ANALYSIS THE PERFORMANCE OF MULTI-CARRIER CDMA SYSTEM WITH FADING AND INTERFERENCE

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ABSTRACT:

Multi Carrier Code Division Multiple Access (MC-CDMA) is a relatively new concept to improve the performance over multipath links .It is a modulation method which is used to transmite multi carrier transmission of DS-CDMA type signals and an MC-CDMA transmitter spreads the original data stream in the frequency domain over different sub carriers using a given spreading code.It offers better frequency diversity to combat frequency selective fading. In this paper we evaluate the performance results of MC-CDMA in terms of bit error rate, power, length, code length and no. of subscriber.

Keywords:*Bit Error Rate (BER), Code Division Multiple Access (CDMA), Multi Carrier Code Division Multiple Access (MC-CDMA), Multipath propagation.*

I.INTRODUCTION

A multicarrier system is that system where several subcarriers are used for parallel transmission of data packets.

In the field of wireless communications, the combinations of Multi-Carrier (MC) modulation [6] and Code Division Multiple Access (CDMA) [7] have gained considerable interest due to their excellent performance .In the former, referred to as Multi-Carrier Direct Sequence CDMA (MC-DS-CDMA), spreading is performed in the time-domain, whereas in the latter, named Multi- Carrier CDMA (MC-CDMA), spreading is performed in the frequency-domain [9-10].

Again MC-CDMA based communication system has some limitation. Bandwidth, Noise and Fading are some major limitation of the system.

- Bandwidth limitation means restricting the quantity of information transmitted from sender to receiver per second. Itmeans the information arrives slower.
- Noise will also affect intelligibility. The noise is additive, i.e., the received signal equals the transmit signal plus some noise, where the noise is statistically independent of the signal.
- Fading is a fluctuation in the received signal strength at the receiver or a random variation in the received signal is known as fading due to reflection,refraction of information signal. There are two types of fading limitations. Frequency-selective fading &Time selective fading. .

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II.SYSTEM MODEL FOR MULTI CARRIER CODE DIVISION MULTIPLE ACCESS

MC-CDMA is a modulation method that uses multi carrier transmission of DS-CDMA type signals in frequency domain over different sub-carrier using a given spreading code.

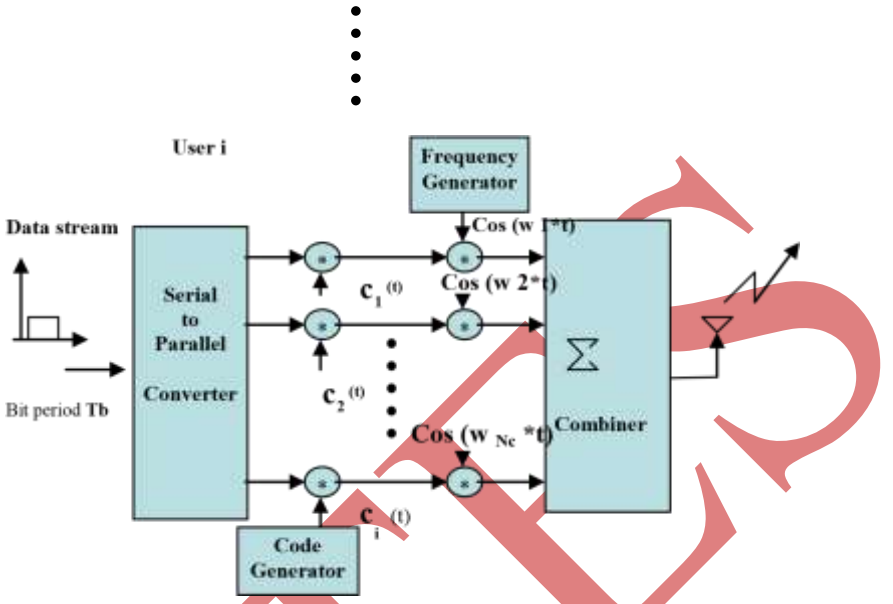

Figure 1 MC-CDMA transmitters

In figure 1 MC-CDMA system for i^{th} number of user. The MC-CDMA transmitter spreads the original data stream using a given spreading code in the frequency domain. The code generator creates different unique codes for each different user and then combines together. Then the frequency generator combines different carrier frequency to the data signal and then combines the entire signal together by a combiner. After combining all the signals the CDMA antenna transmits the signals over the wireless media.

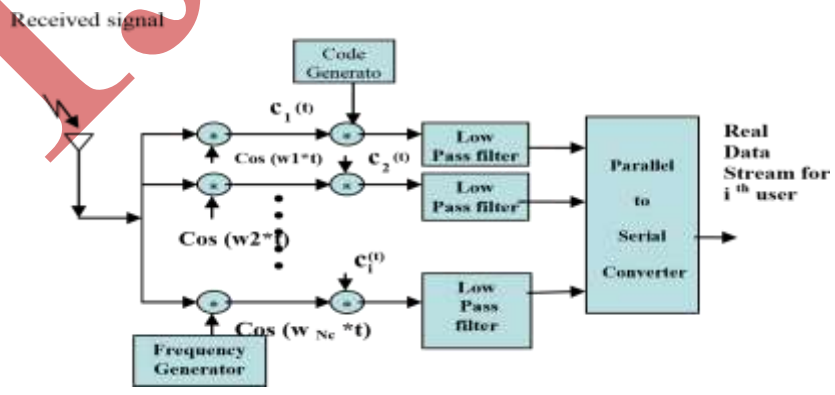

Figure 2 MC-CDMA receiver

In figure 2 the MC-CDMA receiver is designed by the capacity of i^{th} number of user. MC-CDMA receiver also receives the transmitted signal as a summation of i number of users. At first demodulates the received signal by the same career frequency of each signal and then the signals multiply with the specific codes given by the receiver code generator. Then we get the signal of i^{th} user which is same for transmitter and receiver. After that low pass filter remove the high frequencies portion of the signal. Finally, the P/S converter presents the actual digital data signal.

In receiver side, combining all sub-carrier signals we get the received signal with MUI , Noise and ICI is ,

$$X = X_o + X_{MUI} + X_{IC1} + X_{Noise} \ldots\ldots (1)$$

Where,

X_o= wanted signal;

X_{MUI}= Multi user interference due to imperfect restoration of the sub- carrier amplitude;

X_{ICI}=Inter carrier interference due to crosstalk β (m,n) between α(n) and y_m and X_{noise}

By the help of some analyses, we get

$$X_o = \frac{b_o T_s}{N} \left(\sum_{k=1}^{N=1} \beta_{m,n} \omega_{n,n} c_{o[n]} c_o[n-m]\right) \ldots\ldots [2]$$

Where,

N=number of subscriber

n=subscriber number

$\beta_{m,n}$= crosstalk between the user,

T_s= sampling time

$\omega_{n,n}$= weight factors which is constant

$c_o[n]c_o[n-m]$=orthogonal spreading code

whenx$_o$= 0 for large no. of user so system like non-fading channel .

III. THEORATICAL ANALYSES OF MC-CDMA

By the analyses of MC-CDMA, We get relation between no. of user, variance .code length .

Variance due to MUI signal is,

$$\sigma^2_{MUI} = (N-1)T_s/N\ [M_{22} + M_{11}^2] \quad \ldots\ldots [3]$$

Variance due to ICI, $$\sigma^2_{ICI} = \sum_{\Delta \neq 0} P\,\Delta\, M_{02} T^2_S \quad \ldots\ldots [4]$$

$$E_N/N_0 = M_{11}^2/(M_{22}+M_{11}^2) + M_{02}\left[\sum_{\Delta \neq 0} p\Delta + N_o/Ts\right] \ldots\ldots [5]$$

$$BER = 1/2\ \text{erfc} \times (E_N/N_o)^{1/2} \quad \ldots\ldots [6]$$

IV.RESULT AND DISCUSION

The system described above is simulated using Matlab. For the convenience of the readers the parameters used for computation in this paper are shown in table 1.

TABLE 1

Parameter	Value
Max. TxPower	10dBm
Spreading Factor	4
CWmin	4 slots
Cwmax	255 slots
Code Length	8, 16 and 32
Number of Subcarriers	12
Channel Bandwidth	20 MHz
Carrier Frequency	5.25 GHz
Noise Level	-93dBm
Path loss Factor	3.5
TxRate Data	12Mbps
TxRate Control	12 Mbps
Data Packet Length	1024 Byte

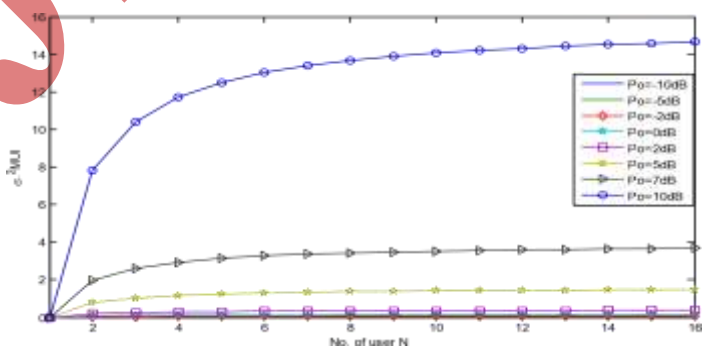

Figure 3: Plots of σ_{MUI}^2 versus number of user in MC-CDMA system

Figure 3 shows the plots of σ_{MUI}^2 versus number of user in MC-CDMA system. This figure comes from equation[3] . We see that if we increase the number of user then the interference between different user increases. The variance of the multi user interference depends on signal power. If we increase the power then the interference increases gradually. For example, in this graph variance of MUI for 10dB power is very high and it is more than 14. Whereas for low power like 5dB variance of MUI is less than 2. And it is close to zero for very low power like -10dB. Figure 4: Plots of $_{\sigma ICI}^2$ versus number of user in MC-CDMA system

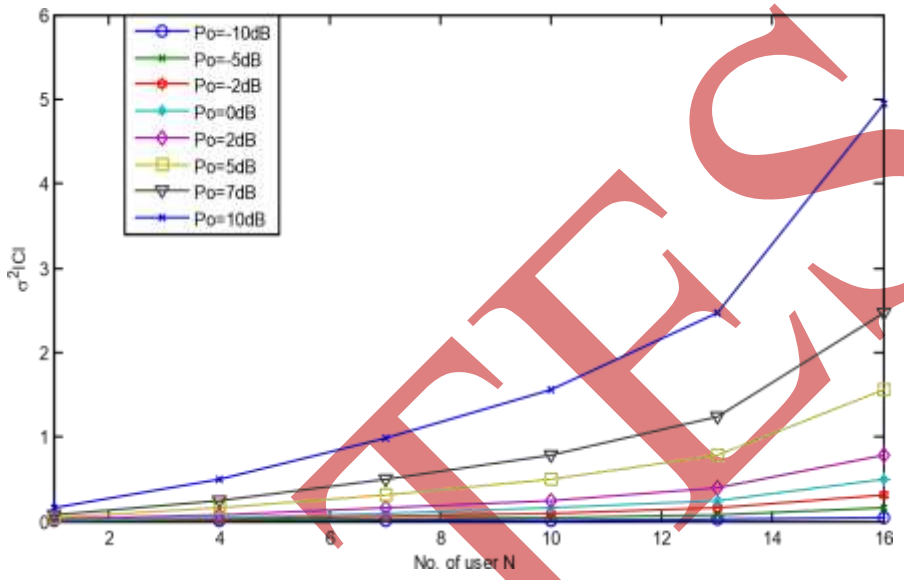

Figure 4 plots of σ_{ICI}^2 verses no. of user

Figure 4 shows the plots of σ_{ICI}^2 versus number of user in MC-CDMA system. This figure comes from equation 4. We see that if we increase the number of user then the variance of ICI increase. The variance of the ICI also depends on the signal power. If power is low then the interference between the carrier is very low but when we increase the power then the inter carrier interference also increase and that case the crosstalk between the sub carrier occurs very rapidly.

V. CONCLUSION

In this paper we used some basic equation to find out our expected results. From the overall analysis we found that the performance result for Multi-user interference and Inter carrier interference for certain number of user. If we increase the user then the MUI and ICI occurs more and more. The major problem of MC-CDMA is Multi carrier interference and inter carrier interference occur. Near far problem and Multi-path fading also another disadvantage of this system. We saw that in CDMA system due to code difference between the users they can easily share the same frequency.

VI. REFERENCES

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