WELCOME

Introduction to Partitions
(Those things on your Hard Drive)
by Stan Reichardt
stanr@sluug.org

9 Jan 2008

WHO

- Who here has (not) modified the partitions on their computer?

WHAT

- Partitions allow the splitting up of a computer hard drive.
- Partitions exist at the physical, media specific level.
- Making separate partitions allows for the installation of multiple Operating Systems or portions of different File Systems for many useful purposes.
- Usually file systems are used for regular files containing text or binary data.

WHAT ELSE

- Special purposes:
  - databases,
  - encrypted partitions, or
  - swap partitions.

WHERE

- A hard disk partition is a defined storage space on a hard drive.

WHY

- Partitioning makes it possible to create several file systems (either of the same type or different types) on a single hard disk.
- This possibility has many benefits.

BENEFITS

- Multi-booting setups - allows multiple operating system on one computer.

  - *For example, one could install Linux, Mac OS X, Microsoft Windows or others onto different partitions of the same hard disk (so they don't conflict) and have a choice of booting into any operating system (supported by the hardware) at power-up.*

MORE BENEFITS

- Sharing swap partitions between multiple Linux distributions so such partitions use less hard drive space.
- Protecting or isolating files, easier to backup file system, easier to recover a corrupted file system or installed operating system.
- Raising overall computer performance because smaller filesystems are more efficient. Cluster sizes can waste space.
    - For instance, large hard drives with only one NTFS filesystem typically have a very large Master File Table (MFT) and it generally takes more time to read this MFT than the smaller MFTs of smaller partitions.

OTHER BENEFITS

* Higher levels of data organization, raising the user efficiency of the system, for example separate partitions dedicated to digital movie processing, photos, email mailboxes or browser cache.
* Partitions may be customized for different requirements:
    - Use of separate encrypted file systems.
    - Damage to one partition should not effect another.

STILL MORE BENEFITS

- Allow making partitions read-only to protect data from change.
- Limit damage:
  - If one partition is damaged, the other file systems are not affected,the drive's data may still be salvageable.
- Recover from capacity problem.
  - EXAMPLE: Linux systems with a separate /var/log partition
    - When /var/log fills up repairs are still possible.

WHEN

- Required
  - If hard disk is larger than partition size supported by the operating system.
- Optional
  - Done for the many benefits

HOW THEY ARE CREATED

- The 'fdisk' command line program is commonly used.
- The Microsoft 'fdisk' and Linux 'fdisk' are not the same.
- There are many similar command line tools.
- There are also many graphical tools.

PROPRIETARY TOOLS

- Acronis Disk Director Suite
- aefdisk (DOS) / aefdisk32 (Windows) [1]
- Apple's Disk Utility
- BeOS Partition Manager / Boot Manager / bootman
- Coriolis Systems' iPartition
- Cute Partition Manager
- Damien Guibouret's Partition Saving
- DIY DataRecovery's DiskPatch - partition recovery and boot sector repair
- EASEUS's Partition Table Doctor and Partition Manager-recover & resize
- Microsoft's DiskPart and FDISK

13

MORE PROPRIETARY TOOLS

- – Microsoft's Logical Disk Manager or Disk Management Console (diskmgmt.msc), part of Windows 2000, Windows XP and Windows Vista
- – Paragon Software's Partition Manager and Hard Disk Manager
- – Ranish Partition Manager
- – Symantec's PartitionMagic
- – Symantec's ServerMagic
- – TeraByte Unlimited's BootIt NG
- – VCOM's Partition Commander
- – VolumeWorks - Dynamic partitioning software for Mac OS X by SubRosaSoft Inc.

MANUFACTURERS' TOOLS

- Hitachi's Drive Fitness Test (formerly IBM DFT) for Hitachi and IBM disks
- Maxtor's Maxblast for Maxtor disks
- Seagate's Discwizard for Seagate Technology disks
- Western Digital's Data Lifeguard Tools for Western Digital disks

FREE/OPEN SOURCE TOOLS

- Cfdisk (Linux)
- fdisk (Unix, DOS and Windows, OS/2), three significantly different programs
- FIPS (MS-DOS)
- Free FDISK (FreeDOS)
- GNU Parted (Linux)
- GParted (Linux)
- Mandriva's DiskDrake (Linux)
- QtParted (Linux)
- Parted Magic (LiveCD)
- Partition Logic (LiveCD)
- sfdisk (Linux)
- TestDisk (multiplatform) -- though primarily for recovering lost partitions, it does create new entries for them in partition table(s).

PARTITIONS AND FILE SYSTEMS

- **IMPORTANT:**
  - Data is not directly stored in hard disk partitions.
  - You store file systems in hard disk partitions.
  - Then data is stored in these file systems.
  - Some operating systems don't make this clear.

PARTITION TABLE

- At the beginning of a hard disk there is a reserved area where information about partitions is stored.
- Standard partition tables only store information about four partitions.
- This would limit hard disks to a maximum of four partitions.
- These four standard partitions are called the primary partitions.

EXTENDED PARTITIONS

- To work around the 4 partition limit, extended partitions were devised.
- An extended partition stores information about other partitions. By using an extended partition, you can create many more than four partitions on your hard disk.
- Partitions under an extended partition are called logical partitions.

PARTITION TYPES

- Partitions use a special byte of data to record the **type** of partition.
- Operating Systems *tend* to agree on the meaning of these values in order to work together.

LIST TYPES

List from fdisk:

```
Command (m for help): l

 0   Empty               1e   Hidden W95 FAT1 80   Old Minix        be   Solaris boot
 1   FAT12               24   NEC DOS            81   Minix / old Lin  bf   Solaris
 2   XENIX root          39   Plan 9             82   Linux swap / So  c1   DRDOS/sec (FAT-
 3   XENIX usr           3c   PartitionMagic     83   Linux            c4   DRDOS/sec (FAT-
 4   FAT16 <32M          40   Venix 80286        84   OS/2 hidden C:   c6   DRDOS/sec (FAT-
 5   Extended            41   PPC PReP Boot      85   Linux extended   c7   Syrinx
 6   FAT16               42   SFS                86   NTFS volume set  da   Non-FS data
 7   HPFS/NTFS           4d   QNX4.x             87   NTFS volume set  db   CP/M / CTOS / .
 8   AIX                 4e   QNX4.x 2nd part 88   Linux plaintext  de   Dell Utility
 9   AIX bootable        4f   QNX4.x 3rd part 8e   Linux LVM        df   BootIt
 a   OS/2 Boot Manag 50   OnTrack DM           93   Amoeba           e1   DOS access
 b   W95 FAT32           51   OnTrack DM6 Aux 94   Amoeba BBT       e3   DOS R/O
 c   W95 FAT32 (LBA) 52   CP/M                 9f   BSD/OS           e4   SpeedStor
 e   W95 FAT16 (LBA) 53   OnTrack DM6 Aux a0   IBM Thinkpad hi  eb   BeOS fs
 f   W95 Ext'd (LBA) 54   OnTrackDM6           a5   FreeBSD          ee   EFI GPT
10   OPUS                55   EZ-Drive           a6   OpenBSD          ef   EFI (FAT-12/16/
11   Hidden FAT12        56   Golden Bow         a7   NeXTSTEP         f0   Linux/PA-RISC b
12   Compaq diagnost 5c   Priam Edisk          a8   Darwin UFS       f1   SpeedStor
14   Hidden FAT16 <3 61   SpeedStor            a9   NetBSD           f4   SpeedStor
16   Hidden FAT16        63   GNU HURD or Sys ab   Darwin boot      f2   DOS secondary
17   Hidden HPFS/NTF 64   Novell Netware     b7   BSDI fs          fd   Linux raid auto
18   AST SmartSleep  65   Novell Netware     b8   BSDI swap        fe   LANstep
1b   Hidden W95 FAT3 70   DiskSecure Mult bb   Boot Wizard hid  ff   BBT
1c   Hidden W95 FAT3 75   PC/IX
```

HOW LINUX SEES PARTITIONS

- The /dev/ directory files point to hardware.
- Traditional descriptions of IDE and EIDE dirves:
  - /dev/hda
  - /dev/hdb
  - /dev/hdc
  - /dev/hdd
- Traditional descriptions of SCSI dirves:
  - /dev/sda
  - /dev/sdb
  - /dev/sdc
  - /dev/sdd
- Linux kernel 2.6 (2.4?) now views all IDE and EIDE as SCSI dirves. Not all utilities changed yet.

22

PRINT TABLE

1ˢᵗ Example

root@dell-laptop:~# fdisk /dev/sda

```
Command (m for help): p

Disk /dev/sda: 20.0 GB, 20003880960 bytes
255 heads, 63 sectors/track, 2432 cylinders
Units = cylinders of 16065 * 512 = 8225280 bytes
Disk identifier: 0x51045103


    Device Boot         Start             End        Blocks      Id  System
/dev/sda1                   1              12         96358+      83  Linux
/dev/sda2    *             13             985       7815622+      7  HPFS/NTFS
/dev/sda3                 986            1083        787185       83  Linux
/dev/sda4                1084            2432      10835842+      5  Extended
/dev/sda5                1084            1206        987966       82  Linux
     swap / Solaris
/dev/sda6                1207            1807       4827501       83  Linux
/dev/sda7                1808            2346       4329486       83  Linux
```

DISK SPACE

1st Example

root@dell-laptop:~# df -Th

```
Filesystem       Type       Size   Used Avail Use% Mounted on
/dev/sda6        ext3       4.6G   2.6G  1.8G   61% /
varrun           tmpfs      189M   104K  189M    1% /var/run
varlock          tmpfs      189M      0  189M    0% /var/lock
udev             tmpfs      189M    64K  189M    1% /dev
devshm           tmpfs      189M      0  189M    0% /dev/shm
lrm              tmpfs      189M    34M  155M   18%
                      /lib/modules/2.6.22-14-generic/volatile
/dev/sda3        ext3       756M   702M   17M   98% /home
/dev/sda1        ext2        92M    50M   37M   58% /media/sda1
```

24

MOUNTS
1ˢᵗ Example

root@dell-laptop:~# mount -l

```
/dev/sda6 on / type ext3 (rw,errors=remount-ro) [Ubuntu]
proc on /proc type proc (rw,noexec,nosuid,nodev)
/sys on /sys type sysfs (rw,noexec,nosuid,nodev)
varrun on /var/run type tmpfs (rw,noexec,nosuid,nodev,mode=0755)
varlock on /var/lock type tmpfs
   (rw,noexec,nosuid,nodev,mode=1777)
udev on /dev type tmpfs (rw,mode=0755)
devshm on /dev/shm type tmpfs (rw)
devpts on /dev/pts type devpts (rw,gid=5,mode=620)
lrm on /lib/modules/2.6.22-14-generic/volatile type tmpfs (rw)
/dev/sda3 on /home type ext3 (rw) [Home]
/dev/sda1 on /media/sda1 type ext2 (rw) [DSL]
securityfs on /sys/kernel/security type securityfs (rw)
binfmt_misc on /proc/sys/fs/binfmt_misc type binfmt_misc
   (rw,noexec,nosuid,nodev)
```

FSTAB

1st Example

root@dell-laptop:~# cat /etc/fstab

```
# /etc/fstab: static file system information.
#
# <file system>          <mount point>    <type>  <options>        <dump> <pass>
proc                        /proc          proc    defaults          0    0
# /dev/sda6
UUID=eb203251-4187-433d-8a56-bc428b6fc6e6 / ext3 defaults       0    1
# /dev/sda3
UUID=01731504-5280-44a0-9692-016a0392f76b /home ext3 defaults     0    2
# /dev/sda1
UUID=c16c5ccb-0451-4838-9800-0a9f347ce179 /media/sda1  ext2 defaults 0  2
# /dev/sda2
UUID=0af06181-48d1-48f0-9c97-c79069860f04 /media/sda2 ext3 defaults 0  2
# /dev/sda5
UUID=b1c41e85-8d24-4930-8a20-5580bfcab018 none  swap sw          0  0
/dev/scd0                   /media/cdrom0    udf,iso9660 user,noauto 0  0
/dev/fd0                    /media/floppy0  auto     rw,user,noauto  0  0
```

UUID and LABEL

1st Example

root@dell-laptop:~# /sbin/blkid

```
/dev/sda1: LABEL="DSL" UUID="c16c5ccb-0451-4838-9800-0a9f347ce179"
   TYPE="ext2"
/dev/sda2: UUID="72F49187F4914DEB" TYPE="ntfs"
/dev/sda3: LABEL="Home" UUID="01731504-5280-44a0-9692-016a0392f76b"
   SEC_TYPE="ext2" TYPE="ext3"
/dev/sda5: TYPE="swap" LABEL="SWAP-hda5"
/dev/sda6: LABEL="Ubuntu" UUID="eb203251-4187-433d-8a56-
   bc428b6fc6e6" SEC_TYPE="ext2" TYPE="ext3"
/dev/sda7: LABEL="Fedora" UUID="cc9cedeb-1f14-4cf7-8b4e-
   ce05acd8c4e7" SEC_TYPE="ext2" TYPE="ext3"
```

GRUB STANSA

1st Example

```
# This entry automatically added by the Debian installer
# for an existing Linux installation on /dev/sda2.
#
title   Fedora Core (2.6.20-1.2944.fc6) (on /dev/sda2)
root     (hd0,1)
kernel /boot/vmlinuz-2.6.20-1.2944.fc6 ro root=LABEL=/
  rhgb quite
initrd /boot/initrd-2.6.20-1.2944.fc6.img
savedefault
boot
```

PRINT TABLE

2nd Example

List from fdisk:

```
Command (m for help): p

Disk /dev/sda: 80.0 GB, 80026361856 bytes
255 heads, 63 sectors/track, 9729 cylinders
Units = cylinders of 16065 * 512 = 8225280 bytes
Disk identifier: 0x49bdf011


    Device Boot  Start      End        Blocks    Id  System
/dev/sda1    *        1       13        104391    83  Linux
/dev/sda2            14     9729      78043770    8e  Linux LVM
```

DISK SPACE

2nd Example

[root@skull ~]# df -Th

```
Filesystem        Type      Size   Used Avail Use% Mounted on
/dev/mapper/VolGroup01-LogVol00
                  ext3       18G   4.8G   13G   28% /
/dev/sdb1         ext3      194M    19M  166M   11% /boot
/dev/mapper/VolGroup00-LogVol00
                  ext3       72G    33G   35G   49% /mnt
tmpfs             tmpfs     252M    24K  252M    1% /dev/shm
```

MOUNTS

2nd Example

[root@skull ~]# mount -l
```
/dev/mapper/VolGroup01-LogVol00 on / type ext3 (rw) [Fedora-8-
    slash]
proc on /proc type proc (rw)
sysfs on /sys type sysfs (rw)
devpts on /dev/pts type devpts (rw,gid=5,mode=620)
/dev/sdb1 on /boot type ext3 (rw) [Fedora-8-boot]
/dev/mapper/VolGroup00-LogVol00 on /mnt type ext3 (rw)
    [Fedora-6-slash]
tmpfs on /dev/shm type tmpfs (rw)
none on /proc/sys/fs/binfmt_misc type binfmt_misc (rw)
sunrpc on /var/lib/nfs/rpc_pipefs type rpc_pipefs (rw)
```

FSTAB

2ⁿᵈ Example

[root@skull ~]# cat /etc/fstab
```
/dev/VolGroup01/LogVol00 /          ext3    defaults       1 1
LABEL=Fedora-8-boot      /boot      ext3    defaults       1 2
LABEL=Fedora-6-slash     /mnt       ext3    defaults       1 3
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/VolGroup01/LogVol01 none       swap    defaults       0 0
/dev/VolGroup00/LogVol01 none       swap    defaults       0 0
```

UUID and LABEL

2nd Example

[root@skull ~]# /sbin/blkid

```
/dev/mapper/VolGroup01-LogVol01: TYPE="swap"
UUID="b7339352-6468-44df-b82b-a30cebc7a3ea"
/dev/mapper/VolGroup01-LogVol00: LABEL="Fedora-8-slash"
UUID="cc9cedeb-1f14-4cf7-8b4e-ce05acd8c4e7" SEC_TYPE="ext2"
  TYPE="ext3"
/dev/mapper/VolGroup00-LogVol01: TYPE="swap"
/dev/mapper/VolGroup00-LogVol00:
  UUID="9d84f996-4a17-458c-8a14-c63b707863a2"
SEC_TYPE="ext2" TYPE="ext3" LABEL="Fedora-6-slash"
/dev/sda1: LABEL="Fedora-6-boot" UUID="3772259c-dc46-4a4a-
  acb6-87f1859fe5ed"
SEC_TYPE="ext2" TYPE="ext3"
/dev/sdb1: LABEL="Fedora-8-boot"
  UUID="f1378b45-189f-40ff-95fc-0562c87976cc"
SEC_TYPE="ext2" TYPE="ext3"
/dev/VolGroup01/LogVol00: LABEL="Fedora-8-slash"
UUID="cc9cedeb-1f14-4cf7-8b4e-ce05acd8c4e7" SEC_TYPE="ext2"
  TYPE="ext3"
```

GRUB STANSAS

2nd Example

```
title Fedora (2.6.23.9-85.fc8)
    root (hd1,0)
    kernel /vmlinuz-2.6.23.9-85.fc8 ro
     root=/dev/VolGroup01/LogVol00 rhgb
    initrd /initrd-2.6.23.9-85.fc8.img

title Fedora (2.6.23.1-42.fc8)
    root (hd1,0)
    kernel /vmlinuz-2.6.23.1-42.fc8 ro
     root=/dev/VolGroup01/LogVol00 rhgb
    initrd /initrd-2.6.23.1-42.fc8.img

title Fedora6
    rootnoverify (hd0,0)
    chainloader +1
```

INTERNET REFERENCES

http://en.wikipedia.org/wiki/Disk_partitioning
http://en.wikipedia.org/wiki/List_of_partition_utilities
http://www.tech-faq.com/hard-disk-partition.shtml

http://www.partimage.org/

QUESTIONS

Introduction to Partitions
(Those things on your Hard Drive)
by Stan Reichardt
stanr@sluug.org

9 Jan 2008