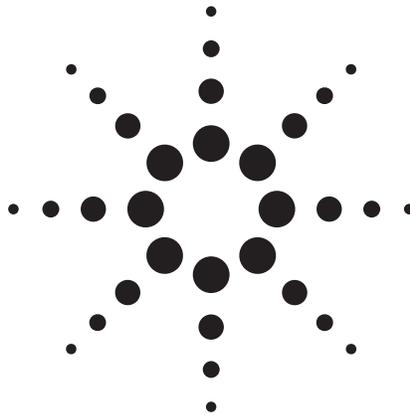


Applications Testing with the Agilent 8960 Series 10 Wireless Test Set

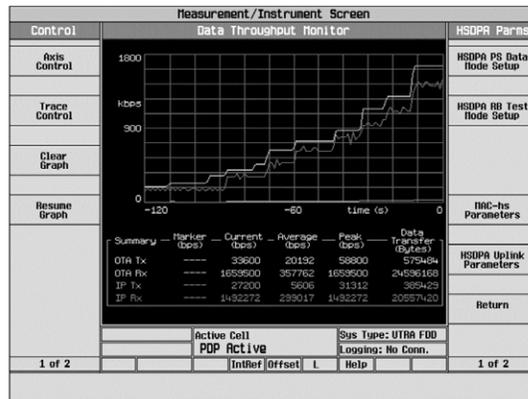
Application Note



network in a box



Agilent 8960 test set



Agilent Technologies

Introduction

As network operators expand their offering of data applications and roll out new services with GPRS, EDGE, W-CDMA, and HSDPA technologies, the requirements on the mobile station (MS) are becoming ever more demanding. The combination of increasing complexity and flexibility in how services are provided is resulting in a growing demand for designers to test the true application performance of their MSs.

Historically the testing needs for MS software and hardware has typically been separated; with protocol developers using scripting solutions and those working on the physical layer using RF based testing. This situation is now changing. The increased complexity of the applications supported by MS is creating a stronger need for testing the combination of both software and hardware working in conjunction with a "real" network. This article will present Agilent's solution for comprehensive application testing which is required during the integration and system test phase of the design and then often repeated as phones are released with new revisions of software.

This article describes how the Agilent 8960 Series 10 Wireless Test Set (E5515C) can be used throughout the design cycle of a mobile handset. The solutions described use both standalone 8960s, as well as the test set as an RF engine within either an Agilent or Anite system solution. In particular, this paper focuses on how the test set can be used with the Agilent E6719C Lab Application Suite for application testing.

Test Needs Throughout the Mobile Handset Development Cycle

The test needs throughout the lifecycle of a mobile handset can be broadly categorized by requirements during the following six stages

1. Design and development
2. Integration, verification, and system test
3. Conformance
4. Interoperability testing
5. Manufacturing testing
6. Service and repair

Figure 1 introduces the test requirements during the first four phases, which are focused on the design stages during wireless handset development.

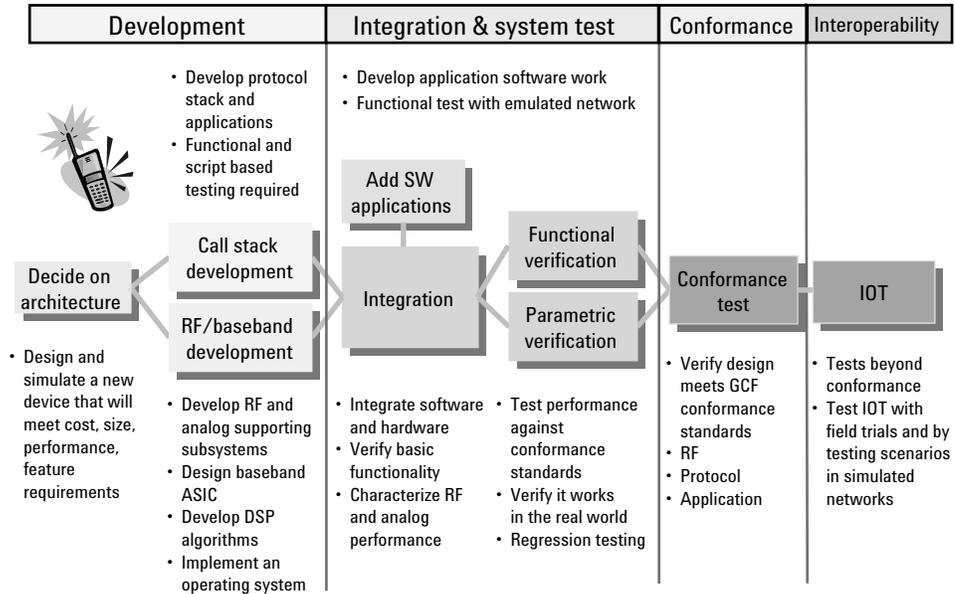


Figure 1. Design lifecycle for wireless handsets

In order to address the test needs at each lifecycle stage there are multiple different test solutions available in the market place today. These can be broadly grouped into three different "types" of tester

1. Scripting engine
2. RF parametric testers
3. Stack based signalling solutions

While the needs in each phase are changing, the scripting engine continues to hold a position of significant importance in the design lifecycle. It provides the ability to exhaustively test protocol behavior during development and in addition, carry out the required protocol tests to meet the requirements for signaling conformance.

Agilent Technologies and Anite's Combined Product Offering

The table in Figure 2 shows how the Agilent Technologies and Anite alliance offers customers solutions for each stage of the MS design lifecycle. Anite has several products that run on its SAT platform to provide solutions for use in pre-silicon and protocol development, conformance testing, and interoperability testing. The SAT consists of the Anite Baseband Processor, a specialized Anite RF combiner, and anywhere from one to eight Agilent 8960 test sets.

- Development and system integration testing – Anite's Development Toolset helps wireless designers meet the standards expected by the consumer and those required by industry bodies such as the GCF, PTCRB, or 3GPP. Running on the Anite's SAT, the only multi-RAT platform in the industry that provides a development test environment for all GSM-evolved technologies, Developers Toolset compliments Agilent lab applications by shortening development cycles through incorporating sophisticated testing at the earliest stages of mobile terminal development.
- Conformance testing – Conformance testing is more than just an industry requirement in mobile handset production. Industry compatibility is fundamental to making sure that new mobile terminals provide the level of service anticipated by the end user. That's why it is crucial to ensure that conformance test equipment operates to the most current industry specifications, such as those specified by 3GPP/OMA. Anite's Conformance Toolset offers proven conformance test solutions to ensure the performance of the protocol, application-enabler, and radio components of a mobile terminal. These solutions incorporate comprehensive analysis tools to measure the quality achieved by all mobile terminals under evaluation.
- Interoperability testing – When a mobile terminal goes to market, company reputations are on the line. Live networks operate differently from the perfect laboratory environment in which the terminal has previously been developed and tested, but attaining certification only requires a limited amount of testing on networks. Field-testing can be costly in terms of travel, time, and potential disruption to the network. Anite offers an alternative with its SAS System simulation product. Network simulation solutions make it possible to carry out detailed, repeatable interoperability tests in the laboratory. By creating, or importing and modifying "real-life" network scenarios, these versatile platforms enable users to test and analyze terminal performance without the travel or trauma of field trials. SAS can be combined with SAM to extend testing to application enablers – ensuring the smooth introduction of new applications on mobile terminals.



8960 Series 10

	Development			Integration, verification, & system test			Conformance			IOT	Manufacturing		Service & repair		
	RF	Digital	Protocol stack	Protocol script	Regression	Throughput	Application	RF	Signaling	Application	Network emulation	Field trial	Calibration	Functional/parametric	Final test
Agilent test application	✓												✓✓	✓✓	✓✓
Agilent lab application	✓		✓		✓✓	✓✓	✓✓				✓				
Agilent GS-8800								✓✓							
<i>Anite</i>		SAT(IQ)-DT	SAT-DT	SAT-DT/CT	SAT-CT/SAS		SAS	RAMS	SAT-CT	SAM-CT	SAS				

✓ = Partial solution
 ✓✓ = Full solution

Figure 2. Agilent and Anite test solutions throughout the development lifecycle

Figure 2 is a useful model for representing the overall design process in order to present the types of testing required. In practice however each design team will use their own process and have specific needs. In addition each technology has developed its own set of requirement, driven by both its standards development process and path to market. Presenting the details of each technology offering is beyond the scope of this article, however Agilent Technologies does have a comprehensive offering which addresses the differing testing needs across the technology landscape.

This article focuses on the Agilent lab application products and their use for application testing during the system integration phase of the project. However for completeness the lifecycle diagram in Figure 2 also shows how Agilent’s test application products offer solutions for the needs of both manufacturing and service and repair. In addition the Agilent GS-8800 provides an RF conformance solution.

Agilent Offers Wireless Applications Testing

As operators continue to deploy technologies such as GPRS, EDGE, W-CDMA, and HSDPA we are seeing an explosion of complexity in both the mobile stations functionality and in the flexibility of how it can offer services. Indeed a 3G mobile can have up to 10 million lines of software code, versus only several thousand for a GSM mobile. This combination of increased complexity and flexibility dictate a need for near “real world” MS application performance testing.

Table 1 highlights how the Agilent E6719C Lab Application turns the 8960 (E5515C) hardware platform into the most flexible application tester available in the industry today.

Table 1. E6719C example features

Parameter	Agilent E6719C Lab Application
Network emulation	
Supported wireless formats	GSM/GPRS, EDGE, cdma2000, 1xEV-DO, W-CDMA
GSM/GPRS, EDGE	AMR, DTM, multi-slot 1-12, 2-cell emulation
W-CDMA	Multiple channel types up to 384 k/s AMR, compressed mode, inter-system handover
cdma2000, 1xEV-DO	Multi-unit sync, hybrid mode, mobile IP
Supported interfaces	Ethernet, serial, GPIB, LVDS
Mobile applications	
Voice calls	Mobile and network originated calls in loopback mode
TCP/IP connectivity	Anything above IP, e.g. “ping”, FTP, HTTP, WAP
UMTS video calls	End-to-end video call
Messaging	SMS and MMS messaging
Cell broadcast	Yes (GSM and W-CDMA)
Service interruption request	Yes (GSM and GPRS/EGPRS)
Additional features and de-bug tools	
Combine with RF measurements	Yes
Protocol analysis	Yes
Throughput testing	Yes
Fading simulator	Yes (with N5101A, does not support GSM/EGPRS)
Two-cell handover	Yes (GSM, GPRS/EGPRS)

This E6719C solution supports voice, video, IP, and messaging applications on either GSM/GPRS, EDGE, cdma2000, 1xEV-DO, or W-CDMA bearer technologies. It provides a stack based signaling architecture, which offers the ability to test application performance alongside taking RF measurements and performing protocol logging. This combination of features makes it an ideal choice for developers requiring application testing and de-bugging tools.

Agilent's "network in a box" solutions

The E6719C combined with the E5155C provides a comprehensive solution for base station emulation. A variety of cell site configuration options are available for each of the wireless formats. This enables the user to establish a network connection such that the mobile station believes it is on a real network. The user can then test the mobile stations functionality both for supporting network functions, such as handover and a full range of applications. For example, Figure 3 shows how two 8960 test sets can be used to test W-CDMA end-to-end video capabilities.

The E6719C supports the widest range of wireless formats and end-user applications in the industry.

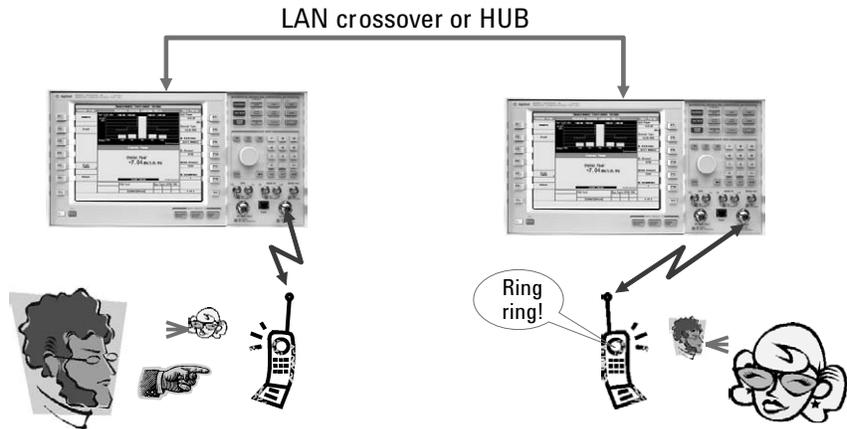


Figure 3. End-to-end video testing over W-CDMA

Comprehensive debug tools available

Within the early phases of integration testing it is useful to be able to log protocol exchanges in order to optimize the design or de-bug issues as they arise. The Agilent wireless protocol advisor (WPA) software supports real-time, over-the-air recording of layer 1, 2, and 3 protocol messages for GSM, GPRS, EGPRS, cdma2000, and W-CDMA technologies. In addition, the software supports user-defined triggering and filtering to help with isolating specific issues during design de-bug. WPA also has the capability to do simultaneous logs for two test sets, which is a useful feature for assessing handover performance. Figure 4 shows a screen capture for the WPA software.

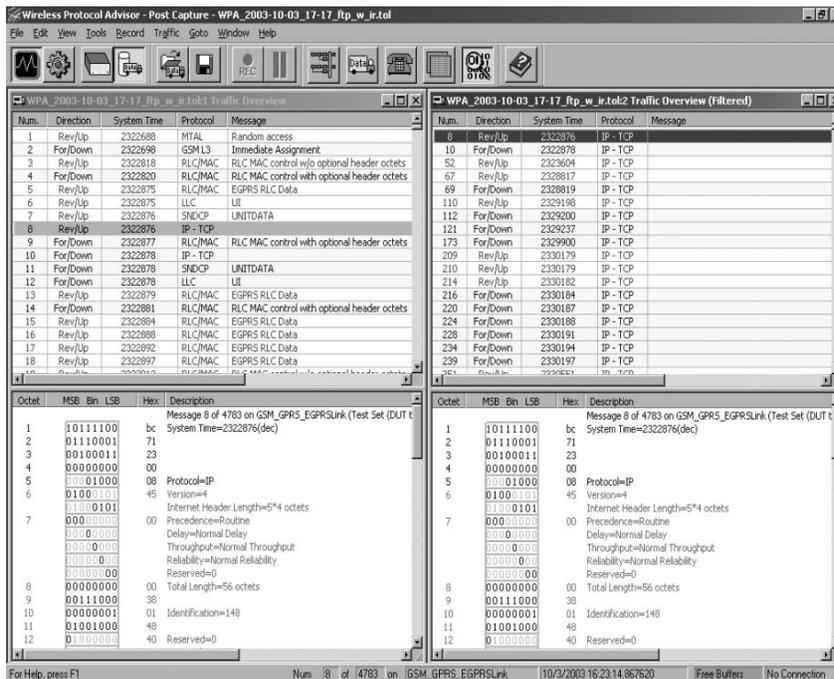


Figure 4. Screen capture for the WPA software

Another tool which is helpful when testing applications is the data throughput monitor. This measurement provides the user with a graph versus time for both over-the-air and IP data throughput on the Tx and Rx channels. If the application needs troubleshooting due to poor performance, then this tool can be used to establish actual data rates versus the theoretical maximum supported by the radio bearer. Figure 5 shows a screen capture for the data throughput monitor.

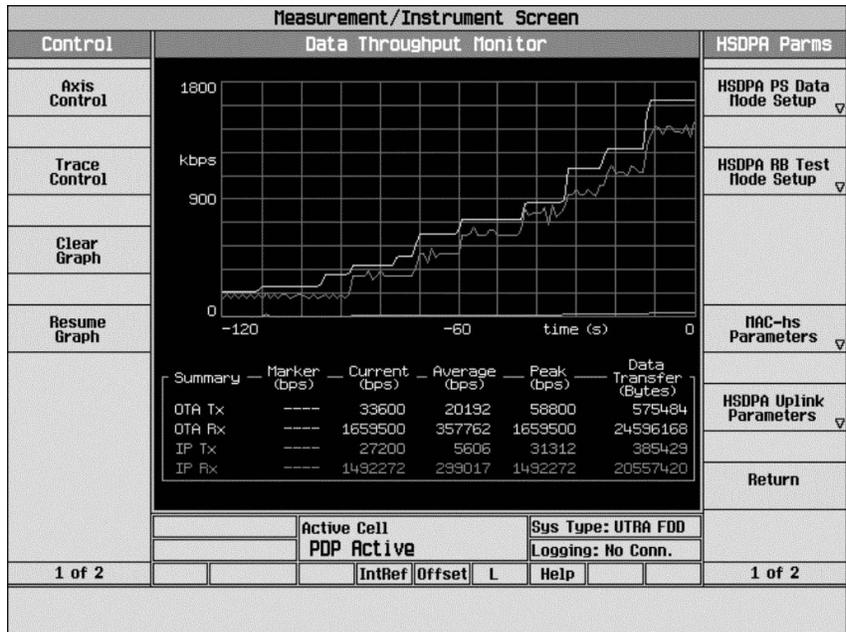


Figure 5. Screen capture for the data throughput monitor (IP and over-the-air)

In addition to protocol analysis, the Agilent solution also offers a suite of RF measurements. This combines both parametric measurement capability and layer 1 performance testing. These can be useful tools either for fault finding or for benchmarking a given handset's performance using well defined test modes. Figure 6 shows a schematic representation of W-CDMA mobile station under going a test with a fixed reference channel H Set-3. Here the mobile station is tested with a defined channel structure to ensure the hardware is able to support the necessary throughput.

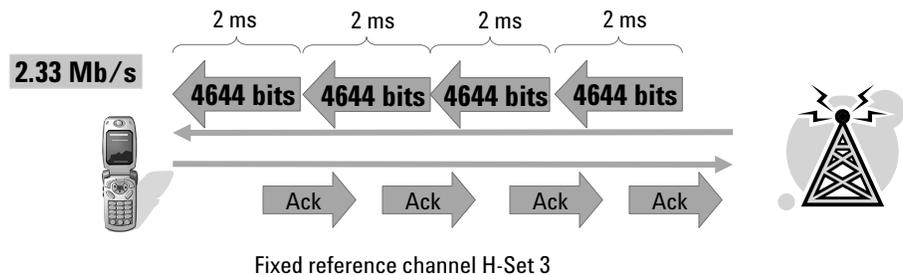


Figure 6. RF measurement tools can be used to benchmark mobile station performance against defined reference channels

Protocol logging and RF measurements can be used together to provide an unbeatable combination of both RF parametric and functional test capability. This is particularly helpful during the early stages of de-bug as the integration team brings the design together.

Two cell emulation

Figure 7 shows the equipment configuration for using the 8960 test set for two cell emulation. This is an important test as many dropped calls happen during a handover transition. Agilent's E6719C supports handover, cell selection, and cell reselection for circuit switched, packet based, and dual transfer mode (DTM) services over GSM, GPRS, and EGPRS.

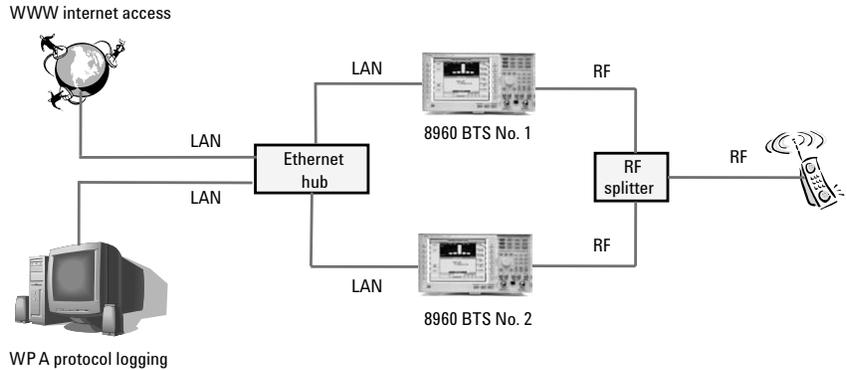


Figure 7. Equipment configuration for two cell emulation

Dual transfer mode (DTM)

Dual transfer mode is a technology which allows a GSM/(E)GPRS mobile station to simultaneously support both packet switched and circuit switched connections. This allows the user to, for example, access their e-mail or surf the Web at the same time as having a conversation on their mobile device. This technique requires the mobile handset to function on contiguous time-slots for both the up-link and the down-link (see Figure 8). The E6719C supports both mobile originated and terminated DTM requests.

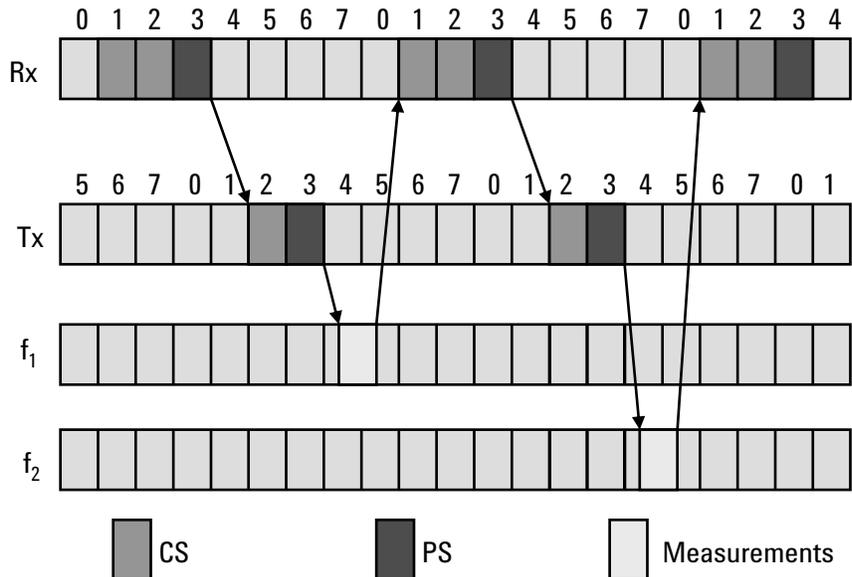


Figure 8. Dual transfer mode for GSM/(E)GPRS

Fading

Agilent has a fading solution for the CDMA-based technologies that allows the designer to test application performance in a simulated radio environment. Use of the N5101A and the 8960 test set (Figure 9) provides functionality, usually associated with much higher cost solutions, in a format which supports use on the engineers' bench.

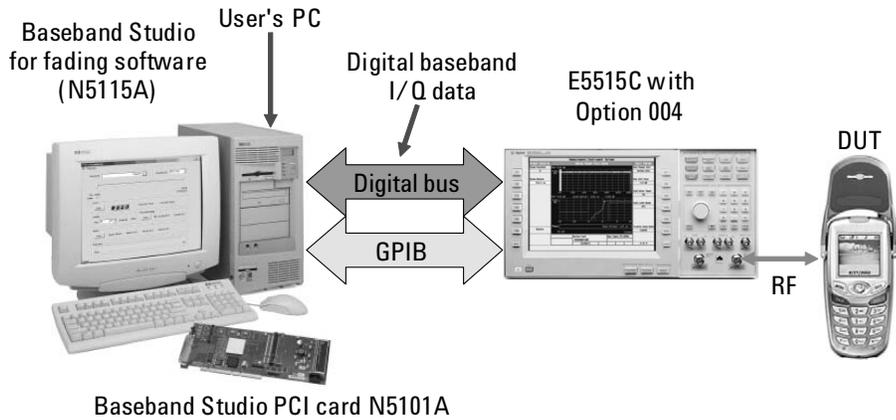


Figure 9. Equipment configuration for CDMA application testing with RF fading

Application performance testing, with a realistic RF channel, will take on a growing importance with new more data-centric wireless technologies, such as HSDPA. The primary reason for this stems from how the networks are optimized. A traditional voice-based cellular network is optimized for capacity in terms of the number of users or calls, where each user is given a fixed bandwidth. For data-based networks the optimization is focused more on overall throughput. As a result, techniques are being developed to increase the instantaneous data throughput where conditions permit. HSDPA does this by using shorter packets and changing modulation format and coding choices depending on the channel characteristics. MIMO (multiple input, multiple output) is a new technology which further seeks to increase the instantaneous throughput by transmitting data on parallel spatial streams where propagation conditions allow.

All of these developments and new techniques mean that the application is now functioning with a communication channel whose characteristics are fluctuating with the changes in the propagation environment. The overall application performance and hence user experience will be governed by the quality of choices made at all layers in the stack and their subsequent interaction in a real environment. For true application performance testing it is no longer sufficient to represent the radio channel using an ideal channel with attenuation.

On-going feature development

As the standards continue to develop new features are constantly being added. The Agilent E6720A Lab Application Annual Contract is a yearly upgrade service. This service gives customers early access to all the latest features as soon as they become available, ensuring that their solution is always up-to date.

Summary

This article has briefly introduced the phases involved in mobile handset development and described how products from Agilent Technologies and Anite combine to meet the majority of test requirements throughout the lifecycle.

Agilent Technologies solutions for application testing have been described in more detail. The E6719C allows engineers to test a variety of applications over a wide range of wireless formats. Furthermore the solution offers additional features such as the ability to use two boxes to test GSM/(E)GPRS handover or, for CDMA technologies, the ability to simulate RF fading characteristics using the N5101A.

Acronyms

1xEV-DO	cdma2000-based high speed wireless data standard
3G	3rd generation wireless standardization
AMR	Adaptive multi-rate
CDMA	Code division multiple access
cdma2000	CDMA-based 3G wireless standard
DTM	Dual transfer mode
EGPRS	Enhanced general packet radio service
GPB	General purpose interface bus
GPRS	General packet radio service
GSM	Global system for mobile communication
HSDPA	High speed downlink packet access
LVDS	Low voltage differential signaling
MMS	Multi-media messaging service
MS	Mobile station
Multi RAT	Multiple radio access technologies
SAM	Anite application conformance testing solution
SAS	Anite interoperability and integration testing system
SAT	Anite single platform multi-RAT signalling test solution
SMS	Short message service
W-CDMA	Wideband code division multiple access
WPA	Wireless protocol advisor

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