

## 3.1 System Design

Steps	Description
<b>Perform a needs assessment</b>	<p>An effective needs assessment determines the goals of the installation, creates a plan to meet those needs, and measures the results of the plan. This involves:</p> <ul style="list-style-type: none"> <li>• Interviewing managers to determine the goals they want to achieve, the problems they need to solve, and the results they expect.</li> <li>• Writing clear, measurable statements that specifically address the goals.</li> <li>• Identifying the stakeholders.</li> <li>• Confirming correct authorization.</li> <li>• Aligning the installation with current organizational strategy and technology.</li> <li>• Verifying funding.</li> <li>• Creating a support strategy.</li> <li>• Determining the scope by: <ul style="list-style-type: none"> <li>◦ Identifying deadlines</li> <li>◦ Determining the tasks that must be completed</li> <li>◦ Planning for human resource allocation</li> </ul> </li> </ul>
<b>Pick a distribution</b>	<p>Picking a distribution involves:</p> <ul style="list-style-type: none"> <li>• Determining whether the computer should be a server or workstation. Most distributions can be either, but some are better designed for specific functions and even specific types of servers.</li> <li>• Determining whether end users will be comfortable with the distribution or configuration changes might be necessary.</li> <li>• Determining if required software is available for the distribution. Make a list of applications and ensure that they are provided on the distribution.</li> <li>• Ensuring that the distribution has the necessary support.</li> </ul>
<b>Determine the hardware requirements</b>	<p>Some computer hardware is incompatible with some distributions. Ensure that:</p> <ul style="list-style-type: none"> <li>• The computers' hardware is on the distribution's hardware compatibility list.</li> <li>• The computers have sufficient CPU speed, memory, and other system requirements to run the distribution and installed software.</li> <li>• The distribution's architecture matches the computer's CPU architecture. These include: <ul style="list-style-type: none"> <li>◦ x86 for 32-bit CPUs</li> <li>◦ x64 for 64-bit CPUs</li> <li>◦ IA-64 for Itanium CPUs</li> <li>◦ ALPHA for Alpha CPUs</li> <li>◦ PPC for Power PC (Apple) CPUs</li> </ul> </li> </ul>
<b>Plan the file system</b>	<p>The file system determines how a computer's files are organized on a hard drive. Linux supports several file system types that have different characteristics, including the following:</p> <ul style="list-style-type: none"> <li>• <b>ext2</b> has volume integrity features that may take several minutes to run after a system crash.</li> <li>• <b>ext3</b> uses journaling to ensure that only incomplete transactions are checked after a system crash.</li> <li>• <b>ext4</b> is similar to ext3, but includes newer features that reduce file fragmentation. It also allows for larger volumes and files and uses delayed allocation to improve flash memory life.</li> <li>• <b>btrfs</b> allows for drive pooling, on-the-fly snapshots, transparent compression, and online defragmentation.</li> <li>• <b>XFS</b> is similar to ext4. It uses delayed allocation to help with file fragmentation and does not allow for mounted snapshots. It can be enlarged on the fly, but not shrunk.</li> <li>• Pick the file system that best meets your organization's needs. Considerations include: <ul style="list-style-type: none"> <li>◦ Maximum volume size</li> <li>◦ Maximum file size</li> <li>◦ File name size</li> <li>◦ Permissions and file security</li> <li>◦ Encryption support</li> <li>◦ Recovery support and speed</li> <li>◦ Backup support</li> <li>◦ Journal support</li> </ul> </li> </ul>

<b>Plan the partitions</b>	<p>Partition planning is another element of file system planning. An efficient strategy is to create multiple partitions based on the types of files held on the partition and the user access needs. Consider creating separate partitions for the following directories and set mount options based on the type of files in the directory:</p> <ul style="list-style-type: none"> <li>• <b>/ (root)</b> must to be at least 8 GB, but really should be much larger. The partition holding the root directory should not be on an extended MBR partition and must be formatted with a Linux file system.</li> <li>• <b>/home</b> should be as large as needed to store the user files.</li> <li>• <b>/boot</b> should be 100–200MB and needs to be in the first 1024 cylinders of the disk for older BIOS versions.</li> <li>• <b>/opt</b> should be large enough to support the applications that will be installed.</li> <li>• <b>/tmp</b> should be large enough to store the temporary files created by the system. Be aware that these temporary files are periodically cleaned out by the operating system.</li> <li>• <b>/usr</b> should be large enough to support the packages to be installed on the system.</li> <li>• <b>/var</b> should be large enough to support the user mail boxes, print queues, and log files that will be created on the system.</li> <li>• <b>swap</b> should be two times larger than the amount of installed RAM on desktop systems and one times the amount of installed RAM on server systems. Linux can use either a swap file or a swap partition for the swap area. Whenever possible, use a separate swap partition. To increase performance, consider creating multiple swap partitions on multiple storage devices.</li> </ul> <p><b>/etc, /bin, /sbin, /lib, /dev, and /proc</b> must all be on the same partition (/). These directories have system configuration files that are necessary for Linux to function properly.</p>
<b>Identify software</b>	Determine which software packages need to be installed and install only those packages. This ensures that system resources are conserved and vulnerabilities are limited.
<b>Identify the users</b>	<p>Determine the users who will use the computer. Consider the following:</p> <ul style="list-style-type: none"> <li>• Ensure correct name spelling for the users.</li> <li>• Determine whether users log in locally or over the network.</li> <li>• Define a list of groups to which the users will belong.</li> </ul> <p>The root user is always installed. Use this account only when necessary to ensure security.</p>
<b>Gather network information</b>	<p>Gather the following types of network information:</p> <ul style="list-style-type: none"> <li>• Protocol (IPv4 or IPv6)</li> <li>• IP address</li> <li>• Default gateway</li> <li>• Subnet mask</li> <li>• Server information for DNS servers, mail servers, and other network servers</li> <li>• Network topology information, such as domain names</li> <li>• Naming conventions for servers and workstations</li> <li>• Domain names</li> </ul>
<b>Select an installation source</b>	<p>Installation sources include:</p> <ul style="list-style-type: none"> <li>• CD</li> <li>• DVD</li> <li>• ISO file</li> <li>• Network share</li> <li>• Online installation repository</li> </ul>

## 3.2 Linux Installation

Installation Method	Description
ISO image	<p>A Linux ISO installation image is a file containing an exact copy of a Linux optical (CD/DVD) installation disc. An ISO image can be mounted (made available to a computer) and used to install Linux. It can also be burned to an optical disc, from which the installation can be performed.</p> <p><b>ISOs and Virtual machines</b></p> <p>One common use of an ISO is to configure your virtual machine to connect directly to the ISO image. Once this step has been completed, the virtual machine thinks that the ISO image file is a real CD/DVD.</p>
Optical disc	<p>If the destination machine contains an optical disc (CD/DVD) reader, you can install Linux by booting from a disc containing the desired Linux distribution. In most cases, you will download the desired distribution from the internet in the form of an ISO image and then burn that image to an optical disc.</p>
USB drive	<p>Similar to the optical disc method, a Linux installation ISO can be transferred to a USB drive (flash or hard drive). The destination machine can then be booted from the USB drive, from which Linux can be installed.</p> <p>Configure a USB drive with the Linux distribution image from an existing Linux machine as follows:</p> <ol style="list-style-type: none"> <li>1. Connect the USB drive to your Linux system and then determine which Linux device file represents the USB drive (such as <code>/dev/sdb</code>).</li> <li>2. Switch to your root account (or use <code>sudo</code>) and run the following command:           <pre><b>dd if=filename.iso of=/dev/sdb or sudo dd if=filename.iso of=/dev/sdb</b></pre> <ul style="list-style-type: none"> <li>• <code>dd</code> is the convert and copy a file command. With this command, you are extracting and writing the ISO file to the USB drive.</li> <li>• In the above command, <code>if</code> stands for input file (the source file), while <code>of</code> stands for the output file (the destination). <code>Filename.iso</code> is the name and location of the ISO distribution file downloaded, while <code>/dev/sdb</code> is the Linux device file being used by the USB device.</li> <li>• This command was original named <code>cc</code>, but was renamed <code>dd</code> because <code>cc</code> was already in use for the C compiler.</li> </ul> </li> </ol>
Network installation	<p>With this method, the Linux distribution is placed on a network server, from which the installation can be performed. Multiple installations can be performed at the same time with network installation. Common protocols used to perform the installation include SMB, NFS, HTTP, and FTP. Make network preparations as follows:</p> <ol style="list-style-type: none"> <li>1. Copy the Linux installation files to a directory on your installation server. These files need to be available in a file system accessible to the desired clients.</li> <li>2. Share the installation directory.</li> <li>3. Select, install, and configure the installation protocol that will be used to access the files. For example, to use SMB, you must install and configure SAMBA.</li> </ol> <p>Not all distributions support a network installation. Before proceeding, verify that this is a viable option.</p> <ol style="list-style-type: none"> <li>1. Download a network installation image (usually an ISO CD/DVD image). This image is used to boot the destination computer, giving it the means by which it can access the source server previously prepared. This is not the Linux distribution installation software.</li> <li>2. Burn the image obtained in step 1 to the desired media (CD/DVD/USB). As an alternative, you can configure the destination and source machines to use PXE ( the Preboot eXecution Environment). Using PXE, the destination computer can download the software required to gain access to the server containing the Linux distribution installation software. Configuring PXE is beyond the scope of this lesson.</li> <li>3. Boot the destination machine from the network installation image (or PXE if being used).</li> <li>4. After completing step 3, at the first installation screen, specify the installation source and protocol (such as SMB, or HTTP, or FTP, or NFS) being used for the installation.</li> </ol>

### 3.2 Linux Installation

Step	Description
<b>Start the installation</b>	<p>In many cases, this step involves booting the computer from installation media (CD/DVD/USB/PXE). When using one of these media types, the BIOS may need to be configured to allow the computer to boot from the desired media before it tries to boot from the hard disk.</p> <p>Some Linux installers offer several installation options:</p> <ul style="list-style-type: none"> <li>• New install</li> <li>• Reinstall</li> <li>• Upgrade</li> <li>• Installation recovery</li> <li>• Reduced feature installation</li> </ul>
<b>Select a language</b>	<p>The selected language becomes the default language for all users. This can be changed later.</p>
<b>Keyboard layout</b>	<p>The keyboards used in different countries will often have different keyboard layouts. As a simple example, the @ key and the " key are swapped with the US and the UK keyboards. Some installations provide a method for automatically identifying the keyboard being used by prompting you to press specific keys.</p>
<b>Set the system time</b>	<p>The system time can be set to local time or Coordinated Universal Time (UTC) time.</p> <ul style="list-style-type: none"> <li>• For networks dispersed over multiple time zones, choosing UTC simplifies administration tasks.</li> <li>• Some distributions have options to synchronize the time over the network.</li> </ul>
<b>Format partitions</b>	<p>A partition is a logical division of a storage device associated with a hard disk drive. Create the partition structure according to the specifications in the installation plan. Determine the directory structure and file system type for each partition. This may require initializing a hard drive.</p> <p>Partitioning options include the following:</p> <ul style="list-style-type: none"> <li>• Use the entire disk (makes a single partition from the entire disk drive)</li> <li>• Use the entire disk and set up LVM</li> <li>• Manual (lets you manually create partitions according to the specific needs of the system or administrator)</li> <li>• Replace existing Linux systems (re-partitions all the previously installed Linux Operating systems)</li> <li>• Shrink partitions (reduces the size of an existing partition making room for additional partitions)</li> <li>• Use free space (creates a partition from unpartitioned space on the disk drive)</li> </ul> <p>Keep the following in mind when creating partitions:</p> <ul style="list-style-type: none"> <li>• Initializing a hard drive removes all existing data.</li> <li>• A swap partition is required for virtual memory. Swap partitions should be between one to two times larger than the computer's installed memory.</li> <li>• Linux computers can only have four partitions; however, a single extended partition can be subdivided into additional partitions.</li> <li>• To keep logs or abnormally large user files from taking all disk space and to make recovery of 'data easier should the operating system crash, create separate partitions for the following directories:             <ul style="list-style-type: none"> <li>◦ /home (user directories)</li> <li>◦ /opt (installed software)</li> <li>◦ /var (log files)</li> </ul> </li> </ul> <p>The operating system can be reinstalled on the root partition (/), and the others can then be remounted with no loss to data.</p>

**Select applications and services**

Installing applications and services depends on the role of the system. Applications and services include the following:

- The boot loader determines which operating system boots by default (if more than one operating system exists on a computer).
- Package patterns include packages necessary for a specific computer role (such as graphical desktop or web server).
- Package repositories are locations on the internet, where software packages are maintained. Specific Linux utilities search and install software automatically from these package repositories.

**Set the root password**

- At least eight characters long (longer passwords are harder to crack)
- Use a combination of letters, numbers, and symbols
- Should not include a username or a dictionary word (or common variations)

**Specify a host name**

The name of the computer identifies the computer on a network. A domain may be required.

**Configure network connections**

Configure the network connections. This can include such things as the interface card, proxy servers, and how the network will obtain its IP address (manually vs. DHCP).

**Configure services**

Some services must be configured based on the role of the system (for example, a web server).

**Add new users and groups**

Create user accounts and groups for the users who will use the computer.

- Installations usually require at least one standard user account. A system user or the root user is often created automatically.
- Network login options enable the system to access a server for login information rather than maintaining local authentication information.

**Configure the hardware settings**

Hardware configuration settings might require appropriate drivers or language settings.

**Identify remote access needs**

Depending on your job role, you may need to manage Linux systems that don't have external peripherals connected, including monitors, keyboards, or mice. This is a common configuration for both Linux servers and virtualized Linux systems that run on a hypervisor. To manage these types of systems, you must access them remotely from another device. There are several options available to accomplish this:

- If the system has a management interface integrated within its hardware, you can use it to access the system display from a web browser and perform management tasks. This type of hardware is typically found only on high-end server systems.
- If the system does not have an integrated management interface, you can use two network protocols to remotely access it.
  - Use SSH to securely access the shell prompt of the system and run commands as if you were sitting in front of the system. You can also tunnel X server traffic through the SSH connection, which allows you to securely access the graphical desktop of the system.
  - You can use Virtual Network Computing (VNC) to remotely access the graphical desktop of the system.

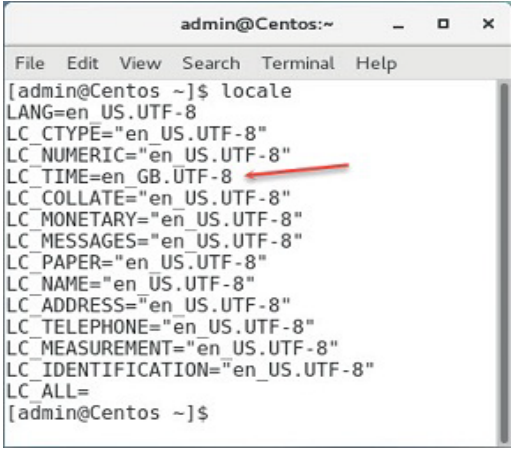
## 3.3 Localization

Variable name	Explanation
<b>LANG</b>	Defines all locale settings at once while allowing further individual customization via the LC_* settings. When this variable is set to LANG=C, programs will display their output without passing it through locale translations. This is helpful when the output is being corrupted by the locale and helps avoid some types of problems.
<b>LC_CTYPE</b>	Defines the character handling properties for the computer. This determines whether characters are recognized as alphabetical, numeric, etc. This also determines the character set used (if applicable).
<b>LC_MESSAGES</b>	Specifies localizations for applications that use a message-based localization scheme.
<b>LC_COLLATE</b>	Defines the alphabetical ordering of strings (for example, the output of sorted directory listings).
<b>LC_NUMERIC</b>	Controls formatting for numeric values that are not monetary (for example, which character to use as the thousands separator and the decimal separator).
<b>LC_MONETARY</b>	Identifies currency units and formatting of currency type and numeric values.
<b>LC_TIME</b>	Defines formatting for dates and times, such as whether to use a 24-hour clock versus a 12-hour clock.
<b>LC_PAPER</b>	Designates the default paper size (for example, US letter versus A4).
<b>LC_NAME</b>	Denotes personal name format (for example, whether the surname comes first or last).
<b>LC_ADDRESS</b>	Specifies address formatting.
<b>LC_TELEPHONE</b>	Defines telephone number format.
<b>LC_MEASUREMENT</b>	Determines which measurement units are used.
<b>LANGUAGE</b>	Overrides the LC_MESSAGES settings.
<b>LC_ALL</b>	Sets all locales to the same setting. This is used for overriding all other settings.

Precedence Rules	
<ol style="list-style-type: none"> <li>1. If the <b>LC_ALL</b> variable is <b>defined</b> (non-null), its value is used, and the values assigned to all other LC_ variables are not checked.</li> <li>2. If the <b>LC_ALL</b> variable is <b>undefined</b> (null), the specific LC_ variable in question is checked. If the specific <b>LC_ variable has a value</b>, it is used.</li> <li>3. If the <b>LC variable</b> in question has a <b>null value</b>, the <b>LANG</b> environment variable is used.</li> </ol>	

## 3.3 Localization

Command	Description
<b>echo</b>	<p>From a shell prompt (terminal), the echo command can be used to view the current locale settings, if one has been set. This is accomplished by typing <b>echo</b> followed by a dollar sign (\$) and then the name of the environment variable that you want to view.</p> <p>Example: <b>echo \$LC_CTYPE</b></p>
<b>locale</b>	<p>From a shell prompt (terminal), this command displays the current locale settings for the computer.</p> <p>If the option shown has quotes, it is obtaining the setting by inheritance. Settings without quotes are explicitly assigned.</p>  <p>Addition options include the following:</p> <ul style="list-style-type: none"> <li>• <b>charmap</b> displays the available charmap (character set description files) used for character encoding.</li> <li>-a displays a list of the installed locales which are available for use.</li> <li>-m displays a list of the installed character encoding options which are available for use.</li> </ul> <p>The locale command is located in /usr/bin.</p>
<b>iconv</b>	<p>The iconv program reads input text using one type of encoding and outputs the text using another encoding type. If no input file is provided, or if it is given as a dash (-), iconv reads from the standard input. If no output file is given, iconv writes to the standard output.</p> <p>Converts encoding from one encoding type to another.</p> <ul style="list-style-type: none"> <li>-f specifies the old encoding type.</li> <li>-t specifies the new encoding type.</li> <li>-o specifies the input and output file.</li> </ul> <p>As an example, the following command will convert text from the ISO 8859-15 character encoding to UTF-8 encoding, where input.txt is the name of the input file:</p> <p><b>iconv -f ISO-8859-15 -t UTF-8 input.txt output.txt</b></p>

3.3 Localization

Keyboard Settings/Mapping	
<b>status</b>	Displays the current setting of the system locale and keyboard mapping.
<b>list-keymaps</b>	<p>Lists the available keyboard mappings that can be configured on your system.</p> <p>Use the <b>grep</b> command to limit the keyboard mappings shown.</p> <p>Example: <b>localectl list-keymaps   grep us</b></p> <p>The results may include the following:</p> <ul style="list-style-type: none"><li>• <b>si-us</b></li><li>• <b>sunt5-us-cz</b></li><li>• <b>us</b></li><li>• <b>us-euro</b></li></ul>
<b>set-keymap map</b>	<p>Sets the default keyboard layout to be used. Replace map with the desired option as found when using the list-keymaps option.</p> <p>Example: <b>localectl set-keymaps us-euro</b></p> <p><b>--no-convert</b> prevents the console from being converted to X11, or X11 to the console.</p> <p>Example: <b>localectl set-keymaps us-euro --no-convert</b></p> <ul style="list-style-type: none"><li>• Different keymaps can be applied to using the --no-convert command.</li></ul> <p>Example: <b>localectl --no-convert set-x11-keymap fe</b></p> <p>In this example, the console remains as is while the X11 changes to French.</p>