White Paper

Partner Board Solutions Allow Immediate Access to Improved HMI Through High-Performance 64-Bit MPU (RZ/G2)

Tomoyuki Yanagi, MPU Products Section, Enterprise & Infrastructure Solutions Division, IoT and Infrastructure Business Unit, Renesas Electronics Corporation

May 2021

Abstract

Embedded controller developers for industrial and building automation applications demand high performance, great reliability, and long-term software support. Renesas has responded to those demands with new models in the RZ/G2 MPU series and an industrial Linux software package including a kernel with over ten years of maintenance; however, customers have encountered issues when creating custom boards needed to implement the new MPUs, requiring them to design and debug transmission lines in the GHz band, as well as customize the BSP. Renesas' solution to these issues is to begin offering mass-producible partner boards, which eliminate those barriers to MPU implementation and allow users to start enjoying RZ/G2 series benefits immediately.

Even Higher Performance

The powerful graphics engine and 4K video engine, built around the RZ/G2 microprocessor's built-in 64-bit Arm® v8-A core, offer extraordinary cost performance.

- Faster and more efficient processing with 64-bit architecture Arm® Cortex®-A53 or Cortex®-A57 CPU
- Multicore structure supports a wide range of applications from low- to high-end, achieving a maximum of 35,600 DMIPS
- Support for DDR3L, LPDDR4, and high-speed external memory protocols up to 3200 MT/s
- On-board USB 3.0, SATA, PCI-e, Gbit-Ethernet, QSPI, and eMMC interfaces for high-speed communication
- Powerful video graphics capabilities with 600MHz PowerVR 3D GFX, 4K UHD H.265 and H.264 codecs, HDMI, LVDS, and MIPI-CSI2 camera inputs

	RZ/G2H	RZ/G2M	RZ/G2N	RZ/G2E
CPU	4xCortex-A57@1.5GHz 4xCortex-A53@1.2GHz L1$, L2$ Parity/ECC	2xCortex-A57@1.5GHz 4xCortex-A53@1.2GHz L1$, L2$ Parity/ECC	2xCortex-A57@1.5GHz L1$, L2$ Parity/ECC	2xCortex-A53@1.2GHz L1$, L2$ Parity/ECC
Performance	35.6k DMIPS	23.3k DMIPS	12.3k DMIPS	5.5k DMIPS
DRAM I/F	LPDDR4-3200 x 64-bit (ECC)	LPDDR4-3200 x 64-bit (ECC)	LPDDR4-3200 x 32-bit (ECC)	DDR3L-1866 x 32-bit (ECC)
Video Codec	4K Resolution H.265 Decoder H.264/AVC	4K Resolution H.265 Decoder H.264/AVC	4K Resolution H.265 Decoder H.264/AVC	Full-HD Resolution H.265 Decoder H.264/AVC
3D GFX	PowerVR GX6650 @ 600MHz	PowerVR GX6250 @ 600MHz	PowerVR GE7800 @ 600MHz	PowerVR GE8300 @ 600MHz
Other Peripheral Features	USB 3.0, SATA, PCI-e, GbE, MIPI-CSI, HDMI	USB 3.0, PCI-e, GbE, MIPI-CSI, HDMI	USB 3.0, SATA, PCI-e, GbE, MIPI-CSI, HDMI	USB 3.0, GbE, PCI-e, MIPI-CSI, LVDS

Figure 1: RZ/G2 Microprocessor Feature Overview

Greater Reliability

Developers working on industrial and building automation applications using embedded controllers demand greater reliability and security than consumer products can offer. The recent expansion of device networking has also opened up the risk of malicious access. RZ/G2 microprocessors have built-in error correction codes (ECC) for both internal and external memory, an essential feature for mission-critical, high-reliability systems. They also feature TrustZone (Trusted Execution Environment) and Secure Boot to help defend devices from external breaches.

- **ECC for Greater Reliability**

  ECC functions play a vital role in protecting RAM from radiation-induced soft errors, resulting in greater reliability.

  - L1 and L2 cache SRAM memories have built-in ECC to reduce/eliminate soft errors
  - DDR3L or LPDDR4 interfaces implement ECC to protect data on external memory devices

- **Code and Data Security**

  Renesas offers exceptionally reliable platforms with these security features:

  - Arm TrustZone partitioning
  - Cryptographic acceleration
  - Secure key generation and storage

- Secure Boot
- Establishment of unique root of trust

Features		RZ/G2H	RZ/G2M	RZ/G2N	RZ/G2E
TrustZone (Trusted Execution Environment)		✓	✓	✓	✓
Boot Protection	Encrypted Kernel Boot	✓	✓	✓	✓
Secure Updates		✓	✓	✓	✓
Encryption Support Functions	Trusted Secure IP	✓	✓	✓	✓
	ARM Cryptography Extension	✓	✓	✓	✓

Figure 2: RZ/G2 Microprocessor Security Features

Long-Term Support and Maintenance

The life cycle for industrial and building automation applications from product development through release and on to operation can be extremely long, so customers require long-term life cycle maintenance. At the individual customer level, maintenance requires enormous cost and time, which interferes with the core development users need to focus on. The solution is a Verified Linux Package.

➢ **Verified Linux Package (with Long-Term Support)**
A Linux package includes all the basic software required for the industrial field, and Renesas offers packages that have been verified for operation based on the MPU data sheet. Customers can use this stable Linux and basic software package to start developing applications immediately. In the past, semiconductor manufacturers have not provided systematic maintenance for the software they offered. Renesas, though, offers verified operation and maintenance for all the software in our Linux packages. Verified Linux packages can drastically reduce embedded system development burden for customers.

➢ **Key Features of the Verified Linux Package**

- Super long-term support by Civil Infrastructure Platform™ (CIP™)
- Five years of backporting for latest kernel's additional functions
- Security patch support for over ten years
- Continued active expansion of maintenance scope by Renesas
- Support for industry-standard APIs
- Enhanced standard software components for Industrial/IoT applications
- Enhanced reliability, real time performance, security, and functional safety
- Operation verification based on standardized software development process
- Free and simple click-through licensing

- Free maintenance

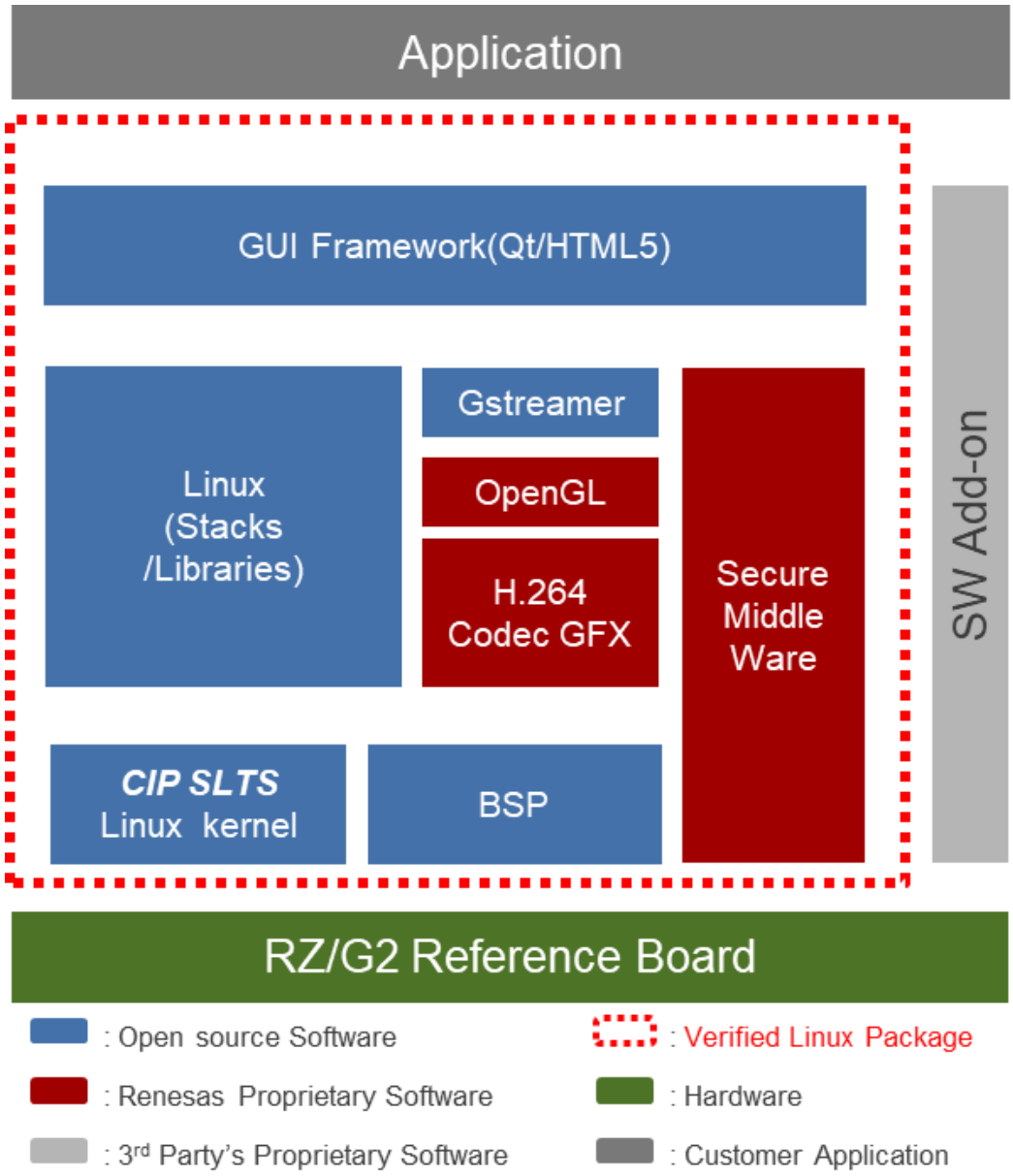

Figure 3: Verified Linux Package Overview

➢ **What is Civil Infrastructure Platform (CIP)?**
CIP is designed to offer a base layer necessary to build Linux-based embedded systems that meet the needs of modern civil infrastructure. The Linux Foundation is heading up this project with cooperation from the world's leading infrastructure system manufacturers. For more information, please see: Civil Infrastructure Platform.

AI Affinity

We have created RZ/G2 microprocessor environments for the seven major open source AI frameworks below. This allows customers to test AI modeling directly on their embedded platforms.
https://github.com/renesas-rz/meta-renesas-ai

Framework	Version	Parser(s)
ArmNN	v19.08.01	ONNX TensorFlow TensorFlow Lite
Caffe2	v0.8.1	Caffe2
ONNX Runtime	v1.1.2	ONNX
OpenCV	v4.1.1	Caffe DarkNet ONNX TensorFlow
PyTorch	v1.5.1	PyTorch
TensorFlow	v2.3.1	TensorFlow
TensorFlow Lite	v2.3.1	TensorFlow Lite

Figure 4: Supported Frameworks and Versions

Simpler Planning and Development

Until now, customers have had to design and verify their own boards and reconfigure BSP before they could enjoy all the benefits of Renesas's RZ/G2 microprocessors. Our solution to these issues is to begin offering mass-producible partner boards, which eliminate these barriers to MPU implementation and allow customers to start enjoying RZ/G2 series benefits right away.

These RZ/G2 partner board solutions offer customers the following benefits:

1. No high-speed I/F or PCB design required

Designing PCBs for GHz band I/Fs such as PCI Express, Serial-ATA, USB3.0, HDMI, and LPDDR4/DDR3L is difficult, time-consuming, and expensive. Partner board solutions are already fully designed and evaluated, so customers do not need to do any PCB designing.

2. Focus on application development

Creating custom boards means spending time developing drivers for RZ/G peripherals. Partner board solutions offer ready-made BSPs, so customers can focus on the application development they truly need to focus on.

3. Choice of boards to meet your needs

Users can choose from a variety of boards to find the solution that meets their needs. Finding the perfect board might be a challenge with fewer options available, but we already offer a range of partner boards to choose from and will continue to release more to meet user needs.

Conclusion

RZ/G2 microprocessors meet the needs of industrial and building automation developers by including an industrial Linux software package boasting a kernel with over ten years of maintenance to ensure performance, reliability, and long-term operation.

With our partner board solutions, Renesas has also solved the issues of board development time and cost that might have prevented customers from adopting the RZ/G2 microprocessors, enabling immediate and easy access to all benefits.

Learn More

1. RZ/G2 64-bit MPU
2. RZ/G Partner Solutions
3. Verified Linux Package (with Long-Term Support)