International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-2, December 2019

Multiuser Detection using Noma Technique in FD-MC-CDMA System in Fading Channels

Guntu Nooka Raju, Muddapu V Tirupathamma, K Srinivasa Rao

Abstract:- ***Non-Orthogonal Multiple Access which is an emerging technique which performs good in any aspects. Multiple users can share the resources that are available and also user can be identified, which adopts successive interference cancelation (SIC). The power domain is considered for detection of power allocation for the base stations. The performance of errors in selective channels like frequency channels is demonstrated with the help of code division multiple access which is a multi carrier (MC-CDMA), in which the frequency diversity can be resolved quickly. Due to high range of multiple access interferences the performance of MC-CDMA is been restricted. To overcome the problems in MC-CDMA, a new technique is proposed i.e frequency division multi carrier code division multiple access by which the multiple access interferences can be reduced by exploiting the available range of frequencies. NOMA is one of the emerging technique used as an answer to boost the spectral potency whereas permitting some extent of accessibility for multiple interferences at receiver end. By using NOMA-FD-MC-CDMA the range of spectrum can be increased and reduced the interferences. Bit error rate(BER) is evaluated and compared with other existing technique. The experimental results are performed using Mat lab tool.***

Keywords: NOMA, FD-MC-CDMA, Fading Channels

I. INTRODUCTION

Wireless science is an emerging style in every issue of present lives. The frequencies tuned in the networks want to be used for many ties by way of considering exclusive kind of customers as the number of units extended gradually. Now a day Internet of Things(IOT) has been emerged as an important method to get in touch with every individual and every corner of objects, demand is been increased [1]. Inorder to meet the demands of present scenario the communication systems which are been utilized have pros and cons, restrictions, number of changes to be made, and develop the system to meet the requirements. Research have been started to meet the demands of upcoming generation in wireless communications. some of the requirements need to satisfy is to improve the spectral efficiency, speed, providing low latency. The data rate need to provide should be high, service quality improvement, consumption of energy need to be reduced, cost is one among the major issue which need to be reduced[2]. Most of the industries and institutions are working to provide the requirements which satisfy the next generation users.

Revised Manuscript Received on December 30, 2019.
***** Correspondence Author
Dr. Guntu Nooka Raju*, GMR Institute of Technology, Rajam, Srikakulam, A.P, India, guntu.raju21@gmail.com,
Muddapu V Tirupathamma, RGUKT, IIIT, Srikakulam, A.P, India, email: anjalipeesa11@gmail.com
Dr K Srinivasa Rao, GVP College of Engineering for Woman, Visakhapatnam, India, ksrinivas.ece@gmail.com

Among the development MM wave is one of the technology which is used to increase the range of transmission by increasing the bandwidth range, by which the speed of communication increases[3].
Hence the reachability for more number of users can be achieved, by which the concept of Multi Input Multi Output(MIMO) is introduced. By using MIMO system the energy is utilized efficiently and the capacity have been increased[4]. Network with more dense condition also introduced to reduce the consumption of energy by using more number of cells that are smaller in size [5].

II. RELATED WORK

As we viewed in general, NOMA plans can be grouped into two kinds: Power based multiplexing and code-area multiplexing. In power-space multiplexing, quite a number consumers are allotted numerous energy coefficients as indicated by way of their divert stipulations so as to accomplish a high framework execution. Specifically, a variety of clients' records signal are superimposed at the transmitter side. At the beneficiary aspect the successive interference cancellation(SIC) is utilized for translating the sign personally until the perfect client's signal is gotten [8], giving a decent tradeoff between the throughput of the framework and the purchaser reasonableness. In code-area multiplexing, a number purchasers are dispensed more than a few codes and multiplexed over a similar time-recurrence assets, for example, multiuser shared get admission to (MUSA) [9], scanty code multiple get right of entry to (SCMA) [10], and lower density spreading (LDS) [11]. Notwithstanding power-space multiplexing and code-area multiplexing, there are other NOMA plans, for example, sample division a couple of access (PDMA) [12] and bit division multiplexing (BDM) [13]. Despite the reality that code-space multiplexing can per chance improve ghostly proficiency, it requires a excessive transmission records transfer potential and is not efficiently relevant to the existing frameworks. Then again, manipulate region multiplexing has a fundamental utilization as giant changes are no longer required on the current systems. Likewise, it doesn't require more data transfer ability so as to enhance ghostly effectiveness [14]. In this audit/instructional workout paper, we will pay attention on the power-area NOMA.
FD-MC-CDMA [15] is a recurrence primarily based a number get entry to engineering that consolidates the quality portions of Frequency division a couple of get right of entry to (FDMA) and multi-carrier code division more than one get entry to (MC-CDMA) [16] to at the same time abuse recurrence respectable range and restriction numerous entrance obstruction referred to as as a couple of get admission to interference (MAI).

It is incredible that MC-CDMA can accomplish excessive respectable variety reap in recurrence unique blurring channels by using at the same time transmitting over N severa subcarriers, and separating the signal into subcarriers at the recipient accommodating dazzling BER execution. The done exhibition enlarge debases within the sight of MAI. Then again, FDMA can definitely stay away from MAI by using appointing each and every patron a one of a variety subcarrier with the alternate off of diminished execution in blurring channels due to the fact of no recurrence diverse variety features at the recipient.

Like MC-CDMA, FD-MC-CDMA framework has N subcarriers. Be that as it may, as an alternative than using all N subcarriers, they are separated into gatherings. Ordinarily, blurring diverts in spread vary faraway frameworks, (for example, MC-CDMA) show a M-crease recurrence respectable range over the transmit information transfer capacity, where M is, for instance, 2, three or four Scientifically, this compares to $BW = M.(\Delta f)_c$ the place BW is the records transfer potential of the MC-CDMA transmission and $(\Delta f)_c$ is the rationality switch pace of the recurrence specific blurring channel. To misuse the M overlap recurrence first rate variety, it is superfluous to unfold a client's facts picture over all (N >> M) subcarriers. The absolute recurrence decent variety can be misused when each client's facts is sent over just M subcarriers remoted with the aid of the recognition switch velocity $(\Delta f)_c$. In FD-MCCDMA, every client's records bit is simply transmitted over a gathering of M subcarriers, as a substitute of all N subcarriers. By having an adequately sizeable recurrence partition between every gathering (bigger than or equal to the intelligibility transmission capacity of the channel), the recurrence decent range increase is virtually equal to that of MC-CDMA. Since each gathering backings simply K ≤ M clients, the MAI at the recipient facet is plenty decrease than that of the MC-CDMA framework. It is a characteristic success win circumstance to consolidate NOMA procedure with FD-MC-CDMA framework for multi client location. The subcarrier decay nature of FD-MCCDMA makes numerous parallel virtual MC-CDMA frameworks with little spreading code length. Subsequently the advantage of utilizing NOMA is to improve the addition and the spectral effectiveness.

III. FREQUENCY DIVISION MULTI CARRIER-CODE DIVISION MULTIPLE ACCESS (FD-MC-CDMA) SYSTEM

The combination of frequency division multiple access (FDMA) and MC-CDMA is termed as FD-MC-CDMA with a design architecture of multiple points that are truly based on frequencies. This combinations assorted variety range of frequencies and also helps in reducing the interferences in case of multiple access. It is outstanding that MC-CDMA can accomplish high assorted variety gain in recurrence specific blurring channels by at the same time transmitting over N numerous bearers, and isolating the sign into transporter parts at recipient. This gives an incredible BER execution, yet the presentation debases within the sight of MAI [15]. Then again, FDMA can totally keep away from MAI by appointing every client an extraordinary subcarrier, yet execution endures in blurring channels since no recurrence decent variety increases are accomplished at the recipient.

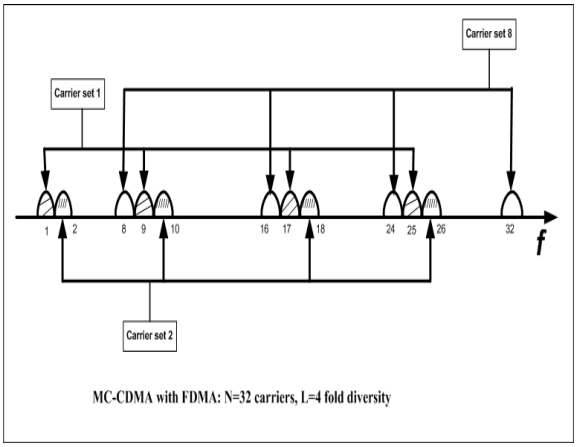

Fig. 1. 32 carrier based FD-MC-CDMA

A frequency diversity of L fold is considered in the fading channels. Here L is considered as the order of 1,2,3 or 4. In fig 1 we consider L value as 4 for every representation of FD-MC-CDMA. The number of subcarriers assorted are said to be 32 in which they are divided into 8 sub groups. So that the level of interference will be demolished. To construct a system with multiple access , every user need to share the carriers with the help of MC-CDMA. The subcarriers which are considered are in symmetric with one other and the subcarriers considers are a set structures a virtual multi carrier CDMA design which consists of M number of subcarriers which are supporting for M symmetrical clients with no obstruction from other different subcarriers that are present. Due to the symmetrical behavior of subcarriers with the other subcarrier, each subcarrier set structures a virtual MC-CDMA framework comprising of M subcarriers supporting up to M symmetrical clients, with no obstruction from other subcarrier sets. A significant advantage of frequency division multi carrier CDMA is the low multifaceted nature of its ideal most extreme probability of multi user identification (MUI) recipient. Here we consider M number of users for each subcarrier set. These are applied in NOMA techniques and is discussed in next section.

IV. NON-ORTHOGONAL MULTIPLE ACCESS (NOMA) TECHNIQUE

When comparing NOMA with OFDM, both are different with their own nature of network accessing. In customary 4G systems, as characteristic expansion of OFDM, symmetrical recurrence division different access is utilized where data for every client is relegated to a subset of subcarriers. The subcarriers that are considered in NOMA can be utilised by every user irrespective of the network sharing. The difference of spectrum sharing between OFDMA and NOMA with multiple users is shown in fig 2. The scheme can be applied on two systems one is uplink transmission system and downlink transmission system.

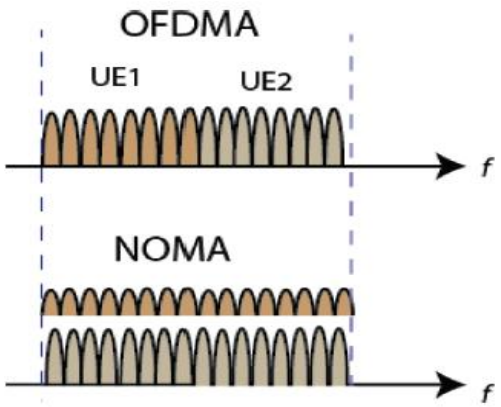

Fig 2. Representation of Spectrum

In this NOMA the throughput of user m and user n is given by

$$R_m^{NOMA} = log_2\left(1 + \frac{\rho\alpha_m|h_m|^2}{1+\rho\alpha_n|h_m|^2}\right) \quad (1)$$

and

$$R_n^{NOMA} = log_2(1 + \rho\alpha_n|h_n|^2) \quad (2)$$

NOMA rules ordinary symmetrical various access (OMA) and OFDM in a few perspectives, for example, It accomplishes predominant phantom effectiveness by serving different clients simultaneously and with a similar recurrence asset, and moderating the obstruction through SIC; It expands the quantity of at the same time served clients, and in this manner, it can bolster gigantic network; Due to the concurrent transmission nature, a client doesn't need experience a planned availability to transmit its data, and subsequently, it encounters lower inertness; NOMA can keep up client reasonableness and assorted nature of administration by adaptable power control between the solid and frail clients [3]; especially, as more power is apportioned to a feeble client, NOMA offers higher cell-edge throughput and therefore improves the cell-edge client experience as depicted in Fig 3

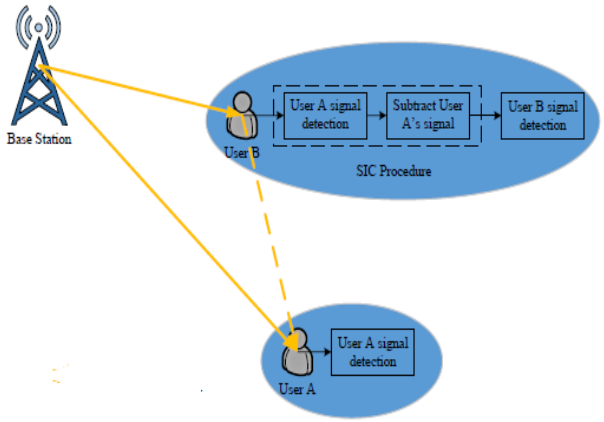

Fig 3. Two user NOMA network Model

V. NOMA technique in FD-MC-CDMA system

From the Fig.4, FD-MC-CDMA is a frequency division multiple access scheme in NOMA based telecommunication systems, which allows number of users in same time using same frequency range. So the advantage of using FD-MC-CDMA in NOMA is to achieve good energy efficiency and spectral efficiency. The receiving signal using NOMA has channel gain and additive noise. In FD-MC-CDMA the number of users considered are N=32 which acts as the carriers and M=4 which is a fold frequency diversity.

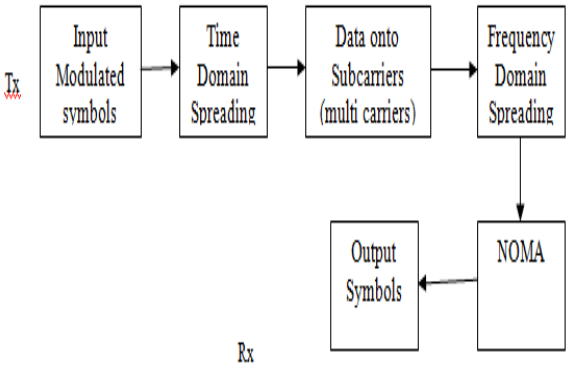

Fig 4. NOMA-FD-MC-CDMA

The transmission signal is given by [15]

$$T_s = b_k\, c_k(t) \quad (3)$$

Where

$b_k = k^{'s}$ information symbol

$c_{k=}\, k^{'s}$ Spreading code

$$c_k(t) = \sum_{i=1}^{N} \beta_i(k) e^{j2\pi i\Delta f t}\, g(t) \quad (4)$$

here, g(t) is the channel gain and $\Delta f = \frac{1}{T_s}$ and T_s is the symbol duration.

The receiving signal using NOMA from the transmitting base station is given as

$$y_k(t) = c_k(t)g_k + w_k(t) \quad (5)$$

where, $w_k(t)$ is the additive noise.

VI. EXPERIMENTAL RESULTS

The performance proposed technique in terms of bit error rate with respect to number of users is shown in Fig 5 and Fig 6. Here, Fig 5 shows the performance of BER for 16 users and Fig 6 shows the performance of BER for 32 users. The comparison is shown for normal FDMA, MC-CDMA, FC-MC-CDMA and NOMA-FC-MC-CDMA. The increase in number of users do not affect the proposed NOMA system , the error rate is shown to be improved using the proposed system. The FD-MC-CDMA has non multi user identification system and also a multi user identification system.

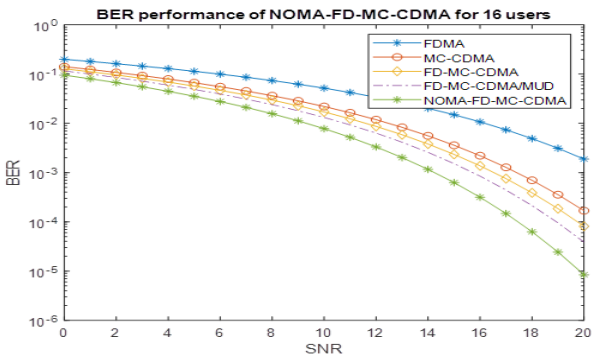

Fig 5. SNR for 16 users

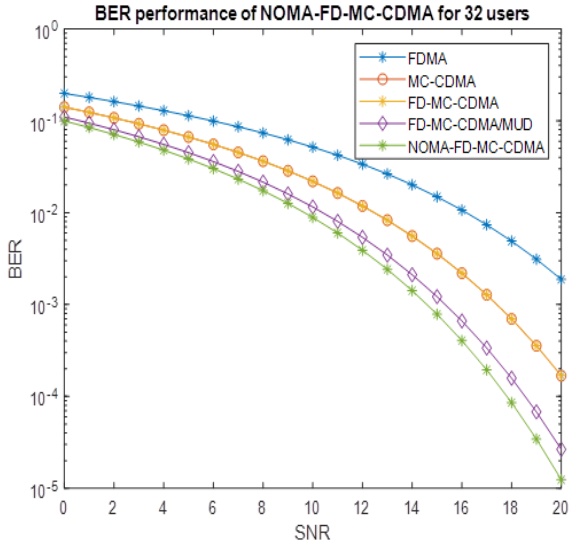

Fig 6. SNR for 32 users

From Fig 7 and Fig 8 it is observed that at a particular SNR value the BER with respect to increase in number of users is obtained.

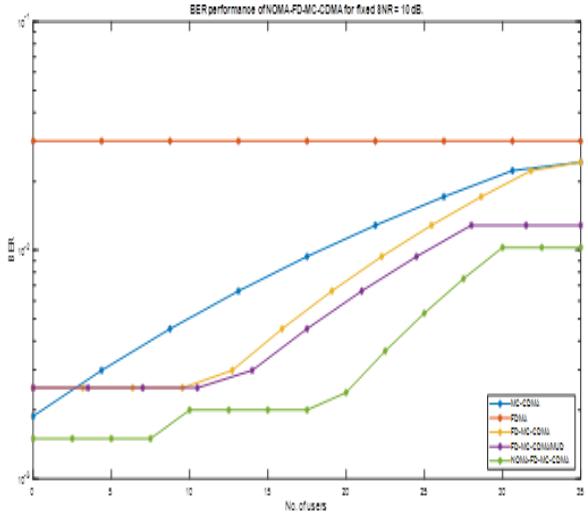

Fig 7. No of Users vs BER at 10dB

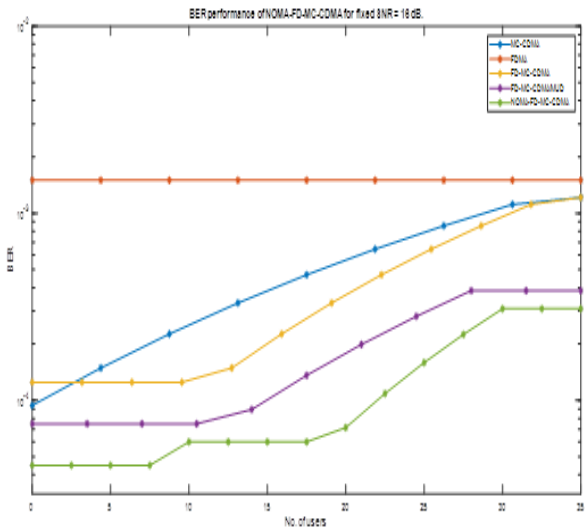

Fig 8. No of Users vs BER at 16dB

VII. CONCLUSION

For effective utilization of constrained network sources NOMA plans are proposed. As per the rules and design, NOMA helps the users to increase the working process with the help of bands provided. The better experience can be obtained by the users. The primary users of the bands provided by NOMA has a good channel condition. In such conditions the manage level of clients is chosen in a manner to focal point on a most precise server error rate. The subcarriers with smaller set are used in FD-MC-CDMA for sharing with number of users and the level of complexity is reduced. In FD-MC-CDMA, by enabling users to share slighter arrangements of subcarriers, genuinely ideal ML-MUDs are developed at low intricacy. The NOMA with FD-MC-CDMA framework to adventure full assorted variety in the channel. The efficiency of the spectrum can be expanded with proposed model. The gain accomplished with NOMA method in FD-MC-CDMA framework is considerably high. The overall performance of FD-MC-CDMA and NOMA can be improved. The bit error using proposed method is improved as shown in experimental results.

REFERENCES

1. G. Wunder, P. Jung, M. Kasparick et al., "5GNOW: non-orthogonal, asynchronous waveforms for future mobile applications," IEEE Communications Magazine, vol. 52, no. 2, pp. 97–105, 2014.
2. J. G. Andrews, S. Buzzi, and W. Choi, "What will 5G be?" IEEE Journal on Selected Areas in Communications, vol. 32, no. 6, pp. 1065–1082, 2014.
3. T. Rappaport, S. Sun, R. Mayzus et al., "Millimeter wave mobile communications for 5G cellular: it will work!," IEEE Access, vol. 1, pp. 335–349, 2013.
4. E. G. Larsson, O. Edfors, F. Tufvesson, and T. L. Marzetta, "Massive MIMO for next generation wireless systems," IEEE Communications Magazine, vol. 52, no. 2, pp. 186–195, 2014.
5. M. Kamel, W. Hamouda, and A. Youssef, "Ultra-dense networks: a survey," IEEE Communications Surveys & Tutorials, vol. 18, no. 4, pp. 2522–2545, 2016.
6. K. Higuchi and Y. Kishiyama, "Non-orthogonal access with successive interference cancellation for future radio access," in Proceedings of APWCS, 2012, Kyoto , Japan, 2012.
7. Q. C. Li, H. Niu, A. T. Papathanassiou, and G. Wu, "5G network capacity: Key elements and technologies," IEEE Vehicular Technology Magazine, vol. 9, no. 1, pp. 71–78, 2014.
8. S. Verdu, Multiuser Detection, Cambridge University Press, New York, NY, USA, 1st edition, 1998.
9. Z. Yuan, G. Yu, and W. Li, "Multi-User Shared Access for 5G," Telecommunications Network Technology, vol. 5, no. 5, pp. 28–30, May 2015.
10. H. Nikopour and H. Baligh, "Sparse code multiple access," in Proceedings of the IEEE 24th Annual International Symposium on Personal, Indoor, and Mobile Radio Communications (PIMRC '13), pp. 332–336, IEEE, London, UK, September 2013.
11. R. Hoshyar, F. P. Wathan, and R. Tafazolli, "Novel low-density signature for synchronous {CDMA} systems over {AWGN} channel," IEEE Transactions on Signal Processing, vol. 56, no. 4, pp. 1616–1626, 2008.
12. J. Zeng, D. Kong, X. Su, L. Rong, and X. Xu, "On the performance of pattern division multiple access in 5G systems," in Proceedings of the 8th International Conference on Wireless Communications and Signal Processing, WCSP 2016, pp. 1–5, Yangzhou, China, October 2016.
13. J. Huang, K. Peng, C. Pan, F. Yang, and H. Jin, "Scalable video broadcasting using bit division multiplexing," IEEE Transactions on Broadcasting, vol. 60, no. 4, pp. 701–706, 2014.
14. L. Dai, B. Wang, Y. Yuan, S. Han, C. I, and Z. Wang, "Non-orthogonal multiple access for 5G: solutions, challenges, opportunities, and future research trends," IEEE Communications Magazine, vol. 53, no. 9, pp. 74–81, 2015.
15. Z. Wu and C. R. Nassar, "FD-MC-CDMA: A Frequency-based Multiple Access Architecture for High Performance Wireless Communication," IEEE Transactions on Vehicular Technology, vol. 54, no. 4, pp. 1392- 1399, July 2005

16. S. Hara and R. Prasad, "Overview of multi-carrier CDMA", IEEE Communications Magazine, vol. 35, no. 12, Dec. 1997, pp. 126-133.