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Semantic Survey on 6th Generation of Wireless Mobile Communication

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Abstract: Today in our ecosphere of data, there are n number of possibilities and means of data production. Wireless communications had made a revolution in transmitting data as of increased agility. It plays a major role in data creation as well as data communication. Mobile networks are another technology of generations that made wireless communication promising for every human being right to use. RND (Research and Development) also gave various generations of mobile networks includes 1G, 2G, 3G, 4G, and 5G. The fifth generation of wireless mobile communication which has in a way to scope for this decade. 5G with amplified specifications will move on our technology to another level of data communication and creation where it nears the level of DARQ (Distributed Ledger, Artificial Intelligence, Extended Reality, and Quantum Computing) technology. But it'll not be adequate to accomplish our future technical aspects according to our research theories. Hence the need of an advanced kind of mobile wireless generation which in time gave birth to the study of 6G as in research and development. This paper proposes a semantic survey over the possibilities and expectations of our upcoming 6th generation of mobile wireless communications in an imminent perception of DARQ.

Keywords: Data Production, Wireless Communication, Mobile Network, RND, 5G, 6G, DARQ, and Artificial Intelligence

I. INTRODUCTION

The word Communication which means the process of passing or sharing the information from one to another. In networking the communication system can be Wired or Wireless and the medium (medium is nothing but the tool to exchange or convey the information) can be either Guided or Unguided. In Wired Communication the medium should be like Coaxial cable, Twisted pair cable, Optical fiber links and so on, whereas Wireless communication is no medium has to be used like wires or cables instead of it has used to transmit the data over the air through electromagnetic signals. There are many different types of wireless communication are available such as satellite communication, Infrared Communication, Broadcast Radio, Microwave Communication, Bluetooth, Wi-Fi, Mobile Communication System, etc. The Mobile Network is also known as Cellular Network which is meant by the technology that can support voice and/or data network connectivity through wireless. Mobile networks have become the backbone of telecommunications, with the extensive adoption of smartphones, tablets, and other mobile devices. In the last few decades, the world of Mobile communication network's generation is rapidly developing. There are various generations of technology evolution and revolution namely from 1st generation to 6th generation.

The 5G technology refers to the short name of Fifth Generation which should be complete wireless communication with providing large broadcasting of data in Gbps and should highly supportable to the WWWW(Wireless World Wide Web). This technology is still under process due to overcoming the challenges of this technology. To overcome the challenges of 5G, the evolution of 6G has come to study. The 6G mobile system for global coverage will integrate a 5G mobile communication system and satellite network. The Internet of Things (Internet of Things) is a world of interconnected things that are capable of sensing, stimulating and collaborating among themselves and with the environment. In the future, the 6G will be the sustenance of the IoE (Internet of Everything).

The 6G technology has exploited to fulfil the new emergent technology of DARQ which is nothing but the convergence of technologies. DARQ stands for Distributed Ledger, Artificial Intelligence, R for the Extended Reality and Quantum Computing. The Distributed Ledger is also known as BlockChain. The chain of transactions or trades called Ledger. The blockchain uses the peak-to-peak connection which means the nodes should be interconnected. While the given information can be access and process among the interconnected nodes through protocols. The BlockChain which enables digital information to be distributed. The Deep Learning, Artificial Intelligence and Machine learning all concepts are coming under the term of Predictive analysis. One of the booming technologies of this modern era is Artificial intelligence which refers to the simulation of human intelligence in machines that are predetermined to think like humans. The term may also have pertained to any machine that exposes traits associated with a human mind such as studying and problem-solving. Extended Reality (XR) refers to all real-and-virtual environments generated by computer graphics which consist of Augmented, Virtual and Mixed Reality.

II. REVIEW OF LITERATURE

Khaled et al. proposed a paper about the current expansion of diversified mobile applications, especially those reinforced by AI [1]. It is discussed on the prominence of the production of 6G regarding AI drives. It was also deliberated about 6G concerns over Computational Oriented Communications (COC), Contextually Agile eMBB Communications (CAeC), Event Defined uRLLC (EDuRLLC). The paper proposes a defined architecture of 6G enabling interrelated AI upsurge connections. Authors describe the future trends and challenges lie on AI applications based on 6G wireless communications. This article is a humble attempt to provide a forward-looking research roadmap for 6G. New features of the 6G evolution were identified, and enabling technologies were discussed.[1]

Baiqing Zong et al. conferred about the requirements for 6G as redefined from the 5G. The requirements of 6G are ubiquitous mobile ultra-broadband (uMUB), the ultra-high speed with low latency communications (uHSLLC), and ultra-high data density (uHDD).The author discussed certain research activities such as network 2030's concept of 6G, 6G-Enabled Wireless Smart Society and Ecosystem (6Genesis) and their previous paper of photonics-defined 6G mobile system architecture. In this paper, the key drivers of 6G technologies termed 5G limitations, photonic technology, and AI, mobile network evolution and so on. They stated that to connecting photonics well-defined radio with ML will be a key evolution of AI in 6G and by merging AI and photonics technology, low-latency, high-reliability, scalable AI can be accomplished in 6G infrastructures. They also specified the 6G technologies, scenarios and system architecture.[2]

Ping Yang et al. projected their paper about the full study of 6G. The authors specified a survey of different wireless generations and then emphasized an initial sketch of 6G based on the time-frequency space resource utilization. They affirmed that the 6G mobile network should be expected to afford the full-fledged exploit terms and techniques to accomplish diverse applications. The 6G mobile communication system to come across the amusing demands of the Internet of Things (IoT) in the future, such as medical imaging, augmented reality, and sensing, virtual reality, machine learning and so on. They justified the promising techniques for evolving to 6G such as multi-band ultrafast speed transmission techniques, super-flexible integrated network designs, multi-mode multi-domain joint transmission, as well as machine learning and big data assisted intelligent approaches. The author depicted that 6G will be an ultra-dense network with super flexibility to accomplish the purpose of the Internet of Everything(IoE) in the future. Moreover, they also explained the further issues for 6G development which as power supply issues, network security issues and hardware design issues.[3]

Samar Elmeadawy et al. summarizes the reason behind the study of 6G and why 6G is rush up to contrivance before 5G. The author unambiguously described the contradistinction between 5G and 6G. In this paper, the author conspicuously derived the revolutionization of the technologies. The paper proposes emerging technologies and applications of 6G as mentioned as Terahertz communication, Cell-free communications, Artificial Intelligence, Holographic Beamforming, Extended Reality, Blockchain, Automation, Wireless power transfer, Wireless Brain-Computer Interface, healthcare and so on. The research challenges of terahertz band, device capabilities, network security, and transceiver and antenna designs were discussed. The paper clinched 6G will improve the network performance, integrate diversified technologies and increase the QoS for the IoE. [4]

The Main Objective of the author's proposal is about the basic aspects of 6g mobile wireless communication. Dr.Dhananjay Kalbande et al. start their paper by defining the specifications of wireless communication using among the 6G in the future. Then the author assimilated the technologies of 6G as explained as cutting edge which sightsees the synergy of the 6g techniques, WISDOM (Wireless Innovative System for Dynamic Operating Mega communications) which is used to provide the high data rates, QoS such like that, then moreover the author depicted about fly sensor and Nanoantennas, Radio Fibre Concept and Encryption. Communication technologies, Evolution, Economical Impact, Past-to-present, and Storage Capability, Speed and Improved Security were discussed in the literature survey. The proposed system explains the future enhance of 6g mobile communication system which consists of the base process of 6g mobile communication and the few features of 6g.[5]

Tongyi huang et al. intended the paper about the survey on the green 6G network. They stipulate the potential technologies, technical objectives for 6g and so on. The evolution of the mobile communication network was implied. According to the survey on his paper, they quoted that 6G is to achieve ubiquitous connectivity by integrating satellite communication networks and underwater communications to provide global coverage. It was also deliberated about 6G concerns over service classes of uMUB, uHSLLC, uHDD were also described. The paper proposes defined different dimensions of the architecture of 6G as from terrestrial to ubiquitous 3d coverage, new network protocol stack architecture and towards intelligent network along with Real-Time Intelligent EDGE d(RTIE), Intelligent Radio(IR), and Distributed AI. Spectrum communication techniques and a new communication paradigm consisting of THz communication, Visible Light Communication, Molecular Communication, Quantum communication were described

as the promising technologies of 6G respectively. The author also deliberated the fundamental techniques of 6G were BlockChain for decentralized security, flexible and intelligent materials, energy harvesting and management.[6]

Walid Saad et al. proposes an enormous splendid vision of 6G along with many characteristics. In this article, service classes, IoE, the revolution in the wireless device, driving applications, enabling technologies were described explicitly. Multisensory XR Applications describes the quality-of-physical-experience (QoPE), Connected Robotics and Autonomous Systems(CRAS), Wireless Brain-Computer Interactions (BCI) and Blockchain and Distributed Ledger Technologies (DLT) was derived in the requirements and deriving applications behind 6G. The service classes of MBRLLC, uRLLC, HCS Human-Centric Services, and MPS Multi-Purpose 3CLS and Energy Services, requirements of 5G vs. beyond 5G vs. 6G, a summary of research areas were explicated. The author recited that in future potentially play a role toward the end of the 6G standardization and research process that one prominent example is Quantum computing. Summary of research areas, Necessary foundations, and associated analytical tools for 6G was concisely discussed. Necessary foundations and associated analytical tools for 6G were AI/ML, Data analytics foundation, communication foundations, Risk, Physics, Computing, optimization, autonomy and sensing foundations depicted in this article.[7]

Ms. Anju Uttam Gawas proposed the evolution of network generation. There has been massive innovation in mobile wireless communication since the last few decades. This innovation comprises of several generations and is still going on. The journey of mobile wireless communication began with 1G followed by 2G,3G,4G,5G,6Gand under research upcoming generations 7G. This paper has provided an overview of the evolution of mobile generations by comparing all generations and explaining how enhancements have been made from the earlier generation to the next one were discussed. [8]

Marcos Katz et al. projected the conceived developing path to 6G. This paper discusses the agreeable and capacity required to develop beyond 5G (B5G) and 6G. The beyond 5G networks (B5G) is called as 6G. This article began with developing trends, which will help to explain the important characteristics of future 6G. Then they illuminate the key skills and capabilities needed to develop the 6G. The global trends towards 6g which exploited in a variety of applications are listed as IoT, VLC (Visible Light Communication), (ML) and artificial intelligence (AI), Big Data, Blockchains, distributed ledgers, Augmented Reality, Virtual reality and so on. The author assimilated the case study about the state of Finald. Because of the state, Finald is one of the first countries to start doing 6G development. Finland is determined to improve and implement the 6G successfully in the next era. This paper tabulated the milestones of 5G and 6G technology.[9]

Md. Jalil Piran et al. proposed the paper about the current mobile network evolution of 5G to 6G. In this paper, the author examined 6G challenges, requirements, and trends. Moreover, the author described how artificial intelligence techniques can support 6G. The growth rate of the mobile industry and IoE comparison was described here. Requirements of both 5G and 6G were explicated clearly. The Broad frequency bands, opportunistic data rate, and latency, mMTC, sMTC, self-X network, super-precision operating and positioning, scalability were described as the requirements and trends of 6G. AI-powered network management and AI-powered device processing were explained with many characteristics. The main objective of this paper was to investigate how AI can contribute to the next generation of wireless communications.[10]

III. SEMANTIC UNDERSTANDING OVERVIEW OF 6G

Human beings had made many kinds of communicational channels since the day of our presence. Research and development of our ecosphere had given birth in many ways regarding communication. Wireless is one among the communication channel which had been a breakthrough amongst all other existing channels where every human being had made a significance communication of information. Wireless communication will be improving day by day since there will be many swirls of changes that have to occur in our approaching global decades and that's how 6G came into research and development.

5G is yet to reach our market, thus individually need a decade to experience its pros and cons in a hands-on approach. 5G has its own set of specifications assuming a good speed better than existing 4G with 1- millisecond of latency.

Few specifications of 5G which will going to experience when compared with 4G are

- Up to 10Gbps data rate - > 10 to 100x improvement over 4G and 4.5G networks.
- 10-millisecond latency.
- 1000x bandwidth per unit area.
- Up to 100x number of connected devices per unit area (compared with 4G LTE)
- 99.999% availability.
- 100% coverage.

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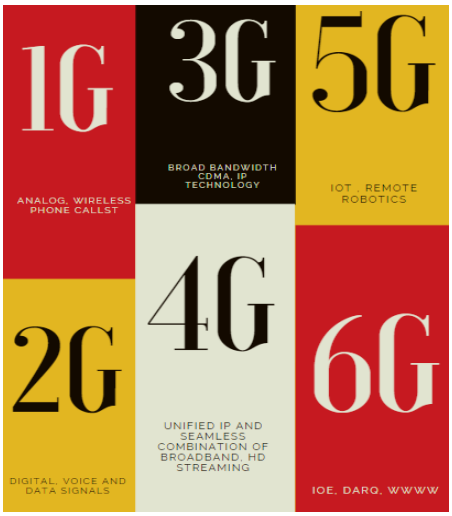
3.1 6G

Even though as people in general are yet going to still experience 5G, this world had been at a fast pace of intellectual improvement in technology and data communication. Since our future will be based upon artificial Intelligence and its sub- methodologies, it's a need an extraordinary channel of data communication to transfer high- end data explicitly to any corner of the world. Where every aspect of technology will be based on artificial intelligence so 6G will be a part of AI data wireless communication.

6G has its specifications regarding the implementation of its wireless network architecture [4].

- Up to 1Tbps data rate - > 10 to 100x improvement over 5G and B5G networks.
- 1-millisecond latency.
- 1000x bandwidth per unit area.
- Up to 100x number of connected devices per unit area (compared with 5G)
- 100% availability.
- 100% coverage.

The future is based on Artificial Intelligence and other technologies of other DARQ technologies that are Distributed Ledger or Blockchain, Extended Reality which includes both virtual realities and augmented reality and there comes Quantum computing.



Evolution Of Wireless Technology

3.2 Distributed Ledger:-

Distributed Ledger or otherwise called as BlockChain is used for digital secured interrelated network communication. It is widely used, implemented and improvised in various sectors. Blockchain provides a decentralized security network architecture. Also this decade it is been increasing in the rate of the Cryptocurrency market which is been dealt with under the umbrella of the successful technology which is Blockchain. Blockchain is a way advanced and a complicated network. Its architecture depends upon high-speed data communication without interrupts in between any of the processes. 5G with low latency had been in production and will be opened in this decade for commercial use. But its need a way speed network which consists of terahertz of bandwidth. Hence 6G is in the stage of research and development. 6G can be very useful in means of Blockchain as it provides a wireless connection without any interrupts and low latency even compared with upcoming 5G wireless mobile communication. Also, 6G will be able to produce enhanced data security along with a high failure resistant as constructed architecture. Hence with the implementation of 6G, the Blockchain can be moved in way more as of future data security which is highly concentrated today. As data can be communicated with a secured and a network with low congestion.

3.3 Artificial Intelligence:-

Everything and everyone will be artificial intelligence that is our world is moving in a way more speed in technology growth towards artificial Intelligence. In every aspect of life's the production and maintenance of human beings will be dependent on Artificial Intelligence. Every application and every applicant will be interrelated to AI data production. Data will be as of real-time and will be produced as well as processed at a high- rate. As now, everything regarding communication is wireless. Hence AI will be completely relied on and depended on Wireless Communications. AI consists of many sub-technologies like

- Machine Learning
- Deep Learning
- Artificial Neural Networks

Machine Learning is, therefore, consists of highly efficient and power-consuming algorithms. Deep Learning is also concerned about the deep analysis of data as both batch processing and real-time processes. Artificial Neural networks as well as work on finding high precision rated solutions in a few periods. Hence individually need a high-speed wireless connection with low latency and reluctant network architecture.

6G which is research and development had made mainly focused on high energy efficiency and high network capacity. The network of 6G can be complex but it will provide a massive breakthrough in AI integrated data communication.

3.4 Extended Reality:-

Considering the survey, the future will be a world of extended reality that is Virtual Reality and Augmented Reality and also holographic imaging. These kinds of visual technologies are a major enlargement of what experienced today. To achieve this which need a massive network communication where 6G comes into play that it is already known the upgraded version of 5G.

Virtual Reality: is one of the extended reality where you can feel anything and everything with an enhanced virtual graphical environment experienced by any sort of instrument like VR Glasses, etc. *Augmented Reality:* is also an extended reality experiencing technology where 3D objects are made with live-action which can be viewed in a screen that seems to be real to our human eyes. *Holographic imaging:* Holographic imaging is part of extended reality but a debateable technological topic for many passed years. 6G may play a wise role in holographic image forming because it has its enhanced specifications

- Enhanced mobile broadband (eMBB)
- Ultra-reliable low latency communications (URLLC)
- Massive machine-type communication (mMTC)
- AI incorporated communication
- Concrete internet
- Great output
- Extraordinary network ability
- Excessive energy proficiency
- Little backhaul
- Little access network traffic
- Enriched data security

Through these specifications, individually can extend our visual experience to the very next level of Virtual Reality and foreseeing the development of holographic imaging.

3.5 Quantum Computing:-

Quantum computing is a computing technology that is based on the theories of quantum physics. Quantum Computing is our future of technology where already research had begun in fast movement in developing reliable and AI integrated Quantum computing machines. Quantum computing is nothing but the future of computers that is it is much faster by 1000 times than any personal computers. It does work at a tremendous speed as it finishes calculation seconds which may take years to finish by a normal home personal computer.

Since Quantum computer is highly compressed and an elaborate technology at the same time, it needs sin a wireless communication that should way speedier than any other existing wireless channels. 6G with the high specification can support and integrate Quantum Computing in everyone's day to day life. Like how humans can achieve more than possible. 6G plays a vital role as it is completely relied on and AI integrated.

3.6 Internet of Everything (IOE):-

Internet of Things (IoT) had been in social deployment in various sectors. It produces Real-time data all over the world. It is said that by 2020 there will be billions of IoT devices as will be deployed all over the globe. These devices form an IoT network with seamless data communication by every second, hence numerous amount of data is been produced. Soon it'll be the Internet of Everything (IoE) that is everything such as day to day wearable and usable materials around us will be connected to the internet and thus produce a lot of data that will need low latency wireless communication that is 6G.

3.7 Robotic Process Automation:-

Robotic Process Automation is an automated process which automates tasks and system process in the background that is it seamlessly access any assigned and scripted task or process to the desired result to achieve the full potential of automation. It connects various devices robotic appliances and applications also **connected** to the internet. Where 6G comes to play in providing access to all of the automated processes without any interrupts in between the network which has a data enriched and AI integrated architecture.

3.8 Brain Computing Interface:-

Brain Computing Interface (BCI) is a software and hardware control process, through various human actions using brain stimulants. 6G is very essential in BCI process, which wirelessly connects into many instruments that are controlled through brain signals.in that way, 6G produces a seamless connection in **data** control. 6G is, therefore, can be used to build various upcoming technology in all aspects as every new and old technology is been relied directly or indirectly on wireless communication. 6G will be 2030's most welcoming technological endorsement.

IV.CONCLUSION

As in this paper, the proposed a semantic survey of what takes place regarding the research and development of the Sixth generation of wireless communication. Many specifications had discussed, therefore it may evolve in upcoming and ongoing researches regarding 6G. 6G is not deniable regarding about any of our future *DARQ technologies*. A better reliable and reluctant architecture of 6G can produce a massive outcome in all of our technological enlargements.

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