is currently v. 8, migration of all software to be v. 8 compatible is not yet complete at the time of this writing.

CERN CentOS 7 is a slightly enhanced CentOS 7 distribution that is better suited to the needs of the CERN computing environment. The major differences between CC7 and CentOS 7 is that CC7 provides only a production version (and no testing version; updates are staged, tested, and then released once a week), and includes yum-autoupdate system. Some additional differences are related to the preinstalled packages: the default path for the yum repository files are the repositories hosted at CERN, there is RPM signing key support for CERN Linux, the Network Security Services (nss) libraries and epel-release, centos-release-sc, centos-release-scl-rh libraries are included, setup utilities for the various network file systems hosted on the CERN network are included, and the CERN CA and GRID CA certificates are included in the installation.

3 Preparing the Installation Media

First, download the ISO image² from Linux CERN. To prepare the installation media, we will need a USB drive that is large enough to fit the full ISO image of the OS. The installation procedure will be listed for MacOS below³.

Insert the USB drive and open a terminal. To list all available drives, execute the `diskutil list` command (output shown in Fig. 1 below).

¹The price of the RHEL OS covers enterprise support and other services available from the company.

²This file format (really ISO 9660) comes from the International Standard of Organization (ISO). See [2].

³The installation will be very similar for any *nix machine; only the GUI applications and two of the command line tools are different in the case of formatting a USB drive on a Linux-based machine.

```
[Stephens-MacBook-Pro-3: ~]$ diskutil list
/dev/disk0 (internal, physical):
#:#:      TYPE NAME              SIZE      IDENTIFIER
0:      GUID_partition_scheme *500.3 GB disk0
1:      EFI EFI                209.7 MB  disk0s1
2:      Apple_APFS Container disk1 500.1 GB  disk0s2

/dev/disk1 (synthesized):
#:#:      TYPE NAME              SIZE      IDENTIFIER
0:      APFS Container Scheme -   +500.1 GB  disk1
           Physical Store disk0s2
1:      APFS Volume Macintosh HD 404.9 GB  disk1s1
2:      APFS Volume Preboot      39.3 MB   disk1s2
3:      APFS Volume Recovery     517.8 MB  disk1s3
4:      APFS Volume VM           12.9 GB   disk1s4

/dev/disk2 (external, physical):
#:#:      TYPE NAME              SIZE      IDENTIFIER
0:      FDisk_partition_scheme *31.0 GB  disk2
1:      0xEF                8.9 MB   disk2s2
```

Figure 1: Executing the `diskutil list` command, which lists all available drives connected to the machine.

From the output, we see the two main disks of the machine `/dev/disk0` for the Apple File System (APFS) and `/dev/disk1` for the different, non-storage partitions. The USB drive is mounted at `/dev/disk2` and we can see has about 31 GB of free space to write an image. From here, one can either use the Disk Utility graphical user interface (GUI) application, or perform the formatting directly from the command line. Both options are listed in the following subsections.

3.1 Formatting Using the Disk Utility Application

Open the Disk Utility application and select the external USB flash drive (Fig. 2).

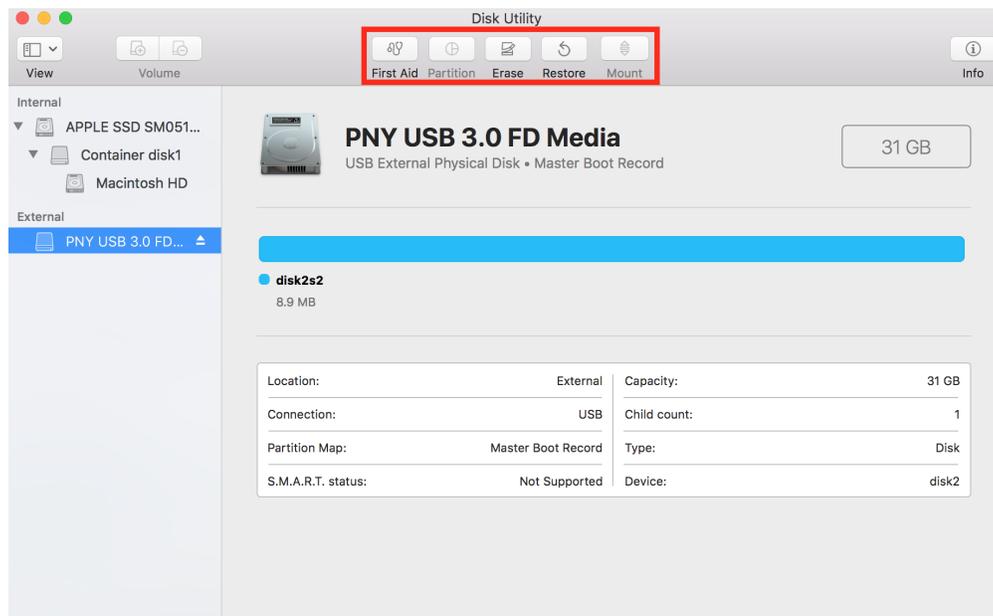


Figure 2: The Disk Utility application with the USB drive selected. The option panel highlighted by the red box contains all of the various utilities for formatting, repairing, and erasing a drive.

In the top option panel (highlighted by the red box in Fig. 2), select **Erase**. From the dropdown menu (Fig. 3), rename the installation media to your choice, then select the MS-DOS (FAT) file system format (which is compatible with all OSs), and the GUID Partition Map⁴ for the scheme (to make the partition bootable).

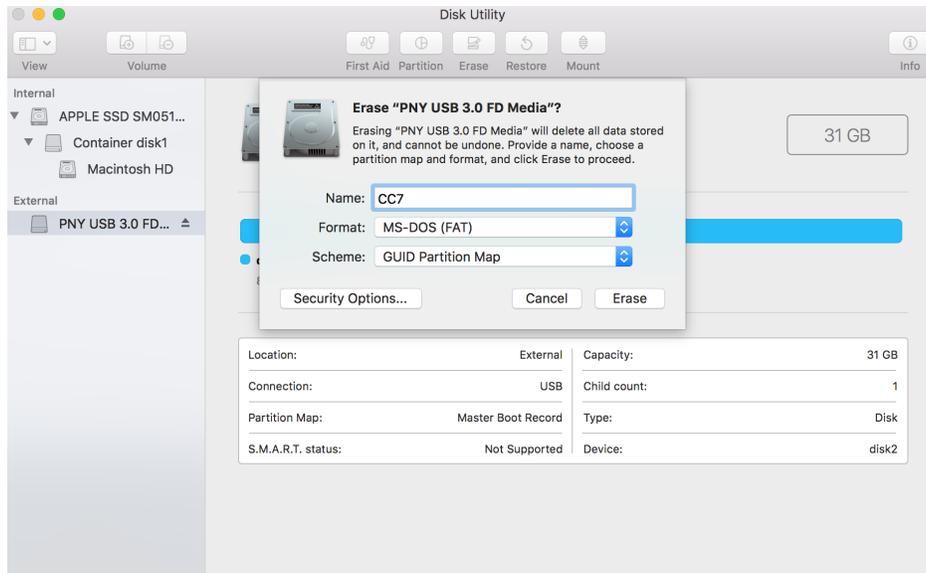


Figure 3: The formatting options for erasing the USB drive. The most important options are the format of the drive (which should be MS-DOS for compatibility between all machines, and the partitioning scheme (which must be the GUID partition table option).

After formatting the drive, you will see the prompt in Fig. 4.



Figure 4: The formatting options for erasing the USB drive.

⁴The Globally Unique Identifiers (GUID) Partition Table (GPT) is a modern partitioning scheme that can be universally booted across OSs, with either type of software/firmware interface available on the motherboard. I.e., it works both with the modern Unified Extensible Firmware Interface (UEFI) or the more traditional Basic Input-Output System (BIOS).

3.2 Formatting Using the Command Line

List all disks using the `diskutil` command as shown in Fig. 1. After verifying the correct disk (`/dev/disk2` in this example), we'll run one of `diskutil`'s utilities, `partitionDisk`. The usage is listed below:

```
1 $ diskutil partitionDisk </path/to/disk> <partition scheme> <file system> <partition name>\
2 <size of partition>
```

To format the USB drive such that it is bootable and that it is compatible with all machines, we run the command as shown in Fig. 5. For this command, we've selected the GUID Partition Table (GPT) option for the partition scheme, MS-DOS for the file system (for compatibility), named the partition "CC7", and listed the partition size as 0 bytes, which tells `diskutil` to use all of the available space on the drive.

```
[Stephens-MacBook-Pro-3: ~]$ diskutil partitionDisk /dev/disk2 GPT MS-DOS CC7 0b
Started partitioning on disk2
Unmounting disk
Creating the partition map
Waiting for partitions to activate
Formatting disk2s2 as MS-DOS (FAT) with name CC7
512 bytes per physical sector
/dev/rdisk2s2: 60112160 sectors in 1878505 FAT32 clusters (16384 bytes/cluster)
bps=512 spc=32 res=32 nft=2 mid=0xf8 spt=32 hds=255 hid=411648 drv=0x80 bsec=60141568 bspf=14676 rdcl=2 infs=1 bkbs=6
Mounting disk
Finished partitioning on disk2
/dev/disk2 (external, physical):
#:          TYPE NAME          SIZE          IDENTIFIER
0:          GUID_partition_scheme      *31.0 GB      disk2
1:          EFI EFI                209.7 MB      disk2s1
2:          Microsoft Basic Data CC7    30.8 GB      disk2s2
```

Figure 5: Formatting the USB drive using the `diskutil partitionDisk` command line utility.

Now that the drive is formatted, we can write the disk image.

3.3 Writing the Disk Image to the USB Drive

To write the disk image to the USB drive, we use the `dd` command to write the input file (`boot.iso`) to the output file (USB drive). Before we write the image, we need to unmount the USB disk drive. In Fig. 1, we see that the mount point for the USB drive was `/dev/disk2`. The full command and successful output is displayed below in Fig. 6.

```
[Stephens-MacBook-Pro-3: CC7]$ diskutil unmountDisk /dev/disk2
Unmount of all volumes on disk2 was successful
```

Figure 6: Unmounting the USB disk drive.

Now that the drive is unmounted, we write the disk image. Execute the command

```
1 $ sudo dd if='path/to/image/boot.iso' of='path/to/disk/' bs=<input/output block size>
```

The command for this example and its successful output is displayed below in Fig. 7.

```
[Stephens-MacBook-Pro-3: CC7]$ sudo dd if=boot.iso of=/dev/disk2 bs=1m
634+0 records in
634+0 records out
664797184 bytes transferred in 261.334141 secs (2543859 bytes/sec)
```

Figure 7: Using the `dd` command to write the CC7 disk image. Note that during this execution of this command, there will be no output to the terminal window. The command can take tens of minutes.

Here, we assign the path to the `.iso` file to the input file (`if`) argument, and assign the output file (`of`) to the path where the USB drive is mounted. The `bs` argument stands for block size; here, we set the block transfer size when writing the image as one megabyte. The tradeoff with the block size parameter is that the copying will be more accurate when the block size is smaller, but the copying operation will take increasingly longer times with decreasing block size.

4 Installing CC7

To install CC7, insert the formatted USB drive into a machine with at least one hard drive (this drive can be formatted or unformatted; during installation, you have the option of formatting and partitioning the drive automatically or in a custom configuration). Power on the machine: at the loading screen, press the key that takes you to the boot menu (for many machines this is `F12`, `Esc`, etc.; consult your computer's manual to find the correct key). Select the formatted USB drive from the menu (the main partition). This will take you to the screen shown in Fig. 8. From here, select `Test this media & install CentOS7`.

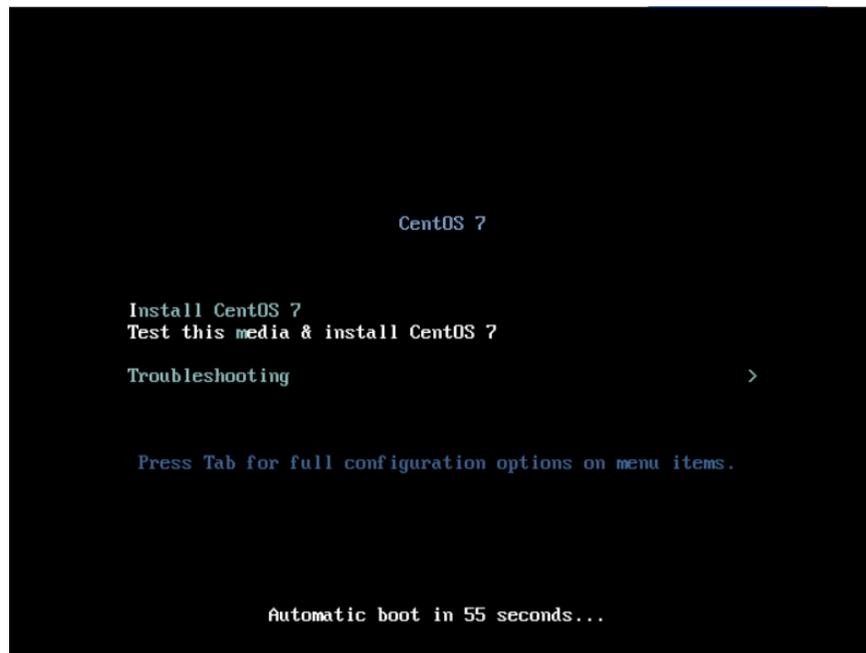


Figure 8: Installation option screen after booting the machine off of the formatted USB drive. Image from [4].

From here, select the language and select `Continue`. You will then see the Installation Summary screen (Fig. 9 below.)

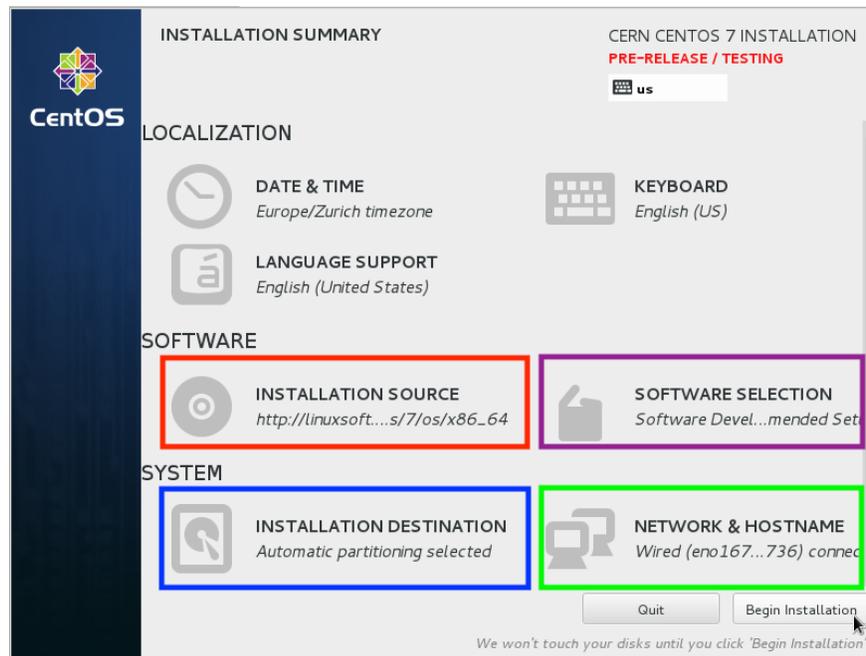


Figure 9: Installation summary screen. Image adapted from [5].

Because the downloadable CC7 ISO image allows only for network installation, one needs to first configure the Network Host and Name (purple box in Fig. 9). After selecting this option, select the appropriate ethernet connection (shown in Fig. 10 below). If you are unable to establish network access, this could be a driver or hardware issue.

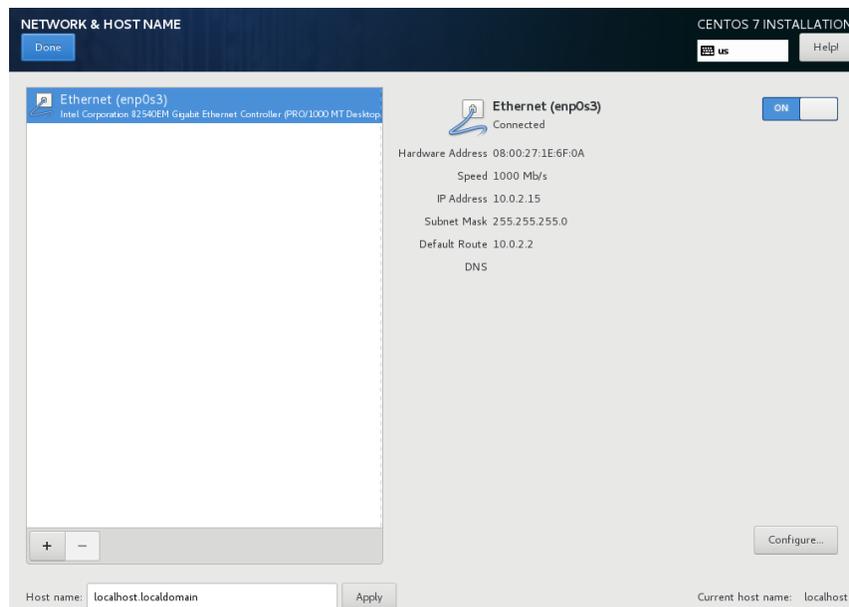


Figure 10: Network and Host name configuration. Image from [5].

Once the network has been configured and you can connect to the internet, click on the Installation Source option (the red box in Fig. 9). You will then see the screen in Fig. 11 below.

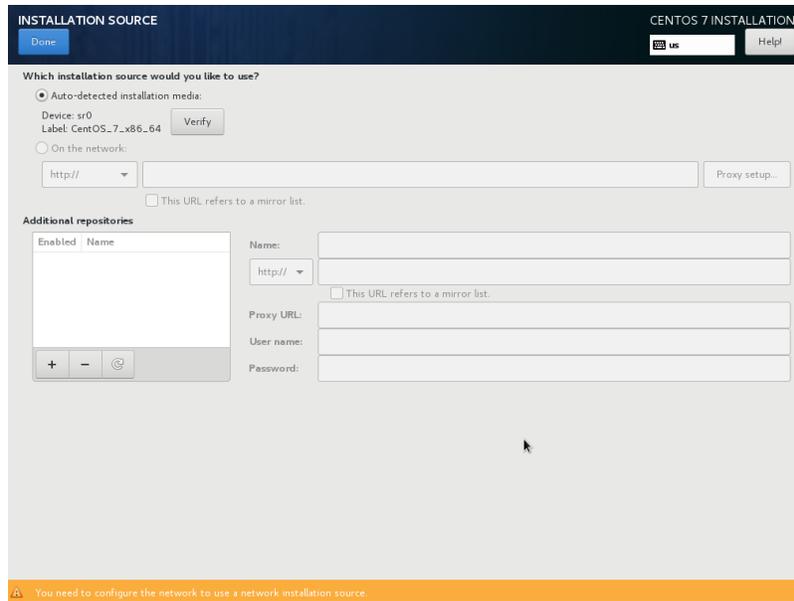


Figure 11: Installation source screen. Image from [7].

Click the radio button label “On the network,” and enter the following URL:

http://linuxsoft.cern.ch/cern/centos/7/os/x86_64/

After entering the URL, return to the installation summary screen and click on the installation destination. Here, you will configure the partitioning scheme on the disk(s) and on which disk the OS will be installed (see Fig. 12 below). To have the installer automatically configure the `/boot`, `/home`, and `/swap` partitions, select the “Automatically configure partitioning” option, unless you have special partitioning requirements.

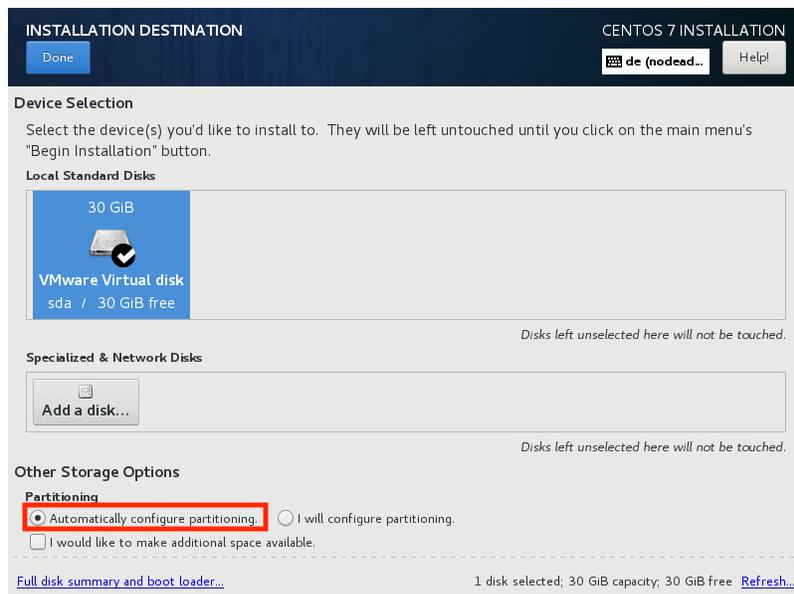


Figure 12: Installation destination. Image adapted from [8].

After selecting the appropriate disk, you will be prompted with the available space on the disk and the partitioning scheme (Fig. 13). In the general case of installing on a previously used disk, select "Reclaim space," which will, when the installation starts, erase all data and repartition the selected disk.

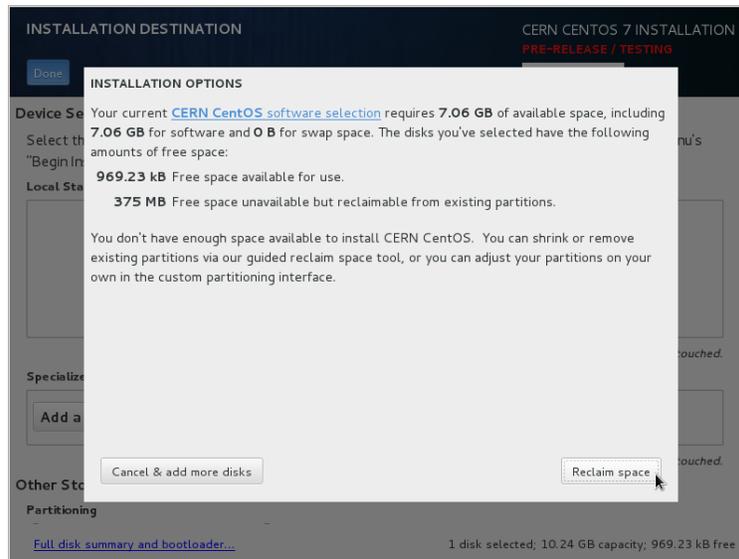


Figure 13: Installation options for reclaiming space on the selected disk. Image from [8].

Now, we need to configure the base environment for the CentOS 7 installation, and any additional packages you want to install (the purple box in Fig. 9). Selecting this option will bring you to the software selection screen (Fig. 14). For a standard desktop, be sure to choose either the GNOME Desktop or KDE Plasma Workspaces. Note that in most installations, GNOME is preferred since, while it is not as customizable as KDE, it is the most stable desktop. In the "Add-Ons for Selected Environment," be sure to choose, at the minimum, the options for GNOME Applications, Compatibility Libraries, Development Tools, and Office Suite and Productivity.

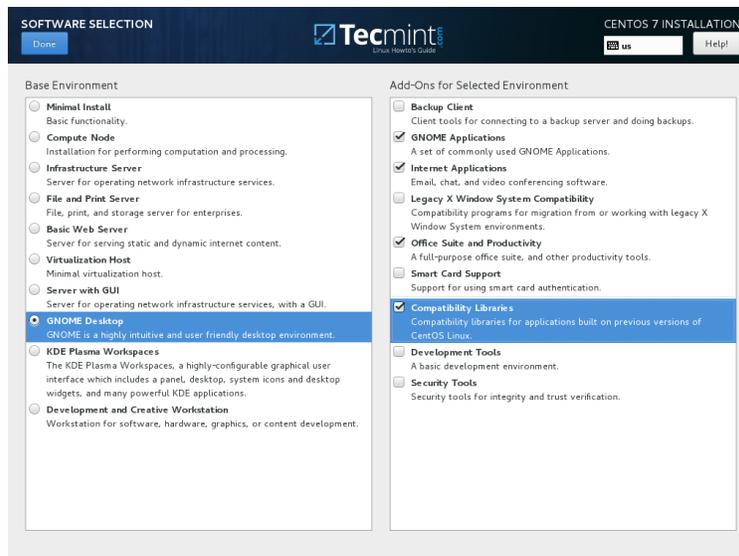


Figure 14: Software selection options. Image from [9].

Finally, we are ready to begin the installation. Click on “Begin Installation” on the summary screen. From here, you will set the root password and create a user while the OS and additional packages are being installed. After the installation is complete, select “Reboot.” During the first boot, you will need to accept the license, and then complete the CERN customization options (Fig. 15).

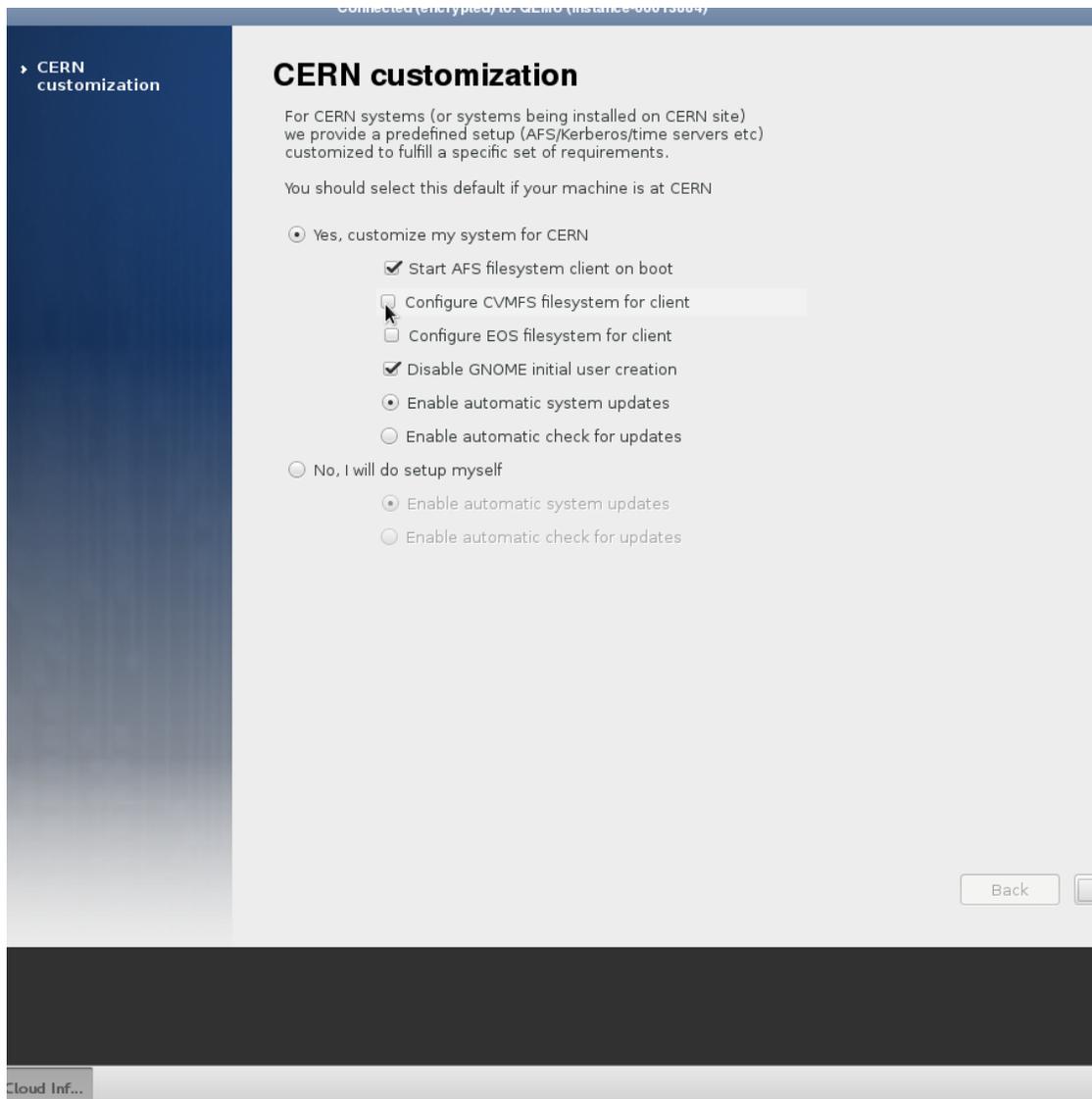


Figure 15: CERN’s CC7 software customization options. Image from [5].

Since this machine is not on CERN’s network, check the radio button “No, I will do setup myself.” Depending on the nature of the software (DAQ, analysis, etc.) you will eventually install, select “Enable automatic check for updates,” so that the OS is not updated without permission, and any potential compatibility issues are avoided. In the event that you need some of the additional CERN customization options, see the section titled “Manual post-install configuration adjustment,” in [5].

5 Conclusion

Your machine is now set up with CC7. Good luck with your future computing endeavors!

References

- [1] The CERN CentOS 7 Team, “What is CERN CentOS 7 (CC7) ?,” 2020, <https://linux.web.cern.ch/centos7/>.
- [2] International Standards of Organization, “ABOUT US,” 2020, <https://www.iso.org/about-us.html>.
- [3] C. Schroder, “Using the New GUID Partition Table in Linux (Goodbye Ancient MBR),” July 25, 2013, <https://www.linux.com/training-tutorials/using-new-guid-partition-table-linux-goodbye-ancient-mbr/>.
- [4] If Not True Then False, “CentOS 7.7 Netinstall Guide — Network Installation Screenshots,” September 28, 2019, <https://www.if-not-true-then-false.com/2014/centos-7-netinstall-guide/>.
- [5] The CERN CentOS 7 Team, “CC7 - Installation,” <https://linux.web.cern.ch/centos7/docs/install/>.
- [6] CentOS 7, “Network & Host Name,” <https://docs.centos.org/en-US/centos/install-guide/NetworkSpoke-x86/>.
- [7] CentOS 7, “Installation Source,” <https://docs.centos.org/en-US/centos/install-guide/SourceSpoke-x86/>.
- [8] CentOS 7, “Installation Destination,” <https://docs.centos.org/en-US/centos/install-guide/StorageSpoke-x86/>.
- [9] TecMint, “Installation of CentOS 7.5 Guide,” <https://www.tecmint.com/centos-7-5-installation-guide/>.