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RF Propagation Measurement and Modelling to SupportAdept Planning of Outdoor Wireless Local Area Networks in 2.4 GHz Band

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Abstract: -Radio Frequency (RF) propagation is the study of how radio waves broadcast over distances. One of the main problems in mobile radio communication is the loss of propagated RF signal power at the receiver due to fading. When the fading is very strong, the signal is blocked. Modeling of the signal propagation loss is an important element of the design and performance analysis of wireless communication systems.The initiative of RF propagation modeling is to devise a model that can predict the signal coverage of an access point placed at a certain location in an environment.Propagation models help network planner to estimate the signal coverage and pathloss for a given deployment plan, as well as perform automated placement of access points. This paper presents a measurement based Log-distance propagation model for effective planning of outdoorWLAN in the 2.4 GHz Band. Measurements were carried out over a distance to determine various received power levels from a fixed WLAN access pointtransmitter; these values were applied to some path loss model equations to obtain the mobile radio planning parameters such as the path loss exponent, the mean path loss intercept and AP cell range. The results obtained show that path loss exponent was 1.85 while the mean path loss intercept was mean path loss intercept 84. Hence the log model for the design of a mobile radio link in the test bed area is
PL(dB) = 84+ 1.85log (d). In general, results show that the obstructions in the environment considered here had little effect (not much) on radio signals.

Keywords: -*RF propagation modeling, Log Distance Pathloss model, WLAN radio link design*

I. INTRODUCTION

The far-reaching demand for wireless communicationtechnologies is ever increasing in all the human-life activities and this has boosted the development of Wireless Local Area Networks (WLANs).Among the WLAN standards, the IEEE 802.11 [1] is the most popular one. A Schema of the IEEE 802.11 standard is represented in figure 1. The IEEE 802.11 standard defines both the physical (PHY) and medium access control (MAC) layers of the network.The basic network building block defined by the standard is the infrastructure Basic Service Set (BSS) which is composed of a single Access Point (AP) connected to a wired backbone network providing wireless connectivity to a bunch of mobile users.Thus, Aps, normally routers, are base stations for the wireless network.

However, it is no easy task to decide on the number and locations where these APs have to be fixed in an outdoor or indoor environment so as to provide not only coverage but ensure minimum signal strength at all node points, requisite bandwidth, in the presence of obstructions, reflections and signal interference. Design of this nature is very complex and needs proper modeling and formulating the problem as an optimization problem with several constraints.

Thus, the development of efficient transmission, operation and management WLAN technologies requires a greater precision on the estimations of the system signal coverage, which is given by propagation pathloss models. This is usually done in order to obtain “total coverage” with which the operator attempts to assure the quality of service.Propagation models to help network designer estimate the signal coverage and pathloss for a given deployment plan, as well as perform automated placement of access points. For this reason a precise and flexible prediction methodologies of signal coverage with easy implementation is needed.

This paper presents Measurement-based RF propagation modellingfor efficient WLAN radio link design. Measurements were carried out over a distance to determine various received power levels from a fixed WLAN access pointtransmitter; this enables to develop a precise path loss modelfor itsefficient RF design.

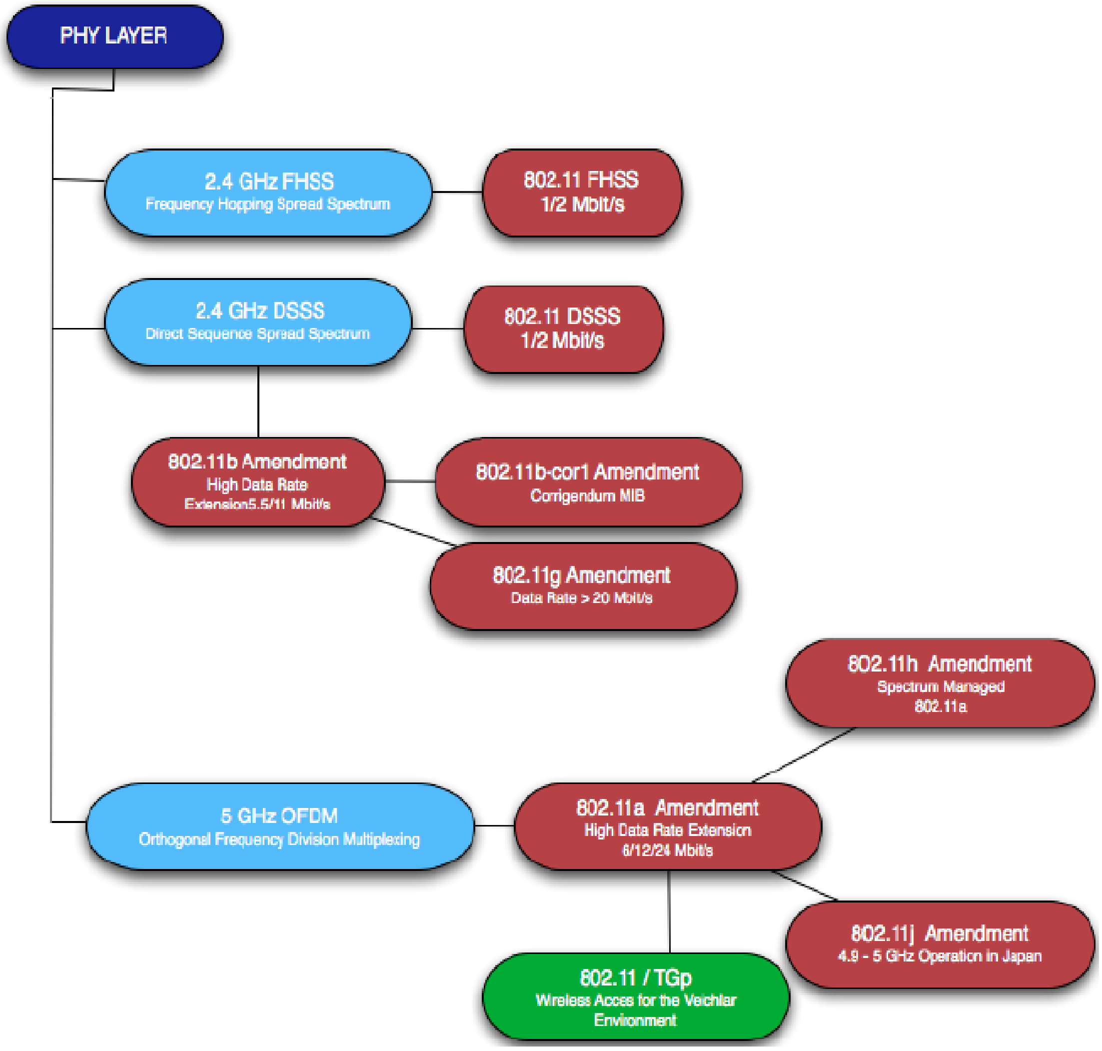

Figure 1.Schema of the IEEE 802.11 standard

II. MOTIVATION AND GOAL

Wireless communication systems are used everywhere, both in indoor and outdoor environments. In these environments, customers demand a good coverage and quality of service. Operator deployment provisionsmust classically guarantee coverage, with certain quality requirements, of a minimum percent of the geographical area and population (e.g., 90-95 % of the geographical area and population covered). Today the challenge is how to accurately predict the propagationsignal coverage and path loss at the cellular frequency of 2.4 GHz in outdoor terrain. There are several empirical propagation models which can precisely calculate up to 2 GHz. But beyond 2 GHz, there are few reliable models which can be referred for the WLAN context. So far, WLAN propagation studies are more tuned to the indoor communications; however, WLAN outdoor networks may also play a role in the wireless communications.Even more so, there had been no upkeep of path loss modeling for the 2.4 GHz frequency, which holds a dominant role in indoor wireless networks (802.11b/g/n) and will continue to be of importance as next-generation networks come into the forefront. Also, the possibility of using WLAN communications for long ranges can therefore be an important feature to add to the WLAN list of exciting potentials.

Therefore, the development of efficient transmission, operation and management of outdoor WLAN technologies and a progressive reduction in the size of the cells requires a greater precision on the estimations of the system coverage, which is given by propagation losses, in order to obtain “total coverage” with which the operator attempts to assure the quality of service. For this reason a precise and flexible prediction methodologies of coverage with easy implementation is needed.

In this paper, our goal is to devise a RF propagation pathloss model that can effectivelypredict the signal coverage of theWLAN access point deployedin the studied location and similar environment.

III. MATERIALS AND METHODS

In planning any radio system, a fundamental task is to predict the coverage of a proposed system and to determine whether the intended service objectives are met. Over the years a wide variety of approaches have been developed to predict coverage using propagation models. Propagation in this context simply means the transfer or transmission of signals from the transmitter to the receiver. Radio propagation modeling is the most complicated aspect of any wireless network planning. This is due to multi-path propagation characteristics that could vary substantially from environment to environmentwith distance as well as with time.

Explicitly, by propagation or radio-channel modelling, what is meant is that the amount of propagation pathloss obtainable within a specified environment is estimated and put forward for (future) estimation/prediction purposes, in addition to characterizing the propagation channel’s impulse response. It is an empirical mathematical formulation for the characterization of radio wave propagation as a function of frequency, distance, and other dynamic factors. In view of that, propagation models are developed with the goal of formalizing the way radio waves propagate from one place to another; such models typically predict the path loss along a link or the effective coverage area of the transmitter. A single model is usually developed to predict the behaviour of propagation for all similar links under similar constraints. An understanding of radio propagation is essential for coming up with appropriate design, deployment, and management strategies for wireless networks. In effect, it is the nature of radio channel that makes wireless networks more complicated than their counterparts wired networks. According to Rappaport [2] propagation models are not only needed for installation guidelines, but they are a key part of any analysis or design that strives to mitigate interference. A (potentially) much more accurate method of determining coverage, bandwidth and other parameters uses RF propagation modeling to analyze the RF environment, and predict the signal strength contours at all points within the environment. From the signal strength contours, the path loss, throughput, error rate, etc. can be deduced.

Several models have been developed to model the propagation characteristics of radio waves under differentscenarios. Each of these models attempt to predict signal strength at various locations for a given access point position. On the basis of scale, the models can be categorized into two - Large scale propagation model and Small scale fading model. The large scale propagation attempts to model the average signal intensity for arbitrary distances between transmitter and receiver. These models can estimate coverage area of a given transmitter, and are therefore used for coverage planning purposes. On the other hand, variations in signal strength over short distances or over short time periods are modeled by small-scale fading models. For small-scale fading models, multipath effects dominate and the distance-based attenuation is considered to be constant. In this paper, we deal mostly with large-scale propagation models as they are useful for coverage planning purposes.

3.1. BasicRF Propagation model

We begin the discussion by introducing the basic propagation model that plays role in deciding signal coverage of a given transmitter. In telecommunication, the most basic propagation model is free space model – the transmitted signal is attenuated only according to the inverse square distance RF radiation law. Free-space path loss (FSPL) is the loss in signal strength of an electromagnetic wave that would result from a line-of-sight path.The FSPL, also known as Friis propagation model [[2], calculates the average radio signal attenuation over distance, d.Friis described the physics of electromagnetic wave behavior in free space using the correlation between the power radiated by the transmitting antenna and the power received by the receiving antenna.

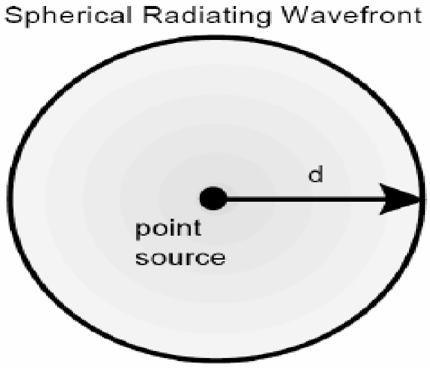

Figure 2: Free space radiating point source

Assuming that the radiating source as shown in figure 2 radiates energy at 360^{o} with a fixed power forming an ever increasing sphere, the power flux at the transmitter is,

$$P_r = A_{er}\langle w(t)\rangle \qquad (1)$$

defined as the product of average power received by the antenna's load, and the time average power density at the antenna, and is called effective area. The average power density for the far-field and effective area of the receiving antenna is defined by [3],

$$\left|\langle w(t)\rangle\right| = \frac{|E_0|^2}{2\eta} \qquad (2)$$

and

$$A_{er} = \frac{\lambda^2}{4\pi} G_r \qquad (3)$$

where G_r is the directive gain of the Hertzian dipole. Equation (3) shows that the receiving antenna's effective area is independent of its length and inversely proportional to the square of the carrier frequency. At this point one can realize that the term frequency dependent propagation loss is not the effect of wave propagation but the receiving antenna itself. The average power density in terms of radiated power, transmitter gain, G_t and the distance *r* can be written as,

$$\langle w(t)\rangle = \frac{P_{rad}\ G_1}{4\pi d^2} \qquad (4)$$

Considering the equations (2), (3) and (4) in (1) yield the following formula:

$$P_r = P_{rad}\, G_1\, G_r \left(\frac{\lambda}{4\,\pi\, d}\right)^2, \qquad (5)$$

Equation (5) is called the Friis transmission formulaand gives a relation between the power radiated by the transmitting antenna and the power received by the receiving antenna. The Pathloss for the free space in dB then can be written as follows:

$$PL(dB) = 10\log\frac{P_{rad}}{P_r} = -10\log\left[\frac{G_1\, G_r\, \lambda^2}{(4\pi)^2\, d^2}\right] \qquad (6)$$

The far-field (Fraunhofer) distance depends on the maximum linear dimension D of the transmitter antenna, R_f

$$R_f = \frac{2D^2}{\lambda} \qquad (7)$$

For the distance to be in the far-field zone it should also satisfy $R_f >> D$ and $R_f >> \lambda$.
Free space path loss is the spreading loss in signal between two isotropic antennas ($G_1 = 1, G_r = 1$), and it can be expressed as:

$$PL(dB) = -10\log\left[\frac{d^2}{(4\pi)^2\, d^2}\right] = -10\log\left(\frac{\lambda}{4\,\pi\, d}\right)^2 \qquad (8)$$

Equation (8) shows that free-space path loss is proportion to the square of the distance between the transmitter and receiver, and also proportional to the square of the wavelength of the radio signal. Substituting (λ (in km) = 0.3/f (in MHz)), the generic free space path loss formula is stated in equation (9):

$PL\ (dB) = 32.5 + 20\ \log10\ (d) + 20\ \log10\ (f)$ (9)

3.2. Log-distance Propagation model

The Log-distance model is an empirical approach for deriving radio propagation models and it is based on fitting curves or analytical expressions that recreate a set of measured data. Adopting this approach has the advantage of taking into account all the known and unknown phenomena inchannel modeling. In this model, power decreases logarithmically with distance. The average loss for a given distance is expressed using a Path Loss Exponent, n. The Log-distance propagation model is the path loss model that will be used in this research.There also exist many studies that use a variation of the Log-distance Path Loss model [4, 5]. For calculating the received power based on this model, we first calculate the received power at a reference distance using the Friis formula and then, we incorporate the effect of path loss exponent. The Log-distance Path Loss model, PL (d) is represented below:

$$PL\ (d)\ \alpha\ \left(\frac{d}{do}\right)^{-n} \qquad (11)$$

$$PL\ (d) = PL\ (d_o) + 10n\log\left(\frac{d}{do}\right) \qquad (12)$$

PL (d_o) is the free path loss in decibels which is usually determined at some specific reference distance, d_o from the transmitted signal; d is the distance between the transmitter and receiver in meters,n is a path loss exponent and it value depend on specific propagation environment. For free space n=2 and when obstruction are present n will have a larger value. The reference distance, d_o(typically 1m, 100m, or 1km depending on the environment [6])should always be in the far field of the antenna so that near field effects do not alter the reference path loss. In this study, d_0 is set to1m.

According to many studies which used the model or a variation of this model, the Log-distance Path Loss model is accurate and simple to use [4, 7]. The Log-distance Path Loss model also will work in our environment and could be used in the development of our signal strength monitoring system.

IV. EXPERIMENTAL DATA COLLECTION METHODS

Our method of data collection is based on site survey. Site survey is a method to survey Wi-Fi signal strength route by route within its coverage area [12]. It also involves measuring network performance at various locations and finding coverage and performance issues.

These experiments were carried out at the outdoor area surrounding of library buildings of our university, Benson Idahosa University (BIU), Benin City, Edo State, Nigeria. It is a story building with three 3 floors. However, the access point used for data collection was installed in the ground floor of the building.

For the field propagation measurement using site survey, an Acer laptop equipped with a wireless card, running on Microsoft windows XP platform with net surveyor software installed was used to collect Received Signal Strength Indicator (RSSI); the software has the ability to sniff any wireless LAN within the test area. In the Network Surveyor interface, the wireless adapter has the ability to scans all Wi-Fi channels of interest and then makes measurements of the RSS along the routes from the access point. Measuring tape of a longer distance calibrated in meters was used to measure the distance of received signal strength from the access point. On each of these paths, test points were manually measured at a 5m interval using the measuring tape to a 65m mark from the AP. Figure 1 shows a snap shot of net surveyor taken during data collection at library building. When taking measurement, the receiving antenna was visible to the transmitting antenna without or with very minimal obstruction. The sources of attenuations were basically from the movement of people and vehicles across the transmission path and attenuation due to the author’s body.

Care has been taken that laptop was all the time oriented towards Access Point (TP-LINK router). For the purpose of this work, the measurements of radio signal strength are limited to consider path attenuation loss and analysis. Table 1and 2 describes measurement setup parameters for transmitter-receiver and the measured RSSI data.

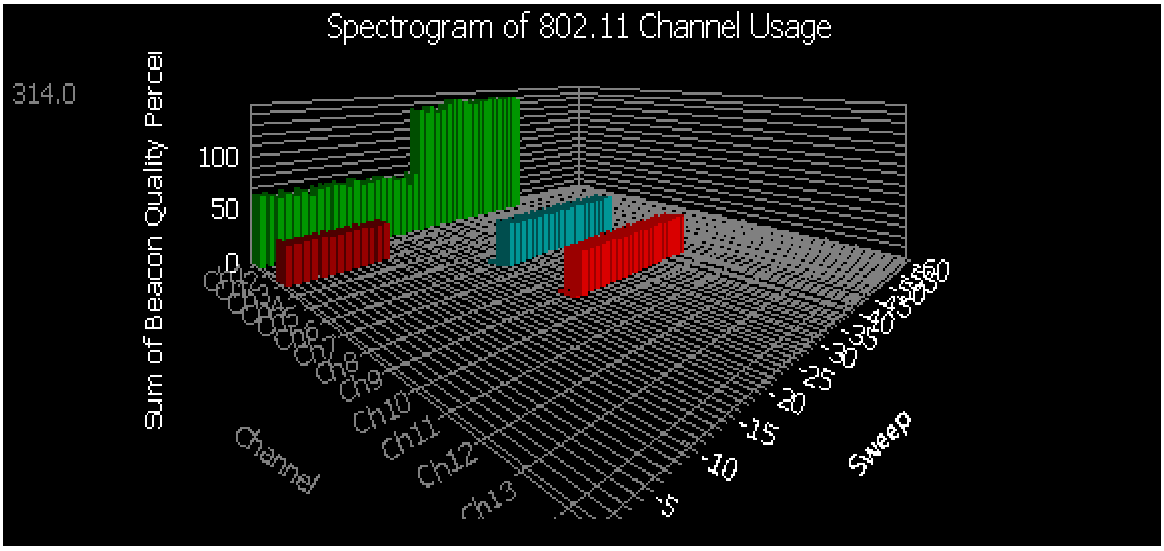

Figure 3: A spectrogram of measured RSSI data using Net surveyor

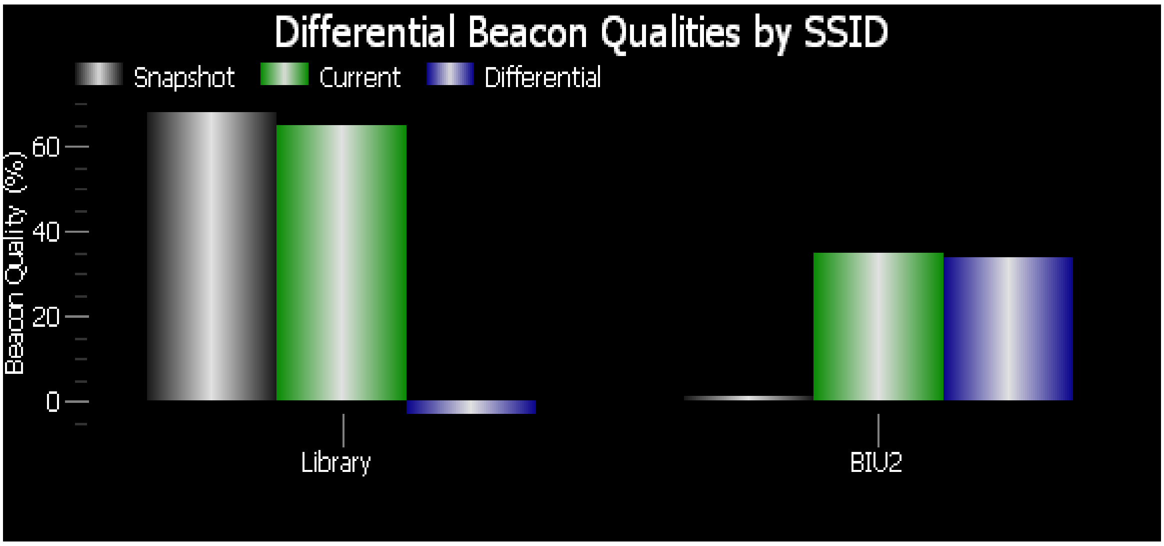

Figure 4: A snapshot of measured RSSI quality (%) using Net surveyor

RSSI is an indication of the power level being received by the antenna. Therefore, the higher the RSSI number the stronger the signal.

Table 1: T-R Measurement setup parameters

No.	Measurement setup	
	Name	Amount
1	Carrier Frequency (GHz)	2.4
2	Bandwidth (MHz)	20
3	Transmit Power (dBm)	30
4	Transmit antenna gain (dB)	6
4	Tx antenna height (m)	7
5	Rx antenna height (m)	1.5
6	Maximum data rate per stream(Mbit/s)	54
7	protocol	802.11g
8	Radio type	OFDM

V. RESULTS AND DATA ANALYSIS

Having known that the close-in reference distance (d_o), the path loss exponent(n) statistically describe the path loss model of an arbitrary location; to truly characterize propagation path loss for the environment (location), values should be establish for these parameters PL, n, and d_o,. The path loss exponent n which characterizes the propagation environment is obtained from the measured data by the method of linear regression (LR) analysis [8].

From field measurement, at close-in distance, (d_o) of 0.001 km, Lp (d_o) = 84 dB. Estimates or Predicted values of Path Loss at specified distances are calculated as follows:

At d_i = 0.001km = d_o,

Lp (d_i) = 84 + 10n log = 84

At d_o = 0.001km and r_i = 0.015km,

Lp (d_i) = 84 + 10n log = 56 + 1.8n

Subsequent evaluations were carried out in the same manner and the results are given in table 3.

Using LRanalysis the difference between the measured and predicted path loss values are minimized in a mean square sense, the sum of the squared errors is given by [8].

$$E(e) = \sum_{i=1}^{N} (PL - P\acute{L})^2 \qquad (13)$$

$$E(e) = \sum_{i=1}^{N} [(PL - PL (d_o) + 10n\log (\frac{d}{do})]^2 \qquad (14)$$

Where PL is the measured path loss and PĹ is the modeled path loss obtained using equation (2). The value of n which minimizes the mean square error e (n) is obtained by equating the derivative of equation (4) to zero and solving for n. Table 2 shows the measured path loss values while table 3 summarizes the regression analysis of measured data.

Table 2: Measurement Results

T-R separation distance, d(m)	RSS (dBm), Route 1	RSS (dBm), Route 2	RSS (dBm), Route 3	Average RSS (dBm)	PL(dB)
1	-54	-44	-45	-48	84
5	-62	-52	-61	-58	94
10	-63	-67	-70	-67	103
15	-68	-63	-75	-69	105
20	-71	-73	-83	-76	112
25	-62	-55	-81	-66	102
30	-76	-72	-80	-76	112
35	-67	-72	-81	-73	109
40	-66	-71	-83	-73	109
45	-77	-80	-86	-81	117
50	-79	-74	-82	-78	114
55	-80	-79	-88	-82	118
60	-79	-81	-89	-83	119
65	-81	-82	-100	-88	124

Table 3: Regression Analysis

Distance, r (m)	PL (dB)	PĹ	PL- PĹ	$(PL- PĹ)^2$
1	84	84	0	0
5	94	84+6.99n	10-6.99n	$100-139.8n+48.86n^2$
10	103	84+10.00n	19-10n	$361-380n+100n^2$
15	105	84+11.76n	21-11.76n	$441-246.96n+493.92n^2$
20	112	84+13.01n	28-13.01n	$784-728.56n+169.26n^2$
25	102	84+13.97n	18-13.97n	$324-502.92n+195.16n^2$
30	112	84+14.77n	28-14.77n	$784-827.12n+218.15n^2$
35	109	84+15.44n	25-15.44n	$625-722n+238.39n^2$
40	109	84+16.02n	25-16.02n	$625-801n+256.64n^2$
45	117	84+16.53n	33-16.53n	$1089-1090.98n+273.24n^2$
50	114	84+16.98n	30-16.98n	$900-1018.8n+288.32n^2$
55	118	84+17.40n	34-17.40n	$1156-1183.2n+302.76n^2$
60	119	84+17.78n	35-17.78n	$1225-1244.6n+316.13n^2$
65	124	84+18.13n	40-18.13n	$1600-1450.4n+328.70n^2$

The value of n, which minimizes the mean square error, is obtained by equating the derivative of equation (15) to zero, and when solving for n.

Therefore the value of the mean square error from the table gives:

$$E(e) = \sum_{i=1}^{N} (PL - PĹ)^2 = 10014.00-10633.30n+2873.91n^2 \qquad (15)$$

Differentiating equation (5) and equating it to zero gives the value for n.

$$\frac{dE(e)}{(dn)} = \frac{d(10014.00-10633.30n+2873.91n2\ )}{(dn)} = 0 \qquad (16)$$

n=1.82

Substituting the above calculated path loss exponent n into the model in equation (12) gives the model that describes the design parameters of a mobile link in that location. Therefore, the resultant path loss model is

$$PL(dB) = 84 + 10(1.85) \log (d) \qquad (17)$$

The model expressed in equation (17) reveals that the corresponding environment has path loss exponent almost equal to that of free space (having n = 2). In general, results show that the obstructions in the environment considered here had little effect (not much) on radio signals. This may well be as a result of the way in which the measurements have been taken; precisely, during the measurements, the transmitting and receiving antennas were, more often than not, in direct sight.

Figure 5shows the relationship between Path loss and distance; as the distance increases the signals fading (path loss) increases.

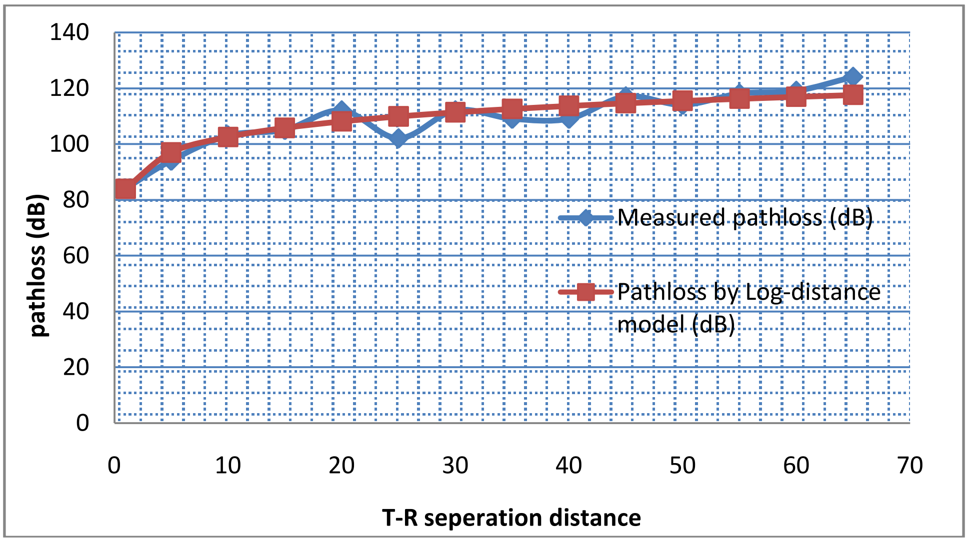

Figure 5: Log-distance model at n=1.85 and measured data.

VI. CELL RANGE AND COVERAGE AREA ESTIMATION

One critical problem in communication network design is the determination of the cell range or radius [9].As a client device moves farther away from the access point, the declining received signal power level forces thecommunication link to operate at successively lower data rates, until the signal or SNR is too low for communication at the lowest data received rate. See figure 6for illustration.

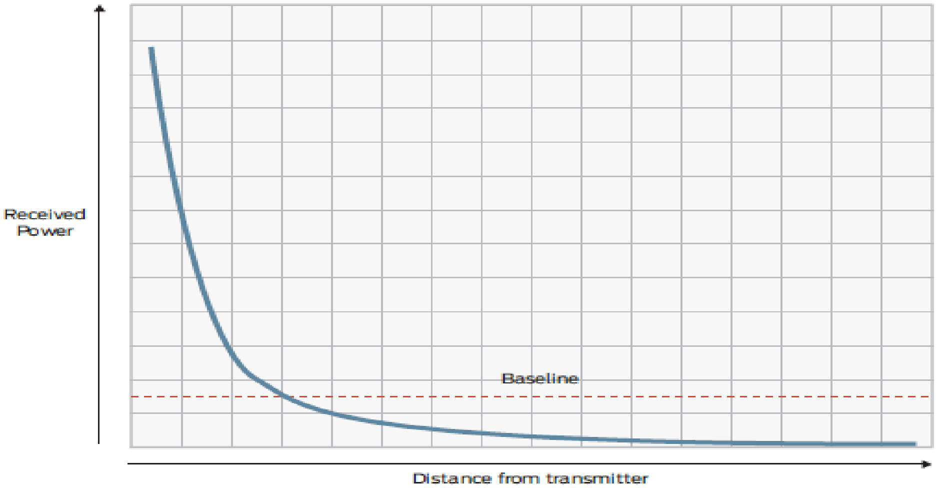

Figure 6: Signal Strength and distance

Thus, cellrange is the greatest distance from an access point (AP) at which the minimum data rate can be demodulated with an acceptable SNR or packet error rate or probability of error per bit (or bit error rate, BER); where it is assumed that there are no co-channel or adjacent-channel radiators in the vicinity. Coverage applies to moderate- size or large cellular deployments and is a measurement of the resulting cell size, or square meters per AP. Range, coverage and rate-weighted coverage are strongly influenced by transmit power, receiver sensitivity, noise and interference, as well as the physical environment. By analyzing, understanding and managing those parameters, WLAN system designers can greatly affect the overall performance of the system [10]. The underestimation of the cell radius leads to an overestimation of the number of access points (Aps) required to provide service in a specific area, and hence excessive deployment investment costs. This is obviously bad news for the business of the network operator. On the other hand, an overestimation of the cell radius results in the installation of fewer APs than needed, and then in shadow areas in also in turn create dead signal spots. This means the network operator provides bad Quality of Service (QoS) in terms of coverage, and customers will complain. This problem is more critical in wireless networks due to its susceptibility to traffic load in a given cell. When traffic increases, the cell radius decreases. Once cell range has been estimated, it can then be used to conduct optimization to obtain a cost-efficient network.

Here, similar to work by [11],the radius of a studied site or an AP determined from the pathloss model for optimal network performance by:

$r= 10^{(P_T - P_{min} - FM_\sigma - A)/B}$ (18)

where A is the intercept of the optimised path loss model in dB, B is the propagation slope, P_T is the BS total transmit power, P_{min} is the minimum required signal strength (signal threshold) at the receiver and $FM\sigma$- is the fade margin. Fade margin is the amount of amount of extra signal, above the minimum receiver threshold level added to the path loss budget to account for signal fluctuations for the purpose of ensuring that the required quality of service is maintained at the cell edge. $FM\sigma$, that ensures the desired cell edge reliability, can be work out as [11]:

$FM_\sigma=\sigma Q^{-1}(1-P_{cov})$ (19)

where σ represents the composite variation due to two primary factors: lognormal fading and measurement error;P_{cov} is the probability the signal strength measured throughout the cell will meet or exceed a desired threshold (e.g. 75%).

The value of σ determined from equation (20) by

$\sigma(dB) = \sqrt{(\sum_{i=1}^{N} (PL - P\acute{L})^2/k)}$ (20)

where n=1.82 and k=14. Therefore substituting these values in equation (18) gives

σ(dB)=3.59

For

$FM_\sigma = 75\%$ (i.e., $FM\sigma = 0.675\sigma$) $=2.43$

$FM_\sigma = 90\%$ (i.e., $FM\sigma = 1.29\sigma$) $= 4.62$

$FM_\sigma = 95\%$ (i.e., $FM\sigma = 1.64\sigma$) $= 5.74$

For 75% cell edge reliability the estimated radius is

$r= 10^{-(30- -75+2.43-84)/18.2} = 0.05km$

Similarly, the radius for 90% cell edge reliability is given by

$r= 10^{-(30- -75+4.62-84)/18.2}= 0.04km$

And 95% cell edge reliability the estimated radius is

$r= 10^{-(30- -75+5.74-84)/18.2}= 0.03km$

The coverage area of the AP is also a critical factor in link budget analysis. Coverage of a serving AP represents the region around it, which it can reliably serve. It directly determines the number of and the separation between APs that must be set up to work together to serve a larger service area or customer base.

The next step is to determine the number of access points (AP) to ensure coverage. Given the cell range, the coverage area can be calculated. Coverage area is defined as an area where all network quality requirements are met. Any location outside the coverage region or of very limited coverage and it is called dead spot or zone.

A cell site is normally dimensioned using a hexagonal shape as shown figure 7. The cell area (shaded area) is given by:

$$Area_{cell} = 2 \text{ x area of } \Delta ABC = 2x(\frac{1}{2} xpx \frac{l}{2}) = \frac{pl}{2} \quad (21)$$

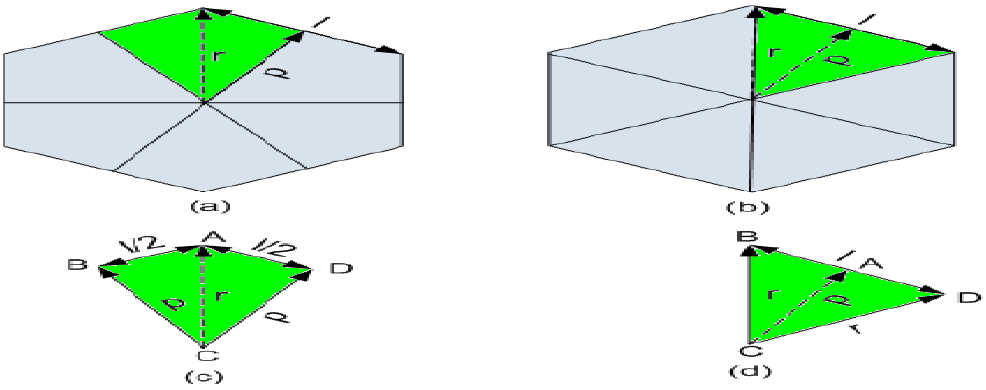

Figure 7: Cell Dimensioning

From the right angled triangle ABC,

$$p = \sqrt{r^2 - (l/2)^2} \quad (22)$$

If the hexagon is regular, i.e., the side length l and the radius r are equal, then $p = \frac{\sqrt{3}}{2} r$.

Now, looking at one of the equilateral triangles:

$$\text{Area of a triangle} = \frac{1}{2}\text{ x base x height } = \frac{1}{2}x\frac{\sqrt{3}}{2}r\text{ x } r = \frac{3\sqrt{3}}{4}r^2$$

and

$$The\ area\ of\ the\ hexagon = \frac{\sqrt{3}}{4}r^2 x6 = \frac{3\sqrt{3}}{2}r^2 x6$$

Thus the cell area,

$$Area_{cell} = \frac{3\sqrt{3}}{2}r^2 \tag{13}$$

Therefore, the number of access points required for coverage is estimated by the expression in equation (14)[13]

$$N_{AP} = \frac{C_{total}}{Area_{cell}} \tag{14}$$

Where N_{AP} is the number of access points required for coverage, C_{total} is the total cell area to be covered, and $Area_{cell}$ is the coverage of a single access point based on maximum power.The location where this research took is a medium-sized university campus and it the campus covers an area approximately 3260 square-metre(i.e C_{total}=3260 square-metre)of plane land [12].

VII. CONCLUSION

Propagation modeling is an effort to predict what happens to signals en route from the transmitter to the receiver. The accurate qualitative understanding of the radio propagation using path loss model as a function of distance from where the signal level could be predicted is essential for reliable mobile wireless system network plan.If network planning is carried out with the help of a network planning system then coverage planning, frequency planning, capacity planning, interference analysis, dominance analysis, handover analysis, etc. rely on the propagation predictions. The process of deciding AP placement can be greatly simplified with the use of propagation modeling tools. These tools use various modeling techniques to predict the signal coverage corresponding to a given placement of access point, enabling the network designer to try out various placements right on his desktop. Accordingly, the accuracy of the path loss models is of critical importance with regard to the design and implementation of wireless LAN.

This paper presents a Log Distance Model for signal path loss prediction in WLAN and the model reveals that the channel path loss exponent and the mean pathloss intercept are 1.82 and 84dB respectively. In summary, results show that the obstructions in the environment considered here had little effect (not much) on radio signals.

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