Server-Grade Performance
Computer-on-Modules:

COM Express Based on Intel® Xeon® Solution
Table of Contents

Introduction: Market Overview and Challenges ................................................................. 1
Advantech Server-grade Solution ......................................................................................... 1
Technologies ....................................................................................................................... 2
  Server-grade Platform Overview ..................................................................................... 2
  Biggest Memory Size of COM Express Basic .................................................................. 4
  10GBASE-KR Integrated ............................................................................................... 4
Summary ............................................................................................................................. 7
Product Offerings ............................................................................................................... 8
Introduction: Market Overview and Challenges

Modularized computers have been with us for many years and have led to the emergence of many form factors such as ETX, COM Express, and Qseven. These architecture-independent hardware platforms allow the user to leverage exchangeability between different chipsets to extend product life cycles and simplify carrier board design, thus shortening development schedules and fulfilling time-to-market demands. Computer-on-modules accounted for 22% of industrial board solutions with CAGR growth of 15%, while other industrial standards like CPCI declined. No doubt, computer-on-modules are here to stay and will become one of the most prevalent platforms in coming decades.

Computer-on-modules are employed in a wide range of applications from servers, HMI, transportation, automation, and gaming, to defense, medical, and more. With growing demand from the IoT market, existing solutions have failed to satisfy industry needs. Most system integrators want higher computing performance to fulfill complicated data processing requirements, as well as more bandwidth to deal with the huge data throughput typical in IoT systems. Meanwhile, redundant systems ensure stable, reliable services and are a common architecture in IoT, as are cluster computing systems, but it will need slim thermal module for extreme computing performance to meet limited space and high-density application requirements. It is difficult to implement a traditional server processor into computer-on-module while still meeting thermal design requirements, since computer-on-modules circuit board dimensions are small but server platforms are usually over TDP 100 W with a large thermal module for heat dissipation. The advent of the embedded Xeon processor has boosted modularized computers to server-grade performance but with low power consumption, something that exactly compensates for the lack of performance in the computer-on-module domain.

Advantech Server-Grade Solution

Extreme performance with the Intel Xeon multi-core processor and maximum memory capacity on the COM Express board’s limited size to drive higher computing capabilities

Increasingly more COM Express users are seeking solutions with higher computing performance to deal with multi-task processing and massive data transmissions for IoT. In the past, users had no choice but to adopt regular x86-based processors to fulfill their requirements, but the new Intel Xeon processor family has made a substantial stride forward and has given system integrators a new arsenal of powerful processors to choose from. Take the Intel Xeon-D platform for instance; it has a maximum of 16 Xeon cores that provide extreme computing capability but with restricted power consumption of only 45 W.
Advantech’s SOM-5992, designed on the Intel Xeon Processor D-1500 family, is the world’s first COM Express to support 64 GB DDR4 SODIMM powered by a server-grade processor that provides a high-bandwidth interface for data transmission, all within a basic form-factor of 125 x 95 mm and in compliance with the PICMG COM.0 R3.0 Type 7 pin-out specification. For micro-server and networking application scenarios, users often adopt a thin chassis or blade/slot architecture. The SOM-5992 is designed with extra, dedicated CPU heatsink screw holes that allow for a low profile and flexible thermal solution. With this new product, users can easily design a scalable, high-performance system with all computer-on-module advantages but without being restricted to ATCA/CPCI slot architectures.

Technologies
Server-Grade Platform Overview

In response to the expansion of the IoT market, Intel launched the new Xeon platform, which targets higher performance for multi-tasking and massive data processing yet with the same low power consumption. The Intel Xeon processor D-1500 product family brings the performance and advanced intelligence of Intel Xeon processors into a dense, low-power, system-on-chip (SoC). With enhanced reliability, availability, and serviceability features; temperature rating spans from -40 to 85 °C operating ambient conditions; and built-in hardware virtualization; the Intel Xeon processor D-1500 product family offers new robust options for optimizing a variety of workloads and new infrastructure solutions for midrange routers, network appliances, security appliances, embedded midrange IoT devices, entry networking, midrange storage area networks, network attached storage appliances, warm cloud storage, and much more.

Figure 1. Intel Xeon D-1500 Processor Family Overview
The D-1500 product family delivers up to 16 Xeon cores to provide extremely powerful computing capability and two integrated ports of 10G Intel Ethernet for ultra-fast connectivity, with resulting benefits for multi-tasking, multi-threading, video rendering, and any other processor-intensive applications. For example, some computer servers slow down when several users access them concurrently, accessing databases or advanced encryption options. With multicore processors, these servers can delegate processing cores to individual user requests instead of multi-tasking a single processor or waiting for one process to complete before starting another; then, exchange data through the high-bandwidth 10G LAN to complete the massive data throughput.

The other Intel Xeon-based platform—the E3 product family—is designed for mobile workstation applications. The Intel Xeon processor E3-1500M product family delivers responsive performance and high-speed I/O, including PCIe x16 gen3, USB 3.1 and SATA3, as well as error-correcting code (ECC) memory support for system stability. Intel vPro™ technology helps to reduce system latency while enabling multi-tasking, remote maintenance, wireless manageability, and out-of-band capabilities.

Built-in P360 HD Graphics permits hardware-accelerated imagery and great media processing effects, helping users to deal with complex map visualizations, video transcoding, and multi-display in 4K resolution (ultra-high definition), and up to 3 ports DP++ simultaneously, suitable for mid-level computing applications as well as for IC test equipment, media decoding, and company server requirements.

Figure 2. Intel Xeon E3-1500 Processor Family Overview
(Source: https://www.intel.com.tw/content/www/tw/zh/processors/xeon/xeon-e3-1500m-v6-mobile-family-brief.html)
Biggest Memory Size of COM Express Basic

The Intel Xeon Processor D-1500 product family uses an integrated memory controller that supports dual-channel interface and up to 2 DIMMs per channel. In order to exploit the full performance of 16 core processors, the SOM-5992 is uniquely designed with a maximum 64 GB SO-DIMM memory in four SO-DIMM sockets (each up to 16 GB), 2400 MT/s (both ECC and non-ECC are supported).

The Intel Xeon Processor D-1500 product family is the next generation of 64-bit, multi-core enterprise SoC built on 14-nm process technology, a maximum of 16 Xeon cores and 32 cores with Intel® hyper-threading technology. With 64 GB memory support, the multi-core SoC delivers the best performance in multi-tasking which is vital for servers. Users can expand the performance by adding a dozen SOM-5992 boards to spare locations in the system with little effort to change firmware or software and reduce design schedules, thus being able to benefit from its scalability and configurability by copying the baseboard design into multiple chasses and configurations in accordance with customer requests.

The scenario is depicted below:

![Diagram](image)

*Figure 3. Structure of Multi-Module Applications*

10GBASE-KR Integrated

This high computing power platform targets networking, cloud storage, and telecommunication products, where massive data flows and high bandwidth transmit-receive interfaces are necessary. The Intel D-1500 product family is the first SoC integrated 10GbE interface; it reduces design complexity, minimizes board size, and saves on BOM costs. The 10GBASE-KR interface mostly operates over a single backplane and uses the same physical layer coding (defined in IEEE 802.3 Clause 49) as 10GBASE-LR/ER/S. From IEEE 802.3-2012 Annex 69B definitions, 10GBASE-KR allows backplane PCB routing for 1M and transfer to copper (10GBASE-T), fiber (SFP/SFP+), or any other protocol through the appropriate PHY, which brings flexibility for scalable and modularized system design.
In contrast to other general differential high-speed signaling that uses visual patterns to verify signal integrity, 10GBASE-KR is designed to keep the passive channel healthy. From IEEE 802.3ap Annex 69B Interconnect Reference Model, electrical characteristics are defined on TP1 (i.e., IC ball out). The KR channel is seen as passive and only defines passive channel characteristics (from TP1 to TP4) such as impedance, insertion loss, insertion to crosstalk ratio, insertion loss deviation, and especially return loss. The figure below shows the Advantech model with the COM Express board-to-board architecture with an add-on card. This add-on card simulates a usage case where a designer may adopt a different PHY to achieve a different protocol to fit an application. Here, we consider only the passive channel characteristics so we need not specify a particular PHY or chip; the simulation results pass.

Figure 4. IEEE 802.3ap Annex 69B Interconnect Reference Model

Figure 5. SOM 10GBASE-KR Channel Simulation Results: Port0_TX, Port_TX
Advantech SOM-5992 integrates a 2-port 10GBase-KR interface, and an add-on card with 10G PHY on a Type 7 carrier board, which supports copper and fiber interfaces, respectively. SOM-EA60 for a copper interface supports two RJ45 connectors. SOM-EA61 supports two port SFP+ connectors. Customers can test all functions or take it as a reference to shorten the system development process.

For 10GBase-KR, there are four differential signals to each 10G LAN port; the following are practical passive channel verification results of a SOM-5992 + SOM-DB5920 + add-on card.

Figure 6. Practical Passive Channel Verification: Fitted Attenuation (FA)
- SOM-5992 + SOM-DB5920 + SOM-EA60
Figure 7. Practical Passive Channel Verification: Fitted Attenuation (FA)
- SOM-5992 + SOM-DB5920 + SOM-EA61

Summary

Computer-on-module designs Intel Xeon base processors create a new page to break through the ceiling of computing power; products can be upgraded for the server-grade segment and the product offering spectrum can be expanded. Advantech, as a leading company in embedded intelligent systems, has launched a complete group of server modules. The SOM-5992 with Intel Xeon-D supports multi-core processors and the maximum memory capacity to deliver excellent data-processing performance under TDP 45 W; the integrated 10G LAN bandwidth ensures a fast connection to the cloud while also acting as a high-speed bridge between two or more COM Express boards in a high-density system such as a blade server. The SOM-5899 design, with Intel’s latest graphics engine (UHD Graphics 630), offers high efficiency in graphics processing, making it an ideal solution for media server and machine vision applications.

For more information about SOM server-grade products and user scenarios, please get in touch with your Advantech contact person.
Product Offerings

**SOM-5992 Product Features** (COM Express R3.0 Basic Module, Type 7 pin-out)

- Intel Xeon Processor D-1500 Product Family
- 64 GB dual channel SODIMM, with ECC. 32 pair PCIe lanes and USB 3.0
- Integrated TPM2.0. Two ports 10GBASE-KR Ethernet I/F

See More: [SOM-5992](#)

**SOM-5899 Product Features** (COM Express R3.0 Basic Module, Type 6 pin-out)

- 8th gen Intel Xeon Processors + PCH. Support Intel UHD Graphics 630
- 48 GB dual channel SODIMM, with ECC. USB 3.1 and super speed expansion
- Integrated TPM2.0. Three ports 4K HD display I/F

See More: [SOM-5899](#)

**SOM-5898 Product Features** (COM Express R2.1 Basic Module, Type 6 pin-out)

- 7th gen Intel Xeon Processors + PCH. Support Intel HD Graphics P630
- 32GB dual channel SODIMM, with ECC. Super speed expansion and I/O interface
- Integrated TPM2.0. Three ports 4K HD display I/F

See More: [SOM-5898](#)

**SOM-5897 Product Features** (COM Express R2.1 Basic Module, Type 6 pin-out)

- 6th gen Intel Xeon Processors + PCH. Support Intel Iris™ Pro Graphics
- 32GB dual channel SODIMM, with ECC. Super speed expansion and I/O interface
- Integrated TPM2.0. Three ports 4K HD display I/F

See More: [SOM-5897](#)

**SOM-DB5920 Product Features** (PICMG COM Express R3.0 Type 7 development board)

- PCIe x16 slot, 2 PCIe x4 slots w/ riser card for extension to 4 PCIe x1
- Add-on card for 2 ports 10GBASE-T or 10G SFP+ function extension
- Integrated BMC supports OOB remote management IPMI, iKVM, VGA interface

See More: [SOM-DB5920](#)