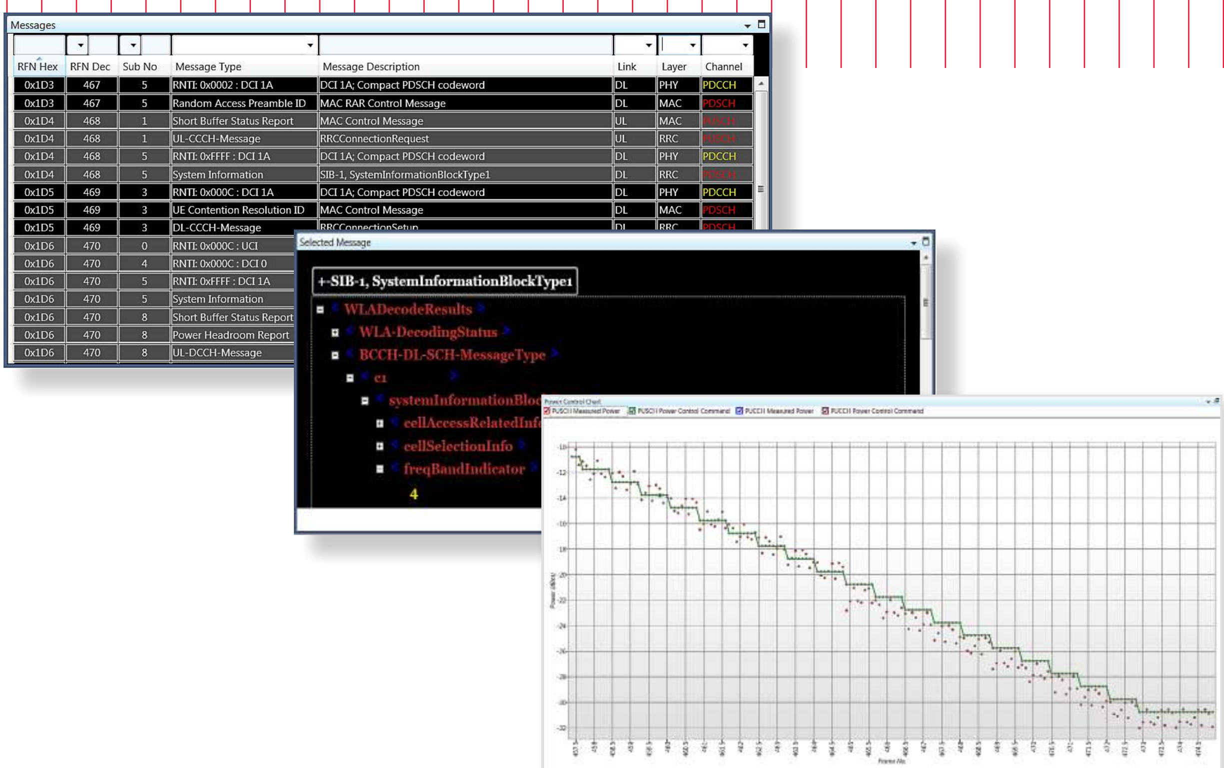
Keysight Technologies
89600 WLA Software

Technical Overview



![KEYSIGHT TECHNOLOGIES]

Key Features

- Decode and verify PHY, MAC, RLC and RRC-layer messages across multiple radio frames
- Extend your existing 89600 LTE FDD test setup with protocol analysis—with minimal additional investment in time or money
- Troubleshoot LTE devices at the PHY and protocol layers simultaneously
- Synchronize the 89600 VSA to the frame containing the currently selected message in WLA
- Use charting capability to view power control, timing advance, HARQ and DCI information
- Save and recall compressed data format message files for sharing between groups and fast certification after BTS software changes

Try before you buy!

Download the 89600 WLA software and use it free for 30 days to do analysis along with 89600 VSA and your analysis hardware, or explore the software in greater detail with our recorded demo signals by selecting File > Recall > Recall Demo > on the 89600 WLA software toolbar. Request your free trial license today:

www.keysight.com/find/89600_WLA_trial

89600 WLA Software

For system-integration engineers and verification engineers, the troubleshooting of new BTS and UE designs will only get tougher as wireless standards evolve. Within standards such as LTE, the biggest challenges stem from the complex interactions between the physical (PHY) and higher layers during signaling operations.

Engineers who typically work at the PHY layer tend to rely on two tools of choice: RF signal analyzers such as the Keysight Technologies, Inc. X-Series and vector signal analysis software such as the Keysight 89600 VSA. As a complement to the 89600 VSA, Keysight has created the 89600 wireless link analysis (WLA) software to help PHY-focused engineers understand the protocol-layer control messaging that occurs between devices. In both system integration and verification the ultimate benefit is deeper insight into system operation and performance that accelerates day-to-day troubleshooting, ultimately improving time to market.

Technology overview

LTE

To ensure the competitiveness of 3G systems in the future, a long term evolution (LTE) of the 3rd Generation Partnership Project (3GPP) access technology was specified in Release 8 of the 3GPP standard. The LTE specification provides a framework for increasing capacity, improving spectrum efficiency, improving coverage, and reducing latency compared with current HSPA system implementations. In addition, transmission with multiple input and multiple output (MIMO) antennas is supported for greater throughput, as well as enhanced capacity or range. To support transmission in both the paired and unpaired spectrum, the LTE air interface supports both frequency division duplex (FDD) and time division duplex (TDD) modes.

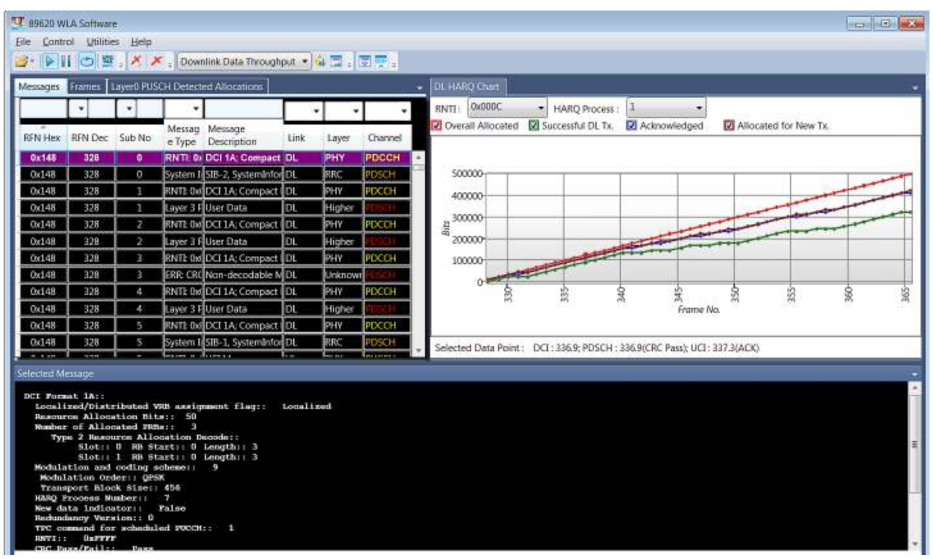


Figure 1. 89600 WLA shows color coded PHY, MAC, RLC and RRC messages with their decoded content. It has built-in charting capability to visualize the information decoded from the signal under test.

System performance in LTE relies on the correct operation of many low level PHY/higher layer control loops and fast responses between the eNB and individual UEs. The flexibility available in LTE results in a complex test and verification environment, where incorrect configurations can go unnoticed.

LTE-Advanced

For higher speed and larger data communications, 3GPP evolves their LTE technologies in Release 10 or later. New technologies of carrier aggregation, enhanced uplink PHY, and higher order MIMO in both DL and UL are deined with more design challenges.

Wireless link analysis

As implemented in the 89600 WLA software, wireless link analysis decodes higher layer control messages and correlates them with the PHY-layer signals they manage.

The decoding and correlation of messages provides greater visibility into higher-layer communication and leads to greater insight into unexpected behavior. The key benefit is the ability to view and interpret RF measurements—power, modulation format, timing, etc.—in a protocol-message context, and to view and interpret protocol messages in an RF context. For example, it's one thing to know the UE is transmitting a PUSCH signal across 15 resource blocks (RB) at +25 dBm; it's another thing altogether to match this against protocol-layer commands and then discover the device was told to transmit at only +23 dBm. This type of low-level control tends to be embedded deeply in the system and it operates with a high degree of autonomy. As a result, one of the only ways to observe and monitor link behavior is through combined PHY/protocol analysis.

Analysis and Troubleshooting

The features that make the 89600 WLA software a great solution for LTE signals include:

A software-only application to extend existing LTE FDD analysis

89600 WLA builds on the hardware/ software connectivity and signal capture of the 89600 VSA software. The direct link between the higher layer protocol messages in the 89600 WLA and the corresponding PHY layer measurement in 89600 VSA allows a deeper level of insight during troubleshooting. For example, when a message is selected in the 89600 WLA, the measurements in the 89600 VSA are automatically moved to the locations corresponding to the selected message, to help the user correlate the higher layer protocol message with the corresponding PHY layer measurement made by the 89600 VSA (Figure 2).

Multi-layer decoding reveals information hidden in upper layer messages, that determines the detailed format of RF signals

Built-in PHY, MAC, RLC and RRC decoders allow recovery and display of information contained in the signaling from the BTS and the UE (Figure 3).

Capturing the RF signal around the initial synchronizing signals, like the PRACH, allows a considerable amount of information to be recovered even from short time records (see Figure 4 on the following page).

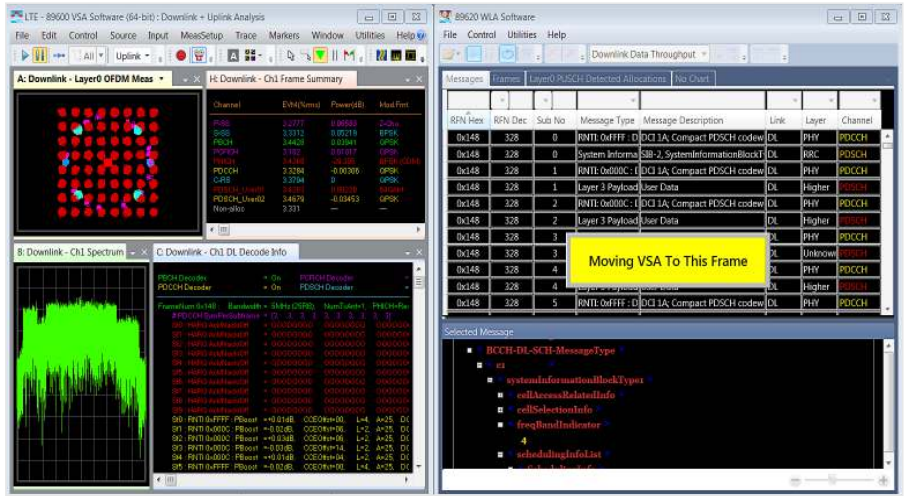


Figure 2. As a software tool, 89600 WLA provides the user an in-depth understanding of the behavior of MAC, RLC and RRC layers and correlates them to the PHY layer, while operating alongside the 89600 VSA software.

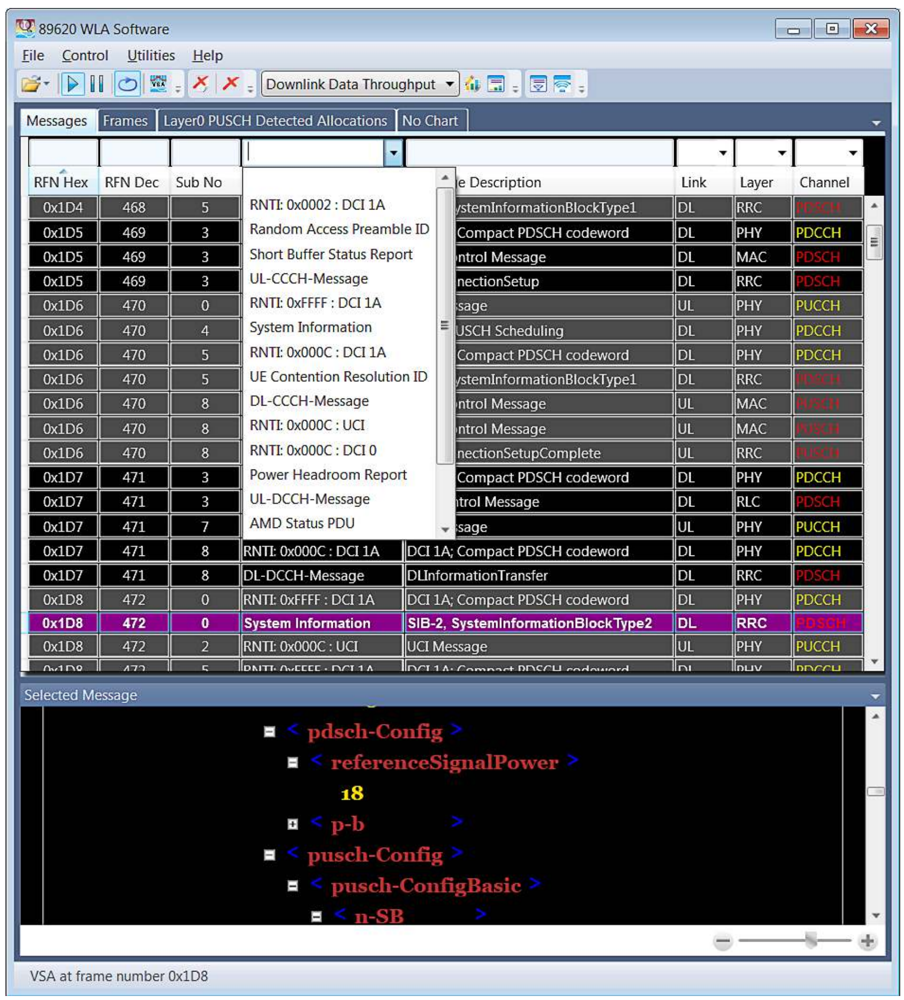


Figure 3. The built-in decoders allow message filtering and tracing of essential information associated with establishing a connection between the eNB and UE. This includes recovery of the settings for uplink transmissions. The example shows the “reference signal power” setting extracted from SIB-2.

User configurable charting capability

LTE signals are highly dynamic and require dynamic signal analysis. For example, the downlink control information and HARQ reports can change on every subframe. The ideal way to assess dynamic problems is to represent information graphically. This approach enables fast identification of unexpected behavior, even if the user is not expecting to see a problem.

The WLA software provides capability to chart various information decoded from an LTE signal. The chart can be built in to the WLA software (Figure 5), or it can be exported to an Excel spreadsheet with user configurable settings.

Figure 5 shows a DL throughput chart example with accumulated bits for each DL HARQ process as a function of the frame number including:

- Overall bits allocated by eNB through DCI signaling
- Bits transmitted by eNB that are successfully decoded by VSA
- Bits transmitted by eNB that are successfully ACKed by UE throughUCI and bits allocated by eNB that are only for new transmissions
- Clicking on a data point in the chart will synchronize the VSA software to the corresponding frame, allowing immediate correlation between the timing of a problem and the location in the captured signal

WLA complements

89600 VSA software is industry-leading measurement software for evaluating and troubleshooting PHY layer signals in R&D. Keysight's 89600 WLA software is the protocol analysis complement to the 89600 VSA to decode and verify the MAC, RLC and RRC-layer messages across multiple radio frames.

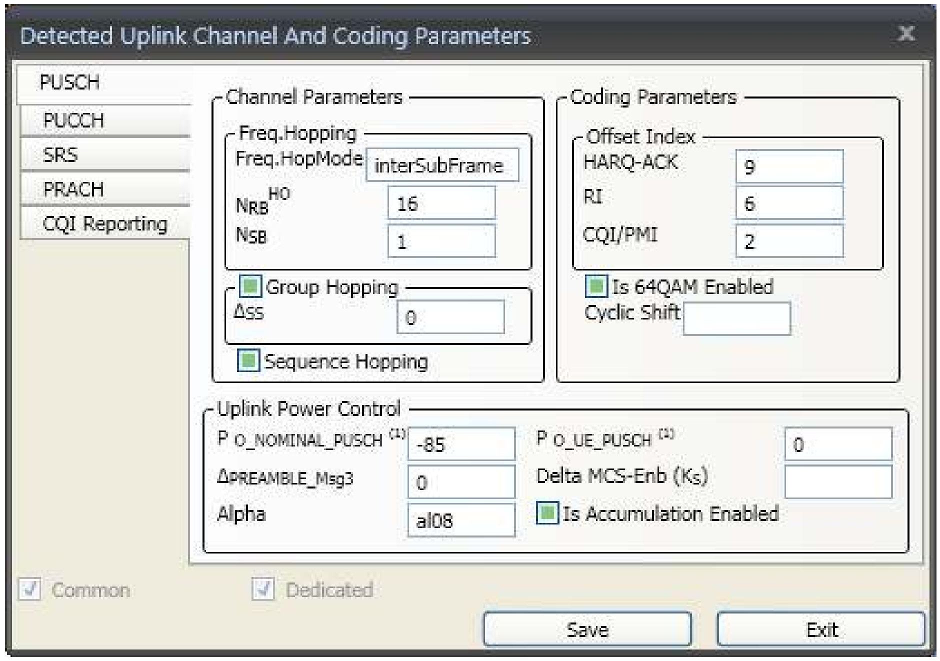


Figure 4. Parameters that control the uplink transmission are recovered and displayed at the touch of an icon.

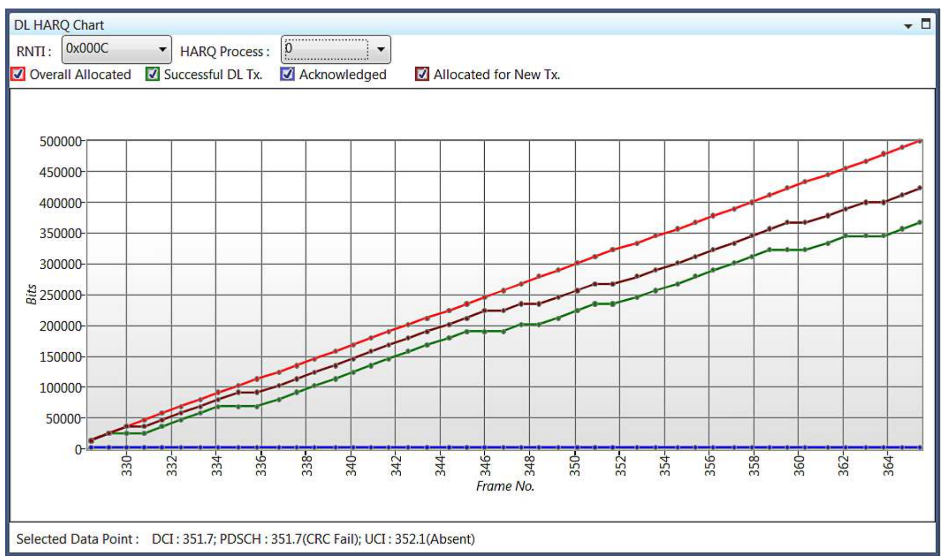


Figure 5. DL throughput chart example.

Key Features

Parameter	Description	
Operating modes		
Operates with time captures or live signals	– Analyze multi-frame views of a recording – Use multiple input hardware to capture and analyze uplink and downlink data simultaneously – Filter messages by multiple virtues – Search for items such as CRC failures	
Operates with real or simulated hardware	Capture a signal and analyze it immediately or save it as a recording to be analyzed later	
Standalone operation	Analyze previously saved frames	
Signal formats supported		
Duplex modes	FDD	
Radio links	Uplink, downlink	
LTE bandwidth	1.4 to 20 MHz	
LTE transmission modes	Downlink: Transmission modes 1-6 (MIMO decoding requires matching number of measurement input channels to spatial coding layers) Uplink: SISO	
LTE release support	3GPP Release 8 (requires 89620B-002)3GPP Release 10 (RRC message decode only, requires 89620B-003)	
Supported channels	**Downlink**	**Uplink**
Physical	– PDCCH – PDSCH – PHICH – PBCH	– PUCCH – PUSCH
Control information	– CFI – HI – DCI	– UCI
Transport	– BCH – DL-SCH	– UL-SCH
Logical	– BCCH – CCCH – DCCH	– CCCH – DCCH
Available traces		
Messages	– Contains a table of messages, listed in increasing frame number, for all frames in the LTE signal being analyzed. – The following is a list of the columns in the Messages trace and their descriptions: RFN Hex - hexadecimal representation of the Radio Frame Number RFN Dec - decimal representation of the Radio Frame Number Sub No - subframe number within a frame Message Type - the type of message Message Description - type of information the message contains Link - the radio link (uplink or downlink) the message is transmitted on Layer - the LTE layer (PHY, MAC, RRC, RLC) the message is contained in Channel - physical-layer channel containing the message – Messages can be filtered by typing a value into the filter fields or using dropdown list	
Frames	– Contains a tree structure with messages grouped by frame, direction (uplink/downlink), and physical channel – Clicking a "Sub Frame" node will cause WLA to show the decoded message results in the "Selected Message" trace – Allows users to search for a specified text within all nodes	

Key Features (continued)

Parameter	Description
Available traces (continued)	

Selected message	– Shows the decoded contents of the currently selected message in the "Messages" trace
	– Depending on the message type, the Selected Message trace will show a combination of the following sections:
	  – Decoded RRC message structure
	  – Decoded message contents - PHY (DCI messages), MAC, RLC, and PDCP layer information
	  – Raw Hex - a hex representation of the data contained by the message

Layer 0 PUSCH detected allocations	Shows a resource block mapping grid containing the following uplink allocations in the current frame: – PUSCH allocations defined by DCI Format 0 messages – Random access response grant allocations defined in the Random Access Preamble ID RAR MAC message or Back-off Indicator RAR MAC message

Chart	– Generate charts for information decoded from an LTE signal
	– The following charts can be built-in to the WLA software or can be exported to Microsoft Office Excel:
	  – Downlink Control Information (DCI) – requires Microsoft Office Excel
	  – Downlink data throughput
	  – Uplink data recovery (HARQ)
	  – Uplink power control
	  – Uplink timing advance

General features	
Save	Save frames, measurement setup and trace layout
Recall	Recall frames, recordings, setup files, trace layouts and demo signal
Help	WLA help system is provided in an external browser window to help users learn more about WLA
Demo signals	Various demo signal packages are provided to help users understand the measurement capabilities and features of the 89600 WLA

Ordering Information

Model/Option	Description	Notes
89620B	89600 WLA software, transportable license	
89620B-001	Basic wireless link analysis, transportable license	– Required – Saved multiframe data can be recalled and analyzed
89620B-002	LTE analysis	– Required if used with 89600 VSA to decode protocol data – Requires Option 001
89620B-003	LTE-Advanced analysis	– Requires Option 001 and 002
Note: When using the 89600 WLA with 89600 VSA, the VSA software is required to have the appropriate license options to be able to perform LTE-FDD modulation analysis.		

Recommended 89600 VSA software configuration when used with 89600 WLA

Model/Option	Description
89601B	89600 VSA software, transportable license
89601B-200	Basic vector signal analysis
89601B-300	Hardware connectivity
89601B-BHD	LTE FDD modulation analysis
89601B-BHG	LTE-Advanced FDD modulation analysis

Related Resources

Literature

Gaining Deeper Insights into Dynamic BTS/UE Signals with Wireless Link Analysis, Application Note
Literature number 5990-9179EN

89600B Vector Signal Analysis Software, Brochure
Literature number 5990-6384EN

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