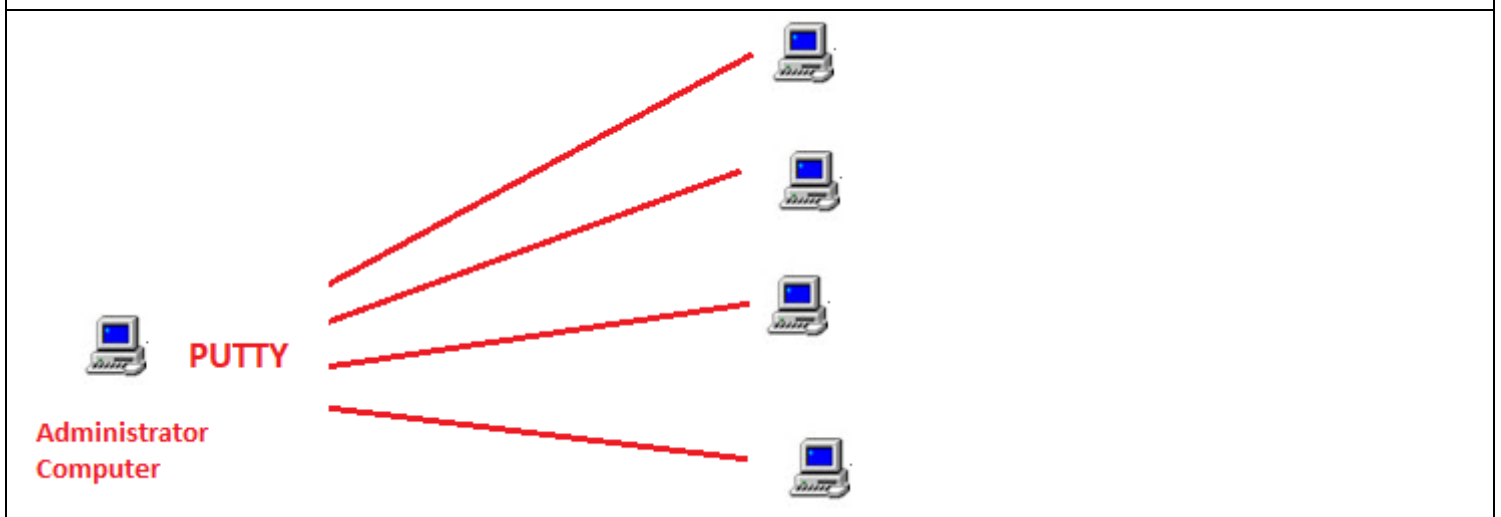
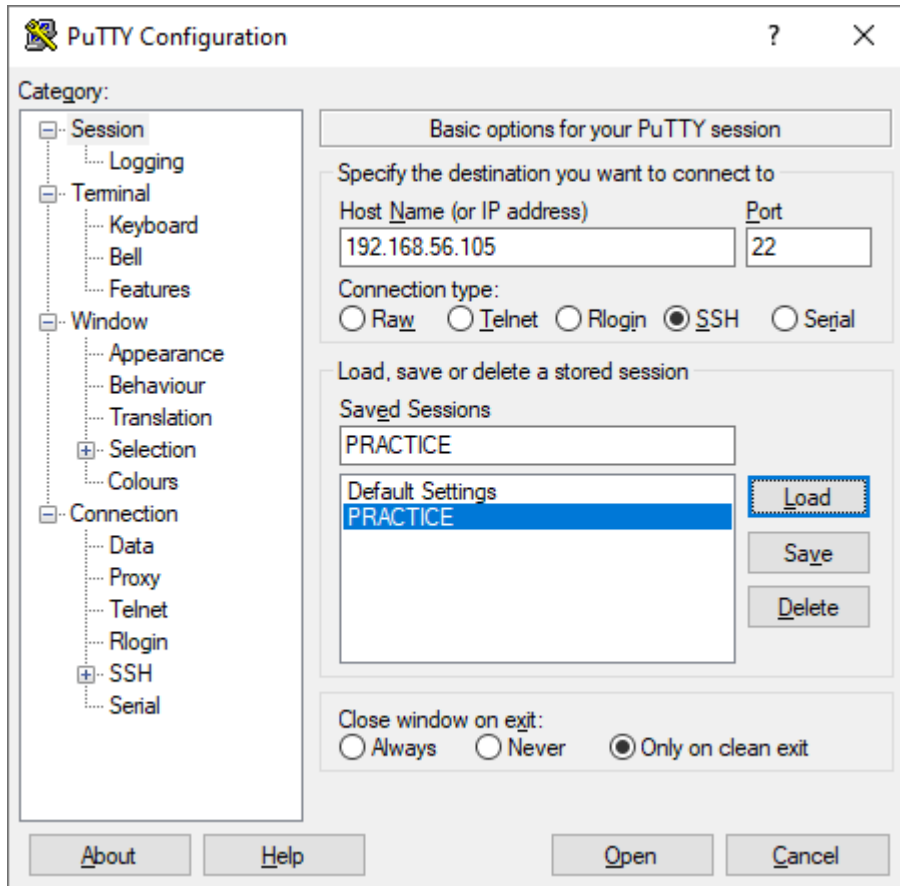
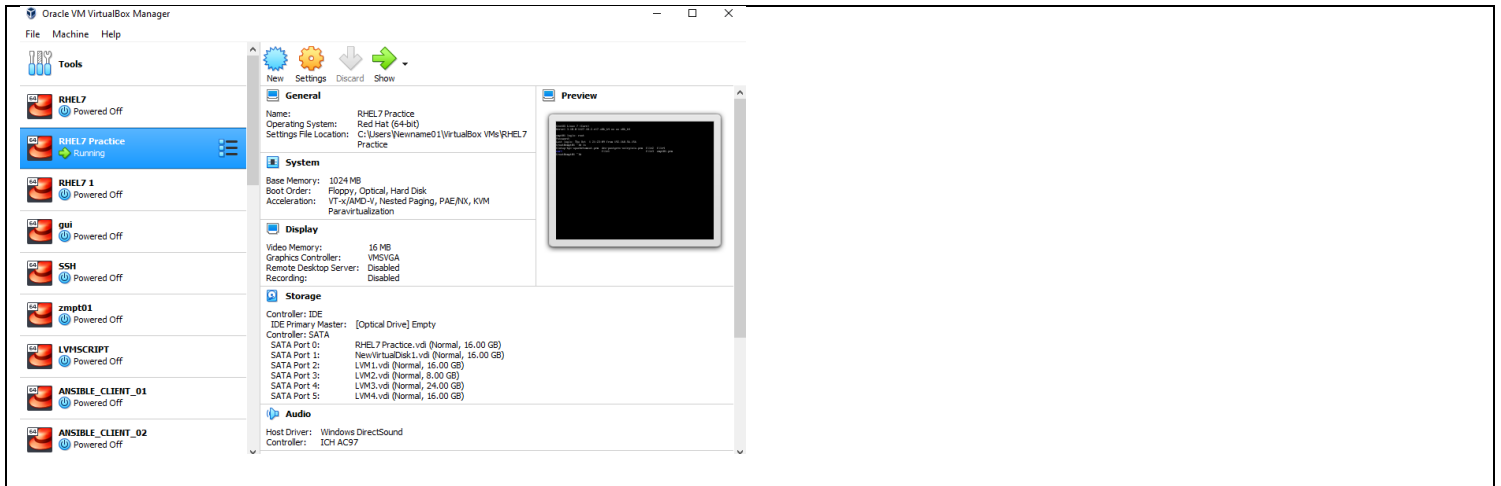




10-10-2020

<https://youtu.be/30Wsc3zCWNk>





CLI – Command Line Interface

```
root@localhost:~
```

```
[root@localhost ~]#
```

root – Administrator – Super user

- Root user has full access
- Root user cannot be renamed
- Never share the password with anybody
- Don't put in email, chats or text messages, don't share it

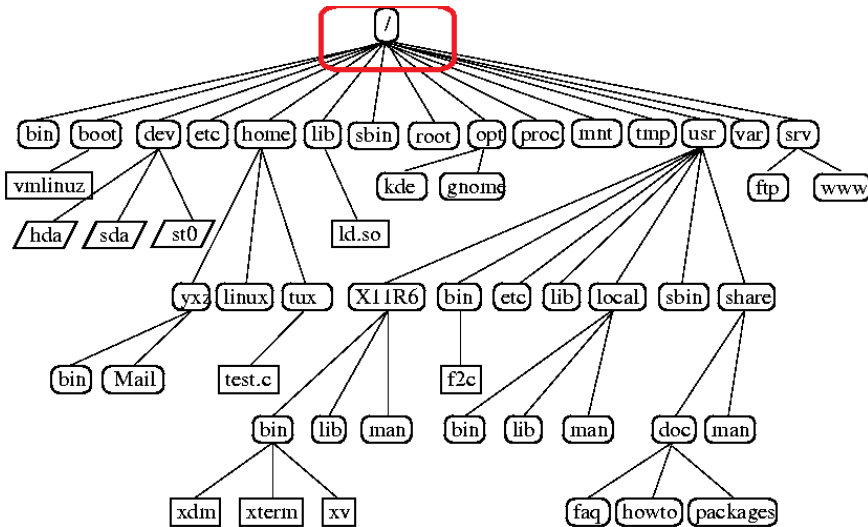
```
/root
```



- Root user home directory or
- When root user logs in to system this is his landing space

/

- Root directory
- This is the topmost directory



File = file
Directory = Folder

For Linux a file and a directory is also file

pwd

- Print working directory
- Present working directory

```
[root@localhost ~]# pwd
/root
```

clear

- Clears the screen

Input

```
[root@localhost ~]# pwd < ---input command to OS
```



Output

```
/root          < --- Response from OS
```

cd

- allows you to change the directory

```
[root@localhost ~]# cd /  
[root@localhost /]#
```

cd

- Simply type cd and hit enter
- You jump back to home directory

```
[root@localhost /]# cd  
[root@localhost ~]#
```

ls

- this command list the content of the pwd directory

```
[root@localhost ~]# ls  
anaconda-ks.cfg
```

ls -l

- long list switch with ls command
- it provides the details of the list contents

```
[root@localhost ~]# ls -l  
total 4  
-rw-----. 1 root root 1407 Oct  4 16:07 anaconda-ks.cfg
```

Ls -a

- shows you the list of files as well as hidden files/ folder
- hidden file or folder starts with . (period)

```
. anaconda-ks.cfg .bash_logout .bashrc .tcshrc  
.. .bash_history .bash_profile .cshrc
```

Ls -la

- this combination of command provides the long list with hidden files

```
[root@localhost ~]# ls -la
total 28
dr-xr-x---. 2 root root 135 Oct 4 16:57 .
dr-xr-xr-x. 17 root root 224 Oct 4 15:50 ..
-rw-----. 1 root root 1407 Oct 4 16:07 anaconda-ks.cfg
-rw-----. 1 root root 209 Oct 4 17:54 .bash_history
-rw-r--r--. 1 root root 18 Dec 28 2013 .bash_logout
-rw-r--r--. 1 root root 176 Dec 28 2013 .bash_profile
-rw-r--r--. 1 root root 176 Dec 28 2013 .bashrc
-rw-r--r--. 1 root root 100 Dec 28 2013 .cshrc
-rw-r--r--. 1 root root 129 Dec 28 2013 .tcshrc
```

history

- displays the history of commands you been using

```
[root@localhost ~]# history
 1 ip a
 2 cd /etc/sysconfig/network-scripts/
 3 ls
 4 vi ifcfg-enp0s3
 5 clear
 6 ls
 7 vi ifcfg-enp0s3
 8 clear
 9 ls
10 vi ifcfg-enp0s8
11 vi ifcfg-enp0s9
12 vi ifcfg-enp0s3
13 clear
14 ls
15 ls -l
16 clear
17 init 6
18 ip a
19 init 0
20 ip a
21 whoami
22 ls
23 lsblk
24 init 0
25 clear
26 pwd
```



```
27 clear
28 pwd
29 clear
30 pwd
31 cd /
32 cd
33 ls
34 ls -l
35 ls -a
36 clear
37 ls -a
38 ls -la
39 clear
40 history
```

!34

- run the specific command number from the history

```
[root@localhost ~]# !34
ls -l
total 4
-rw-----. 1 root root 1407 Oct  4 16:07 anaconda-ks.cfg
```

Run multiple command

;

```
[root@localhost ~]# ls -la;pwd;cd /
```

touch

- it create a file for you

```
[root@localhost ~]# touch file1
[root@localhost ~]# ls
anaconda-ks.cfg file1
[root@localhost ~]# ls -l
total 4
-rw-r--r--. 1 root root  0 Oct 10 16:20 file1 < --- creates file
```

touch file2 file3 file4

- Create multiple files

```
[root@localhost ~]# touch file2 file3 file4
[root@localhost ~]# ls
anaconda-ks.cfg file1 file2 file3 file4
[root@localhost ~]# ls -l
```



total 4

```
-rw-----. 1 root root 1407 Oct  4 16:07 anaconda-ks.cfg
-rw-r--r--. 1 root root   0 Oct 10 16:20 file1
-rw-r--r--. 1 root root   0 Oct 10 16:26 file2
-rw-r--r--. 1 root root   0 Oct 10 16:26 file3
-rw-r--r--. 1 root root   0 Oct 10 16:26 file4
```

touch .file5

- Creates a hidden file

```
[root@localhost ~]# ls -la
```

```
-rw-r--r--. 1 root root   0 Oct 10 16:27 .file5 < --- Hidden file is created
```

mkdir folder1

- Creates the folder with specified name in pwd

```
[root@localhost ~]# mkdir folder1
```

```
[root@localhost ~]# ls -l
```

```
drwxr-xr-x. 2 root root  6 Oct 10 16:29 folder1
```

mkdir folder2 folder3 folder4

- Creates multiple folders

```
drwxr-xr-x. 2 root root  6 Oct 10 16:29 folder1
```

```
drwxr-xr-x. 2 root root  6 Oct 10 16:33 folder2
```

```
drwxr-xr-x. 2 root root  6 Oct 10 16:33 folder3
```

```
drwxr-xr-x. 2 root root  6 Oct 10 16:33 folder4
```

```
[root@localhost ~]# yum install tree -y
```

mkdir -p redhat/whitehat/blackhat

- Create directory inside directory
- -p means parent directory
- This will also check the existing directory, it ignores it its already there

```
[root@localhost ~]# mkdir -p redhat/whitehat/blackhat
```

```
[root@localhost ~]# tree
```

```
.
├── anaconda-ks.cfg
```



```
├── file1
├── file2
├── file3
├── file4
├── folder1
├── folder2
├── folder3
├── folder4
├── redhat
│   ├── whitehat
│   └── blackhat
```

7 directories, 5 files

Changing directory using cd

- Changes the directory

```
[root@localhost ~]# cd redhat/whitehat/blackhat/
```

Tab key auto completes the file or directory

```
[root@localhost blackhat]# pwd
/root/redhat/whitehat/blackhat
```

cd

```
[root@localhost blackhat]# cd
[root@localhost ~]# pwd
/root < ---takes you back to home directory
```

Jump to previous working directory

```
[root@localhost ~]# cd -
/root/redhat/whitehat/blackhat < ---Takes you back to previous working directory
```

```
[root@localhost blackhat]# ls -la
total 0
drwxr-xr-x. 2 root root 6 Oct 10 16:40 . < --- Single dot is link to its self
drwxr-xr-x. 3 root root 22 Oct 10 16:40 .. < --- two dots are link to parent directory
```

.



- This is representation of present working directory
- It is a link to current working directory
- Hidden

..

- This the representation of parent directory
- This will take you back one level up directory
- Hidden

cd ..

```
[root@localhost ~]# cd redhat/whitehat/blackhat/  
/root/redhat/whitehat/blackhat
```

```
[root@localhost blackhat]# cd ..  
[root@localhost whitehat]# pwd  
/root/redhat/whitehat
```

```
[root@localhost whitehat]# cd ..  
[root@localhost redhat]# pwd  
/root/redhat
```

```
[root@localhost redhat]# cd whitehat/blackhat/  
[root@localhost blackhat]# pwd  
/root/redhat/whitehat/blackhat
```

```
[root@localhost blackhat]# cd ../../..  
[root@localhost ~]# pwd  
/root
```

Relative path

```
└─ redhat  
  └─ whitehat  
    └─ blackhat
```

```
[root@localhost ~]# cd redhat/whitehat/blackhat/ < ---used relative to go in the directory 'blackhat'  
[root@localhost blackhat]# pwd  
/root/redhat/whitehat/blackhat
```

Absolute path

```
/root/redhat/whitehat/blackhat  
[root@localhost blackhat]# cd /root/redhat  
[root@localhost redhat]# pwd  
/root/redhat
```

pwd provides you absolute path of the present working directory

rm

- Removes the file

```
[root@localhost ~]# rm anaconda-ks.cfg  
rm: remove regular file 'anaconda-ks.cfg'? y
```

rm -rf

- Removes file forcefully without confirmation

```
[root@localhost ~]# rm -rf file1
```

Wild card

```
[root@localhost ~]# rm -rf fi*  
[root@localhost ~]# ls  
folder1 folder2 folder3 folder4 redhat  
[root@localhost ~]# rm -rf fo*  
[root@localhost ~]# ls  
Redhat
```

Removing folder

```
[root@localhost ~]# rm folder1  
rm: cannot remove 'folder1': Is a directory < --- Folder has delete protection
```

```
[root@localhost ~]# rm -rf folder1/  
[root@localhost ~]# ls
```

-rf – recursively and forcefully

Remove hidden files and folders

```
[root@localhost ~]# ls -a
```

```
. .bash_history .bash_profile .cshrc .tcshrc
.. .bash_logout .bashrc .file5

[root@localhost ~]# rm -rf .*
rm: refusing to remove '.' or '..' directory: skipping '.' <---this will not be removed
rm: refusing to remove '.' or '..' directory: skipping '..' <---this will not be removed
[root@localhost ~]# ls -a
. . .
```

- cp
- Copy files and folders to specified location
 - You can use absolute and relative path to copy

```
[root@localhost ~]# mkdir -p redhat/whitehat/blackhat
[root@localhost ~]# tree
.
├── file1
├── file2
└── redhat
    ├── whitehat
    └── blackhat

3 directories, 2 files
```

```
[root@localhost ~]# cp file1 redhat/whitehat/blackhat/
[root@localhost ~]# tree
.
├── file1
├── file2
└── redhat
    ├── whitehat
    └── blackhat
        └── file1

3 directories, 3 files
```

cp file1 redhat/whitehat/blackhat/

Command	source	destination
cp	File1	redhat/whitehat/blackhat/

cp file2 /root/redhat/whitehat/



- Copy using absolute path

```
[root@localhost ~]# cp file2 /root/redhat/whitehat/
```

```
[root@localhost ~]# tree
```

```
.
├── file1
├── file2
└── redhat
    ├── whitehat
    │   ├── blackhat
    │   │   ├── file1
    │   │   └── file2
    └──
```

10-11-2020

```
-bash-4.2# cp /etc/skel/.b* /root
```

```
cp /etc/skel/.b* .
```

```
[root@localhost ~]# ls -a
```

```
. .bash_history .bash_profile file1 redhat
.. .bash_logout .bashrc file2
```

```
[root@localhost ~]# tree
```

```
.
├── redhat
│   ├── whitehat
│   │   ├── blackhat
│   │   │   ├── file1
│   │   │   └── file2
│   └──
```

Copy files from foreign directory

```
[root@localhost ~]# cp redhat/whitehat/file2 .
```

< ---using relative path

```
[root@localhost ~]# ls
file2 redhat
```

```
[root@localhost ~]# cp /root/redhat/whitehat/blackhat/file1 /root
```

< ---using absolute path

```
[root@localhost ~]# ls
file1 file2 redhat
```



```
[root@localhost ~]# cd redhat/whitehat/
```

```
[root@localhost whitehat]# cp file2 ../..
```

< ---Using relative path

```
[root@localhost whitehat]# cd
```

```
[root@localhost ~]# ls  
file1 file2 redhat
```

Copy directory

```
[root@localhost ~]# cp -rf redhat ibm
```

< --- -rf is needed for directory, recursively, force

```
[root@localhost ~]# ls
```

```
file1 file2 ibm redhat
```

```
[root@localhost ~]# tree
```

```
.  
├── file1  
├── file2  
├── ibm  
│   ├── whitehat  
│   │   ├── blackhat  
│   │   │   ├── file1  
│   │   │   └── file2  
│   └── redhat  
│       ├── whitehat  
│       │   ├── blackhat  
│       │   │   ├── file1  
│       │   └── file2
```

6 directories, 6 files

Copy directory into another directory

```
[root@localhost ~]# mkdir archive
```

```
[root@localhost ~]# cp -rf ibm archive
```

```
[root@localhost ~]# ls -l archive/
```

```
total 0
```

```
drwxr-xr-x. 3 root root 22 Oct 11 15:59 ibm
```

```
[root@localhost ~]# ls archive/
```

```
ibm
```

```
[root@localhost ~]# cd archive/
```

```
[root@localhost archive]# ls
```

```
ibm
```

Moving file

```
[root@localhost ~]# ls
```

```
archive file1 file2 ibm redhat  
[root@localhost ~]# mv file1 archive
```

Command	Source	Destination
mv	File1	archive

```
[root@localhost ~]# ls  
archive file2 ibm redhat  
[root@localhost ~]# cd archive/  
[root@localhost archive]# ls  
file1 ibm
```

Moving directory

```
[root@localhost archive]# cd  
[root@localhost ~]# mv -f redhat archive
```

Command	Source	Destination
mv -f	redhat	archive

```
[root@localhost ~]# ls  
archive file2 ibm
```

Renaming file

```
[root@localhost ~]# mv file2 xfile
```

Command	Old name	New name
mv	file2	xfile

```
[root@localhost ~]# ls  
archive ibm xfile
```

Renaming directory

```
[root@localhost ~]# mv ibm aws
```

Command	Old name	New name
mv	ibm	aws

```
[root@localhost ~]# ls  
archive aws xfile
```

man

```
[root@localhost ~]# man  
What manual page do you want?
```

man - an interface to the on-line reference manuals

Echo

- Repeats after the command and displays on screen

```
[root@localhost ~]# echo
```

```
[root@localhost ~]# echo this is linux course  
this is linux course
```

```
[root@localhost ~]# echo this is linux course and I am enjoying this course  
this is linux course and I am enjoying this course
```

Redirectors

0<	Standard input
1>	Standard out put echo this is linux course and I am enjoying this course 1> file1
2>	Standard error lkskfs! 2> file2

```
1>
```

[root@localhost ~]# echo this is linux course 1> file1

Command	Content	Redirector – output	File name
Echo	this is linux course	1>	File1

0<

[root@localhost ~]# cat 0< file1 < --- 0< is a input redirection
this is linux course

Command	Redirector – input	File name
Cat	0<	File1

[root@localhost ~]# cat < file1 < --- < is a input redirection
this is linux course

[root@localhost ~]# cat file1 < --- is a input redirection
this is linux course

final word: you don't really need to specify 0< or <, the system will automatically read the file

2>

- This will catch only the errors and redirects to the file
- You can also redirect errors to **/dev/null** – discarded location, not retrievable

[root@localhost ~]# dfkjlks
-bash: dfkjlks: command not found

[root@localhost ~]# dfkjlks 2>/dev/null

cat – concatenate

- Most basic use is to read a file

Read the file

[root@localhost ~]# cat file1
this is linux course

read **multiple** files at the same time



```
[root@localhost ~]# cat file1 file2
this is linux course
ls: cannot access nothing: No such file or directory
```

redirect the output another file

```
[root@localhost ~]# cat file1 file2 > file3
```

< --- redirects using >, over writes existing content also creates new file if does not exists

```
[root@localhost ~]# cat file3
this is linux course
ls: cannot access nothing: No such file or directory
```

Add to

```
[root@localhost ~]# cat file1 file2 >> file3
```

< --- user double >> to add to file

```
[root@localhost ~]# cat file3
this is linux course
ls: cannot access nothing: No such file or directory
this is linux course
ls: cannot access nothing: No such file or directory
```

Enter into quick edit mode

```
[root@localhost ~]# cat > file4
```

<--- over rides the content, also create new file if it does not exists

```
This is line1
this is line2
this is line3
```

```
[root@localhost ~]# cat file4
This is line1
this is line2
this is line3
```

Add additional lines

```
[root@localhost ~]# cat >> file4
```

< ---add additional lines

```
this is line4
this is line5
```

```
[root@localhost ~]# cat file4
This is line1
this is line2
this is line3
this is line4
this is line5
```



grep

- Filters the line with matching word in it

```
[root@localhost ~]# cat file4
```

This is line1

this is line2

this is line3

this is line4

this is line5

This is Linux

This is Redhat Linux

This is linux course

this is interesting

```
[root@localhost ~]# cat file4 | grep linux < ---greps match, case sensitive
```

This is linux course

```
[root@localhost ~]# cat file4 | grep -i linux < ---ignores the case
```

This is Linux

This is Redhat Linux

This is linux course

You can use grep directly without cat

```
[root@localhost ~]# grep -i linux file4
```

This is Linux

This is Redhat Linux

This is linux course

|

- Pipe is used for running multiple commands
-
- Primary command | secondary command | third command

```
[root@localhost ~]# cat file4
```

This is line1

this is line2

this is line3

this is line4

this is line5

This is Linux

This is Redhat Linux
This is linux course
this is interesting

```
[root@localhost ~]# cat file4 | grep -i linux
```

This is Linux
This is Redhat Linux
This is linux course

```
[root@localhost ~]# cat file4 | grep -i linux | grep Red
```

This is Redhat Linux

Multiple word search

```
[root@localhost ~]# cat file4 | grep -i 'linux\|line4'
```

this is line4
This is Linux
This is Redhat Linux
This is linux course

wc

- This is a word count
-

```
[root@localhost ~]# wc file4
```

9 29 146 file4

Number of lines	Words	Characters includes spaces	Name of the file
9	29	146	File4

```
[root@localhost ~]# cat file4
```

This is line1
this is line2
this is line3
this is line4
this is line5
This is Linux
This is Redhat Linux
This is linux course
this is interesting

```
[root@localhost ~]# wc -l file4 < --- -l is for lines
```

9 file4

```
[root@localhost ~]# wc -c file4 < --- -c is for characters
```

146 file4



```
[root@localhost ~]# wc -w file4 < --- -w is for words
29 file4
```

Head

- Read top ten lines of the file

```
[root@localhost ~]# head file4
```

```
This is line1
this is line2
this is line3
this is line4
this is line5
This is Linux
This is Redhat Linux
This is linux course
this is interesting
this is line10
```

```
[root@localhost ~]# head -5 file4
```

```
[root@localhost ~]# head -12 file4
```

```
[root@localhost ~]# head -100 error.log
```

Tail

- This command reads bottom ten lines

```
[root@localhost ~]# tail file4
```

```
this is line5
This is Linux
This is Redhat Linux
This is linux course
this is interesting
this is line10
this is line11
this is line12
this is line13
this is line14
```

```
[root@localhost ~]# tail -5 file4
```

```
[root@localhost ~]# tail -12 file4
```

```
[root@localhost ~]# tail -100 error.log
```

more

- Primary use is to read huge file
- This will load the entire file into memory
- Use 'enter' on keyboard to scroll line by line
- Use 'spacebar' on keyboard to scroll page by page
- 'q' to quit the file
- Not good when memory is low

```
/var/log
```

```
[root@localhost log]# more messages
```

Less

- This is similar to more command
- But it will only load the output as needed into memory
- Use 'enter' on keyboard to scroll line by line
- Use 'spacebar' on keyboard to scroll page by page
- 'q' to quit the file
- good when memory is low

```
/var/log
```

```
[root@localhost log]# less messages
```

Sort

- sorts the file alphabetically

```
[root@localhost ~]# sort file5
```

```
[root@localhost ~]# sort -n file5 < --- sorts using numbers
```

Uniq

- removes duplicates
-

```
[root@localhost ~]# cat > file5
```

```
apple
```

```
apple
```

```
berry
```

```
berry
```

```
strawberry
```

```
pineapple
```

```
pineapple
```

```
mango
```

```
[root@localhost ~]# uniq file5
```

```
apple
```

```
berry
```



<pre>strawberry pineapple mango</pre>
<pre>Date [root@localhost ~]# date Sat Oct 17 15:25:19 EDT 2020</pre>
<pre>Cal [root@localhost ~]# cal October 2020 Su Mo Tu We Th Fr Sa 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 [root@localhost ~]# cal 12 1969 December 1969 Su Mo Tu We Th Fr Sa 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31</pre>
<pre>Who - Displays users logged into system - [zafar@assignment01 ~]\$ who zafar pts/0 2020-10-17 15:29 (73.110.42.133) adil pts/1 2020-10-17 15:34 (162-226-246-197.lightspeed.cicril.sbcglobal.net) zafar pts/2 2020-10-17 15:34 (73.110.42.133)</pre>
<pre>Last - Displays the login and reboot [root@localhost ~]# last root tty1 Sat Oct 17 14:59 sti root pts/0 192.168.56.1 Sat Oct 17 14:59 sti reboot system boot 3.10.0-1062.el7. Sat Oct 17 14:57 - 15:</pre>
<pre>Free -h</pre>

- Displays the System RAM and SWAP[virtual memory] information

```
[root@localhost ~]# free -h
      total    used    free   shared  buff/cache   available
Mem:    991M    142M    744M    6.8M    103M    723M
Swap:   1.6G      0B    1.6G
```

Du

- Disk usage information of the file or folder

```
[root@localhost ~]# du -h file4
4.0K file4
```

Top

- Displays the real time information about the system
- Cpu, memory, processes

```
top - 15:51:08 up 53 min, 2 users, load average: 0.00, 0.01, 0.05
Tasks: 99 total, 2 running, 97 sleeping, 0 stopped, 0 zombie
%Cpu(s): 0.3 us, 0.7 sy, 0.0 ni, 99.0 id, 0.0 wa, 0.0 hi, 0.0 si, 0.0 st
KiB Mem : 1014824 total, 761684 free, 146624 used, 106516 buff/cache
KiB Swap: 1679356 total, 1679356 free, 0 used. 740012 avail Mem
```

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
1868	root	20	0	161888	2172	1544	R	0.7	0.2	0:00.34	top
25	root	20	0	0	0	0	S	0.3	0.0	0:04.63	kworker/0:1
1	root	20	0	127964	6536	4108	S	0.0	0.6	0:01.97	systemd

Lscpu

- List the number of CPU system has

```
[root@assignment01 ~]# lscpu
Architecture: x86_64
CPU op-mode(s): 32-bit, 64-bit
Byte Order: Little Endian
CPU(s): 2
```

Which

- Displays if the command or package is installed

```
[root@localhost ~]# which tree
/usr/bin/tree
```



```
[root@localhost ~]# which firefox < ---Not installed
/usr/bin/which: no firefox in (/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/root/.local/bin:/root/bin)
```

Gzip

- Zips and compresses the file
- It adds the extension with .gz

```
[root@localhost ~]# gzip error.log
```

```
[root@localhost ~]# du -h error.log.gz
4.0K  error.log.gz
```

Gunzip

- Unzips and uncompresses the file

```
[root@localhost ~]# gunzip error.log.gz
[root@localhost ~]# ls -l
total 92
-rw-r--r--. 1 root root 72295 Oct 11 17:30 error.log
```

Tar

- It saves the folder to single file
- It does not compress the tar file
- It keeps the original folder and creates is a new file

```
[root@localhost ~]# mkdir folder1
```

```
[root@localhost folder1]# ls -lh
total 4.6M
-rw-----. 1 root root 4.6M Oct 17 16:12 messages
[root@localhost folder1]# cp messages messages2
[root@localhost folder1]# cp messages messages4
[root@localhost folder1]# cp messages messages3
[root@localhost folder1]# cp messages messages5
```

```
[root@localhost ~]# du -h folder1/
23M  folder1/
```

```
[root@localhost ~]# tar -cvf folder1.tar folder1
folder1/
folder1/messages
folder1/messages2
```




```
folder1/messages4  
folder1/messages3  
folder1/messages5
```

-cvf for the folder

```
drwxr-xr-x. 2 root root   90 Oct 17 16:13 folder1  
-rw-r--r--. 1 root root 24074240 Oct 17 16:18 folder1.tar
```

- This makes copying or moving folder easy
- This keeps the data integrity of the content, especially copied over network

*** you can used gzip and gunzip to compress and uncompress the folder

```
[root@localhost ~]# gzip folder1.tar
```

```
[root@localhost ~]# du -h fo*  
23M  folder1  
1.3M  folder1.tar.gz
```

Stat

- Displays detailed information

```
[root@localhost ~]# stat file1  
File: 'file1'  
Size: 21      Blocks: 8      IO Block: 4096  regular file  
Device: fd00h/64768d  Inode: 16797776  Links: 1  
Access: (0644/-rw-r--r--)  Uid: ( 0/  root)  Gid: ( 0/  root)  
Context: unconfined_u:object_r:admin_home_t:s0  
Access: 2020-10-17 16:26:24.332018946 -0400  
Modify: 2020-10-11 16:37:25.730845836 -0400  
Change: 2020-10-11 16:37:25.730845836 -0400  
Birth: -
```

Inode

- It is table on the disk holding the file information
- Owner of the file
- Group of the file
- Type of the file
- Permissions
- Date and time of the file modified and accessed
- Number of links
- Size of the file
- Block information

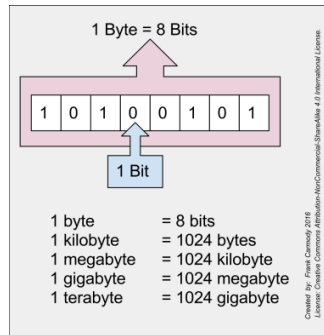


To find inode of a file

```
[root@localhost ~]# ls -li file1
16797776 file1
```

Block information

- One bit is bit = 1 bit
- Eight bit is byte = 1 byte
- Kilo bytes = 1024 = 1 kilo byte
- 4096 bytes = 4kb



4096 = 4kb minimum useable

File Size	Disk Space used 4K
0	4 kb
1 kb	4kb
2 kb	4 kb
4 kb	4 kb
6 kb	8 kb
13 kb	16 kb
21	24 kb



Find

- It finds the files in specified directory

- You can use absolute or relative path
- You can use name or inode number

Using name

```
[root@localhost ~]# find / -name file1
/root/file1
/root/folder1/file1
```

```
[root@localhost ~]# find / -inum 16797776 < --- Using inum
/root/file1
```

10-17-2020

<https://youtu.be/QP7LE9LPMeM>

VI Editor

Vi is a text editor originally created with UNIX, widely used for editing configuration files

```
[root@localhost ~]# vi file1
```

- It opens the editor with specified file name
- If the file does not exist it will create one
- You will vi editor in command mode
- Push 'i' to enter the insert mode
- Push 'esc' to get out of the edit mode
- Once you have edited or put some text in the file
- Shift + :x will save and exit
-

```
[root@localhost ~]# cat file1
```

vi commands

:	This is ready for commands
:x	Save and exit
:q	Quit – if you have not made changes
:q!	Quit – without saving even if you made changes
i	Insert mode
l	Moves cursor one character to left
h	Moves cursor one character to right
K	Moves cursor one line up
J	Moves cursor one line down
o	Opens the new line in insert mode below the cursor



yy	Copies the line - 3yy or 2yy copies that many lines - You got the idea
'u'	Undo
'dd'	This works as cut – you can paste else where
:/RHEL	Searches the pattern – cursor will jump to first instance 'n' to jump between results
:%s/linux/LINUX	Replaces the patter
:wq	Save and quit – official way

'e file1'	Loads the specified file for editing - You can also specifi absolute and relative path
'r'	Load the file content of the file again
:!	Allows you to run shell commands from within vi example: !ls /etc
i	insert text and not replace it
R	over write existing text when new text added
cw	remove current word cursor is on and insert into insert mode to add text
cc	replace the entire of line of text
l	moves cursor one character to the right
h	moves cursor one character to the left
j	moves cursor down one line
k	moves cursor up one line Yank – Term used to copy text. Use YY to “yank” a line of text.
yy	will yank/copy entire line the cursor is currently on
2yy	will copy the current line of text as well as the line underneath it (2lines)
3yy	will copy three lines, 4yy 4 lines of text 5yy...
p	will paste the contents from yanked yy text, starting on the line after your cursor
P	uppercase P will paste the yanked line(s) starting on the line before the cursor
5G	moves your cursor to line 5
5gg	moves your cursor to line 5 (note case sensitive)
G	Moves the cursor to the beginning of the last line in the file
1G	Moves the cursor to the first line of the file
L	Also moves the cursor to the beginning of the last line on the terminal screen



H	Moves the cursor to the first line on the terminal screen
o	opens insert mode to insert text, creates a new line below your current cursor position
u	undo
cc	Removes the entire line and places you into insert mode
/ - search, /root	will search the file for root you can navigate to the next occurrence using the n key
?	is the same as / as it relates to searching

cut

- It cuts the fields or characters in a file
- You have to use a delimiter [; : ? . space]

```
[root@localhost ~]# cut -d " " -f1,3 file1
```

Cut	-d	" "	-f1, 3	File1
Command	Using delimiter	Actual demimiter itself	Fields	File name

```
[root@localhost ~]# cat file2
column1;column2;column3
column1;column2;column3
column1;column2;column3
```

```
[root@localhost ~]# cut -d ";" -f1,3 file2
column1;column3
column1;column3
column1;column3
column1;column3
```

awk

- Similar to cut command, but gives out clean output

```
[root@localhost ~]# awk -F';' '{print $2, $1}' file2
```

Awk	-F	‘;’	{print \$1 \$3}	File2
Command	Fields	Delimiter (space)	Column	Filename

```
[root@localhost ~]# awk -F';' '{print $2, $1}' file2
column2 column1
```

```
[root@localhost ~]# awk -F' ' '{print $1, $2}' file2
```

exce

- This command works with find command

```
[root@localhost ~]# find / -name file1 -exec cp {} /tmp \;
```

```
[root@localhost tmp]# ls
file1
```

exec	Cp	{}	/tmp	\;
Command	Command	Syntax	Destination	syntax

Alias

- You can create a shortcut for the command you are using
- Usually good if you have multiple commands

```
[root@localhost ~]# alias zwd='pwd' < ---Create your own Alias
```

```
[root@localhost ~]# zwd
```

```
/root
```

```
[root@localhost ~]# alias < ---see the list of Alias in your system
```

```
alias egrep='egrep --color=auto'
```

```
alias fgrep='fgrep --color=auto'
```

```
alias grep='grep --color=auto'
```

```
alias l.='ls -d .* --color=auto'
```

```
alias ll='ls -l --color=auto'
```

```
alias ls='ls --color=auto'
```

```
alias which='alias | /usr/bin/which --tty-only --read-alias --show-dot --show-tilde'
```

```
alias zwd='pwd'
```

```
[root@localhost ~]# unalias zwd < ---unalias the command
```

```
[root@localhost ~]# alias mybasic='uptime;who;free -h;date;c
```

```
[root@localhost ~]# alias
```

```
alias mybasic='uptime;who;free -h;date;cal'
```

```
[root@localhost ~]# mybasic
```

/dev/null

- This is considered a device
- This is usually user for filtering out the errors
- It is built in blank space – not same as recycle bin in windows

- Anything sent here will be not be retrieved

```
[root@localhost ~]# mybasic;ajfkljs 2>/dev/null
```

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<https://youtu.be/G6DDJPAjnr0>

In

- This command is used for creating links
- There are two type of links

Hard link

- it has same inode number
- you have to provide absolute path for source and destination
- any changes to either files, it will be updated on either side
- hard link is essentially a duplicate copy
- if the original file is deleted, hard linked file still survives
- you can also use this as backup file
- hard link is not allowed for directories

Soft link

- Symbolic link – sym link
- you have to provide absolute path for source and destination
- has different inode number
- most of the time soft link is used for reading data
- any changes to either files, it will be updated on either side
- if the original file is deleted, soft linked file is useless

- soft is allowed for directories
- inode is same for the original and soft link for directories

Hard link

```
[root@localhost ~]# stat file1
```

```
File: 'file1'  
Size: 0      Blocks: 0      IO Block: 4096  regular empty file  
Device: fd00h/64768d  Inode: 16797776  Links: 1
```

```
[root@localhost ~]# ln /root/file1 /root/folder1/xfile1
```

```
[root@localhost ~]# stat file1
```

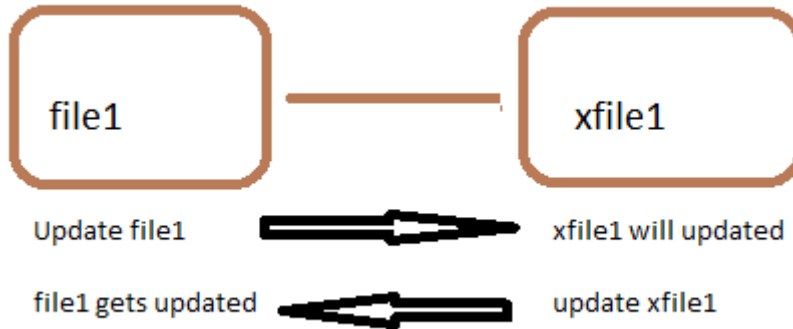
```
Device: fd00h/64768d  Inode: 16797776  Links: 2
```

```
[root@localhost ~]# stat folder1/xfile1
```

```
Device: fd00h/64768d  Inode: 16797776  Links: 2
```

Deleting original file

```
[root@localhost ~]# rm -rf file1
-rw-r--r--. 1 root root 74 Oct 24 15:52 xfile1 < ---hard linked file survives and keeps the data, becomes independent
```



Soft link

```
[root@localhost ~]# ln -s /root/file1 /root/folder1/sfile1
lrwxrwxrwx. 1 root root 11 Oct 24 15:47 folder1/sfile1 -> /root/file1
```

```
[root@localhost ~]# stat file1
Device: fd00h/64768d Inode: 16797776 Links: 2
```

```
[root@localhost ~]# stat folder1/sfile1
Size: 11 Blocks: 0 IO Block: 4096 symbolic link
Device: fd00h/64768d Inode: 16864309 Links: 1
```

Deleting original file

```
[root@localhost ~]# rm -rf file1
lrwxrwxrwx. 1 root root 11 Oct 24 15:47 sfile1 -> /root/file1 < ---Soft linked file is useless
```

Hard link - Directory

Directory

```
[root@localhost ~]# ln /root/dir1 /root/folder1/xdir1
ln: '/root/dir1': hard link not allowed for directory < ---hard link for the directory not allowed
```

Soft Link – Directory

```
[root@localhost ~]# ln -s /root/dir1 /root/folder1/xdir1
```




```
[root@localhost folder1]# ls -l
lrwxrwxrwx. 1 root root 10 Oct 24 16:05 xdir1 -> /root/dir1

[root@localhost ~]# rm -rf dir1
lrwxrwxrwx. 1 root root 10 Oct 24 16:05 xdir1 -> /root/dir1

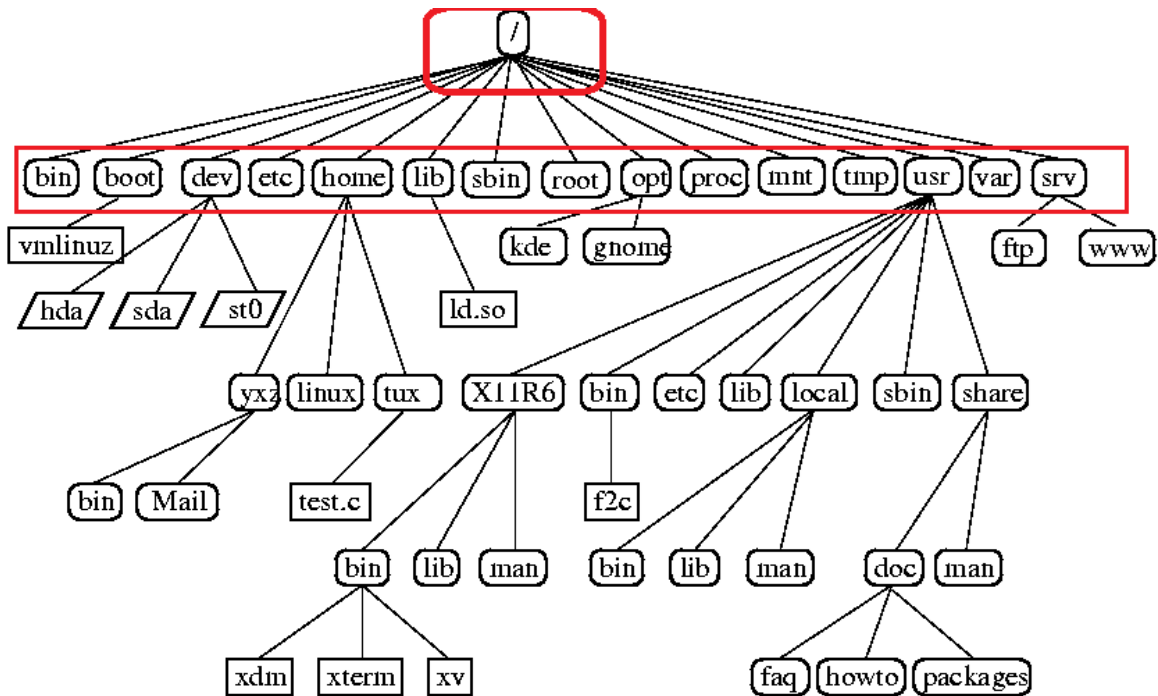
[root@localhost folder1]# ls -l
lrwxrwxrwx. 1 root root 10 Oct 24 16:05 xdir1 -> /root/dir1 < ---Soft linked dir is useless

[root@localhost folder1]# cd xdir1
-bash: cd: xdir1: No such file or directory
```

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Directory Structure



```
[root@localhost /]# ls -l
total 16
lrwxrwxrwx. 1 root root 7 Oct 4 15:44 bin -> usr/bin
dr-xr-xr-x. 5 root root 4096 Oct 4 16:07 boot
drwxr-xr-x. 20 root root 3160 Oct 23 19:51 dev
drwxr-xr-x. 75 root root 8192 Oct 23 19:51 etc
```

```
drwxr-xr-x. 2 root root 6 Apr 11 2018 home
lrwxrwxrwx. 1 root root 7 Oct 4 15:44 lib -> usr/lib
lrwxrwxrwx. 1 root root 9 Oct 4 15:44 lib64 -> usr/lib64
drwxr-xr-x. 2 root root 6 Apr 11 2018 media
drwxr-xr-x. 2 root root 19 Oct 18 15:25 mnt
drwxr-xr-x. 2 root root 6 Apr 11 2018 opt
dr-xr-xr-x. 110 root root 0 Oct 23 19:51 proc
dr-xr-x---. 3 root root 98 Oct 24 16:18 root
drwxr-xr-x. 24 root root 760 Oct 23 19:51 run
lrwxrwxrwx. 1 root root 8 Oct 4 15:44 sbin -> usr/sbin
drwxr-xr-x. 2 root root 6 Apr 11 2018 srv
dr-xr-xr-x. 13 root root 0 Oct 23 19:50 sys
drwxrwxrwt. 8 root root 185 Oct 24 03:55 tmp
drwxr-xr-x. 13 root root 155 Oct 4 15:44 usr
drwxr-xr-x. 19 root root 267 Oct 4 16:08 var
```

/

- this is root directory
- it is top most directory

/bin

- it contains all the binary user commands

/boot

- it contains system bootable files

/dev

- it contains all the attached devices information

/etc

- it contains all the **configuration** files
- short etsy

/home

- this is the home directory for the regular users
- example: /home/zafar

/lib /lib64

- it contains system library files shared by applications

/media



- unused
/mnt <ul style="list-style-type: none">- usually empty- but used for mounting CD drives, hard drives etc.,
/opt <ul style="list-style-type: none">- it contains third party application/ software files- example, Oracle DB, SAP, PostgreSQL etc.,
/proc <ul style="list-style-type: none">- it contains the active memory information [system processes, etc]
/root <ul style="list-style-type: none">- root user home directory
/run <ul style="list-style-type: none">- unused
/sbin <ul style="list-style-type: none">- it contains root user commands
/sys <ul style="list-style-type: none">- unused
/tmp <ul style="list-style-type: none">- this is used to keep temporary files- regular user has access to this directory
/var <ul style="list-style-type: none">- it contains system logs and logs generated by any installed software
/usr <ul style="list-style-type: none">- it contains the backup of some of the system files and folders containing optional commands
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Brief History

ATT – Bell labs – they developed OS Unix

Release UNIX on Dec 31, 1969

It was to be used for internal use

They though UNIX is no good and can't use or make profit

1987 – Released to the source code to Open Source OS

IBM – AIX – its used IBM Hardware

HP – HPUX – its used HP Hardware

Sun – Solaris – it uses Sun Platform

1991 – Linus Trivold took the source code and created Linux – free

- Hardware independent
- Free for anybody
- Anybody can take and Linux Sorce Code and create your own OS
- OS must be free to the public
- Organizations, Universities and Individuals contribute to the code
- New tools and security is added for free
- Linus – Unbreakable Linux

Linux Based Distributions – Distro

- RedHat – RHEL, CentOS, Fedora
- Oracle – OEL – Oracle Enterprise Linux
- SuSE – Suse Linux – SAP
- Debian – Debian
- Ubuntu – South African – Desktop Enviornment
- Apple – iOS, macOS
- Google – Andriod

RPM – Redhat Package Manager – rpm distros

- RedHat
- Orcacle
- SuSe
- Debian

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Hostname

```
[root@localhost ~]# vi /etc/hostname  
zmpt01.prod.zmprotech.com
```

Reboot

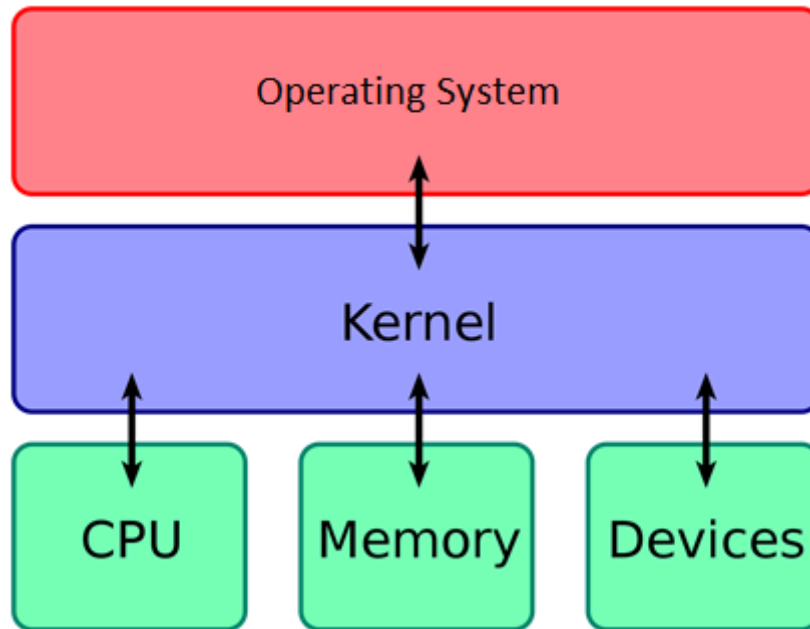
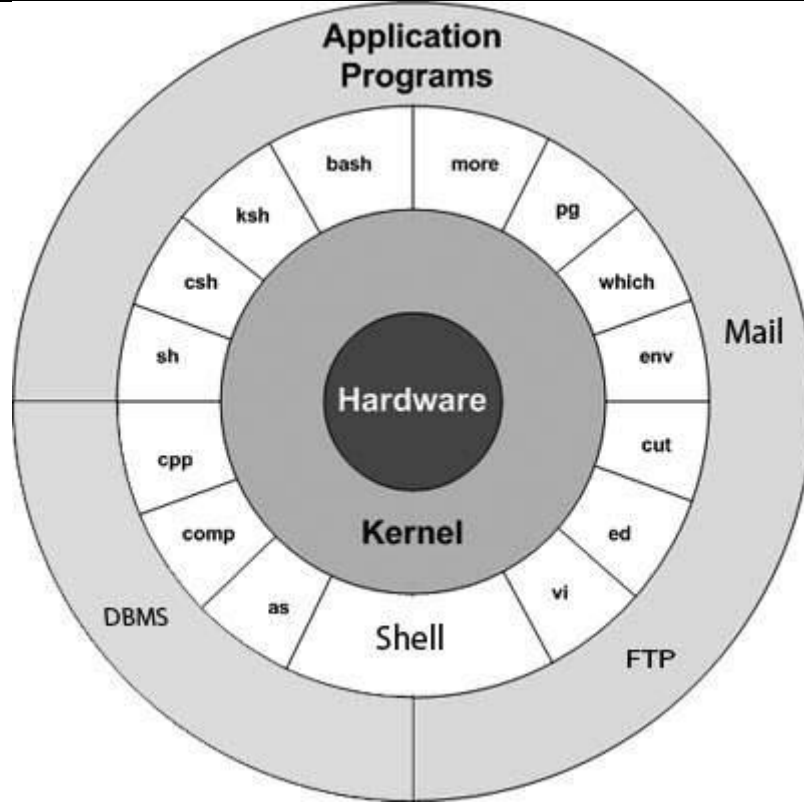
```
[root@zmpt01 ~]# hostname  
zmpt01.prod.zmprotech.com
```

```
[root@zmpt01 ~]# hostnamectl  
Static hostname: zmpt01.prod.zmprotech.com  
Icon name: computer-vm  
Chassis: vm  
Machine ID: 47384aabe2f84a189b94eba36b48046c  
Boot ID: 36fe385645ff48609296af23a491becd  
Virtualization: kvm  
Operating System: CentOS Linux 7 (Core)  
CPE OS Name: cpe:/o:centos:centos:7  
Kernel: Linux 3.10.0-1062.el7.x86_64  
Architecture: x86-64
```

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Kernel



Kernel is central component of an operating system that manages **operations** of computer and hardware. It basically manages operations of memory and CPU time. It is core component of an **operating system**

Kernel: Linux **3.10.0-1062.el7.x86_64**

Major Version	Major Release	Patch	Rehat Version	Linux Verion	64 bit Arch
3	10	0	1062	el7	x86_64

You can use this to look at any package information

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<https://youtu.be/G6DDJPAjnr0>

10-25-2020

<https://youtu.be/BaAolHcypdc>

NIC – Network Ethernet Adapter

```
[root@zmpt01 ~]# cd /etc/sysconfig/network-scripts/
```

```
[root@zmpt01 network-scripts]# ls
```

```
ifcfg-enp0s3
ifcfg-enp0s8
ifcfg-enp0s9
```

Example of NIC configuration file - ifcfg-enp0s3

```
[root@zmpt01 network-scripts]# vi ifcfg-enp0s3
```

```
TYPE=Ethernet
BOOTPROTO=dhcp
NAME=enp0s3
DEVICE=enp0s3
ONBOOT=yes
```

TYPE=Ethernet	Connection
BOOTPROTO=dhcp	Protocol[dhcp is random] [static is assigned]
NAME=enp0s3	This NiC name, matches with config file
DEVICE=enp0s3	This NiC device, matches with Config file
ONBOOT=yes	If yes system will automatically enable ip

DHCP

- Dynamic Host Control Protocol – IP is assigned randomly by router
- DHCP IP can change anytime
- t/s check to see if the IP address has changed

```
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
link/ether 08:00:27:28:09:c4 brd ff:ff:ff:ff:ff:ff
inet 192.168.56.105/24 brd 192.168.56.255 scope global noprefixroute dynamic enp0s3
    valid_lft 1137sec preferred_lft 1137sec
inet6 fe80::a00:27ff:fe28:9c4/64 scope link
    valid_lft forever preferred_lft forever
```

Static

- the IP address is assigned manually to the host/ server/ computer/ box

[root@zmpt01 network-scripts]# vi ifcfg-enp0s3

```
TYPE=Ethernet
BOOTPROTO=static
NAME=enp0s3
DEVICE=enp0s3
ONBOOT=yes
HWADDR=08:00:27:28:09:c4
IPADDR=192.168.56.110
NETMASK=255.255.255.0
```

TYPE=Ethernet	Connection
BOOTPROTO=static	Protocol[dhcp is random] [static is assigned]
NAME=enp0s3	This NiC name, matches with config file
DEVICE=enp0s3	This NiC device, matches with Config file
ONBOOT=yes	If yes system will automatically enable ip
HWADDR=08:00:27:79:66:e0	Hardware Address or MAC Address
IPADDR=192.168.56.110	Static IP of your choice
NETMASK=255.255.255.0	Sub Network Mask

Restart the system

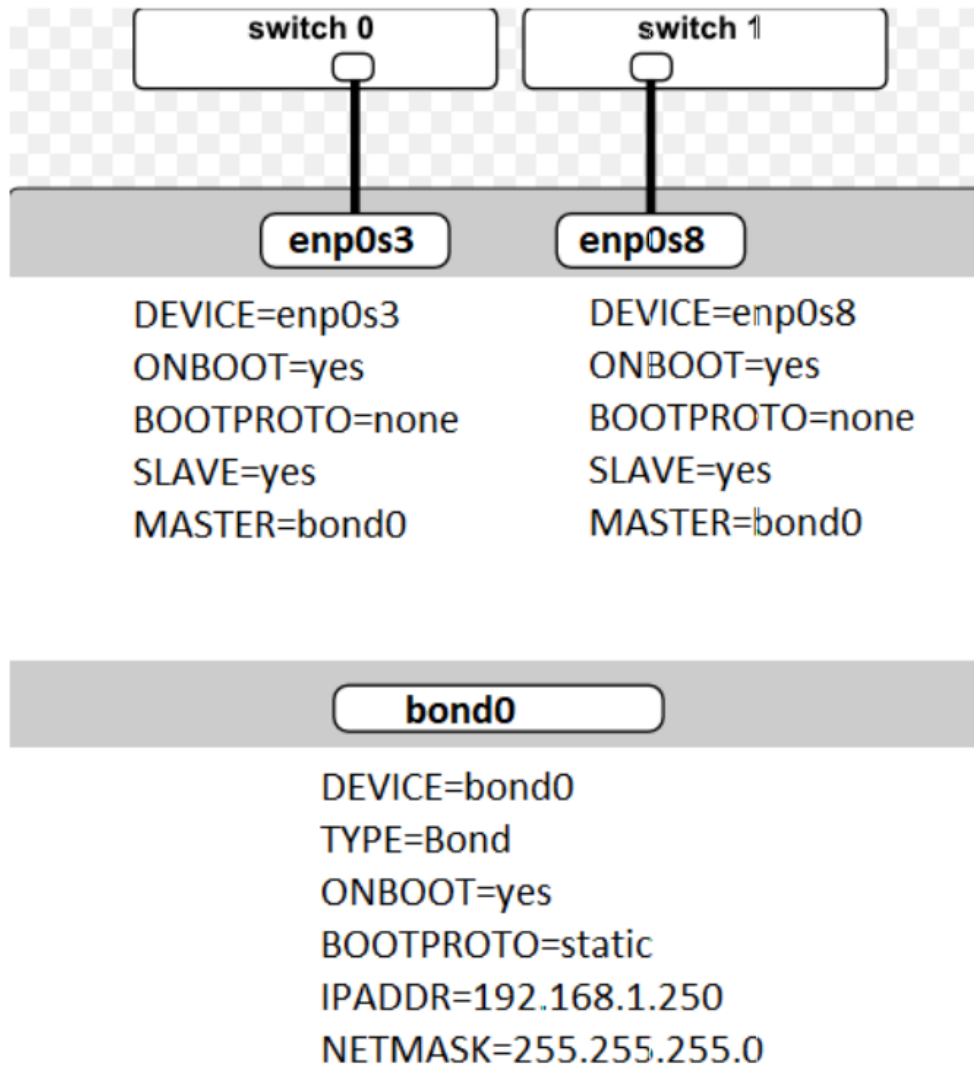
```
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
link/ether 08:00:27:28:09:c4 brd ff:ff:ff:ff:ff:ff
inet 192.168.56.110/24 brd 192.168.56.255 scope global noprefixroute enp0s3
    valid_lft forever preferred_lft forever
inet6 fe80::a00:27ff:fe28:9c4/64 scope link
    valid_lft forever preferred_lft forever
```

10-25-2020

<https://youtu.be/BaAolHcypdc>



NiC Bonding



Linux allows binding of **multiple** network interfaces into a **single channel/NiC** using special kernel module called **bonding**.

Edit files as needed and input following informaiton

```
[root@zmpt01 network-scripts]# cat ifcfg-enp0s3
DEVICE=enp0s3
ONBOOT=yes
BOOTPROTO=none
SLAVE=yes
MASTER=bond0
```



```
[root@zmpt01 network-scripts]# cat ifcfg-enp0s8
DEVICE=enp0s8
ONBOOT=yes
BOOTPROTO=none
SLAVE=yes
MASTER=bond0
```

Create file ifcfg-bond0

```
[root@zmpt01 network-scripts]# cat ifcfg-bond0
DEVICE=bond0
TYPE=Bond
ONBOOT=yes
BOOTPROTO=static
IPADDR=192.168.56.250
NETMASK=255.255.255.0
```

Create bond configuration file

```
[root@zmpt01 ~]# cd /etc/modprobe.d/

[root@zmpt01 modprobe.d]# vi bonding.conf

alias bond0 bonding
```

Activate Bonding

```
[root@zmpt01 ~]# modprobe bonding
```

Check if the bonding is active in memory

```
[root@zmpt01 ~]# lsmod | grep bonding
bonding          152979  0
```

Restart network

```
[root@zmpt01 ~]# systemctl restart network
```

```
2: enp0s3: <BROADCAST,MULTICAST,SLAVE,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast master bond0 state UP group
default qlen 1000
    link/ether 08:00:27:28:09:c4 brd ff:ff:ff:ff:ff:ff
3: enp0s8: <BROADCAST,MULTICAST,SLAVE,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast master bond0 state UP group
default qlen 1000
    link/ether 08:00:27:28:09:c4 brd ff:ff:ff:ff:ff:ff
4: enp0s9: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 08:00:27:f5:49:e8 brd ff:ff:ff:ff:ff:ff
```

```

inet 10.0.2.6/24 brd 10.0.2.255 scope global noprefixroute dynamic enp0s9
  valid_lft 1131sec preferred_lft 1131sec
inet6 fe80::dc0b:5bd8:ba77:427f/64 scope link noprefixroute
  valid_lft forever preferred_lft forever
5: bond0: <BROADCAST,MULTICAST,MASTER,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default qlen 1000
link/ether 08:00:27:28:09:c4 brd ff:ff:ff:ff:ff:ff
inet 192.168.56.250/24 brd 192.168.56.255 scope global noprefixroute bond0
  valid_lft forever preferred_lft forever
inet6 fe80::a00:27ff:fe28:9c4/64 scope link
  valid_lft forever preferred_lft forever

```

10-25-2020
<https://youtu.be/BaAolHcypdc>

Software and package Management RPM and YUM

RPM – Redhat Package manager
This is used to manage a package – add, remove, update – not efficient
Rpm base Linux – RHEL, OEL, CentOS, Fedora, SuSE

The package extension is .rpm

YUM – Yellowdog, Updater, Modifier

Yum is the primary tool for getting, installing, deleting, querying, and managing RPM software packages

RPM

Wuery the installed packages on the system

```
[root@zmpt01 ~]# rpm -qa | sort
```

To check detailed specific dteails of package

```

[root@zmpt01 ~]# rpm -qi tree
Name      : tree
Version   : 1.6.0
Release   : 10.el7
Architecture: x86_64
Install Date: Sat 10 Oct 2020 04:37:34 PM EDT
Group     : Applications/File
Size      : 89505
License   : GPLv2+
Signature : RSA/SHA256, Fri 04 Jul 2014 01:36:46 AM EDT, Key ID 24c6a8a7f
Source RPM : tree-1.6.0-10.el7.src.rpm
Build Date : Mon 09 Jun 2014 03:28:53 PM EDT
Build Host : worker1.bsys.centos.org

```

Relocations : (not relocatable)
Packager : CentOS BuildSystem <<http://bugs.centos.org>>
Vendor : CentOS
URL : <http://mama.indstate.edu/users/ice/tree/>
Summary : File system tree viewer
Description :
The tree utility recursively displays the contents of directories in a tree-like format. Tree is basically a UNIX port of the DOS tree utility.

View by date

```
[root@zmpt01 ~]# rpm -qa -last | grep tree
tree-1.6.0-10.el7.x86_64          Sat 10 Oct 2020 04:37:34 PM EDT
[root@zmpt01 ~]# rpm -qa -last
```

View the package Location

```
[root@zmpt01 ~]# rpm -ql tree
/usr/bin/tree
/usr/share/doc/tree-1.6.0
/usr/share/doc/tree-1.6.0/LICENSE
/usr/share/doc/tree-1.6.0/README
/usr/share/man/man1/tree.1.gz
```

View the package documentation

```
[root@zmpt01 ~]# rpm -qld tree
/usr/share/doc/tree-1.6.0/LICENSE
/usr/share/doc/tree-1.6.0/README
/usr/share/man/man1/tree.1.gz
```

Check the configuration files of a package

```
[root@zmpt01 ~]# rpm -qlc firewalld
/etc/dbus-1/system.d/FirewallD.conf
/etc/firewalld/firewalld.conf
/etc/firewalld/lockdown-whitelist.xml
/etc/sysconfig/firewalld
```

Check file or folder belongs to using name

```
[root@zmpt01 ~]# rpm -qf /etc/firewalld/firewalld.conf
firewalld-0.6.3-2.el7.noarch
```

Find the documentation using the file name



```
[root@zmpt01 ~]# rpm -qfd /etc/firewalld
/usr/share/doc/firewalld-0.6.3/COPYING
/usr/share/doc/firewalld-0.6.3/README
/usr/share/man/man1/firewall-cmd.1.gz
/usr/share/man/man1/firewall-offline-cmd.1.gz
/usr/share/man/man1/firewalld.1.gz
/usr/share/man/man5/firewalld.conf.5.gz
/usr/share/man/man5/firewalld.dbus.5.gz
/usr/share/man/man5/firewalld.direct.5.gz
/usr/share/man/man5/firewalld.helper.5.gz
/usr/share/man/man5/firewalld.icmptype.5.gz
/usr/share/man/man5/firewalld.ipset.5.gz
/usr/share/man/man5/firewalld.lockdown-whitelist.5.gz
/usr/share/man/man5/firewalld.richlanguage.5.gz
/usr/share/man/man5/firewalld.service.5.gz
/usr/share/man/man5/firewalld.zone.5.gz
/usr/share/man/man5/firewalld.zones.5.gz
```

Query what package provides

```
[root@zmpt01 ~]# rpm -q --provides firewalld
config	firewalld = 0.6.3-2.el7
firewalld = 0.6.3-2.el7
```

```
[root@zmpt01 ~]# rpm -q --provides tree
tree = 1.6.0-10.el7
tree(x86-64) = 1.6.0-10.el7
```

Package dependencies

```
[root@zmpt01 ~]# rpm -q --requires tree
libc.so.6()(64bit)
libc.so.6(GLIBC_2.14)(64bit)
libc.so.6(GLIBC_2.2.5)(64bit)
libc.so.6(GLIBC_2.3)(64bit)
libc.so.6(GLIBC_2.3.4)(64bit)
libc.so.6(GLIBC_2.4)(64bit)
rpmllib(CompressedFileNames) <= 3.0.4-1
rpmllib(FileDigests) <= 4.6.0-1
rpmllib(PayloadFilesHavePrefix) <= 4.0-1
rtld(GNU_HASH)
rpmllib(PayloadIsXz) <= 5.2-1
```

To get a list of loactions where the package will be written – when the packages in downloaded locally

```
[root@zmpt01 ~]# rpm -qlp firefox-68.12.0-1.el7.centos.x86_64.rpm
```

Man pages



```
[root@zmpt01 ~]# man rpm
```

10-25-2020

<https://youtu.be/BaAolHcypdc>

YUM

- YUM uses .rpm to install packages on RPM base OS [RHEL]
- YUM resolves dependencies automatically
- YUM uses repositories < --- centralized location to download software from [org, universities, companies]
- You can maintain your own local repo or use from internet
- YUM local repos is maintained by Administrator
- YUM also has a concept of group packages
- YUM group packages contain multiple packages
- Group packages can be installed and removed a group
- Groups can contain optional packages
- Installing group packages is easier and fast
- **YUM check preinstalled package – system will not corrupted if you accidentally install again**

- Location of local repo on the system
- /etc/yum.repos.d
- YUM gets the list of available software packages
- YUM downloads the packages and install them using .rpm libraries
- YUM updates RPM database locally after installation
- *** Installing using YUM is easy

If you want to see if the package is available

```
[root@zmpt01 ~]# yum provides firefox
```

```
firefox-68.12.0-1.el7.centos.x86_64 : Mozilla Firefox Web browser
```

```
Repo      : updates
```

To check the package dependencies

```
[root@zmpt01 ~]# yum deplist firefox | wc -l
```

```
Repodata is over 2 weeks old. Install yum-cron? Or run: yum makecache fast
```

```
551
```

Install using yum

```
[root@zmpt01 ~]# yum install firefox
```

< ---This will install the latest available packaged/ software

Transaction Summary
=====

Install 1 Package (+83 Dependent packages)

Total download size: 126 M
Installed size: **324 M**
Is this ok [y/d/N]:

Remove package

This will not remove the dependencies

```
[root@zmpt01 ~]# yum remove firefox -y
```

Remove package and Dependencies

```
[root@zmpt01 ~]# yum autoremove firefox -y
```

10-31-2020

Check obsolete packages on your system

```
[root@zmpt01 ~]# yum list obsoletes
```

Get the list of packages which are available to install from repo – and still supported

```
[root@zmpt01 ~]# yum --showduplicates list available
```

firefox.i686	68.5.0-2.el7.centos	base
firefox.x86_64	68.5.0-2.el7.centos	base
firefox.i686	68.6.0-1.el7.centos	updates
firefox.x86_64	68.6.0-1.el7.centos	updates
firefox.i686	68.6.1-1.el7.centos	updates
firefox.x86_64	68.6.1-1.el7.centos	updates
firefox.i686	68.7.0-2.el7.centos	updates
firefox.x86_64	68.7.0-2.el7.centos	updates
firefox.i686	68.8.0-1.el7.centos	updates
firefox.x86_64	68.8.0-1.el7.centos	updates
firefox.i686	68.9.0-1.el7.centos	updates
firefox.x86_64	68.9.0-1.el7.centos	updates
firefox.i686	68.10.0-1.el7.centos	updates
firefox.x86_64	68.10.0-1.el7.centos	updates
firefox.i686	68.11.0-1.el7.centos	updates
firefox.x86_64	68.11.0-1.el7.centos	updates
firefox.i686	68.12.0-1.el7.centos	updates
<u>firefox.x86_64</u>	68.12.0-1.el7.centos	updates

< ---if you see package underline, its installed

If you want to search the package using term

```
[root@zmpt01 ~]# yum search firefox
```

```
===== N/S matched: firefox =====  
firefox.i686 : Mozilla Firefox Web browser  
firefox.x86_64 : Mozilla Firefox Web browser
```

If you want to list all the packages from repo – ONLY LATEST PACKAGES

```
[root@zmpt01 ~]# yum list all | grep firefox  
firefox.x86_64           68.12.0-1.el7.centos @updates  
firefox.i686           68.12.0-1.el7.centos updates
```

Install the download only plugin

```
[root@zmpt01 ~]# yum install yum-plugin-downloadonly
```

Download locally specifying the directory – THIS WILL ALSO DOWNLOAD THE DEPENDENT PACKAGES

```
[root@zmpt01 ~]# yum install --downloadonly --downloadaddir=. Firefox
```

TO CHECK the files and directories updated by the package

```
[root@zmpt01 ~]# rpm -qlp firefox-68.12.0-1.el7.centos.x86_64.rpm
```

Reinstall the package – good when package is corrupted or configuration file is missing

```
[root@zmpt01 ~]# yum reinstall firefox -y < ---from repo  
[root@zmpt01 ~]# yum reinstall firefox-68.12.0-1.el7.centos.x86_64.rpm -y < --- from local download
```

Yum detects installed files and only install corrupted files, missing and files and folder

```
[root@zmpt01 lib64]# rm -rf firefox  
[root@zmpt01 lib64]# yum reinstall firefox-68.12.0-1.el7.centos.x86_64.rpm -y
```

skip package which are causing issue

```
--skip-broken  
Resolve depsolve problems by removing packages that are causing  
problems from the transaction.
```


```
[root@zmpt01 ~]# yum install --skip-broken firefox-68.12.0-1.el7.centos.x86_64.rpm -y
```






10-31-2020

https://youtu.be/Ds7UJ_ILG7s

 **RHEL7**
Powered Off

 **PRACTICE**
Powered Off

 **System-Wide-Update**
Running

 **KernelONLY-Update**
Powered Off

 **GUI-UPGRADE**
Powered Off

System wide update

To see the installed packages

```
[root@zmpt01 ~]# yum list installed
```

Bold	Update in repo available
Bold and Underline	Current installed Kernel
Red	Package is installed but its not in repo -
Yellow	New package is available in repo

Check for updates

```
[root@zmpt01 ~]# yum check-updates
```

This will provide the current listed packages that will be updated

```
kernel.x86_64      3.10.0-1127.19.1.el7 updates < ---Careful with the kernel update – this will system upgrade
```

7.1 kernel 3.10.0-229	7.1.1503/
7.2 kernel 3.10.0-327	7.2.1511/

7.3 kernel 3.10.0-514		7.3.1611/
7.4 kernel kernel 3.10.0-693		7.4.1708/
7.5 kernel 3.10.0-862		7.5.1804/
7.6 kernel 3.10.0-957		7.6.1810/
7.7 kernel 3.10.0-1062	< ---current Kernel Version	7.7.1908/
7.8 kernel 3.10.0-1127 upgrade	< ---update version < ---this will be considered	7.8.2003/

7.9 kernel 3.10.0-1160

Kernel: Linux **3.10.0-1062.el7.x86_64**

Major Version	Major Release	Patch	Rehat Version	Linux Verion	64 bit Arch
3	10	0	1062	el7	x86_64
3	10	0	1127	el7	X86_64

You can use this to look at any package information

```
[root@zmpt01 ~]# yum update -y < ---System Update
```

```
Install 2 Packages
Upgrade 141 Packages

Total download size: 258 M

Complete!
```



```
System-Wide-Update [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help

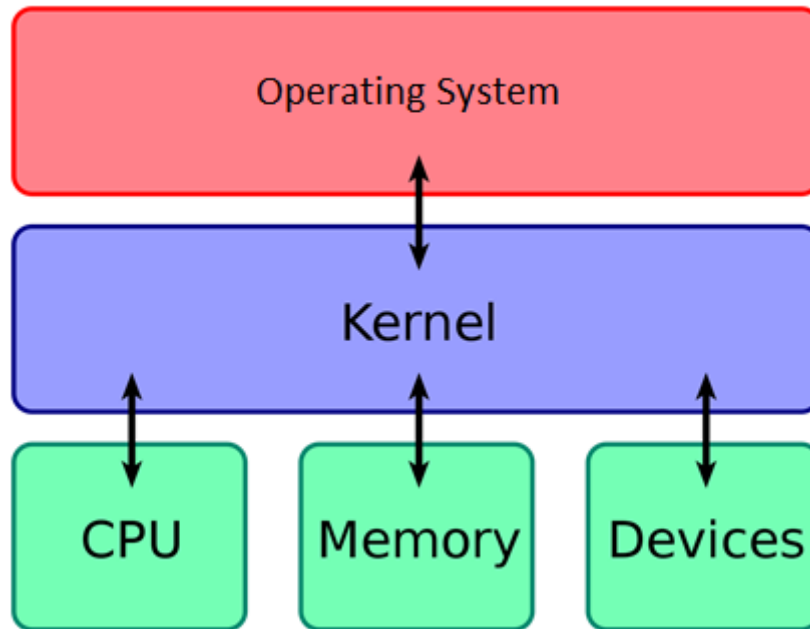
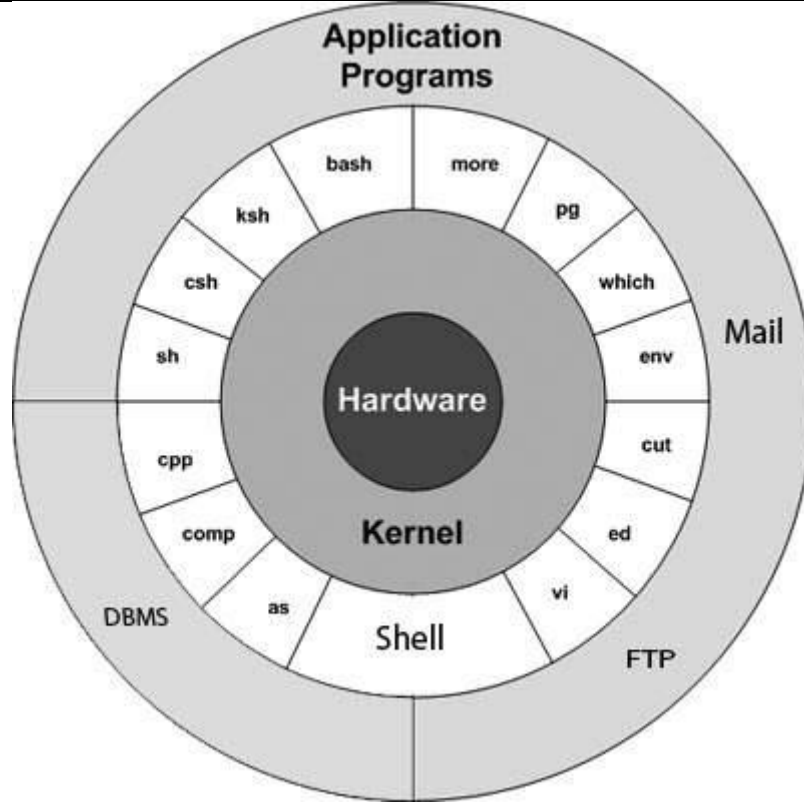
CentOS Linux (3.10.0-1127.19.1.el7.x86_64) 7 (Core)
CentOS Linux (3.10.0-1062.el7.x86_64) 7 (Core)
CentOS Linux (0-rescue-47384aabe2f84a189b94eba36b48046c) 7 (Core)

Use the ↑ and ↓ keys to change the selection.
Press 'e' to edit the selected item, or 'c' for a command prompt.
```

NOTE: you can see new kernel as well as old kernel

If you want you can use old kernel if there is issue after the kernel UPDATE

Kernel update is considered as security update –



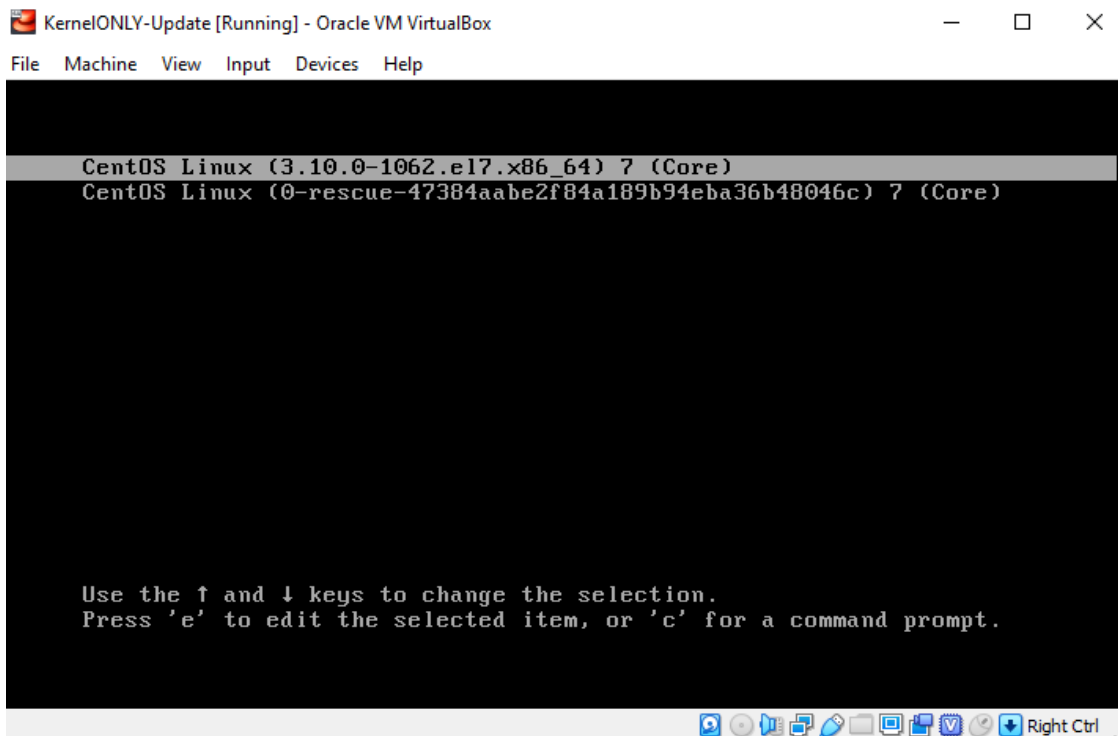
Kernel is central component of an operating system that manages **operations** of computer and hardware. It basically manages operations of memory and CPU time. It is core component of an **operating system**

Kernel: Linux **3.10.0-1062.el7.x86_64**

Major Version	Major Release	Patch	Rehat Version	Linux Verion	64 bit Arch
3	10	0	1062	el7	x86_64

You can use this to look at any package information

Kernel ONLY UPGrade



If only kernel update is required – Kernel update is considered Security Update

Check for available kernel

```
[root@zmpt01 ~]# yum list available kernel
```

```
kernel.x86_64          3.10.0-1127.19.1.el7          updates
```

Current version

```
[root@zmpt01 ~]# uname -r
3.10.0-1062.el7.x86_64
```



Update kernel now

```
=====
Package  Arch   Version             Repository  Size
=====
Installing:
kernel   x86_64 3.10.0-1127.19.1.el7 updates     50 M
=====
```

Transaction Summary

Install 1 Package

Total download size: 50 M

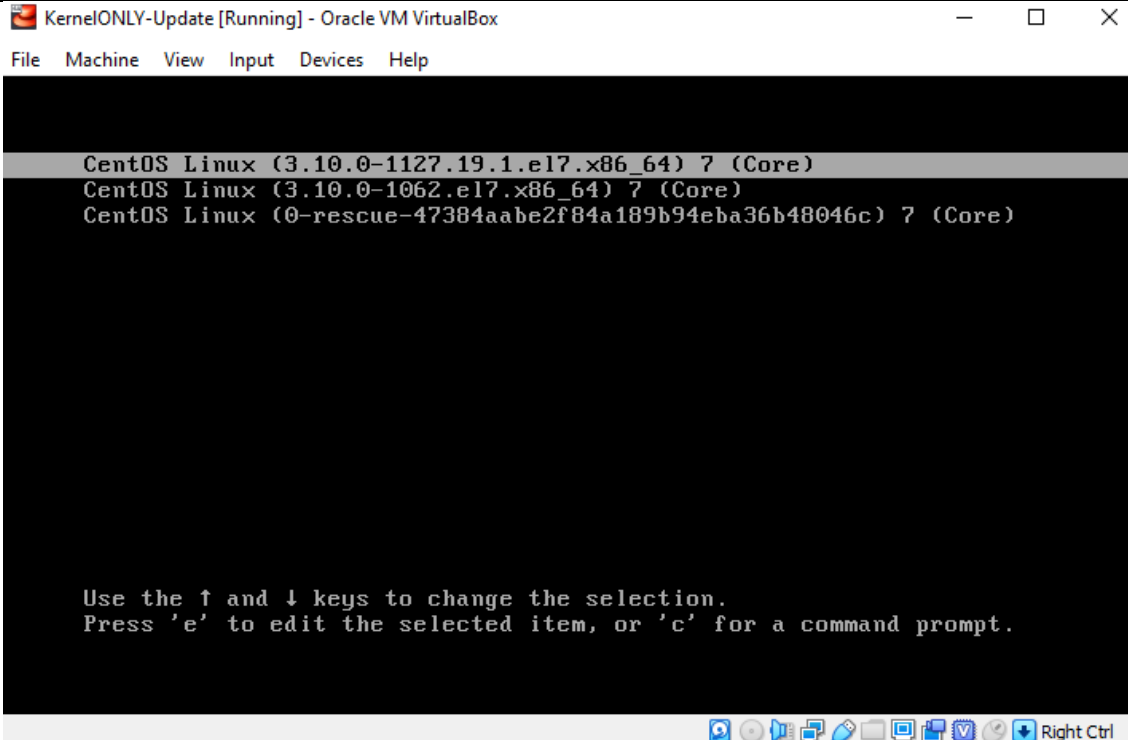
Installed size: 64 M

Is this ok [y/d/N]: y

Reboot

```
[root@zmpt01 ~]# init 6
```

The new kernel will be set as default Kernel



```
[root@zmpt01 ~]# uname -r
```



3.10.0-1127.19.1.el7.x86_64

Kernal physical location on Hard disk

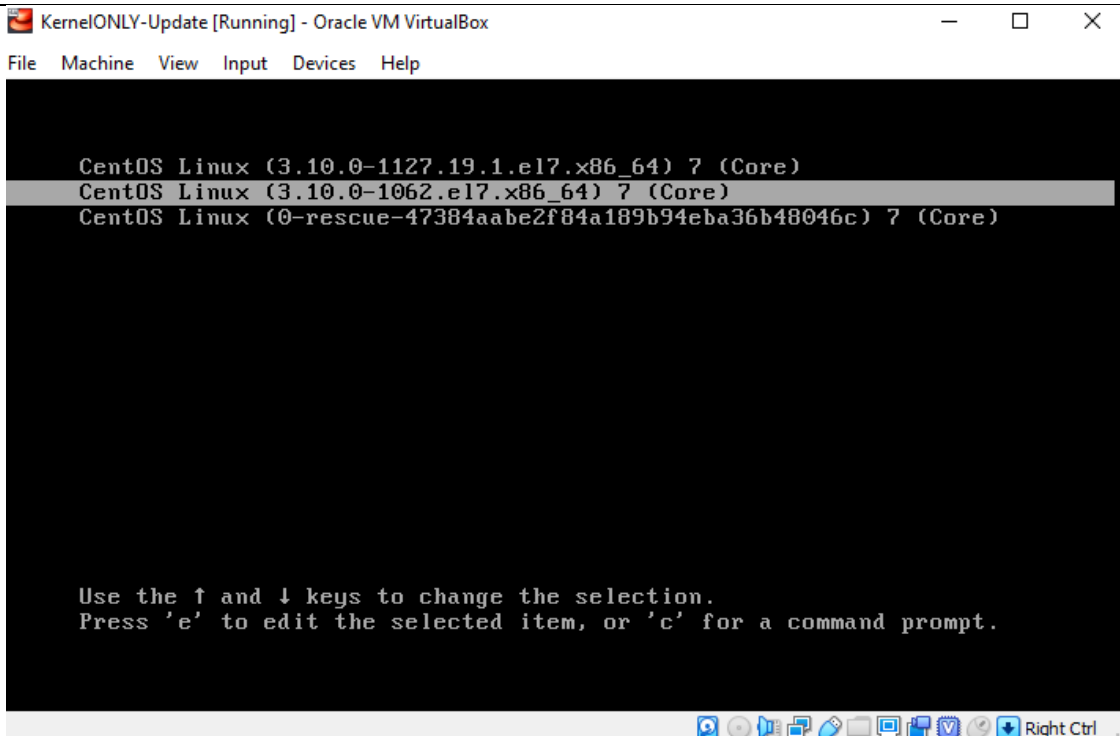
```
[root@zmpt01 boot]# pwd
/boot
[root@zmpt01 boot]# ls -ltrh | grep vm
-rwxr-xr-x. 1 root root 6.5M Aug 7 2019 vmlinuz-3.10.0-1062.el7.x86_64 < ---Old Kernel
-rwxr-xr-x. 1 root root 6.5M Aug 25 13:27 vmlinuz-3.10.0-1127.19.1.el7.x86_64 < ---New Kernel
-rwxr-xr-x. 1 root root 6.5M Oct 4 15:49 vmlinuz-0-rescue-47384aabe2f84a189b94eba36b48046c < ---Rescue Kernel
```

List of installed kernels using awk command

```
[root@zmpt01 ~]# awk -F\ '$1=="menuentry "'{print $2}' /etc/grub2.cfg
CentOS Linux (3.10.0-1127.19.1.el7.x86_64) 7 (Core) < ---This is position 0
CentOS Linux (3.10.0-1062.el7.x86_64) 7 (Core) < ---This is position 1
CentOS Linux (0-rescue-47384aabe2f84a189b94eba36b48046c) 7 (Core)
```

Default kernel is set in following file

```
[root@zmpt01 ~]# grub2-set-default 1
```



Old version is now default

```
[root@zmpt01 ~]# uname -r
```

3.10.0-1062.el7.x86_64

Change it to new version

```
[root@zmpt01 ~]# grub2-set-default 0
```

If you want to set BIOS based or UEFI base GRUB

BIOS based system

Grub2.mkconfig /boot/grub2/grub.cfg < ---if you see this file in this folder then it's a BIOS based OS

UEFI based system

Grub2.mkconfig -o /boot/efi/EFI/centos/grub.cfg < ---if you see this file in this folder then it's a UEFI based OS

10-31-2020

https://youtu.be/Ds7UJ_ILG7s

GUI Install

```
[root@zmpt01 ~]# uname -r
```

3.10.0-1062.el7.x86_64

```
[root@zmpt01 ~]# df -h
```

Filesystem	Size	Used	Avail	Use%	Mounted on
devtmpfs	484M	0	484M	0%	/dev
tmpfs	496M	0	496M	0%	/dev/shm
tmpfs	496M	6.8M	489M	2%	/run
tmpfs	496M	0	496M	0%	/sys/fs/cgroup
/dev/mapper/centos-root	14G	1.8G	12G	14%	/
/dev/sda1	1014M	136M	879M	14%	/boot
tmpfs	100M	0	100M	0%	/run/user/0

< ---Size is just about 2GB, at this point its full functioning OS

GUI Installation is a major upgrade

```
[root@zmpt01 ~]# yum group install gnome-desktop x11 fonts -y
```

Install 286 Packages (+740 Dependent packages)

Upgrade (21 Dependent packages)

Total download size: 720 M

Complete

11-01-2020
https://www.youtube.com/watch?v=UxK_uzWrc10

Reboot

```
[root@zmpt01 ~]# uname -r
3.10.0-1127.19.1.el7.x86_64 < ---Kernel is updated

[root@zmpt01 ~]# df -h
Filesystem      Size  Used Avail Use% Mounted on
devtmpfs        479M  0 479M  0% /dev
tmpfs           496M  0 496M  0% /dev/shm
tmpfs           496M  7.2M 489M  2% /run
tmpfs           496M  0 496M  0% /sys/fs/cgroup
/dev/mapper/centos-root 14G 4.2G 9.3G 32% /
/dev/sda1       1014M 185M 830M 19% /boot
tmpfs           100M  0 100M  0% /run/user/0
```

< ---Size of the OS disk increased

Security updates

```
[root@zmpt01 ~]# yum update --security
[root@zmpt01 ~]# yum update-minimal --security
```

Group packages

List of packages which are grouped together, usually similar packages

```
[root@zmpt01 ~]# yum group list
```

You will get a list of group packages

Example: Security Tools, Development Tools

List of packages in the group package

```
[root@zmpt01 ~]# yum group info "Development Tools"
```

Prefix	Description
-	Package was not installed and won't be installed as part of group
+	Package was not installed but will be installed when you install as group
=	Package was installed as part of group
Blank Space	Package was installed but not as part of the group

If you want to install a group package

```
[root@zmpt01 ~]# yum group install "Development Tools"
```

If you want to update the group package

```
[root@zmpt01 ~]# yum group update "Development Tools"
```

If you want to remove the group package

```
[root@zmpt01 ~]# yum group remove "Development Tools"
```

NOTE: There is no autoremove available for group uninstall

11-01-2020

https://youtu.be/UxK_uzWrc10

Runlevels

Runlevel is a operating state of a system

```
[root@zmpt01 ~]# who -r
run-level 3 2020-11-01 15:22
[root@zmpt01 ~]# runlevel
N 3
[root@zmpt01 ~]# systemctl get-default
multi-user.target
```

Linux has 7 runlevels

Runlevel 0	Shutdown mode	Init 0
Runlevel 1	Rescue, Emergency Mode – No Network	Init 1
Runlevel 2	Multi-UserMode – No NFS	Init 2
Runlevel 3	Multi-UserMode with NFS – default	Init 3
Runlevel 4	Not Used	
Runlevel 5	Graphical User Mode – GUI	Init 5
Runlevel 6	Reboot	Init 6

Unless you the default runlevel, the system will boot into whatever default runlevel is

Set the default run level

```
systemctl set-default
```



- This command is used for changing default run level
- Whenever you use this command
- The symbolic link for the file `/etc/systemd/system/default.target`
- Is changed to the the file associated with the desired runlevel file
- Runlevel files are sitting in this location
- Most of the time you are only setting default either Multi-User or Graphical
- Runlevel 3 or Runlevel 5

During the system boot process

`/etc/systemd/system/default.target`

This file is actually a symlink of the targeted runlevel file

Most common is either 3 or 5

Main file read during system boot	<code>/etc/systemd/system/default.target</code>
Systemctl set-default	This command will chaged the symlink to either one fo the file
Multi-user.target	<code>/usr/lib/systemd/system/multi-user.target</code>
Graphical.target	<code>/usr/lib/systemd/system/graphical.target.</code>

Set the default to graphical

```
[root@zmpt01 ~]# systemctl set-default graphical.target
```

Removed symlink `/etc/systemd/system/default.target`.

Created symlink from `/etc/systemd/system/default.target` to `/usr/lib/systemd/system/graphical.target`.

```
[root@zmpt01 ~]# systemctl get-default  
graphical.target
```

```
[root@zmpt01 ~]# stat /etc/systemd/system/default.target  
File: '/etc/systemd/system/default.target' -> '/usr/lib/systemd/system/graphical.target'  
Size: 40      Blocks: 0      IO Block: 4096  symbolic link  
Device: fd00h/64768d  Inode: 2965052  Links: 1  
Access: (0777/lrwxrwxrwx)  Uid: ( 0/  root)  Gid: ( 0/  root)  
Context: system_u:object_r:systemd_unit_file_t:s0  
Access: 2020-11-01 16:05:23.881107580 -0600  
Modify: 2020-11-01 16:05:23.702105238 -0600
```

Change: 2020-11-01 16:05:23.702105238 -0600 Birth: -
Set the default to multi-user
[root@zmpt01 ~]# systemctl set-default multi-user.target Removed symlink /etc/systemd/system/default.target. Created symlink from /etc/systemd/system/default.target to /usr/lib/systemd/system/multi-user.target.
[root@zmpt01 ~]# systemctl get-default multi-user.target
[root@zmpt01 ~]# stat /etc/systemd/system/default.target File: '/etc/systemd/system/default.target' -> '/usr/lib/systemd/system/multi-user.target' Size: 41 Blocks: 0 IO Block: 4096 symbolic link Device: fd00h/64768d Inode: 2965067 Links: 1 Access: (0777/lrwxrwxrwx) Uid: (0/ root) Gid: (0/ root) Context: system_u:object_r:systemd_unit_file_t:s0 Access: 2020-11-01 16:10:03.827399630 -0600 Modify: 2020-11-01 16:10:03.645397251 -0600 Change: 2020-11-01 16:10:03.645397251 -0600 Birth: -
11-01-2020 https://youtu.be/UxK_uzWrc10
System boot process
System Initialization Boot process
System goes through the following steps before OS is ready for the user
<ol style="list-style-type: none">1. The computer is powered on2. It read the BIOS – it is a physical chip sitting on motherboard3. BIOS – Basic Input/Output System4. BIOS performs POST – Power On Self Test – System Hardware Health Check5. Then BIOS passes control to first stage of BOOTLOADER BOOTLOADER sits in MBR (Master Boot Record) on hard drive



BOOTLOADER has two stages

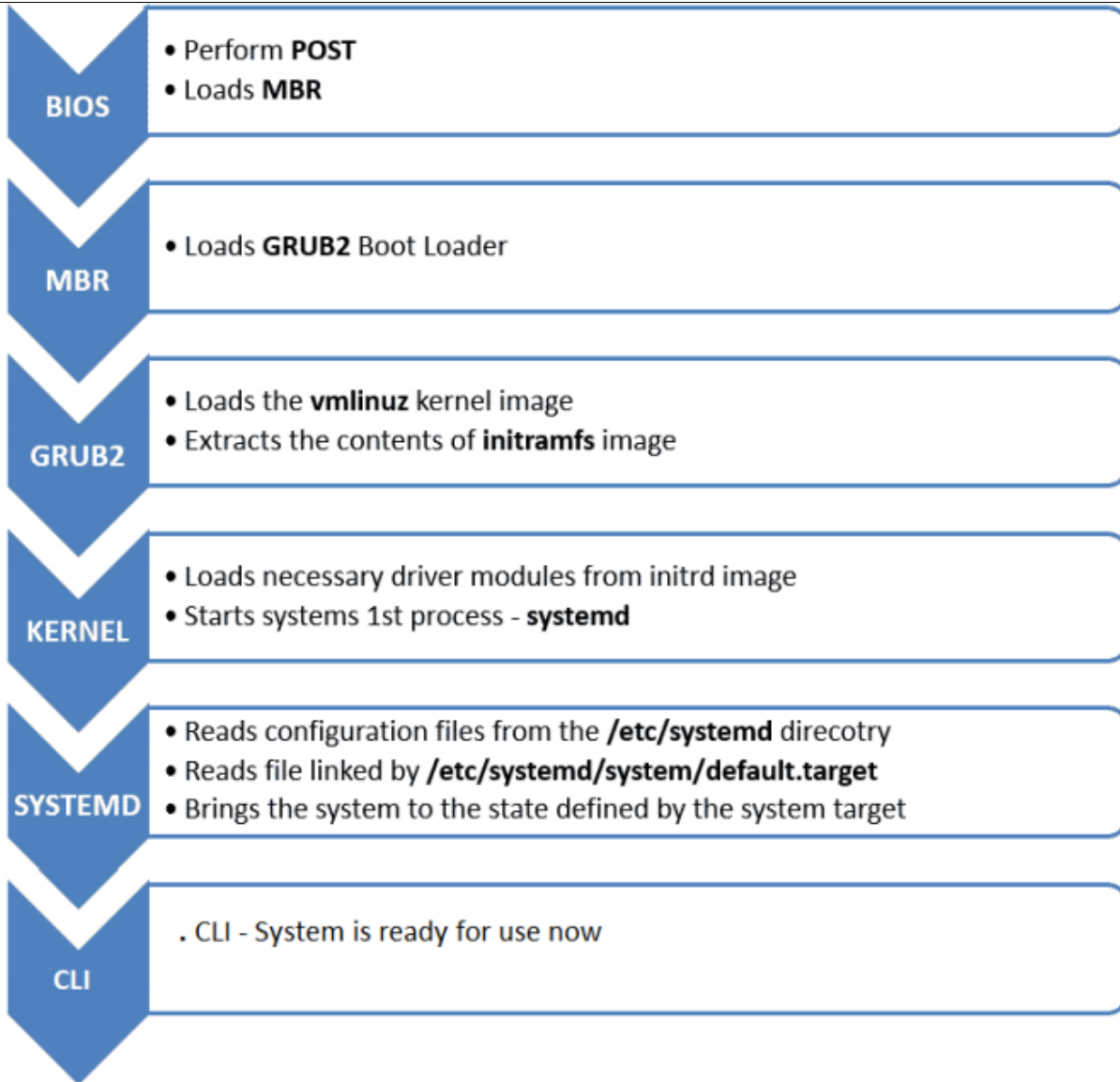
6. First stage of BOOTLOADER passes control to Second Stage of BOOTLOADER

Second stage of BOOTLOADER resides in /boot folder

7. Second stage of BOOTLOADER load **vmlinuz** kernel file
8. Also extracts the content of the file **initramfs** image file
9. Vmlinuz kernel file also load the drivers from the **initramfs** images
10. The kernel files starts the first process of SystemD

Now SystemD is in control

11. SystemD process
 - a. Reads the configuration files from /etc/systemd directory
 - b. While there it also reads runlevel file **/etc/systemd/system/default.target**
 - c. So whatever /etc/systemd/system/default.target is set as (Multi-user or Graphical)
 - d. Runlevel is loaded based on this /etc/systemd/system/default.target
 - e. It executes /etc/rc.local



11-01-2020

https://youtu.be/UxK_uzWrc10

Password Recovery for root user

Reboot

Interrupt boot using 'any key' on the keyboard to stop the countdown



GUI-UPGRADE [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

```
CentOS Linux (3.10.0-1127.19.1.el7.x86_64) 7 (Core)
CentOS Linux (3.10.0-1062.el7.x86_64) 7 (Core)
CentOS Linux (0-rescue-47384aabe2f84a189b94eba36b48046c) 7 (Core)
```

Use the ↑ and ↓ keys to change the selection.
Press 'e' to edit the selected item, or 'c' for a command prompt.

Right Ctrl

'e' to edit the selected item



```
insmod part_msdos
insmod xfs
set root='hd0,msdos1'
if [ x${feature_platform_search_hint} = xy ]; then
    search --no-floppy --fs-uuid --set=root --hint-bios=hd0,msdos1 --hin
t-efi=hd0,msdos1 --hint-baremetal=ahci0,msdos1 --hint='hd0,msdos1' 160e6caa-b\
0a9-468b-9de1-04189acc84ce
else
    search --no-floppy --fs-uuid --set=root 160e6caa-b0a9-468b-9de1-0418\
9acc84ce
fi
linux16 /vmlinuz-3.10.0-1127.19.1.el7.x86_64 root=/dev/mapper/centos-r\
oot ro crashkernel=auto rd.lvm.lv=centos/root rd.lvm.lv=centos/swap rhgb quiet\
LANG=en_US.UTF-8 rd.break
initrd16 /initramfs-3.10.0-1127.19.1.el7.x86_64.img

Press Ctrl-x to start, Ctrl-c for a command prompt or Escape to
discard edits and return to the menu. Pressing Tab lists
possible completions.
```

Using the **arrow key**, scroll to the line that starts with **linux16**, then go to the end of this line **right side arrow key** or push **end** key on the keyboard to jump to the end of the line.

At the end of the line give space and type '**rd.break**'

And hit left '**ctrl + x**' on keyboard

11-07-2020

<https://youtu.be/-rEm3lopuhw>



```
GUI-UPGRADE [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
[ 3.353455] [drm:vmw_host_log [vmwgfx]] *ERROR* Failed to send host log messa
ge.
[ 3.356453] [drm:vmw_host_log [vmwgfx]] *ERROR* Failed to send host log messa
ge.

Generating "/run/initramfs/rdsosreport.txt"

Entering emergency mode. Exit the shell to continue.
Type "journalctl" to view system logs.
You might want to save "/run/initramfs/rdsosreport.txt" to a USB stick or /boot
after mounting them and attach it to a bug report.

switch_root:/# mount -o remount, rw /sysroot
switch_root:/# chroot /sysroot
sh-4.2# passwd
Changing password for user root.
New password:
BAD PASSWORD: The password is shorter than 8 characters
Retype new password:
passwd: all authentication tokens updated successfully.
sh-4.2# touch /.autorelabel
sh-4.2# exit
exit
switch_root:/# reboot
```

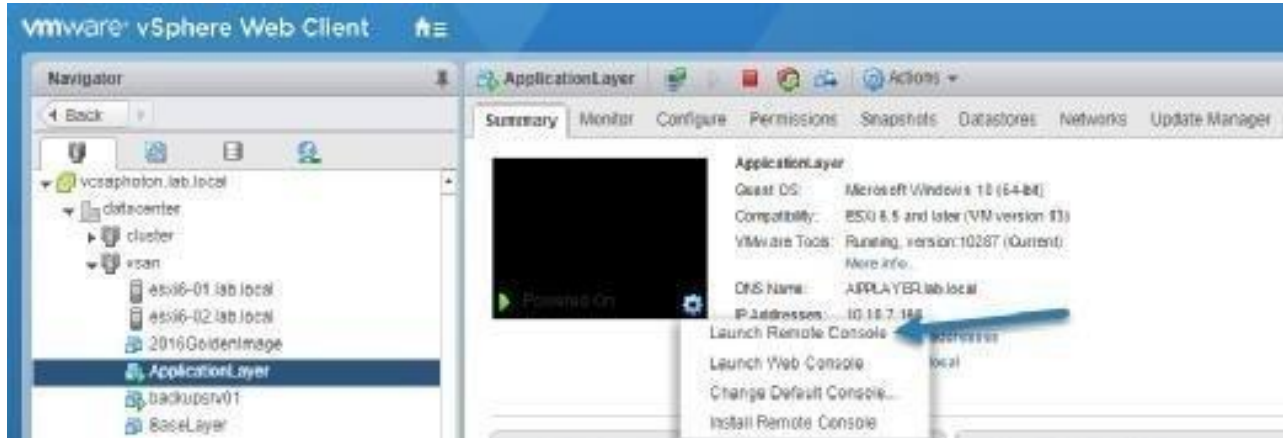
Type as shown

- mount -o remount, rw /sysroot – **Enter**
- chroot /sysroot – **Enter**
- passwd – **Enter**
- touch /.autorelabel – **Enter**
- exit



- reboot

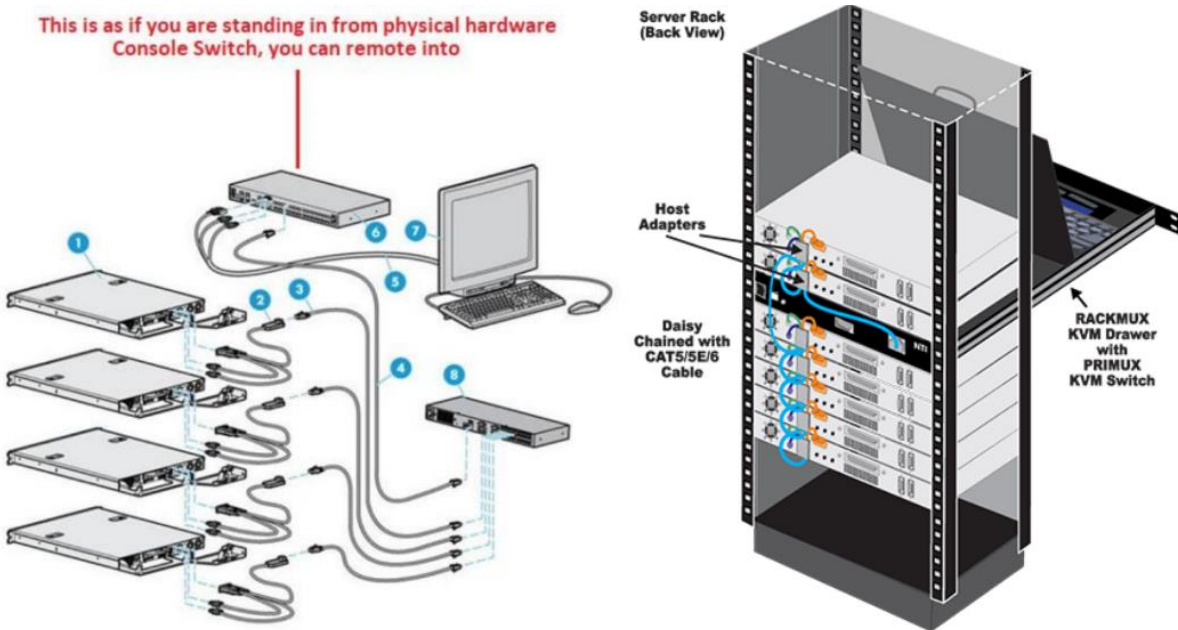
Connecting to console in VMWare



For IBM, HP, DELL

- HP – ILO – Integrated liteout
- IBM – HMC – Hardware Management Console
- Dell – iDRAC – Integrated Dell remote Access Control

This is as if you are standing in from physical hardware Console Switch, you can remote into





HP – ILO – Integrated liteout

hp iLO 4
ProLiant DL380p Gen8
Local User: Administrator
ILO Hostname: !
Home | Sign Out

Expand All

- Information
 - Overview
 - System Information
 - ILO Event Log
 - Integrated Management Log
 - Active Health System Log
 - Diagnostics
 - Location Discovery Services
 - Insight Agent
- ILO Federation
- Remote Console
- Virtual Media
- Power Management
- Network
- Remote Support
- Administration

ILO Overview
?

Information

Server Name: [Redacted]

Product Name: ProLiant DL380p Gen8

UUID: [Redacted]

Server Serial Number: [Redacted]

Product ID: 748304-S01

System ROM: P70

System ROM Date: 12/20/2013

Backup System ROM Date: 12/20/2013

Integrated Remote Console: **.NET Java**

License Type: iLO 4 Advanced

iLO Firmware Version: 2.03 Nov 07 2014

IP Address: 10.50.23.34

Link-Local IPv6 Address: [Redacted]

ILO Hostname: [Redacted]

Status

System Health: ✔ OK

Server Power: ● ON

UID Indicator: ● UID OFF

TPM Status: Not Present

SD-Card Status: Not Present

iLO Date/Time: Mon Jan 26 18:16:01 2015

Active Sessions

User:	IP	Source
Local User: Administrator	[Redacted]	Web UI

● POWER: ON
 ● UID: OFF ✔

IBM – HMC – Hardware Management Console



hmc770: Hardware Management Console Workplace (V7R7.2.0.1) - Mozilla Firefox

https://hmc770/hmc/connects/mainuiFrameset.jsp

Hardware Management Console

Manage Dumps: ddlling | Help | Ingrff

Systems Management > Servers View: Tree

Select	Name	Status	Available Processing Units	Available Memory (GB)	Reference Code
<input type="checkbox"/>	192.168.251.251	No Connection	0	0	Connecting 0000-000
<input checked="" type="checkbox"/>	HV8PFE	Operating	2.5	12.25	
<input type="checkbox"/>	MTSLPMMB	Operating	15.55	227.25	
<input type="checkbox"/>	RCHLPM25	Operating	0.2	9.125	

Max Page Size: 500 Total: 7 Filtered: 7 Selected: 1

Tasks: HV8PFE

- Properties
- Operations
- Configuration
- Connections
 - Service Processor Status
 - Reset or Remove Connections
 - Disconnect Another HMC
 - Add Managed System
- Hardware Information
- Updates
- Serviceability
 - Manage Serviceable Events
 - Create Serviceable Event
 - Reference Code History
 - Control Panel Functions
 - Hardware
 - Manage Dumps**
 - Collect VPD
 - FSP Failover
 - Capacity On Demand (CoD)

Status: Attentions and Events

Dell – IDRAC – Integrated Dell remote Access Control



DELL INTEGRATED DELL REMOTE ACCESS CONTROLLER 6 - ENTERPRISE Support | About | Logout

System
PowerEdge R610
Admin

System
iDRAC Settings
Batteries
Fans
Intrusion
Power Supplies
Removable Flash Media
Temperatures
Voltages
Power Monitoring
LCD

Properties Setup Power Logs Alerts Console/Media vFlash Remote File Share

System Summary | System Details | System Inventory

System Summary

Server Health

Status	Component
✓	Batteries
✓	Fans
✓	Intrusion
✓	Power Supplies
✓	Removable Flash Media
✓	Temperatures
✓	Voltages

Virtual Console Preview
Options : Settings

Refresh Launch

Server Information

Power State	ON
System Model	PowerEdge R610
System Revision	II

Quick Launch Tasks

- Power ON / OFF
- Power Cycle System (cold boot)
- Launch Virtual Console

11-07-2020

<https://youtu.be/-rEm3lopuhw>

Disk Management

Hard Disk (Hard Drive)

IDE – Linux will handle these kind fo devices /dev/hda

SCSI – Linux will handle these kind of devices /dev/sda

Virtual drive – Linux will handle these kind of devices /dev/vda

SCSI –

Small Computer System Interface is a set of standards for physically connecting and transferring data between computers and peripheral devices. The SCSI standards define commands, protocols, electrical, optical and logical interfaces

Very first drive

/dev/sda



Second drive	/dev/sdb
Third drive	/dev/sdc
26th drive	/dev/sdz
27th drive	/dev/sdaa
28th drive	/dev/sdab

List the disk

Lsblk

```
[root@zmpt01 ~]# lsblk
NAME      MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
sda       8:0  0  16G  0 disk
├─sda1    8:1  0   1G  0 part /boot
└─sda2    8:2  0  15G  0 part
   └─centos-root 253:0  0 13.4G  0 lvm /
      └─centos-swap 253:1  0  1.6G  0 lvm [SWAP]
sdb       8:16  0  16G  0 disk
sdc       8:32  0   8G  0 disk
sr0       11:0  1 1024M  0 rom
```

Linux handles the devices as files

```
[root@zmpt01 ~]# ls -l /dev/sd*
brw-rw----. 1 root disk 8, 0 Nov  7 16:54 /dev/sda
brw-rw----. 1 root disk 8, 1 Nov  7 16:54 /dev/sda1
brw-rw----. 1 root disk 8, 2 Nov  7 16:54 /dev/sda2
brw-rw----. 1 root disk 8, 16 Nov  7 16:54 /dev/sdb < ---Working on this disk
brw-rw----. 1 root disk 8, 32 Nov  7 16:54 /dev/sdc
```

Three common ways to manage the disk

- Fdisk – Fixed disk setup program
- Gdisk – Same as fdisk, but uses GPT
- LVM – Logical Volume Manager

FDISK

Fixed Disk Setup Program

/dev/sdb – 16GB



```
[root@zmpt01 ~]# fdisk /dev/sdb
Command (m for help): m
Command (m for help): n
Select (default p): p
Partition number (1-4, default 1): 1
First sector (2048-33554431, default 2048): < ---hit enter
Last sector, +sectors or +size{K,M,G} (2048-33554431, default 33554431): +8G
Command (m for help): w
The partition table has been altered!
```

10-08-2020
<https://youtu.be/QLMONTsxtwA>

Run partprobe

```
[root@zmpt01 ~]# partprobe
```

```
[root@zmpt01 ~]# lsblk
NAME        MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
sda         8:0  0  16G  0 disk
├─sda1      8:1  0   1G  0 part /boot
├─sda2      8:2  0  15G  0 part
│   └─centos-root 253:0  0 13.4G  0 lvm /
│   └─centos-swap 253:1  0  1.6G  0 lvm [SWAP]
sdb         8:16  0  16G  0 disk
├─sdb1      8:17  0   8G  0 part < ---New created partition
sdc         8:32  0   8G  0 disk
sr0        11:0  1 1024M  0 rom
```

Creating the file system

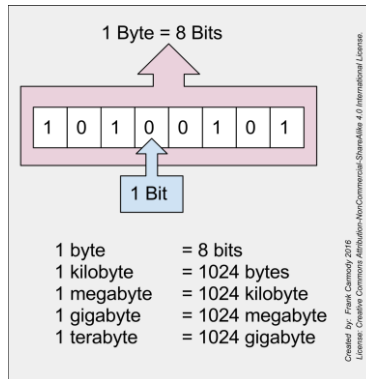
In computing, a file system or filesystem controls how data is stored(writing) and retrieved(access)

```
[root@zmpt01 ~]# mkfs.ext4 /dev/sdb1 < ---Command to create EXT4 file system
mke2fs 1.42.9 (28-Dec-2013)
Filesystem label=
OS type: Linux
Block size=4096 (log=2) < ---4KB is the default black space (smallest useable block)
Fragment size=4096 (log=2)
Stride=0 blocks, Stripe width=0 blocks
524288 inodes, 2097152 blocks
104857 blocks (5.00%) reserved for the super user
First data block=0
```



Maximum filesystem blocks=2147483648
 64 block groups
 32768 blocks per group, 32768 fragments per group
 8192 inodes per group
 Superblock backups stored on blocks:
 32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632

Allocating group tables: done
 Writing inode tables: done
 Creating journal (32768 blocks): done
 Writing superblocks and filesystem accounting information: done



Binary is base 2 = 1 0

1 = on

0 = off

2^8

4096 = 4kb minimum useable

File Size	Disk Space used 4K
0	4 kb
1 kb	4kb
2 kb	4 kb
4 kb	4 kb
6 kb	8 kb
13 kb	16 kb
21	24 kb



File System structure

File System	Max Disk Size	Single file size
Ext2	32 TB	2 TB
Ext3	32 TB	2 TB
Ext4	1 Eib	16 TB
XFS	16 Eib	500 TB for RHEL - 7 100 TB for RHEL - 8

Unit	Shortened	Capacity
Kilobyte	KB	1024 bytes
Megabyte	MB	1024 kilobytes
Gigabyte	GB	1024 megabytes
Terabyte	TB	1024 gigabytes

Mount the file system – makign it available for usage

```
[root@zmpt01 ~]# mkdir /DATA
```

```
[root@zmpt01 ~]# mount /dev/sdb1 /DATA/ < ---you have to provide absolute path when mounting
```

Command	Filesystem	Mount point/ location
Mount	/dev/sdb1	/DATA

To see the disk and mount point being used

```
[root@zmpt01 ~]# df -h
```

Filesystem	Size	Used	Avail	Use%	Mounted on
devtmpfs	484M	0	484M	0%	/dev
tmpfs	496M	0	496M	0%	/dev/shm
tmpfs	496M	6.8M	489M	2%	/run
tmpfs	496M	0	496M	0%	/sys/fs/cgroup
/dev/mapper/centos-root	14G	1.8G	12G	14%	/
/dev/sda1	1014M	136M	879M	14%	/boot
tmpfs	100M	0	100M	0%	/run/user/0
/dev/sdb1	7.8G	36M	7.3G	1%	/DATA

```
[root@zmpt01 ~]# lsblk
NAME      MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
sda       8:0  0  16G  0 disk
├─sda1    8:1  0   1G  0 part /boot
└─sda2    8:2  0  15G  0 part
   ├─centos-root 253:0  0 13.4G  0 lvm /
   └─centos-swap 253:1  0  1.6G  0 lvm [SWAP]
sdb       8:16  0  16G  0 disk
└─sdb1    8:17  0   8G  0 part /DATA
sdc       8:32  0   8G  0 disk
sr0      11:0  1 1024M  0 rom
```

Unmount the disk

```
[root@zmpt01 ~]# umount /DATA/

NAME      MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
sda       8:0  0  16G  0 disk
├─sda1    8:1  0   1G  0 part /boot
└─sda2    8:2  0  15G  0 part
   ├─centos-root 253:0  0 13.4G  0 lvm /
   └─centos-swap 253:1  0  1.6G  0 lvm [SWAP]
sdb       8:16  0  16G  0 disk
└─sdb1    8:17  0   8G  0 part
sdc       8:32  0   8G  0 disk
sr0      11:0  1 1024M  0 rom
```

Reboot

```
[root@zmpt01 ~]# df -h
```

The file system is not mounted

FSTAB – File System Table

Configuration file helpful during boot for mounting disks

/etc/fstab

[root@zmpt01 ~]# vi /etc/fstab

Copy th existing line and paset into new line and edit as needed

Filesystem	Mount point	Filesystem type	OS handles this	priority
/dev/sdb1	/DATA	ext4	defaults	0 0

[root@zmpt01 ~]# mount -a < ---this command will read /etc/fstab and mounts the files if not already mounted

The file system will be mounted during boot up

persistence with the reboot

Changing the mount point

[root@zmpt01 DATA]# touch file{1..100}

/dev/sdb1 7.8G 36M 7.3G 1% /DATA < ---Files are actually written to /dev/sdb1

[root@zmpt01 ~]# umount /DATA

[root@zmpt01 ~]# df -h

[root@zmpt01 ~]# cd /DATA/

[root@zmpt01 DATA]# ls

[root@zmpt01 ~]# mount /dev/sdb1 /IBM

[root@zmpt01 ~]# df -h

```
Filesystem      Size  Used Avail Use% Mounted on
devtmpfs        484M  0 484M  0% /dev
tmpfs           496M  0 496M  0% /dev/shm
tmpfs           496M  6.8M 489M  2% /run
tmpfs           496M  0 496M  0% /sys/fs/cgroup
/dev/mapper/centos-root 14G 1.8G 12G 14% /
/dev/sda1       1014M 136M 879M 14% /boot
tmpfs          100M  0 100M  0% /run/user/0
```

/dev/sdb1 7.8G 36M 7.3G 1% /IBM < ---mount point is changed to IBM, but data will still be available

[root@zmpt01 IBM]# ls

file1 file2 file30 file41 file52 file63 file74 file85 file96

UUID – Universal Unique Identifier

[root@zmpt01 ~]# blkid



```

/dev/sdb1: UUID="1dfbb3a5-8b04-4883-89e7-ceb9e78db6e4" TYPE="ext4"

[root@zmpt01 ~]# vi /etc/fstab

#/dev/sdb1 /DATA          ext4  defaults    0 0

UUID=1dfbb3a5-8b04-4883-89e7-ceb9e78db6e4 /DATA          ext4  defaults    0 0

[root@zmpt01 ~]# mount -a

[root@zmpt01 ~]# df -h
/dev/sdb1      7.8G  36M  7.3G  1% /DATA < ---UUID is associated with /dev/sdb1
    
```

Mount using label

```

[root@zmpt01 ~]# e2label /dev/sdb1 zmpt01

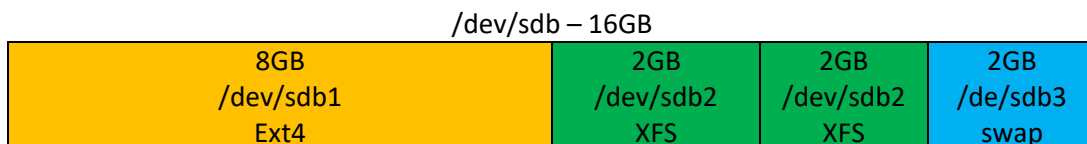
[root@zmpt01 ~]# blkid
/dev/sda1: UUID="160e6caa-b0a9-468b-9de1-04189acc84ce" TYPE="xfs"
/dev/sda2: UUID="oLnQZF-bJU0-02T3-t0wF-DhnB-2JI6-CQI9f2" TYPE="LVM2_member"
/dev/sdb1: LABEL="zmpt01" UUID="1dfbb3a5-8b04-4883-89e7-ceb9e78db6e4" TYPE="ext4"
/dev/mapper/centos-root: UUID="5c79b16a-cfd4-4d5a-8e9c-b9b1a37b4936" TYPE="xfs"
/dev/mapper/centos-swap: UUID="c7801c38-9828-49b2-8a12-7610376d8b8a" TYPE="swap"

[root@zmpt01 ~]# vi /etc/fstab

LABEL="zmpt01" /DATA          ext4  defaults    0 0 < ---using the LABEL

[root@zmpt01 ~]# mount -a
[root@zmpt01 ~]# df -h
/dev/sdb1      7.8G  36M  7.3G  1% /DATA < ---Mounted using LABEL
    
```

Multiple filesystem on same disk



```

[root@zmpt01 ~]# fdisk /dev/sdb
Command (m for help): m
    
```

Command (m for help):

p
Command (m for help): **n**
Select (default p): **p**
Partition number (2-4, default 2): **2**
First sector (16779264-33554431, default 16779264): **< ---hit "Enter" – use default value**
Last sector, +sectors or +size{K,M,G} (16779264-33554431, default 33554431): **+2G**

Command (m for help): **p**

Disk /dev/sdb: 17.2 GB, 17179869184 bytes, 33554432 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk label type: dos
Disk identifier: 0x5460be06

Device	Boot	Start	End	Blocks	Id	System
/dev/sdb1		2048	16779263	8388608	83	Linux
/dev/sdb2		16779264	20973567	2097152	83	Linux < ---New partition is created

Command (m for help): w

```
[root@zmpt01 ~]# lsblk
NAME        MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
sda         8:0  0  16G  0 disk
├─sda1      8:1  0   1G  0 part /boot
└─sda2      8:2  0  15G  0 part
   ├─centos-root 253:0  0 13.4G  0 lvm /
   └─centos-swap 253:1  0  1.6G  0 lvm [SWAP]
sdb         8:16  0  16G  0 disk
├─sdb1      8:17  0   8G  0 part /DATA
└─sdb2      8:18  0   2G  0 part < ---Newly created partition 2GB
sdc         8:32  0   8G  0 disk
```

```
[root@zmpt01 ~]# mkfs.xfs /dev/sdb2
```

```
[root@zmpt01 ~]# mount /dev/sdb2 /IBM/
```

```
[root@zmpt01 ~]# df -h
Filesystem      Size  Used Avail Use% Mounted on
devtmpfs        484M  0 484M  0% /dev
tmpfs           496M  0 496M  0% /dev/shm
tmpfs           496M  6.8M 489M  2% /run
tmpfs           496M  0 496M  0% /sys/fs/cgroup
/dev/mapper/centos-root 14G  1.8G 12G 14% /
/dev/sda1       1014M 136M 879M 14% /boot
tmpfs          100M  0 100M  0% /run/user/0
/dev/sdb1       7.8G  36M 7.3G  1% /DATA
/dev/sdb2       2.0G  33M 2.0G  2% /IBM < ---disk is mounted to /IBM
```

Make appropriate entry into /etc/fstab

```
/dev/sdb2 /IBM          xfs  defaults  0 0
```

```
[root@zmpt01 ~]# mount -a
```

```
[root@zmpt01 ~]# df -h
Filesystem      Size  Used Avail Use% Mounted on
devtmpfs        484M  0 484M  0% /dev
tmpfs           496M  0 496M  0% /dev/shm
tmpfs           496M  6.8M 489M  2% /run
tmpfs           496M  0 496M  0% /sys/fs/cgroup
/dev/mapper/centos-root 14G  1.8G 12G 14% /
/dev/sda1       1014M 136M 879M 14% /boot
tmpfs          100M  0 100M  0% /run/user/0
/dev/sdb1       7.8G  36M 7.3G  1% /DATA
/dev/sdb2       2.0G  33M 2.0G  2% /IBM < ---disk is mounted to /IBM using mount -a
```

11-14-2020

<https://youtu.be/AneCZr5-tLA>

Extending inodes

To create random amount of blank files

```
touch file{1..110000}
```

```
[root@zmpt01 IBM]# df -h
```

```
/dev/sdb2       2.0G 582M 1.5G 29% /IBM
```

```
[root@zmpt01 IBM]# df -l < ---this is used for checking the iNodes
```

```
/dev/sdb2      1048640 1048640    0 100% /IBM
```

Ext4 file system

```
[root@zmpt01 ~]# df -i /dev/sdb1
```

```
Filesystem  Inodes IUsed IFree IUse% Mounted on
```

```
/dev/sdb1  524288 110 524178  1% /DATA
```

```
[root@zmpt01 ~]# umount /dev/sdb1
```

```
[root@zmpt01 ~]# mkfs.ext4 -N 1000000 /dev/sdb1 < ---ALL DATA will be deleted
```

```
[root@zmpt01 ~]# mount /dev/sdb1 /DATA/
```

```
[root@zmpt01 ~]# df -i
```

```
/dev/sdb1      1000448  11 1000437  1% /DATA
```

Increase the partition size

```
[root@zmpt01 ~]# df -h
```

```
/dev/sdb2      2.0G 582M 1.5G 29% /IBM < --- Increase size of file system to 4GB
```

Unmount the partition that needs to be extended

```
[root@zmpt01 ~]# umount /IBM/
```

```
[root@zmpt01 ~]# fdisk /dev/sdb
```

```
Command (m for help): m
```

```
Command (m for help): d
```

```
Command (m for help): w
```

```
[root@zmpt01 ~]# fdisk /dev/sdb
```

```
Command (m for help): p
```

```
Command (m for help): n
```

Partition type:

p primary (1 primary, 0 extended, 3 free)

e extended

```
Select (default p): p
```

```
Partition number (2-4, default 2): 2
```

```
First sector (16779264-33554431, default 16779264):
```

```
Using default value 16779264
```

```
Last sector, +sectors or +size{K,M,G} (16779264-33554431, default 33554431): +4G
```

```
Partition 2 of type Linux and of size 4 GiB is set
```

```
Command (m for help): p
```

```
Device Boot      Start        End      Blocks  Id System
/dev/sdb1        2048    16779263   8388608  83 Linux
/dev/sdb2    16779264   25167871   4194304  83 Linux
```

Command (m for help): **w**

```
[root@zmpt01 ~]# partprobe
```

```
[root@zmpt01 ~]# mount -a
```

```
[root@zmpt01 ~]# df -h
/dev/sdb2          2.0G 582M 1.5G 29% /IBM
```

```
[root@zmpt01 ~]# xfs_growfs /dev/sdb2
```

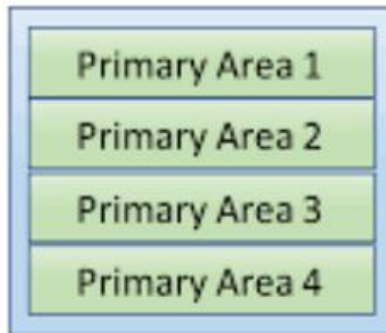
```
[root@zmpt01 IBM]# df -h
/dev/sdb2          4.0G 582M 3.5G 15% /IBM
```

Partiton Inforamtion

- You can have maximum of four primary partitions on single disk
- If you want to create more than four partitions
- Then you need to create extended partion, then you can **nest** multiple partitions inside extended partition

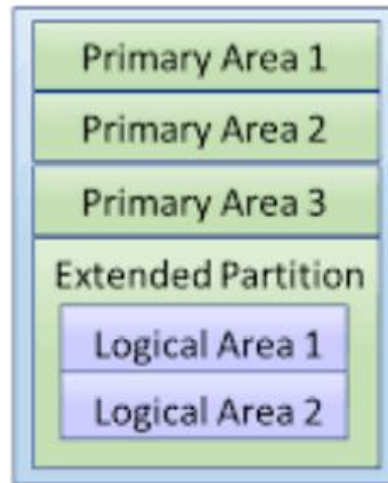


Primary Area Only



Max Four Primary Partitions |

Extended Area Created



Create extended Partition - then create multiple logical partitions

SWAP

Swap is a space on a disk that is used when the amount of physical memory (RAM) is full. When a linux system runs out of RAM, inactive pages are moved from RAM to **swap** space. **Swap** space can take the form of either a dedicated **swap** partition or a **swap** file.

- What is swap? Swap is standby memory
- It's a virtual memory used from hard drive
- Real memory is 1GB
- SWAP memory is 1.6 GB
- Total useable size is 2.6 GB
- If the real memory is full the swap is utilized
- OS will mvoe inactive processes to the swap memory
- Think of it as a safety net for Physical Memory.

```
[root@zmpt01 ~]# fdisk /dev/sdb
```

```
Command (m for help): p
```

```
Device Boot    Start      End    Blocks  Id System
/dev/sdb1      2048    16779263    8388608  83 Linux
```



```

/dev/sdb2 16779264 25167871 4194304 83 Linux

Command (m for help): m
Command (m for help): n
Partition type:
  p primary (2 primary, 0 extended, 2 free)
  e extended
Select (default p): p
Partition number (3,4, default 3): 3
First sector (25167872-33554431, default 25167872):
Using default value 25167872
Last sector, +sectors or +size{K,M,G} (25167872-33554431, default 33554431): +2G
Partition 3 of type Linux and of size 2 GiB is set

Command (m for help): m
Command (m for help): t
Partition number (1-3, default 3): 3
Hex code (type L to list all codes): 82
Changed type of partition 'Linux' to 'Linux swap / Solaris'

Command (m for help): p

Disk /dev/sdb: 17.2 GB, 17179869184 bytes, 33554432 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk label type: dos
Disk identifier: 0x5460be06

   Device Boot      Start         End      Blocks   Id  System
/dev/sdb1            2048    16779263     8388608   83  Linux
/dev/sdb2    16779264    25167871     4194304   83  Linux
/dev/sdb3    25167872    29362175     2097152   82  Linux swap / Solaris

Command (m for help): w

[root@zmpt01 ~]# partprobe

[root@zmpt01 ~]# mkswap /dev/sdb3 < ---creates the swap partition

[root@zmpt01 ~]# swapon /dev/sdb3 < ----make the swap useable

[root@zmpt01 ~]# vi /etc/fstab

/dev/sdb3 swap                swap defaults    0 0

[root@zmpt01 ~]# free -h

```

```
total    used    free    shared buff/cache available
Mem:    991M    284M    345M    1.6M    360M    549M
Swap:   3.6G    279M    3.3G
```

```
[root@zmpt01 ~]# swapoff /dev/sdb3
```

```
[root@zmpt01 ~]# free -h
total    used    free    shared buff/cache available
Mem:    991M    283M    347M    1.6M    360M    550M
Swap:   1.6G    278M    1.3G
```

```
[root@zmpt01 ~]# free -h
total    used    free    shared buff/cache available
Mem:    991M    283M    347M    1.6M    360M    550M
Swap:   1.6G    278M    1.3G
```

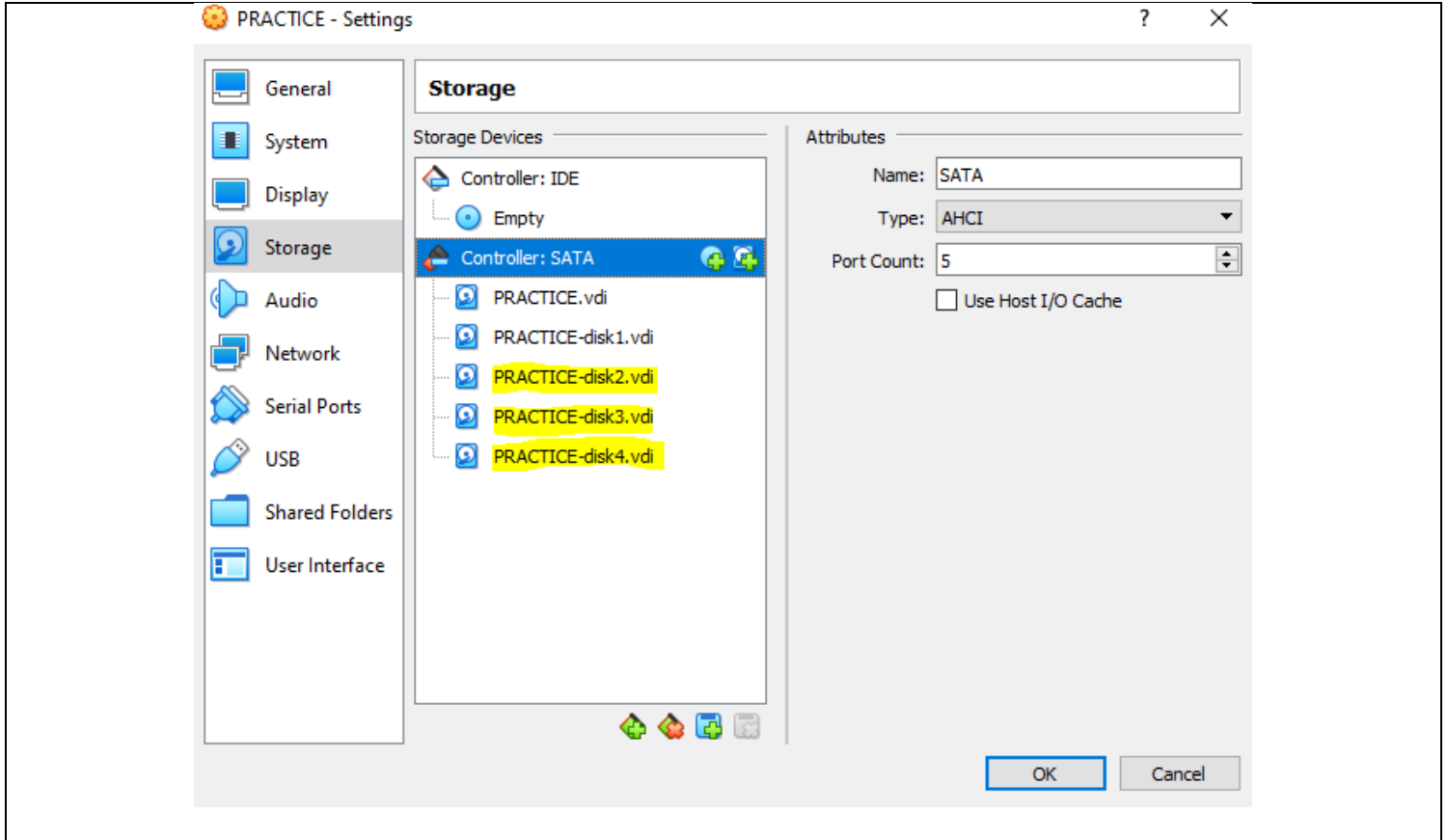
```
[root@zmpt01 ~]# vi /etc/fstab
```

```
[root@zmpt01 ~]# swapon -a
```

```
[root@zmpt01 ~]# free -h
total    used    free    shared buff/cache available
Mem:    991M    284M    345M    1.6M    360M    549M
Swap:   3.6G    278M    3.3G
```

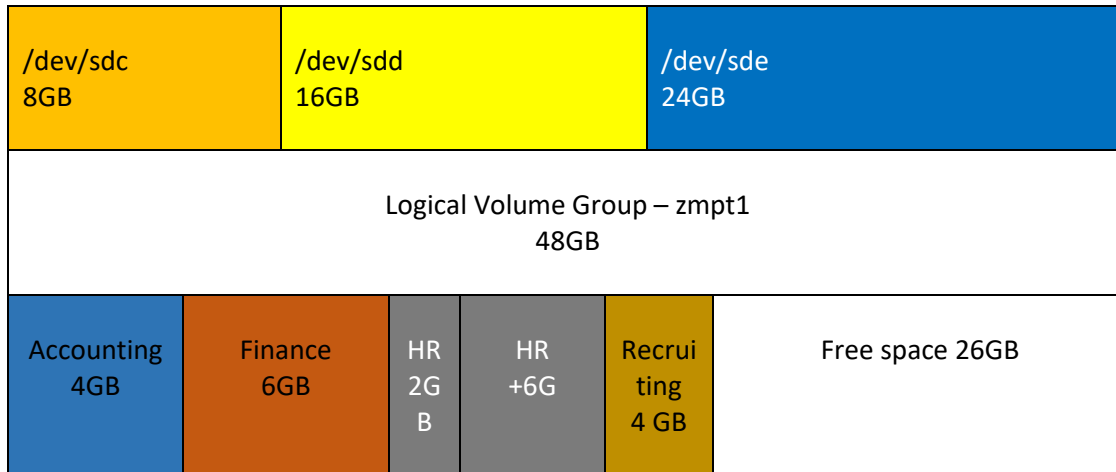
10-14-2020
<https://youtu.be/AneCZr5-tLA>

LVM – Logical Volume Manager



11-15-2020

<https://youtu.be/3oC5SgcoBf0>



LVM stand for Logical Volume Management, it's a system of managing logical volumes or file systems, that is much more **advanced** and **flexible** than the traditional method of partitioning a disk into one or more segments and formatting that partition with filesystem.

File system – ext4 or xfs

```
[root@zmpt01 ~]# lsblk
NAME        MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
sda         8:0  0  16G  0 disk
├─sda1      8:1  0   1G  0 part /boot
├─sda2      8:2  0  15G  0 part
│ └─centos-root 253:0  0 13.4G  0 lvm /
│ └─centos-swap 253:1  0  1.6G  0 lvm [SWAP]
sdb         8:16  0  16G  0 disk
├─sdb1      8:17  0   8G  0 part
├─sdb2      8:18  0   4G  0 part
└─sdb3      8:19  0   2G  0 part
sdc         8:32  0   8G  0 disk
sdd         8:48  0  16G  0 disk
sde         8:64  0  24G  0 disk
```

```
[root@zmpt01 ~]# pvcreate /dev/sdc /dev/sdd /dev/sde
Physical volume "/dev/sdc" successfully created.
Physical volume "/dev/sdd" successfully created.
Physical volume "/dev/sde" successfully created.
```

Command	Disk1	Disk 2	Disk 3
Pvcreate	/dev/sdc	/dev/sdd	/dev/sde

```
[root@zmpt01 ~]# blkid
/dev/sdc: UUID="pYcEYd-WWPb-cwhu-7dn5-IMIk-vWhk-7B9x6x" TYPE="LVM2_member"
/dev/sdd: UUID="MnAGcr-jORK-JhHN-1vBB-xFtf-ECI6-uWYRS3" TYPE="LVM2_member"
/dev/sde: UUID="FpAXdB-xeBK-Hdrq-HKZa-rmF0-lOPF-sK1sGt" TYPE="LVM2_member"
```

```
[root@zmpt01 ~]# pvs
PV      VG      Fmt Attr PSize  PFree
/dev/sda2 centos lvm2 a-- <15.00g  0
/dev/sdc   lvm2 ---  8.00g  8.00g
/dev/sdd   lvm2 --- 16.00g 16.00g
/dev/sde   lvm2 --- 24.00g 24.00g
```

```
[root@zmpt01 ~]# vgcreate zmpt1 /dev/sdc /dev/sdd /dev/sde
Volume group "zmpt1" successfully created
```

zmpt1 now acts as a single disk

Command	Volume group name	Disk 1	Disk 2	Disk 3
vgcreate	zmpt1	/dev/sdc	/dev/sdd	/dev/sde

```
[root@zmpt01 ~]# vgs
VG #PV #LV #SN Attr VSize VFree
centos 1 2 0 wz--n- <15.00g 0
zmpt1 3 0 0 wz--n- <47.99g <47.99g
```

```
[root@zmpt01 ~]# vgdisplay zmpt1
--- Volume group ---
VG Name          zmpt1
System ID
Format           lvm2
Metadata Areas   3
Metadata Sequence No 1
VG Access        read/write
VG Status        resizable
MAX LV           0
Cur LV          0
Open LV          0
Max PV           0
Cur PV          3
Act PV           3
VG Size          <47.99 GiB
PE Size          4.00 MiB
Total PE         12285
Alloc PE / Size  0 / 0
Free PE / Size   12285 / <47.99 GiB
VG UUID          pC41AQ-xwrj-NlKe-3B1i-eXcL-tTEF-NedVpe
```

Accounting	4GB
Finance	6GB
HR	2GB
Recruiting	4GB

```
[root@zmpt01 ~]# lvcreate -n Accounting -L 4G zmpt1
Logical volume "Accounting" created.
```

command	New	Logical volume name	Logical	Size	Volume Group
Lvcreate	-n	Accounting	-L	4G	Zmpt1

```
[root@zmpt01 ~]# vgs
VG   #PV #LV #SN Attr   VSize  VFree
centos 1 2 0 wz--n- <15.00g  0
zmpt1  3 1 0 wz--n- <47.99g <43.99g
```

```
[root@zmpt01 ~]# lvdisplay zmpt1
--- Logical volume ---
LV Path                /dev/zmpt1/Accounting
LV Name                 Accounting
VG Name                 zmpt1
LV UUID                 EnuV1G-5Suf-PfYM-KMAH-XY3O-as1A-K2rT0W
LV Write Access         read/write
LV Creation host, time zmpt01.prod.zmprotech.com, 2020-11-15 16:23:14 -0500
LV Status                available
# open                  0
LV Size                 4.00 GiB
Current LE               1024
Segments                1
Allocation               inherit
Read ahead sectors      auto
- currently set to      8192
Block device            253:2
```

```
[root@zmpt01 ~]# lvs zmpt1
LV   VG   Attr   LSize Pool Origin Data%  Meta%  Move Log Cpy%Sync Convert
Accounting zmpt1 -wi-a----- 4.00g
```

Mount the LVM partition

```
[root@zmpt01 ~]# mkdir /accounting
[root@zmpt01 ~]# mount /dev/zmpt1/Accounting /accounting

[root@zmpt01 ~]# df -h
/dev/mapper/zmpt1-Accounting 4.0G 33M 4.0G 1% /accounting
```

```
[root@zmpt01 ~]# lvcreate -n Finance -L 6G zmpt1
Logical volume "Finance" created.
[root@zmpt01 ~]# lvcreate -n HR -L 2G zmpt1
```

<pre>Logical volume "HR" created. [root@zmpt01 ~]# lvcreate -n Recruiting -L 4G zmpt1 Logical volume "Recruiting" created.</pre>
<pre>[root@zmpt01 ~]# mkdir /finance [root@zmpt01 ~]# mkdir /hr [root@zmpt01 ~]# mkdir /recruiting</pre>
<pre>[root@zmpt01 ~]# mkfs.xfs /dev/zmpt1/Finance [root@zmpt01 ~]# mkfs.xfs /dev/zmpt1/HR [root@zmpt01 ~]# mkfs.xfs /dev/zmpt1/Recruiting</pre>
<pre>[root@zmpt01 ~]# mount /dev/zmpt1/Finance /finance/ [root@zmpt01 ~]# mount /dev/zmpt1/HR /hr/ [root@zmpt01 ~]# mount /dev/zmpt1/Recruiting /recruiting/</pre>
<pre>[root@zmpt01 ~]# df -h /dev/mapper/zmpt1-Accounting 4.0G 33M 4.0G 1% /accounting /dev/mapper/zmpt1-Finance 6.0G 33M 6.0G 1% /finance /dev/mapper/zmpt1-HR 2.0G 33M 2.0G 2% /hr /dev/mapper/zmpt1-Recruiting 4.0G 33M 4.0G 1% /recruiting</pre>
<p>The partitions are created randomly</p> <pre>[root@zmpt01 ~]# lsblk sdc 8:32 0 8G 0 disk └─zmpt1-Accounting 253:2 0 4G 0 lvm /accounting └─zmpt1-HR 253:4 0 2G 0 lvm /hr sdd 8:48 0 16G 0 disk └─zmpt1-Finance 253:3 0 6G 0 lvm /finance └─zmpt1-Recruiting 253:5 0 4G 0 lvm /recruiting sde 8:64 0 24G 0 disk</pre>
<pre>[root@zmpt01 ~]# vi /etc/fstab /dev/mapper/zmpt1-Accounting /accounting xfs defaults 0 0 /dev/mapper/zmpt1-Finance /finance xfs defaults 0 0 /dev/mapper/zmpt1-HR /hr xfs defaults 0 0 /dev/mapper/zmpt1-Recruiting /recruiting xfs defaults 0 0</pre>
<pre>[root@zmpt01 ~]# mount -a [root@zmpt01 ~]# init 6</pre>


```
[root@zmpt01 ~]# df -h
Filesystem      Size  Used Avail Use% Mounted on
devtmpfs        484M  0 484M  0% /dev
tmpfs           496M  0 496M  0% /dev/shm
tmpfs           496M  6.8M 489M  2% /run
tmpfs           496M  0 496M  0% /sys/fs/cgroup
/dev/mapper/centos-root 14G  1.8G 12G 14% /
/dev/mapper/zmpt1-Accounting 4.0G  33M 4.0G  1% /accounting
/dev/mapper/zmpt1-HR    2.0G  33M 2.0G  2% /hr
/dev/mapper/zmpt1-Recruiting 4.0G  33M 4.0G  1% /recruiting
/dev/mapper/zmpt1-Finance 6.0G  33M 6.0G  1% /finance
/dev/sda1        1014M 136M 879M 14% /boot
tmpfs           100M  0 100M  0% /run/user/0
```

Extending the Logical Volume

Simulate the disk is full HR

```
[root@zmpt01 hr]# dd if=/dev/zero of=zafar1 bs=4096 count=+2G
/dev/mapper/zmpt1-HR    2.0G 2.0G 20K 100% /hr
```

Determine the free space available

```
[root@zmpt01 ~]# vgs
VG   #PV #LV #SN Attr   VSize  VFree
centos 1 2 0 wz--n- <15.00g  0
zmpt1 3 4 0 wz--n- <47.99g <31.99g  < ----available disk space

[root@zmpt01 ~]# vgdisplay zmpt1
Alloc PE / Size   4096 / 16.00 GiB
Free  PE / Size   8189 / <31.99 GiB      < ---available disk space
```

```
[root@zmpt01 ~]# lvextend -L +6G /dev/mapper/zmpt1-HR
Size of logical volume zmpt1/HR changed from 2.00 GiB (512 extents) to 8.00 GiB (2048 extents).
Logical volume zmpt1/HR successfully resized.
```

Command	Logical	Size	Logical Volume
lvextend	-L	+6G	/dev/mapper/zmpt1-HR

```
[root@zmpt01 ~]# xfs_growfs /dev/mapper/zmpt1-HR
```

```
[root@zmpt01 ~]# df -h
```

```
/dev/mapper/zmpt1-HR      8.0G  2.0G  6.0G  25% /hr      < ---now you can see the new size
```

```
[root@zmpt01 ~]# lvcreate -n LVSWAP -L 4G zmpt1  
Logical volume "LVSWAP" created.
```

```
[root@zmpt01 ~]# mkswap /dev/zbmpt1/LVSWAP  
Setting up swapspace version 1, size = 4194300 KiB  
no label, UUID=e0908f33-9f5f-461f-9ed1-f702ff06160d
```

```
[root@zmpt01 ~]# free -h  
      total    used    free   shared  buff/cache   available  
Mem:    991M    137M    75M    6.8M    777M    702M  
Swap:   1.6G      0B    1.6G  
[root@zmpt01 ~]# swapon /dev/mapper/zbmpt1-LVSWAP  
[root@zmpt01 ~]# free -h  
      total    used    free   shared  buff/cache   available  
Mem:    991M    141M    72M    6.8M    777M    699M  
Swap:   5.6G      0B    5.6G
```

Make entry into /etc/fstab

Adding Physical Disk

Add 40GB disk



PRACTICE - Settings

Storage

Storage Devices

- Controller: IDE
 - Empty
- Controller: SATA
 - PRACTICE.vdi
 - PRACTICE-disk1.vdi
 - PRACTICE-disk2.vdi
 - PRACTICE-disk3.vdi
 - PRACTICE-disk4.vdi
 - PRACTICE-disk5.vdi**

Attributes

Hard Disk: SATA Port 5

Solid-state Drive

Hot-pluggable

Information

Type (Format): Normal (VDI)

Virtual Size: 40.00 GB

Actual Size: 2.00 MB

Details: Dynamically allocated storage

Location: C:\Users\Newname01\Virtu...

Attached to: --

Encrypted with key: --

OK Cancel

11-22-2020

https://youtu.be/bs0FE_VAUvs

```
[root@zmpt01 ~]# lsblk
NAME          MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
sda           8:0  0  16G  0 disk
├─sda1        8:1  0   1G  0 part /boot
└─sda2        8:2  0  15G  0 part
   ├─centos-root 253:0  0 13.4G  0 lvm /
   └─centos-swap 253:1  0  1.6G  0 lvm [SWAP]
sdb           8:16  0  16G  0 disk
├─sdb1        8:17  0   8G  0 part
├─sdb2        8:18  0   4G  0 part
└─sdb3        8:19  0   2G  0 part
sdc           8:32  0   8G  0 disk
├─zmpt1-Accounting 253:2  0   4G  0 lvm /accounting
└─zmpt1-HR     253:4  0   8G  0 lvm /hr
sdd           8:48  0  16G  0 disk
├─zmpt1-Finance 253:3  0   6G  0 lvm /finance
```



```
└─zmpt1-HR    253:4  0  8G 0 lvm /hr
└─zmpt1-Recruiting 253:5  0  4G 0 lvm /recruiting
sde          8:64  0 24G 0 disk
└─zmpt1-LVSWAP 253:6  0  4G 0 lvm
sdf          8:80  0 40G 0 disk
sr0          11:0  1 1024M 0 rom
```

< ---New Disk Added

/dev/sdf is not part of any group yet

```
[root@zmpt01 ~]# vgs
VG #PV #LV #SN Attr VSize VFree
centos 1 2 0 wz--n- <15.00g  0
zmpt1  3 5 0 wz--n- <47.99g <21.99g
[root@zmpt01 ~]# pvs
PV   VG   Fmt Attr PSize  PFree
/dev/sda2 centos lvm2 a-- <15.00g  0
/dev/sdc  zmpt1 lvm2 a-- <8.00g  0
/dev/sdd  zmpt1 lvm2 a-- <16.00g 1.99g
/dev/sde  zmpt1 lvm2 a-- <24.00g <20.00g
```

Make /dev/sdf LVM formattable

```
[root@zmpt01 ~]# pvcreate /dev/sdf
Physical volume "/dev/sdf" successfully created.
[root@zmpt01 ~]# pvs
PV   VG   Fmt Attr PSize  PFree
/dev/sda2 centos lvm2 a-- <15.00g  0
/dev/sdc  zmpt1 lvm2 a-- <8.00g  0
/dev/sdd  zmpt1 lvm2 a-- <16.00g 1.99g
/dev/sde  zmpt1 lvm2 a-- <24.00g <20.00g
/dev/sdf   lvm2 --- 40.00g 40.00g
```

< ---formatted as LVM, but not part of vg – Volume Group

Add /dev/sdf to the VG – zmpt1

```
[root@zmpt01 ~]# vgextend zmpt1 /dev/sdf
Volume group "zmpt1" successfully extended
[root@zmpt01 ~]# pvs
PV   VG   Fmt Attr PSize  PFree
/dev/sda2 centos lvm2 a-- <15.00g  0
/dev/sdc  zmpt1 lvm2 a-- <8.00g  0
/dev/sdd  zmpt1 lvm2 a-- <16.00g 1.99g
/dev/sde  zmpt1 lvm2 a-- <24.00g <20.00g
/dev/sdf  zmpt1 lvm2 a-- <40.00g <40.00g
[root@zmpt01 ~]# vgs
VG #PV #LV #SN Attr VSize VFree
centos 1 2 0 wz--n- <15.00g  0
zmpt1  4 5 0 wz--n- 87.98g 61.98g
```

< ----/dev/sdf is part of zmpt1

/dev/sdd is corrupted – it need to be removed

```
[root@zmpt01 ~]# lsblk
NAME          MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
sda           8:0  0  16G  0 disk
├─sda1        8:1  0   1G  0 part /boot
├─sda2        8:2  0  15G  0 part
│   └─centos-root 253:0  0 13.4G  0 lvm /
│   └─centos-swap 253:1  0  1.6G  0 lvm [SWAP]
sdb           8:16  0  16G  0 disk
├─sdb1        8:17  0   8G  0 part
├─sdb2        8:18  0   4G  0 part
└─sdb3        8:19  0   2G  0 part
sdc           8:32  0   8G  0 disk
├─zmpt1-Accounting 253:2  0   4G  0 lvm /accounting
└─zmpt1-HR     253:4  0   8G  0 lvm /hr
sdd           8:48  0  16G  0 disk
├─zmpt1-Finance 253:3  0   6G  0 lvm /finance
├─zmpt1-HR     253:4  0   8G  0 lvm /hr
└─zmpt1-Recruiting 253:5  0   4G  0 lvm /recruiting
sde           8:64  0  24G  0 disk
└─zmpt1-LVSWAP 253:6  0   4G  0 lvm
sdf           8:80  0  40G  0 disk
sr0           11:0  1 1024M  0 rom
```

This command will move LVM structure, Data and Block information from /dev/sdd to /dev/sdf – link cloning

```
[root@zmpt01 ~]# pvmove /dev/sdd /dev/sdf
/dev/sdd: Moved: 0.14%
/dev/sdd: Moved: 42.85%
/dev/sdd: Moved: 71.44%
/dev/sdd: Moved: 100.00%
```

```
[root@zmpt01 ~]# lsblk
NAME          MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
sda           8:0  0  16G  0 disk
├─sda1        8:1  0   1G  0 part /boot
├─sda2        8:2  0  15G  0 part
│   └─centos-root 253:0  0 13.4G  0 lvm /
│   └─centos-swap 253:1  0  1.6G  0 lvm [SWAP]
sdb           8:16  0  16G  0 disk
├─sdb1        8:17  0   8G  0 part
├─sdb2        8:18  0   4G  0 part
└─sdb3        8:19  0   2G  0 part
sdc           8:32  0   8G  0 disk
├─zmpt1-Accounting 253:2  0   4G  0 lvm /accounting
```



```

└─zmpt1-HR      253:4  0  8G 0 lvm /hr
sdd            8:48  0 16G 0 disk
sde            8:64  0 24G 0 disk
└─zmpt1-LVSWAP 253:6  0  4G 0 lvm
sdf            8:80  0 40G 0 disk
└─zmpt1-Finance 253:3  0  6G 0 lvm /finance
└─zmpt1-HR      253:4  0  8G 0 lvm /hr
└─zmpt1-Recruiting 253:5  0  4G 0 lvm /recruiting
sr0            11:0  1 1024M 0 rom
    
```

```

[root@zmpt01 ~]# lvs
LV   VG   Attr   LSize Pool Origin Data%  Meta%  Move Log Cpy%Sync Convert
root centos -wi-ao---- 13.39g
swap centos -wi-ao---- 1.60g
Accounting zmpt1 -wi-ao---- 4.00g
Finance  zmpt1 -wi-ao---- 6.00g
HR      zmpt1 -wi-ao---- 8.00g
LVSWAP  zmpt1 -wi-a----- 4.00g
Recruiting zmpt1 -wi-ao---- 4.00g
    
```

```

[root@zmpt01 ~]# pvs
PV   VG   Fmt Attr PSize  PFree
/dev/sda2 centos lvm2 a-- <15.00g  0
/dev/sdc  zmpt1 lvm2 a-- <8.00g   0
/dev/sdd  zmpt1 lvm2 a-- <16.00g <16.00g
/dev/sde  zmpt1 lvm2 a-- <24.00g <20.00g
/dev/sdf  zmpt1 lvm2 a-- <40.00g 25.99g
    
```

< --- Remove the corrupted disk

```

[root@zmpt01 ~]# vgreduce zmpt1 /dev/sdd
Removed "/dev/sdd" from volume group "zmpt1"
[root@zmpt01 ~]# pvs
PV   VG   Fmt Attr PSize  PFree
/dev/sda2 centos lvm2 a-- <15.00g  0
/dev/sdc  zmpt1 lvm2 a-- <8.00g   0
/dev/sdd   lvm2 --- 16.00g 16.00g
/dev/sde  zmpt1 lvm2 a-- <24.00g <20.00g
/dev/sdf  zmpt1 lvm2 a-- <40.00g 25.99g
    
```

< --- Remove completed

/dev/sdc
8GB

/dev/sde
24GB

/dev/sdf
40GB



Logical Volume Group – zmpt1 72GB						
Accounting 4GB	Finance 6GB	HR 2GB	HR +6G	Recruiting 4 GB	SWAP 4GB	Free space 46GB

Increase inodes to xfs files system /dev/sdd1

```
[root@zmpt01 ~]# df -i /dev/sdc
Filesystem  Inodes IUsed  IFree IUse% Mounted on
devtmpfs   123861  446 123415  1% /dev
```

```
[root@zmpt01 mnt]# df -i /dev/sdd1
Filesystem  Inodes IUsed  IFree IUse% Mounted on
/dev/sdd1  1048576 10003 1038573  1% /mnt

[root@zmpt01 ~]# xfs_growfs -m 40 /dev/sdd1
```

```
[root@zmpt01 ~]# xfs_db -f -c "sb 0" -c "p" /dev/sdd1 | grep imax_pct
imax_pct = 40
```

```
[root@zmpt01 ~]# df -i /dev/sdd1
Filesystem  Inodes IUsed  IFree IUse% Mounted on
/dev/sdd1  1677720 10003 1667717  1% /mnt

There is no data loss
```

Delete LV and VG – decommissioning of Physical Hardware

```
[root@zmpt01 ~]# vgs
VG  #PV #LV #SN Attr  VSize  VFree
centos  1  2  0 wz--n- <15.00g  0
zmpt1   3  5  0 wz--n- <71.99g <45.99g < ---Target LVM to delete
```

```
[root@zmpt01 ~]# pvs
PV      VG  Fmt Attr PSize  PFree
/dev/sda2 centos lvm2 a-- <15.00g  0
/dev/sdc  zmpt1 lvm2 a-- <8.00g  0
```

```
/dev/sde zmp1 lvm2 a-- <24.00g <20.00g
/dev/sdf zmp1 lvm2 a-- <40.00g 25.99g
```

```
[root@zmpt01 ~]# umount -a
```

```
[root@zmpt01 ~]# vgremove zmp1 -y
Logical volume "Accounting" successfully removed
Logical volume "Finance" successfully removed
Logical volume "HR" successfully removed
Logical volume "Recruiting" successfully removed
Logical volume "LVSWAP" successfully removed
Volume group "zmp1" successfully removed
```

```
[root@zmpt01 ~]# blkid
/dev/sda1: UUID="160e6caa-b0a9-468b-9de1-04189acc84ce" TYPE="xfs"
/dev/sda2: UUID="oLnQZF-bJU0-02T3-t0wF-DhnB-2JI6-CQI9f2" TYPE="LVM2_member"
/dev/sdb1: UUID="47d30ab1-92ee-4dc8-8c79-ef9dd898e1f0" TYPE="ext4"
/dev/sdb2: UUID="e5a18729-daf6-4c7b-89db-3a5979d3c254" TYPE="xfs"
/dev/sdb3: UUID="7d459795-930e-4cc5-b737-a84b452ff04a" TYPE="swap"
/dev/sdc: UUID="pYcEYd-WWPb-cwhu-7dn5-IMIk-vWhk-7B9x6x" TYPE="LVM2_member"
/dev/sde: UUID="FpAXdB-xeBK-Hdrq-HKZa-rmF0-lOPF-sK1sGt" TYPE="LVM2_member"
/dev/sdf: UUID="ZoCio8-qWEh-NG7u-HILR-hLph-RpI5-d9x6mr" TYPE="LVM2_member"
/dev/mapper/centos-root: UUID="5c79b16a-cfd4-4d5a-8e9c-b9b1a37b4936" TYPE="xfs"
/dev/mapper/centos-swap: UUID="c7801c38-9828-49b2-8a12-7610376d8b8a" TYPE="swap"
/dev/sdd1: UUID="5588ebda-0031-4b2b-b80e-a5a1a68e0bf7" TYPE="xfs"
```

```
[root@zmpt01 ~]# pvs
PV      VG      Fmt Attr PSize PFree
/dev/sda2 centos lvm2 a-- <15.00g 0
/dev/sdc      lvm2 --- 8.00g 8.00g
/dev/sde      lvm2 --- 24.00g 24.00g
/dev/sdf      lvm2 --- 40.00g 40.00g
```

```
[root@zmpt01 ~]# pvremove /dev/sdc /dev/sde /dev/sdf
Labels on physical volume "/dev/sdc" successfully wiped.
Labels on physical volume "/dev/sde" successfully wiped.
Labels on physical volume "/dev/sdf" successfully wiped.
```

11-22-2020

https://youtu.be/bs0FE_VAUvs



Emergency Mode

```

PRACTICE [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
[DEPEND] Dependency failed for Migrate local SELinux p... old store structure to the new structure.
[DEPEND] Dependency failed for Relabel all filesystems, if necessary.
[DEPEND] Dependency failed for Mark the need to relabel after reboot.
[ TIME ] Timed out waiting for device dev-mapper-zmpt1\x2dHR.device.
[DEPEND] Dependency failed for /hr.
[ TIME ] Timed out waiting for device dev-mapper-zmpt1\x2dRecruiting.device.
[DEPEND] Dependency failed for /recruiting.
[ TIME ] Timed out waiting for device dev-mapper-zmpt1\x2dFinance.device.
[DEPEND] Dependency failed for /finance.
[ OK ] Reached target Timers.
[ OK ] Reached target Login Prompts.
[ OK ] Reached target Network (Pre).
[ OK ] Reached target Network.
[ OK ] Reached target Network is Online.
Starting Crash recovery kernel arming...
[ OK ] Reached target Sockets.
Starting Import network configuration from initramfs...
Starting Tell Plymouth To Write Out Runtime Data...
[ OK ] Started Tell Plymouth To Write Out Runtime Data.
[FAILED] Failed to start Crash recovery kernel arming.
See 'systemctl status kdump.service' for details.
[ OK ] Started Import network configuration from initramfs.
[ OK ] Started Emergency Shell.
Starting Create Volatile Files and Directories...
[ OK ] Reached target Emergency Mode.
[ OK ] Started Create Volatile Files and Directories.
Starting Security Auditing Service...
[ OK ] Started Security Auditing Service.
Starting Update UTMP about System Boot/Shutdown...
[ OK ] Started Update UTMP about System Boot/Shutdown.
Starting Update UTMP about System Runlevel Changes...
[ OK ] Started Update UTMP about System Runlevel Changes.
Welcome to emergency mode! After logging in, type "journalctl -xb" to view
system logs, "systemctl reboot" to reboot, "systemctl default" or ^D to
try again to boot into default mode.
Give root password for maintenance
(or press Control-D to continue):
    
```

- The system boot to emergency mode. But why?
 - a. Missing drives
 - b. The file system is corrupted
 - c. The file system is unmountable
- During boot process /etc/fstab read by system
- This will halt the system going into default mode

- Enter password
- Edit /etc/fstab
- Comment out the missing disks



```
##
## /etc/fstab
## Created by anaconda on Sun Oct 4 15:44:22 2020
##
## Accessible filesystems, by reference, are maintained under '/dev/disk'
## See man pages fstab(5), findfs(8), mount(8) and/or blkid(8) for more info
##
/dev/mapper/centos-root / xfs defaults 0 0
UUID=160e6caa-b0a9-468b-9de1-04189acc84ce /boot xfs defaults 0 0
/dev/mapper/centos-swap swap swap defaults 0 0
#/dev/mapper/zmpt1-Accounting /accounting xfs defaults 0 0
#/dev/mapper/zmpt1-Finance /finance xfs defaults 0 0
#/dev/mapper/zmpt1-HR /hr xfs defaults 0 0
#/dev/mapper/zmpt1-Recruiting /recruiting xfs defaults 0 0
```

Filesystem	Mount point	Filesystem type	OS handles this	Priority – 0 1 or 2
/dev/sdb1	/DATA	ext4	defaults	0 0

File System Check	
0	skip
1	1 higher priority
2	2 lesser priority

For demo purpose lests corrupt file system – triggring

```
[root@zmpt01 ~]# dd if=/dev/zero of=/dev/sdd1 bs=1k count=1024 < ---corrupted on block size
1024+0 records in
1024+0 records out
1048576 bytes (1.0 MB) copied, 0.00584049 s, 180 MB/s
```

System will halt and goes into emergency mode

Emergency mode is in Read Only mode

```
mount -o remount, rw / #< --- Command to load system in read/ write mode, so you can edit /etc/fstab
```

Putty is disabled – because Emergency mode is without network

Run mount -a



```
427.696087] ffff94c0bb1f9000: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
427.698386] ffff94c0bb1f9010: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
427.700591] ffff94c0bb1f9020: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
427.702751] ffff94c0bb1f9030: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
427.704921] XFS (sdd1): Metadata corruption detected at xfs_inode_buf_verify+0x79/0x100 [xfs], xfs
inode block 0x40
427.709164] XFS (sdd1): Unmount and run xfs_repair
427.711379] XFS (sdd1): First 64 bytes of corrupted metadata buffer:
427.713652] ffff94c0bb1f9000: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
427.715948] ffff94c0bb1f9010: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
427.718156] ffff94c0bb1f9020: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
427.720287] ffff94c0bb1f9030: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
427.722976] XFS (sdd1): metadata I/O error: block 0x40 ("xfs_trans_read_buf_map") error 117 numb
ks 32
mount: mount /dev/sdd1 on /mnt failed: Structure needs cleaning
root@zmp01 ~#
```

xfs_repair /dev/sdd1 #< ----run this command to repair in real world scenerio

90% successful – Quarantine the bad sectors

For ext4

fsck /dev/sdd1

fsck – file system check



```

PRACTICE [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
cleared inode 125
bad CRC for inode 126, will rewrite
bad magic number 0x0 on inode 126, resetting magic number
bad version number 0x0 on inode 126, resetting version number
inode identifier 0 mismatch on inode 126
cleared inode 126
bad CRC for inode 127, will rewrite
bad magic number 0x0 on inode 127, resetting magic number
bad version number 0x0 on inode 127, resetting version number
inode identifier 0 mismatch on inode 127
cleared inode 127
  - agno = 1
  - agno = 2
  - agno = 3
  - process newly discovered inodes...
Phase 4 - check for duplicate blocks...
  - setting up duplicate extent list...
root inode lost
  - check for inodes claiming duplicate blocks...
  - agno = 0
  - agno = 1
  - agno = 2
  - agno = 3
Phase 5 - rebuild AG headers and trees...
  - reset superblock...
Phase 6 - check inode connectivity...
reinitializing root directory
reinitializing realtime bitmap inode
reinitializing realtime summary inode
  - resetting contents of realtime bitmap and summary inodes
  - traversing filesystem ...
  - traversal finished ...
  - moving disconnected inodes to lost+found ...
Phase 7 - verify and correct link counts...
resetting inode 64 nlinks from 1 to 2
done
[root@zmp01 ~]# _
    
```

11-28-2020
<https://youtu.be/fQlqwMi7JQQ>

DD - Disk Duplication

DD command does the exact photo copy of source to destination

Source

```

sdb      8:16 0 16G 0 disk
├─sdb1   8:17 0  8G 0 part
├─sdb2   8:18 0  4G 0 part
└─sdb3   8:19 0  2G 0 part
    
```

Destination

```

sdf      8:80 0 40G 0 disk
    
```

```
[root@zmp01 ~]# dd if=/dev/sdb of=/dev/sdf
```

Command	If = stands for InPut File	Of – stands for Out Put File
dd	if=/dev/sdb	of=/dev/sdf

The destination disk must be same size or higher in capacity

Disk Duplication is independent of file system

Example, you can disk duplicate a Windows file system

```
33554432+0 records in # < ----Exact match of in and out
33554432+0 records out # < ----Exact match of in and out

17179869184 bytes (17 GB) copied, 608.854 s, 28.2 MB/s
```

```
sdb      8:16 0 16G 0 disk
├─sdb1   8:17 0  8G 0 part
├─sdb2   8:18 0  4G 0 part
└─sdb3   8:19 0  2G 0 part
```

```
/dev/sdb1: UUID="47d30ab1-92ee-4dc8-8c79-ef9dd898e1f0" TYPE="ext4"
/dev/sdb2: UUID="e5a18729-daf6-4c7b-89db-3a5979d3c254" TYPE="xfs"
/dev/sdb3: UUID="7d459795-930e-4cc5-b737-a84b452ff04a" TYPE="swap"
```

Exact replica – even the UUID is duplicated

```
sdf      8:80 0 40G 0 disk
├─sdf1   8:81 0  8G 0 part
├─sdf2   8:82 0  4G 0 part
└─sdf3   8:83 0  2G 0 part
```

```
/dev/sdf1: UUID="47d30ab1-92ee-4dc8-8c79-ef9dd898e1f0" TYPE="ext4"
/dev/sdf2: UUID="e5a18729-daf6-4c7b-89db-3a5979d3c254" TYPE="xfs"
/dev/sdf3: UUID="7d459795-930e-4cc5-b737-a84b452ff04a" TYPE="swap"
```

Create Large file

```
[root@zmpt01 ~]# dd if=/dev/zero of=zafar1 count=1 bs=2G
0+1 records in
0+1 records out
2147479552 bytes (2.1 GB) copied, 75.7903 s, 28.3 MB/s
```

Command	If = stands for InPut File	Of – stands for Out Put File	Count	Byte Size
Dd	If=/dev/zero	Of=zafar1	count=1	bs=2G

```
[root@zmpt01 ~]# ls -ltrh
total 2.0G
-rw-r--r--. 1 root root 2.0G Nov 28 16:01 zafar1
```

Good for network t/s

Wipe the disk

This is the lowest level of disk wipe

```
[root@zmpt01 ~]# dd if=/dev/zero of=/dev/sdb

[root@zmpt01 ~]# dd if=/dev/zero of=/dev/sdb
dd: writing to '/dev/sdb': No space left on device
33554433+0 records in
33554432+0 records out
17179869184 bytes (17 GB) copied, 610.231 s, 28.2 MB/s
```

11-28-2020
<https://youtu.be/fQlqwMi7JQQ>

Hostname

```
[root@localhost ~]# vi /etc/hostname
zmpt01.prod.zmprotech.com
```

Reboot

```
[root@zmpt01 ~]# hostname
zmpt01.prod.zmprotech.com
```

```
[root@zmpt01 ~]# hostnamectl

Static hostname: zmpt01.prod.zmprotech.com
Icon name: computer-vm
Chassis: vm
Machine ID: 47384aabe2f84a189b94eba36b48046c
Boot ID: 36fe385645ff48609296af23a491becd
Virtualization: kvm
Operating System: CentOS Linux 7 (Core)
CPE OS Name: cpe:/o:centos:centos:7
Kernel: Linux 3.10.0-1062.el7.x86_64
```



Architecture: x86-64

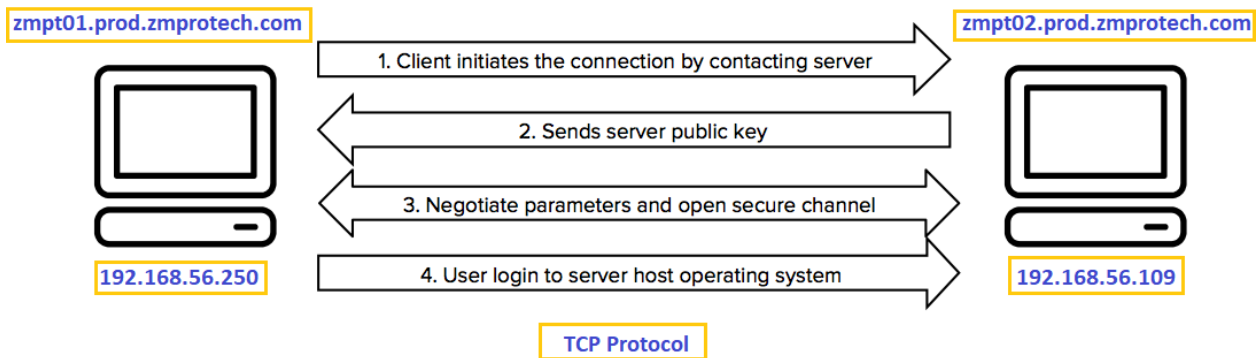
zmpt01.prod.zmprotech.com
 zmpt02.prod.zmprotech.com
 zmpt03.prod.zmprotech.com < --- Production, needs ticket and change request to work on

zmpt01.dev.zmprotech.com < --- Development
 zmpt01.test.zmprotech.com < --- Test
 zmpt01.dep.zmprotech.com < --- deployment
 zmpt01.snd.zmprotech.com < --- Sandbox

11-28-2020

<https://youtu.be/fQlqwMi7JQQ>

SSH – Secure Shell



```
[root@zmpt01 ~]# ssh 192.168.56.109
The authenticity of host '192.168.56.109 (192.168.56.109)' can't be established.
ECDSA key fingerprint is SHA256:e3LN1URGQEPwXaMbDeo+aTYev2cOOWnP3WKmaRG9gRU. < --- #1
ECDSA key fingerprint is MD5:de:11:30:dd:ef:9e:ae:0a:ab:49:16:29:c9:08:36:8f. < --- #2
Are you sure you want to continue connecting (yes/no)? yes < --- #3
Warning: Permanently added '192.168.56.109' (ECDSA) to the list of known hosts.
root@192.168.56.109's password: < --- #4
```

11-29-2020

<https://youtu.be/DVtalAskM3Y>

Now logged into the remote server

```
Last login: Sun Nov 29 15:31:38 2020 from 192.168.56.250
[root@zmpt02 ~]# hostname
zmpt02.prod.zmprotech.com
```

Connecting as non-root user

```
[root@zmpt01 ~]# ssh zafar@71.57.95.5
The authenticity of host '71.57.95.5 (71.57.95.5)' can't be established.
ECDSA key fingerprint is SHA256:6C8O0sIMqNbzLMaV2Lm4OrBh29qCtTheoFi1bgRY6BQ.
ECDSA key fingerprint is MD5:bb:19:a3:ed:01:6d:8e:c5:6a:b7:3c:35:8b:ea:3f:97.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '71.57.95.5' (ECDSA) to the list of known hosts.
zafar@71.57.95.5's password:
```

```
[root@zmpt01 .ssh]# pwd
/root/.ssh

[root@zmpt01 .ssh]# cat known_hosts

192.168.56.109 ecdsa-sha2-nistp256
AAAAE2VjZHNhLXNoYTItbmlzdHAyNTYAAAAIbmlzdHAyNTYAAABBBOP3wf/x3cl2qcKmTcH4KPch
JHdTAHRnnO4ASznR9xZ06KCSbWYXQoj/5p+E85DH9cFmCKh+5rFED8bQZfKH2Q=

71.57.95.5 ecdsa-sha2-nistp256
AAAAE2VjZHNhLXNoYTItbmlzdHAyNTYAAAAIbmlzdHAyNTYAAABBBNXZK5HP3F1AdNYJ5gKTio6z/
uJcDzAAdDPicolYXUBd+r6Qv2PJqXiSq6OIMJrXUDxdTsfr4SofXL6bQWCX59Y=
```

Passwordless SSH

```
[root@zmpt01 .ssh]# ssh-keygen
Generating public/private rsa key pair.
Enter file in which to save the key (/root/.ssh/id_rsa): < --- Hit Enter
Enter passphrase (empty for no passphrase): < --- Hit Enter
Enter same passphrase again: < --- Hit Enter
Your identification has been saved in /root/.ssh/id_rsa. < --- Generates Private Key
Your public key has been saved in /root/.ssh/id_rsa.pub. < --- Gererates Public Key
The key fingerprint is:
SHA256:PFH7mLOaE/vac1SEZ867YhYKusl1PwNJ7UpSzHI3RSE root@zmpt01.prod.zmprotech.com
The key's randomart image is:
+---[RSA 2048]----+
| . Eoo. |
| . ...= |
| .o.. B |
| ...*++ + |
| S=++o . |
| +.+o+ . |
| ..*o= . . |
```




```
| ..oo=+.B . |
| +.++o=.+ |
+----[SHA256]-----+
[root@zmpt01 .ssh]#
```

```
[root@zmpt01 .ssh]# pwd
/root/.ssh
[root@zmpt01 .ssh]# ls -la
total 12
drwx-----. 2 root root  57 Nov 29 16:02 .
dr-xr-x---. 3 root root 123 Nov 28 17:46 ..
-rw-----. 1 root root 1675 Nov 29 16:02 id_rsa < --- Private Key
-rw-r--r--. 1 root root  412 Nov 29 16:02 id_rsa.pub < --- Public Key
-rw-r--r--. 1 root root  348 Nov 29 15:52 known_hosts < --- Saves Public key of previously connected hosts
```

```
[root@zmpt01 .ssh]# ssh-copy-id 192.168.56.109
/usr/bin/ssh-copy-id: INFO: Source of key(s) to be installed: "/root/.ssh/id_rsa.pub"
The authenticity of host '192.168.56.109 (192.168.56.109)' can't be established.
ECDSA key fingerprint is SHA256:e3LN1URGQEPwXaMbDeo+aTYev2cOOWnP3WKmaRG9gRU.
ECDSA key fingerprint is MD5:de:11:30:dd:ef:9e:ae:0a:ab:49:16:29:c9:08:36:8f.
Are you sure you want to continue connecting (yes/no)? yes
/usr/bin/ssh-copy-id: INFO: attempting to log in with the new key(s), to filter out any that are already installed
/usr/bin/ssh-copy-id: INFO: 1 key(s) remain to be installed -- if you are prompted now it is to install the new keys
root@192.168.56.109's password:
```

Number of key(s) added: 1

Now try logging into the machine, with: "ssh '192.168.56.109'"
and check to make sure that only the key(s) you wanted were added.

```
[root@zmpt01 ~]# ssh 192.168.56.109
Last login: Sun Nov 29 16:49:50 2020 from 192.168.56.250
```

```
[root@zmpt02 ~]# hostname
zmpt02.prod.zmprotech.com
```

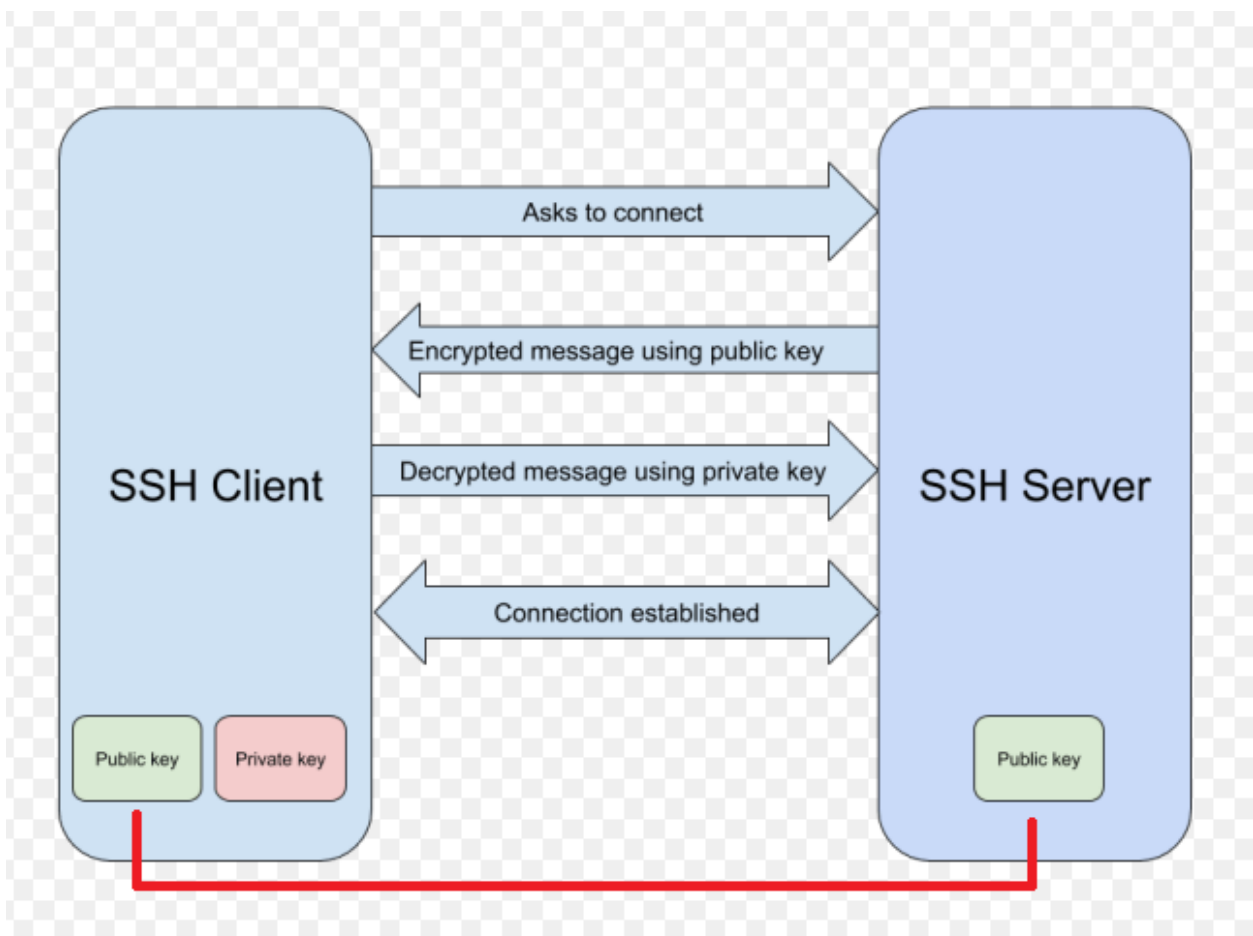
```
[root@zmpt02 ~]# cd .ssh/
[root@zmpt02 .ssh]# ls -la
total 4
drwx-----. 2 root root  29 Nov 29 16:20 .
dr-xr-x---. 3 root root 123 Nov 29 16:20 ..
-rw-----. 1 root root 412 Nov 29 16:20 authorized_keys < --- New file with authorized keys of known hosts
```



```
[root@zmpt01 .ssh]# cat id_rsa.pub  
ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAQ4xSOceATZnKwEUTzSoKns4zEioGBP3uUq9bXVZ1CTIKtGMx4snlq6q  
+/q331sGFKZsEMdgxMaGLy3/mp6bl5Nv2D1LeqCVvkmoew5+rEWn853ggV2Syjigo2UrXqnVUK05Ks6cAmlqPYC3TWvmTH  
nbSMKqbfQGKykxEkFOxv/CRm3FSyVW7S1Aq5yPavAQa0+TFkaxBUO7Ooy+3QZ6Jolb8UiQROo7WdPAKITAOUJoYTVHujKBh  
D9Pf21PutmdiKhqHUX2rlw1HJmUJQFYRBwlJ3INd+Q9qDjllQ1wiPyi/XpmoenGkHjqEXjsQzJGEAQtdF9ayMybdh+TNnb/  
xCX root@zmpt01.prod.zmprotech.com
```

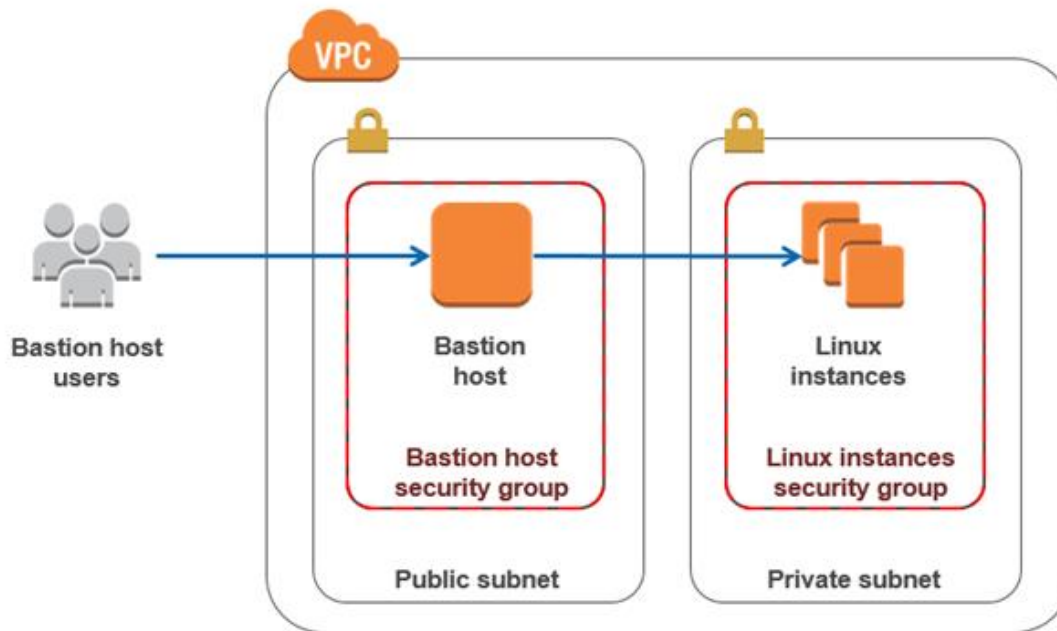
```
[root@zmpt02 .ssh]# cat authorized_keys  
ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAQ4xSOceATZnKwEUTzSoKns4zEioGBP3uUq9bXVZ1CTIKtGMx4snlq6q  
+/q331sGFKZsEMdgxMaGLy3/mp6bl5Nv2D1LeqCVvkmoew5+rEWn853ggV2Syjigo2UrXqnVUK05Ks6cAmlqPYC3TWvmTH  
nbSMKqbfQGKykxEkFOxv/CRm3FSyVW7S1Aq5yPavAQa0+TFkaxBUO7Ooy+3QZ6Jolb8UiQROo7WdPAKITAOUJoYTVHujKBh  
D9Pf21PutmdiKhqHUX2rlw1HJmUJQFYRBwlJ3INd+Q9qDjllQ1wiPyi/XpmoenGkHjqEXjsQzJGEAQtdF9ayMybdh+TNnb/  
xCX root@zmpt01.prod.zmprotech.com
```

NOTE: This is good only for each specific user, you have to establish same connection for each user





Configure Host security – Deny direct root connection



Secure the server

zmpt02.prod.zmprotech.com

```
[root@zmpt02 ~]# vi /etc/ssh/sshd_config
```

PermitRootLogin no < ---root login line is uncommented and changed to no from yes

Restart the service

```
[root@zmpt02 ~]# systemctl restart sshd < --- Change will take affect after restart of service
```

```
[root@zmpt01 ~]# ssh 192.168.56.109
root@192.168.56.109's password:
Permission denied, please try again.
```

Deny access fro mspecific network

```
[root@zmpt02 ~]# vi /etc/ssh/sshd_config
```

ListenAddress 0.0.0.0
ListenAddress 192.168.56.0/24

```
[root@zmpt01 ~]# ssh 192.168.56.109  
ssh: connect to host 192.168.56.109 port 22: Connection refused
```

Allow only specific users

```
[root@zmpt02 ~]# vi /etc/ssh/sshd_config #< --- Add line at the end of file  
  
AllowUsers terminator
```

12-05-2020

Daemon

A Daemon (back ground process) is Linux program that runs in the background. Almost all daemons have names that end with “d”. for example httpd – handles the Apache web server, sshd – handles the SSH connection. Daemons are started when the system is rebooted, it its enabled to be active when the system is up.

Daemon means a service running in background – example sshd

```
[root@zmpt02 ~]# systemctl status sshd  
● sshd.service - OpenSSH server daemon  
  Loaded: loaded (/usr/lib/systemd/system/sshd.service; enabled; vendor preset: enabled)  
  Active: active (running) since Sat 2020-12-05 13:27:39 EST; 1min 5s ago  
    Docs: man:sshd(8)  
          man:sshd_config(5)  
  Main PID: 23357 (sshd)  
  CGroup: /system.slice/sshd.service  
          └─23357 /usr/sbin/sshd -D
```

Check status of service

```
[root@zmpt02 ~]# systemctl status sshd
```

Stop the service

```
[root@zmpt02 ~]# systemctl stop sshd
```

Start the service

```
[root@zmpt02 ~]# systemctl start sshd
```

Disable the service – the service will not start after reboot

```
[root@zmpt02 ~]# systemctl disable sshd
Removed symlink /etc/systemd/system/multi-user.target.wants/sshd.service.
```

- sshd.service - OpenSSH server daemon
Loaded: loaded (/usr/lib/systemd/system/sshd.service; **disabled**; vendor preset: enabled)

Enable the service – this service will be started/ active once the system boots up

```
[root@zmpt02 ~]# systemctl enable sshd
Created symlink from /etc/systemd/system/multi-user.target.wants/sshd.service to /usr/lib/systemd/systeme
```

12-05-2020
<https://youtu.be/j7GrSo7XFdQ>

User Administration

- Root – Administrator – super user
- Root user has highest level of access
 - Root user cannot be renamed
 - Never share root password
 - Don't put password in chats or text messages
 - Root user access to Company Data

Creat a user

```
[root@zmpt01 ~]# useradd terminator
```

The file **/etc/passwd** gets updated

```
terminator:x:1000:1000::/home/terminator:/bin/bash
```

User	Check for password	User id –UID	Group id – GID	User info text	User home	Shell type
Terminator	x	1000	1000		/home/terminator	/bin/bash

```
[root@zmpt01 ~]# id terminator
uid=1000(terminator) gid=1000(terminator) groups=1000(terminator)
```

UID – User id	GID – user primary group	Group User is part of
uid=1000(terminator)	gid=1000(terminator)	groups=1000(terminator)

```
[root@zmpt01 ~]# id 1000
uid=1000(terminator) gid=1000(terminator) groups=1000(terminator)
```

Switching to regular user from root

```
[root@zmpt01 ~]# su terminator
[terminator@zmpt01 root]$ whoami
Terminator
```

Set the user password

```
[root@zmpt01 ~]# passwd terminator
Changing password for user terminator.
New password:
BAD PASSWORD: The password fails the dictionary check - it is based on a dictionary word
Retype new password:
passwd: all authentication tokens updated successfully.
```

Note: root user don't have follow password restrictions, any password will be allowed

Set password as user terminator

```
[terminator@zmpt01 ~]$ passwd
Changing password for user terminator.
Changing password for terminator.
(current) UNIX password:
New password:
BAD PASSWORD: The password is too similar to the old one
New password:
BAD PASSWORD: The password fails the dictionary check - it is based on a dictionary word
New password:
Retype new password:
passwd: all authentication tokens updated successfully.
```

Password file - Shadow file

```
[root@zmpt01 ~]# vi /etc/shadow
terminator:$6$pF2bCs4Z$Yifb7T/yi5uUkGm9ISpGRWxWPrXR.hwYEqbQkxOQ7npyTJpoTtjV
cWfxutdD0W4233i791Ud3Zt7Ec5t1/69C.:18601:0:99999:7:::
```

User	Password	Dec 31 1969	Grace Period	Expiration date from last update	Warning days
terminator	\$6\$pF2bCs4Z..	18601	0	60	7

Group file

```
[root@zmpt01 ~]# vi /etc/group
```

```
terminator:x:1000:
```

Group Name	Check for password	Group id - GID
Terminator	x	1000

Where is all the setting defined for users, groups and passwords?

```
[root@zmpt01 ~]# vi /etc/login.defs
```

```
PASS_MAX_DAYS 60
PASS_MIN_DAYS 0
PASS_MIN_LEN 5
PASS_WARN_AGE 7
```

```
UID_MIN 3000
UID_MAX 60000
```

```
GID_MIN 4000
GID_MAX 60000
```

```
[root@zmpt01 ~]# useradd xmen
```

```
[root@zmpt01 ~]# id xmen
```

```
uid=3000(xmen) gid=4000(xmen) groups=4000(xmen)
```

Assigning same password as a another user

```
[root@zmpt01 ~]# vi /etc/shadow
```

```
terminator:$6$87Fs/vJF$EHqhBznCvyU
5w4d3XsL6tfsaB7Q3WcDnf8xVB0.NwO
bSnBZo/Sw6KTG.qpBfvwvo.AkOajFd.PiKjuE1IAytQ.:18601:0:99999:7:::
```

```
xmen:$6$87Fs/vJF$EHqhBznCvyU
5w4d3XsL6tfsaB7Q3WcDnf8xVB0.NwO
bSnBZo/Sw6KTG.qpBfvwvo.AkOajFd.PiKjuE1IAytQ.:18601:0:60:1:::
```

```
login as: xmen
```

```
xmen@192.168.56.250's password:
```

Last login: Sat Dec 5 14:57:51 2020 from 192.168.56.1

Create user manually

Copy the existing line and paste in new line

```
[root@zmpt01 ~]# vi /etc/passwd
spiderman:x:5005:6005::/home/spiderman:/bin/bash
```

Create group manually

```
spiderman:x:6005:
```

Create password manually

```
[root@zmpt01 ~]# vi /etc/passwd
```

```
spiderman:$6$87Fs/vJF$EHqhBznCvyU5w4d3XsL6tfsaB7Q3WcDnf8xV
B0.
NwObSnBZo/Sw6KTG.qpBfwvvo.AkOajFd.PiKjuE1IAytQ.:18601:0:60:7::
:
```

Create user home directory manually

```
[root@zmpt01 home]# mkdir spiderman
```

Change the permissions for spiderman home directory

```
[root@zmpt01 home]# chown spiderman:spiderman spiderman
[root@zmpt01 home]# chown 5005:6005 spiderman
```

Change the permissions either user the name or the id's

```
[root@zmpt01 home]# ls -ls
total 0
0 drwxr-xr-x. 2 spiderman spiderman 6 Dec 5 15:16 spiderman
```

Login to user spiderman

```
spiderman@192.168.56.250's password:
Last login: Sat Dec 5 15:15:37 2020 from 192.168.56.1
-bash-4.2$ pwd
/home/spiderman
```


.bashrc - .bash_profile - .bash_history are missing

```
-bash-4.2$ cp /etc/skel/.bash* .

-bash-4.2$ ls -la
total 12
drwxr-xr-x. 2 spiderman spiderman 62 Dec 5 15:26 .
drwxr-xr-x. 5 root root 53 Dec 5 15:16 ..
-rw-r--r--. 1 spiderman spiderman 18 Dec 5 15:26 .bash_log out
-rw-r--r--. 1 spiderman spiderman 193 Dec 5 15:26 .bash_pro file
-rw-r--r--. 1 spiderman spiderman 231 Dec 5 15:26 .bashrc
```

Difference between root user and regular user

```
[root@zmpt01 ~]# < --- # root user

[spiderman@zmpt01 ~]$ < --- $ regular user
```

SuDO access

SuDO = Super User DO
Super user access – but not full root access.

- It allows regular user to perform tasks which requires admin access

User without SuDO access

```
[terminator@zmpt01 ~]$ yum install firefox -y
Loaded plugins: fastestmirror
You need to be root to perform this command.
[terminator@zmpt01 ~]$
```

Informational

```
[root@zmpt01 ~]# visudo

## Allows people in group wheel to run all commands
%wheel ALL=(ALL) ALL < --- making sure wheel group is not commented out
```

Grant Access to SuDO

```
[root@zmpt01 ~]# usermod -aG wheel terminator
[root@zmpt01 ~]# id terminator
uid=1000(terminator) gid=1000(terminator) groups=1000(terminator),10(wheel)
```

usermod -aG wheel terminator

Command	Adding to group -a add -G secondary group	Group name/ id	User name/ user id
Usermod	-aG	Wheel	Terminator

Run sudo commands

```
[terminator@zmpt01 ~]$ sudo yum install firefox -y
[sudo] password for terminator:
```

Successfully completed
Complete!

Switch to root

```
[terminator@zmpt01 ~]$ sudo su -
Last login: Sat Nov 28 17:01:34 EST 2020 from 192.168.56.1 on pts/0
[root@zmpt01 ~]#
```

12-06-2020
<https://youtu.be/dnuAu24KUuE>

Permissions

File permission

```
[root@zmpt01 ~]# ls -l
total 0
-rw-r--r--. 1 root root 0 Dec 6 13:22 file
```

```
-rw-r--r--. 1 root root 0 Dec 6 13:22 file
```

Ver first '-' is not part of permissions, but indicates it's a file

User – u			Group – g			Other – o		
Read	Write	Execute	Read	Write	Execute	Read	Write	Execute

r	w	x	r	w	x	r	w	x
4	2	1	4	2	1	4	2	1

Read = 4
Write = 2
Execute = 1

Read = read the file, read permissions
Write = write into the file, edit permissions
Execute = for script file, execute file, deleting file or folder

Number value of permission for file1

-rw-r--r--. 1 root root 0 Dec 6 13:22 file

User	Group	Others
rw-	r- -	r- -
6	4	4

So the final permission number for file1 is 644

644 is also default permission for file in Linux System

Modify the permissions

Grant 'rw' permission for all

Number for read write is 6 = 4 + 2

rw- = 6
rw- = 6
rw- = 6

```
[root@zmpt01 ~]# chmod 666 file1      #< ---chmod will modify the permissions
[root@zmpt01 ~]# ls -l
total 0
-rw-rw-rw-. 1 root root 0 Dec 6 13:34 file1
```

Grant additional execute permission to group

rw-rwxrw-

rw- = 6



```
rw- = 7  
rw- = 6  
  
[root@zmpt01 ~]# chmod 676 file1  
[root@zmpt01 ~]# ls -l  
total 0  
-rw-rwxrw- . 1 root root 0 Dec 6 13:34 file1
```

Take away all the permissions from everybody

----- = 000

```
[root@zmpt01 ~]# chmod 000 file1  
[root@zmpt01 ~]# ls -l  
total 0  
----- . 1 root root 0 Dec 6 13:34 file1
```

regardless of permissions set, root user has unrestricted permissions

Note: if you are modifying permissions using number, it must be three digits

Changing permissions using associated letter

Grant read and write permission only User/ owner

-rw----- = 600 = u+rw

```
[root@zmpt01 ~]# chmod u+rw file1  
[root@zmpt01 ~]# ls -l  
total 0  
-rw----- . 1 root root 0 Dec 6 13:34 file1
```

Grant everybody read write permissions

-rw-rw-rw- = 666 = ugo+rw

```
[root@zmpt01 ~]# chmod ugo+rw file1  
[root@zmpt01 ~]# ls -l  
total 0  
-rw-rw-rw- . 1 root root 0 Dec 6 13:34 file1
```

-rw-rw-rw-

Remove write permission for others

`-rw-rw-r-- = 664 = o-w`

```
[root@zmpt01 ~]# chmod o-w file1
[root@zmpt01 ~]# ls -l
total 0
-rw-rw-r--. 1 root root 0 Dec 6 13:34 file1
```

Full permissions

```
[root@zmpt01 ~]# chmod ugo+rwx file1
[root@zmpt01 ~]# ls -l
total 0
-rwxrwxrwx. 1 root root 0 Dec 6 13:34 file1
```

Informational

```
[root@zmpt01 ~]# ls -l
total 0
d------. 2 root root 6 Dec 6 14:09 dir1
-rwxrwxrwx. 1 root root 0 Dec 6 13:34 file1
```

Look at the permissions you can only see the user and groups, other are not listed

User – Yellow
Group - Orange

Directory Permissions

`drwxr-xr-x. 2 root root 6 Dec 6 14:09 dir1`

very first 'd' is not part of permission – it indicates directory

User – u			Group – g			Other – o		
Read	Write	Execute	Read	Write	Execute	Read	Write	Execute
r	w	x	r	w	x	r	w	x
4	2	1	4	2	1	4	2	1

Read = 4
Write = 2
Execute = 1

Read = read the files in the directory
Write = creating new files in the directory
Execute = going inside the directory

Number value of permission for file1

drwxr-xr-x. 2 root root 6 Dec 6 14:09 dir1

User	Group	Others
rwX	r- x	r- x
7	5	5

So the final permission number for dir1 is 755

755 is also default permission for file in Linux System

```
[root@zmpt01 ~]# mkdir /userdir
```

Remove all access to directory

```
drwxr-xr-x. 2 root root 6 Dec 6 14:25 /userdir
```

```
[root@zmpt01 ~]# chmod 000 /userdir
```

```
[root@zmpt01 ~]# ls -ld /userdir/
```

```
d----- . 2 root root 6 Dec 6 14:25 /userdir/
```

regardless of permissions set, root user has unrestricted permissions

```
[terminator@zmpt01 ~]$ cd /userdir/
```

```
-bash: cd: /userdir/: Permission denied
```

-----x = 001 = o+x

Grant execute permissions only to others

```
[root@zmpt01 ~]# chmod o+x /userdir/
```

```
[root@zmpt01 ~]# ls -ld /userdir/
```

```
d-----x. 2 root root 6 Dec 6 14:25 /userdir/
```

```
[terminator@zmpt01 ~]$ cd /userdir/
[terminator@zmpt01 userdir]$ pwd
/userdir
```

UMASK

```
total 0
drwxr-xr-x. 2 root root 6 Dec 6 14:59 dir2 #< ---755 is the default Directory permission
-rw-r--r--. 1 root root 0 Dec 6 14:59 file2 #< ---644 is the default File permission
```

This is set by default umask

By default system provides 644 permissions to file
By default system provides 755 permissions to directory

```
[root@zmpt01 ~]# umask
0022
```

Symbolic	Users	Group	Others
0	0	2	2

File permission

File permission are based on 666

	Users	Group	Others	Default
System provided permissions	6	6	6	666
Umask – removes the permission	0	2	2	022
Final default permissions	6	4	4	644

Directory permission

Directory permission are on 777

	Users	Group	Others	Default
System provided permissions	7	7	7	777
Umask – removes the permission	0	2	2	022
Final default permissions	7	5	5	755

Lets set umask to 0000

```
[root@zmpt01 ~]# umask 0000
```

```
[root@zmpt01 ~]# umask
0000
```

Note: system goes back to default umask when the system reboots

```
[root@zmpt01 ~]# touch file3
[root@zmpt01 ~]# ls -l
-rw-rw-rw-. 1 root root 0 Dec  6 15:11 file3
```

Permission is 666

```
[root@zmpt01 ~]# mkdir dir3
[root@zmpt01 ~]# ls -l
d-rwxrwxrwx. 2 root root 6 Dec  6 15:12 dir3
```

permission is 777

Group permissions

Linux groups is a mechanism to manage a large collection of users and manage their permissions. All linux users have a **User ID (UID)** as well as **Group ID (GID)** by default

```
[root@zmpt01 ~]# id terminator
uid=1000(terminator) gid=1000(terminator) groups=1000(terminator),10(wheel)
```

UID – User Id	GID – user primary group	Group User is part of
uid=1000(terminator)	gid=1000(terminator)	groups=1000(terminator), 10(wheel)

Create new group

```
[root@zmpt01 ~]# groupadd -g 9000 machine
```

Command	Primary group	GID	Group Name
groupadd	-g	9000	machine

Add user to the group

```
[root@zmpt01 ~]# usermod -aG machine terminator
```


Command	-a Add -G secondary group	GID/ name	UID/ name
usermod	-aG	Machine	terminator

```
[root@zmpt01 ~]# usermod -g 9000 terminator < ---Set primary group using -g
[root@zmpt01 ~]# id terminator
uid=1000(terminator) gid=9000(machine) groups=9000(machine),10(wheel)
```

```
[root@zmpt01 ~]# id terminator
uid=1000(terminator) gid=1000(terminator) groups=1000(terminator),10(wheel),9000(machine)
```

UID – User Id	GID – user primary group	Group User is part of
uid=1000(terminator)	gid=1000(terminator)	groups=1000(terminator), 10(wheel) 9000(machine)

Assign folder permissions

Create folder

```
[root@zmpt01 ~]# mkdir /assignment
[root@zmpt01 ~]# ls -ld /assignment/
drwxr-xr-x. 2 root root 6 Dec 6 15:31 /assignment/
```

Terminator is unable to create file1 in /assignment

```
[terminator@zmpt01 assignment]$ touch file1
touch: cannot touch 'file1': Permission denied
```

Change the group ownership to machine

```
[root@zmpt01 ~]# chgrp 9000 /assignment/
[root@zmpt01 ~]# ls -ld /assignment/
drwxr-xr-x. 2 root machine 6 Dec 6 15:31 /assignment/ #< ---Machine is group owner of /assignment
```

Command	GID	Folder
Chgrp	9000	/assignment

```
[root@zmpt01 ~]# chown :machine /assignment/ #< --- another way of changing group owner of /assignment
```

```
[root@zmpt01 ~]# ls -ld /assignment/
```

Change the group permissions

```
[root@zmpt01 ~]# chmod 775 /assignment/
[root@zmpt01 ~]# ls -ld /assignment/
drwxrwxr-x. 2 root machine 6 Dec 6 15:31 /assignment/ #< ---Machine group has rwx permissions
```

```
[terminator@zmpt01 assignment]$ touch file1
[terminator@zmpt01 assignment]$ ls -l
total 0
-rw-rw-r--. 1 terminator terminator 0 Dec 6 15:38 file1
```

Remove user from the group

```
[root@zmpt01 ~]# gpasswd -d terminator wheel
Removing user terminator from group wheel
```

Command	Delete	User id	Group id
Gpasswd	-d	Terminator	Wheel

```
[root@zmpt01 ~]# id terminator
uid=1000(terminator) gid=9000(machine) groups=9000(machine)
```

```
[terminator@zmpt01 ~]$ sudo su -
[sudo] password for terminator:
terminator is not in the sudoers file. This incident will be reported.
```

12-12-2020
<https://youtu.be/gCipZh-NsSs>

Set Group ID

SGID: all the files that are created in a directory with SGID set belongs to the group to with the directory belongs. Not the group user belong.

- Special permission set for directories
- When ever the user creates a file and direcories insde the SGID configure folder, it will inherit the Group Ownership of the SGID directory
- The group ownership is not retro active.

```
[root@zmpt01 ~]# ls -ld /DATA/
drwxr-xrwx. 2 root humans 6 Dec 12 14:21 /DATA/
```

```
[terminator@zmpt01 DATA]$ ls -l
total 0
-rw-r--r--. 1 terminator machine 0 Dec 12 14:22 file1
```

```
[root@zmpt01 ~]# chmod g+s /DATA/ #< --- set the SGID

[root@zmpt01 ~]# ls -ld /DATA/
drwxr-srwx. 2 root humans 19 Dec 12 14:22 /DATA/ #< --- 's' is indication the SGID is on folder /DATA
```

```
[terminator@zmpt01 DATA]$ touch file2
[terminator@zmpt01 DATA]$ ls -l
-rw-r--r--. 1 terminator humans 0 Dec 12 14:26 file2
```

```
[spiderman@zmpt01 DATA]$ ls -l
-rw-rw-r--. 1 spiderman humans 0 Dec 12 14:38 file4
```

```
[root@zmpt01 ~]# chmod g-x /DATA/
```

```
[root@zmpt01 ~]# ls -ld /DATA/
drwxr-Srwx. 2 root humans 97 Dec 12 15:07 /DATA/ #< --- 'S' upper case S without group execute permission
```

Set UID - SUID

SUID: the command inherits the owners execute permissions

- SUID is used for the files for the execution purpose
- It inherits the owners/root execute permission
- Regular user does not have permissions
- But still can update the file when executing the command

```
[root@zmpt01 ~]# ls -l /usr/bin/passwd
-rwsr-xr-x. 1 root root 27856 Aug 8 2019 /usr/bin/passwd #< --Typical example for user running with root permission
```

Generally passwd command is allowed for regular user, but this command is editing /etc/shadow file

```
[root@zmpt01 ~]# ls -l /etc/shadow
-----. 1 root root 979 Dec 12 15:28 /etc/shadow #< ---Looking at the permission, no one has write permissions
```

```
[terminator@zmpt01 ~]$ passwd
Changing password for user terminator.
Changing password for terminator.
(current) UNIX password:
New password:
Retype new password:
passwd: all authentication tokens updated successfully.
```

```
[root@zmpt01 ~]# ls -l /etc/shadow
-----. 1 root root 979 Dec 12 15:43 /etc/shadow #< --- file got update even though Terminator does not have any
perm
```

```
[root@zmpt01 ~]# ls -l /usr/bin/passwd
-rwsr-xr-x. 1 root root 27856 Aug 8 2019 /usr/bin/passwd
[root@zmpt01 ~]# chmod u-s /usr/bin/passwd
[root@zmpt01 ~]# ls -l /usr/bin/passwd
-rwxr-xr-x. 1 root root 27856 Aug 8 2019 /usr/bin/passwd
```

User is unable to change the password

```
[terminator@zmpt01 ~]$ passwd
Changing password for user terminator.
Changing password for terminator.
(current) UNIX password:
New password:
Retype new password:
passwd: Authentication token manipulation error
```

```
[root@zmpt01 ~]# chmod u+s /usr/bin/passwd
```

User is able change the password now

```
[terminator@zmpt01 ~]$ passwd
Changing password for user terminator.
Changing password for terminator.
(current) UNIX password:
New password:
Retype new password:
passwd: all authentication tokens updated successfully.
```

```
[root@zmpt01 ~]# ls -l /usr/bin/sudo
```



```
---s--x--x. 1 root root 147320 Aug 8 2019 /usr/bin/sudo
```

```
[root@zmpt01 ~]# chmod u-s /usr/bin/sudo  
[root@zmpt01 ~]# ls -l /usr/bin/sudo  
---x--x--x. 1 root root 147320 Aug 8 2019 /usr/bin/sudo
```

```
[root@zmpt01 ~]# id terminator  
uid=1000(terminator) gid=9000(machine) groups=9000(machine)  
[root@zmpt01 ~]# usermod -aG wheel terminator  
  
[root@zmpt01 ~]# id terminator  
uid=1000(terminator) gid=9000(machine) groups=9000(machine),10(wheel)
```

```
[terminator@zmpt01 ~]$ sudo su -  
sudo: /usr/bin/sudo must be owned by uid 0 and have the setuid bit set
```

```
[root@zmpt01 ~]# chmod u+s /usr/bin/sudo
```

```
[terminator@zmpt01 ~]$ sudo su -  
[sudo] password for terminator:  
Last login: Sat Dec 12 16:05:56 EST 2020 on pts/1
```

12-13-2020
<https://youtu.be/A7uNJFZhTro>

Sticky Bit

Sticky Bit – it is a delete protection, if you are not root or owner of the file you cannot delete a file. This is folder level permission

```
[root@zmpt01 ~]# ls -ld /tmp  
drwxrwxrwt. 8 root root 172 Dec 13 03:19 /tmp  
  
by default /tmp folder is set with stick bit permissions
```

```
[root@zmpt01 ~]# mkdir /DATA1  
[root@zmpt01 ~]# chmod 777 /DATA1/
```

```
[terminator@zmpt01 DATA1]$ touch file1  
[terminator@zmpt01 DATA1]$ ls -l
```



```
total 0
-rw-r--r--. 1 terminator machine 0 Dec 13 13:45 file1
```

```
[spiderman@zmpt01 DATA1]$ rm file1
rm: remove write-protected regular empty file 'file1'? y #< ---Spiderman successfully delete the file
[spiderman@zmpt01 DATA1]$ ls -l
total 0
```

Assign sticky bit to /DATA1

```
[root@zmpt01 ~]# chmod o+t /DATA1/
[root@zmpt01 ~]# ls -ld /DATA1/
drwxrwxrwt. 2 root root 6 Dec 13 13:45 /DATA1/ < -- now the folder protect with sticky bit
```

```
[terminator@zmpt01 DATA1]$ touch file1
[terminator@zmpt01 DATA1]$ touch file2
[terminator@zmpt01 DATA1]$ touch file3
```

```
[spiderman@zmpt01 DATA1]$ rm file1
rm: remove write-protected regular empty file 'file1'? y
rm: cannot remove 'file1': Operation not permitted
```

FACL – File Access Control List

```
[root@zmpt01 ~]# mkdir /BANK
[root@zmpt01 ~]# ls -ld /BANK/
drwxr-xr-x. 2 root root 6 Dec 13 13:54 /BANK/
[root@zmpt01 ~]# getfacl /BANK/
getfacl: Removing leading '/' from absolute path names
# file: BANK/
# owner: root
# group: root
user::rwx
group::r-x
other::r-x
```

```
[terminator@zmpt01 DATA1]$ cd /BANK/
[terminator@zmpt01 BANK]$ ls -l
total 0
[terminator@zmpt01 BANK]$ touch file1
touch: cannot touch 'file1': Permission denied #< --- expected denial for other users
```

Grant permission to specific user on folder

```
[root@zmpt01 ~]# setfacl -m u:terminator:rwx /BANK/  
[root@zmpt01 ~]# getfacl /BANK/  
getfacl: Removing leading '/' from absolute path names  
# file: BANK/  
# owner: root  
# group: root  
user::rwx  
user:terminator:rwx  
group::r-x  
mask::rwx  
other::r-x  
  
[root@zmpt01 ~]# ls -ld /BANK/  
drwxrwxr-x+ 2 root root 19 Dec 13 14:00 /BANK/    #< --- + is indication of FAACL
```

```
[terminator@zmpt01 BANK]$ touch file1  
[terminator@zmpt01 BANK]$ ls -l  
total 0  
-rw-r--r--. 1 terminator machine 0 Dec 13 14:00 file1
```

Grant permission on individual file

```
[terminator@zmpt01 BANK]$ setfacl -m u:spiderman:rwx file1  
[terminator@zmpt01 BANK]$ getfacl file1  
# file: file1  
# owner: terminator  
# group: machine  
user::rw-  
user:spiderman:rwx  
group::r--  
mask::rwx  
other::r--  
  
[terminator@zmpt01 BANK]$ ls -l  
total 0  
-rw-rwxr--+ 1 terminator machine 0 Dec 13 14:00 file1
```

```
[spiderman@zmpt01 BANK]$ cat file1  
this is file1 content  
this is file1 content
```

this is file1 content

[spiderman@zmpt01 BANK]\$ vi file1 #< ---user spiderman is able read and write to the file

Permissions

Identity	
User	u
Group	g
Other	o
All	a

Permission		
Read	r	4
Write	w	2
Execute	x	1

Actions	
+	Add permission
'-'	Remove permission
=	Make it only permission

Examples

Permission	Information
g+w	adds write access for the group
o-rwx	removes all permissions for others
u+x	allows the file owner to execute the file
a+r	allows everyone to read and write to the file
ug+r	allows the owner and group to read the file
g=rx	allows only the group to read and execute (not write)
g+w	adds write access for the group
g=rx	allows only the group to read and execute (not write)

Permission	Numerical	Information
-rw-----	600	Only the owner has read and write permissions.



-rw-r--r--	644	Only the owner has read and write permissions; the group and others have read only. DEFAULT
-rwx-----	700	Only the owner has read, write, and execute permissions.
-rwxr-xr-x	755	The owner has read, write, and execute permissions; the group and others have only read and execute.
-rwx--x--x	711	The owner has read, write, and execute permissions; the group and others have only execute.
-rw-rw-rw-	666	Everyone can read and write to the file. (Be careful with these permissions.)
-rwxrwxrwx	777	Everyone can read, write, and execute. (Again, this permissions setting can be hazardous.)

Chmod

```
[root@zmpt01 ~]# ls -l
total 0
-----. 1 root root 0 Oct 11 12:17 file1
[root@zmpt01 ~]# chmod o+w file1
[root@zmpt01 ~]# ls -l
total 0
-----w-. 1 root root 0 Oct 11 12:17 file1

[root@zmpt01 ~]# chmod a+r file1
[root@zmpt01 ~]# ls -l
total 0
-r--r--rw-. 1 root root 0 Oct 11 12:17 file1

[root@zmpt01 ~]# chmod a+rwx file1
[root@zmpt01 ~]# ls -l
total 0
-rwxrwxrwx. 1 root root 0 Oct 11 12:17 file1

[root@zmpt01 ~]# chmod a-x file1
[root@zmpt01 ~]# ls -l
total 0
-rw-rw-rw-. 1 root root 0 Oct 11 12:17 file1

[root@zmpt01 ~]# chmod a-rwx file1
[root@zmpt01 ~]# ls -l
total 0
-----. 1 root root 0 Oct 11 12:17 file1
```

```
[root@zmpt01 ~]# chmod 002 file1
[root@zmpt01 ~]# ls -l
total 0
```

```
-----w-. 1 root root 0 Oct 11 12:17 file1
```

```
[root@zmpt01 ~]# chmod 446 file1
```

```
[root@zmpt01 ~]# ls -l
```

```
total 0
```

```
-r--r--rw-. 1 root root 0 Oct 11 12:17 file1
```

```
[root@zmpt01 ~]# chmod 777 file1
```

```
[root@zmpt01 ~]# ls -l
```

```
total 0
```

```
-rwxrwxrwx. 1 root root 0 Oct 11 12:17 file1
```

```
[root@zmpt01 ~]# chmod 666 file1
```

```
[root@zmpt01 ~]# ls -l
```

```
total 0
```

```
-rw-rw-rw-. 1 root root 0 Oct 11 12:17 file1
```

```
[root@zmpt01 ~]# chmod 000 file1
```

```
[root@zmpt01 ~]# ls -l
```

```
total 0
```

```
------. 1 root root 0 Oct 11 12:17 file1
```

Chage

```
[root@zmpt01 ~]# chage -l terminator
```

```
Last password change          : Dec 12, 2020
```

```
Password expires              : never
```

```
Password inactive             : never
```

```
Account expires               : never
```

```
Minimum number of days between password change : 0
```

```
Maximum number of days between password change : 99999
```

```
Number of days of warning before password expires : 7
```

Last password change	: Dec 12, 2020	Date of the password was changed
Password expires	: never	Password expiration date
Password inactive	: never	Password inactive date
Account expires	: never	Id expiration date
Minimum number of days between password change	: 0	When will next password be force to change
Maximum number of days between password change	: 99999	Maximum days between the next password change
Number of days of warning before password expires	: 7	Warning period

Default setting for the pasword age

```
PASS_MAX_DAYS 99999
```

```
PASS_MIN_DAYS 0
```



```
PASS_MIN_LEN 5  
PASS_WARN_AGE 7
```

```
[root@zmpt01 ~]# vi /etc/login.defs
```

```
PASS_MAX_DAYS 60  
PASS_MIN_DAYS 0  
PASS_MIN_LEN 5  
PASS_WARN_AGE 7
```

```
[root@zmpt01 ~]# useradd ironman  
[root@zmpt01 ~]# chage -l ironman  
Last password change          : Dec 13, 2020  
Password expires              : Feb 11, 2021  
Password inactive             : never  
Account expires               : never  
Minimum number of days between password change : 0  
Maximum number of days between password change : 60  
Number of days of warning before password expires : 7
```

Set password to never expire

```
[root@zmpt01 ~]# chage -m 0 -M 99999 -l -1 -E -1 ironman
```

```
[root@zmpt01 ~]# chage -l ironman  
Last password change          : Dec 13, 2020  
Password expires              : never  
Password inactive             : never  
Account expires               : never  
Minimum number of days between password change : 0  
Maximum number of days between password change : 99999  
Number of days of warning before password expires : 7
```

Chown- change ownership

Chown is to change/assign ownership of the files and folders to users and groups

```
[root@zmpt01 ~]# mkdir /DATA2  
drwxr-xr-x. 2 root root 6 Dec 13 15:14 /DATA2/
```

Change the file ownership

```
[root@zmpt01 DATA2]# touch file1
```

```
[root@zmpt01 DATA2]# ls -l file1  
-rw-r--r--. 1 root root 0 Dec 13 15:15 file1
```

```
[root@zmpt01 DATA2]# chown terminator file1
```

```
[root@zmpt01 DATA2]# ls -l file1  
-rw-r--r--. 1 terminator root 0 Dec 13 15:15 file1
```

Change the gorup ownership

```
[root@zmpt01 DATA2]# chown :machine file1
```

```
[root@zmpt01 DATA2]# ls -l file1  
-rw-r--r--. 1 terminator machine 0 Dec 13 15:15 file1
```

Change user and group ownership

```
[root@zmpt01 DATA2]# chown spiderman:superhero file1
```

```
[root@zmpt01 DATA2]# ls -l file1  
-rw-r--r--. 1 spiderman superhero 0 Dec 13 15:15 file1
```

Change the user ownership of Folder

```
[root@zmpt01 ~]# chown spiderman /DATA2/
```

```
[root@zmpt01 ~]# ls -ld /DATA2/  
drwxr-xr-x. 2 spiderman root 19 Dec 13 15:15 /DATA2/
```

Chgrp – change group

Chgrp – allow to change group only

```
[root@zmpt01 DATA2]# ls -l file1  
-rw-r--r--. 1 spiderman machine 0 Dec 13 15:15 file1
```

Change group ownerhsip of folder

```
[root@zmpt01 ~]# chgrp machine /DATA2/
```

```
[root@zmpt01 ~]# ls -ld /DATA2/  
drwxr-xr-x. 2 spiderman machine 19 Dec 13 15:15 /DATA2/
```

12-13-2020

<https://youtu.be/A7uNJFZhTro>



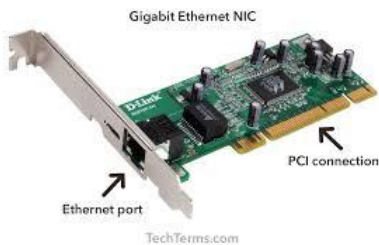
Network

A **Network** is a collection of computers, servers, network devices, peripherals or any other device connected to one another to allow the sharing of data. Example is Internet

Basic requirement

- NIC, Media, Topology, Protocol, IP Address

NIC



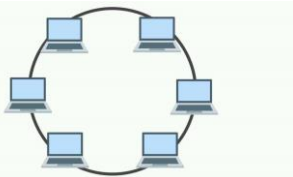
- Hardware/ MAC address: 08:00:27:bd:99:25 # < ---burnt into the hard ware and you cannot change it
- IP Address IPv4: 192.168.137.236
- IP Address IPv6: fe80::a00:27ff:febd:9925

Media

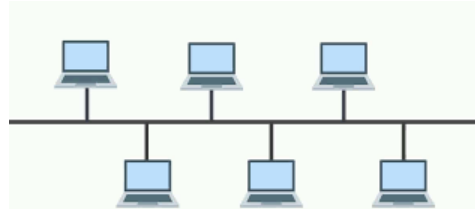
- Cables
- RJ45 –
- CAT5 or CAT6 ethernet cables
- WiFi
- HotSpots

Topology

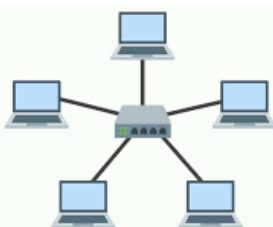
Ring



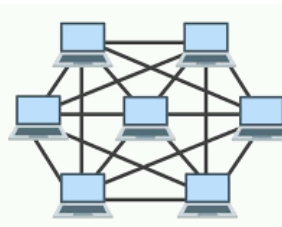
Bus



Star

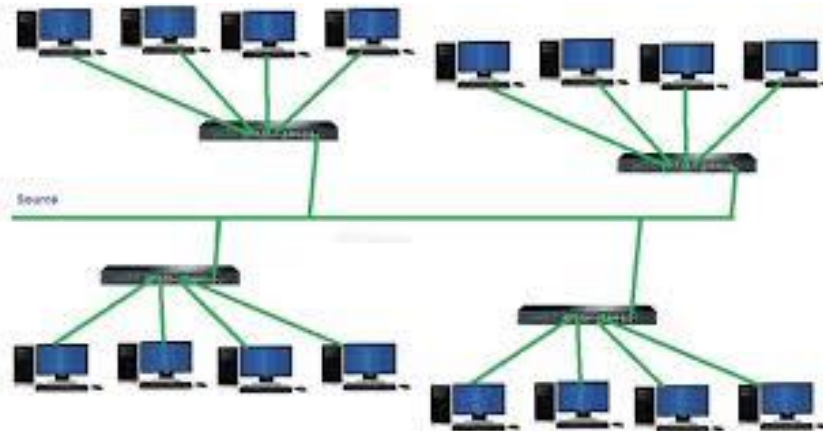


Mesh





Tree



- You have a network
- Each router you add becomes subnet
- Max of 256 devices
- $2^8 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$

Protocol

In computer world, Protocol is set of rules or procedures for transmitting data between electronic devices such as computers.

OSI Layers

OSI – Open Standard interconnection – 7 layer model

- Physical layer – Hardware
- Data layer – Data Being generated
- Network layer – working network – switches, router etc
- Transport layer – communication is being done using serveral methods
- Session layer – session established between two hosts
- Presentation layer – data is presented to application
- Application layer – exam ms office

TCP – Transport Control Protocol

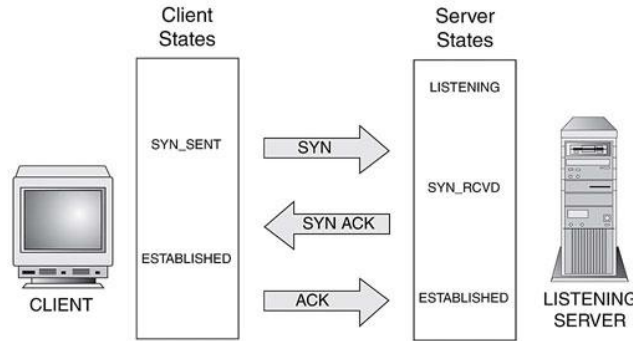
TCP – Transport Control Protocol

- Connection protocol
- DATA, Network, Transport, Application – DNTA
- Connection oriented protocol
- TCP protocol makes 3way hanshake connection
-

TCP makes a 3way Handshake connection established



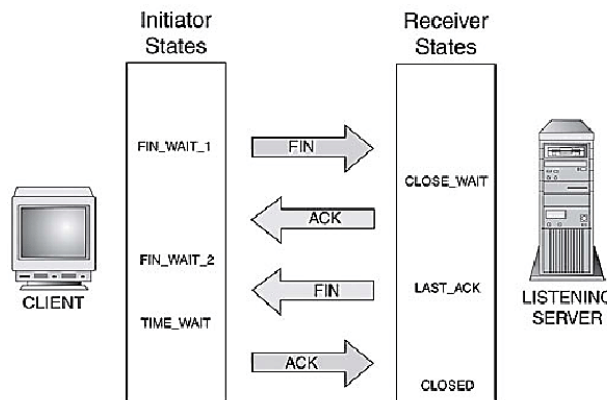
TCP STATES for the 3-Way Handshake



Establishing Connection

- A to B – Synchronization signal is sent
- B to A – Synchronization signal and Acknowledgement signal
- A to B – Acknowledgement
- Connection is established and DATA is transferred
- Sync – Sync Ack – Ack

TCP connection Terminaiton



Closing the connection

- A to B – Finsished – complete connection
- B to A – Acknowledge to Finish connection
- B to A – Send the Finsh signal
- A to B - Acknowledge the final signal
- Fin - Fin Ack – Ack

$2^{16} = 65536$ ports

Exmaple

SSH connection is using TCP protocol and is connection oriented

```
[root@localhost ~]# netstat -anp | grep -w 22
```

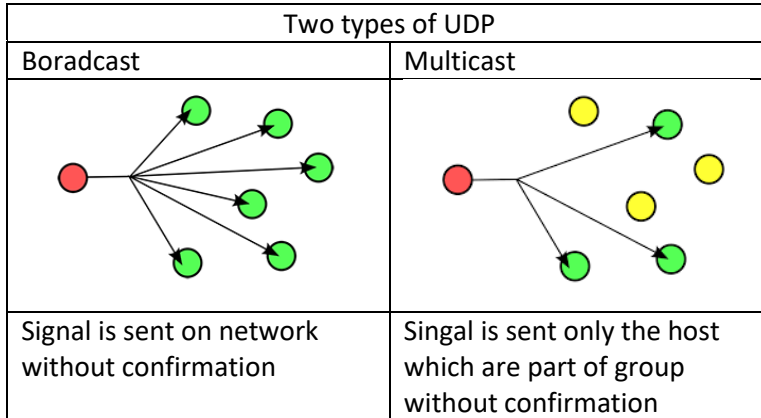
```
tcp    0    0 192.168.137.20:22
```



UDP

UDP – User Datagram Protocol

- Connection less protocol
- Just sends the Data to the host without confirmation
- Connection is faster
-



Differences between TCP and UDP

TCP	UDP
Connection oriented	Connection less
Reliable	Unreliable
Slow	Fast
SSH, HTTP, FTP, SMTP	DNS, DHCP, Broadcast

12-19-2020

<https://youtu.be/NfzvBHVBD0M>

IP Address

An Internet Protocol address is a numerical label assigned to each device connected to a computer network that uses the Internet Protocol for communication. An IP address serves two main functions: host or network interface identification and location addressing.

192.168.56.108

Computers work on Binary system – it can only recognize two digits – base 2

Zero = 0 = off

One = 1 = on



IP address is based on **32** binary bits structure – 2^8 octets
Information is written in Binary

192	168	56	108
8 bits	8 bits	8 bits	8 bit

Total = 32

$2^7 = 1$

1 bit 2^0							
4 bit = nibble = 2^2							
8 bit = octet = 1 byte = 2^3							

- $2^0 = 1$
- $2^1 = 2$
- $2^2 = 4$
- $2^3 = 8 = 1 \text{ Byte}$

8	7	6	5	4	3	2	1
7	6	5	4	3	2	1	0
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1

192.168.56.108

192 – 11000000 #< --- right to left

8	7	6	5	4	3	2	1
7	6	5	4	3	2	1	0
2 ⁷	2 ⁶	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰
128	64	32	16	8	4	2	1
192 -128	64 - 64	0 - 32	0 - 16	0 - 8	0 - 8	0 - 2	0 - 1
1	1	0	0	0	0	0	0

168 - 10101000

8	7	6	5	4	3	2	1
7	6	5	4	3	2	1	0
2 ⁷	2 ⁶	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰
128	64	32	16	8	4	2	1
168 -128	40 - 64	40 - 32	8-16	8-8	0-4	0-2	0-1
1	0	1	0	1	0	0	0

56 – 00111000

8	7	6	5	4	3	2	1
7	6	5	4	3	2	1	0
2 ⁷	2 ⁶	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰
128	64	32	16	8	4	2	1
56 -128	56-64	56-32	24-16	8-8	0-4	0-2	0-1
0	0	1	1	1	0	0	0

108 – 01101100

8	7	6	5	4	3	2	1
7	6	5	4	3	2	1	0
2 ⁷	2 ⁶	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰
128	64	32	16	8	4	2	1
108-128	108-64	44-32	12-16	12-8	4-4	0-2	0-1
0	1	1	0	1	1	0	0

192.168.56.108 = 11000000101010000011100001101100

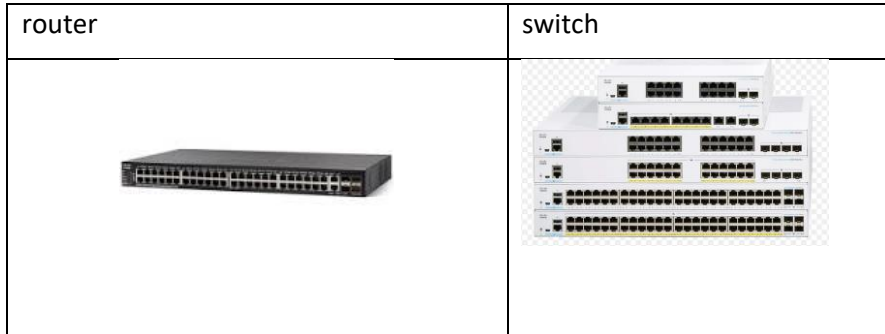
Numbers are from right to left



9-0

Arabic numbers

Gateway



- Router gives out IP address to each connected devices
- Total maximum of 256 IP addresses are available
- $2^8 = 256$
- Each router added becomes a **subnet** (network in its self)
- 1 IP is reserved for router itself
- This reserved IP is entry point for the network to communicate with other networks
- Reserved ip is referred to as default gateway
-
- [root@zmpt01 ~]# netstat -rn
- Kernel IP routing table
- Destination **Gateway** Genmask Flags MSS Window irtt Iface
- 0.0.0.0 **10.0.2.1** 0.0.0.0 UG 0 0 0 enp0s9

Ports – connection on with a application is connected to another device

65,536 – ports on OS

Linux or Windows

Commonly used ports

Port Number	Usage
20	File Transfer Protocol (FTP) Data Transfer
21	File Transfer Protocol (FTP) Command Control
22	Secure Shell (SSH)
23	Telnet - Remote login service, unencrypted text messages
25	Simple Mail Transfer Protocol (SMTP) E-mail Routing
53	Domain Name System (DNS) service
80	Hypertext Transfer Protocol (HTTP) used in World Wide Web



110	Post Office Protocol (POP3) used by e-mail clients to retrieve e-mail from a server
119	Network News Transfer Protocol (NNTP)
123	Network Time Protocol (NTP)
143	Internet Message Access Protocol (IMAP) Management of Digital Mail
161	Simple Network Management Protocol (SNMP)
194	Internet Relay Chat (IRC)
443	HTTP Secure (HTTPS) HTTP over TLS/SSL

IP Address Classes

192.168.56.108

- There are 4 subnets information in each ip address
- 192.168.56.108

192	168	56	108
-----	-----	----	-----

- $2^8 = 256 =$ each subnet

256	256	256	256
0	0	0	0

$256 \times 256 \times 256 \times 256$	4,294,967,296	Maximum for IPv4
$0 \times 0 \times 0 \times 0$	0	2^{32}

- 0.0.0.1 =
- My Public IPv6 is: 2607:fb90:a345:19f9:c171:a28e:9a34:571f
- IPv6 capacity = 340,282,366,920,938,463,374,607,431,768,211,456



CIDR	Subnet mask (decimal)	Subnet mask (binary)	Available addresses	
			Start	End
/0	0.0.0.0	00000000.00000000.00000000.00000000	4.294.967.296	2 ³²
/1	128.0.0.0	10000000.00000000.00000000.00000000	2.147.483.648	2 ³¹
/2	192.0.0.0	11000000.00000000.00000000.00000000	1.073.741.824	2 ³⁰
/3	224.0.0.0	11100000.00000000.00000000.00000000	536.870.912	2 ²⁹
/4	240.0.0.0	11110000.00000000.00000000.00000000	268.435.456	2 ²⁸
/5	248.0.0.0	11111000.00000000.00000000.00000000	134.217.728	2 ²⁷
/6	252.0.0.0	11111100.00000000.00000000.00000000	67.108.864	2 ²⁶
/7	254.0.0.0	11111110.00000000.00000000.00000000	33.554.432	2 ²⁵
/8	255.0.0.0	11111111.00000000.00000000.00000000	16.777.216	2 ²⁴
/9	255.128.0.0	11111111.10000000.00000000.00000000	8.388.608	2 ²³
/10	255.192.0.0	11111111.11000000.00000000.00000000	4.194.304	2 ²²
/11	255.224.0.0	11111111.11100000.00000000.00000000	2.097.152	2 ²¹
/12	255.240.0.0	11111111.11110000.00000000.00000000	1.048.576	2 ²⁰
/13	255.248.0.0	11111111.11111000.00000000.00000000	524.288	2 ¹⁹
/14	255.252.0.0	11111111.11111100.00000000.00000000	262.144	2 ¹⁸
/15	255.254.0.0	11111111.11111110.00000000.00000000	131.072	2 ¹⁷
/16	255.255.0.0	11111111.11111111.00000000.00000000	65.536	2 ¹⁶
/17	255.255.128.0	11111111.11111111.10000000.00000000	32.768	2 ¹⁵
/18	255.255.192.0	11111111.11111111.11000000.00000000	16.384	2 ¹⁴
/19	255.255.224.0	11111111.11111111.11100000.00000000	8.192	2 ¹³
/20	255.255.240.0	11111111.11111111.11110000.00000000	4.096	2 ¹²
/21	255.255.248.0	11111111.11111111.11111000.00000000	2.048	2 ¹¹
/22	255.255.252.0	11111111.11111111.11111100.00000000	1.024	2 ¹⁰
/23	255.255.254.0	11111111.11111111.11111110.00000000	512	2 ⁹
/24	255.255.255.0	11111111.11111111.11111111.00000000	256	2 ⁸
/25	255.255.255.128	11111111.11111111.11111111.10000000	128	2 ⁷
/26	255.255.255.192	11111111.11111111.11111111.11000000	64	2 ⁶
/27	255.255.255.224	11111111.11111111.11111111.11100000	32	2 ⁵
/28	255.255.255.240	11111111.11111111.11111111.11110000	16	2 ⁴
/29	255.255.255.248	11111111.11111111.11111111.11111000	8	2 ³
/30	255.255.255.252	11111111.11111111.11111111.11111100	4	2 ²
/31	255.255.255.254	11111111.11111111.11111111.11111110	2	2 ¹
/32	255.255.255.255	11111111.11111111.11111111.11111111	1	2 ⁰



```
[root@script01 ~]# ./redirectinput.scr springfield, Illinois, US, newyork, chiago
```

\$1 \$2 \$3 \$4 \$5

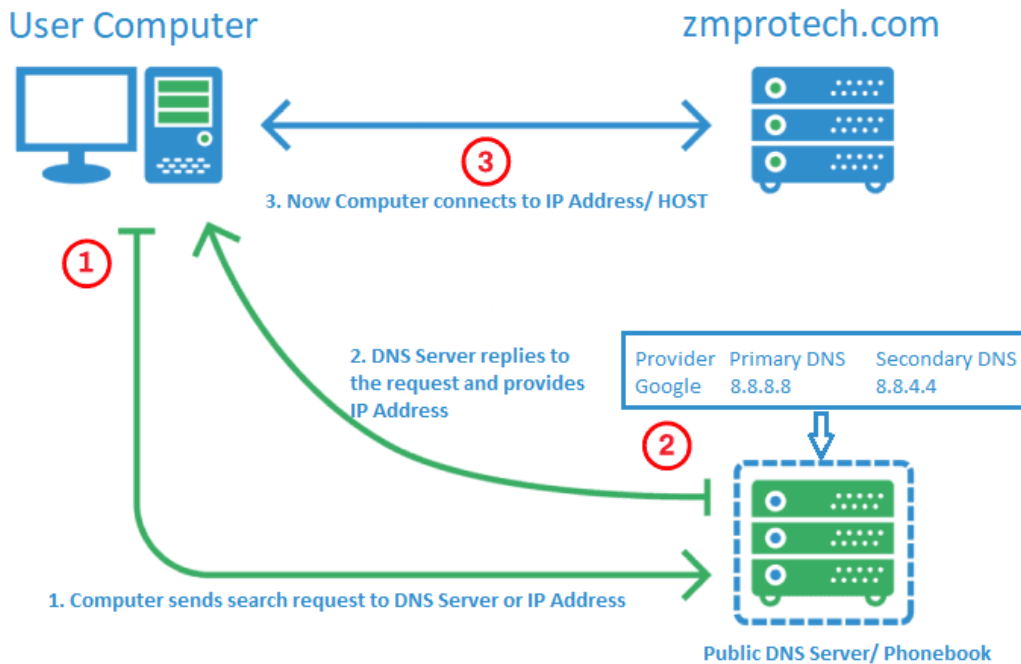
01-09-2021

<https://youtu.be/vhx7s3psguU>

DNS

The Domain Name System (DNS) is the **phonebook** of the Internet. Humans access information online through domain names, like nytimes.com or espn.com. Web browsers interact through Internet Protocol (IP) addresses. DNS translates domain names to IP addresses so browsers can load Internet resources.



888-236-2620	ZM PROTech
IP address	Hostname [Server Name]



DNS Primary Server Setup

Primary DNS Server
Hostname: dnsprimary.zmpt.com
IP: 192.168.56.112



 DNS-PRIMARY Powered Off	dnsprimary.zmpt.com
 DNS-SECONDARY Powered Off	dnssecondary.zmpt.com

Setup Hostname

```
[root@localhost ~]# vi /etc/hostname  
dnsprimary.zmpt.com  
[root@localhost ~]# init 6  
  
[root@dnsprimary ~]# hostname  
dnsprimary.zmpt.com
```

dnsprimary.zmpt.com 192.168.56.112

```
[root@dnsprimary network-scripts]# vi /etc/sysconfig/network-scripts/ifcfg-enp0s3  
  
[root@dnsprimary network-scripts]# vi ifcfg-enp0s3
```

```
TYPE=Ethernet  
BOOTPROTO=static  
NAME=enp0s3  
UUID=b0b60c28-849b-4dde-b3a1-8fa1dbd1cedc  
DEVICE=enp0s3  
ONBOOT=yes  
IPADDR=192.168.56.112  
NETMASK=255.255.255.0
```

```
[root@dnsprimary ~]# init 6
```

Package needed by DNS

Bind
Bind-utils
Bind-chroot

Berkley Internet Name Domain – USC Berkeley, CA

```
[root@dnsprimary ~]# yum install bind bind-utils bind-chroot -y
```

```
[root@dnsprimary ~]# vi /etc/sysconfig/network  
NETWORKING=yes  
HOSTNAME=dnsprimary.zmpt.com
```

```
[root@dnsprimary ~]# vi /etc/hosts
```



192.168.56.112 dnsprimary.zmpt.com

[root@dnsprimary ~]# vi /etc/named.conf

```
options {
    listen-on port 53 { 127.0.0.1; 192.168.56.112; };
    listen-on-v6 port 53 { ::1; };
    directory "/var/named";
    dump-file "/var/named/data/cache_dump.db";
    statistics-file "/var/named/data/named_stats.txt";
    memstatistics-file "/var/named/data/named_mem_stats.txt";
    recursing-file "/var/named/data/named.recursing";
    secroots-file "/var/named/data/named.secroots";
    allow-query { localhost; 192.168.56.0/24; };
}
```

Create forward lookup

[root@dnsprimary ~]# cd /var/named/

```
[root@dnsprimary named]# ls
chroot dynamic named.empty named.loopback
data named.ca named.localhost slaves
```

[root@dnsprimary named]# cp named.localhost forward.zmpt

[root@dnsprimary named]# vi forward.zmpt

```
$TTL 1D
@ IN SOA dnsprimary.zmpt.com. root.zmpt.com. (
    1 ; serial
    1D ; refresh
    1H ; retry
    1W ; expire
    3H ; minimum
)
@ IN NS dnsprimary.zmpt.com.
dnsprimary IN A 192.168.56.112
```

Create Reverse lookup


```
[root@dnsprimary named]# cp forward.zmpt reverse.zmpt
[root@dnsprimary named]# vi reverse.zmpt
```

```
$TTL 1D
@   IN SOA  dnsprimary.zmpt.com. root.zmpt.com. (
        1   ; serial
        1D  ; refresh
        1H  ; retry
        1W  ; expire
        3H  ; minimum
    )
@   IN NS   dnsprimary.zmpt.com.

dnsprimary IN A   192.168.56.112

112 IN PTR  dnsprimary.zmpt.com.
```

Edit named.conf file again

```
[root@dnsprimary ~]# vi /etc/named.conf
```

Copy these lines and paste at the end of file

```
zone "." IN {
    type hint;
    file "named.ca";
};
```

```
#####
```

```
zone "zmpt.com" IN {
    type master;
    file "forward.zmpt";
};
```

```
zone "56.168.192.in-addr.arpa" IN {
    type master;
    file "reverse.zmpt";
```



```
};  
  
#####
```

Disable firewall

```
[root@dnsprimary ~]# systemctl stop firewalld  
  
[root@dnsprimary ~]# systemctl disable firewalld  
  
Removed symlink /etc/systemd/system/multi-user.target.wants/firewalld.service.  
Removed symlink /etc/systemd/system/dbus-org.fedoraproject.FirewallD1.service.  
  
[root@dnsprimary ~]# systemctl status firewalld
```

Enable named

```
[root@dnsprimary ~]# systemctl start named  
  
[root@dnsprimary ~]# systemctl enable named.service  
Created symlink from /etc/systemd/system/multi-user.target.wants/named.service to  
/usr/lib/systemd/system/named.service.  
  
[root@dnsprimary named]# ps -ef|grep named < ---to confirm named service is running  
  
named 2067 1 0 Aug22 ? 00:00:00 /usr/sbin/named -u named -c /etc/named.conf  
root 14757 1514 0 08:20 pts/0 00:00:00 grep --color=auto named
```

Change the group and ownership

```
[root@dnsprimary ~]# cat /etc/passwd  
[root@dnsprimary ~]# cat /etc/group  
  
[root@dnsprimary ~]# chgrp named -R /var/named  
  
[root@dnsprimary ~]# chown -Rv root:named /etc/named.conf  
  
-R – recursively, meaning previously created files or folder  
-v – Verbose, meaning display as the change is being made
```

SELinux

```
[root@dnsprimary named]# restorecon -rv /var/named
```

```
[root@dnsprimary named]# restorecon /etc/named.conf
```

Check forward and reverse lookup zones

```
[root@dnsprimary named]# named-checkzone zmpt.com /var/named/forward.zmpt
zone zmpt.com/IN: loaded serial 0
OK
[root@dnsprimary named]# named-checkzone zmpt.com /var/named/reverse.zmpt
zone zmpt.com/IN: loaded serial 0
OK
```

Make entry into Ethernet file

```
[root@dnsprimary network-scripts]# vi ifcfg-enp0s3

TYPE=Ethernet
BOOTPROTO=static
NAME=enp0s3
UUID=7af95a73-a7bf-4925-8e44-1c4e2219d314
DEVICE=enp0s3
ONBOOT=yes
IPADDR=192.168.56.112
NETMASK=255.255.255.0
DNS="192.168.56.112"    #< ---NEW ENTRY
```

Edit resolve.conf file < ---what is DNS resolution file?

```
[root@dnsprimary ~]# vi /etc/resolv.conf

search mshome.net zmpt.com
nameserver 192.168.137.1    192.168.56.112
```

Test the DNS Primary

Dig stands for (Domain Information Groper) is a network administration **command**-line tool for querying Domain Name System (DNS) name servers.

```
[root@dnsprimary ~]# hostname
dnsprimary.zmpt.com
[root@dnsprimary ~]# dig dnsprimary.zmpt.com
```

```
; <<>> DiG 9.11.4-P2-RedHat-9.11.4-26.P2.el7_9.3 <<>> dnsprimary.zmpt.com
;; global options: +cmd
;; Got answer:
```



```
;; ->>HEADER<<- opcode: QUERY, status: SERVFAIL, id: 56635
;; flags: qr rd ra; QUERY: 1, ANSWER: 0, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags;; udp: 4096
;; QUESTION SECTION:
;dnsprimary.zmpt.com.      IN      A

;; Query time: 0 msec
;; SERVER: 192.168.56.112#53(192.168.56.112)
;; WHEN: Sat Jan 09 15:32:33 EST 2021
;; MSG SIZE rcvd: 48
```

Configure DNS Secondary

Primary DNS Server
Hostname: dnsprimary.zmpt.com
IP: 192.168.56.114

Install the required DNS package

```
[root@localhost ~]# yum install bind bind-utils -y
```

Disable the NAT after installation

Setup Hostname

```
[root@localhost ~]# vi /etc/hostname
dnssecondary.zmpt.com
```

Set the static IP

```
[root@localhost ~]# vi /etc/sysconfig/network-scripts/ifcfg-enp0s3
```

```
TYPE=Ethernet
BOOTPROTO=static
NAME=enp0s3
DEVICE=enp0s3
ONBOOT=yes
```



```
IPADDR=192.168.56.114  
NETMASK=255.255.255.0
```

Edit Network file

```
[root@dnssecondary ~]# vi /etc/sysconfig/network  
NETWORKING=yes  
HOSTNAME=dnssecondary.zmpt.com
```

Edit hosts file

```
[root@dnssecondary ~]# vi /etc/hosts  
192.168.56.114 dnssecondary.zmpt.com #< --TAB between ip and hostname
```

Reboot

```
192.168.56.200 dnssecondary.zmpt.com  
  
[root@localhost ~]# init 6
```

Add information to named.conf

```
[root@localhost ~]# vi /etc/named.conf
```

```
options {  
    listen-on port 53 { 127.0.0.1; 192.168.56.114;};  
    listen-on-v6 port 53 { ::1; };  
    directory "/var/named";  
    dump-file "/var/named/data/cache_dump.db";  
    statistics-file "/var/named/data/named_stats.txt";  
    memstatistics-file "/var/named/data/named_mem_stats.txt";  
    recursing-file "/var/named/data/named.recursing";  
    secroots-file "/var/named/data/named.secrets";  
    allow-query { localhost; 192.168.56.0/24;};
```

```
#####  
  
zone "zmpt.com" IN {  
    type slave;  
    file "slaves/forward.zmpt";  
    masters{192.168.56.112;};  
};
```

```
zone "56.168.192.in-addr.arpa" IN {  
    type slave;  
    file "slaves/reverse.zmpt";  
    masters{192.168.56.112};  
};  
  
#####
```

Start and enable named service

```
[root@dnssecondary ~]# systemctl start named  
[root@dnssecondary ~]# systemctl enable named  
Created symlink from /etc/systemd/system/multi-user.target.wants/named.service to  
/usr/lib/systemd/system/named.service.
```

configure the Ethernet file again

```
TYPE=Ethernet  
BOOTPROTO=static  
NAME=enp0s3  
DEVICE=enp0s3  
ONBOOT=yes  
IPADDR=192.168.56.200  
NETMASK=255.255.255.0
```

```
DNS1="192.168.56.112"  
DNS2="192.168.56.114"
```

Up the DNS resolution file

```
[root@dnssecondary ~]# vi /etc/resolv.conf  
  
search zmpt.com  
nameserver 192.168.56.112  
nameserver 192.168.56.114
```

Disable firewall

```
[root@dnssecondary ~]# systemctl stop firewalld  
  
[root@dnssecondary ~]# systemctl disable firewalld  
Removed symlink /etc/systemd/system/multi-user.target.wants/firewalld.service.  
Removed symlink /etc/systemd/system/dbus-org.fedoraproject.FirewallD1.service.
```

Configure the permissions and ownership

```
[root@dnsprimary ~]# cat /etc/passwd  
[root@dnsprimary ~]# cat /etc/group
```

```
[root@dnsprimary ~]# chgrp named -R /var/named  
  
[root@dnsprimary ~]# chown -Rv root:named /etc/named.conf  
  
-R – recursively, meaning previously created files or folder  
-v – Verbose, meaning display as the change is being made
```

SELinux

```
[root@dnssecondary ~]# restorecon -rv /var/named/  
[root@dnssecondary ~]# restorecon /etc/named.conf
```

ON DNS Primary

Edit forward lookup zone

```
- [root@dnsprimary ~]# vi /var/named/forward.zmpt
```

```
$TTL 1D  
@ IN SOA dnsprimary.zmpt.com. root.zmpt.com. (  
    1 ; serial  
    1D ; refresh  
    1H ; retry  
    1W ; expire  
    3H ; minimum  
    )  
@ IN NS dnsprimary.zmpt.com.  
  
dnsprimary IN A 192.168.56.112  
dnssecondary IN A 192.168.56.114
```

Edit reverse lookup zone

```
$TTL 1D  
@ IN SOA dnsprimary.zmpt.com. root.zmpt.com. (  
    1 ; serial  
    1D ; refresh  
    1H ; retry  
    1W ; expire  
    3H ; minimum  
    )  
@ IN NS dnsprimary.zmpt.com.
```



```
dnsprimary IN A 192.168.56.112
dnssecondary IN A 192.168.56.114

100 IN PTR dnsprimary.zmpt.com.
200 IN PTR dnssecondary.zmpt.com.
```

Perform Dig and nslookup on both servers

```
[root@dnsprimary ~]# dig dnsprimary.zmpt.com
[root@dnsprimary ~]# dig dnssecondary.zmpt.com

[root@dnsprimary ~]# nslookup dnsprimary.zmpt.com
[root@dnsprimary ~]# nslookup dnssecondary.zmpt.com
```

```
[root@dnsprimary ~]# systemctl restart named
```

```
[root@dnssecondary ~]# dig dnsprimary.zmpt.com
[root@dnssecondary ~]# dig dnssecondary.zmpt.com

[root@dnssecondary ~]# nslookup dnssecondary.zmpt.com
[root@dnssecondary ~]# nslookup dnsprimary.zmpt.com
```

On the DNS secondary forward.zmpt and reverse.zmpt will get transferred

DNS – Secondary (SLAVE)

dnssecondary.zmpt.com

```
[root@dnssecondary ~]# cd /var/named/slaves/
```

```
[root@dnssecondary slaves]# ls -l
```

total 8

```
-rw-r--r--. 1 named named 261 Jan 10 13:48 forward.zmpt #< This file get updated from DNS primary
-rw-r--r--. 1 named named 467 Jan 10 11:07 reverse.zmpt #< This file get updated from DNS primary
```

01-10-2021

https://youtu.be/gzTJ_T3Ttus

On any other server

Edit the following files



```
[root@localhost ~]# vi /etc/sysconfig/network-scripts/ifcfg-enp0s3
[root@localhost ~]# vi /etc/hostname
[root@localhost ~]# vi /etc/networks
[root@localhost ~]# vi /etc/hosts
[root@localhost ~]# vi /etc/resolv.conf
```

Set static IP DNS info

```
[root@localhost ~]# vi /etc/sysconfig/network-scripts/ifcfg-enp0s3

TYPE=Ethernet
BOOTPROTO=static
NAME=enp0s3
#UUID=b0b60c28-849b-4dde-b3a1-8fa1dbd1cedc
DEVICE=enp0s3
ONBOOT=yes
IPADDR=192.168.56.116
NETMASK=255.255.255.0
DNS1="192.168.56.112" #< ---Primary DNS
DNS2="192.168.56.114" #< ---Secondary DNS
```

Set the Hostname

```
[root@localhost ~]# vi /etc/hostname

ansiblemaster.zmpt.com
```

Edit Network file

```
[root@localhost ~]# vi /etc/networks

NETWORKING=yes
HOSTNAME=ansiblemaster.zmpt.com
```

Edit hosts file

```
[root@localhost ~]# vi /etc/hosts

192.168.56.150 ansiblemaster.zmpt.com
```

Edit DNS resolution file

```
[root@localhost ~]# vi /etc/resolv.conf

servers info search zmpt.com
```

```
nameserver 192.168.56.112 #< ---DNS MASTER  
nameserver 192.168.56.114 #< ---DNS SLAVE
```

On DNS Master

Edit forward and Reverse lookup zone

Forward lookup zone

```
[root@dnsprimary ~]# vi /var/named/forward.zmpt  
  
$TTL 60  
@ IN SOA dnsprimary.zmpt.com. root.zmpt.com. (  
    7 ; serial  
    60 ; refresh  
    60 ; retry  
    604800 ; expire  
    60 ; minimum  
    )  
@ IN NS dnsprimary.zmpt.com.  
  
dnsprimary IN A 192.168.56.112  
dnssecondary IN A 192.168.56.114  
  
ansiblemaster IN A 192.168.56.116  
oracle IN A 192.168.56.151  
database IN A 192.168.56.152  
production IN A 192.168.56.153
```

Reverse lookup zone

```
[root@dnsprimary ~]# vi /var/named/reverse.zmpt  
  
$TTL 60  
@ IN SOA dnsprimary.zmpt.com. root.zmpt.com. (  
    7 ; serial  
    60 ; refresh  
    60 ; retry  
    604800 ; expire  
    60 ; minimum  
    )  
@ IN NS dnsprimary.zmpt.com.  
  
dnsprimary IN A 192.168.56.112
```

```
dnssecondary IN A 192.168.56.114
ansiblemaster IN A 192.168.56.116
oracle IN A 192.168.56.151
database IN A 192.168.56.152
production IN A 192.168.56.153
```

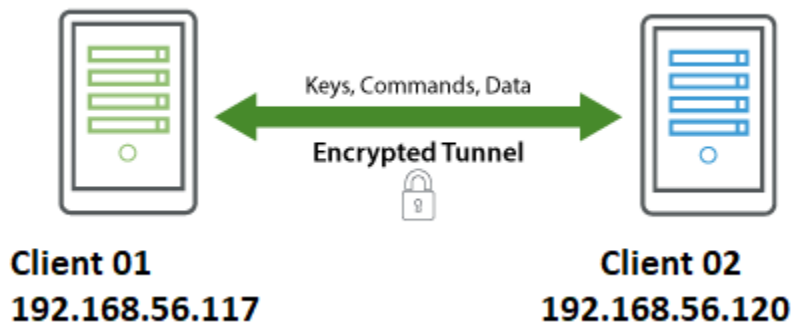
```
100 IN PTR dnsprimary.zmpt.com.
200 IN PTR dnssecondary.zmpt.com.
150 IN PTR ansiblemaster.zmpt.com.
151 IN PTR oracle.zmpt.com.
152 IN PTR database.zmpt.com.
153 IN PTR production.zmpt.com.
```

Successfully demonstrated DNS setup and Ansible commands using the Hostname

01-23-2021
<https://youtu.be/OY6ODRsp0Sc>

SCP – Secure Copy

Used to copy files and folders over the network to another host



```
[root@client01 ~]# ls
anaconda-ks.cfg lvmscript.scr
[root@client01 ~]# scp lvmscript.scr 192.168.56.120:/tmp
```

Command	Source file	Destination and directory location
Scp	Lvmscrip.scr	192.168.56.120:/tmp

```
[root@client01 .ssh]# scp lvmscript.scr 192.168.56.120:/tmp
The authenticity of host '192.168.56.120 (192.168.56.120)' can't be established.
ECDSA key fingerprint is SHA256:e3LN1URGQEPwXaMbDeo+aTYev2cOOWnP3WKmaRG9gRU.
ECDSA key fingerprint is MD5:de:11:30:dd:ef:9e:ae:0a:ab:49:16:29:c9:08:36:8f.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '192.168.56.120' (ECDSA) to the list of known hosts.
root@192.168.56.120's password:
```

Transferring folder

You must make it a .tar file then transfer as single file to preserve **Data Integrity**

```
[root@client01 ~]# mkdir transfer

[root@client01 ~]# touch file{1..1000}

[root@client01 ~]# tar -cvf transfer.tar tranfer/

[root@client01 ~]# scp transfer.tar 192.168.56.120:/tmp
```

You can still transfer folders

```
[root@client01 ~]# scp -r tranfer 192.168.56.120:/tmp
```

Untar the file after transfer

```
[root@client02 tmp]# tar xvf transfer.tar
```

01-24-2021
<https://youtu.be/t8z-na-ZFbl>

NFS – NETWORK FILE SYSTEM

Network File System – it is a client/server application that let a computer user view and store and update files on remote system as though they were on the user's own computer. The NFS protocol is one of the several distributed files system standards for NAS – Network Attached Storage

Clone a host and name it NFS - Server

Hostname

nfs01.zmpt.com

Install packages

```
[root@nfs01 ~]# yum install nfs-utils -y
[root@nfs01 ~]# systemctl start nfs-server
[root@nfs01 ~]# systemctl enable nfs-server
Created symlink from /etc/systemd/system/multi-user.target.wants/nfs-server.service to /usr/lib/systemd/system/nfs-server.service.
```

Create share

```
[root@nfs01 ~]# lsblk
NAME          MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
sda            8:0  0  16G  0 disk
├─sda1         8:1  0   1G  0 part /boot
└─sda2         8:2  0  15G  0 part
   ├─centos-root 253:0  0 13.4G  0 lvm /
   └─centos-swap 253:1  0  1.6G  0 lvm [SWAP]
sdb           8:16  0  16G  0 disk
sdc            8:32  0   8G  0 disk
├─zmpt1-Accounting 253:2  0   4G  0 lvm /accounting
└─zmpt1-HR      253:4  0   2G  0 lvm /hr
sdd            8:48  0   8G  0 disk
└─zmpt1-Finance 253:3  0   6G  0 lvm /finance
sde            8:64  0   8G  0 disk
└─zmpt1-Recruiting 253:5  0   4G  0 lvm
sr0            11:0  1 1024M  0 rom
```

```
[root@nfs01 ~]# pvcreate /dev/sdb
Physical volume "/dev/sdb" successfully created.

[root@nfs01 ~]# vgcreate SHARE-01 /dev/sdb
Volume group "SHARE-01" successfully created

[root@nfs01 ~]# lvcreate -n NFS_SHARE -L 15G SHARE-01
Logical volume "NFS_SHARE" created.

[root@nfs01 ~]# mkfs.xfs /dev/mapper/SHARE--01-NFS_SHARE

[root@nfs01 ~]# lsblk

sdb            8:16  0  16G  0 disk
└─SHARE--01-NFS_SHARE 253:6  0  15G  0 lvm
```

Mount to the directory

```
[root@nfs01 ~]# mount /dev/mapper/SHARE--01-NFS_SHARE /SHARED/
```

Make /etc/fstab entries

```
/dev/mapper/SHARE--01-NFS_SHARE /SHARED xfs defaults 0 0
```

Vi /etc/default/nfs-share – create file if not present

Make entry as shown

```
NEED_IDMAPD=YES
```

vi /etc/default/idmapd.conf

#type exactly as shown

```
nfs01.zmpt.com
```

Change the permissions for the shared folder

```
[root@nfs01 ~]# chmod 777 /SHARED/  
[root@nfs01 ~]# ls -ld /SHARED/  
drwxrwxrwx. 2 root root 6 Jan 24 14:26 /SHARED/
```

Enter vi /etc/exports

```
#enter the list of servers or client to grant access  
/SHARED 192.168.56.117(rw,async)  
/SHARED 192.168.56.120(rw,async)
```

Test

```
[root@nfs01 ~]# showmount -e  
Export list for nfs01.zmpt.com:  
[root@nfs01 ~]#  
[root@nfs01 ~]# exportfs -a  
[root@nfs01 ~]# exportfs -r  
  
[root@nfs01 ~]# showmount -e  
Export list for nfs01.zmpt.com:  
/SHARED 192.168.56.120,192.168.56.117
```

Open NFS port in firewall



```
[root@nfs01 ~]# firewall-cmd --permanent --add-port=2049/tcp  
success
```

```
[root@nfs01 ~]# firewall-cmd --list-ports
```

```
[root@nfs01 ~]# firewall-cmd --reload  
success
```

```
[root@nfs01 ~]# firewall-cmd --list-ports  
2049/tcp
```

```
[root@nfs01 ~]# rpcinfo -p | grep nfs  
100003 3 tcp 2049 nfs  
100003 4 tcp 2049 nfs  
100227 3 tcp 2049 nfs_acl  
100003 3 udp 2049 nfs  
100003 4 udp 2049 nfs  
100227 3 udp 2049 nfs_acl
```

NFS Server is done configuration

Enter these configuration on any other server

You can use ansible to make entires

Install the needed package

```
[root@ansiblemaster ~]# ansible all -i nfs-clients -m shell -a "yum install nfs-utils -y"
```

```
[root@ansiblemaster ~]# ansible all -i nfs-clients -m shell -a "systemctl start nfs-server"
```

```
[root@ansiblemaster ~]# ansible all -i nfs-clients -m shell -a "systemctl enable nfs-server"
```

Make the directory

```
[root@ansiblemaster ~]# ansible all -i nfs-clients -m shell -a "mkdir /NETWORK_FOLDER"
```

```
[root@ansiblemaster ~]# ansible all -i nfs-clients -m shell -a "chmod -R 777 /NETWORK_FOLDER"
```

Mount NFS

```
[root@ansiblemaster ~]# ansible all -i nfs-clients -m shell -a "mount -t nfs 192.168.56.126:/SHARED /NETWORK_FOLDER"
```

```
[root@ansiblemaster ~]# ansible all -i nfs-clients -m shell -a "df -h"
```

Make entry for /etc/fstab

```
[root@ansiblemaster ~]# ansible all -i nfs-clients -m shell -a "echo '192.168.56.126:/SHARED /NETWORK_FOLDER nfs defaults 0 0' >> /etc/fstab"
```

What is the difference between **hard** mount and **soft** mount?

The NFS mount can be a “soft mount” or a “hard mount” – mount option define the way how NFS client should handle NFS crash/failure

Soft mount: suppose you have mounted the NFS by using ‘soft mount’ when a application request a file from NFS server, NFS server Deamon will try to retrieve the data from the NFS server. If it doesn’t get any response from NFS server due to failure or crash on the NFS server. Then NFS client report an error to the process on the client machine requesting the file access.

- Advantage: fast response, it doesn’t wait for the NFS server to respond.
- Disadvantage is this method is data corruption or data loss – so this option is not Recommended

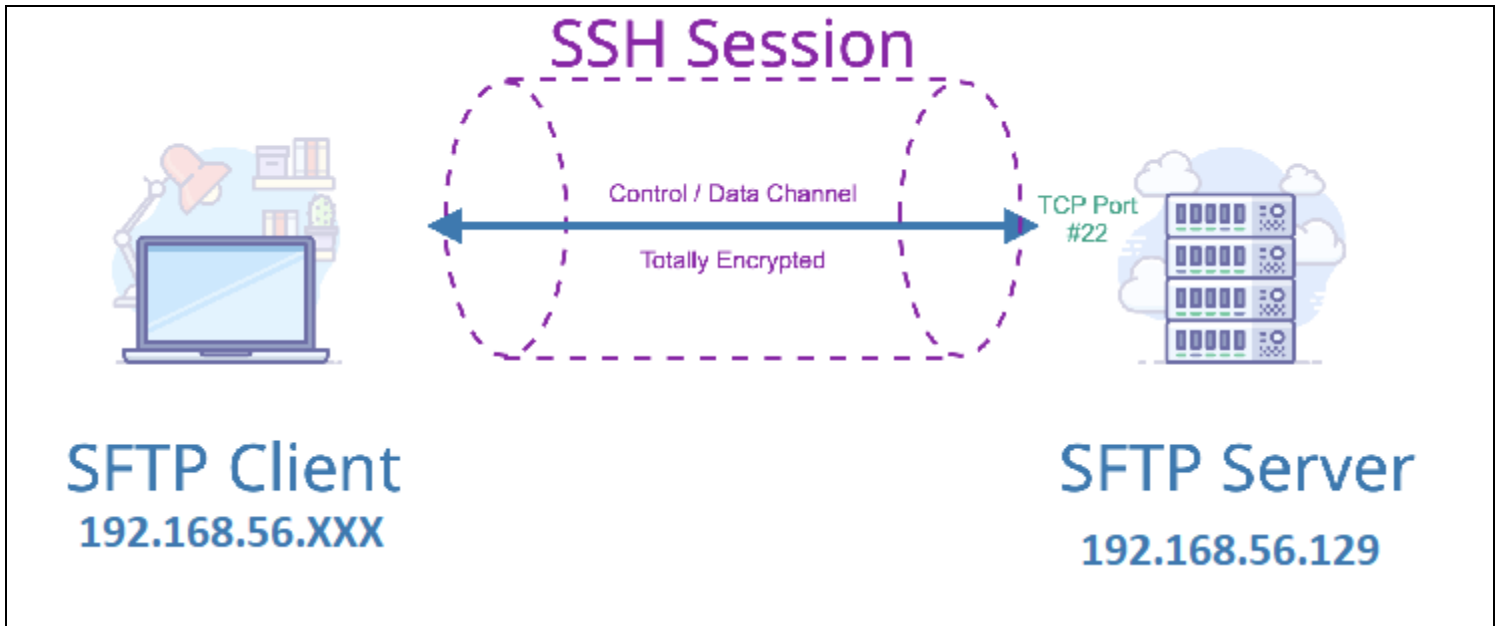
Hard Mount: if you have mounted the NFS by ‘hard mount’, during crash it will repeatedly try to connect to the NFS server. Once the server is back online the application will continue to execute undisturbed where it was during the crash. You can add mount option ‘intr’ which allows NFS request to interrupt if the server goes down or cannot be accessible.

01-30-2021
<https://youtu.be/cEL7MmeOSic>

SFTP- SSH File Transfer Protocol

- Use case for this SFTP - Application team to copy data back and forth
- Clone base image
-

Directory:
Config file:
Port #:
Package:
Services:
Protocol:
Command:
URL:



SFTP Server – 192.168.56.129

```
[root@zmpt01 ~]# yum install openssh-server -y
[root@zmpt01 ~]# systemctl start sshd
[root@zmpt01 ~]# systemctl enable sshd
```

Add user

```
[root@zmpt01 ~]# id terminator
uid=1000(terminator) gid=9000(machine) groups=9000(machine),10(wheel)
```

Done with configuration of server

Client: 192.168.56.117

```
[root@client01 ~]# which sftp
/usr/bin/sftp
```

Log in as non-root user

```
[terminator@client01 ~]$ sftp terminator@192.168.56.129
The authenticity of host '192.168.56.129 (192.168.56.129)' can't be established.
ECDSA key fingerprint is SHA256:e3LN1URGQEPwXaMbDeo+aTYev2cOOWnP3WKmaRG9gRU.
ECDSA key fingerprint is MD5:de:11:30:dd:ef:9e:ae:0a:ab:49:16:29:c9:08:36:8f.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '192.168.56.129' (ECDSA) to the list of known hosts.
terminator@192.168.56.129's password:
```



Connected to 192.168.56.129.
sftp> < --- This is a restricted CLI for user

SFTP Commands

bye	Quit sftp
cd path	Change remote directory to 'path'
chgrp grp path	Change group of file 'path' to 'grp'
chmod mode path	Change permissions of file 'path' to 'mode'
chown own path	Change owner of file 'path' to 'own'
df [-hi] [path]	Display statistics for current directory or filesystem containing 'path'
exit	Quit sftp
get [-afPpRr] remote [local]	Download file
reget [-fPpRr] remote [local]	Resume download file
reput [-fPpRr] [local] remote	Resume upload file
help	Display this help text
lcd path	Change local directory to 'path'
lls [ls-options] [path]	Display local directory listing
lmkdir path	Create local directory
ln [-s] oldpath newpath	Link remote file (-s for symlink)
lpwd	Print local working directory
ls [-1afhlnrSt] [path]	Display remote directory listing
lumask umask	Set local umask to 'umask'
mkdir path	Create remote directory
progress	Toggle display of progress meter
put [-afPpRr] local [remote]	Upload file
pwd	Display remote working directory
quit	Quit sftp
rename oldpath newpath	Rename remote file
rm path	Delete remote file
rmdir path	Remove remote directory
symlink oldpath newpath	Symlink remote file
version	Show SFTP version
!command	Execute 'command' in local shell
!	Escape to local shell
?	Synonym for help

01-30-2021

<https://youtu.be/cEL7MmeOSic>

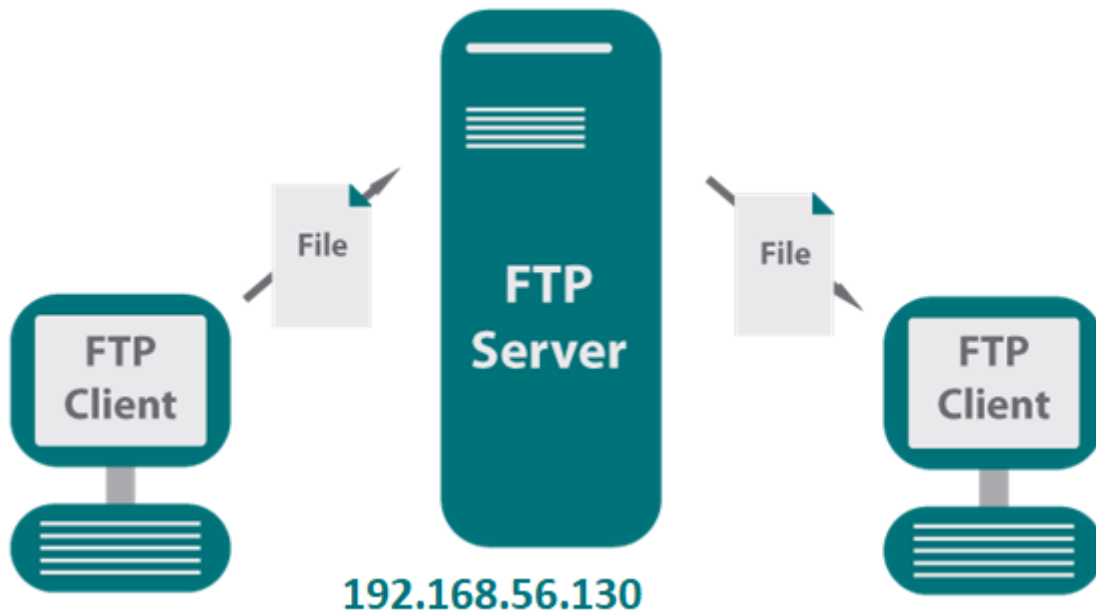


```
[root@zmp01 ~]# vi /etc/cron.allow  
rocky
```

01-30-2021
<https://youtu.be/cEL7MmeOSic>

02-13-2021
<https://youtu.be/4LTNixANuoU>

VSFTP – Very Secure File Transfer Protocol



Directory:
Config file: /etc/vsftpd/user_list, /etc/vsftpd/vsftpd.conf,
Port #: 20, 21, 30000- 31000,
Package: vsftpd, openssl
Services: vsftpd, firewalld
Protocol: tcp, udp
Command: yum, systemctl, lvm, openssl, firewall-cmd, selinux,
URL:

Rhel 8

Installed the package

```
[root@vsftp01 ~]# yum install vsftpd
```

Start vsftpd

```
[root@rhel08 ~]# systemctl start vsftpd  
[root@rhel08 ~]# systemctl enable vsftpd  
Created symlink /etc/systemd/system/multi-user.target.wants/vsftpd.service → /usr/lib/systemd/system/vsftpd.service.
```

```
[root@rhel08 ~]# systemctl status vsftpd  
● vsftpd.service - Vsftpd ftp daemon  
   Loaded: loaded (/usr/lib/systemd/system/vsftpd.se>  
   Active: active (running) since Sat 2021-02-13 14:>  
 Main PID: 25275 (vsftpd)  
   Tasks: 1 (limit: 11251)  
  Memory: 576.0K  
   CGroup: /system.slice/vsftpd.service  
           └─25275 /usr/sbin/vsftpd /etc/vsftpd/vsft>
```

```
Feb 13 14:33:07 rhel08.zmpt.com systemd[1]: Starting>  
Feb 13 14:33:07 rhel08.zmpt.com systemd[1]: Started >
```

Create the user for FTP

```
[root@rhel08 ~]# id zafar  
uid=1000(zafar) gid=1000(zafar) groups=1000(zafar)
```

Create LVM for ftp users

```
[root@rhel08 ~]# pvcreate /dev/sdb  
Physical volume "/dev/sdb" successfully created.  
[root@rhel08 ~]# vgcreate FTP_Volume /dev/sdb  
Volume group "FTP_Volume" successfully created  
[root@rhel08 ~]# lvcreate -n FTP-DATA -L 10G FTP_Volume  
Logical volume "FTP-DATA" created.  
  
[root@rhel08 ~]# mkdir /FTP-USER-DATA  
  
[root@rhel08 ~]# mkfs.xfs /dev/FTP_Volume/FTP-DATA  
  
[root@rhel08 ~]# mount /dev/FTP_Volume/FTP-DATA /FTP-USER-DATA  
  
[root@rhel08 ~]# df -h  
/dev/mapper/FTP_Volume-FTP--DATA 10G 104M 9.9G 2% /FTP-USER-DATA  
  
[root@rhel08 ~]# vi /etc/fstab
```



```
[root@rhel08 ~]# /dev/mapper/FTP_Volume-FTP--DATA /FTP-USER-DATA xfs defaults 0 0
```

Set the permissions and ownership

```
[root@rhel08 ~]# ls -ld /FTP-USER-DATA/  
drwxr-xr-x. 2 root root 6 Feb 13 14:42 /FTP-USER-DATA/  
[root@rhel08 ~]# chmod -R 750 /FTP-USER-DATA/  
[root@rhel08 ~]# ls -ld /FTP-USER-DATA/  
drwxr-x---. 2 root root 6 Feb 13 14:42 /FTP-USER-DATA/  
[root@rhel08 ~]# chown -R zafar: /FTP-USER-DATA  
[root@rhel08 ~]# ls -ld /FTP-USER-DATA  
drwxr-x---. 2 zafar zafar 6 Feb 13 14:42 /FTP-USER-DATA
```

Change FTP user default directory

```
[root@rhel08 ~]# vi /etc/passwd  
zafar:x:1000:1000:zafar:/FTP-USER-DATA:/bin/bash
```

```
[zafar@rhel08 ~]$ pwd  
/FTP-USER-DATA
```

Add user to allow list

```
[root@rhel08 ~]# vi /etc/vsftpd/user_list  
  
# vsftpd userlist  
# If userlist_deny=NO, only allow users in this file  
# If userlist_deny=YES (default), never allow users in this file, and  
# do not even prompt for a password.  
# Note that the default vsftpd pam config also checks /etc/vsftpd/ftpusers  
# for users that are denied.  
root  
bin  
daemon  
adm  
lp  
sync  
shutdown  
halt  
mail  
news  
uucp  
operator  
games  
nobody  
zafar
```

Create the .pem key – encryption keys

```
[root@rhel08 ~]# openssl req -x509 -nodes -days 99999 -newkey rsa:2048 -keyout /etc/vsftpd.pem -out /etc/vsftpd/vsftpd.pem
```

Generating a RSA private key

.....+++++

.....+++++

writing new private key to '/etc/vsftpd.pem'

You are about to be asked to enter information that will be incorporated into your certificate request.

What you are about to enter is what is called a Distinguished Name or a DN.

There are quite a few fields but you can leave some blank

For some fields there will be a default value,

If you enter '.', the field will be left blank.

Country Name (2 letter code) [XX]:**US**

State or Province Name (full name) []:**IL**

Locality Name (eg, city) [Default City]:**SKOKIE**

Organization Name (eg, company) [Default Company Ltd]:**ZMPT**

Organizational Unit Name (eg, section) []:**IT**

Common Name (eg, your name or your server's hostname) []:**FTP-SERVER**

Email Address []:linux@zmprotech.com

Open firewall for the ports

Port 20 – to allow FTP traffic

Port 21 – to allow DATA transfer

Port 30000 – 31000 – vairable port that is used randomly each time

```
[root@rhel08 ~]# firewall-cmd --permanent --add-port=20-21/tcp
```

success

```
[root@rhel08 ~]# firewall-cmd --permanent --add-port=30000-31000/tcp
```

success

```
[root@rhel08 ~]# firewall-cmd --reload
```

success

```
[root@rhel08 ~]# firewall-cmd --list-port
```

20-21/tcp 30000-31000/tcp

Enable through SELinux

```
[root@FTP-SERVER ~]# setsebool -P allow_ftpd_full_access on
```

Configure VSFTPD config file – add or edit as needed

```
anonymous_enable=NO  
local_enable=YES
```

```
write_enable=YES
```

```
chroot_local_user=YES
```

```
listen_ipv6=YES
```

```
pam_service_name=vsftpd  
userlist_enable=YES  
userlist_file=/etc/vsftpd/user_list  
userlist_deny=NO
```

```
allow_writeable_chroot=YES
```

```
pasv_min_port=30000  
pasv_max_port=31000
```

```
rsa_cert_file=/etc/vsftpd/vsftpd.pem  
rsa_private_key_file=/etc/vsftpd.pem  
ssl_enable=YES
```

```
[root@rhel08 ~]# systemctl status vsftpd  
● vsftpd.service - Vsftpd ftp daemon  
   Loaded: loaded (/usr/lib/systemd/system/vsftpd.service; enabled; vendor >  
   Active: active (running) since Sat 2021-02-13 15:26:39 EST; 13s ago  
   Process: 32347 ExecStart=/usr/sbin/vsftpd /etc/vsftpd/vsftpd.conf (code=e>  
   Main PID: 32348 (vsftpd)  
     Tasks: 1 (limit: 11251)  
    Memory: 780.0K  
   CGroup: /system.slice/vsftpd.service  
           └─32348 /usr/sbin/vsftpd /etc/vsftpd/vsftpd.conf
```

```
Feb 13 15:26:39 rhel08.zmpt.com systemd[1]: Starting Vsftpd ftp daemon...  
Feb 13 15:26:39 rhel08.zmpt.com systemd[1]: Started Vsftpd ftp daemon.
```

Connect using File-Zilla





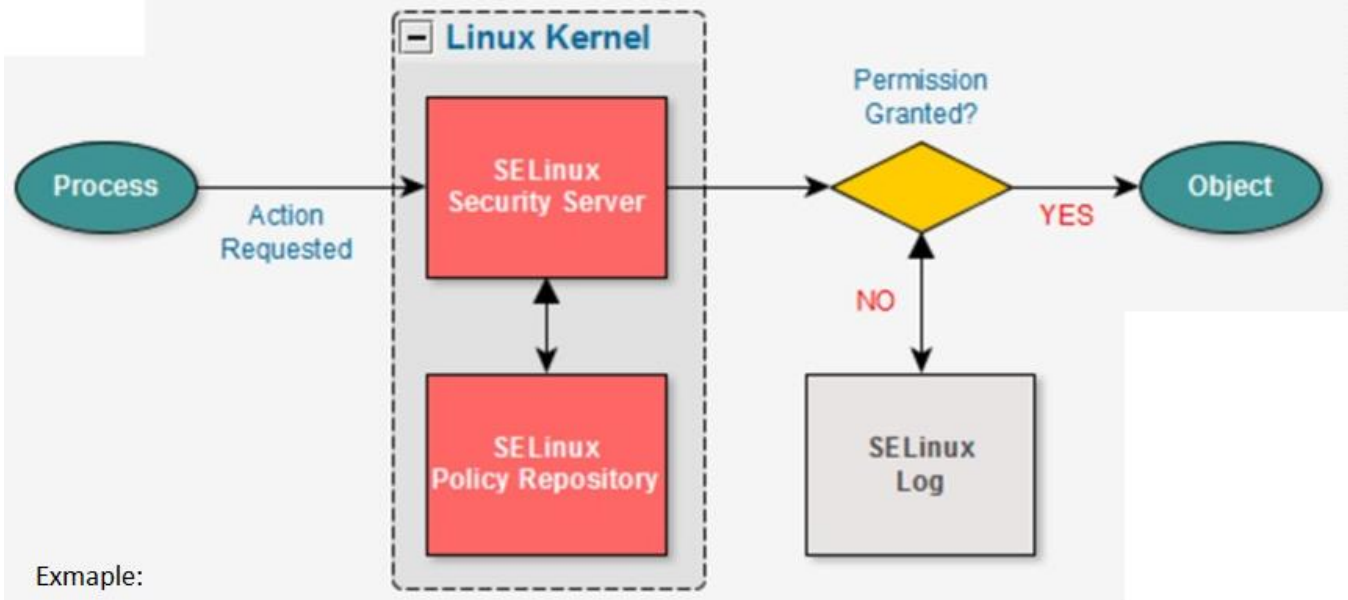
The screenshot shows the FileZilla interface. The local site is 'C:\Users\Newname01\Documents' and the remote site is an FTP server. The local site contains files like 'New Microsoft Access Database.accdb', 'New Microsoft Excel Worksheet (2).xlsx', 'New Microsoft Word Document.docx', 'desktop.ini', 'Default.rdp', and 'New Microsoft Excel Worksheet.xlsx'. The remote site contains files like 'New Microsoft Access Database.accdb', 'New Microsoft Excel Worksheet (2).xlsx', 'New Microsoft Excel Worksheet.xlsx', and 'New Microsoft Word Document.docx'. The transfer status shows 3 files selected for upload, totaling 501,782 bytes.

```
[root@FTP-SERVER FTP-USER-DATA]# pwd
/FTP-USER-DATA
[root@FTP-SERVER FTP-USER-DATA]# ls
'New Microsoft Access Database.accdb'
'New Microsoft Excel Worksheet (2).xlsx'
'New Microsoft Excel Worksheet.xlsx'
'New Microsoft Word Document.docx'
```

02-06-2021
<https://youtu.be/-HK1KLbisNY>

SELinux

Directory: /etc/sysconfig/selinux;
Config file: vi /etc/sysconfig/selinux;
Port #: 22; 2222
Package: polycoreutils-python;
Services: sshd
Protocol: tcp
Command: semanage, getenforce, setenforce, sestatus
URL:



Exmample:

- | | | |
|--------------------|----------------------------|---|
| ssh uses port 22 | SELinux quietly check this | if this is normal, then access is allowed |
| ssh uses port 2222 | SELinux quietly check this | this is not normal, access denied |

Unusual activity is blocked by SELinux

What exactly **SELinux** does? – it protects the system from *unusual activity*.

For example, SSH works on port 22, but if SSH tries to use any other port it will be blocked, even after allowing through firewall.

If a person has access to building going through front door using the badge – this is normal activity for this person.

If the same person tries enter building from the side door using same badge, he will be denied access.

Mandatory Access Control

- An additional security layer over discretionary access control limiting who can do to what

Discretionary access control

- Traditional
 - o File permissions
 - o Access control List
 - o setuid
 - o setguid
 - o su/sudo previlages
- if you own the file or folder – you get to determine who get the access to it.

- This is known a discretionary

Subject

- A user or process that accesses an object

Object

- A resource such as a file, directory, device, ports etc.,

Access

- An action performed by a subject on an object, example read write or create

Security policy

- System-wide policy of rules defining which subject can access which object
- Two policies in Enterprise Linux – Targeted and Strict – targeted is default

Security context

- Tag used by SELinux to store security attributes of subject and objects

SELinux modes

Enforcing mode

- Security policy is enforced
- That means SELinux security is active

```
[root@zmpt01 ~]# getenforce
Enforcing
```

Permissive mode

- Security policy is observed and warning will be displayed, but policy is not enforced

```
[root@zmpt01 ~]# setenforce 0
[root@zmpt01 ~]# getenforce
Permissive
```

If the system reboots the enforcing will turn on

```
[root@zmpt01 ~]# sestatus
SELinux status:      enabled
SELinuxfs mount:    /sys/fs/selinux
SELinux root directory: /etc/selinux
Loaded policy name:  targeted
Current mode:        permissive
Mode from config file: enforcing
Policy MLS status:   enabled
```

```
Policy deny_unknown status: allowed  
Max kernel policy version: 31
```

```
[root@zmpt01 sysconfig]# init 6  
[root@zmpt01 sysconfig]# vi selinux  
[root@zmpt01 sysconfig]# getenforce  
Permissive
```

Disable SELinux

```
[root@zmpt01 ~]# vi /etc/sysconfig/selinux
```

```
# This file controls the state of SELinux on the system.  
# SELINUX= can take one of these three values:  
# enforcing - SELinux security policy is enforced.  
# permissive - SELinux prints warnings instead of enforcing.  
# disabled - No SELinux policy is loaded.  
#SELINUX=enforcing  
SELINUX=disabled  
# SELINUXTYPE= can take one of three values:  
# targeted - Targeted processes are protected,  
# minimum - Modification of targeted policy. Only selected processes are protected.  
# mls - Multi Level Security protection.  
SELINUXTYPE=targeted
```

```
[root@zmpt01 ~]# init 6
```

```
[root@zmpt01 ~]# getenforce  
Disabled
```

Note: Never set SELinux disabled

Least change the SSH Port to use port number 2222

Note: number of ports in OS – $2^{16} = 2 \times 2 \times \dots \times 16 = 65,536$

Ports are nothing but door of the operating system

Normal SSH port – 22

Change SSH port – 2222

Install semanage package

```
[root@zmpt01 ~]# yum install policycoreutils-python
```

Grep for port 22

```
[root@zmpt01 ~]# semanage port -l | grep 22  
ssh_port_t          tcp    22
```

Check the status of port 22

```
[root@zmpt01 ~]# grep SSH /etc/services  
ssh      22/tcp      # The Secure Shell (SSH) Protocol  
ssh      22/udp      # The Secure Shell (SSH) Protocol  
ssh      22/sctp     # SSH
```

Change the port 2222

```
[root@zmpt01 ~]# vi /etc/ssh/sshd_config
```

```
Port=2222
```

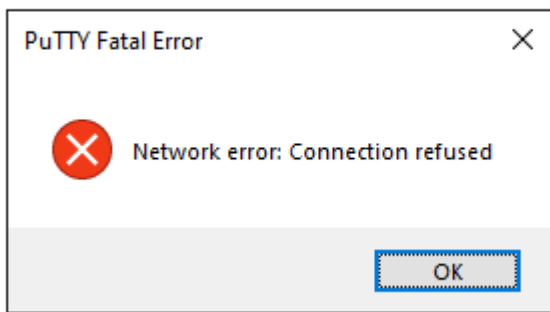
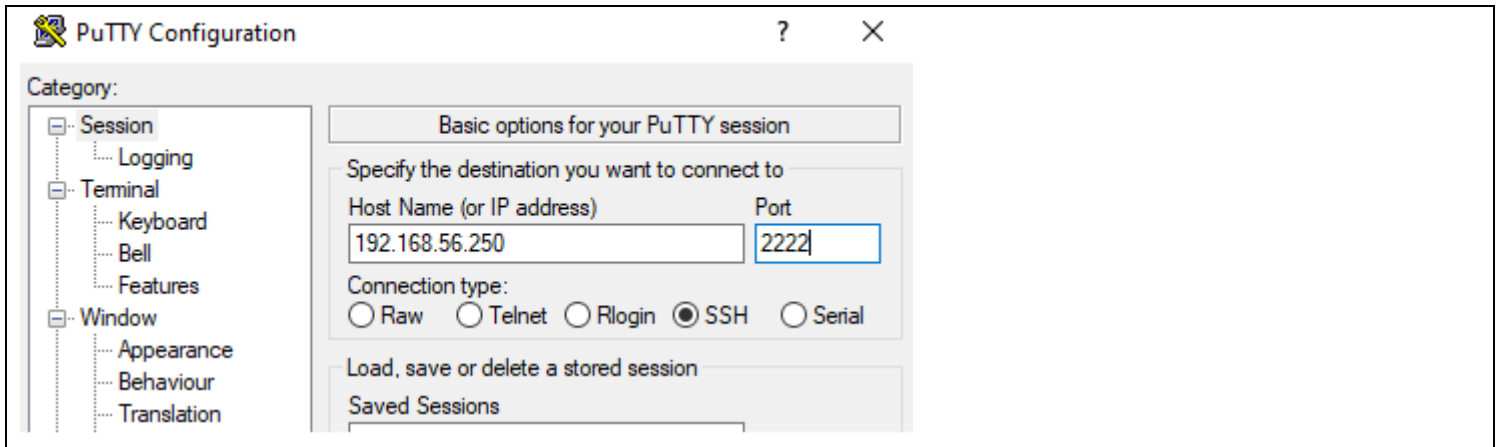
```
[root@zmpt01 ~]# firewall-cmd --permanent --zone=public --add-port=2222/tcp  
success
```

```
[root@zmpt01 ~]# firewall-cmd --reload  
success
```

```
[root@zmpt01 ~]# firewall-cmd --list-port  
2222/tcp
```

```
[root@zmpt01 ~]# systemctl restart sshd
```

Job for sshd.service failed because the control process exited with error code. See "systemctl status sshd.service" and "[journalctl -xe](#)" for details.



Connection is still denied, even though the port 2222 is open through firewall

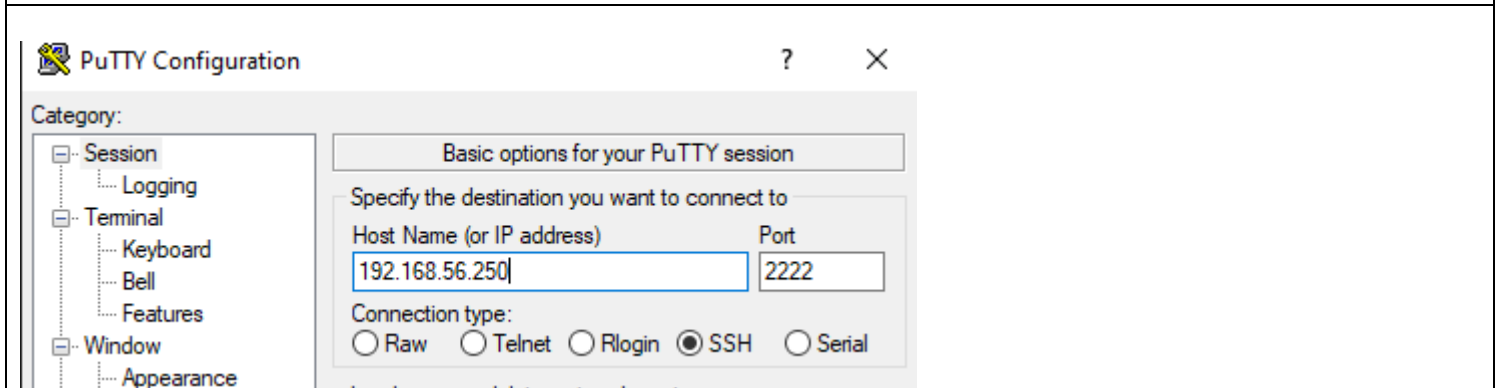
Also regular port 22 will not work either after we perform semanage update through SELinux

Now allow through the SELinux

```
[root@zmpt01 ~]# semanage port -l | grep -i 22  
ssh_port_t      tcp    22
```

```
[root@zmpt01 ~]# semanage port -a -t ssh_port_t -p tcp 2222    #< --- adding port 2222 to SELinux
```

```
ssh_port_t      tcp    2222, 22
```





root@zmpt01:~

```
login as: root
root@192.168.56.250's password:
Last login: Sat Feb  6 14:03:58 2021 from 192.168.56.128
[root@zmpt01 ~]#
```

Login successful

Note: port 22 is disabled, only port 2222 will work

To make port 22 work again, add to /etc/ssh/sshd_config

```
port=2222
```

```
port=22
```

Set it back to original setting

```
[root@zmpt01 ~]# semanage port -d -t ssh_port_t -p tcp 2222
```

Port 2222 is removed

```
[root@zmpt01 ~]# semanage port -l | grep 22
```

```
ssh_port_t          tcp    22
```

```
[root@zmpt01 ~]# vi /etc/ssh/sshd_config
```

```
#Port 22
```

```
[root@zmpt01 ~]# systemctl restart sshd
```

No errors

```
[root@zmpt01 ~]# systemctl status sshd
```

● sshd.service - OpenSSH server daemon

Loaded: loaded (/usr/lib/systemd/system/sshd.service; enabled; vendor preset: enabled)

Active: active (running) since Sat 2021-02-06 15:26:01 EST; 36s ago

Docs: man:sshd(8)

man:sshd_config(5)

Main PID: 2152 (sshd)

CGroup: /system.slice/sshd.service

└─2152 /usr/sbin/sshd -D

Feb 06 15:26:01 zmpt01.prod.zmprotech.com systemd[1]: Stopped OpenSSH server daemon.
Feb 06 15:26:01 zmpt01.prod.zmprotech.com systemd[1]: Starting OpenSSH server daemon...
Feb 06 15:26:01 zmpt01.prod.zmprotech.com sshd[2152]: Server listening on 0.0.0.0 port 22.
Feb 06 15:26:01 zmpt01.prod.zmprotech.com sshd[2152]: Server listening on :: port 22.
Feb 06 15:26:01 zmpt01.prod.zmprotech.com systemd[1]: Started OpenSSH server daemon.

02-06-2021

<https://youtu.be/-HK1KLbisNY>

<https://youtu.be/4LTNixANuoU>

PXE-Server

What is a PXE server? A Preboot eXecution Environment, pronounce pixie. PXE is one of the components of the server installation, which allows a server to boot from a PXE server on a network prior to booting from OS on the local hard drive. This is used for mass installation of the servers without the need for DVD or USB.

Directory: /etc/sysconfig/network-scripts, /etc/xinetd.d/tftp, /usr/share/syslinux/pxelinux.0, /var/lib/tftpboot, /var/lib/tftpboot/pxelinux.cfg, networkboot, /mnt/images/pxeboot/

Config file: /etc/sysconfig/network-scripts/ifcfg-enp0s3, /etc/hostname, /etc/dhcp/dhcpd.conf, etc/xinetd.d/tftp, CentOS-7-x86_64-DVD-1908.iso, andaconda.cfg, centos7.cfg, /var/lib/tftpboot/pxelinux.cfg

Port #:

Package: dhcp tftp tftp-server syslinux vsftpd xinetd

Services: xinetd, dhcpd, vsftpd, tftp, firewallld

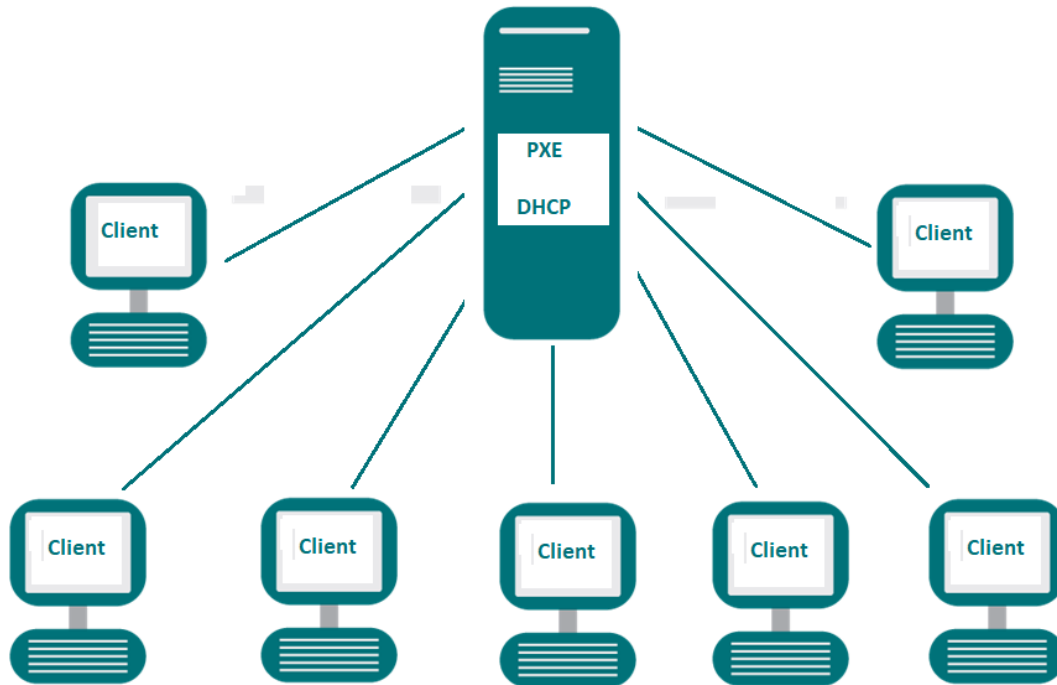
Protocol:

Command:

URL:



PXE - DHCP - TFTP 192.168.56.133



Configure PXE [network boot] installation server

Server ip = 192.168.56.133
Hostname = pxe01.zmpt.com

Set static ip and hostname

```
[root@pxe01 ~]# vi /etc/sysconfig/network-scripts/ifcfg-enp0s3
```

```
TYPE=Ethernet  
DEVICE=enp0s3  
NAME=enp0s3  
ONBOOT=yes  
BOOTPROTO=static  
IPADDR=192.168.56.133  
NETMASK=255.255.255.0  
HWADDR=08:00:27:27:7f:f7
```

```
[root@zmpt01 ~]# vi /etc/hostname  
pxe01.zmpt.com
```

Install the required packages

```
[root@pxe01 ~]# yum install -y dhcp tftp tftp-server syslinux vsftpd xinetd
```

Configure DHCP server – Dynamic host control Protocol

The Dynamic Host Configuration Protocol (DHCP) is a network management protocol used on Internet Protocol (IP) networks, whereby a DHCP server dynamically assigns an IP address

Configure the DHCP configuration file – copy and paste – edit as needed

```
[root@pxe01 ~]# vi /etc/dhcp/dhcpd.conf #< ---delete content and start from scratch
```

```
ddns-update-style interim;  
ignore client-updates;  
authoritative;  
allow booting;  
allow bootp;  
allow unknown-clients;
```

```
subnet 192.168.56.0 netmask 255.255.255.0 {  
  range 192.168.56.171 192.168.56.200;  
  option domain-name-servers 192.168.56.133;  
  option domain-name "pxeboot.zmpt.com";  
  option routers 192.168.56.133;  
  option broadcast-address 192.168.56.255;  
  default-lease-time 600;  
  max-lease-time 7200;
```

```
# IP of PXE Server  
next-server 192.168.56.133;  
filename "pxelinux.0";  
}
```

Config TFTP server file – Trivial File Transfer Protocol

No edit required

```
[root@pxe01 ~]# vi /etc/xinetd.d/tftp
```

```
{  
  socket_type      = dgram  
  protocol         = udp  
  wait            = yes  
  user            = root  
  server          = /usr/sbin/in.tftpd  
  server_args     = -s /var/lib/tftpboot          #< --- Network boot related file goes here  
  disable        = yes
```

```
per_source      = 11
cps             = 100 2
flags          = IPv4
}
```

Copy network boot related files to /var/lib/tftpboot – 5 files

```
[root@pxe01 tftpboot]# cp -v /usr/share/syslinux/pxelinux.0 /var/lib/tftpboot/
[root@pxe01 tftpboot]# cp -v /usr/share/syslinux/menu.c32 /var/lib/tftpboot/
[root@pxe01 tftpboot]# cp -v /usr/share/syslinux/memdisk /var/lib/tftpboot/
[root@pxe01 tftpboot]# cp -v /usr/share/syslinux/mboot.c32 /var/lib/tftpboot/
[root@pxe01 tftpboot]# cp -v /usr/share/syslinux/chain.c32 /var/lib/tftpboot/
```

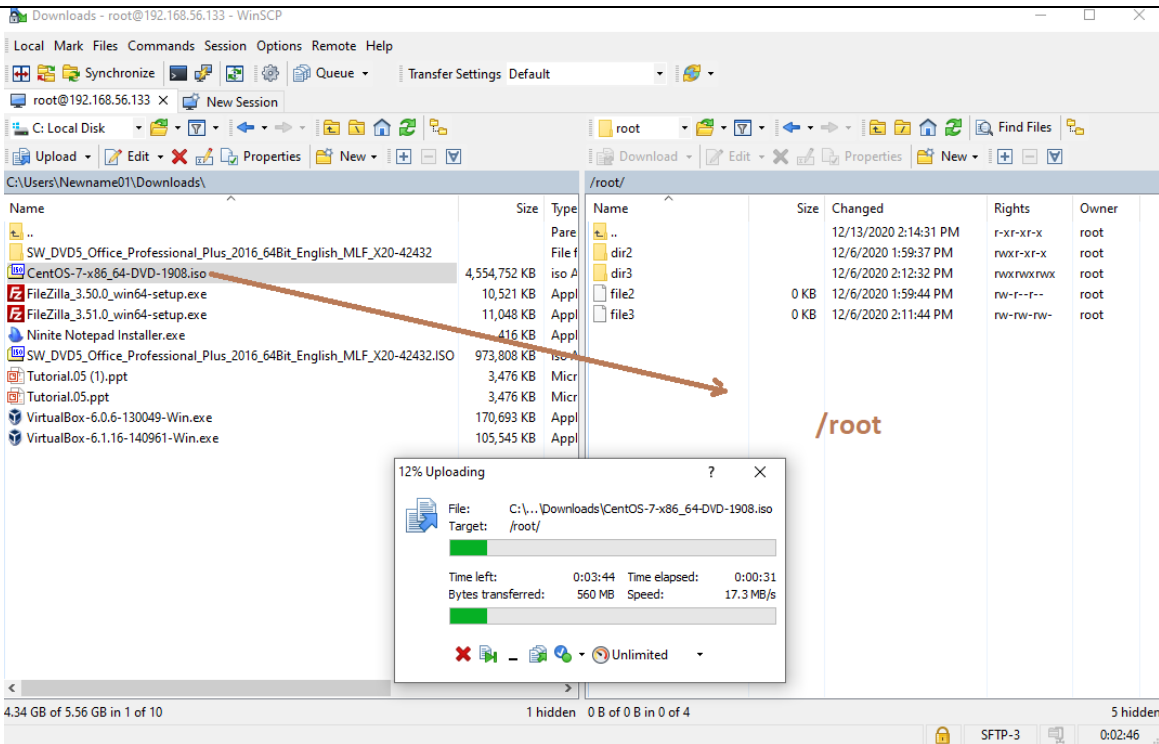
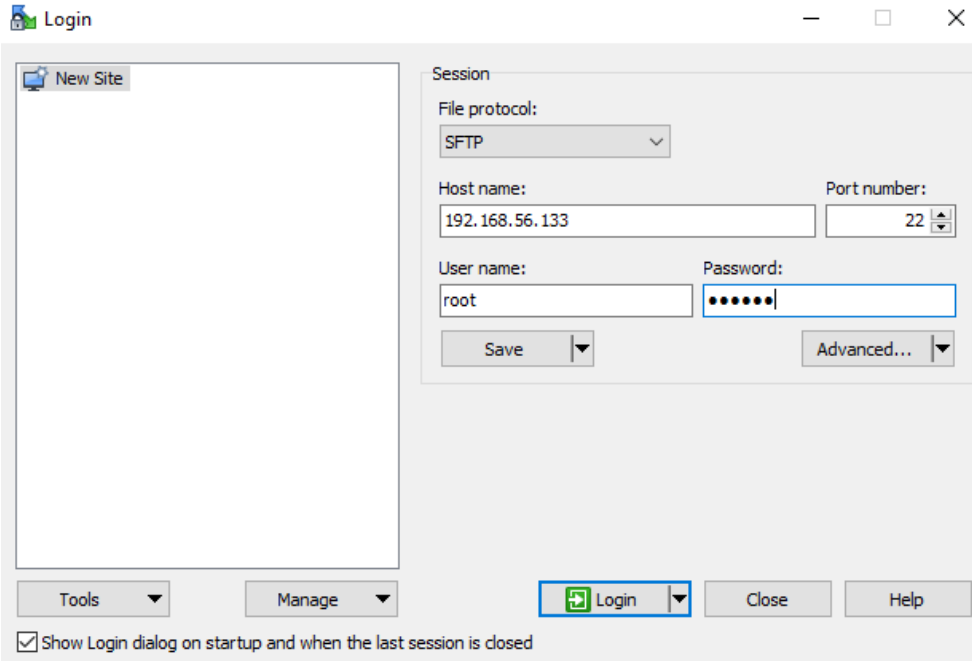
```
[root@pxe01 tftpboot]# pwd
/var/lib/tftpboot
[root@pxe01 tftpboot]# ls
chain.c32 mboot.c32 memdisk menu.c32 pxelinux.0
```

Make a directory in tftpboot folder

```
[root@pxe01 tftpboot]# pwd
/var/lib/tftpboot
[root@pxe01 tftpboot]# mkdir pxelinux.cfg
[root@pxe01 tftpboot]# mkdir networkboot
```

```
[root@pxe01 tftpboot]# ls -l
total 172
-rw-r--r--. 1 root root 20832 Feb  6 16:20 chain.c32
-rw-r--r--. 1 root root 33628 Feb  6 16:20 mboot.c32
-rw-r--r--. 1 root root 26140 Feb  6 16:19 memdisk
-rw-r--r--. 1 root root 55140 Feb  6 16:19 menu.c32
drwxr-xr-x. 2 root root   6 Feb  6 16:23 networkboot
-rw-r--r--. 1 root root 26759 Feb  6 16:19 pxelinux.0
drwxr-xr-x. 2 root root   6 Feb  6 16:23 pxelinux.cfg
```

Copy the iso file to the server



```
[root@pxe01 ~]# ls -ltrh
total 4.4G
-rw-r--r--. 1 root root 4.4G Dec 27 2019 CentOS-7-x86_64-DVD-1908.iso
drwxr-xr-x. 2 root root 6 Dec 6 14:59 dir2
-rw-r--r--. 1 root root 0 Dec 6 14:59 file2
-rw-rw-rw-. 1 root root 0 Dec 6 15:11 file3
```



```
drwxrwxrwx. 2 root root 6 Dec 6 15:12 dir3
```

```
[root@pxe01 ~]# mount -o loop CentOS-7-x86_64-DVD-1908.iso /mnt
mount: /dev/loop0 is write-protected, mounting read-only
```

```
[root@pxe01 ~]# df -h
Filesystem      Size  Used Avail Use% Mounted on
devtmpfs        484M  0 484M  0% /dev
tmpfs           496M  0 496M  0% /dev/shm
tmpfs           496M  6.9M 489M  2% /run
tmpfs           496M  0 496M  0% /sys/fs/cgroup
/dev/mapper/centos-root 14G  6.1G 7.4G 46% /
/dev/loop0      4.4G  4.4G  0 100% /mnt
/dev/sda1       1014M 136M 879M 14% /boot
tmpfs           100M  0 100M  0% /run/user/0
```

Now copy to /var/ftp/pub – directory

```
[root@pxe01 mnt]# pwd
/mnt

[root@pxe01 mnt]# cp -av * /var/ftp/pub
```

Copy Kernel Files

```
[root@pxe01 mnt]# cd /mnt/images/pxeboot/
[root@pxe01 pxeboot]# ls -l
total 60360
-rw-r--r--. 2 root root 55073584 Sep 6 2019 initrd.img
-r--r--r--. 1 root root 441 Sep 11 2019 TRANS.TBL
-rwxr-xr-x. 2 root root 6734016 Aug 7 2019 vmlinuz
```

```
[root@pxe01 pxeboot]# cp initrd.img /var/lib/tftpboot/networkboot/
[root@pxe01 pxeboot]# cp vmlinuz /var/lib/tftpboot/networkboot/
```

Unmount the cd

```
[root@pxe01 ~]# umount /mnt
```

Set the encryption - SSL (Secure Sockets Layer) – save the generated encryption key

```
[root@pxe01 ~]# openssl passwd -1 redhat
$1$qvYA3uE2$jFmQN3bDPC13U41b8OegF/
```



Copy anaconda-ks.cfg from the /root folder, if not available , copy from another computer or online

```
[root@pxe01 ~]# cp anaconda-ks.cfg /var/ftp/pub/
```

Rename anacomda-ks.cfg to centos7.cfg

```
[root@pxe01 pub]# mv anaconda-ks.cfg centos7.cfg
```

Modify the fiels as shown

```
[root@pxe01 pub]# vi centos7.cfg
```

```
#platform=x86, AMD64, or Intel EM64T
#version=DEVEL

#Firewall configuration
firewall --disabled
#Install OS
install
#Use FTP Installation Media
url --url="ftp://192.168.56.133/pub"
#Root password
rootpw --iscrypted $1$qvYA3uE2$jFmQN3bDPC13U41b8OegF/

# System authorization information
auth --enablshadow --passalgo=sha512

# Use graphical install
graphical
# Run the Setup Agent on first boot
firstboot disable

# Keyboard layouts
keyboard us

# System language
lang en_US

#SELinux configuration
selinux disabled

#Installation logging level
logging level=info
```

```
# System timezone
timezone America/New_York --isUtc

# System bootloader configuration
bootloader --location=mbr

# Partition clearing information
clearpart --all --initlabel

part swap --asprimary --fstype="swap" ---size-1024
part /boot --fstype xfs --size=1024
part pv.01 --size=1 --grow

volgroup zmpt01 pv.01
logvol / --fstype xfs --name=lv_01 --vgname=zmpt01 --size=1 --grow

%packages
@^minimal
@core

%end

%addon com_redhat_kdump --enable --reserve-mb='auto'

%end
```

Change the centos7.cfg to allow file execution

```
[root@pxe01 pub]# ls -l centos7.cfg
-rw-----. 1 root root 1006 Feb  7 14:31 centos7.cfg
[root@pxe01 pub]# chmod 755 centos7.cfg
```

Config file explanation – centos7.cfg

```
#platform=x86, AMD64, or Intel EM64T #< ---Architecture of processor
#version=DEVEL

#Firewall configuration #< ---Disable the firewall
firewall --disabled

#Install OS #< --- OS Install
Install

#Use FTP Installation Media #< ----FTP server folder location
url --url="ftp://192.168.56.133/pub"
```




```
# System authorization information
auth --enablshadow --passalgo=sha512

#Root password
rootpw --iscrypted $1$qvYA3uE2$jFmQN3bDPC13U41b8OegF/

# Use graphical install
graphical
# Run the Setup Agent on first boot
firstboot disable

# Keyboard layouts
keyboard us

# System language
lang en_US

#SELinux configuration
selinux disabled

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logging level=info

# System timezone
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# System bootloader configuration
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part /boot --fstype xfs --size=1024
part pv.01 --size=1 --grow

volgroup zmpt01 pv.01
logvol / --fstype xfs --name=lv_01 --vgname=zmpt01 --size=1 --grow

%packages
@^minimal
@core

%end

%addon com_redhat_kdump --enable --reserve-mb='auto'
```



```
%end
```

PXE boot Menu – Create 'default' file

```
[root@pxe01 pxelinux.cfg]# pwd  
/var/lib/tftpboot/pxelinux.cfg
```

```
[root@pxe01 pxelinux.cfg]# vi default
```

```
default menu.c32  
prompt 0  
timeout 30  
MENU Title zmprotech PXE installation  
LABEL centos7_x64 bits  
MENU LABEL Centos7_64  
KERNEL /networkboot/vmlinuz  
APPEND initrd=/networkboot/initrd.img inst.repo=ftp://192.168.56.133/pub  
ks=ftp://192.168.56.133/pub/cento7.cfg
```

Start all the required services

```
[root@pxe01 pxelinux.cfg]# systemctl start xinetd  
[root@pxe01 pxelinux.cfg]# systemctl enable xinetd
```

```
[root@pxe01 pxelinux.cfg]# systemctl start dhcpd  
Job for dhcpd.service failed because the control process exited with error code. See "systemctl status dhcpd.service" and "journalctl -xe" for details.
```

```
[root@pxe01 pxelinux.cfg]# systemctl enable dhcpd  
Created symlink from /etc/systemd/system/multi-user.target.wants/dhcpd.service to  
/usr/lib/systemd/system/dhcpd.service.
```

```
[root@pxe01 pxelinux.cfg]# systemctl start vsftpd  
[root@pxe01 pxelinux.cfg]# systemctl enable vsftpd  
Created symlink from /etc/systemd/system/multi-user.target.wants/vsftpd.service to  
/usr/lib/systemd/system/vsftpd.service.
```

```
[root@pxe01 pxelinux.cfg]# systemctl start tftp  
[root@pxe01 pxelinux.cfg]# systemctl enable tftp  
Created symlink from /etc/systemd/system/sockets.target.wants/tftp.socket to /usr/lib/systemd/system/tftp.socket.  
[root@pxe01 pxelinux.cfg]#
```

SELinux exception – allow through SELinux

```
[root@pxe01 ~]# setsebool -P allow_ftpd_full_access 1
```

Open ports in firewall

```
[root@pxe01 ~]# firewall-cmd --add-service=ftp --permanent  
success  
[root@pxe01 ~]# firewall-cmd --add-service=dhcp --permanent  
success  
[root@pxe01 ~]# firewall-cmd --add-port=69/tcp --permanent  
success  
[root@pxe01 ~]# firewall-cmd --add-port=69/udp --permanent  
success  
[root@pxe01 ~]# firewall-cmd --add-port=4011/udp --permanent  
success  
[root@pxe01 ~]# firewall-cmd --reload  
Success
```


Now configure new VM and set to boot from network

← Create Virtual Machine

Name and operating system

Name:

Machine Folder:

Type: 

Version:

Memory size

2048 MB

4 MB 16384 MB

Hard disk

Do not add a virtual hard disk

Create a virtual hard disk now

Use an existing virtual hard disk file



← Create Virtual Hard Disk

File location
RHEL-NETWORK-INSTALLATION-01

File size
4.00 MB 24.00 GB 2.00 TB

Hard disk file type
 VDI (VirtualBox Disk Image)
 VHD (Virtual Hard Disk)
 VMDK (Virtual Machine Disk)
 HDD (Parallels Hard Disk)
 QCOW (QEMU Copy-On-Write)
 QED (QEMU enhanced disk)

Storage on physical hard disk
 Dynamically allocated
 Fixed size
 Split into files of less than 2GB

Guided Mode Create Cancel

RHEL-NETWORK-INSTALLATION-01 - Settings

General System Display Storage Audio Network Serial Ports USB Shared Folders User Interface

Network

Adapter 1 Adapter 2 Adapter 3 Adapter 4

Enable Network Adapter

Attached to: Host-only Adapter

Name: VirtualBox Host-Only Ethernet Adapter

Advanced

Adapter Type: Intel PRO/1000 MT Desktop (82540EM)

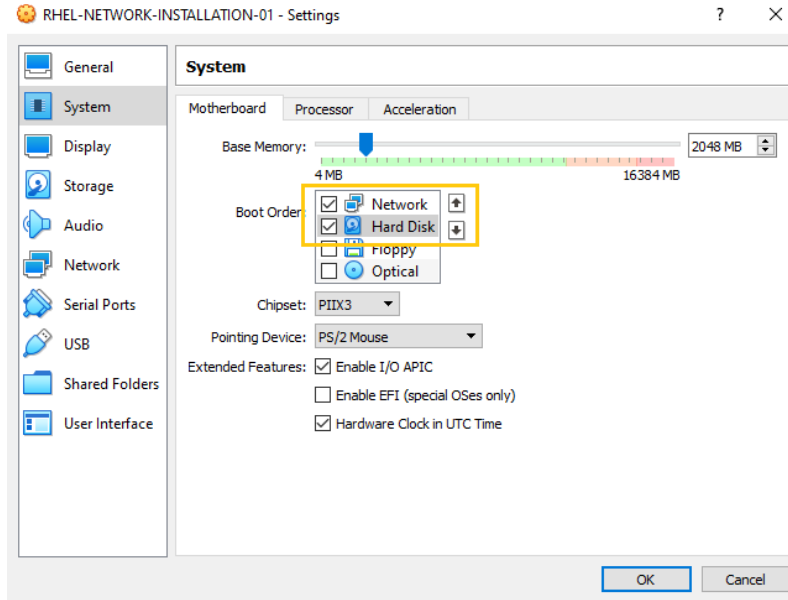
Promiscuous Mode: Deny

MAC Address: 080027D73CFB

Cable Connected

Port Forwarding

OK Cancel



Clone the VM

← Clone Virtual Machine

New machine name and path

Please choose a name and optionally a folder for the new virtual machine. The new machine will be a clone of the machine **RHEL-NETWORK-INSTALLATION-01**.

Name:

Path:

MAC Address Policy:

Additional Options: Keep Disk Names

Keep Hardware UUIDs

Expert Mode

Next

Cancel

