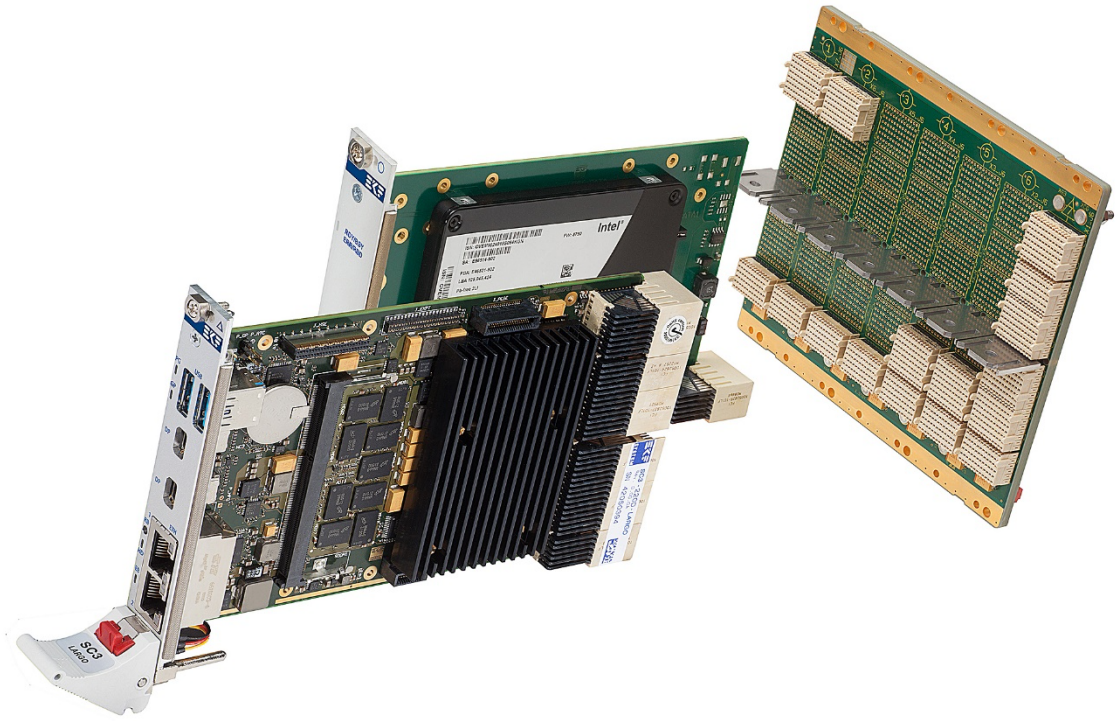
Why CompactPCI Serial Suits Your Application

The benefits of CompactPCI Serial include higher speeds, lower costs, and open standards.

The CompactPCI specification was originally developed under the auspices of PICMG in the mid-1990s when PCI was boosting PC backplane speeds beyond what was currently available. The embedded industry benefitted from the explosive growth of the PCI bus which, for embedded applications, morphed into CompactPCI.



The CompactPCI specification defines a low-cost, modular, and scalable approach to building systems for a wide range of applications, including industrial, commercial, aerospace, military, instrumentation, data acquisition, and communications.

That was followed by a whole family of specifications that define a modular and scalable approach to building high-end systems. The applications that take advantage of this technology are many and include (but are not limited to) industrial, commercial,

aerospace, military, instrumentation, data acquisition, communications, telephony, machine control, and man machine interface applications.

The next evolution took that parallel PCI architecture and serialized it. CompactPCI Serial was born—an open standard that combines speed and versatility with a wide availability of hardware (ICs) and software (drivers, APIs, etc.). And thanks to the economies of scale—think PC volumes when it comes to many of the components—it's hard to compete with the value that can be provided in CompactPCI Serial products.

The Benefits of Open Standards

CompactPCI Serial is built with longevity in mind, as systems built to the spec may be in place for ten or 15 years or longer, a common trait in many industrial applications. When upgrades are needed, CompactPCI Serial platforms can be fit with new CPU cards and other components without having to replace entire systems. And because CompactPCI Serial is an open standard, OEMs can have the confidence that components will be available for many years (even decades) from multiple suppliers.

As the name implies, CompactPCI Serial uses serial point-to-point connections, using specialized connectors that were developed for this higher speed. CompactPCI Serial allows for transmission frequencies of up to 12 Gbits/s. The typical system configuration would include at least one CPU card and a number of slots for additional functionality. Note that the connector specified for CompactPCI Serial represents a cost savings when compared to those used in more rugged VPX systems.

The power supply specified for CompactPCI Serial also represents a potential cost reduction. It operates from a single 12-V supply, which can be a commercial off-the-shelf (COTS) unit.

The total number of available I/O pins from the system/CPU slot was raised to 58 from the original specification. That's more than enough to handle a host of high-speed interfaces, including Ethernet, SATA, and USB. In fact, each slot can support up to eight

Ethernet interfaces, allowing for the construction of a full mesh interconnect without the need for an external switch. And all of the interfaces can be accessed simultaneously. In addition, the pin assignment of the system and the peripheral slots is congruent, meaning that a CPU board can be plugged into any slot to support symmetrical multiprocessing.

In terms of form factors, two different sizes are specified, 3U and 6U, in addition to support for both convection and conduction cooling. And in some scenarios, CompactPCI Serial can be combined with existing CompactPCI boards, offering a hybrid/migration path from a parallel architecture to serial connections. The specification also includes hot-plug/hot-swap capability.

Rugged and Robust Enough for the Rails

CompactPCI Serial is well suited for “moving” applications like rail transport and related off-board applications including signal control rooms and cable management. Note that also translates to applications like automotive, trucking, and other vehicle control units, whether rack-mounted or in a standalone cabinet. These applications require that the hardware adhere to the IP42 and IP54 environmental standards. They also must survive rigorous testing for shock and vibration.

The latest version of the CompactPCI Serial specification, dubbed PICMG CPCI-S.0, defines an interface for high-speed switched fabrics with a star topology. The natural serial point-to-point connectors allow as many as eight peripherals on one system slot without switches or bridges. In addition, Ethernet data transfer can be configured with a full mesh topology, which allows connections as fast as 1000Base-T to all peripheral slots for redundant, safety-critical systems.

Elma Electronic, a global supplier of embedded computing solutions including integrated chassis systems, boards, and enclosures, offers a series of air- and conduction-cooled CompactPCI Serial products and integrated subsystems that are designed for use in

safety critical applications, which would certainly include rail. The company provides products that comply with the EN50155 standard, which covers rail applications.

The ELOS rugged embedded system platform is based on CompactPCI Serial. With its modular approach, it can serve a variety of applications.

One example of a CompactPCI Serial platform that can serve a variety of rugged applications is Elma's ELOS embedded system. Based on a modular approach, it can easily be tailored to an application. It consists of a three-slot enclosure, with active or passive cooling using the CompactPCI Serial backplane, and a power supply with a wide input voltage range (14 to 154 V for rail applications and 10 to 36 V for automotive and industrial applications). Specific boards (CPU and other) can be sourced from Elma and/or third parties, which is one of the beauties of operating with an open standard like CompactPCI Serial.

Elma has vast experience working with open standards, including CompactPCI Serial, as well as other architectures. Hence, its team can point developers in the most appropriate direction. As an executive member of the PICMG trade association, Elma is actively working on CompactPCI Serial and a host of other specifications.

For many of the reasons discussed, particularly small size and adaptability, CompactPCI Serial is finding a home in many medical/healthcare applications, especially those that require higher levels of processing, like MRI, CAT, and PET scan equipment. The architecture's backplane-based modularity is another plus, as it allows for self-controlled systems—systems on wheels—to be built.

The same holds true for general industrial and communications applications. In fact, if the technology is rugged enough for rail and other transportation applications and has the horsepower for medical imaging, it's easy to see why industrial and communications can be attained with little (or no) tweaking of the systems. Simply insert the board or boards that are required to configure the box for those applications.

Reduced Complexity

When compared to some of the existing architectures, like VPX or VME, CompactPCI Serial is much less complex. It has a relatively simple plug and play design that lets OEMs mix and match the components that fit the end application. While integration issues will never completely disappear, they are far simpler when it comes to CompactPCI Serial. In other words, with CompactPCI Serial, it's far more straightforward to pick a compliment of boards and a standard backplane and plug them together and make it work with not too much effort.

In many applications, CompactPCI Serial systems can serve as viable upgrade alternatives to legacy VMEbus systems, where the ruggedness is still required but the complexity and/or higher costs can't be tolerated. As proof of that, CompactPCI Serial is deployed in rugged and high-performance defense applications including a conduction-cooled air transport rack (ATR) with a 3U backplane and a supplemental internal fan for additional cooling. The complexity reduction is partly due to the fact that CompactPCI Serial doesn't require any switches or bridges for operation in most deployments.

Open = Less Complex

The reason for that "simplicity" has to do with how the architecture was originally conceived. The necessary connections are more readily available than on a VPX or VME system, including the processors boards, the I/O, and the peripherals. And thanks to the openness of the specification, any of the components can be delivered by any vendor that complies with the specification.

When it comes time to choose your CompactPCI Serial platform partner, look for one with experience in backplanes and packaging, as those are the cornerstones of the technology. They also help determine key factors like the environmental requirements, shock and vibration, thermals, and EMI. Such a partner has the ability to bring in third-party boards from different suppliers, then configure and test the final product.

An actual example developed by EKF shows an industrial platform that operates safely under ambient conditions where typical PCs would not survive. Based on NVIDIA's CUDA architecture, its features begin with the proven mechanical integrability of a 19-in. standard subrack. The specs required an extended temperature range, robustness against humidity and dust due to module coating, and special power supplies that defy voltage fluctuations as well as transient voltage peaks in the mobile environment. CompactPCI Serial modules offered all that was required for building this high-performance computer system, including the CUDA-based peripheral module that integrates four display ports.

Software Integration

Being akin to a PC brings yet another advantage—less complexity when it comes to software integration. While the operating system of choice may or may not be the same, the bios, drivers, APIs, etc., could all be "borrowed" from the PC world. This lets the developer bring up a prototype using Linux or Windows and connect to common components using standard drivers. If a specialized or unique feature on a peripheral card is required, that board manufacturer would have to supply the drivers.

A second success story hails from PSI (Paul Scherrer Institute), who decided after a three-year evaluation, to switch from VME to CompactPCI Serial (note that the company also joined the PICMG association and participates in the CompactPCI Serial working group). Elma is partnering with PSI to design a next-generation platform.

The company's chassis is equipped with a customized CompactPCI Serial backplane with full mesh, rear I/O configuration, and a customized power backplane. This backplane includes additional utility slots, a system monitor slot for chassis monitoring, and input connectors for up to three 500-W power supplies. Integrated front and rear temperature-sensor boards enable airflow control via PWM-controlled fans separately above each hot spot.

In PSI's chassis, the crate is used to control magnetic fields for beam accelerators. High speed transmission is needed to monitor position of the beam and to process the acquired data to control the magnets for centering or deflecting the beam.

The bottom line is that, with a vendor like Elma, the developer benefits from the latest technologies and from not having to source components from multiple vendors. It's a one-stop-shop that simplifies the integration process and results in the highest performing platform.