

An In-Depth Study on the Broadband Infrastructure in Afghanistan and Mongolia

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I. EXECUTIVE SUMMARY

Between February and April, 2015, Terabit Consulting performed a detailed analysis of telecommunications and Internet markets and broadband infrastructure in Afghanistan and Mongolia.

The analysis followed three previous studies carried out between 2012 and 2014 covering South & Southwest Asia, North & Central Asia, and Southeast Asia, for a total of 27 countries across the continent.

Table 1: Overview of Broadband Status by Country

	GDP per Capita, YE 2014 (PPP, USD)	Int'l. Band-width per Capita (Kbps)	Int'l. Connectivity	Domestic Connectivity	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
Afghanistan	\$1,900	0.5	Moderate	Moderate	Expensive	Somewhat Competitive	Limited	Very Expensive
Mongolia	\$12,000	10.3	Moderate	Moderate	Moderate	Competitive	Limited	Very Expensive

Table 2: Summary and Analysis of International Bandwidth by Country

Country	International Internet Bandwidth (YE 2013)	10-Year CAGR (2003-2013)	Int'l. Internet Bandwidth per Capita (Kbps)	Evaluation
Afghanistan	15 Gbps – The Ministry of Communications and Information Technology (MCIT) reported that the country's international Internet bandwidth increased from 8 Gbps in 2013 to 15 Gbps in 2015. According to the MCIT, "since there is no single gateway in Afghanistan, every ISP is using its own gateway."	81%	0.5	Very Weak
Mongolia	30 Gbps – The Communications Regulatory Commission (CCR) reported that Mongolia's international bandwidth was 28.270 Gbps as of mid-2014. By the end of 2014 it was estimated to have increased to 30 Gbps. Bandwidth grew 24-fold between 2008 and 2011, when it increased from 1.248 Gbps to 30.004 Gbps, according to the CCR; however, the regulator reported that bandwidth decreased in 2012 and by mid-2014 it still had not returned to the level of 2011, leading some sources to speculate that there may have been reporting issues in the collection of the bandwidth data, since no other market had seen its 2014 international bandwidth decrease from 2011 levels.	101%	10.3	Moderate

Table 2a: Historical International Bandwidth Demand (Gbps)
(International Internet, International Corporate Data, & International Voice), 2003-2013

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Afghanistan	0.1	0.1	0.4	0.7	1.1	1.4	2.1	2.8	3.9	5.2	10.7
Mongolia	0.1	0.1	0.2	0.8	1.2	1.6	9.2	19.2	33.3	25.5	29.8

Table 2b: Forecasted International Bandwidth Demand (Gbps)
(International Internet, International Corporate Data, & International Voice), 2014-2024

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Afghanistan	153	221	319	460	665	962	1,391	2,014	2,915	4,222	6,116
Mongolia	15	23	34	51	76	114	171	256	384	577	865

Table 3: Summary and Analysis of International Connectivity by Country

Country	International Connectivity	Evaluation
Afghanistan	<ol style="list-style-type: none"> 1. Afghanistan is connected to all of its neighbors via terrestrial fiber connections, with the exception of China. 2. Afghanistan has dual fiber links to Pakistan and Turkmenistan, as well as links to Iran, Tajikistan, and Uzbekistan. 3. Afghan Telecom's correspondents for transborder fiber connectivity are Telecom Infrastructure Company (Iran), PTCL (Pakistan) Tajiktelecom, Turkmentelecom, and Uzbektelecom. 	Somewhat Weak – Although the geographic coverage of Afghanistan's international connectivity is strong, with connections to all neighbors, the country has yet to implement a solution for high-volume, affordable international bandwidth.
Mongolia	<ol style="list-style-type: none"> 1. Mongolia is considered to be in a prime geographic position to capture Europe-to-Asia traffic; it benefits from some of the lowest latencies between East Asian and European markets. Consequently, multiple Russian operators including TransTelekom, MegaFon, and Rostelecom, as well as Chinese operators including China Unicom and China Telecom, have formed partnerships with the Mongolian operators Railcom, Gemnet, and Mobicom to provide Europe-to-Asia connectivity. 2. The concentration of the country's international connectivity within a single geographic corridor is a source of concern. 	Somewhat Weak – The participation of multiple operators in the provision of trans-Mongolian connectivity is favorable, however development of redundant international gateways will be necessary to ensure high reliability.

Table 4: Summary and Analysis of Domestic Connectivity by Country

Country	Domestic Connectivity	Evaluation
Afghanistan	<ol style="list-style-type: none"> 1. The Afghan Optical Fiber Network consists of a backbone built primarily along the country's circular Highway 1, also known as the Ring Road, with branches to other provinces and transborder connections to Pakistan, Iran, Turkmenistan, Uzbekistan, and Tajikistan. Construction was begun in 2007; current plans call for the construction of a network that will span 4,400 kilometers at a total cost of USD\$130 million. Partial financing was provided by the World Bank Group 2. The Optical Fiber Network is governed by the Open Access Policy of the Afghanistan Ministry of Communications and Information Technology, which was enacted in 2012 in order to "make sure retail telecommunications providers each have access to technologies such as high speed fiber, enabling all providers to serve Afghans at the lowest possible price and still turn a reasonable profit." The policy sets forth core principles of non-discrimination, transparency, and cost-based pricing. 3. Afghan Wireless Communications Company operates a 2,500-kilometer domestic microwave network. 	Limited – Although there is strong connectivity in the east of the country, the country's national fiber optic ring has yet to be completed.
Mongolia	<ol style="list-style-type: none"> 1. Mongolia's domestic fiber optic networks span more than 33,300 kilometers. Fiber deployment tripled between 2009 and 2014. 2. The network of government-owned Information Communication Network Company, also known as Netcom, covers 16,556 kilometers and accounts for half of the country's total fiber deployment. 3. Mobicom and Skynetworks (Skytel) each operate networks of approximately 7,000 kilometers in length. 4. Railcom, a subsidiary of Mongolian Railway, operates a 1,400-kilometer fiber network along the country's primary north-south railway 	Moderate – Multiple operators provide fiber connectivity, although most network infrastructure is concentrated along the country's north-south railway corridor.

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

Country	International Capacity Pricing (Volume Purchases of 1 Gbps or Greater)	Evaluation
Afghanistan	IP transit was priced at \$35 per Mbps per month as of year-end 2014, having fallen an average of 38 percent annually since 2004, when prices were \$4,000 per Mbps. The most precipitous declines took place after the activation of international fiber capacity in 2008, prior to which all international connectivity had been via costly satellite links. Prices fell below \$1,000 in 2011 and below \$100 in 2013.	Expensive
Mongolia	As of the end of 2014, sources indicated that wholesale IP transit bandwidth in Mongolia cost approximately USD\$50 per Mbps per month.	Expensive

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

Country	Competitiveness of Telecommunications Market	Evaluation
Afghanistan	<ol style="list-style-type: none"> 1. The Afghan telecommunications market suffered from extensive damage due to conflict as well as underinvestment and neglect. However, in the years following the U.S.-led invasion, the telecommunications sector has emerged as a leading component of the country's economy. 2. Fixed-line: The country's national fixed-line operator, government-owned Afghan Telecom Corporation (Aftel) started offering service in April 2006. It operates PSTN fixed-line infrastructure as well as a CDMA network. Wasei Telecom, led by the UAE-based investors AG Telecom and Modern Technology International, was awarded a license to operate as a local fixed service provider (LFSP) in 2006, thereby allowing it to provide CDMA-based wireless local loop service, focusing primarily rural areas that had been underserved. 3. Mobile: An Afghan investor re-launched the Afghan Wireless Communications Company (AWCC) in 2002 and a second mobile operator, Roshan, began offering service the following year. AWCC and Roshan were awarded duopoly exclusivity over the market for three years from 2003 to 2006. A third operator, Areeba, entered the market in 2006 and was subsequently renamed MTN Afghanistan after being acquired by the South African mobile group MTN in 2007. A fourth mobile operator, Etisalat, entered the market in 2007. As of 2014, Roshan had a one-third market share, MTN had a one-fourth market share, and AWCC and Etisalat each had shares of approximately one-fifth. 4. Internet/broadband: There were 58 registered Internet service providers as of September, 2014, including two Wi-Max providers. Estimates by the Ministry of Communications and Information Technology placed the number of Internet users at 2.4 million as of 2013, compared to fewer than 2,000 in 2003. The National Internet Exchange of Afghanistan (NIXA) has been under serious consideration since at least 2011 and in September of 2014 the Ministry of Communications and Information Technology issued a request for proposals starting that "since there is no single gateway in Afghanistan, every ISP is using its own gateway, which means every single packet is being routed globally. To route local traffic locally and to have a centralized setup for local contents, local Internet economy; NIXA is being established." 	Somewhat competitive

Country	Competiveness of Telecommunications Market	Evaluation
Mongolia	<ol style="list-style-type: none"> 1. The telecommunications market is competitive and dynamic, with four major operators present in the mobile market and four in the consumer fixed-line market. In both sectors, the leading operators (Mobitel and Telecom Mongolia, respectively) have seen their market shares cut in half since 2006. 2. Fixed-line: As of mid-2014 there were 211,000 fixed-line subscribers. Incumbent operator Telecom Mongolia is the country's largest fixed-line carrier, with a share of 42.4 percent as of mid-2014. Korea Telecom (now KT Corporation) acquired a 40 percent stake in Telecom Mongolia in 1995. 3. Mobile: The market is served by four operators: Mobicom, Unitel, Skytel, and G-Mobile. Mobicom is Mongolia's largest mobile operator, with a 39.5 percent market share. Unitel grew its market share to approximately one-third by 2012 and as of mid-2014 its market share was 35.6 percent. Skytel is Mongolia's third-largest mobile operator with a market share of 13.8 percent. 4. Internet/broadband: The Communications Regulatory Commission reported that there were 1.1 million Internet subscribers in Mongolia as of mid-2014, representing a penetration rate of 38 percent. Mobile Internet subscribers totaled slightly less than 900,000, representing five-sixths of all subscriptions. Fixed broadband subscribers, totaling approximately 175,000, were connected primarily via fiber optic cable (114,000 subscribers). Digital Subscriber Line served 27,000; Wi-Max served 19,000; and there were 12,000 Wi-Fi subscribers. Dial-up connections were used by fewer than 9,000 subscribers. There were more than 30 active Internet service providers as of 2014. 	Competitive

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

Country	Fixed Broadband Infrastructure	Mobile Broadband Infrastructure	Evaluation
Afghanistan	ADSL was first offered in 2011 and is currently priced at 4,000 AFN (USD\$69) per Mbps or fraction thereof. In early-2015 Afghan Wireless Communications Company launched a “Super Wi-Fi” service in the city of Khost (southeast of Kabul, near the border with Pakistan), allowing its mobile customers to access the Internet via a series of Wi-Fi hotspots.	3G mobile broadband service was launched in March of 2012 and there were 748,223 3G subscribers as of September, 2014, an increase of 126 percent during the preceding 12-month period. Following several delays, 4G LTE service was expected to be implemented in 2015.	Limited
Mongolia	Mobile Internet subscribers totaled slightly less than 900,000 as of mid-2014, representing five-sixths of all subscriptions. Fixed broadband subscribers, totaling approximately 175,000, were connected primarily via fiber optic cable (114,000 subscribers). Digital Subscriber Line served 27,000; Wi-Max served 19,000; and there were 12,000 Wi-Fi subscribers. Dial-up connections were used by fewer than 9,000 subscribers. Ulsnet, a subsidiary of Mobicom, launched limited WiMax service in in Ulaanbaatar in February of 2007, using base stations and customer premise equipment supplied by Airspan Networks. The network was expanded to serve some rural areas in 2011. In 2013 the Internet service provider Nomsys announced the deployment of the “Community Involved Nomad Wi-Fi Project” which would consist of hundreds of Wi-Fi hotspots throughout Ulaanbaatar and adjoining rural areas.	Mobile Internet subscribers totaled slightly less than 900,000 as of 2014. 3G service was launched in 2009, in February of 2014 the Mongolian media reported that Telecom Mongolia was planning to implement 4G LTE service in Ulaanbaatar by late-2015 and in each of the country’s 23 aimags by 2018.	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
Afghanistan	<ol style="list-style-type: none"> 1. USD\$17 per month for 256 Kbps ADSL with unlimited download and free installation (<i>Afghan Telecom ADSL, Insta Telecom ADSL</i>) 2. USD\$69 per month for 1 Mbps ADSL with unlimited download and free installation (<i>Afghan Telecom ADSL, Insta Telecom ADSL</i>) 	\$69.00	$\$828 / \$700 = 118.3\%$	Prohibitively Expensive
Mongolia	<ol style="list-style-type: none"> 1. USD\$6.60 per month for 1 Mbps ADSL with unlimited download + USD\$5 installation (<i>Telecom Mongolia-Ulaanbaatar</i>) 2. USD\$8.20 per month for 1 Mbps ADSL with unlimited download + USD\$5 installation (<i>Telecom Mongolia-Other cities</i>) 	\$6.60	$\$84 / \$4,100 = 2.1\%$	Reasonable

Table 9: Analysis of Cross-Border Connectivity and Identification of Priority Trans-Border Projects

International Border (and border length)	Analysis	Recommendation
Afghanistan / China (76 kilometers) Medium Priority	<p>Afghanistan and China share a short 76-kilometer border, but there are no transport links between the countries; the only future possibility for a transport connection would be via the treacherous Wakhjir Pass in the Pamir Mountains. On the Chinese side of the border, authorities reportedly installed fiber to the area in 2009 or 2010, but on the Afghan side, there are no immediate plans for telecommunications infrastructure east of Faizabad or Panjshir.</p>	<p>Although technically and economically challenging, a fiber link between Afghanistan and China would serve as a much-needed “missing link” to improve the continent’s connectivity.</p>
Afghanistan / Iran (936 kilometers) Medium Priority	<p>Afghan Telecom and the Telecommunications Infrastructure Company of Iran operate a link between Islam Qala, Afghanistan (west of Herat) and Dogharoun, Iran (east of Taybad).</p>	<p>The Iran-Afghanistan border would benefit from an additional fiber link to provide redundancy for the existing cable.</p>
Afghanistan / Pakistan (2,430 kilometers) Low Priority	<p>Afghan Telecom and PTCL of Pakistan operate two links across the countries’ border, between Torkham, Afghanistan and Torkham, Pakistan in the north and the southern border crossing between Spin Boldak in Kandahar Province, Afghanistan and Chaman, Pakistan.</p>	<p>The two existing links provide sufficient diversity for the forecasted traffic flows across the border between Afghanistan and Pakistan.</p>
Afghanistan / Tajikistan (1,206 kilometers) Medium Priority	<p>There is a single link across the border at Sher Khan Bandar, Afghanistan and Panji Poyon, Tajikistan, operated by Afghan Telecom and Tajiktelecom.</p>	<p>A second link would provide valuable diversity between the two countries.</p>

International Border (and border length)	Analysis	Recommendation
Afghanistan / Turkmenistan (744 kilometers) Low Priority	Afghan Telecom and Turkmentelecom operate two diverse links across the border of the two countries. A western link connects Serhetabat, Mary Province, Turkmenistan and Torghundi, Herat Province, Afghanistan. An eastern link connects Lebap, Turkmenistan and Aqinah, Afghanistan.	The two existing links provide sufficient diversity for the forecasted traffic flows across the Afghanistan-Turkmenistan border.
Afghanistan / Uzbekistan (137 kilometers) Medium Priority	Afghan Telecom and Uzbektelecom operate a fiber link over the Amu Dharria River via a one-kilometer bridge in between Hairatan, Afghanistan and Akhunbabaev, Uzbekistan.	The Afghan-Uzbek border would benefit from the deployment of a second link to increase diversity.
Mongolia / China (4,677 kilometers) High Priority	Multiple fiber connections link Zamyn Uud, Mongolia to Erenhot, China along the Trans-Mongolian Railway, forming a key segment in what is considered to be the lowest-latency path between European and East Asian hub markets.	Given the importance of Mongolia-China connectivity not only to Mongolia but also within the context of lucrative Europe-to-Asia demand, greater geographic diversity is needed in the fiber connectivity between the two countries.
Mongolia / Russia (3,543 kilometers) High Priority	There are multiple fiber connections that cross the border between Sukhbaatar, Mongolia to Naushki, Russia, along the path of the Trans-Mongolian Railway. As is the case with Mongolia-China connectivity, the crossing forms an integral part of low-latency Europe-to-Asia connectivity.	As is the case with the Mongolia-China crossing, the Mongolia-Russia crossing is a key outlet for Mongolian demand but it also serves lucrative Europe-to-Asia capacity, which is expected to increase significantly during the forecast period. Consequently, there would be clear benefits from increased, diverse fiber deployment across the Mongolia-Russia border.

➤ **High Priority Trans-Border Projects**

1. **Mongolia-China**
2. **Mongolia-Russia**

➤ **Medium Priority Trans-Border Projects**

1. **Afghanistan-China**
2. **Afghanistan-Iran**
3. **Afghanistan-Tajikistan**
4. **Afghanistan-Uzbekistan**

Stakeholder Analysis

The development of the Asian Information Superhighway should be done in collaboration with the following stakeholders:

➤ National Regulatory Authorities

Country	Regulatory Authority	Notes
Afghanistan	Afghan Telecommunications Regulatory Authority (ATRA)	<i>The ATRA was established in 2006 as a replacement for the provisional Telecom Regulatory Board. The country's Telecommunications Services Regulation Act was promulgated in 2005.</i>
Mongolia	Communications Regulatory Commission (CRC)	<i>The CRC was established in 2002. The Information Communications Technology and Post Authority of Mongolia (ICTPA) was established in 2004 and is responsible for the development of strategy and policy. The Laws on Communication was implemented in 1995 and amended in 2001.</i>

➤ Incumbent Telecommunications Operators and Major International Gateway Operators

Country	Incumbent Telecom Operators and Major Int'l. Gateway Operators	Notes
Afghanistan	<ul style="list-style-type: none"> • Afghan Telecom Corporation (Aftel) 	<i>Afghan Telecom was established as the country's national operator in 2006.</i>
Mongolia	<ul style="list-style-type: none"> • Mongolia Telecom • Railcom • Gemnet • Mobicom 	<i>Mongolia Telecom is the country's incumbent operator, but Railcom operates fiber networks along the right-of-way of the Trans-Mongolian Railway, and Gemnet and Mobicom also provide international transit connectivity.</i>

➤ Competitive Telecommunications Operators and ISPs

Country	Competitive Telecommunications Operators and Internet Service Providers	Notes
Afghanistan	<ul style="list-style-type: none"> • Afghan Wireless Communications Company (AWCC) • Etisalat • MTN • Roshan • Wasel Telecom • Insta Telecom • Neda Telecommunications • Sarferaz Bahader • KBI • Ceretechs • New Dunia • Io Global • Rana Technologies • Multinet • Netzone • Afghan Cyber • ASIX 	<i>The Afghan market is served by two fixed-line operators, four mobile operators, and more than 50 registered ISPs.</i>
Mongolia	<ul style="list-style-type: none"> • Unitel • Skytel • G-Mobile • Cyber Security Authority • UB Railway • Optinet • Erdemnet • Sky C&C • Sansar • MTC • Magicnet • BMD • Boldsoft • H&I • Asiatel • Gnet • Yokozunanet 	<i>The Mongolian telecommunications market was estimated to be worth approximately \$350 million in 2014. Mobile revenues in 2014 were between \$250 million and \$300 million. The Internet sector generated between \$40 million and \$50 million, and fixed-line revenues were slightly less than \$20 million. Since 2010 the value of the overall market has grown at a compound annual growth rate of approximately 16 percent.</i>

➤ Road and Railway Authorities/Operators

Country	Road and Railway Authorities / Operators	Notes
Afghanistan	<ul style="list-style-type: none"> Ministry of Public Works Afghanistan Railway Authority (AfRA) Ministry of Transport and Civil Aviation 	<ul style="list-style-type: none"> The country has a reported 42,000 kilometers of roads, which are being upgraded with support from several development initiatives. In December of 2014, the Asian Development Bank and the European Union approved a grant for the Transport Network Development Investment Program. The US Agency for International Development funds a Road Sector Sustainability Program. The country's Ring Road (Highway 1) stretches more than 2,000 kilometers but many segments remain unfinished or in poor condition. Rail service is limited to an international track between the northern city of Mazar-i-Sharif and Uzbekistan, but other lines are under construction. In March of 2015, Afghan President Ashraf Ghani said that "now, our attempt is to get linked to China and to all our neighbors" via rail. An agreement was signed in Dushanbe, Tajikistan in December of 2014 for the development of a China-Kyrgyz Republic-Tajikistan-Afghanistan-Iran Railway. The government of Pakistan has proposed a rail line between Peshawar, Pakistan and Jalalabad.
Mongolia	<ul style="list-style-type: none"> Ministry of Roads and Transportation Ulaanbaatar Railway 	<ul style="list-style-type: none"> Mongolia has 1,800 kilometers of rail track. The Trans-Mongolian Railway crosses the country from the northern border with Russia to the southern border with China, however there is a difference in gauge between Mongolia and China. Mongolia plans to invest \$5.2 billion in the expansion and upgrade of its rail network in coming years. In April of 2014 China's largest producer of coal, Shenhua Group, announced plans to construct a narrow-gauge trans-border railway in partnership with Mongolian investors in order to ship coal to China. There are approximately 1,500 kilometers of paved state roadways in Mongolia, in addition to local roads. The only paved international road links Ulaanbaatar to the border with Russia, although a southern road to the Chinese border is under construction. In April of 2013 the government announced plans to construct a 1,000 kilometer highway between Mongolia's borders with Russia and China, at an estimated cost of \$3.5 billion.

II. COUNTRY ANALYSIS: AFGHANISTAN

	YE 2014
Population	31 million
Population Growth Rate	2.4%
Gross Domestic Product (PPP)	USD\$60 billion / \$1,900 per capita
GDP Growth Rate	6.0% in 2013, 5.6% in 2014 (forecast)
Human Development Index	0.468
HDI Ranking	169 th out of 187 ("Low")
Literacy Rate	31%
Fixed Line Subscribers	103,000 PSTN + 180,000 CDMA
Fixed Line Operators	1. Afghan Telecom Corporation (Aftel) (PSTN & CDMA) 2. Wasel Telecom (Local Fixed Service Provider via CDMA)
Mobile Subscribers	23.6 million
Mobile Operators	1. Roshan 2. MTN 3. Afghan Wireless Communications Company (AWCC) 4. Etisalat 5. Afghan Telecom Corporation (Aftel)
Mobile Broadband	3G launched in 2012; 4G LTE expected in 2015
Regulatory Agency	Afghan Telecommunications Regulatory Authority (ATRA)
International Internet Bandwidth	15 Gbps
Int'l. Internet Bandwidth per Capita	0.5 Kbps
Internet Service Providers	1. Insta Telecom 2. Neda Telecommunications 3. Sarferaz Bahader 4. KBI 5. Ceretechs 6. New Dunia 7. Io Global 8. Rana Technologies 9. Multinet 10. Netzone 11. Afghan Cyber 12. ASIX
Broadband Subscribers	10,000-20,000 fixed broadband subscribers (estimated) (>256 Kbps) 750,000 mobile broadband subscribers
Fixed Broadband Technologies	ADSL, FTTx, Wi-Max
Typical Monthly Broadband Subscription	1. USD\$17 per month for 256 Kbps ADSL with unlimited download and free installation (Afghan Telecom ADSL, Insta Telecom ADSL) 2. USD\$69 per month for 1 Mbps ADSL with unlimited download and free installation (Afghan Telecom ADSL, Insta Telecom ADSL)

Telecommunications Market Overview

Throughout the late 20th Century, Afghanistan's telecommunications infrastructure remained among the least-developed in the world, having been devastated by more than two decades of conflict as well as underinvestment and neglect. During the Soviet invasion and occupation of the country from 1979 to 1989 and throughout years of civil war thereafter, there was little investment in the Afghan telecommunications sector; the country's teledensity never exceeded 0.2 lines per 100 inhabitants, consistently ranking among the lowest in the world. Throughout the 1990s the country depended on a largely analog telephone network employing antiquated equipment, including 45-year-old electro-mechanical step-by-step exchanges.

In the 1980s, the Soviet Union built a small fixed-line system between Afghanistan's five biggest cities, which attempted to integrate the sparsely-distributed telecom infrastructure that had been built in previous years. The entire network ultimately comprised only 40,000 telephone lines and was reportedly plagued by reliability and interconnection problems.

A more advanced telecommunications network was constructed in the late 1990s by the Afghan Wireless Communication Company (AWCC), which at the time was a joint venture between the Taliban-controlled Ministry of Communications and New Jersey-based Telephone Systems International, a company which was established with the sole purpose of developing the communications network in Afghanistan.

The AWCC network offered telecommunications service to the capital of Kabul and the southern city of Kandahar. Although AWCC's fixed-wireless transmission network was considerably more advanced than the antiquated Soviet-built network, the company counted only 9,000 telephone lines and annual revenue of \$1.8 million, mostly from governmental (Taliban) users. Prior to 2001, international communications into and out of Afghanistan had been carried almost exclusively through a satellite earth station in Kabul (there were also a small number satellite phone subscribers through providers such as Iridium or Globalstar).

Most of the telecommunications infrastructure in Afghanistan, including the Soviet-constructed domestic network and the Kabul satellite earth station, was severely damaged by the U.S.-led invasion of the country beginning in late-2001. Notably, however, the Afghan Wireless network emerged from the bombings relatively unscathed.

Following the establishment of the Islamic Transitional Government of Afghanistan in 2002, the Ministry of Communications announced a "Telecommunications Development Strategy." This strategy identified key projects that would be necessary in order to have a modern and fully-functional domestic and international telecommunications network in Afghanistan, including fiber optic, wireless, and satellite infrastructure projects, as well as the development of community telecenters that would allow access to telephone and data communications.

By 2006 the telecommunications sector generated more than \$100 million in revenue annually and was reported to be Afghanistan's "largest single legitimate revenue producer," in addition to employing more than 40,000 workers.

An Afghan investor re-launched the Afghan Wireless Communications Company in 2002 and a second mobile operator, Roshan, began offering service the following year. AWCC and Roshan were awarded duopoly exclusivity over the market for three years from 2003 to 2006. A third operator, Areeba, entered the market in 2006 and was subsequently renamed MTN Afghanistan after being acquired by the South African mobile group MTN in 2007. A fourth mobile operator, Etisalat, entered the market in 2007.

A national operator, Afghan Telecom Corporation (Aftel) was established by presidential decree and launched service in April of 2006 following an initial government investment of \$2 million. The company remains a 100 percent state-owned enterprise, although the MCIT has stated that the government is “committed to the eventual privatization of Afghan Telecom.” In March of 2008, the Afghan Ministry of Communications and Information Technology (MCIT) issued a request for expressions of interest for the privatization of 80 percent of Afghan Telecom shares, but the privatization effort was halted.

In addition to the four mobile operators and the country’s national operator, a sixth company, Wasei Telecom, is licensed as a local fixed service provider (LFSP) providing CDMA-based wireless local loop service.

Regulation and Government Intervention

A provisional body, the Telecom Regulatory Board (TRB), was established by the Ministry of Communications and Information Technology in 2003. The country’s Telecommunications Services Regulation Act was promulgated in 2005 and the Afghan Telecommunications Regulatory Authority (ATRA) was established in 2006 as a permanent replacement for the TRB.

In order to supplement the Telecommunications Services Regulation Act, the Ministry of Communications and Information Technology (MCIT) drafted an ICT Law in 2010 to regulate e-government, e-commerce, online transactions, digital signatures, and other ICT-related issues; as of 2015 the MCIT was reportedly in the process of finalizing the details of the law in order to conform to requirements put forth by the Ministry of Justice.

In October of 2009 the government inaugurated its \$4.7 million Afghanistan National Data Center (ANDC), offering initial storage capacity of 40 terabytes as a cornerstone of its e-government program.

Fixed Line Telephony Market

The Afghanistan Telecommunications Regulatory Authority reported that there were 100,385 PSTN landline telephones in service as of September, 2014; the figure was estimated to have grown to 103,000 as of year-end. The market expanded by approximately 6,000 subscribers between 2013 and 2014, a growth rate of 6 percent.

In addition to traditional PSTN service, CDMA wireless local loop networks served an additional 180,049 subscribers, primarily in rural areas with poor landline infrastructure. While PSTN subscribership has grown in recent years, CDMA subscribership has fallen from its high of well over 200,000.

The country’s national fixed-line operator, government-owned Afghan Telecom Corporation (Aftel) started offering service in April 2006. It operates PSTN fixed-line infrastructure in the cities of Kabul, Mazar-e-Sharif, Kandahar, Jalalabad, Herat, and Kunduz; in other areas, Afghan Telecom provides fixed telephony via a CDMA network supplied by Huawei Technologies and ZTE. In addition to voice services, Afghan Telecom offers Internet access and data services.

Wasei Telecom, led by the UAE-based investors AG Telecom and Modern Technology International, was awarded a license to operate as a local fixed service provider (LFSP) in 2006, thereby allowing it to provide CDMA-based wireless local loop service, focusing primarily rural areas that had been underserved.

Mobile Telephony Market

There were 23.1 million GSM mobile subscribers as of September, 2014 and an estimated 23.6 million subscribers as of year-end. Afghan mobile networks provide geographic coverage to approximately 90 percent of the population.

3G mobile broadband service was launched in March of 2012 and there were 748,223 3G subscribers as of September, 2014, an increase of 126 percent during the preceding 12-month period.

Afghan Wireless Communications Company (AWCC) in its current form was established by an Afghan investor in 2002 (AWCC was originally formed in the 1990s as a joint venture between a US investor, Telephone Systems International, and the Taliban government). AWCC was awarded a 3G license in early-2014 at an estimated cost of \$25 million. In January of 2015 AWCC launched “3.75G” HSPA+ mobile broadband service in Kabul, offering download speeds of up to 42 Mbps. It planned to expand the service to Kandahar and other Afghan cities later in 2015. It was estimated to have a one-fifth share of the mobile market as of 2014, which tied it for third place.

Roshan, also known as Telecom Development Company Afghanistan Corporation, was awarded Afghanistan’s second GSM license in October of 2002 and launched service in 2003. As of 2014 it was the country’s largest mobile operator, with a market share of approximately one-third. Roshan is majority-owned by the Aga Khan Fund for Economic Development (AKFED), with a 51 percent stake. Its minority shareholders are Monaco Telecom International, with 36.75 percent, and the Swedish operator TeliaSonera, with 12.25 percent. In 2013 Roshan received significant long-term debt financing from the World Bank Group’s International Finance Corporation. Roshan’s 3G network was launched in Kabul in April of 2013.

AWCC and Roshan benefited from a duopoly over the marketplace through a three-year exclusivity agreement with the Ministry of Communications and Information Technology which was in place between 2003 and 2006. The country’s third mobile license was awarded in 2005 to a joint venture consisting of the Lebanese investor, Investcom and the Afghan investor Alokozai-FZE, and the company launched service in July of 2006 under the Areeba brandname. Areeba was acquired by the South African mobile operator MTN in 2007 and rebranded as MTN-Afghanistan. The International Finance Corporation holds a 9 percent minority stake in the company. MTN is the country’s second-largest mobile operator, with an estimated market share of one-fourth. The company launched 3G service in October of 2012.

Etisalat Afghanistan, a fully-owned subsidiary of the United Arab Emirates-based operator, began operations in August of 2007. It commissioned its 3G network in March of 2012 and reported 3G coverage in 14 provinces as of 2014. Etisalat had an estimated one-fifth share of the market as of 2014, tying it with AWCC for third place.

Following several delays, 4G LTE service was expected to be implemented in 2015.

Internet and Broadband Market

There were 58 registered Internet service providers as of September, 2014, including two Wi-Max providers. Major Internet service providers include Insta Telecom, Neda Telecommunications, Sarferaz Bahader, KBI, Ceretechs, New Dunia, Io Global, Rana Technologies, Multinet, Netzone, Afghan Cyber, and ASIX.

Estimates by the Ministry of Communications and Information Technology placed the number of Internet users at 2.4 million as of 2013, compared to fewer than 2,000 in 2003. Although the development of the Afghan telecommunications network has increased Internet usage, significant structural issues are expected to limit near-term Internet development. These include the country's low literacy rate and the relative lack of Internet content in the Pashto and Dari languages. Furthermore, only 30 percent of the country has access to electricity, although development plans call for that figure to increase to 83 percent by 2032.

ADSL was first offered in 2011 and is currently priced at 4,000 AFN (USD\$69) per Mbps or fraction thereof, with speeds ranging from 256 Kbps (at a price of 1,000 AFN or USD\$17) to 4 Mbps (at a price of 16,000 AFN or USD\$276). Insta Telecom advertised its base service as having a 3-to-1 contention ratio, which was believed to be the same as Afghan Telecom's. A dedicated 1 Mbps ADSL connection with a 1-to-1 contention ratio was priced at 15,000 AFN (USD\$259). ISPs reported that in most cases ADSL installation was free, although modems were required.

In early-2015 Afghan Wireless Communications Company launched a "Super Wi-Fi" service in the city of Khost (southeast of Kabul, near the border with Pakistan), allowing its mobile customers to access the Internet via a series of Wi-Fi hotspots.

The National Internet Exchange of Afghanistan (NIXA) has been under serious consideration since at least 2011 and in September of 2014 the Ministry of Communications and Information Technology issued a request for proposals starting that "since there is no single gateway in Afghanistan, every ISP is using its own gateway, which means every single packet is being routed globally. To route local traffic locally and to have a centralized setup for local contents, local Internet economy; NIXA is being established." The request for proposals required the supply of two Cisco switches, four Cisco routers to be collocated with ISPs, one Nixus core router at the NIXA facility, four IBM servers, two host PCs, and two 100-Mbps microwave links between NIXA and the ISPs in Kabul.

Domestic Network Connectivity in Afghanistan

The Afghan Optical Fiber Network consists of a backbone built primarily along the country's circular Highway 1, also known as the Ring Road, with branches to other provinces and transborder connections to Pakistan, Iran, Turkmenistan, Uzbekistan, and Tajikistan. Construction was begun in 2007; current plans call for the construction of a network that will span 4,400 kilometers at a total cost of USD\$130 million. Partial financing was provided by the World Bank Group.

The core ring network comprises 18 fiber pairs in a 40 millimeter, high-density polyethylene duct operating at an initial capacity of STM-16 (2.5 Gbps), upgradeable to STM-64 (10 Gbps). Completed segments of the ring network connect the centers of more than a dozen provinces.

Eastern segments along the ring road connect the provinces of Kandahar (Kandahar city), Zabul (Qalat), Ghazni (Ghazni city), Maidan Wardak (Maidan Shar), Kabul (Kabul city), Parwan (Charikar), Baghlan (Puli Khumri), Kunduz (Kunduz city), Samangan (Samangan city), Balkh (Mazar-i-Sharif), Jowzjan (Sheberghan), and Faryab (Maymana).

A western segment along the ring road connects Herat (Herat city) and Farah (Farah city) in the west of the country.

Between Maymana and Karukh, there is an interruption in the network's continuity, as segments are still under development; however, it is possible to bypass the unfinished segments by using Turkmentelecom's

network in Turkmenistan. Redundancy between Kandahar and Kabul is possible via PTCL's fiber network in Pakistan.

Extensions of the network in the east of the country connect to the provinces of Nangarhar (Jalalabad), Laghman (Mihtarlam), Logar (Pul-i-Alam), Ghazni (Ghazni city), and Paktika.

The network is also being expanded from Charikar (Parwan Province) to Bamyan, Chaghcharan (Ghor Province), and Daykundi; construction of those segments were scheduled to be completed during the Solar Hijri year of 1393, which ended in March of 2015.

The Optical Fiber Network is governed by the Open Access Policy of the Afghanistan Ministry of Communications and Information Technology, which was enacted in 2012 in order to "make sure retail telecommunications providers each have access to technologies such as high speed fiber, enabling all providers to serve Afghans at the lowest possible price and still turn a reasonable profit." The policy sets forth core principles of non-discrimination, transparency, and cost-based pricing.

Afghan Telecom, which began operations in April of 2006, assumed responsibility for operating all government-owned telecommunications networks in existence at the time of its creation. In addition to the country's fiber optic backbone, Afghan Telecom operates the Government Communication Network (GCN) and the District Communication Network (DCN).

Afghan Wireless Communications Company operates a 2,500-kilometer domestic microwave network.

Most mobile base stations are deployed around the country's ring road, with the highest concentration of towers in the southeast and north of the country. The weakest mobile network coverage is in eastern Badakhshan, southern Paktika, eastern Farah, southern Kandahar, Ghor, and Nimruz provinces.

International Internet Bandwidth and Capacity Pricing in Afghanistan

Figure 1: International Internet Bandwidth and Capacity Pricing in Afghanistan, 2014

International Internet Bandwidth	International Internet bandwidth per Capita	International Capacity Pricing
15 Gbps	0.5 Kbps	IP transit: USD\$35 per Mbps per month

Source: Terabit Consulting research, Operator data and interviews

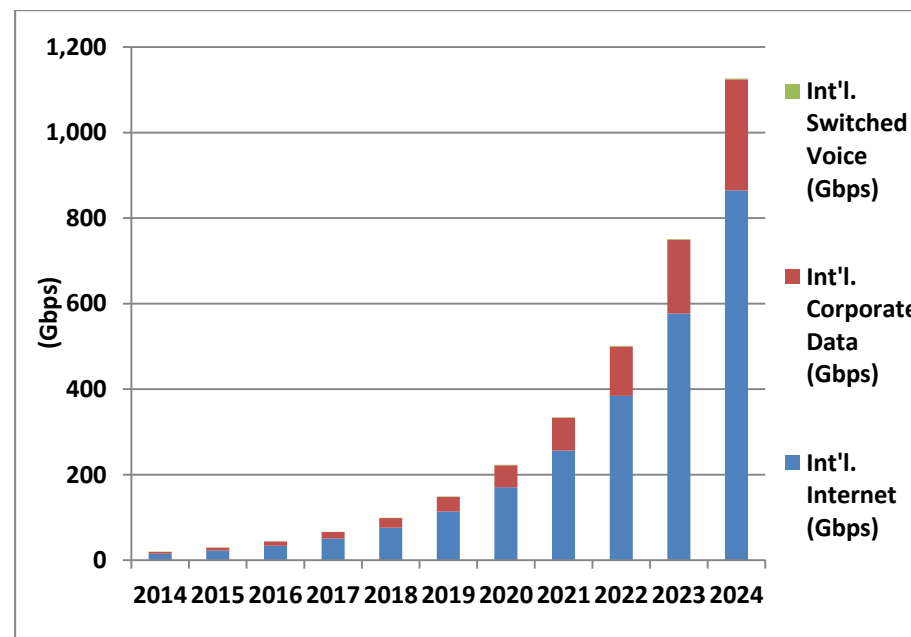
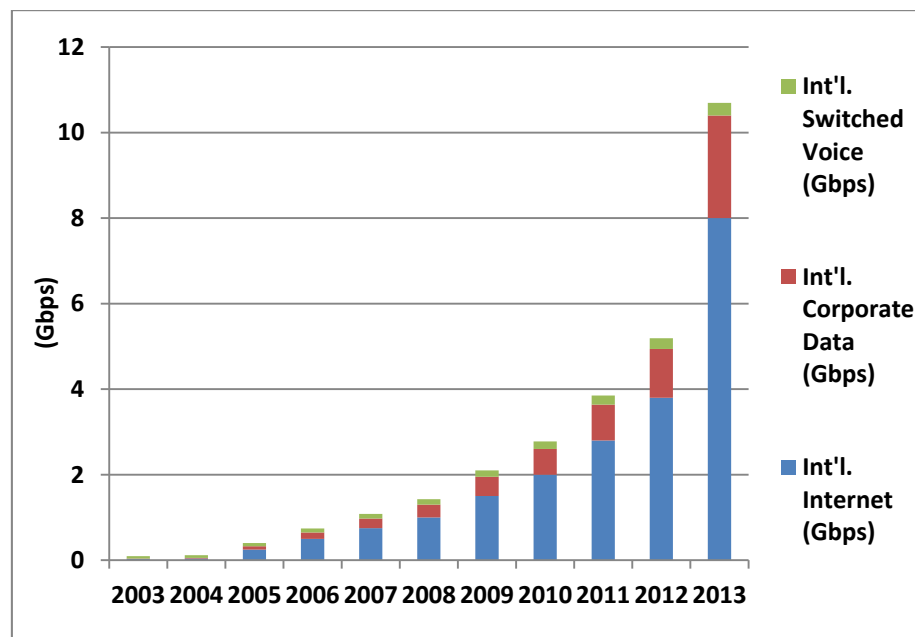
Afghanistan's international Internet bandwidth was 15 Gbps as of 2014. Bandwidth grew at a compound annual growth rate of 81 percent since 2004 when it was only 40 Mbps. During the five-year period between 2009 and 2014 the compound annual growth rate was 58 percent.

IP transit was priced at \$35 per Mbps per month as of year-end 2014, having fallen an average of 38 percent annually since 2004, when prices were \$4,000 per Mbps. The most precipitous declines took place after the activation of international fiber capacity in 2008, prior to which all international connectivity had been via costly satellite links. Prices fell below \$1,000 in 2011 and below \$100 in 2013.

Afghan Telecom offers unprotected international circuits to Pakistan for \$120 per Mbps, to Iran for \$170 per Mbps, and to Uzbekistan for \$400 per Mbps.

Figure 2: Historical and Forecasted International Bandwidth in Afghanistan (Gbps), 2003-2024

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
International Internet	0.0	0.0	0.3	0.5	0.8	1.0	1.5	2.0	2.8	3.8	8.0
International Corporate Data	0.0	0.0	0.1	0.2	0.2	0.3	0.5	0.6	0.8	1.1	2.4
International Switched Voice	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3
Total International Bandwidth	0.1	0.1	0.4	0.7	1.1	1.4	2.1	2.8	3.9	5.2	10.7
CAGR (2003-2013)	60%										
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
International Internet	15	23	34	51	76	114	171	256	384	577	865
International Corporate Data	5	7	10	15	23	34	51	77	115	173	259
International Switched Voice	0	0	0	1	1	1	1	1	1	2	2
Total International Bandwidth	20	30	44	66	99	149	223	334	501	751	1,126
CAGR (2014-2024)	53%										



International Network Connectivity in Afghanistan

➤ Initial Satellite Connectivity

The eight-meter Mahtab Qala satellite earth station is located on Shaheed Mazari Road in Kabul and offers international gateway services for voice and data as well as television. It was inaugurated in 2006 at a cost of \$3.8 million, provided by the World Bank within the aegis of the Afghanistan Reconstruction Trust Fund. The previous Kabul earth station originally transmitted to the Statsionar-13 Russian satellite and the Express-06 Intersputnik satellite. However, that earth station was destroyed during the U.S.-led invasion in 2001.

➤ Terrestrial Fiber Optic Cables Overview

Afghanistan is connected to all of its neighbors via terrestrial fiber connections, with the exception of China.

Afghanistan has dual fiber links to Pakistan and Turkmenistan, as well as links to Iran, Tajikistan, and Uzbekistan.

Afghanistan and China share a short 76-kilometer border, but there are no transport links between the countries; the only future possibility for a transport connection would be via the treacherous Wakhjir Pass in the Pamir Mountains. On the Chinese side of the border, authorities reportedly installed fiber to the area in 2009 or 2010, but on the Afghan side, there are no immediate plans for telecommunications infrastructure east of Faizabad or Panjshir.

➤ Afghanistan-Iran

Afghanistan-Iran	
Length	Estimated to be 10 kilometers
International Connectivity	- A link between Islam Qala, Afghanistan (west of Herat) and Dogharoun, Iran (east of Taybad).
Main Nodes	Islam Qala
Capacity	In 2012 the link was reportedly operating at 200 Mbps.
Network Technology	SDH
Developers / Owners / Operators / Suppliers	- Afghan Telecom - Telecommunications Infrastructure Company (TIC, Iran)
Continuity with Rail/Highway	- The cable follows the A1 (Islama Qala-Herat) Highway and Route 36 in Iran.
Notes	- The Telecommunications Infrastructure Company of Iran said that it expected its Afghan gateway to be upgraded to 430 Gbps [sic] by 2017.

➤ Afghanistan-Pakistan (northern and southern links)

Afghanistan-Pakistan (northern and southern links)	
Length	The two main cities linked by the northern connection are Jalalabad, Afghanistan and Peshawar, Pakistan, a distance of 135 kilometers; in the south, the distance from Kandahar, Afghanistan to Kuchlak, Pakistan via Spin Boldak, Afghanistan is approximately 215 kilometers.
International Connectivity	<ul style="list-style-type: none"> - A northern link connects Torkham, Afghanistan and Torkham, Pakistan. - A southern link connects Spin Boldak in Kandahar Province, Afghanistan and Chaman, Pakistan.
Main Nodes	Torkham and Spin Boldak
Capacity	Sources in Pakistan told Terabit Consulting that the total terrestrial bandwidth between Afghanistan and Pakistan was 10 Gbps as of 2014. Afghan Telecom purchased 1 Gbps of IP transit from Pakistan Telecommunications Company Ltd. (PTCL) and another 1 Gbps from Pakistani Internet service provider Wateen.
Network Technology	SDH
Developers / Owners / Operators / Suppliers	<ul style="list-style-type: none"> - Afghan Telecom - Pakistan Telecommunications Company Ltd. (PTCL)
Continuity with Rail/Highway	<ul style="list-style-type: none"> - The northern cable at Torkham is laid along the Asian Highway (AH-1). - The southern cable at Spin Boldak is laid along the A75 highway in Afghanistan and the N25 highway in Pakistan.
Notes	- Terrestrial links between the two countries were under development since 2009 but were reportedly delayed due to security concerns. However, in 2014 sources confirmed that the links were operational.

➤ Afghanistan-Tajikistan

Afghanistan-Tajikistan	
Length	5 km
International Connectivity	- Sher Khan Bandar, Afghanistan to Panji Poyon, Tajikistan
Main Nodes	Sher Khan Bandar
Capacity	2.5 Gbps
Network Technology	SDH
Developers / Owners / Operators / Suppliers	<ul style="list-style-type: none"> - 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-Tajikistan 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. The link was reportedly activated in 2009.

➤ Afghanistan-Turkmenistan (eastern and western links)

Afghanistan-Turkmenistan (eastern and western links)	
Length	The western link is estimated to be 50 kilometers and the eastern link is approximately 175 kilometers.
International Connectivity	<ul style="list-style-type: none"> - 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	<ul style="list-style-type: none"> - 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	- The links were reportedly completed in 2013. Afghan Telecom reported it intends to use the Turkmentelecom network to link the fiber network in the northwest of Afghanistan with the fiber network in the east; the networks are currently isolated from one another while the national ring-road fiber network is under construction.

➤ Afghanistan-Uzbekistan

Afghanistan-Uzbekistan	
Length	100 km
International Connectivity	- The fiber link crosses between Afghanistan and Uzbekistan over the Amu Dharria 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	<ul style="list-style-type: none"> - Owned and operated by Uzbektelecom and Afghan Telecom - Russian operator Rostelecom also reportedly uses the Afghanistan-Uzbekistan link as part of its "Europe-Afghanistan" network.
Continuity with Rail/Highway	<ul style="list-style-type: none"> - 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.
Notes	- Completed in 2009

III. COUNTRY ANALYSIS: MONGOLIA

	YE 2014
Population	2.9 million
<i>Population Growth Rate</i>	1.5%
Gross Domestic Product (PPP)	USD\$35 billion / \$12,000 per capita
<i>GDP Growth Rate</i>	5.0% in 2013, 5.5% forecasted in 2014
Human Development Index	0.698
<i>HDI Ranking</i>	103 rd out of 187 ("Medium")
Literacy Rate	98%
Fixed Line Subscribers	212,000
Fixed Line Operators	<ol style="list-style-type: none"> 1. Telecom Mongolia 2. Univision (Unitel) 3. Skymedia (Skytel) 4. Mobinet (Mobicom) 5. UB Railway 6. Cyber Security Authority
Mobile Subscribers	4.4 million
Mobile Operators	<ol style="list-style-type: none"> 1. Mobicom 2. Unitel 3. Skytel 4. G-Mobile
Mobile Broadband	3G launch in 2009; 4G LTE expected in 2015
Regulatory Agency	Communications Regulatory Commission of Mongolia
International Internet Bandwidth	30 Gbps
<i>Int'l. Internet Bandwidth per Capita</i>	10.3 Kbps
Internet Service Providers	<ol style="list-style-type: none"> 1. Optinet 2. Erdemnet 3. Sky C&C 4. Sansar 5. MTC 6. Magicnet 7. BMD 8. Boldsoft 9. H&I 10. Asiatel 11. Gnet 12. Yokozunanet 13. Univision
Fixed Broadband Subscribers	175,000 fixed broadband subscribers (>256 Kbps) 900,000 mobile broadband subscribers
Fixed Broadband Technologies	FTTx, ADSL, Wi-Max, Wi-Fi
Typical Monthly Broadband Subscription	<ol style="list-style-type: none"> 1. USD\$6.60 per month for 1 Mbps ADSL with unlimited download + USD\$5 installation (<i>Telecom Mongolia-Ulaanbaatar</i>) 2. USD\$8.20 per month for 1 Mbps ADSL with unlimited download + USD\$5 installation (<i>Telecom Mongolia-Other cities</i>)

Telecommunications Market Overview

The Mongolian telecommunications market was estimated to be worth approximately \$350 million in 2014. Mobile revenues in 2014 were between \$250 million and \$300 million. The Internet sector generated between \$40 million and \$50 million, and fixed-line revenues were slightly less than \$20 million. Since 2010 the value of the overall market has grown at a compound annual growth rate of approximately 16 percent.

As of 2014, Mongolia's telecommunications industry is controlled mostly by Mongolian shareholders, including the Government of Mongolia, which is the majority shareholder in the country's incumbent fixed-line operator, as well as a number of Mongolian private-sector holding companies and other investors. Historically, the country's telecommunications industry benefitted from significant foreign investment, most notably from South Korean and Japanese investors, whose investments have included shares in Telecom Mongolia, Mobicom, Unitel, and Skytel.

The telecommunications market is competitive and dynamic, with four major operators present in the mobile market and four in the consumer fixed-line market. In both sectors, the leading operators (Mobitel and Telecom Mongolia, respectively) have seen their market shares cut in half since 2006.

The mobile sector's average revenue per user (ARPU) is estimated to be approximately USD\$6 per month and has fallen considerably as mobile penetration rates grew from 100 percent in 2011 to 150 percent in 2014.

Regulation and Government Intervention

The Mongolian telecommunications sector is regulated by the Communications Regulatory Commission of Mongolia, which was established in 2002. The Information Communications Technology and Post Authority of Mongolia (ICTPA) was established in 2004 and is responsible for the development of strategy and policy. The Laws on Communication was implemented in 1995 and amended in 2001.

A universal access program, the Information and Communications Infrastructure Development Project, was carried out between 2006 and 2013, with funding from the World Bank Group. By the end of the project each of the country's 360 sum centers (district seats) had telephony and Internet service, and 34 had high-speed Internet service. The program also improved Internet connectivity among the rural herder population.

The Mongolian government has also actively promoted e-Government and telemedicine programs; the latter serves approximately 2,000 patients annually, resulting in a 20 percent decrease in the number of rural patients transferred to Ulaanbaatar hospitals.

Fixed Line Telephony Market

As of mid-2014 there were 211,000 fixed-line subscribers. Incumbent operator Telecom Mongolia is the country's largest fixed-line carrier, with a share of 42.4 percent as of mid-2014. Korea Telecom (now KT Corporation) acquired a 40 percent stake in Telecom Mongolia in 1995. The government remains the company's majority shareholder, with a stake of approximately 55 percent, while approximately 5 percent of Mongolia Telecom shares are publicly traded.

Mongolian fixed-line subscribership contracted by 21 percent between 2010 and 2012, when there were only 152,000 subscribers; the market then grew to more than 200,000 subscribers in 2013 and 2014. Much of the recent increase was due to aggressive "triple-play" offerings from IPTV operators Univision (a member of the Unitel Group) and Skymedia (a subsidiary of Skytel).

Univision had a 31.2 percent share of the market as of mid-2014, and Skymedia had a 16.0 percent share. Mobinet, a subsidiary of Mobicom, started offering fixed-line services in 2013 and quickly grew its market share to 5.2 percent as of mid-2014. The three operators' gains came at the expense of Telecom Mongolia, which saw its fixed-line share cut in half from 92.8 percent in 2008.

Mobile Telephony Market

Mongolia's first mobile network was launched in March of 1996 and by late-2011, the country's mobile penetration eclipsed 100 percent.

As of mid-2014, subscribership was reported to be 4.3 million; it was estimated to be 4.4 million as of the end of 2014, representing a penetration rate of approximately 1.5 lines per person. The market is served by four operators: Mobicom, Unitel, Skytel, and G-Mobile.

Mobicom is Mongolia's largest mobile operator, with a 39.5 percent market share. It was also the country's first mobile operator; its shareholders include Mongolian investment company Newcom Group, with 40 percent, the Japanese operator KDDI, with 30 percent, and the Japanese investor Sumitomo, also with 30 percent. Mobitel upgraded its WCDMA network in Ulaanbaatar to support HSPA data transmission in 2009, using equipment supplied by Ericsson. In 2014 the operator reported that its network had been expanded with 147 new base stations at a cost of USD\$10 million.

Unitel launched service in 2006 as a joint venture between South Korean and Mongolian investors; as of 2010 the Korean investors had sold their shares and the Mongolian company MCS Holding became the company's majority shareholder. Unitel grew its market share to approximately one-third by 2012 and as of mid-2014 its market share was 35.6 percent. Unitel's 3G HSDPA network was launched in 2009. In late-2014 the operator expanded its 3G coverage to include the 1,007-kilometer A-class highway between Altanbulag (on the Russian border in the north) and Zamyn-Uud (on the Chinese border in the south) via 51 base stations; during the network's inauguration ceremony, the chairman of the Information Technology, Post, and Telecommunication Authority noted that the network would serve not only road traffic but also passengers on the parallel railway line.

Skytel is Mongolia's third-largest mobile operator with a market share of 13.8 percent. It was founded in 1999 by investors which included South Korean manufacturer Taihan Electric Wire and South Korean operator SK Telecom, which acquired a 20 percent stake the venture in exchange for allowing the implementation of analog mobile equipment that had been retired by SK Telecom in its own Korean mobile network at the time of an upgrade to CDMA technology. SK Telecom increased its stake in Skytel to 29 percent in 2002 but sold its shares in 2010; the company is now owned by Mongolian investors Altai Holding and Shunkhlai Group. The Chinese supplier ZTE supplied WCDMA equipment to Skytel in 2009, and in 2010 the operator began offering HSPA+ services with download speeds of up to 21 Mbps.

G-Mobile is the country's smallest operator, with a market share of 11.2 percent. A joint venture between Mongolian investors MT Group and Gem International, G-Mobile launched its network in 2007. In 2008 it introduced limited 3G service, becoming the first Mongolian operator to do so.

With the strong growth of Unitel and the emergence of G-Mobile, market leader Mobicom's share of mobile subscribers has fallen by half since 2006, when it had a 79.3 percent market share.

Internet and Broadband Market

The Communications Regulatory Commission reported that there were 1.1 million Internet subscribers in Mongolia as of mid-2014, representing a penetration rate of 38 percent.

There were more than 30 active Internet service providers as of 2014; they included Optinet, Erdemnet, Sky C&C, Sansar, MTC, Magicnet, BMD, Boldsoft, H&I, Asiatel, Gnet, Yokozunanet, Univision, Digicom, Incomnet, Nomsys, Ulusnet, Gmobilenet, Mobinet, Kewiko, Citinet, Megajit, Supervision, NIT systems, Comtel, Topika, CITUnivercity, UCS, and Progamers Network. Gemnet, Mobicom, and Railcom were the primary providers of international Internet transit bandwidth.

Mobile Internet subscribers totaled slightly less than 900,000, representing five-sixths of all subscriptions. Fixed broadband subscribers, totaling approximately 175,000, were connected primarily via fiber optic cable (114,000 subscribers). Digital Subscriber Line served 27,000; Wi-Max served 19,000; and there were 12,000 Wi-Fi subscribers. Dial-up connections were used by fewer than 9,000 subscribers.

Ulusnet, a subsidiary of Mobicom, launched limited WiMax service in Ulaanbaatar in February of 2007, using base stations and customer premise equipment supplied by Airspan Networks. The network was expanded to serve some rural areas in 2011.

In 2013 the Internet service provider Nomsys announced the deployment of the “Community Involved Nomad Wi-Fi Project” which would consist of hundreds of Wi-Fi hotspots throughout Ulaanbaatar and adjoining rural areas. The network used equipment supplied by Ruckus Wireless.

In February of 2014 the Mongolian media reported that Telecom Mongolia was planning to implement 4G LTE service in Ulaanbaatar by late-2015 and in each of the country’s 23 aimags by 2018. The first phase of deployment would reportedly be funded by Mongolia Telecom’s strategic investor KT Corporation; the nationwide implementation project would cost an estimated USD\$1.9 billion.

Domestic Network Connectivity in Mongolia

Mongolia’s domestic fiber optic networks span more than 33,300 kilometers. Fiber deployment tripled between 2009 and 2014.

The network of government-owned Information Communication Network Company, also known as Netcom, covers 16,556 kilometers and accounts for half of the country’s total fiber deployment. In the west, the network links Ulgii, Hovd, Ulaangom, Ulaistai, Altai, Murun, Bulgan, Tseterleg, Arvaihkeer, Bayankhongol, Dalanzadgad, and Mandalgobi. In the east, it connects Ulaanbaatar, Undurkhaan, Baruun-Urt, and Choibalsan.

Mobicom and Skynetworks (Skytel) each operate networks of approximately 7,000 kilometers in length.

Railcom, a subsidiary of Mongolian Railway, operates a 1,400-kilometer fiber network along the country’s primary north-south railway, which is linked with the networks of TransTelekom (TTK) in Russia and China Unicom to provide Europe-to-Asia connectivity. Domestically, its major points of presence are in Sukhbaatar, Zuunkharaa, Ulaanbaatar, Sainshand, and Zamyn-Uud. Railcom has identified G-Mobile, Mobicom, Telecom Mongolia, and Unitel as clients of its domestic leased-line service.

Wholesale network operator Gemnet maintains 1,200 kilometer network which it reports to be upgradeable to a design capacity of 400 Gbps. Gemnet also reportedly leases fiber capacity from Netcom and Railcom.

In addition to the Netcom fiber network, the Government of Mongolia also operates a digital microwave network comprising approximately 1,500 kilometers of links, and between 400 and 500 very small aperture terminal (VSAT) antennae for rural connectivity.

International Internet Bandwidth and Capacity Pricing in Mongolia

Figure 3: International Internet Bandwidth and Capacity Pricing in Mongolia, 2014

International Internet Bandwidth	International Internet bandwidth per Capita	International Capacity Pricing
30 Gbps	10.3 Kbps	IP transit: \$50 per Mbps per month

Source: Terabit Consulting research, Operator data and interviews

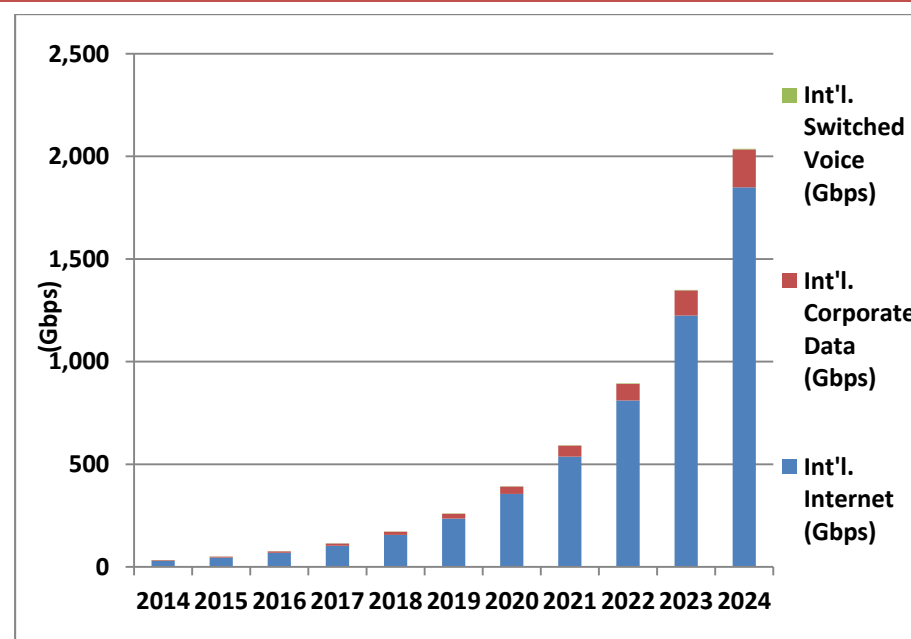
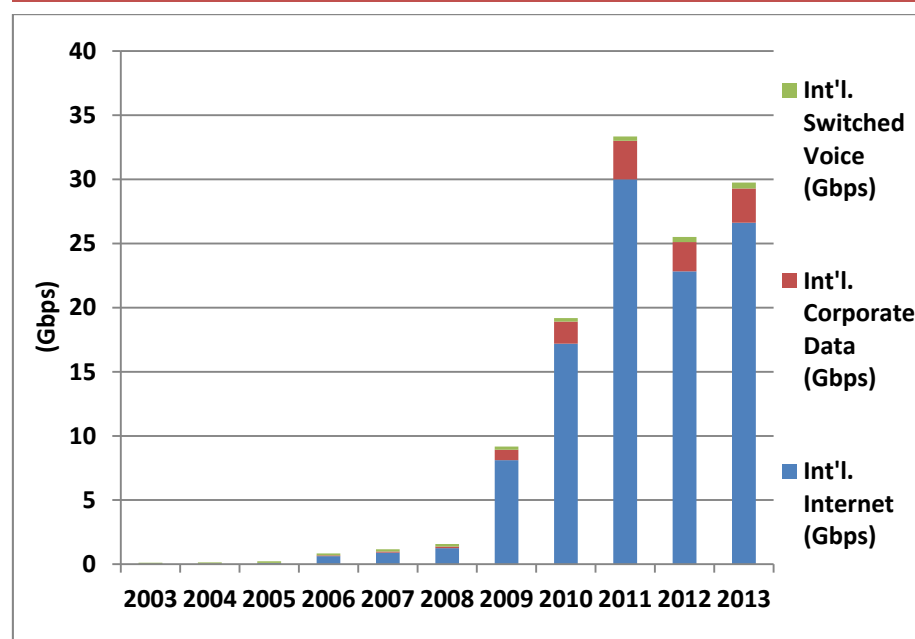
As of mid-2014, Mongolia's international Internet bandwidth was 28.3 Gbps; it was estimated to be at least 30 Gbps as of the end of 2014. According to the Communications Regulatory Commission, the country's bandwidth grew 24-fold between 2008 and 2011, then seemingly leveled off in the following three years, although some sources hypothesized that this may have been due to incorrectly reported data from the country's operators.

Gemnet is the country's largest bandwidth wholesaler; it reported an 80 to 90 percent share of the IP transit market. Its upstream bandwidth providers include the Russian Railways subsidiary TransTelekom (TTK), China Telecom, and Level 3. MobiNet (a subsidiary of Mobicom) and Railcom also advertise wholesale bandwidth services; Railcom has identified the following clients of its IP transit services: Bodicom, Boldsoft, Eznis, G-Mobile, Gnet, Hans Communications, Incomnet, MCSCCom, Mobinet, Sky C&C, Ulusnet, and WirelessCom.

As of the end of 2014, sources indicated that wholesale IP transit bandwidth in Mongolia cost approximately USD\$50 per Mbps per month.

Figure 4: Historical and Forecasted International Bandwidth in Mongolia (Gbps), 2003-2024

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
International Internet	0.0	0.0	0.1	0.6	0.9	1.2	8.1	17.2	30.0	22.8	26.6
International Corporate Data	0.0	0.0	0.0	0.1	0.1	0.1	0.8	1.7	3.0	2.3	2.7
International Switched Voice	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.5
Total International Bandwidth	0.1	0.1	0.2	0.8	1.2	1.6	9.2	19.2	33.3	25.5	29.8
CAGR (2003-2013)	75%										
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
International Internet	30	45	68	103	156	236	356	537	811	1,224	1,849
International Corporate Data	3	5	7	10	16	24	36	54	81	122	185
International Switched Voice	1	1	1	1	1	1	2	2	2	2	3
Total International Bandwidth	34	50	76	115	173	260	393	592	894	1,349	2,037
CAGR (2014-2024)	47%										



International Network Connectivity in Mongolia

➤ Initial Satellite Connectivity

There is a satellite earth station complex in Ulaanbaatar; the first antennas installed in the complex allowed for international communications via the Intersputnik and Asiasat network. In 1994, with technical assistance from KDD of Japan, an Intelsat A-standard antenna known as “Naran” was installed in the complex. It initially offered connectivity via the Intelsat-6 satellite at 60 degrees E longitude and the Intelsat-5A satellite at 66 degrees E longitude; subsequent transmission was via the Intelsat 704 satellite at 66 degrees E.

➤ Terrestrial Fiber Optic Cables Overview

Mongolia has two international borders: one with Russia to the north, spanning 3,500 kilometers, and one with China to the south, spanning 4,700 kilometers. There are international fiber connections at Sukhbaatar on the northern border with Russia, and Zamiin-Uud in the southern border with China; they form part of a relatively low-latency terrestrial path between Europe and Asia via national networks in Russia and China.

➤ China-Mongolia-Russia Links

China-Mongolia-Russia Links	
Length	7,500, including 1,300 within Mongolia
International Connectivity	<ul style="list-style-type: none"> - Sukhbaatar, Mongolia to Naushki, Russia - Zamyn Uud, Mongolia to Erenhot, China
Main Nodes	Ulaanbaatar
Capacity	Initial capacity along the route was 622 Gbps in 2004, but by 2006 it was upgraded to support dense wavelength division multiplexing (DWDM). In 2015 TransTelekom reported that they had 60 Gbps of capacity on the route, but that figure included significant Europe-to-Asia transit capacity. Gemnet reported upgradeability to 400 Gbps.
Network Technology	DWDM
Developers / Owners / Operators / Suppliers	<ul style="list-style-type: none"> - Railcom - TTK (TransTelekom of Russia) - China Unicom - China Telecom - Gemnet - Mobicom - MegaFon (formerly Synterra) - Rostelecom
Continuity with Rail/Highway	- Follows the Trans-Mongolian Railway
Notes	<ul style="list-style-type: none"> - Fiber along the route was initially installed by the Mongolian Railway Authority in 2000, funded by an \$18 million loan offered by the government of Japan in 1992. - An agreement for the construction of a higher-capacity network was signed by Railcom, China Unicom, and TTK in April of 2004. - Gemnet and Synterra (now MegaFon) said that their transborder interconnection was operating at 20 Gbps as of 2009. - Mobicom and Rostelecom signed a network interconnection agreement in December of 2011; Rostelecom reported that it sold 20 Gbps of initial capacity to Mobicom in a long-term deal valued at \$6 million. - China Telecom reported that the round-trip delay (latency) between Frankfurt and Hong Kong via Mongolia was only 200 milliseconds, the lowest of any Europe-to-Asia path. Hong Kong-to-London was 215 milliseconds. - China Telecom has uses capacity on the network in partnership with Railcom and TTK, as part of its "Transit-Mongolia Route."