NEXT GENERATION GSM TECHNOLOGIES: 3GPP VS. LTE

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ABSTRACT

Mobile communication is continuously one of the hottest areas that are developing at a booming speed, with advanced techniques emerging in all the fields of mobile and wireless communications. Wireless services have the highest demand in wireless and internet world. Mobile phones are rapidly becoming the preferred means of personal communication. Communication system has evolved from wired button telephone system to wireless mobile phone in the few years. With wider use of mobile communication which provides an easement to fast and easy communication mode. Nowadays the use of 3G mobile communication systems seem to be the standard, while 4G stands for the next generation of wireless and mobile communications. Due to the increase in demand for speed, multimedia support and other resources, the wireless world is looking forward for a new generation technology to replace the third generation. The 4G system provides mobile ultra-broadband, internet access with very high speed data rate. Currently marketed technologies such as LTE (Long Term Evolution) and Wi-MAX have been around for a few years and are being marketed as 4G whilst not meeting the requirements set by the ITU. In this paper firstly we will introduce a brief study of the generations of the wireless GSM system. Currently we are using the 3G connection almost all over world. But somewhere when we count the no of users in developing countries, we get the reality. Till the date, maximum users use 2G wireless system. But instead of 3G, 4G technology is used in developed countries. Here we will compare the 4G technology with 3G. After comparing this, we will introduce the future GSM technology 5G which will revolute the whole world.

Keywords*: *Mobility, wireless system, 3G, 4G, 3GPP, LTE, Wi-Max, ITU, CDM, WCDMA, GPRS.

I. INTRODUCTION

Over the past decade, wireless communications has seen an exponential growth and will certainly continue to amazing developments due to the emergence of new interactive multimedia applications and its highly integrated systems driven by the rapid growth in information services and microelectronic devices. So far, most of mobile systems are mainly targeted to voice communications with low transmission rates. In the near future, however, broadband data access at high transmission rates will be needed to provide users packet-based connectivity to a

plethora of services. It is also almost certain that the next Generation (XG) wireless systems will consist of complementary systems having a set of different standards and technologies along with different requirements and complementary capabilities that will offer users ubiquitous wireless connectivity between mobile and desktop computers, machines, game systems, cellular phones, consumer electronic products, and other hand-held devices. A key requirement of wireless system in future is their ability to provide broadband connectivity with end-to-end Quality of Service (QoS), a high network capacity, and throughput at a low cost. To support the above services, a host of new issues and problems have to be addressed. This talk will discuss the challenges facing the 3G communication networks and at some of the important issues pertaining to the evolution of mobile communication networks from GSM (Global System for Mobile Communications) to GPRS (General Packet Radio Service) to 3G (Third Generation) and to CDMA and WCDMA. And also describe some of the leading enabling technologies and comparison of CDMA2000 and WCDMA.

II. CONCEPT OF 3G TECHNOLOGIES

In present investigation, the experiment test rig was built in the vibration lab. The vibration characteristics of UMTS (Universal Mobile Telecommunications System) is a so-called "third-generation (3G)," broadband, packet-based transmission of text, digitized voice, video, and multimedia at data rates up to and possibly higher than 2 megabits per second (Mbps), it offers a compatible set of services to mobile computer and phone users no matter where they are located in the world. Based on the GSM communication standard, UMTS, endorsed by major standards bodies and manufacturers, is the planned standard for mobile users around the world by 2002. Once the implementation in UMTS completed computer and phone users can be constantly attached to the Internet whether they travel or as they roaming service, it has the same set of capabilities no matter where they travel to. Users will have access through a combination of terrestrial wireless and satellite transmissions. Until UMTS is fully implemented, users can have multi-mode devices that switch to the currently available technology where UMTS is not yet available.

2.1 Spread Spectrum of 3G System

It is a kind of modulation system in which the modulated (spread spectrum) signal bandwidth is much greater than the message signal bandwidth. The spectral spreading is independent to the massage signal and is only performed by a code. The same code is used at receiver to dispread the received signal and to recover the message signal.

It is very secure, is nearly impossible to intercept without knowing the chip code. A large number of codes can support a large number of users. The system is less liable to distortion as a large bandwidth is used . Since the power is distributed in a large bandwidth so the power spectral density goes below to noise level so it resist to jamming and remain invisible to unintended users. It provides asynchronous multiple access.

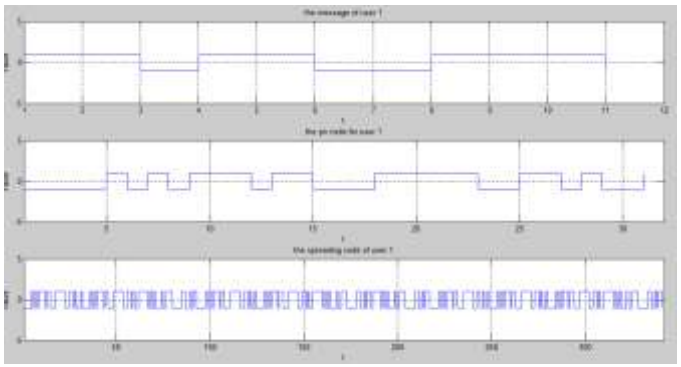

Fig: 1 Spread Spectrum of 3G

In direct sequence spread spectrum, the stream of information to be transmitted is divided into small pieces, each of which is allocated across to a frequency channel across the spectrum. At the point of transmission data signal is combined with a higher data-rate bit sequence (also known as a chipping code) that divides the data according to a spreading ratio. If the data bits are damaged then the redundant chipping code helps the signal resist interference and also enables the original data to be recovered.

In an FH-CDMA system, a transmitter "hops" between available frequencies according to a specified algorithm, which can be either random or replanted. The transmitter and receiver are synchronized and remains tuned to the same centre frequency. A short burst of data is transmitted on a narrowband. Then, the transmitter tunes to another frequency and transmits again. The receiver thus is capable of hopping its frequency over a given bandwidth several times a second, transmitting on one frequency for a certain period of time, then hopping to another frequency and transmitting again. Frequency hopping requires a much wider bandwidth than is needed to transmit the same information using only one carrier frequency. The Near-Far problem of DS/SS is avoided here. FH-CDMA devices use less power and are generally cheaper, but the performance of DS-CDMA systems is usually better and more reliable. The biggest advantage of frequency hopping lays in the coexistence of several access points in the same area, something not possible with direct sequence.

2.2 WCDMA Protocol Architecture for 3G

CDMA is a form of multiplexing, which allows numerous signals to occupy a single transmission channel, optimizing th e use of available bandwidth. The technology is used in ultra-high-frequency (UHF) cellular telephone systems in the 800-MHz and 1.9-GHz bands. CDMA employs analog-to-digital conversion (ADC) in combination with spread spectrum technology. Audio input is first digitized into binary elements. According to the defined pattern (code), the frequency of the transmitted signal is then made to vary, so it can be intercept only by a receiv er whose frequency response is programmed with the same code, so it follows exactly along with the transmitter frequency. There are trillions of possible frequency-sequencing codes; this enhances privacy and makes cloning difficult.

The original CDMA standard, also known as CDMA One and still common in cellular telephones in the U.S.,In single channel form , it offers a transmission speed of only up to 14.4 Kbps and up to 115 Kbps in an eight-channel form. The next version of CDMA, CDMA2000, also known as IMT-CDMA Multi-Carrier or 1xRTT, can support mobile data communications at speeds ranging from 144 Kbps to 2 Mbps.

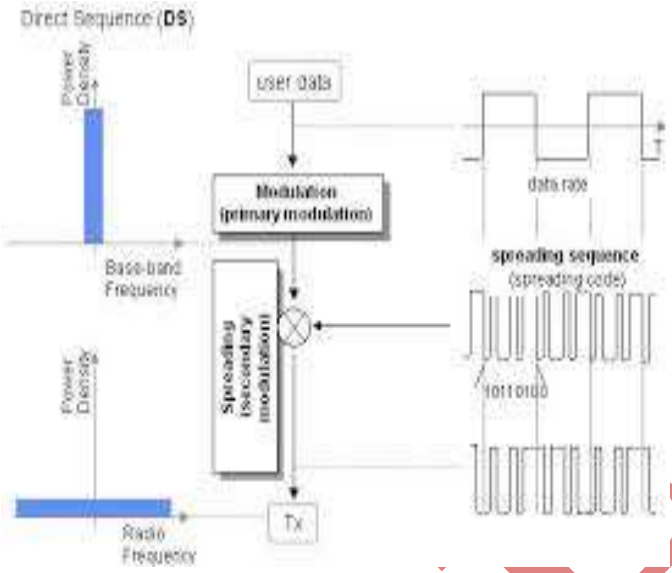

Fig: 3 CDM structure

In CDMAOne and CDMA2000, a 1.25 MHz wide radio signal is multiplied by a spreading signal (which is a pseudo-noise code sequence) with a higher rate than the data rate of the message. The resultant signal appears as seemingly random, this process is reversed and the original signal is extracted, if the intended recipient has the right code. Uses of unique codes mean that in all cells, the same frequency is repeated, which is commonly referred to as a frequency re-use of 1. WCDMA is a step further in the CDMA technology. It uses a 5 MHz wide radio signal and a chip rate of 3.84 Mcps, which is about three times higher than the chip rate of CDMA2000 (1.22 Mcps).

2.21 The main benefits of a wideband carrier with a higher chiprate are:

- Higher bit rates is supported by it• Higher spectrum efficiency thanks to improved trunking efficiency (i.e. a better statistical averaging)
- Higher QoS :Further, experience from second-generation systems like GSM and cdmaOne has enabled improvements to be incorporated in WCDMA. Focus has also been put on ensuring that as much as possible of WCDMA operators' investments in GSM equipment can be re- used. Examples are the re-use and evolution of the core network, the focus on co-sitting and the support of GSM handover. The subscribers need dual mode handsets in order to use GSM handover

The Physical Layer (Layer 1) offers Transport Channels to the MAC layer. With different characteristics of the transmission there are different type of transport channels Common transport channels can be shared by multiple handsets (e.g. FACH, RACH, DSCH, BCH, PCH). Dedicated transport channels (DCH) are assigned to only one handset at a time. The transmission functions of the physical layer include channel coding and interleaving, multiplexing of transport channels, mapping to physical channels, spreading, modulation and power amplification, with corresponding functions for reception. The following is the physical layer frame structure of WCDMA A frequency and a code characterize a physical channel. The specifications include two modes: the FDD mode (Frequency Division Duplex) and the TDD mode (Time Division Duplex). The mainstream mode is the FDD mode that operators are now deploying in WCDMA. The TDD mode may eventually be deployed as well, as a complement to the FDD mode.

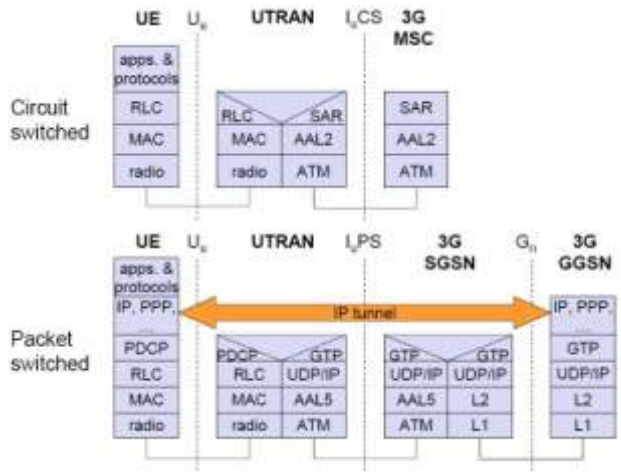

Fig: 2 UMTS Architecture

2.3 Goals for 3G Technology

- Global standards to allow for low cost and worldwide roaming.
- High Quality of Service (QoS) especially for voice. Support for advanced services: Multimedia, Bandwidth on Demand, High speed data.

2.4 Disadvantages of 3G

There are some issues in deploying 3G:

- The cost of upgrading base stations and cellular infrastructure to 3G is very high.
- Requires different handsets and there is the issue of handset availability. 3G handsets will be a complex product. Roaming and making both data/voice works has not yet been demonstrated. Also the higher power requirements (more bits with the same energy/bit) demand a larger handset, shorter talk time, and larger batteries).
- Base stations need to be closer to each other (more cost).
- Tremendous spectrum-license costs, network deployment costs, handset subsidies to subscribers, etc.
- Wireless service providers in Germany and Britain who won spectrum licenses in auctions, paid astronomical prices for them. As a result, they have little money left for building the infrastructure. Consequently, deployment of 3G in Germany and Britain will be delayed.

III CONCEPT OF 4G TECHNOLOGIES

4G is the term used to refer to the next wave of high-speed mobile technologies and 3G networks will be replace by this technology. LTE and Wi-MAX are the two top contenders, both of which are IP based networks that are built from similar, yet incompatible, technologies. 4G WI-MAX service is currently offering sprint and clear wire in the USA, while Verizon and AT&T have committed to the use of LTE and are trialing their own 4G networks. Carriers that use orthogonal frequency-division multiplexing (OFDM) instead of time division multiple access (TDMA) or code division multiple access (CDMA) even when their data speed are not as fast as the international telecommunication union specifies care increasingly marketing their services as to be 4G.

According to the ITU, a 4G network requires a mobile device to be able to exchange data at 100 Mbit/sec. A 3G network, on the other hand, can offer data speeds as slow as 3.84 Mbit/sec.

From the consumer's point of view, 4G is more a marketing term than a technical specification, but carriers feel justified in using the 4G label because it lets the consumer know that he can expect significantly faster data speeds.

Although carriers still differ about whether to build 4G data networks using Long Term Evolution (LTE) or Worldwide Interoperability for Microwave Access Wi-MAX, all carriers seem to agree that OFDM is one of the chief indicators that a service can be legitimately marketed as being 4G. A signal is split into several narrowband channels at different frequencies in OFDM, which is a digital modulation This is more efficient than TDMA, which divides channels into time slots and has multiple users take turns transmitting bursts or CDMA, which simultaneously transmits multiple signals on the same channel.

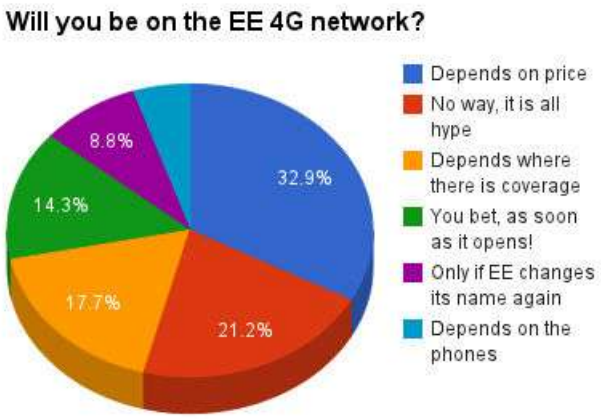

Fig: 4 Evolutions of 4G

When fully implemented, 4G is expected to enable pervasive computing, in which simultaneous connections to multiple high-speed networks will provide seamless handoffs throughout a geographical area. Coverage enhancement technologies such as femtocell and picocell are being developed to address the needs of mobile users in homes, public buildings and offices, which will free up network resources for mobile users who are roaming or who are in more remote service areas.

3.1 LTE Protocols

LTE is a standard for wireless data communications technology and an evolution of the GSM/UMTS to increase the capacity and data rates of wireless data networks, improve spectrum efficiency, improve coverage, reduced latency and packet-optimized system that support multiple Radio Access, are the main goals of LTE .Thus, in order to achieve the goals, the architecture of the network if different from the previous wireless data transfer network, GPRS. So, in post, a comprehensive overview of the network architecture and basic working principle of LTE network is going to be discussed.

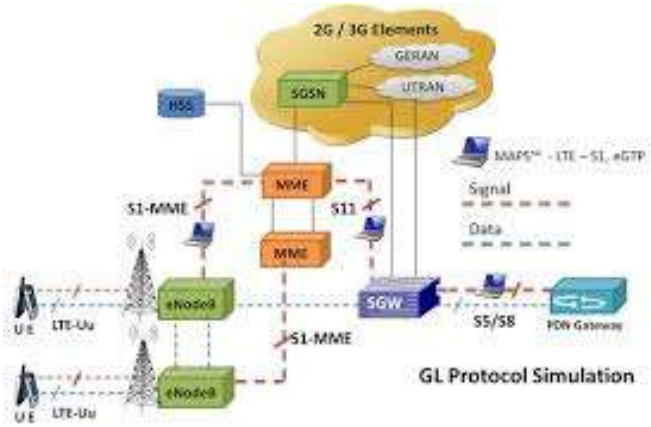

Fig: 5 LTE Protocol Simulations

Basically, the LTE standard only supports packet switching with its all-IP network. The reason why LTE is designed only for packet switching is because without any disruption to the end user application during mobility it aims to provide seamless Internet Protocol (IP) connectivity between user equipment (UE) and the packet data network (PDN). Due to this characteristic, voice calls and text message natively (which are typically handled by circuit-switched networks like GSM and CDMA). In LTE architecture, Evolved UTRAN (E-UTRAN) is an important role which is the air interface of LTE upgrade path for mobile networks meanwhile it is accompanied by an evolution of the non-radio aspects under the term "System Architecture Evolution" (SAE), which includes the Evolved Packet Core (EPC) network. Together LTE and SAE comprise the Evolved Packet System (EPS). Besides that, LTE network uses an eNodeB (evolved node B, essentially an LTE base station), a MME (Mobile management entity), a HSS (home subscriber server), a SGW (serving gateway), and a PGW (a packet data network gateway). These are considered as part of the EPC except eNodeB.

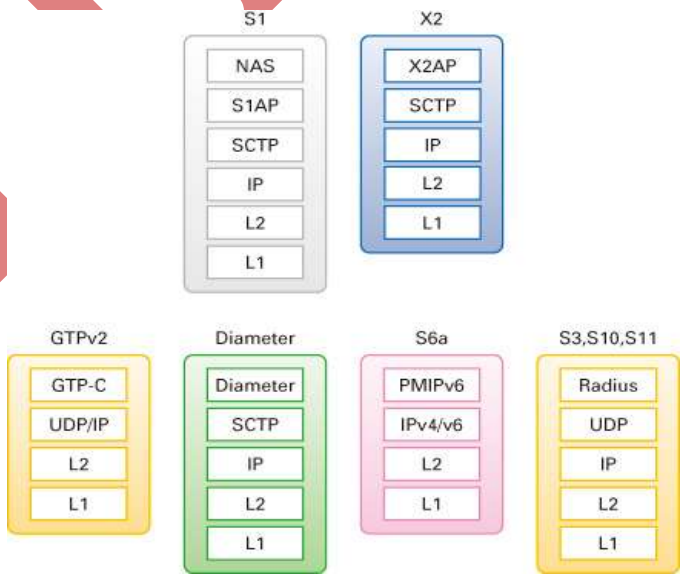

Fig: 6 LTE Protocol

3.2 Goals for 4G Network

- Support for Multiple and Efficient Applications and Services: 4G provides support for unicast, multicast and broadcast services and the applications that depend on them. Prompt enforcement of Service level Agreements (SLA) along with privacy and other security features.
- Quality of Service: Regardless of underlying infrastructure and operator diversity, dependable applications of admission control and scheduling algorithms leads to an increased quality of service (QoS) to the users.
- Network detection selection: A mobile terminal that features multiple radio technologies or possibly uses software defined radios if economical, allows participation in multiple networks simultaneously, thereby connecting to the best network with the most appropriate service parameters (cost, QoS and capacity among others) for the application. For defining eligibility of a terminal to attach to a network and to determine the validity of link layer configuration ,this requires .establishing a uniform process
- Seamless Handover and Service Continuity With zero or minimal interruption, without a noticeable loss in service quality, a base station that features intra and inter technology handover, assuring service continuity. Support for this function requires continuous transparent maintenance of active service instances and inclusion of various access technologies, from Wi-Fi to OFDMA.

3.3 Disadvantages of 4G

- Very high start-up costs of service providers and consumers for equipment upgrades a; new equipments will be needed to be installed.
- For data transmission LTE technology need to use additional antennas at network base stations as a result to the network upgrades users need to buy new cell phones to make use of new network infrastructure.

IV BASICS OF 3GPP

Calculated values of crack growth rate were plotted at frequency 60 Hz, 80 Hz, 100 Hz and 120 Hz. From fig. 3, 3GPP specifications are published - free of charge - up to four times a year following the quarterly Technical Specification Group (TSG) plenary meetings. At each TSG round, specs can be

- Newly brought under change control (i.e. at least 80% complete)
- Unaltered from their previous versions
- Revised as a result of incorporating approved Change Requests (either in existing Releases or in the latest Release)
- Upgraded to that Release with no technical change at the release freeze time

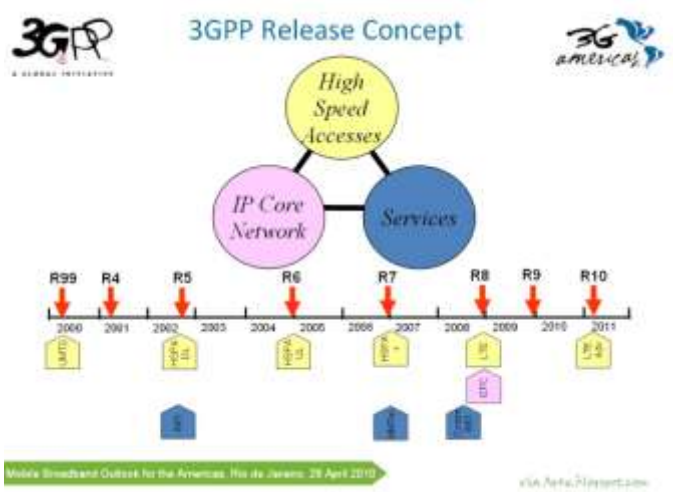

Fig: 7 3GPP Network Overview

The 3GPP Mobile Competence Centre (MCC) aims to make all Specs available following a TSG round as soon as possible. The target dates are shown in the table below. Where very many CRs have to be implemented, or very many specifications are to be produced, a further week beyond the above deadlines may be required. These dates are agreed by the TSG Chairmen. Over the Christmas and New Year period, when the winter TSG round finishes shortly before the holiday period, an extra week or so is normally added to the final deadlines.

Fig: 8 3GPP Architecture

Across much of the established GSM market.3GPP system are deployed they are primarily *Release 6* systems, but as of 2010, growing interest in HSPA+ and LTE is driving adoption of *Release 7* and its successors. Since 2005, as 3GPP2 system 3GPP systems were also seeing deployment in the same markets (for example, North America). With LTE the official successor to 3GPP2's CDMA systems, 3GPP-based systems will eventually become the single global mobile standard.

V INTRODUCTION TO LTE

LTE (Long Term Evolution) is a wireless broadband technology designed to support roaming Internet access via cell phones and handheld devices. Because over older cellular communication standards, LTE offers significant improvements, some refer to it as a *4G* (fourth generation) technology along with Wi-Max. With its architecture based on Internet Protocol (IP) unlike many other cellular Internet protocols, Browsing Web sites, VoIP and other IP-based services are well supported by Long Term Evolution. LTE can theoretically support downloads at 300 Megabits per second (Mbps) or more based on experimental trials. However, the actual network bandwidth available is significantly less to an individual LTE subscriber sharing the service provider's network with other customers.

5.1 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).

5.2 The User Equipment (UE): The internal architecture of the user equipment for LTE is actually a Mobile Equipment (ME) which is identical to the one used by UMTS and GSM. The mobile equipment comprised of the following important modules:

- **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. Information about the user's phone number, home network identity and security keys etc .are also secure by this.

5.3 The Evolved UMTS Terrestrial Radio Access Network (E-UTRAN)

The radio communications between the mobile and the evolved packet core are handle by E-UTRAN and just has one component, the evolved base stations, called **eNodeB** or **eNB**. Each eNB is 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. A home eNB (HeNB) has been purchased by a user to provide femtocell coverage within the home which is a base station. 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.

5.4 The Evolved Packet Core (EPC)

The architecture of Evolved Packet Core (EPC) has been illustrated below To keep the diagram simple .few more components have not shown in it these components are like the Earthquake and Tsunami Warning System (ETWS), the Equipment Identity Register (EIR) and Policy Control and Charging Rules Function (PCRF).

VI RELATION WITH 3GPP OF LTE

GSM was developed to carry real time services, in a circuit switched manner (blue in figure 1), with data services only possible over a circuit switched modem connection, with very low data rates. The first step towards an IP based packet switched (green in figure 1) solution was taken with the evolution of GSM to GPRS, using the same air interface and access method, TDMA (Time Division Multiple Access).

A technology WCDMA (Wideband Code Division Multiple Access) was developed to reach higher data rates in UMTS (Universal Mobile Terrestrial System). UMTS emulates a circuit switched connection for real time services and a packet switched connection for data com services to access network in it. In UMTS when a data com service is established IP address is allocated to the UE and it released when the service is released. Incoming data com services are therefore still depending upon the circuit.

The Evolved Packet System (EPS) is purely based on IP by using IP protocol both real time services and data com services will be carried When the mobile is switched on the IP address is allocated and it released when the mobile is switched off.

The new access solution, LTE, is based on OFDMA (Orthogonal Frequency Division Multiple Access) and in combination with higher order modulation (up to 64QAM), large bandwidths (up to 20 MHz) and spatial multiplexing in the downlink (up to 4x4) high data rates can be achieved. On the transport channel the highest theoretical peak data is 75 Mbps in the uplink, and in the downlink, using spatial multiplexing, the rate can be as high as 300 Mbps. The LTE access network is simply a network of base stations, evolved NodeB (eNB), generating a flat architecture (figure 2).there is no concentrated intelligent controller, and the eNBs are normally inter-connected via the X2-interface and towards the core network by the S1-interface. In LTE the reason for distributing the intelligence amongst the base-stations is to speed up the connection set-up and reduce the time required for a handover. The connection set-up time for a real time data session is in many cases crucial for an end user, especially in on-line gaming. When end-users tend to end calls if the handover takes too long , the time for a handover is essential for real time services.

VII COMPARE 3G VS. 4G

How much faster is 4G compared to 3G? Unfortunately for consumers, the answer to this question is more nuanced than one would like. The speed of a 3G network depends upon its implementation. In the US, by 2010 Sprint and Verizon (both CDMA networks) had reached the limits of how fast they could make their 3G networks. Upgrading to 4G networks allowed them to offer data transmission speeds up to four times faster than their 3G networks. However, the 3G networks of GSM carriers AT&T and T-Mobile were designed such that there was room to upgrade 3G speeds. As of mid-2010, it is anticipated that when AT&T and T-Mobile upgrade their 3G networks, their speeds will become comparable to 4G from Sprint and Verizon.

Comparison Topics	3G	4G
Data Throughput	Up to 3.1Mbps with an average speed range between 0.5 to 1.5 Mbps	Practically speaking, 2 to 12 Mbps (Telstra in Australia claims up to 40 Mbps) but potential estimated at a

		range of 100 to 300 Mbps.
Peak Upload Rate	5 Mbps	500 Mbps
Switching Technique	packet switching	packet switching, message switching
Network Architecture	Wide Area Cell Based	Integration of wireless LAN and Wide area.
Service & Applications	Concatenated codes are used for error corrections in 4G.	Wimax2 and LTE-Advance
Forward Error Correction	3G uses Turbo codes for error correction	Concatenated codes are used for error corrections in 4G.
Peak Download Rate	100 Mbps	1Gbps
Frequency Band	1.8-2.5 GHz	2-8 GHz

VIII INTRODUCTION TO 5G

5G mobile telecommunication standards stand for fifth-generation advancements made in the mobile communications field. These comprise packet switched wireless systems using orthogonal frequency division multiplexing (OFDM) with wide area coverage, high throughput at millimetre waves (10 mm to 1 mm) covering a frequency range of 30 GHz to 300 GHz, and enabling a 20 Mbps data rate to distances up to 2 km. The millimetre-wave band is the most effective solution to the recent surge in wireless Internet usage. These specifications are capable of providing 'wireless world wide web' (WWWW) applications.

The WWWW allows a highly flexible network (flexible channel bandwidth between 5 and 20 MHz, optimally up to 40 MHz), and dynamic ad-hoc wireless network (DAWN). This technique employs intelligent antennae (e.g., switched beam antennae and adaptive array antennae) and the flexible modulation method, which helps in obtaining bidirectional high bandwidth, i.e., transfer of a large volume of broadcasting data in giga bytes, sustaining more than 60,000 connections and providing 25 Mbps connectivity. Users of 5G technology can download an entire film to their tablets or laptops, including 3D movies; they can download games and avail of remote medical services. With the advent of 5G, Piconet and Bluetooth technologies will become outdated. The 5G mobile phones would be akin to tablet PCs, where you could watch TV channels at HD clarity without any interruption.

8.1 Key Features of 5G

- Wearable devices with artificial intelligence (AI)
- Internet Protocol version 6 where the IP address is assigned according to location and the connected network.

- The ability to connect the user to different wireless access technologies, like 2.5G, 3G, 4G or 5G mobile networks, as well as Wi-Fi and WPAN (wireless personal area network)—or even any other technology to be developed in the future. This is basically a concurrent data transfer path technique.

- Smart radio. In order to share the same spectrum efficiently during a wireless transmission scheme, the system will adaptively find (search) unused spectrum. This dynamic radio resource management will be achieved in a distributed fashion and rely on software defined transmission.

- High altitude stratospheric platform station (HAPS) system. This is based on beam division multiple access (BDMA) and group relay techniques.

8.2 5G Hardware

Ultra wideband networks (UWB). It is already known that Wi-Fi, Wi-Max and cellular wide area communications are long-range radio technologies. But systems like WPAN need short-range radio technology, which helps in achieving higher bandwidths (around 4000 Mbps) but at low energy levels (UWB network) for relaying data from host devices to devices in the immediate vicinity, i.e., distances of around 10 metres or so. This higher bandwidth (4000 Mbps) level is almost 400 times faster than today's wireless networks. Each network will be responsible for handling user-mobility while the user terminal will make the final choice among different wireless/mobile access network providers for a given service. However, there should be different radio interfaces for each radio access technology (RAT) in the mobile terminal.

Smart antennas:

These include the following:

- *Switched beam antennae. :*This type of antenna supports radio positioning via angle of arrival (AOA). Information is collected from nearby devices.

- *Adaptive array antennae (Samsung has used 64 antennae elements):* Such antennae promise to improve the capacity of wireless systems by providing improved safety through position-location capabilities. This technique rejects interference through spatial-altering-position location through direction-ending measurements and developing improved channel models through angle-of-arrival channel sounding measurement.

- *CDMA (code division multiple access) technique:* This technique converts audio analogue input signals into digital signals (ADC) in combination with spread spectrum technology. The signal is transmitted using modulation according to some predefined code (pattern), and is demodulated using the same pattern since there can be billions of code patterns which can provide privacy and sufficient security.

8.3 5G Software

1. 5G will be a single unified IP standard of different wireless networks and a seamless combination of broadband, including wireless technologies, such as IEEE802.11, LAN, WAN, PAN and WWWW.

2. 5G will enable software-defined radio, packet layers, implementation of packets, encryption flexibility, etc.

8.4 Chronological Evolution Of Mobile Technologies

- Although the 1G system (NMT) was introduced in 1981, 2G (GSM) started to come out in 1982, and 3G (W-CDMA)/FOMA first appeared in 2001, the complete development of these standards (e.g., IMT-2000 and UMTS) took almost 10 years. It is still unclear how much time it will take to launch the standards for 5G.

- 5G technologies will ensure the convergence of networks, technologies, applications and services, and can serve as a flexible platform. Wireless carriers will have an opportunity to shorten their return-on-investment periods, improve operating efficiency and increase revenues. In short, this will change people's lives in numerous ways.

IX LITERATURE REVIEW

Wi-MAX is exactly not a technology; it is rather than a certification mark, or 'stamp of approval', it is given to equipment that meets certain conformity and interoperability tests for the IEEE 802.16 families of standards. A similar confusion surrounds the term Wi-Fi, which like Wi-MAX, is a certification mark for equipment based on a different set of IEEE standards from the 802.11 working group for wireless local area networks (WLAN). Neither Wi-MAX, nor Wi-Fi is a technology but their names have been adopted in popular usage to denote the technologies behind them. This is likely due to the difficulty of using terms like 'IEEE 802.16' in common speech and writing.

In case of wireless networks, the behavior of cellular networks, examining 3G, 4G, and Wi-Fi networks for both single-path and multi-path data transport. Our contribution is two-fold: First, we perform measurements of single path transport using TCP over major US cellular wireless networks (both 4G and 3G), and characterize them in terms of throughput, packet loss, and round-trip time. Second, we measure and evaluate transport using multi-path TCP in cellular environments and show that leveraging path diversity under changing environments is a promising solution for more reliable and efficient TCP transfer. We also identify potential issues in using multi-path TCP which can limit performance.

The high bandwidth of 3G networks will lead to the creation of new services, some of which we have no idea about at this time. The big question is what services will be big revenue makers for the wireless service providers. In 2G networks, the big winners have been short text messaging in GSM networks (Europe and countries other than USA) and image downloads and forwarding on iMode networks in Japan. Two candidate services for big winners in 3G networks are video streaming and video conferencing.

The Parallel to Wi-MAX, LTE (Long Term Evolution) is introduced by the Verizon. LTE is considered to be promising high data transfer speed. LTE is supposed to provide the internet facility using both systems. It has

the ability of a transition from one mode to another. LTE is developed on the radio waves technology. This is not only increases the speed but also the amount of data allowed through the same bandwidth and results into lower cost. As LTE is compatible with 3G technology so it not only increases the speed but also prevents the need of new network and it can work through the same infrastructure. In LTE will not only support the functions of 3G but also incorporate some newer ones. LTE using MIMO (Multiple input multiple output) able to send and receive huge data negative in the sense that it will overload the base stations networks. While we seeing the working methodologies of both technologies considered being the standards of 4G, the future is of mobile business.

Wi-MAX could not be commercially available until the second half of 2005, and even then at a very controlled level. This is primarily due to standardization issues. In fact, it could not be until 2006 that a robust production and implementation would happen due to the ramp-up period for manufacturers. This is certainly one challenge to the widespread adoption of WiMax. Additionally, WiMax will have issues of pricing, and will remain far more expensive than Wi-Fi. WiMax will be primarily adopted by businesses to replace or displace DSL, and offices that want to cover a lot of territory without entering the world of endless repeaters that are necessary with the 802.11 technologies. It will take some time (2 years) for WiMax to significantly reduce its price-point for residential uptake. WiMax will not displace Wi-Fi in the home because Wi-Fi is advancing in terms of speed and technology. Each year brings a new variant to the 802.11 area with various improvements.

X POSSIBLE FUTURE TECHNOLOGIES

It's a term used to describe the forthcoming fifth generation of mobile network technology. It's not a reference to any specific standard of that technology, in the way that 4G and LTE have become closely entwined. That's because no such 5G standard has yet been fully agreed upon, though a couple of likely technologies are emerging. We'll discuss those in a moment.

Most of us in the UK today still connect to the internet on our phones using crusty old 3G technology, while those who live in the right areas can connect via 4G extremely fast. As in, you'll be able to download a film to your iPhone 12 or Google Contact Lens in less than a second. Chinese mobile giant Huawei reckons that 5G will be 100 times faster than fastest 4G LTE standard currently available.

One of the chief complaints with 4G is that it offers a new level of speed, but sticks its users with the same old data restrictions. At their worst, current 4G contracts are a little like someone giving you the keys to a new Ferrari, but only allowing you to drive to the end of your street and back.

It's estimated 5G technology will offer upwards of 1,000 times the capacity of 4G. This means that there'll be more space for everyone to access this advanced network, which should negate the need for mobile operators to throttle or limit your access to their networks.

Another benefit of 5G that everyone seems to agree on is reduced latency. It should take significantly less time for data transfers to take place, which means that those streaming videos should start pretty much immediately after you press play.

As we've mentioned elsewhere, the plan is to get London up and running with 5G by 2020. This should make it among the first areas in the world to receive this next gen network.

We're a little far out to speculate on when the rest of the country might get the benefits of 5G, but if the recent switch to 4G is anything to go by, it should start spreading out pretty soon after its capital debut. Of course, the likely need for new antenna installations could see a longer delay on the rest of the UK getting 5G, but its all speculation at this point.

XI FUTURE WORK

5G mobile technology changed the use of cell phones within a very high bandwidth. The user never experienced ever before such as high value technology. Nowadays the mobile users have much awareness of cell phone (mobile) technology. 5G technologies include all of advanced features that make 5G mobile technology most powerful and huge demand in near future. The gigantic array of an innovative technology being built into new cell phones is stunning and 5G technologies which are on hand held phone offering an more power and features than at least a 1000 lunar modules. A user can also hook their 5G technology cell phone with their Laptop to get a broadband internet access. 5G technology including the camera, MP3 recording, video player, large phone memory, dialing speed, audio player and much more you never imagine. For children rocking the fun Bluetooth technology and Pico nets has become in market.

But the main problem is the LTE and 4G networks are used only some finger counting developed countries. 3G networks are not satisfying the users. Here a question arise that, when we are till the date unable to use 4G networks, then when 5G technology will satisfy us. In the era of this civilization, within 10 years the 6^{th} generations would be invented. But we are not getting those facilities in the regular basics. So we need to invent new technologies, but we should follow the availability on the market.

XII CONCLUSION

We have already discussed the all technologies here. From the last 3 decades the wireless communication systems are going to be vast uses in all over world. But in the superfast updated industry a new technology can`t be new for more than 1 year. That`s why the GSM generations are flowing from 1G to 5G within 20 years. Here a question arise that, in the next 10 years which technology will be used. 4G is a very promising generation of wireless communication that already changed the people's life in the wireless world. There are many striking attractive features proposed for 4G which ensures a very high data rate, global roaming etc. New ideas are being introduced by researchers throughout the world, but new ideas introduce new challenges. There are several issues yet to be solved like incorporating the mobile world to the IP based core network, efficient billing system, smooth hand off mechanisms etc. 5G is expected to be launched by 2020 and the world is looking forward for the most intelligent technology that would connect the entire globe.

5G technology has changed the means to use cell phones within very high Bandwidth. Nowadays mobile users have much awareness of the cell phones technology. The 5G technology may include all type of advanced features which makes it most powerful technology upcoming years. New mobile generations are typically assigned new frequency bands and wider spectral bandwidth per frequency channel (1G up to 30 KHz, 2G up to

200 KHz, 3G up to 5MHz, 4G up to 40 MHz), but the main issue that there is little room for new frequency bands or larger channel bandwidths.

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