United Nations

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Economic and Social Commission for Asia and the Pacific

Economic and Social Commission for Asia and the Pacific

An in-depth study on the broadband infrastructure in South and West Asia

November 2014

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

The generous funding support provided by the Ministry of Science, ICT and Future Planning, Republic of Korea, is gratefully acknowledged.

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Acronyms

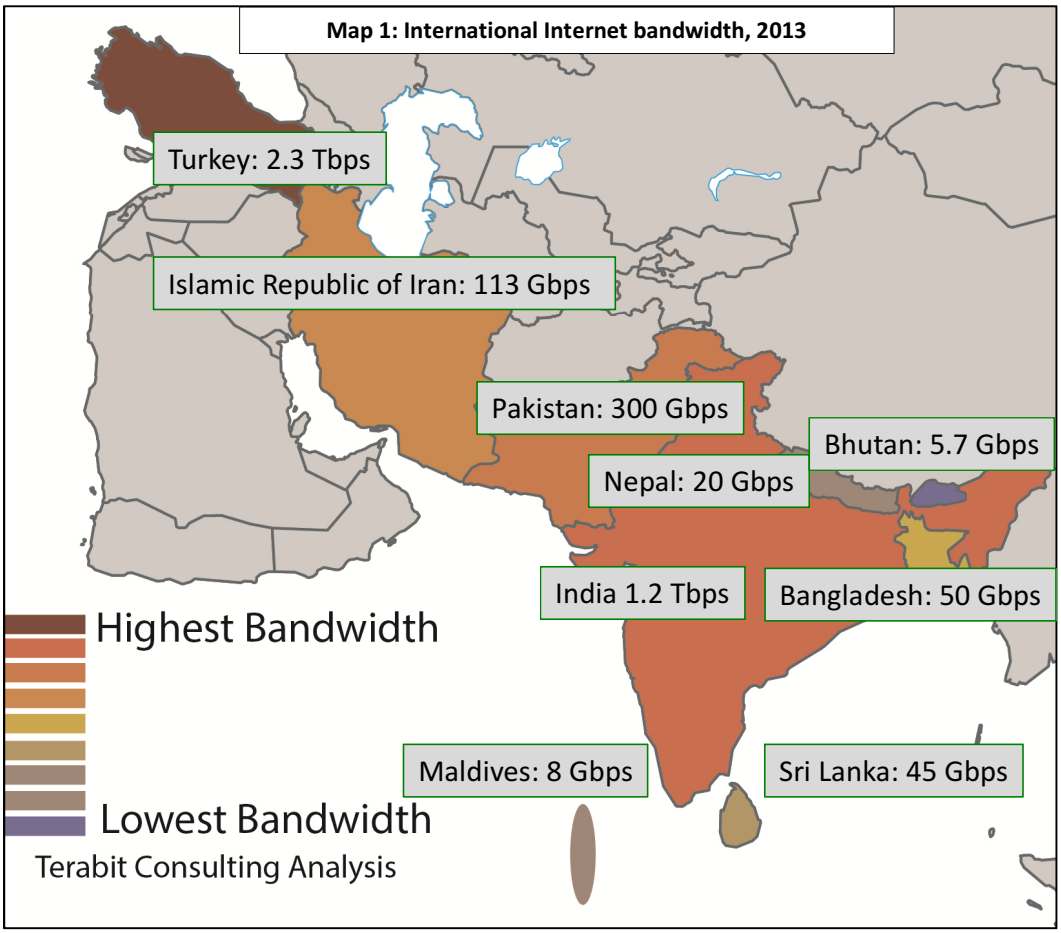
Asymmetric digital subscriber line	ADSL
Bangladesh Submarine Cable Company, Ltd.	BSCCL
Bangladesh Telecommunications Company, Ltd.	BTCL
Bharat Sanchar Nigam, Ltd.	BSNL
Compound annual growth rate	CAGR
Code division multiple access	CDMA
Enhanced data rates for GSM evolution	EDGE
Europe-India Gateway	EIG
Europe-Persia Express Gateway	EPEG
Evolution-data optimized	EvDO
Fiber-Optic Link Around the Globe	FLAG
Fibre-to-the-building	FTTB
Fibre-to-the-home	FTTH
Gulf Bridge International	GBI
Gross Domestic Product	GDP
General packet radio service	GPRS
Global system for mobile communications / Groupe spécial mobile	GSM
High speed packet access	HSPA+
Information and communications technology	ICT
Internet protocol	IP
Internet service provider	ISP
Jeddah-Amman-Damascus-Istanbul Link	JADI Link
Kilobytes per second	Kbps
Megabytes per second	Mbps
Mahanagar Telephone Nigam, Ltd.	MTNL
Long-term evolution	LTE
Optical ground wire	OPGW
Point of presence	POP
Public switched telephone network	PSTN
Pakistan Telecommunications Company, Ltd.	PTCL
Ready for service	RFS
South Asia Subregional Economic Cooperation	SASEC
Special purpose vehicle	SPV
Sri Lanka Telecom	SLT
Telecommunications Company of Iran	TCI
Telecommunications Infrastructure Company of Iran	TIC
Terabytes per second	Tbps
United Nations Economic and Social Commission for Asia and the Pacific	UNESCAP
Voice over Internet protocol	VoIP
Very small aperture transmission	VSAT
Wireless local loop	WLL

I. Executive summary

Between April and November 2014, Terabit Consulting performed a detailed analysis of telecommunications and Internet markets and broadband infrastructure in nine countries in South and West Asia: Bangladesh, Bhutan, India, the Islamic Republic of Iran, Maldives, Nepal, Pakistan, Sri Lanka and Turkey.

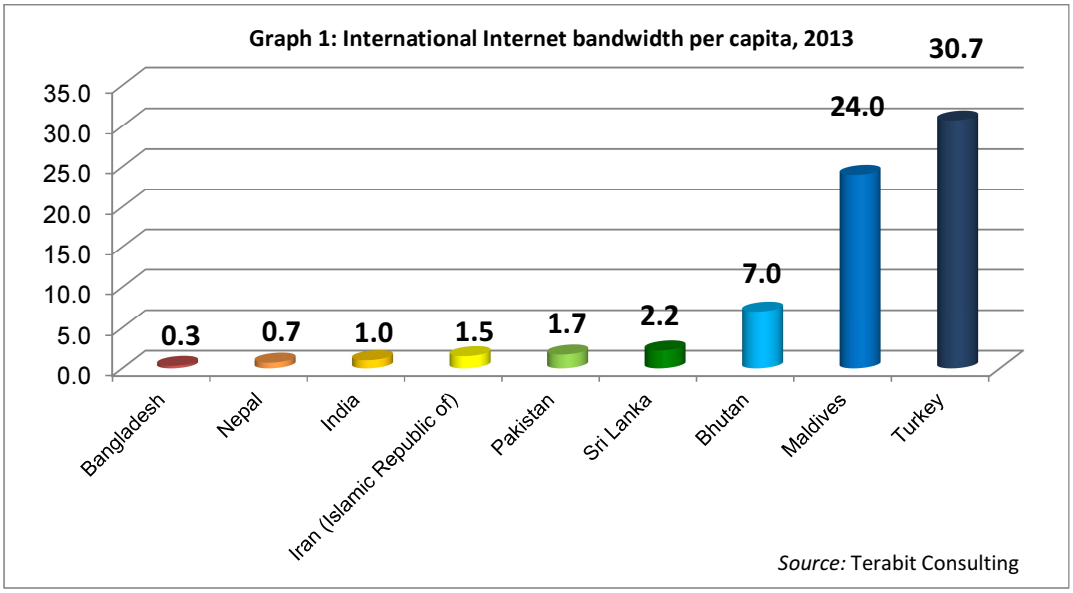
The analysis followed two previous studies carried out between 2012 and 2014 covering North, Central, and South-East Asia, for a total of 25 countries across the continent.

The analyses of South and West Asian countries, as well as the ongoing analyses of markets across the entire continent, revealed an acute disparity between those countries with sufficiently developed markets and infrastructure, and those without. An examination of the "fuel" of the region's information and communications technology (ICT) sector—international bandwidth—reveals that Asia's regional bandwidth inequality is the most pronounced of any continent.



Source: Terabit Consulting

Among the countries analysed in this study, Turkey benefits from per-capita international Internet bandwidth of more than 30 Kbps, while Bangladesh's is only 0.3Kbps, a ratio of 100 to 1. At less than 1 Kbps per capita, bandwidth is unworkably low in the markets of Bangladesh, India and Nepal (which together account for one-fifth of the world's population). Bandwidth in the Islamic Republic of Iran, Pakistan and Sri Lanka is also extremely weak, at 2.2 Kbps or less. By comparison, in Western Europe the average is approximately 100 Kbps.



The differences among the 25 Asian countries analysed were even more extreme. Per-capita international Internet bandwidth in the continent's leading market, Singapore, was more than 250 Kbps as of year-end 2012, while the country with the weakest international Internet bandwidth, Turkmenistan, had only 0.175 Kbps, a ratio of approximately 1,500 to 1.

Such striking disparity perpetuates the continent's uneven macroeconomic development. The region's bandwidth inequality manifests itself in the form of inequalities in the penetration, quality and affordability of consumer telecommunications and broadband services, the availability of new technology, and the overall development of telecommunications and Internet markets. Ultimately, the region's bandwidth inequality is a serious obstacle to economic growth, social development and social integration.

Many of the region's countries have for all intents and purposes become detached from the global Internet economy, with weak international bandwidth preventing the effective implementation of applications and technologies proven to increase growth and efficiency, such as e-learning, e-medicine and e-government. Over the course of its research and during interviews with sources, specific examples were found whereby weak and expensive international bandwidth had prevented technology companies and other bandwidth-intensive clientele from establishing operations in the region's less-developed markets, resulting in lost opportunities for economic growth and Government revenue.

This impact of weak international bandwidth on less-developed markets' telecommunications and Internet sectors, and the resulting impedance of economic growth, incurs significant economic and fiscal costs not only for the less-developed countries themselves, but for regional economic leaders as well. Constrained economic growth in bandwidth-starved countries has deprived the region's stronger economies of revenue-earning opportunities through the export of value-added products and services. Stronger economies such as Turkey and the Russian Federation, which have historically benefited from strong cultural, linguistic and economic ties to the continent's less-developed markets, are thus presented with diminished trade opportunities, not only in the ICT sector but across the entire economy.

The root cause of the region's bandwidth inequality is weak terrestrial fibre optic connectivity. The region's terrestrial connectivity is low-capacity, high-cost and extremely unreliable. It consists mostly of bilateral, point-to-point trans-border links. There are very limited numbers of multinational terrestrial fibre networks serving more than two countries and those that do exist function essentially as inefficient patchworks of domestic network segments stitched together across borders. There are no coherent, purpose-built, cost-effective, high-capacity regional terrestrial fibre optic networks in Asia. Without such connectivity, the region's less-developed markets—and landlocked countries in particular—will find it impossible to compete and thrive.

Based on the present analysis, there is a clear solution to the region's bandwidth inequality, one that would provide perhaps the greatest return on investment of any multinational development project: the implementation of a coherent, purpose-built, pan-regional terrestrial fibre optic network.

Such a network could be efficiently deployed by leveraging Asia's linear infrastructure, including the Asian Highway, the Trans-Asian Railway and energy distribution networks. The extra cost of fibre network installation along highway rights-of-way during open road construction is less than 1 per cent and, depending on labor costs, can sometimes be so low as to be considered as a rounding error within the context of the overall project budget. Across the continent, there are multiple near-term and long-term transport and energy network expansion and improvement projects that would be logical candidates for the simultaneous implementation of either new fibre networks, or at the very least, ducts that could accommodate future fibre installation.

The implementation of fibre connectivity offers clear cross-sectoral benefits and efficiencies for the operators of linear infrastructure (such as operators of highway, rail and energy distribution networks). The advanced fibre network connectivity would allow the network operators to benefit from improved internal communications and would also allow for the implementation of advanced technologies including intelligent transport systems, electronic toll collection, automatic speed enforcement and dynamic power grid control. Furthermore, network owners and operators would receive fibre network right-of-way payments that are often a lucrative source of revenue.

Given that the analysis identified weak international bandwidth connectivity as a root cause of less developed telecommunications and Internet markets, expensive consumer and wholesale pricing of bandwidth, and limited availability and penetration of advanced ICT including consumer broadband, it is imperative that pan-regional terrestrial fibre optic network connectivity adhere to several key principles in order to maximize its benefits for the entire region. The network should be coherently designed and purpose-built from its inception, it should control costs by leveraging linear infrastructure and employing the latest transmission technology. It should also be overseen and managed transparently in a way that ensures a non-discriminatory, open access marketplace.

First and foremost, a successful "Asian information superhighway" should be fully integrated and coherent. Analysis of existing and planned infrastructure reveals that trans-border, bilateral fibre infrastructure has

done little to rectify Asia's bandwidth imbalance. Instead, the region's bilateral links have allowed markets with access to abundant, cost-efficient submarine cable capacity to exploit less-developed neighbouring markets by acting as a primary source of what is ultimately less-reliable, low-quality, high-cost bandwidth. Similarly, research has shown that existing multinational terrestrial fibre networks suffer from low reliability, high costs, and incoherent operational and commercial structures that effectively position the networks as assemblages of domestic segments overseen by different operators, each with different and sometimes conflicting interests. The success of the Asian information superhighway in addressing the region's inequities would be predicated upon its design, implementation and operation as a purpose-built, coherent, end-to-end regional infrastructure and not as a patchwork of individual segments joined together ex post-facto.

Second, to ensure affordable bandwidth at both the operator and consumer levels, the Asian information superhighway must control its costs. This can be accomplished by leveraging existing linear infrastructure and synchronizing deployment with planned improvements and expansion in the transport and energy sectors, taking advantage of the low marginal cost of installing duct and fibre during such projects. Furthermore, unit costs must be kept competitive with submarine cable networks by adopting high fibre counts and 100G wavelengths, which within the last two years have proven to be the most cost-effective transmission bitrate on a per-unit basis.

Finally, the commercial structure of the Asian information superhighway should consist of a special purpose vehicle (SPV), with both public and private shareholding, established with the express purpose of ensuring the success of the project and achieving its objectives, including a fiduciary duty to ensure profitability while still adhering to principles that promote the effective economic development of the entire region. An independent SPV model would ultimately serve as a safeguard against individual stakeholders' efforts to promote their own more limited interests, which could conflict with the best financial and economic outcomes wished for the project as a whole. Arm's-length oversight would also ensure open access to the network on a non-discriminatory basis.

Based on the present research of the region's markets and infrastructure, it can be concluded that a distributed, multilateral approach to network development is the only solution for the clear market failure, which has thus far deprived consumers of innovation and cost-effective services, prevented growth and efficiencies at both the microeconomic and macroeconomic level, and deprived the region's Governments of billions of dollars in resultant revenue.

The geographical design of the Asian information superhighway is of utmost importance. Within the South and West Asia region of the study, seven "high-priority" international borders were identified as being in urgent need of improved connectivity, in addition to three "medium-priority" borders that would greatly benefit from additional fibre.

The high-priority trans-border projects are:

- Bangladesh / Myanmar
- Bhutan / India
- India / Myanmar
- India / Pakistan
- Nepal / China
- Pakistan / China
- Turkey / Armenia

The medium-priority trans-border projects are:

- India / China

- India / Nepal
- Islamic Republic of Iran / Pakistan

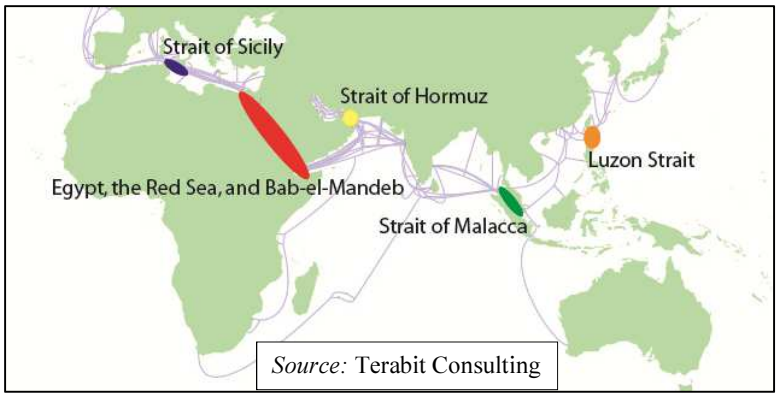
By leveraging existing and planned linear infrastructure such as transport and energy networks, these border crossings should be the focus of plans for improved, coherent, pan-regional terrestrial fibre connectivity under the aegis of a coherent Asian information superhighway.

In addition to addressing the urgent, near-term requirements of improved connectivity in critically underserved border regions, the routing of the Asian information superhighway should take into consideration the network diversity requirements of all of the region's markets, in order to maximize the network's utility for stakeholders across the continent. To that end, a well-designed pan-Asian mesh fibre network could ultimately become the primary international outlet not only for landlocked, less-developed countries, but for markets that are well-served but overly-reliant upon submarine infrastructure, including India and Singapore.

In the process of designing a network route that meets the primary requirements of Asian operators, an incidental yet serendipitous benefit would be the creation of a network that could effectively capture Europe-to-Asia traffic, 95 per cent of which is now handled by submarine cables. If the new Asian information superhighway infrastructure were able to capture even a small part of such traffic, currently in excess of 10 Tbps, preliminary estimates indicate that the commercial case for the project would be extremely robust.

The Europe-to-Asia market opportunity that presents itself is a unique one, in that operators and bandwidth customers worldwide have for the last two decades been seeking a reliable, cost-effective alternative to the concentration of Europe-to-Asia submarine cables passing through Egypt (as well as other "choke points" along the route). There has yet to be any reliable and cost-effective solution, as the disparate resources of network operators and small consortia in Asia and the Middle East have proven no competitive threat to the efficiencies of submarine cables. However, by leveraging the collective potential of stakeholders across the region for the implementation of a coherent, redundant, high-capacity, cost-effective network, the Asian information superhighway could not only compete effectively with submarine cable infrastructure, but it could ultimately become a primary path for the eventual petabits of traffic between the strongest economies of Western Europe and East Asia.

Map 2: Undersea cable choke points affecting Asia



Source: Terabit Consulting

Table 1: Overview of broadband status by country

Country	GDP per capita 2013 (US$)	International bandwidth per capita (Kbps)	International connectivity	Domestic connectivity	IP transit price	Competitiveness of telecom market	Fixed and mobile broadband infrastructure	Annual 1 Mbps broadband subscription + installation as % of nominal GDP per capita
Bangladesh	2,200	0.3	Weak	Moderate	Expensive	Somewhat competitive	Limited	Very expensive
Bhutan	7,000	7.6	Weak	Limited	Expensive	Less competitive	Limited	Reasonable
India	4,000	1.0	Excellent	Moderate	Moderate	Competitive	Limited	Reasonable
Iran (Islamic Republic of)	14,300	1.5	Excellent	Limited	Expensive	Less competitive	Limited	Reasonable
Maldives	10,000	24.0	Sufficient	Moderate	Expensive	Less competitive	Limited	Reasonable
Nepal	1,500	0.7	Weak	Limited	Expensive	Less competitive	Limited	Very expensive
Pakistan	4,300	1.7	Somewhat weak	Moderate	Expensive	Somewhat competitive	Limited	Somewhat expensive
Sri Lanka	8,100	2.2	Sufficient	Moderate	Expensive	Less competitive	Limited	Affordable
Turkey	16,900	30.7	Sufficient	Moderate	Very reasonable	Less competitive	Limited	Extremely affordable

Table 2: Summary and analysis of international bandwidth by country

Country	International Internet bandwidth (2013)	10-year CAGR (2003-2013)	International Internet bandwidth per capita (Kbps)	Evaluation
Bangladesh	**50 Gbps –** As of March 2014, Bangladesh's total international bandwidth, including both Internet and voice, was reported to be 58 Gbps, with 25 Gbps provided by Bangladesh Submarine Cable Company, Ltd. (BSCCL) via the SEA-ME-WE-4 cable and 33 Gbps provided by the six international terrestrial cable licensees.	100%	0.3	**Very weak**
Bhutan	**5.7 Gbps –** In 2008 Bhutan Telecom established a DS-3 connection via the London Internet Exchange (LINX), which it supplemented with a DS-3 from Reliance Globalcom via the Hong Kong Internet Exchange (HKIX). However, utilization rates of the country's international bandwidth were 98 per cent and both links were upgraded to STM-1 in 2010. In June 2013, Bhutan Telecom's subsidiary DrukNet increased its international bandwidth from 1.3 Gbps to 3.1 Gbps. As of 2014, DrukNet's international bandwidth had been increased to 5.3 Gbps, with a peak utilization rate of approximately 50 per cent, while Tashi Infocomm had 370 Mbps of international bandwidth and a utilization rate of approximately 60 per cent. In addition to its POPs at LINX and HKIX, Bhutan Telecom intended to establish a third international POP in Singapore in 2014.	98%	7.6	**Moderate**
India	**1.2 Tbps –** As of year-end 2013, India's total international Internet bandwidth was 1,209 Gbps. During the first quarter of 2014, bandwidth grew an additional 7 per cent to 1,294 Gbps. Bharat Sanchar Nigam, Ltd.(BSNL) reported peak-hour utilization of 81 per cent, Bharti Airtel 67 per cent, Tata 58 per cent and Reliance 53 per cent.	58%	1.0	**Weak**
Iran (Islamic Republic of)	**113 Gbps –**The Islamic Republic of Iran's international bandwidth increased dramatically in 2013: in February 2013, the Ministry of ICT announced an increase from 63 Gbps to 83 Gbps; in October 2013, the Telecommunication Infrastructure Company (TIC) announced a further increase to over 100 Gbps by year-end.	60%	1.5	**Weak**
Maldives	**8.3 Gbps –** Maldives' international Internet bandwidth doubled in 2013, following the implementation of a 1,253-km domestic submarine cable network the previous year. The country's per-capita international bandwidth is among the highest for developing economies.	88%	24.0	**Strong**
Nepal	**20 Gbps –** As of year-end 2011, international bandwidth was 4.2 Gbps, with an upgrade to 10 Gbps planned for 2012. Sources in Nepal indicated that Nepal's international bandwidth as of mid-2014 was approximately 25 Gbps.	92%	0.7	**Very weak**

Country	International Internet bandwidth (2013)	10-year CAGR (2003-2013)	International Internet bandwidth per capita (Kbps)	Evaluation
Pakistan	**300 Gbps –** As of year-end 2013, international Internet bandwidth was estimated to be approximately 300 Gbps, but as of October 2014, total international bandwidth (Internet + voice) had increased to 576 Gbps, with 88 per cent of this capacity provided by the Pakistan Telecommunications Company, Ltd. (PTCL) via its three submarine cables (SEA-ME-WE-3, SEA-ME-WE-4, and I-Me-We) and the remaining 12 per cent provided by the Transworld Associates' TW-1 submarine cable and terrestrial links.	95%	1.7	**Weak**
Sri Lanka	**45 Gbps** – Sri Lanka Telecom (SLT)'s bandwidth in 2012 was reported to be 23 Gbps. In 2013, the Lanka Education And Research Network said that it purchased 1.5 Gbps of international capacity from SLT; the capacity represented approximately one thirtieth of the country's total international bandwidth.	86%	2.2	**Weak**
Turkey	**2.3 Tbps –** Turkey's international bandwidth is robust. The country's position as a transit hub for other markets in the region is likely to assure the continued growth of its international connectivity.	100%	30.7	**Strong**

Table 2a: Historical international bandwidth demand (Gbps)
(International Internet, international corporate data and international voice), 2003-2013

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Bangladesh	1	1	1	2	3	5	9	14	24	44	61
Bhutan	0.02	0.03	0.04	0.05	0.1	0.1	0.2	0.4	1	2	6
India	7	11	17	23	57	183	335	729	814	837	1,446
Iran (Islamic Republic of)	1	2	4	6	8	13	30	30	62	83	124
Maldives	0.04	0.1	0.3	1	1	1	3	4	4	6	9
Nepal	0.05	0.1	0.1	0.1	1	1	2	5	8	14	22
Pakistan	1	2	3	7	12	18	43	83	152	232	347
Sri Lanka	1	1	1	2	3	4	8	10	23	35	52
Turkey	8	13	40	58	127	250	405	744	1,237	1,853	2,839

Table 2b: Forecasted international bandwidth demand (Gbps)
(International Internet, international corporate data and international voice), 2014-2024

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Bangladesh	153	221	319	460	665	962	1,391	2,014	2,915	4,222	6,116
Bhutan	10	16	25	39	61	95	150	235	368	578	907
India	1,911	2,803	4,112	6,035	8,861	13,012	19,113	28,078	41,253	60,616	89,076
Iran (Islamic Republic of)	185	268	388	562	813	1,178	1,706	2,471	3,581	5,190	7,522
Maldives	15	24	36	56	86	132	204	314	483	744	1,145
Nepal	36	55	83	126	192	291	442	672	1,022	1,553	2,360
Pakistan	747	1,074	1,545	2,223	3,198	4,602	6,623	9,533	13,723	19,755	28,440
Sri Lanka	75	109	158	230	335	488	711	1,036	1,511	2,203	3,214
Turkey	3,579	5,222	7,620	11,120	16,230	23,690	34,580	50,477	73,686	107,570	157,037

Table 3: Summary and analysis of international connectivity by country

Country	International connectivity	Evaluation
Bangladesh	1. Bangladesh's primary international link is the SEA-ME-WE-4 Europe-to-Asia cable, which was activated in Jhilongja, Cox's Bazar in May of 2006 (the cable was significantly delayed due to the construction of the Chittagong-Cox's Bazar fibre link; the Bangladeshi landing point entered service seven months after the rest of the cable's landing points and a year after Alcatel-Lucent completed installation of the Bangladeshi segment and construction of the cable landing station). The cable was upgraded in 2012, providing its Bangladeshi landing party, BSCCL, with 200 Gbps, of which it reported a utilization rate of only 20 per cent. BSCCL's largest customer is the Bangladesh Telecommunications Company, Ltd. (BTCL). 2. Six international terrestrial cable operators were licensed in 2012: 1Asia-AHL Joint Venture, BD Link Communication, Fiber@Home, Mango Teleservices, Novocom and Summit Communications. 3. The interconnection of BTCL's network with that of Indian operator BSNL was completed via a terrestrial cable that entered service in late-2010, connecting Chuadanga, Bangladesh, to Kolkata, India, via a new 25-km link between Darshana, Bangladesh and Krishna Nagar, India. 4. A cable linking Bangladesh to the Bharti Airtel network in India entered service in July of 2013, linking Benapole, Bangladesh and Petrapole, India. 5. Tata Communications is reportedly in the process of implementing an India-Bangladesh connection in partnership with BD Link, connecting Benapol, Bangladesh to Bangaon (West Bengal), India. 6. The SEA-ME-WE-5 Europe-to-Asia cable, expected to enter service in 2016, will land at Kuakata in the southern district of Patuakhali, Bangladesh. BSCCL invested BDT5.6billion (US$72 million) and will receive 1.4 Tbps of capacity. 7. Myanmar Posts and Telecommunications and BSCCL are implementing a terrestrial link between Myanmar and Bangladesh to provide Bangladesh with connectivity to SEA-ME-WE-3 and Myanmar with connectivity to SEA-ME-WE-4. BSSCL has reportedly budgeted US$2.75 million for their share of the project, which would include a 50-km link between its Cox's Bazar landing station and the Myanmar border.	**Weak –** With only one submarine cable and limited terrestrial connectivity to India, the country is extremely vulnerable to outages, particularly those caused by cable disruptions in Egypt.
Bhutan	1. Bhutan has two international terrestrial fibre optic cables to India. The first, connecting Phuentsholing in south-west Bhutan to Jaigaon, India, was activated in 2007; the second, connecting the southern Bhutan town of Galephu to Assam, India, entered service in 2011. However, both fibre paths converge at Siliguri, India, where they are then routed to the submarine cable gateway in Mumbai, raising concerns about the vulnerability of the country's international connectivity. **2.** The South Asia Subregional Economic Cooperation (SASEC) programme is in the process of implementing the SASEC Information Highway network connecting Bangladesh, Bhutan, India and Nepal. The network will allow for the implementation of submarine cable connectivity via the Cox's Bazar, Bangladesh, landing point of SEA-ME-WE-4. As part of the SASEC project, in June of 2014 Railtel Corporation of India completed installation of a 10 Gbps link from Thimphu to Phuentsholing and Gelephu.	**Weak –** Although the SASEC Information Highway will improve connectivity, Bhutan's international connectivity is fragile and dependent upon the vulnerable submarine connectivity of its neighbours.

Country	International connectivity	Evaluation
India	1. India is served by eleven interregional submarine cable systems. Three are traditional Europe-to-East Asia systems: FLAG Europe-Asia (1997), SEA-ME-WE-3 (1999), and SEA-ME-WE-4 (2005). Two link India to Africa and then onward to Europe: SAFE (which entered service in 2002 and is interconnected with the SAT-3 cable in South Africa) and Seacom (2009). Two link India to Singapore: i2i (2002) and TGN-TIC (2004). The remaining four connect to the Mediterranean Sea via the Middle East and the Red Sea: Falcon (2006), I-Me-We (2010), Europe-India Gateway (EIG) (2011) and the Gulf Bridge International (GBI) /MENA network (2012). 2. Operators' share of international gateway traffic is as follows: Tata Communications 39 per cent, Bharti Airtel 30 per cent, Reliance Communications 26 per cent and Sify 5 per cent. 3. Approximately 71 per cent of the country's international traffic passes through the Mumbai gateway, while 25 per cent is served by Chennai and 4 per cent is served by Kochi. *Regional submarine cables include:* 4. Bharat-Lanka Cable, a bilateral cable which entered service in 2005 between Tuticorin, India and Mt. Lavinia, Sri Lanka, owned by BSNL and SLT. 5. India-Maldives, sometimes characterized as a Falcon segment, which entered service in 2007 between Thiruvananthapuram, India and Male. *Terrestrial cables include:* 6. Reliance Communications and China Telecom China-India, which entered service in 2009 at a capacity of 20 Gbps, connecting Siliguri, India, to Yadong, China. 7. China Telecom and Bharti Airtel China-India, a 40-Gbps terrestrial link inaugurated in late-2010 between Yadong, China and Siliguri, India, via Nathula. 8. China Telecom and Tata Communications China-India, which was also inaugurated in 2010. 9. India–Myanmar, a 640-km system initiated in December of 2006 and completed in 2010 at a cost of US $7 million, offering a capacity of STM-4 (622 Mbps), connecting Mandalay, Myanmar and Moreh, India via Tamu, Kampatwa, Kyi Gone, Shwebo, Monywa, and Sagaing. The cable is owned BSNL and Myanmar Post and Telecommunications, with the installation contract awarded to Telecommunications Consultants India, Ltd. 10. BTCL and BSNL India-Bangladesh, a 25-km link between Darshana, Bangladesh and Krishna Nagar, India that ultimately connects the cities of Chuadanga, Bangladesh and Kolkata, India. 11. Tata Communications said in 2013 that it would construct a link in partnership with Bangladeshi international terrestrial cable licensee BD Link, between Benapol, Bangladesh and Bangaon (West Bengal), India. 12. Bharti Airtel activated a cable between Benapole, Bangladesh and Petrapole, India in 2013. 13. Two cables connect India to Bhutan, including one which entered service in 2007 between Jaigaon, India and Phuentsholing, Bhutan and another connecting Assam, India to Galephu, Bhutan, entering service in 2011. The links are considered somewhat vulnerable because they both converge at Siliguri, India. 14. Nepal Telecom is linked to the networks of three Indian operators, Reliance, BSNL, and Airtel, via fibre connectivity at the Birgunj-Raxaul and Birtatnagar-Jogbani border crossings; Indian operator Tata links to the network of UTL via links at the Birgunj-Raxaul crossing as well as a link between Bhairahwa and Sunauli. 15. A terrestrial link between India and Pakistan, linking the Indian network of Tata Communications in Amritsar, India, to the Pakistani network of PTCL in Lahore, Pakistan, via Wagah, has been installed but is not yet activated.	**Excellent -** Not only is India served by 11 major interregional submarine systems and multiple terrestrial links, but the world's two largest undersea fibre optic networks are owned by Indian investors after having been acquired separately by Indian operators Tata Communications and Reliance Communications in 2004. Furthermore, other Indian operators including the country's largest mobile operator, Bharti Airtel, also have significant investments in international telecommunications infrastructure. The Egyptian "choke point" still remains a critical vulnerability, however.

Country	International connectivity	Evaluation
Iran (Islamic Republic of)	1. The Islamic Republic of Iran has terrestrial links with all of its neighbours, as well as six submarine cables. Government-owned Telecommunications Infrastructure Company (TIC), a sister company of the Telecommunications Company of Iran (TCI), was created in 2005 to manage the country's international bandwidth infrastructure. *Submarine cables include:* 2. The 170-km United Arab Emirates-Islamic Republic of Iran bilateral cable, constructed in partnership with Etisalat, entered service in 1992. 3. The Islamic Republic of Iran-Kuwait submarine system, a 330-km branched network connecting Bandar Ganaveh, Islamic Republic of Iran to Kuwait City via two islands and an oil platform in the Persian Gulf. It was activated in 2006. 4. Global Cloud Xchange's Falcon cable. The system, which connects Egypt, the Middle East and India, did not initially include landing points in the Islamic Republic of Iran, but in 2008 the system was extended to Bandar Abbas, Islamic Republic of Iran and in 2010 it was extended to Chabahar, Islamic Republic of Iran. **5.** The GBI cable, connecting the Mediterranean, the Middle East and India. GBI signed a memorandum of understanding with TIC in 2010 to land the system in Bushehr, Islamic Republic of Iran. The spur connecting Bushehr to GBI's Persian Gulf submarine cable ring entered service in 2012. 6. The Pishgaman Oman-Islamic Republic of Iran submarine cable, which entered service in 2012. The system was to be owned by the Iranian conglomerate Pishgaman Kavir Yazd Group, which was awarded private access provider, ISP, and VoIP licences by the Iranian Ministry of ICT. Final ownership of this infrastructure is under review. 7. The Europe-Persia Express Gateway (EPEG): Islamic Republic of Iran-Oman submarine cable, which forms part of a 10,000-km network from Germany to Oman and entered service in 2013. It is interconnected with the EIG submarine cable in Al Madina A'Zarqa . *Terrestrial connectivity includes:* 8. In 2012, TIC indicated that the capacities of its border gateways were as follows: Armenia 1.4 Gbps, Azerbaijan 1.2 Gbps, Turkey 600 Mbps, Turkmenistan 600 Mbps, Iraq 300 Mbps and Afghanistan 200 Mbps. TIC confirmed that the only one of its neighbouring countries to which it did not have a fibre link was Pakistan. 9. Also in 2012, TIC forecasted that by 2017, its terrestrial links to neighbouring countries would be increased to a total capacity of 8.9 Tbps, broken down as follows: Azerbaijan 4.3 Tbps, Iraq 1.2 Tbps, Turkey 1.1 Tbps, Armenia 930 Gbps, Turkmenistan 600 Gbps, Afghanistan 430 Gbps and Pakistan 400 Gbps. 10. In addition to its bilateral terrestrial fibre optic links with neighbouring countries, the Islamic Republic of Iran participates in two multinational terrestrial networks: Trans Asia-Europe and EPEG. 11. The 27,000-km Trans Asia-Europe network, which entered service between 1998 and 2001, includes trans-border segments at Bajgiran, Islamic Republic of Iran (between Bonjurd, Islamic Republic of Iran and Ashgabat, Turkmenistan) in the east and between Aslanik, Islamic Republic of Iran and Albayrak, Turkey in the west. Its Iranian point of presence is in Tehran. All of the cable and transmission equipment used in the Iranian segments of the cable (as well as those in neighbouring Turkmenistan) were manufactured in the Islamic Republic of Iran by Iran Telecommunications Industries, Iran Telephone Planning and Development Company, and Shahid Ghandi Communication Cable Company. 12. The 10,000-km EPEG fibre optic network, connecting Germany to Oman, was conceived in 2011, at least partly as a response to obstacles faced by the consortium-owned EIG submarine cable in activating connectivity across Egypt. EIG investors Omantel and Cable & Wireless Worldwide (now Vodafone) signed a memorandum of understanding with TIC and Rostelecom for the construction of the mostly-terrestrial EPEG network, which also includes the submarine cable between the Islamic Republic of Iran and Oman. TIC was given responsibility for the segments within the Islamic Republic of Iran from the Azerbaijani-Iranian border to the Gulf of Oman. The network was tested in 2012 and activated in 2013.	**Excellent –** Although the Islamic Republic of Iran has not historically participated in major Europe-to-Asia cable projects such as the SEA-ME-WE systems, the country has developed robust terrestrial links to its neighbours and has joined multiple regional submarine cable systems, giving it diverse access to global connectivity.

Country	International connectivity	Evaluation
Maldives	1. Maldives benefits from two distinct submarine cable systems. 2. The Dhiraagu Submarine Cable, constructed by Dhiraagu in partnership with Sri Lanka Telecom, links Hulhumale, Maldives to Colombo, Sri Lanka. It entered service in 2006. **3.** The WARF Telecom India-Maldives cable was activated in 2007 by a consortium consisting of Maldivian operator Wataniya (now Ooredoo), Reliance Communications and Focus Infocom, a Maldivian ISP operating under the brand name Raajje Online. The system was extended to Sri Lanka in 2008 in partnership with Lanka Bell.	**Sufficient –** Although the country is served by only two international links, the systems provide diverse connectivity, and position the country as one of the few small island economies with more than one submarine cable.
Nepal	1. Nepal Telecom is linked to the networks of three Indian operators (Reliance, BSNL and Airtel) via fibre connectivity at the Birgunj-Raxaul and Birtatnagar-Jogbani border crossings. Indian operator Tata links to the network of UTL via links at the Birgunj-Raxaul crossing as well as a link between Bhairahwa and Sunauli. 2. The SASEC programme is in the process of implementing the SASEC Information Highway network connecting Bangladesh, Bhutan, India and Nepal. 3. A link to China via Tatopani has been proposed since 2010 but as of 2014 the status of its development could not be confirmed.	**Weak –** For its international connectivity, Nepal is almost entirely dependent upon fibre transiting through India**.**
Pakistan	1. Incumbent operator Pakistan Telecommunication Company, Ltd. (PTCL) is the Pakistani signatory to the SEA-ME-WE-3 (1999), SEA-ME-WE-4 (2005), and I-Me-We (2010) submarine cables, which land in Karachi and link to Europe and India (as well as East Asia, in the case of the SEA-ME-WE cables). 2. In 2006, Private network operator Transworld Associates, which is 51 per cent-owned by Orascom Telecom Media and Technology, activated the 1,274-km TW-1 submarine cable to Oman and the United Arab Emirates. 3. In 2002, submarine cable operator FLAG Telecom (now Global Cloud Xchange) established a "virtual point-of-presence" in Karachi via the SEA-ME-WE-3 cable. 4. A terrestrial link between Pakistan and Afghanistan's Nangarhar Province has been under development since at least 2009. Afghan Telecom confirmed that the Nangarhar link and a second link at Spin Boldak in Kandahar Province are currently operational. Afghan Telecom had purchased 1 Gbps of IP transit from PTCL and another 1 Gbps from ISP Wateen. 5. In 2011, Pakistan's Executive Committee of the National Economic Council indicated its support for a 820-km terrestrial cable connecting Pakistan to China via the Khunjerab Pass. In 2013, a contract for the cable's construction was awarded to Chinese supplier Huawei, the total cost of the network, including connectivity to Karachi, Pakistan, was reported to be US$36 million. 6. India and Pakistan have seriously pursued the implementation of a bilateral cable between the two countries since at least 2006. A terrestrial link between the Indian network of Tata Communications in Amritsar, India and the Pakistani network of PTCL in Lahore, Pakistan, via Wagah, had been installed at the manhole level but has yet to be activated. 7. A fibre link between Pakistan and the Islamic Republic of Iran, linking the networks of TIC and PTCL, is reportedly under development, but its activation could not be confirmed	**Somewhat weak –** Although Pakistan is connected to three major intercontinental submarine cable systems and a fourth regional submarine system, its terrestrial connectivity to neighbours is still under development.

Country	International connectivity	Evaluation
Sri Lanka	1. SLT is an investor in the SEA-ME-WE-3 and SEA-ME-WE-4 Europe-to-Asia submarine cables, which were inaugurated in Colombo in 1999 and 2005, respectively. 2. SLT and BSNL of India inaugurated the Bharat-Lanka Cable System between Colombo and Tuticorin, India, in 2006. 3. The Dhuraagu Submarine Cable Network, funded by the eponymous Maldivian operator in partnership with SLT, linked Sri Lanka and the Maldives in 2006. 4. The India-Maldives submarine cable, which entered service in 2007, was extended to Sri Lanka via a branching unit in 2008. The system is owed by Lanka Bell, as well as Global Cloud Xchange (formerly Reliance Globalcom) and WARF Telecom . 5. SLT is an investor in the proposed SEA-ME-WE-5 cable project, while Dialog Axiata is an investor in the proposed Bay of Bengal Gateway system. Both networks are scheduled for completion in 2016.	**Sufficient –** SLT's participation in the SEA-ME-WE cables, including both existing systems and the proposed SEA-ME-WE-5, has given the country efficient access to intercontinental connectivity. This would be supplemented by the proposed BBG cable in which Dialog Axiata is an investor. Intercontinental connectivity is also supplemented by links to India and Maldives.
Turkey	1. Turkey's primary path for international connectivity is the Telecom Italia-owned Med Nautilus system, which links to Italy, Greece, Cyprus and Israel. The system was initially constructed in 2002 and expanded to Turkey in 2004 as the result of a US$40 million, 15-year capacity purchase commitment from Turk Telekom. Another Med Nautilus segment was constructed from Turkey to Greece in 2011. Turk Telekom operates the cable network's Istanbul, Turkey, landing station. 2. In 2011, Turk Telekom purchased 250 Gbps of IP backbone capacity from the Greek operator OTE, with delivery of the bandwidth via the terrestrial Trans-Balkan Network. 3. Turk Telekom is also an investor in the SEA-ME-WE-3 submarine cable, which entered service in 1999 and offers a significantly lower capacity than subsequent Europe-to-Asia systems. 4. Regional submarine cable systems include KAFOS in the Black Sea, linking to Bulgaria and Romania, and the Turcyos-1 and Turcyos-2 cables to Cyprus. 5. Turkey has strong terrestrial fibre connectivity to each of its neighbours, with the exception of Armenia. Both Turk Telekom and Turkcell-Superonline have fibre connectivity to Bulgaria, Greece, the Syrian Arab Republic, Iraq, Azerbaijan and Georgia. Turk Telekom also has an interconnection with the network of the Islamic Republic of Iran's Telecommunications Infrastructure Company. 6. Turk Telekom is an investor in the terrestrial pan-regional Jeddah-Amman-Damascus-Istanbul (JADI) Link network and Turkcell Superonline is an investor in the Regional Cable Network. However, these links are not yet in operation as of 2014.	**Sufficient –** Turkey has sufficient access to European IP bandwidth, but lacks the diversity of submarine bandwidth infrastructure present in many other European markets. Terrestrial connectivity to neighbouring countries is strong, but is designed primarily for the sale of transit capacity to foreign markets and not intended for the country's own long-term bandwidth needs.

Table 4: Summary and analysis of domestic connectivity by country

Country	Domestic connectivity	Evaluation
Bangladesh	1. BTCL operates a nationwide transmission network that spanned 5,000 km as of mid-2014, as well as a microwave network connecting 88 points. 2. In 2009 the BTRC awarded two licences for nationwide telecommunication transmission networks, to Summit Communications, Ltd. and Fiber@Home. 3. Summit Communications, Ltd.'s domestic network spans 15,000 km including its own fibre backbone, a fibre pair leased from Power Grid Company of Bangladesh (PGCB) and leased capacity from other operators. 4. PGCB operates an OPGW-based fibre network. 5. Bangladesh Railway leases capacity on its fibre network, which is more than 2,000 km. 6. Mobile operators, including Grameenphone, Banglalink, Citycell and Robi Axiata, also have fibre networks of between 600 and 2,000 km in length.	**Moderate** – Although multiple operators provide several thousand kilometres of domestic fibre network connectivity, the transmission capacities of the networks are relatively low.
Bhutan	1. A fibre network connects all 20 district headquarters, as well as 187 gewogs (groups of villages), via OPGW and all dielectric self-supporting fibre optic cable via the infrastructure of the Bhutan Power Corporation (BPC). 2. An additional 13 gewogs will be connected as part of the BPC's rural electrification project in 2014. 3. As part of the SASEC international cable project, Railtel Corporation of India completed installation of a 10 Gbps link from Thimphu to Phuentsholing and Gelephu in June 2014.	**Limited –** Although Bhutan has made great strides in providing fibre connectivity throughout the country, the lack of competition in the domestic infrastructure space could hinder development. Furthermore, the network is a trunk-and-branch configuration and does not benefit from the protection of geographical ring topology would provide.

Country	Domestic connectivity	Evaluation
India	1. A special purpose vehicle, Bharat Broadband Network Limited, was established in 2012 to oversee the development of the National Optical Fibre Network (NOFN). Its participants are BSNL, Powergrid, and Railtel. The goal of the US$3.5 billion project is to connect 250,000 Gram Panchayats (villages and small towns) across India, and funding was drawn from the country's National Service Obligation Fund. The project was reported to be significantly behind schedule, but in September of 2014 the Indian Government mandated a deadline of March 2016. 2. India's domestic fibre network is more than one million route km. BSNL operates the country's largest fibre network, at 650,000 domestic route km. Reliance Communications' network is 190,000 km, Bharti's is 170,000, Tata Communications' is 42,000, Railtel's is 40,000, PowerGrid's is 25,000, and Gailtel's is 15,000. 3. State-owned BSNL, which operates the country's largest fibre network in terms of coverage, has a 70 per cent responsibility for the implementation of the NOFN. In 2014, the company also issued a tender for the installation of an additional 57,000 km of domestic fibre for use by the Indian military.	**Moderate –** India's domestic fibre connectivity is relatively strong, with over 1 million km operated by seven major network operators, but the country's existing fibre infrastructure may not be capable of supporting the long-term bandwidth requirements due to weaknesses in reliability and low capacity.
Iran (Islamic Republic of)	1. As of 2012, TCI reported that its national backbone network was 47,000 km in length, and its metropolitan fibre deployment totaled an additional 83,473 km, for a total of more than 130,000 km. The operator reported continued investment in its network in 2013 and 2014, so that total deployment is now estimated at between 150,000 km and 200,000 km. 2. Domestic Internet bandwidth was reported to be 45 Gbps as of early 2013.	**Limited –** Although the TCI network is relatively robust, the lack of any well-developed competing networks places the country at a disadvantage to peer markets.

Country	Domestic connectivity	Evaluation
Maldives	1. Dhiraagu's 1,253-km domestic submarine cable network, installed by Japanese company NEC at a cost of US$22 million, entered service in 2012 connecting Kulhudhuffushi, Haa Dhaalu Atoll; Eydhafushi, Baa Atoll; Hulhumale (a manmade islet approximately 1.5 km north of Male and the landing point of the international segment of Dhiraagu's Submarine Cable Network to Sri Lanka); Dhangethi, Alif Dhaal Atoll; Gan, Laamu Atoll; Gaddhoo (Gadhdhoo), Gaafu Dhaalu Atoll; Hithadhoo, Seenu Atoll; and Fuvahmulah. 2. Both Dhiraagu and Ooredoo operate inter-island microwave networks.	**Moderate –** Although the implementation of a domestic fibre network was a significant achievement given Maldivian geography, the development of the market is challenged by the lack of domestic fibre network competition as well as the point-to-point architecture of the domestic submarine network.
Nepal	**1.** Construction of Nepal's 12-fibre-pair domestic fibre network along the East-West (Mahendra) Highway was begun in 2002, using equipment supplied by Siemens. The project was overseen by Telecommunications Consultant India, Ltd., with funding provided by the Governments of Nepal and India. Its total length between Bhadrapur and Nepalgunj, via Murchaiya, Godar, Pragatinagar and Kawasoti, is 1,073 km and features 79 nodes. A second phase of the build-out linked Lamahi, Kohalpur, Attaria, Mahendranagar, Birtamod, and Kakarbhitta. An OPGW link leased from the Nepal Electric Authority provided connectivity from Hetauda to the Kathmandu Valley; the OPGW network also linked Butwal, Kaligandaki, Pokhara, and Damauli. Connectivity to some areas north of the highway, particularly in the country's northwest, is primarily via microwave links.	**Limited –** The country's network lacks a redundant mesh topology and its connectivity outside of the Mehendra Highway and the Kathmandu-Pokhara corridor is limited.
Pakistan	1. As of 2012, the country's domestic inter-city fibre network was approximately 20,000 km, with backbones deployed and operated by Link Direct, Multinet, PTCL and Wateen. As of 2014, sources estimated total deployment to be approximately 25,000 km. 2. In 2013 the country's Universal Service Fund was used to finance the deployment of 6,700 km of new fibre deployment to 102 tehsils (local administrative subdivisions).	**Moderate –** Although fibre networks are operated by four competing entities, the total length of network deployment is comparatively low. Also, the country is one of the largest without a domestic Internet exchange, making it extremely reliant upon international bandwidth.

Country	Domestic connectivity	Evaluation
Sri Lanka	1. SLT's domestic network was approximately 15,000 km in length as of 2013. Historically, it has been strongest in the country's south-central region, connecting Colombo, Kalutara, Ratnapura, Awissawella, Nawalapitiya, Hatton, Nuwara Eliya, Kandy, Matale, Kegalle, Kurunegala, Chilaw and Negombo. 2. The National Backbone Network, developed by the Government in partnership with SLT, will ultimately comprise five rings (north, south, east, west, and central), with initial deployment focused on the country's south, including the area between Colombo, Puttalam and Batticaloa, as well as less-developed areas on the country's south coast that were particularly hard-hit by the 2004 Indian Ocean tsunami. Phases II and III of the initiative aim to improve connectivity in the country's north.	**Moderate –** The SLT network is being improved as part of the National Backbone Network initiative, but significant improvement is needed in the country's north and there is little viable competition, with SLT leasing its fibre capacity to other operators.
Turkey	1. As of year-end 2013, total fibre deployment was 227,000 km. 2. Turk Telekom operates the country's largest fibre network (174,000 km). 3. Turkcell Superonline's domestic network was 33,000 km, but its fibre connectivity was increased following its 2014 purchase of Metronet. 4. In late-2013, Vodafone entered into a 15-year, US$62-million agreement to use the fibre network of the state-owned electrical transmission company, TEIAS, thereby increasing Vodafone's domestic fibre network from 6,000 to 16,000 km.	**Moderate –** Most of the country's fibre infrastructure is controlled by Turk Telecom, but competitors are developing their own fibre networks through either new construction or procurement of third-party fibre.

Table 5: Summary and analysis of international capacity pricing by country

Country	International capacity pricing (volume purchases of 1 Gbps or greater)	Evaluation
Bangladesh	In January 2011, the Bangladesh Telecommunication Regulatory Commission lowered the maximum price of capacity on the SEA-ME-WE-4 system in Bangladesh to BDT12,000 per Mbps (US$170). The price represented a significant decline from January 2009, when the maximum price of capacity was set at BDT28,000. As of year-end 2013, BSCCL was reported to be selling IP transit bandwidth via SEA-ME-WE-4 at a price of BDT4,800 (US$62) per Mbps per month, while international terrestrial cable licensees were charging only BDT2,000 (US$26). In 2014, BSCCL reportedly proposed leasing 40 Gbps of international bandwidth to the Indian operator BSNL for use in some northeastern Indian states for BDT45 million (US$580,000, the equivalent of US$14.50 per Mbps per month). Subsequent reports indicated that a memorandum of understanding between the two parties ultimately called for the lease of 10 Gbps at a price of approximately US$10 per Mbps per month.	**Expensive**
Bhutan	There is no transparent market for wholesale IP transit in Bhutan, but managed bandwidth services in the country are uniformly expensive. Bhutan Telecom's Internet leased line price is US$154 per month for 1 Mbps or US$137 per Mbps for increments of 30 Mbps or more, and its IP VPN service is priced at US$438 for 1 Mbps or US$185 per Mbps for larger increments. Tashi Infocomm's leased line prices are approximately 50 per cent higher.	**Expensive**
India	A 10 Gbps wavelength from Mumbai, India, to London costs between US$100,000 and US$150,000 per month (US$10 to US$15 per Mbps), and IP transit in Mumbai is approximately the same price. Despite the fact that Indian bandwidth prices compare favourably to those in neighbouring South Asian markets, several sources indicated that 10 Gbps wavelengths from London to Singapore, a distance that is approximately one-third longer by submarine cable, can be leased from some network operators at as little as half the price of London-Mumbai wavelengths. In 2014, Indian operator BSNL reportedly procured 10 Gbps of bandwidth from BSCCL for approximately US$10 per Mbps per month.	**Moderate**
Iran (Islamic Republic of)	In February 2013, the Islamic Republic of Iran's Communications Regulatory Authority announced a 35 per cent reduction in international bandwidth prices. The price of an STM-1 was reduced to US$9,000 per month, or US$58 per Mbps.	**Expensive**
Maldives	Bandwidth pricing in Maldives is extremely expensive; International private line circuits are priced at approximately US$1,400 per Mbps per month.	**Expensive**
Nepal	IP transit in Nepal is priced at between US$40-60 per Mbps per month, depending on volume. Nepali operators spent NPR2.39 billion (US$24.5 million) on international connectivity during fiscal year 2013-2014.	**Expensive**

Country	International capacity pricing (volume purchases of 1 Gbps or greater)	Evaluation
Pakistan	IP transit pricing can range as high as US$100 per Mbps per month for low-volume purchases, to as low as US$35,000 per month per STM-16, which is equivalent to US$14 per Mbps per month.	**Expensive**
Sri Lanka	In 2013, the Lanka Education and Research Network (LEARN) said that it had paid US$68 per Mbps for 1.5 Gbps of international capacity from Sri Lanka Telecom. LEARN representatives said that this was "the lowest in the country…because of huge bargaining power" (LEARN's capacity was reported to represent approximately one-thirtieth of the country's total international bandwidth).	**Expensive**
Turkey	Turkish bandwidth prices are increasingly converging with the low bandwidth prices in the rest of Europe. IP transit in Istanbul, Turkey, costs approximately US$4 per Mbps per month for high-volume purchases, although pan-European network operator Interoute has reportedly offered a promotional rate of €20,000 per month for 10 Gbps of IP transit (US$2.60 per Mbps). A 10 Gbps wavelength from Istanbul to major European points-of-presence, including London, Amsterdam, Paris, Frankfurt, Germany, or Milan, Italy, costs €10,000 per month (US$1.30 per Mbps), while a protected 10 Gbps wavelength costs 50 per cent more.	**Very reasonable**

Table 6: Summary and analysis of competitiveness of telecommunications markets by country

Country	Competiveness of telecommunications market	Evaluation
Bangladesh	1. State-owned BTCL was formed in 2008 when the Bangladesh Telephone and Telegraph Board was split into BTCL and BSCCL. BTCL's recent losses have resulted in calls to partially privatize the company. There is significant foreign investment from the likes of Norwegian operator Telenor (the majority shareholder of Grameenphone), Malaysian operator Axiata, Singtel, Indian operator Bharti Airtel and Russian operator VimpelCom. 2. Fixed-line: BTCL controls most of the country's fixed-line infrastructure, and has a market share of 79 per cent. Its only viable competitor is wireless local loop operator RanksTel, with 20 per cent; two other operators, BanglaPhone and WorldTel, each have only a few thousand subscribers. Eight of the country's 11 original private PSTN licensees had gone out of business as of 2014; five of these had their licences revoked in 2010 following accusations of selling illegal VoIP services. 3. Mobile: Grameenphone is the country's largest operator, with a 42 per cent share; Banglalink has 26 per cent and Robi Axiata has 21 per cent. Smaller operators include AirTel (7 per cent), TeleTalk (3 per cent) and CityCell (1 per cent). 4. Internet/broadband: Several dozen ISPs have been awarded operating licences but the fixed-line broadband infrastructure is limited, with a relatively small number of FTTB and ADSL subscriptions. Approximately 96 per cent of Internet users access the Internet via their mobile phones. LTE and WiMax operators including Banglalion, Ollo and Qubee have so far catered mostly to corporate customers.	**Somewhat competitive**
Bhutan	1. Bhutan's telecommunications market is effectively a duopoly served by Bhutan Telecom and TashiCell, although there are two additional ISPs: Drukcom and Samden Tech. 2. Fixed-line: Government-owned Bhutan Telecom has a monopoly over the country's fixed-line market. 3. Mobile: The country's first competitive operator, Tashi Infocomm, was awarded a mobile licence in 2006. Bhutan Telecom's B-mobile has a 74 per cent share of the market while TashiCell, which launched the country's first competitive network in 2008 (two years after having been awarded a licence), has a 26 per cent share. 4. Internet/broadband: There are four licensed ISPs. Bhutan Telecom's Druknet is the country's leading ISP. Drukcom offers both ADSL and leased-line services, while Samden Tech offers only leased lines. TashiCell offers leased lines and wireless Internet service.	**Less competitive**

Country	Competiveness of telecommunications market	Evaluation
India	1. Although India's international gateway market is dominated by handful limited number of carriers (namely Tata, Bharti Airtel and Reliance), domestic markets are very competitive, with 13 mobile operators and at least 10 major ISPs each serving one million or more customers in each sector. The fixed-line market, although dominated by incumbent operator BSNL, is served by seven other competitors. 2. Fixed-line: This market is relatively small, at only 29 million subscribers, for a penetration rate of 2.3 per cent. Incumbent operator BSNL dominates the market, with a market share of two-thirds. Smaller operators include MTNL and Bharti Airtel, each with 12 per cent market shares, as well as Tata (5 per cent), Reliance (4 per cent), Quadrant, Sistema and Vodafone. Both BSNL and MTNL are owned by the Indian Government; historically, MTNL held the concessions for New Delhi and Mumbai, while BSNL served the rest of the country. 3. Mobile: This market continues to grow, with a 73 per cent penetration rate as of 2014. The marketplace is extremely competitive and is served by 13 operators, eight of which have subscriber bases of 30 million or more. Major operators include Bharti, with a 23 per cent market share, Vodafone (18 per cent), Idea (15 per cent), Reliance (12 per cent), BSNL (10 per cent), Aircel (8 per cent), Tata (7 per cent) and Telewings (4 per cent). Sistema, Videocon, MTNL, Loop and Quadrant each have market shares of 1 per cent or less. **4.** Internet/broadband: There are six Internet service providers with subscribership of 10 million or more: Bharti, with a market share of 24 per cent, Vodafone (21 per cent), BSNL (16 per cent), Reliance (15 per cent) and Idea (10 per cent). Additionally, Aircel, Telewings, Tata, Loop and MTNL each reported more than one million subscribers.	**Competitive**

Country	Competiveness of telecommunications market	Evaluation
Iran (Islamic Republic of)	1. Competition in the Islamic Republic of Iran's telecommunications markets is limited, with a near-monopoly in the fixed-line sector and a near-duopoly in the mobile sector, although a new third operator has quickly seen its market share grow to almost 5 per cent. The ISP market, while served by hundreds of licensees, is led by a limited number of entities offering broadband service. 2. Fixed-line: The country's incumbent operator, TCI, has a 90 per cent share of the fixed-line market. In 2009, 51 per cent of TCI shares were sold to Mobin Trust Consortium (Etemad-e-Mobin) for approximately US$8 billion. Five private, regional operators share 10 per cent of the market. 3. Mobile: The market is served by four operators, although two operators control 95 per cent of the market. Mobile Communication Co. of Iran (MCI), TCI's mobile arm, is the market leader with a 49 per cent share. MTN Irancell has a 46 per cent share. This company is only 49 per cent owned by MTN Group, with the remaining shares held by local investor Iran Electronic Development Company due to local ownership requirements. A third operator, Tamin Telecom, offers mobile services under the Rightel brand name and was granted exclusivity in the 3G market until mid-2014. Its subscriber base is estimated at approximately four million. A prepaid operator, Taliya, is estimated to have one million subscribers. 4. Internet/broadband: There are several hundred ISPs. TCI launched ADSL service in 2004. Privately-owned Pars Online claims to be the country's largest private data network operator, handling 10 per cent of the country's domestic data traffic. Another ISP, Iranian Net, is reportedly in the process of implementing fibre-to-the-home networks in at least seven major cities. Other major ISPs include ShaTel, Datak Telecom, Sepanta Network Solutions, Neda Rayaneh, Pishgaman, and Afr@net.	**Less competitive**
Maldives	1. Maldives is served by three operators: Dhivehi Raajjeyge Gulhun (Dhiraagu), Focus Infocom, and Ooredoo. 2. Fixed-line: Although its exclusivity has been terminated, Dhiraagu remains the country's sole fixed-line operator, serving approximately 23,000 subscribers. In 2013, Dhiraagu's majority shareholder, CWC Islands Group, was purchased by Bahraini operator Batelco. 3. Mobile: Dhiraagu has a market share of 60 per cent, while Ooredoo (formerly Wataniya) has a 40 per cent share. 4. Internet/broadband: Focus Infocom (now offering services under the Raajjé Online brand name) was licensed as an ISP in 2003, and competes in the broadband sector against Dhiraagu. Ooredoo also offers mobile Internet services.	**Less competitive**

Country	Competiveness of telecommunications market	Evaluation
Nepal	1. The Government of Nepal took steps toward the liberalization of the telecommunications market as early as 1995, although the monopoly of government-owned Nepal Telecom continued until 2003. The market is currently dominated by Nepal Telecom and Ncell, which is controlled by Swedish operator TeliaSonera. 2. Fixed-line: Nepal Telecom, which operates both PTSN and WLL networks, has a market share of 91 per cent. The remaining 9 per cent share of the market is mostly served by United Telecom, Ltd. (UTL), which became the country's first competitive operator in 2003. UTL's network exclusively uses CDMA WLL technology. 3. Mobile: Spice Nepal Private, Ltd. launched the country's first private mobile network in 2005 under the Metro Mobile brand name. TeliaSonera acquired a majority stake in the company in 2008 and it was rebranded as Ncell in 2010. Ncell has a market share of 55 per cent, while Nepal Telecom serves the remaining 45 per cent. 4. Internet/broadband: As of early 2014, there were 45 ISPs, although market share was concentrated between Nepal Telecom and Ncell. Nepal Telecom was the only provider of fixed broadband ADSL service (120,000 subscribers) and it split the mobile Internet market with Ncell (each operator served approximately 3.7 million GPRS, EDGE and WCDMA subscribers). UTL served 100,000 fixed wireless CDMA subscribers. Smaller ISPs include Broadlink, WorldLink, Subisu Cablenet, Mercantile Communications and Web Surfer Nepal, although the ISPs other than Nepal Telecom and UTL collectively served fewer than 100,000 subscribers as of early 2014.	**Less competitive**
Pakistan	1. Pakistan's incumbent operator, PTCL, is majority-owned by the Government; Etisalat is a strategic minority investor. The company has majority shares of both the fixed-line and broadband markets. The mobile sector is significantly more competitive, with the market shared between five relatively strong operators. 2. Fixed-line: PTCL has retained a 95 per cent share of PSTN fixed-line subscribership, but WLL operators have captured a significant share of the overall fixed market, reducing PTCL's overall market share in the sector to 65 per cent. Major WLL operators include Wateen, Telecard and Wi-Tribe. The licence of the country's second-largest WLL operator, Worldcall, was reportedly suspended in mid-2014 in a dispute over spectrum payment fees, but parent company Omantel indicated that the company would continue business as usual. 3. Mobile: The industry leader in terms of market share is Mobilink, a subsidiary of VimpelCom, with a 29 per cent market share. Mobilink benefited from a majority of the mobile market prior to its deregulation in 2004 and has been the market leader ever since. Telenor was ranked second, with 26 per cent. PTCL's Ufone subsidiary has a 19 per cent share, China Mobile's Zong has 16 per cent and Warid has 10 per cent. 4. Internet/broadband: PTCL's share of the broadband market rose by ten percentage points in 2013, to 71 per cent or 1.9 million subscribers, with much of the growth attributed to its wireless EvDO connections. Second-place Wateen had 10 per cent of the broadband market, while WorldCall and WiTribe each had 7 per cent. WiMax operator Qubee had a 2 per cent share.	**Somewhat competitive**

Country	Competiveness of telecommunications market	Evaluation
Sri Lanka	1. Competition in the Sri Lankan telecommunications market is relatively weak, with only a few major operators. 2. Fixed-line: Incumbent operator SLT serves a majority of the fixed-line sector but WLL operators Lanka Bell and Dialog Axiata, a subsidiary of Malaysian telecom investor Axiata Group, have a combined market share of approximately 40 per cent. Dialog Axiata increased its fixed-line market presence following its 2012 has a market share of approximately one-sixth following its 2012 acquisition of Suntel. 3. Mobile: Dialog Axiata leads the mobile market with more than 8 million subscribers as of year-end 2013—a 40 per cent market share. SLT's Mobitel has a share of approximately 25 per cent, Etisalat has approximately 17 per cent, Bharti's Airtel Lanka subsidiary had approximately 12 per cent and Hutchison Lanka had approximately 6 per cent. In late 2013, Airtel was reported to be in advanced discussions to sell its Sri Lankan operations to Etisalat, but in October 2014, Etisalat was reported to be planning its own exit from the Sri Lankan market. According to one source, Bharti Airtel was showing interest in acquiring Etisalat's operations to merge with its own. 4. Internet/broadband: Fixed broadband penetration is relatively low and is mostly limited to SLT's ADSL service as well as offerings from Dialog Axiata and Lanka Bell, but greater investment in fibre infrastructure may increase competitors' market shares, particularly that of Dialog. Increasingly, Internet growth is expected to centre around 4G services.	**Less Competitive**
Turkey	1. Turkey is served by multiple fixed-line operators, although the incumbent controls 90 per cent of the fixed telephony market and 78 per cent of the Internet market. The mobile market is served by three operators. 2. Fixed-line: The market share of Incumbent Turk Telekom is greater than 80 per cent. Competitors include Superonline, Turknet, Is Net, Millenicom and Vodafone Net. 3. Mobile: There are three mobile operators present in the Turkish market. Turkcell's market share is currently just under 50 per cent, Vodafone's is 29 per cent and the share of Turk Telekom's mobile subsidiary Avea is 22 per cent. 4. Internet/broadband: Turk Telecom's TTNet Subsidiary has a 78 per cent share of the Internet market. Superonline has 13 per cent and an additional four ISPs each have market shares of between 1 and 5 per cent.	**Less competitive**

Table 7: Summary and analysis of fixed and mobile broadband infrastructure by country

Country	Fixed broadband infrastructure	Mobile broadband infrastructure	Evaluation
Bangladesh	Some sources indicate as many as one million fixed broadband subscribers in Bangladesh, but that figure could not be corroborated. As of year-end 2013 there were 316,000 fixed WiMax subscribers, according to the BTRC. The WiMax market was served by Banglalion, Ollo and Qubee (Augere), until mid-2014 when Grameenphone, Agni Systems and ADN Telecom also entered the market. WiMax operators reported a decrease in subscribers as users migrated toward 3G providers. In addition to the WiMax market, there were reported to be as many as 350,000 fibre-to-the-building subscribers as well as 15,000 DSL subscribers, although neither figure could be independently confirmed.	There were a total of 34 million mobile Internet subscribers as of year-end 2013, according to the BTRC. 3G subscribership was estimated to be approximately 6 million as of mid-2014. A 3G spectrum auction was held in 2013, which resulted in the awarding of 10 MHz to Grameenphone at a price of US$210 million, while Robi Axiata, Airtel Bangladesh and Banglalink Digital Communications each received 5 MHz at a price of US$105 million. Grameenphone launched 3G services in Dhaka and Chittagong in late-2013 and, as of mid-2014, it had covered all 64 district headquarters, giving it a 3G market share of approximately one-third. Five LTE licences were awarded to BTCL, Bangladesh Internet Exchange, Ltd., Banglalion, Mango and Qubee in 2013; the operators are expected to launch services in late-2014.	**Limited**
Bhutan	As of 2013, Bhutan had 20,481 fixed broadband subscribers served through a combination of ADSL (20,278 subscribers) and FTTB (203 subscribers).	Bhutan Telecom's B-mobile and Tashi InfoComm's TashiCell served a combined 117,659 3G subscribers as of 2013, representing a six-fold increase over 2012. 3G services were launched in 2009 and, as of 2014, B-mobile offered 3G in 15 dzongkhags (administrative districts), while TashiCell offered it in four. Due to a large increase in the number of users, B-mobile representatives conceded in August 2014 that the operator's 3G network was suffering from congestion problems during peak hours. B-mobile also launched a 4G LTE network in selected neighbourhoods of Thimphu in October 2013.	**Limited**

Country	Fixed broadband infrastructure	Mobile broadband infrastructure	Evaluation
India	The Telecommunications Regulatory Authority of India (TRAI) reported approximately 20 million fixed broadband subscribers as of year-end 2013. The majority of these subscribed to ADSL, but the country's weak fixed-line infrastructure means that most growth in broadband Internet subscribership will be in the fixed wireless and mobile sectors, although there have been an increased number of fibre-to-the-home deployments.	TRAI reported 220 million total mobile Internet subscribers as of year-end 2013; 40 million of these were classified as broadband. As of mid-2014, initial figures from carriers indicated that 3G subscribership had grown to almost 50 million. The 3G market in India had struggled due to the perceived high cost of service, but as of 2014, it was considered to have gained momentum. Although 4G services were available in a few cities, most observers do not expect any substantial 4G penetration until 2016.	**Limited**
Iran (Islamic Republic of)	As of late 2012, there were approximately 2.3 million ADSL subscribers and 600,000 WiMax subscribers in the Islamic Republic of Iran. As of year-end 2013, total fixed broadband subscriptions were estimated to have grown to 5 million.	The development of the mobile broadband market in the Islamic Republic of Iran is considered by many observers to have been delayed due to the exclusivity over the 3G market that was accorded to Tamin Telecom, which offers mobile services under the Rightel brand name; its total mobile subscriber base was approximately four million as of 2014. The company's 3G exclusivity ended in mid-2014, at which point both of the country's major mobile operators, MCI and MTN Irancell, announced that they would launch both 3G and 4G services.	**Limited**
Nepal	The fixed broadband market was limited to approximately 200,000 subscribers as of the beginning of 2014, including 120,000 ADSL subscribers served by Nepal Telecom.	Nepal Telecom and Ncell each serve 3.7 million GPRS, EDGE, and WCDMA customers. By 2011 both offered 3G data services in major cities. Both operators are hoping to expand their 3G networks to provide nationwide coverage in 2014; 4G LTE service is expected to be launched in 2015.	**Limited**
Maldives	As of mid-2014, there were 20,000 fixed broadband subscribers. Approximately 75 per cent were DSL subscribers, with the remainder served mostly by cable modems, although there were a few hundred fibre-to-the-home subscribers.	As of mid-2014, there were 145,000 mobile broadband subscribers. Dhiraagu claimed its 3G network covered 82 per cent of the population, while Ooredoo targeted 95 per cent coverage for its HSPA+ service by September 2014. In mid-2014, both Dhiraagu and Ooredoo announced limited implementation of 4G services.	**Limited**

Country	Fixed broadband infrastructure	Mobile broadband infrastructure	Evaluation
Pakistan	DSL subscribership slightly exceeded one million in 2013, as did EvDO connections. WiMax subscribership was approximately 600,000, while cable modem subscribership was only 33,000.	Zong, Ufone, Telenor, and Mobilink were each awarded 3G spectrum during an auction in April of 2014, and 3G services were launched the following month. As of October 2014, 3G usage was reported to be 2.5 million. Additionally, Zong was the sole winner of 4G spectrum at a price of US$210 million (a second 4G licence will be auctioned at a later date). Zong announced in September 2014 that it launched 4G services in seven major cities.	**Limited**
Sri Lanka	There were approximately 500,000 fixed broadband subscribers in Sri Lanka as of mid-2014, with the vast majority served by SLT's ADSL services. Deployment of broadband fibre networks is increasing, on the part of both SLT and Dialog Axiata.	As of mid-2014, there were almost two million mobile broadband subscribers. 3G services were launched relatively early (in 2006) and in 2013, 4G LTE was launched by both Mobitel and Dialog Axiata. WLL operator Lanka Bell has also begun offering 4G services.	**Limited**
Turkey	There were 8.4 million fixed broadband subscriptions in Turkey as of year-end 2013. More than three-fourths, or 6.6 million, were DSL. FibreTTB grew by 85 per cent to 1.2 million; Turkcell Superonline offers a 1 Gbps FTTH service in the cities of Istanbul, Izmir, Ankara, Gaziantep, Bursa, Kocaeli, Mersin, Antalya, Adana, Samsun, Trabzon, Kayseri, Konya, and Diyarbakir. Cable modem subscribership has remained steady at approximately 500,000.	There were a total of 24 million handset-based 3G mobile Internet subscribers in Turkey as of year-end 2013, plus an additional 1.5 million 3G mobile computer-based users (such as USB dongle subscribers). The development of 4G networks has been somewhat restrained due to the comparatively high speeds of existing 3G connectivity.	**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 (US$)	Annual 1 Mbps subscription + installation as a % of nominal GDP per capita	Evaluation
Bangladesh	1. US$15 per month + US$5 installation fee for 1 Mbps ADSL with unlimited download (BTCL BCube Infinity 1000) 2. US$19 per month + required 4G modem for 1 Mbps WiMax with 30GB download limit (Qubee)	15	US$185 / US$830 = 22.3%	**Very expensive**
Bhutan	*1.* US$6.50 per month + US$22 installation for 2 Mbps ADSL with 4 GB monthly download limit (Druknet Home) 2. US$41 per month + US$22 installation for 2 Mbps ADSL with 27 GB monthly download limit (Druknet Enterprise)	3.25	US$61 / US$2,600 = 2.3%	**Reasonable**
India	1. US$13 per month for 1 Mbps ADSL with 6 GB monthly download limit and 512 Kbps speeds thereafter (BSNL BB Home) 2. US$17 per month for 10 Mbps FTTH with 25 GB monthly download limit and 1 Mbps speeds thereafter (MTNL Fibre Thrill 1050)	1.70	US$20 / US$1,200 = 1.7%	**Reasonable**
Iran (Islamic Republic of)	1. US$7.50 per month + US$3.50 installation for 1 Mbps ADSL with 4 GB monthly download limit (Pars Online ADSL2+) 2. US$82 per month + US$3.50 installation for 1 Mbps ADSL with unlimited download (Pars Online ADSL2+)	7.50	US$93.50 / US$5,000 = 1.9%	**Reasonable**
Maldives	1. US$13 per month + US$16 installation for 2 Mbps ADSL with 5 GB monthly download limit (Dhiraagu Home Plus)	6.50	US$94 / US$4,000 = 2.4%	**Reasonable**

Country	Typical monthly broadband subscription pricing	Base package price per Mbps (US$)	Annual 1 Mbps subscription + installation as a % of nominal GDP per capita	Evaluation
Nepal	1. US$15 per month + US$5 installation for 384 Kbps ADSL with unlimited download (Nepal Telecom ADSL) 2. US$6 per month + US$5 installation for 512 Kbps ADSL with 6 GB download limit (Nepal Telecom ADSL)	12	US$149 / US$700 = 21.3%	**Very expensive**
Pakistan	1. US$9 per month + US$19.50 installation for 1 Mbps WiFi with 10 GB download limit (Wateen WiFi) 2. US$4 per month + US$15 installation for 1 Mbps ADSL with 10 GB download limit (PTCL ADSL)	4	US$63 / US$1,100 = 5.7%	**Somewhat expensive**
Sri Lanka	1. US$4 per month + US$4 installation for 2 Mbps ADSL with 1 GB download limit (SLT ADSL) 2. US$11.50 per month + US$8 installation for 8 Mbps ADSL with 25 GB download limit (SLT ADSL)	1.40	US$25 / US$2,200 = 1.1%	**Affordable**
Turkey	*1.* US$27 per month + free installation for 25 Mbps FTTH with unlimited download (Turkcell Superonline FTTH) 2. US$62 per month + US$16 installation fee for 100 Mbps FTTH with unlimited download (TTNet FTTH)	1	US$12 / US$9,000 = 0.1%	**Extremely affordable**

Table 9: Presence of fibre optic connectivity across borders of the countries analysed in this study

	Bangladesh	Bhutan	India	Iran (Islamic Republic of)	Maldives	Nepal	Pakistan	Sri Lanka	Turkey	Other land borders
Bangladesh			multiple fibre links & SMW4		No direct submarine cable links		SEA-ME-WE-4 submarine cable	SEA-ME-WE-4 & planned SEA-ME-WE-5		Myanmar – fibre under implementation
Bhutan			Multiple fibre links							China – no fibre
India	Multiple fibre links	Multiple fibre links		Falcon & GBI submarine cables	WARF Telecom submarine cable	Multiple fibre links	Unlit cable (SMW/ IMW cables	SEA-ME-WE-3, SEA-ME-WE-4, BLCS		China – multiple fibre links Myanmar – fibre present
Iran (Islamic Republic of)					No direct submarine cable links		Fibre under development	No direct submarine cable links	Multiple fibre links	Afghanistan: yes Armenia: yes Azerbaijan: yes Iraq: yes Turkmenistan: yes
Maldives	No direct submarine cable links		WARF Telecom subm. cable	No direct submarine cable links			No direct submarine cable links	Dhiraagu submarine cable, WARF Subm. cable		N/A
Nepal			Multiple fibre links							China – proposed fibre; could not be confirmed
Pakistan	SEA-ME-WE-4 submarine cable		Unlit cable (SMW/ IMW cables	Fibre under development	No direct submarine cable links			SEA-ME-WE-3, SEA-ME-WE-4		Afghanistan – yes China – fibre under implementation
Sri Lanka	SEA-ME-WE-4 & planned SEA-ME-WE-5		SEA-ME-WE-3, SEA-ME-WE-4, BLCS	No direct submarine cable links	Dhiraagu & WARF subm. cables		SEA-ME-WE-3, SEA-ME-WE-4			N/A
Turkey				Multiple fibre links						Armenia: no Azerbaijan: yes Bulgaria: yes Georgia: yes Greece: yes Iraq: yes Syrian Arab Republic: yes ria: yes

A total of six bilateral terrestrial borders exist between the subject countries. Trans-border terrestrial fibre optic connectivity was identified across five borders within the analysed region, while a fifth border (India-Pakistan) has a fibre link that has so far remained unlit and a sixth (Islamic Republic of Iran-Pakistan) was reported to have a completed fibre link but the operation of the system could not be confirmed.

An additional eleven country-pairs were candidates for direct submarine cable connectivity. Among these, eight country-pairs had existing submarine cables linking the two countries, while three country-pairs (Bangladesh-Maldives, Islamic Republic of Iran-Maldives and Islamic Republic of Iran-Sri Lanka) did not have any direct submarine cable links.

1. **Bangladesh-India**: Multiple terrestrial fibre links; submarine cable connectivity via SEA-ME-WE-4
2. **Bangladesh-Maldives (submarine route):** No direct submarine cables
3. **Bangladesh-Pakistan (submarine route):** SEA-ME-WE-4 submarine cable
4. **Bangladesh-Sri Lanka (submarine route):** SEA-ME-WE-4 submarine cable (and planned SEA-ME-WE-5)
5. **Bhutan-India:** Multiple fibre links
6. **India-Islamic Republic of Iran (submarine route):** Falcon and GBI submarine cables
7. **India-Maldives (submarine route):** WARF Telecom Submarine Cable
8. **India-Nepal:** Multiple fibre links
9. **India-Pakistan:** Terrestrial fibre link constructed but unlit; submarine connectivity via SEA-ME-WE-3, SEA-ME-WE-4, and I-Me-We cables
10. **India-Sri Lanka (submarine route):** SEA-ME-WE-3, SEA-ME-WE-4, and Bharat-Lanka submarine cables
11. **Islamic Republic of Iran-Maldives (submarine route):** No direct submarine cables
12. **Islamic Republic of Iran-Pakistan:** Fibre reported to be under development, but completion and activation of the system could not be confirmed.
13. **Islamic Republic of Iran-Sri Lanka (submarine route):** No direct submarine cables
14. **Islamic Republic of Iran-Turkey:** Multiple fibre links
15. **Maldives-Pakistan (submarine route):** No direct submarine cables
16. **Maldives-Sri Lanka (submarine route):** Dhiraagu Submarine Cable and WARF Telecom Submarine Cable.
17. **Pakistan-Sri Lanka (submarine route):** SEA-ME-WE-3 and SEA-ME-WE-4 submarine cables

Table 10: Analysis of cross-border connectivity and identification of priority trans-border projects

International border	Analysis	Recommendation
Bangladesh / India ***Low priority***	The border between Bangladesh and India is served by one existing terrestrial fibre link, as well as an additional terrestrial fibre link currently under implementation. The two countries are also linked by the SEA-ME-WE-4 submarine cable and will be linked by the proposed SEA-ME-WE-5 submarine cable.	Given that Indian operators BSNL and Bharti Airtel have activated terrestrial fibre connectivity between the two countries (with additional terrestrial link under implementation by Tata) and given existing and planned submarine connectivity between the two countries, there is no strong requirement for additional terrestrial fibre between Bangladesh and India.
Bangladesh / Myanmar ***High priority***	Myanmar Posts and Telecommunications and the BSCCL are in the process of implementing a terrestrial fibre link between the two countries.	Additional fibre links are needed in order to ensure that Bangladesh has redundant bilateral connectivity with more than one country.
Bhutan / India ***High priority***	Although Bhutan has two terrestrial links to India, with the first completed in 2007 and the second in 2011, both fibre paths converge in Siliguri, raising concerns about the vulnerability of Bhutan's international connectivity.	Diversification of Bhutan's fibre links to India is urgently needed in order to ensure the robustness of the country's international connectivity.
India / China ***Medium priority***	There are three fibre links between China and India, linking China to the Indian networks of Bharti, Reliance and Tata.	The ability of the Chinese terrestrial route to provide an outlet for Indian international demand, coupled with the relative fragility of existing fibre links, indicates a need for more robust fibre links between the two countries.
India / Nepal ***Medium priority***	Nepal Telecom is linked to the Indian networks of Reliance, BSNL and Bharti Airtel via multiple border crossings.	Despite multiple fibre links, the importance of India's connections with Nepal requires mesh-like connectivity across the countries' border.
India / Myanmar ***High priority***	A 640-km terrestrial fibre link was completed in 2010 at a cost of US$7 million and is operated by BSNL and Myanmar Post and Telecommunications.	The India-Myanmar border is a critical corridor for connectivity between India and South-East Asia, requiring multiple fibre links.

International border	Analysis	Recommendation
India / Pakistan ***High priority***	A terrestrial fibre link has been constructed between India and Pakistan, but remains dormant as of mid-2014.	Deploying more robust connectivity between India and Pakistan would be an important step to ensure regional stability, but requires political momentum.
Nepal / China ***High priority***	A link between China and Nepal via Tatopani was proposed in 2010, but as of 2014 the status of its development could not be confirmed.	Given Nepal's almost exclusive reliance upon terrestrial connectivity with India, the country is in urgent need of diversified connectivity via China.
Islamic Republic of Iran / Pakistan ***Medium priority***	Although the Islamic Republic of Iran has strong fibre connectivity with each of its neighbours, the Iranian-Pakistani border has historically lacked fibre and the implementation of a trans-border link could not be confirmed as of mid-2014.	Improved connectivity between the Islamic Republic of Iran and Pakistan would provide both countries with improved interregional access—from the Islamic Republic of Iran to South Asia and from Pakistan to northwestern destinations.
Islamic Republic of Iran / Turkey ***Low priority***	There are multiple fibre links between the Islamic Republic of Iran and Turkey, and the Iranian Telecommunications Infrastructure Company has set a target of 1.1 Tbps of bandwidth across the countries' border by 2017.	There is no urgent requirement for improved connectivity between the Islamic Republic of Iran and Turkey.
Pakistan / China ***High priority***	A fibre link between Pakistan and China is currently under construction in the Khunjerab Pass.	Both Pakistan and China would benefit from improved fibre connectivity, as the single fibre link under implementation is not considered to be a definitive, long-term solution for linking the two countries with robust connectivity.
Turkey/ Armenia ***High priority***	No activated fibre capacity between Turkey and Armenia could be identified.	Better fibre connectivity between Turkey and Armenia could substantially benefit both countries and the subregion.

High priority trans-border projects

1. Bangladesh / Myanmar
2. Bhutan / India
3. India / Myanmar
4. India / Pakistan
5. Nepal / China
6. Pakistan / China
7. Turkey / Armenia

Medium priority trans-border projects

1. India / China
2. India / Nepal
3. Islamic Republic of Iran / Pakistan

Stakeholder analysis

The development of the Asian information superhighway should be done in collaboration with the following stakeholders: national regulatory authorities, incumbent telecommunications operators and major international gateway operators, competitive telecommunications operators and ISPs, and road and railway authorities/operators.

Table 11: National regulatory authorities

Country	Regulatory authority	Notes
Bangladesh	Bangladesh Telecommunication Regulatory Commission (BTRC)	The key legislation governing the sector is the Bangladesh Telecommunication Act of 2001, which was amended in 2010 to give greater powers to the Ministry of Posts and Telecommunications.
Bhutan	Bhutan InfoComm and Media Authority (BICMA)	BICMA was created in 2006. The primary legislation governing the sector is the Telecommunications Act of 1999.
India	Telecom Regulatory Authority of India (TRAI)	TRAI was established in 1997. The key legislation, which has been amended multiple times since its enactment, is the Indian Telegraph Act of 1885.
Iran (Islamic Republic of)	Communications Regulatory Agency (CRA)	CRA executes the supervisory powers of the Ministry of Information and Communication Technology. The Supreme Council of Cyberspace was established in 2012.
Maldives	Communications Authority of Maldives (CAM)	The Ministry of Transport and Communication maintains responsibility for developing policy.
Nepal	Nepal Telecommunications Authority (NTA)	NTA was established in 1998. The governing legislation is the 1997 Telecommunications Act.
Pakistan	Pakistan Telecommunications Authority (PTA)	PTA was established through legislation passed in 1994. Various telecommunications ordinances and acts were passed in the 1990s, and deregulation and mobile policies implemented in the 2000s.
Sri Lanka	Telecommunications Regulatory Commission (TRC)	TRC was established in 1996 as a result of the Sri Lanka Telecommunications (Amendment) Act.
Turkey	Information and Communications Technologies Authority (ICTA/BTK)	The ICTA, also known as the Bilgi Teknolojileri ve İletişim Kurumu (BTK), was established in 2000.

Table 12: Incumbent telecommunications operators and major international gateway operators

Country	Incumbent telecom operators and major international gateway operators	Notes
Bangladesh	• Bangladesh Telecommunications Company, Ltd. (BTCL) • Bangladesh Submarine Cable Company, Ltd. (BSCCL) • 1Asia-AHL Joint Venture • BD Link Communication • Fiber@Home • Mango Teleservices • Novocom • Summit Communications	BTCL is the country's incumbent fixed-line operator and BSCCL is responsible for the country's undersea cable capacity via SEA-ME-WE-4. The latter six operators are all international terrestrial cable licensees.
Bhutan	• Bhutan Telecom / Druknet • Tashi Infocomm / TashiCell	Bhutan Telecom and Tashi InfoComm both operate international gateways, although Bhutan Telecom controls more than 90 per cent of the country's international bandwidth.
India	• Bharat Sanchar Nigam, Ltd. (BSNL) • Bharti Airtel, Ltd. • Mahanagar Telephone Nigam, Ltd. (MTNL) • Reliance Communications, Ltd. • Sify Technologies, Ltd. • Tata Teleservices, Ltd.	BSNL and MTNL are the country's two incumbent fixed-line operators. The leading international gateway operators, in descending order of bandwidth, are Tata, Bharti, Reliance and Sify.
Iran (Islamic Republic of)	• Telecommunications Company of Iran (TCI) / Mobile Communication Co. of Iran (MCI) • Telecommunications Infrastructure Company (TIC) • Pishgaman Kavir Yazd Group	TTIC was established in 2005 to oversee the Islamic Republic of Iran's telecommunications infrastructure, particularly its international links. A second international operator, Pishgaman Kavir Yazd Group, operates the Pishgaman Oman- Islamic Republic of Iran submarine cable.
Maldives	• Dhivehi Raajjeyge Gulhun (Dhiraagu) (Batelco subsidiary)	Batelco currently owns a 52 per cent stake in Dhiraagu; the Government of Maldives retains 41.8 per cent.
Nepal	• Nepal Doorsanchar Company, Ltd. (Nepal Telecom; NTL) • United Telecom, Ltd. (UTL)	Government-owned operator NTL and its competitor UTL both operate terrestrial fibre links to India.
Pakistan	• Pakistan Telecommunications Company, Ltd. (PTCL) • Transworld Associates	Pakistan's incumbent operator, PTCL, is majority-owned by the Pakistani Government; Etisalat is a strategic minority investor. It controls 88 per cent of international bandwidth. Transworld has 12 per cent primarily via its TW-1 submarine cable.

Country	Incumbent telecom operators and major international gateway operators	Notes
Sri Lanka	• Sri Lanka Telecom, PLC (SLT) / Mobitel (Pvt.), Ltd. • Lanka Bell (Pvt.), Ltd.	SLT operates most of the island's international submarine connectivity, but Lanka Bell has shares in the India-Maldives submarine cable (along with Ooredoo, Reliance Communications and Focus Infocomm).
Turkey	• Türk Telekom / Avea/ TTNet • Turkcell / Turkcell Superonline • MedNautilus (Telecom Italia)	Incumbent Türk Telecom controls most of the country's international bandwidth, but Turkcell Superonline has terrestrial fibre. Telecom Italia subsidiary MedNautilus owns the country's primary submarine cable network.

Table 13: Competitive telecommunications operators and ISPs

Country	Competitive telecommunications operators and ISPs	Notes
Bangladesh	• Airtel Bangladesh, Ltd. • Banglalink Digital Communications, Ltd. • Banglalion • BanglaPhone, Ltd. • BRACNet • Dhakacom • DOT Internet Bd • Grameenphone, Ltd. (Telenor 56% share) • IS Pros • Link 3 • Mazeda • Ollo (Bangladesh Internet Exch. / New Generation Graphics) • Pacific Bangladesh Telecom, Ltd. (Citycell) • Qubee • Ranks Telecom, Ltd. • Robi Axiata, Ltd. • Teletalk Bangladesh, Ltd. • World Tel	The Bangladeshi telecommunications market is valued at between US$3 billion and US$4 billion; the country's largest mobile operator, Grameenphone, had a revenue of US$1.3 billion in 2013.
Bhutan	• Drukcom • Samden Tech	Bhutan Telecom and Tashi Infocomm are the only telecom operators; Drukcom and Samden Tech are ISPs.
India	• Aircel, Ltd. • Idea Cellular, Ltd. • Loop Mobile • Quadrant Televentures, Ltd. • Sistema Shyam TeleServices, Ltd. • Telewings Communications Svcs. Pvt., Ltd. (Uninor) • Vodafone India, Ltd.	India has the second-largest telephony market in the world (after China) in terms of subscribers and the third-largest Internet market (after China and the United States of America) in terms of users. The overall market's annual worth is estimated to be between US$40 billion and US$50 billion.

Country	Competitive telecommunications operators and ISPs	Notes
Iran (Islamic Republic of)	• Afr@net • Datak Telecom • Iranian Net • Iraphone • Jame Novin Communication • Kooh-E-Noor Telecom • Montazeran Adl Gostar • MTN Irancell (Iran Electronic Development Co. / MTN) • Neda Rayaneh • Pars Online • Sepanta Network Solutions • ShaTel • Taliya • Tamin Telecom (Rightel brand) • Zoha-Kish Telecom	Competition in the Islamic Republic of Iran's telecommunications markets is limited. TCI is the country's only nationwide fixed-line operator and the mobile sector is effectively a duopoly between TCI's mobile arm and MTN Irancell, although Tamin Telecom now has a 5 per cent share.
Maldives	• Focus Infocom (Raajjé Online brand) • Ooredoo	The country's telecommunications and Internet sector is worth more than US$200 million annually; Dhiraagu's 2013 revenue was approximately US$135 million, and Ooredoo's was approximately US$50 million.
Nepal	• Broadlink Network & Communication Pvt., Ltd. • Himalayan Online Services Pvt., Ltd. • Mega Broadcast Pvt., Ltd. • Mercantile Communication Pvt., Ltd. • Ncell (TeliaSonera) • Nepal Satellite Telecom Pvt., Ltd. • Smart Telecom Pvt., Ltd. • STM Telecom Sanchar Pvt., Ltd. • Subisu Cablenet Pvt., Ltd. • Vianet Communication Pvt., Ltd. • WorldLink Communications Pvt., Ltd.	The Nepalese telecommunications and Internet markets are worth more than US$1 billion annually. Nepal Telecom and Ncell each reported telecommunications revenue of approximately US$400 million in 2013.

Country	Competitive telecommunications operators and ISPs	Notes
Pakistan	• Brain Telecommunication, Ltd. • Link Direct International (Pvt.), Ltd. • National Telecommunications Corp. (NTC) (Pakistani Government) • Pak Telecom Mobile (Ufone brand) (PTCL subsidiary) • Pakistan Mobile Communications, Ltd. (Mobilink brand) (VimpelCom subsidiary) • Sharp Communications (Pvt.), Ltd. (Qubee brand) (Augere Holdings) • TeleCard, Ltd. (GoCDMA brand) • Telenor Pakistan (Telenor Group) • Warid Telecom, Ltd. / Wateen Telecom (Pvt.), Ltd. (Abu Dhabi Group) • Wi-Tribe Pakistan, Ltd. (Ooredoo subsidiary) • WorldCall Telecom, Ltd. (Omantel subsidiary) • Zong (China Mobile Pakistan)	The Pakistani telecommunications market was worth US$4.3 billion in 2013. Major foreign investment in the Pakistani telecommunications and Internet sectors has come from China, Norway, Oman, Qatar, the Russian Federation, the United Arab Emirates and the United Kingdom, from the likes of China Mobile, Omantel, Ooredoo, Telenor, and VimpelCom.
Sri Lanka	• Bharti Airtel Lanka (Pvt.), Ltd. (Bharti Airtel) • Dialog Broadband Networks (Pvt.), Ltd. / Dialog Axiata, PLC (Axiata Group) • Dynanet, Ltd. • Etisalat Lanka (Pvt.), Ltd. (Etisalat) • Eureka Technology Partners (Pvt.), Ltd. • Hutchison Telecommunications Lanka (Pvt.), Ltd. (Hutch brand) (Hutchison Whampoa) • Lanka Communication Services (Pvt), Ltd. (LankaCom) (Singtel)	In late 2013, Airtel was reported to be considering exiting the Sri Lankan market and was said to have been in advanced discussions to sell its Sri Lankan operations to Etisalat, but in October 2014, Etisalat was reported to be planning its own exit from the Sri Lankan market. Bharti Airtel is now rumoured to be interested in acquiring Etisalat's operations to merge with its own.
Turkey	• Doğan TV Digital • İşNet • Metronet • Millenicom • Net GSM • Teknotel • Telnet-Turcom • TTM Telekom • Turknet • Vodafone Turkey (including Vodafone Net)	The Turkish telecommunications market is worth more than US$18 billion annually.

Table 14: Road and railway authorities/operators

Country	Road and railway authorities / operators	Notes
Bangladesh	• Road Transport and Highways Division, Ministry of Road Transport and Bridges • Bangladesh Railways / Ministry of Railways	• The country's N1 Highway, connecting Dhaka and Chittagong, is in the process of being upgraded to four lanes. • The N2 Highway, connecting Dhaka and Sylhet, is among the world's deadliest highways and there have been repeated calls for the implementation of improved safety features. • Construction of the Padma Multipurpose Bridge to India is expected to begin in 2015, with completion in 2019. • Bangladesh Railway spans approximately 3,000 km. • A new 15-km rail link between Akhaura, Bangladesh and Agartala, India, is in advanced stages of planning. • The proposed Chilahati-Haldibari rail link would connect to Bhutan and Nepal. • Agreements signed at the 18th SAARC Summit in November 2014 are expected to call for improved rail connectivity between Bangladesh, Bhutan, India, Nepal and Pakistan.
Bhutan	• Department of Roads, Ministry of Works and Human Settlement • Road Safety and Transport Authority, Ministry of Information and Communications	• The highway network comprises more than 10,000 km, of which only 6 km are expressways. The AH48 and the AH2 connect to India and onward to Bangladesh and Nepal. • By 2020, the Government hopes to upgrade the national trunk roads to carry 30-ton capacity trucks and complete the Southern East-West Highway, which would be the country's second transnational highway. • There are currently no railways in Bhutan. • Two proposed rail links to India were scrapped due to environmental concerns, although alternative routes are being considered. • China has proposed to construct rail links to its borders with Bhutan, India and Nepal by 2020.

Country	Road and railway authorities / operators	Notes
India	• Ministry of Road Transport and Highways (including National Highway Authority of India and Border Roads Organization) • Indian Railways / Ministry of Railways	• Most recently, India committed to the construction of a new 1,800 km highway in the Arunachal Pradesh region. • The Indian railway network is the largest in the world in terms of passengers carried, and the fourth-largest in length, at 65,000 km, behind only the United States, China and the Russian Federation. • Prime Minister Nerendra Modi's Bharatiya Janata Party has pledged to implement new high-speed rail lines connecting Chennai, New Delhi, Kolkata and Mumbai. • There has been a call for improved rail connectivity to Bangladesh, Bhutan and Nepal.
Iran (Islamic Republic of)	• Islamic Republic of Iran Ministry of Roads and Urban Development (including Road Maintenance and Transportation Organization) • Islamic Republic of Iran Railways • Raja Passenger Train Company • Railway Transportation Company	• The Islamic Republic of Iran has more than 200,000 km of roadways, including 2,000 km of freeway and 13,000 km of highway. • In August 2014, the Islamic Republic of Iran and Turkey signed a memorandum of understanding for the construction of the Tabriz-Bazargan highway. • The Iranian rail network comprises more than 10,000 km, including Trans Asian Railway links to the borders with Turkey, Pakistan and Turkmenistan. • In 2014, an Iranian-Chinese consortium was awarded a contract to construct a 400 km high-speed rail line between Tehran and the Afghan border. • Construction of the Qazbin-Astara railway, which would link to Azerbaijan, is planned but expected to take several years. • The Islamic Republic of Iran is constructing its own segments of a new Islamic Republic of Iran-Turkmenistan-Kazakhstan railway.
Maldives	• Ministry of Transport and Communications (including Transport Authority of Maldives) • Maldives Road Development Corporation, Ltd.	• There are no railways and roadways are only a few kilometres in length. • Road networks are currently under development in H.Dh Kulhudhufushi, Dhidhoo of Haa atoll, Hanimaadhoo of Haa Dhaalu atoll, Kudahuvadhoo of Dhaalu atoll, Villufushi of Thaa atoll, Villingili of Gaaf atoll, Thinadhoo of Gaaf Dhaal atoll, and Hulhudhoo Island.

Country	Road and railway authorities / operators	Notes
Nepal	• Ministry of Physical Infrastructure and Transport (including Department of Roads and Department of Railways) • Nepal Purwardhar Bikash Company, Ltd. • Nepal Railways Corporation	• With assistance from the World Bank, Nepal has increased its paved road network from 7,000 km in 2007 to more than 25,000 km in 2014. • The US$475 million, 58-km, public/private partnership-led Kathmandu-Kulekhani-Hetauda Tunnel project is expected to be completed in 2016. • In mid-2013, the Government's budget called for a new East-West Electric Railway and a new Tarai- Hulaki Highway. • A 60-km passenger rail link connects Janakpur, Nepal and Jainagar, India; a freight line connects Sirsiya, Nepal and Raxaul, India. • China plans to extend the Qinghai-Tibet Railway to Nepal by 2020. • There have been calls for the construction of a new 40-km rail link extension from Sirsiya to Amlekhgunj.
Pakistan	• Ministry of Communications (including National Highway Authority) • Ministry of Railways (including Pakistan Railways)	• Pakistan's highway network is 12,000 km in length and its rail network is 8,000 km. • The M-9 Super Highway between Karachi and Hyderabad is being upgraded to a six-lane motorway. • In 2014, the Government approved the construction of a new motorway between Karachi and Lahore. • In mid-2014 it was reported that the Chinese Government had commissioned a feasibility study for the construction of a 1,800 km rail link to Pakistan that would ultimately offer access to the planned free-trade, deep-sea port of Gwadar. In total, China is reportedly considering offering US$3.5 billion in loans for the improvement of Pakistan's rail infrastructure.

Country	Road and railway authorities / operators	Notes
Sri Lanka	• Ministry of Highways, Ports, and Shipping (including Road Development Authority) • Ministry of Transport (including Sri Lanka Railways)	• Expressways currently total 160 km in length, with all highways totaling 12,000 km. • Key recently-completed highway projects include the Southern Transport Development Project and the Colombo-Katunayake Expressway Project. • Key highway projects currently under implementation include the Outer Circular Highway to the City of Colombo Project and the North East (Colombo-Kandy) Expressway Project. • The Sri Lankan rail network spans 1,500 km. • The US$366 million Matara-Kataragama Railway Line expansion is expected to be completed in 2015.
Turkey	• Ministry of Transport, Maritime Affairs, and Communication (including General Directorate of Highways and Turkish State Railways)	• Turkey's current motorway network of 2,200 km is expected to be enlarged to 7,800 km by 2023, mostly under build-operate-transfer frameworks. New motorways will link to both Iraq (via Habur/Ibrahim Khalil) and the Islamic Republic of Iran (via Gürbulak). • Turkey's rail network spans 11,000 km; the recent implementation of the Marmaray tunnel project has directly joined the country's European and Asian rail infrastructure for the first time. • New high-speed rail lines are planned for Eskisehir–Ankara, Ankara-Sivas, Ankara-Izmir, Ankara-Bursa and Kapikule–Istanbul.

Revenue-earning opportunities for South and West Asia

Based on this regional analysis, it can be postulated that a coherent, open-access Europe-to-Asia terrestrial fibre infrastructure is likely to significantly increase revenue-earning opportunities for the region's stakeholders.

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

1. passive physical infrastructure including dark fibre, duct and manholes;
2. wholesale capacity ("lit fibre") and bandwidth products; and
3. retail end-user telecommunications, Internet and data services

Analysis of historical demand and forecasts of future demand reveals that even under conservative circumstances, the region's international bandwidth will grow from slightly less than 5 Tbps as of year-end 2013 to almost 300 Tbps in 2024—a compound annual growth rate of 45 per cent. If the region's historical ten-year growth rate (74 per cent) is applied to the forecast period, the region's total demand could be as high as 2.2 petabits per second. In wholesale terms, the collective addressable international bandwidth market in the nine countries of the study could easily range from US$1 billion to US$6 billion annually.

The strongest opportunities for direct Government investment and revenue exist at the first layer (passive fibre network infrastructure development), with additional but somewhat more limited investment and revenue-sharing opportunities available at the second layer (wholesale capacity network operation). Meanwhile, major opportunities for operator-led investment are 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 fibre network construction in the region would take place on property either directly government-owned or by publicly-owned entities including highway agencies, railway operators and utilities. The clientele for the passive physical infrastructure layer would be the entity operating 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" fibre.

Because the second layer (wholesale "lit" fibre 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 second layer 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 an integrated pan-Asian fibre infrastructure will present solid investment and revenue opportunities for both public and private investors, given the project's vast economies of scale as well as its competitive advantage over alternative network paths.

Geographically, the strongest revenue opportunities in the 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 fibre 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. Modelling 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 per cent to 40 per cent per year. Furthermore, the three most developed markets of the region are 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. The concentration of Europe-to-Asia submarine cables 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 Egyptian crossing since the 1990s and their fear of catastrophic cable outages were realized multiple times, most notably in 2008 when SEA-ME-WE and FLAG cables were cut simultaneously. Cable operators' concern was further heightened by the political instability in Egypt in 2011. Simultaneous cable outages in Egypt have resulted in the loss of as much as 80 per cent of India's international bandwidth.

Various routings have been constructed or proposed in order to compete against cables passing through Egypt. Pan-Russian 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. Fibre 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 events in Egypt, plans were finalized for multiple terrestrial networks bypassing Egypt to the east, including the EPEG, the Regional Cable Network and the Jeddah-Amman-Damascus-Istanbul (JADI) Link.

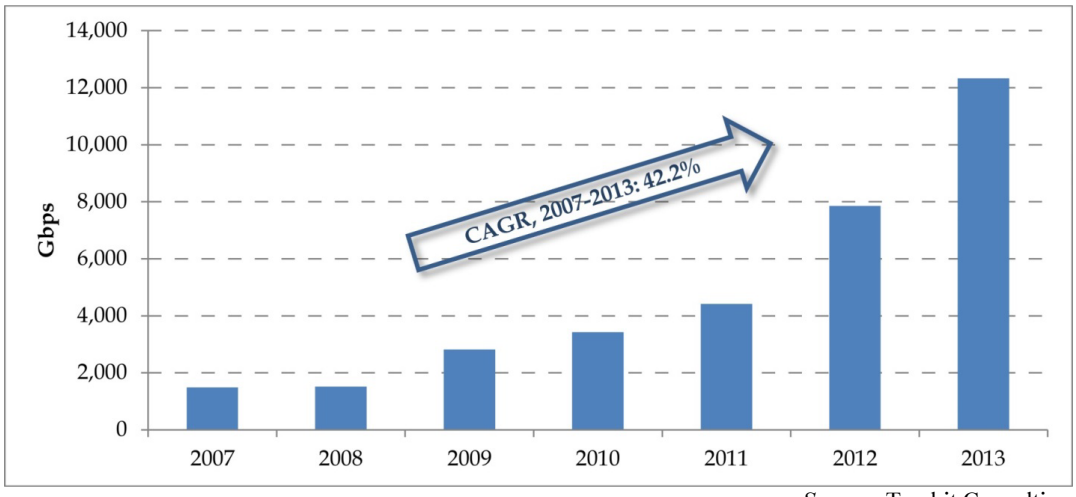
Both the Regional Cable Network and the JADI Link are not operational due to their passing though conflict areas. EPEG opted for a route through the Islamic Republic of Iran and, in 2013, Gulf Bridge International (GBI) announced a terrestrial link via Iraq. Political issues, as well as restrictions 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 wide range of problems with the Egyptian crossing have made the quest for an economically- and technically-viable "Egyptian bypass" one of the submarine industry's top priorities.

Over the last six years, submarine fibre optic capacity between Europe and Asia has grown at a compound annual growth rate of 42 per cent, as shown in the table below. The growth rate of submarine fibre optic capacity is effectively representative of total demand along the route, since Europe-Asia traffic currently routed via terrestrial networks is comparatively minor.

Table 15: Activated Europe-to-Asia submarine cable capacity (Gbps), 2007-2013

	2007	2008	2009	2010	2011	2012	2013
FLAG Europe-Asia (FEA) (formerly FLAG)	20	50	50	50	110	140	240
SEA-ME-WE-3 (SMW3)	150	150	200	200	200	200	410
i2i (ISCN)	160	160	310	640	640	640	640
TGN-TIC (Tata Indicom India-Singapore (TIIS))	320	320	480	480	480	960	1,280
SEA-ME-WE-4 (SMW4)	640	640	1,500	1,500	1,700	2,000	3,590
Falcon	200	200	200	200	300	390	390
Seacom / TGN Eurasia			80	100	110	240	240
India-Middle East-Western Europe (I-ME-WE)				260	640	2,560	3,660
Europe-India Gateway (EIG)					240	240	700
Gulf Bridge International Cable System (GBI) /MENA						480	1,180
Total activated Europe-To-Asia submarine capacity (Gbps)	**1,490**	**1,520**	**2,820**	**3,430**	**4,420**	**7,850**	**12,330**
CAGR (2007-2012)	**42.2%**						

Graph 2: Activated Europe-to-Asia submarine cable capacity increase—trend (2007-2013)



Source: Terabit Consulting

Terrestrial fibre optic network construction cost considerations

It is highly likely that a coherent, next-generation, pan-Asian fibre 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 fibre optic networks. In the event of a submarine cable fault, repairs require specialized vessels and equipment; repair ships may 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 US$50,000 per day.

Terrestrial fibre optic networks, especially those that are easily accessible by highway or railway, 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 activation of dark fibre or the installation of additional fibre 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 fibre 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-fibre-pair terrestrial cable has been reported as US$1,250 per km, with very low marginal costs for additional fibre pairs (as low as US$60 per km). Terrestrial networks can comprise an unlimited number of fibre pairs. Meanwhile, a three-fibre-pair unrepeatered submarine cable is typically US$12,500 per km.

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 US$20,000 to US$40,000 per km to the cost of submarine cable networks.

Furthermore, terrestrial fibre 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-labour-cost market of the United States, conduit plus fibre installation along open roads is estimated to cost US$6,000 to US$18,000 per kilometre. When performed simultaneously with road construction, which costs as much as US$1.8 million per lane, per kilometre, fibre installation can amount to a fraction of 1 per cent of project construction costs.

Policy options for enhancing terrestrial cross-border connectivity

The pan-Asian fibre 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; only an intercontinental, open-access network could be able to achieve true telecommunications equality across all markets in the region.

Wherever possible, the Asian information superhighway 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 fibre optic networks.

Beyond the challenge of securing funding, the primary impediment to the development of a pan-Asian terrestrial fibre optic network will be the desire of incumbent operators (many of which are government-owned) to protect their existing network investments and prevent competition. UNESCAP promotes the development of a coherent, open-access 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 fibre infrastructure is the most obvious option to address inequalities between the region's markets. Asia's current international terrestrial fibre optic infrastructure is hampered by the following limiting factors:

- **Limited geographical scope:** The study region's existing international terrestrial infrastructure consists primarily of bilateral, point-to-point, trans-border links that offer limited geographical coverage. The handful of networks connecting more than two countries function essentially as a patchwork of the national backbone segments of dominant telecommunications carriers rather than as coherent, purpose-built regional networks. Their impact on the pricing or more equitable distribution of the region's international bandwidth can be considered to be minimal.

- **Little or no network redundancy:** Unlike international submarine cables, which are often constructed in geographical 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, thereby reducing the links' reliability and limiting their functionality. Typically, traffic can only be placed over the region's terrestrial trans-border fibre 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 Tbps' worth of bandwidth to the continent.

- **Lack of open access and prohibitive bandwidth pricing:** The region's international terrestrial fibre 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.

Governments and international organizations can facilitate a pan-Asian terrestrial fibre optic network

Intervention by Governments and international organizations is required to ensure the implementation of a pan-Asian terrestrial fibre optic network for the following 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 that are disparate and insufficient; and
5. to stimulate and facilitate future private investment through market maturation.

The fact that there is no viable regional terrestrial fibre optic alternative to the region's submarine infrastructure indicates that the private sector perceives the risk/return profile of any pan-Asian terrestrial fibre optic network to be unworkable without some form of public support or 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 is expected to be increased considerably. The 2010 National Broadband Plan unveiled by the United States Government in March 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. None of the countries studied in this report, aside from Turkey, are likely to achieve similar coverage, affordability and 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.

Public-private partnership options for financing a pan-Asian terrestrial fibre optic network

Based on fibre 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. 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.
- Contributors' equity stakes may be divested once certain milestones are achieved, or alternatively may be held until the winding-down of the SPV.

1. SPV model with Government/organizational contribution

- Network operators form a special purpose vehicle with full responsibility for the pan-Asian terrestrial fibre 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.

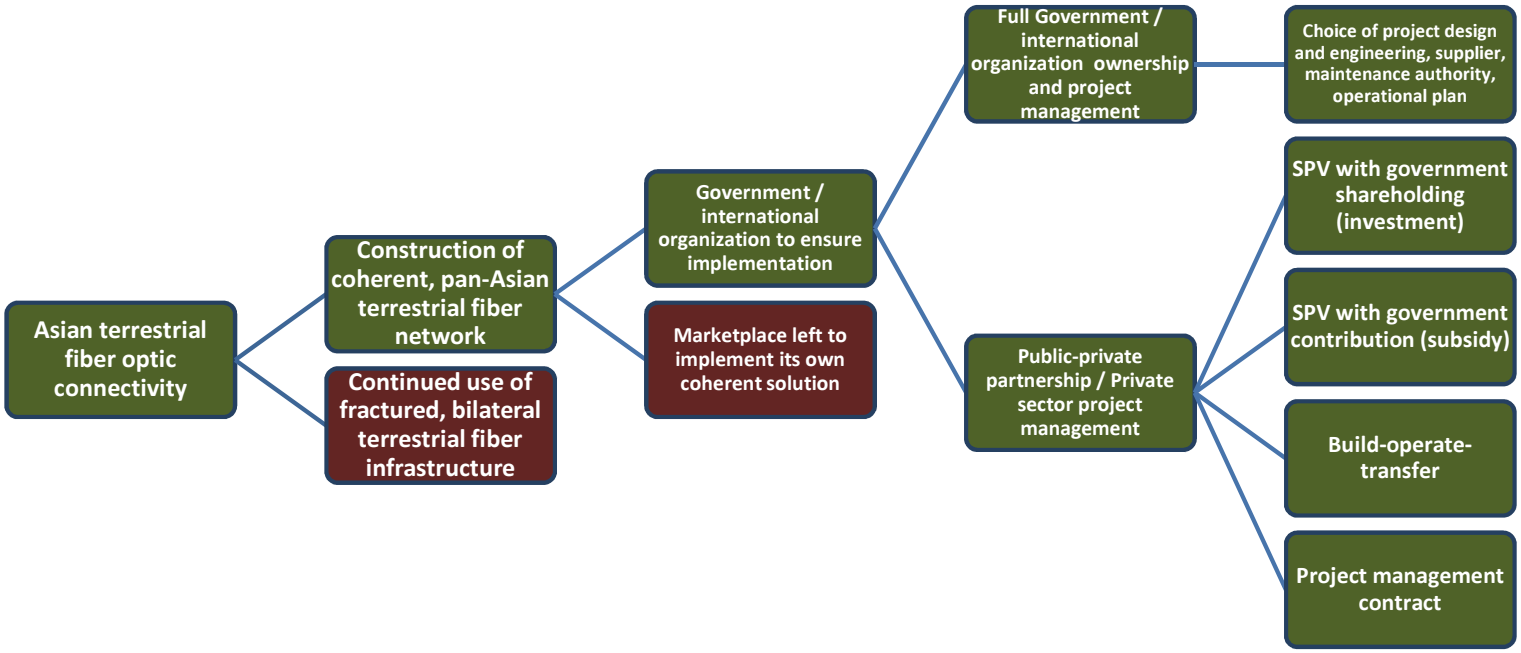
2. Build-operate-transfer

- 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.

3. 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 fibre 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.

Figure 1: Options for participation by Governments and international organizations in the implementation of pan-Asian terrestrial fibre network connectivity



Principles to guide future network development

Given the shortcomings of the existing terrestrial fibre optic infrastructure in South and West Asian markets, as well as previously-studied North and Central Asian and South-East Asian markets, the analysis revealed a strong opportunity for the construction of an international terrestrial fibre optic network providing open, cost-effective access on both an intraregional and intercontinental basis. To ensure the success of such a project, 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. It should be constructed in a mesh configuration that allows for in-network healing in the event of physical cable outages or conflict 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 fibre optic connections are restrained by their weakest segments. Typically, telecommunications carriers in neighbouring 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 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 geographical coverage and transmission capacity/fibre count, a 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 geographical 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 an SPV:** The neutrality and efficiency of the network would be ensured by an SPV shareholding arrangement that would allow participation by all stakeholders while still maintaining arm's-length terms over all capacity sales and leases.

As previously discussed, the chances for success in the development of Asian terrestrial connectivity can be greatly improved by UNESCAP's promotion and facilitation of the project, as it can leverage linear infrastructure such as the Asian Highway and the Pan-Asian Railway, as well as bring together all of the

region's key ICT stakeholders. A useful starting point would to advocate the following advantages of the project:

- **Benefits to consumers** – 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 Organisation 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); and
    - ✓ 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"; and
    - ✓ "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. Governments can also expect increased employment in the telecommunications sector and greater collections from telecommunications licences and excise.

- **Regional stability through better political, economic and intercultural relations** – A more coherent regional fibre 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 health sectors that would not otherwise be possible.

From a commercial perspective, UNESCAP can help convince private-sector stakeholders of the project's viability by focusing on the cost advantages of constructing reliable, high-capacity international fibre optic paths across the entire region (compared to the relatively low-capacity and less-reliable links currently in service). Furthermore, UNESCAP advocates the development of more robust terrestrial connectivity as a response to telecommunications operators' increasing concern regarding network outages in undersea networks' geographical "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 fibre connectivity in the region will likely be the acquisition of funding and opposition from stakeholders with investments in existing networks. It is also very probable that the commercial viability of a pan-Asian terrestrial network will 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.

Next steps for pan-Asian terrestrial fibre 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 Asia-Pacific region and strategy development for linkage to Europe and other intercontinental bandwidth destinations.** In order to be successful, any pan-Asian terrestrial fibre 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. Completed studies for the subregions of South and West Asia, North and Central Asia, and ASEAN should be complemented with analyses of any remaining markets and the integration of all studies into a single coherent and up-to-date analysis covering all markets equally.

- **Completion of a detailed feasibility study.** 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 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 rough order of magnitude 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, 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.

II. Country analysis: Bangladesh

	2013
Population	156 million
Population growth rate	1.2%
Gross Domestic Product	US$350 billion / US$2,200 per capita
GDP growth rate	6.0% in 2013, 5.6% in 2014 (forecast)
Human Development Index	0.558
HDI ranking	142nd out of 187 ("Medium")
Literacy rate	60%
Fixed-line subscribers	1.1 million
Fixed-line operators	1. Bangladesh Telecommunications Company, Ltd. (BTCL) 2. Ranks Telecom, Ltd. 3. BanglaPhone, Ltd. 4. World Tel
Mobile subscribers	114 million
Mobile operators	1. Grameenphone, Ltd. (Telenor 56% share) 2. Banglalink Digital Communications, Ltd. 3. Robi Axiata, Ltd. 4. Airtel Bangladesh, Ltd. 5. Teletalk Bangladesh, Ltd. 6. Pacific Bangladesh Telecom, Ltd. (Citycell)
Mobile broadband	3G launched in 2012; 3G spectrum auctioned and LTE licences awarded in 2013. LTE launch expected in late-2014.
Regulatory agency	Bangladesh Telecommunication Regulatory Commission (BTRC)
International Internet bandwidth	50 Gbps (increased to 110 Gbps as of Oct. 2014)
International Internet bandwidth per capita	0.3 Kbps (increased to 0.7 Kbps as of Oct. 2014)
Internet service providers	1. Bangladesh Telecommunications Company Ltd. (BTCL) 2. Grameenphone 3. Link 3 4. Qubee 5. Banglalion 6. DOT Internet Bd 7. Ollo (Bangladesh Internet Exch. / New Generation Graphics) 8. Mazeda 9. IS Pros 10. BRACNet 11. Dhakacom
Broadband subscribers	As many as 1 million fixed broadband subscribers (>256 Kbps) 6 million mobile broadband subscribers (mid-2014 figure)
Fixed broadband technologies	WiMax, FTTB, ADSL
Typical monthly broadband subscription	1. US$15 per month + US$5 installation fee for 1 Mbps ADSL with unlimited download (BTCL BCube Infinity 1000) 2. US$19 per month + required 4G modem for 1 Mbps WiMax with 30 GB download limit (Qubee)

Telecommunications market overview

The Bangladeshi telecommunications market was valued at US$3 billion to US$4 billion as of 2013, with the mobile sector accounting for well over 90 per cent of revenue. Average revenue per user in the mobile sector was approximately US$2 per month. The country's largest mobile operator, Grameenphone, reported revenue of just under BDT100 billion (US$1.3 billion) in 2013, while the largest fixed-line operator, Bangladesh Telecommunications Company, Ltd. (BTCL), had revenue of approximately BDT11.5 billion (US$150 million).

State-owned BTCL was formed in 2008, when the Bangladesh Telephone and Telegraph Board (BTTB) was split into BTCL and the Bangladesh Submarine Cable Company, Ltd. (BSCCL). BTCL's recent losses have resulted in calls to partially privatize the company. BTCL dominates the fixed-line sector but the other government-owned operator, TeleTalk, has only a few percent of the mobile market; there were calls in 2014 to merge the two operators into a single entity to reduce costs.

The country's telecommunications market has attracted significant foreign investment from the likes of Norwegian operator Telenor (the majority shareholder of Grameenphone), Malaysian operator Axiata, Singtel, Indian operator Bharti Airtel and Russian operator VimpelCom.

Regulation and Government intervention

The Bangladeshi telecommunications and Internet markets are regulated by the Bangladesh Telecommunication Regulatory Commission (BTRC), which was created by the Bangladesh Telecommunication Act of 2001. The act was amended in 2010, giving greater powers to the Ministry of Posts and Telecommunications (MoPT) with respect to licensing and tariffs (the MoPT was subsequently merged with the Ministry of I CT to form the Ministry of Posts, Telecommunications and Information Technology, MoPTIT).

In 2014 it was reported that a plan was under consideration to create a new Department of Telecommunication within the MoPTIT, housing personnel from both BTCL and BSCCL. It was also reported that further changes to the Telecommunication Act were under consideration in order to streamline some regulatory activities.

In anticipation of the country's fiftieth anniversary, the Government has unveiled a "Digital Bangladesh" strategy which would be a cornerstone of the country's planned growth toward middle-income status. The plan draws on recent science, technology and ICT policies promoting e-citizen services as well as greater investment in research, development and technology-based education. The strategy would also earmark greater resources for the country's software and e-government sectors, and sets target penetration rates for tele-centres, community e-centres with Internet facilities and computer laboratories in primary and secondary schools. By 2015, it is expected that broadband will be available in all 86,000 villages and 4G LTE services will be available throughout the country.

According to the Bangladeshi Information and Communication Technology Directorate, as of 2014, there were more than 4,500 Union Information Service Centres, with 60 per cent connected via 3G.

Fixed-line telephony market

The Bangladeshi fixed-line market grew modestly in 2013 to 1.158 million subscribers, although the number of subscribers had fallen to 1.109 million by mid-2014. The fixed-line penetration rate is approximately 0.7 per cent.

State-owned BTCL is the country's incumbent fixed-line operator, with a 79 per cent share of the market and 845,000 fixed-line subscribers as of mid-2014. Due to a severe contraction in earnings from international calls, the company lost a record US$70 million in 2013.

The only other operator with a significant market presence is the private operator Ranks Telecom, Ltd. (RanksTel), a WLL operator which had 250,000 subscribers and a 20 per cent market share as of mid-2014. Two other operators, BanglaPhone and WorldTel, had only a few thousand subscribers each.

In 2010, the licences of five fixed-line operators (Dhaka Phone, National Telecom, PeoplesTel, RanksTel and WorldTel) were revoked following allegations that they had illegally provided VoIP telephony service, although the licences were later reinstated.

As of 2014, the Government was considering amendments to the licensing guidelines for fixed-line operators which would include a reduction in the licensing fee by 50 per cent and allowing the operators to provide limited urban mobile services as well as IP telephony and IP television services. In addition, the sector would be opened to foreign direct investment.

Mobile telephony market

There were 114 million mobile subscribers in Bangladesh as of year-end 2013, for a penetration rate of 73 per cent; as of mid-2014 there were 118 million subscribers.

The country's largest mobile operator is Grameenphone, which had 50 million subscribers as of mid-2014—a market share of 42 per cent. The company's majority investor is the Norwegian Government-owned operator Telenor, which holds 56 per cent of shares (regionally, Telenor has also invested in mobile operators in India, Myanmar, Malaysia, Pakistan and Thailand). Grameen Telecom is Grameenphone's minority investor, with a 34 per cent stake; the nonprofit was established by the microfinance institution Grameen Bank and was instrumental in promoting rural mobile telephony through the Village Phone programme. Grameenphone launched 3G services in Dhaka and Chittagong in late 2013; as of mid-2014 it had covered all 64 district headquarters, giving it a 3G market share of approximately one-third.

Banglalink Digital Communications, the country's second-largest mobile operator with a 26 per cent market share, is a subsidiary of Malta-based Telecom Ventures, Ltd., which is controlled by the Russian operator VimpelCom. In mid-2014, VimpelCom representatives pledged to invest US$350 million in the expansion of Banglalink's 3G network.

Robi Axiata is 92-per cent controlled by the Malaysian investor Axiata Group Berhad, with the remaining 8 per cent of shares held by NTT DoCoMo. Robi Axiata had a market share of 22 per cent as of mid-2014.

Smaller operators include AirTel, a wholly-owned subsidiary of Indian operator Bharti Airtel, with a 7 per cent share of the market; TeleTalk, owned by the Bangladeshi Government, with a 3 per cent share; and CityCell, a joint venture of Singtel, Pacific Motors, Ltd. and Far East Telecom, Ltd., with 1 per cent.

A 3G spectrum auction was held in 2013 which resulted in the awarding of 10 MHz to Grameenphone at a price of US$210 million, while Robi Axiata, Airtel Bangladesh and Banglalink Digital Communications each received 5 MHz at a price of US$105 million.

Internet and broadband market

The BTRC reported that there were 41 million Internet subscribers as of mid-2014. Of these, 96 per cent used mobile Internet service. The remaining subscribers included 1.2 million via fixed Internet service providers and PSTN service and 272,000 via WiMax (some sources indicated that there could be as many as 350,000 fibre-to-the-building subscribers as well as 15,000 DSL subscribers, although these figures could not be independently confirmed).

There were a total of 34 million mobile Internet subscribers as of year-end 2013, according to the BTRC. 3G subscribership was estimated to be approximately 6 million as of mid-2014. Five LTE licences were awarded to BTCL, Bangladesh Internet Exchange Limited, Banglalion, Mango and Qubee in 2013; the operators are expected to launch the service in late 2014.

The WiMax market was served by Banglalion, Ollo, and Qubee (Augere) until mid-2014, when Grameenphone, Agni Systems and ADN Telecom also entered the market. WiMax operators have recently reported a decrease in subscribers, with a churn rate as high as 14 per cent in the first seven months of 2014, as users have migrated toward 3G providers.

The BTRC identified more than 100 nationwide Internet service providers as of 2013. In addition to BTCL and the WiMax and mobile operators, major Internet service providers include BRACNet, Dhakacom, DOT Internet Bd, IS Pros, Link 3 and Mazeda.

Until 2012, there were only two international Internet gateway licencees: BTCL and Mango. However, six licences were issued to international terrestrial cable operators in early-2012 and, as of 2014, there were 34 licensed international Internet gateway operators

At the consumer level, broadband service is relatively expensive, at between US$15 and US$20 per month plus installation for 1 Mbps service, which represents approximately 22 per cent of nominal per-capita GDP. Dial-up Internet from BTCL costs BDT0.10 (US$0.0013) per minute or BDT250 (US$3.23) for unlimited monthly services.

Domestic network connectivity

BTCL's domestic fibre network spans 5,000 km and it operates 768 digital exchanges. Its microwave network connects 88 points, primarily via an STM-1 backbone.

In 2009, the BTRC awarded two licences for Nationwide Telecommunications Transmission Networks (NTTNs) to Fiber@Home and Summit Communications. Fiber@Home operates its own 4,211-km fibre network as well as a 3,577-km shared network, with much of the shared fibre reportedly procured from the Power Grid Company of Bangladesh (PGCB). Summit Communications operates a total of 15,000 km including its own fibre backbone, a leased fibre pair from PGCB and leased capacity from other operators. PGCB's OPGW-based network was reported to be 3,800 km, and Bangladesh Railway operates a 2,000 km network.

Mobile operators, including Grameenphone, Banglalink, Citycell, and Robi Axiata, operate fibre networks of between 600 and 2,000 km in length. In early-2013 the BTRC ordered the operators to stop leasing fibre capacity on their networks, except in areas that were not served by NTTN operators. Later in 2013, the BTRC said that it was considering amendments to the NTTN guidelines which would allow mobile and WiMax operators to develop domestic fibre infrastructure via subsidiaries in which the operators would hold no more than 40 per cent shares.

International internet bandwidth and capacity pricing

Table 16: International Internet bandwidth and capacity pricing in Bangladesh, 2013

International Internet bandwidth	International Internet bandwidth per capita	International capacity pricing
50 Gbps (increased to 110 Gbps as of October 2014)	0.3 Kbps (increased to 0.7 Kbps as of October 2014)	IP transit: US$26 per Mbps per month

Source: Terabit Consulting research, operator data and interviews

As of year-end 2013, Bangladesh's international Internet bandwidth was approximately 50 Gbps. Sources indicated that as of March 2014 the country's total international connectivity for both Internet and voice was 58 Gbps, with 25 Gbps operated by BSCCL and 33 Gbps of lit capacity via the six international terrestrial cable operators (1Asia-AHL Joint Venture, BD Link Communication, Fiber@Home, Mango Teleservices, Novocom, and Summit Communications).

By mid-2014, the country had 110 Gbps of international capacity; international terrestrial cable bandwidth had increased to 80 Gbps and submarine capacity was 30 Gbps.

BSCCL reported that its link via the SEA-ME-WE-4 submarine cable was upgraded to 200 Gbps in 2012, but only a small fraction of this was utilized. BSCCL's primary customer for international capacity is BTCL. BSCCL also says that it is the primary seller of international voice capacity as the SEA-ME-WE-4 cable is generally considered to be of higher reliability than the international terrestrial cable links to India.

The price of international Internet bandwidth has fallen dramatically in recent years, especially with the advent of international terrestrial cable operators, but it still remains high compared to major Asian hubs. As of January 2009, the maximum price of capacity on the SEA-ME-WE-4 cable was BDT28,000 per Mbps per month. In January 2011, the BTRC lowered the price ceiling to BDT12,000 (US$170) and by the end of 2011, the price had been reduced to approximately US$135.

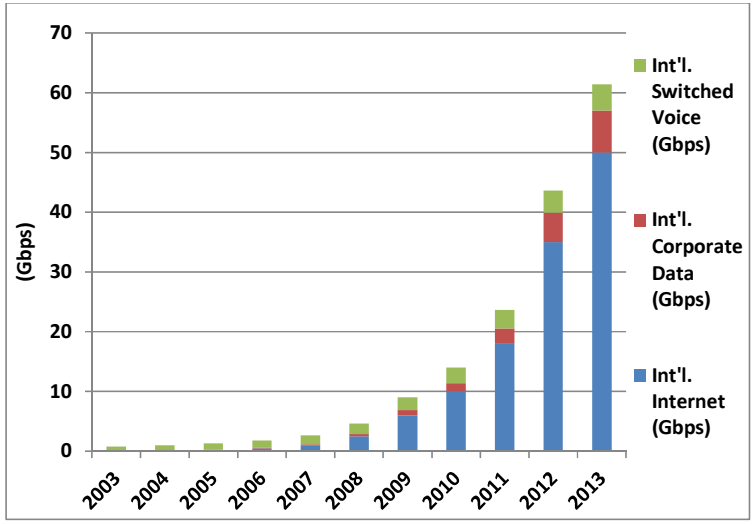
By year-end 2013, BSCCL was reported to be selling IP transit bandwidth via SEA-ME-WE-4 at a price of BDT4,800 (US$62) per Mbps per month, while international terrestrial cable licensees were charging only BDT2,000 (US$26). In mid-2014 BTCL said that the price of capacity on SEA-ME-WE-4 had fallen to BDT2,800 (US$36) in an effort to remain competitive with the terrestrial cables.

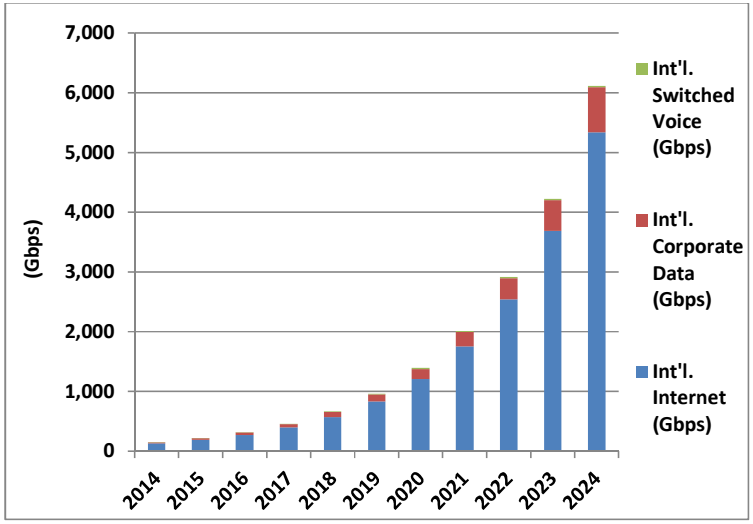
Internationally, in 2014, BSCCL reportedly proposed leasing 40 Gbps of bandwidth to the Indian operator BSNL for use in some northeastern Indian states for BDT45 million (US$580,000, the equivalent of US$14.50 per Mbps per month); subsequent reports indicated that a memorandum of understanding between the two parties ultimately called for the lease of 10 Gbps at a price of approximately US$10 per Mbps per month.

Table 17: Historical and forecasted international bandwidth in Bangladesh (Gbps), 2003-2024

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
International Internet	0	0	0	0	1	3	6	10	18	35	50
International corporate data	0	0	0	0	0	0	1	1	3	5	7
International switched voice	1	1	1	1	2	2	2	3	3	4	4
Total international bandwidth	1	1	1	2	3	5	9	14	24	44	61
CAGR (2003-2013)	55%										

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
International Internet	130	189	273	396	575	833	1,208	1,752	2,540	3,683	5,341
International corporate data	18	26	38	55	80	117	169	245	356	516	748
International switched voice	5	6	7	9	10	12	14	17	20	23	27
Total international bandwidth	153	221	319	460	665	962	1,391	2,014	2,915	4,222	6,116
CAGR (2013-2024)	52%										





International network connectivity

Initial satellite connectivity

BTCL operates one satellite Earth station in Betbunia, inaugurated in 1975 and two in Mohakhali, where the first was inaugurated in 1994. As of 2014, total satellite bandwidth consisted of 24 Mbps of downlink capacity and 8 Mbps of uplink capacity.

Terrestrial fibre optic cables

Six international terrestrial cable operators were licensed in 2012: 1Asia-AHL Joint Venture, BD Link Communication, Fiber@Home, Mango Teleservices, Novocom and Summit Communications.

The interconnection of BTCL's network with that of Indian operator BSNL was completed via a terrestrial cable that entered service in late 2010, connecting Chuadanga to Kolkata via a new 25-km link between Darshana, Bangladesh and Krishna Nagar, India.

A cable linking Bangladesh to the Bharti Airtel network in India entered service in July 2013, linking Benapole, Bangladesh and Petrapole, India.

Tata Communications is reportedly in the process of implementing an India-Bangladesh connection in partnership with Bangladeshi terrestrial cable operator BD Link, connecting Benapol, Bangladesh to Bangaon (West Bengal), India.

Myanmar Posts and Telecommunications and BSCCL are implementing a terrestrial link between Myanmar and Bangladesh in order to provide Bangladesh with connectivity to SEA-ME-WE-3 and Myanmar with connectivity to SEA-ME-WE-4. BSSCL has reportedly budgeted US$2.75 million for their share of the project, which would include a 50-km link between its Cox's Bazar landing station and the Myanmar border.

Submarine fibre optic cables

SEA-ME-WE-4

Bangladesh's primary international link is the SEA-ME-WE-4 Europe-to-Asia cable. It was the country's first submarine fibre optic cable, landing in Jhilongja, Cox's Bazar in May 2006; at that time, the population of Bangladesh was approaching 150 million. The cable was significantly delayed due to the construction of the Chittagong-Cox's Bazar fibre link; the Bangladeshi landing point ultimately entered service seven months after the rest of the cable's landing points and a year after Alcatel-Lucent completed installation of the Bangladeshi segment and construction of the cable landing station.

In July 2007, approximately one year after the SEA-ME-WE-4 cable was inaugurated in Bangladesh, the cable was reported to be "under threat" as a result of coastal erosion near Kalatali Beach, Cox's Bazar. Then, in October 2007, Bangladesh suffered a five-hour Internet outage when three individuals allegedly cut and stole the system's terrestrial backhaul link on the Ichachori Bridge in Chakaria. The fibre optic cable between Cox's Bazar and Dhaka was broken by "miscreants" several times, according to the *Daily Star* newspaper; each break cost BTTB approximately US$70,000 in lost revenue per hour. In December 2007, the Bangladeshi High Court allowed BTTB to swap fibre with private network developer Bangla Phone to provide redundancy on the route.

The original Bangladeshi investor in SEA-ME-WE-4, BTTB, was backed in part by a US$35 million loan from the Islamic Development Bank. In 2008, BTTB was split into two entities: the operator BTCL and BSCCL, which was assigned responsibility for overseeing the country's SEA-ME-WE-4 capacity.

Bangladesh was reported to have initially purchased rights to an STM-64 (10 Gbps) of capacity on the system; as of October 2008, the country's reported Internet bandwidth on SEA-ME-WE-4 had risen to 24 Gbps. In terms of utilization, the Internet Service Providers Association of Bangladesh estimated that total Bangladeshi Internet demand in mid-2006 was about 500 Mbps; by December 2007, BTTB reported that its utilization was 2.799 Gbps of voice bandwidth and 1.244 Gbps of data bandwidth.

BTTB reported sales of approximately 462 Mbps to 73 capacity customers as of year-end 2007, yielding US$3 million in revenue. At the time, BTTB said that the marketing of the system needed improvement and that the numerous service outages on the cable (which occurred 22 times over an 18-month period) had also negatively impacted bandwidth sales.

As of 2010, BSCCL reported that its bandwidth on the cable was 44.6 Gbps, but that the company had agreed to an upgrade of the system costing US$14 million. As such, SEA-ME-WE-4 was upgraded in 2012, providing BSCCL with 200 Gbps of capacity, of which it reported a utilization rate of only 20 per cent. BSCCL's largest customer is BTCL.

Proposed international connectivity

SEA-ME-WE-5

As soon as the SEA-ME-WE-4 cable entered service, there were calls from multiple stakeholders, both public and private, for a second cable to serve Bangladesh. BSCCL gave serious consideration to the construction of a submarine cable linking Bangladesh and either India or Singapore, but such a project never materialized. Ultimately, BSCCL became a shareholder in the SEA-ME-WE-5 Europe-to-Asia cable, which is expected to enter service in 2016 and will land at Kuakata, in the southern district of Patuakhali. BSCCL invested BDT5.6 billion (US$72 million) and will receive 1.4 Tbps of capacity.

III. Country analysis: Bhutan

	2013
Population	750,000
Population growth rate	1.7%
Gross Domestic Product	US$5.3 billion / US$7,000 per capita
GDP growth rate	5.0% in 2013, 6.5% in 2014 (forecast)
Human Development Index	0.584
HDI ranking	136th out of 187 ("Medium")
Literacy rate	63%
Fixed-line subscribers	26,485
Fixed-line operators	1. Bhutan Telecom
Mobile subscribers	545,000
Mobile operators	1. B-mobile (Bhutan Telecom) 2. TashiCell (Tashi Infocomm)
Mobile broadband	3G launched in 2009; 4G LTE launched in 2013
Regulatory agency	Bhutan InfoComm and Media Authority (BICMA)
International Internet bandwidth	5.7 Gbps
International Internet bandwidth per capita	0.3 Kbps
Internet Service Providers	1. Druknet (Bhutan Telecom) 2. Drukcom 3. Samden Tech 4. TashiCell (Tashi Infocomm)
Broadband subscribers	20,481 fixed broadband subscribers (>256 Kbps) 117,659 mobile broadband subscribers
Fixed broadband technologies	ADSL, FTTB, Wi-Fi
Typical monthly broadband subscription	1. US$6.50 + US$22 installation for 2 Mbps download speed and 4 GB monthly download limit (Druknet Home) 2. US$41 + US$22 installation for 2 Mbps download speed and 27 GB monthly download limit (Druknet Enterprise)

Telecommunications market overview

The value of the Bhutanese telecommunications market is estimated to be between US$40 million and US$50 million. Average revenue per user is between US$6 and US$8 per mobile user per month.

Bhutan's telecommunications market is effectively a duopoly served by Bhutan Telecom and Tashi Infocomm, Ltd. (TashiCell), although there are two additional ISPs: Drukcom and Samden Tech.

In addition to its fixed-line business, government-owned Bhutan Telecom operates a mobile subsidiary, B-mobile, and an Internet subsidiary, Druknet.

Regulation and Government intervention

The Bhutanese telecommunications and Internet sectors are regulated by the Bhutan InfoComm and Media Authority (BICMA), which was created in 2006. The agency regulates services, frequencies and spectrum, and also issues licences. It is responsible for technical standards and guidelines as well as terms and conditions for the provision of services.

The primary legislation governing the sector is the Telecommunications Act of 1999.

The National Broadband Master Plan calls for the implementation of optical ground wire fibre connectivity to 18 of the country's 20 administrative districts (dzongkhags), with the remaining two connected via all-dielectric self-supporting (ADSS) cable. ADSS will also provide connectivity to 200 gewogs (groups of villages). The fibre implementation was coordinated with the country's rural electrification project and is almost complete.

In the capital, Thimphu, a high-speed network connects all government agencies. The government network also links 20 district administration offices and 166 community centres, with the goal of not only improving communication between agencies but also providing a network for the promotion of e-government.

Fixed-line telephony market

Bhutan Telecom has a monopoly over the country's fixed-line market. It served 26,485 subscribers as of year-end 2013, representing a penetration rate of 3.5 per cent. The number of subscribers fell by 2 per cent between 2012 and 2013.

Mobile telephony market

There were approximately 545,000 mobile subscribers in Bhutan as of year-end 2013, for a penetration rate of 73 per cent. The number of mobile subscribers has seemingly leveled off, with a modest contraction between 2012 and 2013.

Bhutan Telecom's B-mobile subsidiary has a 74 per cent share of the market; the only competitive telephone operator, Tashi InfoComm, Ltd. (operating under the TashiCell brand name), has the remaining 26 per cent of mobile subscribers. Tashi was awarded a licence in 2006 and launched its network in 2008.

3G service was launched in 2009 and, as of 2014, B-mobile offered 3G in 15 dzongkhags, while TashiCell offered it in four. B-mobile and TashiCell served a combined 117,659 3G subscribers as of 2013, representing a six-fold increase over 2012.

Due to a large increase in the number of users, B-mobile representatives conceded in August 2014 that the operator's 3G network was suffering from congestion problems during peak hours.

B-mobile also launched a 4G LTE network in selected neighbourhoods of Thimphu in October 2013.

Internet and broadband market

According to the Ministry of Information and Communications, as of year-end 2013, Bhutan had 20,481 fixed broadband subscribers served through a combination of ADSL (20,278 subscribers) and FTTB (203

subscribers). There were 117,659 mobile broadband subscribers, with virtually all of these connected via 3G service; only 110 4G subscribers were identified as of year-end 2013.

A report issued by the Bhutan InfoComm and Media Authority indicated that Bhutan Telecom's Druknet served 99.5 per cent of all ADSL subscribers, with Druk Comm serving a total of 90 ADSL subscribers. According to BICMA, Bhutan Telecom served 227 leased line customers, while TashiCell served 99, Samden Tech 30, and Druk Comm three. Bhutan Telecom's share of the EDGE, GRPS, and 3G market was 91 per cent, with TashiCell serving the remaining 9 per cent.

Samden Tech and Drukcom offer Internet service in Thimphu only.

Although 92.8 per cent of Bhutanese households have one or more mobile phone subscriptions, only 16.4 per cent have personal computers, according to the 2012 Bhutan Living Standard Survey Report conducted by the National Statistics Bureau and the Asian Development Bank. However, in urban areas, personal computer penetration is more than one-third.

Druknet's residential package offers a 2 Mbps ADSL connection with a 4 GB monthly download limit for US$6.50 per month, plus US$22 installation, while its enterprise package charges US$41 per month for the same speed with a 27 GB monthly download limit.

Domestic network connectivity in Bhutan

The country's fibre backbone consists primarily of an east-west trunk in the south of the country, with branches to population centres. Bhutan's National Broadband Network infrastructure comprises 3,300 km of fibre optic cable, connecting all 20 district headquarters as well as 187 gewogs via optical ground wire and ADSS fibre optic cable via the infrastructure of the Bhutan Power Corporation. An additional 13 gewogs are in the process of being connected as part of BPC's rural electrificatio4n programme.

National Broadband Network fibres are owned by the Bhutanese Government and operated and maintained by BPC. Dark fibres on the network are leased by operators and ISPs.

As part of the SASEC international cable project, in June 2014, Railtel Corporation of India completed installation of a 10 Gbps link from Thimphu to Phuentsholing and Gelephu.

International Internet bandwidth and capacity pricing

Table 18: International Internet bandwidth and capacity pricing in Bhutan, 2013

International Internet bandwidth	International Internet bandwidth per capita	International capacity pricing
5.7 Gbps	7.6 Kbps	US$100 per Mbps per month (estimated)

Source: Terabit Consulting research, operator data and interviews

Internet and television services were not introduced to Bhutan until 1999. The country's first international gateway was in Phuntsholing; it currently interconnects Bhutan Telecom and Tashi InfoComm with the Indian networks of Reliance and Airtel. In March 2012, the country's second gateway was opened in

Gelephu, where Bhutan Telecom interconnects with Reliance and Tashi InfoComm interconnects with Airtel.

In 2008, Bhutan Telecom established a DS-3 connection via the London Internet Exchange (LINX), which it supplemented with a DS-3 from Reliance Globalcom via the Hong Kong Internet Exchange (HKIX). However, utilization rates of the country's international bandwidth were 98 per cent and both links were upgraded to STM-1 in 2010.

In June 2013, Bhutan Telecom's subsidiary DrukNet increased its international bandwidth from 1.3 Gbps to 3.1 Gbps.

As of 2014, DrukNet's international bandwidth had been increased to 5.3 Gbps, with a peak utilization rate of approximately 50 per cent, while Tashi Infocomm had 370 Mbps of international bandwidth and a utilization rate of approximately 60 per cent.

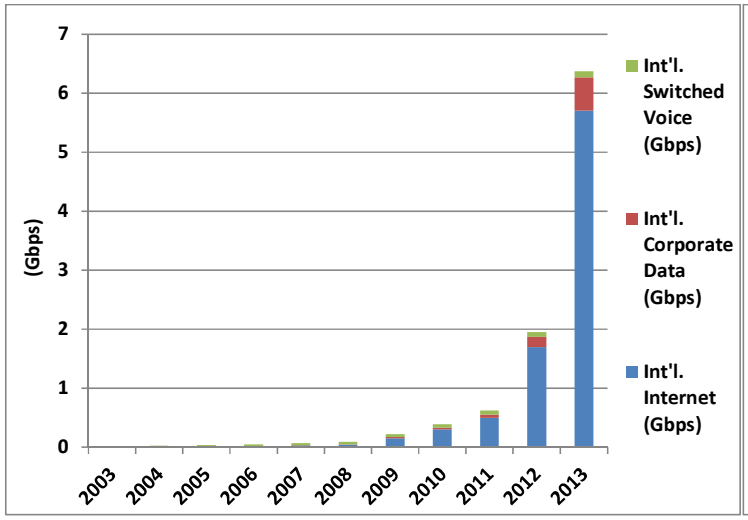
In addition to its POPs at LINX and HKIX, Bhutan Telecom intended to establish a third international POP in Singapore in 2014.

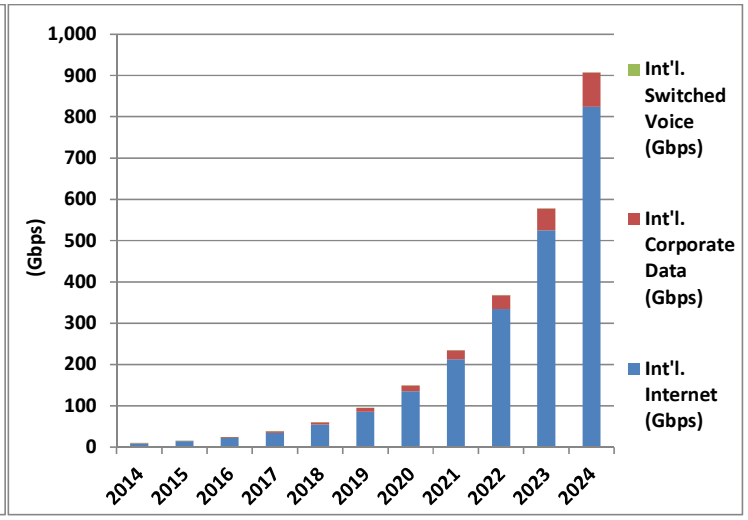
Given the limited number of operators and ISPs in Bhutan, there is no transparent market for wholesale IP transit capacity. However, managed bandwidth services in the country are uniformly expensive: Bhutan Telecom's Internet leased line price is US$154 per month for 1 Mbps and US$137 per Mbps for increments of 30 Mbps or more. Tashi InfoComm's leased line prices are approximately 50 per cent higher.

Table 19: Historical and forecasted international bandwidth in Bhutan (Gbps), 2003-2024

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
International Internet	0	0	0	0	0	0	0	0	1	2	6
International corporate data	0	0	0	0	0	0	0	0	0	0	1
International switched voice	0	0	0	0	0	0	0	0	0	0	0
Total international bandwidth	0	0	0	0	0	0	0	0	1	2	6
CAGR (2003-2013)	75%										

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
International Internet	9	14	22	35	55	86	136	213	334	525	824
International corporate data	1	1	2	4	6	9	14	21	33	52	82
International switched voice	0	0	0	0	0	0	0	0	0	1	1
Total international bandwidth	10	16	25	39	61	95	150	235	368	578	907
CAGR (2013-2024)	57%										





International network connectivity

Initial satellite connectivity

An Intelsat Earth station, connecting via the Intelsat-5A series, was inaugurated in Thimphu in 1990 and provided the country's first international telecommunications, aside from a limited number of trans-border microwave links that connected some border areas in the west to India.

Terrestrial fibre optic cables

Bhutan has two international terrestrial fibre optic cables to India. The first, connecting Phuentsholing in southwestern Bhutan to Jaigaon, India, was activated in 2007 and the second, connecting the southern town of Galephu to Assam, India, entered service in 2011. However, both fibre paths converge at Siliguri, India, where they are then routed to the submarine cable gateway in Mumbai, India, raising concerns about the vulnerability of the country's international connectivity.

The SASEC programme is in the process of implementing the SASEC Information Highway network connecting Bangladesh, Bhutan, India and Nepal. The network will allow for the implementation of submarine cable connectivity via the Cox's Bazar, Bangladesh, landing point of SEA-ME-WE-4. As part of the SASEC project, in June 2014, Railtel Corporation of India completed installation of a 10 Gbps link from Thimphu to Phuentsholing and Gelephu.

IV. Country analysis: India

	2013
Population	1,240,000,000
Population growth rate	1.3%
Gross Domestic Product (PPP)	US$6 trillion / US$5,000 per capita
GDP growth rate	5.0% in 2013, 5.5% forecasted in 2014
Human Development Index	0.586
HDI ranking	135th out of 187 ("medium")
Literacy rate	75%
Fixed-line subscribers	28.9 million
Fixed-line operators	1. Bharat Sanchar Nigam, Ltd. (BSNL) 2. Mahanagar Telephone Nigam, Ltd. (MTNL) 3. Bharti Airtel, Ltd. 4. Tata Teleservices, Ltd. 5. Reliance Communications, Ltd. 6. Quadrant Televentures, Ltd. 7. Sistema Shyam TeleServices, Ltd. (MTS brand) 8. Vodafone India, Ltd.
Mobile subscribers	886.3 million
Mobile operators	1. Bharti Airtel, Ltd. 2. Vodafone India, Ltd. 3. Idea Cellular, Ltd. 4. Reliance Communications, Ltd. 5. Bharat Sanchar Nigam, Ltd. (BSNL) 6. Aircel, Ltd. 7. Tata Teleservices, Ltd. (including Tata DoCoMo) 8. Telewings Communications Svcs. Pvt., Ltd. (Uninor) 9. Others (Sistema, MTNL, Loop, Quadrant)
Mobile broadband	Limited 3G launch in 2008; limited 4G LTE launch in 2012
Regulatory agency	Telecom Regulatory Authority of India (TRAI)
International Internet bandwidth	1,209 Gbps
International Internet bandwidth per capita	1.0 Kbps
Internet service providers	1. Bharti Airtel, Ltd. 2. Vodafone India, Ltd. 3. Bharat Sanchar Nigam, Ltd. (BSNL) 4. Reliance Communications, Ltd. 5. Idea Cellular, Ltd. 6. Others (Aircel, Telewings, Tata, Loop, MTNL)
Fixed broadband subscribers	20 million fixed broadband subscribers (>256 Kbps) 40 million mobile broadband subscribers
Fixed broadband technologies	ADSL, Fixed Wireless, FTTH
Typical monthly broadband subscription	1. US$13 for 1 Mbps ADSL with 6 GB download limit (BSNL BB Home) 2. US$17 for 10 Mbps FTTH with 25 GB download limit (MTNL Fibre Thrill 1050)

Telecommunications market overview

India has the second-largest telephony market in the world (after China) in terms of subscribers, and the third-largest Internet market (after China and the United States) in terms of users. The overall market is estimated to be worth between US$40 billion and US$50 billion annually.

Although India's international gateway market is dominated by only a handful of carriers (namely Tata, Bharti Airtel and Reliance), domestic telecommunications and Internet markets are very competitive, with 13 mobile operators and at least 10 major ISPs each serving one million or more customers in each sector. The fixed-line market, although dominated by incumbent operator Bharat Sanchar Nigam, Ltd. (BSNL), is served by seven other competitors.

The mobile sector's average revenue per user is among the lowest in the world at US$2.10 per month and bodes well for the penetration of mobile services, but the affordability of broadband Internet services remains a concern, given the fact that 80 per cent of households earn less than INR159,600 (US$2,600) per year and the middle quintile of households earns only between INR55,641 (US$900) and INR88,820 (US$1,450) per year, according to the National Council for Applied Economic Research.

The Government retains control over India's two largest fixed-line operators, BSNL and Mahanagar Telephone Nigam, Ltd. (MTNL), but the country's four-largest mobile operators are all privately-owned and foreign direct investment in the telecommunications sector grew to US$2.3 billion during the first four months of fiscal year 2014-2015, spurred in part by new legislation allowing foreign operators to assume 100 per cent stakes in local companies.

Regulation and Government intervention

The Indian telecommunications industry is overseen by the Telecom Regulatory Authority of India (TRAI), which was established as an independent regulator in 1997. The industry's governing legislation is the Indian Telegraph Act of 1885, which has been amended multiple times.

In August 2011, the Indian Department of Telecommunication proposed a US$13 billion National Broadband Plan to the Indian Cabinet; in October 2011, the Cabinet approved a plan to be led by a special purpose vehicle in partnership with BSNL, Railtel and the Power Grid Corporation of India, focusing on rural coverage including the launch of a fibre-to-the-village programme.

The plan ultimately called for the construction of a US$3.5 billion National Fibre Optic Network (NFON) to connect all of India's 250,000 local administrative units (gram panchayats). Bharat Broadband Network, Ltd., the SPV created by the Government, was assigned responsibility for overseeing the network's implementation. BSNL will be responsible for the installation of 70 per cent of the network, while Railtel and PowerGrid Corporation will each be responsible for 15 per cent. The project was reported to be significantly behind schedule, but in September 2014, the Government mandated a completion deadline of March 2016.

The NFON is a crucial element of the Government's most recent National Telecom Policy, NTP-2012, which seeks to increase rural telephone penetration from 39 per cent in 2012 to 70 per cent in 2017 and 100 per cent by 2020. The policy also aims to provide "affordable and reliable broadband-on-demand" by 2015, with 175 million broadband subscribers by 2017 and 600 million by 2020, with speeds of at least 2 Mbps and "on-demand" speeds of at least 100 Mbps.

Fixed-line telephony market

The fixed-line telephony market is relatively small, at only 29 million subscribers, for a penetration rate of 2.3 per cent. The country's two largest fixed-line operators are government-owned incumbents: BSNL, which was historically responsible for providing telephony services to all of India with the exception of metropolitan New Delhi and metropolitan Mumbai, has a market share of two-thirds. MTNL, which covered the two cities outside of the BSNL concession, has a 12 per cent share of the fixed-line market, as does Bharti Airtel. Leading international network operators Tata and Reliance have market shares of 5 per cent and 4 per cent respectively, while Quadrant, Sistema and Vodafone collectively serve 320,000 subscribers.

In recent years, the fixed-line market has lost approximately two million subscribers annually. The lack of profitability in the fixed-line sector has given rise to persistent calls for the merger of MTNL and BSNL. As recently as September 2014, the Indian Cabinet and the Department of Telecommunications were both reported to be seriously considering the combination of the two companies.

Mobile telephony market

The mobile market continues to grow, with a 73 per cent penetration rate as of 2014. The marketplace is extremely competitive and is served by 13 operators, eight of which have subscriber bases of 30 million or more. Major operators include Bharti Airtel, with a 23 per cent market share; Vodafone (18 per cent), Idea (15 per cent), Reliance (12 per cent), BSNL (10 per cent), Aircel (8 per cent), Tata (7 per cent) and Telewings (4 per cent). Sistema, Videocon, MTNL, Loop, and Quadrant each have market shares of 1 per cent or less.

3G adoption was initially weaker than expected, affected by widespread consumer complaints about high prices, weak coverage, incompatible handsets, and "bill shock." In 2012, the latter was experienced by "a majority of customers who are subscribing to 3G," according to telecoms analysts at Goldman Sachs, citing the unaffordability of watching streaming video such as sporting events.

Despite the initial reservations expressed by consumers after the launch of 3G services, as of 2014, the market was considered to have gained momentum. TRAI reported 220 million total mobile Internet subscribers as of year-end 2013; 40 million of these were classified as broadband and, as of mid-2014, initial figures from carriers indicated that 3G subscribership had grown to almost 50 million.

Although 4G services are available in a few cities, most observers do not expect any substantive 4G penetration until 2016, with most mobile broadband investment focused on 3G technology until then.

Internet and broadband market

There are six Indian ISPs with subscribership of ten million or more: Bharti, with a market share of 24 per cent, Vodafone with 21 per cent, BSNL with 16 per cent, Reliance with 15 per cent and Idea with 10 per cent. Additionally, Aircel, Telewings, Tata, Loop and MTNL each reported more than one million subscribers.

TRAI reported approximately 20 million fixed broadband subscribers as of year-end 2013. Approximately 70 per cent of these subscribe to ADSL, but the country's weak fixed-line infrastructure means that most growth in broadband Internet subscribership will be in the fixed wireless and mobile sectors (although there have been an increased number of FTTH deployments). BSNL dominates the fixed broadband sector, with a 72 per cent market share. Airtel has an 8 per cent share and MTNL has a 6 per cent share.

Fixed broadband services are becoming increasingly affordable. Although a standard 1 Mbps ADSL connection from BSNL is relatively expensive at US$13 per month, MTNL offers a 10 Mbps fibre-to-the-home service for US$17 per month.

Domestic network connectivity

India's domestic fibre connectivity comprises more than one million route km. BSNL operates the country's largest fibre network, with more than 650,000 domestic route km, more than three times the network length of its closest competitor.

BSNL will have a 70 per cent responsibility for implementation of the National Fibre Optic Network, overseen by the special purpose vehicle Bharat Broadband Network, Ltd. and connecting 250,000 gram paynchayats. Additionally, in 2014, BSNL issued a tender for the installation of 57,000 route km of domestic fibre to serve the Indian military.

Reliance Communications operates a 190,000-km network; in 2013 the company signed an agreement to provide domestic fibre capacity to the operator Reliance Jio. Bharti Airtel operates the country's third-largest fibre network, at 170,000 km. Other significant networks include those of Tata Communications (42,000 km), Railtel (40,000), PowerGrid (25,000 km) and Gailtel (15,000 km).

International Internet bandwidth and capacity pricing

Table 20: International Internet bandwidth and capacity pricing in India, 2013

International Internet bandwidth	International Internet bandwidth per capita	International capacity pricing
1.2 Tbps	1.0 Kbps	IP transit: US$10 to US$15 per Mbps per month

Source: Terabit Consulting research, operator data and interviews

As of year-end 2013, India's total international Internet bandwidth was 1,209 Gbps. During the first quarter of 2014, bandwidth grew an additional 7 per cent, to 1,294 Gbps. BSNL reported that during peak hours, the utilization rate of its international bandwidth is 81 per cent, Bharti Airtel's is 67 per cent, Tata's is 58 per cent, and Reliance's is 53 per cent.

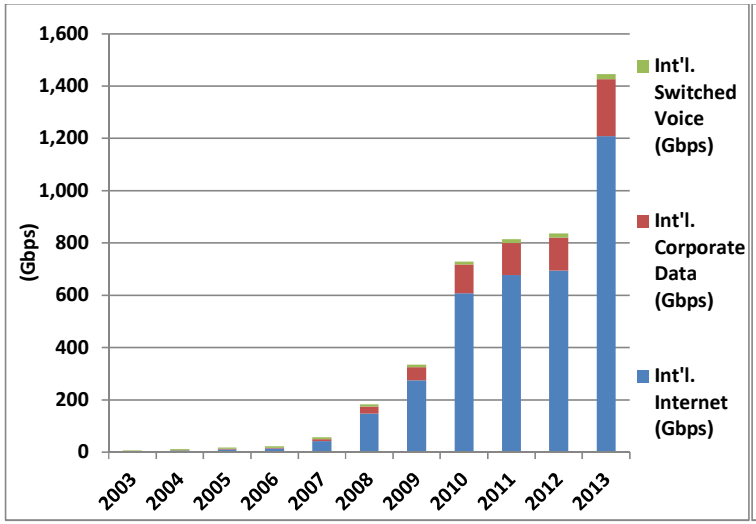
Operators' share of international gateway traffic is as follows: Tata Communications 39 per cent, Bharti Airtel 30 per cent, Reliance Communications 26 per cent, and Sify 5 per cent. Approximately 71 per cent of the country's international traffic passes through the Mumbai gateway, while 25 per cent is served by Chennai and 4 per cent is served by Kochi.

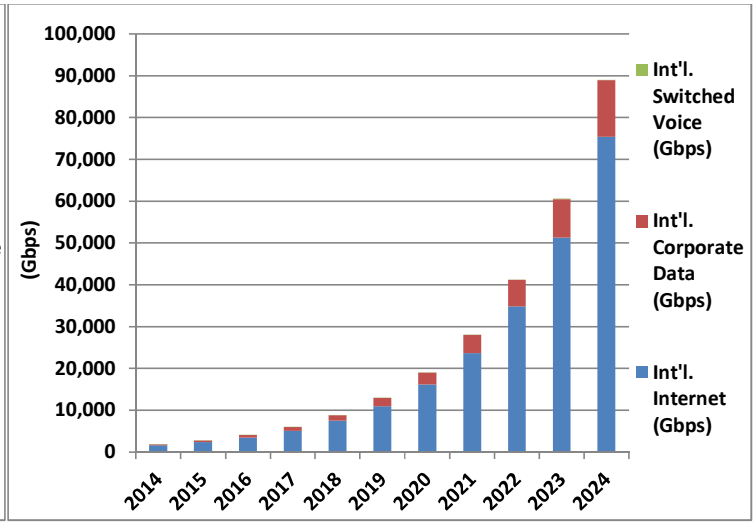
A 10 Gbps wavelength from Mumbai to London costs between US$100,000 and US$150,000 per month (US$10 to US$15 per Mbps) and IP transit in Mumbai is approximately the same price. Despite the fact that Indian bandwidth prices compare favorably to those in neighbouring South Asian markets, several sources indicated that 10 Gbps wavelengths from London to Singapore, a distance that is approximately one-third longer by submarine cable, can be leased from some network operators at as little as half the price of London-Mumbai wavelengths. In 2014, BSNL reportedly procured 10 Gbps of bandwidth from the Bangladesh's BSCCL for approximately US$10 per Mbps per month.

Table 21: Historical and forecasted international bandwidth in India (Gbps), 2003-2024

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
International Internet	3	6	10	14	42	148	275	608	678	695	1,209
International corporate data	1	1	2	3	8	27	50	109	122	125	218
International switched voice	4	4	5	6	7	9	10	12	14	17	19
Total international bandwidth	7	11	17	23	57	183	335	729	814	837	1,446
CAGR (2003-2013)	70%										

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
International Internet	1,600	2,352	3,457	5,082	7,471	10,983	16,144	23,732	34,887	51,283	75,386
International corporate data	288	423	622	915	1,345	1,977	2,906	4,272	6,280	9,231	13,570
International switched voice	23	27	32	38	45	53	62	73	86	102	120
Total international bandwidth	1,911	2,803	4,112	6,035	8,861	13,012	19,113	28,078	41,253	60,616	89,076
CAGR (2014-2024)	45%										





International network connectivity

Initial satellite connectivity

Intelsat satellite Earth stations in India are located in Arvi, Maharashtra (near Pune); Dehradun, Uttaranchal; Fort, Mumbai; Kolkata; Chennai; Halisahar (near Kolkata); Ernakulum; Jalandhar; Ganhinagar; Bangalore and Greater Kailash, New Delhi, among others. Satellite capacity accounts for less than 1 per cent of the country's total international bandwidth.

Terrestrial fibre optic cables

The following terrestrial fibre optic cables serve India:

To Bangladesh:
1. BTCL and BSNL India-Bangladesh, a 25-km link between Darshana, Bangladesh and Krishna Nagar, India, that ultimately connects the cities of Chuadanga and Kolkata.
2. Bharti Airtel activated a cable between Benapole, Bangladesh and Petrapole, India in 2013.
3. Tata Communications said in 2013 that it would construct a link in partnership with Bangladeshi international terrestrial cable licensee BD Link, between Benapol, Bangladesh and Bangaon (West Bengal), India.

To Myanmar:
India–Myanmar, a 640-km system initiated in December 2006 and completed in 2010 at a cost of US$7 million, offering a capacity of STM-4 (622 Mbps), connecting Mandalay, Myanmar and Moreh, India via Tamu, Kampatwa, Kyi Gone, Shwebo, Monywa, and Sagaing. The cable is owned BSNL and Myanmar Post and Telecommunications, with the installation contract awarded to Telecommunications Consultants India, Ltd.

To China:
1. Reliance Communications and China Telecom China-India, which entered service in 2009 at a capacity of 20 Gbps, connecting Siliguri, India to Yadong, China.
2. China Telecom and Bharti Airtel China-India, a 40-Gbps terrestrial link inaugurated in late-2010 between Yadong, China and Siliguri, India via Nathula.
3. China Telecom and Tata Communications China-India, which was also inaugurated in 2010.

To Bhutan:
Two cables connect India to Bhutan, including one which entered service in 2007 between Jaigaon, India and Phuentsholing, Bhutan and another connecting Assam, India, to Galephu, Bhutan, entering service in 2011. The links are considered somewhat vulnerable because they both converge at Siliguri, India.

To Nepal:
Nepal Telecom is linked to the networks of three Indian operators, Reliance, BSNL and Airtel, via fibre connectivity at the Birgunj-Raxaul and Birtatnagar-Jogbani border crossings; Indian operator Tata links to the network of UTL via links at the Birgunj-Raxaul crossing as well as a link between Bhairahwa and Sunauli.

To Pakistan:
A terrestrial link between India and Pakistan, linking the Indian network of Tata Communications in Amritsar to the Pakistani network of PTCL in Lahore, Pakistan, via Wagah, has been installed but is not yet fully activated.

Submarine fibre optic cables

India is served by eleven interregional submarine cable systems. Three are traditional Europe-to-East Asia systems: FLAG Europe-Asia (1997), SEA-ME-WE-3 (1999), and SEA-ME-WE-4 (2005). Two link India to Africa and then onward to Europe: SAFE (which entered service in 2002 and is interconnected with the SAT-3 cable in South Africa) and Seacom (2009). Two link India to Singapore: i2i (2002) and TGN-TIC (2004). The remaining four connect to the Mediterranean Sea via the Middle East and the Red Sea: Falcon (2006), I-Me-We (2010), EIG (2011), and the GBI/MENA network (2012).

Table 22: Submarine fibre optic cables serving India

RFS	Submarine cable system	Network reach	Financing type	Owner(s)
1997	**FLAG Europe-Asia**	Intercontinental and part of global network	Private Carrier	Global Cloud Xchange (Reliance Globalcom)
1999	**SEA-ME-WE-3**	Intercontinental	Carrier Consortium	Consortium
2002	**i2i**	Regional	Private Carrier	Bharti Airtel
2002	**SAT-3/SAFE**	Intercontinental	Carrier Consortium	Consortium
2004	**TGN-TIC**	Regional and part of global network	Private Carrier	Tata Communications
2005	**SEA-ME-WE-4**	Intercontinental	Carrier Consortium	Consortium
2006	**Falcon**	Intercontinental and part of global network	Private Carrier	Global Cloud Xchange (Reliance Globalcom)
2009	**Seacom/TGN Eurasia**	Intercontinental	Investor-led	IPS (Aga Khan Fund) / Remgro / Herakles Telecom / Convergence Partners / Shanduka Group / Tata Communications
2010	**I-Me-We**	Intercontinental	Carrier Consortium	Consortium
2011	**EIG**	Intercontinental	Carrier Consortium	Consortium
2012	**GBI/MENA**	Intercontinental	Investor-led	GBI / Orascom Holdings

Source: Terabit Consulting

In addition, India is served by two regional submarine cables connecting it to the nearby island nations of Sri Lanka and Maldives. They are: the Bharat-Lanka Cable, a bilateral cable which entered service in 2005 between Tuticorin, India and Mt. Lavinia, Sri Lanka, owned by BSNL and SLT; as well as the India-Maldives submarine cable, sometimes characterized as a Falcon segment, which entered service in 2007 between Thiruvananthapuram, India and Male.

Proposed international connectivity

Two major new Europe-to-Asia submarine cable projects would provide additional connectivity to India by 2016, if completed as planned.

The 25,000-km, 17-member Asia-Africa-Europe-1 cable would be 25,000 km in length. The project is unique for its proposal to avoid the "choke point" of the Strait of Malacca by using terrestrial connectivity across southern Thailand rather than a direct landing point in Singapore. Key investors in AAE-1 include China Unicom and Telecom Egypt; the participation of the latter is expected to give the project an advantage in procuring the necessary approval for Egyptian landings as well as for the provision of terrestrial capacity between the Red Sea and the Mediterranean. The Indian signatory to the project is reported to be Reliance Jio Infocomm.

SEA-ME-WE-5 has been under discussion since the completion of SEA-ME-WE-4 in 2005, although initial conceptualization of the project fell apart due to political differences among consortium members, who aligned into two camps and instead opted for the construction of the competing I-Me-We and EIG cables. However, in 2011 the project regained momentum, led by France Telecom-Orange and Singtel. A construction and maintenance agreement for the project was signed by 15 operators in March of 2014. All three Chinese operators (China Mobile, China Telecom and China Unicom) were among its signatories, but the project does not as yet feature the participation of any Egyptian, Pakistani or Indian operators, despite proposed landing points in all three countries.

Additionally, two other proposed submarine cable projects would connect India to Southeast Asia and the Middle East, if constructed. The Bay of Bengal Gateway system, which was announced in April of 2013, would connect India to Malaysia, Sri Lanka, Oman, and the United Arab Emirates. The India Cloud Xchange (ICX) cable, proposed by Global Cloud Xchange (GCX, formerly Reliance Globalcom), would span 5,000 km between Mumbai and Singapore.

V. Country analysis: Islamic Republic of Iran

	2013
Population	77,000,000
Population growth rate	1.3%
Gross Domestic Product	US$1.1 trillion / US$14,300 per capita
GDP growth rate	-5.8% in 2013, 1.5% forecasted in 2014
Human Development Index	0.749
HDI ranking	75th out of 187 ("High")
Literacy rate	85%
Fixed-line subscribers	30 million
Fixed-line operators	1. Telecommunications Company of Iran (TCI) 2. Jame Novin Communication 3. Zoha-Kish Telecom 4. Iraphone 5. Kooh-E-Noor Telecom 6. Montazeran Adl Gostar
Mobile subscribers	90 million
Mobile operators	1. Mobile Communication Co. of Iran (MCI) (TCI subsidiary) 2. MTN Irancell (Iran Electronic Development Co. / MTN) 3. Tamin Telecom (Rightel brand) 4. Taliya
Mobile broadband	3G launched in 2012; 4G LTE launch in 2014
Regulatory agency	Communications Regulatory Authority (CRA)
International Internet bandwidth	113 Gbps
International Internet bandwidth per capita	1.5 Kbps
Internet service providers	1. Telecommunications Company of Iran (TCI) 2. Pars Online 3. ShaTel 4. Datak Telecom 5. Sepanta Network Solutions 6. Neda Rayaneh 7. Iranian Net 8. Pishgaman 9. Afr@net
Fixed broadband subscribers	5 million fixed broadband subscribers (>256 Kbps) 2 million mobile broadband subscribers (est.)
Fixed broadband technologies	ADSL, WiMax, FTTH
Typical monthly broadband subscription	1. US$7.50 per month + US$3.50 installation for 1 Mbps ADSL with 4 GB monthly download limit (Pars Online ADSL2+) 2. US$82 per month + US$3.50 installation for 1 Mbps ADSL with unlimited download (Pars Online ADSL2+)

Telecommunications market overview

Competition in the Islamic Republic of Iran's telecommunications markets is limited. Telecommunications Company of Iran (TCI) is the country's only nationwide fixed-line operator, and the mobile sector is effectively a duopoly between TCI's mobile arm and MTN Irancell, although a new third operator has quickly seen its market share grow to almost 5 per cent. The ISP market, while served by hundreds of licensees, is more competitive than the country's fixed and mobile sectors, but there are only a limited number of entities offering broadband service.

The Iranian telecommunications market is estimated to be worth approximately US$6 billion annually, although an accurate evaluation is complicated by the country's hyperinflationary environment. In the mobile sector, average revenue per user was reported by MTN to be US$7.50 as of 2012, but following the devaluation of the Iranian rial, it had fallen to US$4.13 as of the first quarter of 2014.

Regulation and Government intervention

The Islamic Republic of Iran's Communications Regulatory Agency (CRA) was established in 2003; it executes the supervisory powers of the Ministry of Information and Communication Technology. In March 2012, the Supreme Council of Cyberspace was established to oversee the country's Internet sector and develop policy for all cyber-related issues.

Broadband promotion was a key element of the Islamic Republic of Iran's Fifth Development Plan, covering the period 2011 to 2015. The plan called for 36 million high-speed ports by 2016 and the development of robust fibre-to-the-home networks in the country's ten largest cities. Given the impact of international sanctions on the Islamic Republic of Iran's economy, it is unlikely that the plan's initial targets will be met, but greater broadband connectivity is expected to be a continued goal of the country's Sixth Development Plan.

Fixed-line telephony market

The Iranian fixed-line sector continues to show modest growth in subscribership. TCI is the country's only nationwide fixed-line operator, serving at least 90 per cent of the country's 30 million fixed-line subscribers.

In 2009, 51 per cent of TCI shares were sold to a group of investors led by Mobin Trust Consortium (Etemad-e-Mobin), reportedly affiliated with the country's Revolutionary Guards, for approximately US$8 billion. The Iranian Government retained a direct 40 per cent stake in the company. TCI's subsdiairy, Mobile Communication Co. of Iran (MCI), is the country's leading mobile operator.

In 2003, the CRA issued a limited number of regional PSTN licences to private operators including Jame Novin Communications (ten provinces), Zoha-Kish Telecom (ten provinces), Iraphone (six provinces), Kooh-E-Noor Telecom (two provinces) and Montazeran Adl Gostar (two provinces). Collectively, the operators' initial network capacity was approximately two million lines.

Mobile telephony market

The Iranian mobile market, which exceeds 100 per cent penetration, is served by four operators, although two operators control 95 per cent of the market. MCI, the mobile arm of the TCI, is the market leader with a 49 per cent share. MTN Irancell, with approximately 41 million subscribers, has a 46 per cent share. The

company is 49 per cent owned by MTN Group, with the remaining shares held by local investor Iran Electronic Development Company due to local ownership requirements. A third operator, Tamin Telecom, offers mobile services under the Rightel brand name and was granted exclusivity in the 3G market until mid-2014; its subscriber base is estimated at approximately four million, while a prepaid operator, Taliya, is estimated to have one million subscribers.

The development of the mobile broadband market in the Islamic Republic of Iran is considered by many observers to have been delayed due to the exclusivity over the 3G market that was accorded to Tamin Telecom, which offers mobile services under the Rightel brand name; its total mobile subscriber base was estimated to be approximately four million as of 2014. The company's 3G exclusivity ended in mid-2014, at which point both of the country's major mobile operators, MCI and MTN Irancell, announced that they would launch both 3G and 4G services.

Internet and broadband market

There are several hundred ISPs. TCI launched ADSL service in 2004. Privately-owned Pars Online claims to be the country's largest private data network operator, handling 10 per cent of the country's domestic data traffic. Another ISP, Iranian Net, is reportedly in the process of implementing FTTH networks in at least seven major cities. Other major ISPs include ShaTel, Datak Telecom, Sepanta Network Solutions, Neda Rayaneh, Pishgaman, and Afr@net.

As of late-2012 there were approximately 2.3 million ADSL subscribers and 600,000 WiMax subscribers in the Islamic Republic of Iran. By year-end 2013 total fixed broadband subscriptions were estimated to have grown to five million.

A standard 1 Mbps ADSL connection retails for US$7.50 per month, with a 4 GB monthly download limit. The Iranian dial-up ISP market remains strong.

Domestic network connectivity

As of 2012, the Telecommunications Infrastructure Company of Iran (TIC) reported that its national backbone network was 47,000 km in length and its metropolitan fibre deployment totaled an additional 83,473 km, for a total of more than 130,000 km. The operator reported continued investment in its network in 2013 and 2014, so that total deployment is now estimated at between 150,000 and 200,000 km. Domestic Internet bandwidth was reported to be 45 Gbps as of early-2013.

International Internet bandwidth and capacity pricing

Table 23: International Internet bandwidth and capacity pricing in the Islamic Republic of Iran, 2013

International Internet bandwidth	International Internet bandwidth per capita	International capacity pricing
113 Gbps	1.5 Kbps	IP Transit: US$58 per Mbps per month (STM-1 increments)

Source: Terabit Consulting research, operator data and interviews

The Islamic Republic of Iran's international bandwidth increased dramatically in 2013. In February 2013, the Ministry of Communications announced an increase from 63 Gbps to 83 Gbps. In October 2013, TIC announced a further increase by year-end. Sources indicated that the country's international Internet bandwidth was 113 Gbps as of year-end 2013.

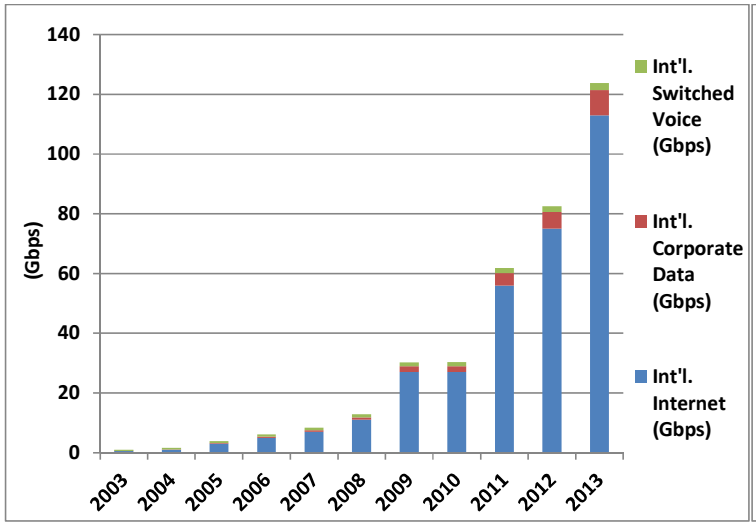
In February 2013, the CRA announced a 35 per cent reduction in international bandwidth prices. The price of an STM-1 was reduced to US$9,000 per month, or US$58 per Mbps.

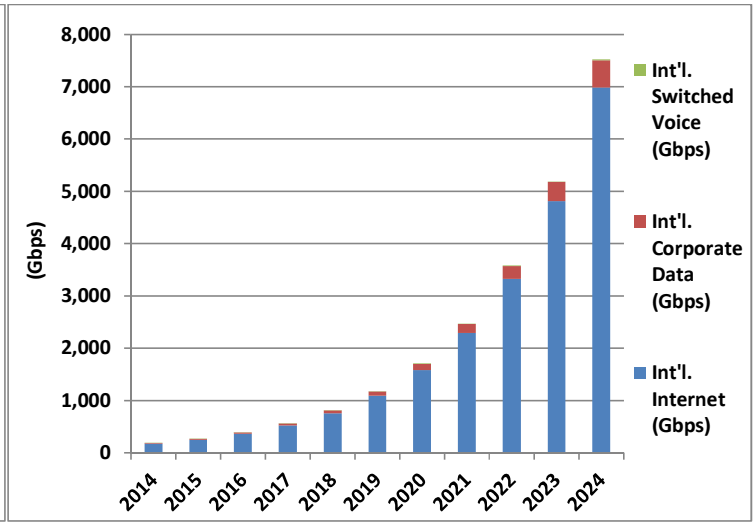
TIC was established in 2005 to oversee the Islamic Republic of Iran's telecommunications infrastructure, particularly its international links. A second international operator, Pishgaman Kavir Yazd Group, operates the Pishgaman Oman-Iran submarine cable.

Table 24: Historical and Forecasted International Bandwidth in the Islamic Republic of Iran (Gbps), 2003-2024

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
International Internet	1	1	3	5	7	11	27	27	56	75	113
International corporate data	0	0	0	0	1	1	2	2	4	6	8
International switched voice	0	1	1	1	1	1	1	1	2	2	2
Total international bandwidth	1	2	4	6	8	13	30	30	62	83	124
CAGR (2003-2013)	62%										

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
International Internet	170	247	357	518	751	1,090	1,580	2,291	3,322	4,817	6,984
International corporate data	13	18	27	39	56	82	118	172	249	361	524
International switched voice	3	3	4	4	5	6	7	9	10	12	14
Total international bandwidth	185	268	388	562	813	1,178	1,706	2,471	3,581	5,190	7,522
CAGR (2013-2024)	45%										





International network connectivity

Initial satellite connectivity

The Islamic Republic of Iran's satellite Earth stations include the Boomehen Earth Station, 35 km northeast of Tehran, which was constructed in 1987, as well as the Asadabad and Mobarakeh Earth Stations.

Terrestrial fibre optic cables

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Bilateral trans-border links

In 2012, TIC indicated that the capacities of its border gateways were as follows: Armenia 1.4 Gbps, Azerbaijan 1.2 Gbps, Turkey 600 Mbps, Turkmenistan 600 Mbps, Iraq 300 Mbps and Afghanistan 200 Mbps. TIC confirmed that the only neighbouring country to which it did not have a fibre link was Pakistan. Also in 2012, TIC forecasted that by 2017, its terrestrial links to neighbouring countries would be increased to a total capacity of 8.9 Tbps, broken down as follows: Azerbaijan 4.3 Tbps, Iraq 1.2 Tbps, Turkey 1.1 Tbps, Armenia 930 Gbps, Turkmenistan 600 Gbps, Afghanistan 430 Gbps and Pakistan 400 Gbps.

Trans Asia-Europe

The 27,000-km Trans Asia-Europe network, which entered service between 1998 and 2001, includes trans-border segments at Bajgiran, Islamic Republic of Iran (between Bonjurd, Islamic Republic of Iran and Ashgabat, Turkmenistan) in the east and between Aslanik, Islamic Republic of Iran and Albayrak, Turkey, in the west. Its Iranian point of presence is in Tehran. All of the cable and transmission equipment used in the Iranian segments of the cable (as well as those in neighbouring Turkmenistan) were manufactured in the Islamic Republic of Iran by Iran Telecommunications Industries, Iran Telephone Planning and Development Company, and Shahid Ghandi Communication Cable Company.

Europe-Persia Express Gateway (EPEG)

In March 2011, a memorandum of understanding was signed by four investors to create the 10,000-km EPEG network between Oman and Frankfurt, Germany. A construction and maintenance agreement was signed by the project's four investors in Tehran in June 2011; testing took place in 2012 and the network was put into service in 2013. Reports placed the cost of the entire network at as high as US$200 million, although some analysts disputed this figure, given that much of the network takes advantage of existing infrastructure.

The four signatories to the March 2011 memorandum of understanding for the EPEG were Cable & Wireless Worldwide, Rostelecom, 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, Germany; Berlin; Warsaw; Lviv, Ukraine; and Kiev; to the Ukrainian-Russian border. Rostelecom assumed responsibility for the segments from the Ukrainian-Russian border, to Rostov-on-Don, Russian Federation; along the western shore of the Caspian Sea to the Russian-Azerbaijani border; and through Azerbaijan via Baku to the Azerbaijani-Iranian border. Delta Telecom of Azerbaijan described itself as a "transit operator" for the project, working in partnership with Rostelecom. TIC was given responsibility for the segments within the Islamic Republic of Iran from the Azerbaijani-Iranian border to the Gulf of Oman. Omantel was assigned responsibility for the undersea segment of the network between the Islamic Republic of Iran to Oman, as well as interconnection to the EIG cable in Al Madina A'Zarqa(, Oman.

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.

The impetus for the EPEG project was the delay in activating the trans-Egyptian segments of the EIG undersea cable project. EIG, which was supposed to have entered service in mid-2010, was still yet to be 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 km south of Suez, Egypt. The new landing point in Zafarana (100 km south of Suez) shortened the cable route by 57 km, requiring reconfiguration onboard the cable ship. While awaiting a new authorization from the Egyptian Government, the cable due to be installed off the north coast of Egypt (originally Alexandria and subsequently Sidi Kerir, Abu Talat) has been temporarily stored in Malta. 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 have indicated that the activation of the terrestrial links across Egypt would be indefinitely on hold not only because of administrative issues but also because of the recent events in Egypt.

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

Submarine fibre optic cables

The Islamic Republic of Iran is served by six international submarine cable systems.

1. The 170-km United Arab Emirates- Islamic Republic of Iran bilateral cable, constructed in partnership with Etisalat, entered service in 1992.
2. The Islamic Republic of Iran-Kuwait submarine system, a 330-km branched network connecting Bandar Ganaveh, Islamic Republic of Iran to Kuwait City via two islands and an oil platform in the Persian Gulf. It was activated in 2006.
3. Global Cloud Xchange's Falcon cable. The system, which connects Egypt, the Middle East and India, did not initially include landing points in the Islamic Republic of Iran, but in 2008 the system was extended to Bandar Abbas, Islamic Republic of Iran, and in 2010 it was extended to Chabahar, Islamic Republic of Iran.
4. The GBI cable, connecting the Mediterranean, the Middle East and India. GBI signed a memorandum of understanding with TIC in 2010 to land the system in Bushehr, Islamic Republic of Iran. The spur connecting Bushehr to GBI's Persian Gulf submarine cable ring entered service in 2012.
5. The Pishgaman Oman- Islamic Republic of Iran submarine cable, which entered service in 2012. The system is owned by the Iranian conglomerate Pishgaman Kavir Yazd Group, which was awarded private access provider, ISP and VoIP licences by the Iranian Ministry of ICT.
6. The Islamic Republic of Iran-Oman submarine segment of the EPEG network, which entered service in 2013. It is interconnected with the EIG submarine cable in Al Madina A'Zarqa.

Proposed international connectivity

Terrestrial connectivity to between the Islamic Republic of Iran and Pakistan is reported to be in the final stages of implementation.

VI. Country analysis: Maldives

	2013
Population	345,000
Population growth rate	1.9%
Gross Domestic Product	US$3.4 billion / US$10,000 per capita
GDP growth rate	3.7% in 2013, 4.5% forecasted in 2014
Human Development Index	0.698
HDI ranking	103rd out of 187 ("Medium")
Literacy rate	99%
Fixed-line subscribers	22,600
Fixed-line operators	1. Dhivehi Raajjeyge Gulhun (Dhiraagu) (Batelco subsidiary)
Mobile subscribers	625,000
Mobile operators	1. Dhivehi Raajjeyge Gulhun (Dhiraagu) (Batelco subsidiary) 2. Ooredoo
Mobile broadband	3G launched in 2005; WiMax launched in 2008; LTE launched in 2011
Regulatory agency	Communications Authority of Maldives
International Internet bandwidth	8.3 Gbps
International Internet bandwidth per capita	24.0 Kbps
Internet service providers	1. Dhivehi Raajjeyge Gulhun (Dhiraagu) (Batelco subsidiary) 2. Focus Infocom (Raajjé Online brand) 3. Ooredoo
Fixed broadband subscribers	20,400 fixed broadband subscribers (>256 Kbps) 90,100 mobile broadband subscribers
Fixed broadband technologies	ADSL, Cable Modem, FTTH, Wi-Fi
Typical monthly broadband subscription	1. US$13 per month+ US$16 installation for 2 Mbps ADSL with 5 GB monthly download limit (Dhiraagu Home Plus)

Telecommunications market overview

Maldives is served by three operators: Dhivehi Raajjeyge Gulhun (Dhiraagu), Focus Infocom (Raajjé Online) and Ooredoo. The country's telecommunications and Internet sector is worth more than $200 million annually; Dhiraagu's 2013 revenue was approximately US$135 million and Ooredoo's was approximately $50 million. In the mobile sector, Ooredoo reported average revenue per user of US$11.40 per month as of 2013. It had been as high as US$15.20 as recently as 2010.

The country's incumbent telecommunications operator, Dhiraagu, was majority-owned by Cable & Wireless Communications until 2013, when Bahrain Telecommunications Company (Batelco) purchased Cable & Wireless Communications' Monaco & Islands division. Batelco currently owns a 52 per cent stake in Dhiraagu, and the Government of Maldives retains 41.8 per cent. Dhiraagu constructed a submarine cable to Sri Lanka in 2006 and a domestic submarine cable network in Maldives in 2012.

Focus Infocom received its ISP licence in 2003. In 2005, it became a 15 per cent shareholder in the WARF Telecom International consortium, which constructed a submarine cable to India in 2007 and Sri Lanka in 2008. Focus Infocom currently offers services under the Raajjé Online brand name.

Wataniya Maldives was awarded a mobile licence in 2005; Qatar Telecom (now Ooredoo) acquired a 51 per cent majority share in Wataniya in 2007 and increased its stake to 92.1 per cent in 2012; Wataniya was subsequently rebranded as Ooredoo. Wataniya was a 65 per cent investor in the WARF Telecom consortium.

Regulation and Government intervention

The Communications Authority of Maldives is the regulator of the country's telecommunications and Internet sectors. The Ministry of Transport and Communication maintains responsibility for developing policy.

In 2003, the Maldivian Government created the National Centre for Information Technology (NCIT) to develop, promote and propagate the information technology sector. The NCIT's Community e-Centre project aims to provide an even distribution of computer and Internet centres across the Maldives, especially in rural communities.

Fixed-line telephony market

Dhivehi Raajjeyge Gulhun (Dhiraagu), which is majority-owned by Batelco, is the country's only fixed line operator, although its official exclusivity was terminated in 2009. As of year-end 2013, there were 22,600 fixed-lines in service, for a penetration rate of 6.6 per cent. At its peak, in 2008, the fixed-line network served almost 47,000 customers.

Mobile telephony market

There were 625,000 mobile subscribers as of year-end 2013—a penetration rate of 181 per cent. Dhiraagu first offered mobile services in 1997 and launched the country's first GSM network in 1999. It remains the country's leading mobile operator in terms of market share, with 60 per cent of subscribers. Ooredoo Maldives began operating in 2005 as Wataniya Maldives and, as of year-end 2013, it served 249,000 subscribers for a 40 per cent market share.

As of mid-2014, there were 145,000 mobile broadband subscribers. Dhiraagu said that its 3G network covered 82 per cent of the population, while Ooredoo targeted 95 per cent coverage for its HSPA+ service by September 2014. In mid-2014, both Dhiraagu and Ooredoo announced limited implementation of 4G services.

Internet and broadband market

Dhiraagu began offering dialup Internet access in 1996 and introduced ADSL service in 2002. Focus Infocom (now offering services under the Raajjé Online brand name) became the country's first competitive ISP in 2003. Ooredoo also offers mobile Internet service.

As of mid-2014, there were 20,000 fixed broadband subscribers. Approximately 75 per cent were DSL subscribers, with the remainder served mostly by cable modems on Raajjé's hybrid fibre-coax network,

although there were a few hundred fibre-to-the-home subscribers. Wi-Fi hotpots were introduced on more than 40 islands beginning in 2006.

Domestic network connectivity

Both Dhiraagu and Ooredoo operate inter-island microwave networks. VSAT services are also used for some remote islands.

In 2012, Dhuraagu completed the installation of its 1,253-km domestic submarine cable network, supplied by NEC at a cost of US$22 million. The network connects Kulhudhuffushi, Haa Dhaalu Atoll; Eydhafushi, Baa Atoll; Hulhumale (a manmade islet approximately 1.5 km north of Male and the landing point of the international segment of Dhiraagu's Submarine Cable Network to Sri Lanka); Dhangethi, Alif Dhaal Atoll; Gan, Laamu Atoll; Gaddhoo (Gadhdhoo), Gaafu Dhaalu Atoll; Hithadhoo, Seenu Atoll; and Fuvahmulah. Dhiraagu said that the project was driven by the impending saturation of the operator's inter-island microwave network.

International Internet bandwidth and capacity pricing

Table 25: International Internet bandwidth and capacity pricing in Maldives, 2013

International Internet bandwidth	International Internet bandwidth per capita	International capacity pricing
8.3 Gbps	24.0 Kbps	IP transit: >US$100 per Mbps per month

Source: Terabit Consulting research, operator data and interviews

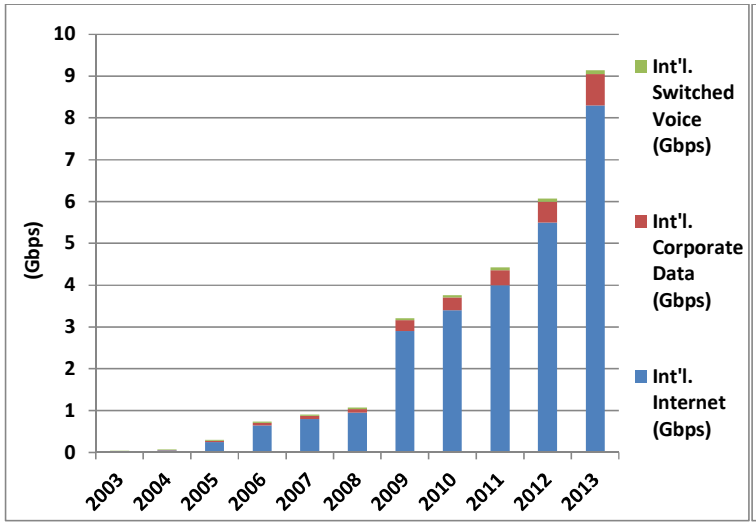
Maldives' international Internet bandwidth doubled in 2013 to approximately 8.3 Gbps, following the implementation of Dhuraagu's domestic submarine cable network the previous year, which was thought to have stimulated demand on islands where bandwidth had been limited. Maldives' per-capita international bandwidth is among the highest for developing economies.

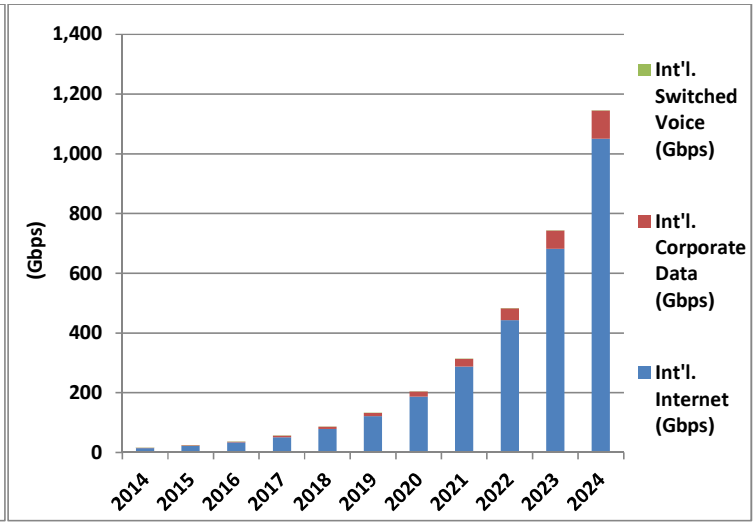
There is no transparent market for wholesale international bandwidth in Maldives, since all three operators have direct investments in international submarine cable infrastructure. However, retail bandwidth pricing in Maldives is extremely expensive: international private line circuits are priced at approximately US$1,400 per Mbps per month.

Table 26: Historical and forecasted international bandwidth in Maldives (Gbps), 2003-2024

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
International Internet	0	0	0	1	1	1	3	3	4	6	8
International corporate data	0	0	0	0	0	0	0	0	0	0	1
International switched voice	0	0	0	0	0	0	0	0	0	0	0
Total international bandwidth	0	0	0	1	1	1	3	4	4	6	9
CAGR (2003-2013)	72%										

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
International Internet	14	22	33	51	79	121	187	288	443	682	1,050
International corporate data	1	2	3	5	7	11	17	26	40	61	95
International switched voice	0	0	0	0	0	0	0	0	0	0	1
Total international bandwidth	15	24	36	56	86	132	204	314	483	744	1,145
CAGR (2013-2024)	55%										





International network connectivity in Maldives

Initial satellite connectivity

An Inteslat Earth station was inaugurated in Male in 1977 and another Earth station was inaugurated in Seenu Atoll in 1995 to provide better connectivity in the country's south.

Submarine fibre optic cables

Maldives is served by two distinct international submarine cables.

The Dhiraagu Submarine Cable, constructed by Dhiraagu in partnership with Sri Lanka Telecom, links Hulhumale, Maldives to Colombo, Sri Lanka. It entered service in 2006.

The WARF Telecom India-Maldives cable was activated in 2007 by a consortium consisting of Maldivian operator Wataniya (now Ooredoo), Reliance Communications, and Focus Infocom. The system was extended to Sri Lanka in 2008 in partnership with Lanka Bell.

VII. Country analysis: Nepal

	2013
Population	27,800,000
Population growth rate	1.2%
Gross Domestic Product	US$50 billion / US$1,800 per capita
GDP growth rate	3.8% in 2013, 4.5% forecasted in 2014
Human Development Index	0.540
HDI ranking	145th out of 187 ("Medium")
Literacy rate	66%
Fixed-line subscribers	851,500
Fixed-line operators	1. Nepal Doorsanchar Company, Ltd. (Nepal Telecom) 2. United Telecom, Ltd. (UTL) 3. STM Telecom Sanchar Pvt., Ltd. 4. Nepal Satellite Telecom Pvt., Ltd. 5. Smart Telecom Pvt., Ltd.
Mobile subscribers	20,118,000
Mobile operators	1. Nepal Doorsanchar Company, Ltd. (Nepal Telecom) 2. Ncell (TeliaSonera)
Mobile broadband	3G launched in 2010; 4G LTE expected in 2015
Regulatory agency	Nepal Telecommunications Authority (NTA)
International Internet bandwidth	20 Gbps
International Internet bandwidth per capita	0.7 Kbps
Internet service providers	1. Nepal Doorsanchar Company, Ltd. (Nepal Telecom) 2. Ncell (TeliaSonera) 3. United Telecom, Ltd. (UTL) 4. Broadlink Network & Communication Pvt., Ltd. 5. WorldLink Communications Pvt., Ltd. 6. Subisu Cablenet Pvt., Ltd. 7. Mercantile Communication Pvt., Ltd. 8. Vianet Communication Pvt., Ltd. 9. Mega Broadcast Pvt., Ltd. 10. Himalayan Online Services Pvt., Ltd.
Fixed broadband subscribers	213,000 fixed broadband subscribers (>256 Kbps) 3 million mobile broadband subscribers (est.)
Fixed broadband technologies	ADSL, Broadband Wireless, Optical Fibre Ethernet, Cable Modem, WiMax
Typical monthly broadband subscription	1. US$15 per month + US$5 installation for 384 Kbps ADSL with unlimited download (Nepal Telecom ADSL) 2. US$6 per month + US$5 installation for 512 Kbps ADSL with 6 GB download limit (Nepal Telecom ADSL)

Telecommunications market overview

The Government of Nepal took steps toward the liberalization of the telecommunications market as early as 1995, although the monopoly of government-owned Nepal Telecom (then NTC) continued until 2003. The market is currently dominated by Nepal Telecom and Ncell, which is controlled by Swedish operator TeliaSonera.

The Nepalese telecommunications and Internet markets are worth more than US$1 billion annually. Nepal Telecom and Ncell each reported telecommunications revenue of approximately US$400 million in 2013. Nepal Telecom's average revenue per user was NPR228 (US$2.30) as of year-end 2013.

Regulation and Government intervention

The Nepal Telecommunications Authority, established in 1998, is the industry's independent regulator. The industry's governing legislation is the Telecommunications Act of 1997.

The Nepalese Government is in the process of implementing its E-government Master Plan, which was developed with technical assistance from the Government of Republic of Korea. In the education sector, the country has sought to increase connectivity to primary and secondary schools through its ICT in Education Master Plan (2014-2018) as well as its "Connect a school, connect a community" initiative. Improved broadband connectivity is also a key element in the country's e-health strategy and National Emergency Telecommunications Plan.

In 2012, the Nepalese Government issued a Wireless Broadband Masterplan, developed in cooperation with the Korean Communications Commission. A comprehensive draft national broadband was launched in 2014 includes an IT roadmap as well as targets and benchmarks for the implementation of broadband service across the country.

Fixed-line telephony market

Fixed-line subscribership totaled more than 851,000 as of year-end 2013, for a penetration rate of 3.1 per cent. Although the sector had exhibited significant growth until approximately 2010, in recent years the number of subscribers has leveled off: preliminary data from mid-2014 showed a loss of approximately 20,000 subscribers during the first seven months of the year.

The government-owned incumbent operator, Nepal Doorsanchar Company, Ltd. (Nepal Telecom) provides fixed-line service via both PSTN (647,000 subscribers) and WLL (123,000 subscribers), for a total fixed-line market share of 91 per cent.

The remaining 9 per cent share of the market is mostly served by United Telecom, Ltd. (UTL), which became the country's first competitive operator, in 2003. Its network exclusively uses CDMA wireless local loop technology and served 73,000 subscribers as of year-end 2013. UTL is a joint venture of three Indian investors (MTNL, Tata Communications, Ltd. and Telecommunications Consultants India, Ltd.) and one Nepalese investor (Nepal Ventures Private, Ltd.).

Three other operators, STM Telecom Sanchar Pvt., Ltd., Nepal Satellite Telecom Pvt., Ltd. and Smart Telecom Pvt., Ltd., serve a combined total of 8,500 subscribers.

Mobile telephony market

Nepal's mobile telephony market continues to grow, with more than 20 million subscribers as of year-end 2013, for a penetration rate of 72 per cent, and an additional two million subscribers as of mid-2014, according to preliminary data.

Nepal Telecom began offering GSM mobile services in 1999, and in 2005 it began offering CDMA. As of year-end 2013, it served 8 million GSM customers and 1 million CDMA customers, for a total market share of 45 per cent.

Spice Nepal Private, Ltd. launched the country's first private mobile network in 2005 under the Metro Mobile brand name. In 2008, Swedish operator TeliaSonera acquired a majority stake in the company and in 2010 it was rebranded as Ncell. Ncell's 11 million customers, as of year-end 2013, accounted for a 55 per cent share of the market.

Nepal Telecom and Ncell each served 3.7 million GPRS, EDGE, and WCDMA customers as of year-end 2013. Both operators offered 3G data services in major cities as of 2011. The two have indicated their intention to expand their 3G networks to provide nationwide coverage in 2014. 4G LTE services are expected to be launched in 2015.

According to preliminary data, Nepal Telecom and Ncell each gained more than one million mobile subscribers during the first seven months of 2014.

Internet and broadband market

As of year-end 2013, Nepal was served by 45 ISPs, although market share was concentrated between Nepal Telecom and Ncell. There were approximately 200,000 fixed broadband subscribers. Nepal Telecom is the only provider of fixed broadband ADSL services (120,000 subscribers). Broadband wireless, fibre optic Ethernet and cable modem services accounted for the remaining 80,000 to 90,000 subscribers.

Nepal Telecom split the mobile Internet market with Ncell; each operator served approximately 3.7 million GPRS, EDGE, and WCDMA subscribers. UTL served 100,000 CDMA subscribers as of year-end 2013, but its subscribership fell considerably according to preliminary figures issued in mid-2014.

Smaller ISPs include Broadlink, WorldLink, Subisu Cablenet, Mercantile Communications and Web Surfer Nepal, although the ISPs other than Nepal Telecom and UTL collectively served fewer than 100,000 subscribers as of year-end 2013.

Broadband Internet remains extremely expensive. A 512-Kbps ADSL package from Nepal Telecom is priced at US$6 per month, with a 6 GB download limit. When installation costs are factored in, a 1-Mbps equivalent equates to approximately 20 per cent of nominal per-capita GDP.

Domestic network connectivity

Construction of Nepal's 12-fibre-pair domestic fibre network along the East-West (Mahendra) Highway was begun in 2002, using equipment supplied by Siemens. The project was overseen by Telecommunications Consultant India, Ltd., with funding provided by the Governments of both Nepal and India. Its total length between Bhadrapur and Nepalgunj, via Murchaiya, Godar, Pragatinagar and Kawasoti, is 1,073 km and features 79 nodes.

A second phase of the build-out linked Lamahi, Kohalpur, Attaria, Mahendranagar, Birtamod and Kakarbhitta. An OPGW link leased from the Nepal Electric Authority provided connectivity from Hetauda to the Kathmandu Valley; the OPGW network also linked Butwal, Kaligandaki, Pokhara and Damauli.

Connectivity to some areas north of the Mahendra Highway, particularly in the country's northwest, is primarily via microwave links.

International Internet bandwidth and capacity pricing

Table 27: International Internet bandwidth and capacity pricing in Nepal, 2013

International Internet bandwidth	International Internet bandwidth per capita	International capacity pricing
20 Gbps	0.7 Kbps	IP transit: US$40 to US$60 per Mbps per month

Source: Terabit Consulting research, operator data and interviews

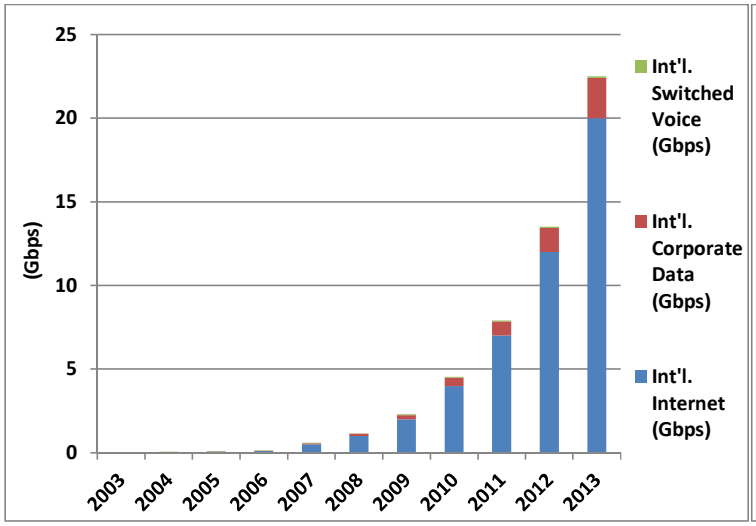
As of year-end 2011, international bandwidth was 4.2 Gbps, with an upgrade to 10 Gbps planned for 2012. Sources in Nepal indicated that Nepal's international bandwidth, as of mid-2014, was approximately 25 Gbps.

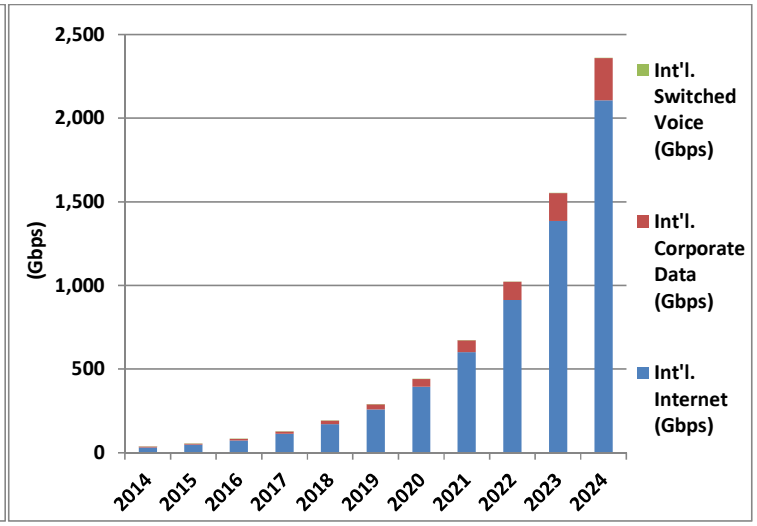
IP transit in Nepal is priced at between US$40 and US$60 per Mbps per month, depending on volume. Nepali operators spent NPR2.39 billion (US$24.5 million) on international connectivity during fiscal year 2013-2014.

Table 28: Historical and forecasted international bandwidth in Nepal (Gbps), 2003-2024

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
International Internet	0	0	0	0	1	1	2	4	7	12	20
International corporate data	0	0	0	0	0	0	0	0	1	1	2
International switched voice	0	0	0	0	0	0	0	0	0	0	0
Total international bandwidth	0	0	0	0	1	1	2	5	8	14	22
CAGR (2003-2013)	86%										

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
International Internet	32	49	74	112	171	260	395	600	912	1,386	2,107
International corporate data	4	6	9	13	20	31	47	72	109	166	253
International switched voice	0	0	0	0	0	0	0	0	0	0	1
Total international bandwidth	36	55	83	126	192	291	442	672	1,022	1,553	2,360
CAGR (2013-2024)	53%										





International network connectivity

Initial satellite connectivity

The Sagarmatha Earth Station in the Balambu neighbourhood of Kathmandu was inaugurated in 1982 and upgraded in 1994 to include an Intelsat A-standard antenna.

Terrestrial fibre optic cables

Nepal Telecom is linked to the networks of three Indian operators (Reliance, BSNL and Airtel) via fibre connectivity at the Birgunj-Raxaul and Birtatnagar-Jogbani border crossings; UTL links to the network of Indian operator Tata via links at the Birgunj-Raxaul crossing as well as a link between Bhairahwa and Sunauli.

Proposed international connectivity

The SASEC programme is in the process of implementing the SASEC Information Highway network connecting Bangladesh, Bhutan, India and Nepal.

A link to China via Tatopani has been proposed since 2010, but as of 2014, the status of its development could not be confirmed.

VIII. Country analysis: Pakistan

	2013
Population	182,000,000
Population growth rate	1.7%
Gross Domestic Product	US$800 billion / US$4,300 per capita
GDP growth rate	6.1% in 2013, 4.4% forecasted in 2014
Human Development Index	0.537
HDI ranking	146th out of 187 ("Low")
Literacy rate	57%
Fixed-line subscribers	5,640,000
Fixed-line operators	1. Pakistan Telecommunications Company, Ltd. (PTCL) 2. WorldCall Telecom, Ltd. (Omantel subsidiary) 3. Wateen Telecom (Pvt.), Ltd. (Abu Dhabi Group) 4. TeleCard, Ltd. (GoCDMA brand) 5. Wi-Tribe Pakistan, Ltd. (Ooredoo subsidiary) 6. National Telecommunications Corp. (NTC) (Pakistani Government.) 7. Sharp Communications (Pvt.), Ltd. (Qubee brand) (Augere Holdings) 8. Link Direct International (Pvt.), Ltd. 9. Brain Telecommunication, Ltd.
Mobile subscribers	131,500,000
Mobile operators	1. Pakistan Mobile Communications, Ltd. (Mobilink brand) (VimpelCom subsidiary) 2. Telenor Pakistan (Telenor Group) 3. Zong (China Mobile Pakistan) 4. Pak Telecom Mobile (Ufone brand) (PTCL subsidiary) 5. Warid Telecom, Ltd. (Abu Dhabi Group)
Mobile broadband	3G and 4G LTE launched in 2014
Regulatory agency	Pakistan Telecommunication Authority (PTA)
International internet bandwidth	300 Gbps (increased to >500 Gbps as of October 2014)
International Internet bandwidth per capita	1.7 Kbps (increased to about 3 Kbps as of October 2014)
Internet service providers	1. Pakistan Telecommunications Company, Ltd. (PTCL) 2. Wateen Telecom (Pvt.), Ltd. (Abu Dhabi Group) 3. WorldCall Telecom, Ltd. (Omantel subsidiary) 4. Wi-Tribe Pakistan, Ltd. (Ooredoo subsidiary) 5. Sharp Communications (Pvt.), Ltd. (Qubee brand) (Augere Holdings)
Fixed broadband subscribers	3.2 million fixed broadband subscribers (>256 Kbps) 2.5 million 3G users as of October 2014
Fixed broadband technologies	ADSL, EvDO, Wi-Max, Cable Modem, FTTH
Typical monthly broadband subscription	1. US$9 per month + US$19.50 installation for 1 Mbps WiFi with 10 GB download limit (Wateen WiFi) 2. US$4 per month + US$15 installation for 1 Mbps ADSL with 10 GB download limit (PTCL ADSL)

Telecommunications market overview

The Pakistani telecommunications market was worth US$4.3 billion in 2013. The mobile sector's average revenue per user was US$2.05 as of early-2014.

Pakistan's incumbent operator, Pakistan Telecommunication Company, Ltd. (PTCL), is majority-owned by the Pakistani Government; Etisalat is a strategic minority investor. The company has majority shares of both the fixed-line and broadband markets—65 per cent and 71 per cent, respectively.

The Pakistani mobile sector is significantly more competitive, with the market shared between five relatively strong operators with market shares of between 10 per cent and 29 per cent each.

Major foreign investment in the Pakistani telecommunications and Internet sectors has come from China, Norway, Oman, Qatar, the Russian Federation, the United Arab Emirates and the United Kingdom, from the likes of China Mobile, Omantel, Ooredoo, Telenor and VimpelCom.

China Mobile's acquisition of Paktel in 2007 and its subsequent rebranding as Zong marks the first time that the world's largest mobile operator (serving almost 800 million subscribers with revenue of more than US$100 billion annually) has established operations outside of China. The Pakistani market is considered to be a key measure of success for China Mobile's overall international strategy. At the time of its acquisition, Paktel was a distant fifth among the country's mobile operators, with only a few million subscribers. However, preliminary data from mid-2014 indicated that Zong had moved into third place with 27 million subscribers, surpassing PTCL's Ufone.

Regulation and Government intervention

The country's regulator, the Pakistan Telecommunications Authority, was established through legislation passed in 1994. Various telecommunications ordinances and acts were passed in the 1990s with the goal of liberalizing the industry. In 2003, shortly after the expiration of PTCL's exclusivity, the Government adopted a policy in favor of greater deregulation, Those objectives, as well as a mobile policy issued in 2004, have guided the industry's development since then.

Pakistan's Universal Service Fund is administered by a public-private partnership and is earmarked for rural telecom, broadband, optical fibre deployment and special projects. As of late 2013, the programme claimed responsibility for almost 500,000 new broadband subscriptions, more than 1,000 educational broadband centres and more than 300 community broadband centres.

In September 2014, Internet Policy Observatory Pakistan called for an improved Government broadband policy that promotes competition through open access and interconnection as well as consumer protection. The organization asserted that 51.5 per cent of consumers seeking 10 Mbps broadband services could choose from only one provider, while 55.3 per cent of consumers seeking 20 Mbps services were not served by any provider and that the lack of competition in higher-speed broadband services was unnecessarily restraining the growth of the market by keeping consumers locked into lower-speed services.

Fixed-line telephony market

There were approximately 3 million PSTN fixed-line subscribers as of year-end 2013, with more than 95 per cent of them served by PTCL. Government network operator NTC served most of the remaining PSTN subscribers.

The WLL market is almost as large as the PSTN market, with 2.6 million subscribers. PTCL serves only 46 per cent of the WLL market, reducing its overall share in the fixed-line market to 65 per cent. Other WLL major operators include OmanTel subsidiary WorldCall (525,000 subscribers), the Abu Dhabi Group's Wateen (310,000 subscribers) and Telecard with its GoCDMA brand (310,000 subscribers). Worldcall's licence was reportedly suspended in mid-2014 in a dispute over spectrum payment, although parent company OmanTel said that the company would continue operating as usual.

Mobile telephony market

Mobilink, now a subsidiary of VimpelCom, benefited from a majority share of the mobile market since before its deregulation in 2004 and has remained the market leader ever since: as of year-end 2013, it had a 29 per cent market share. Telenor was ranked second, with 26 percent, followed by PTCL's Ufone subsidiary (19 per cent), China Mobile's Zong (16 per cent) and Warid (10 per cent).

Zong, Ufone, Telenor, and Mobilink were each awarded 3G spectrum during an auction in April of 2014, and 3G services were launched the following month. As of October 2014, 3G usage was reported to be 2.5 million. Zong was the sole winner of 4G spectrum at a price of US$210 million (a second 4G licence will be auctioned at a later date). In September 2014, Zong announced that it launched 4G services in seven major cities.

Despite the country's relatively low average revenue per user of US$2.05, mobile sector investment is strong, surpassing US$450 million in 2013.

Internet and broadband market

DSL subscribership slightly exceeded one million in 2013, as did EvDO connections. WiMax subscribership was approximately 600,000, while cable modem subscribership was only 33,000.

PTCL's share of the broadband market rose by ten percentage points in 2013, to 71 per cent or 1.9 million subscribers, with much of the growth attributed to its wireless EvDO connections. Second-place Wateen had 10 per cent of the broadband market, while WorldCall and WiTribe each had 7 per cent. WiMax operator Qubee held a 2 per cent share. PTCL's standard 1-Mbps residential ADSL connection cost US$4 per month; after installation charges, this equates to 5.7 per cent of Pakistan's nominal per-capita GDP.

Notably, Pakistan is one of the largest countries without a domestic Internet exchange, making it extremely reliant upon international bandwidth.

Domestic network connectivity

As of 2012, the country's domestic inter-city fibre network was approximately 20,000 km, with backbones deployed and operated by Link Direct, Multinet, PTCL and Wateen. In 2013, the country's Universal Service Fund was used to finance the deployment of 6,700 km of new fibre deployment to 102 tehsils (local administrative subdivisions). As of 2014, sources estimated total deployment to be about 25,000 km long.

International Internet bandwidth and capacity pricing

Table 29: International internet bandwidth and capacity pricing in Pakistan, 2013

International internet bandwidth	International Internet bandwidth per capita	International capacity pricing
300 Gbps (increased to over 500 Gbps as of October 2014)	1.7 Kbps (increased approximately 3 Kbps as of October 2014)	US$100 per Mbps per month for low-volume IP transit, as low as US$14 per Mbps for some preferred high-volume purchasers as of year-end 2013

Source: Terabit Consulting research, operator data and interviews

Historically, Internet bandwidth in Pakistan was tightly controlled by the incumbent operator, PTCL. The SEA-ME-WE-3 and SEA-ME-WE-4 cable systems served as the country's primary links, although PTCL also completed an international terrestrial link to India and in 2002 FLAG Telecom signed an agreement with PTCL to provide a "virtual point of presence" in Karachi linked to the FLAG Europe-Asia cable system via SEA-ME-WE-3.

The growth of the country's Internet sector was driven at least in part by the competitive dynamics introduced following the activation of the Transworld-1 (TW-1) cable system connecting Pakistan with Oman and the United Arab Emirates in July of 2006. In the years thereafter, the price of international capacity fell dramatically and international bandwidth uptake grew significantly.

Multinet, a subsidiary of Telekom Malaysia, also offers international capacity via the SEA-ME-WE cables. In 2010, PTCL launched the country's fourth interregional submarine cable system, I-Me-We.

As of year-end 2013, international Internet bandwidth was estimated to be approximately 300 Gbps, but as of October 2014, total international bandwidth (Internet + voice) had increased to 576 Gbps, with 88 per cent of this capacity provided by PTCL via its three submarine cables (SEA-ME-WE-3, SEA-ME-WE-4, and I-Me-We) and the remaining 12 per cent provided by the Transworld Associates' TW-1 submarine cable and terrestrial links.

According to the Ministry of Information Technology, the country's international connectivity (as of October 2014) was as follows:

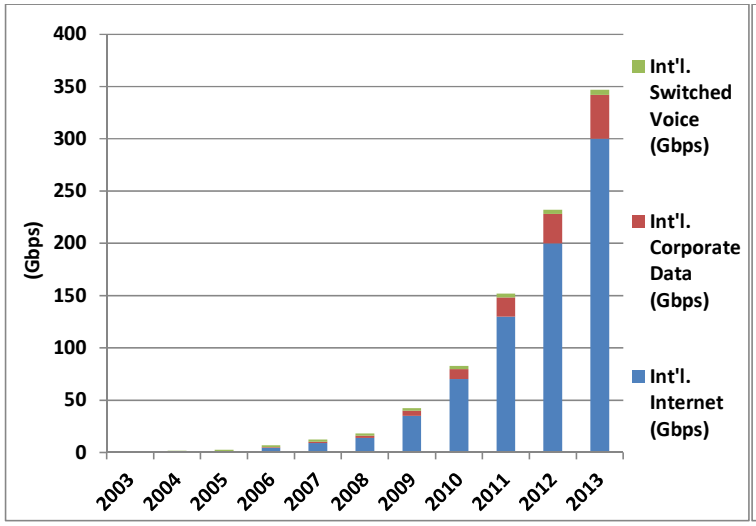
- PTCL via SEA-ME-WE-3: 95 STM-1s (14.7 Gbps)
- PTCL via SEA-ME-WE-4: 1,465 STM-1s (227.8 Gbps)
- PTCL via I-Me-We: 1,712 STM-1s (266.3 Gbps)
- Transworld Associates via TWA-1: 5 STM-64s + 3 STM-16s: (57.2 Gbps)
- Pakistan-Afghanistan Terrestrial: 1 STM-64 (10 Gbps)

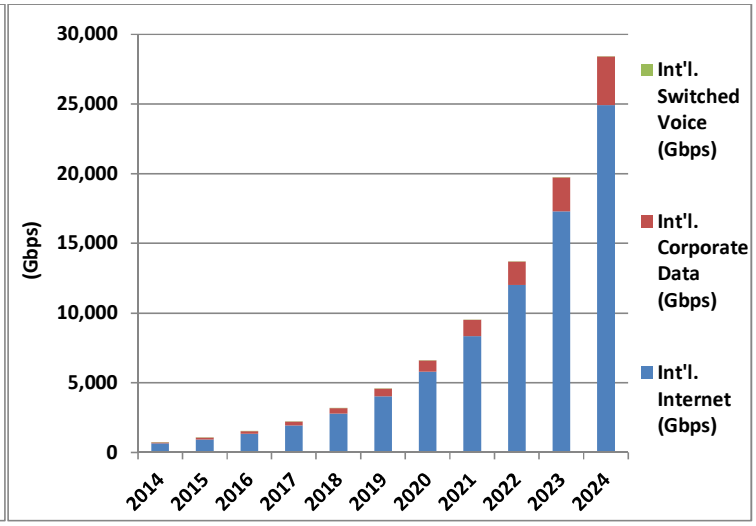
IP transit pricing can range as high as US$100 per Mbps per month for low-volume purchases, to as low as US$35,000 per month per STM-16, which is equivalent to US$14 per Mbps per month.

Table 30: Historical and forecasted international bandwidth in Pakistan (Gbps), 2003-2024

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
International Internet	0	1	1	5	9	14	35	70	130	200	300
International corporate data	0	0	0	1	1	2	5	10	18	28	42
International switched voice	1	1	1	2	2	2	3	3	4	4	5
Total international bandwidth	1	2	3	7	12	18	43	83	152	232	347
CAGR (2003-2013)	75%										

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
International Internet	650	936	1,348	1,941	2,795	4,025	5,795	8,345	12,017	17,305	24,919
International corporate data	91	131	189	272	391	563	811	1,168	1,682	2,423	3,489
International switched voice	6	7	8	10	12	14	16	19	23	27	32
Total international bandwidth	747	1,074	1,545	2,223	3,198	4,602	6,623	9,533	13,723	19,755	28,440
CAGR (2013-2024)	49%										





International network connectivity

Initial satellite capacity

PTCL operates the Dehmandro Earth Station in Karachi, as well as the Mallach Earth Station in Islamabad.

Terrestrial fibre optic cables

A terrestrial link between Pakistan and Afghanistan's Nangarhar Province was under development since at least 2009 and significantly delayed due to security issues. However, Afghan Telecom confirmed that the Nangarhar link and a second link at Spin Boldak in Kandahar Province are currently operational. Afghan Telecom had purchased 1 Gbps of IP transit from PTCL and another 1 Gbps from ISP Wateen.

India and Pakistan have seriously pursued the implementation of a bilateral cable between the two countries since at least 2006. A terrestrial link between the Indian network of Tata Communications in Amritsar, India and the Pakistani network of PTCL in Lahore, Pakistan, via Wagah, had been installed at the manhole level, but the system appears not to have been activated as yet.

Table 31: Submarine fibre optic cables serving Pakistan

RFS	Submarine cable system	Route (km)	Finance type	Owner(s)	Cost (US$ million)
1999	**SEA-ME-WE-3 (SMW3)**	39,000	Consortium	International consortium of carriers (PTCL)	1,300
2005	**SEA-ME-WE-4 (SMW4)**	20,000	Consortium	International consortium of carriers (PTCL)	500
2006	**Transworld-1 (TW-1)**	1,274	Investor-led / carrier-led	Orascom (Egypt) / Omzest Group (Oman) / Orastar, Ltd. (UK)	55
2010	**India-Middle East-Western Europe (I-ME-WE)**	12,091	Consortium	International consortium of carriers (PTCL)	480

Incumbent operator PTCL is the Pakistani signatory to the SEA-ME-WE-3 (1999), SEA-ME-WE-4 (2005), and I-Me-We (2010) submarine cables, which land in Karachi, Pakistan and link to Europe and India (as well as East Asia, in the case of the SEA-ME-WE cables).

In 2006, Private operator Transworld Associates, which is 51 per cent-owned by Orascom Telecom Media and Technology, activated the 1,274-km TW-1 submarine cable to Oman and the United Arab Emirates.

Proposed international connectivity

In 2011, Pakistan's Executive Committee of the National Economic Council indicated its support for a 820-km terrestrial cable connecting Pakistan to China via the Khunjerab Pass. In 2013, a contract for the cable's construction was awarded to Chinese supplier Huawei, the total cost of the network, including connectivity to Karachi, was reported to be US$36 million.A fibre link between Pakistan and the Islamic Republic of Iran, linking the networks TIC and PTCL, is expected to be activated soon.

The 25,000-km, 17-member Asia-Africa-Europe-1 cable would be 25,000 km in length and feature a landing point in Karachi, Pakistan. PTCL became a signatory to the project's construction and maintenance agreement in January 2014. The project is unique for its proposal to avoid the "choke point" of the Strait of Malacca by using terrestrial connectivity across southern Thailand rather than a direct landing point in Singapore.

SEA-ME-WE-5 has been under discussion since the completion of SEA-ME-WE-4 in 2005, although initial conceptualization of the project was put on hold due to differences among consortium members, who instead opted for the construction of the competing I-Me-We and EIG cables. However, in 2011 the project regained momentum, led by France Telecom-Orange and Singtel. A construction and maintenance agreement for the project was signed by 15 operators in March 2014. All three Chinese operators (China Mobile, China Telecom and China Unicom) were among its signatories, but the project does not as yet feature the participation of any Egyptian, Indian or Pakistani operators, despite proposed landing points in all three countries.

IX. Country analysis: Sri Lanka

	2013
Population	21,000,000
Population growth rate	1.0%
Gross Domestic Product	US$170 billion / US$8,100 per capita
GDP growth rate	7.3% in 2013, 7.5% forecasted in 2014
Human Development Index	0.750
HDI ranking	73rd out of 187 ("High")
Literacy rate	92%
Fixed-line subscribers	2,700,000
Fixed-line operators	1. Sri Lanka Telecom, PLC (SLT) 2. Dialog Axiata, PLC (Axiata Group) 3. Lanka Bell (Pvt.), Ltd.
Mobile subscribers	20,300,000
Mobile operators	1. Dialog Axiata, PLC (Axiata Group) 2. Mobitel (Pvt.), Ltd. (Sri Lanka Telecom) 3. Etisalat Lanka (Pvt.), Ltd. (Etisalat) 4. Bharti Airtel Lanka (Pvt.), Ltd. (Bharti Airtel) 5. Hutchison Telecommunications Lanka (Pvt.), Ltd. (Hutch brand) (Hutchison Whampoa)
Mobile broadband	3G launched in 2006; LTE launched in 2013
Regulatory agency	Telecommunications Regulatory Commission (TRC)
International Internet bandwidth	45 Gbps
International Internet bandwidth per capita	2.2 Kbps
Internet service providers	1. SLT / Mobitel 2. Dialog Broadband Networks (Pvt.), Ltd. / Dialog Axiata, PLC (Axiata Group) 3. Lanka Bell (Pvt.), Ltd. 4. Bharti Airtel Lanka (Pvt.), Ltd. (Bharti Airtel) 5. Etisalat Lanka (Pvt.), Ltd. 6. Eureka Technology Partners (Pvt.), Ltd. 7. Hutchison Telecommunications Lanka (Pvt.), Ltd. (Hutch brand) (Hutchison Whampoa) 8. Lanka Communication Services (Pvt), Ltd. (LankaCom) (Singtel) 9. Dynanet, Ltd.
Fixed broadband subscribers	420,000 fixed broadband subscribers (>256 Kbps) 2 million mobile broadband subscribers (estimated)
Fixed broadband technologies	ADSL, FTTH, WiMax, Wi-Fi, wireless broadband
Typical monthly broadband subscription	1. US$4 per month + US$4 installation for 2 Mbps ADSL with 1 GB download limit (SLT ADSL) 2. US$11.50 per month + US$8 installation for 8 Mbps ADSL with 25 GB download limit (SLT ADSL)

Telecommunications market overview

Sri Lanka Telecom (SLT) and Dialog Axiata each reported more than LKR60 billion (US$460 million) in revenue in 2013. Etisalat Lanka reported revenue of US$56 million.

The Government of Sri Lanka retains a 49.5 per cent stake in SLT and its second-largest shareholder is Global Telecom Holdings NV, which is reportedly controlled by Usaha Tegas Sdn. Bhd., the parent company of Malaysian operator Maxis Communications.

Regulation and Government intervention

The industry regulator is the Telecommunications Regulatory Commission (TRC), which was established in 1996 as a result of the Sri Lanka Telecommunications (Amendment) Act.

SLT was assigned responsibility to develop the country's National Broadband Network (NBN) through the issuance of an NBN Service Provider licence. The NBN is expected to provide connectivity to all 329 divisional secretariats by 2018, with a focus on improving connectivity in rural areas.

Fixed-line telephony market

SLT served 1.571 million fixed-line subscribers via both PSTN and CDMA-based WLL networks as of year-end 2013, for a market share of 57 per cent. The rest of the fixed-line market is split between CDMA WLL operators Dialog and Lanka Bell, established in 1996 and 1997, respectively.

Dialog traces its fixed-line CDMA operations to MTT Networks, which it acquired in 2006, and Suntel, which began operations in 1996 but had constructed a network with 382 base stations at the time of its acquisition by Dialog in 2012.

Mobile telephony market

As of year-end 2013, Dialog Axiata had more than 8 million subscribers, for a 40 per cent market share. SLT's Mobitel divison had more than 5 million subscribers—a market share of approximately 25 per cent.

Etisalat, which acquired the Sri Lankan operations of Tigo in 2009, had between 3 and 4 million subscribers in 2013 for a market share of 17 per cent. Hutch had between 2 and 3 million subscribers for an estimated 12 per cent market share. Bharti Airtel entered the Sri Lankan market in 2009, but the company has struggled to gain more than two million subscribers and had an estimated market share of 6 per cent.

In early 2014, it was reported that SLT's Mobitel had agreed to pay US$132 million to acquire Hutch, while Dialog Axiata had offered to purchase the company for only US$78 million. In May 2014, the Sri Lankan President reportedly cancelled Mobitel's takeover of Hutch due to what he felt was a lack of substantiation for the 69 per cent premium that Mobitel had offered over the competing Dialog bid.

In late 2013 Airtel was reported to be considering exiting the Sri Lankan market and was said to have been in advanced discussions to sell its Sri Lanka operations to Etisalat, but in October 2014, Etisalat was reported to be planning its own exit from the Sri Lankan market, and according to one source Bharti Airtel had now become "very interested" in acquiring Etisalat's operations to merge with its own.

According to the TRC, neither Bharti Airtel nor Hutch submitted offers for spectrum in the country's 2013 4G auction. The winning bid, with a value of US$26 million, was submitted by Dialog Axiata. The TRC indicated that it would allow sharing of spectrum by competing operators.

As of mid-2014, there were almost two million mobile broadband subscribers. 3G services were launched relatively early (in 2006) and, following the auction in 2013, 4G LTE was launched by both Dialog Axiata and Mobitel. WLL operator Lanka Bell has also begun offering 4G services.

Internet and broadband market

There are approximately 500,000 fixed broadband subscribers, served primarily by SLT, Dialog and Lanka Bell. Each of the mobile operators offers broadband mobile service and a handful of ISPs, including DynaNet, Eureka and Singtel's LankaCom, target a primarily corporate clientele.

SLT introduced ADSL service in 2003 and as of 2013 its fixed broadband subscribership was approximately 400,000. SLT also rolled out an FTTH network that had attracted 20,000 subscribers as of mid-2013. Both Dialog and Lanka Bell offer Wi-Max.

Domestic network connectivity

SLT's domestic network was approximately 15,000 km in length as of 2013. Historically, it has been strongest in the country's south-central region, connecting Colombo, Kalutara, Ratnapura, Awissawella, Nawalapitiya, Hatton, Nuwara Eliya, Kandy, Matale, Kegalle, Kurunegala, Chilaw and Negombo.

The NBN, developed by the Government in partnership with SLT, will ultimately comprise five rings (north, south, east, west, and central), with initial deployment focused on the south of the country, including the area between Colombo, Puttalam and Batticaloa, as well as less-developed areas on the country's south coast that were particularly hard-hit by the 2004 Indian Ocean tsunami. Phases II and III of the initiative aim to improve connectivity in the northern part of the country, particularly those that were impacted by conflict.

International Internet bandwidth and capacity pricing

Table 32: International Internet bandwidth and capacity pricing in Sri Lanka, 2013

International Internet bandwidth	International Internet bandwidth per capita	International capacity pricing
45 Gbps	2.2 Kbps	US$60-US$70 per Mbps per month for IP transit

Source: Terabit Consulting research, operator data and interviews

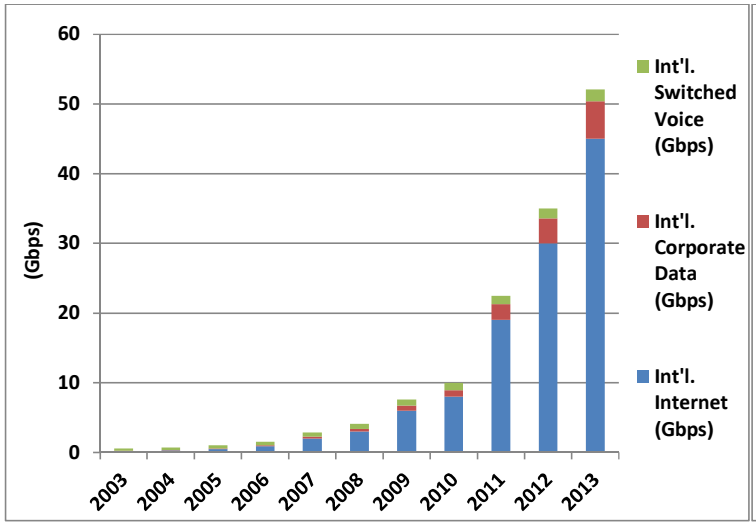
SLT's international bandwidth was reported to be 23 Gbps in 2012 and, as of year-end 2013, the country's total international Internet bandwidth was estimated to be approximately 45 Gbps.

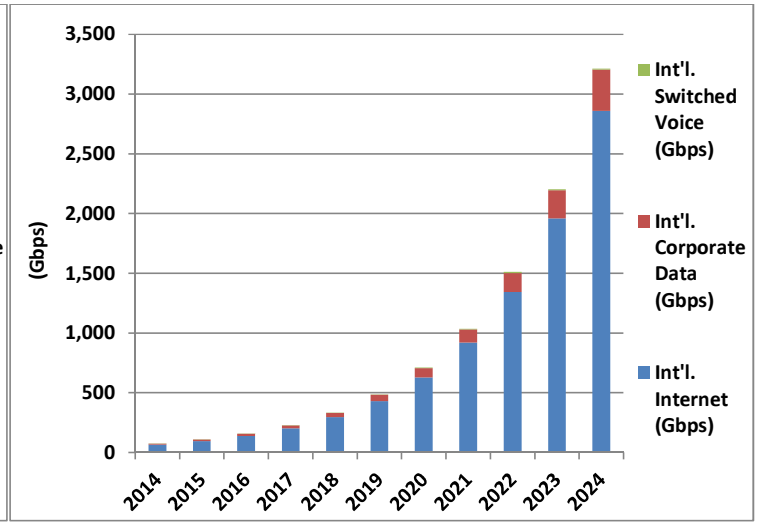
Prices of international bandwidth in Sri Lanka are high. In 2013, the Lanka Education and Research Network (LEARN) said that it had paid US$68 per Mbps for 1.5 Gbps of international capacity from LT. LEARN representatives said that this was "the lowest in the country…because of huge bargaining power" (LEARN's capacity was reported to represent approximately one-thirtieth of the country's total international bandwidth). Historically, some observers have been critical of SLT's interconnection policies and tariffs at submarine cable landing stations, as well as its high backhaul prices.

Table 33: Historical and forecasted international bandwidth in Sri Lanka (Gbps), 2003-2024

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
International Internet	0	0	1	1	2	3	6	8	19	30	45
International corporate data	0	0	0	0	0	0	1	1	2	4	5
International switched voice	0	0	0	1	1	1	1	1	1	1	2
Total international bandwidth	1	1	1	2	3	4	8	10	23	35	52
CAGR (2002-2012)	58%										

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
International Internet	65	95	139	202	295	431	630	919	1,342	1,959	2,860
International corporate data	8	11	17	24	35	52	76	110	161	235	343
International switched voice	2	2	3	3	4	5	5	6	8	9	11
Total international bandwidth	75	109	158	230	335	488	711	1,036	1,511	2,203	3,214
CAGR (2012-2023)	45%										





International network connectivity

Initial satellite connectivity

The Padukka Earth Station, just outside of Colombo, was commissioned in 1976 and the Colombo Earth Station was commissioned in 1993.

Submarine fibre optic cables

Sri Lanka is currently served by five submarine cables, SEA-ME-WE-3 and SEA-ME-WE-4, in which SLT is an investor and which were inaugurated in Colombo in 1999 and 2005, respectively. SLT and BSNL of India inaugurated the Bharat-Lanka Cable System between Colombo and Tuticorin, India in 2006.

The Dhuraagu Submarine Cable Network, funded by the eponymous Maldivian operator in partnership with SLT, linked Sri Lanka and the Maldives in 2006. The India-Maldives submarine cable, which entered service in 2007, was extended to Sri Lanka via a branching unit in 2008. The system is owed by Lanka Bell, as well as Global Cloud Xchange (formerly Reliance Globalcom) and WARF Telecom (a consortium consisting of Ooredoo, Reliance Communications, and Focus Infocom).

Table 34: Submarine fibre optic cables serving Sri Lanka

RFS	Submarine cable system	Route (km)	Finance type	Owner(s)	Cost (US$ million)
1994	**SEA-ME-WE-2 (SMW2)**	18,337	Consortium	International consortium of carriers	780
1999	**SEA-ME-WE-3 (SMW3)**	39,000	Consortium	International consortium of carriers	1,300
2005	**SEA-ME-WE-4 (SMW4)**	20,000	Consortium	International consortium of carriers	500
2006	**Bharat-Lanka Cable System**	333	Bilateral	SSLT / BSNL	16
2008	**India-Sri Lanka (Falcon Extension / India-Maldives Extension)**	400	Bilateral	Lanka Bell / Reliance Group	15

Source: Terabit Consulting

Proposed international connectivity

SLT has been a strong supporter of all fibre optic SEA-ME-WE submarine cable initiatives, including the proposed SEA-ME-WE-5, which would land in Matara. A construction and maintenance agreement for the project was signed by 15 operators in March 2014. All three Chinese operators (China Mobile, China Telecom and China Unicom) were among its signatories, but the project does not as yet feature the participation of any Egyptian, Pakistani or Indian operators, despite proposed landing points in all three countries.

Dialog Axiata is a signatory to the proposed 8,000 km Bay of Bengal Gateway project, which was announced in April of 2013, connecting Sri Lanka to India, Malaysia, Oman and the United Arab Emirates.

X. Country analysis: Turkey

	2013
Population	77,000,000
Population growth rate	1.3%
Gross Domestic Product	US$1.3 trillion / US$16,900 per capita
GDP growth rate	4.0% in 2013, 2.5% forecasted in 2014
Human Development Index	0.759
HDI ranking	69th out of 187 ("High")
Literacy rate	96%
Fixed-line subscribers	13,552,000
Fixed-line operators	1. Türk Telekom (including TTNet) 2. Turkcell Superonline (Turkcell) 3. Turknet 4. İşNet 5. Millenicom 6. Vodafone Turkey 7. TTM Telekom 8. Net GSM
Mobile subscribers	69,661,100
Mobile operators	1. Turkcell 2. Vodafone Turkey 3. Avea (Turk Telekom)
Mobile broadband	3G launched in 2009; 4G LTE services being tested
Regulatory agency	Information and Communications Technologies Authority (ICTA/BTK)
International Internet bandwidth	2.3 Tbps
International Internet bandwidth per capita	30.7 Kbps
Internet Service Providers	1. Türk Telekom (including TTNet) 2. Turkcell Superonline (Turkcell) 3. Doğan TV Digital 4. Millenicom 5. Turknet 6. Vodafone Turkey (including Vodafone Net) 7. Metronet 8. İşNet 9. Telnet-Turcom 10. Teknotel
Fixed broadband subscribers	8.4 million fixed broadband subscribers (>256 Kbps) 25.5 million mobile broadband subscribers
Fixed broadband technologies	ADSL, FTTB, cable modem, fixed wireless
Typical monthly broadband subscription	1. US$27 per month + free installation for 25 Mbps FTTH with unlimited download (Turkcell Superonline FTTH) 2. US$62 per month + US$16 installation fee for 100 Mbps FTTH with unlimited download (TTNet FTTH)

Telecommunications market overview

Given the large size and value of the Turkish telecommunications market, the level of competition in the marketplace is relatively low. In 2013, the total revenue of the country's telecommunications operators and Internet service providers was TRY32.5 billion, or more than US$18 billion at 2013 exchange rates. Average revenue per user is approximately TRY22 (US$10) per month for each of the country's mobile operators.

The fixed-line market is dominated by the incumbent operator Turk Telekom, in which the Turkish Government retains a 30 per cent stake. In 2005, a majority 55 per cent stake of Turk Telekom was privatized and acquired by Ojer Telekomünikasyon A.Ş., a joint venture established by Saudi Oger Limited and Telecom Italia. Telecom Italia sold its stake in the joint venture to Saudi Oger in mid-2007. In 2008, Saudi Telecommunications Company acquired a 35 per cent stake in Oger Telecommunications (which currently holds 99 per cent of shares in Ojer Telekomünikasyon A.Ş.).

There are only three mobile market operators: Turkcell—which integrated the Internet service provider Superonline into its group in 2009, Avea—81 per cent-owned by Turk Telekom, with the remaining shares owned by Turkey's İş Bank and Vodafone, a wholly-owned subsidiary of the Vodafone Group.

Regulation and Government intervention

The Information and Communication Technologies Authority (ICTA) (also known by its Turkish acronym BTK), was established as the country's regulatory agency in 2000, with responsibility for licensing, tariff regulation, consumer protection and promotion of competition, among other duties.

The broadband imbalance between Turkey's eastern regions and the rest of the country is particularly pronounced: fixed broadband penetration in the east of the country is only 20 per cent, roughly half of the household penetration rate for the country as a whole. In 2012, Turk Telekom received a €100 million loan from European Bank for Reconstruction and Development to expand fixed broadband in all regions of the country, with a particular focus on addressing the weakness of fixed broadband infrastructure in the regions of Adana, Diyarbakır, Erzurum, Kayseri, Samsun and Trabzon.

Fixed-line telephony market

There were 13.6 million fixed telephony subscribers as of year-end 2013, for a penetration rate of 18 per cent. The sector contracted by 24 per cent over the last five years. More than 80 per cent of fixed lines were served by the incumbent Turk Telekom or its subsidiary TTNet. Turk Telekom's primary competitor in the fixed-line space is Superonline, a subsidiary of Turkcell. Other fixed-line operators include Turknet, İşNet, Millenicom, Vodafone Turkey, TTM Telekom and Net GSM.

Mobile telephony market

Turkcell launched the country's first GSM mobile network in 1994. It remains the leading operator in terms of subscribers, with a 51 per cent market share as of year-end 2013. Vodafone, which acquired the operations of Telsim in 2005, is the country's second-largest operator, with a 29 per cent share. The third-place operator, Turkcell's Avea, was formed through the merger of three smaller operators in 2004. Avea had a 21 per cent share as of year-end 2013 although preliminary figures indicate that it gained 1 to 2 percentage points over the course of 2014 at the expense of Turkcell Superonline.

There were a total of 24 million handset-based 3G mobile Internet subscribers in Turkey as of year-end 2013, plus an additional 1.5 million 3G mobile computer-based users (such as USB dongle subscribers). The development of 4G networks has been somewhat restrained due to the comparatively high speeds of existing 3G connectivity.

Internet and broadband market

Turk Telecom's TTNet Subsidiary has a 78 per cent share of the Internet market. Superonline has 13 per cent and an additional four ISPs each have market shares of between 1 per cent and 5 per cent.

There were 8.4 million fixed broadband subscriptions in Turkey as of year-end 2013. More than three-fourths, or 6.6 million, were DSL. Fibre-to-the-building grew by 85 per cent to 1.2 million; Turkcell Superonline offers a 1 Gbps FTTH service in the cities of Istanbul, Izmir, Ankara, Gaziantep, Bursa, Kocaeli, Mersin, Antalya, Adana, Samsun, Trabzon, Kayseri, Konya and Diyarbakir. Cable modem subscribership has remained steady at approximately 500,000.

Turkey's fixed-line broadband services are priced extremely competitively, with FTTH services ranging from US$27 per month for 25 Mbps to $62 per month for 100 Mbps.

Domestic network connectivity

Turkey's total fibre deployment was 227,000 km as of year-end 2013. Turk Telekom operates the country's largest fibre network, at 174,000 km; Turkcell Superonline's domestic network was considerably smaller at 33,000 km, but its fibre connectivity was increased following its 2014 purchase of Metronet.

In late 2013, Vodafone entered into a 15-year, US$62-million agreement to use the fibre network of the state-owned electrical transmission company, TEIAS, thereby increasing Vodafone's domestic fibre network from 6,000 km to 16,000 km.

International Internet bandwidth and capacity pricing

Table 35: International Internet bandwidth and capacity pricing in Turkey, 2013

International Internet Bandwidth	International Internet bandwidth per Capita	International Capacity Pricing
2.3 Tbps	30.7 Kbps	US$2.60 per Mbps per month for IP transit in 10 Gbps increments

Source: Terabit Consulting research, operator data and interviews

Turkey's total international Internet bandwidth is approximately 2.3 Tbps. Annual growth of the country's international capacity remains above 60 per cent, driven not only by its own internal requirements but also its increasingly important role as a transit hub for traffic from the Middle East and Asia.

Turkish bandwidth prices are increasingly converging with the low bandwidth prices in the rest of Europe. IP transit in Istanbul costs approximately US$4 per Mbps per month for high-volume purchases, although

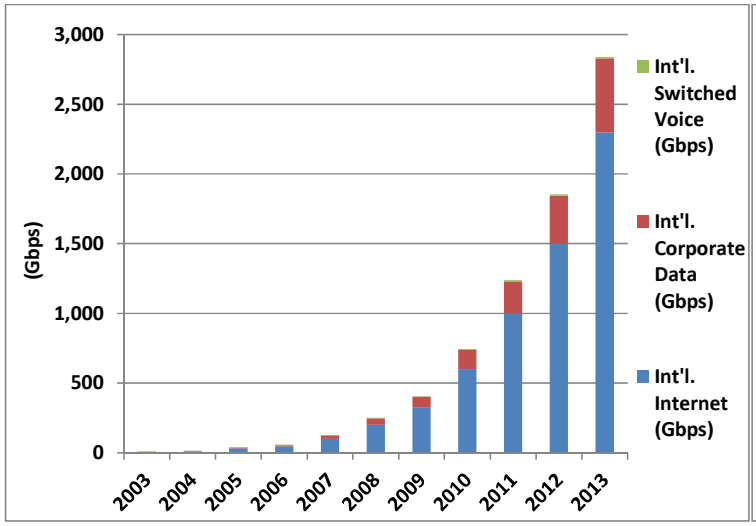
pan-European network operator Interoute has reportedly offered a promotional rate of €20,000 per month for 10 Gbps of IP transit (US$2.60 per Mbps).

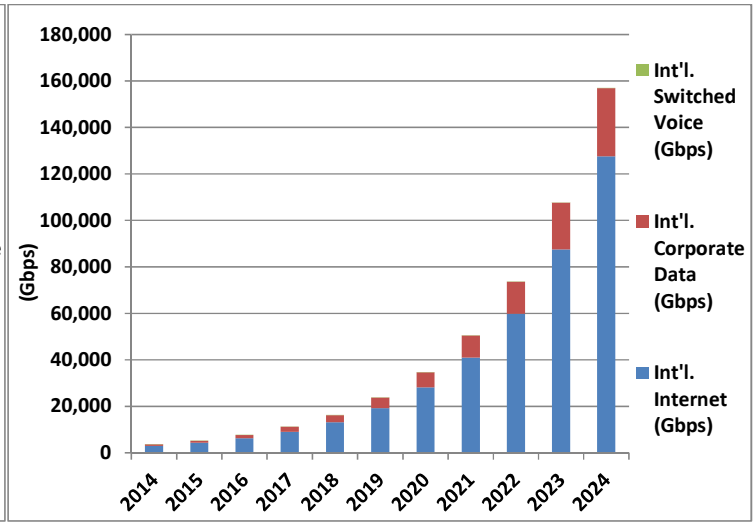
A 10 Gbps wavelength from Istanbul to major European points-of-presence, including London, Amsterdam, Paris, Frankfurt, Germany or Milan, Italy, costs €10,000 per month (US$1.30 per Mbps), while a protected 10 Gbps wavelength costs 50 per cent more.

Table 36: Historical and forecasted international bandwidth in Turkey (Gbps), 2003-2024

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
International Internet	5	9	30	45	100	200	325	600	1,000	1,500	2,300
International corporate data	1	2	7	10	23	46	75	138	230	345	529
International switched voice	2	2	3	3	4	4	5	6	7	8	10
Total international bandwidth	8	13	40	58	127	250	405	744	1,237	1,853	2,839
CAGR (2002-2012)	80%										

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
International Internet	2,900	4,234	6,182	9,025	13,177	19,238	28,088	41,008	59,872	87,413	127,622
International corporate data	667	974	1,422	2,076	3,031	4,425	6,460	9,432	13,770	20,105	29,353
International switched voice	12	14	16	19	23	27	32	38	44	52	62
Total international bandwidth	3,579	5,222	7,620	11,120	16,230	23,690	34,580	50,477	73,686	107,570	157,037
CAGR (2012-2023)	44%										





International network connectivity in Turkey

Initial satellite connectivity

The Ankara Earth Station was commissioned in 1979 as the country's first Intelsat station. Turkey also operates its own satellite network, Turksat, which was established in 1994 following the launch of the Turksat-1B satellite. Turksat-2A, 3A, and 4A are currently operational.

Terrestrial fibre optic cables

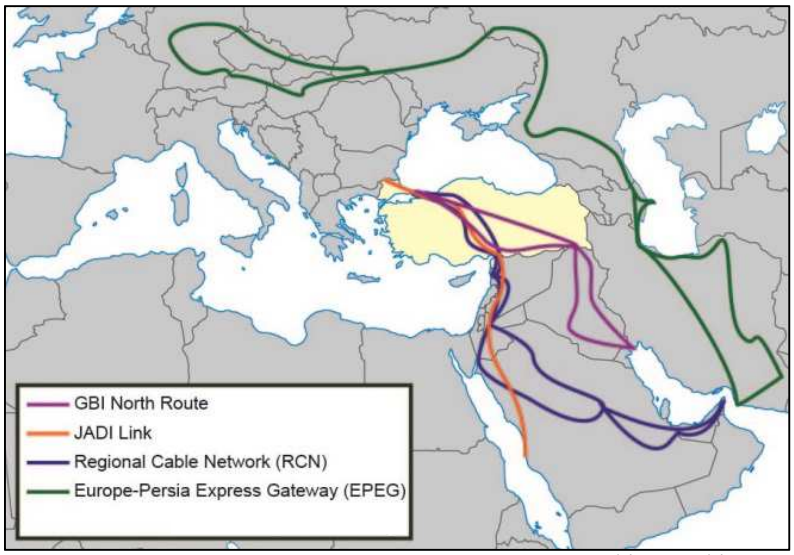
Turkey has strong terrestrial fibre connectivity to each of its neighbours, with the exception of Armenia. Both Turk Telekom and Turkcell Superonline have fibre connectivity to Azerbaijan, Bulgaria, Georgia, Greece, Iraq and the Syrian Arab Republic. Turk Telekom also has an interconnection with the network of Islamic Republic of Iran's TIC. In 2011, Turk Telekom purchased 250 Gbps of IP backbone capacity from the Greek operator OTE, with delivery of the bandwidth via the terrestrial Trans-Balkan Network.

Turk Telekom is an investor in the terrestrial regional JADI Link network, and Turkcell Superonline is an investor in the Regional Cable Network. However, these links are not yet in operation as of 2014. A third new regional network, GBI's North Route, connects Turkey and Iraq.

Table 37: New Middle East-to-Europe terrestrial networks serving Turkey

	Gulf Bridge International North Route	Jeddah-Amman-Damascus-Istanbul Link	Regional Cable Network
Development schedule and RFS	GBI declared it had started migrating traffic to the network in March 2013.	Construction and maintenance agreement signed in June, 2010; ready-for-service in Q3, 2010. Currently offline due to the security situation in the Syrian Arab Republic.	Construction and maintenance agreement signed in December, 2010; scheduled for activation in 2012 but currently offline due to the security situation in the Syrian Arab Republic..
Route	From the GBI submarine cable landing point in Al Faw, Iraq, to Istanbul, Turkey, via a ring in Iraq and a ring in Turkey, with onward connectivity to Frankfurt, Germany.	Jeddah, Amman, Damascus and Istanbul, Turkey	Fujairah (United Arab Emirates). Riyadh, Amman, Istanbul (Turkey)
Length	4,500 km (estimated)	2,530 km, Including 920 in Saudi Arabia, 360 in Jordan, 480 in the Syrian Arab Republic and 770 in Turkey.	7,750 km (3,875 "radial" length)
Investors	GBI. The North Route was assembled using the existing networks of regional operators including Iraq Telecommuni-cations and Post Company and several Turkish operators.	Jordan Telecom Group, Saudi Telecom Company, Syrian Telecommunications Establishment, Turk Telekom	Etisalat, Jordan Telecom Group , Mada-Zain Partnership (Jordan), Mobily (Saudi Arabia), Syrian Telecommunications Establishment, Turkcell-Superonline
Capacity	In 2013, GBI said the network capacity was initially limited to "a couple of [10 Gbps] wavelengths" with upgradeability to "tens of [40 or 100 Gbps] wavelengths".	200 Gbps initial capacity	12.8 Tbps design capacity

Map 3: Europe-to-Asia terrestrial fibre projects (planned and in service)



Source: Terabit consulting

Submarine fibre optic cables

Turkey's primary path for international connectivity is the Telecom Italia-owned Med Nautilus system, which links Italy, Greece, Cyprus and Israel. The system was initially constructed in 2002 and expanded to Turkey in 2004 as the result of a US$40 million, 15-year capacity purchase commitment from Turk Telekom. Another Med Nautilus segment was constructed from Turkey to Greece in 2011. Turk Telekom operates the cable network's Istanbul landing station.

Turk Telekom is also an investor in the SEA-ME-WE-3 submarine cable, which entered service in 1999 and offers a significantly lower capacity than subsequent Europe-to-Asia systems.

Regional submarine cable systems include KAFOS in the Black Sea, linking to Bulgaria and Romania, and the Turcyos-1 and Turcyos-2 cables to Cyprus.