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# RZ/G AI Board Support Package

## Version 1.01

R01TU0372EJ0101

Rev. 1.01

## Release Note

Jan. 15, 2023

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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 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 1.0.1

- **Distribution method**

Please visit the site below and create an account to download the packages. This site is for the entire RZ Family. Basic packages of AI BSP v5.0.0 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. You can also download the basic packages of VLP v3.0.0 or later 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

(\*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	v22.02	ONNX (v1.6.0) TensorFlow Lite (v2.5.3)	CPU GPU (smarc-rzg2l, smarc-rzg2lc)
ONNX Runtime	v1.8.0	ONNX	CPU
TensorFlow Lite	v2.5.3	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**

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

**Table 1. RZ/G Verified Linux Package [5.10-CIP]****Basic packages (RZ/G2H, M, N, E)**

File	Description
meta-renesas-ai	Ai-BSP for RZ/G
RTK0EF0045Z0022AZJ-v1.0_EN.zip or later	RZ MPU Multimedia Package Evaluation Version V1.0 for Verified Linux Package of RZ/G2H, RZ/G2M, RZ/G2N, and RZ/G2E

**Basic packages (RZ/G2L, LC)**

File	Description
meta-renesas-ai	Ai-BSP for RZ/G (This is the same as RZ/G2)
RTK0EF0045Z13001ZJ-v1.3_EN.zip or later	RZ MPU Graphic Library Evaluation Version for RZ/G2L, RZ/G2LC and RZ/V2L
RTK0EF0045Z15001ZJ-v1.0_EN.zip or later	RZ MPU Video Codec Library Evaluation Version for RZ/G2L and RZ/V2L

## 2. Build environment

The environment for building the Board Support Package (hereinafter referred to as “BSP”) is listed in Table 2. Please refer to the below documents for details about setting up the environment:

SMARC EVK of RZ/G2L, RZ/G2LC, RZ/G2UL, RZ/V2L, and RZ/Five Start-up Guide

Reference Boards of RZ/G2H, RZ/G2M, RZ/G2N, and RZ/G2E Start-up Guide

**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	<b>Ubuntu 20.04 LTS</b> 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 <a href="https://tssh2.osdn.jp/index.html.en">https://tssh2.osdn.jp/index.html.en</a>
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"> <li><a href="http://www.ftdichip.com/Drivers/VCP.htm">http://www.ftdichip.com/Drivers/VCP.htm</a> (for ek874, RZ/G2L, and RZ/G1 Group)</li> <li><a href="https://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers">https://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers</a> (for hihope-rzg2h, hihope-rzg2m, and hihope-rzg2n)</li> </ul> Please install VCP Driver corresponding to the target board.

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

The word “offline” means an isolated environment which does not connect to any network. Since VLP includes all necessary source codes of OSS except for the Linux kernel, 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.

```
$ 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 libstdc++12-dev xterm p7zip-full libyaml-dev
```

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 username 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 RZ/G2H, RZ/G2M, RZ/G2N, and RZ/G2E (e.g., RTK0EF0045Z0022AZJ-v1.0_JP.zip)
RZ/G2L, LC	RZ MPU Graphic Library Evaluation Version for RZ/G2L, RZ/G2LC and RZ/V2L (e.g., RTK0EF0045Z13001ZJ-v1.3_EN.zip) RZ MPU Video Codec Library Evaluation Version for RZ/G2L and RZ/V2L (e.g., RTK0EF0045Z15001ZJ-v1.0_EN.zip)

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

```
<work directory>\ RTK0EF0045Z0022AZJ-v1.0_JP.zip
```

If you change the version of proprietary software, please change the description of “install\_prop\_libs()” \meta-renesas-ai\script\build-rzg-ai-bsp.sh file.

### (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/G2E.

```
$ ./scripts/build-rzg-ai-bsp.sh -p ek874 -l ../
```

After first building, directory structure,

```
<work directory>\ meta-renesas-ai
    +build\
    +classes\
    +conf\
    +COPYING.MIT
```

```
+docs\  
+meta-gplv2\  
+meta-openembedded\  
+meta-qt5\  
+meta-renesas\  
+meta-renesas-ai\  
+meta-rz-features\  
+poky\  
+README.md  
+recipes-benchmark\  
+recipes-core\  
+recipes-devtools\  
+recipes-kernel\  
+recipes-mathematics\  
+recipes-support\  
+scripts\  
+wic\  
\RTK0EF0045Z0022AZJ-v1.0_EN  
\RTK0EF0045Z0022AZJ-v1.0_EN.zip
```

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  
gins-ugly commercial_ffmpeg commercial_mpeg2dec commercial_faac commercial_faad2 com  
mercial_x264"
```

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 7524 tasks of which 16 didn't need to be rerun and all succeeded.

All necessary files listed in VLP Release Note will be generated by the bitbake command and will be located in the build/tmp/ deploy/ images directory.

## 4. Building Demo

Two demos based on the Renesas AI BSP are available.

### 4.1 RZ Edge AI Demo

(a) **Supported Platforms:**

Renesas RZ/G2M hihope-rzg2m from Hoperun

Renesas RZ/G2E ek874 from Silicon Linux

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.

[GitHub - renesas-rz/meta-rz-edge-ai-demo](https://github.com/renesas-rz/meta-rz-edge-ai-demo)

## Website and Support

Renesas Electronics Website

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

Inquiries

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

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