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Comparative study between the generations of mobile communication 2G, 3G & 4G

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Abstract- **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. The study is on the comparative study between the 3 generations of mobile communication 2G, 3G & 4G. About the various data handling capacity of the three generation of mobile communication along with the services provided and basic technology behind them.**

Keywords- **CDMA, GSM, HSPA, LTE**

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I. INTRODUCTION

Mobile broadband is becoming a reality, as the Internet generation grows accustomed to having broadband access wherever they go, Out of 1.8 billion people who will have broadband by 2012, some two-thirds will be mobile broadband consumers — and the majority of these will be served by HSPA (High Speed Packet Access) and LTE (Long Term Evolution) networks. One of the requirements on LTE is to provide downlink peak rates of at least 100Mbit/s. The technology allows for speeds over 200Mbit/s and Ericsson has already demonstrated LTE peak rates of about 150Mbit/s. Furthermore, RAN (Radio Access Network) round-trip times shall be less than 10ms. In effect, this means that LTE more than any other technology already meets key 4G requirements

A. *Comparison between 2G and 3G*

2G is cheaper than 3G, the tariff, licensing and maintenance cost of 3G is higher. The main function of 2G technology is the transmission of information via voice signals while that of 3G technologies is data transfer via video conferencing, MMS mobile users who download data and browse the Internet on the mobile phones. They find much faster download speeds, faster access to the data and applications in 3G networks as compared to 2G networks. 2G technology uses a broad range of frequencies in both upper and lower bands, under which the transmission depends on conditions such as weather. A drawback of 3G is that it is simply not available in certain regions.

B. *Comparison between 3G and 4G*

1.3G stands for 3rd generation while 4G stands for 4th generation.3G technologies are in widespread use while 4G compliant technologies are still to be lunched in India. 4G speeds are much faster compared to 3G and while3G is a mix of circuit and packet switching network while 4G is only a packet switching network. 3G networks are delayed in some countries by the enormous Costs of additional spectrum licensing fees. In many parts of the world 3G networks do not use the same radio frequencies as 2G, requiring mobile operators to build entirely new networks and license entirely new frequencies so launching of 4G require time after 3G issue is being materialized.

A comparison among the three generations of mobile communication and there services is in this paper. Which has affected the life of millions of population in India and worldwide, making life easy .The figure shows the evolution of the generations of mobile communication from 1G tto 4G and the band used in the services are shown from narrowband to broadband.

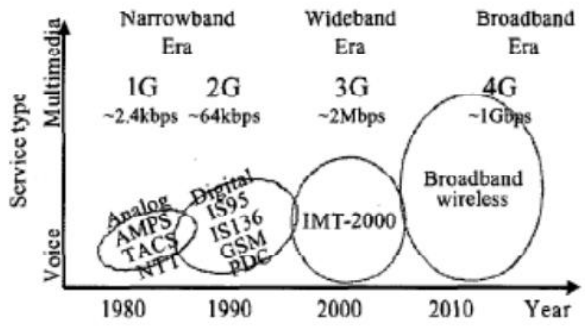

Figure 1 Evolution of generation of mobile communication

II. 2G MOBILE COMMUNICATION

2G Mobile technology revolutionized the concept of mobile uses as compared to 1G. 2G Technology mobiles are now able to do not only verbal communication but also able to send text. There are 3 different types of 2G mobile technologies based on the system they are designed. Adoption of any one of the technology makes them somewhat different from the other because of the difference in their working method.

FDMA It works like a radio system by separating the frequency into equal spectrum but affecting the quality of voice. FDMA, an analog system still exists in 2G mobile technology with the digital module of 2G in limited area. Instead of frequency division now cellular based technology

which divide geographical areas not frequency and improve the service. This technology is first used in 1G mobile as an analog system, introduced in 2G with the increase in its frequency with the help of cellular technology. Able to carry digital transmission but digital transmission is not quality wise as good as in case of analog system. Facilitate with the feature of analogue system by enabling the accessibility of call.

TDMA 2G Mobiles uses TDMA (Time Division Multiple Access) technology in some of its models. It actually divides the band into three time-periods. TDMA contains technologies GSM (Global Service Mobile Communication), which is the most common technology, uses widely across the world. It provides roaming in more than 200 countries. This international roaming feature attracts the subscribers to use it for travelling purpose. The most used and the most appreciative feature is that of short messaging service (SMS).Use of SIM is a prominent feature of GSM. It needs only a SIM to start communication at a particular region. IDEN abbreviated for Integrated Digital Enhanced Network, which is TDMA based technology based on GSM, is utilized by Motorola limited to United State and Canada only. DAMPS (Digital Advanced Mobile Phone System) also known as IS-136 used in America only North and South regions.PCS (Personal Communication System) is used in Japan.

CDMA (2G Mobile Technology) Unlike TDMA, CDMA works using the entire band with the help of code. CDMA is based on a wide spectrum as many calls laid over each other identifying on the basis of unique code. CDMA gives a separate code to a separate phone. Increase the frequency band space by assigning code in sequence. Both senders and receivers are able to use a full band with the help of using their codes. Contrast to one analog call, nearly dozen calls can be channelized at the same time. IS-95 (Interim Standard) widely uses in Korea increases the capacity as able to use complete band. The figure shows summary of access of channel by FDMA, TDMA, CDMA (2Gmobile technology)

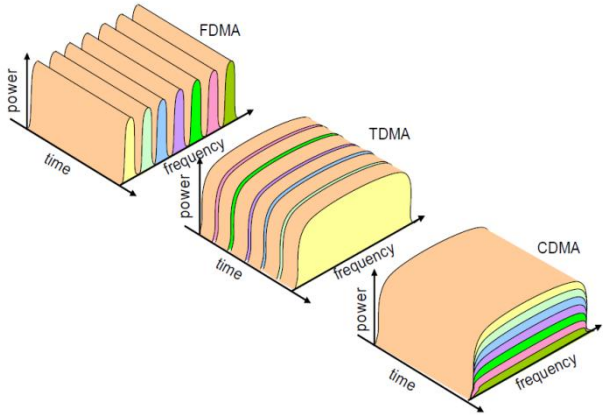

Figure 2 Access of channel by FDMA, CDMA and TDMA

A. Architecture of 2G GSM service

GSM is a PLMN (Public Land Mobile Network) several providers setup mobile networks following the GSM standard.GSM system comprises 3 subsystems

RSS (radio subsystem): covers all radio aspects, which contains MS (mobile station) BSS (base station subsystem) or RAN (radio access network) BTS (base transceiver station) BSC (base station controller) NSS (network and switching subsystem): call forwarding, handover switching. Its contains MSC (mobile services switching centre) LR (location register): HLR and VLR.OSS (operation subsystem): management of the network. It contains OMC (operation and maintenance centre), AUC (authentication centre) EIR (equipment identity register). The figure shows various component of GSM mobile connection.

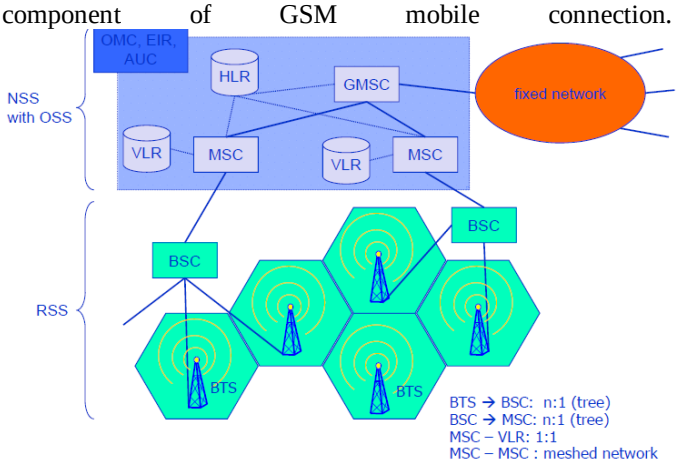

Figure 3 2G Architecture

B. Services provided by 2G

GSM offers several types of connections, voice connections, data connections, short message service and multi-service options (combination of basic services). Three service domains are Bearer Services, Teleservices, and supplementary Services. Telecommunication services to transfer data between access points. Specification of services up to the terminal interface (OSI layers 1-3) Different data rates for voice and data (original standard) data service (circuit switched), synchronous: 2.4, 4.8 or 9.6 KB/S, asynchronous: 300 – 1200 B/S .Data service (packet switched) .superseded by GPRS synchronous: 2.4, 4.8 or 9.6 KB/S asynchronous: 300 - 9600 bit/S. It enables voice communication via mobile phones mobile telephony. Primary goal of GSM was to enable mobile telephony offering nearly ISDN quality (bandwidth of 7 kHz). Today Full rate codec (FR–13kb/s), half rate (HR-5.6kb/s), Enhanced Full rate (EFR-12.2kb/s) emergency number common number throughout Europe (112); mandatory for all service providers, free of charge, connection with the highest priority (pre-emption of other connections possible) , multi numbering several ISDN phone numbers per user possible. In Non-Voice Teleservices we have group 3 fax voice mailbox (implemented in the GSM network), Short Message Service (SMS)Alphanumeric data transmission to form the mobile terminal using the signalling channel, thus allowing simultaneous use of basic services and SMS. Services in addition to the basic services it cannot be offered stand-alone. It is similar to ISDN services besides lower bandwidth due to the radio link. it may differ between different service providers, countries and protocol versions

Important services include call forwarding, identification: forwarding of caller number ,suppression of number forwarding (CLIP, CLIR), automatic call-back, conferencing

with up to 7 participants, locking of the mobile terminal (incoming or outgoing calls).

III. 3G MOBILE COMMUNICATION

3G is currently the world's best connection method when it comes to mobile phones, and especially for mobile Internet. 3G stands for 3rd generation as it just that in terms of the evolutionary path of the mobile phone industry. 3G telecommunications, is a generation of standards for mobile phones and mobile telecommunication services fulfilling the International Mobile Telecommunications-2000 (IMT-2000) specified by the International Telecommunication Union.] Application services include wide-area wireless voice telephone, mobile Internet access, video calls and mobile TV, all in a mobile environment. To meet the IMT-2000 standards, a system is required to provide peak data rates of at least 200 kbit/s. Recent 3G releases, often denoted 3.5G and 3.75G, also provide mobile broadband access of several Mbit/s to smart phones and mobile modems in laptop computers. The following standards are typically branded 3G .the UMTS system, first offered in 2001, standardized by 3GPP, used primarily in Europe, Japan, China (however with a different radio interface) and other regions predominated by GSM 2G system infrastructure. The cell phones are typically UMTS and GSM hybrids. Several radio interfaces are offered, sharing the same infrastructure.The original and most widespread radio interface is called W-CDMA. The TD-SCDMA radio interface, was commercialised in 2009 and is only offered in China. The latest UMTS release, HSPA+, can provide peak data rates up to 56 Mbit/s in the downlink in theory (28 Mbit/s in existing services) and 22 Mbit/s in the uplink.

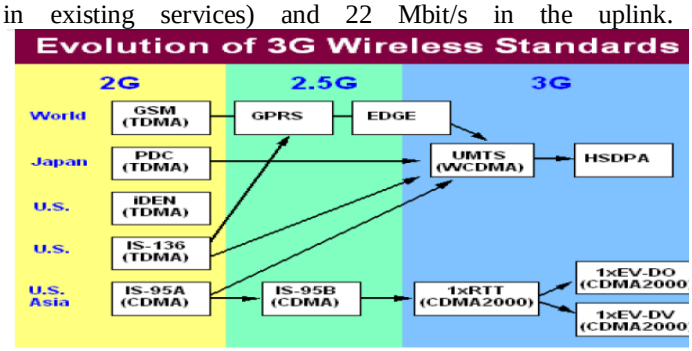

Figure 4 Evolution of 3G

A. *Architecture of 3G mobile communication*

Universal Mobile Telecommunications System (UMTS), standardized by the 3GPP, is the 3G mobile communication technology successor to GSM and GPRS. UMTS combines the W-CDMA, TD-CDMA, or TD-SCDMA air interfaces, GSM's Mobile Application Part (MAP) core, and the GSM family of speech codec's. W-CDMA is the most popular cellular mobile telephone variant of UMTS in use. UMTS, using W-CDMA, supports up to 14.0 Mbit/s data transfer rates in theory with High Speed Downlink Packet Access (HSDPA), although the performance in deployed networks could be much lower for both uplink and downlink connections. A major difference of UMTS compared to GSM is the air interface forming Generic Radio Access Network (GeRAN). It can be connected to various backbone networks like the Internet, ISDN, and GSM or to a UMTS network. GERAN includes the three lowest layers of OSI model. The network layer (OSI 3) protocols form the Radio Resource Management protocol (RRM). They manage the bearer channels between the mobile terminals and the fixed network including the handovers.

The UMTS standard is an extension of existing networks based on the GSM and GPRS technologies. In UMTS release 1, a new radio access network UMTS terrestrial radio access network (UTRAN) is introduced. UTRAN, the UMTS radio access network (RAN), is connected via the IU to the GSM Phase 2+ core network (CN). The IU is the UTRAN interface between the radio network controller (RNC) and CN; the UTRAN interface between RNC and the packet-switched domain of the CN (IU–PS) is used for PS data and the UTRAN interface between RNC and the circuit-switched domain of the CN (IU–CS) is used for CS data. The figure shows the architecture of 3G mobile communication.

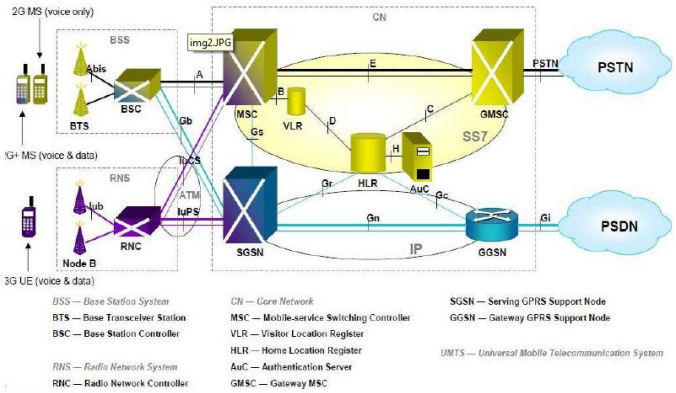

Figure 5 Architecture of 3G

UTRAN is subdivided into individual radio network systems (RNSs), where each RNS is controlled by an RNC. The RNC is connected to a set of Node B elements, each of which can serve one or several cells. Two new network elements, namely RNC and Node B, are introduced in UTRAN. The RNC enables autonomous radio resource management (RRM) by UTRAN. It performs the same functions as the GSM BSC, providing central control for the RNS elements (RNC and Node Bs). Node B is the physical unit for radio transmission/reception with cells. Node B connects with the UE via the W–CDMA radio interface and with the RNC via the Iub asynchronous transfer mode (ATM)–based interface.

B. *Services provided by 3G mobile communication*

Video calling is the first big thing that you will experience on 3G. Video calls means allows to see and capture every moment of expression of someone with whom the conversation is made. It supports real time image to other party however, clarity and continuity depend on some factors like quality of Mobile device, location of user, network condition etc. High Speed Internet is the next big thing which revolutionized the browsing experience. No more breaks buffering and unavoidable wait of desired screen. A speed which will help in sharing thoughts/pictures/albums/videos in the way never experienced in 2G. High speed internet means,

even those transactions can be done which need speed for processing of error free requests like banking services, online ticket booking etc. Though actual speed vary on many factors like handset, location, network capacity, number of simultaneous users in a cell etc. access to online available video resources without buffering from You tube etc and other subscribed services which provide such videos. Live TV services.3G speed gives a new experience of gaming through Mobile.

IV. 4G MOBILE COMMUNICATION.

Fourth (4G) generation mobile communication systems tend to mean different things to different people. For some it is merely a higher-capacity. New radio interface, while for others it is an interworking of cellular and wireless LAN technologies that employs a variant of the Mobile IPv6 mobility management protocol for inter-system handoff and IETF AAA technologies for seamless roaming. There is no doubt that 4G systems will provide higher data rates. It is widely accepted that the individual (wireless and/or wire line) access networks will interface to core and/or backbone network elements over the IP protocol, the lingua franca of networking technology. Regardless of their particular technological blueprints these wireless access networks are expected to have a dynamic address assignment mechanism that is capable of associating a short-lived or long-lived IP address to the respective wireless interface at the mobile terminal, A transparent IP forwarding service that is accessible over the logical termination of the IP layer at the mobile terminal and one or more gateways at the wireless access network infrastructure. The IP forwarding service is set up by signalling procedure specific to the technical architecture of each wireless access network.

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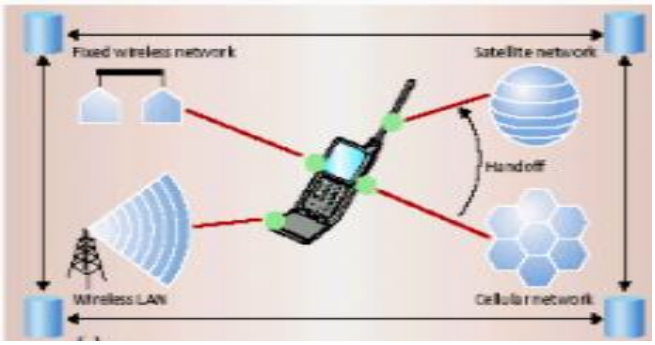
A. Architecture of 4G mobile communication

There are there possible architecture of 4G,multimode device, overlay network and common access protocol..multimode devices architecture uses a single physical terminal with multiple interfaces to access services on different wireless networks. it may improve call completion and expand effective coverage area. it also provide reliable wireless coverage in case of network ,link ,or switch failure .the user ,device or network can initiate handoff between network the device itself incorporated most of additional complexity without requiring wireless network notification or employing inter working devices. Each network can deploy a database that keeps track of user location ,device capabilities ,network condition and user preferences



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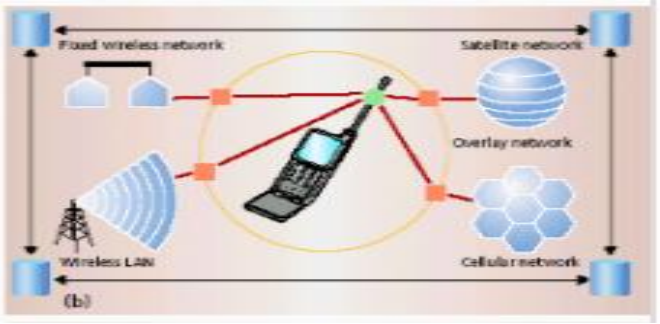
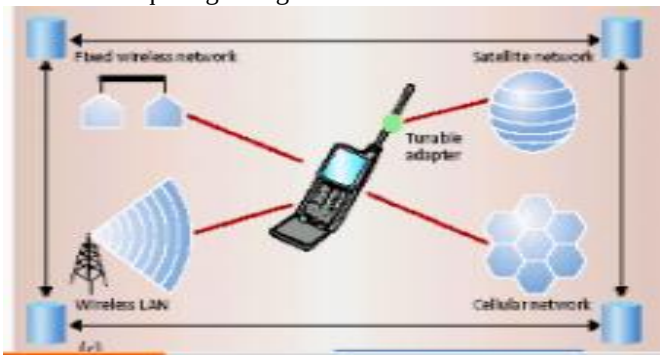
In overlay network, a user accesses an overlay network consisting of several universal access point. These UAPs in turn slect wireless network based on availability of QOS specifications ,and user defined choices. A UAP performs protocol and frequency translation content adaptation and QOS negotiation renegotiation on behalf of users .the overlay network , rather than the user or device ,performs handoffs as the user moves from one UAP to another. A UAP stores user network and devices information capabilities and preferences.



Common access protocol becomes viable if wireless network can support one or two standard access protocols .one possible situation which will require inter working between different network ,uses wireless asynchronous transfer mode .to implement wireless ATM every wireless network must allow transmission of ATM cells with additional header or wireless ATM cells requiring changes in the wireless network.



B. Services provided by 4G

Traffic generated by the different services will not only increase traffic loads on the networks, but will also require different quality of service (QOS) requirements (e.g. cell loss rate, delay, and jitter) for different streams (e.g., video, voice, data).Providing QOS guarantees in 4G networks is a non-trivial issue where both QOS signalling across different networks and service differentiation between mobile flows will have to be addressed. One of the most difficult problems that are to be solved, when it comes to IP mobility, is how to

insure the constant QOS level during the handover. Depending on whether the new access router is in the same or some other sub network, we recognize the horizontal and vertical handover. However, the mobile terminal cannot receive IP packets while the process of handover is finished. This time is called the handover latency. Handover latency has a great influence on the flow of multimedia applications in real time. Mobile IPv6 have been proposed to reduce the handover latency and the number of lost packets. The field "Traffic Class" and "Flow Label" in IPv6 enables the routers to secure the special QOS for specific packet series with marked priority. it provides Higher bandwidths, Lower cost of networks and equipment, The use of licence-exempt spectrum, Higher capacity and QOS enhancement, Higher revenue, Access to broadband multimedia services with lower cost and where mostly needed, Inter-network roaming.

V. RESULT

The study was a comparatively study of the three generations architecture and the services provided by three of them. on various factor one generation stand better than the other in technical advancement, data speed and services 4G stand promising but the launch is still awaited .In present day 3G provide best service but in high tariff as compared to 2G .As the advancement in generation goes the technology become more complex and band utilization increases.

VI. CONCLUSION

The study shows though 2G provide services that are good and high data speed at low cost ,and call rates are at low tariff but the data speed is comparatively low .But 3G provide high rate of data access and some exclusive services that were not provided by previous versions like 3G video calling. The smart phones are more compatible to 3G services as the applications on a smart phone require high data speed. 4G seems to be a very promising generation of wireless communication that will change the people's life to wireless world. There are many striking attractive features proposed for 4G which ensures a very high data rate, global roaming etc.

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