

Comparative Study of 3G / 4G Network Service

Gulshan Kumar¹, Sheenam Bhola², Manisha Batra³

¹Assitant Professor, ^{2,3}Dept of Computer Applications

Department of Computer Applications, SBSSTC Ferozepur
Punjab, India (152004)

Abstract : Modern technology is evolving so fast, that it can be very difficult to keep follow everything new. Cellular Communication is one of the most recent areas which is developing tremendously fast at present times, it is only due to the advancement of technology in all the fields of cellular and wireless communications. Networks are used basically in business and home applications, mobile users, and in all social concerns. At the present time, the use of 3rd Generation (3G) cellular communication systems seems to be the standard, while the 4th generation (4G) stands for the next generation of wireless and cellular communications. This comparative study between 3G & 4G tells about the scope, background and the visualization for the 4G.

In this paper, we first present a brief review on the evolutionary history, features, condition of network communication and comparison of 3G - 4G perspectives. It is followed by the introduction to 4G technologies to fulfill the limitations of 3G services. At the end, the paper is summarized.

Keywords: Cellular Serivces, CDMA, HSPA, EDGE, GPRS, GSM, IMT, ITU, UMTS.

I INTRODUCTION

Cellular Communication is becoming a reality, as the Internet generation grows to broadband access wherever you go, and not just at home but in the office also. Out of the expected 1.8 billion people who will have broadband by 2012, some of them will be mobile broadband consumers and the most of these will be served by HSPA (High Speed Packet Access) and LTE (Long Term Evolution) networks. During EDGE (Enhanced Data Rates for GSM Evolution), large-volume transformation of data was possible, but still there is some problem as the packet movement of the air-interface behaves like a circuit switch call. Thus, part of this packet connection efficiency is lost in the circuit switch environment. Moreover, the standards for developing the networks were different for different regions of the world. Hence, it was decided to have a network which provides services independent of the technology platform and whose network design standards are same globally[5]. Thus, 3G services was born.

The Third Generation Partnership Project (3GPP), the international organization that developed the extensively used UMTS (Universal Mobile

Telecommunication System), WCDMA (Wideband Code Division Multiple Access) / HSPA (High Speed Packet Access) 3G standards, also developed Long-Term Evolution (LTE). LTE offers several important benefits for consumers and operators: Performance and capacity - One of the requirements of 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.

The emergence of new technologies in the cellular communication systems and also the constantly increasing growth of user demand have triggered researchers and companies to come up with a complete demonstration of the up-coming fourth generation 4G network system. In contrast to 3G, the new 4G framework to be recognized will try to achieve new levels of user experience and multi-service capability by also integrating all the mobile technologies that already exist (such as GSM: Global System for Mobile Communications, GPRS: General Packet Radio Service, IMT-2000: International

Mobile Communications, Wi-Fi: Wireless Fidelity, Bluetooth).

Currently, 4th Generation technologies are being obtained around the world and devices are being made accessible that may enjoy this brand-new mobile development in speeds and consistency. In telecommunications, 4G is the fourth generation of cellular wireless standards. It is basically succeeding 3G and preceding 5G network.

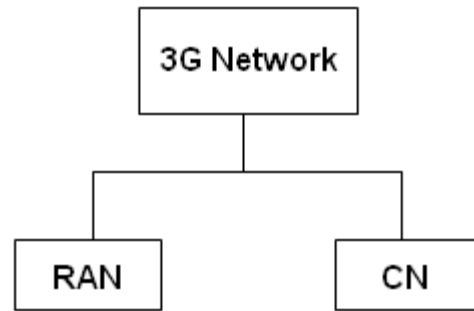
II 3G NETWORK

3G is the short form of third Generation. It's the third generation of mobile telecommunications technology. It's a better and faster mobile communications standard than ever before, offering download speeds of up to 3.1 Mbps. This means a 3G network actually allows for more data transmission and therefore the network enables file transmission, voice and video calling, online TV, play games, internet surfing, view high definition videos and much more. 3G is the best opportunity for users who always want to stay connected to the Internet. The most common 3G data protocols are EDGE, EV-DO and HSPA, each based on a different standard. This is based on a set of standards used for mobile devices and mobile telecommunications use services and networks that meet the terms with the International Mobile Telecommunications-2000 (IMT-2000) specifications by the International Telecommunication Union[1]. The International Telecommunications Union has set no official standards for data rates for 3G technology, although most standards in this group offer at least 144 kilobits per second of download capacity. However, Carriers have significantly upgraded their network over the years. By 2012, 3G speeds could range between 400 kilobits per second and 2 megabits per second, depending on your carrier and region[8]. 3G finds application in wireless voice telephony, mobile Internet access, fixed wireless Internet access, video calls and mobile TV.

Later 3G releases, often denoted 3.5G and 3.75G, also provide mobile broadband access of several Mbit/s to smartphones and mobile modems in laptop computers. This ensures it can be applied to wireless voice telephony, mobile Internet access, fixed wireless Internet access, video calls and mobile TV technologies.

The 3G network has two main components:

- The Radio Access Network (RAN)
- The Core Network (CN)



The RAN consists of the existing GPRS (General Packet Radio Service) / GSM (Global System For Mobiles) RAN system which is connected to the Packet Switched Network and as well to the Circuit Switched Network. The Packet Switched Network will eventually connect to the UTRAN (Universal Terrestrial Radio Access Network) system as part of the full transition to 3G. The UTRAN made up of subsystems, with every subsystem consisting of one Radio Network Controller, which is associated with several Base Transceiver Stations (BTN). The GRPS RAN has a related architecture. The Core Network consists of the Packet Switched Network and the Circuit Switched Network.

III FEATURES OF 3G

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. The Application provided by 3G services consist of 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 [3].

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 commercialized 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.

LIMITATIONS OF 3G

- The cost of cellular infrastructure, upgrading base stations is very high.
- Roaming and data/voice work collectively has not yet been implemented.
- Power utilization is high.
- Requires closer base stations and are expensive.
- We still have circuit voice, circuit data and packet data bearers.

III 4G NETWORK

4G stands for the fourth generation of cellular wireless standards. Currently there are two types of 4G data networks developed in the USA, one of which is WiMax, which is developed by Sprint and its partners and another is LTE which is an extension of the GSM network used by Verizon, T-Mobile and AT&T [9].

4th Generation mobile networks are supposed to provide many value added features. In addition to all the 3G facilities, data transmission is believed to go through the roof with speeds ranging between 100MBPs to 1GBPS. This means it actually allows for networking, conferencing, chatting, happy talking, surfing, partying, or whatever you want to do on your mobile phone.

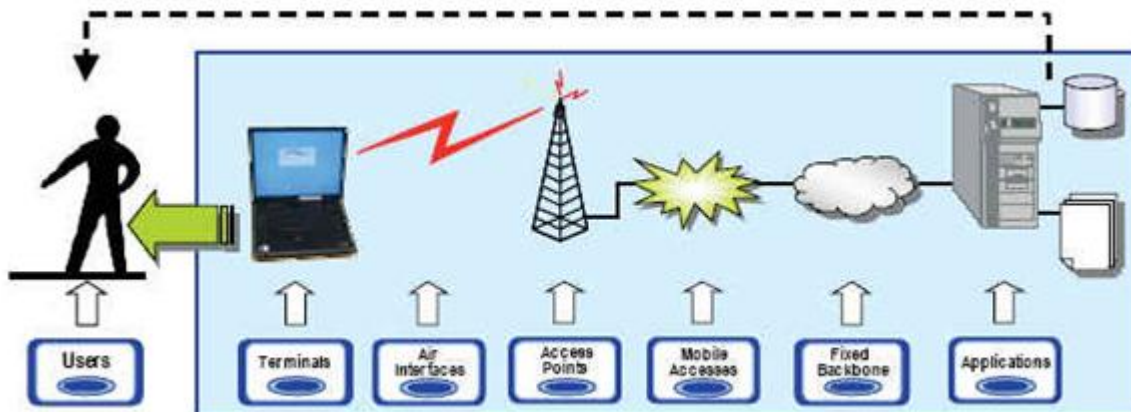
4G technologies are Wi-Max, HSPA+ and LTE, due to their use of the MIMO (Multiple Input/Multiple Output) standard [8]. This allows cell phones to receive and transmit data simultaneously across multiple frequencies, increasing speeds significantly. In 2012, average 4G speeds could range between 3.5 and 13 megabits, depending on the network in your area. The purpose of the 4th-generation network is to dramatically increase data transmission speed. Contrasting previous networks, it concentrates on data transmission rather than voice transmission. That in itself is outstanding, because it means the shift from voice focused mobile networks towards data focused mobile networks. It also is a potential threat for cable Internet providers, because 4G speed can potentially be just as fast as optical fibre [7]. Its current applications include video conferencing, mobile web access, cloud computing, 3D television, gaming services, high-definition mobile TV and IP telephony.

FEATURES OF 4G

4G is the next generation after 3G. Although still 3G has not been completely implemented in the real world, people have started talking about the features of 4G. Some of the 4G services talked about are incorporating quality of service (QoS) and Mobility:

1. High usability: Any time, any where and with any technology.
2. Support for multimedia services at low transmission cost.
3. Personalization.
4. Integrated services.

4G, a range of new services and models will be available. These services and models need to be further examined for their interface with the design of 4G systems. This Figure demonstrates the key elements and the seamless connectivity of the networks [3].



IV COMPARISON BETWEEN 3G & 4G

The main difference between 3G and 4G is speed. 4G speeds can be up to 10 times faster than 3G, similar to the speed difference between DSL and high-speed cable modem. Average download speed on a 3G network is between 600 Kbps and 1.4 Mbps with peak download speed of up to 3.1 Mbps. On a 4G network the average download speed is 3-6 Mbps with peak download speed of more than 10 Mbps. This speed difference is significant enough for people to completely abandon 3G mobile broadband as soon as there is sufficient 4G network coverage [3].

	3G Network	4G Network
Data Throughput	Up to 3.1 Mbps with an average speed range between 0.5 to 1.5 Mbps	Practically, 2 to 12 Mbps but potential estimated at arrange of 100 to 300 Mbps.
Peak Download Rate	100 Mbps	1 Gbps
Peak Upload Rate	5 Mbps	500 Mbps
Frequency Band	1.8-2.5 GHz	2-8 GHz
Services and Applications	CDMA 2000, UMTS, EDGE etc	Wimax2 and LTE-Advance
Forward Error correction (FEC)	3G uses Turbo codes for error correction	Concatenated codes are used for error corrections in 4G
Switching technique	Packet Switching	Packet Switching, Message Switching
Network Architecture	Wide Area Cell Based	Integration of wireless LAN and WAN

V CONCLUSION

4G seems to be a very hopeful invention of wireless communication that will change the life of people and the whole world to the wireless system. There are many remarkable features anticipated for 4G which ensures global roaming and a very high data rate. New thoughts are being introduced by researchers throughout the whole world, but new ideas and thoughts bring in new challenges. There are

numerous issues yet to be solved like efficient billing system, smooth hand off mechanisms, incorporating the mobile world to the IP based core network etc. Now, The whole world is looking ahead for the most intellectual communication network that would connect the entire globe. Multiple 3G principles are the reason that makes it difficult for 3G devices to be truly global. In the future 4G networks may replace all existing 2.5G and 3G networks, possibly even before a full deployment of 3G.

REFERENCES

- [1]. Amit Kumar; Dr. Yunfei Liu; Dr. Jyotsna Sengupta; Divya, “Evolution of Mobile Wireless Communication Networks” <http://www.iject.org/pdf/amit.pdf>
- [2]. <http://www.tele.net.in/technology-watch/item/6644-3g-key-advantages-and-challenges?format=pdf>
- [3]. K. Kumaravel , “Comparative Study of 3G and 4G in Mobile Technology “ , IJCSI International Journal of Computer Science Issues, Vol. 8, Issue 5, No 3, September 2011, <http://ijcsi.org/papers/IJCSI-8-5-3-256-263.pdf>
- [4]. http://www.ijetae.com/files/Volume3Issue7/IJET_AE_0713_52.pdf
- [5]. “Evolution of TDMA-Based 2G Systems to 3G Systems” <http://catalogue.pearsoned.co.uk/samplechapter/0130280771.pdf>
- [6]. B.G. Evans and K. Baughan, “Visions of 4G,” Electronics & Communication Engineering Journal, Vol. 12, No. 6, pp. 293–303, Dec. 2000.
- [7]. <http://www.digitaltrends.com/mobile/3g-and-4g-whats-the-difference/>
- [8]. <http://techchannel.radioshack.com/difference-between-3g-4g-2437.html>
- [9]. <http://www.gbesx.com/tips-and-tricks/what-is-the-difference-between-3g-and-4g/>

- [10]. <http://www.knowyourmobile.com/products/12761/what-4g-everything-you-need-know> future generation of mobile communication,”
Electrical and Computer Engineering, 2002.
- [11]. <http://www.seminarsonly.com/Labels/4g-Technology-Features.php> IEEE CCECE 2002. Canadian Conference on
, Volume:3, 12-15May,2002 , pp:1276 - 1281
vol. 3.
- [12]. L. Zhen, Z. Wenan, S. Junde, H. Chunping,
“Consideration and research issues for the