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An Efficient Data Communication Using Conventional Codes

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Abstract
The BER performance of conventional FFT-OFDM system is compared with DWT-OFDM system and DCT-OFDM system in an AWGN environment and Saleh-Valenzuela (SV) channel model at 60 GHz. Several wavelets such as Haar, Daubechies, Symlet, biorthogonal are considered. The BER is calculated for signaling format BPSK and the performance is analyzed at 60 GHz. Simulation results show that DCT based scheme yields the lowest average bit error rate. While out of all wavelet mother used Haar and Daubechies wavelet based scheme yields lower BER than FFT-OFDM for an AWGN channel. But it may include the implementation of forward error correction techniques such as convolution codes. An efficient channel estimation algorithm may be included for performance evaluation of DCT-OFDM and DWT- OFDM working at 60 GHz band. We introduce the Interfacing Techniques for Accessing data transfer data delivery. By using our approach we are increasing the efficiency of the data communication.

Index Terms: orthogonal frequency-division multiplexing (OFDM), Fourier-based OFDM (FFT-OFDM), discrete cosine transform (DCT), DCT, FPGA, OFDMA, QAM, VHDL.

I. INTRODUCTION

OFDM (Orthogonal Frequency-Division Multiplexing) is a modulation technique which makes good use of available bandwidth by allocating orthogonal sub carriers. OFDM is a parallel data-transmission scheme, which reduces the influence of multipath fading and supports high rates without the need of conventional equalization techniques. OFDM is a special case of multicarrier transmission, where a single data stream is transmitted over a number of lower-rate subcarriers. The implementation complexity is significantly lower than that of a single-carrier system with an equalizer. OFDM is robust against narrowband interference because such interference affects only a small percentage of the subcarriers; it also increases robustness against frequency-selective fading. OFDM is used in physical layer of various wireless standards such as IEEE 802.11a, IEEE 802.16a, and HIPERLAN/2, DAB, DVB. All these commercially used schemes use discrete transforms to generate orthogonal subcarriers. OFDM exploits the frequency diversity of the multipath mobile broadband channel by coding and interleaving the information across the subcarriers prior to transmission. After organizing the time and frequency resources in an OFDMA system into resource blocks for allocation to the individual mobile stations, the coded and interleaved information bits of a specific mobile station are modulated onto the subcarriers of its resource blocks.

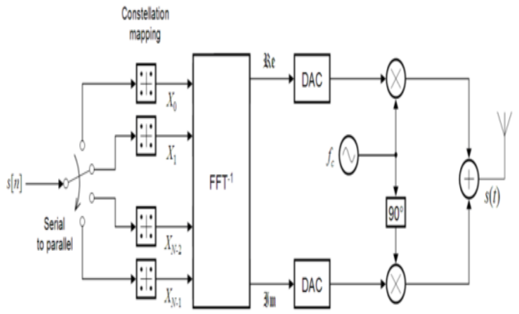

Figure 1: Communication process for data transfer.

OFDM (orthogonal frequency-division multiplexing) is a modulation technique which allocates orthogonal sub carriers. OFDM is a special case of multicarrier transmission, where a single data stream is transmitted over a number of lower-rate subcarriers (SCs). Also OFDM is robust against narrowband interference because such interference affects only a small percentage of the subcarriers increasing robustness against frequency-selective fading.

Recent developments in wireless communications are being driven primarily by the increased demands for radio bandwidth. The 60 GHz band have a massive amount of spectral space (5 GHz), which has been allocated worldwide for dense wireless local communications. At this frequency band the specific attenuation due to atmospheric oxygen is 10–15 dB/km, (precisely 14.7 dB at 60 GHz) which makes the 60 GHz band unsuitable for long-range (> 2 km). For indoor environment distance is considered less than 50 m, therefore 10-15 dB/km attenuation does not carry much significant impact on the performance of communication system working in this band.

Interfacing is the concept of data transfer in earlier technologies. Point of interaction for independent systems or diverse groups

- Electrical characteristics
- Physical means of attachment
- Procedure for sending and receiving data.

In this region we also increase the performance process of the data communication in a network.

II. BACKGROUND WORK

To maintain the orthogonality during channel transmission cyclic prefix is added to OFDM frame which must be longer than the channel impulse response. Channel performance can be estimated and hence equalized by inserting pilot sub-carriers at predefined sub-carrier intervals.

DCT Based OFDM System: DCT-OFDM

Instead of using complex exponential functions, cosinusoidal functions can be used as orthogonal basis to implement multi-carrier scheme. This can be synthesized using discrete cosine transform (DCT). For fast implementation algorithms DCT can provide fewer computational steps than FFT based OFDM. The effect of carrier frequency offset (CFO) will introduce inter-carrier-interference (ICI) in both the DFT-OFDM and DCT-OFDM.

$$\int_0^T \sqrt{\frac{2}{T}}\cos(2\pi F_\Delta t)\sqrt{\frac{2}{T}}\cos(2\pi m F_\Delta t)\,dt = \begin{cases}1, & k = m\\ 0, & k \neq m\end{cases}$$

The continuous-time output signal of a DCT based OFDM system can be written as

$$X(t) = \sqrt{\frac{2}{N_s}}\sum_{n=0}^{N_s-1} d_n \beta_n \cos\left(\frac{n\pi t}{T_s}\right)$$

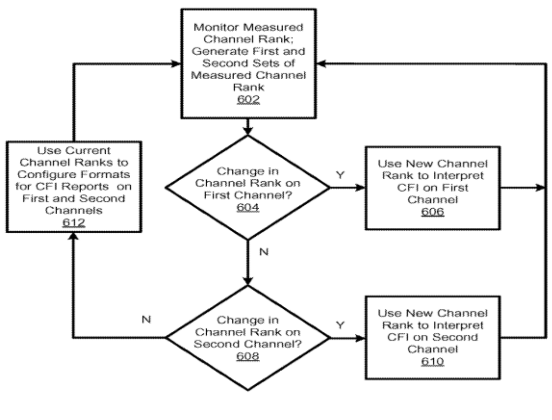

Figure 6

Figure 2: Data Communication using channel representation.

The BER performance of DCT-OFDM is better than DFT-OFDM, the signal energy in DCT is concentrated in a few low-index DCT coefficients, while the remaining coefficients are zero or are negligibly small. Also it has been shown that the DCT is close to optimal in terms of energy-compaction capabilities.

III. PROPOSED APPROACH

Data processing devices (or data terminal equipment, DTE) do not (usually) include data transmission facilities. Need an interface called data circuit terminating equipment (DCE).

a. e.g. modem, NIC

DCE transmits bits on medium DCE communicates data and control info with DTE Done over interchange circuits Clear interface standards required**.**

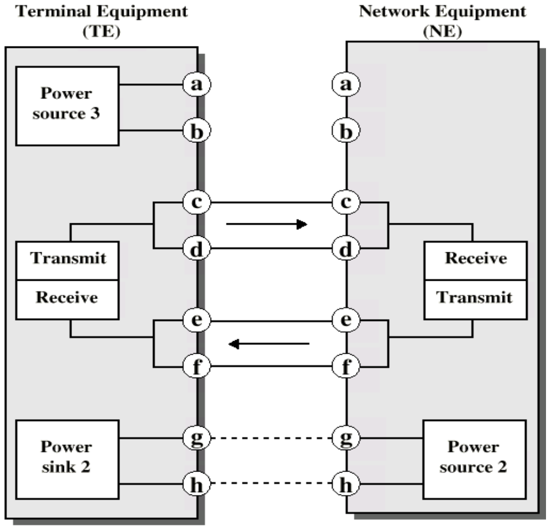

Figure 3: Physical interface diagram.

Synchronous Serial Interface (SSI) is a widely used serial interface standard for industrial applications between a master (e.g. controller) and a slave (e.g. sensor). SSI is based on RS-422 standards and has a high protocol efficiency in addition to its implementation over various hardware platforms, making it very popular among sensor manufacturers.

SSI is a synchronous, point to point, serial communication channel for digital data transmission. Synchronous data transmission is one in which the data is transmitted by synchronizing the transmission at the receiving and sending ends using a common clock signal. Since start and stop bits are not present, this allows the use of transmission bandwidth for more message bits and makes the whole transmission process simpler and easier.

IV. PERFORMANCE RESULTS

Simulations Parameters: The system replicated SV channel model which describes the typical indoor transmission environment at 60 GHz. Channel parameters from IEEE 802.15.3c channel model at 60 GHz are used. The numbers of subcarriers used in OFDM system are 256, and the length of the zero-padding guard interval is 64. All of the simulations assume that, channel-state information will not change in one OFDM symbol. The system simulated does not use any channel estimation technique and error estimation or correction capabilities. BPSK modulation scheme is used. BER performance for FFT-OFDM, DCT-OFDM and DWT-OFDM is evaluated. For DWT-OFDM r different wavelet mothers namely Haar, Daubechies (dB2), Symlets (sym2), Coiflet (coifi2) and Bi-orthogonal were used. The DWT-OFDM families do not require cyclic prefix due to the overlapping nature of their properties. The simulation is carried out for two channel models namely AWGN channel and SV channel model operating at 60 GHz.

Results: Simulation is carried out for SNR in the range 0 to 40dB, for BPSK as a modulation technique, the BER of DCT-OFDM to zero above 5dB of SNR. DWT-OFDM performance is strongly decided by 'mother wavelet'. Out of all wavelet families chosen for simulation the Daubechies' family (Haar and Bi-orthogonal) outperforms the FFT-OFDM as shown in Fig. 4. For other mother wavelets, namely Symlets (sym2), Coiflet (coifi2) and db2 a floor in BER is observed after SNR is more than 10 dB. Even though in the SNR range of 10 to 25 dB DWT-OFDM surpasses FFT-OFDM. For this simulation system no channel estimation technique is used.

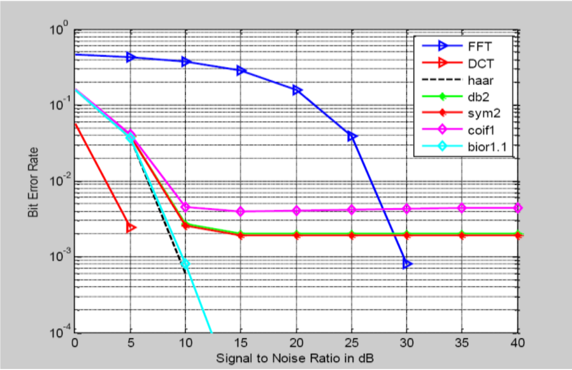

Figure 4: BER performance of FFT-OFDM, DCT-OFDM and DWT-OFDM for AWGN Channel.

Finally increase the efficiency of the network performance in data communication.

V. CONCLUSION

In this paper traditionally we are DCT-OFDM. While out of all wavelet mother used Haar and Daubechies wavelet based scheme yields lower BER than FFT-OFDM for an AWGN channel. But it may include the implementation of forward error correction techniques such as convolution codes. An efficient channel estimation algorithm may be included for performance evaluation of DCT-OFDM and DWT-OFDM working at 60 GHz band. We introduce the Interfacing Techniques for accessing data transfer data delivery. By using our approach we are increasing the efficiency of the data communication.

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