AN ICI REDUCTION SCHEME FOR OFDM WITH PHASE NOISE OVER FADING CHANNELS

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Abstract: Orthogonal Frequency Division Multiplexing has become a key element of todays wireless communication systems. However, its sensitivity to oscillator phase noise is responsible for Common Phase Error (CPE) and Inter-Carrier Interference (ICI) which greatly degrades the overall system performance. In this contribution, we address the problem of reducing the effects of phase noise in an OFDM system operating over a frequency selective fading channel. We propose a method for jointly estimating the channel and CPE in a first step and removing ICI in a second step. The algorithm is simulated on both coded and uncoded systems with phase noise over a fading channel.

Index Terms: Common Phase Error (CPE), Inter-Carrier Interference (ICI), Inter Symbol Interference (ISI).

I. INTRODUCTION

The principles of multicarrier modulation have been in existence for several decades. However, in recent years, these techniques have quickly moved out of textbooks and into practice in modern communications systems in the form of Orthogonal Frequency Division Multiplexing (OFDM). OFDM is a special form of multicarrier modulation technique which is used to generate waveforms that are mutually orthogonal and then distributes the data over a large number of carriers that are spaced apart at precise frequencies. This spacing provides the "orthogonality" in this technique which prevents the demodulators from seeing frequencies other than their own. In an OFDM scheme, a large number of orthogonal, overlapping, narrow band subcarriers are transmitted in parallel. These carriers divide the available transmission bandwidth. The separation of the subcarriers is such that there is a very compact spectral utilization. With OFDM, it is possible to have overlapping sub channels in the frequency domain (Figure 1), thus increasing the transmission rate

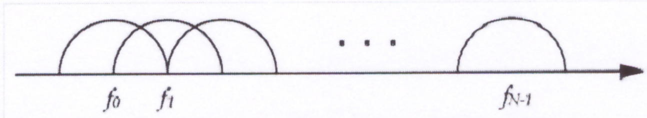

Figure 1: Power Spectrum of the transmitted signal

In order to avoid a large number of modulators and filters at the transmitter and complementary filters and demodulators at the receiver, it is desirable to be able to use modern digital signal processing techniques, such as fast Fourier transform (FFT). OFDM is a promising candidate for achieving high data rates in mobile environment because of its multicarrier modulation technique and ability to convert a frequency selective fading channel into several nearly flat fading channels.

II. OFDM SYSTEM

Figure 2 shows the block diagram of a typical OFDM system. The transmitter section converts digital data to be transmitted, into a mapping of subcarrier amplitude and phase. It then transforms this spectral representation of the data into the time domain using an Inverse Discrete Fourier Transform (IDFT). The Inverse Fast Fourier Transform (IFFT) performs the 20 same operations as an IDFT, except that it is much more computationally efficient, and so is used in all practical systems. In order to transmit the OFDM signal the calculated time domain signal is then mixed up to the required frequency. The receiver performs the reverse operation of the transmitter, mixing the RF signal to base band for processing, then using a Fast Fourier Transform (FFT) to analyze the signal in the frequency domain. The amplitude and phase of the subcarriers is then picked out and converted back to digital data. The IFFT and the FFT are complementary function and the most appropriate term depends on