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Testing LTE TDD MIMO Systems Using ADS Connected Solutions

Technical Overview

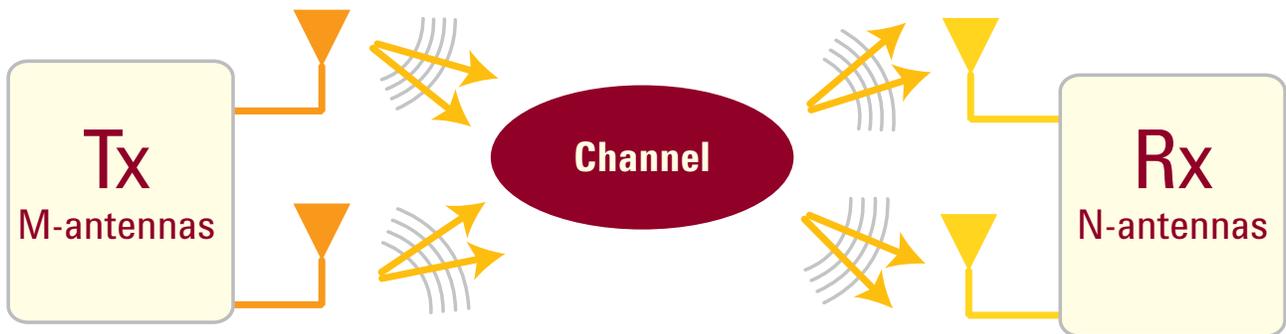


Figure 1. 2x2 MIMO system

Introduction

MIMO is a key feature for advanced wireless communications technologies like Mobile WiMAX™ and 3GPP LTE. MIMO systems can overcome problems associated with the receiver that are encountered as a result of multipath fading, interference and limited spectrum resources.

The Agilent Advanced Design System (ADS) provides a set of unique LTE TDD libraries for designing LTE TDD systems. Using Connected Solutions (CS), ADS can integrate Agilent instruments together to create an LTE TDD test system that provides solutions for both LTE TDD MIMO transmitter and receiver test.



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MIMO Test Set Up

As an example, consider the 2x2 MIMO system depicted in Figure 1.

The test system is set up and configured as shown in Figure 2.

First, ADS generates and sends LTE TDD MIMO signals to two Agilent signal generators (ESGs, MXGs or PSGs). One of these signal generators is set as Master, while the other is set to Slave (Figure 2). The Event 2 connector on the Master signal generator is connected to the Pattern Trigger In connector on each of the two signal generators (with the same model number). A 10 MHz reference is connected between them. RF Outputs from the signal generators,

in this case two ESGs, are sent to a 2-channel DUT, either a real MIMO channel or part of a MIMO receiver branch. DUT Output signals are captured by an Agilent 2-channel analyzer, either the Infiniium Scope or VXI, and sent back to ADS for post processing and to measure system performance (e.g., waveforms, spectrum, constellation, EVM, and BER).

For convenience in using ADS CS, a LTE TDD MIMO project is created. As shown in Figure 3, the project contains a design for MIMO TDD signal generation with multipath fading. The RF source is for RF MIMO signal generation in ADS simulation. Generated MIMO signals are sent to a MIMO

channel and then through ESG Sink 1 and ESG Sink 2. MIMO simulation signals are sent to the ESG signal generators. If the channel model is turned off, RF Outputs from the two signal generators provide test signals that are equivalent to signals at the transmission antennas. Otherwise, the RF Outputs provide test signals that are equivalent to signals at the receiving antennas. ADS sends not only data, but commands to control the ESGs. In the design, there are three Var blocks. Parameters in these blocks are also shared by the ESGs to control RF carriers, amplitudes and other parameters.

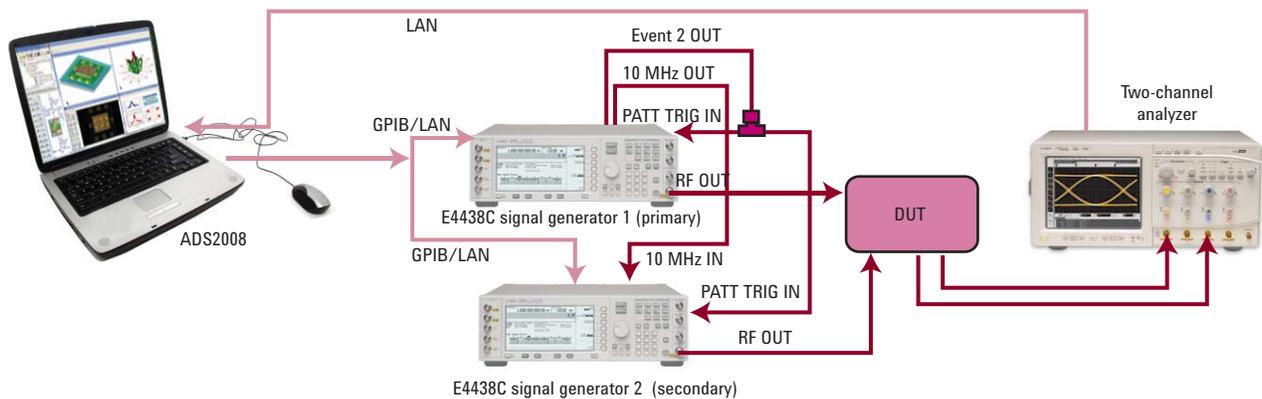


Figure 2. Test system setup

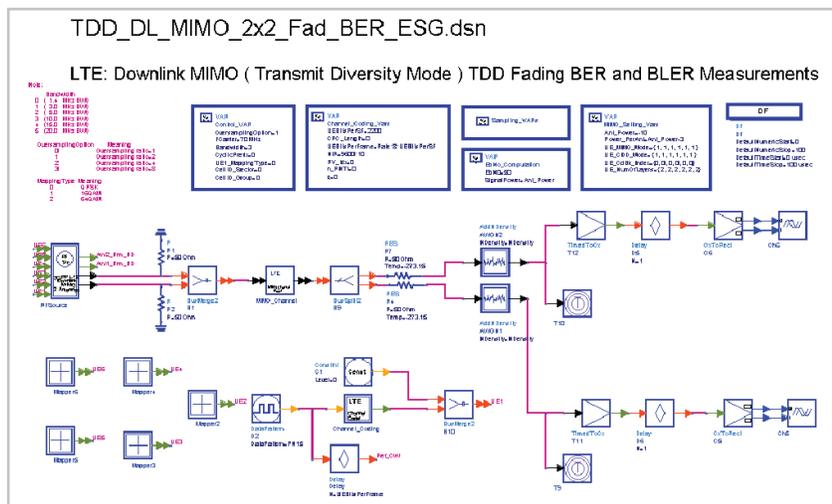


Figure 3. ADS design for LTE TDD MIMO signal generation

MIMO Measurement

Figure 4 depicts a design for MIMO measurements. Here, two VSA source models are linked to an Agilent 2-channel analyzer to capture test waveforms at the outputs of the 2-channel DUT. Waveforms are then sent to the MIMO receiver to demodulate, demap and decode MIMO signals for measuring waveform, spectrum, constellation, EVM, and BER.

ADS provides a set of models for synchronizations in both the time and frequency domain, recover phase shift and estimation channels. ADS MIMO receivers work well under LTE TDD MIMO conditions. In fact, like a golden receiver, the ADS MIMO receiver provides reference signals and measurements that help MIMO developers troubleshoot the MIMO receiver.

Test results

Using the LTE TDD MIMO CS project, a test system was set up based on Figure 2. First, the MIMO signal generation design shown in Figure 3 is run and MIMO signals sent to the two ESG signal generators. Then, the MIMO measurement design shown in Figure 4 is run. Test signals from the ESG RF Outputs are captured back to ADS through the 2-channel analyzer and analyzed by ADS to obtain waveform, constellation, EVM, and BER performance data. In Figure 5, all test results are collected together and displayed using the ADS data server. As expected, all the measurements are good.

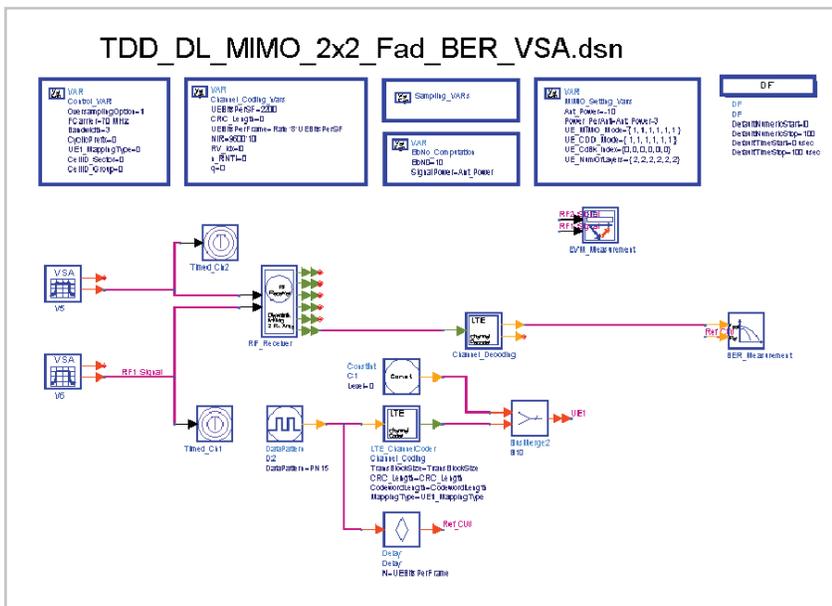


Figure 4. ADS design for MIMO signal measurements

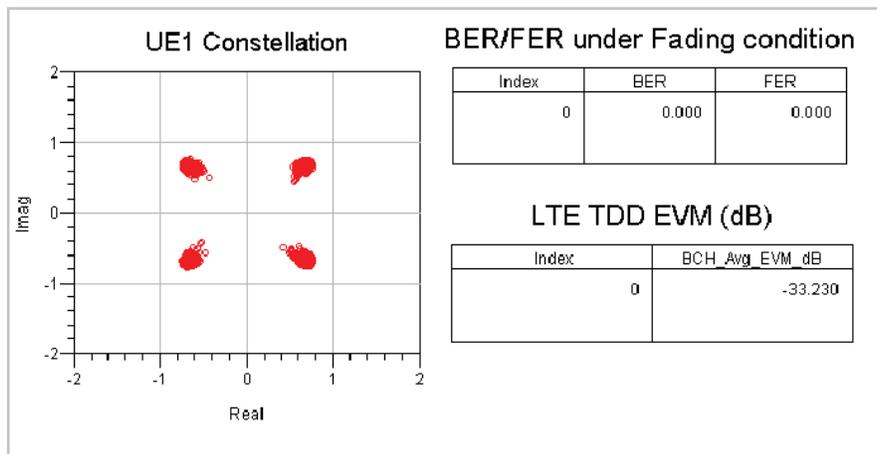


Figure 5. Measured MIMO transmission signals

Conclusions

MIMO is a key feature for advanced wireless communications. Transmission test alone is not enough to verify MIMO systems. MIMO receiver test must also be considered due to all of the advanced components in the receiver.

Most MIMO measurement solutions can demodulate MIMO data at the transmission antennas. However, these solutions do not help customers perform receiver test or troubleshoot MIMO receivers. ADS provides a set of unique LTE TDD MIMO models specifically designed to help customers design LTE TDD MIMO systems. ADS CS integrates Agilent signal generators and signal analyzers together to provide LTE TDD MIMO test solutions for both transmitters and receivers.

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