The Boosting Effect of Network Automation and Edge Computing on the Digital Transformation of Social Economy

Nannan Jiang[a], Wenting Ma[b], Xiaoting Yu[c]

Harbin Huade University, Harbin, Heilongjiang, 150025, China

[a]j905511180@163.com, [b]18845098029@163.com, [c]15145086176@163.com

Keywords: Network automation; Edge calculation; Digital transformation of social economy; Synergistic effect; Technical innovation

Abstract: Network automation and edge computing play a key role in promoting the digital transformation of social economy, and the interaction and synergy between them are worthy of in-depth discussion. This paper expounds the basic knowledge, technical framework and obvious advantages of network automation and edge computing. It reveals the effectiveness of the joint action of the two in improving efficiency, enhancing flexibility and ensuring safety. This paper also analyzes how these two technologies promote the digital transformation of social economy, including stimulating emerging industries and promoting the upgrading of traditional industries. The research shows that network automation and edge computing complement each other in technology and jointly promote the pace of digital transformation. The research conclusion points out that network automation and edge computing are important forces to promote the digital transformation of social economy. In order to promote the further application and development of these two technologies, this study puts forward the following suggestions: strengthening technology research and innovation, broadening application scenarios, improving security and privacy protection, promoting standardization and standardization process, and cultivating professional talents and teams.

1. Introduction

Network automation is a key technological innovation in the field of information technology, which involves the intelligent upgrade of network management system and the automatic configuration, optimization and repair of network resources [1]. Based on the core technologies such as SDN (Software Defined Network) and NFV (Network Functions Virtualization), network automation has significantly improved the flexibility, scalability and management efficiency of the network [2]. From the initial simple script automation to today's intelligent automation driven by artificial intelligence and machine learning, the development of network automation reflects the continuous progress and innovation of technology [3]. At present, network automation is moving towards a higher level of intelligence and autonomy, which provides a solid support for building an efficient, safe and reliable network environment.

As a new computing mode, edge computing has emerged with the development of Internet of Things and big data technology [4]. It transfers computing tasks and data storage from the cloud to the edge of the network, that is, near the equipment or terminal, so as to facilitate the near-ground processing and analysis of data [5]. The global economy is undergoing a profound digital transformation. Digitalization, networking and intelligence, as the core driving force of the transformation, are rapidly changing the operation and business model of all walks of life. Under this global trend, various industries actively explore the path of digital transformation [6]. As cutting-edge technologies, network automation and edge computing are very important to promote the digital transformation of social economy. Network automation improves the efficiency and flexibility of network management, reduces operating costs and provides support for digital transformation [7]. Edge computing realizes the near-ground data processing and analysis, improves the real-time and accuracy of data processing, and provides reliable data support for enterprise

  DOI: 10.25236/icssem.2025.022

decision-making. The integration of the two has promoted the rise of emerging industries and the transformation and upgrading of traditional industries, and injected new vitality into the sustainable development of social economy.

The purpose of this study is to explore the role of network automation and edge computing in promoting the digital transformation of social economy. The expected results include building a theoretical system about the promotion of these two technologies to digital transformation, and proposing policy suggestions and practical paths to promote social and economic development, which can provide reference for related enterprises and institutions.

2. The role of network automation in promoting the digital transformation of social economy

2.1. The core technology of network automation and its technical advantages

Network automation relies on a series of advanced core technologies, the most prominent of which include SDN and NFV. SDN is a technical architecture that separates the network control plane from the data forwarding plane. Through centralized control plane, SDN can realize intelligent management and dynamic configuration of the network. This separation enables network administrators to control network resources more flexibly and respond quickly to changes in business requirements [8]. The technical advantage of SDN is that it provides a global network view, simplifies network management and improves the programmability and expansibility of the network. NFV is a technology to realize the functions of network devices in the form of software. It makes the traditional hardware equipment function run on the general server or virtual machine, thus reducing the hardware cost and improving the flexibility and deployment of the equipment. The technical advantage of NFV is that it can quickly deploy new network services, lower the threshold of service innovation and improve the utilization rate of network resources.

In addition to SDN and NFV, network automation also involves a series of technologies such as automatic configuration management, network monitoring and analysis, and fault self-repair. The comprehensive application of these technologies enables network automation to realize intelligent management, dynamic optimization and automatic repair of the network, which greatly improves the efficiency, flexibility and reliability of the network.

2.2. The promotion of network management by network automation

Network automation greatly improves the efficiency, flexibility and security of network management through intelligent and automated means.

In terms of efficiency improvement, network automation technology can automatically complete the daily configuration, real-time monitoring and regular maintenance of the network and other tedious tasks. This transformation not only greatly reduces the intervention of manual operation, but also significantly improves the overall efficiency of the work. Network administrators can get rid of repetitive work and devote more energy to more strategic network planning and optimization. Network automation can also realize the dynamic allocation and optimization of resources, so that network resources can be used more reasonably. In terms of flexibility, network automation can quickly respond to changes in business requirements and realize dynamic adjustment and optimization of the network. This flexibility enables enterprises to respond to market changes more nimbly, seize fleeting business opportunities and maintain their competitive advantage. Network automation also plays an important role in security. Through centralized management and monitoring means, network automation can grasp the security status of the network in real time, discover and deal with potential security threats and loopholes in time, and improve the security of the network. At the same time, network automation can also realize the automatic deployment and update of security policies, ensuring the continuity and effectiveness of network security.

3. Marginal computing can empower the digital transformation of social economy

3.1. Basic concepts, technical architecture and core advantages of edge computing

Edge computing is a new computing mode that sinks computing tasks and data storage from the traditional cloud center to the edge of the network, that is, near devices or terminals. It aims to realize the nearby processing and analysis of data, so as to reduce the delay of data transmission and improve the real-time and efficiency of processing.

The technical architecture of edge computing usually includes edge devices, edge nodes, edge management platforms and other key components. The core advantages of edge computing are low latency, high bandwidth, data localization and privacy protection. Because the data is processed near the edge node, the data transmission time is greatly reduced and the low delay is realized; At the same time, edge nodes can directly access high-speed networks, providing high-bandwidth data transmission capabilities. Data localization makes it unnecessary to upload sensitive data to the cloud, which reduces the risk of data leakage and improves the real-time performance of data processing.

Edge computing has a wide range of application scenarios in different industries, such as Internet of Things, intelligent transportation, telemedicine and so on, which provides a powerful enabling role for the digital transformation of social economy. The application scenarios of edge computing in different industries are shown in Figure 1:

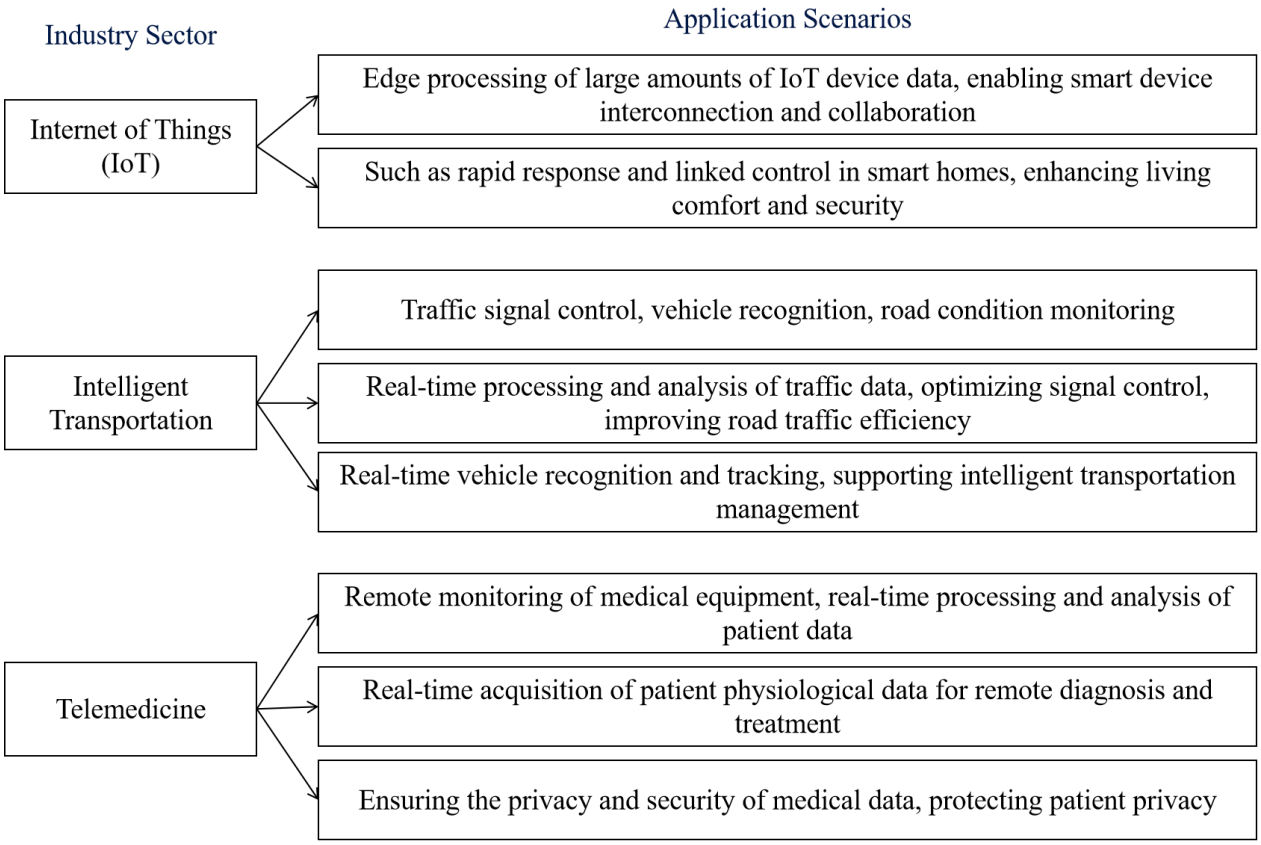

Figure 1 Application Scenarios of Edge Computing in Different Industries

3.2. The influence of edge computing on data processing, storage and transmission mode

Edge computing technology has brought fundamental changes to data processing, storage and transmission. On the data processing level, this technology realizes the near-ground processing and analysis of data, which significantly improves the immediacy and efficiency of processing. For data storage, edge computing allows data to be stored locally at edge nodes, which reduces the cost of data transmission and storage. In data transmission, edge computing optimizes the use of data transmission path and bandwidth, and enhances the efficiency and reliability of data transmission.

Edge computing also plays a key role in privacy protection and data security. Because the data is

processed and analyzed locally at the edge nodes, the necessity of uploading data to the cloud is reduced, and the risk of data leakage is greatly reduced. Edge computing has further strengthened the protection of data privacy and security by adopting encryption technology and access control.

3.3. The potential impact of marginal computing on economic development

The potential impact of marginal computing on economic development is far-reaching. On the one hand, this technology is expected to promote the rise of emerging industries. With the continuous progress of edge computing technology and the expansion of application scenarios, it is expected that a series of emerging industries with edge computing as the core will be born, including the production of edge computing equipment and the provision of edge computing services. These industries will bring new growth impetus to the economy. On the other hand, edge computing contributes to the transformation and upgrading of traditional industries. By integrating edge computing technology, traditional industries can realize the intelligence and automation of production processes, thus improving production efficiency and product quality. Edge computing has also brought new business models and service models to traditional industries. For example, intelligent manufacturing and intelligent transportation based on edge computing will promote the innovative development and structural upgrading of traditional industries.

4. The synergy between network automation and edge computing

4.1. The relationship and synergy between network automation and edge computing

As two important trends in the field of information technology, network automation and edge computing are closely related and synergistic. Network automation focuses on intelligent management and dynamic configuration of network resources, while edge computing focuses on data processing and analysis at the edge of the network. The two technologies complement each other and form a complete solution together. Driven by the rapid development of Internet of Things, big data, artificial intelligence and other technologies, network automation and edge computing came into being, meeting the urgent demand for real-time, high efficiency and data security. They jointly promote the process of social and economic digital transformation by improving efficiency, enhancing flexibility and ensuring safety.

4.2. Integration case of network automation and edge computing in practical application

Table 1 below reflects the application scenarios, fusion technologies and specific fusion cases of smart factories and smart city management systems:

Table 1 Application Case Table of Integration Technology of Smart Factory and Smart City Management System

Application Scenario/System	Description	Integrated Technology	Specific Integration Case
Smart Factory	Sensors and devices exchange data in real-time to achieve production automation and intelligence.	SDN Network Automation	Utilize SDN for intelligent management of the factory network to ensure efficient operation; edge computing nodes process production data in real-time, quickly responding to abnormalities to improve efficiency and quality.
		Edge Computing	Deploy nodes near production lines to analyze data in real-time, such as equipment failures and product quality issues, and trigger timely handling measures.
Smart City Management System	Collect city data in real-time, such as traffic, environment, and safety, to achieve intelligent management.	NFV Network Automation	Rapidly deploy network services, such as intelligent traffic signals and environmental monitoring, through NFV; edge computing nodes process city data in real-time.
		Edge Computing	Deploy nodes throughout the city to analyze traffic flow in real-time and intelligently adjust traffic lights; analyze environmental quality to promptly identify and address pollution issues.

According to Table 1, the synergy between network automation and edge computing provides a

powerful impetus for the digital transformation of social economy. Through complementary technologies and integrated applications, they have jointly promoted the intelligent upgrading and innovative development of all walks of life. With the continuous progress of technology and the continuous expansion of application scenarios, the synergy between network automation and edge computing will play an increasingly important role.

5. Conclusions

This paper expounds the key role of network automation and edge computing in the digital transformation of social economy. This paper points out that network automation improves efficiency, flexibility and security by intelligently managing network resources, while edge computing reduces delay, improves processing efficiency and enhances data security by sinking computing tasks. The two technologies complement each other at the technical level, and they are integrated in practical applications such as smart factories and smart cities, and are widely used in the fields of Internet of Things, intelligent transportation and telemedicine. They jointly promote the rise of emerging industries and the transformation and upgrading of traditional industries, injecting new vitality into the digital transformation of social economy. Based on the above research results, this paper puts forward the following suggestions for the further application of network automation and edge computing in the digital transformation of social economy: strengthening technology research and innovation, expanding application scenarios and depth, strengthening security and privacy protection, promoting standardization and standardization development, and cultivating professionals and teams.

To sum up, network automation and edge computing play an important role in the digital transformation of social economy, with broad application prospects and development potential. By strengthening technology research and innovation, expanding application scenarios and depth, we can further promote the application and development of network automation and edge computing in the digital transformation of social economy.

Acknowledgements

The authors acknowledge the Key topics of Heilongjiang Educational Science Planning in 2024 Subject- “Research and Practice on the Cultivation of Innovative Talents in Computer Related Majors with the Dual Integration of Discipline and Industry Education under the Background of New Engineering"(Grant:GJB1424364).

References

[1] Xu Xianchun, Zhang Meihui, and Zhang Zhongwen. Digital Transformation and the Challenges and Innovations in Social and Economic Statistics[J]. Statistical Research, 2021, 38(01): 15-26.

[2] Song Jing and Chen Jin. The Impact of Entrepreneurs' Social Networks on Enterprise Digital Construction: The Moderating Role of Strategic Flexibility[J]. Research in Science Policy, 2022, 40(1): 103-112.

[3] Xu Xianchun. The Role of Digital Economy, Digital Technology, and Data Assets in Social and Economic Development[J]. Economic Research Journal, 2020, (24): 96-99.

[4] Zhang Wenke, Zhang Linyue, Wan Liquan, et al. Realistic Pathways for Digital Economy to Promote Common Prosperity in Rural Areas[J]. Nankai Economic Studies, 2024(5): 14-30.

[5] Wang Shihui and Xie Xuanli. Economic Pressure or Social Pressure: Digital Finance Development and Commercial Banks' Digital Innovation[J]. Economist, 2021(1): 100-108.

[6] Li Yongjian. "Digitalization of Chinese - Style Service Industry": Basic Framework and Policy Implications[J]. Guizhou Social Sciences, 2023(7): 118-127.

[7] Zhao Chenyu. Research on the Impact of Digital Transformation on Corporate Social Responsibility[J]. Contemporary Economic Science, 2022, 44(2): 109-116.

[8] Wang Yue and Zhu Hejun. Digital Economy: A New Direction for High - Quality Economic Development in China[J]. Reform and Strategy, 2021, 37(04): 67-74.