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Kazakhstan Internet Landscape

Understanding Threats and Opportunities

CAPS unlock CENTRAL ASIAN POLICY STUDIES

Internet Society

Acknowledgements

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Executive Summary

Key Findings

- Kazakhstan has a robust digital infrastructure. However, the ownership of Kazakh telecommunication companies is highly concentrated. This limited market competition encourages state control over the network.
- Recent government initiatives aim to reform the telecom market by introducing more competition. A new phase of private investments in the sector seems to be ramping up.
- The incumbent operator, KazakhTelecom, plays a central role in the country both at the domestic and international connectivity levels.
- Kazakhstan's international Internet traffic has depended on Russia for decades and continues to. However, we have started seeing the impact of strategies to diversify routes towards Europe and other Asian countries.
- Dependence on Russia for international Internet connectivity is a resiliency issue for Kazakhstan. However, bypassing Russia is difficult for Kazakh Internet Service Providers (ISPs), since their Russian partners provide valuable connectivity solutions that are easily reachable and at an attractive price. Moreover, the Kazakh population's consumption of Russian-language and Russian-hosted content creates consumer demand for connectivity with Russia.
- Emerging connectivity options via the Caspian Sea could enable Kazakhstan to create alternative paths towards Europe, increasing resiliency. Developing this data corridor could also enable Kazakh ISPs to earn increased revenues from the Europe-East Asia transit line. At the same time, new connectivity routes could be attacked in the case of future geopolitical conflict.
- Where Internet content is concerned, Kazakhstan has one of the highest levels of content localization within the region. However, there is still room for growth in this domain. Russia is the first foreign destination for Kazakh website hosting followed by Europe and the U.S.
- The January 2022 events of civil unrest in Kazakhstan and the resulting government-led Internet shutdowns have shown that the Kazakh government has strong control over the country's networks.

Recommendations

Kazakhstan's ambition to become a regional digital hub can only be achieved if Internet connectivity in Kazakhstan is resilient, open, trustworthy, and secure. To foster these positive goals, the Internet Society recommends that the government of Kazakhstan:

1. Foster a more resilient Internet by:

a. Encouraging the development of open, market-driven Internet Exchanges instead of government-led ones. A more robust local Internet ecosystem will reduce dependency on International connectivity.
b. Encouraging network operators to deploy IPv6 and adopt routing security and DNS best practices to increase their overall Internet resilience.
c. Continuing to explore satellite Internet options from a diverse range of providers as a way to create redundancies in its connectivity infrastructure.
d. Prioritizing fiber over satellite Internet as a long-term connectivity solution due to its superior speed, lower latency, and reliability,

2. Foster a more open Internet by:
    a. Creating an enabling environment to allow multiple smaller ISPs to thrive by eliminating the barriers to entry such as taxes on IT equipment, access to spectrum, operator license, etc.
    b. Removing regulatory requirements such as majority local ownership for international operators, to boost market competition.
    c. Encouraging infrastructure sharing between operators for long-haul fiber routes and providing fair rates to smaller ISPs.
    d. Promoting fair competition between operators to increase market diversity. Resilience is achieved by technical as well as economic diversity.
    e. Developing the data center market and investing in carrier-neutral data centers. This will help attract both international and local cloud and hosting providers, making the local content hosting scene more attractive.
3. Foster a more trustworthy and secure Internet by:
    a. Removing content surveillance and blocking requirements for ISPs, including satellite Internet providers. Surveillance requirements violate key cybersecurity principles, put users at risk, and harm the right to privacy and associated rights.
    b. Supporting policies that keep the Internet on and strong to build a strong economy and give Kazakh citizens an opportunity for a prosperous future by removing obligations to route traffic through the Unified Gateway to Internet Access.
    c. Formally discontinuing its root certificate program and working with service providers to remove the root certificate from user devices, restoring public trust in the Internet.
    d. Endorsing encryption as a key component of national security, acknowledging its value in protecting users from attack.
    e. Encouraging ISPs to adopt security best practices to increase Internet resilience.

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Introduction

The Internet has become an indispensable element of modern life, fostering economic development, social interaction, and access to information. In Kazakhstan, a nation positioned at the crossroads of Europe and Asia, the Internet's evolution mirrors the country's broader aspirations[1] toward digital transformation and integration into the global economy.

This report explores the current state of the Internet in Kazakhstan and the areas for continued development, examining its infrastructure, resilience, regulatory and policy environment, and emerging trends. Despite significant investments in connectivity and digital services, challenges remain, including uneven access across rural and urban areas, regulatory constraints, and cybersecurity concerns.

By analyzing key metrics, such as Internet penetration rates, and the impact of governmental policies, this report aims to provide a comprehensive overview of Kazakhstan's Internet landscape. It also highlights opportunities for growth and the role of Internet technologies in advancing Kazakhstan's ambition to become a regional digital hub.

According to the Kazakh government, data traffic on social networks and messaging applications increased by 16% between 2021 and 2022, with a 13% increase on YouTube and a record 101% surge of traffic on TikTok.[2] According to the World Bank,[3] the share of households with access to the Internet has reached 92.9% in 2023, which is comparable to Germany (92.5%) and Russia (92.2%). It is therefore important to understand the Internet landscape of Kazakhstan from both a technical and policy perspective to better understand the strengths, weaknesses, and opportunities in Kazakhstan's Internet ecosystem, paving the way for informed decisions and strategic interventions.

According to Talgat Nurlybaev, Chairman of the Kazakhstani Chapter of the Internet Society, 95% of Kazakhstan's Internet traffic goes through Russia.[4] After the first days of the Russian invasion of Ukraine,

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[1] "Accessible Internet National Project: Kazakhstan Residents to Be Provided with High-Speed Internet Access of at Least 100 Mbit/s." *Official Information Source of the Prime Minister of the Republic of Kazakhstan*, https://primeminister.kz/en/news/accessible-Internet-national-project-kazakhstan-residents-to-be-provided-with-high-speed-Internet-access-of-at-least-100-mbits-23858/, accessed on 31 Jan. 2025.

[2] Government of the Republic of Kazakhstan, "Order No. 949: About approval of the national project in the field of communication 'Accessible Internet National Project'—Section 2. Current situation in the field of telecommunications (года № 949 Об утверждении национального проекта в области связи «Доступный Интернет»—Раздел 2. Текущая ситуация в области телекоммуникаций)", 27/10/2023, https://online.zakon.kz/Document/?doc_id=35025676&pos=4;-114#pos=4;-114, accessed on 20 Nov. 2024.

[3] "World Development Indicators." *DataBank*, https://databank.worldbank.org/source/world-development-indicators/Series/IT.NET.USER.ZS#, accessed 31 Jan. 2025.

[4] Dosimzhan Naukhanov (Досымжан Науханов), "If Russia is off the Internet, what will happen to Kazakhstan?—review of the Kazakh media (Если Россию отключат от интернета, что будет с Казахстаном?—обзор казСМИ)", 29/03/2022,

debates about the possibility of an Internet shortage due to Russian attempts to isolate their networks and/or cut off Central Asia from the global Internet were renewed in both Kazakhstani[5] and international media.[6][7] This fear has intensified over the years since Moscow took over Crimea from Ukraine—and its digital networks along with it[8]—and ever since it announced its project of the "sovereign RUnet."[9]

In this rapidly evolving geopolitical environment, it is therefore important and timely to understand the dependence of Central Asian countries on Russia in terms of Internet connectivity. Kazakhstan is primarily concerned not only because most of its international connectivity has to go through Russia, but also because it plays a key role in redistributing Russia-bound international bandwidth to other landlocked countries in Central Asia.

However, debates in Kazakhstan are polarized over the risk of being completely cut off from the global Internet as a result of potential future geopolitical tensions with Russia. While human-rights activists point to Kazakhstan's complete dependence on Russia,[10] industry experts—such as the President of the Internet Association of Kazakhstan—state the exact opposite,[11] saying that Kazakhstan has independent access to the Internet and that there will be no disruption to local Internet access due to actions on the

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https://365info.kz/2022/03/esli-rossiyu-otklyuchat-ot-Interneta-chto-budet-s-kazahstanom-obzor-kazsmi, accessed on 20 Nov. 2024.

[5] "Если Россию Отключат От Глобальной Сети, Что Делать Казахстану?" *Respublika.Kz.Media*, 18 Apr. 2022, https://respublika.kz.media/archives/66004, accessed on 14 Mar. 2025.

[6] Ubaydullaeva, Dilnoza, and Jessica Genauer. "Shifting Geopolitics of Central Asia: The Regional Impact of the Russia-Ukraine War." *Australian Institute of International Affairs*, 20 Nov. 2024, https://www.internationalaffairs.org.au/australianoutlook/shifting-geopolitics-of-central-asia-the-regional-impact-of-the-russia-ukraine-war/, accessed on 14 Mar. 2025.

[7] Noorzadeh, Ahmad Tariq. "Central Asia's Post-Ukraine Future." *The Diplomat*, The Diplomat, 9 July 2024, https://thediplomat.com/2024/07/central-asias-post-ukraine-future/, accessed on 14 Mar. 2025.

[8] Douzet, Frédérick, et al. "Measuring the Fragmentation of the Internet: The Case of the Border Gateway Protocol (BGP) During the Ukrainian Crisis." *GEODE* , https://ccdcoe.org/uploads/2020/05/CyCon_2020_9_Douzet_Petiniaud_Salamatian_Limonier_Salamatian_Alchus.pdf, accessed 31 Jan. 2025.

[9] Stadnik, Ilona. "Sovereign Runet: What Does It Mean?" *Internet Governance Project*, https://www.internetgovernance.org/wp-content/uploads/IGPWhitePaper_STADNIK_RUNET-1.pdf, accessed 31 Jan. 2025.

[10] Daniyar Akmetov, "Digital Slavery or Technical Dependence : How Kazakhstan Becomes a Hostage to Russian Internet (Цифровое рабство или техническая зависимость: как Казахстан стал заложником российского интернета)", *Taspanews*, (29/08/2024), https://taspanews.kz/novosti-kazakhstana/tsifrovoe-rabstvo-ili-tekhnicheskaya-zavisimost-kak-kazakhstan-stal-zalozhnikom-rossiyskogo-Interneta-746612452884, accessed on 20 Nov. 2024.

[11] Artem Volkov (Артем Волков), "Optolf axe: can Russia leave Kazakhstan without the Internet? (Топором по оптоволокну: может ли Россия оставить Казахстан без интернета?)", *Orda*, (09/09/2024), https://orda.kz/toporom-po-optovoloknu-mozhet-li-rossija-ostavit-kazahstan-bez-Interneta-391521/, accessed on 20 Nov. 2024.

Russian network. The aim of this report is to shed light on this debate with qualitative and quantitative data on Kazakhstan's Internet connectivity, its links to Russia, and the existing alternatives.

This report is the result of an extensive survey of the relevant literature and supporting Internet measurements performed during fall 2024 (unless stated otherwise). It first provides an overview of Kazakhstan's Internet architecture, starting with an analysis of both the physical infrastructure and the connectivity landscape. It reveals how the USSR's legacy still conditions the way Central Asian countries gain access to the Internet.

Secondly, it highlights the high dependence of Kazakhstan and other Central Asian countries on Russia for their access to the Internet and the associated risks.

The third section explores the potential alternatives to Russian transit for Central Asian Internet Service Providers (ISPs), by exploring the renewed interest in Trans-Caspian connectivity and the emerging low-Earth-orbit (LEO) satellite options.

Finally, a fourth section analyses the localization of popular content and content filtering trends within Kazakhstan and how this is contributing to a fragmented Internet,[12] both at the domestic and regional levels.

[12] "Protecting the Internet against Fragmentation." *Internet Society,* 11 July 2024, https://www.internetsociety.org/action-plan/protecting-the-internet-against-fragmentation/, accessed on 14 Mar. 2025.

Kazakhstan: A Transit-Crossroad in Central Asia

Kazakhstan Independence and Central Asia's Telecommunications Network

Internet Access in the USSR

The USSR's first Internet connections began in 1990 through a joint venture between Sprint International (USA) and the Soviet Central Telegraph, linking Soviet computers to the global Internet. By August 1991, the first users accessed the Internet via the ISP Relcom, with speeds limited to 9 kb/s through a telephone line to Helsinki. Only around 800 people in the USSR had email in these early days. The Central Asian Republics lacked direct connectivity, relying on telephone links to Relcom, available in about 20 locations, primarily in Kazakhstan, Kyrgyzstan, Turkmenistan, and Uzbekistan.

The Birth of KazNet

After the USSR collapsed, the joint venture became a Russian-American enterprise. Following Kazakhstan's independence in 1991, Kazakhstan's Deputy Minister of Communications, Aldar Tungushbayev, initiated a National Data Transmission Network, "Kazsvyaztekhnika". Some employees later formed ASTEL, partnering with Sprint to launch KazNet in 1994[13], Kazakhstan's first X.25[14] data network connected to the Internet. Before the introduction of VSAT satellite[15] networks, the first commercial operations of KazNet operated by ASTEL happened through dial-up services (using telephone landlines). Initially serving international organizations, KazNet operated via dial-up before VSAT satellite networks became available. In the 1990s, oil, gas, and mining companies relied on satellite connectivity to communicate with their branch offices and international clients.[16] Following KazNet's lead, KazakhTelecom launched its ISP, Nursat, using its fixed-line copper network.[17]

Fiber-Connectivity Along the Railways

With the rise of Internet traffic, satellite connectivity quickly reached its limits, creating the need for landline connections. Following the independence of Kazakhstan and its Central Asian neighbors, the

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[13] Александр. "Казнету - 30 Лет!" *Profit.Kz*, 19 Sept. 2024, https://profit.kz/news/68196/Kaznetu-30-let/, accessed on 14 Mar. 2025.

[14] X.25, a protocol suite for packet-switched wide area network (WAN) communication, was developed by the International Telecommunication Union (ITU).

[15] A very small aperture terminal (VSAT) is a two-way ground station that transmits and receives data from satellites. Satellite Internet is provided by geostationary satellites by connecting to the ground stations.

[16] *Akyl Kenez*, "The emergence of the Internet in Kazakhstan (Появление Интернета в Казахстане", 31/08/2022, https://akylkenes.kz/cases/poyavlenie-Interneta-v-kazahstane/, accessed on 20 Nov. 2024.

[17] Vadim Bannyi (Вадим Банный), " Access via landline phone, crazy prices and low speed. Let's remember how Kaznet began (Доступ через городской телефон, сумасшедшие цены и низкая скорость. Вспоминаем, с чего начинался Казнет)", *Digital Business.kz,* 13/06/2024, https://digitalbusiness.kz/2024-06-13/dostup-cherez-gorodskoy-telefon-sumasshedshie-tseni-i-nizkaya-skorost-vspominaem-s-chego-nachinalsya-kaznet/, accessed on 20 Nov. 2024.

main regional ISPs capitalized on the dense railway network to lay fiber optic cables. Therefore, the Central Asian backbone physical network distribution follows the historical railway lines organized around the south-to-north axis towards the Russian border. As in many countries, including Kazakhstan, national railway companies established a telecommunications subsidiary at the beginning of the 2000s, to surf the new wave of a nascent Internet industry. The railway network's integration made it easy for these companies to build cross-border connections and explore business opportunities.

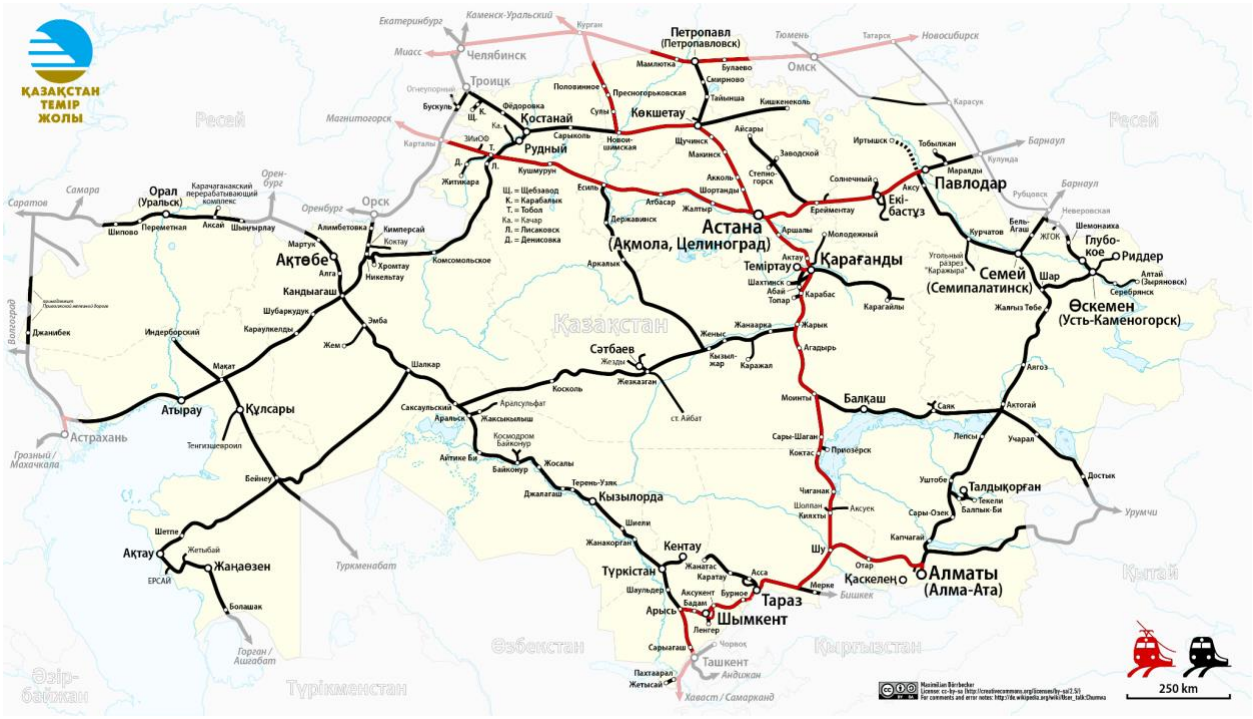

Figure 1. KZ Railway system[18] (June 2024)

Kazakhstan's Quest for Independent Domain Names

In 1994, RelcomSL (a spin-off from the historic Relcom) was awarded the management of the .kz domain extension for the country. The first Kazakh-language website was accessible in June 1998. In 2004, de jure management of the .kz domain was transferred to the Kazakh Agency for Information and Networking. On 1 October 2005, de facto management was transferred to KazNIC and de jure management to the Kazakh Association of Digital Enterprises. In 2008, Kazkontent was created to develop the "Kazakh segment of the Internet."

[18] "Category:Rail Transport Maps of Kazakhstan." Wikimedia Commons, https://commons.wikimedia.org/wiki/Category:Rail_transport_maps_of_Kazakhstan, accessed 31 Jan. 2025.

A Telecommunication Sector Undergoing Diversification

Kazakhstan's telecom sector is organized around two major groups: KazakhTelecom (which includes fixed-line operations under the same brand name, as well as the mobile operator Kcell) and VEON (which owns the mobile operator Beeline and the fixed-line provider TNS-Plus). These two groups own Kazakhstan's two major fixed-line ISPs and the country's main mobile service providers.

Two other major players also operate long-distance fiber backbones: Transtelecom and KazTransCom. In terms of long-haul coverage, KazakhTelecom has the most extensive network, followed by TNS-Plus, as well as Transtelecom and KazTransCom who also sell to end-users, mostly corporate customers. Other minor ISPs provide niche services such as FTTx services in Almaty for AlmaTBV or VSAT connectivity for ASTEL.

Evolution of the Main Operators and Their Ownership Structures

Before providing a detailed overview of each operators' network presence and market shares in the country, a description of the ownership structures is provided to help understand the current dynamics within the sector.

KazakhTelecom

Until 2024, KazakhTelecom, a partially state-owned company (51% held by Samruk-Kazyna), dominated Kazakhstan's telecom sector, operating three of the four main mobile operators (Kcell, Altel, Tele2)—with the only remaining private mobile operator being Beeline.[19] In 2022, KazakhTelecom was holding 73% of the fixed network market. Market concentration increased after privatization efforts in the early 2010s, with foreign firms like Sweden's Tele2 selling stakes back to KazakhTelecom in 2019.[20]

Concerns over monopolistic practices intensified after KazakhTelecom's subsidiaries secured key 5G frequencies[21] in 2022. The Antitrust Agency (APDC) and the Digital Ministry (MDDIA) proposed reforms, including barring subsidiaries from future auctions and divesting assets.

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[19] Altynay Karimova (Алтынай Каримова), "How is mobile communication and Internet developing in Central Asia? (Как развивается мобильная связь и интернет в Центральной Азии?)", Central Asian Bureau for Analytical Reporting (CABAR), 25/10/2021, https://cabar.asia/ru/kak-razvivaetsya-mobilnaya-svyaz-i-Internet-v-tsentralnoj-azii, accessed on 20 Nov. 2024.

[20] *Reuters*, "Sweden's Tele2 agrees deal to exit Kazakhstan", 23/05/2019, https://www.reuters.com/article/business/media-telecom/swedens-tele2-agrees-deal-to-exit-kazakhstan-idUSL5N22Z1FX/, accessed on 30 Jan. 2025.

[21] Albert Fahrutdinov, "Kazakhstan worries about risks associated with KazakhTelecom's success at 5G bids", *Kursiv*, 27/12/2022, https://kz.kursiv.media/en/2022-12-27/kazakhstan-worries-about-risks-associated-with-its-biggest-operator-success-at-5g-bids/, accessed on 20 Nov. 2024.

In June 2024, former Digital Minister Bagdat Musin became KazakhTelecom's CEO, pushing internal reforms.[22] That same month, KazakhTelecom sold MTS (Tele2-Altel) to Qatar's Power International Holding (PIH) for $1.1 billion USD, with PIH committing to network expansion. This move aligned with Kazakhstan's strategy to attract foreign investment, enhance competition, and reduce monopolistic control in telecom.

VEON (Beeline & TNS Plus)

Kazakhstan's second-largest mobile operator, Beeline, is owned by the VEON Group, a former Amsterdam-based group under the process of relocating its headquarters to Dubai.[23] VEON's market structure is complex: 45.5% stakes are owned by the Russian company Alfa Group, the Dutch Stichting Administratiekantoor Mobile Telecommunications Investor owns 7.8%, and Echog N.V. (Private Equity) controls 7%.

On 30 September 2024, VEON announced the sale of its 49% stake in TNS Plus LLP to DAR Group (which already owned 51% of the shares) for $137.5 million, while retaining its stake in Beeline.[24] It appears that VEON's decision—as part of an 'asset-light strategy'—was aimed at consolidating Beeline's key capabilities, such as mobile digital services, and separating it from its wholesale infrastructure services operated under TNS Plus. Under the purchase agreement, TNS Plus will continue to provide long-distance infrastructure for Beeline. The founder of DAR Group, Alidar Utemuratov, has announced that he will continue to focus on TNS Plus' data transit activities.[25]

Transtelecom

Transtelecom JSC was founded in 1998 by the Kazakh state rail company "Kazakhstan Temir Zholy," which owns the country's main railroads. As part of the opening of several state assets to private capital, it was decided in 2015 to partially privatize the company. In 2017, Unit Telecom LLP, a company founded by Nurali Aliyev, the grandson of former President Nursultan Nazarbayev and son of former MP Dariga Nazarbayeva, bought 75% of Transtelecom shares (minus one share), while 25% of the

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[22] Alexey Afonskiy, "President Tokayev appoints former digital minister as new head of KazakhTelecom", 10/06/2024,https://kz.kursiv.media/en/2024-06-10/president-tokayev-appoints-former-digital-minister-as-new-head-of-kazakhtelecom/, accessed on 20 Nov. 2024.

[23] Camilla Aznabakiyeva, "Telecom giant owning Kazakhstan's Beeline relocates headquarters to Dubai", *Kursiv*, 15/10/2024,https://kz.kursiv.media/en/2024-10-15/engk-yeri-telecom-giant-owning-kazakhstans-beeline-relocates-headquarters-to-dubai/, accessed on 20 Nov. 2024.

[24] VEON, "VEON Completes the Sale of Its Stake in TNS+ in Line with Asset-Light Strategy", 30/09/2024, https://www.veon.com/newsroom/press-releases/veon-completes-the-sale-of-its-stake-in-tns-in-line-with-asset-light-strategy, accessed on 20 Nov. 2024.

[25] VEON, *Ibid.*

shares (plus 1 share) remained with Kazakhstan Temir Zholy. According to Transtelecom's website, Nurali Aliyev is still Chairman of the Board of Transtelecom JSC.[26]

KazTranscom

In September 2021, KazakhTelecom sold 24 of the shares in Kcell, one of the country's largest mobile network operators, to Pioneer Technologies and Jusan Bank. Both Kcell and KasTransCom were previously owned by Telia, a Nordic telecommunications company operating in several Central Asian markets. At the beginning of 2021, Jysan Ventures, a company affiliated with Jusan Bank, took over KazTranscom with the aim of investing in mobile financial services. Since then, Jusan Bank has been the owner of KazTranscom.[27]

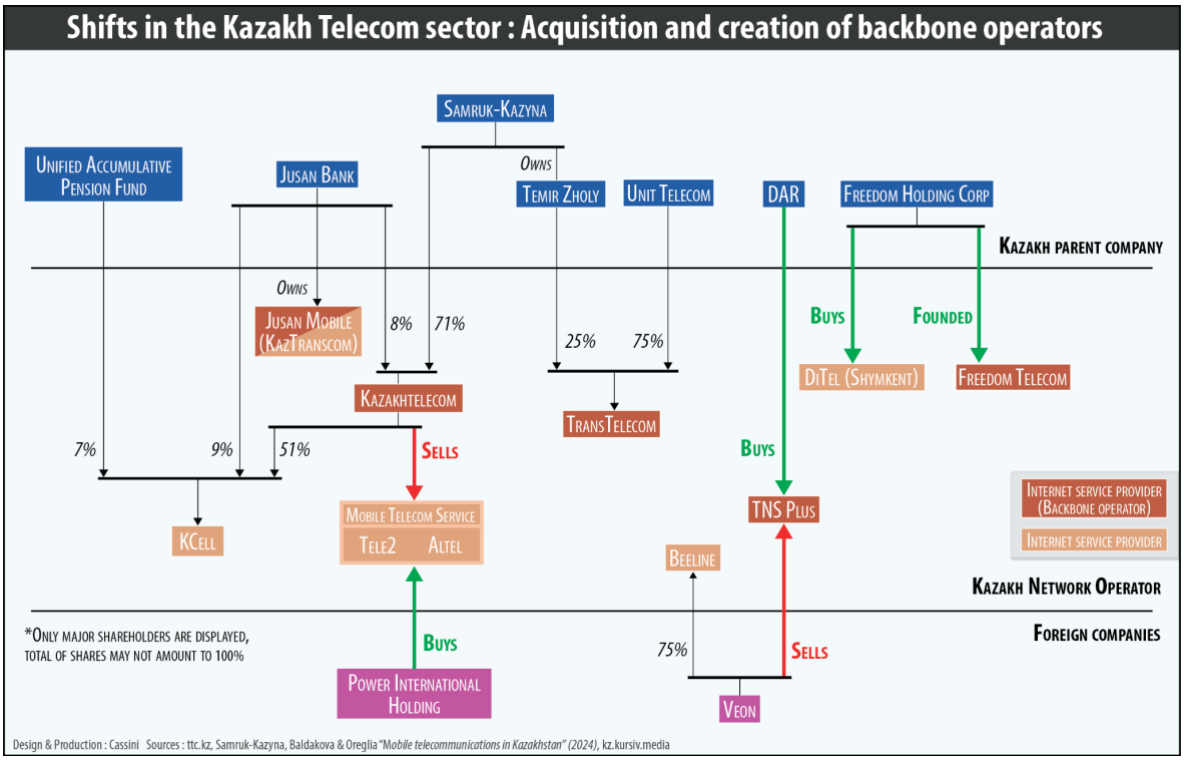

Figure 2. Ownership structure of telecommunication operators[28]

[26] Transtelecom Kazakhstan, "The Board of Directors", https://ttc.kz/en/About/corporate-governance/board-of-directors/, accessed on 20 Nov. 2024.

[27] For more details about the history of the telecommunications sector in Kazakhstan also see : Oyuna Baldakova, Elisa Oreglia. (2024). "Beyond geopolitics: Agency and modularity in mobile telecommunications in Kazakhstan", *Telecommunications Policy*, https://doi.org/10.1016/j.telpol.2024.102878, accessed on 14 Mar. 2025.

[28] Sources: "TTC." TTC Transtelecom, 22 Jan. 2025, ttc.kz; Samruk-Kazyna; Baldakova & Oreglia (2024); "Mobile telecommunications in Kazakhstan"; "Kursiv." Kursiv Media Kazakhstan, 31 Jan. 2025, https://kz.kursiv.media/en/, accessed on 14 Mar. 2025.

Current Market Structure

KazakhTelecom operates a nationwide network connecting its current and former subsidiaries to the Internet. About 58% of Kazakhstanis access the global Internet via KazakhTelecom or via its customers. Kar-Tel/Beeline, on the other hand, relies on the TNS-Plus transit network (recently sold by VEON), making this network quite centralized despite the fact that it does not contract directly with end users. These results highlight KazakhTelecom's monopoly in connecting users of different ISPs and, to a lesser extent, the importance of the TNS-Plus backbone network.

Current market share information (December 2024):

- The incumbent ISP, KazakhTelecom, is serving 29.1% of the Kazakhstani users from its main Autonomous System[29] (AS9198) and an additional 8.73% from the mobile network KCell (a subsidiary of KazakhTelecom).
- Kar-Tel (a.k.a Beeline, part of VEON) is the second largest, with 17.8% (AS206026) and 10.7% (AS21299).
- The Mobile Telecom Service (MTS) (sold to Qatari holding by KazakhTelecom) is the third largest group. It is made of two mobile operators: Altel, which has a 3.67% market share (AS39824)—therein registered as MTS LLP—and the mobile operator Tele2 (AS48503), which has a 16.8% market share.

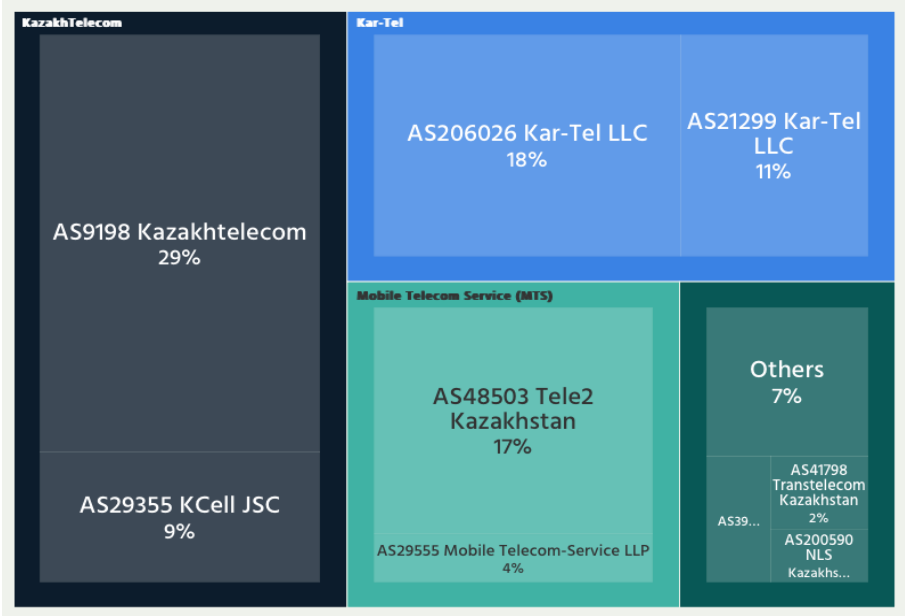

Figure 3. Estimated market share of Kazakh networks (Source: APNIC[30])

[29] An **Autonomous System (AS)** is a collection of IP networks and routers under the control of a single entity, such as an Internet service provider (ISP), enterprise, or university, which presents a unified routing policy to the global Internet. Autonomous Systems are the building blocks of the Internet's structure.

[30] Data provided by APNIC: Huston, Geoff. "How We Measure: ISP User Counts." APNIC Blog, 11 Nov. 2024, https://blog.apnic.net/2024/11/11/how-we-measure-isp-user-counts/, accessed on 14 Mar. 2025.

Using Border Gateway Protocol (BGP[31]) paths, this study investigates the routes used for reaching all networks registered in Kazakhstan and identifies the most important transit providers. As shown in Figure 4, three main networks emerged in this analysis: KazakhTelecom (AS9198), TNS Plus (AS35168), and Transtelecom (AS41798). As discussed above, KazakhTelecom and TNS Plus connect residential and mobile networks to the Internet. Transtelecom Kazakhstan appears to connect other types of networks, notably Transtelecom and KazakhTelecom, which provide transit to Yandex Cloud Kazakhstan (AS208795).

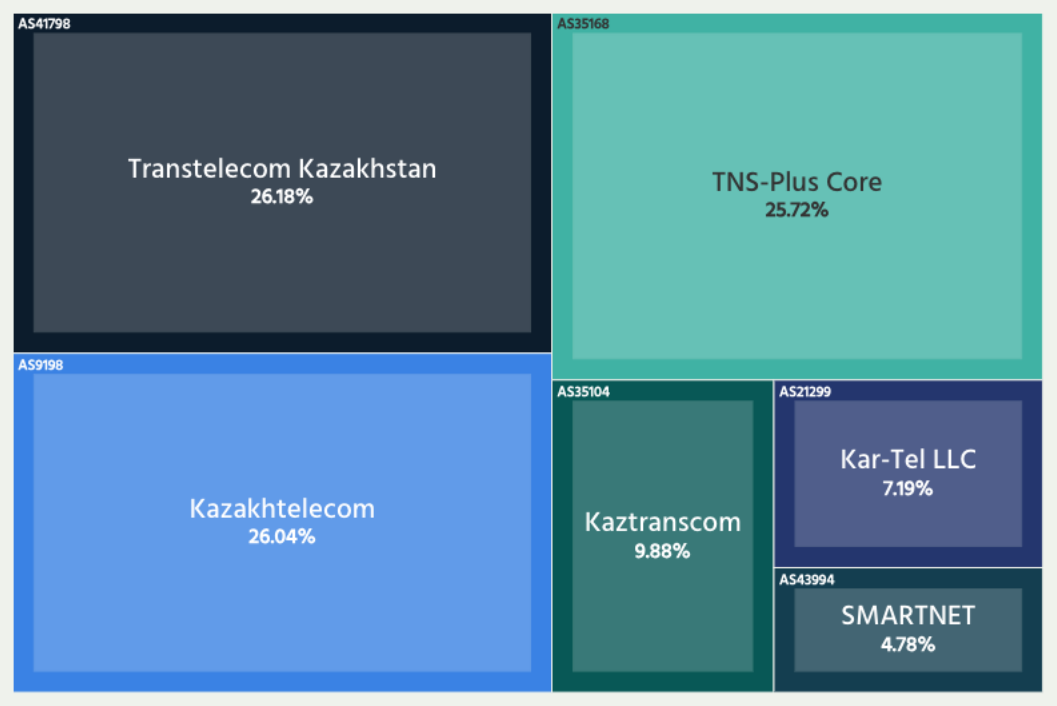

Figure 4. The top 6 transit providers in Kazakhstan and the percentage of Kazakh networks reachable through them. (Internet Health Report)

Central Asia's Largest Domestic Market

Kazakhstan has the largest number of Autonomous System Numbers (ASNs) and Internet Protocol (IP)[32] prefixes allocated to its domestic market. In September 2024, 212 ASNs were allocated to organizations registered in Kazakhstan. Most of these ASNs (171) are active at the BGP level, especially in IPv4 (169), but only a very small fraction is using IPv6 (38). All other countries in the region have less than 100 assigned ASNs.

Kazakhstan has one of the most complex and diversified networks within the region. Compared to Uzbekistan, Kazakhstan has twice as many ASNs despite the fact that Uzbekistan's population is much

[31] The **Border Gateway Protocol (BGP)** is the principal routing protocol used to exchange routing information across the Internet, allowing Autonomous Systems (ASes) to communicate and determine the best paths for data packets to travel.

[32] An IP prefix refers to a range of Internet Protocol (IP) addresses, which come in two versions, IPv4 and IPv6, allocated to an entity such an Internet Service Provider (ISP) or any organization running a public network (e.g., a university).

larger (36.4M compared to 19.9M). Although ASNs allocated to Kazakhstan are significantly fewer than Russia and China which both have over 5,000 active networks, these results reveal that Kazakhstan has the most competitive market in Central Asia.

Figure 5 provides a breakdown of ASNs per country (registered and active for both IPv4 and IPv6) and the number of stub networks. A stub network refers to an end-site such as a company or university network, which does not provide connectivity to other networks.

Figure 5. Number of networks registered in Central Asia and active on the Internet

About 3.2 million IPv4 addresses are allocated to Kazakhstan (Figure 6), and almost all of them (3.1M) are actively announced in BGP. Hence, Kazakhstan manages by far the largest number of IPv4 addresses in the region. Most of the IPv4 space allocated to KZ is active in BGP, but for IPv6, only a small fraction of the allocated space is active. The more IP addresses allocated to a country directly correlates to the country's demand in terms of Internet resources. Despite the growing IPv6 demand around the world, Central Asia and Kazakhstan's transition to IPv6 is relatively slow. Around 20% of IPv6 prefixes are currently announced on the global Internet. As per APNIC Labs[33], 22.46% of users are currently served over IPv6, which is much larger than the regional average (9.98%). The two operators leading the chart for IPv6 are Kar-Tel (Beeline) and Tele2.

[33] APNIC IPv6 Statistics—https://stats.labs.apnic.net/ipv6/KZ, accessed on 14 March 2025.

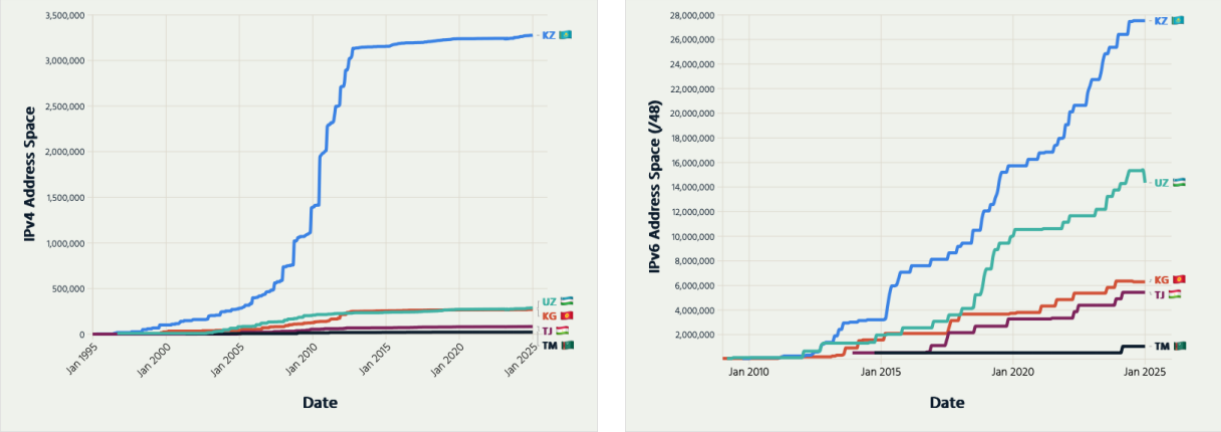

Figure 6. Number of IPv4 and IPv6 prefixes registered in Kazakhstan and the number of these addresses that are globally reachable on the Internet (Source: NRO, RouteViews, RIPE RIS)

Concentrated Yet Competitive Local Market

Kazakhstan has the best affordability rate, measured in the percentage of GNIpc (Gross National Income per capita), as opposed to other countries in the subregion (Figure 7). While Kazakhstan's telecom sector is concentrated, competition among a few major ISPs (KazakhTelecom, Beeline, Transtelecom, and KazTransCom) helps keep prices competitive. The presence of multiple mobile operators (Beeline, Kcell, Tele2, and Altel) creates a price-sensitive environment where operators offer competitive pricing to retain market share.

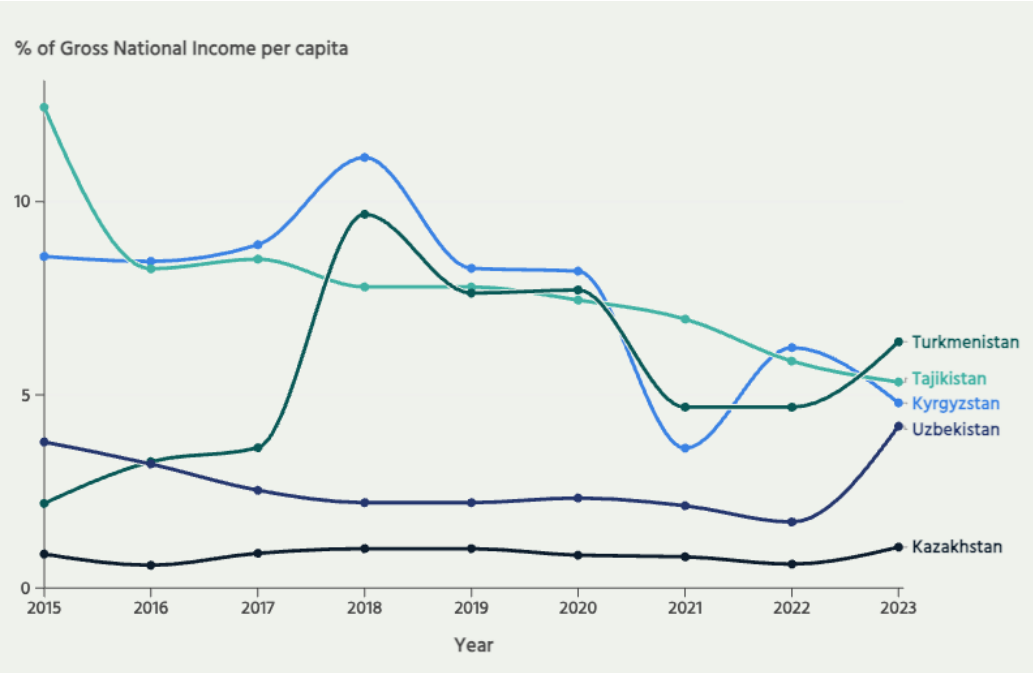

Figure 7. Internet Affordability measured using % of the Gross National Income per capita for Fixed Broadband (Source: ITU)

Another reason is because Kazakhstan sources a large portion of its Internet transit from Russian providers, which offer cheaper bandwidth compared to alternative transit routes. This reduces the cost of international bandwidth and helps keep end-user prices lower.

Kazakhstan: A Gateway Towards Russian Networks

Kazakhstan Sits at the Crossroads of Regional Terrestrial Fiber Lines

Kazakhstan occupies a strategic position that serves as a key hub for connecting its Central Asian neighbors to Russia and the broader Internet. It also lies on the shortest route between Moscow and China. Among its neighbors, Russia boasts the most advanced Internet infrastructure, making it a logical partner for Kazakhstan's connection to the global Internet. This positioning also facilitates an operational pathway from China to Europe.[34]

Kazakhstan's fiber optic network features multiple links to Russia in the northern and northwestern regions. Additionally, other international connections primarily support the integration of neighboring Central Asian states with the global Internet via Kazakhstan (mainly in the south) or provide a direct route linking China, Russia, and Europe.

According to a UNICEF feasibility study on broadband connectivity for schools in Kazakhstan[35] in which Terabit Consulting participated,[36] Kazakhstan imports almost all of its international data traffic from Russia and supplies bandwidth to its Central Asian neighbors the Kyrgyzstan, Turkmenistan, and Uzbekistan. Physically, Kazakhstan has an estimated 17 cross-border fiber optic connection points to Russia, with KazakhTelecom and Transtelecom having the largest number. Kazakhstan also has two connection points with China's western province of Xinjiang, three connections with Kyrgyzstan, two connections with Uzbekistan, and one with Turkmenistan.[37] While Afghanistan and Tajikistan are not bordering countries, they get part of their international connectivity through Kazakhstan.[38] As illustrated in Figure 8, Kazakhstan has up to 16 cross-border connectivity points, which seems to amount to a high degree of physical path diversity. However, most of these interconnections are located at the border with Russia (n=10). Other than Russia, path diversity is less significant. Kyrgyzstan has two active land connection points and one under construction with Kazakhstan, whereas

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[34] Alan Burkitt-Gray, "Transtelecom opens new routes from China across Kazakhstan to Europe", *Capacity Media*, 10/04/2018, https://www.capacitymedia.com/article/29ota593u7c7lkmiba2v4/news/transtelecom-opens-new-routes-from-china-across-kazakhstan-to-europe, accessed on 20 Nov. 2024.

[35] UNICEF, "Feasibility Study of Potential Technical and Financial Solutions for Upgrading School Connectivity to Broadband Speeds in Kazakhstan", August 2022, https://www.unicef.org/kazakhstan/media/9956/file/Feasibility%20study.pdf, accessed on 20 Nov. 2024.

[36] Terabit Consulting has participated in projects such as the Asia-Pacific Information Superhighway sponsored by the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), as well as fiber connectivity initiatives for the World Bank.

[37] International Telecommunications Union, "Connectivity Infrastructure Map", https://bbmaps.itu.int/bbmaps/, accessed on 02 Dec. 2024.

[38] UNICEF, August 2022, *Ibid.*

connectivity with China is served through only two points, and connections towards Uzbekistan and Turkmenistan are limited to a single physical gateway.

According to the same UNICEF report, in 2022, Kazakhstan obtained about 80% of its international bandwidth from Russian operators: Rostelecom, Transtelecom, MegaFon, KVANT, and VimpelCom (Beeline). TNS-Plus, Beeline's backbone network, purchased its international transit almost exclusively from Russian operators. KazTranscom also obtained most of its bandwidth from Russian partners but received a small amount of data traffic via China Telecom and Tata Communications (USA). Transtelecom Kazakhstan received transit from the Russian operators KVANT, MegaFon, RETN, and Telia (Sweden).

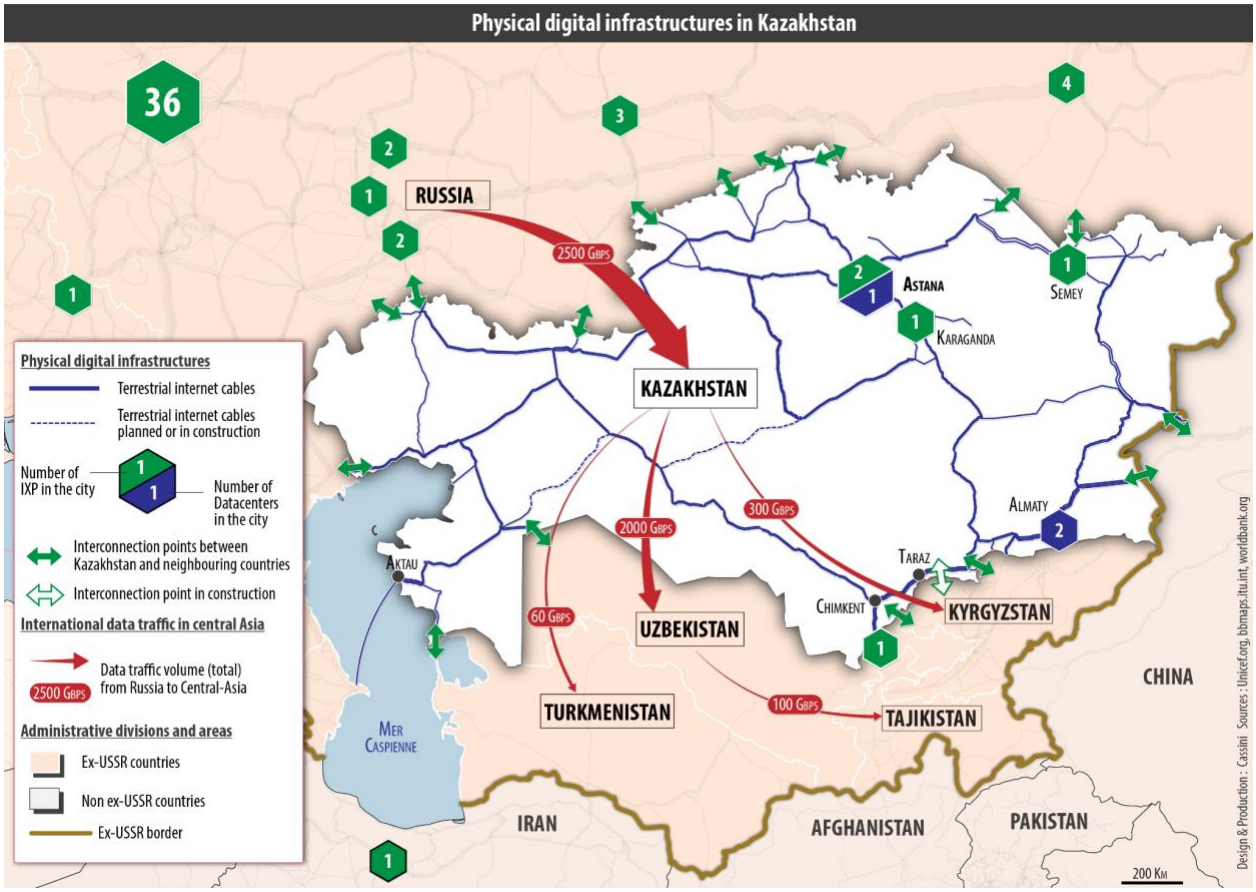

Figure 8. Kazakhstan's physical Internet connectivity map[39]

[39] Sources : UNICEF, www.unicef.org/. Accessed 31 Jan. 2025; "Empowering Connectivity through Broadband Mapping." ITU, bbmaps.itu.int/. Accessed 31 Jan. 2025; worldbank.org.

Kazakhstan's Transit Dynamics With Neighboring Countries

Kazakhstan sources the majority of its international bandwidth from Russia, with most ISPs routing their traffic through Russian networks. This makes Russia Kazakhstan's largest supplier[40] of international bandwidth by a significant margin.

Within Central Asia, the Kyrgyz Republic relies heavily on Kazakhstan for connectivity to Russian networks and beyond. This dependence is driven by Kazakhstan's competitive pricing and the highest available capacities in the region.[41] Similarly, Uzbekistan depends on Kazakhstan for its international connectivity, as most Uzbek ISPs use transit providers based in Russia, resulting in the majority of Uzbekistan's traffic being routed through Kazakhstan to Russia.

Turkmenistan, while a smaller consumer of Kazakh bandwidth, has a more diverse set of connectivity options. Although it relies heavily on Rostelecom for transit, it also has agreements with regional providers such as the Azerbaijani ISP Delta Telecom and Uzbektelecom.[42]

Kazakhstan's strategic position allows its ISPs to generate substantial revenue by providing transit services to neighboring Central Asian countries. However, their tendency to impose high prices has led to frustrations among regional partners. For instance, Kyrgyz ISPs, which depend almost entirely on Kazakh transit, have accused their upstream providers of tripling prices. In 2017, Kyrgyz ISPs invested heavily in extending their networks to the Chinese border to access more affordable transit services from China Telecom. Such pricing practices by Kazakh ISPs can affect retail prices in neighboring countries, potentially making Internet access less affordable for end users.

To foster competition among Kazakh ISPs, Kyrgyz ISPs typically distribute their transit traffic almost evenly among three of the four major Kazakh wholesale operators. This strategy aims to prevent any single operator from gaining excessive dominance. However, a sudden increase in prices by Kazakh operators in 2016–2017 led to accusations of price collusion by their Kyrgyz customers. These complaints arose despite a simultaneous reduction in transit costs between Russia and Kazakhstan and resulted in a formal complaint from the Kyrgyz government addressed to the Eurasian Economic Union

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[40] Also see: RIPE NCC, "Internet Country Report—Central Asia", september 2020, https://labs.ripe.net/media/documents/RIPE_NCC_Internet_Country_Report_Central_Asia_Sept_2020_1.pdf, accessed on 03 Dec. 2024.

[41] 24.kg, ""The Internet will not rise in price—the head of "Kyrgyztelecom" dispelled the fears of operators (Интернет не подорожает—глава «Кыргызтелекома» развеял опасения операторов)", 21/11/2024, https://24.kg/biznes_info/311775_Internet_nepodorojaet_glava_kyirgyiztelekoma_razveyal_opaseniya_operatorov/, accessed on 03 Dec. 2024.

[42] Hurricane Electrics, "AS20661 State Company of Electro Communications Turkmentelecom", https://bgp.he.net/AS20661#_peers; Internet Health Report, "AS20661", https://www.ihr.live/en/network/AS20661?af=4&last=3&date=2024-11-04&active=routing, accessed on 30 Jan. 2025.

denouncing a collusive behavior detrimental to Kyrgyz customers from Kazakh ISPs.[43] While there is no formal policy enforcing balanced routing among upstream providers in Kyrgyzstan, the practical challenges associated with dependence on a single upstream source have likely encouraged Kyrgyz ISPs to adopt routing strategies that promote greater balance and resilience in their international connectivity.

[43] *KaktusMedia*, "Because of Kazakhstan, Internet prices in Kyrgyzstan may double", 09/08/2016, https://kaktus.media/doc/342769_iz_za_kazahstana_ceny_na_Internet_v_kyrgyzstane_mogyt_vyrasti_v_dva_raza.html, ; Askar Muminov (Аскар Муминов), "Kyrgyzstan suspects collusive behavior (Кыргызстан подозревает сговор) ", *InBusiness.Kz,* 26/08/2016, https://inbusiness.kz/ru/news/kyrgyzstan-podozrevaet-sgovor, accessed on 30 Jan. 2025.

Understanding Strategic Dependencies on the Russian Internet

Russia's Sovereign Internet Law

The Russian project[44] for a sovereign Internet, initiated in the 2010s and formalized with the Sovereign Internet Law in 2019, exemplifies how Russian policies can create tensions for networks in former Soviet republics. This initiative pursues two main political goals:

- **Strengthening State Control Over Data Flows:** The law mandates Deep Packet Inspection (DPI) devices on ISPs' networks, allowing extensive traffic monitoring. It also expands Roskomnadzor's authority to block and regulate online content.
- **Territorializing the "Russian Segment of the Internet":** This segment includes domains ending in .ru, .su, and .рф. The law enforces the relocation of critical infrastructure and mandates storing Russian citizens' data domestically, reducing reliance on foreign systems.

This raises sovereignty concerns for former Soviet republics, particularly Kazakhstan, where Russian remains a language regularly used in Internet content. A loose interpretation of the term "Russia's segment of the Internet" by Russian regulators has periodically resulted in tensions between the two countries in relation to content-blocking orders.[45]

Central Asia's connectivity historically depended on Russian services, which provided first-move advantages to Russian content providers. Before the Trans Europe Asia (TEA) cable in 2005, the region suffered poor connectivity and limited foreign investment. Russian services like Yandex, Mail.ru, and VKontakte became dominant in both Russia and Kazakhstan due to early infrastructure advantages.

Russian platforms remain significant in Kazakhstan, offering social media, video, and streaming services. For example, VKontakte (social media platform), has two points of presence (POPs) in Kazakhstan, in Almaty and Astana. Yandex provides a good case study (see appendix), having relocated all `yandex.kz` servers within Kazakhstan and having opened a data center within the country. Their advantage over U.S. and Chinese competitors stems from local cache distribution, enabling lower latency. VKontakte has points of presence in Almaty and Astana, while Yandex relocated `yandex.kz` servers within Kazakhstan. Meanwhile, U.S. cloud services are scarce—Cloudflare has a presence in

[44] Sovereign Runet: What does it mean? https://www.internetgovernance.org/wp-content/uploads/IGPWhitePaper_STADNIK_RUNET-1.pdf, accessed on 14 Mar. 2025.

[45] Service, RFE/RL's Kazakh. "Kazakh News Website Rejects Russian Media Regulator's Request to Delete War Reports." Radio Free Europe / RadioLiberty, RFE/RL, 13 Dec. 2022, https://www.rferl.org/a/kazakhstan-vlast-website-rejects-russian-media-delete-request/32174574.html, accessed on 14 Mar. 2025.

Almaty, but AWS, Azure, and Google do not. Chinese providers like Alibaba, Huawei, and Tencent also lack local infrastructure.

The continued strong presence of Russian-language content providers is a result of historical change in Kazakhstan and other post-soviet republics. Legislative initiatives in Russia to carve out the "Russian segment of the Internet" risk escalating tensions between the countries, potentially harming Internet users and businesses in Kazakhstan that rely on these services.

Kazakhstan's Dependence on Russia for Transit

Sanctions Over Russian Transit Providers

After Russia's invasion of Ukraine in March 2022, major US-registered Tier-1 providers Cogent[46] and Lumen (operating Level-3)[47] ceased to provide transit in Russia, disrupting their access to global networks. Cogent announced it has ceased to serve major Russian ISPs such as Rostelecom, Transtelecom, VEON, and MegaFon. London Internet Exchange (LINX) has also disconnected Megafon and Rostelecom from its peering facilities.[48] However, it is worth noting that in the case of Cogent, peering data shows that overall, the number of Russian networks it connects to has vastly increased since 2022, going from about 20 early in the year, to nearly 40 in September 2024.

At the time of the disconnection, Russian ISPs had to connect via many intermediaries to reach their final destination, bringing more latency and cost to their customers. At the time, KazakhTelecom was getting its international bandwidth or transit through five Russian companies: Rostelecom, Transtelecom, MegaFon, VEON, and China Mobile (Russia).[49] As such the sanction taken against Russian transit providers at a routing level might effect their downstream clients located in Central Asia, such as Kazakhstan, Tajikistan, and Uzbekistan.[50]

According to Kentik's Director of Internet Analysis, Doug Madory, if Russia cuts itself from the Global Internet, Kazakhstan could be left offline. Since Kyrgyzstan, Tajikistan, and Uzbekistan are connected to

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[46] *Reuters*, "U.S. firm Cogent cutting Internet service to Russia", 04/03/2022, https://www.reuters.com/technology/us-firm-cogent-cutting-Internet-service-russia-2022-03-04/, accessed on 20 Nov. 2024.

[47] Lumen, "Lumen's Readiness to Meet Global Events", 07/03/2022, https://news.lumen.com/RussiaUkraine; accessed on 20 Nov. 2024.

[48] Sebastian Moss, "London Internet Exchange disconnects Megafon and Rostelecom", *Data Center Dynamics*, 14/03/2022, https://www.datacenterdynamics.com/en/news/london-Internet-exchange-disconnects-megafon-and-rostelecom/, accessed on 20 Nov. 2024.

[49] Elnur Alimova (Ельнур АЛИМОВА), "It will be a disaster. Where will Kazakhstan get the Internet if Russia is disconnected from the global network? («Это будет катастрофа». Где Казахстан возьмет интернет, если Россию отключат от глобальной Сети?)", *Radio Free Europe*, 24/03/2022, https://rus-azattyq-org.translate.goog/a/31767819.html?_x_tr_sl=auto&_x_tr_tl=fr&_x_tr_hl=fr&_x_tr_pto=wapp, accessed on 21 Nov. 2024.

[50] Doug Madory, "Updated: Cogent and Lumen curtail operations in Russia", *Kentik*, 07/03/2022, https://www.kentik.com/blog/cogent-disconnects-from-russia/, accessed on 20 Nov. 2024.

the global Internet through Kazakhstan, these countries will also be disconnected from the global Internet. This will also affect Turkmenistan and Mongolia, but not to the same extent as other Central Asian states, given that these countries also receive Internet transit through Iran and China and therefore have alternatives.[51] According to Talgat Nurlybaev, Chairman of the Kazakhstani Chapter of the Internet Society, 95% of Kazakhstan's Internet traffic goes through Russia.[52]

KazakhTelecom has declared that it is using different Internet backup routes independent from Russia.[53] According to PeeringDB, JSC KazakhTelecom (AS9198) is connected to three Public exchanges: DATIX, PITER-IX Moscow, PITER-IX St. Petersburg, and three interconnection facilities: Equinix FR5 (Frankfurt), Equinix HK2—Hong-Kong, Moscow M9.[54]

Additionally, KazakhTelecom officials have declared that even if Russia builds an autonomous Internet (analogous to China), it will not affect Kazakhstan's own access since Internet service is provided to Kazakhstan through transit, which crosses the Russian territory towards Europe (it does not enter the Russian network itself).[55] Reportedly, KazakhTelecom is presently increasing its presence abroad to minimize the risks. It is building a resilient connectivity architecture that could sustain external Internet cuts, using other alternatives.[56]

Interconnection Shows Diversification While Dependence on Russia Remains

According to BGP[57] data the most prominent upstreams for Kazakh networks are still Russian ISPs, meaning that routes to the broader Internet are more likely to go through Russian ISPs. However, this does not mean that all traffic terminate in Russia, but Russia is used as a connection points towards Europe and Asia.

Table 1 shows that peering agreements with Russian networks continue to dominate Kazakhstan's connectivity landscape. This analysis reveals 525 AS links originating from 26 different Kazakh networks

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[51] Elnur Alimova. 22/03/2024. *Ibid.*

[52] Dosimzhan Naukhanov (Досымжан Науханов), "If Russia is off the Internet, what will happen to Kazakhstan?—review of the Kazakh media (Если Россию отключат от интернета, что будет с Казахстаном?—обзор казСМИ)", 29/03/2022, https://365info.kz/2022/03/esli-rossiyu-otklyuchat-ot-Interneta-chto-budet-s-kazahstanom-obzor-kazsmi, accessed on 20 Nov. 2024.

[53] Elnur Alimova. 22/03/2024. *Ibid.*

[54] PeeringDB is a public database of Internet data: *PeeringDB*, https://www.peeringdb.com/net/2585, accessed 31 Jan. 2025.

[55] Artem Volkov (Артем Волков), "Optolf axe: can Russia leave Kazakhstan without the Internet? (Топором по оптоволокну: может ли Россия оставить Казахстан без интернета?)", *Orda,* (09/09/2024), https://orda.kz/toporom-po-optovoloknu-mozhet-li-rossija-ostavit-kazahstan-bez-Interneta-391521/, accessed 31 Jan. 2025.

[56] *Profit,* "KazakhTelecom summed up the results of activities for 2023", 09/02/2024, https://profit.kz/news/65393/Kazahtelekom-podvel-itogi-deyatelnosti-za-2023-god/, accessed on 03 Dec. 2024.

[57] **BGP (Border Gateway Protocol)** is the protocol used for networks to exchange routing information on the Internet. BGP data is collected via Route Collectors, placed in strategic locations around the world.

connected to 474 Russian networks. In comparison, links with American networks are limited to 50, stemming from 11 Kazakh networks. The total number of AS links with Europe reaches 118 from 13 Kazakh networks, placing the region as a whole below Russia in terms of logical paths connected to Kazakh networks.

Table 1. Number of international routes per country (Source: NRO, RouteViews, RIPE RIS)

Number of KZ networks	Number of routes	Going to	Number of Networks
26	525	Russian Federation	474
13	118	Europe	90
10	50	United States of America	37
3	9	Kyrgyzstan	7
2	2	Uzbekistan	1
15	132	Other	107

In Asia, Kazakhstan's ISPs maintain only a few links, including seven with Singapore, two with Hong Kong, and one with China. Within Central Asia, Kyrgyzstan has the highest number of Internet routes with Kazakhstan (n=9), followed by Uzbekistan (n=2).

Figure 9 gives an overview of the most common networks seen on routes from the Internet to Kazakhstan in September 2024. The size of nodes conveys the likelihood of an AS to be present on a route towards networks managed by Kazakh organizations. The Kazakh ISPs, KazakhTelecom (AS9198), TNS-Plus (AS35168), Transtelecom Kazakhstan (AS41798) have most of their international routes transiting via Russian transit providers such as Rostelecom (AS12389), VimpelCom (AS3216), KVant (AS43727), Transtelecom Russia (AS20485), Megafon (AS31133), and MMTS (AS60299), except for routes transiting via Tier-1 networks (Cogent, PCCW, Lumen) and a few ISPs registered in Europe such as V-net (AS47864).

To understand whether announced sanctions[58] against Russian networks from Tier-1 providers Cogent and Level-3 had an impact on Kazakhstan's international connectivity the relationships of these Tier-1 networks with Kazakh networks were examined. As per the data collected, KazakhTelecom has direct connectivity with Cogent and Level-3 in Frankfurt and Hong Kong and shall not be impacted by disruptions happening at the Russian transit providers' end. According to the Internet Routing Registries[59] (IRR), connections with U.S. content providers (Amazon, Apple, META, Microsoft, Google,

[58] The Impact and Limits of Sanctions on Russia's Telecoms Industry, https://dgap.org/en/research/publications/impact-and-limits-sanctions-russias-telecoms-industry, accessed on 14 Mar. 2025.

[59] **Internet Routing Registries**: A public database to disclose routing operations and policies.

and Twitch) mainly happen in Hong Kong and Frankfurt.[60] A peering with Google is also visible in Moscow. Moreover, according to the measurements, Cogent and Level-3 have stopped their blockade of Russian ISPs and are re-connected with them as per their routing announcements seen in BGP.

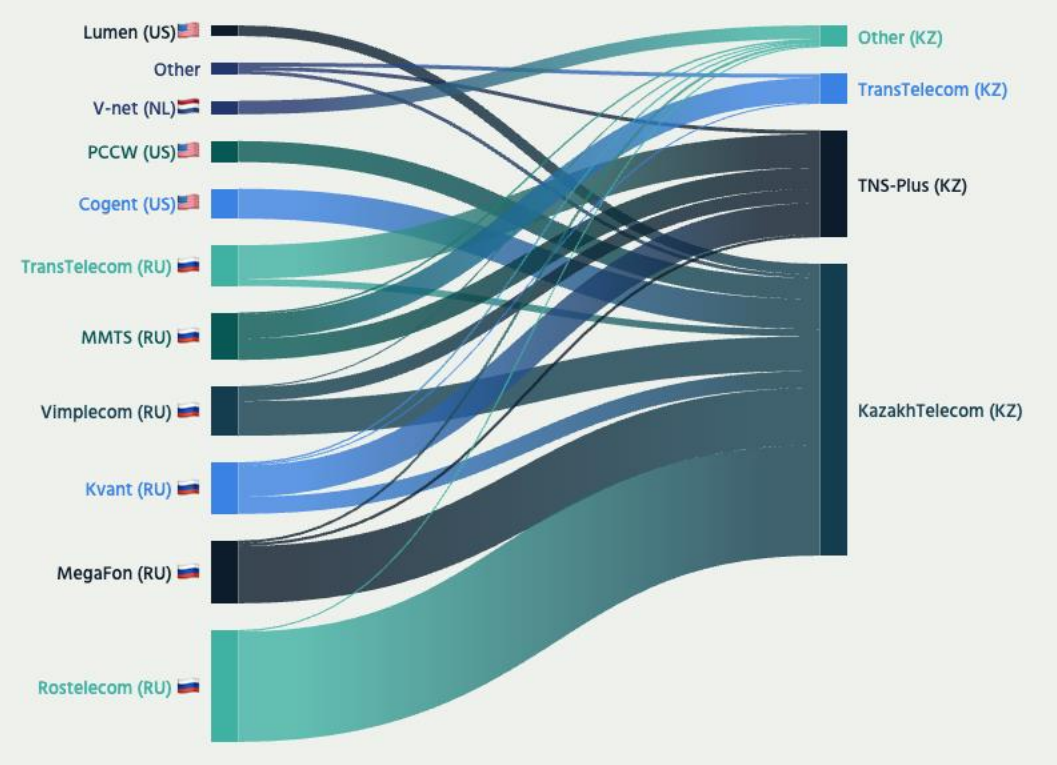

Figure 9. Kazakhstan International connectivity in September 2024. (Source: RouteViews, RIPE RIS).

From a longitudinal perspective, KazakhTelecom's (AS9198) outgoing routes showed better international diversity in September 2024 than in September 2021. In 2021, Kazakhstan's primary ISP relied heavily on Russian providers for international connectivity. By 2024, while Rostelecom remains its primary partner, KazakhTelecom has significantly improved its connectivity to global networks such as Cogent, PCCW, and Lumen. Similarly, in 2021, Kazakhstan's second backbone provider, TNS-Plus (AS35168), primarily depended on Russian ISPs, including its parent company VEON, Vimpelcom (AS3216). As of 2024, its international routes continue to be dominated by Russian ISPs.

[60] "AS9198 JSC Kazakhtelecom." *Hurricane Electric*, https://bgp.he.net/AS9198#_irr, accessed 31 Jan. 2025.

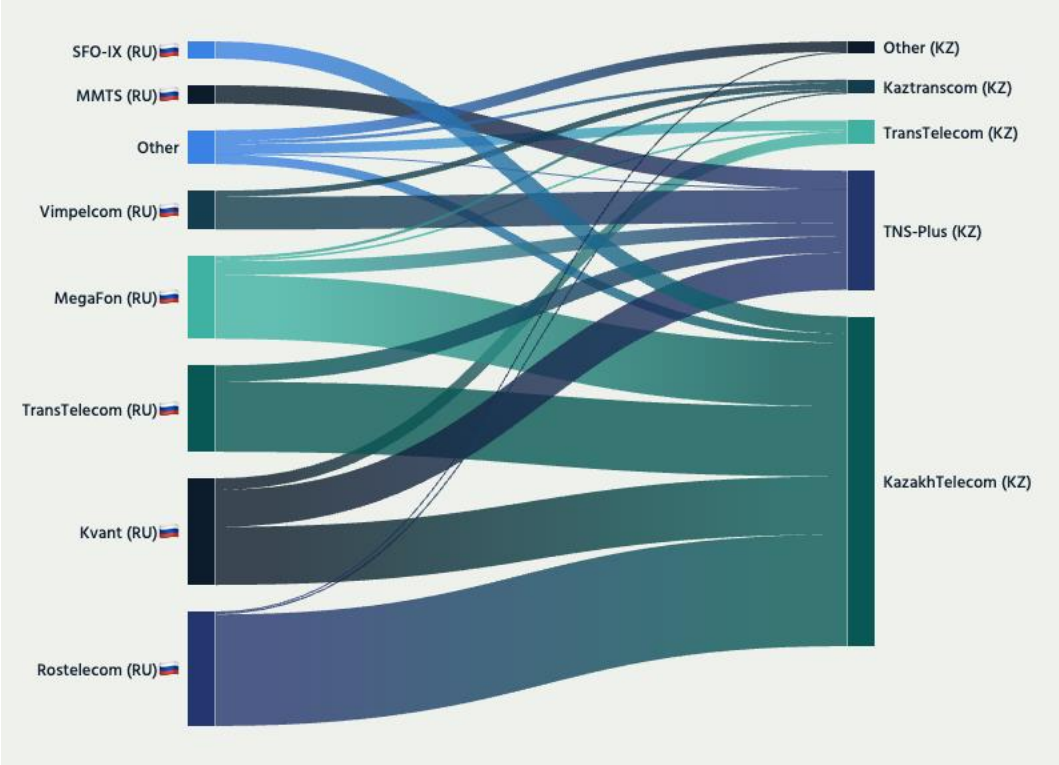

Figure 10. Kazakhstan International connectivity in September 2021 (Source: RouteViews, RIPE RIS)

Based on the analysis of logical routes, Kazakhstan has slightly reduced its reliance on Russian networks since 2021. Kazakh ISPs now have marginally better connectivity to major American networks, while their peering with Europe has remained stable, with no significant changes observed. This effort, mainly driven by KazakhTelecom, should be pursued by all large transit networks in Kazakhstan to further diversify the country's international connectivity.

Kazakhstan's Peering Landscape

There are currently four active Internet Exchange Points (IXPs) in Kazakhstan (Figure 11, blue) where 7.21% of local networks are peering. As is generally the case in Central Asia, the coverage is relatively low in Kazakhstan. This is because the local IXPs are highly controlled by the government. This is the case for KAZ-GOV-IX, Kazakhstan's main public IXP, managed by the State Technical Service (STS).

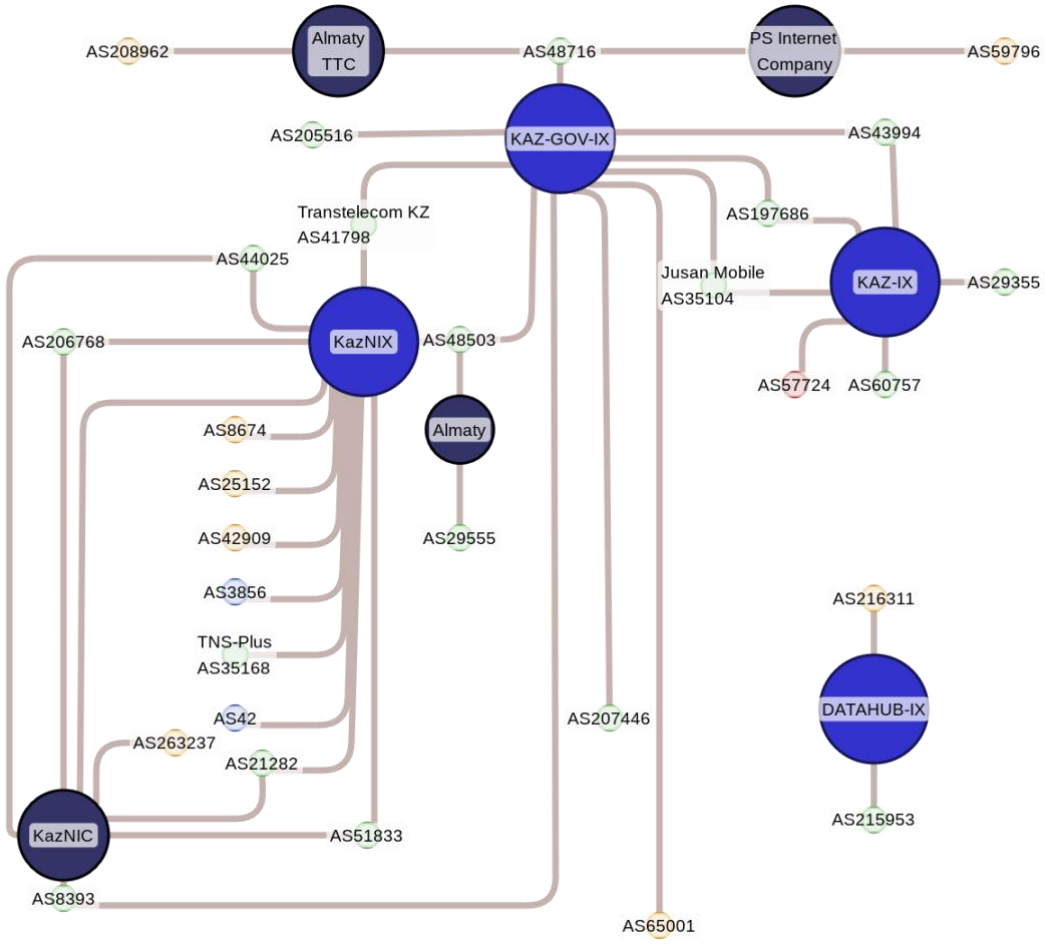

Figure 11. Peering ecosystem in Kazakhstan. Co-location facilities (black), IXPs (blue), Kazakh networks (green), international networks (blue: US, red: Russia, orange: Others).

According to the KAZ-GOV-IX's official website, it is currently connecting all the major national ISPs together. In Almaty, 21 ISPs are interconnected, including KazakhTelecom, TNS+, Transtelecom et KazTransCom[61]. STS is managing exchange facilities in 18 cities of Kazakhstan (Astana, Almaty, Aktau, Aktobe, Atyrau, Zhezkazgan, Karaganda, Kokshetau, Kostanay, Kyzylorda, Pavlodar, Petropavlovsk, Semey, Taldykorgan, Taraz, Uralsk, Ust-Kamenogorsk, and Shymkent). KAZ-GOV-IX concentrates all IXP-routed traffic of the country (over 350GBps) (Figure 12).

[61] KAZ GOV-IX, "Looking Glass", https://lg-ix.sts.kz/, accessed on 18 Nov. 2024.

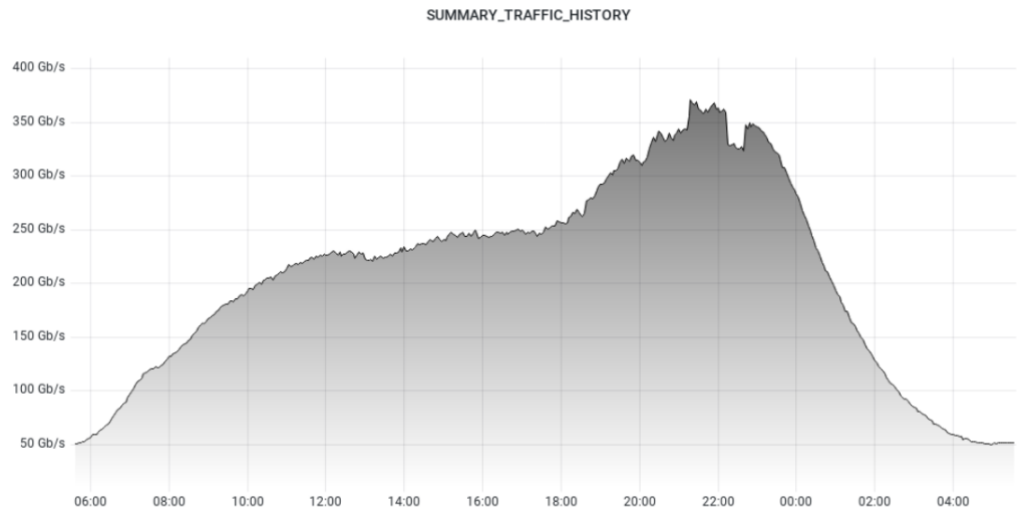

Figure 12. Typical KAZ GOV-IX daily traffic (Source: KAZ GOV-IX)

In comparison, KazNIX, an independent IXP, launched in February 2019 in Semey, only receives 1 Gbps of traffic during peak times (Figure 13). KazNIX describes itself as 'neutral,' and as an exchange platform for "IP traffic between networks and the globally distributed networks of DNS servers for support of root domain zones."

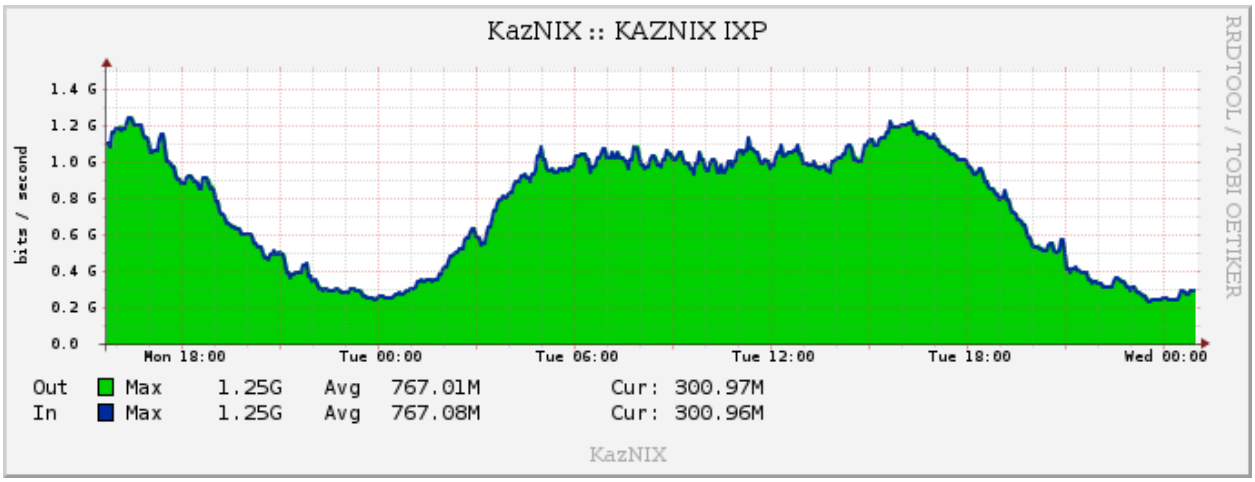

Figure 13. Typical KazNIX daily traffic (Source: KazNIX)

The networks participating at both IXPs convey a key difference between these IXPs. KAZ GOV-IX members are solely domestic operators, while KazNIX has a mix of foreign and domestic operators. For example, DNS root providers (Netnod, PCH, and RIPE NCC) are at KazNIX but not KAZ-GOV-IX. It is recommended to host anycast DNS servers at IXPs not only to increase the overall user experience by reducing DNS resolution latencies, but it adds to the overall resilience of the DNS ecosystem.

The concentration of the traffic at the government-managed IX jeopardizes resilience as it creates a single point of failure which could be vulnerable to operational mishaps and disruptions.

The Internet Society recommends that Kazakhstan's peering landscape should evolve towards a more diversified and resilient interconnection ecosystem. While KAZ-GOV-IX serves as the primary exchange point, its government control and concentration of traffic pose risks to network resilience and redundancy. To enhance stability, more networks should be encouraged to peer at independent IXPs like KazNIX, which already hosts a mix of domestic and foreign operators, including DNS root providers. Regulatory policies should promote a more open and neutral environment for peering, reducing barriers for new IXPs and fostering competition among transit providers.

Additionally, improving local content hosting and deploying more caches within independent IXPs would enhance network performance and reduce reliance on international transit. Encouraging multilateral peering agreements and incentivizing private IXPs to expand their footprint in different cities would also help distribute traffic more evenly across the country, mitigating the risks of a single point of failure.

Content Locality: A Contrasted Picture

The previous section focuses on Kazakhstan's international connectivity. This section provides an overview of where most Internet users in Kazakhstan fetch their content.

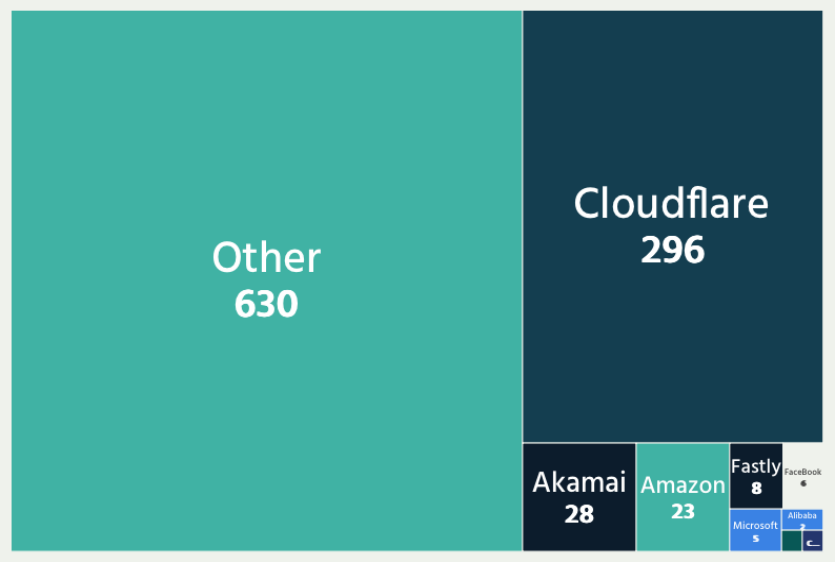

Figure 14. Distribution of host providers for the top 1,000 websites in Kazakhstan.

To understand the extent of popular content in Kazakhstan, it is important to know the localization of the infrastructure hosting the top 1,000 most popular websites reported in Google's CRuX[62] dataset. Out of 1,000 websites, 308 websites are served by Cloudflare, 25 by Amazon, 26 by Akamai, and the rest are hosted either natively or on private clouds (Figure 14).

Figure 15 shows the countries and networks hosting the most popular content accessed by Kazakh Internet users: Almost two-thirds are hosted in Kazakhstan. The Anycast[63] category (33% of websites) represents servers that are located in various places worldwide, but as most of these websites are hosted by Cloudflare and given the presence of Cloudflare at multiple places in Kazakhstan, the vast majority of the websites in the Anycast category are indeed hosted within the country. An additional 27% of websites are clearly identified in Kazakhstan; these are typically hosted by Kazakh networks, including KazakhTelecom, PS cloud services, and Hoster.kz. Over 17% of the studied websites are located in Russia which supports the need for Internet capacity in Russia. The rest are spread out worldwide and include popular American and European hosting providers such as Google, OVH, and Hetzner.

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[62] "Overview of Crux: Chrome UX Report : Chrome for Developers." *Chrome for Developers*, https://developer.chrome.com/docs/crux, accessed on 8 Feb. 2025.

[63] **Anycast** is a network addressing and routing method in which incoming requests can be routed to a variety of different locations (usually to the closest location).

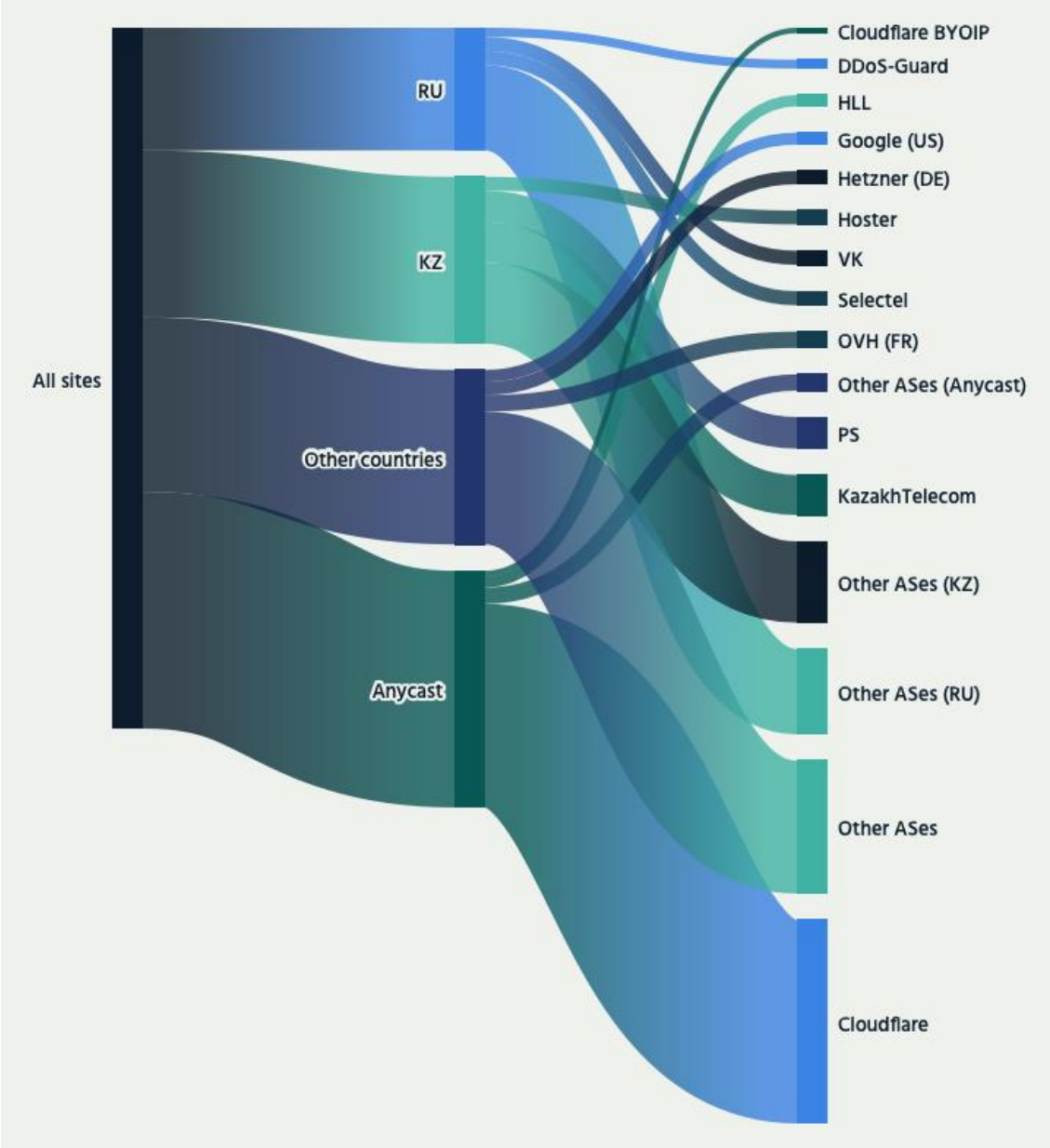

Figure 15. Geographical and topological localization of the top 1,000 websites in Kazakhstan.

Internet Society's Pulse Content Locality Tracker[64] also supports the above results and confirms the local Cloudflare traffic. The chart below shows that almost two-thirds of caches are located inside the country. That is the case of Akamai, Cloudflare, and Facebook. However, other U.S. cloud providers such as Amazon, Fastly, and Microsoft are served from outside of Kazakhstan. As mentioned above, some of these networks are directly connected to KazakhTelecom in Frankfurt and Hong Kong, hence do not require transit via a third-party network, but the distance from the content to the users inevitably causes higher latencies (i.e., ~100ms) compared to content hosted domestically (i.e., <60ms).

[64] "Country Report for Kazakhstan." *Pulse*, pulse.internetsociety.org/en/reports/kz/. Accessed 13 Mar. 2025.

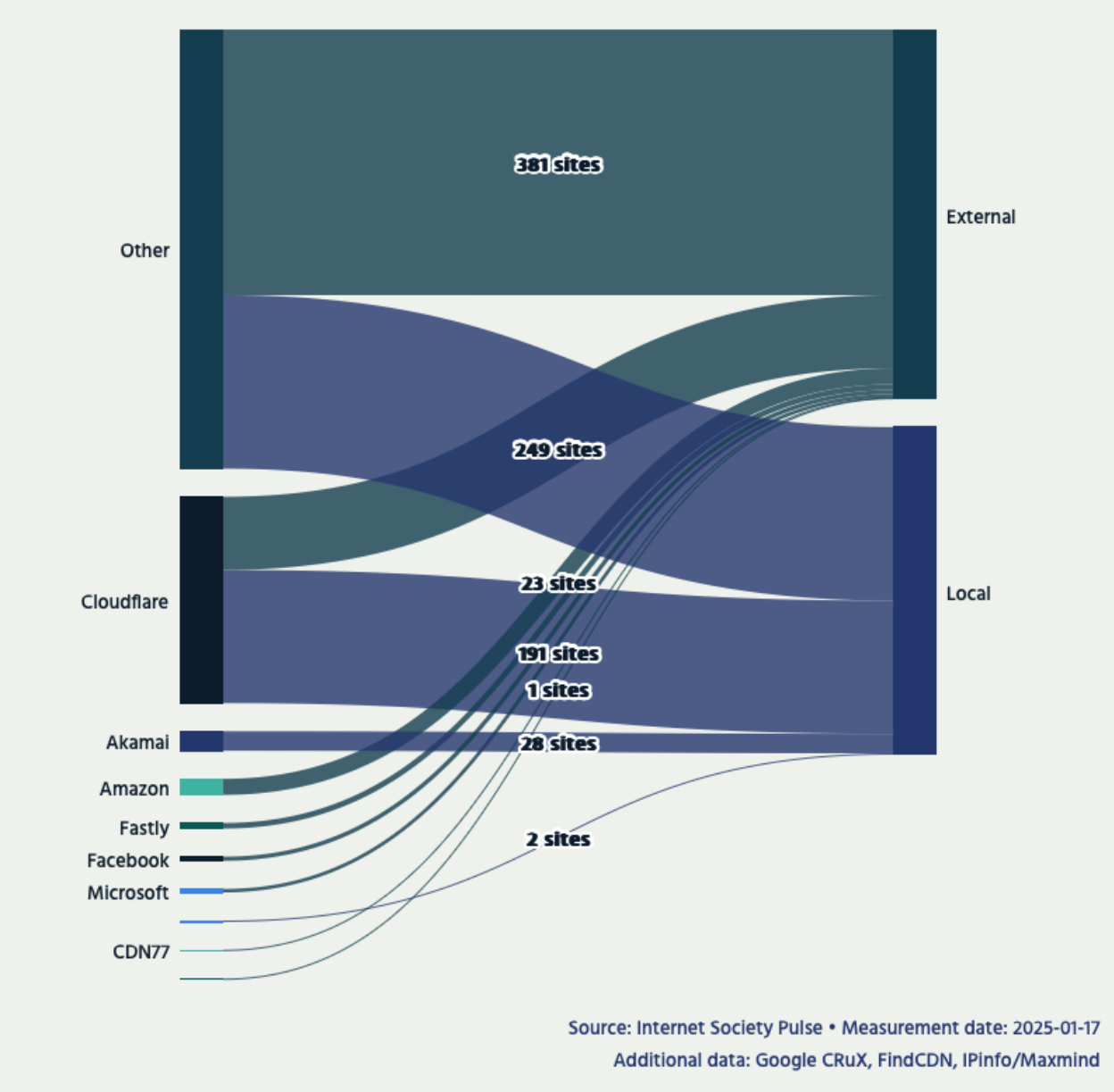

Figure 16. Number of websites (out of 1,000) hitting either a local or external cache.

This study also investigated the location of governmental websites (`.gov.kz`) and found that all of them are hosted by Kazakh networks (Table 2). Unlike many European and North American countries,[65] Kazakhstan is not relying on any of the popular third-party cloud providers. This reveals a distinctive strategy from the Kazakh government to avoid external dependencies in their web infrastructure.

Furthermore, the different e-services offered by the government are distributed over different networks hence avoiding centralization. Since 2021 and the enactment of the "Rules for registration, use, and distribution of domain names in the space of the Kazakhstani segment of the Internet"

[65] Of Choices and Control - A Comparative Analysis of Government Hosting, Rashna Kumar, Esteban Carisimo, Lukas De Angelis Rivas, Mauricio Buzzone, Fabián E. Bustamante, Ihsan Ayyub Qazi, Mariano G. Beiró, ACM IMC 2024.

(adopted in 2018), all the websites registered under a ".kz" domain name are supposed to be hosted within national boundaries.[66]

According to these rules, the use of a domain name can be suspended if the associated Internet resources are hosted on hardware and software complexes outside the territory of the Republic of Kazakhstan. Yet, there is no piece of legislation enforcing ".kz" domain names to be hosted specifically on local cloud providers, as long as an international provider has physical servers located within Kazakhstan it can provide hosting services to local websites.

Table 2. List of government websites and their host providers.

Websites	Host Provider
adilet.gov.kz, did.gov.kz, egov.kz, eotinish.gov.kz, kostanay.gov.kz, mfa.gov.kz, pavlodar.gov.kz, pki.gov.kz, root.gov.kz	National Information Technologies (AS15549)
bkogov.kz, edugov.kz, invest.gov.kz	PS Cloud Services (AS48716)
bolashak.gov.kz, goszakup.gov.kz, orda.gov.kz, qamqor.gov.kz	KazakhTelecom (AS9198)
edu.gov.kz, law.gov.kz, sud.gov.kz, zan.gov.kz	Kar-Tel (AS21299)
election.gov.kz, eqyzmet.gov.kz, esf.gov.kz, kgd.gov.kz, minfin.gov.kz, stat.gov.kz	TransTelecom (AS41798)
mgw.gov.kz	State Technical Service (AS207966)

Finally, this study looks at the DNS infrastructure for the 1,000 most popular websites (as reported by Google's CrUX). Figure 17 shows the country where organizations managing DNS authoritative servers for popular content are registered. A large fraction (46%) are managed by American companies, half of these using Cloudflare DNS services. Russian companies are also managing the DNS for a significant number (16%) of the top 1,000 websites which is slightly higher than the number of websites managed by Kazakh DNS servers (15%), acknowledging again the popularity of Russian services in Kazakhstan. Other DNS providers are mainly spread out through different countries of Europe.

[66] Ministry of Defense and Aerospace Industry of the Republic of Kazakhstan, "On approval of rules for registration, use and distribution of domain names in the space of the Kazakhstani segment of the Internet (**Интернеттің қазақстандық сегментінің кеңістігінде домендік аттарды тіркеу, пайдалану және бөлу қағидаларын бекіту туралы**)", 27/03/2018, https://nic.kz/docs/main-rules-kaz.pdf, accessed on 31 Jan. 2025.

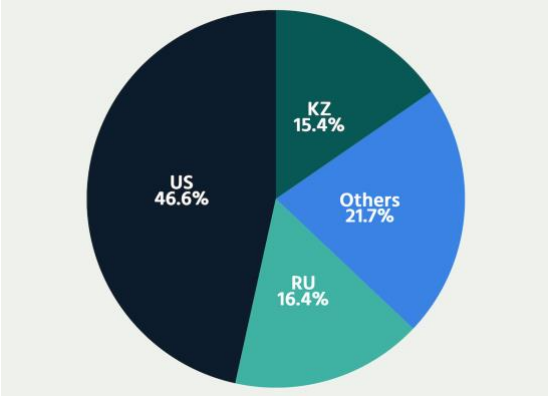

Figure 17. Registered country for networks hosting authoritative name servers of the top 1,000 websites.

The Internet Society recommends a more vibrant cloud ecosystem with both local and international players. Encouraging these providers to deploy local points of presence (PoPs) or data centers through policy incentives or public-private partnerships would be beneficial. While the Kazakh government has successfully distributed its e-services across different networks to prevent centralization risks, similar decentralization principles should be applied to the private sector, promoting competitive, redundant, and resilient cloud hosting solutions across the country.

Finding Alternative Paths: Emerging Initiatives

The Transcaspian Fiber-Optic Cable Project

The current President of Kazakhstan has set the goal of transforming Kazakhstan into a digital regional hub and has declared this to be the main objective of his term in office[67]. In his program, President Tokayev mentions building powerful data centers, updating legislation to attract global IT companies, and building a Transcaspian fiber optic cable connecting Kazakhstan to Azerbaijan and providing further access to Europe (via Georgia, the Black Sea, Bulgaria, Slovakia, and Germany). This cable was introduced as an alternative connection route for Kazakhstan. Figure 18 provides an overview of Kazakhstan's digital constraints and opportunities in the wider Eurasian region.

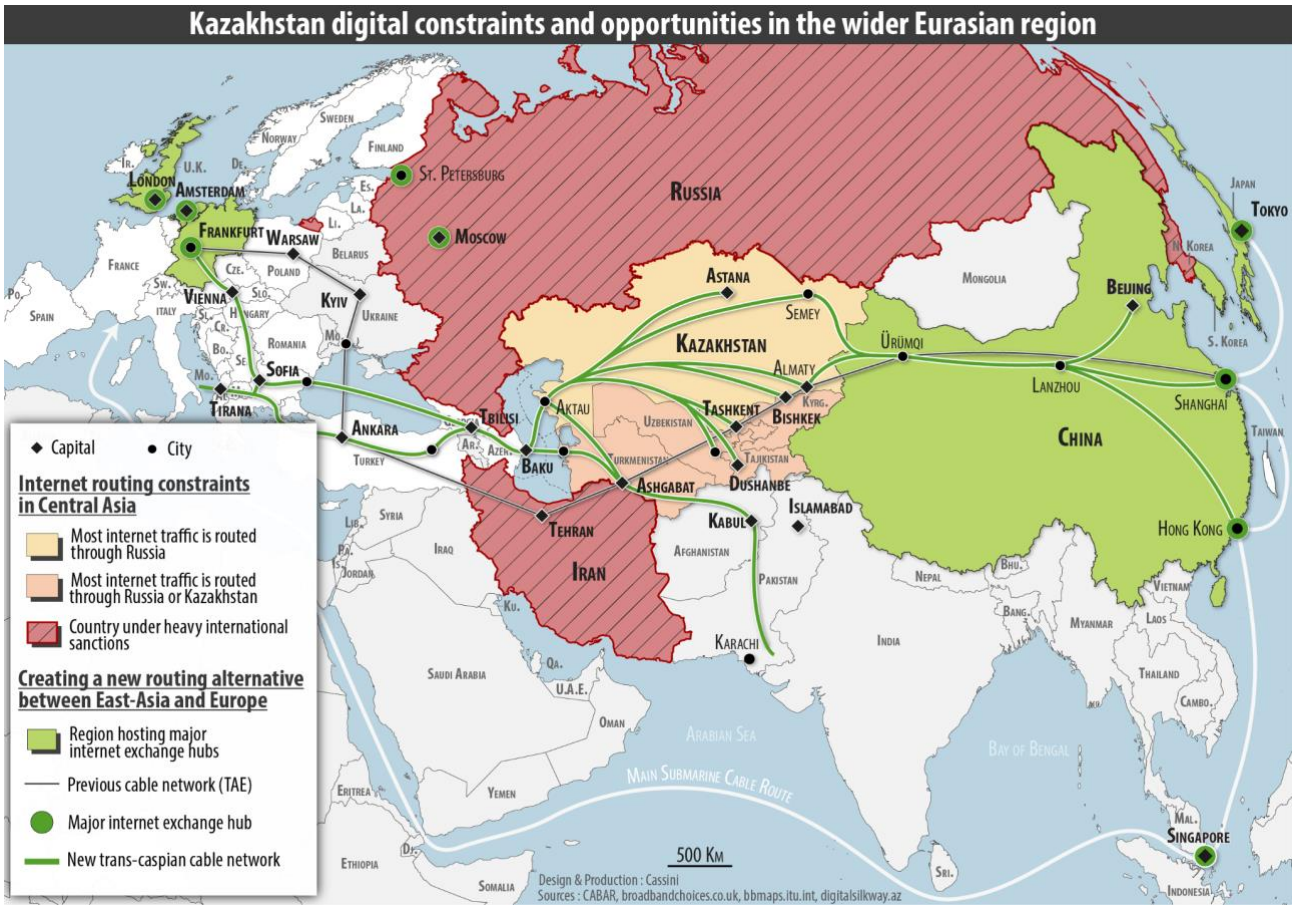

Figure 18. Map of Kazakhstan's digital constraints and opportunities in the wider Eurasian region[68]

[67] Saniya Sakenova, "Kazakhstan Aims to Become One of Eurasia's Largest Digital Hubs, Says President Tokarev", *The Astana Times*, 09/06/2023, https://astanatimes.com/2023/06/kazakhstan-aims-to-become-one-of-eurasias-largest-digital-hubs-says-president-tokayev/, accessed on 21 Nov. 2024.

[68] Sources : cabar.asia; *Broadband, TV, Landline & Mobile Comparison | Broadbandchoices*, https://www.broadbandchoices.co.uk/, accessed 31 Jan. 2025., "Empowering Connectivity through Broadband Mapping." *ITU*, bbmaps.itu.int/, accessed 31 Jan. 2025.; "Connectivity beyond Borders." *Digital Silk Way*, digitalsilkway.az/, accessed 31 Jan. 2025.

The idea of building new telecommunications bridges across the Caspian Sea is not new. It dates back to the 1990s, and since then several projects have followed one another without major breakthroughs due, in part, to the Caspian Sea's disputed legal status.

As early as 1992, negotiators from China, Kazakhstan, Kyrgyzstan, Turkmenistan, and Uzbekistan committed to build a 17,000 km "Trans-Asia-Europe" land cable project that would have stretched from China across Central Asia to Austria and Germany. While China did build a fiber-optic cable that went into operation in 1998, it did not cross the Caspian Sea as planned and instead rerouted by land via Iran.

The legal status of the Caspian Sea was unresolved for decades after the USSR's collapse, mainly due to disputes over seabed delimitation. If classified as a sea, the UN Convention on the Law of the Sea would apply. If classified as a lake, it would be equally divided among the five bordering states. In 2018, Azerbaijan, Iran, Kazakhstan, Russia, and Turkmenistan signed a treaty granting it a unique status: the surface is shared, but the seabed remains under negotiation. This agreement enabled major infrastructure projects like the Trans-Caspian International Transport Route (TITR), a key trade link between East Asia and Europe.

Azerbaijan has the ambition of becoming a "digital hub" and has integrated the Trans-Caspian fiber optic project into its national strategy[69]. AzerTelecom signed an agreement with KazakhTelecom in June 2023 to establish a joint venture for the construction and operation of the Trans-Caspian Fiber Optic Communication Line. The project is currently under tender and scheduled to be completed by the end of 2025. The cable will connect Sumgait, Azerbaijan, to Aktau, Kazakhstan. AzerTelecom has negotiated projects with Georgian, Turkmen, and Turkish providers in tandem, potentially connecting Kazakhstan to new networks for routing.

AzerTelecom has branded its fiber-optic line as the "Digital Silk Way," drawing upon the same historic images of the ancient Silk Road that China also used for its One-Belt-One-Road initiative. Azerbaijan has promoted this vision, particularly through institutions such as the Organization of Turkic States.

Similarly, Kazakhstan has emphasized the project's importance, with President Tokayev directly mentioning the Transcaspian fiber-optic project, calling for its completion by end of 2025. He stressed the project's "[importance] for our country in terms of creating a digital infrastructure associated with international corridors and cross-border data flows."[70] On 4 March 2025, the Chairmen of AzerTelecom

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[69] See: "Azerbaijan Digital Hub", https://www.adh.az/, accessed on 21 Nov. 2024.
Ayaz Museyibov, "Azerbaijan's Latest Steps Toward Becoming a Regional Digital Hub", *Eurasian Daily Monitor*, Vol. 19, n°93, (23/06/2022), https://jamestown.org/program/azerbaijans-latest-steps-toward-becoming-a-regional-digital-hub/, accessed on 21 Nov. 2024.

[70] *Tengri News*, "Fiber-optic cable on the bottom of the Caspian Sea: Tokayev called the timing of the completion of the project (Оптоволокно по дну Каспия: Токаев назвал сроки завершения проекта)", 02/09/2024,

and KazakhTelecom, Emil Masimov and Bagdat Musin, signed an agreement to construct fiber-optic cables across the Caspain Sea.[71]

The Internet Society recommends that Kazakhstan continue to explore alternative routing paths, including under the Caspian Sea. Investment in alternative routing will reduce dependencies, diversify international connection points, and increase Internet resiliency within the country as well as for its downstream Central Asian neighbors.

China's Digital Silk Roads: An Interest for Europe-bound Transit via Kazakhstan

China Telecom has maintained a presence in Kazakhstan since 2006, serving Chinese businesses and working closely with its Xinjiang subsidiary.[72] Unlike Russia, with which Kazakhstan inherited Soviet-era communication links, establishing digital connectivity with China required significant investment. Since 2005, China has developed fiber-optic connections with Kazakhstan and other Central Asian states, aiming to become a regional data transit hub. Projects like the Shanghai Cooperation Organization Information Superhighway and the Belt and Road Initiative have promoted cross-border data routes.[73]

Since 2005, China has established cross-border fiber-optic links with Russia, Mongolia, Kazakhstan, Tajikistan, and Kyrgyzstan,[74] all of which also provide access to Europe. China Telecom has established international branches and a regional bandwidth bureau in Xinjiang, allowing traffic to bypass traditional hubs in Beijing, Shanghai, and Guangzhou.

Kazakhstan views China as a possible alternative transit route if Russia isolates its Internet, but this would introduce challenges. The geographical distance to Europe would cause higher latency, and China's strict Internet controls could increase filtering-related delays and costs. Currently, Internet transit from China to Kazakhstan is minimal, requiring increased traffic flow before it can be a viable alternative to Russian transit.

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https://tengrinews.kz/kazakhstan_news/optovolokno-dnu-kaspiya-tokaev-nazval-sroki-zaversheniya-546614/, accessed on 21 Nov. 2024.

[71] Mammadov, Seymur. "Strategic Breakthrough: Undersea Cable across the Caspian to Link Continents | News.Az." *News.AZ*, 10 Mar. 2025, https://news.az/news/-strategic-breakthrough-undersea-cable-across-the-caspian-to-link-continents

[72] Lin Yuhong (蔺玉红), "China Telecom establishes an office in Kazakhstan (中国电信在哈萨克斯坦设立中亚办事处)", 08/06/2006, https://news.sina.com.cn/c/2006-06-08/15419154659s.shtml, accessed on 21 Nov. 2024.

[73] See the standard proposed by Chinese representatives at the International Telecommunications Union : "ITU-T D.1040 (2020) Amd. 1 (07/2024) Optimizing terrestrial cable utilization across multiple countries to boost regional and international connectivity",https://www.itu.int/rec/T-REC-D.1040-202008-I/, accessed on 28 Nov. 2024.

[74] Yang Jie (杨杰), "Connecting the Eurasian Information Corridor (贯通欧亚信息通道)", *People's Post and Telecommunications Daily*, 03 Sep. 2013.

Kazakh ISPs, such as KazakhTelecom, are now peering with transit providers in Hong Kong (China's main Internet hub), potentially making China a more attractive option. Additionally, the growing influence of Chinese content providers like AliCloud, ByteDance (TikTok), and Tencent may drive higher demand for Kazakhstan-China connectivity, further shaping the region's telecom landscape.

Nevertheless, China is increasingly interested in transiting its own traffic through Kazakhstan. Since the beginning of the 2000s it has tried to balance its international bandwidth between submarine cables and land connections for security reasons. Building trans-Eurasian fiber-optic links with Russia was part of this long-term goal. International sanctions against Russia have added new urgency to these goals, with Chinese ISPs again interested in investing in fiber links circumventing Russia towards Europe, adding redundancy and resiliency to the existing channels.

In 2013, China acquired transmission capacity from four terrestrial cables traversing Mongolia, Kazakhstan, and Russia, all headed for Europe.[75] Since 2016, China Telecom has operated a "Transit Silk Road" in collaboration with KazakhTelecom, offering a direct route between Hong Kong and Frankfurt with a claimed round-trip latency of just 162 milliseconds.[76] TNS-Plus also provides transit services between China and Europe, boasting a reported delay of 153 milliseconds between Hong Kong and Frankfurt. Additionally, in 2016, China Telecom signed an agreement with Transtelecom for communication transit.[77]

A Business Opportunity for Kazakh ISPs

As stated previously, Kazakh ISPs such as KazTransCom, Transtelecom, and KazakhTelecom are already earning revenue from Europe-Asia transit services. The new Trans-Caspian route to Azerbaijan has created new business opportunities, as some Europe-to-Asia bandwidth customers are reluctant to use Russian transit. In the near future, Kazakhstan could become a digital crossroad between Europe, East Asia, and South and Southeast Asia. The three main Kazakh backbone operators all operate multi-terabit Europe-to-Asia networks and are already gaining significant revenue from their cross-continental data transit operations.

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[75] Ministry for Industry and Information Technology, "Communication enterprises are fully promoting the integration of communication in the Eurasian region (**通信企业全力推进亚欧区域通信一体化建设**) ", 17/09/2013, https://www.miit.gov.cn/jgsj/zfs/xhxx/art/2020/art_f08048ece09f4d18b73a720294a5eecb.html, accessed on 21 Nov. 2024.

[76] China Overseas Development Association, " From Hong-Kong to Frankfurt ; China Telecom join hands with Kazakh Telecom for the common building of a Transeurasian communication link (**从香港到弗兰克林：中国电信携手哈萨克公司共建欧亚陆上通信线路**)", 19/02/2020, http://www.ciodpa.org.cn/index.php?c=index&a=show&catid=80&id=2188, accessed on 21 Nov. 2024.

[77] China Overseas Development Association, "The Kazakh company Transtelecom invests jointly with China Telecom in the communication sector (哈萨克斯坦Transtelecom公司将在通讯领域与中国电信联合投资)", 07/11/2016, http://www.ciodpa.org.cn/index.php?m=content&c=index&a=show&catid=80&id=2189, accessed on 21 Nov. 2024.

According to Kazakh government data, in 2023, 5% of traffic between Europe and East Asia is transiting through land communication channels in 2023, with 3.5% directly crossing Russia, and 1.5% transiting through Kazakhstan. Astana wants to raise Kazakhstan's share of data traffic in this direction to 5% by 2027. In other words, Kazakhstan does not only wish to attract more traffic but also to compete with Russia in that domain, the geopolitical context brings business opportunities for Kazakh stakeholders.

To reduce the delay in the passage of transit traffic, the Kazakh government plans to build a national information hyper-highway across the country, from west to east. Along the way, they will also construct a tier-III data center, which will allow it to store and transmit both domestic and international data. The "Accessible Internet National Project" alludes to the allure of US-based platforms on the domestic market, naming Microsoft, Amazon, Google, Apple, and Facebook (without mentioning their Russian counterparts). These investments in Kazakhstan's infrastructure and the expected legal reforms could pave the way for the establishment of Points of Presence (POPs) in the country, serving as hubs for their services in the entire Central Asian region. Astana has earmarked a staggering 560 billion Kazakh Tenges for this purpose. $1.1 billion USD is being invested in digital infrastructure building projects as part of the above-mentioned plan, including general connectivity upgrades, rural connectivity, and international transit-related projects.[78] Different players are trying to position themselves in this profitable market.

Digital development projects are emerging, along with new players, both domestic and international, in the Kazakh telecommunications landscape. Among them, Freedom Telecom stands out. In 2017, Freedom Holding Corp., a US-registered investment firm with its headquarters in Almaty, Kazakhstan, founded Freedom Telecom. The company has just announced its intention to invest approximately $236 million USD in two telecommunications projects in Kazakhstan. With an eye on the anticipated expansion of the data transmission market in Central Asia, FreedomTelecom plans to construct a national West-East traffic corridor and build new data centers for storing and processing international data traffic. FreedomTelecom's chief executive officer, Kairait Akhmetov, characterized the investment as a "parallel" sector of Western Europe—South East Asia global data transmission network. Moreover, Kursiv media reported that a data processing center was to be established in the coastal city of Aktau, suggesting potential synergies with local industries.

Additionally, the Kazakh authorities are considering establishing domestic Internet traffic exchange points. This move aims to keep Internet traffic within the country's borders, avoiding the need for it to

[78] Prime Minister of the Republic of Kazakhstan, "Accessible Internet National Project: Kazakhstan residents to be provided with high-speed Internet access of at least 100 Mbit/s", 25/04/2023, https://primeminister.kz/en/news/accessible-Internet-national-project-kazakhstan-residents-to-be-provided-with-high-speed-Internet-access-of-at-least-100-mbits-23858, accessed on 21 Nov. 2024.

travel through international communication networks. This initiative suggests a growing focus on resilience and reduced reliance on international transit.

Satellite Internet: A Possible Alternative Encountering Limitations

Low Earth Orbit (LEO) satellites offer great promise in helping to connect the unconnected. They could be used to help bridge the digital divide in rural, un-served, and under-served regions, provide relief during natural or human disasters, and reduce infrastructure dependencies, improving Internet resiliency. At the same time, they could also introduce new security and privacy concerns.[79]

The Government of Kazakhstan has shared its "2027 Accessible Internet National Project" which, among other things, seeks to provide 95% of the country's households with high-speed Internet access and bring the Internet to 97% of rural residents. LEO satellites have been identified as a potential solution, with the government of Kazakhstan rolling out new connectivity projects. A partnership with Starlink seeks to connect rural schools[80], while a deal with Eutelsat-OneWeb, seeks to connect rural villages.[81] Most recently, Spacesail Kazakhstan Limited, a subsidiary of the Chinese low-earth orbit satellite provider Spacesail International Limited, was registered for operation in Kazakhstan.[82]

The government of Kazakhstan has described these projects as trials and has emphasized that the use of these services by private citizens is illegal. Individuals found using Starlink using illegal equipment face fines.[83] Despite this, the black market for terminals and equipment has only grown.[84]

In November 2023, Director of the Ministry's Telecommunications Committee Diaz Tolegenov declared that "at the moment, use of the current version [of Starlink] violates the existing legislation, as it does

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[79] "Perspectives on LEO Satellites—Using Low Earth Orbit Satellites for Internet Access." *Internet Society*, Nov. 2022, https://www.internetsociety.org/wp-content/uploads/2022/11/Perspectives-on-LEO-Satellites.pdf, accessed on 14 Mar. 2025.

[80] Kemelova, Fatima. "Starlink Expands Internet Coverage to 1,731 Schools in Kazakhstan." *The Astana Times*, 8 Aug. 2024, https://astanatimes.com/2024/08/starlink-expands-Internet-coverage-to-1731-schools-in-kazakhstan/, accessed on 14 Mar. 2025.

[81] Kemelova, Fatima. "Kazakhstan Tests Eutelsat-OneWeb to Expand Internet Coverage to Remote Areas." *The Astana Times*, 23 Oct. 2024, https://astanatimes.com/2024/10/kazakhstan-tests-eutelsat-oneweb-to-expand-internet-coverage-to-remote-areas/, accessed on 14 Mar. 2025.

[82] Zhazetova, Zhanel. "Chinese Rival of Starlink Enters Kazakhstan's Market." *Kursiv Media Kazakhstan*, Kursiv Media Kazakhstan, 22 Jan. 2025, https://kz.kursiv.media/en/2025-01-22/engk-tank-chinese-rival-of-starlink-enters-kazakhstans-market/, accessed on 14 Mar. 2025.

[83] Pannier, Bruce. "Central Asia in Focus: Kazakh Authorities Send Mixed Signals on Using Spacex's Starlink." *Radio Free Europe/Radio Liberty*, 26 June 2024, https://about.rferl.org/article/central-asia-in-focus-kazakh-authorities-send-mixed-signals-on-using-spacexs-starlink/, accessed on 14 Mar. 2025.

[84] Einhorn, Bruce, et al. "Elon Musk's Starlink Terminals Are Falling into the Wrong Hands." *The Japan Times*, The Japan Times, 27 Mar. 2024, https://www.japantimes.co.jp/news/2024/03/26/world/politics/elon-musk-starlink-terminals/, accessed on 14 Mar. 2025.

not meet safety requirements."[85] The legislation in question is understood to be the laws "On Communications" and "On National Security."[86] Together, these laws indicate that the Internet cannot be distributed within Kazakhstan if the control of the communication network is located outside of the borders of the country.

Telecom operators in Kazakhstan typically work closely with government authorities to inspect the Internet traffic of their users and block content. The government of Kazakhstan has invested significant resources in creating tools to this effect, as evidenced by the development and deployment of root certificates for machine-in-the-middle attacks [see section on Encryption for Web Traffic: Machine-in-the-Middle Attacks]. Maintaining a monopoly or duopoly, particularly through the dominance of the state-owned company KazakhTelecom, has facilitated the implementation of content filtering. However, introducing new services from foreign-registered companies without any legal presence in Kazakhstan may hinder the government's control. In case of a nationwide blockade on the scale of the Internet shutdowns of February 2022, citizens could still have access to the Internet via satellite connections, even if the major nodes of the network would be cut off.[87]

Due to the lack of ground stations within the territory of Kazakhstan, Starlink and other international private-sector LEO satellite providers exist outside of the content detection and moderation system developed by the government of Kazakhstan and implemented by domestic telecom providers. In addition to enforcement of content monitoring and blocking obligations, the government of Kazakhstan has shut down Internet access multiple times in recent years in the name of national security. The government of Kazakhstan would likely lack the levers needed to compel international providers like Starlink to comply with any future shutdowns.

In December 2024, an official order[88] from the Kazakh government imposed a total ban on the import into the territory of the Republic of Kazakhstan of certain types of telecommunications means of communication networks, for which the control center is located outside the Republic of Kazakhstan (this directly applies to Starlink-operated services in the country).

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[85] "Казахстанцам Запретили Использовать Интернет Илона Маска." *Главные Новости Казахстана — Tengrinews.Kz*, 17 Nov. 2023, https://tengrinews.kz/kazakhstan_news/kazahstantsam-zapretili-ispolzovat-internet-ilona-maska-517231/, accessed on 14 Mar. 2025.

[86] "Protenge.Kz." *Instagram*, www.instagram.com/p/DCOqkf6uj_9/?igsh=MXNvZ3ZtdWJmN3R3bg%3D%3D&img_index=10. Accessed 31 Jan. 2025.

[87] Irina Refagi (Ирина Рефаги), "In Kazakhstan, the Internet was disabled: could this happen in Ukraine (В Казахстане отключили Интернет: может ли подобное случиться в Украине)", *Focus*, 06/01/2022, https://focus.ua/digital/502522-v-kazahstane-otkluchili-Internet-mozhet-li-podobnoe-sluchitsya-v-ukraine, accessed on 21 Nov. 2024.

[88] Import regulations, see: "О Некоторых Вопросах Регулирования Ввоза На Территорию Республики Казахстан Отдельных Видов Средств Телекоммуникаций Сетей Связи, Центр Управления Которых Расположен За Пределами Республики Казахстан." *Открытые НПА*, legalacts.egov.kz/npa/view?id=15333399. Accessed 31 Jan. 2025.

The government of Kazakhstan has criminalized access to satellite Internet by private individuals based on the providers' non-compliance with these laws. As the providers are international, the government lacks levers to force compliance. By relaxing the existing requirements on both domestic telecom providers and international satellite providers, the government of Kazakhstan would foster a more secure and trustworthy Internet, facilitating economic growth for the country and its residents.

At the same time, the Internet Society has identified the domination of the LEO satellite Internet market by a small number of players as a concern. By licensing multiple satellite providers in all orbits (low earth, medium earth, and geostationary), the government of Kazakhstan can reduce monopoly effects and power imbalances. Recent reporting indicates that the government of Kazakhstan is already doing this by licensing services from multiple LEO satellite providers, including Amazon's Project Kuiper and Eutelsat OneWeb, and China's SpaceSail.

Note that equipment for LEO satellite providers is not interoperable, in that equipment for one system such as Starlink will not work with another provider such as OneWeb. There is cost associated with each deployment and switching requires replacement of all equipment. For this reason, integration of different services doesn't happen with the services themselves, but rather in the networking software connecting the services together.

The Internet Society notes that fiber continues to be the best connectivity solution as it offers the highest speed, lowest latency, and is typically the most reliable. We encourage the government of Kazakhstan to see LEO satellite Internet not as an alternative to the creation of new routes, such as the planned connection via the Caspian Sea, but instead as a complement. This may be especially true in the short term before major fiber-based projects are completed.

The Internet Society also recommends the removal of requirements for telecom providers, including satellite providers, to block, filter, and comply with Internet shutdown requests. Requirements for content surveillance and blocking in Kazakhstan violate key cybersecurity principles, put residents in Kazakhstan at risk, and harm the right to privacy and its associated rights.

The Internet Society recommends that Kazakhstan continue exploring satellite Internet options from diverse providers. LEO satellite Internet offers both a compelling complement to traditional broadband coverage in Kazakhstan and an alternative where that coverage is lacking. In addition to the benefit of better connecting Internet users in Kazakhstan, LEO satellites could serve as a tool for Kazakhstan to diversify its connectivity options and create needed resilience and redundancies in its infrastructure given rising geopolitical tensions.

Government Internet Control and Monitoring

The Internet Cut of January 2022: Domestic Implications

An **Internet shutdown** is an intentional disruption of Internet-based communications, making them inaccessible or unavailable for a specific population, location, or type of access. It is often a state attempt to try to control the flow of information[89] within a region by preventing people from accessing the global Internet.[90]

Following political unrest in the country over rising energy prices, authorities in Kazakhstan cut off access to the Internet starting at 11:00 UTC on 5 January 2022. The access appeared to be briefly and partly restored for a few hours each day before being cut again. As per the Internet Society Pulse Netloss Calculator, the outage continued until 11 January 2022 and cost the Kazakhstan economy over $32 million USD.[91] The lives of Kazakh citizens were severely disrupted as the outage affected such critical systems as banks and mobile payment systems.[92] Authorities in Kazakhstan counted over 220 casualties during the state of emergency.[93]

During the January 2022 shutdown, Kcell and Beeline explained that authorities had taken actions over their network as a counter to alleged "terrorism activities." According to media reports, the Kazakh government first tried to use a Russian deep packet inspection (DPI) technology to precisely filter Internet resources, yet the attempt failed. They therefore resorted to a last-resort complete blockade of Internet access.[94]

Since the introduction of a decree enacted in July 2017, the State Technical Service (STS) has been placed under the administrative supervision of the National Security Committee (NSC)[95]. Under the

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[89] "#KeepItOn: Fighting Internet Shutdowns around the World." *Access Now*, 12 Nov. 2024, https://www.accessnow.org/campaign/keepiton/, accessed on 14 Mar. 2025.

[90] "Internet Society Position on Internet Shutdowns." *Internet Society Pulse*, https://pulse.internetsociety.org/shutdown-statement, accessed 31 Jan. 2025.

[91] Internet Shutdown in Kazakhstan, ISOC Pulse, https://pulse.internetsociety.org/shutdowns/kazakhstan-cuts-off-internet-access, accessed 02 Feb. 2025.

[92] "Internet Shutdowns—Kazakhstan." *Pulse—Internet Society*, https://pulse.internetsociety.org/shutdowns/kazakhstan-cuts-off-internet-access, accessed 31 Jan. 2025.

[93] Kazakh Authorities Say 225 People Killed in Violent Unrest. Al Jazeera, Al Jazeera, 15 Jan. 2022, https://www.aljazeera.com/news/2022/1/15/kazakh-prosecutors-say-225-people-have-died-in-unrest, accessed on 31 Jan. 2025.

[94] Exclusive.kz, "The authorities tried to block the Internet with the help of DPI technology (Власти пытались заблокировать интернет с помощью технологии DPI)", (12/01/2022), https://www.exclusive.kz/expertiza/daily/127157/, accessed on 21 Nov. 2024.

[95] Government of the Republic of Kazakhstan, "Decree No.457—On certain issues of the State Technical Service (О некоторых вопросах государственной технической службы)", 27/07/2017, https://adilet.zan.kz/rus/docs/P1700000457, accessed on 21/ Nov. 2024.

NSC's supervision—which can act without a court order—the STS has the mandate to disrupt Internet services to maintain law and order, as well as the mandate to block contents deemed unlawful. The government can compel ISPs to restrict access to "unlawful materials," and if ISPs fail to do so, STS can directly act upon their networks to enact the restriction. (According to MISD, there were more than 68,000 web pages blocked as of May 2023.[96])

The same amendment has also made the management of IXPs handling international traffic a state monopoly in the name of "information security." The decree states: "The Ministry of Information and Communications of the Republic of Kazakhstan (...), to ensure the adoption of measures for the transfer to the National Security Committee of the Republic of Kazakhstan of equipment for the implementation of centralized management of telecommunications networks, a single gate of Internet access."

In December 2017, the national law on information and communications was amended to include Article 9-2, about the "State monopoly in the field of information security"[97] detailed as such:

> *The State Technical Service carries out the following types of activities related to the state monopoly in the field of information security:*
>
> - *technical support of the system of centralized management of telecommunications networks of the Republic of Kazakhstan, as well as international points of joint;*
> - *organization and technical support of Internet traffic exchange points of operators of long-distance and international communication operators in the territory of the Republic of Kazakhstan, as well as the accession of networks of operators of intercity and international communication to the point of exchange of Internet traffic.*
>
> *Prices for goods (works, services) produced and (or) sold by the subject of the state monopoly are established by the national security bodies in coordination with the antimonopoly body.*

In March 2018, an order of the Chairman of the National Security Committee introduced the "Rules of connection of networks of communication operators to points of exchange of Internet traffic and Internet traffic transmission," which attributed the management of the points of exchange managing

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[96] Freedom House, "Freedom of the Net 2023—Kazakhstan", 2024, https://freedomhouse.org/country/kazakhstan/freedom-net/2023#footnote1_XecbtGDYJF0vQwRFfmwTXZn9arqSJDgGu6D4k2lAVVc_potDGO3u9cgV, accessed on 21 Nov. 2024.

[97] Government of the Republic of Kazakhstan, "Law No. 128-VI 'About modification and additions to some legislative acts of the Republic of Kazakhstan on questions of information and communications (О внесении изменений и дополнений в некоторые законодательные акты Республики Казахстан по вопросам информации и коммуникацийà)'", 28/12/2017,https://online.zakon.kz/Document/?doc_id=34205812&pos=397;-58#pos=397;-58, accessed on 31 Jan. 2025.

Internet traffic to the State Technical Service (STS).[98] Any operator wishing to interconnect at the public IXP, therefore, needs agreements with the state-led STS. Article 11 of Chapter 2 (The Procedure) specifies that "Bringing of Internet traffic of telecom operators in the territory of the Republic of Kazakhstan is carried out through the points of exchange of Internet traffic."

According to STS's official website, state-related bodies as well as "owners or holders of critical information" are forced to carry their traffic through a Unified Gateway to Internet access (UGIA) which requires the operators to follow specific requirements, such as the installment of regulated equipment and software. UGIA is a specific channel of connectivity reserved for state-related communications which is exclusively provided through reserved operator land channels, with no traffic exchanged by satellite and radio. The aim of such specified access is reportedly to "ensure a reliable and stable connection, as well as strengthening the security of user data."[99] By default, it also blocks virtual private network (VPN) applications, remote access tools, known malware, and unknown programs.

Only special state and law enforcement agencies, as well as the National Bank of Kazakhstan, are allowed to organize Internet connections without using a Unified Gateway to Internet Access for 'operational purposes.'[100]

Since the introduction of a decree in 2018, the National Security Committee (NSC), the Ministry of Defense, the Ministry of Internal Affairs, and the Prosecutor's General Office can have access to ISPs' networks, and enforce a network shutdown in case of emergency. STS was reorganized as a state-owned joint-stock company in October 2020, still placed under the NSC.

Kazakhstan's Internet Shutdowns' Consequences for the Region

According to The Diplomat, the week-long Internet shutdown of January 2022 may have led to a loss of up to $410 million for the Kazakh economy. Besides, amendments from 2014 and 2016 to communication laws now allow the Prosecutor General's Office to cut the Internet without a court decision and the National Security Committee picks government actors that can restrict Internet access

[98] Chairman of the National Security Committee of the Republic of Kazakhstan, "Order No.24 of March 27, 2018, On the Approval of the rules of the exchange of Internet traffic and connection of Internet traffic transmission points of communication operators' networks (Байланыс операторлары желілерін интернет-трафикпен алмасу және интернет-трафикті өткізу нүктелеріне қосу қағидаларын бекіту туралы)", 27/03/2018, https://adilet.zan.kz/kaz/docs/V1800016781; accessed on 31 Jan. 2025.

[99] TeleAlpha, "Unified Gateway to Internet Access (UGIA)", https://telealpha.kz/en/service/Internet-po-eshdi.$, accessed on 21 Nov. 2024.

[100] JSC State Technical Service, "Unified Gateway to Internet Access and Unified Gateway of Email of 'electronic government'", https://sts.kz/en/activity/eshdi/, accessed on 21 Nov. 2024.

and other communication services[101]. As Cloudflare reports, mobile traffic represents about 75% of total Internet traffic in Kazakhstan, leading to massive disruption when mobile traffic stopped in January.[102]

Different hypotheses can be explored to better understand how the Internet was shut down and what it means for the future development of communications in Kazakhstan. Cybersecurity expert Konstantin Korsun notes that blocking the Internet is more easily done if the exchange of international traffic is mostly handled by one carrier (monopolistic situation) or if the state has a monopoly over the communication sector.[103] Korsun points at KazakhTelecom and TransTelecom as such monopolists, providing broadband Internet access, interactive television, cellular communications, and local and long-distance telephone services. He adds that they could restrict access to the Internet using Deep Packet Inspection technology (DPI). However, Andrei Baranovich, another cybersecurity specialist, adopts a more drastic view of the events :

> *"The country's banking system was down, cash registers in shops were not working [...]. I think that we are not talking about traffic filtering here, but perhaps about switching off equipment in places where international Internet systems are switched."*[104]

Baranovich adds that the hyper-centralized structure of the Kazakh network and its restricted number of network operators make the Internet in the country easier to shut down. This can be verified by plotting BGP graphs and ranking networks by their centrality value. Data provided by Cloudflare and Google also supports this hypothesis, showing a slowdown in traffic on 4 January 2022, followed by a complete stop in the days afterward, only picking up again during televised presidential addresses. Although unable to send or receive packets, Kazakh networks still appear visible on the global routing system (BGP), indicating that they've remained "connected" to the Internet.[105]

In office at the time of the January 2022 nationwide Internet shutdown, former Minister Bagdat Musin introduced a list of websites to which access should not be restricted. To appear on the list, companies

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[101] Catherine Putz, "Internet Shutdown Pushback in Kazakhstan", *The Diplomat*, 30/08/2023, https://thediplomat.com/2023/08/Internet-shutdown-pushback-in-kazakhstan/, accessed on 21 Nov. 2024.

[102] João Tomé, "Internet shut down in Kazakhstan amid unrest", *Cloudflare*, 07/01/2022, https://blog.cloudflare.com/Internet-shut-down-in-kazakhstan-amid-unrest/, accessed on 21 Nov. 2024.

[103] "В Казахстане Отключили Интернет: Может Ли Подобное Случиться в Украине." *ФОКУС*, 6 Jan. 2022, https://focus.ua/digital/502522-v-kazahstane-otkluchili-internet-mozhet-li-podobnoe-sluchitsya-v-ukraine, accessed on 21 Nov. 2024.

[104] Irina Refagi, "The Internet has been turned off in Kazakhstan: can this happen in Ukraine", *Фокус*, 06/01/2022, https://focus.ua/digital/502522-v-kazahstane-otkluchili-Internet-mozhet-li-podobnoe-sluchitsya-v-ukraine, accessed on 21 Nov. 2024.

[105] Emile Aben, "The Kazakhstan Outage—As Seen from RIPE Atlas", *RIPE Labs*, 07/01/2022, https://labs.ripe.net/author/emileaben/the-kazakhstan-outage-as-seen-from-ripe-atlas/, accessed on 25 Nov. 2024.

have to register and provide information to the government.[106] More recently, after meeting with Pavel Durov (Telegram CEO) Bagdat Musin announced that KazakhTelecom and Telegram had agreed to exchange data directly without relying on a transit provider. This news comes a few months after Pavel Durov toured central Asia and claimed that Telegram was the main communication platform for the Kazakh people with a 12.5 million user base in the country.[107]

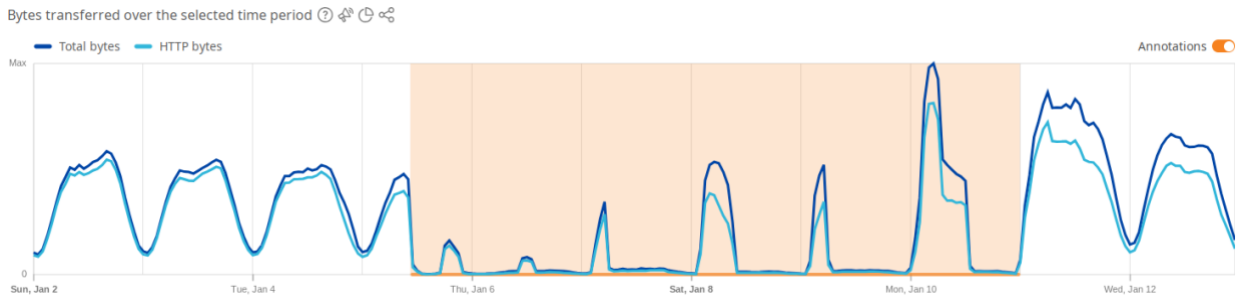

Figure 19. Cloudflare Traffic in Kazakhstan from 2 to 12 January 2022. (Source: Cloudflare Radar)

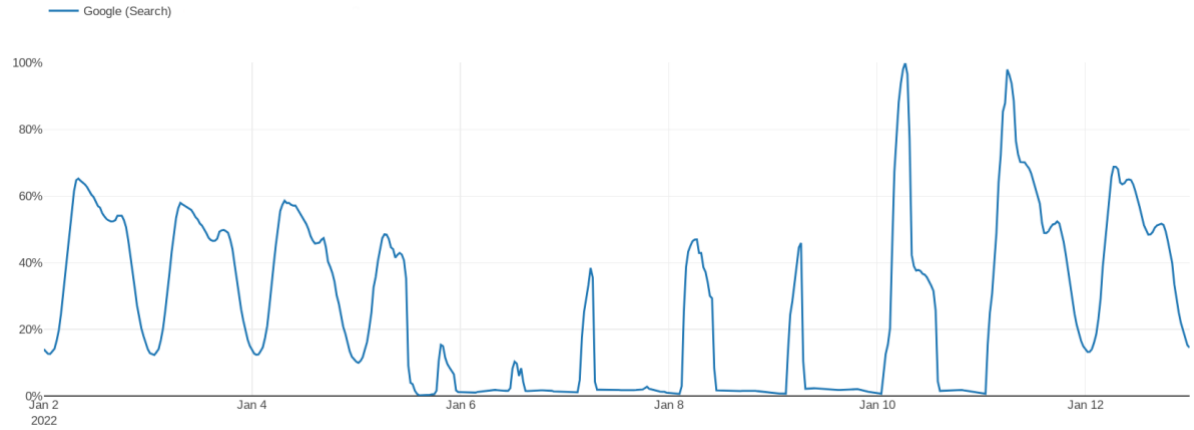

Figure 20. Google search traffic in Kazakhstan, 2 to 12 January 2022. (Source: Google transparency report)

The Internet Society recommends that the government of Kazakhstan support policies that keep the Internet on and strong, to build strong economies and give people an opportunity for a prosperous future. Internet shutdowns harm societies, economies, and the global Internet infrastructure. They also present a risk for many businesses and investors, including those building infrastructure and/or developing services. This is because they signify that a country's Internet infrastructure is not resilient nor reliable and that the country's government has the ability and the willingness to shut it down.

[106] Putz, Catherine. "Internet Shutdown Pushback in Kazakhstan." *The Diplomat*, The Diplomat, 31 Aug. 2023, https://thediplomat.com/2023/08/internet-shutdown-pushback-in-kazakhstan/, accessed on 25 Nov. 2024.

[107] Azimzhanova, Ayturgan. "Kazakhtelecom Intensifies Collaboration with Telegram." Kursiv Media Kazakhstan, Kursiv Media Kazakhstan, 7 Aug. 2024, https://kz.kursiv.media/en/2024-08-07/kazakhtelecom-intensifies-collaboration-with-telegram/#:~:text=According, accessed on 25 Nov. 2024.

Importantly, research has found that in instances when governments have implemented or ordered Internet shutdowns in response to civil unrest, information blackouts resulting from these shutdowns can actually result in increased violence. Violent tactics that are less reliant on effective communication and coordination are substituted for non-violent protests that rely on the Internet for organization.[108]

We recommend that the government of Kazakhstan remove obligations to route traffic through the Unified Gateway to Internet Access. Decentralization of routing will increase Internet resiliency by removing single points of failure that could be misused for Internet shutdown purposes.

Encryption for Web Traffic: Machine-in-the-Middle Attacks

Encryption is the process of scrambling or enciphering information so it can be understood only by someone with the means to return it to its original state. It protects the confidentiality of stored or transmitted data by making it unintelligible so that even if a third party gains access to the data, it would not be able to make sense of it.

Over 95% of web traffic in the world is protected using the encryption protocol TLS (transport layer security). This protocol is what keeps Internet traffic safe and usable for citizens, protecting data as it is transmitted between a website and the user's browser. When browsing the web, the "S" in HTTPS lets Internet users know that the encryption protocol is being used.

In previous years, the Kazakh government has made various efforts to bypass the protection offered by TLS using machine-in-the-middle (MITM) attacks. MITM attacks work by positioning the attacker, in this case the government authority, in between the two endpoints of an encrypted transmission. Criminals use this approach to intercept valuable data, for example, sensitive banking information, or to impersonate another party for the purpose of fraud or blackmail. Government-led MITM attacks could similarly intercept data for the purpose of surveillance, the monitoring of Internet user activities, or blocking users from accessing certain content on the Internet.

A root certificate notifies browsers that a certificate can be trusted within the TLS system, confirming that the encryption protocol is activated and that the transmission is secure. Browsers carefully evaluate root certificates according to a set of security standards before accepting them in their root stores. The certificates associated with these accepted root certificates are typically pre-downloaded on user devices to facilitate quick and efficient web browsing.

A government-issued root certificate, when downloaded on a user's device, would be able to circumvent the protection offered by the TLS encryption protocol by vouching for certificates that do not meet the root store's security standards. Once these certificates are installed, users have no way of knowing their communications are no longer secure. Browsers will still show a lock symbol or other

[108] Rydzak, Jan. "Of Blackouts and Bandhs: The Strategy and Structure of Disconnected Protest in India." *SSRN*, 11 Feb. 2019, papers.ssrn.com/sol3/papers.cfm?abstract_id=3330413.

indicator that the traffic is "encrypted and secure" with the result that users may send sensitive data under false assurances that their data is protected.

The government of Kazakhstan has developed root certificates, which it has periodically pressured Kazakhstani residents to install on their devices. Amendments to Kazakhstan's Law "On Communications" facilitated the creation of government root certificates,[109] and in late 2015, the government announced that all citizens should install the root certificate on their devices.[110] However, pressure from Internet users and businesses in Kazakhstan delayed the roll-out of the certificate.[111]

In 2019 the Internet Society issued a statement[112] in reaction to news[113] that the government of Kazakhstan was again coercing the users of Kazakh mobile operators to download government-issued root certificates on their mobile and desktop devices. At the time we emphasized that requiring Internet users to install root certificates that belong to the government could give the government the ability to intercept encrypted HTTPS traffic, breaking secure communication. As a result, the government could see, monitor, record, and even block interactions between Kazakh users and any website, including banks, email providers, social networks—and critical public services like electricity, elections, hospitals, and transportation.

In 2020, users in Kazakhstan received SMS messages notifying them that the root certificate had to be installed to continue accessing foreign Internet resources.[114] Whereas in previous years government representatives had indicated that installing this certificate was voluntary and intended to combat

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[109] *Internet Freedom—Kazakhstan*, https://ifkz.org/ru, accessed 31 Jan. 2025.

[110] "Kazakhtelecom JSC Notifies on Introduction of National Security Certificate from 1 January 2016." *Kazakhtelecom*, https://web.archive.org/web/20151202203337/telecom.kz/en/news/view/18729, accessed 31 Jan. 2025.

[111] "Kazakhstan Government Is Now Intercepting All HTTPS Traffic." *ZDNET*, https://www.zdnet.com/article/kazakhstan-government-is-now-intercepting-all-https-traffic/, accessed 31 Jan. 2025.

[112] "The Internet Society's Concerns on the Recent Government Action in Kazakhstan Regarding Encrypted Internet Traffic ." *Internet Society*, www.Internetsociety.org/news/statements/2019/Internet-society-concerns-kazakhstan-encryption/, accessed on 26 Nov. 2024.

[113] "Kazakhstan Government Is Now Intercepting All HTTPS Traffic." *ZDNET*, www.zdnet.com/article/kazakhstan-government-is-now-intercepting-all-https-traffic, accessed 31 Jan. 2025.

[114] Yelzhan Kabyshev (Head of Legal Practice, Eurasian Digital Foundation. "Kazakhstan: TLS MITM Attacks and Blocking of News Media, Human Rights, and Circumvention Tool Sites." *OONI*, ooni.org/post/2024-kazakhstan-report/, accessed on 21 Nov. 2024.

phishing attacks,[115] in 2020, officials confirmed that MITM technology was deployed for the general purpose of inspecting Internet traffic and blocking prohibited content.[116]

Apple, Google, Microsoft, and Mozilla have responded to these events by blocking the use of the government root certificate within their browsers. In the case of Mozilla, this means that Internet users in Kazakhstan who have downloaded the certificate will face error messages notifying them that the certificate should not be trusted.[117]

OONI research identified that between 2021 and 2024, four distinct government root certificates and seven distinct intermediate certificates were deployed for MITM attacks. The root certificate was used to carry out MITM attacks on 19 different networks and 14 distinct domain names.[118] The large number of networks suggests that ISPs are highly compliant with government directives.

In February 2024, nongovernmental organization the Cyber Attacks and Analysis Center claimed that an allegedly Chinese state-sponsored espionage operation had gained full access to the critical infrastructure of Kazakhstani telecommunications operators, public service providers, and private companies in the country.[119] It is unclear to what extent Kazakhstani web browsing data intercepted by Kazakhstani telecom operators using the government root certificate may have been compromised during this time.

See Appendix Table 1 where Kazakhstan's root certificate program is analyzed using the Internet Society's Internet Impact Assessment Toolkit.[120] The toolkit identifies that Kazakhstan's program negatively impacts several of the enablers of the open, globally connected, secure, and trustworthy Internet. Internet users in Kazakhstan impacted by the root certificate therefore do not enjoy the full benefits of the Internet.

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[115] "Обязаны Ли Казахстанцы Устанавливать Сертификаты Безопасности, Рассказал Оспанов." *NUR.KZ*, https://www.nur.kz/society/1805962-obazany-li-kazahstancy-ustanavlivat-sertifikaty-bezopasnosti-rasskazal-ospanov/, accessed on 29 Feb. 2024.

[116] "Анонимность Под Угрозой: Анализ Законодательства Казахстана." *Ландшафт Цифровых Прав и Свобод*, Ландшафт цифровых прав и свобод, 30 Nov. 2023, https://drfl.kz/ru/anonymity-in-kazakhstan/, accessed on 29 Feb. 2024.

[117] "Continuing to Protect Our Users in Kazakhstan." *Mozilla: Open Policy & Advocacy*, 18 Dec. 2020, https://blog.mozilla.org/netpolicy/2020/12/18/kazakhstan-root-2020/, accessed on 29 Feb. 2024.

[118] Kabyshev, Yelzhan. "Kazakhstan: TLS MITM Attacks and Blocking of News Media, Human Rights, and Circumvention Tool Sites." *OONI*, https://ooni.org/post/2024-kazakhstan-report/, accessed on 21 Nov. 2024.

[119] "Хакерская Группировка Более 2 Лет Имела Полный Доступ к Критической It Инфраструктуре Казахстана—ЦАРКА." *Аналитический Интернет-Журнал Власть*, Интернет-журнал Власть, https://vlast.kz/novosti/59025-hakerskaa-gruppirovka-bolee-2-let-imela-polnyj-dostup-k-kriticeskoj-it-infrastrukture-kazahstana-carka.html, accessed on 21 Feb. 2024.

[120] "Internet Impact Assessment Toolkit." *Internet Society*, https://www.internetsociety.org/resources/internet-impact-assessment-toolkit/, accessed on 17 Jan. 2025.

The Internet Society recommends that the government of Kazakhstan restore public trust in the Internet by formally discontinuing its root certificate program. The government of Kazakhstan should work with Internet Service Providers and public media to instruct Internet users in Kazakhstan to remove the root certificate from their devices and change their passwords for online accounts.

We also recommend that the government of Kazakhstan vocally endorse encryption as a key component of their national cybersecurity strategy, acknowledging the importance of encryption in protecting the country and its residents against attacks from foreign countries and criminal groups.

Kazakhstan's Geopolitical Connectivity Challenges and Opportunities

Kazakhstan faces ongoing geopolitical challenges in its immediate environment, with tensions in neighboring Russia and China shaping its international connectivity strategy. The uncertainty surrounding Russia's Internet policies, particularly the potential isolation of the Russian Internet through the sovereign RuNet initiative, could disrupt Kazakhstan's reliance on Russian transit routes. At the same time, while China offers an alternative, its strict Internet controls and filtering mechanisms introduce technical and political complexities. Given the potential for further regional instability, Kazakhstan must proactively diversify its connectivity options to maintain robust and resilient Internet access.

One of the key opportunities for Kazakhstan lies in increased global interest in Central Asia. With geopolitical shifts and supply chain realignments, international investors and tech companies are looking to expand their presence in the region. This provides an opportunity for Kazakhstan to attract foreign direct investment (FDI) into its digital infrastructure, improving network redundancy and resilience. Investment from global telecom providers, hyperscalers (such as AWS, Google Cloud, and Microsoft Azure), and IXPs could help Kazakhstan strengthen its Internet backbone while reducing dependency on a small number of transit providers. Similarly, the government should lower the barriers to entry for locally-grown cloud providers and encourage sound competition by diversifying the market.

Another significant opportunity is Kazakhstan's alignment with Azerbaijan and China's digital expansion strategies. Azerbaijan, which sits at a strategic crossroads between Europe, the Caucasus, and Central Asia, is actively expanding its fiber and transit capacity as part of the Middle Corridor. Closer cooperation with Azerbaijan could allow Kazakhstan to develop alternative routes to Europe that bypass Russia, improving network resilience. Similarly, China's growing role as a data transit hub offers Kazakhstan a potential eastward alternative, despite concerns over Internet filtering and geopolitical risks. By negotiating favorable transit agreements with China, Kazakhstan can benefit from improved access to Chinese content and cloud services, particularly as demand for platforms like AliCloud, ByteDance (TikTok), and Tencent grows in the region.

Finally, Kazakhstan should embrace emerging technologies such as low Earth orbit (LEO) satellite broadband to enhance connectivity in remote and underserved areas. Companies like Starlink, OneWeb, and China's Guowang are deploying LEO satellite networks, offering high-speed Internet access without relying on terrestrial fiber or traditional geostationary satellites. By partnering with satellite providers and facilitating regulatory approvals for LEO operations, Kazakhstan can rapidly expand broadband coverage in rural areas, reducing its digital divide and improving access to online services.

Recommendations for Improving Internet Access, Security, and Freedom in Kazakhstan

Based on the above study, the Internet Society is providing these recommendations that can help Kazakhstan improve its Internet resilience, expand access to underserved populations, and foster a more open and secure digital environment:

1. **Strengthening Regional Cooperation:** Kazakhstan should enhance regional cooperation to improve Internet resilience and diversify its connectivity options. One way to achieve this is by encouraging Kazakh network operators and other stakeholders to participate in forums such as the Central Asia Peering and Interconnection Forum (CAPIF). By improving coordination on international infrastructure projects, Kazakhstan and its neighbors can develop alternative routes to Europe and Asia, reducing dependency on any single transit provider.
2. **Encouraging Alternative Connectivity Solutions:** Given the geopolitical risks associated with heavy reliance on Russian transit networks, Kazakhstan must diversify its Internet routes. Investments in fiber-optic connections through Azerbaijan and the Caspian Sea should be prioritized. At the same time, Kazakh Internet users should consider satellite providers as a useful source of additional connection diversity, but overreliance on any single form of Internet transport has the potential to create single points of failure, surveillance, and control.
3. **Connecting Remote Areas**: Kazakhstan should continue to explore the potential of low Earth orbit (LEO) satellite Internet as a backup connectivity option, particularly in remote areas. While fiber remains the superior long-term solution due to its speed and reliability, LEO satellite Internet can provide temporary solutions for underserved communities and during emergency situations.
4. **Enhancing Internet Security and Privacy:** Kazakhstan must take steps to protect Internet users from surveillance and cyber threats. The government should formally discontinue its root certificate program, which has been used to intercept encrypted Internet traffic. This program undermines trust in online services and exposes users to security risks. Internet Service Providers (ISPs) and regulatory authorities should work together to restore public confidence by ensuring that user data remains private and secure. Additionally, encryption should be endorsed as a key component of national security, protecting users from cyberattacks and foreign espionage.
5. **Promoting an Open and Competitive Market:** Kazakhstan's Internet market remains highly concentrated, with KazakhTelecom playing a dominant role. To encourage competition, the government should implement policies that make it easier for new ISPs and content providers

to enter the market. This includes reducing barriers to entry for international cloud providers and content distribution networks such as removing the requirement for majority local ownership to increase competition and open up the market.

6. **Developing more Internet Exchange Points (IXPs):** The Kazakh government should implement policies to promote greater participation in IXPs to enhance network resilience, reduce latency, and lower transit costs. This includes incentivizing all ISPs, content providers, and enterprises to peer at IXPs by ensuring a neutral, transparent, and competitive environment. Privatization or public-private partnerships for the government-owned IXP could encourage wider adoption. Additionally, investment in infrastructure such as in carrier-neutral data centers will help improve local traffic exchange, reducing reliance on costly international transit.
7. **Preventing Internet Shutdowns and State Control Over Content:** Government-led Internet shutdowns have had serious economic and social consequences. To ensure stability, the government should remove obligations that require ISPs to route traffic through the Unified Gateway to Internet Access, which acts as a centralized control mechanism. Instead, Kazakhstan should adopt policies that support an open and globally connected Internet, ensuring that businesses, media, and civil society can operate without disruptions.

Conclusion

This report analyzes Kazakhstan's digital connectivity landscape, identifying potential infrastructure dependencies, the impact of government policy on Internet quality, and opportunities to address these challenges.

The digital connectivity landscape in Kazakhstan is largely robust though issues persist. Efforts to reform the telecom market and increase competition in the sector have been successful, but more work is needed to reduce market concentration further. KazakhTelecom, the incumbent, continues to play a central role at both the domestic and international connectivity levels.

Kazakhstan's connectivity to the global Internet is largely dependent on Russia, which could prove problematic if geopolitical relations between the two countries were ever to be strained. Efforts to reduce these dependencies are evident with government-backed initiatives to create new, diversified routes towards Europe. Such efforts are expected to increase Internet resiliency both for Kazakhstan and its downstream Central Asian neighbors including Kyrgyzstan, Tajikistan, and Uzbekistan.

Kazakhstan's telecom sector remains highly concentrated, dominated by KazakhTelecom (which also owns Kcell) and VEON (Beeline/TNS-Plus). Other players like Transtelecom and KazTransCom have some influence, but overall, market concentration is a concern. With only two major players controlling the majority of the market, competition is weak. This could lead to higher Internet prices and lower service quality, as consumers have few alternative providers. The government should provide incentives (tax breaks, grants) for new ISPs to enter the market and create a healthy and competitive ecosystem.

Furthermore, Russian content is heavily consumed by Internet users in Kazakhstan, solidifying consumer demand for connectivity to Russia. The development of local content over time would likely increase local consumption and increase the proportion of local traffic.

New Internet connectivity projects via the Caspian Sea seek to create alternative paths to Europe. Investment in the Europe-East Asia transit line would reduce dependencies on Russia and could also be lucrative for Kazakh ISPs in the long run as they would be able to extract transit revenue. Meanwhile, government trials of low-earth orbit satellite options offer short-term solutions to dependency concerns but should not be seen as a full substitute for terrestrial infrastructure in terms of quality and reliability.

Government interventions in recent years have damaged Internet trustworthiness and reliability. The use of root certificates to bypass website encryption risks putting Kazakh Internet users at risk. Internet shutdowns and heavy-handed content blocking harm Kazakh society, economy, and the global Internet infrastructure. It is vital that the Kazakh government supports the open, globally connected, secure, and trustworthy Internet to ensure that the Internet works for everyone in Kazakhstan.

Appendix

Internet Impact Assessment

Table 3. Analysis of Kazakhstan's root certificate program using the Internet Society's Internet Impact Assessment Toolkit.

Critical Property		
An Accessible Infrastructure with a Common Protocol		Not impacted
An Open Architecture of Interoperable and Reusable Building Blocks		Not impacted
Decentralized Management and a Single Distributed Routing System		Not impacted
Common Global Identifiers		Not impacted
A Technology Neutral, General-Purpose Network		Not impacted
Goal	Enabler	
Open	Easy and unrestricted access	Not impacted
Open	Unrestricted use and deployment of Internet technologies	The TLS encryption protocol keeps Internet traffic safe and usable for citizens, protecting data as it is transmitted between a website and the user's browser. Use of the Kazakh government's root certificate exposes Internet users to MITM attacks, undermining this protocol. Kazakhstani Internet users are therefore restricted from the full use of TLS encryption in a way that Internet users elsewhere in the world are not.
Open	Collaborative development, management, and governance	Not impacted.

Globally Connected	Unrestricted reachability	The government of Kazakhstan's root certificate facilitates machine-in-the-middle attacks, which can be used to block user access to specific content. While content blocking does is exist in other countries, this usually happens at the website level using processes that are transparent and designed to prevent abuse. MITM attacks allow the Kazakh government to filter and block not only at the website level but also at more granular levels, for example by interfering with specific pieces of text or information. The security actions taken by browsers mean that Internet users in Kazakhstan who have downloaded the certificate may also experience error messages when trying to access websites. Together, Internet users in Kazakhstan may find that they are restricted from reaching specific content on the Internet that is readily available elsewhere in the world.
Globally Connected	Available capacity	Not impacted
Secure	Data confidentiality of information, devices, and applications	MITM attacks work by positioning the attacker, in this case, the government authority, in between the two endpoints of an encrypted transmission. Government-led MITM attacks could intercept data for the purpose of surveillance, violating data confidentiality assurances provided by the TLS encryption protocol. User security is additionally compromised as the storage and transmission of data intercepted by the government is unaccounted for. Criminals and foreign governments could target intercepted communications for their own purposes. The reported compromise by a Chinese state-sponsored espionage operation is a reminder of the associated risk.
Secure	Integrity of information, applications, and services	MITM compromises the TLS encryption protocol, leaving data in transit exposed to interception and manipulation. Internet users will not know if their data has been tampered with by authorities or other third parties (criminals, foreign nations), compromising user security.

Trustworthy	Reliability, resilience, and availability	Once government root certificates are installed on user devices, users have no way of knowing their communications are no longer secure. Browsers will still show a lock symbol or other indicator that the traffic is "encrypted and secure" with the result that users may send sensitive data under the false assurance that the data is protected. This gap between expectations and reality can break down user trust, giving the impression that use of the Internet is unreliable. This runs counter to Kazakhstan's ambitions under the "Accessible Internet National Project."[121]
Trustworthy	Accountability	MITM attacks lack accountability as Internet users do not have mechanisms to know if their data has been intercepted and for what purposes. If a user believes that the confidentiality of their data has been compromised or that their access has been blocked, there is similarly no complaint mechanism available to them. This lack of accountability reduces trust in the Internet and digital technologies in general.
Trustworthy	Privacy	Government-led MITM attacks could intercept data for the purpose of surveillance. Privacy is an essential component of Internet trustworthiness. When Internet users lack the tools to control who they share sensitive information with and when they are likely to perceive the Internet as untrustworthy.

[121] Accessible Internet National Project: Kazakhstan residents to be provided with high-speed Internet access of at least 100 Mbit/s." Official Information Source of the Prime Minister of the Republic of Kazakhstan, April 25, 2023. https://primeminister.kz/en/news/accessible-Internet-national-project-kazakhstan-residents-to-be-provided-with-high-speed-Internet-access-of-at-least-100-mbits-23858/.

Internet Resilience in Central Asia: Kazakhstan Leading the Game

The Internet Society tracks and indexes Internet resiliency metrics using the Pulse Internet Resilience Index (IRI).[122] Our overall measure of Internet resilience is based on the following pillars:

Infrastructure	Performance	Security	Market Readiness
The existence and availability of physical infrastructure that provides Internet connectivity.	The ability of the network to provide end-users with seamless and reliable access to Internet services.	The ability of the network to resist intentional or unintentional disruptions through the adoption of security technologies and best practices.	The ability of the market to self-regulate and provide affordable prices to end-users by maintaining a diverse and competitive market.

Figure 21. Internet Resilience Index four pillars

As of October 2023, Central Asia's overall IRI score of 42% (Figure 1) is below the overall average for Asia (47%) and the lowest of its neighboring sub-regions: Southern Asia (49%), Western Asia (45%), Eastern Asia (56%) and South-Eastern Asia (44%).

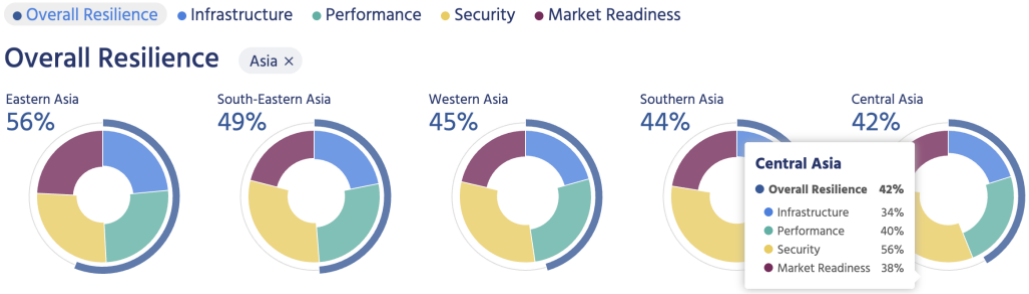

Figure 22. Central Asia's overall Internet resilience ranks last among the five sub-regions in Asia Pulse Internet Resilience Index scores. Source: Internet Society Pulse.

Looking at each country in the sub-region (Figure 23), we can see a wide range of resilience, from 48% in Kazakhstan to 29% in Tajikistan.

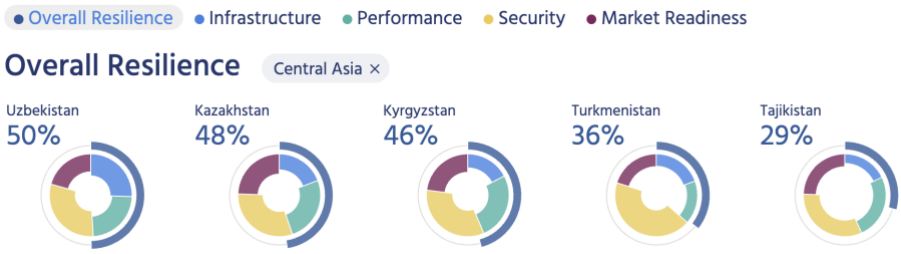

Figure 23. The overall Internet Resilience Index score for each country in Central Asia. Source: Internet Society Pulse.

[122] Internet Resilience Index, https://pulse.internetsociety.org/resilience, accessed on 14 Mar. 2025.

If we compare the scores for the pillars of each country, we can see that Tajikistan resiliency is consistently low across all areas. In the other countries, there have been varying degrees of effort to increase resilience, most notably security resilience, which is the number one ranking pillar for Kazakhstan (58%), Kyrgyzstan (61%), and Uzbekistan (61%).

Kazakhstan has the most developed Internet ecosystem and ranks highest in all three of the four IRI pillars out of the five countries in the region. Its overall IRI score of 48% is above the subregional average of 42% and comparable with the average for Asia (47%).

Routing Security

Internet routing is susceptible to misoperation and routing hijack. This is why it is important to monitor the hygiene of the routing ecosystem. The MANRS Observatory[123] provides an overview of the state of routing security at the network level and by aggregate at the country level. MANRS also provides a score looking at some key metrics such as the number of reported incidents, the % of IP space registered in the IRR (Internet Routing Registries), the % of the IP space covered in RPKI and the % of Route Origin Validation[124] (ROV) performed by network operators.

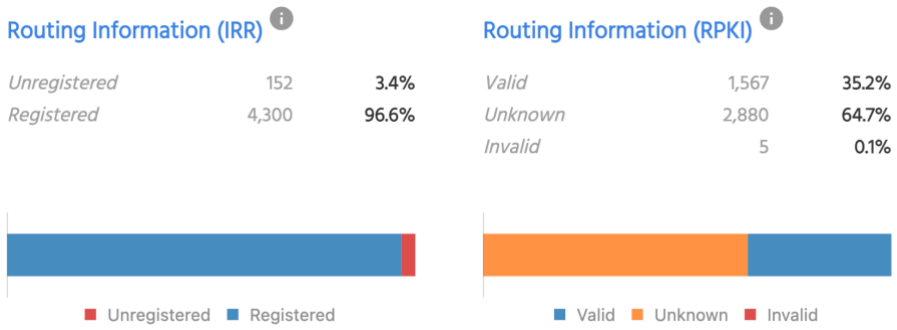

Figure 24. More than 96% of IP prefixes in Kazakhstan appears in the Internet Routing Registries. 35% of IP prefixes are also RPKI-valid.

The MANRS Observatory also provide a global readiness score, broken down in five categories representing the mandatory set of actions for MANRS compliance.

Our analysis reveals that only a very small fraction of Kazakhs IPv4 prefixes are registered in RPKI, hence these prefixes are susceptible to hijacking. Kazakhstan RPKI deployment (12%) is far behind the global RPKI deployment that reached over 50% in 2024. For IPv6, 78% of the active prefixes are registered in RPKI, although this is seemingly more encouraging, this value is deceptively high due to the very low IPv6 adoption in Kazakhstan (only 18% of registered IPv6 prefixes are active in BGP).

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[123] *MANRS Observatory*, https://observatory.manrs.org/#/overview, accessed 31 Jan. 2025.

[124] RPKI ROV Deployment Reaches Major Milestone, Doug Madory and Job Snijders. https://www.kentik.com/blog/rpki-rov-deployment-reaches-major-milestone/, accessed 31 Jan. 2025.

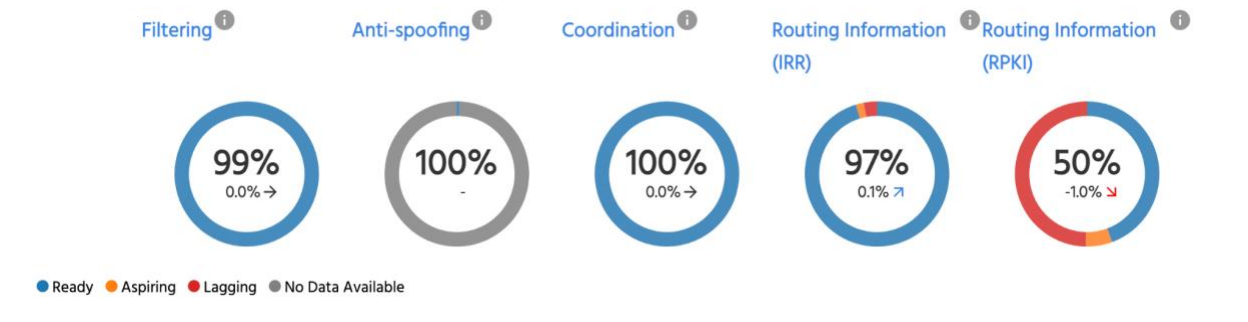

Figure 25. Kazakhstan has a remarkable readiness score in each category except for RPKI.

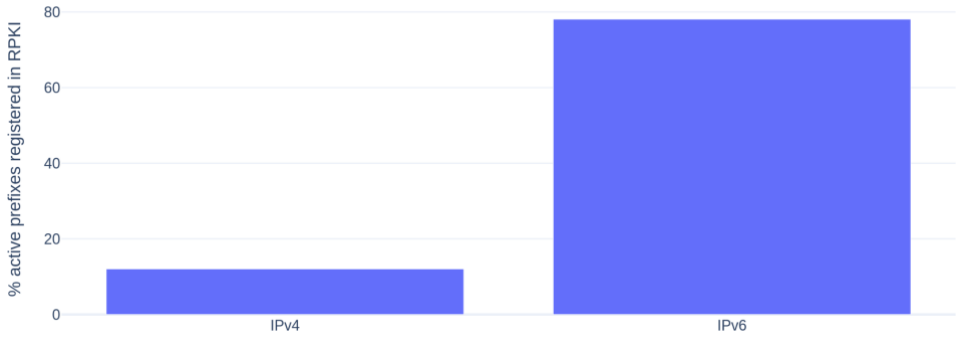

Figure 26. Percentage of prefixes active in BGP that are registered in RPKI.

DNS: Local Presence of Root DNS Servers

The good functioning of the DNS infrastructure resides in the availability of root DNS servers, which play the role of entry points to the DNS system. In Kazakhstan, there are nine instances of root DNS servers including D, E, F, I, K, L servers. The F root server has 3 instances distributed by Cloudflare in Astana, Pavlodar, and Almaty. K-root server has two instances in Semey and Pavlodar. The rest are all located in Semey at KazNIX. Despite the high concentration of root DNS servers at the same location (Semey/KazNIX), the deployment of root DNS servers in Kazakhstan is adequate.

DNS: Infrastructure for the .kz Top-level Domain Name

The accessibility of websites that end with the `.kz` suffix depends on the availability of DNS servers managing the top-level domain `.kz`. This analysis reveals that overall these servers follow best practices. The three different servers are responsible for the `.kz` are hosted by two different providers (KAZNIC and PCH), in three different networks (AS51833, AS206768, and AS42), all with IPv4 and IPv6 connectivity, and using distributed anycast IP addresses. Hence an outage at any of these sites should have no impact on the availability of the `.kz` websites.

Acronyms

AIS	Kazakhstan Agency for Information and Networking
APDC	Asia Pacific Data Centre
APNIC	Asia-Pacific Network Information Centre
AS	Autonomous System
ASN	Autonomous System Number
ASTEL	Association of Telecommunications Operators
AWS	Amazon Web Services
BGP	Border Gateway Protocol
CAPIF	Central Asia Peering and Interconnection Forum
DATIX	Data Exchange Network
DNS	Domain Name System
DPI	Deep Packet Inspection
FDI	Foreign direct investment
FTTx	Fiber to the x
GB	Gigabyte
GNI	Gross National Income
HTTPS	Hypertext Transfer Protocol Secure
IP	Internet Protocol
IRI	Internet Resilience Index
IRR	Internet Routing Registry
ISP	Internet Service Provider
ITU	International Telecommunication Union
IXP	Internet Exchange Point
JSC	Joint Stock Company
KAZNIC	Kazakhstan Network Information Center
LEO	Low Earth Orbit
LINX	London Internet Exchange
LLP	Limited Liability Partnership
MANRS	Mutually Agreed Norms for Routing Security
MDDIA	Ministry of Digital Development, Innovations and Aerospace Industry
MISD	Ministry of Information and Communications (MISD) of Kazakhstan
MITM	Man-In-The-Middle
MMTS	Mezhdugorodnyaya Mezhdunarodnaya Telefonnaya Stanciya
MTS	Mobile Telecom Service
NRO	Number Resource Organization
NSC	National Security Committee
OONI	Open Observatory of Network Interference
OVH	OVHcloud (French cloud computing company)
PCH	Packet Clearing House
PIH	Power International Holding
POP	Point of Presence
RIPE NCC	Regional Internet Registry for Europe
RIS	Routing Information Service
ROV	Route Origin Validation
RPKI	Resource Public Key Infrastructure
SMS	Short Message Service
STS	State Technical Service (STS)
TEA	Trans Europe Asia
TITR	Trans-Caspian International Transport Route
TLS	Transport Layer Security
UGIA	Unified Gateway to Internet access
UN	United Nations
VK	VKontakte (Russian social network)
VPN	Virtual Private Network
VSAT	Very Small Aperture Terminal