United Nations

Economic and Social Commission for Asia and the Pacific

An In-Depth Study of Broadband Infrastructure in North and Central Asia
January 2014

This study has been prepared for ESCAP by Michael Ruddy and Esra Ozdemir, Terabit Consulting.

The generous funding support provided by the Russian Federation is gratefully acknowledged.

Contact:

ICT and Development Section
Information and Communications Technology and Disaster Risk Reduction Division
United Nations Economic and Social Commission for Asia and the Pacific
United Nations Building
Rajadamnern Nok Avenue
Bangkok 10200, Thailand
E-mail: escap-idd@un.org

I. EXECUTIVE SUMMARY

Between June and November 2013, Terabit Consulting performed a detailed analysis of the broadband infrastructure in the seven key markets in North and Central Asia: Azerbaijan, Kazakhstan, Kyrgyzstan, Russian Federation, Tajikistan, Turkmenistan, and Uzbekistan.

The analysis revealed that the region is greatly reliant upon trans-border terrestrial fiber optic connectivity, which places it at a distinct competitive disadvantage relative to coastal markets, which benefit from submarine fiber optic cable systems offering higher capacity, greater cost effectiveness, and more extensive reach than the region's existing terrestrial connectivity. With the exception of the Russian Federation, none of the countries in this study have oceanic coastlines. Consequently, each landlocked country is at an inherent disadvantage to coastal countries with respect to access to cost-effective international bandwidth; while the cost of providing international bandwidth to coastal countries is limited to actual cable infrastructure costs, landlocked countries bear not only the actual cable infrastructure costs but also the bandwidth transit and interconnection costs imposed by their neighbors. One of the countries analyzed in the study, Uzbekistan, is "doubly-landlocked," a status which makes the country's access to affordable international bandwidth exceedingly challenging.

The analysis showed that there are existing fiber optic links across every international border of each country in the study, with the exception of the militarized border between Azerbaijan and Armenia. There is one multinational fiber optic network, the Trans Asia Europe (TAE) Line, which was implemented in the late-1990s, but most sources indicated that the system has never functioned as a coherent network in the way that it had been expected to, and that its low capacity has effectively rendered it obsolete. Each of the other international links identified in the study were low-capacity, trans-border links, typically operating at no more than a few gigabits per second.

As is the case across Asia, the bilateral, point-to-point nature of the links, combined with the disparities in IP transit prices between wealthier and less-developed markets, often allow dominant operators in wealthier nations to exploit the terrestrial links by using them to sell their own IP transit capacity, thereby imposing an additional intermediate layer of cost between consumers and the international Internet content that they wish to access. The study clearly revealed that landlocked countries' telecommunications and Internet development, and consequently their overall ICT growth, have been greatly restrained by the countries' reliance on piecemeal bilateral trans-border links and lack of access to high-capacity pan-regional and intercontinental infrastructure.

A strong opportunity presents itself for a pan-regional terrestrial fiber optic network offering open access, a mesh configuration, and central management, constructed along the rights-of-way of the region's existing transport or energy infrastructure such as highways, railways, or power transmission networks. The realization of such a network would likely require the intervention of governments and international organizations.

Terabit Consulting's analysis indicates that the region would greatly benefit from a coherent pan-regional fiber optic infrastructure across Asia, for three primary reasons:

The development of telecommunications and Internet services and infrastructure in Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan, and each country's economy as a whole, has greatly suffered as a result of restricted international infrastructure.

International Internet bandwidth in each of the four countries is less than 1 Kbps per person, compared to levels of between 16 and 23 Kbps in Azerbaijan, Kazakhstan, and Russian Federation, and more than 250 Kbps in markets such as Singapore. The resulting underdevelopment of the four countries' telecommunications and Internet infrastructure has impeded and will continue to impede the overall economic development of each market and the region as a whole, with the countries' existing bilateral, trans-border fiber optic links and lack of access to cost-effective pan-regional connectivity leaving the region at a serious competitive disadvantage.

Internet growth in the four markets has suffered as the cost of a fixed broadband connection remains at between 15 and 26 percent of nominal per-capita GDP, compared to between 0.2 and 2.2 percent in Azerbaijan, Kazakhstan, and Russian Federation. The analysis also identified Internet service providers in Kyrgyzstan, Tajikistan, and Uzbekistan that distinguish between domestic and international content, with different bandwidth caps for each. Although the bandwidth caps have the short-term effect of encouraging the growth of domestic content, they risk further isolating each country from the global Internet community. Internet service providers in the region have implied that the distinction between international and domestic bandwidth is likely to remain in place as long as the region's inflated international IP transit prices persist.

Despite their developed international connectivity, the three wealthiest markets in the study (Azerbaijan, Kazakhstan, and Russian Federation) would greatly benefit from improved pan-regional terrestrial fiber infrastructure.

Overall, the international telecommunications and bandwidth infrastructure in Azerbaijan, Kazakhstan, and Russian Federation are better developed than in the other four countries of the study. However, a coherent, cost-effective pan-regional terrestrial fiber infrastructure would compensate for existing shortcomings of the countries' international networks and help to place them on a par more connected markets in Western Europe, Southeast Asia, and North America. Even the sole coastal country in the study with access to submarine fiber optic cables, Russian Federation, would benefit. Russian Federation is served by a only a handful of submarine cable systems, the direct connectivity of which is limited exclusively to nearby markets such as Scandinavia, Japan, and the Black Sea/Eastern Mediterranean Region. Although this submarine connectivity is supplemented by proprietary (closed-access) terrestrial networks though China and Eastern Europe, none of the existing terrestrial networks offer the high capacity, cost efficiencies, and multinational access that a coherent next-generation pan-Asian fiber infrastructure would provide.

Furthermore, the markets in the study with stronger international networks would benefit from the stimulated demand in the telecommunications and ICT sectors (as well as the overall regional economic growth) that would result from coherent international infrastructure across the region. Specifically, stimulated demand across the region will result in larger addressable market opportunities for the three countries in this study that have already superior international connectivity. For example, the development of improved pan-regional terrestrial fiber optic infrastructure in Central Asia, in addition to increasing landlocked countries' overall bandwidth demand, would necessarily increase those countries' demand for Russian content. It has been estimated that Russian-language content accounts for between 85 and 94 percent of all Internet usage in Kazakhstan; a survey by Korea's Kumoh National Institute of Technology found that 95 percent of Uzbek Internet users visit Russian-language content websites; and Russian-language websites account for as much as 90 percent of all downloaded content in Kyrgyzstan.

Coherent pan-Asian terrestrial fiber optic infrastructure would benefit markets across the continent and beyond, and help address one of the international bandwidth industry's most pressing concerns, namely the lack of reliable, cost-effective Europe-to-Asia bandwidth. In financial terms, the viability of constructing coherent pan-Asian terrestrial fiber optic connectivity can likely be guaranteed by capturing even a small portion of bandwidth demand between East Asia and Western Europe.

Beyond benefitting the interests of the region's countries themselves, Terabit Consulting believes that the development of a reliable, high-capacity, cost-effective fiber optic network infrastructure across the region would have the far-reaching impact of providing an alternative transit path between Europe and the Far East. Avoidance of network "choke points" on the Asia-to-Europe route, and in particular the mitigation of the risks imposed by the concentration of fiber optic cables through a narrow corridor in Egypt, has become the focus of an urgent effort by global telecommunications and network operators. Each existing alternative to the Egyptian crossing carries inherent disadvantages: capacity via South Africa suffers from high latency and is of limited volume and consequently expensive; new terrestrial routes via the Middle East carry political instability risks and impose limitations on Western investors due to their paths through Syria, Islamic Republic of Iran, and Iraq; and existing Asia-to-Europe terrestrial networks via Russian Federation and Mongolia are unable to compete with submarine infrastructure due to lower transmission capacities, lower reliability of point-to-point networks across challenging terrain, and comparatively higher unit costs.

Bandwidth demand between Europe and Asia is already multiple terabits per second, and operators are willing to pay a premium for bandwidth solutions that avoid risky paths such as Egypt and areas of conflict in the Middle East.

Table 1: Overview of Broadband Status by Country

	GDP per Capita, YE 2012 (PPP, USD)	Int'l. Band-width per Capita (Kbps)	Int'l. Connect-ivity	Domestic Connect-ivity	IP Transit Price	Competitive-ness of Telecom Market	Fixed and Mobile Broad-band Infra-structure	Annual 1 Mbps Broadband Subscription + Installation as % of Nominal GDP per Capita
Azerbaijan	$10,800	22.4	Moderate	Adequate	Reasonably Priced	Somewhat Competitive	Relatively Strong	Reasonable
Kazakhstan	$14,000	16.5	Moderate	Relatively Strong	Reasonably Priced	Somewhat Competitive	Relatively Strong	Reasonable
Kyrgyzstan	$2,400	0.893	Weak	Limited	Very Expensive	Somewhat Competitive	Limited	Very Expensive
Russian Federation	$20,900	17.4	Moderate	Relatively Strong	Inexpensive	Competitive	Strong	Extremely Affordable
Tajikistan	$2,300	0.313	Weak	Limited	Very Expensive	Somewhat Competitive	Very Limited	Very Expensive
Turkmen-istan	$9,600	0.125	Weak	Limited	Very Expensive	Not Competitive	Very Limited	Very Expensive
Uzbekistan	$3,500	0.259	Weak	Limited	Very Expensive	Somewhat Competitive	Limited	Very Expensive

Table 2: Summary and Analysis of International Internet Bandwidth by Country

Country	International Internet Bandwidth (YE 2012)	10-Year CAGR (2002-2012)	Int'l. Internet Band-width per Capita (Kbps)	Evalua-tion
Azerbaijan	**205 Gbps –** The State Statistical Committee reported that international Internet bandwidth was 22.4 Kbps per capita as of year-end 2012, for a total of 205 Gbps. Internet bandwidth grew by a factor of 20 between year-end 2008 and year-end 2012.	126%	22.4	**Moderate**
Kazakhstan	**275 Gbps –** Kazakhstan's international Internet bandwidth was reported to be 16.5 Kbps per capita as of year-end 2012. Kazakhtelecom reported 290 Gbps of international capacity as of May, 2013. Most demand is directed toward Russian Federation; Russian-language content accounts for between 85 and 94 percent of all Internet usage in Kazakhstan.	138%	16.5	**Moderate**
Kyrgyzstan	**5 Gbps –** Terabit Consulting estimates that Kyrgyzstan's international Internet bandwidth was 5 Gbps as of year-end 2012. The country's international connectivity is mostly via Kazakhstan, although recent efforts have focused on improving connectivity via China.	87%	0.893	**Very Weak**
Russian Federation	**2.5 Tbps –** According to Terabit Consulting's international bandwidth database, Russian Federation has the tenth-highest international Internet bandwidth, despite the robust development of its own domestic Russian-language Internet content.	85%	17.4	**Moderate**
Tajikistan	**2.5 Gbps –** There have been no official reports of Tajikistani international Internet bandwidth since 2007, at which time it was 250 Mbps. Based on its research and modeling, Terabit Consulting estimates that the country's international Internet bandwidth as of year-end 2012 was 2 to 3 Gbps.	106%	0.313	**Very Weak**
Turkmenistan	**650 Mbps –** Sources have reported that the country's international Internet bandwidth was between 400 Mbps and 650 Mbps as of year-end 2012. Internet access by private citizens was severely restricted until 2008, and although the market has opened somewhat since then with the advent of mobile Internet access, the country still trails its neighbors in terms of Internet development.	55%	0.125	**Very Weak**
Uzbekistan	**7.8 Gbps –** Uzbektelecom reported that its international Internet bandwidth was 4.835 Gbps as of year-end 2011, and in January 2013 the company indicated international Internet bandwidth had increased by 61 percent to 7.780 Gbps. The capacity of the Uzbektelecom's international packet communication center was increased to 40 Gbps, and company's first deputy director general said that the company planned to eventually increase its international bandwidth to 100 Gbps.	84%	0.259	**Very Weak**

Table 3: Summary and Analysis of International Connectivity by Country

Country	International Connectivity	Evaluation
Azerbaijan	1. State-owned Azercosmos controls the $120 million AzerSat-1 satellite, covering Europe, Asia, and Africa. 2. Trans-Asia Europe (TAE) Line constructed in 2001 provides connectivity to Georgia and Islamic Republic of Iran. 3. At least three terrestrial fiber optic cables to Russian Federation, interconnecting with MegaFon, Rostelecom, and TTK, provide the country's primary international bandwidth connectivity. 4. Nakhchivan Autonomous Republic (exclave) is linked to the rest of Azerbaijan via a fiber link through Islamic Republic of Iran operated by the Telecommunications Infrastructure Company. 5. Nakhchivan is also linked to Turkey's Turk Telecom network. 6. The Europe Persia Express Gateway (EPEG), conceived in response to the delay in activating trans-Egyptian segments of the Europe-India Gateway (EIG) submarine cable, was implemented in 2013 and advertises end-to-end transit capacity of 500 Gbps, upgradeable to 3.2 Tbps. 7. Proposed TASIM and Trans-Caspian submarine cable projects being seriously considered by Azerbaijan and its neighbors.	**Moderate –** Azerbaijan's lack of oceanic coastline leaves it reliant on neighbors, particularly Russian Federation, for transit capacity; however, recent projects such as EPEG and planned projects such as TASIM and the Trans-Caspian Links could position the country as a transit hub for the region.
Kazakhstan	1. 1,500 kilometers of Trans Asia-Europe Line segments were installed in 1998, connecting Kazakhstan to China, Kyrgyzstan, and Uzbekistan. 2. Kazakhstan's network interconnects with Russian Federation operators via at least three border crossings, offering interconnection with the fiber networks of Rostelecom, VimpelCom, TTK, and Sinterra (now Megafon). 3. Recent activity has focused on constructing 4. In addition to the TAE link, there are additional links to Kyrgyzstan, Uzbekistan, and China. 5. A link to Turkmenistan was completed in 2013. 6. Kazakhtelecom reports interconnection agreements with Rostelecom, VimpelCom, MegaFon, and TTK in Russian Federation; Kyrgyztelecom, Elcat, and Saima Telecom in Kyrgyzstan; Uzbektelecom in Uzbekistan; Turkmentelecom in Turkmenistan; and China Telecom, China Unicom, and China TieTong in China.	**Moderate –** Kazakhstan is landlocked and therefore lacks direct access to intercontinental bandwidth, but the country is interconnected with the networks of at least a dozen regional operators.
Kyrgyzstan	1. Kyrgyzstan was linked to the Trans Asia-Europe Line in 2000; connectivity was via a ring linking to one neighbor (Kazakhstan), which was supplemented with a redundant segment in 2007. 2. Links to Tajikistan and Uzbekistan were constructed in 2009. 3. ISP Elcat installed a fiber network in 2013 that interconnects with China, Kazakhstan, and Tajikistan 4. Kyrgyztelecom constructed its own link to China but China Telecom reportedly refused to interconnect with the network due to technical concerns.	**Weak –** Kyrgyzstan has fiber connectivity across each of its borders, including the mountainous Chinese border; however, it lacks direct access to cost-effective IP transit capacity.

Country	International Connectivity	Evaluation
Russian Federation	1. Russian Federation is well-connected to other markets in the Central Asian region, and its terrestrial and submarine links provide connectivity to adjoining nations in East Asia and Europe. However, the country lacks direct intercontinental connectivity. The proposed Russian Optical Trans-Arctic Submarine Cable System (ROTACS) would provide direct connectivity to Western Europe and Japan, and the BRICS cable system would connect Russian Federation's east coast to the emerging economies of Brazil, China, India, and South Africa. 2. Russian Federation's existing submarine connectivity is limited to the Baltic Sea, the Black Sea and Eastern Mediterranean, and the Sea of Japan (East Sea). 3. Rostelecom, VimpelCom, and TTK have been present in the Europe-to-Asia transit market for several years and have grown market shares of 60, 30, and 10 percent respectively; in 2013 mobile operators MTS and MegaFon launched their own Europe-to-Asia transit networks as well. 4. Connectivity to adjoining Central Asian markets includes three fiber optic links to Azerbaijan, three fiber optic links to Kazakhstan, and the recently-commissioned Europe-Persia Express Gateway system through Azerbaijan to Islamic Republic of Iran and Oman. 5. Each of Russian Federation's major national fiber networks (Rostelecom, VimpelCom, TTK, MTS, and MegaFon) connect to China and Eastern Europe.	**Moderate** – Russian Federation benefits from strong links to its neighbors in Central Asia, Eastern Europe, and China, but the country lacks direct intercontinental connectivity.
Tajikistan	1. Tajikistan has trans-border fiber optic links to Afghanistan, Kyrgyzstan, and Uzbekistan. As of 2009 a link to China was also reportedly under implementation, but Terabit Consulting was unable to confirm its activation as of 2013.	**Weak –** Tajikistan has fiber across at least three of its four borders, but unfortunately none of the bordering markets offers access to affordable IP transit bandwidth.
Turkmenistan	1. The Trans Asia-Europe Line was activated in 1998, connecting Turkmenistan to Islamic Republic of Iran and Uzbekistan. 2. Turkmentelecom and Kazakhtelecom installed a link to Kazakhstan in 2013. 3. Two links to Afghanistan are reportedly under construction, and an additional link to Uzbekistan has been proposed. 4. Construction of the Trans Caspian Link submarine cable between Azerbaijan and Turkmenistan is uncertain and will likely depend on relations between the two countries.	**Weak –** Although trans-border links to each of Turkmenistan's conterminous neighbors are either in service or under construction, the capacity and robustness of the links is weak.
Uzbekistan	1. Trans-Asia Europe Line segments connect Uzbekistan to Kazakhstan and Turkmenistan. 2. Two additional diverse links to Kazakhstan, as well as links to Kyrgyzstan, Tajikistan, and Afghanistan were activated in 2009. 3. Turkmenistan has proposed an additional link to Uzbekistan.	**Weak –** Uzbekistan is linked to each of its neighbors, but it lacks direct access to cost-

		effective IP transit.

Table 4: Summary and Analysis of Domestic Connectivity by Country

Country	Domestic Connectivity	Evaluation
Azerbaijan	1. Extensive Azertelekom fiber network connecting Baku to secondary markets via the country's highway system. 2. Nakhchivan Autonomous Republic connected to Baku via Islamic Republic of Iran. 3. Azertelekom connected villages in the southern part of Nagorno-Karabakh to the TAE network in 2012. 4. Group of private ISPs including Alfanet, Azeronline, Caspel, Data Plus, Premier Group, Q-Telecom, and Smart was installing a 420 km primarily rural fiber network as of late-2012.	**Adequate** – the backbone network connects cities in the north, east, and in the Nakhchivan Autonomous Republic; however, greater investment is needed to integrate and develop the network in Nagorno-Karabakh.
Kazakhstan	1. Kazakhtelecom operates a domestic fiber optic network consisting of a ring between Astana and population centers along the country's borders, as well as a north-south trunk connecting the country's interior between Astana and Almaty and spurs to secondary cities. 2. Transtelecom, a subsidiary of Kazakhstan's national rail company KZT, also operates a domestic fiber network along the right-of-way of its parent company. 3. VimpelCom and its subsidiary TNS-Plus operate an 11,970-kilometer domestic fiber optic network.	**Relatively Strong -** Kazakhstan is served by multiple domestic fiber optic networks, although greater investment is needed in rural areas.
Kyrgyzstan	1. Kyrgyztelecom's domestic fiber optic network has been gradually expanded since the construction of domestic Trans Asia Europe (TAE) Line segments in 2000. 2. Kyrgyztelecom expects to activate a major north-south fiber optic link in 2013. 3. Fiber optic connectivity is also supplemented by a domestic microwave network that was upgraded to four STM-1s in 2009.	**Limited** – the Kyrgyztelecom fiber optic network connects major population centers, but its capacity is low and connectivity is limited elsewhere, including the sparsely-populated southeast.

Country	Domestic Connectivity	Evaluation
Russian Federation	1. Extensive national backbone fiber optic networks are operated by Rostelecom, MTS, MegaFon, VimpelCom, and TTK (formerly TransTeleKom). The combined length of the operators' networks is more than 750,000 kilometers, including Rostelecom with 500,000; MTS with 117,000; TTK with 75,000; MegaFon with 65,000; and VimpelCom with 33,516.	**Relatively Strong –** the country is served by extensive fiber optic connectivity and there is strong competition among backbone operators. The east of the country would benefit from additional investment in fiber networks.
Tajikistan	1. The Tajiktelecom domestic fiber optic network is concentrated primarily in the west of the country, with a backbone connecting Khujand in the north, southward to Dushanbe, Qurgonteppa, and Kulob, with radial fiber networks emanating from each city. An eastern segment connects to Murghab.	**Limited** – the fiber network in Tajikistan is limited in its capacity and connectivity, and there is also limited competition in the network infrastructure sector.
Turkmenistan	1. The initial Trans Asia-Europe (TAE) Line trunk network from the Iranian border to the Uzbek border formed the foundation of Turkmentelecom's domestic fiber optic connectivity; additional deployment was constructed westward toward the Caspian Sea region. 2. The first TAE segments were 700 kilometers in length and connected Ashgabat, Mary, and Turkmenabat; additional TAE deployment comprised a 600 kilometer link that connected Ashgabat to Turkmenbashi.	**Limited –** the Turkmentelecom network is currently of relatively low capacity and connectivity, and competition is limited.
Uzbekistan	1. Uztelecom's fiber network totaled 1,900 kilometers as of year-end 2010 and 3,300 kilometers as of year-end 2011. 2. In 2005 Uztelecom deployed 261 kilometers of fiber optic cable in the autonomous region of Karakalpakstan with assistance from the Japanese Bank for International Cooperation, which provided an $18 million credit. In 2007 fiber was installed to Kashkadarya, Surkhandarya, Dekhkanabad, Kamashi, Guzar, Baysun, Kizirik, Bandihan, Sherabad, Karshi, and Termez. In 2011 the Baysun-Denau and Urgut-Shakhrisyabz fiber links entered service.	**Limited –** Uztelecom's fiber network, while expanding, is still limited in capacity and connectivity, and there is little competition.

Table 5: Summary and Analysis of International Capacity Pricing by Country

Country	International Capacity Pricing (Volume Purchases of 1 Gbps or Greater)	Evaluation
Azerbaijan	IP transit in Azerbaijan is among the cheapest in the region. The price of IP transit bandwidth in Azerbaijan has fallen considerably in recent years, from as high as USD$350 per Mbps per month in 2008 to USD$40 in 2011, with current prices estimated to be as low as USD$20 depending on volume and term commitments. Some observers have argued that the low price of IP transit, which prevails despite Delta Telecom's market dominance, is due to strong competition among onward capacity providers at the Russian Federation border.	**Reasonably Priced**
Kazakhstan	IP transit in Kazakhstan was estimated to cost approximately USD$15 per Mbps per month as of year-end 2012. Kazakhtelecom's international network connects to a dozen operators, namely Rostelecom, VimpelCom, MegaFon, and TTK in Russian Federation; Kyrgyztelecom, Elcat, and Saima Telecom in Kyrgyzstan; Uzbektelecom in Uzbekistan; Turkmentelecom in Turkmenistan; and China Telecom, China Unicom, and China TieTong in China. The high number of interconnecting networks has enabled a more competitive IP transit offering.	**Reasonably priced**
Kyrgyzstan	IP transit in Kyrgyzstan is estimated to cost hundreds of dollars per Mbps per month.	**Very Expensive**
Russian Federation	As of late-2012 a Moscow-to-London 10 Gbps wavelength was priced at USD$18,000 ($1.80 per Mbps) per month. IP transit was between $4 and $5 per month when purchased in volume. The Russian market for international transit capacity is estimated to be worth more than USD$150 million annually. Rostelecom is the leader in the transit capacity market, with a share of approximately 60 percent, followed by VimpelCom with 30 percent and TTK with 10 percent. MTS and MegaFon also entered the international Europe-to-Asia transit market with the construction of new fiber links in 2013.	**Inexpensive**
Tajikistan	IP transit in Kyrgyzstan is estimated to cost hundreds of dollars per Mbps per month; several sources indicated that purchasing satellite bandwidth is cheaper than purchasing international fiber bandwidth.	**Very Expensive**
Turkmenistan	IP transit in Kyrgyzstan is estimated to cost hundreds of dollars per Mbps per month	**Very Expensive**
Uzbekistan	The price of IP transit in Uzbekistan has fallen dramatically in recent years but still remains among the most expensive in the world. As of 2010 Uztelecom's international IP transit was priced at USD$1,510 per Mbps per month; it was halved to $705 in mid-2011 and $529 at the end of 2011. By year-end 2012 the price was $422. Further cuts brought the price to $347 as of August, 2013. Uztelecom reported that the IP transit market between Uzbekistan and Russian Federation was worth USD$20 million annually and was growing at a rate of 30 percent.	**Very Expensive**

Table 6: Summary and Analysis of Competitiveness of Telecommunications Markets by Country

Country	Competiveness of Telecommunications Market	Evaluation
Azerbaijan	1. The Azerbiajani government remains a major stakeholder in the country's telecommunications market. The mobile market is competitive, with three GSM operators, and there are also multiple competitors in the fixed-line and Internet sectors. Unlike other markets in the region, foreign investment has been limited, although the country's largest mobile operator is owned by TeliaSonera and Turkcell. 2. Fixed-line: Azertelecom and Baku Telephone Network Production Association (BTRIB), both government-owned operators, serve the vast majority of fixed line subscriptions, but there are at least four other fixed-line operators. 3. Mobile: Azercell (TeliaSonera/Turkcell) has a market share of slightly more than half, Bakcell slightly less than one-third, and the remainder (approximately 18%) is served by Azerfon. 4. Internet/broadband: more than 30 ISPs; Government-owned ISPs Bakinter.NET and Aztelekom had shares of 23% and 16%, respectively, while Uninet had a 12% share and Azeronline had a 10% share.	**Somewhat competitive**
Kazakhstan	1. Government-owned Kazakhtelecom is dominant in the country's fixed-line and fixed-broadband sectors, however its mobile subsidiary Altel has yet to accrue momentum in the mobile sector, where TeliaSonera subsidiary Kcell has a market share of one-half. Other foreign investors include VimpelCom of Russian Federation and Tele2 of Sweden. 2. Fixed-line: Kazakhtelecom has a share of 93% but several other operators are present in the sector, including KazTransCom, Transtelecom, Ducat, GC Beeline (VimpelCom), and SkySilk. 3. Mobile: As of year-end 2012, mobile market shares were as follows: Kcell 50 percent, VimpelCom 32 percent, Tele2 13 percent, and Altel 5 percent. 4. Internet/broadband: Kazakhtelecom has a broadband market share of greater than 75 percent, although several other ISPs, including the fixed-line operators listed above, are present in the market.	**Somewhat Competitive**
Kyrgyzstan	1. Kyrgyztelecom, the dominant fixed-line operator and broadband provider, remains a government-owned entity despite several attempts to privatize it. The mobile sector is led by two Russian-owned operators, MegaCom and VimpelCom. 2. Fixed-line: Kyrgyztelecom has a market share of over 90% but a few fixed-line operators including Saima Telecom provide service in Bishkek and Chui. 3. Mobile: MegaCom and VimpelCom subsidiaries each have market shares of over 40% but NurTelecom, Katel, and Aktel are also present. 4. Kyrgyztelecom's share of the broadband market is 60%; other leading ISPs include Megaline, Saima	**Somewhat Competitive**

	Telecom, and Elcat.	

Country	Competiveness of Telecommunications Market	Evaluation
Russian Federation	1. The Russian Federation telecommunications market is competitive, although recent consolidation has led to the creation of a "Big Four" group of operators: MTS, MegaFon, Rostelecom, and VimpelCom. 2. Fixed-line: Following its 2011 merger with seven Svyazinvest-controlled regional telecom operators (RTOs), Rostelecom is the country's leading fixed-line operator, although MTS subsidiary MGTS (Moscow City Telephone Network) has a 90% share of Moscow's fixed-line market. 3. Mobile: As of year-end 2012, the three largest mobile operators had similar market shares: MTS held a share of 31%, MegaFon 27%, and VimpelCom 25%. The fourth-largest mobile operator, Tele2, saw its ownership change from the eponymous Swedish operator to the state-owned bank VTB. Rostelecom was reportedly seeking to partner with the company to improve its position in the mobile sector. 4. Internet/broadband: Rostelecom's share of the broadband market was estimated to be 40 percent as of year-end 2012; MTS, VimpelCom, and ER-Telecom were each estimated to have shares of between 10 and 12 percent.	**Competitive**
Tajikistan	1. Although Tajikistan's fixed-line market is dominated by Tajiktelecom, its mobile and Internet sectors are competitive, with significant foreign investment. 2. Fixed-line: Government-owned Tajiktelecom is the dominant fixed-line operator. 3. Mobile: Babilon-Mobile and TeliaSonera subsidiary T-Cell each have 35% shares of the market, while Russian Federation operators MegaFon and VimpelCom have shares of 21% and 9% respectively. 4. Internet/broadband: Babilon-T and Tajiktelecom are the broadband market leaders but there are at least ten ISPs in the marketplace.	**Somewhat Competitive**
Turkmenistan	1. Government-owned operators control the Turkmenistani fixed-line and fixed-broadband sectors, and there is only one private competitor in the mobile sector, which was barred from operating for more than a year after its license was revoked. 2. Fixed-line: Turkmentelecom has a monopoly in the fixed-line market. 3. Mobile: Altyn Asyr, a subsidiary of Turkmentelecom, was the only operator present in the market following the license revocation of the only private mobile operator, MTS, in late-2010. In mid-2012 MTS was able to renegotiate its license and its market share was one-third as of year-end 2012. 4. Internet/broadband: All private ISPs had their licenses revoked in 2000 and Turkmentelecom remains the only fixed-line ISP, via its subsidiary Turkmenistan Online. Access to the Internet was severely restricted until 2008, at which point MTS became the only competitor to Turkmenistan	**Not Competitive**

	Online by offering GPRS/EDGE mobile Internet access.	

Country	Competiveness of Telecommunications Market	Evaluation
Uzbekistan	1. Incumbent state-owned operator Uzbektelecom operates three major subsidiaries: fixed-line operator Uztelecom, mobile operator Uzmobile, and ISP Uzonline; the company also maintains exclusivity over the country's international gateway infrastructure. However, each sector of the telecommunications market is competitive. Foreign investors include Korea's KT, Russian Federation's VimpelCom, and Sweden's TeliaSonera; Russian Federation operator MTS, which entered the market in 2004, saw the license of its mobile subsidiary revoked in 2012 following allegations of regulatory violations by the company and money laundering and tax evasion by company management. 2. Fixed-line: state-owned operator Uztelecom is the market leader, but VimpelCom subsidiary Buzton and KT subsidiary East Telecom serve primarily business customers. 3. Mobile: As of year-end 2012, VimpelCom's Unitel was the country's largest mobile operator, with a 51 percent share; TeliaSonera's Ucell was close behind with 48 percent, and CDMA operators UzbekMobile and Perfectum Mobile had shares of approximately 2 percent and 1 percent, respectively. 4. Internet/broadband: Uzbektelecom is the country's Internet backbone operator, and its subsidiary Uzonline had 73,000 broadband subscribers to its DSL and FTTH networks as of year-end 2011; VimpelCom subsidiary Buzton served more than 16,000 fixed broadband customers. In addition to Uzonline and Buzton, fixed Internet service is provided by KT's East Telecom, Sarkor Telecom, Sharq Telecom, EVO, and TPS.	**Somewhat Competitive**

Table 7: Summary and Analysis of Fixed and Mobile Broadband Infrastructure by Country

Country	Fixed Broadband Infrastructure	Mobile Broadband Infrastructure	Evaluation
Azerbaijan	1.3 million fixed broadband subscribers: Most broadband Internet connections to consumers are via ADSL, but several ISPs have revealed plans for greater investment in fiber-to-the-home (FTTH) technology, most notably Aztelekom, which in late-2012 announced a $38 million FTTH investment that would be funded in part by the State Oil Fund of Azerbaijan (SOFAZ).	3.2 million mobile broadband subscribers: 3G service was launched in late-2009 and 4G trials started in 2012. Each mobile operator has reportedly trialed 4G services in Baku; Azercell launched a pilot 4G LTE service in Baku in May of 2012 prior to the Eurovision song contest, followed by commercial 4G service the following month. In August of 2013 the Ministry of Communications and Information Technology indicated that it would supplement 4G LTE spectrum by reallocating analog broadcasting frequencies between 790 and 862 MHz.	**Relatively Strong**
Kazakhstan	1.6 million fixed broadband subscribers: Kazakhtelecom has indicated that it intends to provide fiber-to-the-home connectivity to all multi-story, multi-family residential units in Kazakhstan by 2015. In 2012 it forecasted that the number of FTTH ports on its network would almost double from 300,000 as of year-end 2012 to almost 600,000 by year-end 2014. Kazakhtelecom's iDNet FTTH service offers download speeds of up to 50 Mbps. For its part, VimpelCom reported increased subscribership to its fiber-to-the-building network.	As many as 7 million mobile broadband subscribers: 3G was launched in 2010 and 4G LTE was launched in 2013. Kcell, which clams to operate the country's most extensive 3G network, made significant inroads in the 4G market in early-2013 when its parent company TeliaSonera acquired the WiMax operations of Alem Communications, including WiMax networks in six cities and frequencies in the 2.5-2.6 GHz band. In early-2013 Kazakhtelecom's Altel launched 4G LTE service in both Astana and Almaty; later in the year the company indicated that its 3G network in both cities would be deactivated.	**Relatively Strong**
Kyrgyzstan	150,000 fixed broadband subscribers: Initial broadband deployment was limited to the capital Bishkek but in 2009 ADSL services were launched in the country's second-largest city, Osh. ADSL became available in Talas and Naryn in 2012 and 2013. In October, 2012 Kyrgyztelecom launched a free public Wi-Fi hotspot in Bishkek's Ala-Too Square; by late-2013 the operator reported 32 hotspots.	200,000 mobile broadband subscribers: 3G was launched in 2010 and in 2011 the National Communications Agency awarded 4G LTE and Wi-Max licenses to a total of 12 operators. Saima Telecom 4G launched its LTE network in Bishkek in December of 2011.	**Limited**

Country	Fixed Broadband Infrastructure	Mobile Broadband Infrastructure	Evaluation
Russian Federation	20 million fixed broadband subscribers: Fixed-line broadband penetration was greater than one-third of households as of year-end 2012. The leading technology was ADSL, which accounted for the majority of broadband customers at each of the seven regional telecommunications operators that were merged into Rostelecom in 2011. FTTH deployment has increased significantly, especially in western population centers.	75 million mobile broadband subscribers: 3G was launched in 2007 and 4G LTE was launched in 2011. Russian Federation has rapidly become a leader in the deployment of 4G LTE networks, with strong competition among mobile operators and expected investment of €10 billion by 2019. MegaFon indicated that it expected as many as one million LTE subscribers by year-end 2013.	**Strong**
Tajikistan	6,000 fixed broadband subscribers: Fixed broadband deployment has been limited and there are currently only a few thousand subscribers, mostly via ADSL and fiber-to-the-building networks operated by Babilon-T and Tajiktelecom in Dushanbe and Khujand.	50,000 mobile broadband subscribers: 3G was launched in 2005, WiMax was launched in 2008 and LTE was launched in 2011. In 2008 one of the country's two largest mobile operators, Babilon-Mobile, launched a 4G WiMax network supplied by Huawei Technologies of China. In 2012 the company also began offering 4G LTE services.	**Very Limited**
Turkmenistan	2,000 fixed broadband subscribers: access to the Internet was restricted until 2008 and installation of fixed broadband by the sole fixed ISP, Turkmenistan Online, has been slow.	10,000 mobile broadband subscribers: 3G was launched in Ashgabat in late-2010 by both Altyn Asyr and MTS Turkmenistan; 4G LTE was launched in 2013 by Altyn Asyr.	**Very Limited**
Uzbekistan	200,000 fixed broadband subscribers: Uzbektelecom is the country's Internet backbone operator, and its subsidiary Uzonline had 73,000 broadband subscribers to its DSL and FTTH networks as of year-end 2011. The company planned to add a total of 120,000 new broadband ports in 2013 and 2014. VimpelCom reported that its Uzbekistani fixed-line subsidiary Buzton served 15,560 ADSL ports and 1,162 buildings via its fiber-to-the-building (FTTB) network, including over 200 kilometers of fiber deployment in FTTB networks in the cities of Tashkent, Samarkand, Bukhara, Zarafshan and Uchkuduk.	500,000 mobile broadband subscribers: 3G was launched in 2007 and LTE was launched in 2010. MTS-Uzbekistan launched the country's first 4G LTE network in July of 2010; it was supplied by Huawei and initially limited to Tashkent. TeliaSonera's Ucell activated a ZTE-supplied 4G network the following month. VimpelCom's Unitel unveiled its LTE network in 2012. In early-2012 VimelCom reported more than 200,000 mobile broadband subscriptions.	**Limited**

Table 8: Summary and Analysis of Typical Monthly Broadband Subscription Pricing by Country

Country	Typical Monthly Broadband Subscription Pricing	Base Package Price per Mbps (USD$)	Annual 1 Mbps Subscription + Installation as a % of Nominal GDP per Capita	Evaluation
Azerbaijan	1. USD$12.75 per month + USD$6.40 installation fee for 1 Mbps ADSL with unlimited download *(Bakinter.NET)*	$12.75	$160 / $7,400 = 2.2%	**Reasonable**
Kazakhstan	*1.* USD$13 + USD$57 installation for 1 Mbps download speed and 3 GB monthly download limit *(Kazakhtelecom Megaline)* 2. USD$30 + USD$57 installation for 8 Mbps download speed and 100 GB monthly download limit *(Kazakhtelecom Megaline)*	$13	$213 / $12,000 = 1.8%	**Reasonable**
Kyrgyzstan	1. USD$25 for 1 Mbps with 5 GB of international content and 9 GB of domestic content *(Kyrgyztelecom ADSL)* 2. USD$84 for 1 Mbps with unlimited download *(Kyrgyztelecom ADSL)*	$25	$300 / $1,160 = 25.9%	**Very Expensive**
Russian Federation	1. USD$9 per month for unlimited 10 Mbps ADSL (installation charge estimated to be USD$20) *(MTS)*	$0.90	$31 / $14,300 = 0.2%	**Extremely Affordable**
Tajikistan	1. USD$16 + USD$39 installation for 1 Mbps with 3 GB download limit for international content and unlimited domestic content *(Babilon-T)* 2. USD$844 +USD$39 installation for 1 Mbps with no download limit *(Babilon-T)*	$16	$231 / $950 = 24.3%	**Very Expensive**

Country	Typical Monthly Broadband Subscription Pricing	Base Package Price per Mbps (USD$)	Annual 1 Mbps Subscription + Installation as a % of Nominal GDP per Capita	Evaluation
Turkmenistan	1. USD$31 per month + USD$58 installation for 256 Kbps and 1 GB download limit *(Turkmenistan Online)* 2. USD$77 per month + USD$58 installation for 1 Mbps and 1 GB download limit *(Turkmenistan Online)* 3. USD$210 per month + USD$58 installation for 512 Kbps unlimited download *(Turkmenistan Online)*	$77	$982 / $6,500 = 15.1%	**Very Expensive**
Uzbekistan	1. USD$4.00 for 256 Kbps + free installation, limit of 600 MB international content (Uzonline) 2. USD$27.50 for 1 Mbps + free installation, limit of 10 GB international content (Uzonline) 3. USD$43.50 for 1 Mbps + free installation, unlimited download (Uzonline)	$27.50	$330 / $1,750 = 18.9%	**Very Expensive**

Table 9: Presence of Fiber Optic Connectivity Across Land Borders of the Countries Analyzed in This Study

	Azerbaijan	Kazakhstan	Kyrgyzstan	Russian Federation	Tajikistan	Turkmen-istan	Uzbekistan	Other Borders
Azerbaijan				284km border –yes, fiber present				Armenia (787km) – No Georgia (322 km) – Yes Islamic Republic of Iran (611 km) – Yes Turkey (9km) – Yes
Kazakhstan			1,224km border – yes, fiber present	6,846km border – yes, fiber present		379km border – yes, fiber present	2,203km border – yes, fiber present	China (1,533km) - Yes
Kyrgyzstan		1,224km border – yes, fiber present			870km border – yes, fiber present		1,099km border – yes, fiber present	China (858km) - Yes
Russian Federation	284km border – yes, fiber present	6,846km border – yes, fiber present						Belarus (959km) – Yes China (3,645km) – Yes Estonia (290km) – Yes Finland (1,313km) – Yes Georgia (723km) – Yes Latvia (292km) – Yes Lithuania (227km) - Yes Mongolia (3,441km) – Yes No. Korea (17.5km) – Yes Norway (196km) – Yes Poland (432km) – Yes Ukraine (1,576km) – Yes
Tajikistan			870km border – yes, fiber present				1,161km border – yes, fiber present	Afghanistan(1,206km)-Yes China (414km) – Yes
Turkmen-istan		379km border – yes, fiber present					1,621km border – yes, fiber present	Afghanistan(744km) - Yes Islamic Republic of Iran (992km) – Yes
Uzbekistan		2,203km border – yes, fiber present	1,099km border – yes, fiber present		1,161km border – yes, fiber present	1,621km border – yes, fiber present		Afghanistan(137km) - Yes

Fiber connectivity is present across every border of each country analyzed in the study, with the exception of the border between Armenia and Azerbaijan.

A total of 9 bilateral terrestrial borders exist between the subject countries. Terabit Consulting identified trans-border terrestrial fiber optic connectivity across all borders within the analyzed region (and fiber was also identified on all borders with countries outside the region, with the single exception of the border between Armenia and Azerbaijan).

1. **Azerbaijan-Russian Federation**: Azerbaijan-Russian Federation (Rostelecom); Azerbaijan-Russian Federation (Synterra (MegaFon) / Azertelecom); Azerbaijan-Russian Federation (TransTeleKom (TTK) / Azertelecom); Europe-Persia Express Gateway (EPEG)

2. **Kazakhstan-Kyrgyzstan**: Trans Asia-Europe Line (TAE) (three links); Kazakhstan-Kyrgyzstan (Elcat)

3. **Kazakhstan-Russian Federation**: Kazakhstan-Russian Federation (northern Kazakhstan); Kazakhstan-Russian Federation (northwestern Kazakhstan); Kazakhstan-Russian Federation (western Kazakhstan)

4. **Kazakhstan-Turkmenistan**: Kazakhstan-Turkmenistan link

5. **Kazakhstan-Uzbekistan**: Trans Asia-Europe Line (TAE); Kazakhstan-Uzbekistan (eastern); Kazakhstan-Uzbekistan (western)

6. **Kyrgyzstan-Tajikistan**: Kyrgyzstan-Tajikistan link; China-Kyrgyz-Republic-Tajikistan (Elcat)

7. **Kyrgyzstan-Uzbekistan**: Kyrgyzstan-Uzbekistan link

8. **Tajikistan-Uzbekistan**: Tajikistan-Uzbekistan link

9. **Turkmenistan-Uzbekistan**: Trans Asia Europe Line (TAE)

Table 10: Analysis of Cross-Border Connectivity and Identification of Priority Trans-Border Projects

International Border (and border length)	Analysis	Recommendation
Azerbaijan / Russian Federation (284 kilometers) ***Low Priority*** *in both directions*	The border between Azerbaijan and Russian Federation is served by four trans-border fiber networks, including the high-capacity EPEG network constructed in 2013. In addition, the proposed TASIM network may increase connectivity across the border, depending on its final configuration.	There are multiple fiber networks present, operated by MegaFon, Rostelecom, and TTK on the Russian side, and Azertelecom and Delta Telecom on the Azerbaijani side. Although additional competition on the Azerbaijani side may be beneficial, there is little imminent need for additional fiber infrastructure.
Kazakhstan / Kyrgyzstan (1,224 kilometers) ***Medium Priority*** *from the perspective of Kyrgyzstan*	The Trans Asia-Europe Line (TAE) includes a dual-path ring across the border constructed in 2000 as well as a redundant link constructed in 2007, but its capacity is low. The Kyrgyz Internet service provider Elcat constructed a higher-capacity link in 2013.	The existing trans-border fiber paths are expected to accommodate near-term demand across the border between Kazakhstan and Kyrgyzstan, although Kyrgyzstan would benefit from additional international transit bandwidth via Kazakhstan.
Kazakhstan / Russian Federation (6,846 kilometers) ***Low Priority*** *in both directions*	The Kazakhstani-Russian Federation border is served by at least three fiber links, which are operated by MegaFon, Rostelecom, TTK, and VimpelCom on the Russian side and Kazakhtelecom on the Kazakhstani side.	Although existing capacity on the route is believed to have been installed rather early (between 1999 and 2006), transmission capacity has since been upgraded.
Kazakhstan / Turkmenistan (379 kilometers) ***High Priority*** *from the perspective of Turkmenistan*	Terabit Consulting was able to identify only one fiber link between the two countries, although it was constructed recently (2013) and offers a reported capacity of STM-64 (10 Gbps).	Connectivity between the two countries is considered to be vulnerable due to the presence of only one link; Turkmenistan would gain significantly from additional transit paths via Kazakhstan onward to Russian Federation, in lieu of a Trans-Caspian cable.
Kazakhstan / Uzbekistan (2,203 kilometers) ***Medium Priority*** *from the perspective of*	There are three fiber links between Kazakhstan and Uzbekistan: the somewhat antiquated Trans Asia-Europe Line; a western link built in 2009, and an eastern link also	Connectivity between Kazakhstan and Uzbekistan is expected to be adequate for near-term demand, but Uzbekistan would benefit from increased international transit

Uzbekistan	constructed in 2009.	capacity via Kazakhstan.

International Border (and border length)	Analysis	Recommendation
Kyrgyzstan / Tajikistan (870 kilometers) ***Medium Priority*** *in both directions*	Kyrgyzstan and Tajikistan are connected by a fiber link constructed by Kyrgyztelecom and Tajiktelecom in 2009, as well as a second link constructed by ISP Elcat in 2013; the latter link also spans eastward to China.	Although existing infrastructure is expected to meet near-term demand, Kyrgyzstan and Tajikistan would benefit from additional fiber connectivity across their mutual border.
Kyrgyzstan / Uzbekistan (1,099 kilometers) ***High Priority*** *in both directions*	Terabit Consulting was able to identify only one fiber connection (constructed in 2009) between Kyrgyzstan and Uzbekistan.	Kyrgyzstan and Uzbekistan would greatly benefit from additional fiber infrastructure, especially with regard to providing redundancy to the existing path.
Tajikistan / Uzbekistan (1,161 kilometers) ***High Priority*** *in both directions*	Terabit Consulting's analysis indicated that Tajikistan and Uzbekistan are connected by only one link, constructed in 2009.	Tajikistan and Uzbekistan require additional fiber connectivity across their border.
Turkmenistan/ Uzbekistan (1,621 kilometers) ***High Priority*** *in both directions*	Turkmenistan and Uzbekistan are connected by the relatively antiquated Trans Asia-Europe Line (constructed in 1999), although the government of Turkmenistan has proposed the deployment of new fiber connectivity to the border with Uzbekistan.	Given the age of the only link between the two countries, additional fiber is urgently needed between Turkmenistan and Uzbekistan.

➢ High Priority Trans-Border Projects

1. **Turkmenistan to Kazakhstan** – Only one existing fiber link was identified; additional paths via Kazakhstan and Russian Federation would provide better international transit connectivity options for Turkmenistan.

2. **Kyrgyzstan to Uzbekistan** & **Uzbekistan to Kyrgyzstan** – Only one existing fiber link was identified; bilateral redundancy is required.

3. **Tajikistan to Uzbekistan** & **Uzbekistan to Tajikistan** - Only one existing fiber link was identified; bilateral redundancy is required.

4. **Turkmenistan to Uzbekistan** & **Uzbekistan to Turkmenistan** – The two countries are connected only by the relatively antiquated Trans Asia-Europe Line; additional capacity is urgently needed.

➢ Medium Priority Trans-Border Projects

1. **Kyrgyzstan to Kazakhstan** – ISP Elcat constructed a new fiber link in 2013, but the other three links across the border are part of the Trans Asia Europe Line; given the importance of Kazakhstani and Russian Federation transit capacity in serving Kyrgyzstan's westbound demand toward Europe and North America, additional modern network connectivity between Kyrgyzstan and Kazakhstan is needed.

2. **Uzbekistan to Kazakhstan** – Although there are three fiber links between the two countries, Kazakhstani and Russian Federation transit capacity is important for the development of the Uzbekistani Internet and telecommunications sectors and should be supplemented with additional modern capacity.

3. **Kyrgyzstan to Tajikistan** & **Tajikistan to Kyrgyzstan** – Terabit Consulting identified two existing fiber links between the Kyrgyzstan and Tajikistan but additional fiber would ensure the robustness of bilateral connectivity.

Revenue-Earning Opportunities for North and Central Asia

Based on its analysis, Terabit Consulting believes that a coherent, open-access Europe-to-Asia terrestrial fiber infrastructure is likely to significantly increase revenue-earning opportunities for stakeholders in each of the North and Central Asian markets analyzed in this Study.

The development of open-access fiber infrastructure offers revenue opportunities at each of three layers, specifically:

1. Passive physical infrastructure including dark fiber, duct, and manholes
2. Wholesale capacity ("lit fiber") and bandwidth products
3. Retail end-user telecommunications, Internet, and data services

The strongest opportunities for direct government investment and revenue exist at the first layer (passive fiber network infrastructure development), with additional but somewhat more limited investment and revenue-sharing opportunities available at the second layer (wholesale capacity network operation). Meanwhile, strong opportunities for operator-led investment available at both the second and third layers of telecommunications networks (wholesale capacity and retail end-user services).

The governmental investment and revenue opportunities are strongest at the passive physical infrastructure layer because of its inherent correlation to public works and the likelihood that most long-distance fiber network construction in the North and Central Asian region would take place on property either directly owned by the government or by government-owned entities including highway agencies, railway operators, and utilities. The clientele for the passive physical infrastructure layer would be the actual operator(s) of the network, which would lease or purchase whichever elements of the network the government were to provide, ranging from rights-of-way to installed duct and manholes to actual unlit fiber.

Because the second layer (wholesale "lit" fiber capacity and bandwidth products) and the third layer (retail end-user services) involve elements that have traditionally been the domain of actual telecommunications operators and Internet service providers, the strongest investment and revenue opportunities at these levels are expected to avail themselves to existing operators, although government investment and revenue-sharing is certainly possible at the second layer, especially in the form of public-private partnerships. The clientele for layer 2 services includes both operators and high-volume end-users such as large corporate or academic clientele, while retail end-users include both consumers and organizational customers.

It is expected that the development of integrated pan-Asian fiber infrastructure will present solid investment and revenue opportunities for both public and private investors, given the project's vast economy of scale as well as its competitive advantage over alternative network paths.

Terabit Consulting believes that geographically, the strongest revenue opportunities in the North and Central Asian region would be presented by the Europe-to-Asia transit market, particularly as an alternative to the existing concentration of submarine cables passing through Egypt. However, the development of a coherent fiber network would also capitalize on organic demand from each of this study's subject countries, especially in the countries of the study where Internet, telecommunications, and overall ICT market demand has been artificially restrained due to low international bandwidth: Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. Terabit Consulting's modeling of bandwidth growth indicates that the provision of affordable international bandwidth to these markets would result in strong bandwidth growth rates well in excess of international averages of 35 to 40 percent per year. Furthermore, the three most developed markets of the study (Azerbaijan, Kazakhstan, and Russian Federation), as well as other neighboring markets such as China and Islamic Republic of Iran, are best positioned to capitalize on this growth opportunity. Governments across the entire study area can expect the strongest revenue

opportunities in the first (passive layer) of network construction, while operators can expect the strongest revenue opportunities in wholesale and retail markets.

The Europe-to-Asia Market Opportunity

The Europe-to-Asia bandwidth market and regional bandwidth markets in South Asia and the Middle East have in recent years been dominated by efforts to provide a cost-effective and reliable path to Europe that avoids the bottleneck of cables crossing terrestrially through Egypt between Alexandria and the Suez. While most cable breaks have been on submarine cable segments, the concentration of Europe-to-Asia submarine cables with terrestrial segments passing through Egypt has been identified as perhaps the most vulnerable "choke point" in global telecommunications infrastructure. The concern is not new; carriers had expressed concerns about the Suez crossing since the 1990s and their fear of catastrophic cable outages were realized multiple times, such as in 2013 when the Sea-Me-We-4, IMEWE, and EIG cables were cut simultaneously under unclear circumstances. Frustration increased when the landing of some new cable systems in Egypt were delayed in order to accommodate requirements put in place by the concerned authorities. Cable operators' concerns were further heightened by the uncertainty accompanying the political changes in the Arab world. Simultaneous cable outages in Egypt have resulted in the loss of as much as 80 percent of India's international bandwidth.

Various routings have been constructed or proposed in order to compete against cables passing through Egypt. Pan-Russian Federation networks connecting via China and Mongolia and operated by Rostelecom, MTS, MegaFon, VimpelCom, and TTK have failed to gain traction in the marketplace due to their comparatively high unit costs and lower reliability due to challenging terrain and a lack of redundancy. The only Europe-to-Asia submarine cable alternative was the SAT-3/SAFE project which in 2002 provided the first Europe-Asia connectivity via South Africa but with greater latency; the system is now effectively considered to be technologically obsolete due to its low bandwidth. Fiber optic systems connecting India eastward started to appear at approximately the same time but created an equally-risky chokepoint in the Strait of Malacca. Then in 2011, largely as a result of political uncertainty in Egypt, plans were finalized for multiple terrestrial networks bypassing Egypt to the east including Europe Persia Express Gateway (EPEG), Regional Cable Network (RCN), Jeddah-Amman-Damascus-Istanbul (JADI Link).

Both RCN and JADI Link pass through Syria and have reportedly been impacted by the country's civil war. EPEG opted for a route through Islamic Republic of Iran, and in 2013, Gulf Bridge International (GBI) announced a terrestrial link via Iraq. Political risk in each of those countries, as well as embargo restrictions imposed by the government of the United States against American operators considering investments in the region, have prevented any of the terrestrial networks from emerging as a viable solution. At the same time, a range of issues with the Suez crossing (ranging from economic to technical to political) have made the quest for an economically and technically-viable alternative solution one of the submarine industry's top priorities.

Terabit Consulting estimates Europe-to-Asia bandwidth demand to be in excess of 5 Tbps as of 2013, with growth rates as high as 50 percent per year.

Over the last five years, submarine fiber optic capacity between Europe and Asia has grown at a compound annual growth rate of 41 percent, as shown in the figure below. The growth rate of submarine fiber optic capacity is effectively representative of total demand along the route, since Europe-Asia traffic currently routed via terrestrial networks is comparatively minor.

Activated Europe-to-Asia Submarine Cable Capacity (Gbps), 2007-2012

	2007	2008	2009	2010	2011	2012
FLAG Europe-Asia (FEA) (formerly FLAG)	20	50	50	50	110	140
Sea-Me-We-3 (SMW3)	150	150	200	200	200	200
i2i (ISCN)	160	160	310	640	640	640
TGN-TIC (Tata Indicom India-Singapore (TIIS))	320	320	480	480	480	960
Sea-Me-We-4 (SMW4)	640	640	1,500	1,500	1,700	2,000
Falcon	500	500	1,390	1,390	2,590	2,590
Seacom / TGN Eurasia			80	100	110	240
India-Middle East-Western Europe (I-ME-WE)				260	640	2,560
Europe-India Gateway (EIG)					240	240
Gulf Bridge International Cable System (GBI) /MENA						480
TOTAL ACTIVATED EUROPE-TO-ASIA SUBMARINE CAPACITY (Gbps)	**1,790**	**1,820**	**4,010**	**4,620**	**6,710**	**10,050**
CAGR (2007-2012)	**41.2%**					

Terrestrial Fiber Optic Network Construction Cost Considerations

Terabit Consulting strongly believes that a coherent, next-generation, pan-Asian fiber optic network would compete effectively with submarine cable infrastructure on a cost basis as well as in other aspects, particularly when installed simultaneously with pan-Asian highway infrastructure upgrades and expansion.

Terrestrial networks offer inherent advantages over submarine cable networks, in that submarine cable networks offer connectivity only between cable stations, which are often located in remote, unpopulated locations. Backhaul (from the cable station to the point-of-presence in the targeted metropolitan area) is often the most expensive part of the network, due to lack of competition.

Submarine cable repairs are often more complicated, expensive, and time-consuming than repairs of terrestrial fiber optic networks. In the event of a submarine cable fault, repairs require specialized vessels and equipment; repair ships can often take days to reach the site of the fault, and fault localization and the actual repair process can require additional days. Cable ship running charges, which represent base costs, typically begin at USD$50,000 per day.

Terrestrial fiber optic networks, especially those that are easily accessible by highway, can be repaired in a matter of hours, at much lower cost, particularly in markets with lower labor costs.

Properly designed and maintained terrestrial networks, which allow for the installation of activation of dark fiber or the installation of additional fiber via existing ducting, are typically future-proof, compared to submarine cable networks which have finite lifespans of no more than 25 years and typically shorter economic lifespans due to capacity upgrade limits. Long-haul submarine cables are limited to eight fiber pairs and have submerged electronics in the form of repeaters which limit upgrade potential. Terrestrial electronics, meanwhile, can be easily upgraded.

The cost of a three-fiber-pair terrestrial cable has been reported as USD$1,250 per kilometer, with very low marginal costs for additional fiber pairs (as low as USD$60 per kilometer). Terrestrial networks can comprise an unlimited number of fiber pairs. Meanwhile, a three-fiber-pair unrepeatered submarine cable is typically USD$12,500 per kilometer.

Terrestrial installation can be performed efficiently using plow-burial alongside interurban highways, while submarine installation costs involve extensive surveys, shore-end construction, trenching, and partial burial using remotely-operated vehicles. Marine services typically add USD$20,000 to USD$40,000 per kilometer to the cost of submarine cable networks.

Furthermore, terrestrial fiber network developers are typically able to enter into mutually beneficial agreements with highway or rail operators, which offer the network developers linear connectivity and the possibility of easy mesh network deployment. Limited-access highways have fewer road crossings and require fewer negotiations than rights-of-way on private land, while highway operators view the networks as a reliable source of revenue and a source of bandwidth for internal communications and operations.

In the high-labor-cost market of the United States, conduit plus fiber installation along open roads is estimated to cost USD$6,000 to USD$18,000 per kilometer. When performed simultaneously with road construction, which costs as much as USD$1.8 million per lane, per kilometer, fiber installation can amount to a fraction of one percent of project construction costs.

II. POLICY OPTIONS FOR ENHANCING TERRESTRIAL CROSS-BORDER CONNECTIVITY

The pan-Asian fiber network should be considered as a means for improving intercontinental connectivity and providing cheaper and more reliable access to destinations throughout Asia, Europe, and beyond; Terabit Consulting believes that only an intercontinental, open-access network will be able to achieve true telecommunications equality across all markets in the region.

Terabit Consulting is of the opinion that the network should most logically be integrated with the Asian Highway initiative promoted by UNESCAP; as detailed in this report's country chapters, many Asian Highway segments already support existing fiber optic networks.

Beyond the challenge of securing funding, the primary impediment to the development of a Pan-Asian terrestrial fiber optic network will be the desire of incumbent operators (many of which are government-owned) to protect their existing network investments and prevent competition. However, UNESCAP is in a strong position to convince governments to promote the development of a coherent, open-access pan-regional network on the basis that it will greatly benefit consumers, spur economic growth, increase government revenue, and encourage regional stability through better international and intercultural relations.

Overall Weakness of Existing Terrestrial Cross-Border Connectivity

Terrestrial cross-border fiber infrastructure is the most obvious option for combating the clear inequality between the region's markets. However, the utility of Asia's current international terrestrial fiber optic infrastructure is limited due to the following factors:

- **Limited geographic scope:** The study region's existing international terrestrial infrastructure consists primarily of bilateral, point-to-point, trans-border links that offer limited geographic coverage. The sole multi-national network in the region, the Trans Asia Europe (TAE) Line, was depicted by sources as functioning essentially as a patchwork of the national backbones of dominant telecommunications carriers rather than as coherent, purpose-built pan-regional networks, and their impact on the pricing or more equitable distribution of the region's international bandwidth was considered to be minimal.

- **Little or no network redundancy:** Unlike international submarine cables, which are often constructed in geographic ring configurations that provide immediate in-system restoration in the event of a cable cut, the study region's terrestrial network infrastructure is rarely designed with efficient options for restoration, reducing the links' reliability and limiting their functionality. Typically, traffic can only be placed over the region's terrestrial trans-border fiber links by those carriers that have sufficient undersea capacity in place to use as an alternative path in the event that the terrestrial link suffers an outage.

- **Low transmission capacity:** The study region's international terrestrial infrastructure typically operates at 10 Gbps or less, preventing economies of scale and failing to compete with or extend the cost-effectively reach of international submarine cables which collectively provide many terabits per second worth of bandwidth to the continent.

- **Lack of open access and prohibitive bandwidth pricing:** The region's international terrestrial fiber optic links are almost exclusively operated for the benefit of the dominant telecommunications carriers that own them. Due to the low bandwidth of the links, as well as carriers' general desire to avoid offering cost-effective capacity to their competition, it is difficult for third-party carriers to purchase capacity on the region's international terrestrial links.

Unique North and Central Asian Policy Considerations

While the above considerations apply to the construction of terrestrial fiber connectivity across the entire Asian continent, the North and Central Asian sub-region analyzed in this study carries a unique set of challenges, largely due to the landlocked state of most of its countries. They include:

- **The need to ensure multidirectional, competitive cross-border links:** Each of the region's four least-developed telecommunications markets (Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan) are, for all intents and purposes, exclusively dependent on the terrestrial telecommunications networks of their neighbors for international connectivity. These four markets have historically been beholden to neighboring governments and operators which have charged exorbitant bandwidth transit prices for access to the global telecommunications grid. In many cases international bandwidth has been an extension of neighboring countries' desire to exert political influence across regional markets. For this reason, the construction of a multidirectional, pan-regional network is imperative in order to ensure the long-term growth of the region's markets; countries should not be faced with the current geographical limitations on international connectivity, by which the most cost-effective (but not at all economical) options are limited to the networks of one or perhaps two neighboring countries.

- **A unique opportunity to leverage the region's position as an international crossroads:** For Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan, the opportunity exists to fully and efficiently integrate their fiber networks with those of China, Russian Federation, Islamic Republic of Iran, and South Asia, offering the as-yet underdeveloped markets the opportunity not only to partake of cost-effective and abundant bandwidth in each of the latter markets but also the chance to become regional hubs connecting the North, South, East, and West. The Azerbaijani market, having effectively integrated its telecommunications infrastructure with multiple leading markets in the region, including Russian Federation, Turkey, and Islamic Republic of Iran, is exemplary in this respect, and the country has not only driven down its own international bandwidth costs, but has positioned itself as a regional telecommunications hub in its own right.

- **The urgent need to take advantage of efficiencies presented by the region's upcoming investment in road, railway, and other linear infrastructure:** Terabit Consulting's preliminary analysis revealed major investments in transport infrastructure across the region.
    - Azerbaijan plans to modernize all of its major highways by 2015 and construct the Baku-Tblisi-Kars railway with access to Turkey and Europe.
    - Kazakhstan plans $19 billion of new highways in the near-term, focusing on expanding road connectivity to China; the country also plans to position itself as the hub of a China-Europe rail axis.
    - In Kyrgyzstan, the Bishkek-Osh-Sary Tash North-South highway will undergo an $800 million reconstruction over the next five years.
    - In Russian Federation, car ownership has skyrocketed but road construction has not kept pace, sparking governmental commitments to reconstruct 7,400 kilometers of federal highways and 6,700 kilometers of regional and municipal roadways.
    - In Tajikistan, improved road linkages to China have been funded by the Asian Development Bank and the Chinese government.
    - In Turkmenistan, an improvement of highway links to Turkmenbashi is expected as part of the European Union's Transport Corridor Europe-Caucasus-Asia (TRACECA) project.
    - In Uzbekistan, the Asian Development Bank provided $220 million in financing for the country's national highway project, and the country signed a transport agreement with China that included $400 million for new rail construction between the two countries.

In sum, the major investments in regional transport infrastructure taking place throughout the region provide a unique opportunity for the simultaneous, cost-effective deployment of fiber networks along transport rights-of-way.

- **The North and Central Asian study revealed a number of issues unique to the region which should be analyzed in greater depth in order to ensure the project's success:** The analysis undertaken in this study has clearly indicated that improved fiber infrastructure is an urgent requirement for the development of the region's ICT sector and overall economy. However, more detailed feasibility analysis is recommended in order to ascertain the cost characteristics and optimal configuration of future fiber deployment, as well as the cost-benefit characteristics and efficiencies of cross-sector infrastructure deployment capitalizing on the transport investments mentioned above. Specifically, now that the project's preliminary analysis has been completed, Terabit Consulting believes that the advanced development of the project would benefit from a more detailed study developed in close on-site collaboration with North and Central Asian stakeholders and suppliers, which would serve a bilateral function not only to elicit critical information, but also to more directly involve stakeholders and suppliers in the development of the project and encourage its overall momentum.

The Need for Intervention by Governments and/or International Organizations in Order to Ensure Implementation of a Pan-Asian Terrestrial Fiber Optic Network

Intervention by government and/or international organizations is required to ensure the implementation of a pan-Asian terrestrial fiber optic network for five reasons:

1. To overcome the vast broadband inequality that has been identified in the region.
2. To ensure that the region receives broadband services on a par with more developed markets.
3. To finance or assist in financing a multi-billion dollar capital project that is unlikely to be fully financed by the private sector.
4. To pool and leverage private-sector resources which are disparately insufficient.
5. To stimulate and facilitate future private investment through market maturation.

The fact that there is no viable pan-regional terrestrial fiber optic alternative to the region's submarine infrastructure indicates that the private sector perceives the risk/return profile of any pan-Asian terrestrial fiber optic network to be unworkable without some form of public support or bureaucratic facilitation. The provision of ubiquitous, affordable, and reliable broadband capacity on an equal basis to all of the region's markets will be a requirement in order for the entire region to move forward and promote its overall economic and social development. The participation of the region in the global digital economy will require sufficient international bandwidth and broadband delivery to end users in excess of that which current infrastructure allows.

In 2012, the United States Federal Communications Commission (FCC) announced that it was reevaluating its definition of "advanced telecommunications capability," or broadband, which it had classified since 2010 as being 4 Mbps download and 1 Mbps upload speeds. Following a period of public consultation, the threshold was expected to be increased considerably. The 2010 National Broadband Plan unveiled by the United States Government in March of 2010 recommended that the FCC ensure that 100 million American households have access to affordable broadband Internet with download speeds of at least 100 Mbps and upload speeds of at least 50 Mbps by 2020. Within the study region, none of the countries aside from Russian Federation are likely to achieve similar coverage, affordability, or speed thresholds.

From a developmental perspective, a democratized and equitable broadband infrastructure throughout the region would be a tremendous boon, enabling major advancements in education, telemedicine, scientific research, broadcasting, general government, and entrepreneurialism that would not be otherwise possible.

Available Public-Private Partnership Options for Financing a Pan-Asian Terrestrial Fiber Optic Network

Based on fiber network development models employed by governments through assistance from the World Bank and other development financial institutions, the available options for a public-private partnership are as follows.

1. Special Purpose Vehicle (SPV) Model with Government/Organizational Shareholding

- Network operators form a special purpose vehicle to assume full responsibility for the development, operation, and maintenance of the pan-Asian terrestrial network.
- Government, organizational, and/or developmental entities make capital contributions to the SPV and receive equity stakes and/or capacity on the network.
- The contributor(s) receive a seat on the board of the SPV, thereby ensuring that policy goals are achieved.
- A regulatory framework is adapted to ensure that the SPV's outcome fulfills policy goals and improves the overall welfare of the region.
- The contributor's equity stake may be divested once certain milestones are achieved, or alternatively may be held until the winding-down of the SPV.

2. Special Purpose Vehicle (SPV) Model with Government/Organizational Contribution

- Network operators form a special purpose vehicle with full responsibility for the pan-Asian terrestrial fiber optic network.
- The government, organizational, and/or developmental entities make capital contributions to the SPV.
- The contributor(s) do not receive equity or capacity on the network.
- However, the contributor(s) do participate in the creation of the SPV's governance framework, and receive a seat on the board of the SPV.
- Mechanisms are instituted to ensure that policy goals are met.

3. Build-Operate-Transfer (BOT)

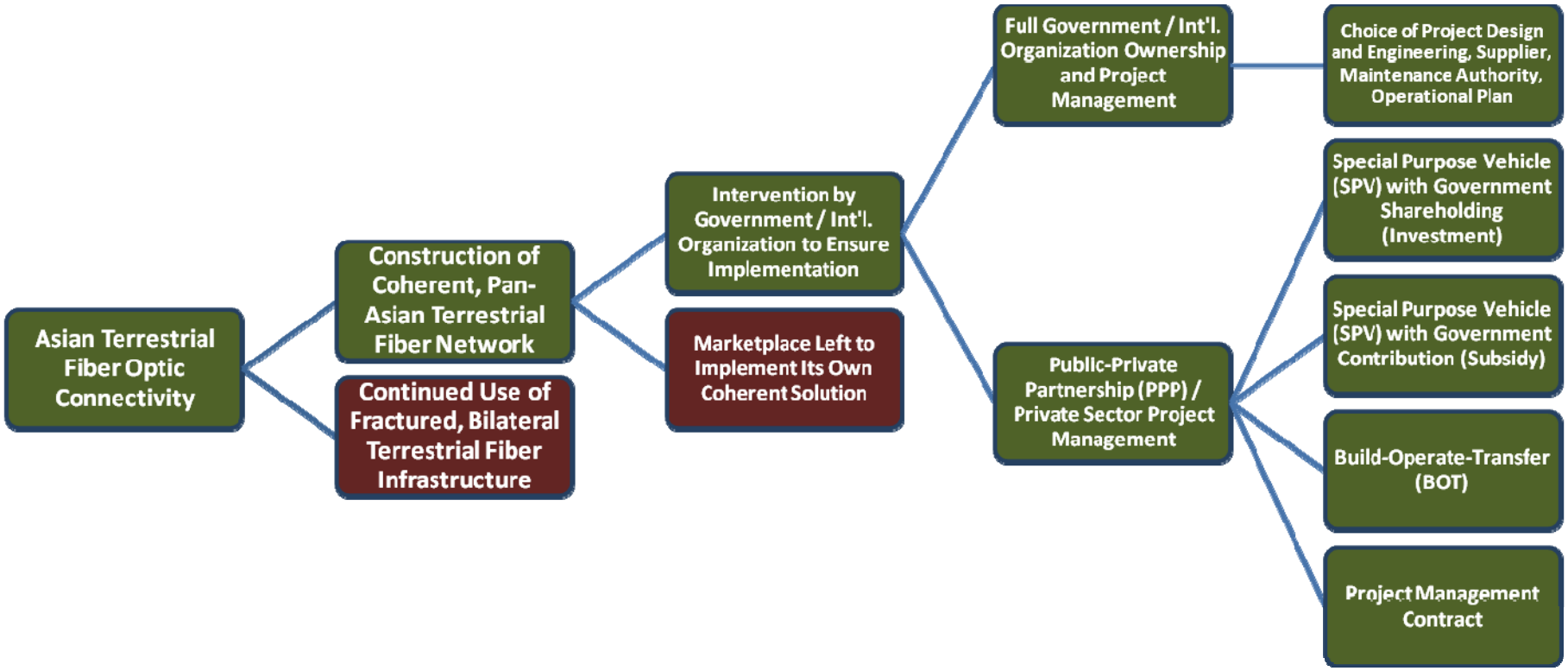
- Following an open tender process, a concession is granted to one or more network operators for a fixed long-term duration (typically 20 years).
- The network operators are assigned full responsibility for financing, operating, and maintaining the cable.
- Certain market privileges may be accorded to the network operators.
- The operators are allowed to retain all revenues during the period of its concession.
- Once the concession agreement expires, ownership of the network is assigned to the government(s) at no cost.

4. Awarding of Project Management Contract

- A tender is issued to select one or more network operators responsible for the construction, operation, maintenance, and commercialization of the pan-Asian terrestrial fiber optic network.

- The contract recipient is paid to manage the cable and assume these responsibilities, including the sales of capacity to operators. The contract recipient's management fees may be fixed or based on a percentage of revenue.
- The network remains the property of the Government(s) and all profits (less management fees) are collected by them.

Options for Participation by Government and International Organizations in the Implementation of Pan-Asian Terrestrial Fiber Network Connectivity



Stakeholder Analysis

The development of any open-access fiber optic network(s) in the region should be done in collaboration with the following stakeholders:

- National Regulatory Authorities

Azerbaijan	Ministry of Communications and Information Technology (MCIT)	*The key legislation governing the sector is the Telecommunications Law of 2005.*
Kazakhstan	Ministry of Transport and Communications (MTC)	*MTC assumed its regulatory role in 2012.*
Kyrgyzstan	National Communications Agency	*The applicable legislation is the Telecommunications Law of 1998.*
Russian Federation	Ministry of Communications and Mass Media (Minkomsvyaz)	*Minkomsvyaz in its present form assumed regulatory duties in 2008.*
Tajikistan	Communications Regulatory Agency	*The Communications Regulatory Agency was created in 2005.*
Turkmenistan	Ministry of Communications	*The sector is governed by the Telecommunications Law of 2000, and the ministry has authority over the issuance of more than 30 licenses.*
Uzbekistan	Uzbek Agency for Communications and Information (UzACI)	*UzACI was created in 2002 to assume regulatory responsibility from the Ministry of Communications.*

- Incumbent Telecommunications Operators and Major International Gateway Operators

Azerbaijan	Aztelekom (Gov't. of Azerbaijan), Delta Telecom	*Aztelekom is the incumbent fixed-line operator but private ISP Delta Telecom is the primary provider of IP transit.*
Kazakhstan	Kazakhtelecom (Gov't. of Kazakhstan)	*Kazakhtelecom's international network, which totaled 290 Gbps as of May, 2013, interconnects with 12 foreign operators.*
Kyrgyzstan	Kyrgyztelecom (Gov't. of Kyrgyzstan)	*Attempts to privatize Kyrgyz Telecom date to the 1990s, but as of 2013 the company was removed from the government's list of proposed privatizations.*
Russian Federation	Rostelecom (Svyazinvest/Gov't. of Russian Federation), VimpelCom, TTK, MTS, MegaFon	*Rostelecom is the leader in the transit capacity market, with a share of approximately 60%, VimpelCom has 30% and TTK has 10%; MTS and MegaFon entered the Europe-to-Asia transit market in 2013.*
Tajikistan	Tajiktelecom (Gov't. of Tajikistan)	*Tajiktelecom has a monopoly over the fixed-line market.*
Turkmenistan	Turkmentelecom (Gov't. of Turkmenistan)	*Turkmentelecom has a monopoly over the fixed-line market.*
Uzbekistan	Uzbektelecom/Uztelecom (Gov't. of Uzbekistan)	*Despite several efforts to privatize Uzbektelecom, the operator remains government-owned.*

- Competitive Telecommunications Operators and ISPs

Azerbaijan	Adamnet Azdatacom (Gov't. of Azerbaijan) Azercell (Fintur Holdings B.V. (TeliaSonera 58%, Turkcell 42%)) Azeurotel Azqtel Aztelekom CDMA Aztelekomnet/Aztelecom (Gov't. of Azerbaijan) Aztrank Aztrank CDMA Bakcell (GTIB) Bakinter.NET (Gov't. of Azerbaijan) Baku Telephone Communications CDMA Baku Telephone Network Production Association (BTRIB) (Gov't. of Azerbaijan) Caspian Telecom (Castel) Connect Dataplus Nar Mobile (Azerfon) Naxtel CDMA Ulnet Ultel/Ultel CDMA	*There are more than 20 competitive operators and ISPs in Azerbaijan with significant market presence.*
Kazakhstan	Altel (Kazakhtelecom) Astel Beeline / KaR-Tel (VimpelCom) Ducat (Arna) iD Net/Megaline (Kazakhtelecom) KazTransCom Kcell / Activ (Fintur Holdings (TeliaSonera, Turkcell) Sky Silk Tele2 Transtelecom VimpelCom (CA-Telecom, 2Day Telecom, TNS-Plus)	*The Kazakhstani telecommunications market was valued at over USD$4 billion in 2012.*
Kyrgyzstan	Aktel (CDMA) Elcat Katel (D-AMPS) MegaCom Megaline NurTelecom Saima Telecom/Saima Telecom 4G SkyMobile/Beeline (VimpelCom)	*Of the competitive operators in Kyrgyzstan, Elcat has been the most active in constructing international fiber infrastructure.*
Russian Federation	Akado (Akado Group) ER-Telecom (Perm Financial and Industrial Group) Orange (France Telecom) Tele2 (VTB Group)	*The five operators at left are the largest operators following the "Big Four" of MegaFon, MTS, Rostelecom,*

	TKK (OSJC Russian Railways)	*and VimpelCom.*
Tajikistan	1KomCiTel Babilon-T/Babilon-Mobile Beeline/Tacom (VimpelCom) CompuWorld Eastera Intercom Megafon MKF Networks Saturn Online Tarena Tcell (TeliaSonera) Telecom Technology	*Overall the Tajikistan telecommunications market is relatively competitive, and in 2012 the mobile market grew significantly due to aggressive price reductions.*
Turkmenistan	MTS	*MTS is the only private operator in the market; Turkmentelecom controls mobile operator Altyn Asyr and ISP Turkmenistan Online.*
Uzbekistan	Buzton (VimpelCom) East Telecom (Korea Telecom) EVO Perfectum Mobile (Rubicon Wireless Communication) Sarkor Telecom Sharq Telecom TPS Ucell (TeliaSonera) Unitel (VimpelCom) Uzmobile (Uzbektelecom) (Gov't. of Uzbekistan) Uznet (Uzbektelecom) (Gov't. of Uzbekistan)	*There has been significant foreign investment in Uzbekistan, although in 2012 and 2013 the transparency and stability of foreign operators' Uzbek investments was called into question: a major mobile operator, MTS-Uzbekistan, was shut down by authorities and another, TeliaSonera's Ucell, was the subject of investigation by European authorities.*

- Road and Railway Authorities/Operators

Azerbaijan	Ministry of Transportation, Azeryolservis JSC, Azerbaijan Railways (Azerbaycan Demir Yollari)	*Major projects include the modernization of all major highways by 2015 and the Baku-Tbilisi-Kars railway providing access to Europe.*
Kazakhstan	Ministry of Transport and Communications, National Operator for Republican Roads Management (proposed) Kazakhstan Temir Zholy (KTZ)	*In 2012 the government said that it would invest USD$19 billion in new highways by 2014, focusing on China-to-Asia highway connectivity. In late-2012 a new China-Europe rail link was inaugurated via Kazakhstan; overall KTZ investment was more than USD$3 billion in 2013.*
Kyrgyzstan	Ministry of Transport, Kyrgyz Railways (KTJ)	*The Bishkek-Osh-Sary Tash north-south highway will undergo a USD$800 million reconstruction over the next five years. Rail infrastructure is only a few hundred kilometers.*
Russian Federation	Ministry of Transport, Federal Road Agency (Rosavtodor), JSC Russian Railways	*By 2020, Russian Federation expects to build or reconstruct 7,400 kilometers of federal highways and 6,700 kilometers of regional and municipal roads. The total length of Russian rail lines is second only to the United States. JSC Russian Railways' subsidiary TransTeleKom (TTK) is a major fiber network operator, using rail ROWs.*
Tajikistan	Ministry of Transport, Tajik Railways	*Road construction and improvement of several hundred kilometers, especially linkages with China, has been undertaken with funding from the Asian Development Bank and the Chinese government. Rail infrastructure is less than a thousand kilometers, although investment is increasing, the Turkmenistan-Afghanistan-Tajikistan rail link was inaugurated in 2013, and a rail link to Uzbekistan is scheduled to be completed in 2016.*
Turkmenistan	Ministry of Automobile Transport, Ministry of Railway Transport, Turkmendemiryollary	*Improvement of highway links to Turkmenbashi is anticipated as part of the EU TRACECA logistics development program. Turkmenistan has thousands of kilometers of railway and new links Afghanistan and Kazakhstan were inaugurated in 2012 and 2013.*
Uzbekistan	Uzbek Agency of Automobile and River Transport, O'zbekiston Temir Yo'llari	*In May of 2013 Uzbekistan and the Asian Development Bank signed a loan agreement for USD$220 in financing for the country's national highway project. In November of 2013 the Uzbekistani government and the Chinese government signed an agreement for a USD$400 million loan to include construction of rail linkages to China.*

Principles to Guide Future Network Development

Given the shortcomings of the existing terrestrial fiber optic infrastructure in North and Central Asian markets, as well as previously-studied Southeast Asian markets, the analysis revealed a strong opportunity for the construction of an international terrestrial fiber optic network providing open, cost-effective access on both an intra-regional and intercontinental basis. In order to ensure the success of such a project, Terabit Consulting believes that the network should adhere to the following principles:

- **Fully integrated and coherent:** The unified network should provide connectivity across the region's borders and throughout the population, and be constructed in a mesh configuration that allows for in-network healing in the event of physical cable outages or political instability that can affect network connectivity in specific countries.

- **Functioning and monitored as a single, uniform network:** Beyond issues of low bandwidth and high cost, many sources indicated that existing international terrestrial networks currently cannot compete with submarine cables because international terrestrial networks are unable to offer uniform quality of service between endpoints. Because they function as connected "patchworks" of telecommunications carriers' domestic networks, the quality and utility of international terrestrial fiber optic connections are restrained by their weakest segments; typically, telecommunications carriers in neighboring countries will offer vastly different terms and service guarantees for transmission over each carrier's segments of the same international terrestrial network.

- **Leveraging existing infrastructure:** In order to remain cost-effective, any pan-regional terrestrial network would require streamlining of right-of-way procurement as well as the use of uniform construction techniques and parameters; such efficiency can only be realized through a partnership with existing long-distance infrastructure such the Asian Highway network, the Pan-Asian Railway project, or power transmission networks.

- **Cost-effective:** If constructed on the proper scale in terms of both geographic coverage and transmission capacity/fiber count, a pan-regional terrestrial network could effectively compete with submarine infrastructure on both a regional and intercontinental basis. In particular, a terrestrial network dimensioned around 100 Gbps transmission technology would benefit from a "last-mover's advantage" that should carry over for several years due to 100G's relatively nascent status and the recent step changes from 10G and 40G technology.

- **Open access and non-discriminatory pricing:** For the network to achieve development and policy goals, as well as to best serve the region's consumers, all purchasers of capacity must be able to access the network on equal, non-discriminatory terms. The concept of non-discrimination should also be carried over on a geographic basis so that countries can receive bandwidth at equal prices in an effort to overcome the paradoxically high pricing of bandwidth in poorer and landlocked markets.

- **Developed and managed by a special-purpose vehicle:** The neutrality and efficiency of the network would be ensured by a special-purpose vehicle (SPV) shareholding arrangement that would allow participation by all stakeholders while still maintaining arm's-length terms over all capacity sales and leases.

Based on its involvement with telecommunications infrastructure projects around the world, Terabit Consulting believes that from a commercial perspective, the most successful international networks are those which feature the participation of multiple telecommunications operators and Internet service providers. Although the initial obstacles are often considerable and development of a multi-party network usually takes much longer than if the project were to be developed by one or two entities, the long-term commercial viability and utility of the system is greatly improved in projects where multiple operators are allowed to participate on equal equity terms.

By contrast, privately-financed projects face significant challenges, particularly in those developing markets where consumer market share is concentrated among a few operators, or where government-owned entities maintain dominant market positions, as is the case in some of the markets analyzed in this study. Terabit Consulting believes that for the most part, privately-financed fiber optic network projects will only succeed in extremely competitive, transparent, and commoditized routes such as those serving North America or Western Europe.

On the other hand, cable infrastructure projects developed by one or two operators are generally intended to serve those operators' own traffic requirements rather than to function as wholesale sellers of capacity, because other competing operators are unlikely to purchase capacity on the projects for fear of subsidizing the projects' owners, who are also their competitors.

Consequently, Terabit Consulting believes that the most successful Asian terrestrial network is one in which all of the region's operators are invited to participate in a consortium on equal terms.

The primary obstacle to forming such a consortium is the desire of incumbent operators to maximize the value of their own existing infrastructure and prevent competition at both the domestic and international level, as well as the goal of operators in developed markets to serve as hub operators for the region and discourage the proliferation of international network outlets that do not aggregate traffic through their home markets.

As previously discussed, the chances for success in the development of Asian terrestrial connectivity would be greatly improved if the project were to be promoted and facilitated by an independent international organization such as UNESCAP. The commission should start by convincing regional governments of the advantages of the project, including the following:

- **Benefits to consumers** – In Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan, 1 Mbps of consumer broadband Internet access costs 25.9 percent, 24.3 percent, 15.1 percent, and 18.9 percent of nominal per-capita gross domestic product, respectively. Of the countries analyzed in this study, only Russian Federation offered broadband Internet access that is considered to be truly affordable. Better connectivity in the region will greatly reduce costs in less developed markets and bring improved and more reliable broadband services across the region.

- **Economic growth** – According to the Organization for Economic Cooperation and Development (OECD), improvement in ICT infrastructure has the following impacts:

  - ✓ Increased demand for the output of other industries (demand multiplier)
  - ✓ New opportunities for production in other industries (supply multiplier)
  - ✓ New goods and services for consumers (final demand)

  The OECD has additionally indicated that ICT improvements achieve the following:

- ✓ "increase firms' innovation capabilities"
- ✓ "increase the probability to introduce a new product both in manufacturing and services"
- ✓ "have a significant effect on the probability to introduce a process innovation"
- ✓ "increase the probability to introduce a new organization"
- ✓ "increase the probability to innovate in marketing"

- **Increased government revenue** – Growth in economic output as a result of ICT investment will result in greater tax revenue; in addition, governments can expect increased employment in the telecommunications sector and greater collections from telecommunications licenses and excise.

- **Regional stability through better political, economic, and intercultural relations** – A more coherent pan-regional fiber infrastructure is expected to bring better relations and opportunities for trade among Asian nations and would, for example, offer the possibility to promote regional initiatives in the education and healthcare sectors that would not otherwise be possible.

From a commercial perspective, UNESCAP can convince private-sector stakeholders of the project's viability by focusing on the cost advantages of constructing reliable, high-capacity international fiber optic paths across the entire region (compared to the relatively low-capacity and less-reliable links currently in service). Furthermore, UNESCAP should encourage the development of more robust terrestrial connectivity as a response to telecommunications operators' increasing fear of network outages in undersea networks' geographic "choke points" including the Luzon Strait, the Strait of Malacca, and the Egypt/Red Sea region.

The primary impediments to the construction of new open-access fiber connectivity in the region will likely be the acquisition of funding and opposition from stakeholders with investments in existing networks. Terabit Consulting is strongly convinced that the commercial viability of a pan-Asian terrestrial network can be proven through further consultation with stakeholders and suppliers. Support from certain incumbent operators wary of increased facilities-based competition will likely only be won if those operators can be presented with clear commercial arguments for the network's development.

Roadmap / Next Steps for Pan-Asian Terrestrial Fiber Optic Network Development

Among the items which should be undertaken in order to ensure the successful development of pan-regional terrestrial infrastructure are the following:

- **Evaluation of broadband infrastructure and state-of-play across the entire UNESCAP region and strategy development for linkage to Europe and other intercontinental bandwidth destinations.** In order to be successful, any Pan-Asian terrestrial fiber network should be envisioned as a continent-wide initiative providing transit capacity to Europe, North America, and other international destinations with a particular focus on direct linkages to low-cost Internet hubs in Europe and high-capacity, transoceanic submarine cable infrastructure.

- **Completion of a detailed feasibility study (DFS).** Once the basic parameters of the network's route and design are determined, a detailed economic, financial, and technical analysis of the network's feasibility should be completed.

- **Preliminary rough order of magnitude (ROM) costing exploration with potential suppliers.** The project's proponents should begin engaging with potential network suppliers as soon as possible to derive preliminary budgetary estimates. The ROM costing exploration can be performed within the context of the detailed feasibility study.

- **Determination of support for the project among stakeholders.** The stakeholders in the project, which would include international organizations such as UNESCAP, the region's governments, telecommunications operators and Internet service providers as identified in each of the country profiles of this report, and operators of complementary infrastructure such as highways, railways, and power transmission networks, should be interviewed to determine levels of support as well as to solicit possible commitments for participation in the project. This element can also be completed within the context of the detailed feasibility study.

- **Identification of financing options.** Private financing of the project is unlikely and public participation will probably be necessary. Regional governments and other stakeholders should be interviewed to determine available funding based on the findings of the detailed feasibility study.

I. COUNTRY ANALYSIS: AZERBAIJAN

	YE 2012
Population	9,235,000
Population Growth Rate	*1.4%*
Gross Domestic Product (PPP)	USD$100 billion / $10,800 per capita
GDP Growth Rate	*2.2% in 2012, 4.0% in 2013 (forecast)*
Human Development Index	0.543
HDI Ranking	*82nd out of 187 ("High")*
Literacy Rate	>99%
Fixed Line Subscribers	1,730,000
Fixed Line Operators	1. Aztelekom (Gov't. of Azerbaijan) 2. Baku Telephone Network Production Association (BTRIB) (Gov't. of Azerbaijan) 3. Caspian Telecom (Castel) 4. Aztrank 5. Azeurotel 6. Ultel
Mobile Subscribers	10,125,000
Mobile Operators	1. Azercell (Fintur Holdings B.V. (TeliaSonera 58%, Turkcell 42%)) 2. Bakcell (GTIB) 3. Nar Mobile (Azerfon) 4. Aztelekom CDMA 5. Aztrank CDMA 6. Baku Telephone Communications CDMA 7. Naxtel CDMA 8. Ultel CDMA
Mobile Broadband	3G service launched in late-2009; 4G trials started in 2012
Regulatory Agency	Ministry of Communications and Information Technology (MCIT)
International Internet Bandwidth	205 Gbps
Int'l. Internet Bandwidth per Capita	*22.4 Kbps*
Internet Service Providers	1. Bakinter.NET (Gov't. of Azerbaijan) 2. Aztelekomnet/Aztelecom (Gov't. of Azerbaijan) 3. Azdatacom (Gov't. of Azerbaijan) 4. Adamnet 5. Azqtel 6. Connect 7. Dataplus 8. Ulnet
Broadband Subscribers	1.3 million fixed broadband subscribers (>256 Kbps) 3.2 million mobile broadband subscribers (est.)
Fixed Broadband Technologies	ADSL, FTTH, Wi-Fi
Typical Monthly Broadband Subscription	1. USD$12.75 per month + USD$6.40 installation fee for 1 Mbps ADSL with unlimited download *(Bakinter.NET)*

Telecommunications Market Overview

The Azerbaijani telecommunications market exceeded USD$1 billion from 2008 onward, and as of 2012 total telecommunications revenue was $1.8 billion, according to the State Statistical Committee. Revenue from mobile services alone exceeded $1.1 billion in 2012. Many stakeholders in the sector believe that the country is well-positioned to become a regional telecommunications hub, capitalizing on the country's strong economic growth and geopolitical positioning.

Regulation and Government Intervention

The Azerbaijani telecommunications and Internet sectors are regulated by the Ministry of Communications and Information Technology (MCIT). The key legislation governing the sector is the Telecommunications Law of 2005.

A key element of Azerbaijan's "2020 Outlook for the Future" strategy is "development of information and communication technologies and a transition to a knowledge-based economy," with particular emphasis on the development of FTTH, WiFi, 4G networks. The Ministry of Communications and Information Technology has set a goal of increasing Internet penetration to 85 percent by 2017, with minimum download speed of 10 Mbps. Significant funding for broadband expansion has come from the State Oil Fund of the Republic of Azerbaijan (SOFAZ), including an estimated USD$130 million in 2013.

Since 2008, as part of an official computerization program for the nation's educational system, the MCIT has also been active in providing Internet connectivity to schools; as of the beginning of 2012 approximately 1,000 secondary schools had been connected, including 500 in Baku. The MCIT has set a goal of connecting every educational institution in the country as well as providing each student with either a netbook or tablet as part of a "one pupil – one computer" project.

The Government of Azerbaijan has also overseen action programs promoting the development of e-government applications and services, including the launch of the e-gov.az portal.

Fixed Line Telephony Market

There were 1.7 million fixed-line subscribers as of year-end 2012, with the capital Baku having the highest penetration rate of 35 percent.

Azertelecom provides fixed-services nationwide and is responsible for long-distance and international telephony, while the Baku Telephone Network Production Association (BTRIB) is the largest fixed-line operator in the capital Baku. In 2011 the Minister for Communications and Information Technologies announced that both Azertelecom and BTRIB would be converted into a joint stock company in anticipation of their privatization; the market value of Azertelecom was estimated by government sources to be USD$1 billion. Officially, the shareholding of Azertelecom was structured as 95 percent Azerfon, 2.5 percent BTRIB, and 2.5 percent Aztelekom (all three companies are government-owned).

Other smaller fixed-line operators, targeting primarily business customers, include Aztrank, Azeurotel, Caspian Telecom (Castel), and Ultel. Castel claimed in mid-2013 that it was able to connect clients in major cities such as Baku and Ganja to its fiber optic network in one working day or less, with connections often completed in as little as three to four hours.

Karabakh Telecom operates in Nagorno-Karabakh.

Mobile Telephony Market

Azercell, the country's largest mobile operator with 4.4 million subscribers as of year-end 2012, launched its network in 1996. The Azerbaijani government's remaining 36 percent stake in Azercell was privatized in 2008, and the company is currently controlled by Fintur Holdings B.V., which in turn is 58-percent owned by TeliaSonera and 42-percent owned by Turkcell.

Bakcell is Azerbaijan' second-largest operator, with 2.6 million subscribers at year-end 2012; the company was formed in 1994 as a joint venture between the Azerbiajani Ministry of Communications and the Israeli investor GTIB, but in 2003 the government sold its shares to GTIB. As of year-end 2012 Bakcell claimed to be the leader in mobile broadband, with a 45 percent market share following the launch of its 3G services in November of 2011.

Azerfon, the 95 percent shareholder in the country's fixed-line operator Azertelecom, commenced operations in 2007, was awarded the country's first 3G mobile network license in 2009, and launched 3G services in at the end of that year. The company signed a non-equity partnership agreement with Vodafone in 2009 however all customers were ultimately migrated to Azerfon's commercial brand, Nar Mobile.

Five operators provided CDMA service as of 2013, namely Aztelekom, Aztrank, Baku Telephone Communications, Naxtel, and Ultel. A sixth CDMA network operator, Caspian American Telecom LLC (Catel), ceased operations in 2011.

Azercell's market share is approximately 51 percent; second-place Bakcell has an estimated share of 31 percent, and Azerfon has an estimated 18 percent share.

Each operator has reportedly trialed 4G services in Baku; Azercell launched a pilot 4G LTE service in Baku in May of 2012 prior to the Eurovision song contest, followed by commercial 4G service the following month. In August of 2013 the Ministry of Communications and Information Technology indicated that it would supplement 4G LTE spectrum by reallocating analog broadcasting frequencies between 790 and 862 MHz.

Internet and Broadband Market

The Azerbaijani Internet market is extremely competitive, with more than 30 Internet service providers. As of 2013 the broadband market leader was Bakinter.NET, with a share of 23 percent, while the country's second-largest ISP, Aztelekom (also known as Aztelekomnet), had increased its market share to 16 percent. Bakinternet and Aztelekom, as well as the smaller ISP Azdatakom, are government-owned. Other major broadband ISPs include Uninet with 12 percent and Azeronline, with 10 percent.

Smaller ISPs include Connect and Dataplus, which both have market shares of 6 percent; Azqtel with 5 percent; Adamnet and Ulnet with 3 percent; Astarnet, Smart, and Avirtel with 2 percent; and Azuerotel and Castel with 1 percent.

In September of 2012 the government-owned Bakinter.NET and Aztelekom doubled the speed of their ADSL offerings, with prices of unlimited monthly subscriptions ranging from 10 to 80 manats (USD$13 to USD$102) for speeds of between 1 and 10 Mbps. Private ISPs including Azstarnet, DataPlus, and Azeronline also reportedly increased their speeds in 2013.

Aztelekom said that its broadband subscriber base increased from 25,000 to 102,000 over the course of 2012.

Private ISP Delta Telecom is the primary provider of international IP transit. Delta peers primarily with TeliaSonera (Sweden), Hurricane Electric (United States), TransTeleKom (Russian Federation), NTT America (United States), and Level 3 (United States) for international connectivity. C-Ring Telecom, a joint venture formed between Azertelecom and Synterra of Russian Federation (which was acquired by MegaFon in 2010), had been expected to emerge as a strong competitor in the IP transit market but failed to do so.

Most broadband Internet connections to consumers are via ADSL, but several ISPs have revealed plans for greater investment in fiber-to-the-home (FTTH) technology, most notably Aztelekom, which in late-2012 announced a $38 million FTTH investment that would be funded in part by the State Oil Fund of Azerbaijan (SOFAZ).

In 2013 the Minister of Communications and Information Technologies said that the consumer price of a 1-Mbps Internet connection had fallen to 2.5 percent of the average Azerbaijani monthly wage. Specifically, the ministry reported that a 1 Mbps ADSL connection cost USD$12 per month, while a 2 Mbps connection cost USD$19. As recently as 2007, a 1 Mbps ADSL connection had been 31 times more expensive.

Domestic Network Connectivity in Azerbaijan

The Azertelecom domestic fiber network is essentially a radial configuration extending from Baku along five major highways:

- A northern fiber route connects Baku to Siyazan, Qusar, and Quba via the M1 highway, which continues into Russian Federation.
- A northwestern fiber route extends to Shamakhi, Goychay, and Mingachevir via the M4 highway, with an extension to Balakan.
- A western route extends from Alat (south of Baku) along the M2 highway to Kurdamir, Yevlakh, Goranboy, Ganja, Tovuz, Agstafa, and Qazax, before crossing into Georgia.
- A southwestern route follows the M6 highway from Alat to Sabirabad, Beylegan and Horadiz.
- A southern route follows the M3 highway to Salyan, Bilasuvar, Msalli, Lenkeran, and Astara on the Iranian border; the link then continues through Islamic Republic of Iran to the Nakhchivan Autonomous Republic.

As of late-2012, a group of private ISPs including Alfanet, Azeronline, Caspel, Data Plus, Premier Group, Q-Telekom, and Smart was reported to have installed 420 kilometers of fiber for interconnection with the Aztelekom network, primarily in rural areas. The group intended to ultimate lay 1,400 kilometers. Between Aztelekom and the private ISPs, broadband coverage was expected to be available in all Azerbaijani villages by 2013.

In 2012 Aztelekom indicated that it had connected villages in the southern area of Nagorno-Karabakh Autonomous Oblast to the Trans Asia-Europe (TAE) fiber optic line; in 2013 Karabakh Telecom reported that it had deployed Wi-Fi networks throughout Nagorno-Karabakh.

Expansion of the TAE was carried out from the country's second-largest city, Ganja, westward to Dashkesan in 2012.

The Azerbaijani press reported in April of 2012 that a metropolitan fiber network had been installed in the Baku Metro system, which itself is approximately 35 kilometers in length.

International Internet Bandwidth and Capacity Pricing in Azerbaijan

Figure 1: International Internet Bandwidth and Capacity Pricing in Azerbaijan, 2012

International Internet Bandwidth	International Internet bandwidth per Capita	International Capacity Pricing
205 Gbps	22.4 Kbps	IP transit: USD$40 in 2011; as low as USD$20 as of 2013

Source: Terabit Consulting research, Operator data and interviews

Total Azerbaijani international Internet bandwidth was reported to be 205 Gbps as of year-end 2012. The majority of this traffic was transported by Delta Telecom; Azertelecom said that its international bandwidth was 20 Gbps as of 2012.

IP transit in Azerbaijan is among the cheapest in the region. The price of IP transit bandwidth in Azerbaijan has fallen considerably in recent years, from as high as USD$350 per Mbps per month in 2008 to USD$40 in 2011, with current prices estimated to be as low as USD$20 depending on volume and term commitments. Some observers have argued that the low price of IP transit, which prevails despite Delta Telecom's market dominance, is due to strong competition among onward capacity providers at the Russian Federation border.

International Network Connectivity in Azerbaijan

➢ Satellite Connectivity

Azerbaijan's first satellite, AzerSat-1, also known as Azerspace-1/Africasat-1a, was launched in February of 2013 at 46° E, providing capacity for both broadcasting and Internet transmission. Its owner, the state-owned open-stock joint company Azercosmos, took control of the satellite in April of 2013 from its primary satellite control facility in Absheron. The $120 million satellite, which has a coverage area across Europe, Asia, and Africa, is expected to remain in service until 2028. Partial financing was 85-percent financed through a loan from the United States Export-Import Bank.

Azerbaijan is expected to launch a low earth orbit (LEO) satellite in 2015 and a second telecommunications satellite in 2016.

- Trans Asia-Europe (TAE) Line (including Azerbaijan-Georgia and Azerbaijan-Islamic Republic of Iran)

Trans Asia-Europe (TAE) Line (including Azerbaijan-Georgia and Azerbaijan-Islamic Republic of Iran)	
Date	2001 (Construction commenced in 1999)
Length	Approximately 800 kilometers within Azerbaijan
International Connectivity	- Connects Baku, Azerbaijan and Tblisi, Georgia via the Red Bridge border crossing (Azerbaijani TAE Segment N1) - Connects Baku, Azerbaijan to Tehran, Islamic Republic of Iran via Astara border crossing (Azerbaijani TAE Segment N2)
Main Nodes	Baku (interconnected to all regional hubs)
Capacity	STM-4 (622 Mbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Azertelecom - Foptnet (Georgia) - Telecommunications Infrastructure Company of Iran (TIC)
Continuity with Rail/Highway	- Follows E60 highway across Red Bridge border crossing and M3 highway at Astara
Notes	- Backup channels for Azerbaijan's TAE segments are provided via fiber owned by Azerbaijani Railways installed along the Baku-Beyuk-Kyaski Railway as part of the Transport Corridor Europe Caucasus Asia (TRACECA) initiative

The 27,000-kilometer international Trans Asia-Europe Optical Fiber Cable (TAE) connects Frankfurt, Germany to Shanghai, China, comprises approximately 800 kilometers of cable in Azerbaijan, from the Red Bridge border crossing with Georgia, eastward to the capital of Baku, and south to the Astara border crossing with Islamic Republic of Iran. Although the primary segments of the TAE network were activated in October of 1998, construction on the Azerbaijani segments did not begin until the following year and the Tblisi-Baku link was activated in 2001.

Following the installation of fiber connectivity between Ganja and Dashkasan in 2012, Azerbaijani authorities reported that the country had successfully linked all of its regional hubs to the TAE network. Azerbaijan assumed the presidency of the Trans Asia-Europe Line network for the period 2013 to 2015, with the country represented by the Ministry of Communications and Information Technology.

TAE's participating countries included China, Kazakhstan, Kyrgyzstan, Uzbekistan, Tajikistan, Turkmenistan, Islamic Republic of Iran, Turkey, Ukraine, Belarus, Poland, Romania, Hungary, Austria, Germany, Georgia, Azerbaijan, Armenia, Pakistan, and Afghanistan. The primary segments of the network were activated in October of 1998, offering an initial capacity of 622 Mbps. The network does not offer any end-to-end service level agreement (SLA).

- Azerbaijan-Russian Federation (Rostelecom / Azertelecom)

Azerbaijan-Russian Federation (Rostelecom)	
Date	2003
Length	400 km
International Connectivity	- Azerbaijan to Russian Federation via the border crossing at Samur, Azerbaijan
Main Nodes	Baku
Capacity	Initial capacity of STM-1 (155.52 Mbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Azertelecom/Delta Telecom - Rostelecom - Fiber supplied by Alcatel
Continuity with Rail/Highway	- Follows the E119 highway
Notes	- Rostelecom's investment in the network, which stretches 200 kilometers on the Russian Federation side between Makhachkala and Derbent, was RUB 137 million (USD$4.5 million).

- Azerbaijan-Russian Federation (Synterra (MegaFon) /Azertelecom)

Azerbaijan-Russian Federation (Synterra (MegaFon) /Azertelecom)	
Date	2010/2011
Length	100 km
International Connectivity	- Derbent, Russian Federation to Quba, Azerbaijan via the border crossing at Samur, Azerbaijan
Main Nodes	Quba, Azerbaijan
Capacity	STM-64 (10 Gbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Azertelecom/Delta Telecom - Synterra (acquired by MegaFon in 2010)
Continuity with Rail/Highway	- Follows the E119 highway

Azertelecom and Russian Federation operator Synterra signed an agreement in May of 2009 for the construction of a 10 Gbps link between Derbent, Russian Federation and Guba, Azerbaijan within the framework of a $17 million joint venture between the two companies, known as C-Ring Telecom, aimed at targeting neighboring telecommunications markets in the Caspian region. In 2009 the Iran Mobin consortium also entered into a 50/50 joint venture with C-Ring to expand connectivity southward toward Islamic Republic of Iran. In July of 2010, the Russian Federation regulator Roskomnadzor granted a license to Sunterra for the operation of the trans-border fiber optic link, and as of 2011 sources in Azerbaijan indicated that the Azerbaijani segments of the network had been completed and that C-Ring was awaiting completion of Russian Federation fiber segments. However, the future of the C-Ring consortium was called into doubt following the purchase of Synterra by Russian telecommunications conglomerate MegaFon in 2010, which reportedly reevaluated the role of C-Ring in its international network development strategy.

➢ Azerbaijan-Russian Federation (TransTeleKom (TTK) / Azertelecom)

Azerbaijan-Russian Federation (TransTeleKom)	
Date	2007/2008 (est.)
Length	20 km
International Connectivity	- Russian Federation to Azerbaijan via Yalama, Azerbaijan
Main Nodes	Yalama, Azerbaijan
Capacity	Initial capacity of STM-64 (10 Gbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Azertelecom/Delta Telecom - TTK (Russian Federation)
Continuity with Rail/Highway	- Follows Azerbaijan-Russian Federation rail line

Russian Federation's TransTeleKom (TTK) has provisioned trans-border IP bandwidth between Yalama, Azerbaijan and Samur, Russian Federation to Delta Telecom since at least 2008. TransTeleKom specified that it provided 2.5 Gbps of IP bandwidth to Delta Telecom as of late-2009; shortly thereafter, the operators' trans-border network was upgraded to 10 Gbps.

➢ Azerbaijan (Nakhchivan Autonomous Republic)-Islamic Republic of Iran

Azerbaijan (Nakhchivan Autonomous Republic)-Islamic Republic of Iran	
Date	2005/2006
Length	134 kilometers within Nakhchivan
International Connectivity	- Connects Islamic Republic of Iran and Nakhchivan via the border crossing between Julfa, Azerbaijan and Jolfa, Islamic Republic of Iran
Main Nodes	Nakhchivan
Capacity	STM-1 (155.52 Mbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Azertelecom/Delta Telecom - Telecommunications Infrastructure Company (TIC) of Islamic Republic of Iran
Continuity with Rail/Highway	- Follows the R65 highway three kilometers south of the E02
Notes	- The Islamic Republic of Iran-Nakhchivan link has historically served as the primary connection between Baku and Nakhchivan, however a new link supplied by Turk Telekom in 2008 has also provided connectivity to Nakhchivan. The Ministry of Communications and Information Technology said that Nakhchivan and Baku were connected via a 2 Mbps Turksat satellite link as of 2010.

- Azerbaijan (Nakhchivan Autonomous Republic)-Turkey

Azerbaijan (Nakhchivan Autonomous Republic)-Turkey	
Date	2008
Length	145 km
International Connectivity	- Turkey to Nakhchivan via the Hasret (Longing) Bridge over the Aras River
Main Nodes	Nakhchivan
Capacity	STM-4 (622 Mbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Azertelecom/Delta Telecom - Turk Telekom
Continuity with Rail/Highway	- E99 Highway (Igdir-Nakhchivan Yolu)
Notes	The fiber cable was installed in 2.5 months beginning in late-2007 and was sponsored by Turk Telekom. Previous connectivity to Nakhchivan had been exclusively via Islamic Republic of Iran.

- Europe-Persia Express Gateway (EPEG)

Europe-Persia Express Gateway (EPEG)	
Date	2013 (MOU signed in 2011 and testing carried out in 2012)
Length	600 km within Azerbaijan; entire network spans 10,000 km
International Connectivity	- Via existing Trans Asia-Europe (TAE) infrastructure connecting the Iranian border at Astara to Baku, then via existing infrastructure to the Russian Federation border at Yalama
Main Nodes	Baku
Capacity	Advertised capacity of 500 Gbps for the entire network (design capacity of 3.2 Tbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Delta Telecom describes itself as the "transit operator" of the Azerbaijani segments, but responsibility for the segments within the consortium is actually assigned to Rostelecom. In addition to Rostelecom, the EPEG consortium also consists of Omantel, the Telecommunications Infrastructure Company of Islamic Republic of Iran, and Vodafone (originally Cable & Wireless Worldwide).
Continuity with Rail/Highway	- The network follows the M3 highway at the Iranian border crossing and the Azerbaijan-Russian Federation railroad right-of-way at the Russian Federation border crossing.
Notes	- Cost of Azerbaijani segments was €3 million, using existing infrastructure including Trans Asia-Europe (TAE) segments

In March of 2011 a memorandum of understanding was signed by four investors to create the 10,000-kilometer Europe Persia Express Gateway network between Oman and Frankfurt am Main, Germany. A construction and maintenance agreement was signed by the project's four investors in Tehran, Islamic Republic of Iran in June, 2011; testing took place in 2012 and the network was put into service in 2013.

The four signatories to the March, 2011 memorandum of understanding for the Europe Persia Express Gateway were Cable & Wireless Worldwide, Rostelecom, the Telecommunications Infrastructure Company of Iran (TIC), and Omantel. Each of the four operators was assigned responsibility for overseeing the activation of different segments of the network.

Cable & Wireless Worldwide was made responsible for the European segments connecting Frankfurt am Main, Germany; Berlin, Germany; Warsaw, Poland; Lviv, Ukraine; and Kiev, Ukraine; to the Ukraine-Russian Federation border.

Rostelecom assumed responsibility for the segments from the Ukraine-Russian Federation border, to Rostov-on-Don, Russian Federation; along the western shore of the Caspian Sea to the Russian Federation-Azerbaijan border; and through Azerbaijan via Baku to the Azerbaijan-Islamic Republic of Iran border. Delta Telecom described itself as a "transit operator" for the project, working in partnership with Rostelecom.

The Telecommunications Infrastructure Company of Iran was given responsibility for the segments within Islamic Republic of Iran from the Azerbaijan-Islamic Republic of Iran border to the Gulf of Oman. TIC is a sister company of the Telecommunications Company of Iran created in 2005 to manage the country's international bandwidth infrastructure; it is responsible for the country's undersea connectivity via the Gulf Bridge International, Falcon, and Iran-Kuwait systems (in 2010 Rostelecom and TIC reportedly signed an agreement for the provision of two STM-4s of international Internet bandwidth via Rostelecom's node in Stockholm, Sweden).

Omantel was assigned responsibility for the undersea segment of the network between Islamic Republic of Iran to Oman, as well as interconnection to the Europe-India Gateway cable in Al Madina A'Zarqa (Blue City), Oman.

Reports placed the cost of the entire network at as high as $200 million, although some analysts disputed this figure, given that much of the network takes advantage of existing infrastructure.

The impetus for the Europe Persia Express Gateway project was the delay in activating the trans-Egyptian segments of the Europe-India Gateway (EIG) undersea cable project. EIG, which was supposed to have entered service in mid-2010, had still yet to completed as of early-2011 because of Telecom Egypt's "considerable difficulties in obtaining the governmental permits necessary" for the implementation of the network's two terrestrial routes between the Red Sea and the Mediterranean, according to the EIG consortium. A decree from the Egyptian government issued after the manufacture of the cable changed the authorized landing points from the initial route plan, which called for cable stations in Alexandria and Ras Sidr (Ras Sudr), 40 kilometers south of Suez. The new landing point in Zafarana (100 kilometers south of Suez) shortened the cable route by 57 kilometers, requiring reconfiguration onboard the cable ship, and while awaiting new authorization from the Egyptian government, cable due to be installed off the north coast of Egypt (originally Alexandria and subsequently Sidi Kerir, Abu Talat) was temporarily stored in Malta.

Some sources attributed the problems with the Egyptian landing point to data security issues. Seacom and I-Me-We were also reportedly affected. Although EIG activated 11 of its 13 cable stations in early-2011, from the United Kingdom to southern France and from the west coast of Saudi Arabia to India, EIG representatives told Terabit Consulting that the activation of the terrestrial links across Egypt would be indefinite not only because of the continued permitting issues but also because of the Arab uprising.

In order to ensure connectivity to Europe and link EIG's disconnected undersea segments, consortium members Cable & Wireless Worldwide and Omantel reportedly pressed forward with plans to construct the Europe Persia Gateway Express. Notably, the two American operators participating in the Europe-India Gateway project, AT&T and Verizon, were prohibited from direct investment in the EPEG project because of economic sanctions against the Islamic Republic of Iran.

Similar sanctions apply to Sudan and Syria; consequently, operators seeking alternatives to (or diversity for) fiber optic connectivity through Egypt face significant geographic restrictions with respect to direct investment. Specifically, American operators wishing to directly invest in projects bypassing Egypt are limited to two relatively narrow passages across the 4,700-kilometer expanse between western Sudan and the eastern part of the Islamic Republic of Iran: a 200-kilometer-wide corridor in the Kurdish-inhabited area along the Iraq-Turkey border, and a 400-kilometer-wide corridor through Jordan which would require an undersea connection via Lebanon, Israel, or the Gaza Strip.

➢ Proposed International Connectivity

Trans-Eurasian Information Super Highway (TASIM) Project

The Trans-Eurasian Information Super Highway (TASIM) project would ultimately connect as many as 20 countries across Eastern Europe, the Commonwealth of Independent States, Turkey. Islamic Republic of Iran, Central Asia (including Afghanistan and Pakistan), India, and China. Some sources have also identified TASIM as the "East-West Information Superhighway." The initiative was first formally proposed by the Azerbaijani Ministry of Communications and Information Technology in November of 2008; the following year, the project was presented at the International Telecommunications Union's Telecom World 2009 conference in Geneva, Switzerland and three United Nations General Assembly resolutions expressing support for the project were formally adopted. The MCIT of Azerbaijan has also funded research into the project's viability.

Specifically, in February 2010 the United Nations adopted a resolution recognizing "the need to build connectivity in the region to help bridge the digital divide, and in this regard, [welcoming] the Trans-Eurasian Information Superhighway initiative and the readiness of the Republic of Azerbaijan to coordinate regional efforts aimed at realizing this initiative."

In April of 2010 the minster of communications and information technology of Azerbaijan traveled to China where he discussed the TASIM project with representatives of the Chinese government as well as the chief executive officer of China Telecom. A source at the ministry was quoted as saying that "the project has received the political, economic and public support of the government in China."

In June of 2010 Azerbaijan signed an accord with Belarussia, entitled "An agreement on cooperation in the field of information and information technologies between the Government of the Republic of Azerbaijan and the Government of the Republic of Belarus", and within the scope of the agreement Belarus had indicated its support for TASIM.

Although none of the international support for the TASIM initiative made explicit mention of trans-Caspian connectivity, several developments took place in 2010 and 2011 specifically focused on the development of Azerbaijan-Turkmenistan and Azerbaijan-Kazakhstan undersea cables which could ultimately become part of the TASIM network.

In June of 2010, the Azerbaijani private media outlet Trend News Agency reported that "some agreements on laying the Caspian segment of the fiber optic cable highway between Azerbaijan and Turkmenistan have

been reached...laying [the] Caspian segment of the fiber optic backbone between Azerbaijan and Turkmenistan is more advantageous as it reduces the route...and has direct access to Kyrgyzstan and China."

Then in December, 2010 Trend News Agency said that the Azerbaijan-Turkmenistan undersea project would soon "enter a new stage" and that the Ministry of Communications and Information Technologies of Azerbaijan and the Ministry of Communication of Turkmenistan had agreed to "accelerate the project."

In April of 2011 the Fineko Informational & Analytic Agency reported via its ABC.az Daily News that the Ministry of Communications and Information Technologies of Azerbaijan had signed a non-disclosure agreement with the operator KazTransCom regarding the development of a trans-Caspian link between Azerbaijan and Kazakhstan.

As of 2013 the TASIM consortium reportedly consisted of Azertelecom, China Telecom, Kaztranscom (Kazakhstan), Rostelecom, and Turk Telecom. In October of 2013 the United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP) agreed to support the TASIM Secretariat in its endeavours to create transcontinental connectivity.

Trans-Caspian Links

An undersea segment of the Trans Asia-Europe Line across the inland Caspian Sea has been under consideration since the 1990s. In its most recently-proposed form, the proposed Trans Caspian Link would comprise two point-to-point cables linking Azerbaijan with Turkmenistan and Azerbaijan with Kazakhstan. The Azerbaijan-Turkmenistan cable would probably consist of a point-to-point cable connecting Baku, Azerbaijan and Turkmenbasy (Turkmenbashi), Turkmenistan, while the Azerbaijan-Kazakhstan cable would probably be a point-to-point link between Baku and Aktau (Aqtau), Kazakhstan. If both cables are constructed, their estimated total length would be 710 kilometers. The Azerbaijan-Turkmenistan cable would be an estimated 270 kilometers while the Azerbaijan-Kazakhstan cable would be an estimated 440 kilometers.

The Caspian Sea is connected to the Black Sea via the 100-kilometer Volga-Don Shipping Canal and the Volga and Don Rivers, although the Russian Federation government reportedly charges Azerbaijani vessels canal passage fees of $20,000 to $25,000, four times higher than the fees charged to Russian Federation vessels. Because of the lack of cable laying ships in the region, proposals for the deployment of a trans-Caspian link as part of the TAE called for the use of refitted navy ships to deploy the submarine cable. In 2003 the United States Government donated a 27-meter former U.S. Coast Guard cutter to the Azerbaijani Navy, following its donation of two smaller cutters in 2000.

The TASIM project has been promoted by the Ministry of Communications and Information Technology of Azerbaijan, although other governments have expressed support for the project and negotiations for the Azerbaijan-Turkmenistan undersea link have reportedly been held with Turkmenistan's Ministry of Communications.

KazTransCom had been identified as a member of the consortium promoting the Trans Caspian-Black Sea (TCBS) project, which would also include an undersea link between Azerbaijan and Kazakhstan. None of the announcements regarding the TASIM trans-Caspian undersea links had made reference to the TCBS project, which was actively promoted between 2007 and 2009 but reported little progress thereafter.

The Ministry of Communications of Azerbaijan had initially awarded a contract for the construction of a submarine cable in the Caspian Sea to Siemens in 1998. The following year the contract was cancelled and

a new $27.5 million contract was awarded to the Turkish company Hesfibel for the construction of terrestrial segments of the Trans-Asia Europe Line within Azerbaijan as well as the so-called Trans Caspian Link.

Upon awarding the contract, Azerbaijan announced that the Trans Asia Europe line was to be routed from Azerbaijan's border with Georgia, through the Azerbaijani cities of Baku and Siyazan, and southward to the border with Islamic Republic of Iran; however, plans for the routing of the Trans Caspian Link were not clear. Plans called for the eastern landing point of the system to be located in either Turkmenistan or Kazakhstan.

Although the Azerbaijani terrestrial portions of the Trans Asia Europe Line were successfully completed in 2001 connecting Azerbaijan via Georgia and the Islamic Republic of Iran, plans for the Trans Caspian Link languished for the next four years. However, in June of 2004 the construction of the underwater segment of the fiber optic cable as part of the Trans Asia Europe project became a priority for Azerbaijan, while negotiations with Turkmenistan were called off back in 2000. However, in late-2010 the communications ministries of Azerbaijan and Turkmenistan met in Ashgabat and agreed to accelerate the development of a submarine cable between the two countries.

In October of 2004 the working group of the Trans-Asia Europe Economic Cooperation Organization, consisting of representatives from Central Asian republics as well as Turkey, Pakistan, and the Islamic Republic of Iran met in Baku, Azerbaijan to discuss the Trans-Asia Europe fiber optic line. Azerbaijani government sources told reporters that it was expected that a deal would be reached between Aztelecom and Kazakhtelecom to construct the Trans Caspian Link along a route between Siyazan, Azerbaijan and Aktau, Kazakhstan.

In early-2006 Pakistan offered support for the development of the submarine cable project while conceding that Pakistan was unlikely to route traffic via the Trans-Asia Europe Line because its prices were significantly higher than those available to Pakistan via its undersea links.

II. COUNTRY ANALYSIS: KAZAKHSTAN

	YE 2012
Population	16,700,000
Population Growth Rate	*1.1%*
Gross Domestic Product (PPP)	USD$234 billion / $14,000 per capita
GDP Growth Rate	*5.1% in 2012, 5.0% in 2013 (forecast)*
Human Development Index	0.754
HDI Ranking	*69th out of 187 ("High")*
Literacy Rate	>99%
Fixed Line Subscribers	4,300,000
Fixed Line Operators	1. Kazakhtelecom (Gov't. of Kazakhstan) 2. KazTransCom 3. Transtelecom 4. Ducat (Arna) 5. VimpelCom (CA-Telecom, TNS-plus) 6. Sky Silk
Mobile Subscribers	28,700,000
Mobile Operators	1. Kcell / Activ (Fintur Holdings (TeliaSonera, Turkcell) 2. Beeline / KaR-Tel (VimpelCom) 3. Tele2 4. Altel (Kazakhtelecom)
Mobile Broadband	3G launched in 2010; 4G LTE launched in 2013
Regulatory Agencies	Ministry of Transport and Communications (MTC)
International Internet Bandwidth	275 Gbps
Int'l. Internet Bandwidth per Capita	*16.5 Kbps*
Internet Service Providers	1. Kazakhtelecom/iD Net/Megaline 2. KazTransCom 3. Transtelecom 4. Ducat (Arna) 5. Astel 6. VimpelCom (CA-Telecom, 2Day Telecom)
Broadband Subscribers	1,600,000 fixed broadband subscribers (>256 Kbps) As many as 7 million mobile broadband subscribers (est.)
Fixed Broadband Technologies	ADSL, FTTH, Wi-Fi
Typical Monthly Broadband Subscription	1. USD$13 + USD$57 installation for 1 Mbps download speed and 3 GB monthly download limit *(Kazakhtelecom Megaline)* 2. USD$30 + USD$57 installation for 8 Mbps download speed and 100 GB monthly download limit *(Kazakhtelecom Megaline)*

Telecommunications Market Overview

The Kazakhstani telecommunications market was valued at $4 billion in 2012. Most observers forecast strong growth in the country's telecommunications sector as a result of expected growth in household income and increased government investment.

Regulation and Government Intervention

The Ministry of Transport and Communications (MTC) has been the industry's primary regulatory body since January of 2012. Regulatory responsibilities were previously held by the Agency for Informatization and Communication (AIC) and the Ministry of Communications and Information (MCI). The primary law governing the sector is the Telecommunications Law of 2004.

Fixed Line Telephony Market

Kazakhstan has one of the highest fixed-line penetration rates in Central Asia, with a total of 4.3 million lines as of year-end 2012 and continued growth in subscribership. The incumbent operator Kazakhtelecom is dominant in the country's fixed-line sector, with more than four million lines in service as of year-end 2012 and a market share of 93 percent. Other fixed-line operators include KazTransCom, Transtelecom, Ducat (Arna), GC Beeline (CA-Telecom, TNS-plus), and Sky Silk.

Kazakhtelecom's majority owner is the Government of Kazakhstan, through the Samruk-Kazyna National Welfare Fund, which holds 51 percent of shares; other Kazakhtelecom shareholders include Dutch holding company Bodam and the Bank of New York.

KazTransCom was formed in 2001 through the merger of three joint stock companies: CaspiMunayBailanys, Aktjubneftesviaz, and Bailanys. As a result of the merger, 50 percent of KazTransCom shares were owned by OJSC Rodnik (believed to be a holding company) and 49.9 percent were held by the Kazakhstani government-owned energy company KazMunayGas (KMG). As of 2011 KazMunayGas was no longer listed as a KazTransCom shareholder while Rodnik had increased its ownership to 76.22 percent (Telecom Azia was identified as the largest minority shareholder with 9.45 percent).

Transtelecom, a subsidiary of the Kazakh rail company KZT.

Mobile Telephony Market

As of year-end 2012, mobile market shares were as follows: Kcell 50 percent, VimpelCom 32 percent, Tele2 13 percent, and Altel 5 percent. Average revenue per user (ARPU) was approximately USD$8 per month.

Kcell, Kazakhstan's largest mobile operator with 13.5 million users as of year-end 2012, provides services under two brand names: Kcell, which targets corporate and government clientele, and Activ, which targets the consumer market. Kcell was founded in 1998 as GSM Kazakhstan, which was 51 percent owned by Fintur Holdings and 49 percent owned by the fixed-line operator Kazakhtelecom. Fintur Holdings, in turn, majority-owned by the Swedish operator TeliaSonera and minority-owned by the Turkish operator Turkcell. In early-2012, TeliaSonera acquired Kazakhtelecom's shares, giving it an 87 percent stake and control of Kcell; in December of 2012, TeliaSonera listed 25 percent of Kcell's shares on the Kazakhstan Stock Exchange, with depository receipts listed on the London Stock Exchange.

Swedish operator Tele2 acquired a 51 percent stake in the Kazakhstani mobile operator Neo in 2010, and in 2011 the company was rebranded as Tele2. Tele2's entry into the Kazakhstani mobile market was widely perceived to have resulted in lower tariffs.

In early-2013 Kazakhtelecom's Altel launched 4G LTE service in both Astana and Almaty; later in the year the company indicated that its 3G network in both cities would be deactivated. The company has reportedly arranged financing for expansion of its 4G network to secondary cities and LTE is expected to be available nationwide by 2018. As of 2013 Altel was the only LTE license holder, but Kcell was seeking to initiate discussions with the government regarding the issuance of an additional LTE license.

Kcell, which clams to operate the country's most extensive 3G network, made significant inroads in the 4G market in early-2013 when its parent company TeliaSonera acquired the WiMax operations of Alem Communications, including WiMax networks in six cities and frequencies in the 2.5-2.6 GHz band. At the same time, TeliaSonera assumed a minority stake in KazTransCom which allowed Kcell to access capacity via the company's fiber optic backbone network.

Kcell has reported that demand for mobile broadband services in Kazakhstan is currently lower than other major markets; for example, average monthly mobile broadband downloads in 2012 were 77 megabytes per user, or one-third of the volume downloaded by Russian Federation mobile broadband customers. However, Kcell has also noted that download volumes had increased 18 times between 2009 and 2012; consequently, Kcell was optimistic that the mobile broadband sector would demonstrate significant growth in the near-future.

Kazakhstan's Agency for Protection of Competition has ordered a reduction in mobile operators' interconnection charges, which it determined to be higher than other markets in the region.

Internet and Broadband Market

Although fixed-broadband was only ten percent of the population as of year-end 2012, Kazakhstan's strong fixed-line infrastructure is expected to serve as a foundation for future growth in the fixed-broadband sector.

Kazakhtelecom's share of the fixed broadband market is greater than 75 percent; in 2012 the company reported having connected its one-millionth Megaline broadband customer and as of year-end 2012 it reported more than 1.2 million broadband subscribers.

Kazakhtelecom has indicated that it intends to provide fiber-to-the-home connectivity to all multi-story, multi-family residential units in Kazakhstan by 2015. In 2012 it forecasted that the number of FTTH ports on its network would almost double from 300,000 as of year-end 2012 to almost 600,000 by year-end 2014. Kazakhtelecom's iDNet FTTH service offers download speeds of up to 50 Mbps.

For its part, VimpelCom reported increased subscribership to its fiber-to-the-building network.

As of 2011, Kazakhtelecom's domestic Internet bandwidth was 373 Gbps, representing an 82 percent increase over 2010.

Domestic Network Connectivity in Kazakhstan

Kazakhtelecom's primary fiber network was initially deployed in a ring configuration between Astana, Petropavlovsk, Aktobe, Almaty, and Pavoldar. Additional segments connected Almaty and Dostyk; Ucharal and Dostyk; Saryozek and Karaganda; Shymkent and Almaty, Almaty and Petropavlovsk; Horgos and Saryozek; Kandyagash, Uralsk, and Chernogovka; and Abai and Shymkent. In 2012 Kazakhtelecom completed construction of a 1,800-kilometer fiber backbone connecting Kostanai, Esil, Arkalyk, Ulytau, Zhezkazgan, and Zharyk, as well as Esil and Astana.

Transtelecom, a subsidiary of the Kazakh rail company KZT, also operates a domestic fiber network along the right-of-way of its parent company; mobile operator Kcell is among its customer.

As of year-end 2012, the domestic fiber network of VimpelCom and its subsidiary TNS-Plus was 11,970 kilometers.

International Internet Bandwidth and Capacity Pricing in Kazakhstan

Figure 2: International Internet Bandwidth and Capacity Pricing in Kazakhstan, 2012

International Internet Bandwidth	International Internet bandwidth per Capita	International Capacity Pricing
275 Gbps	16.5 Kbps	USD$15 per Mbps per month (est.)

Source: Terabit Consulting research, Operator data and interviews

Kazakhtelecom reported 290 Gbps of international capacity as of May, 2013. The operator's network interconnects with those of Rostelecom, VimpelCom, MegaFon, and TTK in Russian Federation; Kyrgyztelecom, Elcat, and Saima Telecom in Kyrgyzstan; Uzbektelecom in Uzbekistan; Turkmentelecom in Turkmenistan; and China Telecom, China Unicom, and China TieTong in China. The high number of interconnecting networks has enabled a more competitive IP transit offering.

International Network Connectivity in Kazakhstan

➢ Satellite Connectivity

Kazakhstan's primary satellite earth station is located in Almaty and contains an Intelsat A-standard antenna, as well as an Intelsat F3 antenna. There are Intelsat F1- and F2-standard antennae in Atyrau, as well as an Intelsat G-standard earth station in Aktau is used primarily by the petroleum industry. An earth station in Astana operated by Orbita is used primarily for receiving broadcast transmissions but may be upgraded for communications use in the future.

In 2006 the country launched its first communications satellite, the $60 million KazSat, although control of the satellite was lost in 2008. It successor KazSat-2 was launched in 2011 and KazSat-3 is expected to be launched in 2015.

Kazakhstan is one of the eight central and east Asian countries participating in the "Silk Project", an initiative led by many European and American organizations (among them NATO). Its intent is to increase the exchange of information among academic and educational institutions in member nations. The other countries are Armenia, Azerbaijan, Georgia, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. Each country has its own VSAT station communicating with a Eurasiasat satellite to a center in Hamburg Germany. The Kazakhstan earth station is in Almaty.

- Trans Asia-Europe Line (TAE) (Kazakhstan-China, Kazakhstan-Kyrgyzstan, and Kazakhstan-Uzbekistan)

Trans Asia-Europe Line (TAE)	
Date	1998
Length	Approximately 1,500 kilometers in Kazakhstan
International Connectivity	- Shymkent, Kazakhstan to Tashkent, Uzbekistan via the border crossing at Chernayevka, Kazakhstan and Gisht Kuprik, Uzbekistan - Almaty, Kazakhstan to Urumqi, China via the border crossing at Khorgos/Korgas - Saribulak, Kazakhstan to Bishkek, Kyrgyzstan via Kamyshanovka, Kyrgyzstan - Merke, Kazakhstan to Bishkek, Kyrgyzstan via Chaldovar, Kazakhstan and Chaldybar, Kyrgyzstan. - Kazakhstan-Kyrgyzstan via Korday, Kazakhstan (constructed in 2007).
Main Nodes	Almaty, Sogety, Merke, Simhent Sarybulak
Capacity	Initial capacity of STM-4 (622 Mbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Kazakhstan segments owned and operated by Kazakhtelecom; TAE developed by consortium of operators in 20 countries.
Continuity with Rail/Highway	- Kazakhstan-Uzbekistan route follows the M39 and A2 highways. - Kazakhstan-China route follows the A353 (AH5) highway. - Kazakhstan-Kyrgyzstan route follows the M39 highway (western segment) - Kazakhstan-Kyrgyzstan route follows the A2 highway (northern segment)

The 27,000-kilometer Trans-Asia Europe line was activated in October of 1998 at a cost of $560 million. It connects Frankfurt, Germany to Shanghai, China. Countries involved in the project include China, Kazakhstan, Kyrgyzstan, Uzbekistan, Tajikistan, Turkmenistan, Islamic Republic of Iran, Turkey, Ukraine, Belarus, Poland, Romania, Hungary, Austria, Germany, Georgia, Azerbaijan, Armenia, Pakistan, and Afghanistan. The TAE had an initial capacity of STM-4 (622 Mbps), which has been upgraded to STM-16 (2.488 Gbps) in the Kazakhstani segments. The Kazakhstani portion of the cable is approximately 1,500 kilometers long; its installation cost $25 million. Direct international connections are to Uzbekistan, China, and Kyrgyzstan, with the latter connected via a ring. The system crosses Kazakhstan's southern border with Uzbekistan via the main road between the Uzbekistani capital of Toshkent and the Kazakhstani city of Shymkent. It continues to Almaty before crossing Kazakhstan's southeastern border with China via the main road between Khorgos, Kazakhstan and Korgas, China. A southern ring extends from Kazakhstan to the Kyrgyzstani capital of Bishkek; it crosses the border at Chaldybar, and Kamyshanovka, Kyrgyzstan, and was subsequently supplemented by a third, redundant link between Kazakhstan and the Kyrgyzstan.

- Kazakhstan-Kyrgyzstan (Elcat)

China-Kyrgyzstan and Kyrgyzstan-Tajkistan (Elcat)	
Date	September, 2013
Length	120 kilometers
International Connectivity	- Bishkek, Kyrgyzstan to Chaldovar, Kazakhstan
Main Nodes	Bishkek, Kara Balta
Capacity	Initial capacity of 2.5 Gbps, upgradeable to 40 Gbps
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Elcat
Continuity with Rail/Highway	- Follows the M39 (Kazakhstan) and M29 (Krygyz Republic) highways

- Kazakhstan-Russian Federation (northern Kazakhstan)

Kazakhstan-Russian Federation (northern Kazakhstan)	
Date	1999
Length	340 kilometers
International Connectivity	- Petropavlovsk, Kazakshstan to Kormilovka, Russian Federation via Omsk, Kazakhstan
Main Nodes	Petropavlovsk
Capacity	Initial capacity of STM-4 (622 Mbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Kazakhtelecom - Interconnection with Rostelecom and TTK (TTK link constructed in 2009)
Continuity with Rail/Highway	- Follows M51 (E30) highway

Petropavlovsk serves as the interconnection point between Kazakhtelecom's network and the Russian Federation networks of Rostelecom and TTK.

- Kazakhstan-Russian Federation (northwestern Kazakhstan)

Kazakhstan-Russian Federation (northwestern Kazakhstan)	
Date	2001
Length	340 kilometers
International Connectivity	- Atyrau, Kazakhstan to Volograd, Russian Federation via Saykhin, Kazakhstan
Main Nodes	Atyrau
Capacity	Initial capacity of STM-4 (622 Mbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Kazakhtelecom - Interconnects with networks of Rostelecom, VimpelCom, and MegaFon (originally Synterra) - Rostelecom link supplied by Siemens
Continuity with Rail/Highway	- Via the main road between Atyrau and Volzhsky, Russian Federation (north of Volgograd).

In late-2013 the mobile operator MegaFon announced that in partnership with Kazakhtelecom, it had activated its Diverse Route for European and Asian Markets (DREAM) network between Germany and Kazakhstan's border with China, using primarily existing infrastructure.

- Kazakhstan-Russian Federation (western Kazakhstan)

Kazakhstan-Russian Federation (western Kazakhstan)	
Date	2006 (est.)
Length	200 kilometers
International Connectivity	- Atyrau, Kazakhstan to Astrakhan, Russian Federation via Ganyushkino, Kazakhstan
Main Nodes	Atyrau
Capacity	Initial capacity of STM-4 (622 Mbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Kazakhtelecom - Rostelecom
Continuity with Rail/Highway	- Via the A27 highway (Kazakhstan) and the A340 highway (Russian Federation)

- Kazakhstan-Turkmenistan

Kazakhstan-Turkmenistan	
Date	2013
Length	220 kilometers. Kazakhtelecom reported that it installed 179 new kilometers of fiber cable on the Kazakhstan side of the network.
International Connectivity	- Zhanaozen, Kazakhstan to Bekdash, Turkmenistan via Temirbaba, Kazakhstan
Main Nodes	Zahnaozen
Capacity	STM-64 (10 Gbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Kazakhtelecom - Turkmentelecom
Continuity with Rail/Highway	- The fiber network was inaugurated simultaneously with the Turkmen-Kazakh section of the Kazakhstan-Turkmenistan-Islamic Republic of Iran transnational railway, which provided the network with its right-of-way. - There is also a parallel Zhanaozen-Turkmenbashi Road which is reportedly in poor condition.

- Kazakhstan-Uzbekistan (eastern)

Kazakhstan-Uzbekistan (eastern)	
Date	2009; MOU signed in 2007
Length	132 kilometers.
International Connectivity	- Skymkent, Kazakhstan to Tashkent, Uzbekistan via the border crossing at Zhibek Zholy, Kazakhstan
Main Nodes	Skymkent
Capacity	Initial capacity of STM-4 (622 Mbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Kazakhtelecom - Uzbektelecom
Continuity with Rail/Highway	- Via the A2 highway (Kazakhstan) and the M39 highway (Uzbekistan)

- Kazakhstan-Uzbekistan (western)

Kazakhstan-Uzbekistan (western)	
Date	2009
Length	400 km
International Connectivity	- Kungrad, Uzbekistan to Beyneu, Kazakhstan via Tajen border crossing
Main Nodes	Beyneu
Capacity	
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Uzbektelecom - Kazakhtelecom
Continuity with Rail/Highway	- The fiber link follows the Beyneu-Kungrad road - There is also a Kungrad-Beyneu rail link

Additional unconfirmed networks, for which Terabit Consulting is still collecting information, may include:

- Kazakhstan-China via Usharal and Dostyk (2009)
- Kazakhstan-China via Sary-Ozek (2009)
- Kazakhstan-Russian Federation via Uralsk (2009)

Kazakhstan's Rail Connectivity

The Kazakh rail network has recently benefited from increased government investment, largely in anticipation of increased government revenue as a result of oil production in the Kashagan Field. National rail operator Kazakhstan Temir Zholy (KTZ) is the country's largest employer, and Kazakhstan has emerged as a major equipment producer in the region following the opening of a new locomotive factory outside Astana by a KTZ subsidiary. Domestically, the Kazakhstani rail network is robust, with railway infrastructure linking almost every village.

KTZ has also been instrumental in Kazakhstan's efforts to reduce its reliance on Russian Federation trade routes, through the construction of a $100 million freight and logistics hub in Lianyingang, China and a second international rail link between Kazakhstan and China. As of 2013, the majority of Kazakhstan's international rail freight originated from or was destined to Russian Federation or former Soviet republics, but freight crossing the border with China had increased to one-fourth of the total and was expected to account for half in the near-future. For its part, Chinese authorities have reportedly encouraged the construction of rail links through Kazakhstan and Central Asia as an alternative to traditional transpacific shipping lanes, which carry the majority of China's exports but are perceived to fall under the political sphere of the United States.

III. COUNTRY ANALYSIS: KYRGYZSTAN

	YE 2012
Population	5,600,000
Population Growth Rate	*1.2%*
Gross Domestic Product (PPP)	USD$13.5 billion / $2,400 per capita
GDP Growth Rate	*-0.9% in 2012, 5.5% forecasted in 2013*
Human Development Index	0.622
HDI Ranking	*125th out of 187 ("Medium")*
Literacy Rate	99%
Fixed Line Subscribers	490,000
Fixed Line Operators	1. Kyrgyztelecom (Gov't. of Kyrgyzstan) 2. Saima Telecom
Mobile Subscribers	6,800,000
Mobile Operators	1. MegaCom 2. SkyMobile/Beeline (VimpelCom) 3. NurTelecom 4. Saima-Telecom 4G 5. Katel (D-AMPS) 6. Aktel (CDMA)
Mobile Broadband	3G launched in 2010; 4G LTE launched in late-2011
Regulatory Agency	National Communication Agency (NCA)
International Internet Bandwidth	5 Gbps
Int'l. Internet Bandwidth per Capita	*0.893 Kbps*
Internet Service Providers	1. Kyrgyztelecom 2. Megaline 3. Saima Telecom 4. Elcat
Fixed Broadband Subscribers	150,000 fixed broadband subscribers (>256 Kbps) 2,000,000 mobile broadband subscribers (est.)
Fixed Broadband Technologies	ADSL, FTTH
Typical Monthly Broadband Subscription	1. USD$25 for 1 Mbps with 5 GB of international content and 9 GB of domestic content *(Kyrgyztelecom ADSL)* 2. USD$84 for 1 Mbps with unlimited download *(Kyrgyztelecom ADSL)*

Telecommunications Market Overview

Attempts to privatize Kyrgyztelecom date to the 1990s; the stake which was to have been made available ranged from 40 to 78 percent.

In 2003 more than a dozen companies from China, Germany, Kazakhstan, Russian Federation, Sweden, and Turkey submitted offers for a 51 percent stake in the operator. Initially, the Swedish investor Swedtel emerged as the leading bidder, but the company reportedly reneged on its bid of USD$15.6 million after reviewing Kyrgyztelecom's financial statements and was also disqualified on the premise that it did not have annual revenues exceeding USD$100 million, as required in the terms of the auction. The Kyrgyz

government then approached Rostelecom, the second-highest bidder, but negotiations over the proposed sale price were unsuccessful.

In 2004 a new phase of bidding was held and a 51 percent stake was awarded to a consortium led by Deutsche Telekom subsidiary Detecon International as well as British company Arextech Ltd., which together offered USD$16.2 million. However, in mid-2004 the Kyrgyz parliament requested that the tender process be suspended since it was believed to not comply with existing legislation. In mid-2005 the government reported that discussions with the Detecon/Arextech consortium had been suspended and a new tender would be carried out.

In January of 2006 the government announced that a 77.84 percent stake in Kyrgyztelecom would be offered. In February of 2010, the Kygyzstan government confirrmed that a 70 percent stake had been sold for USD$40 million to a consortium of investors including Investment Company KSD of Kazakhstan, Nimisco Holdings of Cyprus, Colimar Holdings of Cyprus, and Ala-Too Keni Company of Kyrgyzstan. However, two months later the sale was annulled by the government under the premise that the sale price was too low.

In 2012 the Kyrgyz government formally removed Kyrgyztelecom from its list of proposed privatizations, but in mid-2013 it was reported that the company might be forced into bankruptcy, opening up the possibility that it would fall into the possession of its largest creditor, the China Development Bank. For its part, Kyrgyztelecom asserted that it was servicing its debt satisfactorily.

Regulation and Government Intervention

The Kyrgyzstan's telecommunications regulator is the National Communication Agency (NCA). The applicable legislation is the Telecommunications Law of 1998.

Fixed Line Telephony Market

In addition to its wireline fixed network, Kyrgyztelecom also offers fixed wireless local loop (WLL) service via a CDMA-450 network. In 2011 the company's subsidiary Bishkek Urban Telephone Network offered WLL telephones at a promotional price of 900 som in an effort to increase subscribership.

Eventis Telecom, a holding company based in Cyprus reportedly led by Russian Federation investors, acquired a 50.1 percent stake in Saima Telecom in 2007.

In 2013 Kygyztelecom launched a "Cheksiz Kyrgyzstan" tariff for subscribers Osh, Zhala-Abad, Batken and Issyk-Kul offering unlimited calls to all Kyrgyz fixed-line networks for USD$3.07 per month.

Mobile Telephony Market

Bitel was the country's first GSM operator; it was purchased by Russian Federation mobile operator MTS in 2005. However, as a result of a court challenge by Russian Federation investor Rezervspetsmet, Kyrgyz government authorities reportedly seized Bitel's offices three days after the purchase and MTS was unable to assume control of the company. Bitel announced in 2006 that it would sell its assets to Alfa Group subsidiary Sky Mobile.

Kygyztelecom's KT Mobile subsidiary received a GSM license in 2006.

The Russian Federation operator MegaFon signed an agreement in 2005 with the Kyrgyz GSM licensee Bimocom and launched its GSM network in 2006.

In 2011 the National Communications Agency awarded 4G LTE and Wi-Max licenses to a total of 12 operators. Saima Telecom 4G launched its LTE network in Bishkek in December of 2011.

Internet and Broadband Market

Kyrgyztelecom is the country's leading ISP, with a market share of 60 percent. Other major ISPs include Elcat, Megaline, and Saima Telecom.

Initial broadband deployment was limited to the capital Bishkek but in 2009 ADSL services were launched in the country's second-largest city, Osh. ADSL became available in Talas and Naryn in 2012 and 2013.

In October, 2012 Kyrgyztelecom launched a free public Wi-Fi hotspot in Bishkek's Ala-Too Square; at least four additional Wi-Fi zones were opened by the end of the year. By late-2013 the operator reported a total of 32 hotspots, each offering free access at speeds of 256 Kbps, or 10 Mbps speeds at a cost of 10 som (USD$0.20) per hour.

Kyrgyz ISPs had historically made a distinction between domestic and international content, with Kyrgyztelecom placing caps on international content but not domestic content in many of its consumer broadband plans. Kyrgyzstan is among only a handful of countries worldwide, including Tajikistan and Uzbekistan, that implement such policies.

Domestic Network Connectivity in Kyrgyzstan

Kyrgyztelecom's domestic fiber optic network was enlarged around its Trans Asia Europe (TAE) Line segments, which were initially activated in 2000. The two TAE segments were subsequently complemented by fiber to the borders of Tajikistan (via the Batken-Isfara fiber line) and Uzbekistan (via the Osh-Andijan fiber line). A 265-kilometer link was constructed from the border with China to the border with Uzbekistan via Irgeshtam and Sarytash. A 308-kilometer fiber link between Bishkek and Talas was activated in January of 2013, operating at 1 Gbps and forming part of the Bishkek-Osh-Batken fiber backbone. Kyrgyztelecom reported that it expected to activate a major north-south fiber link (via Jalal-Abad and Bishkek) in 2013.

In addition to its fiber backbone, Kyrgyztelecom also operates a national microwave network that was upgraded to four STM-1s (a total of 622 Mbps) in 2009.

International Internet Bandwidth and Capacity Pricing in Kyrgyzstan

Figure 3: International Internet Bandwidth and Capacity Pricing in Kyrgyzstan, 2012

International Internet Bandwidth	International Internet bandwidth per Capita	International Capacity Pricing
5 Gbps	0.893 Kbps	IP transit: >$100 per Mbps per month

Source: Terabit Consulting research, Operator data and interviews

TTK has estimated the value of the IP transit market between Kyrgyzstan and Russian Federation to be USD$10 million, with traffic volume doubling on an annual basis.

International Network Connectivity in Kyrgyzstan

➢ Initial Satellite Connectivity

There is a teleport on Frunze Street in the Kyrgyz capital of Bishkek. Its primary earth station is a 16.5-meter Intelsat A-standard antenna which was installed by Comsat RSI. The antenna links to the Intelsat 902 satellite at 62 E longitude. There are also antennae which connect to the Turksat 42 E longitude satellite and the and the Intersputnik Express 80A satellite. Funding for the development of the Bishkek Teleport was provided in the mid-1990s by the World Bank and the European Bank for Reconstruction and Development, which offered $18 million and $9.4 million, respectively, to finance Kyrgyzstan's "first telecommunications project."

Kyrgyzstan is one of the eight participating countries in the "Silk Project", an initiative led by many European and American organizations (among them NATO). Its intent is to increase the exchange of information among academic and educational institutions in member nations. The other countries are Armenia, Azerbaijan, Georgia, Kazakhstan, Tajikistan, Turkmenistan and Uzbekistan. Each country has its own VSAT station communicating with a Eurasiasat satellite to a center in Hamburg Germany. The Kyrgyzstan earth station is in Bishek.

➢ Trans Asia-Europe Line (TAE) (Kazakhstan-Kyrgyzstan)

Trans Asia-Europe Line (TAE)	
Date	The first two Kyrgyz segments, consisting of a ring extending southward from Kazakhstan, were completed in 2000. In 2007 an additional redundant segment was constructed.
Length	190 kilometers in Kyrgyzstan
International Connectivity	- The TAE network in Kyrgyzstan initially consisted of a ring extending southward from Kazakhstan; the western segment crosses the border at Chaldybar, Kyrgyzstan and the northern segment crosses the border at Kamysahnovka, Kyrgyzstan. In 2007 a third segment was constructed to the border crossing at Korday, Kazakhstan.
Main Nodes	Bishkek-Solkuluk-Belovodskoye-Kara Balta-Kainda-Chaldovar
Capacity	Initial capacity of STM-4 (622 Mbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Kyrgyz segments owned by Kyrgyztelecom; TAE developed by a consortium of operators in 20 countries. - Supplied by ECI Telecom (Israel) and HT Cable (Israel)
Continuity with Rail/Highway	- Kazakhstan-Kyrgyzstan route follows the M39 highway (western segment) - Kazakhstan-Kyrgyzstan route follows the A2 highway (northern segment)
Notes	- Cost of fiber optic cable (excluding equipment) was $1.8 million

In late-2010 Kyrgyztelecom reported that it had increased its international Internet gateway capacity via Kazakhtelecom to 1.2 Gbps; this accounted for almost all of the country's reported international Internet bandwidth for that year.

- Kyrgyzstan-Tajikistan

Kyrgyzstan-Tajikistan	
Date	2009
Length	25 km
International Connectivity	- Batken, Kyrgyzstan to Isfara, Tajkistan
Main Nodes	Isfara, Tajikistan
Capacity	STM-1 (155.52 Mbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Kyrgyztelecom - Tajiktelecom
Continuity with Rail/Highway	- Non-numbered highway
Notes	- In November of 2010 Kyrgyztelecom announced that it was providing IP transit service to the Tajikistani operators Babilon-T and Telecom Technology.

- China-Kyrgyzstan and Kyrgyzstan-Tajikistan (Elcat)

China-Kyrgyzstan and Kyrgyzstan-Tajkistan (Elcat)	
Date	February, 2013
Length	220 kilometers
International Connectivity	- Nura, China to Karamyk, Kyrgyzstan via the Irkeshtam border crossing
Main Nodes	Karamyk
Capacity	Initial capacity of 2.5 Gbps, upgradeable to 40 Gbps
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Elcat
Continuity with Rail/Highway	- Follows the A371 and S309 highways
Notes	The deputy minister of transport and communications of Kyrgyzstan, Nurlan Bayaman, asserted in March of 2013 that the cost of the EIcat cable was only USD$1.6 million, compared to the USD$17 million cost of Kyrgyztelecom's cable along nearly the same route.

- Kazakhstan-Kyrgyzstan (Elcat)

Kazakhstan-Kyrgyzstan (Elcat)	
Date	September, 2013
Length	120 kilometers
International Connectivity	- Bishkek, Kyrgyzstan to Chaldovar, Kazakhstan
Main Nodes	Bishkek, Kara Balta
Capacity	Initial capacity of 2.5 Gbps, upgradeable to 40 Gbps
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Elcat
Continuity with Rail/Highway	- Follows the M39 (Kazakhstan) and M29 (Krygyz Republic) highways

- Kyrgyzstan-Uzbekistan

Kyrgyzstan-Uzbekistan	
Date	2009
Length	70 km
International Connectivity	- Osh, Kyrgyzstan to Andijan, Uzbekistan via Dostyk border crossing
Main Nodes	Andijan
Capacity	
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Uzbektelecom - Kyrgyztelecom
Continuity with Rail/Highway	- Follows A73 highway (Osh-Tashkent Rd.)

➢ China-Kyrgyzstan (Kyrgyztelecom)

China-Kyrgyzstan (Kyrgyztelecom)	
Date	The project was announced in 2009 but in 2013 China Telecom reportedly refused to interconnect with the network until quality concerns were resolved.
Length	240 kilometers
International Connectivity	- Kashgar, China to Osh, Kyrgyzstan via the Irkeshtam border crossing
Main Nodes	Osh
Capacity	Initial capacity of 2.5 Gbps, upgradeable to 40 Gbps
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Kyrgyztelecom
Continuity with Rail/Highway	- Follows the A371 and S309 highways
Notes	The project cost USD$17 million; when the project was announced, Deputy Minister of Transport and Communications Taalaibek Eshaliev stressed that it would likely result in cheaper access to Internet bandwidth by reducing the reliance on transit paths through Kazakhstan and Uzbekistan and offering access to Hong Kong. However, China Telecom reportedly refused to interconnect with the network due to technical and quality-of-service concerns.

➢ Proposed International Connectivity

ShCo High-Speed Information Backbone

Kyrgyztelecom has proposed the implementation of a pan-regional fiber backbone connecting China, Kazakhstan, Kyrgyzstan, Russian Federation, Tajikistan, and Uzbekistan. The network would comprise three SDH rings using existing infrastructure as well as new construction, spanning 15,670 kilometers and offering an initial capacity of 5 Gbps, upgradeable to 400 Gbps.

IV. COUNTRY ANALYSIS: RUSSIAN FEDERATION

	YE 2012
Population	143,500,000
Population Growth Rate	*0.0%*
Gross Domestic Product (PPP)	USD$3 trillion / $20,900 per capita
GDP Growth Rate	*3.4% in 2012, 1.5% forecasted in 2013*
Human Development Index	0.788
HDI Ranking	*55th out of 187 ("High")*
Literacy Rate	>99%
Fixed Line Subscribers	43,900,000
Fixed Line Operators	1. Rostelecom (Svyazinvest/Gov't. of Russian Federation) 2. MTS (Sistema) 3. VimpelCom (Alfa Group 9/20 stake) 4. MegaFon (Telecominvest/TeliaSonera/Alfa Group) 5. TTK (OJSC Russian Railways) 6. Orange (France Telecom)
Mobile Subscribers	261,900,000
Mobile Operators	1. MTS (Sistema) 2. MegaFon (Telecominvest/TeliaSonera/Alfa Group) 3. VimpelCom (Alfa Group 9/20 stake) 4. Tele2 (VTB Group) 5. Rostelecom (Svayzinvest/Gov't. of Russian Federation)
Mobile Broadband	3G launched in 2007; 4G LTE launched in 2011
Regulatory Agency	Ministry of Communications and Mass Media (Minkomsvyaz)
International Internet Bandwidth	2.5 Tbps
Int'l. Internet Bandwidth per Capita	*17.4 Kbps*
Internet Service Providers	1. Rostelecom (Svyazinvest/Gov't. of Russian Federation) 2. MTS (Sistema) 3. VimpelCom (Alfa Group 9/20 stake) 4. ER-Telecom (Perm Financial and Industrial Group) 5. Akado (Akado Group) 6. TKK (OSJC Russian Railways)
Fixed Broadband Subscribers	20 million fixed broadband subscribers (>256 Kbps) 75 million mobile broadband subscribers (est.)
Fixed Broadband Technologies	ADSL, FTTH/GPON/ETTH, Cable Modem, Fixed Wireless
Typical Monthly Broadband Subscription	1. USD$9 per month for unlimited 10 Mbps ADSL *(MTS)*

Telecommunications Market Overview

The Russian Federation telecommunications services market is estimated to be worth between $40 billion and $50 billion annually.

The fixed-line market had been historically dominated by state-owned holding company Svyazinvest, which controlled seven fixed-line regional telecom operators (RTOs) that were merged into Svyazinvest's

long-distance subsidiary, Rostelecom, in 2011. In mid-2011, Rostelecom indicated that it would seek to increase its fixed-broadband market share from 41 percent to greater than 50 percent in order to offset losses in its fixed-line telephony business. Later in 2011, Svyazinvest proposed that it be fully absorbed by Rostelecom, although the proposal was complicated by cross-shareholding between the two companies.

The mobile sector is dominated by MTS, MegaFon, and VimpelCom, which together with Rostelecom form the Russian Federation telecommunications industry's "Big Four" operators.

The Russian Federation telecommunications sector is robust, with relatively healthy levels of competition. Most of the country's international demand is generated in its western population centers and directed via European outlets. Although the industry is dominated by four operators, as many as a dozen investors have significant, sustainable operations.

Regulation and Government Intervention

The Russian Federation telecommunications sector is regulated by the Ministry of Communications and Mass Media, also known as Minkomsvyaz. The Ministry has set broadband penetration goals of between 60 and 80 percent of households by 2015 and between 90 and 95 percent of households by 2020.

Russian Federation government plans to increase broadband deployment are ambitious but depend largely on the will of private operators, most of which have indicated that targets of 70 percent penetration using a combination of fixed and wireless technologies are achievable.

Fixed Line Telephony Market

Russian Federation's fixed-line market leader is Svyazinvest-controlled (state-controlled) Rostelecom, which absorbed Svyazinvest's seven regional telecommunications operating companies in 2011. Other operators present in the fixed-line market include the country's three largest mobile operators, Vimpelcom, MTS, and Megafon, as well as long-distance fiber optic backbone operator TransTeleKom (TTK).

Although Rostelecom is the country's dominant fixed-line operator overall, MTS subsidiary MGTS (Moscow City Telephone Network) has a 90 percent share of the Moscow fixed-line market.

Mobile Telephony Market

MTS, Megafon, and Vimpelcom dominate Russian Federation's mobile market. As of year-end 2012, MTS was the market leader with a 31 percent market share. MegaFon was in second place, with 27 percent; and VimpelCom had a 25 percent stake. Government-owned bank VTB acquired the Russian Federation operations of Tele2 in 2013, from the Swedish operator of the same name; Tele2 is the country's fourth-largest mobile operator and as of late-2013 the company was being pursued by Rostelecom, which hoped to form a joint venture.

Russian Federation has rapidly become a leader in the deployment of 4G LTE networks, with strong competition among mobile operators and expected investment of €10 billion by 2019. MegaFon indicated that it expected as many as one million LTE subscribers by year-end 2013.

Internet and Broadband Market

Fixed-line broadband penetration was greater than one-third of households as of year-end 2012. The leading technology was ADSL, which accounted for the majority of broadband customers at each of the seven regional telecommunications operators that were merged into Rostelecom in 2011. FTTH deployment has increased significantly, especially in western population centers. The country's long-term broadband strategy was expected to be a combination of fiber and 4G+ wireless technologies.

Rostelecom's share of the broadband market was estimated to be 40 percent as of year-end 2012; MTS, VimpelCom, and ER-Telecom were each estimated to have shares of between 10 and 12 percent.

Domestic Network Connectivity in Russian Federation

National backbone fiber optic networks are operated by Rostelecom, MTS, MegaFon, VimpelCom and TTK (formerly TransTeleKom). The combined length of the operators' fiber optic networks was more than 750,000 kilometers as of year-end 2012: Rostelecom had reportedly installed more than 500,000 inter-city kilometers, MTS had installed 117,000 kilometers, TTK had installed 75,000 kilometers, MegaFon had installed 65,000 kilometers, and VimpelCom had installed 33,516 kilometers.

International Internet Bandwidth and Capacity Pricing in Russian Federation

Figure 4: International Internet Bandwidth and Capacity Pricing in Russian Federation, 2012

International Internet Bandwidth	International Internet bandwidth per Capita	International Capacity Pricing
2.5 Tbps	17.4 Kbps	Moscow-London 10 Gbps wavelength: $18,000 ($1.80 per Mbps) per month as 2012. IP Transit: $4 per Mbps in GigE volume as of 2012.

Source: Terabit Consulting research, Operator data and interviews

The Russian Federation market for international transit capacity is estimated to be worth more than USD$150 million annually. Rostelecom is the leader in the transit capacity market, with a share of approximately 60 percent, followed by VimpelCom with 30 percent and TTK with 10 percent.

In 2013 the country's largest mobile operator MTS announced that it would be marketing Europe-to-Asia transit capacity via its new link between Blagoveshchensk, Russian Federation and Heihe, China; the company said that it would target a 20 percent share of the Europe-to-Asia transit market. The second-largest mobile operator, MegaFon, also entered the transit market later that year when it activated its Diverse Route for European and Asian Markets (DREAM) between Germany and Kazakhstan's border with China.

International Network Connectivity in Russian Federation

Terabit Consulting's analysis of terrestrial networks in the Russian Federation includes only those networks which link to other the other countries in this study; two of the study's countries share borders with Russian Federation, i.e. Azerbaijan and Kazakhstan.

➢ Azerbaijan-Russian Federation (Rostelecom)

Azerbaijan-Russian Federation (Rostelecom)	
Date	2003
Length	400 km
International Connectivity	- Azerbaijan to Russian Federation via the border crossing at Samur, Azerbaijan
Main Nodes	Derbent, Russian Federation
Capacity	Initial capacity of STM-1 (155.52 Mbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Azertelecom/Delta Telecom - Rostelecom - Fiber supplied by Alcatel
Continuity with Rail/Highway	- Follows the E119 highway
Notes	- Rostelecom's investment in the network, which stretches 200 kilometers on the Russian Federation side between Makhachkala and Derbent, was RUB 137 million (USD$4.5 million).

➢ Azerbaijan-Russian Federation (Synterra (MegaFon))

Azerbaijan-Russian Federation (Synterra (MegaFon)	
Date	2010/2011
Length	100 km
International Connectivity	- Derbent, Russian Federation to Quba, Azerbaijan via the border crossing at Samur, Azerbaijan
Main Nodes	Derbent, Russian Federation
Capacity	STM-64 (10 Gbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Azertelecom/Delta Telecom - Synterra (acquired by MegaFon in 2010)
Continuity with Rail/Highway	- Follows the E119 highway

Azertelecom and Russian Federation operator Synterra signed an agreement in May of 2009 for the construction of a 10 Gbps link between Derbent, Russian Federation and Guba, Azerbaijan within the framework of a $17 million joint venture between the two companies, known as C-Ring Telecom, aimed at targeting neighboring telecommunications markets in the Caspian region. In 2009 the Iran Mobin consortium also entered into a 50/50 joint venture with C-Ring to expand connectivity southward toward Islamic Republic of Iran. In July of 2010, the Russian regulator Roskomnadzor granted a license to Sunterra for the operation of the trans-border fiber optic link, and as of 2011 sources in Azerbaijan indicated that the Azerbaijani segments of the network had been completed and that C-Ring was awaiting completion of Russian fiber segments. However, the future of the C-Ring consortium was called into doubt following the purchase of Synterra by Russian Federation telecommunications conglomerate MegaFon in 2010, which reportedly reevaluated the role of C-Ring in its international network development strategy.

➢ Azerbaijan-Russian Federation (TransTeleKom (TTK))

Azerbaijan-Russian Federation (TransTeleKom)	
Date	2007/2008 (est.)
Length	20 km
International Connectivity	- Russian Federation to Azerbaijan via Yalama, Azerbaijan
Main Nodes	Derbent, Russian Federation
Capacity	Initial capacity of STM-64 (10 Gbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Azertelecom/Delta Telecom - TTK
Continuity with Rail/Highway	- Follows Azerbaijan-Russian Federation rail line

Russian Federation's TransTeleKom (TTK) has provisioned trans-border IP bandwidth between Yalama, Azerbaijan and Samur, Russian Federation to Delta Telecom since at least 2008. TransTeleKom specified that it provided 2.5 Gbps of IP bandwidth to Delta Telecom as of late-2009; shortly thereafter, the operators' trans-border network was upgraded to 10 Gbps.

➢ Europe-Persia Express Gateway (EPEG)

Europe-Persia Express Gateway (EPEG)	
Date	2013 (MOU signed in 2011 and testing carried out in 2012)
Length	Entire network spans 10,000 km
International Connectivity	- The entire network connects Frankfurt, Germany to Oman; Russian Federation's connectivity stretches from its border with Ukraine to its border with Azerbaijan.
Main Nodes	Belgorod
Capacity	Advertised capacity of 500 Gbps for the entire network (design capacity of 3.2 Tbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- The Russian Federation party to the consortium is Rostelecom. The EPEG consortium also consists of Omantel, the Telecommunications Infrastructure Company of Iran, and Vodafone (originally Cable & Wireless Worldwide).
Continuity with Rail/Highway	- The network follows the Azerbaijan-Russian Federation railroad right-of-way at the Russian Federation border crossing.

In March of 2011 a memorandum of understanding was signed by four investors to create the 10,000-kilometer Europe Persia Express Gateway network between Oman and Frankfurt am Main, Germany. A construction and maintenance agreement was signed by the project's four investors in Tehran, Islamic Republic of Iran in June, 2011; testing took place in 2012 and the network was put into service in 2013.

The four signatories to the March, 2011 memorandum of understanding for the Europe Persia Express Gateway were Cable & Wireless Worldwide, Rostelecom, the Telecommunications Infrastructure

Company of Iran (TIC), and Omantel. Each of the four operators was assigned responsibility for overseeing the activation of different segments of the network.

Cable & Wireless Worldwide was made responsible for the European segments connecting Frankfurt am Main, Germany; Berlin, Germany; Warsaw, Poland; Lviv, Ukraine; and Kiev, Ukraine; to the Ukraine-Russian Federation border.

Rostelecom assumed responsibility for the segments from the Ukraine-Russian Federation border, to Rostov-on-Don, Russian Federation; along the western shore of the Caspian Sea to the Russian Federation-Azerbaijan border; and through Azerbaijan via Baku to the Azerbaijan-Islamic Republic of Iran border. Delta Telecom of Azerbaijan described itself as a "transit operator" for the project, working in partnership with Rostelecom.

The Telecommunications Infrastructure Company of Iran was given responsibility for the segments within Islamic Republic of Iran from the Azerbaijan-Iran border to the Gulf of Oman. TIC is a sister company of the Telecommunications Company of Iran created in 2005 to manage the country's international bandwidth infrastructure; it is responsible for the country's undersea connectivity via the Gulf Bridge International, Falcon, and Iran-Kuwait systems (in 2010 Rostelecom and TIC reportedly signed an agreement for the provision of two STM-4s of international Internet bandwidth via Rostelecom's node in Stockholm, Sweden).

Omantel was assigned responsibility for the undersea segment of the network between Islamic Republic of Iran to Oman, as well as interconnection to the Europe-India Gateway cable in Al Madina A'Zarqa (Blue City), Oman.

Reports placed the cost of the entire network at as high as $200 million, although some analysts disputed this figure, given that much of the network takes advantage of existing infrastructure.

The impetus for the Europe Persia Express Gateway project was the delay in activating the trans-Egyptian segments of the Europe-India Gateway (EIG) undersea cable project. EIG, which was supposed to have entered service in mid-2010, had still yet to completed as of early-2011 because of Telecom Egypt's "considerable difficulties in obtaining the governmental permits necessary" for the implementation of the network's two terrestrial routes between the Red Sea and the Mediterranean, according to the EIG consortium. A decree from the Egyptian government issued after the manufacture of the cable changed the authorized landing points from the initial route plan, which called for cable stations in Alexandria and Ras Sidr (Ras Sudr), 40 kilometers south of Suez. The new landing point in Zafarana (100 kilometers south of Suez) shortened the cable route by 57 kilometers, requiring reconfiguration onboard the cable ship, and while awaiting new authorization from the Egyptian government, cable due to be installed off the north coast of Egypt (originally Alexandria and subsequently Sidi Kerir, Abu Talat) was temporarily stored in Malta.

Some sources attributed the problems with the Egyptian landing point to data security issues. Seacom and I-Me-We were also reportedly affected by these requirements. Although EIG activated 11 of its 13 cable stations in early-2011, from the United Kingdom to southern France and from the west coast of Saudi Arabia to India, EIG representatives told Terabit Consulting that the activation of the terrestrial links across Egypt would be indefinite not only because of the continued permitting issues but also because of the Arab uprising.

In order to ensure connectivity to Europe and link EIG's disconnected undersea segments, consortium members Cable & Wireless Worldwide and Omantel reportedly pressed forward with plans to construct the

Europe Persia Gateway Express. Notably, the two American operators participating in the Europe-India Gateway project, AT&T and Verizon, were prohibited from direct investment in the EPEG project because of economic sanctions against the Islamic Republic of Iran.

Similar sanctions apply to Sudan and Syria; consequently, operators seeking alternatives to (or diversity for) fiber optic connectivity through Egypt face significant geographic restrictions with respect to direct investment. Specifically, American operators wishing to directly invest in projects bypassing Egypt are limited to two relatively narrow passages across the 4,700-kilometer expanse between western Sudan and the eastern part of the Islamic Republic of Iran: a 200-kilometer-wide corridor in the Kurdish-inhabited area along the Iraq-Turkey border, and a 400-kilometer-wide corridor through Jordan which would require an undersea connection via Lebanon, Israel, or the Gaza Strip.

- Kazakhstan-Russian Federation (northern Kazakhstan)

Kazakhstan-Russian Federation (northern Kazakhstan)	
Date	1999
Length	340 kilometers
International Connectivity	- Petropavlovsk, Kazakshstan to Kormilovka, Russian Federation via Omsk, Kazakhstan
Main Nodes	Kormilovka
Capacity	Initial capacity of STM-4 (622 Mbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Kazakhtelecom - Interconnection with Rostelecom and TTK
Continuity with Rail/Highway	- Follows M51 (E30) highway

Petropavlovsk serves as the interconnection point between Kazakhtelecom's network and the Russian Federation networks of Rostelecom and TTK.

- Kazakhstan-Russian Federation (northwestern Kazakhstan)

Kazakhstan-Russian Federation (northwestern Kazakhstan)	
Date	2001
Length	340 kilometers
International Connectivity	- Atyrau, Kazakhstan to Volograd, Russian Federation via Saykhin, Kazakhstan
Main Nodes	Volograd
Capacity	Initial capacity of STM-4 (622 Mbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Kazakhtelecom - Interconnects with networks of Rostelecom, VimpelCom, and MegaFon (originally Synterra) - Rostelecom link supplied by Siemens
Continuity with Rail/Highway	- Via the main road between Atyrau and Volzhsky, Russian Federation (north of Volgograd).

In late-2013 MegaFon announced that in partnership with Kazakhtelecom, it had activated its Diverse Route for European and Asian Markets (DREAM) network between Germany and Kazakhstan's border with China, using primarily existing infrastructure.

- Kazakhstan-Russian Federation (western Kazakhstan)

Kazakhstan-Russian Federation (western Kazakhstan)	
Date	2006 (est.)
Length	200 kilometers
International Connectivity	- Atyrau, Kazakhstan to Astrakhan, Russian Federation via Ganyushkino, Kazakhstan
Main Nodes	Astrakhan
Capacity	Initial capacity of STM-4 (622 Mbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Kazakhtelecom - Rostelecom
Continuity with Rail/Highway	- Via the A27 highway (Kazakhstan) and the A340 highway (Russian Federation)

- International Submarine Cables Serving Russian Federation

Submarine Cable Name	RFS Date	Status	Route Km	Financing Type	Owner(s)	Cost	Supplier(s)
Denmark-Russia-1	1993	Active	1,260	Consortium	International Carrier Consortium	$126.0	STC (Alcatel-Lucent)
Italy-Turkey-Ukraine-Russia (ITUR)	1996	Active	3,539	Consortium	International Carrier Consortium	$150.0	Alcatel (Alcatel-Lucent) / Pirelli (Alcatel-Lucent) / AT&T-SSI (Tyco Telecommunications)
Georgia-Russia (Including Sochi-Poti and Novorossiysk-Sochi)	2000	Active	433	Consortium	Foptnet (Georgia) / Rostelecom (Russian Federation) / GN Great Northern Telegraph (Denmark)	$25.0	Alcatel (Alcatel-Lucent)
Black Sea Fibre Optic Cable System (BSFOCS)	2001	Active	1,199	Consortium	International Carrier Consortium	$51.0	Alcatel (Alcatel-Lucent) / TyCom (Tyco Telecommunications)
Baltic Cable System North Phase II (Finland-Russia)	2002	Active	280	Consortium	International Carrier Consortium	$15.0	Ericsson
Hokkaido-Sakhalin Cable System (HSCS)	2008	Active	570	Consortium	NTT / TransTeleKom	$25.0	NEC
Russia-Japan Cable Network (RJCN)	2008	Active	1,800	Carrier-sponsored	Rostelecom / KDDI	$80.0	NEC

Source: *The Undersea Cable Report*, Terabit Consulting

➢ Proposed International Connectivity

Russian Optical Trans Arctic Submarine Cable System (ROTACS)

The 17,000-kilometer ROTACS polar-region submarine cable project has been under serious consideration (in the form of its predecessor Polarnet) since at least 2002, and route surveys were carried out in 2002 and 2003. According to court documents, "essential permits" were "issued by the Russian Federation and Norwegian governments." However, by 2005 most sources indicated that the original plans for the Polarnet project had been effectively cancelled.

But in 2011, with growing geopolitical interest in the Arctic region and the opening of new shipping paths due to climate change, the system's sponsors resurrected the project, which was widely considered to be the first developed proposal to route an intercontinental cable via the Arctic.

The project was approved by the Russian Federation minister for communications and mass media, Igor Shchegolev in October of 2011 (Mr. Shchegolev, whose name is alternatively spelled as Schegolev, was appointed as a top advisor to President Vladimir Putin in May of 2012). Mr. Shchegolev was quoted as saying "Strengthening the northern borders of Russian Federation is a strategically important task. For that, following the decision of the Safety Council, we need to develop an information and communication environment in Arctic," including the installation of ROTACS.

In its original configuration, Polarnet would have connected a number of countries via a cable under the Arctic Ocean ice shelf. Among the proposed landing sites were Alaska, USA (with a possible extension to Oregon, USA); the United Kingdom, Norway, Russian Federation, and Japan. Subsequent route plans called for a branched system connecting England (UK); to Kirkenes, Norway; under the Arctic ice cap to Nome, Alaska (USA); to a branching unit from which a cable would have connected to Oregon (USA), to another branching unit from which one cable would have connected to Japan and another to Vladivostok, Russian Federation. Some early initial reports had erroneously indicated that the system was to have "avoided Russian Federation territorial waters" in a supposed effort to attract Western customers and investors.

As of 2011 the ROTACS system had reportedly been reconfigured so that it could be installed entirely in water without the use of icebreakers, according to competitor Arctic Fibre. As of late-2011, reported landing points included Bude, Cornwall, England (United Kingdom); Murmansk, Russian Federation; Vladivostok, Russian Federation; Anadyr, Russian Federation; and Tokyo, Japan. Terrestrial extensions would offer terrestrial connectivity to the Chinese cities Harbin in Heilongjiang Province and Shanghai.

By 2012 the proposed configuration was as follows: from Bude, Cornwall, England; (UK) to Murmansk, Russian Federation; to Arkhangelsk, Arkhangelsk Oblast, Russian Federation (via a branch); to Yamburg, Yamalo-Nenets Autonomous Okrug, Russian Federation (via a branch); to Norilsk, Krasnoyarsk Krai, Russian Federation (via a branch); to Khatanga River, Krasnoyarsk Krai, Russian Federation (via a branch); to Tiksi Bay, Sakha, Russian Federation (via a branch); to Pevek, Russian Federation; to Anadyr, Russian Federation; to a branching unit from which one cable connects to Vladivostok, Russian Federation and the other cable connects to Tokyo, Japan.

The Russian Federation and Iceland met to discuss bilateral relations between the two countries, including Arctic affairs, geothermal energy, and the construction of a submarine cable between Iceland and the Russian Federation, leading to some speculation that the ROTACS system might include an Icelandic landing point.

In the first incarnation of the project, Moscow- and London-based holding companies Polargrid LLC and Polarnet Project Ltd. were identified as the project's developers. Baltimore, USA-based Bovaro Partners was reported to be involved in arranging financing. According to some initial reports, Cable & Wireless was considering an investment in the project, but it was later determined that they served only as consultants to the project's promoters. As of 2004 Polargrid LLC reported that it was a Delaware (USA)-based limited liability company with principal offices in Washington, DC. In the project's more recent form, Polarnet Project has been identified as the lead developer. Terrestrial segments of the system would be constructed in partnership with Russian Federation government-owned oil pipeline operator Transneft.

As of 2012, Polarnet's deputy CEO was identified as Ruslan Saushkin, who has been with the company since 2000 and was previously executive manager of Russian Federation satellite communications company Orbitel, and also served in the Russian Federation military for 25 years between 1969 and 1994, including as a technical operations manager for special communications in the Arctic. He is also a member of Russian Federation's World Academy of Sciences for Complex Security (WASCS).

The most recent data indicated that the project would cost $1.36 billion for undersea segments and an additional $500 million for terrestrial segments.

According to court documents, as of 2004 the company had spent $30 million on marine surveys during the initial incarnation of the project as Polarnet. The documents also indicated that during the project's original incarnation, Tyco Telecommunications (now TE SubCom) had been awarded an $800 million contract to construct the system. In 2002 a desktop study was completed by EGS and Svitzer, and marine surveys were carried out in 2002 and 2003. St. Petersburg, Russia-based Lenmorniiproekt (an engineering and consulting company that was owned by the Russian Federation government until 1993) said that it conducted a survey between the Bering Strait and the Russian Federation-Norwegian border in 2003 using the vessel Kola which followed behind the atomic-powered icebreaker Sovetskiy Sojuz ("Soviet Union"). According to the Russian Hydrographic Society, the surveys marked "the first time in the history of the world hydrography that hydrographic surveys of the bottom relief and sea ground had been carried out by a surface vessel in solid ice fields of 1.5 to 4 metres thick."

In December 2004, Polargrid LLC filed a complaint against VSNL (now Tata Communications) in United States District Court in New York City. The complaint alleged that Polargrid's business plan was contingent upon access to capactiy on the Tyco Global Network (TGN), and that when the TGN was offered for sale in 2003, Polargrid was "intensely interested in bidding for, and winning, TGN and Polargrid had the ability to succeed in this venture." When VSNL emerged as the leading bidder for TGN, representatives of VSNL and Polargrid met and executed a memorandum of understanding in which Polargrid agreed to withdraw from the bidding process for TGN and "collaborate exclusively with VSNL with respect to its bid for TGN," and to attemtpt to provide "any form of assistance [VSNL] desired" in order to complete the aquisition of TGN. In exchange, VSNL allegedly agreed to invest $35 million in the Polarnet project and to lease capacity on TGN at preferential rates. Polargrid alleged that following its successful acquisition of TGN, VNSL reneged on its commitments.

Polarnet said in 2011 that proposals for the supply of the ROTACS project had been requested from Cable & Wireless, TE SubCom, NEC, Alcatel-Lucent, and Huawei Marine Networks.

Some sources indicated that various military agencies were interested in securing capacity on the network.

Brazil-Russia-India-China-South Africa (BRICS) Cable

In 2011 South African investor Imphandze Subtel Services proposed a 34,000-kilometer submarine cable system connecting Brazil, Russian Federation, India, China, South Africa, Singapore, and the United States. Terabit Consulting was retained to deliver the project's traffic and market study. Findings of the study were positive and the project reportedly gained government support, most notably in South Africa. As of late-2013 the implementation schedule of the project was uncertain.

V. COUNTRY ANALYSIS: TAJIKISTAN

	YE 2012
Population	8,000,000
Population Growth Rate	*2.3%*
Gross Domestic Product (PPP)	USD$18 billion / $2,300 per capita
GDP Growth Rate	*7.5% in 2012, 7.0% forecasted in 2013*
Human Development Index	0.622
HDI Ranking	*125th out of 187 ("Medium")*
Literacy Rate	>99%
Fixed Line Subscribers	400,000
Fixed Line Operators	1. Tajiktelecom (Gov't. of Tajikistan)
Mobile Subscribers	6,500,000
Mobile Operators	1. Babilon-Mobile 2. Tcell (TeliaSonera) 3. Megafon 4. Beeline/Tacom (VimpelCom)
Mobile Broadband	3G launched in 2005; WiMax launched in 2008; LTE launched in 2011
Regulatory Agency	Communications Regulatory Agency
International Internet Bandwidth	2.5 Gbps
Int'l. Internet Bandwidth per Capita	*0.313 Kbps*
Internet Service Providers	1. Babilon-T 2. Tajiktelecom 3. Telecom Technology 4. Intercom 5. Saturn Online 6. Eastera 7. Tarena 8. MKF Networks 9. CompuWorld 10. KomCiTel
Fixed Broadband Subscribers	6,000 fixed broadband subscribers (>256 Kbps) 50,000 mobile broadband subscribers (est.)
Fixed Broadband Technologies	ADSL, WiMax, FTTH
Typical Monthly Broadband Subscription	1. USD$16 + USD$39 installation for 1 Mbps with 3 GB download limit for international content and unlimited domestic content *(Babilon-T)* 2. USD$844 +USD$39 installation for 1 Mbps with no download limit *(Babilon-T)*

Telecommunications Market Overview

The development of Tajikistan's telecommunications network was restrained by the Tajikistan Civil War, which damaged much of the country's telecommunications infrastructure. The telecommunications sector has also been impacted by geological and atmospheric challenges such as the country's challenging terrain (which is 93 percent mountainous), frequent seismological activity, climatic extremes, and excessive precipitation, which together have compromised the reliability of communications infrastructure because of earthquakes, flooding, and mudslides. Political fragmentation following the end of hostilities prevented the implementation of a coherent nationwide telecommunications development framework. However, network investment has been aided by the country's international traffic surplus (whereby incoming international minutes greatly exceeded outgoing minutes, due to emigration) as well as the arrival of international fiber connectivity.

Overall the Tajikistan telecommunications market is relatively competitive, and in 2012 the mobile market grew significantly due to aggressive price reductions.

Following the end of the war in 1997, the government said that it would sell a 49 percent stake in Tajiktelecom to foreign investors, which was to have included the granting of a 20-year license for local, long-distance, and international voice services as well as a 10 year exclusivity agreement for those markets. After several delays, in 2004 the government indicated that the company would be privatized through the sale of a majority stake; privatization was again expected in 2007 but as of 2013 no definitive plans have been issued and the company remains government-owned.

Terabit Consulting estimates that the Tajikistan telecommunications market was valued at USD$800 million in 2012.

Regulation and Government Intervention

Tajikistan's telecommunications sector is regulated by the Communications Regulatory Agency, which was created in 2005. The applicable legislation governing the sector is the country's Telecommunications Law of 2002.

Fixed Line Telephony Market

Tajiktelecom is the country's dominant fixed-line operator, although as many as a dozen operators hold fixed-line licenses. Tajiktelecom's fixed-line network was digitized and upgraded due in part to EUR€14 million in financing provided by the European Bank for Reconstruction and Development in 2001. The company's network was reported to have achieved 90 percent digitalization in 2005; ZTE of China has been the primary supplier for much of the Tajiktelecom network.

Mobile Telephony Market

Four GSM operators are present in Tajikistan: Babilon-Mobile, Tcell (a subsidiary of TeliaSonera), MegaFon, and Beeline/Tacom (a subsidiary of VimpelCom), with market shares of 35 percent, 35 percent, 21 percent, and 9 percent, respectively. In addition, there are five CDMA network operators: TK-Mobile, SkyTel, M. Telko, T-Mobile, and Telecom Technology Ltd, although their collective market share is estimated to be no more than 2 percent. Mobile coverage in Azerbaijan is limited primarily to the

population centers in the country's northwest and southwest; coverage is sparse in the eastern two-thirds of the country.

In 2008 one of the country's two largest mobile operators, Babilon-Mobile, launched a 4G WiMax network supplied by Huawei Technologies of China. In 2012 the company also began offering 4G LTE services.

Average revenue per user (ARPU) is estimated at approximately USD$8 per month.

Internet and Broadband Market

Tajikistan's Internet market is competitive, with at least ten Internet service providers in operation. Fixed broadband deployment has been limited and there are currently only a few thousand subscribers, mostly via ADSL and fiber-to-the-building networks operated by Babilon-T and Tajiktelecom in Dushanbe and Khujand. Most observers believe that most growth in the Internet sector will come in the broadband wireless space, rather than fixed broadband.

Domestic Network Connectivity in Tajikistan

The Tajiktelecom domestic fiber optic network is concentrated primarily in the west of the country, with a backbone connecting Khujand in the north, southward to Dushanbe, Qurgonteppa, and Kulob, with radial fiber networks emanating from each city. An eastern segment connects to Murghab and possibly interconnects with the China Telecom network at the border, although Terabit Consulting has yet to confirm the status of the international link between Tajikistan and China.

International Internet Bandwidth and Capacity Pricing in Tajikistan

Figure 5: International Internet Bandwidth and Capacity Pricing in Tajikistan, 2012

International Internet Bandwidth	International Internet bandwidth per Capita	International Capacity Pricing
2.5 Gbps	0.313 Kbps	IP transit: >$100 per Mbps per month

Source: Terabit Consulting research, Operator data and interviews

Several sources have indicated that Tajikistan is one of the few countries where satellite bandwidth is actually cheaper than international fiber bandwidth; consequently, international bandwidth growth has been significantly restrained.

International Network Connectivity in Tajikistan

➢ Initial Satellite Connectivity

The Dushanbe earth station was opened in 1994, providing 60 international voice channels.

➢ Afghanistan-Tajikistan

Afghanistan-Tajikistan	
Date	2009
Length	5 km
International Connectivity	- Sher Khan Bandar to Panji Poyon, Tajikistan
Main Nodes	Panji Poyon, Tajikistan
Capacity	2.5 Gbps
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Afghan Telecom - Tajiktelecom
Continuity with Rail/Highway	- Follows the E-123 highway across the Panj River, which was opened in August, 2007.
Notes	In August of 2007, at approximately the same time as the opening of the Afghanistan-Tajkistan bridge across the Panj River, Tajiktelecom completed the installation of a 300 kilometer fiber network from Dushanbe to Panji Poyon in anticipation of interconnecting with the Afghan Telecom network.

➢ Kyrgyzstan-Tajikistan

Kyrgyzstan-Tajikistan	
Date	2009
Length	25 km
International Connectivity	- Batken, Kyrgyzstan to Isfara, Tajkistan
Main Nodes	Isfara, Tajikistan
Capacity	STM-1 (155.52 Mbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Kyrgyztelecom - Tajiktelecom
Continuity with Rail/Highway	- Non-numbered highway

- Tajikistan-Uzbekistan

Tajikistan-Uzbekistan	
Date	2009
Length	50 km
International Connectivity	- Tursunzoda, Tajikistan to Denau, Uzbekistan
Main Nodes	Tursunzoda
Capacity	STM-1 (155.52 Mbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Tajiktelecom - Uzbektelecom
Continuity with Rail/Highway	- Follows M41 highway

- China-Tajikistan (Unconfirmed)

China-Tajikistan	
Date	The project was reportedly being implemented as of 2009 but Terabit Consulting was unable to confirm that it was placed into service.
Length	Unconfirmed
International Connectivity	- Vanj, Tajikistan to Kashgar, China
Main Nodes	Unconfirmed
Capacity	Unconfirmed
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- China Telecom - Tajiktelecom
Continuity with Rail/Highway	- Unconfirmed
Notes	In 2008 Tajiktelecom and China Telecom signed an agreement to construct the cable. The same year, a 250-kilometer fiber link was installed between Dushanbe and Darvoz, and in 2009 it was extended through the Rushan Range and the Vanj district.

VI. COUNTRY ANALYSIS: TURKMENISTAN

	YE 2012
Population	5,200,000
Population Growth Rate	*1.3%*
Gross Domestic Product (PPP)	USD$50 billion / $9,600 per capita
GDP Growth Rate	*11.1% in 2012, 10.1% forecasted in 2013*
Human Development Index	0.698
HDI Ranking	*102nd out of 187 ("Medium")*
Literacy Rate	>99%
Fixed Line Subscribers	575,000
Fixed Line Operators	1. Turkmentelecom (Gov't. of Turkmenistan)
Mobile Subscribers	4,500,000
Mobile Operators	1. MTS 2. TM Cell/Altyn Asyr (Gov't. of Turkmenistan)
Mobile Broadband	3G launched in Ashgabat in late-2010; 4G LTE launched in 2013
Regulatory Agency	Ministry of Communications
International Internet Bandwidth	650 Mbps
Int'l. Internet Bandwidth per Capita	*0.125 Kbps*
Internet Service Providers	1. Turkmenistan Online (Turkmentelecom) (Gov't. of Turkmenistan)
Fixed Broadband Subscribers	2,000 fixed broadband subscribers (>256 Kbps) 10,000 mobile broadband subscribers (est.)
Fixed Broadband Technologies	ADSL
Typical Monthly Broadband Subscription	1. USD$31 per month + USD$58 installation for 256 Kbps and 1 GB download limit *(Turkmenistan Online)* 2. USD$77 per month + USD$58 installation for 1 Mbps and 1 GB download limit *(Turkmenistan Online)* 3. USD$210 per month + USD$58 installation for 512 Kbps unlimited download *(Turkmenistan Online)*

Telecommunications Market Overview

Turkmenistan's telecommunications market is considered to be somewhat underdeveloped due to a lack of investment during Soviet rule and subsequent restrictions on competition; the market is currently served by only two entities: state-owned Turkmentelecom and its subsidiaries, and the Russian Federation operator MTS.

In December of 2010, MTS' license was revoked, leaving the country with a single telecommunications operator; Turkmentelecom's mobile subsidiary Altyn Asyr was reportedly overwhelmed by the demand from several hundred thousand customers who had formerly subscribed to MTS services (at the time of its shutdown, MTS had 2.4 million subscribers). In mid-2012 MTS was able to negotiate the terms of a new license and restarted its operations.

In 2013, some sources reported that the Turkmenistan government was considering the company's privatization and that the government was immediately transforming the company's mobile subsidiary, Altyn Asyr, into a joint stock company in preparation for its eventual sale.

Estimates of the size of Turkmenistan's telecommunications markets are complicated by the lack of revenue figures from Turkmentelecom and its subsidiaries. Terabit Consulting estimates that Turkmenistan's total telecommunications market is likely valued at approximately USD$300 million.

Regulation and Government Intervention

The Turkmenistan telecommunications market is regulated by the Ministry of Communications; the governing legislation includes the Telecommunications Law of 2000. The ministry has authority over the issuance of more than 30 different telecommunications licenses. The relevant legislation does not grant exclusivity or limit the number of operators.

Fixed Line Telephony Market

Government-owned operator Turkmentelecom has a monopoly over the country's fixed-line market.

Mobile Telephony Market

The mobile operator BCTI, which was Turkmenistan's only mobile operator from the time of its founding in the mid-1990s until 2005, was founded by Georgian-American Michael Barash; it was purchased by Russian Federation operator Mobile TeleSystems (MTS) in 2005. In December of 2010 the Turkmenistan Ministry of Communications suspended MTS' operating license for reasons "that were never fully justified," according to MTS. Government-owned operators Turkmentelecom and Altyn Asyr simultaneously terminated their interconnection agreements with the operator; MTS filed suit against the government, claiming USD$585 in damages.

In July of 2012 the company finally resumed service after signing a five-year agreement with the government, including payment to Turkmentelecom of 30 percent of net profits. MTS said that after recommencing service, it had 615,000 subscribers and that as of year-end 2012 its subscribership had grown to 1.44 million, for a market share of one-third. It also said that it would invest $40 million in the development of its network between 2012 and 2015.

In its last full year of operations prior to its shutdown, MTS Turkmenistan reported approximately USD$190 in revenue, although in the fourth quarter of 2012 it reported revenue of only USD$9.5 million as it restarted operations. Average revenue per user (ARPU) rose from USD$2.80 in the fourth quarter of 2012 to $3.40 in the first quarter of 2013.

Altyn Asyr, which provides mobile service under the TM Cell brand name, was founded as a subsidiary of Turkmentelecom in 2004 and began operations the following year. The company launched a 3G network in Ashgabat in 2010 and its 4G LTE network was launched in September of 2013.

Internet and Broadband Market

The Internet was introduced to Turkmenistan in 1997 with international circuits provided via American operator MCI Communications; a handful of private Internet service providers entered the market but in June of 2000 all of their licenses were revoked by the government on the grounds that all ISPs with the exception of Turkmentelecom had filed misleading and erroneous regulatory data. The largest private ISP, Ariana, which had approximately 350 customers at the time, provided free service to its customers while it appealed the government's actions but was finally forced to close in 2001, leaving Turkmentelecom as the sole provider of Internet access. For most of the 2000s, access to the Internet was restricted.

In 2008 the Turkmenistan government said that it would allow private citizens to access the Internet, but prices for a 45-Kbps home Internet service from Turkmentelecom's subsidiary Turkmenistan Online were considered to be expensive at USD$5 per month plus $4 per hour and $40 installation. Although Turkmentelecom reported a backlog of 2,000 customers seeking fixed Internet access, the operator said that due to technical and personnel limitations, it was able to connect only 20 customers per day. The same year, the country's first alternative means of access became available when mobile operator MTS began offering GPRS/EDGE mobile Internet access.

In 2011 the international press reported that Turkmenistan had the highest Internet tariffs in the world, at USD$6,821 per month for unlimited Internet at speeds of 2 Mbps. The cheapest Internet package was reported to cost USD$43 per month, but download volumes were limited to 2 gigabytes per month.

Domestic Network Connectivity in Turkmenistan

The initial Trans Asia-Europe (TAE) Line trunk network from the Iranian border to the Uzbek border formed the foundation of Turkmentelecom's domestic fiber optic connectivity; additional deployment was constructed westward toward the Caspian Sea region. The first TAE segments were 700 kilometers in length and connected Ashgabat, Mary, and Turkmenabat; additional TAE deployment comprised a 600 kilometer link that connected Ashgabat to Turkmenbashi.

International Internet Bandwidth and Capacity Pricing in Turkmenistan

Figure 6: International Internet Bandwidth and Capacity Pricing in Turkmenistan, 2012

International Internet Bandwidth	International Internet bandwidth per Capita	International Capacity Pricing

650 Mbps	0.125 Kbps	IP transit: >$100 per Mbps per month

Source: Terabit Consulting research, Operator data and interviews

International Network Connectivity in Turkmenistan

➢ Satellite Connectivity

In 1992 an Intelsat earth station was constructed in Ashgabat, providing 2,500 international circuits. The government of Turkey covered the cost of the earth station and its installation as a gift to the government of Turkmenistan.

Turkmenistan is one of the eight participating countries in the "Silk Project", an initiative led the North Atlantic Treaty Organization and financed in part by the suppliers Cisco and Deutsches Elektronen-Synchrotron (DESY). Its intent is to foster the academic and research communities in member nations using very small aperture terminal (VSAT) satellite connections. The other countries involved in the project are Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan. Each country has its own VSAT station communicating with a Eurasiasat satellite to a hub hosted by the Deutsches Elektronen-Synchrotron (DESY) research center in Hamburg, Germany. Turkmenistan's VSAT station is in Ashgabat.

The Turkmen National Space Agency intends to launch its first satellite in 2014. It will be manufactured by Thales Alenia Space and use Ku transponders to provide coverage over Central Asia.

➢ Trans Asia-Europe Line (TAE) (including Islamic Republic of Iran-Turkmenistan and Turkmenistan-Uzbekistan)

Trans Asia-Europe Line (TAE)	
Date	1998
Length	708 kilometers in Turkmenistan
International Connectivity	- Bajgiran, Islamic Republic of Iran to Ashgabat, Turkmenistan via the border crossing at Gaudin, Turkmenistan - Turkmenabat, Turkmenistan to Bukhara, Uzbekistan via the border crossing at Farab, Turkmenistan and Alat, Uzbekistan
Main Nodes	Ashgabat, Mary, Turkmenabat, Turkmenbashi
Capacity	Initial capacity of STM-4 (622 Mbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Turkmenistan segments owned and operated by Turkmentelecom; TAE developed by consortium of operators in 20 countries.
Continuity with Rail/Highway	- Islamic Republic of Iran-Turkmenistan route follows the Gaudin Highway. - Turkmenistan-Uzbekistan route follows the M37 highway.

The 27,000-kilometer Trans-Asia Europe line was activated in October of 1998 at a cost of $560 million. It connects Frankfurt, Germany to Shanghai, China. Countries involved in the project include China, Kazakhstan, Kyrgyzstan, Uzbekistan, Tajikistan, Turkmenistan, Islamic Republic of Iran, Turkey, Ukraine,

Belarus, Poland, Romania, Hungary, Austria, Germany, Georgia, Azerbaijan, Armenia, Pakistan, and Afghanistan. The TAE has an initial capacity of STM-4 (622 Mbps), which is upgradeable to STM-16 (2.488 Gbps). In Turkmenistan the system runs from the Iranian border city of Bajgiran to the Turkmen capital of Ashgabat, a distance of approximately 50 kilometers. The network then continues to Mary, approximately 300 kilometers east of Ashgabat, to Turkmenabat on the border with Uzbekistan. The total length of the Trans-Asia Europe Line's segments in Turkmenistan is 708 kilometers. Approximately 93 percent of the network was buried, with the exception of 7 kilometers of aerial cabling and 40 kilometers of steel-coated cable which was surface-laid through mountainous terrain.

Siemens was responsible for the installation of the network within Turkmenistan; the value of its supply contract was $21.7 million. Financing was provided by the government of the Islamic Republic of Iran. The cable and equipment for the Turkmenistani portions of the network were manufactured in Islamic Republic of Iran by Iran Telecommunications Industries, Iran Telephone Planning and Development Company, and Shahid Ghandi Communication Cable Company.

Several extensions of the network within Turkmenistan have been completed, with financing provided by the Islamic Development Bank. One link connects Ashgabat to Abadan and Baherdin. Another extension, connecting Ashgabat to Balkanabad to Turkmenbashi (a distance of 708 kilometers) was completed in February of 2004 in anticipation of the construction of the undersea Trans Caspian Link.

It is unclear whether Turkmentelecom is formally a member of the TAE consortium; documentation refers to Turkmentelecom as having "observer" status within the group.

Turkmentelecom signed an interconnection agreement with the Russian Federation operator Rostelecom in September of 2010.

- Kazakhstan-Turkmenistan

Kazakhstan-Turkmenistan	
Date	2013
Length	Kazakhtelecom reported that it installed 179 new kilometers of fiber cable on the Kazakhstan side of the network.
International Connectivity	- Temirbaba, Kazakhstan to Bekdash, Turkmenistan
Main Nodes	Bekdash
Capacity	
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Turkmentelecom - Kazakhtelecom
Continuity with Rail/Highway	- The fiber network was inaugurated simultaneously with the Turkmen-Kazakh section of the Kazakhstan-Turkmenistan-Iran transnational railway, which provided the network with its right-of-way. - There is also a parallel Zhanaozen-Turkmenbashi Road which is reportedly in poor condition.

- Afghanistan-Turkmenistan (eastern and western links)

Afghanistan-Turkmenistan (eastern and western links)	
Date	2013
Length	The western link is estimated to be 50 kilometers and the eastern link is approximately 175 kilometers.
International Connectivity	- A western link connects Serhetabat, Mary Province, Turkmenistan and Torghundi, Herat Province, Afghanistan. - An eastern link connects Lebap, Turkmenistan and Aqinah, Afghanistan.
Main Nodes	Serhetabat, Lebap
Capacity	STM-16 (2.5 Gbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Turkmentelecom - Afghan Telecom
Continuity with Rail/Highway	- The western border crossing is served by a roadway (the A77 highway in Afghanistan and the A388 highway in Turkmenistan) as well as a two-kilometer rail link that was constructed by the Soviet Union in the 1960s; the rail link was subsequently abandoned but in 2011 it was renovated by the Government of Turkmenistan at a cost of USD$550,000.
Notes	- Afghan Telecom reported that it will use the Turkmentelecom network to link the fiber network in the northwest of Afghanistan with the fiber network in the rest of the country; the networks are currently isolated from one another while the national ring-road fiber network is under construction.

- Proposed International Connectivity

Turkmenistan-Uzbekistan (Proposed)

Although the Trans Asia-Europe Line already connects Turkmenistan and Uzbekistan, the government of Turkmenistan has proposed an extension of the country's fiber optic network from Ashgabat to Dashhowuz (Dashoguz), on the border with Uzbekistan. From Dahhowuz the network would presumably be linked to the Uzbektelecom network.

Trans Caspian Link

An undersea segment of the Trans Asia-Europe Line across the inland Caspian Sea has been under consideration since the 1990s. In its most recently-proposed form, the proposed Trans Caspian Link would comprise two point-to-point cables linking Azerbaijan with Turkmenistan and Azerbaijan with Kazakhstan. The Azerbaijan-Turkmenistan cable would probably consist of a point-to-point cable connecting Baku, Azerbaijan and Turkmenbasy (Turkmenbashi), Turkmenistan, while the Azerbaijan-Kazakhstan cable would probably be a point-to-point link between Baku and Aktau (Aqtau), Kazakhstan. If both cables are constructed, their estimated total length would be 710 kilometers. The Azerbaijan-Turkmenistan cable would be an estimated 270 kilometers while the Azerbaijan-Kazakhstan cable would be an estimated 440 kilometers.

The Caspian Sea is connected to the Black Sea via the 100-kilometer Volga-Don Shipping Canal and the Volga and Don Rivers, although the Russian Federation government reportedly charges Azerbaijani vessels canal passage fees of $20,000 to $25,000, four times higher than the fees charged to Russian vessels. Because of the lack of cable laying ships in the region, proposals for the deployment of a trans-Caspian link as part of the TAE called for the use of refitted navy ships to deploy the submarine cable. In 2003 the United States Government donated a 27-meter former U.S. Coast Guard cutter to the Azerbaijani Navy, following its donation of two smaller cutters in 2000.

The TASIM project has been promoted by the Azerbaijani Ministry of Communications and Information Technology, although other governments have expressed support for the project and negotiations for the Azerbaijan-Turkmenistan undersea link have reportedly been held with Turkmenistan's Ministry of Communications.

The Azerbaijani Ministry of Communications was reported to have approached the Kazakhstani operator KazTransCom regarding the development of the Azerbaijan-Kazakhstan link. KazTransCom was formed in 2001 through the merger of three joint stock companies: CaspiMunayBailanys, Aktjubneftesviaz, and Bailanys. As a result of the merger, 50 percent of KazTransCom shares were owned by OJSC Rodnik (believed to be a holding company) and 49.9 percent were held by the Kazakhstani government-owned energy company KazMunayGas (KMG). As of 2011 KazMunayGas was no longer listed as a KazTransCom shareholder while Rodnik had increased its ownership to 76.22 percent (Telecom Azia was identified as the largest minority shareholder with 9.45 percent). Given that no public information regarding the ownership of Rodnik is available, some sources have claimed that KazTransCom is actually controlled by KazMunayGas.

KazTransCom had been identified as a member of the consortium promoting the Trans Caspian-Black Sea (TCBS) project, which would also include an undersea link between Azerbaijan and Kazakhstan. None of the announcements regarding the TASIM trans-Caspian undersea links had made reference to the TCBS project, which was actively promoted between 2007 and 2009 but reported little progress thereafter.

The Azerbaijani Ministry of Communications had initially awarded a contract for the construction of a submarine cable in the Caspian to Siemens in 1998. The following year, the Ministry of Communications apparently cancelled the Siemens contract and awarded a new $27.5 million contract to the Turkish company Hesfibel for the construction of terrestrial segments of the Trans-Asia Europe Line within Azerbaijan as well as the so-called Trans Caspian Link.

Upon awarding the contract, then-Azerbaijani communications minister Nadir Ahmadov announced that the Trans Asia Europe line was to be routed from Azerbaijan's border with Georgia, through the Azerbaijani cities of Baku and Siyazan, and southward to the border with Islamic Republic of Iran; however, according to Mr. Ahmadov, plans for the routing of the Trans Caspian Link were not clear. Plans called for the eastern landing point of the system to be located in either Turkmenistan or Kazakhstan.

In August of 2000 it was revealed that the contractor Hesfibel was leasing ships from the Azerbaijani Ministry of Defense to prepare for the laying of a 300-kilometer cable segment across the Caspian.

Although the Azerbaijani terrestrial portions of the Trans Asia Europe Line were successfully completed in 2001 connecting Azerbaijan via Georgia and Islamic Republic of Iran, plans for the Trans Caspian Link languished for the next four years. However, in June of 2004 the current Azerbaijani Minister of Communications and Information Technology, Ali Abbasov, said that "the construction of the underwater segment of the fiber optic cable as part of the Trans Asia Europe project is a priority for Azerbaijan." Mr. Abbasov revealed that the most promising negotiations for the cable's construction were underway with the

Kazakhtelecom, and that "negotiations with Turkmenistan were called off back in 2000." The United States Embassy in Ashgabat, Turkmenistan underscored this by issuing a report saying that because of "continuing tensions between the GOTX [Government of Turkmenistan] and the GOAJ [Government of Azerbaijan]," an undersea link between the two countries was unlikely to be constructed in the near-future.

In October of 2004 the working group of the Trans-Asia Europe Economic Cooperation Organization, consisting of representatives from Central Asian republics as well as Turkey, Pakistan, and Islamic Republic of Iran met in Baku, Azerbaijan to discuss the Trans-Asia Europe fiber optic line. Azerbaijani government sources told reporters that it was expected that a deal would be reached between Aztelecom and Kazakhtelecom to construct the Trans Caspian Link along a route between Siyazan, Azerbaijan and Aktau, Kazakhstan.

In early-2006 the Pakistani Minister for Information Technology Awais Ahmad Khan Leghari pledged to offer Pakistan's support for the development of the submarine cable project while conceding that Pakistan was unlikely to route traffic via the Trans-Asia Europe Line because its prices were significantly higher than those available to Pakistan via its undersea links.

In late-2010 the communications ministries of Azerbaijan and Turkmenistan met in Ashgabat and agreed to accelerate the development of a submarine cable between the two countries.

VII. COUNTRY ANALYSIS: UZBEKISTAN

	YE 2012
Population	30,000,000
Population Growth Rate	*1.5%*
Gross Domestic Product (PPP)	USD$105 billion / $3,500 per capita
GDP Growth Rate	*8.2% in 2012, 7.5% forecasted in 2013*
Human Development Index	0.654
HDI Ranking	*114th out of 187 ("Medium")*
Literacy Rate	>99%
Fixed Line Subscribers	1,960,000
Fixed Line Operators	1. Uztelecom (Uzbektelecom) (Gov't. of Uzbekistan) 2. Buzton (VimpelCom) 3. East Telecom (Korea Telecom)
Mobile Subscribers	20,000,000
Mobile Operators	1. Unitel (VimpelCom) 2. Ucell (TeliaSonera) 3. Uzmobile (Uzbektelecom) (Gov't. of Uzbekistan) 4. Perfectum Mobile (Rubicon Wireless Communication)
Mobile Broadband	3G launched in 2007; LTE launched in 2010
Regulatory Agency	State Committee for Communication, Informatization and Telecommunication Technologies (formerly Uzbek Agency for Communications and Information (UzACI))
International Internet Bandwidth	7.8 Gbps
Int'l. Internet Bandwidth per Capita	*0.259 Kbps*
Internet Service Providers	1. Uznet (Uzbektelecom) (Gov't. of Uzbekistan) 2. Buzton (VimpelCom) 3. East Telecom (Korea Telecom) 4. Sarkor Telecom 5. Sharq Telecom 6. EVO 7. TPS
Fixed Broadband Subscribers	200,000 fixed broadband subscribers (>256 Kbps) 500,000 mobile broadband subscribers (est.)
Fixed Broadband Technologies	ADSL, FTTB, WiFi
Typical Monthly Broadband Subscription	1. USD$4.00 for 256 Kbps + free installation, limit of 600 MB international content *(Uzonline)* 2. USD$27.50 for 1 Mbps + free installation, limit of 10 GB international content *(Uzonline)* 3. USD$43.50 for 1 Mbps + free installation, unlimited download *(Uzonline)*

Telecommunications Market Overview

There has been significant foreign investment in Uzbekistan, although in 2012 and 2013 the transparency and stability of foreign operators' Uzbek investments was called into question: a major mobile operator, MTS-Uzbekistan, was shut down by authorities and another, TeliaSonera's Ucell, was the subject of investigation by European authorities.

The incumbent state-owned operator Uzbektelecom operates three major subsidiaries: fixed-line operator Uztelecom, mobile operator Uzmobile, and ISP Uzonline. In 2004 Uzbektelecom was granted exclusivity over the country's international gateway infrastructure.

Uzbektelecom attracted significant interest in 2004 when the government announced its intention to privatize 64 percent of its shares; however, in 2005 it was decided that only a 49 percent stake would be made available to a "strategic investor." China Mobile was identified as a possible investor, although there was little reported progress over the next several years. In early-2009 the government reiterated its commitment to the privatization process, but as of 2013 the company still remained in government hands.

With Liechtenstein, Uzbekistan is one of only two "doubly-landlocked" countries in the world (i.e., surrounded by landlocked countries); consequently, the country is extremely reliant on terrestrial transit bandwidth.

Regulation and Government Intervention

The Uzbek Agency for Communications and Information (UzACI) was created in 2002 as a successor to the Ministry of Communications and assigned responsibility for regulating the telecommunications sector, issuing telecommunications licenses, and promoting the health of the industry. However, in October 2012 the agency was replaced by the State Committee for Communication, Informatization and Telecommunication Technologies. Key legislation governing the industry includes the Telecommunications Laws of January 1992 and August 1999 as well as a radiofrequency act of December 1998.

In 2011 Uztelecom signed a USD$13 million contract with the Chinese equipment supplier Huawei for the construction of a new educational network connecting 150 higher-education institutions, the network was launched in December of 2011 initially providing fiber connectivity to 80 schools at speeds of up to 1 Gbps. In July of 2013 Uztelecom was formally appointed by the Uzbekistani government to operate the ZiyoNet educational network, connecting schools, universities, libraries, museums, and other institutions via a network based on DSL, FTTx, and CDMA-450 wireless technology.

Fixed Line Telephony Market

Although the Uztelecom fixed-line network is primarily copper-based, beginning in 2004 the company invested in wireless local loop networks in remote markets including Khorezm, Bukhara, and the autonomous republic of Karakalpakstan in the country's northwest.

In early-2012 Uztelecom announced a USD$43 million investment plan for 2012 and 2013 that would increase its broadband network to 300,000 ports and also increase international bandwidth to 40 Gbps; in January of 2013 the company said that it would borrow USD$108 million from the China Development

Bank for the expansion of its main fiber optic, CDMA-450, and FTTx networks. Uztelecom said that the new network upgrade would further increase international bandwidth to 100 Gbps.

Fixed-line operator Buzton was formed in 1995 as a joint venture between the British telecommunications supplier GPT (subsequently Marconi Communications) and Uzbekistan's Ministry of Communications. American investor NCI Projects purchased GPT's stake in 2002. In 2004 the Russian Federation operator Golden Telecom acquired a 54 percent controlling stake in Buzton; the stake was passed to VimpelCom when it purchased Golden Telecom in 2008. VimpelCom reported that as of 2012 Buzton operated a 127-node fixed-line network.

East Telecom was established in 2003, with a controlling 51 percent stake held by UK-based Eastwell Ltd.; Uzbektelecom and Elix Cable of Russian Federation were minority investors with stakes of 30 percent and 19 percent respectively. In 2007, the Korean operator KT acquired 51 percent of East Telecom. KT was joined by the Japanese investor Sumitomo, which bought 34 percent of East Telecom's shares; Uzbektelecom retained a 15 percent stake (simultaneously, KT and Sumitomo purchased the Uzbekistani wireless ISP Super iMax, acquiring 60 percent and 40 percent of share respectively). East Telecom underwent a rebranding in 2012 and shortly thereafter, KT announced its intention to invest USD$400 million in the Uzbekistani telecommunications market, primarily focused on the development of WiMax and LTE technology.

Mobile Telephony Market

As of year-end 2012, VimpelCom's Unitel was the country's largest mobile operator, with a 51 percent share; TeliaSonera's Ucell was close behind with 48 percent, and CDMA operators UzbekMobile and Perfectum Mobile had shares of approximately 2 percent and 1 percent, respectively.

Russian Federation mobile operator VimpelCom is a 100 percent owner of Unitel. In 2005 Russian Federation's Alfa Telecom, a major VimpelCom shareholder, purchased a 74 percent stake in Uzmacom from Superior Communications of Malaysia, and later acquired the remaining 26 percent of shares held by Uzbektelecom. At the time, Uzmacom was only licensed to operate in the Tashkent region and reported average revenue per user (ARPU) of USD$15 to $20 per month, with a total market share of only 2 percent. Many investors suspected that Alfa Telecom's acquisition of the company was intended to facilitate the creation of a nationwide operator using the resources of both Uzmacom and Buztel; indeed, in August of 2005 the Uzmacom network was shut down. VimpelCom purchased both Buztel and Unitel in 2006 and merged the two operators' networks under the Beeline brand name.

Coscom, which launched GSM services in 1997 and was owned by American investor MCT Corporation, was purchased by TeliaSonera's Fintur Holding in 2007 and rebranded as Ucell the following year. As of 2013 TeliaSonera held a 94 percent stake in Ucell. In late-2012 authorities in Sweden and Switzerland began an investigation into TeliaSonera's initial investment in Coscom, and whether TeliaSonera may have made improper and unrecorded payments of USD$300 million to Takilant, a Gibraltar-registered company run by an associate of the eldest daughter of Tajikistan's president. In February of 2013 the chief executive officer of TeliaSonera resigned after a review of the company's activities in Uzbekistan indicated that it had not carried out proper due diligence and background checks. Competitor VimpelCom indicated in regulatory filings that it too had engaged in transactions with Takilant to acquire frequency spectrum in Uzbekistan, and MTS was reported to have done the same.

The Russian Federation operator MTS purchased a 74 percent stake in Uzbek mobile operator Uzdunrobita in 2004 and then increased its control to 100 percent in 2007. The company gained a significant number of subscribers in 2007 when mobile operator Coscom had its license suspended by Uzbek authorities.

However, in mid-2012 Uzdunrobita, which operated under the MTS-Uzbekistan brand name, was effectively shut down by the Uzbekistan government, which accused the company of regulatory violations and arrested members of the company's management on charges of tax evasion and money laundering. Although MTS officials deemed the government's actions a "shakedown" and some observers accused the government of engaging in a pattern of intimidation against foreign investors, in early 2013 MTS-Uzbekistan declared itself bankrupt. Later in 2013 the Uzbekistan government offered to purchase the company's assets from its creditors. Prior to its shutdown, MTS-Uzbekistan had a 37 percent market share.

In 2011 and 2012 mobile operators announced major investments to upgrade their networks: Ucell said that it would spend USD$125 million between 2011 and 2013; Unitel said that it would spend USD$40 million to double its network capacity by 2014; and Uzdunrobita said that it would invest USD$30 million by 2014.

Uzmobile, which operates a CDMA-450 network, had 200,000 subscribers as of year-end 2012. Perfectum Mobile, officially Rubicon Wireless Communication, also operates a CDMA network, but its market share was relatively low.

Average revenue per user in 2012 was between USD$4 and USD$5 per month, however Vimpelcom reported that its ARPU in Uzbekistan had risen by 12 percent between 2011 and 2012, giving Uzbekistan the distinction of being the only one of Vimpelcom's CIS markets in which there was positive growth.

MTS-Uzbekistan launched the country's first 4G LTE network in July of 2010; it was supplied by Huawei and initially limited to Tashkent. TeliaSonera's Ucell activated a ZTE-supplied 4G network the following month. VimpelCom's Unitel unveiled its LTE network in 2012. In early-2012 VimelCom reported more than 200,000 mobile broadband subscriptions.

Internet and Broadband Market

Uzbektelecom is the country's Internet backbone operator, and its subsidiary Uzonline had 73,000 broadband subscribers to its DSL and FTTH networks as of year-end 2011. By mid-2012 the company had 16,500 ADSL subscribers in Tashkent and was constructing a fiber-to-the-building network serving 1,375 apartment buildings; it was expected that the fiber network would add 1,700 additional buildings in 2013 and cover the entire city by 2015. The company planned to add a total of 120,000 new broadband ports in 2013 and 2014. In late-2013 Uzbektelecom announced a promotion whereby customers' installation fees for its 2.2 Gbps fiber-to-the-building service would be waived.

VimpelCom reported that its Uzbekistani fixed-line subsidiary Buzton served 15,560 ADSL ports and 1,162 buildings via its fiber-to-the-building (FTTB) network, including over 200 kilometers of fiber deployment in FTTB networks in the cities of Tashkent, Samarkand, Bukhara, Zarafshan and Uchkuduk.

In addition to Uzonline and Buzton, fixed Internet service is provided by KT's East Telecom, Sarkor Telecom, Sharq Telecom, EVO, and TPS.

Domestic Network Connectivity in Uzbekistan

Uztelecom's fiber network totaled 1,900 kilometers as of year-end 2010 and 3,300 kilometers as of year-end 2011. In 2005 Uztelecom deployed 261 kilometers of fiber optic cable in the autonomous region of Karakalpakstan with assistance from the Japanese Bank for International Cooperation, which provided an $18 million credit. In 2007 fiber was installed to Kashkadarya, Surkhandarya, Dekhkanabad, Kamashi,

Guzar, Baysun, Kizirik, Bandihan, Sherabad, Karshi, and Termez. In 2011 the Baysun-Denau and Urgut-Shakhrisyabz fiber links were activated.

International Internet Bandwidth and Capacity Pricing in Uzbekistan

Figure 7: International Internet Bandwidth and Capacity Pricing in Uzbekistan, 2012

International Internet Bandwidth	International Internet bandwidth per Capita	International Capacity Pricing
7.8 Gbps	0.259 Kbps	USD$422 per Mbps per month for IP transit as of year-end 2012; USD$347 as of mid-2013

Source: Terabit Consulting research, Operator data and interviews

Uzbektelecom reported that its international Internet bandwidth was 4.835 Gbps as of year-end 2011, and in January of 2013 the company indicated international Internet bandwidth had increased by 61 percent to 7.780 Gbps. The capacity of the Uzbektelecom's international packet communication center was increased to 40 Gbps, and company's first deputy director general, Kahramon Yuldoshev, said that the company planned to eventually increase its international bandwidth to 100 Gbps.

The price of IP transit in Uzbekistan has fallen dramatically in recent years but still remains among the most expensive in the world. As of 2010 Uztelecom's international IP transit was priced at USD$1,510 per Mbps per month; it was halved to $705 in mid-2011 and $529 at the end of 2011. By year-end 2012 the price was $422. Further cuts brought the price to $347 as of August, 2013.

Uztelecom reported that the IP transit market between Uzbekistan and Russian Federation was worth USD$20 million annually and was growing at a rate of 30 percent.

International Network Connectivity in Uzbekistan

Uzbektelecom and the Russian Federation operator TTK signed network interconnection agreements in July of 2003; more recently this was supplemented by an IP transit agreement between the two countries signed in October of 2012. Uzbektelecom also signed an interconnection agreement with Russian Federation operator Multiregional Transit Telecom (MTT) in May of 2006. In October of 2007 Uzbektelecom signed an agreement to expand the capacity of its network interconnection with Kazakhtelecom, and in January of 2009 Uzbektelecom signed an interconnection agreement with Afghan Telecom. Uzbektelecom signed an interconnection agreement with MegaFon in December of 2009.

➢ Initial Satellite Connectivity

The Tashkent earth station was inaugurated in October of 1992, at the same time as the country's first international switch (NEAX-61) was installed by NEC of Japan. Although the antennae offered connectivity via Intelsat, Uzbekistan did not join the organization until 1997. The Tashkent earth station now houses antennae that link to the Intelsat-6 satellite located at 63 degrees E longitude, as well as the Intersputnik Stationar-20 satellite. Additional Eutelsat and Asiasat antennae offer capacity used primarily for broadcasting.

➢ Microwave Connectivity

Uzbektelecom operates microwave links to Kyrgyzstan and Tajikistan.

- Trans Asia-Europe Line (TAE) (Kazakhstan-Uzbekistan and Turkmenistan-Uzbekistan)

Trans Asia-Europe Line (TAE)	
Date	Construction completed in 1997; activation in 1998
Length	886 kilometers in Uzbekistan
International Connectivity	- Shymkent, Kazakhstan to Tashkent, Uzbekistan via the border crossing at Chernayevka, Kazakhstan and Gisht Kuprik, Uzbekistan - Turkmenabat, Turkmenistan to Bukhara, Uzbekistan via the border crossing at Farab, Turkmenistan and Alat, Uzbekistan
Main Nodes	Tashkent, Kokdola, Denau
Capacity	Initial capacity of STM-4 (622 Mbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Uzbekistan segments owned and operated by Uzbektelecom; TAE developed by consortium of operators in 20 countries.
Continuity with Rail/Highway	- Kazakhstan-Uzbekistan route follows the M39 and A2 highways. - Turkmenistan-Uzbekistan route follows the M37 highway.

The 27,000-kilometer international Trans-Asia-Europe Optical Fiber Cable (TAE), which connects Frankfurt, Germany to Shanghai, China, spans 886 kilometers within Uzbekistan. The network runs from the country's southern border with Turkmenistan (between Turkmenibat, Turkmenistan and Bukhara, Uzbekistan) to its northeastern border with Kazakhstan (via the main road between the Uzbekistani capital of Tashkent and the Kazakhstani city of Shymkent). Construction of the Uzbekistani portions of the network was completed in 1997 at a cost of $19 million. Funding was provided by the German export credit agency Kreditanstalt fur Wiederaufbau (KfW).

TAE's major Uzbekistani points of presence are in Toshkent, Dzhizak, Samarquand and Alat. Countries involved in the TAE project include China, Kazakhstan, Kyrgyzstan, Uzbekistan, Tajikistan, Turkmenistan, Islamic Republic of Iran, Turkey, Ukraine, Belarus, Poland, Romania, Hungary, Austria, Germany, Georgia, Azerbaijan, Armenia, Pakistan, and Afghanistan. The primary segments of the network were activated in October of 1998, offering an initial capacity of 622 Mbps. The network does not offer any end-to-end service level agreement (SLA).

- Kazakhstan-Uzbekistan (eastern)

Kazakhstan-Uzbekistan (eastern)	
Date	2009; MOU signed in 2007
Length	132 kilometers.
International Connectivity	- Skymkent, Kazakhstan to Tashkent, Uzbekistan via the border crossing at Zhibek Zholy, Kazakhstan
Main Nodes	Tashkent
Capacity	Initial capacity of STM-4 (622 Mbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Kazakhtelecom - Uzbektelecom
Continuity with Rail/Highway	- Via the A2 highway (Kazakhstan) and the M39 highway (Uzbekistan)

- Kazakhstan-Uzbekistan (western)

Kazakhstan-Uzbekistan (western)	
Date	2009
Length	400 km
International Connectivity	- Kungrad, Uzbekistan to Beyneu, Kazakhstan via Tajen border crossing
Main Nodes	Kungrad
Capacity	
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Uzbektelecom - Kazakhtelecom
Continuity with Rail/Highway	- The fiber link follows the Beyneu-Kungrad road - There is also a Kungrad-Beyneu rail link

- Kyrgyzstan-Uzbekistan

Kyrgyzstan-Uzbekistan	
Date	2009
Length	70 km
International Connectivity	- Osh, Kyrgyzstan to Andijan, Uzbekistan via Dostyk border crossing
Main Nodes	Andijan
Capacity	
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Uzbektelecom - Kyrgyztelecom
Continuity with Rail/Highway	- Follows A73 highway (Osh-Tashkent Rd.)

➢ Tajikistan-Uzbekistan

Tajikistan-Uzbekistan	
Date	2009
Length	50 km
International Connectivity	- Denau, Uzbekistan to Tursunzoda, Tajikistan
Main Nodes	Denau
Capacity	
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Uzbektelecom - Tajiktelecom
Continuity with Rail/Highway	- Follows M41 highway

➢ Afghanistan-Uzbekistan

Afghanistan-Uzbekistan	
Date	2009
Length	100 km
International Connectivity	- The fiber link crosses between Afghanistan and Uzbekistan over the Amu Dharia River via a one-kilometer bridge in Khairatan (Hairatan).
Main Nodes	Termez (Termiz), Uzbekistan Mazar-i-Sharif, Afghanistan
Capacity	4 x STM-1 (622 Mbps)
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Owned and operated by Uzbektelecom and Afghan Telecom
Continuity with Rail/Highway	- Termez, Uzbekistan is linked to Tashkent via the M-39 highway. The path from the border to Mazar-i-Sharif partly follows Asian Highway 76. A ring road in Afghanistan linking major towns near the border is planned, with an accompanying fiber network along the same route. - In August, 2011 Uzbekistan Railways (UTY) opened a 75-kilometer rail link between Hairatan (Khairatan) and Mazar-i-Sharif, which was believed to serve primarily as a US military transport route from Central Asia to Afghanistan.

Russian Federation operator Rostelecom also reportedly uses the Afghanistan-Uzbekistan link as part of its "Europe-Afghanistan" network.

Afghan Telecom reported that prior to the activation of its international fiber links, 1 Mbps of IP transit cost USD$4,000 per month. The price fell to USD$1,500 in 2010, $900 in 2011, $300 in 2012, and $150 in 2013.

➢ Proposed International Connectivity

Turkmenistan-Uzbekistan (Proposed)

Although the Trans Asia-Europe Line already connects Turkmenistan and Uzbekistan, the government of Turkmenistan has proposed an extension of the country's fiber optic network from Ashgabat to Dashhowuz (Dashoguz), on the border with Uzbekistan. From Dahhowuz the network would presumably be linked to the Uzbektelecom network.