Low-to-Ground Wideband Channel Measurements over Line-of-Sight and Forested Paths at 300 MHz and 1.9 GHz

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Wideband wireless communication with low antenna heights is vital to emerging military applications such as battlefield sensor networks and communication between dismounted soldiers. Similar capabilities can support public emergency services, search and rescue operations, utility meter monitoring, and other civilian and commercial applications. When channel conditions permit, wideband communication systems can exploit multipath signal combining to enhance the quality of service, as with a RAKE receiver. Reliable low-to-ground wideband radio applications require a detailed understanding of channel characteristics to optimize communication performance. Hence wideband measurements for a variety of channel conditions for low-to-ground applications are needed.

We present results of 300 MHz and 1.9 GHz radio wave propagation measurements of line-of-sight (LOS) channels and of forested paths with dense and light foliage, using low antenna heights. LOS and obstructed wide band measurements were performed for distances up to 2 km, using omnidirectional and directional antennas at varying heights. An additional set of wideband channel measurements was performed on a rainy day to study the effect of wet foliage on signal propagation at 1.9 GHz. Path loss as a function of distance was characterized based on narrowband and wideband measurements, and channel power-delay profiles were extracted from wideband measurements.

Virginia Tech's wideband Vector ImPulsE Response (VIPER) channel measurement system (W.G. Newhall et al., *RAWCON 200*2, 133-136) was used to characterize the multipath channel in terms of the channel impulse response given by power-delay profiles. The transmitter uses a field programmable gate array to generate a 10-80 MHz PN sequence for BPSK modulation of the carrier (300 MHz or 1.9 GHz). The wideband modulated signal is then transmitted. The receiver down converts the signal and samples at 1 Giga-samples/sec. Snapshots of the received signals are processed in software and are used to estimate the channel impulse responses. Cross-correlation between the received and transmitted signals are used to produce the power-delay profile.

Results for different transmitter/receiver heights, several combinations of omni-directional and directional transmitting and receiving antennas, and foliage conditions for distances up to 2 km are reported. Measurement results are compared to path loss models including the Egli, Weissberger, and ITU models to determine how well they represent low-to-ground conditions.. Implications for feasibility of wideband multipath combining are also discussed.