OVERVIEW OF LTE, LTE-A AND 5G MIMO ANTENNA FOR WIRELESS COMMUNICATION

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ABSTRACT: *The communication is very essential component; day by day the communication technology has its own shape and spreads around the world. The world is in a finger tip, with the help of communication the information can travel within a fraction of seconds, the technology merely it has changed its face nearly decade, the 1G, 2G, 3G these technology has revolutionized the world but today people usages of cell phones are increased the processing data is also increased for that the LTE(Long Term Evolution) and then LTE-A (4G) technology has given flourish to the communication technology. It uses Code Division Multiple Access (CDMA), bandwidths from 1.4 MHz to 20 MHz, frequency division duplexing (FDD) and time division duplexing (TDD),OFDM, multiple input / output (MIMO) antenna and carrier aggregation LTE and LTE-Advanced are fourth generation wireless technologies designed to use for high speed broadband internet access. The specifications are published by 3rd Generation Partnership Project (3GPP). LTE is specified in 3GPP release 8 and LTE Advanced is specified in 3GPP release 10 and 5G and antenna plays very important role in the recent years In this paper, it presents an overall description of LTE technology separately in different Aspects of LTE architecture and technical principles to clarify how LTE as a radio technology achieves a high performance for cellular mobile communication systems*

I. INTRODUCTION

The people need information in high speed. Delivery of information in high speed with the help of advancement of technology can be satisfied the needs of the people.
Day by day the data becomes valuable the data has to reach within fraction of second to the desired destination. The mobile technology has taken into many changes in recent days. The growth of mobile communication system had changed the direction researcher. The parameter like security, performance, reliability, dependability accurate, timeliness, BER, Bandwidth, frequency, throughput etc are most important parameter for the information has to deliver for the desire destination. To improve the parameters there is advancement in mobile technology, evolution in technology there tremendous changes in speed. The history of communication system gives an idea how the drastic shifting from Kb data to Gb data.The users of mobile day to day multiplying then the infrastructure is also doubled and due to those challenges are also increased the evolution of technology has overcome some of the problems like deployment of

Antennas system with wider bandwidths and smaller dimensions than any other conventionally possible. The research on antenna in numerous way one of which is by using fractal antenna. Improvement in the antenna technology the characteristics some of geometries have been specifically useful in reducing the size and space.. Since from many years fractal geometries is used for the applications of antenna with various degrees. The fractals have been utilized in numerous numbers of applications of science and engineering.

Communication is exchanging of information from one point to another it is a integral parts of science. The term communication was first introduced after the discovery of telephones which then later replaced to that telegrams and letters. Now communication is the backbone of the people. Wireless communication has undergone technological advances from 1G in later 80's to 4G in 2010. At present the new technology 5G has promised revolutionary changes in communication because of advancement in technology to speed up the communication in lightening speed. As many as the number of cellular telephony subscriptions has surpassed the wire line telephony subscriptions the wire line telephony subscriptions and this leads tool of wireless technology. Day passes the development of signal processing techniques in 3G has improved the communication a lot in last from few decades. Exponential growth of wireless communication has increased the demands in network efficiency and speed of communication.

Zero (0G): the mobile radio telephones of small size.
First Generation (1G): In first generation wireless mobiles used Analog technology for communication. Phones were the first mobile phones to be used in 1982 which was introduced and completed.1990 early used for voice services and was based on technology called as Advanced Mobile Phone System (AMPS).AMPS used frequency modulated and used frequency division multiple access (FDMA) and channel capacity of 30 KHz ,frequency band of 824-894MHz. Basic features

Speed-2.4 kbps Use analog signal, Poor voice quality, Poor battery life, Large phone size, Limited capacity, Poor security, Poor handoff reliability , low level of spectrum efficiency, Mobile Telephone system (MTS), Advanced Mobile low capacity, unreliable handoff, poor voice links, and no security at all since voice calls were Telephone System (AMTS),Improved Mobile Telephone Service (IMTS), and Push to Talk (PTT).

2G (Second Generation):- In 1991 on the GSM(Global System for Mobile) standard 2G cellular technology was launched officially in Finland .This technology used is completely different from that of 1G. The 2GTechnology has served many data services for mobile. A new feature Short Message service (SMS), VMS (Voice Mail Service) and value added services. Band width range of 30-200KHZ. There are many other technologies were used under 2G and they are GPRS (General Packet Radio Service) CDMA (Code division multiple access) GSM (Global System for Mobile) EDGE(Enhanced Data for Global Evolution). GSM which is the first digital mobile cellular system which is still spread all over and used widely as technique of 2G. GSM was implemented in Europe by ETSI (European Telecommunications Standards Institute) to support the concept of international roaming. This worked out as to overcome the 1G disadvantage in lacking of roaming services.

Third Generation (3G): in this technology the speed will be more (High-speed) digital cellular telephony (including video telephony) 2.5G (Generation):- This is a technology which was introduced in 1990's. It uses a technology GPRS (General Packet Radio Service) stand. In this technique delivering packet switched data capabilities to already existing GSM networks. A add on feature of sending Graphics data as packets is available in this technology packet switching made its impact with increasing Internet and Internet protocol. EDGE (Enhanced Data for Global Evolution) network is an example of 2.5G.

Edge technique had faced a major drawback in packet transferring which leads to lower the efficiency in the system. So to overcome 3G is emerged .International mobile Telecommunications-2000(IMT) known as 3G. 3G technology is using wide band wireless network which made to increase the clarity of signal. Packet Switching technique is used to send the Data. The 3G Voice Communication services and provides data services to Television, video & services like Global roaming works up to range of 2100MHZ with a band width of 15020MHZ.

This technology provides a high speed internet services like video, chatting, Digital catalog shopping, GPS & Car navigation, Video streaming much faster. Majorly 3G used as a wide band voice channel in which the entire globe taken as the village and it creates connections from one person to another. Location transparency i.e no matter where the location of each other is. High band width transmission of 3G the power utilization expanded this prompts decrease the battery life really quick.

Fourth Generation (4G): IP-based "anytime, anywhere, anything "the voice, data, and multimedia data for telephony at faster data rates than the third generation. This is the latest redesign of innovation in versatile correspondence field it is 10times faster than 3G.The 4G technology depends on an innovation called LTE(Long-Term Evolution) and it is a complete IP based innovation for data transmission.4G which happened in 2009 on December 14, 2009 in the capital of Sweden and Norway.

LTE uses the OFDM modulation technique which provides the spectral efficiency to achieve high data rates but with an addition of multiple share a common channel. The concept of OFDM is to divide the channel in to many narrow sub-carriers spacing is an orthogonal which helps to reduce interfere with each other despite the lack of guard bands between them. OFDM uses frequency and time to spread the data all across providing high speed & good signal reliability. Issue with 4G 3G and 4G segments made for one landmass is not generally perfect with another mainland sue to conveying recurrence groups. Another conspicuous issue in 4G frameworks is to make higher piece rates accessible in bigger bit of the cell, particularly to clients in an uncovered position in the middle of a few base stations. In flow explore, this issue is tended to by macro diversity strategies, otherwise called bunch agreeable transfer, furthermore by Beam-Division Fifth Generation (5G):

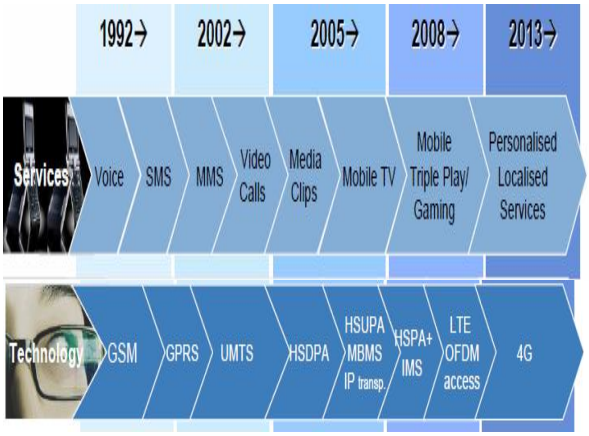


Figure-1 Overview of generation of Mobiles

The Figure-1 shows that the Generation of mobiles overview and the technology used in the that generation this Figure-1 has depicted the up to 4G and the next generation is 5G some of the country they are in implementation and testing phase .

In the view of communication in remote place the antenna device plays prominent role to communicate with system. MIMO antennas have emerged as one of the most significant technical evolution for future generation for wireless communications. MIMO is considered as one of the most important technology for improving the throughput of communication of the systems; MIMO is uses the multiple antennas at both the transmitter and receiver to improve performance communication systems.MIMO is an important part of modern wireless communication standards as specified in IEEE 802.11n Wi-Fi, IEEE 802.16e (Wi-MAX), Long Term Evolution (LTE), 3GPP HSPA +, 4G and 5G systems for near to implement and testing phase

II. CELLULAR NETWORK ARCHITECTURE

The figure-2 shows that the architecture of mobile communication architecture .The area is divided into many geographical area called cells these cells has communication range .The architectures explain the communication between device to device, the device will send signals to the BTS (Base Transceiver Station) then another i.e. another side BTS the receiver will receive the call the figure-2 explain the details of each equipment.

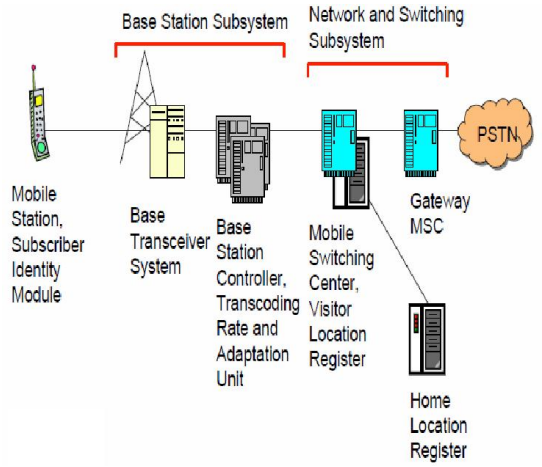


Figure-2 Cellular Network architecture

Mobile Equipment (ME) –This is a physical mobile phone. This mobile phone operates on a cellular network. The earlier mobile phones operated only on a single band. New phones are operating dual-band, triple-band, and even quad-band capable. A quad-band phone has the technical capability to operate on any network worldwide. Each phone is uniquely identified by the International Mobile Equipment Identity (IMEI) number. IMEI number is burned into the phone by the mobile manufacturer.

Base Transceiver Station (BTS) –The BTS It is actually the antenna i.e. is installed on top of the tower. The BTS is the Mobile Phone's access point to the network. The BTS is responsible for carrying out radio communications between the mobile network and the Mobile Phone. BTS handles speech encoding, encryption, multiplexing, usesTDMA and modulation/demodulation of the radio signals. There is generally single BTS usually covers a single 120 degree sector of an area. Minimum 3 BTSs will accommodate all 360 degrees around the tower but this coverage area depending on geography and user demand of that area.

A cell may be divided up into one or two sectors, or a cell may be serviced by several BTSs with redundant sector coverage. A BTS is assigned a Cell Identity. The cell identity denotes a particular Location Area, which provides details of the cell which the BTS is covering.

Base Station Controller (BSC) – The BSC controls multiple BTSs. BSC allocates radio channels, frequency administration, power and signal measurements from the MS, and handovers from one BTS to another . It reduces the number of connections to the Mobile Switching Center (MSC) and allows for higher capacity connections to the MSC. A BSC may be it may be geographically separate. It may even be collocated with the Mobile Switching Center (MSC)

Mobile Switching Center (MSC) – The MSC is the main heart of the cellular network. It handles call routing, call setup, and basic switching functions. AnMSChandles multiple BSCs and also interfaces with other MSC's and registers. It also handles inter-BSC handoffs as well as coordinates with other MSC's for inter-MSC handoffs.

III LTE ARCHITECTURE

Third Generation Partnership Project (3GPP) LTE stands for Long Term Evolution and it was started 2004 the telecommunication body known as the SAE (System Architecture Evolution) is the corresponding evolution of the GPRS/3G packet core network evolution.

LTE evolved from an earlier 3GPP system known as the Universal Mobile Telecommunication System (UMTS), which in turn evolved from the Global System for Mobile Communications (GSM) and also known as the evolved UMTS terrestrial radio access (E-UTRA) and evolved UMTS terrestrial radio access network (E-UTRAN). First version of LTE was documented in Release 8 of the 3GPP specification Figure -3 shows the LTE E-UTRAN

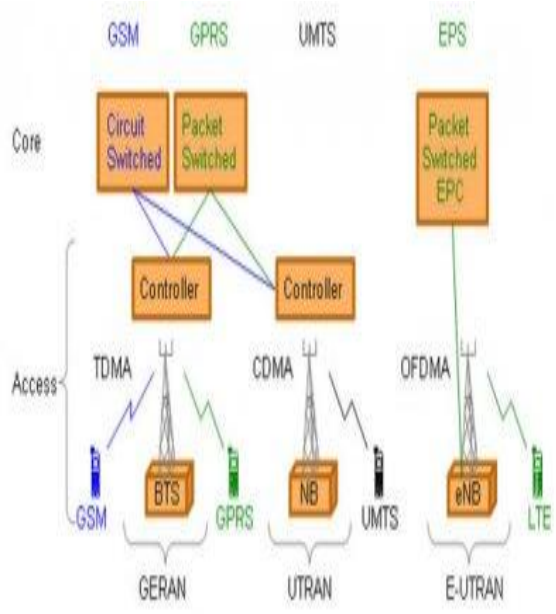


Figure-3 LTE E-UTRAN

The high-level network architecture of LTE is comprised of following three main components: The User Equipment (UE).The Evolved UMTS Terrestrial Radio Access Network (E-UTRAN).The Evolved Packet Core (EPC).

The evolved packet core communicates with packet data networks in the outside world such as the internet, private corporate networks or the IP multimedia subsystem. Figure-3 shows that the interfaces between the different parts of the system are denoted Uu, S1 and SGi

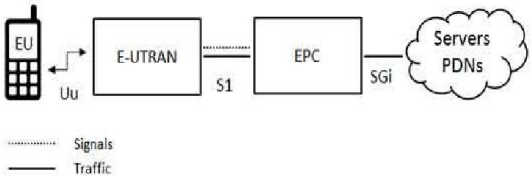


Figure-3.1 shows that the interfaces between the different parts of the system

A. The User Equipment (UE)

The internal architecture of the user equipment for LTE as earlier discussed in the cellular network architecture actually a Mobile Equipment (ME). The UE has composed the some components

Mobile Termination (MT) :This handles all the communication functions. Terminal Equipment (TE): This terminates the data streams. Universal Integrated Circuit Card (UICC) : This is also known as the SIM card for LTE equipments. It runs an application known as the Universal Subscriber Identity Module (USIM).A USIM stores user-specific data very similar to 3G SIM card. This keeps information about the user's phone number, home network identity and security keys etc.E-UTRAN handles the radio communications between the mobile and the evolved packet core and the base stations, called eNodeB or eNB. Each eNB. A base station that controls the mobiles in one or more cells. The base station that is communicating with a mobile is known as its serving eNB the Figure -3.1 explains the E-UTRAN

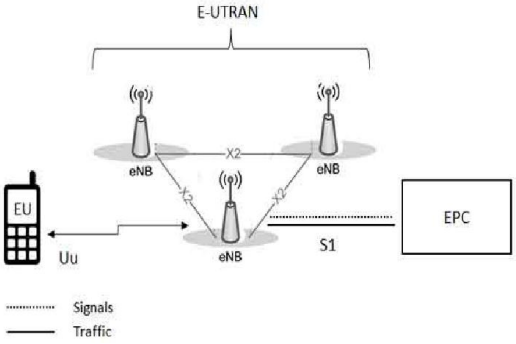


Figure-3.2 The E-UTRAN

LTE Mobile communicates with just one base station and one cell at a time and there are following two main functions supported by eNB:The eBN sends and receives radio transmissions to all the mobiles using the analogue and digital signal processing functions of the LTE air interface. The eNB controls the low-level operation of all its mobiles, by sending them signaling messages such as handover commands. Each eBN connects with the EPC by means of the S1 interface and it can also be connected to nearby base stations by the X2 interface, which is mainly used for signaling and packet forwarding during handover. A home eNB (HeNB) is a base station that has been purchased by a user to provide fem to cell coverage within the home. A home eNB belongs to a closed subscriber group (CSG) and can only be accessed by mobiles with a USIM that also belongs to the closed subscriber group.

B. The Evolved Packet Core (EPC) (The core network)

The architecture of Evolved Packet Core (EPC) has been illustrated below. There are few more components which have not been shown in the diagram to keep it simple. These components are like the Earthquake and Tsunami Warning System (ETWS), the Equipment Identity Register (EIR) and Policy

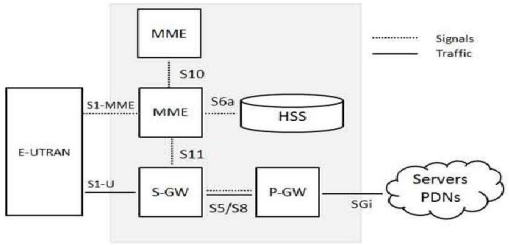
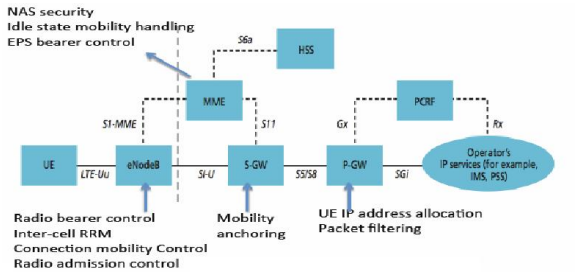


Figure-3.3 Evolved Packet Core (EPC)

The Home Subscriber Server (HSS) component has been carried forward from UMTS and GSM and is a central database that contains information about all the network operator's subscribers. The Packet Data Network (PDN) Gateway (P-GW) communicates with the outside world ie. packet data networks PDN, using SGi interface. Each packet data network is identified by an access point name (APN). The PDN gateway has the same role as the GPRS support node (GGSN) and the serving GPRS support node (SGSN) with UMTS and GSM.The serving gateway (S-GW) acts as a router, and forwards data between the base station and the PDN gateway. The mobility management entity (MME) controls the high-level operation of the mobile by means of signaling messages and Home Subscriber Server (HSS).The Policy Control and Charging Rules Function (PCRF) is a component which is not shown in the above diagram but it is responsible for policy control decision-making, as well as for controlling the flow-based charging functionalities in the Policy Control Enforcement Function (PCEF), which resides in theP-GW.



The Figure-3.4 LTE Complete architecture

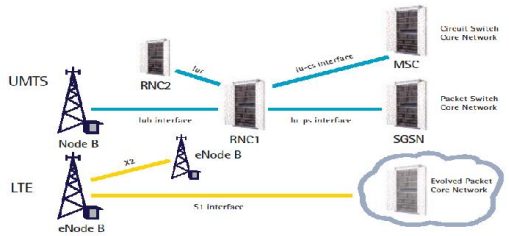


Figure 3.5 UMTS and LTE architecture

IV. LTE-A

The LTE-Advanced the data rate is improved the technique using carrier aggregation mechanism this mechanism or technique will increase the speed of the network.LTE-Advanced focus is on higher capacity: The driving force to further develop LTE towards LTE–Advanced - LTE Release10 was to provide higher bitrates in a cost efficient way and, at the same time, completely fulfill the requirements set by ITU for IMT Advanced, also referred to as 4G.Increased peak data rate, DL 3 Gbps, UL 1.5 Gbps.Higher spectral efficiency, from a maximum of 16bps/Hz in R8 to 30 bps/Hz in R10

Increased number of simultaneously active subscribers

Improved performance at cell edges, e.g. for DL 2x2 MIMO at least 2.40 bps/Hz/cell.

Figure-4 Shows the main LTE-Advanced technology components (overview)

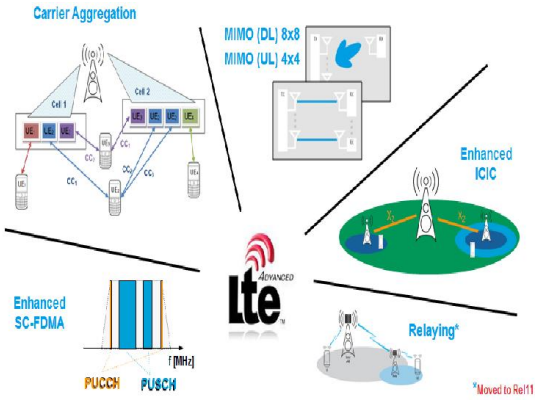


Figure-4 LTE Complete architecture

V. FIFTH GENERATION (5G)

This technology providing really good speed on communication. Now some of the country has in force to implement 5G is only in research development area but in future it will take over the world with its speed and data carrying capabilities. 5G technologies will start deployment in 2-3years around 2020. This technology will give us many new unseen features of earlier generations of mobile technology. One of the main features 5G have is accessing multiple wireless technologies and switch in between. 5G may solve the frequency licensing and spectrum management issues. 5G have different modulation schemes and error control schemes. 3GPP Release 16 will be finalized at the end of 2019.IMT-2020 - Final submission the figure-5 will explains the 5G release and technology.

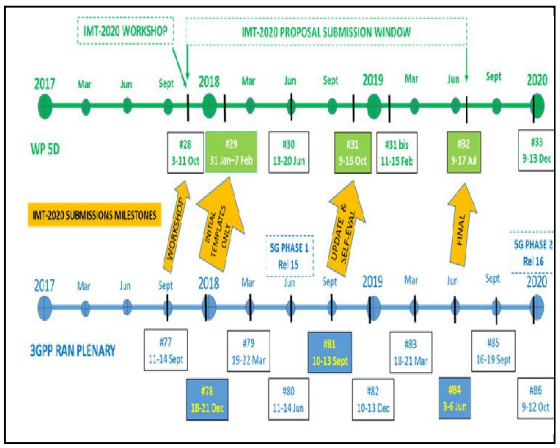


Figure -5 Release 16 will be "5G phase 2" and should be completed in December 2019 (TSG SA#87).

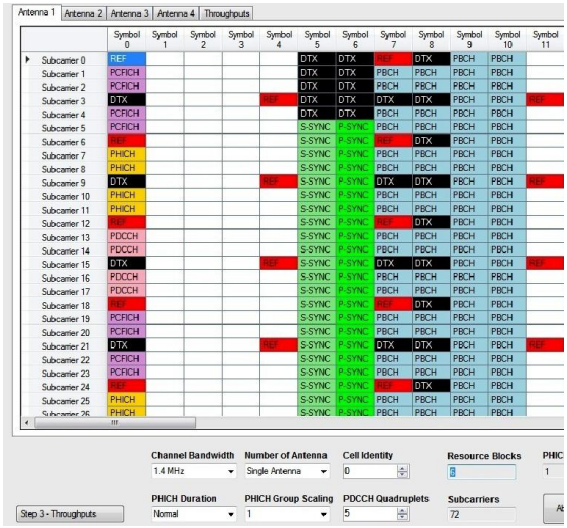


Figure-6.1 Physical channel

VI .MIMO ANTENNA

The LTE antenna simulation using LTE-bullets visualization tool .MIMO antenna plays a very important role in the communication system. LTE-bullets visualization tool has simulated the antenna and the results are compared between the different MIMO antennas like single antenna 2x2MIMO, 4x4 MIMO antenna speed in terms of throughput.

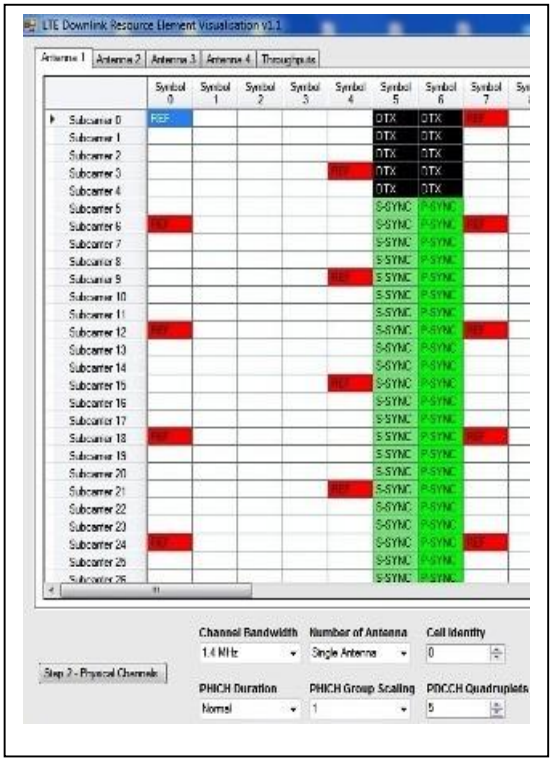


Figure-6 Signals

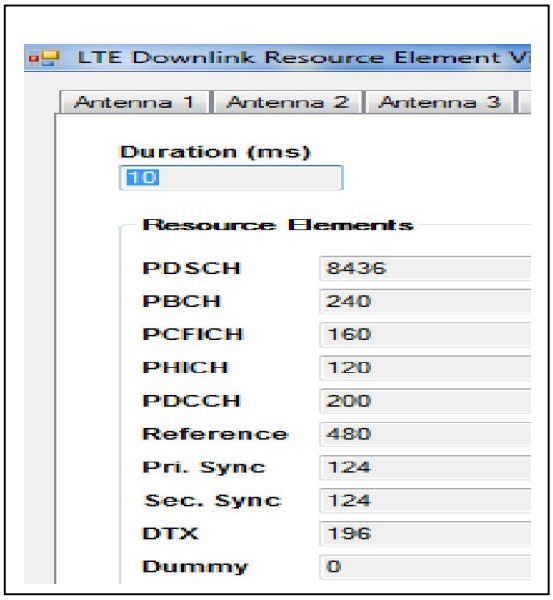


Figure-6.2 Resources Element

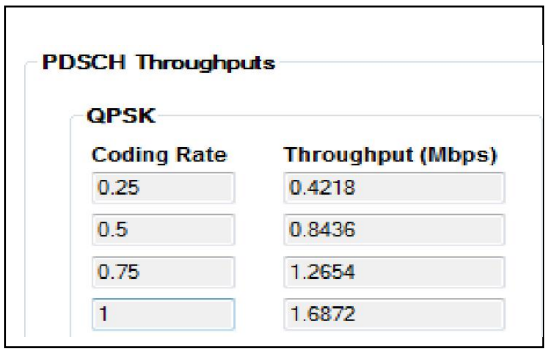


Figure-6.3 Throughput of single antenna QPSK

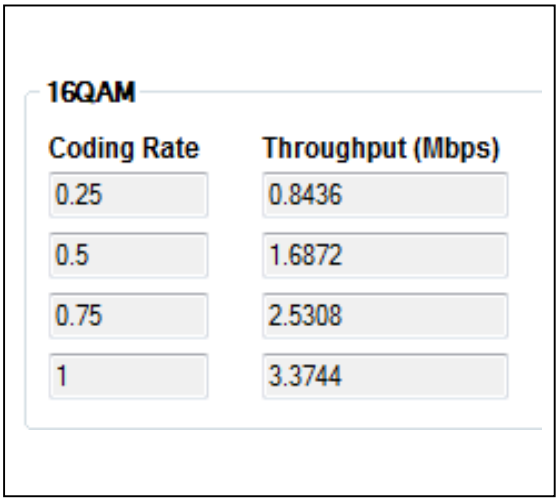


Figure-6.4 Throughput of single antenna 16QAM

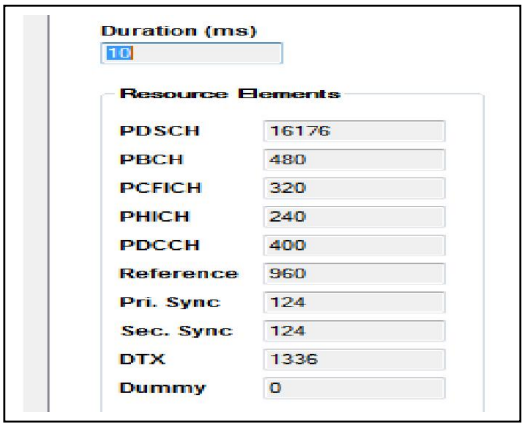


Figure-6.7 Resources Element

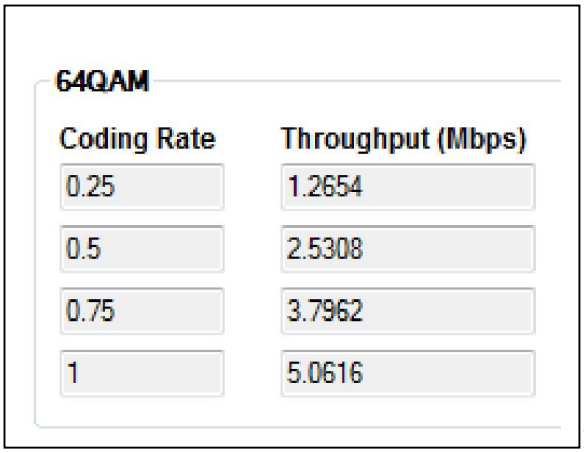


Figure-6.5 Throughput of single antenna 64 QAM

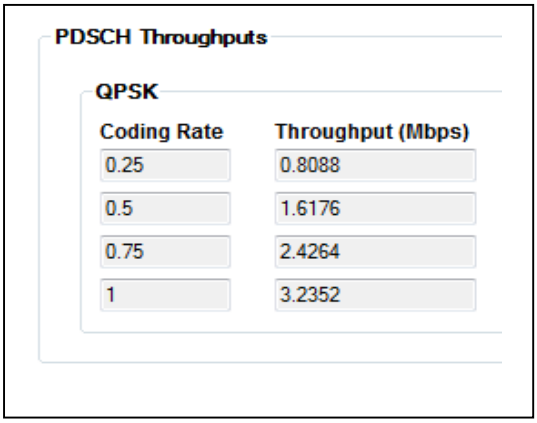


Figure-6.8 Throughput of 2x2 MIMO antennas QPSK

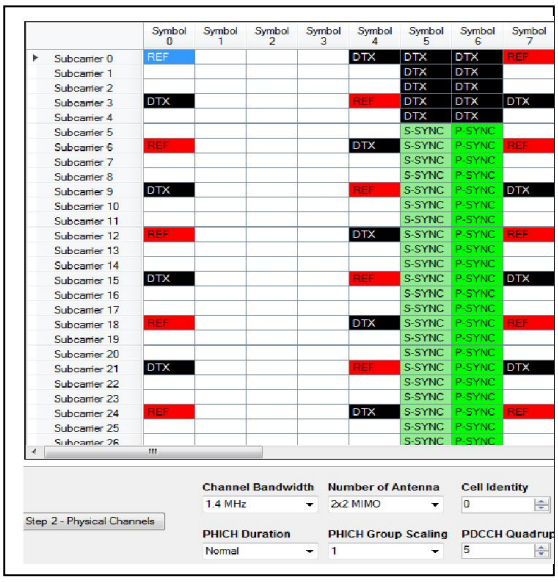


Figure-6.6 Physical channel 2x2 MIMO

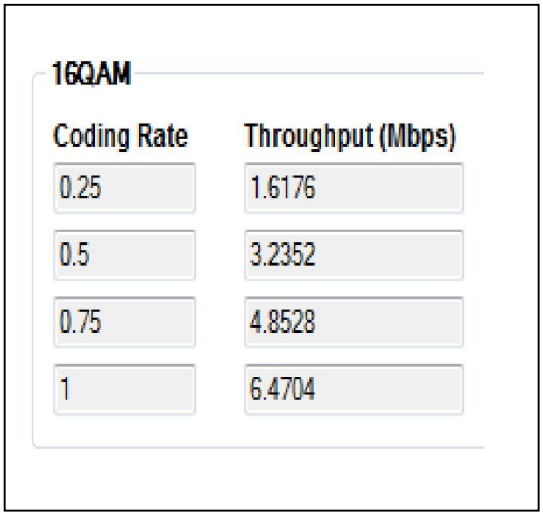


Figure-6.9 Throughput of 2x2 MIMO antennas 16QAM

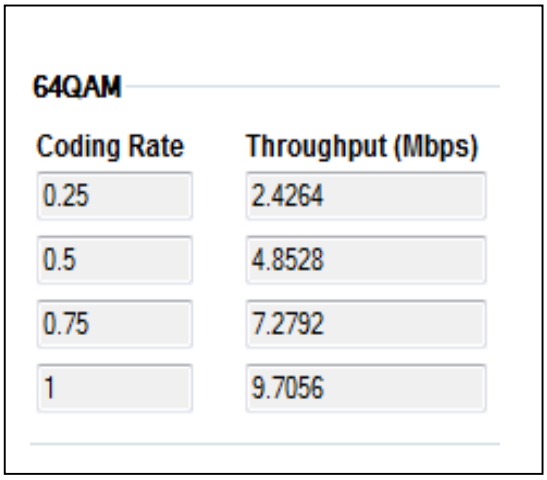


Figure-6.10 Throughput of 2x2 MIMO antennas 64 QAM

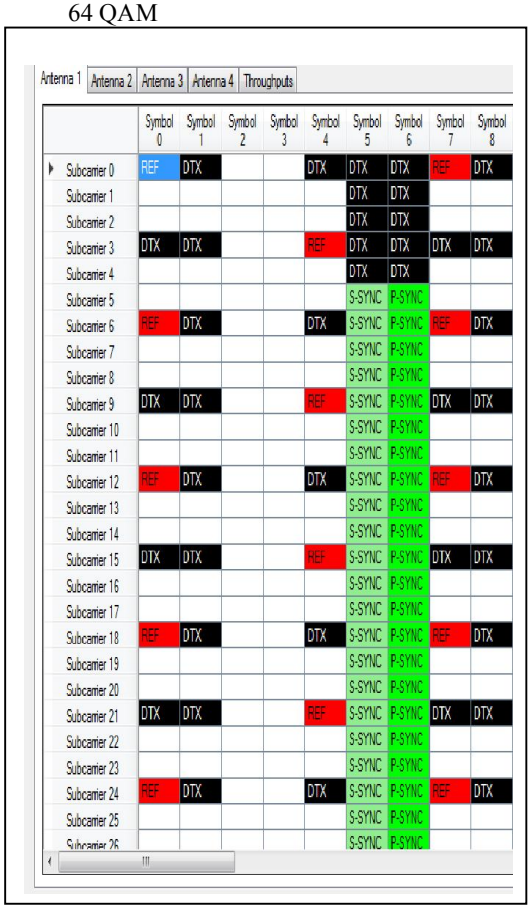


Figure-6.11 Physical channel 4x4 MIMO antenna

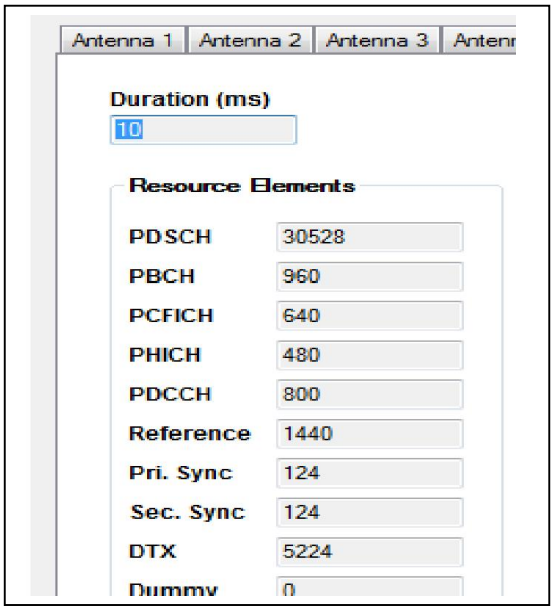


Figure-6.12 Throughput of 4x4 MIMO Antennas QPSK

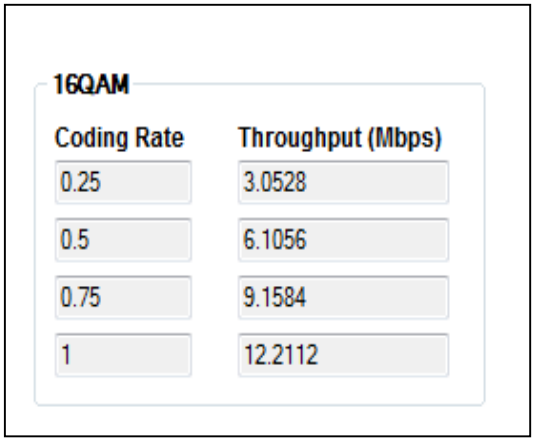


Figure-6.14 Throughput of 4x4 MIMO Antennas 16QAM

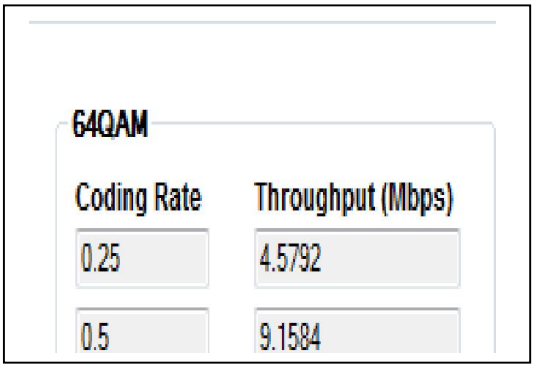


Figure-6.15 Throughput of 4x4 MIMO Antennas 64 QAM

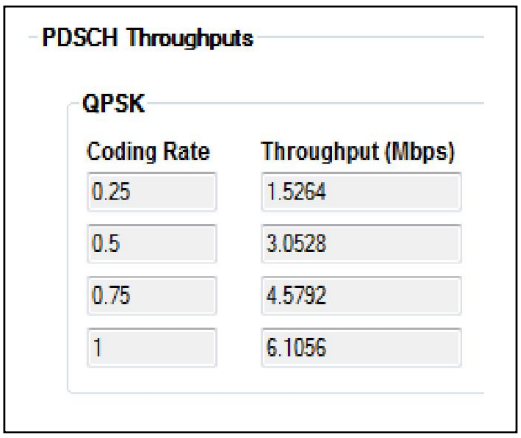


Figure-6.15 Throughput of 4x4 MIMO Antennas PDSCH

Results of LTE simulation tools are shown from the Figure-6.0 to 6.13 are explained the importance of antenna and MIMO antenna how the output of each signals differs for the single antenna, 2x2MIMO antenna, 4X4 MIMO antenna. The resources blocks as the diagram for single antenna explains and 2x2MIMO antenna, 4X4 MIMO antenna diagram and throughput of each antenna are depicted .using the simulation tools we can analyze that the single antenna is not sufficient for proper communication because single antenna had less throughput to increase the signal strength the MIMO concept is used . Multiple Input Multiple Output is the prominent method that increases trough put .As shown in the figure6.8-6.10 gives an idea how 2x2MIMO antenna

Increases the throughput than the single antenna. The figure6.12-6.13 gives an idea how 4x4MIMO antenna Increases the throughput than the 2x2MIMO antenna

VII COMPARISON OF GENERATION:

The generation of mobile communication is compared with various parameters as shown in figure-7.1

	1G	2G	3G	4G	5G
Introduced Year	1980	1993	2001	2009	Soon (probably 2020)
Core Network	PSTN	PSTN	Packet Networking	Internet	Internet
Switching	Circuit	Circuit Packet	Packet	All Packet	All Packet
Multiplexing	FDMA	TDMA/CDMA	CDMA	CDMA	CDMA
Speed of Data Rates	2.4Kbps-14.4Kbps	14.4Kbps	3.1Mbps	100Mbps To 1Gbps	Higher than 1Gbps
Internet services	No Internet	Narrowband	Broadband	Ultra Broadband	Dynamic Information access, Wearable devices with AI Capabilities
Band-width	Analog	25MHZ	25MHZ	100MHZ	More Than 100MHz
Band type	Narrowband	Narrowband	Wideband	Ultra wide band	Ultra wide band More than the wider band
Technology	AMPS	IS-95, GSM	IMT2000, WCDMA	LTE, WiMAX	MIMO antenna enhanced

Table-7.1 comparison of generation

VI. CONCLUSION

This paper is a survey on the technological advancements in mobile communication and antenna over many years.

The generation of mobile communication, the parameters, the architectures of cellular technology, LTE architecture are explained in detail .This paper presents the overview of all generation of mobile communication and in brief the technology used in each generation. The comparison is shown in the table. Today the MIMO technology has attracted the researcher and the application user's .The 2x2MIMO antenna, 4X4 MIMO antenna had many parameters to analyze in future. In 5th Generation, the use of MIMO antenna in broader sense of the research fields. In future the mobile communication can enhance the speed with the help of MIMO antenna and carrier aggregation.

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