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Beam forming and Multiuser MIMO based Performance Analysis of 5G Network Communications

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Abstract

5G is termed as the fifth generation wireless cellular communication networks. Fifth generation networks provides a better performance than the previous generations such as 3G and 4G. The core facility of the fifth generation networks is not only interconnecting people rather provides the connectivity to the whole world such as machine to machine communication, device to device communication etc…The fifth generation networks is known to its efficiency and performance phenomenon characteristics. The Main objective of focus to 5G network is ability to development large number of antennas (i.e: Massive MIMO) whereas LTE focuses on large high speed rather than normal facility. LTE-A is a advanced version of LTE, many features are available in LTE-A Technology. It will supports a spectrum bandwidth is 100 MHz to 6GHz. 5G network will gathering on LTE-A network will operate the by using 5G Networks, 5G will offer high bandwidth with less coverage area due to path loss at high frequencies. In Proposed method Performance analysis about the beam forming and Massive MIMO techniques. The result should be reducing the 10% interference using BDMA.

Keywords: MIMO, BDMA, LTE, LTE-A, 5G

I. INTRODUCTION:

Now a Days Wireless Communication is increased day by day. In 5G Network is a fifth generation of cellular mobile communication overcome a existing services such as 4G, 3G system. 5G being the next generation of mobile networking standards the deliver improved end users and it will provide the new applications and services, large data rate, less delay, and appreciably enhanced the better performance and dependable communications. In a Recent technology industry revolution changing the day by day , So We can see emerging technique and major applications are an artificial intelligence, smart house , independent vehicles, drone-based delivery systems, smart metropolitan, smart industrial unit, etc. The features challenges in machine to machine interface and human centric services is major challenges in Cost of Service. Based on end user services .it can be classified the different types of groups. The new 5G services are: immersive 5G services, intelligent 5G services, universal 5G services, independent 5G services, and public 5G services. Due to multimedia and social network its consuming more mobile data network can us utilized it is a one of the demanding

Categories	Services
Immersive 5G services	Considerable Contents Streaming
Intelligent 5G services	Packed out Area Service
Universal 5G services	Smart Health care and Smart Cities
Independent 5G services	Robot-based Service

Public 5G services	Emerging Services

Table 1: Overview of Five service categories of 5G

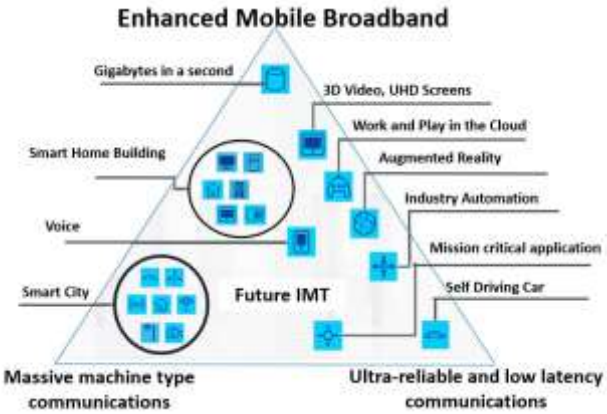


Fig 1: 5G-usage scenario

Enhanced Mobile Broad Band Network is predictable to primary use case for 5G in its early deployments It'll pass high-speed portable broadband organize to colossal zones, empower shoppers to appreciate high-speed gushing for in-home, screen and versatile gadgets on request, and will permit venture collaboration administrations to create. A few administrators may too consider the Upgraded Portable Wide Band Organize as the last-mile arrangement in those ranges missing copper or fiber associations to homes. In future 5G is also estimated to constrain the evolution of smart cities and healthcare and IoT through the deployment of a significant number of low-power sensors networks in various domains. The security and robustness built into 5G will make it suitable for public safety as well as for use in mission-critical services, such as smart grids, police and security services, energy and water utilities, and healthcare. Its low latency performance characteristics make it suitable for remote surgery, factory automation and the control of real-time processes.

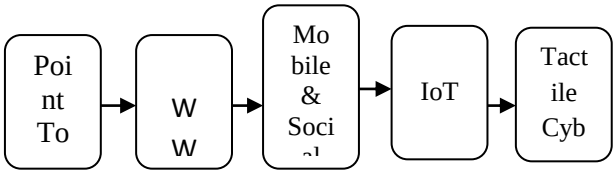


Fig 2: Advancement of Internet Services

II. BEAM FORMING

Transfer of the same signal into single channel location involving phase and wavelength can be employed by beam forming. Generally multiple access techniques are employed to get the optimal results such as time, frequency and codes. The core objective of the proposed technique is to provide the improved quality and services at the affordable cost. BDMA is expanded to as Beam Division Multiple Access technique which will not employ much time and recurrence asset sharing or it provides pillar shaping which will cover multiple clients with in those that of the neighboring zones. The BDMA technique pictures that an isolated pillar of radio wire is transferred through the base stations to the cellular devices. This can be achieved by the assessment of position of portable devices and also the rate at which those devices are moving in accordance to the base station. The mobile devices itself communicates the positional information. Thus employing this beam division multiple access technique provides an enhanced system capacity.

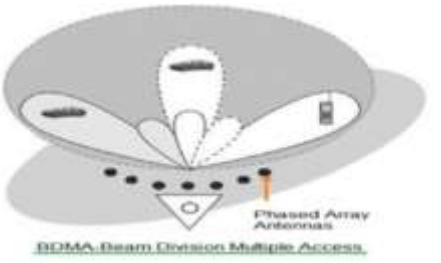


Fig 3 Beam Division Multiple Access

In accordance with the position characteristics and the speed of the mobile, we can ensure the determination of the breadth and direction of all end users through the base stations. The communication of line of sight with the base station is provided with the mobile stations. The beans as a result are clear for all personal stations. Same base stations can be employed for the mobile devices at the same points. The beams split into three dimensions to serve multiple users.

III. MASSIVE MIMO

One of the popular technology named Massive MIMO is a kind of antenna technology which is used in wireless cellular communications which has several standard techniques like LTE and Wi-Fi. MIMO is otherwise called Multi user MIMO. In order to provide high throughput and better spectrum efficiency the information is transferred from one user to another where also to enhance the performance of the signal quality. The basic wireless standard which includes 802.11n (Wi-Fi), 802.11ac (Wi-Fi), HSPA, Wi-MAX and LTE are used to expand the antenna links. This way of implementing the MIMO technology has numerous benefits where it has an added advantage of utilizing less power mechanism and proves to be cost effective, reduced delay, reduced antenna weight and also less frequency congestion. The current proposed method also lies in the factor of transmission media where the channels are orthogonal to the terminals. This technology completely overcomes the problem of the previous existing system.

Fig: 4 Massive MIMO

Gen	Date Rate	Technology	Year	Characteristic	Remarks
1G	2kbps	Analog cellular	1980 – 1990	First wireless communication	Less Battery, Power, Poor voice signal
2G	64kbps	Digital cellular (GSM)	1990 – 2000	Digital	Small Date Services
3G	144kbps – 2Mbps	CDMA, UMTS, EDGE	2000 – 2010	Digital broadband, increased speed	Interference Call, Cannot Communicate with 4G Network
4G	100 Mbps – 1Gbps	LTE, Wi Fi	2010 – 2020	High speed, all IP	Average Speed, Higher data prices for consumers
5G	1Gbps <	WWWW	(2020 - 2030)	Multiple Services & Security	***

Table 2 Comparison of wireless generations

IV. METHODOLOGY

A. performance characteristics of 5G network depending on BER vs SNR.
B. Calculate the cell capacity of 5G networks by analyzing multiple users at the transceivers ends
C. Plots Visualization for minimal interference using beam forming.

V. RESULTS

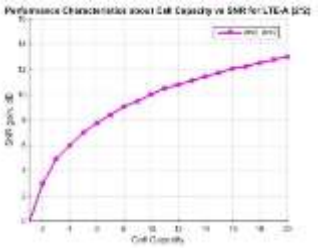
a. Massive MIMO and BDM based Simulation of LTE-A and 5G network.

By using Channel Capacity theorem to calculate Cell Capacity in LTE-A and 5G systems. It will provide the high data rate for transferring the information via communications channel of a specific bandwidth with interference. In Communication link by using Channel Capacity theorem will provide the Closed region area and the highest amount of error free data per unit time , Where data can be transmitted to specific bandwidth in accordance to the noise signal. By using Gaussian noise theorem will determine the Power or power spectral density.

It is formulated by: C

$$C = B.\log2\ (1+S/N)$$

S - Signal Power in watts



N – Noise Power in watts
B – Bandwidth in Hertz.
SNR - Signal to noise ratio in dB.
The above formulation relates that the Cell Capacity is directly proportional to S/N in dB , The System Capacity will enhance the Signal to noise ration value. The Performance phenomenon depends an Outrage probability, which is defined as the probability when mutual information is less than the given threshold. there is a Increased Probability of having a decoding failure which is basically a typical error.

Fig: 5 Performance Characteristics about Cell Capacity vs SNR for LTE-A (2*2)

The graph plotted above between Cell Capacity and SNR is for LTE-A network where MIMO technology is used by deploying 2 transceivers end.

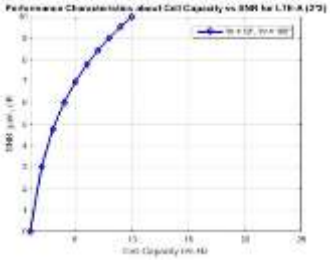


Fig: 5 Performance Characteristics about Cell Capacity vs SNR for 5G (50*100)

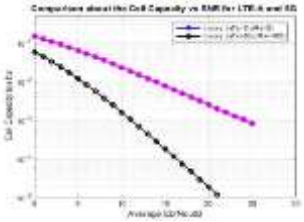


Fig: 6 Comparison about the Cell Capacity vs SNR for LTE-A and 5G (2*2, 50 *100).

The above graphs are plotted for several combinations of Transceivers antennas in 5G network that uses Multi user Multiple Input and Multiple Output (Massive MIMO) technology, where antenna was increased. If we increased the number of antennas simultaneously cell capacity also will increase significantly.

Number of Transmit antenna	Number of Receive antenna	Cell Capacity (b/s/Hz)
2	2	2
2	50	10
5	15	18
50	100	70

Table 7. Cell Capacity in 5G networks for several number of antennas

b. Simulation graph for LTE-A and 5G network using Multiuser MIMO and beam forming for Noise.

In any wireless communication system Interference is a one of the important concerns, it's mainly due to transmission of the signals either from adjoining cells or within the same clusters or neighboring cluster. To diminish the impact of interference signal the technique of beam forming is employed in 5G Networks. The Performance simulation results shows that the proposed beam forming technique enhance

the system reliability and reduce bit error rate for efficient communication systems. SNR values has been increased when N=2 and N=4. N=8 and N=16, where BER has been analyzed to diminish but S/N also diminish along with Bit error rate. based upon no of transmitting antennas and receiving antenna beam forming can be obtained with the replica of Bit error rate and will increase the antennas will reduce the Bit error rate. The modulation scheme used is QPSK in Rayleigh fading channel.

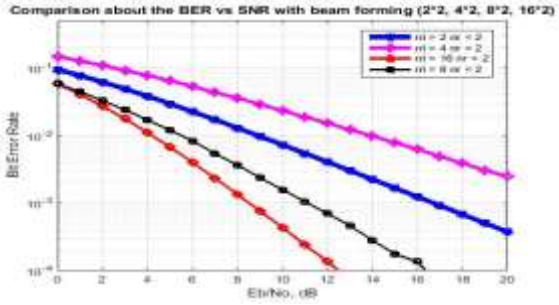


Fig: 7 Comparison about the BER vs SNR with beam forming (2*2, 4*2, 8*2, 16*2).

Number of Antennas	BER		S/N (dB)	
	Existing Method	Proposed Method	Existing Method	Proposed Method
2	10^{-4}	10^{-1}	25	22
4	10^{-3}	10^{-1}	20	20
8	***	10^{-3}	***	18
16	***	10^{-4}	***	11

Table 7.2 Comparison of BER for different number of antennas

VI .CONCLUSION

Cell Capacity analysis of LTE-A and 5G networks result was achieved by using MIMO and Multiuser MIMO correspondingly and the outcome demonstrate the increased system capacity as well as transceivers antennas. We analyzed the result from 2*2 transceivers to 50 transmit and receive antennas (Multiuser-MIMO). The Cell Capacity has been rapidly increased from 2b/s/Hz to 70b/s/Hz showing improvement of about 65%. Beam forming technique is used to moderate the 5G network interference signals. By changing the number of transmit antennas from N=2 to N=16 using QPSK modulation scheme it is analyzed that BER has improved from 10-1 to 10-4 showing improvement of about 65%. Trade-off achieved between Bit Error Rate vs SNR. BER recover at the cost of SNR. Increased speed and cell capacity that is introduced the new devices.

VII. FUTURE SCOPE

A. There is a trade-off between Bit error rate and SNR, Bit error rate will increase and vary the number of antennas but SNR reduces therefore, SNR can be achieved.

B. Work can be also be extensive to moderate adjacent-channel interference when the number of antennas is enlarged.

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