

By **Mathias Claußen** (Elektor Lab)

AMD Ryzen V2000 for Embedded Edge Devices

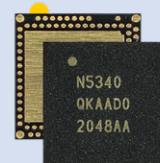
The Cortex-M33 is an Armv8-M mainline core and can be seen as an upgraded Cortex-M4. The **STMicroelectronics** STM32U5 is a low-power, Cortex-M33-based MCU with DSP instructions and FPU. It comes in LQFP48, QFN48, LQFP64, WLCSP90, LQFP100, UFBGA132, LQFP144 and UFBGA169 packages.

The **Renesas Electronics** RA4M2 set of microcontrollers is the newest generation of Renesas 32-Bit MCUs featuring a Cortex-M33 and a rich set of peripherals like USB 2.0 Full-Speed, SDHI, QSPI and advanced analog capabilities.

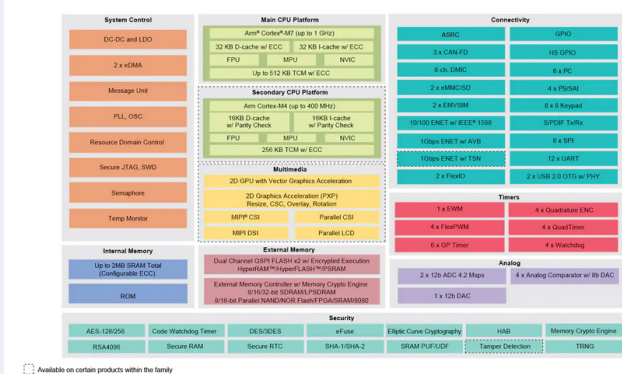
Key Features

- 100MHz Arm® Cortex®-M33 with TrustZone®
- Secure element functionality
- 256kB - 512kB Flash memory and 64kB SRAM with Parity and 64kB SRAM with ECC
- 8kB Data Flash to store data as in EEPROM
- 1kB Stand-by SRAM
- Scalable from 48-pin to 100-pin packages
- Capacitive touch sensing unit
- USB 2.0 Full Speed
- CAN 2.0B
- QuadSPI
- SCI (UART, Simple SPI, Simple I²C)
- SPI/ I²C multimaster interface
- SDHI and MMC

The nRF5340 SoC from **Nordic Semiconductor** features not only a RF radio capable of Bluetooth LE, Bluetooth mesh, NFC, Thread and ZigBee but also incorporates two Cortex-M33 cores in one package. With its peripheral set, it can be a nice MCU for IoT applications and other devices. Its smaller cousin, the nRF51822, powers already the BBC micro:bit.



NXP i.MX RT1170 Crossover MCU Block Diagram



MCU Reaching 1 GHz

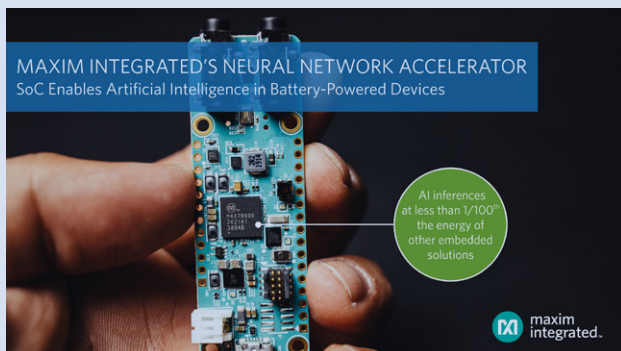
With the **NXP Semiconductors** i.MX RT1170, MCUs are hitting the 1-GHz clock range. Not only integrating a dual-core Arm Cortex-M chip (Cortex-M7 + Cortex-M4) with a rich set of interfaces, it is also featuring a 2D GPU, with OpenVG 1.1 interface. May we get one integrated into a Teensy 5.0 [1]?

The **u-blox** NORA-B1 module is based on Nordic Semiconductor's latest nRF5340 chipset, the first to host a powerful Arm Cortex-M33 dual core MCU. The NORA-B1 series is designed to meet the needs of performance-oriented applications. The brand-new Bluetooth 5.2 low energy NORA-B1 modules comes with the Arm TrustZone® and CryptoCell-312 for enhanced security, making it ideal for industrial machine control, asset tracking, remote controls and gateways, connected power tools requiring continuous motor control, and advanced medical wearables.



AI for Power-Constrained Devices

Winning the "embedded award" of the embedded world show with the MAX78000, **Maxim Integrated** incorporates neural network accelerators into a chip, designed for mobile applications running of batteries. This design is a nice piece of hardware that Elektor engineer Clemens Valens covers in the article "AI at the Edge: Get Started with the Maxim Integrated MAX78000FTHR" [2]. The MAX78000 is available on affordable evaluation boards.



The DS28E40 from Maxim is a 1-Wire authenticator, providing cryptographic functions and authentication to 1-wire capable devices. This can be used to avoid use of untrusted hardware in your systems.

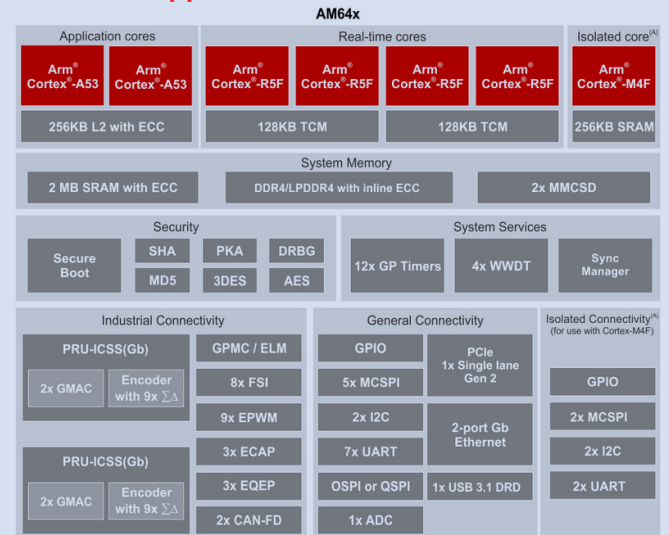
Energy Harvesting



Renesas added the RE family to their set of microcontrollers. An ultra-low-power chip running at low voltages down to 1.62 V at 64 MHz, the RE01 MCU can significantly extend battery life and deliver higher performance with a smaller battery size. Its on-chip energy harvesting controller can bring development to a new

chapter by eliminating a battery completely in achieving a maintenance-free system. The RE Family is suitable for many IoT applications such as hybrid watches, smart homes/buildings, healthcare, smart agriculture, structure monitoring, and trackers.

Industrial Applications and Interfaces in Mind



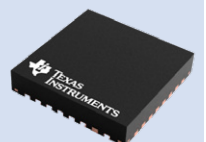
The **Texas Instruments** AM6442 is built for industrial applications, such as motor drives and Programmable Logic Controllers (PLCs), which require a unique combination of real-time processing and communications with applications processing. AM6442 combines two instances of Sitara's gigabit TSN-enabled PRU-ICSSG (programmable real-time unit with Gigabit industrial communication subsystem) with up to two Arm Cortex-A53 cores for web services, up to four Cortex-R5F MCUs for real-time computing, and a Cortex-M4F MCU.

Wired and Wireless Long Range



The **STMicroelectronics** STM32WL range of MCUs is integrating LoRa, SigFox and legacy sub 1-GHz with a single or two core Cortex-M solution into a single die for lowest power consumption.

Texas Instruments 10BASE-T1L single-pair Ethernet PHY makes long-distance 10-Mbps Ethernet networking a reality by enabling cable reach up to 2 km. The DP83TD510E helps designers implement a single communications network, from controller to edge node, that can transmit full-duplex



data over a single pair of twisted wires. By eliminating the need for additional protocols, gateways and cables for higher-bandwidth communications, designers can simplify network management while improving system control and interoperability in long-distance applications.

Semtech's LoRa Edge LR1110 Asset Management Platform is an ultra-low-power platform that integrates a long-range LoRa transceiver, multi-constellation scanner and passive Wi-Fi AP MAC address scanner targeting asset management applications. The LR1110 solution utilizes Semtech's LoRa Cloud geolocation capabilities, to significantly reduce power consumption by determining asset location in a Cloud-based solver.



Lower-Power Position Tracking

The **u-blox** MAX-M10S module is built on the ultra-low power u-blox M10 GNSS platform which provides exceptional sensitivity and acquisition times for all L1 GNSS systems. The extremely low-power consumption of less than 25 mW in continuous tracking mode allows great power autonomy for all battery-operated devices, such as asset trackers, without compromising on GNSS performance.



The **Bosch** smart sensor BHI260AP provides an ideal all-in-one solution for always-on sensor applications such as fitness tracking, pedestrian positioning, machine learning analytics and orientation estimation. The BHI260AP includes a wide variety of software functionalities, a 32-bit customer programmable microcontroller, and a 6-axis IMU, all in one package.



When Hardware Gets Flexible



GOWIN is a newer FPGA vendor that offers some interesting devices. Having more choice for FPGAs is great and having ones with hardwired Cortex-M cores is as well.

Getting the Round Edges



RockTouch show their first full round TFT with touch for outdoor and automotive application. Build for outdoor and harsh environment, with 3-mm Cover Glass it can operate from -30° to +85°C. With a resolution of 1540×1540 pixel at 9.5 inch, this offers new design possibilities for upcoming hardware designs.

Software and Development Tools

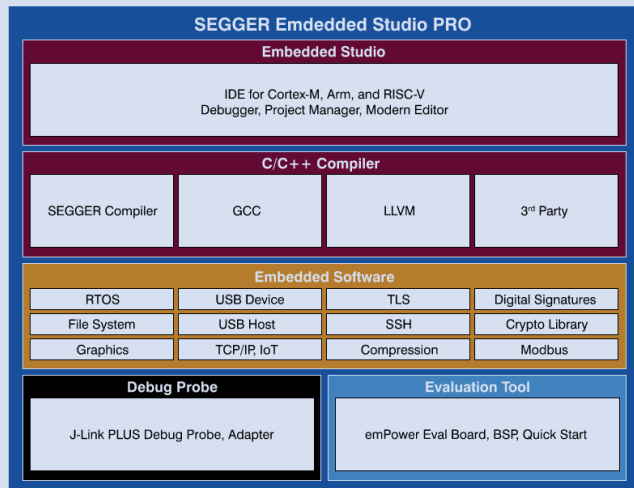


Green Hills has extended its products to be used with the RISC-V architecture. This means their products and compilers are supporting 32- and 64-bit version of the RISC-V ISA. A popular feature of RISC-V is the support of custom vendor dependent instructions. The tools Green Hills provide take this into account and offer an easy-to-learn user interface for adding new instructions into the compiler.

IAR Systems, developer of the IAR Embedded Workbench, added RISC-V support to their product. IAR Embedded Workbench for RISC-V supports RV32 and RV32E 32-bit RISC-V cores and extensions, including RISC-V P extension for Packed-SIMD instructions. The support for custom extensions helps when working with designing custom cores with exact definitions for an application or a product.

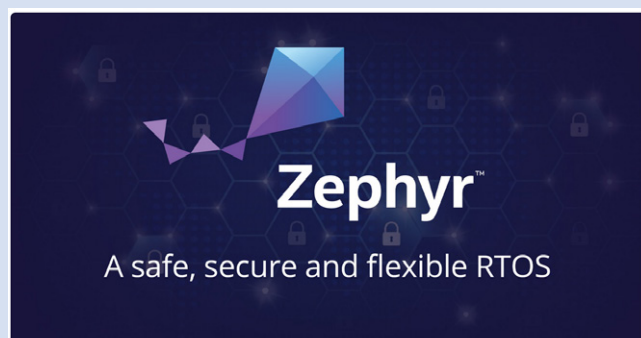


Also shown on the fair: The I-jet and I-jet trace for Arm and RISC-V, debugging and trace probes for these kind of processors, enabling powerful features in IAR Embedded Workbench.



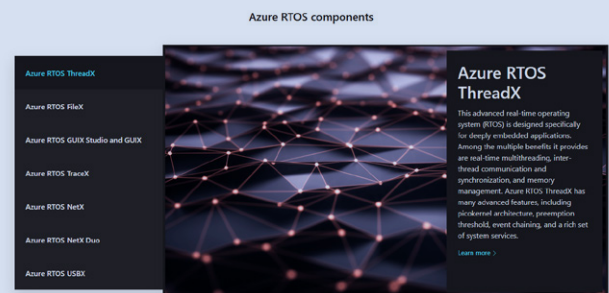
SEGGER presented its Embedded Studio. It is a powerful, cross-platform IDE for embedded C programming, coming along with, for instance, a C/C++ compiler, integrated debugger, and direct J-Link integration. All these components are designed from the ground up for embedded systems to generate extremely small code in order to get the most out of microcontrollers. Specially designed as an all-in-one solution, Embedded Studio provides everything needed for professional embedded development providing continuous workflows: from managing, building, testing, up to deploying embedded applications. Its Visual Studio-like style offers the embedded world of engineering the same intuitive usage that PC developers are familiar with. For non-commercial use and use with licensed partner devices, Embedded Studio is free to use.

More Choice on the RTOS Market



The **Zephyr** Project is a scalable real-time operating system (RTOS) supporting multiple hardware architectures. Licensed under the

Apache 2.0 open-source license, it is free to use in commercial and noncommercial solutions. The Zephyr OS is based on a small-footprint kernel designed for use on resource-constrained systems: from simple embedded environmental sensors and LED wearables to sophisticated smart watches and IoT wireless gateways. The Zephyr kernel supports multiple architectures, including ARM Cortex-M, Cortex-R, Cortex-A, Intel x86, ARC, MIPS Nios II, Tensilica Xtensa, and RISC-V (32 and 64 bit), and many supported boards.



Azure RTOS from **Microsoft** is an embedded development suite including a small but powerful operating system that provides reliable, ultra-fast performance for resource-constrained devices. It's easy-to-use and market-proven, having been deployed on more than 6.2 billion devices worldwide. Azure RTOS supports the most popular 32-bit microcontrollers and embedded development tools, so you can make the most of your team's existing skills.

Wonder why it is called Azure RTOS ThreadX? You might remember a company called Express Logic that once offered an RTOS named ThreadX; well, this is one and the same. Express Logic was bought by Microsoft end 2019 and the RTOS incorporated to become Azure RTOS ThreadX. The code is open and can be found on GitHub [3]. For evaluating the RTOS can be used for free, and if you have one of the licensed hardware MCUs no royalties are needed for commercial use (a list can be found in [4]).

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WEB LINKS

- [1] Discussion on Teensy using a i.MX RT1170: <https://forum.pjrc.com/threads/57842-Future-Teensy-features-amp-pinout>
- [2] C. Valens, "AI at the Edge: Get Started with the Maxim Integrated MAX78000FTHR," 3/5/2021, ElektorMagazine.com : www.elektormagazine.com/articles/ai-edge-get-started-maxim-max78000fthr
- [3] Microsoft Azure RTOS on GitHub: <https://github.com/azure-rtos/threadx/>
- [4] Microsoft Azure RTOS licensed devices: <https://github.com/azure-rtos/threadx/blob/master/LICENSED-HARDWARE.txt>