File Systems

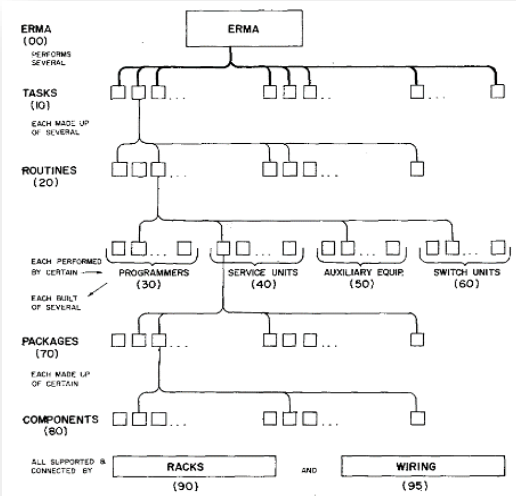


Fig. 2. The ERMA Mark I hierarchical structure

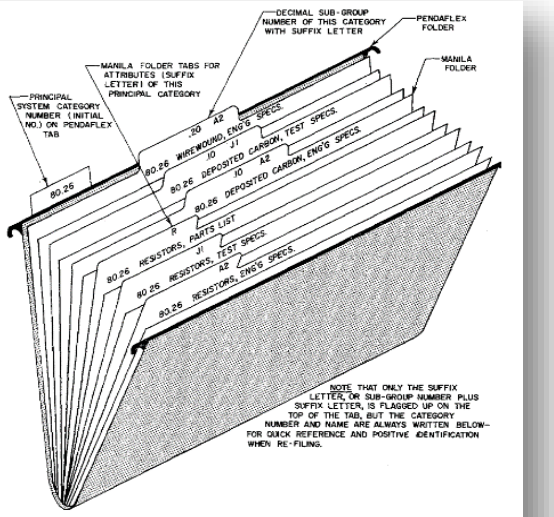
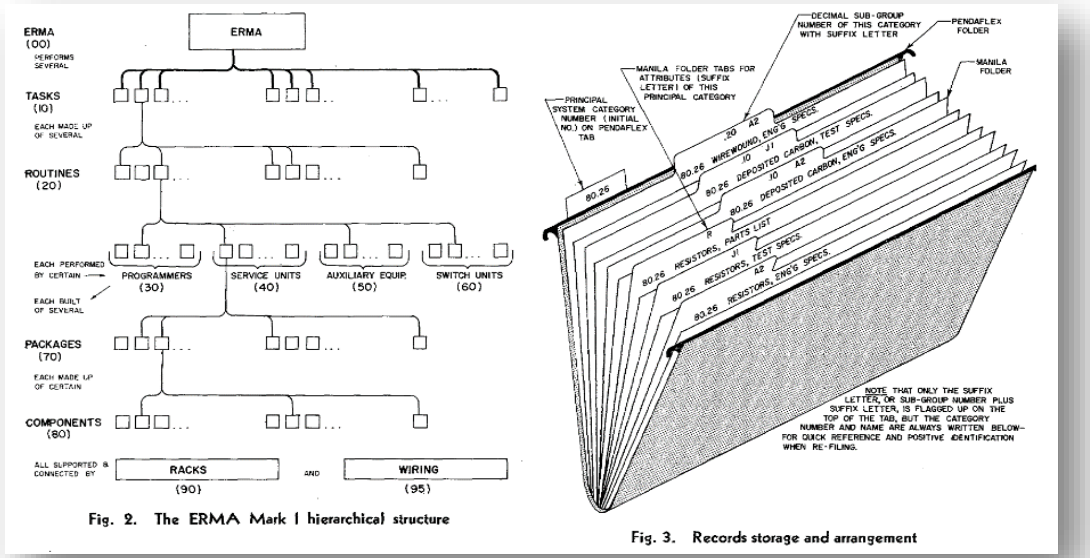


Fig. 3. Records storage and arrangement

Content

- Where to store data?
- CP/M
- Hierarchical
- Distributed



Content

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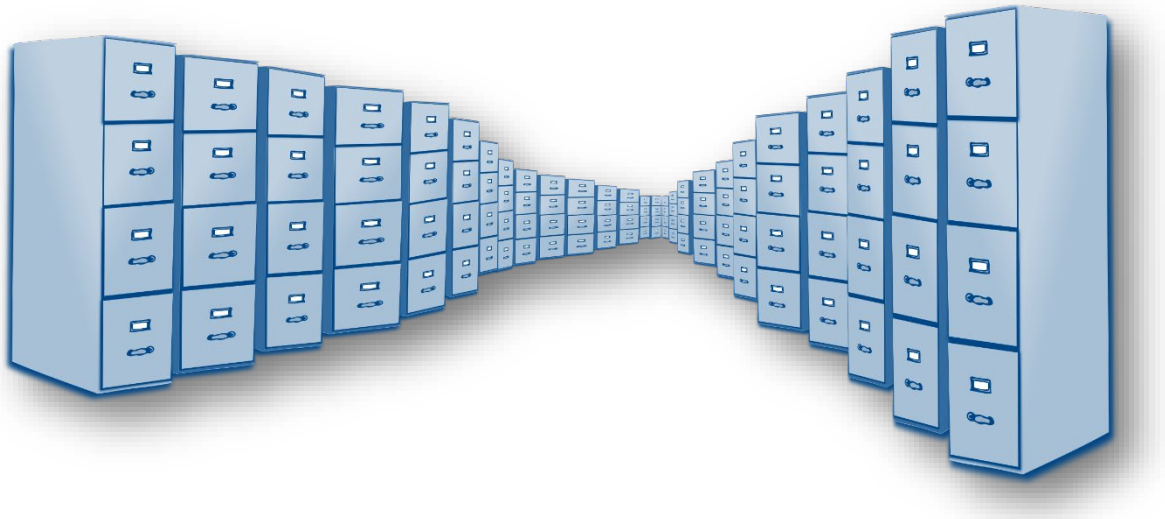
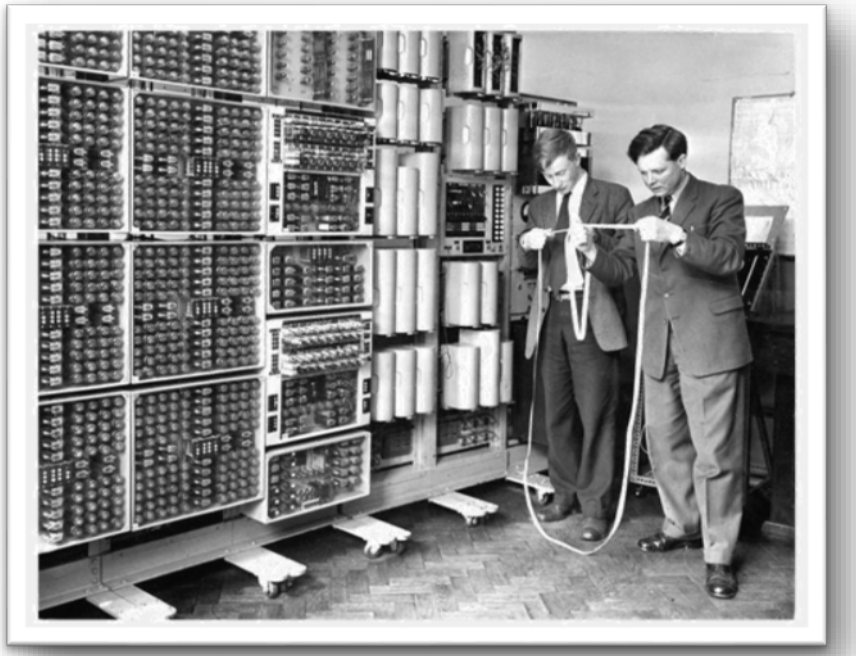
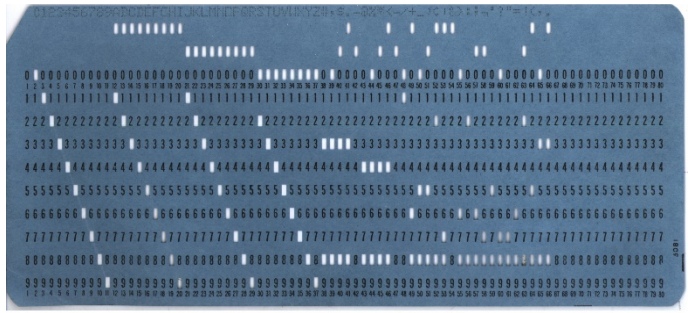


Where to store data?

Early days





Computers did not have a *memory*. Input, output, and the program code where stored on punch cards, punch stripes, and later on magnetic bands.

pure “computing” – neither sound nor images

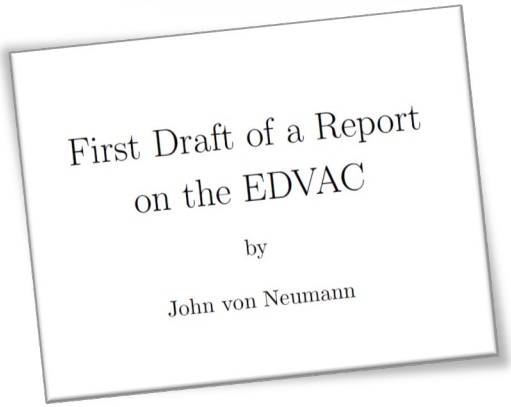
Where to store data?

Early days

Margaret Hamilton

Director of SE
Apollo 11

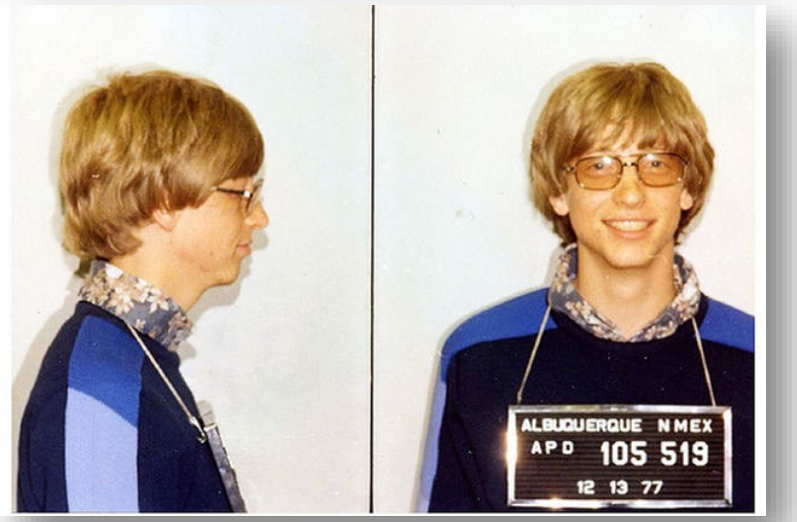
John von Neumann



code and data in the same memory

Where to store data?

Early days



Bill Gates

~~"640K of memory should be enough for anybody"~~
1981

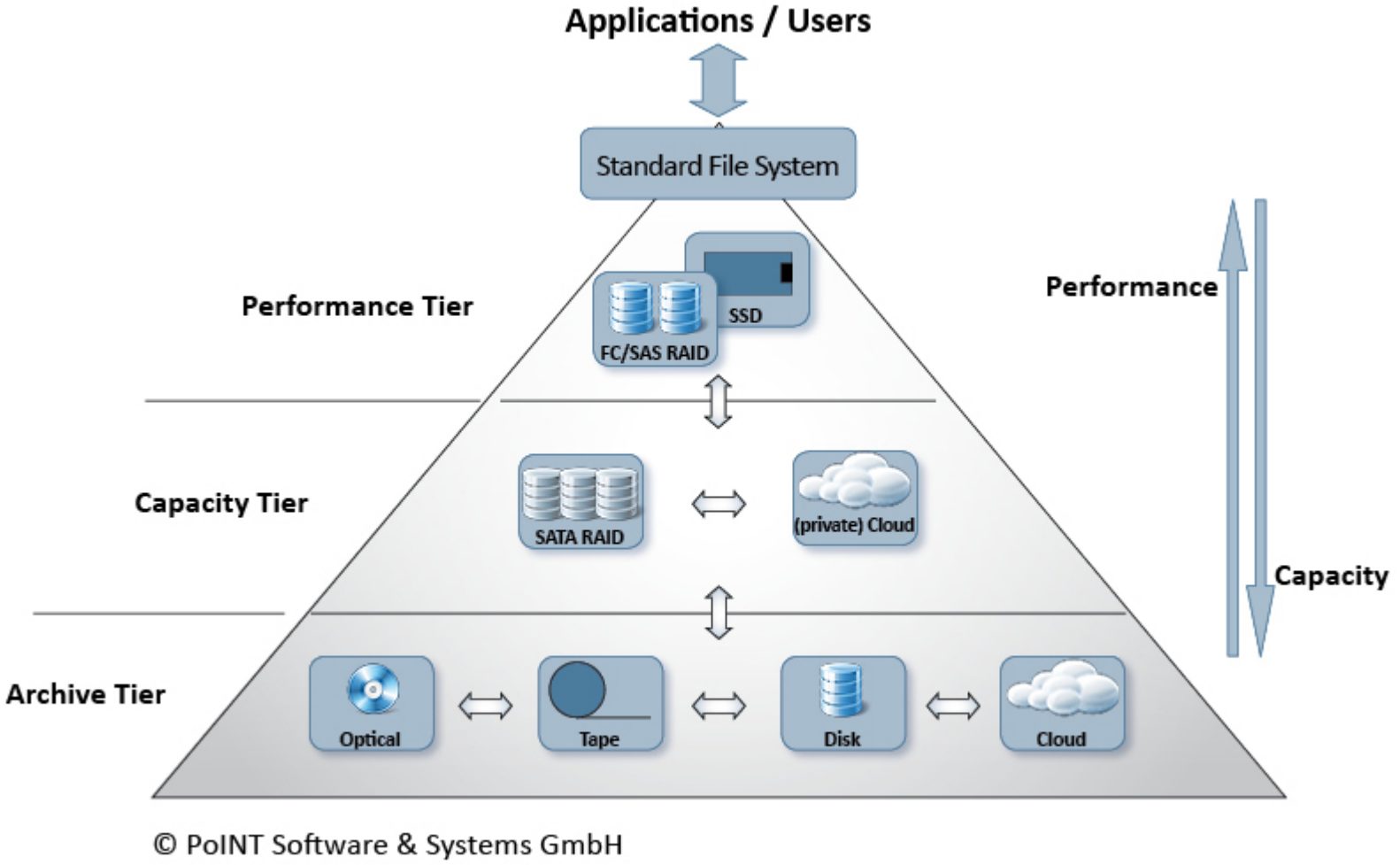
urban legend – he never said that

Where to store data?

Storage devices

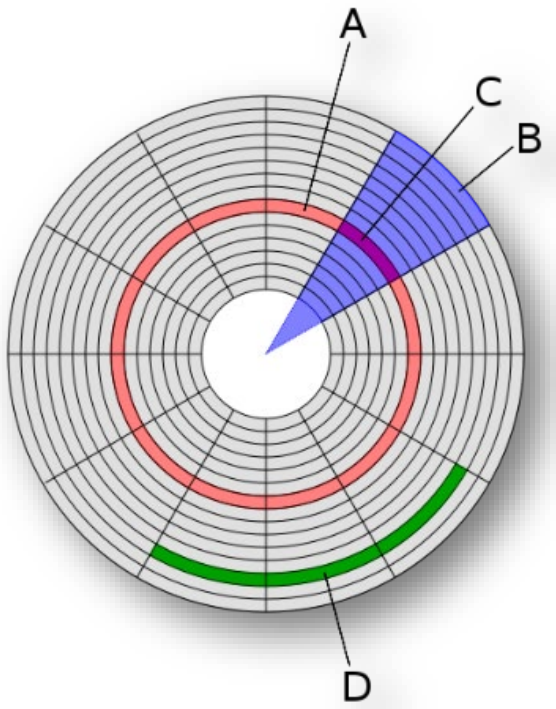
Where to store data?

Storage devices



CP/M

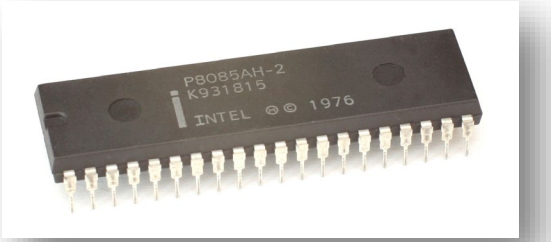
- Where to store data?
- CP/M
- Hierarchical
- Distributed



CP/M

Control Program for Microcomputers

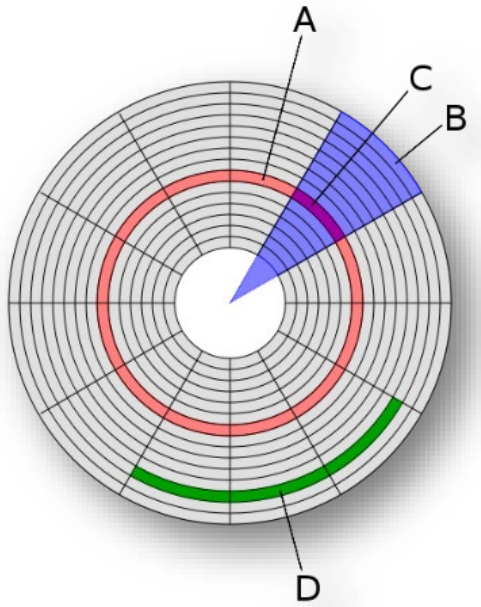
```
Loading CPM.SYS...

CP/M-86 for the IBM PC/XT/AT, Vers. 1.1 (Patched)
Copyright (C) 1983, Digital Research


Hardware Supported :

          Diskette Drive(s) : 3
        Hard Disk Drive(s) : 1
       Parallel Printer(s) : 1
            Serial Port(s) : 1
               Memory (Kb) : 640


D>a:
A>dir
A: PIP      CMD : STAT     CMD : SUBMIT   CMD : ASM86    CMD
A: GENCMD   CMD : DDT86    CMD : TOD      CMD : ED       CMD
A: HELP     CMD : HELP     HLP : SYS      CMD : ASSIGN   CMD
A: FORMAT   CMD : CLDIR    CMD : WRTLDR   CMD : BOOTPCDS SYS
A: BOOTWIN  SYS : CPM      H86 : WINSTALL SUB : PD       CMD
A: WCPM     SYS : DISKUTIL CMD
A>_
    User 0       0:00:11         Jan. 1, 2000
```



Intel 8085AH processor

CP/M

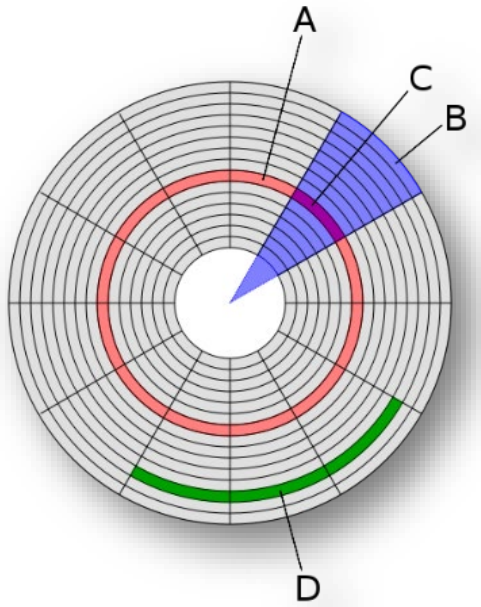
8-inch disk



- 77 tracks
- 26 sectors per track
- 128 bytes per sector
  (which results in 256’256 bytes in total)

CP/M

Storage organization



- First two tracks for the CP/M itself.
- Remaining 75 tracks grouped into allocation blocks of eight sectors.
  243 allocation blocks of 1024 bytes (eight times 128 bytes), which were numbered from 0 to 242.
- First two allocation blocks for the directory

- 77 tracks
- 26 sectors per track
- 128 bytes per sector
  (which results in 256’256 bytes in total)

CP/M

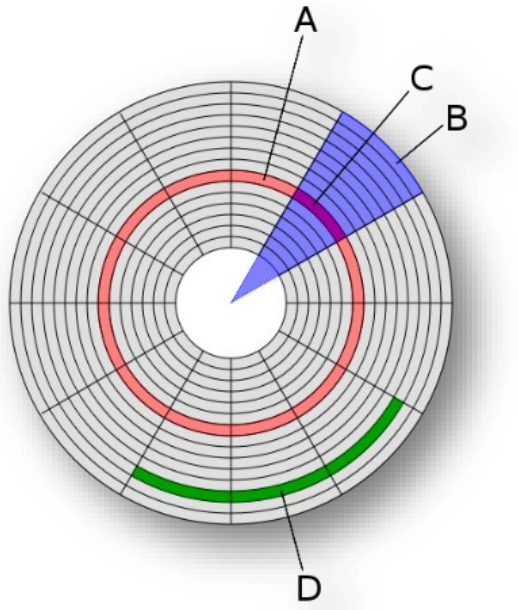
Directory

The directory was a list of file entries, which contained all the necessary information to store and retrieve files.

Thereby, each entry in the directory occupied 32 bytes.

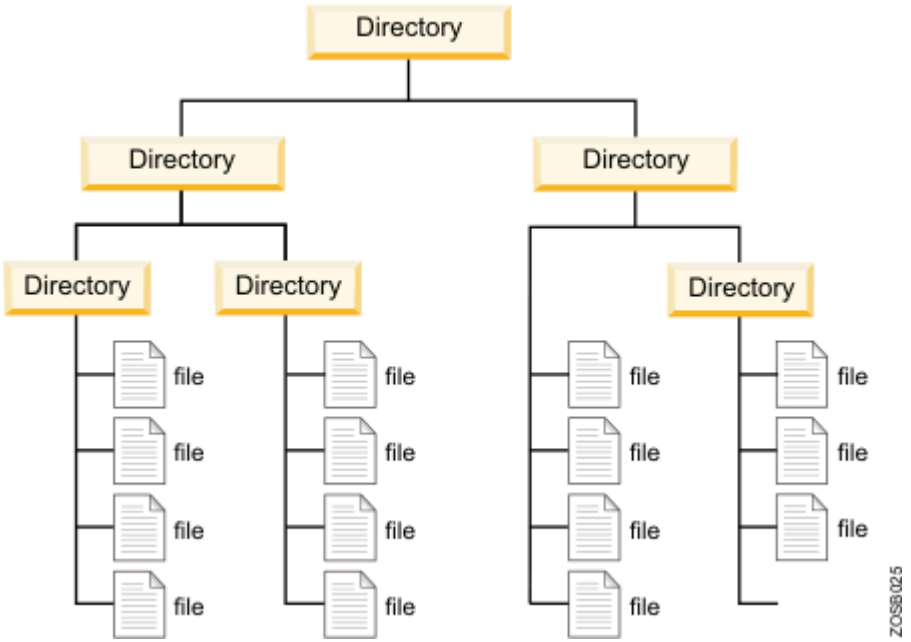
A maximum of 64 files could have been managed (2048 bytes divided by 32 bytes).

Bytes	Meaning	Note
0	Usually set to 0	Used for multiple users
1-8	Filename	The name was limited to 8 characters
9-11	File type	Three character file type identifier, e.g. TXT or COM
12	File extend	Used when a file needed more than one directory entry
13-14	Reserved	Usually set to 0
15	Sectors in last block	How many used sectors in the last allocation block
16-31	Disk map	Numbers of the used allocation blocks (from 0 to 242)



Hierarchical

- Where to store data?
- CP/M
- Hierarchical
- Distributed



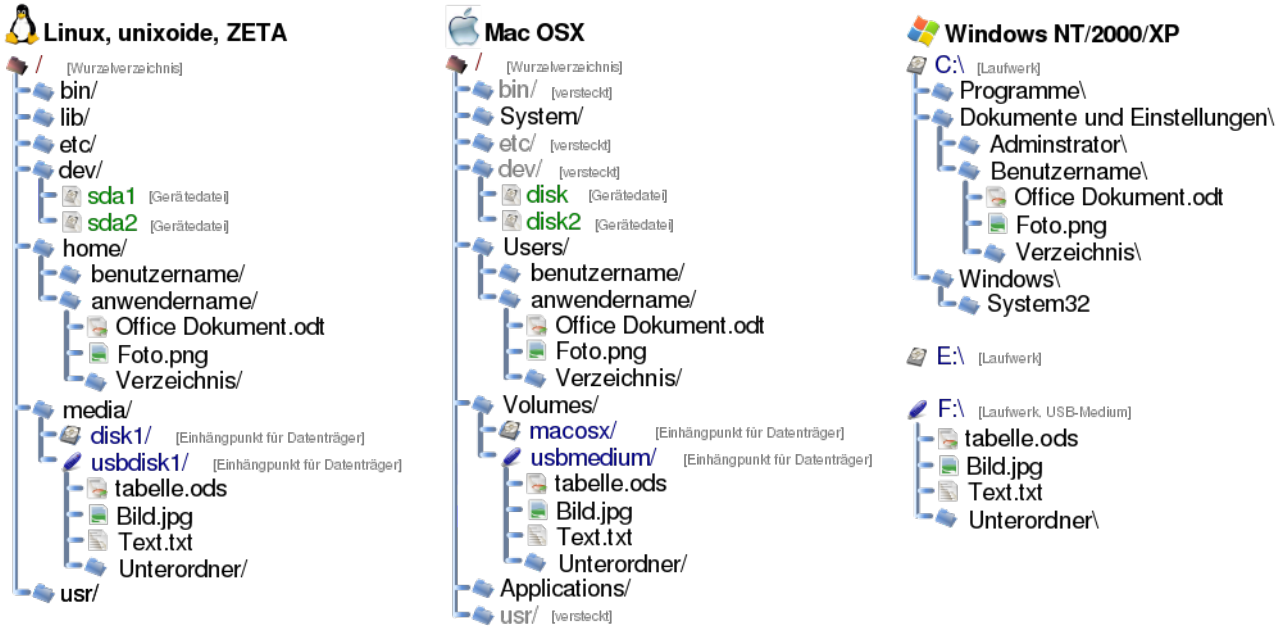
Hierarchical

Directories and Sub-Directories

Files listed in the directory might be directories themselves

Moving and Deleting

If a file is moved or deleted within the same physical storage device, only the entry in the directory is updated or removed. The data remains on the same physical location.



Content

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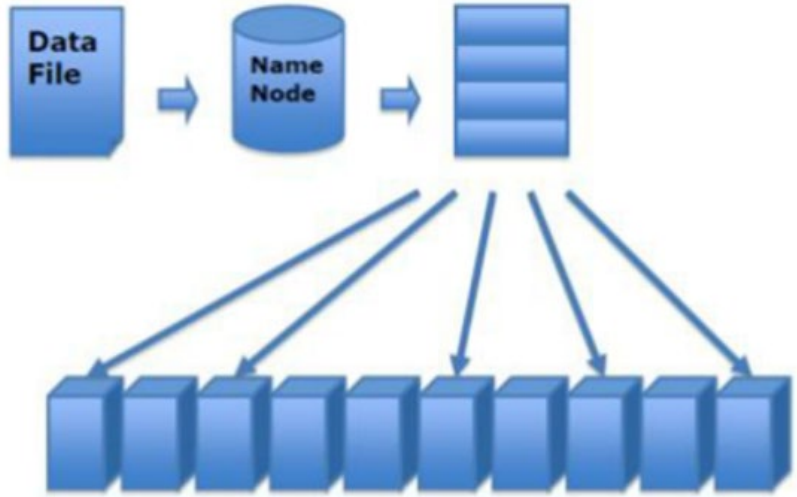

Distributed

Why distributed?

Distributed

Distribution and Duplication