

Data Carrier (2)

- Disk controller translates physical addresses into logical addresses
- logical: cylinders or sectors, numbered
 - with cylinders:

```
# fdisk -l /dev/sda
```

```
Platte /dev/sda: 300.0 GByte, 300090728448 Byte
255 Köpfe, 63 Sektoren/Spuren, 36483 Zylinder
Einheiten = Zylinder von 16065 × 512 = 8225280 Bytes
```

Gerät	boot	Anfang	Ende	Blöcke	Id	System
/dev/sda1	*	1	12562	100897146+	7	HPFS/NTFS
/dev/sda2		12563	35566	184779630	f	W95 Erw. (LBA)
/dev/sda3		35569	35836	2152710	c	W95 FAT32 (LBA)
/dev/sda4		35837	36483	5197027+	1c	Verst. W95 FAT32 (LBA)
/dev/sda5		12563	12691	1036161	82	Linux Swap / Solaris
/dev/sda6		12692	35566	183743406	83	Linux

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Data Carrier (3)

- logical: cylinders or sectors, numbered
 - with sectors:

```
# fdisk -lu /dev/sda
```

```
Platte /dev/sda: 300.0 GByte, 300090728448 Byte
255 Köpfe, 63 Sektoren/Spuren, 36483 Zylinder, zusammen 586114704 Sektoren
Einheiten = Sektoren von 1 × 512 = 512 Bytes
```

Gerät	boot	Anfang	Ende	Blöcke	Id	System
/dev/sda1	*	63	201794355	100897146+	7	HPFS/NTFS
/dev/sda2		201808530	571367789	184779630	f	W95 Erw. (LBA)
/dev/sda3		571399920	575705339	2152710	c	W95 FAT32 (LBA)
/dev/sda4		575705340	586099394	5197027+	1c	Verst. W95 FAT32 (LBA)
/dev/sda5		201808593	203880914	1036161	82	Linux Swap / Solaris
/dev/sda6		203880978	571367789	183743406	83	Linux

```
Sep 19 14:20:18 amd64 sshd[20494]: Accepted rsa for esser from ::ffff:87.234.201.207 port 61557
Sep 19 14:27:41 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 20 01:00:01 amd64 /usr/sbin/cron[29278]: (root) CMD (/sbin/evlogmgr -c "severity=DEBUG")
Sep 20 01:00:01 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 20 02:00:01 amd64 /usr/sbin/cron[30103]: (root) CMD (/sbin/evlogmgr -c "age > *30d*")
Sep 20 02:00:01 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 20 12:46:44 amd64 sshd[6516]: Accepted rsa for esser from ::ffff:87.234.201.207 port 62004
Sep 20 12:46:44 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 20 12:48:41 amd64 sshd[6609]: Accepted rsa for esser from ::ffff:87.234.201.207 port 62105
Sep 20 12:54:44 amd64 sshd[6694]: Accepted rsa for esser from ::ffff:87.234.201.207 port 62514
Sep 20 15:27:35 amd64 sshd[9079]: Accepted rsa for esser from ::ffff:87.234.201.207 port 64242
Sep 20 15:27:35 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 20 16:37:11 amd64 sshd[10102]: Accepted rsa for esser from ::ffff:87.234.201.207 port 63375
Sep 20 16:37:11 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 20 16:38:10 amd64 sshd[10140]: Accepted rsa for esser from ::ffff:87.234.201.207 port 63546
Sep 21 01:00:01 amd64 /usr/sbin/cron[17055]: (root) CMD (/sbin/evlogmgr -c "severity=DEBUG")
Sep 21 01:00:01 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 21 02:00:01 amd64 /usr/sbin/cron[17878]: (root) CMD (/sbin/evlogmgr -c "age > *30d*")
Sep 21 02:00:01 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 21 17:43:26 amd64 sshd[13089]: Accepted rsa for esser from ::ffff:87.234.201.207 port 63397
Sep 21 17:43:26 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 21 17:53:39 amd64 sshd[31269]: Accepted rsa for esser from ::ffff:87.234.201.207 port 64391
Sep 21 18:43:26 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 21 19:43:26 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 22 01:00:01 amd64 /usr/sbin/cron[4674]: (root) CMD (/sbin/evlogmgr -c "severity=DEBUG")
Sep 22 01:00:01 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 22 02:00:01 amd64 /usr/sbin/cron[5492]: (root) CMD (/sbin/evlogmgr -c "age > *30d*")
Sep 22 02:00:01 amd64 log-ng[1131]: STATS: dropped 0
Sep 22 20:12:01 amd64 log-ng[1131]: STATS: dropped 0
Sep 23 01:00:01 amd64 /usr/sbin/cron[1131]: (root) CMD (/sbin/evlogmgr -c "severity=DEBUG")
Sep 23 01:00:01 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 23 02:00:01 amd64 /usr/sbin/cron[25555]: (root) CMD (/sbin/evlogmgr -c "age > *30d*")
Sep 23 02:00:01 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 23 18:04:05 amd64 sshd[6554]: Accepted publickey for esser from ::ffff:192.168.1.5 port 59771 ssh2
Sep 23 18:04:05 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 23 18:04:34 amd64 sshd[6606]: Accepted rsa for esser from ::ffff:87.234.201.207 port 62093
Sep 24 01:00:01 amd64 /usr/sbin/cron[12436]: (root) CMD (/sbin/evlogmgr -c "severity=DEBUG")
Sep 24 01:00:01 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 24 02:00:01 amd64 /usr/sbin/cron[12351]: (root) CMD (/sbin/evlogmgr -c "age > *30d*")
Sep 24 02:00:01 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 24 11:15:48 amd64 sshd[20998]: Accepted rsa for esser from ::ffff:87.234.201.207 port 64456
Sep 24 11:15:48 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 24 13:49:08 amd64 sshd[2317]: Accepted rsa for esser from ::ffff:87.234.201.207 port 61330
Sep 24 13:49:08 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 24 15:42:07 amd64 kernel: snd_seq_midi_event: unsupported module, tainting kernel.
Sep 24 15:42:07 amd64 kernel: snd_seq_osa: unsupported module, tainting kernel.
Sep 24 20:25:31 amd64 sshd[29399]: Accepted rsa for esser from ::ffff:87.234.201.207 port 62566
Sep 24 20:25:31 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 25 01:00:02 amd64 /usr/sbin/cron[662]: (root) CMD (/sbin/evlogmgr -c "severity=DEBUG")
Sep 25 01:00:02 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 25 02:00:02 amd64 /usr/sbin/cron[1484]: (root) CMD (/sbin/evlogmgr -c "age > *30d*")
Sep 25 02:00:02 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 25 10:59:25 amd64 sshd[889]: Accepted rsa for esser from ::ffff:87.234.201.207 port 64193
Sep 25 10:59:25 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 25 10:59:47 amd64 sshd[8921]: Accepted rsa for esser from ::ffff:87.234.201.207 port 64253
Sep 25 11:30:02 amd64 sshd[9372]: Accepted rsa for esser from ::ffff:87.234.201.207 port 62029
Sep 25 11:59:25 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 25 14:05:37 amd64 sshd[11554]: Accepted rsa for esser from ::ffff:87.234.201.207 port 62822
Sep 25 14:05:37 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 25 14:08:10 amd64 sshd[11586]: Accepted rsa for esser from ::ffff:87.234.201.207 port 62951
Sep 25 14:07:17 amd64 sshd[11609]: Accepted rsa for esser from ::ffff:87.234.201.207 port 63392
Sep 25 14:08:33 amd64 sshd[11630]: Accepted rsa for esser from ::ffff:87.234.201.207 port 63709
Sep 25 14:08:33 amd64 syslog-ng[7653]: STATS: dropped 0
```

9.1 Tasks of a File System

Tasks of a File System (1)

- Abstraction of storage space on (typically (non-volatile) data media:
 - hard disks
 - floppy disks
 - CD, DVD, ...
 - other (re-) writable media (USB stick, ZIP disks, compact flash, ...)
 - tape drives (?)
 - very small (178 KByte) and very large (200 GByte) media

Tasks of a File System (3)

- second concept: **Directory**
 - give structure to a collection of files
 - directories contain files and possibly subdirectories
- Management of free space on medium
 - contiguous allocation
 - non-contiguous allocation → fragmentation

Tasks of a File System (2)

- central concept: **File**
 - create file
 - find file on medium (table of contents)
 - open / close file
 - read file sequentially (from start to end)
 - read file with direct access (seek & read)
 - (re-) name file

Tasks of a File System (4)

- Protect against data loss
 - redundantly store important administrative data
 - **Journaling**
 - file „transactions“
 - system creates a journal entry before starting a transaction
 - in case of system failure partial (non-complete) transactions can be undone at next boot time
- allow (parallel) access of several users

Tasks of a File System (5)

- in multi-user / multi-tasking systems:
 - access protection (e.g. read, write, append, execute, find, change attributes) for files, e.g.
 - based on users / groups (Unix / Linux)
 - bases on users / access control lists (ACLs) (Windows)
 - Access Scheduler: in what order to execute file accesses (optimization of disk accesses)
- caching: for performance reasons keep read data in a cache (in main memory) and delay write-back of changes

```
...
Sep 20 01:00:01 amd64 /usr/sbin/cron[29278]: (root) CMD (/sbin/evlogmgr -c "severity=DEBUG")
Sep 20 01:00:01 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 20 02:00:01 amd64 /usr/sbin/cron[30103]: (root) CMD (/sbin/evlogmgr -c "age > *30d*")
Sep 20 02:00:01 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 20 12:46:44 amd64 sshd[6516]: Accepted rsa for esser from ::ffff:87.234.201.207 port 62004
Sep 20 12:46:44 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 20 12:48:41 amd64 sshd[6609]: Accepted rsa for esser from ::ffff:87.234.201.207 port 62105
Sep 20 12:54:44 amd64 sshd[6694]: Accepted rsa for esser from ::ffff:87.234.201.207 port 62514
Sep 20 16:27:35 amd64 sshd[9077]: Accepted rsa for esser from ::ffff:87.234.201.207 port 64242
Sep 20 16:37:35 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 20 16:37:11 amd64 sshd[10102]: Accepted rsa for esser from ::ffff:87.234.201.207 port 63375
Sep 20 16:37:11 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 20 16:38:10 amd64 sshd[10240]: Accepted rsa for esser from ::ffff:87.234.201.207 port 63346
Sep 21 01:00:01 amd64 /usr/sbin/cron[17055]: (root) CMD (/sbin/evlogmgr -c "severity=DEBUG")
Sep 21 01:00:01 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 21 02:00:01 amd64 /usr/sbin/cron[17871]: (root) CMD (/sbin/evlogmgr -c "age > *30d*")
Sep 21 02:00:01 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 21 17:43:26 amd64 sshd[31088]: Accepted rsa for esser from ::ffff:87.234.201.207 port 63397
Sep 21 17:43:26 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 21 17:53:39 amd64 sshd[32691]: Accepted rsa for esser from ::ffff:87.234.201.207 port 64391
Sep 21 18:43:26 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 21 19:43:26 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 22 01:00:01 amd64 /usr/sbin/cron[46741]: (root) CMD (/sbin/evlogmgr -c "severity=DEBUG")
Sep 22 01:00:01 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 22 02:00:01 amd64 /usr/sbin/cron[46741]: (root) CMD (/sbin/evlogmgr -c "age > *30d*")
Sep 22 02:00:01 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 22 20:25:31 amd64 sshd[531]: Accepted rsa for esser from ::ffff:87.234.201.207 port 62093
Sep 23 01:00:01 amd64 /usr/sbin/cron[12474]: (root) CMD (/sbin/evlogmgr -c "severity=DEBUG")
Sep 23 01:00:01 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 23 02:00:01 amd64 /usr/sbin/cron[25550]: (root) CMD (/sbin/evlogmgr -c "age > *30d*")
Sep 23 02:00:01 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 23 18:04:05 amd64 sshd[6554]: Accepted publickey for esser from ::ffff:192.168.1.5 port 59771 ssh2
Sep 23 18:04:05 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 23 18:04:34 amd64 sshd[6606]: Accepted rsa for esser from ::ffff:87.234.201.207 port 62093
Sep 24 01:00:01 amd64 /usr/sbin/cron[12436]: (root) CMD (/sbin/evlogmgr -c "severity=DEBUG")
Sep 24 01:00:01 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 24 02:00:01 amd64 /usr/sbin/cron[13253]: (root) CMD (/sbin/evlogmgr -c "age > *30d*")
Sep 24 02:00:01 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 24 11:15:48 amd64 sshd[20989]: Accepted rsa for esser from ::ffff:87.234.201.207 port 64456
Sep 24 11:15:48 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 24 13:49:08 amd64 sshd[23197]: Accepted rsa for esser from ::ffff:87.234.201.207 port 64330
Sep 24 13:49:08 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 24 15:42:07 amd64 kernel: snd_seq_midi_event: unsupported module, tainting kernel.
Sep 24 15:42:07 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 24 15:42:07 amd64 kernel: snd_seq_oss: unsupported module, tainting kernel.
Sep 24 20:25:31 amd64 sshd[29399]: Accepted rsa for esser from ::ffff:87.234.201.207 port 62566
Sep 24 20:25:31 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 25 01:00:02 amd64 /usr/sbin/cron[18621]: (root) CMD (/sbin/evlogmgr -c "severity=DEBUG")
Sep 25 01:00:02 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 25 02:00:01 amd64 /usr/sbin/cron[14841]: (root) CMD (/sbin/evlogmgr -c "age > *30d*")
Sep 25 02:00:02 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 25 10:59:25 amd64 sshd[8889]: Accepted rsa for esser from ::ffff:87.234.201.207 port 64183
Sep 25 10:59:25 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 25 10:59:47 amd64 sshd[8921]: Accepted rsa for esser from ::ffff:87.234.201.207 port 64253
Sep 25 11:20:02 amd64 sshd[9372]: Accepted rsa for esser from ::ffff:87.234.201.207 port 62029
Sep 25 11:59:25 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 25 14:05:37 amd64 sshd[11554]: Accepted rsa for esser from ::ffff:87.234.201.207 port 62822
Sep 25 14:05:37 amd64 syslog-ng[7653]: STATS: dropped 0
Sep 25 14:06:10 amd64 sshd[11586]: Accepted rsa for esser from ::ffff:87.234.201.207 port 62951
Sep 25 14:07:17 amd64 sshd[11608]: Accepted rsa for esser from ::ffff:87.234.201.207 port 63392
Sep 25 14:08:33 amd64 sshd[11630]: Accepted rsa for esser from ::ffff:87.234.201.207 port 63709
Sep 25 15:25:33 amd64 sshd[12930]: Accepted rsa for esser from ::ffff:87.234.201.207 port 62778
```

9.2 Classical File Systems

Abstraction Layers

- classical: one layer (file system driver)
 - MS-DOS, CP/M, old Mac OS
 - system calls for accessing media that have been **formatted** with the operating system's (native) FS
- Modern: two layers
 1. virtual file system (VFS)
 - system calls for accessing arbitrary media
 2. drivers for specific file systems
 - Linux: ext2, ext3, reiserfs, iso9660, vfat, ntfs, hpfs, udf, ...
 - Windows: NTFS, FAT (-12, -16, -32)

Classical File Systems: CP/M (1)

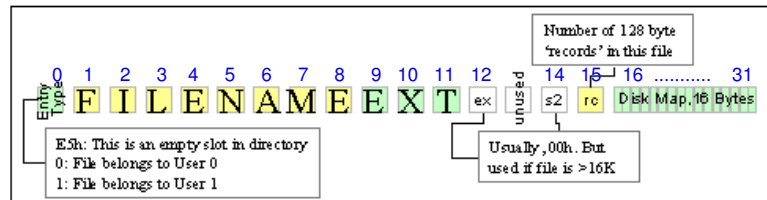
CP/M File System

- flat structure (no directories)
- filenames: 8+3 convention (name + extension)
 - programs: *.COM
 - text files: *.TXT, etc.
- some structure by having „users“ (16 possible file owners)

Classical File Systems: CP/M (2)

- At the start of each medium: table of contents (for 64 files)
- Reserve 32 byte for each entry

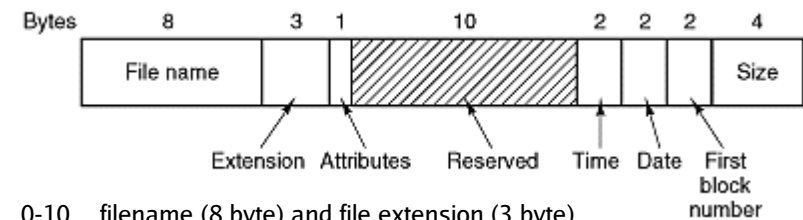
Foto: <http://www.dcast.vbox.co.uk/cpm.html>
(modifiziert)



- Upper bits of extension characters contain attributes (read-only, hidden, archived)
- File size >16 KByte → use more than one entry

Classical File Systems: FAT (1)

- Size of each directory entry: 32 byte:



0-10 filename (8 byte) and file extension (3 byte)

11 file attributes:

Bit 0: read-only (R), Bit 1: hidden(H), Bit 2: system file (S),
Bit 3: volume label, Bit 4: directory, Bit 5: archived (A),
Bits 6-7: unused – attrib +RHS c:\io.sys

12-21 reserved

22-23 time: hours (5 bit), minutes (6 bit), double seconds (5 bit)

24-25 date: year since 1980 (7 bit), month (4 bit), day (5 bit)

26-27 first block (0 = empty file)

28-31 file size in bytes (32 bit: in theory up to 4 GByte)

Foto: <http://www.phptr.com/articles/article.asp?p=25878>

Classical File Systems: CP/M (3)

- All operating system functions for writing / reading etc. must know the file system structure
- Migration to a newer version of the file system (with new structure)
→ case selection in each driver function:

```
void create_file (char* name) {
    switch (fs_version) {
        "1.4": create_file_type1 (name);
        "2.2": create_file_type2 (name);
        ....
    }
}
```

More information about CP/M:
<http://www.seasip.demon.co.uk/Cpm/>

Classical File Systems: FAT (2)

- No used blocks list (as CP/M does)
- Instead: File Allocation Table (FAT) in addition to the directory entries
- Directory entry contains „first block“ field which serves as an index into the FAT
- Each FAT entry
 - corresponds to a block on the disk;
 - contains the number of the next FAT entry (chained list) or -1 (last block)

Classical File Systems: FAT (3)

- Little experiment with FAT:

```

$ mkdosfs -F 12 /tmp/fatfs.img
$ mount -o loop -t msdos /tmp/fatfs.img /dos
$ cp /tmp/readme.txt /dos/
$ sync
$ cp /dos/readme.txt /dos/kopie.txt
$ sync
$ cp /dos/readme.txt /dos/geloescht.txt
$ sync
$ rm /dos/geloescht.txt
$ sync
$ umount /dos
$ hexdump /tmp/fatfs.img
    
```

Classical File Systems: FAT (5)

```

00002600 52 45 41 44 4d 45 20 20 54 58 54 20 00 00 00 00 | README TXT ... |
00002610 00 00 00 00 00 00 00 00 79 35 02 00 b2 00 00 00 | .....o.y5..²... |
00002620 4b 4f 50 49 45 20 20 20 54 58 54 20 00 00 00 00 | KOPIE TXT ... |
00002630 00 00 00 00 00 00 83 83 79 35 03 00 b2 00 00 00 | .....y5..²... |
00002640 e5 45 4c 4f 45 53 43 48 54 58 54 20 00 00 00 00 | äBLOESCHTXT ... |
00002650 00 00 00 00 00 00 91 83 79 35 04 00 b2 00 00 00 | .....y5..²... |
00002660 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 | ..... |
*
00004200 48 61 6c 6c 6f 2c 20 69 63 68 20 62 69 6e 20 6e | Hallo, ich bin n |
00004210 75 72 20 65 69 6e 65 20 6b 6c 65 69 6e 65 0a 54 | ur eine kleine.T |
00004220 65 73 74 64 61 74 65 69 20 66 75 65 72 20 64 69 | estdatei fuer di |
00004230 65 20 56 6f 72 6c 65 73 75 6e 67 0a 42 65 74 72 | e Vorlesung.Betr |
00004240 69 65 62 73 73 79 73 74 65 6d 65 2e 20 49 63 68 | iebssysteme. Ich |
00004250 20 6c 69 65 67 65 20 61 75 66 0a 65 69 6e 65 72 | liege auf.einer |
00004260 20 28 76 69 72 74 75 65 6c 6c 65 6e 29 20 44 4f | (virtuellen) DO |
00004270 53 2d 44 69 73 6b 65 74 74 65 2c 0a 61 6c 73 6f | S-Diskette,.also |
00004280 20 61 75 66 20 65 69 6e 65 6d 20 46 41 54 2d 31 | auf einem FAT-l |
00004290 32 2d 44 61 74 65 69 73 79 73 74 65 6d 2e 0a 0a | 2-Dateisystem... |
000042a0 56 69 65 6c 20 53 70 61 73 73 20 6e 6f 63 68 21 | Viel Spass noch! |
000042b0 0a 0a 00 00 00 00 00 00 00 00 00 00 00 00 00 | ..... |
000042c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 | ..... |
*
00004400 48 61 6c 6c 6f 2c 20 69 63 68 20 62 69 6e 20 6e | Hallo, ich bin n |
00004410 75 72 20 65 69 6e 65 20 6b 6c 65 69 6e 65 0a 54 | ur eine kleine.T |
    
```

Classical File Systems: FAT (4)

```

00000000 eb 3c 90 6d 6b 64 6f 73 66 73 00 00 02 01 01 00 | ë<.mkdosfs..... |
03-0A: OEM Identifier
00000010 02 e0 00 40 0b f0 09 00 12 00 02 00 00 00 00 00 | .à.@.ð..... |
00000020 00 00 00 00 00 00 29 c6 52 68 45 20 20 20 20 20 | .....)ÆRhE |
00000030 20 20 20 20 20 20 46 41 54 31 32 20 20 20 0e 1f | FAT12 .. |
36-3D: FAT type
00000040 be 5b 7c ac 22 c0 74 0b 56 b4 0e bb 07 00 cd 10 | Ÿ[|-"ât.vž.»..î. |
00000050 5e eb f0 32 e4 cd 16 cd 19 eb fe 54 68 69 73 20 | ^ëð2äî.î.èþThis |
00000060 69 73 20 6e 6f 74 20 61 20 62 6f 6f 74 61 62 6c | is not a bootabl |
00000070 65 20 64 69 73 6b 2e 20 20 50 6c 65 61 73 65 20 | e disk. Please |
00000080 69 6e 73 65 72 74 20 61 20 62 6f 6f 74 61 62 6c | insert a bootabl |
00000090 65 20 66 6c 6f 70 79 20 61 6e 64 0d 0a 70 72 | e floppy and..pr |
000000a0 65 73 73 20 61 6e 79 20 6b 65 79 20 74 6f 20 74 | ess any key to t |
000000b0 72 79 20 61 67 61 69 6e 20 2e 2e 2e 20 0d 0a 00 | ry again ... .. |
000000c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 | ..... |
*
000001f0 00 00 00 00 00 00 00 00 00 00 00 00 00 55 aa | .....U* |
/* Anfang der FAT im 2. Cluster (ab 512d = 0200x) */
00000200 f0 ff ff ff ff ff 00 00 00 00 00 00 00 00 00 | ðÿÿÿÿÿ..... |
00000210 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 | ..... |
*
00001400 f0 ff ff ff ff ff 00 00 00 00 00 00 00 00 00 | ðÿÿÿÿÿ..... |
00001410 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 | ..... |
    
```

Problems of Classical File Systems

- System calls (open, read, write, etc.) are tailored to a specific file system
- Support for alien / new file systems problematic; often impossible
- Software (from third parties) for alien file system access is poorly integratable

Solution: Virtual File System