

Computer Science CSCI 251

Systems and Networks

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Virtualization

- Process
 - CPU virtualization

- Address Space
 - memory virtualization

- File
 - persistent storage virtualization

Formatting

- Low Level
 - sector creation
 - sector addressing using LBA (Logical Block Addressing)
e.g., (cylinder 0, head 0, sector 1) = LBA 0,
(cylinder 0, head 0, sector 2) = LBA 1 etc.
 - usually completed at time of manufacture

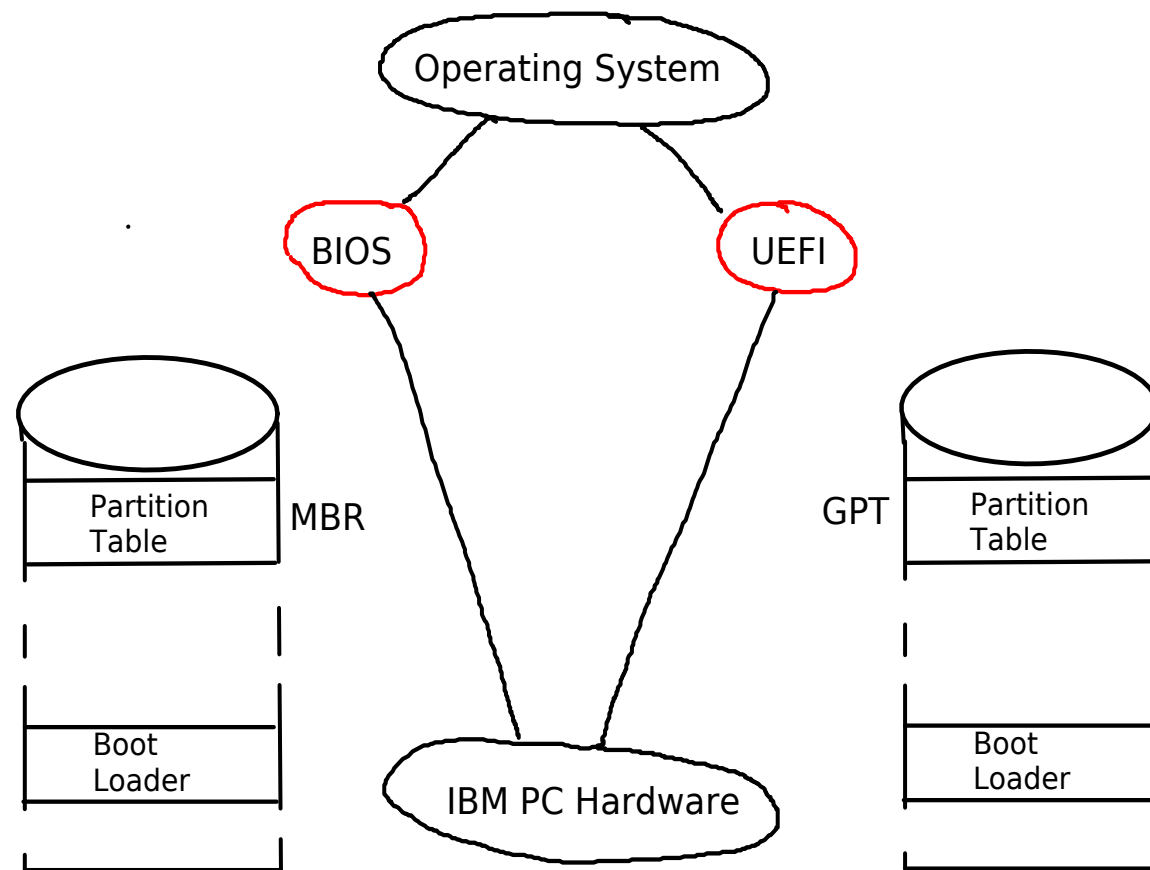
- Partitioning
 - each physical disk can be divided into partitions
 - a partition is a logical disk under OS control

- High Level
 - typically involves file system creation

IBM PC Basic I/O System (BIOS)

- BIOS
 - firmware executes on power-on startup
 - assumes disk data structure and boot-loader code starting at LBA 0 of bootable disk
- Legacy BIOS
 - LBA 0 contains MBR (Master Boot Record)
 - MBR contains the partition table
 - a partition entry contains a 32 bit start LBA field
- UEFI (Unified Extensible Firmware Interface)
 - GPT (GUID Partition Table) starts at LBA 0
 - GPT contains the partition table
 - a partition entry contains a 64 bit start LBA field

IBM PC Basic I/O System (BIOS) cont.



IDE Devices

- Controller
 - typically can support 4 drives (2 ports)

- Old Naming Convention

Device Name	Port#	Drive#
/dev/hda	1	1
/dev/hdb	1	2
/dev/hdc	2	3
/dev/hdd	2	4

- New Naming Convention

Device Name	Port#	Drive#
/dev/sda	1	1
/dev/sdb	1	2
/dev/sdc	2	3
/dev/sdd	2	4

SATA Devices

- Controller

- typically can support 2 - 6 drives (2 - 6 ports)

- Naming Convention

Device Name	Port#	Drive#
/dev/sda	1	1
/dev/sdb	2	2
.....		
.....		

Legacy BIOS - MBR

○ Partitions

- each disk can have 4 primary partitions or 3 primary partitions and an extended partition
- an extended partition can be divided into logical partitions
- fdisk (cfdisk) utility manages partitions
e.g., `fdisk -l /dev/sda`

Legacy BIOS - MBR cont.

- Partitions (Linux)
 - limited to 15 partitions for hot-plug supported drives

○ Naming Convention

Partition Name	Partition Type	Partition ID
sda1	primary	83 0h (Linux)
sda2	primary	82 0h (Swap)
sda3	primary
sda4	extended	
sda5	logical	
.....		
sda13	logical	
sda14	logical	
sda15	logical	

UEFI BIOS - GPT

- Partitions (Linux)
 - limited to 128 partitions
 - gdisk utility manages partitions
e.g., `gdisk -l /dev/sda`

○ Naming Convention

Partition Name	Partition ID
sda1	83 0h (Linux)
sda2	82 0h (Swap)
sda3
sda4	
sda5	
.....	
sda127	
sda128	

Partition ID

○ Type (cfdisk)

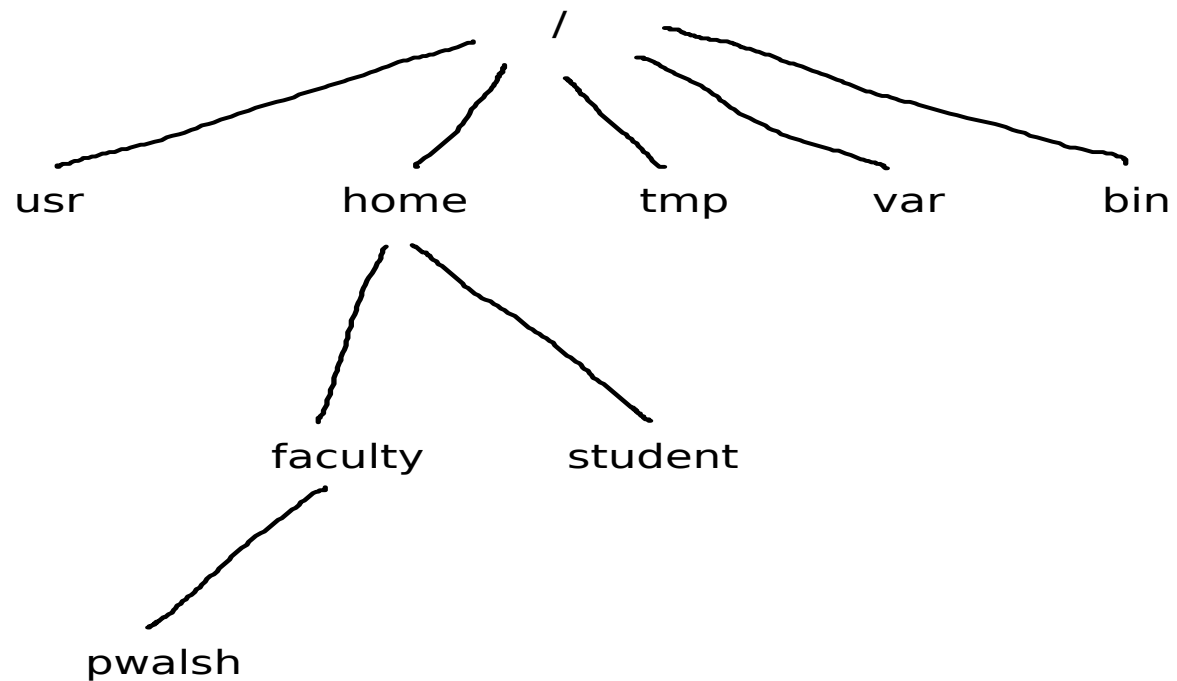
0 Empty
1 FAT12
2 XENIX root
3 XENIX usr
4 FAT16
.....
81 Minix / old Linux
82 Linux swap / Solaris
83 Linux
.....

○ Linux File System

- can be created in a partition with ID = 0x 83
- mkfs utility manages file system creation
e.g., `mkfs -t ext3 /dev/sda1`

File System Structure

- hierarchical
- root is named /



File System Access

- Mounting
 - the process of making the files in a file system accessible
- Mount Point
 - the directory where files in a mounted file system can be accessed
- Hot-plugging
 - devices can be is added/removed to/from a system without shutting down the system
e.g., USB thumb drives are hot-pluggable and automatically mounted in `/media`

Summary

- Top Down
 - how to access a file in user-land using the I/O API
 - how to determine the resulting system calls
- Bottom Up
 - how to add partitions to a disk
 - how to add a file system to a partition
 - how to mount a file system and make files accessible in user-land