



5thG

An innovation in Mobile Communication Technology

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Abstract

In our daily life every day, we face new technology which provides new and better performance. Now a day 4G and 5G are most emerging trends in the telecommunication system. 5G is upcoming technology and still under experimental condition and might be launched commercially in 2020 and it will offer 1Gbps internet speed. The first generation based on Frequency Division Multiplexing (FDM). It was the first analog mobile communication system which supported only audio calls. 2G or Second Generation is considered the most renowned and influential in the communication world. It is also named the Global system of mobile communication (GSM). A Universal Mobile Telecommunication System (UMTS) based technology which provides greater speed up to 2 Mbps or slightly exceed. By introducing third generation, a new service has added such as video call. The fourth generation(4G) is based on the standards of LTE(Long Term Evolution) and ()WiMAX, which offers speeds of up to 173 Mbps, that has been modified to reach 225 Mbps using new standards ()LTE-A, that enables you to download a movie at 800 MB in less than half a minute.

Background

A new generation of wireless communications is considered as the fourth stage of the revolution mobile trade ⁵. This enables connectivity between different objects and machines all over the world. During 1950's and 1960's, there was deployment of the first commercial analog mobile communication system with low penetration. In 1991, the 2G Global system for mobile communications (GSM) network was installed internationally which permits digital transmission and switching technology ⁵. 2G network provides Improvement in quality of voice and capability of network. It also provides supplementary

services as Short message service (SMS).General packet radio services (GPRS)

is an evolution of 2G known as 2.5G that provides Packet-switched data services. There was further evolution of GSM in Boosted Data Rates for Global Evolution (EDGE).

CDMA was implemented by the European Telecommunications Standards Institute (ETSI) in two modifications i.e. Wideband Code Division Multiple Access (WCDMA) and Time Division CDMA (TD-CDMA) and called it a (UMTS) which was the major 3G mobile communication



Evolution of cellular standards

system.The new specifications were developed by 3rd generation partnership project (3GPP) which is named as 3.5G.After that there were number of publications that signifies the evolution of 3G to 4G LTE.

Keywords:

5th Generation, Global System for Mobile Communications(GSM), European Telecommunications Standards Institute (ETSI), Universal Mobile Telecommunication System (UMTS), General Packet Radio Services (GPRS), Wi MAX.

Problem Statement:

The primary goal of this research Paper is to enable synchronized connectivity across

multiple available network interfaces in a unified and efficient manner on mobile devices and Desktop Broadband which is not fulfilled by 3g and 4g.

I. Introduction

Mobile communication any time, any place and the station is a technique in which the entities. From the perspective of communication networks, mobile networks of wired communication networks can be seen as an extension, therefore, the two parts of a mobile network, which consists of wireless and wired. Internet and mobile communications on the subject were found through the library, but video conferencing is focused on the research paper about Wi MAX via 3G and 4G, is not about quality assurance. The goal of the research is to evaluate the usability of 3G and 4G and ensure quality of telecommunication quality of telecommunication quality environment and also in rural areas for purposes all over Pakistan for same services, Different for the quality of the wireless signal transfer method using. 3G model and its usability for people living far from the city to improve the quality of services that can help. 3G and 4G in rural areas compared with the analysis are much easier to be established.

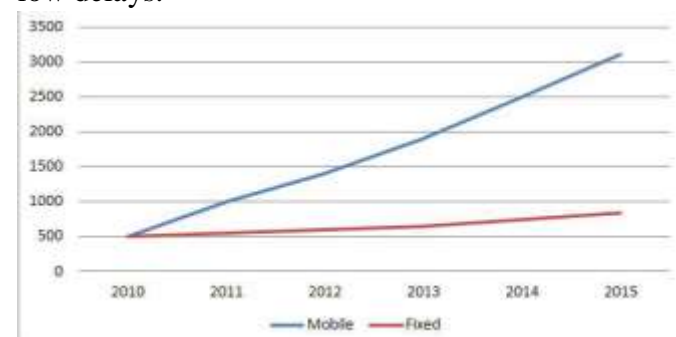
II. Motivation

The telecoms trade is at an early stage in the development of 5G. There is still much life missing in LTE networks – with a wide range of standards-compliant network features being developed by vendors and deployed by operators that improve the performance of LTE. But analysis of major trends by many in the industry has led to a compromise that evolution of LTE needs to be complemented with a radical change within the next few years in the fundamentals of wireless networks – a generational swing in technology and architectures and business processes – in order to ensure the industry continues to meet market demand for wireless services as they evolve, and to stimulate new economic and social development.³

Mobile broadband networks from a crucial part of our daily life along with the development of small and multi-purpose mobile devices such as tablets and smart phones and the availability of height capacity 3G and 4G/LTE Internet services⁶. Broadband traffic has grown rapidly and is being estimated to grow by 66% annually until 2017. If users are not satisfied with the connectivity and Quality service performance of the Broadband networks they have subscribed to, it is natural that they change the Internet service even if it costs more to new service. Therefore, it is important to provide reliable Broadband services with good performance.

There are still issues related to performance of Broadband especially under mobility. In order provide realistic performance information to many participants and assuming quality of services to the subscribers of broadband networks, detail study is needed about the performance, stability and reliability under mobility^{3,6}.

In 2015, 4G networks were mounted practically which are currently being deployed throughout the globe that provides data rated in 100Mbps for high mobility users and 1 Gbps for stationary users. But the request for data rates of the order of many Gbps has been growing due to increase in video traffic and ultra-high definition video streaming. These outcomes in the primer of 5G that will provide wireless networks to match data rates at very low delays.



Numerous of Mobile versus Fixed Broadband Subscription 2010 to 2015

III. Evolution of Wireless Technologies

Mobile communication has become more widespread in last few years due to fast

revolution in mobile technology. This mutiny is due to very high increase in telecoms customers. This revolution is from 1G- the first generation, 2G- the second generation, 3G- the third generation, and then the 4G- the fourth generation, 5G- the fifth second generation.^{1,8}

A. First Generation (1G)

1G emerged in 1980s. It contains Analog System and commonly known as cell phones. It introduces mobile technologies such as Mobile Telephone System (MTS), Advanced Mobile Telephone System (AMTS), Improved Mobile Telephone Service (IMTS), and Push to Talk (PTT) ⁸. 1G uses analog radio signal which have frequency 150 MHz, voice call modulation is done using a technique called Frequency-Division Multiple Access (FDMA). It has low capacity, unreliable handoff, poor voice links, and no confidence at all since voice calls were played back in radio towers, making these calls vulnerable to unwanted spying by third parties.¹

B. Second Generation (2G)

2G developed in late 1980s. 2G uses digital signals for voice transmission and has speed of 64 kbps. This one provides facility of SMS (Short Message Service) and use the bandwidth of 30 to 200 KHz. Next to 2G, 2.5G system uses packet switched and circuit switched domain and provide data rate up to 144 kbps. E.g. GPRS, CDMA.¹

C. Third Generation (3G)

It uses Wide Brand Wireless Network (WBWN) with which clarity is increased. The data are directed to this technology called Packet Switching. Voice calls are interpreted through Circuit Switching. Along with vocal communication it includes data services, access to television/video, new services like Global Roaming. 3G operates at a range of 2100MHz and has a bandwidth of 15-20MHz used for High-speed internet service, video chatting. 3G uses Wide Band Voice Channel that is by this the world has been contracted to a Global village because a person can contact with other person located in any part of the world and can even send messages too.¹

D. Fourth Generation (4G)

4G compromises a downloading speed of 100Mbps. 4G provides same feature as 3G and additional services like Multi-Media Newspapers, to watch T.V programs with more clarity and send Data much faster than previous generations. LTE (Long Term Evolution) ⁷ is considered as 4G technology. 4G is being developed to provide accommodations the .Quality Of Service (QoS) and rate requirements set by forthcoming applications like wireless broadband access, Multimedia Messaging Service (MMS), video chat, mobile TV, HDTV content, Digital Video Broadcasting (DVB), minimal services like voice, data and other services that utilize bandwidth.¹

IV. COMPARISION OF 1G TO 5G ²

Content	1G	2G	3G	4G	5G
Start	1970	1990	2004	NOW	SOON (2020)
Data BW	2KBPS	64KBPS	2MBPS	1GBPS	>1GBPS
Multiplex	FDMA	TDMA	CDMA	CDMA	CDMA
Switching	Circuit	Circuit	Packet	All Packet	All Packet
Core Network	PSTN	PSTN	PACKET N/W	Inter-Net	Inter-Net

V. 5G ARCHITECTURE

Fifth generation mobile systems model is all-IP built model for wireless and mobile networks interoperability. The All-IP Network (AIPN) is proficient to fulfill increasing demands of the cellular communications market. It is a mutual platform for all radio access technologies. The AIPN uses packet switching and its uninterrupted evolution provides optimized performance and cost. In fifth generation Network Architecture consist of a user terminal (which has a crucial role in the new architecture) and a number of independent, autonomous Radio Access Technologies (RAT).⁹

In 5G Network Architecture all IP based mobile applications and amenities such as Mobile portals, Mobile commerce, Mobile health care, Mobile government, Mobile

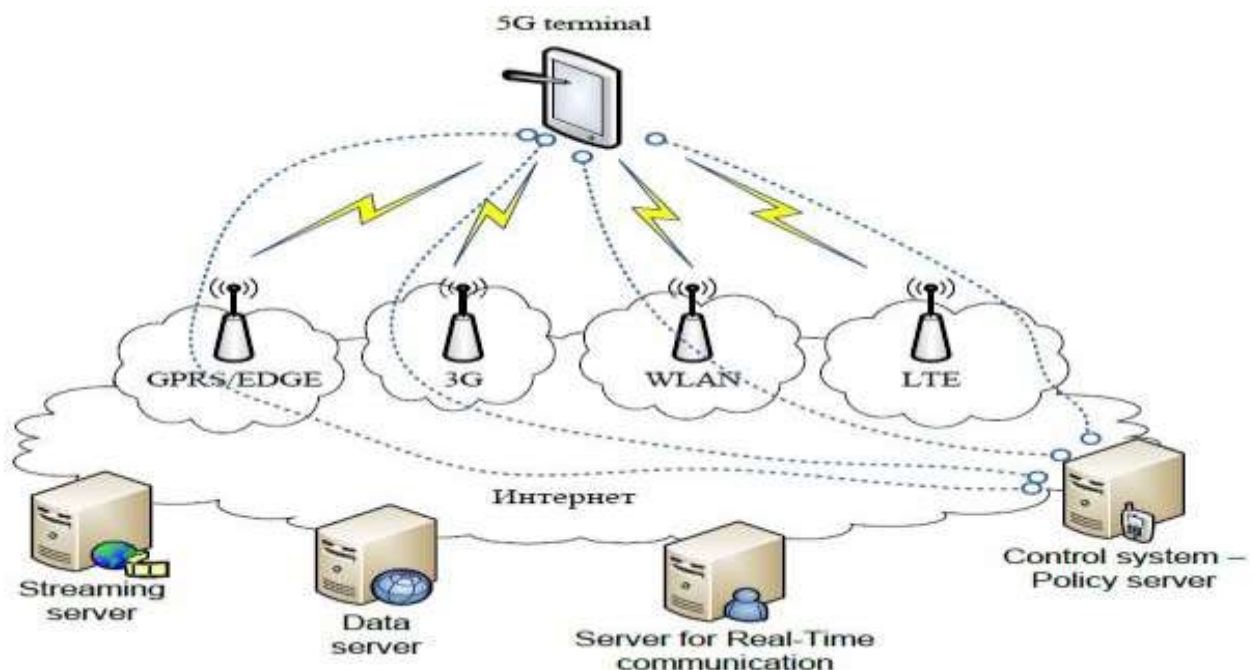
banking and others, are offered via Cloud Computing Resources (CCR). Cloud computing is a model for appropriate on-demand network access to configurable computing resources (e.g., networks, servers, storage, applications, and services). Cloud computing allows consumers to use applications without installation and admittance their peculiar data at any computer with internet access. Cloud Computing Resources (CCR) links the Reconfigurable Multi Technology Core (RMTC) with remote reconfiguration data from RRD attached to Reconfiguration Data models (RDM). The key challenge for a RMTC is to transaction with increasing different radio access technologies. The vital is a convergence of the nanotechnology, cloud computing and radio, and based on All IP Platform. Core changes its communication functions depending on status of the network and/or user demands.⁵

insignificant management effort or service provider interaction...” a definition from. Therefore, cloud computing is a technology that uses the internet and central remote server to maintain data and applications. In 5G networks this dominant remote server could be a content provider. Cloud computing tolerates consumers and business to use applications without installation and access their personal files at any computer with internet access. The same notion is going to be used in multi -core **5G Network Architecture**

technology where the user tries to access his private account form a global content provider through cloud computing.

VII. QUALITY OF SERVICE (QoS)

Next Generation Networks (NGN) comprises



VI. CLOUD COMPUTING

Cloud computing is a prototypical for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be quickly provisioned and released with

of support functionalities for data transport, and control transport, as well as functionalities for support of services and applications. The measurement of traffic is a basic control activity in order to provide Quality of Service.¹⁰ In addition 5G communication system is designed by the finest Quality of Service (QoS).⁸

Quality of Service (QoS) states to a network's ability to achieve maximum bandwidth and deal with other network performance elements like latency, error rate and uptime. Quality of service also implicates controlling and managing network resources by setting priorities for specific types of data (video, audio, files) on the network. QoS is absolutely applied to network traffic generated for video on demand, IPTV, VoIP, streaming media, videoconferencing and online gaming.

The Prime goal of quality of service is to

provide priority to networks, including dedicated bandwidth, controlled jitter, low latency and improved loss characteristics. Its technologies stock the essential building blocks that will be used for future business applications in campus, wide area networks and service provider networks. There are three Fundamental Components for basic QoS implementation.

- Identification and marking techniques for coordinating QoS from end to end between network elements.
- QoS within a single network element.
- QoS policy, management, and accounting functions to control and administer end-to-end traffic across a network.

VIII. WHY 5G?

- ✚ Very High speed, high capacity, and low cost per bit.¹¹
- ✚ It supports interactive multimedia, voice, video, Internet, and other broadband services, more effective and more attractive, and has Bi- directional, accurate traffic statistics.¹¹
- ✚ 5G technology offers Global access and service portability.¹¹
- ✚ 5G offers the high quality services due to high error patience.
- ✚ It is providing large broadcasting aptitude up to Gigabit which supporting almost 65,000 connections at a time.
- ✚ More applications mutual with artificial intelligent (AI) as human life will be

surrounded by artificial sensors which could be communicating with mobile phones.

- ✚ 5G technology use isolated management that user can get better and fast solution.
- ✚ The uploading and downloading speed of 5G technology is very extraordinary.¹²
- ✚ 5G technology offer high resolution for crazy cell phone user and bi-directional large bandwidth shaping.¹⁰
- ✚ The traffic measurements by 5G technology makes it more accurate.¹⁰
- ✚ The high quality services of 5G technology based on Policy to avoid error.¹⁰

IX. Risks and Challenges

Regarding with the perspective features and services offered by 5G, one gets quite fascinated about the power and abilities of this technology. Still, to achieve the full benefits of anticipated features of 5G there are some challenges to overcome and make those features realizable. Below is brief discussion on some of the important challenges for 5G technology.^{2,15}

A. Cognitive Radio

With the increasing number of mobile phone subscribers and growing demand for better coverage and data rates, frequency spectrum is becoming a scarce resource.¹³ So far, telecommunication industry is relying dedicated frequency spectrum for mobile communication. frequency spectrum is further divided into sub spectrums and licensed to different service providers/operators. In case this licensed spectrum runs out, despite its most efficient use, there is need to find some other ways to increase availability.¹³ one way is to use unlicensed spectrum, which is dedicated to other types of communication, to cover the short fall in licensed spectrum.¹⁶ However, doing so requires great care to be taken so that usage of unlicensed spectrum does not reduce those communications for which this spectrum was reserved. Unlicensed spectrum can turn as secondary spectrum for operator only if it is spare and unused. This approach needs perpetual monitoring of unlicensed spectrum and taking advantage of idle frequency channels. This approach is

called Cognitive Radio. The applicability of cognitive radio in wireless mobile communication is relatively new concept and further studies are needed to assess the viability and impact of such usage.²

B. Network Energy Efficiency

Energy consumption has always been a fundamental issue in any electrical and electronic design. With the miniaturization of hardware battery size has also been inadequate. Efficient use of available battery to extend the battery time has been focus of many researches. In the past, energy efficiency of handheld devices was of paramount interest but today energy consumption in radio access networks¹⁷ is also receiving growing attention because energy cost constitutes a significant portion of overall operational cost for the operator. If sufficiently energy efficient solution are figured out, reasonably sized solar panel can replace diesel fueled generator resulting is substantial cut down of operational cost.²

C. Machine Type Communication

Quick expansion of Machine Type Communication (MTC or M2M) is not only a potential source of revenue for operators but also a potential source of traffic on wireless networks. It is expected that M2M devices are expected to outnumber ordinary mobile phone subscribers by at least 2 to 1 in the near future. Handling such overwhelming traffic is sure to pretense a great challenge for the core network. So, improvements in connection setup and proficient handling of control signals in radio access network for 5G technology are desperately needed.²

D. Software Defined Radio

Cognitive Radio is a vigorous resource management technique and is implemented in a distributed fashion. Cognitive Radio relies on Software Defined Radio which takes advantage of high processing power of today's hardware to develop multiband, multi-standard base stations and terminals. Currently this is being done by the structure but it is expected that in future, terminals will be able to adapt the air interface to the available access technology.

For 5G systems, software defined radio will show its role more actively by enabling the terminals to configure dynamically through software download. This approach can be very attractive for manufacturers because they will be able to produce multiband, multi-standard hardware with far less development effort and manufacturing cost.²

X. CONCLUSION

The expansion of the mobile and wireless networks is going towards higher data rates and all-IP principle. Mobile terminals are procurement each year more processing power, more memory on board, and longer battery life for the identical applications. 5G comprise latest technologies such as cognitive radio, SDR, nanotechnology, cloud computing and based on All IP Platform. It is estimated that the initial Internet philosophy of keeping the network simple as possible, and giving more functionalities to the end nodes, will become reality in the future generation of mobile networks, here stated to as 5G.

XI. Acknowledgements

The authors would like to thank **Afro Asian Institute, Lahore** Affiliated with Government College University Faisalabad (GCUF) for the support provided to carry the research work presented in this paper.

XII. References

1. **5G WIRELESS TECHNOLOGIES** by Ganesh R. Patil Prof. Prashant S.Wankhade IJCSMC, Vol. 3, Issue. 10, October 2014.
2. **4G and 5G Mobile Communication Networks: Features Analysis, Comparison and Proposed Architecture** By Abdullah Al Mamun, , Sultan Anwar and Hassan Ali Dept. of Computer Engineering, King Fahd University of Petroleum & Minerals, KSA.
3. **The Road to 5G: Drivers, Applications, Requirements and Technical Development**

4. Review on 5G Wireless Technology by Ravali Kollil,

Swetha Mile, Shreya Shetty, Dr. Sunanda Dixit.

5. 5G Technology Introduction by TELECOMO an ISO certified Company. <https://telcomaglobal.com>.

6. 5G Network Architecture-A High Level View. BY HUAWEI TECHNOLOGIES CO.LTD

7. <https://www.lifewire.com/lte>

8. Evolution of Mobile Wireless Technology from 0G to 5G by Mohammad Meraj ud in Mir and Dr. Sumit Kumar /Mohammad Meraj ud in Mir et al, / (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 6 (3) , 2015, 2545-2551.

9. Design for 5G Mobile Network Architecture. International Journal of Communication Networks and Information Security (IJCNIS) Vol. 3, No. 2, August 2011.

10. 5G Technology of Mobile Communication: A Survey by Asvin Gohil, Hardik Modi, Shobhit K Patel. Charotar University of Science and Technology. Changa-388421, Gujarat.

11. 5G Mobile Technology by Ms. Reshma S. Sapakal Ms. Sonali S. Kadam, Computer Science and Engineering Department, Shivaji University Arvind Gavali College of Engineering, Panmalewadi, Varye, Satara, Maharashtra, India

12. The Impact of Existing and Future Mobile Technologies on Pakistan: A Survey by Hamid Asmat and Sultan Ullah

13. Cognitive Radio in 5G , A Smart City Perspective by Eberchukwu PAULSON, Mohamad KAMALUDIN, Sharifah KAMILAH, Umar DAUDA, Faculty of Electrical Engineering, University Technology Malaysia, 81310 UTM Skudai, Johor Bahru, Malaysia.

14. 5G Spectrum Sharing KEYNOTE, CROWNCOM 2017 by Maziar Nekovee, Department of Engineering and Design, School of Engineering and

Informatics, University of Sussex Brighton BN1 9RH, UK

15. Emerging Technologies and Research Challenges for 5G Wireless Networks by Woon Hau Chin, Zhong Fan, and Russell Haines Toshiba Research Europe Limited, Bristol, BS1 4ND, United Kingdom

16. Spectrum Considerations for 5G Mobile Communication Systems by Guntis Ancansa , Vjaceslavs Bobrovs , Arnis Ancans, Diana Kalibatiene

17. 5G IN RURAL AND LOW-INCOME AREAS: ARE WE READY? by Luca Chiaraviglio,¹ Nicola Blefari-Melazzi,^{1;2} William Liu,³ Jairo A. Gutierrez,³ Jaap Van De Beek,⁴ Robert Birke,⁵ Lydia Chen,⁵ Filip Idzikowski,⁶ Daniel Kilper,⁷ Paolo Monti,⁸ Jinsong Wu,⁹

18. A Survey of 5G Network: Architecture and Emerging Technologies by A. Gupta and R. K. Jha



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