Towards 6G: Wireless Communication

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***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*

# 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 can be expected that most of the current 5G features will continue to be retained and enhanced in 6G systems.

In the rest of paper, the vision and challenges of 6G described in section-II, Section III: Explore Emerging 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.

# VISION AND CHALLENGES:

*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. 6G technology visions [1] can be outlined as four key words: "Intelligent Connectivity", "Deep Connectivity", "Holographic Connectivity" and "Ubiquitous Connectivity”. Deep connectivity is expecting deep sensing, deep leaning and deep Mind: like Telepathy, Mind-to-Mind Communication. Holographic connectivity can be holographic communication, high fidelity Augmented / Virtual Reality (AR/VR) with seamless coverage anytime, anywhere. And the Ubiquitous Connectivity is a three-dimensional coverage and connection to Integration of Space-Air-Ground-Sea communication.

*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/m2 |
| Connectivity Density | 107 Devices/km2 |
| 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.

Also, wireless 6G networks support super-high-definition (SHD) and extremely high- definition (EHD) videos, with super-high throughput requests, the Internet of Internet of Bodies and Nano-Things, through smart wearable gadgets and intra-body communications are obtained by implantable nano-gadgets and nano-sensors with extremely low power consumption, hyper- high-speed railway (HSR)[2]. The key performance indicators for evaluating 6Gwireless networks are presented in Table1.

# EMERGING TECHNOLOGIES FOR 6G:

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

*Tetra Hertz Communication:* Spectral efficiency is often increased by increasing the given bandwidth; it can be achieved by the use

of sub-Tetra Hz communication with wider bandwidths and by applying advanced massive MIMO.

*Artificial Intelligence (AI):*

In machine-machine, machine-human, human-machine communications, AI can also be a crucial part. AI-based communication systems might be supported with the aid of meta-materials, intelligent networks, intelligent cognitive radio, machine learning intelligent devices, and self-sustaining wireless networks.

*Blockchain:*

It is one sort of the distributed ledger technology. A distributed ledger may be a database that is scattered across large number of nodes. Each node duplicates and stores a replica of the ledger. The blockchain is managed by peer-to-peer networks. The data on a blockchain is gathered together and structured in blocks. The blocks are connected to each other and secured using cryptography.

*Quantum communications:*

Unsupervised reinforcement mastering in networks is assuring inside the context of 6G networks. Supervised learning methods will no longer possible for labeling huge volumes of information generated in 6G. Unguided learning will not require labeling. Hence, this approach may be used for autonomously building the representations of complex networks.

*Unmanned aerial vehicle:*

UAVs might be essential element in 6G communications. It provides high-data-rate wireless connectivity. The BS entities may be mounted in UAVs to provide cellular connectivity. This technology can facilitate three central essential needs of wireless networks that are, eMBB, URLLC, and mMTC.

*Holographic beam-forming (HBF):*

Beam-forming is a signal processing process by which an array of antennas is often driven to send signals in a particular direction. HBF may be a latest process for beam-forming that might differ from the MIMO systems since it does the use of SDR antennas. HBF are going to be a really efficient methodology in 6G for the efficiency and versatility in reception and transmission of signals in multi-antenna devices.

*Dynamic network slicing:*

It allows the operator of a network to permit focused virtual networks to support the optimized transport of any service closer to wide range of users, vehicles, machines, and industries. It is one of the most significant components for managing, when numerous users might relate to a numerous hetnets.

*Cell-free communications:*

It could provide better QoS. It can be achieved through multiple connectivity and muti-tier hybrid techniques and by various heterogeneous radios within the devices.

*Optical Wireless Communication (OWC):*

OWC innovations are so far been utilized since 4G correspondence systems. However, to meet the demands of 6G communication systems, OWC will be more widely used. Optical band is based on the OWC technologies which provide light accuracy, light communication, optical communication, and FSO communication. Very high data rates, less latencies, and secure communications.

*Integration of wireless information and energy transfer (WIET):*

WIET makes use of the similar fields and waves as wireless communication system. This is achieved by using wireless power transfer during communication sensors. This extends the lifetime of battery-charging wireless systems. Hence, gadgets might be upheld in 6G technology without batteries.

1. 6G SERVICES:

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

*Web of holograms:* Applications like holographic telepresence enables effective communicationin 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.

*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.

*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.

*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.

*Tactile Internet (TI):* The next expansion of IoE is TI, human-to-machine and machine-to- machine communications are dealt in real-time. Tactile applications such as haptics, creating an experience of touch by applying forces, vibrations, or motions to the user plays a vital role in super-reliable MTC, and high security.

1. 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.

Potential Solutions

Hardware Design

Optoelectronic Integration (Smaller modems and antennas)

Well integrated Multi-level Security (Distributed Management Mechanism)

Hybrid Power Supply (Wireless energy harvesting and wireless power transfer)

Problems leading to 6G Communications

Network Security

Power Supply

Fig. 1 Issues for 6G development

*Power supply:* We can configure low-unpredictability pre-coding and detection algorithms to manage its ultra-high-dimension counterparts in UM-MIMO multi-user scenarios, leading to high power efficiency. The integrated optimization of power supply method and wireless technique- based power supply methods are often developed.

*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.

*Hardware Design:* 6G system involves a number of heterogeneous types of communication systems such as frequency bands, communication topologies and service delivery. Moreover, in the hardware settings the access points and mobile terminals will be outstandingly unique. Upgrading from 5G to 6G using the massive MIMO technique might require a more complex architecture. Accordingly, to integrate all the communication systems into a single platform it will be challenging.

1. *CONCLUSION:*

In this paper, new features, challenges, applications and technologies that will be deployed in 6G are provided. It is concluded that 6G will enhance the network performance, can integrate different technologies connected to the network.

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