CASE STUDY

Breaking the RISC-V adoption barriers

Encouraging developers' hands-on experience with low-cost and free-of-charge tools.

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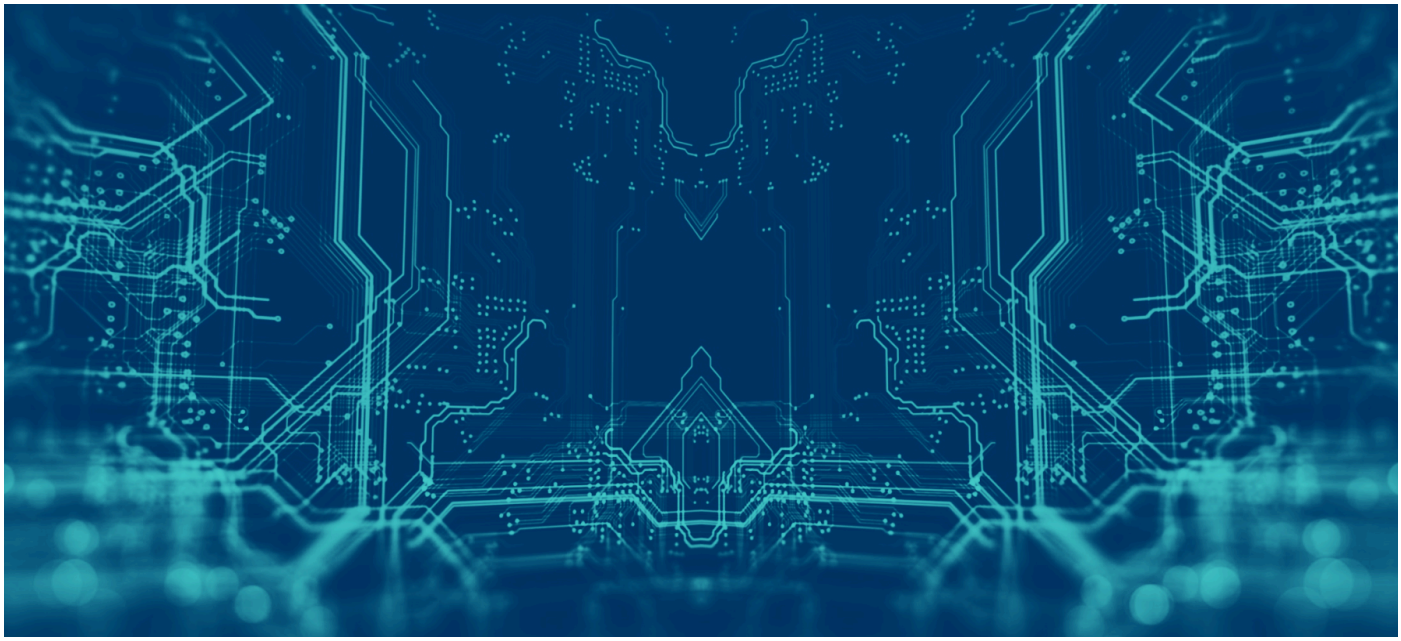

Introduction

RISC-V has a demonstrated potential to challenge and disrupt existing markets with innovative products, establishing itself as the ideal open platform for next-generation, non-proprietary solutions. Renesas enables the broad market success of RISC-V-based microcontrollers by eliminating adoption barriers, and unleashing engineer's creativity to explore, test, and get involved with the emerging RISC-V architecture. Anyone among professional developers, universities, or 'maker' communities, can just get started and develop interesting projects, at no risk. Renesas contributes to the expansion of the RISC-V ecosystem for MCUs by deploying high-quality devices and tools including a fully supported and free-of-charge IDE with compiler toolchain, low-cost prototyping hardware, and enabling support on commercial environments behind the proof-of-concept phase.

RISC-V Microcontroller Ecosystem challenges

For microcontroller-based products, there are many aspects which play a significant role when migrating to a new platform. The level of modifications required to port an application software can be quite significant, as the low-level architectural and device implementation differences cannot be hidden easily behind the abstraction provided by a rich operating system,

for example. Considering RTOS or even “bare metal” applications, the user needs to take care of lots of configuration details, which requires specific skills in deeply embedded development. Writing a target application software from scratch, including a hardware abstraction layer for IOs and peripherals, is not trivial.

The next step demands a viable hardware platform to validate and test the application, including an integrated compiler toolchain and reliable debug support. Fortunately, few commercial development environments exist which might be usable at no cost for non-commercial projects, however, the integration work to add support for a certain platform needs to be typically co-sponsored by the silicon vendors, so it finally depends on market opportunities, and therefore might quickly morph into a ‘chicken-and-egg’ dilemma.

Fully open-source and free development environments enjoy support from large and motivated communities, but in commercial projects, the lack of commitment for professional support poses a threat. Paired with the need to switch the tools away from a legacy established architecture, it might be difficult to justify as an upfront investment step.

To summarize, the main users’ concerns are related to learning the new architecture, the availability, and support of tools, the overall debug experience expectation, the available software ecosystem, the software migration efforts,and finally the hardware supplier reliability and the total investment costs. This view is supported by the comments provided in an embedded software developer survey conducted by Aspencore („*Embedded Survey: The current state of embedded development, 2023*“, www.embedded.com). In the survey, the opportunity for RISC-V becomes evident since almost half of the respondents working on IoT related projects declared to be developing incremental upgrades to add software features and/or better MPUs/MCUs, particularly in larger OEMs. Use of off-the-shelf development boards for a proof of concept (like Raspberry Pi, Arduino, or supplier proprietary) was mentioned in about half of the cases, and among those willing to change processor, ~54% chose one from a different family, architecture or instruction set.

But besides obvious application requirements, the most perceived challenges when choosing a new platform were debugging, integration, and test-related activities. The “ecosystem” (IDEs, software, toolchain, development tools) plays a dominant role for embedded engineers, and whilst the choices made in terms of architecture/chip family tend to be long-term, broad commercial support and reliable sourcing are equally important.

How Renesas helps solve those challenges

Renesas contributes to the expansion of the RISC-V ecosystem for MCUs by deploying high-quality devices and tools including a fully supported and free-of-charge IDE with compiler toolchain, low-cost prototyping hardware, and enabling support on commercial environments behind the proof-of-concept phase. This is summarized in Figure 1 below:

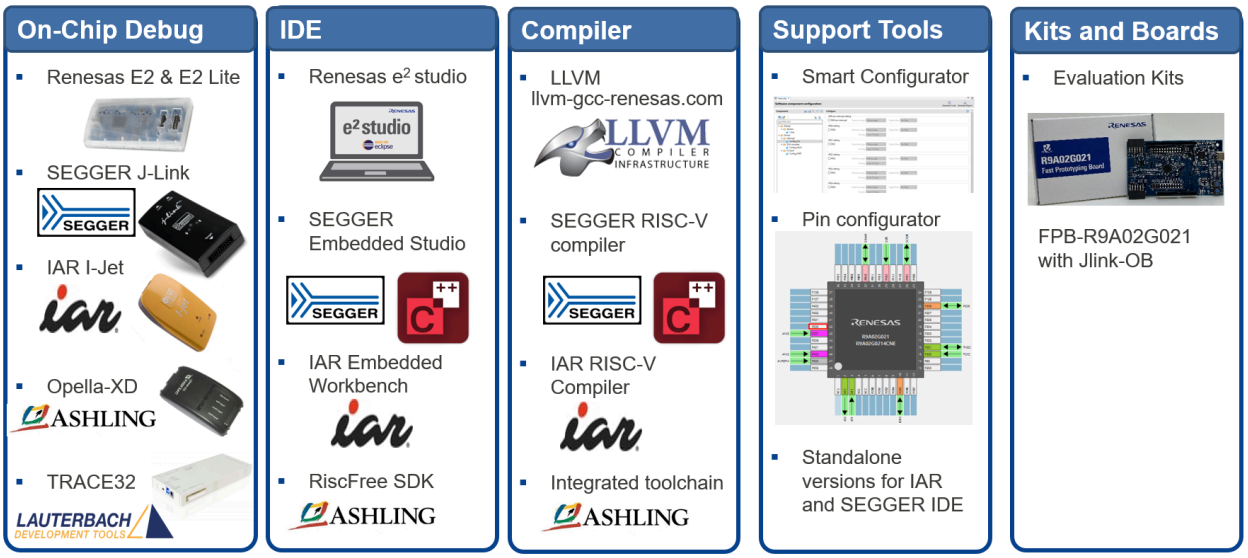

Figure 1: Ecosystem for Renesas RISC-V Microcontrollers

Users can download e²studio, a free-of-charge development environment, directly from the Renesas website. The IDE includes already an LLVM-based compiler toolchain, and debug plugins, for a developer to build and test his C or C++ application. The IDE is available for both Windows and Linux environments.

On top of that, Renesas provides an integrated plugin called 'Smart Configurator'. With the help of this graphical configuration tool, the user can quickly create a project and configure the microcontroller by defining not only system-level settings like the startup behavior, clocks, I/O ports, and such, but also display all pin function options, assign pins per each peripheral module, check configuration consistency and resolve pin multiplexing conflicts automatically. More to this, Smart Configurator allows to add graphically the desired peripheral driver modules, modify all the related hardware settings, and generate with a mouse click the related low-level driver code for the application. With this tool, engineers can create a working software framework in a matter of minutes and focus on their application development.

For customers already using professional environments to debug and test their code, Renesas has partnered with leading embedded software and tools suppliers like SEGGER, IAR,

Ashling, and Lauterbach, to make sure the chip is supported within a broad set of environments. At the time of writing, for generating SEGGER and IAR projects there is also a standalone version of the Smart Configurator, generic cmake project support is under development.

Renesas also designed a Fast-Prototyping Board (FPB) which is globally available through catalog and channel distributors, at low cost, and includes an on-board debugger from SEGGER. Engineers can simply connect the board to their PC with a USB cable and get started without further investments. The board is designed to be compatible with different interfacing standards like Arduino, Pmod, Grove so that users can simply combine and connect expansion boards and modules, use those to quickly prototype their proofs-of-concept, and not have to worry about developing their own hardware platform. The design files for the board are freely available at **renesas.com/fpb-r9a02g021**. Technical manuals, application notes and tools user guides for the MCU can be found at renesas.com/r9a02g021. A picture of the FPB is shown in Figure 1 below:

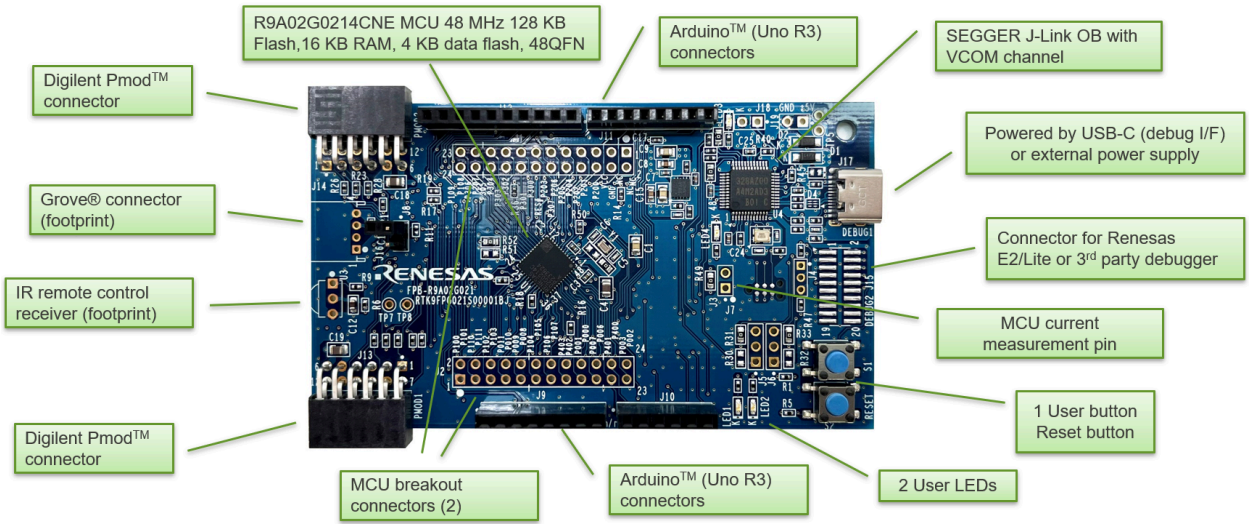

Figure 2: Ecosystem for Renesas RISC-V Microcontrollers

Conclusion

Renesas' approach enables the broad market success of RISC-V-based MCUs by providing an environment eliminating all the above concerns, unleashing engineer's creativity to explore, test and get involved with the emerging RISC-V architecture. Anyone among professional developers, universities, or 'maker' communities, can just get started and develop interesting projects, at no risk.

Welcome to the Open Era of Computing!

Join us and see how open technical collaboration along with the support of many RISC-V programs can accelerate your business.

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