

## Assignment - 3

**Description:** In this assignment we will modify our CSF scheduler in such a way that our added system call will have soft run time. So, we are supposed to write a system call which will be given priority on the basis of soft run time as processes are selected from RB – tree. We will pass the soft run time value from rtnice, so every time we will check and would give higher priority to the process which have soft run time than with vruntime.

### 1. Updating the kernel to 5.9.1

➔ Download the .tar file and extract it anywhere in your linux environment.

➔ Now before compiling the kernel install the necessary packages

```
apt-get install gcc &&  
apt-get install libncurses5-dev &&  
apt-get install bison &&  
apt-get install flex &&  
apt-get install libssl-dev &&  
apt-get install libelf-dev &&  
apt-get update &&  
apt-get upgrade &&  
apt-get make
```

➔ Now we will change the directory to new kernel code.

➔ Now we will configure our kernel

```
make menuconfig
```

A window will be popped up after this command so exit from there by using left-right keys

➔ Now we can compile our kernel by using the following command.

```
sudo make -j2
```

Here -j n depends upon your linux machine where parameter n is the number of cores. In my case that n was 2 as I was using Virtual Machine so I had given 2 cores to vm.

If you have more cores you should use them as it will decrease your compilation time. This compilation took 4-5 hours in my case.

➔ After successful compilation type the following command

```
make modules_install install
```

This will take some time, around half an hour.

➔ After successful compilation of the last command, we need to reboot our linux

```
sudo reboot
```

➔ Now check your kernel version by typing the following command

```
uname -r
```

## 2. Implementation

➔ We have made some changes in scheduling algorithm such that it will choose the soft run time process first.

➔ We have added an extra attribute `rtnice` in linux-

5.9.1/include/linux/sched.h and have initialized its default as 0 in linux-5.9.1/kernel/sched/core.c in `__sched_fork()`. This attribute is our time slice which is nothing but soft run time.

➔ We have made some changes in `entity_before()` which is present in linux-5.9.1/kernel/sched/fair.c. So the default scheduler is selecting a process by comparing it with others, and we are selecting the process from `pick_next_entity()`. The comparison is done on the basis of `vruntime` and `soft_time` is done in this function. This function either returns 0 and 1. If it returns 1 that means first or curr process has higher priority than the second and vice-versa.

➔ We also have made some changes in `update_curr()` function, this function updates our `soft_time` of the processes. So, If any `sched_entity` has a `soft_time` i.e. `rtnice` value  $> 0$ , we are updating the `rtnice` rather than the `vruntime`. This function is present in linux-5.9.1/kernel/sched/fair.c.

➔ We have implemented our system call in linux-5.9.1/kernel/sys.c and have entered its entry in linux-5.9.1/arch/x86/entry/syscalls/syscall\_64.tbl.

➔ Now we need to compile it again, type the following commands

```
sudo make -j2
```

```
make modules_install install
sudo reboot
```

We have modified CFS and added our system call successfully.

### 3. Testing

- We have given two inputs to the system call one is pid and second is soft\_time from the rttest.c file. In this program we are running two processes one is with soft run time and second without soft run time i.e. with vruntime. So the execution time of the process with vruntime will be greater than the execution time of soft\_time.
- If some invalid values are passed it will show error messages.

```
aman@aman:~/Desktop$ make compile
gcc test.c
aman@aman:~/Desktop$ make run
gcc test.c
./a.out
In Parent process, time taken in ns: 160833843
In child process, time taken in ns: 231171065
aman@aman:~/Desktop$
```

### 4. Error handled

We have handled two errors

- If invalid PID is passed it will throw an error.
- If invalid time slice is passed then an error will be thrown.

```
aman@aman:~/Desktop$ make run
gcc test.c
./a.out
System call didn't execute!!
Error : Invalid argument
Error No.: 22
In child process, time taken in ns: 838052719
aman@aman:~/Desktop$
```

```
aman@aman:~/Desktop$ make compile
gcc test.c
aman@aman:~/Desktop$ make run
gcc test.c
./a.out
System call didn't execute!!
Error : No such process
Error No.: 3
In child process, time taken in ns: 945686337
aman@aman:~/Desktop$
```