

CYBR 4423

Unix/Linux Administration

Storage

Device Management

Most, but not all, of the devices are represented by files in the /dev directory

Device files are the way the kernel provides access to devices for applications and services

The /dev directory is populated by a kernel service. When a device is detected, a representation of that device (a device file) is created in the /dev directory

[15 min video](#)

Two Types of Device Files

Character special files or Character devices

Talks to devices in a character by character (1 byte at a time) way

Examples: mouse, keyboard, terminal, serial modem, etc.

Devices that have “c” in front of it

Block special files or block devices

This category covers hard disks, tape drives, CD and DVD drives, and even floppy drives.

Devices that have “b” in front of it

```
crw-r----- 1 root    tty      29,  2 Oct 29  2013 fb2
crw-r----- 1 root    tty      29,  3 Oct 29  2013 fb3
brw-r----- 1 root    root      3,   0 Oct 29  2013 hda
brw-r----- 1 root    root      3,   1 Oct 29  2013 hda1
brw-r----- 1 root    root      3,  10 Oct 29  2013 hda10
brw-r----- 1 root    root      3,  11 Oct 29  2013 hda11
brw-r----- 1 root    root      3,  12 Oct 29  2013 hda12
```

Disk Partitions

A partition is a logical storage unit on a disk. A physical disk can be divided into multiple logical units as if there were multiple disks.

At least one partition is required

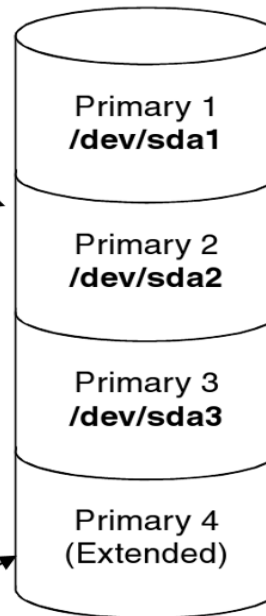
Disk partitioning is an operation of dividing a physical disk into multiple virtual disks

```
brw-r----- 1 root    root      8,  2 Oct 29  2013 sda2
brw-r----- 1 root    root      8,  3 Oct 29  2013 sda3
brw-r----- 1 root    root      8,  4 Oct 29  2013 sda4
brw-r----- 1 root    root      8,  5 Oct 29  2013 sda5
brw-r----- 1 root    root      8,  6 Oct 29  2013 sda6
brw-r----- 1 root    root      8,  7 Oct 29  2013 sda7
brw-r----- 1 root    root      8,  8 Oct 29  2013 sda8
brw-r----- 1 root    root      8,  9 Oct 29  2013 sda9
brw-r----- 1 root    root      8, 16 Oct 29  2013 sdb
brw-r----- 1 root    root      8, 17 Oct 29  2013 sdb1
brw-r----- 1 root    root      8, 26 Oct 29  2013 sdb10
brw-r----- 1 root    root      8, 27 Oct 29  2013 sdb11
brw-r----- 1 root    root      8, 28 Oct 29  2013 sdb12
brw-r----- 1 root    root      8, 29 Oct 29  2013 sdb13
```

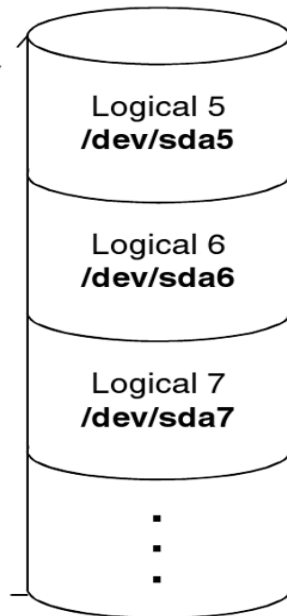
Partitions Types

Only 4 physical (primary) partitions allowed on a single disk. This is because only a limited amount of partition information can be stored in the 64 bytes that are available. A partition needs 16 bytes of data to be described, so with information on four partitions, it's full!

/dev/sda



/dev/sda4



Extended and logical partitions:
One (and only one) of the available physical partitions is marked as an extended partition, which then functions as a container for up to 15 additional logical partitions.

Disk Device and Partition Naming

- ◆ All types of hard disks (ATA, Serial ATA, SCSI) are represented by device files whose names start with "sd" (SCSI disk), as all these different types of drives are accessed as if they were SCSI drives.

On older systems, IDE disk files starts with "hd"

```
$ ls -l /dev/sd*  
brw-rw---- 1 root disk 8, 0 2008-12-19 20:24 /dev/sda  
brw-rw---- 1 root disk 8, 1 2008-12-19 20:24 /dev/sda1  
brw-rw---- 1 root disk 8, 2 2008-12-19 09:26 /dev/sda2  
brw-rw---- 1 root disk 8, 5 2008-12-19 20:24 /dev/sda5
```

"b" represents
block devices

The letter following "sd" represents the physical disk by the alphabetical order: the first one is "a", and the next one is "b", etc.

The number following the disk letter represents the logical partition, starting from 1.

Check Partition Information

"fdisk -l"

```
Disk /dev/sda: 21.5 GB, 21474836480 bytes
255 heads, 63 sectors/track, 2610 cylinders
Units = cylinders of 16065 * 512 = 8225280 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk identifier: 0x0002611f
```

Device	Boot	Start	End	Blocks	Id	System
/dev/sda1	*	1	2546	20446208	83	Linux
/dev/sda2		2546	2611	522241	5	Extended
/dev/sda5		2546	2611	522240	82	Linux swap / Solaris

"parted" (Partition Editor) provides more understandable format

```
root@ubuntu0:~# parted /dev/sda print
Model: VMware, VMware Virtual S (scsi)
Disk /dev/sda: 21.5GB
Sector size (logical/physical): 512B/512B
Partition Table: msdos
```

Number	Start	End	Size	Type	File system	Flags
1	1049kB	20.9GB	20.9GB	primary	ext4	boot
2	20.9GB	21.5GB	535MB	extended		
5	20.9GB	21.5GB	535MB	logical	linux-swap(v1)	

Provide the disk or partition as an argument

Check Storage Space

Use "df" (disk free) command to check disk usage

The -h option give more readable format of size

```
root@ubuntu0:~# df -h
```

Filesystem	Size	Used	Avail	Use%	Mounted on
/dev/sda1	20G	3.7G	15G	21%	/
none	495M	628K	494M	1%	/dev
none	501M	24K	501M	1%	/dev/shm
none	501M	104K	501M	1%	/var/run
none	501M	0	501M	0%	/var/lock
/dev/sdb1	7.9G	18M	7.5G	1%	/second-disk

Use "du" (disk usage) to check file and directory sizes

Partition Management Tools

Command line

fdisk
cfdisk
parted

GUI

Disk Utility (palimpsest)

Menu → System → Administration

[PyGTK Storage Device Manager \(pysdm\)](#)

[Gnome partition editor \(GParted\)](#)

Disk usage analyzer

fdisk

fdisk provides a command-based interface

Help

Delete partition

Add partition

View current partitions

Cancel changes

Save changes

```
root@ubuntu0:~# fdisk /dev/sdb
```

```
WARNING: DOS-compatible mode is deprecated. It's strongly recommended to  
switch off the mode (command 'c') and change display units to  
sectors (command 'u').
```

```
Command (m for help): m
```

```
Command action
```

```
a  toggle a bootable flag  
b  edit bsd disklabel  
c  toggle the dos compatibility flag  
d  delete a partition  
l  list known partition types  
m  print this menu  
n  add a new partition  
o  create a new empty DOS partition table  
p  print the partition table  
q  quit without saving changes  
s  create a new empty Sun disklabel  
t  change a partition's system id  
u  change display/entry units  
v  verify the partition table  
w  write table to disk and exit  
x  extra functionality (experts only)
```

cfdisk

cfdisk provides a text user interface

```
root@ubuntu0: ~  
File Edit View Search Terminal Help  
cfdisk (util-linux-ng 2.17.2)  
  
Disk Drive: /dev/sdb  
Size: 8589934592 bytes, 8589 MB  
Heads: 255 Sectors per Track: 63 Cylinders: 1044  
  
-----  
Name      Flags      Part Type  FS Type      [Label]      Size (MB)  
-----  
sdb1      Primary    Linux      ext2          8587.20  
  
[ Bootable ] [ Delete ] [ Help ] [ Maximize ] [ Print ]  
[ Quit ] [ Type ] [ Units ] [ Write ]  
  
Quit program without writing partition table
```

Partitions are displayed here. Use up and down arrow keys to select a partition.

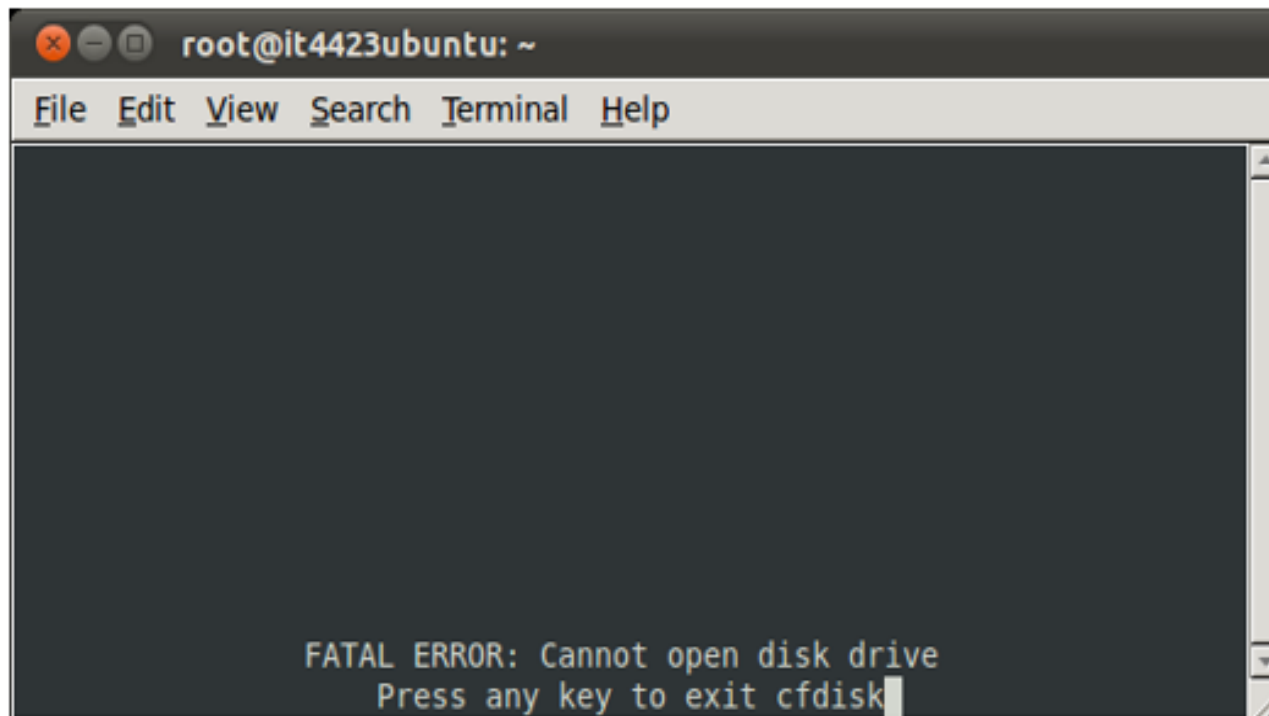
Commands are on the bottom. Use left and right arrow key to select and enter key to run.

Errors

You have the following error

`cfdisk sdb` //use full path `/dev/sdb`

Make sure `sdb` is in the `/dev` directory



A terminal window titled `root@it4423ubuntu: ~` with a menu bar containing `File`, `Edit`, `View`, `Search`, `Terminal`, and `Help`. The terminal output shows a fatal error: `FATAL ERROR: Cannot open disk drive` followed by `Press any key to exit cfdisk` with a cursor at the end.

```
root@it4423ubuntu: ~  
File Edit View Search Terminal Help  
  
FATAL ERROR: Cannot open disk drive  
Press any key to exit cfdisk
```

Steps to Add a Storage Device/Partition

Add a new disk device if needed

Partition the disk

Use fdisk, cfdisk, or any GUI tools

Create a file system (formatting)

Use "mkfs" command

Mount to the directory hierarchy

Create a new mount point (directory) if needed

Use "mount" command to access the new partition

Add an entry to "/etc/fstab" to auto mount it at system startup.

Make File System (Formatting)

Before a partition can be accessed, it needs to be *formatted*, or have a file system created, and *mounted* to the current directory structure

Use the "mkfs" command to format the partition

Use the default file system type

```
#> mkfs /dev/sdb1
```

Explicitly specify a file system type

```
#> mkfs -t ext3 /dev/sdb1
```

parted

parted (partition editor) is a GNU project to manage disk, partition, and file system.

[Command reference and examples](#)

[How to Create Disk Partitions with Parted Command in Linux](#)

Mounting

Mounting is the operation of attaching of an additional file system to the currently accessible file system

Removing the connection between the mounted device and the rest of the file system is referred to as *unmounting*

```
#> mount /dev/sdb1 /mydrive
```

This is a mount point, or an existing directory

```
#> umount /mydrive
```


Automatic Mounting

All current mounts are maintained in the file `/etc/mtab`

All auto-mounting entries are maintained in the file
`/etc/fstab`

Add an entry (columns separated by tab)

View more at [Windows Bulletin Tutorials](#)

Summary

Key concepts and terms

Device file, block device, character device

Disk partition, partitioning

Primary, extended, logical partition

Partition naming

File system

Mounting, unmounting, auto mounting

/dev directory

Key practices

Use "fdisk" or "cfdisk" to manage partitions: view, add, delete

Use "mkfs" to format a partition

Manage mounting using "mount" and "umount" command

Understand and edit the /etc/fstab file

Other commands and tools: du, df, parted, e2fsck



Good Readings and Resources

[Disk partitions](#)

[Adding a Hard Drive in Linux](#)

[Linux partition HowTo](#)

[How to edit and understand /etc/fstab](#)

[TestDisk, Datarecovery](#)

[Linux Disk Utilities](#)

[Disk Maintenance under Linux](#)

[Beginner's Guide to Linux Disk Utilities](#)

[Linux Partition HowTo](#)

