A Review of WiMax-Orthogonal Frequency Division Multiplexing (OFDM) For PAPR and ISI

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Abstract- WiMAX (Worldwide Interoperability for Microwave Access) is a technology which can offer high speed voice, video and data services as per demand of customer's end. It provides data rates up to 75 Mbps over the distance of 50 km. WiMAX uses frequency bands of 10-66 GHz, covering long geographical areas using licensed or unlicensed spectrum. Many technologies have been investigated so far to reduce increase PAPR and throughput of the WiMAX-OFDM system. This paper presents a comprehensive review of Peak to average power ratio (PAPR) and Inter symbol Interference (ISI) of WiMAX-OFDM system.

Keywords - WiMAX, PAPR, ISI, OFDM

1. INTRODUCTION

Wireless communications using WIMAX offers opportunity to support high data rate and combat the inter-symbol interference (ISI) because of the multipath propagation effects inherently present in the wireless channel. IEEE WiMAX/802.16 is a advanced technology for broadband Wireless Metropolitan Area Networks (WMANs), as it can provide throughput high over long distances and different Qualities of Service (QoS). WIMAX provided a wireless backhaul network that enabled higher speed Internet access to residential, small, and medium business customers, Internet access for Wi-Fi hot spots and cellular base stations [1].Additionally, WiMAX will be represent a serious competitor to 3G (Third Generation) cellular systems for as high speed mobile data, applications of WiMAX and it will be achieved with 802.16e specification. Non-Line of Sight (NLOS) connections is provide in IEEE 802.16-2004 standard, It specifies Orthogonal Frequency Division Multiplexing (OFDM).

WiMAX physical layer is based on OFDM and it supports a variety of modulation and coding schemes. OFDM is the multi carrier transmission scheme to enable high-speed data, video, multimedia communications and is used by a variety of commercial broadband systems [2], [3] and the transmission parameters based on the link quality, improving the spectrum efficiency of the system and the capacity limits of the underlying wireless channel.

Orthogonal Frequency Division Multiple Access (OFDMA) is a multi user of digital modulation technique that had been introduced as associate implementation of WiMAX physical layer [4]. WiMAX use OFDMA to enhance wireless performance as a result of the multipath propagation which may cause ISI [5]. OFDMA has been proposed within the mobility mode of IEEE 802.16 wireless for Metropolitan Area Network (MAN) standard to extend data rate and achieved high speed data association in wireless communication system [6]. OFDMA is completely different with OFDM as a result of the subset of subcarriers will be assigned to different user [7].

The paper is organized as follows: Section II presents the WIMAX OFDM System Model, section III presents the Challenges and issues, section IV presents Literature review, Results and discussions are provided in Section V. Finally, in section VI conclusions are summarized.

2. SYSTEM MODEL

Block Diagram of WiMAX system is shown in Fig. 1 to begin with, random bits are generated and then, coded by means of a concatenated Reed-Solomon (RS) and Convolution encoder. The systematic outer RS code uses a codeword period of 255 bytes, a records length of 239 bytes, and a parity period of sixteen bytes. After coding, an interleave is applied to avoid lengthy runs of low reliable bits on the decoder input. The coding, interleaving, and image mapping are similar to described in the WiMAX IEEE 802.16d specification [8] – [9]. After mapping the bits to symbols, serial-to-parallel conversion is performed to shape OFDM symbols. Pilots, a zero DC provider, and guard companies are introduced. Pilots are used at the receiver for channel estimation. After an inverse rapid Fourier transformation (IFFT), a cyclic prefix (CP) is introduced. CP is a duplicate of the last part of OFDM symbol which is appended to the the front of transmitted OFDM image, cyclic prefix length of one/4 of the entire OFDM symbol period for constant WiMAX (and 1/eight for mobile WiMAX [9]. CP is used to combat inter image interference (ISI) and inter carrier interference (ICI) delivered by the multipath fading channel.

The Multipath Fading channel model used in our simulation for fixed Wi-MAX is SUI-three. This model with SUI-x channel fashions have been based totally at the Stanford university's suggestion for broadband WI-FI get entry to route loss estimation [10].

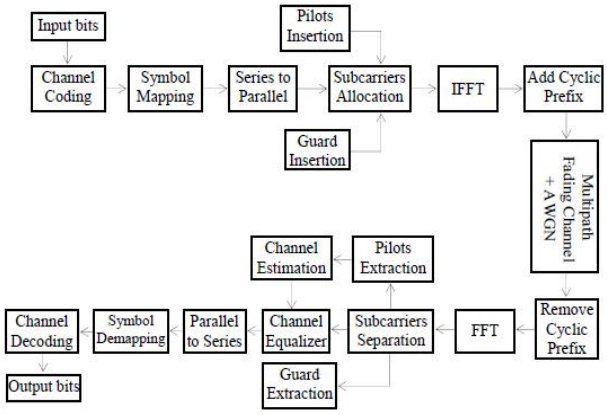

Fig. 1 Block diagram of Wimax system

At the receiver, we first perform the converse operations of the transmitter, that is, cyclic prefix (CP) evacuation, quick Fourier change FFT, extraction of information subcarriers and pilots subcarriers. Keeping in mind the end goal to fix the impacts of the multipath blurring channel, channel estimation and recurrence space evening out ought to be done at the collector. The pilot subcarriers are removed can then be utilized for channel estimation at the areas of pilots. To assess the channel at the information focuses, interjection is utilized. In the reproduction minimum squares (LS) gauge has been utilized for channel estimation at the pilot subcarriers. In the event that the cyclic prefix is longer than the greatest postponement spread of the channel, we can display the impact as a mind boggling augmentation in recurrence area. The evening out subsequently streamlines to an unpredictable division of the got signal by the evaluated channel [11] - [14].

3. CHALLENGES AND ISSUES

A key issue with the utilization of OFDM based balance is the high top to-normal (PAR) proportion of the transmitted OFDM signal. The PAR increments with number of orthogonal bearers (N). Practically speaking, the PAR for a 256-bearer OFDM-adjusted sign (WiMAX) is seen to associate with 12 dB [15]. This is a noteworthy bottleneck in execution of force productive transmitters since the effectiveness (η) of a straight power intensifier (PA) diminishes by an element of two for each 3dB force back off. In this way, for the PA to work in the straight district it must be supported off by at any rate the PAR (where η is low: 5% for class A speakers). In this way, it is very attractive to enhance PAPR execution of the sign.

The sign achieves the recipient end spreading through diverse ways. There will be distinctive postponement time for the got signal. It has comparable impact as clamor that will create poor information transmission. Multipath can bring about entomb image obstruction (ISI) in the remote framework [16]

4. LITERATURE REVIEW

4.1 PAPR REDUCTION TECHNIQUES

To manage this PAPR issue, a few procedures have as of now been produced in the writing for case coding and tone reservation [17], cutting/sifting [18], top windowing [19], incomplete transmit grouping [20][24] and collector redress calculations [21], for example, iterative unraveling. As talked about in [22], every one of these particular strategies gives diverse amounts of adequacy and presents distinctive arrangements of exchange offs that may incorporate decreased ghostly proficiency, expanded many-sided quality and execution corruption. Among these strategies, cutting and sifting is perhaps the most straightforward PAPR decrease plan. This plan straightforwardly cuts OFDM signs to a predefined edge and afterward utilizes a channel to dispense with the out-of-band radiation. All things considered, the separating operation results in crest re-growth. Consequently, iterative cutting and sifting (ICF) is generally expected to stifle the crest re-growth [23].Various PAPR lessening Techniques has been appeared in Fig.2.

4.2 CRITERIA OF THE PAPR REDUCTION [17]

As above analyzed, we find most of existing solutions still have some drawbacks and the obvious one is the trade-off between PAPR reduction and some factors such as bandwidth. The criteria of the PAPR reduction is to find the approach that it can reduce PAPR largely and at the same time it can keep the good performance in terms of the following factors as possible.

1) High capability of PAPR reduction: It is primary factor to be considered in selecting the PAPR reduction technique with as few harmful side effects such as in-band distortion and out-of-band radiation.

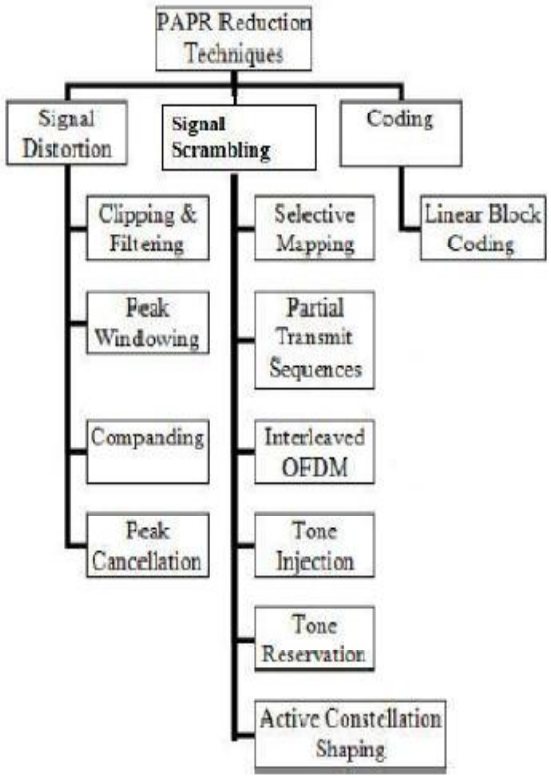

Fig.2 PAPR reduction Technique

2) Low normal force: Although it likewise can decrease PAPR through normal force of the first flags build, it requires a bigger direct operation district in HPA and in this way bringing about the debasement of BER execution.

3) Low usage unpredictability: Generally, many-sided quality procedures display better capacity of PAPR decrease. In any case, by and by, both time and equipment prerequisites for the PAPR lessening ought to be insignificant.

4) No transmission capacity development: The data transfer capacity is an uncommon asset in frameworks. The transfer speed development straightforwardly brings about the information code rate misfortune because of side data, (for example, the stage elements in PTS and corresponding bits in CBC).Moreover, when the side data are gotten in blunder unless a few methods for assurance, for example, channel coding utilized. Accordingly, when channel coding is utilized, the misfortune in information rate is expanded further because of side data. Accordingly, the misfortune in data transfer capacity because of side data ought to be maintained a strategic distance from or if nothing else kept negligible.

5) No BER execution corruption: The point of PAPR decrease is to get preferable framework execution including BER over that of the first OFDM framework. In this way, every one of the techniques, which have an expansion in BER at the beneficiary, ought to be given careful consideration by and by. Additionally, if the side data is gotten in mistake at the recipient, which might likewise bring about entire incorrect information outline and in this manner the BER execution is decreased.

6) Without extra power required: The configuration of a remote framework ought to dependably look into the effectiveness of force. On the off chance that an operation of the system which lessens the PAPR require more extra power, it corrupts the BER execution when the transmitted signs are standardized back to the first power signal.

7) No phantom spillage: Any PAPR diminishment procedures cannot wreck OFDM alluring specialized components for example, resistance to the multipath blurring. In this manner, the otherworldly spillage ought to be kept away from in the PAPR decrease.

8) Other elements: It likewise ought to be given careful consideration on the impact of the nonlinear gadgets utilized as a part of sign handling circle in the transmitter, for example, DACs, blenders and HPAs since the PAPR lessening chiefly stay away from nonlinear contortion because of these memory-less gadgets bringing into the correspondence channels. In the meantime, the expense of these nonlinear gadgets is additionally the essential element to outline the PAPR diminishment plan.

4.3 ISI REDUCTION TECNIQUES

Different equalization adaptive algorithm will be used with decision feedback equalizer (DFE) to overcome ISI problem. DFE is much better compare to linear equalizer because it has lower noise enhancement while processing the received signal [25].But still, ISI is not totally removed from the system even with the help of equalizer. As a solution, cyclic prefix (CP) as a guard interval will be added to help DFE as long as the CP at least equal or larger than channel delay spread [5]. Due to above reason, transmitted symbol that is in linear convolution form change to circular convolution form and ISI will completely eliminated from the system [26]. In order to improve more on wireless communication performance, space time frequency (STF) code had been introduced to spread information symbol over the transmitting antenna. STF will separate spatial and

frequency diversity by mapping the information symbols to antenna [26].

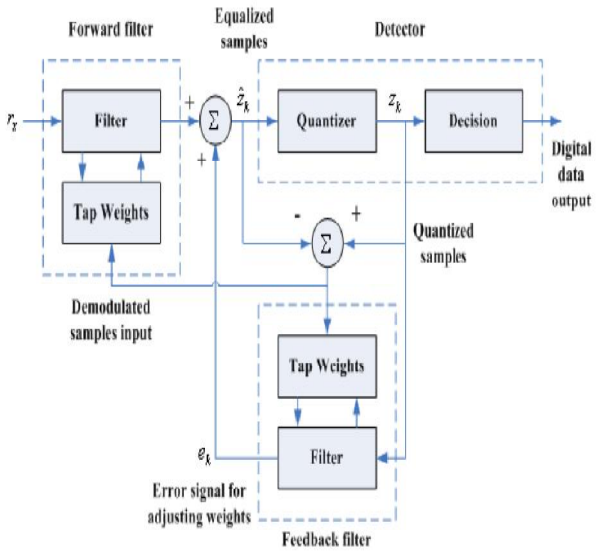

Fig.3 Simplified Block Diagram of a DFE

V RESULT & DISCUSSION

The Comparison of CCDF and BER based on different PAPR reduction methods are in shown in Fig.4 and Fig.5 respectively, in which we analyzed that exponential Companding technique is best for PAPR reduction and performance based technique, is best for lower BER as compared with other shown techniques.

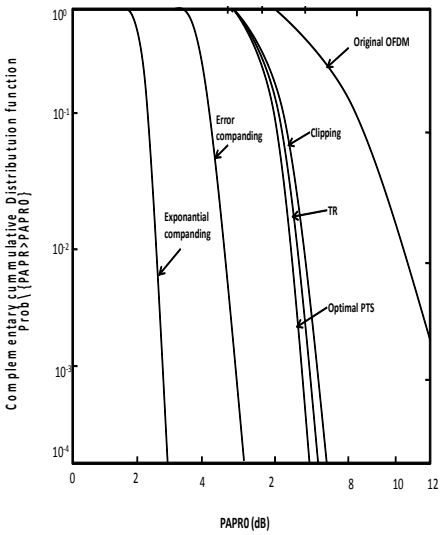

Fig.4 Comparisons of CCDF based on different PAPR reductions

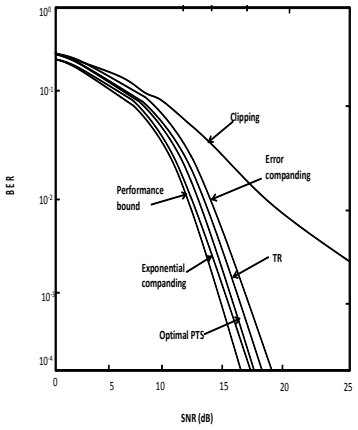

Fig.5 Comparisons of BER based on different PAPR reductions.

Different methods are compared in terms of power, complexity, Bandwidth and BER in Table-1

Table 1 COMPARISON OF DIFFERENT PAPR REDUCTION TECHNOLOGIES

	Power increase	Implementation Complexity	Bandwidth expansion	BBER degardation
Clipping	No	Low	No	YYes
Coding	No	Low	Yes	NNo
PTS/SLM	No	High	Yes	NNo
NCT	No	Low	No	NNo
TR/TI	Yes	High	Yes	NNo

5. CONCLUSION

In this paper, we described several important aspects, including the distribution of the PAPR, in OFDM systems. Various techniques to reduce PAPR and ISI have been analyzed, all of which have the potential to provide substantial reduction in PAPR at the cost of loss in data rate, transmit signal power increase, BER performance degradation, computational complexity increase, and so on. We also showed that it is possible to reduce the PAPR and ISI of for WiMAX OFDM systems. The effect of ISI using DFE and STF are also discussed.

7. FUTURE SCOPES

With the help of this review we are able to identified the different problem and various technique for its solution, In WiMAX OFDM waste research has been investigated till now, in future we may use different technique, parameter and different environments to reduce the PAPR, ISI and BER.

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