WaveJudge 5000

LTE-A Carrier Aggregation Testing

Real-time analysis of all protocol layer interactions, plus user-defined searches and triggers enable efficient and productive testing, troubleshooting, and long-term analysis of LTE-Advanced Carrier Aggregation, for product and network development

SANJOLE

LTE Carrier Aggregation

LTE Advanced brings increased network efficiency and higher throughput, but Carrier Aggregation is the key to meeting global expectations for mobile broadband performance. It does so by allowing service providers to consolidate multiple component carriers and use the bandwidth as a single medium between the user equipment (UE) and an evolved NodeB (eNB). LTE CA gives carriers with fragmented spectrum the flexibility to offer 4G performance to subscribers.

More carriers equals more complexity

The complex interaction between the PHY and upper layers in wireless communications makes it difficult to determine what messages were sent, what events occurred, and the timing of those messages and events.

As LTE CA adds one or more secondary carriers, known as serving cells, between a UE and eNB, that complexity is multiplied. Feedback control messages are all carried on the primary cell (PCell), but the content may refer to one or more secondary cells (SCells), so their format is determined by the SCells. Control messages used for scheduling can be carried on a PCell or a SCell and may schedule traffic on other serving cells in a process known as cross-carrier scheduling.

With the complexity significantly increased, when implementing CA the root cause of symptoms such as a non-responsive UE, low throughput, packet loss, or CRC errors can take hours to track down.

For example, if the eNB is reporting CRC errors:

- Did RRC correctly specify the indexing and association between cells?
- Did CA MAC activation identify the correct DCI to monitor for cross-carrier scheduling?
- Did the DCI message specify the proper length CSI request field for DCI blind detection?
- Were HARQ ACK/NAKs for multiple serving cells correctly multiplexed?

Sanjole's WaveJudge provides more information than any other tool about all aspects of wireless communications, including LTE CA. All of the above questions can be answered definitively within minutes with the WaveJudge using probing and cross-layer correlation.

CA Meets the WaveJudge

The Sanjole Wavejudge was designed specifically to troubleshoot the kind of problems that arise when designing and implementing new technologies such as LTE CA.

Introducing the middleman

By tapping into the signal at the RF interface instead of one of the endpoints, the WaveJudge sees the complete conversation for all component carriers, including the PCell and all related SCells. The result is more reliable test results and fewer troubleshooting dead ends.

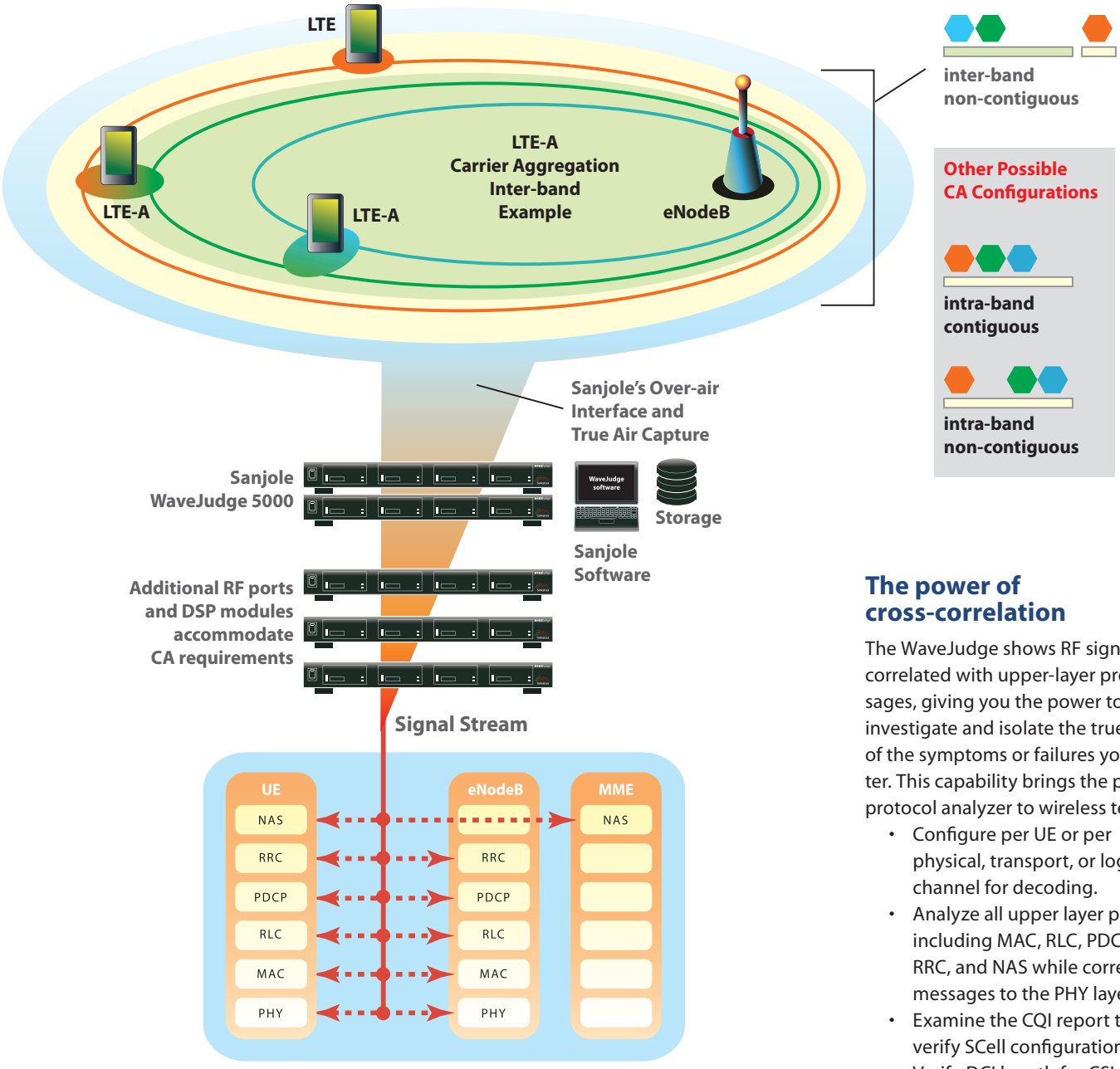
Multiple ports, no waiting

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 architecture is expandable, allowing you to scale your test bed to accommodate the implementation of multiple carriers by adding ports, each completely independent with its own radio and internal resources and all configured from one GUI.

Configure the PHY on the fly

The WaveJudge defines the PHY in software rather than hardware, enabling you to quickly customize the LTE PHY to adjust to the frequent changes in PHY specifications that often occur with emerging technologies. This can be used to troubleshoot problems such as 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.

Sanjole's WaveJudge 5000



The power of cross-correlation

The WaveJudge shows RF signals time-correlated with upper-layer protocol messages, giving you the power to rapidly investigate and isolate the true root cause of the symptoms or failures you encounter. This capability brings the power of a protocol analyzer to wireless testing.

- 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.

Repeat the past with true air capture

Problem resolution depends on reproducing the conditions under which the error occurred to verify that the fix actually works, which is impossible with over-the-air testing where conditions cannot be tightly controlled and reproduced.

The WaveJudge captures protocol messages and RF-signal characteristics, errors included, over the air and saves them for replay to validate that the problem has been resolved. This gives you visibility into problems arising from errors in RRC configuration, CQI reports, and multiple PUCCH, PUSCH, and DCI formats.

USE CASES

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 troubleshooting 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.

Simplify complexity and accelerate schedules

The unique and revolutionary capabilities of the WaveJudge make it an essential tool for fixed and mobile LTE wireless solutions and especially for the increased complexity and multiple serving cells that Carrier Aggregation requires. The WaveJudge offers analysis well beyond the reach of legacy test tools and is the most cost-effective wireless test instrument available.

Call for a demonstration

To inquire about a demonstration or for more information about the IntelliJudge, 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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