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Performance Analysis of Maximal Ratio Combining with FBMC for 5G

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Abstract

One of the main objectives of upcoming 5G technology is to support huge data capacity with high data rate. To support high data traffic, designs of new multicarrier techniques are essential. FBMC is considered to be one such promising technique for 5G.The major concern with the wireless time varying channels when transmitting a signal is its nature and behavior for that period of duration. When mobile systems are used for transmission and reception across these time varying channels, the signals are subjected to ISI and multipath fading. These are the key setbacks which worsen the quality of overall received signal. The author proposes a solution to this problem by the use of receiver diversity techniques with Filter Bank Multi Carrier technique.

Keywords: *FBMC, Receiver Diversity Technique Maximal Ratio Combining, 5G*

INTRODUCTION

The upcoming advancement in mobile technology beyond LTE standards is referred to as 5G which is the current interesting researchers' topic. The official 5G specifications are yet to be standardized. The essential requirements of 5G to support increasing traffic volume, effective spectrum utilization to allocate more users, reduction in energy consumption by mobile devices, and cost efficiency, high quality services, connectivity speed are highlighted in [1]. Need for design of new waveforms for 5G to fulfill the requirement of having better Spectral Efficiency, high data rate, low latency, increasing the battery life has been emphasized in [2]. Among the new waveform techniques FBMC is most promising technique and considered for this project. An over view of FBMC, its implementation and its advantages over OFDM are discussed in [4] and [3]

The major concern with the wireless time varying channels when transmitting a signal is its nature and behavior for that period of duration. When mobile systems are used for transmission and reception across these time varying channels, the signals are subjected to ISI and multipath fading [5]. These are the key setbacks which worsen the quality of received signal. Performance of any system which suffers from fading can be improved by employing receiver Diversity techniques [6]. Several research works have been done on analyzing the BER performance of diversity techniques in Rayleigh fading Channel. Three Diversity combining techniques that improve the reception quality are Maximal Ratio combining (MRC), Selection Combining (SC) and Equal Gain Combining (EGC) [7].

MAXIMAL RATIO COMBINING

Maximal Ratio Combining (MRC) provides better BER performance as compared to other two diversity techniques [8]. In MRC signals from different receiver branches are weighted by their SNR and then added. The output of the MRC block will be the sum of all individual branches. Even though none of

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the branches signals are not acceptable, MRC will produce acceptable SNR output [9].

FBMC OVER OFDM

Though cyclic prefix-OFDM provides robustness to system, inter symbol interference and inter carrier interference cancellation abilities, it reduces the efficiency of spectrum utility. The degree of freedom towards flexibility provided by CP-OFDM is less. On the other hand, Multicarrier Modulation technique is generalized by Filter Bank Multi Carrier (FBMC). Instead of using Cyclic prefix like OFDM, FBMC scheme uses pulse shaping filters to shape modulated signals on each sub-carrier. Where OFDM filters the whole band while FBMC filters each subcarrier exclusively and delivers narrowband sub channels in time and frequency domain. New degree of freedom is achieved with FBMC in enhancing the waveforms towards several different channel characteristics, which is an improvement over CP-OFDM. Since there is no need for cyclic prefix in FBMC signal transmission, it utilizes spectrum resource in an efficient manner [10].

PROPOSED METHODOLOGY

The proposed model of this paper is designed and simulated using the software called Simulink. Random integers are used as the input and are fed to FBMC transmitter. A Rectangular QAM Modulator block modulates 16-QAM with constellation on a rectangular lattice. With OQAM Pre-processing serial to parallel conversion is done. A multiport selector is used to separate incoming row index into even and odd index. The Complex to Real-Imaginary block converts incoming complex signal into real and imaginary values. A part of the imaginary signal is delayed and added with real part. Signal is then given to bank of Raised cosine transmit filters. IFFT is then performed by IFFT block.

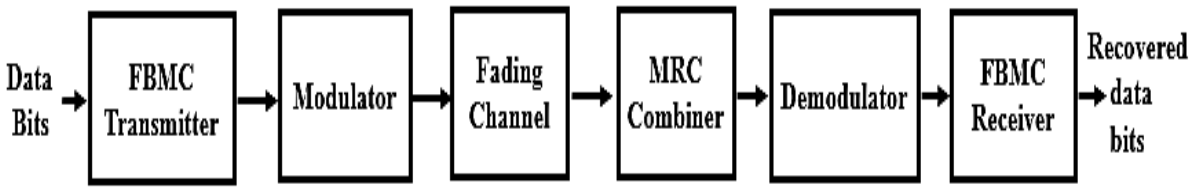

***Fig: 1** Block diagram of proposed system*

Then generated FBMC signal is then up sampled over a carrier frequency of 6GHz and transmitted over a fading channel. At receiver the incoming signals are first combined by Maximal Ratio Combiner block. Input at FBMC receiver is then first applied to FFT block which demodulates each carrier. Raised cosine receiver filter block filters the input using square root cosine FIR filter. Fallowed by filtering process OQAM post processing is done where incoming signal is down sampled and real and imaginary are extracted from the complex signal. 16- QAM De-mapper converts the complex signal to integer values. BER is calculated for received and transmitted integer values.

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SIMULATION RESULTS

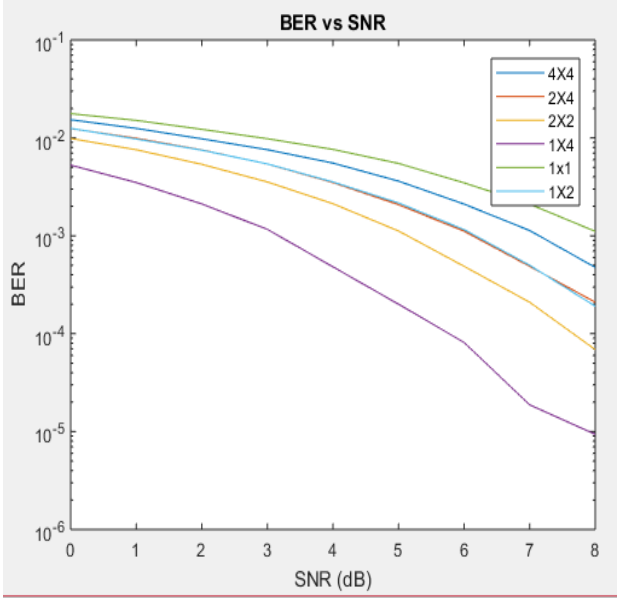

***Fig: 2** BER versus SNR over different Tx and Rx configuration*

The performance of Maximal Ratio Combining for SIMO configurations like 1X2 and 1X4 and MIMO configurations like 2X2, 2X4 and 4X4 are analyzed with Filter bank multi carrier technique and plotted as shown in figure2. It is observed that MRC combining techniques gives its best performance with FBMC for SIMO channel configurations. In the MIMO configuration as the number of transmitting antenna increases the BER performance decreases.

CONCLUSION

In this work the performance of FBMC with receiver diversity technique is investigated for different antenna configurations for 5G signal. With FBMC Maximal Ratio combining gives an optimal performance for SIMO configurations.

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