A Review on Study and Implementation of Universal Filter Multicarrier

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Abstract : The purpose of this project is to compare the proposed 5G modulation techniques UFMC against OFDM which is the modulation technique used in 4G communications. We compare key parameters of these modulation techniques to analyze the merits of each candidate. The parameters Power spectral density, spectral efficiency, Bit Error rate and Peak to average power ratio are considered for evaluation. Universal Filtered Multi-Carrier (UFMC) where blocks of subcarriers are filtered before transmission and reception for the same purpose of eliminating inter carrier and inter symbol interferences Adjacent Channel Power Ratio analysis and several other metric analysis are performed using Matlab simulations to characterize the waveforms

***IndexTerms* - : 4G, 5G, UFMC, OFDM, Spectral Efficiency**

I. INTRODUCTION

The rise of mobile devices in today's world has led to a dramatic increase in load of existing communication networks. It has become a necessity for these networks to greatly improve their data rates and reliability to cope up with the ever increasing mobile traffic. The 4G technology brought a significant improvement in Data rate and reliability. The OFDM modulation technique used for 4G is capable of very high data rates. However, the use of cyclic prefixes and guard bands to avoid too big side lobes, results in a loss of 16% of spectral efficiency compared to theoretical performance. Several modulation techniques have been proposed to solve the shortcomings of the OFDM technique. Although OFDM has been a great success and still has many advantages, there are many ideas for new 5G waveforms that could bring additional advantages to the new cellular system under certain conditions and circumstances. The potential requirement includes high speed data, provide low latency transmissions and energy efficient communications. No single waveform provides all the advantages and answers that are needed. This might result in 5G having an adaptive solution using optimal waveform for a given situation. There are several modulation techniques that are being considered for 5G. These include Filter Bank MultiCarrier (FBMC), Universal Filtered MultiCarrier (UFMC) and Generalized Frequency Division Multiplexing (GFDM). Here, we compare FBMC and UFMC modulation techniques against the existing OFDM technique,

II. What is 5G?

There have been a lot of expectations and views about the ultimate form that 5G wireless technology should take. In order to meet the industry and user needs, it is necessary to accommodate all requirements within the definition process, ensuring that the final definition meets the majority of users' needs without becoming so demanding that any system cannot succeed. The following set of requirements have been widely accepted as a set of requirements for 5g technology

- 1-10Gbps connections
- 1 millisecond end-to-end latency
- 1000x BW per unit area
- Reduced network energy usage
- High battery life for low power devices
- 10-100x number of connected devices

The requirements listed above cover a wide range and many believe cannot be satisfied through a single technique. The new scheme should be designed in a way to enable a number of different radio access networks to work simultaneously meeting its own needs

III. UFMC

UFMC is seen as a generalization of Filtered OFDM and FBMC (Filter Bank Multicarrier) modulations. The entire band is filtered in filtered OFDM and individual subcarriers are filtered in FBMC, while groups of subcarriers (sub bands) are filtered in UFMC. This subcarrier grouping allows one to reduce the filter length (when compared with FBMC). Also, UFMC can still use QAM, which works with existing MIMO schemes. The full band of subcarriers (N) is divided into sub bands. Each subband has a fixed number of subcarriers and not all sub bands need to be employed for a given transmission. An N-pt IFFT for each subband is computed, inserting zeros for the unallocated carriers. Each subband is filtered by a filter of length L, and the responses from the different sub bands are summed. The filtering is done to reduce the out of band spectral emissions. Different filters per subband can be designed, however, in this example, the same filter is used for each subband. A Chebyshev window with parameterized side lobe attenuation is employed to filter the IFFT output per subband.

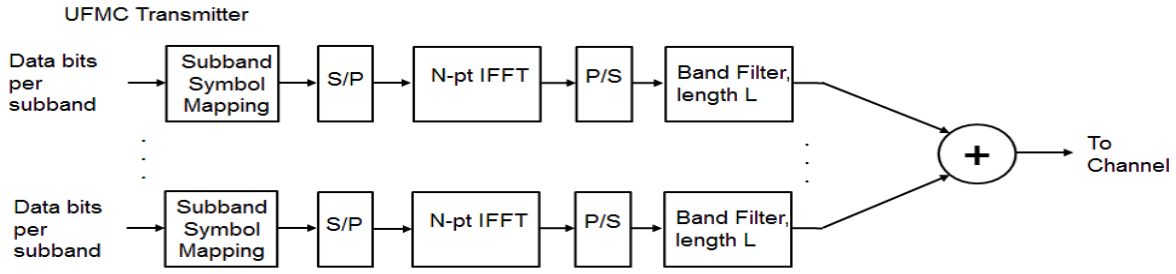

Figure 1. UFMC Transmitter

The example next highlights the basic UFMC receive processing, which is FFT based, as is OFDM. The subband filtering extends the receive time window to the next power of two length for the FFT operation. Every alternate frequency value corresponds to a subcarrier main lobe. In typical scenarios, per subcarrier equalization is used for equalizing the joint effect of the channel and the subband filtering. In this example, only the subband filter is equalized because no channel effects are modeled. The receive - end processing is shown in the following diagram

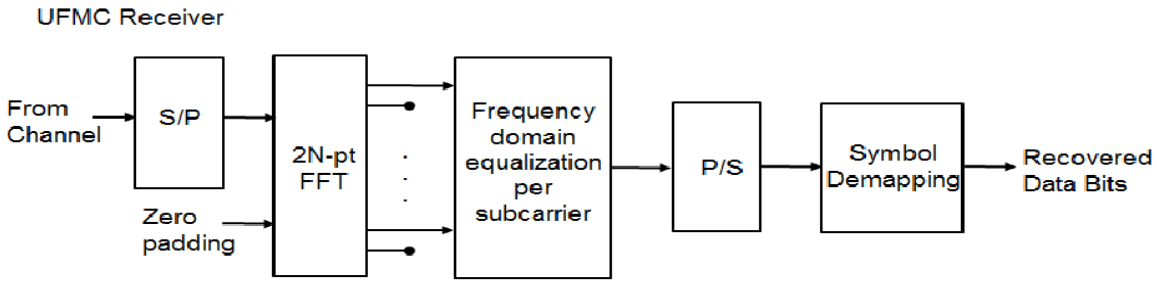

Figure 2. UFMC Receiver

UFMC is considered advantageous in comparison to OFDM by offering higher spectral efficiency. Subband filtering has the benefit of reducing the guards between sub bands and also reducing the filter length, which makes this scheme attractive for short bursts. The latter property also makes it attractive in comparison to FBMC, which suffers from much longer filter length.

IV. PROPOSED WORK

The paper involves comparison of modulation technique for 5G. 5G standard is not completely established and thus uses a number of modulation techniques. Here, we compare modulation techniques such as OFDM, FBMC, UFMC. The comparison involves simulating these modulations over different set of parameters. The results obtained includes measurements such as spectral efficiency, BER vs SNR, PAPR and power spectral density. The implementation is performed using MATLAB.

V. CONCLUSION

The goal of the project to obtain a performance analysis of different modulation schemes FBMC,UFMC,OFDM implemented in 5G communications. This helped in obtaining the efficiency of the modulation techniques considering parameters like PAPR,BER,Spectral Density and Spectral Efficiency. This could further be enhanced by applying the modulation on schemes across different wireless communication on channels. MIMO feature could be added to test the capability of the system for multiple users..

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