ANALYSIS OF NON LINE OF SIGHT PROPAGATION ENVIRONMENT FOR RADIO FREQUENCY IDENTIFICATIO (RFID) INDOOR APPLICATIONS

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ABSTRACT

Among developing wireless sensor network technologies radio frequency identification (RFID) technology is gaining more ground by the day due to its ease of use, security, cost effectiveness and ease of deployment. Radio frequency identification technology become one of the main indoor wireless sensor network applications and need to get proper idea about indoor propagation environment. Non Line of Sight (NLOS) is when there is no direct wave path between a transmitter and a receiver. The NLOS can be as a result of rise buildings or tall trees like tall objects. In non- line of sight environment, time difference of arrival, time of fight and angle of arrival of signal at receiver are retroaction by the nature of the environment, in this case multipath occurs and performance of the system is limited. In wireless communication systems, the medium for information transfer between the transmitting and receiving antenna is accomplished by electromagnetic waves. The interaction between the electromagnetic waves and the environment reduces the signal strength generated from the transmitter to the receiver. Path loss between two communicating antennas strongly depends on the propagation environment. Modeled and observed the behavior of power ratio between transmitter and receiver. Path loss occurs in a physical building and takes into account reflection, path obstruction, absorption and other attenuation effects introduced by the presence of objects inside the building. In-building path loss model simulated to depicts the effect of obstructions in a NLOS environment with Additive White Gaussian Noise (AWGN) with zero-mean and standard deviation in different path loss exponent n. The path loss equation modified with an additional random noise factor ε. by results we could observed that the environment with high path loss exponent *n* is a hostile environment for radiation and its in-building path loss will be higher compared to the case in low path loss exponent *n* environment. With an additional random noise factor ε gives higher path loss compare to the case of without additional random noise factor epsilon ε.

Keywords: Radio Frequency Identification (RFID), Non Line of Sight (NLOS), Additive White Gaussian Noise (AWGN), Standard deviation

1. INTRODUCTION

Radio frequency identification (RFID) technology is getting more ground by the day due to its ease of use cost effectiveness and ease of deployment. Radio frequency identification technology become one of the main indoor wireless sensor network applications and need to get proper idea about its indoor propagation environment as well. Mostly RFID indoor environment gets multipath due to the non line of sight propagation environment such as radio signal moves from transmitter to receiver antenna of the reader or tags, the signal or radio wave travels through different paths to get to the receiver antenna. Part of the signal would have undergone diffraction, scattering or reflection due to the different objects, the ceiling and the floor. NLOS is when there is no direct wave path between a transmitter and the receiver. The NLOS could be as a result of high rise buildings or tall objects between the propagation channels, leading to electromagnetic wave travelling along different paths of varying length due to multiple reflections from various objects within the environment [1]. In NLOS environment, In-building path loss model simulated to depicts the effect of obstructions in a NLOS environment with Additive White Gaussian Noise (AWGN) with zero-mean and standard deviation in different path loss exponent n. The path loss equation modified with an additional random noise factor ε. by results we could observed that the environment with high path loss exponent *n* is a hostile environment for radiation and its in-building path loss will be higher compared to the case in low path loss exponent *n* environment. With an additional random noise factor ε gives higher path loss compare to the case of without additional random noise factor epsilon ε.

2. MODELING OF NON LINE OF SIGHT PROPAGATION CHANNEL

In wireless communication systems, the medium for information transfer between the transmitting and receiving antenna is accomplished by electromagnetic waves. The interaction between the electromagnetic waves and the environment reduces the signal strength generated from the transmitter to the receiver.

Path loss between two communicating antennas strongly depends on the propagation environment. [2]The power transfer ratio for a pair of lossless antennas in free space with optimum orientation is given by:

$$\frac{P_r}{P_t} = G_t G_r \left(\frac{\lambda}{4\Pi d}\right)^2 \qquad (1)$$

Where λ - wavelength; P_r - received power; P_t- transmitted power; G_r- receiver antenna gain; G_t- transmitter antenna gain;*d* - separation distance between antennas. The factor $(\lambda/4\pi d)^2$ in (1) if separated from the effect of transmitter and receiver antenna gain is referred to as the free space path loss.

Considering an airport scenario which is the case study, is categorized as an in-building path loss model. This is a path loss that occurs in a physical building and takes into account reflection, path obstruction, absorption and other attenuation effects introduced by the presence of objects inside the building .The in-building path loss model used to depicts the effect of obstructions in a NLOS environment is given by (2),

$$PL[dB] = PL(d_o) + 10nlog\left(\frac{d}{d_o}\right) + AWGN \qquad (2)$$

Where d_0- arbitrary reference distance away;*n* - path loss exponent that depends on the surroundings and building types; *d*- the transmitter-receiver separation distance;$PL(d_0)$ - is the in-building path loss at arbitrary reference distance away; *AWGN* - additive white Gaussian noise with zero-mean and standard deviation[3].

3. IMPLIMENTATION OF NON LINE OF SIGHT PROPAGATION CHANNEL

To depict the effect of noise in the channel, the in-building path loss model from (2) was implemented by modifying the equation slightly as shown in (3)

$$PL[dB] = PL(d_o) + 10nlog\left(\frac{d}{d_o}\right) + AWGN + \varepsilon \qquad (3)$$

$$PL(d_o) = \left(\frac{\lambda}{4\Pi d_o}\right)^2$$

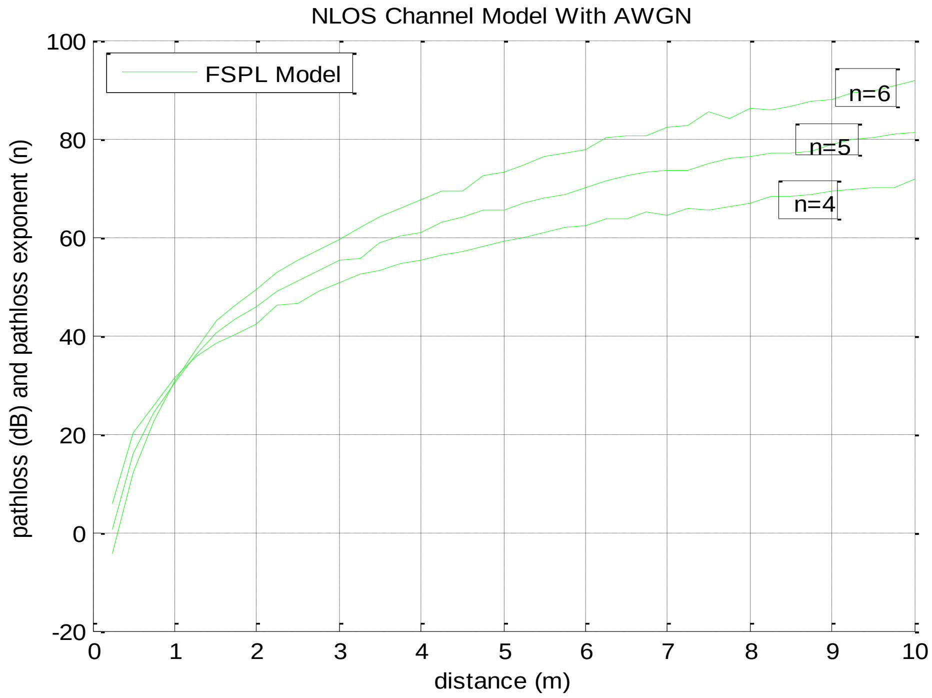
These two equations were implemented using the parameters from Table 1.

4 SIMULATION OF NON LINE OF SIGHT PROPAGATION ENVIRONMENT

The operating frequency used for the purpose of this simulation is 866 MHz which is within the frequency range for European standard [25]. The reference distance away for our simulation was 1 m and Figure 1 and 2 show the simulation output for NLOS channel model with AWGN and AWGN plus ε respectively [4].

Table 1: Showing the NLOS channel simulation Parameters

Parameters	Values
Arbitrary reference distance away (d_o)	1 m
Transmitter-Receiver separation distance	10 m
Path loss exponent (*n*)	4 to 6
Operating frequency	866 MHz
Velocity of light	$300*10^6$ m/s
Additional random noise ε	Random values of length *n*



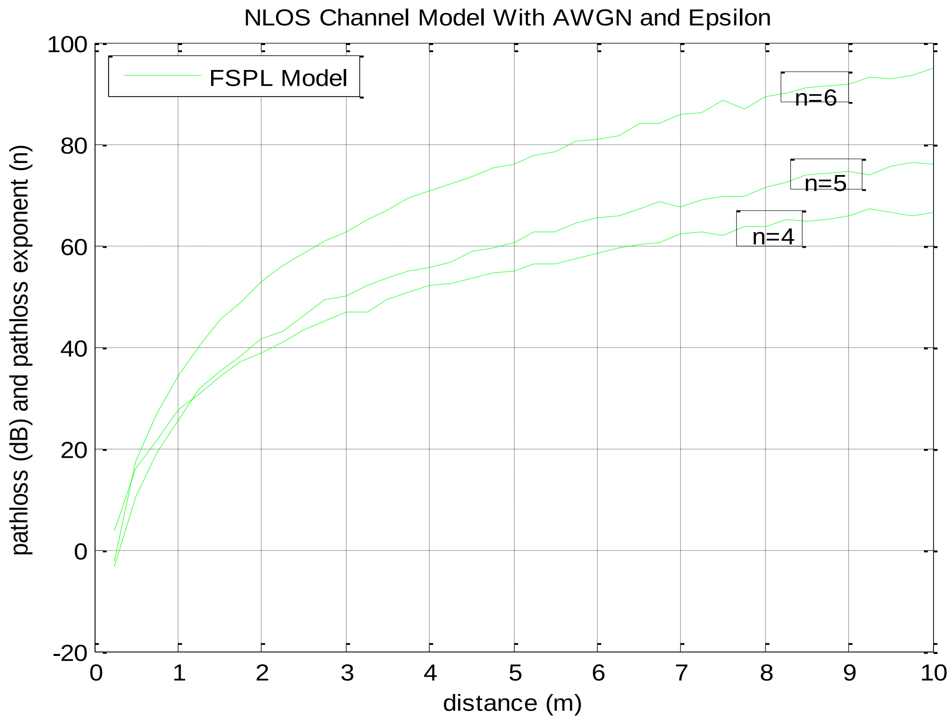


Figure 1: NLOS channel implemented with AWGN

Figure 1: NLOS channel implemented with AWGN and ε

5 ANALYSIS OF SIMULATION RESULT FOR THE PROPAGATION CHANNEL

The result from NLOS channel model in Figure 1 and 2 shows that for an in-building that is *n* from 4 to 6, the environment experienced great and fluctuating path loss due to random value of the noise. This is as a result of reflection created from many sources like the ground surfaces.
Table 2: Path loss [dB] values for in- building NLOS channel model

Table 2 shows the path loss of both the NLOS channel model with AWGN and channel model with AWGN and ε.

Path loss Exponent *n*	Path loss [dB]	
	NLOS channel model with AWGN	NLOS channel model with AWGN and ε
4	73	65
5	82	78
6	92	96

6. CONCLUTION

In this study we could observed that, once we increase the path loss component in NLOS channel with AWGN, the path loss get high so these aspects we could use for deploying the RFID networks in indoor environment.

7. REFERENCES

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