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Radio Channel Modeling of Line-of-Sight Microcellular Environments of Adaptive Array Antennas at the Basestation

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Abstract- This paper presents radio channel modeling for wideband propagation prediction in 360^{o} azimuth range in urban Line-Of-Sight (LOS) microcellular environments of array antennas at the basestation and its experimental validations.

The use of adaptive antennas at the basestation is considered as a promising technique for increasing capacity and enhancing quality for future broadband mobile communication systems. To support the development of adaptive antennas, multiple antenna channel models (vector channels) are needed to analyze and predict the performance.

A physical modeling of wideband propagation in LOS microcellular environment of whole 360^{o} azimuth angle range is developed. It is an extension of [1],[2] and is divided into two steps. First, narrow band channel transfer function **H**(f) is derived that includes the angle of arrival, spacing between elements, and the number of elements. The second step results in time domain path loss $L_p(t)$. The measurements were carried out in the city center of Helsinki, Finland [3]. The system used here is based on a complex wideband radio channel sounder. The carrier frequency of the sounder is 2.154 GHz. The used chip frequency is 53.85 MHz code length is 1023 chips. The system has eight channels. Each results in a channel impulse response measurement. To facilitate comparison, Table 1 summarizes the predicted and the measured results. In Table 1 numerical values of measured and calculated time domain wideband absolute path loss of the first element of the array for the peak and wideband path loss for all sectors, M_W and C_W are the measured and calculated wideband path loss respectively, L_m and L_p are the measured and predicted peak values respectively, and 0^0 is the direction parallel to the main street, opposite to the transmitter, and the counting direction is clockwise. Fig. 1 presents the path loss prediction in two dimension i.e. the spatial and temporal domains. Figure 2 presents the $L_p(t)$ calculations for the first element of the array antennas in all sectors versus the corresponding measurements for comparison. Predictions for all elements have been obtained. Acceptable agreements between prediction and measurements are evidenced. Better agreements can be obtained if the average relative permittivity ε_r and conductivity σ for the building walls is known. ε_r =5 and σ=4 were selected in numerical calculation. As a second aspect, comparison between wideband model prediction with measurements is made in frequency domain as well.

Table 1 Numerical values of measured and calculated time-domain path loss of the first element of the array.

Sector	Model (rays)	M_W (dB)	C_W (dB)	L_m (dB)	L_p (dB)
0^o	6	-94.9	-89.5	-92.3	-92.0
60^o	7	-127.0	-116.7	-122.7	-122.1
120^o	3	-110.6	-104.2	-108.3	-104.7
180^o	4	-85.5	-78.1	-81.2	-78.8
240^o	5	-89.5	-87.1	-93.6	-88.7
300^o	9	-125.4	-113.4	-122.5	-116.8

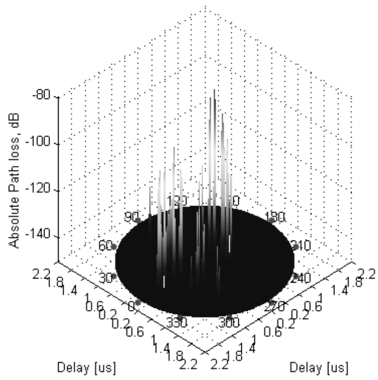

Fig.1 Predictions of the incoming signals to the array antennas at the basestation in temporal and spatial domains.

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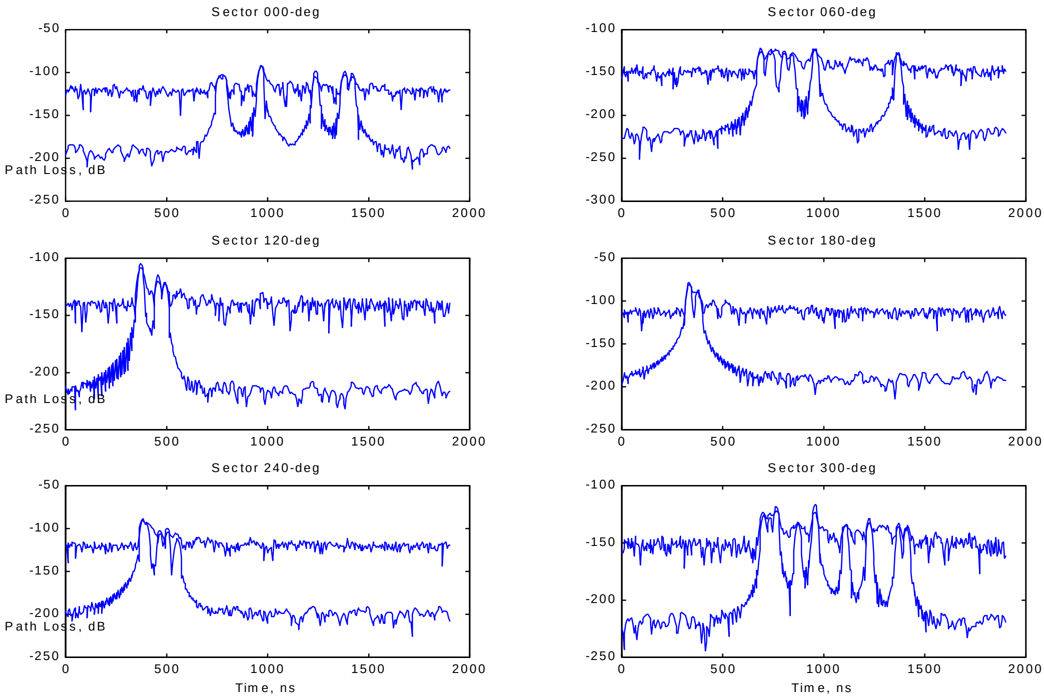

Fig. 2 Measured and calculated time-domain path loss.