MCUs build foundation for integrated hardware/software platform

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The key to building a presence in a new market with an innovative new technology is to construct that technology on a solid foundation. To achieve that goal, embedded designers need an extensive line of compatible and scalable MCUs to maximize software and hardware reuse.

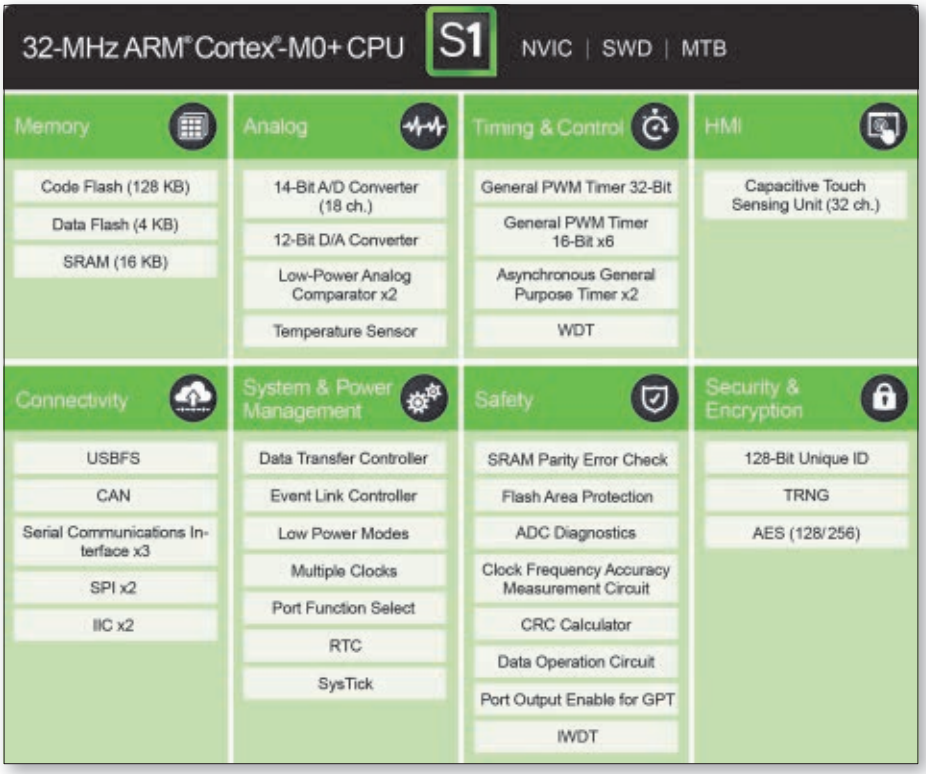
Designers eyeing new applications in the embedded and rapidly emerging IoT market need a highly scalable, upwardly compatible family of MCUs that combine high efficiency with competitive price/ performance characteristics. Synergy MCUs are designed from the ground up to serve that purpose. Based on the ARM Cortex-M family CPU cores, these new microcontrollers combine extremely low power consumption with excellent deterministic behaviour in a small package. The range of potential embedded applications for these new MCUs runs the gamut from simple tags designed to attach to a cow's ear to monitors in household appliances. Given the wide variety of application requirements, crafting the right MCU feature set is no small task. But some functions are clearly essential. One is connectivity.

Most of the MCUs in the embedded market today supply a base set of peripherals including a wide array of connectivity options. Synergy MCUs take this one step further. The top-of-the-line MCU family, for example, offers dual Ethernet with IEEE-1588 synchronization, USB HS, plus many serial interfaces including UART, IIC, SPI, IrDA, QSPI, SSI, SDHI and CAN interfaces. As embedded and IoT applications move toward the edge of the network where systems are often measuring the environment, analog interfaces play an increasingly crucial role. To meet this need the MCUs add a full array of analog-to-digital and digital-to-analog converters, analog comparators and temperature sensors. In addition, the MCUs add a variety of timing functions that are typically used in motor and industrial control applications.

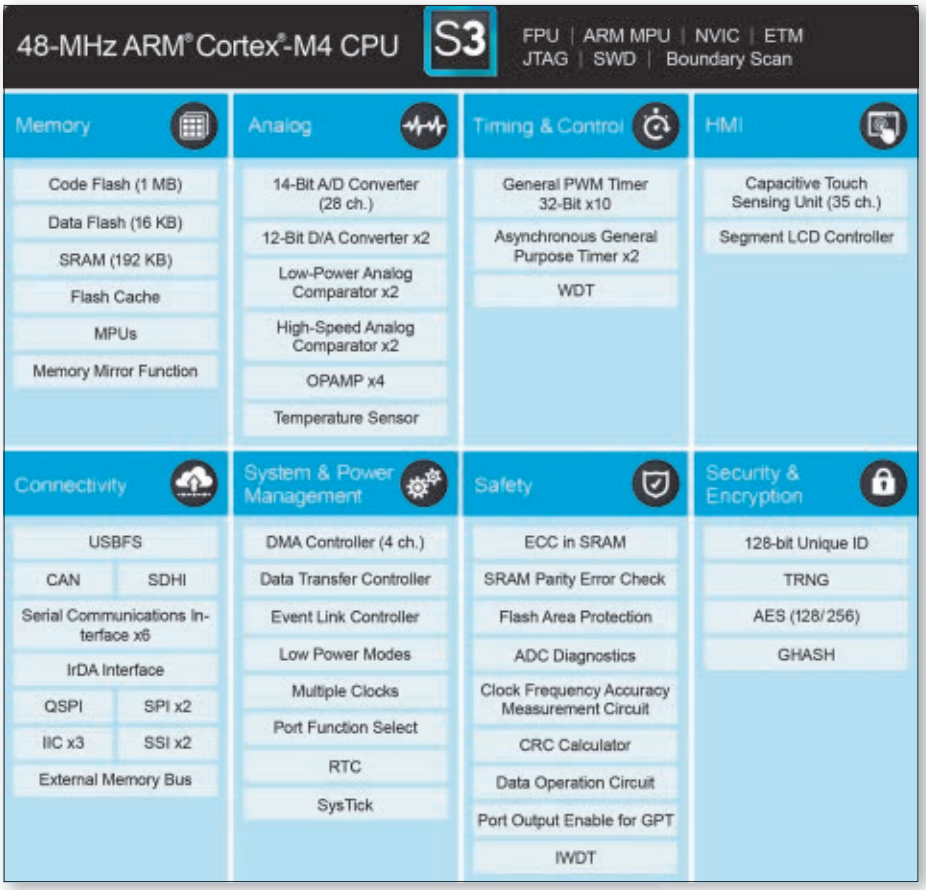
Time to market is a huge factor in the success of any company. The ability to reuse hardware and software helps design teams shorten development time. Synergy MCUs are architected from the ground up to provide a seamless scalability and peripheral compatibility among products, enabling customers to extend software reuse by using common peripherals based on a consistent memory map. MCU scalability enables customers to easily migrate from one product to another in the same family or between families. And the use of a concentric package design allows customers to easily migrate from one package to another with minimum hardware changes.

In addition, a common CPU architecture based on ARM Cortex-M CPU cores enables seamless code migration across the entire MCU family. Taken together these characteristics make it a truly scalable and compatible solution, enabling customers to maximize reuse of software and hardware and, in the process, shorten development time and reduce time to market.

Given the fundamental role connectivity plays in every IoT design, solutions at every level of the network are vulnerable to malicious attacks. The threats can occur at every stage of the product lifecycle. During manufacturing a less-than-honest employee could clone firmware or the security configuration of a product. Once the product goes into the field hackers could replace firmware with malware



Based on the ARM Cortex-M0+ CPU core, Synergy S1 Series MCUs, represented here by the superset S124 device, offer an ideal solution for low power, cost-sensitive embedded and IoT applications.



For higher levels of integration, Synergy S3 Series MCUs, represented here by the S3A7 device, offer more memory and a wider array of peripherals than the S1 Series.

or exploit a software update session to inject malware into a system. And if system parameters are lost, firmware could be susceptible to an eavesdropping attack. Clearly product designers must address a wide array of potential security concerns, not only to ensure the integrity of their product, but also to reassure prospective consumers before they buy into this new market.

To protect embedded systems from these threats, Synergy MCUs add significant security capabilities in hardware where they are less susceptible to attack. As an example, when each MCU in the Synergy product line is manufactured, it is assigned a 128-bit unique ID which can be used to generate keys to protect applications and assist provisioning. Synergy includes on a chip a true random number generator for use with industry standard specifications such as NIST SP800-90 recommended deterministic random bit generators (DRBGs). Many of the MCU members also feature Memory Protection Units (MPUs) that can be used to read- and write-protect an area across the entire addressable memory map. Developers can use this feature to create a secure region that is protected from access by a rogue program. Hardware accelerators are also featured for symmetric cryptography and asymmetric cryptography as well as HASH.

At the low power end of the market where many embedded and IoT solutions are expected to emerge, Renesas selected the ARM Cortex-M0+ CPU core. Optimized for battery-powered applications, this core combines a state of the art low-power architecture with optimized low-power modes, faster wake-up time and low-power peripherals. Utilizing these capabilities Renesas engineers have developed the S1 Series MCUs for very low power, cost-sensitive embedded and IoT applications where developers may be considering migrating from an 8- or 16-bit solution. With these new devices they now have access to the processing resources of a 32-bit MCU. Fabricated using a 130nm low power process, the S1 Series MCUs dissipate exceptionally low power in both standby and operating mode. On-chip memory for initial devices ranges up to 128KB of code flash, 4KB of data flash and 16KB of SRAM.

S3 Series initial devices are based on a 48 MHz ARM Cortex-M4 CPU core and serve applications that demand higher levels of integration than the ARM Cortex-M0+ CPU core-based S1 Series. Fabricated using the same 130nm low power process used for the S1 Series, the S3 Series adds up to 124 GPIOs and larger memory resources with up to 1MB of code flash, 16KB of data flash and up to 192KB of SRAM. Emerging IoT applications require

With up to 2MB of code flash and an extensive array of security and connectivity capabilities, Synergy S5 Series MCUs offer a platform for higher performance embedded applications.

a high level of security. The S3 Series offers essential security and encryption building blocks such as GHASH, AES and True RNG. In addition, the Series features a flexible Segment LCD controller and high accuracy analog peripherals such as a 14-bit A/D converter. Finally, on-chip operational amplifiers and high-speed analog comparators make the S3 Series MCUs a solution for IoT building automation applications.

For higher performance applications, the S5 Series MCUs use an ARM Cortex-M4 CPU core running at between 100 MHz and 200 MHz. Targeted at more complex embedded applications, this Series offers more memory on chip including up to 2MB of code flash, 64KB of data flash and 640KB of SRAM. These MCUs are fabricated using the same high performance 40nm process used for the S7 Series. The S5 series also offers a higher level of encryption for IoT applications. These devices feature True RNG, AES, DES/ARC, RSA/DSA and Hashing functions. In addition, rich connectivity such as Ethernet controller, USB HS and QSPI make the S5 devices suited for economical HMI applications in the appliance market that require a Graphics LCD controller with 2D drawing engine and JPEG Codec.

At the top end of the performance spectrum, the initial devices in the S7 Series deliver high performance using a 240 MHz ARM Cortex-M4 CPU core. This MCU series features a wide array of peripherals and significantly more memory on-chip including an industry-leading 4MB of code flash and 640KB of SRAM fabricated using a high performance 40nm process. These additional resources give embedded developers substantial new design options particularly when their solutions require memory resources to buffer large high-speed messages, perform calculations in background, or run multiple software applications concurrently.

The S7 Series devices are suited for applications that require a higher level of encryption and security. The MCUs feature True RNG, AES, DES/ARC, RSA/DSA and Hashing functions. In addition to superior performance, the S7 Series offer high speed, high precision analog interfaces such as high-speed analog comparators and 12-bit A/D converters with an outstanding sampling rate of 2.5 Msps. The S7 Series also feature multiple high-speed connectivity options including USB HS, Dual Ethernet controller and QSPI. When combined with an integrated Graphics LCD controller with a 2D drawing engine and a JPEG Codec, this feature set makes this Series suited for HMI, factory automation and building applications. ■