YEARS OF INNOVATION PROVE VXI TO BE AN ESTABLISHED BUS

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November 2007

Abstract - For the past 20 years, military and aerospace programs requiring long cycles have looked to the VXIbus for solutions. VXI's long history as an open industry standard, continued innovation, and steady growth have fueled the popularity of this platform. Furthermore, since 1989, the MXIbus has provided remote control options with high-performance and low-cost solutions for VXI systems. This and the development of cabled PCI Express technology for remote control of VXI ensure that the platform will be supported for many years to come.

INTRODUCTION

Ever since the VXIbus Consortium was formed in 1987, the VXIbus has proven to be a well-supported platform for instrumentation systems. As an open industry standard, the VXIbus maximizes reliability and life cycles, making it an ideal platform for automated test equipment (ATE) applications used in industries such as mil/aero.

A large part of the VXIbus success is due to its interoperability with multiple vendor instruments and multiple industry-standard platforms. By using VXI in hybrid systems, engineers can choose the appropriate bus and instruments for their applications. Furthermore, the MXIbus provides remote controller options for VXI systems, which incorporate the evolving technology of the PC, such as PCI Express. This has proven to decrease cost and improve performance. MXI-based VXI solutions are commonly used in mil/aero programs such as the U.S. Navy's Consolidated Automated Support System (CASS) to test electronics and avionics.

THE VALUE OF AN OPEN INDUSTRY STANDARD

For the past 30 years, there have been four major open industry-standard buses, GPIB, VXI, PXI, and LXI. IEEE standardized GPIB in 1975. Developed in the late '60s by Hewlett-Packard, GPIB was designed to enable easier communication between instruments and controllers. Since its mainstream acceptance in the early '70s, GPIB has been incorporated into thousands of instruments and continues to be included in new instrument designs.

The second open industry standard for instrumentation systems was the VXIbus. The VXI specification was defined in 1987 and accepted as an industry standard by IEEE in 1993. The definition of the VXI specification was driven by the U.S. Department of Defense and its need to reduce the physical size of rack-and-stack instrumentation systems, create tighter timing and synchronization between multiple instruments, and achieve faster transfer rates than GPIB could offer.

The third major industry-standard bus was PXI (PCI eXtensions for Instrumentation). Introduced in 1997 by National Instruments and adopted as a standard in 1998, PXI is designed for high-performance measurement

and automation applications that require a rugged industrial form factor.

The newest standard, LXI, was released by the LXI Consortium in 2005. LXI is the LAN-based successor to GPIB and adds more features to LAN-based instruments.

By building systems based on open industry standards, engineers can choose components for their systems based on their requirements, regardless of vendor. Open standards also allow for the use of hybrid systems. Engineers can use VXI for a portion of an application and GPIB or PXI for another portion because of the interoperability of open standards. This ensures that once a system is built, the investment continues to pay off for many years to come.

VXIBUS BENEFITS

Because many of the largest VXI instrument vendors belong to the VXIbus Consortium and VXIplug&play Systems Alliance, engineers can be assured that components from different vendors work reliably in the same system. Members of these organizations have combined their expertise to develop sound standards for both hardware and software, which has brought the VXI industry into a new generation of instrumentation – a generation that stresses ease of use and open systems without sacrificing flexibility or performance.

VXI has been around for 20 years, so there is a rich product offering, software support is better than ever, and system integration is easier than ever. With its vast install base, VXI is engrained in many strategic applications.

VXI SOLUTIONS FOR MIL/AERO APPLICATIONS

Because of the longevity and reliability that the VXIbus offers, VXI-based solutions have been implemented in numerous mil/aero applications. Some of these programs are shown in Table 1.

Program	Developed By	Developed For	Purpose
CASS	Lockheed Martin	U.S. Navy	Standard ATE for electronics and avionics
VIPER/T (TETS)	DME	U.S. Marine Corps	Primary piece of test gear
RTCASS	Boeing	U.S. Navy	Support existing CASS weapons system test program sets
JSF LM-STAR	Lockheed Martin	U.S. DoD	Used in applications from manufacturing to environmental stress screening to depot testing on the more than 3,000 planned Joint Strike Fighter aircraft
VDATS	Robins Air Force Base	U.S. Air Force	Tests multiple avionics components
IFTE	Northrop Grumman	U.S. Army	Tests electronic and electro-optic weapons devices
ESTS	Northrop Grumman	U.S. Army	Part of IFTE
EA-IAIS	BAE Systems	U.S. Air Force	Tests ALQ-131 and ALQ-184 electronic attack pods

Table 1. Military/Aerospace Programs Using VXI Solutions

These applications rely heavily on the reliable VXIbus, which has outlived many of the initial units under test. There is no indication that the VXIbus will be designed out of these programs in the near future.

THE EVOLUTION OF THE MXIBUS

The MXIbus, which was defined as an open industry standard in 1989 by National Instruments, provides a high-performance way of controlling VXI systems using commercially available desktop computers and workstations. Because the PC industry is constantly evolving, the MXIbus allows VXI to leverage the latest technology.

MXI combines the performance benefits of an embedded VXI computer with the flexibility of a general-purpose desktop computer. With a PC-based MXI approach, engineers can add value to their VXI instrumentation systems by using technologies that make sense from both a cost and performance perspective.

With MXIbus, engineers can interface industry-standard desktop computers to VXIbus or VMEbus; create multiple chassis configurations by using VXI-MXI or VME-MXI extenders; and integrate VXI and VME chassis into the same test system.

Figure 1 shows the evolution of the MXIbus and its long-term stability since its inception in the late ’80s. The innovation and longevity of the MXIbus make it an ideal solution for applications requiring long life cycles.

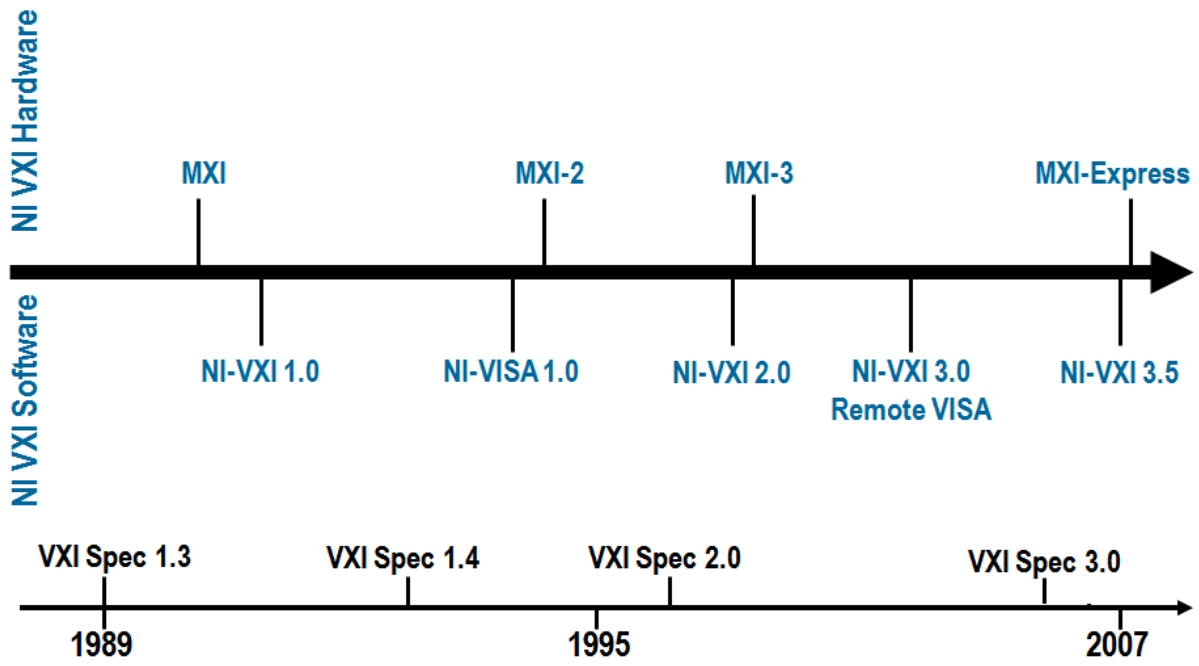

Figure 1. National Instruments MXI Controller History

The long history, continued innovation, and ease of use of the MXIbus have helped establish the VXIbus as a dependable platform for years to come.

STEADY GROWTH PROJECTED FOR VXI

According to the *Frost and Sullivan World General Purpose Test & Measurement Equipment Markets*, the growth rate of the

VXI market is forecasted to be steady around 4 percent for the next several years. "The world VXI test and measurement equipment market is projected to grow to $267.0 million in 2007 and $315.0 million in 2011. Overall, the world VXI test and measurement equipment market is projected to attain a CAGR (Compound Annual Growth Rate) of 4.2 percent over the period 2004 to 2011." Table 2 shows the projected growth in revenue and percent growth rate of the VXI test equipment market through 2011.

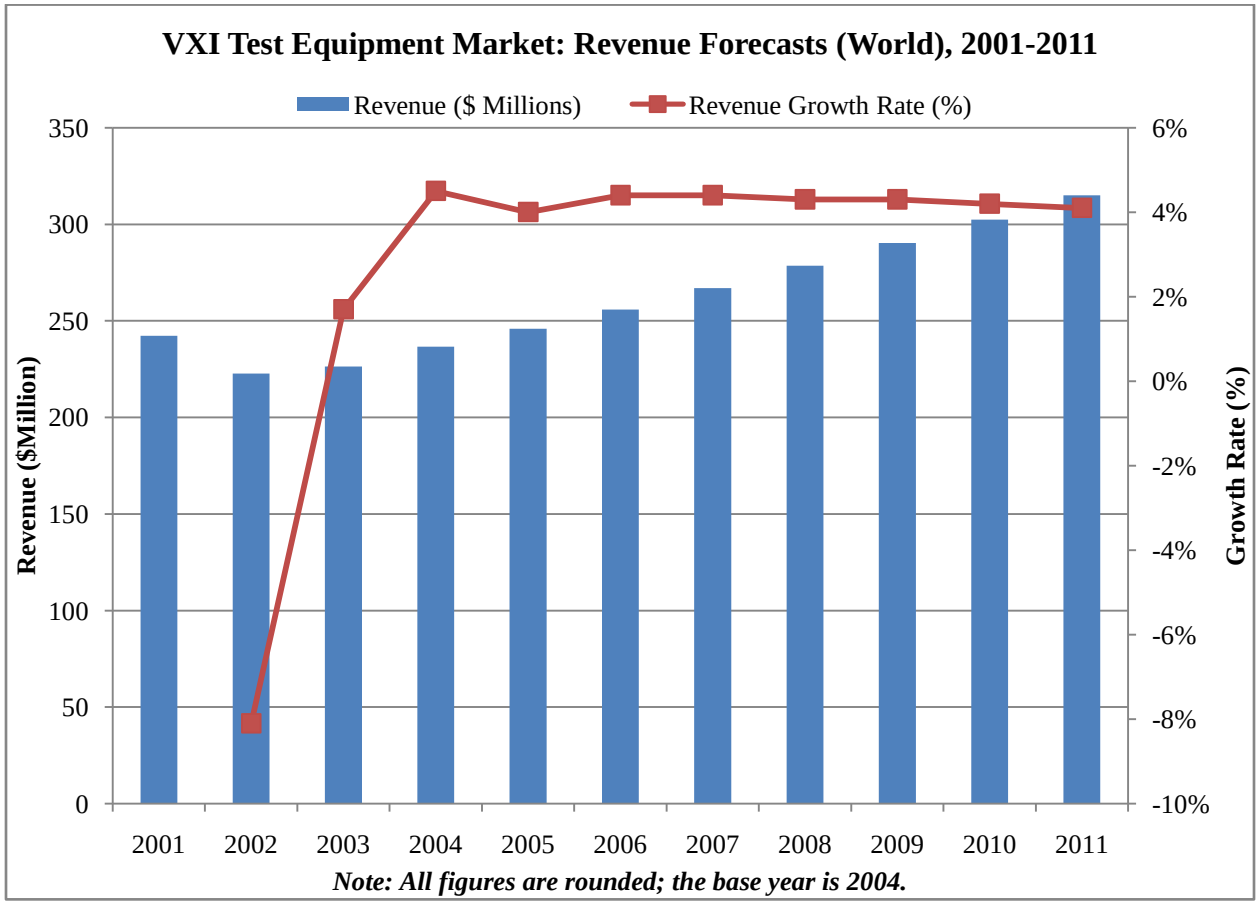

Table 2. VXI Test Equipment Market Revenue Forecasts
Source: Frost and Sullivan, 2005

The steady growth rate further confirms that the VXIbus is established and will provide solutions for ATE systems for the next several years.

CONTINUED INVESTMENT IN VXI

Many vendors continue to invest in the VXI industry. For example, ZTEC Instruments recently released a software developer's kit (SDK) and drivers package for its PCI, PXI, and VXI modular oscilloscopes. ZTEC also announced the ZT4610 and ZT450 families of digital storage oscilloscopes, which are available in VXI. And EADS North America Defense Test & Services introduced the high-density VXI Racal Instruments™ Adapt-a-Switch® X-Series modular switching products.

National Instruments is also continuing its investment in R&D with support for VXI controllers. In December 2007, NI will release a VXI-MXI-Express remote controller

incorporating the high bandwidth and low latency of the PCI Express bus (see “Cabled PXI Express for VXI Remote Control”). Also planned is a VXI embedded controller that will be aligned with Intel’s embedded roadmap. NI is committed to supporting VXI customers for the next several years by continually investing in VXI controllers.

CABLED PCI EXPRESS FOR VXI REMOTE CONTROL

A current usage ofCurrent test and measurement applications often incorporate cabled PCI Express to connect a host PC to a PXI chassis with sustained transfer rates of roughly 830 Mbytes/s. The high performance, low cost, and easy connectivity of cabled PCI Express make it ideal for a number of measurement applications. For example, the National Instruments VXI-MXI-Express, a PCI Express-based VXI remote controller, uses cabled PCI Express technology to provide a viable replacement for the VXI-MXI-2.

Tests of the VXI-MXI-Express remote controller have demonstrated performance comparable to the VXI-MXI-2. On specific types of commands like word serial VI write, high-level access, and low-level access, the VXI-MXI-Express achieved performance greater than the VXI-MXI-2. This improvement occurs due to the low latency of the PCI Express bus. Previously, other VXI remote controllers, including those based on IEEE 1394 and USB, were not able to achieve performance equal to the VXI-MXI-2 due to the latency of those buses. With PCI Express, however, the low latency bus enables performance equal to or even greater than the VXI-MXI-2.

SUMMARY

The VXIbus has proven to be established due to its long history as an open industry standard, continued innovation, and steady growth. As the MXIbus continues to evolve by leveraging current technology, VXI systems will continue to be a viable solution for ATE systems.