CENTRE ESPECÍFIC
D´EDUCACIÓ A DISTÀNCIA DE
LA COMUNITAT VALENCIANA

UNIT 10.LINUX - PART 2

Computer systems
CFGS DAW

Autor: Alfredo Oltra

Revisado: Vicent Bosch

vicent.bosch@ceedcv.es

2020/2021

Versión:210214.1455

Licencia

Nomenclatura

A lo largo de este tema se utilizarán distintos símbolos para distinguir elementos importantes dentro del contenido. Estos símbolos son:

Importante

Atención

Interesante

INDEX

UD010. LINUX - PART 2

1. USERS IN LINUX

Linux is a multi-user operating system.

Users in Linux have a name associated to them, but internally they are identified by a number. This identifier is called UID. If two users have different name but same UID, they are internally the same user. More information in https://en.wikipedia.org/wiki/User_identifier

Basically there are two kind of users: normal users and root.

- A normal user is a user with UID greater than 0 and can do limited operations and only access/modify to resources that he has permission to access.
- Root user is a user with UID=0. It is the main administrator of the system and virtually can do almost everything (change configuration, install programs, install drivers, run servers, read/delete any file,…).

> To do operations being root user is very dangerous (you can do a mistake and broke your system). If you enter in a system being root, you have to know very well what are you doing.

1.1 Files "/etc/passwd" and "/etc/shadow"

List of users is stored in a file called "/etc/passwd". It stores several attributes like UID, home directory, if user is enabled or not,…

Check the following information about "/etc/passwd" to understand the structure of the file.

https://www.cyberciti.biz/faq/understanding-etcpasswd-file-format/

Also encrypted password can be stored in "/etc/passwd", but it is not recommended for security reasons ("/etc/passwd" could be read by everybody).

If we execute "cat /etc/passwd" we can view its content.

The user data is separated with ":" as you can see in the image below:

```
sddm:x:119:125:Simple Desktop Display Manager:/var/lib/sddm:/bin/false
geoclue:x:120:126::/var/lib/geoclue:/usr/sbin/nologin
pulse:x:121:127:PulseAudio daemon,,,:/var/run/pulse:/usr/sbin/nologin
profesor:x:1000:1001:profesor:/home/profesor:/bin/bash
systemd-coredump:x:999:999:systemd Core Dumper:/:/usr/sbin/nologin
```

For this reason, there is other file for store passwords called "/etc/shadow" that only root user can read and modify. Using the terminal, execute "sudo cat /etc/shadow" to view its content.

```
profesor:$6$e8Ok2sBJGyFyZdWz$XY7a2s2SZ6bq/polpOPOs3ITxcc0lhO3CekkNgSvuBNFiC64
n1WoEwKSoJlLaE8018doa3xbaRaDj7.M7eO/A0:18658:0:99999:7:::
systemd-coredump:!!:18658:::::
```

Check the following information about "/etc/shadow" to understand the structure of the file.

https://www.cyberciti.biz/faq/understanding-etcshadow-file/

> Summarizing, "/etc/passwd" stores general info of users and "/etc/shadow" stores encrypted passwords.

1.2 Command "sudo" and sudoers list

A few lines ago we have said that there are 2 kind of users: **root** and **normal** users. It is an inefficient and insecure way to manage admin accounts.

For this reason, in modern Linux distributions like Ubuntu or Mint:

- By default, root account is deactivated (you can't log in as root).
- There is a list called "sudoers". In this list, you can give several privileges to normal users.
- Most common (and useful) privilege is to "became root" **temporarily** using a command called "sudo" before the instruction to perform. With this tool and this configuration, system can have more than one admin (each user that is in **sudoers** list can perform root operations).

Also it is mandatory to use the command "sudo" before the command run as root. It increase security because it is supposed that if you use "sudo" you know what are you doing.

Example:

If user pepe (UID=1001) is in sudoer list and executes:

"sudo cat fichero.txt"

It executes the command "cat fichero.txt" being root (UID=0).

> When you run first time in your session a sudo command (or your last sudo command was a lot of time ago, usually more than 15 minutes), the system asks you your own login for security reason.

More information in https://en.wikipedia.org/wiki/Sudo

1.3 Command "su"

Command "su" is an abbreviation of "Switch User".

This command can be called:

- Without parameters: in this case, it tries to log as root (UID=0). It works even if root account is disabled.
- With parameter: it has a parameter that is the username that you want to log in.

If you run the command being root, it automatically logs as the user. If you are a normal user, it asks you the user password.

Example:

"su pepe"

The system will try to log in as the user "pepe".

"sudo su"

The system will try yo log as root (UID=0).

More information in https://en.wikipedia.org/wiki/Su_(Unix)

1.4 Creating users in Linux

In this page, you can read information about how to create users (by command line) and if you wish, give them "sudo" privileges: https://www.digitalocean.com/community/tutorials/how-to-add-and-delete-users-on-ubuntu-16-04

Also you can watch an example with graphical interface in this video

https://www.youtube.com/watch?v=DQHS1tQ2Xt8

> 📢 When you create a user in Linux, default content of its new home directory is obtained from directory "/etc/skel". It works like a "template". More information in http://linuxg.net/the-unix-and-linux-skeleton-directory-etcskel/

Basically there are two ways to create users:

1. Using the script "adduser *username"* and follow the "wizard".
2. Using the command "useradd *username".* This is more advanced option.

Try this example and check the content of /*etc*/*passwd* for the new user.

```
profesor@profesor-virtualbox:/$ sudo adduser student
Adding user `student' ...
Adding new group `student' (1002) ...
Adding new user `student' (1001) with group `student' ...
Creating home directory `/home/student' ...
Copying files from `/etc/skel' ...
New password:
Retype new password:
passwd: password updated successfully
Changing the user information for student
Enter the new value, or press ENTER for the default
        Full Name []: Student A
        Room Number []: DAW
        Work Phone []: 000
        Home Phone []: 111
        Other []: this is a test
Is the information correct? [Y/n] Y
```

Type cat ***etc/passwd | grep student*** to get the lines that match the word "student". Grep command will be explained later.

```
profesor@profesor-virtualbox:/$ cat /etc/passwd | grep student
student:x:1001:1002:Student A,DAW,000,111,this is a test:/home/student:/bin/b
ash
```

1.5 Modifying and deleting users in Linux

The commands to modify and delete users are:

1. "usermod *username".* Type "man usermod" to learn more about this command.
   - **usermod -L student,** will lock the user so that the login is not possible.

     Remember that you must be root to apply these changes. The changes are applied on the shadow file. Check its content and locate the difference.
   - **usermod -U student,** will unlock the user.
2. "userdel *username".*

2. GROUPS IN LINUX

Linux lets you create groups of users. It is useful to give permissions or privileges (like sudoers list) to a complete group (for example, you can give "sudo" privilege to a group and each member of this group could run sudo command to became root).

A user can be member of several groups at the same time.

Like users, groups have a name, but internally they are identified by an integer GID. If two groups share the same GID, internally they are the same group.

2.1 File "/etc/group"

There is a file "/etc/group" where groups are listed. Each line is a group and it stores several information like name, GID and the most important value: the complete list of users that are members of that group.

Check the following information about "/etc/group" to understand the structure of the file.

https://www.cyberciti.biz/faq/understanding-etcgroup-file/

```
sambashare:x:1000:profesor
profesor:x:1001:
systemd-coredump:x:999:
student:x:1002:
```

2.2 Creating groups in Linux

In this link you can watch how to create a group and add an existing username to that group using console http://www.omnisecu.com/gnu-linux/redhat-certified-engineer-rhce/how-to-create-a-new-group-in-linux-using-groupadd-command.php

Also you can view how to do it graphically in this video https://www.youtube.com/watch?v=ZNeWntArcOg

For example:

1. Create a new group:

```
sudo groupadd dawuser
```

2. Add two users to this group:

```
sudo usermod student -aG dawuser
sudo usermod profesor -aG dawuser
```

3. Check the content of */etc/group*

```
dawuser:x:1003:student,profesor
```

3. FILES AND DIRECTORIES IN LINUX

3.1 Types of files

In Linux there are those types of files:

- **Regular files**: contains information. They are regular files, like we use everyday.
- **Directories**: they are special files with references to other directories and files.
- **Links**
  - **Symbolic links**: it is a file that contains the route to other file. Is similar to Windows shortcuts. If you delete original file, symbolic link remains, but it points to a nonexistent file.
  - **Hard links**: it is not a type of file, it is a second name to a file. If you create a hard link of a file, for the file system they are the same file and there is no way to know which is the original. If a file have more than one reference, it is only delete when all references al deleted.
- **Special files**: they are files that usually represent physical devices, like storage units, printers….

If you type "`ls /etc -l`", the first letter indicates the type of file: - regular, d directory, l link.

```
drwxr-xr-x  2 root root     4096 jul 31  2020 rcS.d
-rw-r--r--  1 root root       52 feb  1 18:07 resolv.conf
lrwxrwxrwx  1 root root       13 mar 14  2020 rmt -> /usr/sbin/rmt
-rw-r--r--  1 root root      887 abr  1  2013 rpc
-rw-r--r--  1 root root     1382 feb 11  2020 rsyslog.conf
drwxr-xr-x  2 root root     4096 jul 31  2020 rsyslog.d
drwxr-xr-x  3 root root     4096 jul 31  2020 sane.d
```

Check the following information about type of files in Linux to learn how to identify them.

https://linuxconfig.org/identifying-file-types-in-linux

3.2 Hidden files

In Linux, hidden files are files that start with "." like ".bash". When you list a directory, they don't appear, unless you use "-a" (all files) parameter. You can see them using "ls -a".

4. PERMISSIONS IN LINUX

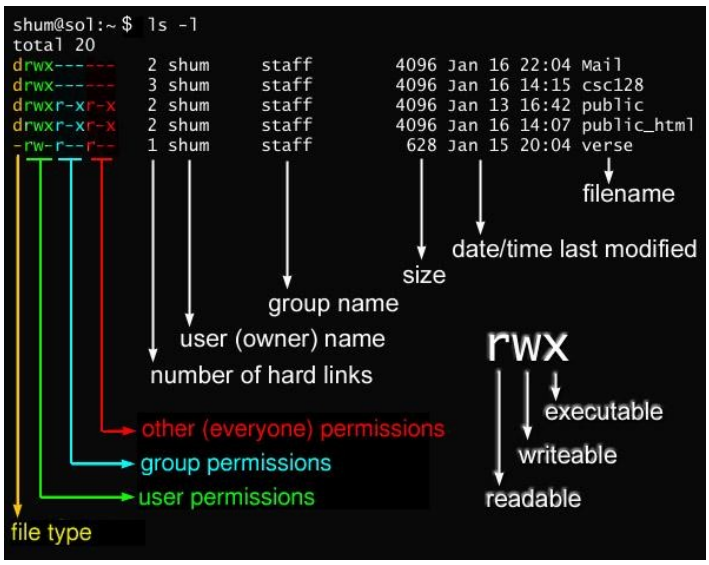
In Linux using command line command "ls -l" you can view detailed information about files and directories. This information contains permissions of each file or directory.

The main types of permissions in Linux are:

- Read
  - In a file: lets to read its content.
  - In a directory: lets to list its files, directories names and attributes (command ls).
- Write
  - In a file: you can modify content of the file.
  - In a directory: you can delete or create files and directories in that directory.
- Execute
  - In a file: you can run the file (like Windows ".exe").
  - In a directory: you can enter the directory (cd command).

This main permissions should be defined in 3 groups: owner (affects to owner of the file), group (affects to member of the group) and others (affect to other users).

An example of "ls -l" command applied to permissions:



4.1 Permission grant algorithm

To determine if a permission is granted or not, it follows the next algorithm:

1) First check if user is root (UID=0). If it is true, permission is granted.
2) Secondly check if user is the owner. If it is the owner, "owner permissions" are applied.

3) Thirdly if user is not root or the owner, but it is a member of group associated to the file, “group permissions” are applied.

4) Lastly, it user is not root, not the owner and not member of group, “other permissions” are applied.

> 📣 It is possible to find contradictions like “others” have more permissions than “owner”. If “others” can write and owner can’t, although it is strange, it is a valid configuration.

4.2 Using chmod command to set permissions

Command chmod is used to set permissions. Only root and owner of the resource can change permissions.

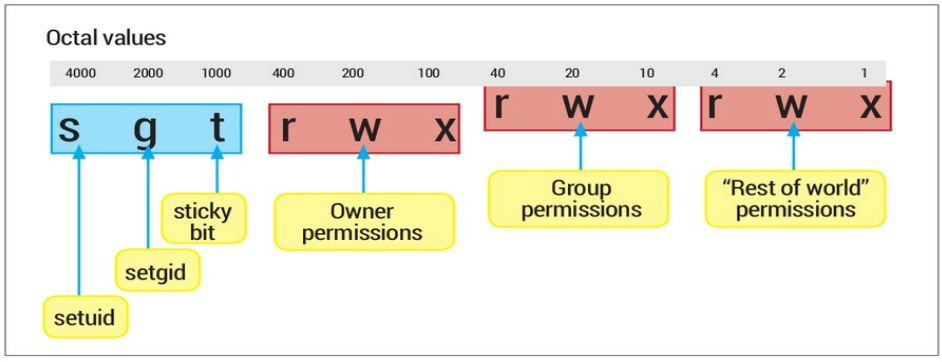
Chmod mainly has two notations:

- **Alpha notation:**
  - Example: chmod u=rwx, g=rx, o=- myFile.txt #It puts all permissions to owner, read an execution to group and nothing to others.
- **Octal notation:**
  - Uses “Binary value” of an octal value to set permissions. For example, 5 is 101 in binary and it is equivalent in rwx to read and execute permissions.
  - Example: chmod 750 myFile.txt It puts the same permissions that last example

More information about it in http://www.perlfect.com/articles/chmod.shtml

4.3 Special permissions

We have talked about 9 bits of permissions (rwx for owner, rwx for groups and rwx for other). But there are 3 bits more: setUID, setGID and Sticky bit:



- **setUID**: https://en.wikipedia.org/wiki/Setuid
  - In files: if setUID permission is activated, when you execute that file, you don’t execute it with your own UID, you execute it with owner UID.

    - In directories: if setUID permission is activated, if you create a file or a directory, you are not the owner. The owner is the one of the parent directory where you are.
- **setGID**: https://en.wikipedia.org/wiki/Setuid
    - The same than setUID, but with group ID instead user ID.
- **Sticky bit:** https://en.wikipedia.org/wiki/Sticky_bit
    - Nowadays is mainly used in directories. If somebody have write permission in a directory, he can create files and directories but he also can delete any file or directory. If sticky bit is activated in a directory, any person with write permissions can create files and directories, but only can delete files and directories that are owned by him.
    - The only exceptions are: root and owner of the parent directory.

More information about those permissions in https://www.liquidweb.com/kb/how-do-i-set-up-setuid-setgid-and-sticky-bits-on-linux/

5. MAIN COMMANDS

In this section we are going to describe the main console commands on Linux systems. If you want to obtain detailed information about each of them, you can use "man command".

Command	What it does	Example
Commands to manage the interface		
man	Shows help of a command	man ls
clear	Clear screen	Clear
echo	Show a literal text in screen.	echo "Hello World"
exit	Closes the session in console	exit

Command	What it does	Example
Commands to configure the system		
date	Set date of the system	date #Shows date date -s #Sets date
cal	Shows the calendar	cal
shutdown	Shutdown the system	shutdown
reboot	Reboot the system	Reboot

Command	What it does	Example
Commands to obtain information about disks		
du	Shows disk usage for each file.	du -h #Human readable format
df	Shows information about filesystems	df -h #Human readable format

Command	What it does	Example
Commands to manage files and directories		
touch	Creates an empty file	touch myfile.txt
vi / nano	Creates/edits a text file	nano myfile.txt vi myfile.txt
mkdir	Creates a directory	make mydir
cat more	Shows the content of a text file	cat myfile.txt more myfile.txt
grep	Searches a text patron in a text file	grep root /etc/password
ls	Shows contents of a directory	ls ls -la
cd	Changes directory	cd /home #Absolute route cd ../myDir #Relative route
pwd	Shows current route	pwd
rm	"rm" deletes files "rm -r" deletes a directory recursively	rm myfile rm -r myDirectory
cp	"cp" copy a file "cp -r" copies a directory	cp myFile /home/admin cp -r myDir /home/admin

	recursively	
mv	Moves/renames a file or a directory	mv myFileOldName /home/myNewName
ln	"ln" creates a hard link. "ln -s" creates a symbolic link (like windows shortcuts.	ln myFile hardLinkMyFile ln -s myFile shortcutMyFile
mount	Mount a device in a folder.	mount /dev/sda1 /media/myDisk

Command	What it does	Example
Commands related to permissions		
chmod	Changes permissions of a file or a directoy	chmod 750 myFile
chown	Changes propietary/group of a file or a directory	chown newuser:newgroupt my file

Command	What it does	Example
Commands related to redirections and pipelines		
>	Redirects the output to a new file if does not exist, overwrites it if it exists.	cat file.log > newfile
>>	Adds the output to an existing file. If does not exist, it will create a new file.	cat file.log >> newfile
2>	If there's an error in the execution, redirects the error message.	cat nofile.log 2> error.log
2>>	If there's an error in the execution, redirects the error message to the end of an existing file. If does not exist, it will create it.	cat nofile.log 2>> error.log
|	Pipeline. The output of a command becomes the input of a second command.	cat /etc/group | grep user ls -l file2* | grep student

6. GREP COMMAND

Grep command is the short form of *global search for the regular expression.*

It is used to search a *pattern* in lines of one or more files.

https://www.softwaretestinghelp.com/grep-command-in-unix/

The pattern used to filter can use the following expressions:

- ^ start of line.
- $ end of line.
- . (equals to ? from Shell). One character.
- [abc] represents one character in the list. (a, b or c)
- [^abc] represents on character not in the list.
- [A-Z] range.
- r* 0 o more occurrences of r.
- \<string words starting with string
- string\> words ending with string.

7. ADDITIONAL MATERIAL

[2] Exercises

8. BIBLIOGRAPHY

[1] “The Linux command line” Creative Commons book http://linuxcommand.org/tlcl.php

[1] Glossary.