Microwave Journal

THE LXI STANDARD: PAST, PRESENT AND FUTURE

The idea for an LXI standard was first formulated in 2004. Since then, what progress has been made? What is the role of the LXI Consortium? How does LXI fit with competing standards? Are LXI-compliant products being widely produced and adopted? And what does the future hold? This Special Report attempts to offer some answers.

Test and measurement (T&M) is one of the most dynamic sectors of our industry as rapidly developing technologies require complementary, parallel T&M development to support and augment their implementation. Technological advances are moving apace, particularly in the communications sector as manufacturers of handsets, wireless systems, etc. develop products to satisfy the seemingly insatiable demand for the latest innovations. Test and measurement manufacturers have a significant role to play in developing the associated standards, test procedures and protocols for prototyping right through to full production of the end product.

To provide insight into just what this role entails this Special Report focuses on the development of the LXI standard and resultant initiatives and products. First, key figures from the LXI Consortium provide background information, starting from the identification of the need for a new standard, then chart its development and proffer future goals and objectives. Second, to give a 'coal-face' perspective, representatives from individual companies involved in the development of the standard and compliant products answer questions on their involvement in the development of the LXI standard, its adoption, the availability of compliant products, international reach and future developments.

DEVELOPMENT OF THE LXI STANDARD

Bob Helsel, ***president of Bode Enterprises and executive director of the LXI Consortium, and*** **Fred Bode,** ***retired president of Bode Enterprises***

The LXI standard is the result of several change vectors prevalent at the beginning of this millennium. The Ethernet had become more ubiquitous and a number of test and measurement companies began experimenting with this interface. No one, though, had solidified this into a vision or a set of products that challenged the current dominant interconnect for instruments—GPIB—although it was clear that a successor for GPIB was desired for many applications. Many interfaces had been proposed and introduced on instruments. Firewire, or IEEE-1394, and USB were leading contenders at

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one time, and a few products were introduced with these interfaces. However, it was generally recognized that Ethernet was the obvious choice, but there was no agent for change.

That was until 2004 when Agilent Technologies and VXI Technology banded together and proposed forming an open consortium for standardizing Local Area Network (LAN)-based instrumentation systems. After publicly announcing the initiative at AUTOTESTCON 2004 in September of that year the first meeting was held in Salt Lake City, UT, in November 2004. Over 50 people encompassing vendors, systems integrators and end users attended the open meeting where a very rough draft of the initial specification was circulated, scrutinised and discussed. Some excellent work had been done in formulating the outlines of the specification and defining particular parameters, but it was clear that there was still a lot of work to be done to complete the specification.

However, from this first meeting, a few things were very clear. First, there was tremendous interest and enthusiasm in this new proposed technology from the test and measurement industry. Second, many companies in attendance had thought about connecting their instruments to computers via a LAN interface and many had done some preliminary investigations into how to develop such an interface. Third, there was virtually unanimous agreement that an industry standard for LAN interfacing of instrumentation was needed and viable.

From this positive standpoint, what followed was an extremely rapid formation and development of the LXI standard from draft to first release, very strong growth in the membership of the LXI Consortium and the rapid introduction of new products that were conformant to the standard. To put the pace and extent of these developments into perspective consider the initial accomplishments.

Within the first two months the LXI Consortium had been joined by five additional Sponsor members, bringing the number of Directors to seven. They had elected officers, hired a management firm (Bode Enterprises), set up a Technical Committee, formed six Technical Subcommittees to work on various aspects of the specification, hired a firm to develop the *LXIstandard.org* web site and began holding weekly technical subcommittee meetings.

Within 18 months of the concept being first introduced the membership had grown to over 40. The first release of the LXI standard was at AUTOTESTCON 2005, less than nine months after the first meeting of the LXI Technical Committees in January of 2005. At AUTOTESTCON 2006 over 150 products had been introduced by a large array of instrument vendor member companies, which had been invented, tested for compliance and offered for sale.

This momentum has continued and to explain some of the intricacies of the LXI standard's progress, its place within the larger LAN/instrumentation picture and future development, consider some pertinent questions.

First, "Isn't LAN already a standard?" Of course, LAN is a well-established standard, and the Consortium follows it completely. This is especially important since the design and protocol (TCP/IP) is very widespread and universally recognized. In addition, LAN data transfer speed is flexible and has been designed in such a way as to grow with technology. While initial LXI implementations are required to work with 10 MHz systems, most implementations are being designed to work with 100 MHz systems, which are currently being deployed. 1 GHz systems are available now, and the LAN and LXI standards will be able to seamlessly adopt the new faster implementations as they develop.

The answer to the question, "What else needs to be added for instrumentation systems?" is quite a bit, actually. Particularly significant are the 'extensions for instrumentation' that LXI has standardized. The first to look at is *Discovery*, which is when a new printer (or other standard peripheral, such as a scanner or hard drive) is connected to a PC, it notifies the user of the new device, identifies the type and suggests the right driver. The user may still have to locate the correct driver, download and install it, but MS Windows makes this fairly straightforward. However, there are millions of these similar devices and Microsoft is very interested in making this interconnect easy for its millions of consumers. The test and measurement industry is much smaller and has hundreds of instrument categories, in each of which the number of installations is probably only in the thousands. This makes each instrument category three or four orders of magnitude less important to Microsoft (or any other OS developer).

No matter how much we would like connecting a new instrument to a PC to be as easy as hooking up a new printer, Microsoft is not going to do this for us. Therefore, we need agreement on some software that will help in this process. The industry already has such a standard, called VXI-11, which was developed by the VXIbus Consortium, but works for other interconnects too. It is a little cumbersome but it is well proven and currently available. The computer industry is working on additional standards in this area, and the LXI Consortium plans to follow this development and may adopt a more elegant way of discovery in the future, but for now, it has adopted the VXI-11 method and made it a requirement for LXI-compliant devices.

With regards to the *Web Interface* extension, the natural way for any computer controlled device to be controlled when it is initially connected is through a computer screen interface, in this instance, a web interface. There are thousands of ways to design a web interface, but upon studying the problem, the LXI design engineers all agreed on a specific set of functions.

For instance, the LXI Web Welcome Page requires the following information: Instrument Model, Manufacturer, Serial Number, Short Description, LXI Class (A, B or C), LXI specification version (initially Rev. 1.0), Host Name, MAC address, TCP/IP address, Firmware of software revision and IEEE-1588 current time (optional for Class C devices). LAN Configuration Web Pages and SYNC Configuration Web Pages have similar lists of required information. Standardization of this information goes a long way to ensuring that the system integrator will have the information needed to quickly implement a system and this will help ensure rapid implementation of LXI systems.

For *Software Control of the Instruments – IVI Drivers* the industry has been working for many years to standardize software solutions to help test engineers control their instru-

ments. This started with the Standard Commands for Programmable Instruments (SCPI), which was first introduced in 1990. That effort gave way to VXIplug&play drivers, introduced in 1995, which used SCPI commands as their default command set. As the demand for an even more robust standard became evident and the requirement for interchangeable instruments and drivers rose in importance, the Interchangeable Instruments Foundation (IVI) was formed by the same manufacturers who had worked on SCPI and VXIplug&play standards. Both of these former organizations were absorbed by the IVI Foundation and the resulting IVI Driver standards are well recognized as 'the' software driver standards supplied by the leading test instrument vendors. LXI requires that an IVI compliant driver be supplied with every LXI instrument.

With regards to *Hardware Triggering* any LXI device can supply trigger signals or receive triggers in a wide variety of ways. Most current programmable GPIB instruments can receive or provide triggers via external BNC connectors, or via software over GPIB. This is also perfectly acceptable for any LXI device, if it provides acceptable trigger precision. However, triggering precision has undergone considerable advances since GPIB was invented some 35 years ago.

Therefore, both VXI and PXI, with their controlled impedance backplanes and known distance between modules, have been able to offer the industry much tighter triggering. Considerable effort has been invested in working with commercial manufacturers of connectors, cabling and internal circuits to develop unique hardware trigger systems that could match or exceed anything available, without the constraints of a fixed backplane and this is available on Class A LXI instruments.

Finally, there is *Software Triggering, Time Stamping and IEEE-1588 Capability – The Precision Time Protocol*. Perhaps the most exciting and interesting new capability introduced to the industry by LXI is the adoption of the IEEE-1588 Precision Time Protocol. This new standard has already been adopted by other industries, but is just now being introduced into the test industry. Briefly described, it allows all instruments on the same network to automatically look for the most accurate clock available to them on their internet subnet, synchronize to it and then provide either time of daytime stamps or synchronization signals to all instruments with exceptional accuracy. It also provides peer-to-peer communications between instruments (relieving traffic congestion and loading of the control computer). We are still learning about this capability as new implementations appear and, as time goes by, this may be the most important aspect of LXI.

Another pertinent question is: "By adding additional requirements, do you break LAN compatibility?" The answer is a resounding no. All LAN requirements are intact, and we expect to be able to follow the developments of the LAN development with complete transparency.

Also frequently asked is, "Do I have to wait for enough LXI instruments to make a complete system, or can I mix VXI, PXI or GPIB instruments in the same system with LXI instruments?" Again, the answer is easy. LXI instruments are expected to be used in test systems with legacy instrumentation that already exists. This includes GPIB instruments, clusters of LXI and/or PXI instruments, and perhaps other interfaces. It is extremely important that LXI instruments integrate easily with other interface technologies, and the LXI Consortium is working on specifying bridges and enhancing our own specifications to make this transition easy and transparent. While testing is still ongoing, we have not yet found a combination that could not be accomplished, usually in a very straightforward manner.

Perhaps the most important question though remains, "Is LXI a viable replacement for GPIB, and if so, will it be successful?" There is no doubt that the jury is still out, but some pretty strong indicators are already visible. First, there is the impressive list of enhancements to LAN listed above. Then there are the advantages that LAN brings to instrument connectivity when compared to GPIB even without any of the LXI enhancements. These include low cost cabling and no requirement for a GPIB interface card, no distance restriction, whereas GPIB is limited to 20 m, no restriction on the number of instruments, while GPIB is limited to 14 instruments per interface, and the LAN speed is faster for large data transfers and will get faster still as internet technology progresses.

Also, the cost to implement basic LXI requirements (Class C) for instrument manufacturers is low, as LAN technology is mass produced and very inexpensive. This may eventually drive down the cost of instruments, although for some time vendors are expected to provide LAN interfaces in addition to GPIB and other current interfaces.

What cannot be ignored is the overwhelming acceptance of the concept by the test and measurement vendor community, as evidenced by the growth of the LXI Consortium membership, the intense activity for specification development and immediate product introductions.

That said, it is also true that the T&M user community is very conservative and adopts new technology slowly. Most test engineers subscribe to the old adage, "If it ain't broke, don't fix it," as do we. The intriguing point of the argument then, is that GPIB is not broken. It works just fine. Sure, it may be a little slow for some applications, but it works for most. It may be a little more expensive, and the thick cable is a pain, but users are used to it, and it is not that burdensome.

SUMMARY

After tracing the developments and presenting the evidence what can we conclude? Undoubtedly, users will vote with their money, but the momentum behind LXI is fairly overwhelming. Some unforeseen glitches could still be encountered, but we are beginning to get some significant experience with implementation, both in developing compatible instruments and by initial systems integrators developing systems.

So is GPIB dead? Not by a long shot. GPIB instruments will be around for a very long time… probably another 35 years or so. However, as more LXI instruments are introduced, and as more systems are implemented using LXI, we believe the inherent advantages of LAN and the enhancements offered by the LXI extensions will become increasingly apparent. As more IEEE-1588 imple-

mentations appear, these will foster new applications not possible by GPIB instruments, which will open still more applications.

And if more powerful tools for systems integration through the use of the internet are provided, then LXI will, over time, become the de facto instrument standard that GPIB has been for the last 35 years. Of course, this will not happen overnight. It may take five or possibly 10 years, but it will happen and hopefully the preceding explanations have proffered the reasons why.

A COMMERCIAL VIEWPOINT

That is the history, background, development and prospects for the LXI standard, but what are the practicalities of promoting, developing and selling LXI compliant products. To get another perspective, this time from the manufacturer's point of view, *Microwave Journal* asked representatives from leading T&M manufacturers, who are also key players in the LXI Consortium, questions designed to give a commercial insight into the development of the LXI standard.

COMPANY SURVEYS

Aeroflex Inc.

David Poole, *technical fellow, Aeroflex; chairman, Hybrid Systems, Physical Specifications and Resource Management Working Groups, LXI Consortium*

MWJ: *Briefly explain Aeroflex's role to date in the development of the LXI standard.*

DP: Aeroflex has been very active in supporting the development of the LXI standard. We are a Participating Member of the Consortium and, as such, work very closely with the other members, while also advising the Board of Directors on various matters. At the initial meeting of the Consortium we volunteered to chair two working groups—the Programmatic Interface WG (which we led for 18 months) and the Physical Specifications WG, which defines the mechanical, thermal and electrical standards for LXI devices. Since then we have also chaired two of the new working groups that were formed to solve specific applications: Hybrid Systems was tasked with establishing interfaces to non-LXI instruments; and Resource Management with developing specifications for the control of LXI devices assembled into an integrated system in a multi-threaded environment for use by more than one client. We also continue to participate and advise at various levels in the LXI Consortium, including on the other working groups and the Technical Committee.

MWJ: *What do you see as the next key stage of development of the LXI standard?*

DP: The IEEE-1588 version 2.0 standard (due out near the end of 2007) will bring improvements in terms of reduced uncertainty in system wide timing with possible applications to any large scale test system. It will have the capability to synchronize all test and data tag times of LXI Class A and B devices to around 10 nanoseconds (from the 50 nanoseconds of V 1.0) using only the LXI Ethernet bus. The Consortium is also pursuing the development of conformance tests that will allow manufacturers to certify their own instruments, which will definitely help the manufacturing base. However, it seems clear that LXI will have to go through the adoption phase by both commercial and military users before any more major developments can occur. The Consortium will be actively focusing on this aspect over the next year.

MWJ: *As they are developed are LXI products being readily accepted and adopted?*

DP: LXI is still in its infancy and it is difficult to gauge the impact on the overall market. There were over 170 LXI products registered with the Consortium at the end of 2006, and it is clear that these manufacturers believe it has a bright future. The LXI specification is also starting to emerge in some procurements. Overall, it seems a natural step for instrument customers to use the ubiquitous LAN bus to connect various devices into a system. Consequently, we assume that LXI devices will generally be accepted by some segments of the test market.

MWJ: *Generally, do potential customers need to be educated as to the benefits of LXI products and if so how can this be best achieved?*

DP: There is no easy answer to this question since the knowledge of LXI and the inherent advantages vary widely across the customer base. There is still a strong market and a well-established customer base for PXI and VXI products. Consequently, LXI will have to compete with these other standards and start establishing a footprint of its own. Doubtlessly there are real advantages to all these standards and form factors in different applications. At this point in time all indications point toward coexistence of the various standards as well as possible integration of VXI, PXI and LXI-based devices and system components.

MWJ: *The vast majority of the member companies of the LXI Consortium are North American. Is this a true reflection of the global commitment to LXI?*

DP: At present there are many North American members. However, there are also T&M OEMs such as Agilent, Rhode & Schwarz and Aeroflex that are very active with an established global presence. Now that the initial specifications have been defined the Consortium is also focusing on Europe and Asia since there is a significant interest in LXI in these geographical areas.

Agilent Technologies Inc.

Bob Rennard, *program manager, Agilent; LXI Consortium president*

MWJ: *Briefly explain Agilent's role to date in the development of the LXI standard.*

BR: Agilent, along with VXI Technology, founded the LXI Consortium in 2004 following some conversations where we realized we were pursuing very similar paths. We also noted others were pursuing LAN-based instruments as well and we reasoned it made more sense to collaborate as an industry standard than to develop independent implementations. Our goal was simply to recommend a common LAN implementation to ensure instruments behave in a consistent manner, simplifying life for system designers and integrators. LXI is

really a bunch of test and measurement companies who recognize that LAN is an ideal interface for test systems and agree on a common implementation.

Recognizing the power and potential of Ethernet as an instrument interface, VXIT and Agilent approached other companies in the industry to solicit interest and participation. The response was overwhelming. Most vendors were already developing products with LAN ports on them and we all realized a common implementation would improve multi-vendor interoperability and simplify integration tasks. The two founder companies developed the initial draft document describing LXI and presented it to potential members at the first meeting in Salt Lake City. During that meeting, we proposed a governance structure and set up technical working groups to develop the specification.

Addressing your question directly, Agilent contributed many engineers to help create and test the specification and we license our IEEE-1588 IP to member companies. We also contributed leadership, chairing the Consortium since its inception. Further, Agilent contributes leadership and engineering to IVI, IEEE-1588, DoD SIWG and DoD ATML, organizations that draw upon or contribute technology to LXI.

MWJ: *What do you see as the next key stage of development of the LXI standard?*

BR: As a new standard, LXI's top priority and challenge is to build awareness and preference to spur LXI system demand. We want to show LXI is real, there are real products available and users are building real systems with it. In its first year, over 300 LXI products were launched by test vendors across all product classes. There were 171 by the end of 2006, which ballooned to 313 in January 2007, just 13 months after the first one was certified.

In addition to terrific acceptance by the vendor community, we have seen some very impressive system performance improvements by some leading system integrators. Our biggest challenge now is to spread the word and show how it is done through tutorials, application examples and LXI User Groups.

The top priorities for the LXI Consortium in 2007 include simplifying the LXI infrastructure and ease of adoption for integrators, developing and demonstrating basic and advanced features, and updating the LXI specification and developing marketing programmes to build awareness and preference for LXI as the successor to GPIB.

MWJ: *As they are developed are LXI products being readily accepted and adopted?*

BR: Absolutely. We are seeing a large number of requests for LXI instruments and many leading systems integrators clearly see the benefits of networked test systems. The beauty of LXI is it is just an interface standard. There is a simple migration path from GPIB and other interfaces—integrators can simply swap a GPIB cable for a LAN cable. Yet LXI also gives integrators new tools they can use when they want to adopt them. They get to use the same products with the same performance they are accustomed to. We are seeing LXI products available in both bench top and card implementations, allowing integrators to leverage software and specifications from development through deployment.

LXI, at its basic implementation, simply brings an additional IO to allow networked systems, significantly reducing costs and improving performance over legacy GPIB. At its best, it offers advanced new capabilities like peer-to-peer, downloadable scripts and precision timing capabilities that make high performance synthetic instruments realizable. The DoD Synthetic Instruments Working Group (SIWG) has enthusiastically endorsed LXI and chose it as the basis for military synthetic instrument implementations.

MWJ: *Generally, do potential customers need to be educated as to the benefits of LXI products and if so how can this be best achieved?*

BR: Yes and no. At its basic level, LXI is just another interface and many integrators use the LAN port much as they would the familiar GPIB port. LXI was developed to provide a very easy transition from GPIB to LXI. Integrators can use as much or as little capability as they want without penalty. Think of it as allowing integrators to use the same familiar GPIB capabilities with a new toolbox available when they want and need it.

That said, many systems designers are still unfamiliar with creating networks, particularly without the assistance of IT professionals. In most implementations, LXI will be used in a dedicated subnet, completely isolated from IT, enterprise traffic and bad guys who may lurk on the other side of the firewall. In practice, it is no more complex or vulnerable than familiar GPIB, but it is still new to many systems designers. For that reason, we are putting time and resources into tutorials, best practice guides and infrastructure recommendations to help designers accelerate the learning curve.

MWJ: *The vast majority of the member companies of the LXI Consortium are North American. Is this a true reflection of the global commitment to LXI?*

BR: We view LXI as a global standard and three of the eight LXI board members are international (Rohde & Schwarz, Pickering and EADS). Further, the Aeroflex Board member is European, so the board is essentially half international. We get strong technical participation from the European board members and companies such as B&K in Denmark. However, we are conscious of becoming US centric and we are actively reaching out to the international community. We had a meeting and Plug-fest in Germany last spring and we participated twice in Electronica/Productronica in Germany. We will do that again this year. We have several system integrators and OEM/self integrators throughout Europe actively working on LXI systems for automotive, aerospace and wireless applications.

In Asia, we participated in several Chinese system integrator meetings towards the end of last year. We are engaged with the China Test & Control, Metrology and Instrument Technology Institute, a government supported organization that represents 132 companies in China. Agilent represented the LXI Consortium by presenting at the 2006 Test & Control Bus Technology and LXI Technology Conference in Zhang Jia Jie as well as the 15th China Test & Measurement and Fault Diagnosis Technology Conference in Xi'an, China. We will have our June LXI General Meeting in China and, in addition to these organizations, we have several member companies from Japan, Taiwan and China.

Keithley Instruments

Chuck Cimino, *marketing director, Keithley Instruments; member of the LXI Board of Directors*

MWJ: *Briefly explain Keithley Instruments' role to date in the development of the LXI standard.*

CC: Keithley was the first joining member of the consortium (after founders Agilent and VXI Tech) at the strategic (BoD) level in late 2004. Our technology lab manager was asked to chair the technical working groups that developed the various elements of the standard and continues to do so. Numerous Keithley business and technical people have and do actively participate in the on-going advancement of the standard now in its second version 1.1. We contribute to weekly teleconferences with the LXI BoD, marketing and technical committees, as well as quarterly combined general and Plug-fest conformance testing meetings.

MWJ: *What do you see as the next key stage of development of the LXI standard?*

CC: Moving forward into the development and release of version 1.2 during 2007 there is a roadmap to address the evolution of technologies such as IEEE-1588 v2, newer methods of instrument discovery and the continuous knowledge gained from the vendor and applications communities. Keithley will continue to support the continued adoption and evolution of this important standard as new products continue to emerge.

MWJ: *As they are developed are LXI products being readily accepted and adopted?*

CC: Keithley now has two LXI enabled RF products that are being embraced by our customers in large part due to the advantages of their LXI capabilities. In some cases the remote web browser interface provides useful capabilities and in others the basic Ethernet interface provides lower cost and data transfer advantages. Interoperability with other LXI instruments has also been an advantage of embracing the standard.

MWJ: *Generally, do potential customers need to be educated as to the benefits of LXI products and if so how can this be best achieved?*

CC: Globally detailed LXI awareness remains fairly low despite high levels of PR spending by the Consortium and key members such as Agilent over the past year or so and since the release of v1.0 towards the end of 2005. Keithley has developed a number of presentations on the various aspects and advantages of LXI applied to our targeted applications, and has made them available through various sources. There is still a lot to be done to drive awareness and preference for LXI in the Asia region, for example, and the Consortium and member companies are acting accordingly.

MWJ: *The vast majority of the member companies of the LXI Consortium are North American. Is this a true reflection of the global commitment to LXI?*

CC: Expanding on the comment above about Asia, the Consortium is fully aware of, and concerned about, the urgent need for more international participation. We are actively working on broadening the membership through various PR activities in China, for example. We are also looking to increase liaison leverage through existing and potential international members to increase the international content and preference for LXI.

Rohde & Schwarz

Jochen Wolle, *head of R&D software spectrum and network analyzers; member of LXI BoD, LXI Conformance WG chair*

MWJ: *Briefly explain Rohde & Schwarz' role to date in the development of the LXI standard.*

JW: Rohde & Schwarz strongly supports the LXI Consortium and the move to open standards for modular instrument platforms. LAN is a ubiquitous interface in today's test and measurement world and LXI's LAN-based architecture provides the basis for flexible, modular instruments for the aerospace, defence and communications markets. Rohde & Schwarz joined the Consortium as a strategic member at an early stage in November 2004 and hosted the first LXI Plug-fest outside North America in Munich, Germany, in April 2006. The event had 69 registered attendees representing more than 25 different organizations, encompassing manufacturers, system integrators, customers, universities and the press.

We are contributing to the standard development by chairing the Conformance Working Group and leading the effort to define the conformance process as well as participating in the joint development of the Multi Vendor Systems Demo, which was shown at AUTOTESTCON 2006 and Electronica 2006. Also, Rohde & Schwarz has certified the FSL, FSP, FSU and FSQ spectrum analyzer families as well as the SMU, SMJ and SMATE signal generators as LXI compliant, making a total of more than 20 instruments.

MWJ: *What do you see as the next key stage of development of the LXI standard?*

JW: The LXI Consortium is currently working on the LXI Standard Release v1.2. The working groups are actively developing the specifications for resource management and for an enhanced discovery protocol based on XML schema. The upcoming new release v2.0 of the IEEE-1588 precision time protocol will also be adopted by the LXI standard and the LXI Consortium is also working on a self-certification process supported by tools for LXI Class C devices.

MWJ: *As they are developed are LXI products being readily accepted and adopted?*

JW: We are seeing a growing interest in the LXI standard from our customers. Nevertheless, customers are still in the investigation phase regarding the benefits and integration of LXI-based test systems. We expect to see more LXI instruments being used in hybrid systems, combining existing GPIB/VXI/PXI-based instruments, together with LXI devices in the near future. As more and more compliant LXI instruments become available, this adoption process will quicken.

MWJ: *Generally, do potential customers need to be educated as to the benefits of LXI products and if so how can this be best achieved?*

JW: There is still a great need to educate potential customers concerning the benefits of the LXI technology. Therefore, the LXI Marketing Committee coordinates the promotional activities with articles, application notes, web blogs, seminars and trade show participation. Rohde & Schwarz is actively involved in all of these efforts and serves as a focal point for the promotion of the LXI standard in Europe.

MWJ: *The vast majority of the member companies of the LXI Consortium are North American. Is this a true reflection of the global commitment to LXI?*

JW: The primary initiators of the LXI standardization were companies in North America. Nevertheless, there has been a growing interest for LXI in Europe and Asia, too. As an example, the June 2007 Plug-fest that will be held in Beijing, China, demonstrates the global commitment being undertaken outside of North America, in order to help promote the awareness of LXI.

CONCLUSION

The development of the LXI standard has come a long way in a relatively short period of time. Instigated by the emergence of LAN and driven by the LXI Consortium and its partners, the standard has gained considerable momentum. They have a commercial interest in making it a success and are striving towards that goal. That said, there is still some work to be done. Technologically, compatibility and interoperability issues need to be addressed, especially if the standard is to be widely accepted by a traditionally conservative T&M user community. Efforts to publicise and extend its global reach are key too. The LXI standard has progressed rapidly and has now reached a critical stage of its development. It will be interesting to see how that development advances over the next few years. ■