
Linux



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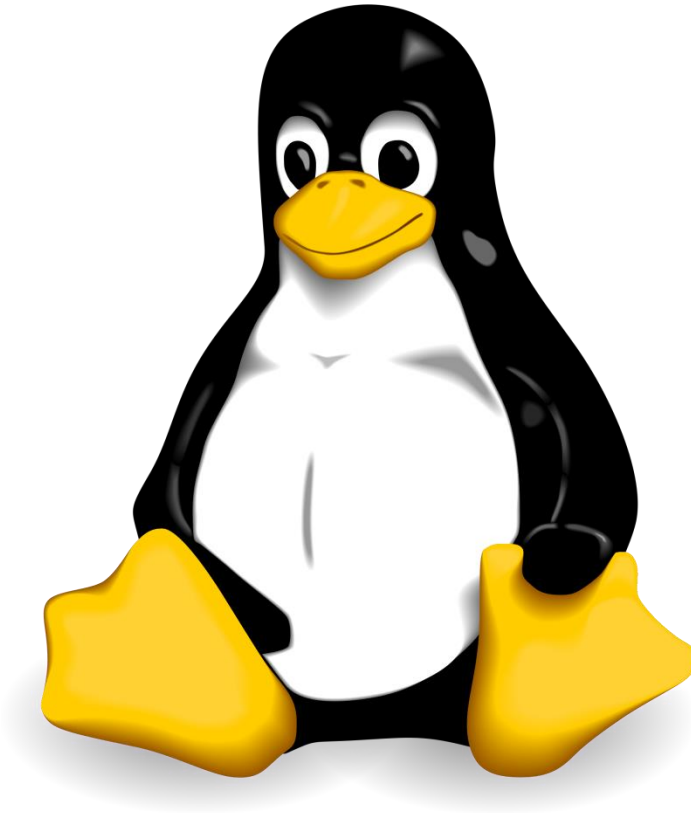
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Module 1: History of Linux

- ▶ Linus Torvalds developed Linux kernel in 1991.
- ▶ The motive behind developing Linux was to release free academic version of Unix.
- ▶ Linux was released under GPL (General Public License)

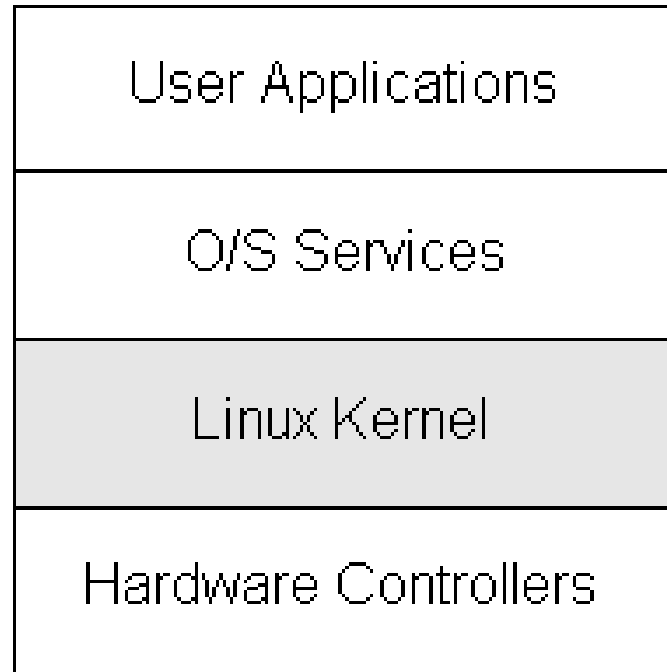


Linux logo



TUX (Torvalds Unix)

Linux Architecture



Linux Architecture

▶ **Hardware Controllers**

Hardware controllers comprises all physical devices like CPU, hard disk, RAM, network hardware etc.

▶ **Linux Kernel**

Linux Kernel mediates access to the hardware resources. Kernel is a heart of every OS.

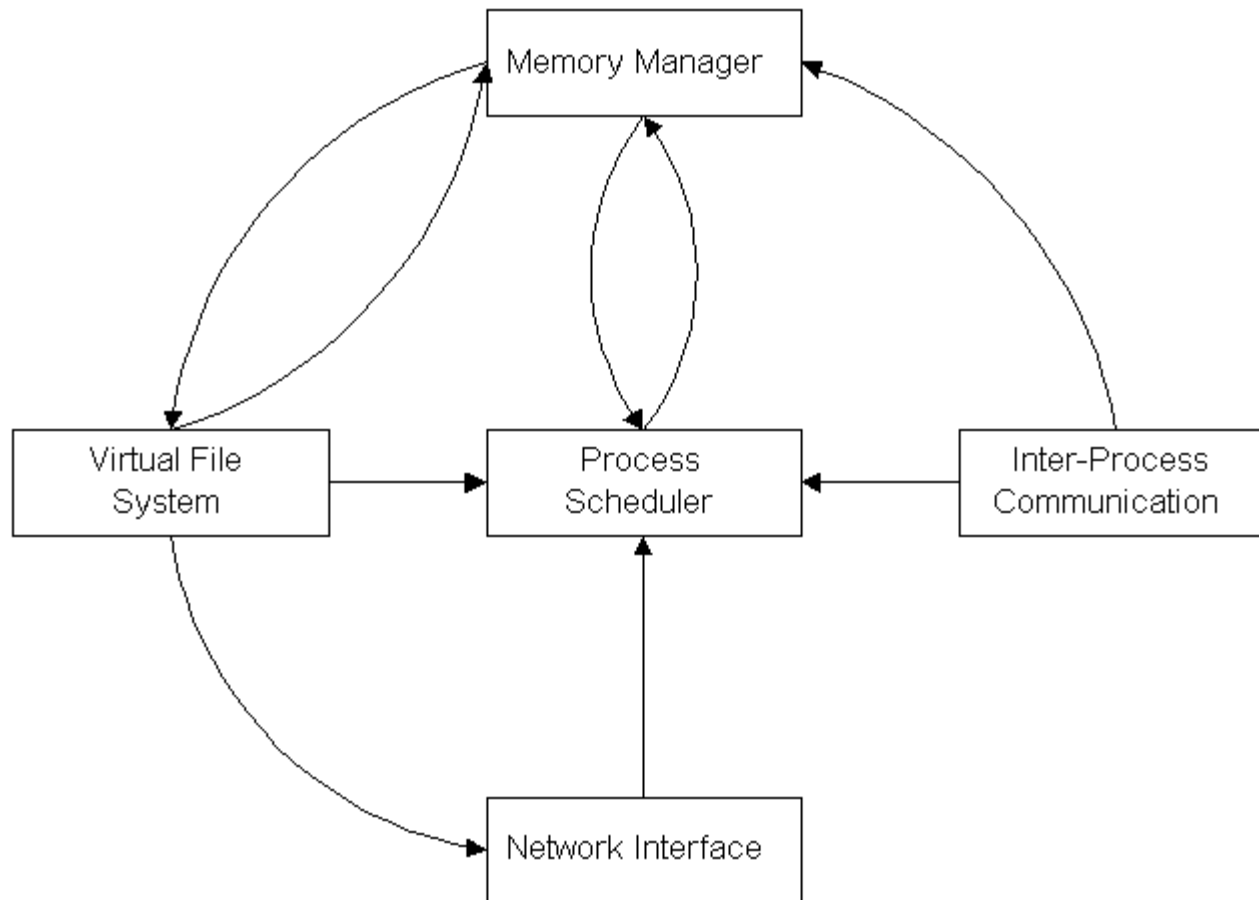
▶ **O/S Services**

OS Services is a programming interface to the kernel. It includes compiler tool, libraries, shell etc.

▶ **User Applications**

User applications include the applications used by end user. For example editors, word processors, web browsers etc.

Linux Kernel Architecture



Linux Kernel Architecture

▶ **Process Scheduler**

Process Scheduler controls the process access to the CPU & ensures that every process will have access to the CPU.

▶ **Memory Manager**

Memory manager permits multiple processes to securely share the machine's main memory system.

▶ **Virtual File System (VFS)**

VFS is an abstraction layer on top of a more concrete file system. VFS allows client application to access different types of files in uniform way. For example local file & network file.

Linux Kernel Architecture

▶ **Network Interface**

Network Interface provides us access to variety of network protocols & different network hardware.

▶ **Inter-process Communication (IPC)**

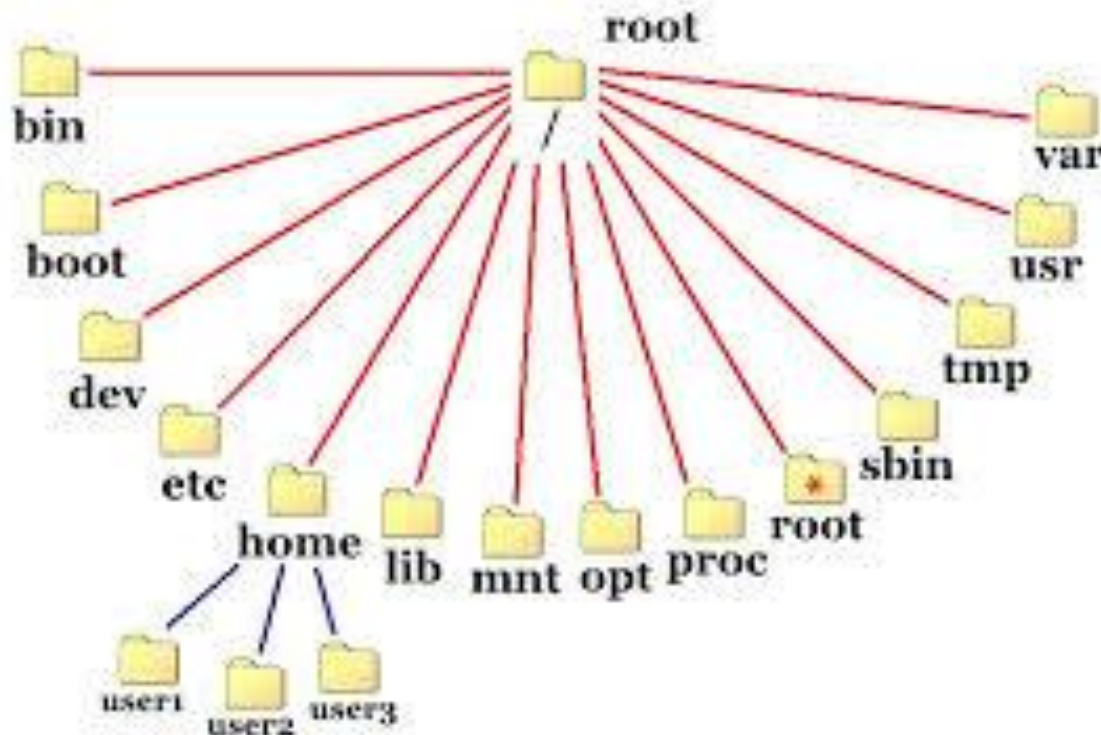
IPC establishes communication among several processes on a Linux system.

Unix vs Linux

Sr. No.	Unix	Linux
1.	Unix is paid operating system. Depending upon Unix flavor, the cost structure changes.	Linux can be freely distributed, freely copied, freely downloaded.
2.	Unix is developed for mainframes users and server side users.	Linux is used by home users, server side users etc.
3.	Unix is mainly developed by AT&T, few commercial vendors and NGOs.	Linux is developed by open source community. Thus it is a community work.
4.	Unix support Bourne shell as text mode interface. Now it also supports BASH, Korn & C.	Linux default shell is BASH (Bourne Again SHell).
5.	Unix is shipped with GUI called CDE(Common Desktop Environment). Presently Unix also supports Gnome.	Linux has 2 primary GUIs KDE & Gnome. Apart from this, there are many other GUIs have been developed like Xfce, LXDE, Unity etc.

Linux File System

- ▶ In Linux, everything is a file. Even directory is also a file.
- ▶ Linux mainly supports file formats Ext3 & Ext4. Apart from this, it also has support for JFS, NFS, FAT32 etc.



Linux File System

PATH	CONTENTS
/bin	Essential user command binaries. For example cp, pwd, rm etc.
/boot	Static files of boot loader.
/dev	Device files like CD-ROM, hard disk, CPU etc.
/etc	System related configuration files. For example host.conf, httpd.conf.
/home	User home directories like /home/anand, /home/guest etc
/lib	Essential shared libraries & kernel modules.
/media	Mount point for removable media like /media/cdrom. The removable media is automatically mounted in /media.
/mnt	Mount point for temporarily mounted file systems. /mnt is used to manually mount the devices using 'mount' command.
/opt	Contains third party softwares like Java etc.
/proc	Contains the information about running process with a particular processId.

Linux File System continued..

PATH	CONTENTS
/root	Home directory of root user.
/run	Run-time variable data i.e. information about the running system since last boot, e.g., currently logged-in users etc.
/sbin	Contains binary executable programs required by System Administrator. For example reboot, iptables, ifconfig etc.
/srv	Contains server specific and service related files.
/sys	/sys stores & allows modification of the devices connected to the system.
/tmp	/tmp stores the temporary files of the user & system till next boot.
/usr	Contains executable binaries, documentation, source code, libraries for second level program. For example /usr/bin, /usr/lib, /usr/src etc.
/var	/var contains the files that are expected to grow i.e. logs, mails etc.

Linux GUI



Linux Distributions



BASH commands

- ▶ Bash is a Unix shell and command language written by Brian Fox released in 1989.
- ▶ The Bash command syntax is a superset of the Bourne shell command syntax.
- ▶ Bash commands are widely used in Linux environment.

File operation related BASH commands

Sr. No.	Command	Description
1.	cat	Concatenate and print (display) the content of files.
2.	cd	Change Directory.
3.	cmp	Compare two files
4.	cp	Copy one or more files to another location
5.	cut	Divide a file into several parts.
6.	dd	Convert and copy a file, write disk headers, boot record.
7.	diff	Display the differences between two files.
8.	find	Search for files that meet a desired criteria.
9.	grep	Search file(s) for lines that match a given pattern.
10.	locate	Find files.
11.	ls	List information about file(s).
12.	mkdir	Create new folder(s).

File operation related BASH commands

Sr. No.	Command	Description
13.	gzip	Compress or decompress named file(s).
14.	rar	Archive files with compression.
15.	zip	Package and compress (archive) files.
16.	mv	Move or rename files or directories.
17.	pwd	Print Working Directory.
18.	rcp	Copy files between two machines.
19.	rename	Rename files.
20.	rm	Remove files.
21.	rmdir	Remove folder(s).
22.	slocate	Find files.
23.	Tail	Output the last part of file.
24.	wc	Print byte, word, and line counts.

System operations related BASH commands

Sr. No.	Command	Description
1.	df	Display free disk space
2.	Free	Display memory usage
3.	Hostname	Print or set system name
4.	ifconfig	Configure a network interface
5.	kill	Kill a process by specifying its PID
6.	logname	Print current login name
7.	logout	Exit a login shell
8.	mount	Mount a file system
9.	netstat	Networking information
10.	passwd	Modify a user password

System operations related BASH commands

Sr. No.	Command	Description
11.	ping	Test a network connection.
12.	pkill	Kill processes by a full or partial name.
13.	ps	Process status.
14.	reboot	Reboot the system.
15.	shutdown	Shutdown or restart linux.
16.	sleep	Delay for a specified time.
17.	su	Substitute user identity.
18.	sudo	Execute a command as another user.
19.	umount	Unmount a device.
20.	vmstat	Report virtual memory statistics.

Miscellaneous BASH commands

Sr. No.	Command	Description
1.	cal	Display a calendar.
2.	clear	Clear terminal screen.
3.	date	Display or change the date & time.
4.	echo	Display message on screen.
5.	env	Environment variables.
6.	exec	Execute a command.
7.	exit	Exit the shell.
8.	export	Set an environment variable.
9.	expr	Evaluate expressions.
10.	help	Display help for a built-in command.

Miscellaneous BASH commands

Sr. No.	Command	Description
11.	less	Display output one screen at a time.
12.	man	Help manual.
13.	more	Display output one screen at a time.
14.	vi	Text Editor

File Permissions

You can see the following output after running command 'll' on console:

```
-rw-r--r-- 1 anand developers 1892 Jul 10 18:30 info.txt
```

-rw-r--r: File permission

anand: User name

developers: Group name

File Permissions continued...

r – User can read the file contents.

w – User can write into the file or directory.

x – User can execute the file or directory.

$$r = (100)_2 = 4$$

$$w = (010)_2 = 2$$

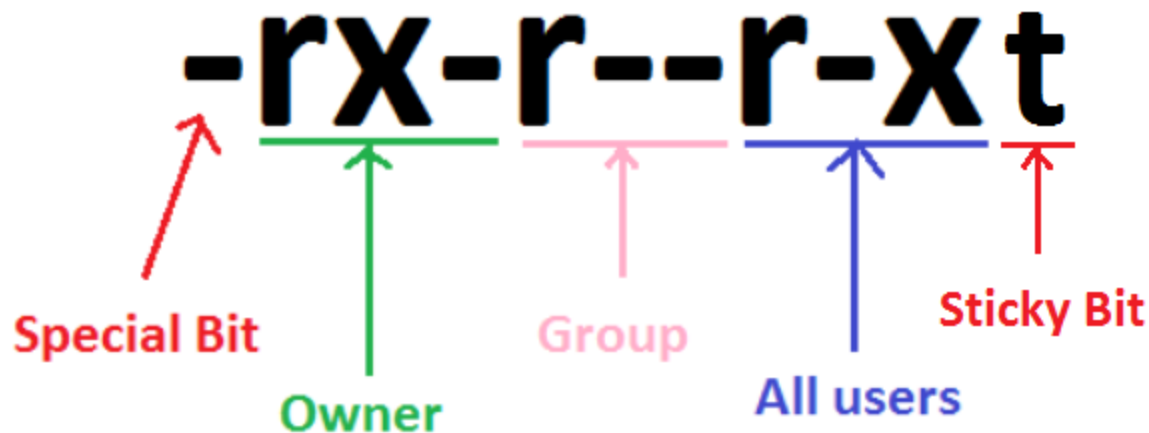
$$x = (001)_2 = 1$$

File Permissions continued...

#	Permission	rwX
7	read, write and execute	rwX
6	read and write	rw-
5	read and execute	r-X
4	read only	r--
3	write and execute	-wX
2	write only	-w-
1	execute only	--X
0	none	---

Special bits

File permissions are described with a string having 10 bits:



Special Bit:

_ No special permission
d Directory
l Symbolic Link

Sticky Bit:

t – File or directory having sticky bit can be deleted only by owner or by root.

Changing file permission

File permissions can be changed using three basic BASH commands:

- ▶ **chmod**

This allows you to change the "access rights" to the file or directory.

- ▶ **chgrp**

This allows you to change "Group Ownership" of a file or directory.

- ▶ **chown**

This will change the ownership of the file/directory (need to be root to use)

‘chmod’

\$ chmod u+x filename

[Adds single permission to file/directory]

\$ chmod u+r,g+x filename

[Adds multiple permissions to file/directory]

\$ chmod u-rx filename

[Remove permission from a file/directory]

\$ chmod a+x filename

[Change permission for all roles on a file/directory]

‘chmod’

\$ chmod --reference=file1 file2

[Make permission for a file same as another file]

\$ chmod -R 755 directory-name/

[Apply the permission to all the files under a directory recursively]

\$ chmod u+X *

[Change execute permission only on the directories (files are ignored).]

\$ chmod +t filename

[Adds sticky bit to the file or folder]

‘chgrp’

\$ chgrp sysadmin readme.txt

[Changes the group ownership of the file to ‘sysadmin’]

\$ chgrp sysadmin mydir

[Changes the group ownership of the directory to ‘sysadmin’]

\$ chgrp -R sysadmin mydir

[Changes the group ownership recursively of the directory to ‘sysadmin’ including its sub-directories]

‘chown’

\$ chown anand readme.txt

[Changes file ownership to ‘anand’]

\$ chown anand:developers readme.txt

[Changes file ownership to user ‘anand’ & group ‘developers’]

\$ chown :sysadmins readme.txt

[Changes file ownership to the group ‘sysadmins’]

‘chown’

\$ chown root:developers mydir

[Changes directory ownership to ‘root’ user & ‘developers’ group]

\$ chown -R root mydir

[Recursively changes file ownership to the directory ‘mydir’ including all sub directories.]