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Evaluation of Three Indoor Mobile Model in Term of Energy Loss and BER Using Different Constraints

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Abstract: - Evaluation of Spectrum Access Options for Indoor Mobile Network Deployment about to perform the effective communication in indoor network under the identification of type of node and the license type. But in this work, the work is defined under different constraints like energy, distance and density analysis The objective of this work is to reduce BER in a noisy channel In the presented indoor mobile network communication is through the noisy channel .This is an ad-hoc network that is limited to a small area such as a room or the building. The network is congested having a small range of communication for each node. In such network, the communication strength depends on the propagation type used in the network. There are number of such propagation methods to provide effective communicationover the network. To achieve an effective communication, the effective propagation method must be selected for the communication. These propagation methods also affected from different network, environmental and communication parameters. In this workno channel communication problem is defined but the presented work is defined for noisy channel also This work will be performed on three different models, theyare: Ray-leigh indoor propagation model, Friis model, Log distance shadowing model. The work is about to reduce the BER while performing the communication in indoor network under different distance and density constraints.

Keywords: ITU, ISM, BER

I. INTRODUCTION

In the 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 tasks, end workers and content developers of impressive new applications. This article explores 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 recounting, printing, supervising, and controlling of eight process variables at the same time, using a dispersed control system. Indoor Propagation is an open standard for wireless connectivity with supporters mostly from the PC and cell phone industries. Not exceptionally, it primary marker is for data and voice transfer between communication devices and PCs. Therefore, it is similar in purpose to the IrDA agreement, Indoor Propagation; this is a radio frequency (RI) technology utilizing the unauthorised 2.5 GHz industrial, scientific, and medical (ISM) band. Bulls'eye applications include PC and tangensial networking, unseen computing, and data synchronization such as for address bookrack calendars. Other pertinence could include home networking and home applications of the future such as smart gadgets, heating systems, and entertainment devices.

II. INDOOR MOBILE NETWORK

A radio reproduction model, also known as the Radio Wave Propagation Model or the Radio Frequency Propagation Model, is an factual mathematical formulation for the characterization of radio wave propagation as a function of frequency, distance and energy etc. A single model is usually developed to envision the behavior of propagation for all similar links under similar constraints. Designed with the target of determining the way radio waves are propagated from one place to another, such models predict the path loss along a link or the effective coverage area of a transmitter. The ITU indoor generation model, also known as ITU model for indoor fading, is a radio reproduction model that finds the path loss inside a room or a closed area
inside a building delimited by walls of any kind. Sufficient for appliances designed for indoor use, this model calculates the total path loss an indoor link may experience. This model is applicable to only the indoor environments. Typically, such gadgets use the minimum microwave bands usually 2.4 GHz. This model used for a much wider range. The Coverage Frequency is 900 MHz to 5.2 GHz. The ITU indoor path loss model is perfectly depicted as:

$L= 20 \log f + N \log d + Pf (n) – 28$…………………….. (1)

Where
L= energy loss of signal
f = spectrum frequency of the signal
d = space measured between the transmitter & receiver
N= distance power loss coefficient
Pf == floor loss factor

n = no. of users

Estimation of distance power loss coefficient The distance power loss collateral, *N* is the portion that expresses the loss of signal power with distance. This collateral is an empirical one. Estimation of floor penetration loss factor The floor penetration loss factor is a constant dependent on the number of floors the waves need to penetrate.

RAY-LEIGH PROPAGATION MODEL

Mean received power is just one aspect of the first-order behavior of radio channels. In order to have a better understanding of the first-order behavior of radio channels, the received signal power or envelope Probability Density Function (PDF) is necessary. Since power P is just the square of envelope, the power PDF and the envelope PDF can be interconvert according to:

fp (p) = (1 / 2√p) fα (√p)…………………… (1)

fα (α)= 2α fp (α2)………………………… (2)

In wireless communications, fading is deviation of the attenuation affecting a signal over certain propagation media. The attenuation may vary with time, geological locations or radio frequency, and is often formed as a regular process. A fading channel is a communication channel consisting fading. In wireless environment, fading may either be due to multipath propagation, referred to as multipath induced fading, or because of shadowing from rovers affecting the wave motion, sometimes referred to as shadow fading. Rayleigh fading is a statistical model for the effect of a propagation environment on a radio signal, that used by wireless devices.

Rayleigh fading models assume that the magnitude of a signal that has passed through such a transmission medium (also called a communications channel) will vary regularly ,or attenuate, according to a Rayleigh distribution — the radial component of the sum of two uncorrelated Gaussian variables. Rayleigh fading is a reasonable model for tropospheric and ionospheric signal propagation as well as the effect of heavily built-up urban environments on radio signals.[1][2] Rayleigh fading is most applicable when there is no dominant propagation along a line of sight between the transmitter and receiver.

Rayleigh fading is a reasonable model when there are many objects in the environment that scatter the radio signal before it arrives at the receiver. The main limit theorem states that, if there is suitably much scatter, the channel influence response will be well-modelled as a Gaussian process irrespective of the distribution of the individual components. If there is no prevailing component to the scatter, so that operation will have zero mean and phase evenly distributed between 0 and 2π radians. The case of the channel response will therefore be distributed. Calling this random variable R, it will have a probability density function:[1]

$$p_R(r) = \frac{2r}{\Omega} e^{-r^2/\Omega},\ r \geq 0$$

Where

$$\Omega = E(R^2) \text{……………… .(4)}$$

Often, the gain and phase elements of a channel's distortion are conveniently represented as a complex number. In this case, Rayleigh fading is presented by the assumption that the real and imaginary parts of the response are modeled by independent and identically distributed zero-mean Gaussian processes so that the amplitude of the response is the sum of two such processes

III. FRIIS MODEL

The Friis Transmission Equation is used to calculate the power received from one antenna (with gain *G1*), when transmitted from another antenna (with gain *G2*), separated by a distance *R*, and operating at frequency *f* or wavelength lambda. This page is worth reading a couple times and should be fully understood.

1) Derivation of Friis

Transmission Formula To begin the derivation of the Friis Equation, consider two antennas in free space (no obstructions nearby) separated by a distance *R*:

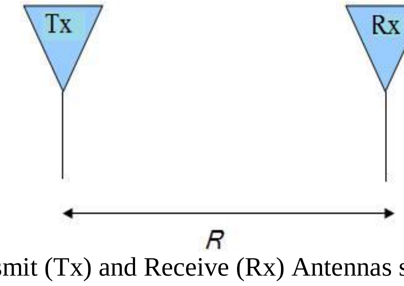

Fig Transmit (Tx) and Receive (Rx) Antennas separated by *R*.

Assume that Watts of total power are delivered to the transmit antenna. For the moment, assume that the transmit antenna is Omni directional, lossless, and that the receive antenna is in the far field of the transmit antenna. Then the power density *p* (in Watts per square meter) of the plane wave incident on the receive antenna a distance *R* from the transmit antenna is given by:

$$p = \frac{P_T}{4\pi R^2}$$ ……………………… (5)

If the transmit antenna has an antenna gain in the direction of the receive antenna given by G_T, then the power density equation above becomes:

$$p = \frac{P_T}{4\pi R^2} G_T$$ ……………………………………………………………... (6)

The gain term factors in the directionality and losses of a real antenna. Assume now that the receive antenna has an effective aperture given by A_{ER}. Then the power received by this antenna (P_R) is given by:

$$P_R = \frac{P_T}{4\pi R^2} G_T A_{ER}$$ …………………… .(7)

Since the effective aperture for any antenna can also be expressed as:

$$A_e = \frac{\lambda^2}{4\pi} G$$ ………………………………… (8)

The resulting received power can be written as:

$$P_R = \frac{P_T G_T G_R \lambda^2}{(4\pi R)^2}$$ .... (9)

This is known as the *Friis Transmission Formula*. It relates the free space path loss, antenna gains and wavelength to the received and transmitted powers. This is one of the fundamental equations in antenna theory, and should be remembered (as well as the derivation above).Another useful form of the Friis Transmission Equation is given as below. Since wavelength and frequency *f* are related by the speed of light *c*, we have the Friis Transmission Formula in terms of frequency.

$$P_R = \frac{P_T G_T G_R c^2}{(4\pi R f)^2}$$ …………….(10)

It shows that more power is lost at higher frequencies. This is a fundamental result of the Friis Transmission Equation. This means that for antennas with specified gains, the energy transfer will be highest at lower frequencies. The difference between the power received and the power transmitted is known as *path loss*. Said in a different way, Friis Transmission Equation says that the path loss is higher for higher frequencies.

LOG DISTANCE SHADOWING PROPAGATION MODEL

The log-distance path loss model is a radio propagation model that predicts the path loss, a signal confrontation inside a building or densely populated areas over distance. The model is used to predict the propagation loss for a wide range of environments. The model Log-distance path loss model is formally expressed as:

$$PL = P_{Tx_{dBm}} - P_{Rx_{dBm}} = PL_0 + 10\gamma \log_{10} \frac{d}{d_0} + X_g,$$ ……………………………………………. (11)

PL=total path loss ,units in Decibel (dB)
PTi=is the transmitted power in watt.
PRi=is the received power in dBm, where
= is the received power in watt.
PL= is the path loss at the reference distance *d*0. Unit:Decibel (dB)
d= is the length of the path.
do= is the reference distance, usually 1 km (or 1 mile).
Xg= is a normal (or Gaussian) random variable with zero mean , reflecting the attenuation (in decibel) caused by flat fading. In case of no fading, this variable is zero. In shadow fading or slow fading, only this random variable may have Gaussian distribution having standard deviation in decibel, arise in log-normal distribution of the received power in Watt. In only fast fading, caused by multipath propagation, the corresponding gain in Watts may be modeled as a random variable with Rayleigh distribution or Ricean distribution.

BIT ERROR RATE (BER)

The Bit error rate and bit error probability. The Bit Error Rate (BER) is a key parameter for measuring the quality of radio links. It is defined as the ratio of the number of error bits to the total number of transferred bits

$$BER = \frac{N_{error}}{N_{total}}$$ ………………………… (12)

Where Nerror and Ntotal are the number of error bits and the number of transferred bits, respectively. The BER provides an end-to-end measure of radio links. Unlike other parameters stated above which reflects radio link quality indirectly, the BER measures the link quality directly, i.e. the SNR, the average fade duration etc reflect the radio link quality through their impacts on the BER. Hence, the BER is the fundamental parameter for radio link quality and it has been widely used. Another relevant parameter is the Bit Error Probability (BEP). The BER can be considered as the estimate of the BEP. The larger the total number of the transferred bits is, the more accurate the estimate becomes. In radio propagation channels, the received signal power fluctuates as a function of the time, space and frequency. To quantify the impacts of fading channels on the system performance, a wireless network designer must quantify first the distribution of the received signal power or voltage envelope. Mean received signal power, SNR and SINR Among all the first-order fading statistics, the mean received signal power is may be the most common parameter since it is the most intuitive measure of the radio link quality. According to the Shannon's Theorem, the achievable channel capacity C is a function of the available bandwidth

B and the Signal-to-Noise Ratio (SNR) as follows

C = B _ log 2(1 + S/N) (3.22)………………………… (13)

Where S and N are the mean received signal power and the mean noise power, respectively. The Ratio S/N is the SNR. In AWGN channels, the SNR has an explicit relationship with the BER of radio channels. The bigger the SNR, the smaller the BER (i.e. the better the radio channels).

IV. RESULTS

The results are figured out based on the Rayleigh propagation model, Friis transmission model, Log distance shadowing propagation model .The initial parameters are set as the creation of 10 nodes is done in a topological environment. The network topology coverage area is set as: Coverage area= (2* width*height) / total no. of nodes………………………………………………….. (14)

Where the height & width is set to 100 & 100.Then, the graph between capacity of signal & distance is figured out. On that signal strength basis the spectrum frequency is figured out against the time. Then the Energy Loss of signal transmission is the final output. The Energy Loss is :-

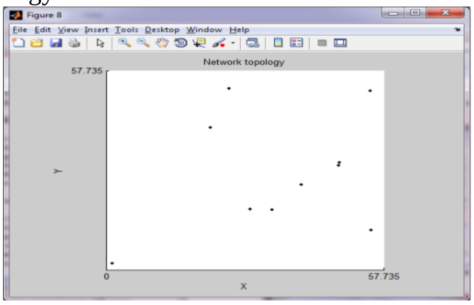

Fig-2 Creation Of 10 Nodes in Network Topology

Rayleigh Propagation Model:

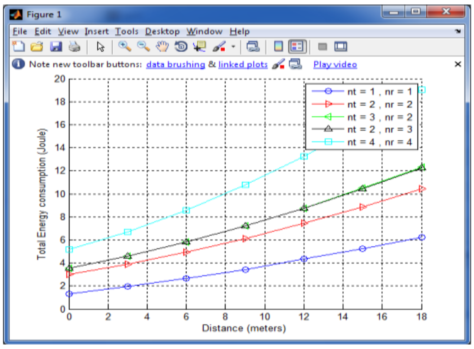

Fig-3 Graph between Energy Consumption and Distance of Rayleigh Model

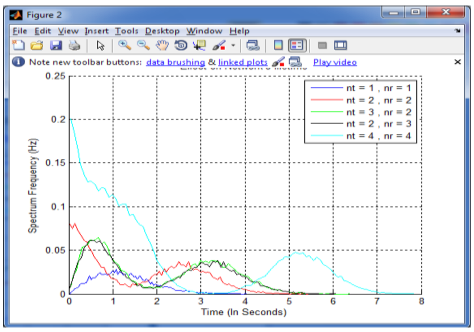

Fig-4 Graph between Spectrum Frequency and Time of Rayleigh Mode

FRIIS MODEL

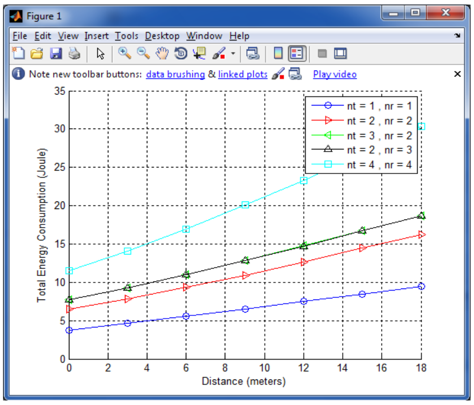

Fig -5: Graph between Total Energy Consumption and Distance of Friis Model

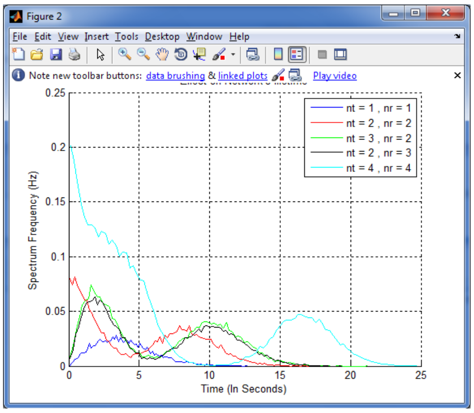

Fig-.6: Graph between Spectrum Frequency and Time of Friis Model

LOG DISTANCE SHADOWING MODEL

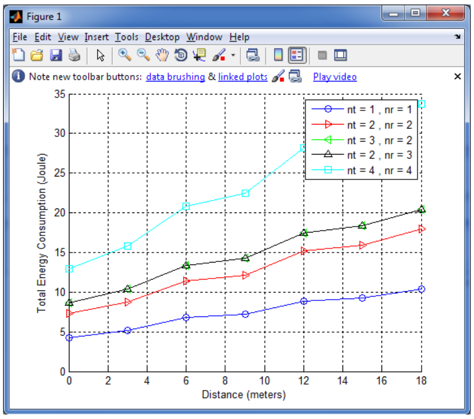

Fig -7: Graph between Total Energy Consumption and Distance of Log Distance Shadowing Model

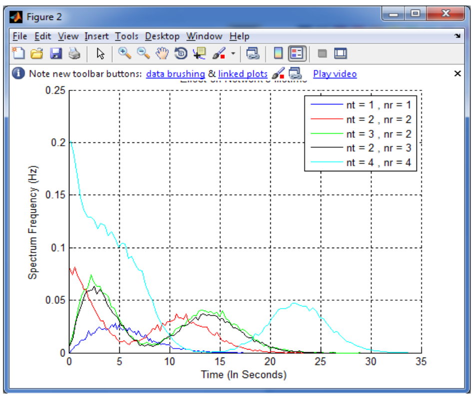

Fig 8: Graph between Spectrum Frequency and Time of Log Distance Shadowing Model

BER PERFORMANCE OF THESE MODEL

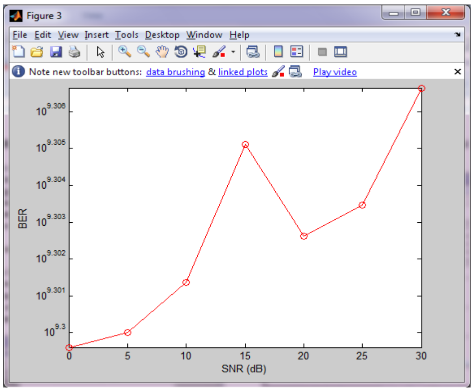

Fig 9: Ber Performance Of Rayleigh Model

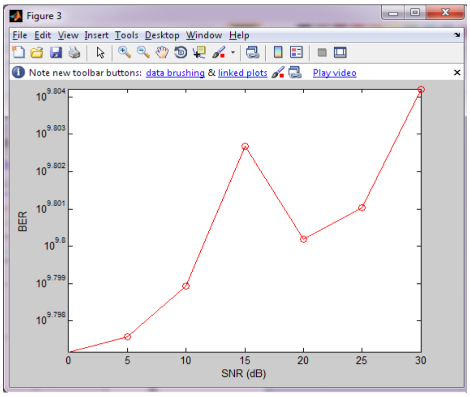

Fig 10: BER Performance Of Friis Propagation

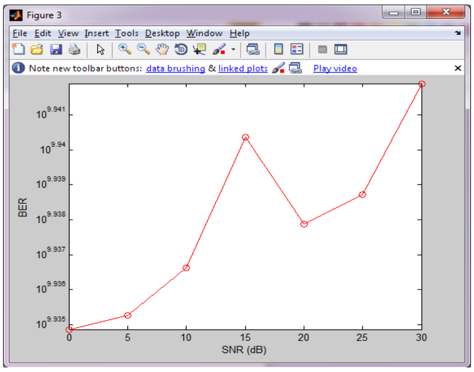

Fig 11: BER Performance Of Log Distance Propagation Model

COMPARISON:-

The output result of total energy loss in decibel for Rayleigh propagation model is $3.9978 * 10^{10}$, for Friis transmission model is $1.2572 * 10^{10}$ and for Log distance shadowing model is $1.7262 * 10^{10}$. If we compare the results then Friis propagation model i.e. free space path loss model is the best one in predicting BER performance and has less energy loss as compare to Rayleigh propagation model and Log distance shadowing propagation modeI

V. CONCLUSION AND FUTURE WORK

In this paper a brief survey of basic solving techniques behind constraint programming has been studied. The overview of the main technique for solving constraint optimization problem i.e. branch and bound algorithm has been used. There are various wireless indoor propagation models used for channel communication and to find the energy loss using constraint satisfaction algorithm. Although most of the radio propagation simulators provide only the mean power prediction, but it has been shown that on system performance fading has also an important impact. Hence fading information has been extracted on the basis of Rayleigh model, Friis model and Log distance shadowing model and then an accurate prediction of the energy loss is achieved.The prediction of the energy loss has been tackled for different constraints which are based on three different parameters: distance, density, energy. It is well known that the BER depends not only on the mean power but also on the fading severity. The Friis model is the best one in terms of signal strength and energy loss an also for the best performance of BER.The future scope of this work can be done in many ways by using different parameters, again different models for the propagation path in indoor mobile network. .

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