2. LITERATURE REVIEW

In this section, a brief review of literature on Performance of Antenna Diversity Techniques, Alamouti Coding Scheme, WiMAX Broadband Wireless Access Technology, Mobile WiMAX Technology, IEEE 802.16 Standards, Efficient Wireless Channels and Orthogonal Frequency Division Multiplexing Technique are reported and discussed.

- Technical paper on “WiMAX Broadband Wireless Access Technology: Services, Architecture and Deployment Models” describes the overview of the forthcoming most promising wireless system WiMAX-Worldwide Interoperability for Microwave Access. In this research paper the basic WiMAX introduction, comparison with the existing wireless systems, types of IEEE standards as well as layered structure has been included. This paper presented a brief description of some of the major functions of a WiMAX network architecture currently being designed and specified in the network group. This paper is useful to analyze the basic architecture and supporting features of WiMAX for this research work. [6]

- The research paper on Mobile WiMAX: Performance Analysis and Comparison with Experimental Results describes the current demand of wireless communication system is to achieve highest capacity with lowest requirement of bandwidth and improved error rate. The mobile WiMAX is the wonderful invention which is fulfilling the latest demand. This research paper presents the theoretical aspect of the mobile WiMAX system whose remarkable features are scalable OFDM and Advanced antenna techniques such as MIMO. Each and every parameter which are required to build and to model the WiMAX system such as channel coding, sampling frequency, sampling period, symbol duration of OFDM, modulation scheme, etc. have been discussed in this paper which are the useful matters to develop a simulation model of this research work. [7]

- The research paper on “The competition and Cooperation of WiMAX, WLAN and 3G” analyses both the competitive and cooperative relationships between WiMAX, WLAN and 3G from various aspects such as technical standards, current status and future trends, etc. WiMAX and WLAN are two most emerging IEEE standards for
providing efficient wireless networking whereas 3G is the most important mobile communication standard for providing highest speed along with maximum accuracy. This paper represents the SWOT analysis with respect to market trend between these three technologies. This paper will be helpful to understand the role of one technique to cope up with other technologies. [8]

- The research paper on “WiMAX: A Key to Bridging the Digital Divide” identifies the cost effective, flexible 4th generation standard of IEEE i.e. WiMAX system which is becoming the perfect solution to meet the current demands of the future wireless networks thereby providing the tough competition to the existing 3G standards. This paper includes the modeling of WiMAX layer by considering its physical layer as well as various parameters related to it which is the main utilization in this research work. The two variants of WiMAX system i.e. fixed WiMAX (IEEE 802.16d) and mobile WiMAX (IEEE 802.16e) have been included in the paper which helps to derive the characteristics of WiMAX system. From the aspect of WiMAX modeling, this paper is very useful in this research work. [9]

- The research paper on “An Overview of Next-Generation Mobile WiMAX Technology” presents the thorough analysis of IEEE 802.16 architecture which is becoming the most popular 4G standard for the different mobile communication applications. The growing demand for mobile Internet and wireless multimedia applications has motivated the development of broadband wireless access technologies in recent years. Mobile WiMAX has enabled convergence of mobile and fixed broadband networks through a common wide-area radio-access technology and flexible network architecture. The theoretical aspect of WiMAX architecture and parameters of this paper at very minute level helps in this research work to understand the whole WiMAX system. [10]

- The research paper on “Inter-System Interference Effect on WiMAX Network Performance” basically discusses the effect of interference in the WiMAX network thereby analyzing the effect of the same on the capacity of the network. Due to imperfections at both the ends of the system i.e. at transmitter and at the receiver, the interference can occur which limits the system performance. At the transmitter due to inefficient filter response, spurious transmission can be encountered and at the receiver,
due to insufficient selectivity, the interference will occur. The paper checks the effects of this kind of interference in the WiMAX system which is the main reason behind the degradation in the network capacity. [11]

- The research paper on “System-level Modeling of IEEE 802.16e Mobile WiMAX Networks: Key Issues” basically deals with the analysis of one to one layer of the WiMAX network which is the very important issue from the view point of service providers and network developers. The paper includes the system level modeling at various levels such as physical layer modeling, MAC layer modeling, interference level modeling, frequency level modeling, etc so as to analyze many system level parameters. The readings and observations generated at the abstract level are the very useful outcomes for this research work. [12]

- The research paper on “Rayleigh Fading Channel Model versus AWGN Channel Model in Audio Watermarking” illustrate that for the efficient and fruitful wireless communication, the virtual channel i.e. radio channel of propagation should be modeled properly. This paper estimates the efficiency of AWGN channel and Rayleigh channel under different scenarios. As per the nature of application, the type of channel modeling should get selected. In this paper, the concentration is on the modern digital video compression technique i.e. mp3 system where during watermarking, the impairment due to noise in the transmission would be analyzed by modeling the channel as Rayleigh channel which is frequency selective channel not by AWGN channel. This paper justifies the utility and use of channel modeling in this research. [13]

- The research paper on “MIMO OFDM Physical Layer Real-Time Prototyping” discuss that in today’s world, the main goal of any system is to achieve highest system capacity with lowest error rate which is not possible with single transmitter and single receiving antenna because it can't overcome the effects of fading. For this particular reason, the current wireless communication trend is tilting towards the multiple transmitter and multiple receiver antenna systems i.e. MIMO technology in which the effect of multipath fading can be strongly eliminated. This research paper is based on the same fundamental by considering the effect and application of MIMO technique with the implementation of OFDM in wireless communication system. The
methodology and results derived from the experiment of MIMO and OFDM are very useful deductions for this research work. [14]

- The research paper on “Simulation of WiMAX Systems” discusses two main issues. The first one presents models for simulating OFDM WiMAX system in Simulink including channel estimation and equalization subsystems in MATLAB functions. Next, the effect of channel estimation error on the performance of MIMO VBLAST receivers in uncorrelated Rayleigh flat fading channels is investigated. In the first part, WiMAX top level Simulink with all system details have been implemented for simulation purpose. In the second part, the performance of MIMO VBLAST ZF receivers over uncorrelated Rayleigh flat fading channels in the presence of channel estimation error is investigated. This IEEE transaction is very much useful to derive the simulation model of the WiMAX system along with the reference BER reading with MIMO implementation. [15]

- The research paper on “Wideband Channel Characterization for 3G/4G Systems” covers a thorough study of wideband frequency selective channels from the perspective of multi-carrier modulation system. Wideband communications systems suffer from frequency selective channels. Accordingly, 3G/4G systems have endorsed the concept of multi-carrier modulation such as OFDM and MC-CDMA, where the wideband channel is sub-divided into numerous subcarriers. This research paper is useful to analyze the behavior of various wireless channels such as Rayleigh and Rician channel along with the basic parameters of it for modeling purpose. For 3G and 4G systems how the different channels and their parameters are affecting the behavior of the whole system while modeling was the true strength of this paper for this research work point of view. [16]

- The research paper on “The WiMAX 802.16e Physical Layer Model” discusses the model building of the WiMAX Physical layer using Simulink in MATLAB. This model is a useful tool for performance evaluation of the WiMAX standards 802.16e under the various parameters like carrier frequency, frequency bands, bandwidth, radio technology etc which have been mentioned. For this research work, this IEEE transaction will be the mile stone. This paper is useful to find the most valuable information regarding the modeling of the WiMAX physical layer with the various
aspects of OFDM and MIMO. For WIMAX System modeling, this research paper may come across the very minute detailing of each and every blocks of the WiMAX modeling along with the most precise readings. [17]

- The research paper on “Space–Time Codes for High Data Rate Wireless Communication: Performance Criterion and Code Construction” basically includes the characterization of wide band wireless channel for the future wireless technologies along with the feature of antenna diversity. In this paper the most practical approach of increasing the capacity of the channel has been presented for modern wireless communication systems with the introduction of antenna diversity and space time codes i.e. Alamouti coding. This paper provides the base for this research work regarding the different antenna diversity techniques such as SIMO, MISO, MIMO along with the space time coding. [18]

- The research paper on “Multicast Broadcast Services Support in OFDMA-Based WiMAX Systems” describes Multimedia Multicast and Broadcast service (MBS) over wireless links, such as mobile TV and IP radio broadcasting. As one of the most promising enabling technologies, mobile WiMAX can offer scalability in both radio access and network architecture, thus providing important flexibility in terms of network services and deployment options. This paper presents the overview of network architecture of OFDM based WiMAX system. Also the enhanced features such as antenna diversity, multiple modulation schemes, etc which can be a part of WiMAX system for improved network performance are the helpful contents for this research work. [19]

- The research paper on “Overview of Mobile WiMAX Technology and Evolution” discusses the brief of Mobile WiMAX technology with the layered architecture and evolution. Mobile WiMAX combines OFDMA and advanced MIMO schemes along with flexible bandwidth and fast link adaptation, creating a highly efficient air interface that exceeds the capacity of existing and evolving 3G radio access networks. This research paper is useful for the implementation of advanced antenna techniques and OFDMA in the physical layer of WiMAX to improve Quality of Service. [20]

- The research paper on “A Discrete-Time Model for Triply Selective MIMO Rayleigh Fading Channels” presents a new discrete-time channel model for MIMO
systems over space-selective (or spatially correlated), time-selective (or time-varying), and frequency-selective Rayleigh fading channels, which are referred to as triply selective Rayleigh fading channels. MIMO is the current trends in the modern cellular system towards achieving high data rate with low error rate. This paper is helpful in deriving the performance analysis of MIMO system with Rayleigh channel for the research work. Here in this the discrete time channel model has been developed which evaluates the statistical properties of the system. [21]

- The research paper on “WiMAX: The Emergence of Wireless Broadband” includes the brief of WiMAX and its layered architecture i.e. physical layer and MAC layer. The theoretical aspects presented in this chapter define the functioning as well features of MAC layer and Physical layer. The MAC layer of the WiMAX technology decides the quality of service and the algorithms related to error control while physical layer is responsible for data transfer with high capacity and low error rate. This paper is purely helpful for the theoretical survey of WiMAX system in the research work. [22]

- The research paper on” MIMO Channel Sounder at 3.5 GHz: Application to WiMAX System” Illustrate that to improve data rates and to enhance the quality of the system for the future generation wireless systems, the most prominent solution is antenna diversity techniques i.e. MIMO. The referred reference paper gives the design of MIMO channel sounder utilized for the WiMAX technology. The basic illustrations given in this paper related to MIMO system design along with channel characteristic analysis are the useful estimates for this research work. [23]

- The research paper on” System-Level Model for OFDM WiMAX Transceiver in Radiation Environment” has the objective of building a System level model for a WiMAX Orthogonal Frequency Division Multiplexing based transceiver. OFDM technique theoretically saves the bandwidth about 50%. Modeling irradiation noise as an external effect added to the Additive White Gaussian noise (AWGN). This paper represents the basic simulation model of WiMAX OFDM system which is the most important helpful aspect of the paper in this research work. [24]

- The research paper on” Mobile WiMAX Handover Performance Evaluation” describes that the demand for mobile internet access is continuing its growth at increasing speed. New wireless access technologies compete with each other at the
global market and it is still unsure which one will be the winner. One of the most promising ones is WiMAX which is based on IEEE 802.16 air interface standard. This paper includes the WiMAX simulation model along with the handover process. The paper is useful to analyze the three types of handover process i.e. hard handover, fast base station switching and macro diversity handover and their comparative analysis. [25]

- The research paper on” Comparison of Bit Error Rate Performance of Multi carrier DE-APSK systems and single carrier DE-APSK in presence of AWGN and Rician Fading Channels” represents the bit error rate performance comparison of AWGN channel and Rician fading channels by considering their application in multi carrier DE-APSK and single carrier DE-APSK system. Frequency flat Rayleigh fading is a typical channel model found in land mobile radio situations. This model is suitable for modeling urban areas that are characterized by many obstructions where a line of sight path does not exist between the transmitter and receiver. In suburban areas a line of sight path may exist between the transmitter and receiver and this will give rise to Rician fading. The analysis of the channel comparison is the helpful conclusion for this research work. [26]

- The research paper on” Performance of Multi-Band OFDM UWB System with Multiple Receive Antennas” represents performance analysis of OFDM UWB system with two antennas at the receiver side. Different antenna selection and combining methods, such as simple antenna selection, antenna selection per sub-carrier, equal gain combining and maximal ratio combining are considered. This paper discusses the simulation model, different antenna selection and combining techniques which are the important conclusions for this research work. [27]

- The research paper on” Performance of Parallel Combinatory SS Communication Systems in Rayleigh Fading Channel” discussed the performance of system over the type of frequency non-selective Rayleigh fading scenario. Fading and interferences are the two phenomenons that make the problem domain of modern wireless communication system most challenging and interesting. This paper illustrates the implementation of the diversity techniques for the significant reduction in Bit Error Rate performance over fading channel. The degradation of performance is over come
by introducing the selection diversity and time diversity techniques. This research paper is useful to introduce the time diversity technique i.e. Reed-Solomon coding in physical layer modeling of WiMAX system for the remarkable reduction in system BER. [28]

- The technical paper on” *The Mobile Broadband WiMAX Standard*” discussed the IEEE 802.16e Standards for Mobile WiMAX. This paper illustrates the implementation of frequency diversity technique for the high speech mobile service perspective. Also the comparison of WiMAX standards with WLANs and cellular is mentioned. More specifically this paper focused on the exploitation of technology in Mobile WiMAX standards. This paper is useful for the modeling of WiMAX System using IEEE 802.16e standards. [29]

- The research paper on” *On the Capacity of Cellular Systems with MIMO*” discussed the benefits of transmitting the information through the multiple antennas over the fading channels. It also describes that the mutual information of a single, isolated, multiple transmit and receive antenna array link is exploited by transmitting the maximum number of independent data streams for a flat fading channel with independent fading coefficients for each path. This paper is useful in this research works as it purely focused on great potential achieved by transmit and receive antenna arrays used in Multiple Input Multiple Output antenna system.[30]