Flexible Test and Development Architecture for Emerging Wireless Technologies

As wireless proliferates, both in platforms and devices, test and measurement take on diverse dimension that requires a new paradigm — flexible, configurable test equipment.

By Joseph E. Kovacs

Wireless is everywhere. We take for granted that consumer products deliver untethered functionality that was not possible or even heard of just a few years ago.

For example, cameras now feature WLAN (802.11x) functionality for immediately uploading images from a camera to the Internet via a Wi-Fi hotspot — no cables required. New alarm clocks provide connectivity to backyard weather stations through remote wireless sensors, providing up-to-the-minute weather details and onboard algorithms generating forecasts based on the collected data. Wireless connectivity has eliminated the need to continually adjust the household clock because new clocks synchronize to the NIST low-frequency atomic clock broadcast on WWVB.

Historically, wireless has been the domain of a small set of specialists focusing on the vertical telecommunications industry. Now, wireless is in the hands of a much broader set of designers. This has increased the applications using wireless technologies, requiring the need for standards and tools, as well as the need for engineers familiar with RF principles.

The following information surveys emerging wireless standards and presents PXI, a modular instrumentation standard, as a flexible test platform solution to meet the needs of fast-changing wireless devices.

New Wireless Standards

Wireless standards are inundating the market at an increasingly rapid rate. Never before have more standards been proposed or needed. Whether through a standards body, task group or forum, more are created every month.

The extreme success of 802.11, for example, and its widespread adoption, has fueled a pipeline of new task groups focused on enhancing the standard. The 802.11n standard, which is due at the end of 2006, promises to increase throughput to at least 100 Mb/s. It uses as much as 40 MHz of bandwidth and will implement some form of MIMO technology.

The 802.16e standard, also known as WiMAX, adds mobility to the 802.16-2004 version of the standard. Although the line-of-sight version of 802.16-2004 operates at frequencies as high as 66 GHz, 802.16e uses frequencies as high as 6 GHz, consuming as much as 20 MHz of real-time bandwidth.

Then there are the 802.15.4 (ZigBee), 802.15.3a (UWB) and 802.22 standards. Although not an exhaustive representation, Figure 2 depicts the increase in the number of standards.

Design and Test Challenges

To provide seamless operation to the customer along with the greatest functional capabilities, new products are implementing multiple coexisting technologies. In addition, the life spans of standards are decreasing as they give way to newer, updated versions. Therefore, design, prototyping and test systems need to adapt quickly to the requirements driven by these standards. An archaic platform cannot deliver the necessary functionality. Each new standard adds another requirement to the test and development system, such as greater real-time bandwidth capability, higher frequency coverage and enhanced or proprietary modulation formats, along with a plethora of new and unforeseen requirements. These requirements challenge the test and development system and the test and design engineer.

Adding emerging technologies such as wireless and multimedia functionality increases system integration and validation times. Surprisingly, the time and resources spent in system validation often equal or exceed the time and resources spent in design.

For example, consider an automotive electronics engineer. A simple AM/FM/cassette car radio from a decade ago has now become an automotive telematics module that integrates audio, video, GPS navigation, diagnostics interfaces and wireless communications functions into a single subsystem. The engineer has to integrate a bewildering array of data, audio, video and RF signal sources and acquisition tools to validate system performance. The design’s mixed functionality causes an exponential increase in the validation effort.

Accelerating development in the face of these challenges requires systematic adoption of new tools and methods throughout the development cycle. Leading organizations are adopting a variety of best practices:

• Early and aggressive use of simulation

- Connecting design, validation and analysis environments
- Common tools and open platforms re-useable across the development flow
- Rapid prototyping methods using hardware/software emulation

As technology continues to evolve, it becomes even more imperative that organizations streamline their processes and adopt methods to accelerate development and test cycles. This also implies that the platform used possess a critical element: *flexibility*.

Required Flexibility

In the past, as new functionality was needed in a test or development system, a company would purchase a new standalone box instrument or a costly firmware upgrade to an existing instrument. Because the rate at which new standards appeared or new functionality was added to existing products was much slower, this capital purchase was not of extreme concern. Today, however, new standards and functionality appear at an accelerated rate. Therefore, a new approach must be adopted to add only the functionality needed and on the same platform — just enough, nothing more. Why purchase a whole cabinet of tools when only one is needed? In addition, this system must be easily upgradeable to take advantage of increases in processor speed to increase system throughput without necessitating the obsolescing of the entire test and development system.

It’s About Modularity

Modular instrumentation is one solution answering this market need. Modular instruments, built on PXI, offer the flexibility needed for testing wireless products. PXI offers mechanical integrity and easy installation and removal of modular hardware components. Because PXI takes advantage of the exponential advances of PC technology, it inherently has the benefits of reduced cost, increased

computational power and a mainstream software model. Need to increase throughput in manufacturing? PXI provides the flexibility to upgrade the system controller to the latest and greatest independent of module functionality. In this way, the original capital investment in test equipment is preserved while at the same time increasing system throughput at minimal cost.

The PXI platform is an open standard with well-defined Windows driver definitions and more than 1,000 I/O modules available from more than 60 vendors. Need to add an odd function to an RF test system like temperature or pressure? Purchase the new functional module, slide it into the chassis and you are ready to go. Along with imaging and motion control capability, PXI provides an unmatched breadth of signal generation, switching and acquisition functionality required for rapid prototyping and test of designs across a broad performance range (see Table 1).

PXI modular hardware integrates with a variety of PC-based simulation, test and analysis software running locally on a PC-based controller, or remotely via Ethernet, USB, GPIB or parallel/serial network interfaces. This combination gives engineers access to cost-effective hardware and customizable functionality and provides an extensible test and development platform.

PXI Systems

Because of PXI’s flexibility, engineers can develop an endless array of systems to test wireless along with many other functions using the hardware shown in Figure 1.

An interesting example is a 4G wireless communications link using OFDM and MIMO antenna technology. Dr. Robert Heath Jr. and his students from WNCG at the University of Texas at Austin built the system. It uses a combination of PXI baseband and RF hardware including a RF vector signal analyzer, RF vector signal

generator, a Modulation Toolkit, Windows OS and LabVIEW graphical development environment for emulation of the design. Heath and his students developed this 4G system quickly, efficiently, and ahead of mainstream knowledge because of the flexible tools and rapid prototyping methods employed. In commercial endeavors, this translates directly into immediate time and cost savings.

For 802.11, SeaSolve Software (www.seasolve.com) and Lyocom (www.lyocom.com) developed 802.11 test software using the PXI RF hardware shown in Figure 2. SeaSolve also developed a compliance system for ZigBee using the same RF system.

AmFax (www.amfax.co.uk) developed a PXI-based GSM/EDGE BTS test system. This turnkey solution provides a faster, cheaper and more flexible solution than the traditional GPIB instrumentation-based solutions on the market.

Wineman Technology (www.winemantech.com) developed a PXI-based test system for tire pressure monitoring systems. Tire pressure monitoring has received attention since Congress passed legislation requiring passenger cars to have these systems starting with the 2006 model year.

DAQTron (www.daqtron.com) developed a hardware and software turnkey cable modem/CMTS design verification system built on the PXI platform.

Other systems for RFID, cellular phones, WCDMA, wireless sensors, wireless telemetry, DVB equipment and satellite radio are being tested using the same PXI platform from National Instruments.

What does the future hold?

As wireless technology continues to penetrate new and existing markets, engineers — along with their test and development systems — will be put to the test. As new wireless products are developed, new standards are born, and consumers continue to demand more functionality crammed into their latest gadgets, organizations will need to migrate to a test and development platform that provides the flexibility to respond to these changes. The PXI platform is one solution that is rapidly gaining acceptance as a flexible test and development architecture for emerging wireless technologies.

About the author

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