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Performance of Multiband UWB-OFDM in WPAN MIMO QAM Communications System

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ABSTRACT: Performance Analysis of the Multiband UWB OFDM wireless personal area networks improved multiple access and signal bandwidth diversity MIMO QAM Communications System for multipath fading and multiuser interference channels the BER/SNR performance of the MB-OFDM UWB system with multiple interferences based on the derived approximation, the effects on the BER performance for the choice of the codeword constraint lengths of the convolutional encoder, the length of the cyclic prefix, and the multiuser environments of two or more interferers are thoroughly discussed. Four UWB multipath fading channels are also investigated for the BER/SNR performance of the MB-OFDM UWB system QPSK, PSK, MIMO QAM the simulated

Index Terms: MB-OFDM UWB QPSK, PSK, MIMO QAM,

I. INTRODUCTION

Multiband orthogonal frequency-division multiplexing (MB-OFDM) is a spectrally efficient Technique proposed for high data-rate, short-range ultra wideband (UWB) applications operating in the range from 3.1 to 10.6 GHz [1]. In this scheme, the available 7.5 GHz of UWB spectrum is divided into several sub bands of at least 500 MHz bandwidth, with a conventional OFDM Modulation within each sub band. Several standard proposals such as IEEE802.15.3a that proposed MB-OFDM, employ bit interleaving combined with convolutional channel coding. as bit-interleaved coded modulation, can provide high diversity order for transmission over Rayleigh fading channels with coherent detection and perfect knowledge of the channel. It is well known that reliable coherent data detection is not possible unless an accurate channel state information is available at the receiver. A typical scenario for wireless communication systems assumes the channel changes so slowly that it can be considered time invariant during the transmission of an entire frame. PSK, QPSK Modulation has been shown to be an effective solution for obtaining channel state information at the receiver It consists of sending some known training on which the receiver estimates the channel before proceeding to the detection of data symbols. However, in practical systems, due to the finite number of pilot symbols and to noise, the receiver can only obtain an imperfect estimate of the channel. The performance of over fading channels was studied, for instance, in under prefect channel knowledge at the receiver. A rich literature exists on the impact of imperfect channel estimation. In signal-to-noise ratio (SNR) situations, the poor quality of channel estimates may prevent iterative decoding of be used at the decoder. In considered a training-based MIMO system and showed that for compensating the performance degradation due to imperfect channel estimation, the number of receives antennas should be increased. Obviously, this may not be always possible in mobile applications. In order to deal with imperfect channel estimation, the classical technique, referred to as mismatched detection, consists in replacing the exact channel by its estimate in the receiver for instance, in this scheme greatly degrades the detection performance in the presence of channel estimation errors for a multi-carrier system. Furthermore in, that under imperfect channel, the rates achieved by the mismatched detector are significantly lower than the channel capacity. As an alternative to the aforementioned mismatched approach, and recently in, proposed an improved maximum Signal detection that mitigates the impact of imperfect and applied it to a QAM,MIMO system. A similar investigation was carried out in for PSK, QPSK modulation.

II. MB-OFDM SYSTEM

The multi-band OFDM system is an OFDM solution proposed for the UWB WPAN physical layer standard [5]. In that proposal, the whole available ultra wideband spectrum between 3.1-10.6 GHz is divided into several sub-bands with smaller bandwidth.

Fig. 1 shows the band planning for the multi-band OFDM system. In each sub-band a normal. In the current proposal, there are four groups of 3-band systems to support 4 independent piconets. The main difference between the multi-band OFDM system and other narrowband OFDM systems is the way that different sub-bands are used in the system. The transmission is not done continually on all sub-bands. Rather, it is time multiplexed between different bands in order to use a single hardware for communications over different sub-bands. Different patterns of sub-band switching can be chosen in order to support more piconets operating in the same environments. Fig. 1 shows the structure of a multi-band OFDM transmitter and receiver. The system looks like a normal

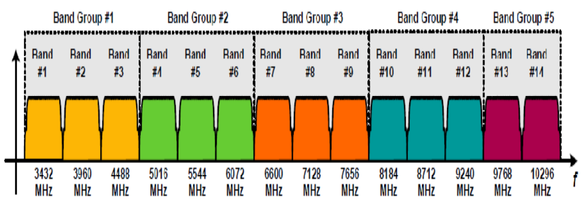

Fig. 1. Band planning for the multi-band OFDM system.

OFDM system except that the carrier frequency changes from symbol-to symbol according to a sub-band hopping scheme. The convolutional code with interleaving is used to combat multipath fading. The main idea of the MB-OFDM is that the high rate serial data stream is converted into the N parallel low rate data stream in order to combat the frequency selective fading prevent inter-carrier-interference (ICI) while avoiding adopting the complex MIMO-EQ at the receiver In addition, the ISI also can be efficiently eliminated by adding a cyclic prefix(CP) of duration longer than the anticipated delay spread of the channel. Information is transmitted using OFDM modulation on each sub-band and different types of conventional modulation techniques, such as QAM, QPSK can be adopted within each sub-carrier. OFDM carriers are efficiently generated using a 128-point IFFT/FFT. The OFDM modulation is performed by an inverse fast Fourier transform (IFFT) and a cyclic prefix (CP) is added to cancel inter-block interference (IBI) and inert-channel interference (ICI). A guard interval of silence is also added to allow the transmitter and receiver to switch from one sub-band to another. The signal is then is fed into a D/A converter and sent to the RF section. At the receiver the signal is sampled after down conversion and filtering. Demodulation is performed using a fast Fourier transform (FFT) followed by one-tap frequency domain equalization. A block of transmit data is scrambled, encoded, and interleaved, and modulated to form each OFDM symbol. The MB-OFDM system employs a convolutional encoding with four possible code rates: 11/32, 1/2, 5/8, and 3/4. These code rates are derived from a baseline rate 1/3 encoder with a generator polynomial (1338, 1458, 1758) and constraint length 7 through puncturing. The interleaving is performed using a three-stage block interleaver. In the first stage, data corresponding to three or six subsequent OFDM symbols are interleaved, and the output is partitioned into three or six blocks. In the second stage, each block of the symbol interleaver output is interleaved separately. In the third stage, each symbol is cyclically shifted by a different amount. The interleaved data are modulated by a Gray-mapped QPSK/QAM. An inverse FFT (IFFT) is performed on a series of modulated symbols to get a series of time domain samples. [7] The total number of subcarriers for OFDM modulation in each subband is 128, among which 100 are dedicated to data subcarriers, 12 to pilot subcarriers, and 10 to guard subcarriers. The guard subcarriers are in two sets of five, one at each end of the OFDM symbol, with the five subcarriers in each set repeating the nearest five data subcarriers. The remaining six subcarriers are nulls over which no signal is transmitted. After the IFFT, a null suffix of 37 samples is attached to the 128 time-domain samples to form a complete OFDM symbol. The resulting OFDM symbol is 165 samples or 312.5 nsec long, and it is transmitted through a sub band determined by the FH pattern. Time and/or frequency domain repetitions are also employed in the OFDM symbol level to enhance the performance The MB-OFDM scenario proposed in the IEEE 802.15.3a WPAN proposal . In this scheme, the frequency spectrum between 3.1 to 10.6 GHz is divided into several no overlapping sub bands, each one occupying approximately a 500 MHz bandwidth [1]. As depicted the information is transmitted using OFDM modulation over one of the sub bands in a particular time-slot. The binary sequence is encoded by a non-recursive non-systematic convolutional code, before being interleaved by a pseudo-random inter leaver. The interleaved bits are gathered in subsequences of B bits d1k. . . dBk and mapped to complex Mc- QAM (Mc = 2B) symbols sk. At each time-slot, a time-frequency code (TFC) selects the center frequency of the sub band over which the OFDM symbol is sent. The TFC is used not only to provide frequency diversity, but also to distinguish between multiple users.

We assume single-user OFDM transmission with M subcarriers per sub band, through a frequency selective multipath fading channel, described in discrete-time baseband equivalent form by the taps {hl}L−1 l = 0. At the receiver, after removing the cyclic prefix (CP) and performing fast Fourier transform (FFT), the received OFDM In 2002, the Federal Communications Commission (FCC) allocated a large spectral mask from 3.1 GHz to 10.6 GHz for unlicensed use of commercial UWB communication devices Since then, UWB systems have gained high interest in both academic and industrial research community.UWB was first used to directly modulate an impulse like waveform with very short duration occupying several GHz of bandwidth Two examples of such systems are Time-Hopping Pulse Position Modulation (TH-PPM) introduced in and Direct-Sequence UWB (DS-UWB) Employing these traditional UWB techniques over the whole allocated band has many disadvantages including need for high complexity Rake receivers to capture multipath energy, high speed analog to digital converters (ADC) and high power consumptions. These considerations motivated a shift in UWB system design from initial Single-band radio that occupies the whole allocated spectrum in favor of Multi-band design approach Multi-banding consists in dividing the available UWB spectrum into several sub-bands, each one occupying approximately 500 MHz. By interleaving symbols across different sub-bands, UWB system can still maintain the same transmit power as if it was using the entire bandwidth. Narrower sub-band bandwidths also relax the requirement on sampling rates of ADCs consequently enhancing digital processing capability. Multiband-OFDM (MB-OFDM) is one of the promising candidates for PHY layer of short-range high data-rate UWB communications. It combines Orthogonal Frequency Division Multiplexing (OFDM) with the above multi-band approach enabling UWB transmission to inherit all the strength of OFDM technique which has already been proven for wireless communications (ADSL, DVB, 802.11a, 802.16.a, etc.)

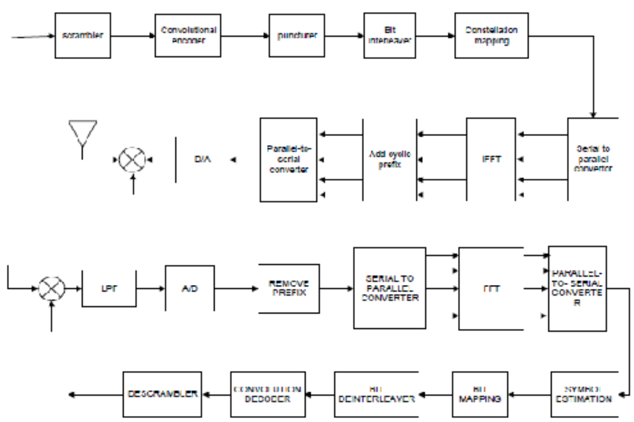

Fig. 2. The structure of a multi-band OFDM transmitter and receiver.

III. UWB TECHNOLOGY BASIC

UWB send information through pulses. The pulses are sent one by one, after each other with a given pulse repetition frequency (PRF). The pulses have large bandwidth, which means that the energy of a pulse is spread over a wide frequency band whereas a carrier wave system concentrates the energy on a specific frequency. Comparing these two alternatives, it can be seen that a pulse based system can have a lower average output power per MHz than a carrier wave based system and hence does not disturb the carrier wave under simultaneous operation.

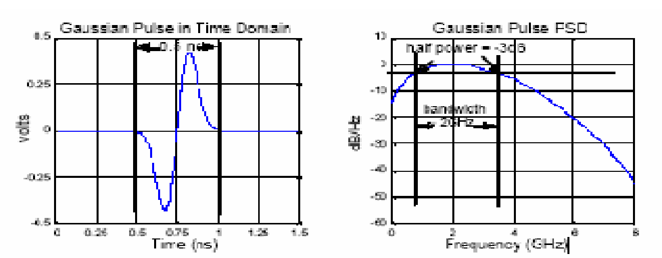

Fig. 3. GHz centre frequency Gaussian Monocycle in time and frequency domains.

The pulses can be created in different ways and have different characteristics. The basic element in UWB radio technology is the use of Gaussian monocycle as shown in Fig. 3. In both time and frequency domains. The monocycle [11] with a narrow pulse width produces a wide bandwidth signal. The monocycle's width determines the centre frequency and the bandwidth. High-data-rate applications, more and more energy are consumed in wireless networks to Guarantee quality-of-service (QoS). Therefore, energy-efficient communications have been paid increasing attention under the background of limited energy resource and environmental-friendly transmission behaviours. In this article, basic concepts of energy efficient communications are first introduced and then existing fundamental works and Advanced techniques for energy efficiency (EE) are summarized, including information theoretic analysis, orthogonal frequency division multiple access (OFDMA) networks, multiple-input multiple-output.

IV. RESULTS

The proposed Multiband UWB-OFDM in WPAN MIMO QAM is simulated by using MATLAB 7.8.0. MATLAB is a strong mathematical tool which provides help to engineers to solve, model, simulate the problems and find solutions assuming environment in to mathematical equations. It is standard engineering tool as it perform many different tasks using different tool box relevant to different particular cases e.g. Control systems, signal processing, image processing, communication systems, and support complex matrix manipulation, simulink etc. In different research field it provides platform for learning and comparison of theoretical hypothesis and simulated values. It even provides support to nonlinear system calculations and result. This chapter presents performance of the Performance of Multiband UWB-OFDM in WPAN MIMO QAM Communications System developed in MATLAB. In the simulation process, the goal was to reach. UWB communication provides a new and exciting opportunity for high-bandwidth data communications. We discuss about a multiband OFDM UWB system with simple block and we show we can improve the performance of system with such a simple system. We show additional antennas at the transmitter and receiver can decrease BER of the system and increase data rate of it. Also we discuss about the channel capacity of the PSK MIMO multiband OFDM UWB. We use 64 QAM in the receiver and show it's equation for estimation of channel and symbol Also we discuss about UWB link budget and the importance of it in designation. Finally we show the results of our simulations and we show that according to our simulation, we can improve the performance of the multiband UWB system.

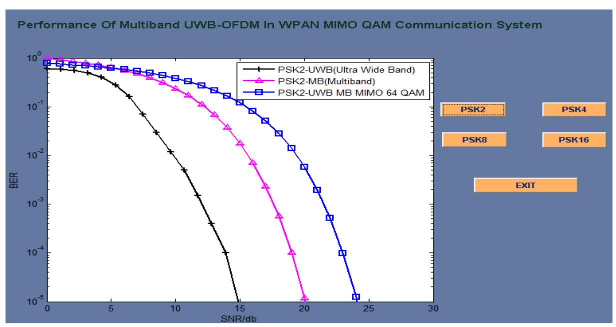

Fig. 4. Performance of the system PSK2,UWB,15 SNR/db and PSK2 MB 20 SNR/d with PSK2 UWB-MB-MIMO,64QAM, 24 SNR/db proposed.

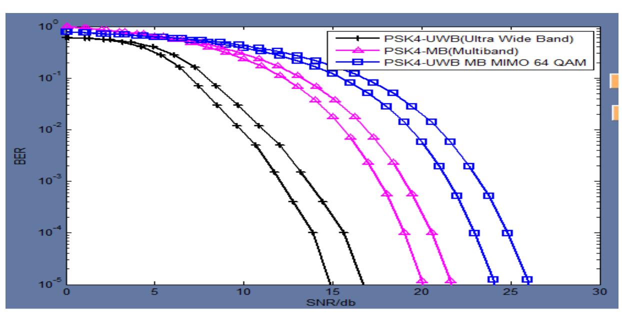

Fig. 5. Performance of the system PSK4,UWB,17 SNR/db and PSK4 MB 23 SNR/d with PSK4 UWB-MB-MIMO,64QAM, 26 SNR/db proposed.

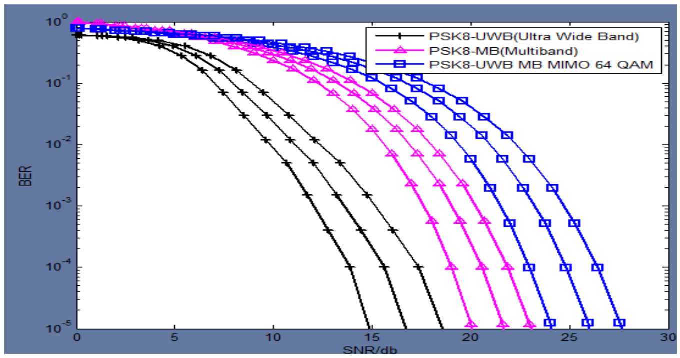

Fig. 6. Performance of the system PSK8,UWB,19 SNR/db and PSK8 MB 24 SNR/d with PSK8 UWB-MB-MIMO,64QAM, 28 SNR/db proposed.

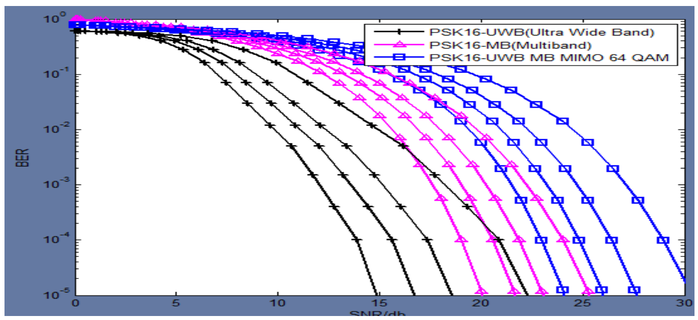

Fig. 7. Performance of the system PSK16,UWB,23 SNR/db and PSK16 MB 25 SNR/d with PSK16 UWB-MB-MIMO,64QAM, 30 SNR/db proposed.

V. CONCLUSION

Performance study of MB-OFDM system in indoor UWB propagation environment has been carried out in this research. Paper Results were obtained by simulating an MB-OFDM system over various modified realistic UWB channel scenarios using different modulation technique. A more realistic study has been attempted by using modified channel models. The MB-OFDM UWB performs better using PSK modulation technique than that MIMO, 64-QAM. The PSK2 modulated MB-OFDM UWB performance in better than channel model. However MIMO, 64-QAM modulation result in a much more utilization of available spectrum compared to PSK4 modulation. By increasing the data rate using same PSK8 and PSK16 modulation technique, it can be observed that low data rate system performs better than that of high data rate system. Thus the MB-OFDM performs better in the channel environment than in the MIMO QAM channel model for low data rate. In 480 Mbps mode, the performance in found to be better than that of data channel model. Thus it can be concluded that MB-OFDM system provides very good technical solution to be used as UWB PHY layer for short-range high data-rate wireless.

VI. FUTURE SCOPES

UWB We described key features of two UWB technologies, DS-UWB and MBOFDM, and discussed global status of standardization and regulation. In addition to UWB technology, 60 GHz millimeter-wave-based short-range wireless communications are expected to play a crucial role for multigiga bit. To realize multigiga bit 60 GHz communications, accurate channel modeling, efficient modulations, and broadband circuits must be addressed. In addition to high data rate we also discussed a low data rate, low cost, and ultra low-power consumption technology named ZigBee. Although it is on the other end of UWB and 60 GHz millimeter-wave in data rate, ZigBee has potential in sensor networks and the wireless inventory tracking control of next generation wireless networks. Together with PHY technology, upper layer protocols also are crucial for next-generation broadband. We focused on the MAC sublayer of multigigabit and described the issues of high throughput and directional antennas. Additionally, we highlighted an optimized partition of MAC functions between hardware and software. ZigBee are potential technologies to realize short-range wireless communications of 4G technology. To successfully deploy these in the near future, globally unified standardization and regulations, as well as technical issues should be addressed.

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