Performance Enhancement of 5G by using Adaptive Modulation Scheme with Wideband Reflection Array Antenna

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Abstract: In this work, we analyze the main characteristics of the proposed waveform and highlight relevant features. After introducing the principles of 5G, this work contributes to the areas like the means for engineering the waveform's spectral properties; analytical analysis of bit error performance over different modulation models; concepts for 5G to achieve diversity; preamble-based synchronization that preserves the excellent spectral properties of the waveform; bit error rate performance improvement for channel coded 5G transmission using iterative receivers for the relevant application scenarios and suitable parameterizations. The objective is to provide 5G proof-of-concept and implementation aspects of the prototype using simulation platforms available today.

Keywords: 5G, Dense Networks, MIMO, LTE

1. Introduction:

5G LTE is an emerging global broadband wireless system based on IEEE 802.16 standard. It is a new wireless OFDM-based technology that provides high quality broadband services long distances based on IEEE.802.16 wireless (Metropolitan Area Network) MAN air interface standard to fixed, portable and mobile users[1,2]. 5G LTE promises to combine high data rate services with wide area coverage (in frequency range of 10 – 66 GHz (Line of sight) and 2 -11 GHz (Non-Line of Sight)) and large user densities with a variety of Quality of Service (QoS) requirements. 5G LTE can provide broadband wireless access (BWA) up to 30 miles (50 km) for fixed station and 3 to 10 miles (5-15 km) for mobile stations with theoretical data rates between 1.5 and 75 Mbps per channel. The new standards for 5G LTE are being developed for expanding the mobility further with enhanced coverage, performance and higher data rates (of the order of 100 Mb/s) in a 5G LTE Network. The 5G LTE standard air interface incorporates the meaning of both the medium access control (MAC) and the physical (PHY) layers for the endorser station and base station while the entrance system operability is characterized by the 5G LTE Forum, an association comprising of administrators and part and gear producers. As the essential capacity of 5G LTE PHY layer is the genuine physical transportation of information. The primary execution turns out to be all the more difficult when portable situations are experienced in remote channel. Keeping in mind the end goal to accomplish most extreme execution at low BER, high information rate transmission (both in settled and versatile situations) and high ghastly productivity with assortment of QoS needs IEEE 802.16d/e standard backings assortment of PHY layer instruments with an assortment of components. The adaptability of the PHY empowers the framework planners to tailor their framework as per their prerequisites.

2. Related Work:

Nitin Sharma et al, "On the use of particle swarm optimization for adaptive resource allocation in orthogonal frequency division multiple access systems with proportional rate constraints" presented his work on the use of particle swarm optimization for adaptive resource allocation in orthogonal frequency division multiple access systems with proportional rate constraints. In this work they proposed that orthogonal frequency division multiple access (OFDMA) was a promising technique, which could provide high downlink capacity for future wireless systems. The total capacity of OFDMA could be maximized by adaptively assigning subchannels to the user with the best gain for that subchannel, with power subsequently distributed by water-filling algorithm. In this work they had proposed the use of a customized particle swarm optimization (PSO) aided algorithm to allocate the subchannels. The PSO algorithm is population-based: a set of potential solutions evolves to approach a near-optimal solution for the problem under study. The customized algorithm worked for discrete particle positions unlike the classical PSO algorithm which was valid for only continuous particle positions. It was showed that the proposed method obtains higher sum capacities as compared to that obtained by previous works, with comparable computational complexity. In his work, they had proposed the use of PSO, a stochastic optimization technique, for sub-channel allocation in downlink of OFDMA systems followed by power allocation using water-filling algorithm. The results produced by the simulations indicate that the algorithm performs better in terms of sum capacities as compared. The sum capacity increases with the increase number of users. The sum capacity also increases initially with the increase in number of iterations and population size but rapidly saturates to a near optimal value. This result suggests that PSO aided subchannel allocation could provide significant gain in capacity even with very small population size and number of iterations. Moreover in PSO aided subchannel allocation the search and subchannel allocation was performed simultaneously as compared to traditional methods where the subchannels were first sorted in accordance of their gains and then allocation was performed. This significantly reduces the complexity of PSO aided allocation. The complexity of our algorithm was assessed to be O(N) as compared to O(KNlog2N) for that of method in. Hence it might be concluded that the proposed algorithm was order of magnitude faster as compared to the method in This fact makes PSO aided subchannel allocation a suitable choice for practical wireless systems like WiMAX (802.16e) where the convergence rate plays a very important role as the wireless channel changes rapidly. The fact that the channel is assumed to be constant during allocation makes convergence rate a very important parameter for wireless systems. The future scope of this paper could be to use multiple antennas on both transmitter and receiver site, which can provide further gain in capacity because of spatial multiplexing.

Nelly M. Shafik" Wavelet Transform Effect on MIMO-OFDM Systems Performance "presented his work and proposed that many reasons cause multi- carrier CDMA to be the best technology in the latest mobile generations known by fourth generation for mobile. As well known, the greatest enemy for any wireless communication is multi- path fading which usually result in distortion in time- domain, or in frequency domain or even in both. Therefore any new technique applied into mobile communication system was concerning with mitigating multi-path fading distortion which appears in form of reducing BER level. In this work three techniques had been combined in order to enhance mobile system performance in the presence of multipath fading channel. These techniques were, orthogonal frequency division multiplexing (OFDM), code division multiple access (CDMA), and modified space shift keying (SSK). The last technique was considered special case for MIMO technology. By the aid of MATLAB code, proposes system was simulated in order to display BER performance versus variation in the SNR at many various system conditions.

Fourth generation of mobile has introduced many different families one of those families uses both OFDM and CDMA techniques together in order to join benefits of frequency and time diversity. But in spite of the efficient performance of all families of the 4G, it faces great challenge because of required services. Modern applications for digital communication systems such as video calls, internet services, mobile live entertainments. .etc all those applications need higher transmission data rates and high quality of services. They had recommended in this paper, novel technique for MIMO technology denoted by modified SSK had been inserted into OFDM- CDMA system. This modified algorithm provided efficient selection for transmitting antennas instead of using all transmitting antennas as in case of traditional MIMO technology. Simulation results for proposed system showed acceptable BER level at small value of SNR and also at bad fading channel condition. For example at only SNR = 4dB, BER is order of 10^-6 using 7 transmitting antennas and 2 receiving antennas in presence of multi- path Rayleigh fading channel.

Yue Hong Gao et al presented his work on "**Performance Evaluation of Mobile 5G LTE with Dynamic Overhead"**. In this work they proposed that Mobile WiMAX had become one of the 3rd Generation communication systems and its performance has been widely evaluated. The physical overhead is a critical factor that may affect the overall performance significantly. But almost no attention has been paid to the impact of overhead on system performance yet. In this paper, we first analyze main signaling resources needed in physical layer, which consist of the physical overhead. Then the dynamic overhead model for downlink and uplink are proposed respectively and simplified, while maintaining the simulation accuracy. Average overhead amount was obtained through system level simulation using dynamic overhead calculation. Finally, it was proved that the model was reasonable and the average overhead size may be used instead of dynamic calculation for the sake of reducing simulation complexity as well as keeping evaluation results precise.

In his work, they analyze each signaling component needed in mobile 5G LTE physical layer on the downlink and the uplink, respectively. Then the dynamic overhead calculation model is presented and simplified by using the average value. It was proved that the model was reasonable and the average overhead size may be used instead of dynamic calculation for the sake of reducing simulation complexity as well as keeping evaluation precision.

3. Methodology:

The Orthogonal Frequency Division Multiplexing (OFDM) is developed to support high data rate and can handle multi carrier signals. Its specialty is that, it can minimize the Inter Symbol Interference (ISI) much more compared to other multiplexing schemes. It is more likely improved Frequency Division Multiplexing (FDM) as FDM uses guard band to minimize interference between different frequencies which wastes lots of bandwidth but OFDM does not contain inter-carrier guard band which can handle the interference more efficiently than FDM. So, this is the perfect choice for 5G LTE as it can help to satisfy the requirements of efficient use of spectrum and minimize the transmission cost. On top of that OFDM handles multipath effect by converting serial data to several parallel data using Fast Fourier Transform (FFT) and Inverse Fast Fourier Transform (IFFT).

Proposed work:

The goal of this paper is to implement and OFDM Physical layer specification by following IEEE 802.16e-2005[1] Using Adaptive decision control techniques we analyze the performance of OFDM physical layer in mobile 5G LTE based on the simulation results of Bit-Error-Rate (BER), Signal to Noise Ratio (SNR) and Probability of Error (Pe). The performance analysis of OFDMA- is done in MATLAB 7.4 under reference channel model with channel equalizer

4. Simulation Results:

We have designed physical layer of 5G LTE model following the IEEE 5G LTE Standards using Simulink/MATLAB platform. In this model various IQ mapping schemes are considered in presence of fading channel to understand the performance of modulation schemes at different SNR.

First of all we studied the model performance in presence of AWGN channel only without the effect of any kind of fading. Figure 4.1 shows the 5G LTE model having AWGN channel here the performance is evaluated using three criteria. These criteria are Bit error rate scatter plot and signal spectrum scope.

Model 1: Physical layer model without fading:

In figure 4.1 the input is provided by binary data generated from MAC layer in packet data unit format. In MAC PDU block the generated data could be predefined integers or random integers. These inputs are arrays of 35x1 sizes generating repetitively. The generated inputs are attached with 6 byte MAC header and passed to randomizer in binary packets. These MAC PDUs (packet data units) are transmitted at the end from physical layer and we have connected AWGN channel to introduce white noise in transmitted signal.

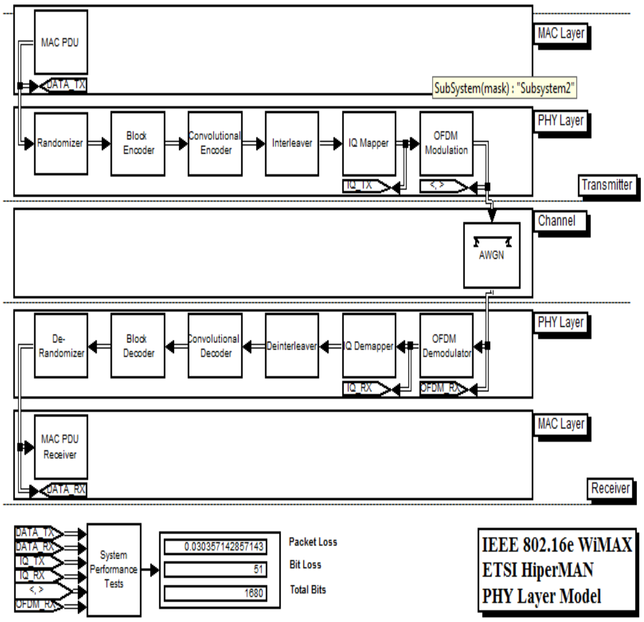

Fig. 1: Simulink model for 5G LTE Physical layer without fading

The transmit diversity system has a computation complexity very similar to that of the receive diversity system. The resulting simulation results show that using two transmit antennas and one receive antenna provides the same diversity order as the maximal-ratio combined (MRC) system of one transmit antenna and two receive antennas.

Also observe that transmit diversity has a 3 dB disadvantage when compared to MRC receive diversity. This is because we modelled the total transmitted power to be the same in both cases. If we calibrate the transmitted power such that the received power for these two cases is the same, then the performance would be identical. The theoretical performance of second-order diversity link matches the transmit diversity system as it normalizes the total power across all the diversity branches.

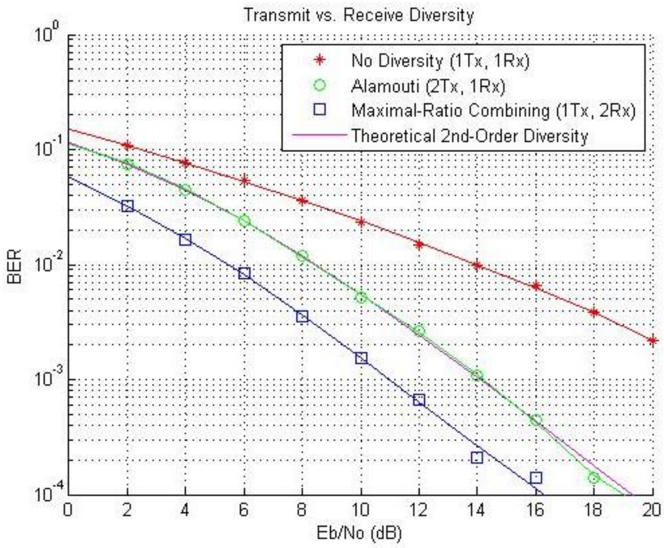

Fig 2: BER performance at different MIMO coding schemes for 1x2 or 2x1 systems.

Since these results take some time to generate, we load the results from a prior simulation. The functional script OSTBC4M.m, OSTBC4M.m is included, which, along with MRC1M.m, MRC1M.m and OSTBC2M.m, OSTBC2M.m, was used to generate these results. The user is urged to use these scripts as a starting point to study other codes and systems.

As expected, the similar slopes of the BER curves for the 4x1, 2x2 and 1x4 systems indicate an identical diversity order for each system.

Also observe the 3 dB penalty for the 4x1 system that can be attributed to the same total transmitted power assumption made for each of the three systems. If we calibrate the transmitted power such that the received power for each of these systems is the same, then the three systems would perform identically. Again, the theoretical performance matches the simulation performance of the 4x1 system as the total power is normalized across the diversity branches.

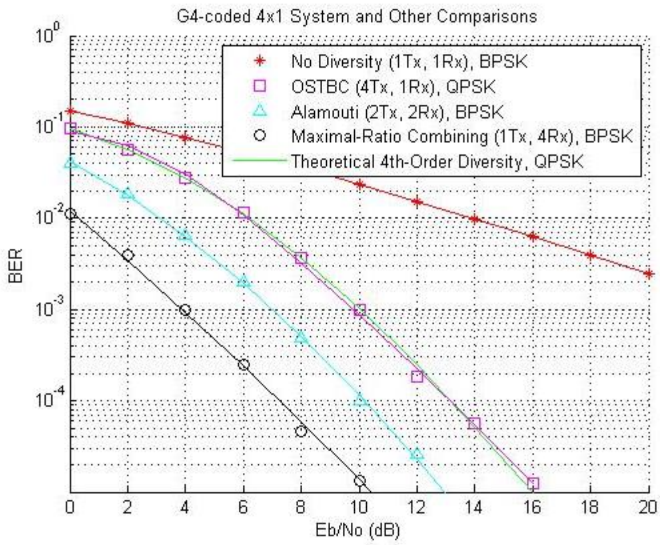

Fig. 3: BER performance at different MIMO coding schemes for higher order diversity.

5. Conclusion:

This work discuss and implements the issue that has helped to improve the channel distortion estimation accuracy due to the channel effect for enhancing the standard a reliable transmission for different modulation technique including adaptive channel modulation in presence of channel fading, noise and distortions. To this end in the thesis work we have develop an highly accurate and simple algorithm which can jointly estimate channel state prior to data decoding for a wireless communication system. In the future numerous algorithms can be applied to deal channel estimation for MIMO-OFDM systems. The results are generated at different modulation schemes at different SNR values and then we have tabulated the estimated carrier frequency offset values to observe the average estimated offset frequency and its error to the ideal offset value as defined in the algorithm. The average error is found to be very small.

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