Filesystem Maintenance

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Lectures

1. System administration introduction
2. Operating System installation
3. User management
4. Application management
5. System monitoring
6. **Filesystem Maintenance**
7. Local services
8. Network services
9. Security and Protection
10. Virtualization
Outline

1. Introduction
   - Goals

2. Filesystems

3. Disk verification

4. Logical Volume Manager (LVM)

5. Backups
Goals

Knowledge
- Filesystems
- Backup tools
- Backup media

Abilities
- Filesystem resizing
- Filesystem verification
- Perform and restore backups
Outline

1. Introduction
2. Filesystems
3. Disk verification
4. Logical Volume Manager (LVM)
5. Backups
Filesystems (I)

- **FAT (FAT16) → DOS**
  - Small disks (< 4GB)
  - File names 8+3

- **FAT32 (VFAT) → Win95**
  - Larger disks
  - Long filenames
  - Partial definition of soft-links
  - No owner or file access privileges

- **exFAT**
  - FAT32 Extension
  - Theoretical maximum capacity of 64ZiB (512TiB real)

- **NTFS → WinNT, XP, Vista, Windows 7**
  - Integrates ownership and privileges (create, modify, access...)
  - Maps to Windows NT security model
Filesystems (II)

- ext2
  - UNIX Filesystem
  - Soft/hard links
  - Access privileges
  - Longfilenames
- ext3
  - Adds journaling (eases error recovery)
- reiserfs
  - Files and directories organized similarly to a database
  - Features journaling
  - Very efficient in small files
  - No internal block fragmentation
Filesystems (III)

- **xfs**
  - journaling
  - Dynamic i-node management
  - ACLs
  - Very large disk sizes
  - Filesystem activity log

- **jfs**
  - journaling
  - Dynamic i-node management
  - ACLs and MAC (Mandatory Access Control)
  - Very large disk sizes
Filesystems (i IV)

- **ext4**
  - 64 bits addressing, improvements in journaling
  - Delayed allocation
  - Extents
  - 1 exbibyte (EiB) maximum size

- **btrfs**
  - Extents
  - Online resizing
  - Online balancing
  - Online filesystem check
Journal filesystems

- Journal: disk operation registry
  - Eases the recovery of the FS in case of crash or error
  - Slightly decrease in disk operations performance
- Journal outside the buffer cache
  - Journal can be stored in another disk or partition
- Ext3/4, reiserfs, JFS, XFS, NTFS, BTRFS have journal
Outline

1. Introduction
2. Filesystems
3. Disk verification
   - Filesystem ampliation
   - Disk quota management
4. Logical Volume Manager (LVM)
5. Backups
Disk verification (I)

Reason for errors
- Hardware errors
- Power shortage
- Operating system bugs
- Administration errors
  - Incorrect machine shutdown

Never verify a filesystem while mounted
- High probability of disk corruption
- Verification access skips the buffer cache and acts directly on the device
Disk verification (II)

Logical verification
- Filesystem metadata
- Directory structure
- Lost data recovery
  - Directory lost+found

Physical recovery
- Disk blocks with Input/output errors
- Command: badblocks
Filesystem ampliation

- Install and configure the new disk
  - Partition
  - or recycle existing ones...
- Create filesystem
- Decide mountpoints
- Transfer the required data to the new partition
- Mount the partition
  - Update `/etc/fstab`
- Maybe you have to reorganize existing directories
  - `/home → /homeA + /homeB`
  - `/home → /home/students + /home/professors`
Plan and issue a filesystem resizing for the partitions

- /home
- /var
Disk quota (I)

Quota

Ability to limit the amount of data a user (or user group) is able to use in a filesystem (partition)

Requires

- Support from the filesystem
- Support from the kernel
Quota management (II)

Partition preparation

- Mounted using options `usrquota` and/or `grpquota`
- It can be done from `/etc/fstab`
  
  ```
  /dev/sda9  /home  ext4  defaults,usrquota,grpquota  1  1
  ```

- `quotacheck` command to create the quota files
  
  ```
  quotacheck -v -a -g -u -m
  verbose all group user no-remount
  ```

- Creates
  - `/aquota.user`
  - `/aquota.group`
Quota management (III)

- **Quota enabling**
  
  
  ```bash
  quotaon -v -a -g -u
  verbose all group user
  ```
  
  Activates quota mechanisms, usually from `/etc/init.d/`

- **Quota disabling**
  
  `/sbin/quotaoff`

- **Quota editing (edquota)**
  
  Disk quotas for user xavim (uid 500):
  
<table>
<thead>
<tr>
<th>Filesystem</th>
<th>blocks</th>
<th>soft</th>
<th>hard</th>
<th>inodes</th>
<th>soft</th>
<th>hard</th>
</tr>
</thead>
<tbody>
<tr>
<td>/dev/sdb1</td>
<td>3</td>
<td>16</td>
<td>32</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

  - Data blocks and i-nodes quota
  - It is not possible to edit the used blocks/inodes, but the limits of the quota can be changed
Quota management (and IV)

- **Visualize quotas:** `quota -v`

```
Disk quotas for user xavim (uid 500):
Filesystem  blocks quota limit grace files quota limit grace
/dev/sdb1    32*  16  32  6days  2  0  0  0  -
```

* We are above the quotas, within the "hard" limit!!

- **"Grace period"**
  - Grace time where the user can reach the hard limit, it only raises warnings
  - If the grace period expires, then the system does not allow to go above the soft limit
Other maintenance tasks

Monitoring

- Free space \((\text{df})\)
  - Most systems reserve a (5%) of the space to be exclusively used by root
- Occupied space \((\text{du})\)

Synchronization

- Write to disk the modified buffers
  - \text{sync}
  - Update daemon
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Logical Volume Manager (LVM) (I)

Physical Volumes (PV)

- /dev/sda1
- /dev/sdb1
- /dev/sdb2

Volume Group

Logical Volumes (LV)

- home (ext3)
- swap
- usr (btrfs)
- / (root) (ext4)
Logical Volume Manager (and II)

- High level abstraction of the disk space
- Aggregates multiple physical partitions/disks
  - Allows to add more partitions to the volume
- It allows logical partitions within the volume
  - They can be assigned logical names
  - Customized distribution among the physical volumes
- Resizing
- Move

**Example:** `/etc/fstab`

```
/boot    /dev/sda1       ...
swap    /dev/vg00/swap   ...
/        /dev/vg00/root  ...
/home    /dev/vg00/home  ...
/usr     /dev/vg00/usr   ...
```
Introduction

Filesystems

Disk verification

Logical Volume Manager (LVM)

Backups
- Full Backup
- Incremental Backup
- Reverse Incremental Backup
Backups

- **Data to copy**
  - User data (home, mail, ...)
  - Program data (BBDDs, CVS, web, ...)
  - System configuration
  - Binary?

- **Backup frequency**
  - Data confidence
  - Data importance

- **Backup types**
  - Full Backup (all)
  - Incremental Backup (only changes)
  - Reverse Incremental Backup (only changes)
**Full Backup**

- Always copy all the data
  - Fast to restore
  - Large size
Incremental Backup

- Only backup the changed files

**Advantages**
- Small size
- It can be done in any media

**Inconveniences**
- Slower to restore
- The first one is equal to a full backup

Do not create a large backup sequence
Reverse Incremental Backup

- Everything is copied but in the former backup only the changes are kept

**Advantages**
- Fast to restore
- Little space

**Inconveniences**
- Only possible in random access media
# Backups

## Physical support

- Floppy, disc, CD, tape, network...

## To consider:
- Cost size ratio
- Reliability
- Availability
- Usability
- Speed

## Copy location

- Accident protection
- Fireproof boxes
- Keep some backups outside the company premises
- Stealing protection

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Exercise

Define a backup policy (data to backup, backup type, frequency, device, compression, ... ) for a multi-user server within a company with:

- 500 Gb. disk and 80 users
- Mail
  - 50Mb per user
- Web pages
  - 20 Mb per user
  - 100 Mb company web
- Code repository
  - 10 GB distributed among 20 projects
  - Only 5 active projects
Other considerations

- When having different servers it is recommended to
  - Define specific backup machines
    - cheaper
    - easy to administer

**Tools:** tar+rsync/ssh, amanda, bacula
Personal Homework

- Task automation
  - Programming language: bash, perl
  - Information search: find, grep...