Photo courtesy Teradyne

ATE

Higher-density instrumentation, standardized platforms, tester replacement drive market for Automatic Test Equipment

By Barry Rosenberg

The automatic test equipment industry has entered what some ATE engineers say is a new golden age. With a plethora of new civil and military aircraft being developed, an imperative to transition legacy software programs to new testers, and an annual growth rate of 6 to 7 percent, ATE has arguably never played a more important role in aerospace and defense.

"This is certainly a good time to be in ATE, with old equipment being replaced, a massive deployment of new systems, lots of R&D spending in [the Department of Defense] over the last decade, and new aircraft coming into production that demand new test equipment," said Walter Vahey, general manager, Functional Test Group, with Teradyne, North Reading, Mass.

Market figures bear that out. The avionics global ATE market is valued at $1.2 billion to $1.3 billion, according to S. Vidyasankar, senior research analyst at Frost & Sullivan. The scales favor military ATE, with that sector accounting for about 53 percent of global revenue. Commercial ATE accounts for the remaining 47 percent, though Vidyasankar believes military and civil ATE could equalize as the latest air surveillance systems penetrate the low-fare carrier market.

There are three key trends driving the ATE industry: customer demand for higher density test instrumentation; growth in interest in "common core" test systems; and replacement of legacy test systems.

The desire for more capability on a single instrument — in other words, higher density instrumentation — has now been realized through the availability of more capable integrated circuits. No more than four or five channels of instrumentation could be found on one tester in just the recent past. Now, as many as eight channels of instrumentation are possible.

"When you step back from the picture, I see clear demand for higher density systems where greater functionality and test capability is packed into the tester," Vahey said.

New demand is also about the need for designing greater reliability into the instrument, manufacturing a system with a smaller footprint or form factor, and enhancing maintenance and logistics in support of the tester. Aircraft avionics are a good fit for higher-density technology because of the number of precise measurements that must be made.

The challenge is to take instruments that contain hundreds of channels of parallel digital stimulus and response, and extend that digital parallel test concept to the analog domain. For Teradyne, the fruit of that effort is the Ai-760 analog test instrument, which first shipped in January and is now in volume production.

"By virtue of making the Ai-760 instrument denser we were also able to change and improve its topology to what we call tester-per-pin architecture," said Vahey.

"The benefits of parallel (per pin) testing are noteworthy. Whereas conventional test systems connect the unit under test (UUT) to single-function resources through a relay-based switching unit, and sequentially stimulate and measure each test point, the Ai-7 Series is built and programmed to synchronize its multichannel stimulus and response system. This multi independent channel approach improves test times. More importantly, parallel test ensures that the UUT is stim-

ulated as it would be in its actual environment, and the outputs can be examined in parallel, as they should be, to better evaluate real-world response."

Common Core Systems

The ATE industry is also moving toward the concept of common core systems. It used to be that each customer would buy a different tester for each application, resulting in a factory floor crowded with dozens of tester types.

The new trend toward common cores began a few years ago and has picked up steam. The common core system can be thought of as a standardized ATE platform that in itself covers 80 percent of the common requirements for testing avionics systems. These core systems are used to support the backbone of most avionics systems while the specialty systems like radar are tested using the core system augmented with the necessary instrumentation to support a "class" of avionics systems like radar or infrared.

"Standardization has many of the typical benefits of common training, common user environment, common spare parts and maintenance," Vahey said. "But more importantly it allows the work load, the avionics being tested, to be easily moved between ATE systems when the volume of repairs in one particular unit requires temporary incremental ATE capacity."

Vertically focused systems are eliminated as test programs are migrated to common core systems. That eliminates floor space and unique environments, while improving ATE availability and ultimately increasing output from repair at much lower cost.

For the end user, common core systems allow avionics suppliers to provide solutions that augment existing ATE rather than providing a dedicated solution, thus lowering the capital cost for both supplier and end user.

"The common core tester must be both modular and scalable," Vahey said. "The advantages of such a tester are significant. First, the system itself will have a longer shelf life. Over its life, the tester will be far less expensive to own and operate because users can maintain and operate one system used across multiple applications. The common core approach is also more cost efficient because it uses commercial off-the-shelf, standards-based technologies that lower cost."

The need for common core systems is particularly acute in the military services, each of which typically has its own standard platform for avionics testing — and all of which are incompatible with each other.

"A lot of RFQs (requests for quotes) from the military are asking for modernization of test equipment," said Kevin Leduc, director of sales for EADS North America Defense Test & Services, Irvine, Calif. "If you look at platforms that customers are supporting — aircraft, ships, tanks — those systems are used for many years. Many times, ATE systems are built with COTS systems that become obsolete over time."

Vidyasankar estimates the Air Force, Army, Navy, Marine Corps and Coast Guard own 460 different test systems, with 80 percent redundancy in form and capability. The military spends $500 million a year maintaining those systems, and, all together, they have a lifetime-of-ownership cost of about $250 billion.

The hoped-for solution is the Agile Rapid Global Combat Support (ARGCS) system, a Pentagon advanced concept technology demonstration program to design and build an open system architecture that will allow test program sets (TPS) to be easily re-hosted through the use of synthetic technologies.

Re-hosting would prove advantageous, for example, if an Army attack helicopter on the battlefield encountered fire-control errors that had to be repaired quickly. By enabling the nearest tester, perhaps a Marine Corps unit typically used for an AV-8B Harrier, to repair the helicopter component, the Army could return the helicopter to service.

In the future, this functionality will be achieved just by re-compiling an Army TPS, for example, on another service's tester and then running it.

Northrop Grumman's Electronics Systems Sector (ESS) is the lead contractor on ARGCS. Laboratory testing of the first systems was completed in early 2007, and, at press time, the first demonstrator system had been delivered to Marine Corps Logistics Base Albany in Georgia. A second unit was to be delivered to the Army's Picatinny Arsenal in New Jersey, and a third to Naval Air Station Lemoore in California.

"This is more than a tester, it's a system of systems solution," said George Hammontree, director of business development for ATE & Simulation, Northrop Grumman ESS. "With synthetic technology, we can use software to change the personality of the test instrument. It will lead to the preservation of millions of dollars in development of TPSs for legacy systems."

The ARGCS program is expected to conclude by the end of the year.

'Legacy Forward'

One of the greatest challenges is the obsolescence of 1980s-era test equipment, which has created a replacement cycle in the industry. The task is multi-faceted but comes down to one basic problem: how do test engineers migrate test programs, particularly when the original engineers who wrote the programs are long retired.

A good example of a commercial avionics tester that would have long ago ended up in the scrap yard if not for the valuable and still workable programs contained within is the Boeing ATS-182. Celebrating a quarter century since it entered service in 1982, the system is designed for acceptance testing and troubleshooting on Boeing 737 Classic and next-generation aircraft, as well as 747s, 757s and 767s.

"While this system has long served its purpose, electronic advancements have essentially made it obsolete," Vahey said. "You can imagine the legacy this system carries forward."

In fact, Leduc calls the entire process of migrating legacy programs to new-generation testers "legacy forward."

Companies like EADS and Teradyne are designing new systems with emulators that mimic the functionality and graphical user interface of the older systems, and translators that let the legacy programs run on the new testers.

"Much more money is invested in test programs than in the tester so you can't walk away from old test programs," said Vahey, adding that one of Teradyne's airline customers uses an old tester with 250 programs on it.

And while the industry is expending significant effort on developing systems that run old programs, there's also a drift away from older languages like ATLAS (Abbreviated Test Language for Avionics Systems) coupled with demand for more standard programming languages like C# (C Sharp), Microsoft's object-oriented programming language that is becoming increasingly popular in the development of software designed for distributed environments.

More robust and less prone to errors in the development of test programming, C# also facilitates the writing of modular programs that can be better changed, modified and maintained over time. It also helps that students coming out of engineering school have a working knowledge of the language. avs