MaaXBoard 8ULP

Linux Yocto Development Guide

V3.1

Copyright Statement:

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Regulatory Compliance:

- MaaXBoard 8ULP single board computer has passed the CE, FCC & SRRC certification.

Revision History

Version	Note	Author	Release Date
V1.0	Initial version	Lily	2022/11/09
V2.0	Updated Yocto to kirkstone(4.0), BSP_VERSION to lf-5.15.71-2.2.0, Converts the file format to markdown	Lily	20230516
V3.0	Updated Yocto to Langdale(4.1), BSP_VERSION to lf-6.1.1-1.0.0	Lily	20230630
V3.1	Updated Yocto to mickledore(4.2), BSP_VERSION to lf-6.1.22-2.0.0	Lily	20231024

Catalog

Chapter 1 Build with Yocto

1.1 Setup Build Environment

To setup the build environment need:

- Hardware: It is recommended that at least 300GB of disk space and 4GB of RAM
- Software: Ubuntu 64-bit OS, 20.04 LTS version or later LTS version (Ubuntu Desktop or Ubuntu Server version). You could also run the Ubuntu 64-bit OS on virtual machine or in docker container.

The following packages are required for the development environment. The required packages can be installed using the bash script below:

```
$ sudo apt-get update
$ sudo apt-get install -y wget git-core diffstat unzip texinfo gcc-multilib \
build-essential chrpath socat cpio python python3 python3-pip python3-pexpect \
xz-utils debianutils iputils-ping python3-git python3-jinja2 libegl1-mesa libsdl1.2-dev \
pylint3 xterm rsync curl gawk zstd lz4 locales bash-completion
```

Install repo:

```
$ mkdir -p ~/bin
$ curl https://storage.googleapis.com/git-repo-downloads/repo > ~/bin/repo
$ chmod a+x ~/bin/repo
$ export PATH=~/bin:$PATH
```

Set Git configuration:

```
$ git config --global user.name "Your Name"
$ git config --global user.email "you@example.com"
```

1.2 Fetch Source Code

1.2.1 Download meta layers from NXP

```
$ mkdir ~/imx-yocto-bsp
$ cd ~/imx-yocto-bsp
$ repo init -u https://github.com/nxp-imx/imx-manifest -b imx-linux-mickledore -m imx-6.1.22-2.0.0.xml
$ repo sync
```

1.2.2 Download MaaXBoard 8ULP Source Code

To download the source code of MaaXBoard 8ULP, clone the repository from Github:

```
$ cd ~/imx-yocto-bsp/sources
$ git clone https://github.com/Avnet/meta-maaxboard.git -b mickledore meta-maaxboard
```

1.3 Build

1.3.1 Edit build Configuration

If you want to create a new build folder or set the configuration for the first time, run the command:

```
$ cd ~/imx-yocto-bsp
$ MACHINE=maaxboard-8ulp source sources/meta-maaxboard/tools/maaxboard-setup.sh -b maaxboard-8ulp/build
```

If you want to build in an existing build folder, use the following command:

```
$ cd ~/imx-yocto-bsp
$ source sources/poky/oe-init-build-env maaxboard-8ulp/build
```

1.3.2 Build

Execute the following command to build a Weston Wayland image:

```
$ bitbake avnet-image-full
```

After the build has successfully completed, the output files are deployed in:

~/imx-yocto-bsp/maaxboard-8ulp/build/tmp/deploy/images/maaxboard-8ulp/

imx-boot-tagged	Bootloader Image
avnet-image-full-maaxboard-8ulp -xxxx.rootfs.wic	System image, this includes: Linux kernel, DTB and root file system.
Image	Kernel image
maaxboard-8ulp.dtb	MaaXBoard 8ULP device tree binary
overlays	MaaXBoard 8ULP device tree overlay binary
avnet-image-full-maaxboard-8ulp -xxxx.rootfs.tar.bz2	System image compressed archive file

Chapter 2 Standalone Build of u-Boot and Kernel

This chapter describes how to build U-boot and Kernel using SDK or ARM GCC in a standalone environment.

2.1 Cross-compile tool chain

The cross-compile tool chain that is used, can be ARM GCC or Yocto SDK.

2.1.1 ARM GCC

Download the tool chain for the A-profile architecture on arm Developer GNU-A Downloads page. It is recommended to use the 10.3 version for this release. You can download the "gcc-arm-10.3-2021.07-x86_64-aarch64-none-linux-gnu.tar.xz ", and decompress the file into a local directory.

```
$ mkdir ~/toolchain
$ tar -xJf gcc-arm-10.3-2021.07-x86_64-aarch64-none-linux-gnu.tar.xz -C ~/toolchain
```

Execute the following command to check that the toolchain can be directly run.

```
$ cd toolchain/gcc-arm-10.3-2021.07-x86_64-aarch64-none-linux-gnu/bin/
$ ./aarch64-none-linux-gnu-gcc -v
```

To compile a project with ARM GCC, first set the environment with the following commands before building :

```
$ TOOLCHAIN_PATH=$HOME/toolchain/gcc-arm-10.3-2021.07-x86_64-aarch64-none-linux-gnu/bin
$ export PATH=$TOOLCHAIN_PATH:$PATH
$ export ARCH=arm64
$ export CROSS_COMPILE=aarch64-none-linux-gnu-
```

2.1.2 Yocto SDK

Generate an SDK from the Yocto Project build environment with the following command after generating the image in the previous chapter.

```
$ cd ~/imx-yocto-bsp
$ source sources/poky/oe-init-build-env maaxboard-8ulp/build
$ bitbake avnet-image-full -c populate_sdk
```

The generated file is: *~/imx-yocto-bsp/maaxboard-8ulp/build/tmp/deploy/sdk/*

fsl-imx-wayland-lite-glibc-x86_64-avnet-image-full-armv8a-maaxboard-8ulp-toolchain-6.1-mickledore..sh

and execute this script to install the SDK. The default location is /opt but can be placed anywhere on the host machine.

```
$ sudo ./fsl-imx-wayland-lite-glibc-x86_64-avnet-image-full-armv8a-maaxboard-8ulp-toolchain-6.1-mickledore.sh
NXP i.MX Release Distro SDK installer version 6.1-mickledore
==========================================================
Enter target directory for SDK (default: /opt/fsl-imx-wayland-lite/6.1-mickledore):
You are about to install the SDK to "/opt/fsl-imx-wayland-lite/6.1-mickledore". Proceed [Y/n]?
Extracting
SDK.....................................................................................done
Setting it up...done
SDK has been successfully set up and is ready to be used.
```

When using SDK to compile a project, first execute the following command to configure environment variables :

```
$ . /opt/fsl-imx-wayland-lite/6.1-mickledore/environment-setup-armv8a-poky-linux
```

2.2 Build U-Boot in a standalone environment

2.2.1 Get the source code and firmware

To get the source code of u-boot, imx-atf and imx-mkimage, execute the following commands:

```
$ mkdir tmp
$ cd tmp
$ git clone https://github.com/Avnet/uboot-imx.git -b maaxboard_lf-6.1.22-2.0.0
$ git clone https://github.com/Avnet/imx-atf.git -b maaxboard_lf-6.1.22-2.0.0
$ git clone https://github.com/Avnet/imx-mkimage.git -b maaxboard_lf-6.1.22-2.0.0
```

Download the firmware-imx, decompress and accept NXP EULA when running:

```
$ wget https://www.nxp.com.cn/lgfiles/NMG/MAD/YOCTO/firmware-imx-8.20.bin
$ chmod +x firmware-imx-8.20.bin
$ ./firmware-imx-8.20.bin
```

Execute the ‘ls’ command to view the tmp directory:

```
$ ls tmp
firmware-imx-8.20 firmware-imx-8.20.bin imx-atf imx-mkimage uboot-imx
```

So far, the required source code and firmware have been prepared.

2.2.2 Compile script

Create a bash script in the tmp directory and change the file mode:

```
$ cd tmp
$ touch make_mx8ulp_uboot.sh
$ chmod 766 make_mx8ulp_uboot.sh
$ vi make_mx8ulp_uboot.sh
```

Copy the following content into the make_mx8ulp_uboot.sh script:

```
#!/bin/bash
PRJ_PATH=`pwd`
export JOBS=`cat /proc/cpuinfo | grep processor | wc -l`
export CROSS_COMPILE=$HOME/toolchain/gcc-arm-10.3-2021.07-x86_64-aarch64-none-linux-gnu/bin/aarch64-none-linux-gnu-
MKIMG_BIN_PATH=$PRJ_PATH/imx-mkimage/iMX8ULP/
set -e
function fetch_firmware()
{
   if [ ! -d firmware-sentinel-0.10 ] ; then
      wget https://www.nxp.com/lgfiles/NMG/MAD/YOCTO/firmware-sentinel-0.10.bin
      bash firmware-sentinel-0.10.bin --auto-accept > /dev/null 2>&1
   fi
   if [ ! -d firmware-upower-1.3.0 ] ; then
      wget https://www.nxp.com/lgfiles/NMG/MAD/YOCTO/firmware-upower-1.3.0.bin
      bash firmware-upower-1.3.0.bin --auto-accept > /dev/null 2>&1
   fi
   if [ ! -d meta-maaxboard ] ; then
      git clone https://github.com/Avnet/meta-maaxboard.git -b mickledore
   fi
   rm -f *.bin
}
function build_atf()
{
   SRC=imx-atf
   if [ ! -d $SRC ] ; then
      git clone https://github.com/Avnet/$SRC.git -b maaxboard_lf-6.1.22-2.0.0
   fi
   cd $SRC
```

```
    make -j${JOBS} CROSS_COMPILE=${CROSS_COMPILE} PLAT=imx8ulp bl31
    cd $PRJ_PATH
}
function build_cortexM()
{
    DEMO_PATH=boards/evkmimx8ulp/multicore_examples/rpmsg_lite_str_echo_rtos/armgcc
    DEMO_BIN=release/rpmsg_lite_str_echo_rtos.bin
    SRC=mcore_sdk_8ulp
    cd $PRJ_PATH/${SRC}
    cd $DEMO_PATH
    export ARMGCC_DIR=$MCORE_COMPILE
    #bash clean.sh
    if [ ! -s $DEMO_BIN ] ; then
        bash build_release.sh
    fi
    set -x
    cp $DEMO_BIN $MKIMG_BIN_PATH/m33_image.bin
    # For Yocto
    cp $DEMO_BIN $PRFX_PATH/maaxboard_8ulp_m33_image.bin
    set +x
}
function build_uboot()
{
    SRC=uboot-imx
    if [ ! -d $SRC ] ; then
        git clone https://github.com/Avnet/$SRC.git -b maaxboard_lf-6.1.22-2.0.0
    fi

    cd $PRJ_PATH/${SRC}

    if [ ! -f .config ] ; then
        make ARCH=arm ${BOARD}_defconfig
    fi
    make -j${JOBS} CROSS_COMPILE=${CROSS_COMPILE} ARCH=arm
    cd $PRJ_PATH
}
function build_imxboot()
{
```

```
    SRC=imx-mkimage
    if [ ! -d $SRC ] ; then
        git clone https://github.com/Avnet/$SRC.git -b maaxboard_lf-6.1.22-2.0.0
    fi
    cd $SRC
    # copy firmware
    cp $PRJ_PATH/firmware-upower-*/upower_a1.bin iMX8ULP/upower.bin
    cp $PRJ_PATH/firmware-sentinel-*/mx8ulpa0-ahab-container.img iMX8ULP/

    # copy atf-imx image
    cp $PRJ_PATH/imx-atf/build/imx8ulp/release/bl31.bin iMX8ULP/
    # copy uboot-imx image
    cp $PRJ_PATH/uboot-imx/u-boot.bin iMX8ULP/
    cp $PRJ_PATH/uboot-imx/u-boot-nodtb.bin iMX8ULP/
    cp $PRJ_PATH/uboot-imx/spl/u-boot-spl.bin iMX8ULP/
    cp $PRJ_PATH/uboot-imx/arch/arm/dts/maaxboard-8ulp.dtb iMX8ULP/imx8ulp-evk.dtb
    cp $PRJ_PATH/uboot-imx/tools/mkimage iMX8ULP/mkimage_uboot
    # generate bootloader image
    make SOC=iMX8ULP flash_singleboot_m33
    cp iMX8ULP/flash.bin u-boot-maaxboard-8ulp.imx
    chmod a+x u-boot-maaxboard-8ulp.imx
    # copy bootloader image out
    cp u-boot-maaxboard-8ulp.imx $PRJ_PATH
}
fetch_firmware
build_atf
build_cortexM
build_uboot
build_imxboot
```

Execute the script to build:

```
$ ./make_mx8ulp_uboot.sh
$ ls -t
u-boot-maaxboard-8ulp.imx  uboot-imx  meta-maaxboard       firmware-sentinel-0.8  firmware-
upower-1.3.0
imx-mkimage                imx-atf    make_mx8ulp_uboot.sh  firmware-imx-8.18
```

The boot image for Maaxboard 8ULP is u-boot-maaxboard-8ulp.imx in the current directory.

2.3 Build Kernel in a standalone environment

Get the Linux source code

```
$ git clone https://github.com/Avnet/linux-imx.git -b maaxboard_lf-6.1.22-2.0.0
```

Check that the environment variables are correctly set :

```
$ echo $CROSS_COMPILE $ARCH
```

Build the kernel sources

```
$ cd linux-imx
$ make distclean
$ make maaxboard-8ulp_defconfig
$ make -j4
```

Execute the ‘ls’ command to view the Image and dtb files after compilation.

```
$ ls arch/arm64/boot/Image
$ ls arch/arm64/boot/dts/freescale/maaxboard*dtb
arch/arm64/boot/dts/freescale/maaxboard-8ulp.dtb
```

Execute the following command to compile the kernel modules, and install the modules to rootfs in the current directory.

```
$ make modules
$ make modules_install INSTALL_MOD_PATH=./rootfs
```

Chapter 3 System power on and boot up

To program the generated new Bootloader and System image files into MaaXBoard 8ULP's eMMC memory, or for guidance on power-up MaaXBoard 8ULP, the boot-up process, and how to exercise the supported BSP features of MaaXBoard 8ULP, please refer to ***MaaXBoard-8ULP-Linux-Yocto-UserManual***.

Chapter 4 Appendix

4.1 Hardware Documents

For the detail hardware introduction, please refer to ***MaaXBoard 8ULP Hardware user manual***.

4.2 Software Documents

MaaXBoard 8ULP supports Yocto Linux, for additional information, please refer to the following documents:

- ***MaaXBoard 8ULP Linux Yocto User Manual***
  - Describes how to boot up MaaXBoard 8ULP and aspects of the BSP functionality
- ***MaaXBoard 8ULP Linux Yocto Development Guide***
  - Detailed guidance on how to rebuild the Linux system image (This document)

4.3 Contact Information

- Product Webpage:

  https://www.avnet.com/wps/portal/us/products/avnet-boards/avnet-board-families/maaxboard/maaxboard-8ulp/