

# The Impact of Existing and Future Mobile Technologies on Pakistan: A Survey

Hamid Asmat and Sultan Ullah

**Abstract**—The development of telecom industry is a key to the social and economic growth of a country. New telecom technologies are being developed and deployed. Among these technologies wireless cellular technologies are the most quickly adopted and used. Many generations of wireless, cellular communication has been developed starting from 1G to 4G. A new technology known as the 5G and is expected to be developed in the near future, which will take the cellular technology to the new peaks. The future technology 5G will definitely have some remarkable advantages over the existing technology 3G/4G. This paper is aimed at explaining some basic benefits of 5G with respect to existing technologies and also explaining the economic and social benefits that these technologies could bring in a country.

**Index Terms**—Mobile communication, 3G, 4G, 5G.

## I. INTRODUCTION

The need for mobile communication started early when people started to communicate on a wired link with other people. When the first generation of mobile communication started, it became successful overnight but with some disadvantage like use of analog signals, limited coverage etc.. To remove such disadvantages 2<sup>nd</sup> generation (GSM) mobile communication was introduced which is pan-European Mobile communication System [1]. This generation is the widely excepted mobile generation, with having huge coverage area and able to support a huge amount of users [1]. Initially this Mobile system provided the voice communication and later on it was extended with a technique known as GPRS to enable a user to send packet data over a mobile communication network. This technique was the first true mobile packet data transmission technique [2].

The extension of 2G with GPRS is classified with 2.5G [3]. The GPRS was later on extended to a new technique known as EDGE, this was also classified into generation 2.5. This technique was useful but as the number of users grew and with the advancements of application on Internet GPRS was unable to provide the transmission rate for those applications.

Keeping in view the aforementioned problem the need for new technology was made which could provide both voice and also provide a high data rate for packet data transmission,

thus the 3<sup>rd</sup> generation mobile system was introduced; this generation was an upgrade to 2<sup>nd</sup> generation. This generation for mobile system was widely demanded and accepted by subscribers because of its ability to transfer at about 2mbps per user. By the end of 2005, 3G had about 44 million users [4].

After the world wide success of 3G, new generation known as the 4<sup>th</sup> Generation or 4G was introduced which could provide even higher speed than 3G and also overcoming few disadvantages of 3G[5].In 4G the user can shift its packet to another network even without notification; this is known as Anytime, Anywhere features [5].

The upgrade to 4G is a new Generation known as the 5<sup>th</sup> Generation or 5G. The aim of this technology is to have even higher speed than 4G and have uninterrupted packet data access.

The First generation has fulfilled the basic mobile voice, while the Second generation has dealt with capacity and coverage. The third generation focused for higher data rate, multimedia support and spread spectrum followed by Fourth generation providing access to wide range of telecommunication services including advanced mobile services, along with a support for low to high mobility application. Fig. 1 reflects the evolution of network technologies [6]-[8].

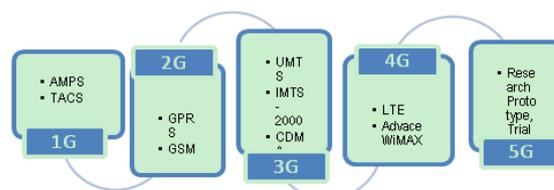


Fig. 1. Development of different generation of mobile technologies.

This paper is aimed to survey and study the characteristics of the fifth generation Mobile system, i.e what is the need of this generation, what the new additions of this generation are; and what will be the social impact of this 5G when it hits the Pakistani market. And also this paper will do some basic technological comparisons among 3G, 4G and 5G which will basically explain the advantages of 5G over the 3G and 4G.

It is examined different reasons like execution interoperability, transfer speed, merging, expense, and adaptability serving to be the driving element for moving to new era of systems. System structural engineering of 4G, working standard behind it, advancements that bolster 4G has been informed. Utilizations of 4G and part of remote industry being developed of new system era has been examined. 4G is proposed to be more keen innovation interconnecting the whole world unbounded [9].

The paper will comprise of six parts. The first part contains

Manuscript received September 24, 2014; revised June 24, 2015.

Hamid Asmat is with the Faculty of Information Technology, Sarhad University of Science and Information Technology, Peshawar Pakistan (e-mail: hamid.ismat111@gmail.com).

Sultan Ullah Jadoon is with Computer and Communication Research Lab, Department of Information Technology, University of Haripur Pakistan (e-mail: sultan@uoh.edu.pk).

the brief introduction of the different mobile generation system. Second part explains some existing technologies, third part explain the 5G, its needs, benefits and disadvantages, fourth part shows the comparison between 3G, 4G and 5G; the fifth part explains the economic and social effects of these technologies and in the last is conclusion to this paper.

## II. 3G AND 4G: PRE-REQUISITE TO 5G

The Before going into the details of the 5<sup>th</sup> generation we first have to understand the road to 5G i.e the current available technologies known as the 3G(UMTS) and 4G (LTE).

The first pre commercial 3G network was introduced in Japan in 1998 since then this generation has seen a very rapid and steady growth throughout the international market. The reason for the success of this generation was that it was able to provide high data rates for packet data access as well as voice communication. The aim of the 3G technology was to address the growing needs of mobile and Internet application on a cell phone. 3G uses WCDMA radio access technology additionally it uses HSDPA (high speed down link packet data access) and EUL (Enhanced up link) [4]. Due the said techniques used 3G was able to provide a data rate of about 2 mbps per user or subscriber. Because of its good data rate, this generation was the first wireless technology to support services which were only available on wired networks such as VPN, VOIP, video conferencing etc...

Apart from these many advantages 3G still has its share of disadvantages such as if we first say with a subscriber point of view the old GSM or 2G Mobile phones will not support 3G a new mobile handset would be required which are normally of high cost. The cost of cellular infrastructure up gradation is very high. 3G requires closer base station thus very expensive and last the acquiring of signal is very costly. Even with these disadvantages 3G has still managed its way to being a successful technology.

4G LTE (long term evolution) is another generation of the mobile system which was introduced following to 3G and is a predecessor of 5G. 4G providing services of the usual voice and other 3G services also provides even more high data rates for packet data access. At the core of 4G, OFDM access technology is used [6]. The use OFDM enables 4G to efficiently use the acquired signal spectrum by orthogonally dividing the signals and signal overlapping [6]. 4G network could provide services in the same capacity as of wired network that are VOIP, VPN, high definition mobile TV, good downloading and uploading speed etc...

4G also has its disadvantages. The disadvantage on the subscriber point of view is that it will be not supported by 2G or 3G mobile phones, so a new mobile phone is required for 4G connection. The infrastructure is complex hence being costly [5]. Some security issues have risen in this technology [5].

## III. 5G: NEEDS, OBJECTIVES, PROS AND CONS

The 5G is currently a name given to the next generation of the mobile system which will be implemented after 4G. 5G technology is aimed to go the next level of wireless

communication. In this, researches are related to the development of World Wide Wireless Web (WWW), Dynamic Adhoc Wireless Networks (DAWN) and Real Wireless Communication [9]. 5G will have to support a multitude of new applications with a wide variety of requirements, including higher peak and user data rates, reduced latency, an enhanced indoor coverage, an increased number of devices, and so on. The expected traffic growth in 10 or more years from now can be satisfied by the combined use of more spectrum, higher spectral efficiency, and densification of cells [10].

User expectations for mobile broadband service quality are expanding in parallel with activity various nature and expanded usage. Complex and continually advancing multi-vendor networks and services are placing sizable request on service management. The direction is shifting towards the delivery of high-quality services i.e., support service centric and user-centric management [8].

The following Step of the Digital Society will be characterized by an ICT system's capacity for prompt administration accessibility and on-demand adaptability. The new demands for mobile services will lay the foundation for a whole new need of mobile apps to grow and increase the capabilities of communication beyond the current capability. The acceptance of M2M services will be encouraged when there would be provision procurement of higher system limit needed for taking care of gigantic associations [10].

Server workloads are increasing by 10% a year. System bandwidth need is increasing by 35%. Storage space is increasing by 50%. Power costs increase is 20%. Adding more capacity to the need is not the answer to the growing demand; new methods will be required to optimize the capacity. More than 1.5 billion Web pages are ready to accessed, 450,000 iPhone applications are available for download, more than 200,000 Android applications are already in use, and 10,500 radio stations are there to be heard. All of these increases for Demand in IT [10], [11].

The benefits of 5G over 3G and 4G are clearly for providing high data rate, and complete mobility and also supporting a huge amount of devices which could connect a network without any problem anywhere, anytime. This Generation is aiming at the real wireless world where a user can move about without getting service interruption.

Some disadvantages can be related to this generation such as to make the real wireless world, a very huge signal spectrum is required, a person could be near to invisible in this kind wireless deployment, any malicious activity could go unseen. With wireless technology security is always going to be an issue. These issues need to be addressed while the development of 5G is underway.

## IV. A ROAD TO 5G

The 5G network technology will open a new chapter in mobile technology. The 5G phones will have access to several wireless technologies at the same time and the device should be able to join different flows from several wireless technologies. 5G is expected to be an intelligent innovation equipped for interconnecting the whole world without any

limits.

At present, 5G is not a term formally utilized for any specific particular or in any official archive yet made open by teleco organizations or standardization bodies like Wi-Max Forum or ITU-R. New version will further raise system performance and add new features with new application domain [12].

The 5G is going to be a complete wireless communication introducing excellent real world wireless – World Wide Wireless Web (WWWW). 5G is going to be the futures mobile telecommunication standard beyond the 4G/IMT-Advanced standards [13].

The 5G technology incorporate all sort of cutting edge techniques which make 5G most capable, powerful and in high demand in not so distant future. Clients can connect their 5G innovation phones with their Laptop to get broadband web

access [14].

In 5G, Network Architecture comprises of a client terminal, and various free, self-governing Radio Access Technologies (RAT). 5G mobile technology is an IP based system for wireless and mobile networks, to operate with each other.

5G system won't be just of more speed additionally it will basis for carrying more information. This 5G is predicted to be released around 2020. This generation might work out the problem of frequency allocation and spectrum management issues. The 5G terminals will have software-defined radios. Also, it will use different modulation methods and error-control methods. It would give several channel without streaming. [11], [12], [15].

TABLE I: COMPARING DIFFERENT MOBILE TECHNOLOGIES

Generation	Definition	Throughput/ speed	Radio access
3G	High Speed Data Packet	3.1 mbp speak, 500 -700 kbps	WCDMA
4G	High speed data Packet with all IP support	100-300Mbps (peak) 3-5 Mbps	OFDM
5G	Real time broad band packet data, probably all IP support	In Giga bits as tests conducted by Samsung	Not yet but preferably Massive mimo as according to Samsung

Increase of traffic, increase in number of devices and variety of requirements such as latency, reliability and low cost and energy consumption possess key challenge to 5G technology. This magnitude of requirements is in turn stretching the limits of available technologies. Vision of Super Core is based on IP platform. All network function such as GSM, CDMA, Wi-Max, Wire line are going to be connected to one Super core with extreme capability. This is the achievement of single network infrastructure. The concept of super core will eliminate all interconnecting charges and complexities, which right now network operator is facing. It will also reduce number of network entities in end to end connection, thus reducing latency considerably. The 5G core is to be a Re-configurable, Multi-Technology Core. The core could be a convergence of new technologies such as Nano technology, Cloud Computing and Cognitive Radio and based on All IP Platform [15].

#### V. A COMPARISON OF THE DIFFERENT MOBILE TECHNOLOGIES

Some basic comparisons of the three most advanced generations of mobile technologies are given in the Table I.

#### VI. ECONOMICS AND SOCIAL EFFECTS OF 3G, 4G AND 5G IN PAKISTAN

The 5G High speed broadband the internet is one of the

primary ways of transferring information among people. But initially it was only restricted to desktop PC's or Laptops. Later the need of the internet with mobility was raised, so the mobile phones were given the ability to browse the Internet, this was known as GPRS. Now as time passed speed requirement has increased and the need for new technologies such as 3G, 4G and may be in future 5G needs to be deployed Each and every one of these technologies give some economic benefit to the country who adopts it, as well as all of these technologies also tend to have some positive social impact on the country.

Pakistan is one of those countries, which is a late adapter of advanced technologies such as 3G and 4G. Successive governments kept delaying these technologies thus depriving the country and people from the economic and social benefits of these technologies. Now Pakistan has finally adapted these technologies and has auctioned the frequency spectrum on 23 April 2014; thus making it a reality for economic and social benefits of these technologies.

If we talk about economic benefits, a total of 75% of Pakistan's population is a mobile phone user, thus making it a huge market for 3G and 4G. The auction alone gave the government of Pakistan a benefit of about US \$1.12 billion. After the deployment new jobs can be created in the telecommunication sector, businesses would and can completely become mobile.

Social benefits of these technologies are related to every field of life. If we look at the health we can have a doctor's

appointment anytime anywhere, education sector can benefit from these technologies. People living in the rural area can greatly benefit from this technology as there is little or no facility of having broad band internet so now; they can have high speed broadband internet on their mobile phones.

Adaptation of new technologies is in the greater benefit of everyone i.e government and the people. The Pakistani government should now start preparing a road map towards the future technology 5G.

## VII. CONCLUSIONS

In this paper we have done a survey of 5G technology with respect to the existing 3G/4G technologies, and also we have discussed some economic and social impacts on the society if these technologies are adapted. This generation will definitely surpass all the existing wireless data and voice transmission technologies. This technology will surely increase the reliability and scalability of the wireless network. This generation of mobile system will provide services like real time communication, IPTV, VOIP; VPN etc. 5G will definitely have greater advantages over the existing technologies.

## REFERENCES

[1] G. Gu and G. Peng, "The survey of GSM wireless communication system," in *Proc. 2010 International Conference on Computer and Information Application (ICCIA)*, 2010, pp. 121-124.

[2] B. Ghribi and L. Logrippo, "Understanding GPRS: The GSM packet radio service," *Computer Networks*, vol. 34, pp. 763-779, 2000.

[3] A. Dowler, A. Doufexi, and A. Nix, "Performance evaluation of channel estimation techniques for a mobile fourth generation wide area OFDM system," in *Proc. 2002 IEEE 56<sup>th</sup> Vehicular Technology Conference*, 2002, pp. 2036-2040.

[4] E. Dahlman, H. Ekstrom, A. Furuskar, Y. Jading, J. Karlsson, M. Lundevall *et al.*, "The 3G long-term evolution-radio interface concepts and performance evaluation," in *Proc. IEEE 63rd Vehicular Technology Conference*, 2006, pp. 137-141.

[5] J. Govil, "4G: Functionalities development and an analysis of mobile wireless grid," in *Proc. ICETET'08. First International Conference on Emerging Trends in Engineering and Technology*, 2008, pp. 270-275.

[6] M. M. Siddiqui, "Vision of 5G communication," *High Performance Architecture and Grid Computing*, pp. 252-256, Springer Berlin Heidelberg, 2011.

[7] A. Tudzarov and T. Janevski, "Functional architecture for 5G mobile networks," *International Journal of Advanced Science and Technology*, vol. 32, pp. 65-78, 2011.

[8] A. K. Pachauri and O. Singh, "5G technology—redefining wireless communication in upcoming years," *International Journal of Computer Science and Management Research*, vol. 1, no. 1, pp. 12-19, 2012.

[9] A. Rana, K. Kaur, and A. Aggarwal, *Wireless Network (3G & 4G)*, 2007.

[10] A. Gohil, H. Modi, and S. K. Patel, "5G technology of mobile communication: A survey," in *Proc. 2013 International Conference on Intelligent Systems and Signal Processing (ISSP)*, 2013, pp. 288-292.

[11] S. S. Sahoo, M. K. Hota, and K. K. Barik, "5G network a new look into the future: Beyond all generation networks," *American Journal of Systems and Software*, vol. 2, no. 4, pp. 108-112, 2014.

[12] F. Boccardi *et al.*, "Vodafone," *Communications Magazine*, vol. 52, no. 2, pp. 74-80, 2014.

[13] J. R. Churi *et al.*, "Evolution of networks (2G-5G)", in *Proc. International Conference on Advances in Communication and Computing Technologies*, pp. 8-13, 2012.

[14] P. Sharma, "Evolution of mobile wireless communication networks-1G to 5G as well as future prospective of next generation communication network," *International Journal of Computer Science and Mobile Computing*, vol. 2, no. 8, pp. 47-53, 2013.

[15] S. Singh and P. Singh, "Key concepts and network architecture for 5G mobile technology," *International Journal of Scientific Research Engineering & Technology*, vol. 1, no. 5, pp. 165-170, 2012.



**Hamid Asmat** was born in Kurrum Agency (FATA), Pakistan in 1984. He received the MSc and MS degrees in computer science from Sarhad University, Peshawar in 2006 and 2011 respectively. He is currently a PhD candidate at the Faculty of Science and Information Technology, Sarhad University of Science and Information Technology Peshawar Pakistan. His research interests include adhoc networks, wireless sensor networks, bio-inspired networks.



**Sultan Ullah Jadoon** was born in Swabi Khyber Pukhtunkhwa Pakistan in 1981. He received the MSc and MS degrees in computer science from Sarhad University of Science and Information Technology, Peshawar in 2004 and 2010 respectively. He received a PhD degree from the School of Computer and Communication Engineering, University of Science and Technology, Beijing in 2014. He is currently associated as an assistant professor, and the head researcher with Computer and Communication Research Lab, and the Department of Information Technology, University of Haripur. He has published more than 15 research articles in the journals, conferences of international repute. His research interests include access control, network security, information and cloud computing security. He is a member of the International Association of Engineers.