



**ПОЛТАВСЬКА
ПОЛІТЕХНІКА**

Міністерство освіти і науки України
Національний університет
«Полтавська політехніка імені Юрія Кондратюка»

ЗБІРНИК НАУКОВИХ ПРАЦЬ

**78-Ї НАУКОВОЇ КОНФЕРЕНЦІЇ
ПРОФЕСОРІВ, ВИКЛАДАЧІВ, НАУКОВИХ
ПРАЦІВНИКІВ, АСПІРАНТІВ ТА
СТУДЕНТІВ УНІВЕРСИТЕТУ**

І ТОМ



**15 – 22 травня 2026 року
Полтава**

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DIRECTIONS FOR OPTIMIZATION OF MOBILE SDN ARCHITECTURE IN ULTRA-DENSITE SENSOR NETWORKS

Modern telecommunications systems are characterized by a rapid growth in the number of connected devices, which is especially evident in ultra-dense sensor networks and Internet of Things environments. This leads to a significant complication of network management processes, increased infrastructure load, and increased requirements for quality of service (QoS). Traditional approaches to centralized network management in such conditions lose their effectiveness due to limited scalability and high delays.

One of the promising directions for solving this problem is the use of the software-defined networking (SDN) paradigm, which provides separation of the control plane from the data transmission plane [1]. This allows for increased flexibility, centralized management of network resources, and rapid adaptation to changes in the network environment. However, in ultra-dense sensor networks with high node mobility, there is a need to improve the classic SDN architecture.

The paper considers an approach to developing mobile SDN based on the use of a multi-layer architecture with a combination of centralized, distributed stationary and mobile SDN controllers. The proposed structure allows for a balance between centralized management and localized data processing, which is critically important for networks with a high density of nodes.

A special role in the proposed architecture is played by edge computing (MEC), which provides data processing directly at the network periphery [2]. The integration of MEC with SDN allows for reducing transmission delays, optimizing the use of computing resources and increasing the efficiency of network operation in real time. Mobile SDN controllers placed on mobile nodes provide additional system flexibility, allowing adaptation to changes in network topology.

To formalize the network model, the apparatus of graph theory was used, where the network topology is represented as a set of nodes and connections between them. The performance of controllers is assessed based on crowd-sourcing models, which allows for consideration of request processing delays and system load. This allows for analyzing the efficiency of network operation under different operating conditions.

A method for adaptive placement of SDN controllers on mobile nodes is proposed, which takes into account key network parameters: delay, bandwidth, load level, and communication reliability. Optimization is performed by minimizing the total cost of interaction between network elements, including switches and controllers of different levels. This allows for effective resource allocation and improved service quality.

The implementation of a mobile SDN architecture helps reduce the load on central control nodes, reduce data processing delays, and increase network availability. This is especially important for scenarios with high performance requirements, such as autonomous transport, smart cities, and the industrial IoT.

The effectiveness of the proposed approach was assessed using the NS-3 and CloudSim modeling environments, which allowed for a comprehensive consideration of network and computing aspects of the system. The simulation results showed improved latency and resource efficiency compared to traditional SDN architectures.

Thus, the development of mobile SDN for ultra-dense sensor networks is a promising direction for the development of telecommunication systems, which allows ensuring their scalability, adaptability and high efficiency of functioning in the conditions of modern challenges.

References:

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