Cross Compiling Ubuntu Kernel & Prophesee device drivers

Detail Document - 02 for Kria-App

Ubuntu Kernel Corss Compilation Steps:

This document is on how to cross-compile ubuntu kernel in Host PC. For updating the Prophesee camera driver and camera operation inside Kria-Ubuntu, we have to re-build the Kria-Ubuntu kernel with the necessary support for custom camera driver.

Steps for cross compiling linux kernel from source as mentioned here:
Rebuilding+the+Certified+Ubuntu+for+Xilinx+Devices+20.04+LTS+Kernel+from+Source

Above link is used for `Ubuntu 20.04 LTS`: focal , which was changed to `jammy` corresponding to `Ubuntu 22.04`

So terminal command used:

```
echo "deb-src http://archive.ubuntu.com/ubuntu jammy main" | sudo tee -a
/etc/apt/sources.list.d/jammy.list

sudo apt-get update

sudo apt-get build-dep linux

sudo apt-get install git fakeroot libncurses-dev gcc-aarch64-linux-gnu
linux-tools-common

git clone
https://git.launchpad.net/~canonical-kernel/ubuntu/+source/linux-xilinx-zyn
qmp/+git/jammy
```

This will create `jammy` folder containing linux kernel source code..

Next selected the kernel branch as currently running in kria board:

```
cd jammy

git tag
```

```
git checkout Ubuntu-xilinx-zynqmp-5.15.0-1027.31

export ARCH=arm64
export $(dpkg-architecture -aarm64)
export CROSS_COMPILE=aarch64-linux-gnu-
```

Next configure the kernel by running following commands:
```

fakeroot debian/rules clean
fakeroot debian/rules editconfigs do_enforce_all=false
```

Update the cross compiled linux kernel with CONFIG_VIDEO_ADV_DEBUG config enabled:

```
Symbol: VIDEO_ADV_DEBUG [=y]
Type  : bool
Defined at drivers/media/v4l2-core/Kconfig:28
  Prompt: Enable advanced debug functionality on V4L2 drivers
  Depends on: MEDIA_SUPPORT [=y]
  Visible if: MEDIA_SUPPORT [=y] && VIDEO_DEV [=y]
  Location:
    -> Device Drivers
      -> Multimedia support (MEDIA_SUPPORT [=y])
(2)      -> Video4Linux options
```
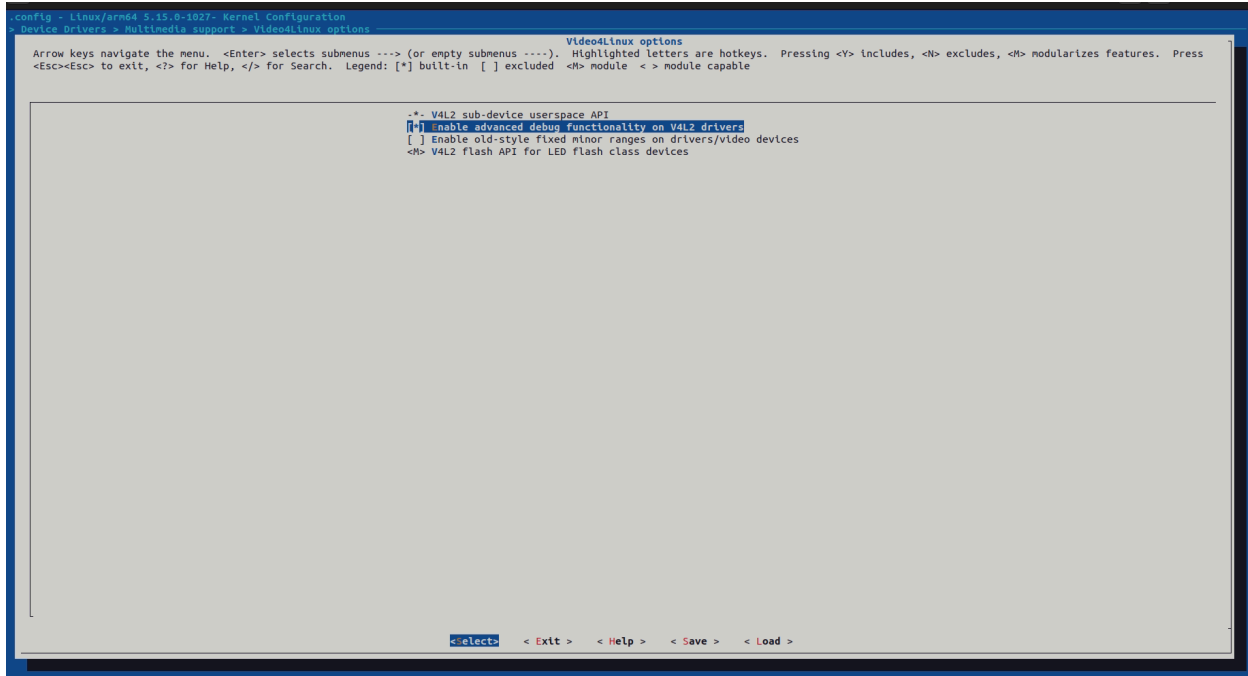
```
fakeroot debian/rules clean
fakeroot debian/rules binary
```

Note:
Error during build:
```
mkdir
/home/logictronix03/ubuntu_workspace/jammy_custom/jammy/debian/linux-libc-dev/usr/include/
aarch64-linux-gnu
mkdir: cannot create directory
'/home/logictronix03/ubuntu_workspace/jammy_custom/jammy/debian/linux-libc-dev/usr/include/
aarch64-linux-gnu': File exists
make: *** [debian/rules.d/2-binary-arch.mk:569: install-arch-headers] Error 1
```

Soln:
Remove the aarch64-linux-gnu directory using rm -rf command:
```
rm -rf
/home/logictronix03/ubuntu_workspace/jammy_custom/jammy/debian/linux-libc-dev/usr/include/
aarch64-linux-gnu
```

After build is complete *.deb files are found outside ubuntu kernel folder `jammy` folder:

```
logictronix03@logictronix03:~/ubuntu_workspace/jammy_custom$ ls *.deb
linux-buildinfo-5.15.0-1027-xilinx-zynqmp_5.15.0-1027.31_arm64.deb  linux-modules-5.15.0-1027-xilinx-zynqmp_5.15.0-1027.31_arm64.deb  linux-xilinx-zynqmp-tools-host_5.15.0-1027.31_all.deb
linux-headers-5.15.0-1027-xilinx-zynqmp_5.15.0-1027.31_arm64.deb    linux-xilinx-zynqmp-headers-5.15.0-1027_5.15.0-1027.31_all.deb
linux-image-5.15.0-1027-xilinx-zynqmp_5.15.0-1027.31_arm64.deb      linux-xilinx-zynqmp-tools-common_5.15.0-1027.31_all.deb
logictronix03@logictronix03:~/ubuntu_workspace/jammy_custom$
```

Also kernel build directory is found at : `jammy/debian/build/build-xilinx-zynqmp/` which is needed to cross compile the device drivers.

After build is completed, copy the *.deb file to Kria target board.

Install the kernel files by running following command:
```
sudo dpkg -i *.deb
```

Then reboot the system:
```
sudo reboot
```

Cross Compiling Prophesee device drivers:

Prophesee device driver consist of following drivers:

- Prophesee ccam5 sensor driver:
  - Sensor driver repository : https://github.com/prophesee-ai/linux-sensor-drivers

- Prophesee video drivers
  - for processing event data from sensor and v4l2 compatible video device.
  - Video driver repository : https://github.com/prophesee-ai/zynq-video-drivers

Get the drivers using git commands:

```
git clone https://github.com/prophesee-ai/linux-sensor-drivers
git clone https://github.com/prophesee-ai/zynq-video-drivers
```

First setup the KERNEL_SRC and arm64 environment variable to linux kernel build directory:
```

```
export KERNEL_SRC=<path of
workspace>/jammy/debian/build/build-xilinx-zynqmp/
export ARCH=arm64
  export $(dpkg-architecture -aarm64)
  export CROSS_COMPILE=aarch64-linux-gnu-
```
```

Building Prophese device drivers:

```

```
cd linux-sensor-drivers
make
```
```

Here is the log of the device driver build:

```
logictronix03@logictronix03:~/ubuntu_workspace/linux-sensor-drivers$ make
make -C /home/logictronix03/ubuntu_workspace/jammy_custom/jammy/debian/build/build-xilinx-zynqmp/ M=/home/logictronix03/ubuntu_workspace/linux-sensor-drivers
make[1]: Entering directory '/home/logictronix03/ubuntu_workspace/jammy_custom/jammy/debian/build/build-xilinx-zynqmp'
  CC [M]  /home/logictronix03/ubuntu_workspace/linux-sensor-drivers/imx636.o
  MODPOST /home/logictronix03/ubuntu_workspace/linux-sensor-drivers/Module.symvers
  CC [M]  /home/logictronix03/ubuntu_workspace/linux-sensor-drivers/imx636.mod.o
  LD [M]  /home/logictronix03/ubuntu_workspace/linux-sensor-drivers/imx636.ko
  BTF [M] /home/logictronix03/ubuntu_workspace/linux-sensor-drivers/imx636.ko
make[1]: Leaving directory '/home/logictronix03/ubuntu_workspace/jammy_custom/jammy/debian/build/build-xilinx-zynqmp'
logictronix03@logictronix03:~/ubuntu_workspace/linux-sensor-drivers$ ls
COPYING  imx636.c  imx636.ko  imx636.mod  imx636.mod.c  imx636.mod.o  imx636.o  Makefile  modules.order  Module.symvers  psee-format.h  sony,imx636.yaml
logictronix03@logictronix03:~/ubuntu_workspace/linux-sensor-drivers$
```
```

Above build creates kernel driver : `imx636.ko`

*For any Queries, please contact us at : info@logictronix.com*

Next building video drivers:
```

cd zynq-video-driver
make
```

Above build fails with undeclared media bus type error:



It can be solved by adding `psee-format.h` header in `psee-tkeep-handler.c` file:



Then running `make` command driver is compiled and build:

After Prophesee Video driver build, following linux driver modules are created:
- psee-csi2rxss.ko
- psee-streamer.ko
- psee-tkeep-handler.ko
- psee-video.ko

To use the Prophesee drivers, copy all the *.ko file to Kria Ubuntu /lib/modules/5.15.0-1027-xilinx-zynqmp/ folder.