1. INTRODUCTION TO RESEARCH WORK

This research work is presented for the topic “MODELING, SIMULATION AND COMPARATIVE ANALYSIS OF WIMAX SYSTEM USING MIMO-OFDM AND ALAMOUTI CODING SCHEME”, to Faculty of Engineering and Technology, J.J.T. University, Rajasthan.

1.1 Motivation

Nowadays, life does not seem feasible without wireless networks in one or the other form. Wireless is becoming the leader in communication choices among users. In the current era life is converging towards the cable less environment where the last mile connectivity can be easily achievable without the need of physical connections. So the field of wireless communication is continuously emerging one which is the demand for the transfer of data with high speed and with long coverage range. The claim for broadband mobile services continues to grow. Usually, high-speed broadband solutions are based on wired-access technologies such as digital subscriber line (DSL). This type of solution is not easy to deploy in remote rural areas, and furthermore it lacks support for terminal mobility. [1]

Also the gradual development in the use of wireless networks has led to the requirement for the design of new modern communication networks with higher capacity and lower error rate. The telecommunication industry is also upgrading, with a requirement for a greater range of services, such as video conferences, or applications with multimedia contents. The increased dependence on computer networking and the internetwork has resulted in a larger demand for connections to be allotted any time, any place, leading to a increase in the requirements for greater capacity and ultimate reliable broadband wireless communication systems.

For this issue, new technologies with high throughput with less requirement of bandwidth have been designed. As a matter of fact the requirements on bandwidth and spectrum availability are endless. As a result, the designers working in the domain of wireless communication has to face the lots of difficulties to fulfill the requirement of bandwidth for the efficient and accurate transmission and reception. Moreover the problems of time varying nature of channel such as fading and multipath put the limitation on the performance of high data rate with good quality of service. The demands for greater
capacity, high reliability as well as accuracy are the prime requisites for the forth coming
generations of the wireless networking systems such as Wi-Fi, WiMAX, etc.

1.2 Problem Definitions
There are two fundamental phenomenon of wireless communication that makes the
problem challenging and interesting. First is the phenomenon of fading: the variations in
the signal strength, frequency and time delay i.e. phase as well as time-variation of the
channel strengths due to the small-scale effect of multi path fading, as well as larger scale
effects such as path loss via distance attenuation, shadowing, refraction or reflections by
obstacles. [2]
Second, unlike in the wired communication in which each transmitter-receiver pair can
often be identified as an isolated point-to-point link, wireless users communicate over the
air spectrum and there is significant interference between them in wireless
communication. The interference can be between transmitters communicating with single
receiver (e.g. uplink of a cellular system), between signals from a single transmitter to
multiple receivers (e.g. downlink of a cellular system), or between different transmitter-
receiver pairs (e.g. interference between users in different cells).
WiMAX (Worldwide Interoperability for Microwave Access) is considered today the
most interesting invention, capable to provide radio coverage range of almost 50
kilometers and data throughput or data rate up to 70 Mbps, and to fill the gap with wired
network architectures, anticipating an accurate and economic solution for the last point.
WiMAX has the potential to cope up with all forms of telecommunication services. Also
the most recent terminology of WiMAX i.e. mobile WiMAX can replace the traditional
cellular networks in the nearer future. In this way, the WiMAX may be seen as the fourth
generation (4G) of mobile communications systems.
Now is the time when the potential of WiMAX to develop an entirely new generation of
applications is at its prime [3]. In the present scenario of WiMAX system, the maximum
research work is done in Single Input Single Output WiMAX system physical layer
model and maximum data throughput received accordingly. However in present scenario,
during the phase of real time voice or image transmission through WiMAX system, the
available Bit Error Rate and Signal to Noise Ratio and hence Capacity of the Systems are serious limitations for real time implementation.

So in 4G transmission system, link reliability and maximum data throughput is the need for transmitting voice as well as image at high speed. Implementation of antenna diversity techniques along with OFDM technique is one of the promising solutions for this. But very few resources are available in which the modeling and critical comparative analysis of WiMAX system with antenna diversity such as Single Input Single Output, Single Input Multiple Output, Multiple Input Single Output and Multiple Input Multiple Output along with Alamouti coding has been done. Very few results for simulating and modeling of WiMAX system are available for real time data transmission (such as image and speech) to achieve the lower Bit Error Rates, higher Signal to Noise Ratio and higher system Capacity.

1.3 Contribution of this research work to the Problem Definitions

How to deal with fading and with interference is central aim to the design of wireless communication systems, and by taking the advantage of multi-path fading and improving the system capacity and bit rate of 4G modern wireless system will be the fundamental objective of this research work.

The first phase of this research work deals with the simulation and performance analysis of various Diversity techniques. With the transmit diversity, the space time coding i.e. alamouti coding would be implemented so as to increase the capacity of the system with low bit error rates. Also comparative analysis of single antenna system and multiple antennas system will be carried out for the successful modelling, simulation and performance analysis of WiMAX system.

Another aspect of this research work deals with the analysis of the most recent wireless networking technique; WiMAX along with its physical layer functioning which is based on the Orthogonal Frequency Division Multiplexing technique. Despite being a nearly 50-year-old concept, it is only in the last decade that OFDM becomes the modem of choice in wireless applications. One of the biggest advantages of an OFDM modem is the ability to convert dispersive broadband channels into parallel narrowband sub channels, thus significantly simplifying equalization at the receiver end [4]. The basic OFDM
technique along with advanced antenna structure i.e. MIMO principle is used to increase the system capacity by reducing the effects of ISI. First of all, the simulation and performance analysis of OFDM technique will be carried out for the physical layer functioning of WiMAX system. Then after the modeling of physical layer i.e. single antenna WiMAX system will be carried out and simulation results will be displayed mainly in terms of Input data, coding techniques as per IEEE 802.16 standards [5], digital modulation techniques, OFDM technique, channel SNR and Bit Error Rate.

To improve the bit error rate and the capacity of the WiMAX system, in the final phase the various antenna diversity techniques are to be implemented in the WiMAX model with the alamouti coding scheme. The performance of the WiMAX model would be evaluated by means of transfer of real time image and speech signals. Figure 1 shows the area of research in brief.