

LTE/LTE-Advanced Design Solution

Overview

Synopsys and Rohde & Schwarz joined in a strategic collaboration to accelerate the design and verification of chipsets, handsets, and base stations that serve the next-generation LTE and LTE-Advanced standards. Synopsys is contributing its strength in algorithm design and verification solutions to the collaboration, including standard-compliant reference libraries. Rohde & Schwarz is contributing its signal generation expertise and proven test and measurement solutions that are used worldwide in research and development, verification, production and service.

Synopsys' LTE Library, for its System Studio and SPW algorithm design products, includes models of the transmitter and the physical channel as defined in the 3GPP standard, as well as functional models of ideal receivers that can serve as references. The library provides an end-to-end simulation chain for both uplink and downlink transmission and reception. Through the collaboration, Synopsys' LTE library is verified against Rohde & Schwarz's test and measurement solutions, greatly increasing design confidence for algorithm designers needing to achieve standards compliance.

Starting with signal generators, Rohde & Schwarz test equipment is able to automatically derive its configuration from the Synopsys simulation setup. Since typical configurations consist of more than 100 parameters, this integration significantly reduces the time it takes to achieve a correct setup. It also reduces the risk of configuration inconsistencies that often result in losing days of system integration time in the lab.

Highlights

- ▶ Accelerate LTE and LTE-Advanced wireless system design and verification while reducing risk for standards compliance.
- ▶ Synopsys' LTE and LTE-Advanced libraries for SPW and System Studio are verified against Rohde & Schwarz's test and measurement solutions, helping ensure standards compliance.
- ▶ Rohde & Schwarz signal generators derive configuration from simulation setup, reducing time-to-first-test and creating more efficient interaction between algorithm designers and hardware testers.

Synopsys LTE Library for SPW and System Studio

- ▶ The LTE Physical Layer Simulation Library is a ready-to-use simulation setup featuring transmitter-to-receiver systems as defined in the 3GPP standard specifications. Ready-to-use simulations include Downlink, Uplink, Uplink Control, Uplink Soundings Reference, LTE Cell Search and LTE Random Access Channels.
- ▶ Organized into specific regression testbenches: ability to mirror the tests specified in the standards reference documents. Users can immediately run these regressions and easily modify system parameters of interest in order to study performance impact in any scenario.



Figure 1: Synopsys LTE Physical Layer Library Generates Parameter Configuration for R&S SMU 200A Vector Signal Generator

- ▶ Support for both FDD and TDD
- ▶ Includes receiver models: both ideal receivers (with perfect knowledge of the channel) and non-ideal receivers (which must estimate the channel characteristics). The ideal receiver provides the best achievable performance for comparison against real, non-ideal receiver implementations.
- ▶ By replacing or modifying blocks or subsystems, users can quickly adapt the reference model to the specific implementation for their end product.
- ▶ Source code availability: provides valuable insight into the standards definition, which may otherwise require months of perusing the written standards documents. The source code can also be used as a starting point for today's often processor-based implementation of wireless systems.

Rohde & Schwarz Signal Generators

- ▶ Rohde & Schwarz vector signal generators are designed for physical layer verification testing of hardware devices like chipsets, RF and baseband modules, components, mobile phones and base stations.
- ▶ All important digital communication systems are covered, including LTE-FDD and TD-LTE, HSPA, GSM/EDGE, WLAN, Bluetooth®, GPS.
- ▶ Available LTE signal generation solutions range from cost-efficient all-purpose signal generators like the R&S® SMBV100A to unique one-box solutions for LTE MIMO receiver testing. The R&S SMU200A vector signal generator combines multiple

baseband sources with complete LTE channel coding, real-time MIMO fading simulation (incl. settable correlations) and RF signal generation, all in one compact instrument.

- ▶ LTE uplink and downlink signals are generated in line with the 3GPP LTE standards TS 36.211, TS 36.212 and TS 36.213. All physical channels, reference and synchronization signals as well as all bandwidths and frequency bands are covered.
- ▶ Supported downlink MIMO modes include MIMO precoding, transmit diversity, spatial multiplexing as well as LTE beamforming.
- ▶ A user-friendly GUI with graphical visualization of the generated LTE signals and the availability of predefined signal configurations eases operation.
- ▶ Internal signal generation allows configuration of all signal parameters directly on the instrument. Parameters can easily be changed which simplifies debugging of the device under test.
- ▶ A convenient LTE eNB test case wizard and the possibility to get access to intermediate results of the LTE forward-error correction (FEC) coding chain, assure straight-forward HW testing.

Cross-validation of I/Q signals

- ▶ Both the LTE Simulation Library as well as the Rohde & Schwarz signal generators produce signals according to the 3GPP standard specification.
- ▶ Signals generated by the LTE library as well as the Rohde & Schwarz signal generators have been validated to be equivalent.

Configuration of the Rohde & Schwarz Signal Generators from the Synopsys LTE Library

- ▶ Both the LTE Simulation Library as well as the Rohde & Schwarz signal generators come with many configuration options, which are controlled through dedicated parameter files.
- ▶ Keeping both parameter files in sync manually, and being able to reproduce simulation results when moving to real hardware testing is time consuming and error prone.
- ▶ The LTE Library allows the automatic generation of the corresponding signal generator configuration file, mapping the simulation-environment parameters to the corresponding combination of signal-generator parameters.
- ▶ Smooth transition: combined with the equivalence of the generated I/Q signals, the automatic configuration allows signal generator users to reproduce simulation scenarios immediately. This applies to tests defined as 3GPP scenarios, as well as to user-defined scenarios.
- ▶ Quick debugging: quick reproduction of test scenarios in SPW or System Studio, enabling a simulation-based debugging setup including the option of RTL co-simulation.

About Rohde & Schwarz

Rohde & Schwarz offers a complete product portfolio for LTE, from highly accurate R&D and production testing to conformance tests. The latest LTE enhancements can be added to Rohde & Schwarz products like signal generators or analyzers with an easy software update. Visit www.rohde-schwarz.com/technologies for more information.



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