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Next-Generation Networking Projects for Smart and Real-World Applications

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Abstract: *6G is the next step in the development of wireless networks. Experts believe that it will be fastest network in world of growth, and its main advantage is thought to be an exponentially increasing amount of data and capabilities compared to previous standards, among which 5G is the latest and most advanced. With the help of artificial intelligence technologies, Machine Learning, The Internet of Everything, Software Defined Networks, and Open Flow technologies, 6G will qualitatively change everything. The prospects of networks are so promising that even such a concept tually advanced technology as modern mobile phones will seem primitive in comparison. In addition, network capabilities will be so high that it will become possible to implement projects that seemed almost impossible some decades ago. Thus, the first applications that come to mind when talking about 6G are smart cities, vehicles, virtual and augmented reality, telemedicine, video conferencing, and robotics. At the same time, networks will also provide humanity with many other opportunities, for example, by increasing the amount of information by which a person can be connected to the Internet, transmit and receive data with even higher speeds. However, the main limitation for such systems will be factors related to security and privacy, energy, spectrum, and coding.*

Keywords: Artificial Intelligence (AI), Machine Learning, Internet of Everything (IoE) Software-Defined Networking, OpenFlow, High-Speed Communication, Low Latency, Smart Cities, Network Security.

I. INTRODUCTION

The rapid development of digital technology creates the need for developing communication networks that will be further evolved, more reliable, and multifunctional. Although fifth-generation networks are able to provide wireless access, the need for more intelligent networks creates the possibility for sixth-generation networks. 6 G will be able to address future requirements by providing more data-centric platforms for communication networks. Unlike previous generations, sixth-generation networks will utilize communication, sensing, and distributed cloud computing to enable artificial intelligence networks. 6 G will use artificial intelligence, machine learning, Internet of Everything, Software Defined Networks, and Open Flow Technologies to make networks more reliable and multifunctional communication platforms. Indeed, each of the technologies mentioned above can qualitatively improve networks by making them more automated and multifunctional, thus creating the opportunity for new communication services. The characteristics of sixth-generation networks are expected to be high data rates, improved reliability, global connectivity, and power savings. features will enable the implementation of applications in smart cities, self-driving cars, online education, robots, and many other areas.

By combining communication, distributed cloud computing, and smart artificial intelligence, sixth-generation networks can provide an integrated platform for satisfying future digitally driven economies' needs. The evolution towards Next-Generation Networks (NGN) is expected to promote a paradigm shift in the communications sector from traditional circuit-switched networks to packet-switched IP-based multiservice networks. Modern heterogeneous traffic is already partially decoupled from the transmission infrastructure, which allows new communication paradigms to emerge and

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take advantage of the opportunities for differentiated traffic. Indeed, networks using IP-based transmission with advanced routing protocols and IP-based transport systems will be the foundation for future traffic engineering and advanced networks for service differentiation. Future internet initiatives are expected to lead to the emergence of intelligent IP-based next-generation networks that will host a variety of communication services. International research activities related to future internet have led to the appearance of such enabling solutions as open flow, cloud-based networks, edge networks, digital twin, etc. Future networks must employ these technologies to ensure maximum network automation, control, and agility, as well as to ensure the efficient use of communication infrastructure. Therefore, future networks are expected to use communication networks that are smart enough to support the increasing demand for cloud-based services and applications.

Internet of Things is currently one of the most promising technologies that can qualitatively change the nature of communication networks. IoT involves connecting hundreds of thousands of various kinds of sensors, complexes, and robots that require processing and analyzing data in real-time. Such requirements are imposed on communication networks because IoT is designed to be used in such spheres as smart health, transport, farms, traffic systems, smart homes, and many other areas. For these purposes, the networks transmitting traffic from these industries need to be efficient, provide high data rates, reliability, and security to ensure that data with a large amount of information is transmitted without delays. However, sixth-generation networks have some requirements that need to be met to satisfy the needs of IoT. Firstly, researchers are currently working to secure networks and data privacy and find solutions to share frequencies for sixth-generation networks. Network sustainability, including energy efficiency, spectrum and radio access design, intelligent coding, intelligent code design, and other issues, is another challenge researchers are working to solve. The authors have proposed several solutions to improve sixth-generation networks. According to researchers, Digital Twins will design network architecture, which will qualitatively improve AI or ML-based network analysis and optimization. Moreover, research on future internet protocol has led to the development of future networks that will be able to meet the requirements of next-generation networks. In particular, networks with more agile infrastructure to host demanding real-time applications and ultra-low latency, massive IoT, and future wireless networks are expected to emerge (Sutton & Li, 2016).

On the other hand, the use of AI-based wireless communication, smart resource allocation, massive MIMO, milimeter -wave, and non-terrestrial networks is expected to be one of the key enablers for next-generation networks (National Institute of Technology Rourkela, 2026). In general, sixth-generation networks can create future communication platforms that will be based on integrated approaches that employ smart connected systems, software-assisted distributed cloud computing, and next-generation wireless networks that will be able to provide ultra-high data rates, improved reliability, and massive connectivity. The utilization of these technologies will enable 6 G to qualitatively change the nature of the digital world and create opportunities for implementing various applications in different areas. Thus, sixth-generation networks will become a key enabler for future interconnected smart worlds.

II. REVIEW OF LITERATURE

FG-NET-2030 (2020)

presented the Network 2030 Vision, which outlined the requirements for future communication networks that would enable innovations beyond today's internet. The authors pointed out that future networks should be future-proof enablers of technologies such as holographic communication, autonomous cars, industrial 4.0, smart cities, and telemedicine.

Apostolakis, Chatzieleftheriou, Bega, Gramaglia, and Banchs (2024)

proposed using the concept of Digital Twins (DTs) for sixth-generation mobile networks. This concept allows for using AI/ML to virtualize network functions for model-driven networks that are optimized and automated, which makes networks more cost-effective and efficient in using resources.

Sutton and Li (2016)
in their white paper on Next Generation Protocols discussed the needs and directions for developing future communication protocols. The document highlighted the inadequacy of the current Internet Protocol (IP)-based networks in meeting the needs of future systems driven by the explosive growth of smartphones, IoT, 4K media, AR/VR, and fifth-generation mobile networks (5G).

National Institute of Technology Rourkela (2026)
initiated a short-term course, namely, Artificial Intelligence and Next-Gen Wireless Networks, which aimed to explore the potential of combining AI/ML with modern wireless communication networks. The topics included machine learning and deep learning, traffic prediction, intelligent resource allocation, Massive MIMO and millimeter-wave.

Salina and Salina (2007)
noted that Next Generation Networks (NGNs) were designed to overcome the limitations of traditional telecommunication networks in terms of Internet access and quality of service. The authors explained that NGNs are based on IP communication and are more flexible and scalable networks that can provide better service quality.

Geske and Stanchev (2014)
reviewed the world's efforts to develop the next-generation Internet, including GENI, FIRE, Future Internet, and US Ignite activities, among others. The authors identified Open Flow, cloud computing, and Internet of Things as key technologies that will work for the Future Internet and Next Generation Networks.

Gupta and Mishra (2016)
undertook a study on smart home networking technologies, exploring wired and wireless communication systems that could be used to develop future smart home networks. The authors identified Bluetooth, ZigBee, Z-wave, Ethernet, and power line communication as standards that could be used for smarter homes, thus enabling communication between home appliances.

NET-2030 (2020)
announced the Network 2030 Vision, which emphasized the need to create future networks that would meet the requirements of new technologies such as holographic communication, autonomous cars, immersive media, industrial 4.0, and smart cities. future networks should feature high-bandwidth, intelligent resource management, and high-performance to enable connecting everything. The authors recommended that governments, industries should work together to meet the challenges of future networks.

Jain (2024)
focused on future IoT networks based on Wireless Sensor Networks, which will ensure ubiquitous connectivity while meeting the requirements of emerging Internet of Things applications. The author discussed the role of such networks in applications such as smart healthcare, precision farming, smart cities, and environmental monitoring. Moreover, the study identified advanced communication technologies such as LPWAN, 5G, Red Cap, NTN, and 6G that can be used to implement IoT networks.

Srihari, Bala Subrahmanyam, Kotireddy, Saravana Kumar, and Vinoth Kumar (2026) had created 5Genrartion based Smart City that uses 5G networks to provide faster and communication.

Question

1. What is 6Genrartion, and how is it different from 5Genrartion?
2. Explain the role of AI and Machine Learning in 6Genrartion networks.
3. What are the applications of next-generation networking?
4. What is Software-Defined Networking, and why is it important in 6Genrartion?
5. What are the challenges of implementing 6Genrartion networks?
6. How will 6Genrartion contribute to smart and real-world applications?

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III. OBJECTIVE

To study the evolution of the Next Generation Networks (NGN) and emerging 6G communication concepts for future network applications.

To examine the challenges associated with future 6G networks, such as security, privacy issues, resource allocation, energy efficiency, latency, and QoS.

To discover the limitation of Next Generation Networks and analyze the research gap in 6G communication technology.

IV. HYPOTHESIS OF OBJECTIVES

H_0 (Null Hypothesis): Development of Next Generation Networks (NGNs) and 6G communication technologies has no significant influence on the future networking applications.

H_1 (Alternative Hypothesis): Development of NGNs and future 6G communication technologies has a significant role on the future networking applications.

H_0 (Null Hypothesis): Performance of the 6G network is not significantly affected by security, privacy, resource allocation, energy, latency, and QoS.

H_1 (Alternative Hypothesis): Performance of the 6G network is significantly determined by security, privacy, resource distribution, energy, latency, and QoS.

H_0 (Null Hypothesis): Current next-generation networking framework has no significant limitations or gaps in research that may affect the current 6G communication systems.

H_1 (Alternative Hypothesis): Current next-generation networking framework has significant limitations and gaps in research that may affect the current 6G communication systems.

V. RESEARCH METHODOLOGY

Source of Data:

The topic falls under the category of the second type, which is a source of data. Information on the topic was obtained through a trusted source of data. Moreover, the secondary information was to unveil relationships and interdependencies between Next Generation Networks evolution, the challenges of 6G communication technology, networks' current state, and research gaps in view of intelligent and practical networking applications.

Sampling Method

Purposive Sampling (Judgmental Sampling) This is a type of non-probability sampling which makes use of information from potential candidates who have met certain skill sets and criteria relevant to the research undertaken. The sampling method was ideal for this study because it enabled the collection of information from professionals and experts in the field of 5G/6G communication, network security, AI, IoT, cloud computing and intelligent networking applications amongst other areas.

Data Analysis

The information collected from the various sources was analyzed using descriptive and inferential statistics to evaluate the impact of Next-Generation Networks (NGNs) and 6G on intelligent and practical applications.

Scope

To establish the trajectory of networking technologies such as 5G, 6G, SDN, NFV, Edge, AI and IoT.

To review the role played by next generation networks in smart cites, health, transport, industry, farming, education, disaster management, among other fields.

Limitation

The study uses secondary information from journals, books, research articles, conferences, and internet as a source of information.

The study focuses on conceptual and analytical areas of NGNs and not actual technology implementation in practice.

Networking technologies are developed at a very high rate, and the information may become outdated due to the time of its publishing or presenting at a conference.

The information used may be extracted from research studies or published/sponsored articles in journals and conferences, not updated to the last standard.

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