



Future Aspects of 6G Wireless Communication Technology

Ajay Suri¹, R.V.S.Bhadoria², Lokesh Kumar Bansal³, H. R. Singh⁴

¹ ABES Engineering College, Ghaziabad, India

² IIMT College of Engineering, Gr. Noida, India

³ BIT, Muzaffarnagar, India

⁴ GNIOT, Greater Noida, India

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Abstract—

The fifth generation (5G) is the emerging wireless communication technology, in that many smart applications are being integrated comparatively to the fourth generation (4G). The specifications of 5G are on the edge of new promising technologies, which includes data rate, capacity, reliability, latency, resource sharing, and energy per bit. To address these demanding requirements, research is to be focused towards next generation i.e. 6G wireless communications, which enables a variety of new technologies and applications supported by artificial intelligence (AI) & machine learning (ML). The most recent research on 6G technology and its applications are given in the paper, along with the accompanying research difficulties.

Index Terms— AI, ML, IoT, MIMO, M2M, BCI

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1. INTRODUCTION

Nowadays, the user's demand is growing very fast to get better performance in terms of data rate, capacity, reliability, latency, resource sharing, and energy per bit in telecommunication industries and the research tradition is shifting towards data-driven intelligent systems. The first mobile phone call was set up in 1973 and that was named as first generation (1G), major evolutions in wireless cellular technology was observed in around 10-year cycles from the commencement of the first generation analog communication systems, which was commercialized since 1980. Data transmission from generation to generation improved the quality of services (QoS) with additional new facilities to the subscriber. The fourth generation (4G) technology was introduced in between 2000 to 2010 and after that fifth-generation (5G) was came in existence[1-3]. The 5G technology is the basis of smart networks that connect artificial intelligence (AI) services[16][17][18][19][20][21][22][23][24][25]

The 5G wireless communication technology have many additional features comparatively to the 4G communication system. In the recent

years, mobile uses has grown significantly in terms of smart electronic devices and communication from machine to machine (M2M). The development stages of wireless mobile communication systems are shown in Figure 1. It is expected that the volume of mobile traffic will enhance to approximately 670 times in the year 2030 around the world comparatively to portable traffic in the year 2010. It is also predicted that the total mobile data volume would be around 5 ZB per month accordingly to the International Telecommunication Union (ITU) by the end of the year 2030, and the number of subscribers would be around 17.1 billion in comparison to 5.32 billion of the year 2010. In addition to that the applications of M2M connections will also enlarge significantly [3]. The data density of the subscriber will also increased by approximately 50 times in the year 2030 and the M2M subscriptions would be greater than before around 455 times by the year 2030, comparatively to the year 2010. It is predicted that the data requirement of 5G will attain to its limit by 2030 and it would be needed to adapt a fully intelligent network with an advanced service delivery management, that will be required a next generation wireless



networks i.e. sixth-generation (6G) to fulfill the requirement in the future [1].

The future wireless communication technology i.e. 6G is supposed to be unveiled during the year 2027 to 2030 and it will be fully supported by Data Science, Machine Learning (ML), Blockchain & Artificial Intelligence (AI). The 6G technology will also address the fundamental issues of 5G and provide improved system capacity and enhance data rate, better

quality of services (QoS), and low latency, which are the significant concerns that need to be addressed for better performance in 5G. The telecommunication industries are still in process to deployment of 5G, and 6G is at the stage where researchers from industry and academia are searching the possibilities for dreaming big & imagining that the world might look like in next 10 to 15 years [4].

AMPS	Advanced Mobile Phone Service
GSM	Global System for Mobile communication
CDMA	Code Division Multiple Access
WCDMA	Wideband CDMA
EVDO	Evolution-Data Optimized
HSPA	High-Speed Packet Access
LTE	Long Term Evolution
WiMax	Worldwide Interoperability for Microwave Access
OFDM	Orthogonal Frequency Division Multiplexing
Massive MIMO	Massive Multiple-input, multiple-output
AI	Artificial Intelligence
ML	Machine Learning
ZB	Zetta Byte



Fig. 1. Evolution of Mobile Technology

The rest of the paper is organized as follows: the next section emphasis on prospects of future wireless technology, Sec. III shows benefits of 6G wireless communication technology, and in Sec. IV the limitations of 6G is mentioned. Finally, Sec. V concludes this paper by outlining the promising 6G future wireless technology.

2. PROSPECTS OF FUTURE WIRELESS TECHNOLOGY

The International Telecommunications Union has started to work on a vision for future generation wireless technology i.e. 6G to improve the reliability, coverage, latency, energy, cost, and massive connectivity. It will also support a wide range of applications across many industries compared to the existing applications along with the experience of



holographic-type communications for fully immersive 3D, and use of Internet in real time remote operations for audio, visual, and haptic situations. It will be possible to show the significance of sensing in 6G, which is the foundation for all physical environment interaction and simulation, it will also promise to extend into digital health, autonomous vehicles, and beyond.

The 6G Wireless Network is expected to be complicated and vibrant technology, which will support new applications but it will demand a new wireless radio technology standards. It may also have a number of key issues in operation, planning, & network management, and the data

generation & utilization will be shifted towards machine-centric communications from people-centric, which will make this future wireless network operation even more difficult.[26-25]

The AI approach can solve many problems in the real time dynamic situation by employing Internet of Things (IoT) and the applications of real-time traffic data may be related to the sensor from automated vehicle, digital health system, smart home, recommendations of Netflix entertainment[30-45]. In such type of communication, the core intelligence can be implemented by integrating AI and ML technology with wireless communication and end-user devices[50-60].

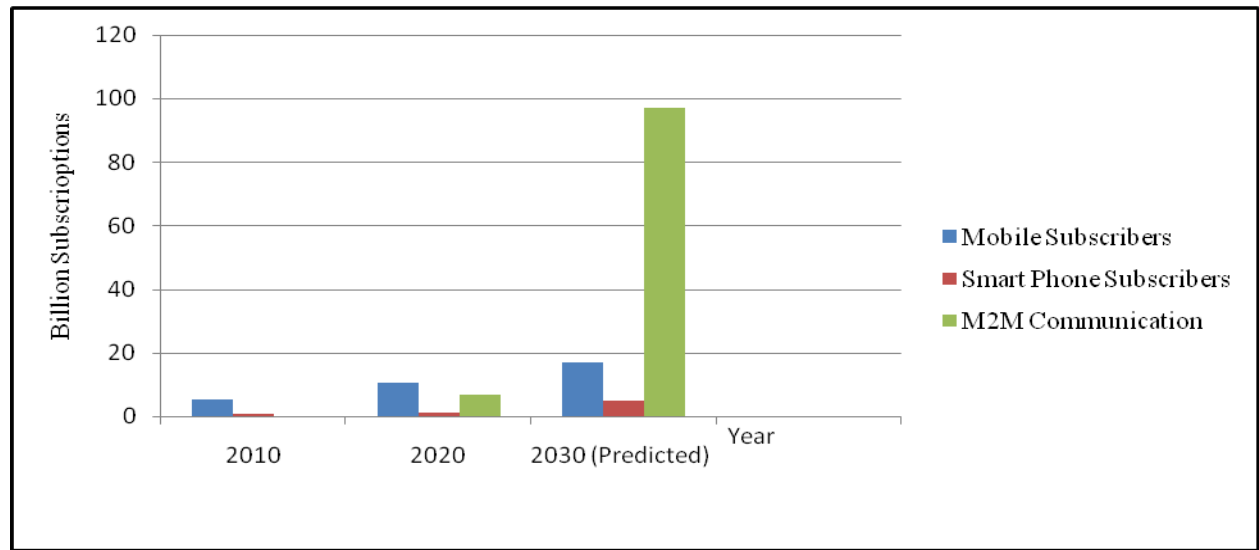


Fig. 2. Global Trends of Wireless Subscriptions

Therefore, 6G technology would be the solution of growing subscriber's need beyond the 5G network which can offer, all network tools, management, processing of interface layer signal, service-based communications, resource management, etc. would be integrated with AI. It will also promote the digital transformation of Industrial 4.0 for industrial production. Figure 2 represent the global trends of wireless subscribers to visualize the need of future generation technology [5-6].

3. BENEFITS OF 6G WIRELESS COMMUNICATION TECHNOLOGY

The 6G features will accelerate to connect in the world with smart communities, which will improve medical facility for better health quality,

even remote surgery will be happen using 6G, complete automation using M2M-based communications, environmental monitoring, power harvesting, etc. and it will make the society very smart. The flying taxis and smart automated home will be a reality in the future and any remote device could be controlled from anywhere by applying a command through smart mobile phone devices. The 6G technology can spectacularly change the daily life by connecting robots and other independent systems with the society, the 6G system will endorse the actual delivery of self-driving vehicles. The operation of self-driving vehicle is to detect the surroundings of the movable vehicle through various sensors, like RADAR, GPS, SONAR, light detection, departure (LiDAR), etc. and 6G



systems will support wireless connectivity for automotive communication with the server.

The 6G connectivity will be the actual implementation of brain-computer interface (BCI) for smart living plans. The BCI is a system for controlling daily electronic devices in smart societies, particularly in home appliances and health related medical systems, which will directly connect the brain and superficial outside

machinery. The BCI will detect the brain signals, and then it will be transmitted to a digital device for analyzing, and after that, it will interpret signals for actions[60-75]. The proposed 6G wireless connection will support haptic connectivity, i.e. a non-verbal sense of touch communication among electronic devices at the remote locations to experience real-time operation[75-90].

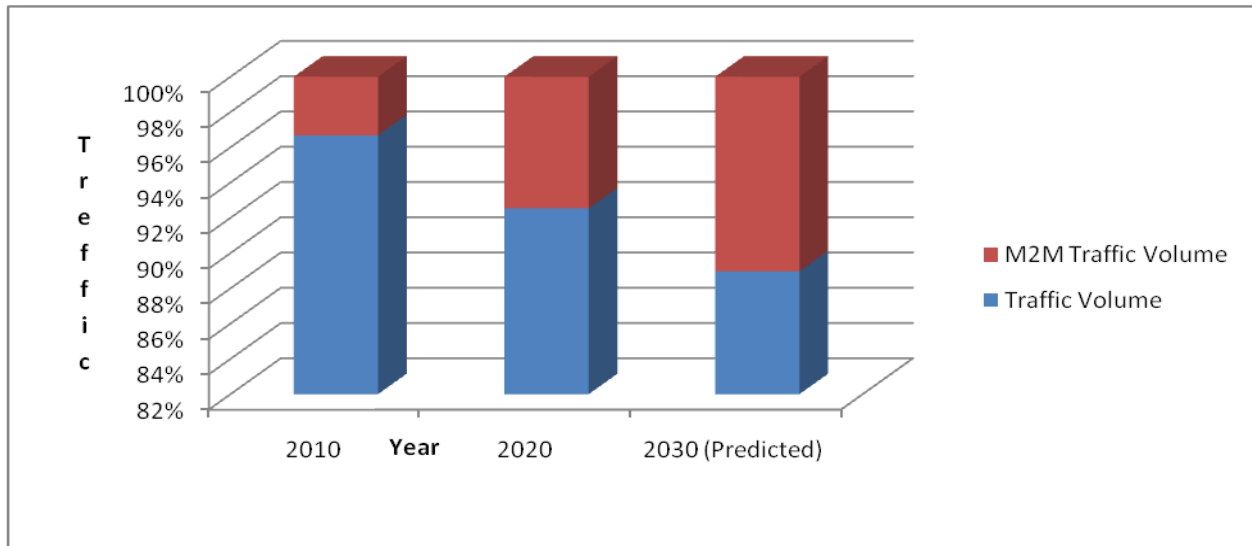


Fig. 3. Global Trends of Wireless Traffic

The human being to realize the world uses five senses smell, touch, hearing, sight, taste and similarly the 6G technology will apply a sensor based process to transmit these data collected from the five sensors to experience the real time system and according to that BCI technology will develop the smart system. The upcoming 6G future technology will be entirely supported by AI & ML for automation that will make smarter real-time communication networks [90-100]. The performance of the system will enhance and the processing time delay of the task will reduce through selection of dedicated network[101-103]. In 6G technology, the high-speed data communication can be achieved by using THz frequency band in between 0.1 THz to 10 THz or sub-millimeter rays of wavelength range from 0.03mm to 3.0mm. In case of small range of wavelength, the MIMO approach may be applied to install large number of antennas at the mobile station and base station to improve the performance [7-9].

Blockchain is also a useful technology for managing big data in the communication

systems, the blockchain is dominated to a node-to-node network communication, which work without the control of any central authority or server. In the blockchain system data is collected in blocks, and then blocks are communicated to each other after protecting with cryptography. The blockchain actually interacts with the larger IoT devices to enhance security, privacy, interoperability, reliability, and robustness. The electronic sensors at the node and mobile station will be capable to charge the battery by using the received wireless power signal during wireless communication [5].

4. LIMITATIONS OF 6G TECHNOLOGY

There are various technical issues need to address in deploying 6G wireless technology successfully and some of the concerns are presented here to resolved by the researchers if future, i.e. the THz frequencies band provide high amounts of data, but it required to overcome the challenges of spread losses and atmospheric absorption during data transmission over a long distance. A new transceiver will be required that



can support THz frequency signal and it should fully utilized the most available bandwidth. Another concern is health and safety, which is also need to be considered during THz frequency band applications [10, 11].

The application of MIMO strategy will also be needed to upgrade at the transceiver end from transferring 5G technology to 6G technologies, which may build a system more complex and it may affect on communication process. To build an autonomous wireless communication system, it is needed to combine many different sub-domain systems, such as standalone computers, AI, ML, and other various wireless devices. Therefore, the improvement in a general system becomes more difficult and challenging, for example, making of driver less car would be very difficult, but after implementing 6G, the self-driving cars would work better than people-controlled cars [12-14].

5. CONCLUSION

The probable applications of 6G technology have been introduced and the concern of THz frequency band applications is discussed. In addition to that the future projection of 6G wireless communications technology will depends upon the integration of a wide range of smart technologies, such as AI, ML, Blockchain, Data Science, Cloud Computing, Cognitive Networks, Post Quantum Cryptography, and Internet of Things (IoT) based applications to make a smart automation system. The AI will be the key technology which will communicate among machine-to-person, person-to-machine, machine-to-machine and to fully implement the AI in a real time system, it will be required an unprecedented level of network security, reliability, and privacy protection to reflect the attractive use of 6G according to the situations.

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