# The SMARC evolution in embedded COM form factors

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*In this article the author describes SMARC2.0, the new SGET version of the popular Computer-on-Modules small form factor standard of his company, and highlights the changes which it incorporates.*


*Figure 1. SMARC-sAMX6i: Ultra-Low Power ARM and SOC-based SMARC Module based on Freescale i.MX6-Family with Single-, Dual and Quad-Core versions*

■ The final Version 2.0 of the Smart Mobility Architecture (SMARC) embedded computing format was announced by the Standardization Group for Embedded Technologies (SGET) SDT 0.1 in June 2016. In just three years, SMARC has proved to be an innovation boost for the ultra-low power embedded market and it is this rapid success which has largely contributed to the requirement for Version 2.0 in a relatively short period. Essentially, the SMARC2.0 specifications provide an enhanced pinout to better accommodate customer needs and processor interfaces, perfectly matching the original standard set in 2013 for low-profile form factor modules. While SMARC was born out of the necessity for further development of Computer-on-Modules (COMs) standards for energy-saving ARM System on Chip (SoC) processors, Intel subsequently improved the power efficiency of its processors with Atom-based SoCs and allowed x86 architecture products to also benefit from the SMARC format. Consequently, SMARC modules have rapidly emerged as scalable building blocks for enabling an entire new generation of embedded computing applications.

Using SMARC, Systems Integrators can take full advantage of the user-interface options available to mobile device OEMs, providing access to the smaller, low-cost display modules employed in smart phones, tablets and advanced human machine interfaces. Aimed at manufacturers of COMs, carrier board and system developers requiring SoC-based ultra-low power COMs in miniature format, the area of application for SMARC modules is continually expanding, from solutions in the automation market to graphics and image-centric devices which also require extremely low energy consumption and have to withstand extreme environmental conditions. The modules also serve as building blocks for very small portable handheld devices as well as for larger devices where consumption must not exceed a few watts and the computing power has to be particularly high.

Of course, Kontron is no stranger to SMARC. As part of the SGET manufacturer-independent initiative, it has always played a leading role in its development going back to 2012 when the company completed the original SMARC specification under the working title Ultra Low Power Computer-on-Modules (ULP-COM). Looking back, it is remarkable how smoothly SGET was established and able to quickly eliminate the usual standardization bottlenecks. Clearly market demand played an important role in this, allowing the embedded market to benefit from an additional standards body for contributing to innovative specifications, and totally capable of bringing new standards to market within just a matter of months. With the SMARC standard in place, Kontron was quick to address pent-up market demand by launching in 2013 its first highly scalable SMARC module families with ARM SoC processors including the Freescale i.MX 6, Texas Instruments Sitara 3874, and NVIDIA Tegra 3. These enabled developers to begin work immediately on engineering innovative ultra-low power devices.

In fact, the smooth ratification of the SMARC standard also underlines the power of Kontron to innovate in its role as an international technology leader and as a standardizer of COMs. With over 15 years of experience in the development of COMs, the company has always provided extensive support along with notably long-term product availability, allowing industrial customers, partners and module manufacturers to profit from the high level of investment security available. Its success story with COMs began in 1998 with DIMM-PC which, in 2000, led to the ETX standard being licensed worldwide. The X-board specification followed in 2002 and ETX Express as the technological basis for PICMGs COM Express technology was launched in 2003. COM Express was finally developed by members of the PICMG standards consortium, and Kontron was a major contributor to the technology. Over the years COM Express has been

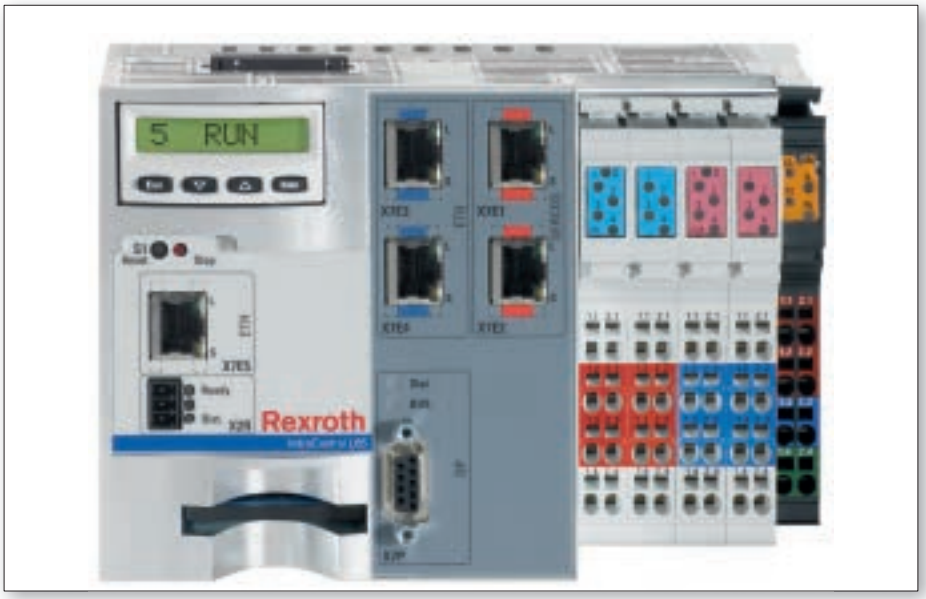


*Figure 2. IndraControl L45: Kontron COMe is an essential core element in the new PLC controller of Bosch Rexroth*

consequently adapted to meet the increasing need for miniaturization on a high performance level: COM Express basic was complemented by the smaller COM Express compact and in 2008, Kontron introduced the technological basis for the credit card sized COM Express® mini.

Further success came in February 2014 when Kontron introduced the first ultra-low-power SMARC Computer-on-Modules with Intel Atom processors E3800 series. This was significant as at that time only ARM processors had been available and therefore the new launch opened up completely new possibilities for developers in terms of the form factor scalability, software re-use and compatibility. Now firmly established, Kontron SMARC-sXBTi Computer-on-Modules offer excellent graphics, high processor performance and x86 compatibility on the smallest SMARC footprint combined with very low power consumption (5 to 10 watts). Both the flat profile of the module and its mobile feature set are tailored for the smallest portable handheld devices. The modules can, however, be deployed in any application where power consumption has to be kept at just a few watts but high-level computing and graphics performance are required.

SMARC2.0 - why the changes? In order to assess the changes to the SMARC standard it is necessary to first take a step back. Utilising the proven Mobile PCI Express Modules (MXMs) edge connector, SMARC was originally established to define two sizes of modules - a full-size module that measures 82 mm by 80 mm, and a short module for more compact systems measuring 82 mm by 50 mm. In contrast to the PCI Express focus of COM Express, SMARC provided the flexibility for handling different types of video and graphics output, serial buses, general purpose SPI, client and host forms of USB, serial and parallel camera interfaces, and support for standard flash-memory card formats such as SD and eMMC. Today, however, the 314 electrical contacts of the SMARC connector need to support and provide compatibility with not only ARM, but also x86 - two distinct SoC architectures. With ARM, for example, the connector must guarantee a high degree of signal integrity as required by the high-frequency serial interfaces, as well as support a parallel TFT display, MIPI display interface, camera interfaces, multiple SPI links and SDIO interfaces. At the same time it must offer full compatibility with X86 requirements such as many USB and PCI Express lanes, LPC bus and more.

In response to this challenge SGET has been able update the original specification based on three years valuable market feedback from a broad range of developers and users. As part of its policy of continuous improvement this has culminated in various modifications and enhancements to be included in SMARC 2.0. Furthermore, some interfaces which were rarely used or considered as almost outdated, have been removed from the specification including the Parallel Camera Interface, Parallel Display Interface, PCI Express Presence and Clock Request signals, Alternate Function Block, SPDIF, one I2S (out of 3) and eMMC interface to the carrier. Throughout this process, the goal of SMARC 2.0 has been to create a new pinout version while maintaining compatibility with the V1.1 pinout as far as possible. Accordingly, there has been a repurposing of selected, previously under-utilized, V1.1 pins for accepting new interfaces.

The guiding principal has been that there should be no damage if a V1.1 compliant module is placed into a V2.0 compliant carrier, or if a V2.0 compliant module is placed into a V1.1 compliant carrier.

SMARC 2.0 – what's new? The new version V2.0 will repurpose selected V1.1 pins that are underused for new interfaces in order to keep the compatibility with the V1.1 pins. No damage will be caused to modules that were placed in a V2.0 compliant carrier or inverse with a V2.0 compliant Module in a V1.1 compliant Carrier. New interfaces include 2nd channel LVDS, a 2nd Ethernet port, IEEE1588 Trigger Signals, a 4th PCI Express Lane, extra USB ports (now up to 6x USB 2.0 + 2x USB SS signals), x86 power management signals, eSPI and DP++. Three digital displays: as primary display, 2x 24 bit LVDS or eDP (4 channels) or MIPI DSI (4 channels) can be used, the secondary display can either be HDMI or DP++ and the third display can be DP++.

Undoubtedly, SMARC 2.0 will be the basis of many innovative and sophisticated applications over the next few years and Kontron, as one of the world leading embedded computing technology manufacturers, fully intends to remain at the forefront of SMARC innovation. The company already has Version 2.0 product introductions scheduled for late 2016 and these, like all current Kontron embedded boards and controllers, will be Internet of Things ready and benefit from deep software integration. ■