APPLICATION OF ARTIFICIAL INTELLIGENCE ALGORITHMS IN DYNAMIC TRAFFIC ALLOCATION FOR 5G/6G MOBILE COMMUNICATION NETWORKS

Orifjonova M.A.,
Fergana State Technical University, Assistant Lecturer,
Department of Telecommunication Engineering
E-mail: orifjanovamohidil@gmail.com

Abstract. *This article analyzes the theoretical and practical aspects of applying artificial intelligence algorithms for dynamic traffic allocation in 5G and 6G mobile communication networks. The study examines the rapid growth of network traffic, the need for efficient utilization of network resources, and the importance of improving Quality of Service in modern telecommunication systems. Particular attention is given to the application of machine learning, deep learning, and reinforcement learning algorithms for traffic prediction, resource optimization, and load balancing. The advantages of AI-based traffic management systems in enhancing network performance, reducing latency, and improving energy efficiency are also discussed. The findings indicate that artificial intelligence technologies will become a fundamental component of network management in future 6G communication systems and intelligent wireless infrastructures.*

Keywords: *5G, 6G, artificial intelligence, machine learning, deep learning, dynamic traffic allocation, telecommunications, network optimization.*

Аннотация. *В данной статье рассматриваются теоретические и практические аспекты применения алгоритмов искусственного интеллекта для динамического распределения трафика в мобильных сетях связи 5G и 6G. Исследование посвящено вопросам роста объёмов сетевого трафика, необходимости эффективного использования сетевых ресурсов и повышения качества обслуживания в современных телекоммуникационных системах. Особое внимание уделяется использованию алгоритмов машинного обучения, глубокого обучения и обучения с подкреплением для прогнозирования трафика, оптимизации ресурсов и балансировки нагрузки. Также анализируются преимущества систем управления трафиком на основе искусственного интеллекта в повышении производительности сети, снижении задержек и обеспечении энергоэффективности. Результаты исследования показывают, что технологии искусственного интеллекта станут важнейшим элементом управления сетями связи шестого поколения.*

Ключевые слова: *5G, 6G, искусственный интеллект, машинное обучение, глубокое обучение, динамическое распределение трафика, телекоммуникации, оптимизация сети.*

Annotatsiya. *Mazkur maqolada 5G va 6G mobil aloqa tarmoqlarida trafikni dinamik taqsimlash jarayonida sun'iy intellekt algoritmlaridan foydalanishning nazariy va amaliy jihatlari tahlil qilingan. Tadqiqotda zamonaviy telekommunikatsiya tarmoqlarida yuzaga kelayotgan trafik hajmining ortishi, tarmoq resurslaridan samarali foydalanish zarurati hamda xizmat ko'rsatish sifatini oshirish masalalari ko'rib chiqilgan. Mashinali o'qitish, chuqur o'qitish va mustahkamlovchi o'qitish algoritmlarining trafikni prognozlash, resurslarni optimallashtirish va tarmoq yuklamalarini muvozanatlashtirishdagi imkoniyatlari yoritilgan. Shuningdek, sun'iy intellekt asosidagi boshqaruv tizimlarining tarmoq samaradorligini oshirish, kechikishlarni kamaytirish va energiya tejamkorligini ta'minlashdagi afzalliklari tahlil etilgan. Tadqiqot natijalari kelajakdagi 6G tarmoqlarida sun'iy intellekt texnologiyalari tarmoq boshqaruvining asosiy elementi bo'lishini ko'rsatadi.*

Kalit so'zlar: *5G, 6G, sun'iy intellekt, mashinali o'qitish, chuqur o'qitish, trafikni dinamik taqsimlash, telekommunikatsiya, tarmoq optimallashtirish.*

Introduction. The rapid development of information and communication technologies has increased the demand for next-generation mobile communication

systems. While 5G mobile networks are being actively deployed worldwide, extensive research is already underway on the development of 6G technologies. These networks are characterized by ultra-high data transmission speeds, extremely low latency, massive connectivity, and enhanced service quality. However, the continuous growth in the number of users and the increasing volume of data traffic have made efficient network resource management a critical challenge. Traffic patterns in 5G and future 6G networks are highly dynamic and constantly changing. The mobility of users, the growing popularity of multimedia services, and the rapid expansion of Internet of Things (IoT) devices create uneven traffic distribution across the network. As a result, dynamic traffic allocation and efficient resource utilization have become key issues in modern mobile communication systems. Traditional traffic management methods often fail to provide sufficient efficiency in such complex and rapidly changing network environments. Recent advances in Artificial Intelligence (AI) and Machine Learning (ML) technologies have created new opportunities to address these challenges. AI algorithms can analyze large volumes of network data in real time, predict traffic fluctuations, and optimize resource allocation automatically. In particular, neural networks, deep learning techniques, reinforcement learning models, and evolutionary algorithms are considered promising solutions for traffic management in 5G and 6G networks. These technologies contribute to increased network throughput, reduced latency, improved reliability, and enhanced Quality of Service (QoS). AI-based traffic management systems enable networks to become more adaptive, autonomous, and intelligent. This capability is essential for the development of future smart communication infrastructures. In 6G networks, artificial intelligence is expected to be deeply integrated into network architecture, providing intelligent control and optimization of all network components. Consequently, AI-driven traffic allocation is becoming a fundamental element of next-generation wireless communication systems.

Methods. This study employed a comprehensive analytical and comparative research methodology to investigate the application of artificial intelligence algorithms in dynamic traffic allocation within 5G and 6G mobile communication networks. Scientific literature, international research articles, conference proceedings, and technical reports related to artificial intelligence, machine learning, and next-generation wireless communication systems were systematically reviewed and analyzed. Comparative analysis was used to evaluate the performance and effectiveness of different artificial intelligence algorithms, including neural networks, deep learning models, reinforcement learning techniques, and optimization algorithms.

In addition, a theoretical modeling approach was applied to examine the impact of artificial intelligence on traffic prediction, resource allocation, network optimization, and Quality of Service enhancement. Statistical and logical analysis methods were employed to assess the advantages and limitations of AI-based traffic management systems. The study also utilized a descriptive research approach to identify current trends, challenges,

and future prospects of intelligent traffic allocation in advanced mobile communication networks. The obtained results were synthesized and interpreted to determine the effectiveness of artificial intelligence technologies in improving network performance, reducing latency, and increasing resource utilization efficiency in 5G and future 6G environments.

Literature Analysis. Scientific studies conducted on this topic demonstrate that the application of artificial intelligence technologies in mobile communication networks is rapidly expanding. Research carried out by both international and local scholars confirms the significant role of AI algorithms in traffic management, resource optimization, and network performance enhancement within 5G and future 6G communication systems.

Among international researchers, Zhang N., Wang Y., and Li X. investigated AI-based traffic management systems in 5G and beyond-generation networks. According to their findings, artificial intelligence algorithms can monitor network traffic in real time and allocate resources dynamically according to changing network conditions. Their research showed that automated traffic management significantly improves network efficiency, reduces congestion, and enhances service quality.[1] Chen M., Saad W., and Bennis M. focused on the application of machine learning techniques in wireless communication networks. Their studies emphasized the effectiveness of neural networks and deep learning models in traffic prediction and resource allocation. The researchers concluded that AI-driven solutions provide higher prediction accuracy and improve overall network performance compared with conventional traffic management methods.[2]

Another important contribution was made by Khan I., Ahmed S., and Kim J., who explored deep reinforcement learning approaches for dynamic resource allocation in 6G networks. Their findings demonstrated that intelligent learning algorithms can effectively adapt to complex and rapidly changing network environments. The authors argued that future 6G networks will heavily rely on autonomous AI-based decision-making systems to optimize communication processes and network operations.[3] Among local researchers, Rasulov B.B. examined intelligent methods for traffic management in 5G mobile networks. His research focused on the application of artificial intelligence technologies to optimize network load distribution and improve Quality of Service (QoS). The study highlighted the importance of predictive algorithms in managing traffic fluctuations efficiently.[4]

Qodirov A.T. investigated the optimization of telecommunication networks using artificial intelligence techniques. His research addressed issues related to resource management, energy efficiency, and network performance improvement. The author emphasized that AI-based optimization approaches contribute significantly to the sustainable development of modern communication systems.[5] Tursunov Sh.X. studied resource allocation algorithms in next-generation mobile communication networks. His work demonstrated that intelligent traffic allocation methods can increase network

ISSN: 2992-8850
www.uzresearchers.com

throughput, reduce latency, and improve the overall efficiency of communication services. The study also highlighted the practical significance of AI technologies in future wireless communication infrastructures.[6]

The rapid growth of mobile data traffic has created significant challenges for network operators worldwide. Modern 5G networks support a large number of users, devices, and applications that require high-speed and reliable communication services. Future 6G networks are expected to handle even greater traffic volumes generated by smart cities, autonomous vehicles, industrial automation, and the Internet of Things. Under such conditions, traditional traffic management methods become insufficient for maintaining optimal network performance. Artificial intelligence algorithms provide an effective solution for addressing these challenges. AI technologies can analyze large amounts of network data in real time and make intelligent decisions regarding resource allocation. Machine learning algorithms are capable of identifying traffic patterns and predicting future network demands. Deep learning models can process complex datasets and improve prediction accuracy. Reinforcement learning algorithms enable networks to learn optimal traffic allocation strategies through continuous interaction with the environment. These intelligent approaches allow communication systems to adapt dynamically to changing traffic conditions. AI-driven traffic allocation reduces network congestion and improves resource utilization efficiency. It also enhances the overall Quality of Service by minimizing packet loss and transmission delays. The integration of artificial intelligence into 5G and 6G networks represents a major step toward fully autonomous communication systems. Researchers believe that AI-based traffic management will become a fundamental component of future wireless infrastructures.

Machine learning has become one of the most important technologies for intelligent traffic management in next-generation mobile networks. The effectiveness of traffic allocation largely depends on the ability to predict network conditions accurately. Machine learning algorithms can analyze historical traffic data and identify hidden relationships between network parameters. Supervised learning techniques are widely used to forecast traffic demand and user behavior. Neural network models are particularly effective in handling large-scale and highly dynamic datasets. Deep learning approaches enable more accurate prediction of traffic fluctuations compared to conventional statistical methods. Recurrent Neural Networks and Long Short-Term Memory models are frequently applied for traffic forecasting tasks. These algorithms can capture temporal dependencies and improve prediction performance. Accurate traffic prediction allows network operators to allocate resources proactively rather than reactively. Machine learning also supports intelligent load balancing across network cells and communication channels. This helps prevent congestion and improves network efficiency. Optimization algorithms can automatically adjust bandwidth allocation according to current traffic conditions. As a result, users experience better service quality and reduced latency. Machine learning-based

optimization contributes to more efficient utilization of network infrastructure. Furthermore, these techniques support energy-efficient network operation by reducing unnecessary resource consumption.

The development of 6G communication networks is expected to transform the way wireless systems operate and manage network resources. Artificial intelligence will play a central role in the architecture of future communication infrastructures. Unlike previous generations, 6G networks are being designed with built-in AI capabilities that support autonomous decision-making and self-optimization. Intelligent traffic management systems will continuously monitor network conditions and adapt resource allocation strategies in real time. AI-driven automation will improve network reliability, flexibility, and scalability. Future 6G environments will support applications such as holographic communication, extended reality, digital twins, and fully autonomous transportation systems. These services require extremely low latency and highly efficient traffic management mechanisms. Artificial intelligence algorithms will help satisfy these demanding requirements by optimizing network operations automatically. Deep reinforcement learning is expected to become one of the most important technologies for dynamic resource allocation in 6G systems. AI models will also contribute to intelligent spectrum management and energy optimization. Network slicing techniques combined with artificial intelligence will enable customized service delivery for different applications and users. Furthermore, AI will enhance network security by detecting anomalies and preventing cyber threats in real time. Researchers predict that future communication networks will evolve into fully self-organizing and self-healing systems.

Results. The conducted analysis showed that artificial intelligence algorithms significantly improve the efficiency of dynamic traffic allocation in 5G and 6G mobile communication networks. The study revealed that machine learning models are capable of accurately predicting traffic fluctuations and optimizing resource distribution according to changing network conditions. Deep learning techniques demonstrated higher prediction accuracy compared with traditional statistical approaches. Reinforcement learning algorithms successfully adapted to dynamic network environments and provided autonomous decision-making capabilities. The results indicated that AI-based traffic management reduces network congestion, improves bandwidth utilization, and minimizes communication delays. Furthermore, intelligent traffic allocation mechanisms contributed to higher network throughput and enhanced Quality of Service. The analysis also confirmed that artificial intelligence technologies can support real-time resource optimization in highly complex communication infrastructures. As a result, AI-driven approaches provide significant advantages for future 6G communication systems and intelligent wireless networks.

Discussion. The obtained results confirm that artificial intelligence has become an essential technology for modern traffic management in next-generation mobile

communication networks. The increasing complexity of 5G and future 6G infrastructures requires intelligent solutions capable of making rapid and accurate decisions under dynamic conditions. Machine learning and deep learning models offer substantial benefits in traffic prediction and resource optimization. The findings are consistent with previous international studies that emphasize the effectiveness of AI in enhancing network performance and service quality.

However, the implementation of artificial intelligence in large-scale communication networks is associated with several challenges. High computational requirements, data security concerns, and the need for extensive training datasets may limit practical deployment. In addition, maintaining the reliability and transparency of AI models remains an important issue for network operators and researchers. Despite these challenges, the advantages of AI-based traffic allocation significantly outweigh its limitations. The continuous development of intelligent algorithms is expected to further improve network efficiency, automation, and adaptability. Therefore, artificial intelligence will play a central role in the evolution of 6G networks and future intelligent communication ecosystems.

Conclusion. The rapid development of 5G and future 6G mobile communication networks has created a growing need for intelligent and adaptive traffic management mechanisms. The findings of this study demonstrate that artificial intelligence algorithms play a crucial role in dynamic traffic allocation by improving network efficiency, optimizing resource utilization, and enhancing service quality. Machine learning, deep learning, and reinforcement learning techniques provide effective solutions for traffic prediction, congestion control, and autonomous network management. The analysis revealed that AI-based traffic allocation significantly increases network throughput, reduces latency, and improves the overall Quality of Service. These advantages are particularly important for emerging applications such as the Internet of Things, smart cities, autonomous transportation systems, and industrial automation, all of which require reliable and high-performance communication infrastructures. At the same time, several challenges remain, including computational complexity, data security concerns, model transparency, and the need for large-scale datasets. Addressing these issues will be essential for the successful deployment of artificial intelligence technologies in future communication systems. Continuous research and technological innovation are therefore required to develop more efficient, scalable, and reliable AI-driven network management solutions.

References:

1. Zhang N., Wang Y., Li X. Artificial Intelligence-Based Traffic Management in 5G and Beyond Networks // IEEE Communications Magazine. - 2023. - Vol. 61. - No. 4. - P. 54–61.
2. Chen M., Saad W., Bennis M. Machine Learning for Wireless Networks with Artificial Intelligence Applications // IEEE Transactions on Wireless Communications. - 2022. - Vol. 21. - No. 8. - P. 6124–6140.

3. Khan I., Ahmed S., Kim J. Deep Reinforcement Learning Approaches for Dynamic Resource Allocation in 6G Networks // Future Internet. - 2024. - Vol. 16. - No. 2. - P. 75–89.
4. Park J., Lee H., Choi S. Intelligent Traffic Prediction Models for Next-Generation Mobile Networks // Computer Networks. - 2023. - Vol. 231. - P. 109–121.
5. Gupta R., Sharma P. Artificial Intelligence Techniques for Network Resource Optimization in 5G Systems // Wireless Personal Communications. - 2024. - Vol. 128. - No. 3. - P. 1875–1891.
6. Alam M., Hassan K. AI-Driven Dynamic Traffic Engineering in Future 6G Communication Networks // Journal of Network and Computer Applications. - 2024. - Vol. 236. - P. 103–118.
7. Rasulov B.B. Intelligent Methods of Traffic Management in 5G Mobile Networks // Muhammad al-Khwarizmi Generations. - 2024. - No. 3. - P. 45–52.
8. Qodirov A.T. Issues of Telecommunication Network Optimization Based on Artificial Intelligence // Information Technologies and Telecommunications. - 2023. - No. 4. - P. 28–36.
9. Tursunov Sh.X. Efficient Resource Allocation Algorithms in Next-Generation Mobile Communication Networks // TUIT Bulletin. - 2024. - No. 2. - P. 39–47.
10. Karimov O.R. Prospects of Artificial Intelligence Technologies in 6G Mobile Communication Networks // Journal of Digital Technologies. - 2024. - No. 1. - P. 25–33.