International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Impact Factor (2012): 3.358

PER Ratio and Bit Rate in Wi-Fi Network

Safaa Elnour Ibrahim [1], Dr. Khalid Hamid Bilal [2]

[1]Department of Telecommunication - Al Neelain University-Khartoum-Sudan

[2]Department of Telecommunication-University of Science and Technology-Khartoum-Sudan

Abstract: ***The wireless connection has become a preferred technology in recent years, because of its ease of use and mobility from one place to another, there is a rapid development in wireless technologies. Wi-Fi is now the most common used wireless technology today. This paper aim to evaluate the Performance of Wi-Fi network for AWGN channel only without fading and AWGN with dispersive fading by measuring bit rate and packet error rate ratio (PER).in term of charts using IEEE 802.11a WLAN Physical Layer model to simulate these two cases using Matlab simulink software program.***

Keywords: Wi-Fi, AWGN, Performance, Dispersive Fading, PER, IEEE, Simulation.

1. Introduction

In the last years the mobility in computing and communications became more and more essential, especially for business usage. Mobility implies smaller sizes and more power considerations. It also, does not fit with fixed wired connections. The only suitable communication for mobile applications is wireless communication. The implication of mobility on computers appeared in the evolution of Notebook personal computers. On the other hand, the effect of mobility on computer networks appeared in the evolution of Wireless Computer Networks of which Wireless Local Area Networks are one kind. [1]

Currently Wi-Fi is the primary wireless communication technology which is extensively utilized in the internet services because of its excellent capability and transparency to internet protocols and created to meet the requirements of relatively high bit rate and large bandwidth, so it has become the most common used wireless technology today. [2]

Many prior studies talking about Wi-Fi network, we describe some of thesis studies. Paper [3] studied the utilization of Wi-Fi networks in a broad range of environments, the results are based on packet traces that collected from a variety of locations, as well as traces from the CRAWDAD repository, they concluded to: there is no correlation between the number of APs and the utilization, and there is little correlation between the number of clients and the utilization, finally a high loss rate is not a cause for low utilization that they have observed. Another paper discussed the performance of three diversity techniques in Wi-Fi by plotting the graph between BER and E_b/N_o values, various channel models were taken into account to simulate the real time scenario of a noisy unreliable wireless environment, the comparison BER graphs for each technique, revealing that the MIMO technique gives least BER and exhibits optimum performance [4]. M.Sc thesis [5] outlines the achieved prediction accuracy of a direct-ray, single path loss exponent adapted Seidel-Rappaport propagation model as determined through measurements and analysis of the established 2.4 GHz, 802.11g outdoor Wi-Fi network deployed on the campus of the Georgia Institute of Technology, Results show, that for the area under study, the standard deviation of the prediction error for the proposed model is below 6.8dB in all analyzed environments, and is approximately 5.5dB on average.

This paper describes the Performance of Wi-Fi network for two cases: No fading, dispersive fading with Additive White Gaussian Noise (AWGN). The paper first gives an analysis of the Wi-Fi network. Then the paper explains the simulator environment used and the model using Matlab simulation Program. The paper then shows the results in graphs and provides a comparative analysis of the two cases of fading and. lastly we conclude our paper.

2. Wi-Fi Network Analysis

Referring to Institute of Electrical and Electronic Engineers Wi-Fi stand as WLAN-IEEE 802.11. The IEEE 802.11 task group issued the first set of specifications in 1997 for Wi-Fi working at a frequency of 2.4 GHz. Wi-Fi stands for “Wireless Fidelity”. An 802.11 WLAN is based on a cellular architecture where the system is subdivided into cells, where each cell (called Basic Service Set or BSS) is controlled by a Base station (called Access Point or AP) [6].

An AP operates within a specific frequency spectrum. It informs the wireless clients of its availability and authenticates and associates wireless clients to the wireless network. It also coordinates the wireless clients’ use of wired resources. An AP supports between 60 to 200 users and the coverage area of one AP can be up to 375ft (114 m) [7].

Two WLANs connections are supported in IEEE 802.11 standard; these connections are the ad-hoc connection (peer to peer) and the infrastructure network connection (client/server). In Ad-Hoc mode connection the wireless station is connecting to each other directly without using an AP or any other connection [8].

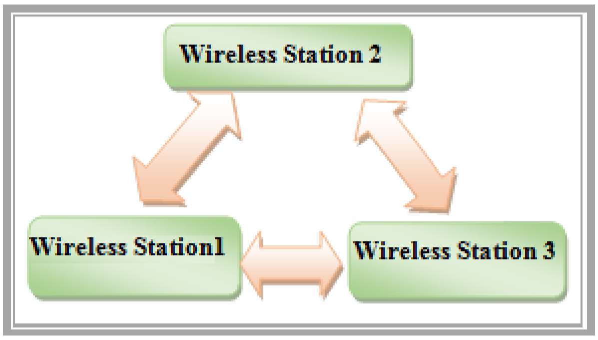

Figure 1: Ad-Hoc connection

In the infrastructure mode connection, the wireless network consists of at least one AP connected to the wired infrastructure. All the wireless stations are connected to the AP [9].

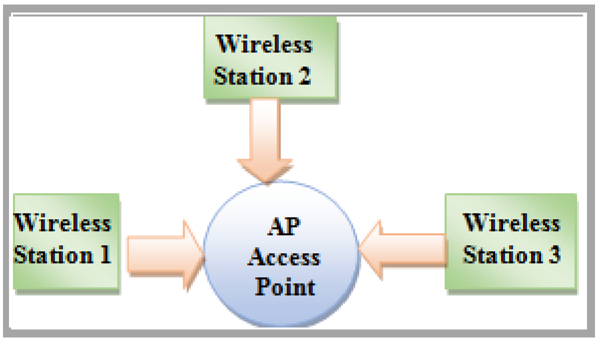

Figure 2: infrastructure connection

The Wi-Fi technology used adaptive modulation techniques, the most popular techniques are: Direct Sequence Spread Spectrum (DSSS) and Frequency Hopping Spread Spectrum (FHSS). In both techniques the spreading of the signal is performed using a pseudo-random code called Pseudo-random Noise PN [10]. The IEEE 802.11 task group comprised several task force named a, b, g, e, h, I, n to address the user needs, regarding security, speed, Quality of Service (QoS) and throughput [11]. Table 1 below shows the details of each standard:

Table 1: Standards of Wi-Fi

Wi-Fi standard	Frequency (GHz)	Modulation	Channel BW (MHz)	Data rate (Mbps)	Max range (m)
802.11 a	5.15-5.25	OFDMA	20	6-54	50
802.11b	2.4-2.485	CCk DSSS/FHSS	25	11	100
802.11g	2.4	Code keying OFDM	20	5.5-54	100
802.11n	2.4-5.5	MIMO	40	320	200

3. Simulator Environment

The parameters which effect the performance evaluation of Wi-Fi network are adjusted according to table (2) below:

Table 2: Parameters of simulation

Parameter	value
SNR	0-40 dB
Noise	AWGN
Fading	dispersive fading
Doppler Shift	100, 200, 300 Hz
Modulation	Adaptive modulation
No. of OFDM symbols per transmit block	20 symbols

4. Simulation

The descriptive analysis mathematical model to describe the performance of Wi-Fi network was implemented using Matlab simulink software program as depicted in figure 3:

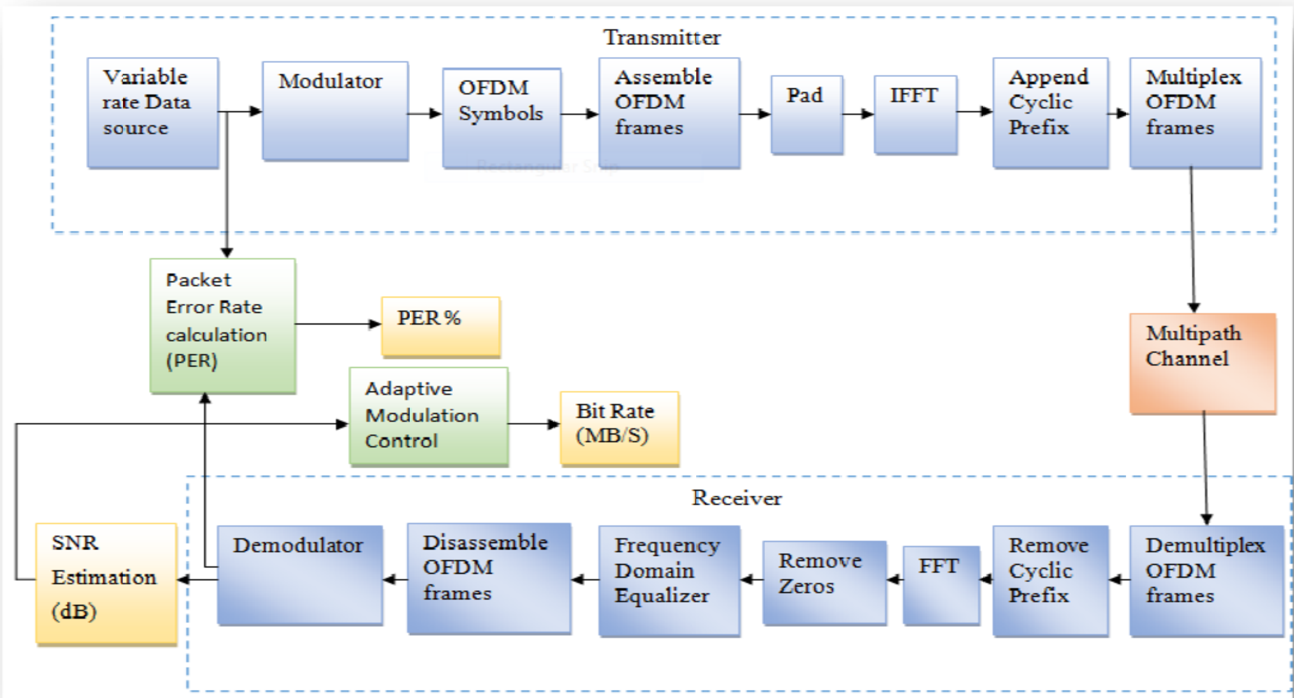

Figure 3: 802.11a WLAN Physical Layer Model

The Model represented an end-to-end baseband model of the physical layer of a wireless local area network (WLAN) according to the IEEE 802.11a standard. The model supported all mandatory and optional data rates: 6, 9, 12, 18, 24, 36, 48, and 54 Mb/s.

The model consists of three main components are: transmitter, receiver and channel. Transmitter and receiver consist of channel coding and modulation sub-components whereas channels are modeled as AWGN and dispersive fading channels.
In transmitter the variable data modulated by adaptive modulation, then interleaved in OFDM frames, converted from time domain to frequency domain using IFFT (Inverse Fast Fourier Transform),to prevent the OFDM frames from the effect of the inter symbol interference caused by channel time spread, cyclic prefix are used as a guard band [12]. Finally the OFDM frames multiplexed and transmitted through AWGN fading channel. The received signal is de-multiplexed, removed cyclic prefix and demodulated.

In this model to analyze the performance of the network we used two cases; when the network under AWGN only in the multipath channel, then when there is dispersive fading with AWGN channel. The SNR was graded from (0 to 40) dB, its equivalent values of packet error rate (PER) and bit rate were then calculated. Also the maximum Doppler shift was changed from 100 Hz to 200 Hz and last to 300 Hz. The results were taken from the simulation model and represented in graphs using Microsoft Excel.

5. Results

After the execution of simulation for different parameter we get the following results:

Figure 4, 5, 6 shows the result of PER and bit rate when the Wi-Fi network under AWGN only; Figure 4 shows the result of PER and bit rate when the maximum Doppler shift is 100 Hz. Figure 5 shows the result of PER and bit rate when the maximum Doppler shift is 200 Hz. Figure 6 shows the result of PER and bit rate when the maximum Doppler shift is 300 Hz.

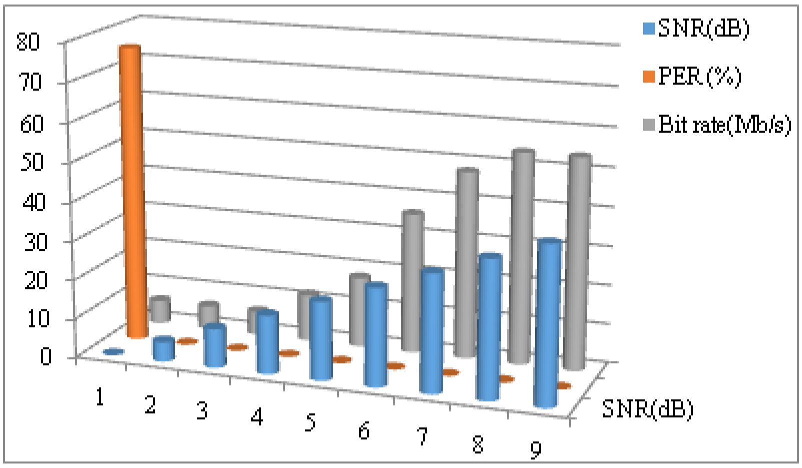

Figure 4: SNR (dB) Vs PER (%) and Bit rate (Mb/s) when max Doppler shift is 100 Hz.

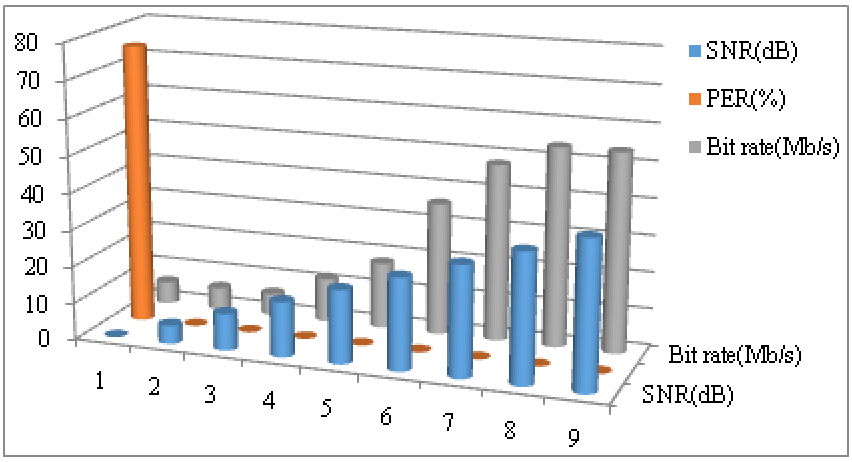

Figure 5: SNR (dB) Vs PER (%) and Bit rate (Mb/s) when max Doppler shift is 200 Hz.

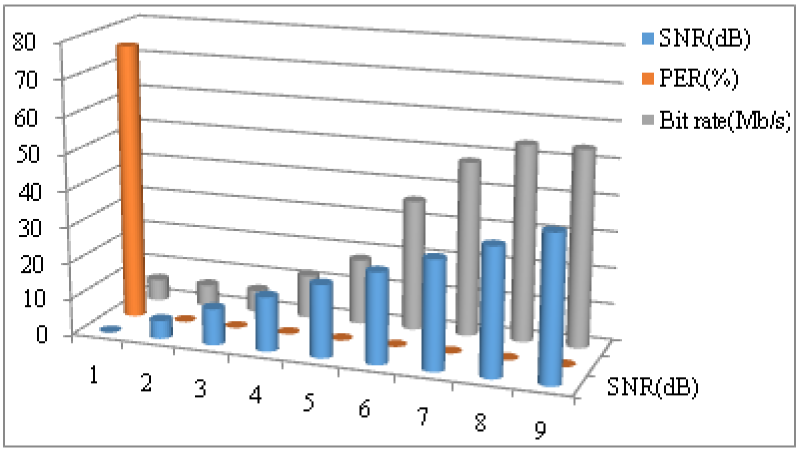

Figure 6: SNR (dB) Vs PER (%) and Bit rate (Mb/s) when max Doppler shift is 300 Hz.

The results of Wi-Fi network for dispersive fading with AWGN channel shown on figures 7, 8, 9; Figure 7 shows the result of PER and bit rate when the maximum Doppler shift is 100 Hz. Figure 8 shows the result of PER and bit rate when the maximum Doppler shift is 200 Hz. Figure 9 shows the result of PER and bit rate when the maximum Doppler shift is 300 Hz.

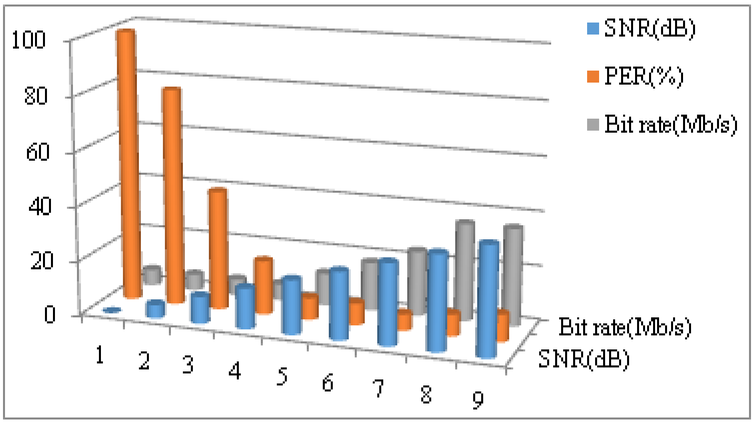

Figure 7: SNR (dB) Vs PER (%) and Bit rate (Mb/s) when max Doppler shift is 100 Hz.

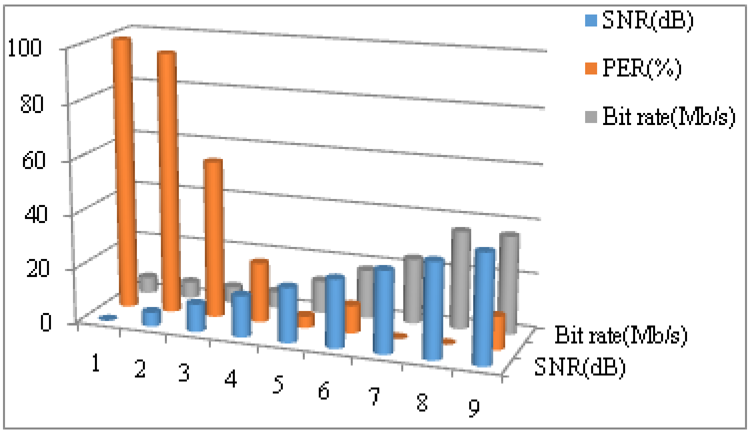

Figure 8: SNR (dB) Vs PER (%) and Bit rate (Mb/s) when max Doppler shift is 200 Hz.

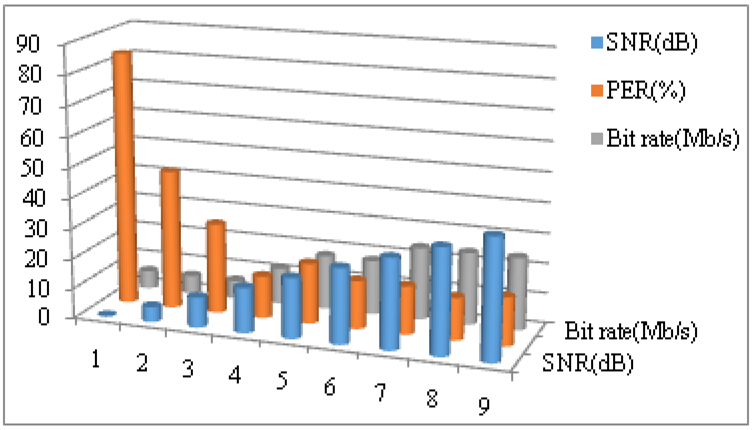

Figure 12: SNR (dB) Vs PER (%) and Bit rate (Mb/s) when max Doppler shift is 300 Hz.

6. Results Discussion

When the Wi-Fi network under AWGN only, we found that There is no PER when SNR ranges from (5 to 40) dB and the bit rate increases from (6 to 54) MB/S. Doppler shift was not effect in results, so the performance of the network in this case was perfect.

In the second case when the network under dispersive fading and AWGN,the results shows that the performance degraded,when the doppler shift was 100 Hz the PER ratio has maximum value when SNR equal zero and then minimizes when SNR increases, bit rate value maximizes with the increasing of the SNR value. The PER ratio maximizes and bit rate minimizes when Doppler shift increases from 100 Hz.

7. Conclusion

This paper discussed two cases for the Performance of Wi-Fi network: one case for Wi-Fi network under AWGN only, and other case for Wi-Fi network dispersive fading and AWGN by measuring the bit rate and packet error rate ratio (PER). We conclude that when there was no fading the Wi-Fi network have a perfect performance, PER ratio decreases to zero and bit rate increases. When there was dispersive fading; with the maximum Doppler shift less than 200 Hz the degradation of performance for Wi-Fi network was reduced, PER decreases and Bit rate increases.

References

[1] Eng. Tamer Mohamed Samir Khattab,"**Performance Analysis of Wireless Local Area Networks (WLANs)**", Faculty of engineering, Cairo University, Giza, 2000.

[2] Munir A Abbasi **"Interoperability of wireless communication technologies in hybrid networks: evaluation of end-to-end interoperability issues and quality of service requirements**", May 2011, Brunel University London.

[3] Ramya Raghavendra, Jitendra Padhye, Ratul Mahajan and Elizabeth Belding," **Wi-Fi Networks are Underutilized**", University of California, Santa Barbara, Microsoft Research.

[4] M.HEMALATHA, V.PRITHVIRAJ, S.JAYALALITHA, K.THENMOZHII, "**Diversity analysis in Wi-Fi system**", Journal of Theoretical and Applied Information Technology, 15th November 2011. Vol. 33 No.1.

[5] Lorne C. Liechty,"**Path loss measurements and model analysis of a 2.4 GHZ wireless network in an outdoor environment**", Georgia Institute of Technology, August, 2007.

[6] **"Understanding Wi-Fi"**, hp invent, January 2002.

[7] "**Wi-Fi technology**", national telecom regulatory authority, technical affairs and technology, July 2003

[8] Cathy Zhang, Ricky Chau, Wenqi Sun, **"Wi-Fi NETWORK SIMULATION OPNET",** ENSC 427 COMMUNICATION NETWORKS**,** spring 2009.

[9] Luca Sanna Randaccio, "**Resources optimization in multimedia communications"**, University of Cagliari, department of electrical and electronic engineering, 2007.

[10] V.B. Kirubanand and S. Palaniammal,"**Study of Performance Analysis in Wired and Wireless Network**", American Journal of Applied Sciences 8 (8): 826-832, 2011.

[11] Zhang, Y., Ansari, N. and sunoda, H. (2010). "**Wireless telemedicine services over integrated IEEE 802.11/WLAN and IEEE 802.16/WiMAX networks.**" Wireless Communications, IEEE 17(1): pp. 30-36.

[12] L. J. Cimini, Jr.1985: "**Analysis and simulation of a digital mobile channel using orthogonal frequency division multiplexing**", IEEE Trans. Commun., vol. COM-33, pp. 665–675.

Author Profile

Safaa Elnour Ibrahim was born in 1986 at Omdurman, Sudan. She received B.Sc (Hons.) degree in Electronic Engineering; Department of Telecommunication from Al Neelain University, Khartoum, Sudan, in 2010.She is an M.Sc student, department of data network and Telecommunication.

Dr.Khalid Hamid Bilal was born in 1968 at Khartoum, Sudan. He received M.Sc degree in telecommunication engineering from Khartoum University in 2001, and PhD from Islamic university of Omdurman. He associated professor in university of science and technology, head department of telecommunication Engineering.