



Digital Economy Transformation Driven by Fiber Optic Telecommunications Networks

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Abstract. General Background: The globalization process is reshaping the global economy by intensifying trade, investment, and information exchange between countries. Specific Background: Telecommunications technologies and fiber optic networks serve as the core infrastructure enabling the digital economy, supporting technologies such as 5G, artificial intelligence, cloud computing, and the Internet of Things. Knowledge Gap: Despite extensive research on digital infrastructure, the integrated relationship between telecommunications systems, fiber optic networks, and digital economy transformation within globalization remains insufficiently explored. Aims: This study aims to analyze the theoretical and practical aspects of digital economy transformation based on telecommunications technologies and fiber optic networks in the context of globalization. Results: The findings confirm that fiber optic networks constitute the backbone of the digital economy, accelerating data transmission, reducing transaction costs, and fostering global economic integration. Empirical data indicate significant growth in telecommunications markets, increased broadband penetration contributing to GDP growth, and rapid expansion of fiber optic infrastructure supporting cloud services and data centers. Novelty: This study provides a comprehensive synthesis linking telecommunications development, fiber optic infrastructure, and globalization as interconnected drivers of digital economic transformation. Implications: The results highlight the strategic importance of expanding fiber optic networks, strengthening cybersecurity, and implementing flexible regulatory policies to ensure sustainable economic growth and integration into the global digital system, particularly for developing countries such as Uzbekistan.

Keywords: Digital Economy, Telecommunications, Fiber Optic Networks

1 Introduction

Telecommunications technologies accelerate globalization because they facilitate communication between countries and lower the cost of economic transactions. For example, establishing effective communication networks reduces the costs of all economic operations and strengthens the interconnection of markets. This process highlights the interdependence between technological development and globalization: the advancement of information technologies strengthens globalization, while globalization, in turn, refines IT to meet new demands. In Europe, for example, fixed broadband in high-income countries drives 2.94% growth, which is above the global average. In Arab countries, mobile broadband leads to a 1.82% increase. These figures

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R. Lomotey et al. (eds.), *Proceedings of the 1st International Conference on Communication and Digital Multimedia 2025 (ICCDM 2025)*, Advances in Social Science, Education and Humanities Research 1020, https://doi.org/10.2991/978-2-38476-589-8_45

show that telecommunications technologies help reduce economic disparities in the globalization process, but their impact varies depending on the level of development.

Fiber optic networks are a key element of the digital economy transformation because they provide high-speed data transmission. At the same time, fiber optic technology supports 5G networks, cloud computing, and AI, which leads to industrial digitalization. For example, the fiber optic communications industry stands at the center of the digital economy's infrastructure, supporting projects such as “East Data, West Computing.”

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The flourishing of the digital economy has created strong demand for fiber optic communication. The rapid growth of cloud computing, AI data centers, and the “East Data, West Computing” initiative has made fiber optic networks a lifeline for transmitting massive amounts of data. As of March 2024 in China, the total length of fiber optic cable lines reached 65.58 million kilometers, and the share of gigabit broadband internet users increased significantly. In 2024, the emergence of the “10G era” further accelerated the deployment of gigabit optical networks (10G PON), Operators such as China Telecom and China Mobile are actively upgrading their infrastructure to meet the growing needs of businesses and individuals.

2 Literature Review

The formation and development of the digital economy are closely linked to globalization processes, and in particular, the development of telecommunications technologies and fiber-optic networks is considered one of the main driving forces of this process. Recent scientific research in this field has extensively highlighted the important role of digital infrastructure in promoting economic growth, implementing innovations, and increasing the efficiency of information exchange.

The concept of the digital economy was first introduced into scientific discourse in the late 20th century, and its theoretical foundations were developed by many economists. In particular, Don Tapscott (2012) defines the digital economy as a new economic system built on information technologies, emphasizing that knowledge and data become the primary production resources. According to the author, the Internet and digital networks bring about fundamental changes in all areas of economic activity [1].

The impact of telecommunications infrastructure on economic development has been studied by many researchers. In his concept of the “Network Society,” Manuel Castells places special emphasis on the importance of information and communication technologies in the development of modern society. According to him, the acceleration of information flow through global networks leads to the transformation of economic systems and shapes new economic relationships [2]. Additionally, the research conducted by the ITU (International Telecommunication Union) and the World Bank on the impact of telecommunications technologies on economic growth also serves as an important scientific basis. According to analyses by these organizations, an increase

in broadband internet coverage has a positive impact on GDP growth in countries. In particular, fiber-optic networks enable high-speed data transmission, accelerating the development of digital services.

In scientific works on optical fiber communication technologies, Govind P. Agrawal and other authors have conducted extensive analyses of the technical capabilities of optical networks and their role in the global telecommunications infrastructure. According to research findings, optical fiber networks have become a key element of the digital economy's infrastructure, with high bandwidth, low signal loss, and the ability to transmit large amounts of data [3]. In recent years, digital transformation processes have been considered an important factor in the development of national economies. The concept of the "Fourth Industrial Revolution," proposed by Klaus Schwab, also indicates that digital technologies, the internet, artificial intelligence, and big data are shaping a new phase of economic systems. In this process, telecommunications infrastructure, especially high-speed fiber-optic networks, is considered a critical strategic resource [4].

In Uzbekistan, the development of the digital economy and telecommunications infrastructure has also been studied by a number of scientists and researchers. In local scientific studies, expanding fiber-optic networks, increasing internet speeds, and developing digital services are considered important factors in boosting economic efficiency during the digital transformation process.

Thus, an analysis of existing scientific research shows that telecommunications technologies and fiber-optic networks are a critical infrastructural foundation for the transformation of the digital economy in a globalized context. However, conducting comprehensive scientific research on the interrelationship of these factors and their impact on the development of national economies remains a pressing issue.

3 Method

This research is aimed at analyzing the theoretical and practical aspects of the transformation of the digital economy based on telecommunications technologies and optical fiber networks in the context of globalization. Modern scientific methods of economic analysis were widely used in the research process.

First, the methods of scientific abstraction, induction and deduction, systems analysis, and comparative analysis were used to form the theoretical basis of the research. Through these methods, existing scientific views on the formation of the digital economy, the development of telecommunications technologies, and the impact of fiber-optic networks on the economic system were studied and generalized.

4 Results and Discussion

It is known that market demand is equally strong on a global scale. In 2023, China's optical fiber communication exports grew by 112%, totaling 3,665 tons - a trend that continued into 2024. - driven by the need for 5G base stations, submarine cables, and data centers. Companies like YOFC (Yangtze Optical Fibre and Cable) and Hengtong Optic-Electric have leveraged their technological and manufacturing strengths to secure key positions in infrastructure projects along the Belt and Road Initiative. One such project is where YOFC's ultra-low-loss optical fiber products were exported to

Southeast Asia and Europe, becoming key factors in local digital transformation. This market demand not only drives industry growth but also serves as a direct testament to its foundational status—without fiber optic networks, the grand vision of the digital economy would remain impossible to realize.

The findings of this study confirm with empirical evidence that telecommunications technologies and fiber-optic networks have become the core infrastructure of the digital economy in the process of globalization. The results of this study indicate that the optical fiber communications industry is at the center of not only technological but also economic and geopolitical changes, radically accelerating information exchange, trade, and investment between countries.

This situation directly impacts the following areas: market growth statistics, economic impact mechanisms, the advantages and risks of digital transformation, as well as strategic significance for developing countries (including Uzbekistan). First and foremost, global market demand and the activities of leading companies demonstrate how dependent the digital economy is on fiber optic networks. In 2023, China's optical fiber communication exports grew by 112% to a total of 3,665 tons, a trend that continued into 2024. Companies like Yangtze Optical Fibre and Cable (YOFC) and Hengtong Optic-Electric are accelerating local digital transformation by supplying ultra-low-loss fiber products to Southeast Asia, supplying ultra-low-loss fiber products to Europe and other regions, accelerating local digital transformation. These figures are not just export statistics: they reflect a new phase of globalization. Optical fiber networks optimize data centers, supporting projects like “East Data, West Computing,” and enable the real-time transmission of large volumes of data (AI, IoT, cloud computing). As a result, the costs of cross-border trade and investment are drastically reduced—a practical confirmation of the economic transformation of global networks highlighted in Manuel Castells's concept of the “Network Society.”

Table 1. Dynamics of Telecommunications and Digital Economy Development (2020–2025)

Year	Dynamics of the Telecommunications Sector	Advancements in Optical Fiber Networks	Transformation in the Digital Economy	Emerging Trends
2020	Initial deployment of 5G technology	Expansion of FTTH (Fiber to the Home) infrastructure	Significant increase in remote work and online education	Growth of online services and e-commerce
2021	Expansion of 5G network coverage	модернизация trunk optical networks → Modernization of backbone optical networks	Expansion of digital banking services	Development of fintech and mobile payment systems
2022	Development of IoT (Internet of Things) technologies	Increased coverage of optical fiber internet	Introduction of smart services	Smart city initiatives and intelligent transport systems
2023	Widespread adoption of cloud technologies	High-speed optical internet deployment	Expansion of digital government services	GovTech and e-government solutions

Continued **Table 1.**

Year	Dynamics of the Telecommunications Sector	Advancements in Optical Fiber Networks	Transformation in the Digital Economy	Emerging Trends
2024	AI-based telecommunication management systems	Development of 5G-enabled optical networks	Automation of business processes	Artificial intelligence, Big Data, and digital platforms
2025	Preparation for 6G technology	Integration of global optical infrastructure	Transition to a fully digital economy model	Metaverse, digital twins, and intelligent economy

According to this table, the development of telecommunications systems and fiber-optic networks is observed to have served as one of the main factors in the transformation of the digital economy between 2020 and 2025. It is noteworthy that remote work and education formats saw a sharp development in 2020 as a result of the launch of 5G technology and the expansion of FTTH optical networks. This, in turn, is leading to an increase in the volume of online services and e-commerce.

By 2021, the expansion of 5G networks continued, and backbone optical networks were modernized. During this period, digital banking services expanded, and fintech technologies and mobile payment systems developed. This process accelerated the economy's transition to a digital format and increased the convenience of financial services.

In 2022, smart services were introduced as a result of the development of IoT technologies and the expansion of fiber-optic internet coverage. In particular, smart cities, smart transportation systems, and automated management technologies were developed. This increased the efficiency of the infrastructure, contributing to the economy's transition to a new stage.

In 2023, the widespread adoption of cloud technologies and the development of high-speed fiber optic internet led to the expansion of digital government services. As a result, GovTech and e-government systems were improved, and the processes for accessing government services became much simpler and faster.

In 2024, AI-based telecommunications management and the development of 10G optical networks further enhanced automated business processes. During this period, artificial intelligence, big data, and digital platforms became the main drivers of the economy, and corporate efficiency increased.

By 2025, preparations for 6G technology had begun, and global optical infrastructure integration was completed. As a result, the necessary conditions were created for the formation of a fully digital economy model. New directions such as the metaverse, digital twins, and the smart economy developed, ensuring the economy's transition to an innovative stage.

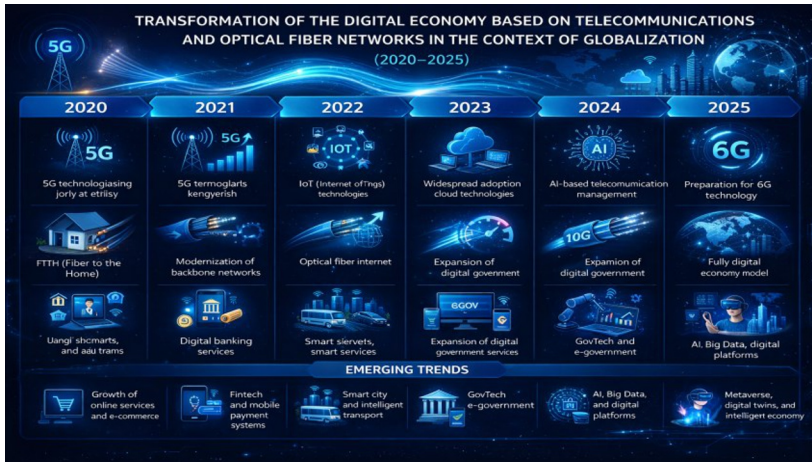


Fig. 1. Stages of telecommunications network development

On the other hand, the growth of the telecommunications market and digital transformation investments indicates the stable development of the digital economy. The global telecommunications services market is projected to reach approximately \$2.1 trillion in 2025 and \$2.87 trillion by 2030. This growth is driven by rising demand for broadband services and the integration of 5G, AI, and IoT. Meanwhile, global investments in digital transformation are expected to grow sharply after 2024, reaching nearly \$4 trillion by 2027, according to IDC (International Data Corporation) forecasts. The fiber optic market itself is projected to grow from \$98.65 billion in 2024 to \$171.7 billion by 2032 (CAGR 8.4%).

These indicators mean that fiber-optic networks are expected not only to serve as the “backbone,” but also to play a decisive role in the development of industrial automation, smart cities, and data centers. This means that growth activates the two-way mechanism of globalization: on the one hand, technological development accelerates the flow of information, lowering the cost of economic operations; on the other hand, globalization creates new demands (e.g., artificial intelligence data centers) and further improves the fiber-optic infrastructure. The third important aspect is the Empirical Statistical Assessment of the impact on economic growth. The data above confirms that doubling broadband internet speeds can increase GDP by 0.3%, while increasing broadband coverage by 10% increases GDP by 1% [5]. In high-income European countries, fixed broadband provides a 2.94% increase, while in Arab countries, mobile broadband reaches 1.82%. Although this difference depends on the level of development, the overall trend is the same: fiber optic networks ensure digital inclusivity and reduce economic disparities. Digital transformation reduces operational costs at telecom companies by up to 30% and increases service delivery speed by more than 40%. Artificial intelligence and cloud technologies optimize network efficiency and create new business models. Thus, globalization increases not only trade volume but also innovation and job opportunities – according to UN forecasts, digital technologies will create millions of new jobs by 2030. However, data analysis shows that the transformation is also causing a number of problems. Project complexity, barriers to technology adoption, cyber threats, data privacy, and infrastructure gaps in developing countries are the main risks. For example, if collaboration among

stakeholders in fiber optic projects is weak, the digital transformation may fail. In developing countries (including Uzbekistan), low broadband coverage slows economic integration. In Uzbekistan, local studies consider the expansion of fiber-optic networks and increased internet speeds to be a key factor in economic efficiency. A strategic approach here requires investments, regulatory flexibility, and international cooperation [6].

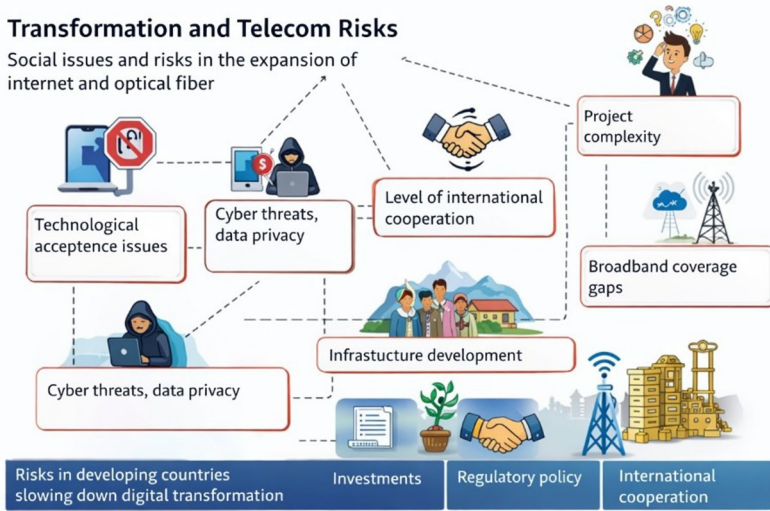


Fig. 2. Factors related to the telecommunications sector of the digital economy

Overall, the results demonstrate that telecommunications and optical fiber networks are the foundation of the digital economy's transformation in the globalization process. They not only increase technological speed and efficiency but also drive economic, social, and environmental changes (the transition to a green economy). However, success requires developing infrastructure, strengthening cybersecurity, and closing the digital divide. For countries like Uzbekistan, this process is of strategic importance: expanding fiber-optic networks can achieve integration into the global digital economy and sustainable growth [7]. Today, digital technologies such as data collection and artificial intelligence are being used in agriculture, are used for monitoring and diagnosing problems in agriculture, healthcare, and the environment, as well as for managing transportation and performing daily tasks such as making payments. They can also be used to protect and implement human rights. Governments and businesses are increasingly equipped with the means to obtain and use data for financial and other purposes. The telecommunications industry has revolutionized global communication systems and has had a profound impact on sectors such as internet services, mobile communications, and voice communications. The global telecommunications market is projected to exceed \$2 trillion by 2026, which broadband serv. The telecommunications industry has fundamentally transformed global communication systems and profoundly impacted areas such as internet services, mobile communications, and voice communications. The global telecommunications market is projected to exceed \$2 trillion by 2026, driven by rising demand for broadband services and digital transformation initiatives. (for example, according to the latest data, the telecom

services market was estimated at approximately \$2.1 trillion in 2025 and is expected to reach \$2.87 trillion by 2030) [8]. Digital transformation enables telecommunications companies to streamline operations and enhance service quality. Globally, investments in digital transformation continue to grow sharply after 2024 – for example, According to IDC and other analyses, this figure could reach nearly \$4 trillion by 2027, but the 2024 forecast, based on estimates exceeding \$1.7 trillion, underscores its significant importance for the sector. [9]. Technological innovations, including cloud computing, the Internet of Things (IoT), and artificial intelligence (AI), are fundamentally transforming telecommunications operations. AI-based analytics optimize network efficiency, while cloud platforms ensure scalable and accelerated service delivery. These advancements play a crucial role in enabling telecommunications companies to adapt to the demands of a connected world. However, challenges also exist. Research highlights the complexity of projects, barriers to technology adoption, and the need for effective collaboration among stakeholders. If these issues are not addressed, they can hinder the successful implementation of digital transformation in managing fiber optic projects. Addressing these challenges requires strategic approaches, investments, and collaboration [10]. Fiber optic networks are considered the “backbone” of the digital economy: they support technologies such as 5G, artificial intelligence, cloud computing, and the Internet of Things. Fiber networks are crucial for the development of data centers, smart cities, and industrial automation, providing high speeds, low latency, and energy efficiency. Studies show that doubling broadband speed can increase GDP by 0.3%, while increasing broadband penetration by 10% can boost GDP by 1%. These indicators also help accelerate economic integration and growth in developing countries [11].

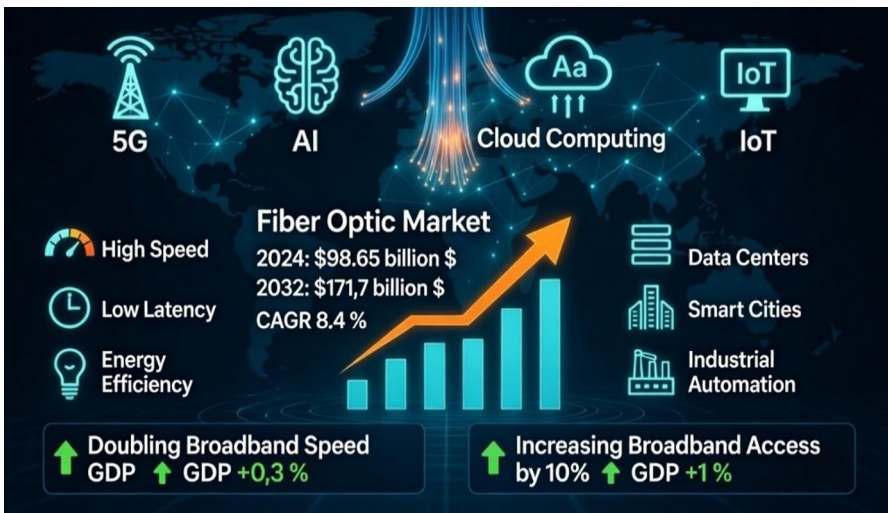


Fig. 3. Comparative analysis of fiber optic networks for 2024 and 2032.

Digital transformation can reduce operational costs in the telecommunications sector by up to 30% and increase service delivery speed by more than 40%. Artificial intelligence and cloud technologies are optimizing network efficiency and creating new services and business models. However, this process is also creating a number of challenges, including project complexity, barriers to technology adoption, cyber threats, data privacy, and infrastructure gaps in developing countries. Effective

collaboration among stakeholders and flexibility in regulatory policy are crucial in fiber optic projects.

In the future, telecommunications and fiber optic networks will play an even greater role in global trade, sustainable development, and the transition to a green economy. According to forecasts by the UN and other organizations, digital technologies could create millions of new jobs and increase environmental efficiency by 2030 [12]. This transformation brings not only technological but also economic, social, and environmental changes. As a result, governments and companies must fully capitalize on these opportunities by developing infrastructure, attracting investment, and providing policy support. In the new phase of globalization, telecommunications and optical fiber networks will remain the fundamental foundation for ensuring the stable and inclusive development of the digital economy[13].

5 Conclusion

In conclusion, it should be noted that, In today's geopolitically unstable period, we believe that the expanding coverage of the Uzbek internet network within the telecommunications system is part of the measures aimed at improving GII's position in international indices. This is because the creation of an electronic environment, developed with consideration for the population's lifestyle, income, and needs to address a number of shortcomings in digitalization, serves as a foundational mechanism.

The above analyses indicate that telecommunications and fiber-optic infrastructure are emerging as the primary drivers of the digital economy transformation. They play a crucial role in increasing economic efficiency, improving the quality of social services, and ensuring environmental sustainability. At the same time, the widespread adoption of digital technologies is also creating challenges such as data security, infrastructure gaps, and the digital divide.

Research findings confirm that, especially in developing countries, including in Uzbekistan, the positive impact of digital transformation can be maximized by expanding fiber-optic networks, strengthening cybersecurity, and shaping effective regulatory policy. Therefore, applying a comprehensive strategic approach in this area is a key factor in ensuring sustainable economic growth and integration into the global digital system.

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