Research Paper Engineering

Qualitative Analysis on Log-Distance Propagation Model for Wlan Standard

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ABSTRACT

WLANs is the most widely deployed technology for wireless communication which is based on the IEEE 802.11 standard ; the key features of IEEE 802.11 WLANs are simplicity, scalability, and robustness against failure. To know the behaviour of WLAN properly there are several indoor propagation models already exists. In this research paper we have used the log normal propagation model to compare the Received signal strength which was measured inside a corridor using the prediction software. The measurement results are compared to the calculations on several key points.

KEYWORDS WLAN, Log-distance model, Log-Normal model, Free-space model, WirelessMon

Introduction:

The indoor mobile radio channel is difficult to model as the channel varies significantly with the surrounding. It depends heavily on factors including building structure, room layouts, the type of construction materials used etc. To make it clear we need to concentrate on the effects of wave propagation which are mainly reflection, diffraction, and scattering.

The combined effects of these three effects cause multipath. which is happened when the signal arrives at the receiver by more than one path. The components of the transmitted signal combine at the receiver which results a distorted version of the transmitted waveform. This signal components can combine constructively or destructively depending on the variations of phase of the signals. The destructive version of the multipath component result in a attenuated received signal.

The object of this paper is to determine how the indoor radio channel affects the performance of the wireless propagation system. The main object is to determine the amount of attenuation that can be observed because of the effects from walls, floors, doors etc. in an indoor environment. Beside that , we would be able to estimate the amount of path loss occurred due to the given transmitter-receiver (T-R) separation within a home.

Existing Indoor Propagation Models

Free Space Path Loss:

We know the free space path loss model is not directly associated to indoor propagation, but it is necessary to compute the path loss at different reference distance as required by the models. The free space model provides an account of path loss as a function of T-R separation when the transmitter and receiver are within line of sight range in a free space environment. The model is depicted by the equation below which represents the path loss as a positive quantity in dB:

$$Pl(d) = -10 \log [G_t . G_r . l^2/(4p)^2.d^2]$$

where Gt and Gr are the ratio gains of the transmitting and receiving antennas respectively, λ is the wavelength in meters, and d is the T-R separation in meters. When antennas are excluded, we assume that Gt = Gr = 1.

Log-Distance Path Loss

The log-distance path loss model describes that the path loss varies exponentially with distance. The path loss in dB is given by following equation

$$PL(d) = PL(d_0) + 10\, n \log (d/d_0)$$

where n is the path loss exponent, d is the T-R separation in meters, and d_0 is the crossover reference distance in meters. $PL(d_0)$ is computed by the free space path loss equation. The value d_0 should be selected in such a way that it should be in the far-field of the transmitting antenna, although the small distances are used according to any practical distance are used in the mobile communication channels.

The path loss exponent n is dependent on the different conditions of environment. n is equal to 2 in free space. But in practice, the value of n is estimated using the empirical data.

Log-Normal Shadowing

Varying degrees of clutter between the transmitter and receiver can causes shadowing effects but it cannot be calculated by the log-distance path loss model and it is one of its downfall. The log-normal shadowing model can solve this problem. The log-normal shadowing model path loss equation is given by

$$PL(d) = PL(d_0) + 10\, n \log(d/d_0) + X_\sigma$$

where X_σ is a zero-mean Gaussian random variable with standard deviation σ. Both X_σ and σ are given in dB. The random variable X_σ can solve the random shadowing effects that can result from clutter. From empirical data the values n and σ are determined.

Experimental Set up:

The measurements are done using one access point and which is IEEE 802.11b compliant and operates on 2.4 GHz . It also provide a bandwidth of 54 Mbps. The signal measurements were done using the software 'WirelessMon' which is a tool for Windows that allows one to measure the signal level of WLANs . Using this software the measurements were taken. The signal strength was measured for various distances from access points at regular increments of distance. At each interval signal measurements were taken by different positions.

Results:

Receiver Location	T-R Seperation(m)	Average Received Signal Strength(dBm)	Path Loss (dBm)
1	1.83	-68.34	19.22
2	3.37	-65.13	22.08
3	5.23	-65.84	36.68
4	6.28	-61.28	39.57
5	7.03	-58.18	43.03
6	10.34	-56.23	55.13
7	13.48	-63.20	57.34
8	15.01	-68.41	60.19
9	17.25	-65.36	62.53
10	22.90	-72.63	68.61
11	24.85	-67.64	71.29
12	28.13	-71.49	73.24
13	37.79	-82.06	75.51
14	39.95	-78.08	77.32
15	40.64	-77.06	79.34

Table 1. Table of measurement data

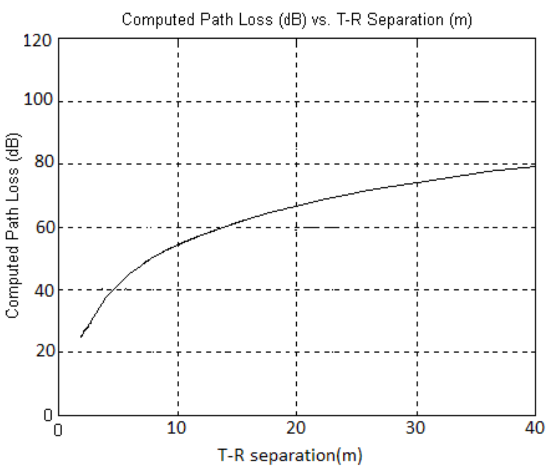

Fig. 1. Path Loss vs. Distance as Computed from Log-Distance Path Loss Model

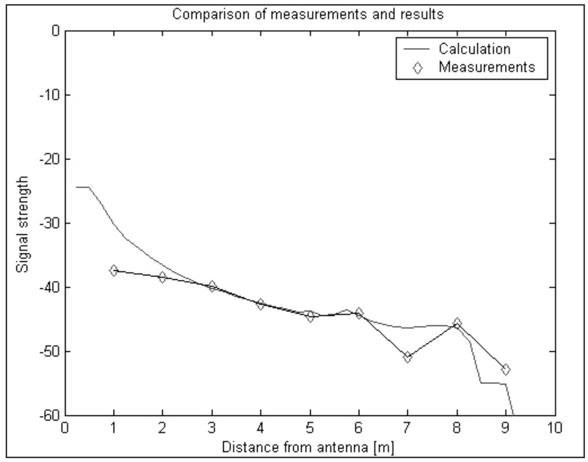

Fig. 2 – Comparison of calculated and measured signal strength within the main corridor.

Conclusion:

In this paper we were working on IEEE 802.11 WLAN standard. Here we have used Wi-fi Modem and Laptop as measurement device for WLAN standards. We have used Log-distance path loss wave propagation model for reference. First we compare Received Signal Strength between the calculated data with the measured one and. Then we also determine the effective path loss according to the varying distance. The measurement was taken with the help of a software and demonstrated by MATLAB software. As further work, more detailed simulation scenarios will be created to determine the effect of different obstacles upon the path loss.

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