Analysis of PAPR in Digital Video Broadcasting over AWGN & Rayleigh Channel

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Abstract **The development of the Digital Video Broadcasting (DVB) standards was started in 1993 [1]. DVB is a transmission scheme based on the MPEG-2 standard, as a method for point to multipoint delivery of high quality compressed digital audio and video. It is an enhanced replacement of the analogue television broadcast standard, as DVB provides a flexible transmission medium for delivery of video, audio and data services [2]. The DVB standards specify the delivery mechanism for a wide range of applications, including satellite TV (DVB), cable systems (DVB) and terrestrial transmissions (DVB) [3]. The physical layer of each of these standards is optimized for the transmission channel being used. Satellite broadcasts use a single carrier transmission, with QPSK modulation, which is optimized for this application as a single carrier allows for large Doppler shifts, and QPSK allows for maximum energy efficiency [4].**

The major difference between DAB and DVB is the larger bandwidth used and the use of higher modulation schemes to achieve a higher data throughput. The DVB-T allows for three subcarrier modulation schemes: QPSK, 16-QAM (Quadrature Amplitude Modulation) and 64- QAM; and a range of guard period lengths and coding rates. This allows the robustness of the transmission link to be traded at the expense of link capacity. DVB is a Uni-directional link due to its broadcast nature. Thus any choice in data rate verses robustness affects all receivers. If the system goal is to achieve high reliability, the data rate must be lowered to meet the conditions of the worst receiver. This effect limits the usefulness of the flexible nature of the standard. However if these same principles of a flexible transmission rate are used in bi-directional communications, the data rate can be maximized based on the current radio conditions. Additionally for multiuser applications, it can be optimized for individual remote transceivers.

Keywords **PAPR, OFDM, AWGN, Rayleigh**

I INTRODUCTION

Orthogonal frequency division multiplexing (OFDM) system has been considered as one of the strong standard candidates for the next generation mobile radio communication systems. Multiplexing a serial data symbol stream into a large number of orthogonal subchannel makes the OFDM signals spectral bandwidth efficient. It has been shown that the performance of OFDM system over frequency selective fading channels is better than that of the single carrier modulation system. One of the major drawbacks of OFDM system is that the OFDM signal can have high peak to average power ratio (PAPR). The high PAPR brings on the OFDM signal distortion in the nonlinear region of high power amplifier (HPA) and the signal distortion induces the degradation of bit error rate (BER). Moreover, to prevent spectral growth of the multicarrier signal in the form of inter modulation among subcarriers and out-of-band radiation, the transmit power amplifier must be operated in its linear region (i.e., with a large input backoff), where the power conversion is inefficient.

One of the major drawbacks of OFDM has been the high peak-to-average power ratio (PAPR) that is characteristic of signals with multiple sub-carriers. The high PAPR requires additional back off to achieve linear amplification at the transmitter end which results in inefficient power consumption. This inefficient power consumption is the major impediment in implementing OFDM in portable device. Previous efforts to address this problem have been principally directed at two areas, the reduction of signal PAPR and various methods of achieving linear and efficient power amplification (PA). However, all approaches suffer due to various deficiencies such as complexity, computational time, memory requirements, data rate loss and high distortion.

There has been momentous progress in the field of wireless communication during last twenty years. The internet and digital communication evolution has resulted in enormous increase in methods of personal communication as well as commercial applications. The new paradigm of information access to everybody everywhere all the time is in making. To achieve the ever increasing demands of higher data transfer rates for new multimedia applications, the physical wireless link of wireless communication networks is constantly under trial. The phenomenon of multipath fading, mobility and the limited availability of bandwidth are major precincts. Lately, there have been many breakthroughs to triumph over these limitations. Many modulation techniques compete for new solutions and future applications. Modulation schemes can be broadly categorized in to single carrier and multi carrier.Wideband code division multiple access (W-CDMA) is single carrier modulation scheme. While OFDM, Multi Carrier Code Division Multiple Access (MC-CDMA) are multi carrier schemes.

II MEHODOLOGY

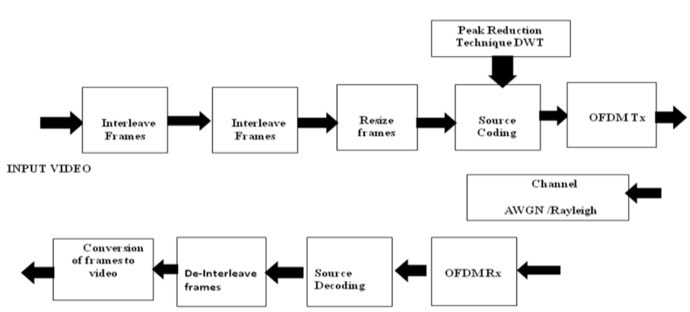

Fig.1 Digital Video broadcasting implementation using OFDM system

Digital Video broadcasting application over OFDM has been studied over AWGN & Rayleigh channel. The PAPR without reduction algorithm (DWT) & PAPR with reduction algorithm (DWT) is as par following table. Number of frames to processed (1-119) are 30 with SNR:2 The DVB allows for three subcarrier modulation schemes:

QPSK

16-QAM (Quadrature Amplitude Modulation)

64-QAM

The terrestrial network operator can choose one of the two modes of operation

- 2k mode: suitable for single transmitter operations and small single frequency networks (SFN) with limited transmitter distances. It employs 1705 carriers.
- 8k mode: suitable for both single transmitter operations and small and large single Frequency networks (SFN). It employs 6817 carriers.

Simple OFDM system with digital video broadcasting is modelled (designed) in MATLAB

III DESIGN SPECIFICATIONS

Following design specifications are follwed while designing the model System. Number of frames to processed (1-119) are 30 with SNR:2dB IFFT size 512.The DVB allows for three subcarrier modulation schemes: BPSK Word size 1. *QPSK* Word size 2 *8PSK* Word size 3 & *64-QAM* Word size 6

The terrestrial network operator can choose one of the two modes of operation 2k mode: suitable for single transmitter operations and small single frequency networks (SFN) with limited transmitter distances. It employs 1705 carriers. Kmin =0 Kmax=1704. 8k mode: suitable for both single transmitter operations and small and large single Frequency networks (SFN). It employs 6817 carriers.Kmin=0 Kmax=6816

IV SIMULATION RESULTS

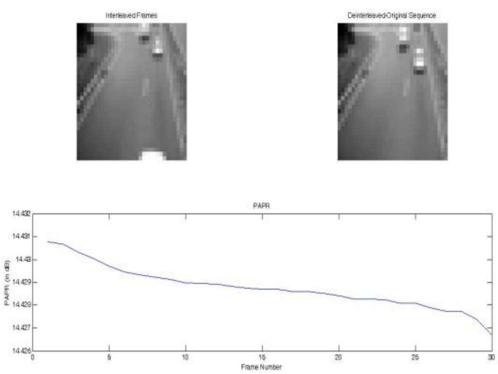

Fig 2. PAPR before technique (AWGN)

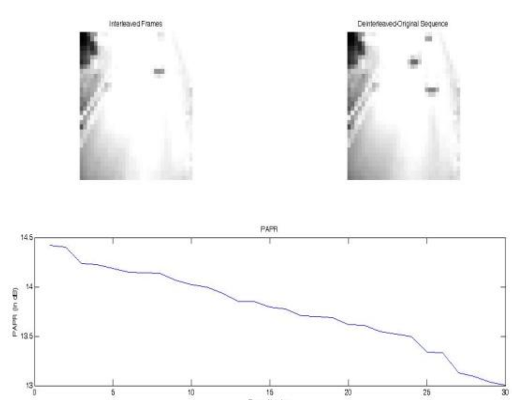

Fig 3. PAPR after technique (AWGN)

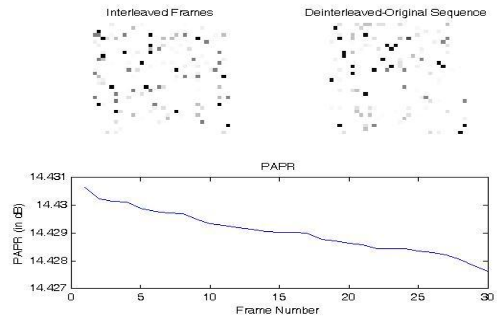

Fig 4. PAPR before technique (Rayleigh)

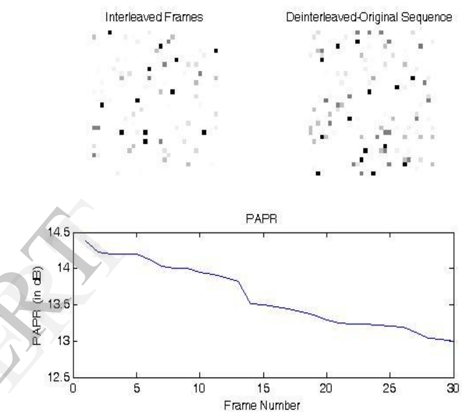

Fig 5. PAPR after technique (Rayleigh)

IV COMAPRISION

Frame	AWGN Channel			Rayleigh Channel		
	PAPR before	PAPR after	Improve ment	PAPR before	PAPR after	Improve ment
1	14.42846	13.60858	0.81988	14.42913	13.22867	1.20046
2	14.42976	14.13539	0.29437	14.42764	13.21746	1.21018
3	14.42882	14.1455	0.28332	14.42844	13.44332	0.98512
4	14.42994	14.18952	0.24042	14.43015	13.39662	1.03353
5	14.42824	13.51959	0.90865	14.42919	13.87546	0.55373
6	14.42872	13.49958	0.92914	14.42902	14.12629	0.30273
7	14.42825	13.85293	0.57532	14.42928	13.02095	1.40833
8	14.42837	14.41795	0.01042	14.42989	14.00103	0.42886
9	14.42834	13.00031	1.42803	14.42843	14.22876	0.19967
10	14.42883	13.70043	0.7284	14.42904	14.20154	0.2275
11	14.42811	14.02512	0.40299	14.42806	13.2057	1.22236
12	14.42923	13.33458	1.09465	14.42973	13.82378	0.60595
13	14.42908	13.0939	1.33518	14.42859	13.128	1.30059

14	14.42833	14.39905	0.02928	14.42905	13.28852	1.14053
15	14.42811	13.7041	0.72401	14.4295	14.00577	0.42373
16	14.42984	13.03306	1.39678	14.42782	13.51065	0.91717
17	14.42828	14.24039	0.18789	14.42837	14.02799	0.40038
18	14.43018	13.61835	0.81183	14.43011	13.03903	1.39108
19	14.42807	13.1324	1.29567	14.42979	13.22756	1.20223
20	14.42825	13.77622	0.65203	14.42831	13.3591	1.06921
21	14.42973	14.14759	0.28214	14.42872	13.47407	0.95465
22	14.42845	14.06853	0.35992	14.42845	14.19326	0.23519
23	14.4297	14.22519	0.20451	14.42821	14.38669	0.04152
24	14.42781	13.93091	0.4969	14.43023	13.94468	0.48555
25	14.42943	13.33957	1.08986	14.42864	14.20152	0.22712
26	14.42909	13.54949	0.8796	14.42877	12.99069	1.43808
27	14.42938	13.99614	0.43324	14.429	13.18624	1.24276
28	14.42725	13.849	0.57825	14.43064	13.92152	0.50912
29	14.42873	13.79423	0.6345	14.42934	13.50312	0.92622
30	14.42814	13.68532	0.74282	14.42969	13.24575	1.18394

Table 1 Comparison of PAPR before and after algorithm for AWGN & Rayleigh channel

V CONCLUSION & FUTURE SCOPE

The simulation done in MATLAB worked well. The Additive White Gaussian Noise (AWGN) & Rayleigh noise corrupted the transmitted signal and this resulted in a different received constellation than the original constellation. For small SNR values the calculated error rate was quite large and ISI was produced due the relative high power of noise. As SNR was increased the error rate was decreasing, as expected. In fact, for a SNR value greater than 8 dB, the error was zero. This is a quite different than expected and it is due to the fact that the program is simulating only few OFDM symbols (i.e. one frame), sent one by one. If the number of transmitted OFDM symbols is increased, than a more accurate error rate can be obtained, but this necessitates a high processing power PC and time. There are more aspects of OFDM that need to be researched since this simulation was only a basic one. As an example, there are a lot of improvements that can be brought to the program, such as the addition of guard interval, coding the original information, simulation over multipath channel etc.

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