

## A Fast-Fading Mobile Channel Measurement System

Robert T. Johnk, Chriss A. Hammerschmidt, Mark A. McFarland,  
John J. Lemmon

Institute for Telecommunication Sciences (NTIA/ITS)  
325 Broadway  
Boulder, Colorado 80305 USA

Engineers at the Institute for Telecommunication Sciences (NTIA/ITS) are developing a new measurement system to investigate the mobile radio channel. This system is designed to evaluate the fading characteristics of a narrowband mobile radio channel.

The measurement system consists of two primary parts: a transmitter and a receiver. It transmits a continuous-wave (CW) signal from a fixed location to a mobile receiving system located on a van. The van is driven through selected environments and the received signal is routed to both a spectrum analyzer and vector signal analyzer. The spectrum analyzer has two purposes. First, it functions as a real-time signal monitor to continuously observe the levels of the received signal. Second, the spectrum analyzer has a built-in global positioning system (GPS) which enables accurate position tracking. The vector signal analyzer (VSA) is the primary data acquisition system, and it digitizes the received signal and down-converts it to a discrete time series of baseband in-phase (I) and quadrature (Q) components. We post-process the resulting complex time series signal to analyze selected channel characteristics.

We performed a two-part evaluation of this system. First, we used a mobile-radio channel simulator to mimic the effects of a CW signal transmitted through a Rayleigh channel. We applied the simulator signal to the receiver section and recorded a 600 second time series of the baseband I-Q samples using the VSA. We simulated a non-line-of-sight (NLOS) Rayleigh channel with a receiver moving at a constant velocity. The second part of this effort consisted of actual fixed-to-mobile measurements. We located the transmitting antenna at a fixed location at the Boulder Commerce laboratories. We installed the receiving system in a custom-designed van. We drove the van in a prescribed pattern through residential neighborhoods adjacent to the labs. The drive route was designed to provide both line-of-sight (LOS) and non-line-of-sight conditions.

The results show much promise and indicate that this measurement system is a useful tool.