8.6.1 File System Mounting Facts

Hard disk partitions, optical drives, USB drives, and other similar devices in a Linux system must be mounted before they can be used.

This lesson covers the following topics:

- Mounting process
- Manage and monitor mountings
- Manage file system mountings
- Troubleshoot storage issues

Mounting Process

Mounting is the process of making a storage device accessible to users through the directory tree. The file system directory that's used to access the files on the device is called the *mount point* .

- Partitions and LVM logical volumes are represented by device files located in the **/dev** directory. However, these storage devices must be mounted before the data on them can be accessed.
- A storage device can be mounted on a directory in the file system. When accessing the directory in the file system, you're actually accessing the device that's mounted in that directory.
- You should mount storage devices in empty directories. Mounting a volume to a directory that contains data makes the data inaccessible.
- The **/mnt** and **/media** directories (depending on the system configuration) are directories that contain mount points specifically for external storage devices (e.g., CD-ROM drives, floppy drives, and magnetic tape drives).
- If LUKS (Linux Unified Key Setup) is used to encrypt a device, the passphrase for the key used for encryption must be entered when mounted. Although you can can automate this process, it is not recommended for laptops.

Manage and Monitor Mountings

The following files manage and monitor the file system mounting:

File	Description
/etc/fstab	The /etc/fstab file identifies devices to mount each time the system boots. When the system boots, it automatically mounts the volumes identified in the file. The file contains entries with six fields that control how a device is mounted. The following is a typical fstab entry: `/dev/sda3 /mnt/disk1 ext3 auto,ro,nosuid,users 0 1` An entry consists of the following variables, which are described below:

File	Description

	`[ device_to_mount ] [ mount_point ] [ file_system_type ] [ options ] [ dump ] [ fsck ]`
	
	• *Device_to_mount* is the path to the device file or the label that describes the storage device to be mounted.
	• *Mount_point* specifies where to mount the device. This is the directory where the data on the device can be accessed.
	• *File_system_type* specifies the type of file system that has been created on the storage device.
	• *Options* specify the additional options to be used when mounting the device. Multiple options are separated by commas.
	  ◦ **sync** enables synchronous I/O. Changes are written to disk immediately. This option is normally used for removable storage devices (**async** disables this function).
	  ◦ **async** enables asynchronous I/O. Changes are cached and then written when the device isn't busy. This option is normally used for non-removable devices such as hard drives (**sync** disables this function).
	  ◦ **atime** updates the timestamp on each file's inode (**noatime** disables this function).
	  ◦ **auto** allows the device to be mounted automatically when the system boots.
	  ◦ **noauto** prevents the device from being mounted automatically when the system boots.
	  ◦ **dev** allows block files to be read from the device (**nodev** disables this function).
	  ◦ **exec** allows programs and script files in the file system to be run (**noexec** disables this function).
	  ◦ **owner** identifies that only the device owner can mount the file system.
	  ◦ **ro** mounts the storage device as read-only.
	  ◦ **rw** mounts the storage device as read/write.
	  ◦ **suid** allows the SUID bit to be set on files in the file system (**nosuid** disables this function).
	  ◦ **nouser** allows only the root user to mount the file system.
	  ◦ **users** allows any user to mount the file system.
	  ◦ **defaults** uses the following default settings: **rw** , **suid** , **dev** , **exec** , **auto** , **nouser** , and **async** .
	• *Dump* determines whether the file system needs to be dumped. If set to a value of **0** , it is assumed that the file system does not need to be dumped. If set to a value of **1** , the file system will be dumped.
	• *fsck* determines the order to run **fsck** (file system check) during system boot. This field should always be set to a value of **1** for the device

File	Description
	containing the root file system (/). All other file systems should be set to a value of **2** .
/etc/mtab	The /etc/mtab file tracks the currently mounted volumes on the system.
/procs/mounts	The /procs/mounts file contains entries for all currently mounted volumes on the system.
systemd.mount	A unit file that encodes information about a file system mount point controlled and supervised by systemd.

Manage File System Mountings

Use the following commands to manage the file system mounting:

Command	Description	Example
mount /dev/[device]	Mount a volume or device. Common mount options: • **-a** mounts all file systems listed in the /etc/fstab file. • **-r, ro** mounts the volume as read-only. • **-w, rw** mounts the volume as read/write. • **-t** specifies the volume type. (If you mount an ext3 file system without the **-t** , the system recognizes it as an ext2 file system.) • **-o loop** mounts an ISO file.	• **mount -a** reads the **/etc/fstab** file and mounts all volumes listed (except those with the **noauto** option). • **mount -rt reiserfs /dev/sdc1 /mnt/reis** mounts the sdc1 device using the read-only Reiser file system to the /mnt/reis mount point. • **mount -t iso9660 /dev/sr0 /media/cdrom** mounts an optical disc device to the /media/cdrom mount point. • **mount -wt vfat /dev/fd0 /mnt/floppy** mounts the fd0 device with the VFAT file system as read/write to the floppy mount point.

Command	Description	Example
mount	View the currently mounted volumes on the system.	• **mount /etc/mtab** displays the contents of the /etc/mtab file.
df	View which file systems are mounted to specific mount points.	
umount	Unmount a volume or device from the system. If a "disk is busy" error message is displayed when unmounting a device: • Make sure that the current working directory is not in that file system. • Close any open files located on that file system.	• **umount /dev/sdc1** unmounts the sdc1 device. • **umount /mnt/reis** unmounts the device on the /mnt/reis mount point. • **umount /dev/sr0** unmounts the optical disc device. • **umount /mnt/cdrom** unmounts the device on the /mnt/cdrom mount point (most likely an optical disc drive).

Troubleshoot Storage Issues

Many storage issues center around the physical aspects of the storage device. Other issues involve operating system configurations. A good strategy for troubleshooting storage issues is to start checking the simplest system features and then move to the more complex features. Many problems are resolved outside of Linux. Here are a few general items to check before moving to the Linux operating system.

- Determine whether the storage device has power. If the device is external to the computer, ensure that it's plugged in and turned on. A power light is also a good indicator.
- If the drive has platters (it's not a solid-state device), determine that the drive is spinning. You should be able to hear the head moving across the platters.
- Determine if the drive is recognized by the BIOS/UEFI. If not, the problem could be a hardware issue.

The following table list some issues that are detected and resolved with Linux.

Storage Issue	Description	Resolution Techniques
Degraded storage	Disk volumes, especially RAID sets, may show a status of *Degraded* . This means that I/O errors have been detected on a region of the disk. This can occur when one disk in a RAID set is offline or is unable to provide the proper RAID redundancy.	Repair or replace the disk volume.
Missing devices or volumes	A storage device with hardware problems may not show in the /dev directory, or the partitions on a storage device might be missing.	The **fdisk -lu** and **parted -l** commands may give some clues to the problem.
Missing mount point	Missing mount points indicate that a partition is not mounted. Often, this happens after a reboot.	Ensure that the proper entry has been added to the /etc/fstab file.
Disk performance	A slow disk can dramatically affect the total performance of a Linux system, especially if the system partition is on the slow disk.	The **atop** command can be used to monitor disk I/O stats. This may give an indication of a slow disk.
Resource exhaustion	A full volume, especially if it's the system volume, can cause Linux to freeze or crash.	Use the **df** command to monitor disk space.
Adapters	Physical storage devices are attached to storage adapters. Example are SCSI, RAID, and SATA host bus adapters (HBAs). Other HBAs, like a fiber channel adapter, can connect to storage area networks.	Use **/sys/class/scsi_host#/scan** to scan for storage devices connected to the SCSI adapter.
Storage integrity	Bad sectors and bad blocks on a storage devices can corrupt data.	Use the **badblocks** command to scan for bad sectors and blocks.