Solution Brief

Government and Defense
Single-Board Computers

New Rugged Plug-In Card Is Ideal for Sensor-Based Systems

Concurrent Technologies TR L9x/6sd-RCx processor board, built on SOSA and VITA standards, provides high performance for I/O sensor device needs

Defense applications and devices need to analyze large amounts of data and rely on low-latency connectivity. From ship sensors to satellite telemetry and ground transportation operations, access to an ever-widening array of data streams is vital. Military and security personnel depend on being able to capture, analyze, and gain insight from massive volumes of data as quickly as possible. Military operations expect accurate data collection for mission effectiveness while maintaining a high level of security. With technology improvements in connectivity, more data can be captured and analyzed remotely, at the edge in the field.

Today, military computer systems need to deliver high-performance edge computing in an array of harsh environments—whether on land, at sea, in the air, or in space. Many defense systems are required to perform in all conditions, withstanding significant altitudes and temperature ranges, as well as exposure to liquid, shock and operational vibration, and other environmental challenges like salt fog. And in many cases, edge computing systems must be lightweight and compact to accommodate extreme space constraints.

Challenges

Small form factor design requirements

Design requirements are becoming increasingly complex. Form factor sizes are getting ever smaller, even as functionality requirements are increasing. Power requirements demand lower power consumption and thermal output. Additionally, ruggedness requirements need to accommodate for the shock, vibration, humidity, and temperature extremes inherent in mobile and outdoor applications that often present embedded systems designers with difficult problems to resolve.

Attention to size, weight, and power (SWaP) is critical in defense applications. At the same time, the demand for high-performance embedded computers has never been greater. Military engagements depend on access to complex, near-real-time data and the ability to share that data between commanders and frontline personnel. As the defense market demand grows for better SWaP with every increasing level of performance, solution providers must respond with small form factor, high performance, rugged, embedded computing designs. And these designs need to be based on open standards.

Additional complexities of sensor system design

In addition to SWaP considerations, sensor systems need to process and transfer vast amounts of data between computing elements within a system. For example, phase-array, antenna-based systems send and receive large amounts of sensor information that need to be precisely timed. This means that low latency is essential to enable the signals and packets to get in and out of the system as quickly as possible. OEM and systems architects must also navigate a host of business challenges, including:

- The need for more I/O-intensive processing and high-speed communication
- The need for reliable performance in harsh environments and extreme temperatures, ranging from -40°C to 85°C
- Advancing security requirements to protect systems, applications, and data from malware and other cyberthreats

Solution: The TR L9x/6sd-RCx processor board for sensor systems

Concurrent Technologies designs a range of high-performance Intel-based processor boards, switches, networking, storage, and software products for use in embedded computing solutions. Concurrent has developed a rugged plug-in card that can be used as the system controller in high-performance sensor-based solutions in the defense space. The TR L9x/6sd-RCx is ideal for use in situational awareness, software-defined radio (SDR), and radar processing applications. This new 3U VPX conduction-cooled card was designed in alignment with the SOSA Technical Standard for I/O-intensive processor boards.

The Sensor Open Systems Architecture (SOSA) is a standard initiated by the US Air Force, Army, Navy, and various US government agencies to develop a unified, technical, open-systems architecture for complex systems such as radar, EO/IR, SIGINT, communications, and other activities. The standard is focused on addressing problems with vendor interoperability, limited path for upgrades to new technologies, and vendor lock. These problems were pushing prices up and hindering improvements of new sensor-based platforms. Sensor technologies developed to the SOSA standard use commercial off-the-shelf (COTS) parts that can be more easily integrated, repaired, or replaced in an existing system, thereby removing dependence on parts from specific vendors. In alignment with the SOSA Technical Standard for I/O-intensive processor boards, Concurrent Technologies has developed a new rugged plug-in card, ideal for use in sensor systems.

SOSA Consortium goals for sensor systems design

SOSA's goal is the development of open standards that provide rapidly reconfigurable, upgradable, and cost-effective sensor-based solutions. These complex and high-performance sensor systems are typically constructed using best-in-class plug-in cards that are provided by expert vendors. Having the ability to upgrade existing systems for higher performance and doing this rapidly enables the delivery of new functionality in a cost-effective way and extends the life cycle of the platform. The SOSA Consortium provides the collaboration framework for all the stakeholders from government and industry to create these truly interoperable sensor systems. SOSA will enable military embedded systems designers to create new systems, and make substantial upgrades to existing systems, in a fraction of the time that traditional open-systems standards allow.[1]

The consortium has developed an open-system reference architectures applicable to military and commercial sensor systems and a business model that balances stakeholder interests. The architectures employ modular design and use widely supported, consensus-based, nonproprietary standards for key interfaces that are expected to:

- Reduce development cycle time and cost
- Reduce systems integration cost and risk
- Increase commonality and reuse
- Reduce sustainment and modernization cost
- Support capability evolution and mitigate obsolescence
- Enable technology transition
- Facilitate interoperability
- Isolate the effects of change[2]

Processing large amounts of sensor data

Using this technology greatly enhances applications that need to process large amounts of sensor data. The TR L9x/6sd-RCx offers up to eight cores for high-performance compute algorithms that are used in sensor-based systems for radar, SDR, electronic warfare, and C4ISR (command, control, communications, computers, intelligence, surveillance, and reconnaissance) applications.

Combining open standards like SOSA with VITA 49.2[3] standardizes sensor systems from both a hardware and software perspective. For example, VITA 49.2 extends the original VITA 49 standard by also delivering outgoing signals into radio transmitter equipment. Here, timestamp information can specify precisely when trigger transmit signals are generated, which is ideal for radar pulses. The 100GbE data planes are used to transfer this information between the various subsystems.

Ruggedization is a big part of the Concurrent Technologies development process. Products are available for increasing levels of operating temperature range, shock, and vibration, including three typical operating temperature ranges plus rugged variants. Humidity protection and conformal coatings are offered to provide reliable operation in different environmental conditions.

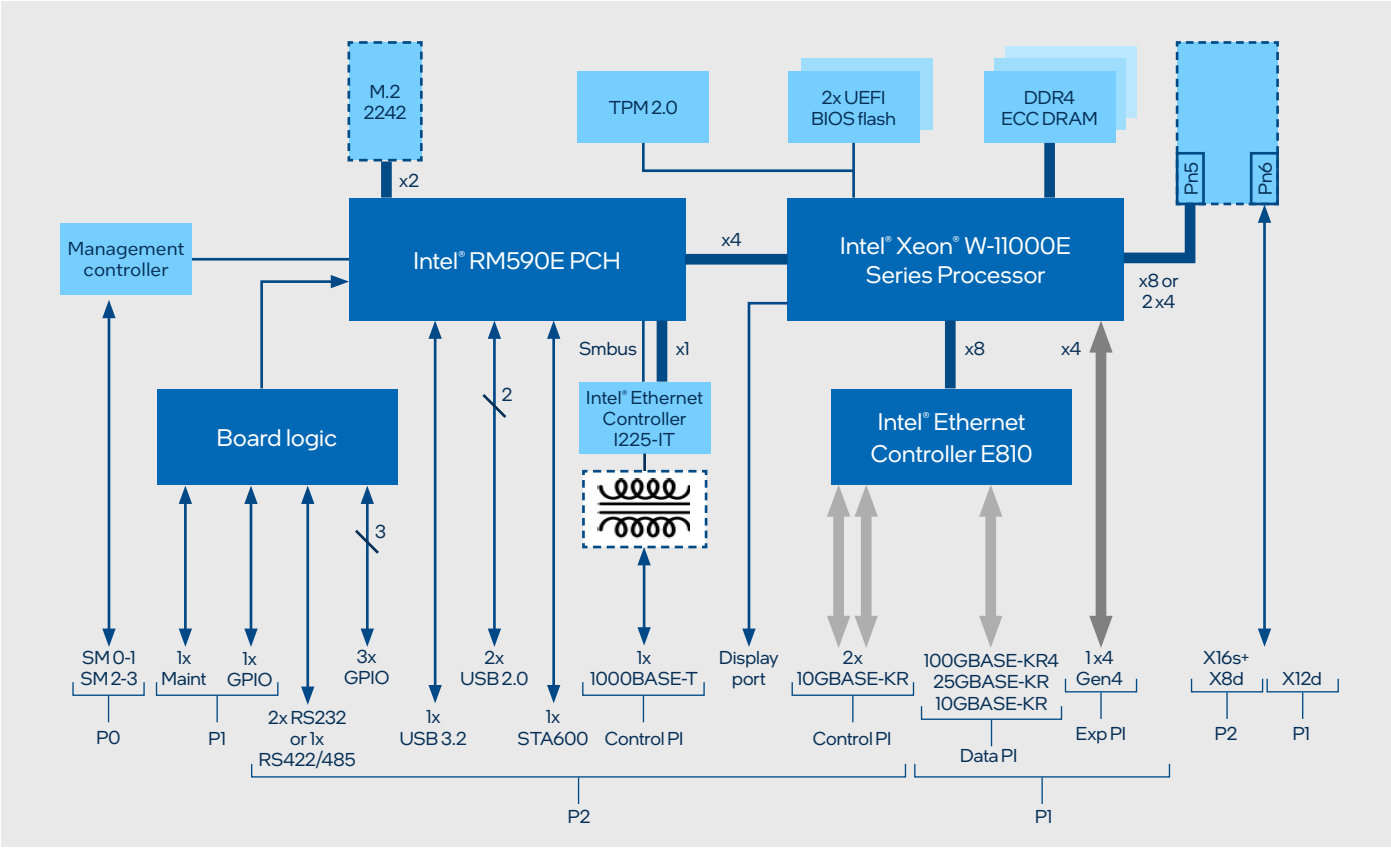

Figure 1: TR L9x/6sd-RCx diagram.

Built with Intel® Xeon® W processor technology

TR L9x/6sd-RCx is based on the Intel® Xeon® W-11000E Series processor. There are two processor options: an eight-core Intel® Xeon® W-11865MRE processor and a four-core Intel® Xeon® W-11155MRE processor. Both have integrated Intel® UHD Graphics with up to 32 execution units (EUs), which can be used for display or acceleration purposes using OpenCL™ 3.0, Intel® oneAPI, or the OpenVINO™ toolkit for image processing or artificial intelligence (AI). The graphics engine also supports DirectX 12.1 and OpenGL 4.6. In addition to the graphics engine, the Intel® Xeon® processors include AI acceleration technologies, virtualization technologies, and built-in hardware-based security.

Accelerated AI inferencing: Intel Xeon W processors deliver accelerated AI inferencing in parallel with other core functions. AI and deep learning technologies include the following:

- Intel® Gaussian and Neural Accelerator (Intel® GNA) 2.0 is designed to run audio-based neural networks at ultralow power while simultaneously relieving the CPU of this workload.
- Intel® Deep Learning Boost (Intel® DL Boost) is a new set of processor technologies designed to accelerate AI deep learning use cases. It extends Intel® Advanced Vector Extensions 512 (Intel® AVX-512) with new Intel® Vector Neural Network Instructions (Intel® VNNI) that significantly increases deep learning inference performance over previous generations.

Increased performance and virtualization: Intel® virtualization and Turbo Boost technologies help to reduce overhead and improve performance.

- Intel® Turbo Boost Technology 2.0 dynamically increases the processor's frequency as needed by taking advantage of thermal and power headroom to give a burst of speed.
- Intel® Virtualization Technology (Intel® VT-x) offers improved manageability by limiting downtime and maintains productivity by isolating computing activities into separate partitions.
- Intel® Virtualization Technology for Directed I/O (Intel® VT-d) continues from the existing Intel VT-x by adding new support for I/O-device virtualization. Intel VT-d can help improve the security and reliability of systems and also improve the performance of I/O devices in virtualized environments.

Built in hardware-based security: Intel provides security at the platform boot level, security for data at rest on the platform, and security for data in flight. Strong security features include the following:

- Intel® AES New Instructions (Intel® AES-NI) enables fast and secure data encryption and decryption.
- Intel® Trusted Execution Technology (Intel® TXT) aids in measured launch and protected execution. It enables an environment where applications can run within their own space, protected from all other software on the system.
- Intel® Boot Guard helps protect the system's pre-OS environment from viruses and malicious software attacks.
- Intel® Control-flow Enforcement Technology (Intel® CET) helps protect against the misuse of legitimate code snippets through return-oriented programming control-flow hijacking attacks.
- Intel® Total Memory Encryption (Intel® TME) helps protect data against exposure via physical attack on memory, such as cold boot attacks.

In addition to supporting the Intel® security technologies, the TR L9x/6sd-RCx is fitted with a Trusted Platform Module 2.0 (TPM 2.0) for key storage. The TPM provides integrity measurements, health checks, bulk encryption, authentication services, and a protected store for keys and data. Along with these security features, Concurrent Technologies offers a Guardian Package for a range of security options that can be tailored to meet customer security requirements. The Guardian Package ties together specific hardware features with a range of software functionality to deter tampering and to lock access to intellectual property.

The TR L9x/6sd-RCx is the first processor board from Concurrent Technologies to support up to 100GBASE-KR4 Ethernet capability, which makes it suitable for many future applications needing high-throughput communications. The TR L9x/6sd-RCx uses Intel® Ethernet Controller E810, which can provide up to 100Gbit/s throughput for diverse workloads. The Intel Ethernet Controller E810 supports both Remote Direct Memory Access over Converged Ethernet (RoCEv2) and iWARP to enable sensor-based applications to have the ability to transfer huge amounts of data without using up CPU resources. These technologies enable high-bandwidth, zero-copy transfers to take place, which significantly relieves the CPU load and frees memory bandwidth. This low-latency, fast-throughput communication is valuable for sensor-based applications, providing the ability to transfer huge amounts of data without using up CPU resources. The Ethernet control plane also supports IEEE 1588 Precision Time Protocol. Using these technologies greatly enhances applications that need to process large amounts of sensor data, like radar or SDR systems.

Conclusion

Since the new the SOSA Technical Standard 1.0 was released, its adoption by the US government and the industry has grown substantially. The demand for SOSA-aligned, SWaP-optimized, secure, high-performance I/O computing has never been greater. Concurrent Technologies' new 3U VPX conduction-cooled, SOSA-aligned, plug-in single-board computer card based on the Intel Xeon W-11000E Series processor meets the needs of many of these sensor-based systems.

For more information about the Concurrent Technologies TR L9x/6sd-RCx, please contact your Intel account executives or email us at **IOTG-PublicSector@intel.com**.

Key features of the TR L9x/6sd-RCx single-board computer:

- Up to an eight-core processor for high performance
- Up to 100GbE data plane
- X4 PCIe 4.0 expansion plane for high-speed communication with adjacent board(s)
- XMC site for additional I/O resources
- Optional M.2 module for storage with write/protect and Opal 2.0 compliance
- Rugged conduction-cooled variant only

Learn more

Intel Xeon W-11000E processors

Designed for avionics, defense, and other heavy-compute applications, Intel Xeon W-11000E processors feature high-performance, hardware-based security, extended temperature for cold and harsh environments, and long product availability on selected SKUs.

Get the details ›

TR L9x/6sd-RCx single board computer

TR L9x/6sd-RCx is the first processor board from Concurrent Technologies to support up to 100GBASE-KR4 Ethernet capability, which makes it suitable for many future applications needing high-throughput communications.

Learn more ›

About Concurrent Technologies

Concurrent Technologies manufactures board products to meet the highest level of inspection standards for long life cycles and reliable operation. Their products are used by many of the world's leading integrators within the defense, security, aerospace, telecommunications, transportation, medical, and industrial markets and are designed to be operated in a range of temperatures and environments from benign to extremely rugged.

gocct.com

intel + CONCURRENT TECHNOLOGIES

1. Keller, John. "SOSA open-systems standards for military embedded computing could double or triple the market." Military & Aerospace Electronics, January 29, 2019. https://www.militaryaerospace.com/computers/article/16722043/sosa-opensystems-standards-for-military-embedded-computing-could-double-or-triple-the-market
2. SOSA, "Sensor Open Systems Architecture." https://www.opengroup.org/sosa
3. VITA Standards, VITA – Standards Access.

Notices and disclaimers

Intel is committed to respecting human rights and avoiding complicity in human rights abuses. See Intel's Global Human Rights Principles. Intel's products and software are intended only to be used in applications that do not cause or contribute to a violation of an internationally recognized human right.

Intel does not control or audit third-party data. You should consult other sources to evaluate accuracy.

Intel® technologies may require enabled hardware, software, or service activation.

No product or component can be absolutely secure.

Your costs and results may vary.

© Intel Corporation. Intel, the Intel logo, and other Intel marks are trademarks of Intel Corporation or its subsidiaries. Other names and brands may be claimed as the property of others.

0222/LM/CMD/PDF