Assignment 4: RTOS and Priority Preemption - Part 1

Group 20:

Ashlesha Deokar: G01374665
Aniket Anil Raut: G01387118
Mandar Chaudhari: G01393699
Ganesh Madarasu: G01413183

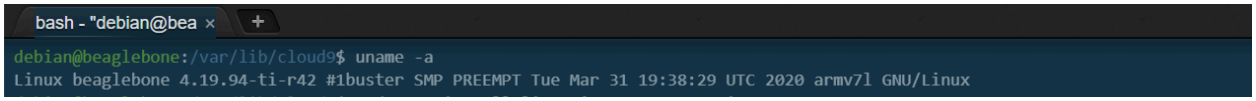
Github Repository: https://github.com/mandarc64/CS692_001_G20

Step1: Installing Real-Time PREEMPT_RT Kernel on BeagleBone

To patch the BeagleBone's Debian Linux with PREEMPT_RT, we used the following steps:

1. Check the current kernel version:
Uname -a

Linux beaglebone 4.19.94-ti-r42 #1buster SMP PREEMPT Tue Mar 31 19:38:29 UTC 2022 armv7l GNU/Linux



2. Install the Real-Time Linux Kernel:

sudo apt install linux-image-4.19.94-ti-rt-r73

We obtained the kernel version and release number from the official BeagleBoard repository on GitHub (https://github.com/beagleboard/linux/tree/4.19-rt).

3. Reboot the system:
sudo reboot

4. verify the kernel version after reboot to ensure the Real-Time patch is applied:
uname -a

Step 2: Executing the program on updated OS

- Compile the program:
  gcc -o hello helloworld.c
- Execute the program:
  ./hello

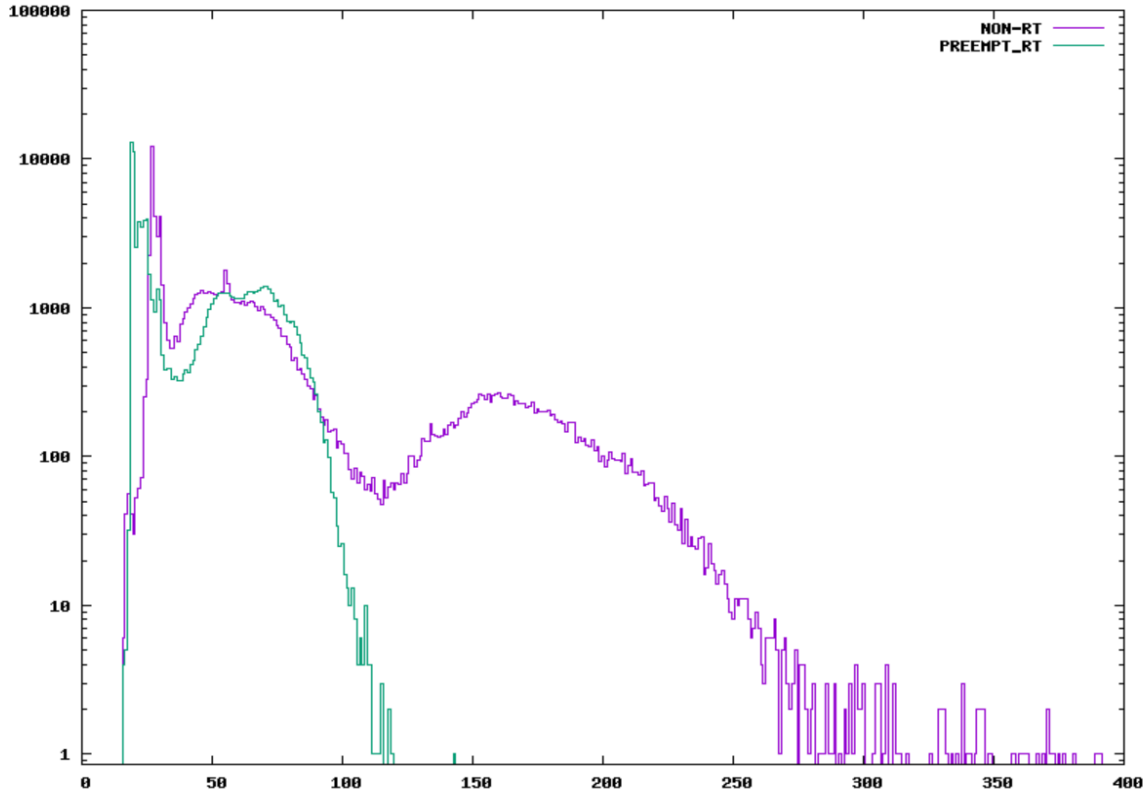
```
bash - "beaglebone" ×  bash - "debian@bea ×  +
debian@beaglebone:/var/lib/cloud9$ uname -a
Linux beaglebone 4.19.94-ti-rt-r73 #1buster SMP PREEMPT RT Fri Apr 15 21:47:59 UTC 2022 armv7l GNU/Linux
debian@beaglebone:/var/lib/cloud9$ cd RealTimeEmbedded/
debian@beaglebone:/var/lib/cloud9/RealTimeEmbedded$ cd Assignment4/
debian@beaglebone:/var/lib/cloud9/RealTimeEmbedded/Assignment4$ gcc -o hello helloworld.c
debian@beaglebone:/var/lib/cloud9/RealTimeEmbedded/Assignment4$ ./hello
Hello World!
System Name: Linux
Node Name: beaglebone
Machine: armv7l
Group Name: Group 20
Student Name: Ashlesha Deokar
Student Name: Aniket Raut
Student Name: Mandar Chaudhari
Student Name: Ganesh Madarasu
debian@beaglebone:/var/lib/cloud9/RealTimeEmbedded/Assignment4$
```

Step 3: Compare the preemption latency

To compare the preemption latency between the real-time and non-real-time OS versions, we installed the rt-tests.

sudo apt install rt-tests

Here is the graph we obtained from the latency test:



The comparison between the real-time and non-real-time versions of my operating system using cyclictest revealed distinct differences in preemption latency. The real-time OS demonstrated lower average latency, around 21 microseconds, compared to the non-real-time OS, which had an average latency of approximately 24 microseconds. This indicates the real-time OS's superior predictability and timely response, crucial for real-time applications. However, the real-time OS also showed slightly higher maximum latency spikes, which may require consideration depending on the application's tolerance for occasional delays.

In summary, the real-time OS offers better performance for applications where consistent low latency is critical, but it's essential to evaluate the impact of rare higher latency peaks.