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Multiband-OFDM MIMO Based Ultra-Wideband Communication System

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ABSTRACT: In this paper we present a Multiband UWB systems the proposed scheme incorporates frequency-domain differential en/decoding with the hopping multiband OFDM modulation to capture the effect of multipath-rich clustering property of UWB channels the pair wise error probability performance of the proposed scheme in terms of cluster and ray arrival rates. It turns out that the diversity advantage does not strongly depend on the random-clustering of UWB channels, and we can achieve the same diversity gain in different channel environments. However, the system performance relies on the clustering behavior through the coding gain. Simulation results show that the proposed differential scheme achieves good performance in the short-range line-of-sight scenarios. In addition, the jointly encoded differential multiband UWB scheme is able to yield superior performance to the un coded coherent multiband UWB system.

Keywords: Multiband UWB, OFDM, subcarriers, mobile broadband.

I. INTRODUCTION

Though cooperative communication has been intensively examined for general wireless systems, such as mobile and ad-hoc networks, it has been almost unexplored in the case of Space-Time-Frequency Coded Multi-band OFDM Ultra-Wideband (STFC MB-OFDM UWB). This thesis proposes a framework of cooperative communication in such systems where nodes are equipped with Simulation results show that cooperative communication might, in some cases, provide better error performance than non-cooperative communication without any additional transmission power we propose a differential encoding and decoding scheme for UWB systems employing MIMO multiband OFDM. In the proposed scheme, the information is jointly encoded across spatial, temporal, and frequency domains. By differentially en/decoding in the frequency domain, the proposed scheme does not rely on the assumption that the fading channel stays constant within several OFDM symbol durations. In this way, we are able to explore the available space and frequency diversities, richly inherent in UWB channels. More importantly, it allows us to incorporate the differential transmission with hopping multiband OFDM modulation so as to gain the additional diversity from time-domain spreading. In order to capture the unique multipath-rich and random clustering properties of UWB channels we consider a peer-to-peer multiband UWB system receive antennas. Within each sub band, OFDM modulation with subcarriers is used at each transmit antenna. The modulated OFDM symbols can be time- interleaved across several sub bands as specified in .According to the IEEE 802.15.3a standard the fading channels for UWB systems are based indoor channels. mobile broadband networks are followed and supported by a novel research and development works towards the framework that could lead to high performance delay-sensitive utility networks, spectral efficiency, network stability and high QoS provisioning for the key QoS parameters for any given multimedia service in nowadays and future order to the average power expenditure subject to network stability is presented in In comparison with all above mentioned works, this paper applies a version of the drift-received samples. This paper describes the fundamentals of MIMO-OFDM system and study of various channel estimation techniques and their performance. In order to satisfy the exponential growing demand of wireless multimedia services, a high speed data access is required. Therefore, various techniques have been proposed in recent years to achieve high system capacities. Among them, we interest to the multiple-input multiple output (MIMO).

The MIMO concept has attracted lot of attention in wireless communications due to its potential to increase the system capacity without extra bandwidth [1]. Multipath propagation usually causes selective frequency channels. To combat the effect of frequency selective fading, MIMO is associated with orthogonal frequency-division multiplexing OFDM) technique. OFDM is a modulation technique which transforms frequency selective channel into a set of parallel flat fading channels. A cyclic prefix CP is added at the beginning of each OFDM symbol to eliminate ICI and ISI. The inserted cyclic prefix is equal to or longer than to the channel [2]. The 3GPP Long Term Evolution (LTE) is defining the next generation radio access network. LTE Downlink systems adopt Orthogonal Frequency Division Multiple Access (OFDMA) and MIMO to provide up to 100 Mbps (assuming a 2x2 MIMO system with 20MHz bandwidth). The performance of a MIMO-OFDM communication system significantly depends upon the channel estimation. However, in most of these research works, the CP length is assumed to be equal or longer than the maximum propagation delay of the channel. But in some cases and because of some unforeseen channel behavior, the cyclic prefix can be shorter than channel length. In this case, both ICI and ISI will be introduced and this makes the task of channel estimation more difficult. Equalization techniques that could flexibly detect the signals we will focus on the study of the performance of LS and LMMSE channel estimation techniques for LTE Downlink systems under the effect of the channel length. wireless services require high-bit-rate transmission over mobile radio channels. To reduce the effect of inter symbol interference (ISI) caused by the dispersive Rayleigh-fading environment [1], the symbol duration must be much larger than the channel delay spread. In orthogonal frequency-division multiplexing (OFDM) the entire channel is divided into many narrow sub channels, which are transmitted in parallel, thereby increasing the symbol duration and reducing the ISI. Therefore, OFDM is an effective technique for combating multipath fading and for high-bit-rate transmission over mobile wireless channels. To eliminate the need for channel estimation and tracking, differential demodulation can be used in OFDM systems, at the expense of a 3–4-dB loss in

II. FUNDAMENTALS OF UWB TECHNOLOGY

Ultra wide bandwidth (UWB) transmission systems have achieved compelling concern in the scientific, commercial and military sectors past the last decagon. A 2002 commanding by the US Federal Communications Commission (FCC) grant for harmony of UWB systems with classical and secured radio services, and enables the potential use of UWB transmission without allotted spectrum. Wide bandwidth allow limited delay resolution, force adjacent fading, and good obstacle penetration, creating UWB technology a viable candidate for reliable communications and accurate positioning in challenging environments, such as civic canyons and forests. UWB transmission systems likely grant low-cost production and restate of earlier populated spectrum; and hence they are currently under consideration for communications and localization in a wide variety of applications. With its small chance of detection and anti-jam capacity, UWB also has operations in military and homeland security function. UWB or Ultra-Wide Band technology allow various assets, especially in terms of very high data transmission rates which are well above those available with currently deployed technologies such as 802.11a, b, g, WiMax and the like. As such UWB, ultra wideband technology is achieving appreciable acceptance and being expected for use in a number of areas.

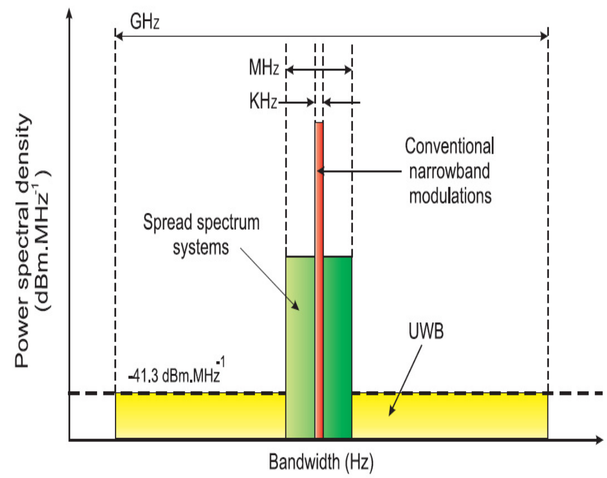

Fig. 1. Power spectral Density.

Earlier Bluetooth, Wireless USB and some others are developing solutions, and in mentioned areas only its use should be enormous. As the name involve UWB, ultra wide band technology, is a design of transmission that attend a very wide bandwidth. Typically this will be many Gigahertz's, and it is this aspect that enables it to bear data rates of Gigabits per second. The matter that UWB transmissions the high rates are perhaps the most compelling aspect from a user's point of view and also from a commercial manufacturer's position. With UWB, transmission rates of over 100 Mbps have been demonstrated, and the potential for higher data rates over short distances is there. The high data rate capability of UWB can be best understood by examining the Shannon's famous capacity.

Bands with maximum bandwidths about 10 MHz. An UWB link functions as a “cable replacement” with data rate requirement that ranges from 100 Kbps for a wireless mouse to several hundreds of Mbps for rapid file sharing or download of video files. In summary, UWB is seen as having the potential for applications which to date have not been fulfilled by the aforementioned wireless short range technologies. Depict the positioning of the UWB compared to WLAN/WPAN standards in terms of data rate and maximum range. As observed, the potential applications of UWB technology concern two technical areas: very high data rate transmission over short distances (typically 200 Mbps up to 10 m), and low data rate communications with ranges of 100 m with positioning capabilities. It is noticed that in contrast with the Wi-Fi standard, the high data rate mode of UWB belongs to the family of short range WPANs. However, the potential data rate of UWB exceeds the performance of all current WLAN and WPAN standards. In the low data rate mode, the IEEE802.15.4a standard targets UWB systems with centimeter accuracy in ranging as well as with low power and low cost implementation. These features allow a new range of applications, including military applications, medical applications (e.g., monitoring of patients), search-and-rescue applications, logistics (e.g., package tracking), and security applications (e.g., localizing authorized persons in high-security areas). UWB Regulations Devices utilizing UWB spectrum are subject to more stringent requirements because the UWB spectrum underlays other existing licensed and unlicensed spectrum allocations. In order to optimize spectrum use and to reduce interference to existing systems, regulatory bodies in both Europe and the United States impose very restrictive rulings to UWB devices. Compare the spectral occupation and emitted power of different radio systems. The essence of these rulings is that the power spectral density (PSD) of the modulated UWB signal must satisfy predefined spectral masks specified by spectrum-regulating agencies. In the United States, the FCC requires that UWB devices occupy more than 500 MHz of bandwidth in the 3.1 – 10.6 GHz band, according to the spectrum mask of. As observed, the PSD must not exceed –43 dBm per MHz of bandwidth. This limit is low enough not to cause any interference to other services sharing the same bandwidth. Cellular phones, for example, transmit up to +30 dBm per MHz, which is equivalent to 107 higher PSD than UWB transmitters.

III. RESULTS

The Results of simulations using MATLAB tool shows that the BER for all the PSK based OFDM MIMO schemes decrease monotonically with increasing values of SNR. A QPSK system transmits information at twice the bit rate of a BPSK system for the same channel BW due to which QPSK is mostly used in practice. In case of 8-PSK the probability of error is greater as constellation points come closer, but BW of 8-PSK is one third of the BW of BPSK. So, an 8-PSK system transmits information at thrice the bit rate of a BPSK system. It is observed from the simulation curves and the mathematical analysis of the signals that as the number of signals or number of M increases, the error probability also increases over AWGN channel. It is seen that higher order modulations exhibit higher error-rates; in exchange however they deliver a higher raw data-rate. Increasing the data rate will increase the SNR, however, increasing Rb (Bit rate in bits /second) will also cause more noise and noise term also increases, since more bits are packed closer and sent through the channel. So, we cannot increase SNR by simply increasing Rb. We must strike a compromise between the data rate and the amount of noise our receiver can handle.

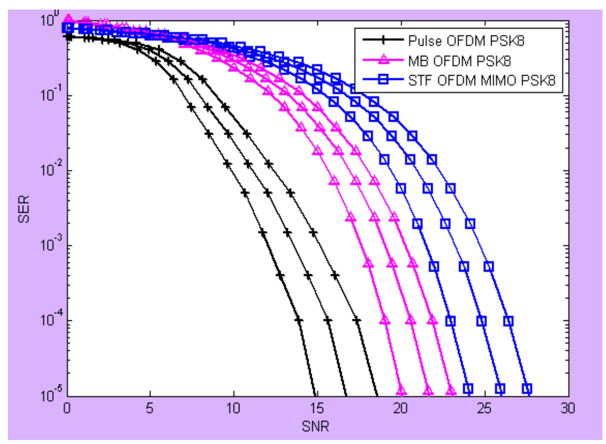

Fig. 2. Comparative performance analysis of 8-PSK.

Shows that Comparative result analysis there are For all techniques The values of the SER is very close to 10,where as the SNR is different for all the different modulation techniques 15-19 for Pulse OFDM,20-24 for MB OFDM,and 24-28 for STF OFDM MIMO.

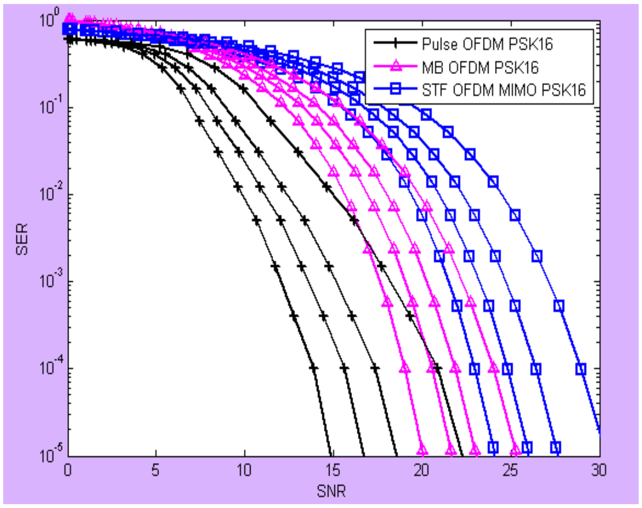

Fig. 3. Comparative performance analysis of 16-PSK.

IV. CONCLUSIONS

Space-time-frequency (STF) coding across OFDM blocks can lead to a maximum achievable diversity order of, where is the number of resolvable paths and is the rank of the temporal correlation matrix of the channel. In this paper, we proposed a multi band MIMO coding framework for UWB systems. By a technique of band hopping in combination with jointly coding across spatial, temporal and frequency domains, the proposed scheme is able to exploit all available spatial and multi path diversities, richly inherent in UWB environments. From the theoretical results, we can draw some interesting conclusions as follows. First, the effect of Nakagami fading parameter on the diversity gain is insignificant, and the diversity advantages obtained in Nakagami- fading and Rayleigh fading channels are almost the same. Second, the maximum achievable diversity advantage of multi band UWB-MIMO system.

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