High Speed PXIe Instruments:

What to do with the potentially massive volume of high-speed data they produce.

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The PCI eXtensions for Instrumentation, or PXI bus, is firmly established in the world of test. Instrument manufacturers have exploited the PXI back-plane standard to create modular, configurable, high performance test systems. Numerous vendors now offer over 1,500 products that allow the test engineer to chose from a virtually unlimited combination of modules, accessories and software to quickly build highly optimized environments for each testing challenge. However with the growing success of PCI Express in compute intensive arenas such as display graphics and other bandwidth demanding applications, the standard is finding applicability in the test instrument domain.

By utilizing PCI Express capability in the back-plane, a new breed of PXI Express instruments have been emerging over the past several years. PXI Express leapfrogs PXI band-width limits of 132 MB/s to 1 GB/s (peripheral bus) which is a substantial increase in potential data transfer speed. One stand-out feature of PCI Express is a point-to-point bus topology. Gone is the shared bus of PCI. Now a shared switch capability allows each device (instrument, peripheral) to control direct peer to peer communication over the bus. Each device has its own dedicated data pipeline. Data packets move through "lanes" which support transfer rates of 250MB/s per direction, per lane. Lanes can be combined into x2 (by two),x4, x8, x16 bundles to increase bandwidth for faster data streaming. At this point many instrument vendors are offering 4 lane implementations.

It is clear that this new found speed and flexibility is changing the world of test automation and other data intensive activities. But with this new functionally comes the question "Can we record, archive and potentially playback all the data gathered during data acquisition, test or signal monitoring? Again PCI Express provides the answer.

PCI Express-based high speed digital recorder and playback subsystems have entered the playing field. Today there are recorders capable of handling data streams of up to 800MB/sec for prolonged periods with data capacities of 32 Terabytes or beyond. These recorders link directly with the automation environment with no need for a host computer and the potential overhead of operating system delays and file system extensions. Specialized storage systems of this type are deterministic by design and stated streaming rates can be depended on. Typical storage systems including RAIDs are often characterized by best-case burst data rates. This inherent unpredictable performance can lead to data loss and overall system degradation.

The increased performance of the PXI Express implementation and associated real-time storage systems will also allow the development of test systems that can aggregate the data streams from multiple instrument cards to a single recording system. With a directly addressable storage system on PXI Express, these instrument cards can send data to a common recording system up to the aggregate data rate capability of the recording system. For example, an application requiring 6 channels running at 50MS/s (2 bytes/sample) might use 3 – 2 channel acquisition cards all sending data to a single recorder on the PXI Express bus since the aggregate data rate is 600MB/s. For high channel count applications this will provide a lower cost and simpler solution over what is available on PXI today.
Recorders need also to be very fast playback platforms. For example a large data sample collected in the field can be reused many times in the laboratory setting. With real time playback performance

numerous scenarios can be tried against the data-set without the cost of recreating the events in the real world. Post evaluation of field data allows the insertion of trigger event alerts and closer review of edge conditions can be made that would normally interrupt field data collection.

Another consideration with recorder selection centers on supported data transfer standards and protocols. Although this paper focuses on the PCI Express interface for data recorders there maybe a requirement for more specific hardware interfaces. Commonly supported hardware interfaces include optical high speed serial, copper high speed serial and LVDS. Protocols including SerialFPDP, 10GigE, SerialLite II and LVDS are used extensively and should be supported by the recorder vendor.

PXI Express has changed the world of test automation. Instruments are now faster, data sets are larger and real time data must be recorded and played back with precision. Ultra speed storage has benefited from the PCI Express evolution. Deterministic recording performance and real time data playback expand the utility of the test automation environment and open the door to greater flexibility and creativity.

Conduant, located in Longmont, CO, has been focused on high-speed long duration data recording and real time playback for 14 years. The key to Conduant's expanding line of StreamStor® controllers is an on-board Real Time OS and deep memory buffer for maximum adaptability in high performance environments. Conduant’s equipment is used by over 300 companies around the world. For more information please visit: www.conduant.com