**What is a Partition?**

**Partition**: The division of storage on a hard disk into separate sections.

**Why make partitions?**

* To organize and separate data.
* To install multiple operating systems.
* To improve performance and security.

**Why not use A and B?**

* Historically, A and B were reserved for floppy disks.

**Types of Hard Disks**

1. **PATA (Parallel ATA) / IDE (Integrated Device Electronics)**
2. **SATA (Serial ATA)**
3. **SSD (Solid State Drive)**
4. **NVMe (Non-Volatile Memory Express)**
5. **SCSI (Small Computer System Interface)** - Typically used in servers.

**Internal Structure of a Hard Disk**

**Types of Partitions**:

1. **Primary Partition**: Can contain OS and data. Max: 4 primary partitions.
2. **Extended Partition**: Acts as a container for logical partitions. Max: 1 extended partition.
3. **Logical Partition**: Can contain data. Max: 255 logical partitions.

Primary partitions: Min - 1, Max - 4

Extended partitions: Min - 0, Max - 1

Logical partitions: Min - 0, Max - 255

**Listing Hard Disks and Partitions**

* **List block devices**: lsblk
* **List partitions**: fdisk -l

**Device Naming**:

* **PATA**: /dev/hd
  + Example: /dev/hda1 (1st partition of 1st PATA HD)
* **SATA/SSD/SCSI**: /dev/sd
  + Example: /dev/sda1 (1st partition of 1st SATA HD)
* **NVMe**: /dev/nvme
  + Example: /dev/nvme01p1 (1st partition of 1st NVMe HD)

**Creating and Deleting Partitions**

1. **Create Partition**:
   * fdisk /dev/sda
   * Press n (new partition)
   * Select partition type and number
   * Specify size
   * Press w (write changes)
   * partprobe (inform the kernel)
2. **Delete Partition**:
   * fdisk /dev/sda
   * Press d (delete partition)
   * Select partition number
   * Press w (write changes)

**Filesystems in Linux**

* **Windows Filesystems**: FAT, NTFS
* **Linux Filesystems**: Ext2, Ext3, Ext4, XFS

**Differences**:

1. **Ext2**: Max file size: 2TB, Max partition size: 32TB, No journaling.
2. **Ext3**: Max file size: 2TB, Max partition size: 32TB, Supports journaling.
3. **Ext4**: Max file size: 16TB, Max partition size: 1EB, Supports journaling.
4. **XFS**: Max file size: 9EB, Max partition size: 18EB, Supports journaling.

**Formatting Partitions**

* **Ext2**: mke2fs /dev/sda1 or mkfs.ext2 /dev/sda1
* **Ext3**: mke2fs -j /dev/sda1 or mkfs.ext3 /dev/sda1
* **Ext4**: mke2fs -t ext4 /dev/sda1 or mkfs.ext4 /dev/sda1
* **XFS**: mkfs.xfs /dev/sda1 or mkfs.xfs -f /dev/sda1

**Viewing Filesystems**

* **View file systems**: blkid (block identification)

**Mounting Partitions**

1. **Temporary Mounting**:
   * mount /dev/sda1 /abc
   * View mounts: df -h or mount
   * Unmount: umount /dev/sda1 or umount /abc
2. **Permanent Mounting**:
   * Edit /etc/fstab:
   * /dev/sda1 /abc ext4 defaults 0 0
   * Inform kernel: mount -a

**Swap Partition**

* **Swap Partition**: Used to save temporary instructions when RAM is full.

**Swap Partition Size**:

1. If RAM ≤ 2GB: Swap = 2 x RAM size
2. If RAM > 2GB to 8GB: Swap = RAM size + 2GB
3. If RAM > 8GB: Swap = RAM size

**Creating Swap Partition**:

* Create partition with ID 82.
* Format swap partition: mkswap /dev/sdb1
* Enable swap: swapon /dev/sdb1
* Edit /etc/fstab:
* /dev/sdb1 swap swap defaults 0 0
* Inform kernel: mount -a
* View swap: free -h or swapon -s