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Performance Estimation of Multi Carrier-CDMA for Single/Multi-User detection in Frequency Selective Fading over Wireless Communication Channels

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ABSTRACT: This paper presents an efficient estimation of multicarrier code division multiple access (CDMA) that is affected by frequency selective fading for single or multiuser detection over wireless communication. One of the key drivers for the success of this development has been the continuous adaptation of wireless technologies to the rapidly changing needs of the user. To solve the above issue, consideration of the frequency selective slow fading channels for the lower error rate is taken. The proposed method's experimental results are compared with the methods such as Differential Based Method (DBM) and Non Data Assisted (NDA) and show better Mean Square Error (MSE), Bit Error Rate (BER) and Peak to Average Power Ratio (PAPR). The error rate of FSSF shall be is less than DBM and NDA, especially when equalizer was applied. While comparing the existing method, the proposed method shows 17% better accuracy and 10% lower error rate. The Differential Based Method is the most common method for estimating noise variance within NDA systems. The Peak to Average Power Ratio (PAPR) values for the OFDM and CDMA is 5.7523 db and 5.5843 db respectively. The results of the proposed system have contributed for Multi Carrier CDMA systems to become a viable candidate for futuristic mobile radio systems many of which are expected to dominate fifth generation systems.

Keywords: Multi Carrier-CDMA, Orthogonal Frequency Division Multiplexing, Equalization, Mean Square Error, Peak to Average Power Ratio

I. INTRODUCTION

The convergence of multimedia services such as speech, audio, video, image, and data will be the main aspects of the future generation wireless systems. This means that, all the way through the provision of high-speed data, a future wireless terminal can connect to various networks to support various services such as switched traffic or broadband streaming, Internet Protocol data packet and video streaming. The development of wireless terminal with standard protocols and multiple physical layers or software defined radio interfaces will facilitate the end users to switch between accessible and prosecutable standards with lower complexity.

The rapid increase in the number of wireless mobile terminals users emphasizes the importance of wireless communications in this new millennium. Thus the international wireless access system has a heterogeneous variety of standards and systems and will continue to characterize them. The advantages of Multi Carrier modulation and the convenience of the spanning spectrum technology led many researchers to study the composition of these two methods, called multi-carrier systems that are capable of being simulated either in the time domain or in the frequency domain with more computational efficiency. The state of affairs for the implementation of frequency domains are the absence of Inter Symbol Interference(ISI) and Inter Carrier Interference(ICI), the non-selective fade per subcarrier, and the invariance of frequency during an OFDM symbol. An appropriate system design approximately fulfills these preconditions.

II. RELATED WORKS

Sun *et al.,* (2016) had suggested a combined pre-equalization with adaptive combining method. It creates utilize of additional diversity gains athwart constituent codes in a CC-CDMA scheme with an assist of pre-equalization and adaptive combining methods as in [1]. Ma, (2017) had proposed to raise the data transmission efficiency and further improve the system performances over frequency selective fading channels [2]. Sheng, (2016) had proposed a non-data-aided (NDA) method to estimate the noise variance for orthogonal frequency division multiplexing (OFDM) system in frequency-selective channels [3]. Sipal *et al.,* (2011) had proposed that the Frequency selective fading increases the probability of error in wireless transmission. To enable operation in the presence of frequency-selective fading, wireless systems include measures to overcome it [4]. Huang *et al.,* (2017) investigated the performance of a modified evolutionary multi-user detector (MUD) in multicarrier direct-sequence code-division multiple-access (MCCDMA) communication systems over frequency-selective fading channels [13]. Sad and Khera (2018) proposed that MC-CDMA is a promising wireless access method for wideband downlink transmission due to its robustness against the frequency-selectivity of a multipath channel and its high-frequency efficiency [37]. Jain and Khera (2019) reviewed different multipath channel characteristics for estimation of a Multi Carrier CDMA system [35].The main objective of the Multi Carrier transmission system is to convert a sequential high data rate on to multiple analogous low rate substreams. Each sub-stream is modulated on another subcarrier as the symbol rate on each subcarrier is much lesser than the sequential data symbol rate. Inter Symbol Interference (ISI) which is the effect of delay spread, considerably decreases by reducing the complexity of the equalizer. Orthogonal Frequency Division Multiplexing (OFDM) is a lower complex method that can be utilized for modulating multiple sub-carriers resourcefully by using digital signal processing technique [10-13].

The major design objective of an OFDM based Multi Carrier transmission system in a mobile radio channel is to consider the channel as an invariant time during one OFDM symbol and to mull over fading on the substation as flat. Therefore the OFDM symbol duration should be smaller than the coherence time of the channel and the sub-carrier bandwidth should be smaller than the coherence bandwidth of the channel so that the lower complexity realization of the receivers is probable. The minimum delay and channel behavior computing is major thing for high speed applications such that the system can keep away from inter carrier interference (ICI) among subsequent frequency components and inter symbol interference occurring among neighboring symbols. OFDM plays a pivotal role in wireless communications due to its high data rate handling ability and robustness to frequency selective fading channels. OFDM is a robust scheme to frequency selective fading, however, it has several disadvantages such as difficulty in subcarrier synchronization and sensitivity to frequency offset and nonlinear amplification, which result from the fact that it is composed of a number of subcarriers with their overlapping power spectra and exhibits a non-constant nature in its envelope. However, the combination of OFDM signaling and CDMA scheme has one major advantage that it can lower the symbol rate in each subcarrier so that a longer symbol duration makes it easier to quasi-synchronize the transmissions [5-12].

III. MULTI CARRIER-CDMA

Multi Carrier-Code Division Multiple Access is also known as OFDM-CDMA where the different users share the same bandwidth at the same time and separate the data by applying different user specific spreading codes for separation of the user signals in the code domain. Multi carrier modulation scheme is used to reduce the symbol rate as that the amount of ISI per sub-channel gets minimized. In systems with large spectrum where the high chip rates occur, there is decrease in ISI dominance. The principle of Multi Carrier-CDMA is to map the chips of a dispersed data symbol in a frequency direction over several subchannels. At the same time, this system broadcasts a user data symbol in the narrow band on several sub-channels. These subchannels are multiplied by chips in the specific code for user propagation as shown in Fig.1.

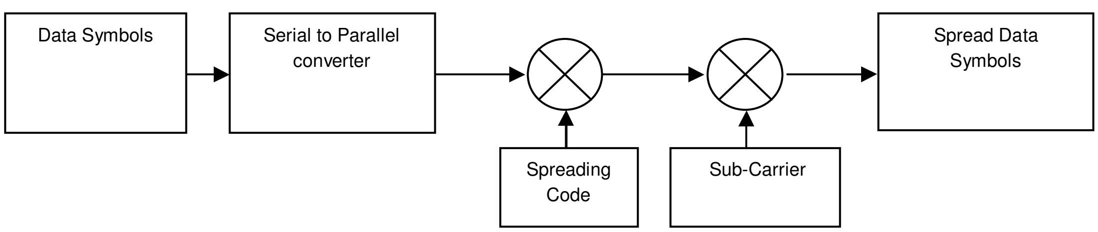

Fig. 1. Block diagram of Multi Carrier-CDMA systems signal generation.

The use of the lower complex OFDM is the Multi Carrier modulation since the fading on the narrowband subchannels must be considered as flat. A simple equalization of the multiplication by subchannel can be realized, which does not have to be chosen to match the number of sub-carriers to allow adjustment of receiving complexities, offering a flexible system design with spreading code length. A major advantage of OFDM is that the use of IDFT or a more computationally-efficient IFFT allows multi-component modulation in the distinctive domain. Due to the almost rectangular frequency spectra for high quantities of subcarriers which can be realized by FFT operation, OFDM has a high spectral efficiency. This system has low complex receivers because of the lack of ISI and ICI with a enough long guard interval and flexible spectrum adaptation and use of various modulation schemes for different sub-carriers adapted to each sub-carrier's transmission conditions.

In Multi Carrier Transmission Schemes, the physical layer of both High Performance Radio Local Area Networking (HIPERMAN) and Wireless Metropolitan Area Network (MAN) standards support Multi Carrier transmission modes. The fundamental transmitting method used is OFDM, which operates on the time / frequency parameters in which both TDMA and OFDMA are supported by the scheme. That kind of flexibility indicates that the scheme can be optimized for (a) brief burst types and more streaming-type implementations as well as for (b) mobile and fixed recognition circumstances. The primary benefits of using OFDMA with large amounts of sub-carriers with the same data rate as OFDM seem to be greater coverage, with bigger guard time and reduced transmission capacity in portable terminal stations. There are totally 256 sub-carriers that transmitted at once and the down link applies time division multiplexing (TDM) and the uplink uses time division multiple access (TDMA). In this mode, the channel bandwidth is divided into up to 2048 sub-carriers, where each user is assigned to a given group of sub-carriers. However in the scalable OFDMA mode that uses mobile applications, the number of sub-carriers is scalable with the useable bandwidth.

A. Single/Multi-User Detection Techniques

The techniques of data detection can be classified as single-user detection or as multi-user detection. The single-user detection approach detects the user signal in which information about multiple access interference has not been taken into consideration. The single-user detection on mobile radio Multi Carrier-CDMA systems is performed through a tap equalization to offset the distortion due to the fading on every sub-canal, followed by a user-specific de-spreading. Just as in OFDM, one tap equalizer is a complex multiplication by subcarrier. When knowing about the coding structure of the interference, single-user detection is less than optimal because the interference with multiple access should not be seen as noise in advance. In order to address the sub-optimality of individual user detection by means of multi-user detection, the previous knowledge about the distributor codes of the interfering users is deprived of. The performance improvements with multi-user detections are made to the expense of greater receiver complexity compared to single-user detection.

The methods for the detection of multi-users can be divided between interference cancellation and joint detection. The principle of interference cancellation is that interfering user information is detected and the interfering contribution is reconstructed in the received signal, before the interfering sign is removed from the received signal. The optimal detector applies joint detection with maximum likelihood detection. Since with the number of users the complexity of maximum probability detection increases exponentially, it is in practice only used in applications with a small number of users. The maximum a posteriori (MAP) criterion or maximum probability criteria are respectively used as the appropriate MAP detection method. Two optimal Maximum Likelihood Detection algorithms (MLSE) and maximum Likelihood symbol-by-symbol (MLSSE) algorithms that can be extended to MAP sequence test (MAP) are discussed.

B. Maximum Likelihood Sequence Estimation (MLSE)

The MLSE optimally estimates the transmitted data sequence $d = (d^{(0)}, d^{(1)}, \ldots, d^{(K-1)})$ and reduces the probability of the sequence error by using the vector error probability data symbol which is equal for maximizing the conditional probability $P|\{d_\mu \mid r\}$, that d_μ is the transmitted given the received vector {r}.The MLSE estimate, d can be obtained as

$$d = \arg\max P\{d_\mu \mid r\} \quad (1)$$

Where arg denotes the argument of the function and if the noise $N_l$is an additive white Gaussian, then the equation (1) will be equivalent for finding the data symbol vector d_μ that minimizes the squared Euclidean distance between the received and all possible transmitted sequences. The most likely transmitted data vector is derived as in equation (3)

$$\Delta^2(d_\mu, r) = \|r - Ad_\mu\|^2 \quad (2)$$

$$d = \arg\min \Delta^2(d_\mu, r) \quad (3)$$

The MLSE may require the evaluation of M^K squared euclidean distances in order to estimate the data symbol vector d.

C. Maximum Likelihood Symbol-by-Symbol Estimation (MLSSE)

The MLSSE optimally estimates the transmitted data symbol $d^{(k)}$ that minimizes the symbol error probability, which is equivalent to maximizing the conditional probability $P\{d^{(k)}_\mu \mid r\}$ that $d^{(k)}_\mu$was transmitted given the received sequence {r}. The MLSSE estimate of $d^{(k)}$ can be obtained by

$$d^{(k)} = \arg\max P\{d^{(k)}_\mu \mid r\} \quad (4)$$

If the noise N_l is additive white Gaussian, then the most likely transmitted data symbol is

$$d^{(k)} = \arg\max \sum e^{-\frac{1}{\sigma^2}\Delta^2(d_\mu, r)} \quad (5)$$

Thus the complexity with MLSSE is higher than MLSE, so comparisons of (5) to (3) can be observed. The additional benefit of MLSSE over MLSE is that MLSSE generates consistency data for detected data symbols which can be used in the soft decision channel decoder. Then, the estimator based on the MAP criterion and one based on the maximum probability criterion are identical to all possible sequences or symbols transmitted one time equally probable. There are possible $d_\mu, \mu = 0, \ldots, M^{K-1}$, where M^Ks the number of potential data vectors of a transmitted symbol, and M is the number of possible $d^{(k)}$.

D. Pre-Equalization

Pre-equalization is a technique that is applied at the transmitter such that the signal at the receiver appears non-distorted and the estimation of the channel at the receiver is not necessary, only when the information about the actual channel is a priori known at the transmitter. The Information about the channel state can be made available in TDD schemes if the TDD slots are short enough such that the channel of an uplink and a subsequent downlink slot can be considered as constant and the transceiver can use the channel state information obtained from previously received data. An application scenario of pre-equalization in a TDD mobile radio system would be that the terminal station sends pilot symbols in the uplink which are used in the base station for channel estimation and detection of the uplink data symbols as shown in Fig. 2. The estimated channel state is used for pre-equalization of the downlink data to be transmitted to the terminal station. Thus, no channel estimation is necessary in the terminal station which reduces its complexity. Only the base station has to estimate the channel, i.e. the complexity can be shifted to the base station.

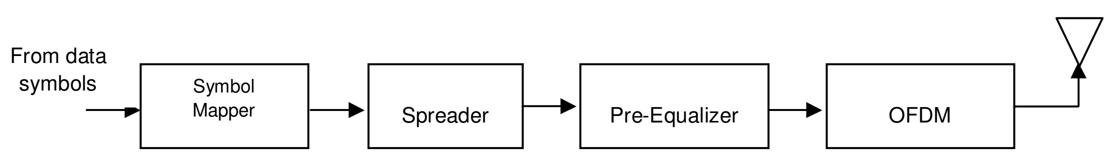

Fig. 2. Multi Carrier transmitter with pre-equalization.

A further application scenario of pre-equalization in a TDD mobile radio system would be that the base station sends pilot symbols in the downlink to the terminal station, which performs channel estimation. In the uplink, the terminal station applies pre-equalization with the intention to get quasi-orthogonal user signals at the base station receiver antenna. This results in a high spectral efficiency in the uplink, since MAI can be avoided.
More-over, complex uplink channel estimation may not be required. The accuracy of pre-equalization can be increased by using prediction of the channel state in the transmitter where channel state information from the past is filtered. Pre-equalization is performed by multiplying the symbols on each sub-channel with an assigned pre-equalization coefficient before transmission [14-16] as shown in Fig. 3. The selection criteria for the equalization coefficients is to compensate the channel fading as far as possible, such that the signal at the receiver antenna seems to be only affected by Additive White Gaussian Noise (AWGN).

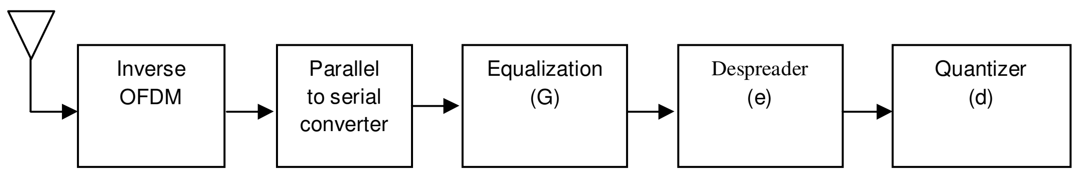

Fig. 3. Multi Carrier CDMA receivers with single/multi user detection system.

E. Combined Equalization
The channel state information is provided both by the transmitter and by the receiver a combined equalization scheme. This allows pre-equalization and post-equalization of the receiver to be implemented on the transmitter. There are three different techniques of combined equalization to be analyzed. The first type is called as the Maximum Ratio Transmission (MRT) - Maximum Ratio Combining (MRC) which is a combined equalization method that is based on the combination of the transmitter MRT principle and the recipient MRC principle. The second technology is called as the combined equalization of selection diversity (SD) that is the optimal single-user combined equalization technique to minimize Bit Error Rate. The third technique is in fact a type of technique that represents a specific compromise between a combined equalization of MRT–MRC and SD [17-20].

F. MRT–MRC Combined Equalization
In this type of equalization when there is case of the single user, both the Maximum Ratio Combining (MRC) and Maximum Ratio Transmission (MRT) transmission are optimum. The equation (6) provides the assigned MRT pre-equalization coefficients. The post-equalization coefficients must be adapted to the additional distortion caused by pre-equalization to maximize the Signal to Noise Ratio (SNR) on the receiver. The post-equalization coefficients results in the following equation

$$G_{l,l} = |H_{l,l}|^2 \sqrt{\frac{L}{\sum_{n=0}^{L-1}|H_{n,n}|^2}} \qquad (6)$$

G. Selection Diversity Combined Equalization
The highest overall equalization technique of the single-user situation is primarily focused on enforcing the transmitter and recipient selection diversity criterion. The optimum technique in the sense of Signal to Noise Ratio maximization for combined equalization within the Multi Carrier-CDMA is the selection diversity. The Selection diversity consolidates the power of transmission so that only one sub-carrier has the full signal. The coefficients for pre-equalization are provided by

$$\bar{G}_{l,l} = \begin{cases} \sqrt{L}, & l = \arg\max\left|H_{n,n}\right| n = 0,1,2,3,\ldots L-1 \\ 0, & otherwise \end{cases} \qquad (7)$$

The coefficients are chosen based on selection diversity post-equalization as

$$G_{l,l} = \begin{cases} \frac{H_{l,l}^*}{|H_{l,l}|}, & l = \arg\max\left|H_{n,n}\right| n = 0,1,2,3,\ldots L-1 \\ 0, & otherwise \end{cases} \qquad (8)$$

The average max y(x) function recovers the x value maximizing the y(x) function. In order to maintain the transmit power of the same factor as for the other function y(x) the value is preselected, all without pre-equalization. The correction phase of the rapidly declining coefficients upon either side of the transmitter or receiver is realistically possible. The correction of the phase takes place entirely over here on the receiver.

H. Combined Equalization Based on Generalized Pre-Equalization
The optimal solution for single user case is the selection diversity combined equalization, where as for multi -user case, the generalized combined equalization technique have been enacted. The general pre-equalization coefficients are indicated by

$$\bar{G}_{l,l} = |H_{l,l}|^p H_{l,l}^* \sqrt{\frac{L}{\sum_{n=0}^{L-1}|H_{n,n}|^{2p+2}}} \qquad (9)$$

The generalized pre-equalization approach includes various known methods of pre-equalization, like MRT (p= 0), EGT (p= –1), and zero-forcing (p= -2), for example. The setting of p>0 gives more power in powerful sub-carriers and less in weak sub-carriers than MRT. The post equalization coefficients are determined by

$$G_{l,l} = |H_{l,l}|^{p+2} \sqrt{\frac{L}{\sum_{n=0}^{L-1}|H_{n,n}|^{2p+2}}} \qquad (10)$$

For p→∞, generalized pre-equalization is equivalent to the combined equalization of selection diversity. For single users, the Bit Error Rate minimization problem is approximately equal to maximizing of the SNR since the only deficiency is the depletion of the fading channel caused by SNR. In the case of multiple users, multiple access interference also occurs in contrast to SNR degradation. The BER minimization is very much more complex because it also depends on a receiver's SNR and multiple access interference. The Pre-equalization co-efficient are used in the BER minimization paradigm to efficiently distribute the transmission power among the sub-carriers available rather than as a way of canceling multiple access interference.

In the generalized transmitter pre-equalization technique, p is a design function determined for achieving reasonable solution between efficient allocation of transmission power to maximize SNR and multiple access interference mitigation capacity. At around the receiver, the residual interference occurs if p≠2. Therefore, an optimal post-equalization is therefore necessary to mitigate the harmful effect of interference with multiple access interference. A soft interference cancelation on the receiver gives an efficient solution for addressing multiple access interferences. The systems of Multi Carrier-CDMA have the capability to cope up multiple access interfaces. The uplink channel estimate must address the fractal pattern of signal from multiple users that fades separately on the same subcarriers in Multi Carrier-CDMA systems, thereby increasing the complexities in the estimation of the uplink channel. The manifestation of enhanced Multi Carrier-CDMA performance is that ISI and ICI can be avoided and that the user signal separation is efficient and simple [21-27].

I. Peak to Average Power Ratio (PAPR)

The Multi Carrier-CDMA is responsive to non-linearity amplification effects; therefore, for the multi carrier transmission in downlink, Walsh–Hadamard codes are used rather than just using gold codes Multi Carrier-CDMA systems are presented with the upper limits for the PAPR of different propagation codes. Both the uplink and downlink are examined and different codes for up and downlinks are demonstrated to be optimal with respect to PAPR. The significant change between the envelopes of a multi carrier signal can be determined by the maximum to average power (PAPR) ratio given by

$$PAPR=\frac{\max |x_v|^2}{\frac{1}{Nc}\sum_{v=0}^{N-1}|x_v|^2} \quad (11)$$

By correctly choosing the spreading code as Walsh Hadamard, the PAPR for the multi-carriers signal can be decreased. The varying spreading code allows an adequate equilibrium between the coverage, single / multi-cell settings and their mobility. Large spread variables can be implemented for elevated detection regions with a large error allocation, and for small deletion regions the lowest tracking factor can be used [28-38].

IV. EXPERIMENTAL RESULTS & DISCUSSIONS

This segment describes the proposed method's experimental results and compares existing methods such as Differential Based Method (DBM) and Non Data Assisted (NDA) with proposed work. NDA method has many data-aided (DA) Signal to Noise Ratio (SNR) estimators in the sense that known data transmission (such as a sequence of training) is used to facilitate the estimation process. The periodic transmission of known data, the problem of NDA limits the system BER, MSE performance. SNR estimates were also considered in terms of both the performance limits and the estimation procedures. The proposed work is implemented by using the MATLAB tool. The results prove the feasibility and efficiency of the proposed work and the table 1 shows the simulation parameters that are used for analyzing the experimental result of the proposed work.

Table 1: Simulation Parameters and Values.

Parameters	Values
N –No of subcarriers	128
N_{cp}- Cyclic prefix length	16
T_s- Sampling period of channel	1e-3
F_d- No of pilot symbols	0
N_p- No of pilot symbols	4
M-No of symbols for FSK modulation	2

While comparing other fading channels slow fading has low Doppler spread. It's time for coherence is longer than the period of symbols. Impulse response changes much slower than the transmitted signal. Based on the analysis of the Multi - carrier CDMA systems on different fading channels, the frequency selective slow fading Input Signal is given in the below figure 4. The relation between MSE with SNR in OFDM is shown in the following figure 7. It should be noted that the fading channel will be generated as intercarrier interference (ICI) for each OFDM symbol. However, since the speed is low, the ICI power can be neglected. Due to very low-SNR procedure, then the noise becomes very low as well as the MSE increases quickly. To reduce the MSE, estimated noise variance should be increased.

In this section, the parameters of the CDMA systems for Multi Carrier systems were summarized in Table 1 with 128 subcarriers and having 16 cyclic prefix length. The assessment metric is a measure to evaluate the effectiveness of current methods and to interpret the proposed approach. In order to calculate the effectiveness of the suggested technique the outcomes of Mean Square Error (MSE), Bit Error Rate (BER) are calculated.

Thus the Fig. 4 shows as how the multicarrier CDMA system is undergoing frequency selective slow fading over a wireless communication channel for single/ multi users. The mean square error is the average error between the desired signal and the output signal. Clearly, the smaller the MSE is, the better efficiency of the proposed work. The MSE can be computed by using equation (12) as

$$MeansquareError(MSE) = \sqrt{\frac{1}{k}\sum_{i=1}^{k}(E_X - E_Y)^2} \quad (12)$$

Where E_X, E_Y are desired and output signals respectively.

Bit Error Rate (BER) is often represented in terms of the normalized carrier to noise ratio measure that is energy per bit to noise power spectral density ratio (E_b/N_0) or energy per modulation symbol to noise spectral density (E_s/N_0).

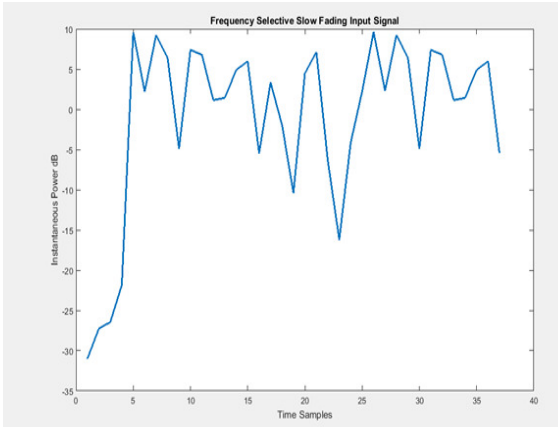

Fig. 4. Frequency Selective Slow Fading Input Signal.

The Bit error rate function is given equation (13) as

$$BitErrorRate(BER) = \frac{1}{2} erfc\left(\sqrt{\frac{E_b}{N_0}}\right) \quad (13)$$

A. Ergodic Capacity

The situation where the Channel State Information (CSI) is known at the receiver that is known at the beneficiary for each time moment. This is the ability to use channel estimation systems by and by. In addition, this is known to be transmitted at Transreceiver. At the transmitter, the CSI cannot be accessible; the source information is transmitted at a steady rate. Since no CSI is accessible at the transmitter, the broadcast of information occurs in all fading states as well as profound fading where the information is lost and the compelling limit is substantially reduced.

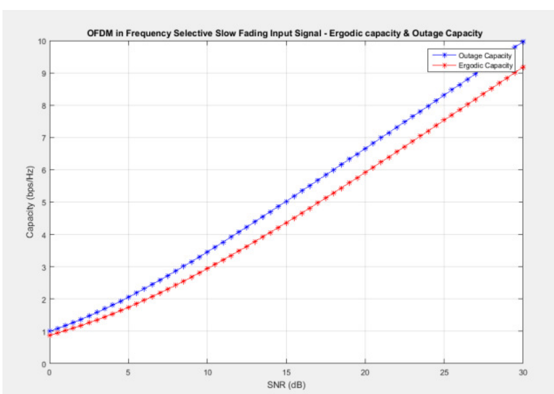

Fig. 5. OFDM in Frequency Selective Slow Fading Input Signal-Ergodic capacity and Outage Capacity.

B. Outage capacity

Outage capacity is used for slowly varying channels where the instantaneous SNR is assumed to be constant for a large number of symbols. Hence, in deep fades these schemes allow the data to be lost and a higher data rate can be there by maintained than schemes achieving Shannon capacity, where the data needs to be correctly received over all fading states. Specifically, an intended P_{out} parameter is selected indicating the likelihood that the system may be out of order is the likelihood that the system will be unable to decode the transmitted symbols successfully. Corresponding to this outage probability, there is a minimum received SNR.

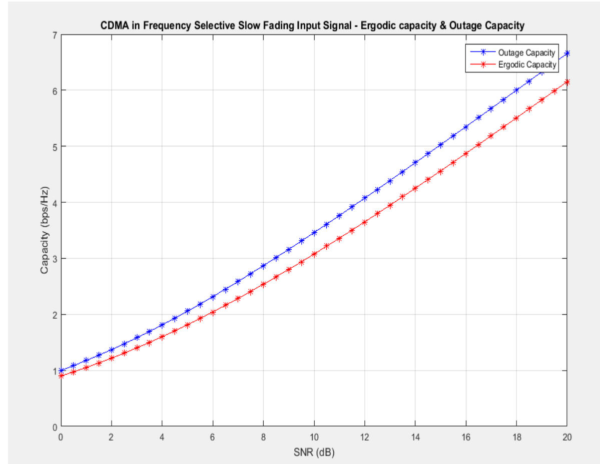

Fig. 6. CDMA in Frequency Selective Slow Fading Input Signal-Ergodic Capacity and Outage Capacity.

Thus the Figs. 5 and 6 shows the performances of the proposed system in which the Ergodic capacity and outage capacity of OFDM and CDMA under Frequency Selective Slow Fading is compared. The analysis shows that OFDM that uses multi carrier CDMA system has better performance in terms of SNR and channel capacity.

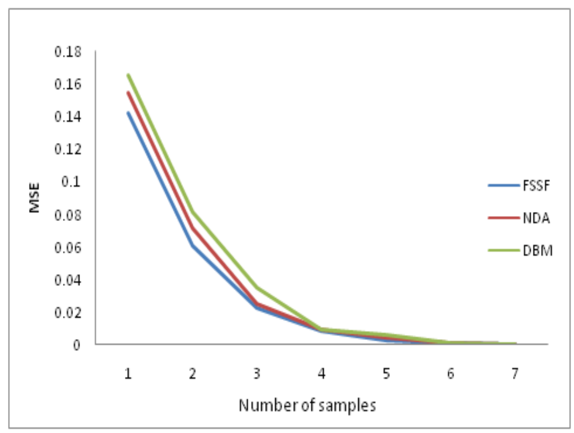

Fig. 7. Comparison of MSE between Existing and proposed work.

In order to illustrate the advantages of the proposed method, compare the Mean Square Error rate performance of FSSF (Frequency Selective Slow Fading) with the existing algorithms such as Differential Based method (DBM) and Non-Data Aided method (NDA). As shown in the figure 7, the error rate of FSSF is 10% lesser than DBM and NDA, especially when equalizer was applied. While comparing the existing method, the proposed method shows 17% better accuracy and 10% lower error rate. The Differential Based Method is the most common method for estimating noise variance within NDA systems. The Peak to Average Power Ratio (PAPR) values for the OFDM and CDMA is 5.7523 db and 5.5843 db respectively.

V. CONCLUSION

The proposed system therefore has an efficient spectrum and a low receiver complexity with a high frequency diversity increase due to the propagation in the frequency direction of a cellular wireless communication system. Thus the results of above comparisons have contributed Multi Carrier CDMA systems to become a viable candidate for futuristic mobile radio systems many of which are expected to dominate fifth generation systems. In the uplink system with low power consumption in the terminal station, this PAPR decrease might be extremely beneficial towards efficient communication. In the case of Walsh Hadamard as a spreading code, the PAPR declines as the number of user increases and for the downlink, the different number of active users and a certain diffusion factor. The major benefits behind this approach are the capacity to address multipath ways and the small accessibility of complex equipment in the application of this technique. The proposed method shows 17% better accuracy and 10% lower error rate as compared with the existing systems. The Differential Based Method is the most common method for estimating noise variance within NDA systems. In future work, we are going to analyse the estimation of Carrier Frequency Offset (CFO) with PAPR reduction for different modulation schemes.

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CONFLICT OF INTEREST

There is no conflict of interest.

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