LPIC-1 101-400 – Lesson 12

102.1 Design hard disk layout

Introduction

- During the installation of a new Linux system we are given the option to partition the hard disk to different filesystems
- Every filesystem occupies its own partition
- For personal computers, small servers or virtual machines we usually do not need more than 1 or 2 filesystems e.g. **/boot**, **/ (root)**
- For large systems like physical servers we generally have more filesystems

The *root "/"* filesystem

- It is the root of the filesystem tree and all other directories and filesystems are subdirectories of "/"
- It hosts the appropriate applications and files for the proper operation of a Linux system
- It usually does not need to be very large in case /var, /usr,
- /home and /tmp directories are hosted on their own partitions
- If the case above is true "/" is static in capacity and the minimum space required can be as low as **500MB** and not larger than **2GB**

The */boot* filesystem

- Hosted the kernel files (vmlinuz*), ramdisk files (initrd*), bootloader files (/boot/grub) and generally files related to booting up the system
- It grows only in case new kernels are installed. In this case old kernels need to be removed so that **/boot** does not fill up
- A typical size for /boot is up to **100MB** with maximum up to **500MB**
- Old systems had a restriction where the BIOS could not read beyond 1024th cylinder. In that case **/boot** had to be equal or less than the size corresponding to the 1023th cylinder or else **BIOS** could not find a kernel to boot the system

The */boot/efi* filesystem

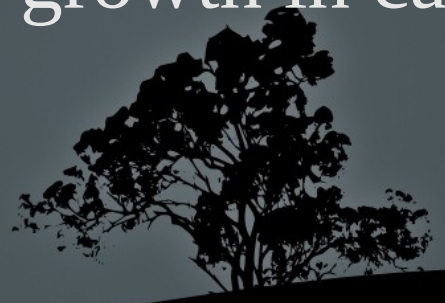
- Known as the **EFI System Partition** (**ESP**)
- It is needed when the system has **UEFI** instead of a **BIOS** and the disks are **GPT** formatted instead of **MSDOS** (aka **MBR**)
- The minimum size for **/boot/efi** is **100MB** but **512MB** is recommended for compatibility with other systems (like Windows) on dual boot systems. The system is formatted as FAT32

The */home* filesystem

- Hosts the user home directories (homedirs)
- For users **user1** and **user2** the **/home/user1** and **/home/user2** directories are assigned respectively
- The environment variable **$HOME** as well as the tilde "~" symbol, represent the home directory for the current user
- The size of **/home** depends on the number of users, the size of the user date and the available disk space on the disk. Generally it is one of the larger filesystems

The */usr* filesystem

- Hosts user (non-system) applications and initial data of applications, user libraries, as long as documentation for applications (/usr/share/doc/<application name>)
- It grows only when a new a new program, library or documentation is installed
- In many setup this can be a common network directory (e.g. via NFS) for many systems
- The size is determined from the size of the application files and the expected growth in case of new applications



The */var* filesystem

- Hosts variable data like log files, emails, print spools, temporary application files, cached files, application data, databases, etc
- It is one of the most rapidly changing filesystems
- Its size depends on the specific needs. If there will be no data hungry applications it can be as small as **2GB**
- It is usually recommended for the **/var** directory to be on a different filesystem (aka partition) than "/" so in case it fills up, the overall system stability is not affected

The */tmp* filesystem

- Hosts temporary files for users, like session data, temporary application files, etc
- In this directory everybody has writing rights but can only delete the files/directories they own!
- If a user writes too many files it can fill the system up so it is recommended to exist as a different filesystem

The *swap* partition

- The **swap** partition has its own format
- It serves as a temporary virtual memory in case the real memory (RAM) fills up
- Traditionally there was a thumb rule that it should be double the RAM
- In systems with large RAM (>2GB) it does not need to be bigger than 2GB but that depends on the system applications
- Instead of a swap partition we can have a swap file hosted on a normal filesystem
- Because swapping is related with degraded performance some systems with high I/O are build with big enough RAM and no swap

Filesystem Mount Points

- Mount point are directories attached to filesystems
- They can be set on startup in the /etc/fstab file:
  `$ cat /etc/fstab`
- The active mount points can be found in /etc/mtab
  `$ cat /etc/mtab`
- **`$ mount`** `# show filesystems related to their mount points and their mount arguments`
- **`$ df -hT`** `# shows filesystem usage, in human readable form` **`(-h)`** `and the type of the filesystem` **`(-T)`**

Filesystem Mount Points

```
$ cat mtab
/dev/sda2 / ext3 rw 0 0
proc /proc proc rw 0 0
sysfs /sys sysfs rw 0 0
devpts /dev/pts devpts rw,gid=5,mode=620 0 0
/dev/sda8 /tmp ext3 rw 0 0
/dev/sda7 /var ext3 rw 0 0
/dev/sda6 /usr ext3 rw 0 0
/dev/sda5 /home ext3 rw 0 0
/dev/sda1 /boot ext3 rw 0 0
tmpfs /dev/shm tmpfs rw 0 0
none /proc/sys/fs/binfmt_misc binfmt_misc rw 0 0
sunrpc /var/lib/nfs/rpc_pipefs rpc_pipefs rw 0 0
```

Mount points are marked in yellow

Partitions

- **$ cat /proc/partitions** # show disks and their partitions
- # **fdisk -l** # show partitions, filesystems, their size and hard disk parameters
- # **parted -l** # similar to **fdisk -l**

http://en.wikipedia.org/wiki/Master_boot_record
https://en.wikipedia.org/wiki/GUID_Partition_Table

Logical Volume Manager – LVM

- **LVM** provides more flexibility in managing storage
- **Physical Volumes** (**PV**): the PV are the disks or partitions assigned to a Volume Group
- **Volume Group** (**VG**): the VG is at the top of the LVM hierarchy. It receives storage resources in the form of PV and exports Logical Volumes to be used as filesystem
- **Logical Volumes** (**LV**): logical volumes are logical structures, grouped under a VG and they replace the partitions of a more traditional storage

Logical Volume Manager – LVM

- **LVM** features:
- Logical volumes can grow online
- Volume groups can grow online by adding more PVs
- Supports snapshots
- Supports RAID (1, 5, 6) and stripping
- High Availability features

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