Solutions for

Optimizing Power Savings on WiMAX™ and Other Cellular WWAN Interface Devices

Application Note

OVERVIEW

Wireless Wide Area Network (WWAN) Interface Cards (NICs) and devices are quickly being adopted to provide "anytime, anywhere" internet access for laptops. WiMAX™ and other broadband cellular format-based devices take over where most Wireless LANs end, no longer being tethered a short distance from a wireless access point.

The penalty of most first generation devices is considerably higher power consumption and current drain, reducing run time, especially for smaller lap tops. Power consumption will continue to be a challenge with achieving greater data rates that are planned in the future. While USB and the laptop PC Cards are in common use today, ExpressCard™ format devices are now starting to supplant the PC Card. The ultimate objective however is to get the power consumption low enough such that the chipset reference design can be used in handheld devices. All of these things drive the need for ongoing power savings optimization. Efficient methods and tools for measuring, visualizing, analyzing, and reducing current drain of these WWAN devices during their development and evolution, as well as assess performance in use in actual networks, is of paramount importance to the device developers and network providers in their quest to optimize power savings.

Agilent Technologies

PROBLEM

Useful and efficient tools for measuring, visualizing, analyzing, and reducing the current drain of WWAN devices are generally not widely available. Tapping into the laptop's internal power source for measuring the WWAN interface device's current drain is often met with complications. Additional equipment to provide controlled RF and other stimulus and measurements is needed. It takes many months developing and integrating equipment and software for developing a test solution for measuring and evaluating the device's current drain under controlled stimulus. Often the end result is inflexible and of limited capability. A lot of testing ends up being done manually, which can take weeks to perform. This can be time much better spent developing and optimizing the interface card's performance while reducing its current drain and power consumption.

SOLUTION

The Agilent 14565B Device Characterization Software, in conjunction with an Agilent 66321B/D or 66319B/D Mobile Communications DC Source, is a ready-to-use solution for long-term current drain measurement, visualization, analysis, and optimization. This dispenses with time consuming traditional approach of integrating DC sources, current shunts, digitizing measurement equipment, and creating custom application software.

Major capabilities of the 14565B software include:

- Three specialized modes of operation for measurement and analysis:
  1. Current waveform capture and analysis
  2. Long-term current drain data logging and analysis
  3. Long-term current drain capture and CCDF distribution analysis
- Programming interface layer for automated control from other programs.

Results in all three modes can be readily saved, recalled and compared for evaluating and quantifying differences in design changes and performance settings, for optimizing power savings. The programming interface allows the 14565B to be controlled from and return measurement results to other programs, enabling overall test system automation.

Key relevant features of the Agilent 66319B/D and 66321B/D DC sources include:

- A high-speed 16-bit DSP-based digitizing measurement system, similar to a digital scope, but with extended dynamic range and resolution.
- Three current measurement ranges suited for a device's active, standby, idle, and off modes of operation.

These features eliminate the need to use multiple external current shunts or probes as well as a high speed digitizing data acquisition system, digitizing DMM, or digital oscilloscope, to measure and digitize a WWAN network interface device's current drain.

HSDPA WWAN INTERFACE PC CARD CURRENT DRAIN TEST SET UP EXAMPLE

By using an appropriate PC Card test extender as depicted in Figure 1 it is a simple matter to replace the laptop's bias powering the WWAN PC Card with the Agilent DC source output. Some commercial test extenders are designed specifically this purpose, having integrated switching to connect the external power supply to the DUT at the correct times. Having the external power for the PC Card turned on before digital signals are applied is important for correct operation and avoiding having it or the laptop hang-up.

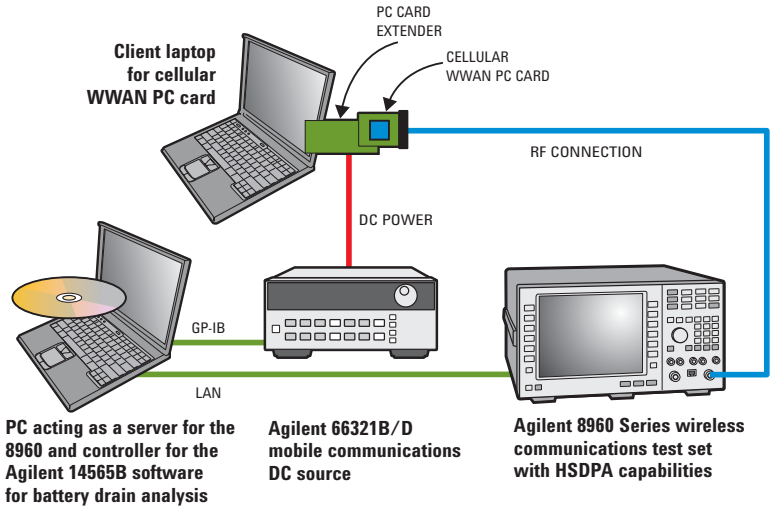

FIGURE 1: *HSDPA WWAN interface PC card current drain test example*

WIMAX WWAN USB INTERFACE DEVICE AUTOMATED TEST EXAMPLE

Manually setting RF stimulus test conditions while making a number of corresponding current drain measurements is often very time consuming and laborious. In Figure 2 the Agilent N6422C WiMAX Wireless Test Manager (WTM) software is used to sequence the Agilent E6651A Mobile WiMAX Test Set through a series of RF settings. At the same time, the WTM software also sends commands to the 14565B software, treating it as a seamless solution with the 66319B DC source to set up, capture, and then return corresponding current drain

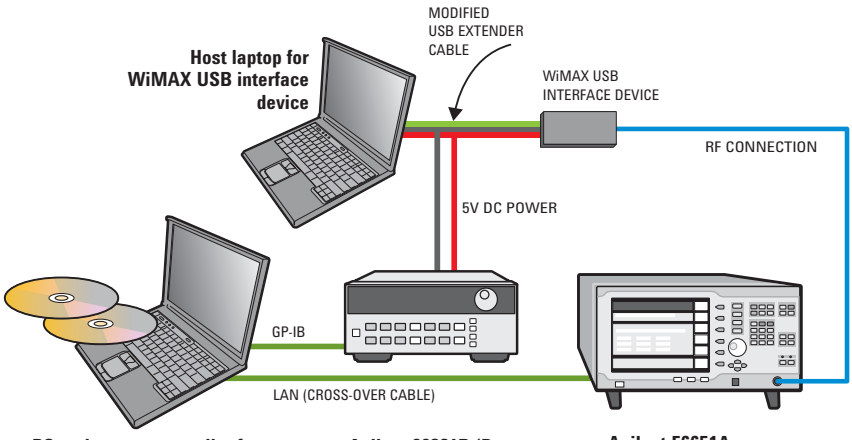

FIGURE 2: *WiMAX WWAN USB device automated test example*

WIMAX WWAN USB INTERFACE DEVICE AUTOMATED TEST EXAMPLE

CONTINUED

measurements on the WiMAX USB interface device, greatly simplifying this task. DC power is provided by the 66319B DC source using a suitably modified USB extender cable. The N6422C WTM is one of many RF software solutions are available from Agilent to test a variety of wireless formats, which interface with the 14565B software. The 14565B can also be controlled from a variety of other programs, such as Agilent VEE, and National Instruments' LabVIEW, and programming languages, such as Microsoft® Visual Basic 6.0 and Visual Basic.NET, for example, giving the test engineer flexibility to add automated current drain measurements to most any test platform.

For this example the 14565B's CCDF (Complementary Cumulative Distribution Function) operating mode was used to profile the WiMAX USB interface device's current drain for an extended period for a variety of RF conditions, all under automated control of the N6422C WiMAX WTM SW, in Figure 3. The resultant current drain CCDF profiles in Figure 4 are for the device operated at different RF TX power levels.

FIGURE 3: *N6422C WiMAX Wireless Test Manager automating RF and DC stimulus and measurements*

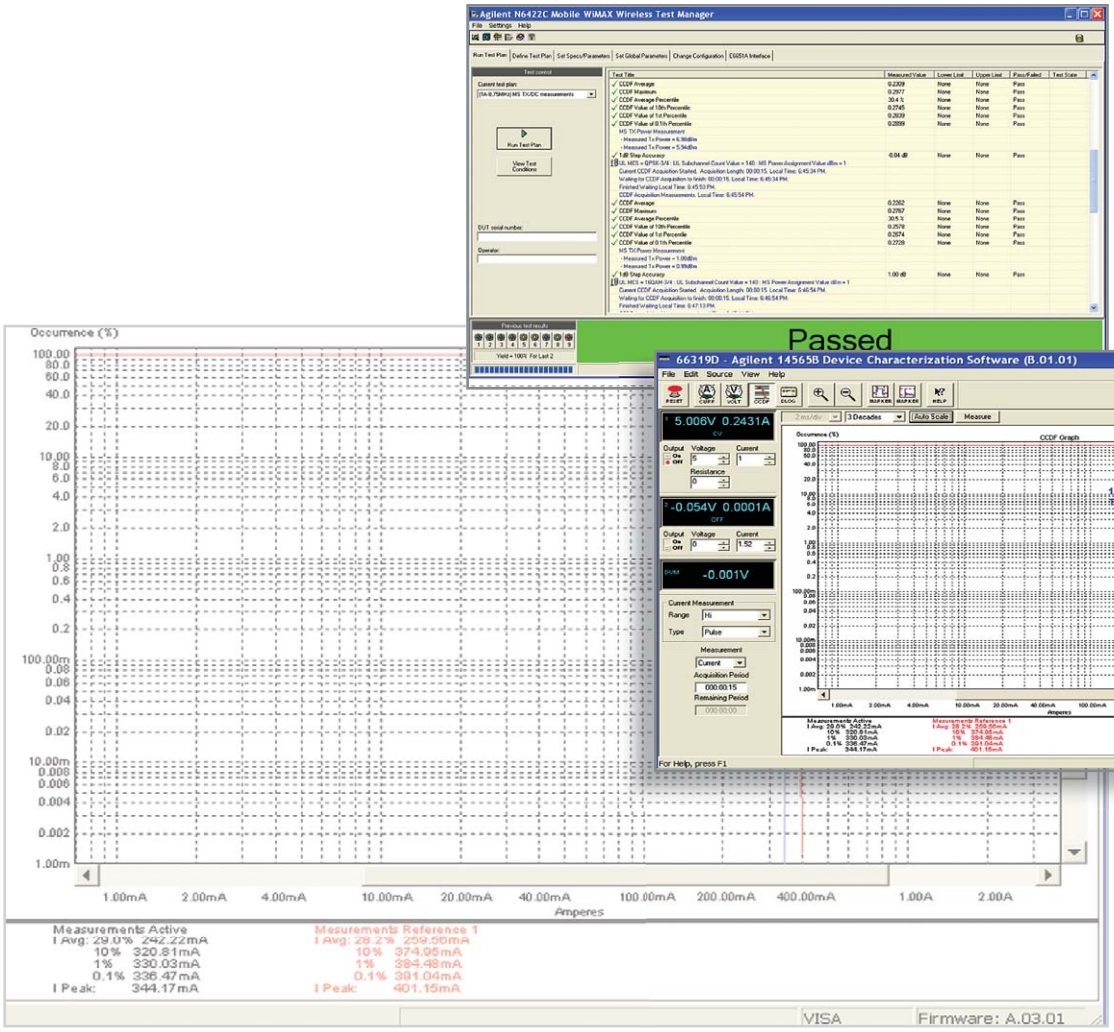

FIGURE 4: *Automated 14565B current drain measurements for a WiMAX device*

SUMMARY OF RESULTS

The complex task of battery current drain testing on WiMAX and other cellular WWAN interface devices for laptops is greatly simplified by using the Agilent 14565B software and Agilent 66319 B/D or 66321B/D DC source, serving as a ready-to-use solution tailored to battery current drain measurement, visualization, and analysis. A suitable adapter simplifies directly powering and measuring the devices' current drain using the Agilent DC source. More importantly, the 14565B features programming automation so it can be easily integrated with test programs such as Agilent's N6422C WiMAX Wireless Test Manager, creating a flexible and capable automated test solution for RF and DC stimulus and measurement. Instead of taking months for programming development and weeks for manual testing, setting up and running battery drain tests now take only hours to accomplish, resulting in dramatic improvements in test time and personal productivity.

RELATED APPLICATIONS

Device application software regression testing
Device functional stress testing (real-world, in-network simulation)
Current drain design validation tests
Operating time use-model benchmarking

RELATED AGILENT PRODUCTS

14565B Device Characterization Software
66321B/D and 66319B/D Mobile Communications DC Sources
8960 Series Wireless Communications Test Set
E6651A Mobile WiMAX Test Set
N6422C/23C WiMAX Wireless Test Manager software
E656xC and N588xA Wireless Test Manager software (a variety of cellular wireless formats are available)
N5970A Interactive Functional Test software (for cellular wireless device real-world functional stress testing)

E5515C wireless communications test set

66319D mobile communications DC source

E6651A mobile WiMAX test set

Remove all doubt

Our repair and calibration services will get your equipment back to you, performing like new, when promised. You will get full value out of your Agilent equipment throughout its lifetime. Your equipment will be serviced by Agilent-trained technicians using the latest factory calibration procedures, automated repair diagnostics and genuine parts. You will always have the utmost confidence in your measurements.

Agilent offers a wide range of additional expert test and measurement services for your equipment, including initial start-up assistance, onsite education and training, as well as design, system integration, and project management.

For more information on repair and calibration services, go to:

www.agilent.com/find/removealldoubt

Agilent Email Updates

www.agilent.com/find/emailupdates
Get the latest information on the products and applications you select.

Agilent Direct

www.agilent.com/find/agilentdirect
Quickly choose and use your test equipment solutions with confidence.

www.agilent.com

For more information on Agilent Technologies' products, applications or services, please contact your local Agilent office. The complete list is available at:

www.agilent.com/find/contactus

Americas

Canada	(877) 894-4414
Latin America	305 269 7500
United States	(800) 829-4444

Asia Pacific

Australia	1 800 629 485
China	800 810 0189
Hong Kong	800 938 693
India	1 800 112 929
Japan	0120 (421) 345
Korea	080 769 0800
Malaysia	1 800 888 848
Singapore	1 800 375 8100
Taiwan	0800 047 866
Thailand	1 800 226 008

Europe & Middle East

Austria	0820 87 44 11
Belgium	32 (0) 2 404 93 40
Denmark	45 70 13 15 15
Finland	358 (0) 10 855 2100
France	0825 010 700* *0.125 €/minute
Germany	01805 24 6333** **0.14 €/minute
Ireland	1890 924 204
Israel	972-3-9288-504/544
Italy	39 02 92 60 8484
Netherlands	31 (0) 20 547 2111
Spain	34 (91) 631 3300
Sweden	0200-88 22 55
Switzerland	0800 80 53 53
United Kingdom	44 (0) 118 9276201

Other European Countries:
www.agilent.com/find/contactus

Revised: March 27, 2008

Product specifications and descriptions in this document subject to change without notice.

Printed in USA, July 15, 2008
5989-8870EN

Agilent Technologies