# DETERMINISTIC SPATIAL CHANNEL MODELING FOR PROPAGATION IN A CITY STREET MICROCELL

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**Abstract- This paper presents a proposed deterministic model in an explicit form and its simulation results for characterizing wideband line-of-sight (LOS) radio channel in an urban microcellular environment. The wideband channel characterization can be presented in two-dimensional domains. The spatial-temporal path loss characteristics are presented in delay-azimuth and delay-elevation angles domains.**

The spatial characteristics of mobile communication channels are important in determining the performance of smart antenna systems. The recent trend to increase the capacity of cellular systems has led to the adoption of the concept of microcells. The antenna placement below rooftops results in the propagation mechanism that is dominated by multiple reflections which is strongly affected by street structure and wall reflectivity. The detailed characterization of the radio channel propagation is a major requirement for successful design of wireless communication system.

This paper presents deterministic modeling and simulation results for characterizing wideband propagation channel. The model is given in an explicit form. Thus, it is fast to compute, easy to implement, and only those rays that reach the receiver locations are calculated. This work models LOS propagation in urban streets which are usually crossed by some number of side-streets that may vary in width. This model is proposed in terms of multiple wall-reflections (i.e., wall-wall and wall-ground-wall) rays approaching the observer along a direct and ground reflected rays. The number of wall-reflected rays is spatial-variant. The model provides three dimensional (3D) propagation information for both the base and mobile stations (e.g., direction of arrival). The developed model can predict both wideband and narrowband propagation characteristics in a city street with any number of crossing streets. The propagation characteristics are described here in terms of spatial-temporal path loss [1]. The detailed information on received signal strength in the coverage area will be required for the optimum combining technique at the basestation when adaptive antenna is used. Fig. 1 and Fig. 2 depict directional information since the spatial dimension is taken into account in the form of angular domain. They present the multipath received signals at the basestation in both delay and azimuth (and elevation) angular domains. The BS and Ms antennas heights are 8.7 m and 1.6 m, respectively. The presented results are for vertically co-polarized transmission and reception. The rays of higher reflection order have larger path loss, due to multiple reflections loss, with larger time delay, larger azimuth angle, and smaller elevation angle. The urban microcellular environment under study is shown in Fig.1. The spatial-temporal path loss corresponds to multipath time dependent received power from direction of azimuth angle of arrival and elevation angle of arrival at the basestation. The spatial-temporal path loss physically interprets power delay profile in delay domain and power angular profile in angular domain. It can be used to calculate both the root mean square (RMS) delay spread as well as the RMS angular spread [2].

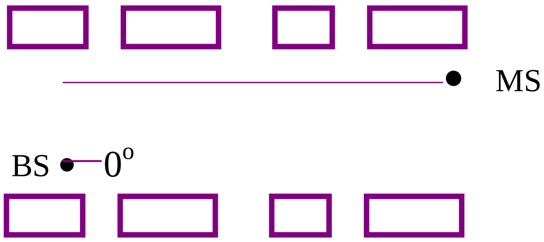


Fig. 1. Urban LOS microcell with MS route along the main street.

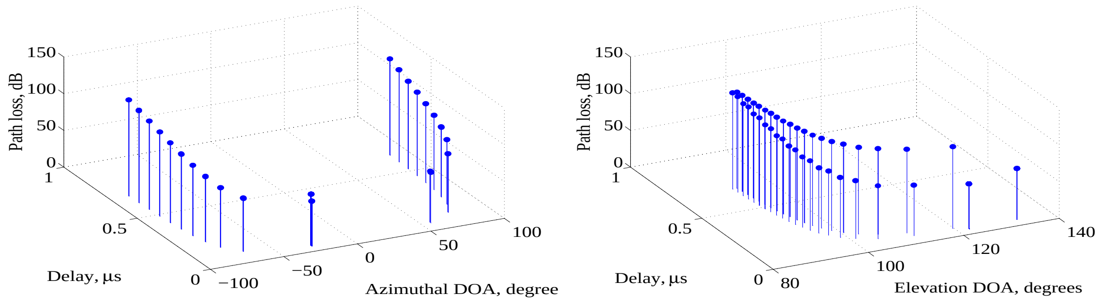


Fig. 2. Spatial-Temporal Path Loss, No crossing street between BS and MS.

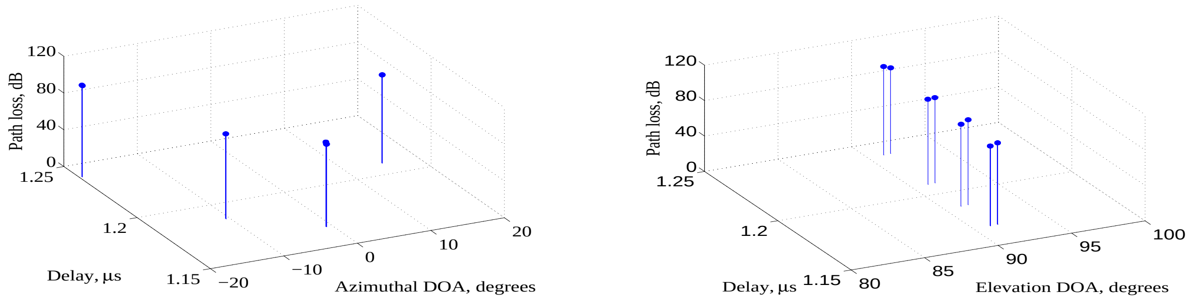


Fig. 3. Spatial-Temporal Path Loss, three crossing street between BS and MS.

**Conclusion:**

This work presents modeling and simulation results for wideband LOS propagation in microcell. The model is presented in an explicit form. The developed model can be made for urban LOS with street grid of any number of crossing streets and with different widths. The model can be used for studying mobile communication aspects like diversity techniques and testing adaptive antenna techniques for wireless applications.

**References:**


[1] H. M. El-Sallabi, W. Zhang, K. Kalliola and P. Vainikainen, "Full 360° azimuth angle wideband propagation modeling for an urban line-of-sight microcellular environment " *Proc. of IEEE International Conf.* on *Communication , (ICC'99),* Vancouver, Canada, June-1999, pp. 1608-1612.

[2] H. M. El-Sallabi and P. Vainikainen, "Modeling and simulation of wideband radio channel characterization for an urban line-of-sight microcell" to appear in *Proc. of IEEE Vehicl. Tech. Conf.* (VTC'99-fall), Amsterdam, the Netherland, 19-22 Sep. 1999.