The First Slot-0 for the new VXI Specification 4.0

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Why this slot-0 was selected for a major, new military test program

General
The ProDAQ 3030 PCI Express VXIbus Slot-0 Interface (see picture 1) is a C-size, register-based VXIbus module, providing a direct connection from your PC to a VXIbus mainframe using the high-speed PCI Express serial bus. Together with any of the available host cards, the ProDAQ 3030 enables you to use your desktop or server computer just like an embedded controller. Optimized for low latency and high throughput, it provides a high-performance, but cost-effective solution for your Data Acquisition and Test & Measurement systems. The device is by far the fastest on the market with a first word latency of less than 1 µs and a throughput of up to 320MB/s, using the newly specified 2eSST protocol.

![ProDAQ 3030 PCI Express Slot-0 Interface](image)

Bustec achieved a sustained throughput with its ProDAQ 3180 motherboard in excess of 200MB/s. This translates to a fully simultaneous sampling of 100 channels, 16 bit with a speed of 1MHz/channel (6 * ProDAQ 3180 motherboard each with 4 * ProDAQ 3430 function cards), or 384 24-bit channels/mainframe, each running at 130KHz (12 * ProDAQ 3180 motherboard each with 4 * ProDAQ 3424 function card); all channels are fully synchronized.

Cabling and Multi-Chassis Configuration
The ProDAQ 3030 offers two PCI Express ports with four lanes according to the PCI Express External Cabling specification. One of the ports is used to connect it to the host computer, while the second port can be used to connect to another VXIbus mainframe in a daisy-chain
configuration. To connect the slot-0s to the ProDAQ 3261 PCI Express host interface card a standard copper 4-lane cable or a fiber optic cable can be used. The 3261 fits into a standard PCI Express x4 slot in a desktop or server computer. Up to two ProDAQ 3030 can be connected directly to the interface card. If an application requires more ProDAQ 3030 to be connected to the host, the daisy-chain capability of the ProDAQ 3030 can be used. In this way the user can connect up to 16 chassis with ProDAQ 3030 slot-0 controllers to one PCIe ProDAQ 3261 interface card. If more mainframes are needed, multiple interface cards in a host computer allow the user to connect multiple multi-mainframe systems to a single host using a star configuration. The optical cable option offers connectivity beyond the maximum cable length of seven meters for copper cables by extending the maximum range between the host computer and the VXIbus system or between two VXIbus systems to 300 meter. These fiber-optical cables connect to the same ports as the copper cable. Bustec has developed cables with the transceivers built directly into their connectors. Thus the user can choose the appropriate cable for the application without having to use and maintain separate slot-0 interface models. For older desktop or server computers featuring PCI bus slots only, Bustec offers the ProDAQ 3262, which provides a PCI-to-PCI Express bridge in addition to the PCI Express cable interface.

**Hot-Plug Support**

Because the ProDAQ 3030 supports PCI Express hot-plug functionality, you can power up your host PC independently from any and all of your VXI chassis. You can also power off any of your VXI chassis without having to shut down the host PC. Thus the user can swap VXI instruments in the chassis without having to shut down and restart the entire system.

**LXI-Compatible Trigger Bus**

Most modern test systems are built with components from different standards, like VXI, PXI, PXIe and LXI. With LXI rapidly gaining market share, this new instrumentation bus has modules in most new systems built today. One of the major features of LXI is the LVDS trigger and timing interface. Therefore, Bustec implemented this optional trigger interface, which is compatible to the LXI trigger bus as specified in the LXI Standard, rev. 1.3. The interface implemented by Bustec in its ProDAQ 3030 not only allows forwarding and receiving all of the eight VXIbus TTL trigger lines or the CLK10 to/from other VXIbus mainframes in a multi-chassis system, but also connecting to LXI-compatible devices in hybrid test systems. The interface is based on an 8-channel Multipoint LVDS (M-LVDS) signaling system that allows all devices on the bus to be configured as sources and/or receivers of trigger signals. Devices can be connected in a daisy-chain configuration through separate input and output connectors or in a star configuration utilizing readily available star hubs.

**Reasons for the use of the Bustec ProDAQ 3030 in this new, major military test system**

The integrator of this new military test system, a large US defense contractor, had specific requirements that could not be fulfilled with existing controllers. While the high data throughput provided by the 2eSST support is important, the integrator primarily chose the ProDAQ 3030 for its unique capabilities that satisfy the requirements listed below.

1. True 64-bit VISA: Bustec provides as the first supplier a true 64-bit VISA for VXI interfaces.
2. Multi-mainframe System: With its multi-port host interface and daisy-chaining capabilities, the ProDAQ PCI Express Slot-0 solution allows to build multi-mainframe systems using only one PCI Express slot in the host computer.

3. Test Time: The extremely low first word latency of down to 400 ns and the high throughput shortens the test time considerably.

4. Optimized Modern Processor Support: The hard- and software of the ProDAQ 3030 offers enhanced support for state-of-the-art computer systems. By making full usage of the transactional nature of the PCI Express bus, PCI Express bridges with independent routing capabilities and state-of-the-art kernel driver design, it supports non-blocking, concurrent access with full multi-threading and multi-core support.

5. LXI-compatible M-LVDS Trigger Bus: The implementation of the LXI-compatible LVDS trigger interface on the front-panel enables the user to forward and receive all of the eight VXIbus TTL trigger lines or the CLK10 to/from other VXIbus mainframes in a multi-chassis system and also to connect to LXI compatible devices in his hybrid test system.

6. Hot-plug/Hot power-cycle Capability: One more very important point was the hot-plug functionality. The possibility of a computer crash, if one of the mainframes looses power or if a cable becomes disconnected, was not acceptable to the user. Also, since restarting the entire station after rebooting can take a long time, there is a requirement that test operators must be able to swap and replace VXI instruments (requiring powering down of the VXI chassis) without shutting down the host PC.

These six reasons plus the capability of updating system to VXI specification 4.0 made the ProDAQ 3030 from Bustec the clear choice for a slot-0 interface for this test station. It should be mentioned that this revision 4.0 compatible mainframes have already been specified for this system, so using a revision 4.0 compatible slot-0 was a logical choice. For more information, please visit [www.bustec.com](http://www.bustec.com).

About the author: Dr. Fred Blönnigen ([fred@bustec.com](mailto:fred@bustec.com)) has a Ph.D. in physics. After he earned his Ph.D. in France, he worked in the University of Berkeley in California as Nuclear and Elementary particle Physicist. Back in Europe, he worked for a large American data-acquisition and test company for several years. In 1997 he founded Bustec in Ireland and opened a branch in 2000 in the USA. Dr. Blönnigen is the CEO of Bustec.