

CS60038
Advances in Operating System Design

Prof. Arobinda Gupta & Prof Sandip Chakraborty

Assignment-1
Report

Group Members
Yashraj Singh - 20CS10079
Rishi Raj - 20CS30040

Part - 1

Steps to install a new kernel version in Ubuntu are as follows:

1. First we increase the `GRUB_TIMEOUT` in the file `/etc/default/grub` to 10 seconds using
`$ sudo nano /etc/default/grub`
2. Now, we update the grub using
`$ sudo update-grub`
3. Now we go to an empty directory, say **Downloads** in this case.
`$ cd Downloads`
4. Now we use **wget** command to download the kernel zip
`$ wget https://cdn.kernel.org/pub/linux/kernel/v5.x/linux-5.10.191.tar.xz`
5. Next step is to install the dependencies using following commands
`$ sudo apt install dwarves && sudo apt install -y zstd`
`$ sudo apt-get install build-essential libncurses-dev libssl-dev libelf-dev gcc bc bison flex`
6. Making a directory and extract the kernel zip file in it
`$ mkdir kernel`
`$ tar -xf linux-5.10.191.tar.xz -C kernel/ --strip-components=1`
7. Now we copy the config of our current kernel in this directory so that it could support variety of devices
`$ cp /boot/config-$(uname -r) .config`
8. Disabling **environment variables**
`$ scripts/config -disable SYSTEM_TRUSTED_KEYS`
`$ scripts/config -disable SYSTEM_REVOCATION_KEYS`
9. Using **menuconfig** to edit the configuration file
`$ make menuconfig`
10. Now we use **localmodconfig** to make some final changes
`$ make localmodconfig`
11. Compile the kernel
`$ make -j$(nproc)`
`$ make modules_install`

12. Install the Kernel

```
$ make install
```

13. Enabling kernel for boot

```
$ sudo update-grub
```

14. Rebooting the system

```
$ reboot
```

One point to remember is that after reboot, one should press the **Shift** key on the keyboard to enter the **grub menu**.

- **Removing NUMA memory allocation, scheduler and emulation**

NUMA memory allocation, scheduler and emulation was removed using **menuconfig**.

For this we navigated to the submenu **Processor type and features** to find the **NUMA Memory Allocation and Scheduler Support** and disable it.

Before ⇒

```
Activities Terminal Sep 10 18:46 aos@aos-VirtualBox -
aos@aos-VirtualBox:~$ grep NUMA /boot/config-$(uname -r)
CONFIG_ARCH_SUPPORTS_NUMA_BALANCING=y
CONFIG_NUMA_BALANCING=y
CONFIG_NUMA_BALANCING_DEFAULT_ENABLED=y
CONFIG_X86_NUMA_CHIP=y
CONFIG_NUMA=y
CONFIG_AMD_NUMA=y
CONFIG_X86_64_ACPI_NUMA=y
CONFIG_NUMA_EMU=y
CONFIG_USE_PERCPU_NUMA_NODE_ID=y
CONFIG_ACPI_NUMA=y
CONFIG_NUMA_KEEP_MEMINFO=y
aos@aos-VirtualBox:~$ numactl --hardware
available: 1 nodes (0)
node 0 cpus: 0 1 2 3 4 5 6 7
node 0 size: 7936 MB
node 0 free: 4240 MB
node distances:
node 0
0: 10
aos@aos-VirtualBox:~$ numactl --show
policy: default
preferred node: current
physcpubind: 0 1 2 3 4 5 6 7
cpubind: 0
nodebind: 0
membind: 0
aos@aos-VirtualBox:~$ uname -r
5.15.0-83-generic
aos@aos-VirtualBox:~$
```

After ⇒

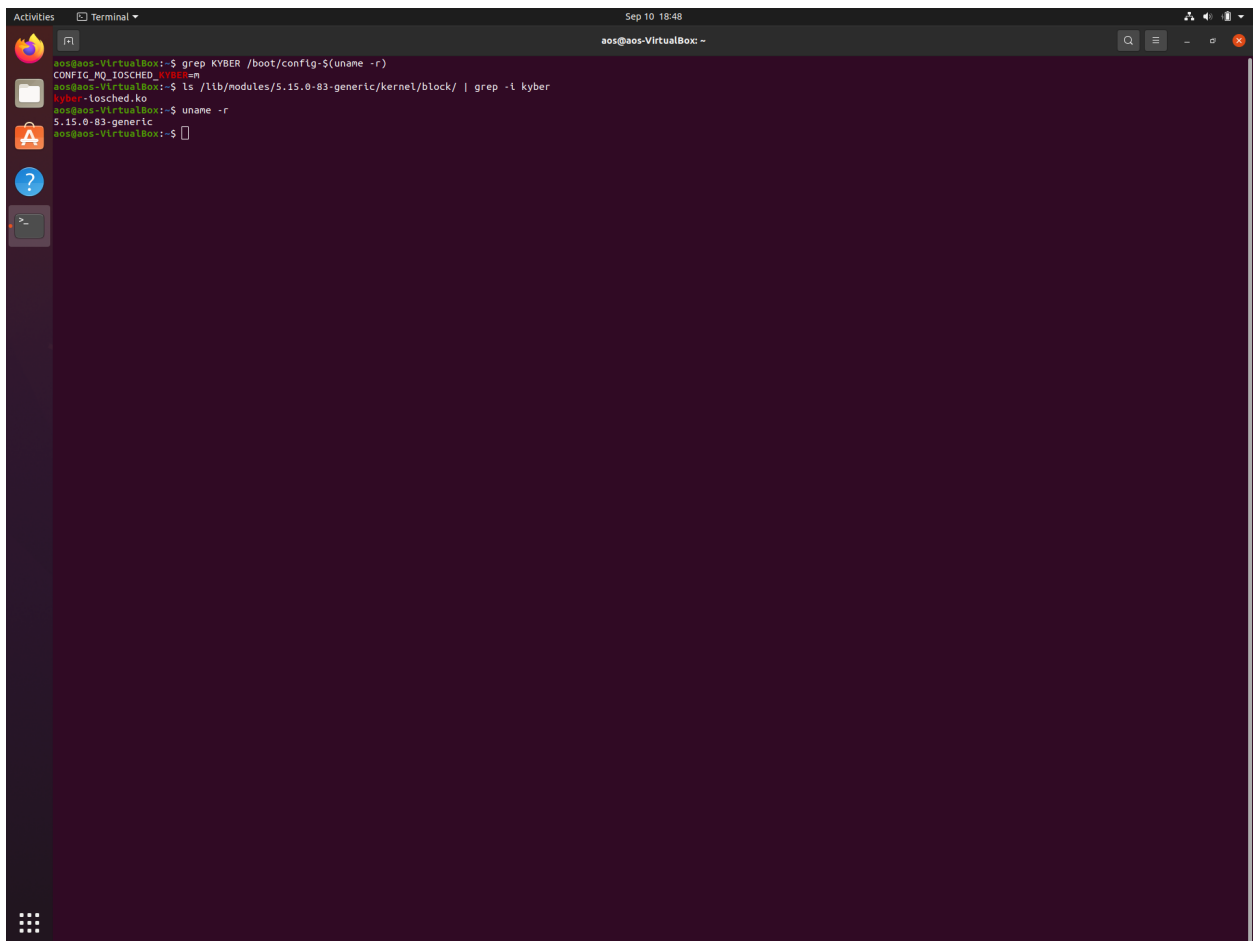
```
Activities Terminal Sep 10 19:42 aos@aos-VirtualBox -
aos@aos-VirtualBox:~$ grep NUMA /boot/config-$(uname -r)
CONFIG_ARCH_SUPPORTS_NUMA_BALANCING=y
# CONFIG_NUMA is not set
aos@aos-VirtualBox:~$ numactl --hardware
No NUMA available on this system
aos@aos-VirtualBox:~$ numactl --show
physcpubind: 0 1 2 3 4 5 6 7
No NUMA support available on this system.
aos@aos-VirtualBox:~$ uname -r
5.10.191
aos@aos-VirtualBox:~$
```

- **Removing Kyber I/O Scheduler**

This was also removed using **menuconfig**.

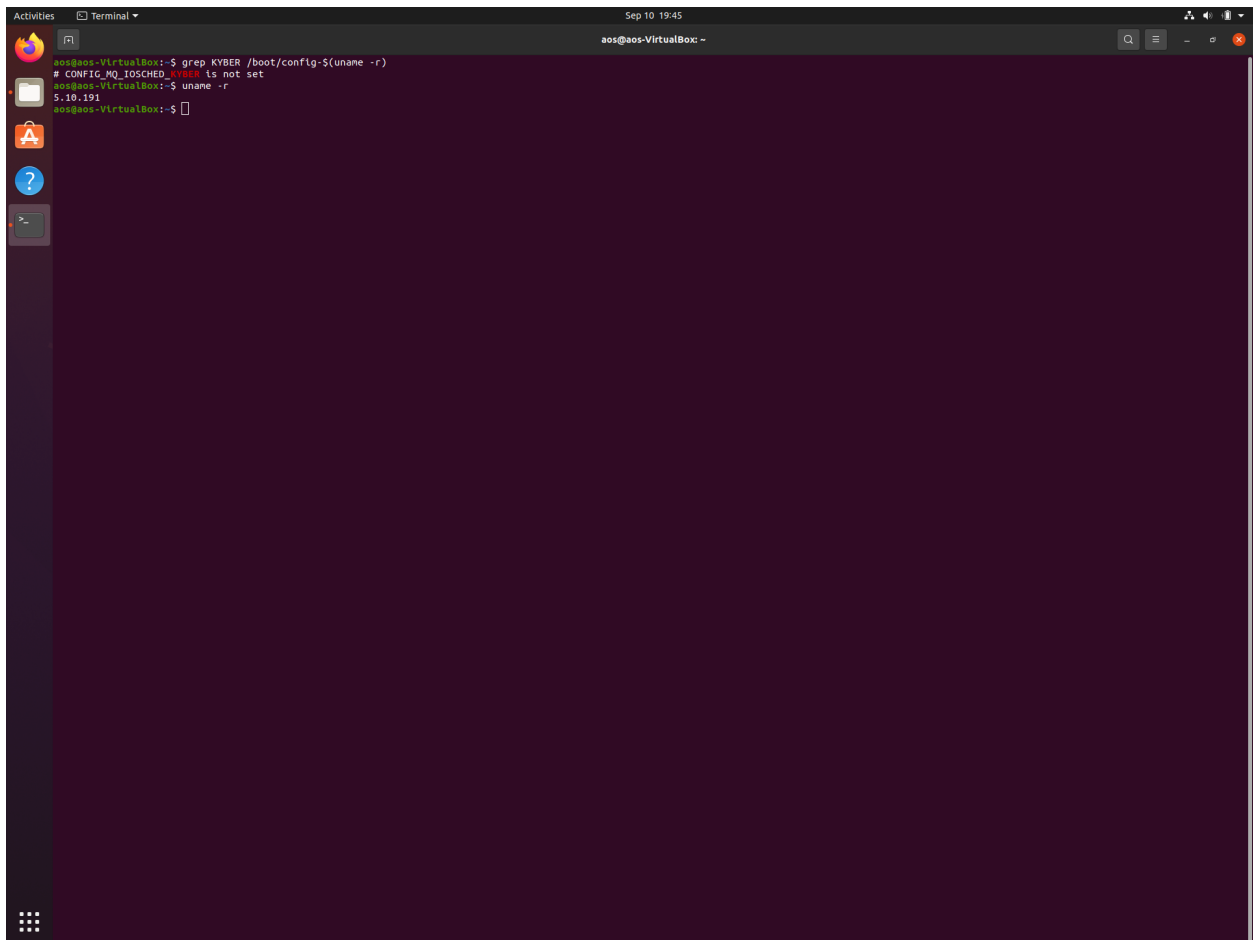
For this we navigated to the **Kyber I/O Scheduler** option inside the submenu of **IO Schedulers**. Then we disabled the scheduler.

Before ⇒



```
aos@aos-VirtualBox:~$ grep KYBER /boot/config-$(uname -r)
CONFIG_MQ_IOSCHED_KYBER=y
aos@aos-VirtualBox:~$ ls /lib/modules/5.15.0-83-generic/kernel/block/ | grep -i kyber
kyber-iosched.ko
aos@aos-VirtualBox:~$ uname -r
5.15.0-83-generic
aos@aos-VirtualBox:~$
```

After ⇒



A terminal window titled "Terminal" with a subtitle "aos@aos-VirtualBox -". The window shows the following commands and output:

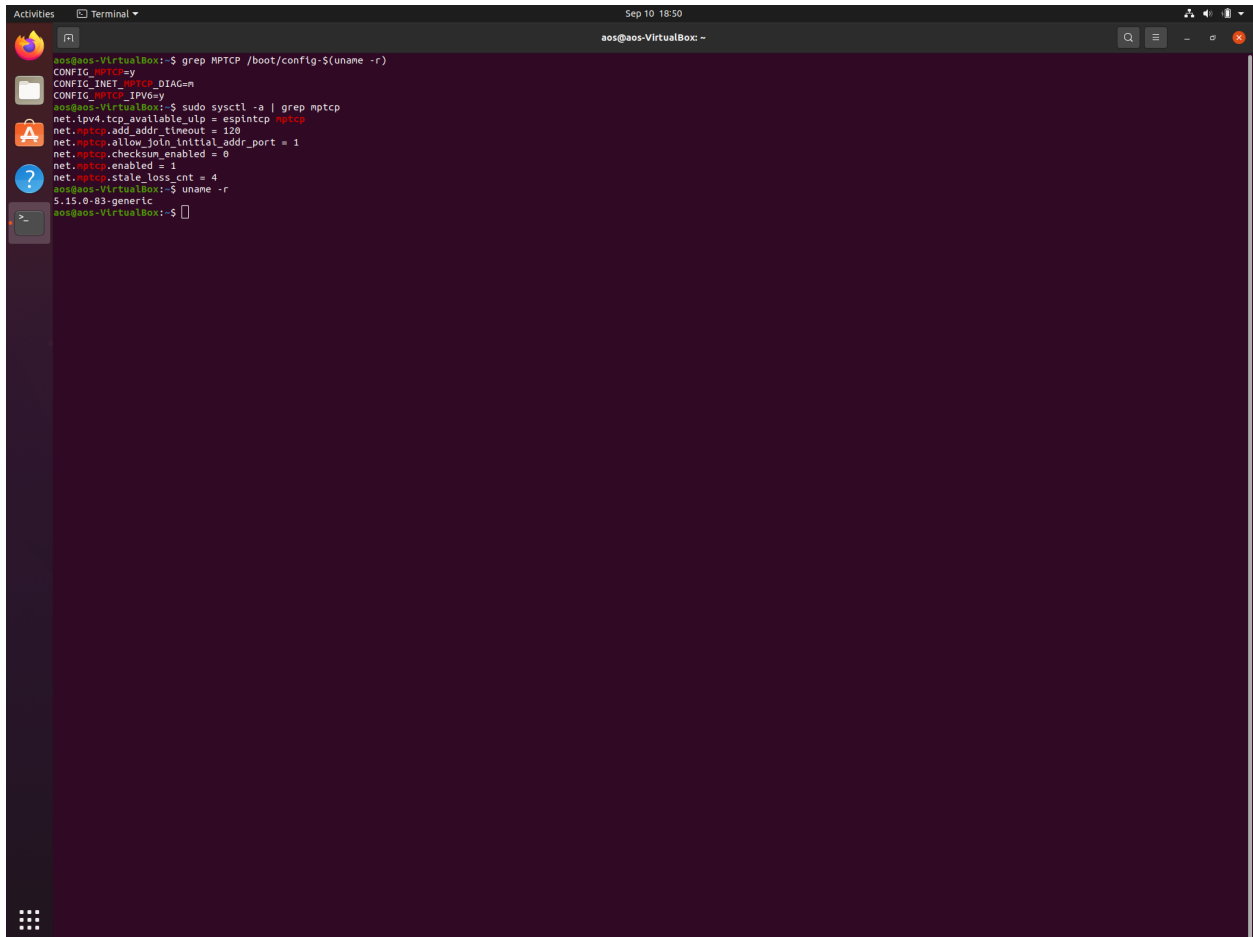
```
aos@aos-VirtualBox:~$ grep KYBER /boot/config-${uname -r}
# CONFIG_MQ_IOSCHED_KYBER is not set
aos@aos-VirtualBox:~$ uname -r
5.10.191
aos@aos-VirtualBox:~$
```

The terminal has a dark purple background and a light gray border. The window title bar includes standard Linux window controls (minimize, maximize, close) and a search icon. The left sidebar shows a dock with icons for the Dash, Home, and Applications menus, as well as a few application icons.

- Including Multipath TCP (MPTCP)

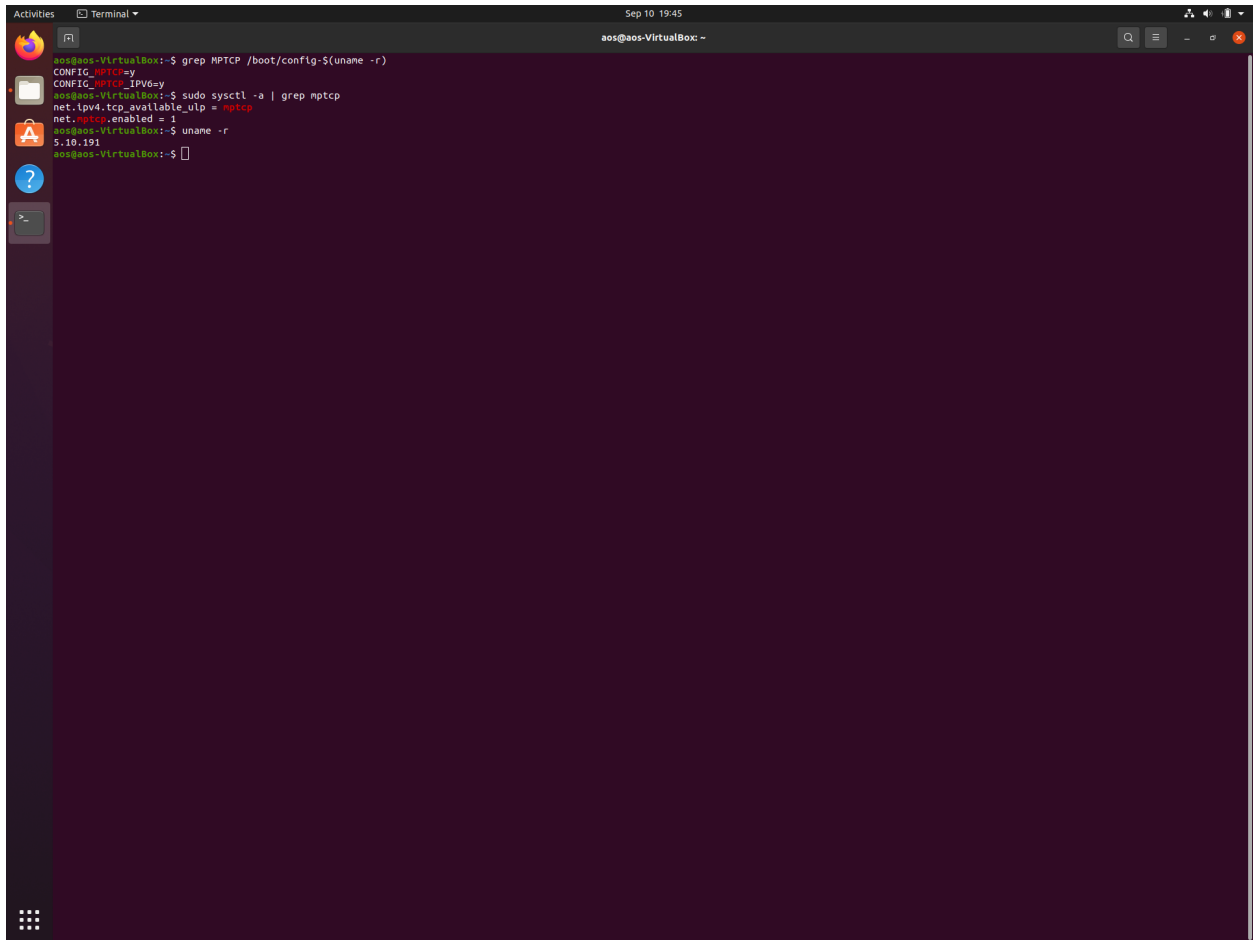
By default, this option is already enabled in the kernel version 5.15.0
Hence, we did not make any change for it in **menuconfig**.

Before ⇒

A terminal window titled 'aas@aas-VirtualBox -' showing the configuration of Multipath TCP (MPTCP) in a Linux environment. The user runs 'grep MPTCP /boot/config-\$(uname -r)' to check the current configuration. The output shows 'CONFIG_INET_MPTCP=y', 'CONFIG_INET_MPTCP_DIAG=n', and 'CONFIG_MPTCP_IPV6=y'. Then, the user runs 'sudo sysctl -a | grep mptcp' to show the runtime configuration. The output shows 'net.ipv4.tcp_available_udp = espintcp mptcp', 'net.mptcp.add_addr_timeout = 120', 'net.mptcp.allow_join_initial_addr_port = 1', 'net.mptcp.checksum_enabled = 0', 'net.mptcp.enabled = 1', and 'net.mptcp.stale_loss_cnt = 4'. Finally, the user runs 'uname -r' to show the kernel version '5.15.0-83-generic'.

```
aas@aas-VirtualBox:~$ grep MPTCP /boot/config-$(uname -r)
CONFIG_INET_MPTCP=y
CONFIG_INET_MPTCP_DIAG=n
CONFIG_MPTCP_IPV6=y
aas@aas-VirtualBox:~$ sudo sysctl -a | grep mptcp
net.ipv4.tcp_available_udp = espintcp mptcp
net.mptcp.add_addr_timeout = 120
net.mptcp.allow_join_initial_addr_port = 1
net.mptcp.checksum_enabled = 0
net.mptcp.enabled = 1
net.mptcp.stale_loss_cnt = 4
aas@aas-VirtualBox:~$ uname -r
5.15.0-83-generic
aas@aas-VirtualBox:~$
```


After ⇒



A terminal window titled "Terminal" with a search bar and window controls. The terminal shows the following commands and output:

```
aos@aos-VirtualBox:~$ grep MPTCP /boot/config-$(uname -r)
CONFIG_MPTCP=y
CONFIG_MPTCP_IPV6=y
aos@aos-VirtualBox:~$ sudo sysctl -a | grep mptcp
net.ipv4.tcp_available_udp = mptcp
net.mptcp.enabled = 1
aos@aos-VirtualBox:~$ uname -r
5.10.191
aos@aos-VirtualBox:~$
```