User's Manual

RZ/G Series

Development Environment Guide

Target Devices

RZ Family

Renesas Electronics
www.renesas.com

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How to Use This Manual

Purpose and Target Readers

This manual is provided to give users of the RZ/G Linux platform a description of the features of the platform and the flow of using the development environment. Applying the information in this manual requires knowledge of the fundamentals of software development, including operating systems and programming.

Particular attention should be paid to the precautionary notes when using RZ/G-series products. These notes occur within the body of the text, at the end of each section, and in the Usage Notes section.

The following documents are provided for RZ/G-series products.

Document Type	Outline	Document Title
Development tools	Describes how to use RZ/G Linux platform Development Environment, consisting of the Linux Customization tool, Verification tool, and Analysis tool.	RZ/G Linux Platform Development Environment User's Manual for the Linux Customization Tool, the Verification and Analysis Tools
	Describe how to use Linux Customization tool and Verification tool, based on examples.	RZ/G Linux Platform Development Environment Tutorial Manual
	Describes how to set up the local build server for the RZ/G Linux Platform Development Environment.	Build Server Setup Manual for RZ/G Linux Platform Development Environment
	Describes how to create test programs.	Guide for Creating Test Programs for the Software Verification Tool
Hardware user's manual	Describes common specifications.	RZ/G Series User's Manual: Hardware
	Describes specifications specific to the RZ/G1H-PF.	RZ/G1H-PF User's Manual: Hardware
	Describes specifications specific to the RZ/G1M-PF.	RZ/G1M-PF User's Manual: Hardware
	Describes specifications specific to the RZ/G1N-PF.	RZ/G1N-PF User's Manual: Hardware
	Describes specifications specific to the RZ/G1E-PF.	RZ/G1E-PF User's Manual: Hardware
	Describes specifications specific to the RZ/G1C-PF.	RZ/G1C-PF User's Manual: Hardware

Abbreviation

Abbreviation	Spelling Out	Description
BSP	Board Support Package	In general, “BSP” means the "Board Support Package" (a software component that allows you to run the operating system on a specific hardware platform). But in this document and each tool described in this document, the "Verified Linux Package" provided by our company is referred to as "BSP" depended on each context.
OpenGL ES	OpenGL for Embedded Systems	This is a subset of OpenGL for embedded systems. It serves as the programming interface for graphics processing.
Qt	Qt	Cross-platform application framework in the form of a widely known GUI toolkit
CMMI	Capability Maturity Model Integration	Framework for use in evaluating or improving software development processes in organizations and companies. It is defined in terms of the degrees of maturity of development processes.
e^2 studio	e^2 studio	Eclipse-based integrated development environment which supports devices from Renesas

Contents

1. Overview

This manual gives users of the RZ/G Linux platform a description of the development environment services and the flow of development in the environment.

Note that the manual only provides an overview. For details, see the separate documents for the RZ/G Linux platform listed in Figure 1.

The tool related documents for the RZ/G Linux Platform

Figure 1. The tool related documents for the RZ/G Linux Platform

1.1 Related Documents

Table 1. Related Documents

No.	Document Title	Outline
1	RZ/G Linux Platform Development Environment User's Manual	Describes how to use the tool for Linux customization / verification / analysis on development on RZ/G Linux platform.
2	Build Server Setup Manual for RZ/G Linux Platform Development Environment	Describes how to setup the local server used by Linux customize tool.
3	RZ/G Linux Platform Development Environment Tutorial Manual	Describes how to use each tool of RZ/G Linux platform, based on examples.
4	Guide for Creating Test Programs for the Software Verification Tool	Describes how users create test programs to be registered with the software verification tool.

1.2 Provided Tools

Table 2 lists tools provided in the development environment.

Table 2. Tools Provided in the Development Environment

Tool Name	State of Provision	Outline
e^2 studio	Application software	Eclipse-based integrated development environment from Renesas The build and analysis tools are included as plug-ins, and the e^2 studio serves as the front end for the development environment on the cloud server. And e^2 studio5.4.0 and e^2 studio6.1.0 support cross compile Linux application for RZ/G and remote debug by GDB,
RZ/G Linux Platform Development Environment	e^2 studio plug-in	The Linux customization tool This tool provides the function for customizing and building based on “Verified Linux Package”, by using a local build server.
		The Verification tool This tool provides the function for verifying using the test programs which are used for “Verified Linux Package”. It can be used for checking whether the Linux environment is degraded by customer customizing. The test programs are released on the web server for the “Development Environment service”.
		The Analysis tool This tool provides the function for analyzing log files, which are given as the execution results of the verification tool, on the web server for the “Development Environment service”. The function gives a description and cause and countermeasures as a hint, for items on errors found in verification.
	Application software	The Smart Configurator This tool provides the function which configure pin settings on GUI and generate Linux source codes (device tree files).
	DVD image	The Build Server for the Linux Customization tool This is a build server software which is provided as a setup DVD image file, and it can be installed for the customer PC. This can be used only with Linux Customization tool. **Note:** The file released as “Verified Linux Package V2.1.0” cannot be installed for this server directly. To register “Verified Linux Package V2.1.0” to this build server, use the “BSP2.1.0” released on which the web server for the “Development Environment service”.
	Data file	The “Verified Linux Package 2.1.0” for registering Build Server (“BSP 2.1.0”) This is a format changed package of “Verified Linux Package 2.1.0” for installing to the Build Server. In case of use “Verified Linux Package 2.1.0”, download “BSP 2.1.0” and install it to the Build server. The next version for “Verified Linux Package 2.1.0” can be install to the Build Server directly.

1.3 Server PC using for the Build Server

The Linux Customization Tool in the RZ/G Linux Platform development Environment requires a dedicated build server to perform the build process. As this build server, **please prepare a server PC which can erase existing data and set it up from "OS"**.

Table 3 lists the recommended specifications of a PC on which a development environment for use with the Build server is to be installed.

Table 3. Recommended Specifications for a Server PC

Item	Tentative Specification
CPU	Core-i7 series, or Core-i5 series and CPU cores with higher performance
RAM	4 Gbytes × at least the number of users who will be building at the same time Note: A user is assumed to use 4 Gbytes of RAM. Specify the allowable number of users who will be able to proceed with the build process at the same time.
HDD	100 Gbytes × number of BSPs to be used × at least (number of users of the server + 1) Note: The number of users of the server are up to 10 users.
Others	A bootable DVD drive is required for the setup process.
models of PCs with proven performance	Lenovo ThinkCentre M71e, M700

Note: The "Server Software" set up on the server PC also includes "OS". Please note that the existing data in the server PC will be erased by Setup.

Note for the Build Server

- **Renesas will not provide security patches for the Build Server software (including "OS").**
- **In use of the Build Server, do not connect it to networks which have security risk.**

2. Features of the RZ/G Linux Platform

The RZ/G Linux platform consists of the following five elements (also see Figure 2). Utilizing these elements can help solve problems encountered by users in development, as shown in Table 4.

1. Verified Linux Package (Super Long-Term Support)
2. RZ/G Linux Platform Development Environment and Development Tools
3. Software Add-Ons
4. RZ/G-PF Multimedia Processors
5. Board Solutions

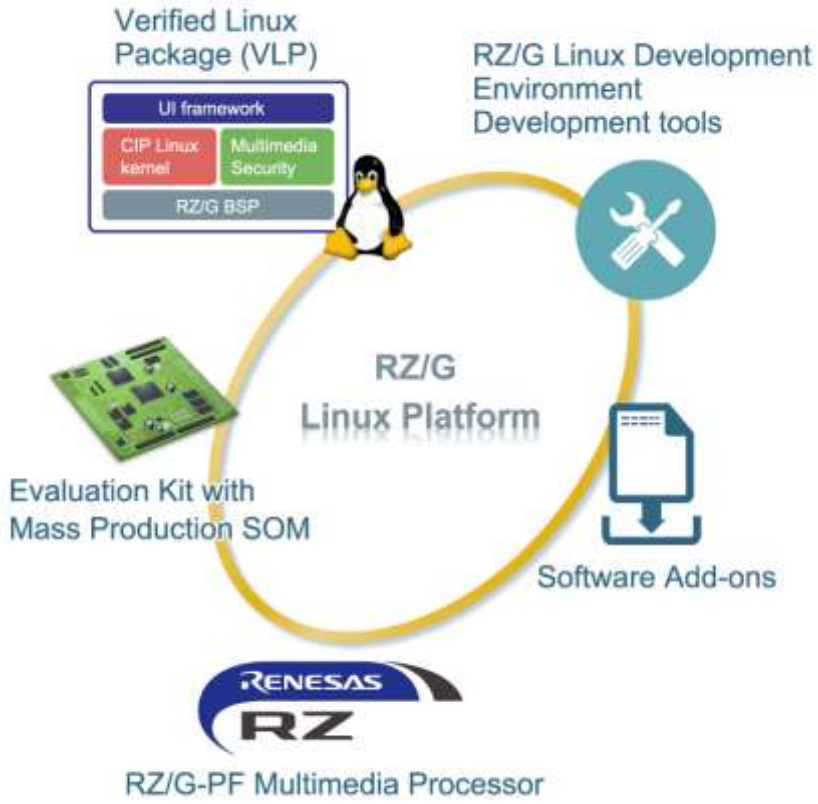

Figure 2. Configuration of the RZ/G Linux Platform

Table 4. Problems Solved by the RZ/G Linux Platform

Problem / Element	Increases in Times for Develop-ment	Increases in Costs of Develop-ment and Main-tenance	Difficulties in Quality Control	High Barriers against Employing Linux	Difficulties in Ensuring Security	Increasing Degrees of Support for Multimedia	Increases in Times until Mass Production Starts
1. Verified Linux package	√	√	√	√	√	√	
2. Development environment	√	√	√	√		√	
3. Software add-ons	√	√	√			√	
4. RZ/G-PF processor					√	√	
5. Board solutions	√	√					√

The features of each element are described on the following pages.

2.1 Verified Linux Package (Super Long-Term Support)

The Linux package offered by Renesas contains basic ported and tested software necessary for the industrial segment, for which operation and performance has been verified based on test cases and conditions determined by Renesas. It enables you to get started with a stable Linux environment immediately, so you can concentrate on developing your application.

Software that has traditionally been provided by semiconductor chip manufacturers has been sample-level quality where operation was not guaranteed, and maintenance was not performed systematically. Due to this, developers needed to develop product-level software by themselves.

The operation of the software in Renesas' Linux package and software add-ons has been verified, and the process is carefully managed and maintained. This vastly reduces the software development burden inherent to embedded system design.

Key Features

- Super long-term support by Civil Infrastructure Platform™ (CIP™)
  - ✧ 5 years of backporting of additional functions for latest kernel
  - ✧ Over 10 years of security patch support
  - ✧ In addition, Renesas is independently carrying out activities to expand the scope of maintenance
- Support for industry-standard APIs
- Enhanced standard software components for use with industrial and IoT applications
  - ✧ Improved reliability, real-time performance, security, and functional safety as required by industrial segment
- CMMI Level 3 software development process management
- Support for industry-standard APIs
- Free and simple click-through licensing
- Free maintenance

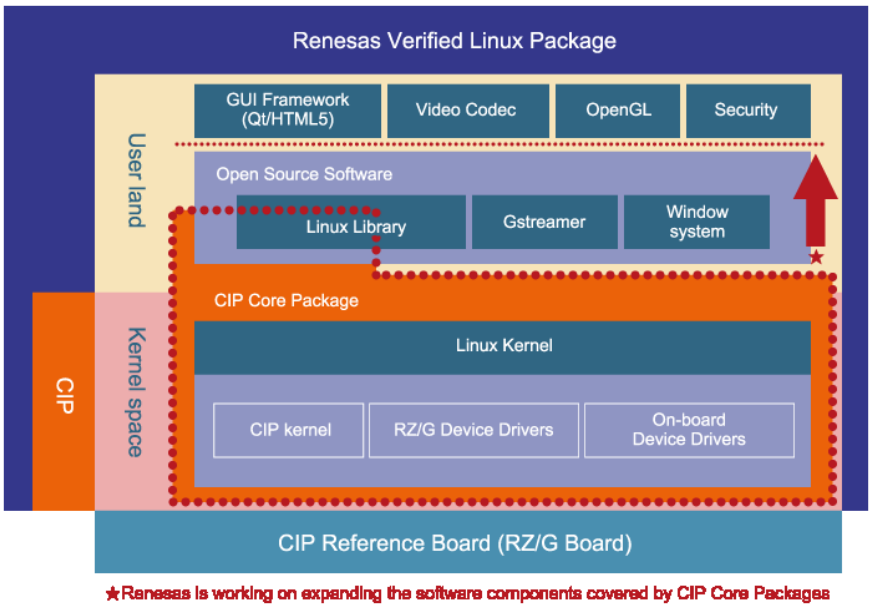

Figure 3. Verified Linux Package

2.2 RZ/G Linux Platform Development Environment and Development Tools

RZ/G Linux platform development environment provides reduction for board design, customization of Linux BSP, verification and debugging efforts. Customers can start up the RZ/G Linux Platform Development Environment immediately with the Linux customization tool. In addition, using Verification and Analysis tools can be verified and debugged our Verified Linux Package.

Key Features

- Linux customization tool：Reduce the burden of build environment building, making software customization easier
  - ✧ Customers can easily build the build server by providing installation file of it including OS.
  - ✧ It is easy to start up the platform compatible board and to customize the Linux package by the GUI.
- Verification tool: Reduce verification TAT
  - ✧ Error reports from the verification tool are automatically analyzed using a database in which numerous troubleshooting use cases have been aggregated Debugging guidance is provided to the user.
  - ✧ User-caused malfunctions are detected by a tool and output to a log file.
- Analytical tool: Reduce analysis TAT
  - ✧ API verification is carried out using verification patterns, with error reports generated.
  - ✧ When errors occur, guidance is provided to the user based on the verification tool output log and FAQ database.

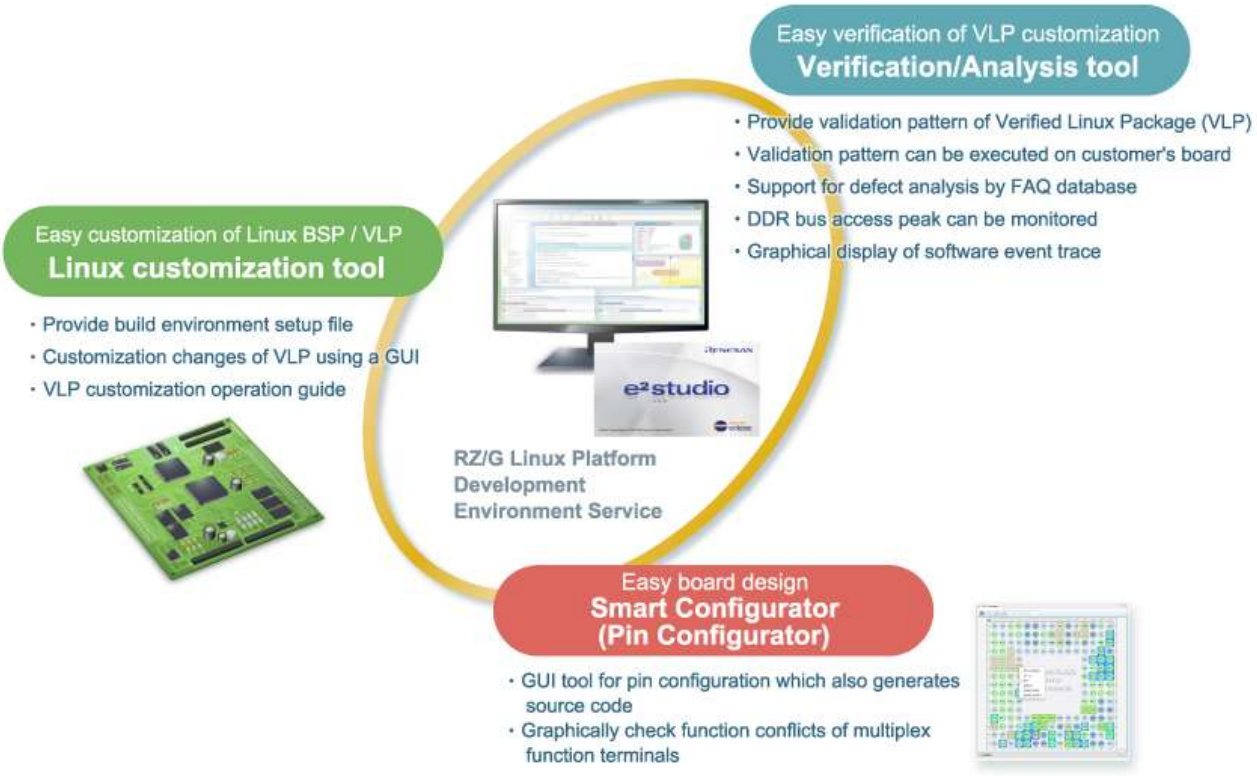

Figure 4. Development Environment

2.3 Software Add-ons

We offer a lineup of verified middleware for the Verified Linux package. Since the middleware has been verified including setup operations by both partners and Renesas, customers can avoid cut-and-try for introducing and can leverage them to easily expand the functionality of customer application system.

Key Features

- Expand the functionality of the Verified Linux Package.
- Operation of all add-ons are verified by Renesas and partners.
- Sample application software can be run immediately.
- Evaluation versions can be downloaded from the Marketplace.
- Release versions can be licensed directly from partner developers.

The software add-ons can be built in to the Linux environment by the Linux Customization tool.

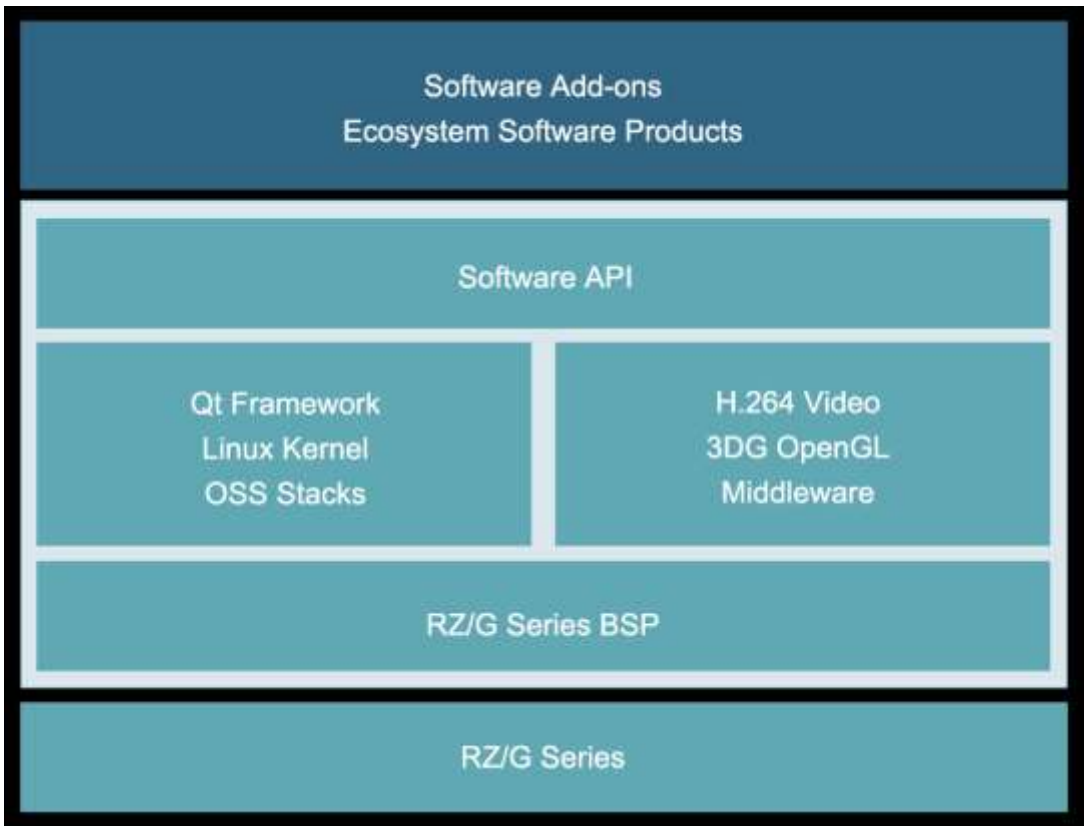

Figure 5. Software Add-ons

2.4 RZ/G-PF Multimedia Processors

The RZ/G Linux platform supports all RZ/G-series products.

2.5 Board Solutions

The RZ/G Linux platform supports board products from a partner company which are applicable without modification to the products of customers.

Supported products from our partner company:

- RZ/G1H Q7 development kit (from iWave Systems Technologies Pvt. Ltd., with an RZ/G1H-PF mounted on the board)
- RZ/G1M Q7 development kit (from iWave Systems Technologies Pvt. Ltd., with an RZ/G1M-PF mounted on the board)
- RZ/G1N Q7 development kit (from iWave Systems Technologies Pvt. Ltd., with an RZ/G1N-PF mounted on the board)
- RZ/G1E SODIMM development kit (from iWave Systems Technologies Pvt. Ltd., with an RZ/G1E-PF mounted on the board)
- RZ/G1C development kit (from iWave Systems Technologies Pvt. Ltd., with an RZ/G1C-PF mounted on the board)

3. Flow of the Development Environment

Figure 6 shows the flow up to product development.

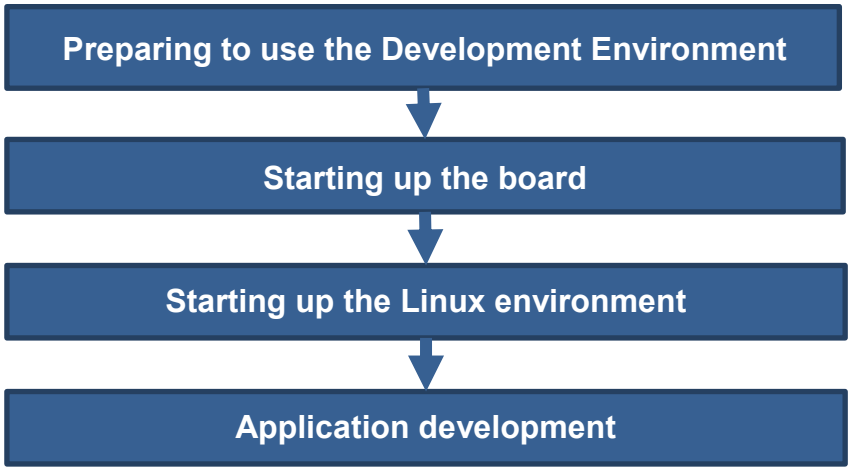

Figure 6. Flow of the Development Environment on the Cloud Server

The phases shown in Figure 6 are described on the following pages.

3.1 Preparing to use the Development Environment

Steps involved in the phase of preparing to use the Development Environment are listed and described in Table 5.

Table 5. Steps Involved in the Phase of Preparing to use the Development Environment

Step	Procedure	Description	Reference Document for Details
1	Registration for use	Please apply for the "RZ/G Linux Platform Development Environment" license from the market place. Renesas will provide three type of licenses below. **[Trial license (free)]** This is a free 6 months license to try out the development environment. (Cannot be used for product development) **[Product license (first year free)]** This is a license which is applied while first year, and can be used for product development for free. If you hope to extend the license after first year, please apply for **[Product license extend service]**. **[Product license extend service]** This is a paid license which can be used for product development. If you hope to extend the license more 1 year, please apply for **[Product license extend service]** again. Renesas will issue user accounts to you based on your registration information, send you the guide for “Development Environment Service web server”, and login information. .	**The Market Place** Refer following URL Americas: https://mp.renesas.com/en-us/rzg/ Europe/Middle East/Africa: https://mp.renesas.com/en-eu/rzg/ Singapore/South & Southeast Asia/Oceania: https://mp.renesas.com/en-sg/rzg/

Step	Procedure	Description	Reference Document for Details
2	Downloading the tools	Following tools and related documents as latest can be download from “Development Environment service web server”. - Linux Customization tool - Verification and Analysis tool - Build Server setup DVD image - “Verified Linux Package 2.1.0” for registering Build Server (“BSP 2.1.0”) - Test programs for the Verification tool	**How to download:** **No.1 in table 1** Refer “RZ/G Linux Platform Development Environment User’s Manual”
		e^2 studio and Smart Configurator can be downloaded on different site. Please download according following descriptions. - e^2 studio Access to the official Renesas Electronics Corp. site and search “e2studio6.1.0” or “e2studio7.0.0”. Then download the installer. https://www.renesas.com/en-us/ - Smart Configurator Refer following site. Americas: https://www.renesas.com/us/en/products/software-tools/tools/solution-toolkit/smart-configurator.html#productInfo Europe/Middle East/Africa: https://www.renesas.com/eu/en/products/software-tools/tools/solution-toolkit/smart-configurator.html#productInfo Singapore/South & Southeast Asia/Oceania: https://www.renesas.com/sg/en/products/software-tools/tools/solution-toolkit/smart-configurator.html#productInfo	

Step	Procedure	Description	Reference Document for Details
3	Setting up the tools	For setup following tools, please refer the User's Manual. - e^2 studio - Linux Customization tool - Verification and Analysis tool - Test programs for the Verification tool	**How to setup** **No.1 in table 1** Refer "RZ/G Linux Platform Development Environment User's Manual"
		For setup following tools, please refer the Build Server Setup Manual. - Build Server setup DVD image - "Verified Linux Package 2.1.0" for registering Build Server ("BSP 2.1.0")	**How to setup** **No.2 in table 1** Refer "Build Server Setup Manual for RZ/G Linux Platform Development Environment"
		For setup the Smart Configrator, please refer following URL. Americas: https://www.renesas.com/us/en/products/software-tools/tools/solution-toolkit/smart-configurator.html#productInfo Europe/Middle East/Africa: https://www.renesas.com/eu/en/products/software-tools/tools/solution-toolkit/smart-configurator.html#productInfo Singapore/South & Southeast Asia/Oceania: https://www.renesas.com/sg/en/products/software-tools/tools/solution-toolkit/smart-configurator.html#productInfo	

3.2 Starting Up the Board

The Linux environment can be started in the sequence shown in Figure 7 on any board described as a target in this manual. The device has been programmed with the Boot loader in the sequence in its initial state so does not have to be updated. **For U-boot**, on the other hand, an earlier version of the binary file may have been written to the device in its initial state. Therefore, **be sure to update** the U-boot program by following the procedure below.

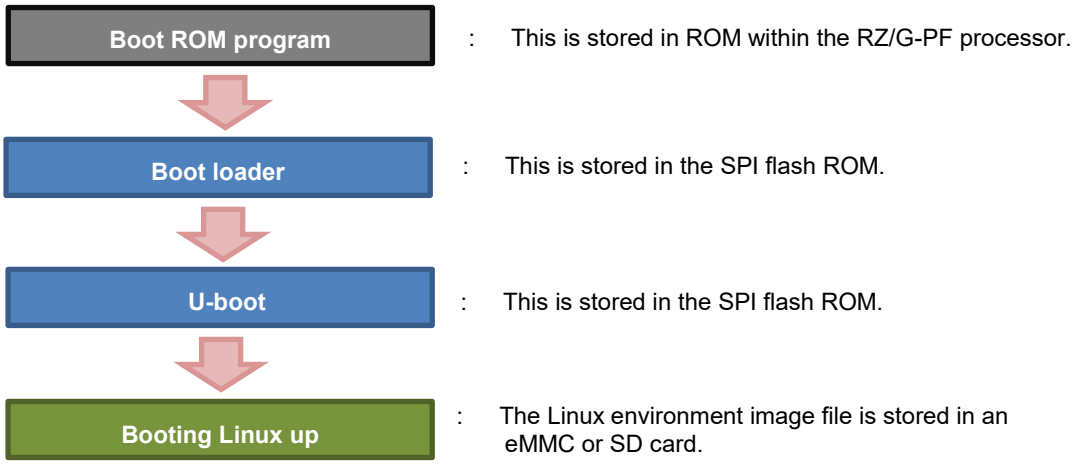

Figure 7. Outline of the Booting Sequence

Table 6. Step Involved in the Phase of Starting Up the Board

Step	Procedure	Description	Reference Document for Details
1	Updating U-Boot [Tool to be used] - Linux Customization tool - Terminal software	Based on the sample source code for the reference board, modify it and build by Linux Customization tool. Note: For getting sample source code for the reference board, please query us on the Market place. The binary generated by building, can be wrote to the SPI flash ROM on the target board, by using the ICE. For debugging, embed the process for outputting a message to the console serial to the source code, and verify the console serial at runtime.	**How to build, write to SPI flash ROM, debug** **No.3 in table 1** Refer "RZ/G Linux Platform Development Environment Tutorial Manual"
2	Updating U-Boot [Tool to be used] - Linux Customization tool - Terminal software	Based on the sample source code for the reference board, modify it and build by Linux Customization tool. The binary generated by building, can be wrote to the SPI flash ROM on the target board, by using the ICE. For debugging, embed the process for outputting a message to the console serial to the source code, and verify the console serial at runtime.	

3.3 Starting Up the Linux Environment

In the phase of starting up the Linux environment, process the RZ/G Verified Linux Package shown in Figure 8 through the following steps: select functions, customize the BSP (changes to drivers), and build the software add-ons. After that, load the Linux environment image file you have created to the board and start the Linux environment up.

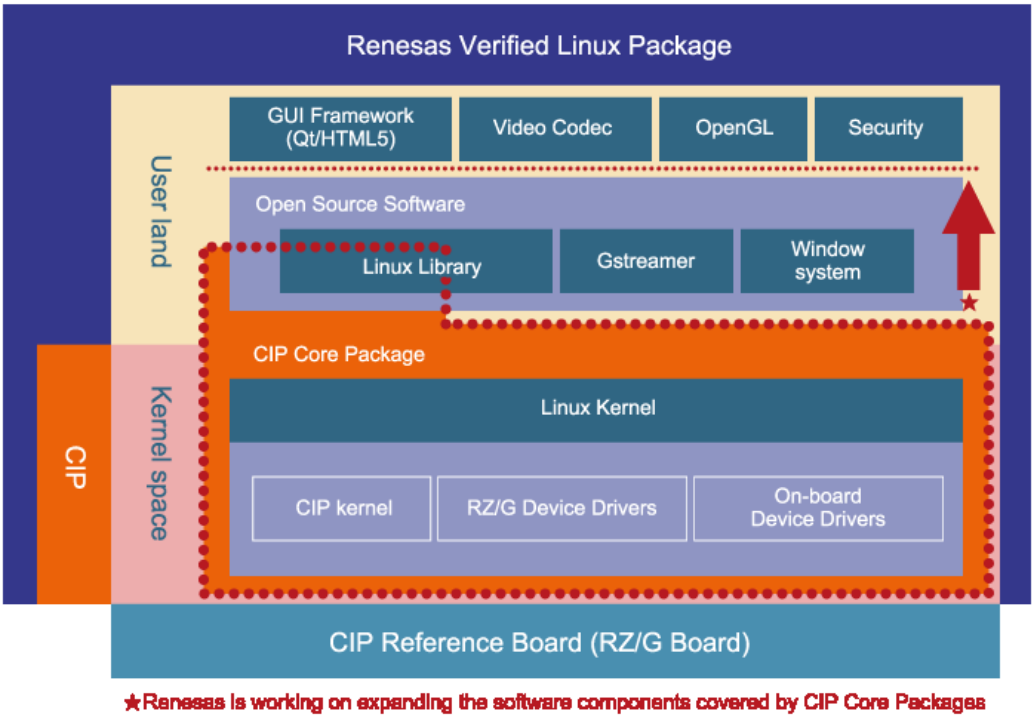

Figure 8. Configuration of the Verified Linux Package

Steps involved in the phase of starting up the Linux environment are listed and described in Table 7.

Table 7. Steps Involved in the Phase of Starting Up the Linux Environment

Step	Procedure	Description	Reference Document for Details
1	Creating a project for building the Linux environment [Tool to be used] - Linux Customization tool	Create a project for building the Linux environment by using the Linux Customization tool. You can do the following for the project. - Select functions - Customize the BSP - Build software add-ons The Smart Configurator can be checked conflicts among pins and can be configured pin settings, on using GUI. And it can generate Linux source code (Device Tree files) from pin settings.	**How to create a project, build, write to the target board** **No.1 in table 1** Refer "RZ/G Linux Platform Development Environment User's Manual" **Smart Configurator** Refer following URL: Americas: https://www.renesas.com/us/en/products/software-tools/tools/solution-toolkit/smart-configurator.html#productInfo Europe/Middle East/Africa: https://www.renesas.com/eu/en/products/software-tools/tools/solution-toolkit/smart-configurator.html#productInfo Singapore/South & Southeast Asia/Oceania: https://www.renesas.com/sg/en/products/software-tools/tools/solution-toolkit/smart-configurator.html#productInfo
2	Building the Linux environment [Tool to be used] - Linux Customization tool	When you build from the project created in step 1, the required Linux environment is built on the Build Server. The set making up the Linux environment (a kernel file, device tree file, U-Boot, and file system) created by the build operation can be downloaded as an image file.	
3	Loading the created Linux environment file [Tool to be used] - Linux Customization tool	The image file of the Linux environment created in step 2 can be loaded to the following. - SD card for booting up the target board - eMMC on the target board If needed, use the Linux Customization tool to renew the U-boot settings, to match for booting the above Linux image.	
4	Debugging the Linux environment [Tool to be used] - Linux Customization tool - ICE	For debugging the kernel, build the kernel image (vmlinux) with a debug option. By using ICE, download Linux Kernel image to the target board, and debug it. Please refer ICE manual for the detail of how to debug with ICE.	**How to debug** **No.3 in table 1** Refer "RZ/G Linux Platform Development Environment Tutorial Manual"
5	Confirming whether degrading for customized Linux Environment. [Tools to be used] - Verification tool - Analysis tool	After customizing the Linux environment, you can use the verification tool to confirm whether the "not changed part" from the Verified Linux Package is degraded. If the result of verification is included "NG(Failed)", you may use the Analysis tool to get hints on how to solve problems.	**How to use Verification and Analysis tool** **No.1 in table 1** Refer "RZ/G Linux Platform Development Environment User's Manual"

3.4 Application Development

The application development phase is the development of an application program to be run in the Linux environment started in section 3.3.
Steps involved in the application development phase are listed and described in Table 8.

Table 8. Steps Involved in the Application Development Phase

Step	Procedure	Description	Reference Document for Details
1	Creating a project for an application program, and building and debugging it. [Tool to be used] - e^2 studio	e^2 studio supports following feature, and use them to build an application program, and debug. - Creating a RZ/G application project. - Cross-compiling a Linux application program for RZ/G, on Windows PC. - Debugging by using GDB, through remote connection.	**How to build, debug** **No.3 in table 1** Refer “RZ/G Linux Platform Development Environment Tutorial Manual”
2	Loading the application program you have created to the board [Tool to be used] - Linux Customization tool	Realizing below functions, by using the project created in way of 3.3. - Building applications by using the Build Server. - Creating a boot image that application binaries is placed on each specific path. - Writing applications to the target board.	**How to build, write** **No.1 in table 1** Refer “RZ/G Linux Platform Development Environment User’s Manual”
3	Testing the application program [Tools to be used] - Verification tool	Using the framework of the verification tool enables testing of the application program. Create test programs in accord with “*Guide for Creating Test Programs for the Software Verification Tool”*.	**How to verify** **No.1 in table 1** Refer “RZ/G Linux Platform Development Environment User’s Manual” **How to create original test programs** **No.4 in table 1** Refer “Guide for Creating Test Programs for the Software Verification Tool”

Revision History	Development Environment Guide for the RZ/G Series

Rev.	Date	Description	
		Page	Summary
2.00	Oct 2017	All	First revision issued. * Translated from Japanese document Rev2.00.
2.10	Oct 2018	All	Changed the names of tools and Linux package.
		4	Added the description for build server.
		11-18	Changed the description for each step based on the tutorial manual.
		12	Changed the license names and their description.

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