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БУДУЩЕЕ 6G: ТЕХНОЛОГИЧЕСКИЕ ВЫЗОВЫ И ПОТЕНЦИАЛ ДЛЯ УМНЫХ ГОРОДОВ

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THE FUTURE OF 6G: TECHNOLOGICAL CHALLENGES AND POTENTIAL FOR SMART CITIES

Introduction

One of the main resources of today's society is information. People are increasingly using electronic devices in their daily life. Every year the number of devices increases, their power and data processing speed increases. So the coming 6G era will be, a revolution in the field of information transmission, providing large bandwidths and minimal delays, which were previously impossible.

The main objective of this paper is to review the technological challenges of modern communication arising from the introduction of 6G and identify its potential for smart cities. Current challenges will be discussed, and solutions will be proposed that take into account global trends in communications and infrastructure development.

6G Technology Challenges

One of the main challenges in the development of 6G is to maximize data rates and minimize latency. Significant progress has already been made to date with the 5G standard, but 6G will require solutions that deliver data rates thousands of times faster than 5G, as well as significantly reducing latency to less than 1 millisecond. This will require the use of advanced technologies, including working with broadband frequencies such as millimeter waves and terahertz bands. This will require the use of advanced technologies, including working with broadband frequencies such as millimeter waves and terahertz bands.

In addition, 6G will require expanding network capabilities to handle the vast amounts of real-time data generated from the multitude of devices connected to the Internet of Things (IoT). IoT is expected to play a key role in smart cities, providing connectivity between buildings, transportation, energy supply and other infrastructure elements. However, for the IoT to function effectively, it will be necessary to address the increased network load, as well as improve data security and privacy, which will be one of the main challenges for developers of network solutions.

Table 1

Comparative characteristics of 5G and 6G

Standard	Data transfer rate (max.)	Average data transfer rate	Year of implementation	Communication standards	Frequencies
5G	1 Gbit/s	100 Mbit/s – 1 Gbit/s	2020	UMTS/HSPDA	От 30 до 300 GHz
6G	1 Tbit/s	100 Gbit/s	2030 (forecast)	NR (The new standard)	От 100 ГГц до 1 THz

Potential for smart cities

The future of 6G is directly linked to the development of smart cities, a concept that involves using technology to improve the quality of life in megacities. Smart cities are systems in which information and communication technologies are integrated with urban infrastructure to manage transportation, energy, water, healthcare and other aspects of urban life. The implementation of 6G will contribute to the creation of smarter and more sustainable ecosystems in which each element of urban infrastructure interacts with others in real time.

One important part of this process will be the development of autonomous vehicles. 6G networks will be able to provide the necessary speed and reliability of data transmission to support communication between vehicles and infrastructure, enabling efficient traffic management, reducing congestion and improving road safety. With faster and more accurate communication systems, autonomous vehicles will be able to make real-time decisions by processing data from the environment with a high degree of accuracy.

Another area of 6G application in smart cities will be healthcare. In the future, a new level of telemedicine will become available for medical institutions, which will allow diagnostics and treatment using artificial intelligence, virtual reality and other high technologies. Monitoring the health of city residents through wearable devices and integrating this data into smart city systems will also become an important aspect.

Challenges and opportunities

One of the most significant challenges to 6G deployment is building the infrastructure that will be able to support these high-speed, high-capacity networks. This is expected to require significant investment in the development of new appliances, improved power supply systems, and the development of new methods to protect data that may become vulnerable at such high transmission speeds.

On the other hand, 6G offers unique opportunities to create sustainable and environmentally friendly technologies. Implementing more efficient network solutions will reduce carbon footprints by optimizing energy consumption and

using resources more efficiently. It will also pave the way for more efficient urban management, which will have a positive impact on the overall ecosystem of megacities.

Conclusion

The future of 6G is not only an important step in the development of telecommunications technology, but also an important milestone in the creation of smart cities. The potential of this technology lies not only in increasing speed and performance, but also in creating new opportunities to manage the infrastructure of cities, improve the quality of life of citizens and address new scientific discoveries. Nevertheless, the implementation of 6G will require the solution of many technical, economic and social challenges, which will open new horizons for scientists and developers in the field of telecommunications. The development of 6G is not just a technological process, but an important part of the global transformation towards smarter and more sustainable cities, where technology will be an important catalyst for progress and improved lives.

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