

Performance Analysis of MIMO-OFDM with Different Detection Techniques

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Abstract--MIMO-OFDM technology is a combination of multiple-input multiple-output (MIMO) wireless technology with orthogonal frequency division multiplexing (OFDM) that has been recognized as one of the most promising techniques to support high data rate and high performance in different channel conditions. We have focused on developing the six symbol detection algorithm of WiMAX system for the MIMO-OFDM receiver. To find best signal detection technique for WiMAX system in MIMO-OFDM environment. MIMO-OFDM system gives BER that we required for next generation wireless system i.e WiMAX and also gives high data rates that can be useful for many wireless systems.

Keywords: MIMO, OFDM, ASTBC, Channel capacity

I. INTRODUCTION

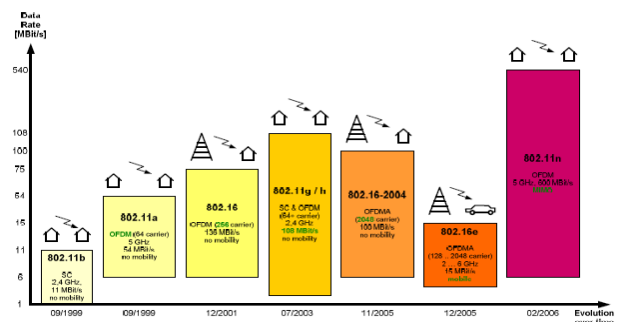
The key challenge of future wireless communication systems is to provide high data rate wireless access at high quality of service. During the last decade, many researchers have proposed multiple-input multiple-output (MIMO) wireless technology that seems to meet these demands by offering increased spectral efficiency through spatial multiplexing gain and improved link reliability due to antenna diversity gain [1, 2]. In addition, the MIMO system containing multiple antennas both at transmitter and receiver end can potentially meet the growing demand for higher capacity in wireless communications [3, 4]. The information capacity of wireless communication systems increases dramatically by using multiple transmitting and receiving antennas. Space-time coding, an effective approach for increasing data rate over wireless channels, employs coding techniques appropriate to multiple transmitting and receiving antennas. Hence, a new generalized complex orthogonal space time block code for several transmit antennas with full rate has been proposed in [5, 6]. In the 4G wireless communication systems the data rate may be as high as 1Gbps. For that, space-time coding techniques may be employed in conjunction with the multi-carrier code division multiple access (MC-CDMA) system to achieve very high data rate [7]. In this paper, We present a MIMO-OFDM system for various antenna configurations to fulfill the demand of WiMAX wireless technology.

II. WiMAX

WiMAX (Worldwide Interoperability for Microwave Access) is a wireless communications standard designed to provide 30 to 40 megabit-per-second data rates, with the 2011 update providing up to 1 Gbit/s for fixed stations. The name "WiMAX" was created by the WiMAX Forum, which was formed in June 2001 to promote conformity and interoperability of the standard. The forum describes

WiMAX as "a standards-based technology enabling the delivery of last mile wireless broadband access as an alternative to cable and DSL. The new WiMAX radio technology worldwide interoperability for microwave access is based on wireless transmission methods defined by the IEEE 802.16 standard. WiMAX has been developed to replace broadband cable network such as DSL and to enable mobile broadband wireless access.[8]

FROM 802.11b TO 802.16e



This brief introduction chapter shows the evolution of the Wireless Local Area Network (WLAN) standard 802.11 and the Wireless Metropolitan Area Network (WMAN) standard 802.16 over the last seven years.

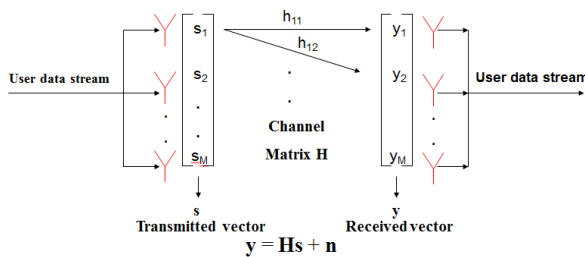
- The evolution of wireless LAN started with the introduction of the 802.11b standard in 1999. This standard used a single carrier (SC) modulation at an RF frequency of 2.4 GHz with BPSK and QPSK modulation and had a maximum transfer rate of 11 Mbit/s.
- In the same year, the 802.11a standard introduced the Orthogonal Frequency Division Multiplexing (OFDM) method to transmit up to 54 Mbit/s at a RF frequency of 5 GHz to 6 GHz by spreading the information over several OFDM carriers that can have modulation orders from BPSK

to 64 QAM.

- In 2003, “the best” of both standards (low RF frequency of 802.11b and 54 Mbit/s of 802.11a) were joined to the 802.11g standard. This standard uses the RF frequency of 2.4 GHz and supports both 802.11 modulation types (SC and OFDM) Additionally, turbo modes with up to 108 Mbit/s were introduced.
- While all former standards were used for small networks with no network operator required (small office & home office, SOHO), the first 802.16 standard which was introduced at the end of 2001 provided an operator based standard for e.g. internet

access over long distances as they occur in urban areas[8].

III. MIMO



MIMO is tends to Multiple-Input Multiple-Output. MIMO is an abbreviation for Multiple-Input Multiple-Output, which refers to the ability of equipment to handle multiple data input and multiple data output operation. One of the most important means to achieve the high data rate objectives for LTE-Advanced is multiple antenna transmission.[1,2] Wireless communication using multiple-input multiple-output (MIMO) systems enables increased spectral efficiency for a given total transmit power. Increased capacity is achieved by introducing additional spatial channels that are exploited by using space-time coding. In this article, we survey the environmental factors that affect MIMO capacity. These factors include channel complexity, external interference, and channel estimation error.

IV. SOME FEATURES OF MIMO-OFDM

Spatial multiplexing gain: the transmission of multiple data streams over more than one antenna is called spatial multiplexing [2]. The advantage of spatial multiplexing is linear capacity gains in relation to the number of transmit antennas. This gain, referred to as spatial multiplexing gain, is realized by transmitting independent data signals from the individual antennas.

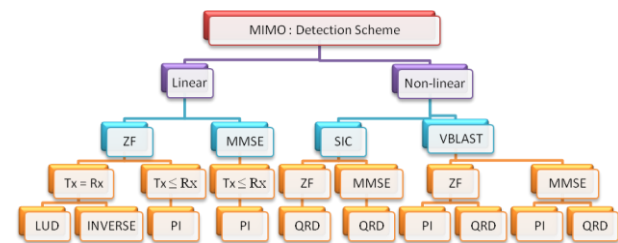
Spatial diversity gain: spatial diversity improves the signal quality and achieves a higher signal to noise ratio at the receiver side. Signal power in a wireless channel fluctuates randomly or fades. Diversity is a powerful technique to

mitigate fading in wireless links.

Among many different types of antenna diversity techniques, transmit diversity techniques have been widely adopted in practice since it is useful in reducing the processing complexity of the receiver and it requires multiple antennas only on the transmitter side.

V. CLASSIFICATION OF MIMO DETECTION TECHNIQUE

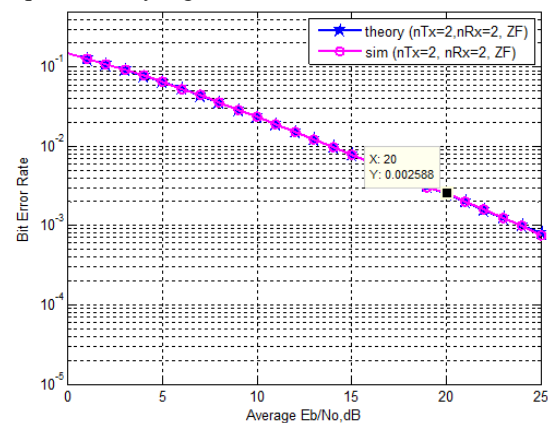
- ZF zero forcing
- MMSE minimum mean square error
- SIC successive interference cancellation
- VBLAST vertical-bell-labs layered space-time architecture
- PI pseudo inverse
- QRD QR decomposition
- LUD LU based decomposition



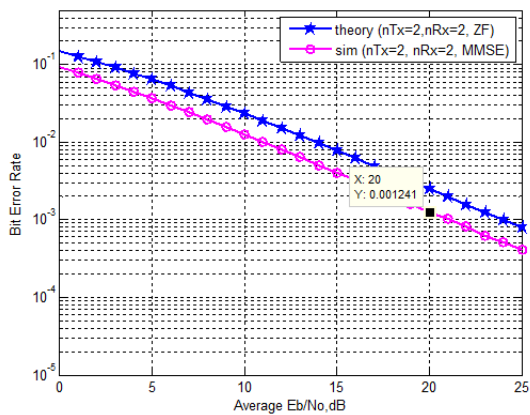
MIMO detection techniques are mainly classified in two part that is linear and non-linear technique. We are concentrating on the Non-linear based detection of MIMO using VBLAST algorithm. We are implementing new symbol detection technique based on MAP instead of using ZF or MMSE or LLSE[9].

VI. Simulation Results

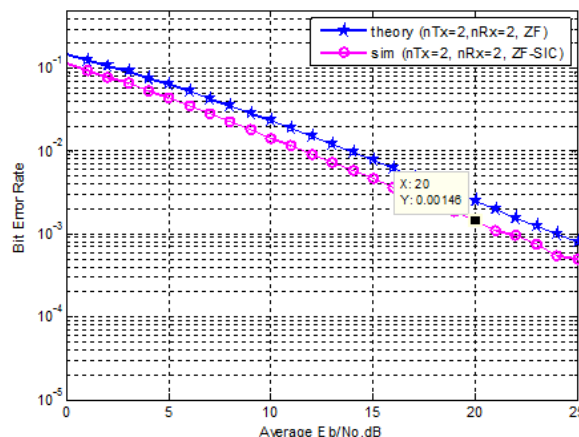
1. BER for BPSK modulation with 2x2 MIMO and ZF equalizer(Rayleigh channel)



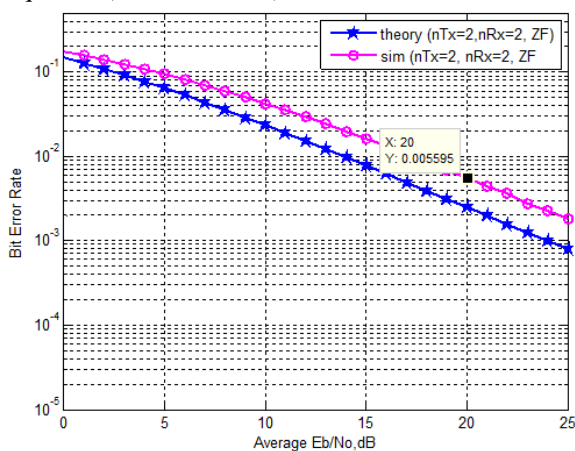
2. BER for BPSK modulation with 2x2 MIMO and MMSE equalizer(Rayleigh channel)



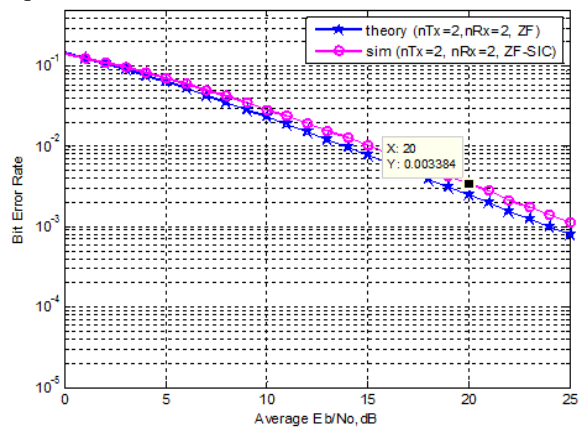
3. BER for BPSK modulation with 2x2 MIMO and ZF equalizer(Rician channel)



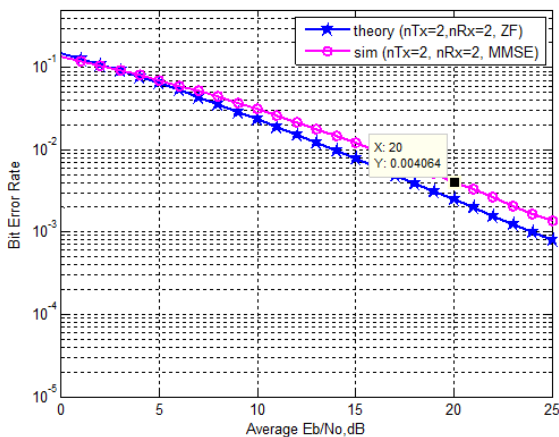
6. BER for BPSK modulation with 2x2 MIMO and ZF-SIC equalizer (Rician channel)



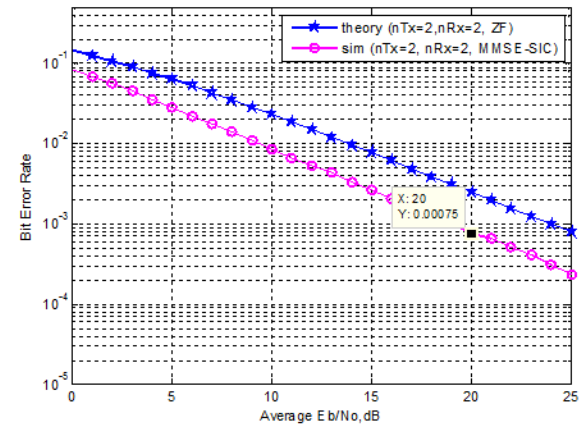
4. BER for BPSK modulation with 2x2 MIMO and MMSE equalizer(Rician channel)



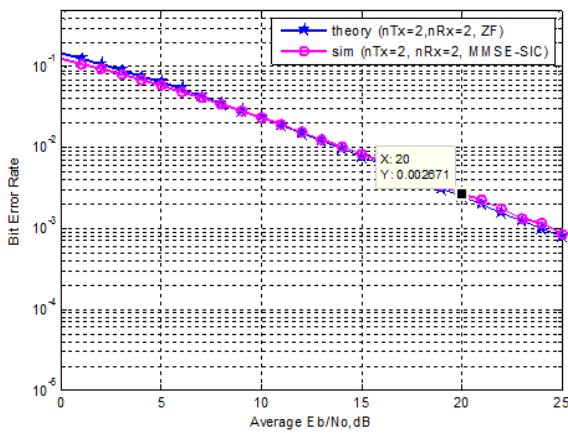
7. BER for BPSK modulation with MIMO and MMSE-SIC equalizer (Rayleigh channel)



5. BER for BPSK modulation with MIMO and ZF-SIC equalizer (Rayleigh channel)



8. BER for BPSK modulation with 2x2 MIMO & MMSE-SIC equalizer(Rician channel)



CONCLUSIONS AND FUTURE WORK

As we can see from the simulation results MMSE-SIC equalizer gives low BER for MIMO system using Rayleigh channel. And we conclude that if the number of transmitter and receiver is more, gives good error performance.

Based on these concepts we can make new algorithm that gives low BER for WiMAX system and it is very useful for next generation.

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Finally, thanks to ALLAH.

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