Xilinx Zynq FPGA, TI DSP, MCU 프로그래밍 및 회로 설계 전문가 과정

강사 – Innova Lee(이상훈)
gcccompil3r@gmail.com

AM5728 Based FTDI Driver Activation (USB 2 CAN)

먼저 기존 AM5728 System 에 USB 2 CAN 드라이버가 잡혀있는지 확인을 우선시한다.
USB 를 변환하는 작업이기 때문에 FTDI Driver 에 묶여있게 되며
USB 관련 정보들을 lsusb 를 통해 확인하도록 한다.
우선 해당 장치의 ID 는 0403:6001 로 잘 잡히는 것을 확인할 수 있다.

```
[   31.608544] rtc-ds1307 2-006f: write: 92 02 13 0a 10 07 17
[   31.609154] rtc-ds1307 2-006f: read: 92 02 13 2a 10 07 17
[   31.609170] rtc-ds1307 2-006f: read secs=12, mins=2, hours=13, mday=10, mon
[  364.873986] usb 1-1.3: USB disconnect, device number 3
[  367.159284] usb 1-1.2: new full-speed USB device number 4 using xhci-hcd
root@am57xx-evm:/lib/modules/4.4.32-gadde2ca9f8# lsusb
Bus 001 Device 004: ID 0403:6001 Future Technology Devices International, Ltd
Bus 002 Device 002: ID 0451:8140 Texas Instruments, Inc.
Bus 002 Device 001: ID 1d6b:0003 Linux Foundation
Bus 001 Device 002: ID 0451:8142 Texas Instruments, Inc. TUSB8041 4-Port Hub
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation
root@am57xx-evm:/lib/modules/4.4.32-gadde2ca9f8# lsusb -s 0c52
root@am57xx-evm:/lib/modules/4.4.32-gadde2ca9f8# lsusb
Bus 001 Device 004: ID 0403:6001 Future Technology Devices International, Ltd
Bus 002 Device 002: ID 0451:8140 Texas Instruments, Inc.
Bus 002 Device 001: ID 1d6b:0003 Linux Foundation
Bus 001 Device 002: ID 0451:8142 Texas Instruments, Inc. TUSB8041 4-Port Hub
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation
root@am57xx-evm:/lib/modules/4.4.32-gadde2ca9f8#
```

ftdi_sio.ko 를 찾으러 간다.
실제로 lsmod 등의 명령어로도
Kernel Module 을 찾을 수 없으니
실제 커널 소스 코드상에서
컴파일이 되었는지
여부를 확인해야할 필요가 있다.

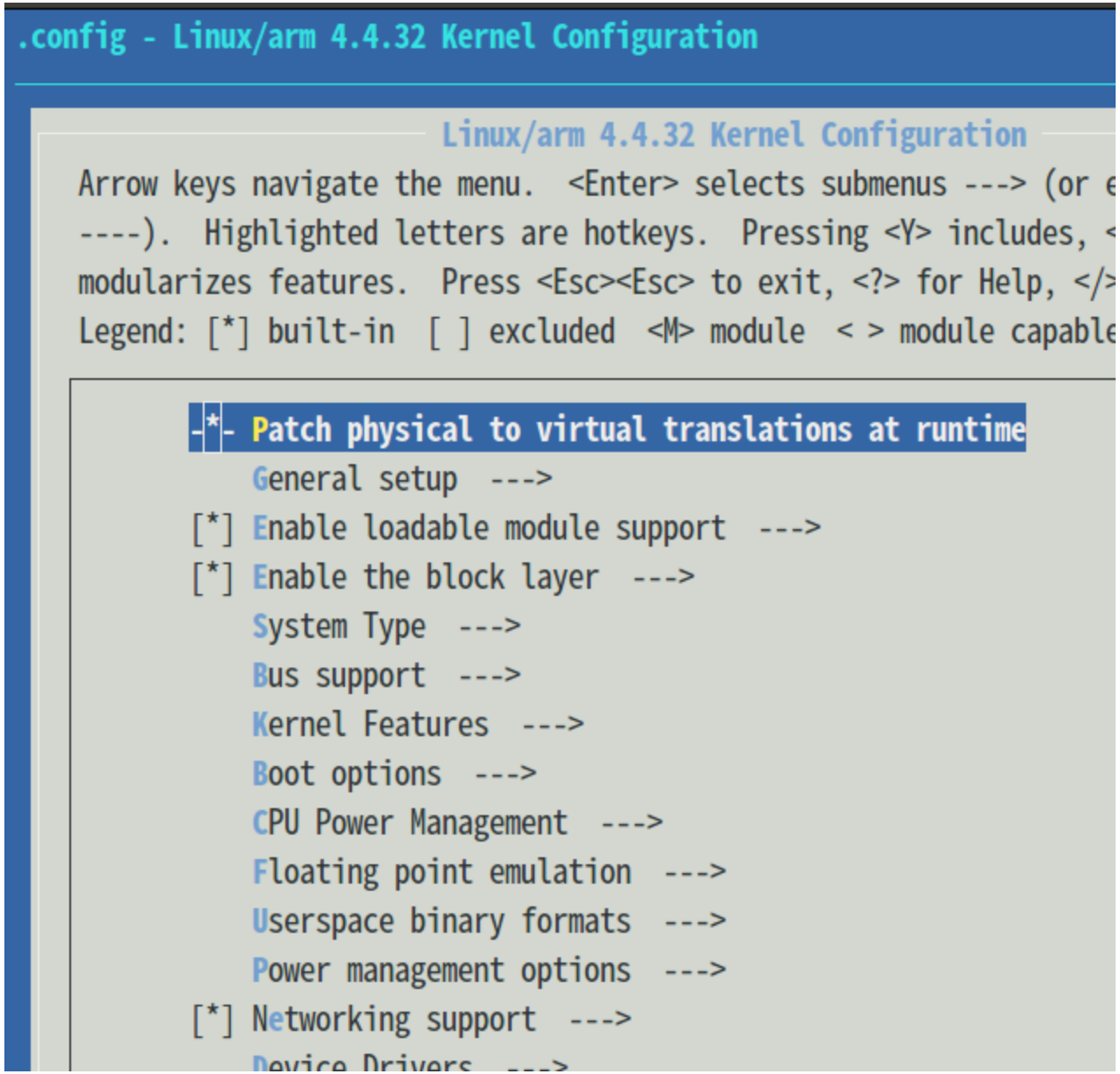
살펴보니 아니나 다를까
모듈 자체가 컴파일 되지 않았다.

```
kwrg@kwrg-Samsung-DeskTop-System:~/ti-processor-sdk-linux-am57xx-evm-03.02.00.05/board-support/
linux-4.4.32+gitAUTOINC+adde2ca9f8-gadde2ca9f8/drivers/usb/serial$ ls
Kconfig                  garmin_gps.c       keyspan_usa90msg.h  safe_serial.c
Makefile                 generic.c          kl5kusb105.c        sierra.c
Makefile-keyspan_pda_fw  generic.o          kl5kusb105.h        spcp8x5.c
aircable.c               io_16654.h         kobil_sct.c         ssu100.c
ark3116.c                io_edgeport.c      kobil_sct.h         symbolserial.c
belkin_sa.c              io_edgeport.h      mct_u232.c          ti_usb_3410_5052.c
belkin_sa.h              io_ionsp.h         mct_u232.h          ti_usb_3410_5052.h
built-in.o               io_tables.h        metro-usb.c         usb-serial-simple.c
bus.c                    io_ti.c            modules.order       usb-serial.c
bus.o                    io_ti.h            mos7720.c           usb-serial.o
ch341.c                  io_usbvend.h       mos7840.c           usb-wwan.h
console.c                ipaq.c             mxuport.c           usb_debug.c
cp210x.c                 ipw.c              navman.c            usb_wwan.c
cyberjack.c              ir-usb.c           omninet.c           usbserial.ko
cypress_m8.c             iuu_phoenix.c      opticon.c           usbserial.mod.c
cypress_m8.h             iuu_phoenix.h      option.c            usbserial.mod.o
digi_acceleport.c        keyspan.c          oti6858.c           usbserial.o
empeg.c                  keyspan.h          oti6858.h           visor.c
ezusb_convert.pl         keyspan_pda.c      pl2303.c            visor.h
f81232.c                 keyspan_usa26msg.h pl2303.h            whiteheat.c
ftdi_sio.c               keyspan_usa28msg.h qcaux.c             whiteheat.h
ftdi_sio.h               keyspan_usa49msg.h qcserial.c          wishbone-serial.c
ftdi_sio_ids.h           keyspan_usa67msg.h quatech2.c          xsens_mt.c
```

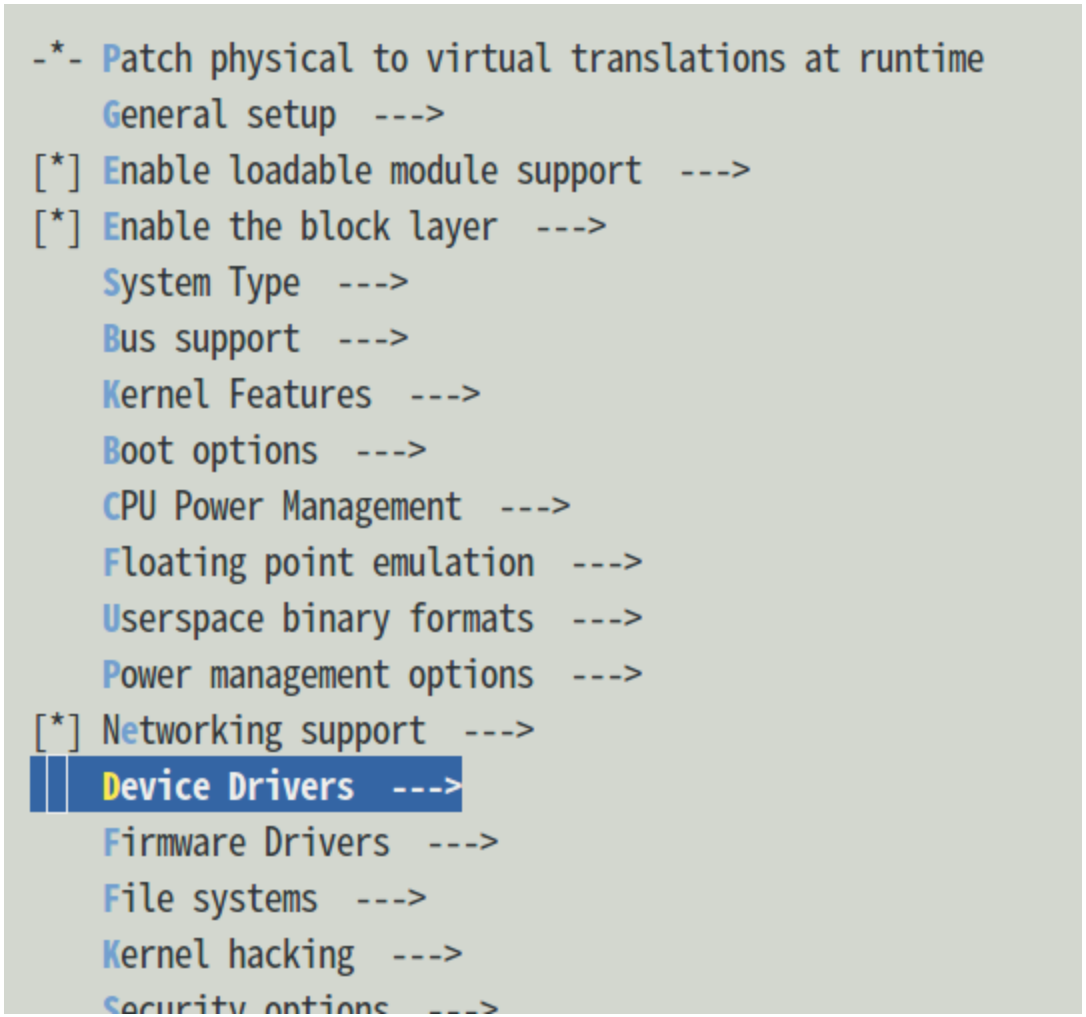
이전에 Kernel Compile 을 수행할 때 빼먹었던 부분이라서 추가해넣었다.
최근 기존 Kernel Compile 문서를 업데이트 하였으니 전체적인 과정이 기억이 안난다면 해당 문서를 참고하라.

```
kwrg@kwrg-Samsung-DeskTop-System:~/ti-processor-sdk-linux-am57xx-evm-03.02.00.05/board-support/
linux-4.4.32+gitAUTOINC+adde2ca9f8-gadde2ca9f8$ export TOOLCHAIN_PATH=~/ti-processor-sdk-linux-
am57xx-evm-03.02.00.05/linux-devkit/sysroots/x86_64-arago-linux/usr/bin
kwrg@kwrg-Samsung-DeskTop-System:~/ti-processor-sdk-linux-am57xx-evm-03.02.00.05/board-support/
linux-4.4.32+gitAUTOINC+adde2ca9f8-gadde2ca9f8$ export CROSS_COMPILE=arm-linux-gnueabihf-
kwrg@kwrg-Samsung-DeskTop-System:~/ti-processor-sdk-linux-am57xx-evm-03.02.00.05/board-support/
linux-4.4.32+gitAUTOINC+adde2ca9f8-gadde2ca9f8$ export ARCH=arm
kwrg@kwrg-Samsung-DeskTop-System:~/ti-processor-sdk-linux-am57xx-evm-03.02.00.05/board-support/
linux-4.4.32+gitAUTOINC+adde2ca9f8-gadde2ca9f8$ [ "$TOOLCHAIN_PATH" != "DEFAULT" ] && export PA
TH=$TOOLCHAIN_PATH:$PATH
kwrg@kwrg-Samsung-DeskTop-System:~/ti-processor-sdk-linux-am57xx-evm-03.02.00.05/board-support/
linux-4.4.32+gitAUTOINC+adde2ca9f8-gadde2ca9f8$
```

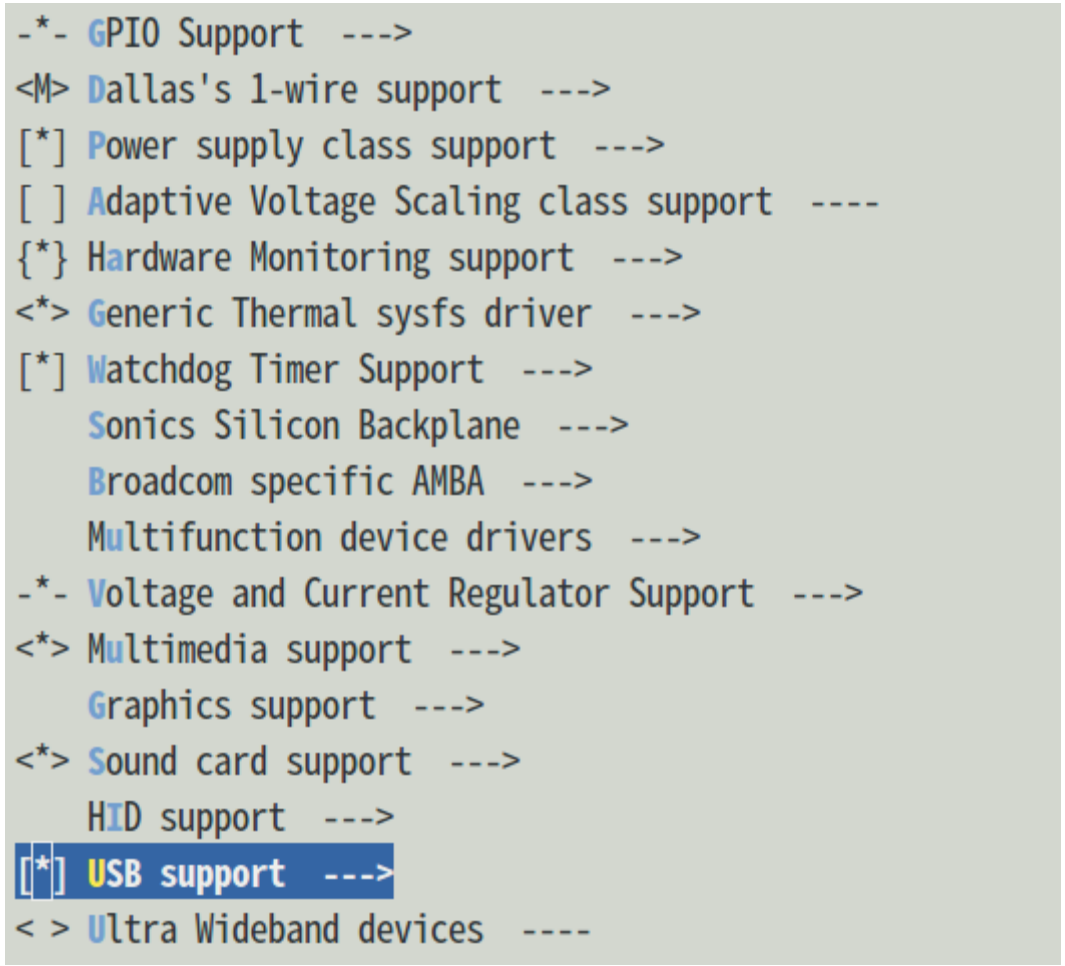
menuconfig 쪽으로 진입하도록 한다.



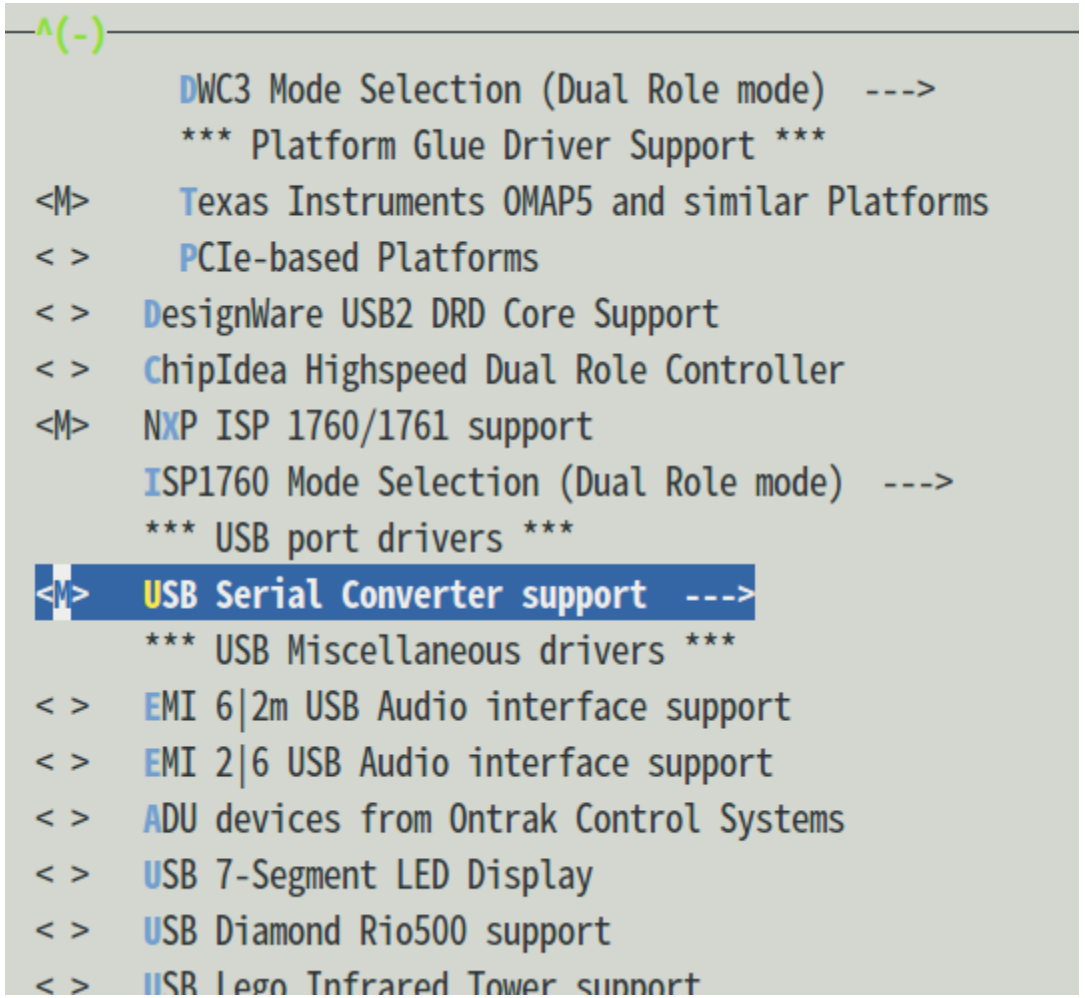
Device Drivers 로 이동한다.



USB support 로 이동하도록 한다.



USB Serial Converter support 를 선택하도록 한다.



USB FTDI Single Port Serial Driver 를 선택하라.

기존에 한 번씩 컴파일을 했을테니
작업은 순식간에 끝난다.

그리고 새로 ftdi_sio.ko 가
컴파일 되는 것을 볼 수 있다.

```
  Kernel: arch/arm/boot/zImage is ready
kwrg@kwrg-Samsung-DeskTop-System:~/ti-processor-sdk-linux-am57xx-evm-03.02.00.05/board-support/
linux-4.4.32+gitAUTOINC+adde2ca9f8-gadde2ca9f8$ make ARCH=arm CROSS_COMPILE=arm-linux-gnueabih
- am57xx-evm-reva3.dtb
make[1]: 'arch/arm/boot/dts/am57xx-evm-reva3.dtb'은(는) 이미 업데이트되었습니다.
kwrg@kwrg-Samsung-DeskTop-System:~/ti-processor-sdk-linux-am57xx-evm-03.02.00.05/board-support/
linux-4.4.32+gitAUTOINC+adde2ca9f8-gadde2ca9f8$ make ARCH=arm CROSS_COMPILE=arm-linux-gnueabih
- am57xx-evm.dtb
make[1]: 'arch/arm/boot/dts/am57xx-evm.dtb'은(는) 이미 업데이트되었습니다.
kwrg@kwrg-Samsung-DeskTop-System:~/ti-processor-sdk-linux-am57xx-evm-03.02.00.05/board-support/
linux-4.4.32+gitAUTOINC+adde2ca9f8-gadde2ca9f8$ make ARCH=arm CROSS_COMPILE=arm-linux-gnueabih
- modules
  CHK     include/config/kernel.release
  CHK     include/generated/uapi/linux/version.h
  CHK     include/generated/utsrelease.h
make[1]: 'include/generated/mach-types.h'은(는) 이미 업데이트되었습니다.
  CHK     include/generated/bounds.h
  CHK     include/generated/timeconst.h
  CHK     include/generated/asm-offsets.h
  CALL    scripts/checksyscalls.sh
  CC [M]  drivers/usb/serial/ftdi_sio.o
  Building modules, stage 2.
  MODPOST 368 modules
  CC      drivers/usb/serial/ftdi_sio.mod.o
  LD [M]  drivers/usb/serial/ftdi_sio.ko
kwrg@kwrg-Samsung-DeskTop-System:~/ti-processor-sdk-linux-am57xx-evm-03.02.00.05/board-support
```

아래와 같이 Module 을 복사하여 이동시킨 디렉토리(파일시스템)에서 ftdi_sio.ko 를 찾을 수 있다.

```
kwrg@kwrg-Samsung-DeskTop-System:~/tmp_fs2$ ls lib/modules/4.4.32-gadde2ca9f8/bu
ild/drivers/usb/
.built-in.o.cmd  class/          image/          renesas_usbhs/
Kconfig          common/         isp1760/        serial/
Makefile         core/           misc/           storage/
README           dwc2/           modules.builtin  usb-skeleton.c
atm/             dwc3/           modules.order   usbip/
built-in.o       early/          mon/            wusbcore/
c67x00/          gadget/         musb/
chipidea/        host/           phy/
kwrg@kwrg-Samsung-DeskTop-System:~/tmp_fs2$ ls lib/modules/4.4.32-gadde2ca9f8/bu
ild/drivers/usb/serial/
Display all 106 possibilities? (y or n)
kwrg@kwrg-Samsung-DeskTop-System:~/tmp_fs2$ ls lib/modules/4.4.32-gadde2ca9f8/bu
ild/drivers/usb/serial/ftdi_sio
ftdi_sio.c      ftdi_sio.ko     ftdi_sio.mod.o  ftdi_sio_ids.h
ftdi_sio.h      ftdi_sio.mod.c  ftdi_sio.o
```

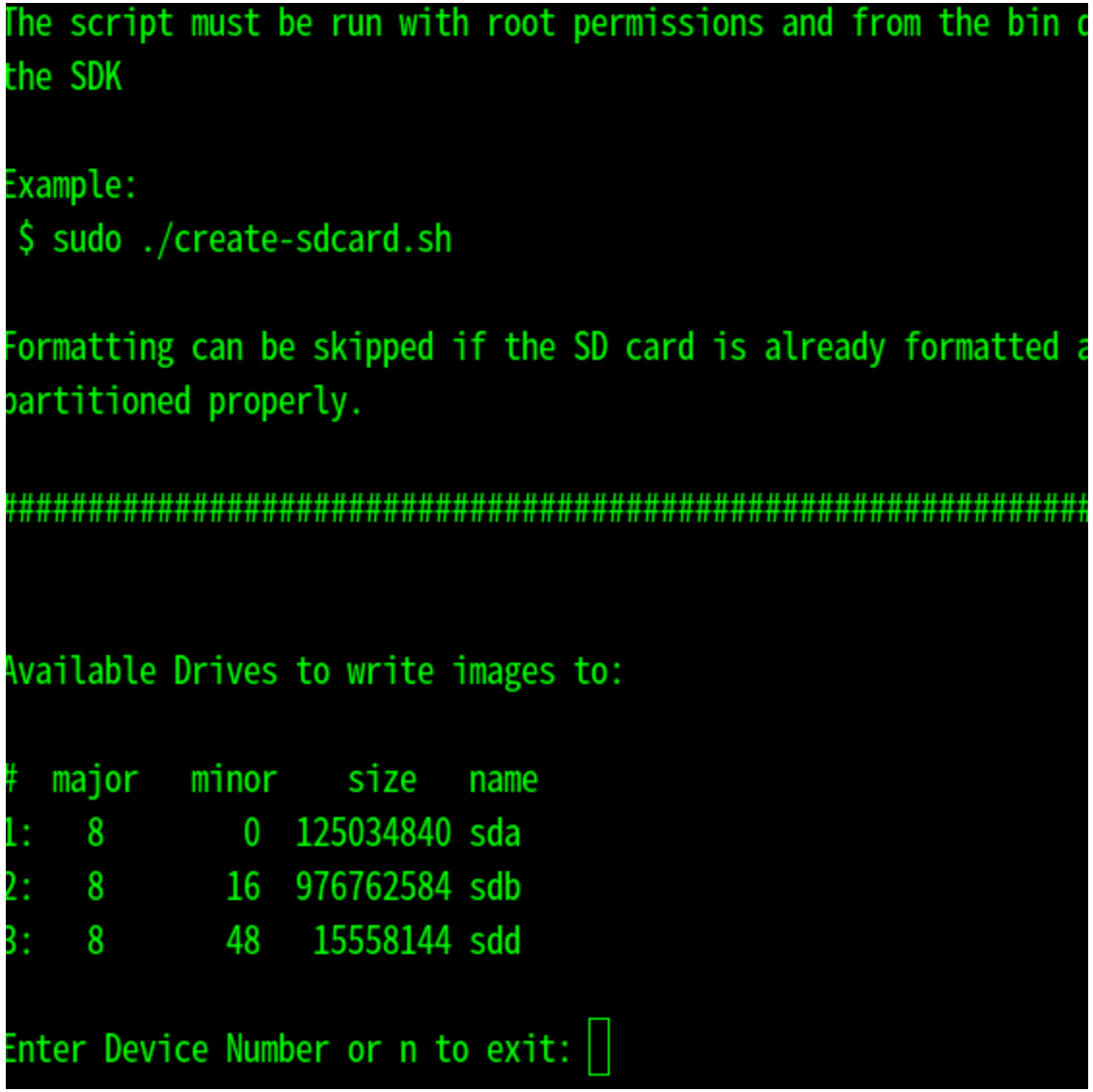
이제 다시 이미지를 SD 카드에 굽도록 한다.

```
kwrg@kwrg-Samsung-DeskTop-System:~/ti-processor-sdk-linux-am57xx-evm-03.02.00.05/bin$ ls
add-to-group.sh    create-ubifs.sh       setup-package-install.sh  setup-uboot-env.sh
common.sh          setup-host-check.sh   setup-targetfs-nfs.sh     unshallow-repositories.sh
create-sdcard.sh   setup-minicom.sh      setup-tftp.sh
kwrg@kwrg-Samsung-DeskTop-System:~/ti-processor-sdk-linux-am57xx-evm-03.02.00.05/bin$
```

아래 명령을 통해 구울 수 있다.

```
kwrg@kwrg-Samsung-DeskTop-System:~/ti-processor-sdk-linux-am57xx-evm-03.02.00.05/bin$ sudo ./cr
eate-sdcard.sh
```

SD 카드 16 G 에 해당하는 3 번을 선택한다.



직접 커널을 커스터마이징 하는 것이니
2 번 눌러서 경로를 지정해주도록 한다.

```
Enter Device Number or n to exit: 3

sdd was selected

/dev/sdd is an sdx device
Unmounting the sdd drives
 unmounted /dev/sdd1
 unmounted /dev/sdd2
Current size of sdd1 71680 bytes
Current size of sdd2 15469568 bytes

#############################################################################

        Select 2 partitions if only need boot and rootfs (most users).
        Select 3 partitions if need SDK & other content on SD card.  This is
        usually used by device manufacturers with access to partition tarballs.

        ****WARNING**** continuing will erase all data on sdd

#############################################################################

Number of partitions needed [2/3] :
```

```
Proceed anyway? (y,n) y
Creating filesystem with 3867392 4k blocks and 967232 inodes
Filesystem UUID: 0094ec11-0bdd-45b9-844e-4a366a1cd1ee
Superblock backups stored on blocks:
        32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632, 2654208

Allocating group tables: done
Writing inode tables: done
Creating journal (32768 blocks): done
Writing superblocks and filesystem accounting information: done



################################################################################

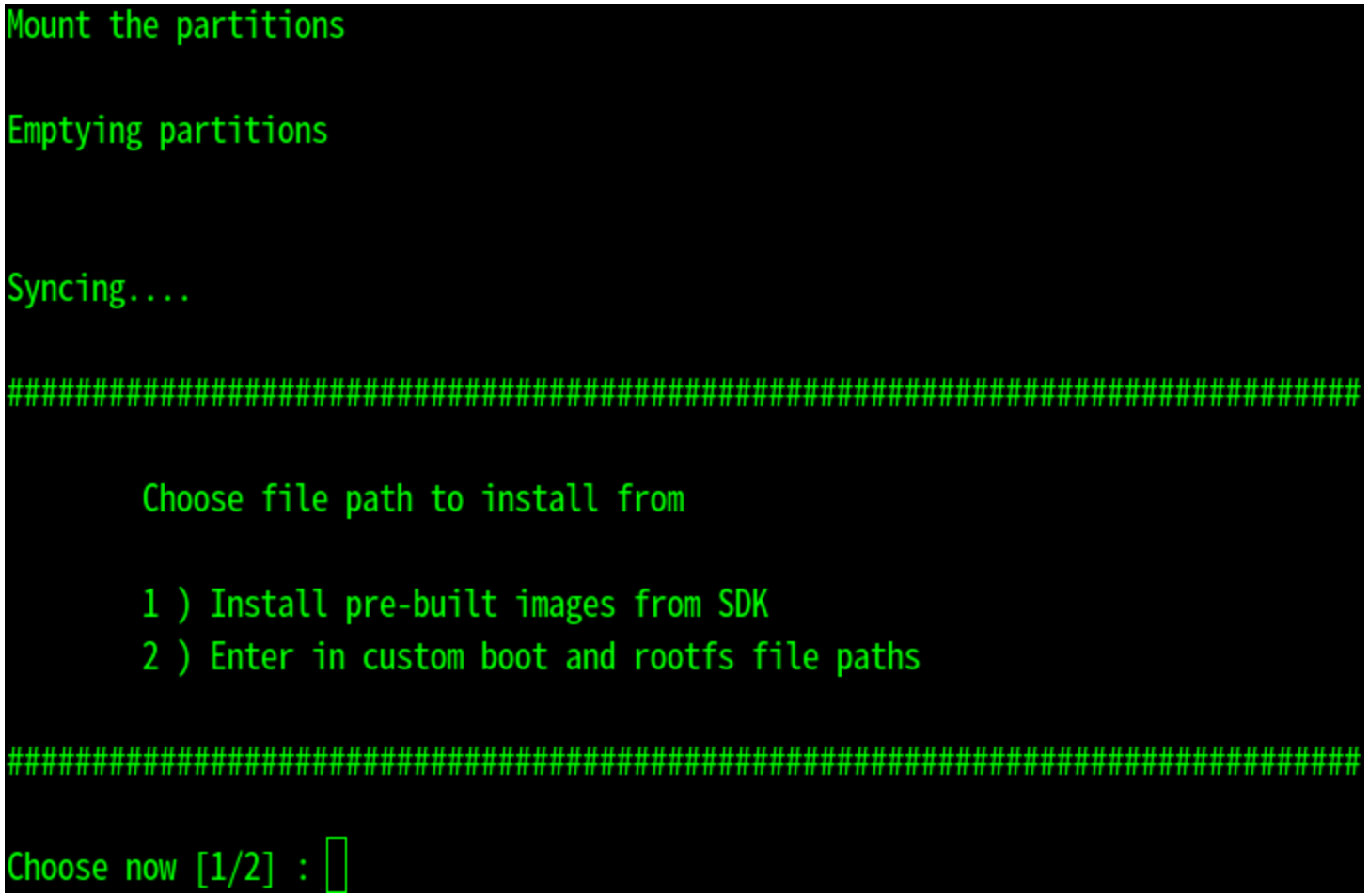
   Partitioning is now done
   Continue to install filesystem or select 'n' to safe exit

   **Warning** Continuing will erase files any files in the partitions

################################################################################


Would you like to continue? [y/n] : y
```

경우에 따라서 빠를수도 있고 느릴수도 있다.
역시 직접 만든것을 선택해야하니 커스텀 옵션을 선택해라.



```
Choose now [1/2] : 2



################################################################################

  For U-boot and MLO

  If files are located in Tarball write complete path including the file name.
      e.x. $:  /home/user/MyCustomTars/boot.tar.xz

  If files are located in a directory write the directory path
      e.x. $: /ti-sdk/board-support/prebuilt-images/

  NOTE: Not all platforms will have an MLO file and this file can
        be ignored for platforms that do not support an MLO.

  Update: The proper location for the kernel image and device tree
          files have moved from the boot partition to the root filesystem.

################################################################################

Enter path for Boot Partition :
```

```
.gradle/                                        exploit/
.installjammerinfo/                             fpga/
.java/                                          gproj/
.local/                                         imagination_sgx/
.macromedia/                                    mach_learn/
.matlab/                                        mat/
.minirc.dfl                                     minicom.log
.minirc.dfl.old                                 mp3/
.mozilla/                                       nvidia/
.nano/                                          ocv/
.nv/                                            ogl4/
.oracle_jre_usage/                              opencv_src/
.pam_environment                                setup/
.pki/                                           sw/
Enter path for Boot Partition : /home/kwrg/tmp_
tmp_boot/ tmp_fs/   tmp_fs2/
Enter path for Boot Partition : /home/kwrg/tmp_boot/
MLO         u-boot.img
Enter path for Boot Partition : /home/kwrg/tmp_boot/
```

```
Directory exists

This directory contains:
MLO  u-boot.img

Is this correct? [y/n] : y


##############################################################################

   For Kernel Image and Device Trees files

    What would you like to do?
     1) Reuse kernel image and device tree files found in the selected rootfs.
     2) Provide a directory that contains the kernel image and device tree files
        to be used.

##############################################################################

Choose option 1 or 2 :
```

```
Choose option 1 or 2 : 2


Choosing a directory that contains the kernel files to be used

#############################################################################

  For Kernel Image and Device Trees files

  The kernel image name should contain the image type uImage or zImage depending
  on which format is used.

  The device tree files must end with .dtb
      e.g    am335x-evm.dtb am43x-gp-evm.dtb


#############################################################################

Enter path for kernel image and device tree files :
```

```
Enter path for kernel image and device tree files : /home/kwrg/tmp_fs2/boot/
am571x-idk-lcd-osd.dtb
am571x-idk-lcd-osd101t2587.dtb
am571x-idk.dtb
am572x-idk-lcd-osd.dtb
am572x-idk-lcd-osd101t2587.dtb
am572x-idk-pru-excl-uio.dtb
am572x-idk.dtb
am57xx-beagle-x15-revb1.dtb
am57xx-beagle-x15.dtb
am57xx-evm-reva3.dtb
am57xx-evm.dtb
devicetree-zImage-am571x-idk-lcd-osd.dtb
devicetree-zImage-am571x-idk-lcd-osd101t2587.dtb
devicetree-zImage-am571x-idk.dtb
devicetree-zImage-am572x-idk-lcd-osd.dtb
devicetree-zImage-am572x-idk-lcd-osd101t2587.dtb
devicetree-zImage-am572x-idk-pru-excl-uio.dtb
devicetree-zImage-am572x-idk.dtb
devicetree-zImage-am57xx-beagle-x15-revb1.dtb
devicetree-zImage-am57xx-beagle-x15.dtb
devicetree-zImage-am57xx-evm-reva3.dtb
devicetree-zImage-am57xx-evm.dtb
vmlinux-4.4.32-gadde2ca9f8
zImage
```

```
am572x-idk.dtb
am57xx-beagle-x15-revb1.dtb
am57xx-beagle-x15.dtb
am57xx-evm-reva3.dtb
am57xx-evm.dtb
devicetree-zImage-am571x-idk-lcd-osd.dtb
devicetree-zImage-am571x-idk-lcd-osd101t2587.dtb
devicetree-zImage-am571x-idk.dtb
devicetree-zImage-am572x-idk-lcd-osd.dtb
devicetree-zImage-am572x-idk-lcd-osd101t2587.dtb
devicetree-zImage-am572x-idk-pru-excl-uio.dtb
devicetree-zImage-am572x-idk.dtb
devicetree-zImage-am57xx-beagle-x15-revb1.dtb
devicetree-zImage-am57xx-beagle-x15.dtb
devicetree-zImage-am57xx-evm-reva3.dtb
devicetree-zImage-am57xx-evm.dtb
vmlinux-4.4.32-gadde2ca9f8
zImage
zImage-4.4.32-gadde2ca9f8

Is this correct? [y/n] : y
```

```
Is this correct? [y/n] : y


################################################################################

   For Rootfs partition

   If files are located in Tarball write complete path including the file name.
      e.x. $:  /home/user/MyCustomTars/rootfs.tar.xz

  If files are located in a directory write the directory path
      e.x. $: /ti-sdk/targetNFS/

################################################################################

Enter path for Rootfs Partition :
```

```
################################################################################

  For Rootfs partition

  If files are located in Tarball write complete path including the file name.
     e.x. $:  /home/user/MyCustomTars/rootfs.tar.xz

 If files are located in a directory write the directory path
     e.x. $: /ti-sdk/targetNFS/

################################################################################

Enter path for Rootfs Partition : /home/kwrg/tmp_fs2/
```

```
Enter path for Rootfs Partition : /home/kwrg/tmp_fs2/

This directory contains:
bin   dev  home     lib    mnt  proc  sbin  sys  usr  www
boot  etc  include  media  opt  run   srv   tmp  var

Is this correct? [y/n] : y

################################################################################

        Copying files now... will take minutes

################################################################################

Copying boot partition

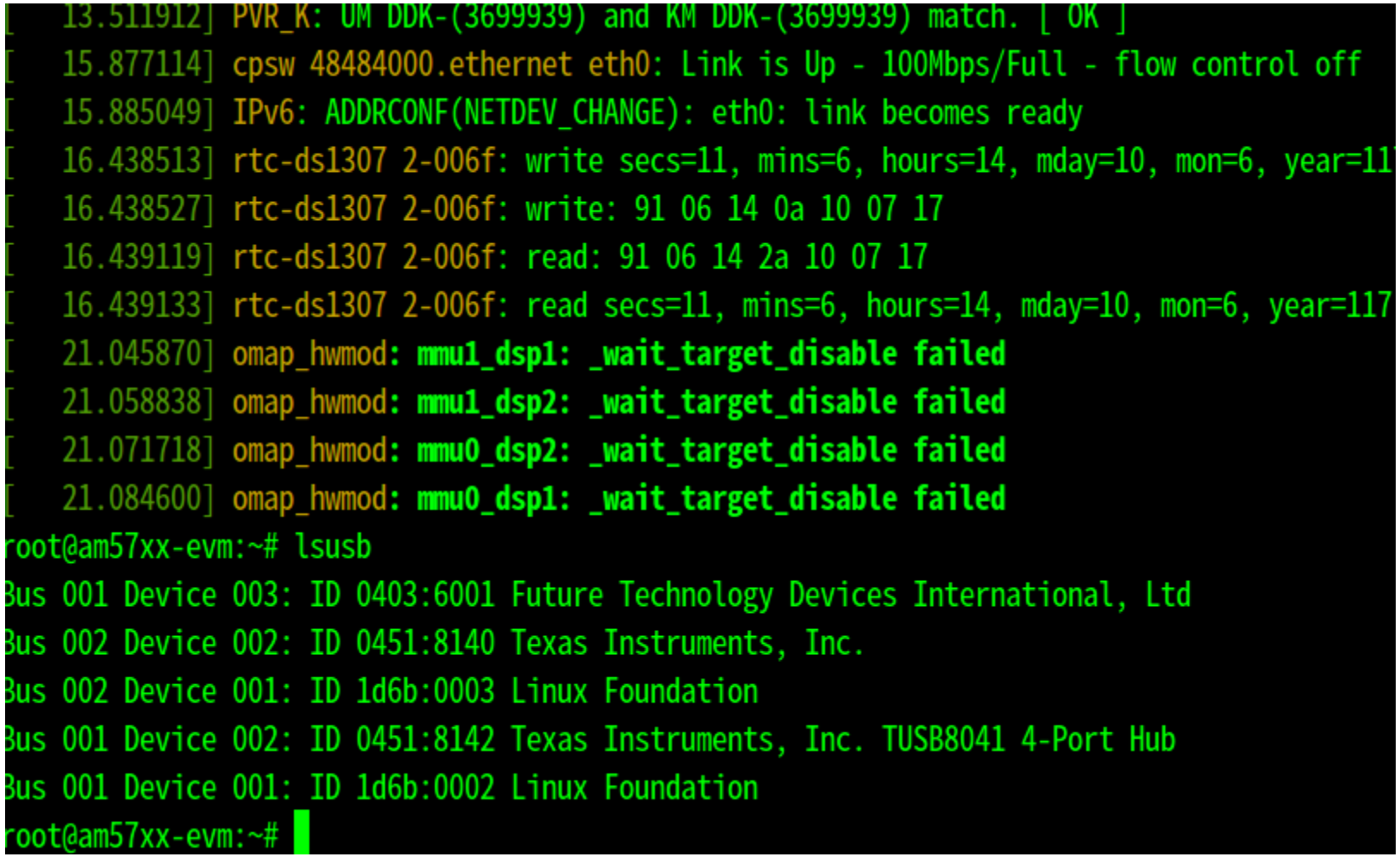
MLO copied


u-boot.img copied


Copying rootfs System partition
8 /  2024496 copied
```

```
Add correct host key in /home/kwrg/.ssh/known_hosts to get rid of this message.
Offending RSA key in /home/kwrg/.ssh/known_hosts:5
  remove with:
  ssh-keygen -f "/home/kwrg/.ssh/known_hosts" -R 192.168.25.11
RSA host key for 192.168.25.11 has changed and you have requested strict checking.
Host key verification failed.
kwrg@kwrg-Samsung-DeskTop-System:~/ti-processor-sdk-linux-am57xx-evm-03.02.00.05/bin$ ls /home/kwrg/.ssh/known_
hosts
add-to-group.sh            create-ubifs.sh            setup-package-install.sh   setup-uboot-env.sh
common.sh                  setup-host-check.sh        setup-targetfs-nfs.sh      unshallow-repositories.sh
create-sdcard.sh           setup-minicom.sh           setup-tftp.sh
kwrg@kwrg-Samsung-DeskTop-System:~/ti-processor-sdk-linux-am57xx-evm-03.02.00.05/bin$ ls /home/kwrg/.ssh/
known_hosts
kwrg@kwrg-Samsung-DeskTop-System:~/ti-processor-sdk-linux-am57xx-evm-03.02.00.05/bin$ vi /home/kwrg/.ssh/known_
hosts
kwrg@kwrg-Samsung-DeskTop-System:~/ti-processor-sdk-linux-am57xx-evm-03.02.00.05/bin$ vi /home/kwrg/.ssh/known_
hosts
kwrg@kwrg-Samsung-DeskTop-System:~/ti-processor-sdk-linux-am57xx-evm-03.02.00.05/bin$ ssh root@192.168.25.11
The authenticity of host '192.168.25.11 (192.168.25.11)' can't be established.
RSA key fingerprint is SHA256:q7VLGwVGBQ8vd8xmm6DPw7yAQJGgOgRsSNb1SPqE5XY.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '192.168.25.11' (RSA) to the list of known hosts.
root@am57xx-evm:~# ls
root@am57xx-evm:~# ls /dev/ttyUSB0
/dev/ttyUSB0
root@am57xx-evm:~#
```

```
[    7.356943] palmas-usb 48070000.i2c:tps659038@58:tps659038_usb: using device tree for GPI
[    7.356950] of_get_named_gpiod_flags: can't parse 'vbus-gpios' property of node '/ocp/i2c
@58/tps659038_usb[0]'
[    7.357012] of_get_named_gpiod_flags: parsed 'vbus-gpio' property of node '/ocp/i2c@48070
s659038_usb[0]' - status (0)
[   11.123948] usbcore: registered new interface driver usbfs
[   11.123995] usbcore: registered new interface driver hub
[   11.124073] usbcore: registered new device driver usb
[   11.242336] usb usb2: We don't know the algorithms for LPM for this host, disabling LPM.
[   11.558509] usb 1-1: new high-speed USB device number 2 using xhci-hcd
[   11.565084] usb 2-1: new SuperSpeed USB device number 2 using xhci-hcd
[   12.028525] usb 1-1.2: new full-speed USB device number 3 using xhci-hcd
[   12.293675] usbcore: registered new interface driver usbserial
[   12.320732] usbcore: registered new interface driver ftdi_sio
[   12.342513] usbserial: USB Serial support registered for FTDI USB Serial Device
[   12.398123] usb 1-1.2: Detected FT232RL
[   12.408002] usb 1-1.2: FTDI USB Serial Device converter now attached to ttyUSB0
root@am57xx-evm:~#
```


[13.511912] PVR_K: UM DDK-(3699939) and KM DDK-(3699939) match. [OK]
[15.877114] cpsw 48484000.ethernet eth0: Link is Up - 100Mbps/Full - flow control off
[15.885049] IPv6: ADDRCONF(NETDEV_CHANGE): eth0: link becomes ready
[16.438513] rtc-ds1307 2-006f: write secs=11, mins=6, hours=14, mday=10, mon=6, year=11
[16.438527] rtc-ds1307 2-006f: write: 91 06 14 0a 10 07 17
[16.439119] rtc-ds1307 2-006f: read: 91 06 14 2a 10 07 17
[16.439133] rtc-ds1307 2-006f: read secs=11, mins=6, hours=14, mday=10, mon=6, year=117
[21.045870] omap_hwmod: mmu1_dsp1: _wait_target_disable failed
[21.058838] omap_hwmod: mmu1_dsp2: _wait_target_disable failed
[21.071718] omap_hwmod: mmu0_dsp2: _wait_target_disable failed
[21.084600] omap_hwmod: mmu0_dsp1: _wait_target_disable failed
root@am57xx-evm:~# lsusb
Bus 001 Device 003: ID 0403:6001 Future Technology Devices International, Ltd
Bus 002 Device 002: ID 0451:8140 Texas Instruments, Inc.
Bus 002 Device 001: ID 1d6b:0003 Linux Foundation
Bus 001 Device 002: ID 0451:8142 Texas Instruments, Inc. TUSB8041 4-Port Hub
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation
root@am57xx-evm:~#

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devicetree-
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Un-mount th

Remove crea
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  -h, --help
      Show usage and help
root@am57xx-evm:~# lsusb -s 0c52
root@am57xx-evm:~# lsmod | grep ftdi
ftdi_sio               31772  0
usbserial              25475  1 ftdi_sio
usbcore               193449  4 usbserial,xhci_plat_hcd,ftdi_sio,xhci_hcd
root@am57xx-evm:~#
```

```
root@am57xx-evm:~# lsmod | grep ftdi
ftdi_sio               31772  0
usbserial              25475  1 ftdi_sio
usbcore               193449  4 usbserial,xhci_plat_hcd,ftdi_sio,xhci_hcd
root@am57xx-evm:~# cat /proc/devices | grep -i "ttyUSB"
188 ttyUSB
root@am57xx-evm:~# cat /proc/tty/driver/usbserial
usbserinfo:1.0 driver:2.0
0: module:ftdi_sio name:"FTDI USB Serial Device" vendor:0403 product:6001 num_ports:1 port:0 path:usb-xhci-hcd.
2.auto-1.2
root@am57xx-evm:~#
```