

Disks and file systems

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I. Basic concepts

- Physical disks for storage
 - IDE, SCSI, USB, SATA, LVM,
 - Represent in file system /dev/hdX, /dev/sdX, /dev/fdX
 - X is alphabet character

Partitions

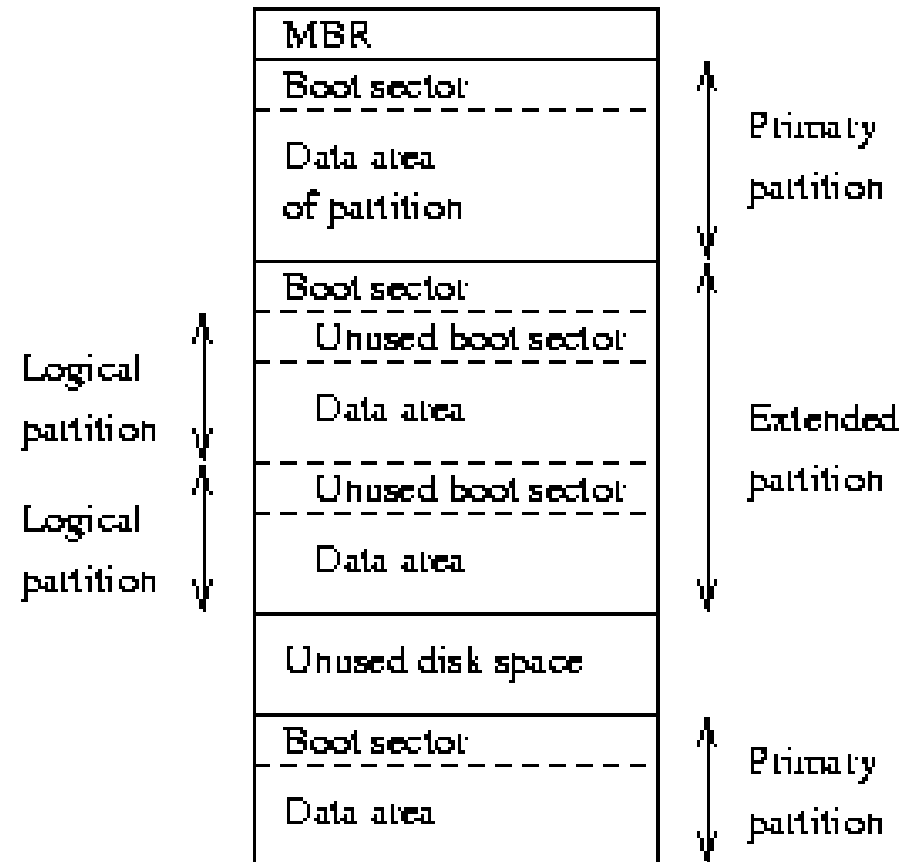
- Physical disks can be divided to multiple partitions
- OS can access partitions as logical disks
- Linux OS manages partitions as files, block device type
- Represented as dev/XY
 - X is the name of the disk
 - Y is the partition number in the disk
- Partitions of LVM or RAID can have different names

File systems

- A method and data structure that the operating system uses to control how data is stored and retrieved
 - Ex: NTFS, EXT2, EXT3, SWAP,
- NTFS: file system for Windows OS. Can be read by new Linux kernels
- Linux file system
 - EXT2: 2nd Extended file system
 - EXT3: 3rd Extended file system
 - EXT4: 4th Extended file system

Structure of a disk

- Master boot record
- Boot record
- Primary partition (max 4)
- Extended Partition
- Logical Partition



II. Manage disks and partitions

- Tools: pdisk, fdisk, parted
- Operations
 - Show information of partitions
 - Delete a partition
 - Change the configuration of a partition
 - Create a new partition
 - Write changes to MBR

III. Manage file systems

- Create/Format a file system
- Check the file system
- Optimise the file system
- Use a file system

Create a file system

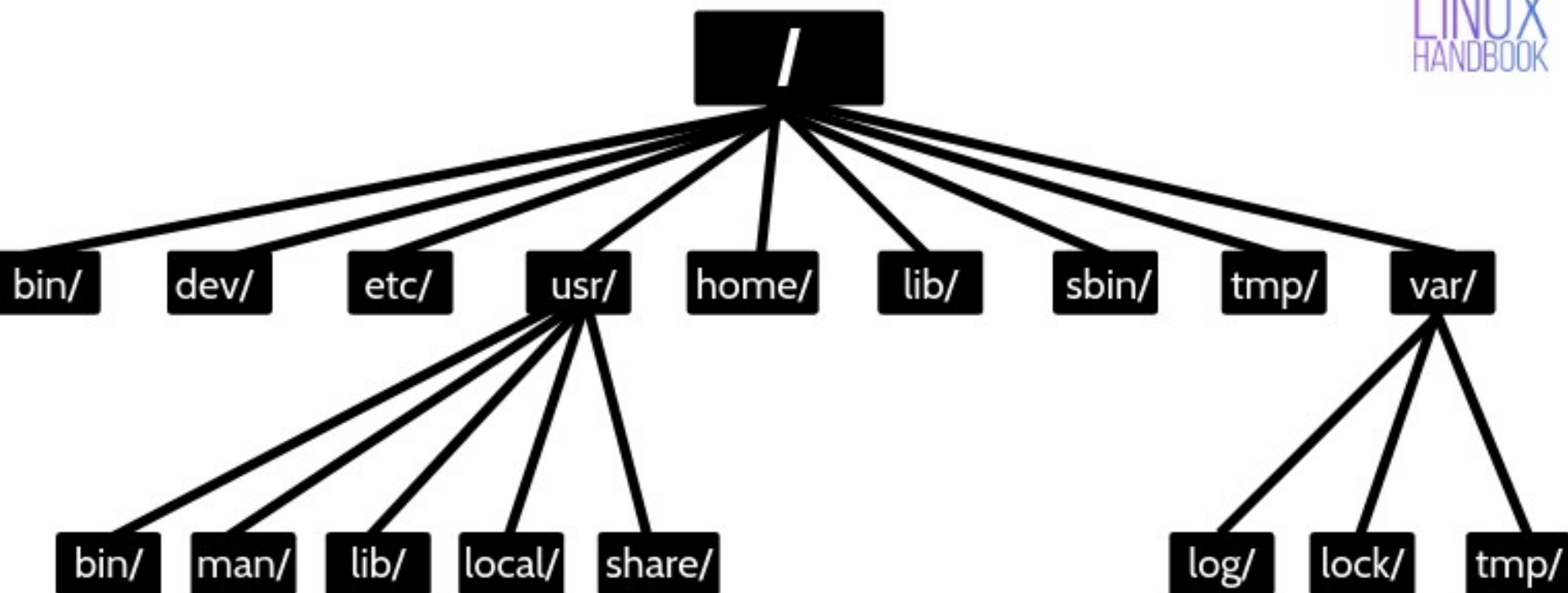
- `mkfs`
 - Create a file system on an empty partition
 - Use `-t` to specify the file system type
- It will link to the equivalent commands to create file systems for Linux
- `mk2fs`, `mkfs.ext2` to create ext2 file system
- `mk2fs -j`, `mkfs.ext3` to create ext3 file system

Format an ext2 file system

- -b block size
- -i byte numbers for one inode
- -c Number of mounts
- -j journal?
- -m reserve
- -r number of reserved blocks
- -g, -u group and users can use reserved storage

How to use file system

- Use command mount
 - Mount point
 - Mount device
 - File system
 - Other criteria
 - Read, write, quotas,
- /etc/mtab
 - The list of mounted file systems it is maintained by the mount and unmount programs
- umount: release the device
- fuser: processes are using files



Options of mount command

option	Ý nghĩa
-t	File system type (ext2, ext3, vfat, ntfs, nfs, cifs,)
rw/ ro	Readonly, read-write
usrquota,grpquota	User and group quota
users/nousers	Allow users to mount/umount
exec/noexec	Allow to run executable files on the partition after mounting
sync/async	Synchronise/Asynchronise updates
suid/nosuid	
user=, password=	Provide username and password to connect with remote storage devices (network)
loop	Allow to work with virtual disks (files)

Mount when booting

- /etc/fstab: a list of filesystems to be mounted at boot time
- Example

```
[root@localhost ~]# cat /etc/fstab
```

#device	mount point	fs	option	dump	chk
/dev/VolGroup00/LogVol00	/		ext3	defaults	1 1
LABEL=/boot	/boot	ext3	defaults	1	2
tmpfs	/dev/shm	tmpfs	defaults	0	0
devpts	/dev/pts	devpts	gid=5,mode=620	0	0
sysfs	/sys	sysfs	defaults	0	0
proc	/proc	proc	defaults	0	0
/dev/VolGroup00/LogVol01	swap	swap	defaults	0	0

Operations to use a new disk

- Create new partitions by using fdisk.
- Format file systems for each partition by using mkfs (ext2/3/4)
- Label the partition by the command e2label.
- Create the mount point
- Try to mount
- Add a line to /etc/fstab if needed

Operations on disks

- `df`
 - Show information of disks
- `dd`
 - copy from a disk to another one
- `du`
 - Summarise storage and usage

Create and manage virtual memory

- Concept of virtual memory
 - Memory on hard disks when main memory is not enough for programs
- Virtual memory on Linux
 - Separate partitions, created when installing OS
- Use files for virtual memory
 - Partitions are managed as files
 - `mkswap /test/swap.img; swapon /test/swap.img`
- Use partitions as virtual memory
 - Change partition for swap partition
 - `mkswap /dev/sda5; swapon /dev/sda5`
- Can use multiple virtual memories
- Modify `/etc/fstab` to turn on swap when booting
 - `/etc/fstab`

/etc/fstab for multiple virtual memory

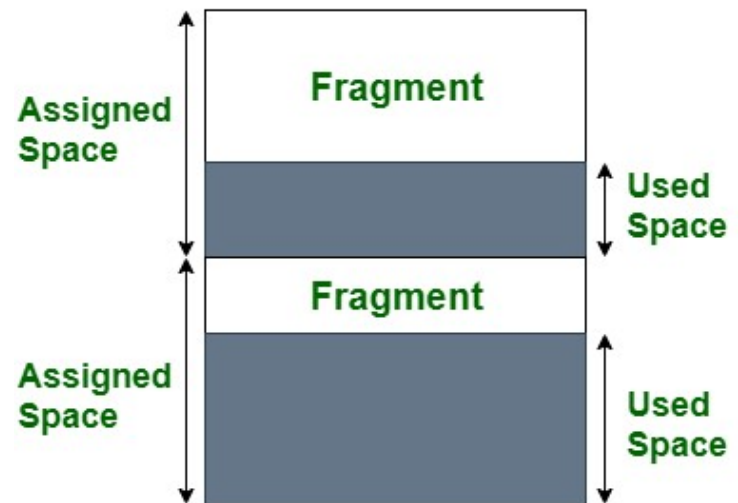
```
/dev/VolGroup00/LogVol00 /          ext3 defaults    1 1
LABEL=/boot          /boot          ext3 defaults    1 2
tmpfs                /dev/shm       tmpfs defaults    0 0
devpts              /dev/pts       devpts gid=5,mode=620 0 0
sysfs               /sys          sysfs defaults    0 0
proc               /proc         proc defaults    0 0
/dev/VolGroup00/LogVol01 swap          swap defaults    0 0
/k52-test/swap.img  swap          swap defaults    0 0
```

Ví dụ

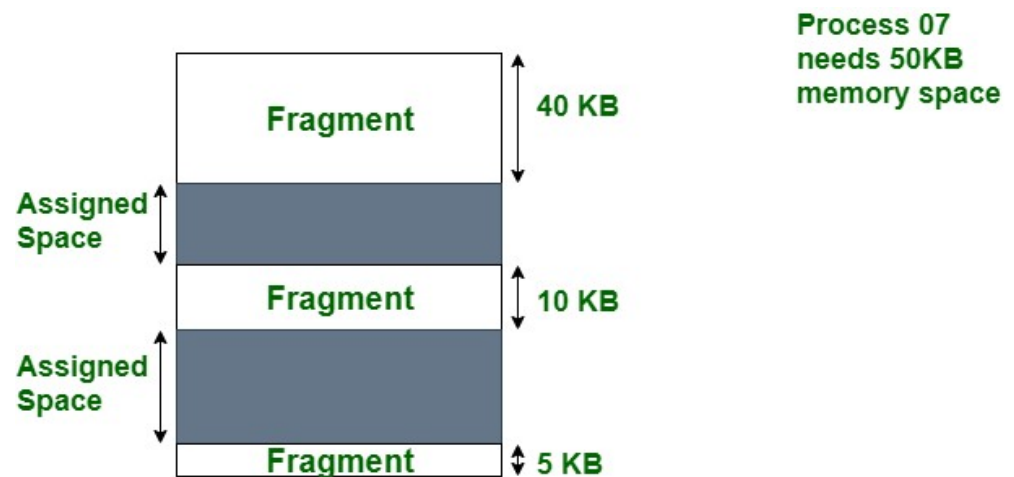
- Tạo một ổ đĩa ảo
- Dữ liệu NSD được lưu trữ trên ổ đĩa ảo
- Cấu hình fstab để mount ổ ảo khi khởi động

Disk fragmentation

- internal defragmentation
 - the memory is split into mounted sized blocks
 - the mounted sized block is allotted to the method
 - the memory allotted to the method is somewhat larger than the memory requested
- external defragmentation
 - the process's memory request cannot be fulfilled because the memory offered is during a non-contiguous manner
- Linux
 - 5% storage space reserved
 - After closing files, it will release unused space
 - No need to run de-fragmentation



Internal Fragmentation



IV. Quotas

- Concepts
 - Quotas for users and groups
 - Limitation of inodes and blocks
 - Hard and soft limitation

Turn on the quota mode

- Prepare for the quota mode
- Mount with quota option
- Make sure that users accessing to the file system have the right privileges
- Change quota information
- Check the changes

Turn on the quota mode

- Mount a file system with quota option
 - `mount -o usrquota,grpquota /dev/sda1 /test`
- Create necessary files for managing quotas
 - `touch /test/aquota.user; touch /test/aquota.group`
- Modify created files to the right format
 - `quotacheck -f /test`
- Change quotas of each user
 - `edquota -u trunghq`
- Turn on/off quotas
 - `quotaon, quotaoff`
- List current quotas in the current system
 - `repquota; repquota -a`

Change quotas

- Change quota of a user or group
 - edquota -u trunghq;
 - edquota -g grp1
- Turn on/off quotas
 - quotaon; quotaoff

Bài tập

- Thiết lập hệ thống để
 - Tự động mount các tệp-phân vùng ảo cho dữ liệu NSD và chương trình NSD
 - Với phân vùng chương trình: không ghi lại khi tắt máy
 - Với chương trình NSD: ghi lại khi tắt máy