PXI

TEST REPORT

RF instruments challenge PXI versatility

By Richard A. Quinnell, Contributing Technical Editor

One of the most dynamic applications for PXI is its use in the testing of complex, high-bandwidth RF applications. I recently spoke by phone with Tim Carey, PXI product manager at Aeroflex, who explained the difficulties of creating RF-capable instruments and who cautioned that multi-module RF instruments could limit PXI's versatility.

Q: How is RF a challenge for PXI?
A: Physical space is one of the main limitations that we have to work at overcoming. For one thing, the spacing of the boards makes it impossible for us to use double-sided component mounting and still provide shielding in a single-slot board. As a result, many RF instrument modules need two or more slots. Heat dissipation is also a challenge in such tight quarters. Also, the available rail voltages and currents, which are carry-overs from digital computing, are not what we would ideally like for RF.

Q: How is PXI providing an advantage?
A: The modularity of PXI allows us to separate the transducers from the processing capability of an RF instrument. CPUs evolve much faster than RF transducer technology, and the separation gives engineers access to higher-performance processors as soon as they become available. The separation also reduces the cost of upgrading. If a new processor or advanced transducer stage becomes available, engineers only need to change the system element that has improved rather than buying an entirely new instrument each time.

Q: What is the state of the art in PXI for RF?
A: Aeroflex and other vendors now offer modules that can produce and analyze signals with frequencies as high as 6 GHz, but we're beginning to see systems capable of operating at even higher frequencies. One signal analyzer now being demonstrated operates on signals to 26 GHz. Pretty good for a technology not intended for RF applications.

Q: What gaps do you see in the RF functionality available on PXI?
A: We haven't seen any real-time signal-generation capability for applications such as channel fading and base-station simulations. What is being offered now is the use of "canned" waveforms, not those computed in real time. PXI Express allows us to stream data through an RF module for complex, high-bandwidth signal generation, but some standards are best tested by having a closed loop and computing the test signal in real time.

Tim Carey
PXI product manager
Aeroflex

Q: Any concerns for the future?
A: If we're not careful, we may lose the versatility of the PXI architecture in RF instrument design. You have to break an instrument up into a number of functional blocks to put it on PXI. A signal analyzer, for instance, needs downconverter, signal-conditioning, and digitization blocks. But it is highly unlikely that vendors will do their partitioning the same way and have the same interface signals between blocks.

This will prevent engineers from creating instruments by combining modules from different vendors. The test system may be multivendor in nature, but not the individual instruments within the system.

Q: How can the industry avoid that?
A: The panacea would be for the industry to agree on the definitions of standard functional blocks and the interfaces between. Then engineers could mix and match vendor boards when creating their instruments. At the very least, though, there can also be collaboration between vendors to develop compatible blocks that will allow engineers to form instruments for themselves. □

INSIDE THIS REPORT

GUEST COMMENTARY

PXI changes how manufacturers deploy ATE

By Gary Clayton, MAC Panel Company

Experts involved in developing ATE (automated test equipment) applications cannot deny the revolution that has taken place since the introduction of the PXI platform. PXI, along with complementary software tools, now offers the opportunity to deploy functional test capabilities to electronics manufacturers in many more markets, yielding improved products and processes.

There are more than 1500 PXI instruments on the market, providing unprecedented configuration and performance possibilities. When coupled with software tools that simplify the process of integration, PXI-based ATE achieves ever-higher test coverage.

Test requirements vary by application and technology, but there are essential requirements common to all applications: comprehensive test coverage, ease of integration, and low initial and total life-cycle costs. I will focus here on ease of system integration and the associated positive impact on short- and long-term system costs.

The core elements that make up a typical functional ATE system include measurement instrumentation, signal switching, power sources, a software development environment, and a suitable electrical interface to bring the system resources to a single connection point for the unit under test—typically referred to as a mass interconnect. The ease with which a test system can be configured is largely governed by the instrument platform being used and the compatibility between the instrumentation and the available mass interconnects.

With the selection of instruments available for the PXI platform today, most system configurations can be housed in a PXI chassis, available in either a 3U or 6U form factor. By having all instrumentation and switching in one or more chassis, much of the rack size and system wiring associated with legacy platforms is eliminated. Mass-interconnect systems are offered in high-performance PCB (printed-circuit board) or traditional cable-connectivity formats.

Initial system configuration is just the start of the process. A good design will allow for future enhancements and upgrades. This is particularly true for the aerospace and defense markets, where system service will often exceed 20 years. The PXI platform has the resources and features necessary to make test system integration easy, robust, and reliable for the long haul. □

Gary Clayton is the director of sales and marketing at MAC Panel Company in Macclesfield, England. gpc@macpanel.com.

HIGHLIGHTS

Sundance debuts DSP/FPGA platform for PXI Express

In conjunction with becoming a member of the PXI Systems Alliance, Sundance Multiprocessor Technology has announced that it will introduce a range of PXIe (PXI Express) products for DSP (digital signal processor) and FPGA (field-programmable gate array) multiprocessor systems. Product roll out will begin with the SMT7 Series, which comprises more than 25 modular PXIe products.

The SMT702 provides eight PXIe lanes and two channels of 3-GHz analog-to-digital conversion that can be combined to deliver 6 Gsamples/s. It also features clock circuitry, two banks of DDR2 memory, and a Xilinx Virtex-5 FPGA optimized for logic and serial I/O.

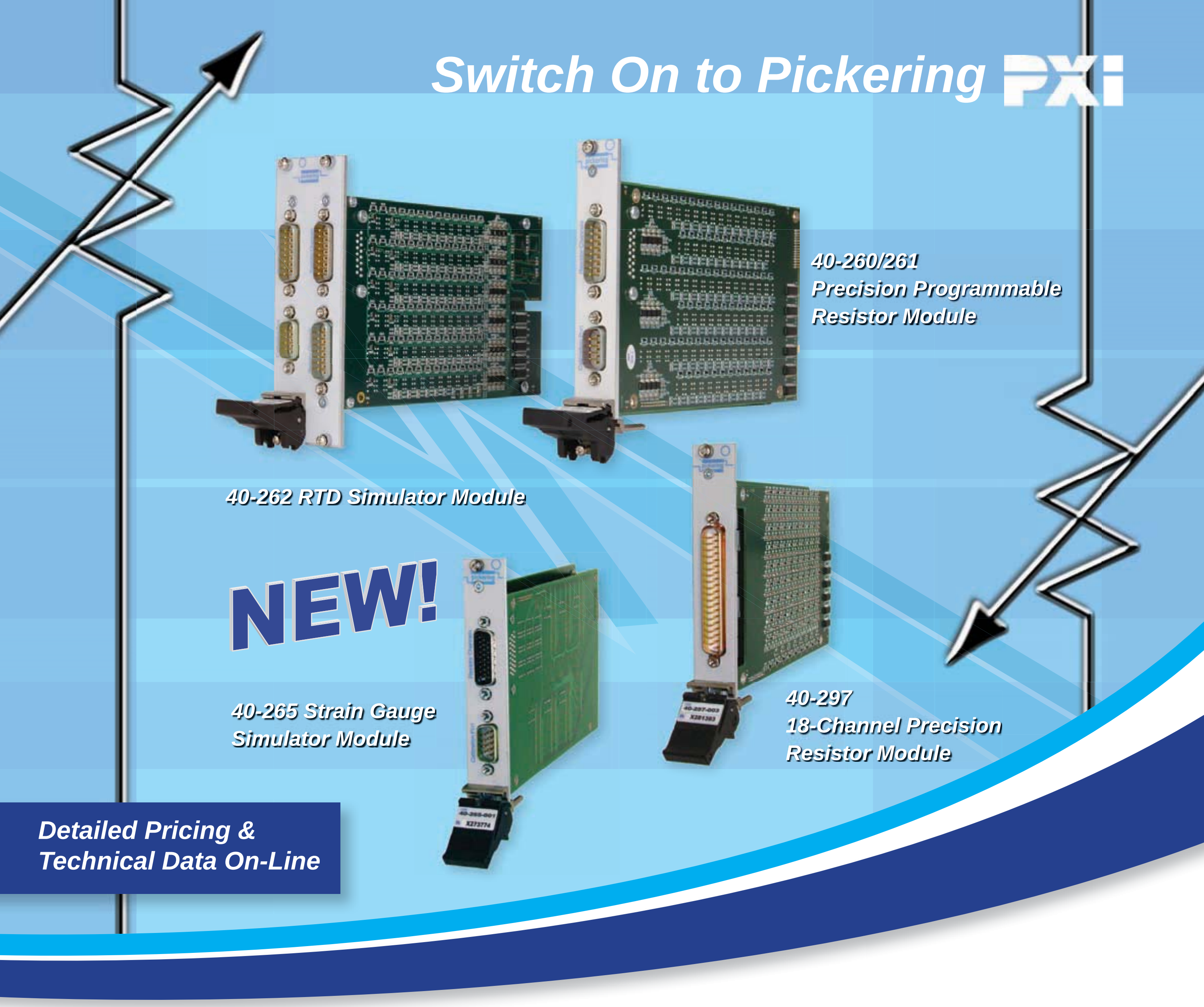
The SMT700 carrier board will bring FPGA acceleration to PXIe systems. The board employs a Virtex-5 LXT or SXT device, which can be configured either through the onboard flash or through the Xilinx JTAG header. It includes a direct connection to an SLB (Sundance Local Bus) mezzanine card, enabling a variety of cards to be added to a system to provide Ethernet, video in/out, analog-to-digital conversion, and digital-to-analog conversion functions.

Data from these additional cards, along with data from the SMT700's own inputs—Gigabit Ethernet, 2.5-Gbps optical inks, and Rocket Serial Links—can be processed via the Virtex-5 or by another linked card or module. www.sundance.com.

Geotest to convert EADS tester to PXI

Geotest—Marvin Test Systems reports that it will implement the EADS Talon Instruments T964 series of digital test instruments in the PXI bus form factor. Currently, the T964, which is aimed at testing avionics and electronic equipment as well as communications products, is available in the larger VXI format.

James Mulato, president of EADS North America Test and Services, said, "Our T964 is the newest, most exciting test instrumentation product available in VXI and provides a comprehensive solution for testing today's advanced electronic boards and systems—as well as emulating older functional test systems and digital instrumentation." www.geotestinc.com; www.ts.eads-na.com.



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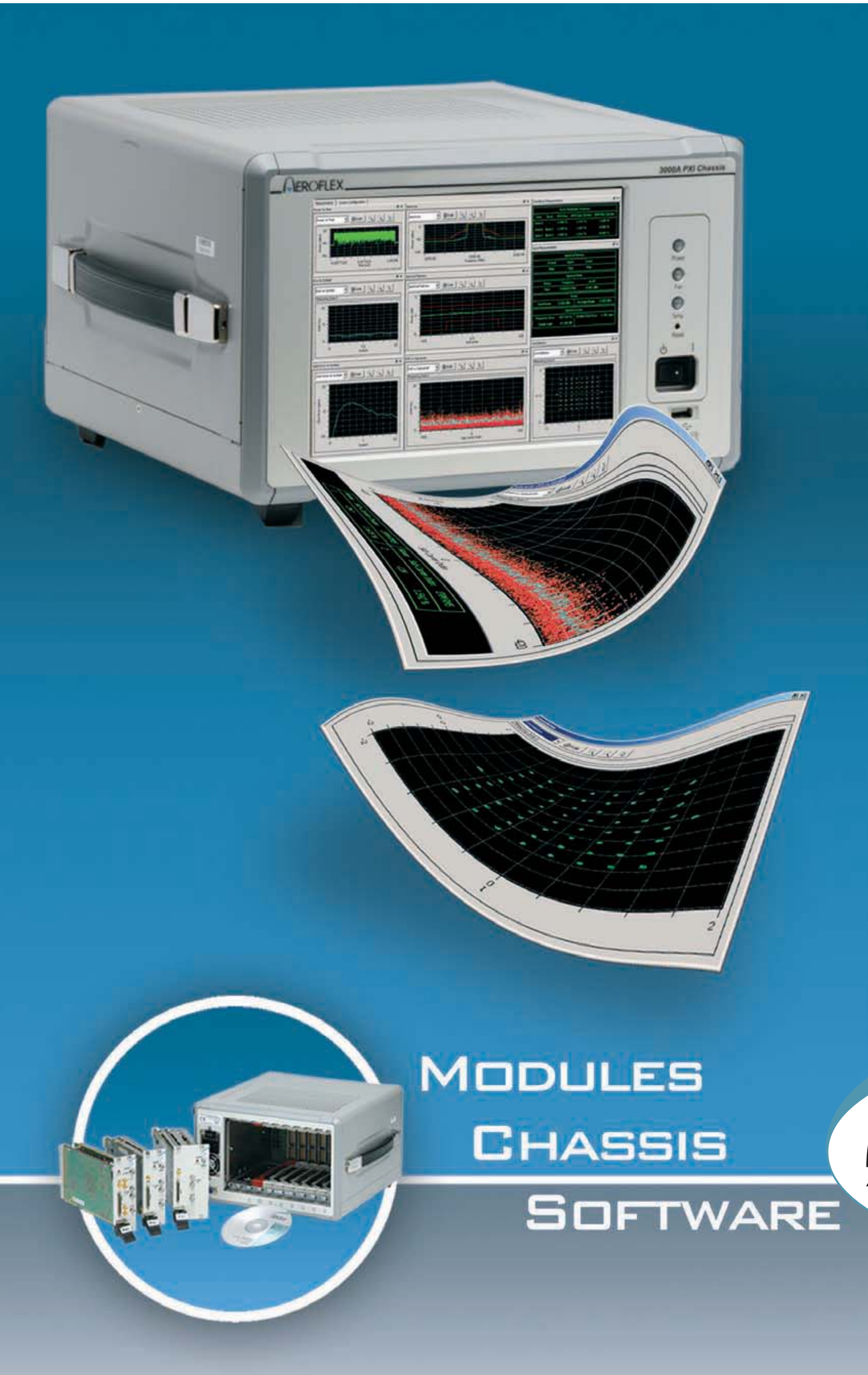

For RF test applications requiring both RF vector signal generation and RF vector signal analysis, Aeroflex solves your RF test needs by combining the best attributes of configured solutions and the benefits of modularity.

The Aeroflex 3000 Series PXI modular RF instruments together with Aeroflex PXI Studio application software provide stimulus and response measurement capability for a wide variety of application needs to 6 GHz, including advanced digital communications systems such as WiMAX and WLAN.

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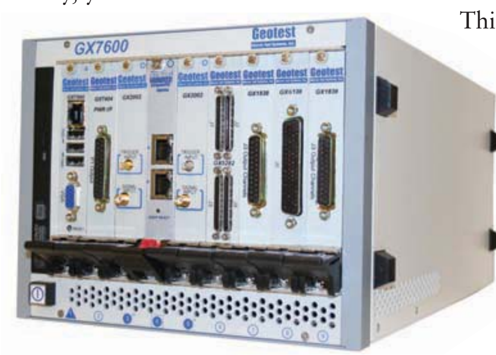
Chassis layout is key to success with PXI Express

By Richard A. Quinnell, Contributing Technical Editor

With the electronics industry's never-ending appetite for speed, the bandwidth advantages of PXIe (PXI Express) are becoming increasingly important for test instrument designs. To take full advantage of the capabilities offered by this technology, you'll need a chassis designed to handle PXIe cards.

You could work with a manufacturer to design a custom card cage for your application, or you could turn to a commercial chassis offered by companies such as National Instruments (NI) and Geotest. Either way, you'll need to understand the connection architecture of the system backplane and then position the modules to maximize bandwidth usage.



Smaller PXIe enclosures such as the GX7600 offer hybrid slots that provide a growth path for PXI system developers. Courtesy of Geotest.

The place to start is by recognizing the fundamental characteristics of PCI Express, the serial bus that provides PXIe its bandwidth. PCI Express provides system elements with a point-to-point serial connection composed of multiple lanes, each of which has both send and receive channels operating at 2.5 Gbps. Designers can scale the performance of PCI Express connections to meet performance needs by grouping lanes together; configurations of x1, x4, x8, and x16 lanes are common. Because the lanes run point-to-point, their data bandwidth is dedicated to the connection, not shared with other connections in the system.

Compatibility is key

A key component of the PCI Express bus is its compatibility with traditional PCI. Anything that can connect to the PCI bus can connect through a bridge chip to a PCI Express bus without any software changes. The bridge chip handles all the mapping of transactions across a shared parallel bus onto a dedicated serial bus. This software compatibility ensures that PCI and PCI Express elements can work together in a system as though they were all on the PCI bus.

When adapting PCI Express for the PXIe specifications, the PXI Systems Alliance (PXISA) sought to take advantage of this ability to interoperate in order to help developers preserve their investment in PXI modules. The PXIe specification calls for the PXIe system controller to communicate with PXIe modules as well as through a bridge to a standard PCI-based PXI bus. In addition, the specification defines a hybrid module slot that accepts either PXI or PXIe modules. These two definitions ensure that developers can mix traditional PXI and new PXIe modules in the same system without software changes.

The specification does not, however, define how many of each type of module slot—PXI, PXIe, or hybrid—a system enclosure must contain, nor does it specify the arrangement of slots beyond the locations for the system controller and system timing module. These choices are left open for developers to make as needed, and many custom configurations are thus possible. In their commercial PXIe system enclosures, Geotest and NI have already made those choices for you, but you still need to pay attention to how you position your modules to make the most efficient use of bandwidth.

Small cages ease development

Geotest offers a nine-slot hybrid PXIe enclosure, the GX7600, that provides five PXI slots, two hybrid slots, a PXIe controller slot, and a PXIe system timing slot. The backplane supports a x4 lane connection from the system controller to each hybrid slot as well as the system timing slot. It also has a x1 lane connection to a bridge chip that drives the five PXI slots. NI has a similar, eight-slot enclosure, the NI PXIe-1062Q, that offers only four PXI slots but otherwise offers the same connections as the GX7600.

The relative simplicity of these small enclosures means that there is only one positioning issue to keep in mind. The hybrid slots replace the PXI J2 connector that carries a PXI local bus with a different connector to carry the PXIe bus. PXI cards that use the local bus and J2 connector thus cannot be located in a hybrid slot.

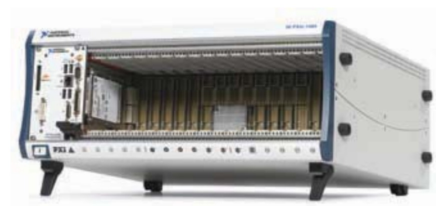
Modules that do not have a J2 connector, however, can be positioned anywhere in the chassis, which makes these chassis good candidates for developers who are just beginning to need the PXIe bandwidth or who see PXIe needs looming but not yet present. The hybrid slots provide a growth path for eventual adoption of PXIe: You can use PXI modules for the present design and then replace them with higher-performance PXIe modules without having to change software or modify the system configuration. *(continued)*

Positioning modules in larger PXIe chassis

In addition to its small hybrid enclosures, NI has introduced two 18-slot PXIe enclosures: The NI PXIe-1065 provides a PXIe system controller slot, four hybrid slots, four PXIe slots (including the system timing controller), and nine PXI slots; the NI PXIe-1075 has no pure PXI slots, offering one controller, nine PXIe, and eight hybrid slots.

Connections for the 18-slot enclosures are somewhat more complex than for the smaller configurations. The NI PXIe-1065 breaks the PXI bus into two segments. One contains five PXI slots and a hybrid slot while the other contains four PXI slots and three hybrids.

The first segment has a x1 direct link to the system controller, while the second shares a switched x4 link to the controller with two PXIe slots. The NI PCIe-1075 uses four switches on its backplane. This organizes the hybrid slots into two



Even developers with no current need for PXI Express can benefit from properly positioned cards in a PXI Express cage because of the split PXI bus that enclosures such as the NI PXIe-1065 offer.

Courtesy of National Instruments.

four-slot PXI segments and the PXIe slots into two additional groups, each collection sharing a x4 link to the controller.

This type of grouping and use of switches creates pathway restrictions that impact the data bandwidth and inter-module connectivity available at any given slot. The way you position modules in a PXIe enclosure, therefore, can affect the data throughput of a system. For instance, the presence of two independent PXI buses in the 18-slot cage allows you to bypass a bottleneck when two groupings of PXI modules require high bandwidth in order to transfer data back and forth. If all the modules are located on a single segment, the groups must share the PXI bus. If the two groups are located on different segments, each grouping has sole access to its segment's bandwidth.

Because the links from the segments to the system controller are also independent, the effect is like having two small independent systems that share common clock and trigger functions. The enclosure thus offers a system performance boost to developers not using PXIe at all.

Switches offer opportunities

When positioning modules in the PXIe slots, developers should pay attention to the location and nature of the switches on the backplane. In the PXIe-1075, for instance, each switch serves to connect the system controller and four or five other connections using x4 links to the PXIe slots or a x1 link to the PXI bridge. These switches force the PXIe modules that connect to them to share the link bandwidth. You will get maximum performance, therefore, if you use separate switches to isolate high-demand module groupings from one another.

You should be aware that the PXIe links in the cages currently available from NI and Geotest are limited to x4 configurations. Yet, some high-performance PXIe modules offer x8 connections to achieve maximum performance. The specifications allow the system controller to provide up to 24 PCI Express lanes configured as a x16 link and a x8 link or as multiple clusters of fewer lanes with the same total. Thus, the PXIe specification supports the x8 connections of such modules, but the currently available commercial backplanes do not. To gain this top performance, you will need custom backplanes for your enclosures.

When creating custom backplanes, you will need to partition the available links while bearing in mind how data flows within the system. Fortunately, you have a wide range of options for developing dedicated and shared-bandwidth connections. Switches, for instance, provide a means of distributing one link from the system controller slot to multiple module slots. The slots will have to share the bandwidth of the link to the controller, but they may not need to share bandwidth for connections among them. Nonblocking switches can provide independent pathways among ports, so two ports can link together and not share bandwidth with a similar linking between two other ports on the same switch.

The key, however, is to recognize the opportunities as well as the restrictions that a specific PXIe backplane configuration offers. An ad hoc insertion of modules into the enclosure can create performance obstacles. By positioning modules within the enclosure appropriately, however, you can maximize the performance attainable, making the most out of PXI Express. □

PRODUCTS

Pickering introduces high-current switches

Pickering Interfaces has expanded its range of PXI high-current switching products with the introduction of a family of high-power solid-state relays. The range comprises eight modules configured as fault-insertion, SPST (single-pole, single-throw) relay, multiplexer, and matrix switches capable of handling 10 A at 200 V and 30 A at 40 V. Each unit occupies two slots in a 3U chassis.

The 40-192 is a six-channel fault-insertion switch with two fault buses capable of hot-switching signals up to 10 A and 200 V. The 40-191 uses the same architecture, but is capable of switching signals of 30 A and 40 V and handling surge currents in excess of 120 A with no lifetime degradation. Each module can simulate most common faults found in a system, including open circuits and short circuits to one of two fault connections.

The other models in the family are the 40-182 and 40-183 six-channel SPST solid-state relay switches; the 40-666 and 40-667 solid-state multiplexers, which are available in dual three-channel or single six-channel configurations; and the 40-553 and 40-554 6X2 solid-state matrices.

Pickering Interfaces, www.pickeringtest.com.

Adlink debuts 19-slot PXI chassis

The PXIS-2719 from Adlink Technology is a RoHS-compliant 3U 19-slot PXI chassis that provides one system controller slot and 18 peripheral card slots. It also provides uniform air flow for each slot with a maximum 10% difference in temperature measured on load boards during testing. The fans pull cool air in from the bottom of the chassis, through the PXI modules, and then exhaust it out the rear. This design minimizes hot air draw from the rear of the rack where all other devices typically exhaust.

Through a feature the company calls "smart chassis management," fan speed is controlled either automatically based on the internal temperature or manually through user input. Chassis temperature, fan speed, and system voltages are self-monitored to ensure system stability. The PXIS-2719 also supports remote management by providing chassis status through an RS-232 connection. An optional rack-mount kit allows the chassis to be recessed up to 10 cm in a cabinet rack to accommodate multiple wires and connectors or mass-interconnect modules.

Adlink Technology, www.adlinktech.com.