

# Teradyne-Raytheon Team Pursues New Open Architecture Test Technologies

In 1996, Teradyne and Raytheon Systems Company began collaborative work on an exercise known at Teradyne as a “voice-of-the-customer” survey. Detailed customer surveys (including in-person interviews and written questionnaires) were conducted to better understand the needs and future direction of Raytheon, one of Teradyne’s military/aerospace customers.

Headquartered in Lexington, Mass., Raytheon Company is a global technology leader with 118,000 employees worldwide. The company provides state-of-the-art products and services in the areas of commercial and defense electronics, engineering and construction, and business and special mission aircraft. Raytheon has operations throughout the United States and serves customers in more than 80 countries around the world. Recent acquisition of E-Systems, Hughes Defense Systems, and Texas Instruments Defense Systems have made Raytheon one of the three largest suppliers of military equipment.

“Their input,” says Teradyne sales engineer Bill Griffin, “made it apparent that Raytheon saw the marketplace heading towards a new paradigm of lower-cost, higher-quality test equipment based on a common open architecture. And it was clear they were going to achieve their test goals with this vision one way or another. So we approached them to discuss ways we could work together to realize their vision.”

From that beginning, the two companies formed a strategic alliance — one that is beginning to bear fruit for both. “Raytheon has direct input into future product direction to better meet their needs and early access to new technology,” says Walter Vahey, Boston-based Teradyne marketing manager. “And Teradyne gets better products that have broad appeal.”

Raytheon has purchased two systems to date: a Spectrum™ 8800-Series system for in-circuit test, and the new Spectrum™ 9000-Series functional test system, developed with Raytheon’s step-by-step input.

## Optimizing the relationship

“In the test business, Raytheon was an experienced user of custom ‘point solutions,’” says Mike Segal, manager of Raytheon’s Test Systems Operation in Tewksbury, Massachusetts. “But recently, the military/aerospace industry has moved toward commercial-off-the-shelf (COTS) technologies and test systems designed to handle a variety of test needs over long life cycles, instead of systems customized to do a few very specific tasks.

Segal continues, “Teradyne, who had been a long-time Raytheon supplier, tended to build custom solutions for our products. We knew the company was already doing some work with COTS VXI instrumentation and that it was interested in expanding the availability of VXI-based systems suitable for military/aerospace customers. We were already

sophisticated users of Teradyne’s L-Series test systems. We wanted to figure out how to optimize the relationship between our internal design processes and Teradyne’s.

“Because we are both located in the Boston area, we were able to form a close alliance to develop integrated solutions, rather than continue working together in a traditional customer/supplier relationship,” says Segal.

Brian Hatt, section manager for TSO’s digital systems department, adds, “Historically, we’ve had to test with whatever equipment our suppliers created. Here we had an opportunity to help a supplier develop a system designed specifically for our new test goals.”

## A look back

Raytheon traditionally ran a high-volume, low-mix board production shop that required relatively few changes in manufacturing setup. In the past five years, new technology gave Raytheon’s engineers the ability to increase functionality with less board real estate. As a result, Raytheon’s manufacturing gradually shifted to low-volume, application-specific manufacturing runs with high complexity. The new paradigm made it important that Raytheon’s in-house test equipment now be capable of handling frequent setup changes and a variety of instruments to test different features. These conditions made modularity and reconfigurability high priorities.

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For in-circuit test, the open architecture of Teradyne's Spectrum 8800 family fit the bill. Says Paul Mongillo, manager of the digital systems department for Raytheon's Test Systems Operation laboratory, "The Spectrum 8800 family offered significantly improved technical capabilities, including highly integrated boundary-scan and vectorless testing. And its expandable VXI architecture allows us to select the lowest-cost options for the manufacturing environment."

For functional test, however, the two companies decided to collaborate on a new system geared specifically toward Raytheon's VXI-based vision of where special test equipment (STE) was headed.

#### **TIMs: A holistic discussion**

"Our first order of business was to establish — in detail — Raytheon's requirements for a new functional test system and how Teradyne was going to prove the concept," says Griffin. "So we began a series of monthly technical interchange meetings (TIMs) between people from Raytheon's system architecture, program development, fixturing and manufacturing groups and the corresponding Teradyne groups. Bringing together all these perspectives resulted in a very holistic discussion of the work to be done."

"From the beginning, Teradyne's 'voice-of-the-customer' analysis really helped their engineers to understand our needs," says Mongillo. "Then, through the TIMs, we defined common interfaces and standard structures to use. The team members also worked together on other technical issues, such as fixturing, preferred software, and test station ergonomics."

Explains Segal, "The TIMs allowed the engineering personnel on both sides to see what our test system operators were going to need."

Hatt adds, "The TIMs kept the engineering teams from working in a vacuum. We were always aware of the work Teradyne was doing, and Teradyne's engineers could get answers to questions as they came up, which kept the pace moving."

"The TIMs also built trust and communication between our organizations and gave engineers from both companies an awareness of each other's design challenges," Segal says.

Block-by-block, starting with digital test in its voice-of-the-customer feedback, Raytheon described their vision of a modular functional test platform. "We wanted a system

with maximum flexibility and reconfigurability," says Segal. "So we were looking for a platform that would run with just the basic capabilities and allow us to add or subtract additional capacity as needed."

Teradyne's engineers took the building block approach. The plug-and-play design for the Spectrum 9000-Series begins with the M910 VXI digital test instrument (DTI), TestStudio™ operating software, and a standard set of analog instrumentation.

The M910 DTI was Teradyne's answer to Raytheon's new digital test requirements. For one, Raytheon wanted to reduce the cost of digital test by moving from traditional pre-configured test systems to a modular test architecture. Raytheon also wanted faster digital test to keep up with its newer,



more advanced products, which, according to Hatt, had exceeded the speed capacity of their standard in-house testers.

Raytheon took delivery of the Spectrum 9000 in January 1998. Teradyne helped install and integrate the Spectrum 8800 and Spectrum 9000 into Raytheon's test lab. "The history of Teradyne's strong support showed itself here," says Hatt. "Engineers from both sides worked together to port VICTORY- and LASAR-generated test programs from L200-Series test systems to the new Spectrum-Series platforms."

Says Segal, "As our products become further integrated, our needs will be shifting from a digital test approach closer to a mixed-signal approach.

"What's ideal about this open test platform design is that we'll be able to simply add VXI instrumentation to handle the new requirements instead of adding whole new systems."

#### Protecting software investments

On the software side, according to Hatt, "We were aiming to convert as many as possible of our existing VICTORY and LASAR TPSs to our new Spectrum systems, from the top-level test executive down to our application projects."

From its earlier evaluation of the M910 DTI, Raytheon already knew that the digital component of the Spectrum 9000 met this objective. "We were able to take a digital TPS created on our legacy L-Series and fairly painlessly port it to the DTI," says Hatt.

#### Moving in lock step

As development of the new functional test platform progressed at Teradyne, close communication with Raytheon continued. "We were in lock step with Teradyne at each stage," says Hatt. "We were giving their engineers immediate feedback so they could incorporate our suggestions into their product."

Says Mongillo, "The Spectrum 9000 gave us what we were looking for — high-speed digital test at a lower cost. With the new system, our test costs on a per channel basis were reduced to a third of our previous generation systems.

"The open platform design also assured easier training, because we could readily allocate our existing engineering personnel," he adds.

The Spectrum 9000's data rate of 25 MHz and clock rate of 50 MHz were also a significant improvement over Raytheon's in-house L200-Series system.

In designing the new Spectrum 9000 platform, Teradyne also developed TestStudio, an open-architecture ATE operating environment. TestStudio is tightly integrated with Teradyne's VICTORY and LASAR test generation tools, allowing Raytheon to readily migrate TPSs and related data to its new Spectrum 9000 system. And because of TestStudio's "plug-and-play" software design, Raytheon can easily add third-party software to the operating environment as needed.

#### The relationship continues

"Our alliance with Teradyne allowed Raytheon to use the new Teradyne hardware and software modules as they were being developed," says Segal. "That helped us to ensure that they met our requirements. This arrangement also gave us the advantage of getting the earliest possible use of sub-assemblies, starting with the M910 digital test instrument, so we could continue to meet our customer obligations while working on the next-generation system."

Looking ahead, Hatt says the partnership will continue to focus on building speed and performance for both functional and in-circuit test as new test requirements arise.

Segal adds, "The strategic alliance is proving to be the right way to achieve both Raytheon and Teradyne's goals. As we move forward, Raytheon will continue to share its new needs with Teradyne and Teradyne will continue to share its new technologies with us." ■

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