NI AWR Design Environment’s Visual System Simulator (VSS) for long-term evolution (LTE), commonly known as 4G LTE, enables RF/analog engineers to effortlessly evaluate LTE communication systems and readily explore their designs from concept through to final prototype board. They can verify error vector magnitude/adjacent channel leakage ratio (EVM/ACLR) performance of the entire RF front end or monitor the contribution of an isolated component to the overall measurement, measure EVM over an orthogonal frequency-division multiplexing (OFDM) symbol or of individual sub-carriers, and/or interchange commercial off-the-shelf components (COTS) with ideal behavioral models and/or circuit-based models at each level of the design process. Finally, users can take advantage of the LabVIEW and TestWave compatibility in VSS to perform simulations with an actual device under test (DUT) or prototype board to close the loop of the design cycle.

Features at a Glance

- LTE specifications
- LTE DL and UL signal sources
- Multiple-input and multiple-output (MIMO) technology and 3GPP specifications
- Test benches

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The VSS LTE Design Flow Features and Advantage

The LTE Standard: VSS supports multiple wireless standards. Specific to LTE, additional details include:

- LTE specifications
  - Downlink peak rates of at least 100 Mbps, uplink of at least 50 Mbps
  - Radio access network (RAN) round-trip times of less than 10 ms
  - An all-IP flat networking architecture, scalable carrier bandwidths of 20 MHz to 1.4 MHz
  - Support for both frequency-division duplexing (FDD) and time-division duplexing (TDD)
- LTE DL and UL signal sources
  - Average output power, number of assigned resource blocks, channel bandwidth
  - Physical downlink shared channel (PDSCH): scrambling code, type, and offset
  - Physical downlink control channel (PDCCH): scrambling code, type, and offset
  - Modulation type: quadrature phase shift keying (QPSK), 16 quadrature amplitude modulation (QAM) or 64 QAM
- MIMO technology and 3GPP specifications
  - TS 36.211 physical channels and modulation
  - TS 36.212 multiplexing and channel coding
  - TS 36.213 physical layer procedures
- Test benches
  - Complementary cumulative distribution function (CCDF)
  - Time-domain waveforms, I/Q plot, ACLR or adjacent channel power ratio (ACPR)
  - EVM vs. input and/or output power
  - Spectral emission mask

Specifications: VSS for LTE provides significantly increased peak data rates reduced latency, scalable bandwidth capacity, and backwards compatibility with existing global system for communications (GSM) and universal mobile telecommunications system (UMTS) technology. For LTE to work with existing networks, designers must employ complex modulation schemes, MIMO, and other challenging features. VSS for LTE makes evaluating the performance of these components significantly easier and more accurate. Like all of the communications standards incorporated within VSS, the LTE library includes all requirements for Layer 1 (physical layer) outlined in the 3GPP LTE standard.

Signal Sources: VSS for LTE has downlink (DL) and uplink (UL) signal sources with parameter settings that are self-explanatory. RF engineers get right to the simulation work at hand versus spending precious time manually setting up signal sources. DL and UL sources are built from the ground up as sub-circuits using easy-to-understand basic building blocks, readily allowing baseband engineers to “drill into” sources to verify and possibly modify physical layer (PHY) 1 specifications.

Measurements and Test Benches: With VSS for LTE, systems engineers can readily optimize the performance of an LTE amplifier based upon peak-to-average ratio (PAR), ACLR, EVM, or any number of performance metrics. It also allows designers to effectively evaluate the “in situ” performance of other devices in the system, not just for LTE, but for all other current cellular standards as well. EVM measurements can be made on individual sub-carriers and/or over the entire OFDM symbol. Adjacent channel interference (ACI) analysis can also be easily performed. Furthermore, there is no need to start with complicated and difficult-to-understand test benches in order to obtain critical performance measurements as VSS for LTE users can extend simulation analyses to include a DUT in the laboratory via the use of LabVIEW and/or TestWave software.