Out of Band Suppression in OFDM-Based Systems

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Abstract — In this paper,we introduce a method of out of band reduction of Orthogonal Frequency Division Multiplexing Systems. OFDM systems are used extensively in wireless technologies due to their high data rates and high resistance towards multipath and fading. Despite all these advantages, OFDM systems produce a large out of band interference due to the sidelobes present in the spectrum.This leads to the wastage of spectrum and also causes interference in adjacent bands.In this paper we propose a method for reducing OOB radiations in OFDM systems.In this process,an extension is added to OFDM symbols that is calculated using optimization methods to minimise interference in adjacent channels.The power of the extensions used should be kept at acceptable levels. However due to the extensions used,there is a slight compromise in the throughput of the system.

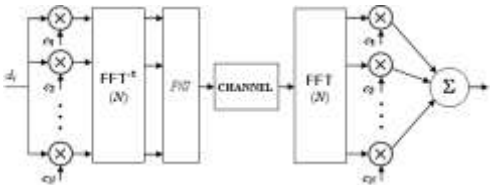
Key Words — Out-Of-Band Emission,Interference Cancellation, Spectrum Efficiency, Sidelobe Suppression, OFDM, MC systems, AST.

I. INTRODUCTION

Recently multicarrier OFDM systems became the centre of attraction in the wireless systems. Digital broadcasting, wireless access and high data rate systems like WiFi, WiMAX, LTE are among main applications. MC system has the advantage of reducing the ISI due to multipath fading considerably. In OFDM systems, high data rate streams are covetrtyed into many lower rate data streams that are transmitted in parallel over many subchannels. In each subchannel, syabol duration is large as compared to the maximum delay of the channel known as ISI handling. In thsdi letter, we propose a method known as Adaptive Symbol Transition , AST to suppress OFDM sidelobes and shape the signal spectrum accordingly.It is a time domain method in which the OFDM symbols are extended in time to reduce the effect of symbol transition.These transition symbols are optimised adaptively based on the bits of the symbols to be transmitted on the channel, thus reducing the OOB interference effectively.

II. BASIC OFDM SYSTEM MODEL

To generate OFDM successfully, the relationship between all the subcarriers must be carefully controlled to maintain the orthogonality of the carriers. For this reason,OFDM is generated by first choosing the spectrum required based on the input data and the modulation scheme used. IDFT correlates the frequency domain input data with its orthogonal basis functions, thus mapping the input data onto basis functions. After IFFT stage, the time domain signal must be received in serial form through parallel to serial conversion. At the receiver, the FFT transforms a time domain signal into its equivalent frequency spectrum



In general case coefficients ci which describe amplitudes and phases of subcarriers are complex. Note the QPSK (or QAM) signal can be represented by the sum (weighted sum) of binary signals which phases are in quadrature. Therefore its spectrum is a superposition of independent binary signals spectra. That is why the binary case is the most appropriate for studying.

III. ADAPTIVE SYMBOL TRANSITION TECHNIQUE

Previously, various methods have been used experimentally to reduce the sidelobes in cae of OFDM systems. One such method is Windowing in which a Raised cosine filter is used which which produces a smoother roll off. However, certain compromises are made due to overlapping in adjacent channels.

In case of Adaptive symbol transition, the symbol time is extended and this extension is used to reduce the adjacent channel interference. Certain subcarriers are disabled to avoid interfering with the adjacent symbols. However, this leads to an increase in the signal power level due to the extensions used. To minimise this effect, a constraint is put on the symbol power to restrict it to a certain level.

It is noteworthy that since AST technique is performed on time-domain symbols, the performance is not sensitive to the CP size. In addition, the AST does not introduce any intersymbol interference (ISI) to the system as the leakage from the symbol extension is contained in the CP. The intended receiver can remove the AST extension along with the CP to maintain an ISI-free signal.

Encoded data ---->
Modulator ---->

Subcarrier Mapper ---->
IFFT---->
Parallel to Serial Conversion---->
Add CP---->
AST unit---->
To Channel
AST FLOWCHART

IV. CONCLUSION

A method of reducing out of band interference caused due to the sidelobes in the OFDM syatems is proposed. This technique extends the OFDM symbols and hence this extension is used to reduce the interference in adjacent channels which are present in the same frequency band.

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