Simulate the missing link

Test companies are stimulating innovative design by simulating real world operating conditions. By **Mike Richardson**.

By definition, a system test allows the entire system to be tested, exercising and verifying all the features of the assembly in a way that represents actual operational conditions. This provides the necessary level of confidence that the system will perform reliably under all required conditions.

There are many different approaches to system test: you can either look for a simulator that can mimic the equipment infrastructure behind the device under test (DUT), or create a real world scenario to trace what is going on between the infrastructure and the DUT. The problem is that simulation of this magnitude can be very complex and many vendors cannot satisfy all the permutations.

Aeroflex Test Solutions' CTO, Dr Francesco Lupinetti describes the ways in which Aeroflex works with the customer to simulate as closely as possible a 'real world' set up.

"In avionics and satellite payload type tests, we often use emulators and/or simulators provided by our customers or developed jointly or entirely by us. For wireless commercial applications, our test systems provide network and air interface emulation/simulation that are fully compliant with the standards as well as being able to reproduce proprietary interfaces and protocols associated with various OEM implementations.

"Overall, as the complexity and level of integration of the system to be tested increases, the need for close cooperation with customers and the generation of common roadmaps for the system to be tested and for the test system will continue to grow. This paves the way for an incremental embedding of test systems, enabling features within the systems to be tested.

"Whilst it might never become totally practical or economical to embed test systems completely within each test object, it is becoming clear that test system components are being integrated gradually into the system or test object. Aeroflex has been pursuing this type of test environment solution with its customers, especially in the area of synthetic test."

The extent of moving beyond testing a single board to an entire system can involve the challenge of testing large scale systems. For example, one National Instruments' (NI) customer was testing fly by wire hardware comprising aircraft control units and needed to simulate everything that was going to happen in the real world. Therefore, the test system had to be able to stimulate and provide signals and interface to those units to mimic the real sensors on the aircraft, as well as measure the response from the unit.

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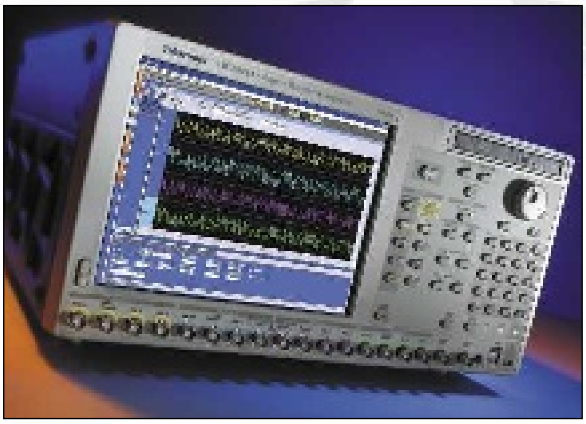
Ian Bell, **National Instruments.**



and physical parameters like temperature, vibration and pressure," explained NI's technical marketing manager Ian Bell. "What is demanded of test systems to deal with larger scale systems is a greater range of flexibility and a more broadly based approach than pure functional board level testing."

NI takes a software defined modular approach to building systems, bringing together a broad range of I/O, other measurements of parameters including measurement of position and vision based methods to integrate them with electronic testing. NI prefers to 'break down' a test system – whether it's a board or an entire aircraft – into 'layers' and consider them almost in isolation. This starts with a software framework which brings various test code modules from different environments and pulls them together into a single test program.

"Ideally, we want test engineers to choose the most appropriate devices to interface with their system and not have to worry about the need to connect in a certain way," said Bell. "We don't want people to think everything has to connect a certain way, because it restricts their choice of connectivity. We want them to choose the most appropriate means."

Agilent's test system consultant Stefan Kopp says that, at a system level, you're already working with the operational software the end customer will be using.

"If we take a base station, you already have the operational software loaded," he confirmed. "This means that, for testing, we need to simulate the environment around this test system very closely. Having test software downloaded to the system takes away some of the problems because you can test one part of the product after the other. However, if you are using the 'final' operational software, you have to perform everything simultaneously. Therefore, synchronisation between the different measurements and the stimulus signals you apply become more important.

"With a base station, it's easier if you have real equipment in place, because simulating the complete infrastructure can prove too complex for some test and measurement equipment," Kopp continued. "Many customers apply real infrastructure behind the base transceiver station and use spectrum analysers to take snapshots of the rf spectrum emitted, tracing the protocol messages between the base transceiver station and the infrastructure behind it. By changing the signal strength of a simulated or real mobile phone, you can induce handover from one base station to another. This allows you to synchronise everything, trace the protocol messages and correlate a spectrum snapshot of these protocol messages to determine the time taken to handover."

Tektronix' market development manager Trevor Smith sees the proliferation of rf and wireless systems as a growing design and test challenge.

"In the past, rf designers worked on intermediate frequencies (IF) and required specialist equipment to work on the rf throughout the design. IF is tested through digital signal processing and then modulated using an I/Q modulator. Tektronix' arbitrary waveform generators (AWGs) stimulate both the digital and the IF analogue part of the design and particularly those areas of the design that are 'missing'. They monitor the parts of the design that work with logic analysers for the digital elements and oscilloscopes for the analogue element, while monitoring the backend rf side using real time spectrum analysers.

"Collectively, this equipment transitions to become elements in an integrated test solution when the whole system is assembled. Once you have a complete system, you can probably forgo the stimulus, put the system in a 'real world' situation and just use the monitoring tools."

At full system test, you see if the design operates under normal conditions, or you may want to 'stress' the system so that it experiences the complete range of conditions it will encounter during its lifetime. Smith states that, in this instance, the AWG has a key role as it simulates and stimulates both known good and bad 'real world' signals.

"Simulation accelerates the process of design and test and is a great tool for checking the feasibility and performing initial design and design validation," concluded Smith. "Physical design validation is the next important stage in the process, but when it comes to turning it into a real design, no amount of individual component simulation or verification can replace the final integrated test."