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# Novel Application of OFDMA-IDMA in Modern Telecommunication System

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***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. In this paper we decide the impact of a joined IDMA-OFDMA framework on execution of touch blunder rate (BER) concerning change in SNR during remote transmission for various balance plans. We have limited ISI by the cyclic prefixing method in OFDM [4], by iterative discovery with IDMA [5]. OFDM-IDMA enjoys benefits of minimal expense recipient, variety against blurring and adaptable rate transformation.***
***Keywords: BER, IDMA, OFDMA, QOS.***

## I. INTRODUCTION

Wireless Over the last two decades, correspondence has become almost ubiquitous. Initially, only the highest-quality notepads were equipped with connectivity to Wireless Local Area Networks (WLAN), which allowed for remote broadband access to the internet. Due to increased demand, WLAN networks are now standard in all journals, and various new consumer devices have entered the market, offering new services like as mixed media real-time and video-on-demand. In order to provide remote web access, several tunnels for WLAN have been installed in houses and offices.

This enhancement piqued client interest in "remote broadband connectivity anywhere." Existing services, such as surfing the web or watching a video transfer, are provided in a flexible environment. This attracts additional customers (for example, people who surf the web while driving); extrapolating the success of remote broadband via WLAN, this will be a massive market. In addition to providing existing sorts of help in a portable format, numerous new administrations have emerged that specifically demand portable broadband access. One example for such a new service is “augmented reality”, which enables users to obtain interactive information about sights near their current location by a clever combination of GPS enabled mobile devices, broadband internet access and a (user-generated) database accessible over the internet. Many of these new services are currently evolving, and will offer attractive opportunities and revenue models for service developers and network operators. Current WLAN standards work reliably only up to 10 meters, making deployment in large areas, especially outdoors, difficult and costly. Given the infrastructure cellular network operators already have, it is only natural to extend current cellular communication technologies such that broadband internet access can be provided. Current second-age cell correspondence advancements like the Global System for Mobile Communications (GSM) are for the most part customized for voice-driven organization traffic and perform inadequately for information driven applications. The third-age cell innovation, Universal Mobile Telecommunications System (UMTS) and augmentations, like High Speed Downlink Packet Access (HSDPA) are more qualified for information driven organization traffic. Notwithstanding, these new guidelines are not relied upon to have the option to give the expanding information rates and expanded degrees of nature of administration (QoS) needed later on. Hence new norms for the forthcoming fourth-age (4G) cell correspondence frameworks have been proposed, which give higher information rates and backing QoS requirements. Most conspicuously, Worldwide Interoperability for Microwave Access (WiMAX) and Long-Term Evolution (LTE) of the 3GPP are as of now thought of or being as of now conveyed.

Increased data rates and QoS constraints over the wireless channel pose three main challenges to system design and standard development:

1) The spectrum usable for wireless communications is limited by various factors. Physical laws imply certain propagation conditions, thereby allowing only a portion of the available spectrum to be used for wireless communications. Also, process limitations in current semiconductor device technology limit the range of available frequencies. Spectrum regulation puts constraints on spectrum use, as frequency bands are sold to operators in auctions, and given the high prices for UMTS licenses paid in Europe, allocating more bandwidth poses a severe economical burden on operators.

2) The need for mobility poses a severe constraint on the energy consumption of wireless devices. Current rechargable batteries are highly complex and optimised components, but offer only limited capacity; novel energy sources like fuel cells are still being in the development phase.
3) Given the many mobile devices already deployed and the limited spectrum resources, interference between users is becoming stronger, thereby reducing data rates and limiting QoS. This implies that cooperation between different devices becomes more and more important.

Past strategies to overcome these challenges were increasing power levels or allocating more bandwidth to wireless devices, but these are not feasible anymore. Therefore new transmission schemes and algorithms are required, which allow for a much more efficient use of the limited resources available, promote cooperation between different wireless devices, and increase data rates and power efficiency to cope with tomorrows' communication requirements.

## II. RELATED WORK

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.

## III. METHODOLOGY

OFDM-IDMA can work with any FEC coding. However, low-rate coding is particularly attractive because it can provide more robust performance in frequency-selective channels. An even simpler approach is to introduce spreading after FEC coding, which is similar to OFDMCDMA [4]. With spreading, each bit is 'spread' as 'chips' over different OFDM sub-carriers. At the receiver, the information is collected from these sub-carriers. This results in diversity that averages out the fading effect.

Spreading reduces throughput but this can be compensated by superposition coding [8]. With superposition coding, each user can transmit more than one coded sequence using a multi-layer encoder, as shown in Figure 3.3. In this way, high-rate transmission and very flexible rate adjustment can be achieved. For example, different number of layers can be assigned to different users according to their channel conditions. The receiver principle is similar to that in Section 4 (since a layer in Figure 3.3 is equivalent to a user in Figure 3.2) and the details are omitted here. Later we will show that given the transmission rates of the users, the introduction of spreading and superposition coding can yield noticeable performance improvement.

Receiver complexity increases when more layers are involved. This is mainly due to the ESE cost that increases linearly with the spreading length. The cost related to despreading

is marginal and the cost related to DEC, which usually dominates the receiver complexity, is independent of spreading. Overall, the cost increase is quite moderate.

The above superposition coding scheme has an additional advantage regarding the clipping issue that it is more robust to clipping effect than other alternatives such as bit-interleaved coded modulation with iterative decoding (BICM-ID) [10]. This interesting property of superposition coding is briefly explained below. Recall that the clipping noise estimation is based on $\{E[x_k[n]], Var[x_k[n]]\}$ that are computed from the extrinsic LLRs about the coded bits of the DECs. Denote by $v_k$ the average of $Var[x_k[n]]$ over n. Generally speaking, a smaller vk implies a more accurate estimate of $x_k[n]$, which in turn implies a more accurate estimate of clipping noise. (In the extreme case of vk = 0, the estimates of all $\{x_k[n]\}$ are perfect. Then the estimates of their IDFT $\{X_k[i]\}$ are also perfect and so are the clipping noise estimates computed from Equation (19).) Clearly, $v_k$ can be used to characterise the accuracy in estimating $x_k[n]$. We find that $v_k$ is significantly affected by the coding scheme employed. Furthermore, it can be proved that superposition coding achieves the minimum $v_k$ among all possible coding schemes (for the same DEC feedbacks).We omit the related proof as it is beyond the scope of this chapter. Instead, we provide in Figure 3.4 a comparison between a two-layer superposition coding scheme and a BICM-ID scheme with 16-QAM modified set-partitioning (MSP) signaling [10]. The rates of both schemes are the same. The extrinsic LLRs of the DECs are assumed to be i.i.d. Gaussian and characterised by the mutual information between them and the coded bits. From Figure 3.4, superposition coding yields smaller average variance, implying that it may outperform BICM-ID in mitigating clipping effect. This is one of the reasons for the advantage (in addition to MUG) of OFDMIDMA presented in Figure 3.

OFDM-IDMA SYSTEMS

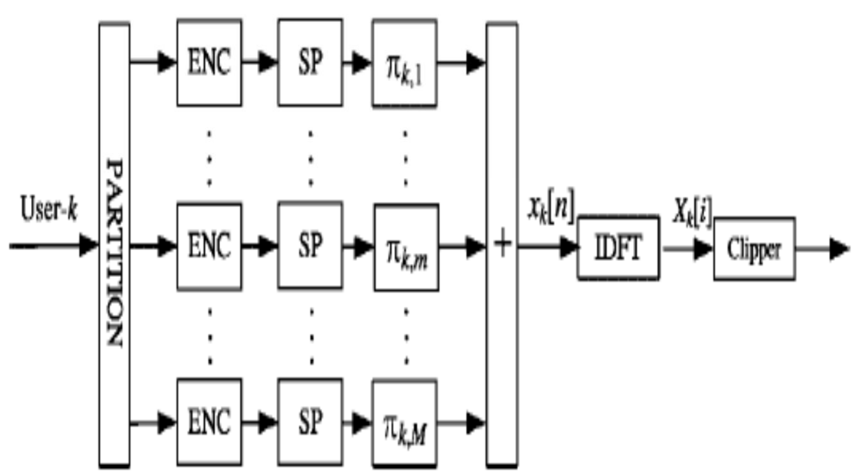



Fig. 1: Transmitter structure of OFDM-IDMA with superposition coding, where SP represents spreader.

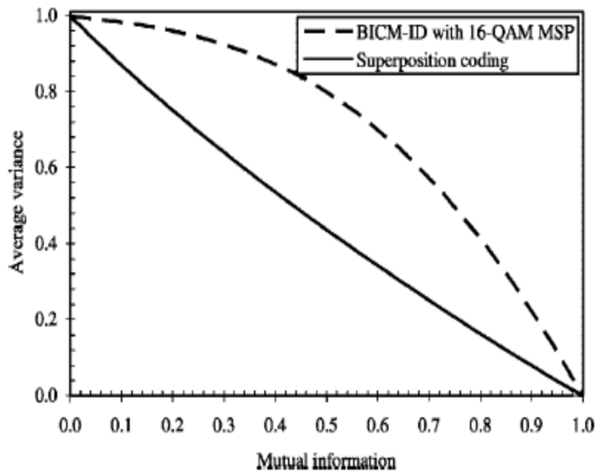



Fig. 2: Average variance achieved by different coding schemes. The average power of $x_k[n]$ is normalized to 1.

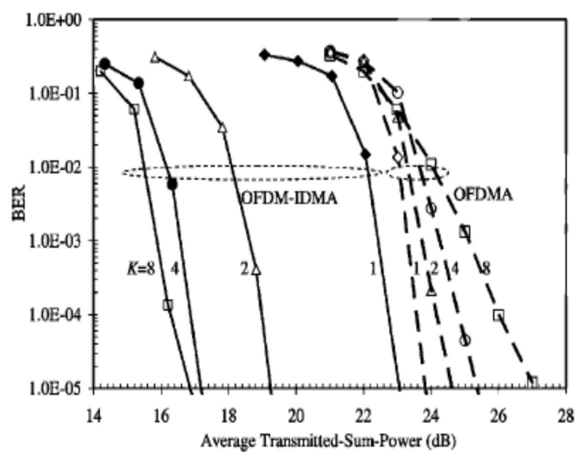
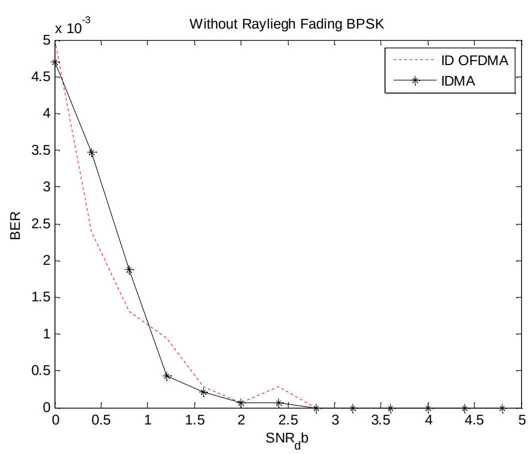


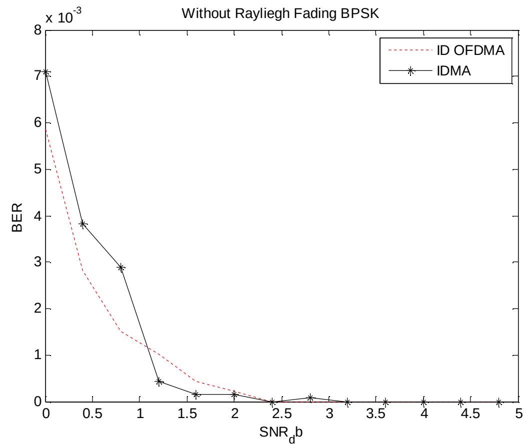

Fig. 3: Comparison of the power efficiency of OFDM-IDMA and OFDMA with clipping in an uplink scenario. The over sampling factor Q = 4 and clipping ratio CR =  dB. R = 3. The power of the channel noise is set to 1 (i.e.  dB).

## IV. RESULT AND DISCUSSION

We have used Matlab 10 based platform for writing algorithm.We have written script file for wireless transmission in AWGN noise at different SNR.



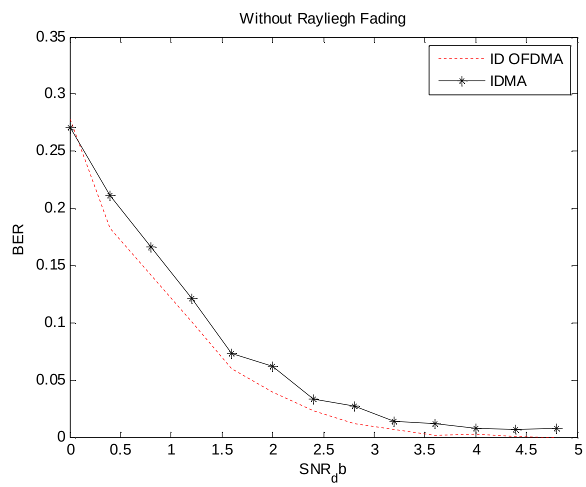

(a)



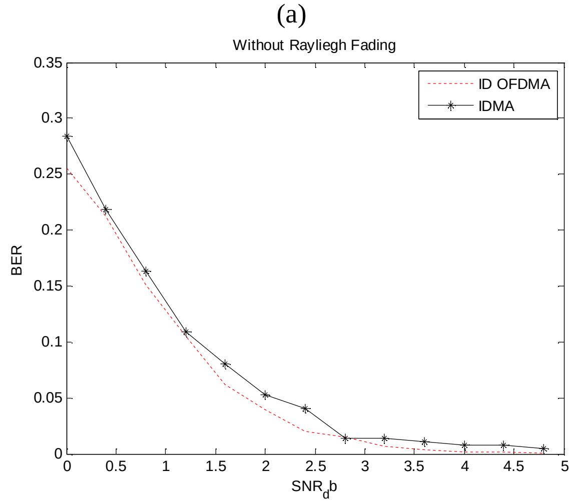

(b)

Fig 4: BER vs SNR plot for BPSK modulation using IDMA(solid) & IDMA-OFDMA(dash) transmission.

We applied first IDMA on our message signal and checked BER at SNR values varying from 0 to 5. Figure 4 (a & b) are BER vs SNR plot for BPSK modulation solid line for IDMA and dashed line for IDMA-OFDMA transmission. We can see that the BER for OFDMA-IDMA transmission is lower than IDMA. 4 (a) and (b) are results obtained for two different random messages.




(a)




(b)

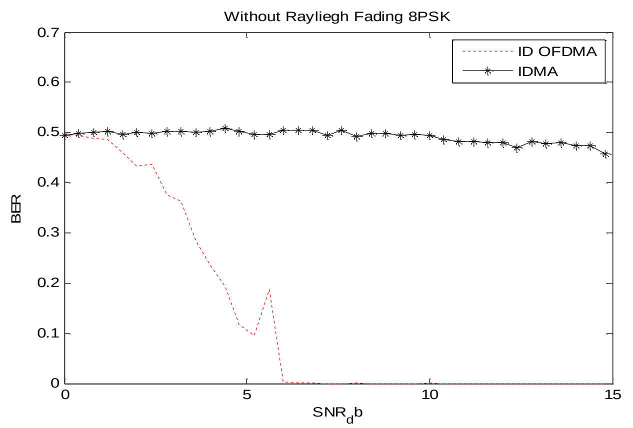
Fig. 5: BER vs SNR plot for QPSK modulation using IDMA (solid) & IDMA-OFDMA(dash) transmission.

Similar algorithm is applied for QPSK modulation. Figure 5 (a & b) are obtained again for two different random signals and we an again see that The BER for OFDMA-IDMA (dashed) is obtained lower than IDMA only(solid).

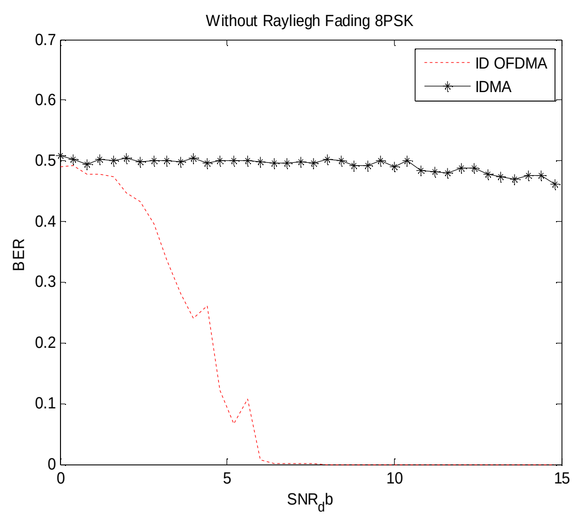
Prior to interleaving we have applied conventional coding.For BPSK the polly to trellis structure used is (5,[23,35,32,31]) for generating polynomial and for QPSK it is ([5 4],[23 35 32 31; 17 14 5 13]) about 1384 binary message signals are generated different time for testing the algorithm.

Similar algorithm is applied for 8PSK modulation. Figure 4.3 (a & b) are obtained again for two different random signals and we can see that The BER for OFDMA-IDMA (dashed) is obtained lower than IDMA only (solid).

We have considered three case for each case the maximum value of BER obtained is given in table 4.1.




(a)




(b)

Fig 6: BER vs SNR plot for 8PSK modulation using IDMA(solid) & IDMA-OFDMA(dash) transmission.

Table 1: Maximum BER obtained for different modulation using IDMA and IDMA-OFDMA transmission.

| | BPSK | | QPSK | | 8PSK | |
|---|---|---|---|---|---|---|
| | Data1 | Data2 | Data1 | Data2 | Data1 | Data2 |
| BER IDMA | 7x $10^{-3}$ | 4.8x $10^{-3}$ | 0.25 | 0.3 | 0.5 | |
| IDMA-OFDMA | 5.6x $10^{-3}$ | 4.7x $10^{-3}$ | 0.25 | 0.25 | 0.501 | |

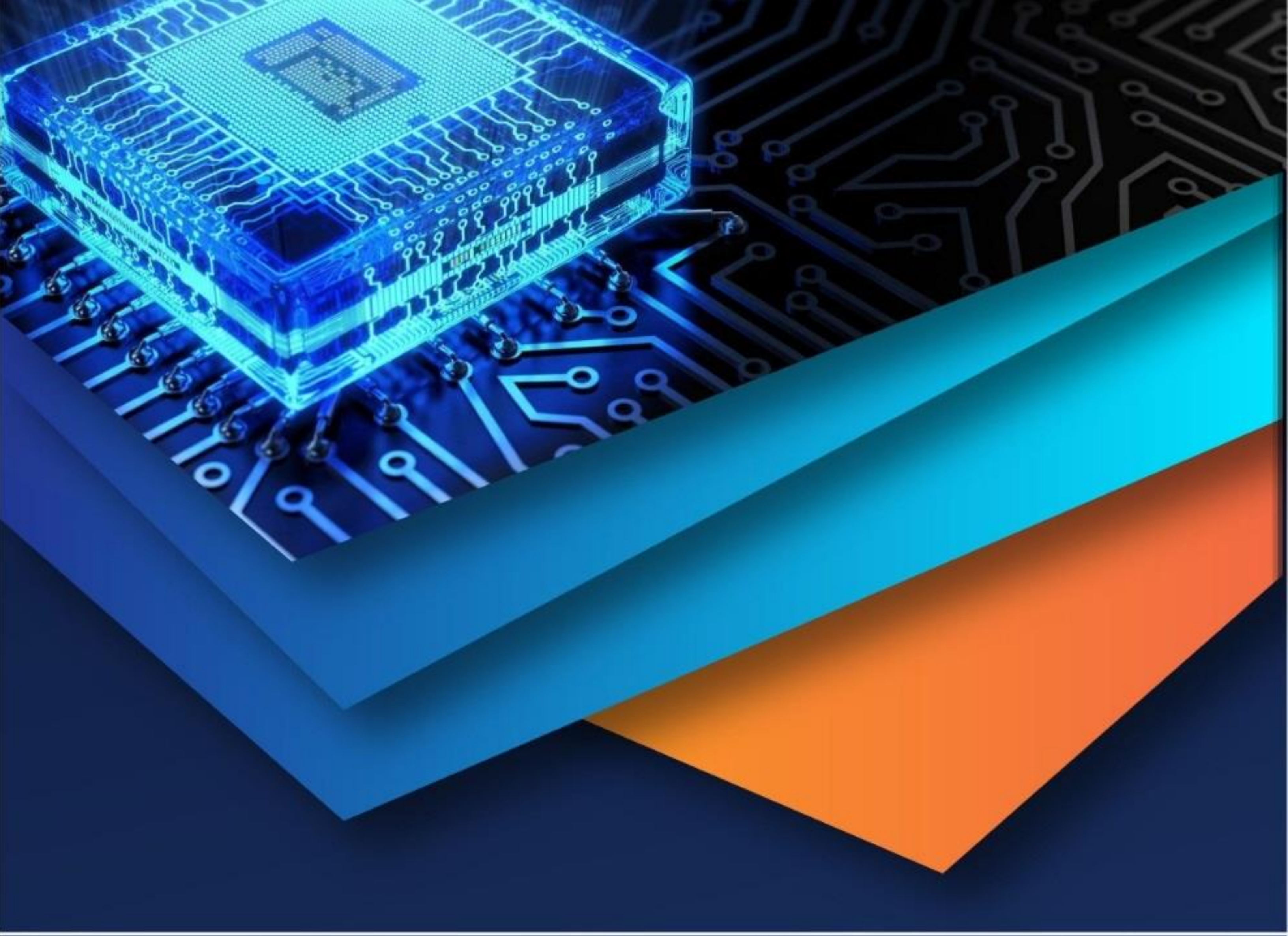
Table 1 represents that BER is minimum in case of BPSK and as the M-array number is increased BER is increasing.

## V. CONCLUSION

We have designed an IDMA-OFDMA system to check its performance and robustness against the AWGN noise. Three different schemes are used for modulation known as BPSK; QPSK and 8PSK the BER values are calculated by using Matlab based simulation algorithm. It has been found that for different random generation of binary signals we get lower BER in the case of OFDMA –IDMA system. Hence IDMA system alone can perform good performance against multiuser access interference but along with OFDMA IDMA we can combat with ISI and get reduced bit error rate. At higher SNR performance of both IDMA and IDMA-OFDMA become equivalent but at lower SNR OFDMA-IDMA helps in lower the BER. For different modulation the lowest BER is obtained for BPSK in the range of 5 $x10^{-3}$ to $7x10^{-3}$ hence the performance is best for BPSK. But in the case of 8PSL our IDMA-OFDMA outperforms to IDMA only.

## REFERENCES

[1] Chulhee Jang, IDMA System with Relays, 978-1-4244-4067-2/09/$25.00 2009 IEEE
[2] Tao Yang, Jinhong Yuan, Zhenning Shi Rate Optimization for IDMA Systems with Iterative Joint Multi-User Decoding IEEE TRANSACTIONS ON WIRELESS COMMUNICATIONS, VOL. 8, NO. 3, MARCH 2009.
[3] Bin Zhang, Kai Niu, Zhiqiang He, Relaying Scheme Based on IDMA for MIMO Relay Networks978-1-4244-3693-4/09/$25.00 ©2009 IEEE
[4] Xiaoxiang Wang, Hongtao Zhang, Dezhi Li, Partner Selection Based on IDMA Superposition Modulation in Cooperative Cellular Networks, 978-1-4244-2519-8/10/$26.00 ©2010 IEEE
[5] Xing-Zhong Xiong · Jian-Hao Hu · Xiang Ling A Cooperative Transmission and Receiving Scheme for IDMA with Time-Reversal TechniqueWireless Pers Commun (2011) 58:637–656.
[6] J. Dang, L. Yang, and Z. Zhang, "On grouped OFDM-IDMA," in *Proc. 2011 Asilomar Conference on Signals, Systems, and Computers*, pp. 1298–1303
[7] Olutayo O. Oyerinde, Stanley H. Mneney. Iterative receiver with soft-input-based-channel estimation for orthogonal frequency division multiplexing-interleave division multiple access systems, & The Institution of Engineering and Technology 2014.
[8] W. Belaoura, M. Djeddou and K. Ghanem, GRP-based interleaver for IDMA systems over frequency selective channel ELECTRONICS LETTERS 3rd September 2015 Vol. 51 No. 18 pp. 1462–1464
[9] *urbo-Transceivers*. Hoboken, NJ, USA: Wiley, 2010. P. Botsinis, S. X. Ng, and L. Hanzo, "Fixed-complexity quantum-assisted multi-user detection for CDMA and SDMA," *IEEE Trans. Commun.*, vol. 62, no. 3, pp. 990–1000, Mar. 2014.
[10] Yang Hu et. al, "Low-Cost Implementation Techniques for Interleave Division Multiple Access", IEEE Wireless Communications Letters, Vol. 7, No. 6, December 2018.
[11] D. Sony et. al., "Simulation and Performance Analysis of Interleave Division Multiple Access (IDMA) in Comparision with Code Division Multiple Access (CDMA)", Asian Journal of Applied Science and Technology (AJAST), Volume 5, Issue 2, Pages 90-94, April-June 2021



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