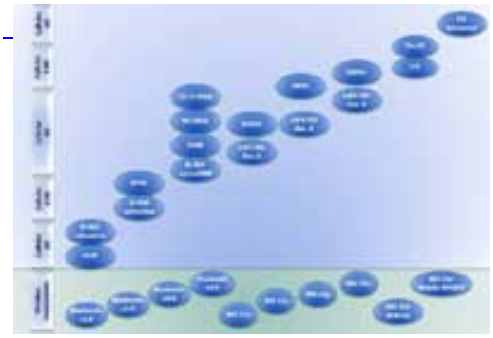
Meeting the Challenge of Multi-standard Wireless Communications Testing

By Tim Carey, Aeroflex Test Solutions

Non-cellular technologies are increasingly being integrated into cellular terminals, and this has generated the need for test systems that comprise a number of different test platforms, which can make system integration both complex and costly. At the same time, there is pressure to increase test speed and, in combination with the proliferation of functional tests associated with the introduction of new standards, this further increases the costs.



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This article describes how using a PXI based modular RF test platform can break this cycle of spiralling test costs and provide a fast, flexible and cost-effective approach to testing multi-standard wireless communications devices and subsystems.

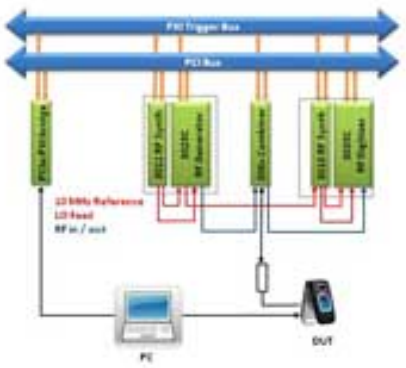
The Case for Multi-com Testers

As the number of wireless standards supported within a single mobile terminal grows, production testing of such devices, and the components used in their design, is becoming ever more challenging. There has been a sharp rise in the number of multi-standard phones and those featuring wireless connectivity-high-end smartphones-typically integrate Wireless LAN, Bluetooth, FM (Tx/Rx) and GPS, in addition to a range of cellular standards in different frequency bands. Machine-to-machine communications and near field communications (NFC) are likely to begin making an impact in the near future, too.

Figure 1 depicts the range of the most common wireless standards currently in use, a scenario that is inevitably continuing to evolve in response to the growing demand for faster data rates and more bandwidth. As operators upgrade their networks-for example from GSM through UMTS and HSDPA to LTE-they must still retain backwards compatibility with legacy standards.

Using a single-standard, stand-alone test instrument for production testing of each of the individual wireless standards would be impractical in most cases. On the other hand, a general-purpose instrument more suited to R&D testing would be too expensive for use on a production line. The answer to this dilemma is to use a modular instrumentation-based multi-com tester that allows testing of a range of cellular and wireless connectivity standards within the same instrument.

Multi-Com Testing Challenges



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The multi-com tester must meet a number of needs, some of which involve trade-offs. The need for a multiplicity of functional tests must be met, while at the same time ensuring that both the requirement for faster test times and the effects of increasing integration complexity are addressed. There are inevitably cost implications in deciding on the appropriate test methodology, both in the purchase of the equipment, and the cost of ownership in the longer term, such as training, calibration, and ability to upgrade.

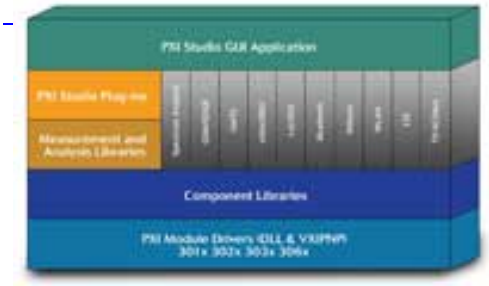
Benefits and Implications of One Box Multi-Com Test

Among the key benefits of using a single box for multi-com test are flexibility and speed in converting production line testers to satisfy demand. For example, a GSM production line can be converted almost instantaneously with hardware or software to test LTE devices.

Modularity further increases value. Modular design means that even if hardware requirements change (such as the introduction of 100 MHz bandwidth channels for LTE-A), only a small investment will be required in order to bring the instrument base up to date, and there will be no need to modify existing operational patterns.

Although the latest standards are software-defined, they are hardware expandable. For example, additional hardware allows support for MIMO as defined in IEEE 802.11n, WiMAX and LTE specifications, and this introduces additional complexity in

testing. Using a traditional approach, multiple discrete test instruments would need to be connected together to test 2x2, 4x4 or more complex MIMO, with a consequent increase in equipment cost.



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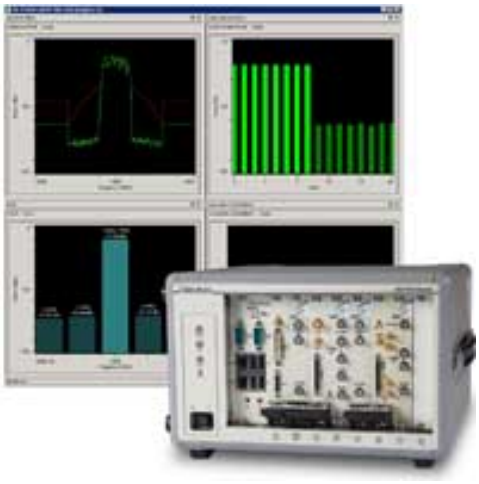
With a PXI platform, on the other hand, all the modules are housed in the same chassis and share a common system backplane. A single PXI-based test system can be used to test more than 12 wireless standards, including: GSM; EDGE; cdmaOne; W-CDMA; HSPA; HSPA+; CDMA2000; 1xEV-DO Rev 0, Rev. A, and Rev B; LTE FDD; WiMAX 802.16e; WLAN 802.11a ,b ,g and n; and Bluetooth.

If the need arises, the flexible software architecture enables users to design their own test system for proprietary standards using standard programming interfaces (VB, C++, etc.) that are familiar to most test engineers.

Fierce competition in the wireless industry means that both cost and speed of test are critical to business success. Because the processor resides in the control PC rather than being embedded in the instrument, the test speed of the equipment can readily be increased as multi-core processing capabilities progress.

For companies looking to be more "green", power consumption of PXI modular equipment is low compared to technology-specific instruments, thus reducing the environmental impact of the test process. In addition, a software-defined solution reduces the amount of hardware that needed to achieve the same functionality. The PXI-based modular multi-com tester consumes fewer resources both in its construction and during its operational lifetime.

Concurrent Multi-Standard Test



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A range of hardware modules is available in PXI format for inclusion in a customized multi-com tester. Modules include RF synthesizers, RF digitizers, digital signal generators, and RF combiners, covering frequencies up to 6 GHz. Signal generators are used with a low noise local oscillator input from an RF synthesizer module, and PXI RF digitizers used with a synthesizer module provide precision conversion of RF signals into digital IF or I and Q data.

With a wide measurement bandwidth, a PXI-based system also offers the opportunity for testing multiple devices at the same time (multi-DUT testing). It also offers the possibility of performing concurrent tests to different standards using different test modules, for example testing the WLAN air interface of one device while testing GSM in another.

Speed can be continually enhanced by taking advantage of evolving processing power in off-the-shelf multi-core controllers, and by a non-signalling approach to device test. These enhancements in speed are largely made possible by the modular design of PXI systems, which decouple signal processing from the RF subsystem.

Conclusion

A modular test platform based on PXI, which scales to meet future requirements, provides an ideal solution for addressing current and next-generation wireless handset test requirements. The re-configurable RF platform, which can be used in the design, validation, and production test of multi-standard wireless devices, combines the bandwidth of PXI Express with the parallel processing power of multi-core processors. The speed advantages of PXI over traditional instruments will become even more pronounced as new multi-core devices are introduced to upgrade the existing instrument platform.

Further advantages of the PXI approach include compliance with open industry hardware and software standards, and the use of register-based addressing and "list" modes to reduce command latency. The common high speed wideband

communications backplane provides for efficient and fast data transfer, with modular hardware components designed for manufacturing test that have been optimized to give the most rapid response. This is backed up with powerful signal processing hardware and efficient measurement algorithms.

Aeroflex PXI 3000 hardware modules have functionality and performance tailored to the needs of mobile device characterization, where speed, RF performance, repeatability and accuracy are key drivers. This is supported by dedicated software suites (as shown in Figure 2) that cover all the necessary global cellular and wireless connectivity standards, and which continue to evolve as new standards are introduced. Ease of upgrade and low cost of ownership are major benefits, both for manufacturers of mobile terminals and component and RFIC vendors.

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Links:
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