*Solutions for*

# Aerospace Avionics Testing

## How to optimize test systems using LXI technology

Success Story

## Introduction

**A large, multi-national aerospace/defense (A/D) company located in the United Kingdom is involved in a major European jet fighter program. The company's contributions to the program include a number of safety-related avionics modules. Because the modules are intended for airborne and military operation, the test team's role is critical.**

**When the team set out to design its test systems, the test engineers compared different test architectures. They found that LXI is the perfect enabling technology for their needs. This application note describes the unique challenges the team faced and discusses the benefits they found in LXI.**

## Aerospace and Defense—A Unique Industry

The aerospace and defense industry is different from other industries in many respects. The most important differences:

- **Especially in military and satellite applications, technology is pushed to the limit.** Many applications require very high frequencies, extremely low noise, advanced digital modulation, frequency hopping etc. As a result, automated test applications often require the use of instruments and tools designed for utmost flexibility (a requirement normally found in R&D where instrument use is mainly interactive).
- **Product quality is paramount.** Defects and non-performance can lead to dramatic consequences, and often lives are at stake. As a result, quality is the major concern in all phases of the product life cycle (PLC). Testing is extremely thorough, both in design verification and manufacturing.
- **Products need to perform flawlessly under harsh environmental conditions.** Testing includes in-depth verification under mechanical stress and different atmospheric conditions (temperature/pressure/humidity).
- **Products have a very long intended use life,** up to several decades. Especially for repair and depot testing, the test solutions must be similarly long-lived. Standardization and openness are key values.
- **Test execution time** is important (albeit in balance with test depth), and test development time even more so. Due to the complex nature of the projects (with many industry and government organizations involved), slips in the project schedule are a major hassle and often lead to penalties.

## LXI Adds Versatility

During the project, the A/D company's test team found LXI to be an extremely versatile standard. Unlike other standards, LXI does not optimize a single aspect of testing (such as execution speed) at the expense of other attributes. LXI is a balanced standard that provides value in all areas relevant to testing. It combines very decent throughput and advanced system capabilities with the benefits of rack-and-stack instruments (ease of use, dependability of a standalone unit).

LXI helps address the unique challenges of the aerospace and defense industry in the following ways.

- **LXI instruments are standalone, rack-and-stack units.** Each instrument provides its own power, shielding, cooling etc. You can rely on the instrument to do its job with little or no side effects on its neighbors.
- **LXI instrument sizes are flexible.** Form factors range from compact, half-rack-size, 1U units to full-blown 19-inch, several-units-high instruments. This is especially important with RF/microwave equipment where miniaturization of the RF front-end is difficult.
- **Ethernet is a stable and long-lasting standard,** simplifying long-term support and maintainability of the test solution.
- **Instrument front panels and the Web servers** built into the instruments greatly simplify solution prototyping, software testing, troubleshooting and system commissioning and help reduce overall system development time. Since test development time is so critical, this is a real benefit to the program.

LXI also enables other benefits that are less industry-specific, such as lower cost through the availability of off-the-shelf network infrastructure. For a more generic view of the benefits of LXI, see Agilent's application note AN1465-21 (5989-4372EN), *10 Good Reasons to Switch to LXI.*

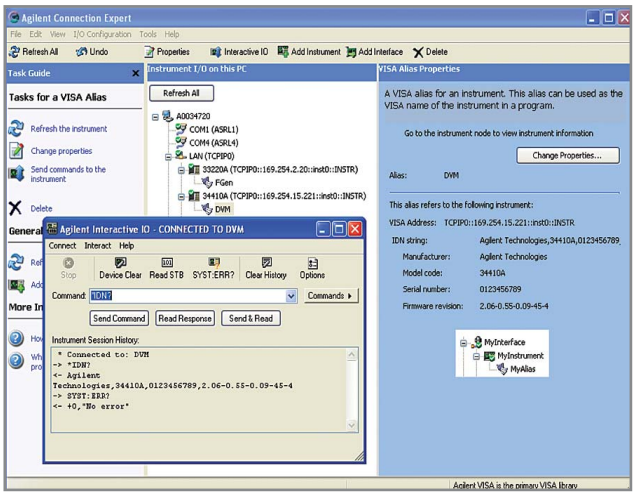



FIGURE 1: *The Agilent Connection Expert finds and configures I/O interfaces and instruments.*

## System Implementation Time – A Key Concern

Efficient test development, or "time-to-test", is a key concern for the A/D company. LXI and Agilent Open — a combination of proven standards and time-saving tools (hardware, software, I/O) for test automation — helped the company achieve its implementation goal in the following ways.

In the start-up phase of the project, the Agilent Connection Expert (ACE, see Figure 1) greatly simplified the initial configuration and verification of the test instruments. ACE is part of the Agilent IO Libraries Suite, available for free with every Agilent instrument. It allows you to detect and configure I/O interfaces, search for attached instruments, configure them and verify their operation.

A member of the A/D company's test team said, "The Agilent Connection Expert eliminates the classic system integration problem of getting instruments connected. What used to take hours now takes a simple click on the refresh button." ACE makes it easy to configure and verify your instruments regardless of the interface.

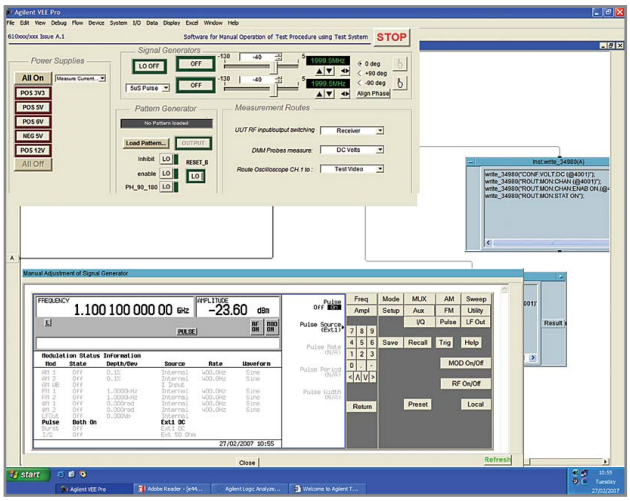



FIGURE 2: *Screenshot of the team's test application in manual/debug mode*

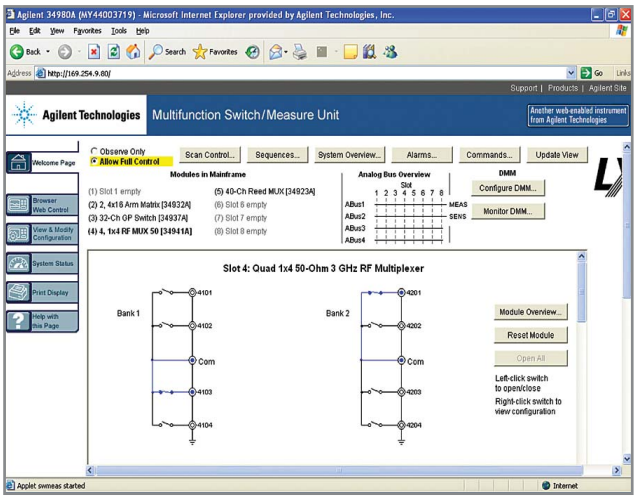



FIGURE 3: *Web page served by the Agilent 34980A multifunction switch measure unit (example)*

For the implementation of the test application, the test team used Agilent's award-winning VEE Pro programming environment (see Figure 2). VEE is an intuitive, graphical language geared to test and measurement applications. Unlike other languages, VEE features powerful objects and building blocks that simplify various aspects of test application design, including instrument control, data analysis and results display and storage. For advanced math and visualization, VEE includes a tightly-integrated MATLAB® script engine.

According to the lead test engineer, VEE allows his team to get results quickly. "We refine and build on these results as we go," he said. This combination of powerful tools and ease of use helps the team meet its objective of minimizing development time.

In the system verification and commissioning phase, the test team relied heavily on the Web pages served by the Agilent LXI instruments (see Figure 3). These pages are active, based on Java, giving them an intelligent, dynamic behavior. For example, the page shown in Figure 3 always displays the instrument's accurate state, no matter how changes to the state are made (through the Web server, front panel or programmatically using SCPI commands). Also, the Web server has an unobtrusive design and can run concurrently with the main application software, which is an obvious advantage over the soft front panels supplied with PXI and VXI cards.

While the LXI standard calls for a relatively simple minimum design with regards to Web pages, it is left to the individual vendor to add more advanced capabilities. Many Agilent instruments offer additional development tools and features (such as instrument usage reports, SCPI command logging etc). It is extremely easy to use the Web features. Once Java is installed, it is simply a matter of opening a Web browser to the instrument page.

Another aspect the test team learned to appreciate in all phases of system development is the throughput of Ethernet and the increase in test execution speed that often results from it. According to the test team leader, the speed of LAN allowed his test engineers to make real-time adjustments and see the effects on their product immediately.

## Test Solution Overview

**The A/D company's test solution includes the following components. (system photo below)**

**The Agilent E4445A PSA** is a high-performance spectrum analyzer for measurements up to 13.2 GHz and excellent dynamic range (DANL of -154 dBm). Analysis bandwidth goes up to 80 MHz. Many measurement personalities are available, including those for phase noise and noise figure. Other models of the PSA family go higher up in frequency (up to 50 GHz).

**The Agilent ESG signal generator** is available in an analog and digital (vector) version. It goes up to 6 GHz in frequency and generates signals with excellent spectral purity and level accuracy. It supports a large number of wireless standards. In addition, Signal Studio and MATLAB® software and other tools can be used to create custom waveforms.

**The Agilent N6700 modular power system** is a modular and compact (1U) system power supply mainframe — it can be fitted with up to four independent power modules. A wide range of modules is available, with different output power, voltage and functionality.

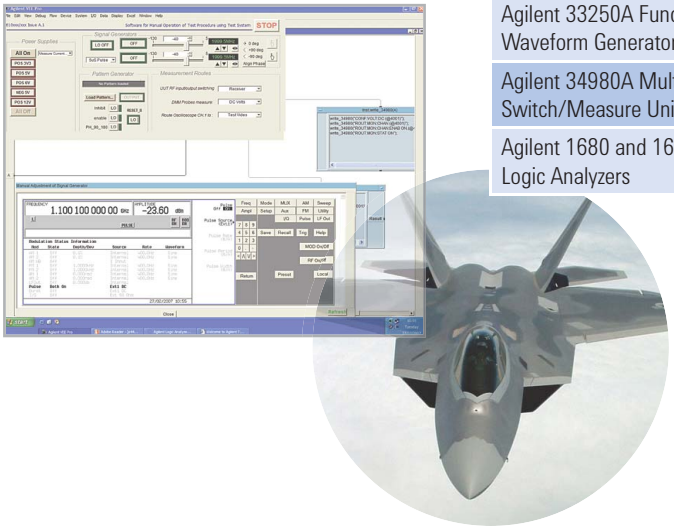
**The Agilent N5700 Series power supplies** are power-houses—they deliver 750 watts or 1500 watts of DC power in a compact, single-U package.

**The Agilent 33250A** is a high-performance arbitrary waveform generator for signals up to 80 MHz. Its built-in D/A converter features 200 MSamples/s and 12-bit waveform generation. The generator offers burst mode, as well as AM, FM and FSK modulation capability.

**The 34980A** multifunction switch measure unit is a core element in the company's system — it handles the signal switching requirements. It is a modular mainframe with eight slots that can be fitted with various switch cards, ranging from low-frequency multiplexers and matrices to 20-GHz coaxial switches. With the 34945A plug-in card, the 34980A can even control external switches and attenuators. The 34980A can do more than just switching — it also includes a 6.5-digit DVM and can be equipped with additional digital or analog stimulus/response modules.

**The Agilent 1692A** is a 68-channel, PC-based (its user interface runs on the controlling PC) logic analyzer. It offers sample rates of up to 800 MHz in timing mode and up to 200 MHz in state mode.

All of the instruments are integrated in a dual 19-inch rack. The elements are self-contained, dependable units, each with its own cooling, shielding and power supply. As a result, the instruments can be placed anywhere in the rack, allowing test engineers to optimize the rack design for application parameters, such as short cable length between critical system elements.



## Summary

Aerospace is a unique market with unique challenges. In this business, test system designers will especially appreciate the ease-of-use, flexibility and longevity of the LXI architecture. LXI and Agilent Open clearly excel in these areas and have helped the aerospace/defense company meet its project goals. What separated LXI from other solutions was how well it fit the unique aerospace/defense requirements and how easy it was to get everything running.

## Related Agilent Literature

| Publication Title | Publication Type | Publication Number |
|---|---|---|
| Agilent PSA Series Spectrum Analyzers | Data Sheet | 5980-1284E |
| Agilent E4428C ESG Analog Signal Generator | Data Sheet | 5989-1992EN |
| Agilent E4438C ESG Vector Signal Generator | Data Sheet | 5988-4039EN |
| Agilent N6700 MPS Low-Profile Modular Power System | Data Sheet | 5989-1411EN |
| Agilent 33250A Function/Arbitrary Waveform Generator | Data Sheet | 5968-8807EN |
| Agilent 34980A Multifunction Switch/Measure Unit | Data Sheet | 5989-1437EN |
| Agilent 1680 and 1690 Series Logic Analyzers | Data Sheet | 5988-2675EN |

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LXI

**www.lxistandard.org**
LXI is the LAN-based successor to GPIB, providing faster, more efficient connectivity. Agilent is a founding member of the LXI consortium.

*MATLAB is a U.S. registered trademark of The Math Works, Inc.*

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