PERFORMANCE ANALYSIS OF NOMA TECHNIQUES FOR 5G NETWORKS

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ABSTRACT

In this project a new technique used to enhance the throughput of 5G network using NOMA. Non-Orthogonal Multiple Access (NOMA) scheme is one of the emerging radio access techniques to enhance the system performance for 5G networks. It is demonstrated that it is possible to achieve NOMA technology is better than that of OMA technology. We analysis various parameters and comparison is made using scheme of NOMA. In this method 5G networks are designed to allow simple virtual network configuration to better network cost with application needs. The throughput of 5G network is enhanced, by using the NOMA Algorithm. The power-domain NOMA is one of the basic NOMA schemes that perform superposition coding (SC) at the transmitter and successive interference cancellation (SIC) at the receiver. Power Allocation (PA) plays a significant role in attaining successful SIC and high system throughput. This work is focused on reduction of interference, to maximize the throughput for NOMA-based 5G network. The objective functions, algorithms, constraints and limitations of the system design in PDSCH techniques for MIMO- NOMA based 5G networks in terms of throughput analysis are extensively investigated and reported.

Keywords:- *Orthogonal Multiple Access, Non-Orthogonal Multiple Access, Power Allocation, Successive Interference Cancelling, Base Station, Physical Downlink Shared Channel, Multiple Input and Multiple Output, Long Term Evaluation.*

1.INTRODUCTION

Wireless Communication is the fastest growing and most vibrant technological areas in the communication field. Wireless Communication is a method of transmitting information from one point to other, without using any connection like wires, cables or any physical medium. Generally, in a communication system, information is transmitted from transmitter to receiver that are placed over a limited distance. Communication Systems can be Wired or Wireless and the medium used for communication can be Guided or Unguided. 5G is the next generation technology which will offer agile and safe communication. With the 5G technology the data speeds are expected to be 100 times higher than the 4G networks. The basic purpose of 5G is to transform smartphones, smart TV's, any electronic gadget that can be connected to internet is expected to have consistent speed that will be 100 times faster than the current 4G network. The 5th Generation technology is beyond the mobile internet to enormous Internet of tings (IOT). The major difference between 5G & 4G technology is, 5G technology is 100 times more agile than the 4G technology. The 5G network uses less power consumption, and 1 milli second latency time. In simple words the 5G technology is beyond Mobile phones it revolutionizes the gigantic IOT things. Technology in 5G are: New radio frequencies, Frequency range 1 (< 6 GHz), Frequency range 2 (> 24 GHz), FR2 coverage, Massive MIMO, Edge computing ,Small cell, Beamforming, Wifi-cellular convergence, NOMA (non-orthogonal multiple access), SDN/NFV, Channel coding. NOMA scheme is envisioned as an emerging radio access technique to achieve high bit-rate and capacity for 5G networks. The ever-increasing demand of capacity by users have generated interest of researchers to seek alternative scheme to the existing OMA. The bandwidth resources allocation in OMA technique offered a low spectral efficiency under poor channel condition. Conversely, the NOMA scheme tends to allocate bandwidth for users regardless of their channel condition. This is a significant improvement of the spectral efficiency over OMA. NOMA can provide high capacity and enhance spectral efficiency.

2. LITERATURE SURVEY

[1] Ding Z, Lei X, Karagiannidis GK, Schober R, Yuan J, Bhargava VK proposed efficient way to realize multiple access to utilize the power domain. Power-domain NOMA can serve multiple users in the same time slot, OFDMA subcarrier, or spreading code, and multiple access is realized by allocating different power levels to different users. Since multi-carrier NOMA achieves a favourable tradeoff between system performance and complexity, various practical forms of multi-carrier NOMA have been proposed for the 5G standard. Both LDS and SCMA are based on the idea that one user's information is spread over multiple subcarriers.

[2] Yu Bo1 and John Fonseka proposed both NOMA and BOMA can enhance the overall throughput by additionally transmitting bits of a strong user when transmitting bits of a weaker user. It is shown that both NOMA and BOMA have the same transmitted signal format that emerge from the building block approach for designing multilevel codes (BB-MLCs).

[3] MahmoudAldababsa, MesutToka, SelahattinGokceli, GuneGKarabulutKurt, OLuzKucur proposed that the true potential of the orthogonal frequency divisional multiple access (OFDMA)coordinated multipoint (CoMP) is in turning the adverse effects of the inter-cell interference (ICI) into the system performance gains. The small ultra-dense deployments of data-hungry users in the forthcoming generations of wireless mobile access systems, namely the long term evolution (LTE) A as 4G and the subsequent 5G, will be pushing for the revolutionary innovations to accommodate the required peak rates and the reliability in the cell edge.

[4] Song L, Li Y, Ding Z, Poor HV proposed that Non-orthogonal multiple access (NOMA) techniques have been recently proposed for the small-cell networks in 5G to improve access efficiency by allowing many users to share the same spectrum in a non-orthogonal way. Due to the strong co-channel interference among mobile users introduced by NOMA, it poses significant challenges for system design and resource management. This article reviews resource management issues in NOMA systems.

[5] Dai L, Wang B, Yuan Y, Han S, I CL, Wang Z, proposed that The increasing demand of mobile Internet and the Internet of Things poses challenging requirements for 5G wireless communications, such as high spectral efficiency and massive connectivity. In this article, a promising technology, non-orthogonal multiple access (NOMA), is discussed, which can address some of these challenges for 5G.

[6] Haiyang Yu, Jaeho Choi, proposed that a new evaluation criterion is developed to investigate the performance of non-orthogonal multiple access (NOMA) from an information theoretic point of view. In particular, the relations among the capacity region of the broadcast channel and two rate regions achieved by NOMA and time-division multiple access (TDMA) are first illustrated.

3. PROPOSED METHOD

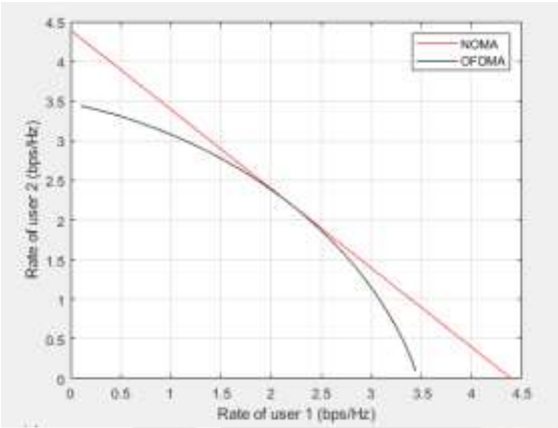
A NOMA-based 5G system consists of multiple users sharing the same subcarrier served by a base station (BS).The users will be multiplexed on the same frequency using different level of transmit power. This setup can also applied for code or time domain. In the NOMA-based system, both multiplexed users will receive a combined signal for both users. Based on the NOMA concepts, SIC is applied on the multiplexed users who receive a stronger signal. The transmitted signal is a linear combination of the two messages for multiplexed users where SIC is applied at the receiver side . The transmitted signals carry the intended message to the users are multiplexed on the same frequency. Users are assumed to experience better channel condition than one another. Thus, Users will perform SIC, which firstly decodes the message of other. Subsequently, Users cancels it from the received signal and decodes its intended message .On the other hand, Users will consider the signal of other User as noise and decodes the intended message from the received signal. The achievable throughput for NOMA-based system can be expressed, where the subcarrier bandwidth is the signal to interference plus noise ratio (SINR) for users . Users SNR value is increased to get accurate data. Users experience the better data transmission while the noise is less.

4. RESULT

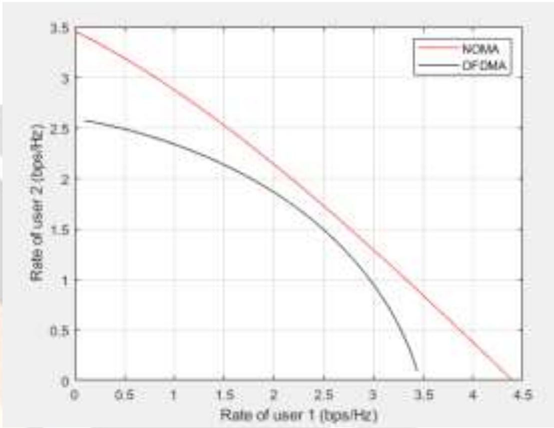
4.1 SIMULATION OF RATE PAIR

Case 1: We consider two users with equal distance from the base station. NOMA achieves higher rate pairs than the OFDMA. But at particular point both the NOMA and OFDMA meets with same capacity range, only when the SNR values of the two users are same.That too NOMA is more efficient than OFDMA.

Case 2: In this also, we consider two users but with different distance from the base station. NOMA achieves higher rate pairs than the OFDMA. Here the NOMA and OFDMA does not meets with same capacity range, Because the SNR values of the two users are different. So, NOMA is more efficient than OFDMA.



Fig(1): Downlink SNR1is equal to SNR2



Fig(2): Dowlink SNR1 not equal to SNR2

4.2 ENERGY EFFICIENCY AND SPECTRUM EFFICIENCY TRADE OFF

For all the cases, the energy efficiency and Spectrum efficiency are inversely proportional to each other. If Energy efficiency increases Spectrum efficiency decreases ,and if Spectrum efficiency increases Energy efficiency decreases. The peak of the curve is where the system has the maximum energy efficiency. The

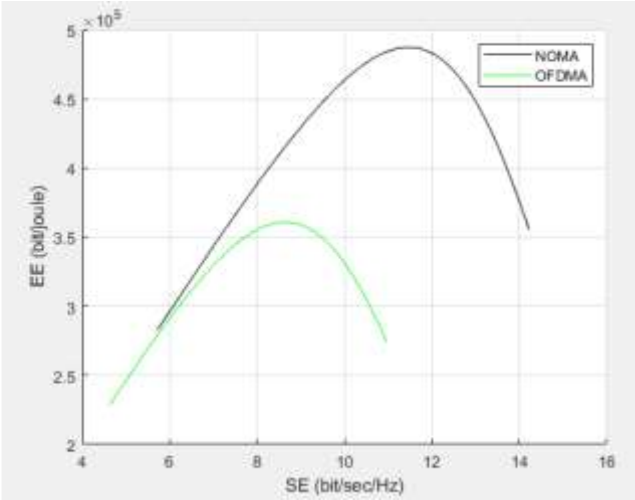
Energy efficiency –Spectrum efficiency relationship is linear with a positive slope of R_T / P_{total}, where an

$$EE = \frac{R_T}{P_{total}} = SE \frac{W}{P_{total}} (bits/joule)$$

increase in Spectrum Efficiency simultaneously results in an increase in Energy Efficiency. So, NOMA provides higher energy efficiency than OFDMA.

Where EE- Energy Efficiency, SE- Spectrum Efficiency, R- Sum Capacity ,P-Power consumed,

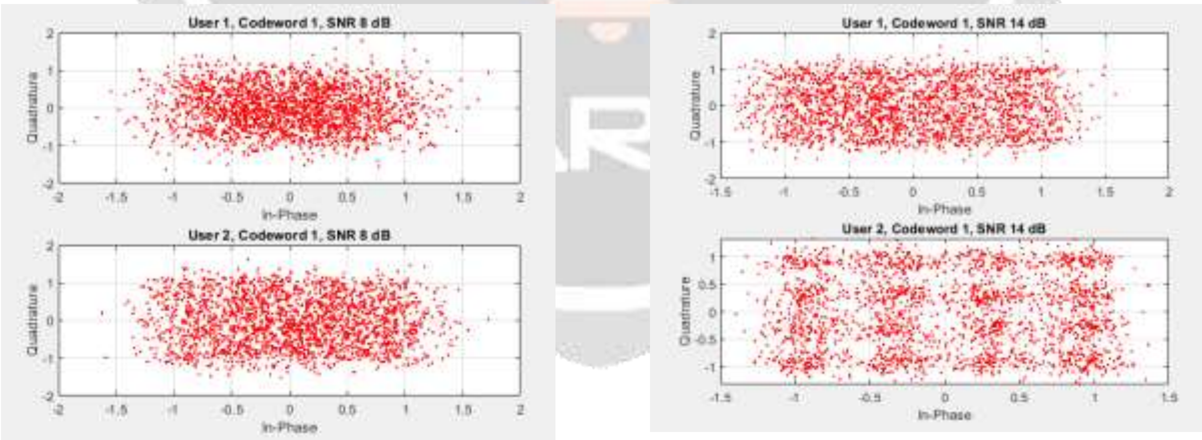
W-Bandwidth



Fig(3) : Energy Efficiency and Spectrum Efficiency trade off of NOMA and OFDMA

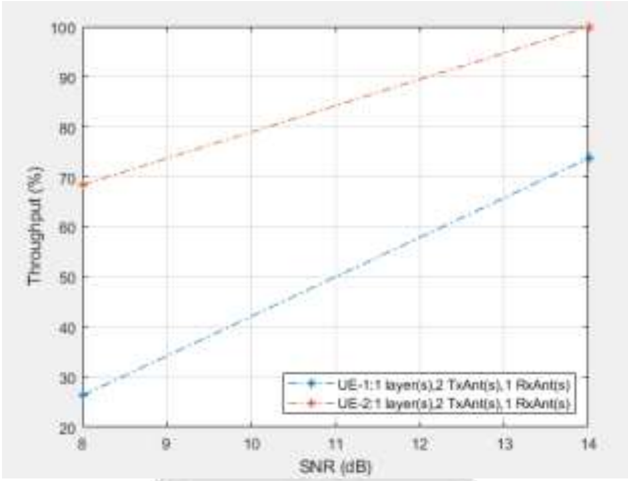
4.3 THROUGHPUT USING MIMO-NOMA

In a MU-MIMO scenario, due to the simultaneous transmission of data to multiple users, inter-user interference will be present at the receiver. Inter-user interference at the receiver can be canceled using precoding techniques at the transmitter. Two linear precoding techniques for MU-MIMO transmission are channel inversion and block diagonalization. The Physical Downlink Shared Channel (PDSCH) Throughput Performance in a Multiuser Multiple-Input Multiple-Output (MU-MIMO) Scenario with Non-Orthogonal Multiple Access (NOMA).
Constellation diagram below shown demonstrates that, when SNR value is high receiver can differentiate noise and signal but when SNR value is decreased it can't differentiate among them.
Here we compared the two users with SNR values variation, by increasing the SNR value among the users - user 2 has less noise, is clearly shown so user 2's is highly beneficial.



Fig(4): Comparison of two users's SNR with codeword for 8db and 14db in the cluster form.

As by the constellation simulation user 2 has less noise it is more efficient than user 1. So user 2 has high throughput than user 1. User's noise level is less, leads to better data transmission, it is done by codeword generation in the transmitter to make the data send to its receiver.



Fig(5): Throughput level graph of 2 users using MIMO-NOMA

5. CONCLUSION

The proposed system discussed about the key concept and advantages of NOMA techniques, which constitute one of the promising technologies for future 5G systems. We have implemented the NOMA scheme to improve the efficient usage of limited network resources. We also highlighted a range of key challenges, opportunities and future research trends related to the design of NOMA. It is expected that NOMA will play an important role in future 5G wireless communication systems supporting massive connectivity and low latency. We have presented the fundamentals of NOMA and demonstrated its superior performance over conventional OFDMA in terms of sum capacity, energy efficiency and spectral efficiency. All are using LTE, LTE becomes the mostly used network. So interference is high in LTE due to more number of users. By this we proposing the idea of using PDSCH(Physical Downlink Shared Channel) in MIMO-NOMA reduces the interference even though the users are more. This is done in transmitter itself to transmit the data to the specified receiver. In this a codeword is generated for each transmission so the data can be send to its receiver without scattering or lost by its transmitter. This all can be done only when the noise and signal has been easily differentiated by the transmitter, it can be executed by increasing the SNR value, as higher the SNR value the transmission will be better. By this the throughput will also be very efficient.

Future work - SIC receiver is sensitive to cancellation errors which can easily occur in fading channels. It can be eliminated with some other diversity techniques with coding schemes in order to increase the reliability and accordingly reduce the decoding errors. Interference by noise is also to be limited, so noise reduction schemes by increasing SNR, to its high rate is to be done.

6. REFERENCE

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