ADLINK
LEADING EDGE COMPUTING

ADLINK's PC/104 Locomotive Streaming Event Recording Solution



Safeguarding Rails

Solution Brief 2024

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Customer Application

Modern data acquisition and remote monitoring systems are essential across travel markets, including cruise lines, airlines, and especially rail. However, solutions for these markets must often tackle extreme challenges to gather the data needed to keep passengers, vehicles, and assets safe. They must protect hardware against vibration and turbulence damage, manage around-the-clock maintenance and reliability, operate in the most rugged environments, and produce as much compute performance as possible in a size, weight, and power (SWaP)-constrained platform.

ADLINK is able to leverage its decades of success in the embedded and rugged computing markets to serve this diverse and demanding travel market. In this solution brief, the customer is a world-renowned Locomotive Data Acquisition Recording System (LDARS) solution provider headquartered in the United States. Inspired by the unsolved disappearance of Malaysia Airlines Flight MH370 in 2014, the customer developed a live event recording system. This system continuously streams data to a cloud-based application accessible to authorized users, from anywhere at any time. For the rail industry, this real-time solution easily becomes the preferred event recording system, beating out traditional "black box" methods with locally stored data that can only be retrieved and read in a lab during a post-event investigation.

The customer's legacy LDARS used a PC/104 computing platform with a form factor perfectly suited for transportation applications. Its attributes included compact size, fanless operation, ruggedized build, stackable modular design, and low power consumption.

However, to develop this next-generation, intelligent LDARS solution, the customer needed a CPU with more processing power to support several new and innovative features. In general, faster CPUs generate more heat, which then require a larger thermal solution to provide the required heat dissipation capacity. The client wanted the benefits of cutting-edge CPUs without sacrificing a small, ruggedized form factor design and fanless PC/104 architecture and turned to ADLINK to create and manufacture the hardware platform for these new systems.

The collaboration led to the rail industry's first real-time streaming event recording system. This hardware/software solution includes an event recorder, digital video recorder, continuous data fusion/analysis capabilities, and visual intelligence. Running on an ADLINK PCI/104-Express compute module, the advanced LDARS solution enabled staff to remotely monitor the rail system and improve situational awareness.

By combining the customer's vast experience in rail systems with ADLINK's industry-proven, ruggedized compute technology, this new LDARS solution, with its integration of IoT-based intelligence, quickly became a revolutionary tool for the rail industry.



Challenges

As mentioned, the real-time LDARS solution falls within the IoT market category. It demands a platform that can support high-performance computing within a highly ruggedized hardware design and packaging in a SWaP-constrained compute chassis built to challenge the limits of embedded system technology.

SWaP Sensitive Requirements

The client's LDARS was a part of a complex onboard Positive Train Control (PTC) system, and it had to operate within constrained dimensions to fit safely and easily into the train's prescribed bezel mount. This small footprint also helped with durability, as a smaller design can resist physical stresses more readily than larger boards.

The customer also needed a fanless design to achieve higher levels of robustness and reliability. Often, computer fans are the most vulnerable mechanical part inside an embedded computer system. They collect dust and break down over time. However, fanless systems sometimes have trouble dissipating the heat generated by the system's processor and other active components due to a lack of active heat radiation and air circulation. To meet the thermal constraints of the operating environment, the customer required a processor with a 20-watt power envelope, allowing the system to run with only passive (fanless) cooling.

High Performance Computing

More challenges arose when the customer's end users added real-time functions and intelligence to the LDARS' list of requirements. These new features required a high-performance processor, which made it more difficult to design a small form factor system able to run at lower power levels. The customer needed an innovative design to meet these demands and strike the best balance between compute power and size. Accomplishing this would require a design able to extract the maximum compute performance per watt.

Ruggedness and Reliability

Vibration and shock remain some of the biggest threats to industrial vehicle system reliability and uptime. Breakdowns cannot be tolerated in around-the-clock operations and mission-critical use. Because of this, our customer wanted to further ruggedize the PC/104 form factor by adding latch-type connectors to maximize the system's structural strength and endurance.

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ADLINK's Solution

In addition to meeting long life cycle requirements, the LDARS solution provider ultimately chose the ADLINK CM4-SL2 PCI/104-Express SBC because ADLINK was also able to customize the standard product quickly to incorporate the latch-type connectors the customer needed. Without this latching design, every cable connection would need hot glue to achieve the required level of ruggedness. The hot glue approach would not only complicate deployment, it would also increase production costs. Switching to the CM4-SL2 and its latch connectors eliminated these issues while delivering great convenience and time-to-market benefits for the customer.

The ADLINK CM4-SL2 hardware solution offers the following advantages and features:

Industry Proven, Built to Last

ADLINK led the development and innovation behind the PC/104 form factor. Along the way, the company has consistently worked to implement innovative features into its PC/104 solutions that enable them to operate and survive in the harshest environments. Today, the CM4-SL2 showcases ADLINK's years of research and production on this front.

The CM4-SL2 system board is compliant with both EN50155:2017 vibration and shock standards. For climate-related endurance, the CM4-SL2 has an operating temperature range of -40°C to +85°C in its standard version and in humidity up to 90% non-condensing RH. True to its ruggedized shock and vibration resistant design, the CM4-SL2 employs soldered-on components, including DDR4-ECC memory chips and a 64GB SLC-based SATA SSD. The CM4-SL2's power features include ACPI compliance, a power-saving ECO mode, and standard ATX input or optional +5V, 3.3V, +12V VDC single voltage supply.

Performance and Convenience

The ADLINK CM4-SL2 is designed for performance and efficiency. The board uses the 6th Generation Intel® Core™ i3-6102E 1.9GHz (no Turbo), 25W (2C/GT2) and up to 8GB of soldered single channel 2133 MHz DDR4-ECC memory. The CM4-SL2's PCI/104-Express bus provides high-performance bus speeds with legacy interface compatibility. With these resources, a fully built system can realize all the processing power and throughput needed to produce real-time LDARS data.

For hardware expansion, the CM4-SL2 includes 4x PCIe x1 and a 1x PCIe x16 configurable as 1x PCIe x16, 2x PCIe x8, or 1x PCIe x8 + 2x PCIe x4. Additional system expansion interfaces include USB 3.1, USB 2.0, SATA 6Gb/s, COM and GbE ports.

Excellent ODM Capabilities

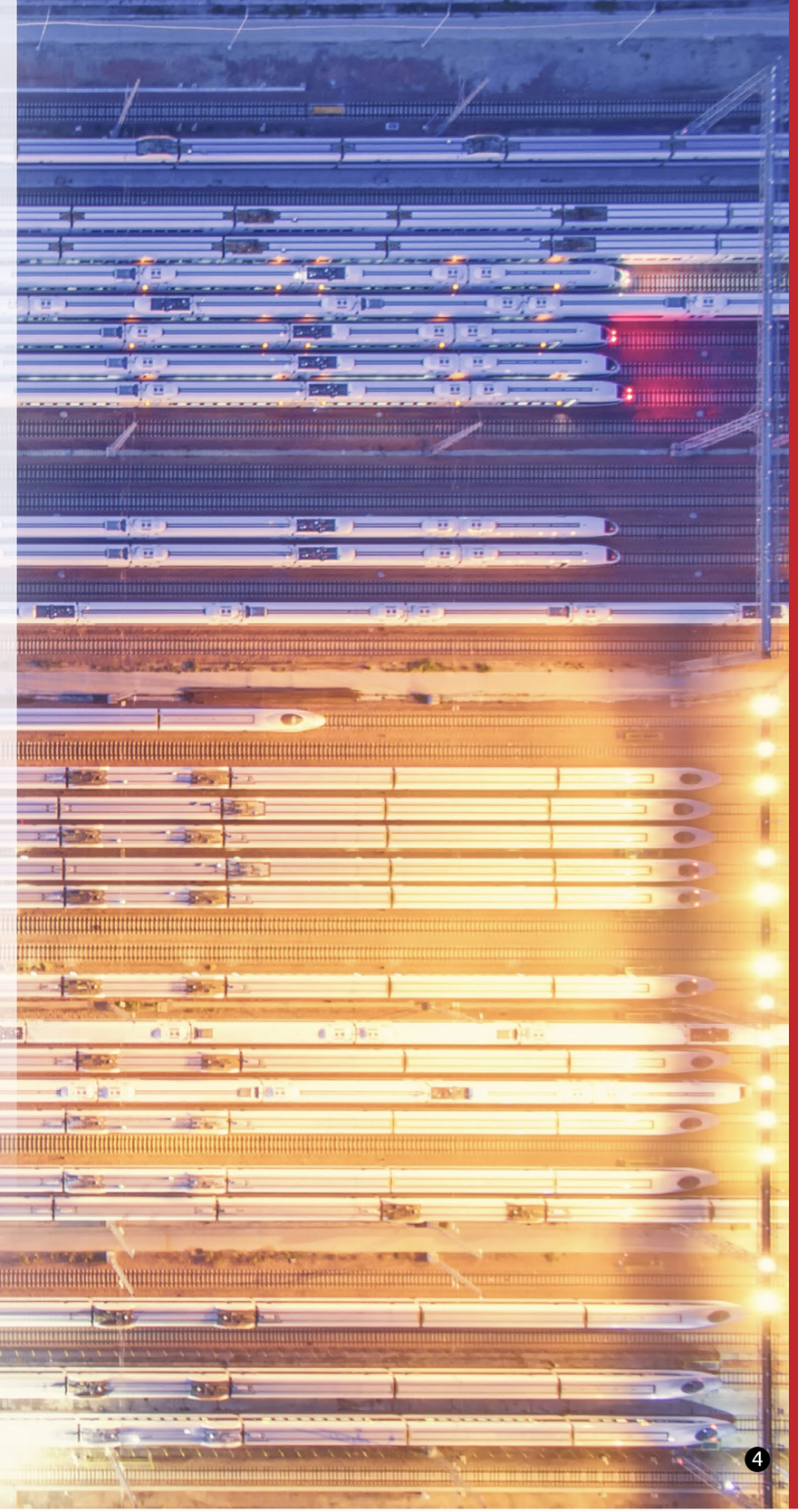
ADLINK, with its extensive expertise in PC/104 technology, offers a complete range of commercial-off-the-shelf (COTS) PC/104 products customers can integrate into their application needs with a shortened time to market. However, mission-critical system developers introduce special requirements that standard COTS products are unable to meet. To address this shortcoming, ADLINK uses its world-class team of in-house engineers and designers to modify an existing product and add custom functions and features as required. ADLINK can also build customized systems from scratch to meet specific customer needs. This service includes solution validation and quality control, providing ADLINK customers with reduced product development time and allowing them to better focus on their core business.

Deep Industry Partnerships

In addition to its leading position in the PC/104 Consortium, ADLINK is also a Premier Member of Intel's Internet of Things Solution Alliance and a partner in NVIDIA's "AI at the Edge" initiatives. This industrial collaboration provides ADLINK with early, "inside" access to partner resources, including engineers and deep service support. This gives ADLINK exceptional ability to craft Intel-based and NVIDIA-based products for maximum performance and early-to-market opportunity, especially in purpose-built form factors like PC/104. Note that PC/104 is also backward and forward compatible. Products using different versions of the PC/104 family can typically be bridged or upgraded with transitional modules, resulting in a prolonged service cycle for these systems, and ADLINK's partnerships help here, as well, to ensure optimal compatibility and benefits.

Conclusion

With the goal of providing a safe rail experience for travelers, vehicles, and assets, the LDARS solution provider required the most robust and effective compute system platform possible. ADLINK met and overcame every challenge the rail-based industry presented for this solution. We provided a high-end and high-performance small form factor platform with low power consumption, resulting in cost-effective savings for the customer. ADLINK's design also offered the latch connectors needed to deliver an extra level of ruggedness, allowing the LDARS solution to operate reliably in a rail environment. Lastly, by using ADLINK's CM4-SL2, the customer extended its return on investment, benefitting from a seven-year lifecycle support plan for its hardware. As a result of ADLINK's extensive experience in the embedded and rugged markets and excellent ODM capabilities, the customer successfully launched a system built to help make rail travel a better and safer experience.

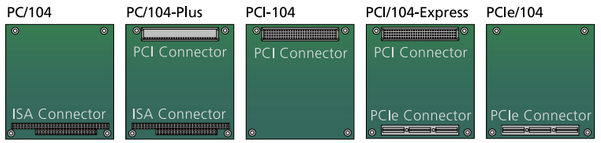


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Why ADLINK?

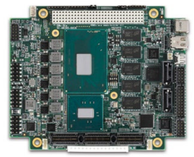
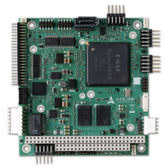
Ampro was pivotal in the founding of the PC/104 Consortium. When ADLINK acquired Ampro, it integrated Ampro's experience and position in the embedded computing world and accepted the responsibility to continue innovating within the small form factor market, always seeking to improve quality and value whenever possible.

In striving to be the world's leading PC/104 supplier, ADLINK relies on its team of in-house engineers and designers. The company owns and operates its own manufacturing facilities to maintain direct quality control over all production aspects. ADLINK also manages system integration, customer support, and extended life cycle support on an ever-increasing range of solutions. This holistic approach to the embedded computing market enables ADLINK to deliver exceptional value, combining low product cost with outstanding levels of client service, including integration services and product customization capabilities.



ADLINK PC/104 product line naming rule

ADLINK PC/104 Selection Guide

	PCI/104-Express	PCI-104	PC/104-*Plus*	PC/104
Product Name	**CMx-SLx**	**CM3-BTx**	**CMx-BTx**	**CM1-86X3**
Product Image				
CPU	Intel® Core™ i3-6102E 1.9GHz Options: Intel® Core™ i3-6100E 2.7GHz Intel Xeon® E3-1505L v5 2.0/2.8GHz	Intel Atom® E3845 (4C), 1.91 GHz, Intel Atom® E3815 (1C) 1.46 GHz	Intel Atom® E3800 Series SoC	Vortex86DX3 SoC
Cache	Core™ i3 = 3MB (Option: Xeon® processor = 8MB)	Primary 32 KiB, 8-way L1 instruction cache and 24 KiB, 6-way L1 write-back data cache	Primary 32 KB, 8-way L1 instruction cache and 24 KB, 6-way L1 write-back data cache	L2: 512kB
Memory	Up to 16 GB soldered ECC DDR4	Up to 4 GB DDR3L SO-DIMM	Up to 4 GB DDR3L SO-DIMM	2 GB soldered DDR3L
SATA	2x SATA 6Gbit/s and 1x SATA to onboard SATA-SSD	1x SATA 3G/s shared with mSATA (opt. 2nd SATA 3Gb/s port w/o mSATA support)	1x SATA 3G/s shared with mSATA (opt. 2nd SATA 3Gb/s port w/o mSATA support)	1x SATA 1.5Gb/s (or CFast)
Serial Port	2x RS-232	2x RS-232/485 (with full handshake) 2x RS-232/485 (TX, RX, CTS, RTS only)	4x RS-232/422/485	2x RS-232 2x RS-232/422/485
USB	1x USB 3.1, 6x USB 2.0	3x USB 2.0 (1x on mSATA)	3x USB 2.0	2x USB 2.0
GPIO	8	8	8	8
Audio	HDA (available on DisplayPort & HDMI port)	HDA	HDA	-
LAN	2x GbE	2x GbE	2x GbE	1x GbE 1x 10/100 Mbit
Graphics	Intel® HD Graphics	Intel® HD graphics	Intel® HD graphics	Integrated 2D graphics
Video	HDMI/DVI, DisplayPort	VGA	VGA	VGA
Flat Panel	Single channel 18/24-bit LVDS	Single/dual channel 18/24-bit	Single/dual channel 18/24-bit	LVDS Single channel 18/24-bit TTL/TFT
SEMA Support	Yes	Yes	Yes	Yes
Operating Temperature	0°C to +60°C -40°C to +85°C (opt.)	0°C to +60°C -40°C to +85°C (opt.)	0°C to +60°C -40°C to +85°C (opt.)	0°C to +60°C -40°C to +85°C (opt., contact for availability)
OS support	Windows 7/10, Linux, VxWorks 7, QNX 6.6	Windows 7/8/10, WEC7, Linux, QNX, VxWorks	Windows 7/8/10, WEC7, Linux, QNX, VxWorks	WES2009, WES7, Linux, QNX WEC7, Windows CE 6.0 (by request)
Dimensions (W x L)	117.4 x 96 mm	90 x 96 mm	90 x 96 mm	90 x 96 mm

Note: All specifications are subject to change without further notice.

PC104

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