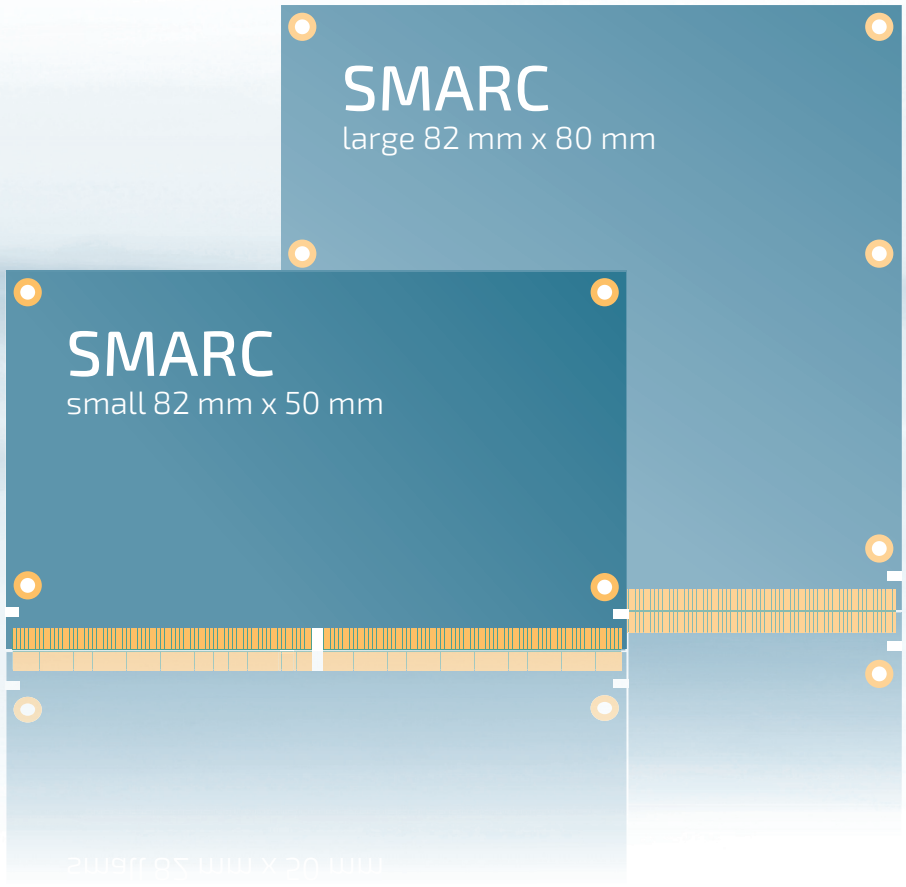
SMARC

WHITE PAPER



SMARC 2.0

AT THE HEART OF NEXT GENERATION IoT EMBEDDED SOLUTIONS

POSSIBILITIES START HERE kontron

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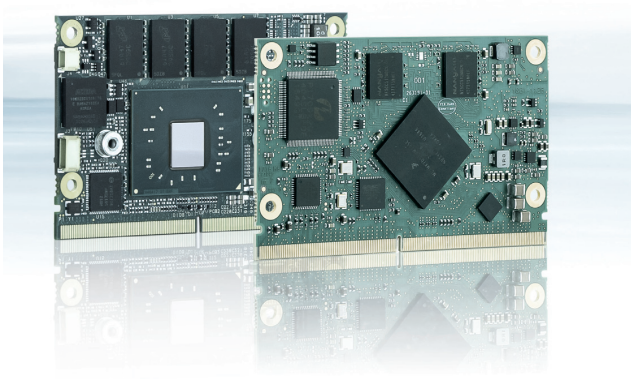
The SMARC™ (Smart Mobility Architecture) standard has in a matter of a few years become a major driving force behind the enablement of innovative ultra-low-power embedded computing technology solutions. Market demand and the disruptive influence of the Internet of Things (IoT) have already hastened the arrival of a new specification, SMARC 2.0. What are the implications for embedded systems designers and developers?



// SMARC -sXAL (Intel Atom® processor)
// SMARC -sAMX7(NXP iMX7)

High-performance embedded systems have been used in industrial, corporate and consumer sectors for some time for controlling larger computer systems, providing human-machine interfaces, as well as for collecting and analysing large volumes of data.

By definition embedded systems must not only be extremely small, very robust and high performing, they must also consume minimal power. Furthermore, with the advent of the IoT, embedded systems are becoming more and more critical for the hyper-scale interconnectivity of humans, machines and all kinds of devices in order to deliver an increasingly diverse, seemingly infinite, range of innovative applications.

Faced with these growing requirements, a new version of the now widely accepted Smart Mobility Architecture (SMARC) standard for Computer on Modules (COMs) was introduced in 2016, just three years after its inception by SGET (Standardization Group for Embedded Technologies).

With SMARC already proven in a range of applications, from industrial production to smart phones, tablets, and advanced human-machine interfaces, why was a new version necessary and what exactly makes the new version better than its predecessor?

This paper discusses SMARC's ongoing evolution to ensure system designers and OEMs can address the growing challenges and requirements for more rapid and cost-effective development of next generation IoT-enabled embedded systems.

INTRODUCTION: A CHANGING LANDSCAPE

In early 2016 Version 2.0 of the SMARC (Smart Mobility Architecture) embedded computing format was announced by SGET SDT 0.1 (Standardization Group for Embedded Technologies). Essentially, the SMARC2.0 specification provides 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.

In just three years SMARC had proved to be an innovation boost for the ultra-low power embedded market and it was this rapid success which largely contributed to the requirement for Version 2.0 in a comparatively short period.

SMARC modules have rapidly emerged as scalable building blocks for enabling a whole 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.

Whilst SMARC was originally born out of the necessity for further development of Computer-on-Modules standards for energy-saving ARM System on Chip (SoC) processors, Intel subsequently improved the power efficiency of its processors with Atom-based SoCs, allowing x86 architecture products to also benefit from the SMARC format.

At the same time, The Internet of Things (IoT) has become a hugely significant disruptor, bringing previously unforeseen opportunities as well as challenges for vendors seeking to connect numerous devices with different technological requirements.

Therefore, the need to accommodate universal IoT connectivity while at the same time bridging the gap between the specific interface requirements of ARM and Intel® processors became the catalyst for SMARC 2.0. It ensures the compatibility of multiple different hardware components without complications, and is fit for purpose for meeting the hyper-scale interconnectivity demands of the rapidly evolving IoT Age.

MEETING THE NEW CHALLENGE

Aimed at manufacturers of Computer-on-Modules, carrier board and system developers requiring SoC-based ultra-low power Computer-on-Modules 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 must 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.

SMARC - DESIGN CONSIDERATIONS:

- Increasingly sophisticated IoT-driven customer requirements
- Size, power and cost constraints
- Faster processing and growing bandwidth demands
- Higher reliability/ extreme operating environments
- Shorter time to market
- Improved lifecycle/ROI
- Scalability from ARM to Atom using a single carrier
- Long term availability

As with the original version, SGET has developed the latest SMARC 2.0 specifications based on feedback from the market. The goal during this process was to create a new pinout version while at the same time ensuring the highest possible compatibility with the V1.1 pinout. To achieve this, selected, rarely used V1.1 pins were repurposed for SMARC 2.0 to recognize new interfaces. The guiding principle was that there should be no damage if a V1.1 conformant module is built into a V2.0 conformant carrier, or vice versa.

However, to fully understand the changes to the SMARC standard it is perhaps necessary to take a step back. Utilising the proven Mobile PCI Express® Modules (MXMs) edge connector, SMARC was originally established to define two sizes of module - 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®, the SMARC pinout provided the flexibility for handling different types of video and graphics output, serial buses, 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 MXM's 314 electrical contacts need to support and provide compatibility with not only ARM, but also x86 - two distinct SoC architectures. With ARM, for example, the connector must support a parallel TFT display, MIPI display interface, camera interface, multiple SPI connections, and SDIO interfaces. At the same time, it must be compatible with x86 requirements, offering more USB and PCI Express® lines, DisplayPort and many more features.

In response to this challenge SGET has updated the original specification based on three years' valuable market feedback from a broad range of developers and users. This has included some interfaces which were rarely used or considered as almost outdated being removed from the specification. For example: the Parallel Camera Interface, Parallel Display Interface, PCI Express® Presence and Clock Request signals, Alternate Function Block, SPDIF, one I2S (out of 3) and the eMMC interface to the carrier.

SMARC 2.0 – KEY REVISIONS

- 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 3.0), 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++. With three graphics interfaces now included, multimedia applications run much more smoothly than before

KONTRON AND THE SMARC CONNECTION

As part of the SGET manufacturer-independent initiative, Kontron 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 ULP-COM (Ultra Low Power Computer-on-Modules).

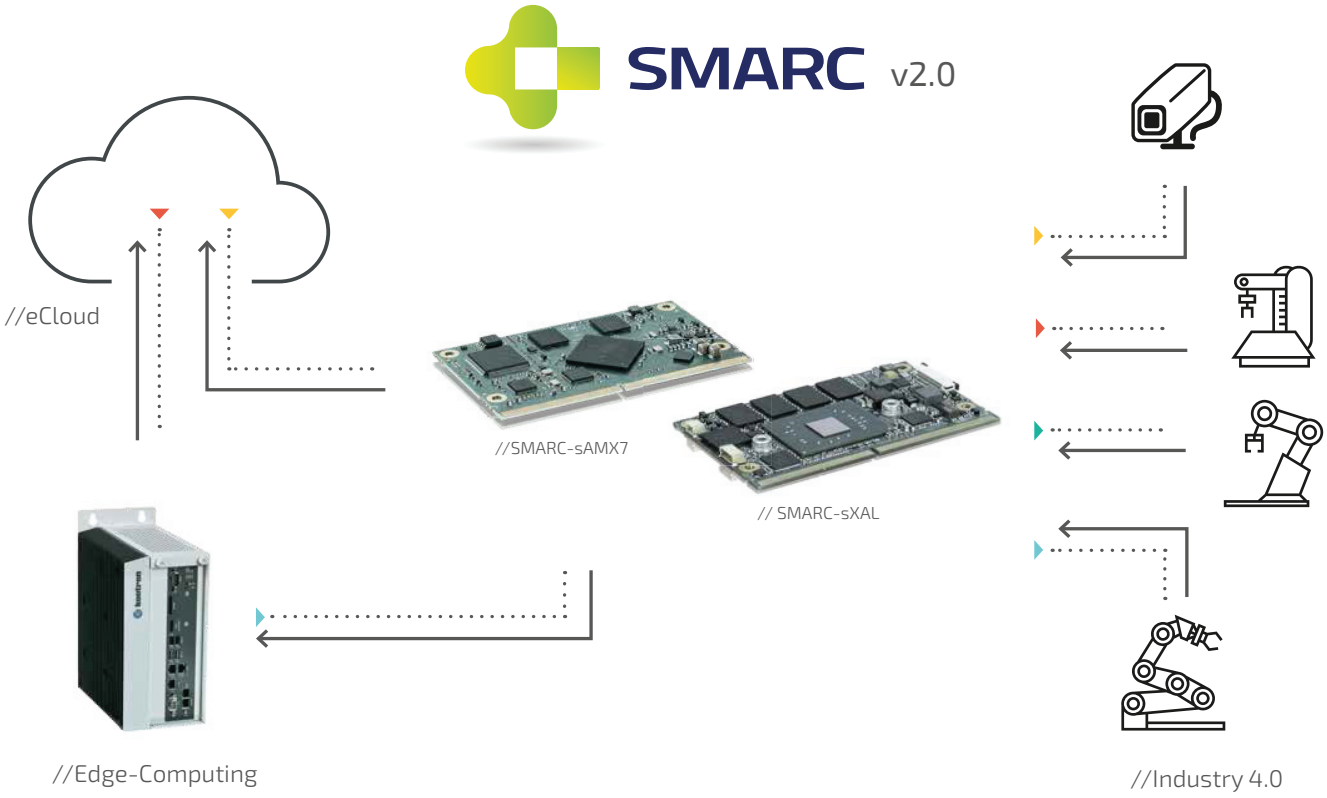
The smooth ratification of the SMARC standard also underlines Kontron's ability to innovate in its role as an international technology leader and as a 'standardiser' of Computer-on-Modules, including the widely adopted COM Express® technology which has been consistently adapted to meet the increasing need for miniaturization on a high performance level. Kontron 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.

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.

Further success came in 2014 when Kontron introduced the world's 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's scalability, software re-use and compatibility

KONTRON SMARC 2.0 COMPUTER-ON-MODULE SOLUTIONS

Kontron has already introduced its first SMARC 2.0 Computer-on-Modules based on the latest generation Intel® and ARM processors including the highly scalable SMARC-sXAL module, covering the entire range of Intel's latest IoT-ready embedded processors. This includes the Intel Atom® processor E3900 series, as well as Intel® Pentium® processor N4200 and Intel® Celeron® processor N3350. The SMARC-sXAL module is available in both dual-core and quad-core configurations.



Further examples include the extreme low power SMARC-sAMX7 modules with single or dual core NXP i.MX7 processors. These cover an extremely wide performance range and are intended for small and power critical applications. Based on the ARM Cortex A7 technology, they enable an efficient development of smart devices in an extremely compact, fanless design with balanced processor and graphics performance.

In addition, as part of its commitment to helping embedded application developers become familiar with the SMARC modular platform as quickly as possible Kontron has introduced The SMARC Evaluation Carrier 2.0. This offers a head start on the total system design by simple selection and installation of the SMARC module best suited for the required application. It is compliant with the SMARC 2.0 specification and supports a broad range of interface options for low power applications including 2x Gigabit Ethernet support, SD-card socket, USB 2.0 and 3.0, mSATA, PCIe and many more. Furthermore, the implementation of LVDS, HDMI and DP++ allows multimedia applications that have never been possible on SMARC before.

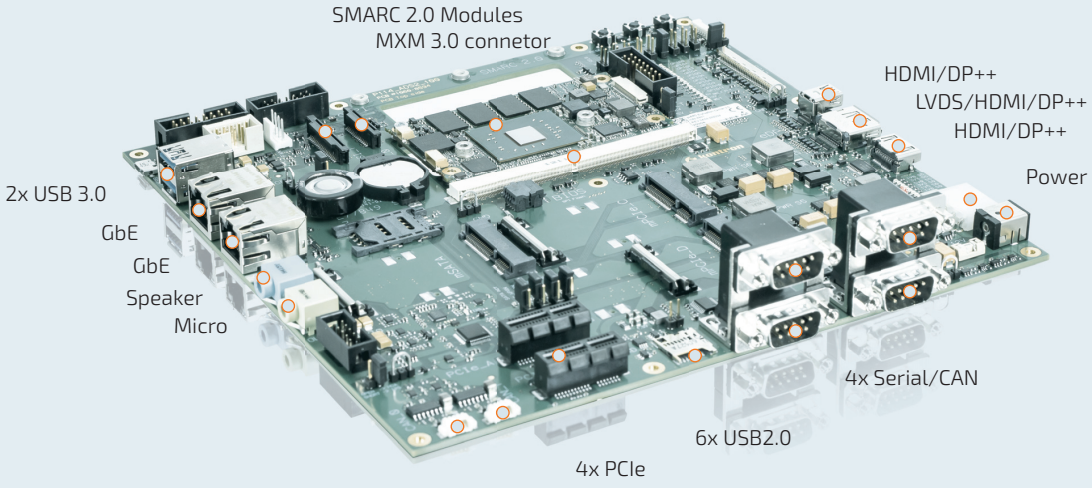
SMARC: AN ONGOING EVOLUTION

It is remarkable how smoothly SGET was first established in 2013 and able to quickly eliminate the usual standardisation bottlenecks. Clearly market demand has played an important role and allowed the embedded market to benefit from an additional standards body for contributing to innovative specifications, totally capable of bringing new standards to market within just a matter of months.

While SMARC does not have to shy away from comparisons with older form factors, a fit for purpose standard has to evolve and keep pace with the speed of change that characterises the embedded technology computing industry. This is why the current SMARC specifications update is but the latest step on the development ladder.

One thing is for certain however, as SMARC continues to evolve as the foundation for many more pioneering and highly developed applications in the coming years, Kontron is committed to remaining as a key contributor and maintaining its leadership position as a provider of highly innovative SMARC solutions.

Rapid prototyping - Kontron SMARC™ Carrier 2.0



SUMMARY

SMARC has rapidly become accepted and proven in the market and its latest incarnation, SMARC 2.0, is already the basis for a growing number of innovative and sophisticated next generation IoT-enabled applications.
Kontron will continue to play an instrumental part in the further development of the SMARC standard and, as one of the world's leading embedded computing technology manufacturers, fully intends to remain at the forefront of SMARC innovation. The company already has SMARC 2.0 product introductions available on the market which, like all current Kontron embedded boards and controllers, are IoT-ready and benefit from deep software integration, extended lifecycle, and global technical support.

For more information about Kontron SMARC embedded systems visit https://www.kontron.com/products/boards-and-standard-form-factors/smarc/

About Kontron – An S&T Company

Kontron is a global leader in embedded computing technology (ECT). As a part of technology group S&T, Kontron offers a combined portfolio of secure hardware, middleware and services for Internet of Things (IoT) and Industry 4.0 applications. With its standard products and tailor-made solutions based on highly reliable state-of-the-art embedded technologies, Kontron provides secure and innovative applications for a variety of industries. As a result, customers benefit from accelerated time-to-market, reduced total cost of ownership, product longevity and the best fully integrated applications overall.

Kontron is a listed company. Its shares are traded in the Prime Standard segment of the Frankfurt Stock Exchange and on other exchanges under the symbol "KBC". For more information, please visit: **www.kontron.com**

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