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Review Paper on Filter Optimization 5G Technologies for FBMC Transceiver for High Power Amplifiers

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***Abstract*—** Filter bank Multicarrier (FBMC) is a novel technique evolved from OFDM which resolves most of these problems by taking a filtering approach to multicarrier communication system. FBMC signals can easily meet the Adjacent Channel Leakage Ratio (ACLR) and they do not use cyclic prefix thus improves spectral efficiency. The Filter bank Multicarrier (FBMC) transmission technique also leads to enhanced physical layer for future communication systems and it is an enabling technology for cognitive radio environment. Due to the inclusion of band-limited pulse shaping filters into the signal model in FBMC technique, the design of efficient transceiver architectures for multicarrier systems becomes a challenging task. In this paper the studied of MIMO technique for FBMC transceiver for 5G technologies is presented.

Keywords: **-** Filter Bank Multicarrier (FBMC), Filter Bank, MIMO System, 5G Technology

I. INTRODUCTION

In every decade, new generation of wireless communication system is launched. The functioning of cellular system for mobile communication is begun in the year 1981 through First generation (1G). This technology based on analog in nature and offered poor spectrum utilization and security features. In the year 1992 based on digital modulation techniques; the Second generation (2G) was deployed. It is primarily meant for voice and very low data transmission. To provide high data rate and to enhance voice security features Third generation (3G) was made available for communication in the year 2001. In third generation (3G) communication system apart from mobile telephone, new modes of communication systems takes place major part, such as WLAN protocols, Bluetooth and 802.11 protocol suits. Third generation cellular mobile communication system offered high speed data rate and greater bandwidth utilization for the users. Fourth generation (4G) was developed in the year 2011, for efficient utilization of available bandwidth, long range connection of the devices and high speed real time data transmission. As this is the 4G era, wireless communication is moving towards providing high speed connectivity to costumers through IP (Internet Protocol) based technology and Long Term Evaluation (LTE) systems. As the requirement for bandwidth increases, the next generation wireless communication will gain more demand compared to present3G and 4G systems. The innovations of new wireless communication systems have their phases of development and decay sooner or later. It is very uncertain whether next generation is beginning new era in the year 2020. Currently fourth generation (4G) cellular mobile communication system was established and publics are experiencing services. Still they are looking towards the deployment of fifth generation (5G) technology to experience more advancement in new technologies. Based on the present research studies 5G technologies for cellular mobile communication systems can come to end result around 2020. Because the development and establishment of any cellular system is requires several years. The 5G cellular mobile communication devices are quick enough to communicate with each other compared with 4G and LTE systems. And also, 5G is relied upon to accomplish enhanced framework limit and throughput. The main aim of 5G research and development is to improve device-to-device communications, at lower cost, lower latency and better implementation than previous generation. This can be enabled by developing sophisticated machines, like advanced field programmable gate arrays and digital signal processors. These hardware devices allow the use of efficient algorithms implementation for communication system. The potential applications of 5G technology is to facilitate to the users for high speed video downloads, vehicle-to-vehicle communications, and general cellular communication systems.

II. LITERATURE REVIEW

Zongmiao He et al. [1], filter optimization of out-of-band emission plays an important role for FBMC-OQAM system. The main idea of this paper is to minimize the stopband energy with constraints of side lobe and inter channel interference (ICI)/inter symbol interference (ISI) by optimizing the filter coefficients. The main contribution is that the improved approach reduces the stop band energy and suppresses the side lobe simultaneously with nearly perfect reconstruction (NPR) condition. Simulation results show that the improved filter reduces the stop band energy and the side lobe more than the optimized windowing based filter. Meanwhile, the improved filter has almost the same bit error rate (BER) performance as the optimized windowing based filter for FBMC-OQAM system in additive white Gaussian noise (AWGN) channel.

Mawlawi, B. et al. [2],initial 5G organizations should be in reverse perfect with existing 4G frameworks, i.e., a 5G eNB likewise needs to help 4G UEs. UFMC can be effortlessly coordinated into the uplink (UL) of existing 4G frameworks by essentially supplanting the last advance of the SC-FDMA flag age with a UFMC modulator (see Fig. 1). The collector of the eNB can stay unaltered and will work ordinarily if the UE is completely synchronized to the system. As we will see later, the extra sifting in the UFMC flag age brings about the way that little planning balances don't make any impedance to transmissions from different UEs in neighboring asset pieces. Be that as it may, an extra planning estimation step is required at the eNB. UFMC along these lines empowers the transmission of short bundles without the necessity of experiencing the full connection system. At the point when a UE awakens, it simply needs to synchronize the phone on the DL in both recurrence and time, however as opposed to transmitting an introduction on the physical arbitrary access channel (PRACH) to start the association and permit the eNB to gauge and flag the planning development to the UE, it basically transmits its information utilizing the proposed UFMC transmitter on the same PRACH assets.

Viholainen et al. [3], This could be viewed as a super-PRACH since it works similarly as the traditional PRACH yet in the meantime permits the transmission of more data. Lessened intricacy design has been proposed which targets both IFFT and sifting segments of UFMC transmitter. They proposed a 64-guide IFFT toward each physical asset square (PRB) set up of 1024-point IFFT and applying sifting in recurrence area. This is the thing that they call as recurrence area age technique for UF-OFDM. At last, before transmission, the sifted information is changed over once again into time space information by taking IFFT. With this system, they guarantee that if the traditional plan of UFMC transmitter has unpredictability of 150 times that of CP-OFDM at that point applying recurrence area arrangement the multifaceted nature decreases to 120 times that of CP-OFDM.

Chen, D. et al. [4], the FFT (Fast Fourier Transform) and its opposite (IFFT) are the key parts of OFDM (Orthogonal Frequency Division Multiplexing) structures. Starting late, the enthusiasm for long length, quick and low-control FFT has extended in the OFDM applications. There are three sorts of essential setup models for realizing a FFT processor. One is the single-memory outline. It influences them to process part and one essential memory. Thusly, it includes a little zone. The second is the twofold memory plan, which has two memories. This outline has a higher throughput than the single-memory building since it can store butterfly yields and read butterfly contributions to the interim. The speedy Fourier change expect a basic part in various modernized flag dealing with (DSP) structures. Late advances in semiconductor planning development have engaged the game plan of dedicated FFT processors in applications, for instance, data exchanges, talk and picture taking care of. Specifically, in the OFDM correspondence systems, FFT and in reverse FFT (IFFT) accept a key part. The OFDM methodology, as a result of its sufficiency in defeating negative channel impacts and also run utilization, has ended up being comprehensively grasped in wire line and remote correspondence standards.

P. Siohan, C. et al. [5], the OFDM technique has been grasped in a couple of measures like automated sound TV (DAB) [3], propelled video TV physical (DVB-T) [4], unbalanced mechanized supporter line (ADSL) [5] and quick propelled endorser line (VDSL) [6]. As needs be, capable and low-control VLSI use of FFT processors is principal for productive course of action of these OFDM-based systems. According to the rules of DAB, DVB-T, ADSL and VDSL, distinctive FFT sizes are required, as showed up in Table 1. From this Table, evidently factor length FFT gear is an essential module in the insignificant exertion game plan of the above correspondence systems. The Cooley – Tukey N-point FFT figuring requires O(Nlog N) counts, which is a titanic saving over direct estimation of the discrete Fourier change (DFT). Regardless, hardware utilization of the figuring is both computational genuine, to the extent calculating activities, and correspondence raised, the extent that data swapping. For progressing planning of FFT, O(log N) math tasks are required per test cycle. Rapid constant preparing can be proficient in two diverse ways.

III. FILTER BANK MULTICARRIER (FBMC) TECHNIQUE

The filter bank multicarrier scheme was introduced first time by Saltzberg and Chang in the year 1971. FBMC is also a family of OFDM technique. In the beginning this approach were adopted to support the OFDM technique. The main intention to identify this technique is to overcome the limitations of existing multicarrier modulation schemes. FBMC uses specific pulse shaping filters which generates good confine sub-band in time and frequency domain with the help of filter bank and its poly phase structure. In communication system, digital signal processing signals have high bandwidth in the range of GHz. Most of the presently available FPGA‘s and DSP Hardware kits are having clock rate in the range of some MHz’s. In order to reduce the clock frequency, multiplexing techniques are used to sort out the required data rate at lesser clock frequency. The efficient way of achieving this task, is through adopting filter bank multicarrier modulation (FBMC) technique for sub-band processing of input signals. FBMC is considered as a promising alternative multicarrier technique for future communication systems. The next generation of mobile communications (5G) is ambitious by more spectral efficient wave-forms. FBMC has gained a high degree of interest to provide flexibility for 5G mobile communications system, as a 5G waveform candidate. In the advancement in digital signal processing (DSP) capabilities, research has been carried out to identify alternative to existing multicarrier modulation technique for next generation communication system.

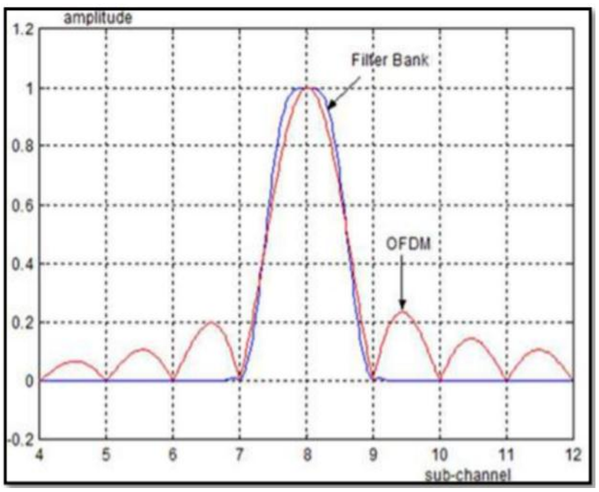

Figure 1: Time domain response of FBMC prototype filter and OFDM technique

Due to the finite transition region at the end of the FIR pass band, small gaps are produced between the sub-bands, which avoid crosstalk and spectral leakage. Analysis filter bank is used at transmitter for sub-band processing of higher band into several lower band signals with the help of decimation filter. After processing of signals, Synthesis filter bank is used at receiver to form a replica of the original signal, using interpolator based on the sub-band channels. Finally, sub-band channels are recombined into a full band output signal.

IV. BLOCK DIAGRAM OF FBMC

Most of the investigated and analyzed new communication techniques are algorithmic stage. Hardware and software implementation cost are considered as main parameters required for future mobile communication systems. But, for practical implementation of any wireless communication system are bound by many parameters. These parameters include economical, social, hardware complexity and essential need of users. These constraints can be achieved effective use of resources and technology. Therefore, this thesis mainly deals with design and implementation of advanced and efficient hardware architecture, which may be suitable for the physical layer of future communication (5G) transceiver architecture prototype on FPGA. With this essence, a novel hardware architecture design for future communication (5G) system, based on Filter Bank Multicarrier modulation technique is presented. This technique is being studied and considered these days by recent researches for the future adoptable 5G air interface. It provides enhanced range of spectrum compartment compared to conventional multicarrier modulation technique and allows enhanced mobility management. There are some other alternative and subcategories for FBMC as well.

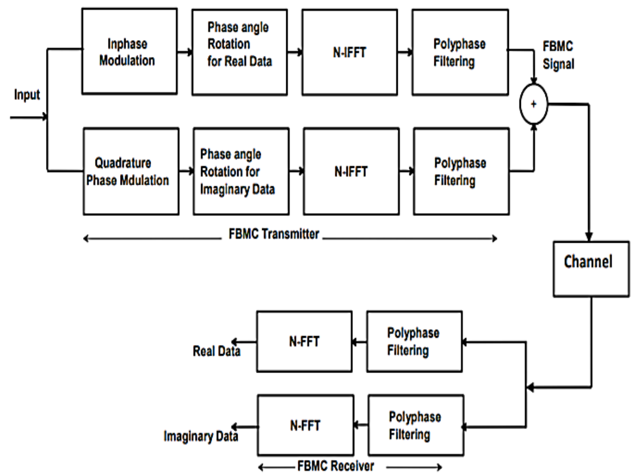

Figure 2: Block diagram of FBMC transceiver

V. POWER AMPLIFIER INTEGRATION

Working closely with leading edge semiconductor suppliers, API Technologies exploits the benefits of innovative semiconductor technologies, paving the way toward increased power density and complexity while reducing the overall size of the amplifier. This translates to power amplifier solutions that are reliable, smaller, lighter, and more efficient.

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VI. PROPOSED METHODOLOGY

There are different categories of prototyping transmitter for FBMC transceiver. Many FBMC transmitters are designed using NK-IFFTs and it requires more signal processing operations. And also, it requires more computational complexity to reduce the complexity in IFFT and avoid the overlapping of signals in the receiver instead of parallel implementation of NK-IFFTs; we are only utilizing 2 N-IFFTs. Where N indicates number of inputs and K represents overlapping factor of each sub-band. So the range of the impulse response is L= NK. To construct the FBMC signal it performs the Inverse - Fourier transforms (IFFT) both sides and then it performs the poly phase filtering.

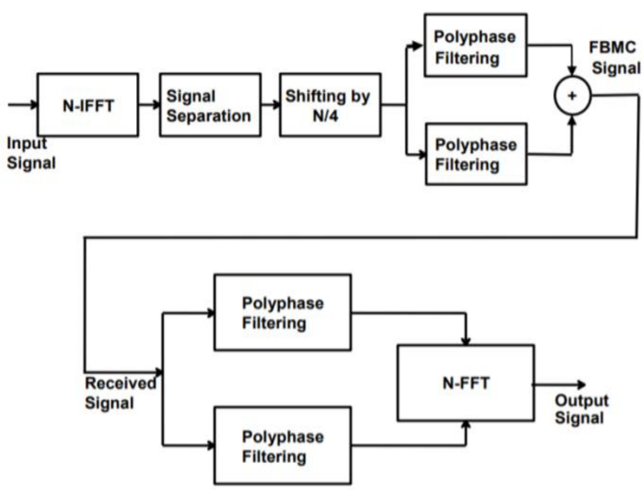

Figure 3: Simplified FBMC transceiver

The multiplication of IFFT with phase rotation vector θ k in frequency domain leads to circular shift of N/4 in time domain, which results in reconstruction of the FBMC signal N-IFFT Signal Separation Shifting by N/4 Poly phase Filtering Poly phase Filtering + FBMC Signal Input Signal Poly phase Filtering Poly phase Filtering Received N-FFT Signal Output Signal by utilizing two poly phase filter modules as depicted in the above Figure 3. To construct the FBMC signal in transmitter, we can use NK-IFFT and Poly phase filters. In receiver, we may use poly phase filtering stage and NK-FFT to recover data. In order to retrieve the original signal back, pipelined FFT Architecture is used. By using pipelined FFT Architecture it is easy to compute higher FFT point by making short variations in the code. Therefore, with this architecture, the complexity level and area utilization get reduces while the speed of communication system improves.

VII. CONCLUSION

Both OFDM and FBMC strategies depend on the basic working principles of IFFT/FFT computational engines. However, the procedure of adding CP in OFDM prompts an overhead that adversely impacts on the transmission bandwidth efficiency. Though cyclic prefix is absent in case of FBMC and blend of filter banks prompts greatest productivity and information transmission speed. A similar channel bank can be utilized for transmission and reception in FBMC transceiver architecture which ensures low BER and high performance compatibility in terms latency and throughput. The out-of-band reduction of the prototype filter amplitude curve in FBMC system assures spectral preservation of other subscribers which leads to new physical layer containment for future communication system.

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