

COMPACT PCI SERIAL

FAST AND SAFE



Railway technology needs to meet the highest standards of safety, reliability and availability. The most widely used, proven CompactPCI standard with its parallel bus structure has now reached the limits of its performance capacity. System specialist ELMA presents compatible migration paths to systems with state-of-the-art, high-speed serial architectures such as CompactPCI Serial and CompactPCI PlusIO.

Systems that will be used in railway technology must meet the highest requirements. They include maximum reliability and availability even under adverse environmental conditions such as extreme temperatures (e.g. -40° C to 85° C), dust, moisture, and mobile operation. In addition, the systems must be impervious to the strong electric and magnetic fields that occur in the rail sector and they must exhibit excellent EMC performance.

Because developing such systems from scratch is so expensive, suppliers of railway technology started, at a very early stage, to rely on modular, international standards-based systems capable of implementing requirements faster and more cheaply due to the properties of this type of modular system architecture. These are generally referred to as "commercial-off-the-shelf" systems (COTS).

The CompactPCI (PICMG 2.0) standard, by the PCI Industrial Computer Manufacturers Group (PICMG), which was founded in 1994, is particularly popular and frequently used. It is mechanically very robust thanks to its two me-

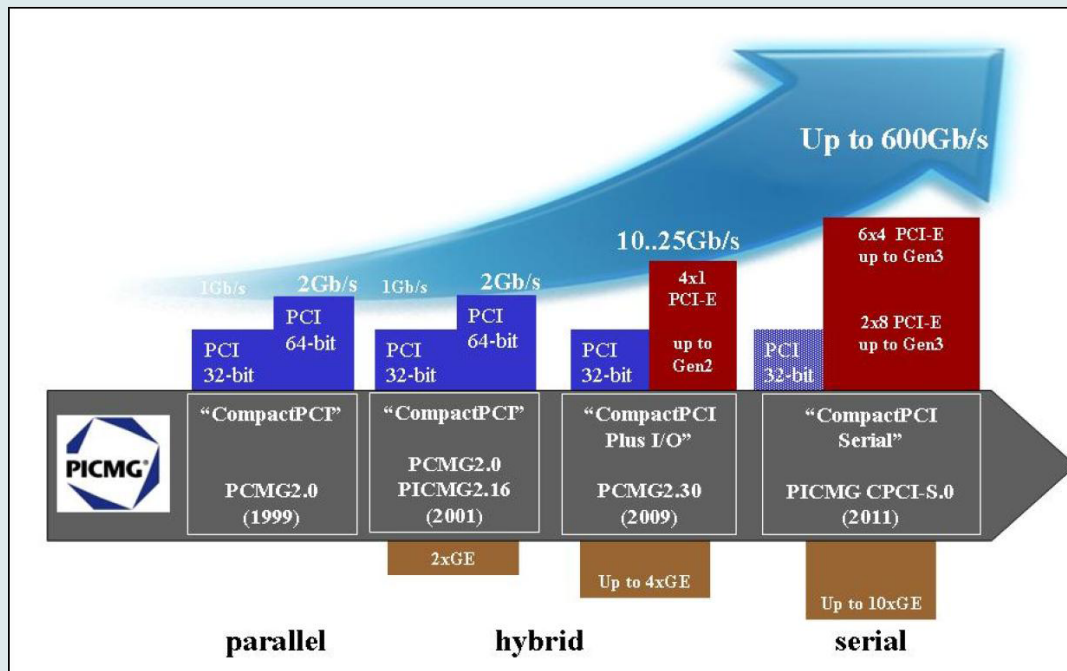
chanical form factors in single or double Eurocard formats. Many sub-standards are also defined for a wide variety of mechanical railway standards and electrical requirements.

WHAT ARE TODAY'S CHALLENGES?

The problem is that CompactPCI is still based on the parallel bus structures typical of recent decades and that the connectors defined by the standard are also starting to show their age. This limits the available bandwidth relatively clearly to rates up to 500 Mbps. With serial buses winning the battle for the PC world with PCI Express in 2003, it is also becoming increasingly difficult to source highly-integrated active components with direct parallel bus support. In addition, the performance and performance-to-power consumption ratios of many of these legacy components are no longer state-of-the-art. Nowadays, high-performance and highly energy-efficient systems are built almost exclusively on serial architectures; therefore it is essential - in new developments at least - to look for more recent standards.

THE SOLUTION: EVOLUTION OF PROVEN TECHNOLOGIES

EVOLUTION OF COMPACT PCI SERIAL (SOURCE: PICMG)



It is, of course, ideal if as many existing modular components as possible can be carried over. That is the reason why PICMG has ensured, in the development of its proven PICMG 2.0 technology, that the essential mechanical housing parameters were either kept or are at least compatible. CompactPCI PlusIO (PICMG 2.30) became available as a bridging and transitional technology in 2009; it supports both the classic CompactPCI bus (in its 32-bit version) and higher data rates of up to 5 Gbps per differential connection pair via an Ultra Hard Metric (UHM) connector. Since 2011, CompactPCI Serial (PICMG CPCI S.0) and the high-speed-capable "AirMax" connector have even allowed for data transfer rates of up to 12 Gbps per differential connection pair. This means that state-of-the-art 3rd-generation protocols (PCI Express, SATA, USB) are well supported, and there is still plenty of scope for future protocol generations. Like the previous CompactPCI, both standards are defined in the proven Eurocard 3 and 6 height unit form factors, and are thus completely compatible in terms of format.

In line with the trend towards increasingly compact systems and energy-efficient processors, such as Intel's Haswell generation, modules are currently primarily offered in 3U. In defining CompactPCI Serial, PICMG placed special emphasis on a large number of freely-definable, application-specific I/O signals. Up to 112 differential pairs are available for 3U systems, while 6U systems can even define a fully application-specific I/O connector. This means that "off the shelf" systems can be adapted to almost any project situation, if the stakeholders have the appropriate expertise to do so. A system integrator with appropriate experience can help to find the optimal solution in a faster, safer and, above all, more cost-effective way.

COST-EFFECTIVE OPERATION POSSIBLE WITHOUT A SWITCH

CompactPCI Serial systems can also be operated without a switch and directly support configurations with one system slot (master) and up to 8 peripheral slots (slaves). The peripheral slots can be equipped with either I/O cards or processor cards. The maximum power budget per slot in this case is 60 watts in 3U and 120W for 6U systems with a +12 V power supply and 5V as the backup voltage.

In contrast to the "classical" CompactPCI, keying is not currently envisaged; hot swap is optionally supported. The use of proven, existing form factors and the robust high-speed connectors result in mechanically impervious ("rugged") systems and the ability to continue using all known cooling methods (air, conduction and liquid cooling) with the existing infrastructure. The supported standard topologies are full-mesh (Ethernet only) and single star (PCI Express, SATA, and USB). This allows developers to design systems that connect peripherals to a single CPU, or network several single board computers (SBCs).

EASY MIGRATION

CompactPCI PlusIO is a transitional standard in which the 3U form factor uses a hybrid backplane to support both the conventional 32-bit CompactPCI (parallel) bus including the matching, legacy peripheral cards as well as up to 4 additional "fast" CompactPCI Serial peripheral cards. It thus allows for rapid and reliable implementation of the new serial technology while at the same time keeping existing key components as peripherals. However, the bandwidth is restricted here because the special CompactPCI PlusIO Master can only provide a single PCI Express lane (Ultra Thin Pipe, x1) in serial communication with CompactPCI Serial peripheral cards. Additionally, the master only has two Gbit Ethernet interfaces, and only supports the Gen1 and Gen2 protocols at up to 5 Gbps.

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COMPACT PCI SERIAL PLUS I/O



SUMMARY AND OUTLOOK

The known mechanics and compatible development of CompactPCI allow a rapid and low-risk entry into the world of state-of-the-art, high-speed serial systems, opening up a "soft" migration path with just as much innovation as necessary. The expertise of an experienced system integrator can significantly reduce the overhead and risk of migration or entry into the world of high-speed serial bus systems. Moreover, the security and availability of highly-complex computer systems can be further enhanced by extensive remote maintenance and intelligent system management options. PICMG also recognizes this fact, and has set up a working group under the auspices of ELMA to develop IPMI (Intelligent Platform Management Interface) standard-based chassis management as an extension to CompactPCI Serial.

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ABOUT ELMA

Elma Electronic is a global manufacturer of electronic packaging products for the embedded systems market – from components, storage boards, backplanes and chassis platforms to fully integrated subsystems. Elma is listed on SIX (Swiss Stock Exchange), with subsidiaries in 9 countries on 3 continents. To ensure our integrated solutions are optimized to our customer's needs, Elma partners with leading board manufacturers in the industry. Elma also provides enclosure solutions to electronics companies, from cases to vertical cabinets, as well as precision components such as rotary switches/encoders, front panels, and LEDs. The company has a broad base of proven standard products that can be tailored to individual applications, from initial concept to volume production. Elma's reliable solutions, flexibility, and design expertise are key reasons why the leading electronics companies in the world choose Elma time and again.