MaaXBoard 8ULP

Yocto User Manual

V3.1

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Revision History

Rev.	Description	Author	Date
V1.0	Initial version	Lily	2022/10/28
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	2023/05/16
V3.0	Updated Yocto to Langdale(4.1), BSP_VERSION to lf-6.1.1-1.0.0	Lily	2023/06/21
V3.1	Updated Yocto to mickledore(4.2), BSP_VERSION to lf-6.1.22-2.0.0	Lily	2023/10/25

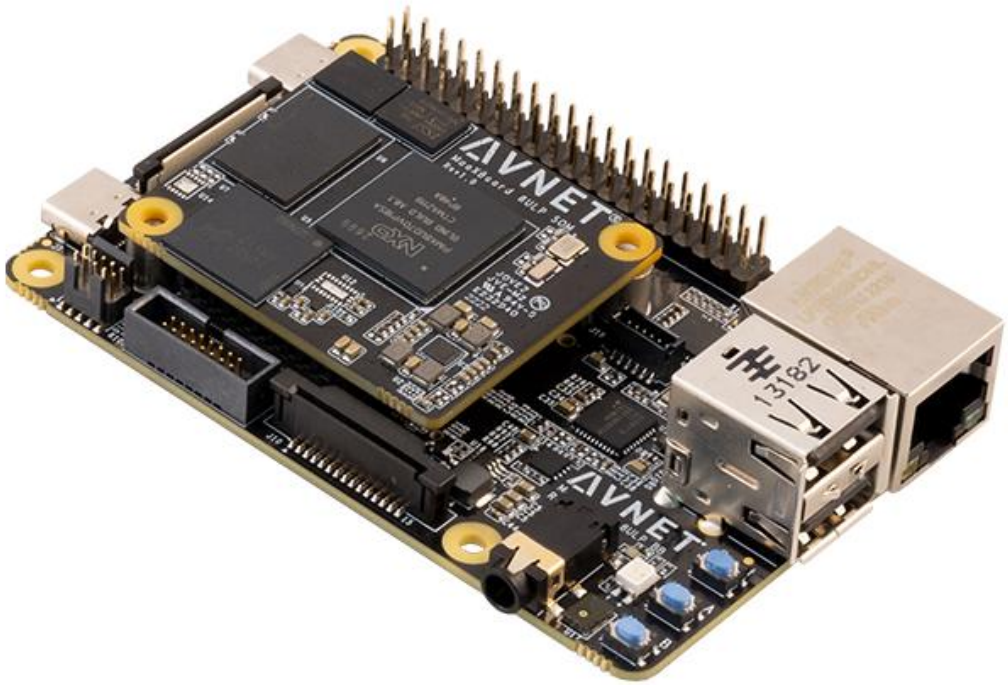
Catalog

Chapter 1 Introduction

1.1 Target Board: MaaXBoard 8ULP

MaaXBoard 8ULP is a development board developed by Avnet, Which featuresthe NXP i.MX 8ULP processor to achieve ultra-low power, EdgeLock® secured intelligent edge applications.

MaaXBoard 8ULP is engineered as two PCBs, a small SOM (43mm x 36mm) connected via 2x100-pin connectors to a baseboard (BB) in compact Raspberry Pi form-factor, which supports a versatile set of I/O interfaces. These include 100M Ethernet, two USB 2.0 host interfaces, plus separate USB 2.0 device interface, MIPI DSI display and MIPI CSI camera interfaces, a Pi-HAT compatible 40-pin header, MikroE Click 16-pin header plus ADC/DAC 6-pin header.



1.2 Introduction

This document provides a guide to prepare MaaXBoard 8ULP to boot up with the Verified Linux Package and introduces how to use the functions of MaaXBoard 8ULP.

1.3 Feature List

- Yocto version: mickledore(4.2), based on NXP SDK version: imx-6.1.22-2.0.0

- U-Boot version: 2023.04
- Kernel version: 6.1.22
- Evaluation image: Yocto Image
- Development based on NXP i.MX 8ULP
- eMMC boot
- Device-tree Overlay support
- Desktop (Weston 11.0.0)
- 100M Ethernet (RJ45)
- 2 x USB 2.0 Host
- 2 x UART debug ports from USB 2.0 Device
- Pi HAT 40 Pin Expansion Interface (I2C,UART,SPI and GPIO)
- WIFI & BLE 5.0
- MIPI-DSI display
- Audio playback
- MIPI-CSI Camera/USB Camera

Chapter 2 Boot up System

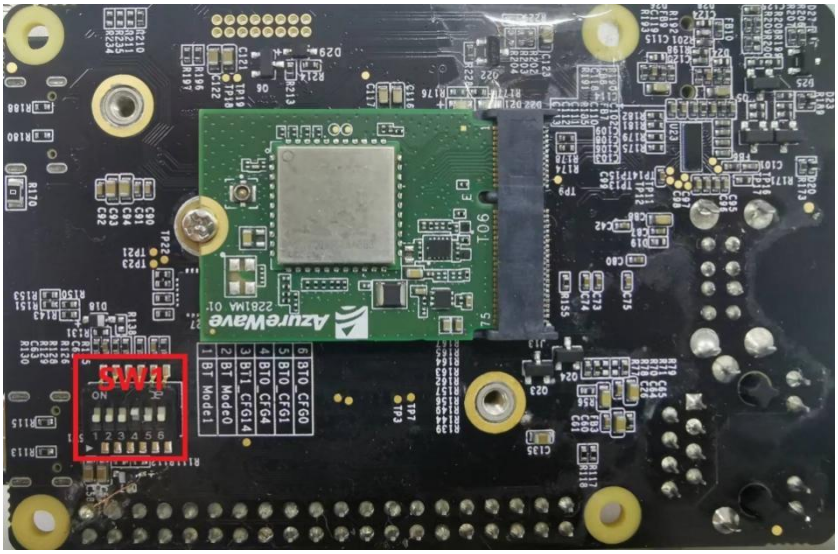
MaaXBoard 8ULP supports boot up from eMMC, We will introduce how to program system images to eMMC and boot from it in this chapter.

2.1 Program images into MaaXBoard 8ULP

2.1.1 Preparation for programming

1. Set ***SW1*** Boot Switch on MaaXBoard-8ULP to Serial Download Mode:

	1(CFG0)	2(CFG1)	3(CFG4)	4(MOD0)	5(MOD1)	6(SEL)
Serial Download Mode：	0	0	0	ON	0	0
Internal Boot Mode：	0	0	0	0	ON	0



2. Connect J7（USB0/POWER）and J4(USB for Debug) to PC USB port, connect J8 to a network cable.

3. Download the program tool uuu.exe from the network, The recommended website is:

https://github.com/nxp-imx/mfgtools/releases/tag/uuu_1.5.21

4. Put the built files: u-boot image, entire system image, and uuu.exe into a same folder.

After completing the preparations, take the following images as an example:

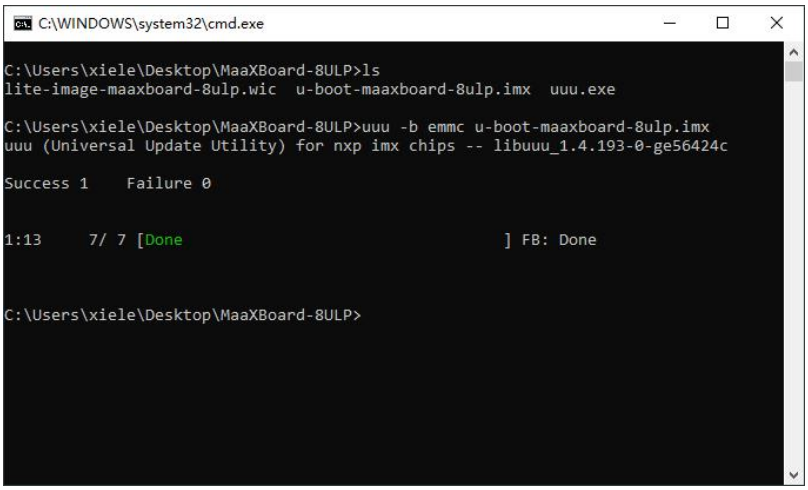
u-boot image: u-boot-maaxboard-8ulp.bin

entire system image: avnet-image-full-maaxboard-8ulp.wic

2.1.2 Only Program u-boot Image

1. Executing uuu.exe in Command Prompt, The specific commands are as follows:

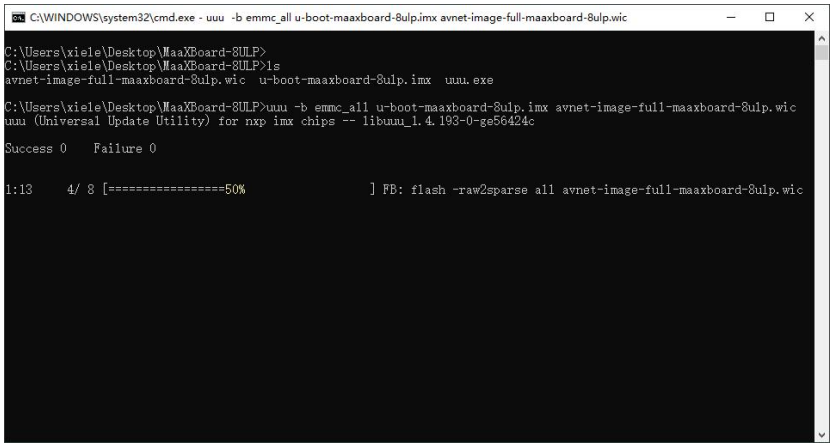
```
uuu -b emmc u-boot-maaxboard-8ulp.bin
```



2.1.3 Program Entire System Image

1. Executing uuu.exe in Command Prompt, The specific commands are as follows:

```
uuu -b emmc_all u-boot-maaxboard-8ulp.bin    avnet-image-full-maaxboard-8ulp.wic
```

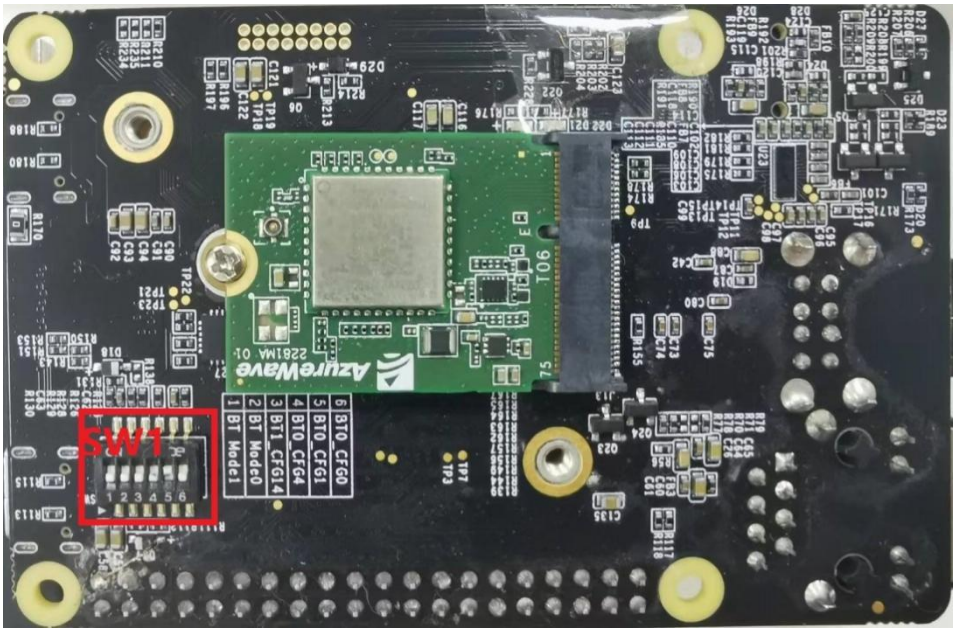


NOTE: To program the entire system image, the boot image must be programmed at the same time.

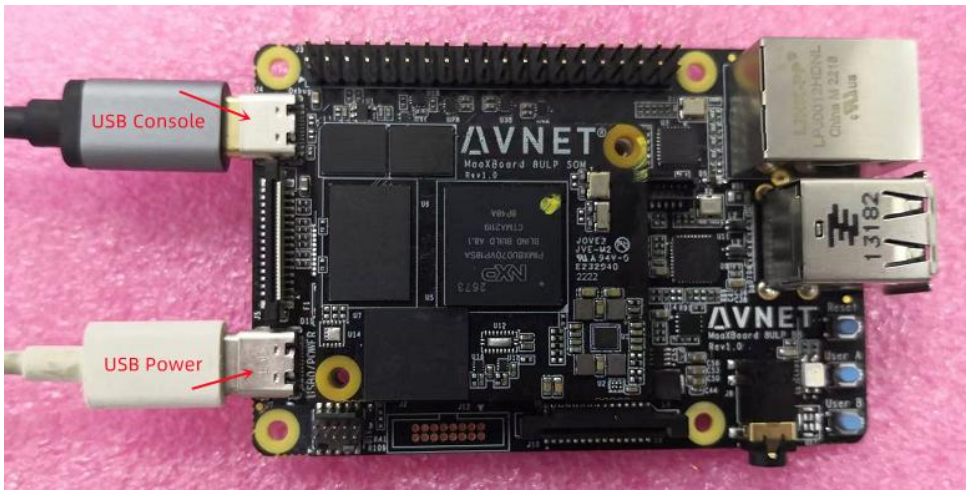
2.2 Boot from eMMC

- Set ***SW1*** Boot Switch on MaaXBoard-8ULP to ***Internal Boot Mode***.

	1(CFG0)	2(CFG1)	3(CFG4)	4(MOD0)	5(MOD1)	6(SEL)
Serial Download Mode：	0	0	0	ON	0	0
Internal Boot Mode：	0	0	0	0	ON	0



- Connect the two USB type C ports to your PC, one is for serial console (J4), and another is for power supply(J7).



- When the system boots up, LED1 blinks blue.

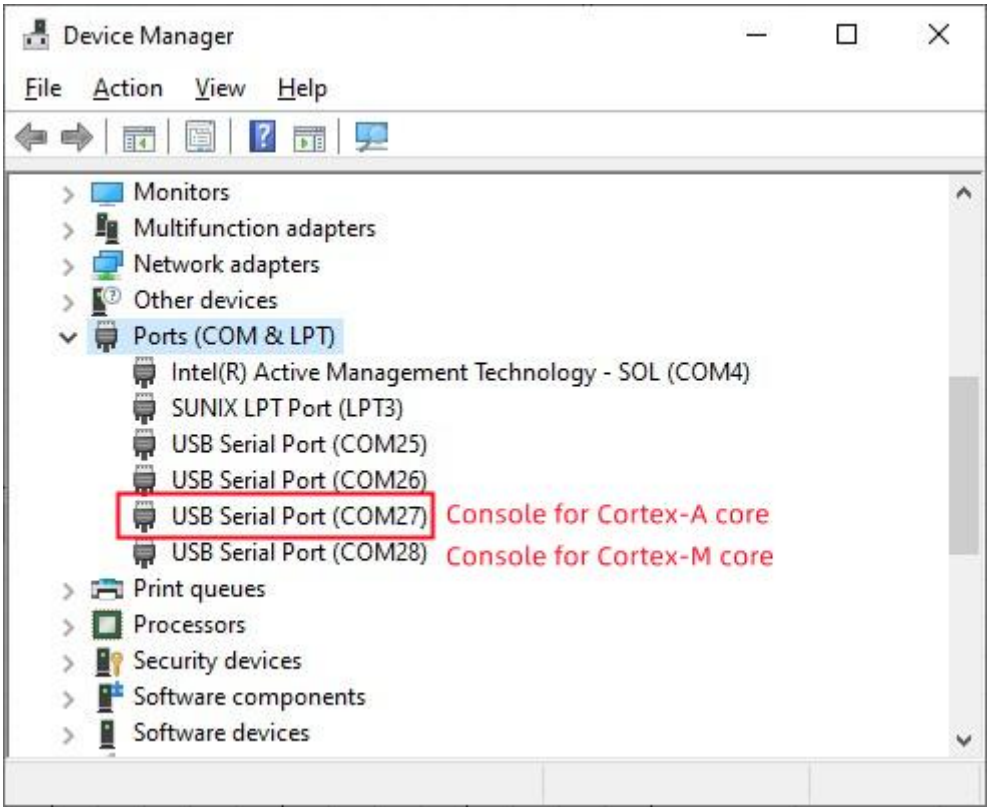
2.3 Debug UARTs

MaaXBoard 8ULP has 4 UARTs converted from the USB 2.0 device port (J4). The first two are reserved, the third UART is used for A35 debug, the last UART is used for M33 debug.

UARTS on MaaXBoard 8ULP	Interface Type
The first two	Reserved
The third UART	A35 Debug Interface
The last UART	M33 Debug Interface

The following is an example, when connect J4 of MaaXBoard 8ULP to the PC USB, view the ***Device***

Manager on the PC, there are four USB Serial Ports, the first two (COM25&COM26) are reserved, the third (COM27) is A35 Debug Interface, the last one (COM28) is M33 Debug Interface.



2.4 Login system

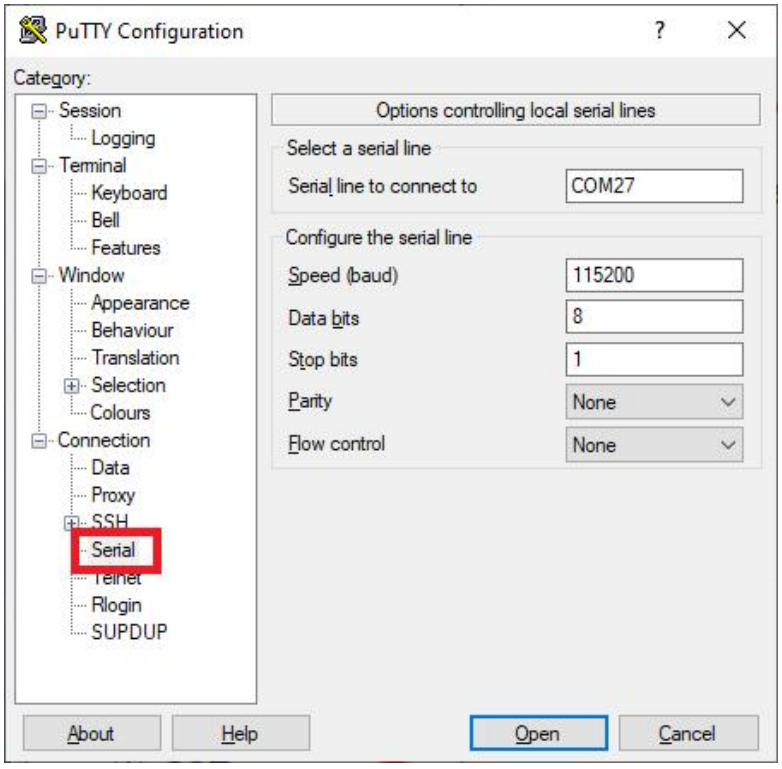
Yocto system supports the following login methods: login directly, login from debug serial, login from SSH.

2.4.1 Login Directly

Connect screen and keyboard to MaaXBoard 8ULP. When the system boots up, it will run the Weston Wayland Desktop Environment directly, click Wayland Terminal to operate the board.

2.4.2 Login from Debug Serial

- Install the Serial Communication software (e.g. PUTTY), select the corresponding port number (Obtained from Device Manager refer to 2.3 Debug UARTS), baud rate as 115200, data bits as 8, stop bits as 1, parity as none.



- Connect the debug interface serial console(J4) to PC with USB.
- When the system boots up, the serial terminal of A35 debug interface will print the following information:

```
NXP i.MX Release Distro 6.1-mickledore maaxboard8ulp ttyLP1
maaxboard8ulp login:
```

- Enter username as “root”, login without password.
- When the system boots up, the serial terminal of M33 debug interface will print the following information:

```
Start SRTM communication

RPMSG String Echo FreeRTOS RTOS API Demo (v2.14.0-gd2ecb41e6
e04) ...
Handle Peer Core Linkup

Nameservice sent, ready for incoming messages...
```

2.4.3 Login from SSH

Yocto OS install and startup SSH service automatically by default. Connect to internet, then login the system using SSH.

Linux system supports SSH in default, in windows OS, you can install ssh by yourself, or use other software which supports SSH, such as PuTTY, WinSCP, etc.

2.4.3.1 Preparation

Check the IP of MaaXBoard 8ULP: The IP will be used in SSH login.

```
root@maaxboard8ulp:~# ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.2.151  netmask 255.255.255.0  broadcast 192.168.2.255
        inet6 fe80::54c2:6ff:fece:1c8f  prefixlen 64  scopeid 0x20<link>
        ether 56:c2:06:ce:1c:8f  txqueuelen 1000  (Ethernet)
        RX packets 532  bytes 44087 (43.0 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 78  bytes 8226 (8.0 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

2.4.3.2 Login Command line

In this example, the IP of MaaXBoard 8ULP is 192.168.2.151, enter following command in command line window to connect: **ssh root@192.168.2.151**. Enter **yes** in the first connection.

```
root@maaxboard-8ulp:~# ssh root@192.168.2.151
The authenticity of host '192.168.2.151 (192.168.2.151)' can't be established.
ED25519 key fingerprint is SHA256:DaOsL80SC9DMKUvYbHBmik/vvvh+naMedRIWwzOhcVc.
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])? y
Please type 'yes', 'no' or the fingerprint: yes
Warning: Permanently added '192.168.2.151' (ED25519) to the list of known hosts.
[ 2125.158298] audit: type=1006 audit(1663659668.823:4): pid=544 uid=0 old-auid=4294967295
auid=0 tty=(none) old-ses=4294967295 ses=3 res=1
[ 2125.173562] audit: type=1300 audit(1663659668.823:4): arch=c00000b7 syscall=64 success=yes
exit=1 a0=7 a1=fffffe66f0e0 a2=1 a3=0 items=0 ppid=1 pid=544 auid=0 uid=0 gid=0 euid=0 suid=0
fsuid=0 egid=0 sgid=0 fsgid=0 tty=(none) ses=3 comm="sshd" exe="/usr/sbin/sshd" key=(null)
[ 2125.198091] audit: type=1327 audit(1663659668.823:4):
proctitle=737368643A20726F6F74205B707269765D
Last login: Fri Nov 19 17:19:41 2021
```

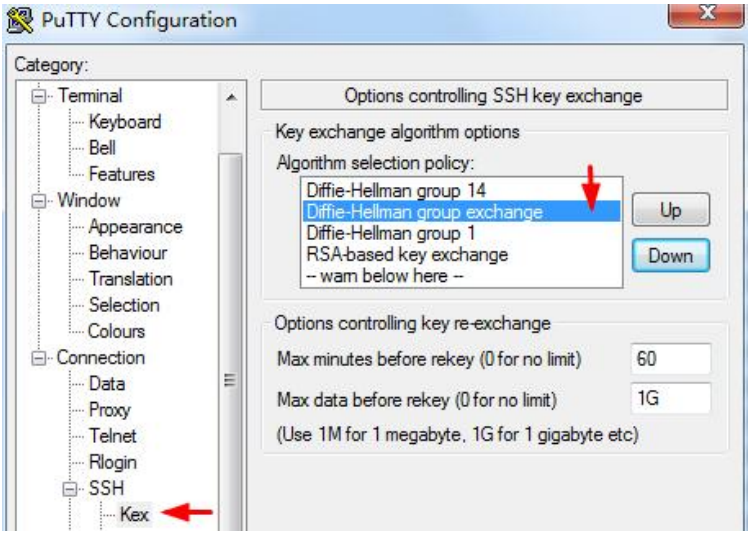
Then create a new SSH session, login as **root**, enter **exit** to logout:

```
Last login: Tue Sep 20 07:43:10 2022 from 192.168.2.151
root@maaxboard-8ulp:~#
```

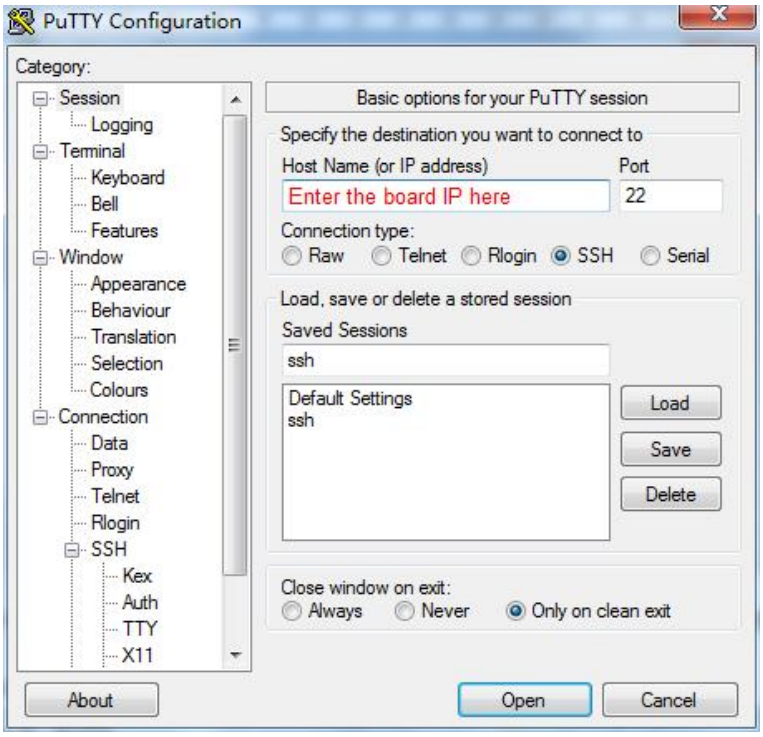
2.4.3.3 PuTTY

PuTTY supports SSH, setting method as follows:

- Run PUTTY, in Connection->SSH->Kex, Change the sequence of algorithm.



- In Session, enter IP address, e.g. 192.168.2.151, port 22, and Connection type SSH, Then click Open.



- In the first connection, click Y in the pop-up window.

- Enter username as “root” to login, enter exit to logout.

Chapter 3 Feature Configuration & Introduction

First of all, please refer to the previous chapter and boot up the system. Then configure or use the functions according to the following guidance.

3.1 Settings in uEnv.txt

User could configure some environment variables in uEnv.txt, which can be loaded in the U-boot stage. The uEnv.txt file has a very simple file format. The format is a single property=value statement on each line, where value is either an integer or a string. Comments may be added, or existing configuration values may be commented out and disabled, by starting a line with the # character.

The device-tree overlay function is supported from this version and the device-tree overlay file (*.dtbo) is placed in the overlay/ directory in the FAT partition of the eMMC. To load the device-tree overlay file (*.dtbo), you need to set ***fdt_extra_overlays*** and ***dtoverlay_*** prefix variable in uEnv.txt. Also you could add other configurations defined in U-boot to the uEnv.txt file.

The specific description is as follows:

Environment Variable	Value if Set (other invalid)	To be Loading in U-boot
dtoverlay_camera	ov5640	camera-ov5640.dtbo
dtoverlay_display	mipi	display-mipi.dtbo
dtoverlay_gpio	'1' or 'yes'	ext-gpio.dtbo
dtoverlay_i2c	'4'	ext-i2c4.dtbo
dtoverlay_spi	'5'	ext-spi5.dtbo
dtoverlay_uart	'4'	ext-uart4.dtbo
fdt_file	Board base dtb file, should be maaxboard-8ulp.dtb	
console	Some u-boot environment variables	

Note: ***fdt_file*** must be set to a device tree binary blob, which is the basis for applying dtbo file. ***fdt_file*** should be set, other configurations are optional.

Here is the default setting in uEnv.txt:

```
# Refer to readme.txt for more information on setting up U-Boot Env

# Device tree base file
fdt_file=maaxboard-8ulp.dtb

# Camera can support ov5640
#dtoverlay_camera=ov5640
```

```
# Display can support mipi
dtoverlay_display=mipi

# Set 40-pin extended GPIO pin default work as GPIO
dtoverlay_gpio=yes

# Enable lpi2c4 on 40-pin extended GPIO pin
#dtoverlay_i2c=4

# Enable lpspi5 on 40-pin extended GPIO pin
#dtoverlay_spi=5

# Enable lpuart4 on 40-pin extended GPIO pin
#dtoverlay_uart=4

# Extra other device tree overlay
#dtoverlay_extra=1.dtbo 2.dtbo 3.dtbo

# U-boot bootargs for console
console=ttyLP1,115200 console=tty1
```

Modify uEnv.txt methods:

Mount the first partition of eMMC to the system, Then use **nano** or **vi** command to modify the uEnv.txt. After the modification, execute **sync** and **reboot** command to make it effect.

```
root@maaxboard-8ulp:~# mkdir mount
root@maaxboard-8ulp:~# mount /dev/mmcblk0p1 mount/
root@maaxboard-8ulp:~# vi mount/uEnv.txt
```

We can edit the uEnv.txt as needed and save it.

After the modification, execute **sync** and **reboot** commands to make it effect.

```
root@maaxboard-8ulp:~# sync
root@maaxboard-8ulp:~# reboot
```

3.2 USER LED(RGB)

User can control the Tri-color LED indicators, LED1 on MaaXBoard 8ULP. Execute the following instructions in serial terminal to control them.

LED lights on and off blue:

```
root@maaxboard8ulp:~# echo 1 > /sys/class/leds/ledblue/brightness
root@maaxboard8ulp:~# echo 0 > /sys/class/leds/ledblue/brightness
```

LED lights on and off red:

```
root@maaxboard-8ulp:~# echo 1 > /sys/class/leds/ledred/brightness
root@maaxboard-8ulp:~# echo 0 > /sys/class/leds/ledred/brightness
```

LED lights on and off green:

```
root@maaxboard-8ulp:~# echo 1 > /sys/class/leds/ledgreen/brightness
root@maaxboard-8ulp:~# echo 0 > /sys/class/leds/ledgreen/brightness
```

3.3 Button Switches

There are three push-button switches on MaaXBoard 8ULP: User A, User B and Reset.

1. Test USR_KEY buttons with following instructions:

Enter **evtest** command, then choose the event id for **gpio_keys**

```
root@maaxboard-8ulp:~# evtest
No device specified, trying to scan all of /dev/input/event*
Available devices:
/dev/input/event0:          gpio-keys
Select the device event number [0-0]: 0
Input driver version is 1.0.1
Input device ID: bus 0x19 vendor 0x1 product 0x1 version 0x100
Input device name: "gpio-keys"
Supported events:
  Event type 0 (EV_SYN)
  Event type 1 (EV_KEY)
    Event code 2 (KEY_1)
    Event code 3 (KEY_2)
Properties:
Testing ... (interrupt to exit)
Event: time 1663662568.970160, type 1 (EV_KEY), code 2 (KEY_1), value 1
Event: time 1663662568.970160, ---------- SYN_REPORT ------------
Event: time 1663662569.239617, type 1 (EV_KEY), code 2 (KEY_1), value 0
Event: time 1663662569.239617, ---------- SYN_REPORT ------------
Event: time 1663662573.704278, type 1 (EV_KEY), code 3 (KEY_2), value 1
```

```
Event: time 1663662573.704278, ---------- SYN_REPORT ------------
Event: time 1663662574.025870, type 1 (EV_KEY), code 3 (KEY_2), value 0
```

Use "**Ctrl+C**" to exit this test.

2. Test Reset button

When system is on, press the Reset button for more than 8 seconds, system will restart.

3.4 Display output

MaaXBoard 8ULP supports MIPI-DSI screen.

Users can connect the screen to the board before booting up the system according to the following table. When the system boots up, the screen will print the related startup message and login UI. Users can connect keyboard to login the MaaXBoard 8ULP file system.

Screen Type	Screen Resolution	Interface
MIPI-DSI	720*1280	J5

3.4.1 MIPI-DSI Screen

Choose MIPI-DSI screen, the ***dtoverlay_display*** value should be set to ***mipi*** in uEnv.txt:

```
dtoverlay_display=mipi
```

MIPI-DSI supports backlight brightness adjustment. The backlight brightness has a range from 0 to 9, in which 9 means highest brightness, 0 means lowest.

Execute the following instructions on the serial terminal to implement the backlight test:

```
root@maaxboard8ulp:~# echo 0 > /sys/class/backlight/pwm-backlight/brightness
root@maaxboard8ulp:~# echo 5 > /sys/class/backlight/pwm-backlight/brightness
root@maaxboard8ulp:~# echo 9 > /sys/class/backlight/pwm-backlight/brightness
```

3.5 Touchscreen

The MIPI-DSI supports touch screen. If the Desktop environment run automatically, user could open the Wayland Terminal, click or drag the window, etc.

User could also use ***evtest*** command in serial terminal and then touch the screen to test:

```
root@maaxboard-8ulp:~# evtest /dev/input/touchscreen0
Input driver version is 1.0.1
```

```
Input device ID: bus 0x18 vendor 0x416 product 0x38f version 0x1060
Input device name: "Goodix Capacitive TouchScreen"
Supported events:
  Event type 0 (EV_SYN)
  Event type 1 (EV_KEY)
    Event code 59 (KEY_F1)
    Event code 60 (KEY_F2)
    Event code 61 (KEY_F3)
    Event code 62 (KEY_F4)
    Event code 63 (KEY_F5)
    Event code 64 (KEY_F6)
    Event code 125 (KEY_LEFTMETA)
    Event code 330 (BTN_TOUCH)
  Event type 3 (EV_ABS)
    Event code 0 (ABS_X)
      Value      363
      Min          0
      Max        719
    Event code 1 (ABS_Y)
      Value      803
      Min          0
      Max       1279
    Event code 47 (ABS_MT_SLOT)
      Value        0
      Min          0
      Max          9
    Event code 48 (ABS_MT_TOUCH_MAJOR)
      Value        0
      Min          0
      Max        255
    Event code 50 (ABS_MT_WIDTH_MAJOR)
      Value        0
      Min          0
      Max        255
    Event code 53 (ABS_MT_POSITION_X)
      Value        0
      Min          0
      Max        719
    Event code 54 (ABS_MT_POSITION_Y)
```

```
        Value      0
        Min        0
        Max     1279
      Event code 57 (ABS_MT_TRACKING_ID)
        Value      0
        Min        0
        Max    65535
Properties:
  Property type 1 (INPUT_PROP_DIRECT)
Testing ... (interrupt to exit)
Event: time 1663666210.409777, type 3 (EV_ABS), code 57 (ABS_MT_TRACKING_ID), value 8
Event: time 1663666210.409777, type 3 (EV_ABS), code 53 (ABS_MT_POSITION_X), value 170
Event: time 1663666210.409777, type 3 (EV_ABS), code 54 (ABS_MT_POSITION_Y), value 497
Event: time 1663666210.409777, type 3 (EV_ABS), code 48 (ABS_MT_TOUCH_MAJOR), value 21
Event: time 1663666210.409777, type 3 (EV_ABS), code 50 (ABS_MT_WIDTH_MAJOR), value 21
Event: time 1663666210.409777, type 1 (EV_KEY), code 330 (BTN_TOUCH), value 1
Event: time 1663666210.409777, type 3 (EV_ABS), code 0 (ABS_X), value 170
Event: time 1663666210.409777, type 3 (EV_ABS), code 1 (ABS_Y), value 497
Event: time 1663666210.409777, ---------- SYN_REPORT ------------
```

Use “**Ctrl+C**” to exit this test.

3.6 Audio

MaaXBoard 8ULP supports on-board audio output interface, on-board MIC, USB audio device and Bluetooth audio device.

3.6.1 Check Audio Device IDs

Before playing or recording an audio interface, you should check the device ID.

Use the **aplay -l** and **arecord -l** commands to list the audio playback- and record- device IDs.

3.6.1.1 On-board Audio Output Interface

The audio output interface J9 is the default audio output device of MaaXBoard 8ULP. Connect the audio device such as 3.5mm headset to J9 to use it. Use command **aplay -l** to check that the device id is 0, device name is da7212audio.

```
root@maaxboard-8ulp:~# aplay -l
**** List of PLAYBACK Hardware Devices ****
card 0: da7212audio [da7212-audio], device 0: rpmsg hifi da7213-hifi-0 []
```

```
  Subdevices: 1/1
  Subdevice #0: subdevice #0
```

3.6.1.2 USB Audio Device

MaaXBoard 8ULP can support USB audio device (which do not need specified driver) to play audio. You can record and play audio from USB audio device. Connect a USB audio device to the USB port on MaaXBoard 8ULP, Use command **arecord -l** and **aplay -l** to check that the device id is 1.

```
root@maaxboard-8ulp:~# aplay -l
**** List of PLAYBACK Hardware Devices ****
card 0: da7212audio [da7212-audio], device 0: rpmsg hifi da7213-hifi-0 []
  Subdevices: 1/1
  Subdevice #0: subdevice #0
card 1: Seri [Plantronics Blackwire 3225 Seri], device 0: USB Audio [USB Audio]
  Subdevices: 1/1
  Subdevice #0: subdevice #0
```

3.6.1.3 Bluetooth Audio

Yocto system also supports play audio files via the Bluetooth audio device such as Bluetooth headset. For detail, refer to Bluetooth part.

3.6.2 Record Audio

Use the following command to record audio to file audio.wav:

```
root@maaxboard-8ulp:~# arecord -c 2 -f S16_LE -r 48000 audio_sample.wav -D hw:0,0
```

Note: press **Ctrl+C** ro exit record.

In the above command:

S16_LE = audio format

-r 48000 = sample rate of the audio file (48KHz),

-c 2 = 2 channel audio recording,

-Dhw:0 = use audio card 0 to record (device id of the codec-connected MIC),

Use command **arecord -l** and **aplay -l** to check the device ID.

Change those parameters according to your device.

3.6.3 Play Audio File

```
root@maaxboard-8ulp:~# pulseaudio -D -v
root@maaxboard-8ulp:~# aplay audio_sample.wav
```

```
root@maaxboard-8ulp:~# gst-play-1.0 audio_sample.wav
root@maaxboard-8ulp:~# mpg123 audio_sample1.mp3
```

The **aplay** command supports audio file in wav format, **gst-play-1.0** command supports wav, mp3 and aac format, while the **mpg123** command supports mp3 format.

When using above commands, Audio will play from the default device (on-board audio output interface).

Use the following command to view the current available sound cards and the default sound card:

```
root@maaxboard8ulp:~# pacmd list-sinks | egrep '(index|name):'
    index: 0
        name: <alsa_output.platform-imx-audio-rpmsg.3.auto.stereo-fallback>
  * index: 1
        name: <bluez_sink.8C_53_C3_21_8A_EE.a2dp_sink>
root@maaxboard8ulp:~# pactl get-default-sink
bluez_sink.8C_53_C3_21_8A_EE.a2dp_sink
```

If the Bluetooth device isn't the default sound card, set it as follow:

```
root@maaxboard8ulp:~# pactl set-default-sink 1
```

3.7 Video

This Yocto system supports playback of video files in mp4 format, with maximum resolution of 1080p, select one of the following four commands and enter it in the serial terminal to play:

```
root@maaxboard-8ulp:~# gst-play-1.0 video.mp4
root@maaxboard-8ulp:~# gplay-1.0 video.mp4
root@maaxboard-8ulp:~# gst-launch-1.0 playbin uri=file:///home/root/video.mp4
```

Note: press Ctrl+C ro exit play.

3.8 Camera

MaaXBoard 8ULP can support USB camera or MIPI-CSI camera. This section describes how to preview, capture photos and record video from the command line.

To use the MIPI-CSI camera, the ***dtoverlay_camera*** value should be set:

```
dtoverlay_camera=ov5640
```

Note: To show the camera preview on the desktop, it is recommended that the ***dtoverlay_camera*** option should be set in **uEnv.txt**.

3.8.1 Check Device ID

```
root@maaxboard-8ulp:~# ls /dev/video*
/dev/video0
```

In default, MIPI-CSI camera is /dev/video0. The device ID will be used in following commands.

3.8.2 Preview

Use the following command to open Camera and preview the video on the screen.

```
root@maaxboard-8ulp:~# gst-launch-1.0 v4l2src device=/dev/video0 ! autovideosink
```

Note: Press **Ctrl+C** to exit, change /dev/video0 to your device ID.

3.8.3 Take Photo

Use the following instruction to take a photo and saved to specific location.

```
gst-launch-1.0 v4l2src device=[video] num-buffers=1 ! jpegenc ! filesink location=[filename]
```

In above command, replace [video] to the camera device ID, [filename] to the path and name of saved file, [width*height] to the resolution. For example:

```
root@maaxboard-8ulp:~# gst-launch-1.0 v4l2src device=/dev/video0 num-buffers=1 !
video/x-raw,format=YUY2,width=1920,height=1080 ! jpegenc ! filesink location=sample.jpg
```

Use the follow following command to view this photo directly:

```
root@maaxboard-8ulp:~# gst-launch-1.0 filesrc location=sample.jpg ! jpegdec ! imagefreeze !
autovideosink
```

Or copy the photo to other device, such as computer to display it.

3.8.4 Record Video

Use the following instruction to record a video in mp4 format and save it to the specified location.

```
root@maaxboard-8ulp:~# gst-launch-1.0 -e v4l2src device=/dev/video0 num-buffers=30 !
video/x-raw,format=YUY2,framerate=30/1,width=640,height=480 ! videoconvert ! x264enc !
video/x-h264, profile=baseline ! mp4mux ! filesink location=output.mp4
```

In above command, modify the camera device ID, the width and height of the video, the path and name of the saved file, etc. The video file can be copied to other devices, such as computer to display, or use gst-play-1.0 to display it on the screen directly.

```
root@maaxboard-8ulp:~# gst-play-1.0 output.mp4
```

3.9 100M Ethernet Interface

Connect the network cable to J8, enter the following instructions to set the IP address:

The below IP address is an example, replace it with your real network environment

3.9.1 Network Test

After connecting the network cable, it will automatically obtain the IP by default. You can use the following command to view the IP information:

```
root@maaxboard-8ulp:~# ifconfig eth0
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.2.77  netmask 255.255.255.0  broadcast 192.168.2.255
        inet6 fe80::4c16:9ff:fe37:c0e4  prefixlen 64  scopeid 0x20<link>
        ether 4e:16:09:37:c0:e4  txqueuelen 1000  (Ethernet)
        RX packets 16  bytes 1676 (1.6 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 38  bytes 4357 (4.2 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

3.9.2 Set MAC Address

If you need to set the MAC, execute the following step:

Set the static MAC for the Board: modify the ***ethaddr*** value in uEnv.txt.

For example: **ethaddr=cb:3a:e1:44:62:2d**

3.9.3 Set Static IP

If you need to set a static IP, execute the following commands:

Set Static IP info: use **vi** command to modify **/etc/dhcpcd.conf**, add following info.

```
root@maaxboard-8ulp:~# vi /etc/systemd/network/01-eth0.network
[Match]
Name=eth0

[Network]
Address=192.168.2.77/24
Gateway=192.168.2.1
DNS=8.8.8.8
DNS=114.114.114.114
```

```
root@maaxboard-8ulp:~# systemctl restart systemd-networkd
```

In above command, replace the IP address, router, DNS with your real network environment. Execute **sync** after the modification, then **reboot** the system to make it effect.

3.9.4 Set Dynamic IP

```
root@maaxboard-8ulp:~# vi /etc/systemd/network/01-eth0.network
[Match]
Name=eth0

[Network]
DHCP=yes
root@maaxboard-8ulp:~# systemctl restart systemd-networkd
```

3.10 Storage

MaaXBoard 8ULP supports on-board eMMC, It can be boot up from it.

Use **lsblk** command to list all available block devices in system:

```
root@maaxboard-8ulp:~# lsblk
```

3.10.1 eMMC

The size of on-board eMMC is 32GB. The storage device node for eMMC is /dev/mmcblk0.

3.11 USB 2.0 Interface

MaaXBoard 8ULP supports two USB 2.0 Host Interfaces.

3.11.1 USB Host

Insert two U-disks into J6, serial terminal will display the disk information:

```
[   329.076353] usb 1-1.2: new high-speed USB device number 3 using ci_hdrc
[   329.206353] usb-storage 1-1.2:1.0: USB Mass Storage device detected
[   329.229330] scsi host0: usb-storage 1-1.2:1.0
[   330.259060] scsi 0:0:0:0: Direct-Access     Generic  MassStorageClass 1536 PQ: 0 ANSI: 6
[   330.469793] sd 0:0:0:0: [sda] 122142720 512-byte logical blocks: (62.5 GB/58.2 GiB)
[   330.478513] sd 0:0:0:0: [sda] Write Protect is off
[   330.484573] sd 0:0:0:0: [sda] Write cache: disabled, read cache: enabled, doesn't support DPO
or FUA
[   330.501911]  sda: sda1
```

```
[   330.505774] sd 0:0:0:0: [sda] Attached SCSI removable disk
[   338.980805] usb 1-1.1: new high-speed USB device number 4 using ci_hdrc
[   339.094935] usb-storage 1-1.1:1.0: USB Mass Storage device detected
[   339.102354] scsi host1: usb-storage 1-1.1:1.0
[   340.119547] scsi 1:0:0:0: Direct-Access                    5.00 PQ: 0 ANSI: 2
[   340.133176] sd 1:0:0:0: [sdb] 4014080 512-byte logical blocks: (2.06 GB/1.91 GiB)
[   340.141253] sd 1:0:0:0: [sdb] Write Protect is off
[   340.159011] sd 1:0:0:0: [sdb] No Caching mode page found
[   340.164803] sd 1:0:0:0: [sdb] Assuming drive cache: write through
[   340.177596]  sdb:
[   340.180687] sd 1:0:0:0: [sdb] Attached SCSI removable disk
[   341.347760]  sdb:
```

Execute the following instructions on the serial terminal:

```
root@maaxboard-8ulp:~# ls /dev/sd*
/dev/sda  /dev/sdb
```

The storage device node for U-disk is /dev/sda, users could mount the storage device to the file system to read and write data.

MaaXBoard 8ULP also supports other USB device such as key board, mouse, Camera, etc.

3.12 Wi-Fi

The on-board Wi-Fi module supports 2.4G/5G network.

3.12.1 Enable Wi-Fi

User can create wpa_supplicant.conf in /run/media/mmcblk0p1/ to load the Wi-Fi driver and firmware (take "TEST23"&"12345678" as an example), Run the following commands to start Wi-Fi:

```
root@maaxboard-8ulp:~# vi /run/media/boot-mmcblk0p1/wpa_supplicant.conf
ctrl_interface=/var/run/wpa_supplicant
ctrl_interface_group=0
update_config=1
network={
        scan_ssid=1
        ssid="TEST23"
        psk="12345678"
}
root@maaxboard-8ulp:~# systemctl enable wpa-conf.timer
```

```
root@maaxboard-8ulp:~# reboot
```

After the system reboots, User can check the mlan0 and test Wi-Fi network with ping command:

```
root@maaxboard-8ulp:~# iwconfig mlan0
mlan0        IEEE 802.11-DS    ESSID:"TEST23" [2]
             Mode:Managed    Frequency=2.412 GHz    Access Point: 80:8F:1D:8A:F6:D0
             Bit Rate:72 Mb/s     Tx-Power=24 dBm
             Retry limit:9     RTS thr=2347 B     Fragment thr=2346 B
             Encryption
             …
             Power Management:on
             Link Quality=5/5    Signal level=-39 dBm    Noise level=-88 dBm
             Rx invalid nwid:0    Rx invalid crypt:0    Rx invalid frag:3012
             Tx excessive retries:9    Invalid misc:3     Missed beacon:0
root@maaxboard-8ulp:~# ifconfig mlan0
mlan0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>    mtu 1500
            inet 192.168.2.203    netmask 255.255.255.0    broadcast 192.168.2.255
            inet6 fe80::7266:55ff:fe8a:aeb3    prefixlen 64    scopeid 0x20<link>
            ether 70:66:55:8a:ae:b3    txqueuelen 1000    (Ethernet)
            RX packets 188    bytes 16237 (15.8 KiB)
            RX errors 0    dropped 0    overruns 0    frame 0
            TX packets 44    bytes 5756 (5.6 KiB)
            TX errors 0    dropped 0 overruns 0    carrier 0    collisions 0

root@maaxboard8ulp:~# ping www.avnet.com -I mlan0
PING www.avnet.com (184.50.90.49) 56(84) bytes of data.
64 bytes from a184-50-90-49.deploy.static.akamaitechnologies.com (184.50.90.49): icmp_seq=1
ttl=55 time=34.4 ms
64 bytes from a184-50-90-49.deploy.static.akamaitechnologies.com (184.50.90.49): icmp_seq=2
ttl=55 time=33.8 ms
```

Use “**Ctrl+C**” to exit this test.

3.12.2 Connect Wi-Fi Manually

Users can also add a WiFi connection manually.

Execute the following instructions on the serial terminal to search Wi-Fi network:

```
root@maaxboard-8ulp:~# iwlist mlan0 scan | grep SSID
                    ESSID:"TEST23"
```

```
                    ESSID:"AAAA_2.4G" [2]
                    ESSID:"Development " [3]
                    ESSID:"XXXX-5G" [4]
```

It prints the information for all available network.

Configure SSID and SSID_PASSWD with the following command: (take "TEST23" as an example)

```
root@maaxboard-8ulp:~# wpa_passphrase "TEST23" "12345678" >> /etc/wpa_supplicant.conf
```

Or edit ***/etc/wpa_supplicant.conf*** directly and append the following parameters:

```
network={
    ssid="TEST23"
    psk="12345678"
}
```

Run the following command to start the Access Point:

```
root@maaxboard-8ulp:~# ifconfig mlan0 up
root@maaxboard-8ulp:~# wpa_supplicant -B -i mlan0 -c /etc/wpa_supplicant.conf
```

An example of command output:

```
Successfully initialized wpa_supplicant
rfkill: Cannot open RFKILL control device
[  490.104578] wlan: SCAN COMPLETED: scanned AP count=15
[  490.128098] mlan0:
[  490.128124] wlan: HostMlme Auth received from 80:XX:XX:XX:f6:d0
[  490.149954] wlan: HostMlme mlan0 Connected to bssid 80:XX:XX:XX:f6:d0 successfully
[  490.359693] mlan0:
[  490.359722] wlan: Send EAPOL pkt to 80:XX:XX:XX:f6:d0
[  490.373093] mlan0:
[  490.373113] wlan: Send EAPOL pkt to 80:XX:XX:XX:f6:d0
[  490.381649] IPv6: ADDRCONF(NETDEV_CHANGE): mlan0: link becomes ready
[  490.393642] woal_cfg80211_set_rekey_data return: gtk_rekey_offload is DISABLE
```

Run the command to get the IP address:

```
root@maaxboard-8ulp:~# udhcpc -i mlan0 -n -R
root@maaxboard-8ulp:~# ifconfig mlan0
```

Test Wi-Fi network with **ping** command:

```
root@maaxboard8ulp:~# ping www.avnet.com
PING www.avnet.com (184.50.90.49) 56(84) bytes of data.
```

```
64 bytes from a184-50-90-49.deploy.static.akamaitechnologies.com (184.50.90.49): icmp_seq=1
ttl=55 time=33.8 ms
64 bytes from a184-50-90-49.deploy.static.akamaitechnologies.com (184.50.90.49): icmp_seq=2
ttl=55 time=33.6 ms
```

Use "**Ctrl+C**" to exit this test.

3.12.3 Wi-Fi Hotspot

Use the following steps to configure and start the 2.4 GHz/5 GHz Access Point from the wireless module.

Make sure the Wi-Fi is disconnected:

```
root@maaxboard-8ulp:~# killall wpa_supplicant
root@maaxboard-8ulp:~# killall hostapd
```

Then use the following steps to set up Wi-Fi hotspot.

Edit the configuration file for hostapd:

```
root@maaxboard-8ulp:~# vi /etc/hostapd-5g.conf
```

Parameter values in the configuration file:

```
interface=uap0
# specify the band: hw_mode=g (2.4 GHz) and hw_mode=a (5 GHz)
hw_mode=a
channel=0
country_code=US
ssid=MY_HOSTAP
ieee80211n=1
```

Note: If you want to configure the 2.4 GHz Access Point, change ***hw_mode=g*** and default is 5GHz AP.

If you want to configure WPA2 for the AP using open source supplicant, need to add the following additional lines:

```
wpa=2
wpa_key_mgmt=WPA-PSK
rsn_pairwise=CCMP
wpa_passphrase=123456789
```

Note: You can modify your **ssid** and **wpa_passphrase** in hostapd-5g.conf file.

Create the configuration file for udhcp server:

```
root@maaxboard-8ulp:~# vi /etc/udhcpd.conf
```

Add the following content to udhcpd.conf file:

```
interface uap0
start 192.168.6.10
end 192.168.6.100
opt router 192.168.6.1
opt dns 114.114.114.114 8.8.8.8
```

Note: The IP address 192.168.6.x can be modified at will but it must be consistent with its related IP.

Command to start the 5 GHz Access Point and start udhcp server to assign the IP address:

```
root@maaxboard-8ulp:~# ifconfig uap0 192.168.6.1 netmask 255.255.255.0 up
root@maaxboard-8ulp:~# udhcpd /etc/udhcpd.conf
root@maaxboard-8ulp:~# hostapd -B /etc/hostapd-5g.conf
```

At this time, you can use other devices to scan the access point **"*MY_HOSTAP*"**, and enter the password **"*123456789*"** to connect. After obtaining the IP address, the device will display a status of "Connected, no Internet".

If the Ethernet interface is connected to the Internet, you can use the following commands to add packet forwarding rules so that the devices connected to the hotspot can access the Internet.

```
root@maaxboard-8ulp:~# echo 1 > /proc/sys/net/ipv4/ip_forward
root@maaxboard-8ulp:~# iptables -t nat -A POSTROUTING -o eth0 -j MASQUERADE
root@maaxboard-8ulp:~# iptables -A FORWARD -i eth0 -o uap0 -m state \
--state RELATED,ESTABLISHED -j ACCEPT
root@maaxboard-8ulp:~# iptables -A FORWARD -i uap0 -o eth0 -j ACCEPT
```

3.13 Bluetooth 5.0

The firmware binary file supports both Wi-Fi and Bluetooth over an SDIO interface, so user should enable Wi-Fi first (refer to Chapter 3.12.1).

3.13.1 Enable Bluetooth

Before using Bluetooth, we need to use the **hciattach** command to establish a data connection channel between the serial port and the Bluetooth protocol layer. This command is mainly used to initialize the Bluetooth device:

```
root@maaxboard-8ulp:~# hciattach /dev/ttyLP2 any 115200
Setting TTY to N_HCI line discipline
Device setup complete
```

Use **hciconfig** to check the Bluetooth address and start the Bluetooth:

```
root@maaxboard-8ulp:~# hciconfig
hci0:   Type: Primary  Bus: UART
        BD Address: 20:4E:F6:D7:A8:98  ACL MTU: 1021:5  SCO MTU: 60:12
        UP RUNNING
        RX bytes:749 acl:0 sco:0 events:46 errors:0
        TX bytes:999 acl:0 sco:0 commands:46 errors:0
root@maaxboard-8ulp:~# hciconfig hci0 up
root@maaxboard-8ulp:~# hciconfig hci0 version
hci0:   Type: Primary  Bus: UART
        BD Address: 70:66:55:8A:AE:B2  ACL MTU: 1016:5  SCO MTU: 60:12
        HCI Version: 5.2 (0xb)  Revision: 0x8300
        LMP Version: 5.2 (0xb)  Subversion: 0x101a
        Manufacturer: Marvell Technology Group Ltd. (72)
```

3.13.2 Connect Bluetooth Device

Use **bluetoothctl** to connect Bluetooth Device:

```
root@maaxboard-8ulp:~# bluetoothctl
[bluetooth]# power on
[bluetooth]# pairable on
[bluetooth]# agent on
[bluetooth]# default-agent
```

Make the MaaXBoard 8ULP discoverable by other Bluetooth device:

```
[bluetooth]# discoverable on
```

Enable and Disable Scan:

```
[bluetooth]# scan on
[bluetooth]# scan off
```

Pair and connect the device:

```
[bluetooth]# pair E8:EC:A3:21:57:6C
[bluetooth]# trust E8:EC:A3:21:57:6C
[bluetooth]# connect E8:EC:A3:21:57:6C
[device name]# disconnect E8:EC:A3:21:57:6C
```

Exit **bluetoothctl**.

```
[bluetooth]# exit
```

In above instructions, **E8:EC:A3:21:57:6C** is the address of the Bluetooth device, change it according to your device.

3.13.3 Configure A2DP sink or source

When connected to a remote Bluetooth device that supports the A2DP sink feature, MaaXBoard 8ULP can be configured as an A2DP Source. This type of bluetooth devices are usually bluetooth headsets, bluetooth speakers, etc.

Set the baud rate to 3M bps (0x002dc6c0 == 3000000)

```
root@maaxboard-8ulp:~# hcitool -i hci0 cmd 0x3f 0x0009 0xc0 0xc6 0x2d 0x00
< HCI Command: ogf 0x3f, ocf 0x0009, plen 4
C0 C6 2D 00
> HCI Event: 0x0e plen 4
01 09 FC 00
root@maaxboard-8ulp:~# killall hciattach
[ 132.691727] Bluetooth: hci0: sending frame failed (-49)
root@maaxboard-8ulp:~# hciattach /dev/ttyLP2 any -s 3000000 3000000 flow
Setting TTY to N_HCI line discipline
Device setup complete
root@maaxboard-8ulp:~# hciconfig
hci0: Type: Primary Bus: UART
BD Address: 70:66:55:8A:AE:B2 ACL MTU: 1016:5 SCO MTU: 60:12
UP RUNNING PSCAN
RX bytes:798 acl:0 sco:0 events:53 errors:0
TX bytes:2028 acl:0 sco:0 commands:53 errors:0
```

Run the following command to verify the Audio Sink Profile capability of the connected Bluetooth device:

```
root@maaxboard-8ulp:~# pulseaudio -D -v
root@maaxboard-8ulp:~# bluetoothctl info
```

Command output example showing the feature:

```
    UUID: Audio Sink                (0000110b-0000-1000-8000-00805f9b34fb)
    UUID: A/V Remote Control Target (0000110c-0000-1000-8000-00805f9b34fb)
    UUID: A/V Remote Control        (0000110e-0000-1000-8000-00805f9b34fb)
    UUID: PnP Information           (00001200-0000-1000-8000-00805f9b34fb)
    UUID: Generic Access Profile    (00001800-0000-1000-8000-00805f9b34fb)
    UUID: Generic Attribute Profile (00001801-0000-1000-8000-00805f9b34fb)
```

Connect Bluetooth device:

```
root@maaxboard-8ulp:~# bluetoothctl
[bluetooth]# power on
[bluetooth]# pairable on
```

```
[bluetooth]# default-agent
[bluetooth]# scan on
[NEW] Device 8C:53:C3:21:8A:EE device-name
[bluetooth]# pair 8C:53:C3:21:8A:EE
Attempting to pair with 8C:53:C3:21:8A:EE
[CHG] Device 8C:53:C3:21:8A:EE Connected: yes
[CHG] Device 8C:53:C3:21:8A:EE UUIDs: 0000110b-0000-1000-8000-00805f9b34fb
[CHG] Device 8C:53:C3:21:8A:EE UUIDs: 0000110c-0000-1000-8000-00805f9b34fb
[CHG] Device 8C:53:C3:21:8A:EE UUIDs: 0000110e-0000-1000-8000-00805f9b34fb
[CHG] Device 8C:53:C3:21:8A:EE UUIDs: 00001200-0000-1000-8000-00805f9b34fb
[CHG] Device 8C:53:C3:21:8A:EE UUIDs: 00001800-0000-1000-8000-00805f9b34fb
[CHG] Device 8C:53:C3:21:8A:EE UUIDs: 00001801-0000-1000-8000-00805f9b34fb
[CHG] Device 8C:53:C3:21:8A:EE ServicesResolved: yes
[CHG] Device 8C:53:C3:21:8A:EE Paired: yes
Pairing successful
[bluetooth]# scan off
[bluetooth]# connect 8C:53:C3:21:8A:EE
Attempting to connect to 8C:53:C3:21:8A:EE
[CHG] Device 8C:53:C3:21:8A:EE Connected: yes
Connection successful
[device-name]# exit
root@maaxboard-8ulp:~#
```

Play the audio file using pulseaudio play utility:

```
root@maaxboard-8ulp:~# gst-play-1.0 audio_sample.wav
root@maaxboard-8ulp:~# mpg123 audio_sample1.mp3
```

User can listen to music from the connected Bluetooth device.

3.14 Pi HAT 40 Pin Expansion Interface

This chapter will provide the Control methods of 40 Pin interface, include GPIO, I2C, SPI and UART.

3.14.1 GPIO

To use the GPIOs of the 40-pins interface, enable the following options in uEnv.txt :

```
dtoverlay_gpio=1
```

System use /sys/class/gpio to control the GPIO pin, refer to the following table:

Table: GPIO corresponding relation table

GPIO number	PINMUX	Function	PIN	PIN	Function	PINMUX	GPIO number
		3.3V	1	2	5V		
	PTF9	SDA4	3	4	5V		
	PTF8	SCL4	5	6	GND		
	PTD14	GPIO	7	8	LPUART4_TX	PTF10	
		GND	9	10	LPUART4_RX	PTF11	
	PTD22	GEN0(TPM8_CH3)	11	12	GPIO	PTF25	
	PTD21	GEN2(TPM8_CH2)	13	14	GND		
	PTD20	GPIO	15	16	GPIO	PTD15	
		3.3V	17	18	GPIO	PTD16	
	PTF16	LPSPI5_MOSI	19	20	GND		
	PTF17	LPSPI5_MISO	21	22	GPIO	PTF3	
	PTF18	LPSPI5_CLK	23	24	LPSPI5_SS0	PTF19	
		GND	25	26	GPIO	PTF4	
	PTE13	GPIO	27	28	GPIO	PTE12	
	PTF1	GPIO	29	30	GND		
	PTF2	GPIO	31	32	GPIO	PTD17	
	PTD19	PWM(TPM8_CH1)	33	34	GND		
	PTF31	GPIO	35	36	GPIO	PTF5	
	PTF0	GPIO	37	38	GPIO	PTF6	
		GND	39	40	TPM8_CH0	PTD18	

*pinum= $group * $groupin + $pin + $pinbase（pinbase=128, groupin=32，group（PTD）=0, group（PTE）=1, group（PTF）=2）*

Here we use PIN35 as an example:

1. In above table, the GPIO Number of connector PIN35 is calculated to be 223.

   PTF31 means group=**2**, pin=**31** for calculation of: **2x32 + 31 + 128 = 223**

2. Set the function of PIN35 to be GPIO output.

```
root@maaxboard-8ulp:~# echo 223 >/sys/class/gpio/export
root@maaxboard-8ulp:~# echo out >/sys/class/gpio/gpio223/direction
```

3. Set the level of PIN35, 0 means low, 1 means high.

```
root@maaxboard-8ulp:~# echo 1 >/sys/class/gpio/gpio223/value
```

Measure the voltage of PIN35, the result is 3.3V.

```
root@maaxboard-8ulp:~# echo 0 >/sys/class/gpio/gpio223/value
```

Measure the voltage of PIN35, the result is 0V.

3.14.2 SPI

To use the SPI of the 40-pins interface, enable the following options in uEnv.txt :
Add ***dtoverlay_spi=5*** to uEnv.txt, then execute ***sync*** and ***reboot*** command to make it effect.
Connect SPI_MOSI(#19) and SPI_MISO(#21), then execute ***spidev_test***, the result:

```
root@maaxboard-8ulp:~# spidev_test -D /dev/spidev0.0 -v
spi mode: 0x4
bits per word: 8
max speed: 500000 Hz (500 kHz)
TX | FF FF FF FF FF FF 40 00 00 00 00 95 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
F0 0D   |......@.....................|
RX | FF FF FF FF FF FF 40 00 00 00 00 95 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
F0 0D   |......@.....................|
```

Disconnect SPI_MOSI(#19) and SPI_MISO(#21), then execute ***spidev_test***, the result:

```
root@maaxboard-8ulp:~# spidev_test -D /dev/spidev0.0 -v
spi mode: 0x4
bits per word: 8
max speed: 500000 Hz (500 kHz)
TX | FF FF FF FF FF FF 40 00 00 00 00 95 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
F0 0D   |......@.....................|
RX | FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF FF   |............................|
```

3.14.3 UART

To use the UART of the 40-pins interface, enable the following options in uEnv.txt :

Add ***dtoverlay_uart=4*** to uEnv.txt, then execute **sync** and **reboot** command to make it effect.

Connect LPUART4_TX (#8), LPUART4_RX (#10) and GND to PC by a USB to serial device, then execute ***microcom***, MaaXBoard 8ULP can receive data from PC or send data to PC:

```
root@maaxboard-8ulp:~# microcom -s 115200 /dev/ttyLP0
Abcdefgddddddddddddabcdefgddddddddddd
```

Use "Ctrl+X" exit this test.

3.14.4 IIC

To use the SPI of the 40-pins interface, enable the following options in uEnv.txt :

Add ***dtoverlay_i2c=4*** to uEnv.txt, then execute **sync** and **reboot** command to make it effect.

Connect SDA4 (#3), SCL4 (#5), VCC and GND to a IIC device, then execute ***i2cdetect***, MaaXBoard

8ULP can detect the IIC device:

```
root@maaxboard-8ulp:~# i2cdetect -y 4
     0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
00:                         -- -- -- -- -- -- -- --
10: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
20: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
30: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
40: 40 -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
50: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
60: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
70: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
```

3.15 Reserved Ports from M33

MaaXBoard 8ULP reserves two rows of port interfaces (J12 &J18) from Cotex M33, users can use them to develop corresponding functions based on their specific requirements. See the schematic diagram of MaaXBoard 8ULP for details.

3.16 Procedure to Increase eMMC Partition Size

As configured during manufacture, only a section of the 32GB eMMC is accessible. Use the following steps to expand the rootfs partition in eMMC flash memory:

- Open a serial port connection to MaaXBoard 8ULP's A35 debug connector
- Boot Linux and login to the board with user: root
- View the Partition Size using following command:

```
root@maaxboard-8ulp:~# df -h
Filesystem      Size  Used Avail Use% Mounted on
/dev/root       3.6G  2.2G  1.3G  65% /
devtmpfs        643M  4.0K  643M   1% /dev
tmpfs           965M     0  965M   0% /dev/shm
tmpfs           386M  8.9M  378M   3% /run
tmpfs           4.0M     0  4.0M   0% /sys/fs/cgroup
tmpfs           965M  288K  965M   1% /tmp
tmpfs           965M  168K  965M   1% /var/volatile
tmpfs           193M  4.0K  193M   1% /run/user/0
/dev/mmcblk0p1   84M   32M   52M  38% /run/media/boot-mmcblk0p1
```

- Expand the partition using following command:

```
root@maaxboard-8ulp:~# expand_rootfs
[   374.822503] EXT4-fs (mmcblk0p2): resizing filesystem from 993045 to 7745536 blocks
[   374.977098] EXT4-fs (mmcblk0p2): resized filesystem to 7745536
Expand rootfs size successfully, it will be enlarged upon the next reboot.
```

- View again, the partition size has been expanded:

```
root@maaxboard-8ulp:~# df -h
Filesystem      Size  Used Avail Use% Mounted on
/dev/root        29G  2.2G   26G   8% /
devtmpfs        643M  4.0K  643M   1% /dev
tmpfs           965M     0  965M   0% /dev/shm
tmpfs           386M  8.9M  378M   3% /run
tmpfs           4.0M     0  4.0M   0% /sys/fs/cgroup
tmpfs           965M  288K  965M   1% /tmp
tmpfs           965M  168K  965M   1% /var/volatile
tmpfs           193M  4.0K  193M   1% /run/user/0
/dev/mmcblk0p1   84M   32M   52M  38% /run/media/boot-mmcblk0p1
```

Chapter 4 Appendix

4.1 Hardware

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

4.2 Software

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

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

4.3 Contact Information

- Product Webpage:

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