

Advances in Operating Systems Design

Assignment-1 Part A

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This report includes the changes that were observed when a Linux kernel (version 5.10.191) was configured using *menuconfig* and installed into the system. The configurations made are as follows:-

1. Remove NUMA memory allocation, scheduler, and emulation

Linux Kernel v5.10.191 has NUMA support enabled by default.

It can be disabled from,

[Processor Types and Features --->](#)

[NUMA Memory Allocation and Scheduler Support](#)

Before Removal

- Options in *.config* file:

```
gaurav@gaurav-VirtualBox:/usr/src/linux-headers-5.15.0-82-generic$ cat .config | grep NUMA
CONFIG_ARCH_SUPPORTS_NUMA_BALANCING=y
CONFIG_NUMA_BALANCING=y
CONFIG_NUMA_BALANCING_DEFAULT_ENABLED=y
CONFIG_X86_NUMACHIP=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
gaurav@gaurav-VirtualBox:/usr/src/linux-headers-5.15.0-82-generic$
```

- Checking with *numactl* command:

```
gaurav@gaurav-VirtualBox:~$ numactl --hardware
available: 1 nodes (0)
node 0 cpus: 0 1 2 3 4 5 6 7 8 9 10 11
node 0 size: 8068 MB
node 0 free: 5676 MB
node distances:
node 0
  0: 10
gaurav@gaurav-VirtualBox:~$
```

After Removal

- Options in *.config* file:

```
gaurav@gaurav-VirtualBox:~/Downloads/linux-5.10.191$ cat .config | grep NUMA
CONFIG_ARCH_SUPPORTS_NUMA_BALANCING=y
# CONFIG_NUMA is not set
gaurav@gaurav-VirtualBox:~/Downloads/linux-5.10.191$
```

- Checking with *numactl* command:

```
gaurav@gaurav-VirtualBox:~/Downloads/linux-5.10.191$ numactl --hardware
No NUMA available on this system
gaurav@gaurav-VirtualBox:~/Downloads/linux-5.10.191$
```

2. Remove Kyber I/O Scheduler

Kyber I/O Scheduler is also enabled in Kernel v5.10.191 by default.

To remove it we need to go this location,

[IO Schedulers --->](#)

[Kyber IO Scheduler](#)

Before Removal

- Options in *.config* file:

```
gaurav@gaurav-VirtualBox:/usr/src/linux-headers-5.15.0-82-generic$ cat .config | grep KYBER
CONFIG_MQ_IOSCHED_KYBER=m
gaurav@gaurav-VirtualBox:/usr/src/linux-headers-5.15.0-82-generic$
```

- checking in */lib/modules* directory:

```
gaurav@gaurav-VirtualBox:~$ ls /lib/modules/5.15.0-82-generic/kernel/block/
bfq.ko  kyber-iosched.ko
gaurav@gaurav-VirtualBox:~$
```

After Removal

- Options in *.config* file:

```
gaurav@gaurav-VirtualBox:~/Downloads/linux-5.10.191$ cat .config | grep KYBER
# CONFIG_MQ_IOSCHED_KYBER is not set
gaurav@gaurav-VirtualBox:~/Downloads/linux-5.10.191$
```

- checking in */lib/modules* directory:

```
gaurav@gaurav-VirtualBox:~$ ls /lib/modules/5.10.191/kernel/block/
bfq.ko
gaurav@gaurav-VirtualBox:~$
```

3. Include multipath TCP (MPTCP)

MPTCP Support is already included in Kernel v5.10.191 so we don't need to toggle its option. However the option to change it can be found in,

Networking Support --- >

Networking Options --->

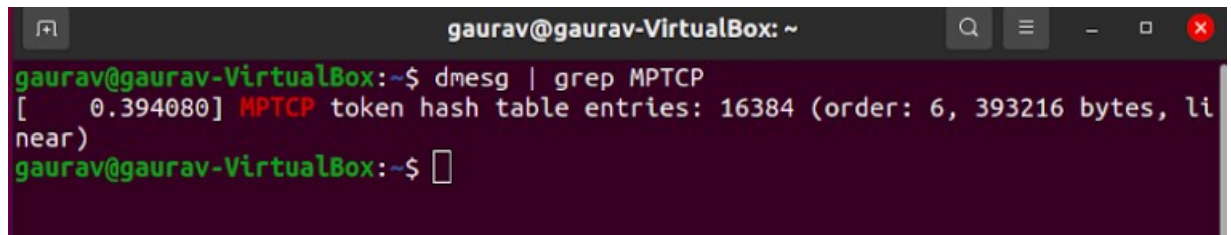
TCP/IP Networking --->

MPTCP: Multipath TCP

- Options in *.config* file:

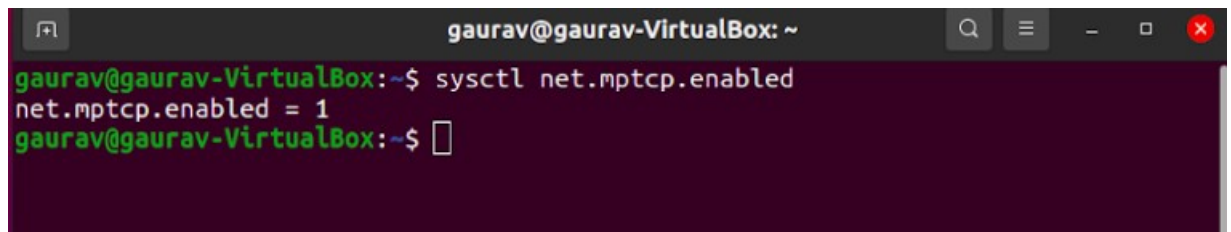
```
gaurav@gaurav-VirtualBox: ~/Downloads/linux-5.10.191
gaurav@gaurav-VirtualBox:~/Downloads/linux-5.10.191$ cat .config | grep MPTCP
CONFIG_MPTCP=y
CONFIG_INET_MPTCP_DIAG=m
CONFIG_MPTCP_IPV6=y
gaurav@gaurav-VirtualBox:~/Downloads/linux-5.10.191$
```

- Output of *dmesg*:

A terminal window titled 'gaurav@gaurav-VirtualBox: ~' with search, menu, and window control icons. The command 'dmesg | grep MPTCP' is entered, resulting in the output: '[0.394080] MPTCP token hash table entries: 16384 (order: 6, 393216 bytes, linear)'.

```
gaurav@gaurav-VirtualBox:~$ dmesg | grep MPTCP
[ 0.394080] MPTCP token hash table entries: 16384 (order: 6, 393216 bytes, linear)
gaurav@gaurav-VirtualBox:~$
```

- Checking with *sysctl*:

A terminal window titled 'gaurav@gaurav-VirtualBox: ~' with search, menu, and window control icons. The command 'sysctl net.mptcp.enabled' is entered, resulting in the output: 'net.mptcp.enabled = 1'.

```
gaurav@gaurav-VirtualBox:~$ sysctl net.mptcp.enabled
net.mptcp.enabled = 1
gaurav@gaurav-VirtualBox:~$
```