A Review on OFDM-IDMA Uplink Multi-user System with Scalable Latency for Next Generation WLAN

Ravi Prakash Vishwakarma, Shambhavi Shukla
Department of Electronics and Communication
Institute of Engineering and Technology, DRMLAU, Ayodhya, U.P., India
rp.vishwkarma@gmail.com, shambhavishukla@rmlau.ac.in

Abstract: Alongside giving existing correspondence application in a versatile manner many new administrations have opened up which unequivocally require portable broadband access. The expansion in requests on remote applications, future frameworks need to structure new advances that help high limit and QOS. Future communication networks may encounter various issues in order to facilitate heavy heterogeneous data traffic and large number of users; therefore, more advanced multiple access (MA) schemes are being developed to meet the changing requirements. The research space on making more robust MA scheme is continuously increasing, so it becomes significant to analyze the various schemes to determine the appropriate MA scheme. Therefore, in this paper, the comprehensive overview of the most popular and recent MA schemes is presented.

Keywords: IDMA, OFDMA, WLAN, GSM.

1. Introduction:

Development in wireless communication has changed modern world. Two decades before only high-tech notebooks had connectivity capability with Wireless Local Area Networks (WLAN), for wireless broadband internet access. But now WLAN connectivity is common to many modern communication devices due to increasing consumer demand. This growth has offered new application like multimedia streaming and video-on-demand. This development has created a innovative research field for "wireless broadband access everywhere". Mobile environment also providing services of internet surfing or watching a video stream it indicates the success of wireless broadband by means of WLAN.

Current 2G cellular technologies like (GSM) are designed for voice-centric network but they work poorly for data-based applications. The 3G cellular technology like UMTS and HSDPA are better suited for data-centric based network transmission. But these standards are not able to provide the demand of high data rates and high expectations of quality of service (QoS) for future prospects.

Future systems are designed in respect of fields that gives high capacity. It has been found that [1, 2] interleave division multiple access (IDMA) systems provides capacity of higher information transfer over orthogonal frequency division multiplexing (OFDM). Two major disabilities multiple access interference (MAI) and inter-symbol interference (ISI)

are present in wireless communication systems that can degrade transmission performance. Many proposed techniques like time domain equalization are available but they are very costly, OFDM can fight with ISI very efficiently with methodology of conversion by using the frequency selective channel into parallel flat fading channels. The benefits of IDMA [3] are over minimizing MAI by iterative process of combining elementary signal and decoding. In next section we will discuss about both technologies in details and final we will determine the effect of an IDMA-OFDMA system on performance of bit error rate (BER) with respect to change in SNR.

2. Literature Review:

Chulhee Jang, In this paper, they recommend a IDMA machine with relays. We describe the machine model and the detection set of rules of the vacation spot. The detection algorithm is based totally at the chip-by using-chip detection algorithm. The proposed gadget enhance no burden to the mobiles and needs quite simple relays. Simulation outcomes suggests that the proposed system does a function of a couple of get right of entry to scheme and obtains the variety advantage. In this paper, they propose the IDMA gadget with relays. The proposed machine is primarily based on the chip-with the aid of-chip detection set of rules. The proposed device raise no burden to the mobiles and wishes quite simple relays. It is proven that the proposed system does a function of a multiple access scheme and obtains the diversity advantage [1].

Tao Yang, proposed a changed linear programming approach to locate the satisfactory fee profile for the scheme. Numerical outcomes show that with simply repetition coding and greatest fee allocation, the overall performance of the scheme is handiest approximately five dB far away from the capacity for a huge variety of SNR, furnished that the range of users is sufficiently big. Compared with power allocation schemes for IDMA, the proposed fee allocation scheme achieves a comparable overall performance at a mild spectral efficiency and the requirement of sophisticated energy amplifiers may be comfortable [2].

Bin Zhang, extended the DD-IDMA relay scheme to MIMO relay networks employing spatial multiplexing. They additionally broaden a image-with the aid of-image iterative detection method at the destination for the machine. The overall performance of the MIMO relay device is classed thru simulation results. The simulation effects display that the

variety advantage will boom with the variety of relays. They use a simple repetition code simplest in this paper for simplicity, while the usage of extra state-of-the-art channel codes incorporating with repetition code will similarly enhance the machine overall performance [3].

Xiaoxiang Wang,2010 This paper studies expression of outage possibility and associate choice strategies for cooperative network based on IDMA superposition modulation. By converting existing outage benefit matrix into a symmetric new one and making use of Hungary and WLF algorithm, a centralized most efficient and a allotted sub-choicest accomplice selection techniques are proposed for superposition modulation cooperative multiple get entry to cell community. Simulation results display that the 2 proposed accomplice choice strategies may want to lessen the average outage opportunity of the community efficiently. Presently, no have a look at has focused on outage performance and associate choice strategy of the lately proposed ISM cooperative community. In this paper, we advocate a allotted and a centralized associate selection method which meet the call for of the superposition modulation gadget better [4]. Further, we proved that the centralized strategy is most beneficial. Simulation consequences show that, the proposed techniques outperform the existing techniques in common outage in a superposition modulation cooperative network.

Xing-Zhong Xiong 2011 proposed an green uplink and downlink cooperative transmission and receiving scheme for interleave-division a couple of get right of entry to (IDMA) structures with time-reversal (TR) method. They refer this device as TDR-IDMA, for the reason that time division duplexing (TDD) mode is used on this transceiver device. In TDR-IDMA systems, the time-reversed model of the channel impulse responses received from the uplink is used to manner the obtained signal earlier than the fundamental sign estimator in the receiver of base station (BS). Due to the weak correlations of multi-path for distinctive users, the sign to interference and noise ratio (SINR) at the beginning of faster-like detection of TDR-IDMA can be accelerated significantly. Compared with conventional IDMA machine, tons much less iterations is wished for sign detection in TDR-IDMA systems. Thus, the proposed scheme correctly reduces the multi-person detection (MUD) computation load for the uplink, which is the bottleneck for IDMA gadget [5].

Jian Dang,2013 delivered a generalized model of orthogonal frequency division multiplexing interleave division multiple get entry to (OFDMIDMA) referred to as grouped OFDM-IDMA (G-OFDM-IDMA). The person grouping hassle is formulated into an integer linear programming trouble whose suboptimal solution is proposed and compared with the lower sure. The optimization complexity problem is also addressed. Simulations are accomplished to test the performance of G-OFDM-IDMA beneath diverse device configurations. It is discovered that up to eighty% complexity might be stored whilst the traditional OFDM-IDMA is substituted through G-OFDM-IDMA configured according to the suboptimal grouping answer [6].

Olutayo O. Oyerinde,2014 presented sets of channel estimation methods that employ soft input from the decoder to enhance channel estimation system for orthogonal frequency department multiplexing -interleave department a couple of get entry to (OFDMIDMA) system. The first channel estimation scheme exploits both time and frequency domain names for channel estimation and prediction. The second iterative channel estimation scheme, in time domain, is based totally on regularized noise electricity estimate-based variable forgetting issue recursive least rectangular (ℓ1-NPEVFF-RLS)-based CIR estimator.From the simulation effects, the 2 proposed channel estimators show off better performance in evaluation with different schemes in the literature, but with better computational complexities. However, of the 2 proposed strategies, the ℓ1-NPEVFF-RLS-primarily based CIR estimator that exhibits almost the same performance because the blended ISLMMSE-primarily based CTF estimator and ℓ1-VSSNLMS-primarily based predictor famous decrease computational complexity [7].

W. Belaoura,2015 proposed an interleaver based on the new concept of adopting permutation manage keys generated the usage of cryptography elliptic curves in which the degree of randomness of the interleaved series is scalable by means of the use of numerous rounds and a specific subkey in every spherical. In addition to presenting a certain degree of information security, it is suggests via simulation effects that the ensuing structure incorporating the proposed interleaver yields a possible bit mistakes fee performance.The robustness of the unconventional scheme to the multi-direction fading and multi-person interference turned into highlighted [8].

Panagiotis Botsini,2015 supplied layout of low complexity tender-enter tender-output quantum-assisted multi-consumer detectors (QMUD), which may be quite simply integrated into modern iterative receivers. Our layout relies on extrinsic statistics transfer charts. QMUDs had been employed in multi-provider interleave-department a couple of-get right of entry to (MC-IDMA) structures, which might be investigated in the context of different channel code fee and spreading thing pairs, even as solving the overall bandwidth requirement. One of QMUDs is observed to perform within zero.Five dB of the classical maximum a posteriori possibility MUD after three iterations between the MUD and the decoders, whilst requiring best half its complexity [9].

Yang Hu et. al, (2018), [10], considered a low-cost code shift division multiple-access (CSDMA) scheme, in which user-specific shifting is used to replace user-specific interleaving in interleave division multiple access (IDMA). We also outline a low-cost Gaussian approximation-based linear minimum mean square error message passing detection technique for CSDMA. We show that CSDMA can offer almost the same performance as the original IDMA in low-density parity-check or turbo coded systems, but with considerably lower implementation cost.
We discussed low-cost implementation techniques for IDMA involving user-specific shifting at the transmitter and GA-LMMSE detection at the receiver. Some of the software used in this letter are available in the following site:

http://www.ee.cityu.edu.hk/%7Eliping/
Research/Simulationpackage/.

D. Sony et. al. (2021) [11], provided a study of Interleave division multiple access (IDMA) system by implementing in MATLAB and comparison with Code division multiple access (CDMA) in terms of performance. By using MATLAB we can analyze data, develop algorithms, create models and applications as it is more familiarised to engineers and scientists. CDMA is a technology used in 4G. This system provides multiple access communication capabilities. In CDMA as the number of users increase, the overall quality of performance decreases. So to overcome the drawbacks in CDMA, a new technology IDMA has been developed with the inheritance and advancement of CDMA. IDMA is a technology that is explored world-wide in 5G Communication system. IDMA is a multiuser scheme where users are separated by unique interleaver sequences.

3. OFDM-IDMA:
The OFDM-IDMA scheme was first introduced in [22][23]. The basic principle of an OFDM-IDMA system is similar to that in Fig. 1, except for an additional inverse FFT operation at the transmitter and an FFT operation at the receiver. These two operations transform the convolution effect of the ISI channel in the time domain into a fluctuation effect in the frequency domain (due to frequency selectiveness). The key advantage of OFDM-IDMA is that MUD can be realized efficiently with complexity per user independent of the channel length and the number of users, which is significantly lower than that of other alternatives.
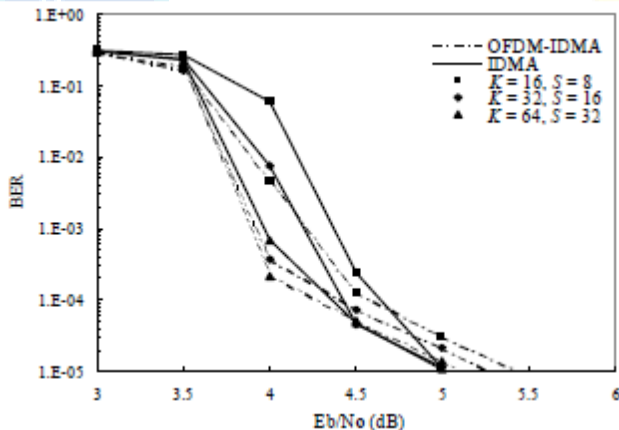

Fig 1: Performance comparison between IDMA and OFDM-IDMA systems over ISI channels. The system throughput is *KR = 2*.

Fig. 1 shows the performance of a single-carrier IDMA system with frequency domain detection and an OFDM-IDMA system over an ISI channel. An un-correlated Rayleigh fading among the sub-carriers is assumed. The coding scheme for each user in both systems is a rate-1/2 convolutional code followed by a length-S repetition code and QPSK modulation. The system throughput is fixed at KR = 2 bits/symbol. From Fig. 1, we can see that both systems have similar performance. For the OFDM-IDMA system, the performance can be slightly improved by increasing K (and S as well). This is because longer spreading length S is more effective to combat the frequency selectiveness among different sub-carriers.

Multi-user gain can also be achieved in OFDM-IDMA systems when near-far effect is involved. Fig. 2. below considers an OFDM-IDMA system over a single-cell fading channel. In addition to Rayleigh fading, path loss and lognormal fading are also considered here. In Fig. 2., a rate-1/2 convolutional code followed by a length-8 repetition code and QPSK modulation is used by all users. The system throughput is fixed at 3 bits/symbol and hence 24 code streams are involved here. When K < 24, multiple code streams are assigned to each user based on SCM. A single-user BICM-ID scheme with the same throughput is also considered, which has similar performance to that of the OFDM-IDMA scheme with K = 1. A multi-user BICM-ID scheme (not shown in Fig. 2) with orthogonal frequency-division multiple-access (OFDMA) always performs slightly worse than the single-user one because the block length of each user is decreased when K increases. However, we can see from Fig. 2 that the performance of the OFDM-IDMA system can be improved by increasing the number of users K and a large portion of power saving can be achieved at K = 2. This again indicates that the near-far effect is advantageous in IDMA-based systems and multi-user gain can be achieved by multi-user simultaneous transmission.
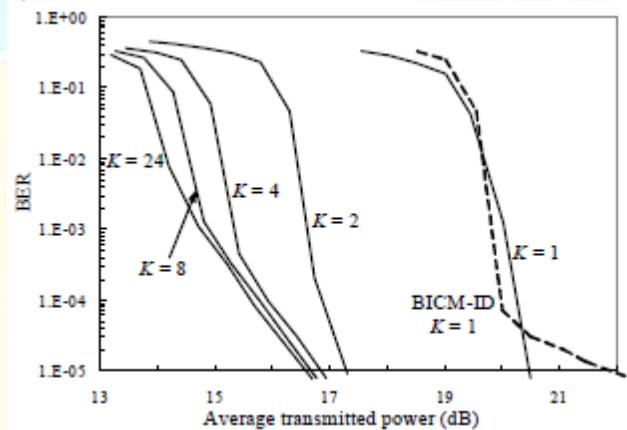

Fig. 2: Simulation performance of an OFDM-IDMA system over an ISI channel containing path loss, lognormal fading and Rayleigh fading. The throughput is fixed at KR = 3. The transmitters know the path loss and lognormal fading but don't know Rayleigh fading.

3. Conclusion:
In this review we have determined the effect of a combined IDMA-OFDMA system on performance of bit error rate (BER) with respect to change in SNR during wireless transmission for different modulation schemes. Now we will have minimized ISI by the cyclic prefixing technique in OFDM, by iterative detection with IDMA in our work.

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