Multiband Ultra Wide Band Communication System- A survey

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ABSTRACT
Ultra wideband technology has great potentials to enhance the wireless technologies as compared to conventional narrow band technology. Because of this fact researchers are attracted towards this band. A report in February 2002 by Federal Communication Commission was issued which was a major breakthrough for UWB Technology. FCC had approved the band of 3.1 GHz to 10.6 GHz for unlicensed use for indoor and outdoor applications in the USA. This paper gives brief introduction of Ultra wide band system, the related works associated with the development of ultra wide band communication system. This paper also gives the problem facing in the ultra wide band communication system. This paper also proposed the new way to overcome the problem associated in UWB communication that is Multiband OFDM system.

Keywords:- UWB, OFDM, FCC, MB-OFDM UWB.

INTRODUCTION

In the recent years, short-range wireless applications and ad-hoc networking have become increasingly important in line with the vision to achieve ubiquitous communications. Due to the convergence of wireless connectivity, the next generation of the wireless world will most likely be an integration of heterogeneous networks including wireless regional area networks (WRAN), wireless wide area networks (WWAN), wireless metropolitan area networks (WMAN), wireless local area networks (WLAN), and wireless personal area networks (WPAN). Ultra-wideband (UWB) radio is an emerging technology in WPAN wireless systems that have attracted a great deal of interest from academia, industries, and global standardization bodies. The IEEE 802.15.3a (TG3a) and IEEE 802.15.4a (TG4a) are two task groups (TGs) within 802.15 working group (WG) that develop their standards based on UWB technology [4]. UWB technology has been around since 1960, when it was mainly used for radar and military applications.

Recent advances in silicon process and switching speeds are moving it into the commercial domain. One of the most promising commercial application areas for UWB technology is the very high data rate wireless connectivity of different home electronic devices at low cost and low power consumption. Ultra-wideband technology offers a solution for sharing the bandwidth resource and physical size requirements of next generation consumer electronic devices. In addition, UWB promises low susceptibility to multipath fading, high transmission security and simple design.

There are two main differences between UWB and other narrowband or wideband systems. First, the bandwidth of UWB systems, as defined by the Federal Communications Commission (FCC) is more than 25% of a center frequency or more than 1.5GHz. Clearly, this bandwidth is much greater than the bandwidth used by any current technology for communication. Second, UWB is implemented in a carrier less fashion. UWB transmissions can transmit information by generating radio energy at specific time instants and occupying large bandwidth thus enabling a pulse position or time modulation. Information can also be modulated on UWB pulses by encoding the polarity of the pulse, and/or also by using orthogonal pulses [8]. Conventional narrowband and wideband systems use Radio Frequency (RF) carriers to move the signal in the frequency domain from baseband to the actual carrier frequency where the system is allowed to operate. Conversely, UWB implementations can directly modulate an impulse that has a very sharp rise and fall time. The extremely short duration of UWB pulses spreads their energy across a wide range of frequencies i.e. several GHz. Due to the extremely low emission levels currently allowed by regulatory agencies, UWB systems tend to be short-range and indoors applications. However, due to the short duration of the UWB pulses, it is easier to engineer extremely high data rates, and data rate can be readily traded for range by simply aggregating pulse energy per data bit using either simple integration or by coding techniques. One of the important advantages of UWB systems is their inherent robustness to multi-path fading. Multipath fading results from the destructive interference caused by the sum of several received paths that may be out of phase with each other [6]. The very narrow pulses of UWB waveforms result in the multiple reflections caused by the channel being resolved independently rather than combining destructively at the receiver. As a result, the time-varying fading that affects narrowband systems is significantly reduced by the nature of the UWB waveform.

One of the important considerations for the success of UWB systems is the compatibility and coexistence of such systems with other WLANs or WPANs. The ultra wide bandwidth cannot be assigned exclusively to UWB signals and overlapping with the bands of many other narrowband systems arise. In order to ensure a robust communication link, the issue of coexistence and interference of UWB systems with current indoor wireless systems must be considered. Due to the wideband nature of UWB emissions, it could potentially interfere with other licensed bands in the frequency domain if left unregulated. Industry's first commercial UWB standard employs unlicensed 3.1 − 10.6 GHz authorized by US's Federal Communications Commission (FCC). The assessment of mutual interference between UWB devices and existing narrowband systems during overlay is important to guarantee no conflicting coexistence and to gain worldwide acceptance of UWB technology [10]. Hence, various technical challenges remain as open issues, which need to be confronted to ensure the successful deployment of this upcoming technology.

RELATED WORK

In the recent years, UWB communication has received great interest for short range applications like sensor networks and Personal Area Networks (PAN) [1]. The potential strength of the UWB radio technique is its wide transmission bandwidth which results in accurate position location, ranging and high multiple access capability. Orthogonal Frequency Division Multiplexing (OFDM) has recently been applied in wireless communication systems due to its high data rate transmission capability with high bandwidth efficiency and robustness to multipath delay. Later, the UWB OFDM called Multiband OFDM (MB OFDM), has been preferred communication technique for physical layer in the IEEE 802.15.3a standard which covers wideband communication in Wireless Personal Area Networks (WPANs) [2–5]. The IEEE 802.15.3a subgroup has recently adopted a short range UWB indoor channel model by modifying the wideband S-V model. The key parameters to be considered for UWB channel environments were described by Molisch [6]. Hayar and Vitetta [7] have demonstrated the modified UWB channel model based on ray arrival of two Poisson process. Unfortunately this model failed to model with more accuracy in the ray arrival rate for UWB channel environment.

Liano et al. [8] have reported the parameters of UWB channel model based on frequency domain approach with lognormal statistics. It was reported that the model can be used to derive more accurate channel models in both UWB system design and performance optimization. Earlier the performance of UWB channel in industrial environment was analyzed by Johan et al. [9].

The analysis of Nakagamim fading channels have been presented by Mehbodniya and Aissa [10]. The performance of the Nakagamim fading channels has been analyzed using binary phase shift keying time hopping technique. The channel estimation was found to play an important role for the development of multiband OFDM systems and the performance of the fading distribution over UWB channel have been analyzed using Kalman filter based channel estimation which removes noise from multipath components.

Foersher et al. [11] have presented the analyses of different channel estimation techniques for wireless MB OFDM systems. Least Square (LS), Least Minimum Mean Square Error (LMMSE) and Kalman filter algorithms were considered for Comb type, Pilot type and Blind type channel estimation. The mathematical model for both discrete and extended Kalman filter (EKF) algorithms were developed byWelch and Bishop [12]. It was reported that, performance of discrete Kalman filter (DKF) was better is compared to extended Kalman filter (EKF).

Recently Riazual Islam and Sup Kwak [13] have developed Winner-Hopf interpolation aided Kalman filter based channel estimation technique for MB-OFDM UWB systems in time varying dispersive fading channel environment. It has been found that the winner-hopf interpolation in Kalman filter algorithm improves the smooth tracking of channel state information. However, the interpolation technique could not improve that the accuracy for fast time varying channel. Keeping the above facts, the modified S-V model with Nakagami fading distribution for modeling UWB channel environment is proposed in the present work.

PROBLEM FORMULATION

The classical UWB systems had the main disadvantage of very wide bandwidth [14] which enhances the problem of building analog and RF circuits with large bandwidth, high speed ADCs for processing the signal and complex circuitry to deal the multi-path energy in multipath path environments. This problem was overcome by pulsed multi-band [15] approach which divides the spectrum into smaller sub bands more than 500 MHz or comparative excess 0.2. Single carrier modulation techniques are used to transmit information on each sub-band. The UWB system maintains the same transmit power by interleaving the symbols across the sub-bands. The smaller sub bands results in the effective bandwidth is reduction which in turn reduces the complexity of the design and hence cost. This improves the overall spectral flexibility.

PROPOSED METHODOLOGY

The disadvantage of pulsed multi-band system is with a single RF chain significant collection of multipath energy. Multi-path energy collection is an important issue as it determines the range and robustness of any communication system. But if OFDM is combined with multi-banding, the strength of the pulsed multi-band (MB-OFDM) system can be regained, insensitivity to group delay. This MB-OFDM implements simplified synthesizer architectures and relaxes the band switching timing requirements.

CONCLUSION

Ultra wideband characteristics are well-suited to short-distance applications, such as PC peripherals. Due to low emission levels permitted by regulatory agencies, UWB systems tend to be short-range indoor applications. Due to the short duration of UWB pulses, it is easier to engineer high data rates; data rate may be exchanged for range by aggregating pulse energy per data bit (with integration or coding techniques). This paper deals the complete overview of the UWB system and the problem associated with this. We suggest the proposed method to overcome the problem too.

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