

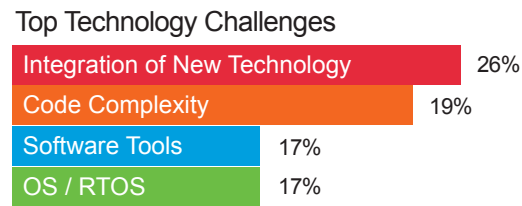
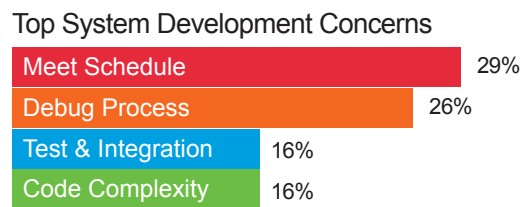
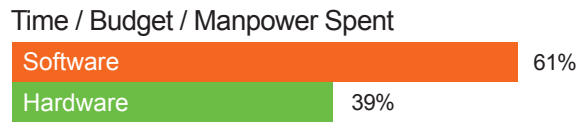
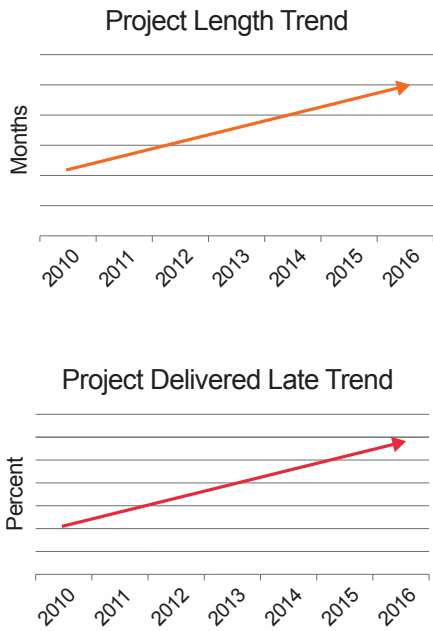
Renesas Synergy™ Software Package Redefines Software Development for the Industrial and IoT Market

By integrating basic core system software functions in a commercial-grade package, SSP offers embedded developers a shortcut to market

IN TODAY'S FAST-moving IoT market, should developers be responsible for integrating major components of the base software platform, such as the RTOS, communications stacks, software frameworks, and device drivers, in their MCU-based design? Or should those software components be part of a larger, integrated MCU-based hardware/software package? Should developers grapple with the continuously changing roadmaps of the different software components in the base software platform? Or should those constant integration headaches be handled by the MCU supplier?

Renesas' engineers know their developer audience very well. One thing had become clear — accelerating time-to-market is becoming increasingly crucial to product success. In an environment where product lifecycles are now measured in months instead

of years, developers who are late to market risk losing significant market share. That is why we developed the Renesas Synergy™ Platform.



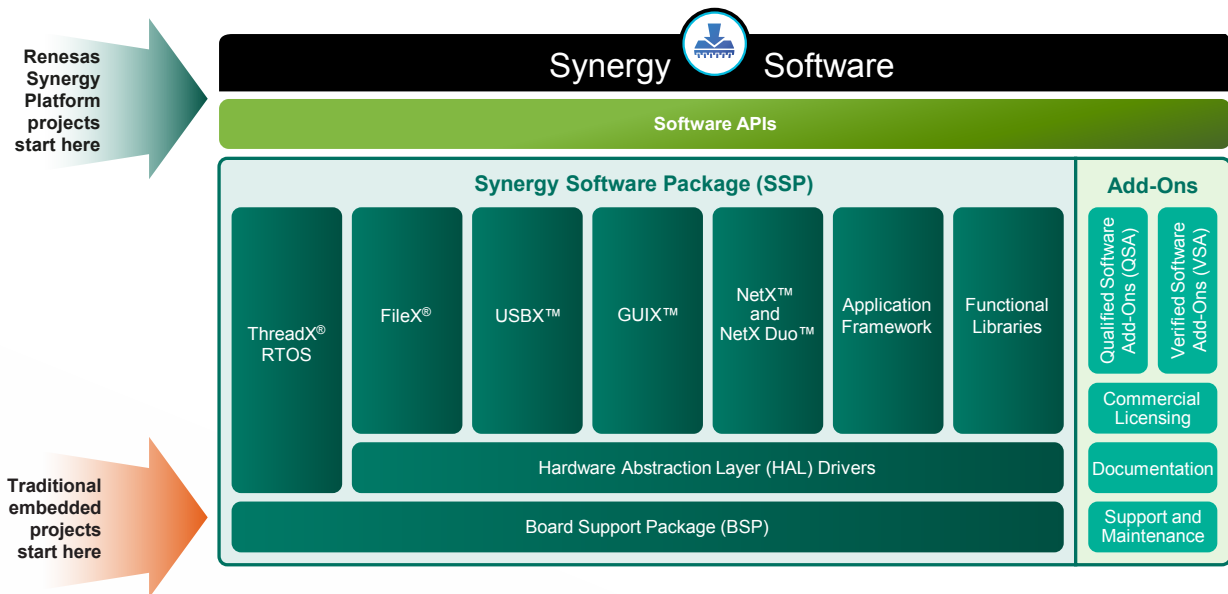
2014 UBM Tech Embedded Market Study

Software has major impact on projects

The increasing complexity of software development in MCU projects is driving up development costs and extending development schedules.

Product development requirements have changed. The days when each developer created his or her own solution by mixing and matching an MCU and software components are quickly fading. Today's internet-connected, MCU-based designs have become too complex. The Renesas Synergy design team looked at the traditional development cycle and asked why developers should devote so much of their development cycle to basic system core

code – designing software drivers, middleware, integrating with the RTOS and connecting to the cloud. That effort doesn't offer developers much opportunity to differentiate features in the end-product. Instead, developers should be devoting more of their time to the truly innovative portion of their design – creating application code or adding new features to their product.



Move up and get a head start

By integrating the Renesas Synergy Software Package in with Synergy MCUs, developers can begin development farther along in the design process and dramatically shorten time-to-market.

To minimize cost of ownership and allow developers to more quickly begin developing code for their particular application, the Renesas team decided it would take a radically new approach to product development. The Renesas Synergy Platform would treat hardware and software as a unified product. With this new platform, Renesas would

assume responsibility for the development and integration of the components which are the building blocks of the platform software. That would allow developers using the platform to spend less time on those basic functions and more time on the implementation of differentiating software features in their product.

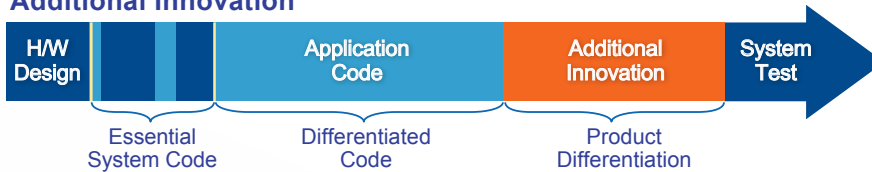
Traditional Development



Accelerated Development



Additional Innovation



Spend Your Time Innovating

By eliminating many of the tasks associated with developing non-differentiated code, the Renesas Synergy Platform allows developers to spend more time on the innovative aspects of their product.

In addition to the coding challenges involved when using traditional embedded software, the Renesas team also wanted to reduce or eliminate many of the business barriers that can make working with embedded software difficult. For example, using different software components from different vendors requires sourcing and paying for multiple licenses

and maintaining multiple points of contact for technical support. Knowing that wrestling with contracts and trying to get vendors to take ownership of technical issues can also consume valuable design time, the Renesas team realized these issues could be avoided if all software used in a project was licensed and supported by one vendor.

Key Functions

Next, the Renesas Synergy team asked what characteristics were essential to successful embedded industrial and IoT applications. If the Renesas Synergy Software Package (SSP) was going to serve as the optimal platform for IoT applications, what kind of challenges would it have to address?

Clearly any prospective industrial and IoT solution would have to offer a wide range of communications options. It would also have to offer security features to address the many threats to any networked product. For developers to confidently rely on this integrated platform, it would have to provide them with high-quality, commercial-grade software. In addition, that software would have to be tested and qualified on high-quality hardware reference designs. And given the large number of complex software components in the platform and the massive quantity of the documentation associated with the entire package, developers would need a new, much more efficient method to quickly find the most relevant information when they needed it.

Security was a major challenge. Threats lie everywhere. How could the Renesas Synergy designers prevent unauthorized code from being programmed

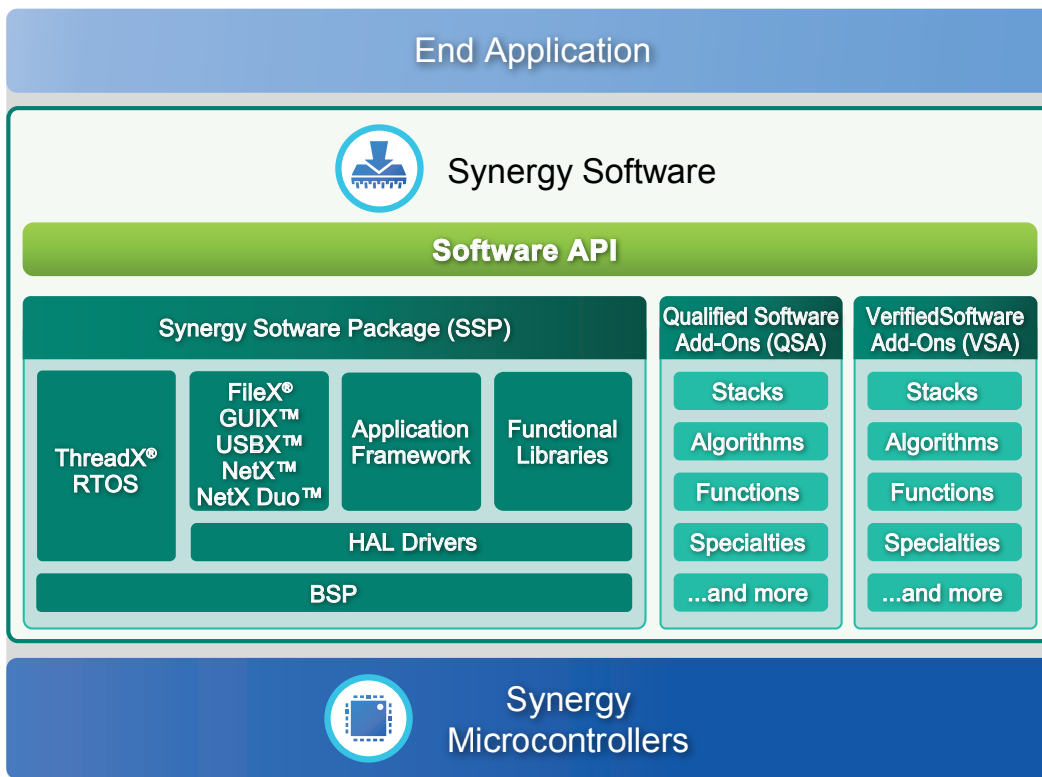
and executed, protect the firmware and data on the MCU, identify the right source of communication and secure communication data from interception and tampering?

To accomplish these tasks, the Renesas Synergy team integrated an extensive portfolio of security features into the platform. They took advantage of the significant processing capabilities of the ARM® Cortex®-M cores coupled with a hardware-based security accelerator to accelerate those functions in hardware. Accordingly, most of the Renesas Synergy MCUs feature hardware accelerators for symmetric cryptography, asymmetric cryptography, HASH, and asymmetric key generator. They also feature a true random number generator, key secure storage, limited JTAG access, and a unique ID assigned to each MCU. On the software side, designers implemented a security services library to utilize the hardware acceleration.

To help build the SSP, Renesas engineers leveraged some key advantages of Express Logic's X-Ware™, an integrated set of software components optimized for the industrial and IoT applications. The SSP uses ThreadX®, a popular multitasking RTOS,

with a number of middleware components including NetX™, USBX™, FileX® and GUIX™. With over 2 billion installations, ThreadX® is an industry-proven RTOS. This priority-based, fully-preemptive, deterministic RTOS offers basic system services such as pre-emptive and round-robin scheduling, semaphores, message queues, timers, interrupts and memory management. Advanced features such as preemption-threshold scheduling reduce

context switches and the RTOS' deterministic performance remains consistent, regardless of the number of threads or objects. ThreadX® also features integrated event trace capability and run-time stack analysis, two very effective design and debug tools which allow developers to detect bugs before the product is released. It also supports numerous safety certifications.



Renesas Synergy Software at a Glance

The Renesas Synergy Software Package (SSP) combines all the key components developers need to create IoT applications.

NetX™ and NetX Duo™ provide high performance TCP/IP stacks in a small footprint. NetX™ is IPv4 capable while NetX Duo™ supplies both IPv4 and IPv6 capabilities in a dual stack product. A Zero-Copy API helps optimize buffer management. UDP fast path technology allows packets to pass through NetX™ without copying or any system context switches.

The NetX™ core stack supports TCP, IP, UDP, ARP, RARP, ICMP and IGMP. The NetX™ applications bundle includes PPP, DHCP, DNS, FTP and other functions. Beside IPv6 NetX Duo™ features, components for include IPsec with IKEv2, Neighbor Discovery Protocol, Router Discovery Protocol, Stateless Address Auto-configuration and Duplicate Address Detection.

USBX™, the Universal Serial Bus protocol stack for embedded software includes host, device and on-the-go (OTG) support. The stack supports low speed (1.5 Mbps), full speed (12 Mbps) and high speed (480 Mbps). USBX is very easy to use and supports a wide range of device classes including CDC, HID, PIMA (PTP), RNDIS, and STORAGE.

FileX® is the SSP's MS-DOS compatible file system. Tightly integrated with ThreadX®, it boosts performance by minimizing function call layering, using contiguous cluster allocation, and consecutive cluster reading and writing. Advanced features include FAT 12, 16, 32-bit support, real-time performance, internal FAT entry cache, and internal logical sector cache. It also supports RAM, flash and a variety of physical media as well as long filename and unlimited FileX® objects. Integrated functions like error detection and recovery, fault tolerant options and built-in performance statistics boost reliability.

The SSP also includes a GUI design and development flow that allows developers to create a GUI layout using the Windows-based GUIX™ Studio. Developers can export source, header and resources and use the Synergy development tool suite, e² studio ISDE, to build executables with the GUIX™ library that run on a Synergy MCU system.

For developers who need to create a graphical user interface, GUIX™ offers a graphical user interface framework. It includes a full runtime UI library and a matching desktop design application called GUIX™ studio. The high-performance graphical library is optimized specifically for the Renesas Synergy MCU graphic engine to support hardware accelerated 2D graphics operations, complete windowing support with multiple displays and different resolutions, and the use of multiple languages. The core library includes a wide array of buttons, windows, scroll bars, test display and text editing controls. The supporting framework features event queues and signals, windowing and viewport management, and other functions.

When it comes to peripheral drivers, the SSP gives developers a choice. Framework peripheral functions offer easy-to-use, feature-oriented functions for application programs. The framework automatically takes care of the details of the RTOS integration. Since the drivers abstract hardware registers by logically defined values, the API and parameters are consistent across different Synergy MCUs. This approach allows the developer to build solutions without spending time learning Renesas Synergy MCU hardware specifications or ThreadX® specifics. Instead, developers can concentrate on building their own application. The application framework also offers commonly used system

services such as an elaborate message-passing infrastructure for inter-process communications, an audio framework for simple development of audio playback capability, an infrastructure for easy management of different power profiles of an application and other functions.

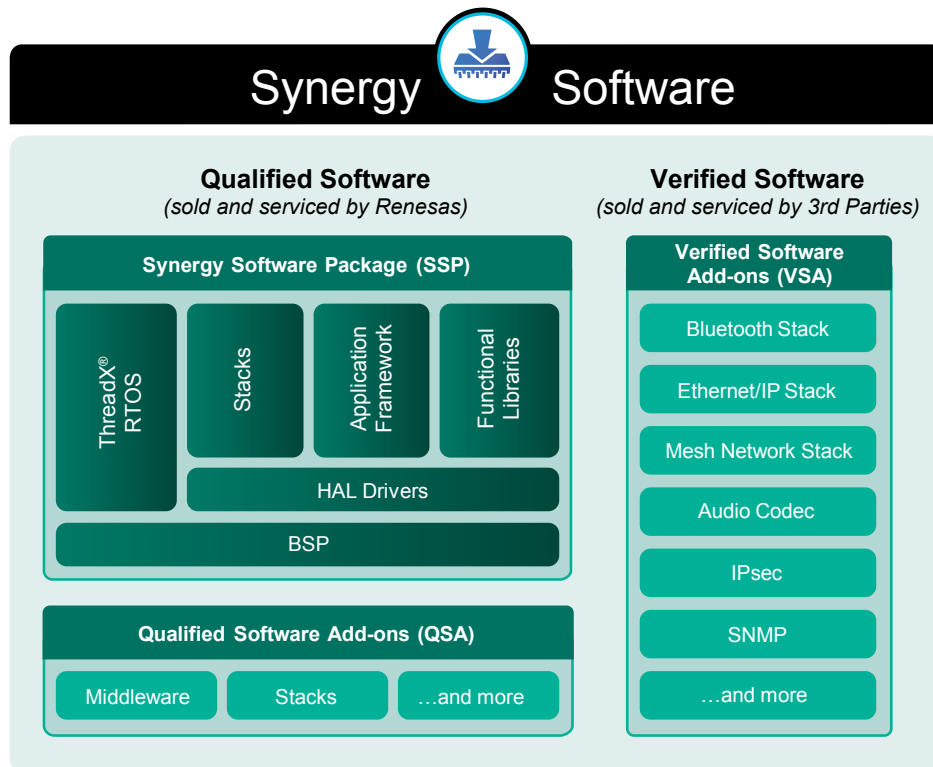
A complete set of low-level peripheral driver modules are available for a wide array of functions

including memory, connectivity, analog, timing, system and power management, security and encryption, safety and human machine interface. Embedded developers who want access to individual peripheral drivers directly, outside the framework, may do so with direct calls from the application to meet specific requirements or to operate within time-critical bounds.

Productizing software

To accommodate this new environment, Renesas engineers decided to approach the SSP as if it were a product. Renesas would be responsible for software functionality and quality. For the SSP, the company implemented an industry-standard

design process and tools to ensure high-quality. The process includes project management, configuration management, coding standards and analysis, test and quality assurance, and continuous integration. Furthermore, Renesas made



Synergy Software Classification

The Synergy Software Package is delivered as “Qualified Software”. Additional software components may be provided as either “Qualified Software Add-ons” or “Verified Software Add-ons.”

available the documentation needed to validate the software package specification and quality including all test data.

Under this new classification scheme, software developed by Renesas—including the SSP—is defined as “Qualified Software”. Renesas will identify additional software functions that may be added to the SSP in the future as Qualified Software Add-ons (QSAs). These components are qualified with the same rigorous standards used for the SSP, but are not included in the standard SSP distribution. An example of a future QSA component would be a special security function library.

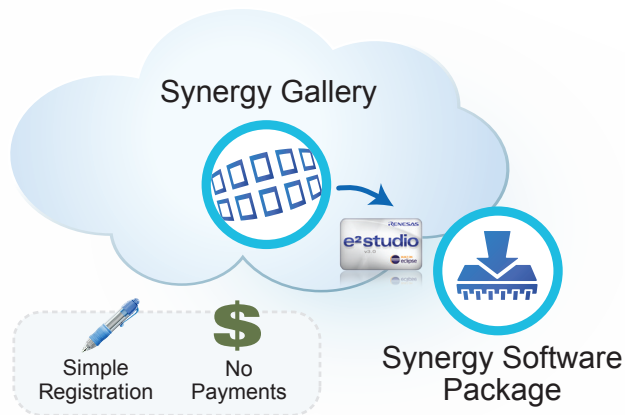
To fill in gaps in its software portfolio, Renesas is developing a partnership program with industry

leaders. Software components developed by third-party developers and integrated into the platform are “verified” to work with the Renesas Synergy Platform and are named VSA, or Verified Software Add-on components. These VSA components have been tested for functionality and compatibility with the SSP and approved by Renesas. All test procedures and results are provided to customers. An example of a VSA component would be a communications stack for Bluetooth® or an industrial Ethernet IP protocol. Over time, Renesas will work with selected VSA component vendors to convert from VSA to QSA, or even to pull a VSA component into the SSP itself. At that point, the VSA would become a Renesas product and part of regular SSP distributions.

Software Access and Licensing

Obtaining and licensing the SSP, the QSA components, and the VSA components is easy using the on-line Renesas Synergy Gallery. The main difference between the three software types is that

QSA and VSA components are not part of the SSP distribution and are licensed and obtained separately. For more details go to the Renesas Synergy Gallery online.



How to Get SSP

The SSP is available free-of-charge with all Renesas Synergy MCUs.

ALL of Synergy MCUs include SSP License

- Simple registration on Synergy Gallery, download SSP into Synergy e2Studio without any payment
- Access to all software components and tools
- No limit to number of end-products, MCUs, maintenance, or seats
- Source code is available for debug session

To use the SSP, customers simply register on the Renesas Synergy Gallery to obtain an evaluation license; that gives them the right to use the SSP for prototyping purposes. Customers receive a license file that, once it's entered into the Renesas Synergy Software development tools suite, enables them to download and gain access to the entire SSP for full development of their end-product. When it's time for product production, the customer goes again to the Renesas Synergy Gallery to register and obtain a SSP production license at no extra charge. Once that license is entered into the Synergy tool suite, the customer gains the right to use SSP software in its company's end-products with no restrictions on how many different end-products will use a Renesas Synergy MCU or how many Synergy MCUs will be used in any one end-product. With this license the customer's company receives perpetual software maintenance of the SSP from Renesas including bug fixes, technical product support, future updates and upgrades.

The source code of the entire SSP is visible during development and debugging. For example, within the Renesas Synergy development tool suite, customers can view the source C code of all SSP components while single-stepping through the RTOS and communications stacks for complete code visibility. However, there are some components of the SSP which, while they are visible, are also protected and cannot be printed, saved to a file, or modified. If customers wish to obtain the source code of these protected components, they can use the Renesas Synergy Gallery to select a customized mix of SSP components to obtain the source files. For example, a developer might ask

for source code of all SSP components or just the ThreadX® RTOS and USBX™ components. They will receive a quotation document that can be exercised with their local Renesas sales representative to complete the purchase of a source code license for the selected components.

With the source code license entered into the Renesas Synergy tool suite, the purchased software components become unprotected and customers are free to save the source code of those components as a file, modify the source files, and print the source files. Examples of components with protected source code are the application framework, ThreadX® RTOS, the NetX™ TCP/IP stack, and the GUIX™ graphics middleware. For these protected components, the customer must purchase a source code license in order to acquire clear-text C code files. It is important to note that if any portion of the source code is modified and used in a product, the Renesas SSP warranty is invalidated. Many components of the SSP, such as the low-level Renesas Synergy MCU peripheral drivers, the capacitive-touch library, and others, are not protected and are distributed as clear-text C code files within the SSP distribution.

While the SSP is available for use in protected form and as source code if the customer buys a source license, QSA components are not available for download without an explicit purchase of the component from Renesas. VSA components are available to registered Renesas Synergy customers on the Renesas Synergy Gallery for download as evaluation files which are in binary form or time-limited versions that have been verified to be

compatible with the Renesas Synergy Platform. Customers seeking to purchase these VSA components can use the Renesas Synergy Gallery to access the third-party VSA vendors' website for purchasing a license, source files, maintenance, and support based on the VSA vendor's terms. Qualification of the SSP and QSA software components will be based upon the software running on a number of different Synergy MCU-based hardware platforms from Renesas, including Renesas Synergy Development Kits, Starter Kits, Design Examples, and Application Examples. Qualification documents tied to the SSP and QSA components refer to the particular Synergy hardware platform on which the software was running and tested. Rene-

sas stands behind these documented qualifications and will resolve software bugs which can be reproduced in any of these test platforms.

Reflecting this new integrated hardware/software philosophy, Renesas is restructuring its support practices to offer full product-level support for silicon and software together. Developers seeking support can resolve all hardware and software issues via a single point of contact. Renesas will resolve software issues on the SSP and QSA components and devote the resources needed to create chat, forums and the technical support infrastructure to build a vibrant developer community around the Renesas Synergy Platform.

Software Technical Support

Consistent with the unified hardware/software platform concept, Renesas supplies product-level support for both silicon and software. Accordingly, Renesas will stand behind and warrant the operation of software issues on all qualified software components against the specifications in the software datasheet much like it does with silicon

products. To support the platform, Renesas has created a Renesas Synergy Platform 24/5 chat service, and a forum plus knowledge database including FAQs. It also provides access to applications engineers, online tech support and will offer on-site training in special cases.

Conclusion

For the MCU-based embedded market, the age of the "platform" has arrived. Today, developers must build higher-performance, increasingly complex solutions in a fraction of the time. To accomplish that task and meet shrinking development timetables, they need integrated platforms that allow them to virtualize the hardware and software and differentiate their end-products using APIs. As an

innovative hardware/software solution for embedded applications, the Renesas Synergy Platform offers developers an exciting, new opportunity to focus on the most crucial aspects of their product design.

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