Performance comparison of IEEE802.11a Standard in Mobile Environment

Goriparthi Venkateswara Rao, K.Rushendra Babu, Sumit Kumar

Abstract- The IEEE802.11a standard uses Orthogonal Frequency Division Multiplexing (OFDM). It can provide data rate up to 54 Mbps in Wireless Local Area Networks (WLAN's). This standard is used in indoor applications as well as in vehicles i.e. mobile environments. In this paper, we evaluate Bit Error Rate (BER) by changing the number of pilots using multiple modulation schemes such as BPSK, QPSK, 16QAM, 64QAM and 256 QAM. We also analyze the BER with varying user velocity. The overall simulation has been performed using MATLAB as the simulation tool.

Keywords—WLAN, IEEE802.11a, OFDM, Mobility.

1. INTRODUCTION

Worldwide Interoperability for Microwave Access (WiMax), Wireless Local Area Network (WLAN), Universal Mobile Telecommunication system (UMTS) and Global system for Mobile (GSM) are the communication systems offer the Mobile internet access. WLAN based IEEE802.11a standard is increasing its popularity in wide range in the field of wireless communications. The IEEE802.11a standard uses OFDM. At 5GHZ band, it supports data rate up to 54 Mbps. In the practical manner it provides an achievable throughput of mid 20 Mbps. It is faster than 802.11b but expensive.

This paper analyzes IEEE802.11a standard performance under several channel model scenarios in order to achieve optimal performance. If the channel is constant less number of pilots are sent otherwise pilots are sent very frequently.

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Following is the overview of entire work. In section 2, we discussed the WLAN performance at different channel models. In section 3, we discussed OFDM. In section 4, we discuss significance of pilots. In section 5, discuss various multipath models. In section 6, we discuss simulation results.

2. BACKGROUND WORK AND LITERATURE SURVEY

In this section we discuss similar work performed by various authors. Authors in [2] proposed a technique which presents mobility characteristics to find a parameter set for mobility model, and for a parameter set to create mobility scenarios for simulations. Normally used simulation time which is 900 seconds is not enough to display the characteristics.

Authors in [3] proposed that cellular phones can access internet by using WLAN technology. Access points will be represented in network users by mobility trace. Collecting the data from college campus-wide wireless network that provides 500 access points and more than 6000 users and works on predicting the upcoming visited access point. In this real user mobility data to discover a range of predictor types to get new insights to the challenge of predicting the time of a user's next access point. No predictor feature performance is well after estimation procedure i.e., the quality of the predictors varies from one to other users and also from one access point to other. When combined with intelligent predictors, VOIP (Voice Over Internet Protocol) has improved its performance in those cases where only simple predictors are allowed or when no reservations are made at all.

Authors in [4] proposed that UMTS facilitates wide coverage area at high mobility which was carried by the use

of WLAN. For disruption less mobility, integrates the UMTS and Wireless Local Area Network. From the keen examination, mobility between UMTS and 802.11 networks is asymmetric. To obtain the advantage of high speed of 802.11 WLAN, handoff to 802.11 WLAN from UMTS, may happen when 802.11 coverage is in existence. In reverse direction mobile station may stay with the 802.11 WLAN and handover to UMTS will be occurred only when 802.11 coverage is not available.

Authors in [5] proposed a technique which provides seamless handoff and a novel system which creates a connection manager to manage the changes in the connection from time to time in an accurate manner. This system is projected in order to facilitate handoff between WLAN and WWAN in vertical manner.

Authors in [6] proposed the effect of WLAN mobility on call blocking and dropping probabilities. In order to facilitate this novel multi-region mobility model which estimates the probabilities under a resource-efficient dynamic threshold SVHO (Soft Vertical Hand-off) compared to a standard static threshold SVHO. From the results it is clear that the resource efficient SVHO has better performance in the situations where mobility of the area is low.

3. REVIEW OF OFDM:

The 802.11a uses OFDM (Orthogonal Frequency Division Multiplexing). In this splitting of higher data streams into a various lower data streams. It divides one broad frequency channel into number of component sub channels. The typical OFDM transceiver block diagram shown in Figure-1. OFDM uses IFFT (Inverse Fast Fourier Transform) at the transmitter and FFT (Fast Fourier Transform) at the receiver. Bank of demodulators and modulators relplaced by FFT and IFFT respectively. These reduces the system complexity.

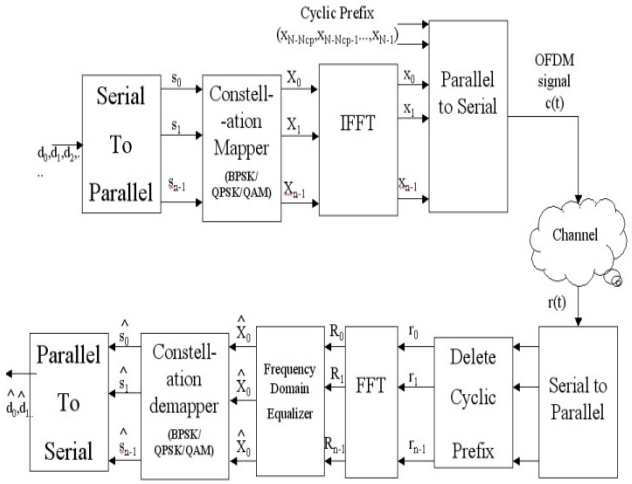

Figure 1: OFDM Transceiver block diagram (Reference)

FFT is represented by

$$X(K) = \Sigma\, x(n) e^{-j2\pi kn/N} \qquad (1)$$

IFFT is written by

$$x(n) = \Sigma\, X(K) e^{j2\pi kn/N} \qquad (2)$$

4. PILOT ASSISTED CHANNEL ESTIMATION

Pilots sequences are the unmodulated data which are transmitting along with the OFDM data. Pilots are used for channel estimation and synchronization. Channel estimation is a main functionality essential for increasing the channel capacity by decreasing Bit Error Rate. More number of pilots is used for better estimation of the channel. In OFDM the number of pilots used, depends on the characteristics of the channel for which the signal is being sent. In Figure 2, the data is shown in blue lines while the pilot is being shown in red lines. When the channel is constant, less number of pilots is sent. When the Channel is fluctuating, pilots are sent more frequent.

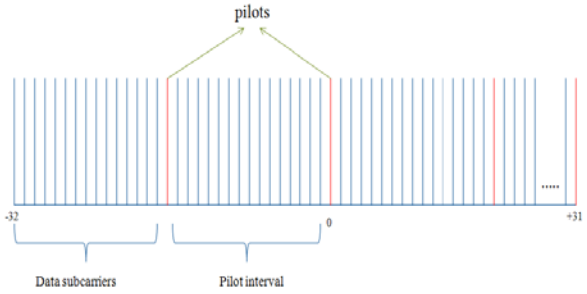

Figure 2: Representation of pilots

5. MULTIPATH CHANNEL MODELS

The BER (Bit Error Rate) increases for a given channel SNR (Signal to Noise Ratio) when multipath fading is occurred. Techniques such as equalization, data interleaving, and diversity are used to combat multipath fading. Some of the typical multipath models in use are discussed in brief below.

5.1. Rayleigh model

The Rayleigh fading channel is a specific model for stochastic fading where there is no line of sight between receiver and source. It is formed by multipath reception. To evaluate radio signal propagation on statistical bases, Rayleigh fading model can be used. It operates best under conditions when there is no dominant signal (e.g. direct line of sight signal). Radio fading model operate at its best when the absence of dominant signal. (e.g. direct line of sight signal).

5.2. AWGN channel model

AWGN (Additive White Gaussian Noise) channel is very straight forward. In order to gather the SNR requirements it adds white Gaussian noise into signal. For the approximation of the way errors that are introduced the data stream, when it is transmitted over a lossy medium, AWGN channel model is used effectively.

5.3. Rician model

One of the models used for radio propagation is the Rician Fading (RF). In this model, signal arrives at the receiver through two different paths having at least one of the paths is varying (lengthening or shortening). It happens when one of the paths is a line of sight signal that is much stronger than the other. The RF channel model is appropriate for direct propagating line of sight component in addition to the faded component that is arising from multipath propagation.

6. SIMULATION RESULTS

6.1. BER on varying number of pilots

In this paper we have concentrated on analyzing BER vs SNR with varying number of pilots with five modulation schemes such as BPSK, QPSK, 16QAM, 64QAM, 256QAM in OFDM. We also analyze the BER verses SNR with varying user velocities. OFDM uses IFFT and FFT. IFFT is used for modulate the all subcarriers. FFT is used for demodulate the all subcarriers. These reduce the complexity. In OFDM we use 64 subcarriers. So we selected the number of pilots are 2, 4, 6, 8. In Figure 3, we observed that when the number of pilots increases the BER decreases in BPSK modulation. At 15dB SNR, the BER is 0.4, 0.34, 0.25 and 0.23 with number of pilots 2, 4, 6, 8 respectively. The channel becomes more efficient if we increase the number of pilots. Figure 4 represents BER decreases with increasing pilots using QPSK modulation. At 15dB SNR, the BER is 0.65, 0.59, 0.47 and 0.44 with number of pilots 2, 4, 6, 8 respectively. Similarly varying number of pilots at different modulation schemes can be implemented to the remaining simulation results. Figure 5 represents varying number of pilots using 64QAM. In figure 6, as if the number of pilots increases BER decreases.

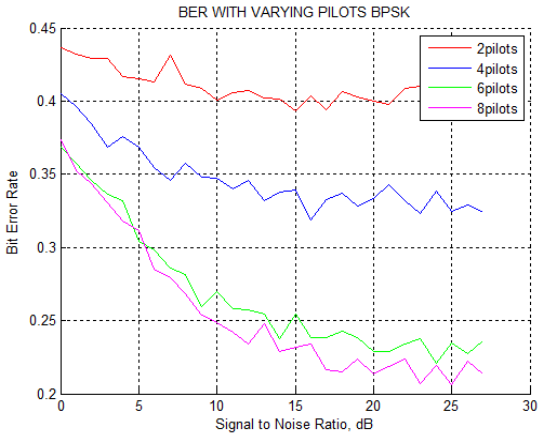

Figure 3: BER with varying pilots using BPSK

Figure 4: BER with varying pilots using QPSK

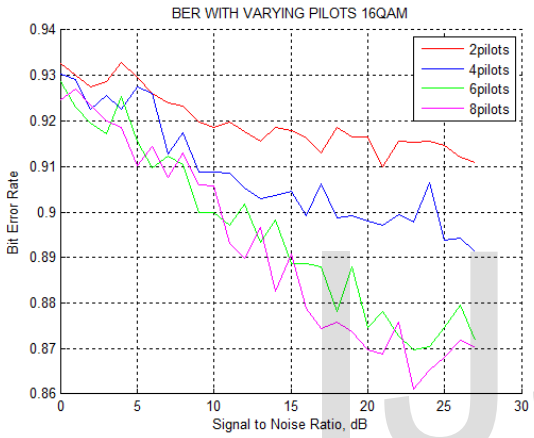

Figure 5: BER with varying pilots using 16QAM

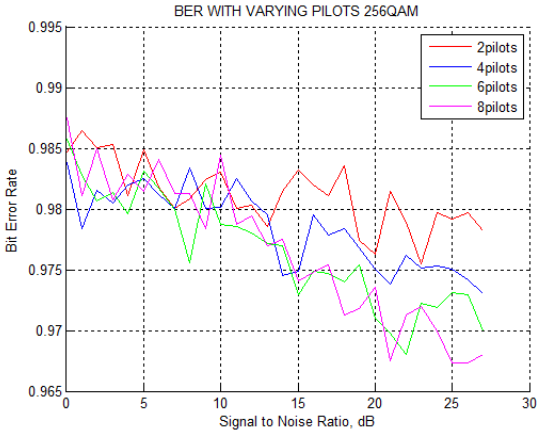

Figure 6: BER with varying pilots using 256QAM

6.2. BER with mobility

If the speed of the user increases BER also increases due to the Doppler spread. Using Rician channel. In Figure 6, we can see that at SNR 15dB, the BER is 0, 0.01, 0.025 and 0.04 with user velocities 30, 40, 50, 60 kmph respectively. If the mobile user speed increases then BER increases even more.

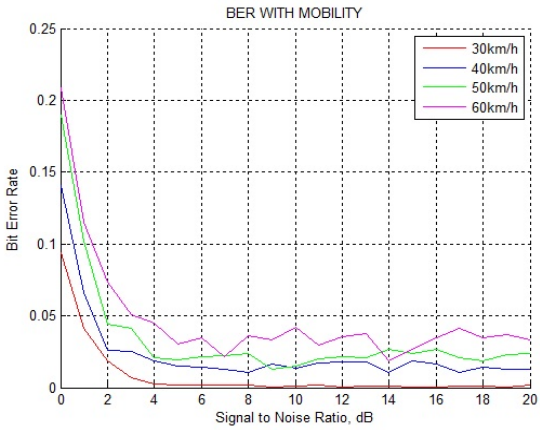

Figure 7: BER with mobility at different velocities

7. CONCLUSION

In this paper we discussed on the analysis of IEEE802.11a with multiple modulation schemes such as BPSK, QPSK, 16QAM, 64QAM, 256QAM. The Bit Error Rate is decreased with increasing the number of pilots. Depending upon the BER values we select best modulation schemes for particular channel. And also we analyzed Bit Error Rate with increasing user velocity in mobile environment at different channel models. The work will be used for analyzing the IEEE802.11a standard performance under several channel model scenarios in order to achieve optimal performance.

8. REFERENCES

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