A Review of Issues and Challenges in 5G Evolution

Usman Ali[*], Siddiq Ali[†], Farman Ali[‡], Maqsood Ahmad Khan[§], Muhmmad Salman Qamar[**],Shabbir Ahmad[††]

Abstract

Now a days the demands of high bandwidth capacity, huge number of users in communication systems are highlighted goals. To utilize users with these demands the 4G technology is limited due to saturated facilities. Thus, a new approach is necessary to fulfil the user's demands like on-line services and long-range transmissions. In this paper the new 5G technology is reviewed and a future direction is discussed in terms of latency rate, reliability, privacy and quality of service. Moreover, the background of the previous generation like 1-G, 2-G, 3-G and 4-G are analyzed including their framework, performance and quality of service in this paper. The outcomes of proposed system are compared with current model.

Keywords: generations of wireless communication technology, offered services of 1-G, 2-G, 3-G and 4-G technologies, Expectation from 5-G technology.

Introduction

It is developing extremely fast in present times and deals with all the fields of mobile and wireless communications. The wireless setup is part of Stone Age technology, where people were utilizing fire for sending signs from one location to another. Furthermore, with the passage of time due to demand of communication network the ideas towards modern network are adopted. The speed of this adaptation is increased rapidly from last decade, including transmission range, bandwidth capacity and privacy.

[*]Department of Electrical Engineering, Qurtuba University of Science and IT, D. I. Khan, 29050, KP, Pakistan, Email: usmanali@qurtuba.edu.pk

[†]Department of Electrical Engineering, University of Engineering and Technology, Peshawar, Pakistan, siddique.ali@gmail.com

[‡]Department of Electrical Engineering, Qurtuba University of Science and IT, D. I. Khan, 29050, KP, Pakistan: Email: drfarmanali.optics@qurtuba.edu.p

[§] Department of Electrical Engineering, Qurtuba University of Science and IT, D. I. Khan, 29050, KP, Pakistan, Email: maqsood@qurtuba.edu.pk

[**]Department of Electrical Engineering, Qurtuba University of Science and IT, D. I. Khan, 29050, KP, Pakistan, Email: mskhan131@qurtuba.edu.pk

[††] Khyber Tobacco Company Limited Mardan, Mardan 23200, Pakistan; Shabbirahmad1992@gmail.com

The rapid growth in the communication technology is divided into
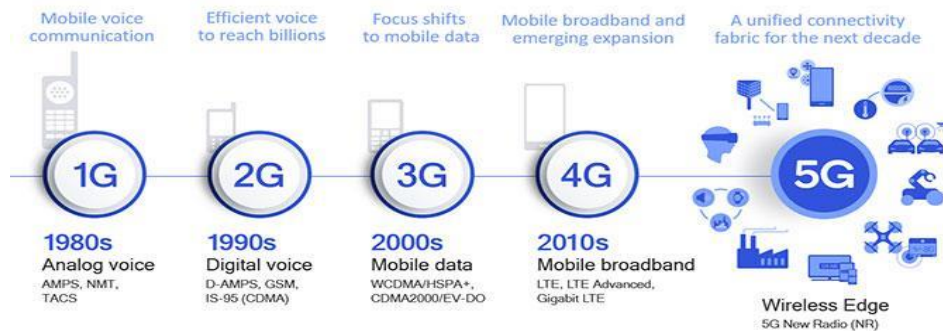
different generations called 0-G, 1-G, 2-G, 3-G, 4-G and the 5-G al, F. A. (n.d.)Each evolution has tremendously change the way of life in several scenarios like business, education, health and privacy etc. the main theme of the designing of every new generation is to manage the use demands in terms of security and bandwidth capacity Atanasovski, V., & Leon-Garcia, A. (2015). It also helps to support new facilities for the users like real time data and online services. It is therefore, to compensate the limitations of 4-G technology is replacing by 5-G in current era Baharom, B., & Ali, M. (2017). Now a days w-less and mobile technology are going towards over all Internet Protocol basis Haerick, W., & Gupta, M. (n.d.). Figures 1 and 2 presents the summary.

Figure. 1: Applications of 1G to 5G Technologies
Figure. 2: Summary of 1-G to 5-G Technologies

This paper investigates each generation of w-less technologies briefly and discusses the future directions.

Zero Generation

Zero generation (Z-G) is the beginning of the wired technology which was designed for the purpose of switching. The Z-G supports the technologies, including Mobile Telephone System (MTS), and Mobile telephony system (MTD) technologies.
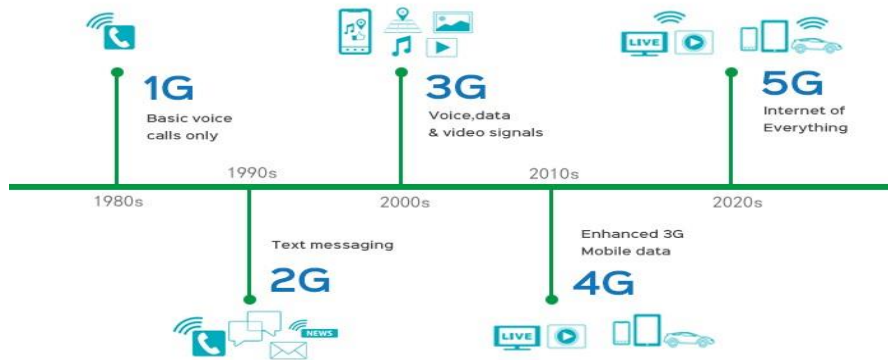
First Generation (1-G)

The duration of 1-G was from 1980 to 1990. Where it's all responsibilities of services transfer to 2-Generation. These are the analog telecommunications standards that were introduced in the 1980s and continued until being replaced by 2G digital telecommunications. The main difference between the two mobiles

cellular systems (1G and 2G), is that the radio signals used by 1G networks are analog, while 2G networks are digital.

Figure 3: Sample of 1-G mobile Phones

Second Generation (2-G)

This technology jumps towards the 64kbps data rate with new modern standards and providing better capacity to its subscribers. This technology was launched in 1990's and replaced by 3-G in 2000. The key change from first-G was digital system from analogue. The services which were provided by 2-G are Short Message Service (SMS), fast switching and voice calling. Figure 4 represents the samples of 2-G mobile phones.

Figure 4: Sample of 2-G mobile Phones

Third Generation (3-G)

The packet switching technology was first applied in 3-G services which improved the performance of w-less communication framework. This technology is launched in 2000 and still provides internet services, calling and video services to its users. Moreover, the quality of sectors like businesses, health and education are modified by 3-G systems. The standards such as CDMA 2000, EVDO, IXRTT and WCDMA are used in 3-G technologies. In addition, 3-G offers huge capacity for transmitting and receiving over long range. Figure 5 represents the samples of 3-G mobile phones.

Figure 5: Sample of 3-G mobile Phones

Fourth Generation (4-G)

The fourth generation (4-G) is a conceptual framework which issues huge capacity w-less networks that can transmit multimedia, data. Furthermore, it supports more than 100 Mbps data rate in full-mobility wide area coverage and 1Gbps in low-mobility local area coverage Mudrakola, S. (2019). E-mail, message and contacts are synchronizing easily and give power to users. 4G have broader bandwidth, high data rate and smooth as well as quicker handoff etc. [13-15]. It can support the speed beyond to 100 Gbps speed. The main feature of this technology is to support the previous generations as mentioned in Figure 6.
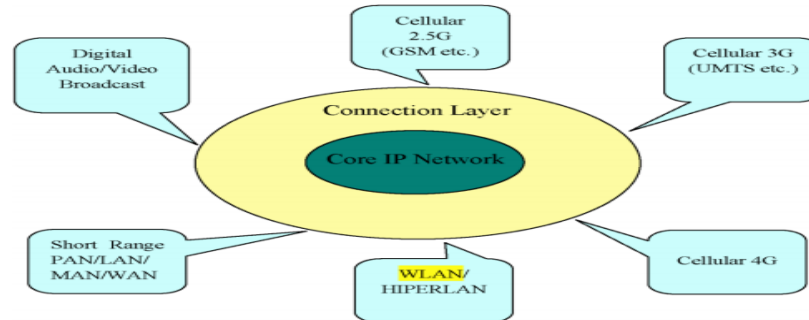
Figure 6: Connection of 4-G with previous generations

The 4-G is upgraded by Long Term Evolution (LTE), aiming to increase the capacity and data rate for the users which was further modified by OFDMA, SCFDMA and IMT standards. Figure 7 displays the 4-G mobile phones. However, the issues like battery charging and complex applications are induced with this modern technology to handle these issues the researchers are working for the 5-G technology.

Figure 7: Sample of 4-G mobile Phones

Fifth Generation (5-G)

The flexible technology is the main need of modern era which can avail users with HD live streaming, online services with low latency and high securable environment. Thus, the researchers have worked on 5-G which includes features like less complex application with accurate performance, easy to access and simple model which helps their users to cluster all globe. In 5-G technology the OFDM modulation scheme is modified by using advance filtering techniques like filtered-OFDM and universal filtered-OFDM. This procedure helps to manage the boost demands and support the previous mechanisms. The estimated model for 5-G mobile phones is shown in Figure 8. The architecture of 5-G is explained in 5-G.
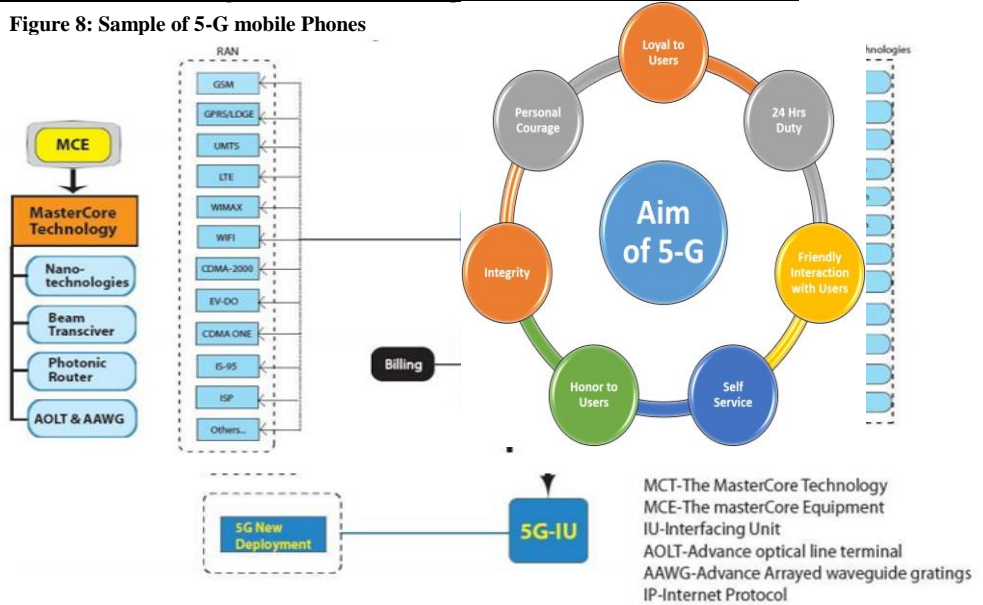
Figure 8: Sample of 5-G mobile Phones

MCT-The MasterCore Technology
MCE-The masterCore Equipment
IU-Interfacing Unit
AOLT-Advance optical line terminal
AAWG-Advance Arrayed waveguide gratings
IP-Internet Protocol

Figure 9: Architecture of 5-G.

Key Aims of 5-G.

The key aims of 5-G are elaborated in Figure 10, which explains that the 5-G users expected reliable framework with better latency and security and without any discontinuity. Figure contains the cycle of aims

of 5-G in detail.

Figure 10: Aims of 5-G.

Key Features of Pent-Generation:

5-G technology provides the services like easy implementation and installation of new software's, better speed, high reliability, supporting all previous technologies, efficient life cycle, and able to

support the protocols like TCP, IPv4 and IPv6. Moreover, all services by 5-G will be performed without human interaction because it is self-organized technology. The smart phone will consist of its own home address and IP address which will decrease the ratio of crime and hacking. Friendly interaction will be allowed for its users with self-programming system. 5-G has WISDOM service ability and can utilize it users from everywhere and anytime. The fast downloading and uploading is another important feature of 5-G with tremendous speed.

Quality of service of 5-G:
        The 5-G contains the following quality of services as compare to 1G, 2-G, 43-G and 4-G.
- ✓ The economy of a country and organization will be increased several folds because of online services.
- ✓ The hacking and crime acts will be decreased because of self-security system. It informs users in case of any unwanted interruption with smart device.
- ✓ It includes the same properties from entire globe so structure complexity is minimized.
- ✓ It will include unique structure and manner for the users which will decrease the distortions in the system.

5-G Comparison with Previous Technologies.
        Table 1 explains the comparison of 5-G technology with current installed technologies, which clarifies the fruitful features of 5-G as compare to 1-G, 2-G, 3-G and 4-G.

Conclusion
        The demands of high capacity and securable wireless communication are increasing exponentially from last decade. To facilitate users with these demands the current system induces huge amount of impairments such as peak to average power ratio, and signal degradation etc. This chapter elaborates the background of wireless communication and issues which are generated in current 4-G wireless technology. The fundamental elements of orthogonal frequency division multiplexing (OFDM) modulation schemes, including limitations to support current demands are investigated. The evolution of w-technologies from past to future are discussed in detail with the data speed, reliability, features and security. It is studied that how these technologies and the future coming one are beneficial for users. The

limitations of each generation of w-less are explored and how it is replaced by new generation. It is found that the number of users is increased the demands of data is maximized in terms of online services and live HD streaming due to the current technology is loaded. So, the researcher has started work on 5-G to overcome the limitations on previous generations. It is concluded that the quality of service will be enhanced several folds in 5G as compare to current generations.

References

Al, F. A. (n.d.). Analysis and Design of Wireless Technology from Past to future. *International Journal of Computer Engineering and Information Technology, vol. 3, no. 1, 2015, pp. 53-64.*

Atanasovski, V., & Leon-Garcia, A. (2015). Future Access Enablers for Ubiquitous and Intelligent Infrastructures. *Springer: Berlin, Germany.*

Baharom, B., & Ali, M. (2017). Multiple-element PIFA MIMO antenna system design for future 5G wireless communication applications. *In Proceedings of the 2017 IEEE Asia Pacific Microwave Conference (APMC), Kuala Lumpur, Malaysia, 13–16 pp. 743–746. .*

Elayoubi, S., Fallgren, M., Spapis, P., Zimmermann, G., Martín-Sacristán, D., Yang, C., et al. (n.d.). 5G service requirements and operational use cases: Analysis and METIS II vision. *In Proceedings of the 2016 European Conference on Networks and Communications (EuCNC), Athens, Greece, 27–30 June 2016; pp. 158–162. .*

Haerick, W., & Gupta, M. (n.d.). 5G and the Factories of the Future. 5G-PPP White Paper. 2015. *Available online: https://5g-ppp.eu/wp-content/uploads/2014/02/5G-PPP-White-Paper-on-Factories-of-the-FutureVertical-Sector.pdf (accessed on 10 June 2020). .*

Mudrakola, S. (2019). Private 5G Networks. . *Available online: http://techgenix.com/private-5g-networks/ (accessed on 10 June 2020).*

O'Connell, E., Healy, M., O'Keeffe, S., Newe, T., & Lewis, E. (n.d.). Development of a discriminating fibre optic sensing array for wireless real time analysis of the maritime environment. *In Proceedings of the OFS2012 22nd International Conference on Optical Fiber Sensors, Beijing, China, 14–19 October 2012.*

Osseiran, A. B. (2014). Scenarios for 5G mobile and wireless communications: The vision of the METIS project. *IEEE Communications Magazine, 52(5), 26–35.*

Plc., A. D. (2020). Creating a Gigabit Society. *https://www.vodafone.com/content/dam/vodcom/files/public-policy/Vodafone_Group_Call_for_   the_Gigabit_SocietyFV.pdf (accessed on 10 June 2020).*

Rampa, V., Savazzi, S., & Malandrino, F. (n.d.). Opportunistic sensing in beyond-5G networks: The opportunities of transformative computing. *In 5G Italy Book 2019: A Multiperspective View of 5G; CNIT: Parma, Italy, 2019; pp. 461–476. ISBN 9788832170030. .*

Ruili, J., Haocong, W., Han, W., O'Connell, E., & McGrath, S. (n.d.). Smart Parking System Using Image Processing and Artificial Intelligence.

Singh, S., & Singh, P. (n.d.). Key concepts and network architecture for 5G mobile technology. *Int. J. Sci. Res. Eng. Technol. (IJSRET) 2012, 1, 165–170.*

Wdowik, R., & Ratnayake, R. (2019). Collaborative Technological Process Planning with 5G Mobile Networks and Digital Tools: Manufacturing Environments' Perspective. *In Proceedings of the 2019 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM), Macau, China, 15–18 December 2019; pp. 349–353.*

Wu, J. Z. (2015, IEEE Communications Surveys & Tutorials, 17(2), 803–826.). *Energy-efficient base stations sleep mode techniques in green cellular networks: A survey.*