CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The natural resources such as spectrum, power and speed of data transfer are needed to be utilized at optimum level. In order to increase the data rate in an allotted bandwidth of frequency, different types of high efficient, low power modulation and access techniques are essential. In conventional broadband (>1.44 M Bits/s) serial data communication only carried out in the back haul transmission networks such as optical cable between exchanges, coaxial cable/optical fiber cable between exchange and particular area and twisted pair between particular area to Asynchronous Digital Subscriber Link (ADSL) modem. Hence, the different modulation schemes and multiple access schemes are reviewed in terms of spectral efficiency, throughput, power and cost. In order to increase the spectral efficiency different interferences cancellation schemes are needed. It is also important to synchronize the data between transmitter and receiver due to fading in the additive white gaussian noise channel.

In addition to serial data transmission the parallel data transmissions are examined. The possibility to reduce the latency between transmitter and receiver is studied. Spectral efficient, low delay applications to be developed for ever growing data traffic required application in the field of wireless communication.
2.2 INTEREFERENCE CANCELLATION TECHNIQUES

Interference cancellation should be interpreted to mean the class of techniques that demodulate desired information and the use this information along with channel estimates to cancel received interference from the received signal defined by (Andrews 2005).

2.2.1 Co-Channel Interference Cancellation Techniques

Large areas with a high user density cannot be served by one base station. This problem can be solved by using cellular concept: The service area is divided into cells such as macro cell, microcell, picocell and nanocell based on coverage area like one third of earth, 20 km radius, 100 m and 5 m respectively and the same band of frequency is used for remote cells.

Peter et al (2005) presented, an increasing amount of interference from neighboring cells operating on the same channel. This co-channel interference can impact the performance, resulting in poor speech quality, lower data rates, dropouts, and even complete loss of voice calls. Due to channel reuse in neighboring cells, CCI is unavoidable. Techniques for reducing the performance degradation due to CCI include discontinuous transmission, dynamic power control, frequency hopping, dynamic channel allocation, adaptive multirate speech transcoding as well as suppression.

In discontinuous transmission, transmission is suspended when users are silent during voice.: by continuously adjusting transmission power levels of mobile phones, dynamic power control reduces interferences. By changing the carrier frequency hopping from burst to burst, frequencies can be reused more often in adjacent cells. The resources like time slots and frequencies are distributed dynamically for channel allocation. By dynamically splitting the gross bit rates between speech and channel coding.
according to channel quality, almost wireline speech quality even for relatively poor radio conditions can be obtained using additive multirate speech transcoding. For good conditions, a higher speech quality can be obtained. Interference cancellation techniques can remove CCI from the desired signal. It can be classified into filter based approaches and multi-user detection techniques.

2.2.1.1 Filter based approaches

These approaches include Linear CCI and ISI cancellation, decoupled linear CCI cancellation/nonlinear equalization and predictive CCI cancellation in conjunction with auto-regressive interference modeling stated by (Coulson 2006).

Linear CCI cancellation is capable of a single interferer if and only if the data sequences are real valued, that is, the modulation is one dimensional. When the desired signal occupies two dimensional per transmitted symbol, linear single antenna CCI cancellation is not applicable described by Peter et al (2005).

Decoupled linear CCI cancellation/nonlinear equalization, the tasks of CCI suppression and ISI cancellation are done separately. This improves fewer constraints on the linear filter. The overall receiver is nonlinear and more powerful than a linear receiver.

In predictive CCI cancellation in conjunction with auto regressive interference modeling, the interference plus noise process is modeled by an auto–regressive model. The decoupled linear CCI cancellation/nonlinear equalization outperforms predictive CCI in conjunction with auto regressive interference modeling, due to the inherent model mismatch in the latter approach.
2.2.1.2 Multi-user detection techniques

These techniques include joint multi user detection, full state trellis based detection, reduced state trellis based detection sequential detection, successive CCI cancellation and parallel CCI cancellation.

Multi user detection algorithms are different from filter based approaches in the sense that the signals of all cochannels are estimated explicitly. Either the data of the co-channels can be estimated jointly, or the interference is subtracted off the received signal in either a sequential or parallel fashion. Joint multiuser detection is prohibitive, however, because it exponentially increases with the number of cochannels. Full state trellis based detection provides excellent results from a performance/complexity point of view stated by (Hu 1993).

The use of the spatial diversity, wireless transmission system capacity can increase dramatically. But, in the multiple-user environment, the system performance is limited by co-channel interference. Beamforming technique is used to suppress the interference, but it is not always able to process a multipath signal environment. This spatial detection scheme is compatible with TDMA, FDMA or CDMA and not for OFDM described by Kim et al (2000).

Semi-Analytical evaluations of signal to interference and noise ratio are performed by Rahman et al (2007). It shows the co channel interference cancellation in MIMO based system in STBC is a severe interferer compared to others.

2.3 SUCCESSIVE INTERFERENCE CANCELLATION

Successive Interference Cancellation (SIC) is implemented with suboptimal coding to nearly achieve Shannon capacity of multi-user additive
white Gaussian noise channels, assuming accurate channel estimation and a larger spreading factor. A linear MMSE receiver with single user coding has been shown to achieve the same capacity as the optimum Maximum Likelihood (ML) receiver when combined with SIC described by Varanasi et al (1997). There are many similarities between the suppression of inter symbol interference (equalizer design), spatial interference (MIMO receivers) and multi-user interference (multiuser detectors). All the three interferences are best handled by a ML receiver, but this is generally complex. Linear techniques are frequently considered, usually in the form of zero-forcing and are attractive from a complexity point of view but not very robust. Nonlinear interference cancellation techniques provide practical solution with best performance, but also the hardest to analyze and grasp intuitively.

2.4 PARALLEL INTERFERENCE CANCELLATION

In Parallel Interference Cancellation (PIC) all users detect simultaneously. This initial very coarse estimate can then be used to cancel some interference, and then parallel detection stages can be repeated. Since the first stage generally results in noisy data estimates, soft interference cancellation is necessary as stated by Divsalar et al (1998).

There are a variety of trade-offs between SIC and PIC. PIC has decreased latency, but higher overall complexity because K users are detected in parallel, plus there are number of cancellation stages P. So the latency is proportional to P, but the complexity is proportional to KP. SIC, on the other hand, has latency proportional to K, and this latency may be prohibitive if there are many users with real time data.

2.5 MIMO-OFDM SYSTEM BASED ON MVDR WEIGHTING SCHEME

Communication is the activity of passing the message from the sender to the intended recipient. Over the time, the forms of communication
have changed due to the fast development of technology. The message is in the form of binary data transmitted over a channel in data communication. In analog transmission, the transfer of unceasingly fluctuating analog signal occurs, though in digital communications the transfer of discrete messages occurs. Throughout the past two decades, the fast development of digital integrated circuit technologies had directed to ever more cultured signal processing systems described by (Mitlo 1995) and (Wepman 1995).

A general digital communication system consists of three basic elements: a transmitter, a communication channel and a receiver. The transmitter translates the information bits to signals that can be efficiently transmitted over the channel. The communication channel is the physical medium employed to send the signal from the transmitter to the receiver. The receiver attempts to recover the transmitted information as correctly as possible at the receiving end of a digital communication system (Nghie 2010). Both the transmitter and the receiver could either be fixed or mobile, and they are detached by the channel. The channel can be wire line or wireless (Oyerinde & Olutayo Oyeyemi 2010). A communication system is defined by three parameters: bandwidth efficient, power efficient, or cost efficient. There is a high priority on bandwidth efficiency in most of the systems explained in Pramod Viswanath & Cambridge (2005).

To transfer a digital bit message stream (lower frequency) over a channel, digital communication systems use modulation for avoiding attenuation. Modulation is the process of fluctuating one or more properties of a high-frequency periodic waveform (carrier signal) with a modulating signal (message signal). Several modulation methods are used in communication systems and frequency division multiplexing is one among them. FDM is a signal multiplexing form where non-overlapping frequency ranges are allotted to different signals or to each "user" of a medium described by (Kundu 2010).
OFDM is a frequency-division multiplexing scheme used as a digital multi-carrier modulation method to attain high data rates and permits digital data to be efficiently and consistently transmitted over a radio channel, even in multipath environments as explained by Falsafi et al (1996).

OFDM is based on the discrete Fourier transform in which a high bit rate stream is divided into a huge number of low data rate sub-channels each of which modulates a single carrier. Sub-carriers are dispersed by the reciprocal of the sub-channel data rate and are so orthogonal. OFDM is spectrally efficient and equalization is very simple compared to single-carrier systems quoted by (Eric 2001) and has been implemented in several wireless standards such as Digital Audio Broadcasting (DAB), Digital Video Broadcasting (DVB-T), the IEEE 802.11a specified in (Part 11 1999), Local Area Network (LAN) standard and the IEEE 802.16a (Part 16 2003) Metropolitan Area Network (MAN) standard demonstrated by Bolcskei at el (2003).

The significant goals of the communication system are to offer good coverage in a non-Line-Of-Sight (LOS) environment, reliable transmission, high peak data rates and high spectrum efficiency. These system necessities can be encountered by the combination of two powerful technologies in the physical layer design: multi-input and multi-output (MIMO) antennas and orthogonal frequency division multiplexing (OFDM) modulation. Multiple antennas at the transmitter and receiver offer assortment in a declining environment. Through retaining multiple antennas, multiple spatial channels are generated, and it is unlikely all the channels will fade concurrently. Multiple base transceiver station antennas are employed to multiply the data rate for users with certain channel characteristics by transmitting independent data streams from the various antennas and this significantly increase the system capacity modeled by Paulraj (1994) and
Foschini et al (1996). At the receiver, multiple antennas are used to discrete spatial multiplexing streams. OFDM is selected over a single-carrier solution due to lower complexity of equalizers for high delay spread channels or high data rates. OFDM can be executed competently by consuming fast Fourier transforms (FFTs) at the transmitter and receiver. At the receiver, FFT minimizes the channel response into a multiplicative constant on a tone-by-tone basis. With MIMO, the channel response becomes a matrix. Subsequently each tone can be equalized independently and the complexity of space-time equalizers is evaded. Multipath ruins an advantage for a MIMO-OFDM system since frequency selectivity caused by multipath expands the exuberant distribution of the channel matrices across frequency tones, thereby increasing capacity provided by Bolcskei at el (2002).

MIMO-OFDM system is discussed which utilizes MVDR for weight assignment for interference cancellation. The transmission is carried out using antenna array which use OFDM where the serial user signal is divided into parallel streams, signal mapped (QPSK) and taken Inverse Fast Fourier Transform (IFFT). The transmitted signals propagate through the fading channel and are received by the antenna array. The signals are demapped, taken FFT and weighted using the minimum variance distortionless response where the weights are assigned so as have the output signal with minimum variance and also helps removing the signal distortion. The parallel weighting scheme leads to having a faster, reliable and higher capacity system and also results in parallel interference cancellation. Subsequently, the approximate weights are found out using the iterative procedure using the minimum error value. The calculated approximate weight can be later used as the weight for the other user signals assuming the same channel and conditions prevail.
Soyal et al (2007 & 2010) proposed training signal to minimize the channel estimation error, and then, developed an iterative algorithm to solve for the optimum system resources such as time, power and spatial dimensions. It finds the unique optimum power allocation policies of all users. OFDM demultiplexer has an $N \times N$ multi-mode interference coupler-based DFT circuit. The demultiplexer, which can demultiplex four OFDM sub-carriers simultaneously, is realized and applied to $4 \times 10$-Gbit/s signal demultiplexing reported by Takiguchi et al (2010).

### 2.6 MIMO-OFDM WITH MVDR INTERFERENCE CANCELLATION

There has been several works in the literature correlated to MIMO-OFDM systems. Hang et al (2012) examined precoding in the multiple-input multiple-output orthogonal frequency division multiplexing system. In conventional Wide Band Precoding (WBP), only one precoder, attained from the disintegration of the subcarrier independent channel matrix, was used for all subcarriers. With an investigation of the relationship between the subcarrier independent channel matrix and the temporal/frequency channels, an enhanced WBP scheme was suggested for practical scenarios in which a part of subcarriers were assigned to a user. The enhanced WBP scheme was a widespread scheme of which narrow-band precoding and conventional WBP schemes were special modes. Guoqiang & Ping (2011) presented an iterative estimation using soft decided signals and pilots to improve the estimated accuracies of channel matrix. Moreover, an iterative equalization technique related on subtracting interference terms, that was a maximum a posterior probability (MAP) MMSE algorithm and had lesser complexity than traditional algorithms. Simulation results specified that the proposed technique could yield significant improvements in performance after no less than two iterations. Yechang et al (2010) suggested a blind multiuser
detection approach based on Fast ICA (fast fixed-point algorithm for independent component analysis) for a SDMA-aided MIMO OFDM system with additive white Gaussian noise for the target of better reliability. The proposed method offered better BER performance than usually-used spatial-multiplexing-based MIMO OFDM system. Simulation results established the better reliability of the proposed approach.

Saqib et al (2011) proposed two linear channel estimation techniques, Least Square Error (LSE) and Linear Minimum Mean Square Error (LMMSE) along with their modified versions, for reduced complexity, for LTE-Advanced which was related on MIMO-OFDM technology. LMMSE showed better performance but with more complexity than LSE because it required channel and noise statistics. By modifying LSE and LMMSE techniques the performance and complexity can be enhanced. These algorithms were assessed based on CIR samples and multi-path channel taps. MATLAB Monte–Carlo Simulations were used to optimize their performance in terms of Mean Square Error (MSE), BER and Frame Error Rate (FER) for 2×2 MIMO System.

Ahmad et al (2010) proposed the Bounded Block Parallel Lattice Reduction (BBP-LR) algorithm, which was an implementation friendly low complexity algorithm precisely optimized for practical MIMO-OFDM systems. The optimization of the BBP-LR algorithm was related on the exploiting the frequency coherence in MIMO-OFDM to enable parallel processing that suits SIMD/vector architectures; bounding the execution behavior to reduce complexity and enable hard real-time task scheduling; and performing a frame based preprocessing to significantly reduce complexity. The proposed BBP-LR algorithm had been estimated in the context of LTE MIMO receivers. When comparing to linear MIMO detectors, the proposed algorithm took performance improvement at a small complexity increase.
Xiaofan et al (2011) discussed a Simplified Tone Reservation (STR) method with low computational complexity which was related on the Fourier series expansion. Then, they examined how to combine the STR method with the cross antenna rotation and inversion method to minimize the peak-to-average power ratio (PAPR) for multi-input multi-output orthogonal frequency division multiplexing (MIMO-OFDM) system. To authenticate the logical results, wide simulations were conducted and the numerical results displayed the efficiency of the proposed schemes including the PAPR reduction and low computational complexity for MIMO-OFDM system.

2.7 BAYESIAN PROBABILITY BASED ICI

The increasing developments of telecommunication raised the need for efficient usage of spectral resources, so the multiplexing techniques in particular the multi-carrier modulation are widely used to optimize these resources as explained by Karima et al (2011). To transfer a digital bit message stream (lower frequency) over a channel, digital communication systems use modulation for avoiding attenuation. Several modulation methods are used in communication systems. OFDM is a frequency-division multiplexing scheme used as a digital multi-carrier modulation method to attain high data rates and permits digital data to be efficiently and consistently transmitted over a radio channel, even in multipath environments OFDM is spectrally efficient and equalization is very simple compared to single-carrier systems and has been implemented in several wireless standards.

The combination of multi-input and multi-output antennas and orthogonal frequency division multiplexing modulation strives to achieve significant goals of good coverage in a non-line-of-sight environment, reliable transmission, high peak data rates and high spectrum efficiency. Multiple antennas at the transmitter and receiver offer assortment in a declining environment and this significantly increase the system capacity. At the
receiver, multiple antennas are used to discrete spatial multiplexing streams. OFDM is selected over a single-carrier solution due to lower complexity of equalizers for high delay spread channels or high data rates. In OFDM, the computationally-efficient Fast Fourier Transform (FFT) is used to transmit data in parallel over a large number of orthogonal subcarriers.

In MIMO-OFDM systems, at the receiver side multi-stream detection is required to cancel out interference effects. The basic principle behind interference canceller detectors is to estimate the interference signals and then remove all or part of the Multiple Access Interference (MAI) seen by the user of interest before demodulating the user's signal. PIC is one of the nonlinear Multi User Detectors (MUD) employed in vast areas. It possesses several desirable properties, such as the potential for near optimum performance, very low computational complexity and low decision latency. Parallel interference cancellation technique is more practical with its low computational complexity.

Bayesian probability based inter-carrier interference cancellation techniques has been used. The technique employs Bayesian probability computation process and parallel cancellation. The transmitted signals propagate through the channel and are received by the receiver section. In the receiver, hard decision decoding on spatial dimension is carried out and subsequently, parallel cancelation is carried out. It is improved by the use of Bayesian probability.

2.8 PROGRESSIVE PARALLEL ICI

There has been several works in the literature related to PIC in MIMO-OFDM systems and in this section the some of those works are considered. Chao-Wang et al (2011) designed a message passing MIMO data detector/ decoder with progressive parallel inter-carrier interference canceller
(PPIC) which was based on factor graph for OFDM-based wireless communication systems. By exchanging messages both in space domain and frequency domain, the proposed algorithm was able to suppress inter-antenna interferences and cancel inter-carrier interferences iteratively and progressively. They obtained good results. Pankaj et al (2011) have discussed a partial transmit sequence (PTS) scheme to reduce the peak to average power ratio (PAPR) in multiple input multiple output orthogonal frequency division multiplexing systems. In their method, the conjugate symbols on two antennas had the same property with orthogonal Space Time Block Coded (STBC). Their method is based on selecting part of the OFDM signal from all possible signals to make better tradeoff between PAPR reduction and computational complexity. The experimental results have shown the efficiency of their method when compared to the conventional PTS schemes in terms of PAPR reduction and bit error rate.

(Hoa Tran 2012) designed a successive interference canceller which was a multistage approach that sequentially recovered each user from the received signal. Each stage provided an estimate using the MF detector. The re-modulated signal was subtracted from the original signal and the difference signal became the input. Bit error rate expressions were derived to evaluate the performance.

Xu et al (2011) discussed an H-infinity estimator over time-invariant system models that modified the Krein space accordingly. In order to remove the large matrix inversion and multiplication required in each OFDM symbol from different transmit antennas, expectation maximization (EM) was established to minimize the high computational load. Joint estimation over multiple OFDM symbols were used to resist the high pilot overhead produced by the increasing number of transmits antennas. The performance of the proposed estimator was improved via an angle-domain process.
In downlink receivers at the mobile terminals will provide relatively simple multi-user receivers that attempt to restore the orthogonality of intracell users at receivers will be provided. Intercarrier interference reduction in multi-user OFDM, while handling at most a few dominant and other-cell interferences is considered. On the other hand, uplink receivers at the base station will employ multi-user receivers that are capable of robustly decoding all desired and interfering users in the cell in presence of nontrivial amounts of other-cell interference. Using multiple antenna techniques or opportunist multi-user scheduling will not change this fundamental reality in a multicell system. Multiple –antenna systems will be especially subject to interference limitations since by increasing the data rate per user and using many transmit antennas, the total interference imposed on neighboring cells is increased, making multi-user algorithms all the more prescient if multiple input multiple output is adopted. Although multiuser scheduling may increase throughput and decrease the number of interfering users, at lower spreading factors interference suppression will become even more critical overviewed by (Andrews 2005).

2.8.1 Parallel Data Transmission

Current digital techniques involve transmitting one bit of data per unit time. This is the common techniques used for transmitting digital information whether the media be hard wire connection (copper), optical fiber (fiber), or radio frequency (RF)-bits. The computers communicate serially, they typically operate in a parallel data mode. 8-bits, 16-bits and 32-bits are the most common parallel bused systems. In systems all parallel data lines change states synchronously per unit time. Parallel connections are by far the fastest mode communication. However, they require physical connections for all these lines. The physical lengths of the connections are limited. The speed is limited because of cross talk on the lines, impedance of the wires, and
susceptibility to outside RFI/EMI interference. Consequently, the internal parallel buses of a computer are very short. The external connections on parallel buses are also short—typically less than 10 feet. Serial connection on the other hand can be quite lengthy—100s of feet, (enhanced systems such as those used by phone companies can be 100s miles long) partly because there is significantly less interference due to cross talk and the cable being shielded.

There are two types of serial communications—synchronous and asynchronous. In asynchronous serial communications the computer transfers data to a device having an n-bit storage register. This device also has an external clock that is used to synchronize the data transmission between the transmitting devices. The transmitting device shifts one data bit, the least significant bit, onto a single output line, counts specified number of clock pulses, shifts the next bit on the transmitting line, and continues until all n data bits are transmitted. The transmitting device then indicates to the computer, it is ready to transmit another n-bit byte. The cycle continues until all data are transmitted.

All the receiving end, when the receiver senses that it is receiving data it counts half of the specified number of clock pulses, then samples the data again. If the state has not changed, the receiver assumes it is receiving a data byte and the first data bit is shifted into an n-bit shift register. The receiving device then counts the specified number of clock pulses and shifts whatever is on the receiving line into the shift register. The first bit received is shifted one bit position. This continues until all bits of the word are received.

At the time the receiving computer notifies that data can be received. There are starts and stop bits that help the receiver determine that data are being received properly, and there are numerous forms of flow control bytes in the data. In short length of serial lines is typically less than 25
feet. There may also be additional hardware control lines used to determine when data should be transmitted stated by (Akashi 1982).

In synchronous serial communications, one computer or the other generate the clock signal and this signal is transmitted over a physical connection between the two devices. This allows for higher speeds as the receiver can store bits on every clock pulse as opposed to sampling at what is assumed to be the middle of each transmitted bit. The transmission of parallel based computer generated information via copper, fiber, or RF from one location to another requires that the parallel data be converted to a serial format prior to transmission. Over the years the transmission speeds have increased significantly in order to transmit serial data at higher data rates.

There is a need for an enhanced method of digital data transmission that would increase the speed of parallel data transmitted without transformed into a serial mode. Such a parallel transmission method would significantly increase data transmission rates, allow for more users at the same time (or callers on a phone system using the same time-division multiplexed protocols currently in use), and provide for new communications system developments to accommodate increased usage.

The transmission of 125 electrically time division multiplexing channels at 42.7 Gbit/s is demonstrated over 12×100 km of the new Ultra fibre namely Teralight. The result is obtained Raman-assisted erbium amplification over C and L bands only described by Bigo et al (2000).

Optical discrete Fourier transformer instead of electrical digital processing is used to obtain spectral efficiency. A set of delay lines, a phase shifter and a coupler in the frequency domain and bit synchronization and an optical gate in the time domain. It results error-free operation was obtained with a 0.8 bit/s/Hz of spectral efficiency as given by Sanjoh et al (2002).
A fractionally spaced equalizer for electronic compensation of chromatic dispersion and polarization-mode dispersion in a dually polarized (polarization-multiplexed) coherent optical communications system experimented by Ip et al (2007). The oversampling rate is at least 3/2 and that a sufficient number of equalizer taps are used to avoid aliasing. But, increasing the number of taps has no effect on performance due to aliasing that causes signal cancellation and noise enhancement.

Optical real-time FFT signal processing is executed at speeds far beyond the limits of electronic digital processing. An optical 400 Gbit/s OFDM receiver performs an optical real-time FFT on the consolidated OFDM data stream, thereby demultiplexing the signal into lower bit rate subcarrier tributaries, which can then be processed electronically described by Hillerkuss et al (2010).

2.9 WEAKNESS OF EXISTING INTERFERENCE CANCELLATION TECHNIQUES

Drawbacks of Successive Interference Cancellation Techniques are as follows.

SIC has more latency compared with the linear multiuser detector type. The strongest received signal is detected first, then the next strongest, and so on. The decoder output signal is re-encode and modulate in order apply input to the imperfect channel estimation. Earlier users they can have disproportionately high received power. Later users because a large fraction of the total interference has been removed by the time they are detected.

Optimal maximum likelihood detector consists of more complexity and also error correction code is not integrated in this detector. Linear detector complexity order is very high and latency is less. The error correction code is
separate instead of integrated one. In Turbo interference cancellation technique complexity order is equal to optimal maximum likelihood and increased latency.

Parallel interference cancellation detects all users simultaneously. This initial coarse estimate can be used to cancel some interference and then parallel detection can be repeated. This process can be repeated over several stages; hence PIC is sometimes called multistage interference cancellation.

If Linear parallel interference cancellation technique is used with linear matrix filter, bit error rate is more comparable with improved linear parallel interference cancellers.

To overcome the above problems in the existing interference cancellation techniques, it is planned to develop, propose and implement the Minimum Variance Distortion less Response and Bayesian probability based ICI techniques. These techniques are used to reduce the bit error rate of the signal in the slow fading and fast fading channels.

2.9.1 Weakness of Existing Multiple Access Techniques

Analog multiple access technique FDMA consists of circuit switching. Hence, the dedicated frequency between transmitter and receiver is not used during the interval between speech, audio and video. As the spectral efficiency is very less, the power efficiency is also very less.

In TDMA, the band of frequency is divided into number of time slots. Hence the spectral efficiency is improved but the power efficiency is not up to the level. The speed of data transmission is not very high. It is mainly suited for voice and low data rate applications.
In CDMA, the performance of the system is degraded if the numbers of users are increased. It consumes more power and spectrum compared to other systems. However, it produces good quality of data transmission between transmitter and receiver for high data rate applications and improves security.

To overcome the above problems, OFDM technique is proposed. It is a multi tone multiplexing scheme. It provides improved spectral efficiency, high data rate and as well as power efficiency.

2.10 RESEARCH GAP

The previous literature works mainly suggested that the serial communication perform better. However, Jing Xu et al (2013) demonstrated better parallel data transmission through OFDM backbone networks. Hence, the optical OFDM can apply into Wireless OFDM directly. It can reduce the delay for conversion from serial to parallel at transmitter and vice versa at the receiver with reduced complexity and power.

The multicarrier OFDM is directly interconnected between the base transmitters to the backbone network and at the receiver reverse process is carried out. Hence, the conversion time taken to convert the high speed serial data into parallel at the transmitter side is reduced to zero and it also the signal from MIMO antenna need not convert into the serial data. So, the latency is reduced. The speed of data stream can be increased at the data rate transmitted from the source.

2.11 OBJECTIVES

As the number of orthogonal frequency increases, the interference between the signals also increases. Hence, the different data rate and bit error
rate are to be calculated for slow fading channel and fast fading channel. The objective is to increase the data rate with reduced bit error rate. The latency of multimedia applications such as live video received by internet consist of a few 100 millisecond delay compared to live Closed Circuit Cable Television (CCTV). In addition, the wireless network data transmission is delayed than internet data transmission. Hence, OFDM is the right candidate to increase the data rate for the wireless network with increased number of $n$ orthogonal frequencies. These $n$ frequencies are transmitted in MIMO antenna in wireless communication. The data rate is increased by $n$ times. These orthogonal frequency signals can be converted into optical light using LED or LASER. This less delay with high speed data packet switching network highly suited to monitor the health of the patient too.

2.12 PROBLEM FORMULATION

Systems with more than one input and/or more than one output are known as multi-input multi-output systems. The research work explains that a single user MIMO system where the system exploits multiple transmit and receive antenna to improve the capacity, reliability and resistance to interferences. OFDM digital data encoded on multiple carrier frequencies is used in order to make up the single user MIMO system. The signals transmitted by the antenna array are received by the receiver antenna array after travelling through the channel. It considers both the channel noise and the White Gaussian Noise (WGN) which gets added to the signals. The received signals are weighted using the minimum variance distortion less response and later reconstructed in order to obtain the estimated user signal.

The system performance can also be increased by using progressive parallel interference cancellation technique. The performance analysis is carried out with data rate in the Rayleigh fading channel and Rician fading
channel. The best technique can be adapted with direct interconnection between the basestation and backbone network.

The output of the MIMO based OFDM signal is applied into WiMAX system in such a way to transmit Gigabit medical transmission between mobile and medical care system.