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Study of the Impact of 6G Technology on the Strategic Management of Mobile Network Operators

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ABSTRACT

The **objective** of this study is to analyze the emerging trends in the development of sixth-generation (6G) technology, to identify the key challenges and opportunities associated with the 6G era, including changes in mobile network operators' business models, revenue structures, and infrastructure requirements, and to assess the impact of full-scale 6G deployment on the transformation of strategic management models within mobile operators. The authors applied a comparative analysis **method**, examining priority development goals of 6G technology alongside statistical data on the evolution of mobile networks. The empirical basis of the research comprised analytical reports and forecasts from leading industry analysts, as well as expert interviews with representatives of Russian and international operators and research institutions specializing in 6G technology. The study's **findings** include the identification and systematization of priority objectives for 6G implementation in the context of the data economy; an analysis of the evolution of services provided by mobile operators during the transition to new technologies; and the formulation of fundamental approaches to changes in operator strategies. The **novelty** of the approach lies in the focus on 6G technology and the task of elucidating the interconnection between the necessity to transform operators' strategic management systems and the development and deployment of 6G. The authors also propose key recommendations for developing a transformational strategic management model for mobile operators. The **practical significance** of this study lies in offering scientifically grounded recommendations and tools to all stakeholders for successfully adapting to technological and economic challenges and opportunities associated with 6G network deployment, including those related to business development strategies.

Keywords: mobile network operators; 6G technology; development strategy; strategic management; digital services; data economy; transformation; innovation

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INTRODUCTION

The modern development strategy for mobile operators and the telecommunications industry as a whole should be based on the analysis of trends in the evolution of mobile networks and the prospects for the implementation of innovative technologies. In the context of the digital transformation of the economy of the Russian Federation and the implementation of national programs "Digital Economy of the Russian Federation"[1] and "Data Economy"[2] the study of the development of 6G networks, the commercial deployment of which is planned to begin in 2030, becomes particularly relevant. The latter are considered an evolutionary stage in the development of telecommunications technologies, aimed at overcoming the limitations of fifth-generation (5G) networks and ensuring a qualitatively new level of performance, reliability, and intelligence. Their use opens up opportunities for operators to provide an expanded range of services and solve tasks that are either unfeasible or economically inefficient in 5G networks.

At each stage of the development of the telecommunications industry, the change in technologies not only leads to changes in the composition and structure of digital services offered by operators to their users, but also has a significant impact on the strategic management of their activities. The potential restructuring of the technological paradigm may lead to the adjustment or global revision of operators' strategic development goals, the development and implementation of adapted or fundamentally new business models, as well as significant transformations in business processes and the organizational structure of the operators. Moreover, the transition to new mobile communication technology affects not only their activities and the industry as a whole but also stimulates the digital transformation of domestic enterprises and the country's economy.

FEATURES OF 6G TECHNOLOGY AND DEVELOPMENT COMMUNICATION SERVICES IN 6G NETWORKS

Investments in new telecommunications technologies in recent years have led to significant changes in society, transformed business processes, and increased the efficiency of various industries. Despite the fact that the development and implementation of technologies (from 2G to 5G) were accompanied by the emergence of new services, cost optimization, and increased productivity, operators faced challenges in revenue and profit growth [1]. In this regard, a key task in the era of 6G networks is to create new opportunities to overcome such negative trends associated with the decline in revenue and profitability growth rates, which have emerged during the implementation of 3G, 4G, and 5G technologies. The focus is on creating a new business model that ensures operators play a significant role in digital transformation, as well as increasing revenue and business margins. The solution to the task at hand requires the management of mobile service providers to have innovative thinking and strategic vision.

6G networks will become the defining technology for the development of mobile telecommunications. This statement is due to their significance as a key element of the digital economy infrastructure at both global and national levels. 6G networks will provide new functional and technological capabilities, allowing for the transformation of existing 5G network services into new innovative services. 6G operators, in turn, will play the role of not only communication service providers and in-

[1] National Program "Digital Economy of the Russian Federation". Ministry of Digital Development (official website). URL: https://digital.gov.ru/target/naczionalnaya-programma-czifrovaya-ekonomika-rossijskoj-federaczii

[2] National project "Data Economy and Digital Transformation of the State". URL: http://government.ru/rugovclassifier/923/about/

tegrators of comprehensive solutions but also catalysts for the development of various sectors of the economy, contributing to increased productivity and stimulating the digital development of society as a whole.

A comparative analysis of the main technological and functional parameters of 5G and 6G networks demonstrates the significant superiority of 6G network characteristics [2], which, being based on the "network of networks" concept, include terrestrial, aerial, and satellite segments and create the prerequisites for the implementation of breakthrough innovations, providing ultra-fast, reliable mobile communication with minimal latency. This will meet the growing data transmission needs of both businesses and end users, as well as open up opportunities for increased productivity and stimulate the growth of the digital economy. The implementation of 6G networks is expected to be a revolutionary step in the development of "internet of senses" networks, which engage vision, hearing, touch, smell, taste, and emotions to create fundamentally new applications and services. If 5G networks are primarily focused on cyber-physical systems and supporting enhanced mobile broadband (eMBB), massive machine-type communications (mMTC), and ultra-reliable low-latency communications (uRLLC), then 6G networks will provide a broader range of services designed to meet human needs as well as to address the challenges of Industry 5.0 in applying cyber-physical systems with human-like intelligence [2].

In particular, 6G networks will be able to provide users with the following main groups of services, significantly expanding capabilities compared to 5G technologies [2]:

1. Mobile broadband low-latency data transmission services (mBRLLC), characterized by high efficiency, reliability, and data transmission speed, which are crucial for the development of autonomous transport, telemedicine, augmented and virtual realities.

2. Massive ultra-reliable low-latency communication (mURLLC) services, which represent a combination of uRLLC and mMTC technologies from 5G networks and provide higher service quality when using the Internet of Things (IoT), automation of production processes, and implementation of smart city concepts.

3. Human-Centered Service (HCS) combines physical perception parameters with traditional service quality indicators to ensure a personalized experience.

4. Multi-purpose services (MPS), combining communication, computing, management, positioning, and power supply services, and requiring the simultaneous fulfilment of ultra-reliable and high-speed mobile communication, precise environmental sensing, and ultra-precise positioning conditions, which will contribute to the convergence of various technologies.

5. Artificial Intelligence (AI) as a Service. AI services can be provided to users on demand from external and internal applications.

The key capabilities of 6G networks, which will enable operators to solve new tasks compared to 5G, are presented in the *Table*. The fundamental difference of 6G is the multiple increase in data transmission speed — up to 1 Tbps.

The need to increase bandwidth is driven by the growing demand for applications and services that require the transmission of large volumes of data in real time, as well as the emergence of new use cases, including industrial IoT, "smart homes", "digital twins", and "smart cities". Users will be able to appreciate a significant improvement in the quality of video, audio, online games, and other multimedia services, take advantage of holographic communication, tactile internet, and intelligent automation.

The timeliness of data display and calculation, which determines the efficiency and functionality of modern systems, is directly dependent on the volume of transmitted in-

Table

Operator challenges that can be addressed with the implementation of 6G networks, but are difficult to implement in 5G networks

Development direction	Task	5G network capabilities	6G network capabilities
Holographic communication and teleportation	Transmit and display holographic images	Insufficient for transmitting and displaying complex holographic images in real time	Provides the necessary speed, latency, and bandwidth for full-fledged holographic communication and teleportation
Tactile Internet (IoS)	Transmit data on tactile sensations, smells, tastes, etc.	Limited capabilities due to delays and insufficient bandwidth	Allow the transmission of huge volumes of sensor data in real time
Extended reality (XR) with high resolution and low latency	Provide an immersive experience in XR applications	Provides basic XR support, but with limitations in image quality and latency	Open up opportunities for XR by creating applications with high resolution, low latency, and complex interaction with the virtual world
Autonomous Cyber-Physical Systems (CPS)	Manage critical systems (transportation, robots, medical equipment, etc.)	Provides CPS support, but do not always guarantee the necessary communication parameters	Provides ultra-reliable and fast communication for CPS, which will enable the creation of fully autonomous systems without human intervention
Smart spaces	Combine all sensors and devices into a single network for monitoring and managing the environment (smart homes, cities, factories)	Supports the connection of multiple devices, but does not provide the necessary connection density and energy efficiency	Provides support for a vast number of devices, high energy efficiency, and low latency for creating smart spaces
Quantum communication and cybersecurity	Ensure ultra-secure data transmission	Vulnerable to future threats	Through the integration of quantum technologies, the protection of confidential information and critical infrastructure is ensured
Development of “digital twins”	Create virtual copies of physical objects and processes for monitoring, analysis, and optimization	Provides the ability to collect data from sensors, but is insufficient for transmitting large volumes of data and quick feedback for managing digital twins in real time	Ensure the transmission of large volumes of data in real-time and ultra-low latency, enabling the creation of more accurate and interactive digital twins across various industries

Source: compiled by the authors.

formation. The implementation of 6G in industrial enterprises will enable real-time data transmission from a greater number of sensors, opening up prospects for both the optimization of production processes through cyber-physical systems with human-like thinking and the use of virtual and augmented reality in staff training and maintenance.

The demand for high bandwidth is also crucial for the effective functioning of the following systems: "smart home" (due to the increase in video resolution and the number of cameras, the emergence of new devices and services, as well as the increase in data update frequency from sensors); "digital twins" (for accurate modelling of physical objects, improved data visualization, and rapid transmission of information from sensors); "smart cities" (for collecting and processing large volumes of data, transmitting high-resolution video from surveillance cameras, managing traffic flows, and providing digital services); intelligent healthcare (for remote monitoring of patient conditions, remote consultations, and telemedicine); autonomous transport (for the prompt transmission of data from sensors and cameras to ensure safety).

Thus, the implementation of 6G networks will ensure the resolution of tasks that are difficult to achieve in 5G networks, thereby opening up new opportunities for operators in the following areas:

1. Development of fundamentally new types of services for users, including holographic communication, tactile internet, virtual reality, and autonomous systems.

2. Diversification of income sources through the monetization of new services, increasing average revenue per user (ARPU), expanding the customer base, and implementing integration services in the field of digital transformation for B2B[3] and B2G[4] sectors.

Increasing operational efficiency through the automation of business processes, optimization of network management, and reduction of operational costs.

Currently, a number of scientific works are exploring the trends and technological features of building 6G networks as an omnipresent intelligent system, as well as considering possible solutions for ensuring virtual reality, quality service, and efficient resource management [3–5]. As the basis for the conclusions, an analysis of the development concepts of 6G networks proposed by the world's leading developers and manufacturers of telecommunications equipment is used [6–10].

The results of the conducted research indicate the need for technological innovations, standardization of technologies, and preparation for the next technological stage of societal development. The success of the implementation of 6G networks will be determined by the market's readiness to adopt innovations and their economic feasibility.

ANALYSIS OF PRIORITY GOALS FOR THE DEVELOPMENT OF 6G TECHNOLOGY

The authors of this paper conducted an analysis of the key directions determining the development of 6G networks and reflecting the general patterns of social progress, taking into account the specifics of territorial technological zones (American and Asian). It was found that in the American technological zone, the priority goals for the development of 6G are[5]:

1. Promoting economic growth and social sustainability — addressing the issue of digital inequality by ensuring connectivity accessibility regardless of income level and geographical lo-

[3] B2B — business model in which the operator provides its services and solutions to other companies.

[4] B2G — business model in which the operator provides its services and solutions to government bodies, institutions, or enterprises.

[5] Mobile Communications towards 2030. A 5G Americas White paper. 2022. URL: InDesign_ compressed.pdf

cation. From the perspective of sustainable development, the emphasis is on the environmental friendliness of networks and devices, as well as the application of energy-efficient network architectures [11].

2. Harmonization of standardization and development of 6G within the framework of the 3GPP Partnership Project. This process aims to align the interests of manufacturers, regulators, and consumers, which promotes targeted research and development, as well as accelerates the implementation of innovations [11].

3. Creating new opportunities and applications for 6G by modernizing services, including telepresence with holograms and 3D media, the use of robots in various industries, and expanding the prospects of virtual and augmented realities [11].

The Asian technology zone is also characterised by three key priorities for 6G development[6] [12]:

1. Improving the efficiency of operators' businesses. 6G networks are seen as a factor capable of significantly changing the business model, opening up new opportunities for operators to diversify their revenue and increase profitability. The emphasis is on expanding opportunities beyond the traditional B2C model[7] towards B2B and B2G, providing businesses and government institutions with specialized services. Mobile operators will be able to offer infrastructure solutions for various sectors of the economy, such as transportation, energy, and agriculture, enhancing their efficiency through advanced technologies. The integration of 6G networks into diverse industries and areas of life will provide operators with new opportunities for growth and sustainable development.

2. Reduction of the total cost of ownership (TCO) of the network. The implementation of 6G networks involves significant capital investments in new equipment and infrastructure, necessitating a comprehensive assessment that takes into account technological, economic, and socio-economic aspects. Justifying such costs, as well as the feasibility of significantly increasing bandwidth, is an important task when planning the deployment of 6G networks.

The key factors in this case are:

- the use of the terahertz (THz) frequency range entails increased requirements for components (antennas, transceivers, amplifiers) and materials (including advanced metamaterials);
- the need for significant investments in research and development (R&D) to create new technologies, standards, and protocols;
- relatively small volumes of equipment produced at the initial stage, which leads to an increase in the cost price per unit of product;
- the need for new technologies and specialized personnel for the installation and maintenance of 6G equipment.

At the same time, it is assumed that the high initial cost of the required equipment will be offset by the following factors:

- increase in productivity and efficiency of business processes through production automation and reduction of costs in various sectors of the economy;
- development of new markets and services, driven by applications and services that were previously impossible;
- improvement of the quality of life through expanding access to social sectors such as education, healthcare, and others;
- stimulating innovative activities, mastering modern technologies, and creating jobs.

Thus, reducing TCO is a key factor determining the commercial attractiveness of 6G networks and

[6] Target Network NetX 2025: Technical Document. The model of the network of the future. URL: https://www.huawei.ru/upload/medialibrary/909/909d5ebb82ff8c1237b9abce6c9f2959.pdf; Communications of Huawei Research. 2022. Issue 2. URL: https://www-file.huawei.com/-/media/corp2020/pdf/publications/huawei-research/2022/huawei-research-issue2-en.pdf

[7] B 2C — business model in which the operator provides its services directly to end consumers, that is, individuals.

influencing the speed of their implementation. Achieving this goal requires a comprehensive approach, including:

- intelligent resource management and process automation based on machine learning (ML) algorithms, ensuring increased efficiency in network resource management;
- application of energy-efficient network equipment (including antennas and reconfigurable intelligent surfaces), virtualization of network functions, as well as the use of cloud technologies;
- effective use of the radio frequency spectrum through dynamic allocation and the development of new coding and modulation methods;
- shared infrastructure aimed at reducing the costs of building and maintaining 6G networks.

Thus, reducing TCO represents a multifaceted task that requires technological innovations, organizational changes, and a revision of business models. Its successful implementation will enable the creation of economically sustainable and competitive 6G networks, contributing to the development of digital services and enhancing economic efficiency.

Technological advancement of digital services in 6G networks. Integration of AI, ML, edge computing, and other advanced technologies to provide innovative services that meet the growing demands of the modern world.

Analysis of the priority development goals for 6G in various technological zones shows that, despite the common goal of technological development, the emphases differ: the American zone is focused on sustainable development, while the Asian zone is focused on increasing the economic efficiency of operators' operations.

THE IMPACT OF 6G TECHNOLOGY ON THE STRATEGIC MANAGEMENT OF OPERATOR ACTIVITIES MOBILE COMMUNICATION

The implementation of 6G technology necessitates the adaptation of operators' management systems to the new economic and technological conditions of the telecommunications market. It is evident that the strategic management of their activities will undergo significant changes during the deployment of 6G networks and the provision of a fundamentally new class of services. As a result, opportunities will arise to enhance interaction, automation, and efficiency across various sectors of the economy, which will serve as a stimulus for further digital transformation. In turn, 6G operators, by overcoming industry limitations and adapting their services and ecosystems to the future demands of networks and users, will become key drivers of these changes. The conducted analysis shows that the operators' management must ensure the transformation of strategic management in such key areas as:

1. *Business model of production and economic activities.* The change in the business model should be implemented in terms of increasing operational efficiency through the introduction of the entire set of innovations. This can be achieved through the use of 6G technology, as well as increasing revenue by specialising operators in projects aimed at both developing enterprises in various business sectors as integrators and scaling the unique customer experience obtained. For this, management must focus on creating a comprehensive digital platform solution for clients based on the operator, with the capability to implement digital transformation projects of any complexity.

2. *Joint implementation of partnership infrastructure projects,* involving the active integration of 6G in various sectors of the economy. This could stimulate investments in network development from enterprises and government structures, which would reduce the burden on operators. It is necessary to develop mechanisms and formats for mutually beneficial partnerships in this area.

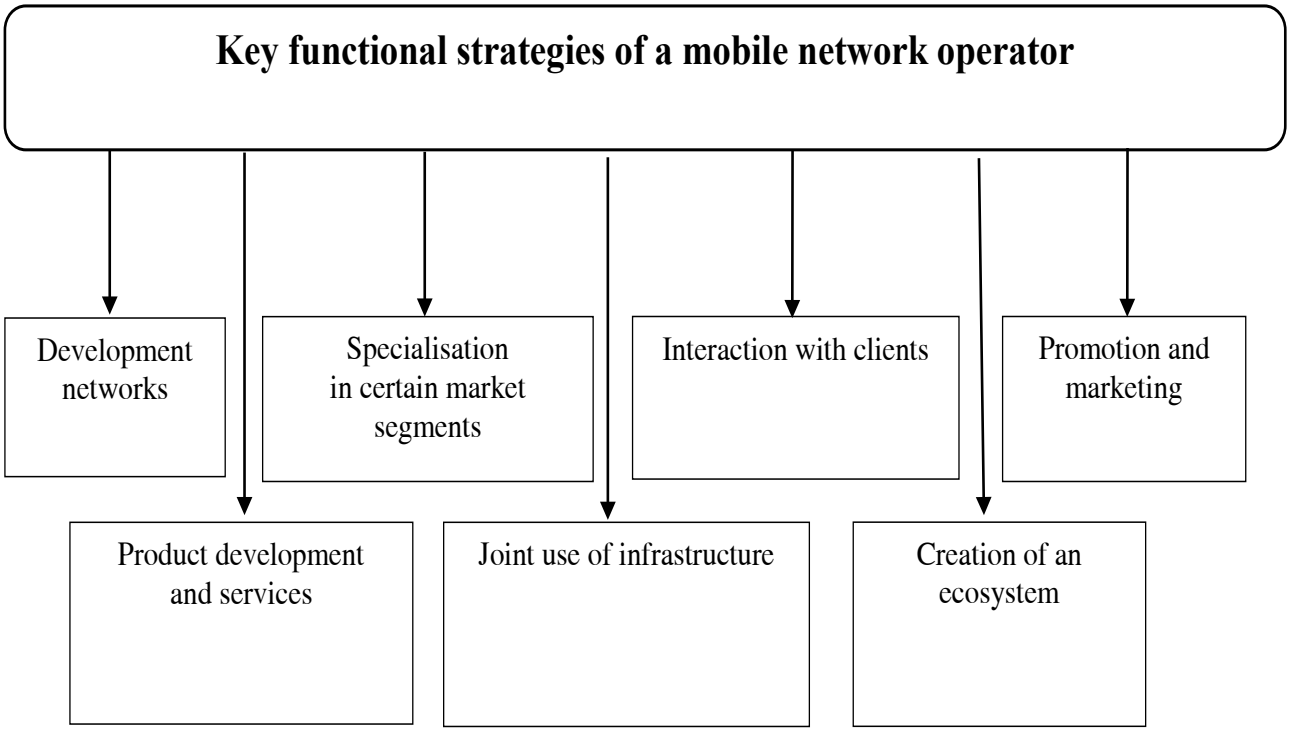

Fig. **Key functional strategies of a mobile operator**

Source: compiled by the authors

3. Development of new employee competencies. The implementation of 6G and the execution of joint projects with enterprises will require mobile network operators' personnel to acquire new competencies and skills in integration, consulting, and engineering. Being experts in their field, operators will be able to become digital leaders, gain a competitive advantage, and secure new sources of revenue.

To implement the listed directions, it is necessary to analyze the transformation of the existing strategies used by operators. If at the initial stages of the industry's development they were focused on creating and growing the business, expanding the subscriber base [13], then in the 6G era, operators need to independently determine the main type and concept of their further activities, taking into account the accelerating pace of innovations that are changing business processes and business models [14].

The *Figure* in block form presents several key functional development strategies of operators that they use in their current activities, but which will undergo the most significant transformation with the implementation of 6G networks.

Let's examine them in more detail.

Network development strategy. The evolution of mobile networks from 2G to 5G was primarily characterized by an increase in bandwidth and an expansion of coverage areas. However, with the onset of 6G network deployment, the focus shifts from simple scaling to creating an intelligent, self-optimizing infrastructure capable of supporting ultra-high data transfer speeds, ultra-low latencies, and providing an enhanced level of security.

Instead of extensive construction of base stations, operators will need to create adaptive networks that dynamically respond to changes in traffic, user needs, and external conditions. This necessitates the implementation of advanced technologies for automating and optimizing management processes, including AI,

ML, and Edge Computing[8]; the development and implementation of new methods to protect the network from cyber threats, including quantum technologies and advanced encryption algorithms.

Strategy of specialization in specific market segments. In the history of mobile communication development, operators often employed a specialization strategy, focusing on specific market segments (youth, corporate clients, specialized groups). This approach allowed for a deeper understanding of the target audience's needs, fostering loyalty, and achieving high margins. However, the implementation of 6G networks entails a transformation of the specialization strategy in terms of moving beyond traditional segments and focusing on creating comprehensive ecosystem solutions for digital transformation across various sectors of the economy.

Instead of providing basic communication services, 6G operators will act as integrators, combining various technologies and services to solve specialized enterprise tasks. For this, a deep understanding of industry specifics, as well as staff competencies in AI, ML, and other advanced technologies, will be required. The use of AI and ML will enable operators to develop and implement digital transformation projects aimed at improving operational efficiency, reducing costs, enhancing product quality, and creating competitive advantages for enterprises. In the context of the deployment of 6G networks, active development of the B 2G services segment, focused on solving state-level tasks (security, development of space communication, etc.), is also expected.

Virtual network operators (MVNO) play a special role in implementing this strategy. They provide mobile communication services without using their own infrastructure, which ensures flexibility and the ability to focus on specialized niches. Analysis shows that the implementation of 6G networks will have a significant impact on the development strategy of MVNO operators due to:

1. Increase in demand for their services due to the development of IoT and M2M.[9] MVNO operators will be able to offer specialized solutions for various industries (smart cities, healthcare, transportation, agriculture), while large operators will be unable to fully meet all market needs.
2. Fundamentally new opportunities for providing customers with personalized intelligent services with flexible tariff plans based on telecom platforms as a service model for business development due to the implementation of 6G networks with more efficient spectrum utilization capabilities, increased data transmission speeds, minimal latency, and integration with AI and ML. Thus, the services of MVNO operators based on augmented and virtual reality will become relevant for the education sector, healthcare, and other industries, while services using AI and ML will be used for analyzing user data and adapting to their personal requests and preferences.
3. Development of cooperation and partnership based on an ecosystem approach. Integration with a wide range of technology companies, device manufacturers, content and application providers will enable MVNO operators to create new value for customers and ensure revenue growth.

Thus, operators who successfully adapt to these changes and acquire unique specialization will be able to achieve sustainable growth and take leading positions in the telecommunications services market in the 6G era.

Customer interaction strategy. The evolution of such strategies in mobile communications reflects the technological changes that occurred at each stage of development. If in 2G-4G net-

[8] Edge Computing is a distributed computing model where data processing is performed near the source of the data, rather than in a centralized cloud or data center.

[9] M2M (Machine-to-Machine) — is a technology that ensures automated data exchange between devices (machines, sensors, instruments) without requiring direct human intervention.

works the focus was on providing basic services and attracting a mass audience, in 5G networks it has shifted towards personalizing offers and improving service quality. In the 6G era, customer interaction is undergoing a radical transformation, moving towards a level of hyper-personalization and the creation of immersive experiences — operators can no longer limit themselves to targeting ads based on demographic data. It is necessary to take into account a broader range of factors, including sensor data (biometrics, emotional state, physical activity), contextual information (location, time of day, social environment), as well as predicting future customer needs based on the analysis of their behavior and preferences. The implementation of this strategy requires the management of operator companies to take measures such as:

1. Development and implementation of advanced data analysis methods that allow processing large volumes of customer information (including sensor and contextual data) with the aim of predicting needs and creating personalized offers.

2. Creation of hyper-personalization platforms for customer offerings, ensuring dynamic adaptation of tariff plans, content recommendations, and services based on the current situation and consumer needs.

3. Investing in content generation and applications for creating virtual and augmented reality, providing holographic communication and tactile internet, aimed at forming an emotional connection with the customer and developing new interactive communication channels.

4. Ensuring the security of customers' personal information, which requires the development and implementation of advanced methods for protection against cyber threats.

In conclusion, it should be noted that the customer interaction strategy in the 6G era must evolve into a complex, multi-level system based on a deep understanding of consumer psychology, the application of innovative technologies, and the pursuit of creating a sustainable emotional connection with the brand.

Promotion and marketing strategy. With the spread of smartphones and digital platforms, there has been a change in the format of interaction between operators and customers, manifested in:

1. Providing personalized offers based on end-to-end analytics and studying customer preferences, using big data technologies, AI, ML, and A/B testing.[10]

2. The formation of a digital footprint of customer behavior at all stages of interaction, which opens up new opportunities for transforming traditional business models.

Within the framework of this strategy, 6G operators should pay special attention to the creation of personalized media content. The further development of technologies shifts the focus to digital interaction channels, resulting in the active implementation of new tools for analyzing customer preferences and business processes in customer communication practices [15, 16]. For example, process analytics [17, 18], which allows for the examination of digital traces of consumer interactions. An effective approach can be considered the conduct of experiments and A/B testing aimed at testing hypotheses about increasing customer loyalty [1].

The implementation of 6G implies a shift from mass marketing to hyper-personalized marketing based on data and contextual information. The marketing strategy should focus on creating an emotional connection with consumers and promoting brand values through personalized advertising campaigns that take into account the needs and preferences identified, considering operators' pursuit of profitability and cost optimization. Despite the increasing digitalization of interaction channels, the importance of retail

[10] A/B testing is a method of marketing research in which two (or more) versions of something are simultaneously shown to random groups of users (A and B) to determine which version performs better in achieving the set objective.

presence for enhancing consumer satisfaction and loyalty, according to the authors, will remain.

Infrastructure sharing strategy. Infrastructure sharing or joint use of infrastructure — passive (supports, antenna-mast structures, cable ducts, etc.) and active — is considered an important development strategy for operators. This allows for significant cost reductions in the construction, modernization, and maintenance of the network [19] and could become one of the options for implementing 6G technology in the context of limited frequency resources.

In this case, it is possible to create a single national-level 6G infrastructure operator (predominantly state-owned), to whom all the radio frequency resources allocated for the creation of 6G networks and ensuring national coverage are transferred. In this scenario, other operators act as virtual ones, implementing the following connection models [13]:

• shared use of the 6G RAN radio access network, where the point of interaction between the infrastructure operator and the MVNO is located in the radio access network at the base stations;

• application of the gateway scenario — in this case, the point of interaction is located in the core network of the 6G infrastructure operator.

The choice of the optimal strategy depends on the characteristics of each company providing 6G services (its maturity and investment capabilities) and can be medium-term or long-term in nature.

Product and service development strategy. In the context of deploying 2G and 3G networks, the key task for the operator was business scaling, which involved the continuous improvement of the functionality of existing services (voice, internet, SMS, etc.), active promotion, and optimization of pricing offers. The development of 4G networks and the expansion of the range of innovative types of services have led to an increased emphasis on the product approach. It is focused on evaluating the effectiveness of products when launching them to the market, and in the era of 5G and 6G, it becomes a necessary condition for the success of the operator's business due to the emergence of broad opportunities for the development and provision of new digital services.

The implementation of 6G networks necessitates fundamental transformations in the development strategies of mobile communication. Thus, its basic services are being replaced by intelligent services and platforms integrated with various sectors of the economy. In this paradigm, operators act not only as providers of the "pipe" that ensures data transmission but also as architects of digital ecosystems, offering clients comprehensive solutions that go beyond traditional telephony and internet access.

The key distinction of the product and service development strategy in the 6G era is the focus on the consumer and innovation. Instead of standard solutions, operators should offer customers personalized options tailored to their individual needs and business characteristics. To achieve this goal, it is necessary:

1. Development of innovative services and applications based on 6G, including holographic communication, tactile internet, augmented reality, autonomous transport, smart cities, and more. This direction requires a deep understanding of the technological capabilities of 6G and the needs of various market segments.

2. Organization of strategic partnerships for the creation of new services based on 6G. This approach allows for the use of external innovations and the formation of an ecosystem of applications that expand the capabilities of the 6G network.

3. Development of an effective system for collecting, processing, and analyzing customer data, facilitating the identification of their needs, preferences, and behavioral characteristics. The obtained information should be used to create personalized products and services, as well as to foster a culture of experimentation and willingness to take risks.

4. Ensuring high security standards in light of increasing cyber threats and the complexity of technological solutions.

Thus, the strategy for developing products and services by operators in the 6G era is transforming into the concept of creating intelligent ecosystems that integrate the technological capabilities of the 6G network with the needs of various sectors of the economy and the demands of end users. To achieve the desired result in this new paradigm, it is necessary to apply a business valuation methodology based on customer metrics, such as CLTV (customer lifetime value), which reflect the quality of the company's interaction with the consumer and the effectiveness of the organization of product thinking [20].

This approach has become widespread, especially in digital ecosystems; however, the implementation of 6G will have a significant impact on it. Due to changes in customer behavior, emerging interaction opportunities, and profit generation methods, a revision of CLTV assessment methodologies and models will be required. Let's outline the main directions of changes in approaches to CLTV assessment in connection with the implementation of 6G:

• consideration of new sources of income from services and business models related to 6G, and the development of revenue forecasting methods;

• use of advanced customer data (behavior, preferences, location, sensor data) and machine learning and big data analysis methods to predict consumer behavior;

• taking into account the influence of ecosystems and developing methods for determining the value of customers who are part of the ecosystem;

• engaging continuous evaluation and adjustment methods for CLTV based on real-time data flow, and ML methods for predicting customer churn;

• taking into account the impact of personalization on user behavior and their value to the company.

Following the listed trends will ensure operators more efficient management of resources and investments and will allow them to gain competitive advantages.

Ecosystem creation strategy. The active interest in implementing an ecosystem approach in the development of operators is driven by current trends in the telecommunications industry and the digital transformation of various sectors of the economy. In recent years, operators, using existing assets, have been striving to form ecosystems and view them as a driver of revenue growth in a saturated market.

From this perspective, digital platform solutions play a key role in transforming business processes and creating new opportunities for companies and customers. They form the basis of new ecosystems, ensuring audience engagement, participant coordination, providing tools, defining interaction rules [21], and enhancing the customer experience [1, 22].

When creating ecosystems, operators often act as a digital platform for offering partner services in the fields of IT, finance, telemedicine, entertainment, and others [23].

The practice of building their own ecosystems is primarily implemented by operators in two main directions [24,25]:

• by acquiring startups and established businesses that develop various services;

• with the help of attracting partners and integrating their services.

In the context of 6G, an important factor should be the transition from closed to open and decentralized platforms that ensure value creation and data exchange while considering security requirements. To achieve this, operators will need to establish partnerships with various companies, ensuring secure and transparent data exchange, as well as developing transparent revenue models (commission fees, subscriptions, advertising).

The data presented in the GSMA Association report[11] confirms the trend of growth in new digital services within the revenue structure of operators, indicating that the latter will focus

[11] The Mobile Economy 2023. URL: https://www.gsma.com/mobileeconomy/wp-content/uploads/2023/03/270223-The-Mobile-Economy-2023.pdf.

their efforts in this direction to increase the level of monetization. A distinctive feature of the 6G operator ecosystem could be the integration of services for implementing complex digital transformation projects based on AI, ML, and edge computing technologies for corporate and government entities.

CONCLUSIONS

6G technologies represent a qualitatively new stage in the development of telecommunications, aimed at creating intelligent, flexible, and reliable networks that provide ultra-high data transfer speeds, ultra-low latencies, and support for fundamentally new services. The implementation of these ambitious goals requires significant efforts in research and development, as well as effective collaboration between the scientific community, industry, and government. The implementation of 6G marks a radical shift in the mobile communication paradigm, opening new opportunities for operators and driving the transformation of the economy and society. Operators who timely adapt to these changes and develop effective strategies will be able to gain sustainable competitive advantages.

The conducted analysis of the key features of 6G[12] technology, as well as the existing trends in the mobile communication market, allowed for the identification of priority areas for the transformation of operators' activities. In particular, the need to transition from scaling-oriented strategies to more modern ones aimed at forming a flexible and adaptive business model, deep specialization, and the development of new staff competencies has been identified.

The results of the conducted research can be used as a basis for forming development concepts for operators in the context of 6G, as well as in the development of regulatory documents governing the development of next-generation communication networks, particularly in the updating of the Roadmap for the Development of the High-Tech Direction "Modern and Prospective Mobile Communication Networks", approved by the Government of the Russian Federation.[13]

[12] European Vision for the 6G Network Ecosystem. 5G AI White paper. 2021. URL: https://5g-ppp.eu/wp-content/uploads/2021/06/WhitePaper-6G-Europe.pdf

[13] Roadmap "Modern and Prospective Mobile Communication Networks". Action plan for the development of fourth (4G/LTE) and subsequent generations of mobile communication networks. 2022. URL: https://digital.gov.ru/activity/radioelektronika/dorozhnaya-karta-sovremennye-i-perspektivnye-seti-mobilnoj-svyazi

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R. Yu. Umanskiy — conceptualization of the article, formulation of the research hypothesis, interpretation of the findings, assessment of the impact of 6G technology on the strategic management of mobile network operator activities.
V. O. Tikhvinskiy — problem statement, critical analysis of the literature on the prioritized objectives of 6G technology development, conclusions, interpretation of the findings.
T. A. Kuzovkova — source selection, analysis of the theoretical foundations of the research topic, investigation of the evolution of communication services in 6G networks.

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