
RZ/G AI Board Support Package

Version 1.0

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Rev. 1.0

Release Note

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Introduction

This release note describes the contents, building procedures for AI Board Support Package. This AI BSP enables AI frameworks of Verified Linux Package for RZ/G and RZ/G2 platforms. In this release, AI Board Support Package is preliminary and provided AS IS with no warranty.

The implementation of the AI framework introduced in Chapter 3 makes it possible to perform AI inference in the RZ/G family using trained data. If you want to run the demo, please refer to Chapter 4.

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1. Release Items

- **Name and version**

RZ/G AI Board Support Package
Version 1.0.0

- **Distribution method**

Please visit the site below and create an account to download the packages. This site is for the entire RZ Family which includes the RZ/G series. Basic packages of AI BSP v4.5.0 which are listed in **Table 1** can be downloaded.

RZ Family:

<https://www.renesas.com/products/microcontrollers-microprocessors/rz-arm-based-high-end-32-64-bit-mpus>

AI BSP can build with Verified Linux Package(VLP) for RZ/G family. VLP is available for each RZ/G series. You can also download the basic packages of VLP64 v1.0.8, VLP v2.1.9, and BSPv1.3update1 which are listed in **Table 1** from the site below.

RZ/G Marketplace:

<https://www.renesas.com/products/microcontrollers-microprocessors/rz-cortex-a-mpus/rzg-linux-platform>

- **Target board**

RZ/G2 Group

Hoperun Technology HiHope RZ/G2H platform (hihope-rzg2h) Rev 4.0
Hoperun Technology HiHope RZ/G2M platform (hihope-rzg2m) Rev 4.0 (*1)
Hoperun Technology HiHope RZ/G2N platform (hihope-rzg2n) Rev 4.0
Silicon Linux RZ/G2E evaluation kit (ek874) Rev C
Silicon Linux RZ/G2E evaluation kit (ek874) Rev E
RZ/G2L Evaluation Board Kit PMIC version (*2):

- RZG2L SMARC Module Board v02
- RZ SMARC Series Carrier Board v04

RZ/G2LC Evaluation Board Kit

RZ/G1 Group

iWave RZ/G1H-PF Qseven Development Platform R2.1
iWave RZ/G1M-PF Qseven Development Platform R2.0
iWave RZ/G1E-PF SODIMM Development Platform R3.1, R4.0

- (*1) There are 2 versions of RZ/G2M LSI devices. There are version 3.0 and 1.3 (hereinafter referred to as “RZ/G2M v3.0” and “RZ/G2M v1.3”).
- (*2) “RZ/G2L Evaluation Board Kit” and “RZG2L Evaluation Board Kit PMIC version” includes the RZG2L SMARC Module Board and the RZ SMARC Series Carrier Board.

- **Supported Frameworks/Versions**

Framework	Version	Parser(s)	Inference Hardware
ArmNN	v21.05	ONNX TensorFlow Lite	CPU
ONNX Runtime	v1.8.0	ONNX	CPU
TensorFlow Lite	v2.3.1	TensorFlow Lite	CPU

- **Verified functions**

Linux BSP

- Linux Kernel
- Linux Drivers
- Graphics Libraries

- **Evaluation vs Product Version**

Because the package that contains the VLP Yocto recipes also contains the multimedia packages, there are two release versions: Evaluation (eva) and Product (pro). Please note that both of these packages have the same exact functionality. The only difference is that when you execute an application that uses the evaluation version of the multimedia libraries, operation will automatically be stopped after a few hours. The product version does not have this time limitation. To acquire the product version, please contact Renesas to start the formal process of acquiring those releases.

- **File contents**

VLP64 is delivered by the files listed in **Table 1**.

Table 1. RZ/G Verified Linux Package for 32bit or 64bit kernel**Basic packages (RZ/G2H,M,N,E)**

File	Description
meta-renesas-ai(1.01GB)	Ai-BSP for RZ/G
RZG2_Group_Evaluation_Software_Package_for_Linux_20200619.tar.gz(22KB)	RZ/G Multimedia Package for 64bit kernel for RZ/G2

Basic packages (RZ/G2L,LC)

File	Description
meta-renesas-ai(1.01GB)	Ai-BSP for RZ/G (This is the same as RZ/G1, 2)
RTK0EF0045Z13001ZJ-v0.51_JP.zip(73KB)	Mali GPU Graphics Library Version V0.51 for RZ/G2L Group Board Support Package

Basic packages (RZ/G1H,M,E)

File	Description
meta-renesas-ai(1.01GB)	Ai-BSP for RZ/G (This is the same as RZ/G2 and RZ/G2L,LC)
RZG_Series_Evaluation_Software_Package_for_Linux_all_20191127.tar.gz(7KB)	RZ/G Multimedia Package for RZ/G1 Group
RZG_Series_Software_Package_of_Linux_Drivers_all_20180626.tar.gz(3KB)	Multimedia Drivers for RZ/G1 Group

2. Build environment

Figure 1 shows an overall constitution of the recommended environment of VLP64 or VLP. This environment uses the equipment and the software listed in Table 2. Please refer to “RZ/G Verified Linux Package Start-Up Guide” for details about setting up the environment.

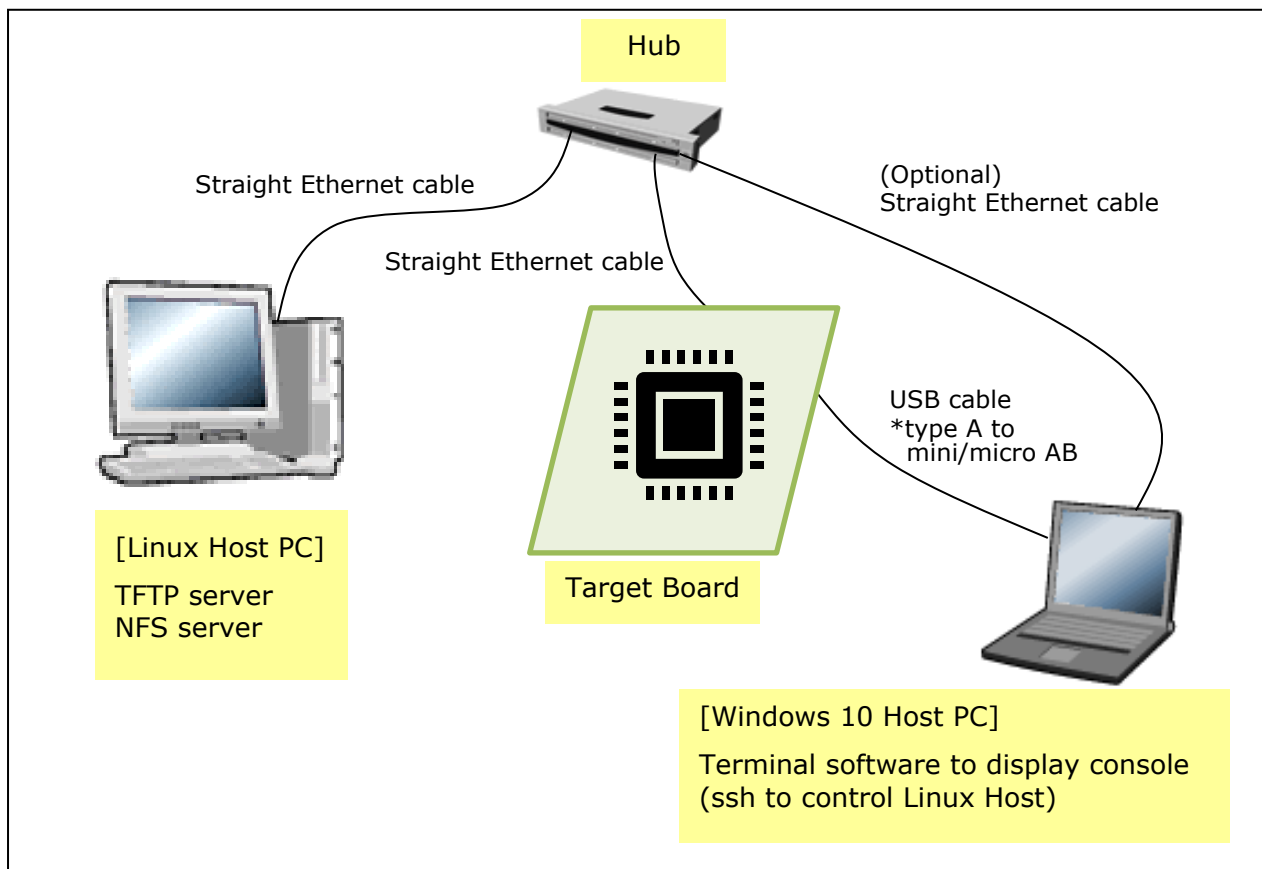


Figure 1. Recommended Environment

Table 2. Equipment and Software Necessary for Developing Environments of RZ/G Linux Platform

Equipment	Description
Linux Host PC	Used as build/debug environment 100GB free space on HDD is necessary
OS	Follow the requirements of each VLP or BSP RZ/G2H,M,N,E(Ubuntu 18.04 LTS) RZ/G2L,LC(Ubuntu 20.04 LTS) RZ/G1H,M,E(Ubuntu 16.04 LTS) 64 bit OS must be used.
TFTP server	Used for downloading the Linux kernel to the board
NFS server	Used for mounting rootfs via NFS
Windows Host PC	Used as debug environment, controlling with terminal software
OS	Windows 10
Terminal software	Used for controlling serial console of the target board Tera Term (latest version) is recommended Available at https://tssh2.osdn.jp/index.html.en
VCP Driver	Virtual COM Port driver which enables to communicate Windows Host PC and the target board via USB which is virtually used as serial port. Available at: <ul style="list-style-type: none"> http://www.ftdichip.com/Drivers/VCP.htm (for ek874, RZ/G2L, and RZ/G1 Group) https://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers (for hihope-rzg2h, hihope-rzg2m, and hihope-rzg2n) Please install VCP Driver corresponding to the target board.

Note) Build may fail if Ubuntu 14, 16, 20 or 21 is used.

Most bootable images VLP64 and VLP supports can be built on an “offline” environment.

The word “offline” means an isolated environment which does not connect to any network. Since VLP64 and VLP includes all necessary source codes of OSS except for the Linux kernel, VLP64 and VLP can always build images in this “offline” environment without affected from changes of repositories of OSS. Also, this “offline” environment reproduces the same images as the images which were verified by Renesas.

Below are not available in the “offline” environment. Please connect your Linux Host PC to the internet.

- Preparing a Linux Host PC

3. Building Instructions of an AI BSP

3.1 Building images to run on the board

This section describes the instructions to build the AI Board Support Package (hereinafter referred to as “AI BSP”). Before starting the build, run the command below on the Linux Host PC to install packages used for building the BSP.

RZ/G2H,M,N,E and RZ/G1H,M,E

```
$ sudo apt-get update
$ sudo apt-get install 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 libstd1.2-dev xterm p7zip-full
```

RZ/G2L,LC

```
$ sudo apt-get update
$ sudo apt-get install gawk wget git-core diffstat unzip texinfo gcc-multilib \
build-essential chrpath socat cpio python3 python3-pip python3-pexpect xz-utils \
debianutils iputils-ping python3-git python3-jinja2 libegl1-mesa libstd1.2-dev \
pylint3 xterm
```

Please refer to the URL below for detailed information:

- <https://www.yoctoproject.org/docs/2.4.3/yocto-project-qs/yocto-project-qs.html>

Run the commands below and set the user name and email address before starting the build procedure. **Without this setting, an error occurs when building procedure runs git command to apply patches.**

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

Copy all files obtained from Renesas into your home directory prior to the steps below.

(1) Create a working directory (user_work) at your home directory, and decompress Yocto recipe package

Run the commands below.

```
$ export WORK=~/.user_work
$ mkdir -p $WORK
$ cd $WORK
$ git clone https://github.com/renesas-rz/meta-renesas-ai
```

Note) Please note that your build environment must have 100GB of free hard drive space in order to complete the build. The Yocto BSP build environment is very large. Especially in case you are using a Virtual Machine, please check how much disk space you have allocated for your virtual environment.

The structure of the work directory is as follows.

```
\<work directory>\ meta-renesas-ai
```

(2) Download and setup the proprietary software

Download and setup to working directory Multimedia Package and Multimedia Drivers.

MPU	package
RZ/G2/H,M,N,E	RZ/G Multimedia Package for 64bit kernel (e.g. RZG2_Group_Evaluation_Software_Package_for_Linux_20200619.tar.gz)
RZ/G2L,LC	Mali GPU Graphics Library for RZ/G2L Group Board Support Package (e.g. RTK0EF0045Z13001ZJ-v0.51_JP.zip)
RZ/G1H,M,E	RZ/G Multimedia Package (e.g. RZG_Series_Evaluation_Software_Package_for_Linux_all_20191127.tar.gz) Multimedia Drivers (e.g. RZG_Series_Software_Package_of_Linux_Drivers_all_20180626.tar.gz)

The structure of the work directory is as follows.(RZ/G2)

```
<work directory>\meta-renesas-ai
                \RZG2_Group_Evaluation_Software_Package_for_Linux_20200619.tar.gz
```

(3) Start a build

Run the commands script below to start a build. Building an image can take up to a few hours depending on the user's host system performance.

```
$ cd ~/user_work/meta-renesas-ai/
$ ./scripts/build-rzg-ai-bsp.sh -p <platform> -l <prop lib dir>
```

Script option

- h Print this help and exit.
- c Only perform checkout, proprietary library extraction and configuration. Don't start the build.
- d Install OS dependencies before starting build.
- f <framework> Select which AI framework to include in the filesystem.
Choose from:
benchmark-armnn+tfl, benchmark-onnx,
benchmark-tflite, armnn, onnxruntime or
tensorflow-lite.
By default \${FRAMEWORK} will be used.
- l <prop lib dir> Location when proprietary libraries have been downloaded to.
- o <output dir> Location to copy binaries to when build is complete.
By default \${OUTPUT_DIR} will be used.
- p <platform> Platform to build for. Choose from:
iwg21m, iwg20m-g1m, iwg22m, hihope-rzg2h,
hihope-rzg2m, hihope-rzg2n, ek874, smarc-rzg2l.

e.g. for RZ/G2L.

```
$ ./scripts/build-rzg-ai-bsp.sh -p smarc-rzg2l -l ../
```


After first building, directory structure,

```
<work directory>\ meta-renesas-ai
    +build\
    +meta-benchmark\
    +meta-openembedded\
    +meta-rzg2\
    +output\
    +README.md
    +COPYING.MIT
    +meta-gplv2\
    +meta-qt5\
    +meta-rzg-ai\
    +patches scripts\
    +meta-armnn\
    +meta-onnxruntime\
    +meta-renesas-ai\
    +meta-tensorflow-lite\
    +poky\
    \RZG2_Group_Evaluation_Software_Package_for_Linux_20200619.tar.gz
```

While running the script, a message asking whether the license agreement is complete or not is displayed. After the message is displayed, the script stops.

```
Have licensing options been updated in the local.conf file?
```

After the script stops, please uncomment the line that is commented out in meta-renesas-ai/build/conf/local.conf in **another** terminal as shown below.

About from 270 to 310 line

From:

```
#LICENSE_FLAGS_WHITELIST = "commercial_gstreamer1.0-libav commercial_gstreamer1.0-pl
ugins-ugly commercial_ffmpeg commercial_mpeg2dec commercial_faac commercial_faad2 co
mmercial_x264"
```

To:delete “#”

```
LICENSE_FLAGS_WHITELIST = "commercial_gstreamer1.0-libav commercial_gstreamer1.0-plu
ugins-ugly commercial_ffmpeg commercial_mpeg2dec commercial_faac commercial_faad2 com
mercial_x264"
```

When using RZ / G2L, the following additional processing is required.

```
$ cd meta-rzg2
$ git am ../meta-renesas-ai/patches/meta-rzg2/dunfell-rzg21/0001-cip-core.inc-Fix-\
recipes-debian-BBMASK.patch
```

After the license agreement is completed, please continue the script by entering “y”.

Have licensing options been updated in the local.conf file? y
--

After the build is successfully completed, a similar output will be seen, and the command prompt will return.

NOTE: Tasks Summary: Attempted 7427 tasks of which 16 didn't need to be rerun and all succeeded.
--

All necessary files listed in エラー! 参照元が見つかりません。 will be generated by the bitbake command and will be located in the **build/tmp/deploy/images** directory.

For details on the file name (Linux kernel, boot loader, etc.), refer to the release notes of each VLP or BSP release note.

VLP2.1.9 : <https://www.renesas.com/us/en/document/rln/release-note-rzg-verified-linux-package-v219>

VLP64v1.0.8 : <https://www.renesas.com/jp/ja/document/rln/release-note-rzg-verified-linux-package-64bit-kernel-version-108?r=1163891>

BSP1.1-update1 : <https://www.renesas.com/jp/ja/document/sws/rzg2l-board-support-package-v11update1-rtk0ef0045z0019azj-v11update1zip>

4. Building Demo

Two demos based on the Renesas AI BSP are available.

4.1 Object detection demo

(a) **Supported Platforms:**

- Renesas RZ/G2H hihope-rzg2h from Hoperun
- Renesas RZ/G2M hihope-rzg2m from Hoperun
- Renesas RZ/G2E ek874 from Silicon Linux

(b) **Build Instructions**

Please refer to the following page and read README.md for build details.

[meta-renesas-ai-demos/meta-object-detection-demo at master · renesas-rz/meta-renesas-ai-demos \(github.com\)](https://github.com/renesas-rz/meta-renesas-ai-demos/tree/master/meta-object-detection-demo)

4.2 Shopping basket demo

(a) **Supported Platforms:**

- Renesas RZ/G2E ek874
- Renesas RZ/G2M smarc-rzg2m
- Renesas RZ/G2L smarc-rzg2l
- Renesas RZ/G2LC smarc-rzg2lc

(b) **Build Instructions**

Please refer to the following page and read README.md for build details.

[meta-renesas-ai-demos/meta-shopping-basket-demo at master · renesas-rz/meta-renesas-ai-demos \(github.com\)](https://github.com/renesas-rz/meta-renesas-ai-demos/tree/master/meta-shopping-basket-demo)

Website and Support

Renesas Electronics Website

<http://www.renesas.com/>

Inquiries

<http://www.renesas.com/contact/>

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