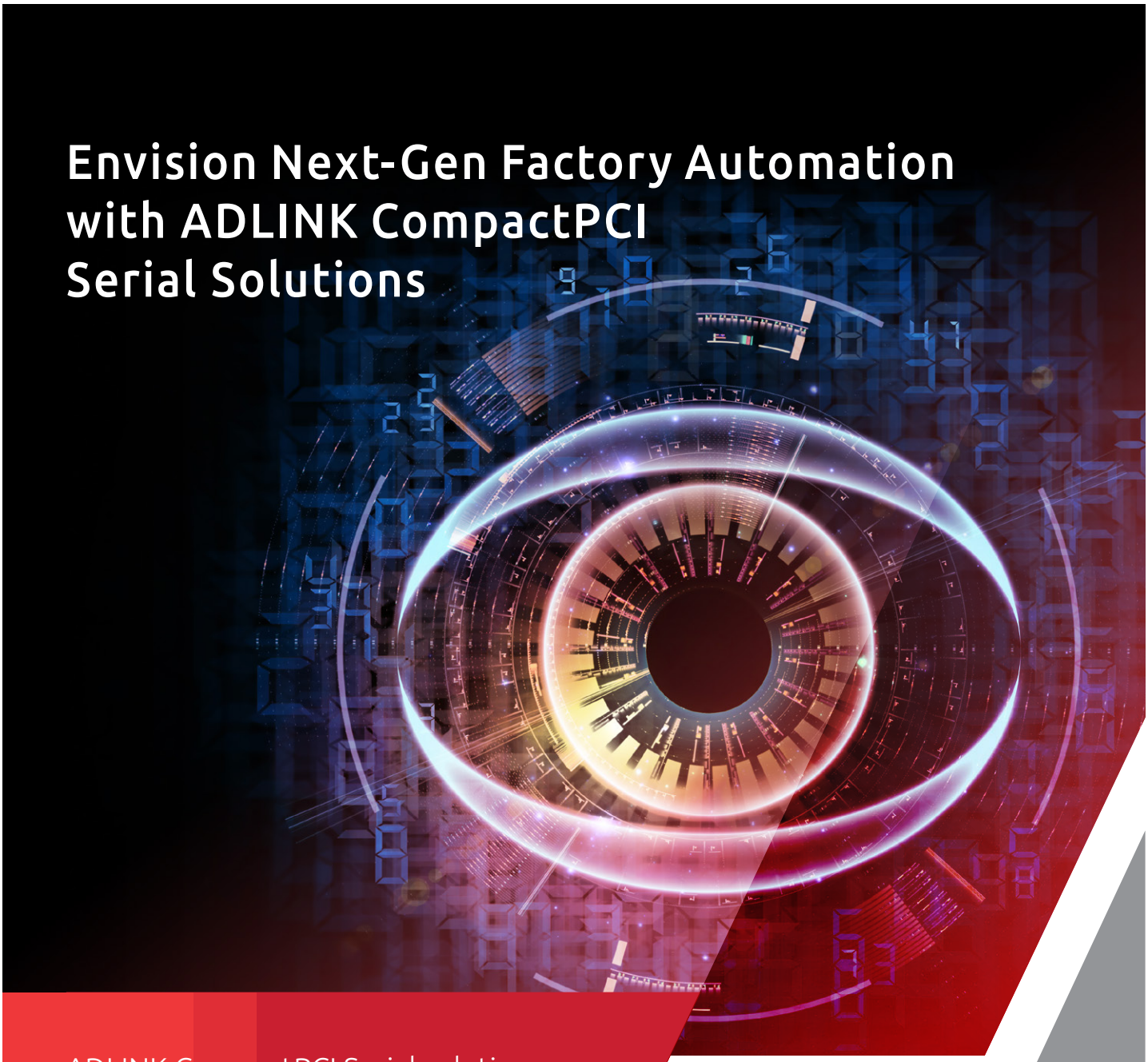
ADLINK
LEADING EDGE COMPUTING

Envision Next-Gen Factory Automation with ADLINK CompactPCI Serial Solutions



ADLINK CompactPCI Serial solutions enable a new level of camera-driven productivity and capability in today's forward-looking factory environments

Solution Brief

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Envision Next-Gen Factory Automation with ADLINK CompactPCI Serial Solutions

Seeing Quality is Believing

Today's industrial manufacturing market faces a host of challenges. Among these are demands for increased quality, improved worker safety, more environmentally friendly products and processes, higher output speed and efficiency, and ever-lower labor costs. As Statista shows, even in developing economies such as Mexico and Vietnam, manufacturing labor costs continue to rise each year. Industrial automation offers many opportunities to counter labor costs and address the manufacturing sectors' chief concerns. Given current trends in Internet of Things (IoT) and Industry 4.0 adoption, both of which intersect significantly with automation technologies, Mordor Intelligence estimates that industrial automation will exhibit 8.5% compounded annual growth rate (CAGR) through 2026.

An increasingly critical factor in industrial automation is machine vision (MV), the automated ability to extract information from digital images. Vision systems will consist of a camera assembly (at least one lens and image sensor), an image processing computer system, image processing software, and a network that links the MV system to local (edge) or remote factory systems. Uses can include:

- Decoding of barcodes or QR codes, and optical character recognition (OCR)
- Counting of items to make sure there are the correct number (e.g. lace holes/eyelets on a shoe)
- Measuring of distances between items to ensure they are spaced apart correctly from each other
- Locating and verifying that features on a product are present and in exactly the right place

A well-calibrated MV system can perform these repetitive tasks with far greater speed and accuracy than humans. This also leads to higher overall quality control, much improved efficiency, and significant gains in production line yields. Moreover, these actions can provide the foundation for more sophisticated applications, such as multi-axis hydraulic motion control or robot guidance.

With its modern roots in the 1960s and first industrial deployments in the 1980s, machine vision growth is stronger than ever. Grand View Research puts the MV market at an annual compounding rate of 6.9% through 2028, but within this lies notable growth pockets. For example, the "deep learning software sub-segment is anticipated to expand at the highest growth rate [7.2%] over the forecast period owing to the increasing demand for the smart machine vision systems that are equipped with the capabilities of reacting smartly based on the necessity of the operation."

The larger the MV deployment and the more sophisticated the application, the more likely it is to involve many cameras, and those cameras may demand the highest possible resolutions, frame rates, and/or dynamic ranges. In industrial settings, this large amount of data will likely need to be processed in real-time since every second of delay means a loss of efficiency in production. (As a reference point from a related field, consider that one 4K camera in an autonomous vehicle can generate up to 5.4TB of data per hour.) The upside of such performance is the ability to inspect hundreds if not thousands of items per minute with highly dependable accuracy. Ordinary PCs often lack the processing capability and round-the-clock reliability under harsh factory conditions to support such MV performance.



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Challenge: Boosting Bottling with Machine Vision

A multi-billion-dollar bottling operator approached ADLINK with a need to implement much faster, more sophisticated vision systems in its production lines. The customer already had a solution in place based on the CompactPCI standard, and while the platform needed updating to allow the production line to scale, the factors that led to the original decision to choose CompactPCI over other standards remained constant.

CompactPCI has been a fixture in industrial computing since its arrival in the late 1990s. One of the standard's top benefits is its ruggedness, as evidenced by NASA selecting CompactPCI "to stand up to the punishing shock, vibration, and other harsh operating conditions of the Mars Science Laboratory rover Curiosity." A bottling factory is not the Martian surface, but it is an environment with constant vibration and the potentially frequent shocks caused by heavy machinery. Additionally, as noted in one university's career description, bottling environments may entail "long hours in conditions that can get extremely hot."

Exceptional ruggedness and reliability has fueled CompactPCI's popularity in industrial markets for over two decades, but it also provides exceptional scalability around a backplane design for 3U and 6U cards, allowing users to add functionality and performance to rackmounted CompactPCI systems as needed. The standard grew to include switched Ethernet fabric support, but it was inherently based on the parallel PCI bus architecture, which would ultimately face the same performance ceiling as other parallel signaling technologies, such as parallel ATA and SCSI. Modern MV systems demand higher performance than parallel communications can support. Hence, the customer required a solution based on modern standards with forward-looking scalability.

Additionally, the manufacturer had developed a range of specific requirements within its factory data infrastructure. Any new system for this application would need specific I/O interfaces and configuration, a custom BIOS, Linux BSP support, and other elements that made an off-the-shelf solution difficult if not impossible to procure. Because of the heavy capital investment in this manufacturing solution, the customer also needed a solution with substantial longevity, both in technical operation and reliability as well as vendor support.

ADLINK's CompactPCI Serial Solution for Exceptional Edge Performance

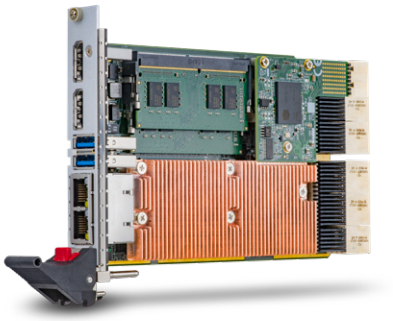
The CompactPCI Serial standard arrived from the PCI Industrial Computer Manufacturers Group as PICMG CPCI-S.0 CompactPCI Serial in March 2011. The update provided a serial communications alternative to parallel buses and adopted point-to-point connections, including USB, SATA/SAS, and PCI Express. CPCI-S.0 continues to utilize the 3U and 6U eurocard form factor, and supports the legacy CompactPCI ecosystem (which can be instrumental in adding value for customers with existing CompactPCI investments). The update introduced a new, rugged 184-pin connector, with enclosures that support one system slot and eight peripheral cards. Importantly, the pin assignments of system and the peripheral slots are congruent, allowing system cards to be installed into peripheral slots to enable highly scalable multiprocessing. Also, each peripheral slot can support up to eight Ethernet interfaces, eliminating the need for an external switch when implementing a mesh fabric. All the previous ruggedness and reliability aspects that made CompactPCI so valuable have also been carried forward into CPCI-S.0.

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The bottling customer approached ADLINK in search of a solution that met its many needs. ADLINK showcased a portfolio deep in both CompactPCI and CPCI-S.0 products, as well as 25 years of experience in developing solutions for mission-critical applications across industries including rail, aerospace, defense, and industrial automation. ADLINK's long track record in modified commercial off-the-shelf (MCOTS) solutions adapted to fit unique application needs attracted the client. Other ADLINK benefits included the ability to extend support cycles, thanks in large part to numerous partnerships with key computing industry suppliers, including Intel and NVIDIA, and ADLINK's long-term commitment to the CompactPCI and CPCI-S.0 standards. ADLINK also demonstrated extensive experience in providing rugged solution for demanding manufacturing environments.

In response to the bottler's request, ADLINK designed a new CPCI-S.0 solution around its flagship CPCI-S.0 processor blade, the 3U cPCI-A3525. The blade is based on Intel's 14nm, 9th generation Coffee Lake Refresh architecture. In this case, ADLINK used the six-core Intel® Xeon® E-2276ML (2.8/4.7GHz, 12MB cache, 45W), although Core™ i7 options are also available. The blade supports up to 32GB of DDR4-2666 memory, 10 USB 2.0/3.0 ports, and seven rear SATA ports. Users can integrate an optional 128GB SSD, and ADLINK supports TPM 2.0 for security as well as IPMI and Intel® AMT for remote manageability. Additionally, the cPCI-A3525 supports two PCIe x8 Gen 3 and two PCIe x4 Gen 3 connections for high-speed storage, GPGPU, or other peripheral expansion. Twin dual-mode DisplayPort ports and two RJ45 Gigabit Ethernet ports come standard, although graphics and networking capabilities can both be expanded.

ADLINK modified the cPCI-A3525 to meet the customer's needs for features such as user-defined LED indicators on the front panel as well as BIOS-level tweaks, including the addition of a dual/backup BIOS. Default operating temperature is 0°C to 60°C, but ADLINK modified to support operation from -40°C to 85°C. Shock and vibration tolerances already met the client's stringent requirements, but ADLINK worked with its partners and engineers to implement a 10-year longevity program for the solution.



CompactPCI® Serial

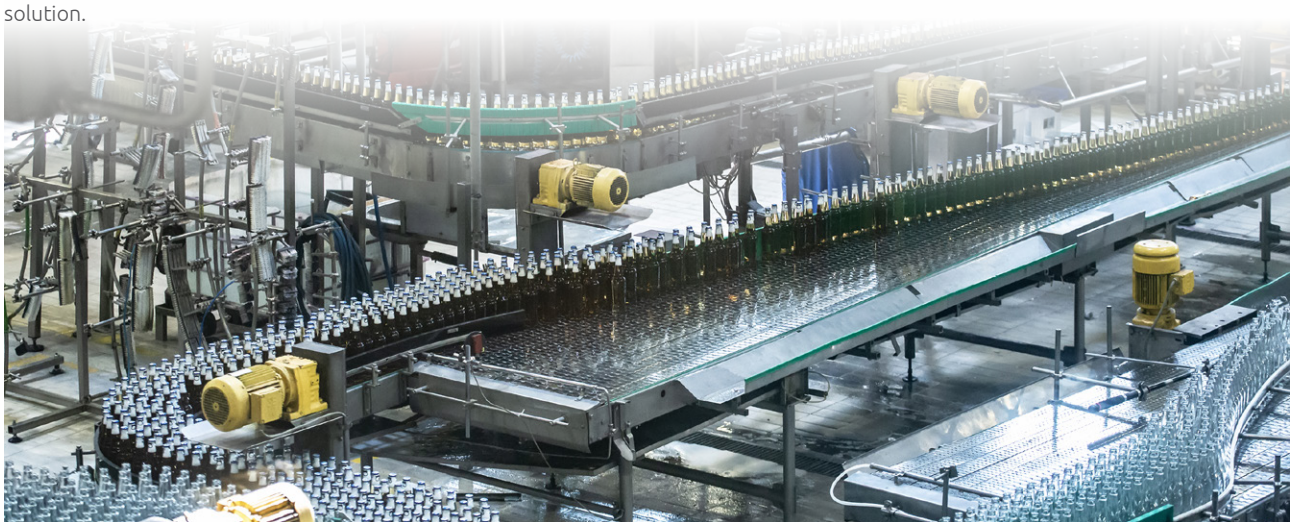
The cPCI-A3525 offered more than enough compute power to meet the manufacturer's MV application configuration. This included:

- A 24V power supply module with EtherCAT slave connection
- A 5-port switch blade with a redundant hot spare
- Up to two 4-port frame grabbers, meaning that each processor blade must support up to eight GigE cameras

Conclusion

ADLINK helped deploy its cPCI-A3525-based CompactPCI Serial solution into the manufacturer's site. As expected through ample pre-installation testing and validation, the solution met every application need and performed flawlessly. The client was able to scale its use of production line cameras, implement a more effective MV application, improve manufacturing line yields, and increase profitability.

These benefits were realized in large part by laying a technology foundation that was grounded in proven industry standards, optimized with the latest platform innovations, and modified to fit the customer's exact demands. Now, the manufacture has a fully modern, high-performance machine vision solution that can still accommodate future growth without sacrificing reliability or easy access to long-term support. This is precisely the value that ADLINK solutions bring to today's industrial computing challenges.



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