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Analysis of MIMO-OFDM and MISO-OFDM System

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Abstract:

This paper investigates OFDMA and SC-FDMA techniques combined with the Orthogonal Frequency Division Multiplexing (OFDM). it is very popular for high data rate capacity and against multipath fading. To avoid ISI due to multi-path, successive OFDM symbols are separated by guard band. CDMA is not so complicated to implement as OFDM based systems. As CDMA has a wide bandwidth, it is difficult to equalize the overall spectrum - significant levels of processing would be needed for this as it consists of a continuous signal and not discrete carriers. Promising results are obtained to enhance spectral efficiency on the expense of computational complexity which needs to be addressed..

Keywords — **SC-FDMA, OFDMA, MISO, Analysis** .

I. Introduction:

The OFDM is the modulation scheme having multicarrier transmission techniques here the available spectrum is divided into many carriers each one being modulated at a low rate data stream. In an OFDM technique, a large number of orthogonal, overlapping, narrow band sub-channels or subcarriers, transmitted in parallel, divide the available transmission bandwidth. The Orthogonal Frequency Division Multiplexing (OFDM) technology is able to provide a high transmission data rate with enhanced communication performance at a relatively small bandwidth cost, together with proper estimation and compensation of channel effects. MIMO shows better PAPR reduction compared to the MISO. The Performance of QPSK, 16-QAM modulation techniques are investigated in terms of PAPR and BER under different SNR scenarios. The principal reason of this increasing interest is due to its capability to provide highspeed data rate transmissions with low complexity and to counteract the Inter Symbol Interference (ISI) introduced by dispersive channels.

OFDM is a special type of multicarrier modulation, in which a single high rate bit stream is divided into multiple low rate substreams and transmitted over parallel subchannels. The number of subchannels is proportional to the number of substreams. When this number is large enough, the bandwidth of each subchannel is sufficiently small, smaller than the channel coherent bandwidth. Therefore each subchannel experiences flat fading. This implies that the receiver can be implemented fairly easily, with a simple frequency equalizer. OFDM offers many advantages in terms of resilience to fading, reflections and the like. OFDM also offers a high level of spectrum efficiency. However to reap the rewards, it is necessary that the OFDM system operates correctly, and to achieve this, it is necessary for the OFDM synchronization to be effective. If the frequency synchronisation is impaired, then the orthogonality of the carriers is reduced within the demodulation process and error rates increase. Accordingly it is essential to maintain orthogonality to reduce errors and maintain the performance of the link.

II. OFDM synchronization:

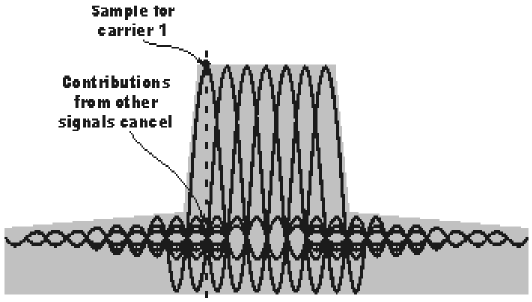

Fig.1. An OFDM signal where demodulation is in synchronization

III. OFDM System Model:

Orthogonal frequency division multiplexing (OFDM) is a parallel transmission scheme, where a high-rate serial data stream is split up into a set of low-rate sub streams, each of which is modulated on a separate sub-carrier (SC) (frequency division multiplexing). Thereby, the bandwidth of the sub-carriers becomes small compared with the coherence bandwidth of the channel, i.e., the individual sub-carriers experience flat fading, which allows for simple equalization. This implies that the symbol period of the sub-streams is made long compared to the delay spread of the time-dispersive radio channel. Selecting a special set of (orthogonal) carrier frequencies, high spectral efficiency is obtained, because the spectra of the sub-carriers overlap, while mutual influence among the sub-carriers can be avoided (see Figure 1-3 in Chapter 1). The derivation of the system model shows that, by introducing a cyclic prefix (the so-called guard interval (GI)), the orthogonality can be maintained over a dispersive channel.

IV.OFDM Transmitter:

Because of the low-pass filters required for the analog-to-digital and digital-to-analog conversion (ADC and DAC) of the transmitted and received (baseband) signals, not all N sub-carriers can be used, if an N-point IFFT is applied for modulation. The sub-carriers close to the Nyquist frequency fs/2 will be attenuated by these filters and thus cannot be used for data transmission (see Figure 4-4). (fs = 1/Ts is the sampling frequency.) Also the DC-sub-carrier might be heavily distorted by DC offsets of the ADCs and DACs, by carrier feed-through, etc., and should thus be avoided for data.

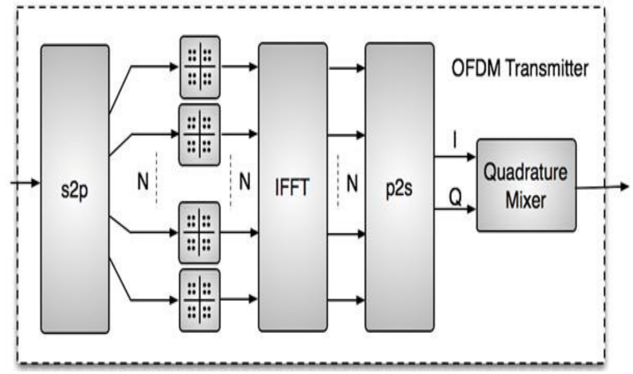

Fig.2. An OFDM signal Transmitter

V. OFDM Receiver:

In order to reconstruct the generated OFDM signal, OFDM receiver has to comprise modules purposed for serial to parallel conversion, cyclic prefix removal, FFT computation, parallel to serial conversion and QAM decoding. The block diagram of OFDM receiver, illustrating OFDM signal processing on the receiver side.

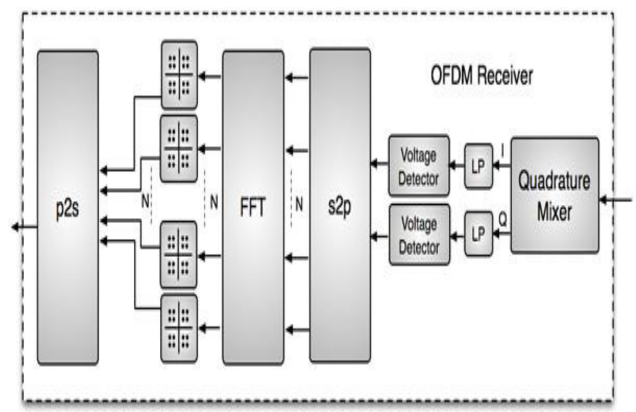

Fig.3. An OFDM signal receiver

The receiver performs inverse operations, in contrast to the OFDM transmitter. The input data of the OFDM receiver first goes through the serial to parallel conversion and cyclic prefix removal modules. Afterwards, the signal is passed to the 8-point FFT module, which converts it to frequency domain, and therefore retrieves the exact form of the transmitted symbols. This module executes the computations given in equation (2), where x(n) are input symbols and X(k) are outputs of the FFT block.

VI.Implementation OFDM cooley-tukey based :

The discussed model of an OFDM system, presented in the previous section, has been implemented using aCooley– Tukey based method for IFFT/FFT computation. This method is the most general of all IFFT/FFT algorithms and is based on the "divide and conquer" approach. Its applicability is due to its recursive nature and ability to reduce the overall algorithm runtime from O(N 2) to O(NlogN).One of the most important blocks of an OFDM system is the FFT block where the number of Fourier points is related to the OFDM symbols. There are various methods for implementing FFT block. The methods differ from maximum operating frequency, power consumption and chip area occupation viewpoints and performance evaluating of FFT approaches helps to implement OFDM receiver and transmitter systems according to required characteristics

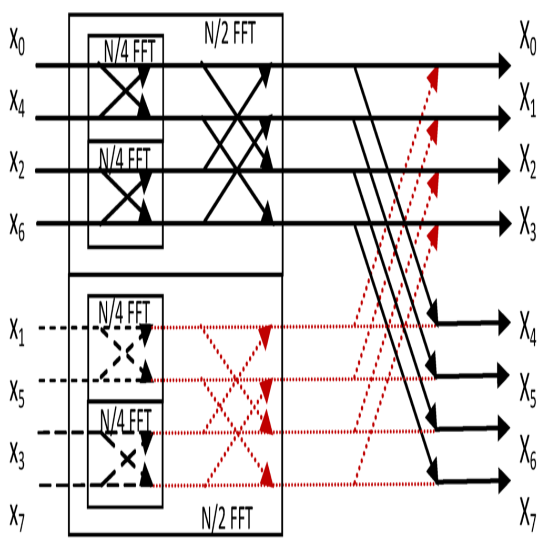

Fig.4 Implementation OFDM cooley-tukey

VII. Rom-based and minimized Rom-based OFDM processing units:

The sender maps its incoming data stream into the QAM symbol values and feeds them into the IDFT module, whereas the receiver, rounds up the received values to the nearest symbol of the QAM constellation, and again computes a Fourier transform over the same symbol set. The limited number of OFDM inputs allows us to consider the possibility of storing the DFT/IDFT products precomputed in look-up tables or a ROM memory. In this way multiplications are avoided completely and the hardware is reduced to adders and simpler logic components such as decoders, counters and shifters.Increasing speeds and complexity of wireless communication systems have necessitated the progress and advancement of high performance signal processing elements. Today's emerging technologies require fast processing and efficient use of resources. These resources include power, memory, and chip area. Ongoing research seeks to optimize resource usage as well as performance. Design becomes a balance and compromise of flexibility, performance, complexity, and cost.

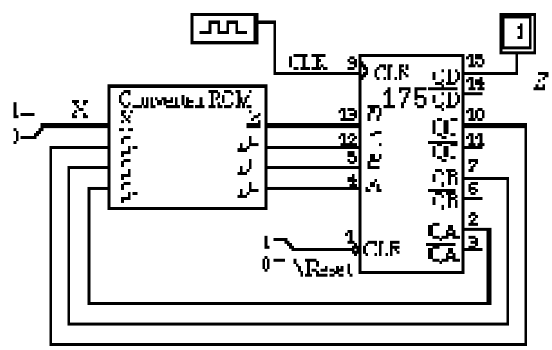

Figure 5 synchronous Mealy ROM-based implementation

VIII. Conclusion:

The derivation of the OFDM system model has confirmed that data symbols can be transmitted independently over multipath fading radio channels. It has to be assumed,however, that the channel's maximum excess delay is shorter than the guard interval,and that the system has been synchronized sufficiently. Small synchronization errors lead to systematic phase rotations of the data constellation points – a property which can be exploited for estimating synchronization offsets. If the timing- or frequencysynchronization error becomes too large, the orthogonality of the sub-carriers is partly lost and the signal-to-noise ratio of the system is degraded. That is, inter-carrier-interference (ICI) and inter-symbol-interference arise. ICI can also result from very fast channel variations (Doppler spreads) or from carrier phase jitters.

IX.Reference :

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