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TRENDS OF TRANSFORMATION AND DIGITALIZATION IN THE TELECOMMUNICATIONS SECTOR OF UKRAINE DURING WARTIME

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ТРЕНДИ ТРАНСФОРМАЦІЇ ТА ЦИФРОВІЗАЦІЇ СФЕРИ ТЕЛЕКОМУНІКАЦІЙ УКРАЇНИ В УМОВАХ ВОЄННОГО ЧАСУ

In conditions of wartime, significant transformations are taking place in the telecommunications sphere of Ukraine, which are caused not only by the need for emergency optimization of telecommunications networks due to the emergence of needs for supporting stable communication (especially in areas close to hostilities or in areas affected by hostilities) and taking measures to protect national telecommunications networks and means of telecommunications from new threats, but also by the necessity of expanding users' access to telecommunications services. Therefore, the research is aimed at studying the basic trends of transformation and digitalization of the telecommunications sphere of Ukraine in conditions of wartime.

According to the research findings, it has been noted that the processes of digitization in conditions of wartime significantly change the telecommunications sector of Ukraine. The basis for these changes is the numerous processes of implementing and using 5G network technologies, expanding coverage, developing virtual operators, developing mobile internet providers, developing artificial intelligence, electronic payments, the internet of things, and multimedia services that ensure a rapid transition from traditional communication technologies to digital ones, significantly expanding the range of services. It should be noted that due to the transformation and digitization of the telecommunications sector, the number of economic entities operating in this sector decreases, but the quality and convenience of telecommunications services improve, their range expands and becomes more accessible to users. This is due to the fact that the development of digital technologies allows companies to quickly respond to consumer needs and quickly introduce new services and features, while overall transformations allow increasing efficiency and automating business processes, and therefore reducing the number of employees necessary to provide services. The prospects for research in this direction lie in the formation of a concept for the development of proprietary ecosystems in the telecommunications sector of Ukraine. It should be noted that the trends of transformation and digitization of the telecommunications sector of Ukraine, in our opinion, are the trigger for the creation of telecommunications ecosystems that include communication services, financial services (such as online banking), medical and online commerce services.

В умовах воєнного часу відбуваються помітні трансформації сфери телекомунікацій України, зумовлені не лише потребами екстреної оптимізації телекомунікаційних мереж, у зв'язку з виникненням потреби підтримки сталого зв'язку (особливо в районах, що знаходяться біля зони бойових дій, або в районах, що постраждали від бойових дій), але й необхідністю розширення доступу користувачів до послуг сфери телекомунікацій, захисту національних телекомунікаційних мереж та засобів телекомунікацій від нових загроз, а також необхідністю розширення доступу користувачів до телекомунікаційних послуг. Відтак дослідження спрямоване на вивчення базових трендів трансформації та цифровізації сфери телекомунікацій України в умовах воєнного часу. За результатами дослідження, відмічено, що процеси цифровізації в умовах воєнного часу значно змінюють сферу телекомунікацій України. Основою змін є чисельні процеси впровадження та використання технологій мереж 5G, розширення покриття, розвиток віртуальних операторів, розвиток провайдерів інтернету в рухомому зв'язку, розвиток штучного інтелекту, електронних платежів, інтернету речей, мультимедійних послуг, які забезпечують швидкий перехід від традиційних комунікаційних технологій до цифрових, значне розширення номенклатури послуг. Зазначимо, що внаслідок трансформації та цифровізації сфери телекомунікацій, зменшується кількість суб'єктів економічної діяльності, що діють у цій сфері, однак покращується якість та зручність телекомунікаційних послуг, розширюється їх номенклатура та доступність для користувачів. Це відбувається через те, що розвиток цифрових технологій дозволяє компаніям швидко реагувати на потреби споживачів та швидко впроваджувати нові послуги та функції. Загальні трансформації дозволяють збільшити ефективність та автоматизувати бізнес-процеси, а відтак зменшити кількість працівників, необхідних для надання послуг. Перспективи досліджень у даному напрямку полягають у формуванні концепції розвитку власницьких екосистем у сфері телекомунікацій в Україні. Зазначимо, що тренди трансформації та цифровізації сфери телекомунікацій в Україні, на нашудумку, є тригером створення екосистем телекомунікацій, що включають послуги зв'язку, фінансові сервіси (такі як он-лайн-банкінг), медичні та послуги онлайн-комерції.

Key words: coverage areas; services; service portfolio; virtual operators; 5G networks; mobile internet providers.

Ключові слова: зони покриття; послуги; номенклатура послуг; віртуальні оператори; мережі 5G; провайдери інтернету.

PROBLEM SETTING (DESCRIPTION OF THE PROBLEM BEING ANALYZED IN GENERAL AND ITS CONNECTION WITH IMPORTANT ACADEMIC OR PRACTICAL TASKS)

In wartime conditions, striking transformations are occurring in the sphere of telecommunications in Ukraine, driven not only by the need for emergency optimization of telecommunications networks due to the demands for sustaining communication, particularly in areas close to combat zones or in areas affected by hostilities, and taking measures to protect national telecommunications networks and means from new threats, but also by the necessity of expanding users' access to telecommunications services.

The outlined needs are driving specific changes, which are determined by the rapid digitization of service processes and the implementation of new technologies and equipment. These changes are improving the speed and quality of the internet (in particular, Ukraine is gradually

preparing for the launch of 5G networks and providers are already actively testing new technologies and equipment to provide high-speed and high-quality internet, including in conflict zones), expanding coverage areas (telecommunications providers in Ukraine are actively working to expand coverage, particularly in rural areas, through the implementation of various technologies including satellite coverage, the development of wired networks, and others), enabling the transition to electronic payments, which simplifies payment for telecommunications services, and enhancing subscriber protection.

Furthermore, there is an increasing number of virtual operators in Ukraine (who provide communication services based on provider networks, allowing customers to receive quality service at a lower price) and mobile network providers (who provide improved communication quality in subways and other enclosed spaces, as well as expanding network coverage in remote areas).

These changes are leading to the active development and digitization of Ukraine's telecommunications industry,

even in times of war, by improving the quality and accessibility of services for users. However, this is also leading to other transformations that require further research.

THE ANALYSIS OF THE LAST RESEARCH AND PUBLICATIONS IN WHICH THE SOLUTION TO THIS PROBLEM IS BEGUN

Among the studies dedicated to the issues of digitization of the telecommunications sector in Ukraine, we have identified the works of Samoylenko M., Nikolaenko B.A., Peleshok Y.V., Nikolaenko B.A., Peleshok Y.V., Patryak O.T., and several others. Together with these researchers, the dynamics of revenue in the global telecommunications market over the last five years have been studied, and an analysis of trends in the development of new telecommunications technologies has been conducted. The penetration of the Internet in some countries has been analyzed, or those market segments that are most attractive from the perspective of investment and development have been identified. However, the identification of basic trends in the transformation and digitization of the telecommunications sector in Ukraine during wartime remains outside the focus of researchers. Therefore, in the study, the authors also relied on observations and research of such phenomena, experiments, as well as generalization, classification, and description of such changes (namely, data from the State Statistics Service of Ukraine, data from the Operator using equipment from the Swedish company Ericsson, "Lifecell," "Vodafone Ukraine," and "Kyivstar," etc.). The specific nature of the study is due

to the fact that empirical data is informative for answering empirical questions.

FORMULATING OF ARTICLE PURPOSES (THE PURPOSE OF THE STUDY)

The aim of the research is to study the basic trends of transformation and digitization of the telecommunications sector in Ukraine during wartime.

THE PAPER'S MAIN BODY WITH FULL REASONING OF ACADEMIC RESULTS

In modern conditions when Ukraine is experiencing a war on its territory, the telecommunications industry is undergoing significant changes and transformations. Ensuring the security and reliability of communication is becoming a top priority, which requires telecommunication service providers to make great efforts and investments in transforming and digitizing their telecommunications infrastructure and internal business processes. Thus, the key trends in the telecommunications industry in Ukraine are highlighted by us in Figure 1. Among these key trends are:

— Beginning of the development of 5G networks, resolution of frequency coordination issues, infrastructure development, tax and regulatory regime, combating fake news, and establishing norms for electromagnetic radiation exposure. In particular, the development of 5G networks in Ukraine began in 2018 when communication providers actively tested the new technology, and in 2020 the National Commission for the State Regulation of Communications and Informatization announced an auction for obtaining permits to use frequencies for 5G networks.

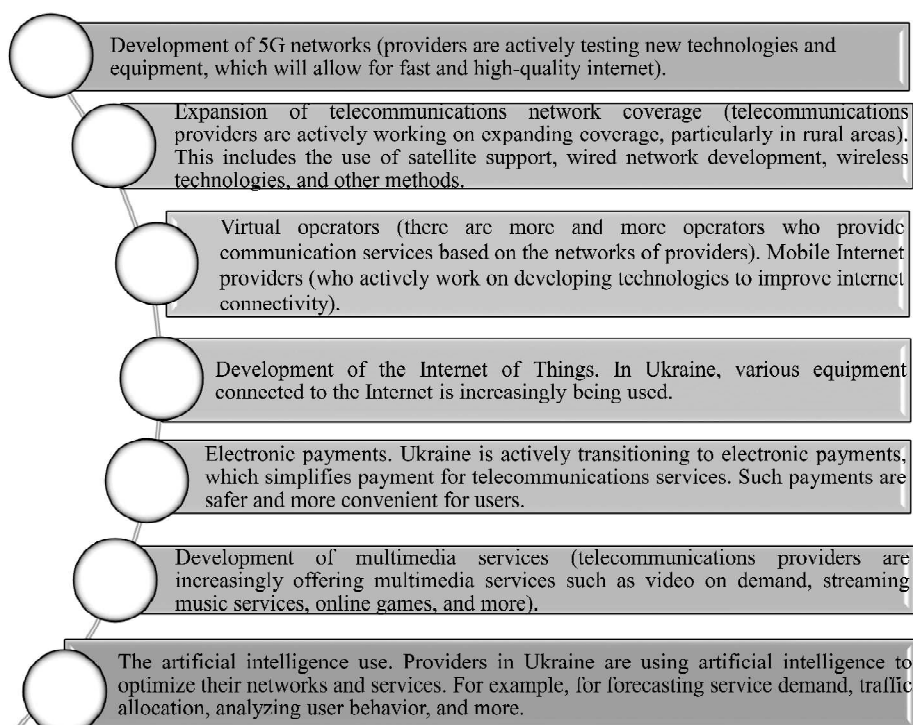


Figure 1. Processes that ensure the transformation and digitalization of the telecommunications sector in Ukraine in times of war

Note:

*In Ukraine, 5G networks began public testing in November 2021 on the basis of the Lifecell network. The operator uses equipment from the Swedish company Ericsson.

Source: Compiled based on data from the Swedish company Ericsson, "Lifecell," "Vodafone Ukraine," "Kyivstar," and [2; 4; 6].

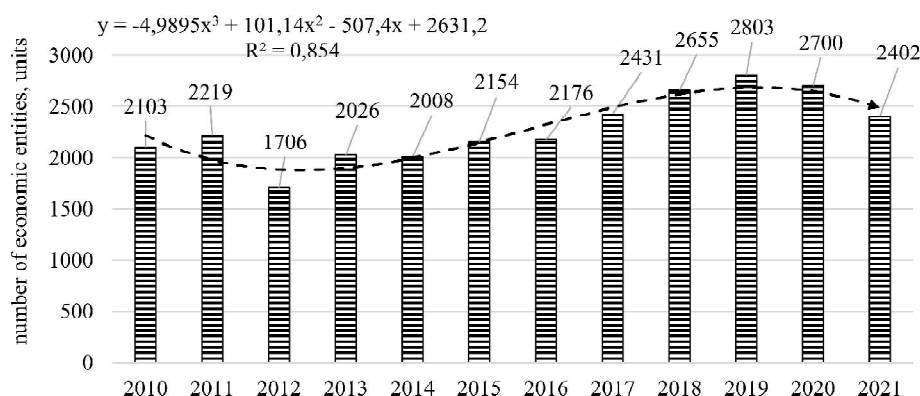


Figure 2. Changes in the number of economic entities in the field of wired telecommunications in Ukraine, 2010–2021, units

Source: Compiled from data from the State Statistics Service of Ukraine <https://www.ukrstat.gov.ua/>

The auction took place in 2021, after which providers began actively deploying 5G networks throughout the country, particularly in major cities.

— Expansion of telecommunications network coverage for their full development requires satellite support, wired network development, wireless technologies, and their joint use. In particular, in 2020, "Lifecell," "Vodafone Ukraine," and "Kyivstar" signed a memorandum of understanding to jointly use telecommunications infrastructure to accelerate the deployment of 4G networks in rural areas and on highways (which will give all citizens of Ukraine, living in villages with up to 2,000 inhabitants and small towns with a population of 3,000—4,000, access to 4G services [1]).;

— Development of virtual operators. Currently, Ukraine has an international virtual operator, Lycamobile (which offers cheap rates for calls and internet), and TriMob (which offers 3G communication services and unlimited internet). Additionally, in 2019, mobile operators "TriMob" and lifecell launched an electronic SIM card service, which is located directly on the smartphone's motherboard (eSIM). Currently, eSIM is also offered by Vodafone Ukraine and Kyivstar [2];

— Development of internet providers in mobile communication, which ensures improved communication quality in subways and other enclosed spaces, as well as expanded network coverage in remote areas. Significant efforts in this regard have been made by mobile communication providers Vodafone, Kyivstar, Lifecell. For example, Kyivstar has introduced a new technology called "LTE Advanced Pro", which provides high-quality communication in enclosed spaces and expanded network coverage in remote areas;

— Development of artificial intelligence (for predicting demand for services, traffic distribution, user behavior analysis, and more);

— Development of electronic payments (which contribute to reducing costs associated with payment operations and reduce risks related to abuse of cash, which can be stolen or lost);

— Development of the Internet of Things (which allows controlling various processes, such as room temperature, security, etc., through a mobile application);

— Development of multimedia services (such as video on demand, streaming music services, online gaming, and more).

The outlined processes are creating systemic changes in the telecommunications industry in Ukraine, driven by its optimization through the adoption of digital technologies and innovations that are transforming business processes, increasing efficiency and competitiveness of economic entities within it, through a series of specific changes produced by these processes.

In particular, a specific change is observed in the number of entities engaged in activities in the field of wired telecommunications, including operation, technical maintenance, or provision of access to devices transmitting voice, text, sound, or video data using wired telecommunications infrastructure (Fig. 2). From 2010 to 2021, the number of entities offering wired telecommunications services as a whole increased from 2103 to 2402. However, it is precisely since the beginning of the improvement of business processes for providing specific services and increasing efficiency (since 2019) that a sharp reduction in the number of entities belonging to this sphere has occurred, as shown in the processes of transformation and digitization highlighted in Fig. 2.

This specific change in the number of entities implementing activities in the field of wire telecommunication can be explained by several factors:

Firstly, digital technologies and the internet have changed the way people communicate and exchange information. With the increasing popularity of mobile phones and wireless communication, there is a need for a different type of infrastructure that replaces wired telecommunications, and as a result, the number of businesses in the field of wired telecommunications has decreased. New technologies have emerged, such as optical fiber, which provides higher data transfer speeds and improves communication quality. Furthermore, new business models have emerged, such as free Wi-Fi and VoIP systems, for economic entities in the field of wired telecommunications in Ukraine.

Secondly, business processes in this field are constantly changing and improving, which is accompanied by the complication of the specifics of operating and maintaining switching and transmission equipment, cable distribution networks, and so on. This naturally leads to an increase in competition in the market. Companies that cannot compete with others disappear, while more efficient and innovative ones increase their market share.

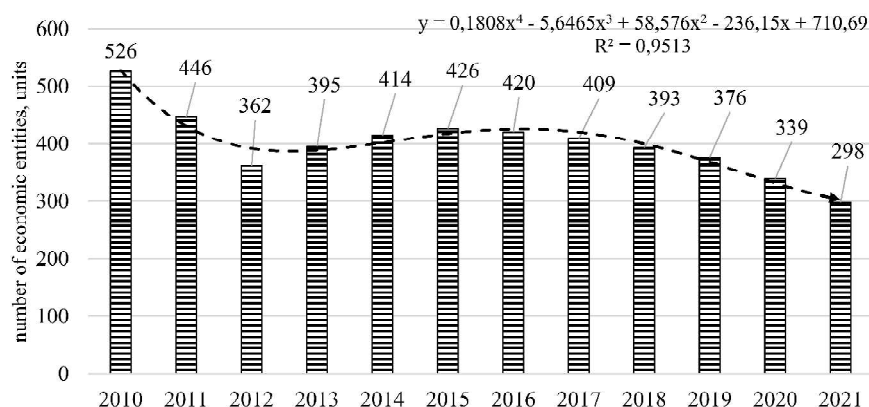


Figure 3. Changes in the number of economic entities in the field of wireless telecommunications in Ukraine, 2010–2021, units

Source: Compiled from data from the State Statistics Service of Ukraine <https://www.ukrstat.gov.ua/>

Thirdly, regulatory policy requirements change the conditions of competition and requirements for companies providing wireless communication services. This affects competition and contributes to the displacement of smaller or financially struggling entities from the market.

Regarding the wireless communication sector, it should be noted that the number of economic entities has been decreasing since 2010 (see Fig. 3). Specifically, from 2010 to 2021, the number of entities engaged in the operation, technical maintenance, or provision of access to devices that transmit voice, text, sound, or video data using wireless communication infrastructure, as well as the operation, technical maintenance of paging and cellular communication, and other types of wireless communication systems, decreased from 526 to 298 units.

This specific change in the number of entities involved in the wireless telecommunications sector can be explained by several factors.

Firstly, due to competition and increasing technical requirements, large economic entities are opening up ways to a greater share of the market by absorbing or displacing smaller companies. One of the biggest examples of bankruptcy in the

wireless telecommunications sector was the privatization of PJSC "Ukrtelecom" by the "ESPL" company for 10.5 billion hryvnias in 2011. In 2013, "Ukrtelecom" became part of SCM Rinat Akhmetov's group. In 2017, PJSC "Ukrtelecom" and its subsidiary LLC "TriMob", which provided CDMA mobile communication services, filed for bankruptcy. Later, the court granted these requests and declared both companies bankrupt. Another wireless telecommunications operator that ceased operations in 2020 was LLC "PepiNet". The company provided WiMAX (Worldwide Interoperability for Microwave Access) — wireless access to broadband Internet.

Secondly, regulatory policy requirements established at different times can change the conditions of competition and requirements for companies providing wireless telecommunications services. This can affect competition and the displacement of smaller or financially troubled market players. An illustrative example is LLC "Intertelecom," which also provided CDMA mobile communication services. However, in 2019, the company received a letter from the National Commission for the State Regulation of Communications and Informatization of Ukraine stating that its license for the use of radio frequencies would not be renewed due to significant debt to the state. In 2020, LLC "Intertelecom" informed its subscribers of the termination of mobile communication services.

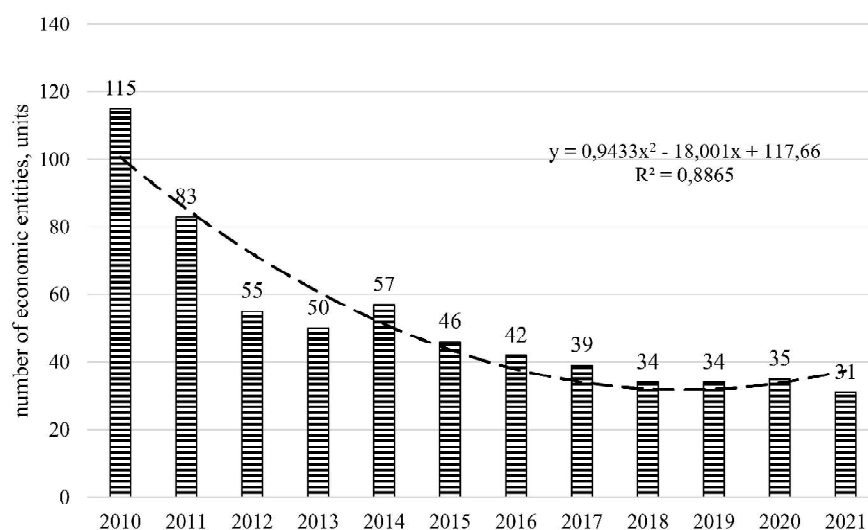


Fig. 4. Changes in the number of economic entities in the field of satellite telecommunications in Ukraine, 2010–2021, units

Source: Compiled from data from the State Statistics Service of Ukraine <https://www.ukrstat.gov.ua/>

Regarding satellite telecommunications, the number of economic entities in this field has also significantly decreased. From 2010 to 2021, the number of entities that provide the operation, technical maintenance, or access to devices that transmit voice, text, sound, or video data using satellite telecommunications infrastructure, as well as the delivery of video, audio, or text programs purchased from television channels, wired network operators, or radio networks through satellite "direct to home" systems, typically classified in this category, but do not manufacture programs, only distribute them, decreased from 115 to 31 (Figure 4).

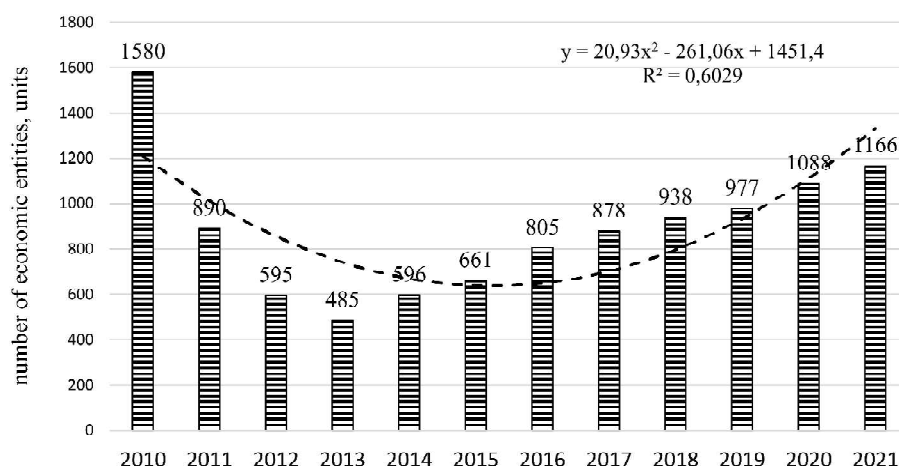


Fig. 5. Changes in the number of entities engaged in other activities in the field of telecommunications in Ukraine, 2010–2021, units

Source: Compiled from data from the State Statistics Service of Ukraine <https://www.ukrstat.gov.ua/>

Among the main reasons for the reduction in the number of economic entities in the satellite telecommunications sector accompanying the transformation and digitization of the telecommunications industry in Ukraine, we have identified the following [3; 5]:

Firstly, the high cost of the satellite telecommunications service chain, which includes the cost of renting satellite channels, equipment for signal reception and transmission, as well as fees for licenses and radio frequencies. This cost is further exacerbated by the acceleration of digitization processes, due to the need to implement additional services for customers.

Secondly, low demand for satellite telecommunications services due to competition from other types of telecommunications (such as mobile communication (GSM, 3G, 4G), wireless internet access (Wi-Fi, WiMAX), and fiber optic communication), as well as its high cost for subscribers.

Thirdly, there is dependence on other companies that inflate satellite communication services through their satellites. For example, the reduction in the number of economic entities in this field was caused by the reorganization and bankruptcy of some companies. In 2017, the State Space Agency of Ukraine, which provided satellite communication services through its national satellite "LYCH", was reorganized. In 2019, LLC "Satellite Systems", which also provided satellite communication services through its commercial satellite "LIM", was declared bankrupt.

Another area of telecommunication activity has a specific trend of development (Fig. 5), which is characterized by a decrease in the number of corresponding entities from 2010 to 2013 (from 1580 to 485) due to a decrease in demand for telephone communication services and access to the Internet in public buildings, and a further increase in their number from 2014 to 2021 (from 596 to 1166) due to the transformation of service content and expansion of their range.

The processes of increasing the number of such entities are driven by the need for specialized telecommunications applications, such as satellite tracking, communication telemetry, and operation of radar stations.

Since 2020, there has been significant demand for the operation of satellite terminals functionally connected to one or more terrestrial telecommunications systems, capable of transmitting and receiving data from satellite systems, and so on.

It should be noted that due to the transformation and digitization of the telecommunications industry, the number of entities engaged in economic activity in this field is decreasing. However, the quality and convenience of telecommunications services are improving, their range is expanding, and they are becoming more accessible to users. This is happening because:

— The development of digital technologies allows companies to quickly respond to consumer needs and rapidly implement new services and features. Some of the most popular new services and features include: high-speed data transmission; Voice over LTE (VoLTE) calls over the Internet network; Wi-Fi Calling; cashback programs that allow customers to receive monetary rewards for using their services; IoT solutions (which enable various devices to be connected to the Internet network and interact with them). Additionally, many providers offer personalized tariff plans that allow customers to choose services that best suit their needs and budget. Such tariffs may include unlimited voice calls and messages, various data packages, and other services.

— Allowing to increase efficiency and automate business processes, thus reducing the number of employees required to provide services. In particular, many entities in this field offer specialized applications for their clients (which allow them to manage their account, check data usage, make payments), as well as online services that enable customers to perform basic operations automatically over the internet (such as changing their tariff plan, ordering new services, and more).

CONCLUSIONS FROM THIS STUDY AND PROSPECTS FOR FURTHER EXPLORATION IN THIS AREA

According to the research results, it has been noted that the processes of digitalization in conditions of wartime significantly transform the telecommunications

sphere of Ukraine. It has been observed that the basis of these changes are numerous processes of implementing and using 5G network technologies, expanding coverage, developing virtual operators, mobile internet service providers, artificial intelligence, electronic payments, the Internet of Things, and multimedia services, which provide a rapid transition from traditional communication technologies to digital ones and a significant expansion of the range of services.

It should be noted that as a result of the transformation and digitization of the telecommunications sphere, the number of economic entities operating in this sphere is decreasing, but the quality and convenience of telecommunications services are improving. This is due to the fact that the development of digital technologies allows companies to quickly respond to consumer needs and to quickly introduce new services and functions, while overall transformations allow for increased efficiency and automation of business processes, and thus reduce the number of employees required to provide services.

The prospects of research in this field lie in the development of a concept for the formation of proprietary ecosystems in the telecommunications industry in Ukraine. It should be noted that the trends of transformation and digitization in the telecommunications industry in Ukraine, in our opinion, are the trigger for the creation of telecommunications ecosystems that include communication services, financial services (such as online banking), medical services, and online commerce services.

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