TOWARDS 6G: WIRELESS COMMUNICATION

Abstract

The Development of 5G Wireless system is continuously exposing the inherent limitations, in this situation 6G are expected to offer performance advanced to 5G. A survey on Wireless evolution towards beyond 5G (B5G) and 6G communication networks are discussed in this paper. Moreover, we outline the vision and challenges associated with 6G.

Keywords: 5G, Wireless system, 6G

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I. INTRODUCTION

Wireless 5G communications era is being launched, with many integrated applications. However, 5G specs like latency, data rate, reliability meager the needs of upcoming technologies forcefully. To meet these challenging demands, studies are mainly looking on beyond 5G networks (B5G) called 6G technology empowering emerging new applications and different technologies. It is anticipated that the majority of the functionality found in 5G systems today would be kept and improved in 6G systems.

In the rest of paper, the vision and challenges of 6G described in section-II, Section III: ExploreEmerging technologies for 6G, Section IV gives a 6G services and use cases, V section about Issues for 6G, finally, we conclude this article in Section VI.

II. VISION AND CHALLENGES

1. **Vision:** 6G is going be one of key enabler to associate everything, gives broader coverage integrating all functions, that include detecting, caching, communicating, positioning, routing, imaging, computing, control, radar, a self-ruling environment with intelligence like humans and consciousness. It helps automatic systems which uses AI. The 6G technology helps information society which 5G technology cannot. 5G technology has to be updated to 6G. The 6G technology vision [1] can be summarized using four key concepts: "Intelligent Connectivity," "Deep Connectivity," "Holographic Connectivity," and "Ubiquitous Connectivity." Deep connectivity envisions profound sensing, deep learning, and deep cognition, including concepts like telepathy and mind-to-mind communication. Holographic connectivity involves holographic communication and high-fidelity Augmented/Virtual Reality (AR/VR) experiences with seamless coverage accessible anytime and anywhere. Ubiquitous Connectivity entails three-dimensional coverage and integration of Space-Air-Ground-Sea communication.

2. **Requirements and Challenges**:

Table1: Key capabilities and Network features of 6G

Characteristics	6G
Usage Scenarios	FeMBB ERLLC umMTC LDHMC and ELPC
Peak Data Rate	1TB/s
Experienced Data Rate	1 GB/s
Spectrum Efficiency	5–10x that of 5G
Network Energy Efficiency	10–100x that of 5G
Traffic Capacity	1 Gb/s/m^2
Connectivity Density	10^7 Devices/km^2
Mobility	1,000 km/h
Latency	10- 100 s

Technologies	SM-MIMO, LIS and HBF, THz Communications, LASER and VLC, OAM Multiplexing, Block chain, AI/Machine Learning, Quantum Communications and Computing
Network Characteristics	Intelligentization, Cloudization, Virtualization, Slicing
Applications	Space Travel, Deep-ocean touring, Industrial Internet, Internet of Bio-Nano-things, Tactile

The deployment of 5G has brought a shift from the drawing board to reality, since the upcoming generation of wireless technology was designed, outlined and evolved for decade nearly, starts a limited service. So, information transmission rate has to be increased up to 1 TB/s and a very low latency in microseconds. Various countries around the globe have started to focus on 6G. In 6G technology, to have global coverage everywhere, we need to integrate the underwater communications and satellite communication networks.

Furthermore, 6G wireless networks provide the capability to support super-high-definition (SHD) and extremely high-definition (EHD) videos, along with accommodating super-high throughput demands. These networks facilitate the Internet of Bodies and Nano-Things, enabling connectivity through smart wearable devices and intra-body communications achieved using implantable nano-devices and nano-sensors with remarkably low power consumption. Additionally, 6G networks are designed to cater to hyper-high-speed railway (HSR) communication [2]. Table 1 outlines the key performance indicators used to evaluate the effectiveness of 6G wireless networks.

III. EMERGING TECHNOLOGIES FOR 6G

Some of foreseen main technologies for 6G are discussed below:

Tetra Hertz Communication: Increasing the available bandwidth is a common way to improve spectral efficiency. This can be done by using advanced massive MIMO and sub-Tetra Hz transmission with broader bandwidths.

1. **Artificial Intelligence (AI):** AI can play a significant role in communications between humans and machines as well as between machines and machines. Meta-materials, intelligent networks, intelligent cognitive radio, machine learning intelligent gadgets, and self-sustaining wireless networks could all help support AI-based communication systems.

2. **Blockchain:** It belongs to the category of distributed ledger technologies. A database dispersed among numerous nodes could be referred to as a distributed ledger. Every node makes a copy of the ledger and keeps it in storage. Peer networks are in charge of overseeing the blockchain. On a blockchain, information is collected and organized into blocks. Using cryptography, the blocks are linked to one another and kept secure.

3. **Quantum Communications:** Unmonitored repetition Network expertise is reassuring in the context of 6G networks. Using supervised learning techniques to identify the massive amounts of data produced by 6G will no longer be feasible. Labeling won't be necessary for unguided learning. Therefore, this method can be applied to automatically construct complex network representations.

4. **Unmanned Aerial Vehicle:** UAVs may play a crucial role in 6G communications. High-bandwidth wireless communication is offered by it. It is possible to install the BS entity in UAVs to offer cellular communication. Three fundamental requirements of wireless networks—eMBB, URLLC, and mMTC—can be met by this technology.

5. **Holographic Beam-Forming (HBF):** A signal processing technique called beam-forming involves often driving an array of antennas to deliver signals in a specific direction. As HBF uses SDR antennas, it might be a more recent beam-forming technique that varies from MIMO systems. In 6G, HBF will be a very effective technique for improving the adaptability and efficiency of signal transmission and reception in multi-antenna systems.

6. **Dynamic Network Slicing:** The network operator can enable targeted virtual networks to facilitate the efficient transportation of any service near a variety of people, automobiles, equipment, and sectors. It is among the most important tools for managing multiple users who may be connected to multiple hetnets.

7. **Cell-free Communications:** It might offer improved QoS. It can be accomplished through different heterogeneous radios inside the devices, multiple connectivity, and multi-tier hybrid approaches.

8. **Optical Wireless Communication (OWC):** OWC improvements have been used since 4G communication systems. However, OWC will be employed more extensively to satisfy the demands of 6G communication networks. The OWC technologies, which offer light communication, optical communication, FSO communication, and light accuracy, form the foundation of optical band technology. Secure connections, reduced latency, and very high data rates.

9. **Integration of Wireless Information and Energy Transfer (WIET):** Similar fields and waves are used by WIET as well as wireless communication systems. Wireless power transfer during communication sensors is used to accomplish this. This increases the lifespan of wireless systems that charge batteries. As a result, 6G technology may enable devices to run without batteries.

IV. 6G SERVICES

Services and use-cases [3] which can’t be served by the existing innovations are:

1. **Web of Holograms:** Applications like holographic telepresence enables effective communication in 5D of human sense information like smell, touch, taste, sight and hearing. Industry*:* The manufactures requires reliability and less delay in the order of 0.1 to 1ms.

2. **Multisensory XR Applications:** We can have a mesmerizing experience by using various sensors by collecting data regarding area, temperature, location, orientation, acceleration and audiovisuals. These sensors will be used in various applications like advertisements, entertainment, broadcasting, automobile, gaming, medical, manufacturing, training, education, workspace communications, etc.

3. **In-Vehicle Infotainment (IVI):** By the future systems, it is one of the exciting services that will be offered i.e., providing excellent services to the drivers and passengers. For an example, in-vehicle ultra-high-quality terrestrial TV broadcasting, IVI enables the driver not only get TV channels, but also secure firmware updates and map updates.

4. **Smart City:** Smart urban application provides core infrastructure, a clean and sustainable environment. To improve infrastructure and services, shopping, security assurance, transportation management, clinical treatment, intelligent medical diagnosis (IMD) application of Smart Solutions will be enabled to use technology, information and data which need an extensive sensing and intelligent decision makers and actuators.

5. **Tactile Internet (TI):** The next development in the Internet of Everything is TI, which deals with real-time machine-to-machine and human-to-machine communication. Super-reliable MTC and high security depend heavily on tactile applications like haptics, which give the user a tactile sensation by exerting forces, vibrations, or motions.

V. ISSUES FOR 6G DEVELOPMENT

The research in 6G is still in its inception; there are quite a few opening issues to get resolved. The fundamental clashing [5] issues like power supply, hardware design and network security issues of the future 6G network organized structure in this section are summarized in figure 1.

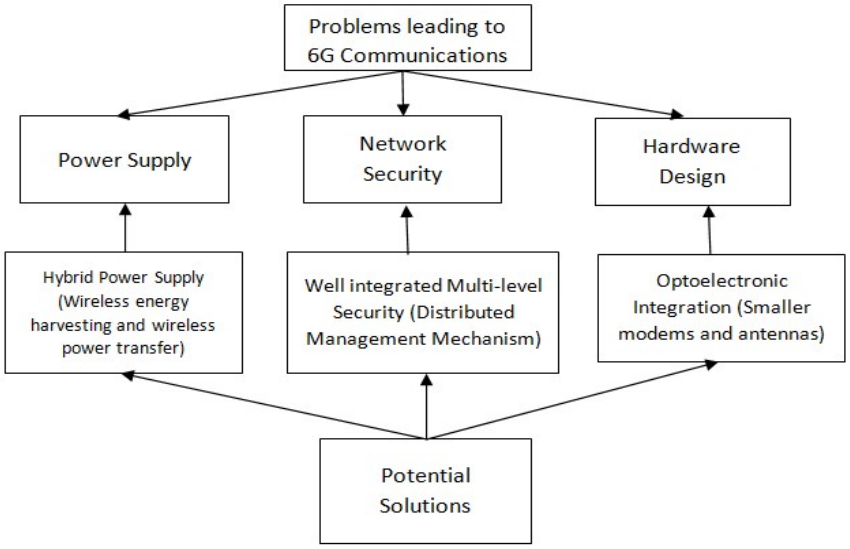

Figure 1: Issues for 6G development

1. **Power Supply:** In UM-MIMO multi-user settings, we can set up low-unpredictability pre-coding and detection algorithms to handle its ultra-high-dimension equivalents, resulting in good power efficiency. Power supply solutions based on wireless techniques and integrated optimization of power supply methods are frequently developed.

2. **Network Security:** PHY layer security techniques are also proposed for 6G networks. Such as LDPC-based secure massive MIMO, mm-Wave techniques may be appropriate for UM-MIMO &THz band applications.

3. **Hardware Design:** Numerous heterogeneous communication system types, including frequency bands, communication topologies, and service delivery, are used in 6G systems. Furthermore, the mobile terminals and access points will have remarkably distinct hardware configurations. Using huge MIMO to upgrade from 5G to 6G may necessitate a more intricate infrastructure. It will therefore be difficult to combine all of the communication methods into a single platform.

VI. CONCLUSION

This article presents the new features, difficulties, applications, and technology that will be used with 6G deployment. It has been determined that 6G will improve network performance and allow for the integration of various networked technologies.

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