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TOWARDS 6G: A SURVEY ON TECHNOLOGY ENABLERS, CHALLENGES AND USE CASES

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Abstract
Mobile communication refers to the utilization of technology that permits us to communicate with people across the globe. Our day – day life has become easier with the advent of wireless communication.
Every ten years or so, mobile communications undergo a generational shift. While 5G technology becoming more commercialized, there is already significant interest in systems beyond 5G, i.e.; 6G wireless systems. Following that, we interpret barrier for practically feasible system solutions across all layers of OSI (Open system interconnection), based on which we examine key challenges and achievability of system solutions. Because many of the 6g applications may require considerable amount of magnitude, of varying frequency between 100 GHz - 1 THz. As a result, a wide range of frequency bands, from 6 GHz to 1 THz, are supported by the 6G environment. This review research identifies several prospective problems and issues. Following that, we describe major possible aspects of 6G to provide a state-of-the-art for future research. Technology prospects, problems, critical areas, and related issues and its used cases are briefly reviewed in this study. Keeping this in mind, we concentrate on recent research challenges and recent advanced technologies and applications.
Keywords: Mobile Communication, 6G Technology, Applications.

1. Introduction

The Internet-of-Things (IoT) device market is expanding quickly, which encourages the development of next-generation communication systems that have high spectral and energy efficiency, low latency, and broad connectivity[1]. The IoT devices will enable enhanced services in automation, such as environmental monitoring and control, virtual reality, digital sensing. It will likely have more than 25 billion IoT devices by 2025, making it difficult to manage the many access methods. Even the present 5G communication systems being deployed globally are unable to support a significant number of IoT devices[2].

According to the 3GPP - Third Generation Partnership Project, the three major use cases for 5G are massive machine type communication, ultra-reliable and low latency communication, and Enhanced mobile broad-band. 6G's objective is to completely support the growth of a Ubiquitous Intelligent Mobile Society with intelligent lives and industry. Finally, a future roadmap for the 6G standard is proposed for its recent technologies and used cases in 6G.

2. Technology Enablers in 6G

The following is a list of the five primary technological enablers[3] that will be required to meet the requirements of the next-generation system. These technical enablers enable the fundamental standard shift from the internet of objects to the internet of intelligence.

2.1. Combined Sensing and Communication

The sensing capabilities infused at device and access point level will works at very high frequencies and it utilizes very large continuous bandwidths. According to predictions, 6G wireless would increase the frequency bandwidths, transmit at exceedingly low transmission strengths and a multitude of carrier frequencies. It can detect in higher frequency ranges like mmW or THz.

2.2. Artificial Intelligence at the Network Edge

The 6G AI-native communication platforms are replacing the 5G network that was boosted by artificial intelligence. The outer semantic channels that will be incorporated into 6G Wireless will imitate how the brain functions.

2.3. Space, Air and Extreme Ground Connectivity

It enables international services in far-off places. Such services will produce a perfect integrated connection framework made up of infrastructures for pseudosatellites, aircraft, and satellite constellations. The NTN - New Technology Network's unification has the ability to provide extensive coverage in areas that are expensive or challenging to access with other global networks.

2.4. Privacy Preservation, Security Controls and Assurance

Privacy and online safety are at issue.The 6G communication system was created with security in mind. Security must be incorporated into the infrastructure's core for 6G to make the switch from a security-enhanced network to a security-by-design system and to adopt a defense-in-depth strategy across the whole network. The process of standardisation must take into account the new technologies, such as privacy protection, security measures, and assurance in 6G.

2.5. Admirer Centric Systems

It is projected that an operator-centric system focused on the end user would mature into a true admirer, meaning they will be able to produce and consume content and information and make it available to the general public and internet businesses.

3 Physical layer security approaches

3.1. Rate of secrecy: The highest transmission rate at which an attacker cannot deduce anything about the message by analysing the signal received. The attacker will not be able to extract the data by boosting SNR, or signal-to-noise ratio. The biggest disadvantage is that we must be aware of the attacker's location.

3.2. A physical verification: The common shared secret message is created using the authorised wireless link. The authorised nodes can use this method to examine the channel and retrieve the cypher key.

3.3. Beamforming: In order to alter the broadcast information or to introduce noise in the same direction as the attacker, this method employs multidirectional antennas. The biggest disadvantage is that we must be aware of the attacker's location.

3.4. Spectrum spreading: This approach uses the method of hopping the signal over multiple frequencies like Frequency Hopping Spread Spectrum (FHSS). Macro eNB Pico eNB Open HeNB Closed HeNB Relay eNB UE 5. Cooperation: In this approach the adjacent nodes or friendly nodes sends noisy signal towards the attacker to worsen their link. The main drawback is we need to know the position of the attacker.

4. Challenges in physical layer

There are some challenges in physical layer such as unit cell phase range, levels of phase quantization IRS and dynamic reconfigurability, realistic user-centered strategies, and scalable power control, Packaging/interconnect techniques, Transceiver design, Measurements & standardisation, Channel estimation, Adaptive filtering.

5. Technologies in 6G

The essential enabling technologies[4] for 6G wireless networks are addressed based on the concept of 6G and its network architecture. The main functions of 6G can only be made possible by a mix of cutting-edge technology.

5.1. Quantum ML and quantum communication

Quantum physics allows for the creation of ultra-accurate clocks, medical imaging, and quantum computers by utilising phenomena like the interaction of molecules, atoms, and even photons and electrons. But the potential's full realisation is still a ways off. A quantum Internet is a global network that links quantum simulators, computers, and sensors to safely disseminate data and resources.

The Quantum Flagship was established by the European Commission in October 2018, one-billion-euro project involving 5000 scientists. For more than 10 years, the EU has supported quantum research with the goal of creating a quantum internet. During the following ten years, the EU plans to build and implement a safe pan-European quantum infrastructure (QCI) that will act as the quantum Internet's foundation. QCI will integrate quantum cryptography into traditional communication networks, safe information sharing between nations while simultaneously protecting Europe's digital infrastructure and sensitive data. The satellite part of the system will be used to cover extraordinarily long distances over a wide area, and the terrestrial part will leverage current fibre communication networks to link vital infrastructure inside and between nations. Quantum key distribution will be the first service to make advantage of this infrastructure. In order to prevent eavesdropping or system manipulation, it offers the receiver and the sender of an encrypted message an intrinsically safe random key. It will defend essential communications from code-cracking by quantum computers in the future. Among other things, it will provide secure information exchange, digital signatures, authentication services, and time synchronisation. The economy and society would gain from this infrastructure, and it would also guarantee the security of crucial government data coming from the land, the sea, and space.

As of right now[11], the QC and the QML are thought to be the main players in 6G wireless communication networks. In the expanded channel domain, the QC can provide the best 6G communication network solutions, such as new multiple access technologies like NOMA and RSMA, which have very high power requirements when running SIC computation. The QC and QML are thought to play a significant role in 6G when taking into account the fields of channel coding (quantum turbo codes), channel estimation, load balancing, routing, and multiuser transmissions. By providing data packets in ad hoc sensor networks and Cloud IoT with an instantaneous and optimal routing selection, QC and QML can handle complicated challenges like multiobject exhaustive search on the communication network core side.

5.2. Blockchain

There are a number of crucial sectors, including financial, supply-chain management, bank, and multinational money transfers, are being completely transformed by blockchain. The idea of a blockchain introduces novel commercial operations. All network participants benefit from the trust, transparency, security, and autonomy that blockchain offers. The most crucial factor for successful businesses in the telecommunications sector is innovation in a market with fierce competition and falling prices. The blockchain sector has many advantages for the telecommunications sector.

5.3. Blockchain based digital services

Telecommunications companies can create more money by offering their clients new blockchain-based services like mobile gaming, digital asset trades, music, payments, and other services. In addition to the previously mentioned, the telecom sector can make money by enabling user-to-user money transfers.

5.4. Internal network operations

The automation of systems for many different applications has been transformed by Ethereum's smart contracts, a second-generation blockchain technology. When a specific event occurs, smart contracts let you automatically run computer code. Blockchain is also particularly appealing for applications in the telecommunications sector that aim to automate a variety of processes, involving monetary transactions, logistics, and travelling. Blockchain technology has potential to enhance operator revenue by reducing illegitimate traffic on telecommunications networks, conserving a significant amount of bandwidth, and using less resource. By using smart contracts to authenticate and release invoices, blockchain can speed up the time-consuming post-billing verification process in the telecommunications sector. The accounting and auditing processes in the telecommunications sectors can be automated by this method.

5.5. Verification of identification online

Every year, the governments invest one million dollars on digital identity verification. The next generation of communication networks can use a block chain-based digital identity verification system that effectively replaces the existing identity verification technologies.

5.6. Ecosystem for productive collaboration

The upcoming wireless communication networks will likely offer a wide range of new digital services. For complicated transactions started against these services, blockchain is a compelling application. By effectively utilising user information, blockchain can potentially be employed in the advertising sector. Large Machine-to-Machine (M2M) transaction results as a result. Carriers can take the lead in introducing blockchain in this particular industry and launching the subsequent wave of digital services. It is challenging to manage network resources like power and frequency sharing and computer resource allocation due to the demand for ubiquitous connectivity in 6G. By using smart contracts to handle operator-user relationships, blockchain can offer 6G network solutions in these fields[12]. Similar problems with unlicensed spectrum and energy management can be resolved with blockchain. Blockchain technology can also be applied to smart healthcare, reduced cybercrime, and seamless environmental protection and surveillance.

5.7. Tactile internet

Data and video may now be exchanged across mobile devices thanks to the growth of the mobile Internet. The development of IoT, which permits connectivity between intelligent devices, is the next phase. The Tactile Internet is the next step in the growth of the Internet in networks, incorporating real-time interactions between M2M and H2M communications, expanding this field's use of touch and tactile feeling. The term "tactile internet" refers to the transmission of touch over great distances. Tactile Internet is sometimes referred to as the "Internet of Senses" by researchers[11].

ITU refers to the Internet as the "Tactile Internet" for networks that require extremely high performance, ultra-low latency, high reliability, and high security. Through the haptic internet, a specific local environment can be communicated with in real time by both machines and people. There are tactile interactions possible on the tactile internet.

Among the biggest issues with the tactile internet is pressing on the skin without using actual things. Using high pressure sound waves is one method for producing this tactile sense. A British business called Ultrahaptics is dedicated to harnessing ultrasound to produce tactile sensations. By modulating the generation of ultrasonic waves through a number of transducers, ultrasonic transducers can provide haptic sensations. The depth camera's built-in transducers are able to recognise the position of the body and respond appropriately. With the aid of an air vortex ring that resembles a speaker cone, Microsoft is also experimenting with tactile sensations. Concentrated waves from microscopic holes can move at a distance of 8.2 feet with a resolution of 4 inches. Compared to an ultrasonic system, it can cover a wider area but is far less accurate.

5.8. Free duplexing and spectrum sharing (FDSS)

Prior wireless generations, such as 1G, 2G, 3G, and 4G, employed fixed duplexing (TDD / FDD), while 5G used flexible duplexing. As duplex technology advances, 6G is anticipated to feature a full-service duplex that enables all users to utilise all resources concurrently.

Governmental organisations are now assigning operators to the spectrum and monitoring it. The full right to use the spectrum belongs to the owner. The spectra assigned to them cannot be used by other operators. This is due to the fact that no effective spectrum monitoring or management technology is currently in development. As a result, it is anticipated that effective spectrum monitoring and spectrum management techniques would be created for 6G deployments, as AI and blockchain are projected to be the core technologies for 6G. The network resources can be dynamically regulated with the use of AI in 6G systems. As a result, 6G can be thought of as free spectrum sharing becoming a reality.

In the context of open spectrum sharing technologies, NOMA has been proposed as a potential multiple access challenger for B5G and 6G communication systems[13]. By simultaneously providing a whole block of resources (frequency band and time slot) to every user, NOMA distributes users to the power domain. The message of the weak user is cleared by the strongest user, who then extracts his message by applying the SIC to the composite NOMA signal. The BS gives the most power to the user who is the weakest. The complexity of the NOMA system, however, rises exponentially with the number of SICs as the number of users does. At NOMA, user collaboration can be used to increase diversity at the cost of more time slots while lowering the chance of failure for users who are more fragile. The quantity of synchronised time slots, however, correlates with an increase in SICs. As an alternative, an STBCNOMA-a spatiotemporal block coding-based NOMA has been proposed to shorten the time slots while maintaining the same diversity order.

5.9. Visible Light Communication

Visible light between 400 and 800 THz is used in visible light communication (VLC) to transport information (780–375 nm). It offers exceptionally high frequency reuse, little electromagnetic interference, a lot of available unlicensed spectrum, and ultrahigh bandwidth (THz). VLC thus aids in the growth of short-range communications in 6G networks. Furthermore, sub-6 GHz microwave communications, which have been used by 1G to 5G wireless networks, are running out quickly. High capacity thus becomes a crucial requirement of 6G as more smart devices are integrated into the network and area traffic capacity develops at an exponential rate. The potential use of VLC technologies in 6G to satisfy capacity or data rate requirements exists.

The technique known as visible light communication (VLC) is one that will be used in the 6G network. 6G moves to higher frequencies due to spectrum congestion in the frequencies used by 5G and the expanding demand for better data rates. The characteristics of VLC include large data rates, a broad frequency range, high-speed transmission, and interference resistance. VLC therefore aids in the development of 6G short-range communications.

In short-range communication, photodetectors are utilised as receivers and data-modulated white laser diodes or light-emitting diodes are used as transmitters. Due to its ability to communicate across an unlicensed band, VLC is also viewed as a supporting approach for radio frequency communication.

5.10. Intelligent Surfaces

Intelligent surfaces[5] include Large Intelligent Surfaces (LIS) and Intelligent Reflecting Surfaces (IRS) (IRS). Antenna arrays as the LIS in massive MIMO systems. The LIS is electromagnetically active in the physical environment [6], in contrast to beam forming, which needs many antennas to focus signals. LIS prevents antenna correlations' negative effects. However, the LIS consumes a lot of power and is not energy efficient due to the dynamic nature of the surfaces. Wu et al. suggest the IRS to replace the active antennas utilized to overcome the shortness of power consumption[7].

Although the IRS's benefits are appealing, there are still several obstacles to overcome when using IRS technology, although accessible references allude to channel estimate methods, technical process of determining CSI remains difficult, especially when the number of IRS components is large.

5.11. Space-Air-Ground-Sea Integrated Network (SAGSIN)

Through SAGSIN, the 6G wireless communication network provides global coverage. An integrated space-sea-sea network is built by 6G. (SAGSIN). The white paper released in January 2020 predicted that 6G networks would need to reach settings like the sky (10,000 km) and the sea (20 nautical miles). SAGSIN compensates the varying traffic demand for various users and services where the three networks are combined. To overcome the 5G bottleneck, 6G integrates satellite, UAV, terrestrial, and maritime communications networks to support global coverage and ubiquitous connectivity.

- **Network for Satellite Communications**

Some places are not covered by 5G communication networks because they are primarily focused on terrestrial coverage. In order to provide complete coverage and high throughput in regions that are not serviced by terrestrial wireless communications, 6G satellite communications are linked with terrestrial communications. Based on the satellite's height, satellite communications can be divided into geosynchronous orbit (GEO) and non-GEO.

- **UAV Communication Network**

Unmanned aerial vehicles (UAVs) are unmanned aircrafts that function automatically .Every UAV is seen as a node and Various UAVs build a UAV network.

- **Maritime Communication Network**

6G's underwater connection facilitates Deep sea communications. In essence, underwater cables provide sensor, submarine, and ship communication.

Additionally, there are various obstacles in the way of maritime communications. They are global radio spectrum interoperability, capacity and scalability, simplicity and dependability, device heterogeneity, traffic heterogeneity, pervasive connectivity, and service continuity.

5.12. AI at the Network Edge

It entails switching from a 5G network with AI enhancements to an AI-native communication platform. It's anticipated that 6G Wireless will have outer range channels. An AI-native 6G wireless system may enable outer range communication capabilities by design and function similarly to how human brain functions.

5.13. Modulation by Index

Using conventional APM signals choose the resource entity's source information bits. As a result, IM The usage of a bit of information that can be sent by an antenna index MIMO system in 6G can increase transfer speeds. They refer to this method as space-shifting. Spatial modulation (SM), for instance, is proposed based on the same concept at SSK. SSK and APM are combinations of SSK and traditional linear modulation. The transmit antenna index and other components of APM make up the two portions of the source information in SM technology, which is a bit. Therefore, SM is significantly sent alternative information to increase transmission speed it’s from the antenna index of a traditional APM transceiver. In addition to the antenna, there may be other resource units as well. Indexed to carry additional information bits. This resource entity includes time slot, subcarrier, channel situation. Also, in this modulation class, the resource's index sends pieces of information for substitution. In order to enable more users using the 6G network, orthogonal frequency division multiplexing access (OFDMA) and IM will be crucial technologies.

5.14. Simultaneous Remote Information and Power Transfer

6G is said to be a large network the system is accessed by various smart devices you have a duty to communicate with others at all times, you must consider the battery charger module's lifespan as well. Abide by the restrictions for ultra-low power consumption. How to increase the lifespan of different gadgets A network-based technology called simultaneous wireless information and energy transfer (SWIPT) has been proposed. SWIPT will activate the sensor charging from wireless energy transmission. Afterwards, Devices that do not require a battery can be supported by 6G. Network power consumption is basically explained from the perspective of SWIPT technology. Details of scientific hypotheses and engineering practices. Next, in performance regarding the probability of failure, non-orthogonal multiple throughput and total rate Access (NOMA) networks can be derived using SWIPT. First, we use SWIPT to perform a NOMA-based network error probability analysis.

6. 6G Use Cases:

6.1 Local trust zones

Certain use cases urgently demand high levels of performance, for instance in terms of throughput, dependability, or protection, which may be impossible to fulfill with a wide area network. In scenarios involving precision healthcare, for instance, in-frame devices will connect to a nearby hub on their own, ensuring that any private records remain local and private. Sensor infrastructure network, where omnipresent sensors, both onboard and third-party devices, are connected, authorised, and in which sensor data is confirmed and added to a combined virtual representation of the physical world. It must be possible to install a network of sub-networks, in which the information and connectivity are saved at a neighborhood scale while the configurations and management can be handled on a macroscopic scale, to enable a cost-effective deployment without the deployment of dedicated custom-built networks.

6.2 Cobots against robots

Robots are becoming much more integrated in our societies and industries as a result of the development of AI/ML and the spread of autonomous systems, including consumer robots that can be found in public areas and homes as well as sophisticated industrial robots that enable flexible manufacturing. As their skills advance, they'll be held responsible for increasingly difficult tasks that call for cooperative, tightly coupled cell robots, also known as cobots, working together with people or other autonomous structures to find solutions and prevent destructive accidents. In addition, a lot of AI structures will exist just as software, such as inside the cloud, where they will seem as an AI partner assisting the user whenever they interact with a linked device or other gadget.

6.3 Prodigious twinning

The creation of a virtual twin from people, physical objects, and methods by accurately photographing and simulating the physical world will enable previously unimaginable reviews and system perception and control. This includes extending the digital twin concept of business procedures brought by 5G, using the digital twin for production, as well as a variety of applications to other spheres of society. For instance, by using digital twins to produce sustainable food, the health, requirements, and sicknesses of plants and farm animals may be tracked in real-time, autonomously delivering nutrients/food and treating any threat to increase the yield and decrease waste.

Additionally, it is anticipated that almost everything in a city will be able to be represented digitally. This will allow for accurate modeling, tracking, and management of almost any public or private service, including utilities, public transportation, public health, environmental monitoring, and pollution tracking for an immersive smart city.

6.4 Digital/bio sensing and e-health

Recent years have seen a major threat to human health and life from the spread of the coronavirus, a virus that affects both humans and animals. Severe Acute Respiratory Syndrome (SARS) is a family of respiratory diseases that affects both humans and animals' airways. COVID19 is related to this family. The need for accurate, precise, sensitive, user-friendly, and distinctive biosensors for infection detection and monitoring grows as the number of COVID19 infections rises develops to provide early pandemic detection and containment.

By efficiently combining biotechnology, ML, and QC, 6G networks may be able to detect viral illnesses by monitoring the body temperature of affected persons [8]. To more accurately identify various disorders, optical biosensors can be utilised to monitor the pathogenic activity of biorecognition components such antibodies, entire cells, enzymes, and DNAzymes. 6G can also be useful in other electronic health (ehealth) applications, such as environmental condition management.

6.5 Transmissions using holograms

A method for getting a full 3D image of an item is holography. Gabor first suggested this strategy in 1947. Holography is a combination of the Greek words "holo," which means "perfect," and "graphic," which means "writing". Normal photographs simply capture the amplitude or intensity distribution of an object, which results in a two-dimensional representation of the object. Holography thus allows for the detection of both the intensity and phase of the light wave. Holography is the process of archiving the physical properties of light, including interference, reflection, refraction, and diffraction. Every user on the network has the option of playing each hologram repeatedly. While holograms lack object likeness, they do contain all object information in an optical format [9].

6.6 Space & deep sea communication

Over the next ten years, space travel has a huge economic and scientific potential. People from many walks of life go into space. Some businesses intend to launch in-orbit commercial space combat. The next phase is to open space hotels and space hospitals to the public after a few profitable and successful space launches. Space exploration is yet another potential application, in addition to commercial space combat. 6G increases the global reach of operations by providing quick and efficient communication methods. Robots that are autonomous and intelligent are used in challenging conditions for communication and study. Using the robust and wonderful features of 6G networks, the mysteries of the world can be answered. Deep-sea exploration for resources like oil and minerals has the potential to materialize.

6.7 Beyond the "Industry 4.0" era: robotics and autonomous vehicles

The phrase "Industry 4.0" refers to the Fourth Industrial Revolution. Fully automated machines in the Industry 4.0 factory can set up and streamline your business, including cloud computing, NFV, slicing, and industrial IoT operations. Industry 4.0 is a new industrial revolution brought about by 6G[10]. In a very efficient and economical manner, self-driving cars and robots participate in the diagnostic, operating, monitoring, and maintenance operations in real time. Automation's incredibly dependable and self-organizing qualities are present in every facet of daily living. Through the use of cutting-edge hardware, ML, and QML algorithms, UAV swarms are used in a variety of applications, including agriculture, construction, emergency response, and fire control.

7. 6 G Challenges

7.1 Increasing chip size and hardware complexity

Communication between sensors, HD video transmission devices, bullet trains, and aeroplanes is all integrated into next-generation mobile communications. Unlike earlier mobile communication technologies, such devices require changeable packet sizes for transmission. With changing packet sizes delivered, hardware complexity rises. It is vital to choose signal processing and RF chain based on the arriving packet because the frame/packet size of the mobile station cannot be predicted in advance. In other words, as chip size increases, the mobile station's size eventually follows. This slows down processing and is not ideal for next-generation wireless communications. The spectrum of frequencies covered by 6G communication networks is extensive, spanning 3GHz to 60GHz. As a result, in order to facilitate communication at any frequencies within this range, the hardware circuit's complexity increases[15]. Each requires its own specific communications, antenna, RF filter, and amplifier designs. To span the entire bandwidth, upcoming communication networks require multiple Radiofrequency and data transmission chain, which ultimately increases chip size and hardware. Consequently, open research needs to receive a lot of attention.

7.2 Variable allocation of radio resources

Users must be given changeable radio resources in order to comply with changing QoS requirements. Variable power, bandwidth, or both may be involved. A further challenge with 6G is the signal's rapid decay at the propagation frequency, which can lead to significant transmission losses at high frequencies. When you enter your house, apartment, or place of business, the signal is immediately weakened. Your QoS needs may be impacted by higher frequencies because they weaken radio waves and reduce their likelihood of penetrating walls of homes and buildings. In order to manage the requirements for 6G communication through dynamic allocation of variable resources, it is crucial to design stable, quick, and accurate algorithms.

7.3 Circuits with extremely low power consumption and powerful computing capability

To address delay-critical situations, such as those involving self-driving cars and medical or health applications, communication must be extremely brief. It is quite challenging to achieve a delay of only a few milliseconds. It is crucial to create a potent high-end CPU that uses very little power in order to achieve low latency and extremely high reliability.

7.4 Scheduling in Advance for Massive Connectivity

Network nodes in wireless communication provide wireless resources to other nodes according to priority. However, for 6G wireless networks where many devices are interconnected, it is very difficult to set priority levels for all of these devices to meet the 6G delay and packet loss requirements. Performing such advanced communications in another open research area, 6G wireless networks, requires some suitable algorithms.

7.5 Multiple RATs coexisting without incident

The 6G network may integrate numerous RATs due to its different interfaces. This provides compatibility of 6G with other technologies including Wi-Fi, Bluetooth, ad hoc sensor networks, and the Internet of Things. You can dynamically change the air interface to change the user's wireless environment. Developing scalable technologies that ensure interoperability while meeting 6G KPI requirements remains an open issue.

7.6 Security and privacy

The number of IoT devices has drastically expanded in recent years. These gadgets include mesh network-connected personal, healthcare, and industrial IoT devices. IoT applications and large-scale cyber operations are anticipated to be made possible by 6G. IoT devices may experience more frequent widespread DDoS (Distributed Denial of Service) assaults since they are connected to the Internet. This significant DDoS attack can affect network security, privacy, and trust while enabling 6G IoT technologies. As a result, this is another unsolved research problem for 6G networks.

Conclusion

Technological evolution has paved way to move towards 6G. In this paper, an attempt has been made to shed light on 6G's technology enabler, challenges and use cases. The intention is to focus on 6G's future directions, applications, and practical factors in order to aid researchers in their search for possible breakthroughs.

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