A Study on the Performance of IEEE 802.16-2004 Includes STBC

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Abstract: This generation and coming generations depend entirely on wireless communication, where mobile communication is essential. The consumers want more efficiency, convenience, and user friendliness without losing performance. There has been an exponential growth for high speed broadband and more efficient and productive products are in production. The challenge is to produce more high speed, performance, mobile and nature friendly alternatives for the users. The solution for these requirements may just be WiMAX (Worldwide Interoperability for Microwave Access). WiMAX is a Broadband Wireless Access (BWA) technology that offers service to individuals and groups in sub-channels. In this experiment, our objective is to examine the performance of IEEE 802.16-2004 including the Multiple-Input Single-Output (MISO) and Space-Time Block Coding (STBC). We discovered the rate of data transmission is being increased in particular models. For example, 64 QAM ¾ is very efficient for particular ranges of bandwidths.

Introduction:

The technology has now evolved from voice calls and texts messages. Latest mobile devices such as phones, tablets, lightweight and smarter laptops have transformed how users as and businesses communicate. Internet based application and cloud computing are one of the few which have found new dimensions in this complex technology environment. This generation of communication depends on mobility and speed. Hence, the demand for new technologies should continue to develop and keep changing the way we communicate.
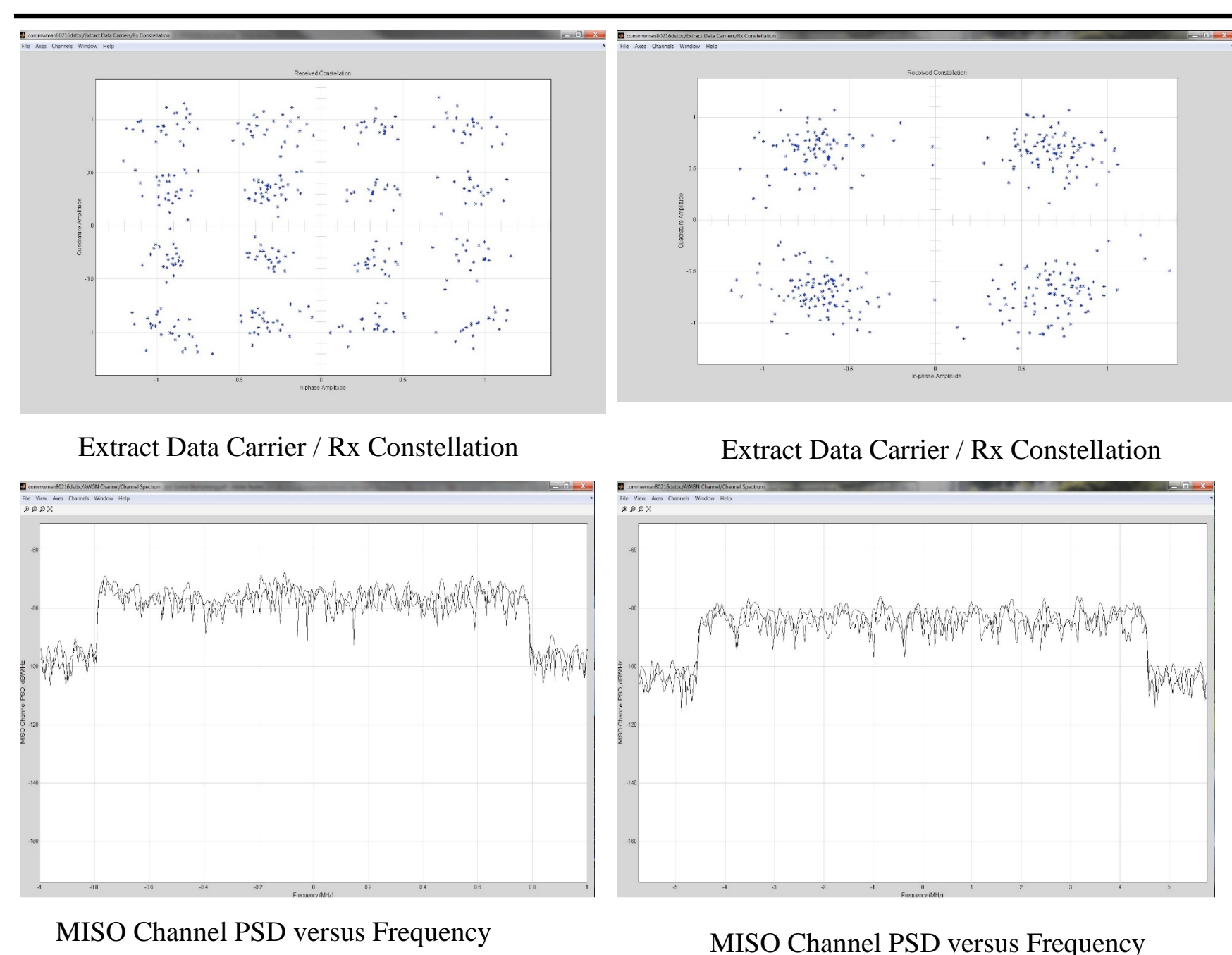
For major businesses the three principle factors are customer service, provider, and users. At present, we do have network providers to send strong signals to areas where the coverage is less. This generation consists of tech-savvy users with financial status and diverse age. However, one of the key factors is falling behind, i.e. service. Service is where the vendor fulfills the need of the user and user agrees to the terms of the vendor.

WiMAX is one of the new advancements, which is based on the IEEE 802.16 standard, which gives coverage of upto 31 miles. Also, it comes with specifications such as adapting and modifying to the environment. It can transmit high speed broadband of 70 Mbps while connecting users from end to end. WiMAX (technically known as IEEE 802.16 – 2004) was approved by the committees for fixed wireless network in June 2004. After the addition of some features such as optimizing mobile radio channels dynamically, in December 2005 by the IEEE committee, WiMAX gained approval as IEEE 802.16.

The altering features of WiMAX gives various alternatives in terms of transmission flexibility. The Physical layer (PHY) of WiMAX is a powerful management tool as it offers to transmit through Multiple routes of access and Non-Line-Sight (NLOS) environments efficiently. Adaptive Modulation and Coding (AMC) can enhance the output related to the propagation conditions with respect to modulation, where modulation is used to adjust the conditions of the Bit error rate (BER) performance which was caused by shadowing and various fading paths.

TABLE I.   TABLE LIST THE VARIOUS MODULATION AND CODING SCHEMES

AMC	Modulation	RS code	Overall Code Rate
1	BPSK	-	1/2
2	QPSK	(32, 24)	1/2
3	QPSK	(40, 36)	3/4
4	16 QAM	(64, 48)	1/2
5	16 QAM	(80, 72)	3/4
6	64 QAM	(108, 96)	2/3
7	64 QAM	(120, 108)	3/4

Extract Data Carrier / Rx Constellation

Extract Data Carrier / Rx Constellation

MISO Channel PSD versus Frequency
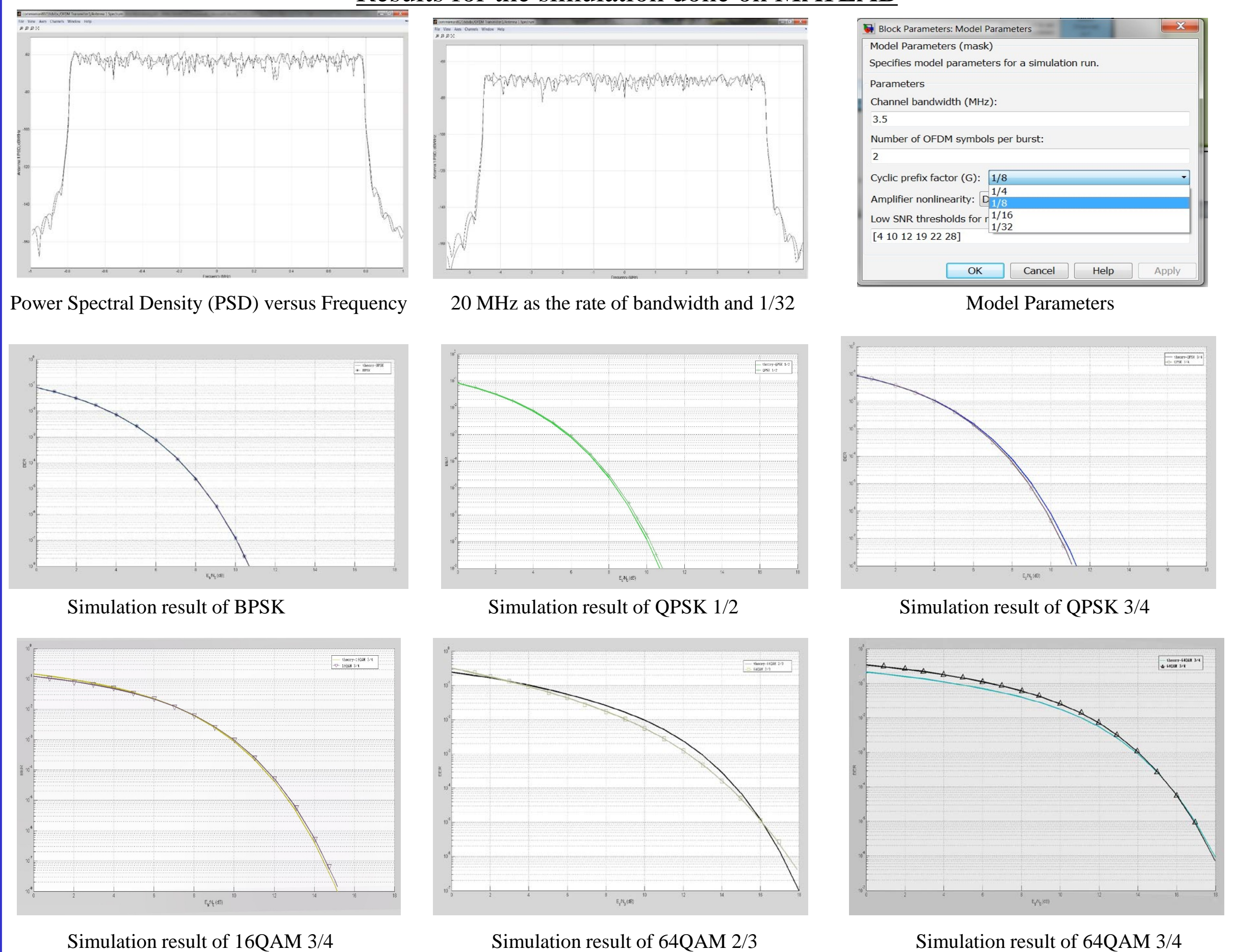

MISO Channel PSD versus Frequency

Simulation Model:

The simulations for examining WiMAX was done based on IEEE 802.16-2004 Orthogonal Frequency Division Multiplexing (OFDM) on its Physical Layer (PHY) Link, including Space-Time Block coding (STBC) which was implemented in MATLAB R2012a version (7.14.0.739) under Windows 64 bits Operating System.

The various factors (steps) which made this possible were:
• PHY layer of WiMAX
• Randomization
• Modulation and coding schemes
• Inverse Fast Fourier Transform (IFFT)
• Interleaving
• OFDM (Orthogonal Frequency Division Multiplexing)
• AWGN (Additive White Gaussian Noise) channel

Results for the simulation done on MATLAB

Power Spectral Density (PSD) versus Frequency

20 MHz as the rate of bandwidth and 1/32

Model Parameters

Simulation result of BPSK

Simulation result of QPSK 1/2

Simulation result of QPSK 3/4

Simulation result of 16QAM 3/4

Simulation result of 64QAM 2/3

Simulation result of 64QAM 3/4

Simulation Results:

The IEEE 802.16 gives accurate results for all specific inputs applied. Such inputs affect the condition of the signal, transmission speed and other numerous factors. There is no result for BER, if low values of bandwidth and a small rate of cyclic prefix factor are being used at the same time by the user. When the user sets the channel bandwidth at 20 MHz and cyclic prefix factor at (1/32), the BER gives [6.705e-06] as result.

Apart from BER, this model performs error detection, and different number of bits. The simulated figures above present the modulations used in WiMAX system. The last six figures are simulations of BER v/s SNR, where we can see the effects of error bits on the signal. These signals are fed with specific energy, which delivers more capacity to the system by use of an efficient bandwidth. Furthermore, to have strong signal strength, it is a must to use a higher value of cyclic prefix factor.

Conclusion:

We investigated the functioning of IEEE 802.16 WiMAX system by applying STBC when UL (Uplink) and DL (Downlink) are applied with a variety of bandwidths, while testing several values of Packet Error Rate. We achieved this by altering the parameters and observed how the signal conditions change and also observed the variations in the processing time.

By the examining the ranges of bandwidths and cyclic prefix factors, we achieved to have optimal performance of frequency and time. The transmission speed increased with certain models such as, the 64QAM when a user compares with multiple inputs.

With promising features, such as rate of speed, reliability, WiMAX offers its users quality of service, mobility and dependability which users demand in this technologically advanced world.

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