



/ RZBOARD V2L

Linux Yocto Development Guide

V2.6

Copyright Statement:

- The RZBoard V2L and its related intellectual property are owned by Avnet.
- Avnet has the copyright of this document and reserves all rights. Any part of the document should not be modified, distributed or duplicated in any form without written permission issued by Avnet.

Disclaimer:

- Avnet does not make warranty of any kind, either expressed or implied, as to the program source code, software and documents provided along with the products, and including, but not limited to, warranties of fitness for a particular purpose; The entire risk as to the quality or performance of the program is with the user of these products.

Revision History

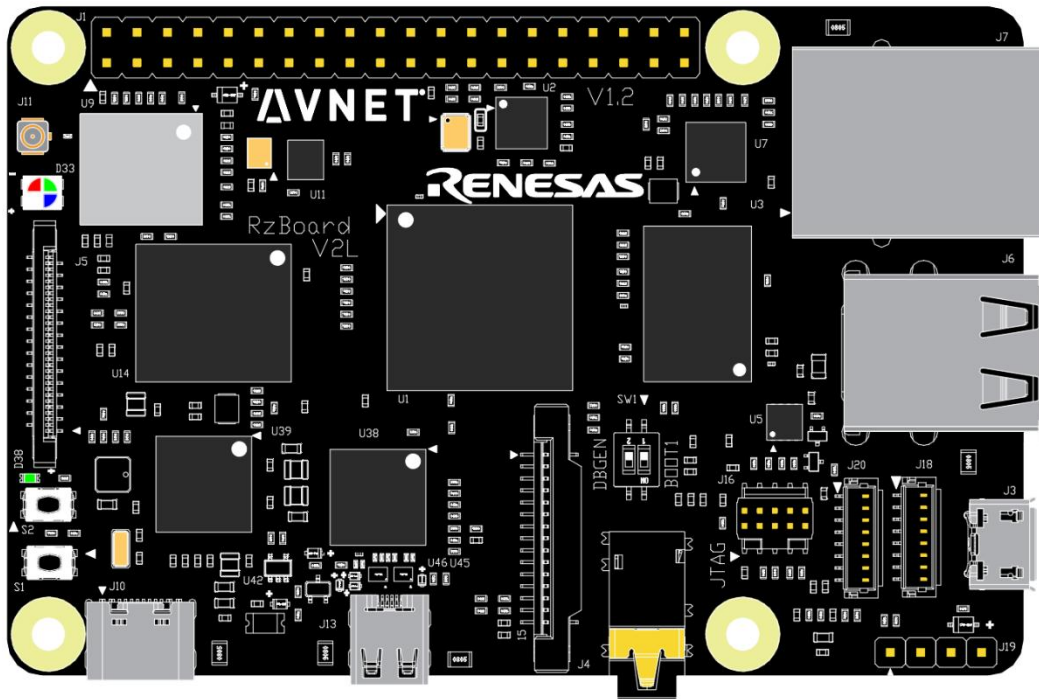
Version	Note	Author	Release Date
v1.0	Initial version	Lily	2022/07/08
v2.0	Update Yocto Project to 3.1.14	Lily	2022/09/28
v2.1	Procedure and readability improvements	Peter	2022/11/08
v2.2	1.Description of reorganizing structure of Yocto source code 2. Script <i>make_rz_uboot.sh</i> is now provided on github	Lily	2022/11/28
v2.3	Miscellaneous document readability edits	Peter	2022/12/05
V2.4	1. Provided direct links to Renesas support packages 2. Git config is unneeded	Evan	2023/04/05
V2.5	1. Updated link to Renesas codec support package	Evan	2023/04/26
V2.6	1. Make updates based on the updates of Renesas.	Lily	2023/08/09

Contents

Revision History	3
Summary	5
Chapter 1 Build Instructions	6
1.1 Setup Build Environment	6
1.2 Fetch Source Code	6
1.2.1 Download Renesas software packages	6
1.2.2 Extract Renesas software packages	7
1.2.3 Download meta-rzboard	7
1.3 Yocto Build of BSP	7
1.3.1 Edit build configuration	7
1.3.2 Setting build environment and Build	8
Chapter 2 Standalone Build of Kernel and u-Boot	9
2.1 Cross-compile tool chain	9
2.1.1 ARM GCC	9
2.1.2 Yocto SDK	9
2.2 Build u-Boot in a standalone environment	10
2.3 Build Kernel in a standalone environment	10
Chapter 3 Flash-Programming and Board Operation	12
Chapter 4 Appendix	13
4.1 Hardware Documents	13
4.2 Software Documents and Links	13
4.3 Contact Information	13

Summary

RZBoard is a development SBC board designed and manufactured by Avnet, based on RZ/V2L 64bit Arm A55 MPUs with DRP-AI acceleration from Renesas Electronics.



RZBoard is fitted with a Renesas RZ/V2L dual-core MPU (p/n R9A77G054L2)

This document describes key aspects of development on RZBoard using Yocto Linux

Note: Two methods are detailed in this document for building the Linux image and boot files:

- 1) Yocto build (simpler than the standalone method)
- 2) Standalone build

For simplicity, Renesas recommends using the **Yocto build method**

[https://renesas.info/wiki/RZ-G/RZG_yocto#Online vs Offline Yocto build](https://renesas.info/wiki/RZ-G/RZG_yocto#Online_vs_Offline_Yocto_build)

Chapter 1 Build Instructions

1.1 Setup Build Environment

To setup the build environment the following resources are required:

- Hardware: At least 300GB of disk space and 8GB of RAM
- Software: Ubuntu 64-bit OS, 20.04 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 install -y gawk wget git-core diffstat unzip texinfo gcc-multilib \
build-essential chrpath socat cpio python python3 python3-pip python3-pexpect \
xz-utils debianutils iputils-ping libssl1.2-dev xterm p7zip-full libyaml-dev \
rsync curl locales bash-completion
```

1.2 Fetch Source Code

1.2.1 Download Renesas software packages

Due to licensing restrictions on the Renesas website, users are required to download in person. The links have been provided below:

#	Package Name	Version	File to be downloaded
1	RZ/V Verified Linux Package	V3.0.2	RTK0EF0045Z0024AZJ-v3.0.2.zip
2	RZ MPU Graphics Library	Evaluation Version V1.2	RTK0EF0045Z14001ZJ-v1.4_rzv_EN.zip
3	RZ MPU Codec Library	Evaluation Version V0.58	RTK0EF0045Z15001ZJ-v1.0_EN.zip
4	RZ/V2L DRP-AI Support Package	V7.20	r11an0549ej0720-rzv2l-drpai-sp.zip
5	RZ/V2L ISP Support Package	V1.20	r11an0561ej0120-rzv2l-isp-sp.zip
6	RZ/V2L Multi-OS Package	V1.02	r01an6238ej0102-rzv2l-cm33-multi-os-pkg.zip

After downloading these packages, copy them to the **home directory (~/)** to prepare for the next step.

Note: The “Evaluation” packages contain a time limitation that stops the software after a few hours.

For more information please refer to [RZ/V2L Wiki](#).

1.2.2 Extract Renesas software packages

Download a script to extract the file.

```
$ cd ~/
$ wget https://raw.githubusercontent.com/Avnet/meta-rzboard/rzboard_dunfell_5.10/tools/create_yocto_rz_src.sh
$ chmod a+x create_yocto_rz_src.sh
$ ls ~/
create_yocto_rz_src.sh      RTK0EF0045Z0024AZJ-v3.0.2.zip
r01an6238ej0110-rzv2l-cm33-multi-os-pkg.zip RTK0EF0045Z14001ZJ-v1.4_rzv_EN.zip
r11an0549ej0730-rzv2l-drpai-sp.zip      RTK0EF0045Z16001ZJ-v1.0.1_rzv_EN.zip
```

Run the script to generate **yocto_rzboard/** directory.

```
$ ./create_yocto_rz_src.sh
$ ls yocto_rzboard/
meta-gplv2      meta-openembedded  meta-renesas      meta-virtualization
meta-multi-os   meta-qt5           meta-rz-features  poky
```

1.2.3 Download meta-rzboard

```
$ cd ~/yocto_rzboard
$ git clone https://github.com/Avnet/meta-rzboard.git -b rzboard_dunfell_5.10_v2
```

So far, all the yocto related sources are in place.

```
$ ls ~/yocto_rzboard
meta-gplv2  meta-openembedded meta-renesas meta-rz-features  poky
meta-multi-os meta-qt5          meta-rzboard meta-virtualization
```

1.3 Yocto Build of BSP

1.3.1 Edit build configuration

```
cd ~/yocto_rzboard
$ mkdir -p ~/yocto_rzboard/build/conf
$ cp meta-rzboard/conf/rzboard/* build/conf/
$ ls build/conf/
bblayers.conf local.conf
```

The directory to which all Yocto packages are downloaded, can be set by User in **conf/local.conf**:

```
DL_DIR ?= "${HOME}/downloads"
```

1.3.2 Setting build environment and Build

```
$ cd ~/yocto_rzboard/  
$ source poky/oe-init-build-env build/  
$ bitbake avnet-core-image
```

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

/yocto_rzboard/build/tmp/deploy/images/rzboard/

flashwriter_rzboard.mot	FlashWriter image tool
bl2_bp-rzboard.srec	BL2 bootloader file in S-record format
fip-rzboard.srec	BL31 bootloader plus u-Boot packages in S-record format
avnet-core-image-rzboard-xxxx.rootfs.wic	System image, this includes: Linux kernel, DTB and root file system.
Image	Kernel image
rzboard.dtb	RZBoard device tree binary
overlays/rzboard-*.dtbo	RZBoard device tree overlay binary
avnet-core-image-rzboard-xxxx.rootfs.tar.bz2	System image compressed archive file

Chapter 2 Standalone Build of Kernel and u-Boot

This chapter describes how to build u-Boot and the kernel using either Yocto SDK or ARM GCC in a standalone (offline) 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-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 ~/yocto_rzboard/
$ source poky/oe-init-build-env build
$ bitbake avnet-core-image -c populate_sdk
```

The SDK will be generated under: ~/yocto_rzboard/build/tmp/deploy/sdk/./poky-glibc-x86_64-avnet-core-image-aarch64-rzboard-toolchain-3.1.17.sh

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

```
$ ./poky-glibc-x86_64-avnet-core-image-aarch64-rzboard-toolchain-3.1.17.sh
Poky (Yocto Project Reference Distro) SDK installer version 3.1.17
=====
Enter target directory for SDK (default: /opt/poky/3.1.17):
```

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

```
$ source /opt/poky/3.1.17/environment-setup-aarch64-poky-linux
```

2.2 Build u-Boot in a standalone environment

To build a bootloader for RZBoard, the user should get cloned different repositories, such as `renesas-u-boot.git`, `trusted-firmware-a.git` and `bootparameter` code. After compiling the code of each repository, the user has to perform some steps to generate the final boot image.

A shell script named ***make_rz_uboot.sh*** is provided to simplify these processes. So the user can download the all code and build with this script. The boot image build steps are as follows:

Download the bash script into the **tmp** directory and change the file mode:

```
$ mkdir ~/tmp
$ cd ~/tmp
$ wget https://raw.githubusercontent.com/Avnet/rzboard-build-tools/main/make_rz_uboot.sh
$ chmod a+x make_rz_uboot.sh
```

Execute the script with parameter **-g** to download the code first:

```
$ ./make_rz_uboot.sh -g
```

Then execute the script with parameter **-rz** to start the build process:

```
$ ./make_rz_uboot.sh -rz
```

The following outputs are generated by default in the tmp directory:

- `bl2_bp_rzboard.srec`
- `fip_rzboard.srec`

Please refer to `RZBoard-Linux-Yocto-Usermanual.pdf` to update these boot images to the board.

2.3 Build Kernel in a standalone environment

Get the Linux source code

```
$ cd ~/
$ git clone https://github.com/Avnet/renesas-linux-cip.git -b rzboard_v2l_v5.10.145
```

Check that the environment variables are correctly set:

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

Build the kernel sources

```
$ cd ~/renesas-linux-cip
$ make distclean
$ make rzboard_defconfig
$ make -j4
```

Execute the 'ls' command to view the Image, dtb file and dtbo files after compilation.

```
$ ls arch/arm64/boot/Image
$ ls arch/arm64/boot/dts/renesas/rzboard.dtb
$ ls arch/arm64/boot/dts/renesas/overlays/rzboard-*.dtbo
```

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 Flash-Programming and Board Operation

To program the generated new Bootloader and System image files into RZBoard's eMMC memory, use the procedure described in the ***RZBoard-Linux-Yocto-UserManual***

(This also detailed in section 12 of the ***RZBoard Hardware User Guide***)

For guidance on power-up RZBoard, the boot-up process, and how to exercise the supported BSP features of RZBoard, please refer to ***RZBoard-Linux-Yocto-UserManual***

All Avnet documents are accessible via the RZBoard product page at <https://www.avnet.me/rzboard>

Chapter 4 Appendix

4.1 Hardware Documents

For hardware details please refer to:

- ***RZBoard Hardware User Guide***
-
- ***RZBoard Block Diagram***
-

4.2 Software Documents and Links

RZBoard supports Yocto Linux, for additional information, please refer to the following documents accessible from the RZBoard product page at <https://www.avnet.me/rzboard>

- ***RZBoard Linux Yocto User Manual***
- - Describes how to reflash RZBoard and aspects of the BSP functionality
-
- ***RZBoard Linux Yocto Development Guide***
- - Detailed guidance on how to rebuild the Linux system image using Yocto (this document)
-
- ***RZ/G2 Group Linux BSP Porting Guide*** (this is applicable to RZ/V2L)
- <https://www.renesas.com/us/en/document/mas/rzg2-group-linux-bsp-porting-guide>
-
- ***RZ/V and RZ/G key Wiki pages on Renesas.info***
- <https://renesas.info/wiki/RZ-V>
- <https://renesas.info/wiki/RZ-G>
- https://renesas.info/wiki/RZ-G/RZG_kernel
- https://renesas.info/wiki/RZ-G/RZG_DeviceTree
- https://renesas.info/wiki/RZ-G/RZ-G2_BSP
- https://renesas.info/wiki/RZ-G/RZ-G2_BSP_Porting
-

4.3 Contact Information

Product Webpage: <https://www.avnet.me/rzboard>