ECEN 449 Lab Report 4

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Introduction

Similar to the previous lab this time we are tasked with synthesizing and implementing a Zynq processor. Instead of only running one program on it, however, we will compile and install the Linux kernel onto it. This is accomplished by installing a series of boot loaders that will eventually lead to a normal Linux boot procedure from an initial ramdisk. This particular computer will have DDR3 RAM, a memory management unit, SD card peripheral, and interrup controller, as well as a timer.

Procedure

We follow roughly the same procedure as in Lab 3 by creating the Zynq 7 processor, however this time we will enable several additional peripherals to be used by the kernel in addition to our multiply IP module.

In addition to burning the Zynq 7 on the FPGA we must also compile U-boot and the Linux kernel.

Results

During this lab I encountered several issues mainly because of how I was organizing my work. I use a git system to distribute my work wherever I need it. When pushing the compiled linux kernel to my laptop there were issues with files not getting transferred which I later found was due to the .gitignore inside that particular directory structure. To mitigate this I simply archived it first.

Other than that there were no issues and the lab went smoothly.

Conclusions

Overall this lab was a success with no major incidents to report. The Linux kernel compiled successfully and was easy to copy over to the processor we created for this lab and future labs.

Questions

1. Because this memory is located internally (inside the CPU) I am led to believe that this local storage serves as a CPU cache. Such memory would reside in all modern processors within the CPU as it considerably reduces the amount of time to access repeated data.

2. This is a standard GNU/Linux system and therefore we can determine this by running the following command:

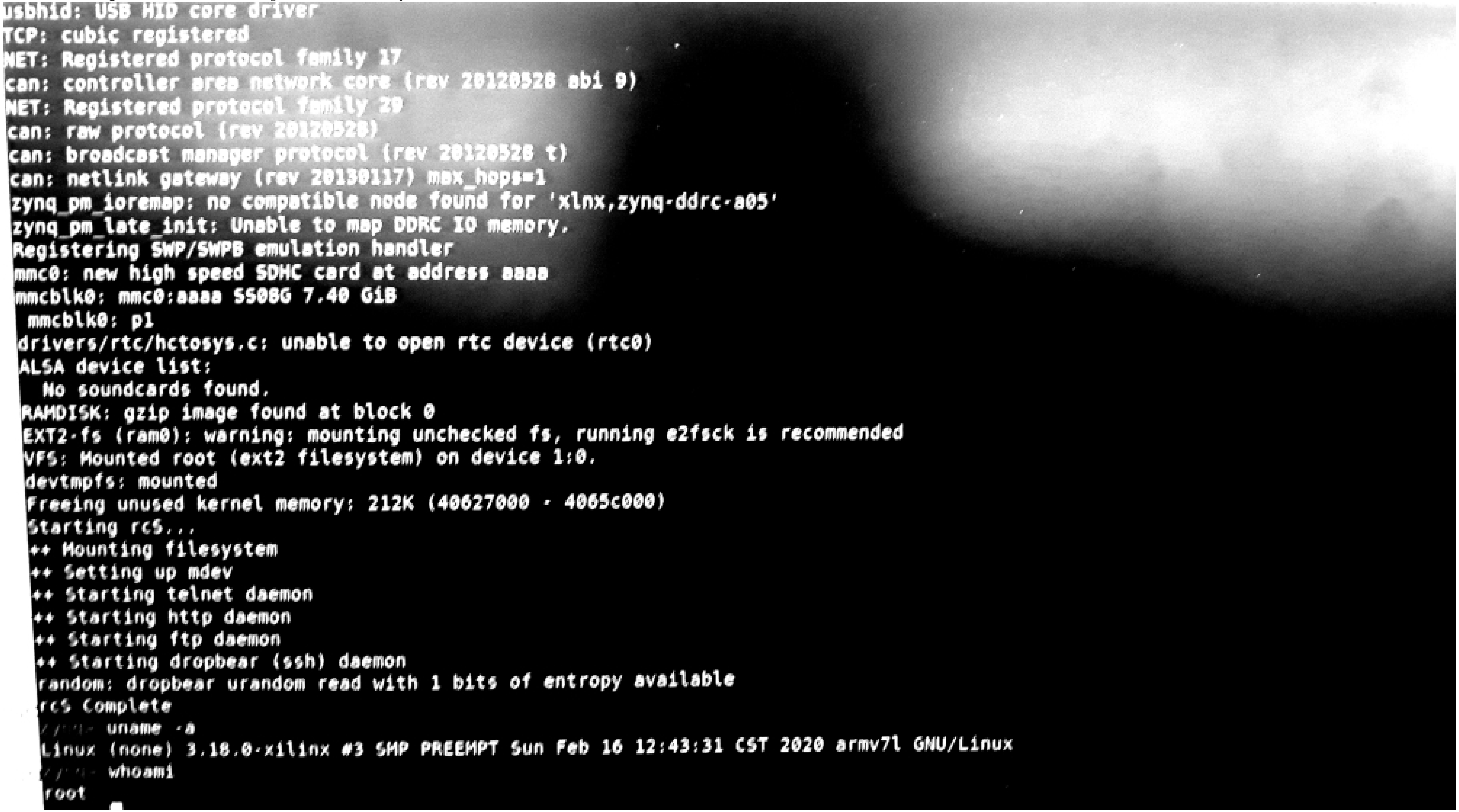
   ```
   # ls -l / | grep "^dr-"
   dr-xr-xr-x  95 root root     0 Feb  5 03:56 proc
   dr-xr-xr-x  13 root root     0 Feb 17 16:56 sys
   ```

   All other root directories are writeable by root or an appropriate account. Changes made are not persistent and will not survive a reboot.

3. Adding a new peripheral would constitute recompiling the kernel with the new address space information added/updated.

Appendix A - Console Output

The following is the console output immediately after boot :



```
usbhid: USB HID core driver
TCP: cubic registered
NET: Registered protocol family 17
can: controller area network core (rev 20120528 abi 9)
NET: Registered protocol family 29
can: raw protocol (rev 20120528)
can: broadcast manager protocol (rev 20120528 t)
can: netlink gateway (rev 20130117) max_hops=1
zynq_pm_ioremap: no compatible node found for 'xlnx,zynq-ddrc-a05'
zynq_pm_late_init: Unable to map DDRC IO memory.
Registering SWP/SWPB emulation handler
mmc0: new high speed SDHC card at address aaaa
mmcblk0: mmc0:aaaa SS08G 7.40 GiB
 mmcblk0: p1
drivers/rtc/hctosys.c: unable to open rtc device (rtc0)
ALSA device list:
  No soundcards found.
RAMDISK: gzip image found at block 0
EXT2-fs (ram0): warning: mounting unchecked fs, running e2fsck is recommended
VFS: Mounted root (ext2 filesystem) on device 1:0.
devtmpfs: mounted
Freeing unused kernel memory: 212K (40627000 - 4065c000)
Starting rcS...
++ Mounting filesystem
++ Setting up mdev
++ Starting telnet daemon
++ Starting http daemon
++ Starting ftp daemon
++ Starting dropbear (ssh) daemon
random: dropbear urandom read with 1 bits of entropy available
rcS Complete
 uname -a
Linux (none) 3.18.0-xilinx #3 SMP PREEMPT Sun Feb 16 12:43:31 CST 2020 armv7l GNU/Linux
 whoami
root
```