RIPE NCC
RIPE NETWORK COORDINATION CENTRE

RIPE NCC
Internet Country Report: Central Asia

September 2020

Introduction

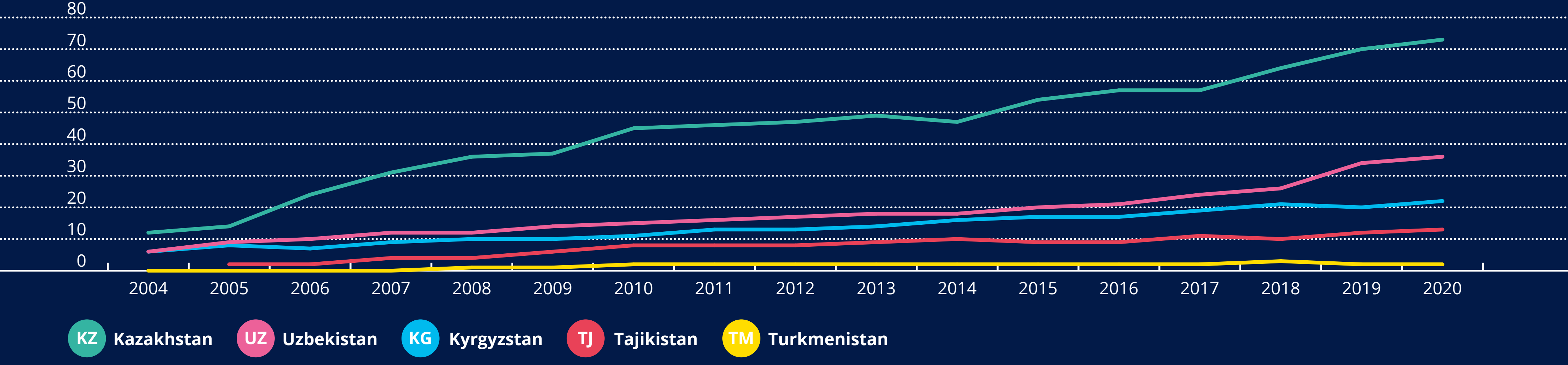
The Internet is a global network of networks, yet every country's relationship to it is different. This report provides an outlook on the current state of the Internet in Central Asia. We offer an analysis of the region's current Internet number resource holdings and its history of development, examine Internet routing within the region, take a close look at its access to the global domain name system, and investigate its connections to the global Internet. This analysis is based on what we can observe from the RIPE NCC's measurement tools as well as a few external data sources.

We focus the spotlight on Central Asia as a sub-region within the RIPE NCC's service region that has its own unique opportunities and challenges, and present a comprehensive analysis of the region's Internet development in order to inform discussion, provide technical insight, and facilitate the exchange of information and best practices regarding Internet-related developments in this particular region. This is the fifth such country report that the RIPE NCC has produced as part of an ongoing effort to support Internet development throughout our service region by making our data and insights available to local technical communities and decision makers.

Highlights

- Central Asia's geography, history and regulatory landscape all contribute to limitations on the region's Internet access
- There is limited market competition and private or foreign investment, although some major digital initiatives in the region aim to improve connectivity
- As in many parts of the world, a lack of IPv4 poses a major challenge to future development
- Significant improvements in IPv6 deployment are needed to support future growth
- Access to the domain name system is generally optimised, occurring at the local level
- The vast majority of traffic is exchanged on the local level, with limited peering opportunities and exchange points
- There are limited international connections into the region

Figure 1:
Number of Local Internet Registries over time



The Central Asian Market and Opportunity for Growth

The Market Landscape

In general, the landscape in Central Asia is not one based on free market competition, but government influence and control. Although the region is trying to redefine itself in a post-Soviet and post-oil era, security and sovereignty remain driving forces. As a result, the state-owned incumbent providers play a dominant role in all five countries, and the cost of Internet connectivity is extremely high compared to many other parts of the world even in absolute terms, and especially given local salaries and cost of living.

Internet service providers are also far more regulated in Central Asia – where operators may require a licence or permit to lay fibre or access international connectivity – than in many other parts of the world. In recent years, several foreign operators that had begun to penetrate the Central Asian market have left the region and there is little foreign or private investment.[1] Although broadband and mobile development are a priority for the region's governments, the strategy is often one of centralisation, which includes limited points of connectivity to the outside world offered by a small number of providers. Although this approach may appear on the surface to offer governments more control, it can in fact contribute to higher prices, lead to suboptimal routing and hampers the development of a stable, resilient Internet.

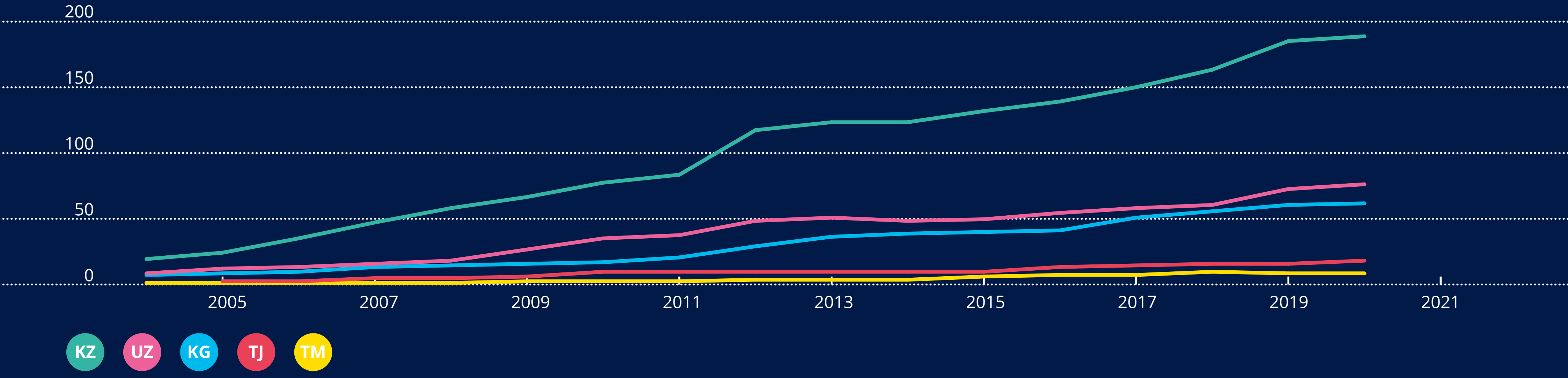
However, there are currently some major infrastructure development projects underway in the region, including the UN's Asia-Pacific Information Superhighway, the Digital CASA initiative, and investment on the part of several major Chinese companies, which aim to improve Internet accessibility and affordability.

Number of Providers

As a general rule, we would expect the number of Local Internet Registries (LIRs) to roughly correspond with a country's population. However, Kazakhstan clearly dominates the region here, with far more LIRs per capita than any of the other countries. Uzbekistan, despite having nearly double the population of Kazakhstan, lags behind in the number of LIRs serving its population. Some of this discrepancy can be attributed to the fact that Kazakhstan is by far the largest of the five countries in terms of geographical size. However, the disproportionately larger number of providers serving Kazakhstan, which includes several large providers and a number of smaller ones, likely indicates a more competitive market than we see in the rest of the region. Overall, Turkmenistan has the least developed market, with only two LIRs operating in the country.

1 *See, for example: https://cn.reuters.com/article/telia-company-eurasia-idINL8N1BJ10N https://www.reuters.com/article/us-russia-mts-uzbekistan-idUSKCN10G20G*

Figure 2:
Number of networks over time



RIPE NCC Members and Local Internet Registries (LIRs)

RIPE NCC members include Internet service providers, content hosting providers, government agencies, academic institutions, businesses and other organisations that run their own networks in the RIPE NCC's service region of Europe, the Middle East and Central Asia. The RIPE NCC distributes Internet address space to these members, who may further assign IP addresses to their own end users. It is possible for members to open more than one account, called a Local Internet Registry (LIR).

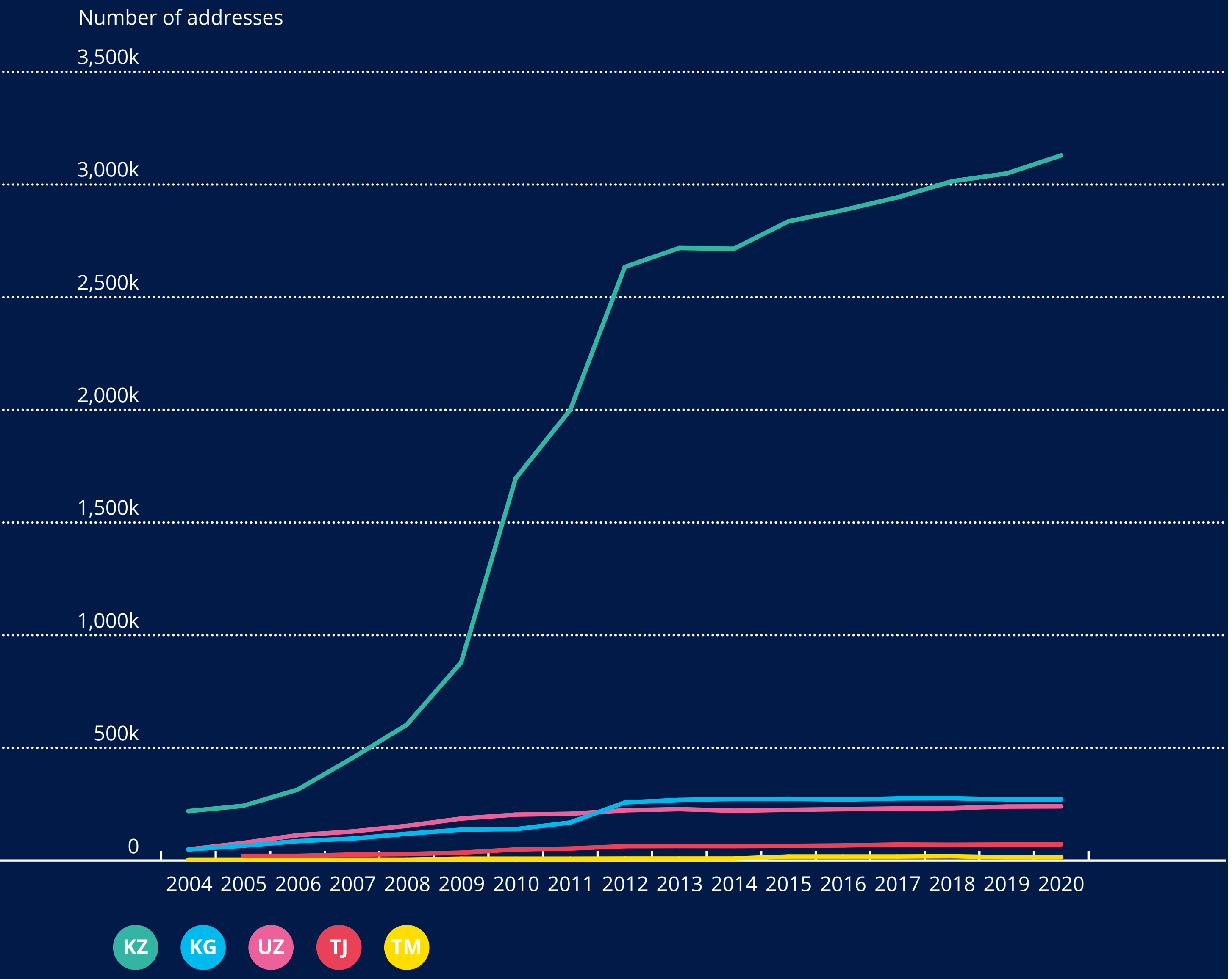
All countries in the region except for Turkmenistan show a growth in the number of LIRs over time. However, an increasing number of LIRs doesn't necessarily translate into a growth in the number of Internet access providers. Other types of organisations requiring IP addresses also open LIRs, including hosting providers, government agencies, universities, businesses, etc. While in some parts of the RIPE NCC's service region we see examples of the same organisation opening additional LIRs in order to receive more IPv4 address space, this is less of an issue in Central Asia.

Number of Networks

A larger number of Local Internet Registries generally corresponds to a larger number of independently operated networks (called Autonomous Systems, each of which is represented by an Autonomous System Number, or ASN), which is exactly what we see in the region. Again, Kazakhstan's higher number of networks compared to its population suggests a more robust market.

While we see significant growth in Kazakhstan, Uzbekistan and Kyrgyzstan, there has been little to no increase in the number of networks operating in Tajikistan and Turkmenistan over the past 15 years.

Figure 3:
IPv4 holdings over time



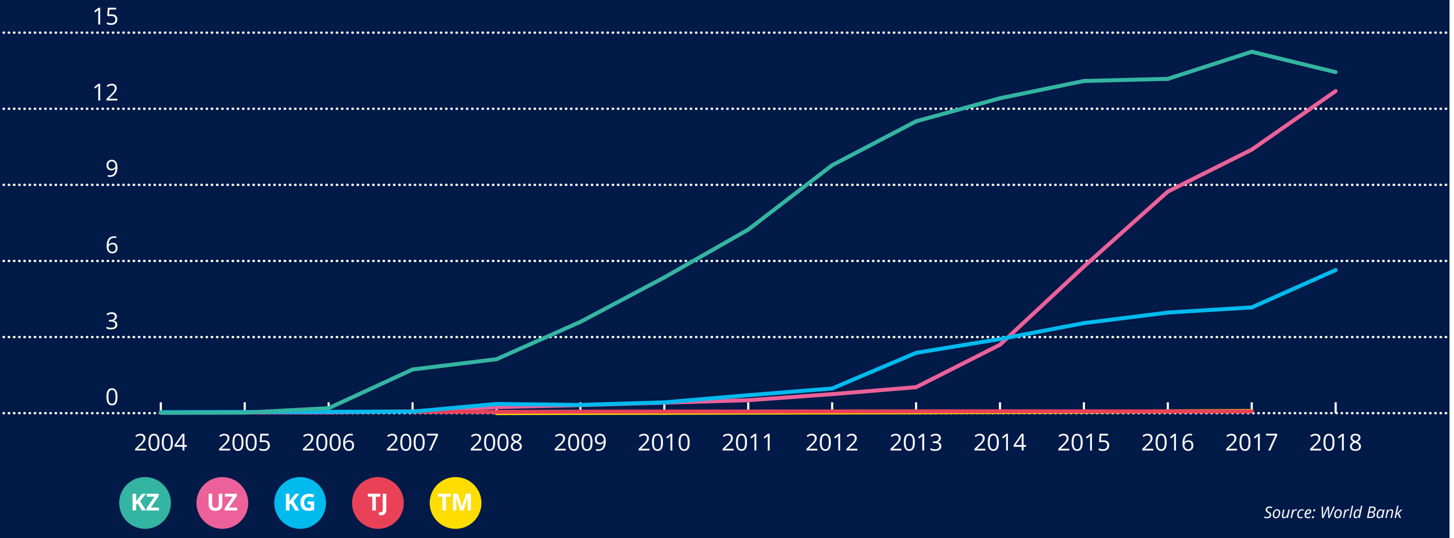
IPv4 Address Space in Central Asia

Until 2012, RIPE NCC members could receive larger amounts of IPv4 address space based on demonstrated need. When the RIPE NCC reached the last /8 of IPv4 address space in 2012, the RIPE community instituted a policy allowing new LIRs to receive a small allocation of IPv4 in order to help them make the transition to IPv6, the next generation protocol that includes enough IP addresses for the foreseeable future. In November 2019, the RIPE NCC made the last of these allocations and a waiting list now exists whereby organisations who have never received IPv4 from the RIPE NCC can receive an even smaller allocation if and when enough address space is recovered (occasionally member accounts are closed and address space is returned to the RIPE NCC).

Even before 2012, there wasn't much of an increase in the number of IPv4 addresses held by LIRs in Central Asia – the exception again being Kazakhstan, which saw huge growth in its amount of IPv4 address space in the years leading up to 2012 (when the change in allocation size took place). Since then, growth has tapered off, as LIRs could receive only a small, final IPv4 allocation of 1,024 addresses.

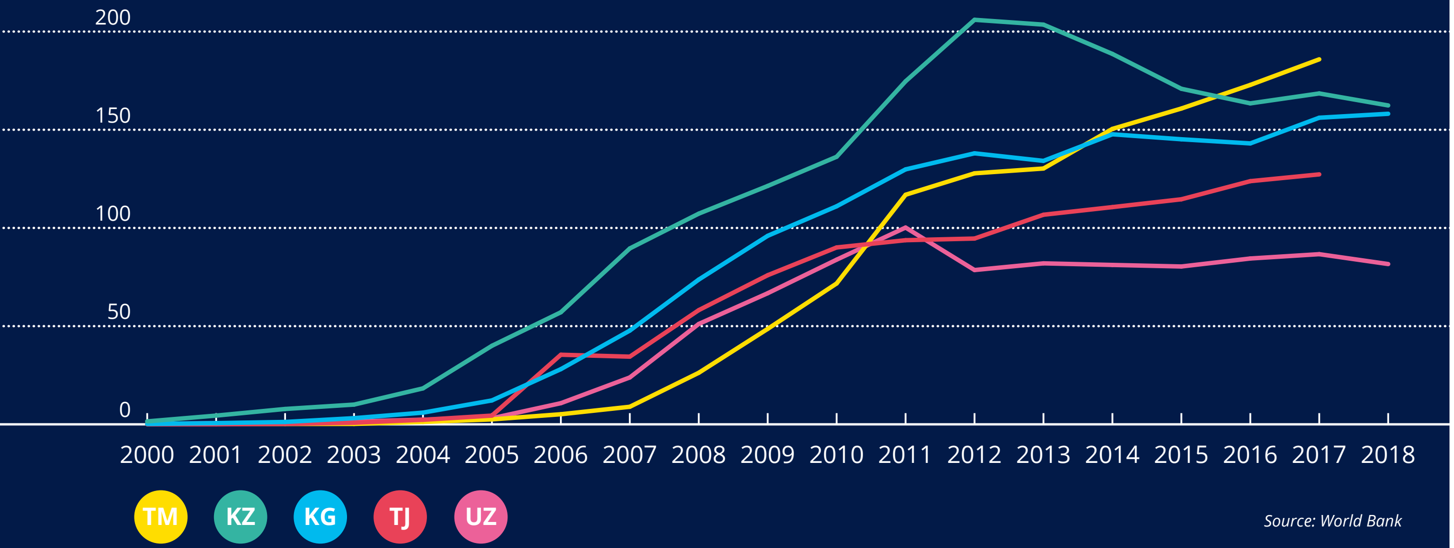
With more than 3.1 million IPv4 addresses, Kazakhstan clearly dominates the region. Still, the country has only one IPv4 address for every six people – far less than we see in other parts of the RIPE NCC's service region. The other countries in the region range between having one address for every 24 people (Kyrgyzstan) to one address for every 400 people (Turkmenistan).

Figure 4:
Fixed broadband subscriptions per 100 people over time



Source: World Bank

Figure 5:
Mobile subscriptions per 100 people over time



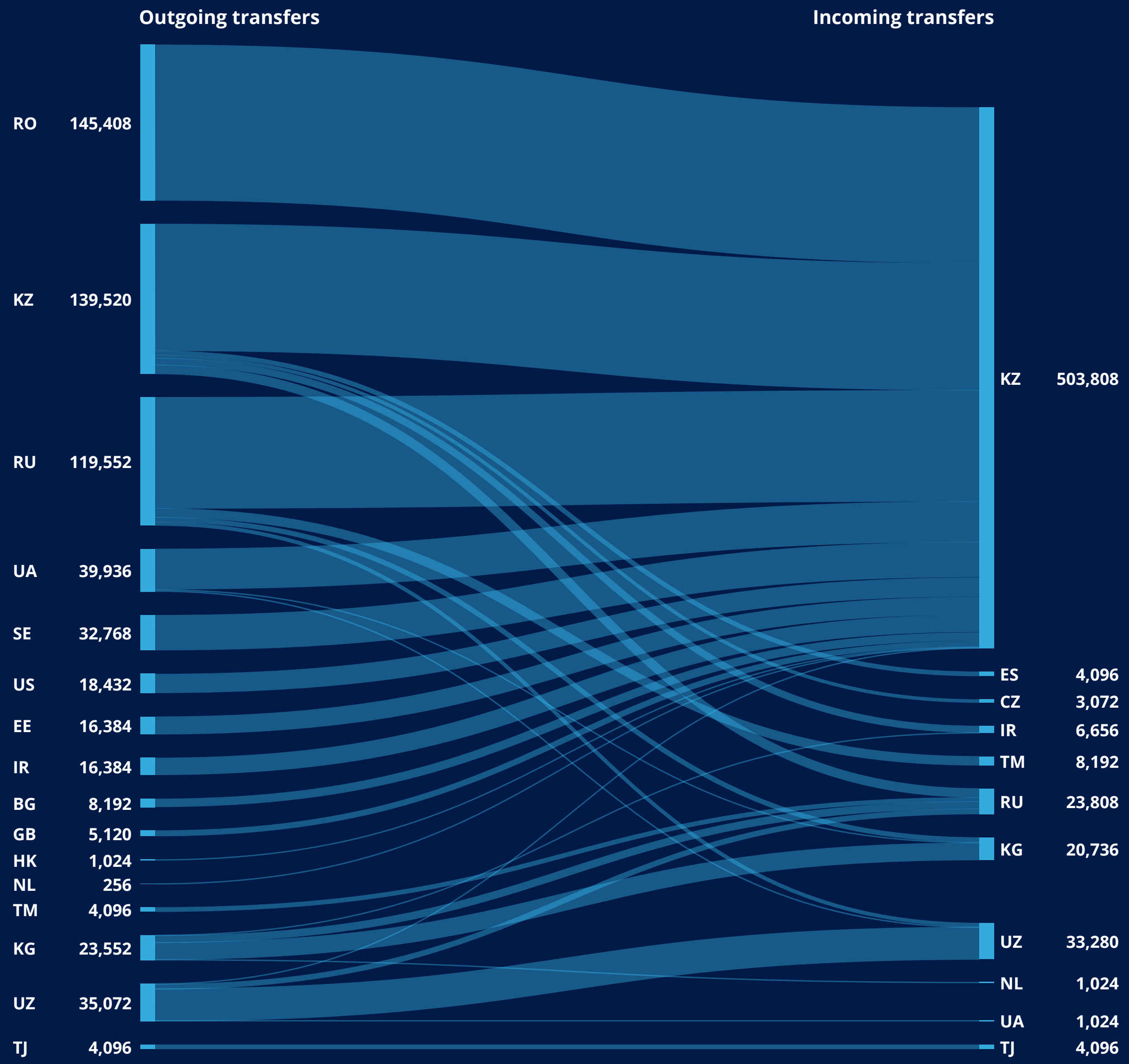
Source: World Bank

It's important to note that a low address-to-population ratio doesn't necessarily mean that it will be impossible for a country to provide connectivity to all its citizens, even in a region like Central Asia where fixed broadband isn't as widely available as many other areas (and is almost non-existent in Tajikistan and Turkmenistan). The region's landlocked countries and mountainous geography obviously pose major challenges to its ability to provide ubiquitous broadband access, particularly in rural areas. In addition, the market was late to develop in the region compared to much of Europe and North America, which resulted in rapid growth in the mobile rather than broadband market. As a result, we see high mobile subscription rates throughout the region, with four of the five countries averaging more than one mobile subscription per person (the exception being Uzbekistan, which may be partially explained by its higher percentage of fixed broadband subscriptions).

Technical workarounds exist that allow multiple users to share a single IP address, such as carrier-grade network address translation (CGN), and such technologies are in widespread use in mobile broadband connectivity. Given the region's high reliance on mobile access, there may still be enough IPv4 to accommodate short-term growth if mobile operators employ these technical workarounds to share IPv4 addresses among their users.

However, there are well-documented drawbacks to address-sharing technologies, and in order to fully unlock the potential societal and economic benefits of further digitalisation, we highly recommend deploying IPv6 as a more sustainable long-term solution (discussed in more detail in the IPv6 section below).

Figure 6:
IPv4 transfers within, into and out of Central Asia between April 2014 and June 2020



IPv4 Secondary Market

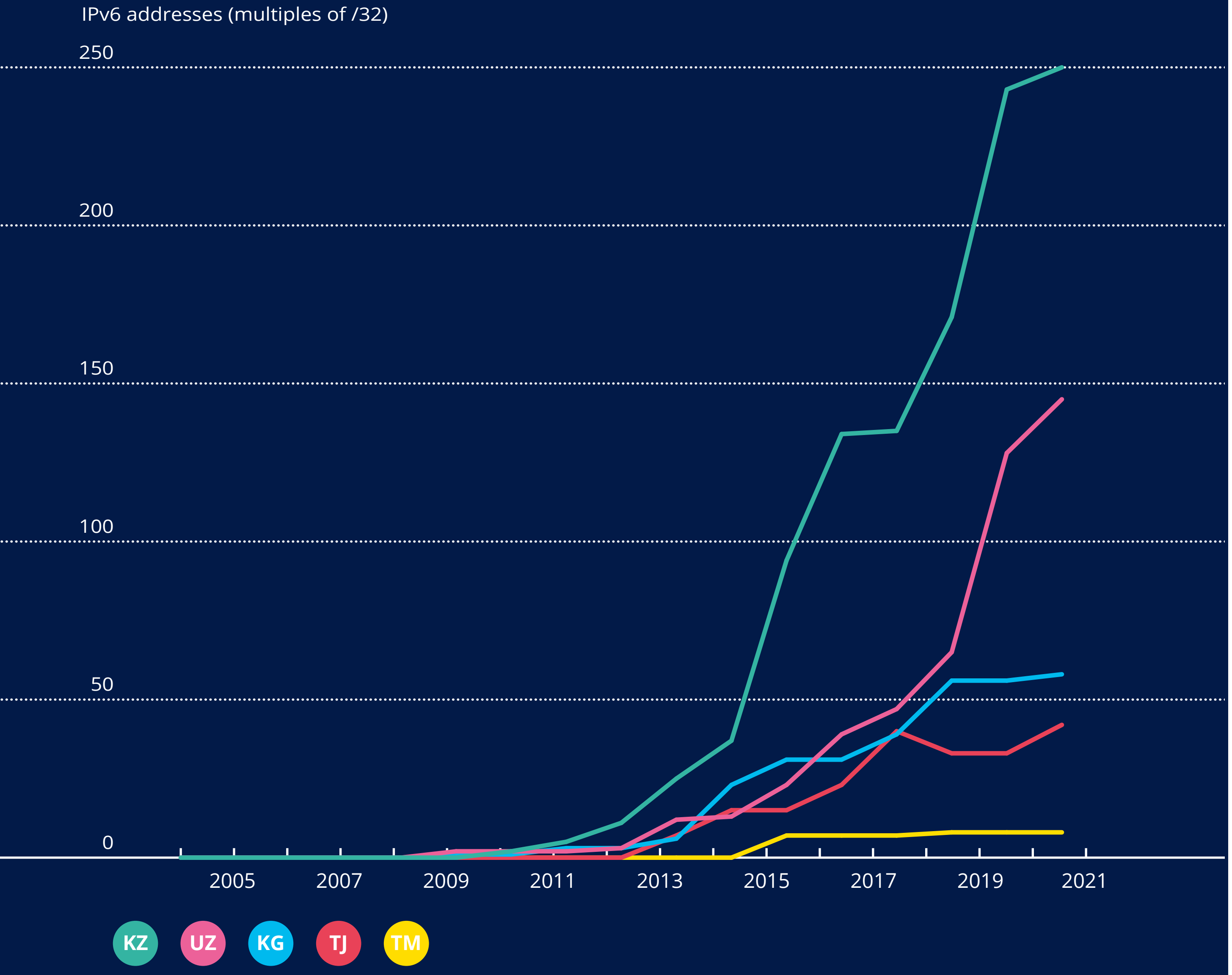
To fill the demand for more IPv4 address space, a secondary market has arisen in recent years, with IPv4 being bought and sold between different organisations. The RIPE NCC plays no role in these financial transactions, ensuring only that the RIPE Database – the record of which address space has been registered to which RIPE NCC members – remains as accurate as possible.

As IPv4 has become more scarce, many providers have turned to the secondary market. Figure 6 shows the IPv4 transfers that have taken place within, into and out of each country in the region since the market became active.

Given its larger number of Local Internet Registries and IPv4 holdings, Kazakhstan's similar dominance of the IPv4 secondary market in Central Asia comes as little surprise. More than 500,000 addresses were transferred to organisations in the country over the past eight years, approximately 118,000 of which were domestic transfers that originated from other organisations within the country. Romania and Russia were the two major sources of Kazakhstan's imported IPv4, together contributing about 65% of the IPv4 addresses Kazakhstan received from foreign sources. In total, about 12% of Kazakhstan's current total IPv4 holdings were obtained from foregin sources via the secondary market.

Uzbekistan and Kyrgyzstan have also been somewhat active in the IPv4 secondary market, although to a much lesser degree than Kazakhstan. The majority of transfers in both Uzbekistan and Kyrgyzstan have been domestic transfers and have therefore remained in the country; however, both countries have exported slightly more IPv4 overall than they have imported. We see just two transfers involving Turkmenistan providers, resulting in a net increase of a

Figure 7:
IPv6 holdings over time



modest 4,096 addresses, and just one transfer of 4,096 addresses between two providers within Tajikistan. It's interesting to note that while Kazakhstan has sourced IPv4 addresses from all over the world, the other countries tend to transfer between former Soviet nations.

Despite the region's relatively low IPv4 address space per capita, operators in these countries don't appear to be relying on the secondary market as a primary method of obtaining more address space. Although current levels of IPv4 may be enough to maintain the status quo via address sharing and other workarounds, deploying IPv6 is the only sustainable strategy for accommodating future growth and supporting the region's Internet development.

IPv6

Despite the dwindling availability of IPv4 and its increasing cost on the secondary market, the transition to IPv6 in Central Asia has been slow. Although Kazakhstan and Uzbekistan in particular have increased their IPv6 holdings in recent years, we don't see much evidence that it is actually in use. Some of this increase is due to the fact that, for a time, LIRs receiving their final IPv4 allocations were required to have IPv6, although that policy changed in 2015 and, in 2019, 65% of new LIRs in Central Asia received an IPv6 allocation.

In the RIPE NCC Survey 2019[2] (which polled more than 4,000 network operators and other members of the technical community from the RIPE NCC's service region), 69% of respondents from Central Asia said that their organisations will require more IPv4 address space in the next two to three years, compared to a 53% average across all respondents.

2 RIPE NCC Survey 2019: https://www.ripe.net/survey

In fact, respondents in Central Asia were the only ones to rank IPv4 scarcity and IPv6 deployment as bigger challenges than network security, which was the top challenge identified in all other regions. Clearly operators in Central Asia are aware of the lack of readily available IPv4, with 37% responding that they plan to use NAT to fill the scarcity gap, similar to the total average of 41%. However, while 35% said they plan to obtain IPv4 on the secondary market and 18% plan to move to IPv6, these figures are significantly lower than the total averages across all respondents of 61% and 37%, respectively, indicating that while the price of IPv4 address space on the current secondary market may be cost-prohibitive for many providers in Central Asia, deploying IPv6 doesn't appear to be a priority, either.

Indeed, we see that only 7% of respondents from Central Asia answered that their organisations have fully deployed IPv6, compared to the survey average of 22%.

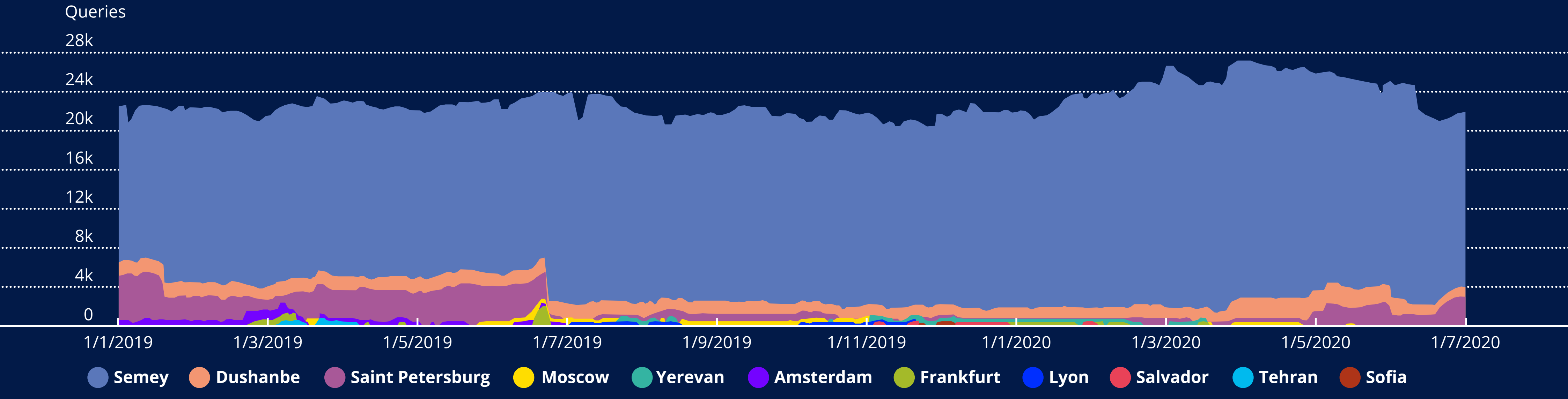
Compared to the rest of the RIPE NCC service region, IPv6 deployment in Central Asia remains extremely low according to several organisations that measure IPv6 adoption per country, including APNIC, Facebook, Akamai, Google and Cisco. The first four of these try to provide an indication of how far IPv6 deployment has progressed from the user's end. In Central Asia, these organisations measure little to no deployment; only in Turkmenistan do Facebook[3] and Google[4] register small amounts of 1.2% and 1.9% respectively.

Cisco's 6lab[5] provides a composite metric that takes into account IPv6-enabled transit networks within the country as well as content available over IPv6 and IPv6 users. According to this metric, we see Kazakhstan score best in the region, with 17.9% adoption.This rating is primarily due to the larger fraction of networks that provide IPv6 transit in the country; without any IPv6 users, even significant amounts of content available over IPv6 is not enough to change things on its own. However, the fact that IPv6 content is ready means that Internet service providers could make significant strides forward if they enable IPv6 on their networks for users with relatively modern (i.e. IPv6-capable) equipment.

It's worth noting that 62% of the RIPE NCC Survey respondents from Central Asia answered that they are either currently testing IPv6 or are working on deployment plans, so perhaps we will see an increase in these figures in the years ahead. Although there has been support on the part of some governments in the region to move ahead with IPv6 in an effort to fight cybercrime (as address-sharing makes it particularly difficult to trace IP addresses being used for criminal purposes), network operators tend to push back against a regulatory approach to IPv6 deployment, as regulation can easily have unintended consequences and can become too technically restrictive.

3 *Facebook IPv6: https://www.facebook.com/ipv6*
4 *Google IPv6: https://www.google.com/intl/en/ipv6/statistics.html#tab=per-country-ipv6-adoption*
5 *Cisco 6lab: https://6lab.cisco.com/stats/search.php*

Figure 8:
K-root locations reached from within Central Asia (IPv4)



2. Regional View of Central Asia

Reaching the Domain Name System

Turning now to investigate how traffic is routed to, from and within the region, we first examine which local instances of K-root are queried from requests originating in the different countries.

These measurements are based on the RIPE NCC's RIPE Atlas measurement platform, which employs a global network of probes to measure Internet connectivity and reachability. Note that K-root is just one of the world's 13 root name servers, and every domain name system (DNS) client will make its own decisions about which particular root name server to use. In cases where response times to K-root would be relatively slow, it is highly likely that clients would opt for faster alternatives among the other root name servers.

Even so, confining our measurements to look only at the choices that different RIPE Atlas probes in the region make about which K-root instance to query provides some insight into how the routing system considers the various options and decides which networks and locations will provide the best results.

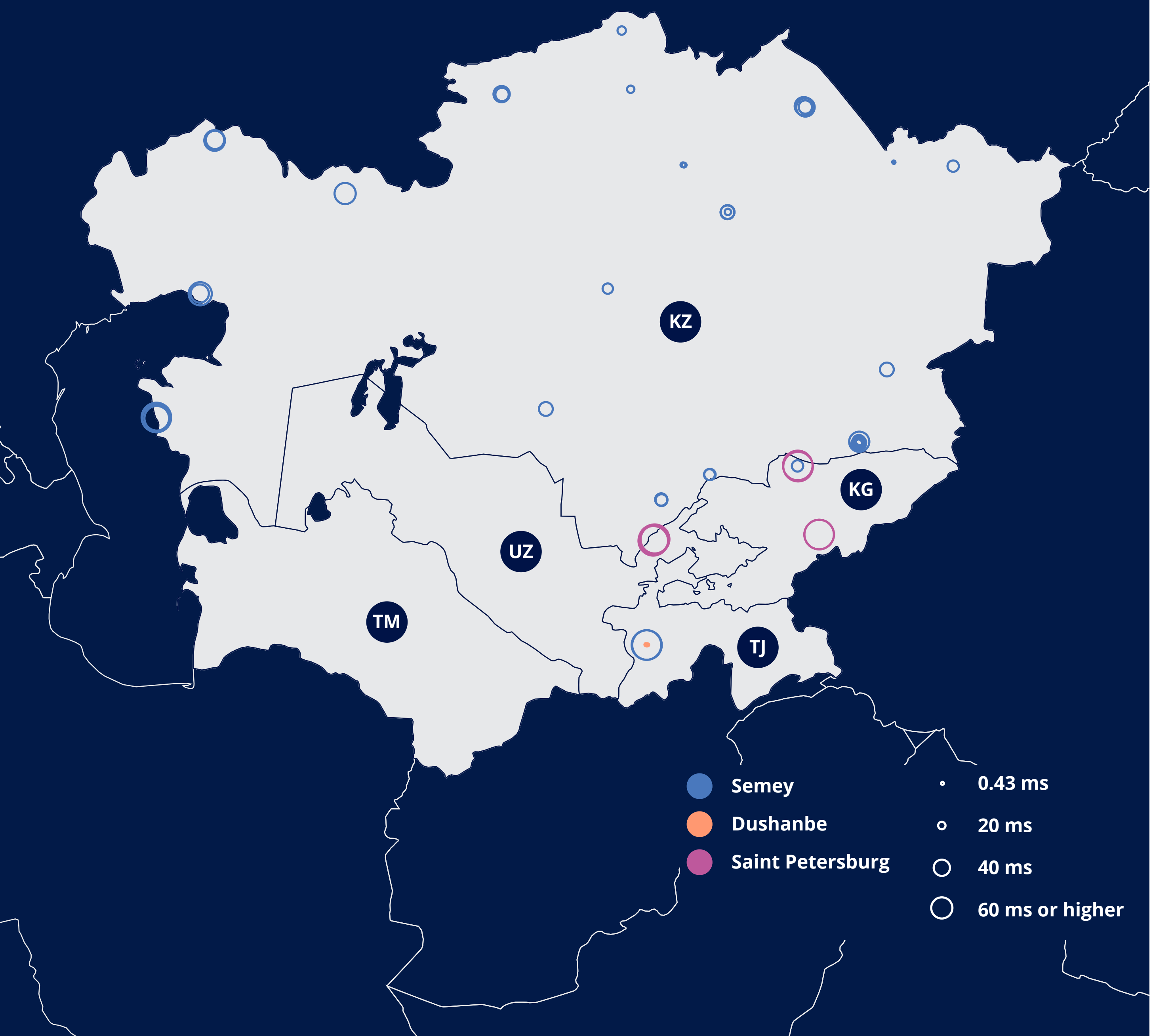
K-root and DNS

K-root is one of the world's 13 root name servers that form the backbone of the domain name system (DNS), which translates human-readable URLs (such as https://www.ripe.net) into IP addresses. The RIPE NCC operates the K-root name server. A globally distributed constellation of these root name servers consists of local "instances" that are exact replicas. This set-up adds resiliency and results in faster response times for DNS clients and, ultimately, end users.

Of the five countries included in this report, only Kazakhstan has a significant number of RIPE Atlas probes. Having more volunteers who connect RIPE Atlas probes throughout the region could possibly give different results, and in any case, would provide a more detailed picture (see the section on RIPE Atlas at the end of the report for more information about how to get involved). Regardless, we include the data that we were able to collect here.

Figure 8 shows the different K-root instances that were queried by probes in Central Asia over the course of approximately 18 months. Since July 2019, probes predominantly query K-root instances within Central Asia, which is good for response times. As Kazakhstan has significantly more RIPE Atlas probes, it's understandable that most queries we detect were sent

Figure 9:
K-root locations reached from vantage points throughout Central Asia (IPv4)

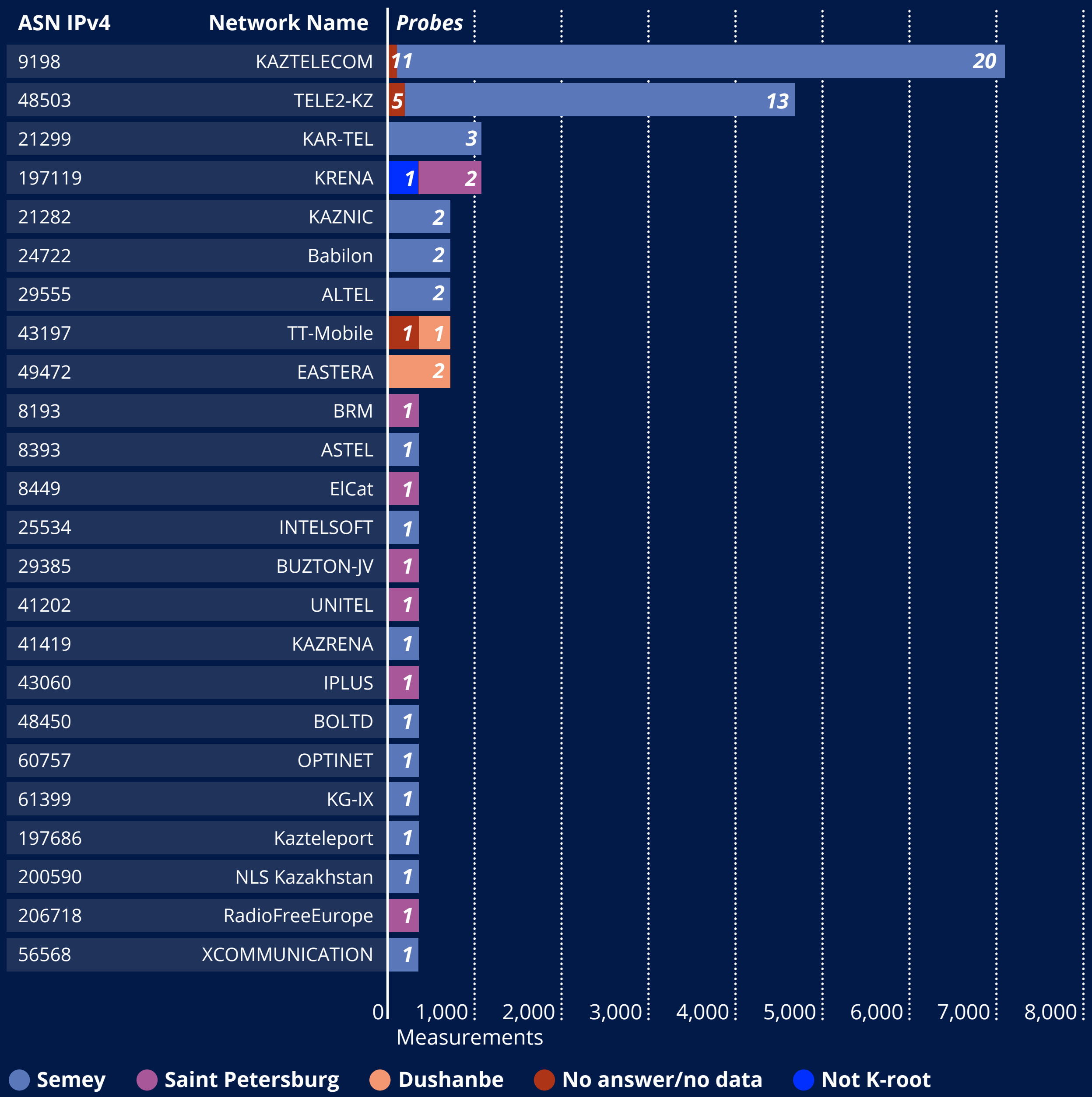


to the K-root instance in Semey. Dushanbe in Tajikistan is a good second choice, as its geographical proximity also results in low response times. We do see probes querying other instances that are farther away, including Saint Petersburg and Amsterdam, but only for a small number of probes. Overall, the region's DNS access seems to be fairly optimised.

Looking at individual RIPE Atlas probes in the different countries, we see the different K-root instances queried by the probes along with the round-trip times in figure 9. While all the probes in Kazakhstan queried the K-root instance in Semey, we see more diversity in Kyrgyzstan, where probes chose K-root instances both in Semey and in Saint Petersburg. Both probes in Uzbekistan selected the Saint Petersburg instance. In Tajikistan, some probes queried the K-root instance in Semey, while others queried the local instance in Dushanbe; in terms of round-trip times, we can see that the Dushanbe instance provides much faster responses.

We should note that these results, while considered generally representative, offer only a snapshot of measurements made on a single day in July 2020. As seen in figure 8, preferred locations can change continuously due to subtle changes in routing. All the response times we measured fall within an acceptable range, in which an end user would be unlikely to experience any noticeable delay.

Figure 10:
K-root locations reached from different networks throughout Central Asia (IPv4)



We can also look at which K-root instances are queried by probes in different networks, as opposed to different countries. Traditionally, the Border Gateway Protocol (BGP) decision-making process would ensure that once a particular path has been identified as being the best option, there is consistency across all the routers that are part of that particular network. Indeed, this is generally what we see in figure 10 (again, using a snapshot from July 2020), where all probes in a particular network end up querying the same K-root instance, with a few exceptions. One probe in the KRENA network (AS197119) received answers from a server that is not a K-root instance managed by the RIPE NCC, which may indicate that this query was redirected.

We can also see that the vast majority of networks query the K-root instance in Semey. Given the nature of the DNS, this shouldn't pose a problem, as DNS clients will automatically query another root name server if one becomes unavailable. Overall, we see that networks query local K-root instances, which should result in good response times.

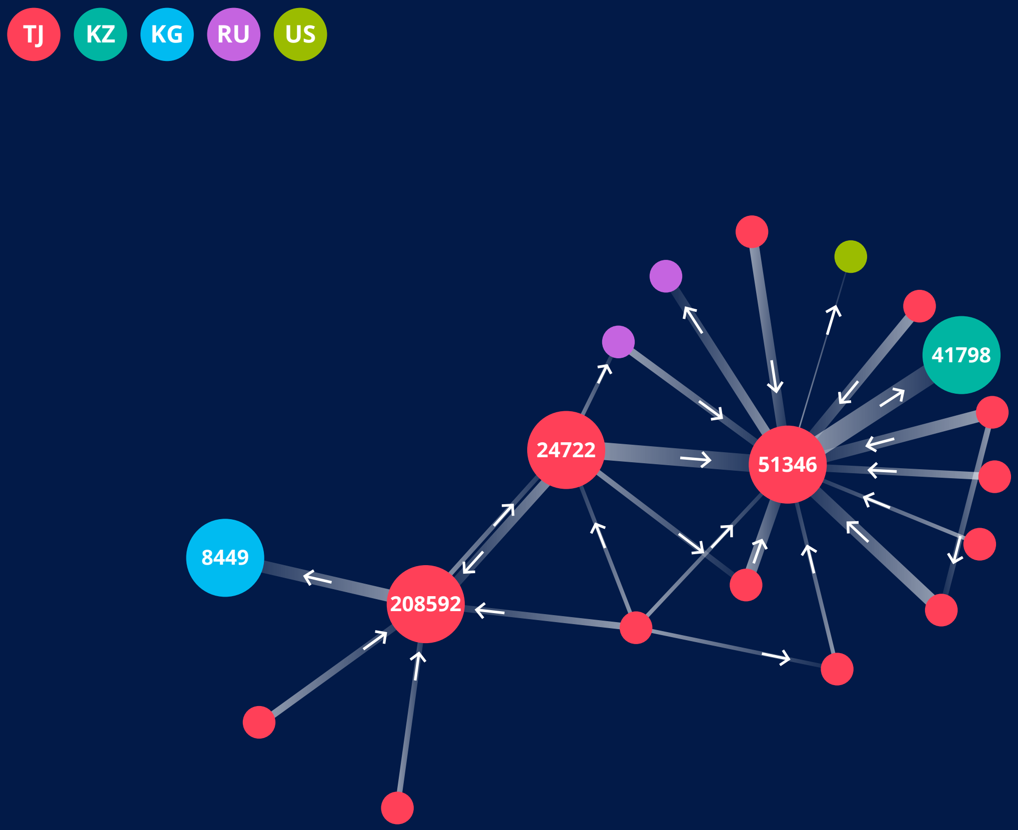
It's worth noting that although DNS response times (latency) appear to be quite good in the region, Internet speeds in the region – which rely on bandwidth and are affected by physical infrastructure along with technical factors that can create other bottlenecks – for the most part remain very slow.[6]

Domestic Connectivity Between Different Networks

Because the countries in Central Asia have a small to modest number of networks, we can also look at how the networks within the different countries connect to one another. To do this, we use data from the RIPE NCC's Routing Information Service (RIS), which employs a globally distributed set of route collectors to collect and store Internet routing data.

6 Speedtest Global Index: https://www.speedtest.net/global-index

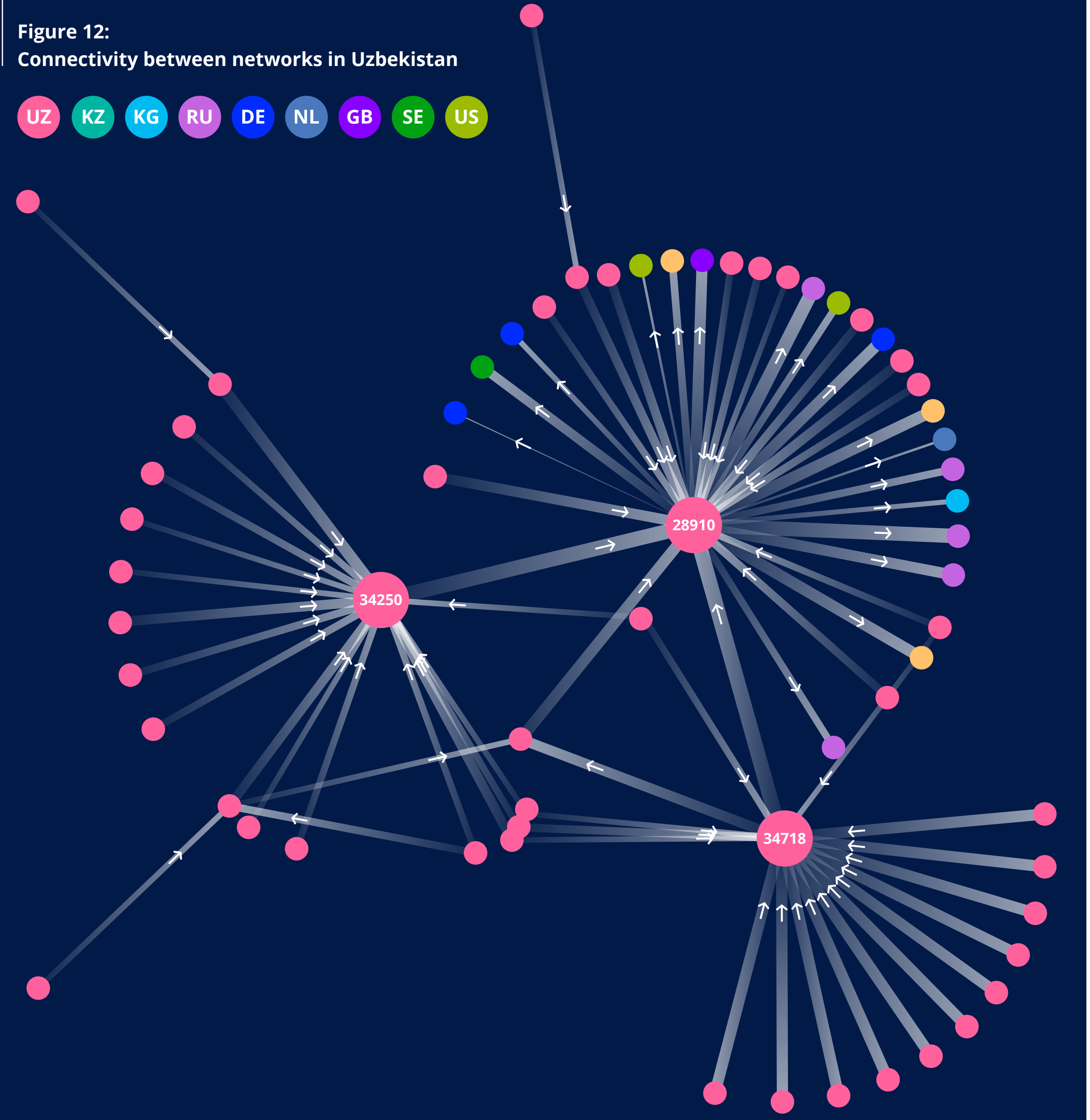
Figure 11:
Connectivity between networks in Tajikistan



For each country, we plot how the routes propagate from one network to another (indicated by arrows) up to the point where the path reaches a foreign network. The nodes in each figure are colour-coded according to the country in which the network (ASN) is registered, and the width of the lines is determined by the number of paths in which we see the connection between the different ASNs. Note that we only label the ASNs that we specifically mention in the text, and that the position of the different networks doesn't correspond to any kind of geographical layout; instead, these figures are merely a visual representation of the interconnections between the networks in each country.

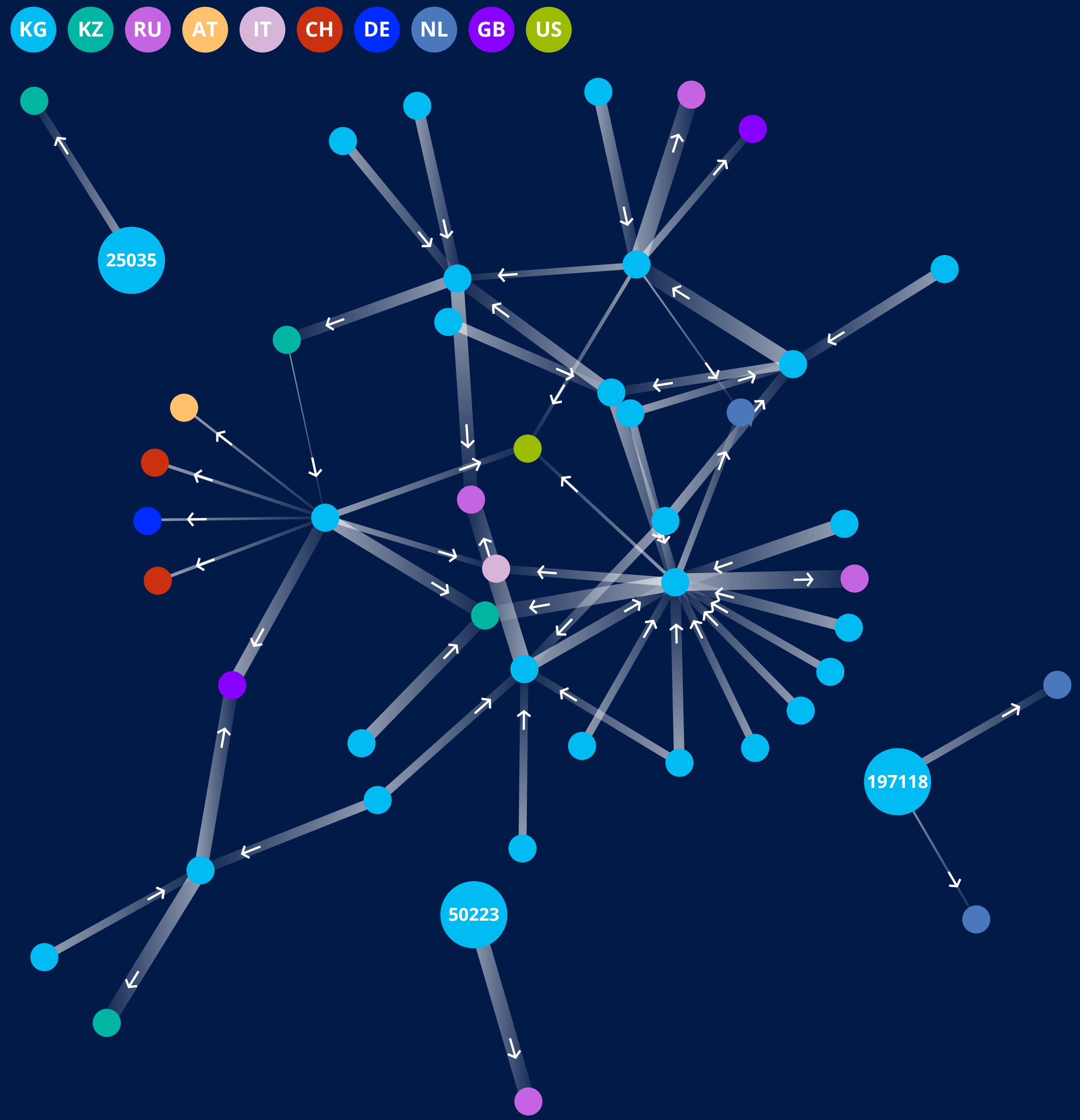
In Tajikistan, we see that Tojiktelecom (AS51346) acts as an upstream provider for most other networks in the country. As we will see below, Transtelecom Kazakhstan (AS41798) is the main transit provider for Tojiktelecom. We see two networks which, as far as we can observe, appear to rely exclusively on Avesto internet (AS208592) for connectivity. From Avesto internet, packets can reach the rest of the Internet via ElCat Ltd (AS8449) in Kyrgyzstan, or via Tojiktelecom, by way of the connection that Avesto internet has to Babilon-T (AS24722).

Figure 12:
Connectivity between networks in Uzbekistan



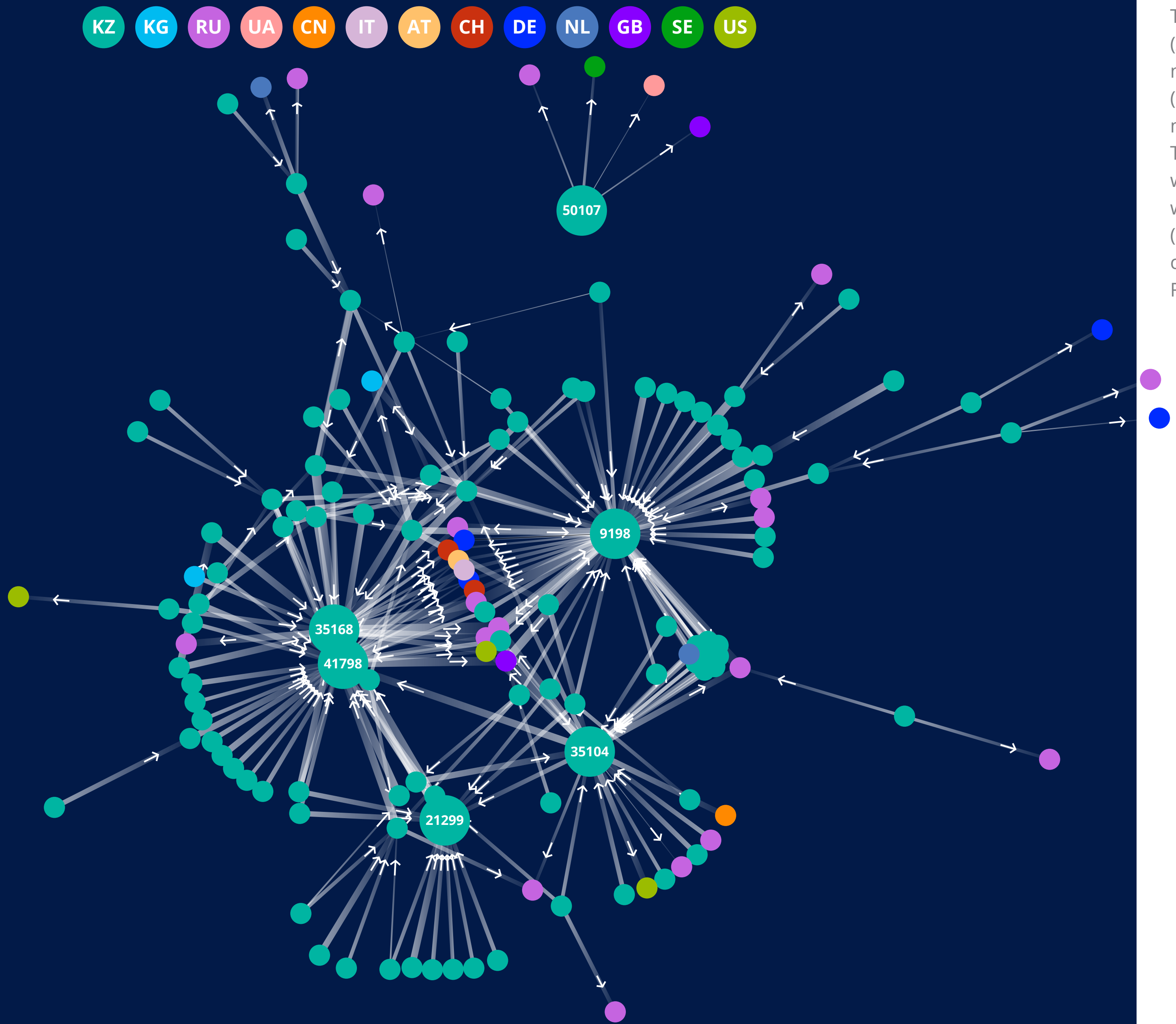
In Uzbekistan, we see three main connectivity clusters. The first is around Uzbektelecom (AS28910), which provides all the international connections. The second cluster is around another network also held by Uzbektelecom (AS34250). The third centres on LLC Texnoprosistem (AS34718). Most of the remaining "stub" networks that are not directly part of these clusters connect to one, and only one, of these three networks via another ASN; we observe very little multihoming.

Figure 13:
Connectivity between networks in Kyrgyzstan



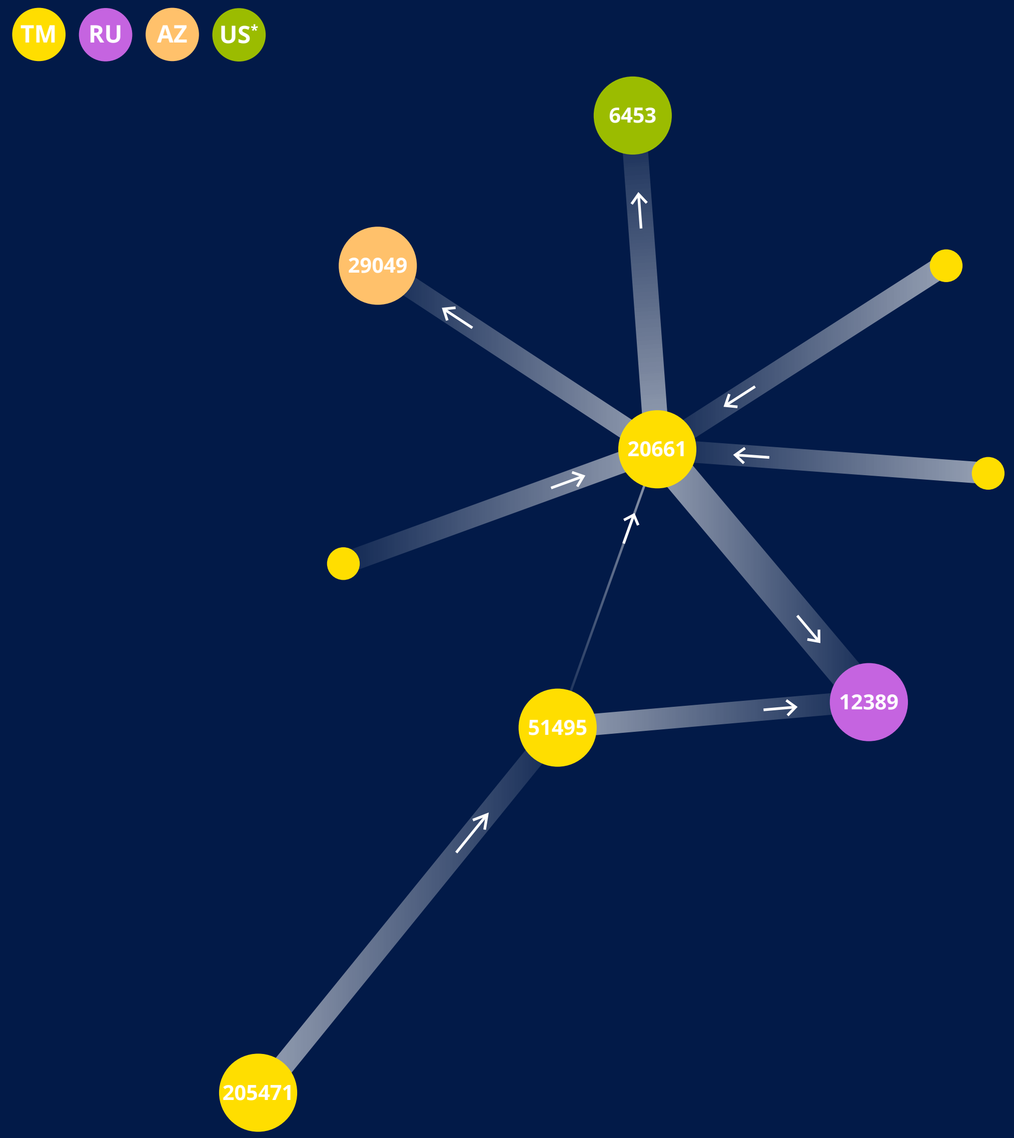
In Kyrgyzstan, we see more interconnections between local providers, as well as more networks with international connections. However, three networks stand out as being isolated – they are not connected to any other networks in the country and have no upstream connections in common with the others. These are Transfer Ltd (AS25035), which connects to Transtelecom Kazakhstan, Alfa Telecom (AS50223), which connects to Megafon, and the National Information Technology Center (AS197118), which connects to GÉANT, the network that further connects the European research and education networks (NRENs).

Figure 14:
Connectivity between networks in Kazakhstan



Because of Kazakhstan's many networks, its figure is more complex. We observe clusters around TNS-Plus (AS35168), Transtelecom Kazakhstan (AS41798) and Kazakhtelecom (AS9198), which provide connectivity to downstream networks. But we also see a cluster around Kaztranscom (KTC) (AS35104) as well as around Kar-Tel (AS21299), with most connectivity for Kar-Tel and its customers handled by TNS-Plus, as indicated by the large arrow. As in Kyrgyzstan, we also observe one network, Vista Technology (AS50107), which has no paths to other networks in the country (according to the RIS data) but which receives external connectivity primarily from Telia and the Russian provider Rascom.

Figure 15:
Connectivity between networks in Turkmenistan

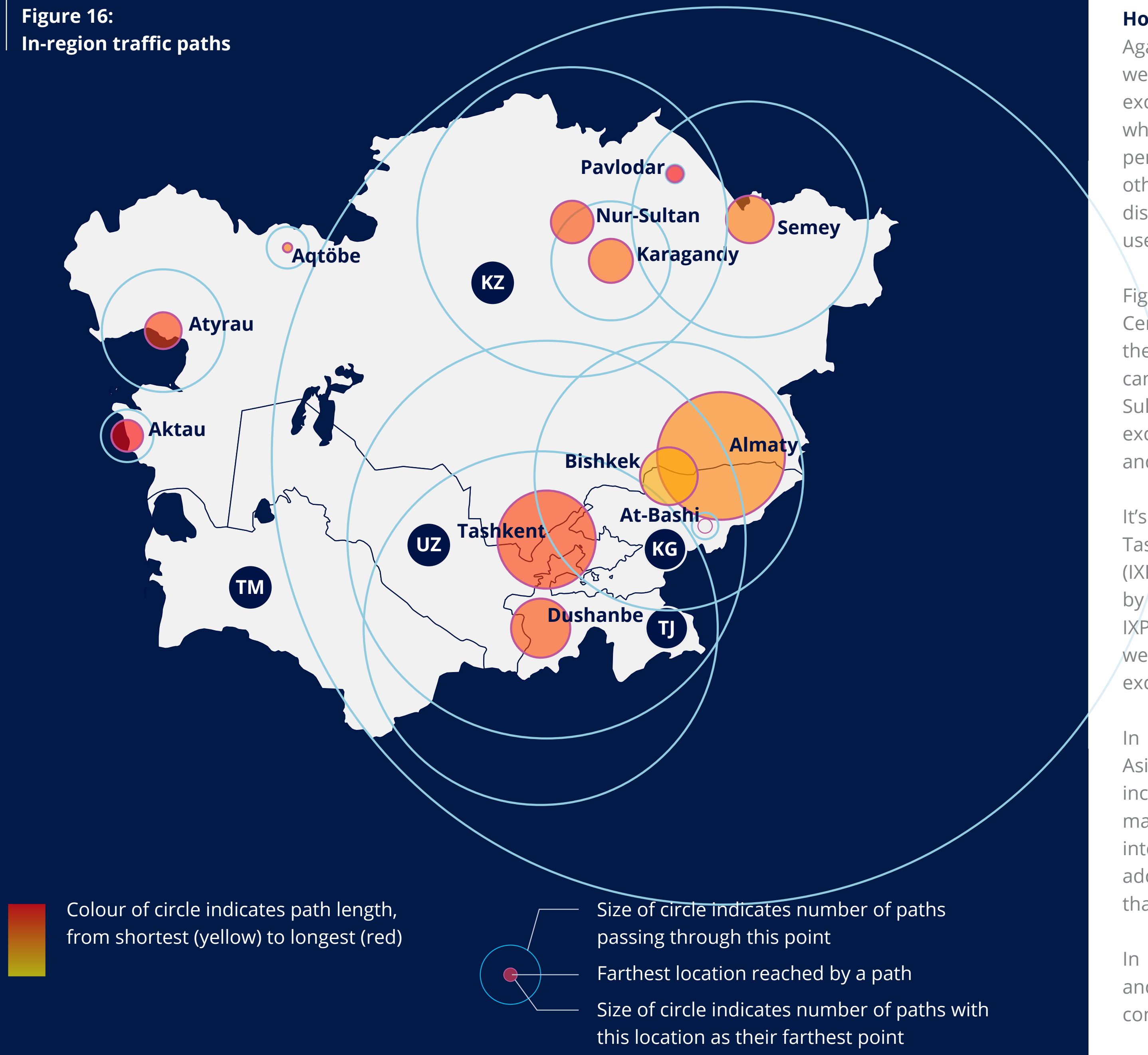


* *Tata Communications, which is based in India, acquired AS6453 from Teleglobe America and so this ASN is still registered in the US; however, Tata Communications operates globally and there is no direct link from Turkmenistan to the US or India.*

Turkmenistan only has six ASNs in the routing system. Turkmentelecom (AS20661) provides most international connectivity; it has paths to Rostelecom (AS12389) in Russia, Tata Communications (AS6453), which operates globally, and Delta Telecom in Azerbaijan (AS29049). Telephone Network of Ashgabat (AGTS) (AS51495) has a path to Turkmentelecom, too, but the RIS data shows that international connectivity for this network and AGTS's mobile branch (AS205471) is mostly handled by Rostelecom (AS12389).

Overall, the region's resiliency could likely be improved. A visualisation of Internet connectivity, like we see in the above figures, should resemble a deeply interconnected web, with a greater distribution of paths and interconnections than we see in the region and without clear choke points or bottlenecks. Relying on a handful of networks to carry local connectivity and only a couple of networks with international connectivity diminishes the stability of the local Internet by creating potential single points of failure. Without more alternative paths in place, any kind of disruption with one of these networks can create a critical situation for a large number of users and services.

Figure 16:
In-region traffic paths



How Regional Traffic is Exchanged

Again using data from the RIPE Atlas measurement network, we can investigate how some of the networks in the region exchange traffic with each other, and get some indication of where those exchanges take place. For this experiment, we performed traceroutes from each RIPE Atlas probe to every other probe in the region. Because those measurements disclose the IP addresses of the routers involved, we then used RIPE IPmap to geolocate those network resources.

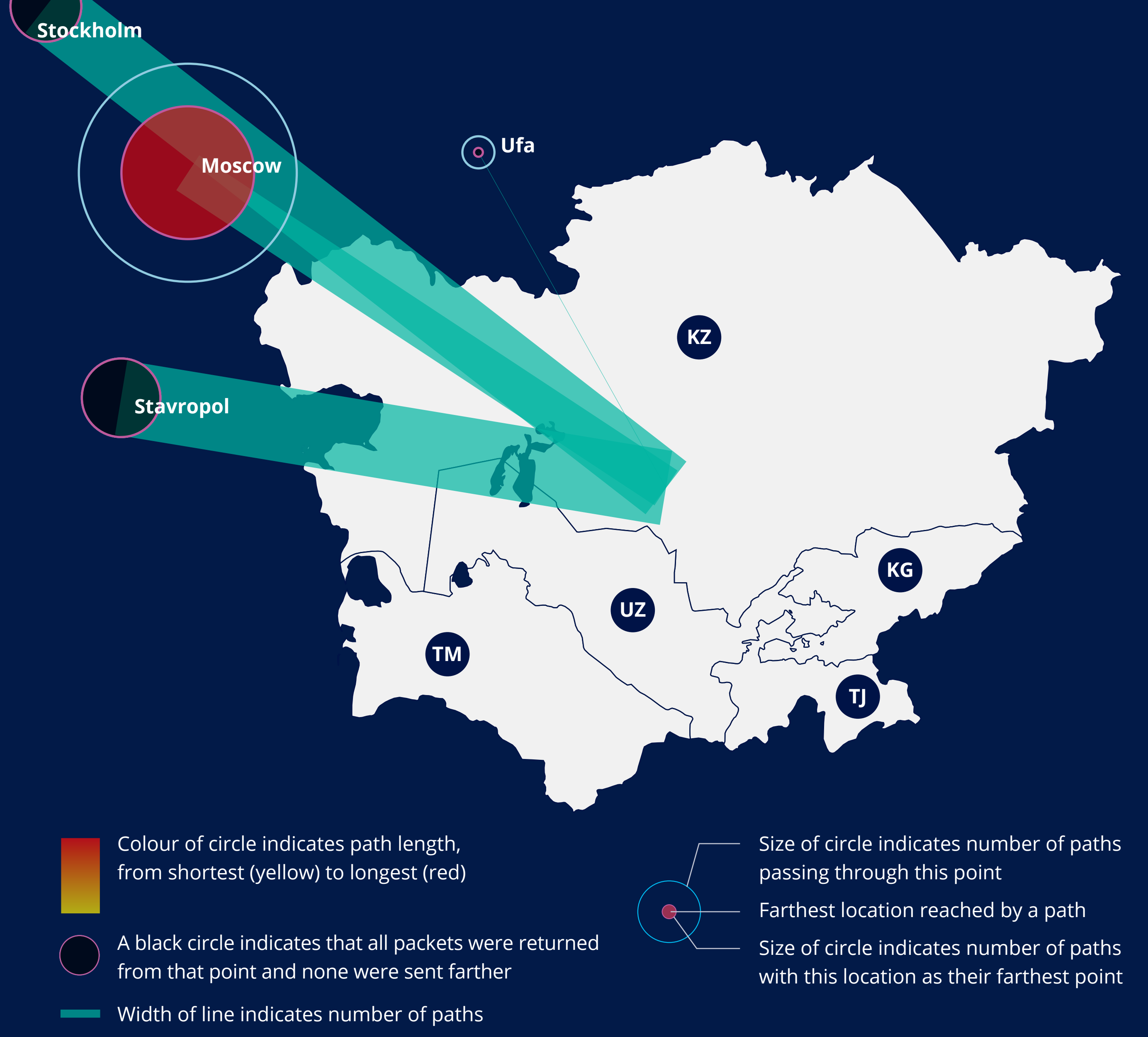
Figure 16 shows the results of these measurements within Central Asia, with the size of the outer circles representing the number of paths passing through those points. We can clearly see how Almaty, Tashkent, Dushanbe, Nur-Sultan, Bishkek and Semey are the major centres of traffic exchange within the region. Bishkek, followed by Almaty and Semey, offer slightly better response times on average.

It's possible that some of the traffic being exchanged through Tashkent is a result of TAS-IX, the Internet Exchange Point (IXP) hosted there. KAZ-IX, the IXP in Almaty, is controlled by the Kazakh government and is not run like a traditional IXP. As a result, much of the high volume of traffic exchange we see taking place in Almaty is more likely a result of local exchange rather than the influence of KAZ-IX.

In general, IXPs do not (yet) play a big role in Central Asia, where they are not widely embraced by the local incumbents due to fears that IXPs will erode their dominant market position. In conjunction with regulated fibre and international connectivity, as well as the lack of available IP address space, this leads to a third man-made bottleneck that throttles Internet development in the region.

In Kazakhstan, only state-run IXPs are legally permitted and operators must have a licence to provide intercity connectivity in order to connect to an IXP. In Kyrgyzstan,

Figure 17:
Out-of-region traffic paths



too, providers must obtain licenses to provide telecommunication and cross-border services. KG-IX and FVIXP are two small IXPs that have recently been established in Kyrgyzstan, while Uzbekistan recently allowed the establishment of ITI-IX, the technical side of which is run by MSK-IX in Moscow. The Digital CASA initiative, of which Kyrgyzstan is one of the first countries to participate, seeks to enhance the role of IXPs in the country.

This reluctant attitude towards IXPs is not unique to the region and has played out before as IXPs were first established in other parts of the world. Over time, however, even large operators in many other markets have come to embrace peering at IXPs as they have realised the economic benefits of much wider market exposure and the role of IXPs in facilitating better, faster and more stable connectivity at lower costs for end users.

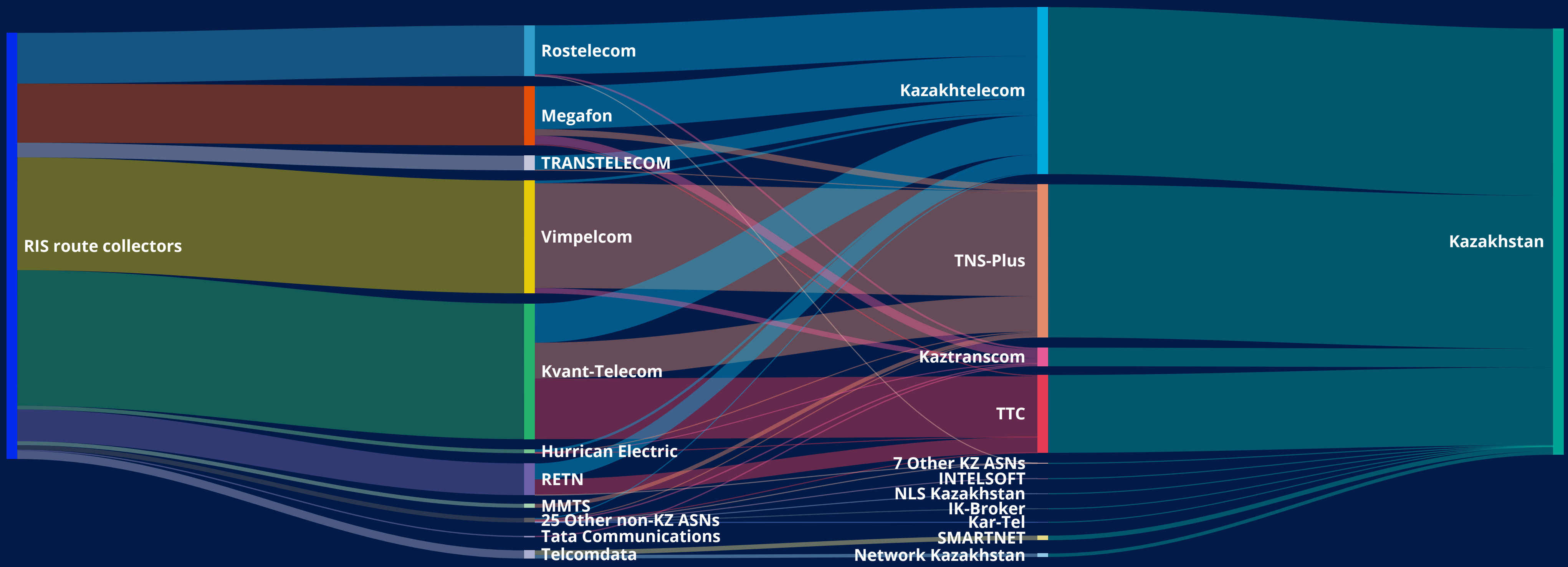
Figure 17 extends the view to look at where traffic might be exchanged outside of the region. Ideally, paths should travel in a straight line from end user to end user, in order to reduce round-trip times. In reality, however, this is almost never feasible. Although figure 16 showed that a lot of traffic is exchanged locally within the region, there is still a significant amount of traffic exchanged in more distant locations. The paths to Moscow and Stavropol are not surprising given the region's close historical ties to Russia, while the connection to Stockholm appears to be a relic of Telia's past involvement in the region.

This behaviour of routing packets a long way to an exchange point, only to have them travel back to a destination close to the origin, is referred to as "tromboning". The farther a path extends from the origin/destination, the more inefficient the path is. The delay that this introduces might be so minimal as to not even be noticeable to an end user, but it generally increases costs for the network operator.

More importantly, the additional distance travelled unnecessarily increases the risk of disruptions and often creates additional dependencies on external suppliers, many of which reside in foreign jurisdictions.

Delays from detours as far away as Moscow and Stockholm will not be minimal, although how noticeable this is to an end user would depend on their activity. We also do not know how often the tromboning paths are used in practice. Our data suggests that tromboning only exists between probes in different countries and not within any of the five countries themselves. However, these figures are based on a small number of measurements that were taken at a particular point in time and therefore offer only a limited snapshot of the situation. We would expect that measurements taken at any other time would likely offer very similar results, but again, having more RIPE Atlas probes deployed in the region would produce more robust results.

Figure 18:
Kazakhstan's international connectivity



3. External View of Central Asia

Extending our view even further, we now look beyond regional traffic exchange to examine how the countries in Central Asia connect to the rest of the world. To investigate this, we again turn to the RIPE NCC's Routing Information Service (RIS). We look at the routes collected by RIS for IP networks in each country and identify the last foreign and first domestic network encountered in these paths. This gives us an overview of which operators provide international connectivity into each country.

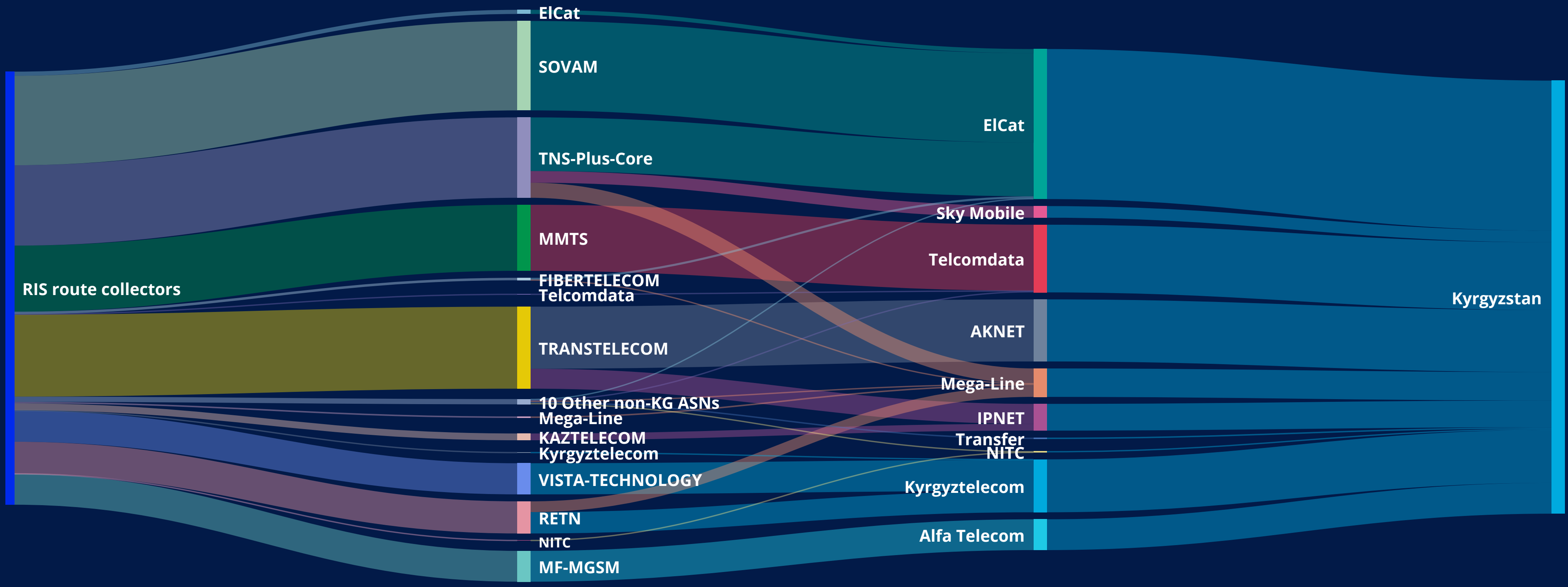
Because of Kazakhstan's proximity and the region's close ties to Russia, most international telecommunications reaching Central Asia will pass through Kazakhstan and Russia. However, other connections have also been established in recent years. Transtelecom Kazakhstan, for example, provides service via a connection to China at Dostyk, which lies right at the border.[7] Because Tajikistan doesn't share a border with Kazakhstan, traffic in the country would also have to pass through one of its neighbours, Uzbekistan or Kyrgyzstan. On the level of Internet routing protocols, the detailed geographical paths aren't clearly visible, as operators can set up multi-segment paths.

In the following figures, we look at the routing data from the RIS route collectors captured on 1 July 2020.

In Kazakhstan, we see that most routes into the country pass through three providers: Kazakhtelecom, TNS-Plus and Transtelecom Kazakhstan (TTC). These in turn connect to Russian providers Rostelecom, Megafon, Vimpelcom and Kvant-Telecom, as well as some other networks with an international presence.

7 *Capacity Media: Transtelecom opens new routes from China across Kazakhstan to Europe* *https://www.capacitymedia.com/articles/3799554/Transtelecom-opens-new-routes-from-China-across-Kazakhstan-to-Europe*

Figure 19:
Kyrgyzstan's international connectivity



We also see some diversity in Kyrgyzstan in terms of the operators that provide international connectivity, but less redundancy at this level than we see in Kazakhstan. For each Kyrgyz provider, paths predominantly pass through one or two upstream operators, which are based in Russia or Kazakhstan.

Figure 20:
Turkmenistan's international connectivity

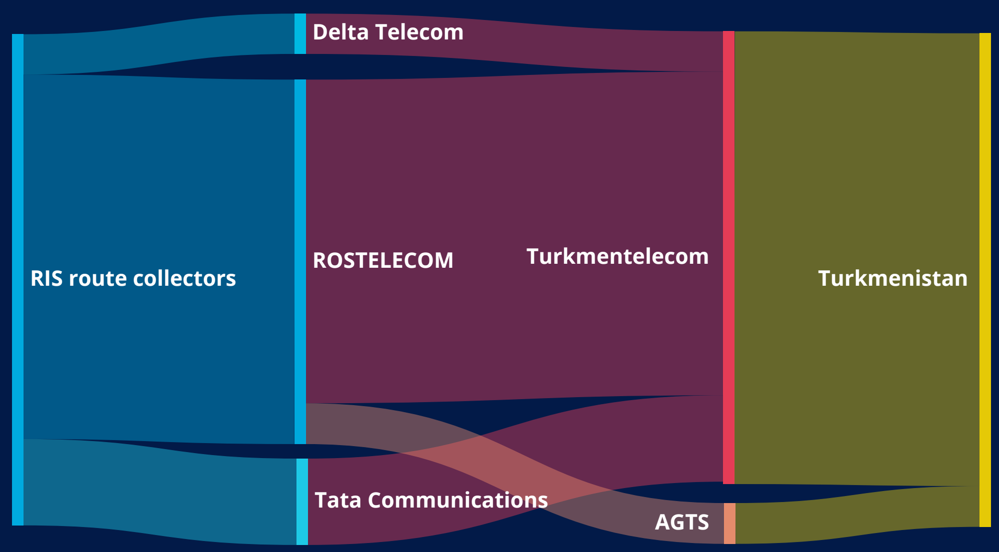
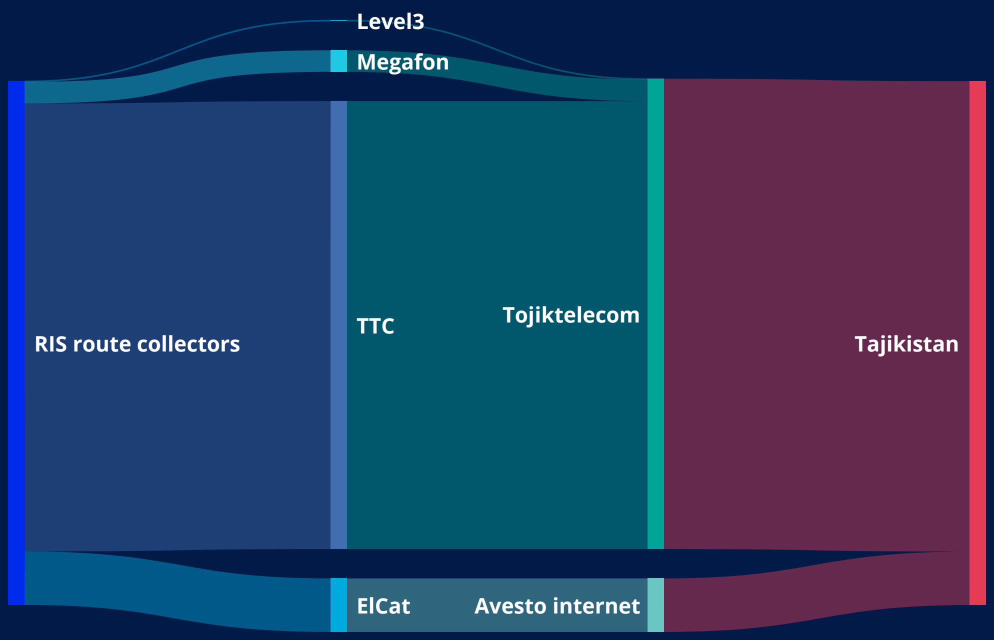


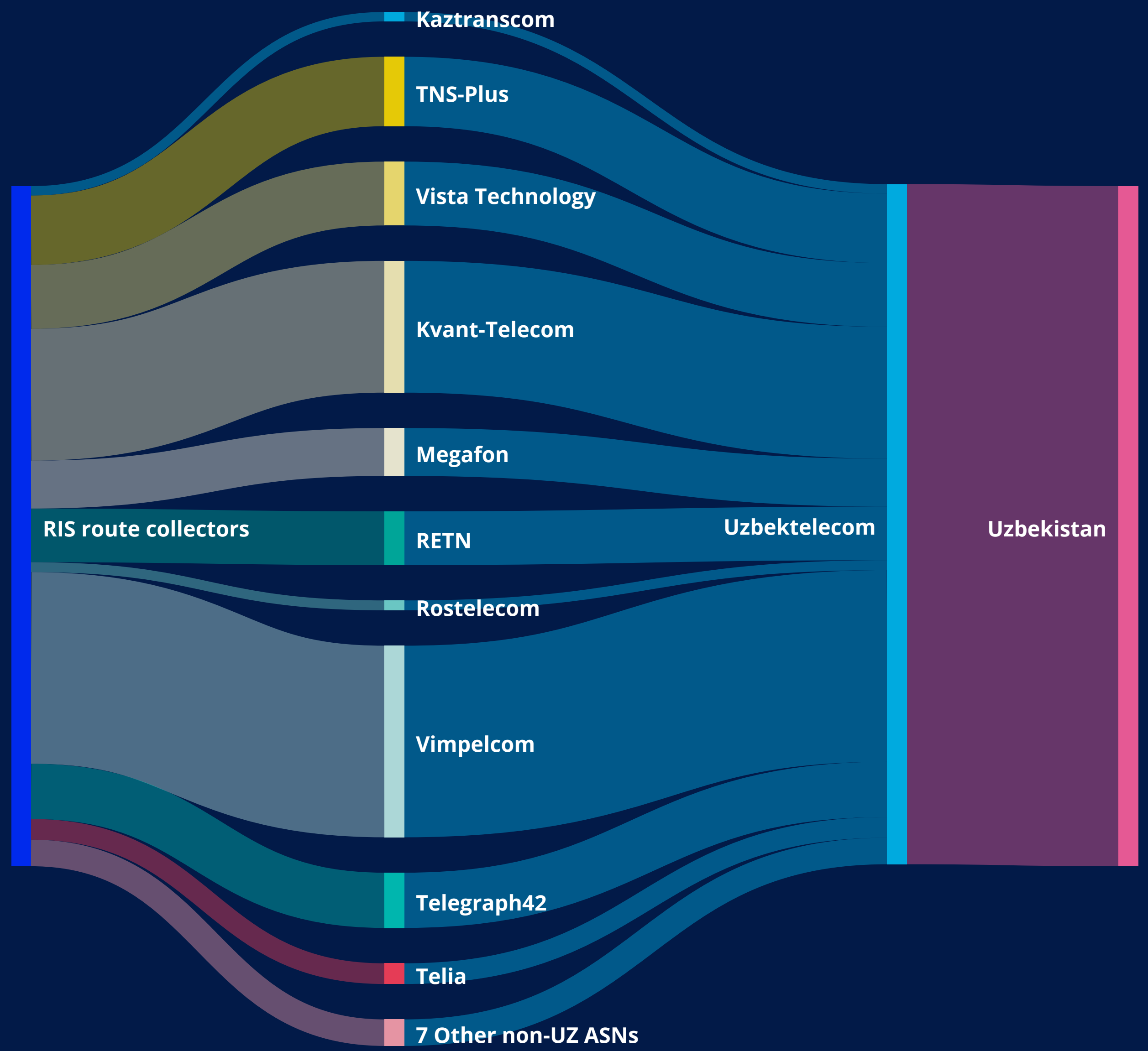
Figure 21:
Tajikistan's international connectivity



Turkmenistan's IP networks mostly receive international connectivity from Turkmentelecom. One has an additional path via Telephone Network of Ashgabat (AGTS), which, like Turkmentelecom, receives transit from Rostelecom in Russia. Turkmentelecom also has connections to Tata Communications, which operates globally, as well as to Delta Telecom, based in Azerbaijan.

Tajikistan's international connectivity is also very simple. Tojiktelecom is the dominant provider, which relies mostly on Transtelecom Kazakhstan (TTC), but also has a few paths through Megafon and Level3. In addition, we see a small subset of paths where Kyrgyzstan's ElCat provides connectivity to Avesto internet in Tajikistan.

Figure 22:
Uzbekistan's international connectivity



In Uzbekistan, we see all prefixes in the routing system pass through Uzbektelecom's network before reaching the final destination network in the country. The fact that all connectivity into the country depends on a single provider is extremely risky from a technical and security point of view. Again, the Internet is designed to operate as a network of networks in order to make it both efficient and resilient. Uzbeketelecom does have several upstream providers, three of which (Kaztranscom, TNS-Plus and Vista Technology) are based in Kazakhstan.

Conclusion

The Internet landscape in Central Asia is more restricted, both geographically and politically, than in much of the RIPE NCC's service region. Heavy regulation, the dominance of state-controlled providers and a lack of infrastructure mean there is little competition, while a centralised approach to security and focus on national sovereignty hampers technical redundancy and resiliency. More diversity is needed to alleviate the risks entailed with the region's current model of Internet connectivity, including more Internet service providers in order to decrease the dependency on a small handful of large operators, and a more open approach to building fibre infrastructure and establishing international connectivity to the global Internet.

Historically, we've seen that open competition and a healthy interconnection environment, whereby traffic can flow easily between providers and which includes active Internet exchange points, actually leads to improved security and economic outcomes for a country and its citizens. Free markets and shared access to infrastructure tends to promote increased content development, improved e-services and lower connectivity costs – all things that the governments of Central Asia have prioritised in their current development programs.

Much of the traffic being exchanged within the region happens on a local level, along with its access to the domain name system, which should result in reasonable response times. However, other factors (which may include restrictive policies) mean that Internet speeds in the region include some of the slowest in the world. There is little diversity in the international connections into and out of the region, where we again see the dominant role played by the incumbents and a heavy reliance on Russia to connect the region to the rest of the global Internet.

It's worth noting that all of the observations in this report are based on active paths, and we cannot know what "hidden" world of backups exists that would automatically take over in the case of any disruptions. Whatever redundancy does exist would provide the system with more resiliency.

As in many other parts of the world, IPv4 scarcity poses another major challenge to future development in Central Asia. In order to connect their populations and fully realise the myriad benefits promised by digital societies and economies, including innovations such as 5G and IoT, governments need to actively promote IPv6 in a way that supports technical operators and avoids unnecessary regulation.

Many of the findings in this report are based on data that the RIPE NCC has collected through its RIPE Atlas measurement platform, which is significantly limited in the Central Asia region. Having more volunteers install RIPE Atlas probes in the region would allow for substantially more robust data and analysis.

About the RIPE NCC

The RIPE NCC serves as the Regional Internet Registry for Europe, the Middle East and parts of Central Asia. As such, we allocate and register blocks of Internet number resources to Internet service providers (ISPs) and other organisations.

The RIPE NCC is a not-for-profit organisation that works to support the open RIPE community and the development of the Internet in general. https://www.ripe.net

Data Sources

The information presented in this report and the analysis provided is drawn from several key resources:

RIPE Registry

This is the record of all Internet number resources (IP addresses and AS Numbers) and resource holders that the RIPE NCC has registered. The public-facing record of this information is contained in the RIPE Database, which can be accessed from https://www.ripe.net/db

RIPE Atlas

RIPE Atlas is the RIPE NCC's main Internet measurement platform. It is a global network of thousands of probes that actively measure Internet connectivity. Anyone can access this data via Internet traffic maps, streaming data visualisations, and an API. RIPE Atlas users can also perform customised measurements to gain valuable information about their own networks. https://atlas.ripe.net

Routing Information Service (RIS)

The Routing Information Service (RIS) has been collecting and storing Internet routing data from locations around the globe since 2001. https://www.ripe.net/ris

The data obtained through RIPE Atlas and RIS is the foundation for many of the tools that we offer. We are always looking at ways to get more RIPE Atlas probes connected and to find network operators willing to host RIS collectors. Please see the RIPE Atlas and RIS websites to learn more.

Other RIPE NCC tools and services

- RIPEstat: https://stat.ripe.net/
- RIPE IPmap: https://ipmap.ripe.net/
- K-root: https://www.ripe.net/analyse/dns/k-root

External Data Sources

We would like to acknowledge the following people and organisations for providing background information included in this report, including information around the regulatory environment and IXPs:

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