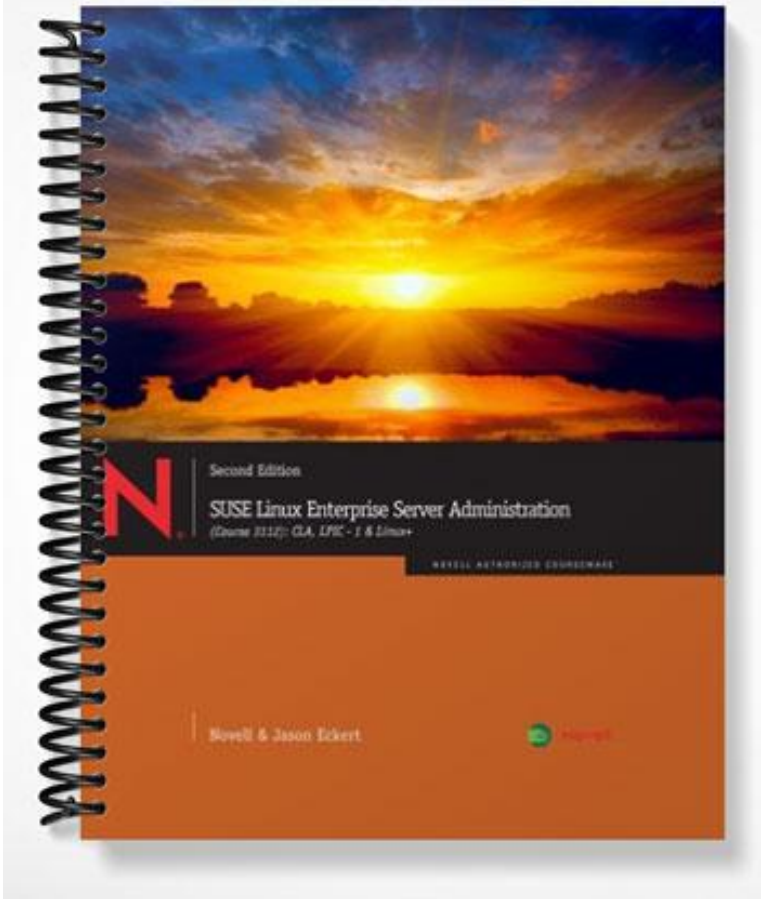
SOLUTIONS MANUAL



Section 2

Install SUSE Linux Enterprise Server 11

At a Glance

Instructor's Manual Table of Contents

Lecture Notes

Overview

This section covers partitions, Logical Volume Manager (LVM), Redundant Array of Independent Disks (RAID), and file systems. Students need these to plan and perform a successful installation of SUSE Linux Enterprise Server 11 (SLES 11). Once SLES 11 is installed, students can explore the file system layout, which is standardized in the Linux File System Hierarchy Standard.

Objectives

- Understand Partitions, LVM, RAID, and File Systems
- Perform a SLES 11 Installation
- Understand the File System Hierarchy Standard (FHS)

Teaching Tips

Understand Partitions, LVM, RAID, and file Systems

1. Begin the discussion by explaining that before installing an operating system, one has to decide how to use available hard disk space.

2. Point out that the division of the available space should take into consideration the applications that will be installed.

Understand Partitions in a Linux System

1. Introduce the term partition and explain the advantages of partitioning the hard disk.

2. Outline the available partition types, specifying the advantages and disadvantages of each.
    a. Primary partition: contiguous range of cylinders. Limited to four primary partitions on x86 systems
    b. Extended partition: contiguous range of cylinders. Can be subdivided into logical partitions. Container of logical partitions and circumvents the limitation imposed by the maximum of four primary partitions on x86 systems.
    c. Logical partition: exists within an extended partition. In SLES11 limited to 11 logical partitions

3. Explain that an extended partition can replace the fourth primary partition, thus allowing for more than four partitions on a single hard disk.

4. Point out that the type of partitions used for a Linux system doesn't matter, and that primary and logical partitions work equally well.

Teaching Tip	Read more about partitions in general, and specifically about types of partitions, at: http://tldp.org/HOWTO/Partition/.

Design Guidelines for Implementing Partitions

1. Explain to students that YaST normally proposes a partitioning scheme consisting of two partitions, one swap partition, and partition using the rest of the disk space to hold the / directory.

2. Point out that if there is an existing partition on the hard drive, YaST attempts to maintain that partition.

3. Outline to students the recommendations for implementing partition schemes other than what is suggested by YaST.

4. Explain that if the hard disk has less than 4GB available space, it is recommended to use one partition as a swap partition and one for the root partition.

5. Explain that if the hard disk has more than 4GB, it is recommended to at least create a swap partition and a root partition, using 4GB of space. Point out that separate partitions can be created for different directories in the server's file system, such as /boot/, /opt/, /usr/, /var/, /srv/, /home/, and /tmp/, and explain why these directories would be good candidates for having separate partitions.

6. Explain that if the partitioning is performed by YaST, and other partitions not defined by YaST exist on the system, they are entered in the `/etc/fstab` file to enable easy access to the data. Point out that these partitions are defined by YaST with `noauto` and `user` options to allow the user to mount or unmount these partitions as needed.

Naming Conventions for Partitions

1. Use Table 2-1 to discuss the names of Linux devices used for hard drives.

2. Explain that partition names follow the naming conventions of the hard drive, followed by a partition number. Use Table 2-2 to demonstrate this.

Understand Logical Volume Manager and Software RAID

1. Explain the function of the Logical Volume Manager (LVM) in providing a high level view of the disk storage on a computer system and in providing flexibility in allocating storage space for applications and users.

2. Point out that after creating logical volumes with LVM, you can resize and move logical volumes while they are mounted and running.

3. Demonstrate how LVM can be used to manage logical volumes with names that make sense instead of the default system names.

4. Explain that RAID is used together with the Linux Kernel to combine hard disks into arrays.

5. Point out that LVM and software RAID can be managed with YaST or from the command line.

Volume Manager Components

1. Explain that conventional partitioning of hard disks is basically inflexible, and changes to the partitioning often require many actions that typically affect neighboring partitions as well.

2. Explain that LVM provides a virtual pool of memory space from which logical volumes can be generated when necessary. Point out that the operating system accesses these logical volumes like conventional partitions.

3. Point out that LVM allows you to resize the physical media during operation without affecting the applications.

4. Use Figure 2-1 and the accompanying text on Page 157 to discuss the basic structure and components of LVM. Be sure to clearly define a physical volume, a volume group, and a logical volume.

Logical Volume Manager Features

1. Point out that LVM is very flexible when you need to adapt to changed storage space requirements, and can be installed on any computer.

2. Use the bullet points on Pages 157-158 to discuss the features of LVM that help users implement storage solutions.

Software RAID

1. Explain the purpose of RAID in enabling users to combine several hard disk partitions into one large virtual hard disk for optimizing performance and improving data security.

2. Discuss the differences between hardware RAID and software RAID, particularly with respect to the function of the operating system. Point out that though this was not true in the past, currently software RAID provides comparable performance and data security as hardware RAID.

3. Explain that the RAID level is determined by the method with which the hard disks are combined, and by their number.

4. Use the bullet points on Pages 158-159 to discuss the unique features of RAID levels 0, 1, 5, and 6, and when each of these RAID levels would be used.

5. Point out that using YaST you can set up RAID levels 0, 1, and 5.

Select a Linux File System

1. Explain that a file system must be created on a partition before it or a logical volume residing on it can be used.

2. Point out that each file system has particular strengths and weaknesses which must be taken into account when selecting the file system to be used for a given application.

Linux File Systems

1. Explain that the type of file system used depends on several factors, including speed and journaling, and list the file systems available on Linux.

2. Point out that the /proc/filesystems contains a list of the file system formats that the kernel currently supports.

3. Explain that traditional file systems do not journal data or metadata, and overview the available traditional file systems and their features, using the bullet points on Page 160 of the text as a guide.

4. Explain that a journaling file system logs changes to a journal before actually writing them to the main file system. Point out that the journal may include just metadata or also the data itself. Review the journaling file systems available for Linux and their features using the bullet points on Pages 160-161 of the text as a guide.

5. Explain that Linux can transparently include remote file systems in its file system tree, and that from the user's point of view, there is no difference between remote file systems and local ones. Provide an overview the remote file systems supported by Linux and their features, using the bullet points on Page 161 of the text as a guide.

Virtual File System Switch

1. Explain that for a user or a program, the file system format used does not matter, and the same interface to the data is always used.

2. Explain that VFS is an abstraction level in the kernel providing defined interfaces for processes, and includes functions such as opening a file, writing to a file, and reading from a file.

3. Use Figure 2-2 to discuss how the VFS switch is used to forward program requests to drivers for the file system format.

4. Point out that the VFS displays file characteristics to the user as they are known from UNIX file system formats.

Linux File System Internals

1. Explain that in Linux file systems, the data and administration information are kept separate.

2. Point out that each file is described by an inode, which has a size of 128 bytes and contains all the information about a file other than the filename.

3. Explain that the data organization takes place differently in different file system formats.

4. Explain that the ext2 file system the format is similar to the traditional UNIX file systems, in that it maintains the concepts of inodes, blocks, and directories.

5. Point out that when an ext2 file system is created, the maximum number of files that can be created is specified by the inode density, since an inode must exist for every file and directory, and that it is not possible to generate additional inodes at a later stage.

6. Explain that in order to optimize the capacity of a partition, on average, each file should be of size 4KB. Point out that for applications that create a large number of small files, the inode density should be increased, even though this would increase the time needed for a file system check.

7. Introduce the concept of blocks, and explain that these are created when the file system is created and have a fixed size which is set at file system creation and cannot be changed later. Point out that the block size determines how much space is reserved for a file.

8. Use Figure 2-3 to explain how data is stored in classic file system formats including ext2.

9. Use the bullet points on Page 164 of the text as a guide for discussing the components of a block group, including the superblock, group descriptor, block bitmap, inode bitmap, inode table, and data blocks.

10. Discuss the length and size limitations for filenames, paths, files, and file systems, under ext2.

11. Explain that in the ext2 file system, space waste often occurs due to using a small fraction of a block for a file, thus rendering the block used and unavailable for use by other files.

12. Introduce the ReiserFS format and explain that it allows multiple small files or file ends to reside in a single block.

13. Discuss the advantages of the ReiserFS format over the ext2 format, such as the fact that inodes are only generated when they are actually needed and faster access to files, which is possible through the use of balanced binary trees in the organization of data blocks.

14. Point out that the ReiserFS format has the same limitations on file names as the ext2 format.

15. Discuss the structure of a directory, explaining that it is like a catalog which stores information on other files including each file's inode number and its name.

16. Point out that directories serve as a table in which inode numbers are assigned line by line to filenames. Explain how one can view the inode number assigned to a filename. Be sure to clarify that inode numbers are only unique within the partition, and therefore the same inode number may exist in two different partitions.

17. Explain the concept of links, which are special types of files that point to another file.

18. Define a hard link, which is another entry in a directory that points to the inode of a file that already has a filename. Clarify that both entries point to the same inode and are indistinguishable from one another, and that hard links can only be used when the file and the link are in the same partition.

19. Define a symbolic link, which is a file of its own that points to another file in the file system. Clarify that the symbolic link has its own inode, and could point to a non-existent file if the file it pointed to has been deleted.

20. Explain how the `ln` command is used to create a hard link and a symbolic link.

21. Explain that file system are basically databases that store files and use file information such as the filename and metadata to organize and locate the files on a disk.

22. Explain that the data and metadata are changed when you modify a file in two separate actions. Point out that a corruption may occur when only one of the elements has been changed, resulting in a difference between the data and the metadata which requires a system check.

23. Explain that in a journal based system, the journal keeps a record of all current transaction and updates the journal when a transaction is complete, such that checking the file system consists only of checking the journal to find what transaction was not completed.

Quick Quiz 1

1. A(n) ____ file system logs changes to a file before actually writing them to the main file system.
   Answer: journaling

2. (True or False) Two directories in the same partition can have the same inode number.
   Answer: False

3. (True or False) minix is a journaling file system.
   Answer: False

4. (True or False) NFS is designed for sharing files and directories over a network and requires the configuration of an NFS server and NFS clients.
   Answer: True

Perform a SLES 11 Installation

1. Outline the various tasks required as part of the SLES 11 installation process.

Boot from the Installation Media

1. Explain how to start the installation by inserting the installation DVD and rebooting the computer to start the installation program.

2. Describe to students the options that can be selected in the screen shown in Figure 2-4, and explain when each of these options would be used.

3. Explain how the function keys at the bottom of the screen can be used to change the installation settings, and outline each of the settings listed in the bullet points on Page 171 of the text.

4. Point out that after the installation option is selected, a minimal Linux system loads and runs YaST.

Select the System Language

1. Use Figure 2-5 to discuss the structure of most YaST installation dialogs, and explain how these can be navigated if the installation program does not detect the user's mouse.

2. Outline the steps for selecting the language and keyboard layout from the language dialog.

Check the Installation Media

1. Explain that it is possible, and recommended, to check whether the installation media is valid and demonstrate how this is done.

2. Point out that if the installation fails you should stop the installation as it is likely to be problematic. If this is the case, the installation should be restarted from another copy of the installation media.

Select the Installation Media

1. Demonstrate how to select the installation mode in the installation mode screen, using Figure 2-7. Be sure to explain each of the available installation modes, and explain when each mode should be selected.

Set the Clock and Time Zone

1. Demonstrate how to configure the clock and time zone in the appropriate screen, shown in Figure 2-8.

2. Explain how a UTC hardware clock affects the setting of the time and time zone, and point out that YaST selects the time zone based on the selected language, unless specified otherwise.

Specify the Server Base Scenario

1. Demonstrate the steps for specifying the server's base scenario, making sure to explain what the available scenarios are and when each of these is used.

Configure Installation Settings

1. Demonstrate the steps for configuring the installation settings for the SLES 11 server.

2. Explain that YaST analyses the system and creates an installation proposal, where the proposed settings are displayed in two tabs.

3. Outline the options that can be used to change the settings proposed by YaST using the bullet points on Pages 177-178 as a guide.

Verify Partitioning

1. Explain that in most cases, the partitioning scheme proposed by YaST is suitable, but overview when one should manually change the partitioning scheme, using the bullet points on Page 179 as a guide.

The Basic Linux Partitioning Scheme

1. Explain that the optimal partitioning scheme for a server depends on the purpose of the server.

2. Review the basic partitions required in a SLES 11 installation, specifically a swap partition and a root partition. Point out that any partitioning scheme must include at least one swap partition and at least one root partition.

Changing the Default Partitioning Proposal

1. Explain to students that they can change the default partitioning scheme to create partitions for various directories, and that doing so adds a degree of stability to the system.

2. Outline the steps required to change the default partition scheme using the Expert Partitioner.

3. Use the bullet points on Pages 183-184 as a guide to discussing the information provided for each partition on the hard disk.

4. Discuss the steps for creating a new primary partition on the disk and configuring it to be suitable to your needs. Be sure to clarify that the options displayed by the system when creating a new partition depend on the partitions already existing on the drive, and that the user can select the size and formatting of the partition.

5. Describe the steps for creating a new extended partition on the disk and configuring it to be suitable to your needs.

6. Outline the steps for editing an existing partition. Be sure to point out that extended partitions cannot be edited.

7. Review the steps for deleting an existing partition.

8. Describe the steps for resizing an existing partition. Be sure to stress that it is important to back up the data on a partition before resizing it.

Select Software

1. Explain that SLES11 includes a variety of software packages that can be included in the installation, and that provide various applications and services.

2. Point out that YaST allows you to select categories, or patterns, of software based on its function, such that all packages needed for your purpose would be installed automatically.

3. Describe the steps for viewing and selecting the software patterns that are preselected by YaST and how you can find out which packages are contained in a pattern.

4. Introduce the concept of package dependency, and explain that YaST automatically adds additional dependent software packages to the installation proposal.

5. Go over the steps for installing software packages. Be sure to explain each of the options listed in the bullet points on Page 194 of the text.

Start the Installation Process

1. Review the steps for installing the customized installation proposal.

2. Explain that YaST changes the hard disk partitioning before installing software packages.

3. Point out that after installation of all the packages, YaST reboots the computer and prompts you for information to further customize the installation.

Set the root Password

1. Explain that root is the name of the Linux system administrator, and has unlimited access to do anything, and should be used only for system administration, maintenance, and repairs.

2. Overview the steps for setting the root password during installation.

3. Point out that the selected password should be one that cannot be guessed easily.

Set the Hostname

1. Explain the purpose of setting the hostname for the server, and outline the steps for doing so.

Configure the Network

1. Review the steps for configuring the network using the YaST Network Configuration screen shown in Figure 2-28. Point out that the network can be configured using a network configuration proposal similar to the installation proposal provided by YaST.

2. Explain what is included in a network configuration proposal, using the bullet points on Pages 197-198 as a guide.

3. Explain how you can change the network configuration proposed by YaST.

4. Explain why and how the configuration should be changed when a server system is being configured.

Add a Network Card Manually

1. Outline the steps for manually configuring a network card that was not automatically detected.

Edit an Existing Configuration

1. Go over the steps for editing the configuration for an existing network interface.

Delete an Existing Configuration

1. Describe the steps for deleting an existing network configuration.

2. Point out that the network device configuration should be saved when finished adding, editing, or deleting network card configurations.

Test the Internet Connection

1. Overview the steps for testing the connection to the Internet.

Configure Novell Customer Center Configuration and Online Update

1. Introduce the Novell Customer Center, and explain that it is required to perform online updates which can be downloaded and installed to deal with bugs and security issues.

2. Overview the steps for registering at the Novell Web site, and for using the Online Update dialog box.

Configure Network Services

1. Overview the steps for configuring the certificate authority and openLDAP server. Be sure to explain the available options for each of these configuration steps.

Manage Users

1. Overview the steps for configuring the user authentication method, making sure to explain each of the possible authentication methods listed in the bullet points in Pages 209-210 of the text.

Add Local Users

1. Explain that if the Local authentication method in selected, at least one regular user account must be created on the system.

2. Overview the information that needs to be provided to create a new user account, using the bullet points on Page 211 as a guide.

Configure the System as an LDAP Client

1. Explain that if the LDAP authentication method is selected, you need to configure the LDAP client.

2. Overview the options that can be configured when configuring the LDAP client, using the bullet points on Pages 212-213 as a guide.

3. Overview the steps for creating a new LDAP user.

Configure Hardware

1. Explain that YaST displays a hardware configuration proposal for the server.

2. Overview the steps for manually changing the automatically generated configuration.

3. Point out that the hardware configuration can be skipped, and hardware can be configured at a later stage, though the settings of the graphics card should be correct to avoid problems during the first system start.

Finalize the Installation Process

1. Point out that the installation is now complete, and the finish button should be clicked to complete the install.

2. Explain the purpose of the *Clone This System for Autoyast* option, and how it can be useful.

Quick Quiz 2

1. (True or False) A system with a Local authentication method must include a root user and at least one regular user.
   Answer: True

2. (True or False) The partition edit screen can be used to change all aspects of a partition other than its size.
   Answer: True

3. The ____ file system is a version of the Ext2 file system which offers journaling.
   Answer: Ext3

4. The ____ directory is the top directory in the Linux file system hierarchy.
   Answer: root

Understand the File System Hierarchy Standard (FHS)

1. Explain how the file system concept of Linux and all UNIX systems is different from that of other operating systems, using the bullet points on Page 118 as a guide.

The Hierarchical Structure of the File System

1. Explain that the Linux file system can be shown in the form of a tree beginning in a root directory, which is not limited to a local partition and can stretch over several partitions which can be located on different computers in the network.

2. Point out that each file in the directory tree is uniquely defined by its path.

3. Explain the difference between an absolute path and a relative path. Be sure to point out that the length of the path cannot exceed 4096 characters including slashes.

File System Hierarchy Standard

1. The structure of the file system is described in the file system hierarchy standard, which specifies which directories must be located on the first level after the root directory and what they should contain.

2. Point out that the FHS leaves some areas for your own definitions.

3. Use Figure 2-48 to describe the structure of directories defined by the FHS.

Root Directory (/)

1. Explain that the root directory refers to the highest layer of the file system tree, and typically only includes directories, not files. Point out that when the system is booted the partition in which the root directory is located is the first one to be mounted.

2. List the directories that have to be on the same partition as the root directory.

Teaching Tip	Be sure to clarify to students the difference between the root directory and the root user, as the two terms can easily be confused.

Essential Binaries for Use by All Users (`/bin/`)

1. Explain that the `/bin/` directory contains important executable programs that are required when no other file systems are mounted, including the various shells, most important commands for working with files, and commands for system analysis and configuration.

Boot Directory (`/boot/`)

1. Explain that the `/boot/` directory contains system files, and list the specific files it contains using the bullet points on Page 221 as a guide.

Other partitions (`/data/`)

1. Point out that when YaST finds other partitions or another hard disk during installation it creates a mount point for each partition labeled `/datax/`

Device Files (`/dev/`)

1. Explain that each hardware component in the system is represented as a file in the `/dev/` directory.

2. Explain the difference between character-oriented device files and block-oriented device files, and when each type of device file is used.

3. Explain the difference between major device numbers and minor device numbers, and specify what each of these numbers is used for.

4. Discuss how one can generate special device files if they are required for specific devices.

5. Point out that the null device `/dev/null` is located in this directory, and explain the purpose of the null device.

Configuration Files (/etc/)

1. Point out that configuration files are contained in the /etc/ directory and its subdirectories, and that this directory cannot include any executable programs, though subdirectories can include shell scripts.

2. Stress that most of the files are ASCII files, and that they can be read by normal users but can only be edited by root

User Directories (/home/)

1. Explain that every user has a home directory in which to work with files, and to which the user is directed when he logs in.

2. Point out that the home directory includes individual configuration files, though these are hidden files whose names begin with a dot.

3. Explain that if there are no special settings, the home directories of all users are located beneath the `/home/` directory, and can be accessed via the shortcut ~.

Libraries (/lib/)

1. Explain that shared libraries include specific functions that can be used by many programs, and that are removed from the actual program and called up when the program runs.

2. Point out that the `/lib/` directory contains libraries that are use by programs in the `/bin/` and `/sbin/` directories, and that kernel modules are located in the `/lib/modules/` directory.

Mount Point for Removable Media (/media/)*

1. Explain that the `mount` command is used to attach a device's file system to the Linux tree file system rooted at /.

2. Point out that the /media/ directory includes directories for mounting removable media when such media is detected. Use the bullet points on Page 225 to describe the different mounting directories which are created.

Application Directory (/opt/)

1. Explain that installed programs can store their static files in the `/opt/` directory, within a subdirectory bearing the name of the application or vendor.

Administrator's Home Directory (/root/)

1. Point out that the home directory for the root user is not located beneath /home/ as the home directories for regular users.

2. Explain that the home directory for root should preferably be on the same partition as the root directory (/).

System Binaries (/sbin/)

1. Explain that the `/sbin/` directory contains important programs for system administration, which can be run by normal users only to display configured values. Point out that changes to the configuration of programs in this directory can only be made by the root user.

2. Use Table 2-9 to describe the important executables in the `/sbin/` directory.

Data Directories for Services (/srv/)

1. Explain that the /srv/ directory contains subdirectories designed for containing data of various service provided by the system.

Temporary Area (/tmp/)

1. Point out that temporary files generated by various programs are stored in this area until they are deleted.

The Hierarchy Below /usr/

1. Explain that according to the FHS, the `/usr/` directory represents a second hierarchical layer, and is the location for all application programs, GUI files, additional libraries, locally installed programs, and commonly shared directories.

2. Use Table 2-10 to describe the subdirectories of the `/usr/` directory.

Variable Files (/var/)

1. Explain that this directory and its subdirectories contain files that can be modified while the system is running.

2. Use Table 2-11 to describe the subdirectories of the `/var/` directory.

Windows Partitions (/windows/)

1. Point out to students that if YaST finds a partition with a Microsoft file system, it creates a /windows/ directory automatically, and places in it subdirectories labeled with Windows drive characters.

Process Files (/proc/)

1. Explain that the /proc/ directory is used to handle process information that is made available to users.

2. Point out that this directory does not contain any real files and therefore does not take up any disk space.

3. Explain that /proc/ is generated dynamically when it is access, and that each process has its own directory, with the values in the directory being read as if they were in a file. Point out that changes to this virtual file system only have an effect while the system is running.

4. Demonstrate how the status of a process can be viewed using the cat command, and what information is obtained this way.

5. Point out that /proc/ also includes directories and files containing information about the state of the system, and use Table 2-12 to discuss the most important such files and directories.

System Information Directory (/sys/)

1. Explain that this directory provides information about various hardware devices in the form of a tree. Point out that it does not contain any real files and does not occupy any disk space.

Mount Point for Temporarily Mounted File Systems (/mnt/)

1. Explain that in Linux, you have to mount a file system before you can access it.

2. Point out that a file system can be mounted anywhere, but the standard location for mounting it is the /mnt/ directory, which should only be used for temporary mounting.

3. Demonstrate how the mount command can be used to mount a file system to the /mnt/ directory, and how the file system is unmounted using the umount command. Be sure to discuss the various options that can be used with the mount and umount commands.

Directories for Mounting Other File Systems

1. Explain that other file systems can be mounted to the file system at any point, but must be mounted to an existing directory which will be the mount point.

2. Point out that in most cases only the root user can mount and unmount directories, other than removable media that can be mounted by any user.

3. Demonstrate how a file system would be mounted and unmounted.

4. Explain what happens when you mount a file system in a directory that contains files and subdirectories, making sure to point out that once the file system is unmounted the original contents of the directory are once again accessible.

5. Use Table 2-13 to discuss directories that can be shared between many computers, and Table 2-14 to discuss directories that cannot be imported from other computers and must always be present locally on each machine.

Quick Quiz 3

1. System executables are located in the ____ directory.
   Answer: `/sbin/`

2. (True or False) The root directory (/) typically includes only directories, and not files.
   Answer: True

3. The ____ symbol is used as a shortcut to a user's home directory.
   Answer: ~

4. (True or False) If a file system is mounted to a directory that contains files, those files are deleted forever.
   Answer: False

Class Discussion Topics

1. Have students discuss the differences between the installation of SUSE Linux and other operating system installations they have performed in the past. Are there advantages to the SUSE Linux installation process?

2. Discuss the importance of selecting an appropriate partition scheme. What problems could arise if an inappropriate partition scheme is selected during installation?

Additional Projects

1. Use the Internet to research the appropriate partitioning scheme for a specific situation of your choice. Do your research results correspond to what you would have thought was appropriate without carrying out the research?

2. Research the idea of FHS. Does it exist in other operating systems? Why is it so important for the functionality of Linux?

Additional Resources

1. SUSE Linux: http://en.opensuse.org/Main_Page

2. SUSE Linux installation: http://suseroot.com/install.php

3. Filesystem Hierarchy Standard: http://www.pathname.com/fhs/

Key Terms

- **AutoYaST file** – An XML file that contains SUSE Linux installation settings that can be imported into future SUSE Linux installations.
- **block-oriented device file** – A device file that describes devices that transfer information block-by-block to a formatted file system.
- **certification authority (CA)** – A software service that digitally signs encryption keys for other entities to prove their authenticity.
- **character-oriented device file** – A device file that describes devices that transfer information in a character-by-character format.
- **extended partition** – A section of the physical hard disk that serves to contain logical partitions.
- **File System Hierarchy Standard (FHS)** – The widely adopted standard that details the names and function of files and directories on a Linux or UNIX system.
- **file system journaling** – The process whereby disk operations are first written to a journal file before they are performed. Following a power outage, the system does not need to check the entire file system for errors, as it can simply consult the journal file.
- **hardware RAID** – A form of RAID in which the read and write operations are performed by a specific hardware-based disk controller.
- **journaling file system** – A file system that logs disk operations to a journal file prior to performing them. Common journaling file systems include ext3, ReiserFS, XFS, and NTFS.
- **logical partition** – A section of an extended partition that can be formatted with a file system and mounted by the operating system.
- **logical volume** – A section of an LVM volume group that can contain a file system and be mounted by the operating system for use.
- **Logical Volume Manager (LVM)** – A set of software components that can be used to create and manage logical volumes across several hard disks on a Linux system.
- **major number** – The number stored within a device file that indicates the associated device driver in the Linux kernel.
- **minor number** – The number stored within a device file that indicates the instance of the physical hardware device.
- **mirroring** – A type of RAID in which a single copy of data is written to two hard disks simultaneously to allow for redundancy in the event that a single hard drive fails. It is also called RAID level 1.
- **`mknod` command** – Used to create device files.
- **`mount` command** – Used to mount a file system on a device to a directory in the Linux file system hierarchy.
- **network file system** – A file system that allows remote access to files from computers across a network. Common network file systems include NFS and CIFS/SMBFS.

- **partition** – A section of a physical hard disk that can be formatted with a file system and mounted by the operating system.
- **physical volume** – A partition or hard disk that is used by the LVM.
- **primary partition** – The default partition type used to subdivide a hard disk. They can be formatted with a file system and mounted by the operating system.
- **Red Hat Package Manager (RPM)** – The default package management system used by SUSE Linux.
- **Redundant Array of Independent Disks (RAID)** – A technology that writes data to multiple hard disks from a single volume. It is sometimes referred to as Redundant Array of Inexpensive Disks.
- **redundant striping** – A type of RAID in which data is written across several disks alongside parity information that can be used to regenerate data if a hard disk fails. It is implemented by RAID level 5 and 6.
- **root partition** – A partition that is mounted to the root (/) of the file system hierarchy on a Linux system. It is one of the two partitions that need to be specified during the Linux installation process.
- **software RAID** – A form of RAID in which the read and write operations are performed by an operating system component.
- **striping** – A type of RAID in which data is written across several disks. It is a form of RAID level 0.
- **swap partition** – A partition that can be used to store virtual memory by the Linux operating system. It is one of the two partitions that need to be specified during the Linux installation process.
- **traditional file system** – A file system that does not support journaling. Common traditional file systems include ext2, MS-DOS/VFAT, minix, and ISO9660.
- **`umount` command** – Used to dismount a file system on a device from a directory in the Linux file system hierarchy.
- **Virtual File System Switch (VFS)** – A Linux kernel component that allows multiple file systems to be used on the same computer.
- **volume group** – A group of physical volumes used by the LVM.