GSMA

Regulatory best practices for mobile network development in the Republic of Kazakhstan

2023

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Contents

Introduction

The development of cellular networks in the Republic of Kazakhstan has ensured widespread access to the Internet and a high level of penetration of various digital services. In the current decade, cellular operators are working to expand coverage and increase capacity, and preparations are underway for the launch of 5G networks, followed by the introduction of industry-specific services for the digitalisation of various sectors of the economy.

However, over the past decade, both the economy as a whole and the telecommunications sector in particular have changed significantly. Many operators' traditional value-added services have been supplanted by IT-services, while the constant growth in mobile traffic volumes has not been accompanied by a significant increase in revenue. The ongoing investment cycle in today's 4G networks, and the upcoming investments in 5G in the coming years, coincides with the low margins and predominantly excessive regulation of the industry inherited from the 2G/3G era.

To further incentivise the development of mobile networks in the Republic of Kazakhstan, it is necessary to establish a favourable regulatory framework, as well as measures to attract investments in network deployment. This will require a review and simplification of a number of industry regulatory approaches used in the Republic of Kazakhstan, including spectrum assignments, administrative procedures liberalisation and the introduction of mechanisms to spur investment in the digital infrastructure. Figure 1 illustrates the key aspects of mobile network deployment in the Republic of Kazakhstan, the regulation of which could be improved significantly.

Figure 1
The regulatory approaches required to promote mobile network infrastructure development

- Ensuring access to new frequency bands without imposing economically unjustified obligations and high spectrum prices
- Sunset of legacy networks in cooperation with the regulator to free up resources for 4G/5G development
- Simplifying the rules for base station deployment and obtaining necessary permissions
- Avoiding non-market based regulatory mechanisms and creating conditions for the investment in infrastructure development

As seen worldwide, in the Republic of Kazakhstan, an increase in mobile traffic volume requires the assignment of additional spectrum to operators, primarily in the lower 3.5 GHz range (3.3-3.8 GHz) band with wide channels of 100 MHz. To provide coverage, it is also advisable to allocate complementary spectrum in low frequency bands, in particular in the 700 MHz range (694-790 MHz).

Although the Republic of Kazakhstan is working on these spectrum assignments, there are a number of issues with the terms and conditions. In both cases, the spectrum is to be assigned, without migrating the existing spectrum users to other frequency bands. At the same time, the estimated price of spectrum and infrastructure deployment obligations do not take into account either the specifics of implementation in different frequency bands, or the practical feasibility of rolling out 5G networks cost-effectively. This report provides recommendations on how to take these factors into account so that the assignment of new frequency bands becomes an effective tool, and not a burden for operators.

In addition to capital expenses, operating costs are becoming increasingly critical for operators. To optimise such costs, minimisation or complete shutdown of 2G and 3G networks is required in the upcoming years, freeing up resources for new generations of mobile networks. To avoid the negative consequences of such shutdowns, this document provides recommendations on the preparation of network sunsets through the joint efforts of operators and the regulator.

Another important step to reduce the burden on operators is to simplify the numerous authorisation procedures required to deploy, and in some cases operate, base stations. This report considers approaches to possible simplification of the most resource-intensive or restrictive procedures, including procedures for the rights of way for land or urban infrastructure and obtaining sanitary-epidemiological permits (EMF exposure permits).

Finally, major measures to incentivise investment are considered to further mobile network development. Such measures include the exclusion of non-market mechanisms for cellular tariffs and connectivity quality regulation, which further limit the investments available for operators and lead to degradation of mobile networks against the growing traffic consumption. This is further exacerbated by fines for not fulfilling coverage targets, the overall amount of which reflects significant discrepancies between network planning approaches adopted by operators and exaggerated requirements specified in the testing methodology applied by the regulator. International experience shows that for 4G/5G network development, the governments of many countries reduce the fiscal burden on operators by introducing various tax exemptions to release funds to invest in infrastructure roll-out. In many rural coverage projects, operators are directly subsidised to recover the costs of network deployment.
This report provides recommendations on the implementation of industry regulation in the Republic of Kazakhstan aimed at stimulating investment without disrupting market-based mechanisms and business processes within the industry.

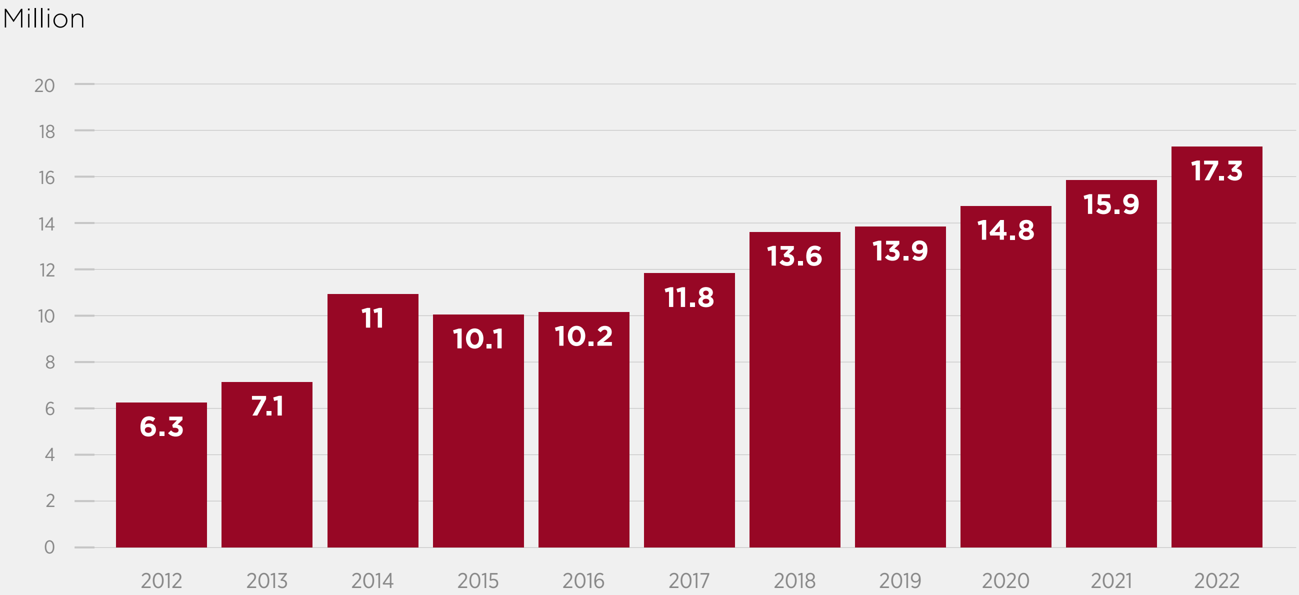
01

Mobile industry overview in Kazakhstan

The Republic of Kazakhstan is distinguished by high rates of Internet accessibility and digitalisation in general, facilitated by the widespread use of cellular networks and the proliferation of mobile phones within households at the level of 99.4%[1]. The availability of mobile broadband has also reached values close to 90%[2] due to the steady development of 3G and 4G network (see Figure 2).

At the same time, over the past few years, there has been a rapid increase in the consumption of mobile data per subscriber, which, together with the growth in services availability, has ensured double digit percentage traffic growth in mobile networks. At the end of 2021, the average traffic consumption in the Republic of Kazakhstan was 14.4 GB per month per user[3], which is significantly higher than the global average (see Figure 3). In many respects such high consumption was achieved by preserving rather low tariffs for cellular communication services. According to the Internet Accessibility Index[4] for 2022, the Republic of Kazakhstan shares the 8th position in terms of the lowest mobile internet tariffs with such countries as Vietnam, Poland, Belarus and Indonesia. The cost of 1 GB of mobile data for subscribers in Kazakhstan is only 0.8 USD. Moreover, in 2021, this figure was 0.9 USD.

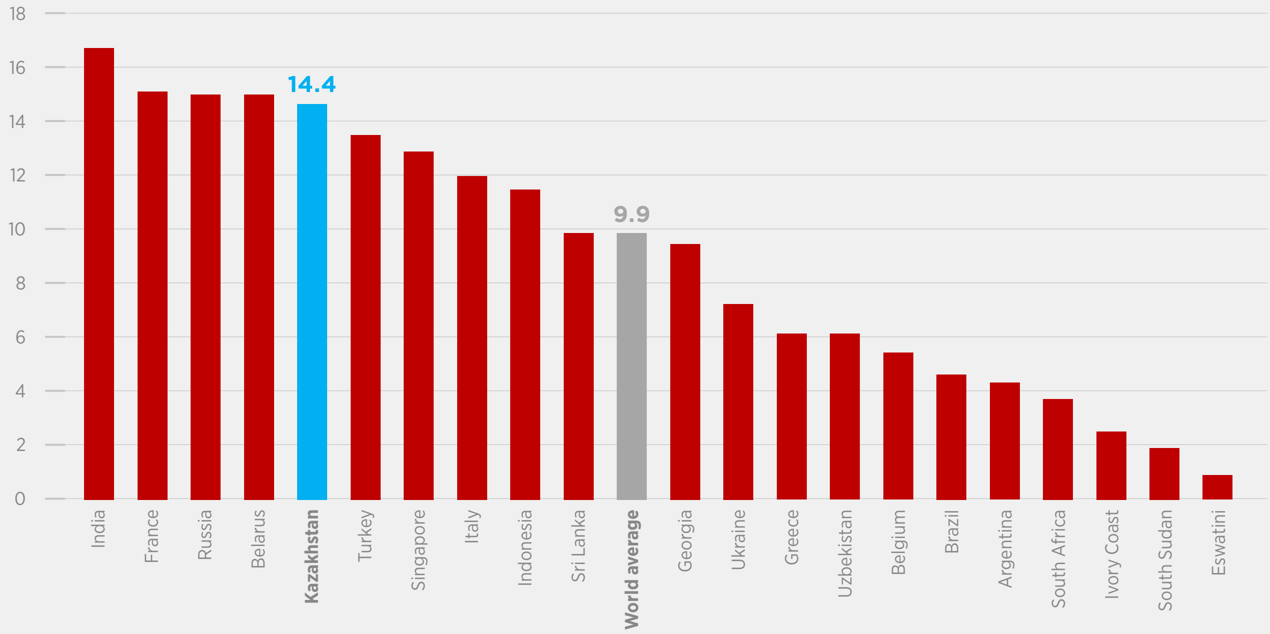
Figure 2
Number of cellular subscribers with access to high-speed broadband Internet



1 Based on the data from monitoring the economy of Kazakhstan Ranking.kz
2 Based on the data of the Bureau of National Statistics of Agency for Strategic Planning and Reforms of the Republic of Kazakhstan
3 Based on the data of GSMA Intelligence
4 https://www.broadbandchoices.co.uk/features/internet-accessibility-index

Figure 3
Average monthly mobile traffic per subscriber at the end of 2021

GB per month



To ensure the capacity for ever-increasing traffic volumes and expand population coverage, operators were pressured to increase capital expenditures, which, according to operators, are approaching 20% of revenue, one of the highest values for capital intensity across all industries in Kazakhstan. This investment made it possible to accelerate the implementation of the "250+" programme for connecting settlements to cellular networks, as well as helping with the implementation of the "Digital Kazakhstan" state programme, effective in the 2017-2022 period.

However, further coverage expansion and maintaining QoS by increasing base stations density require not only significant capital costs, but also an increase in operating costs. In the context of ever-growing traffic, it is becoming more and more difficult for operators to intensify mobile network infrastructure deployment and maintain data rates specified by license conditions, which were set without consideration of network congestion. In 2021, based on the results of 562 services quality checks, mobile operators were fined 132 million tenge[5]. In 2022, this amount has increased significantly and reached almost half a billion tenge[6] due to multiple increases in the amount of the fine for providing poor-quality communications up to 1500 MCI (monthly calculation index)[7], starting from September 2022. Considering the forthcoming spending for 5G spectrum, as well as a sharp increase in the number of mandatory 5G base stations, the above factors can lead to a significant disruption of operator's business models and mobile communications industry stagnation in the Republic of Kazakhstan. This, in return, will negate its relative success compared with other countries within the CIS region and will reduce the overall investment attractiveness of the digital economy of Kazakhstan.

For this reason, it is extremely important to review the key factors, mechanisms and procedures in the Republic of Kazakhstan affecting the access to spectrum, permits for mobile network infrastructure deployment, investments in such infrastructure and their return in a competitive time frame. The following sections of this report are covering these specific issues. The implementation of its recommendations will optimise the existing business processes of operators, maintain the pace of 4G networks deployment and ensure successful 5G networks implementation. In addition, the reduction of administrative barriers, excessive regulation and hidden financial burden on operators will allow them to focus on the development of new digital services to accelerate the digital transformation for various sectors of Kazakhstan's economy beyond the ICT sector.

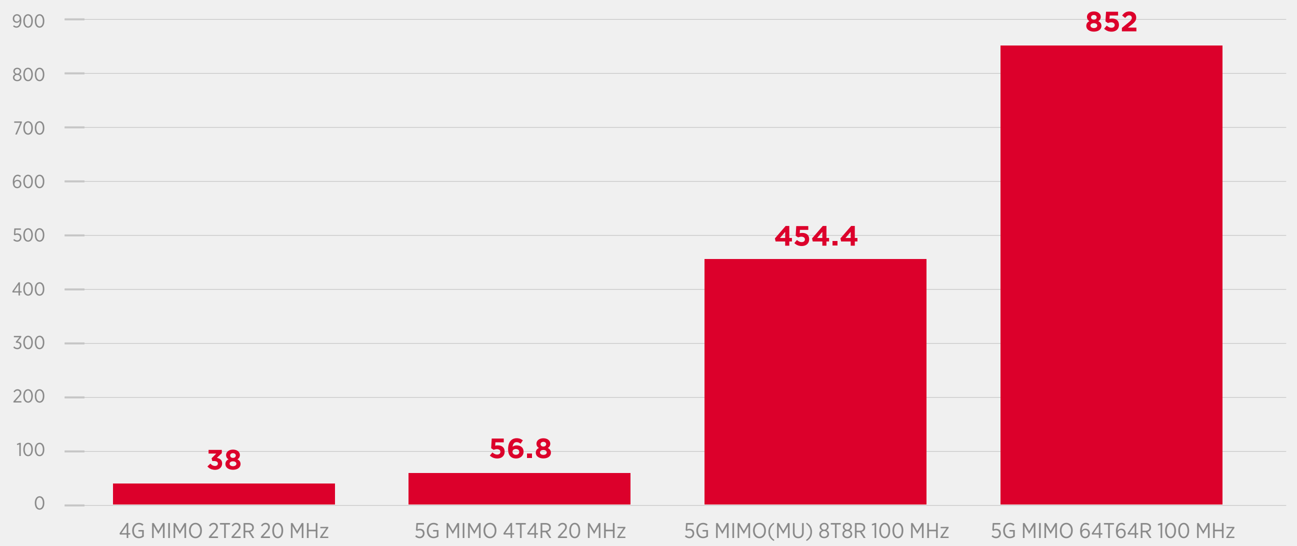
5 According to the Ministry of Digital Development, Innovations and Aerospace Industry of the Republic of Kazakhstan (MDDIAI RK)
6 According to the online magazine vlast.kz
7 According to the MDDIAI RK, in case of violations, instead of 100 MCI, telecom operators are fined with 1000 MCI, and in case of a repeated violation during the year, the fine increased from 200 to 1500 MCI. The value of the MSI established from April 1, 2022 is 3180 tenge and from January 1, 2023 is 3450 tenge.

02
Ensuring access to new spectrum

2.1 Spectrum needs

Spectrum is a necessary element for the development of mobile networks. The growth of mobile data traffic forces operators to constantly increase the capacity of their networks, which is possible by increasing the number of base stations, increasing the spectral efficiency or expanding spectrum resources. Meanwhile, an increase in base station density is the most expensive and the least effective way to increase the capacity of networks, and is used as the last resort. Spectral efficiency enhancement is also associated with increased investment in more sophisticated antenna equipment and does not provide a significant increase in capacity. The access to new wide bandwidth in frequency ranges able to match existing coverage is a key way to increase capacity. The 3.6 GHz band, which has received the widest support among network equipment vendors, operators and within terminals. In addition, the simultaneous transition to wider channels and modern antenna systems has the greatest effect, as shown below (Figure 4)[8].

Figure 4
Estimation of the average throughput for different combinations of antenna systems and channel bandwidth
mbps



8 Based on a comparison of spectral efficiency estimates provided by CommScope и Coleago Consulting

It is for these reasons that 5G networks in the 3.4-3.8 GHz band with 100 MHz bandwidth per operator are currently the most widespread in the world. Using the existing base station grid in the 1.8-2.6 GHz frequency range and modern antenna systems, operators in many cases have been able to achieve robust downlink coverage to meet the traffic demand in that direction. In a recent report, the GSMA estimated spectrum needs in mid-bands (1-7 GHz) taking into account mobile traffic consumption growth and a base station density assessment[9]. Thus, between 2025-2030, operators will require an average of 2 GHz of spectrum resources in mid-bands, which will require the use of several frequency bands (e.g., 2.3 GHz, 2.6 GHz, 3.6 GHz, 4.8 GHz and 6 GHz). Some countries, such as China, Japan and Saudi Arabia have already assigned 200 MHz of spectrum per operator or even more, combining spectrum resources in the 3.3-3.8 GHz band with wide channels in other bands, such as 2.3 GHz, 2.6 GHz, and 4.8 GHz.

There is also a continued need for the lower frequency range (below 1 GHz). The low-bands are used jointly with mid-bands to provide balanced coverage and capacity. Despite lower capacity, and even with network deployed in the mid-band, indoor coverage is often provided using frequency bands below 1 GHz (except cases with indoor base station installations).

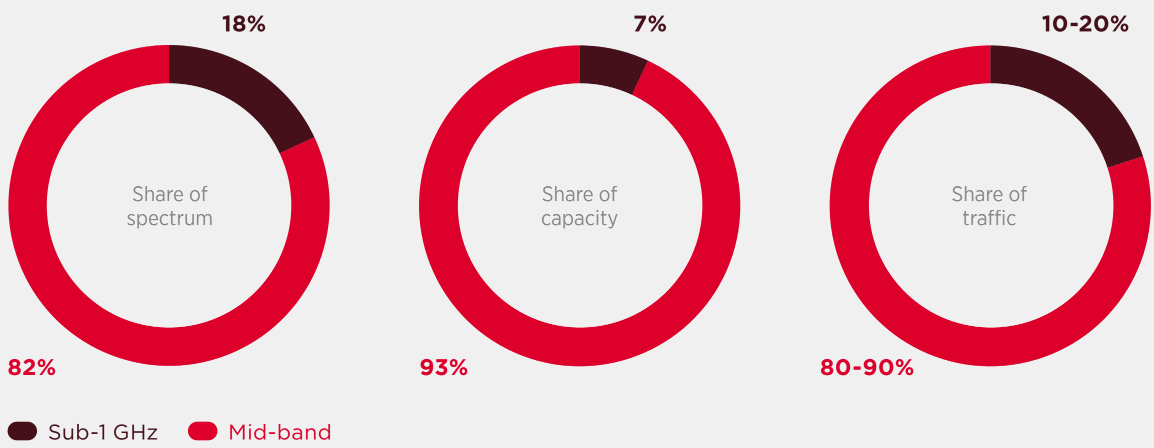
At the same time, estimating spectrum needs in the low-band is complex, since in a theoretical model it is rather difficult to accurately distinguish mobile traffic that cannot be served by mid-band spectrum.

For this reason, a GSMA study[10] examined several aspects of how low-band spectrum impacts mobile networks' performance. One of the most accurate methods turned out to be an approach based on the collection of statistics in existing mobile networks. Figure 5 illustrates this assessment and lower bands' contribution to the total network capacity and traffic throughput.

The left graph shows the sub-1 GHz spectrum share of total spectrum, excluding new 5G frequency bands. The middle graph illustrates the contribution to the capacity. Due to the lower spectral efficiency of narrower channels and lack of complex antenna systems due to low-band antenna sizes, the network capacity contribution is only 7%. However, the most illustrative graph is the share of traffic facilitated by lower bands, which is on average twice the value of sub-1 GHz share in capacity. This means that in almost any mobile network in rural or urban areas there is always traffic that could not be served using higher frequency bands due to coverage constraints. For this reason, lower frequency bands always operate with more congestion than higher bands. Therefore, even with wider channels due to transition to mid-band, locations and usage scenarios will remain that have to be served using low-band spectrum. Therefore, the overall traffic and spectrum needs growth will be relevant for these cases as well.

For the reasons described above, the mobile network development in the Republic of Kazakhstan requires new frequency bands allocation from both low- and mid-bands.

Figure 5
Sub-1 GHz share of spectrum, capacity and traffic



9 Vision 2030: Insights for Mid-band Spectrum Needs, GSMA, 2021.
10 Vision 2030: Low-Band Spectrum for 5G, GSMA, 2022.

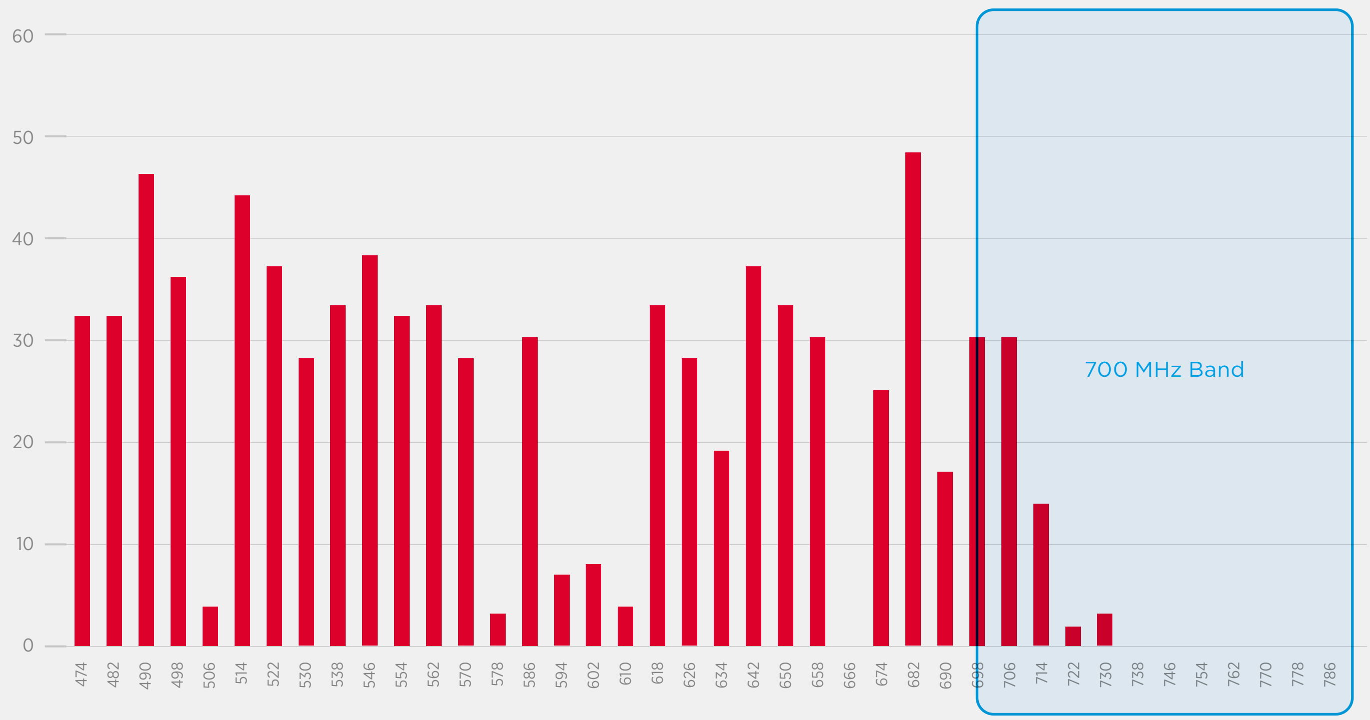
2.2 Low-band spectrum usage in Kazakhstan

In the Republic of Kazakhstan, the 800 MHz and 900 MHz radio frequency bands are already in use, however usage of the 900 MHz band by broadband technologies is limited by its fragmentation and by incumbent GSM networks carrying voice traffic. The 800 MHz range is already being utilised for the introduction of LTE networks by a number of operators, but the problem of switching to the European band plan[11] has not yet been fully resolved (one of the operators used the 850 MHz band plan[12]). But even taking this into account, in general, the amount of spectrum below 1 GHz available for mobile networks is inferior to many countries in the world. First of all, this is due to the unavailability of the 700 MHz band (694-790 MHz).

As in other countries of the CIS region, the 470-790 MHz range has been used for terrestrial television broadcasting for a long time. In the previous decade, this frequency band was used during the transition period for simultaneous operation of analogue and digital television broadcasting. At present, the process of switching-off analogue television broadcasting is almost completed, which makes it possible to release this band for mobile networks. In addition, due to the peculiarities of planning in the Republic of Kazakhstan, a relatively small number of digital terrestrial television broadcasting transmitters in the 694-790 MHz band are actually used[13] (Figure 6).

Figure 6
Usage of TV channels by DTV stations in the Republic of Kazakhstan

Number of TV stations



11 3GPP band plan 20 with Downlink in the 791-821 MHz band and Uplink in the 832-862 MHz band
12 3GPP band plan 5 with Downlink in the 869-894 MHz band and Uplink in the 824-849 MHz band
13 According to JSC "Kazteleradio" website http://tsetv.kz

The process of preparing for the 694-790 MHz band release has already been launched in the Republic of Kazakhstan. Thus, the winners of the 5G auction held in December 2022, in addition to each lot of 100 MHz in the 3600-3800 MHz range, should subsequently be awarded with spectrum in the 694-790 MHz range, following analogue and digital television broadcasting reallocation[14]. In particular, the search of additional frequency channels in the 470-694 MHz band to replace those released in the 694-790 MHz band has already begun in border areas, where this requires cross-border coordination with neighbouring countries. Cross-border coordination processes are underway with Azerbaijan and Russia, and have also been launched with the countries of Central Asia under ITU and RCC activities.

In addition to the process of cross-border coordination and the planning of new frequency channels within the country, it is necessary to reconfigure both the existing television transmitters of JSC “Kazteleradio” and those still being commissioned to operate on frequencies below 694 MHz. To organise this process, there is a need for greater inter-ministerial interaction between the Ministry of Digital Development, Innovation and Aerospace Industry of the Republic of Kazakhstan (MDDIAI RK), responsible for the release of spectrum resources, and the Ministry of Information and Social Development of the Republic of Kazakhstan, which controls the work of JSC “Kazteleradio”.

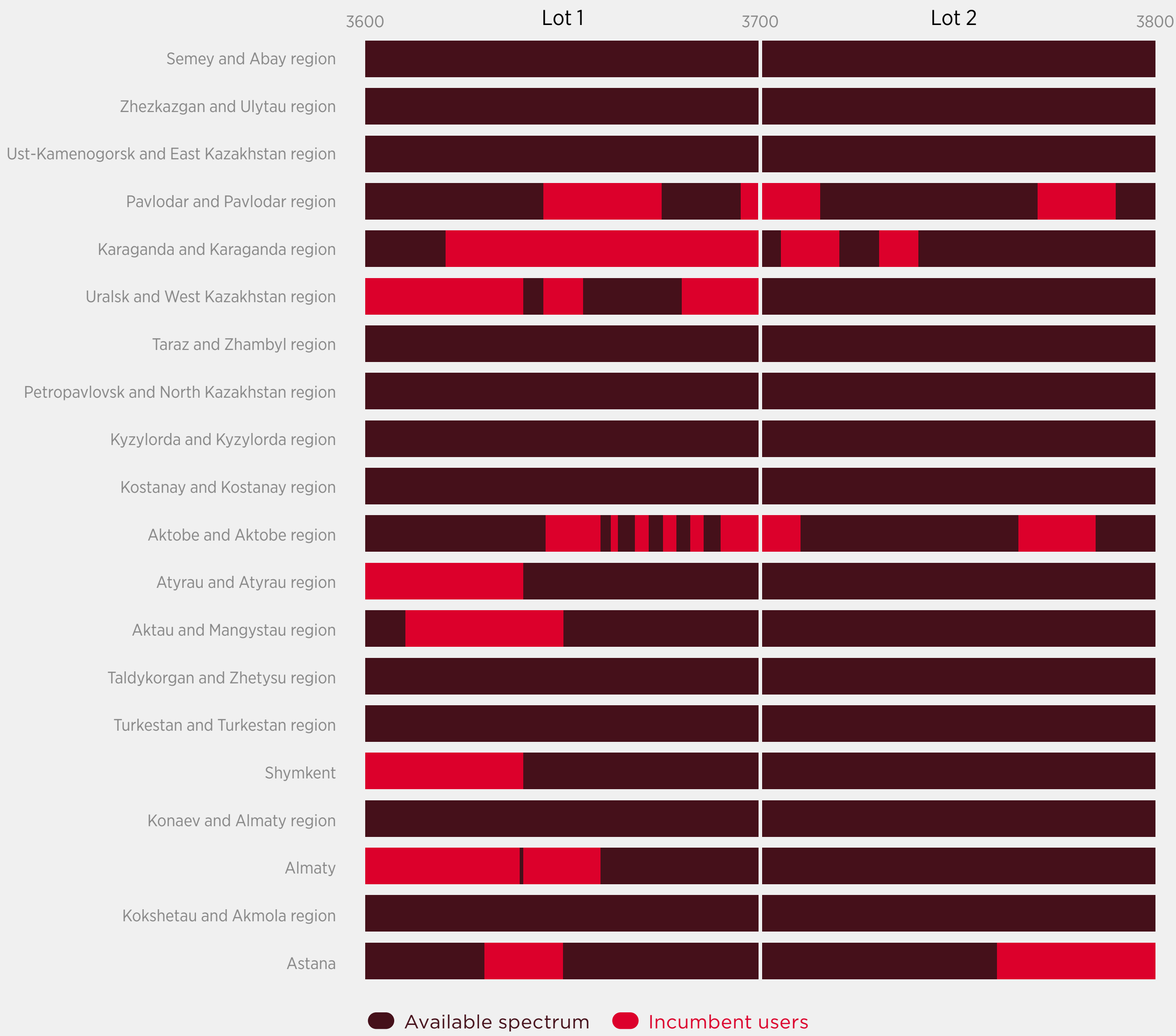
14 According to the auction documentation for the 3600-3700 MHz lot and the 3700-3800 MHz lot, the winner of the auction for each lot will be duly provided with 20 MHz bandwidth frequencies in the 694-790 MHz range

2.3 Mid-band spectrum usage in Kazakhstan

The government of the Republic of Kazakhstan has already made a decision on the allocation of specific frequency bands in the 3.4-3.8 GHz range with the 100 MHz block assignment per operator. In accordance with the announced plans, only two blocks of 3600-3700 MHz and 3700-3800 MHz have been auctioned at the end of 2022, while there are three major mobile operators in the country. Both blocks were purchased by a consortium of two mobile operators, being a part of JSC "Kazakhtelecom" holding, with a total payment to the state budget of 156 billion tenge. At the same time, it is expected that in the near future about 100 MHz of additional spectrum will be released in the 3400-3600 MHz range.

However, a more detailed analysis of the auction rules shows that even the offered lots are not fully available for use and have a number of restrictions, shown below (Figure 7).

Figure 7
Lots and territories restrictions within the 3.6-3.8 GHz auction



The reason for such a situation, as well as for the unavailability of other parts of the 3.4-3.8 GHz band, is primarily due to inefficient spectrum use by existing incumbents, providing wireless access services to subscribers with so-called Wireless Local Loop systems (WLL). Local assignments of such systems to various spectrum users do not allow the transformation of such licenses into cellular licenses. The problem is exacerbated by the fact that Kazakhstan previously issued perpetual licenses for the use of frequencies, which makes the defragmentation process difficult. Similar problems are observed in other frequency bands suitable for 5G networks, such as 2300-2400 MHz and 2500-2690 MHz.

Spectrum defragmentation problems have been observed in many countries, primarily in the 3.4-3.8 GHz band. To address it, a separate study[15] was released in Europe to help regulators organise the redistribution process. This, in particular, requires setting expiration dates for current uses, reallocating WLL frequency blocks within the band to form wide channels for the introduction of mobile networks, or migrating WLL systems to other bands, or switching to wired communication, including costs compensation. There are also alternative approaches, when the spectrum is allocated without refarming, but with fixed expiration dates for existing systems assignments. At the same time, the costs to accelerate the release of spectrum are passed on to operators, who received the spectrum. In particular, the 2500-2690 MHz band was released in such a way in Russia, while similar mechanisms involving operators are also used in the USA to release the 3700-3980 MHz band and in Brazil to release the 3300-3700 MHz band.

In the Republic of Kazakhstan, MDDIAI RK has already announced proposals to change the legal framework to establish expiration dates for previously issued perpetual licenses, as well as to implement redistribution mechanisms, but without disclosing specific details. At the same time, it is important that high-level changes in the legislation are later transformed into working redistribution mechanisms via enforcing acts. The best practice is for the regulator to organise redistribution through compensation mechanisms or migration to other bands, the costs of which are compensated through auctions and partly through state support measures. Given that spectrum assignment in Kazakhstan could occur prior to its complete release, it is also possible for operators to be involved in the migration process. In this case, the regulator will need to create conditions for accelerating the release of spectrum and, together with the operators, organise an effective spectrum redistribution process. The potential result of applying these approaches will be the redistribution of the spectrum currently allocated for WLL technologies in favour of cellular operators for 4G and 5G networks roll-out.

2.4 Spectrum pricing issues

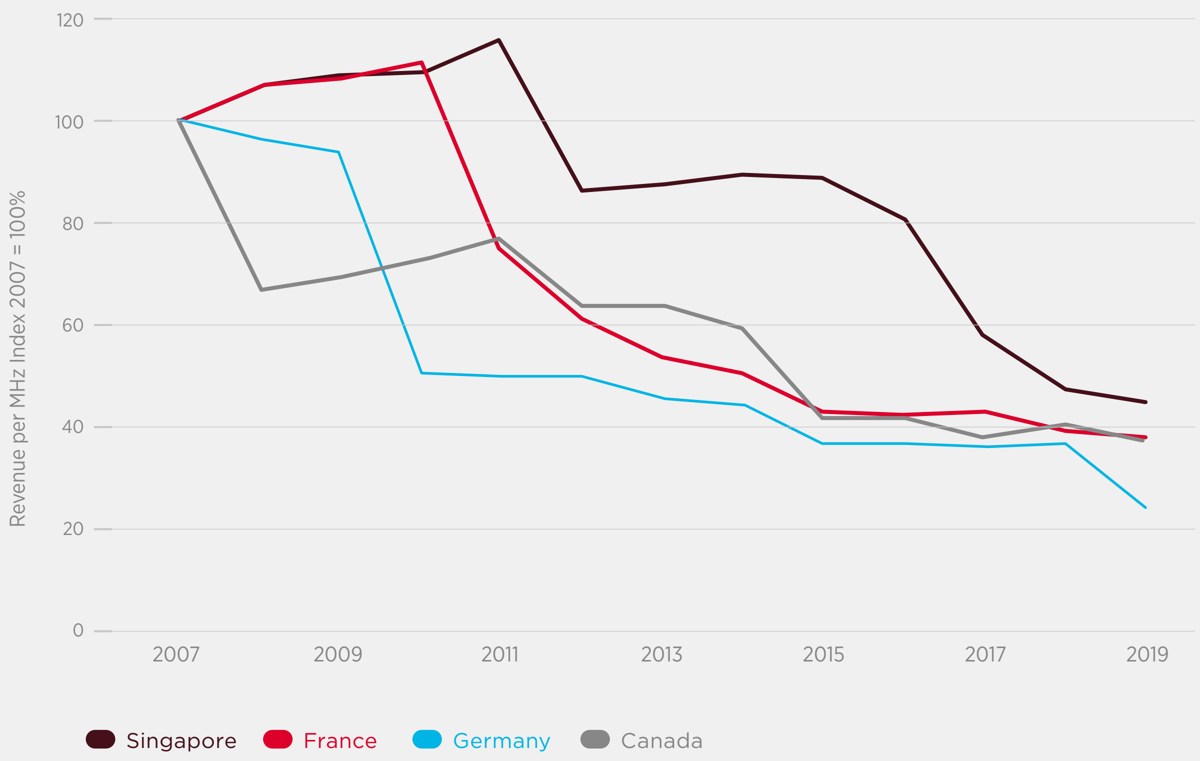
The technical issues, associated with spectrum release and its use, have been discussed above. However, spectrum cost issues play an equally important role. There are various approaches to estimating the cost of spectrum, but most of them (with the exception of comparative estimates) assess the impact of spectrum cost on mobile network development. At the same time, the situation with spectrum costs and the return on investment in the cellular market changes over time. One study[16] covering a number of countries over the past decade found a significant drop in the profitability per 1 MHz of spectrum, which is associated with an increase in traffic, while maintaining service prices for end users (see Figure 8).

In the current environment, the use of newly assigned narrow channels for mobile networks will not provide a return on investment as was the case a decade ago. This is another and perhaps the most important factor for assigning wide channels of about 100 MHz in the mid-band to incentivise investment. As low-bands' narrow channels are still essential for rolling-out networks with reliable coverage, spectrum prices for new low-bands could be considered inflated in many cases, actually diverting investments from coverage expansion. Therefore, for Kazakhstan's situation, spectrum fees per MHz should be many times lower for wider channels in the mid-band compared to fees used previously for low-bands. For new spectrum in low-bands, spectrum fees should be also minimised to promote further investment.

Modern trends in mobile networks development

15 ECC Report 287 "Guidance on defragmentation of the frequency band 3400-3800 MHz"
16 Sustainable spectrum pricing Fostering the deployment of 5G through appropriate spectrum pricing. Coleago Consulting, 2019.

Figure 8
Decrease in revenue of mobile services per 1 MHz of spectrum



are largely taken into account in the Republic of Kazakhstan, where special measures are already in place to support operators developing mobile networks in rural areas in the form of a 90% discount on spectrum fees. However, the final spectrum price at the recent auction, which is paid in addition to annual spectrum fees, almost achieved 0.09 USD/MHz/POP value, similar to auctions in such countries as Austria, Spain, Ireland and UK. However, taking into account the difference in tariffs for cellular services in Kazakhstan and European countries such a spectrum price seems extremely high[17]. In addition, given the current level of inflation, any one-time payments for operators are actually multiplied, when servicing of debt obligations is taken into account.

The cost of spectrum in many countries of the CIS region consists not only of explicit payments for the spectrum, but also of the cost of obtaining numerous permits for each base station. Moreover, in the Republic of Kazakhstan, various penalties have been introduced for operators, including turnover-based fines, for violations, which in many cases are just inherent specifics of mobile network operation. Even if the cost of spectrum is low enough, the overall financial burden of such implicit charges can significantly limit the development of mobile networks, similar to the record prices for spectrum in some countries. This problem is described in more detail in the investment incentives section.

17 If spectrum price USD/MHZ/POP in Kazakhstan is additionally normalised by average ARPU, its value becomes very close to record spectrum prices in the North America

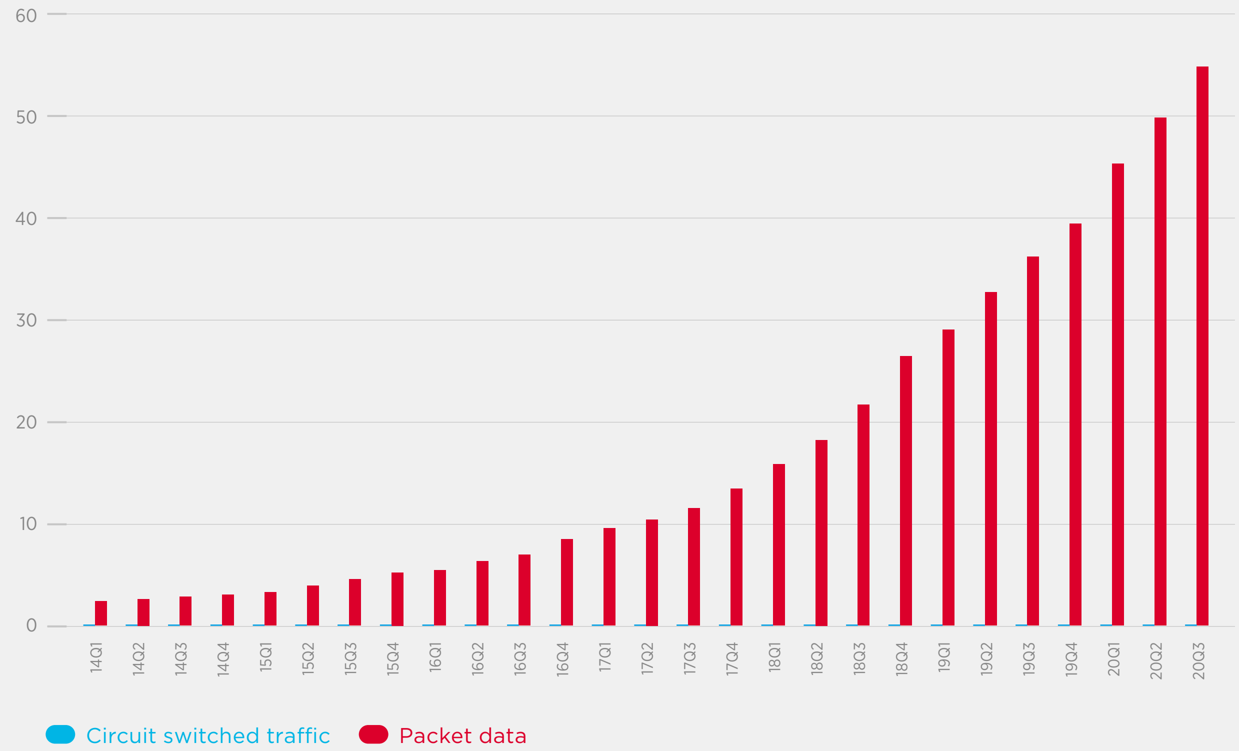
03

Preparation for 2G/3G switch-off

3.1 Key drivers for 2G/3G switch-off

For quite some time, operators have been implementing technological neutrality in the 2G and 3G bands, replacing these generations with 4G networks based on the LTE standard. Recently, NR networks have also been introduced in the 2G and 3G bands. Initially, this trend was associated with the data traffic increase against practically unchanged or falling level of voice traffic, for which 2G and 3G standards were optimised. Figure 9 shows the low volume of voice traffic compared to data traffic, which already in the previous decade led to inefficiency in the use of previous generations networks.

Figure 9
Global traffic in mobile networks in 2014-2020
EB/month



Today in Kazakhstan, as in most countries of the world, many LTE networks have been implemented in the bands originally used for 2G and 3G networks, which made it possible to increase the efficiency of spectrum use and the capacity of 4G networks. However, the next step is the complete switch-off of previous generation networks, starting with 2G or 3G. The key drivers for complete networks switch-off are not to increase capacity, which requires allocation of new frequency bands, but to reduce operating expenses for previous generations networks and simplify transition to a virtualised architecture based on modern technologies.

The main factor holding back 2G/3G switch-off is the unfinished migration of subscribers and corporate users to new technologies. However, this process has already made significant progress, which has led to the beginning of 2G/3G switch-off around the world. The actual situation differs from country to country and includes aspects of migration, not only of ordinary subscribers, but also of a wide range of machine-to-machine communication equipment, which is updated at a much slower pace than smartphones.

In particular, planning for the shutdown of 2G/3G networks in Kazakhstan should take into account the current lack of mobile broadband access in many rural settlements. For this reason, it is necessary to establish a phased expansion of coverage in rural areas within the ongoing development of the National project "Accessible Internet". At the same time, within the framework of this project, it is necessary to take into account the realistic capabilities and resources of cellular operators, implementing mobile networks roll-outs in rural areas.

3.2 International experience of 2G/3G switch-offs

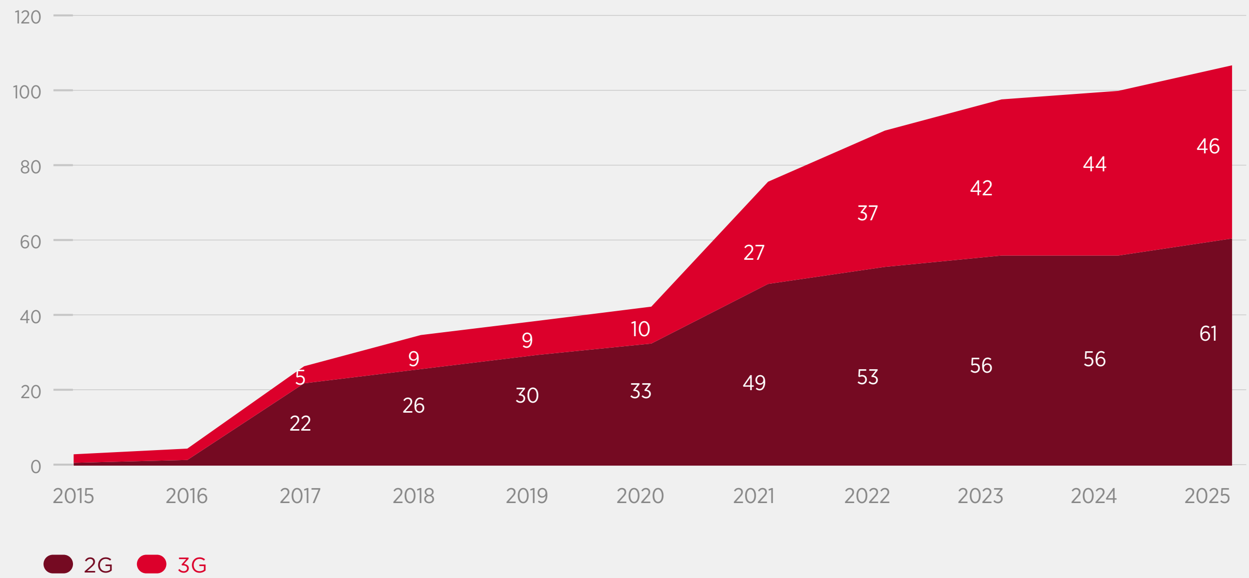
By the end of 2022, about 50 operators around the world had switched-off 2G networks and about 35 had switched-off 3G networks. 2G networks include not only GSM, but also cdma2000 networks, which explains the significant number of 2G switch-offs in previous years. In the coming years, more active 3G switch-offs are expected, which is confirmed by the GSMA statistics and forecasts below (Figure 10).

The 2G switch-offs, including GSM and cdma2000, in previous years occurred mainly in the Asia-Pacific region. In Europe, the rate of 3G switch-offs is accelerating (12 networks were switched-off in 2021). The reason lies in the eCall emergency response system for road traffic accidents in Europe, which is based on the GSM radio interface.

As a result, diverse experience on 2G/3G switch-off has already been accumulated, illustrating various strategies of operators. Thus, Singapore carried out coordinated simultaneous 2G switch-offs in close cooperation between operators and the regulator. The main operators in Germany have switched-off 3G networks completely with no noticeable connectivity issues or complaints from subscribers. In Macau (special administrative region of China), with the simultaneous GSM switch-off of the main operators, a separate dedicated network for roaming was created. In Australia, due to the significant development of UMTS in bands below 1 GHz, operators conducted GSM switch-offs independently.

However, negative experience has also been accumulated in cases when independent switch-offs by operators turned out to be difficult to implement or required the intervention from the regulator. Thus, in South Korea, 2G switch-off by KT was postponed for six months on the instructions from the regulator due to a significant base of 2G subscribers (5%) and a short notice period (3 months). Chinese operators' plans to switch-off 2G were postponed to a later date due to a significant number of retaining subscribers and IoT devices. In the USA, final 2G/3G switch-offs are taking place against complaints from users to the regulator, especially from IoT devices users, which ultimately led to a shift in the timing of the networks shutdown.

Figure 10
Number of 2G/3G networks switch-offs for spectrum release

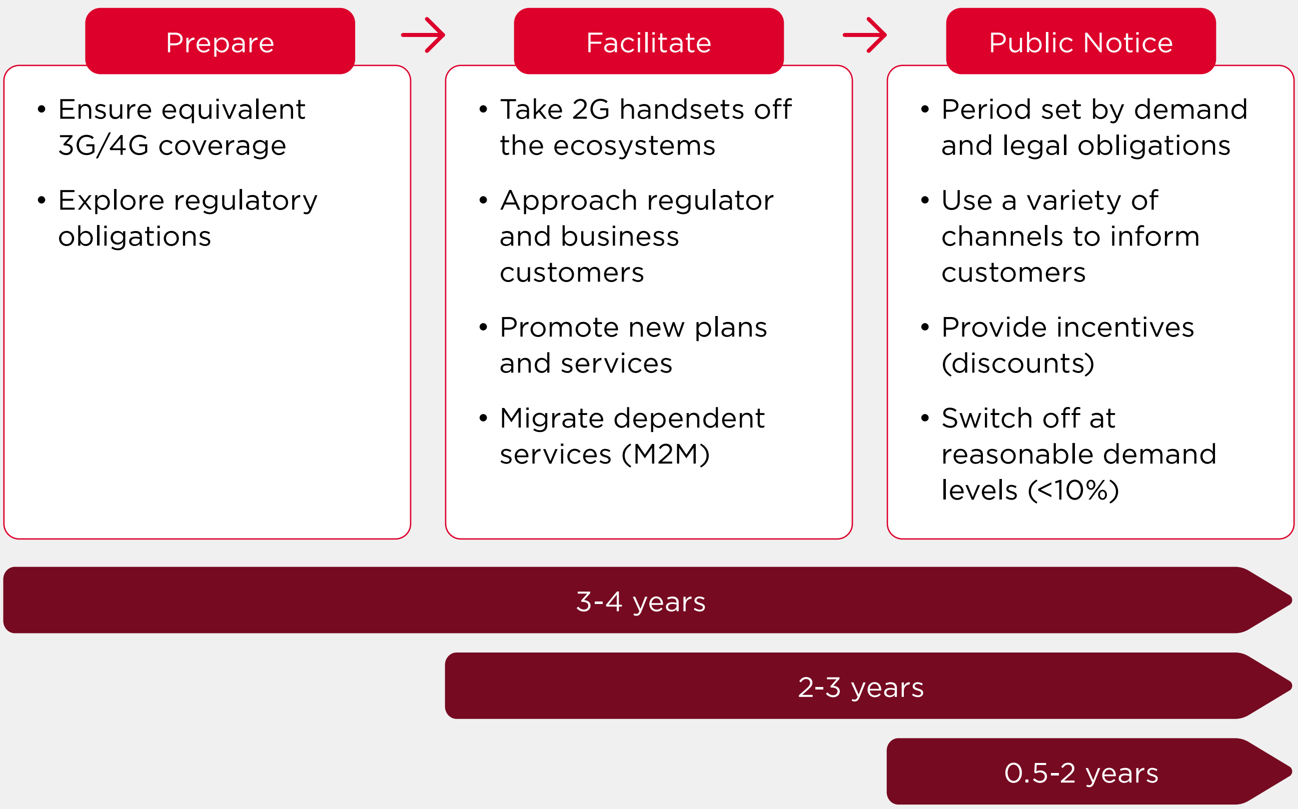


3.3 Regulators’ involvement in 2G/3G switch-off process

As can be seen from international experience, the success of shutting down 2G/3G networks largely depends on the ability and pace of migration of subscribers and IoT devices. These aspects were the subject of disputes between operators and users, often requiring the involvement of the regulator. To avoid such issues, thoroughly planning the shutdown of 2G/3G networks in advance best practice[18]. The preparation process flow shown below, using 2G network shutdown as an example, can be a starting point (Figure 11).

Figure 11

Process flow of switching off a 2G network



18 Legacy mobile network rationalisation. Experiences of 2G and 3G migrations in Asia-Pacific. GSMA, May 2020.

There aren't examples of regulators explicitly stating the residual fraction of the subscriber or IoT devices base, but a value of the order of 1% (from tenths to several units) is most often used in practice as an acceptable threshold to initiate a shutdown. Besides the discussion on target values for 2G/3G connections share, the elaboration of technical aspects is also required, such as:

- issues related to LTE coverage expansion to replace previous generations;
- penetration of VoLTE terminals (and VoNR in the future) for voice traffic migration;
- readiness of IoT technologies within LTE networks for migration of IoT devices;
- roaming and backward compatibility issues with services based on legacy protocols, such as SMS (including aspects for emergencies alerts).

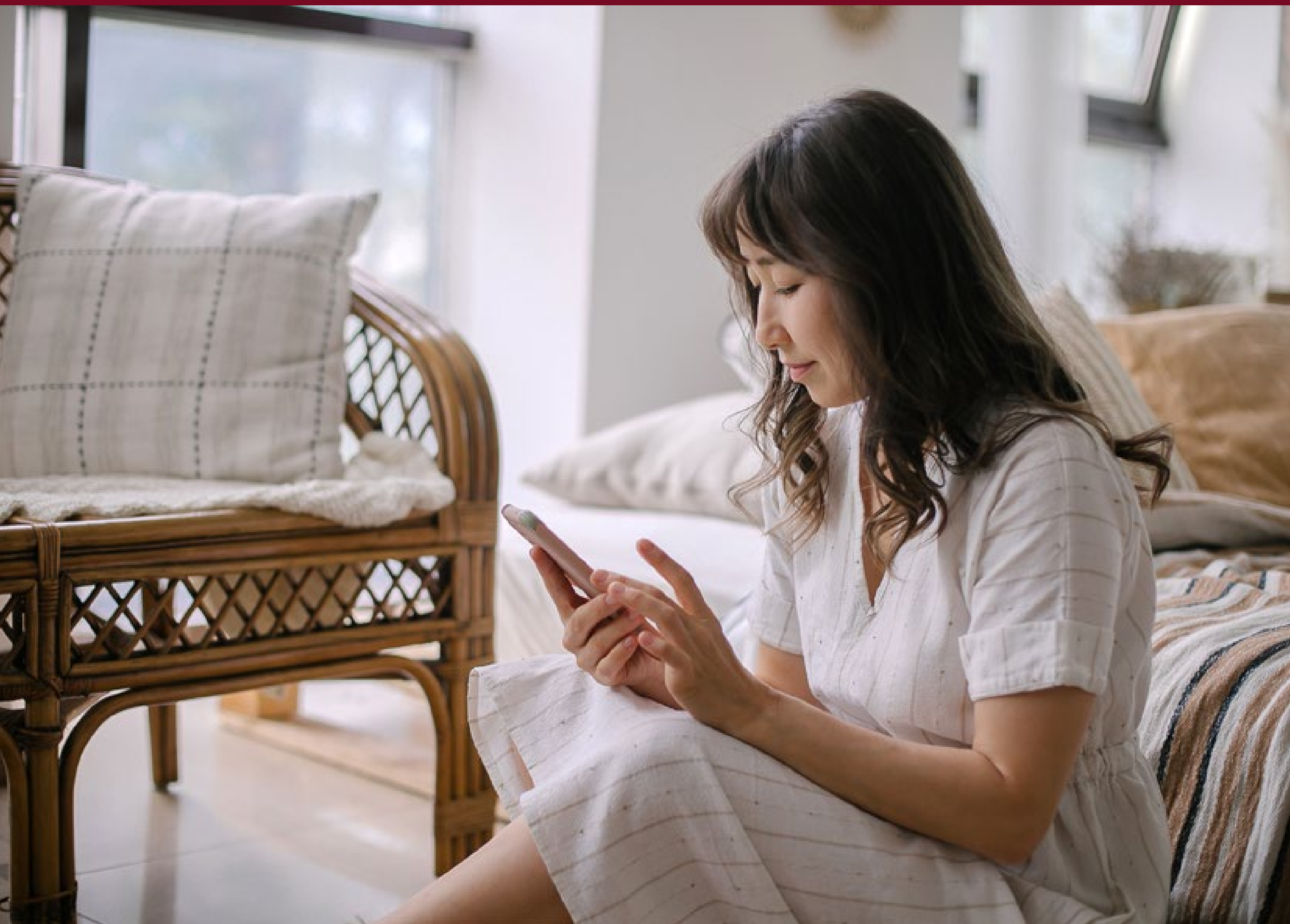
The aforementioned tasks and issues are relevant for operators in Kazakhstan. It should be stressed, that the longer and more difficult the process of shutting down 2G/3G networks, the less opportunities operators will have to invest in 4G and 5G networks.

For this reason, in order to speed up and facilitate these processes for subscribers, it is advisable to involve the regulator at an early stage. Operators, together with the regulator, could start implementing preparations for shutting down 2G/3G networks already in the near future, including:

- establishing general terms and rules for shutting down 2G/3G networks;
- exclusion or minimisation of sales of terminals without LTE and VoLTE support in the country;
- subsidising of new terminals for certain categories of citizens;
- subsidising and incentivising the migration of IoT devices to new generation networks;
- widespread public notice of the necessity to transit to new generations;
- ensuring the possibility of using flexible tariff policies to accelerate the transition;
- ensuring the possibility of fulfilling license requirements for 2G/3G coverage by new generation networks.

04

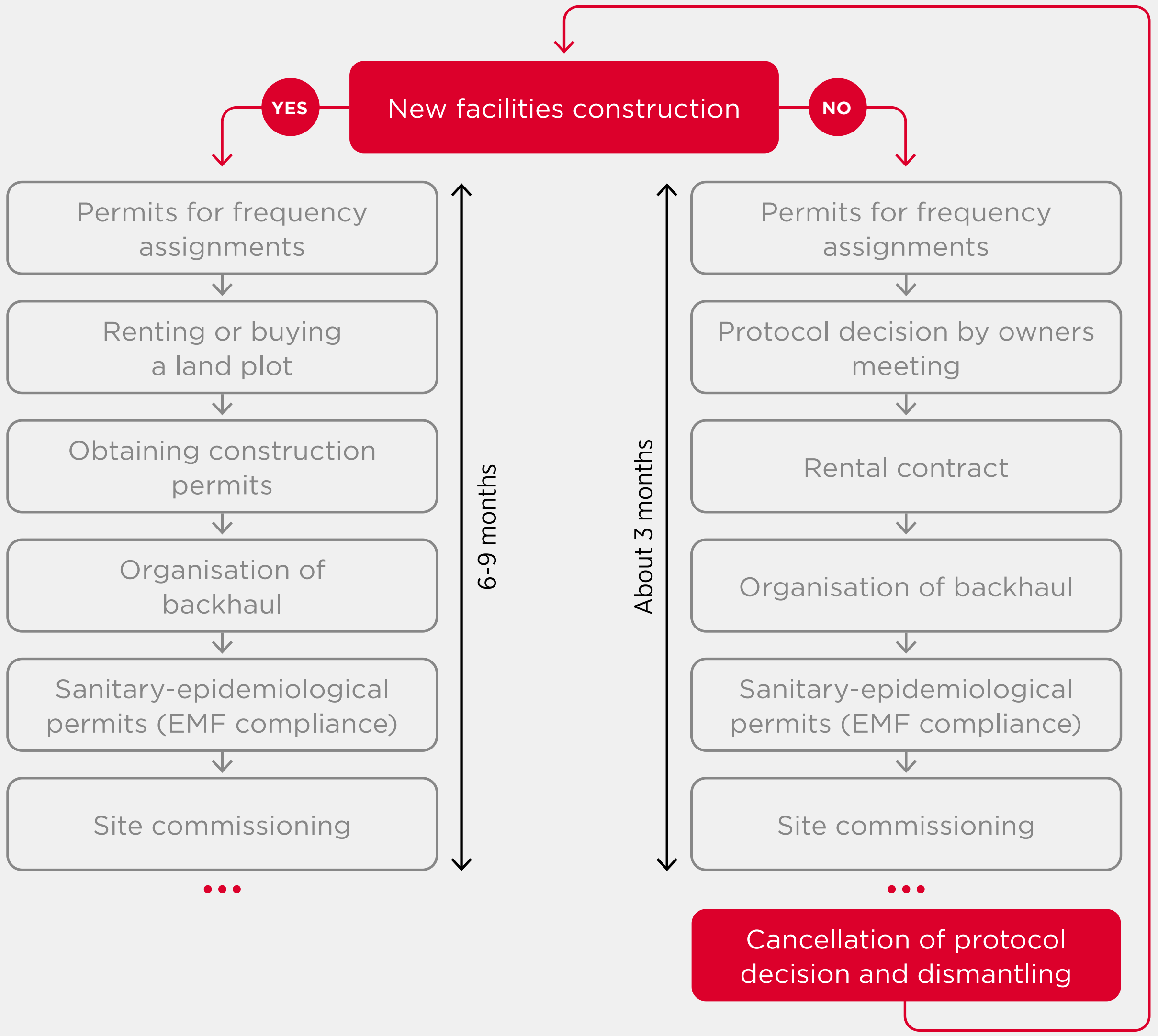
Simplification of mobile network deployment rules



4.1 Overview of obtaining permits procedures

In addition to planning, antenna-masts construction, purchasing and installing equipment for deploying cellular networks, operators need to obtain a sufficiently large number of permits and certifications, which in many cases require significant time and financial expenses. This situation was acceptable at the initial stage of mobile networks development, when macro base stations were installed to serve sufficiently large territories and a large number of subscribers. With the densification of networks and the development of higher and higher frequency bands, the administrative and financial burden of lengthy permits procedures becomes a serious obstacle to network development. The general scheme for obtaining permissions for new base stations is given below (Figure 12).

Figure 12
General scheme for obtaining permits for base station deployment in the Republic of Kazakhstan

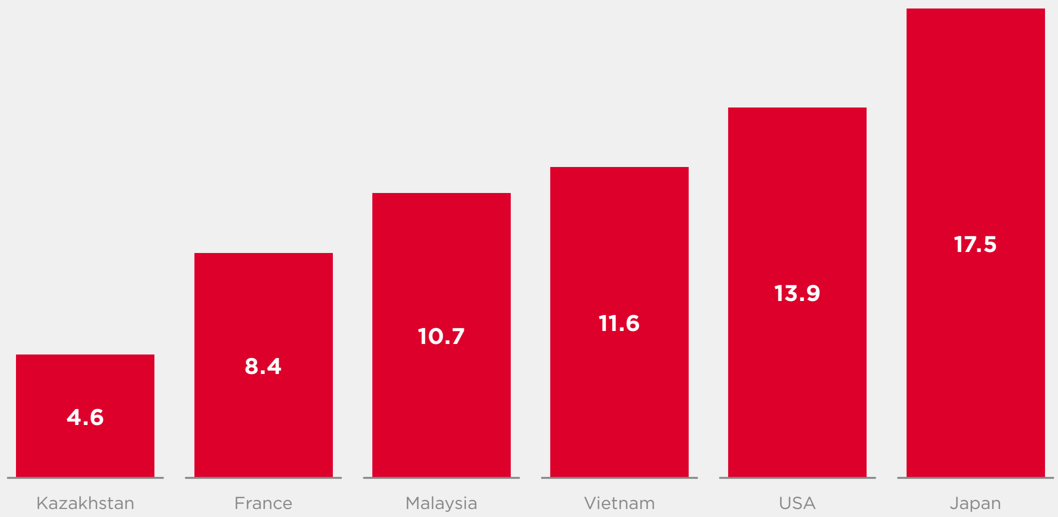


Issues related to obtaining numerous permits range from long waiting times to excessively stringent requirements that must be met. Especially notable is the protocol decision by the meeting of apartments or non-residential areas owners, which is required for sanitary-epidemiological permits (EMF exposure compliance). In addition to the fact that such protocol is redundant, taking into account the compliance of operators with EMF exposure standards, under the influence of radiophobia this situation often leads to the subsequent dismantling of base stations upon protocol decision cancellation. All this leads to even more significant time and financial costs for finding new locations to install equipment and passing new compliance procedures. For this reason, the Ministry of Healthcare of the Republic of Kazakhstan is already considering terminating this requirement, which is expected to happen in the beginning of 2023.

Such a large number of licensing and permit procedures exacerbates Kazakhstan's lag in the pace of mobile network infrastructure development. Figure 13 illustrates an estimate for the number of cellular sites in the Republic of Kazakhstan in comparison with countries that have liberalised procedures for new base stations deployment[19].

A number of procedures, the simplification of which is feasible in the short term and can have a significant effect, are described in more detail in the following subsections. Both international experience and the current situation in Kazakhstan are taken into account to form recommendations. In addition, the streamlining of sites renting on the infrastructure owned by the state and municipalities is discussed in more detail in Section 5 as part of support measures.

Figure 13
Estimation of the number of cell sites per 10,000 people in different countries



19 Based on the analysis of open-source data on the number of unique sites (match or other installation sites) of mobile communications over the past few years.

4.2 Obtaining permits for the base station equipment placement

The constant growth of base stations numbers, associated with coverage expansion and network capacity increase, is faced with the complication of finding new installation sites on existing structures, and with an ever-decreasing choice of locations for new construction. At the same time, each new base station within the existing coverage provides an ever-smaller return on investment, taking into account the reduction in the service area and the number of subscribers served. To maintain development dynamics and avoid price spikes for subscribers, many countries have liberalised or are in the process of simplifying compliance procedures for deploying new base stations.

For example, the regulation of the Federal Communications Commission of the United States FCC-18-133 «Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure»[20], which in 2018, in anticipation of the rollout of 5G networks, set a maximum timeframe for obtaining permits for installing equipment at existing facilities of 90 days and 150 days for obtaining permits for the construction of new communication facilities. In addition, the period for obtaining permits for the installation of equipment has been further reduced to 60 days in a number of states. The same act also stipulates the maximum tariffs for the lease of land and accommodation facilities at state and municipal property in the case of placement of small antenna-mast structures up to 15 meters high, including installment of such masts on the roof of building. In 2022, the FCC continued its policy on regulating the relationship between landlords and mobile operators, proposing a regulatory procedure[21] for replacement of poles and columns to avoid situations when the owner, replacing his property, disproportionately transfers his costs to operators who have installed equipment on poles subject to replacement.

India auctioned 5G spectrum in 2022 and is in the process of reviewing its regulatory framework to simplify infrastructure deployment[22]. In particular, control has been introduced over municipal and state bodies in terms of simplifying the placement of equipment at their facilities, as well as regulation on prices limits for access to infrastructure or land. In addition, a special portal has been created to obtain all permits in India, through which interaction is ensured immediately with all departments involved in permit procedures. The new legislation also limits the list of reasons to refuse equipment hosting for government agencies, and also allows for more effective interaction with private infrastructure owners in case of their unreasonable refusal to lease installation sites.

In Europe today there is no common regulation to simplify the deployment of base stations, except for the case of using small cells with a radiated power of less than 10 W. However, some countries introduced different simplifications depending on base station power, antenna height, or the need to modify the supporting building structures. Thus, in Estonia, a notification procedure has been introduced for radiated power up to 100 W; in the UK, no permit is required for the construction of masts from 8 to 25 metres high, depending on the type of territory; in a number of countries, it is not necessary to obtain permission to install base stations, if they do not increase the height of buildings, etc.

An important aspect is a maximum simplification of access to the infrastructure, which is in state and municipal ownership, to ensure the possibility of deploying new base stations. This is achieved both by regulation and by the construction of dual-purpose poles. As an example, Japan provided access to 200,000 municipal infrastructure facilities with partial costs reimbursement by municipalities. In particular, base stations can be installed at traffic lights throughout Japan. In Singapore, rooftop placements are free for operators. In China, at the provincial level, there are all sorts of simplifications and subsidies for deploying base stations on urban infrastructure.

20 https://www.fcc.gov/document/fcc-facilitates-wireless-infrastructure-deployment-5g

21 A Proposed Rule by the Federal Communications Commission on 04/28/2022 «Accelerating Wireline and Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment»

22 https://dot.gov.in/relatedlinks/indian-telecommunication-bill-2022

Recommendations for infrastructure development in Kazakhstan

Obtaining permits for the construction of a new communication facility

Currently, the Republic of Kazakhstan already has legislation that defines various categories of antenna-mast structures.

Nevertheless, further division of antenna-mast structures by type and height is required, while streamlining procedures for more simple types. To implement this, it is necessary to establish a comprehensive framework for construction safety and the institute of competent independent construction experts. It is possible to introduce various gradations depending on the type of terrain and the size of settlements, where the construction of antenna-mast is planned.

Obtaining permits to install base station on an existing infrastructure

Despite the smaller number of permits to install base station on existing buildings or structures, it still requires permits in the field of construction legislation. In many countries, a notification procedure has been introduced for simple structures, in some cases even with antenna-mast deployed on the rooftop when positive results of independent examinations on the safety of load-bearing structures are provided as well. Similar simplifications are proposed to be introduced into the construction legislation of Kazakhstan.

In the field of sanitary-epidemiological permits, it is necessary to implement the already planned termination of a protocol decision from the apartments or non-residential areas owners meeting to install base station.

In addition, Kazakhstan should implement the best practices of developed countries in providing access to the roofs of buildings. It is also advisable to provide operators with opportunities for rent-free placement of telecommunications equipment within buildings, similar to utility providers (gas, water, electricity, alarms, etc.).

Ensuring access to infrastructure owned by the state and municipalities

Given the density of base stations in cities, the difficulty of finding suitable installation sites increases dramatically. For this reason, assistance is required from the state and municipal authorities in ensuring access to installation sites, including new sites planning for future base station installations.

Currently, the Digital Assets Bill allows dual-purpose poles construction, which also includes the upgrade of existing poles. At the same time, the issues of access to such sites by mobile operators and the cost of rent remain open. It is advisable, within the framework of the development of smart city projects in Kazakhstan, to create favourable conditions for the infrastructure deployment using such poles (quick issuance of permits up to 10 calendar days, free placement of telecom equipment).

In addition, the situation can be improved by introducing an easement assigned to the state, and including the right to use locations on buildings and structures by mobile operators to install equipment, following international experience. With regard to newly commissioned buildings and structures, it would be possible to introduce the allocation of space for the placement of telecommunications equipment by the owner with its transfer to the state control (in the form of an obligatory share of the state). Such spaces could constitute a state resource and be used for leasing to interested operators.

This approach to locations provision can also ensure uniformity in renting payments for the installation of cellular communication equipment.

4.3 Facilitation of fiber deployment

Ensuring access to buildings and urban infrastructure is a prerequisite, but successful deployment of mobile network base stations also requires an increase in backhaul availability for the connection to the mobile core. Although microwave links can solve this problem in some cases, the key task is the widespread deployment of fiber backhaul, both in cities and beyond. The construction of such fiber backhaul from scratch is associated with rather high costs and obtaining a large number of permits. To solve this problem, many countries are taking measures to share passive (cable ducts and poles pipelines, etc.) and active infrastructure (selling or leasing capacity on existing fiber optic communication lines).

In the USA, in addition to the aforementioned federal legislation to simplify access to urban infrastructure, many states have local legislation that provides non-discriminatory access to cable ducts, including housing and communal infrastructure. In the European Union, since 2014 the need to simplify access to passive infrastructure and permits for laying communication lines is asserted by Directive 2014/61/EU on actions to reduce the costs of deployment of high-speed electronic communications networks. In 2018, these requirements were additionally fixed in the fundamental legislative document "European Electronic Communications Code". Since late 2000s, Indian legislation has also been regulating certain aspects of non-discriminatory access to infrastructure and permits for laying communication lines. However, in anticipation of the massive 5G rollout, as noted above, India revisited the regulation by establishing a one-stop service to obtain all permits for fiber deployment, including access to existing municipal cable ducts.

In addition to non-discriminatory access to existing and constructed cable facilities, some countries also ensure the availability of information on such infrastructure. For example, in Germany, a special electronic atlas has been created, in which owners of existing and newly built infrastructure are required to provide information necessary for communication networks planning. A similar information system has also been implemented in Turkey.

Finally, to ensure the availability of fiber backhaul within newly constructed facilities, necessary passive and often active infrastructure should be mandated by legislation. This applies both to the construction of buildings, and to laying new roads or railways, power lines, pipelines etc. This practice is legally enshrined in Europe, USA, India and some African countries.

In 2020, Omdia conducted a comparative analysis on the development of fiber telecommunications in various countries using a number of parameters[23], including the prevalence of fiber backhaul. According to the results of this study, the Republic of Kazakhstan was ranked 56th, far behind such large countries as Russia and Canada (14th and 21st places, respectively). Despite high broadband penetration rates in the country, analysis results showed a low level of fiber penetration. This situation is typical for mobile backhaul, reusing general fiber infrastructure within the country.

23 Global Fiber Development Index: 2020 Brought to you by Informa Tech A global index comparing fiber development on a country-by-country basis

Recommendations to simplify fiber deployment in Kazakhstan

In the Republic of Kazakhstan, it is advisable to use international experience and establish mandatory requirements for cable ducts or indoor fiber optic cabling preinstallation in newly built apartment buildings. Proposals for such requirements have been developed already by the MDDIAI following the explosive data traffic growth during COVID-19 restrictions. However, their approval and final implementation requires further interdepartmental interaction for inclusion in the MIID24 regulations.

Also, at the legislative level, rules and obligations should be established to ensure both non-discriminatory access to existing cable ducts for fiber, and the possibility of dismantling unused cables. For the new cable ducts deployment, it is necessary to establish a requirement to increase ducts' capacity beyond planning targets to provide capacity to other operators. Such requirements should be extended to municipal housing and communal infrastructure, road infrastructure, pipelines and power lines. To ensure the use of existing infrastructure, it is also advisable to establish a database with ducts' locations and equipment that can be reused to deploy fiber, similar to the digitalisation of other types of engineering networks currently being carried out within the MDDAI framework. In addition, the possibility of placing fiber backhaul on power lines free of charge should be considered in order to reduce the cost of infrastructure deployment.

Finally, for cases where there is no reusable infrastructure or existing fiber links, especially outside of settlements, it may be appropriate to consider subsidies to individual operators to deploy fiber, while ensuring non-discriminatory access and regulating capacity leasing fees.

The implementation of the aforementioned measures will become a powerful driver in expanding the penetration of fiber in Kazakhstan, even taking into account the large territory of the country.

24 Ministry of Industry and Infrastructural Development of the Republic of Kazakhstan

4.4 Obtaining permits for frequency assignments

In general, obtaining permits for base stations' frequency assignments is already optimized in Kazakhstan. To achieve a further reduction in the time required to obtain permits, or transition to a notification procedure, it is necessary to solve problems of spectrum clearing, which were described in detail in the section on getting access to new spectrum bands. In addition, the implementation of a notification procedure requires the establishment of effective cross-border coordination agreements that would clearly set out all the conditions for the use of radio frequencies in border areas.

However, government incumbents are not involved in the optimisation. Compatibility of new base stations with government incumbents is checked separately and is not automated to the same extent as compatibility calculations with civilian incumbents. As the Inter-ministerial Commission on Radio Frequencies has recently been abolished, it is advisable to create a structure within the radio frequency service that could carry out compatibility calculations for both civil and state spectrum users, utilising interrelated automated calculation systems. Together with more transparent and automated procedures for cross-border coordination, the discussion of which has already been initiated by the Republic of Kazakhstan with neighbouring countries, this will minimise the time to obtain frequency assignments and associated permits.

Such automation, together with spectrum refarming or transparent restrictions on its usage, will become a solid foundation for switching to a notification procedure at least in some frequency bands.

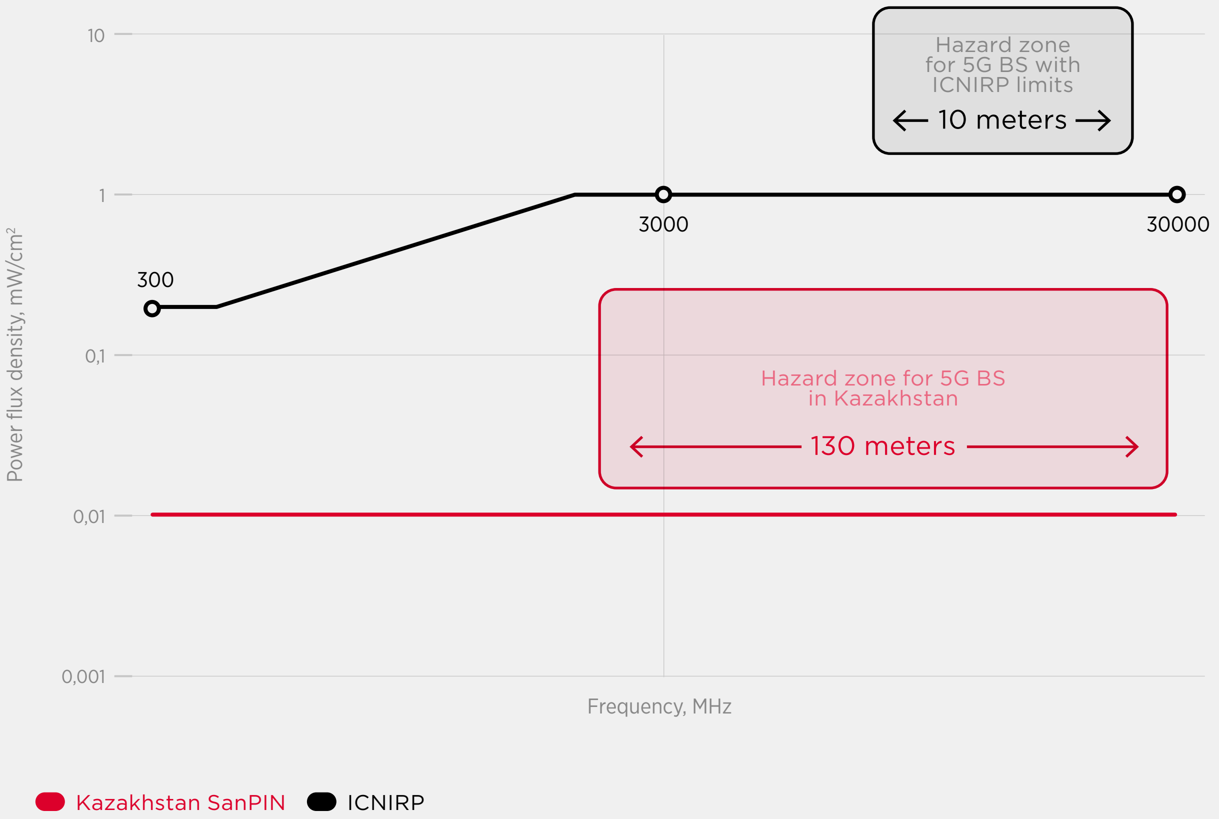
Finally, in order to improve the transparency of the frequencies assignment process and optimise the use of spectrum resources by civil and government users, it is advisable to consider the introduction of spectrum fees for all spectrum users. As international experience shows, this approach makes it possible to streamline the frequencies assignment process and speed up the release of spectrum for the introduction of modern radio technologies.

4.5 Obtaining sanitary-epidemiological permits (EMF exposure compliance)

Obtaining sanitary-epidemiological permits involves not only time and financial costs for operators, but also additional, often unreasonable, restrictions on base station power. This leads to the necessity to increase the number of base stations and even greater financial and time costs. Moreover, in some cases, this prohibits new base station installations, where they are required to expand coverage or capacity. This in return can lead to significant penalties for operators, as described in Section 5. Therefore, EMF exposure compliance regulations are in conflict with the regulatory requirements to expand coverage and ensure capacity

The problems of obtaining EMF permissions can be divided into three components: more restrictive than international standards, conservative calculation methods for theoretical compliance and measurements interpretations for instrumental compliance. These problems are typical for the majority of countries in the CIS region, including Kazakhstan. Given their significant impact on 4G networks development and 5G networks launch, in 2020 GSMA has issued a dedicated report on this issue[25]. Practically the whole content of this report is applicable to the situation in Kazakhstan. Figure 14 illustrates the difference between power flux-density levels established internationally and levels set in the Republic of Kazakhstan, as well as depicting the resulting hazard zone for a typical 5G base station in the 3.6 GHz band.

Figure 14
EMF exposure limits comparison between ICNIRP and Kazakhstan's standards



25 Adopting International Radio Frequency Electromagnetic Fields (RF- EMF) Exposure Guidelines: Benefits for 5G Network Deployment in Russia. GSMA, 2020.

Recommendations for clarifying the EMF exposure compliance legislation in Kazakhstan

EMF exposures limits in Kazakhstan are 20 to 100 times (depending on the frequency range) more restrictive than those recommended by the International Commission on Non-Ionizing Radiation Protection (ICNIRP)[26]. ICNIRP is an independent non-profit scientific organisation that is officially recognised by and cooperates with the World Health Organization, the International Labor Organization, the International Electrotechnical Committee (IEC), the International Telecommunication Union (ITU) and the European Commission. ITU studies concluded: "EMF exposure limits that are more strict than the ICNIRP or IEEE guidelines negatively affect all potential levers to enhance the wireless infrastructure and deployment of 5G: spectrum, technology (determining the spectral efficiency) and network topology (number of sites and sectors)"[27]. Many countries in the CIS region are reviewing existing requirements to harmonise them with ICNIRP or bring them to at least the equivalent of 10% of ICNIRP levels (up to 100 μW/cm^2 from current limit of 10 μW/cm^2). In addition to this step, Kazakhstan also requires a review of certain restrictions, which are not considering exposure levels and significantly restricting cellular antennas placement on residential buildings, taking into account the start of 5G deployment in 2023. Furthermore, it is advisable to draw on international experience and provide the possibility for a notification procedure for obtaining sanitary and epidemiological permits for base stations with a radiated power of up to 100 W.

In addition to streamlining EMF limits, the update of compliance assessment methods is also required. As shown by studies in Belarus, where all the above problems with strict limits are also present, the calculated values of exposure at control points significantly (from 2 to 40 times) exceed measurement results[28]. A more accurate consideration of the actual power and dynamic radiation pattern, as well as propagation losses in the calculation methods, can reduce this difference. It is advisable to develop and approve calculating methods for EMF exposure levels taking into account the characteristics of mobile communications in order to reduce this gap.

Uncertainty, when assessing EMF exposure from mobile networks, presents the major difficulty as it aggergates peak EMF values from different sources instead of averaging, which can lead to unreasonable restrictions on equipment placement. The IEC has developed measurement methods specifically tailored for cellular communications to minimise uncertainty. The IEC standard 62232[29] provides means to achieve measurements uncertainty values of less than 4 dB, which is sufficient to determine compliance. In addition, not considering the dynamic nature of base station's signals and active antennas' behaviour could lead to incorrect interpretation of measurement results and significant overestimation of actually observed exposure levels. To avoid such cases, more precise regulation of instrumental assessment methods is required.

26 www.icnirp.org/en/home/index.html
27 The impact of RF-EMF exposure limits stricter than the ICNIRP or IEEE guidelines on 4G and 5G mobile network deployment. ITU-T K.Supplement 14. May 2018.
28 Report RCC 3/21 Introduction of 5G systems in RCC countries
29 International Standard IEC 62232 Ed. 2 (2017) «Determination of RF field strength and SAR in the vicinity of radiocommunication base stations for the purpose of evaluating human exposure».

05

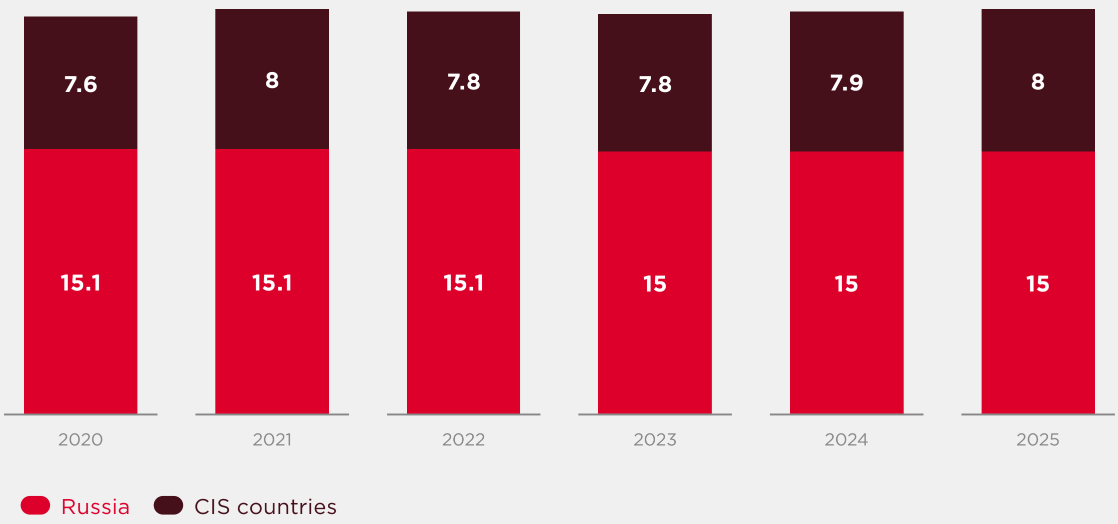
Investment incentives and support measures

5.1 Creating an enabling environment for investment

Currently, the mobile communications industry is transitioning from the classical model of providing communication services to a model where a significant part of revenue is generated by more complex integrated services in various sectors of the economy. This trend has been observed for several years, but it is the advent of 5G networks that will bring about substantial business transformation. However, this transformation in the CIS region is expected to take place only in a few years. In the short term, the level of operator's revenue, in the CIS region as a whole and in Kazakhstan in particular, will grow at rather slow rates (Figure 15).

Figure 15
Market forecast for mobile services in the CIS countries

Market scale, billion USD



This transformation in the CIS region and in Kazakhstan is additionally complicated by rather low ARPU of about 4 USD. Thus, in the USA and Canada, ARPU is about 45 USD, in South Korea it is more than 20 USD, and the average for Western European countries is more than 15 USD. Under these conditions, it is difficult for operators in Kazakhstan to simultaneously invest in 4G networks expansion, in 5G networks roll-out and in the development of modern services applicable in various sectors of the economy. For this reason, it is necessary to create the most favourable conditions to attract investments in the development of mobile network infrastructure, and most importantly, to ensure the return of these investments in terms comparable to the key sectors of the national economy.

Taking into account the importance of having a digital infrastructure for the further digitalisation of the economy of Kazakhstan, the following sections provide recommendations on investment incentives and support measures, both taking into account international experience and the national specifics of mobile industry regulation.

5.2 Avoiding over-regulation

As noted above, mobile tariffs in Kazakhstan are quite low compared to many countries. Although this situation has facilitated mobile communications penetration growth, as well as ensured the proliferation of private and state services, excessively low tariffs become an obstacle for further digital infrastructure development. Operators need to compensate for inflation and currency fluctuations, and also introduce new services, stimulating the growth of service consumption. In addition, in the mass market, operators have to compete for additional services revenues with international IT companies, whose traffic creates the main load on the networks of mobile operators.

Under these circumstances, operators require flexibility in establishing new tariffs and in terminating existing ones. This is especially important during the introduction of new technologies, when operators implement flexible tariff policies to encourage subscribers to switch to next generation networks at or even below the cost of traffic delivery. Later, with the growth of consumption, such tariffs need to be increased to enable a return on investment.

Tariff regulation at the state level leads to a disruption of market mechanisms and the business models of operators, in the long-term exacerbating the lack of investment in network infrastructure and degrading quality of service. At the same time, the market for mobile services, which includes three operators, is highly competitive and far from monopolization. Moreover, as recent studies[30] show, the pace of mobile network infrastructure development and the tariff policy for subscribers could degrade, with the number of operators increased, due to capital intensity rise from digital infrastructure duplication.

In accordance with Article 20 of the Law of the Republic of Kazakhstan "On Communications", telecommunication operators independently set tariffs for communication services based on reasonable costs. In contradiction to this Law, the MDDAI Order, dated December 24, 2021 No. 441 / NҚ, requires operators to obtain the consent from the subscriber before changing the conditions of the tariff plan. In addition, this Order introduced a rule which prescribes tariff plan cancellation by mobile operators only in a case of no demand, that is, the absence of subscribers using this tariff plan. Furthermore, in some cases in the Republic of Kazakhstan, tariffs settings and telecommunication services are interpreted as a monopoly activity, to which certain articles of the Entrepreneurial Code of the Republic of Kazakhstan are applied, implying, among other things, the risk of significant turnover-based fines.

Recommendations for liberalising regulation in the Republic of Kazakhstan

According to the Law of the Republic of Kazakhstan "On Natural Monopolies", cellular communication services are excluded from the list of regulated services. Moreover, after the establishment of the Entrepreneurial Code of the Republic of Kazakhstan, the government denounced the policy of price regulation for communication services. For this reason, it is necessary to ensure the application of market-based mechanisms in a competitive cellular market and avoid applying antitrust legislation in contradiction to fundamental laws of the Republic of Kazakhstan. Moreover, the application of antimonopoly measures in the telecommunications services market is beginning to affect even more competitive markets for additional services, reducing the competitiveness of national operators compared to international IT companies.

It is recommended to remove administrative barriers in terms of both direct and indirect regulation of communication services pricing, which negatively affects the investment climate in Kazakhstan.

30 Competition dynamics in mobile markets. An assessment of the effects on network investment and quality in Europe

5.3 Reviewing coverage obligations

License obligations to provide mobile network coverage are used in many countries of the world. However, the requirements and verification methods vary from country to country[31]. Moreover, there are many technical nuances both in terms of theoretical requirements and subsequent measurement methods. The non-triviality of this task required the development of separate recommendations for measuring the quality of coverage in Europe. Therefore, over time separate recommendations have been developed for 3G[32], 4G[33], and recently for 5G[34].

The complexity of establishing detailed requirements and verification methods often leads to overstated requirements that become practically unfeasible from an economic point of view. For example, when assigning the 800 MHz band in Germany, the established requirements for data rates, population coverage and implementation time turned out to be unfeasible in practice. Subsequently, the regulator, together with the operators, was forced to revise associated requirements and deadlines.

To avoid such situations, the advisory body of national telecommunications regulators at the European Parliament, called BEREC[35], has prepared a special report[36] describing universal approaches to coverage assessment. According to the methodology developed by BEREC, the prescribed data rate in fixed networks must be achieved most of the time, which is determined as at least 75% of cases. However, data rates measurements are only mandatory for fixed broadband networks and optional for mobile broadband networks. BEREC recommends that national regulators do not apply requirements and methodologies for measuring the quality of fixed broadband access for mobile networks, recognising the difficulty in providing representative data due to external factors beyond the control of operators.

Overestimated requirements due to incorrect measurement methods may arise for a variety of factors. Radio signal propagation and network loading are probabilistic in nature. For example, the minimum data rate at the edge of a service area can vary significantly. In rural areas, where network capacity is usually limited, 1 or 2 active subscribers within a cell can introduce distortions in throughput measurements at the edge of the service area. For this reason, for example, in Estonia and Hungary, coverage requirements are set only based on measured signal levels, while measurements on the service level are of an informative nature, and are not used for regulatory verification of coverage. In India, the regulator also uses mobile network data rates measurements as an optional metric, recognising the dependence of this indicator on factors such as:

- the number of simultaneously active subscribers in the cell;
- the location of the subscriber relative to the base station;
- total load in the cell;
- type of subscriber equipment used.

Many countries have also relaxed coverage obligations by implementing technology neutrality. Thus, coverage obligations could be fulfilled using any band or technology with required capabilities, which for example, opened an opportunity to provide voice coverage with VoLTE to prepare for upcoming 2G/3G networks sunset.

In addition, variations in network load and complexity of radio signals propagation could lead to a significant discrepancy between network planning processes, theoretical and instrumental verification of coverage, which in turn could result in a systematic discrepancy between the estimates made by operators and the regulator's assessment.

31 ECC Report 231 "Mobile coverage obligations"
32 ECC Report 103 "UMTS coverage measurements"
33 ECC Report 256 "LTE coverage measurements"
34 ECC Report 341 "Coverage availability and performance aspects for 5G NR"
35 The Body of European Regulators for Electronic Communications
36 Report to enable comparable national broadband coverage indicators throughout Europe. BEREC, 2021.

Recommendations for clarifying methods for verifying the operator obligations in the Republic of Kazakhstan

Special methodology has been established in the Republic of Kazakhstan[37], which is used to control the license obligations of operators. This methodology is much more complex and detailed than in many countries around the world, and is comparable to the internal quality control methods used by operators. The methodology sets quite stringent requirements for coverage indicators and throughput, as well as high probability thresholds for their implementation. In practice, measurements based on this methodology do not allow exceptions for congestion situations, as well as for limited capacity backhaul (especially relevant for rural areas). Contradictions with operators' planning principles have led to systematic penalties, which in turn disrupt operators' business processes and force them to further invest in areas where their own service statistics do not show a necessity for capacity expansion. It is reasonable to review the existing methodology by finetuning of controlled parameters and their values in order to eliminate significant discrepancies between network planning and coverage verification by measurements. The updated framework should also take into account the use of active infrastructure sharing between operators to fulfill obligations. Finally, it is prudent to consider technology neutrality for coverage obligations instead of stipulating data rates targets or base station numbers for specific network generations, which significantly disrupts investment and rollout planning processes.

In addition, the current methodology for measuring the quality of communications should function in conjunction with the conditions established for the construction and operation of mobile networks. For example, the assessment of communications quality should exclude areas where residents refused to install telecommunications equipment on buildings, or where independently installed cellular signal boosters (often leading to a deterioration in network operation) and special technical means for jamming are present. Also, the assessment should take into account agreements between operators for active infrastructure sharing.

37 MDDAI Order dated April 28, 2021 N°. 153/НҚ "On amendments to the order of the Minister of Information and Communications of the Republic of Kazakhstan dated August 29, 2017 N°. 327 "On approval of the Methodology for measuring the technical parameters of the quality of communication services""

5.4 Introduction of tax benefits

Simultaneous 4G network expansion and 5G network introduction is associated with an increase in operators' capital and operating costs. Taking into account the rather high cost of raising capital in the telecommunications industry, which usually significantly exceeds the current refinancing rate, it is necessary not only to search for additional financial sources, but also to implement appropriate government support measures.

This situation is typical for both developed and developing countries. As practice shows, direct co-financing of mobile networks infrastructure development is not widespread, with the exception of cases of rural coverage provisioning (see the next subsection). One exception is the co-financing of 5G network development in China, which has been implemented in the form of a wide range of subsidy programmes at the level of individual municipalities. To a much greater extent, governments provide indirect support measures to accelerate investment in digital infrastructure in the form of various tax incentives.

For example, the United States has legislation to reduce tax payments for enterprises developing Industry 4.0 solutions, including 5G network operators. Japan has tax laws to account for accelerated depreciation of cellular equipment. South Korea has reduced taxes for operators by several percent in order to incentivise 5G networks development. Taxes, associated with fiber infrastructure deployment, including for mobile communications, have been reduced in the UK.

Recommendations for optimising the tax burden in the Republic of Kazakhstan

Despite some similarities, taxation and related support measures in the telecommunications industry differ significantly from country to country. Examples of such differences can be observed in GSMA studies in Ukraine[38] and in Uzbekistan[39]. However, there are also universal mechanisms in the form of lowering income taxes or optimising equipment depreciation. The depreciation mechanism is a possible tool in the Republic of Kazakhstan. The introduction of various multipliers, or the use of so-called accelerated depreciation, will allow operators to quickly release funds that can be directed to further investments or maintenance of existing infrastructure. In this regard, it is proposed to amend the Tax Code[40] in order to apply increasing coefficients for depreciation rates in relation to assets acquired or created as part of 4G and 5G networks development.

In addition, it is recommended to establish a zero VAT rate for the purchase of radio access network equipment for mobile networks.

Finally, as noted in the section on spectrum fees, further reductions in spectrum fees are possible. Therefore, in order to incentivise the development of 5G networks, Article 595 of the Tax Code could be updated with a zero rate for 5G spectrum, valid for the next few years.

38 Mobile taxation in Ukraine. Proposals for reform to unlock economic value.
39 Reforming mobile sector taxation in Uzbekistan: Unlocking economic and social benefits through tax reform in the mobile sector
40 The Code of the Republic of Kazakhstan dated December 25, 2017 No. 120-VI "On taxes and other obligatory payments to the budget (Tax Code)"

5.5 Further measures for rural infrastructure development

As noted above, providing coverage in rural areas is often difficult and economically unjustified. For this reason, in many countries there is a practice of directly subsidising the development of mobile network infrastructure in rural areas, and additional measures are being taken to simplify procedures for such infrastructure deployment.

For example, the United States currently has an extensive multi-year programme for the development of fiber in rural areas with tens of billions USD funding. In addition, the USA has a separate «Rural America» project that subsidises mobile communications in rural areas, which also includes funds of several billion USD per year. As noted above, China has implemented a mechanism to subsidise 5G network infrastructure development at the level of provinces and municipalities, which also applies to rural areas. In many countries, there is a practice of establishing a universal service fund, the resources of which are spent on the telecommunications infrastructure deployment in rural areas. In recent years, such funds are increasingly being used to develop mobile communications. Examples of such countries, close in population density to Kazakhstan, are Russia and Canada.

In the Republic of Kazakhstan, a socially-oriented project "250+" has been rolled-out since 2020, aimed at providing high-speed Internet access to all villages with a population of more than 250 people, which includes mobile communication infrastructure deployment in such settlements. Each operator within the framework of this project builds and operates a network in one zone, providing access to the infrastructure to other operators. The project provided 3G/4G services to about 600,000 people in more than 1,000 rural settlements. In exchange for investing in this infrastructure, operators received a 90% discount on spectrum fees until 2024. However, the discount will be applied retroactively at the end of the period, subject to a deployment costs review by the regulator.

Recommendations for further reducing the digital divide in the Republic of Kazakhstan

Maintaining the infrastructure built under the «250+» project and implementing plans to further expand it to «50+» requires additional efforts from operators and additional support measures from the government. For already covered settlements in rural areas, it is of utmost importance to convert the announced spectrum fees discount into factual benefits without imposing additional conditions. Furthermore, minimisation of operating costs is required. In particular, subsidising the cost of electricity could greatly simplify the payback of such sites, as well as the exclusion of fees for microwave links frequency assignments, through which many of the settlements are connected due to the extremely high costs of deploying fiber. In addition, it is necessary to reduce mobile network coverage requirements in rural areas, due to microwave links usage instead of fiber.

Similar support measures are required for new base stations deployment, since the main difficulties for rural deployment are electricity and backhaul availability, as well as the lack of access roads to base station sites.

Subsidising such network expansion through regional development programmes will help connect the most remote and sparsely populated settlements.

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