

Tajikistan Internet Exchange Point Environment Assessment

June 2017



CAREN 



Internet
Society

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Executive Summary

Internet use in Tajikistan is below average for the region, partly contributing to the low levels of economic growth and efficiency in the country. The number of Internet users is estimated at between 15-40%¹ of the population, broadband services are costly, and areas outside the main cities do not have good access to broadband. Internet uptake and use has been constrained by a variety of different factors, some of which are related to the specific historical, demographic and geographic conditions (such as the landlocked mountainous nature of the country). These have led to high prices for international capacity, high cost of services and equipment for the public, lack of carrier-neutral local-hosting facilities and limited local content development.

The establishment of an efficient Internet exchange point (IXP) in Tajikistan is a key part of improving the overall Internet ecosystem in the country, not only at a technical level to immediately improve local network interconnection, but also at a strategic level. As the health of an IXP is a reflection of how well a variety of different factors are functioning in the local Internet environment, achieving an effective IXP will also help to build additional technical expertise, and the necessary institutional relationships between all of the stakeholders so that the other constraints can be addressed. The most important of these are outlined further below.

One of the most immediate and potentially solvable problems with the Tajikistan Internet ecosystem is constrained local interconnection and access to international content. This can be fixed by establishing an IXP with broad participation from domestic and regional networks, and international Content Distribution Networks (CDNs), such as Akamai, Alibaba, Yandex, mail.ru and Google. This will not only save costs on international traffic for operators but will also reduce network latency, substantially improving performance for local end-users and stimulating higher demand. This in turn helps to justify investment in expansion of network infrastructure, especially as equality of access to content also creates a much more attractive environment for local content developers – for both e-government and commercial applications.

The lack of an IXP is not a technical problem and requires few resources to set up, but it does require the major competing operators to agree on a suitable, and preferably neutral, location to interconnect as soon as possible, and to work together with all stakeholders to establish the operating modalities for the facility.

A non-profit association of network operators and ISPs is likely to be the most appropriate operating entity for the IXP. As has been found in other countries, these associations can also have an important role to play in raising awareness in government about other issues that need to be addressed to create a better enabling environment for growth of the Internet and information and communication technology (ICT) sector, and the impact this can have on the economy more generally.

¹ Statistics vary widely depending on the source of information (ITU has not received statistics from Tajikistan since 2006)

Roadmap for Establishing An IXP

Accelerating the development of a strong and sustainable IXP in Tajikistan will likely require the following sequence of actions:

1. **Community building** – stakeholders should continue to hold regular meetings of all the local network operators and technical advisers to build relationships between the networks that will participate at the exchange.
2. **Situation analysis** - The meetings above would identify any potential relationship issues, policy problems or market barriers to setting up an IXP.
3. **Strategy formulation** – The results of the situation analysis will provide the basis for the stakeholders to formulate the short-term strategic objectives of the project to ensure smooth establishment of the IXP.
4. **Core group formation** – A small team could then be selected by the stakeholders to carry the project forward on a day to day basis.
5. **Policy engagement** - Meetings with government policy and regulatory officials would then be held to obtain their support and understanding of the benefits and strategy of the IXP, and to minimise any potential barriers to its establishment, such as taxation or requiring a license.
6. **Location identification** – In parallel with policy engagement, a systematic and objective assessment of the options already identified for the IXP premises should be carried out, looking at both short and medium-term needs. This would also include examination of other options for using existing data centres or server rooms in which the IXP could be hosted if acceptable to all potential participants, as well as identifying possibilities for converting a facility to carrier neutral status, or setting up a new carrier neutral data centre combined with the IXP.
7. **Institutional development** – Once the location has been identified, setting up the IXP and installing the equipment can begin, along with defining the details of the shared services to be provided, the institutional model for the IXP and cost recovery plan for its sustainable operation. This would benefit from management and technical assistance from teams that have set up and run similar IXPs in other countries.
8. **Services marketing** – To build the value of participation at the IXP, a marketing and membership development strategy would then need to be executed to encourage domestic networks to connect to the exchange and to work with international content distribution networks (CDNs) to ensure they are present at the IXP.
9. **Capacity building** – With participation at the IXP expected to grow as new networks are established, on-going capacity building mechanisms need to be established to help facilitate this growth.

Actions for Improving Sector Efficiency

The IXP can be seen as one of the key components required to ensure efficient, universal and affordable access to the Internet in Tajikistan. There are other components that are also required to function efficiently to achieve this goal, and thereby to leverage the benefits of the IXP to the full. The following section lists the main actions that are required grouped by the different stakeholders.

Private Operators:

a) Share infrastructure.

Increasing numbers of operators around the world are adopting approaches to infrastructure provision which involve sharing or outsourcing non-core aspects of their business, such as masts and ducts. This can considerably reduce the cost of service provision and allows operators to concentrate on their key business proposition. Such shared infrastructure can also extend to jointly establishing a wholesale operator for provision of more national fibre or wireless services in rural areas, potentially augmented by Universal Service Funds, or ownership of a metropolitan area fibre network, a domestic backbone or cross-border fibre cable.

b) Invest in incubator facilities.

To foster the development of local applications and content, network operators could sponsor the establishment of incubator facilities which nurture entrepreneurs and small enterprises by allowing them to share office space, exchange knowledge, and access low-cost high-speed Internet and hosting facilities.

c) Explore innovative solutions for providing last mile connectivity in rural and remote areas.

New technology developments for providing broadband continue apace, and a number of promising opportunities have emerged recently that could lower costs and provide more effective solutions for rural broadband. These include the use of high altitude platforms (e.g., Google's Loons), dynamic spectrum access and shared spectrum systems such as TV White Space (TVWS), and new high bandwidth satellites and medium earth orbit (MEO) satellites which provide lower latency than traditional geostationary satellites. In addition, new business models can be explored which allow local communities to take more responsibility for the provisioning and management of their infrastructure.

Government:**a) Fast track the establishment of the independent regulator.**

Government action is needed to implement the Post-WTO Action Plan² (scheduled for 2018), to ensure the establishment of the independent regulatory authority takes place as soon as possible in order to begin the process of establishing a conducive regulatory environment.

b) Restructure Tajiktelecom and split wholesale operations from retail.

Once the regulator has been established, this could be followed³ by the restructuring of Tajiktelecom into functionally separate wholesale and retail operations. These could both be sold to the private sector to inject new capital into the industry. Ideally the wholesale operations (primarily backbone and cross-border capacity) should be structured as a special purpose vehicle (SPV) in which all local network operators could invest. Alternatively, a PPP model could be used in which a management company without retail operations in the country would take over operations while government retains a share. In any event a more detailed study of the options would be the first step.

c) Adopt a set of policies and regulations which provide a more enabling environment for Internet growth.

These are:

- Not imposing any special licensing requirements, authorizations, or taxes on the proposed IXP
- Allowing ISPs to self-provide infrastructure where needed, both domestically and internationally.
- Allow ISPs and operators to lease dark fibre from the electricity provider Barqi Tojik
- Adopting infrastructure sharing and dig once regulations which require operators to give access to their passive infrastructure assets (masts, cabinets, ducts, dark fibres), to require any operator that lays fibre to allow others to access the duct, and to require that ducts are included in the construction or refurbishment of any public utility (roads, rail, power grids, pipelines etc.) and public buildings.
- Instituting price-caps on the leasing of passive infrastructure and rights of way from other operators and also from other utilities (e.g., electricity poles) and municipal buildings and way-leaves, including those on national and secondary roads.
- Establishing a Universal Service Fund (USF) to support the deployment of infrastructure in areas that are not attractive to commercial operators.
- Requiring publically available reference wholesale offers from wholesale providers.
- Reviewing radio spectrum policy to come into line with new technology developments in spectrum management and shared/secondary use, such as TV Whitespace (TVWS).

² Approved by Government Decree No. 691 of 31 October 2014, <http://www.osce.org/tajikistan/215401?download=true>

³ Many countries have made the mistake of privatisation before establishing an effective regulatory body, which created a more problematic environment with an even more powerful private monopoly

d) Develop a national broadband plan.

As indicated above, currently no formal state strategy exists for promoting Internet access and use, and government department coordination and leadership is necessary to maximise the potential for Internet development in the country. A national broadband plan would aim to address issues such as provision of public access facilities, ensuring digital literacy training is available and the development of connectivity and applications/content development strategies for each of the sector ministries in an integrated e-government strategy.

Of particular importance in the strategy is the setting of appropriate targets, especially for broadband speeds, coverage and prices. In terms of affordability targets, it may be appropriate to review the Alliance for Affordable Access' (A4AI) new proposed target for mobile broadband of a 1Gb data bundle costing no more than 2% of monthly GNI/capita⁴.

e) Establish an effective national Internet observatory.

Strategies to promote better Internet connectivity require measures by which to judge their effectiveness. Measures also need to be pragmatic, rather than exhaustive – they need to be easily obtained, objective, comparable and up to date. In this respect, a few simple measures are proposed, aiming to provide not only an indication of the numbers connected but also the level of internet utilisation.

International Community:

Support progressive private sector and government initiatives.

The private sector and government are likely to benefit from knowledge of experience outside the country as well as potentially needing material support for some of the initiatives described above, in particular the IXP, incubators and many of the government policies, ranging from development of a national broadband plan, to finding the most effective model for operating a Universal Service Fund.

This would also include capacity building of the planned national regulator and raising awareness of recommendations or guidelines by international institutions (i.e., ITU, EEC, EU, OECD, WTO) which could help encourage the government to adopt a more enabling policy environment.

Coordination of support from the different members of the international community can be a problem, and establishing a mechanism to maximise synergies and minimise overlap may be needed.

Civil Society

Raise awareness and maintain dialogue with the private sector, government and the international community.

Civil society's chief activity is to represent the broad interests of the public in obtaining better access to the Internet and relevant content by raising awareness of new and on-going issues with the relevant entities, be they individual, the private sector, government or international agencies. The capabilities of civil society stakeholders in Tajikistan in this respect is significant. Their inputs will support the development of Internet infrastructure in the country and will help ensure a balanced and neutral approach to security, privacy and regulatory issues relating to the deployment and use of the Internet.

⁴ <http://a4ai.org/1for2-affordability-target>

1. Background to the Study

This study was commissioned by the Internet Society and GÉANT to support the development of the Internet in Tajikistan through the development of an Internet Exchange Point (IXP) in the country. The study has been co-financed by the European Union through the Central Asia Research and Education Network (CAREN) project which is managed by GÉANT, along with ISOC's own budget. Other interested parties include Tajikistan's national research and education network (NREN) TARENA, the Association of mobile operators, the Scientific Enterprise Center "Cybernetics", The Public Fund "Internet", the Civil Internet Policy Initiative (CIPI), the Public Organization ICT Centre, the World Bank Group, and the Open Society Institute (OSI).

Establishing at least one IXP in Tajikistan is seen as a vital step in cementing the nation's Internet sector, making the exchange of traffic between Internet providers much more efficient, reducing costs for providers and increasing the performance of Internet-based services for the end user. Despite these rather obvious advantages, IXPs are still absent in Tajikistan and in about 80 other countries⁵. In addition, many of those that do exist are operating sub-optimally. It turns out that the establishment and effectiveness of IXPs is sensitive to a wide variety of the other factors in the Internet ecosystem that often constrain the deployment and uptake of the Internet. The absence of IXPs in a country also points to the need to address these factors in order to ensure that the public can fully take advantage of universal access to affordable broadband Internet services. It is with this aim in mind that this study was conducted.

The content of this report is the sole responsibility of ISOC and should not be regarded as reflecting the position of GÉANT or the European Union.

5 See the map of IXPs at <http://ixptoolkit.org/ixps> and the list of countries at: <https://www.pch.net/ixp/summary>

2. Introduction

Tajikistan is a landlocked country in Central Asia, occupying a central position in the region, bordered by China, Afghanistan, Uzbekistan and the Kyrgyz Republic. Pakistan lies to the south, separated by the narrow Wakhan Corridor. About 93% of the territory is covered by mountains.

Maps: Tajikistan: Regional Context and Topography



2.1 Development Challenges

Tajikistan emerged from a six-year civil war in 1997, which erupted after the country became independent from Soviet rule, claiming the lives of about 100,000 people and causing over 500,000 to flee the country. Tajikistan is officially a republic, holding elections for the presidency and parliament. President Emomali Rahmon is now in his third term, coming to power in 1994.

Most of Tajikistan's 8 million people are part of the Tajik ethnic group, who speak Tajik (a dialect of Persian). Many Tajiks also speak Russian as their second language, and Russian is routinely used in business, although this is diminishing, especially in the younger age groups. Tajikistan has a high rate of literacy, with an estimated 99.5% of the population having the ability to read and write. However, UNICEF estimates that about 25% of girls in Tajikistan fail to complete compulsory primary education because of poverty and gender bias.

Between 2000 and early 2015, poverty in Tajikistan fell from over 83% to about 31% - a pace of poverty reduction over the past 15 years that has been among the top 10% in the world⁶. However, as the table below shows, Tajikistan is still on the low end of the wealth spectrum in the region, only surpassing Afghanistan and the Kyrgyz Republic in terms of GNI/capita. Like most of the other Central Asian countries that were a part of the Soviet Republic, it is classified by the World Bank as a Lower Middle Income country (Kazakhstan is the exception, which is classified as Middle Income). However, income distribution is relatively concentrated and according to the UNDP, about 20% of the population lives on less than US\$1.25 per day.

Table: Basic Development Indicators in the Central Asian Region

	GNI/ Capita (2015)	Population (2016)	Annual Electricity Consumption (kWh/capita)	Life Expectancy at Birth
Tajikistan	1,280	8,669,464	1,682	69
Afghanistan	610	33,369,945	-	61
Azerbaijan	6,560	9,868,447	2,093	71
Kazakhstan	11,390	17,855,384	4,892	72
Kyrgyz Republic	1,170	5,990,006	1,887	71
Russian Federation	11,450	143,439,832	6,539	71
Turkmenistan	7,380	5,438,670	2,602	66
Uzbekistan	2,160	30,300,446	1,637	68

Source: World Bank

Tajikistan's economy largely depends on aluminium, cotton and remittances. In 2014 remittances were responsible for about 50% of GDP, making it the most remittance dependent country in the world, and thus particularly vulnerable to external economic shocks. Tajikistan also has other mineral resources (namely antimony, gold, silver, tungsten, uranium) and considerable hydro power export potential.

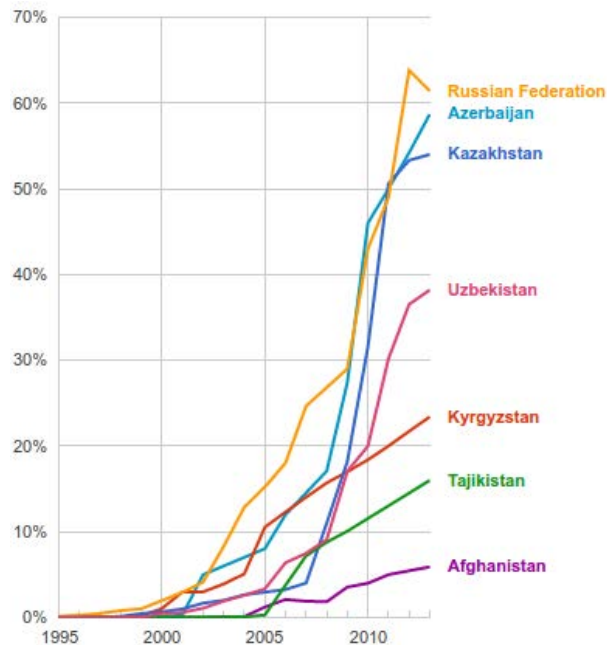
In relation to regional integration initiatives, Tajikistan is a member of variety of regional organisations. The most important of these are the Commonwealth of Independent States (CIS) which comprise the former Soviet republics with the exception of the Baltic States, Georgia, and Ukraine; the Collective Security Treaty Organization, which comprises Armenia, Belarus, Kazakhstan, Kyrgyz Republic, Russia, and Tajikistan; and the Shanghai Cooperation Organization (SCO). Tajikistan is also a member of the Organisation of Islamic Cooperation (OIC), and the Economic Cooperation Organisation (ECO), which is mainly composed of Muslim majority states. Tajikistan is also on track to become a member of the Eurasian Economic Union which includes Armenia, Belarus, Kazakhstan, Kyrgyz Republic, and Russia, having signed the treaty on the Eurasian Customs Union and the Single Economic Space.

6 <http://pubdocs.worldbank.org/en/707131475782010877/Tajikistan-Snapshot-October2016FINAL.pdf>

2.2 Internet Challenges

As shown in the chart below, the level of Internet-use in Tajikistan has grown steadily over the last few years, but is still amongst the lowest in the region.

Chart: Trends in Internet Uptake in Central Asia (% of Population that use the Internet)



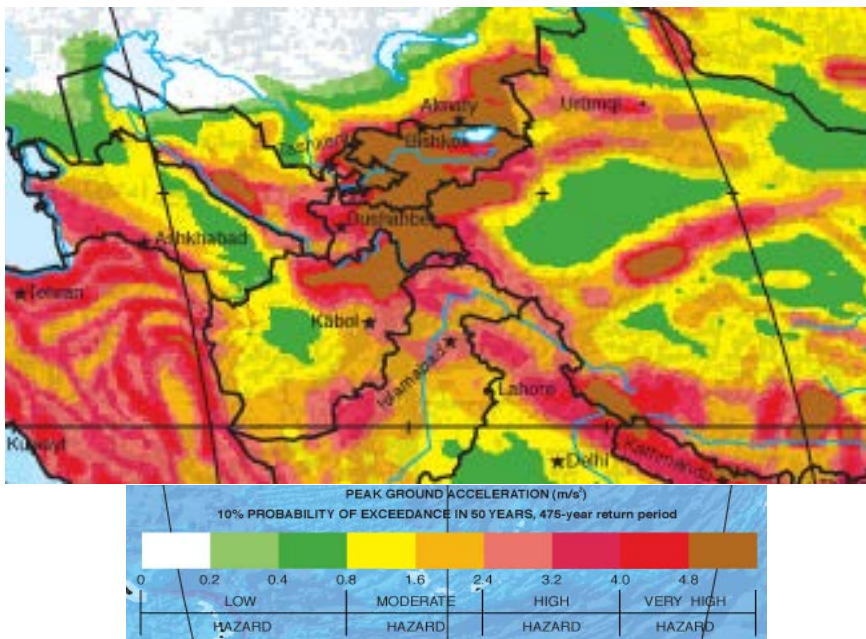
Source: ITU <http://www.itu.int/net4/itu-d/icteye>

Aside from the negative impact on Internet uptake caused by relatively low-income levels and population density, Tajikistan also faces a large number of other significant challenges in developing its use of the Internet:

1. The country is landlocked, which makes it difficult and expensive to reach the nearest submarine cables that carry most of the world's traffic to the global Internet hubs in Asia (Singapore and Tokyo), Europe (Germany and London), and the United States (New York and Miami). Pakistan has the closest submarine cable landings, but this requires transiting strife-torn Afghanistan, making it expensive, but more feasible to route traffic via the backbones of multiple countries to the north and west. As a result, the cost of international capacity is amongst the highest in the region. Considering that up to 80% of local traffic is to external sites, this creates high local access costs, which is a major constraint on uptake and use, and results in a vicious cycle with Internet providers having less revenue with which to invest in local infrastructure.

- As shown in the map below, the region is amongst the most earthquake prone areas in the world, which makes both cable infrastructure and masts vulnerable to disruption.

Map: Seismic Hazard Probabilities in Central Asia



Source: UN GSHAP <https://mitnse.files.wordpress.com/2011/09/globalseismichazardmap.jpg>

- Tajikistan's high altitude and consequent low winter temperatures, combined with 93% of the land area being covered by mountains, makes laying cables more expensive, and a much higher density of wireless base stations to cover the population is also required.
- Efficient and effective use of the Internet requires an affordable and reliable source of electricity. While Tajikistan's electricity tariffs are amongst the lowest in the world, and more than 96% of households are connected to the electricity grid, due to the lack of local energy generation facilities and isolation from the region's power distribution grids, about 70% of the population unfortunately suffers winter blackouts⁷.
- The telecom and Internet industry is still at a relatively early stage of development. When Tajikistan became independent from the Soviet Union, its telecommunications infrastructure was among the least developed of all the former Soviet republics. In addition, the subsequent civil war led to the fragmentation of the sector up until the late 1990s, with little investment and almost no interconnection between telecom operators, which were sometimes in violent competition. During this period, ISPs were also aligned with feuding political interests.
- Although the government has taken steps to attract investors and liberalize the telecom sector, a number of key policies are still required, and some policies have been implemented which could limit Internet uptake, such as the plan for a single international gateway and increased taxation on ICTs.
- Lack of a skilled ICT labour force is a constraint for deployment of Internet infrastructure and development of local applications and content.
- Language isolation means that little relevant content is available from outside the country to attract users, except for Russian language sites, mainly for older users.
- The recent slowdown in the Russian economy, which has resulted in 40-60% less remittances from Tajiks working in Russia, has had a direct impact on available funds for Internet use.

⁷ <https://www.adb.org/sites/default/files/publication/189730/taj-export-diversification-growth.pdf>

3. Baseline Assessment of Tajikistan’s Internet Ecosystem

This section of the report outlines the current status of the components of the Internet ecosystem in Tajikistan, looking at the value chain in terms of:

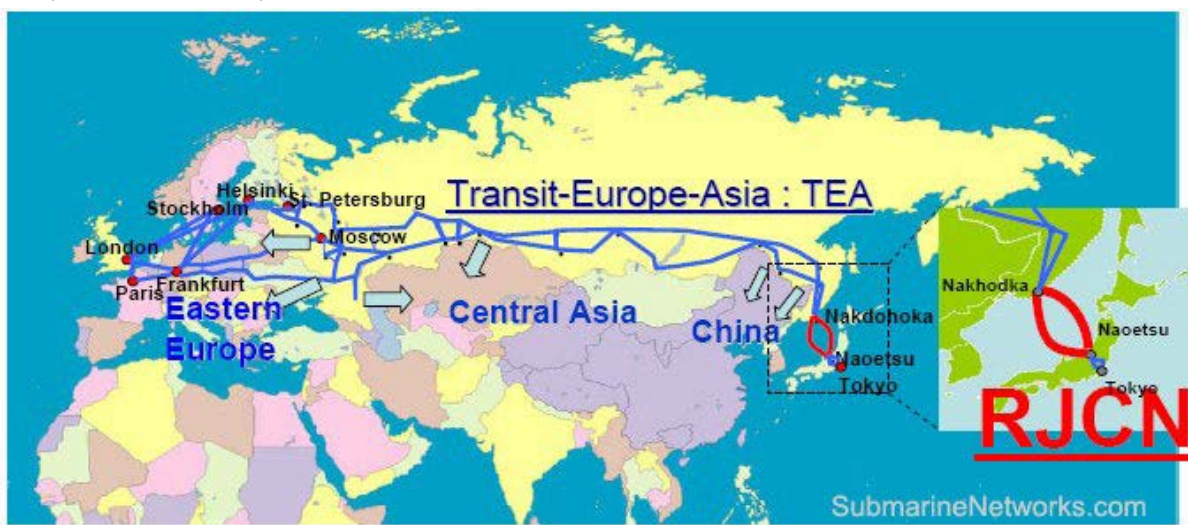
- The supply-side infrastructure, applications and devices required to maximise performance (e.g., speed, latency, coverage) and minimise costs in the creation of Internet traffic between source and recipient.
- The demand side aspects, which affect the extent of usage of Internet services in Tajikistan.

3.1 International Capacity & Connectivity

As indicated above, the high price of international bandwidth is one of the chief reasons for high end-user costs, resulting in low levels of Internet uptake and usage. As a result, access to sufficient low-cost international capacity is a key driver for the development of Internet services in most developing countries and emerging economies. Experience has shown elsewhere that the arrival of low cost international routes is often a trigger for investment in domestic infrastructure, as it then becomes possible to service demand for more affordable broadband services.

Being landlocked (actually ‘double-landlocked’ on all routes except via a very long path to China’s coast) means there are few options for Tajikistan to reduce the cost of international connectivity. Until relatively recently the country relied on the Dushanbe satellite earth station, which was established in 1994. Due to the high costs and limited capacity, however, most operators now primarily use fibre links via the Kyrgyz Republic and Kazakhstan to reach Russian backbones, in particular the Transit-Europe-Asia (TEA) cable, as shown below.

Map: The Transit-Europe-Asia Backbone



Source: <http://www.submarinenetworks.com/systems/asia-europe-africa/tea/tea-cable-network>

As the chart below shows, transit capacity in Tajikistan still is amongst the highest in the region.

Chart: Wholesale Transit Pricing USD/Mbps/Month (2015)



Although international capacity prices have continued to drop in Tajikistan, this has taken place more slowly compared to some of the other countries in the region. For example, capacity is about 50 times more expensive in Tajikistan than in Kazakhstan. Capacity on the Kazakhstan-Kyrgyz Republic route is about USD 10/Mbps/month, while Kyrgyz Republic-Tajikistan is about USD 55-70/Mbps/month.

Immediate alternatives for improving international connectivity via other neighbouring countries are limited. Aside from the Afghanistan cross-border link (see below), which is restricted to Tajiktelecom, there is a fibre link from Dushanbe toward the border of Uzbekistan via Tursunzade. From Uzbekistan, however, it is still necessary to traverse Kazakhstan to get to TEA and low-cost termination in Russia. Although transit capacity in Kazakhstan is relatively cheap, Uzbekistan prices are much higher – similar to Tajikistan's at \$100 /Mbps/month (UZ Telecom capacity is well known for its high prices).

As a result, the main international route for Tajikistan continues to be via the Kyrgyz Republic cable link (Isfara-Batken) which was constructed in 2009, and then onward through Kazakhstan. This is being developed further in terms of capacity, and in addition it has been reported that the Kyrgyz Republic ISP Elcat has deployed fibre across the border to Tajikistan.

There is currently no wholesale operator in Tajikistan, so retail operators obtain their international capacity in a variety of ways. Beeline, TTL, Babilon-T and Saturn-Online all have their own international links and smaller providers make use of these for their services. Saturn connects with both Uzbekistan and Kyrgyz Telecom, while Babilon-T obtains capacity from Elcat in the Kyrgyz Republic but connects directly with iHome's POP in London (iHome is a Russian operator with an international footprint). Another operator, Beeline, obtains some capacity from Babilon-T and the rest via a link to a Russian provider. Through the EU-funded CAREN project TARENA, the Tajik Academic Research Educational Networking Association, is connected to the GÉANT network in Frankfurt and to KRENA (the NREN in the Kyrgyz Republic) using capacity tendered from regional connectivity providers. Tajiktelecom's traffic to Western Europe travels via Kyrgyz Republic and the Russian Federation before arriving in Germany, as shown in the traceroute map below.

Map: Traffic to Tojnet.tj from Germany



Source: Authors' Open Visual Traceroute April 2017

There is also cross-border fibre between Tajikistan and Afghanistan at Sher Khan Bandar, established by Tajiktelecom. Applications for operators to use this route⁸ or to lay their own fibre have not been authorised as yet. Nevertheless, it appears that Tajiktelecom has provided transit capacity to Afghanistan via this route since 2009, according to Terabit Consulting⁹.

Diagram: Afghanistan fibre link to Tajikistan



Source: Afghanistan MCIT 2015

⁸ A number of operators have tried to establish additional routes in Tajikistan e.g. southern hub or northern route, but both initiatives were blocked by the government.

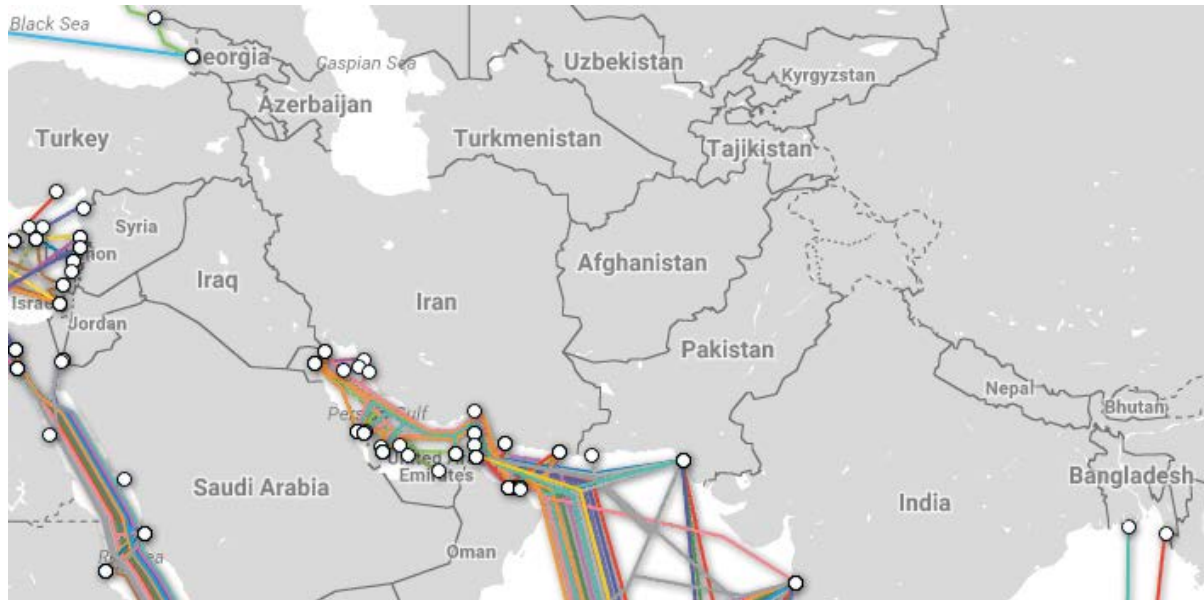
⁹ Authors' interview with Michael Ruddy

International Connectivity Outlook

Pakistan

As shown in the map below, the Afghanistan route is an important one because Afghanistan is connected to Pakistan and this could potentially allow Tajikistan access to the nearest submarine-cable landing stations in the region and onwards to the global hubs.

Map: Submarine Cables in the Central Asian Region



Source: <http://www.submarinecablemap.com>

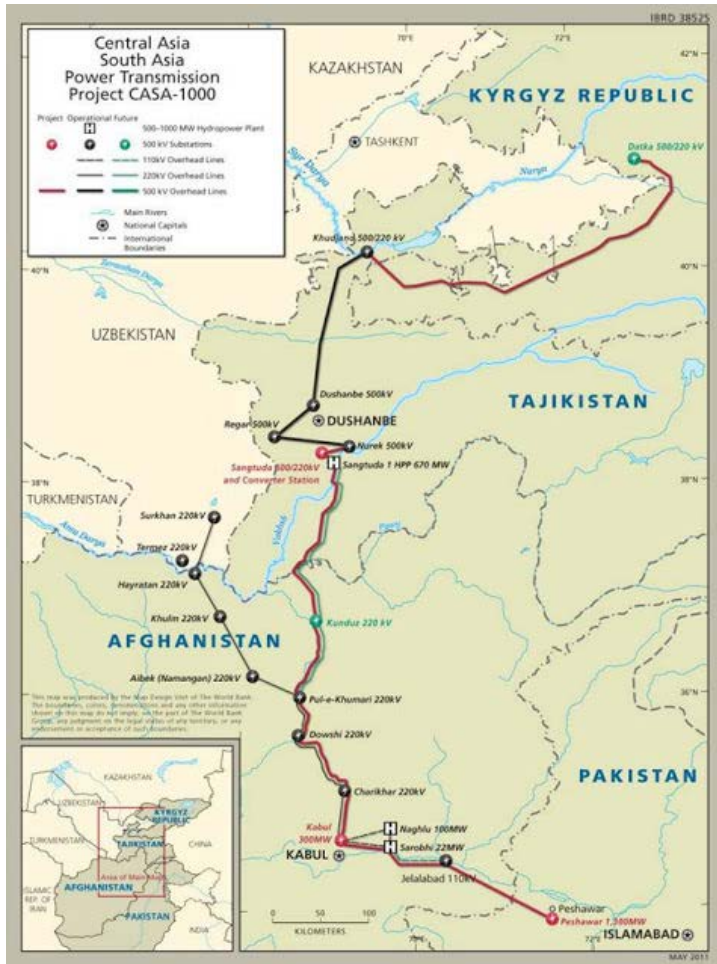
Pakistan is increasingly becoming a regional hub and is currently connected with the world via four undersea fibre optic cables, with another other five cables in progress. There is also a recently launched IXP in Islamabad and IXPs in development in Karachi and Lahore. As part of the China-Pakistan Economic Corridor Project (CPEC), a \$44m fibre optic project to connect the two countries by the end of 2017 has been announced. Fibre optic cables have been laid along the corridor and the 1,030km SRG-1 system¹⁰ – which is scheduled to be ready for service (RFS) in Q4 2017 – will connect Muscat (Oman) to Gwadar and Karachi (both Pakistan), and is already promoting onward connectivity to Afghanistan, China, Iran, Turkmenistan, and Tajikistan.

However, the Tajikistan fibre link with Afghanistan is problematic due to the on-going strife there, and the national backbone in Afghanistan is not reliable because the planned fibre ring has not been completed due to security issues. As a result, the potential for obtaining better connectivity to global hubs via Afghanistan's existing infrastructure seems poor at this point.

An alternative for this route in the future could be the Central Asia-South Asia 1,000-megawatt (CASA-1000) regional grid power-distribution programme being funded by the World Bank and the IFC. In December 2016, it was announced that this power supply project, in which fibre optic cables will be laid along with electricity transmission lines, will connect Tajikistan and Kyrgyz Republic with Pakistan via Afghanistan. The proposal has been approved by authorities in all four countries and the first phase of the implementation plan in Afghanistan is being funded by the World Bank. Barqi Tojik, the Tajikistan state electricity operator is expected to become a transit operator on the link, and it already has fibre infrastructure from Dushanbe to Khujand in the north, close to the borders of both Uzbekistan and the Kyrgyz Republic. Political stability in Afghanistan remains a risk for the successful completion of the CASA project, although there have been recent assurances from the Taliban that national infrastructure projects will not be attacked.

¹⁰ <http://www.silkroutegateway-1.com/>

Map: CASA-1000



Source: <http://infopak-zone.blogspot.pt/2016/05/>

In 2009, an agreement was made between Tajikistan, Pakistan, and Afghanistan to improve and extend a 1,300 km highway and rail system connecting the three countries to Pakistan's ports. The proposed route would go through the Gorno-Badakhshan Autonomous Province in the eastern part of the country. In 2012, the presidents of Tajikistan, Afghanistan and Iran signed the agreement to construct the roads and railways as well as oil, gas, and water pipelines to connect the three countries. However, little has taken place since then, and there have not been any proposals to include fibre on these routes.

China

Tajiktelecom and China Telecom announced a plan in 2008 to build a fibre connection between the two countries, but this did not come to fruition. However, at the Central Asia Launch of World Development Report 2016 in February (2016) in Almaty, Kazakhstan, a Tajikistan government representative announced that a fibre cable would be laid along the infrastructure of the planned gas pipeline from Turkmenistan to China, via Tajikistan (and the Kyrgyz Republic)¹¹, known as the China-Central Asia gas pipeline network. Since that time, plans for Uzbekistan's section of the pipeline were suspended and Kyrgyzstan's section was similarly postponed. As a result, it was announced in March this year (2017) that the whole section of the pipeline project that would pass through Tajikistan (Line D) was being indefinitely suspended¹².

It is possible that other cross-border links with China will be explored, but the long distance and mountainous terrain between Dushanbe and the Chinese border would make this an expensive route, and traffic would likely be subject to China's firewall. In addition, the cost of capacity in China is currently not particularly attractive, as experience in the Kyrgyz Republic shows. In 2013, the Kazakhstan operators raised transit prices to about USD60/Mbps/month, and

¹¹ <http://www.worldbank.org/en/news/feature/2016/03/15/reaping-the-benefits-of-digital-technology-in-central-asia>

¹² <http://thediplomat.com/2017/03/the-central-asia-china-gas-pipeline-network-line-dead>

in response Kyrgyz Telecom arranged for transit through China to Vladivostok, but before the deal was finalized, the Kazakhstan operators lowered their prices to previous levels. Currently it is estimated that transit via China is about USD35-40/Mbps/month.

Tajikistan is a member of the Shanghai Cooperation Organisation (SCO), which also comprises China, Kazakhstan, the Kyrgyz Republic, Russia, and Uzbekistan (India and Pakistan will become members in June 2017). Although the SCO is primarily focused on security-related concerns and military co-operation, social development projects have been increasing of late, with the priority on joint energy projects. It has also been promoting plans for High-Speed Internet Backbone (HSIB).

In addition, in 2013 China announced the One Belt One Road (OBOR) initiative to boost connectivity with 64 countries by building infrastructure and facilitating trade. The initiative is backed by the USD 40 billion Silk Road Fund and the USD 100 billion Asian Infrastructure Investment Bank (AIIB). The initiative will focus on jointly building a new Eurasian land bridge and developing China–Mongolia–Russia, China–Central Asia–West Asia, and China–Indochina Peninsula economic corridors. If these routes include fibre optic cable or ducts, this could significantly improve international connectivity in the region.

A similar opportunity has been outlined by Linne Asia to exploit the Asian Highway network, which links most countries in Central and South Asia, by deploying fibre along the roads¹³.

Turkmenistan

In 2016, the government announced that a fibre link is planned as part of the rail connection from Tajikistan to Turkmenistan via Afghanistan, known as the TAT line. The Asian Development Bank and the Islamic Development Bank have promised to help fund the estimated \$2 billion project.

Map: The TAT Line

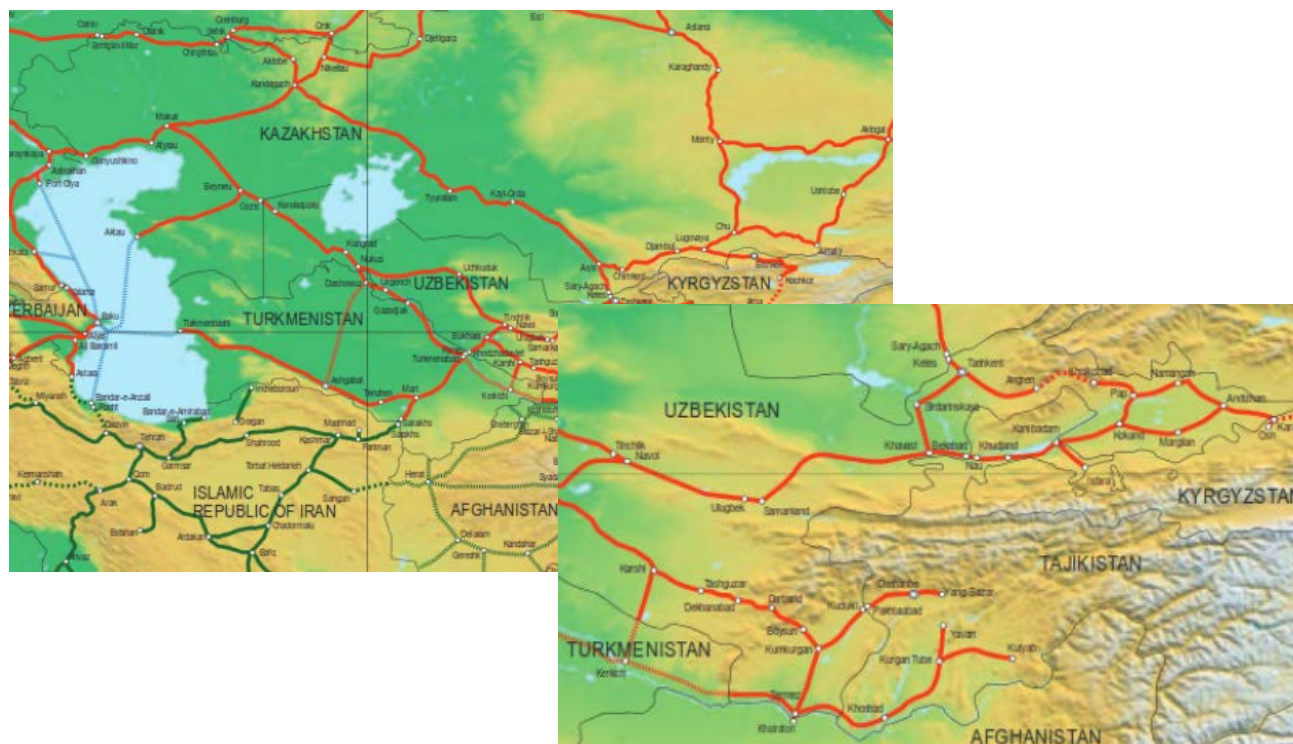


Source: <http://www.rferl.org/a/afghanistan-turkmenistan-tajikistan-railway/28146465.html>

This infrastructure would be used to further interlink with the regional railway networks in the region which could become important low cost routes for the deployment of fibre in the region, as shown in the map below.

¹³ <http://www.itu.int/en/Lists/CWGContributionSP/Attachments/28/2014%20January%20LIRNEasias%20response%20to%20ITU.pdf>

Map: Trans-Asian Railway Network



Source: <http://www.unescap.org/resources/trans-asian-railway-network-map>

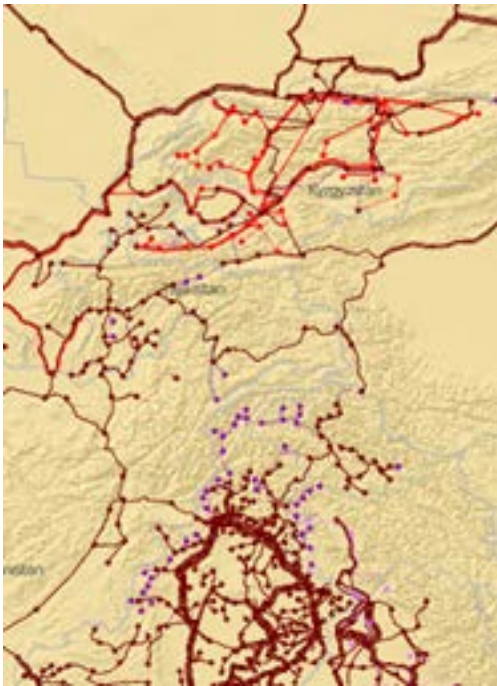
A regional comparison of international bandwidth in use is shown in the table below. As can be seen, Tajikistan's current requirements for capacity reflect the relatively limited Internet use in the country. International bandwidth use per subscriber is low - less than 10 Kbps – which puts Tajikistan in the group of countries that are well behind the leaders in the region - Kazakhstan and Azerbaijan, which are around 30Kbps. For comparison, the more advanced European markets are at around 100Kbps/capita.

Country	International Bandwidth (Gbps)
Tajikistan	10
Afghanistan	15
Azerbaijan	340
Kazakhstan	500
Kyrgyz Republic	15
Russian Federation	4,000
Turkmenistan	1
Uzbekistan	20

3.2 Domestic Backbone Connectivity

The backbone fibre network in Tajikistan is relatively undeveloped compared to some other countries in the region as shown in the map below (the Annex shows the other backbones in the region).

Map: Domestic Backbones in the Central Asian Region



Source: ITU <https://www.itu.int/itu-d/tnd-map/>

Tajiktelecom has a backbone spanning a significant part of the country, as shown below, and the four largest mobile operators have deployed some fibre, mainly for cross-border links. In the current economic climate, the private operators have said that investment in remote areas does not pay off because the return on investment is too low. As a result, in rural areas, connectivity is often lost due to rough terrain and poor conditions. Capacity costs on the domestic network are reasonable – for example on the Dushanbe-Khujand route the cost is said to be about USD 7000/year for a 1Gbps circuit.

Map: Tajiktelecom Domestic Backbone



Source: http://www.eeca-ict.eu/uploads/new_documents/eReadiness_of_Tajikistan_full_En.pdf

3.3 Last-mile Connectivity

Fixed Networks

The use of fixed-line services is relatively low in Tajikistan, servicing around 5.3% of the population, while fixed broadband subscriptions stood at only 0.07% penetration in 2016¹⁴. The state-owned operator Tajiktelecom is the primary provider of fixed-line voice and xDSL services, with about 400, 000 lines mainly concentrated in the major cities, although it announced plans in 2012 to provide 100, 000 new fixed lines for low-income families.

Aside from Tajiktelecom, there are a number of other operators providing fixed services, including some FTTx. However, there are only about 100,000 users, mainly serviced by Babilon-T, Intercom, Eastera and Telecom Technology, which also provide VoIP services.

Mobile Networks

There are six major mobile operators: Tcell, Babilon-Mobile, MegaFon, Tacom / Beeline (VEON), TK-mobile, and Tajiktelecom Mobile (the mobile service of the incumbent operator Tajiktelecom). The table below lists the number of mobile operators per country, which indicates that Tajikistan is about average in terms of the degree of mobile competition.

Country	Mobile Operators
Tajikistan	6
Afghanistan	6
Azerbaijan	4
Kazakhstan	3
Kyrgyz Republic	5
Russian Federation	9
Turkmenistan	2
Uzbekistan	5

Basic mobile voice services (2G) are said to have reached 100% of the population last year (2016)¹⁵. Babilon-Mobile and Tcell are the market leaders at about 30% of the subscriber base each, followed by Megafon & Beeline with about another 30% of the market between them.

Mobile broadband (3G) services have been available since 2005, and 4G/LTE services since 2012. Little information has been made public on the extent of mobile broadband coverage in Tajikistan, although it was announced last year that Babilon-M had expanded the coverage of its LTE network outside of capital city Dushanbe to include Khujand, Qurghonteppa and Kulob. More recently, VimpelCom announced that it has partnered with ZTE Corporation to build a virtual network infrastructure providing 4G/3G/2G mobile data services to customers across five Central Asian markets.

The table below summarizes the latest available information for local Internet uptake and fixed line costs in the region, which indicates that Tajikistan is well behind most of the other countries except Afghanistan and Turkmenistan in terms of the proportion of the population using the Internet, line speeds and the costs of fixed-line broadband.

¹⁴ It has been observed that there are considerable inconsistencies with the telecom and Internet market statistics available for Tajikistan. See for e.g., <http://www.azernews.az/business/101102.html>

¹⁵ Budde Reports: <https://www.budde.com.au/Research/Tajikistan-Telecoms-Mobile-Broadband-and-Digital-Media-Statistics-and-Analyses>

Table: Internet Uptake and Fixed-Line Costs in Central Asia

	Internet Users (2016)	Fixed Internet / 100 (2015)	Mobile Internet Subs 100 (2016)	Ave Connection Speed (Kbps) (2016)	Monthly subscription for fixed broadband (USD)	Cost of fixed broadband (% GNI/capita PPP)
Tajikistan	18.3	0.1	17.0	3,469	58	26.4
Afghanistan	11.7	0.0	10.0	1,787	69	42.2
Azerbaijan	75.5	20.0	37.0	5,409	10	1.5
Kazakhstan	73.3	12.9	24.0	8,955	21	1.1
Kyrgyz Rep.	33.9	4.2	17.0	3,600	6	2.2
Turkmenistan	14.3	0.0	9.0	2,623	171	14.2
Uzbekistan	50.4	1.9	33.0	6,039	38	7.7

Sources: Various¹⁶

Although statistics on Internet-use vary considerably, estimates indicate that Internet penetration has now reached about 20% of the population in Tajikistan. The cost of connectivity is a significant issue, as underlined by recent indications from the government which has said the number of Internet users has recently been decreasing as a result of the slowdown in the Russian economy that has had a negative impact on discretionary spending.

Mobile broadband pricing is currently very similar between the major operators, with a 1Gb data-bundle costing about USD4, while a 6Gb bundle costs USD12, and a 10Gb USD18.

3.4 Internet Traffic Exchange and Hosting

As indicated previously, the presence of a local facility to interconnect the different IP networks present in the country is a vital component of the domestic Internet ecosystem. By eliminating the need to exchange local traffic internationally, these Internet Exchange Points (IXPs) maximise the efficiency of local traffic flow, which in turn encourages the presence of local hosting services. This is now well recognised as essential for a robust domestic ICT sector, and from a public policy perspective, helping to ensure the presence of local IXPs is an important priority so that online services are equally accessible to every citizen. It also enhances competitive opportunities, and generally improves the quality and affordability of Internet services in the country.

Although most of the larger commercial networks have bilateral peering arrangements, there are currently no open IXPs in Tajikistan. In 2005, the Association of Tajik ISPs aimed to establish a national IXP that connected four of the ten commercial ISPs (Babilon-T, Compuworld, Eastera, and MKF Networks) as well as TARENA. Although the project was launched, it was not sustained as envisaged and was terminated at the end of 2006. Nevertheless some of the larger operators have continued informally to connect some networks. In 2016 efforts to establish an IXP in Dushanbe were renewed, with a number of meetings and workshops held with potential participants and other stakeholders.

This was an important first step in the establishment of an IXP in Tajikistan by helping to build the level of interest of potential users of the exchange. A number of meetings of local network operators and technical advisers is now likely to be necessary, so that relationships between networks can develop and an atmosphere of co-operation and trust among the group can be built, especially between competitors. The establishment of a local IXP is often seen as a threat by some competing providers which may not be aware of the full advantages of local traffic exchange.

Building support for the project among all stakeholders, and systematically identifying any potential relationship issues, policy problems or market barriers to the establishment of an IXP is also valuable groundwork. It may also be important to engage local policy and regulatory officials to obtain their support or understanding of the benefit of the IXP. It is worth noting here that establishing an IXP is “80% social and 20% technical” – i.e. without a high level of

¹⁶ <http://www.internetworldstats.com/stats3.htm> ITU ICT Eye: <http://www.itu.int/net4/itu-d/ict-eye>, Broadband Commission Annual Report 2016, GSMA: <https://www.gsmaintelligence.com> Akamai: <https://www.akamai.com/uk/en/our-thinking/state-of-the-internet-report/state-of-the-internet-connectivity-visualization.jsp>, Terrabit Consulting 2014.

co-operation between the networks, an Internet exchange is unlikely be successful. Ideally in the course of the initial processes, a local champion can be identified who can bring the community together to develop the IXP.

The start-up costs of an IXP are relatively modest, especially compared to the potential long-term economic benefits. Deciding on a location is likely to need to require a systematic assessment of existing facilities that could be used - costs associated with leasing space can be a large part of the overall operating cost, so hosting the IXP in a shared suitable location can substantially reduce start-up and operating expenses. Facilities that are usually considered include the premises of telecom operators and broadband providers, the facilities of academic and research networks (particularly suitable as neutral locations), data centres or facilities that support municipal emergency services.

The most important features of potential sites that would need to be evaluated are:

- Proximity to the networks of the potential members. This may also depend on whether the IXP is to be centralised in one room, located in a campus of adjacent buildings or more widely dispersed across a different locations, such as by using fibre channel switched fabric.
- Availability of electric power, including backup supply or generator. Reliable power supply is critical, and if the energy source is costly, this can be a significant operating expense for the IXP. Also ensure there is sufficient power for future growth – this is often underestimated when starting an exchange.
- Availability of air-conditioning.
- Number, capacity, and reliability of backbone telecommunication links to the site, especially fibre facilities.
- Ability to build antenna towers on the site or dig trenches for fibre – access to rights-of-way.
- Ease of access. Independent 24/7/365 access for IXP member staff is highly desirable so that problems can be dealt with at any time.
- Quality of security. CCTV, 24-hour monitoring, fire and break-in detection is necessary to minimize risk at these critical facilities.
- Availability of ancillary equipment and services, e.g., equipment cabinets and telephones, etc.

A common location for an IXP is a carrier neutral data centre facility - these are usually set up to provide web hosting services and other in-country cloud based applications on an open-access basis to all networks. These have usually addressed all of the requirements above, and as a result, an IXP can be very easily integrated with this. However, Tajikistan does not currently have any carrier neutral data centres. Most of the larger local operators and ISPs in Tajikistan have their own commercial data centres, and some content is hosted in Russia and Western Europe. Babilon-T's data centre is open to third parties, as is the government data centre at the Communication Service. In addition the Ministry of Finance, the Tax Committee and the Customs service also operate their own data centres.

Although Babilon-T has offered to host the IXP, discussions that have taken place so far indicate that some stakeholders are opposed to establishing the IXP at a commercial ISP premises. It has also been suggested that the location where legacy telephony infrastructures cross at a specific municipal facility in Dushanbe would be a natural point for an IXP, most probably near landline stations #23 and #27. Another location that has been proposed is a central TV studio in Dushanbe, as most operators connect here. An alternative that has also been proposed is a container sited at an appropriate location with power and proximity to local fibre infrastructure. It should also be noted that concerns have been raised that government operated infrastructure may cease operations at some stage, and hence any publicly owned location could be more risky.

A strategy that has been used effectively elsewhere in the world is hosting the exchange at a campus of the national research and education network (NREN). As with other NRENs around the world, TARENA has large numbers of users, high international bandwidth needs and a mandate to ensure research and education content is accessible. It also has the necessary connectivity, skills and technical resources, as well as access to international expertise and equipment resources, so an IXP could be very quickly established in one of TARENA's member institutions.

The Association of Mobile Operators of Tajikistan has expressed interest in establishing an IXP in the immediate future. However, this agency functions primarily to serve the interests of mobile operators, and might not be the best long term governance solution since it may not have broad support from the other ISPs unless it adopts an open model for participating in decision making. Experience with many other IXPs has indicated that the most

effective institutional model for ensuring the largest number of networks present at the IXP, is one in which any type of domestic or international network can be represented in the administrative body, and not just access providers but also content networks, government networks and other types of non-profit networks such as research and education networks.

In any event, all involved parties will need to agree on the location for the IXP, and if potential IXP members are at an impasse, an independent expert could be brought in to visit sites and provide an opinion. The location for the IXP can also change as the local infrastructure develops, so one longer term option may be to choose an interim location while pursuing the development of a more suitable site in Dushanbe in which to host the IXP in the future. This would likely require a market assessment of the demand for local hosting services from the existing content providers, followed by the development of a business plan to attract private investment, or approaching one of the larger multinational data centre operators to raise their awareness of the local market potential.

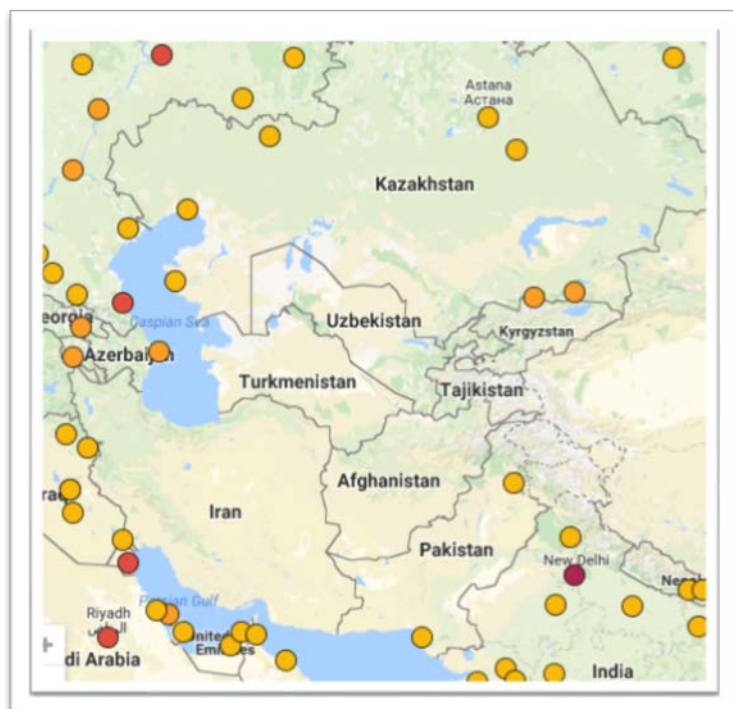
Local stakeholders have agreed to draft a concept note on setting up the IXP which reflects the positions of local ISPs and other related businesses, NGOs, and academic institutions. The note will then be used to gain the support of relevant international institutions and to open discussions and awareness raising with the government. This is important to ensure the government does not view the IXP as a network operator and subject it to licensing requirements and taxation. This also assumes that the government will not carry through with its proposal to switch all international traffic through a single switching centre, as this would radically change the local Internet environment and would likely require a reassessment of strategy.

Once the institutional strategy of the IXP and the site has been identified, a more detailed business plan can be developed that covers set-up and maintenance costs, proposed revenues, and cost recovery projections. In order not to lose the momentum of the process, the exchange can be operationalised while more detailed plans and policies continue to be developed. Once the IXP is set up and exchanging traffic, then it can be steadily enhanced with additional services and facilities, and via staff training.

An important component of the IXP startup strategy is to include support for caching of international content, which can be a strong attractant for getting the IXP established and to attract as many members as possible. As can be seen from the map below, there are currently no Google Global Caches in the country, and it appears that there are no other content delivery networks in Tajikistan which means that each operator must duplicate the use of international capacity to bring down popular international content. This can result in significant load on international links to deliver high bandwidth consuming content such as YouTube, which results in higher costs for the ISP and lower performance for the end user.

Considering that an IXP is often the most appropriate place to host shared caches of content, their absence in the country provides a significant incentive for the establishment of an IXP. In addition to minimising the use of international capacity and sharing the cost of bringing in international content, software caches and other types of static content can also be hosted at the exchange to further reduce the loads on long-distance links. Another shared service that increases the attractiveness of setting up and participating in the IXP is hosting DNS servers - root name servers and ccTLD name servers. These also increase the responsiveness of the network to local users and improve resilience in the case of international connectivity interruptions. A variety of other shared administrative and technical facilities for network operators, such as time servers, routing and traffic measurement facilities, and public key infrastructure (PKI) can also be hosted at the IXP.

Map: Google Global Caches in Central Asia



Source: Google¹⁷

3.5 Local Content Development

The presence of relevant local content is both an indicator of the strength of the domestic Internet ecosystem, as well as a key driver for Internet uptake and use. [Some estimates indicate that in Tajikistan only about 20% of traffic is locally based.]¹⁸

The tables below summarise some of the available indicators of local Internet activity in the region. Of particular note is the few number of visible Autonomous System (AS) numbers (a key indicator of the quantity of independent IP networks operating in the country), mail servers, and IPv4 allocations for Tajikistan, which put it in the same rank as Afghanistan and Turkmenistan on a per-capita basis.

Table: Regional Indicators of Internet Activity

Country	Visible ASNs	Domains under ccTLD	Mail Servers	IPv4 Allocations	Web pages indexed under ccTLD
Tajikistan	12	7,168	36	81,056	949,000
Afghanistan	52	6,105	283	209,437	1,820,000
Azerbaijan	49	19,719	1183	759,363	64,900,000
Kazakhstan	129	122,205	15384	3,154,562	42,600,000
Kyrgyz Republic	42	10,130	163	275,976	11,900,000
Turkmenistan	6	16,285	?	22,800	767,000
Uzbekistan	48	31,111	367	25,884	7,620,000

Source: Various¹⁹

¹⁷ https://www.google.com/maps/d/viewer?mid=18FeuDz0xtVnpvLiFz9HsPk7ZTDq&hl=en_US&ll=42.39086294753613%2C82.037149999999994&z=4

¹⁸ <http://ict4d.tj/2013/12/issledovanie-po-elektronnoy-gotovnosti-tadzhikistana/>

¹⁹ IPInfo: <http://ipinfo.io/countries> DomainTools: <http://research.domaintools.com/statistics/tld-counts/> Google: <http://www.google.com>

Table: Regional Indicators of Internet Activity on a per Capita Basis

Country	ASNs / (/1M Capita)	Domains under ccTLD (/1K Capita)	Mail Servers (/100K/Capita)	IPv4 Allocations (/10K Capita)	Web pages index under ccTLD (/1K Capita)
Tajikistan	1.4	0.8	0.4	93	109
Afghanistan	1.6	0.2	0.8	63	55
Azerbaijan	5.0	2.0	12.0	769	6,577
Kazakhstan	7.2	6.8	86.2	1,767	2,386
Kyrgyz Republic	7.0	1.7	2.7	461	1,987
Turkmenistan	1.1	3.0	-	42	141
Uzbekistan	1.6	1.0	1.2	9	251

As indicated, the Tajikistan ccTLD (.tj) only has some 7100 domain names, less than 1 per thousand people. The .tj Registry is operated by the President's Administration ICT Centre and was closed for 6 months (until November 16 2016), apparently due to managerial issues. Registry operations for registering domains under .tj are not automated, and as a result local content development can be slowed down. Local domain name prices are a little above average - about USD 15, in comparison to USD 2-9 abroad, including Russia.

In 2010, the Organization for Security and Cooperation in Europe (OSCE) claimed the current administration was censoring the media, including both local and foreign websites, and instituting tax inspections which led to the cessation of printing activities of a number of independent newspapers²⁰. This is likely to be a significant restraint on the use of the Internet for supporting freedom of speech and participation in public debate.

3.6 Role of Government – The Policy and Regulatory Environment

While market liberalisation began after the civil war in 1997, Tajikistan's communications sector strategy is managed by a government department, known as the Communication Service, which is responsible for policy making, regulations and management of state owned telecom/Internet enterprises (namely the incumbent operator Tajiktelecom).

However, by joining the WTO in March 2013, Tajikistan has committed itself to comply with the obligations set out in the Reference Paper by 2018, including the establishment of an independent regulator. OSCE and the Open Society Institute (OSI) office in Tajikistan have since supported a joint Feasibility Study with the Ministry of Economic Development and Trade on the establishment of a single converged regulator for the broadcasting and telecom sector, which is expected to be established shortly as the Communications Regulatory Agency (CRA)²¹.

In December 2016, Parliament approved the 2030 National Development Strategy in which the development of communications infrastructure is one of the three strategic goal, as stated by the President: "Our earlier declared three national objectives remain as priority in this document and we are strongly intended to ensure their achievement in the nearest future. These objectives will qualitatively change in upcoming period in order to ensure transfer (1) from energy security to efficient use of electricity, (2) *from eliminating communication deadlock to transforming the country into a transit country*, and (3) from ensuring food security to providing public access to quality food."²²

As such, Tajikistan sees a role for itself in the digital development of the region as a transit country in Central Asia, such as via the rail, electricity and gas pipeline projects for communications infrastructure.

²⁰ OSCE urges Tajikistan to stop attacks on free media. Reuters. 18 October 2010. <http://af.reuters.com/article/worldNews/idAFTRE69H2FD20101018>

²¹ <http://www.osce.org/tajikistan/215401?download=true>

²² <http://www.president.tj/en/node/10608>

Most nations have developed plans for national broadband development²³, however Tajikistan has not developed a broadband strategy. Those of the other countries in Central Asia, include:

- Azerbaijan - National Broadband Network Project I - Azerbaijan 2020
- Russia - The Goals of the Ministry of Telecom and Mass Communications of the Russian Federation 2012–2018²⁴
- Kazakhstan – Digital Kazakhstan State Programme 2017-2020²⁵
- Kyrgyz Republic - Regional Arrangement concerning the planning of the digital terrestrial broadcasting service and the digital Plan (GE06) 2006

Tajikistan does have a national ICT Council as an advisory body under the President that promotes dialogue between the private sector and the government. However, meetings have not taken place since 2012.

A law for establishing a single international gateway was approved in January 2016. Although not yet put into practice, this would mean that all international connections will have to go through a single switching centre hub operated by Tajiktelecom.

There are relatively high levels of taxation on the ICT sector, which have been increased in the past two years. This includes sector-specific taxes on renting mobile numbers, as well as other taxes that are estimated to add 33% to the cost of Internet connections.

Some government departments have made efforts to develop the use of the Internet in their sector, notably the Education Ministry which in 2013 developed the *National Strategy for Education Development of the Republic of Tajikistan 2020*. The strategy states that 'educational institutions, through the Internet will have permanent access to materials for teachers and electronic educational resources for professional growth'²⁶.

Access to the Internet is available all universities and the Ministry is now proceeding to provide connectivity for schools. Most public schools in Dushanbe have been connected, although few schools are connected in rural areas.

23 Such as: Italy's Strategy for the Digital Agenda 2014-2020, Mexico's National Digital Strategy (2013), Germany's Digital Agenda 2014-2017, Digital Czech v 2.0, Plan France Numérique, Digital Agenda for Norway, Information Economy Strategy of the United Kingdom, Digital Agenda for Austria, Digital Agenda for Sweden, Digital Canada 150. A full list is published in the ITU Broadband Commission Annual report 2016.

24 In 2012, the Russian Federation announced particularly ambitious broadband Internet development goals to provide 80% of Russian households with "ultrafast" connection speeds, of at least 100Mbps by 2018, a goal exceeds the current targets in Germany and the European Union.

25 <http://zerde.gov.kz/en/activity/program-control/digital-kazakhstan>

26 http://uis.unesco.org/sites/default/files/documents/out-of-school-children-tajikistan-country-study-2013-en_0.pdf

4. Conclusions and Recommendations

The use of the Internet in Tajikistan is below average for the region, partly contributing to the low levels of economic growth and efficiency in the country. The number of Internet users is estimated at only about 20% of the population, broadband services are costly, and areas outside the main cities do not have good access to broadband.

Sub-optimal Internet uptake and use is the result of a variety of different factors, some of which are related to the specific historical, demographic and geographic conditions (such as the landlocked mountainous nature of the country). These have led to high prices for international capacity, high cost of services and equipment for the public, lack of carrier neutral local hosting facilities and limited local content development.

The establishment of an efficient IXP in Tajikistan is a key part of improving the overall Internet ecosystem in the country, not only at a technical level to immediately improve local network interconnection, but also at a strategic level and for capacity building of the local technical community. As the health of an IXP is a reflection of how well a variety of different factors are functioning in the local Internet environment, achieving an effective IXP will also help to build the necessary institutional relationships between all of the stakeholders so that the other constraints can be addressed. The most important of these are outlined further below.

4.1 Considerations for IXP Establishment

Constrained interconnection and access to international content is one of the most immediate and potentially solvable problems in the Tajikistan Internet ecosystem. This can be fixed by establishing an IXP with broad participation from domestic and regional networks, and international Content Distribution Networks (CDNs), such as Akamai and Google, and/or possibly regional content providers such as Yandex or mail.ru. These will not only save costs on international traffic for operators, but also reduce network latency that will substantially improve performance for end-users, resulting in higher demand. This in turn helps to justify investment in expansion of network infrastructure, especially as equality of access to content also creates a much more attractive environment for local content developers – for both e-government and commercial applications.

The lack of an IXP is not a technical problem and requires few resources to set up, but it does require the major competing operators to agree on a mutually acceptable neutral location to interconnect as soon as possible, and to work together with all stakeholders to establish the operating modalities for the facility.

A number of potential locations for the IXP have already been identified (see section 3.4 above) and once a suitable location is agreed on and there is rough consensus in favour of participation among the major networks, then the necessary equipment and training to set up the IXP can be quickly sourced. Stakeholders will need to approach local content providers to better understand their requirements and to assess what is realistically needed; especially if the IXP setup is tied to the establishment of a carrier neutral data centre.

While this is taking place, reaching agreement on the formation of the operating entity for the IXP and development of its constitution and membership guidelines will be required. A non-profit association of participants at the exchange is likely to be the most appropriate operating entity for the IXP. Limiting the participation requirements or governance structure to only one type of operator has often been found to be a constraint to encouraging participation at the exchange by as many networks as possible, especially international ones. Generally a simple monthly port fee with perhaps an annual membership fee has been found to be a popular model for cost recovery revenue generation.

Due to lack of clarity in the legislation, the stakeholders will also need to seek assurances from government that no additional licensing fees and taxes would be levied on the networks or operations of the IXP, as these would make it uneconomic to operate. Likewise, in order to encourage the presence of international CDNs and ISPs at the

exchange, it will need to be established that they will not be required to obtain licenses or other permits in order to be present at the IXP.

Similarly, minimising the cost of the local capacity needed for the networks to link to the IXP is an important consideration for ensuring its initial viability. This can be an important consideration in locating the IXP, but if some of the participating networks must pay significant amounts for their physical links or traffic to connect to the exchange, then this can make it much harder to justify economically, especially in the initial stages when local traffic is small. As a result networks may need to be authorised to deploy their own fibre or wireless links to the exchange unless they can open access rates from other providers.

Considering that no shared content caching facility exists in Tajikistan, establishing this is likely to be strong incentive for setting up the IXP in the country as this will significantly improve performance of high bandwidth content for broadband users in the country, while saving international capacity costs for the network operators. The actual installation of a cache could happen almost immediately, assuming a strategy for sharing the caching costs could be agreed on. For example, to populate a Google Global Cache, a high capacity link (currently about 1Gbps) is necessary, and the cost of this would have to be met by the networks in Tajikistan, but this makes economic sense because they are already paying the entire cost of their own traffic. In some cases networks pay their share of the total traffic to a joint fund, while in other cases the responsibility for meeting the cost is rotated between the IXP members participating in the cache on a regular basis, such as quarterly.

Reaching agreement to publish the aggregate level of traffic exchange at the IXP is important, as this provides a good indicator of the health of the facility. This is also an important metric used by international networks when deciding where to establish their points of presence.

Accelerating the development of a strong and sustainable IXP in Tajikistan would require the following sequence of actions:

1. **Community building** – stakeholders should continue to hold regular meetings of all the local network operators and technical advisers to build relationships between the networks that will participate at the exchange.
2. **Situation analysis** - The meetings above would aim to identify any potential relationship issues, policy problems or market barriers to setting up an IXP.
3. **Strategy formulation** - The results of the situation analysis will provide the basis for the stakeholders to formulate the short-term strategic objectives of the project to ensure smooth establishment of the IXP.
4. **Core group formation** - A small team could then be selected by the stakeholders to carry the project forward on a day to day basis.
5. **Policy engagement** - Meetings with government policy and regulatory officials would then be held to obtain their support and understanding of the benefits and strategy of the IXP, and to minimise any potential barriers to its establishment, such as taxation or requiring a license.
6. **Location / host identification** – In parallel with policy engagement, a systematic and objective assessment of the options already identified above for the IXP host and premises should be carried out, looking at both short and medium-term needs. This would also include examination of other options for using existing data centres or server rooms in which the IXP could be hosted if acceptable to all potential participants, as well as identifying possibilities for converting a facility to carrier neutral status, or setting up a new carrier neutral data centre combined with the IXP.
7. **Institutional development** – Once the location has been identified, setting up the IXP and installing the equipment can begin. This also includes defining the details of the shared services to be provided, the institutional model for the IXP, and cost recovery plan for its sustainable operation. This would benefit from management and technical assistance from teams that have set up and run similar IXPs in other countries.
8. **Services marketing** – To build the value of participation at the IXP, a marketing and membership development strategy would need to be executed to encourage domestic networks to connect to the exchange and to work with international content distribution networks (CDNs) to ensure they are present at the IXP.

9. **Capacity building** – With participation at the IXP expected to grow as new networks are established, on-going capacity building mechanisms need to be established to assist the provisioning of technical staff.

4.2 Medium Term Sector Efficiency Related Actions

While the IXP can be seen as one of the key components required to ensure efficient, universal and affordable access to the Internet in Tajikistan, there are other components of the Internet sector that also need to operate efficiently to achieve this goal, and thereby to leverage the benefits of the IXP to the full. The following section lists the main actions that are required.

4.2.1 Network Operator Actions

a) **Share infrastructure.**

An increasing number of operators around the world are adopting approaches to infrastructure provision which involve sharing or outsourcing non-core aspects of their business, such as masts, poles, and ducts. This can considerably reduce the cost of service provision and allows operators to concentrate on their core businesses. Such shared infrastructure could even extend to jointly establishing a wholesale operator for provision of services in rural areas, or ownership of a metropolitan area fibre network, a domestic backbone or cross border fibre cable.

b) **Invest in incubator facilities.**

To foster the development of local applications and content, network operators could sponsor the establishment of incubator facilities which nurture entrepreneurs and small enterprises by allowing them to share office space, exchange knowledge, and access low-cost high speed Internet and hosting facilities.

c) **Explore innovative solutions for providing last mile connectivity in rural and remote areas.**

New technology developments for providing broadband continue apace, and a number of promising opportunities have emerged recently that could lower costs and provide more effective solutions for rural broadband. These include the use of high altitude platforms (e.g., Google's Loons), dynamic spectrum access and shared spectrum systems such as TV White Space, and new high bandwidth satellites and medium earth orbit (MEO) satellites which provide lower latency than traditional geostationary satellites. In addition, new business models can be explored which allow local communities to take more responsibility for the provisioning and management of their infrastructure.

4.2.2 Government Actions

a) **Fast track the establishment of the independent regulator.**

Government action is needed to implement its commitments to the post-WTO Action Plan²⁷ in 2018 to ensure the establishment of the independent regulatory authority takes place in order to begin the process of establishing a conducive regulatory environment.

b) **Restructure Tajiktelecom and split wholesale operations from retail.**

Once the regulator has been established, this could be followed²⁸ by the restructuring of Tajiktelecom into functionally separate wholesale and retail operations. These could both be sold to the private sector to inject new capital into the industry. Ideally the wholesale operations (primarily backbone and cross-border capacity) should be structured as a special purpose vehicle (SPV) in which all local network operators could invest. This model has been successfully used to ensure open access to capacity on submarine landing stations. Alternatively, a PPP model could be used in which a management company without retail operations in the country would take over operations while government retains a share. In any event a more detailed study of the options would be the first step.

²⁷ Approved by Government Decree No. 691 of 31 October 2014, <http://www.osce.org/tajikistan/215401?download=true>

²⁸ Many developing countries have made the mistake of privatisation before establishing an effective regulatory body, which created an even more problematic environment with an even more powerful private monopoly

c) Adopt a set of policies and regulations which provide a more enabling environment for Internet growth.

These are:

- Not imposing any special licensing requirements or taxes on the proposed IXP
- Allowing ISPs to self-provide infrastructure where needed, both domestically and internationally.
- Allow ISPs and operators to lease dark fibre from the electricity provider Barqi Tojik.
- Adopting regulations requiring operators to give access to their passive infrastructure assets (masts, cabinets, ducts, dark fibres), requiring any operator laying fibre to allow others to access the duct, and to require that ducts are included in the construction or refurbishment of any public utility (roads, rail, power grids, pipelines etc.) or public building.
- Instituting price caps on the leasing of passive infrastructure and rights of way from other operators, and from other utilities (e.g. electricity poles), municipal buildings and way-leaves, including those on national and secondary roads.
- Establishing a Universal Service Fund to support the deployment of infrastructure in areas that are not attractive to commercial operators.
- Requiring publicly available reference wholesale offers from wholesale providers.
- Reviewing radio spectrum policy to bring into line with new technology developments in spectrum management and shared use, such as TV Whitespace (TVWS).

d) Develop a national broadband plan.

As indicated above, no formal state strategy currently exists for promoting Internet access. Establishing a national broadband plan would aim to address public access facilities, ensure digital literacy training is available, and develop connectivity and applications/content development strategies for each of the sector ministries in an integrated e-government strategy. This would likely include mechanisms for conducting expert evaluations of state programs.

Of particular importance in the strategy is the setting of appropriate targets, especially for broadband speeds, coverage and prices. In terms of affordability targets, it may be appropriate to review the Alliance for Affordable Internet's new proposed target for mobile broadband of a 1Gb data bundle costing no more than 2% of monthly GNI/capita²⁹.

e) Establish an effective national Internet observatory.

Strategies to promote better Internet connectivity require measures by which to judge their effectiveness. Measures also need to be pragmatic, rather than exhaustively accurate – they need to be easily obtained, objective, comparable and up-to-date. In this respect, the following few simple measures are proposed, aiming to provide not only an indication of the numbers connected but also the level of Internet utilisation.

- Number of broadband subscriptions per capita (%), "broadband" being defined as a connection of at least 1Mbps today, but later growing to the higher rates available in more developed countries. Data should be disaggregated according to gender, age, geographic area and minority groups. Full data disaggregation may only be feasible on an annual basis.
- Data traffic per capita (Bps), defined as the total of domestic and international network traffic generated by broadband users divided by the total population.
- Network coverage (% of geographic territory in which broadband connectivity is available).
- Cost of 10 Gb/month of broadband data traffic, relative to average income levels (% of GNI/capita). 10 Gb is a common tariff package and on a monthly basis is a desired minimal level of utilisation, corresponding to 10-20 hours per month of video.
- Average download and upload speed per subscriber (Mbps).
- Autonomous System Numbers (ASNs) per capita. AS numbers are used by IP networks that are reliable – they are needed if the network has more than one connection to the rest of the internet. As such they provide a reliable indication of the extent of independent network development in the country.
- .tj domain name registrations.

²⁹ <http://a4ai.org/1for2-affordability-target>

Comparison between countries can be useful in identifying effective strategies, but the key aim with the use of indicators is to be able to measure progress of the country over time. Therefore, the data points should ideally be updated on a quarterly basis and the regulatory authority may need a new regulation to ensure that network operators provide the necessary data in a timely fashion.

4.2.3 International Community

Support progressive private sector and government initiatives

The private sector and government is likely to benefit from knowledge of experience from outside the country as well as potentially needing material support for some of the initiatives described above, in particular the IXP, incubators and many of the government policies, ranging from development of a national broadband plan, to finding the most effective model for operating a Universal Service Fund. This would also include capacity building of the planned national regulator and raising awareness of recommendations or guidelines by international institutions (i.e., ITU, EEC, EU, OECD, WTO) which could help encourage the government to adopt a more enabling policy environment.

Coordination of support from the different members of the international community can be a problem, and establishing a mechanism to maximise synergies and minimise overlap may be needed.

4.2.4 Civil Society

Raise awareness and maintain dialogue with the private sector, government and the international community.

Civil society's chief activity is to represent the broad interests of the public in obtaining better access to the Internet and relevant content by raising awareness of new and ongoing issues with the relevant entities, be they individual, the private sector, government or international agencies. The capabilities of civil society stakeholders in Tajikistan in this respect is significant, as their inputs will support the development of Internet infrastructure in the country, and will help ensure a balanced and neutral approach to security, privacy and regulatory issues relating to the deployment and use of the Internet.

5. Key References and Further Reading

Tajikistan Electronic Readiness Assessment" - Public Foundation "Internet" Tajikistan 2012.

<http://ict4d.tj/2013/12/issledovanie-po-elektronnoy-gotovnosti-tadzhikistana>

Changing media and politics in Tajikistan - Reuters Institute Fellowship Paper, University of Oxford 2013

<https://reutersinstitute.politics.ox.ac.uk/sites/default/files/Changing%20media%20and%20politics%20in%20Tajikistan.pdf>

Unleashing the Potential of the Internet in Central Asia, South Asia, the Caucasus and Beyond, UNESCAP/ISOC:

<http://www.unescap.org/resources/unleashing-potential-internet-central-asia-south-asia-caucasus-and-beyond>

Asia-Europe Connectivity Vision

http://www.eria.org/Asia_Europe_Connectivity_Vision_2025.pdf

Feasibility study on the establishment of a single, converged regulator for telecommunication and broadcasting services in Tajikistan https://khoma.tj/images/boks/feasibility/Feasibility_study_ready.pdf

Feasibility Study to identify the needs for development of ICT and Telecommunication infrastructure connectivity, policy and regulation regimes and ICT services in the ECO Member States. ECO, ITU-D May 2016.

<https://www.itu.int/en/ITU-D/Technology/Documents/FeasibilityStudies/ECOFeasibilityStudy.pdf>

Fibre Connectivity in Afghanistan – Ministry of Communications and IT 2015

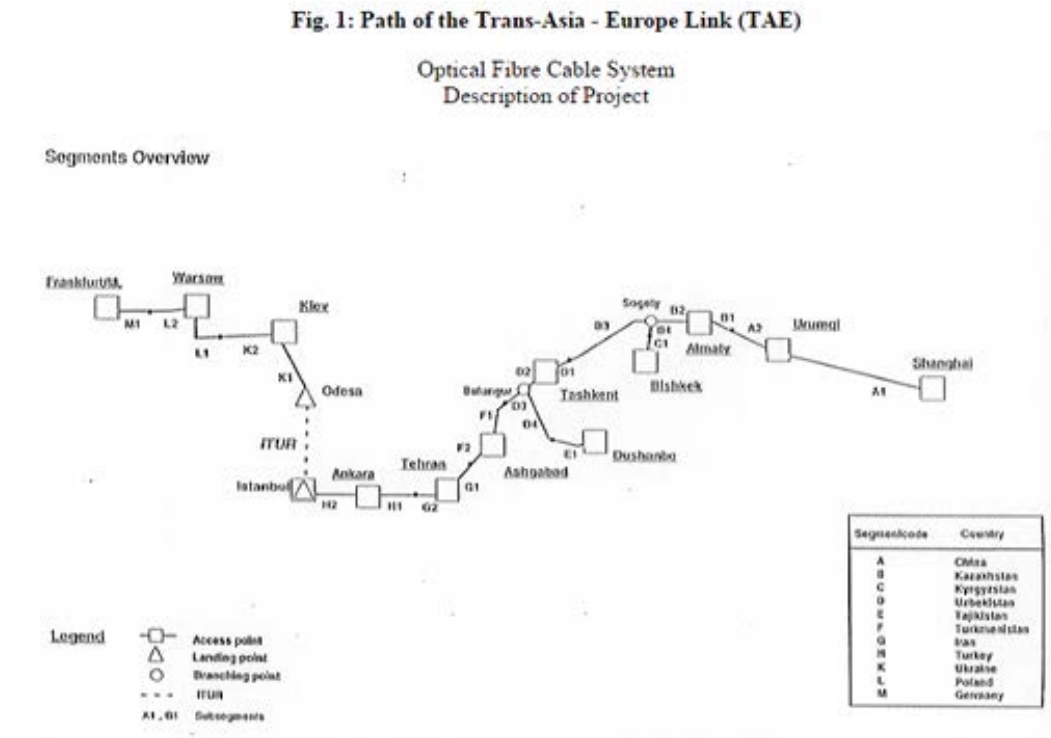
<http://www.unescap.org/sites/default/files/Presentation%20by%20MCIT%20On%20fiber%20connectivity%20in%20Afghanistan.pdf>

Tajikistan, Promoting Export Diversification and Growth. Country Diagnostic Study, Asian Development Bank 2016.

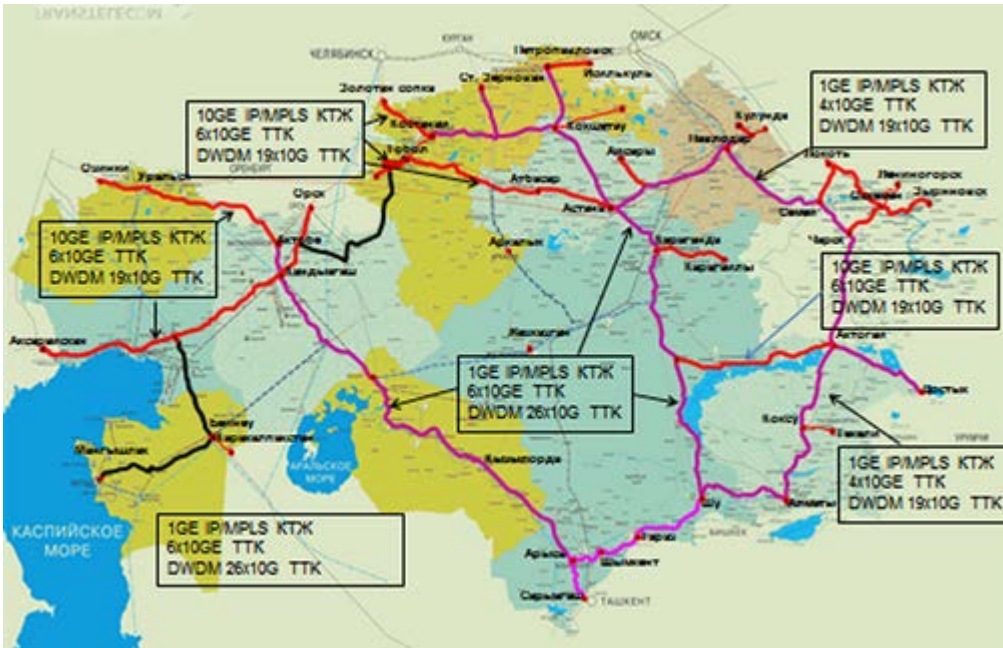
<https://www.adb.org/sites/default/files/publication/189730/taj-export-diversification-growth.pdf>

Annex - National and Regional Fibre Backbones in Central Asia

1. Trans Asia – Europe Link



2. Kazakhstan: TransTeleCom



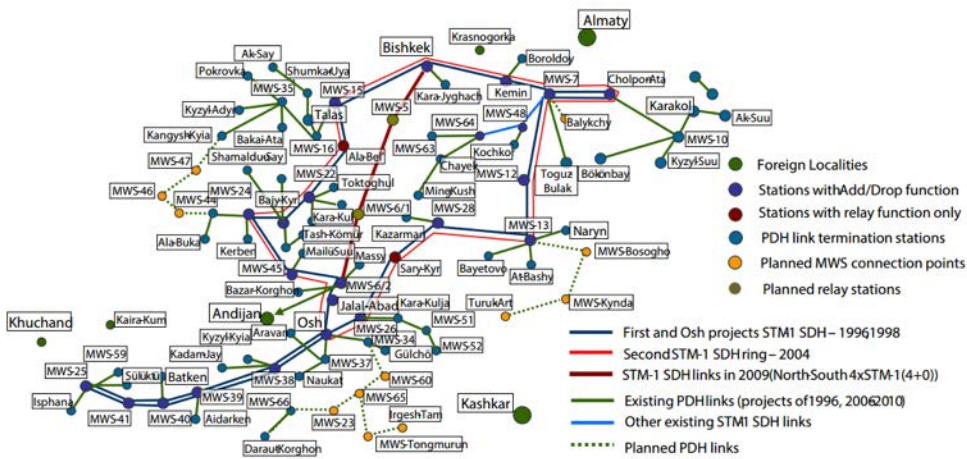
3. JSC Usbektelecom



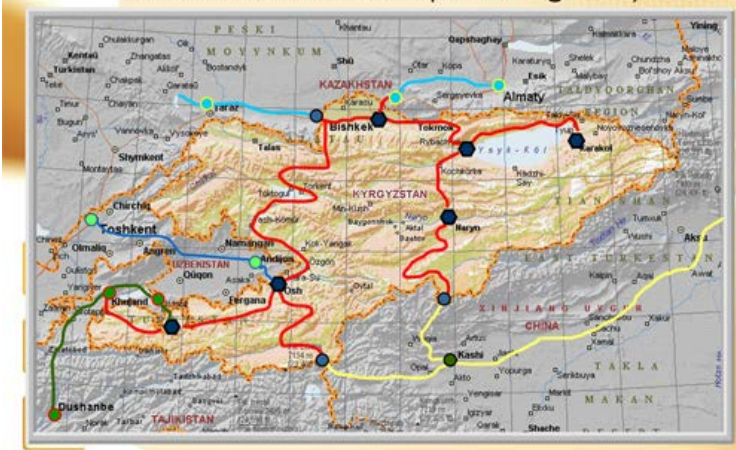
Source: <http://www.jp-ca.org/navoiforum/materials/no.1/3uzaci.pdf>

4. JSC Kyrgyztelecom

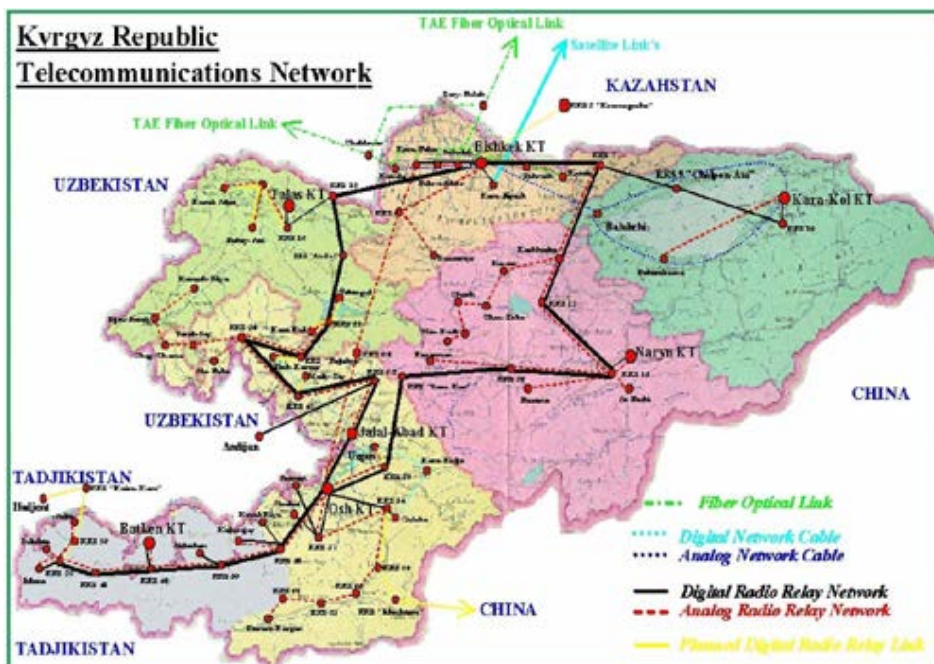




Perspective of provisioning transit services over international fiber-optical highways



Sources: <http://static.caspianworld.com/speech/casptel/2010/day2/session1/Eshmambet-Amatov.ppt>
http://www.unescap.org/idd/working%20papers/IDD_TP_09_05_of_WP_7_2_909.pdf



5. China Telecom



Source: <http://defence.pk/threads/india-and-china-get-first-terrestrial-fibre-link-across-the-himalayas.33596/>