

The significance of international backhaul: Points to ponder by Nepal

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How to engage in broadband policy and regulatory processes
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Nagarkot, Nepal



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Internet's infrastructure fragility and cost

Terrestrial cables are damaged every 30 minutes.



Construction



Vehicles



Mother nature



Vandalism



Floods



Animals



Equipment failures

MORE THAN \$26.5 BILLION

in revenue is lost each year
from IT downtime.

Submarine cables are damaged every 3 days.



Fishing



Anchors



Components



Abrasion



Earthquakes



Dredges/drills/pipelines



Fish bites



Icebergs

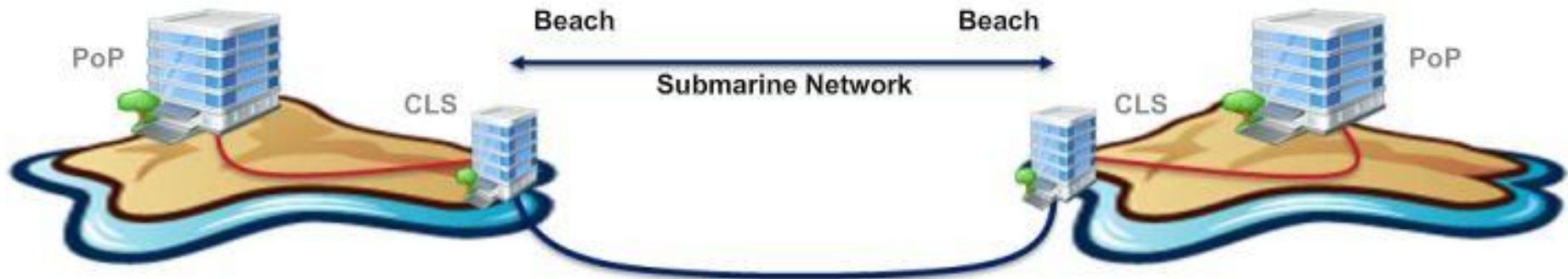
Submarine networks = Terrestrial networks

Landlocked countries = Coastal countries

PoP ←————→ PoP
Optimized PoP-to-PoP Network Design

PoP ← Beach →
Terrestrial Backhaul

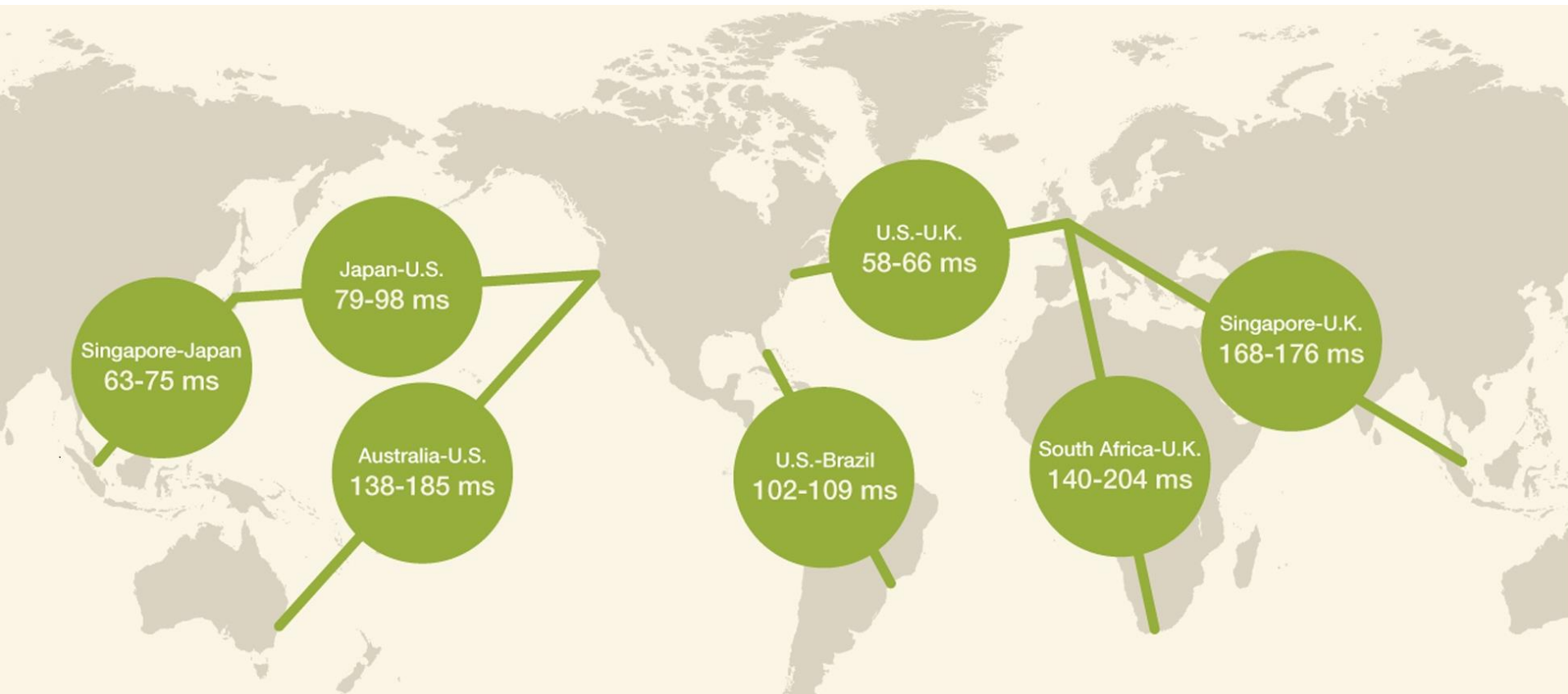
Beach ← PoP →
Terrestrial Backhaul



PoP= Point of Presence
CLS – Cable Landing Station

Courtesy: Ciena

Latency ranges by route



Notes: Data shown are round trip delay latencies measured in milliseconds between cable stations and do not factor in additional latency introduced due to backhaul or local access.

Source: TeleGeography
2014

DREAM (Diverse Route for European and Asian Markets)

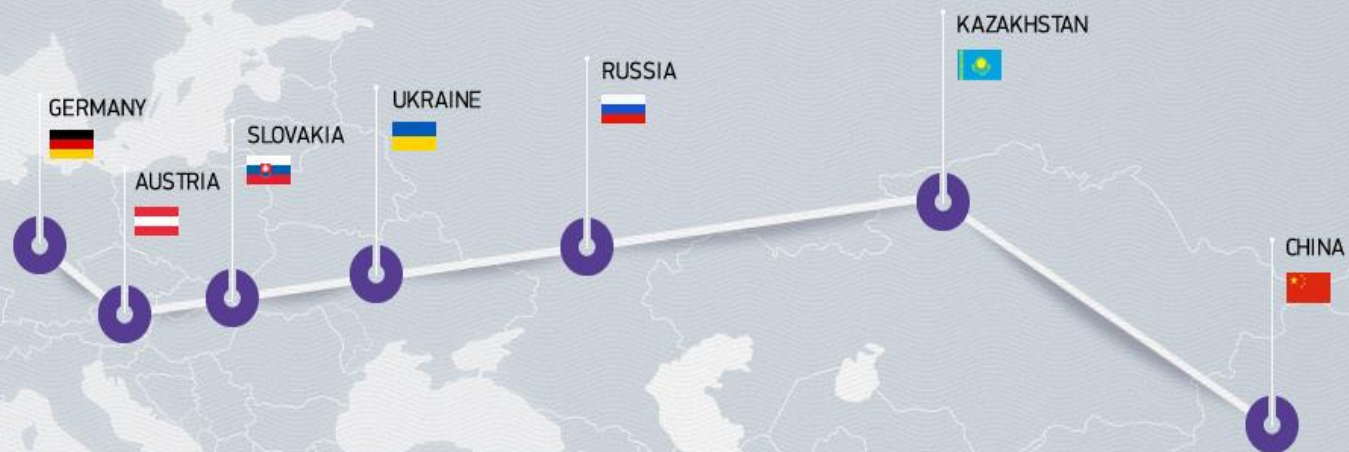
DREAM IS THE OPTIMAL COMMUNICATIONS PATH FROM FRANKFURT AM MAIN TO CHINA



CAPACITY
Up to 10 Gbps

TOTAL BANDWIDTH
Up to 8 Tbps

ROUND TRIP DELAY
175 ms



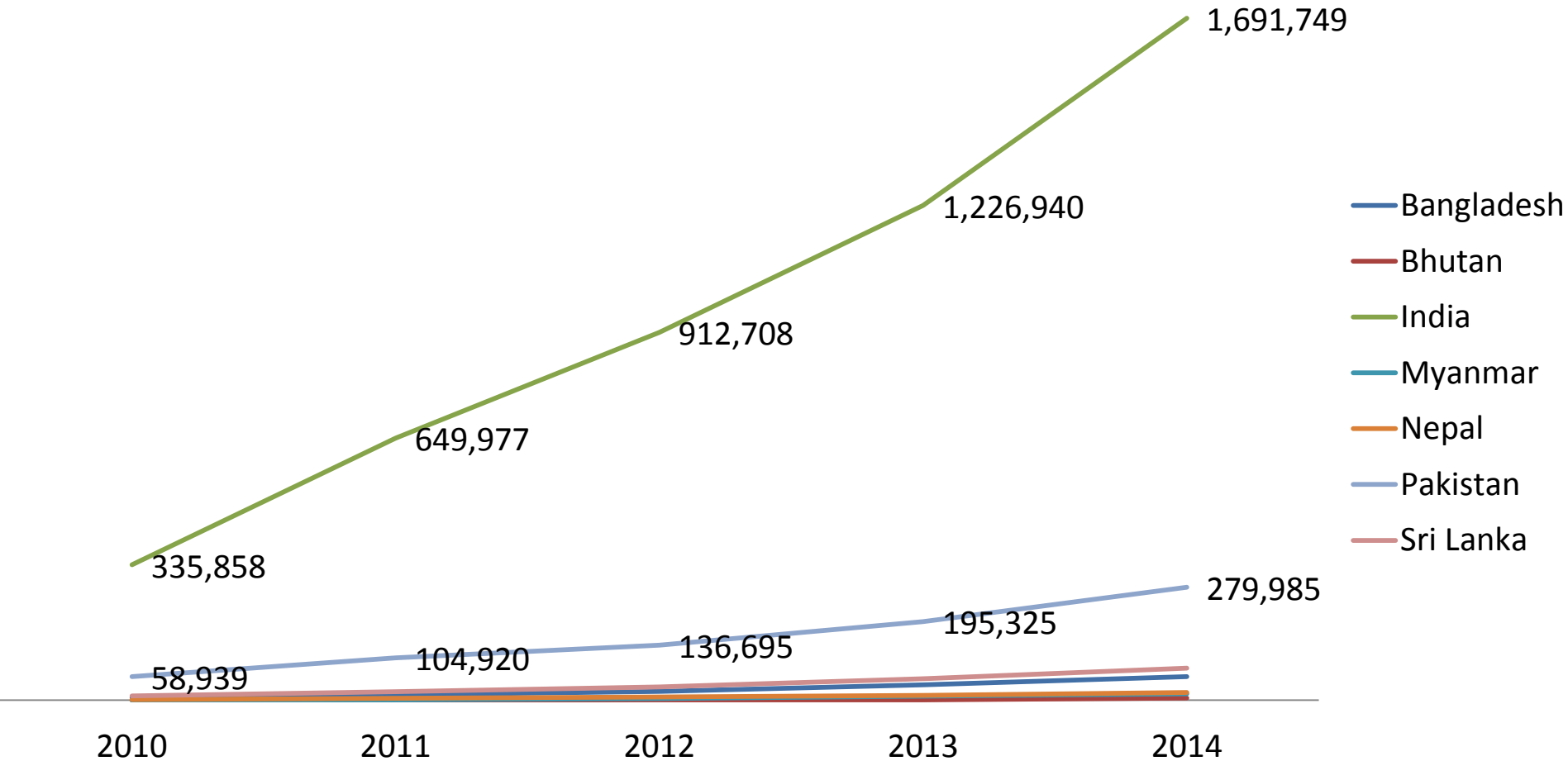
Terrestrial offers better latency

Europe Persia Express Gateway



International Internet Bandwidth (Mbps) by country (South Asia)

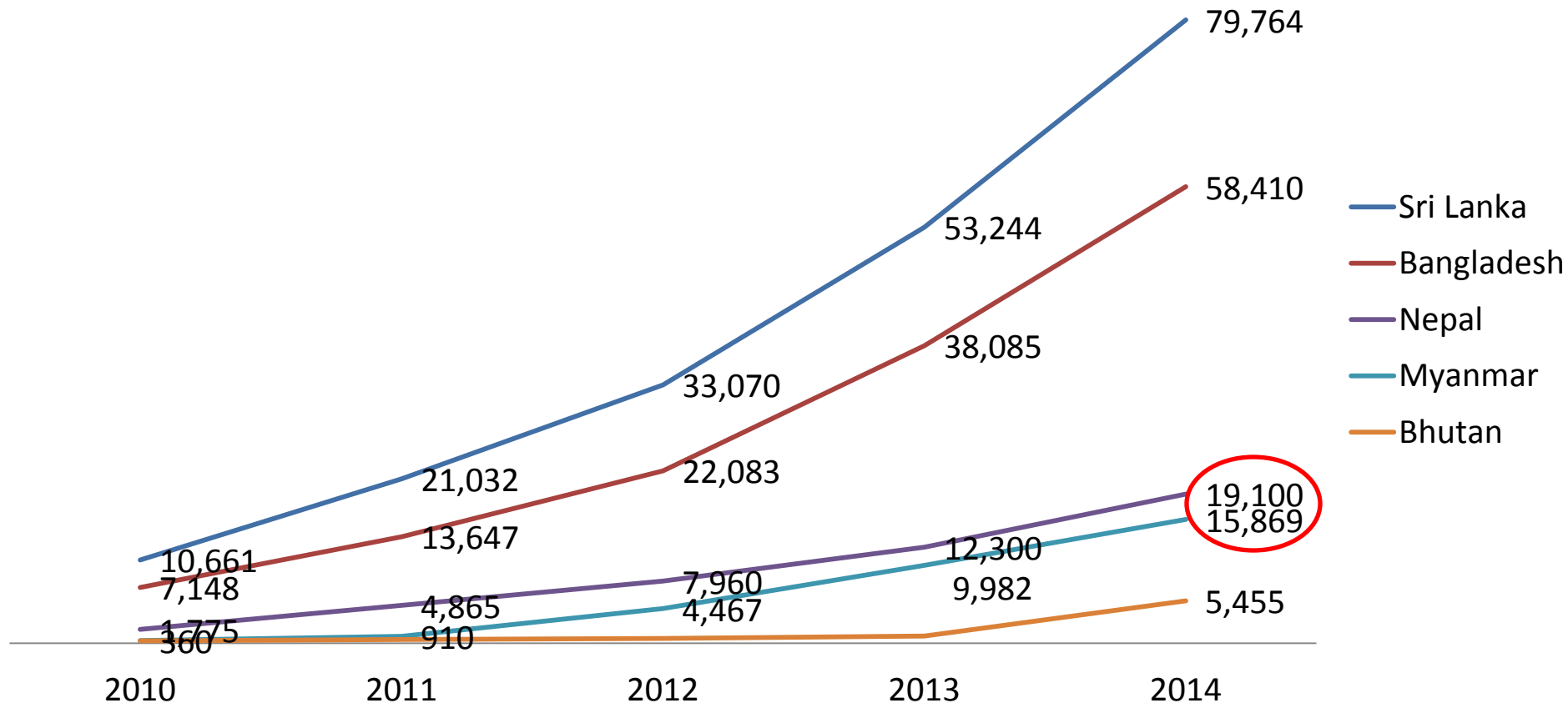
Myanmar is included deliberately



Source: Global Internet Geography, TeleGeography. Figures represent Internet bandwidth connected across international borders. Data as of mid-year.

Myanmar is breathing on Nepal's neck

India and Pakistan have been excluded for a clearer picture

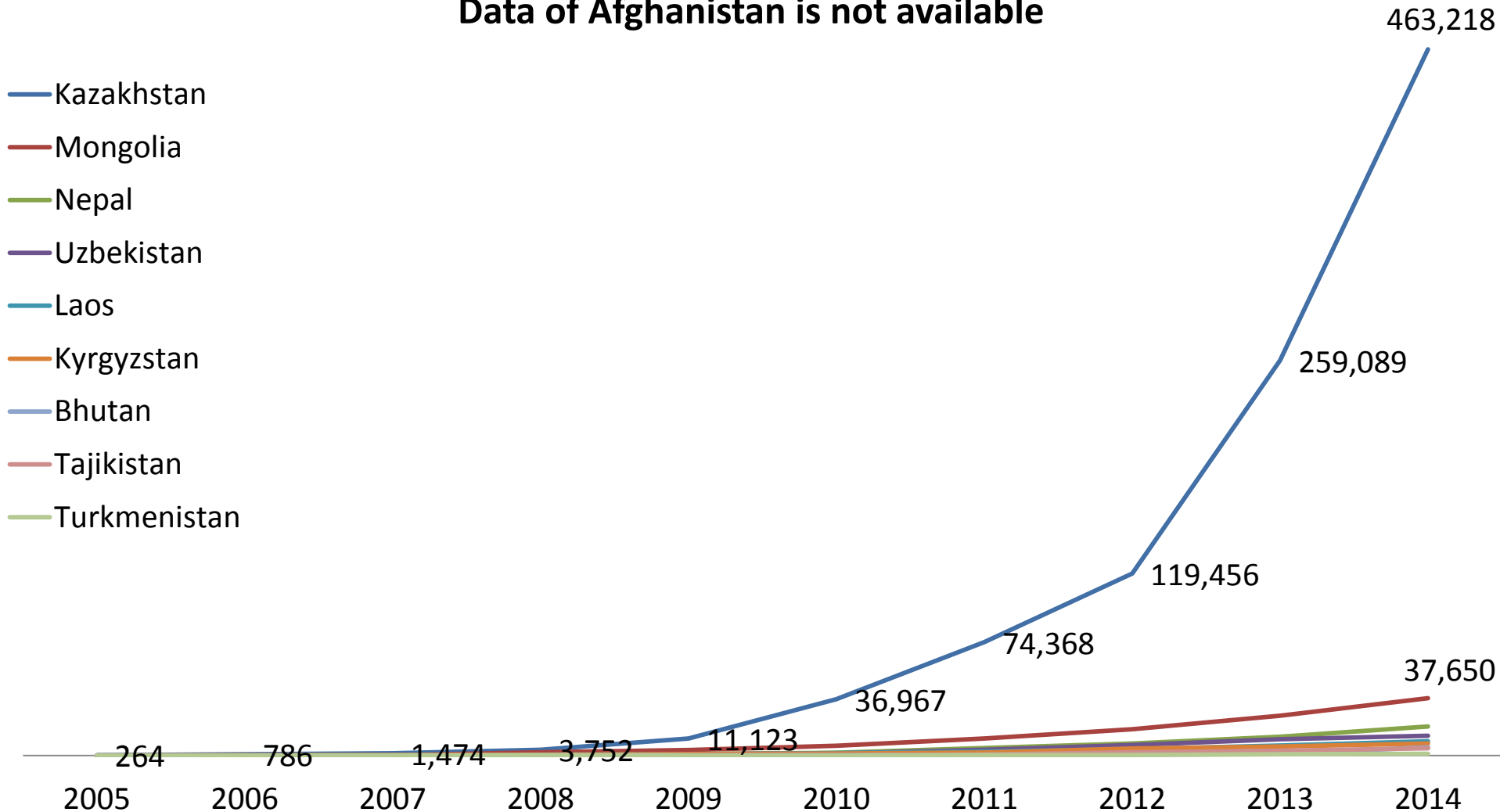


Source: Global Internet Geography, TeleGeography. Figures represent Internet bandwidth connected across international borders. Data as of mid-year.

International Internet Bandwidth (Mbps) by Country (Asia Pacific LLDCs)

Data of Afghanistan is not available

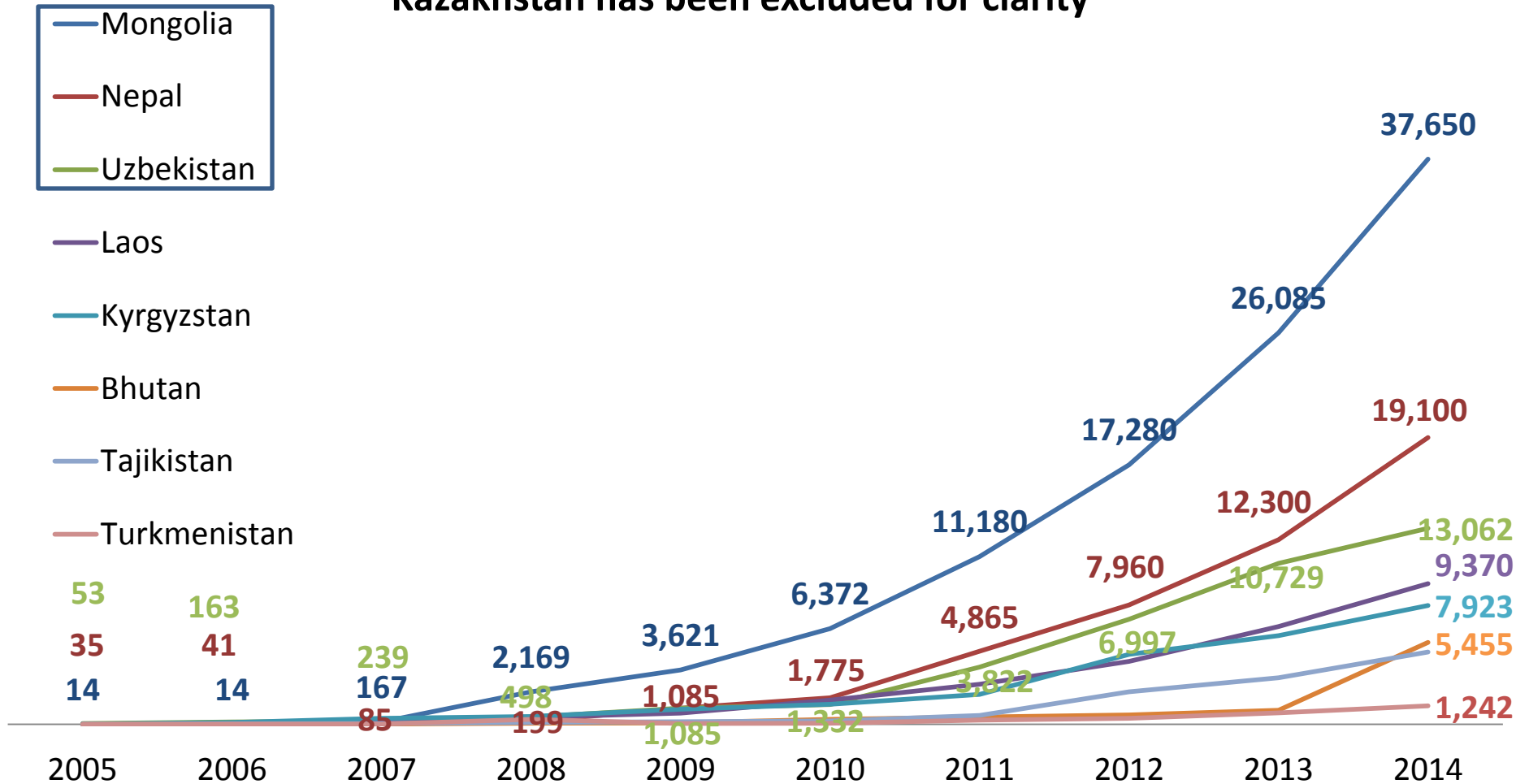
— Kazakhstan
— Mongolia
— Nepal
— Uzbekistan
— Laos
— Kyrgyzstan
— Bhutan
— Tajikistan
— Turkmenistan



Source: Global Internet Geography, TeleGeography. Figures represent Internet bandwidth connected across international borders. Data as of mid-year.

Amazing tale of three LLDCs

Kazakhstan has been excluded for clarity



Source: Global Internet Geography, TeleGeography. Figures represent Internet bandwidth connected across international borders. Data as of mid-year.

Uzbekistan: An unfinished revolution

- December 10, 2004: Uzbekenergo and Uzbekistan Railway were granted licenses for five years to “**provide long distance telecommunication services**” ensuring “**access to its networks for other operators and providers on equal terms**”.
- November 4, 2009: Both the licenses were extended for further five years (i.e., until December 12, 2014).
- Neither of the license is yet to be functional!

Uzbektelecom retains end-to-end monopoly

International Internet Bandwidth by Country, 2005–2014 (Mbps)

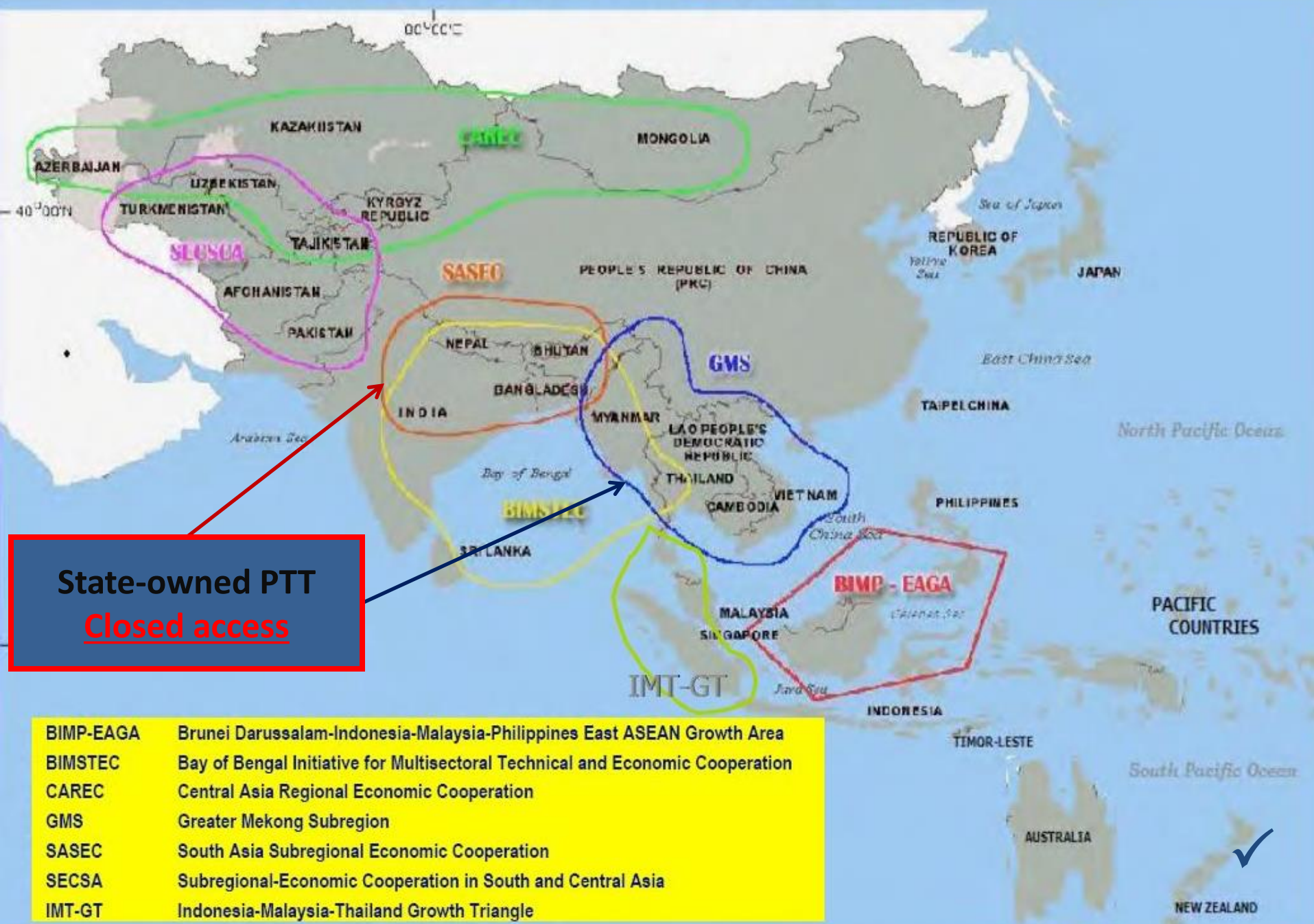
Country	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Mongolia	14	14	167	2,169	3,621	6,372	11,180	17,280	26,085	37,650
Nepal	35	41	85	199	1,085	1,775	4,865	7,960	12,300	19,100
Uzbekistan	53	163	239	498	1,085	1,332	3,822	6,997	10,729	13,062
Laos	24	57	326	481	756	1,616	2,682	4,190	6,522	9,370
Kyrgyzstan	22	130	398	524	1,019	1,335	2,005	4,662	5,904	7,923
Bhutan	7	22	30	75	116	330	485	640	940	5,455
Tajikistan	10	46	68	129	179	235	595	2,174	3,104	4,815
Turkmenistan	12	20	30	344	54	69	290	400	775	1,242

- **Mongolia crossed Nepal, Bhutan, Tajikistan, Turkmenistan in 2007. It also passed Laos and Kyrgyzstan in 2008.**
- **Mongolia plugged itself with Russia (North) and China (South).**
- **Uzbekistan lost to Nepal in 2010. It may regain the title.**
- **What should Nepal do now?**

Nepal is to diversify its route via China ASAP

- **Terrestrial links with four Indian networks:**
 - Reliance, BSNL, and Airtel via the Birgunj-Raxaul and Birtatnagar-Jogbani border crossings.
 - Tata links to the network of UTL via Birgunj-Raxaul and Bhairahwa-Sunauli.
- **SASEC Information Highway:**
 - Pending for nearly a decade. No clear picture.
- **Nepal-China link (NTC and China Telecom):**
 - Nepal Telecom to plug a second cross-border fiber link with China Telecom via Rasuwagadhi. It will supplement the existing Tatopani fiber link that was deployed in 2010/11.

Connecting Asia Through Subregional Cooperation Initiatives



Route diversity urgent not only for Nepal

International Border (and border length)	Analysis	Recommendation	International Border (and border length)	Analysis	Recommendation
Bangladesh / India (4,053 kilometers) <i>Low Priority</i>	The border between Bangladesh and India is served by one existing terrestrial fiber link, as well as an additional terrestrial fiber 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 fiber 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 fiber between Bangladesh and India.	India / Myanmar (1,463 kilometers)	A 640-kilometer terrestrial fiber link was completed in 2010 at a cost of \$7 million and is operated by BSNL and Myanmar Post and Telecommunications (MPT).	The India-Myanmar border is a critical corridor for connectivity between India and Southeast Asia, requiring multiple fiber links.
Bangladesh / Myanmar (193 kilometers) <i>High Priority</i>	Myanmar Posts and Telecommunications (MPT) and the Bangladesh Submarine Cable Company Ltd. (BSCCL) are in the process of implementing a terrestrial fiber link between the two countries.	Additional fiber links are needed in order to ensure that Bangladesh has redundant bilateral connectivity with more than one country.	India / Pakistan (2,912 kilometers) <i>High Priority</i>	A terrestrial fiber link has been constructed between India and Pakistan, but security agencies on both sides of the border have refused to allow its use for non-voice traffic. The cable remains dormant as of mid-2014.	Deploying more robust connectivity between India and Pakistan could be an important step to ensure regional stability, although there is currently little political momentum to do so.
Bhutan / India (605 kilometers) <i>High Priority</i>	Although Bhutan has two terrestrial links to India, with the first completed in 2007 and the second in 2011, both fiber paths converge in Siliguri, raising concerns about the vulnerability of Bhutan's international connectivity.	Diversification of Bhutan's fiber links to India is urgently needed in order to ensure the robustness of the country's international connectivity.	Nepal / China (1,236 kilometers) <i>High Priority</i>	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.
India / China (3,880 kilometers) <i>Medium Priority</i>	There are three fiber 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 fiber links, indicates a need for more robust fiber links between the two countries.	Islamic Republic of Iran / Pakistan (909 kilometers) <i>Medium Priority</i>	Although Iran has strong fiber connectivity with each of its neighbors, the Iran-Pakistan border has historically lacked fiber and the implementation of a trans-border link could not be confirmed as of mid-2014.	Improved connectivity between Iran and Pakistan would provide both countries with improved interregional access, i.e. from Iran to South Asia and from Pakistan to northwestern destinations.
India / Nepal (1,690 kilometers) <i>Medium Priority</i>	Nepal Telecom is linked to the Indian networks of Reliance, BSNL, and Bharti Airtel via multiple border crossings.	Despite multiple fiber links, the importance of India's connections with Nepal requires mesh-like connectivity across the countries' border.	Islamic Republic of Iran / Turkey (499 kilometers) <i>Low Priority</i>	There are multiple fiber links between Iran and Turkey, and Telecommunications Infrastructure Company of Iran 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 Iran and Turkey.
			Pakistan / China (523 kilometers) <i>High Priority</i>	A fiber link between Pakistan and China is currently under construction in the Khunjerab Pass.	Both Pakistan and China would benefit from improved fiber connectivity, as the single fiber link under implementation is not considered to be a definitive, long-term solution for linking the two countries with robust connectivity.
			Turkey/ Armenia (268 kilometers) <i>High Priority</i>	Terabit Consulting did not identify any activated fiber capacity between Turkey and Armenia.	Given the gradual improvement of relations between the two countries, as well as increasing opportunities for closer social and economic cooperation,

Source: Michael Ruddy, Broadband Infrastructure in South Asia and West Asia. October 2014.

Cushman & Wakefield Data Center Risk Index - 2013

2013 RANK	INDEX SCORE 1ST = 100	COUNTRY	TIER 1 60%			TIER 2 35%								TIER 3 5%				2012 RANK	POSITION CHANGE
			ENERGY COST	INT'L BANDWIDTH	EASE OF DOING BUSINESS	CORPORATION TAX	COST OF LABOUR	POLITICAL STABILITY	SUSTAINABILITY	NATURAL DISASTER	EDUCATION	ENERGY SECURITY	GDP PER CAPITA	INFLATION	WATER AVAILABILITY				
1	100.00	US	3	1	3	30	18	20	20	29	1	17	8	10	11	1	0		
2	89.53	UK	21	2	5	12	16	15	26	12	13	23	17	17	21	2	0		
3	82.29	SWEDEN	15	10	10	11	26	3	4	3	9	15	6	4	9	8	5		
4	81.29	GERMANY	19	4	15	25	25	8	15	9	16	20	15	10	24	3	-1		
5	81.16	CANADA	4	11	13	19	20	2	10	23	2	1	7	5	2	5	0		
6	79.63	HONG KONG	27	3	2	4	9	10	28	16	23	29	5	22	22	7	1		
7	79.47	ICELAND	8	29	11	8	21	20	1	18	7	8	14	24	1	4	-3		
8	79.45	NORWAY	13	19	4	19	30	1	3	15	12	6	2	3	3	12	4		
9	78.74	FINLAND	11	22	8	13	24	3	7	1	15	30	12	20	7	9	0		
10	78.37	QATAR	1	30	21	2	28	12	30	2	19	7	1	8	30	6	-4		
11	77.11	SWITZERLAND	9	15	17	1	29	5	9	13	18	11	3	1	13	10	-1		
12	76.26	NETHERLANDS	16	6	18	15	22	10	23	5	10	16	11	16	15	14	2		
13	74.59	KOREA, REP.	6	21	6	13	13	19	12	20	8	26	19	12	19	13	0		
14	73.98	FRANCE	17	5	19	27	23	20	17	10	20	18	16	12	18	11	-3		
15	72.49	SINGAPORE	23	14	1	5	14	17	29	4	17	22	9	26	29	17	2		
16	68.96	MALAYSIA	7	28	9	15	8	26	22	19	26	3	25	7	8	19	3		
17	67.43	POLAND	18	16	24	6	10	13	18	7	21	24	22	21	25	22	5		
18	67.09	IRELAND	24	26	12	3	19	15	24	14	6	21	13	6	10	16	-2		
19	66.73	THAILAND	12	23	14	8	3	29	8	22	22	14	28	18	14	15	-4		
20	65.55	SOUTH AFRICA	5	27	20	19	7	29	13	8	30	10	26	29	28	18	-2		
21	65.15	SPAIN	22	11	22	22	15	24	14	11	10	25	18	14	20	21	0		
22	64.14	CZECH REP.	20	19	25	6	12	7	19	6	24	12	20	19	27	25	3		
23	62.70	AUSTRALIA	28	18	7	22	27	6	21	21	5	2	4	8	6	23	0		
24	61.56	RUSSIA	2	9	27	8	6	26	27	24	4	5	21	27	5	24	0		
25	58.91	CHINA	10	13	26	15	5	18	11	25	27	13	27	15	23	26	1		
26	55.12	JAPAN	29	8	16	29	17	8	25	30	3	27	10	2	17	20	-6		
27	52.01	MEXICO	26	24	23	22	2	25	16	27	14	9	24	22	16	27	0		
28	46.37	INDONESIA	14	25	28	15	1	28	5	26	29	4	29	25	12	28	0		
29	40.85	INDIA	25	16	30	28	4	13	6	28	28	28	30	30	26	29	0		
30	35.15	BRAZIL	30	6	29	26	11	23	2	17	25	19	23	28	4	30	0		

**National Broadband
Policy, 2071
should comprehensively
address Nepal's
international diversity.**

Key targets of National Broadband Policy

- By 2015:
 - Urban broadband users will have a choice of at least three suppliers. All 75 district headquarters will be connected by optical fiber backbone links.
- By 2018:
 - Entry level broadband prices will be brought to 3.5% or less of GNI per capita
 - Nationwide penetration of 30% at >512kbps and making available >10 Mbps download speed on demand in urban areas.
 - Broadband coverage for 45% of households.

Open access is pronounced twice

- **10.2. Backbone/backhaul and access network infrastructure**
 - 10.2.1 Measures will be taken to drive investments in creating optical fiber backbone infrastructure, predominantly on an **open access** basis, recognizing the fact that microwave frequencies used for backhaul transport of voice traffic is not sufficient to carry substantial broadband traffic. **Open access** policies and approaches will be extended to cover existing fiber backbone infrastructure through proper regulatory instrument.
 - 10.2.9 Appropriate policy measures will be taken to implement **open access** and interconnection arrangements for backbones, international capacity and international gateways.

Infrastructure Sharing is pronounced 4 times (1)

- **3. Key Issues and challenges**
 - Difficult terrain and disruptions in power supply pose yet another set of challenges warranting appropriate policy responses. This underscores the need, among others, to formulate mandated arrangements aimed at encouraging cooperation and **sharing of passive infrastructure** among the operators to the extent possible. Similarly, policy incentives must be formulated to facilitate and promote the use of green technologies for broadband deployment given a scenario of acute power shortages and the imperative to minimize carbon footprints.

Infrastructure Sharing is pronounced 4 times (2)

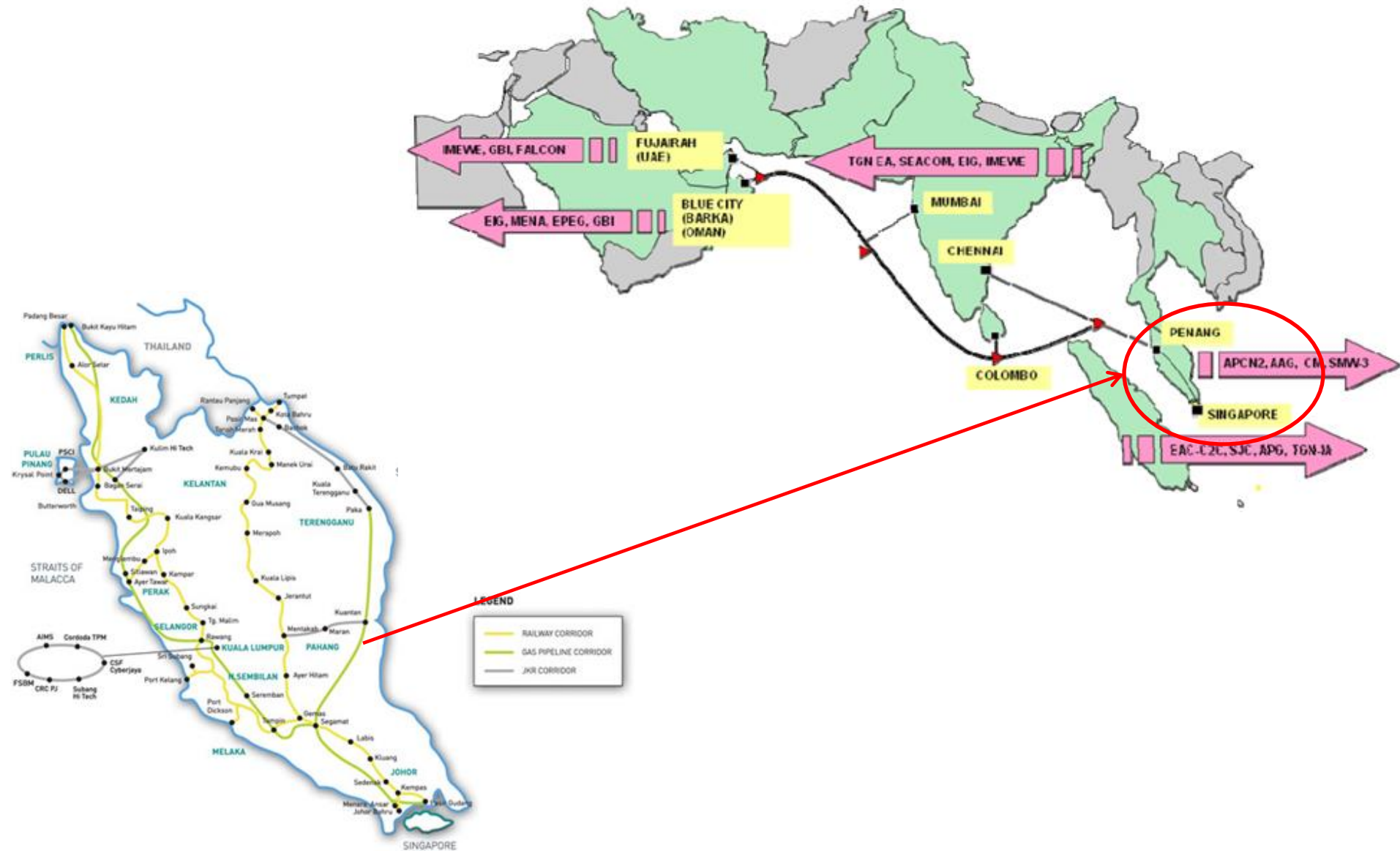
- **9.0 Policy**

- 9.5 **Infrastructure sharing** will be promoted through legal and regulatory instruments and directives so as to minimize the overall cost of service provision and increase choices for users in urban, rural and underserved areas.
- 10.2.3 Special measures will be taken to encourage and promote **infrastructure sharing** and to develop mechanism for securing local government cooperation in infrastructure build-out.
- 10.2.5 A forum for key business and government interests to promote **infrastructure development and sharing** will be created

Fiberail of Malaysia = Gas pipeline + Rail + Road



Cross-sector Fiberail has been integrated to BBG submarine cable



Costs of civil works in fiber deployment

France	Approximately 80%
United Kingdom	Between 70% and 80%
Republic of Korea	Between 80% and 90%
European Union	Approximately 80%
MENA	Approximately 80%
OECD average (2008)	Between 50% and 80%

Right-of-way (ROW) = ?%

Lesson from India: ROW up to \$208,000/km.

THE ECONOMIC TIMES

Telecom

Home Industry Auto Banking/Finance Cons. Products Energy Ind'l Goods/Svs Healthcare

03:00 PM | 24 Sep
MARKET STATS

Live

SENSEX
26,767.93 ▼ -7.76

NIFTY
8,008.55 ▼ -9.00

GOLD (MCX) (Rs/10g.)
26,645.00 ▼ -24.00

USD/INR
60.94 ▼ -0.02

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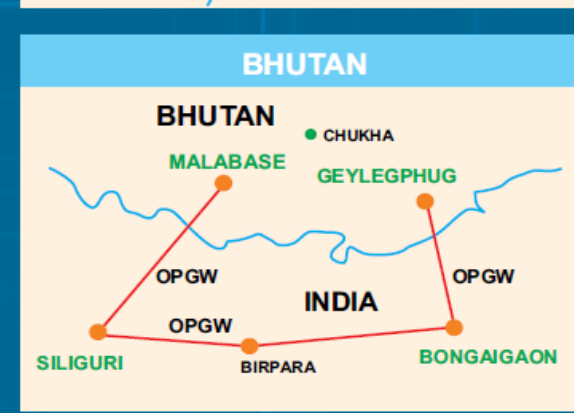
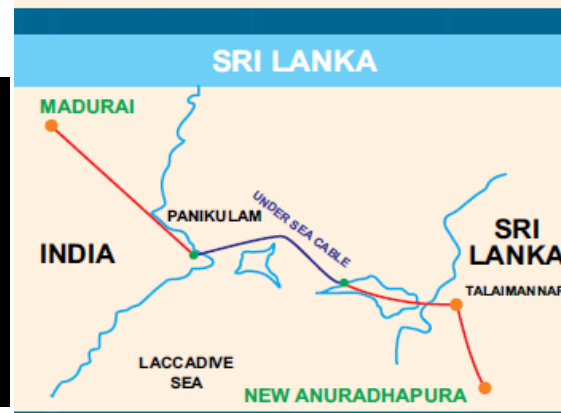
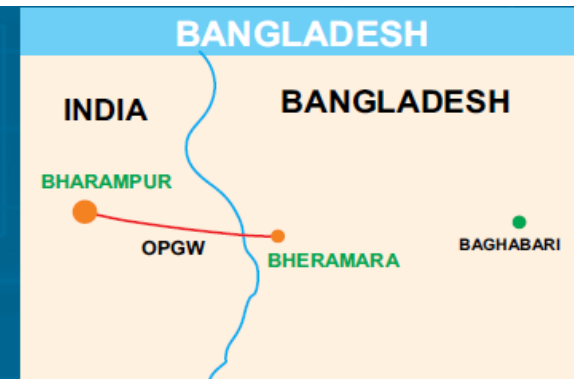
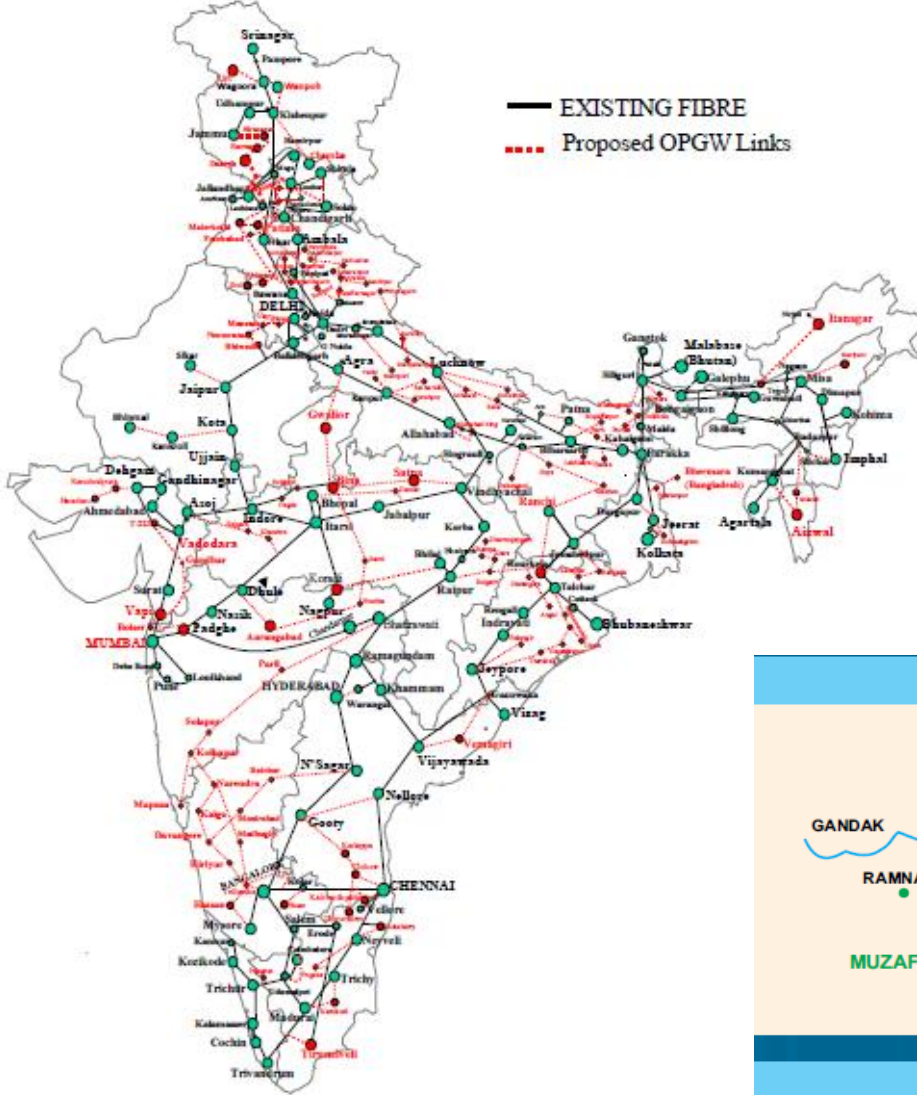
Up to extra 7% off
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DoT asks state governments to waive right of way charges for speeding up NOFN rollout

Kalyan Parbat, ET Bureau Sep 2, 2014, 05.25AM IST

“Noting that some states were levying hefty RoW charges, equivalent to Rs 1.27 crore (US\$ 208,000) per km, DoT has urged states to scrap such practices, failing which NOFN project costs would shoot up and scuttle the Centre's ambitions of delivering affordable broadband services. DoT has reached out to states as there has scarcely been any progress in laying down optic fibre over the past three years.”

Powertel of India can trade only power, not bandwidth, across the border. It serves the private cartel's interest.



Even the state-owned incumbent (BSNL) doesn't use Powertel's domestic network.

Bangladesh wasted infrastructure sharing



বাংলাদেশ টেলিযোগাযোগ নিয়ন্ত্রণ কমিশন

আইইবি ভবন, রমনা, ঢাকা-১০০০, বাংলাদেশ।

নং-বিটিআরসি/এলএল/ইনফ্রাস্ট্রাকচার শেয়ারিং(৩০৪)/২০০৮-৪৪৮

তারিখঃ ০৭-০৭-২০১১

বিষয় : Guidelines for Infrastructure Sharing এর অনুমোদন প্রসঙ্গে।

সূত্রঃ ডাক ও টেলিযোগাযোগ মন্ত্রণালয়ের পত্র নং-১৪.০০৫.০১৮.০০.০০.০০১.২০১১-২৯৭, তারিখঃ ২৩-০৬-২০১১।

উপরোক্ত বিষয়ে সূত্রস্থ পত্রের প্রেক্ষিতে নির্দেশিত হয়ে জানানো যাচ্ছে যে, কমিশন কর্তৃক প্রস্তাবিত সংশোধিত Guidelines for Infrastructure Sharing সরকার কর্তৃক অনুমোদিত হয়েছে। বর্ণিত সংশোধিত Guidelines for Infrastructure Sharing টি ইতোমধ্যেই কমিশনের ওয়েবসাইটে সকলের জন্য অবগতির প্রকাশ করা হয়েছে। এমতাবস্থায় সংশোধিত Guidelines for Infrastructure Sharing টি অবগতি ও পরবর্তী কার্যক্রমের জন্য এতদসঙ্গে প্রেরণ করা হলো।

সংযুক্তিঃ গাইডলাইন ০৯ (নয়) পাতা।

(সাজেদা পারভীন)

সিনিয়র সহকারী পরিচালক
জীগ্যাল এন্ড লাইসেন্সিং বিভাগ

Also created duopoly

Original and amended telecom Infrastructure Sharing Guidelines

2008

- 2.1 To maximize the use of network facilities including but not limited to network capacity and capabilities, base station sites, backbone, towers etc. to enhance sharing and reduce duplication of investment for network facilities. In this context “Infrastructure Sharing” means the joint use of telecommunication infrastructures and facilities by two or more operators. The term “Infrastructure Sharing” for the purposes of these guidelines refers to the Passive Infrastructure, optical fiber wired access and backbone transmission network sharing.

2011

- 3.1 To maximize the use of network facilities including but not limited to base station sites, towers, in-house wiring, local loops etc. to enhance sharing and reduce duplication. **Optical fiber TX and Access have been dropped** “Infrastructure Sharing” means the joint use of telecommunication infrastructures and facilities by two or more operators. The term “Infrastructure Sharing” for the purposes of these guidelines refers to the Passive Infrastructure.

From competition to captive market

- 4.6 Operators may jointly develop, build, maintain and operate new passive infrastructure for providing telecommunication services to the subscribers. However, an individual operator can build passive infrastructures with the permission of the Commission.
- 4.7 Operators (except the Nationwide Telecommunication Transmission Network's Licensee) will not be permitted to build optical/wired backbone transmission network, if such networks of NTTN operators are already available there.
- 4.8 (a) Telecom Operators may jointly or individually develop, maintain and operate optical/wired backbone transmission network with the approval of the Commission if NTTN operators fail to provide them with transmission network facility fulfilling the requirement of the telecom operators.
- (b) The telecom operators may sell/lease the excess capacity/core/fiber of the transmission network to NTTN operators. In such case, the NTTN operators will be entitled to buy/take lease of the excess capacity/core/fiber from telecom operators and shall submit the copy of such agreement to the Commission accordingly.

Impact of amended guideline

- NTTNs not necessarily own fiber infrastructure. Yet, they are exclusive providers of transmission services.
 - Duopoly (Two NTTNs) wholesalers also provide retail service.
- Airtel and Robi.
 - Increased operating costs and slower network rollout.
- Grameenphone, Banglalink and CityCell
 - Investment (>US\$ 400 million) under jeopardy.
- The entire telecom sector
 - Reliability and affordability of fixed and mobile broadband is compromised.
 - Discouraging for foreign investments in infrastructure development.

Lessons from Africa's terrestrial projects

- Fiber not being buried deep enough
 - Frequent physical damage (accidental and deliberate).
- Poor quality splicing
 - Intermittent faults and reduction in throughput
- Poor maintenance of manholes
 - Leads to flooding and cable damage.
- Poor systems and processes for fault management
 - Sometimes the maintenance companies deliberately sabotage cables to create work for themselves.

Let there be light!

POWER DEVELOPMENT MAP OF NEPAL

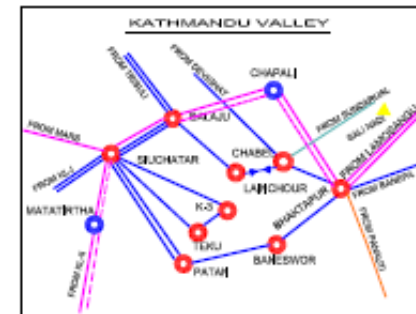
EXISTING / UNDER CONSTRUCTION / FUNDING SECURED POWER STATIONS & TRANSMISSION LINES / SUBSTATIONS

(Revised Date: JULY 2014)

(NOT TO SCALE)



CHINA



INDIA

LEGENDS

EXISTING	UNDER-CONST, FUNDING SECURED	
		400 kV TRANSMISSION LINE PROPOSED
		220kV TRANSMISSION LINE
		132kV TRANSMISSION LINE
		66kV TRANSMISSION LINE
		GRID SUB-STATION
		HYDRO-POWER STATION
		IPP's HYDRO-POWER STATION
		DIESEL/M-F POWER STATION

NEPAL ELECTRICITY AUTHORITY
TRANSMISSION DIRECTORATE
GRID DEVELOPMENT DEPARTMENT

Prepared by : Manager Gagan Manandhar

Dateline: Bangkok. October 17, 2014

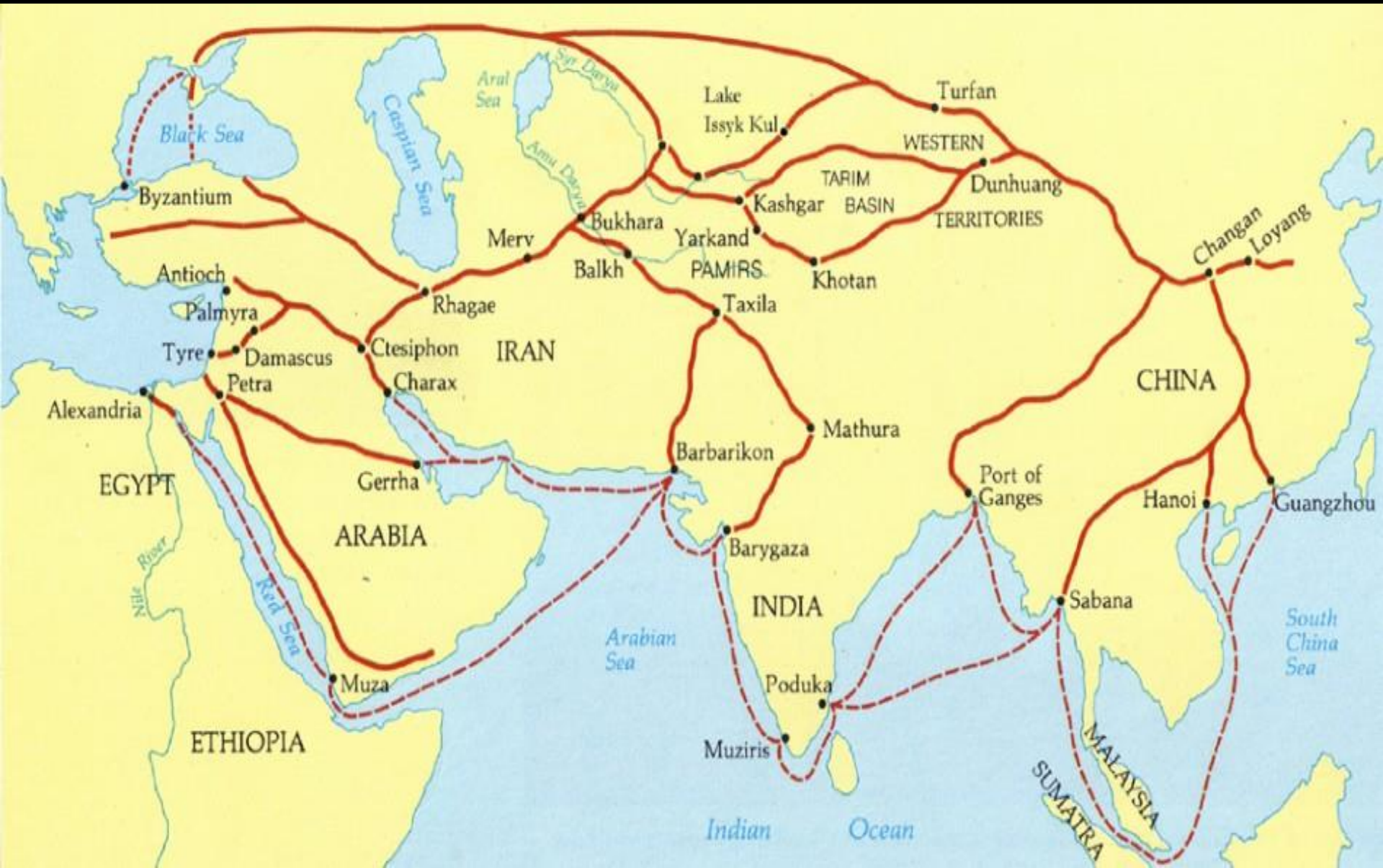


- **Reducing Digital Divide: Asia-Pacific Information Superhighway**
- **Asia-Pacific countries pledge to lower costs for Internet infrastructure across region**

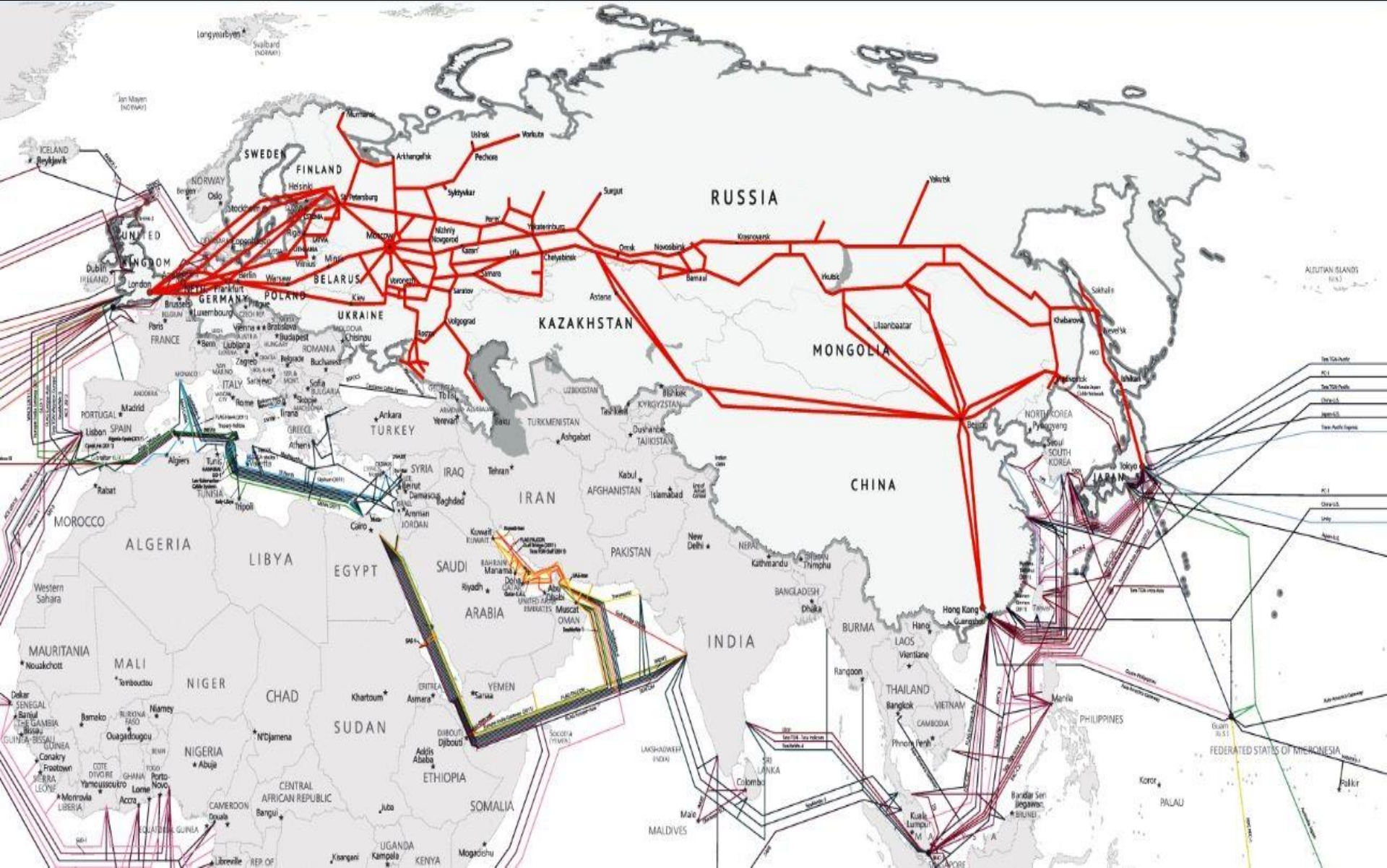
Objectives of Asia-Pacific Information Superhighway

- **Exploit every right-of-way for national and cross-border optical fiber cable (OFC) networks.**
 - Highway, Railway track, Power Transmission Grid, Oil and Gas pipelines.
- **Deploy seamless cross-border OFC network along the Asian Highway.**
 - Comprehensive open access being the fundamental regulatory principle.
- **Allow cross-border trading of bandwidth and connectivity.**
 - Guarantees universal access to broadband.

Ancient Silk Road.....

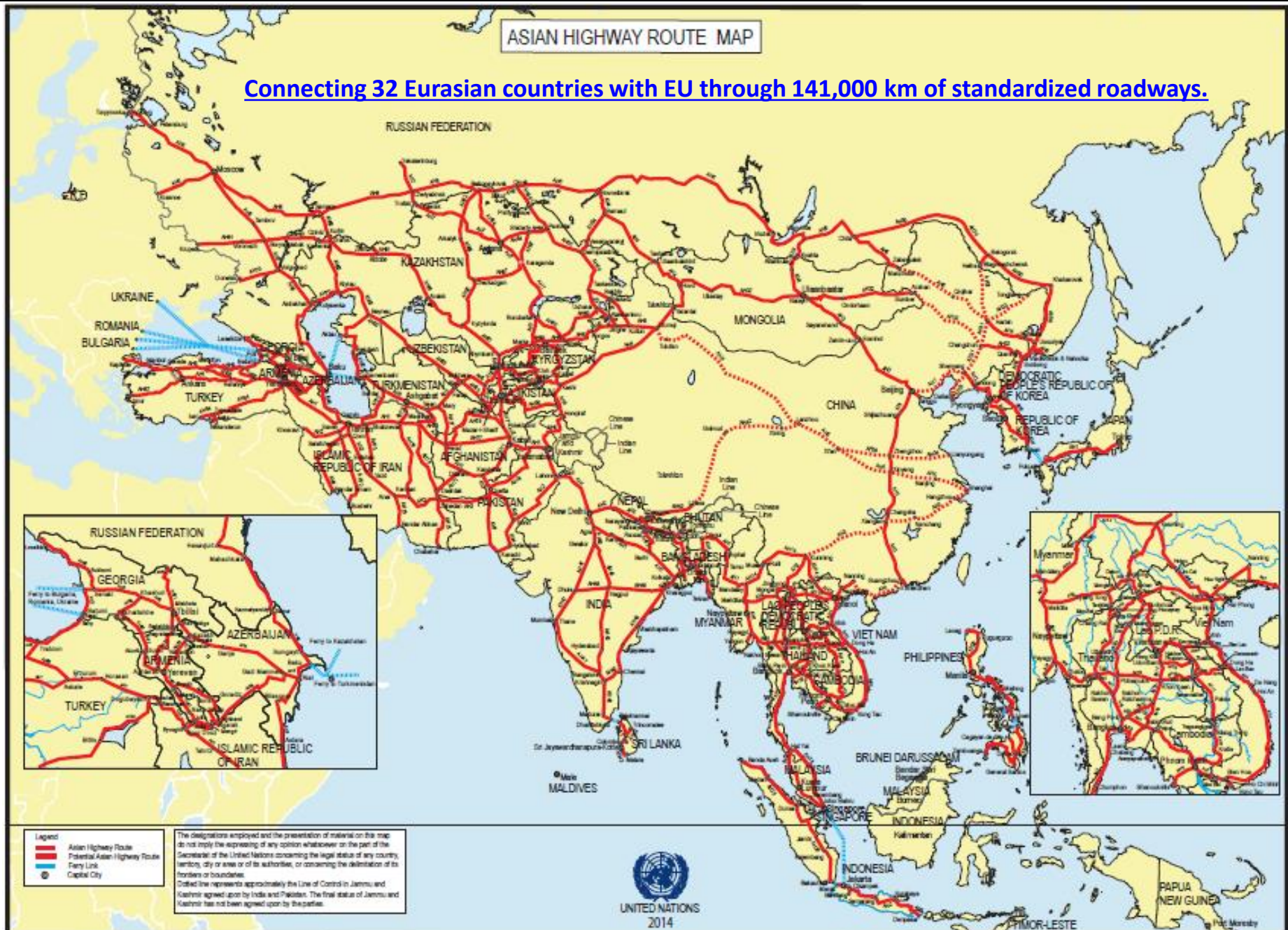


...guiding today's digital Silk Road



The best candidate in every respect

Connecting 32 Eurasian countries with EU through 141,000 km of standardized roadways.



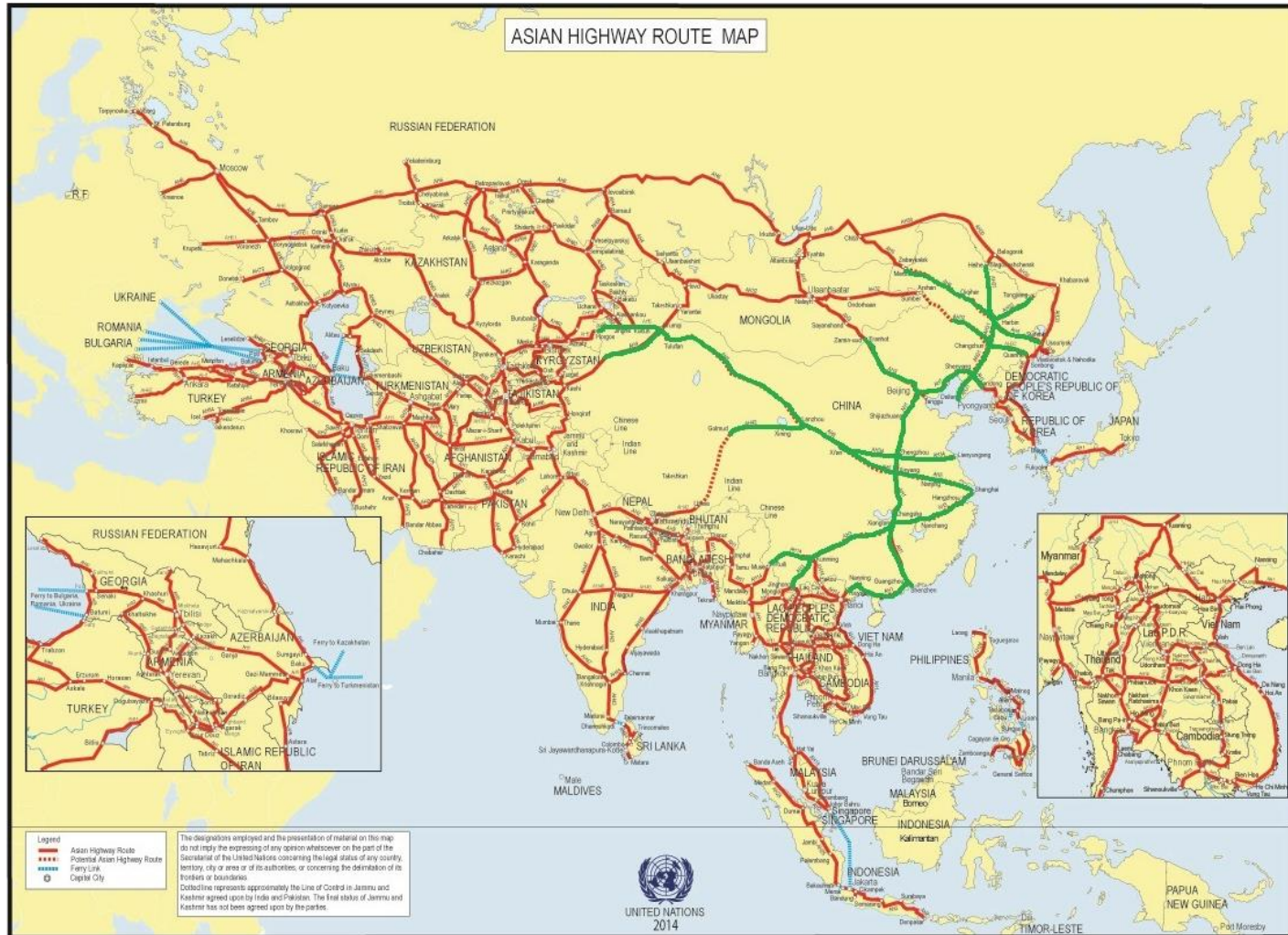
Asian Information Superhighway:

Core objectives

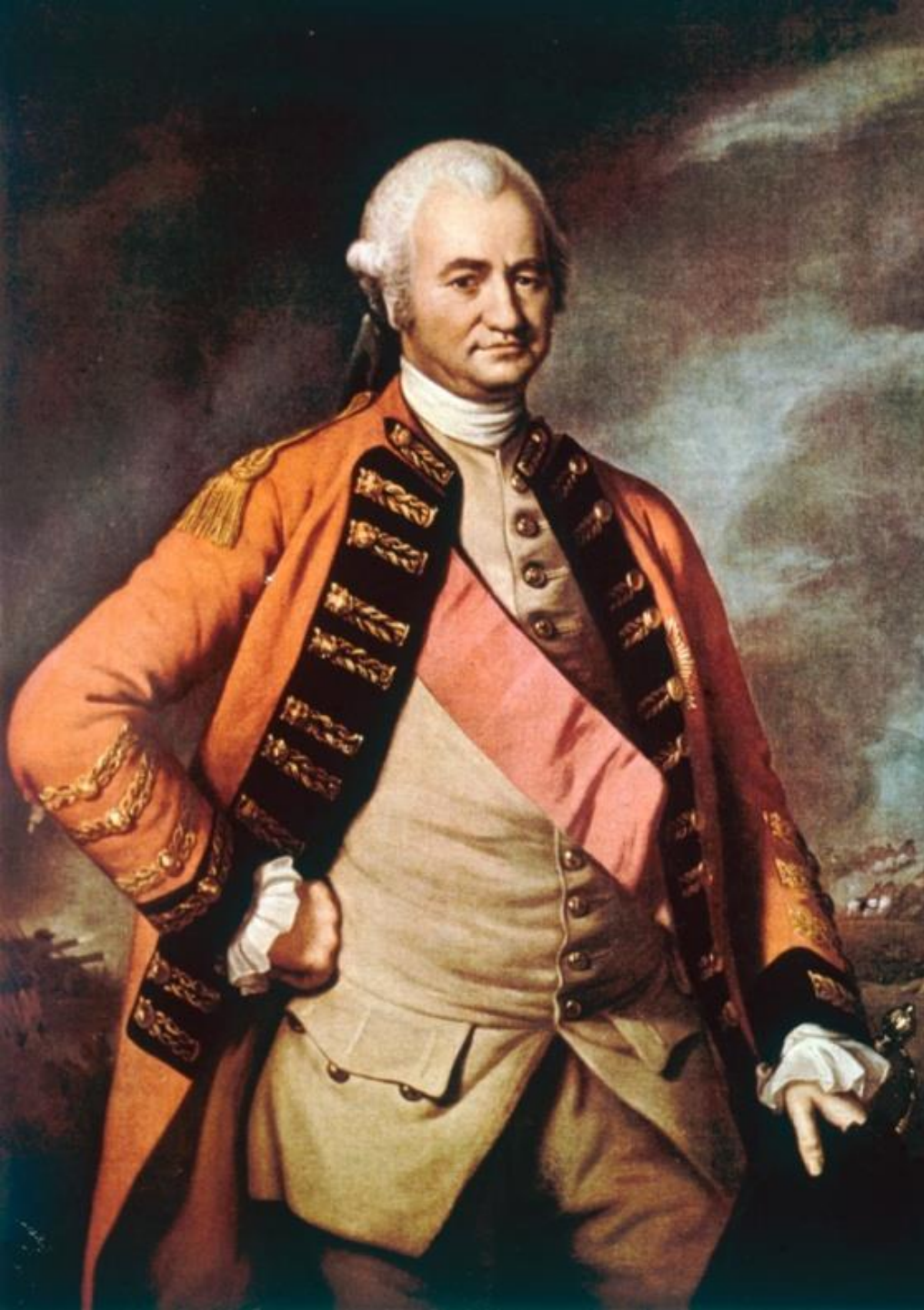
- **Creating a cross-border telecoms consortium of 32 countries being linked through the Asian Highway.**
 - Example: Intelsat (Past) and SEA-ME-WE3/4/5 (Present).
- **Using Asian Highway's right-of-way (ROW) for open-access optical fiber transmission networks.**
 - Highways are preferred ROW for long distance telecoms.
- **Each country's road authorities will own the fiber.**
 - State-ownership and open-access guaranteed. No payment is required for ROW.
- **Only the licensed operators will have access to it.**
 - No regulatory disruption.

China's 22,300 km fiber follows AH

Source: Ruyu Zhao, Transport Planning and Research Institute, MOC, China.



It deserves a closer look.



“It was not the British government that seized India at the end of the 18th century, but a dangerously unregulated private company headquartered in one small office, five windows wide, in London, and managed in India by an unstable sociopath – Clive.”

**William Dalrymple
The Guardian
4 March 2015**