Connecting You To The Future

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Good Morning. Thank you Forrest (Staffanson, general chairman of AUTOTESTCON 98) for that introduction and thanks also to Fred Bode and the executive committee for extending me the invitation to address AUTOTESTCON 98. The relationship between Agilent Technologies and the aerospace and defense industry goes back many decades, and I really appreciate the opportunity to give this keynote today. AUTOTESTCON is at a crossroads. The volunteer organizers from the IEEE® recognize that because the military relies more and more on commercial-off-the-shelf solutions, its automatic test equipment issues are shared by many commercial industries.

In fact, I'll not be the only speaker from industry today. A consortium of representatives from a variety of industries including satellite, airline, railroad, automotive, medical and communications is being organized by Bill Ross, deputy director of the Department of Defense s automatic test systems executive agent office. One of the new consortium s goals is to establish a dialogue among all ATE customers. There's a panel discussion about this DOD-led initiative following my talk. I want to take a moment to applaud this new effort. We think this is a great step forward to finding common solutions to common problems.

Often, the military is an early adopter of new technology. And yet this creates a dichotomy for you. You have the difficult problem of preserving the taxpayers investment in legacy systems for 20 years or more in a world where technology changes constantly. Later on, I will suggest new ways we can work cooperatively to begin to remove the obstacles that stand between you and your need for test-asset interchangeability and software interoperability.

I don t guarantee we'll put an end to all the insomnia caused by COTS. But, hopefully many of you will sleep better. Before I talk about what we can do today however, I d like to share our vision for how the use of instruments or automatic test systems will change in the future.

It is a vision that Agilent Technologies research and development labs are now developing. In the future, test systems and instruments will operate very differently. Engineers, technicians and managers working in the disciplines of design, manufacturing and support will have access to test information whenever and wherever they need it.

Test systems and instruments will be networked to computers and other devices - some not yet conceived. Just as telecommunications service providers can do remote testing today, that capability will be routine for the military services and other commercial industries in years to come.

One word I want to underscore is information. There is a lot of data in electronic files all over your operation. But it often isn't leveraged well. So getting the answers you need isn't always easy. Measurement data increases in value and usefulness when it is easily accessed, shared and distributed throughout an enterprise. When data is converged and analyzed across an operation, new information is

created. That helps people gain new insights into problems and hopefully make better decisions. The growing use of intranets and the Internet is just beginning to help businesses find answers to problems faster. Imagine with me for a minute that the year is 2020. Test instruments and systems will be faster, smaller, and often built-in to the electronics they are testing. Some testers will be tiny, distributed sensors connected to an intranet. They will be smarter than today s instruments. By smart, I mean they will be able to diagnose when they are having problems, alert users about the problems and suggest alternative testing strategies.

Connected to an intranet or even the Internet, they could retrieve code to help remedy whatever problem they are having. Future test systems and instruments will be intelligent enough to know their calibration status and when a re-calibration is needed. Most importantly, they will be self-aware. Now, that s not a New Age/California development. It means a test instrument would know its capabilities and the network topology it is connected to, and be able to communicate that information to other devices interconnected on that network.

One advantage of this connectivity, which each of you could benefit from, is that the information about the device under test could be linked and shared. The ability to link and share information throughout an operation would be very beneficial.

For example, a designer working on the next generation of a device could easily access lifecycle information and transfer it into a computer-aided-design application so design mistakes aren't repeated. The automotive companies in the audience will appreciate how linking information from design to diagnostics and service could eliminate the many cycles of design re-work that goes on today.

You can envision that linking and sharing information could also enable a technician or engineer to go beyond diagnostics and predict how much life is left in a test instrument or system.

Because most of you today are in, or somehow associated with, the military, let me try to explain this future scenario from the vantage point of a fighter jet pilot. Granted I am neither a pilot, nor an admiral -- but here s one civilian s view.

Let s assume in 20 years that several jet fighter squadrons are deployed to a hotspot somewhere in the world. These pilots are flying a new generation of aircraft with built-in test capabilities. As one jet speeds toward an aircraft carrier, its built-in tester flags its telemetry system, which in turn signals the failure conditions of the jet s electronic warfare system to a maintenance crew waiting on board. Meanwhile, the jet s health-monitoring equipment predicts that there will be a problem with the radar in an hour.

Before the jet touches down, the maintenance crew accesses a database it shares with the manufacturer about previous failures and figures out a remedy that won t require replacing the system.

When the jet lands, instead of cycling down an elevator as planes on carriers do today, it travels to a bay on deck - a pit stop if you will. While fuel is poured in from above and ordinance is added from the bottom, the maintenance crew repairs the electronic warfare system and substitutes the radar replacement assembly that is about to quit. Minutes later, the pilot takes off again on another mission. And the failure analysis information is e-mailed to the manufacturer for later analysis. Of course, the pit crew is smiling - their uptime record hasn't been broken.

But that's not all. When the carrier was in port before deployment, its test system needed a maintenance update because a vendor had made an older microwave receiver obsolete. When they swapped out the old for the new - and that took less than 20 minutes - the new receiver could immediately run the older system s application, or test program set. That s because people knew how to achieve this future vision. Collectively, we have the capability of creating a future that greatly simplifies test logistics.

Let s talk about how to get there. As I've said there's that huge problem, unique to the military, of preserving legacy systems for 20 years or more.

As you've also experienced, the pace of change in all markets is accelerating. Customers pressure

Agilent Technologies and other vendors to get new products out much faster so they can meet the needs of their customers. Auto makers, hospitals, cell phone suppliers, satellite manufacturers and other businesses require electronics that are faster, better and less expensive to help them be more competitive in the global marketplace.

Keeping up with constant change costs a lot of money. As you all know, the military in the United States and other countries is under tremendous pressure to reduce spending. Which is why COTS is so important.

As an example, highlighted here in red are all the COTS components that make up a CASS CNI Station.

In talking about ATE issues, Air Force Colonel Andy Nodine of the Department of Defense s ATS management board, has repeatedly told the test industry that the military wants to be treated - in his words - as "just another customer." But, following that order hasn't been easy for ATE manufacturers.

Aerospace and defense prime contractors are trying to abandon the mil-spec and custom-systems approach. They want to use as much commercial off-the-shelf (COTS) technology as possible. Those of you who have taken that approach know COTS has many benefits. Often the technology adheres to open industry standards, cost less than custom systems, has more cost-effective commercial support and utilizes the latest advancements in technology.

Let me give you a couple of examples of how this has worked. Boeing used commercial-off-the-shelf technology when we helped them put together a radar antenna test system for several F-15 jets like this one for the Israeli Air Force. The COTS approach enabled Boeing to cut test times in half, virtually eliminate paper documentation and expand its fault-detection.

Another example of a successful COTS implementation was used to build the Lunar Prospector that is currently orbiting the Moon. Lockheed Martin Missiles and Space created a faster, better and cheaper space exploration mission for NASA, when we helped them build a test system made of COTS components. COTS enables NASA to do more science for the dollar than ever before.

But as you may have experienced, COTS has a dark side. Abandoning the comfort of custom systems for COTS can be painful. I've already mentioned that your test systems may need support for 20 years or more.

That time span conflicts with the commercial world s cycle of upgrading products every year or so, and making products obsolete in 5 years or less. Another obstacle is that the military often needs a level of ruggedness not required by commercial industries.

That means, for example, testers in VXI card cages might need to be in shock-mounted transit cases, which for example are put into submarines or Army or Marine Humvees. They have to survive extreme movement and temperature, and still make accurate measurements.

Even in a few situations today, the "hammer test" needs to be applied to ensure a test system can hold up despite underwater shock waves and other rigors of military deployment.

To cope with technology changes that make test equipment obsolete or in need of an upgrade, the aerospace and defense industry needs test-asset interchangeability. Commercial industries would also benefit greatly if this technological problem was solved.

During a period of years, the number of test program sets, or software applications, for a system becomes large. Then, it becomes almost impossible to know which asset features are actually being used. This makes it extremely difficult for you to replace older test and measurement equipment with newer equipment. Sometimes even replacing an instrument, such as a voltmeter, can be very costly and take many months. So you can imagine - or maybe you've experienced - that changing a spectrum analyzer with 300 functions becomes a whopping headache.

Before I go any further, let me define what we at Agilent Technologies mean by test-asset

interchangeability. We define interchangeability as the ability to replace a given test asset with an alternative asset of sufficient capability, but of a different design or manufacturer. That means software changes are limited to replacing a modular piece of software that is asset specific. So no changes are needed for the user s software application, or test program set, to run on the replacement instrument.

The companion problem of test-asset interchangeability is software interoperability. To us, software interoperability is the ability to run a given application, or test program set, on multiple physical configurations of test equipment. Practically that means if software interoperability had been available in the past, the Navy could now avoid spending hundreds of millions of dollars to rewrite test program sets for CASS. Software interoperability is a very difficult problem to solve. However, we believe that finding a common solution to test-asset interchangeability is a key step toward solving the bigger interoperability problem.

The lack of test-asset interchangeability is costing the military - and US taxpayers - millions and millions of dollars, and many thousands of hours of lost productivity. So how do the military and commercial worlds act as one to realize the economic and technological benefits that COTS could provide us?

I believe the goal of test-asset interchangeability is now possible, but only if we commit to open industry standards for test software development and implement those standards in the same way across all industries.

Agilent Technologies has advocated open industry standards for ATE since the early 1970s when all interfaces were custom. We realized then that customers would be much better served by standards that all vendors implement in the same way. And that s key. It is one thing to agree on standards, but if standards are going to be painless for customers their implementation by all test equipment vendors must be the same.

As you recall back in the early seventies, Agilent Technologies s realization about standards lead to the creation of a standard digital interface that became IEEE- 488 General Purpose Interface Bus or GPIB. And, it's still popular 20 years later. Ten years ago, Tektronix, Agilent Technologies and others worked together on a set of common commands to improve customer efficiency that became the Standard Codes for Programmable Instruments, or SCPI.

And along with four other companies, Agilent Technologies helped create the VXI standard.

In fact, in response to your requests for RF and microwave products in VXI, today we are excited about our first public showing of a product many of you have asked for -- a 20 gigahertz, VXI microwave synthesizer. It s shown on the left here, and as you can see is much smaller than earlier sources.

The need for new interface standards is emerging as an issue because the need to connect test instruments and systems to computers and networks is necessary to reduce the total cost of ownership of test equipment.

For that reason, we are doing research on user connectivity needs and how to take the science of making measurements into the distributed computing environment. We know that customers want test instruments and systems that are simple to configure and use while providing much faster access. We believe ATE vendors need to standardize on computer input / output interfaces, such as USB and IEEE 1394 - which is also known as Firewire.

The computer industry is investing a lot of money in interfaces that enable much faster communication between peripherals and computers, and we believe this will facilitate instrument connectivity as well. There is no reason today for the test industry to invest in creating instrument-based standards for connectivity. IO standards exclusively for instruments only increase a test instrument s cost and complexity.

We see growing momentum in the computer industry for Firewire. It could be fully adopted as a standard peripheral interface by the computer industry within two years. A sign of its acceptance is Compaq s

recent introduction a home computer with a Firewire I/O port. Eventually, we expect Firewire will succeed GPIB as the main connection between instruments and computers. Many of the outstanding issues are being resolved. As part of the shift to computing standards, the test industry also needs to provide measurement results in a format that lets users perform analysis with spreadsheets and word processors. Improved connectivity will let customers move measurement data from instruments to commercial software applications, such as Microsoft Word and Excel without doing any programming.

Like many commercial industries, for you in the military the computing environment tends to be a mix of Unix and Windows NT. There are some technical barriers to using NT computers for mission-critical applications. However, the commercial world is heavily driven by NT tools. Just look at how colleges are graduating more computer engineers and programmers with NT skills. Because of this trend, Agilent Technologies is developing strategies to help customers migrate to NT when they are ready.

And because customers want easier programming and interoperability with all computer applications, test and measurement vendors must respond with instrument drivers based on a single standard, such as ActiveX. Again, instrument-specific standards add unnecessary cost and complexity. Additionally, customers want to use known development tools and learn standards only once. That means really standardizing on computer programming languages, such as Visual Basic, C++ and Visual C++.

Let me mention here that in this new era of test instruments and systems built on the same standards as desktop computers -- VXI will continue to be very important not only for aerospace and defense, but also for other markets such as automotive and wireless communications as a means of reducing size, providing a degree of mechanical and electrical asset interchangeability and a higher degree of ruggedness.

The vision of test-asset interchangeability and software interoperability is compelling. Creating open industry standards and implementing those standards in the same way will be our bridge to get there.

At last year s AUTOTESTCON, Agilent Technologies s Roger Oblad presented a technical paper on some work we've been doing to create a measurement subsystem architecture that provides test-asset interchangeability. Keep in mind this work is far from done -- but more on that in a minute.

For those of you who haven t heard about this architecture, let me explain. The measurement subsystem architecture permits upgrading a test system while retaining as much of the existing test software as possible. It allows flexibility in hardware configurations, which allows you to take advantage of future technology improvements. Let me show you what I mean.

Here is a block diagram of a system that measures the pulsed residual noise of a radar transmitter. It is a measurement of medium complexity that involves multiple instruments. The software orchestrates the transmitter test setup, measurement calibration and the measurement itself.

Here is a measurement example using a vector signal analyzer as the system s baseband analyzer.

Now, suppose you need to replace the vector signal analyzer because it has become obsolete.

Let s replace it with a VXI digitizer. Normally, this cause a lot of problems with the test program set because these test assets are so different.

However, because the system was designed using the measurement subsystem architecture, this change is easy. The residual noise measurement using the digitizer as the baseband analyzer produces the same measurement results with the same accuracy as the vector signal analyzer without any changes to the test program set.

We could keep on replacing test assets - say with a PCI card - and continue to make the same measurement.

Last year we introduced a phase noise product based on this architecture, which as I explained has what we've been calling asset control module capabilities.

One of the first customers to use the new phase noise product is Raytheon, which incorporated it into a system for vibration sensitivity tests. They told us that our older phase noise system wasn't flexible enough. It didn't provide an easy way to automate Raytheon s application. But the new phase noise system - with its measurement subsystem architecture - enables their engineers to integrate the test system in a third of the time as before, and more importantly positions them for ease of growth in the demanding area of hybrid testing.

This isn't a commercial for our new phase noise system - but rather an offer to you.

We believe, and early adopters are bearing this out, that an architecture like this has great promise for helping ATE vendors remove the obstacles that block the military and commercial customers from enjoying the benefits of test-asset interchangeability.

So let me extend an invitation to our competitors, the military services, DOD and the commercial industries to help us evolve this measurement subsystem architecture into an open industry standard. We propose that you kick the tires and help us to make it better.

This technology is still in its early stage. We are opening the doors to share this technology because we believe that test solutions built from an open industry standard measurement subsystem architecture that is implemented the same way will minimize and preserve the test investments made by customers over the lifetime of their products. We suggest that those interested contact Bob Stern of Agilent Technologies to help organize a workgroup that will determine how to move forward on this.

We know that the Department of Defense has as a goal to reduce the overall cost of ownership of automatic test systems and diagnostics. No doubt that same goal is shared by the communications, medical, airline, railroad, automotive and satellite industries.

So our invitation extends not only to all ATE vendors but to users beyond the aerospace/defense community as well. Insist that we vendors create a standard that enables test-asset interchangeability. And then - when we do - please ask for it by name when writing your system specifications.

I will summarize by saying that the ATE industry is undergoing a major transition as it embraces computing and connectivity standards. This shift will save money and provide customers tremendous improvements in productivity, functionality and ease of use. These changes will enable information to be shared and distributed throughout an enterprise thereby increasing personal productivity, operational efficiency and greatly enhancing the value of their measurement information. In that way, people will be able to get answers more easily, so they can make better-informed decisions more quickly.

The need to drive down costs will only intensify. Using commercial-off-the-shelf-technology is going to help address that problem, but only if we unite to cooperatively create open industry standards and implement them in the same way.

We hope ATE customers will demand that their vendors cooperate to create an architecture that provides for test-asset interchangeability. By doing that we'll be taking the first step towards the holy grail of software interoperability. We all know change isn't easy. But, these changes are necessary. We encourage ATE users, prime contractors and competitors to cooperate on open industry standards so testing isn't the cause of sleepless nights, frustrating days and wasted money.

If we make this shift, in the future we will be able have at our disposal very intelligent test systems that will enable our military weapons and communications systems to offer higher levels of protection at much lower costs. Not only will that make our tax-paying citizens much happier, but it will enable us to provide the men and women who protect us the tools to make better-informed decisions as they strive to preserve our security and make our world a more peaceful place.

Thank you.

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