PERFORMANCE ANALYSIS OF NON ORTHOGONAL MULTIPLE ACCESS FOR 5G WITH MIMO CELLULAR SYSTEM

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***Abstract:** For the future wireless cellular systems we propose a new scheme that is Non orthogonal multiple accesses (NOMA) this has been proposed for the 3GPP-LTEA networks. In this paper we will discuss about basic NOMA system with Multiple-input Multiple-output (MIMO) Cellular System that will be use for future wireless communication system. In this cellular system we will use total no off receiver antennas at end side is more than the total no of transmitter antennas at the base station side in a cell that is use for communication system. In the first actively order the users receiver antennas into a no of arrays of beam that is equal to & more than number of base station transmitter antennas. In arrays of beam we will use an existent beam-forming vector that is shared by all the receiver antenna .For the system method we will propose a linear beam-forming technique in which all the receiver antennas can decidedly cancel the inter interference of inter arrays of beam . Receiver antennas in each arrays of beam are arranged on the power domain NOMA basic with Successive interference cancellation at the receiver end side. For maximize the overall cell capacity we provide mighty power allocation solution for inter arrays of beam and intra array of beam power allocation in the system .NOMA system is a power domain user multiplexing scheme that we are use for future wireless cellular networks for 5G.Basic NOMA system is a power domain scheme that is consist of superposition coding at the transmitter and successive interference cancellation at the receiver side makes it possible to operate the same spectrum for all users in wireless communication system. By using the Successive interference cancellation in NOMA system users get better cell coverage and higher throughput for users located at cell edge region than orthogonal multiple access. In this paper first we will discuss about why we need MIMO-NOMA system for 5G, then the basic principal of MIMO-NOMA result of throughput gains and network capacity of 2users NOMA system. By the use of basic NOMA system with multi input multi output for future wireless communication system it is guarantee that we will get high region of capacity and throughput gain and spectral efficiency of the networks. NOMA system is a scheme for the development of 5G and beyond wireless networks by NOMA with MIMO system multiple users can use the same frequency at same time and same code in different power level. By the use of MIMO-NOMA system we can fulfill the demand of increasing massive connectivity of mobile internet and internet of thing poses challenging requirement for 5G wireless communications.*

***Index Terms** - Orthogonal multiple access (OMA), Non-orthogonal multiple access (NOMA), superposition coding (SC), successive interference cancellation (SIC), Spectral efficiency (SE), Energy efficiency (EE),Multiple input multiple output (MIMO)*

I. INTRODUCTION

For fifth generation(5G) and beyond 5G(B5G) cellular communication system term the Non-Orthogonal Multiple access(NOMA) will use it, and is well-known as multiple access technology that can ultimate enhance system overall spectrum efficiency and region of capacity. In the basic idea of NOMA systems multiple users simultaneously assist over the same spectrum resource at the expense of inter user interference. In orthogonal multiple access(OMA) every user in a cell is assisted on entirely allocated communication resources(Time & frequency) in a cell of wireless communication system, but in Non-orthogonal multiple access(NOMA) superposes multiple users message signal in power domain by exploiting their corresponding channel gain differences . In basic NOMA system Successive interference cancellation (SIC) is activated at the receiver ends for inter user interference cancellation. For Multiple users multiple-input multiple-output (MIMO) communication with beam-forming have been advised extensively as a potential technology for achieving significant gains in the overall system throughput. In MIMO system each user is assisted by one or multiple array of beam depending on the no of base station transmitter antennas and sum total number of receiver antennas at the users in the cell .The interference of inter array beam can be completely discarded when the number of transmitter antennas is more than or equal to the number of receiver antennas. In MIMO system each user receiver is sustained by individual beam-forming vector which is orthogonal to the other receivers channel gains. In MIMO-NOMA system multiple receiver antennas of particular users specific channel gains are arranged into array of beam in the system. All the users/receiver antennas in each array of beam are arranged on NOMA basis. The sum total number of array of beam is equal to the number of base station transmit antennas, ie, the sum total number of transmitting array of beam. A single array of beam of beam is utilized by all the receivers of an array of beam which follow the basic NOMA of system. In case of more array of beam than the base station transmit antennas, multiple array of beam may share the same beam but utilize orthogonal spectrum resources, while each array of beam bunch distinctively is scheduled on a NOMA basis .The number of user receive antennas in MIMO-NOMA system is much higher than the number of base station transmit antennas it results in heavy inter array of beam interference. We implement beam-forming in this proposed system is by using the channel information of the highest channel gain users of each array of beam is defined as standard MIMO –NOMA system, while orthogonal spectrum resource allocation among the users of each array of beam is defined as standard NOMA. We define the highest channel gain user of each MIMO-NOMA array of beam as the array-head, and each receive antenna in a array of beam is defined as a user. So this system for future wireless communication system and by using this we can improve the capacity and spectral efficiency of the system.

(A) Why we need NOMA system with massive multiple-input multiple(MIMO) for future wireless communication system-

(I) Fast traffic growth in every year.

- In future we need wirelessly connected society.
- In upcoming year user will consume more GB/month.

- New application will come in mobile communication system.

(II) Data traffic will increases in every year.

- 50% annual increases in data traffic
- 1000 times more than 2034
- Require new technology for future cellular system

(III) 5G radio access technology is more than broadband.

- Future radio access technology (5G) that will support internet-of-things (IOT).

(IV) Link reliability is very important for mobile communication system.

- Connected factory robot, traffic safety application is need of future mobile communication system.
- Ultra-reliable low-latency communication (URLLC) in the future mobile communication system.

(V) We will use Massive machine-type communication system in future radio access.

- In future radio access many low-cost sensors and actuators deployed everywhere by 2020.

(B) How we will achieve enhance cellular communication for 5G

- By Increasing Network throughput(bit/s/km^2)
- By divided Coverage area into cells for the communication.

Throughput = (Cell density ×Available spectrum× Spectral efficiency)

- **Higher spectral efficiency [bit/s/Hz]-**

We know that Shannon's capacity limit is:-

$$log_2\left(1+\frac{Received\ signal\ power}{Interference\ power+Noise\ power}\right) \text{ [bit /s / Hz]}$$

We know the Shannon's channel capacity theorem-

$$\text{Capacity (bit/s) = Bandwidth} \times \log_2\left(1+\frac{S}{N}\right)$$

$\frac{S}{N}$ =signal to noise ratio

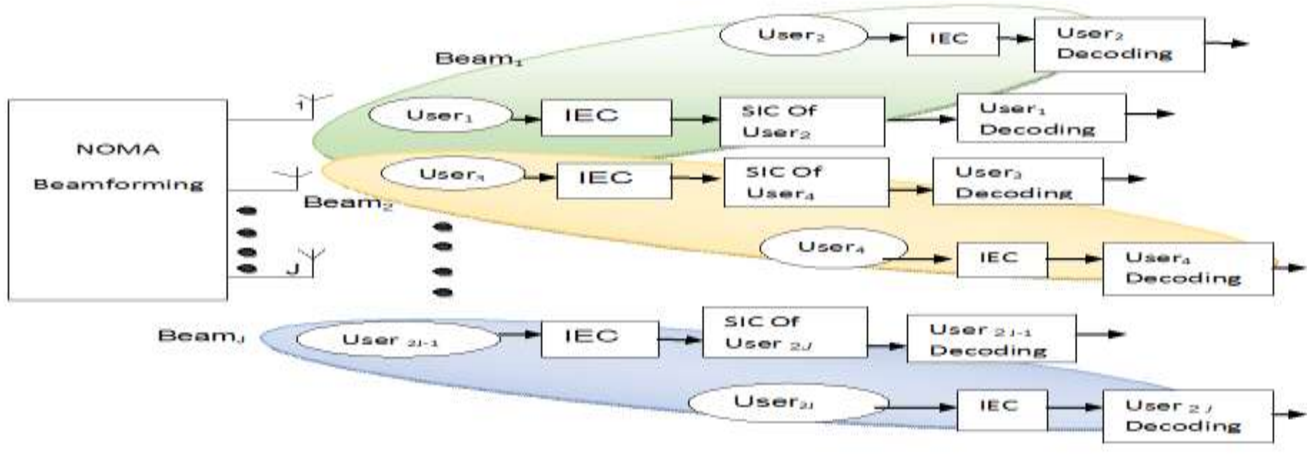
So from the above discussion we can say that if we will increase these factors then we can achieve higher data rate or throughput for 5G.Here we apply Shannon capacity limit and theorem in NOMA system. So we can say that by the use of NOMA system in 5G, we can fulfill the requirements of future mobile communication system.

(C) NOMA with massive MIMO is the solution for taking multi-user MIMO to the next level

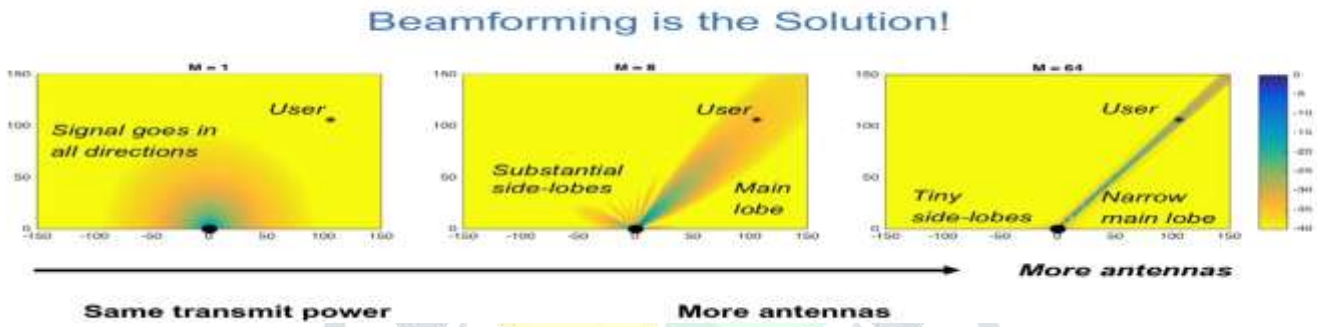
- This system will deliver ultimate spectral efficiency to the user in wireless communication system.
- For the multiuser Beam-forming is the solution in mobile communication system in this system we use more antennas-and then get more directivity in the signal.

(II)PROPOSED NOMA SYSTEM WITH MIMO SCHEME-Successive interference cancellation that is use in Non Orthogonal Multiple Access system it will improve the throughput in the channel and give the high power to the signals which are at the edges. In future mobile communication system we will provide wide transmission bandwidth to the channel, it will increase the region of capacity of the channel in the system, and by the NOMA system we can fulfill the demand of future mobile communication system. In basic NOMA system with SIC we will use different power allocation factor but in same time, code and frequency spectrum, in results will see that how power and bandwidth factor effect the region of capacity and spectral efficiency of the system with high bandwidth we get high throughput .But in case of multiuser we don't get high gain and throughput and spectral efficiency, we face the distortion in the channel and user face interface at the receiver. So to reduce this problem we need a new scheme for multi-input and, multi-output (multi-user) power allocation scheme that is NOMA with array of beam-forming. In NOMA with successive interference cancellation system combined with array of beam-forming, in this system we will use multiple-antenna /transmission and reception scheme to increase the spectrum efficiency and capacity gain. In this technology base transmitter will generate multiple array of-beams to multi-user, than multiple users are superimposed within each array of beam, number of receiving antennas are higher than transmitting antennas in each cell of array. NOMA with array of beam-forming for multi-users will use IEC (Interference elimination combining) before SIC of signals in the system. SIC in multi-input/multi-output is used for multiplexing intra array of -beam & IEC is used for inter array-beam interference elimination. In this system SIC interference cancellation is applied among the users associate to a array with the same decoding weights, and multiple access technique among each array of-beam is the same as the basic NOMA system.IEC is applied for inter array-beam interference elimination in the system , interference elimination within user sets with different pre-decoding weights .Interference from other array of beam is eliminate by combining the signals received at the receiver antenna of the user, Interference of signals eliminated by combining the signals received at multiple antennas so IEC does not demand for pre-decoding to other users. IEC can utilized MIMO pre-decoding or Array of beam-forming weights for other users on individual basis. The spectrum efficiency can be increased by selecting relevant users at the base station transmitter side which in turn uses a basic NOMA system with array of beam-forming. From above discussion we can say that NOMA with array of beam-forming will achieve excellent spectral efficiency and throughput gain of the channel. By the combination of basic NOMA system and NOMA with array of beam-forming/MIMO we can full-fill the demand of future radio access technology.

(III) PRINCIPAL OF NOMA-MIMO SYSTEM



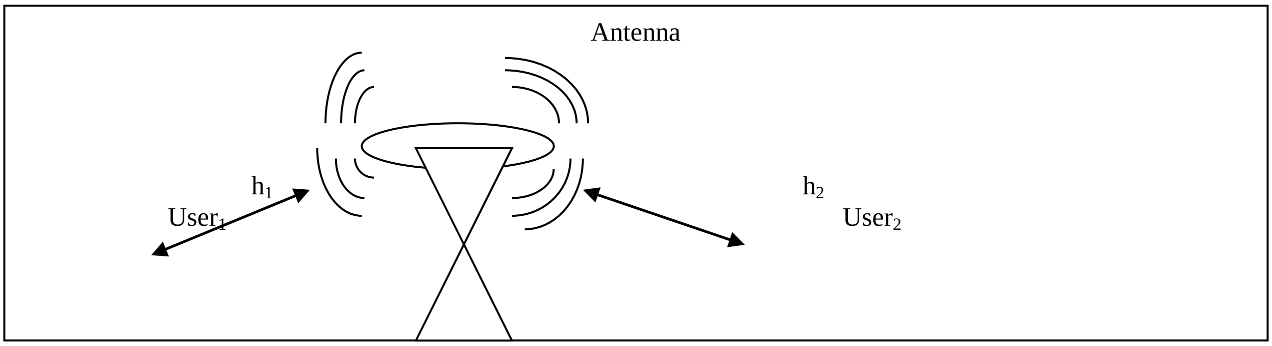
In this proposed method we will use basic NOMA system with beam-forming for multi-input /multi-output, at the base station side transmit the sum total number of array of beam is equal to the base station antenna. For the multiuser signal multiplexing with a array of beam we use super coding of the signals in the system that is based on the basic principal of NOMA system . In this proposed system of beam-forming, IEC is different from SIC technique, it is for inter array beam interference, if receiver has multiple receiving antennas, it eliminate inter array beam interference in the system. By SIC Intra array beam interference with superposition coded users is completely eliminated .In Beam-forming we use multiple antennas in the system by use of many antennas ,we get more directivity in the signal ,So beam-forming is the solution for the multi-input multi-output transmission of the signals ,that is shown in below figure-



From the above figure we can say that by the use of more antennas in the system, we get narrower beams ,get more directivity and then we get array gain:- $10\log_{10}(M)$dB larger at the user side and less leakage in undesired directions so we get high directive signal in desire area. The features of massive MIMO (multiple-input multiple output) for example we use here that are-

- In the NOMA with MIMO system we use many base station antennas example-B=100 ,X=10 single –antenna users
- Here many more antennas than users in the wireless communication system:-B>>X
- By using more antennas in the system we will get high spectral efficiency for the users, where many users synchronous in the system then we get strong directive signals with little leakage of interference of signals.

Here we take a example Rayleigh fading for results-
-Two users send signals S_k for X=1,2
-Channels $h_k = [h_{k1} \ldots\ldots\ldots\ldots h_{kB}]^T \sim \mathcal{CN}(0, I_B)$
-Noise $n \sim \mathcal{CN}\ (0, I_B)$
-Received $[Y = h_1 s_2 + h_2 s_2 + n]$



Here in the below equation we use linear vector $\mathbf{V_1}$ for User1:
$[\tilde{Y}_1 = V_1^H Y = V_1^H h_1 S_1 + V_2^H h_2 S_2 + V_1^H n]$
Second we use Maximum ratio filter $V_1 = (1/B) h_1$
We get Signal remains is -
$V_1^H h_1 = (1/B)\, \|h_1\|^2 \xrightarrow{B \to \infty} E[|h_{11}|^2] = 1$

Then Interference Vanishes-

$V_1^H h_2=(1/B)\, h_1^H h_2 \xrightarrow{B\to\infty} E[h_{11}]^H h_{21}=0$

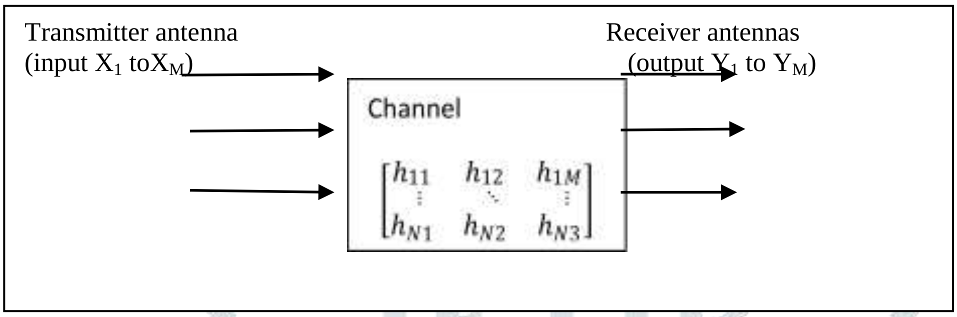
Noise also vanishes-

$V_1^H n=(1/M)\, h_1^H n \xrightarrow{B\to\infty} E[h_{11}]^H n=0$

We know that in asymptotically noise and interference free comunication:

$\tilde{Y} \xrightarrow{B\to\infty} s_1$

We know that Massive MIMO system provides Favorable propagation to the users-
Here we considred that there are two users M dimensional channels:h_1,h_2 in the system so fvorable propgation – $\{h_1/||h_1||\}$and $\{h_2/||h_2||\}$ it means that they are orthogonal to each other so we can say that base station can fully separate the users.
Select V_1 orthogonl to $\hat{h}_2$



Y=Hs+n

We expressed the received vector [y] in term of the channel transmission matrix H, and the input signal is [s] and noise vector is[n]as-

$$y=\begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix},x=\begin{bmatrix} s_1 \\ s_2 \\ \vdots \\ s_3 \end{bmatrix},H=\begin{bmatrix} h_{11} & h_{12} \dots\dots & h_{1M} \\ h_{21} & h_{22} \dots\dots & h_{2M} \\ \vdots & \vdots & \vdots \\ h_{N1} & h_{N2} \dots\dots & h_{N3} \end{bmatrix},n=\begin{bmatrix} n_1 \\ n_2 \\ \vdots \\ n_M \end{bmatrix}$$

In linear equation we expressed the response of the MIMO link.

IV. Basis NOMA and NOMA with MIMO System Method

In this section we will discuss about the system method of NOMA system, here we consider that base station transmit a signal for i users with the transmitting power $\boldsymbol{P_i}$ .Then superimposed signal from the base station is given as-

$$M_i = \sum_{i=1}^{n} M_i\sqrt{P_i}\ . \qquad (1)$$

In the given equation where M_i are the superimposed coded signals of the *i user i(1…..N)* .By the use of basic principal of NOMA we assume that here N=2,for *i=1* for the high gain user (near to base station) and *i=2* for the low gain user(far from the base station) and then the received signal from the *i* user is given as-

$$[Y_i=H_i\times M_i+W_i] \qquad (2)$$

$$Y_i = H_i \times \sum_{i=1}^{N} M_i\sqrt{P_i}\ . \qquad (3)$$

H_i = channel gain from the base station to the *i* user
W_i =Additive white Gaussian noise (AWGN) with zero mean & variance
$P_i = (\alpha_i \times P_{BS})/N_{BS}$ =Transmitted power, α_i = power allocation ratio of the *i* user, P_{BS} is the transmitter power of supplying base station, N_{BS} =no of sub band in the system
We discussed earlier that NOMA system the SIC is placed at the receiver side so to know the order for decoding the received signal. This order decided by the order of the increasing channel gain normalized by noise ($|H_i|^2/W_{0,i}$), based on this method any user with high channel gain can perfectly decoded the signals of users come out before that user in the order. We assume that $User_1$ with high channel gain in the total *i* user then $User_1$ can decoded the signal of the Users whose channel gain $|H_i|^2/W_{o,i} < |H_A|^2/W_{o,A}$,in this case the desired signal at $User_1$ will be given as –

$$Y_A = \underbrace{H_A \times M_A\sqrt{P_A}}_{\text{Desired signal}} + \underbrace{H_A \times \sum_{i=1}^{N} M_i\sqrt{P_i}}_{\text{removed by SIC (Unwanted signal)}} + W_i\ . \qquad (4)$$

Desired signal removed by SIC (Unwanted signal)

Here we take two user {i=1,2},so in the two user case we assume that
$|H_1|^2/N_{0,1}>|H_2|^2/N_{0,2}$ $User_1$ perform perfect SIC it comes last in the order,$User_1$ has high channel gain than $User_2$ in third case we can say that desired signal in this case given as according the equation (4) is -

$$Y_1 = \underbrace{H_1 \times M_1\sqrt{P_1}}_{\text{Desired signal}} + \underbrace{H_2 \times M_2\sqrt{P_2}}_{\text{Removed signal by SIC}} + W_i \,. \quad (5)$$

Equation (5) is the equation for the received signal of the near user, after which SIC is performed to remove the replica (unwanted information) for the decoding the desired information. In NOMA system cases (1) when- perfect SIC, In perfect SIC the near user is considered to have complete and perfect knowledge of the far user signal information, in this process interference from the far user is assumed to be totally cancelled at the near user receiver. In total *i* user, the detection of user$_A$ signal using perfect SIC can be given as-

$$M_A = \left\lfloor Y_A - \left(\sum_{i=A+1}^{N} M_i\sqrt{P_i}\right) \Big/ \sqrt{P_A} \right\rfloor \quad (6)$$

$\lfloor\ \rfloor$ Shows that detection of the signal including demodulation for two user equation can rewrite as for user$_1$ (near user) as-

$$M_1 = \left\lfloor \frac{Y_1 - M_2\sqrt{P_2}}{\sqrt{P_1}} \right\rfloor . \quad (7)$$

According to proposed method Transmitted signal for NOMA with massive MIMO

$$M = \underbrace{\sum_{j=1}^{j} B_j}_{\text{J}^{\text{th}}\text{ array beam veator}} \times \underbrace{\sum_{i=1}^{N} M_i\sqrt{P_i}}_{\text{User multiplexing by SIC of Intra array beam user}} . \quad (8)$$

Received signal for NOMA with massive MIMO -

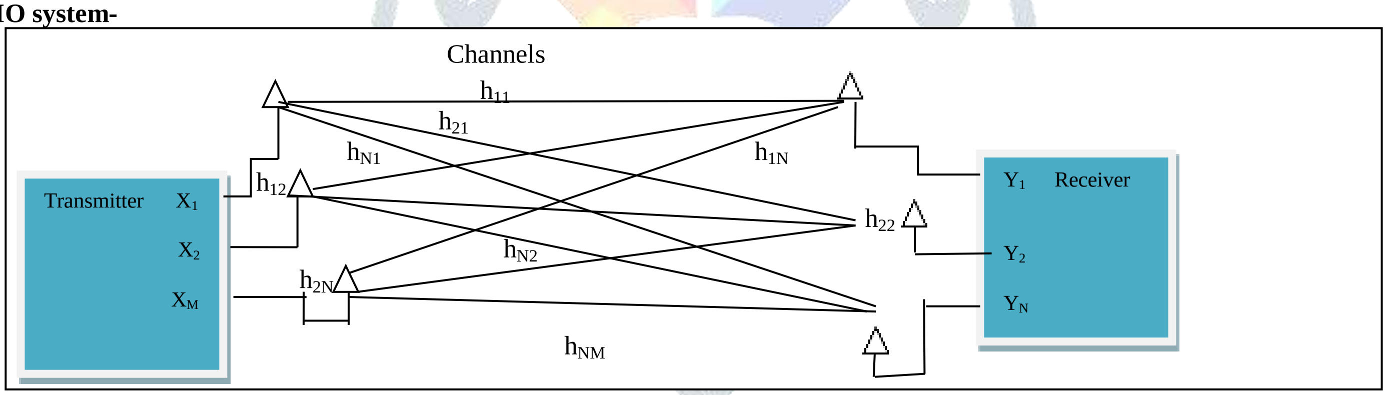
[$Y_i = H_i \times M_i + W_i$]

$$Y_i = H_i \times \sum_{j=1}^{j} B_j \times \sum_{i=1}^{N} M_i\sqrt{P_i} + W_i \,. \quad (9)$$

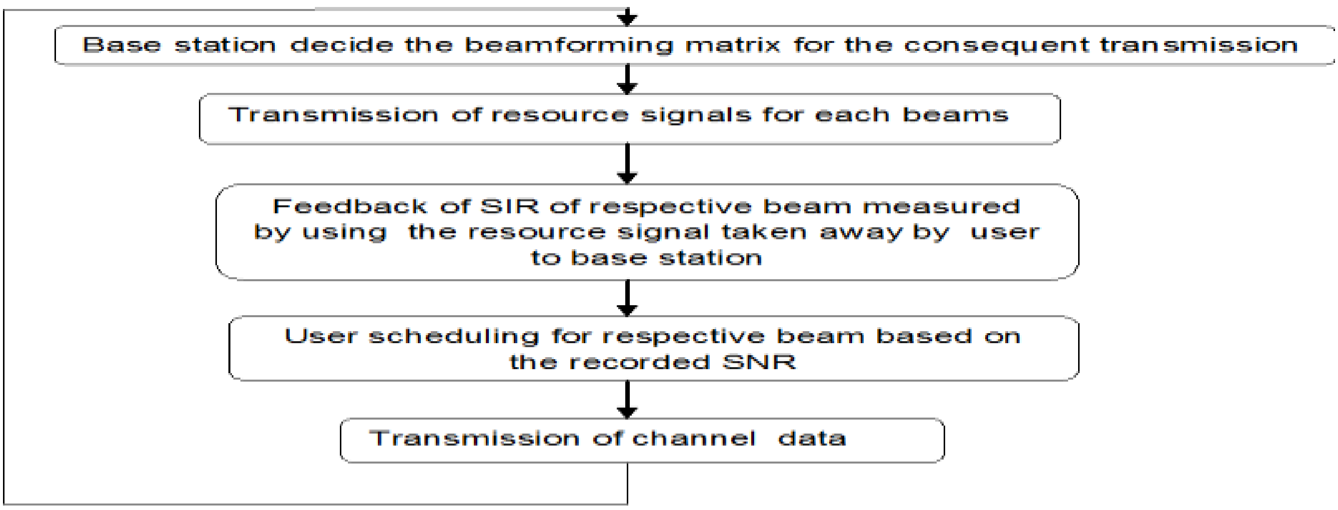
Proposed method to control beam-forming in transmission

MIMO system is the enhanced form of SISO where multiple independent radio terminals are enabled for increasing the communication capabilities with scheduling multiple users in the wireless communication system. In antenna technology for wireless communication when we use multiple antennas at both the source (transmitter) and the destination (receiver) side that is called MIMO scheme. To minimize errors and optimize data speed in wireless communication system we combine the antennas at each end of the communication circuit. To make use of reflected signals to provide gains in channel robustness and throughput in the wireless communication system we use multiple input multiple output technology.

MIMO system-



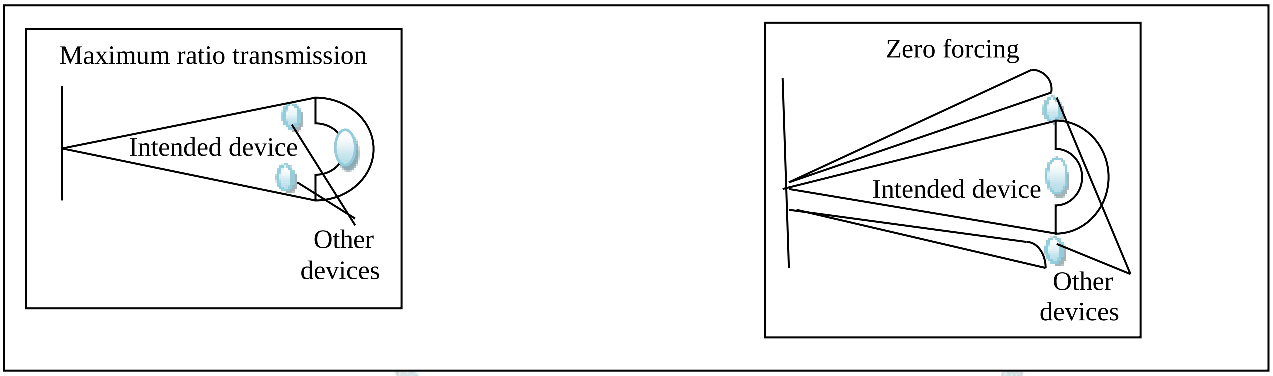
Method to control beam-forming-



MIMO implement using by using the spatial diversity techniques and spatial-multiplexing we implement MIMO technology for communication system. Diversity gain that is provided by the Diversity techniques its -aimed to improve the reliability in signal of the channel .When the information traveling from transmit to receive end then we see fading effects in the channel so to minimizes this we use MIMO based system for communication Different types of diversity techniques we use in the antenna technology, various diversity techniques such as time, frequency, and space are there in the system. When the same message is transmitted at different time slots this is called Time diversity, When the same message is transmitted at different frequencies that is called Frequency diversity ,In the Space diversity we use separate antennas in the system. To take the advantage of the different radio paths, that exist in a typical terrestrial environment we use distributed antennas which are located in different positions in communication system. Second type of diversity is spatial diversity this is enhance the link performance at the receiver side. We get higher data rate, downlink and uplink throughput of the system by the help of multiple antennas and spatial multiplexing technique in communication access of signals. Two different types of strategies are used in beam-forming to create a certain required antenna pattern to give the required performance under the given conditions that are-

(1)-Maximum ratio Transmission (MRT)

(2)-Zero forcing (ZF)



- To maximize sum of channel gains to the device we sets beam forming weights by the maximum ratio transmission.
- By using Zero forcing we minimizes the interference to all other users in cell, placing them within local nulls.

We use those antennas in MIMO beam-forming that can be controlled automatically according the required performance and the prevailing conditions these types of antennas are smart antennas, types of smart antenna use in beam-forming-

(1)-Phased Array system (PAS)

(2)-Adaptive array system (AAS)

By the use of adaptive array system we can somehow unlikely exactly match the required direction for the signal in fixed direction, solve this problem. Mathematically working of MIMO systems-

[Sum total number of receiving antennas>= Sum total number of transmitting antennas]

We can represented in matrix format like-

[R]= [H] × [T]

[R]=receiver antennas matrix,[H]=channel properties matrix,[T]=Data stream matrix.

To recover the transmitted data-stream in the receiver –

$[T]= [H]^{-1}\times[R]$

We need to add coding to the different channel before using this, MIMO uses space time block codes in system to represent by matrix from, and so we can say that

{MIMO technique = Spatial diversity technique+ Spatial multiplexing technique+ Antenna beam-forming technique}

We get the idea that spatial diversity enhance link performance, spatial multiplexing enhance link efficiency, Antenna beam-forming improve the coverage and MIMO technique increase link capacity in the system so at the receiver we get enhance link capacity.

System and signal model of NOMA with MIMO

In MIMO-NOMA system we assume a single cell base station arrayed with J_t transmit antennas for beam-forming .The sum total number of users in the cell is M, where each user can be arrayed with one or more receive antennas. The sum total number of user/receiver antennas in the cell is L where $L>J_t$. The receiver antennas grouped into a array of beam is J where $J\geq J_t$ .In a array of beam no more than one user/receive –antenna only belong to one user, while one user/receive –antenna only belongs to one array of beam.

The multiple array of beam utilize the same beam-forming vector when $J>J_t$ while users in each array of beam are arranged on a NOMA basis but use orthogonal spectrum resources to each other. If $J=J_t$ then all the arrays of beam use the same spectrum resources (full bandwidth) and each beam-forming vector assist individual array of beam in the system. Each array of beam in this system consists of K users/receiver –antennas such that $\sum_{j=1}^{J}|k| = L$ we assume that number of arrays of beam is equal to the number of transmit antennas $J=J_t$.

SIGNAL MODEL- Transmitted data vector in system is $M=[m_1,m_2,m3\ldots\ldots mJ]T\in CJ\times 1$,

Where the data stream for J-array of beam is $m_n=\sum_{K=1}^{K} P_{j,k}\, S_{j,k}$

$P_{j,k}$ =Transmit power and $S_{j,k}$ =transmit message signal for k-th user in the j-th array of beam. By pre-coding matrix $\{\mathcal{M}\in C^{J\times J}\}$ array of beam-forming data vector is modulated in the system, and then it is transmitted over the radio channel $H=[H_1^T\ H_2^T\ ,H_3^T,\ldots\ldots H_J^T]^T\in CL\times J$,where $H_J\ \in CK\times J$, correlate with the radio channel of all K users of j-th array of beam. The transmitted enclosed signal is

$$\widetilde{m}\ \in C^{J\times 1}$$

We can be expressed this as $\widetilde{m}=\mathbb{M}m$

The decoding scaling weight factor define by $D_{j,k}\in C$. In $D_{j,k}\in C$ received signal is multiplied ahead to decode at K-th user of j-th array of beam can be expressed as –

$$Y_{j,k}=D_{j,k}[h_{j,k}\mathbb{M}m+W_{j,k}] \qquad (10)$$

$h_{j,k}\in C^{1\times J}$ =The radio channel gain column vector for k-th user of j-th array of beam
$W_{j,k}$ = is complex Gaussian noise with variance σ^2.
If $\mathcal{M}_j$ denote the j-th column of the array beam-forming pre-coding matrix $\mathbb{M}$ then (10) can be expressed as follow:

$$Y_{j,k} = D_{j,k}\, h_{j,k}\mathcal{M}_j\, m_j + D_{j,k}\, h_{j,k}\sum_{i=1,i\neq j}^{J}\mathcal{M}_i\, m_i + D_{j,k}W_{j,k}$$

$$= D_{j,k}\, h_{j,k}\mathcal{M}_j\, P_{j,k}\, S_{j,k} + D_{j,k}\, h_{j,k}\mathcal{M}_j\sum_{n=1,n\neq k}^{K} P_{j,n}\, S_{j,n} + D_{j,k}\, h_{j,k}\sum_{i=1,i\neq j}^{J}\mathcal{M}_i\, m_i + D_{j,k}W_{j,k} \qquad (11)$$

In NOMA-MIMO system the dynamic power allocation within each (array of beam) is performed in such a way that the higher channel gain user can thoroughly decode and then suppress the intra-array beam interference from lower channel gain users. Thus (11) can be rewritten as follows:

$$Y_{j,k} = D_{j,k}\, h_{j,k}\mathcal{M}_j\, P_{j,k}\, S_{j,k} + D_{j,k}\, h_{j,k}\mathcal{M}_j\sum_{j=1,}^{K-1} P_{j,n}\, S_{j,n} + D_{j,k}\, h_{j,k}\sum_{i=1,i\neq j}^{J}\mathcal{M}_i\, m_i + D_{j,k}W_{j,k} \qquad (12)$$

The signal-to–intra-cell-interference-noise-ratio (SINR) of received signal for k-th user of j-th array of beam can be expressed as follows:

$$SINR_{j,k} = \frac{|D_{j,k}\, h_{j,k}\mathcal{M}_j|^2\, P_{j,k}}{\underbrace{|D_{j,k}\, h_{j,k}\mathcal{M}_j|^2\sum_{j=1,}^{K-1}P_{j,n}}_{\text{Interference of Intra array of Beam}} + \underbrace{\sum_{i=1,i\neq j}^{J}|D_{j,k}h_{j,k}\,\mathcal{M}_i|^2\, P_i}_{\text{Interference of Inter array of beam}} + \underbrace{D_{j,k}W_{j,k}}_{\text{Noise}}} \qquad (13)$$

P_j = The total transmit power for j-th array of beam, and we assume that $E[|S_{i,n}|^2] = 1\ \forall_{i,n}$.
For k-th user of n-th array of beam the achievable throughput can be expressed as -

$$R_{j,k} = B\log_2(1+\left(1+\frac{G_{j,k}P_{j,k}}{G_{j,k}\sum_{n=1}^{k-1}P_{j,n}+1}\right) \qquad (14)$$

B = The total system bandwidth utilized by each transmit array of beam,
$G_{j,k}$ = the normalized channel gain could be expressed as follows:

$$SINR_{j,k} = \frac{|D_{j,k}\, h_{j,k}\mathcal{M}_j|^2}{\sum_{i=1,i\neq j}^{J}|D_{j,k}h_{j,k}\,\mathcal{M}_i|^2\, P_i + D_{j,k}W_{j,k}} \qquad (15)$$

The complete receiving cell system throughput of the proposed NOMA with MIMO can be expressed as-

$$\hat{R}_{cell} = R\sum_{j=1}^{J}\sum_{k=1}^{K} B\log_2(1+\left(1+\frac{G_{j,k}P_{j,k}}{G_{j,k}\sum_{n=1}^{k-1}P_{j,n}+1}\right) \qquad (16)$$

We can enhance cell spectral efficiency with the help of basic NOMA system with MIMO system .By using efficient user array of beam-forming and power allocation in NOMA with MIMO system we can mitigate this interference and provide high spectral efficiency performance in the channel. MIMO technique can potentially multiply the spectral efficiency gain in proportion to the spatial multiplexing order by using multiple antennas at the transmitter and receiver ends. Inter-user interference in MIMO can be completely eliminated by using the sum total number of total receiver antennas is equal to or less than the sum total of transmit antennas in a cell. The number of receiver antennas is more than the number of transmitter antennas; in NOMA with MIMO system thus the resultant interference for each user is very high. For transmission in wireless communication system our motivation is to develop a ‘‘robust" MIMO-NOMA system that can minimize the net interference, and thus maximize the system capacity (or throughput).

(VII) Results – In this section we will see the result and relation between capacity & power , capacity & bandwidth, Spectral efficiency & bit to noise ratio ,by the results we can see that how bandwidth and power effect the capacity of wireless communication system and play big role in communication system. In NOMA with MIMO we used different power level in whole bandwidth, according the region of area we allot the different power allocation factor at same time, code and in same bandwidth .We know that when we increasing signal power in communication system that will lead to more capacity, Capacity is the logarithmic function of power so when increase capacity that returns are decline. Bandwidth play a big role in capacity of system, when we provide more bandwidth to the users then we get more transmission per second for the user in the mobile communication system hence we get higher the region of capacity for the users. We will use NOMA system with MIMO for future wireless communication where we will use more frequency spectrum for the users (more bandwidth) we know that by Shannon theorem bandwidth is directly proportional to the capacity so when we increase the bandwidth we will be get high throughput in the wireless communication system. So by the use of basic non orthogonal multiple access scheme for future wireless communication we get high region of capacity and spectral efficiency response in the system .For the multi users we combine the MIMO with basic NOMA system and apply the basic principal of NOMA with MIMO then we get higher region of capacity of the system .So NOMA with MIMO we will get high throughput and spectral efficiency at the edge and this system fulfill the requirements of future wireless communication system.

Figure 8(A) (In wireless communication system the relation Curve of Capacity with power)

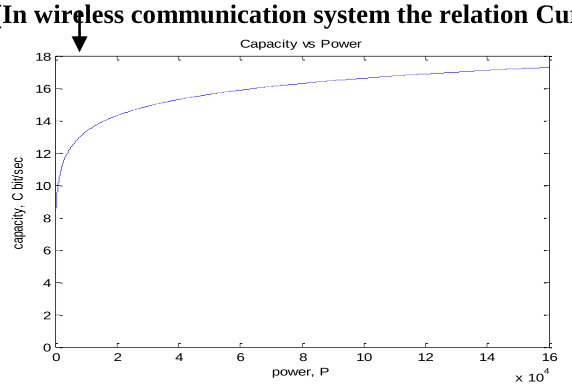


Figure8 (B)-(In wireless communication system the relation Curve of Capacity with Bandwidth)

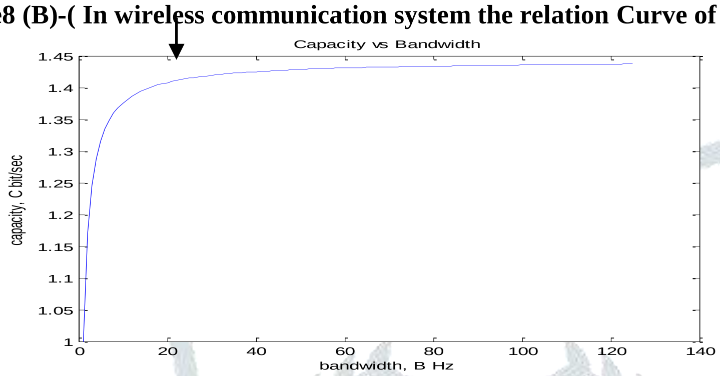


Figure8(C) (In wireless communication system the relation Curve of spectral efficiency vs Bit to noise)

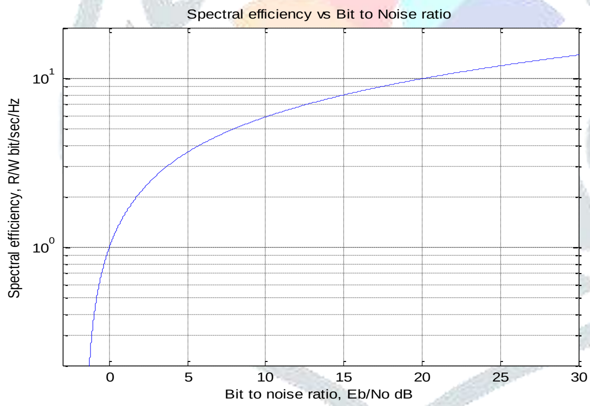


Figure8 (D)-Result of Capacity with single input to signal output vs multi-input multi-output)

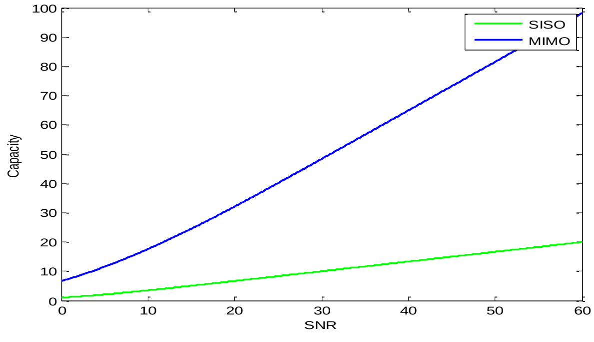


Figure8(E)-(Rate pair (throughput) of user at the edge)

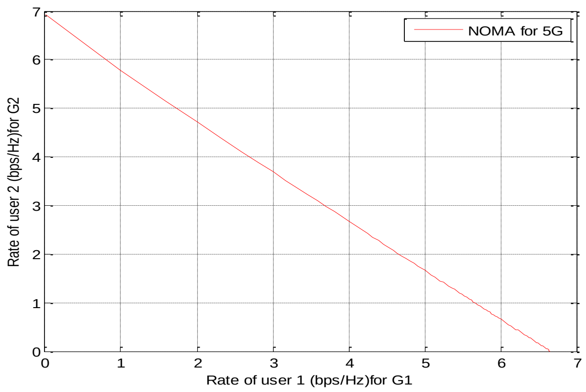
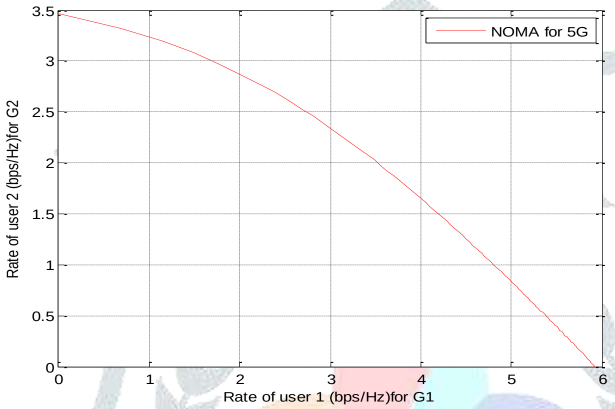


Figure8(F)-(Rate pair of user at the edge)



VIII) Conclusion -In this paper we discussed about the basic NOMA system with MIMO, and fundamental of NOMA system, in this scheme we used SIC for downlink transmission, presented the performance of capacity with power, bandwidth, and spectral efficiency and see the result of capacity with MIMO system. We focused about how SIC performed in NOMA with MIMO system and its performance in channel system. When perfect SIC in system then channel achieved high throughput, high rate pairs then in signals information for the far Users. Future work for power domain NOMA is NOMA with Massive MIMO system. In beam forming for multi-input-multi-output we achieve high spectral efficiency in the mobile communication system. In this system SIC is used at the receiver side for intra-beam user multiplexing and IEC is used for inter-beam multiplexing using these in system we can robust the multiple access in system. By combination of basic NOMA system with NOMA-beam forming we get excellent spectral efficiency and throughput in the channel and provide wide range of frequency bands for the 5G network that is new radio access technologies. NOMA–beam forming/MIMO will fulfill the requirements of future radio access technologies.

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