ISSN: 2096-3246
Volume 54, Issue 02, December, 2022

Special Issue

APPLICATION OF 6G WIRELESS COMMUNICATION SYSTEM: REQUIREMENTS, TECHNOLOGIES, CHALLENGES AND RESEARCH DIRECTION

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Abstract-

Over the past several decades, the need for wireless communication has increased dramatically. Worldwide deployment of fifth-generation (5G) communications, which has many more capabilities than fourth-generation communications, is likely to begin. Faster system capacity, higher data rate, lower latency, higher security, and enhanced quality of service (QoS) compared to the 5G system are some basic concerns that need to be solved beyond 5G. This article outlines the network architecture and future of 6G wireless communication. This article discusses cutting-edge technologies, including artificial intelligence, wireless optical technology, free-space optical networks, block chain, three-dimensional networking, quantum communications, unmanned aerial vehicles, cell-free communications, integrated access-backhaul networks, dynamic network slicing, holographic beam forming, and backscatter. In addition, potential technologies and anticipated applications with 6G communication needs are outlined. We also discuss potential obstacles to success as well as future research possibilities.

IndexTerms—5G,6G,artificialintelligence,automation,beyond5G,datarate, massive connectivity, virtual reality, terahertz.

I. Introduction

The internet of things (IoE), virtual reality (VR), artificial intelligence (AI), and other upcoming applications have all developed quickly. This has resulted in a tremendous amount of traffic [1]. In 2010, there were 7.462 EB/month of mobile traffic worldwide. By 2030, this traffic is expected to reach 5016 EB/month [2]. The significance of enhancing communication networks is demonstrated by this statistic. A civilization with completely automated remote management systems is what we are moving toward. All spheres of civilization, including business, healthcare, transportation, the environment, and outer space, are embracing autonomous systems. The 5G communication systems will significantly outperform the current systems, but after 10 years they won't be able to keep up with the needs of growing intelligent and automation systems [4]. Compared to fourth-generation (4G) communications, the 5G network will offer more features and a higher quality of service (QoS) [5]–[8]. As a result, the design objectives for 5G's next stage are already being investigated in literature, with the technology hitting its limitations in 2030. Sixth-generation (6G) systems may be needed for new technologies like I massive man-machine interfaces, (ii) ubiquitous computing between local devices and the cloud, (iii) multi-sensory data fusion to create mixed-reality experiences like multi-verse maps, and (iv) precision in sensing and imaging. A mechanism for influencing the physical world [9Even though it would be hard to fully understand 6G at this moment, we think that our article will point future scholars in the correct path. The following is a summary of the contributions made by this paper:

• A brief discussion is made on the rising trends in wireless connectivity and mobile data.

• Approaches to potentially obtaining the 6G communication system are discussed
• Discussion is held about anticipated service requirements for 6G communication.
• A quick comparison of the anticipated 6G communication system with the 4G and 5G systems is made.
• New 6G technologies are displayed.
• Different technologies' responsibilities in the 5G and 6G networks, respectively, are explored.
• The needs and anticipated 6G applications are shown.
• Related ongoing and existing 6G projects are reviewed.
• The 6G goal's potential obstacles and future research areas are discussed.

The remaining parts of the essay are arranged as follows. The usage of mobile communications is becoming more and more prevalent, as seen in Section II. Section III of the 6G communication systems presents the anticipated service needs and network characteristics. In Section IV, a potential network design that incorporates applications for upcoming 6G communication technologies is proposed. Section V includes a brief discussion of the potential key technologies for the creation of the 6G system. We explore numerous 6G research initiatives in Section VI. For accomplishing 6G targets, Section VII outlines the major difficulties and research directions. In Section VIII, we finally reach our findings. The numerous acronyms used in this article are listed in Table 1 for quick reference.

II. COMMUNICATIONS ON MOBILE DEVICES

A new generation of communication systems has been developed roughly every 10 years since the introduction of the first analogue communication system in the 1980s. The transition from one generation to the next enhances the measures for quality of service, adds new services, and offers new features. B5G and 6G are intended to have capabilities that are 10-100 times more than those of the preceding mobile generation upgrades. The emergence of smart gadgets and machine-to-machine (M2M) mobile connection during the past 10 years has resulted in a significant increase in mobile data traffic. In comparison to mobile traffic in 2010, it is predicted that the volume of mobile traffic worldwide would rise 670 times by 2030 [2]. Recently, data-driven adaptive and intelligent strategies have become more popular in research. A foundation of intelligent networks that support AI operations will be created by the 5G wireless networks [3]. According to predictions, 5G's capacity will be exhausted by 2030 [14]. High bit rate, high reliability, low latency, high energy efficiency, high spectral efficiency, new spectra, green communication, intelligent networks, network availability, communications convergence, localization, computing, control, and sensing are a few of the key driving trends behind the evolution of 6G communication systems. As a result, the 6G era will usher in a completely digital connectivity.

III. SPECIFICATIONS AND REQUIREMENTS

A number of factors, including throughput, latency, energy efficiency, deployment costs, dependability, and hardware complexity, are traded off in 5G technology. After 2030, it's likely that 5G won't be able to keep up with demand. Then, 6G will close the demand gap between the market and 5G. The primary goals of 6G systems are I extremely high data rates per device, (ii) a very large number of connected devices, (iii) global connectivity, (iv) extremely low latency. These goals are based on historical trends and predictions of future needs. Comparing 6G with 4G and 5G communication technology is shown in Table 3. In addition to the KPIs of 5G communication systems, it is projected that 6G would require additional key performance indicator (KPI) drivers. Many KPIs from the 5G system will also apply to the 6G system. The early 6G KPIs may be roughly divided into two groups, namely I sustainability and social driven KPIs and (ii) technology and productivity driven KPIs [15]. Jitter, connection budget, extended range/coverage, 3D-mapping, mobile broadband, positioning accuracy, cost, and energy-saving KPIs are among the factors covered by the first category. The KPIs for security and intelligence, however, are brand-new for 6G. Along with the advancement of 5G systems, all potential KPIs for 6G systems will be realized.

A. ServiceRequirements

The following categories of KPI-related services are anticipated to be offered by 6G communication systems [16]:

- Widespread use of mobile ultra-broadband (uMUB)
- Low-latency, extremely fast communications (uHSLLC)
- Widespread machine communication (mMTC)
- Extreme data density (uHDD)

The 6G communication system will be distinguished by the following main characteristics:

- AI-enhanced communication
- Touchscreen internet
- Extremely energy-efficient
- Congestion in the access and low-backhaul networks
- Better data security

The simultaneous wireless connection of the 6G system is predicted to be 1000 times greater than that of the 5G system. In contrast to the improved mobile broadband (eMBB) in 5G, it is anticipated that ubiquity services, or uMUB, would be a part of 6G. A crucial component of 5G, ultra-reliable low-latency communications (uHSLLC) will be a driving force in 6G communication, with capabilities including E2E delay of less than 1 ms [14], more than 99.99999% dependability [17], and 1 Tbps peak data throughput. The 6G communication infrastructure will be capable of supporting numerous linked devices (up to 10 million per km2) [17]. It is anticipated that 6G would attempt to offer Gbps coverage everywhere, including novel settings like the sky (10,000 km) and the sea (20 nautical miles) [17]. In contrast to the frequently quoted area spectral efficiency, volume spectral efficiency will be substantially better in 6G [14]. Ultra-long battery life and cutting-edge battery technology for energy harvesting will be provided by the 6G system. Mobile devices won't require separate charging in 6G systems.

A. New Network Characteristics

Satellite integrated network: To enable omnipresent connection, satellite communication is necessary. It is virtually completely unrestricted by geographic conditions. It can enable seamless worldwide coverage across a range of regions will the demand for uMUB services be met.

Connected intelligence: The sixth generation of wireless communication networks, or 6G, will revolutionize wireless technology and propel "connected objects" to "connected intelligence" [18

Seamless integration of wireless information and energy transfer: In order to recharge battery-powered devices like smartphones and sensors, 6G wireless networks will also transport electricity. Wireless information and energy transfer (WIET) will be incorporated as a result.

Ubiquitous super 3D connectivity The super-3D connectivity in 6G will become universal when drones and very low earth orbit satellites can access the network and use core network functions.

Few General Requirements in Network CharacteristicsSmallcellnetworks: The concept of tiny cell networks has been put out to enhance the received signal quality as a result of cellular systems' increased throughput, energy efficiency, and spectrum efficiency [20]–[22]. Small cell networks are therefore a crucial component of 5G and beyond (5GB) communication systems. As a result, this network feature is also used by 6G communication systems.

Ultra-denseheterogeneousnetworks: Another crucial aspect of 6G communication systems will be their ultra-dense heterogeneous networks [23, 24]. Heterogeneous networks forming multi-tier networks will enhance overall QoS while lowering costs.

High-capacitybackhaul To accommodate a sizable amount of 6G data traffic, the backhaul link must be characterized by high-capacity backhaul networks. Free-space optical (FSO) systems and high-speed optical fiber are potential remedies for this issue.

IV. PROSPECTS AND APPLICATIONS

The 6G communication networks will incorporate fully-AI. AI will be used to encompass all network management, instrumentation, physical-layer signal processing, resource management, service-based communications, and other functions [14]. It will support the Industry 4.0 revolution, which is the industrial manufacturing sector's digital transformation [25]. Fig. The communication architecture scenario for the 6G communication systems is shown in Figure 2. The four categories of 6G applications are uMUB, uHLSLLC, mMTC, and uHDD services. The following is a quick description of several important 6G wireless communication prospects and applications.

Super-smartsociety: The enhanced capabilities of 6G will hasten the development of intelligent communities that will improve living quality, monitor the environment, and automate tasks utilizing AI-based M2M communication and energy harvesting. Additionally, a lot of cities will introduce flying taxis based on 6G wireless technology. Any gadget at a remote place may be controlled by utilising a command issued from a smart device, making smart homes a reality.

Extendedreality: The core components of 6G communication systems include extended reality (XR) services, such as augmented reality (AR), mixed reality (MR), and virtual reality (VR). These features all rely on AI and 3D objects as their primary driving forcesIt utilizes the present reality and enhances it by using some sort of technology. MR combines the real and virtual worlds to create novel landscapes and graphics that enable in-the-moment communication.

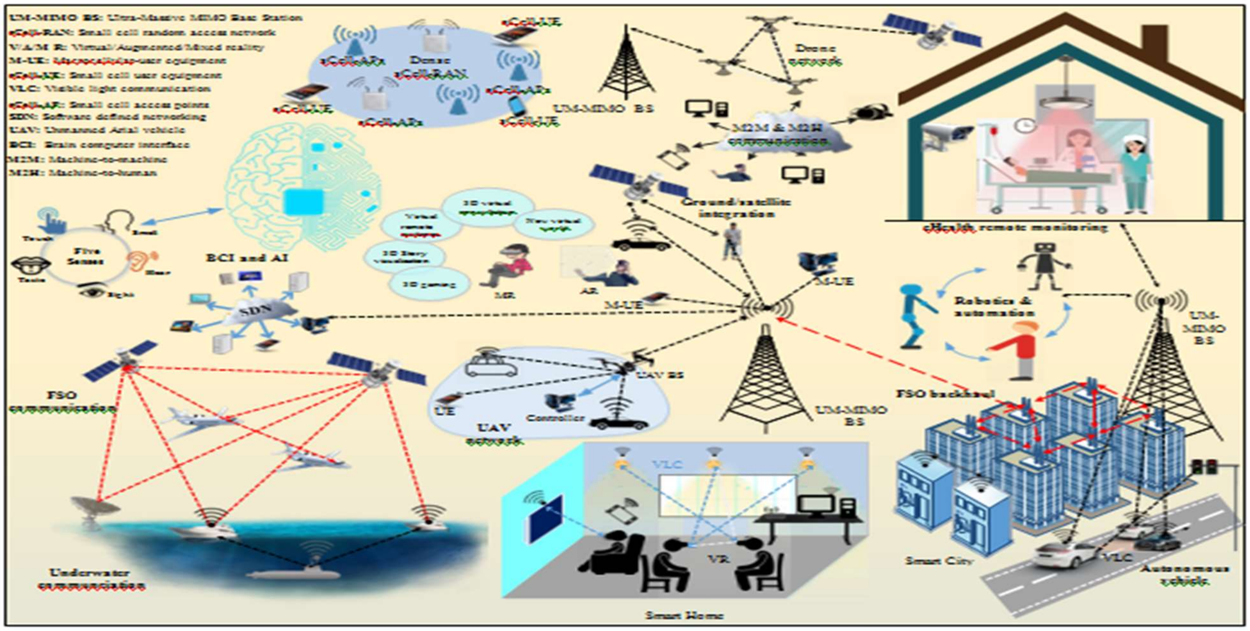

Fig.1. Possible 6G communication architecture scenario

A true XR (i.e., AR, VR, and MR) experience requires high-data-rate, low latency, and extremely dependable wireless connectivity, all of which are given by the 6G system. The effective deployment of XR apps in the future will be made feasible by the 6G service, uHLSLLC.

Connected robotics and autonomous systems: Currently Numerous experts in automotive technology are looking towards linked and automated automobiles. Currently, the advancement of data-centric automation systems outperforms 5G's capabilities. Even higher transmission rates than 10 Gbps are required in particular application domains, such as XR devices. The implementation of autonomous systems and linked robots will be aided by the 6G networks. One example of such a system is the drone-delivery UAV system. The driverless car powered by 6G wireless connectivity has the potential to significantly alter our daily lives. The 6G network encourages the widespread use of autonomous vehicles (autonomous cars or driverless cars). A self-driving car uses a combination of sensors to understand its surroundings, including light detection and ranging (LiDAR), radar, GPS, sonar, odometer, and inertial measurement units (IMUs).

Haptic Communication: Using the sense of touch, haptic communication is a subset of nonverbal communication. Remote users will be able to enjoy haptic sensations through real-time interactive systems with the proposed 6G wireless communication [28]. The uHLSLLC, mMTC, and uHDD characteristics of 6G communication networks can make it easier to create haptic systems and applications.

Smart healthcare and biomedical communication: The 6G wireless networks will also improve medical health systems by enabling the development of intelligent healthcare systems through breakthroughs like AR/VR, holographic telepresence, mobile edge computing, and AI [25]. A trustworthy remote healthcare system monitoring system will be made possible by the 6G network. The use of 6G technology will even enable remote surgery. Large volumes of medical data will be transferred swiftly and reliably thanks to the 6G network's high data throughput, low latency, and ultra-reliability (zero error) capabilities, enhancing both patient access and care quality. A battery-free near-field compatible body sensor connectivity system that can create wireless power and data connections between numerous remote sites on the body was introduced by R. Lin et al. [29]. These applications can be described by 6G's uHLSLLC and uMUB services.

Automation and manufacturing: Using AI, 6G will offer total automation. The automatic management of systems, equipment, and processes is referred to as automation. With 5G, the production processes based on cyber-physical systems that use automation and data interchange got their beginnings. The disruptive technologies of 6G will fully define the automation system. Using high-data-rate and low latency provisioning, such as uHLSLLC, mMTC, and uHDD services, the 6G automation systems will offer communications that are extremely dependable, scalable, and secure. Because it guarantees error-free data transfer without any data loss between transmission and reception, the 6G system will also provide network integrity.

Five senses information transfer: Humans employ their five senses—hearing, sight, taste, smell, and touch—to perceive the world around them. The five senses' worth of data will be transferred remotely through 6G communication technology. This technology makes advantage of sensory integration to exploit the neurological process.

Internet of everything: IoE, or the Internet of Everything, is the seamless integration and autonomous coordination between a vast number of computing units and sensors, objects or devices, people, processes, and data [31]. With its revolutionary goals for IoE, 5G is reshaping the current mobile communication infrastructure. But 5G is seen as the start of the Internet of One of the key requirements for extensive IoE connection in 6G is the deployment of energy-efficient sensor nodes. Broad area coverage (up to 20 km) networking with extended battery life (>10 years) and inexpensive deployment costs is something that low-power extensive area networks (LPWAN) have the ability to support. LPWAN hence takes part in the majority of IoE use cases commercially. The uMUB, uHLSLLC, and uHDD characteristics of 6G communication can support this application.

V. FUNDAMENTAL ENABLING TECHNOLOGIES OF 6G :

Based on how mobile networks have historically developed, 6G networks initially mostly use the 5G architecture and carry over its advantages [33]. There will be some new technologies included, and several 5G technologies will get an upgrade for 6G. The 6G system will therefore be powered by a variety of technologies. Below, a few anticipated key 6G technologies are covered.

ArtificialIntelligence: The core feature of 6G autonomous networks is intelligence. AI is therefore the most important and recent technology for 6G communication networks . AI was not a part of the 4G communication networks. Future 5G communication technologies will only partially or barely enable AI. However, AI will provide complete automation support for 6G. Machine learning innovations produce more intelligent networks for 6G real-time communications. AI in communication will streamline and enhance the delivery of real-time data.

Block chain: Block chain technology is crucial for managing enormous amounts of data in future communication networks [54–58]. One type of distributed ledger technology is block chains. A database that is spread across several nodes or computing devices is referred to as a distributed ledger. The ledger is replicated and stored on each node in exact duplicate. The block chains are managed via peer-to-peer networks. The huge IoT is effectively enhanced by the block chain thanks to its better security, privacy, interoperability, dependability, and scalability. The inherent characteristics of block chain, such as decentralized tamper-resistance and secrecy, present the chance to make it perfect for a variety of 6G communication applications. By establishing transparency, confirmed transactions, and the avoidance of illegal access, it establishes a secure and verifiable solution for spectrum management The requirement for local and global standardization and regulation of the widespread implementation of block chain in 5G presents another difficulty.

3D networking: For customers in the vertical extension, the 6G system will integrate the terrestrial and aerial networks to provide communications. Low orbit satellites and UAVs are used to deliver the 3D BSs [60, [61]. The addition of new degrees of freedom and dimensions in terms of altitude distinguish 3D connection from traditional 2D networks. The 3D coverage will be provided by the 6G heterogeneous networks. The decentralized 6G networks effectively provide global coverage and strict seamless access, especially for ocean and mountainous places, through the integration of terrestrial networks, UAV networks, and satellite systems.

Quantumcommunications: In the context of 6G networks, unsupervised reinforcement learning in networks appears promising. Large amounts of data generated by 6G cannot be labeled using supervised learning techniques. Labeling is not necessary for unsupervised learning. As a result, this method can be used to automatically create representations of complex networks. It is possible to run the network in a truly independent manner by fusing unsupervised learning and reinforcement learning [3]. Furthermore, because quits can exist in superposition, quantum communications increase throughput.

Cell-free communications: For 6G systems to function properly, several frequencies and communication technologies must be tightly integrated. The user won't need to manually configure the device in order to go from one network to another as a result [4]. The ideas of traditional cellular and orthogonal communications will be replaced, respectively, by cell-free and non-orthogonal communications in 6G. The user's movement from one cell to another currently results in an excessive number of handovers in crowded networks. Additionally, it results in data loss, handover delays, failures, and the ping-pong effect.

Integration of wireless information and energy transfer: One of the most cutting-edge 6G technologies will be WIET in communication. The same fields and waves are utilised by WIET and wireless communication systems. Using wireless power transmission, sensors and smartphones are charged while communicating. WIET is a promising solution for extending the lifespan of wireless systems that charge batteries [65]. Therefore, 6G connections will support battery-free gadgets. Additionally, near-field enabled apparel offers the potential for continuous physiological monitoring in the medical area using battery-free sensors [29].

Sensing and communication are integrated: The ability to continuously sense the environment's dynamically changing states and exchange information between different nodes is a key driver for autonomous wireless networks [66]. Sensing and communication will be strongly integrated in 6G to facilitate autonomous systems. The main obstacles to achieving this integration are the enormous number of sensing objects, complex communications resources, multilevel computer resources, and multilevel caching resources.

Integrationofaccess-backhaulnetworks: In 6G, the access networks will have a very high density. Backhaul connection, such as optical fibers and FSO networks, is related to each access network.

The majority of access networks are handled by tightly integrated access and backhaul networks.
Dynamic network slicing: A network operator can provide dedicated virtual networks to assist the efficient delivery of any service to a variety of customers, cars, machines, and industries thanks to dynamic network slicing. When many users are connected to numerous heterogeneous networks in 5GB communication systems, it is one of the crucial components for management. Dynamic network slicing can be implemented with the help of software-defined networking and network function virtualization. These have an impact on the network management paradigm for cloud computing, where the network includes a central controller to dynamically direct and regulate traffic flow and coordinate network resource allocation for performance optimization .
Holographic beam forming: Through the use of signal processing, an array of antennas can be directed to broadcast radio signals in a particular direction using beam forming. It is a subset of advanced antenna systems or smart antennas. A high signal-to-noise ratio, interference prevention and rejection, and excellent network efficiency are only a few benefits of the beam forming technology. HBF can play important roles in the areas of location, wireless power transmission, expanded network coverage, and physical-layer security.
Big data analytics: Enormous data analytics is a challenging method for examining various big data collections. To ensure thorough data management, this approach unearths data like hidden patterns, undiscovered connections, and client inclinations. The E2E latency reduction is one example of how big data analytics is used. Predictive analytics will use a combination of machine learning and big data to choose the user data's optimal path, reducing the E2E delay in 6G systems.
Backscatter communication: Interaction between two battery-free devices is made possible via ambient backscatter wireless communication, which makes use of already-exisiting RF signals like cellular communications and ambient television [68]. Short communication distances allow for the achievement of a respectable data rate. Additionally, non-coherent backscatter communication can offer improved service and resource usage in network devices.
Proactivecaching: One of the key concerns for 6G is the widespread deployment of small cell networks, which will considerably improve network capacity, coverage, and mobility management. Massive downlink traffic overload at the BSs will result from this. The joint optimization of proactive content caching, interference management, intelligent coding scheme, and scheduling techniques, however, needs to be thoroughly researched if 6G communication is to be successful.

TABLE: Characterization of emerging technologies under different 6G services

Technology	uMUB	uHSLLC	mMTC	uHDD
ArtificialIntelligence	√	√	√	√
Terahertzcommunications	√	√		
OWC	√	√	√	√
FSOfronthaul/backhaul	√	√		
MassiveMIMO		√	√	√
Blockchain		√		
3Dnetworking	√	√		√
Quantumcommunications		√	√	

Unmannedaerialvehicles	√	√	√	√
Cell-freecommunications	√	√	√	√
Integrationofwireless information and energytransfer	√			√
Integrationofsensingandcom munication	√			√
Integration of access-backhaulnetworks	√	√		
Dynamicnetworkslicing	√	√		
Holographicbeamforming		√		
Bigdataanalytics		√	√	√
Backscatter communication			√	
Intelligentreflective surface		√	√	√
Proactivecaching		√	√	√
Mobileedgecomputing	√			

Mobile edge computing: Mobility-enhanced edge computing (MEEC), which is a key component of 6G technologies, is necessary because of the scattered enormous cloud applications. The use of AI-based MEEC will push system control and big data analytics processing to the periphery. An developing paradigm called edge intelligence satisfies the challenging demands of upcoming scenarios for ubiquitous services including heterogeneous processing, communication, and high-dimensional intelligent configurations.

The aforementioned upcoming technologies can be categorized as several 6G service kinds. The 6G technologies included under the uMUB, uHSLLC, mMTC, and uHDD services are displayed in Table 5. Every method can improve one or more services.

VI. STANDARDIZATION AND RESEARCH ACTIVITIES

All 5G stages will be implemented in 2020, however the 5G standards have already been created and are now accessible in some regions of the world. The early phases of 6G research are now underway. The standardization of 6G will be the subject of several research beginning in 2020; 6G communication is still in its early stages. 6G is often referred to as B5G or 5G+ by researchers. The United States of America has already begun doing preliminary study. The US president has asked that 6G be introduced in the nation. 2019 will see the start of China's concept study for the creation and standardization of 6G communications. The Chinese are preparing to conduct active 6G research in 2020. Numerous 6G projects are being planned in the majority of European nations, Japan, and Korea. It's anticipated that 6G research will begin in 2020. We outline a few research projects and standardization initiatives in this area. The results of a few investigations on 6G communication are summarized in Tables 6 and 7. An overview of 6G industry efforts is provided below:

Samsung Electronics: An R&D facility has been established by Samsung Electronics to concentrate on the creation of critical technologies for 6G mobile networks. Samsung is performing in-depth research on cellular technologies to hasten the development of solutions and for the standardization of 6G. Their group studying next-generation telecommunications has been transformed into a centre.

Finnish 6G Flagship program: The 6G research initiatives were started at the University of Oulu as part of Finland's national agenda. The four main intended study areas for 6G Flagship are wireless connectivity, distributed computing, services, and applications. Important 6G technology components are being produced with the help of scientific advances.

International Telecommunication Union : IMT-2020 served as the foundation for the ITU-R radio communication sector's 5G standardization operations. As a result, ITU-R will likely publish IMT-2030, which lists potential criteria for mobile communications in 2030. (i.e., 6G).

6G wireless summit: The first 6G wireless summit was a success and took place in Lapland, Finland, in March 2019. Scholars, business leaders, and suppliers from around the world had extensive hands-on talks. Leading experts in wireless communication research attended the conference. The meeting also attracted the top telecom corporations in the globe. The 6G summit started talks on important topics, including the drivers behind 6G, how to transition from 5G to 6G, current market trends for 6G, and enabling technologies.

6G research directions were introduced in several research articles. The process of identifying the primary motivators, research needs, difficulties, and crucial research topics connected to 6G was started during the inaugural 6G wireless summit. the social and commercial motivations for 6G, 6G use cases and new device shapes, 6G spectrum, radio hardware advancement and obstacles, physical layer and wireless system, 6G networking, and new service enablers are also briefly covered in this white paper. NTT DOCOMO INC., a Japanese company, published a further white paper titled "5G Evolution and 6G" [17]. NTT DOCOMO's present technological prospects for the 5G and 6G development are discussed in this white paper. It briefly highlights technological research areas, 6G needs and use cases, and the trajectory of 5G progression and 6G.

VII. CHALLENGES AND FUTURE RESEARCH DIRECTIONS :

For 6G communication systems to be effectively deployed, several technological issues must be resolved. Below, a few potential issues are briefly covered.

High propagation and atmospheric absorption of THz: High data speeds are made possible by high THz frequencies. The substantial propagation loss and atmospheric absorption properties of the THz bands, however, provide a considerable obstacle to data transmission over comparatively long distances [1]. For the THz communication systems, we need a novel transceiver architectural design. We need to make sure that extremely broadly accessible bandwidths are used to their maximum potential and that the transceiver can work at high frequencies. Another difficulty in THz communication is the limited gain and effective area of the various THz band antennas. Concerns about THz band communications' impact on public health and safety must also be addressed.

Complexity in resource management for 3D networking: Vertically was the extent of the 3D networking. As a result, a new dimension was created. Additionally, many attackers might intercept valid information, which could seriously harm system performance. New methods of resource management and optimization for routing protocol, multiple access, and mobility assistance are therefore crucial. A new network structure is required for scheduling.

Heterogeneous hardware constraints: Numerous diverse communication system types, including frequency bands, communication topologies, service delivery, and more, will be used in 6G. The hardware configurations of the access points and mobile terminals will also differ greatly. Massive MIMO will be enhanced from 5G to 6G, which may call for a more complicated design. The communication protocol and algorithm design will also become more difficult. However, the conversation will also include AI and machine learning.

Additionally, each communication system has a unique hardware architecture. The implementation of unsupervised and reinforcement learning may also be complicated. As a result, integrating all the communication systems into a single platform will be difficult.

Device capability: Numerous additional functions will be offered via the 6G network. Smartphone and other devices should be able to handle the new functionalities. Supporting Tbps speed, AI, XR, and integrated sensing with communication features utilizing separate devices is particularly difficult. Some 6G capabilities could not be supported by 5G devices, and the cost of 6G devices could go higher due to their increased capacity. Billions of gadgets are anticipated to support 5G.

High-capacity backhaul connectivity: The 6G access networks will be extremely dense. Additionally, these access networks are many and varied throughout a given region. For certain user classes, each of these access networks will offer connectivity at very high data rates. In order to enable high-data-rate services at the user level, the backhaul networks in 6G must be able to manage the massive amounts of data required for connecting between the access networks and the core network; otherwise, a bottleneck would be established.

Spectrum and interference management: Spectrum and interference management: It's critical to effectively manage the 6G spectra, including spectrum-sharing plans and cutting-edge spectrum management systems, due to the limited availability of spectrum resources and interference problems. It takes effective spectrum management to maximize QoS while utilizing resources to their fullest potential. Researchers must deal with issues including spectrum sharing and spectrum management in heterogeneous networks that synchronize signals on the same frequency for 6G.

Beam management in THz communications: A technique that shows promise for facilitating high-data-rate communications is beam forming using huge MIMO systems. However, due to the propagation properties of the sub-mm Wave, or the THz band, beam control is difficult. Therefore, for huge MIMO systems, effective beam control against poor propagation characteristics would be difficult [39]. Furthermore, it's crucial for flawless handover in high-speed vehicle systems to select the best beam quickly.

Physical-layer security: Human-centric communications are the most crucial among many 6G applications, hence 6G networks are built with this in mind [86]. As a result, the main characteristics of 6G networks should be security, secrecy, and privacy. Regarding decentralization, transparency, data interoperability, and network privacy concerns, 5G systems continue to face a number of security issues. The present regulatory, privacy, and security procedures are insufficient for 6G to guarantee the network's physical security

As a result, a new physical-layer privacy approach must be created for future 6G communication that is powered by big data and AI. In 6G, safe interactions with the top layers and physical-layer security design are required. Security in 6G must be provided by physical security technologies and quantum key distribution via VLC.

Planning of economic prospect: For the introduction of 6G connectivity, the economy is equally crucial. A new 6G deployment will raise the cost of the network infrastructure significantly. However, the cost may be decreased with careful planning and the conversion of the 5G system to a 6G system. In order to make the 6G network cost-effective, the possibilities for infrastructure, data, and spectrum sharing must be properly studied.

VIII. CONCLUSION

Successive and fascinating features are added to communication systems with each new iteration. The 5G communication technology, which will be rolled out globally in 2020, has certain noteworthy features. But by 2030, 5G won't be able to fully meet the rising demand for wireless connectivity. As a result, 6G needs to be implemented. The investigation phase and early stages of 6G research are still present. In this study, the possibilities and strategies for achieving the 6G communication objective are envisioned. In this paper, we discussed the potential uses and the 6G communication technologies that will be implemented. In order to achieve the objectives for 6G, we also discussed potential obstacles and future research directions. We have described the many technologies that may be utilized for 6G communication in addition to outlining the mission and vision of 6G communications.

ACKNOWLEDGMENT:

The Institute for Information and Communications Technology Promotion (IITP) Grant through the Korea Government (MSIT) under Grant 2017-0-00824, the Development of Intelligent and Hybrid OCC-LiFi Systems for Next Generation Optic Fiber Networks, and the Institute for Information and Communications Technology Promotion (IITP) Grant through the International Cooperative R&D program (Project ID: P0011880) all provided financial support for this research.

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