



**/ RZBOARD V2L**

**Linux Yocto Development Guide**

**v2.3**

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## Revision History

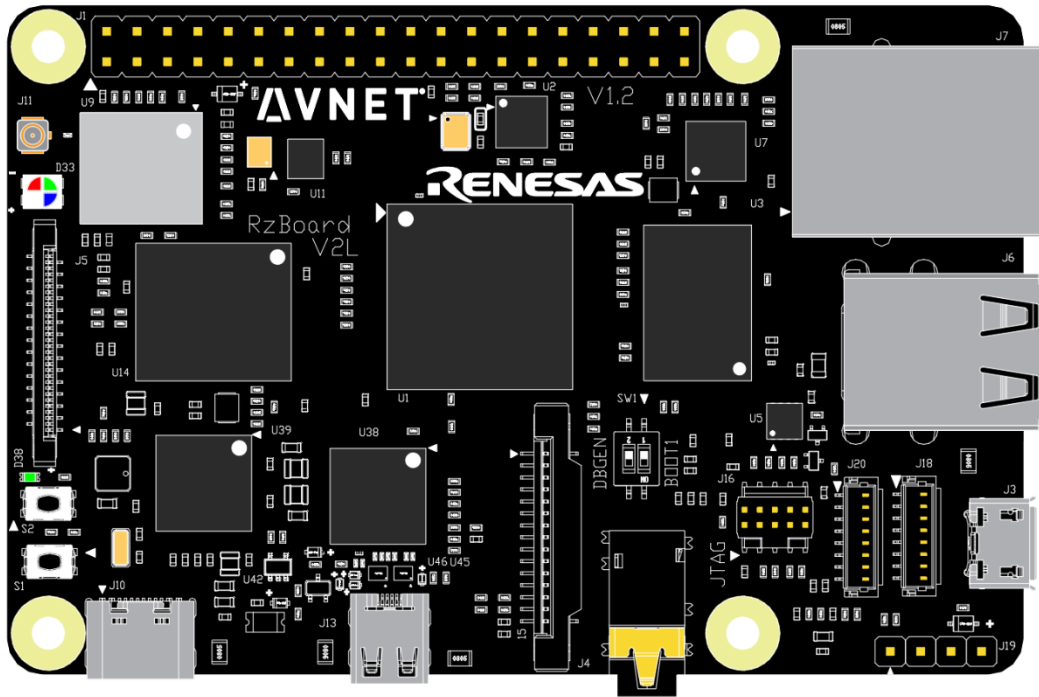
Version	Note	Author	Release Date
v1.0	Initial version	Lily	2022/07/08
v2.0	Update Yocto Project to 3.1.14	Lily	2022/09/28
v2.1	Procedure and readability improvements	Peter	2022/11/08
v2.2	1. Description of reorganizing structure of Yocto source code 2. Script <i>make_rz_uboot.sh</i> is now provided on github	Lily	2022/11/28
v2.3	Miscellaneous document readability edits	Peter	2022/12/05

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## 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
```

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 Renesas software packages

Due to licensing restrictions on the Renesas website, users are required to download in person, the following six software packages from the [Official RZ/V2L Website](#)

#	Package Name	Version	File to be downloaded
1	RZ/V Verified Linux Package	v3.0.0-update2	RTK0EF0045Z0024AZJ-v3.0.0-update2.zip
2	RZ MPU Graphics Library	Evaluation Version V1.2	RTK0EF0045Z13001ZJ-v1.21_EN.zip
3	RZ MPU Codec Library	Evaluation Version V0.58	RTK0EF0045Z15001ZJ-v0.58_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-v3.0.0-update2.zip
r01an6238ej0102-rzv2l-cm33-multi-os-pkg.zip RTK0EF0045Z13001ZJ-v1.21_EN.zip
r11an0549ej0720-rzv2l-drpai-sp.zip      RTK0EF0045Z15001ZJ-v0.58_EN.zip
r11an0561ej0120-rzv2l-isp-sp.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
```

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/`**

<b>flashwriter_rzboard.mot</b>	FlashWriter image tool
<b>bl2_bp-rzboard.srec</b>	BL2 bootloader file in S-record format
<b>fip-rzboard.srec</b>	BL31 bootloader plus u-Boot packages in S-record format
<b>avnet-core-image-rzboard-xxxx.rootfs.wic</b>	System image, this includes: Linux kernel, DTB and root file system.
<b>Image</b>	Kernel image
<b>rzboard.dtb</b>	RZBoard device tree binary
<b>overlays/rzboard-*.dtbo</b>	RZBoard device tree overlay binary
<b>avnet-core-image-rzboard-xxxx.rootfs.tar.bz2</b>	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 8.3 version for this release. You can download the "gcc-arm-8.3-2019.03-x86\_64-aarch64-linux-gnu.tar.xz", and decompress the file into a local directory.

```
$ mkdir ~/toolchain
$ tar -xJf gcc-arm-8.3-2019.03-x86_64-aarch64-linux-gnu.tar.xz -C ~/toolchain
```

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

```
$ cd toolchain/gcc-arm-8.3-2019.03-x86_64-aarch64-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-8.3-2019.03-x86_64-aarch64-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-3.1.14.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-3.1.14.sh
```

Poky (Yocto Project Reference Distro) SDK installer version 3.1.14

```
=====
```

Enter target directory for SDK (default: /opt/poky/3.1.14):

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

```
$ source /opt/poky/3.1.14/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
```

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_kernel)  
[https://renesas.info/wiki/RZ-G/RZG\\_DeviceTree](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)  
[https://renesas.info/wiki/RZ-G/RZ-G2\\_BSP\\_Porting](https://renesas.info/wiki/RZ-G/RZ-G2_BSP_Porting)

### 4.3 Contact Information

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