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Review Paper on Performance of OFDM in 4g Wireless Communication

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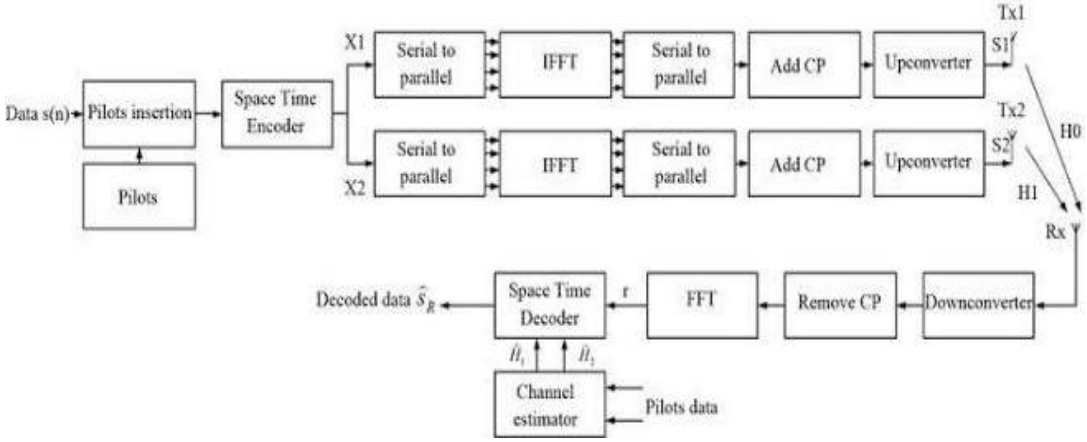
Abstract -: this paper studies about the demand and development of broadband wireless technologies along with high speed data transfer. the main aim of the next generation of mobile communication system is integrated with large Varity of communication services which is high speed data transfer, video call as well as audio and internet access without buffering. Mobile communication plays very important role in telecommunication industry through wide area radio access technique. The flexible network WiMAX and LTE is able to combine the mobile and fixed broadband network. in the communication technologies the OFDM technique is wildly used in many wireless and wired multicarrier communication systems. The IEEE802.16 standards is next generation air interface to gather the requirement of ITU for next generation mobile network 4G. long term evolution (LTE) use OFDM along with MIMO. It is able to transfer data in high speed without losing performance and efficiency. The challenges are to provide the high speed access with the security. so OFDM is the one of the brightest technique to overcome the challenges. this paper represents the performance of OFDM system and achieve high data rate. under the work performance bit error rate is low(BER) with respect to the SNR (signal to noise ratio), also Doppler effect and guard interval. The modulation technique BPSK, QPSK,16QAM,64QAM are used. the SNR and guard interval in OFDM signal improve the system performance.

Key words- BER, SNR, GUARD INTERVAL, OFDM, MIMO, LTE, WIMAX

I. INTRODUCTION

The world wide mobile communication technologies changing and improving day by day. it is because the changing is the requirements of the human being to communicate each other to share the information at a distance. the increasing the consumer need and requirement of wireless communication have to require effective communication system and their implementation. the challenges of future communication system are to provide high data rate access at high quality. Whereas the radio spectrum is limited and need to increase the apparitional efficiency. The propagation condition is unfriendly due to fading interference from the user .to overcome the disadvantage and improve the apparitional efficiency is achieved by the MIMO wireless technology. MIMO wireless technique appear to gather these requirements by providing the apparitional efficiency. the high data rate and link range can be achieved. MIMO take also important role in LTE development by 3G and 4G. to increase the effective efficiency of the communication system required the multi-carrier modulation (mcm) transmission technique. this requirement fully-fills by the OFDM. orthogonal frequency division multiple access is the latest technique that has been used in communication. In the OFDM technique a high rate data flow break in to the form of lower rate flow which can be transmitted at same time over the number of sub-carrier. OFDM can be viewed as the modulation technique input and output signal, modulation techniques.

II. OFDM-MIMO SYSTEM



OFDM is an efficient process transmitting data over frequency selective channel. the cause using the OFDM is to divide a broadband frequency channel into some narrowband sub-channel after that each sub-channel is flat fading channel despite the frequency selective in the broadband channel. to generate these parallel sub-carriers in OFDM by the inverse fast Fourier transform (IFFT) symbol and cyclic prefix. The cyclic prefix reduces the inter symbol interface (ISI). The cyclic prefix is also called guard interval. The cyclic prefix sample can be large then the length of the channel. The effect of the sample of cyclic prefix is removed at the receiver end .at that time fast Fourier transform (FFT) is use to recover the symbol of the IFFT. Block diagram show the OFDM for ISO channel.

III. OFDM

OFDM is a bright physical layer modulation technique in front of 3G and 4G wireless communication due to effective high speed data transmission. Although the time required by the OFDM symbol is main challenging issue in OFDM receiver design but it will be overcome by the orthogonal frequency division multiplexing access(OFDMA) has been latest recognized. It is excellent multiple access technique for the next generation down link receiver. A multicarrier transmission technique can have used to bidirectional wireless data communication. All the proposal which have been adopted by the fourth generation4G. WIMAX and LET are two competitors in 4G technology field. The both standard those are belike to dominate the fourth generation wireless landscape is IEEE 802.16e based on WIMAX and 3GPP based LTE but OFDMA is the one of the common technique which is used in both WIMAX and LTE. OFDMA is used in both downlink as well as uplink in WIMAX and it is only used downlink in LTE.

Need of OFDMA

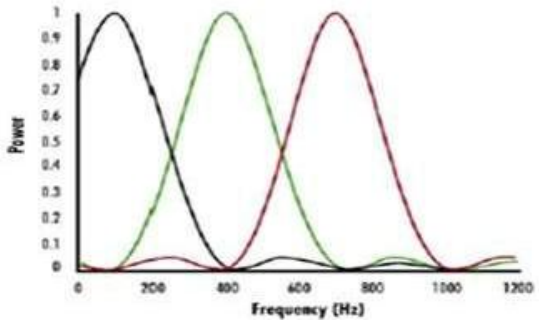
There are many reason to use the OFDMA such as multipath handling ability, reliability in different bandwidth, ability to handle easily different data rate.it can be combined with the multiple antenna technique are the common reason. OFDMA technique is considered critical for achieving high apparitional efficiency in fourth generation 4G wireless system because its working ability integrate better with MIMO (multi input multi output). So it called is MIMO-OFDM.

Advantages of OFDM [2]:

- Immunity to delay unfold and multipath
- Resistance to frequency selective attenuation
- Simple feat
- Less interference
- Good efficiency

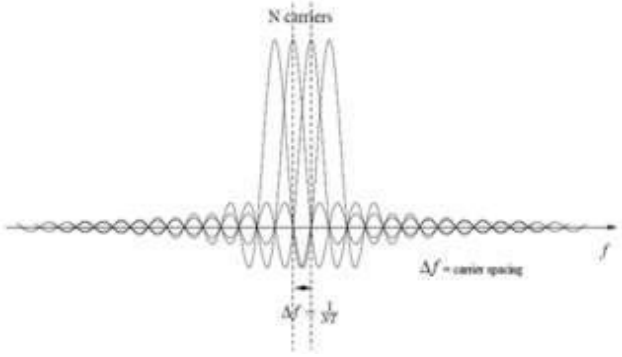
IV. ORTHOGONELITY

It can be possible to arrange the carrier in an OFDMA. So that the sideband of each carrier overlap and the signal can yet be received without adjustment carrier interference. In other word the carrier must be mathematically orthogonal. The orthogonal name indicates that two or more than two signal are orthogonal when orthogonality between sub-carrier.



Number of Carrier:

When number of sub-carrier can be driven based on the channel bandwidth, data throughput and useful symbol time required. The carrier spaced by the reciprocal of the usable symbol duration. For HDTV application the number of user are in the range of thousands so to accommodate the data rate and guard interval requirement



V. MODULATION

(a) Ouadreture Amplitude Modulation(QAM)

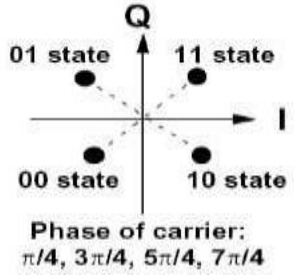
The QAM is modulation process in which two sinusoidal carrier are 90° out of phase with respect to the other transmitted data over a given physical channel. Because the orthogonal carrier occupy the same frequency band and different 90° phase shift each can be modulated individually transmitted over the same frequency band and separated by demodulation at the receiver end. The carrier signal c(t) can be expressed in twice of side band suppressed carrier quadrature. $C(t) = I(t) \cos wct + Q(t) \sin wct$

(b) M-LEVEL QAM:

In M-level QAM the bit data is suitably arrange into N symbols (M=2N) and each symbol transmitted by a carrier wave having a unique amplitude and phase. The duration of each symbol determines the bandwidth of the QAM signal. Each AM carrier is transmitted with amplitude of either - (N-1) d…-3d, -d, d, 3d… (N-1) d, where d is the coordinate spacing shown in figure. The N-level AM components are binary encoded using N/2 Gray coded bits for each level. For example, the 4-level AM components of 16-QAM are binary encoded using two Gray coded bits for each level; Gray codes 00, 01, 11and 10, are assigned to levels -3d, -d, d and 3d, respectively.

(c) QPSK:

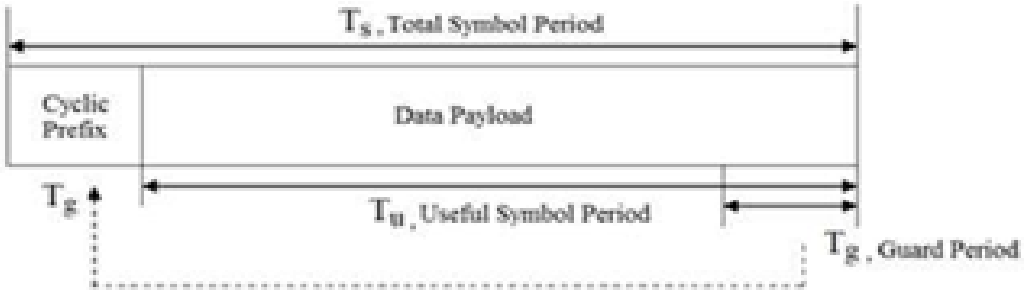
It is a multilevel modulation technique it uses 2 bit per symbol to present each phase. By comparing it with BPSK it has more apparitional efficiency. But it required more complex receiver. QPSK can encode two bit per symbol shown in fig. it is taken from google.



gray code overcome the bit error rate(BER). QPSK represent the four. Due to this its data rate is more than the BPSK. Although maintaining the bandwidth of the signal or data rate of the BPSK but half of the bandwidth required.

(d) Cyclic Prefix:

It is the periodic extension of the end part of the OFDM symbol that is added to the front of the system in the transmitter and it is removed at the receiver before demodulation.it act as the guard space between successive OFDM symbol and present inter symbol interface(ISI) if the length of the cyclic prefix is more the impulse response of the channel.



VI. USE OF OFDMA IN WIMAX AND LTE

(a) Frame Structure:

In the WiMAX, frame duration of 5ms along with time division duplexing (TDD) is used. The frame is break into OFDM symbols which are allocated for downlink and for uplink transmissions. For effective transmission, the first symbol of the frame is used. To convey the downlink and uplink allocation, the base station announces a schedule every 5ms frame period. In LTE, sub frames of 1 ms duration is formed by dividing the frame duration of 10ms. A sub frame is used to formed two slots of 0.5ms duration each. The base station schedules transmissions every 1 ms and the subcarriers formed resource blocks for allocation on the downlink.

(b) Subcarrier's Resource Mapping:

In the frequency domain, sub-carriers are the smallest particle units and in the time domain, OFDM symbol duration is the smallest particle units. In an OFDM symbol, sub-carriers are too large in number to handle in the allocation plane and hence cluster of sub-carriers are considered together. To minimize the signaling overhead while still achieving practically in the achievable rates so as to support various services, a cluster of OFDM symbols are handled together.

(c) Multiuser Diversity:

In WiMAX, to achieve multi-user change groups of contiguous sub-carriers spread out over a few OFDM symbols in the BAMC method. The sub-carriers are organized into grouping of nine neighboring sub-carriers which are called as bins. A grouping of four bins are called as a band, each bin has eight data and one pilot sub-carrier. In one of these bands, the base station chooses two bins and for a BAMC slot it allocates the same bin over three sequential OFDM symbols resulting in forty-eight data subcarriers. The most popular method needed for WiMAX certification is BAMC sub channelization method. In LTE, the BTS choses the RB to be used for sending data to a user. It uses the channel feedback from the mobile to schedule a RB for the user in a frame. The channel feedback in LTE sends configuration for the base station for its scheduled downlink. in the periodic feedback, 160 MS is the maximum gap between feedback messages and is 2 MS is the minimum duration between feedback messages.

VII. CHALLENGES

Managing Channel Quality:

There is a lot of lecture about how OFDM will provide very high broadband speeds on 4G wireless networks, but the verity is that the data throughput rate on a channel of given RF is bandwidth is limited by channel quality and channel structure. In urban areas where most of us will be using 4G services, channel quality is generally determined by levels of interference from other users of the same RF channel. As the channel is used more intensively within a given geographic area, interference levels rise. Indeed, managing mutual interference among users within a wireless network is the fundamental task in network design and optimization.

User Throughput Expectations:

The other challenge for 4G is related to the fact that a wireless data channel is a shared resource. Any throughput is delivers to be shared by all simultaneous users of that channel. This fact is often glossed over in discussions of outstanding 4G bandwidths, according to my opinion it is really good. A major problem in distinguishing between channel and individual throughput rates is typical usage patterns for Internet access have dramatically changed in the past few years and are still changing rapidly. Never long ago, the most popular Internet applications or demand were "Web surfing" and e-mail. This characteristic of high peak, moderately average user throughput demand is ideal for shared

channels because it allows significant numbers of simultaneous users to be served with satisfactory sensed speeds.

VIII. CONCLUSION

In this paper we studied the improve the performance OFDM in term of 4G network such as LTE and WIMAX. the combination of MIMO-OFDM performance is observed by using BER and SNR. The use of multiple antenna at both side of the wireless link it gives high data rate in case of LTE. While OFDM reduce the receiver complexity in wireless broadband system. OFDM technique can also use in underwater communication. Some defects arise in OFDM that is inter symbol interference and inter carrier interference but this problem solve by the using guard period or cyclic prefix techniques. In term of BER or SNR when we increase the SNR the BER is decrease in same way. SNR directly proportional to BER. This case the BER is zero. we can use the modulation technique such as BPSK, QPSK, 16QPSK. it is useful to solve this problem because BER is depend upon the sub carrier and symbol time. The minimum signal ratio for BPSK is 7db, QPSK is 12db and for 16QAM 26 db. Finally, it observed that if we use the MIMO with OFDM in combination it gives the effective output and for future broadband is may be depending upon this theory. Because it must be cheap in cost and easy to spreading in throughput, coverage and capacity.

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