WHITE PAPER

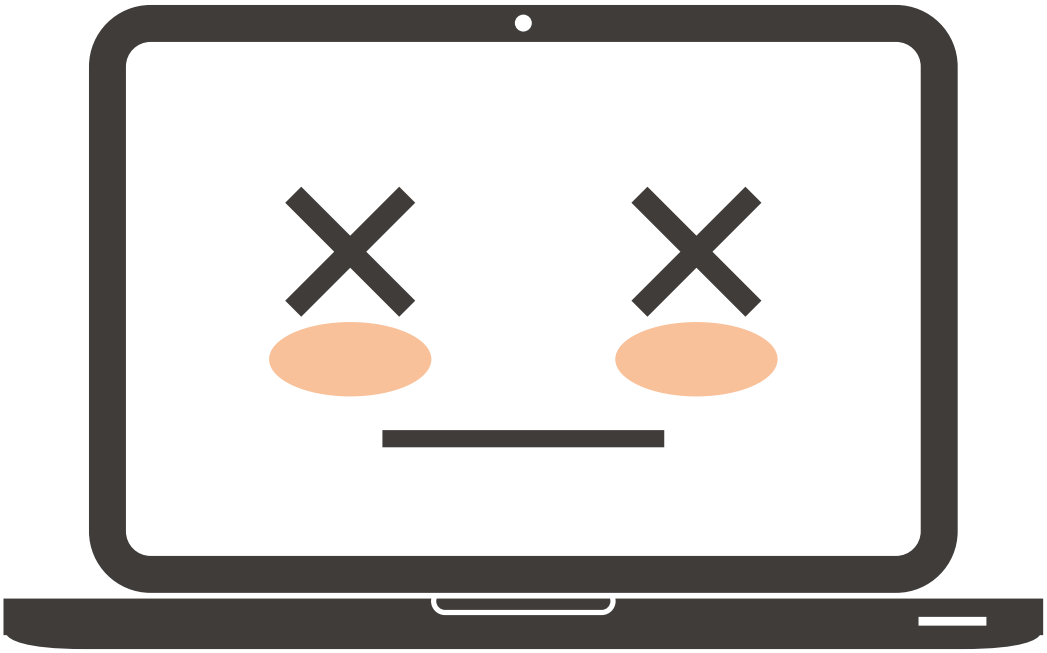
Thunderbolt 3: a path forward for avionics data bus interfaces and Abaco's ARINC 615-3 data loader

abaco SYSTEMS

Thunderbolt 3: a path forward for avionics data bus interfaces and Abaco's ARINC 615-3 data loader

Introduction

It's no secret that the expansion slot capability available on commercial laptops has changed dramatically over the past ten years. PC Card™ slots (also commonly referred to as PCMCIA slots) have all but vanished and it's rare to find Express Card slots. Thunderbolt ports are now gaining in popularity for high-performance peripheral support.



For avionics engineers, avionics technicians and other aerospace technical professionals who rely on commercial laptops to do their jobs, the rapid change in available expansion capability can make routine tasks like loading software updates to an aircraft computer a challenge.

For Abaco's ARINC 615-3 data loader users, the disappearance of ExpressCard and PC Card slots has given way to the desire to use USB. Unfortunately, USB device access latency is a key impediment.

The headaches of migrating to new computer hardware and operating systems also present some significant hurdles to overcome. On top of that, the always-present pressure to do more with less can put a strain on efficiency when engineers must compete internally for budget.

This white paper looks at a possible solution to these challenges.

Thunderbolt 3: a path forward for avionics data bus interfaces and Abaco's ARINC 615-3 data loader

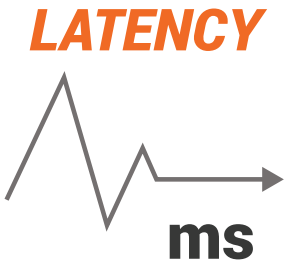
ExpressCard and PC Card expansion slots: not always available
For years, Abaco's ARINC 615-3 data loader software supported laptop-based data loading using ARINC 429 interface devices that were based on the ExpressCard or PC Card form factors. They were a relatively straightforward solution: they were easily portable, hot-swappable, and slots were readily available on most laptops. Additionally, ExpressCard and PC Card devices provided software running on the host computer with low-latency memory-mapped access to the device.

As technology has evolved, however, these slots have virtually disappeared from most commercially available laptops, leaving avionics engineers and technicians with a challenge.

USB: latency issues
While USB is an attractive option due to its wide availability on nearly every laptop computer, it poses a challenge that isn't presented by ExpressCard or PC Card. USB does not allow memory-mapped access to the device: every access to the device by software running on the host computer requires processing by the USB device's driver and the operating system, introducing a variable latency associated with every device access (for example, to send or receive ARINC 429 traffic).

While most typical latencies are low and perfectly acceptable for many avionics applications, the potential for occasional high access latencies precludes operation of Abaco's ARINC 615-3 data loader over USB.

Although USB is a high-speed bus capable of efficiently moving large amounts of data, device access latencies are an issue; what is needed is a widely available portable form factor capable of providing memory-mapped access to an ARINC 429 interface device.



Mini PCIe: not always practical
Small and modular, one contemporary portable form factor supporting memory-mapped device access is Mini PCIe® (also known as PCI Express® Mini Card). Unfortunately, it can be a challenge to locate a commercially available laptop which includes a Mini PCIe slot. Laptops that do include Mini PCIe slots often bury the slots inside the case. As a result, using a Mini PCIe card can present challenges when routing cabling from the card to outside of the case. The search for a better portable form factor solution continues.

Thunderbolt 3: the answer
The recent emergence of Thunderbolt 3 has revolutionized portable form factor expansion port capability.

Promoted by Intel as the "one port that does it all", Thunderbolt 3 ports allow operation of many device interface standards (including USB 3.1, DisplayPort 1.2, and PCI Express Gen 3) and power delivery over a single compact cable. With seamless support for PCI Express devices, Thunderbolt 3 provides application software running on the host computer with low-latency memory-mapped access to the device - an important advantage over USB.

THUNDERBOLT™

Thunderbolt 3: a path forward for avionics data bus interfaces and Abaco's ARINC 615-3 data loader

Furthermore, since Thunderbolt 3 ports utilize the familiar thin and reversible USB Type-C style connector, they are perfectly suited for today's modern laptops with ever-shrinking connector space.

Thus, the search for a suitable portable form factor comes to an end. With wide support across low-cost commercially available laptops running 64-bit Windows 10, pairing Abaco's TB3-to-CMC-LP Thunderbolt 3-to-PMC/XMC adapter with one of Abaco's PMC/XMC avionics data bus interface modules provides a headache-free migration path for users who were previously dependent on older operating systems or computer hardware due to form factor limitations.

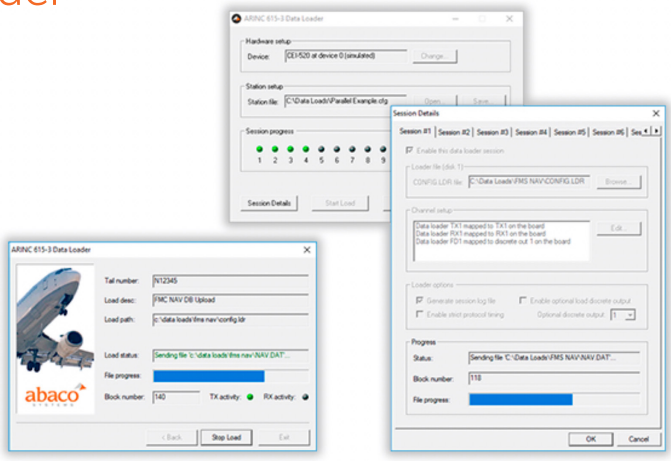
One such offering, the RCEI-830A-TB ARINC 429 interface device, provides a much-needed portable path forward for Abaco's ARINC 615-3 data loader users, among others.

The RCEI-830A-TB

Avionics data bus interface devices that are based on PCI Express running over Thunderbolt 3, like Abaco's RCEI-830A-TB, provide a long-term solution that is free of the discussed limitations associated with the PC Card, ExpressCard, USB and Mini PCIe form factors.

Abaco's RCEI-830A-TB

Available in a range of flexible configurations, the up to 32-channel RCEI-830A-TB provides complete, integrated data bus functionality for ARINC 429, ARINC 575 and selected 2-wire, 32-bit protocols with a single Thunderbolt 3 port. The RCEI-830A-TB supports maximum data throughput on all channels while providing on-board message scheduling, label filtering, multiple buffering options, time-tagging and error detection. On-board



Abaco's CEI-DL ARINC 615-3 Data Loader Software

firmware, large data buffers, and a high-level API are integrated to provide total flexibility in monitoring and generating ARINC bus traffic. Configurations with support for avionics-level discrete I/O, ARINC 717, ARINC 573 and IRIG-B receiver (AM or DC/TTL) and generator (DC/TTL) support are optional.

The RCEI-830A-44N-TB configuration, for example, includes four ARINC 429 RX channels, four ARINC 429 TX channels and four avionics-level discrete inputs and outputs. This Thunderbolt 3-based RCEI-830A configuration is popular for laptop-based ARINC 615-3 data loading when purchased with Abaco's optional CEI-DL ARINC 615-3 data loader software package and RCONA615-10 data loader cable.

RCEI-830A-TB Software

Abaco's robust and proven software tools and APIs add significant value to the avionics data bus interface hardware. Included with every RCEI-830A-TB is Abaco's flexible CEI-x30 API, a powerful yet simple programming interface that is supported across a wide variety of form factors and dramatically reduces the time required to integrate support for ARINC 429 and other avionics protocols into an application.

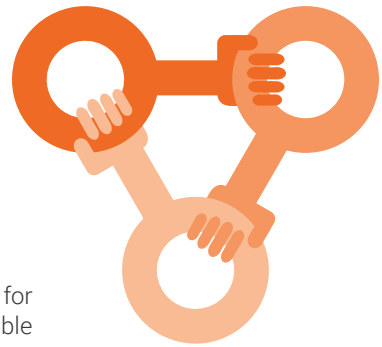
Already mentioned, Abaco's optional CEI-DL ARINC 615-3 data loader software provides intuitive ARINC 615-3/603 data loading capability that can be easily deployed across a wide array of environments from aircraft maintenance to lab/simulation using the included single-session and multi-session utilities. Well suited for aircraft maintenance, the streamlined single-session utility loads one aircraft computer at a time using a simple administrator-configurable interface, while the multi-session utility (which allows data loading of multiple avionics computers simultaneously) is ideal for lab or simulation users.

Thunderbolt 3: a path forward for avionics data bus interfaces and Abaco's ARINC 615-3 data loader

Other optional software tools are available for use with the RCEI-830A-TB as well. Abaco's CEI-LV software enables quick and painless Lab¬VIEW™ application integration, while Abaco's feature-rich and easy-to-use BusTools/ARINC software package provides powerful ARINC 429 analysis, simulation, and data logging capability from an easy-to-use Windows-based GUI.

Support

In addition to meeting software and hardware requirements, increasingly, companies are looking not just for the right product solution, but for an avionics partner to share the load – not just a vendor.



Responsiveness to requests for information and knowledgeable technical and application support are paramount. At Abaco, our support stretches from initial development and test through deployment, from design to delivery - and beyond. Dedication to providing the highest level of customer support at every step is a key differentiator that sets Abaco apart.

Conclusion

PC interfaces come and go: there was a time, for example, when every PC was equipped with parallel and serial interfaces as well as a VGA port. Just as with the decline – or disappearance – of PC Cards and ExpressCards, such changes create challenges for those who have relied on them. Neither Mini PCIe nor USB provided a perfect alternative.

Today, however, it seems that Thunderbolt provides the necessary availability and functionality to deliver what those working with avionics data bus interfaces require. As such, it looks well-positioned to become the standard for the future.