RTOS and Priority Preemption - Part 1

Team Members:

1) Ananya Yendluri
2) Aparna Kanakamedala
3) Aamani Mannava
4) Nishta Jain
5) Virat Dev

The Debian version that incorporates the Beagle in its setup comes with the PREEMPT feature. To ensure tasks run smoothly, it's important to have the Real-Time (RT) path in place.

```
debian@BeagleBone:~$ uname -a
Linux BeagleBone 5.10.145-ti-r53 #1bullseye SMP PREEMPT Sun Nov 6 17:24:30 UTC 2
022 armv71 GNU/Linux
```

To check the Debian Kernel Version:

```
debian@BeagleBone:~$ head /boot/uEnv.txt
#Docs: http://elinux.org/Beagleboard:U-boot_partitioning_layout_2.0

uname_r=5.10.145-ti-r53
#uuid=
#dtb=

###U-Boot Overlays###
###Documentation: http://elinux.org/Beagleboard:BeagleBoneBlack_Debian#U-Boot_Ov
erlays
###Master Enable
enable_uboot_overlays=1
```

Established an internet connection with a Beagle using an Ethernet cable.

```
debian@BeagleBone:~$ ping google.com
PING google.com(bc-in-f139.1e100.net (2607:f8b0:4004:c07::8b)) 56 data bytes
64 bytes from bc-in-f139.1e100.net (2607:f8b0:4004:c07::8b): icmp_seq=1 ttl=59 time=105 ms
64 bytes from bc-in-f139.1e100.net (2607:f8b0:4004:c07::8b): icmp_seq=2 ttl=59 time=5.09 ms
64 bytes from bc-in-f139.1e100.net (2607:f8b0:4004:c07::8b): icmp_seq=3 ttl=59 time=7.89 ms
64 bytes from bc-in-f139.1e100.net (2607:f8b0:4004:c07::8b): icmp_seq=4 ttl=59 time=10.0 ms
64 bytes from bc-in-f139.1e100.net (2607:f8b0:4004:c07::8b): icmp_seq=5 ttl=59 time=6.46 ms
64 bytes from bc-in-f139.1e100.net (2607:f8b0:4004:c07::8b): icmp_seq=6 ttl=59 time=7.24 ms
64 bytes from bc-in-f139.1e100.net (2607:f8b0:4004:c07::8b): icmp_seq=7 ttl=59 time=8.86 ms
64 bytes from bc-in-f139.1e100.net (2607:f8b0:4004:c07::8b): icmp_seq=8 ttl=59 time=7.95 ms
^[64 bytes from bc-in-f139.1e100.net (2607:f8b0:4004:c07::8b): icmp_seq=9 ttl=59 time=7.91 ms
64 bytes from bc-in-f139.1e100.net (2607:f8b0:4004:c07::8b): icmp_seq=10 ttl=59 time=9.48 ms
^C
--- google.com ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9016ms
rtt min/avg/max/mdev = 5.089/17.616/105.295/29.257 ms
```

Proceeding with rt kernel installation:

```
debian@BeagleBone:~$ apt search linux-image-5.10.145
Sorting... Done
Full Text Search... Done
linux-image-5.10.145-ti-r53/unknown,now 1bullseye armhf [installed]
  Linux kernel, version 5.10.145-ti-r53

linux-image-5.10.145-ti-r54/unknown 1bullseye armhf
  Linux kernel, version 5.10.145-ti-r54

linux-image-5.10.145-ti-r55/unknown,now 1bullseye armhf [installed]
  Linux kernel, version 5.10.145-ti-r55

linux-image-5.10.145-ti-rt-r53/unknown 1bullseye armhf
  Linux kernel, version 5.10.145-ti-rt-r53

linux-image-5.10.145-ti-rt-r54/unknown 1bullseye armhf
  Linux kernel, version 5.10.145-ti-rt-r54

linux-image-5.10.145-ti-rt-r55/unknown,now 1bullseye armhf [installed]
  Linux kernel, version 5.10.145-ti-rt-r55

debian@BeagleBone:~$ sudo apt install linux-image-5.10.145-ti-rt-r53
[sudo] password for debian:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following NEW packages will be installed:
  linux-image-5.10.145-ti-rt-r53
0 upgraded, 1 newly installed, 0 to remove and 51 not upgraded.
Need to get 34.5 MB of archives.
After this operation, 61.2 MB of additional disk space will be used.
Get:1 http://repos.rcn-ee.com/debian bullseye/main armhf linux-image-5.10.145-ti
-rt-r53 armhf 1bullseye [34.5 MB]
Fetched 34.5 MB in 7s (4715 kB/s)
Selecting previously unselected package linux-image-5.10.145-ti-rt-r53.
(Reading database ... 69538 files and directories currently installed.)
Preparing to unpack .../linux-image-5.10.145-ti-rt-r53_1bullseye_armhf.deb ...
Unpacking linux-image-5.10.145-ti-rt-r53 (1bullseye) ...
Setting up linux-image-5.10.145-ti-rt-r53 (1bullseye) ...
update-initramfs: Generating /boot/initrd.img-5.10.145-ti-rt-r53
W: Possible missing firmware /lib/firmware/xc3028L-v36.fw for built-in driver tuner_xc2028
W: Possible missing firmware /lib/firmware/xc3028-v27.fw for built-in driver tuner_xc2028
W: Possible missing firmware /lib/firmware/dvb-fe-xc4000-1.4.fw for built-in driver xc4000
cp: cannot stat '/usr/lib/linux-image-5.10.145-ti-rt-r53/*.dtbo': No such file o
r directory
zz-uenv_txt: Updating /boot/uEnv.txt [uname_r=5.10.145-ti-rt-r53]
```

Checking the real-time (RT) patch has been downloaded and is accessible within the "boot" folder.

```
debian@BeagleBone:~$ ls /boot
SOC.sh                          initrd.img-5.10.145-ti-r53
System.map-5.10.145-ti-r53      initrd.img-5.10.145-ti-r55
System.map-5.10.145-ti-r55      initrd.img-5.10.145-ti-rt-r53
System.map-5.10.145-ti-rt-r53   initrd.img-5.10.145-ti-rt-r55
System.map-5.10.145-ti-rt-r55   initrd.img-5.10.168-ti-r71
System.map-5.10.168-ti-r71      uEnv.txt
config-5.10.145-ti-r53          uboot
config-5.10.145-ti-r55          vmlinuz-5.10.145-ti-r53
config-5.10.145-ti-rt-r53       vmlinuz-5.10.145-ti-r55
config-5.10.145-ti-rt-r55       vmlinuz-5.10.145-ti-rt-r53
config-5.10.168-ti-r71          vmlinuz-5.10.145-ti-rt-r55
dtbs                            vmlinuz-5.10.168-ti-r71
```

After restarting the Beagle Bone to trigger the boot sequence with the RT-patched Linux kernel, we can verify that the Beagle Bone is now operating with the RT-patched version that has been successfully installed.

```
debian@BeagleBone:~$ sudo reboot
```

```
debian@BeagleBone:~$ uname -a
Linux BeagleBone 5.10.145-ti-rt-r53 #1bullseye SMP PREEMPT_RT Sun Nov 6 17:28:49
 UTC 2022 armv7l GNU/Linux
```

Running c file to print system info.

```
debian@BeagleBone:~/examples$ gcc code.c -o output
debian@BeagleBone:~/examples$ ./output
System name - Linux
Machine     - armv7l
Nodename    - BeagleBone
Release     - 5.10.145-ti-rt-r53
Version     - #1bullseye SMP PREEMPT_RT Sun Nov 6 17:28:49 UTC 2022

Ananya
Aparna
Aamani
Nishta
Virat
```

Beaglebone has been successfully booted up with rt patch.