Measured Characteristics of Urban Depolarization in Ground-to-Ground UHF Wideband Channels

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Ground-to-ground radio links in urban terrain often depend on non-line-of-sight (NLOS) paths involving one or more reflections from the built environment. At the low UHF frequencies typically utilized for ground-to-ground communications by military and first-responder organizations, significant interaction with wavelength-scale structures in/or buildings (windows, doors, cladding materials, etc.) is possible, resulting in varying degrees of signal depolarization and apparent building radio reflectivity as functions of both location and delay time. While the existence of depolarization in urban environments has been discussed previously in the literature, its impact on the channel as a function of delay time and the specific urban terrain comprising the channel itself has not.

To assess the importance of these building-specific radio interactions, we investigated the differences in ground-to-ground channel impulse response at 440 MHz between co- and cross-polarized channels using vertical and horizontal (both cross-street and parallel to street) polarizations in several different urbanized regions within Boston, Massachussetts. Our sounding system used a fixed, vertically polarized transmitter (antenna height 2.5 m above ground level) and a cart-based mobile receiver with both vertical and horizontal antennae (height 2.0 m) to record channel impulse responses at a given location. All antennae were sleeve-dipole type, and we conducted measurements using three different link polarizations: vertical to vertical, vertical to horizontal (cross-street, determined at receiver), and vertical to horizontal (parallel to street axis, again, determined at receiver).

Given the low antenna heights and the dense nature of the urban environment, essentially all of the study links were NLOS, dominated by reflections from buildings within 1 km or less. Our preliminary results indicate that depolarization is significant in all of the urban areas studied. The cross-polarized channel power delay profile is grossly similar to that of the co-polarized channel: typically 6-8 dB lower than the co-polarized channel at delay times where prominent reflectors exist, and generally comparable powers in the Saleh-Valenzuela "tails" (A. Meijerink and A. F. Molisch, *IEEE Trans. Antennas Propag.*, v. 62, no. 9, pp. 4780-4793, 2014) following these strong reflectors. Cross-street and parallel-street horizontal polarizations generally had similar power delay profiles, though we observed several striking differences in delay profile behavior which may be associated with either reflector characteristics, or reflector to receiving street geometry.