Short Range Lower VHF Channel Study Using Full-wave Simulations and Measurements

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In complex propagation environments such as urban canyons, tunnels, and indoor environments, achieving a reliable communications link is very challenging at conventional microwave frequencies. However, the lower VHF band has significant potential to support low complexity, low power, and reliable one-hop communications, because obstacles are much smaller relative to wavelength at this frequency (Dagefu et. al, Trans. Ant. Prop., vol. 61, no. 6, 2252).

Potential applications of such a capability would include persistent networking, topology tracking, and/or situational awareness in highly adverse environments; example use-cases include sensor networks or autonomous mobile agents. The large size of conventional antennas at lower VHF has been a major obstacle in enabling practical systems such as small robotic platforms (e.g. crawlers, flyers and rovers). However, recently a set of highly miniaturized antennas with good performance have been developed; currently active and tunable antennas with wider bandwidth are being designed (J. Oh, et. al. Trans. Ant. Prop., vol. 61, no. 6, 2991).

We have been studying the short range near-ground channel characteristics at 40MHz in cluttered indoor and outdoor scenarios, drawing from extensive propagation measurements and simulations. Based on these measurements, we have shown that the measured channels exhibit minimal phase distortion and that multipath propagation is insignificant. The main objective of this presentation is to report on expanded measurement and simulation based analyses of channel behavior in the VHF band at frequencies up to 200 MHz. In various realistic scenarios, we quantify the extent of multipath as a function of frequency, transmit power, and range. Our results are based on a two-fold approach. One, we employ very large-scene FDTD based propagation simulations, enabled by high performance computing (HPC) platforms. Two, we collect measurements from tone and pulse waveforms in various challenging indoor/outdoor environments. We then apply statistical tests to characterize the frequency-dependent behavior of multipath phenomena across the range 40 MHz - 200 MHz, for various ranges and transmit power levels.