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OPTIMIZING THE PATH LOSS OF WIRELSS INDOOR PROPAGATION

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Abstract: The presented work is actually the construction of the propagation algorithm with environmental and communication parameters specification so that effective network construction is been defined. The algorithm is here been defined in the form of network construction and communication steps. To construct an indoor network under the environmental and communication parameters. To construct the network under different propagation models. Analysis of the work under the different distance vectors Analysis of work under different number of users. Result Analysis under the energy constraint Conclude the results from the analysis and present them in the form of Graphs.

Keywords: **AWGN,SNR,SIG,FRISS**

1.0 Introduction:

Indoor Propagation is a method for data communication that used short-range radio links to replace cables between computers and their connected units. Industry-wide Indoor Propagation promises very substantial benefits for wireless network operations, end workers and content developers of exciting new applications. This article delves into the implementation and architecture of Indoor Propagation. It also describes the functional overview and applications of Indoor Propagation, and deals with the development of a model for recording, printing, monitoring, and controlling of eight process variables at the same time, using a distributed control system. Indoor Propagation is an open standard for wireless connectivity with supporters mostly from the PC and cell phone industries. Not surprisingly, it primary marker is for data and voice transfer between communication devices and PCs. In the way, it is similar in purpose to the Infrared Data Access protocol, Indoor Propagation, however, is a radio frequency (RI) technology utilizing the unlicensed 2.5 GHz industrial, scientific, and medical (ISM) band. Target applications include PC and peripheral networking, hidden computing, and data synchronization such as for address bookstand calendars. Other applications could include home networking and home applications of the future such as smart appliances, heating systems, and entertainment devices Indoor Propagation was invented in 1994 by L.M. Eriesson of Sweden. The standard is named after Harald Blaatand “Indoor Propagation” II. King of Denmark 940-9SIAD. A nice stone has be received in his capitol[1] city Jelling (Jutland) that depicts the chivalry of Harald and the ‘runces’ say

- Harald christianized the Danes.
- Harald controlled Denmark and Norway.
- Harald thinks and cellular phones should seamlessly communicate.

The blue tooth Special Interest Group (SIG) was founded by Ericsson. IBM. Intel. Nokia and Toshiba in February 1998 to develop as open specification[2] for short-range wireless connectivity. The group is now also promoted by 3 Com. Microsoft. Lucent and Motorola. More than 1900 companies have joined the SIG.

The following section describes some of the requirements for the Indoor Propagation system and in essence suggests the functionalities planned for it.

2.0 Communications System Impairments

2.1 Uniform Noise

Additive white Gaussian noise (AWGN) is the most common impairment encountered in a communications[3] system. In a wireless medium, the noise source is typically considered to be thermal noise that is Gaussian and uniform across the frequency range. Additional noise sources include atmospheric sources and solar radiation. In a contained media, such as a coaxial cable system, thermal noise will be present, but the system may also have other sources that can increase the noise in the system. The effect of AWGN on an Communication system is similar to its effect on a single carrier system. The signal-to noise ratio (SNR) is a function of the total signal power over the total noise power across the received channel. The uniform noise contributes to the SNR[4] of each subcarrier in the Communication system and the net result is equivalent to the effect on single channel systems.

2.2 Non-Uniform Noise

Noise in a communications channel can often be shaped, or "colored", by various effects. These effects can include transmit signal imperfections, transmission channel characteristics, or receiver frequency shaping. The implications of these effects for an Communication system can be different compared to its single-carrier counterpart. The modulation of the Communication[5] system can be tailored for the noise characteristics. One method previously mentioned involves lowering the modulation (number of bits/symbol) on subcarriers in a low SNR environment as illustrated in Figure 2.1 Another method involves sending the same data on several subcarriers, or sending data that can be considered lower priority. In extreme cases, the subcarriers can transmit no data, essentially turning them off.

Uniform and Non-uniform noise and SNR

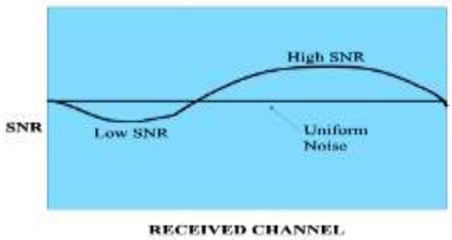

Figure 2.1

2.3 Impulse Noise

Impulse noise is a common impairment in a communications system arising from motors or lightning. Impulse noise is typically characterized as a short time-domain burst of energy. The burst may be repetitive or may be a single event. In either case, the frequency spectrum from this energy burst is wideband, typically much wider than the channel, but is present for only a short time period. One of the most important concepts to understand about Communication and its properties related to the FFT[7] algorithm is how the algorithm changes the nature of the signal. In a single-carrier system, the symbol can be viewed as occupying the entire available frequency spectrum for the time duration of the symbol. A group of symbols then occupies the entire spectrum for the duration of the whole group, but in a time division arrangement. Communication, using the FFT, takes symbols and creates these groups directly and then transforms them. They are no longer time-domain multiplexed; they are now frequency-domain multiplexed. The Communication symbol is now a collection of these source symbols, and this Communication symbol now has a much longer duration. Each original symbol occupies only a small frequency[8] region, but now occupies that region for the entire Communication symbol duration. For impulses that are short in duration, the impulse energy masks a smaller percentage of time of each Communication symbol compared to the single carrier case. Impulse noise can therefore have less of an effect on short duration noise.

3.0. Problem Formulation:

A mobile network is the most required and busy public area network used by general. The main advantage of this network is its user friendly nature. This kind of network is defined in different ways for different kind of users. These network types actually differ respective to network size, shape, protocol, battery power and the criticality.

These all parameters get affected because of the real time scene in which the network is composed or established. As the network formation is done under any scenario or the scene, the analysis of the work is done under different parameters such energy loss etc. One of such important aspect is the propagation model in a particular network. The presented work is the analysis of indoor network in different propagation model so that energy effectiveness can be analyzed. In this work, the work is presented for three main propagation models called log-distance model, Friis Model and Rayleigh Propagation model. All these models are defined under different environmental and communication constraints. The work is here presented in the form of analytical comparison of these propagation model. The analysis of work is done under the energy loss vector etc.

4.0 Significance of Work:

The proposed work will give the following benefits. In this work the analysis of the work is been defined under the distance and number of users for different propagation model in indoor scenario. It shows that the network with same communication constraints is affected by number of users. As the number of users increases, the interference over the network is increased and it results the energy loss over the network. The analysis is performed in terms of distance vector. It helps to identify the optimum distance between the nodes where the energy loss is minimum. The work also includes the comparative analysis of these propagation model so that most effective model will be analyzed.

4.1 Objectives

The presented work will be studied and defined in order to achieve the energy optimization in indoor network under different propagation models. In this work, the work is divided in terms of smaller research objectives given as under.

- To construct an indoor network under the environmental and communication parameters.
- To construct the network under different propagation models.
- Analysis of the work under the different distance vectors
- Analysis of work under different number of users.
- Result Analysis under the energy constraint
- Conclude the results from the analysis and present them in the form of Graphs.

4.2 Proposed Work:

The proposed work is an analytical study of different propagation models for indoor Mobile area networks. The analysis is here been performed under two main vectors called number of users and distance vector. In this work three main propagation models are considered, given as

- Log-distance Propagation
- Friss Propagation Model
- Rayleigh Model

4.3 Log-Distance Propagation:

This propagation model defines the path loss model under the assumption of the power loss based on the distance. The path loss is identified using the following formula

$$\overline{PL}(d) = \overline{PL}(d0) + 10n \log\left(\frac{d}{d0}\right) + X_\sigma \quad (6.1)$$

X is a zero Mean Gaussian Random Variable with standard deviation. The value of n is determined form the empirical data. The shadowing effect is defined under the distance vector so that fading over the signal is performed. d is the distance ctor that represents the transmission and recieve user seperation in meters. d0 is the close in reference distance and it is also defined in meters. PL(d0) is the computed value that represents the path loss in free space.As the distance between the source and the destination points increases, the energy loss increases and the fading vector for the propagation model increases and received power is calculated from formula

$$Pr = \frac{Pt*Gt*Gr*\lambda^{2*} d0\text{^}pathloss\ Exp\ (X0/10)}{(4*\pi*d)^2*L\ d\text{^}pathloss\ Exp}$$

4.4 Friss Propagation Model

It is the another propagation model that gives the path loss in Friss propagation model. In this model, the power fall as the square of the Transmission and receiver separation distance. The free space loss is defined under the antenna vector. As the distance from the antenna increases, the loss over the system also increases. The approach also affected from the reflection, diffraction and scattering. Reflection is the term that represents the electromagnetic component that affects the communication. Diffraction is the radio loss if the sender of the receiver is obstructed by the surface and has the sharp edges. Scattering is the term that defines the medium through which the wave travels. It also consist of objects with dimensions of that the wavelength based comparison is done. Number of obstacles and the distance increases the path loss during the communication.

4.5 Rayleigh Propagation

The Rayleigh propagation is defined in the horizontally layered media so that easy way communication can be performed. This propagation model is characterized by a group and phase velocity that are determined by the elastic properties of the layered media. If the media contain a vertical boundary across which there is a velocity contrast. It also defines the group and phase velocities on one side of the boundary so that effective analysis will be drawn respective to the interference parameters. The received power is identified by following formula

$$P_r = \alpha^2 \, 10^{x/10} \, g(d) \, P_t \, G_t \, G_r$$

$$P_r(\alpha) = \alpha \, e^{-\alpha\hat{}2/2\sigma\hat{}2} / \sigma^2$$

5.0 Result Analysis

The parameters considered in work are the frequency parameter, loss propagation vector, distance power loss coefficient, distance vector and number of users. Frequency is the channel vector that actually represents the signal strength, This parameters is defined at constant value. The loss propagation vector, defines the propagation loss over the network if the communication is perform in indoor scenario. This contain is effective to analyze the network under the congestion or the interference scenario. As the number of users will be increased, the propagation loss increased. This vector cannot be defined zero. This constraint is also defined with fix value. The distance power loss coefficient defines the loss ratio as the distance increases. This constraint is effective to perform the analysis under the distance vector. This vector actually represents the fading property of channel. Distance vector is another constraint that affects the network communication. As the distance increases, the communication loss also increases. We have defined this distance vector from 1 Mtr to 5 Mtr. It is the average distance between the communicating users. The last parameter considered in this work is the no of users. As the users increased in an indoor scenario, the interference over the network increased and it gives the communication loss. In this work, the analysis is performed for the energy loss vector with different distance vectors and different number of users. The work is simulated in matlab environment.

Here figure 5.1 is showing the node placement over the network. The network is defined with random size with maximum limit of 100x100 mtrs. Here x axis represents the x coordinate position and y axis represents the y coordinate position.

Table 5.1. Simulation parameters for Rayleigh Model.

Parameters	**Specification**
Number of Users	10
Propagation Type	Rayleigh
Distance	1 meter
Distance Power Loss Coefficient (unit less)	1
Loss Penetration Vector (unit less)	30

The results obtained in case of Rayleigh propagation are listed as under we can see, as the distance is been increased, the energy consumption over the network will also increased. The coefficient vector is also been defined as the major criteria to decide the energy consumption.

Here figure 5.1 is showing the energy consumption at different distance levels at different coefficient vector.

As Figure 5.2 shows the energy loss at different coefficient level as well as Time vector is been described. At the initial stage, the energy loss over the network is high respective to the coefficient vector but later on the energy consumption is been decreased as the symmetric communication respective to the defined vectors is been performed.

Energy Consumption (Rayleigh Propagation)

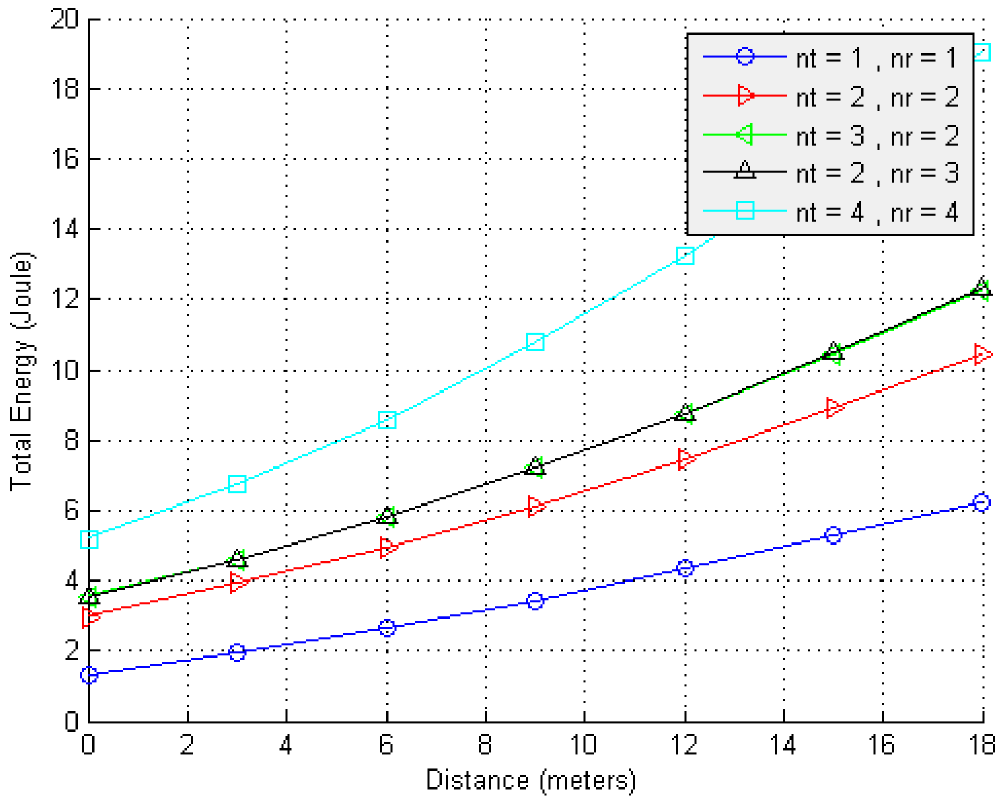

Figure 5.1

Energy Loss (Rayleigh Propagation)

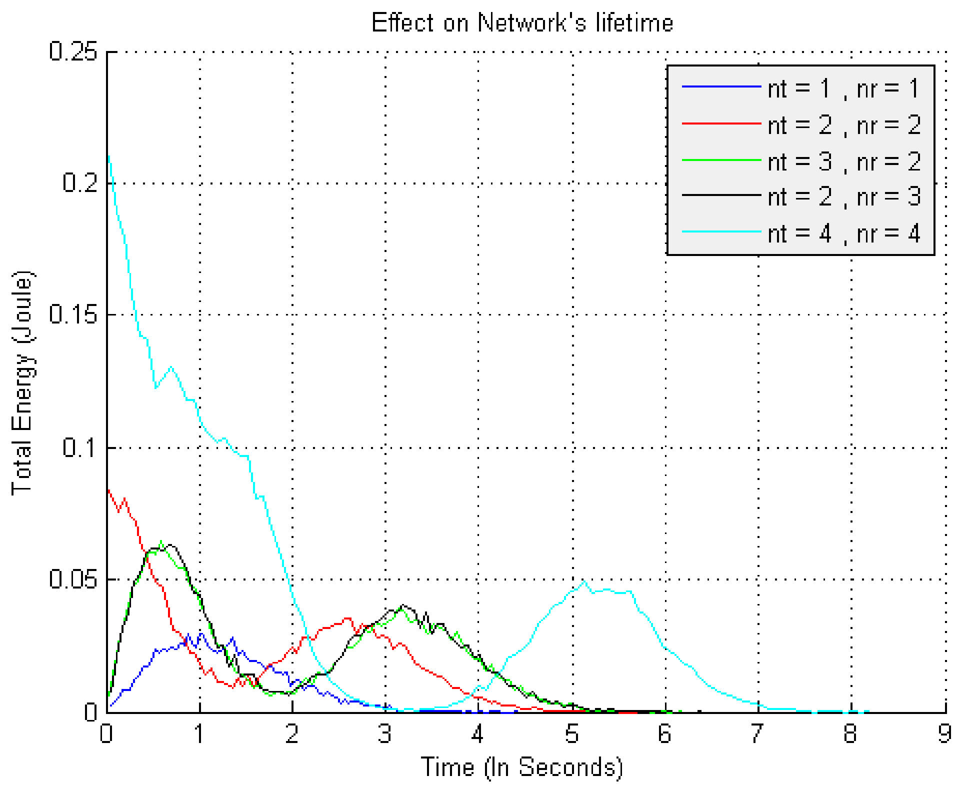

Figure 5.2

Table 5.2. Simulation parameters for Friss Model.

Parameters	Specification
Number of Users	10
Propagation Type	Friss
Distance	1 meter
Distance Power Loss Coefficient (unit less)	1
Loss Penetration Vector (unit less)	30

The results obtained in case of Friss propagation are listed as under

Energy Consumption (Friss Propagation)

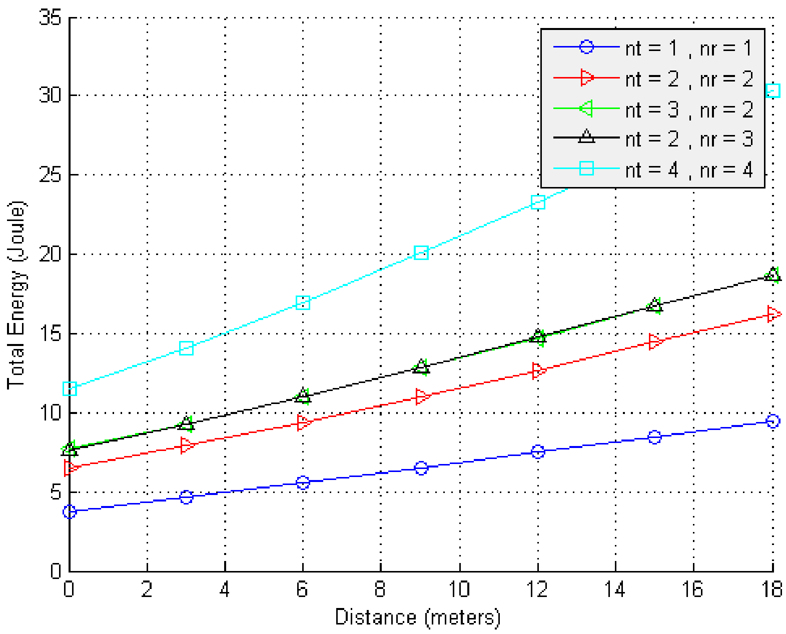

Figure 5.3

Energy Loss (Friss Propagation)

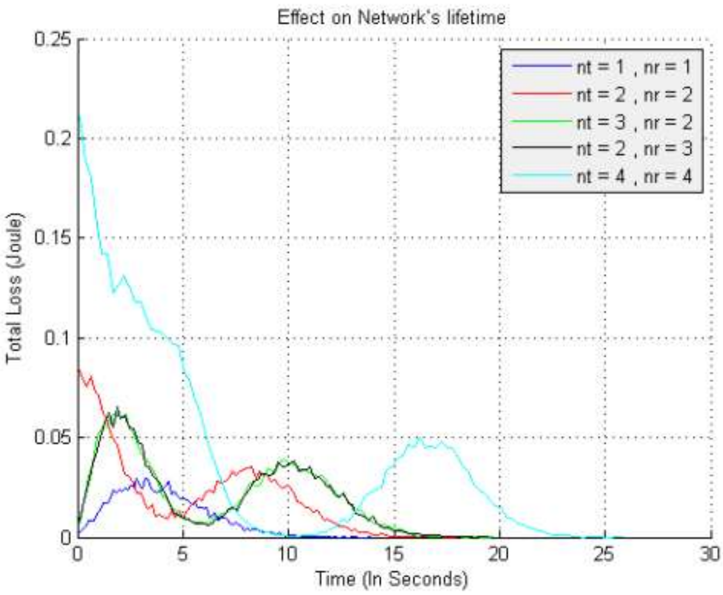

Figure 5.4

Here figure 5.3 is showing the energy consumption at different distance levels at different coefficient vector. As we can see, as the distance is been increased, the energy consumption over the network will also increased. The coefficient vector is also been defined as the major criteria to decide the energy consumption. Figure 5.4 shows the energy loss at different coefficient level as well as time vector is been described. At the initial stage, the energy loss over the network is high respective to the coefficient vector but later on the energy consumption is been decreased as the symmetric communication respective to the defined vectors is been performed.

6.0 Conclusion and Future Scope

In this paper , we have propsed the Indoor Propagation based system model is presented under different kind of interference After analyzing each propagation method under different methods, the analytical comparisons are also performed between these methods. This comparison was about to identify the most effective and worst propagation model for indoor environment. The obtained results from the system shows that the Rayleigh is most effective propagation model that gives least power loss in indoor environment whereas Log-Distance Model is worst and give heavy loss during the communication.

The presented work is about to define an analytical study of indoor communication network under different propagation methods. These propagation methods includes the log-distance propagation, Rayleigh propagation and Farris propagations. To perform the analysis, a constraint satisfaction approach is suggested in this work. Constraints are here defined in terms of some network and environmental parameters R.K Crane,

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