The future starts now: Next generation Computer-on-Modules

Interview with Dirk Finstel, ADLINK Technology

With the release of two new specifications from the standardization bodies PICMG and SGET, there are significant improvements happening right now to simplify the design of next generation carrier-grade network equipment, cloud services based on embedded edge and fog servers as well as IoT devices. Boards & Solutions spoke with Dirk Finstel, Executive Vice President Global Module Computer Product Segment with ADLINK,- to get the latest insights from one of the originators of these standards.

■ **B&S:** ADLINK Technology is one of the eading embedded Computer-on-Module vendors in the world and has significantly shaped recently released new SGET SMARC 2.0 specification and pre-release of the new COM Express Type 7 specification by PICMG. What is the reason behind the concurrent launch of two new next generation standards?

Finstel: The tremendous performance improvements within carrier networks together with the trends to IoT, cloud computing and network virtualization change the way we want to set up new applications. That makes it necessary to specify Computer-on-Module standards that meet these new requirements most efficiently.

B&S: Aren't Computer-on-Modules one-for-all platforms and therefore suitable for nearly all embedded system designs? Why do we need new standards?

Finstel: Yes. They are of course standardized, application-ready computing cores for customized designs with carrier boards and thus universally applicable. But the standards are only defined for their specific application areas. The well-established COM Express Type 6 specification, for example, is designed to meet the requirements of powerful stand-alone rugged systems that, from a performance, graphics and TDP point of view, are comparable to what we use on the desktop PC and notebook level. But with the IoT and cloud trends we need high-end cloud computing intelligence and optimized I/Os for headless edge and fog server technologies, and that's what COM Express Type 7 as well as the latest Intel Xeon processors with a maximum power draw of 65 watts are designed for. And we need IoT gateways and a large number of cloud-connected smart devices in the field that support smart cameras and wireless antennas natively in order to build, for example, smarter and more secure cities or to connect vending machines and ticketing systems with their dedicated clouds. These are major application areas that SMARC 2.0 is designed for.

B&S: So you see SMARC 2.0 as the platform for IoT connected devices and IoT gateways; and COM Express Type 7 modules for headless edge and fog servers as well as virtualized carrier-grade network equipment?

Finstel: Yes. These are among the most important new horizontal application areas for which nearly every vertical market that uses embedded computing technologies needs to be prepared.

B&S: Let's start going more into the details. What are the differences between COM Express Type 7 and the widely accepted COM Express Type 6 specification?

Finstel: One of the most fundamental innovations of the COM Express Type 7 pin out is the support of more performance and more I/O bandwidth with server-grade headless Intel Xeon processors that have a maximum power draw of 65 watt, up to four 10GbE KR interfaces and up to 32 PCIe lanes. On the module, they are implemented as 10GbE KR single backplane lanes according to IEEE 802.3, paragraph 49. The physical shaping of the 10GbE interfaces takes place on the carrier board itself. Here, developers can define the signal transmission as optical SFP+, copper cable (T) or as KR – in order to implement, for example, module-to-module connections on multi-module carrier boards. This provides maximum flexibility for new designs.

B&S: So are we talking about a completely new specification here?

Finstel: It is a new specification suitable for many new high-end embedded systems such as virtualized carrier-grade network equipment or IoT edge and fog servers. But it is not entirely new. It is backed up by the highly reliable embedded high-end COM Express Computer-on-Module standard and thus reliable right from the start of the specification release.

B&S: Which interfaces needed to be omitted?

Finstel: Since all the new edge and fog server appliances are headless and don't need any high-end display support, the Digital Display Interfaces (DDI) on the CD connector were removed to make way for the four 10GbE ports. Type 7 will also support up to 32 PCIe lanes, which is 8 more than on Type 6. To make space for this, LVDS was completely removed and SATA and USB ports where downgraded to 2 and 4 respectively. Finally, the VGA graphics interface was removed to make place for an NC-SI port on the AB connector. NC-SI can be used in combination with either the original GbE port, or with any of the four 10GbE ports.

B&S: What is a typical design example for COM Express Type 7 modules?

Finstel: We see them as a substitute for legacy ATCA platforms and the many proprietary systems in carrier-grade telco networks because technology upgrades are quite expensive due to all these deployed platforms. With COM Express modules, upgrades can be executed parallel to the performance cycles of the latest processor technologies. So I can imagine that performance hungry new telco platforms might get updated annually for the fastest performance hike at the lowest cost. New designs can also have quite a small footprint that is not much larger than the module footprint itself, which is 95x125mm. Add a height of 1U or 2U for the system and you have a very compact embedded server computing box. This is interesting for edge and fog server technology that is hosted by the field application vendor. But we also see rack mount as well as carrier-grade system designs with up to 10 modules in a high-bandwidth 1U system for data-intensive applications with transfer rates of up to 0.4 terabits per system.

B&S: Why Computer-on-Modules in such a complex multi-processor system?

Finstel: Thanks to the modular design with its defined pin out, system design becomes independent of processor technology. Systems can be upgraded by a simple module exchange. This minimizes development costs for performance upgrades and helps to shorten time-to-market. OEMs also gain greater design security and can use their designs for longer, thereby additionally increasing their return on investment.

B&S: When will we see the first COM Express Type 7 module from ADLINK Technology?

Finstel: It's already here for early field tests and full series production will start at the end of this year. Our new COM Express Type 7 module, the Express-BD7, is based on server-grade Intel Xeon D SoC processors with a TDP of 65 watts or less. It targets customers that are building space-constrained systems in industrial automation and data communication, such as virtualization, edge computing or other numerical applications that require high-density CPU cores balanced by reasonable power consumption. It hosts up to 32GB dual channel ECC DDR4 and supports two 10GbE ports, up to eight PCIe x1 Gen2 lanes, one PCIe x16 Gen3 interface, two SATA 6Gb/s and four USB 3.0/2.0 ports. The module comes with a build option for an extreme rugged operating temperature range of -40°C to +85°C.

B&S: Is COM Express Type 7 backed up by support from processor vendors?

Finstel: COM Express Type 7 only became possible because there is a clear silicon roadmap behind it offering embedded long-term availability!

B&S: OK. That's great. Now let's take a look at SMARC 2.0. Why a new interface specification for a standard that already addresses all the new credit card sized small form factor designs based on ARM and x86 technologies?

Finstel: The technology evolves quite fast in this low power to ultra-low power segment and many technologies were not available at the launch of SMARC 1.0 in 2012.

B&S: So are we talking here about something brand new that is designed for entirely different systems?

Finstel: No. SMARC 2.0 is very impressive as well, but it is 'only' the successor of SMARC 1.1. The challenge in developing the SMARC 2.0 specification was to integrate the latest features of current SoC platforms while maintaining compatibility with the 1.1 pin out to the widest possible extent. Only pins for interfaces that were rarely used or looked likely to be replaced in the near future by more modern interfaces were allowed to be reassigned. Thus most of the key interfaces supported by 1.1 have not changed in 2.0, and the specification ensures that no damage will occur if a 2.0 module is deployed by accident on a 1.1 carrier board, or vice versa.

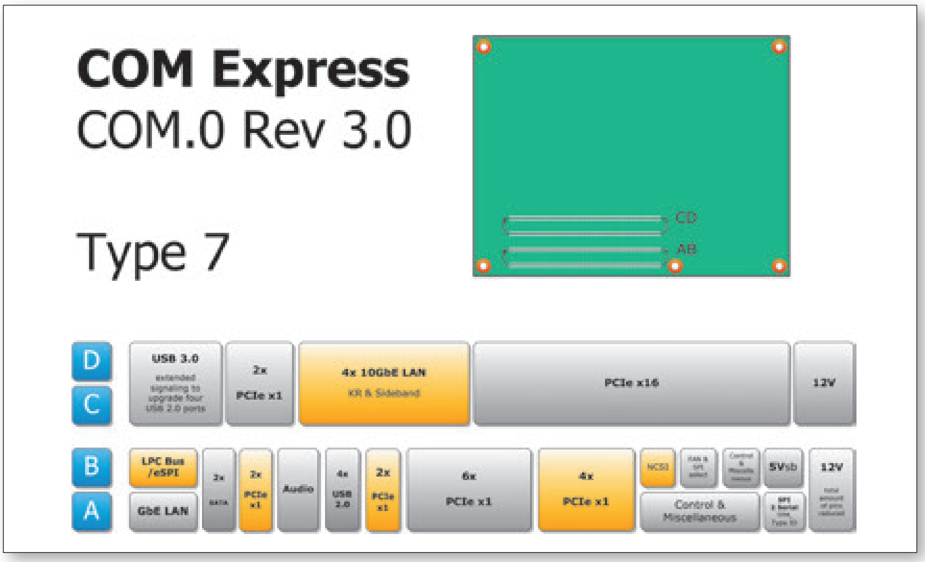
B&S: What's new?

Finstel: Within the new application areas of the IoT, cloud and wireless sensor networks, I first want to mention the -40°C to +85°C extended temperature support for the harshest environments which is a unique feature of all ADLINK Technology SMARC 2.0 modules. Furthermore, dual GbE support as well as the option to design-in antenna interfaces directly on the module is massive innovations in embedded module design. They differentiate SMARC 2.0 significantly from competing module specifications such as Qseven or COM Express Mini. Native support of antennas enables system engineers to design in various wireless interfaces such as 3G or WLAN, or any of the many local wireless interfaces such as Zigbee, 6LowPAN, LoRaWAN or Sigfox, just to name a few.

B&S: Why is the second Ethernet port so important?

Finstel: Native support of a second Ethernet interface instead of only one is a plus for IoT gateways and process computers with vertical integration, where one Ethernet port connects to the field and the other to the management level. Support of two GbE interfaces also benefits many industrial devices that simply loop this bus through to connect multiple devices in the field, thereby reducing the amount of cabling by allowing the implementation of line or even redundant ring topologies instead of star topologies.

B&S: What other features beside dual Ethernet and wireless support are important to mention?



The new Type 7 pinout provides up to 4x 10GbE KR for bandwidth- and data-intensive designs.

Finstel: First of all, I would like to say that especially in the context of IoT and cloud services we have a unique feature that differentiates all our SMARC 2.0 and COM Express Type 7 modules from all competing platforms, which is SEMA Cloud support. SEMA Cloud allows all of our latest modules to have native support of cloud services implemented so that OEMs and their customers can access, control, manage and maintain all our boards and modules via cloud servers. And they can use this cloud interface for the entire system. No other embedded computing vendor has such a considerable and consistent offering.

B&S: So your modules can deliver data such as temperatures and power consumption as well as fan speeds and many other health parameters to the cloud?

Finstel: Not only that. We can integrate local peripherals as well and manage OS, firmware and application upgrades or distribute new application data such as sales prices to thousands of devices with only a few clicks. Therefore, IoT connectivity is inherent to our platforms and implemented with the highest security because we designed a dedicated encryption engine into our BMC which makes it more or less impossible to hack our devices.

B&S: The connectivity question seems to be quite comprehensively addressed at ADLINK Technology, which benefits OEMs who already have enough challenges to master with all the new IoT and cloud based applications and services. But I assume that connectivity is not the only feature that makes SMARC 2.0 a next generation module specification!

Finstel: Exactly. Other new features that we have implemented include two MIPI CSI serial camera interfaces. One of them supports up to 4 lanes which is again very interesting for smart digital signage, smart vending machines and smart cameras in smart cities and connected vehicles. And finally, we have also significantly improved the monitor interfaces.

B&S: Which graphics features are new?

Finstel: SMARC 2.0 now also offers dual-mode DisplayPort, a.k.a. DP++, to support resolutions up to Ultra HD/4K with 3840 × 2160 pixels. This interface makes DVI and HDMI displays easier to implement because all that is required is a signal level conversion from TMDS to LVDS. Also, since single-channel LVDS in SMARC 1.1 has become dual-channel LVDS in 2.0, this interface can now drive either two low-resolution displays or one high-resolution display. Depending on which processor is used, the interface can support up to 1920 x 1200 pixels at 60Hz. And since the HDMI/DP interface remains unaltered, developers can connect up to three high resolution digital displays via modern serial display interfaces. Existing carrier boards with single channel LVDS and HDMI can be used with SMARC 2.0 just as before.

B&S: How can we differentiate SMARC 2.0 from Qseven?

Finstel: The new SMARC 2.0 specification offers the latest state-of-the-art interfaces as well as the largest number of interfaces because its MXM 3.0 connector provides 314 pins, which is a lot for such a small form factor. Thus SMARC 2.0 is an ideal platform for highly integrated Computer-on-Modules in credit-card format and we expect that SMARC 2.0 will become the leading SFF standard for both x86 and ARM designs. Qseven addresses the same market but has fewer interface capabilities.

B&S: When can we expect your first SMARC 2.0 Computer-on-Module?

Finstel: The first launch will be with a new processor generation. The new Intel Atom, Celeron and Pentium processors codenamed Apollo Lake are already launched and it is only a matter of weeks before our first SMARC module based on that processor will be available. We couldn't make it parallel to the launch because the time frame from official specification release in June to the launch date in early September was too short.

B&S: Will SMARC 1.1 modules become obsolete?

Finstel: We don't think so. All relevant low and ultra-low power processors such as Altera Cyclone V, Xilinx Zynq, Freescale i.MX6, Intel Atom E3800 Series, Intel Celeron N3000, Intel Quark, DMP's Vortex 86EX, Nvidia Tegra 3 as well as Texas Instruments ARM Cortex A8 and A9 are perfectly suited for SMARC 1.1. Thus we expect that we will have modules based on that specification for many years to come.

B&S: Thanks for all these insights.

Finstel: You're welcome! ■