BER Performance of "OFDM-IDMA" Comparison to OFDM for Femtocell

Sandeep Kumar Dwivedi, Vaibhav Purwar, Sanjiv Mishra

Abstract- In increase in system capacity and data rates can be achieved by getting the transmitter and receiver closer to each other. In wireless communication system, with the increase of data rate the distortion of the received signal caused by multipath fading channel become a major problem. OFDM (orthogonal frequency division multiplexing) technique is a solution of this problem in wireless communication. OFDM provides much more bandwidth efficiency as compared to conventional multicarrier modulation schemes. Simulation results are based on MATLAB completely.

In wireless communication, in increase in system capacity and data rates can be achieved by getting the transmitter and receiver closer to each other. This paper summarizes the main concept of of femtocells that is covered in literature and major challenges are also described. The femtocell base station also called as femtocelll access point is fully user deployed and reduces the operational cost, interferences.

Index Terms- Femtocell, OFDM Interference management, OFDM-IDMA.

I. INTRODUCTION

OFDM is a digital modulation schame in which a wideband signal is split in to a number of narrowband signals.Because the symbol duration of a narrowband signal will be larger than that of a wideband signal, the amount of time dispersion caused by multipah delay spread is reduced.OFDM is a multicarrier modulation scheme in which multiple user symbols are transmitted in parallel using different orthogonal subvarriers. The conventional multicarrier modulation techniques suffer from bandwidth inefficiency due to use of guard interval or spacing between adjacent channels.Our aim is here to achieve high data rate by using limited avalaible frequency bandwidth efficiency [1] [2].

IN femtocell, femto means 10^-15. Because femtocells are much smaller than the standard Macro cell cellular tower. Femtocell is a small, inexpensive, 3G base station that is sold by a customer from the operator. After that, it is installed in customers home or offices and connected to the network operator via broadband connections. it can be plug and play by the customers .when the mobile phone arrives under the coverage area of femtocell, phone switches over from macrocell to femtocell automatically. when phone leaves the coverage area of femtocell, phone switches over from femtocell to macrocell automatically. Femtocell can provide a better solution for the indoor coversge problem. Basically due to small cell radius, the distance between transmitter and receiver is reduced, hence transmitted signal is less attenuated and in turn receiver can receive a good receive signal strength. The quality of a signal at the receiver is measured in terms of SINR. The SINR is a function of the transmitted power from the desired base station, transmitted power from interfering transmitters, shadowing, fading, and path losses. This attenuation is more prominent at higher frequencies that are commonly used in 3G technology for their high bit rate operations [3] [4].

II. WORKING PRINCIPLE OF FEMTOCELL NETWORK

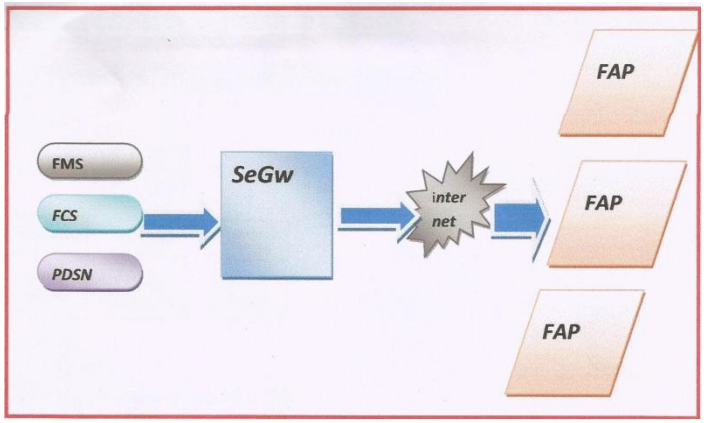

Figure. 1 Working Principle of Femtocell Network

Femtocells are an emerging technology adopted by the operators to enhance 3G connectivity and a new step for 4G wireless communication systems .Femtocell are ssecured devices installed in the customers home and office and connect the mobile phone to the mobile network operators network using an existing broadband connection [4].

1. Mobile Station- It is end user device or physical equipment used by the customer to acess the telecommunication services. It includes mobile handset and SIM.

2. Access Network- Access network enables the connection between the core network and itself. There are different components are used in access network such as antennas which is called NODE-B and Radio network controller controlling the NODE-B. This combination of components forms radio network system.

3. Core Network- This section is divided in to two parts such as circuit switched and packet switched. circuit switched services are connection oriented whereas packet switched services are connectionless services. The core network provides routing of telecommunication traffic, voice, SMS, data. For authentication and to identify the home user HLR is used and to identify the visitor user VLR is used [5] .

III. SECURITY IN FEMTOCELL NETWORK

Security in any wireless communication system is first requirement. In Femtocell network, SeGw, called security gateway provides internet security to the femtocell users by using IP security protocol. IP protocol is a network layer protocol in OSI model. The IP encrypted HNB (HOME NODE-B). traffic enters in to the core network via the SeGw. It authenticates the HNB first and estsblish further security .All the data are transferred to core network. The connectivity between core network and SeGw provides sure security for femtocell users [1].

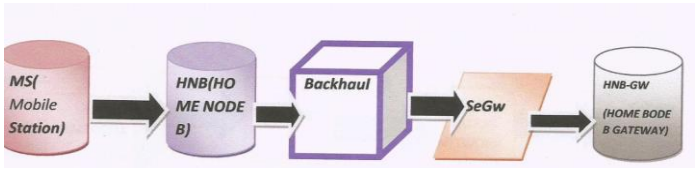

Figure.2 Security in Femtocell network

Advanced timing over [acket (TOP) technology supports bothIEEE1588-2008 andNTPv4 protocols to provide high performance and cost efficient synchronization for femtocell access point.

TOP is installed on the core network, RNC (server side) and on each femtocell access point (client side).when installed in the RNC TOP works like time server and provides time reference for femtocell access point. across the packet network. every packet sent from the RNC containing time that the packet was launched in to the network. When the RNC receives a packet from a femtocell client, it automatically returns a acknowledgement message including the reception time of the packet. The femtocell client uses an acknowledgement message as a reference to adjust its own clock. Figure 4 shows the clock synchronization from the RNC to femtocell client [2].

IV. REASONS OF ISI IN WIRELESS COMMUNICATION

In wireless communication ISI (Inter Symbol Interference) is the major problem,ISI is caused by high data rate transmission using conventional transmission schemes. Multipath propagation and bandlimited channels are the two factors causing ISI [3].

1. Multipath propagation-when the signal reaches the receiver end propagating through different paths, this is called Multipath Propagation. The time taken by the signal to reach the receiver end from transmitter end is directly proportional to the distance between the transmitter and receiver .Due to different path lengths for multipath propagation the delay time of received signal at the receiver end varies.

2. Band limited Channel-Band limited channel is a channel whose frequency response is zero above and below a certain cut-off frequency. When the signal is passed through such a channel the frequency components above the cut-off frequencies are completely removed therefore the removal of higher frequency components due to band limited channel making the time domain pulse spread. The distortion due to pulse spreading is referred as ISI.

V. COMPARISON OF OFDM

1. *OFDM vs. CDMA*

Table 1.Comparison of CDMA and OFDM [1]

PARAMETERS	OFDM	CDMA
Near Far Effect	Insensitive	Sensitive
Synchronization	Yes	No
Crosscell Interference	Sensitive	Mitigated
Intercell Interference	NO	Sensitive
Treatment for ISI	Cyclic Prefix	Rake Receiver
To achieve high data rate	High order Modulation	Difficult

2. OFDM vs. IDMA

Table 2 Comparison of OFDM and IDMA [1]

PARAMETERS	IDMA	OFDM
Near Far Effect	MUG	Insensitive
Synchronization	NO	NO
Crosscell Interference	Mitigated	Sensitive
Intercell Interference	Suppressed by MUD	NO

VI. OFDM PRINCIPLE

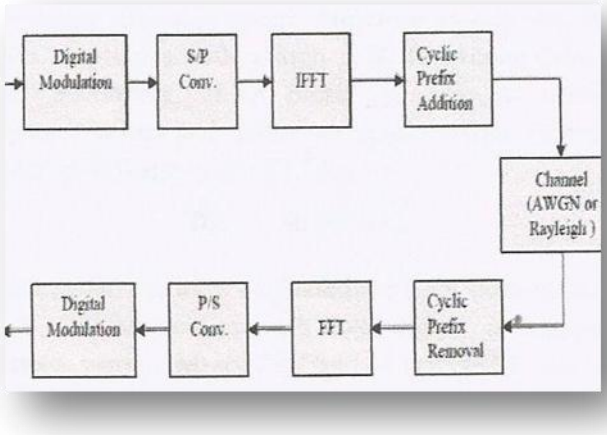

Figure 3 Working Principle of OFDM System

As shown in above figure, First the transmitted data is digitally Modulated using modulation schemes. Mostly QAM and PSK digital modulation schemes are used to modulate the transmitted signal. The output of the modulator is converted in to parallel signal. By this techniques signal is transmitted through subcarriers which are orthogonal to each other Due to orthogonality property, sub channels are not overlapped to each other, and ICI (Inter channel Interference) problem is reduced. The output of the serial to parrel converter is then applied to

IFFT (Inverse Fast Fourier Transform) .By using IFFT the spectral representation of the data is transferred in to time domain, which is much more computationally efficient. The Cyclic prefix scheme is used at the output of the IFFT [3].

VII. CYCLIC PREFIX

Cyclic prefix is a process of addition of a guard period to the start of each symbol. This guard period is a cyclic copy that extends the length of the symbol waveform. The addition of cyclic prefix to each symbol solves both ICI and ISI problems. From figure 1,

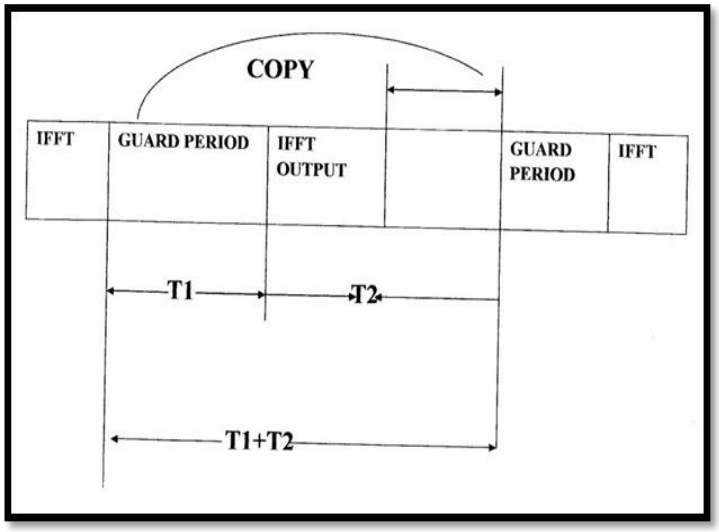

Figure 4 Concept of cyclic prefix

After that, the digital data is transmitted over the channel. At the Receiver side the reverse process is adopted as shown in the figure.2 we can see that the guard period is T1.When the guard period is not added the symbol period of IFFT output is T2 only. But when Guard period is added at the output of IFFT, then the symbol period is T1+T2. Therefore, the symbol period of transmitted data is increased, and ISI is reduced [4] [5].

VIII. OFDM-IDMA PRINCIPLE

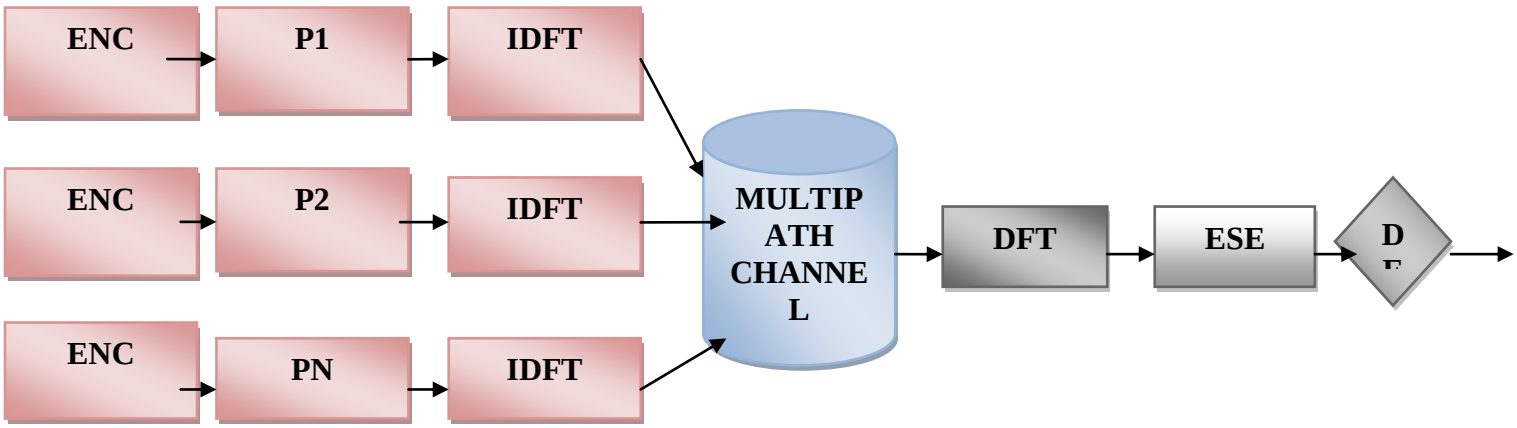

Figure 5 Working Principle of OFDM-IDMA System

The IDMA receiver complexity over multi-path channels is related to the channel length. Recently, OFDM-IDMA was proposed as an alternative to plain IDMA over multi-path channels. OFDM-IDMA inherits most of the merits of OFDM and IDMA. The key advantage of OFDM-IDMA is that MUD can be realized efficiently with complexity per user independent of the channel length and the number of users, which is significantly lower than that of other alternatives.

IX. SIMULATION RESULTS

BER Performance of OFDM system

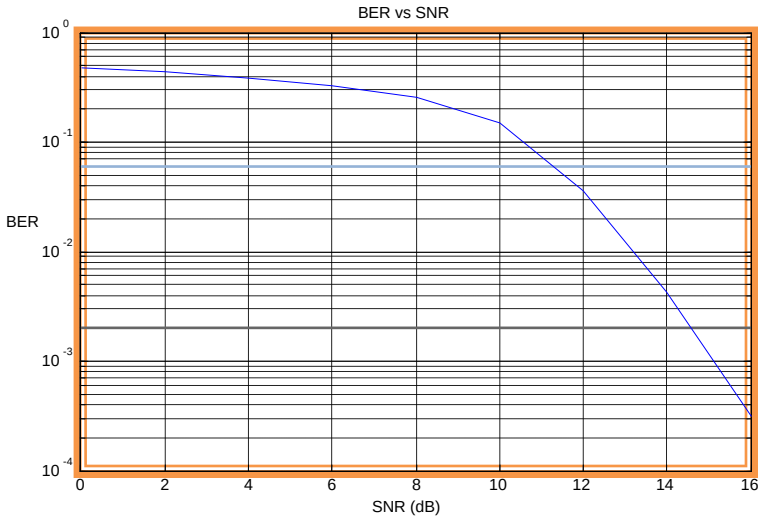

Figure 6 BER Performance of OFDM system

BER Performance of OFDM-IDMA

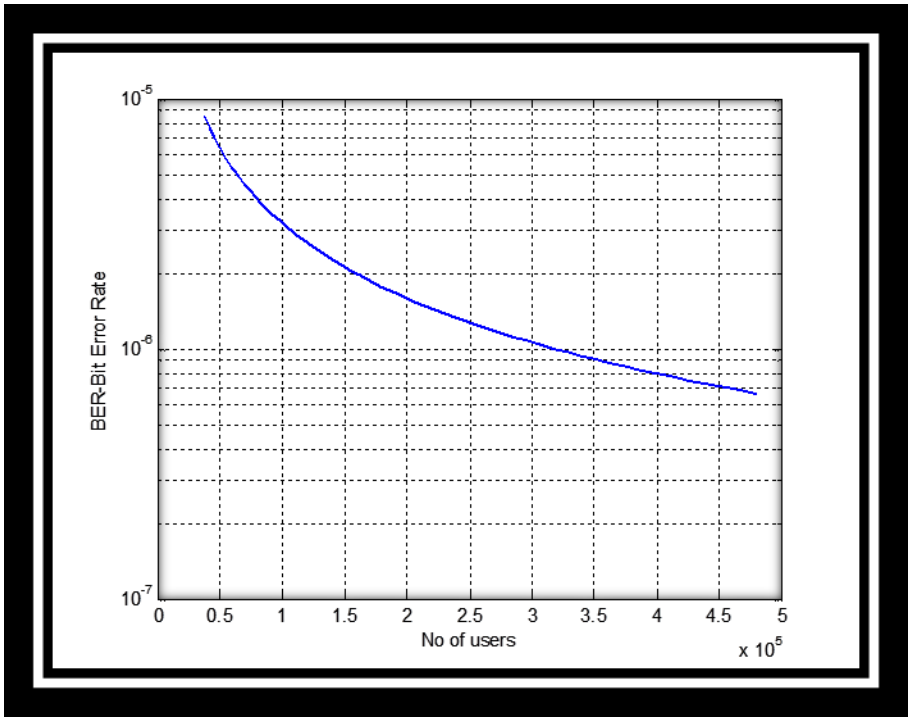

Figure 7 BER performance of OFDM-IDMA

X. CONCLUSION

In this paper we explained the problem of ISI and ICI in wireless communication and also discuss the Solution for it and this is OFDM system with Cyclic Prefix scheme. Now if we use Raised cosine filter with BPSK technique, the BER can be reduced and ISI is reduced. But we use OFDM-IDMA System, we find that by using OFDM-IDMA system Both ISI and ICI

problems are reduced. Therefore, OFDM-IDMA offers better BER performance tham IDMA and OFDM.

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