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Exploring the Potential Future Market Utilizations of 6G Network Technology

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ABSTRACT

With the widespread adoption of 5G network technology, its benefits have revolutionized various aspects of human life. However, as we look ahead, the research focus has shifted to the next frontier: 6G networks. This paper aims to investigate the realm of 6G applications, comparing and contrasting them with the accomplishments of 5G networks. By examining existing literature and analyzing relevant case studies, valuable insights emerge. Notably, 6G networks are expected to surpass the capabilities of 5G, exhibiting enhanced speed and efficiency. Furthermore, the future development of 6G is projected to witness a paradigm shift, characterized by immersive experiences, intelligent systems, and global connectivity.

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I. INTRODUCTION

China and the United States, the prominent players in 5G technology, have taken the lead in researching 6G technology as well. These nations have already laid the groundwork for 5G and are likely to exhibit certain similarities in their approaches to 6G networks. Meanwhile, other countries have joined the research efforts, albeit with a delayed start. Since the commercialization of 5G and its subsequent realization of numerous envisioned possibilities, three primary application scenarios have emerged: Massive machine-type Communications (mMTC), Enhanced Mobile Broad Band (eMBB), and Ultra-reliable Low Latency Communications (URLLC) .These scenarios have shaped the trajectory of 5G development thus far.

6G network technology is poised to outperform 5G in various key aspects, like high synchronization, storage capacity, real-time precision, and reliability. Should the developed 6G network possess these advantages, it has the potential to surpass the research trajectory of 5G. Currently in the research stage and without widespread application, 6G presents an open opportunity for future development after the successful commercialization of a wide range of applications in the 5G era. The ongoing research direction for 6G primarily encompasses the exploration of 6G bands and bandwidth [1], AI integration, and 6G communication. By comparing the technical characteristics of 5G, this study primarily focuses on investigating the future application and service industries of 6G. The comparative research expands the range of options for addressing problems and future applications in the realm of 6G, offering convenience to human life and contributing to the advancement of scientific and technological domains. This paper contributes to the enrichment of relevant academic research content and enhances the understanding of the future research and application directions of 6G.

II. 6G's Development and Vision

The emergence of industries like the ecosystem industry, robotics industry, and machine interaction field highlights the growing relevance of these technologies. To enable intelligent living and widespread automation, sensors are being deployed across various domains such as cities, vehicles,

homes, industries, and more. As a result, future networks will need to support high-speed data transfer and ensure exceptional reliability to meet the demands of these diverse applications.

The deployment of 5G wireless networks has already taken place in the United States and China, with global implementation expected between 2020 and 2024. However, while 5G networks offer advantages over previous generations, they are insufficient to support user experiences [5]. Future systems will require advancements to meet the evolving demands of intelligent and automated systems in the next 15 years [6]. The increasing growth of global Internet usage and the projected surge in global mobile traffic highlight the need for advanced network infrastructures capable of efficiently processing and handling the escalating data demands of our interconnected world.

To meet the requirements of 6G development, the collaboration of AI and photonic technology presents potential implementation approaches such as photon-based cognitive radio and holographic radio. The exploration of low-latency optical networks indicates the significance of multipurpose, full-spectrum, and all-photon Radio Access Networks (RANs) for facilitating ultra-reliable and low-latency communications (uBBLLC) scenarios [10]. Additionally, the vision for an extraterrestrial integrated network in the context of the ultra-massive broadband (uMUB) service involves utilizing hyper-spectral systems operating at 100Gbps, employing laser-millimeter wave-terahertz convergence, and incorporating payloads of satellite. This integration is set to revolutionize the next generation of wireless communication, bringing forth transformative capabilities. These advancements are expected to deliver an enhanced user experience and unlock transformative possibilities across various industries.

In the realm of 6G wireless networks, managing large volumes of data and establishing high-speed connections are paramount. The increasing growth of global Internet usage and the projected surge in global mobile traffic highlight the need for advanced network infrastructures capable of efficiently processing and handling the escalating data demands of our interconnected world.

III. Analysis of the Market Economy

The advent of the 6G will have significant global implications for human society. The 6G vision's value and use cases will play a critical role in supporting the substantial investment of trillions of dollars in 6G-related research and development over the next 15 years.

During the initial stages of research and development, costs are incurred, but as the technology progresses and reaches the later stages of development, these costs are offset by the potential profitability for the company. Once the technology is successfully implemented and utilized, it not only benefits individuals by providing convenience but also has a broader impact on the global landscape.

The acquisition of knowledge forms the basis for scientific research and encompasses a wide-ranging knowledge system that can have a positive impact. The drive for scientific advancement stems from the aspiration to surpass existing limitations and explore deeper and more intricate realms of knowledge, mirroring the trajectory witnessed in the development of 5G technology. This progress involves transitioning from the current frequency band exceeding 1.8 GHz to a broader range spanning 3 GHz to 6 GHz.

6G technology offers enhanced security and reliability, along with significant time savings. With its intensified base station infrastructure and significantly faster transmission speeds compared to 5G, 6G technology not only improves efficiency but also ensures a higher level of security and reliability. The choice to opt for 6G is driven by its superior attributes in terms of security, reliability, and efficiency, surpassing those of traditional networks.

In the future, it is crucial for the cost of 6G networks to be affordable in comparison to that of 5G. The sustainability aspect of 6G networks, including green energy conservation and sustainable development, highlights their significance in terms of energy consumption and the long-term well-being of humanity. 6G networks are characterized by their focus on cost reduction, lower energy consumption, and improved network performance. Achieving these goals requires the development of energy-efficient software and hardware, advancements in networking technology, and a commitment to improved energy efficiency. Additionally, there is a strong emphasis on promoting environmentally friendly practices and fostering sustainable development in future network infrastructure.

Based on the analysis, it is evident that 6G network technology has the potential to revolutionize various fields and contribute to their advancement. This technology offers the advantages of reduced energy consumption, lower costs, and significant time savings. Furthermore, it will impact future urban planning due to its extensive network coverage, requiring large-scale base station deployment. The subsequent paragraph will delve into the applications

of 6G, comparing them with the current applications of 5G network technology.

IV. Comparsion with 5G applications

The three properties of 5G that drive its applications. Firstly, Enhanced Mobile Broadband (eMBB) addresses the need for high data rates, supporting applications like VR/AR industries and ultra-HD video calls. Secondly, Massive Machine Communication (mMTC) caters to scenarios with high terminal density but low real-time performance requirements, making it essential for the Internet of Things industry. Lastly, Low Latency, High-Reliability Communication (uRLLC) offers secure and real-time control of remote devices, making it ideal for industries focused on remote device control and security monitoring. By examining the applications of 5G network technology, we can gain valuable insights into the extensive possibilities that can be expected with the introduction of 6G network technology in the future.

The integration of the capabilities in 5G technology results in common services that can be offered. Intelligent control allows for remote device operation and control using a combination of high bandwidth, low latency. Identification involves target and environment recognition through sensing devices, such as cameras, sensors, and AR glasses, with data processed using AI and bulk data. The service industry stands to benefit from the utilization of 5G's extensive bandwidth and low latency, as it enables the playback of Ultra HD videos and facilitates the immersive experience of VR/AR content. Information services encompass the collection and sharing of crucial data such as environmental information, equipment status, user behavior, and workflow. These data sets are processed on cloud computing platforms, enabling enhanced user services, informed decisions of budiness, effective monitoring management and streamlined process optimization. The relationship between 5G and 6G is one of evolution, where 6G builds upon the applications of 5G while introducing new technologies such as artificial intelligence and blockchain, further enhancing intelligence and reliability in the next generation of wireless communication.

V. Conclusion

This paper provided a concise overview of 6G technology, analyzing its key technologies and highlighting its advantages. By reviewing the markets of 5G network technology, it was revealed that 6G possesses unique advantages that allow it to not only encompass existing 5G applications but also develop novel applications. Significantly, 6G technology presents notable advancements in terms of speed, introducing unique technical applications like holographic communication and XR technology.

Nevertheless, it is essential to recognize that 6G technology is currently in its nascent phase and is yet to be widely accessible and applied by the general public. Therefore, the paper relied on a comparative study of 5G technology to draw conclusions, with a limitation of limited specific data on 6G technology. Future research should focus on overcoming the limitations of 5G technology and defining the standards for 6G. For instance, one crucial technology to explore is terahertz communications, which has the potential to meet the requirements of the 6G spectrum in the terahertz range.

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