Solutions for

Manufacturing Next-Generation Wireless Devices

Using Non-Signaling Test to Cost-Effectively Deliver the Highest Speed in Volume Production

Application Note

Overview

From the early days of cellular handset shipments, signaling test has been used to address interoperability problems during cellular device production. In today's highly competitive marketplace, more wireless bands and multiple technologies (e.g., LTE, HSPA+, GSM/EDGE, W-CDMA, cdma2000®, 1xEV-DO, *Bluetooth*®, and WiMAX™) are being implemented in smart phones and other mobile devices. Therein lies the dilemma. Adding more formats with existing signaling test methods, increases test time and, in turn, cost. But, manufacturers under competitive pressure have to find ways to reduce the cost-of-test in order to improve their profit margins.

Non-signaling offers one solution to this dilemma. Non-signaling is commonly used to describe the next-generation test techniques continuing to develop within the cellular industry. Non-signaling test techniques decrease cost-of-test, per device, by removing over-the-air (OTA) signaling test time overhead and test equipment cost, during mobile device production. The extent to which individual vendor chipsets have been designed with non-signaling test modes determines the amount by which the test time can be reduced. Because of its benefits to manufacturers, chipset design engineers are now implementing fast-sequenced non-signaling test modes in chipsets. It is critical, therefore, that test engineers understand test mode requirements in order to implement a test plan that exploits the non-signaling capabilities of test equipment.

Problem

Implementing non-signaling techniques into a test plan can be challenging. Consider that non-signaling techniques are divided into two categories: non-signaling, as we know it today, and the emerging fast-sequenced non-signaling (Figure 1). With early non-signaling test modes, the device-under-test (DUT) must first sync with an appropriate RF downlink (DL) signal (as if it were from a base station or signaling test equipment), before the transmitter test can begin. Non-signaling test equipment requires the ability to create complex waveform files in order to simulate base station DL signals. Additionally, a means to orchestrate between the test equipment and chipset is required throughout the process of DL sync, setting up transmission and subsequent measurements. With both the early non-signaling and signaling test methodologies, there is a also a cost penalty associated with setting up the DUT prior to each test, as well as setting up the test equipment for acquisition and measurement.

With fast-sequenced non-signaling modes, no sync signal is needed before testing can begin. Here, the ultimate goal is that all device control and new test modes that provide output sequences, will be available via the device's programming interface, thereby minimizing signaling overhead.

Agilent Technologies

Solution

Overcoming the challenges of adopting a non-signaling cellular test plan requires a one-box test solution that can execute test plans at the highest speed for multiple technologies and frequency bands. It also requires a future-proof architecture with the flexibility to optimize both for the early non-signaling test modes and the evolving fast sequenced non-signaling test modes.

Easy-to-use test development tools are also needed to create standard-based DL test waveforms and the sequences that coordinate between DL signal generation for chipset sync and subsequent device transmission for uplink (UL) analysis within the test equipment. Such tools are critical for enabling engineers to design and implement the new non-signaling test process in the shortest time possible.

The EXT wireless communications test set from Agilent offers just such a solution, making it ideal for test design engineers ready to move to next-generation non-signaling test (Figure 2). It integrates a vector signal analyzer, vector signal generator, multi-port RF input/output hardware, and an innovative test sequencer into a single, one-box test solution.

The EXT works in sync with chipset test modes, using fast measurements and flexible sequencer techniques to speed calibration and verification of the latest wireless devices. The EXT's fast standards-based measurement and modulation analysis capabilities are based on proven Agilent X-Series measurement algorithms. Unique graphical Sequence Studio software for the EXT dramatically simplifies test plan creation and reduces the need for test programming support. Agilent Signal Studio software helps engineers easily create complex test waveforms.

The EXT features a number of critical capabilities that make it well suited to support non-signaling test. These capabilities include:

- Fast test development, which simplifies test code generation and reuse, measurement correlation and troubleshooting, and implementation of measurement routines and allows engineers to more quickly optimize test plans.

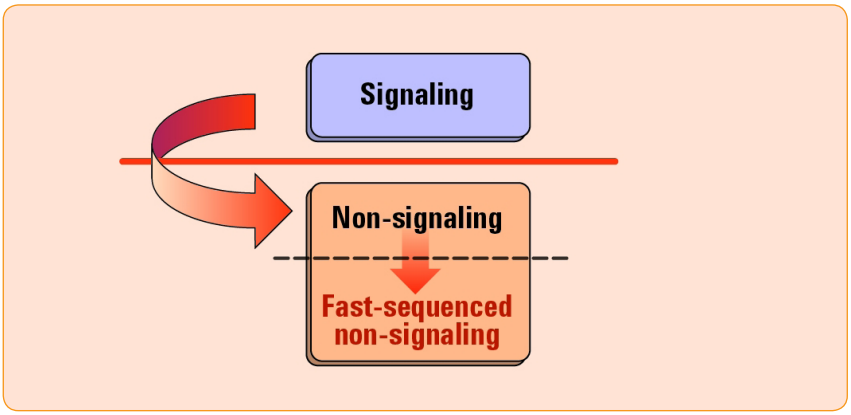

FIGURE 1. Shown here are non-signaling test categories.

FIGURE 2. The Agilent EXT wireless communications test set.

- The ability to execute test plans at the highest speed with a highly flexible test sequencer, fast frequency and amplitude switching, and multi-signal acquisition.
- The ability to test multiple radio formats (both new and existing), including LTE, HSPA+, cdma2000, 1xEV-DO, *Bluetooth,* WiMAX, and more.
- An architecture optimized for lower-cost non-signaling test, which reduces initial capital investment.
- Superior hardware and software scalability for technology and test-mode advances, which preserves user investment and reduces long-term costs.
- The flexibility to work with a device's built-in test modes to provide automated measurement sequencing over a wide frequency range.
- The ability to deliver high first-pass yields and measurement confidence with repeatable results that are accurate to the industry standards.

Creating Non-Signaling Test Sequences

To provide the optimum test coverage for devices with fast-sequenced non-signaling test modes, engineers require test equipment that offers flexible, sequence-based test during verification. Signaling test equipment does not offer sequence-based test and therefore, cannot maximize the potential of the fast-sequenced non-signaling test modes. Next-generation non-signaling testers, however, can remove any band, cellular format, channel, power range, and time slot limitations that may have been enforced as a rule within signaling.

One way to create non-signaling test sequences, such as fast device tune calibration, is through use of the graphical Sequence Studio software tool, available exclusively with the EXT (Figure 3). Using Sequence Studio makes it easier for engineers to use the EXT's source list sequencer analyzer. The tool instantly captures signals from a device and displays

them onscreen. The engineer can then easily drag-and-drop analysis interval bars and burst timings to debug a non-signaling sequence.

Summary of Results

While OTA signaling to access RF parameters provides a proven means of testing cellular handsets, that benefit comes at the price of test time overhead. In cases where the chipset test mode can align with non-signaling test techniques, test time can be improved. For this reason, cellular chipset providers and phone manufacturers are now adopting non-signaling test techniques as a means of testing RF parameters to perform device calibration and verification.

As testing methods evolve, manufacturers can optimize cost reductions by using one-box testers best suited to device test mode capabilities. The EXT offers a solution for those ready to move to next-generation non-signaling test. This one-box tester is designed to make the best possible use of new test modes and predefined device sequences. As a result, it allows mobile device manufacturers to smoothly transition to fast-sequenced non-signaling, while realizing the much sought after benefits of reduced test time and cost.

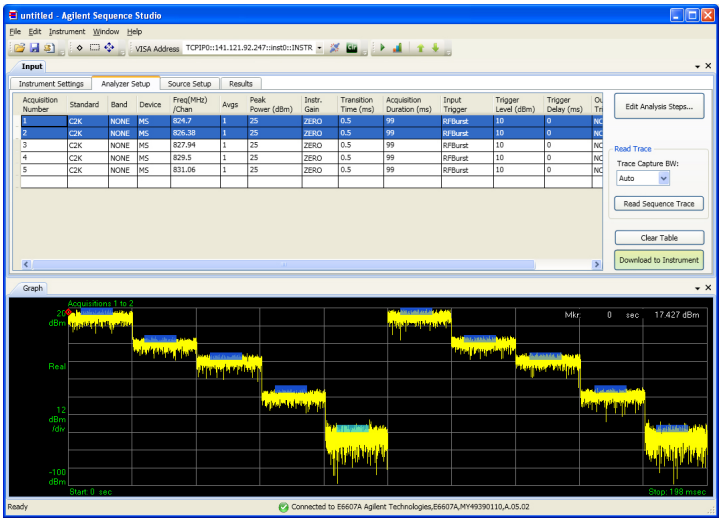

FIGURE 3. Sequence Studio software helps accelerate non-signaling test sequence development.

The Power of X

The EXT wireless communications test set and X-Series signal analyzers are key products in Agilent's comprehensive Power of X suite of test products.

The Power to Accelerate Next-Generation Wireless

You face increasing technical and operational complexity. Agilent's X Platforms help you anticipate these growing complexities so you can accelerate your ability to achieve both engineering and business goals faster. To learn more about Agilent's suite of X products please visit: www.agilent.com/find/powerofx.

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Printed in USA, March 14, 2012
5990-7209EN

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