Instrumentation bus history

By Tim Carey

Instrumentation bus technology has evolved quite a bit throughout the past 30 years. For standalone general-purpose instruments, the main bus technology during this time has been General Purpose Interface Bus (GPIB) and, to a lesser degree, RS-232, with more recent emergence of Ethernet, Universal Serial Bus (USB), and IEEE-1394 (Firewire). For modular instruments, the main choice has been VXI based upon an evolution of VME and PXI, an evolution of PCI and CompactPCI with PXI emerging as the front runner. In this article, Tim compares standalone and modular instruments and describes why his company ultimately chose PXI.

Standalone vs. modular

Because of its track record of decades of reliability and compatibility, the standalone GPIB bus has earned an unrivaled position at the top of the test and measurement world. Since its inception in 1975, there have been approximately 5-10 million instruments deployed with a GPIB interface. Anyone would be hard-pressed to find a measuring instrument for system applications that is not equipped for the GPIB bus. Due to this fact, any modifications made to this standard must be compatible with current technologies to be beneficial to GPIB users. This requires the HS488 extension proposal, which is currently presented for adoption by the American IEEE TC-8 committee, to adhere to current compatibility issues. The goal of HS488 is to ensure that new technologies are compliant with instruments that operate with both the HS488 and GPIB protocols.

Modular bus technologies have evolved from VME into VXI, and more recently, from PCI into CompactPCI and now PXI. PXI was designed to bridge the gap between desktop PC systems and high-end VXI and GPIB bus systems. While standard PCs offer a very low-cost option for instrumentation systems, they fail to meet many of the needs of industrial and embedded applications. VXI and GPIB systems meet the specific needs of instrumentation users, but are often too large and expensive.

While PXI extends CompactPCI, it also maintains complete interoperability so the user can deploy any CompactPCI-compliant product in a PXI system and vice versa. PXI extensions also leverage off other standard technologies, such as Windows software, VXI timing and triggering, VXIplug&play instrument drivers, and international environmental testing standards to deliver a powerful and affordable system.

Modular bus technology offers many advantages over older bus standards. However, it must overcome an enormously installed worldwide base of users. Figure 1 to the right shows the instrumentation bus milestones during the last 30 years.

PXI is an ideal architecture for rapid product and custom solution development. This stable architecture has become an essential requirement to remain competitive and to satisfy market needs in fast evolving communications development and manufacturing applications. Table 1 shows a comparison of standalone and modular test platforms. PXI's modular architecture leverages a single user interface and a common chassis that enables much higher bus speeds and lower system cost. Modular instruments don't need multiple power supplies, cooling, built-in controllers, or front panels.

Taking PXI into the realm of RF communications

As part of its strategy to provide customers with flexible and cost-effective test systems, Aeroflex has launched the Aeroflex 3000 series, a PXI-based modular test suite for mobile phone and general-purpose wireless testing. This test suite is shown in Figure 2. Aeroflex has made it a high priority to market

	Standalone	Modular	
	GPIB	VXI	PXI
Speed	1 Mbyte (488.2) to 8 Mbytes (HSS488)	40 Mbytes to 80 Mbytes (VME64)	132 Mbytes
Timing and Synchronization	None	Defined	
Product Availability	>10,000	>1,000	~1,000
Form Factor	Large	Medium	Small/Medium
Standard Software Framework	None	VXIplug&play	
Modular	NO	YES	
EMI Shielding	Optional	Defined	Module Specific
System Cost	High	Medium-High	Low-Medium

Table 1

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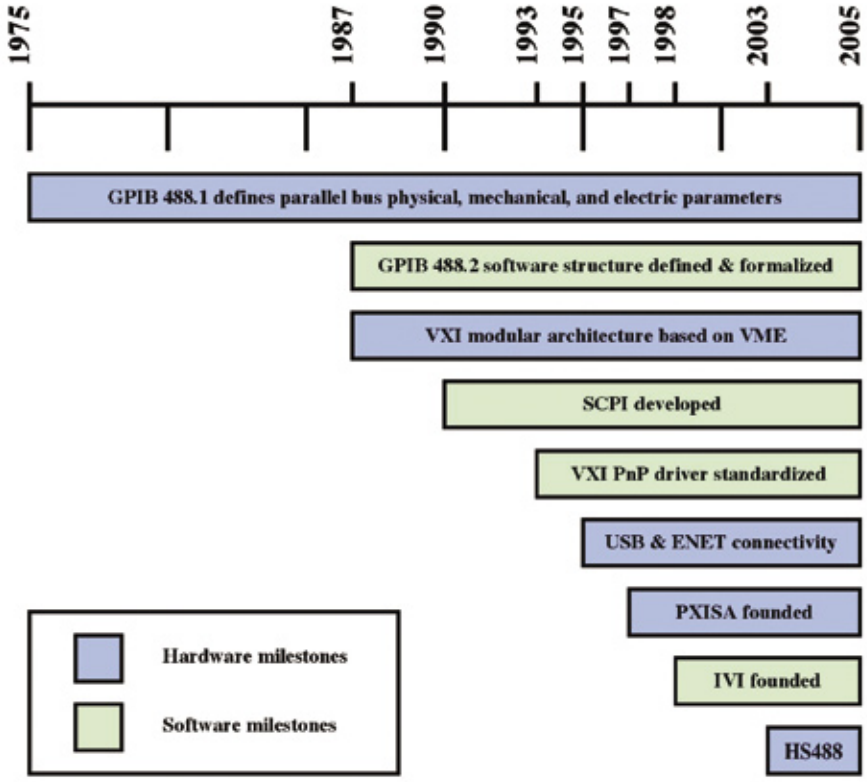

Figure 1

Figure 2

high-performance RF test capability on the PXI platform. With a long history in systems development, Aeroflex is extending its vast systems and RF experience into the PXI instrumentation market. Now, both high-performance and low-phase-noise capability are available in PXI. Aeroflex engineers designed the PXI modules to cater to the broadest possible range of mobile terminal markets, including private mobile radio, cellular, WLAN, cordless telephone, and military radio systems.

The Aeroflex 3000 series encompasses four PXI modules and complementary software applications for RF signal generation and RF signal analysis. Signal analysis software applications address the specific needs of GSM/EDGE and UMTS/WCDMA mobile phone testing, whereas signal generation applications additionally provide a broad range of other standards and generic system personalities. The new PXI modules include:

- 3 GHz RF synthesizer
- 2.5 GHz RF signal generator
- 3 GHz RF digitizer
- 2.5 GHz RF combiner

RF performance breakthroughs for PXI

Aeroflex used the digital RF synthesizer as a test bed for proving the viability of using PXI for RF instrumentation. Aeroflex based the RF synthesizer on the company's patented fractional N synthesizer technology. It provides a low-noise local oscillator input to other modules. The 3010 digital RF synthesizer is an industry first for PXI. The 1.5-3.0 GHz frequency synthesizer offers low phase noise and frequency agility in a single-width 3U module.

The 3020 digital RF signal generator provides modulation and waveform generation, RF leveling, and frequency tuning from 250 MHz to 2.5 GHz, with the 3010 providing the low-phase-noise LO input.

In addition to the groundbreaking 3010 and 3020, Aeroflex launched the 3030, a compact RF digitizer with higher performance than any similar PXI product. The 3060 RF combiner, designed for use in RF test systems in conjunction with the 3020 RF signal generator and 3030 RF digitizer, is the first PXI module of its kind designed specifically for RF component and radio terminal system test.

Aeroflex has carefully defined each module to maximize reuse for the development of future modules. Taking PXI into the realm of RF wireless testing broadens the choices for system developers, and accelerates the adoption of PXI in a major test market.

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