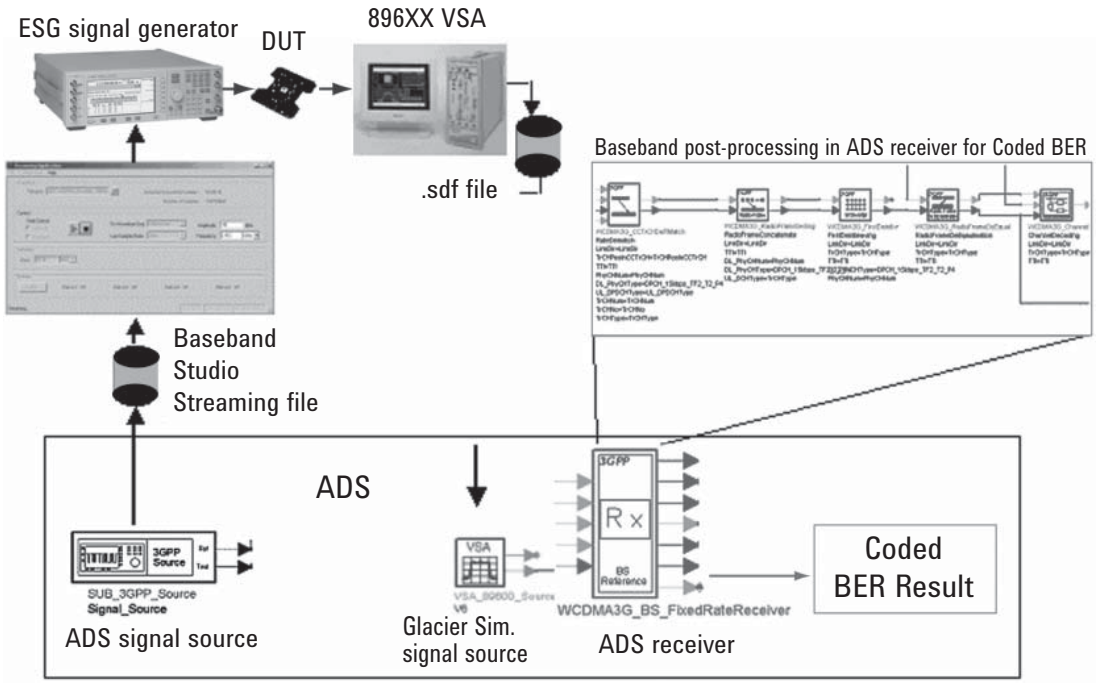
Performing Bit Error Rate Measurements with ADS and Baseband Studio Streaming

Connected Solutions
Application Bulletin 1476-5



Introduction

Verifying Bit Error Rate (BER) and Block Error Rate (BLER) performance can present real challenges to RF engineers. Two major factors should be considered: (1) the number of bits required to produce a statistically meaningful BER/BLER result, and (2) the baseband functionality required to verify coded BER/BLER.

Arbitrary waveform generator (Arb) based solutions allow waveforms to be downloaded from simulation to the signal generator Arb for BER/BLER testing, but are limited by the Arb depth of the signal generator. Depending on the application, this may or may not be sufficient.

Another challenge is that RF engineers designing RF receivers may not have access to the baseband functionality required to perform coded BER measurements, which can present a barrier to verifying coded BER - a key receiver design specification with today's digital communications signal formats.

The Connected Solutions application described in this note can help in verifying RF BER performance when a large number of data bits are required to achieve a statistically meaningful BER result.

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Concept

A conceptual flow diagram is shown on page 1. The ADS simulation signal can be stored to a Baseband Studio Streaming data file using a new file writing capability available in ADS 2003C. The amount of data to be streamed out of the ESG is determined by the hard disk storage size to store the Baseband Studio Streaming file.

After the ADS simulation has been run and the binary Baseband Studio Streaming file is created, the signal is streamed to the ESG using Baseband Studio Streaming to turn the simulated signal into a real RF test signal.

The RF test signal is input into the device under test (DUT), which could be an RF component or a receiver RF front-end. The DUT output is captured using a Vector Signal Analyzer (896XX VSA) to record an sdf file (.sdf). After the sdf recording is read into ADS, the signal can be post-processed with a simulation baseband receiver (for example, WLAN or WCDMA) to compute the coded BER or Packet Error Rate (PER).

Test Setup Overview

This application uses the new Baseband Studio file writer in ADS 2003C and the Connection Manager. An E4438C Electronic Signal Generator (ESG) with the Baseband Studio Streaming card, option 602, is required for streaming large amounts of data from the ADS-created file to the ESG output.

An 896XX VSA with option 288 is used to capture the IQ waveform to read back into ADS. The ADS wireless design libraries, such as the WCDMA or WLAN design library, can be used to post-process the data to compute BER or PER. The 89601 VSA software with option 105 is useful for reading the recorded signal back into simulation and for performing RF measurements such as error vector magnitude (EVM) in ADS.

Verifying Coded BER/PER Performance

One of the key challenges of verifying coded BER/PER performance of RF hardware is that the baseband functionality required for coded BER/PER may not be available for testing. For example, performing a coded BER measurement for 3GPP W-CDMA requires that the baseband functionality to perform such tasks as de-scrambling, de-spreading, de-interleaving, de-multiplexing, and so on, are required to recover the data bits from the measured signal so that a BER measurement can be performed. This can present a potential barrier if the RF hardware being tested does not include that baseband functionality.

This Connected Solutions application uses the Wireless Design Libraries in ADS to perform the post-processing on the measured signal so that coded BER/PER can be measured.

An example of a coded WCDMA BER measurement with fading is performed with ADS and Baseband Studio Streaming, with 1000 frames (or 10 seconds) of data streamed out of the ESG from a file created by ADS with the simulated fading. The ESG output is captured with an 89641 VSA and read back into ADS for the BER measurement. The results are shown in Figure 1.

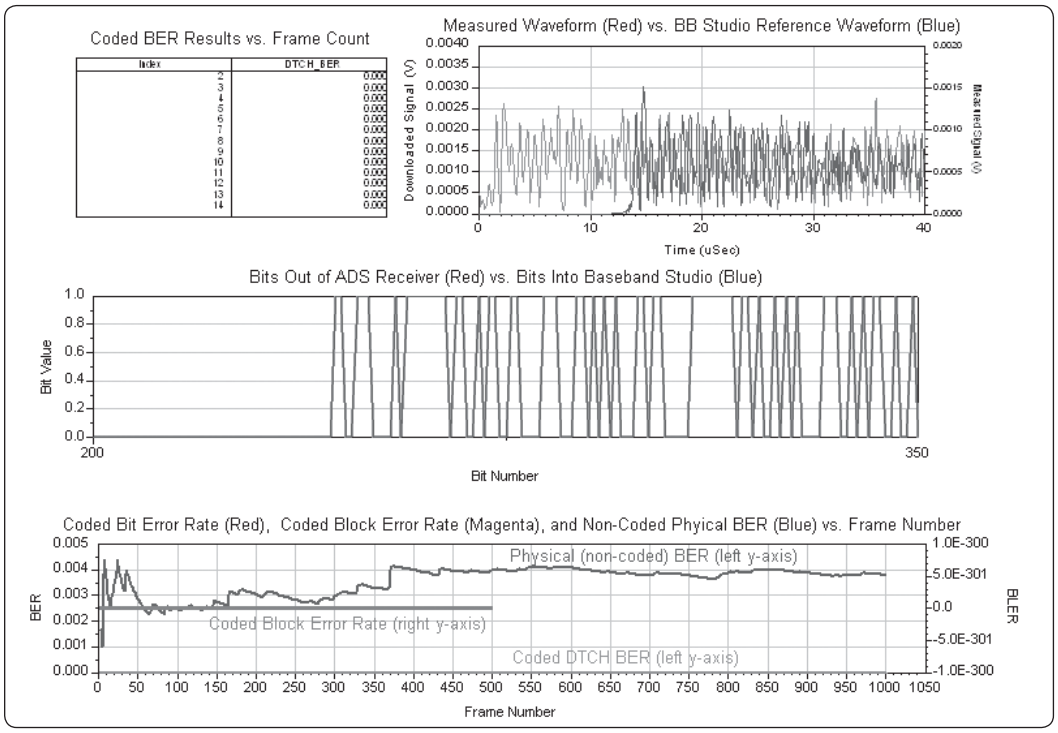

Figure 1. BER/BLER results for data streamed out of the ESG, captured with a VSA, and read back into ADS to obtain the measurements.

Summary

Connected Solutions can help with performing coded BER/PER measurements when a large number of data bits are required for the BER/PER measurement. This application is useful for RF component testing or for RF subsystem testing, such as testing a receiver front-end. ADS Design Libraries provide the necessary baseband post-processing to perform coded BER and PER measurements.

Required Equipment/Software

E8900A/AN ADS 2003C
E5720A/AN Connection Manger
E8850A/AN Communications System Designer
E8875A/AN 3GPP W-CDMA Design Library (optional)
E8874A/AN WLAN Design Library (optional)
E4438C ESG with option 602
896XXA VSA Software with option 288, 100, AYA, 105, B7N for 3GPP W-CDMA, B7R for WLAN

Resources

Connected Solutions Web Page:

For more information about Agilent Technologies' connected solutions, including additional application notes and a configuration guide, visit:
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Agilent EEsof EDA Home Page:

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Revised: October 6, 2008

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Printed in USA, March 19, 2009
5989-0130EN

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