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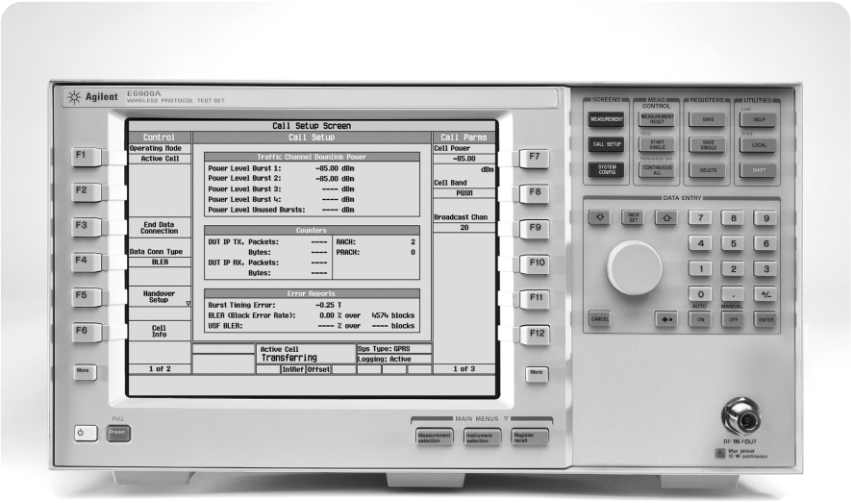
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Agilent
Integrate and Verify Protocol Wireless Data Devices

Using Agilent Wireless Protocol Test Solutions
E6900A Wireless Test Set and Protocol Applications
E5515C Wireless Test Set and Lab Applications

White Paper



Agilent Technologies

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Introduction

Mobile communications are no longer the domain of voice-only phones. A new generation of wireless devices combines voice and data, presenting numerous R&D challenges. Evolving standards, increasingly complex protocol stacks, and embedded applications are putting far more demand on the design of software and hardware, that requires more testing and verification in the lab.

With product-development cycles getting shorter, you need fast, effective ways to integrate and verify hardware/software designs under real-world conditions. Until now, that has meant finding a real network or using unwieldy systems designed for conformance testing or designing your own tools.

The situation is changing, however, with the introduction of one-box test solutions with software tools designed specifically for the needs of wireless product developers. Agilent offers solutions that can connect you to the Internet, emulate a real-world RF environment and monitor the messages over the air. These solutions cover the latest 2.5 and 3G technologies, are easy to use, and are sized and priced so that it's practical to put one on each of your R&D benches.

This paper discusses the challenges of integrating and verifying software in today's wireless data devices and illustrates how Agilent's wireless test solutions simplify the tasks of verifying and integrating software design and verifying protocol implementation.

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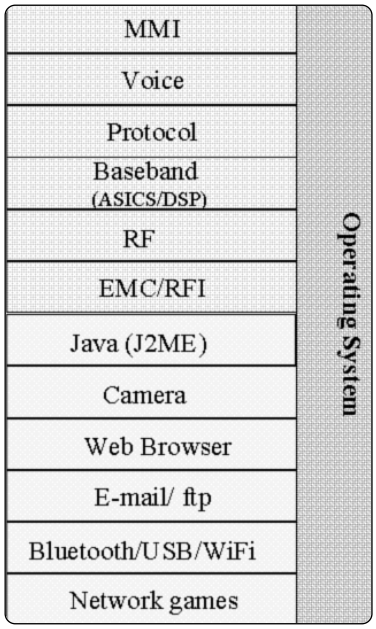
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Evolution of Wireless Devices

In contrast to the first two generations of mobile phones, today's wireless devices support a growing number of data applications as well as voice and voice-related services. That means there are many more components and subsystems in today's wireless devices, including everything from RF circuitry (combiners, filters, oscillators, mixer, power amplifiers) and audio components to chip sets, protocol stacks, datacom software, and display drivers, along with a more complex manual user interface, mechanical packaging, and battery.



One of the biggest effects of adding Internet connectivity and packet-based data to wireless devices is a huge increase in the amount of embedded software. In previous generations of phones, software dealt mainly with the signaling protocols used to control the operation of the phone. Now, data communication protocols account for an increasingly larger percentage of the code.

Changing architecture

Historically, the architecture of wireless telephone systems has not been that different from that of wireline plain old telephone service (POTS). Traditional POTS consists of a signaling system and a parallel network that makes up the dedicated circuit. Likewise in the wireless world there is a signaling system, although that system is far more complicated than its wireline counterpart because the wireless system must handle mobility functions such as handovers and changing power levels. Wireless networks also have a "mini" protocol stack, primarily for error correction, that is loosely equivalent to the dedicated circuits of the wireline telephone network.

New 2.5 and 3G technologies, however, introduce an application stack in parallel with the existing signaling protocols. These application protocols allow new wireless data devices to run embedded software such as Web browsers and Java™ engines. They also can turn the wireless device into a modem for transmitting data — for example, between a PDA and the Internet. The addition of this IP data capability adds significant complexity to the design and operation of the wireless device.

Software integration challenges

With the multiplicity of air interface technologies being deployed for wireless communications — from 2G, 2.5G, and 3G cellular technologies to wireless LAN and *Bluetooth*™ — there is a large and growing number of protocols to validate in a wireless device design. A variety of tests are required to verify the performance of the software, from conformance tests that addresses compliance with the standards to data transfer performance and interoperability tests to field trials.

At the design stage, it's important not just to test the individual software components, but to verify how well they perform when integrated into the wireless device. You will need to stress the device under real-world conditions, using real data, checking for such things as lost data packets, data throughput, and delays. For this you need either a real network or a test system with powerful emulation capability.

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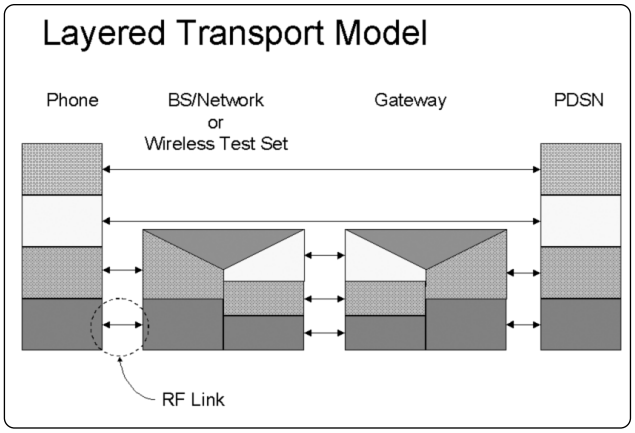
Layered structure of a wireless data network

Before considering the kinds of test solutions available, it is useful to review the layered structure of a wireless data network. In general, wireless systems are based on the familiar International Standards Organization (ISO) seven-layer Open Systems Interconnect model, shown below.

International Standards Organization - Open Systems Interconnection (ISO-OSI) 7 Layer Model

Layer	Function	Typical Protocol
Application	Specialized network functions such as file transfer, virtual terminal, electronic mail, and file servers.	
Presentation	Data formatting and character code conversion and data encryption.	
Session	Negotiation and establishment of a connection with another node.	
Transport	Provision for reliable end-to-end delivery of data.	TCP
Network	Routing of packets of information across multiple networks.	IP
Data Link	Transfer of addressable units of information, frames, and error checking.	RLC
Physical	Transmission of binary data over a communications network.	GPRS Physical

Within this model, different layers of the protocol stack have different functions. The physical layer (Layer 1) represents the network's physical connections or links. Messages exchanged at this layer cause direct changes to the links; in wireless networks, examples of such changes are timing adjustments (in TDMA systems), power adjustments, changes in the level of coding used, and hand-over to another cell, an action that opens a new channel.



This diagram shows how different layers of a stack can be implemented in different devices. The stack on the left represents a wireless device; the second stack is the combination of base station, network, and a mapping function needed to get the data to the Internet. The third stack is a gateway, and the stack on the far right is the Internet. The wireless device has physical and data flow connections with its own cell, but the next layer up, IP, is transferred from the Internet and has been passed through each of the intermediate pathways.

The gateway is necessary to allow WAP web pages to be adjusted for the screen size of a specific phone. The gateway maps generic data onto each of these screens.

Note that the black line with two arrows at the bottom left represents the RF link in both directions. With "intelligence" added at layer 2, it becomes simply a modem.

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Methods of Verifying Software and Testing for Functionality

One method of supplying the IP traffic needed to exercise a wireless data device is to test the device in a live network. This approach, however, is not practical for an R&D engineer. Setting up and maintaining an actual 2.5 or 3G network is expensive. Moreover, testing is limited to the network's technology format (for example, GPRS, WCDMA, or cdma2000) and you have little control over the environment in which the test is performed. For these reasons, most verification testing has been done using the large, script-based systems developed for conformance testing.

A script in this case is the exact sequence of protocol messages that must be exchanged between a wireless device and the network to implement a specific feature. (See table below.) Scripts can be written to test any possible scenario; the message exchanges between the wireless device and the network are spelled out line by line. The system will step through the messages sequentially and notify the user when an unexpected response occurs. Scripted tests are used to verify conformance to a particular standard, and a technology will have test suites that have been developed as part of the minimum performance requirements. Product developers generally augment the minimum set with hundreds of additional tests. These can take weeks or even months to develop, depending on the complexity of the test case scenario.

Like real networks, conformance test systems are expensive, have steep learning curves, and require expert resources to create the code. Writing and validating the complex scripts takes time and requires extensive knowledge of the protocols being worked on. This method of testing is not well-suited for an environment in which multiple designers need to test and debug software in parallel so that they can turn their designs around quickly.

An emerging alternative for lab use is the one-box tester based on the wireless protocol stack. In a stack-based tester, state machines implement at least a subset of the wireless standard to emulate real network functionality. Stack-based systems can provide substantial coverage of a wireless standard for a much smaller investment, and the learning curve for this type of instrument is hours instead of months. Additionally, they allow you to run tests in any order, creating test scenarios on the fly, unlike script-based systems that require planning in advance of each scenario that you want to try. Nevertheless, message coverage and range of testing with stack-based protocol test systems will be limited to just those features implemented in the installed stack.

Stack-based testers can offer other benefits by testing aspects of the wireless device's functionality that aren't covered in the standards. For example, the standards tell you that the wireless device needs a display, but they don't tell you how to do the implementation. The display must be usable under a variety of conditions, and as you add Web browsers and Java to the device, the implementation gets complicated. Stack-based testers can provide the capability needed to test the display running Web applications under changing conditions.

Similarly, the standards specify the format required to send and receive short message service (SMS) messages, but they don't tell you how to set up the wireless device to handle the service. Will the device beep when a message comes in? Will the message automatically pop up on the display? Once again you need to design and test an implementation, and stack-based testers will help you ensure its performance.

When you verify a wireless protocol implementation, it's essential that you have a way to capture transient events meaningfully so that you can sort through the events to find the needle in the haystack that may be causing problems. Stack based solutions can be the most efficient way to test and debug your implementation.

The following table contrasts scripting and stack-based systems.

	Scripting	**Stack**
Message coverage	Complete possible	Limited
Ease of use	Difficult Weeks to months	Moderate Minutes to hours
Data at high speed?	No	Yes
Connect to internet?	Yes, but at low speeds	Yes
Price	High $300k - $2M	Moderate $50k to $150k

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An Affordable Network for Your R&D Bench

New one-box protocol test sets from Agilent are stack-based tools for verifying, troubleshooting, and documenting wireless software protocol implementations. They provide a network emulator with advanced capabilities, offering an efficient, cost-effective way to put a “network” on your R&D bench.

With support for packet data and voice testing, Agilent’s wireless protocol test sets do everything that a normal network does–setting up calls, performing authentication, setting up voice and data channels, connecting to the Internet, sending and receiving SMS messages, sending and receiving FTP files, and performing handovers. They allow you to stress and validate the entire operation of a wireless data device.



Realistic test conditions

Often stack-based protocol testers bypass the RF sections of a device, focusing solely on the data communication. In doing so, these products operate using high quality, usually high bandwidth connections. In a real wireless network, however, the radio link is less than perfect. Bandwidth may be relatively low and a certain number of packets inevitably will be lost and require re-transmission. Time delays may cause glitches in the applications running on the device. Testing under ideal conditions will not tell you how your device handles these error conditions.

Because the Agilent test sets supply the air interface as well as the protocol stack, you can create imperfect data channels and realistic network conditions. For example, you can emulate a live network with interference, change signal levels in the base station transmitter, and set packet-error and channel-data rates. And, you’ll have far more control of the test environment than would be possible using an actual live network.

The test sets also allow you to probe at any layer of the wireless protocol stack to see all the peer communication taking place. By probing at multiple protocol layers under realistic network conditions, you’ll capture the subtle interactions between the layers of the protocol stack and see more of the communications picture than has been possible before.

Productivity features

The Agilent wireless protocol test sets are designed to help you work efficiently and shorten the device design cycle. The test sets support the theoretical throughput allowed by the standards. Software options cover 2.5 and 3G wireless technologies, so you can emulate most of the world’s wireless networks from your bench. Operation of the instrument is easy. You choose the wireless technology and a channel plan and begin testing.

You can test individual software components or exercise the entire phone to make sure that all software and hardware components are integrated and working properly. Message chains are captured with their contents for troubleshooting, and they can be saved as a file for validation or later action.

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Two Cost-effective Platforms

To meet varying price and performance needs, Agilent offers two platforms for wireless protocol device testing:

If you are working on software applications, firmware, or protocol implementation, the economical Agilent E6900A wireless protocol test set and Agilent E69XX protocol applications offer breakthrough price and performance. You can connect to the Internet, analyze active or test data, and verify protocol transmission across the air interface. The E6900A-based system includes IP data emulation to test data throughput, and base station emulation to test the signaling protocols. It analyzes the messages that are exchanged between a network and a device; provides an RF-to-LAN interface to the Internet; and delivers end-to-end application layer connectivity using all layers of the air interface protocol stack. With the means to validate and troubleshoot software more quickly, you'll require less rework to ensure a robust and stable product.

If your work calls for RF measurement capability — for example, to develop or integrate RF hardware and firmware — Agilent has the E5515C test set and E67XX lab application software. This combination provides everything you need to troubleshoot and validate both the parametric and functional capabilities of wireless data devices. The package includes all the call processing, networking, and protocol analysis features of the protocol applications and E6900A, plus it includes RF measurements and calibrated RF performance. The RF measurements can be synchronized with the protocol analysis, allowing you, for example, to verify RF performance during an IP data transfer. This solution also can be used for regression testing and measurement of specific absorption rate (SAR), the high-power output from mobile devices.

The E5515C is the same hardware platform used for Agilent's industry-leading 8960 Series 10 manufacturing test solution. It gives you the benefits of extremely fast measurements, high accuracy, reliability, and ease of programming. By using the same test set in R&D and manufacturing, you can reduce test development time, increase throughput, minimize support costs, and move wireless device designs more smoothly from development into production.

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Call Processing and Measurement Features

Agilent supplies its test sets with comprehensive protocol stacks for testing the wireless signaling protocols involved in call processing (camping, setting up calls, configuring connections, maintaining calls, initiating handovers, terminating a call, and disconnecting from the network).

Because different technologies have unique methods of handling call processing, Agilent offers different protocol application and lab application options. Two major technologies covered today are GPRS and cdma2000. Summarized below are examples of the features and test capabilities that the protocol and lab applications provide.

For GPRS

- *Call processing* includes realistic multi-slot and data-coding configurations, with a complete set of network coverage from Railroad (400 MHz) to PCS (1900 MHz).
- *User-settable* features such as timing advance and cell parameters help solve timing and network issues.
- *Support for Short Message System (SMS)* allows SMS messages to be sent to the wireless appliance for comprehensive testing of the appliance's performance and that of the SMS service itself. GPRS point-to-point SMS test capability includes mobile-originated, mobile-terminated, and loopback

Support for the Packet Broadcast Control Channel (PBCCH) gives added flexibility for testing this feature that is being implemented in GPRS base stations.

- *Additional protocol extensions* increase your ability to test over a wider range of network conditions.
- *Spectrum monitor* in the E5515C and GPRS lab application adds an on-screen viewer for finding spikes and spurious signals in known locations, along with a full set of transmitter and receiver measurements.
- *Infrequent network events* are almost impossible to test on any other test equipment, and can take weeks to test on a live network. The following infrequent events are covered: accept/reject options for key requests; accept/reject PDP context activation; accept/reject attach request; base-station-initiated detach request; and identify request.

For cdma2000

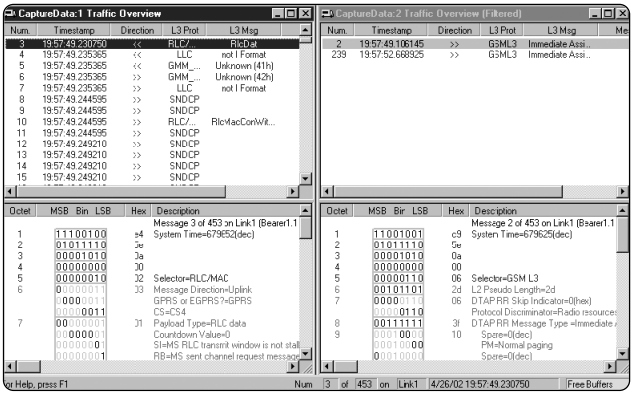
- *Soft and softer handoff* capability ensures that your CDMA appliance can transfer a CDMA call between cell sites or within the sectors of a single cell. These are the only solutions on the market today that can make this critical verification of CDMA handoff capability. Additional TIA/EIA-98-D test coverage is included in this feature.
- *Enhanced frame error rate measurements* include reporting of forward and reverse link frame erasures, help you quickly identify call setup issues (with the E5515C and the cdma2000 lab application).
- *Call processing capability* includes call orientation, paging, registration, and hard handoffs.
- *RF measurements* provide full transmitter and receiver test capability for evaluating the quality and RF performance of your cdma2000 wireless devices (with the E5515C and the cdma2000 lab application).

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Protocol Logging and Analysis

Included with every lab and protocol application is the Agilent wireless protocol advisor, a software package that provides real-time logging, triggering, and filtering of the inter-layer and peer-to-peer signaling and data messages exchanged between a wireless device and the emulated network. Based on Agilent's popular signaling advisor product, the wireless protocol advisor lets you capture events of interest and take a closer look at specific messages. The software runs on an external PC with a familiar Windows® interface to provide added capability and ease of use. A new application programming interface (API) allows you to program the control of the logging capability.

The wireless protocol advisor includes all the protocol decodes needed for message analysis. Captured messages are displayed sequentially on the screen of the PC. If you highlight a captured message, the software breaks the message packets into the individual fields, decodes the contents of each field, and provides additional information about content (size, mapping, etc.). The data can be searched, and large files of captured data stored directly to a PC for post-capture analysis.



The productivity features provided by the wireless protocol advisor are summarized here:

- *Filtering and triggering* on specified or dropped messages; on specified fields within a specified message; or after, before, or within a specified time period. You can set filters for the test set output to remove unwanted message traffic before it is sent to the PC; to filter logged data by event, message type, message validity, or time; and to restrict the data displayed on the PC, while still preserving the captured data in the data log.

- *Real-time logging*, with raw data presented in binary, hex, or decimal format to aid in-depth troubleshooting. Color-coding and time-stamping add to the quality of the information delivered. And you can pause the display of the test set during the logging process to view selected data in more detail—the software will continue to log data uninterrupted.

The software provides a summary of logged message information that includes the protocol path, message name, message direction (uplink or downlink), and time stamps (elapsed and system). It also provides the detail of logged message information, including the complete protocol log stream.

- *Post-capture mode*, which allows large files of logged data to be stored on a PC. File size is limited mainly by the size of the PC's hard drive. Multiple files of captured data can be synchronized, and you can hide sensitive information from view.

- *File sharing*, with Traffic Overview (summary screens) stored as .csv files and Decode View (protocol detail screens) stored as .txt files.

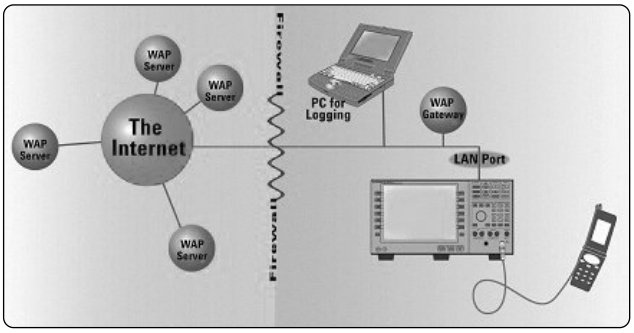
- *Full Search and Save/Recall* including views and settings.

- *LAN connectivity* to the wireless protocol test set.

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The Protocol Test Setup

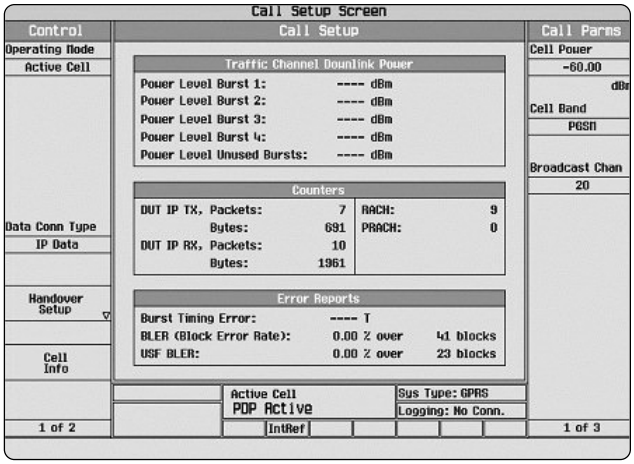
The diagram below shows how Agilent's wireless protocol test set takes the place of a wireless network, allowing you to verify at your bench the protocol implementations in a wireless device. The setup is the same for either the E6900A or E5515C. The device is connected to the RF connector on the front panel of the test set. This connection supplies the air interface between the device and the emulated network. You then can control the air interface to add impairments and check to see how the device responds.



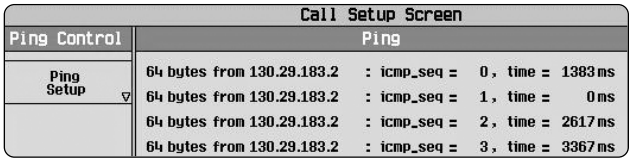
The PC is used to log the data messages flowing between the device and the emulated network.

Connecting to the Internet

Rather than try to generate every type of Web application inside the test equipment, the test set has a network port that links with the air interface. This method of creating an IP data channel for Internet connectivity lets you use the test set as a router or modem. You can hook up the wireless device under test and go directly onto the Internet.



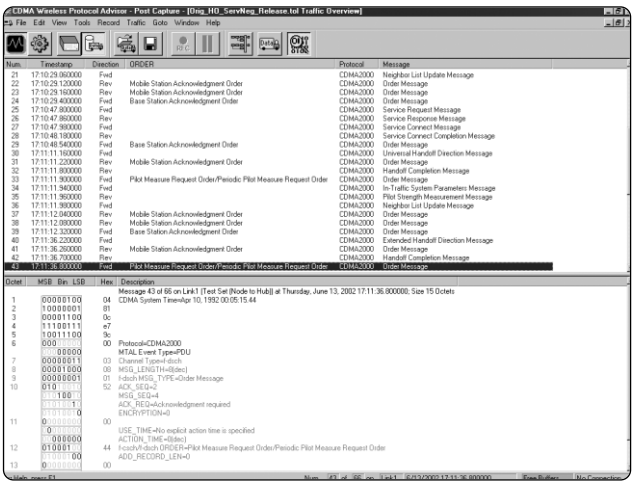
The screen above shows the protocol test set once a wireless device has established an IP data connection. You can see that basic traffic metrics are displayed as long as an active connection exists.



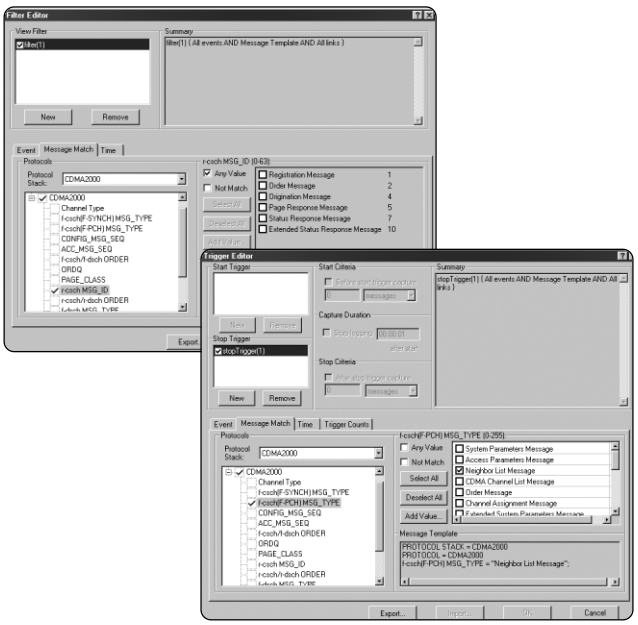
Once you've established a connection, you can test the functionality of a wireless device. For example, you can do the following:

- test the throughput of a file transfer (FTP) to the phone from the Internet
- send and receive SMS messages and verify that they are displayed correctly at both the phone and test set
- check system interconnects by pinging the phone from the test set or pinging an Internet site from the phone
- perform functional tests of wireless modems or WAP devices such as WAP-enabled GPRS phones
- add impairments to the channel for any of these tests to verify that your device can operate in marginal network environments

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In the display shown above, the message traffic between the wireless device and the “network” (test set) appears in the upper portion of the screen. If you highlight a specific message, the details of that message are shown in the lower of the screen.



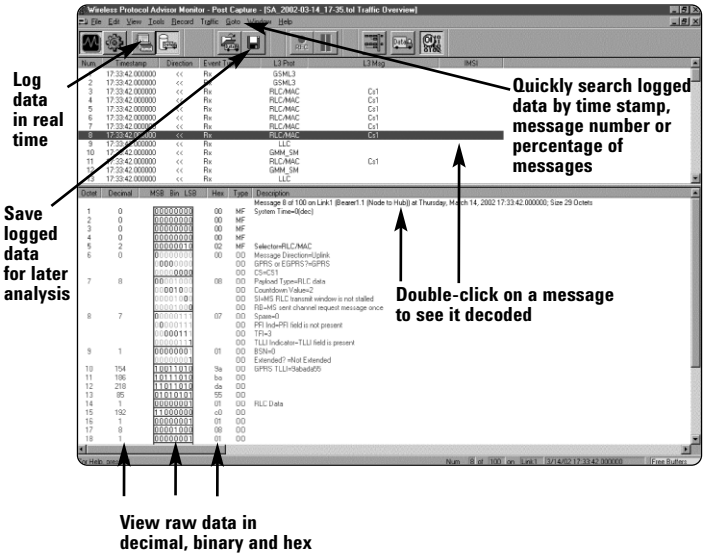
A large amount of message traffic flows between a data device and the wireless network. To speed your troubleshooting efforts, the wireless test advisor lets you configure and select filter settings to reduce the number of messages captured or displayed.

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Summary of the Protocol Logging and Analysis Procedure

The basic protocol logging procedure using the E5515C or E6900A wireless protocol solutions can be summarized as follows:

- connect test set to PC via LAN
- start wireless protocol advisor software on PC
- enter test set's IP address in software (first time use)
- establish connection
- select measurement type
- select message filters and triggers
- connect and turn on wireless device under test
- start logging data from PC
- review logged data traffic from windows on PC screen
- select messages of interest and decode view
- observe message details on lower portion of the screen
- save needed protocol logs to the PC hard drive
- disconnect from test set when you have finished logging
- continue with protocol analysis and troubleshooting in post-capture mode



Example: Logging Protocols in a GPRS Transaction

To illustrate the complexity of wireless protocol transactions, messages were logged when a GPRS mobile phone was first turned on and carried out the normal procedures to "attach" to the wireless network (in this case, the protocol test set). For the purpose of this demonstration, the message count was stopped as soon as a traffic channel was assigned to start the packet transfer. Shown partially in the log screen below, 135 messages were exchanged to get the handset into the attached state, followed by 27 more control messages and ending with the assignment of a traffic channel for transferring Web data. The decoded view at the bottom of the screen shows you the individual field and parameter values (including raw bits) for the messages.

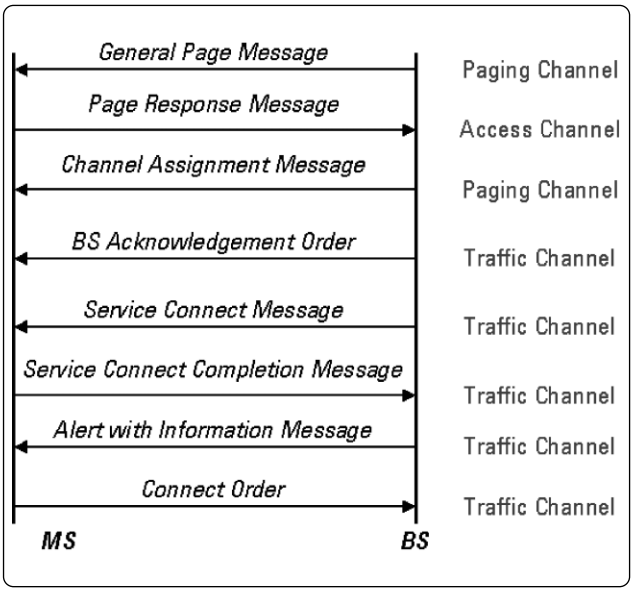
171	Down	17:41:05.111715	30123	RLC/MAC	RLC MAC control with optional header octets	Packet Uplink Ack/Nack
172	Up	17:41:05.120945	30125	RLC/MAC	RLC data	
173	Up	17:41:05.139405	30129	RLC/MAC	RLC data	
174	Up	17:41:05.157865	30133	RLC/MAC	RLC data	
175	Down	17:41:05.176325	30137	IP		
176	Down	17:41:05.176325	30137	SNDCP	UNITDATA	
177	Down	17:41:05.180940	30138	LLC		
178	Up	17:41:05.180940	30138	RLC/MAC	RLC data	
179	Down	17:41:05.185555	30139	IP		
180	Down	17:41:05.185555	30139	SNDCP	UNITDATA	
181	Down	17:41:05.185555	30139	LLC		
182	Down	17:41:05.190170	30140	RLC/MAC	RLC MAC control with optional header octets	Packet Downlink Assignment
183	Up	17:41:05.199400	30142	RLC/MAC	RLC MAC control w/o optional header octets	Packet Uplink Dummy Ctrl Block
184	Up	17:41:05.217860	30146	RLC/MAC	RLC MAC control w/o optional header octets	Packet Uplink Dummy Ctrl Block
185	Up	17:41:05.240935	30151	RLC/MAC	RLC MAC control w/o optional header octets	Packet Uplink Dummy Ctrl Block
186	Up	17:41:05.259395	30155	RLC/MAC	RLC MAC control w/o optional header octets	Packet Uplink Dummy Ctrl Block
187	Up	17:41:05.277855	30159	RLC/MAC	RLC MAC control w/o optional header octets	Packet Control ACK
188	Up	17:41:05.360925	30177	RLC/MAC	RLC MAC control w/o optional header octets	Packet Control ACK
189	Down	17:41:05.411690	30188	RLC/MAC	RLC data	
190	Down	17:41:05.430150	30192	RLC/MAC	RLC data	
191	Down	17:41:05.453225	30197	RLC/MAC	RLC data	
192	Down	17:41:05.471685	30201	RLC/MAC	RLC data	
193	Down	17:41:05.490145	30205	RLC/MAC	RLC data	
194	Down	17:41:05.513220	30210	RLC/MAC	RLC data	
195	Down	17:41:05.531680	30214	RLC/MAC	RLC data	
196	Down	17:41:05.550140	30218	RLC/MAC	RLC data	
197	Down	17:41:05.573215	30223	RLC/MAC	RLC data	
198	Down	17:41:05.591675	30227	RLC/MAC	RLC data	
199	Down	17:41:05.610135	30231	RLC/MAC	RLC data	
200	Up	17:41:05.619365	30233	RLC/MAC	RLC MAC control w/o optional header octets	Packet Downlink ACK/NACK
201	Down	17:41:05.633210	30236	RLC/MAC	RLC MAC control with optional header octets	Packet Downlink Assignment
202	Up	17:41:05.660900	30242	RLC/MAC	RLC MAC control w/o optional header octets	Packet Downlink ACK/NACK
203	Up	17:41:05.675360	30246	RLC/MAC	RLC MAC control w/o optional header octets	Packet Downlink ACK/NACK
204	Up	17:41:05.697820	30250	RLC/MAC	RLC MAC control w/o optional header octets	Packet Downlink ACK/NACK
205	Up	17:41:05.720895	30255	RLC/MAC	RLC MAC control w/o optional header octets	Packet Downlink ACK/NACK
206	Up	17:41:05.757815	30263	RLC/MAC	RLC MAC control w/o optional header octets	Packet Downlink ACK/NACK
207	Up	17:41:05.780890	30268	RLC/MAC	RLC MAC control w/o optional header octets	Packet Downlink ACK/NACK
208	Up	17:41:05.799350	30272	RLC/MAC	RLC MAC control w/o optional header octets	Packet Control ACK

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Example: Validating a Voice Call Setup in a cdma2000 Phone

The following example illustrates the use of the protocol test capability in validating a voice call on a cdma2000 phone. This process involves logging messages at the layer 3 control stack.

The diagram below shows the general procedures for setting up a voice call according to the standards. In this example, the call originates in the wireline network for transmission to the cdma2000 phone. A base station pages the phone, which answers with a page response message. Messages are exchanged to set up a traffic channel for a voice service. When the physical change of channels has been made, the base station sends an alert message telling the phone to ring. After this series of messages has been sent back and forth between the phone and the base station and the phone finally rings, the user hits the talk button and the voice transaction begins. At this point the signaling messages cease (at least until another aspect of call control is needed) and the state of transferring phone data back and forth is underway.



Here we see a log of the call setup message sequence captured using the wireless test set's protocol logging capability. The first few messages in the log are those required by the standard. Numbers 1-3 are examples of such messages. You can see that the messages match those required in the basic call setup procedure.

The next group of messages in the log, numbers 4-6, are several additional messages relating to a request from the test set to the phone for a report of the signal strength of the current link. Several optional acknowledgment messages, numbers 7-9 and 11, are not required in the basic call setup procedure.

Num.	System Time	Channel Type	Event Type	L3 Msg	ORDER
1	07:29.7	f-csch (F-PCH)	PDU	General Page Message	
2	07:30.3	r-csch	PDU	Page Response Message	
3	07:30.5	f-csch (F-PCH)	PDU	Extended Channel Assignment Message	
4	07:31.0	f-dsch	PDU	Order Message	Base Station Acknowledgment Order
5	07:31.0	f-dsch	PDU	Order Message	Pilot Measure Request Order
6	07:31.1	f-dsch	PDU	Service Connect Message	
7	07:31.1	r-dsch	PDU	Pilot Strength Measurement Message	
8	07:31.1	r-dsch	PDU	Order Message	Mobile Station Acknowledgment Order
9	07:31.2	r-dsch	PDU	Service Connect Completion Message	
10	07:31.3	f-dsch	PDU	Alert With Information Message	
11	07:31.4	r-dsch	PDU	Order Message	Mobile Station Acknowledgment Order
12	07:31.6	f-dsch	PDU	Order Message	Base Station Acknowledgment Order
13	07:34.3	r-dsch	PDU	Order Message	Connect Order
14	07:34.7	f-dsch	PDU	Order Message	Base Station Acknowledgment Order

The screen capture below shows the how the test set decodes and presents the details of a selected message; in this case, the details of the first message captured, the general page message.

6	00000000	00	MTAL Event Type=PDU
7	00000001	01	Channel Type=f-csch (F-PCH)
8	00010010	12	MSG_LENGTH=18(dec)
9	00010001	11	f-csch MSG_TYPE=General Page Message
10	000100--	10	CONFIG_MSG_SEQ=4
	------00		ACC_MSG_SEQ=2
11	0010----	2e	
	----1---		CLASS_0_DONE=1
	-----1--		CLASS_1_DONE=1
	------1-		TMSI_DONE=1
	-------0		ORDERED_TMSIS=0
12	1-------	80	BROADCAST_DONE=1
	-0000---		RESERVED=0
	-----000		ADD_LENGTH=0
13	0010----	25	PAGE_CLASS=Class 0, IMSI_S and MCC included
	----010-		MSG_SEQ=2
	-------1		MCC= 000

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Example: Verifying Higher-layer Application Interoperability

Imagine the following scenario: from home, a subscriber places a bid on an item during an on-line auction. The subscriber's option will expire while he is on his way to the airport, so he plans to use his wireless phone to check to see whether he needs to increase his bid at the last minute. As the subscriber drives to the airport, he crosses many different networks and cells, passing through multiple WAP or i-mode gateways. Will his Internet connection and Web applications continue to work?

Maintaining an Internet connection and running Web applications in a mobile environment presents unprecedented challenges for wireless device designers. One important use of the wireless protocol test set is to evaluate how well data applications work together in the wireless device under realistic conditions.

In this case, the test set acts essentially as a transducer used to plug your wireless device into the Internet or an into an intranet running captive gateways on a server. With the latter approach, you can exercise the device in a controlled manner against various combinations of other devices, gateways, servers, and applications. You don't have to know how to configure network broadcast channels (as you would if you were using a real base station and switches for testing); the test set does this for you automatically. You can obtain real data content from the data channel and check to see what happens when the Internet content is received by the device.

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Agilent's one-box test sets with unique software tools are designed specifically for the needs of wireless product developers. They emulate an operating network and give you Internet connectivity with real data traffic flows. You'll be able to test your designs or applications under realistic conditions and move more quickly through the design-to-ship cycle. If you are involved in protocol development, the same test sets provide extensive real-time protocol logging and analysis tools.

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- E6912A W-CDMA protocol application

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- E6703A W-CDMA lab application
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Speed development of new wireless data devices with Agilent's cost-effective, multi-format R&D test solutions, literature number 5988-5950EN

Application notes

Value of handset RF testing - Application Note 1375, literature number 5988-2881EN

Designing and testing cdma2000 mobile stations, literature number 5980-1237E

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