An Efficient Modulation Scheme Based on FBMC-OQAM for Future Generation Wireless Communications

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Abstract : Future Wireless communications technologies give more applications in various fields. Filter bank multicarrier employing offset quadrature amplitude modulation (FBMC/OQAM) technology is considered as a data transmission scheme for 5th generation. Filter bank multiple carriers (FBMC) with OFDM scheme give better performance in terms of necessary parameters. This paper proposed an efficient modulation scheme based on FBMC-OQAM for communication advancements. Simulation result shows that proposed method gives significant better performance than existing approach.

IndexTerms - *FBMC, OQAM, OFDM, LTE, wireless, Generation.*

I. INTRODUCTION

Filter bank multicarrier (FBMC) is an elective transmission strategy that settles the above issues by utilizing brilliant filters that stay away from both entrance and departure clamors. Likewise, as a result of the extremely low out-of-band emanation of subcarrier filters, use of FBMC in the uplink of multiuser systems is insignificant. It tends to be sent without synchronization of portable client hubs signals. In the utilization of intellectual radios, the filter bank that is utilized for multicarrier information transmission can likewise be utilized for range detecting. Then again, contrasted with OFDM, FBMC misses the mark in giving multiple-input multiple-output (MIMO) channels, despite the fact that a couple of answers for embrace FBMC in MIMO diverts have been accounted for in the writing. By the by, as our ongoing exploration examine has appeared, in the rising territory of enormous MIMO, FBMC is found as amazing as OFDM and now and again better than OFDM.

Previously, numerous endeavors have been made to embrace FBMC in different gauges. Clearly, the soonest proposition to utilize FBMC for multicarrier correspondences is a commitment from Tzannes et al. of Mindful Inc., in one of the hilter kilter computerized supporter lines (ADSL) standard gatherings in 1993. The proposed strategy that was called discrete wavelet multitone (DWMT) was additionally considered in. Regardless of energy from the examination network, DWMT was not received in the ADSL standard. This was somewhat a direct result of the apparent unpredictability of this strategy when contrasted with its adversary, DMT (discrete multitone, a proportional name for OFDM in DSL writing). In reality, the DWMT structure proposed by Tzannes et al. was fundamentally more mind boggling than that of DMT. The significant piece of the multifaceted nature of DWMT originated from the balance strategy that was embraced. The point by point discourse displayed in accepted that one needs an equalizer that joins signals from each subcarrier band and its adjoining groups. Ordinary equalizer lengths proposed in were 21 genuine esteemed taps for every subcarrier.

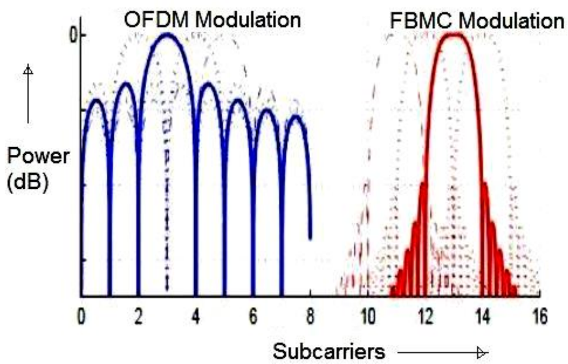


Figure 1: FBMC-OFDM Modulation

It was later noted by the creator of this work if each subcarrier is adequately restricted with the end goal that it very well may be approximated by a level increase, two genuine taps for every subcarrier would be adequate for evening out. This perception prompted further investigation of DWMT. In electrical cable interchanges (PLC) people group, it has been named wavelet OFDM and was embraced in the IEEE P1901 standard. The fundamental inspiration for utilization of DWMT in DSL and its reception later in PLC was to manage entrance and departure clamors, since both DSL and PLC utilize unshielded copper lines that are liable to solid radio impedance. Besides, in 1999, a FBMC technique with non overlapping subcarrier groups was proposed as an answer for filtering the limited band impedances in extremely rapid DSL (VDSL) channels. The proposed strategy was called filtered multitone (FMT). This suggestion that was incorporated as an extension in one of the underlying draft reports of VDSL was additionally created by various specialists. Be that as it may, to stay away from incongruence with ADSL, FMT was excluded in the last archive of the VDSL standard. Another fruitless story is an endeavor by France Telecom to present FBMC in the IEEE

802.22, a subjective radio standard to get to television groups in remote country region systems (WRAN). Up to now, evidently, the main standard for radio transmission that utilizes FBMC is the TIAs Computerized Radio Specialized Standard.

II. FBMC MODEL

As we have seen that, more trucks are used to transport the load, the fewer packets are going to be carried by each one, the easier it is for each truck to complete the journey, and the less load is going to be lost in case of an accident. Then, it can be said that in an OFDM transmission a large number of subcarriers is desirable so that the minimum possible quantity of data is lost in case of any non-ideality occurring in the transmission channel.

However, creating an OFDM signal with a large number of subcarriers following the analogue method presented before leads to an extremely complex architecture involving many oscillators and filters at both the transmit and receive ends. In present-day OFDM transmissions, though, this complexity is reduced by transferring it from the analogue to the digital domain.

To see this, take Equation (3.1), where just one OFDM symbol of the signal s(t) is sampled at an interval of $T_{s/}N$ sec . Then, the n_{th} sample of s(t) becomes:

$$s(nT_s/N) = \sum_{k=0}^{N-1} c_k\, e^{\frac{j2\pi f_k n T_s}{N}} = \sum_{k=0}^{N-1} c_k\, e^{\frac{j2\pi kn}{N}} = \mathcal{F}^{-1}\{c_k\} \qquad (1)$$

Where Ƒ is the Fourier transform, and n € [1, N]. Thus, it can be said that the discrete value of the transmitted OFDM signal s(t) is merely a simple N-point inverse discrete Fourier transform (IDFT) of the information symbol . The same case can be applied at the receiver, where the received information symbol will be a simple N-point discrete Fourier transform (DFT) of the received sampled signal.

Where f_N is the Nyquist frequency, which will be the highest frequency component of the OFDM signal. This ideal filter will remove the alias generated due to the sampling process, leaving the fundamental signal untouched.

The contribution of the different sinc pulses at each of the samples of the OFDM symbol results in a perfect square pulse of the OFDM symbol, and each of the subcarriers would be represented by a perfect sinc function in the frequency domain.

FBMC is interested by researchers and many equalization and synchronization methods to develop this modulation have been improved and showed in Figure 2. Transmitted signal is formulated in Equation 2.

$$s(t) = \sum_{k=0}^{K-1}\sum_{l=0}^{L-1} g_{l,k}(t)x_{l,k} \qquad (2)$$

When $s(t)$ is accepted as transmit signal, data symbols are $x_{l,k}$, basis pulses are $g_{l,k}$ and 1 describes frequency position, k describes time position. Basis pulses $g_{l,k}$ also formulated as Equation 2, a time and frequency shifted sample of prototype filter $p(t)$ which is based on Hermite polynomials showed in Equation 3.

$$g_{l,k}(t) = p(t-kT)e^{j2\pi lF(t-kT)}e^{j\frac{\pi}{2}(l+k)} \qquad (3)$$

$$p(t) = \frac{1}{T_0}e^{-2\pi(\frac{t}{T_0})^2} \sum_{\substack{i=\{0,4,8,\\12,16,20\}}} a_i H_i(2\sqrt{\pi}\frac{t}{T_0}) \qquad (4)$$

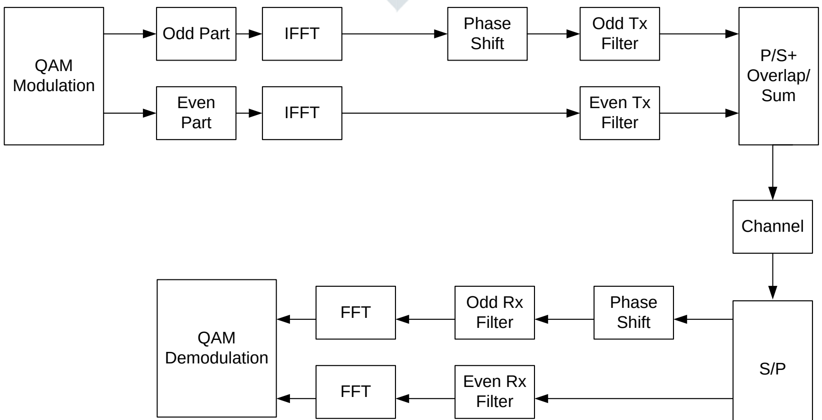


Figure 2: QAM FBMC block diagram

In Equation 3, when the basis pulses for in $T = T_0$ time spaces and frequency spacing in $F = \frac{2}{T_0}$. While maximum spectral efficiency is obtained for $TF = 1$ that is not relevant for placed pulses in time and frequency domain.

III. PROPOSED FBMC-OQAM SYSTEM

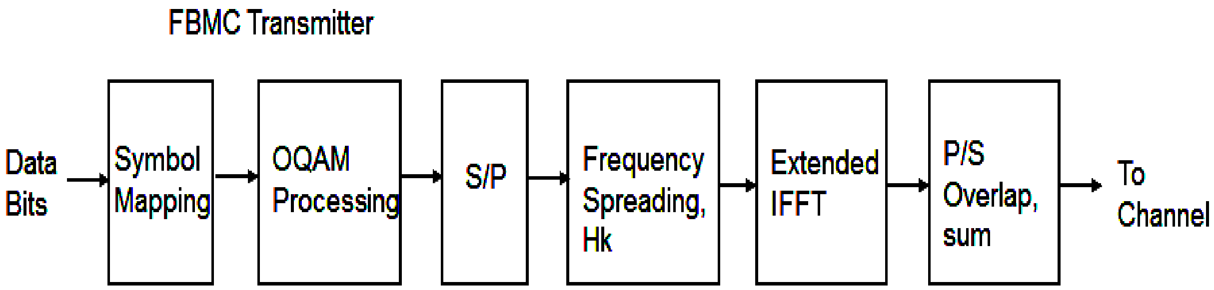


Figure 3: FBMC-OQAM Transmitter

Figure 3 demonstrating FBMC filters each subcarrier adjusted sign in a multicarrier framework. The model filter is the one utilized for the zero frequency bearers and is the reason for the other subcarrier filters. The filters are portrayed by the covering factor, K which is the quantity of multicarrier images that cover in the time area. The model filter request can be picked as 2*K-1 where K = 2, 3, or 4.

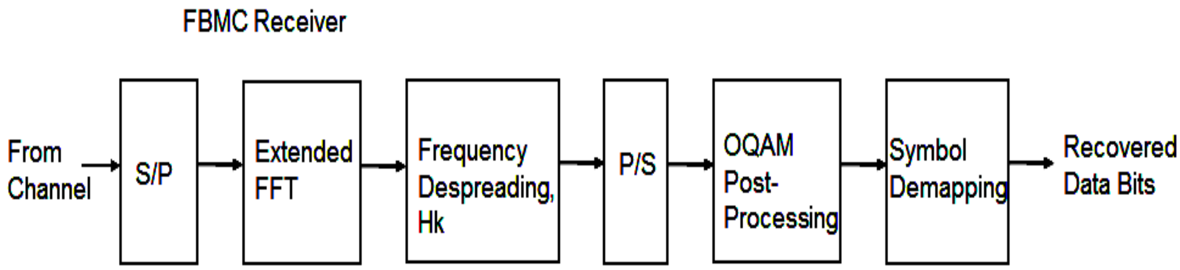


Figure 4: FBMC Receiver

Figure 4 is appearing of an essential FBMC demodulator and measures the BER for the picked setup without a channel. The handling incorporates coordinated filtering pursued by OQAM division to frame the got information images. These are de-mapped to bits and the resultant piece blunder rate is resolved. Within the sight of a channel, direct multi-tap equalizers might be utilized to relieve the impacts of frequency-selective fading.

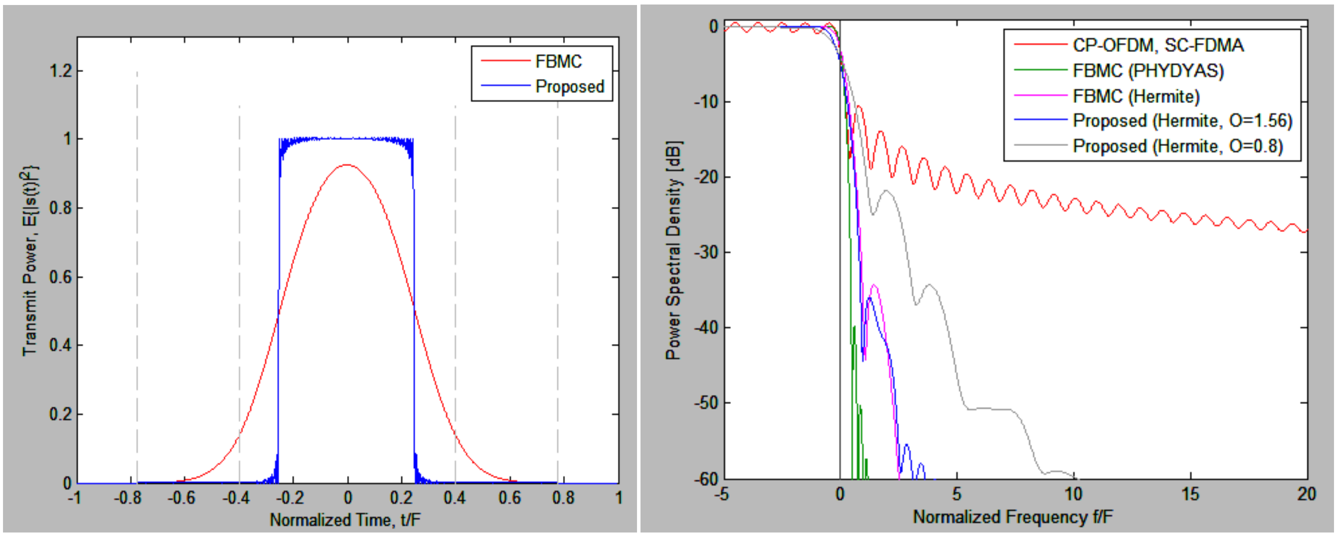
The current FBMC usage utilizes frequency spreading. It utilizes a N*K length IFFT with images covered with a deferral of N/2, where N is the quantity of subcarriers. This structure decision makes it simple to break down FBMC and contrast and other modulation strategies. To accomplish full limit, counterbalance quadrature plentifulness modulation (OQAM) preparing is utilized. The genuine and fanciful pieces of a perplexing information image are not transmitted at the same time, as the imaginary part is delayed by half the symbol duration.

IV. SIMULATION AND RESULT

Table.1: Simulation parameter

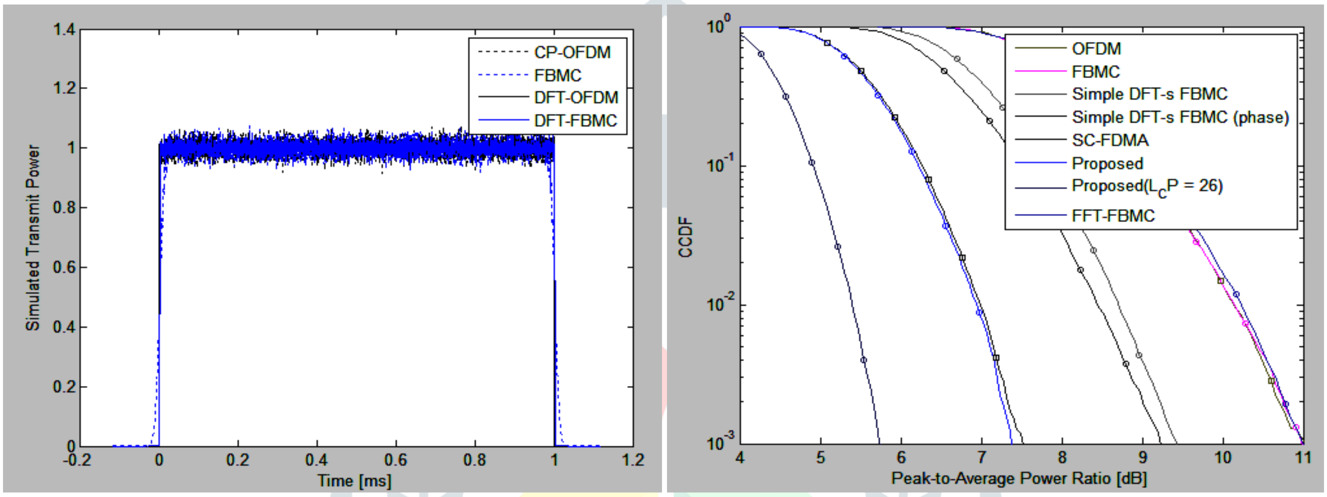
Sr No.	Parameter	Value
1	No of channel	1
2	Modulation order	3
3	SNR	50 dB
4	Modulation name	PAM
5	Monte carlo repetition	1
6	Noise	0.0012

Table 1 is showing simulation parameter, which is using during simulation; we can change the simulation value as per model and simulation scenario.



(a) (b)

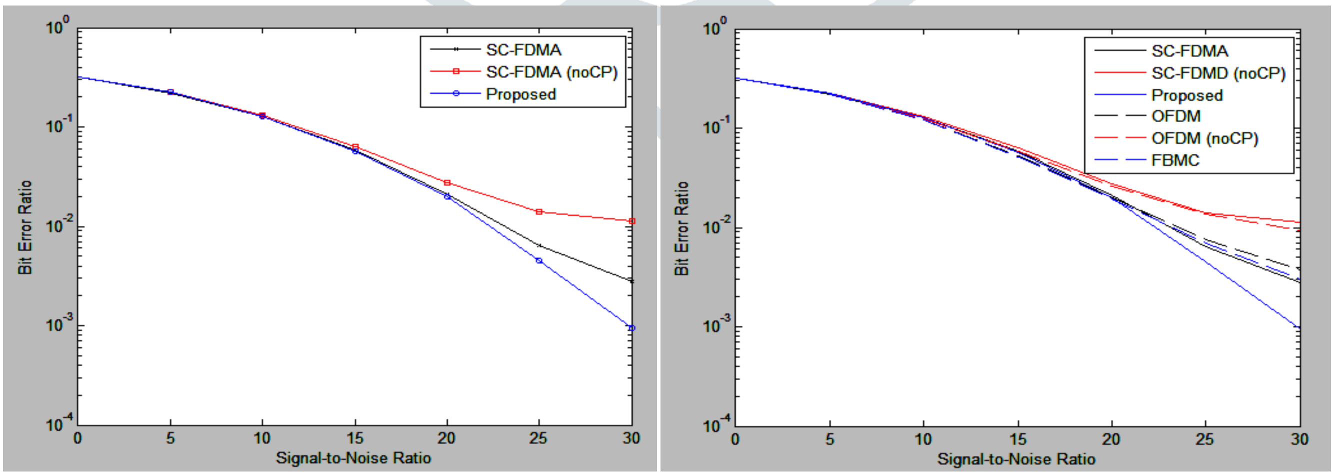
Figure 5: (a) Transmit power vs time (b)Power spectral density vs normalized frequency



(a) (b)

Figure 6: (a) Simulated Transmit power vs time (b)CCDF vs PAPR

Figure 5 and 6 are showing the transmitted power vs time analysis and some parameters like PAPR, complementary cumulative distribution function (CCDF). Therefore the result graph shows that there are various modulation schemes for advance wireless communication. Proposed scheme gives better results than previous.



(a) (b)

Figure 7: (a) SNR vs BER when SC-FDMA (b) SNR vs BER when FBMC

Figure 7 is showing bit error rate vs signal to noise ratio comparison graph. It is clear from graph proposed scheme gives better signal to noise ratio and reduced bit error rate.

Table 2: Comparison of previous work with proposed work

Sr No.	Parameter	Previous Work	Proposed Work
1	Software	MATLAB	MATLAB
2	Proposed Method	Novel scheme (FBMC-FDMA)	Efficient Approach (FBMC-OQAM)
3	Simulation Time	NA	200 Sec.
4	Complexity	Two times higher	Less Complex
5	Modulation Scheme	OQAM	New
6	PAPR	4.5	3.8
7	Latency	1.6ms	1.2ms
8	Spectral Efficiency	7.2	9.3
9	SNR	30	50
10	BER	10^{-2}	10^{-3}
11	Power Spectral Density	-22dB	-23dB
12	Bit Rate	7680000 Bits/sec	7680000 Bits/sec

V. CONCLUSION

A method of designing FBMC systems for a near-optimum performance in doubly dispersive channels is presented and its superior performance over OFDM is shown. As a multicarrier scheme, FBMC can benefit from multi-antenna systems. MIMO techniques can also be applied Modulation and multiplexing is a key technique to make successful communication in long distance. Future wireless communication proposed various new single and hybrid technique for modulation and multiplexing like NOMA replace the OFDM. FBMC has also a lot of advantages, due to this researcher are proposing this technique. This paper proposed FBMC-OQAM technique for new modulation scheme in next generation communication applications.

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