

5G: PERSPECTIVES ON FUTURE TECHNOLOGICAL ADVANCEMENTS IN COMMUNICATIONS

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ABSTRACT

In today's era fast communication and ubiquitous connectivity is the foremost priority. In this paper, an attempt has been made to review various existing generations of mobile wireless technology in terms of their portals, performance, advantage, disadvantage. The paper throws light on the evolution and development of various generation of mobile wireless technology along with their significance and advantage of one over the other. Current research in mobile wireless technology concentrates on advance implementation of 4G technology and 5G technology. Currently 5G term is not officially used. 5G will not only provide high data speed to users but will also provide a great support in the upcoming network technologies. 5G is based on the development of World Wide Wireless Web (www), Dynamic Adhoc Wireless Networks (DAWN) and Real Wireless World. 5G is the need of the society of 2020 and beyond. In this review paper we will be going to discuss about the various generations of wireless, its applications and its architecture on which the mobile terminal has the possibility to change the Radio Access Technology - RAT based on certain user criteria. and many more. Basically, the key concept of our paper are "Evolution from 1G-5G; 5G Network Architecture; Need of 5G."

Keywords: 5G, Communications, DAWN, Wireless Networks, www

I. INTRODUCTION

Wireless is the most active area of technology development of today's world. Evolution of wireless technology was started in 1970's. Mobile wireless technologies have experienced many generations (1G-4G) since evolution. [1] 5G technology will change the means to use cell phones within very high range of bandwidth. It includes all type of advanced features which makes it the most powerful and most demanding in near future. [2] Fifth generation is based on 4G technologies. The 5th wireless mobile internet networks are real wireless world which shall be supported by LAS-CDMA (Large Area Synchronized Code-Division Multiple Access), OFDM (Orthogonal frequency-division multiplexing), MCCDMA (Multi-Carrier Code Division Multiple Access), UWB (Ultra-wideband), Network-LMDS (Local Multipoint Distribution Service). Fifth generation technologies offers tremendous data capabilities and unrestricted call volumes and infinite data broadcast together within latest mobile operating system. Fifth generation should make an important difference and add more services and benefits to the world over 4G. Fifth generation should be more intelligent technology that interconnects the entire world without limits. This generation is expected to be released around 2020. [2] Due to 5G, all the services and applications will be accessed by single IP address as telephony, gaming and many other

multimedia applications. IPv6 (Version of Internet Protocol) is used by 5G. Besides high data rates and large bandwidth, 5G will also offer handling of billions of devices and less network congestion, allowing for better connectivity. The aim of 5G is to supersede the current propagation of core mobile networks with single worldwide core network. [2] With 5G, there would not be a difference between a PC and a mobile phone rather both would act vice versa.

II. 5G NETWORKS

5G network is very fast and reliable. all the services and applications are going to be accessed by single IP. There is only need to make it accessible so that a common man can easily afford the profitable packs offered by the companies so that 5G network could hold the authentic place. [2] To complete with the preceding wireless technologies in the market 5G network has to tender something reliable something more pioneering. All the features like telephony, camera, mp3 player, are coming in new mobile phone models. 4G is providing all these utility in mobile phone. By seeing the features of 4G one can get a rough idea about what 5G Networks could offer.

2.1 5G Mobile Network Architecture

The network architecture for 5G mobile systems, which is all-IP based model for wireless and mobile networks. [2] The system consists of a user terminal (which has a crucial role in the new architecture) and a number of independent, autonomous radio access technologies. Within each of the terminals, each of the radio access technologies is seen as the IP link to the outside Internet world. However, there should be different radio interface for each Radio Access Technology (RAT) in the mobile terminal. For an example, if we want to have access to four different RATs, we need to have four different access -specific interfaces in the mobile terminal, and to have all of them active at the same time, with aim to have this architecture to be functional. The system consists of a user terminal (which has a crucial role in the new architecture) and a number of independent, autonomous radio access technologies. Within each of the terminals, each of the radio access technologies is seen as the IP link to the outside Internet world. However, there should be different radio interface for each Radio Access Technology (RAT) in the mobile terminal. For an example, if we want to have access to four different RATs, we need to have four different access -specific interfaces in the mobile terminal, and to have all of them active at the same time, with aim to have this architecture to be functional. [2] The first two OSI levels (data-link and physical levels) are defining the radio access technologies through which is provided access to the Internet with more or less QoS support mechanisms, which is further dependent upon the access technology (e.g., 3G and WiMAX have explicit QoS support, while WLAN has not) . Then, over the OSI-1 and OSI-2 layers is the network layer, and this layer is IP (Internet Protocol) in today's communication world, either IPv4 or IPv6, regardless of the radio access technology. The purpose of IP is to ensure enough control data (in IP header) for proper routing of IP packets belonging to a certain application connections -between client applications and servers somewhere on the Internet. Routing of packets should be carried out in accordance with established policies of the user.

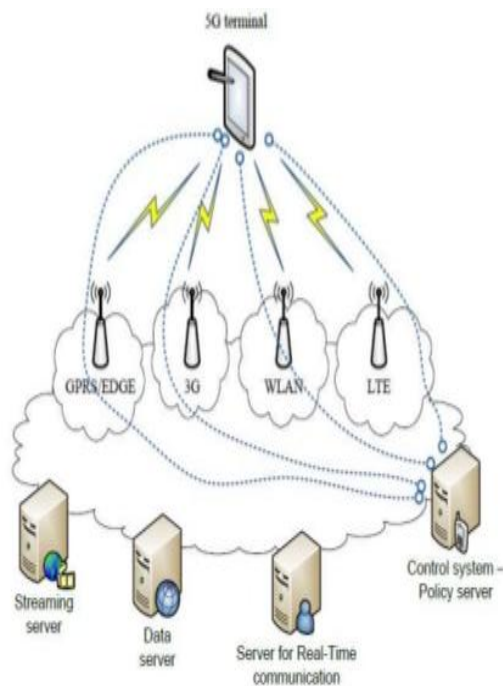


Fig.1 5G Mobile Network Architecture [3]

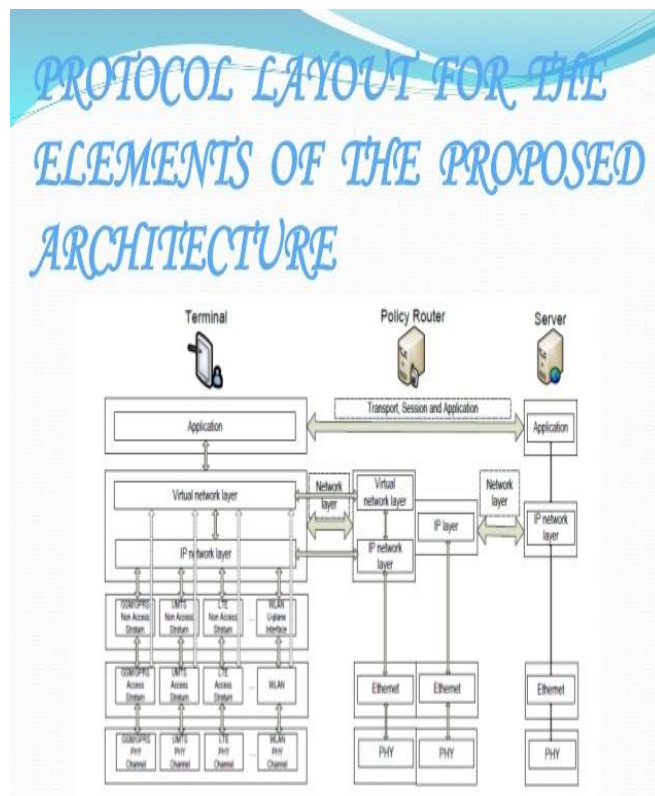


Fig.2 Protocol Layout for the Elements of the Proposed Architecture [4]

The network abstraction level would be provided by creating IP tunnels over IP interfaces obtained by connection to the terminal via the access technologies available to the terminal (i.e., mobile user). In fact, the tunnels would be established between the user terminal and control system named here as Policy Router, which

performs routing based on given policies. In this way the client side will create an appropriate number of tunnels connected to the number of radio access technologies, and the client will only set a local IP address which will be formed with sockets Internet communication of client applications with Internet servers. The way IP packets are routed through tunnels, or choosing the right tunnel, would be served by policies whose rules will be exchanged via the virtual network layer protocol. This way we achieve the required abstraction of the network to the client applications at the mobile terminal. The process of establishing a tunnel to the Policy Router, for routing based on the policies, are carried out immediately after the establishment of IP connectivity across the radio access technology, and it is initiated from the mobile terminal Virtual Network-level Protocol. Establishing tunnel connections as well as maintaining them represents basic functionality of the virtual network level (or network level of abstraction) as shown in figure [2].

III. LITERATURE SURVEY

3.1 Evolution from 1G to 5G

3.1.1 1G

The first generation mobile systems were analogue and was developed in 1980's. Analogue signals had frequency of 150 MHz. These systems rendered handover and roaming capabilities. 1G had low capacities, poor voice links and no security since voice calls were played back in radio towers making those calls susceptible to unwanted third parties [1]. Different 1G standards were used in different countries. One such standard was NMT (Nordic Mobile Telephone), used in Europe and Russia. No data services were available in 1G technology. It was time consuming and supported data band width in kbps. This technology used frequency modulation technique for radio transmission. Unable to interoperate among different countries was its main disadvantage.

3.1.2 2G

Second generations cellular telecom networks were commercially launched on the GSM standard in year 1991. 2G generation used digital communications to operate. This generation overcame the problem of interoperability of mobile network over different countries. 2G cell phone emitted less radio power as compared to 1G technology. SMS (short message service) and MMS (multimedia message service) were the key features of this technology. 2G generation was comparatively secure and had improved voice quality. Band width of frequency per channel was up to 20 KHz with maximum speed up to 64 kbps. In 2G, two schemes such as Time Division Multiple Access (TDMA) and Code Division Multiple Access (CDMA) were used. TDMA allows for the division of signals into time slots and a special code generated by a CDMA for each user in order to communicate over a multiplex physical channel [5]. Complex data such as videos were difficult to handle.

3.1.3 2.5G

2.5G defines that the 2G cellular systems can combine with the General Packet radio Services (GPRS) or other facilities that are not found in 2G or 1G network. It can have a data rate up to 144 kbps and the technologies used in 2.5G are GPRS, EDGE, & CDMA 2000. The major features are Camera Phones, Web Browsing, Send/Receive E-Mail Messages, Speed 64-144 kbps, and Phone Calls.

3.1.4 2.75G

EDGE (Enhanced data rates for GSM evolution) is a phone technology used in this generation. EDGE allows clear and fast transmission of data. EDGE transfers the data in few seconds as compared to GPRS. [1] The

biggest advantage of this technology is that one does not have to install any other hardwires and software for using EDGE.

3.1.5 3G

The third generation mobile systems were designed to provide a very high speed internet access. Some of the most important services this generation provides are video calls, broadband wireless data and other services like mobile television, GPS (Global Positioning System) and other audio and video services. The data is sent through the packet switching technique which is more effective and faster than earlier circuit switched system. Wi-Fi is another key feature of this technology. Band width per frequency channel is upto 20MHz and maximum data transfer speed is upto 3 mbps. 3G technologies make use of TDMA and CDMA. The purpose of 3G was to provide more coverage and evolution with lowest investment. It is little difficult to build the Infrastructure for 3G as it requires large band width.

3.1.6 4G

The fourth generation mobile systems offered very high speeds upto 100mbps. The important feature of 4G systems are high quality audio and video streaming along with multimedia newspaper and ultra-broad band internet access which were not present in 3G[6]. 4G is the current technology used all over the world but there are many countries which are not able to access 4G because of band width related issues. It is entirely packet switched network. High data rates upto 1 Gbps can be achieved. 4G technology has high quality of service and security. The significant features of 4G technology are video conferencing, location based services, telemedicine, high security, speed, capacity and low cost per bit. The two important standards in 4G technology are LTE (Long Term Evaluation) and WiMax (Worldwide Interoperability for Microwave Access). Implementation of hardware is one of the great challenge of this technology moreover exclusive network is compulsory to implement the following generation network[7].

3.1.7 5G

5G network will be very fast and reliable. The concept of hand held devices is going to be revolutionized with the advent of 5G[5]. In 5G technology all the services and applications will going to be accessed by single IP as telephony, gaming and many other multimedia applications. The 5G will be called as Real world wireless or www worldwide wireless web because it does not require limitations. Bidirectional bandwidths, less traffic, equally availability of network across the world, 25Mbps connectivity speed, data bandwidth higher than 1GB and low cost will be the main features of 5G technology. The 5G technology will distribute internet access to nodes within the building and can be deployed with union of wired or wireless network connections. 5G technology will have extraordinary capability to support software and consultancy. 5G technology has a bright future because it can handle best technologies and offer priceless handset to their customers.[8]

Evolution of mobile phone communications

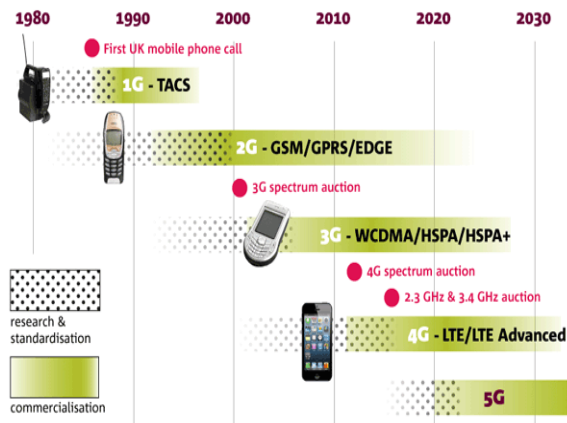


Fig.3 Evolution of Mobile Phone Communications.

IV. USEFULNESS OF 5G

4.1 How 5G Will help in Making Life Easy

5G will help in a number of ways in making life easy, simple and interesting. List of such are given below:

- In remotely controlled devices or even self-driven cars.
- In health sector such as Telemedicine [9].
- Lightning-fast responses.
- Device to device communications.
- Wearable devices with AI (Artificial Intelligence) technology.
- Lower out age probability; better coverage and high data rates available at cell edge.[2]
- Lower battery consumption and Multiple concurrent data transfer paths.
- Around 1Gbps data rate in mobility[10].
- More secure; better cognitive radio/SDR Security.Higher system level spectral efficiency.

V. CURRENT SCENARIO

Today's current advanced technology is LTE advanced which provides the peak download speed of 1Gbps and upload speed of 512Mbps[11].The current 4G LTE system uses advanced technologies such as OFDM, MIMO and sophisticated radio resource management algorithms. The fundamental concepts of 5G are being evolved and developed from the existing technology.

5.1 Significant 5G Initiatives Till Date [10]

Year	5G initiative	Entity	Country
2008 , November	5G system based on Beam Division Multiple Access	South Korea IT R&D department	South Korea.
2012 May	First 5G system	Samsung Electronics	South Korea
2012 October	5G Research Center	University Of Surrey	United Kingdom
2013 November	Research on 5G system	Huawei Technologies Co. Ltd	China

VI. APPLICATIONS OF 5G TECHNOLOGY

There are a number of applications of 5G such as :

- Real wireless world with no more limitation with access and zone issues.
- Wearable devices with AI capabilities.
- Internet protocolversion 6(IPv6), where a visiting care-of mobile IP address is assigned according to location and connected network.
- One unified global standard.
- Cognitive radio technology, also known as smart radio: allowing different radio technologies to share the same spectrum efficiently by adaptively finding unused spectrum and adapting the transmission scheme to the requirements of the technologies currently sharing the spectrum. This dynamic radio resource management is achieved in a distributed fashion, and relies on software defined radio.[2]

VII. CONCLUSION

In this paper, we have focused on 1st, 2nd, 3rd and 4th generations of mobileCommunication technology and predicted about upcoming 5th generation. 1G was based on analog signal and usually used for voice call only with speed up to 10kbps. The 2nd generation is based on digital signal. In 2G one additional feature of text messaging is present in context to 1G with speed up to 64kbps. Further 3G is introduced and in comparison to 2G it is much better because of faster speed than 2G i.e., up to 3.1Mbps. 3G is based on high broad band data and provides digital navigation as well as video access. After 3G 4G is introduced with HD multimedia streaming with speed up to 40Mbps. Further In this paper we conclude that the upcoming 5G technology will be the most important and the fastest technology of the wireless communication world for an example a movie can be downloaded within a seconds. It is a real wireless world with no more limitation with access and zone issues.

VIII. FUTURE SCOPE

8.1 Beyond 5G

If 5G will be implemented, it will prove a boon for the society as it will create lot of opportunities of development in sectors like health sector, IT sector, ROBOTICS, AUTOMOBILE sector etc. It will make the life more interesting and simple and connect the world in a close network. It is the base of the development of the generation 2020 and beyond . With the advancement of 5G technology,bandwidth can be utilized in an efficient manner and reduce the operational expenditure cost. Development of 5G is not just replacing the current existing technologies, but it is a matter of evolving and complementing new technologies.[2]The future enhancement of Nano-core will be incredible as it combines with artificial intelligent (AI).One can able to control his intelligent Robot using his mobile phone. Your Mobile can automatically type the message what your brain thinks. We might get a circumstance where we don't require any spectrum for communication. The Google hot trends have rated the term 6G as the 17th most searched word in the search engines. The iPod 6G comes in seven different colour and has an aluminium body which makes the body strong to with stand constant daily usage. It has a clip on design like iPod shuffle and it attached to shirt firmly. 6G technology haven't been fully revealed yet but search phrases like what is 6G mobile technology, 6G technology, 6G mobile, 6G network, 6G wiki, 6G technology ppt. are getting more familiar with new mobile technology getting evolved.

REFERENCES

- [1] Mudit Ratana Bhalla ,Anand Vardhan Bhalla , Generations of Mobile Wireless Technology : A survey , Volume 5- No.4 , International Journal of Computer Applications(0975-8887) , August 2010.
- [2] Meenal G. Kachhavay, Ajay P.Thakare, 5G technology-Evolution and Revolution,Volume.3,Issue. 3,IJCSMC,March 2014.
- [3] Data electronically available at-<http://www.slideshare.net/vineetkathan/5gwirelessssysteme>,Data accessed on 12september2015.
- [4] Data electronicallyavailable at-<http://www.slideshare.net/gkbiosterminator/5g-29006273> ,Dataaccessed on 15 september2015.
- [5] S.Venkata Krishna Kumar,Poornima.T.V, A study of wireless mobile technology,Volume 4,Issue 1,International journal of advanced research in computer science and software engineering, January 2014.
- [6] Author-SanskarJain,NehaAgrawal,Mayank Awasthi, 5G-The future of mobile wireless communication network, Volume 3,ISSN 2231-1297, pp. 569-574Number 5 (2013).
- [7] Data electronically available at-<https://en.wikipedia.org/wiki/4G>,Date accessed on-2september 2015.
- [8] Data electronically available at-<http://www.slideshare.net/TechUK/tech-uk-communication-policy-council-workshop-spectrum-above-6ghz-chairman-notes>,Data accessed on 16 September2015.
- [9] Data electronically available at-<http://www.connect-world.com/index.php/magazines/europe/item/25775-how-5g-will-change-the-world>, Author-LauriOksanen, Data accessed on-23august 2015.
- [10] Ramjee Prasad, Global ICT Standardisation Forum for India(GISFI) and 5G Standardization,,Journal of ICT standardization,Volume 1-No.2,pp.123-136.
- [11] 5th generation mobile networks , Wikipedia [online] Data Available at URL: <http://en.wikipedia.org/wiki/5G>, Data Accessed on 8 September 2015.