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OFDM Emerging in Wireless Multigiga bit Communication

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Abstract
Transfer the information data and signal without wire is more challenge for us. Not only for communication purpose but also research point of view is quite difficult. Convey the multimedia data is fast as possible without any deprivation of quality performance. Now a day wireless communication is more necessary to use as well as manufacturing. User requires more quality when they work with multimedia data. And device which related to transfer these types of data is requiring more capacity and give us high quality of multimedia data. OFDM (orthogonal frequency division multiplexing) is a modulation technique that achieves high data rates and increase band width efficiency and use to multipath environment. OFDM have ICI which create noise. So that studies about OFDM technique and its block and analysis of that transmitter model first. Then study and analysis of receiver side block that support the high data rate and its performance quality also increase. The aim of this paper is to survey and compare previous methods for Data-aided timing and frequency synchronization of OFDM System.

Keywords: synchronization, multi gigabit communication, OFDM (orthogonal frequency division multiplexing)

Introduction
The main approaches to expansion of multi-gigabit or high speed wireless communications. This work includes information of usage OFDM, describes advances in wireless technology such as 3G and 4G. Orthogonal Frequency Division Multiplexing (OFDM) is the used in WLAN and WiMax air interfaces. It also has been planned for use in next generation cellular systems such as Super-3G in the 3GPP standards group. OFDM has a number of advantageous qualities, such as good tolerance to multi-path fading and inter-symbol interference (ISI). By using a number of multicarriers, the symbol length can be kept long and a cyclic prefix used to remove problem of ISI. Transmit information are allocated to a number of sub-carriers so that any nulls in the frequency domain do not knock out a whole allocation. This gives forward error correction (FEC) a better chance to pick up the information in the receiver[7]. First of all we generated orthogonal modulated carrier. Fortunately, the Inverse Fast Fourier Transform (IFFT) algorithm can be used to convert suitably constructed frequency domain signals into the necessary time domain waveform. Same as transmitter, the receiver can use the FFT algorithm to convert back to the frequency domain before de-modulation. These algorithms are efficient and can be implemented in either software in a DSP or, for higher bandwidth and increased processing capacity. But actually the receiver has no prior knowledge of either the symbol timing or exact frequency of the local oscillator at the transmitter end. A number of approaches to estimation timing and frequency offset in OFDM systems have been presented in the literature. Many of these operate in the time domain (before the FFT) and use the repeating pattern of the preamble or the cycle prefix, or both, to gain information about the symbol timing and frequency offset[8]. The timing is determined by noticing that the correlation of the signal with a delayed version of itself will reach a peak when the repeated pattern is located. The data flow for the three methods is discussed in this section. Park method was chosen for this study because they occupy the middle of the complexity range covered by the surveyed work. It was described using the cyclic prefix of the OFDM symbol. Demand for very high-speed wireless communications is growing with respect to the increasing data rates reach at optical fibres. The emerging research trend in communication is to cut more and more cables and to provide mobile and roaming users with a data rate at least comparable with that one of wired Ethernet.

Synchronization
SYNCHRONIZATION: In OFDM systems, the main synchronization parameters to be estimated are a sync flag indicating the presence of the signal (especially for burst-mode transmission), the starting time of the FFT window (timing synchronization), the frequency offset due to the inaccuracies of the transmitter and receiver oscillators, and the Doppler shift of the mobile channel, as well as the channel estimates if coherent reception is adopted[7]-[9]. The sync flag can be generated by automatic gain control (e.g., ramp-up indication via power measurement and threshold decision) or using a training symbol (which can also be used for timing synchronization and possibly frequency synchronization). For the latter case, the same metric used for timing synchronization may be used together with the threshold decision, in order to generate the sync flag. After detecting the presence of the signal, the other sync parameters are estimated.

OFDM system synchronization
The synchronization is very critical key in using all the advantages of the technology. It also makes the processing and fading effect more severe if the synchronization of frequency

is not achieved. This can be easily understood by the following figure, and its explanation.

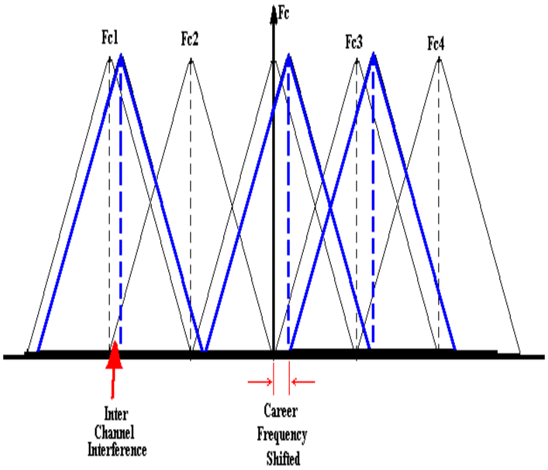

Fig. 1. Carrier Frequency Shifting and its effect[5]

OFDM is the system in which all the sub-carrier of the main carrier frequency are orthogonal to each other. Means the band of the sub-carrier doesn't overlap to each other and their effect on each other is zero, ideally. Thus, in very narrow band we can accommodate more channels without interference and could get more data rate with limited frequency band.

Frequency Offset Estimation

This advantage also comes with limitations and drawbacks. This system is very sensitive to carrier frequency settings for OFDM system at both transmitter and receiver side. It means the carrier frequency set at transmitter side must be set same as receiver side.

If the frequency is not synchronized tightly at receiver side we may get the interference output. As we has earlier discussed all sub-carrier are orthogonal to each other and has no effect on each other due to orthogonality nature of the signals. But, as the carrier frequency changes slightly, the characteristics of the signals of orthogonality breaks down. The channel component of other sub-carrier are started to mix with neighbouring channels and generates Inter Channel Interference [10]. To cure with this limitation we need to estimate how much the carrier frequency is shifted and applying this change on the synchronization system so, the correct data could be received. The technique which is used to find this fix is called Frequency Offset Estimation technique.

Timing Offset Estimation

The estimating the starting location of the frame of data is also important in detecting and synchronizing the data of each channel. Because the symbol arrival time of the OFDM system is unknown to receiver side[4]. Thus the Timing Offset Estimation is very important to detect the data in each channel of the system.

The ML Estimation Technique

To overcome those problems as discussed earlier, we use the Joint Maximum Likelihood (JML) Estimation technique for dealing the problems. In this technique inspite of generating separate symbol for training and cyclic prefix, we use the data symbol itself to improve the efficiency of the system. Thus, using the data signal itself reduces the complexity of generating pilot symbols.

OFDM modulation

In the system the data is first taken as group of bunch and then the IDFT (Inverse Discrete Fourier Transform) is applied on each buffered sequence to generate the OFDM symbol. The resulting OFDM symbol is than serially transmitted over the channel. Here, we assume that if L samples are transmitted than the impulse response of the channel would be lesser than L samples. At receiver side the data is received and DFT (Discrete Fourier Transform) is applied on buffered data and the original data sequence is retrieved [8].

In this system we assume that OFDM symbol has length of N samples long. We put the last L samples of the OFDM symbol in starting of the OFDM symbol. It means we are putting the last L samples as preamble or Cyclic Prefix, at starting location of original OFDM sample of length N. Now, the transmitted symbol has total width of L+N means Cyclic + OFDM data. Consider the transmitted signal is X(n) and channel response is H(n). From the transfer function equation, Y(n) =H(n)*X(n), we can say that the received data will be as X(n) =Y(n)/H(n). According to principles of DFT when we multiply any two terms it is also a circular convolution in time domain. And as we know the hardware always performs linear convolution. So, to interpret the signal is circular we introduce the system of cyclic prefix in which the last L symbols of the OFDM symbols is added at starting part of OFM system as Cyclic Prefix.

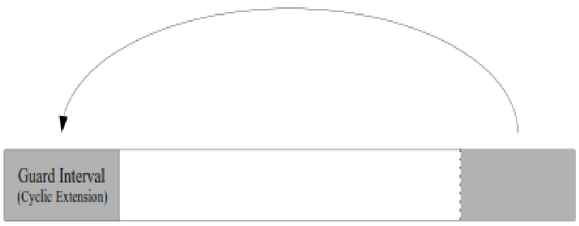

Fig 2. Cyclic Prefix Extension

The uncertainty in arrival time of the channel is modeled as let $\delta(k-\theta)$. Where, θ is unknown value because, it is an arrival time of OFDM symbol[9]. The noise also affects the signal which causes its signal to become loss or deteriorate to original signals. Let take only assumption that noise signal be n(k) is of type Additive White Gaussian Noise(AWGN) which has complex nature, it can affect both amplitude and phase of the signal. We also take the shifting in carrier frequency at oscillator in consideration for analysis of the system. Received data in the time domain is distorted form of the signal.

Introducing SNR in estimation

SNR (Signal to Noise Ratio) is measure of signal quality at receiver side as compared to the signal generated at transmitter side. Let us consider the transmitted signal is s(k) and noise signal mixed in the channel is n(k).

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Park's method

Minn's method reduces the timing metric found in Schmidl's method but the MSE is still large particularly in ISI channels. This is resulted from the timing metric values around the correct timing point in Minn's method are almost the same. Park method proposed to increase the difference between the peak timing metric with respect to other metric values. The proposed method entails modifying the training sequence's pattern and timing metric's definition to maximize the different pairs of product between them [4]-[6].

$$CP=[A,B, A^*, B^*] \quad (1)$$

The first training symbol having four parts with the following patterns:

$$p(d) = \sum_{k=0}^{\frac{N}{2}} (r_{d-k} \cdot r_{d+k}) \quad (2)$$

$$R(d) = \sum_{m=1}^{N/2} |r_{d+m}|^2 \quad (3)$$

Where A represents samples of length $L = N / 4$ generated by FFT of a PN sequence. B is designed to be symmetric with A. A^* and B^* are conjugate of A and B respectively. Figure show the magnitude response using two parameter P(d) and R(d).

Simulation Result

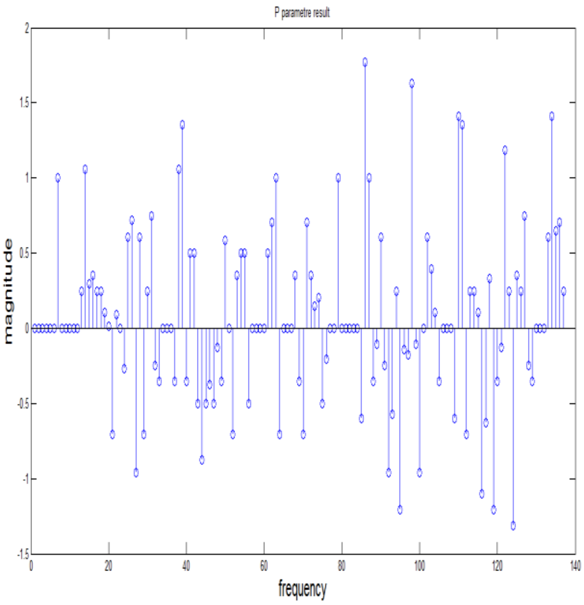

Fig 3. P parameter of park method

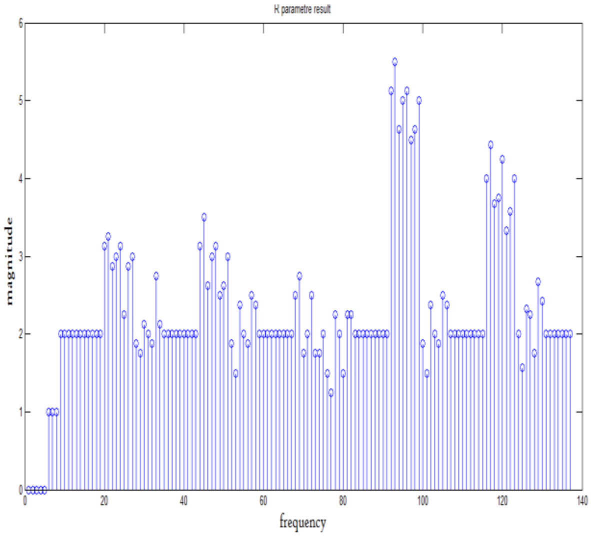

Fig 4. R parameter of park method

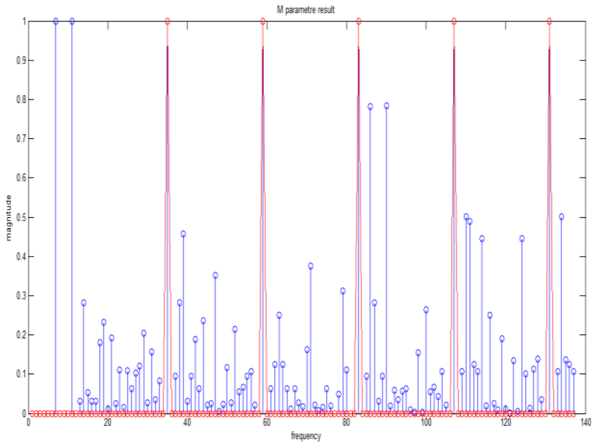

Fig 5. M parameter of park method

CONCLUSION:

The demand for high data rate wireless communication has been increasing drastically over the last decade. One way to transmit this high data rate information is to employ well-known straight single carrier systems. Since the transmission bandwidth is much larger than the coherence bandwidth of the channel, highly complex equalizers are needed at the receiver for accurately recovering the transmitted information. Multi-carrier techniques can solve this problem significantly. In this paper we have discussed about the basic idea behind the OFDM, the most up-and-coming technology of cyclic prefix. Here we take a review on its concept, its properties in terms of its advantages and disadvantages, its limitations and also its applications in different fields. This paper has explored the role of OFDM in the wireless communication and its advantages over single carrier transmission. There are also some limitations of this technique which can be removed with the help of synchronization techniques.

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