An Analytical Study of the Effects of Parameter Variation on Radio-Wave Propagation Loss

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This paper describes a study of the effects of parameter variation on radio-wave propagation loss using various prediction models for very low antenna heights (1 to 3 meters) and very short distances (2m to 2 km) over the frequency range of 150 to 6000 MHz. These results can be applied to longer distances and higher antenna heights. The models are unique in their ability to work seamlessly over these difficult combinations of parameter ranges. The parameters considered in this variation of parameters study include: antenna heights, ground constants, frequency, path length, and antenna patterns. The results of this study can be applied for use in system performance prediction as well as prediction of interference phenomenon. It is based on the analytical calculations from the physics of electromagnetic theory and their application to radio-wave propagation including the effects of antennas. The topic of radio propagation between terminals in close proximity to the ground has received renewed attention recently. In cases where the terminals are close to the ground, the ground interactions of the radiated fields depart in significant ways from plane wave approximations in free space, giving rise to the Sommerfeld representation for the total (incident plus ground interacted) field. Another important aspect for radio propagation is the immersion of the propagation path in the surrounding environmental clutter. The presence of this clutter can give rise to non-line-of-sight propagation conditions in which scattering and diffraction dominate, even for very short path distances. For a given source/transmitter location, there are two facets of the environmental “clutter” which, broadly speaking, contribute to the radio propagation problem. These are the features of the static background, such as buildings, fences, trees and other vegetation, utility poles and wires, signage, etc., and the dynamic background features, such as vehicular and pedestrian traffic. There are two sorts of variability that cannot really be separated by measuring the field in this manner. There is the inherent position dependence of the field based on the static background along with the short term average or median dynamic background. This static component of the variability is almost completely deterministic, if one can capture sufficient detail about the structure of the static background, which is very difficult to describe analytically, but can sometimes be described via suitable time averages or medians of the dynamic background.