Carrier Aggregation Testing

CA Meets the WaveJudge 5000

The Sanjole Wavejudge 5000 over-air capture, wireless communication analyzer is designed specifically to troubleshoot the kind of problems that arise when designing and implementing new technologies such as LTE Carrier Aggregation (CA).

The basics still count

The WaveJudge was the first over-air monitor solution to give you real-time visibility into the interaction between protocol and physical layers in wireless transmissions. In doing so, the WaveJudge caused a major leap by enabling users to reduce troubleshooting time from days to minutes.

The WaveJudge 5000, our newest over-air, wireless commmunications analyzer retains the reknowned utility and effectiveness of the WaveJudge 4900 / IntelliJudge but now employs an expandable modular platform with increased capabilities for testing and troubleshooting current and advanced/evolving high-bandwidth technologies. In the case of CA, with 40 MHz channels, up to five instances of CA can be supported.

However, even with the complexities of CA, root wireless concerns still reign. The WaveJudge 5000 enables you to:

- Understand the interactions between the mobile station or user equipment and the base station at all layers
- Identify complex causes of interoperability problems
- Improve the performance of the overall wireless connection
- Verify base station behavior from an over-the-air interface, including complex antennae and modulation schemes
- Evaluate the impact on performance of MIMO, beamforming and scheduling
- Capture wireless conditions in the field for replay in the lab
- Accurately identify anomalies that affect throughput and delay

Over-air capture & cross correlation

The WaveJudge 5000 taps into the signal at the RF interface, giving users a real-time view and record of the complete conversation for all component carriers, including PCell and all related SCells (enables visibility into problems arising from errors in RRC configuration, CQI reports, and multiple PUCCH, PUSCH, and DCI formats).
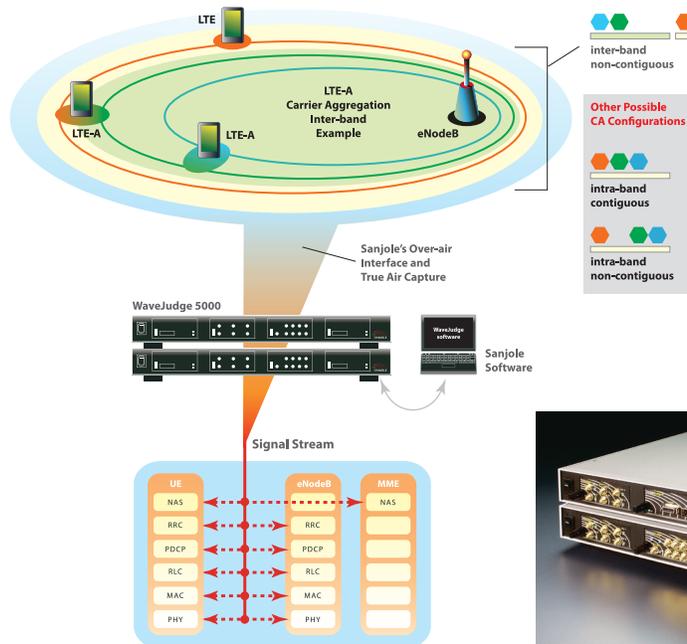
WaveJudge 5000 gives visibility into interaction between physical and protocol layers enabling better test & troubleshooting outcomes for Carrier Aggregation

Users view RF signals time-correlated with upper-layer protocol messages in order to rapidly find and analyze the true root cause of symptoms or failures.

- Configure per UE or per physical, transport, or logical channel for decoding.
- Analyze all upper layer protocols including MAC, RLC, PDCP, RRC, and NAS while correlating messages to the PHY layer.
- Examine the CQI report to verify SCell configuration.
- Verify DCI length for CSI scheduling.
- Check the PUCCH RRC field for proper channel allocation.
- Automatically extract CA RRC configuration parameters.
- Verify CA MAC activation/deactivation of Scells.
- Inspect CSI reports and examine cross carrier scheduling.
- Monitor multiplexed HARQ ACK/NACK of all configured cells.
- View all physical channels including PUCCH format 1b, 3 and PUSCH reporting channel.

Ports & more ports

By its very nature, Carrier Aggregation requires port density to create PCells and SCells for both uplink (UL) and downlink (DL), especially in applications using multiple carriers. The WaveJudge 5000 can support up to 32 ports in each coherent set.

Test 8x4, 8x2, or 4x4 MIMO configurations and incorporate multiple layers. For large-scale testing, up to 64 WaveJudge 5000 chassis (up to 256 modules) can be daisy-chained per system. In instances using a large number of antennae, WaveJudge 5000 ports are synchronized, and sample- and phase-locked allowing you to avoid time-consuming tangents such as troubleshooting alignment issues between devices.

Customizable PHY

The WaveJudge defines the PHY in software rather than hardware, enabling you to quickly customize the LTE PHY to adjust to frequent PHY specifications changes. This can be used, for example, to troubleshoot a misconfigured CQI report by editing the parameters in a live capture and then replaying it to verify that the new parameters resolve the issue.

Hours of memory

Data capture to troubleshoot timing or functionality requires tons of memory. The WaveJudge 5000's RAM and SSD memory can store hours of IQ data, with flexible configuration options for tracking long-term trends or to isolate intermittent anomalies. Depending on your application, IQ captures can be invaluable in re-creating the wireless channel for in-depth physical analysis.

Competence & confidence today & tomorrow

As 5G approaches, technologies such as Carrier Aggregation, higher-order MIMO, coordinated multipoint, and beamforming arise to meet the ever-increasing demand for speed, quality, and reliability in wireless communications. The WaveJudge 5000 modular platform provides the flexibility and scalability needed to enable coverage of current wireless networks, while giving users the adaptability and readiness for evolving spectrum.

Call for a demonstration

To inquire about a demonstration or for more information about the WaveJudge 5000, please call Sanjole at 1-808-457-1452 or email sales@sanjole.com.

About Sanjole

Sanjole is a leader in 4G, WIFI and 5G testing with expertise in innovative wireless technology. Sanjole provides problem solving capabilities from inside the wireless network through over-the-air analysis tools that provide visibility into events spanning multiple layers. Sanjole has been involved from the very beginning of LTE as a test vendor in the LTE/SAE Trial Initiative (LSTI) events for both fixed and wireless devices. Our work with the WiMAX Forum and 3GPP, participation in the Small Cell Forum, TETRA, WIFI Alliance and extensive experience in interoperability trials, enable deep insight into the complex technical issues specific to the LTE and 4G community.

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CA Test and Troubleshooting Examples

Unwanted interaction between serving cells

The various DL and UL component carriers can affect other carriers. As a result, a problem in one serving cell can actually originate in a different serving cell. For example, scheduling problems with the UL for a SCell can be caused by the configuration in the PCell DL carrier, which carries scheduling information for both serving cells. Or problems with the DL of multiple serving cells could originate in the PUCCH, which carries the uplink control information (UCI) for all component carriers for all DL and UL channels.

The WaveJudge enables best practices for system designers by monitoring the DL and UL of all serving cells simultaneously and identifies root causes of failures through its ability to look at all layers and detect invalid parameters that have been set by an LTE entity.

Exponential increase in the number of configuration combinations

UL feedback on the PCell can contain feedback elements from several serving cells that can each be configured differently. For example, they could have different bandwidths or duplexing modes. It only takes a misconfiguration for one serving cell to lose the feedback for all channels. If control is multiplexed with data, then even the data can be lost.

By monitoring all channels simultaneously across all layers, the WaveJudge detects these complex interactions, reducing trou-bleshooting time by quickly locating the element in the network configuration that is the source of the cascading problem.

In the case of DCI blind decoding, the number of possible DCI message lengths has increased as additional parameters have been added. As a result, the message lengths for the various serving cells may be different. This variability increases the risk of miscalculating the message length or detecting the wrong DCI message.

Cross-correlation using the WaveJudge gives you the visibility you need into upper-layer protocol messages to see when DCI blind decoding fails and why.

MAC layer aggregation requires monitoring all serving cells simultaneously

When carrier aggregation is activated, data from multiple serving cells is aggregated at the MAC layer, eliminating the need for the RLC or PDCP sublayers. Consequently, IP or any other higher layer protocol is not available from the PCell alone. To monitor any layer above the MAC layer, you must have visibility into all serving cells as any higher-layer issue could potentially involve any or all serving cells.

The WaveJudge gives you that critical visibility by monitoring all cells at all layers, accelerating troubleshooting by identifying errors that often are not recorded in the logs of the devices under test and that can break the promise of LTE CA for greater bandwidth and performance.

Specifications

Modulation Formats
- OFDMA/SC-FDMA with BPSK, QPSK, 16QAM, 64QAM, Zadoff-Chu

Port Triggers
- Manual Trigger In
- Trigger on Boolean Phrase (Ex. Power > -20 dBm)

Traces
- Constellation
- Time Domain Power
- EVM vs. SubCarrier
- EVM vs. Symbol Time
- MIMO Rank per subcarrier
- MIMO Rank per symbol
- Spectral Flatness (Frequency Domain)
- Amplitude Flatness (Time Domain)
- CCDF, PAPR
- Spectral Power
- Amplitude, Phase, Frequency during synchronization signal
- Impulse Response

Statistics
- RCE
- RCE Peak
- Reference signal RCE
- Carrier and Sampling Clock Frequency Error
- IQ Offset
- CFI Error Rate
- Payload Bits
- RSSI, RSRP, RSRQ

Protocol Analyzer Decodes
- MAC
- RLC
- PDCP
- RRC
- NAS
- TCP/IP (WireShark supported decodes available)

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