File Permissions in Linux

Every file and directory in Linux has **three permission levels**:

Permission	Symbol	Meaning
Read	`r` (4)	View file contents (e.g., `cat file.txt`)
Write	`w` (2)	Modify file contents (e.g., `nano file.txt`)
Execute	`x` (1)	Run as a program/script (e.g., `./script.sh`)

Permission Groups

Each file/directory has permissions for three groups:

Group	Description
Owner	The user who created or owns the file
Group	A set of users who can access the file
Others	Everyone else (including guests)

Example: Viewing Permissions

Run:

```
bash
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ls -l
```

Example output:

```
csharp
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-rwxr--r-- 1 user group 1234 Mar 19 10:00 script.sh
```

🛠️ Breakdown:

- `-` → Regular file (if `d`, it's a directory)
- `rwx` → Owner (`user`) has **read (r), write (w), and execute (x)**
- `r--` → Group (`group`) has **read-only**
- `r--` → Others have **read-only**
- `1` → Number of hard links
- `user` → Owner's username
- `group` → Owner's group
- `1234` → File size in bytes
- `Mar 19 10:00` → Last modified date
- `script.sh` → File name

2 Changing File Permissions (`chmod`)

Symbolic Mode

```
bash
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chmod u+x script.sh  # Give execute permission to the owner
chmod g-w script.sh  # Remove write permission from the group
chmod o+r script.sh  # Give read permission to others
chmod a+x script.sh  # Give execute permission to everyone (a = all)
```

Numeric (Octal) Mode

Each permission has a numeric value:

- `r = 4`
- `w = 2`
- `x = 1`

Combine them:

- `rwx = 7` (4+2+1)
- `rw- = 6` (4+2)
- `r-- = 4`

Example:

```
bash
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chmod 755 script.sh
```

- `7` → Owner (`rwx`)
- `5` → Group (`r-x`)
- `5` → Others (`r-x`)

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3 File Ownership (`chown`)

Every file belongs to a **user** (owner) and a **group**.

Check Ownership

```
bash
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ls -l
```

Example:

```
css
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```

```
-rw-r--r-- 1 alice devteam  1024 Mar 19 file.txt
```

- **Owner** = `alice`
- **Group** = `devteam`

Change File Owner

```
bash
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sudo chown bob file.txt  # Change owner to 'bob'
```

Change Group

```
bash
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sudo chown :admin file.txt  # Change group to 'admin'
```

Change Both Owner & Group

```
bash
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sudo chown bob:admin file.txt
```

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4 Changing Access (`chgrp`)

You can change the group without changing the owner:

```
bash
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sudo chgrp developers file.txt
```

Now, the file belongs to the `developers` group.

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5 Special Permissions

Linux also has three special permissions:

Special Bit	Symbol	Meaning
SetUID	`s`	Run as the file owner (used in executables)
SetGID	`s`	Run with group privileges (useful for directories)
Sticky Bit	`t`	Only the owner can delete the file (used in `/tmp`)

Example Usage

```
bash
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chmod u+s myscript.sh  # Enable SetUID
chmod g+s myfolder/    # Enable SetGID
chmod +t /tmp          # Enable Sticky Bit
```

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6 File Access (`lsattr`, `chattr`)

Linux also allows **immutable** files, which even `root` can't modify easily.

Make a File Immutable

```
bash
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sudo chattr +i important.txt
```

Now, even `root` cannot modify or delete `important.txt` until `+i` is removed:

```
bash
CopyEdit
sudo chattr -i important.txt
```

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7 Summary of Commands

Command	Description
`ls -l`	Show file permissions
`chmod`	Change file permissions
`chown`	Change file owner
`chgrp`	Change file group
`lsattr`	Show file attributes
`chattr`	Change file attributes