



# 5G COUNTRY PROFILE



## UKRAINE

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Version 1.1

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*Note: Version 1.1 of this document is an advanced draft for possible additional inputs, comments, feedback. The final version of the document is planned to be released after the ITU Regional Forum for Europe.*

## 1. ICT background and current status of broadband

Ukraine has set the ICT sector as a policy priority and implemented several ICT programs on education and public health.<sup>1</sup> With 4G being implemented in 2018, the government is rapidly improving the network coverage while promoting e-services in the public and private sectors,<sup>2</sup> and recently signed a memorandum with operators to provide 4G coverage for 90% of Ukraine's territory by 2022.<sup>3</sup> Some of the main challenges in the ICT sector include updating the legislative framework for electronic communications and the development of an accurate up-to-date interactive map of broadband coverage of its territory.<sup>4</sup> In the 2017 ITU ICT Development Index (IDI), Ukraine ranks 79<sup>th</sup> out of 176 countries.<sup>5</sup>

In January 2018, the Government and State Agency for e-Governance of Ukraine published the new "Digital Agenda for Ukraine 2020,"<sup>6</sup> which aims to guide the country's digital development. The agenda has seven main pillars: I) Telecommunications and ICT Infrastructure; II) Digital Skills; III) e-Market; IV) Digital Governance; V) Innovation and R&D; VI) Trust and Cybersecurity; VII) Benefits from ICT for Society and Economy.<sup>7</sup>

To enact the implementation of the "Digital Agenda of Ukraine 2020" and to remove barriers toward sustainable digital transformation in the country, the Ordinance of the Cabinet of Ministers of Ukraine No. 67-p approved in 2018 the "Conception for Developing Digital Economy and Society in Ukraine for 2018 to 2020" and adopted the "Action Plan Implementing the Conception."<sup>8</sup>

The implementation of the concept measures should pursue the following objectives:<sup>9</sup>

- Stimulating the country's economy and attracting investment;
- Creating the basis for the transformation of domestic industries toward increased competition and efficiency via digitalization;
- Solving the domestic problem of the digital divide, thus bringing digital technologies closer to citizens and providing them with access to broadband Internet—especially in villages and small towns;
- Creating new opportunities for the realization of human capital, the development of innovative, creative and digital industries and businesses;
- Developing more exports of digital products and services—IT outsourcing.

The document also establishes the priority sectors and suggestions for the digital development in Ukraine with a particular focus on bridging the digital divide through the development of digital infrastructures; developing digital competencies; implementing the concept of digital workplaces; digitizing the country's

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<sup>1</sup> See: [https://joinup.ec.europa.eu/sites/default/files/inline-files/SC64\\_D05.01\\_Digital\\_Government\\_Factsheets\\_Ukraine\\_vFINAL2\\_0.pdf](https://joinup.ec.europa.eu/sites/default/files/inline-files/SC64_D05.01_Digital_Government_Factsheets_Ukraine_vFINAL2_0.pdf)

<sup>2</sup> See: <https://eufordigital.eu/countries/ukraine/>

<sup>3</sup> See: <https://www.kmu.gov.ua/news/uryad-pidpisav-memorandum-shcho-zabezpechit-pokritttya-4g-na-90-teritoriyi-ukrayini>

<sup>4</sup> See: <https://eufordigital.eu/broadband-access-is-key-to-digital-transformation-of-ukraine/>

<sup>5</sup> See: <https://www.itu.int/net4/ITU-D/idi/2017/index.html>

<sup>6</sup> See: [https://issuu.com/mineconomdev/docs/digital\\_agenda\\_ukraine-v2\\_\\_1](https://issuu.com/mineconomdev/docs/digital_agenda_ukraine-v2__1)

<sup>7</sup> See: [http://www.e-ukraine.org.ua/media/Lviv\\_Minich\\_2.pdf](http://www.e-ukraine.org.ua/media/Lviv_Minich_2.pdf)

<sup>8</sup> See: <https://mtu.gov.ua/en/news/29453.html>

<sup>9</sup> See: <https://www.kmu.gov.ua/npas/pro-shvalennya-koncepciyi-rozvitku-cifrovoyi-ekonomiki-ta-suspilstva-ukrayini-na-20182020-roki-ta-zatverdzhennya-planu-zahodiv-shodo-yiyi-realizaciyi>

economic systems implementing digital transformation projects; supporting public security; education; health care; tourism; e-democracy; ecology and environmental protection; and life of cities; e-payments; and harmonization with European and world initiatives as well as governance.

The accelerated scenario of digital development envisages the following actions to facilitate the implementation of the above-mentioned objectives and priorities:<sup>10</sup>

- The removal of legislative, institutional, fiscal and other barriers to the development of the digital economy;
- The introduction of incentives and motivations to encourage business and industry in general to digitize;
- The creation of demand and formation of needs among citizens for digitalization through an introduction by the state of large-scale projects concerning digital transformations—based on modern models of public-private partnership;
- The creation and development of digital infrastructures as a basis for using the advantages of the digital world in everyday life and a platform for achieving economic efficiency in general;
- The development and deepening of digital competencies of citizens to ensure their readiness to use digital opportunities, as well as to overcome the associated risks;
- The development of digital entrepreneurship coupled with the creation of appropriate (including analogue) infrastructures to support and develop innovation, as well as the introduction of funding mechanisms, incentives, and support.

In coordination with the ministries and aligned with international practices, the Action Plan identifies the required indicators and methods for assessing the digital development. Ukraine’s implementation plan has also been supported by private stakeholders. Increasingly, the government is offering incentives and motivations for the private sector to foster business and empower citizens to consume and use information, communication, and digital technologies.<sup>11</sup>

With specific reference to broadband development in Ukraine, and in context of the plan’s focus toward a national hard digital infrastructure, the “Conception for Developing Digital Economy and Society in Ukraine for 2018 to 2020” calls for a national broadband plan that has appropriate indicators of I) Internet access coverage in the country; II) specifications on the technical requirements for the broadband Internet access services; and III) models for using the existing physical infrastructures (highways and railways, gas pipelines, power lines) for the development of telecommunications networks.

In this regard, the document argues that particular attention should be paid to broadband Internet access in rural areas.<sup>12</sup> In April 2020, Iskratel, PJSC Ukrtelecom and SID Bank signed an agreement to build a fibre-optic Internet network (GPON) to connect the rural areas of Ukraine under a two-year network construction project. This has had a total investment of almost 200 million Hryvnia (about 6.1 million EUR). The project will include the manufacture of more than 2,000km of fibre optic cables and the installation

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<sup>10</sup> See: <https://zakon.rada.gov.ua/laws/show/67-2018-%D1%80#Text>

<sup>11</sup> See: <https://zakon.rada.gov.ua/laws/show/67-2018-%D1%80#Text>

<sup>12</sup> <https://zakon.rada.gov.ua/laws/show/67-2018-%D1%80#Text>

of modern certified telecommunication equipment.<sup>13</sup> Other initiatives concerning rural areas and Internet connectivity are currently undergoing under the auspices of the Ministry of Education and Science, Ministry of Digital Transformation, Ministry of Finance,<sup>14</sup> as well as the Ministry of Culture and information policy, which recently collaborated with the World Bank on the fixed-broadband market and connectivity maps.<sup>15</sup>

## 2. Broadband and mobile telecommunication sectors data

ITU data shows that 62.55% of individuals had access to the Internet in 2018,<sup>16</sup> with the majority being in urban areas. In 2010, the ITU data for the country was 23.30% in 2010, in 2000, 0.72%.<sup>17</sup> In 2019, the number of fixed-broadband subscriptions per 100 inhabitants was 16.16<sup>18</sup> and DSL remains the most used technology platform while fibre continues to grow due to the efforts by operators build networks based on Fibre-to-the-Premises (FTTP).<sup>19</sup> While most cities have access to fibre-optic networks operated by several private stakeholders, the urban-rural gap in terms of Internet coverage is significant in Ukraine, given that the country has more than 17,000 settlements not covered by this technology.<sup>20</sup> The government recently announced that about 65% of Ukrainian villages are not covered by high-quality broadband, which corresponds to about 5.75 million citizens.<sup>21</sup> For rural areas that not covered by optical fibres, the cost of connection exceeds the average market cost by about 150%. From the regional perspective, Europe's average fixed-broadband basket cost was 1.5 per cent of the GNI per capita (and the CIS region was 3.7 per cent) in 2019, while Ukraine's corresponded to 1.8 per cent for an unlimited Internet data cap.<sup>22</sup> Continued growth in community wireless platforms based on Wi-Fi and WiMAX technologies is expected to attract investments and shape the average price for Internet connectivity.<sup>23</sup>

In 2019, the number of active mobile-cellular subscriptions per 100 inhabitants was of 130.63.<sup>24</sup> In 2018, the number of active mobile-broadband subscription per 100 inhabitants corresponded to 47.16.<sup>25</sup> There are three major mobile network operators (MNOs) that dominate the market in Ukraine: Vodafone Ukraine (formerly MTS), Kyivstar (VEON), and lifecell (Turkcell). The country's mobile-data basket cost corresponded to 1.2 per cent of the GNI per capita in 2019 for a monthly allowance of 2.0 Gb, while the European region's average was 0.8 per cent (and the CIS region was 2.2) for the same year.<sup>26</sup> Over the past years, significant investment has been made in extending 3G infrastructure, while operators have more recently concentrated on LTE. Kyivstar, Ukraine's largest operator, announced that the 3G coverage

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<sup>13</sup> See: <https://www.fibre-systems.com/news/rural-ukraine-benefit-new-fibre-network>

<sup>14</sup> See: <https://thedigital.gov.ua/news/podililisy-planami-rozvitku-optichnogo-internetu>

<sup>15</sup> See: <https://thedigital.gov.ua/news/mintsifra-ta-svitoviy-bank-rozpochinayut-spivpratsyu-zi-svitovim-bankom>

<sup>16</sup> See: ITU World Telecommunication/ICT Indicators Database online (2020): <http://handle.itu.int/11.1002/pub/81550f97-en> (indicator "i99H")

<sup>17</sup> See: [https://www.itu.int/en/ITU-D/Statistics/Documents/statistics/2019/Individuals\\_Internet\\_2000-2018\\_Dec2019.xls](https://www.itu.int/en/ITU-D/Statistics/Documents/statistics/2019/Individuals_Internet_2000-2018_Dec2019.xls)

<sup>18</sup> See: ITU World Telecommunication/ICT Indicators Database online (2020): <http://handle.itu.int/11.1002/pub/81550f97-en> (indicator "i992b")

<sup>19</sup> See: [https://www.reportlinker.com/p05355157/Ukraine-Telecoms-Mobile-and-Broadband-Statistics-and-Analyses.html?utm\\_source=PRN](https://www.reportlinker.com/p05355157/Ukraine-Telecoms-Mobile-and-Broadband-Statistics-and-Analyses.html?utm_source=PRN)

<sup>20</sup> See: <https://data.gov.ua/dataset/788580dd-e3ae-45b4-a93b-f7f3e8a3f80d/resource/4d2fdbd7-41b5-4478-9bc0-d59eb2d86c19>

<sup>21</sup> See: <https://thedigital.gov.ua/news/17-tisyach-naselenikh-punktiv-ne-mayut-zhodnogo-optichnogo-provaydera-doslidzhennya-mintsifri>

<sup>22</sup> See: [https://www.itu.int/en/ITU-D/Statistics/Documents/publications/prices2019/ITU\\_ICTpriceTrends\\_2019.pdf](https://www.itu.int/en/ITU-D/Statistics/Documents/publications/prices2019/ITU_ICTpriceTrends_2019.pdf)

<sup>23</sup> See: [https://www.reportlinker.com/p05355157/Ukraine-Telecoms-Mobile-and-Broadband-Statistics-and-Analyses.html?utm\\_source=PRN](https://www.reportlinker.com/p05355157/Ukraine-Telecoms-Mobile-and-Broadband-Statistics-and-Analyses.html?utm_source=PRN)

<sup>24</sup> See: ITU World Telecommunication/ICT Indicators Database online (2020): <http://handle.itu.int/11.1002/pub/81550f97-en> (indicator "i911")

<sup>25</sup> See: ITU World Telecommunication/ICT Indicators Database online (2020): <http://handle.itu.int/11.1002/pub/81550f97-en> (indicator "i992b")

<sup>26</sup> See: [https://www.itu.int/en/ITU-D/Statistics/Documents/publications/prices2019/ITU\\_ICTpriceTrends\\_2019.pdf](https://www.itu.int/en/ITU-D/Statistics/Documents/publications/prices2019/ITU_ICTpriceTrends_2019.pdf)

corresponded to nearly 80% in 2018, although a large portion of the territory still lacks 4G/LTE coverage.<sup>27</sup> With the recent expansion of LTE in Ukraine, it is expected that the majority of the country's territory will be covered in the next years.<sup>28</sup>

Additionally, data from ITU show that in 78.1% of the population in Ukraine had 4G/LTE coverage in 2019, while 3G coverage corresponded to 89.1%.<sup>29</sup> In August 2020, the government announced that 4G is now available in nearly half of the underground stations of the Kyiv metro, a result of a partnership between the country's MNOs with Huawei.<sup>30</sup>

### **3. Current progress on 5G: consultations and national strategies**

In May 2019, on the World Radio Day, Ukrainian President signed a decree to roll out 5G network in the country,<sup>31</sup> which is a similar government approach to what was done in the past for the launching of 3G and 4G.<sup>32</sup> While the decree defines a timetable stating that 5G will be launched in 2020, it has no details regarding conversion or freeing up of new frequencies for the new networks.

The decree has been sent to the regulator, the National Commission for the State Regulation of Communications and Informatization (NCCIR), by the State Service for Special Communication & Information Protection of Ukraine on 25 October, 2019.<sup>33</sup> Under this decree, the government and NCCIR, must structure and adopt a step-by-step plan for 5G implementation, sending relevant information to the Cabinet of Ministers for confirmation before setting up a frequency auction allocation for the operators.<sup>34</sup>

In March 2020, Ukraine held in Kyiv the third of a series of consultations to discuss cybersecurity policy, national cyber capacity building, international cybersecurity policy issues and security issues for future 5G networks.<sup>35</sup>

### **4. Spectrum assignment for 5G & market development**

Ukraine has been successful in harmonizing the 1800MHz, 2100MHz and 2600MHz bands by introducing technology-neutral principles for operators in the Ukrainian market.<sup>36</sup> In January 2018, the Ukrainian regulator provided operators with additional spectrum in the 2600MHz band, and with spectrum in the 1800MHz band in the following July, issuing 15-year licenses.<sup>37</sup> In November 2019, NCCIR issued decision No. 529 confirming it will allocate country-wide 5G-suitable wireless spectrum in the 3400MHz-3600MHz

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<sup>27</sup> See: <https://www.epravda.com.ua/publications/2018/03/15/634981/>

<sup>28</sup> See: <https://www.president.gov.ua/en/news/zhittya-dedali-bilshe-perehodit-v-onlajn-krayinu-treba-zyedn-61061>

<sup>29</sup> See: ITU World Telecommunication/ICT Indicators Database online (2020): <http://handle.itu.int/11.1002/pub/81550f97-en> (indicator "i271G and i271GA")

<sup>30</sup> See: <https://thedigital.gov.ua/news/shche-7-stantsiy-kiivskogo-metro-pidklyucheni-do-4g>

<sup>31</sup> See: <https://www.president.gov.ua/documents/2422019-26881>

<sup>32</sup> See: <https://www.cms-lawnow.com/ealerts/2019/05/ukraine-to-launch-5g-in-2020>

<sup>33</sup> See: <https://www.commsupdate.com/articles/2019/11/14/nccir-issues-decisions-on-3-4ghz-3-6ghz-licensing-2020-5g-plan/>

<sup>34</sup> See: <https://www.kyivpost.com/technology/president-poroshenko-signs-decree-to-launch-superspeed-5g.html>

<sup>35</sup> See: <https://mfa.gov.ua/news/v-mzs-ukrayini-vidbuvsya-tretij-raund-mizhvidomchih-ukrayinsko-amerikanskih-konsultacij-u-sferi-zabezpechennya-kiberbezpeki>

<sup>36</sup> See: [https://www.itu.int/en/ITU-D/Regional-](https://www.itu.int/en/ITU-D/Regional-Presence/Europe/Documents/Publications/0719_ITU%20Outcome%20Report%20Ukraine_finalweb.pdf)

[Presence/Europe/Documents/Publications/0719\\_ITU%20Outcome%20Report%20Ukraine\\_finalweb.pdf](https://www.itu.int/en/ITU-D/Regional-Presence/Europe/Documents/Publications/0719_ITU%20Outcome%20Report%20Ukraine_finalweb.pdf)

<sup>37</sup> See: <https://www.businesswire.com/news/home/20190617005826/en/Ukraine-Mobile-Infrastructure-Broadband-Operators-Statistics-Analyses>

range on a competitive or tender basis in accordance with the 2000 “Law on Radio Frequency Resource of Ukraine”<sup>38</sup> and other regulations.<sup>39</sup>

Given that 4G auctions were conducted in 2018, some private stakeholders recently expressed their unwillingness to invest in new technologies for the moment. Even though some 5G-related commercial progress has occurred,<sup>40</sup> part of the telecommunication sector in Ukraine is currently focused on the development of 4G and the expansion of Internet services in rural areas,<sup>41</sup>

In January 2020, Kyivstar, lifecell and Vodafone Ukraine have submitted a joint statement on redistribution of the 900MHz band and separate applications for license renewal to the NCCIR.<sup>42</sup> Previously, the 900MHz band was fragmented and a large proportion of it was concentrated with one of the telecommunications operators, preventing the provision of next-generation 4G services across Ukraine.<sup>43</sup> Currently, these MNOs are deploying 900MHz LTE services to expand their existing LTE-1800/2600 networks in rural areas, after their LTE-900 licences became valid at the start of July 2020.<sup>44</sup> As a result, in March 2020, NCCIR provided a technology-neutral license to Kyivstar, lifecell and Vodafone Ukraine, allowing them to begin offering 4G LTE-900 services starting on July 1<sup>st</sup>, 2020.<sup>45</sup> Under the terms of the licenses, the operators must extend LTE-900 services to all areas of the country with a population of over 2000 people across the next two years.<sup>46</sup>

As of August 2020, no announcement has been made regarding the tendering process for the 5G spectrum assignment in Ukraine. Government representatives also stated that it is necessary to provide a regulatory apparatus for technological neutrality for mobile communications, and that release of the first (790-862MHz) and second (694-790MHz) digital dividends is one of its priorities for 2020.<sup>47</sup>

## 5. Electromagnetic fields levels and the implementation dynamics

To foster the development of current 4G networks and advance the potential of 5G-enabled services and applications, the Cabinet of Ministers of Ukraine instructed the Ministry of Health to increase the maximum permissible level of EMR for high (30-300 MHz), ultra-high (300-3000 MHz) and very high (30-300 GHz) frequency bands by 10 times—from 10  $\mu\text{W} / \text{cm}^2$  to 100  $\mu\text{W} / \text{cm}^2$ , which remains 40 W/m<sup>2</sup>

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<sup>38</sup> See: <https://cis-legislation.com/document.fwx?rgn=11669>

<sup>39</sup> See: <https://nkrzi.gov.ua/index.php?r=site/index&pg=422&id=8842&language=uk>

<sup>40</sup> See: <https://www.kinstellar.com/locations/news-deals-insights/detail/kyiv-ukraine/982/5g-spectrum-auctions-in-kinstellar-jurisdictions>

<sup>41</sup> See: <https://ucap.io/shkoda-vid-5g-shho-var-to-znaty-pro-tehnologiyu-shho-zmynyt-globalnyj-rynok/>

<sup>42</sup> See: <https://eufordigital.eu/implementation-of-lte-900-high-speed-mobile-internet-on-track-with-joint-statement-by-largest-operators-in-ukraine/>

<sup>43</sup> See: <https://en.brdo.com.ua/news/the-implementation-of-lte-900-high-speed-internet-is-at-the-track-thanks-to-a-joint-statement-of-the-largest-operators-of-ukraine/>

<sup>44</sup> See: <https://www.commsupdate.com/articles/2020/08/07/lifecell-joins-kyivstar-vodafone-in-4g-sharing-pact-intertelecom-4g-ambitions-stalled/>

<sup>45</sup> See: <https://www.commsupdate.com/articles/2020/03/20/kyivstar-lifecell-vodafone-ukraine-receive-lte-900-licences-intertelecom-gets-extension-to-pay-licence-fee/>

<sup>46</sup> See: <https://www.kmu.gov.ua/news/uryad-pidpisav-memorandum-shcho-zabezpechit-pokrittya-4g-na-90-teritoriyi-ukrayini>

<sup>47</sup> See: <https://ubr.ua/ukraine-and-world/technology/zamhlavy-mintsifry-rasskazal-o-planakh-vseobshchej-internetizatsii-ukrainy-do-2022-hoda-3888361>

(4000  $\mu\text{W}/\text{cm}^2$ ). In 2017, a similar change occurred<sup>48</sup> to the original legislation on EMF from 1996,<sup>49</sup> which already increased the permissible level from 2.5 to 10  $\mu\text{W}/\text{cm}$ .<sup>50</sup>

In response to public pressure on alleged health hazards from 5G introduction in Ukraine,<sup>51</sup> an order from the President of Ukraine from July 2020 requested NCCIR to propose a number of measures to resolve the issue and provide the public with the appropriate information on the impact of mobile technologies and networks. In August 2020, the NCCIR announced its action plan<sup>52</sup> to meet the President's demands. Some of the measures include the provision of protocols for measuring electromagnetic fields by operators; public consultations with suppliers of radio equipment; creation of a new section of impact mobile technologies (4G, 5G) on human health on the NCCIR website; among others.<sup>53</sup>

Furthermore, NCCIR intends to involve the Ministry of Digital Transformation, the Ministry of Health, the Administration of the State Service for Special Communications and Information Protection of Ukraine and other bodies to take action on a number of EMF-related challenges and issues such as:<sup>54</sup>

- The need to adopt national standards that are necessary to assess the impact of the electromagnetic field from cellular base stations on humans;
- The introduction of a warning sign about the presence of a source of non-ionizing radiation of the appropriate level of its danger to humans;
- The need for additional medical research on the effects on humans of non-ionizing radiation from 5G stations in the millimetre wave range or scientific recognition of such research conducted outside Ukraine, including their implementation in the legislation of Ukraine;
- The need to develop and approve the procedure for the relevant bodies in the system of the Ministry of Health of Ukraine to measure compliance with the levels of EMF at the request of citizens;
- Carrying out of regular measurements within the Ministry of Health's system to monitor EMF levels during deployment of 5G networks;
- Placing social advertising or information on the impact of mobile radio technologies on human health within the context of 5G.

Private stakeholders in Ukraine are also engaging with questions pertinent to EMF. In August 2020, representatives from Huawei Ukraine<sup>55</sup> and ZTE<sup>56</sup> have presented solutions on electromagnetic fields from 5G base stations and 5G Massive-MIMO EMF<sup>57</sup> to NCCIR.

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<sup>48</sup> See: <https://zakon.rada.gov.ua/laws/show/z0488-96#Text>

<sup>49</sup> See: <https://zakon.rada.gov.ua/laws/show/z0488-96#Text>

<sup>50</sup> See: <https://112.international/society/ukraine-to-increase-permitted-level-of-electromagnetic-radiation-ten-times-what-does-this-mean-53426.html>

<sup>51</sup> See: <https://petition.president.gov.ua/petition/92038>

<sup>52</sup> See: <https://nkrzi.gov.ua/index.php?r=site/index&pg=444&id=9258&language=uk>

<sup>53</sup> See: [https://nkrzi.gov.ua/images/upload/608/9258/Dodatok\\_304\\_04082020.doc](https://nkrzi.gov.ua/images/upload/608/9258/Dodatok_304_04082020.doc)

<sup>54</sup> See: <https://nkrzi.gov.ua/index.php?r=site/index&pg=99&id=1956&language=uk>

<sup>55</sup> See: <https://www.youtube.com/watch?v=zozJol6QcHQ>

<sup>56</sup> See: <https://www.youtube.com/watch?v=98C-Aa8K6ul>

<sup>57</sup> See: <https://nkrzi.gov.ua/index.php?r=site/index&pg=460&language=uk>

## 6. 5G commercial launches: announcements, trail cities, and digital cross-border corridors

In May 2019, Vodafone Ukraine announced it was ready to launch 5G tests.<sup>58</sup> During the same month, operator lifecell—part of the Turkcell Group—has tested 5G mobile technology in the 28GHz frequency range in the city of Kyiv in partnership with Ericsson.<sup>59</sup> Through massive multiple-input multiple-output (MIMO), a peak download speed of 25.6Gbps was reached in the ultra-high frequency range of 28Ghz.<sup>60</sup>

As part of the 2019 Swedish-Ukrainian Business Forum, lifecell also showcased a demonstration of 5G network and applications, including remote robotics for surgery, immersive real-time conferencing and virtual reality (VR) multiplayer interactive games. Private stakeholders organizing the event outlined six main regulatory and economic factors that would make 5G roll out a success in Ukraine: I) Transparency on the state's plans for 5G development; II) Comprehensive frequency spectrum allocation and licensing strategy; III) Consumer and market readiness that includes accessible devices; IV) Economic demand and developed infrastructure; V) Having mobile networks, hardware, and software ready to be operated; and VI) Develop partnerships and ecosystem (devices and app developers, for example) necessary to take the offers to prospective customers.<sup>61</sup>

In April 2019, Ukraine's Ministry of Infrastructure launched a pilot project regarding the Internet of Things (IoT) on the roads in partnership with Vodafone, Nokia Solutions, and Networks Ukraine to create a virtual network to tackle issues related to road safety and traffic flow analysis. The project is divided into three phases: testing, scaling and full implementation.<sup>62</sup> The long-term goal is to launch a full-scale project which will provide coverage of all highways of international importance with modern technologies.<sup>63</sup>

Between December 2019 and May 2020, Ericsson and operator lifecell conducted 5G tests using 3.5GHz band in seven of the operator's points of sales in six Ukrainian cities: Kyiv, Dnipro, Kharkiv, Lviv, Odesa, and Cherkasy.<sup>64</sup>

In February 2020, the Ministry of Digital Transformation of Ukraine and Swedish company Ericsson signed a Memorandum of Cooperation in the development of fixed and mobile 4G LTE-A and 5G networks.<sup>65</sup> The Ministry noted that a joint working group is being organized to work on technical expertise in mobile and fixed internet development.<sup>66</sup> The working group will also provide advisory and information support to the Ministry on the evolution of mobile communications, frequency strategy and licensing policies.<sup>67</sup> The

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<sup>58</sup> See: <https://www.kyivpost.com/technology/vodafone-ukraine-confirms-plans-to-launch-5g-communication-tests-in-h2-2019.html>

<sup>59</sup> See: <https://www.telecompaper.com/news/lifecell-ericsson-test-5g-in-kyiv--1294300>

<sup>60</sup> See: <https://internetua.com/v-shesti-gorodah-ukrainy-protestiruuat-5g>

<sup>61</sup> See: [https://www.lifecell.ua/uploads/filelibrary/public/press\\_releases/EN\\_Press\\_release\\_5G%20Demo\\_Test\\_%20Ericsson\\_%20lifecell.pdf](https://www.lifecell.ua/uploads/filelibrary/public/press_releases/EN_Press_release_5G%20Demo_Test_%20Ericsson_%20lifecell.pdf)

<sup>62</sup> See: <https://aiconference.com.ua/en/news/svyaz-5g-na-dorogah-i-umnie-viveski-dlya-gorodov-o-glavnih-sobitiyah-v-sfere-iskusstvennogo-intellekta-97933>

<sup>63</sup> See: <https://www.unian.ua/economics/telecom/10522014-v-ukrajini-testuvatimut-5g-dlya-rozumnih-dorig.html>

<sup>64</sup> See: <http://arab.com.ua/en/in-six-cities-of-ukraine-will-test-5g-connection>

<sup>65</sup> See: [https://lb.ua/economics/2020/02/26/451014\\_mintsifri\\_ericsson\\_podpisali.html](https://lb.ua/economics/2020/02/26/451014_mintsifri_ericsson_podpisali.html)

<sup>66</sup> See: <https://thedigital.gov.ua/news/mintsifra-ta-ericsson-spivpratsyuvatimut-zadlya-rozvitku-merezh-novogo-pokolinnya-4g-lte-advanced-ta-5g>

<sup>67</sup> See: <https://thedigital.gov.ua/news/mintsifra-ta-ericsson-spivpratsyuvatimut-zadlya-rozvitku-merezh-novogo-pokolinnya-4g-lte-advanced-ta-5g>

Ministry also started a cooperation with Vodafone and Nokia to launch a pilot project regarding the implementation of the IoT on roads through 5G connectivity.<sup>68</sup>

In April 2020, Vodafone Ukraine completed testing of AirScale equipment from Nokia on its LTE network in Kyiv. The 5G-ready equipment was tested on the 1800MHz and 2600MHz bands, achieving connectivity speed as fast as 525 Mbps.<sup>69</sup>

In July 2020, Vodafone Ukraine and Kyivstar signed a Memorandum of Intent (MOI) on network sharing for the exchange of the 900MHz spectrum in 8 Ukrainian regions.<sup>70</sup> The agreement covers both passive and active infrastructure on operators' mobile networks and should result in the acceleration of LTE technology coverage of Ukraine, reaching the country's rural areas and highways.<sup>71</sup> The operators plan to start the practical implementation of the memorandum in November-December 2020 after approval of the project by government agencies.

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<sup>68</sup> See: <https://aiconference.com.ua/en/news/svyaz-5g-na-dorogah-i-umnie-viveski-dlya-gorodov-o-glavnih-sobitiah-v-sfere-iskusstvennogo-intellekta-97933>

<sup>69</sup> See: <https://itc.ua/news/vodafone-ukraina-protestiroval-oborudovanie-nokia-airscale-v-4g-seti-kieva-na-chastotah-1800-i-2600-mgcz-dostignuv-skorosti-mobilnogo-interneta-525-mbit-sek/>

<sup>70</sup> See: <https://www.developingtelecoms.com/telecom-technology/wireless-networks/9684-ukrainian-operators-begin-joint-lte-900-expansions.html>

<sup>71</sup> See: <https://www.insidetelecom.com/kyivstar-and-vodafone-ukraine-partnership-offering-4g-networks-to-rural-areas/>