ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

# Performance Comparison of OFDMA and MC-CDMA in Mimo Downlink LTE Technology

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## Abstract:

Orthogonal frequency division multiple access (OFDMA) and multicarrier code division multiple access (MCCDMA) have recently drawn much attention for being potential candidates of future generation cellular systems. In single-cell scenario, while MC-CDMA is good at achieving frequency diversity when there is no channel state information available at the transmit side (CSIT), OFDMA achieves higher capacity than MC-CDMA due to its finer resolution in exploiting multiuser diversity with CSIT. Whether multiple-input-multiple-output (MIMO) MC-CDMA or OFDMA is a better option in multi-cell system remains unjustified in the literature. In this paper, we, study the ergodic capacity and the goodput of MIMO-MC-CDMA and MIMO-OFDMA downlink systems with CSIT in multi-cell scenario assuming that the base station has the knowledge of the average inter-cell interference level only. Compared to MC-CDMA, the goodput of an OFDMA system is more sensitive to the activity factor of the voice users and suffers from noticeable loss. This demonstrates the superiority of the two systems in different practical situations.

## Introduction:

Long Term Evolution (L TE) enhances the susceptibility and speed of wireless data networks using various types of modulations (QPSK, 16QAM etc.). L TE redesigns and modifies the network architecture with substantially diluted transfer latent period. It depicts a wireless communication system which endorses downlink transmission using Orthogonal Frequency Division Multiple Access (OFDMA) scheme up to 300 mbps of data transmission and 75 mbps throughput for uplink data transmission using Carrier Frequency Division Multiple Access (Sc-FDMA). OFDMA transmits data over a large number of subcarriers. These signals are spaced in reciprocally perpendicular axis assembling at right angles to each another and their summation will be zero which removes mutual interference. SC-FDMA aggregates multipath interference abjuration and flexible subcarrier frequency assignment which provides only one carrier at a time instead of multiple carriers in transmission. Frequency Division Duplex (FDD) and Time Division Duplex (TOO) are the two most common Frame Structure that are used in L TE where both transmitter and receiver operate on same frequency band and same time in FDD, but in TDD both transmitter and receiver works on same frequency at different time. The purpose of this paper is to analysis the performance of OFDMA (Downlink transmission) in different types of LTE Frame structures with different modulation techniques and to compare with MC-CDMA.

## I. OFDMA SYSTEM MODEL:

LTE (Long Term Evolution) uses OFDMA and SC-FDMA at downstream and upstream for downlink and uplink transmission. The OFDMA system model is shown in Figure I. A brief description of the model is provided below. At first, S symbols/second data are transmitted to thetransmitter and the data symbols are passing through a serial to parallel converter and the data rate on every X line is SIX symbols.The input

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data stream on each carrier is then mapped by using different types of modulation scheme such as QPSK, 16-QAM, 64QAM etc. Then Inverse fast Fourier Transform is used to find the corresponding Time wave form, which means that M symbols are sent to an Inverse Fast Fourier Transform that performs N-point IFFT operation. The output is N time sample. The Guard interval is then introduced at the start of each sample which is known as addition of cyclic extension in the prefix. Then the length of the output sample is N+LP. The cyclically extended symbols are passed through a parallel to serial converter and then transmitted through a channel. A channel model is then applied to the transmitted signal. The model allows for the signal to noise ratio, channel to be controlled. The signal to noise ratio is set by adding a known amount of white noise to the transmitted signal which is known as A WGN Additive white Gaussian noise.The Receiver basically does the reverse operation of the transmitter. The transmitted signals which pass through the channel are then converted by using Serial to parallel converter and cyclic extension is also removed. The signals pass through an N-point Fast Fourier Transform which converted time domain signal into frequency domain. Then the signal is de-mapped and performs parallel to serial conversion using Parallel to serial convert block and the resultant signal is a M sample output.

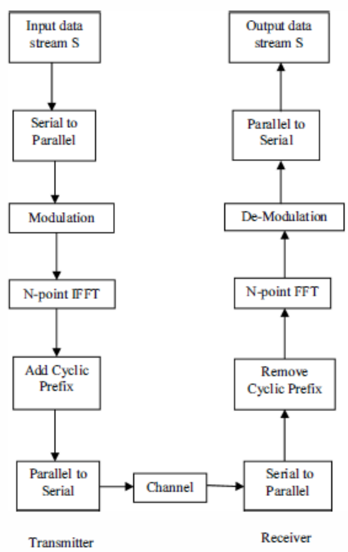

Figure 1: OFDMA System Model

## II. Multi-carrier CDMA (MC-CDMA):

Two main variations of the MC spread spectrum systems are the MC-CDMA (frequency domain spreading) and MC direct sequence CDMA (MC-DS-CDMA) (time domain spreading). One way of looking at MC-CDMA is as a combination of CDMA and OFDM, resulting in better frequency diversity and higher data rates. In MC-CDMA, each symbol is spread using code chips and transmitted on several subcarriers. There is no necessity for the number of carriers to be equal to the code length; thus offering a degree of flexibility in our design.MC-DS-CDMA differs in the fact that the data is spread in time domain rather than in frequency; with each sub channel representing a regular DSCDMA system. The principle of MCCDMA is that a single data symbol is transmitted over independent subcarriers. The eminent advantage of MC-CDMA is the increase in bandwidth efficiency; the reason being the multiple accesses made possible through proper systems design using orthogonal codes.

### 2.1 Need for MCCDMA:

MC-CDMA takes advantage of both OFDM and CDMA and makes an effective efficient transmission system by spreading the input data symbols with spreading codes in frequency domain. It uses a number of narrowband orthogonal subcarriers with symbol duration longer than the delay spread. This makes it unlikely for all the subcarriers to be affected by the same deep fades of the channel at the same time thereby performance increases. During transmission becomes easier with longer symbol durations. As the number of paths increases the performance of the two systems improves at first due to diversity, then, it starts to deteriorate due to the increased interference from large number of paths of all users. In general, there is an optimum number of paths that depends on the system used and the number of users. As the number of users increases, interference from all users through all paths increases. Therefore, the optimum number of paths decreases.

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## MC-CDMA BLOCK DIAGRAM:

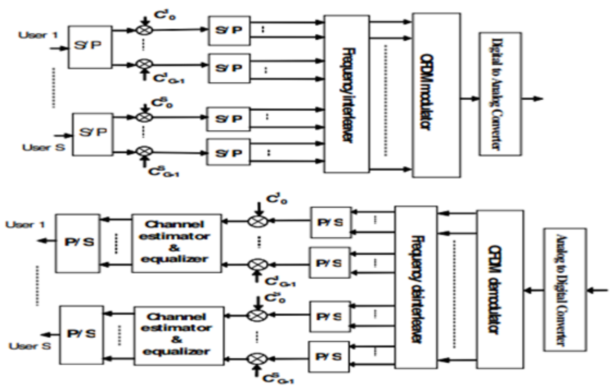


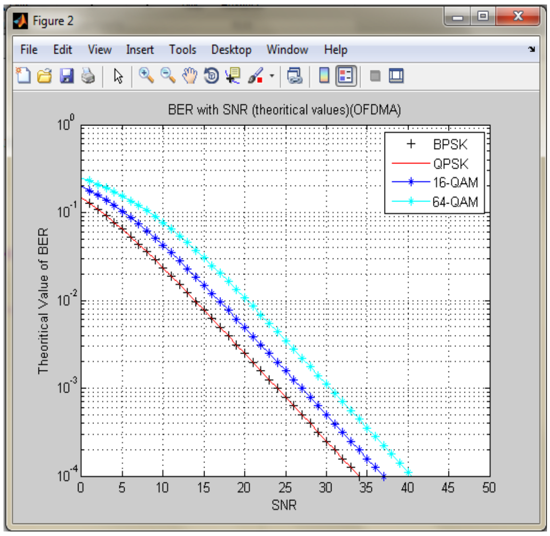

Figure: Block diagram of MC-CDMA

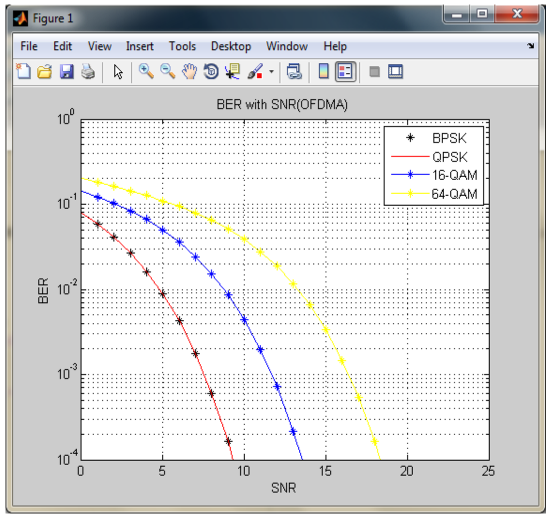
## III. MIMO OVERVIEW:

MIMO systems use multiple antennas at both transmitter and receiver, so both transmit and receive diversity areapplied to mitigate fading resulting from signal fluctuations through the wireless channel. Based on the degree at which the multiple data replicas are faded independently, the system provides diversity gains representing the difference in SNR at the output of the diversity combiner compared to that of single branch diversity at certain probability level. A MIMO system consisting of *N* transmit antenna elements equal to eight, and of *M* receive antenna elements equal to two was modeled, accordingly diversity order of 16 can be achieved. Combining the multiple versions of the signals created by different diversity schemes is needed for improving the performance.

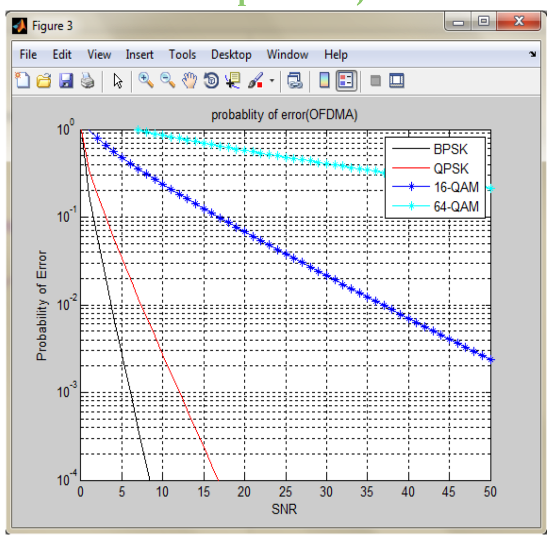
The paper applies maximal ratio combining (MRC) technique using maximum-likelihood (ML) decoder to combine these M received signals to resonate on the most likely transmitted signal. The sum of the received SNRs form these M different paths is the effective received SNR of the system with diversity M. The receiver needs to demodulate all M receive signals in case of MRC for a source with M independent signals in the receive antennas.

## Results:




Figures: BER with SNR in OFDMA (Theortical and practical )



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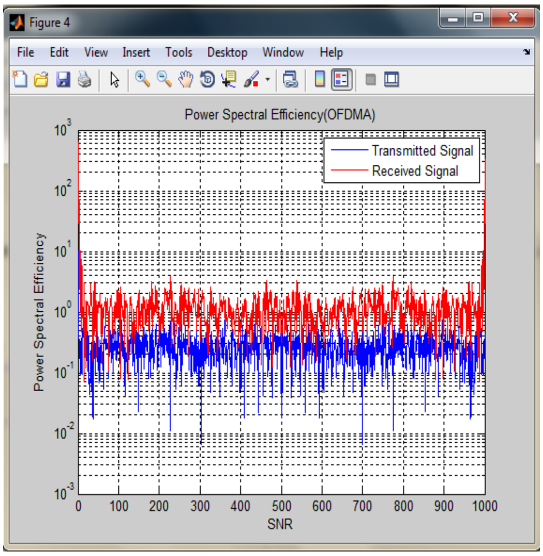
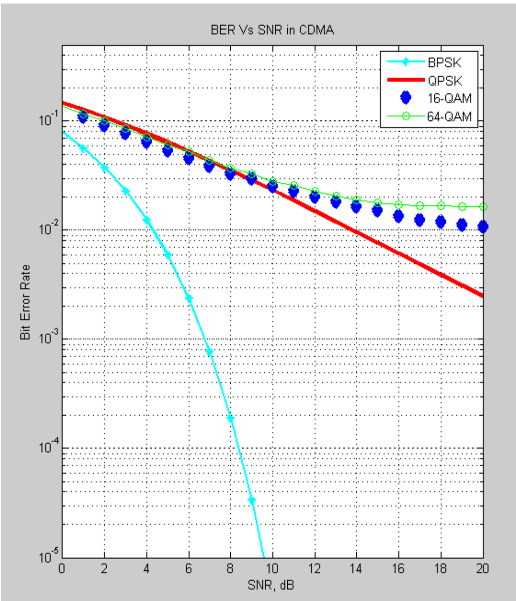
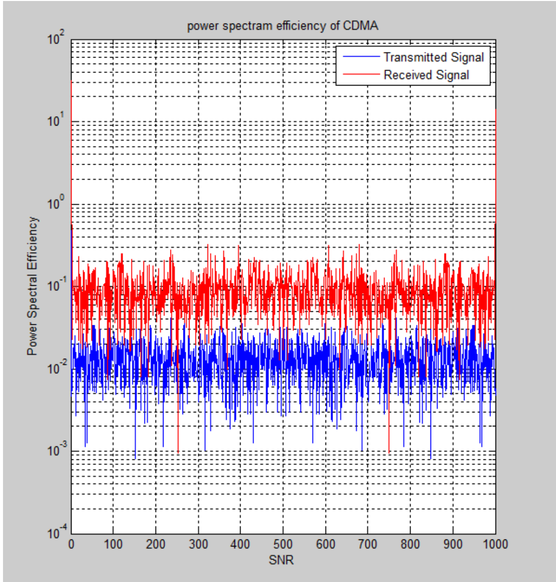



**Figures: Probability of error and Power spectral efficiency (OFDMA)**




**Figures: BER Vs SNR and POWER SPECTRAL EFFICIENCY (CDMA)**

## Conclusion:

Multicarrier Code division multiple access technology, has been widely used in mobile communications higher bitrate data transmission and multiple access, because of its high spectrum efficiency. MIMO-CDMA is one technique by which a given portion of the radio spectrum can be shared among multiple users, and provide diversity so it is ideallysuited for mobile cellular network. LTE (Long Term Evolution) is the last step towardsthe 4th generation of radio technologies designed to increase the capacity and speed of cellular networks.. In this paper we compared OFDMA and MC-CDMA in MIMO technology. The results are obtained for performance evaluation of both the systems.

## References:

[1] Hara , S., &Prasad, R.(l999). "Design &perfonnance of MC-CDMA system in frequency-selectivefading channels".IEEE Trans. On Veh.Tech.48,(5) 1584-1595

[2] Lui, Hui (2000), "Signal processing application in CDMA communication"

[3] Hara, Shinsuke and Prasad, Ramjee (1997), "Overview of Multicarrier CDMA",IEEE Comm. Magazine, 35, 126

[4] Hsieh, M.-H. and Wei, C.-H. (1998), "Channel estimation for OFDM systems based on comb-type pilot arrangement in frequency selective fading channels", IEEE Transactions on Consumer Electronics, 44,217

[5] Coleri, S., Ergen, M., Puri, A., and Bahai, A. (2002), "A study of Channel estimation in OFDM systems", In 56th IEEE Vehicular Technology Conference

[6] A. Sharmila and Srigitha S. Nath,(2012) "Performance of MIMO Multi-Carrier CDMA with BPSK Modulation in Rayleigh Channel", ICCCE , 12 & 13 April, 2012.

[7] R. Kanchanawat, S. Kunaruttanapruk, P. Khunabut, P. Tansongcharoen, and S. Jitapunkul, "V-BLAST Techniquefor Uplink MC-CDMA Systems in Rich Scattering Environment", IEEE Communications Society, pp. 104-107, 2004.

[8] Sami Ahmed Haider and KhalidaNoori, "System Design and Performance Analysis of Layered MIMO OFDM and MC-CDMA Communication Systems",ICACT2009,pp. 1509-1511, Feb. 15-18.

[9] Jingxu Han and YoannPaichard, "Performance Analysis for MIMO MC-CDMA Systems with Imperfect Channel Estimation", IEEE, 2009.

[10] V.Nagarajan and P. Dananjayan, "Performance Analysis of MIMO MC-DS/CDMA System Using Chaotic Spreading Sequence", IACSIT, pp.329-333, Vol. 2, No. 2, April, 2010