International Journal of Information and Computation Technology.
ISSN 0974-2239 Volume 3, Number 10 (2013), pp. 1041-1046

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A Survey Paper on Performance Improvement of WiMAX System Using Smart Antenna

N. Priyanka Ratna[1] and B.G. Hogade[2]

[1]Electronics Engineering, Mumbai University, Mumbai, Maharashtra, India.
[2]Department of Electronics Engineering, Mumbai University, Mumbai, Maharashtra, India.

Abstract

In today's world a large number of wireless transmission technologies exist. These technologies are distributed over different network families depending upon the network scale such as PAN, WLAN, WMAN and WAN. As the demand for data transmission with higher data rate changed, so as the focus on the development of wireless network is changed. Technologies that promise to deliver higher data rate are attracting more and more vendors and operators towards them. One of the most promising candidates of such arising technologies is WiMAX system. The performance improvement of WiMAX system with underlying OFDM technology and using smart antennas is proposed to study and this is demonstrated through MATLAB simulation.

Keywords: WiMAX, wireless technology, smart antenna, OFDM technology.

1. Introduction

What has been seen and observed in recent years is a remarkable increase in the Broadband Wireless Access (BWA) networks as the need for broadband and mobile services are getting into demand. BWA is increasingly acquiring a great deal of popularity as an alternative "last-mile" technology to DSL and cable modems.Think about how the internet is being accessed today. There are basically three different options: Wired network (broadband access, dial-up access), Wireless network (Wi-Fi access).

The biggest difference between the 3G and 4G is in the existence of compliant technologies. There are a bunch of technologies that fall under 3G, including WCDMA, EV-DO, and HSPA among others. Although a lot of mobile phone companies are quick to dub their technologies as 4G, such as LTE, WiMAX, and UMB, none of these are actually compliant to the specifications set forth by the 4G standard. These technologies are often referred to as Pre-4G or 3.9G. Current 3G speeds are topped out at 14Mbps downlink and 5.8Mbps uplink. To be able to qualify as a 4G technology, speeds of up to 100Mbps must be reached for a moving user and 1Gbps for a stationary user. So far, these speeds are only reachable with wired LANs.

WiMAX system is actually coming into being right now. WiMAX is short for Worldwide Interoperability for Microwave Access, and it also known by its IEEE standard 802.16. WiMAX has the potential to provide broadband Internet access what cell phones have done to land-line phone access. WiMAX will also be as painless as Wi-Fi, turning your computer on will automatically connect you to the closest available WiMAX antenna.There are basically three limiting factors for transmitting high data rate over the wireless medium that mainly include: Multipath fading, Delay spread and Co-channel interference.

2. Literature Survey

2.1. IEEE 802.16 standard:

The IEEE 802.16 standard, commonly known as WiMAX, is the latest technology that has promised to offer broadband wireless access over long distance. Since 2001 WiMAX has evolved from 802.16 to 802.16d for fixed wireless access, and to the new IEEE 802.16e standard with mobility support.

Table 1: Features of Fixed & Mobile WiMAX.

Feature	Fixed WiMAX	Mobile WiMAX
IEEE Standard	802.16d	802.16e
Multiplexing	OFDM	SOFDMA
FTT Size	256	512,1024
Duplexing Mode	TDD, FDD, HFDD	TDD
Modulation	BPSK, QPSK, 16-QAM, 64-QAM	QPSK, 16-QAM, 64-QAM (optional)
Channel Bandwidth	1.75,3,3.5,7,5.5, 10 MHz	5,7,8.75,10 MHz
Frequency Bands	2 -11 GHz	3.3-3.4 GHz
Hand Offs	None	Hard as well as Soft

2.2. Important performance metrics:
First, we must define what we mean by "performance." Performance includes many factors. Two of the most visible metrics, from a user's point of view, are download speed in megabits per second (Mbps) and upload speed in Mbps. Download speed has traditionally been the metric that most users care about because it affects the user's Web-browsing experience, but the emergence of peer-to-peer networking and the growing need to upload user-generated content such as videos and pictures is creating the need for faster upload speeds.

2.3. Factors affecting performance:
Next, we must draw a distinction between peak performance and average performance. Peak performance is the best possible performance that the technology can achieve under ideal conditions. The peak performance makes for a great headline, but users will never experience this lofty performance level. Rather, average performance is what users will typically experience with a deployed mobile service. Average performance can vary throughout a coverage area and is affected by many factors, such as: Channel bandwidth, backhaul capacity, MIMO, path loss, shadowing, network load, mobility speed.

3. Problem Definition

The main problems with broadband access are that it is pretty expensive and it doesn't reach all areas. The main problem with Wi-Fi access is that hot spots are very small so coverage is sparse.This new technology would provide:

- The high speed of broadband service
- Wireless rather than wired access, so it would be a lot less expensive than cable or DSL and much easier to extend to suburban and rural areas
- Broad coverage like the cell phone network instead of small Wi-Fi hotspots.
- Multipath.
- 802.11a has data rates range from 25 mbps to 54 mbps. Indoor range is 100 feet. Operating frequency is 5 GHz.
- 802.11b has data rate range from 6.5 mbps to 11 mbps. Indoor range is 100 feet. Operating frequency is 2.4 GHz.
- 802.11g has data rate range from 25 mbps to 54 mbps. Indoor range is 100 feet. Operating frequency is 2.4 GHz.

Table 2: Technical differences between WiMAX and Wi-Fi.

	802.16 REVd/WiMAX	802.11/Wi-Fi	Technical Difference
Range	Up to 30 miles-typically cell size of 4-6 miles	Sub=300 feet(add access points for greater coverage)	802.16 tolerate greater multi-path, delay spread via implementation of 256 FFT vs. 64 FFT for 802.11.
Coverage	Outdoor NLOS-performance standard support for advanced antenna techniques	Optimized for indoor performance, short range	802.16 systems have an overall higher system gain, delivering greater penetration through obstacles at longer distances.
Scalability	Designed to support hundreds of CPE's with unlimited subscribers behind each CPE	Intended for LAN applications, users scale from one to tens with one subscriber for each CPE device.	802.16 can use all available frequencies, multiple channels, support cellular development. 802.11 is limited to license exempt spectrum.
Bit rate	5 bps/Hz peak up to 100 Mbps in 20 MHz channel	2.7 bps/Hz peak up to 54 Mbps in 20 MHz channel	Higher modulations coupled with flexible error correction results in more efficient use of spectrum.
QoS	QoS built into MAC-voice/video service levels	No QoS support	802.11 is contention based MAC (CSMA/CA) basically wireless Ethernet. 802.16: Dynamic TDMA-based MAC with on-demand bandwidth allocation.

4. Methodology

4.1. Transmitter Module:

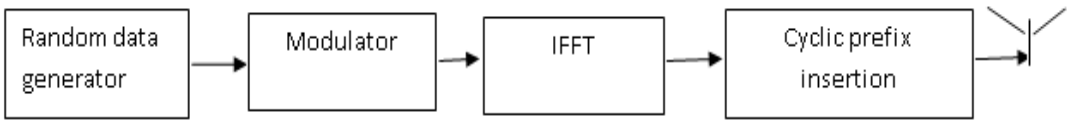

Fig. 1: Transmitter Module.

4.2. Receiver Module:

Fig. 2: Receiver Module.

4.3 Implementation Platform

The project mentioned above will be implemented using MAT LAB , Flowchart for simulation of the system is as follows:

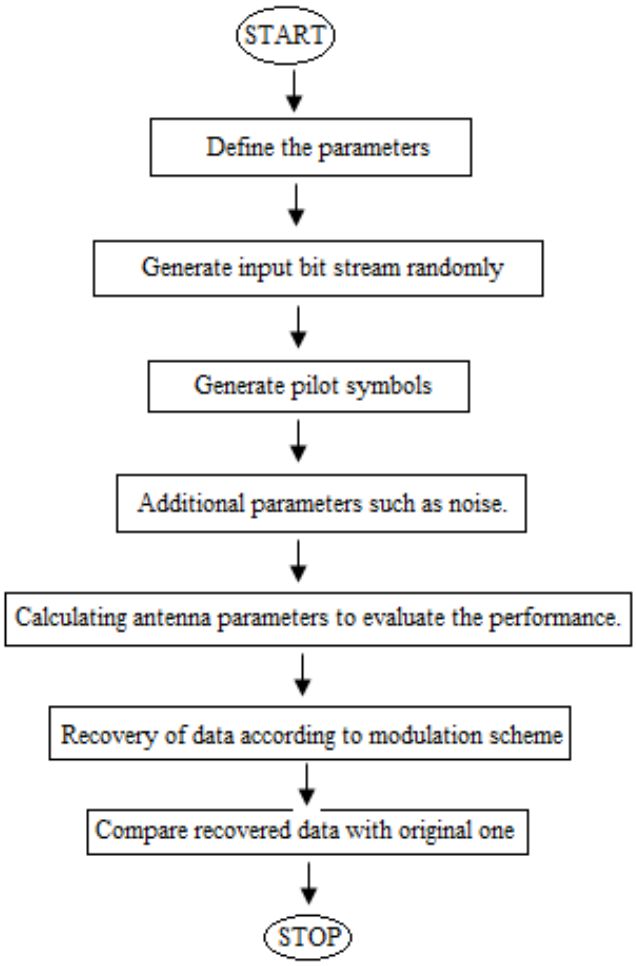

Fig. 3: Flow chart for simulation.

5. Conclusion

The fading is one of the major limiting factors in wireless communications. So the problem is multipath fading in WiMAX. The channel which is having fading components will corrupt the data sequence while transmitting. The required signal is corrupted by the previous multipath.To reduce the effect caused by fading, smart antenna is implemented at the receiver module by using algorithm and beam forming .Finally using smart antennas using at the receiver then performance of the system drastically increases.

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