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Technical article

Modules for Servers

Computer-on-Module Standards

Modules for Servers

COM Express Type 7 modules are suitable for embedded cloud, edge, and fog servers as well as telecommunications and server farm equipment such as base stations, media cloud servers, and SDN/NFV infrastructures.

Computer modules are now empowered to be deployed in servers, a fact PICMG recognizes with the recent publication of the COM Express Type 7 specification. With the launch of this specification, congatec is now offering application-ready server-on-modules with Intel® Xeon® D processors.

The use of modules in servers has not been common until now, partly because server technology developers have had their own ideas about the specific hardware design of the systems, and partly because they had the volumes to justify developing dedicated systems. This is why there are currently a large number of dedicated systems with homogeneous designs in carrier networks and server farms.

However, now that performance has increased to a point that can support server virtualization, server functions will increasingly be specified in software, abstracted from the actual hardware. The main keywords in this context are software-defined networks (SDN) and network functions virtualization (NFV). Because specific designs are no longer necessary, this trend is leading to hardware standardization, enabling projects such as the Open Compute Project (OCP) — driven by server farm operators such as Google and Facebook — to achieve greater efficiency, flexibility, and scalability. A core aspect here is modularization of the hardware. Basically each server module can assume any task, it is only a matter of deciding where the module will reside in the network and what its performance will be. Innovation cycles in processor performance continue to be fast and cost pressures on services are constantly increasing, forcing systems developers, network operators, and service providers to look for ways to implement performance upgrades as simply and cost-effectively as possible.

Cost-effective Performance Upgrades

Standardized computer modules are now perfectly suited to flexible design and requirements-based scaling of server performance. With standardized modules, systems can easily be upgraded, even over the course of several processor generations, without any other hardware changes being required. This reduces the costs of an upgrade to the cost of exchanging the modules, which is much cheaper than exchanging complete SBCs or entire blades. A previous challenge - is that up to now there has been no module standard to support native 10-Gigabit Ethernet (10 GbE). That changed with the introduction of the PICMG specification COM Express Type 7. Modular server designs with redundant 10-Gigabit Ethernet switching can now be developed with all the benefits of computer modules.

Carrier-grade Servers

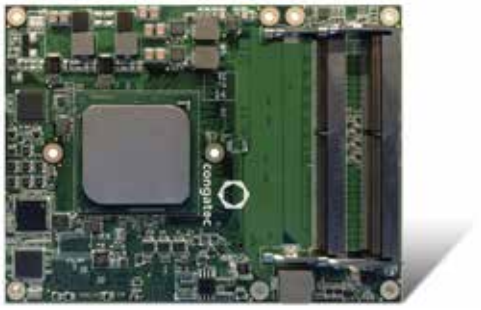
Carrier-level applications include: virtualized infrastructure computers; dedicated platforms for cloud, edge, and fog servers operated by the carrier; cellular phone towers, and storage and content distribution systems that require efficient solutions for more performance and ease of scalability. Enterprise-level application fields are primarily found in research centers for content distribution, where service providers for IPTV, cable and (mobile) clouds operate server farms close to the edge of the carrier network to deliver device-specific transcoding and supply of content on demand, as well as in security applications such as Video Surveillance as a Service (VSaaS).

IoT and Embedded Servers

Server-on-Modules based on the PICMG COM Express Type 7 specification are not only suitable for carrier and network server installations. IoT and Embedded OEMs can also profit from the new server-on-modules. Application areas include cloud, edge, and fog servers that are operated by the OEM or end user; servers that reside at the edge of the network but run outside the carrier networks. There are also a number of classic application fields including, for example, robust microserver designs for robot controllers, test and measurement systems, higher-level factory automation, and Industry 4.0 server nodes. Another useful application for the modules is in industrial-grade OPC servers, which often form the interface between Office applications and industrial production and that have to be able to manage increasing amounts of data.

COM Express Type 7 Interfaces

Server-on-modules conforming to the COM Express Type 7 specification feature up to four 10 GbE interfaces, a complete set of NC-SI sideband signals, and additional PCI Express lanes. The new modules hence differ significantly from the Type 6 specification; numerous interfaces had to give way to the new interfaces: Deleted were all audio and video interfaces as well as four of the eight USB 2.0 ports, the ExpressCard interface, and two of four SATA ports. This freed up 60 pins on the AB connector and 42 pins on the CD connector for the new interfaces.



congatec's new COM Express Type 7-compliant server-on-module comes with Intel® Xeon® processors (codename: Broadwell DE).

The 10 GbE interfaces are designed as 10GBASE-KR single backplane lanes (see IEEE 802.3/49) to keep them from being bound to predefined physical interfaces. Subsequently the PHY, which defines the physical transmission layer, is not on the module but is instead implemented on the carrier board. This means that the data transmission method (be that copper or fiber optic cable) only needs to be defined during implementation on the carrier board. For even greater flexibility, the interfaces can be implemented as interchangeable SFP+ modules. It is also possible to combine the performance of several 10-Gigabit Ethernet signals. Four 10GBASE-KR lanes can be combined in a PHY for 40GBASE-KR4.

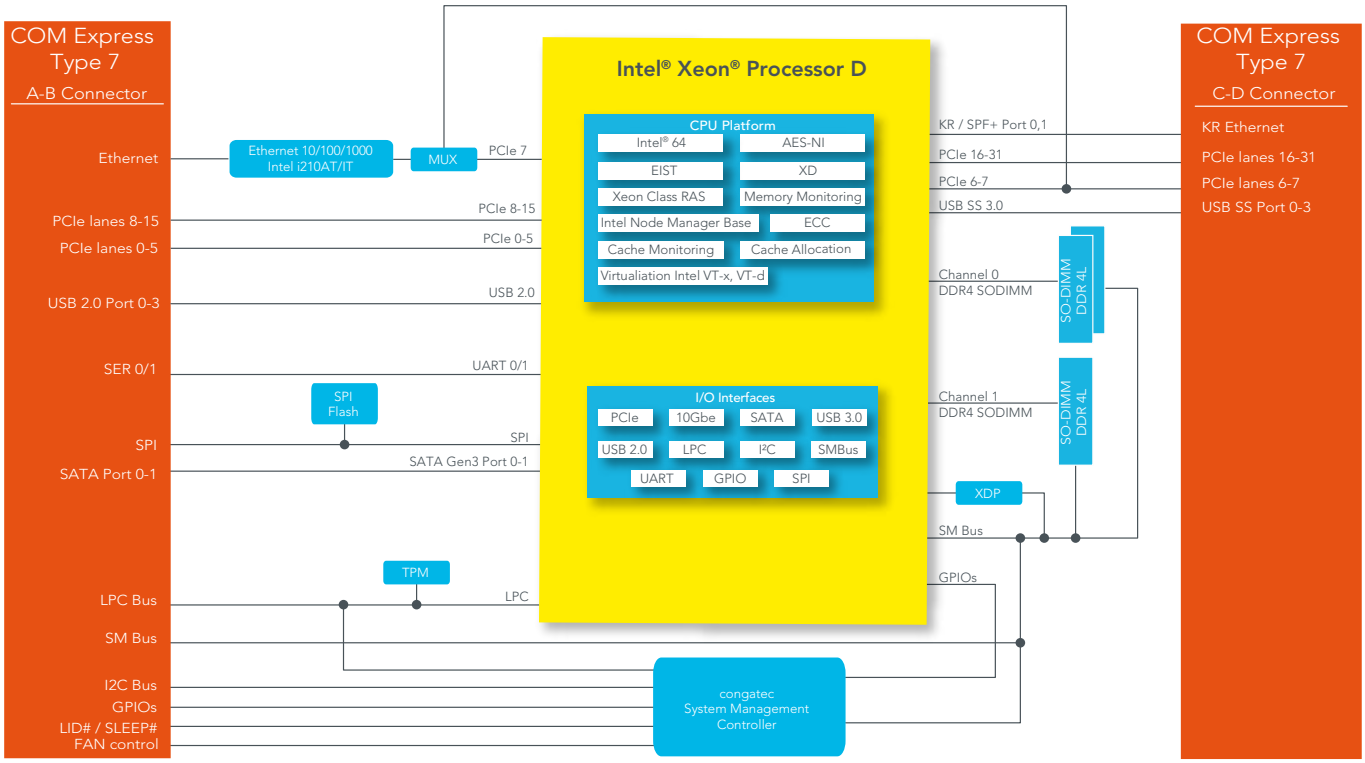
The COM Express 10GBASE-KR interface feature set provides a software-definable pin for each of the four interfaces. This physical pin can be configured as an input or an output and is controlled by the corresponding Ethernet controller. A typical application is implementation of a hardware-based timing protocol in accordance with IEEE 1588 for powerful real-time applications.

Mass Storage Interface

The omission of two SATA ports may seem confusing at first because server applications always need greater mass storage capacity. However, the latest technology trends clearly show that SATA drives are increasingly being replaced by solid-state drives (SSDs). Because SSDs are much faster, the SATA interfaces are now becoming bottlenecks and are being superseded by NVMe (NVM Express or Non-Volatile Memory Host Controller Interface specification – NVMHCI; see www.nvmexpress.org), which PCI Express uses for connecting mass storage devices. Type 7 clearly supports this development with its greater number of PCIe lanes.

Feature Set

The new COM Express Type 7-compliant conga-B7XD server-on-modules are designed as headless modules with ten different server processors: from the 16-core Intel® Xeon® D1577 processor to the Intel® Pentium® D1519 processor for industrial temperature ranges (-40 °C to +85 °C). They offer up to 48 GB of 2400-MHz DDR4 RAM with or without error correction (ECC), as required by the customer.



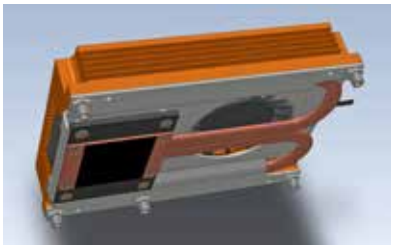
Die neuen Server-on-Module bieten auf Basis des weltweit führenden COM Express Basic Formfaktors (95 x 125 mm) erstmals 10 Gigabit Ethernet Schnittstellen, 32 PCIe Lanes sowie Headless Serverperformance mit aktuell bis zu 16 Server-Cores und 48 GByte DDR4 ECC RAM.

The distinguishing feature of the new congatec server-on-modules is the high network performance with 2 x 10 Gigabit Ethernet. For connection of powerful system extensions, including flash memory, they also feature up to 24 PCI Express Gen 3.0 lanes and eight PCIe Gen 2.0 lanes. Conventional storage media can be connected via 2 x SATA 6G. Four USB 3.0, four USB 2.0, an LPC, an SPI, an I2C bus, and two UART are also available as additional I/O interfaces. OS support is offered for all common Linux distributions and Microsoft Windows variants – including

Microsoft Windows 10 IoT. Support of remote management technologies completes the feature set.

Single-source cooling solutions

The new server-on-modules are able to consume up to 65 W, so to improve chip reliability and extend service life, system developers have to pay special attention to efficient cooling. A good cooling design should provide enough cooling so the Turbo Boost can be used to supply additional processing power. Turbo Boost enables overclocking of the processor, but only if it remains cool enough. To facilitate thermal management for developers, the COM Express specification defines a standard heat spreader. Its flat surface allows it to be easily integrated into server designs and also enables fast technology upgrades without the need for mechanical and/or electrical system architecture changes. This also makes it much easier to follow the constantly changing roadmaps of the chip manufacturers. However, even with the specification, designers must take into account the necessary thermal material stack between the module and the heat spreader. The location and material is often unique with each module family and manufacturer. Suitable specification-compliant heat spreaders and heat sinks supplied by congatec are tailored for each module to make the job of integrating the new server-on-modules easier for developers, completely in line with the congatec's motto "we simplify the use of embedded technology." congatec also supplies an evaluation carrier board for evaluating the server-on-modules. The circuit diagrams and the layout are available for free and can be used as the basis for customized designs.



For the new COM Express Type 7 server-on-modules, congatec also offers matching heat pipe-based cooling solutions:

The original COM Express 3.0 specification can be obtained directly from the PICMG. www.picmg.org/shop

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