Improving Regional Connectivity
with the
Asian Information Superhighway

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Part 1: Background and Methodology

Project Scope

Since 2012, Terabit Consulting has completed **detailed analyses of broadband infrastructure and markets** on behalf of UN ESCAP, covering a total of 29 countries:

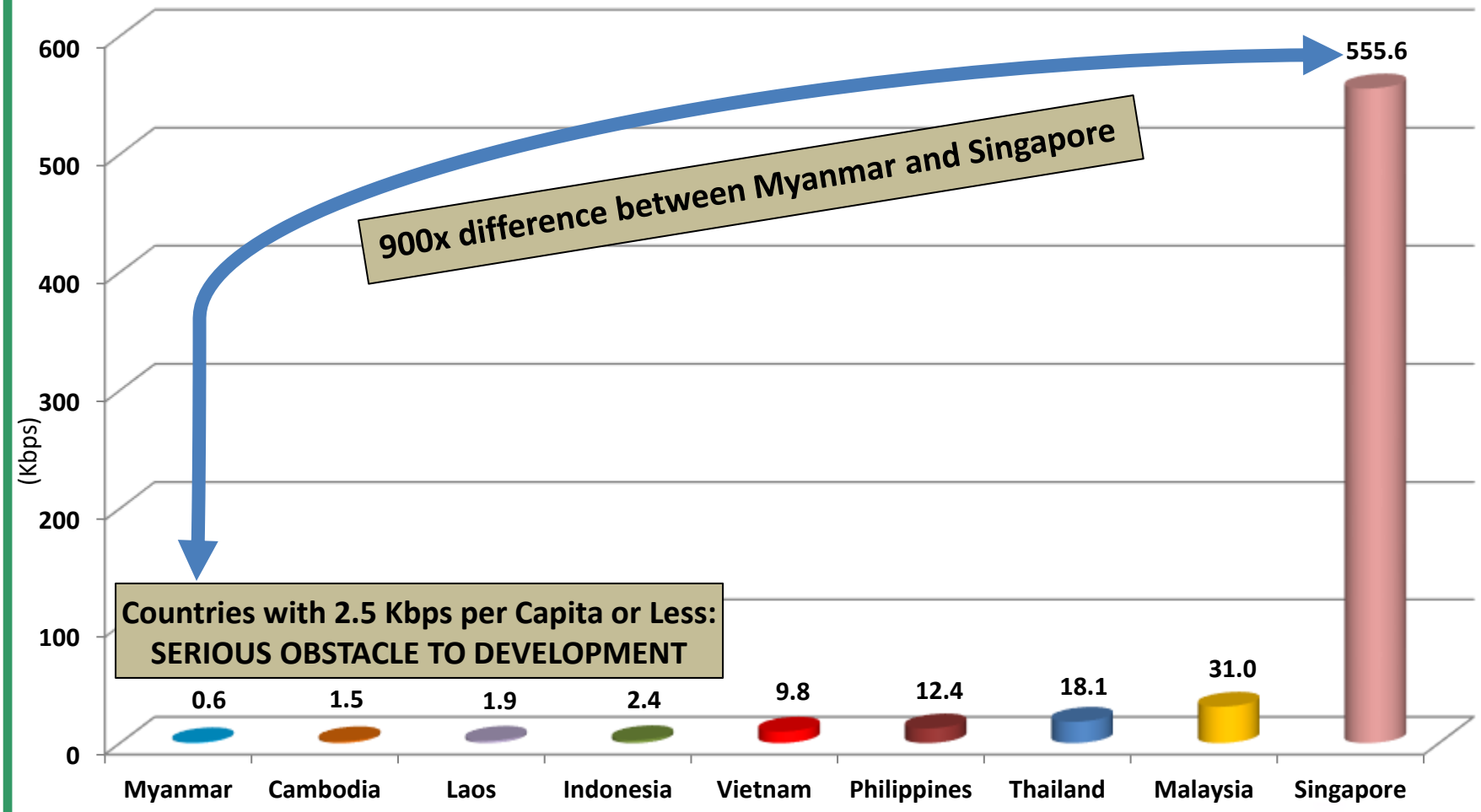
- **ASEAN-9** (study delivered August, 2013)
- **North and Central Asia** (November, 2013)
- **South and West Asia** (November, 2014)
- **Afghanistan and Mongolia** (April, 2015)

Sources of Data

- **Terabit Consulting has completed dozens of demand studies for submarine and terrestrial fiber networks worldwide**
  - Constant contact with operators, ISPs, and other stakeholders
- **Terabit Consulting's published reports include:**
  - *The Undersea Cable Report* (1,500+ pages)
  - *International Telecommunications Infrastructure Analysis* (1,000+ pages)
- **Terabit Consulting's core data and intelligence covers infrastructure, demand, traffic flows, pricing, and market share**

Part 2: The Bandwidth Divide

ASEAN Int'l. Internet Bandwidth per Capita



- Average in Western Europe: 100 Kbps

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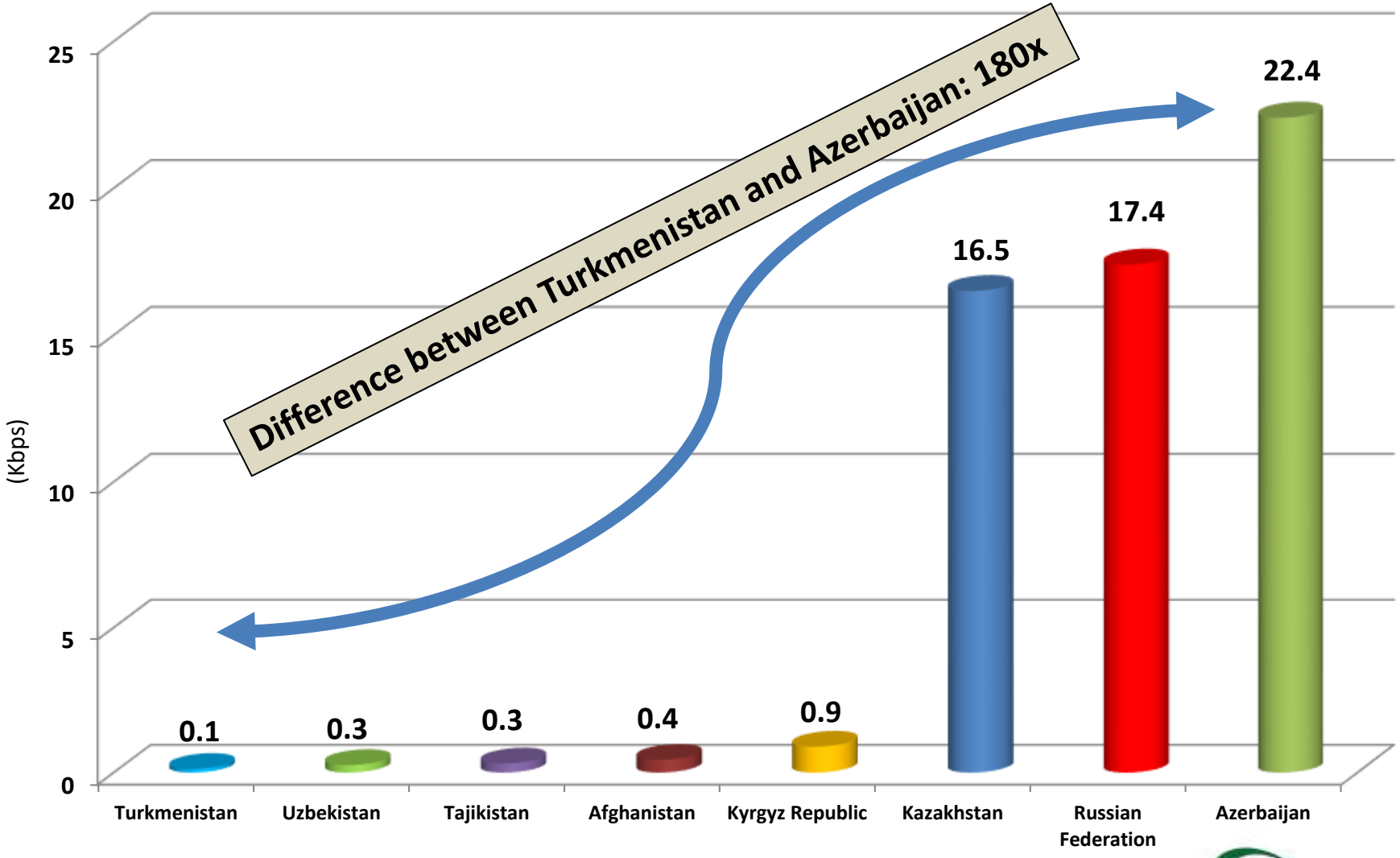
No. & Cent. Asia Int'l. Internet Bandwidth per Capita



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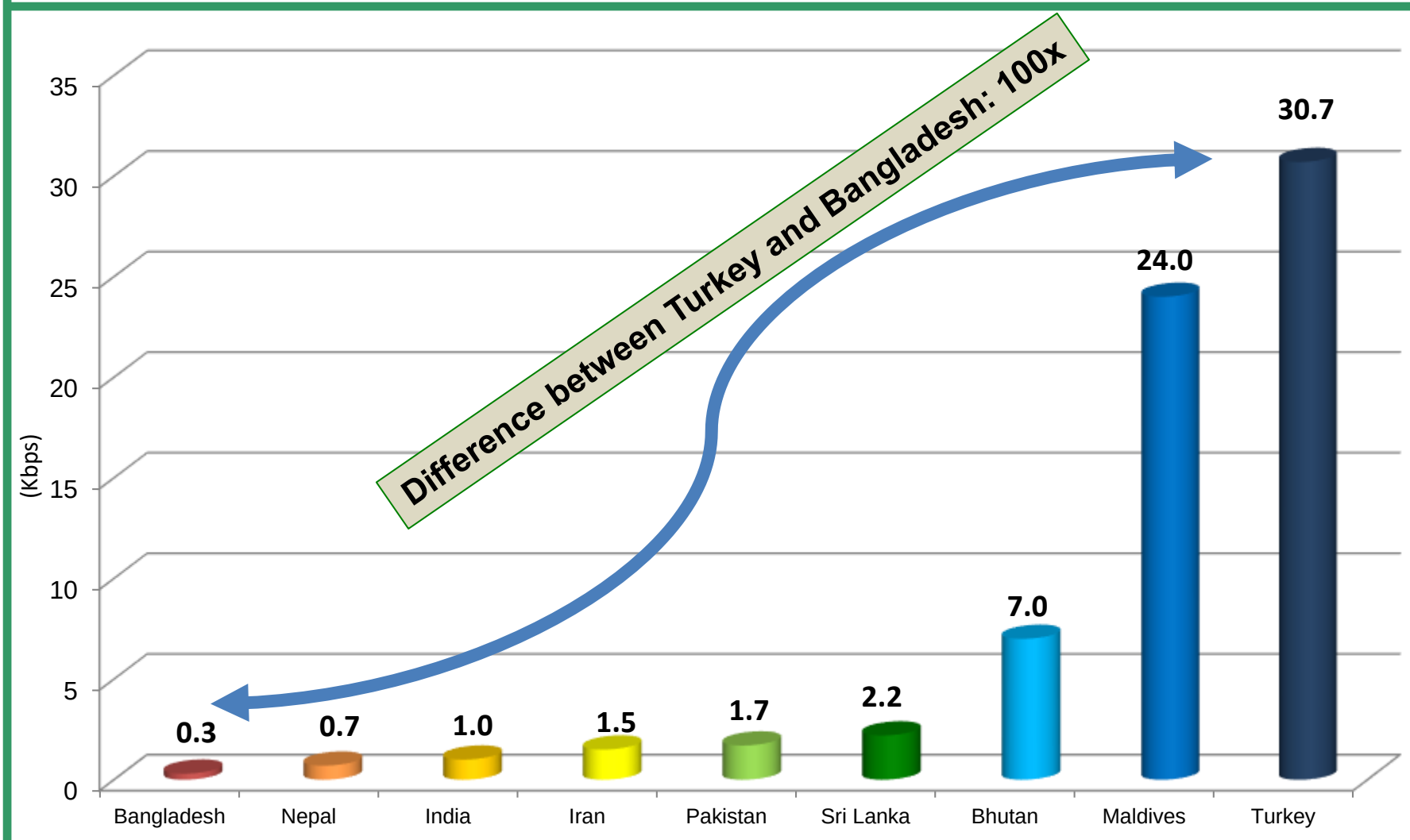
W. and So. Asia Int'l. Internet Bandwidth per Capita



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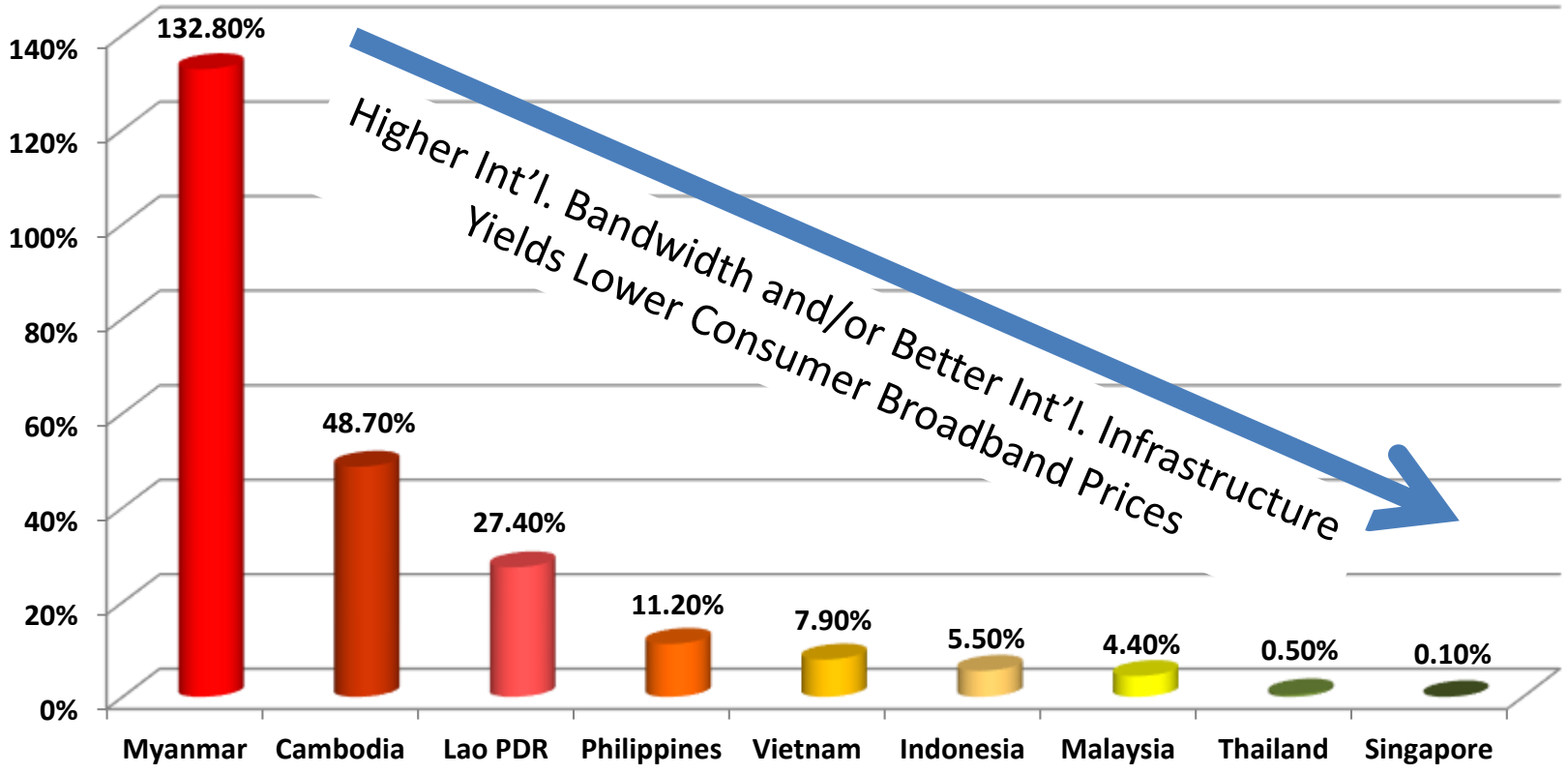
Weak Int'l. Bandwidth Impacts Consumer Pricing

1 Mbps Broadband Connection: Annual Subscription + Installation as a % of Per-Capita GDP (2013)



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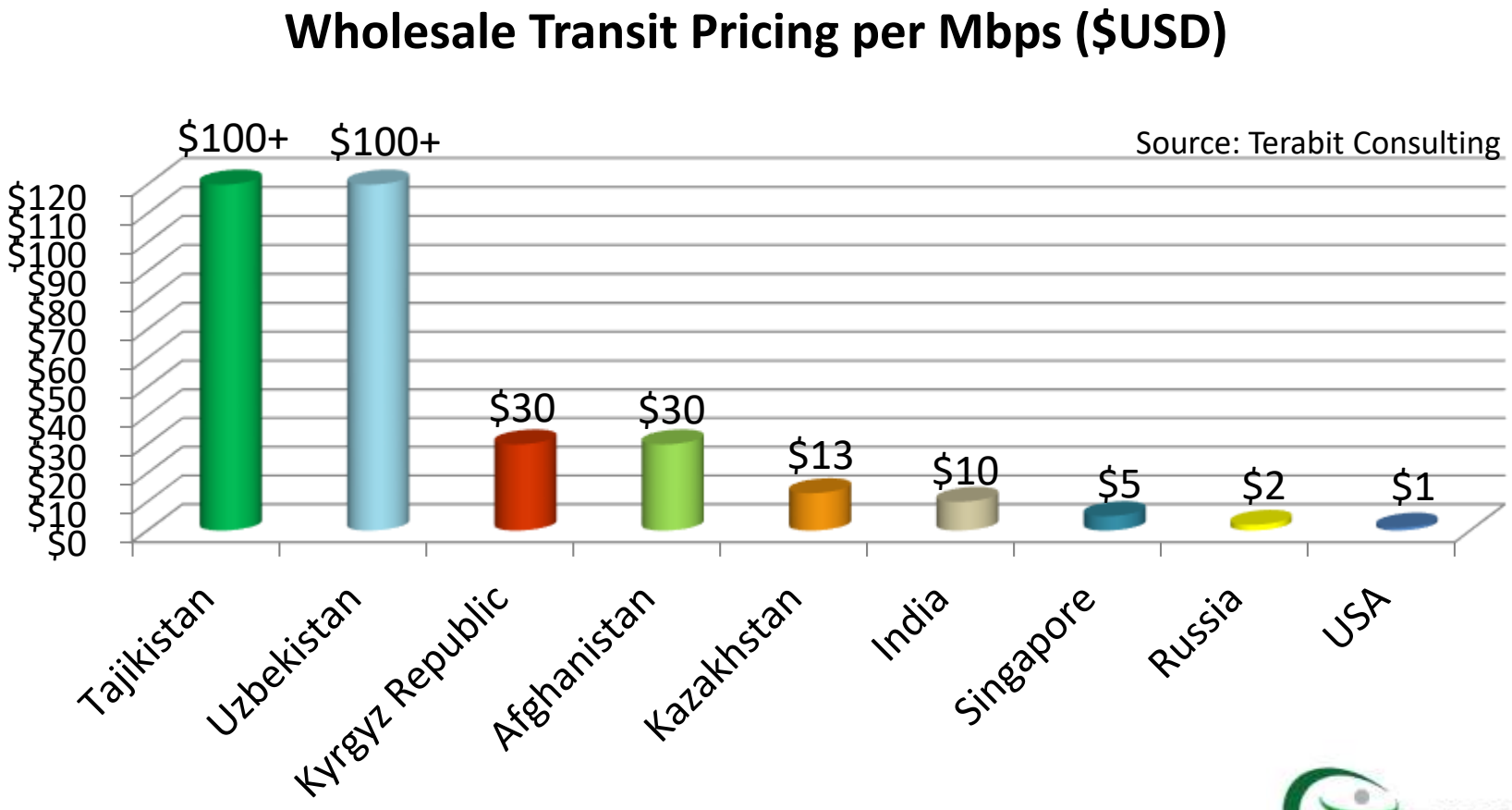
Weak Bandwidth Also Impacts Wholesale Bandwidth Prices

- Wholesale bandwidth prices are 10 to 100+ times higher in Central Asia than in America or Europe



Conclusion of Bandwidth Analysis

- There is a clear divide between Asia's bandwidth "haves" and its bandwidth "have-nots":
  - Among the 29 Asian countries analyzed by Terabit Consulting, 16 had unacceptably low levels of per-capita bandwidth, and unacceptably high prices
- The first step in addressing the inequality is the construction of international fiber infrastructure that puts the entire continent on an equal footing.

Part 3:
Regional Terrestrial Infrastructure

Asia-Europe & China-Russia Transit Networks

- **Trans Asia Europe (TAE)**
  - Conceived in 1990s; very low capacity; missing trans-Caspian links
- **China-Russia Networks**
  - Trans Europe Asia (TEA) (Rostelecom)
  - Europe-Russia-Asia (ERA) / China-Russia-2 / Eurasia Highway (TransTeleCom)
  - Europe-Russia-Mongolia-China (ERMC) via Mongolia Railway (2004)
  - MegaFon Diverse Route for European & Asian Markets (DREAM) (2013)
  - Europe-Kazakhstan-Asia (EKA) / Information Silk Road
- **Trans Eurasian Information Superhighway (TASIM)**
  - Under development: China, Kazakhstan, Azerbaijan, Georgia, Turkey (would include a trans-Caspian link)

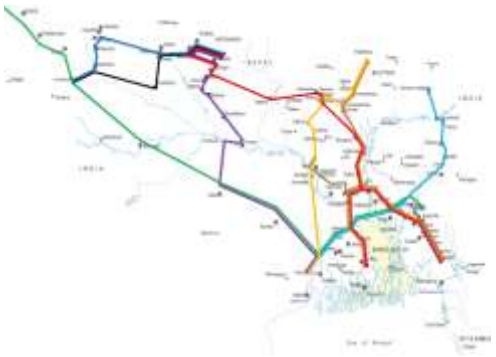
Subregional Initiatives

- **Greater Mekong Subregion (GMS) Information Superhighway**

Cambodia, China, Laos, Myanmar, Thailand, Vietnam (Asian Development Bank)

- **South Asian Subregion Economic Cooperation (SASEC) Information Superhighway**

Bangladesh, Bhutan, India, Nepal (ADB)



- **Digital Central Asia-South Asia (Digital CASA)**

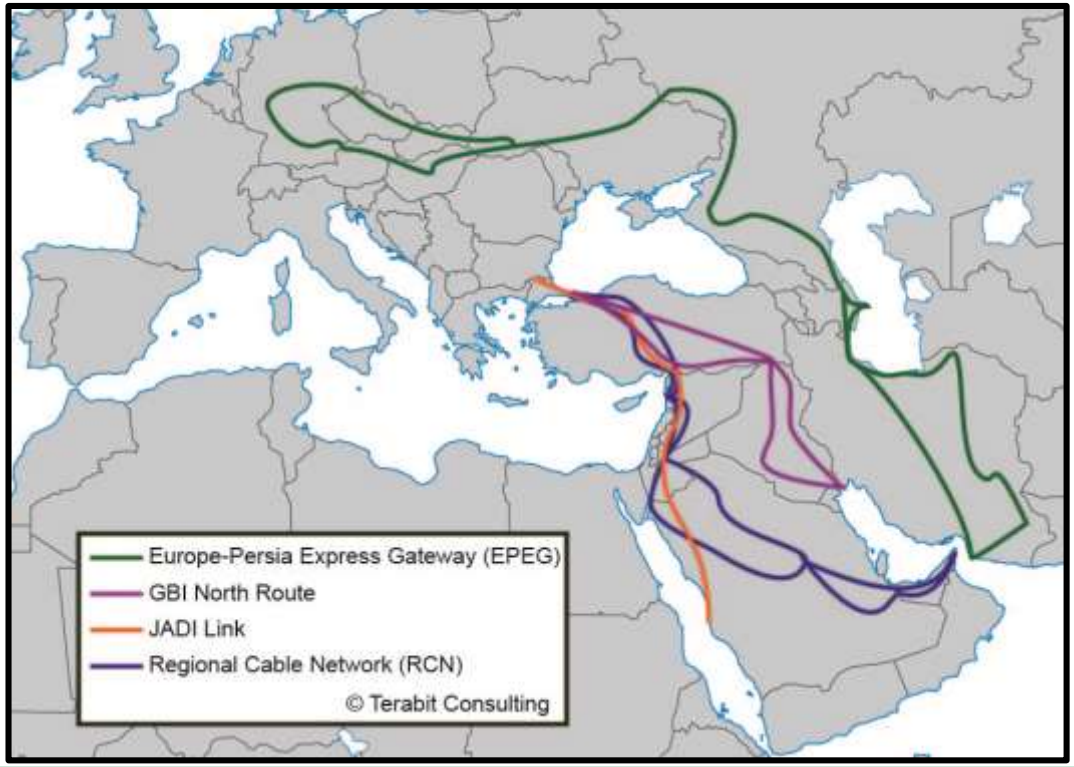
Kyrgyz Republic, Tajikistan, Afghanistan, with future expansion to neighboring countries (World Bank, IFC)

Southeast Asian Multi-National Networks

- **China-Southeast Asia Cable (CSC) (2001)**
  - China, Vietnam, Laos, Thailand, Malaysia, Singapore
- **Thailand-Cambodia-Vietnam-Hong Kong (2012-2013)**
  - TCC (Thailand), VTI/VNPT (Vietnam), NTC (Cambodia), DHT (Hong Kong)

New W. Asia/Middle East Networks

- 2010:2013, four new interregional terrestrial networks were constructed between the Middle East and Europe.
- 2010: **JADI Link** & **Regional Cable Network (RCN)**: as of 2015, out-of-service (Syrian Civil War)
- 2012: **Europe-Persia Express Gateway (EPEG)**, conceived as a terrestrial backup route for the Europe-India Gateway (EIG) submarine cable, which had been prevented from landing in Egypt.
- 2013: Gulf Bridge International (GBI) activated its terrestrial **GBI North Route** through Iraq and Turkey in 2013 in order to provide redundancy for its Egyptian terrestrial crossing via the TE Transit Corridor.



China-India & Other Bilateral Cables

- The region is also connected by trans-border links, typically developed by two operators (one in each country).
- These bilateral systems are typically closed-access networks designed for the use of the two investing operators.
  - Very high prices for other bandwidth purchasers

Part 4:
Why a Coherent, Open-Access, Cost-Effective Pan-Asian Fiber Infrastructure Would Benefit the Region

Reason #1

Telecommunications and Internet development in the *"bandwidth have-not"* countries, as well as each country's overall economic development, has been greatly restrained as a result of weak international infrastructure.

The Impact of Low International Bandwidth & Weak International Infrastructure

- **At the macro level: a major obstacle to economic and human development**
  - Detachment from digital economy
  - Continued economic inefficiencies and restrained growth
  - Lack of access to critical social development tools including telemedicine, distance learning, scientific/research networks
- **More specifically within the telecom environment: higher wholesale and consumer prices, and lower broadband adoption rates**
  - IP transit in the region's less developed markets can be more than $100 per Mbps
    - *Compared to HK: $5 per Mbps*
    - *Compared to Turkey: $2.60 per Mbps*
    - *Compared to USA: $1 per Mbps*

Reason #2

Despite their well-developed international connectivity, the markets with strong, low-cost bandwidth (the *"bandwidth haves"*) would greatly benefit from improved pan-regional terrestrial fiber.

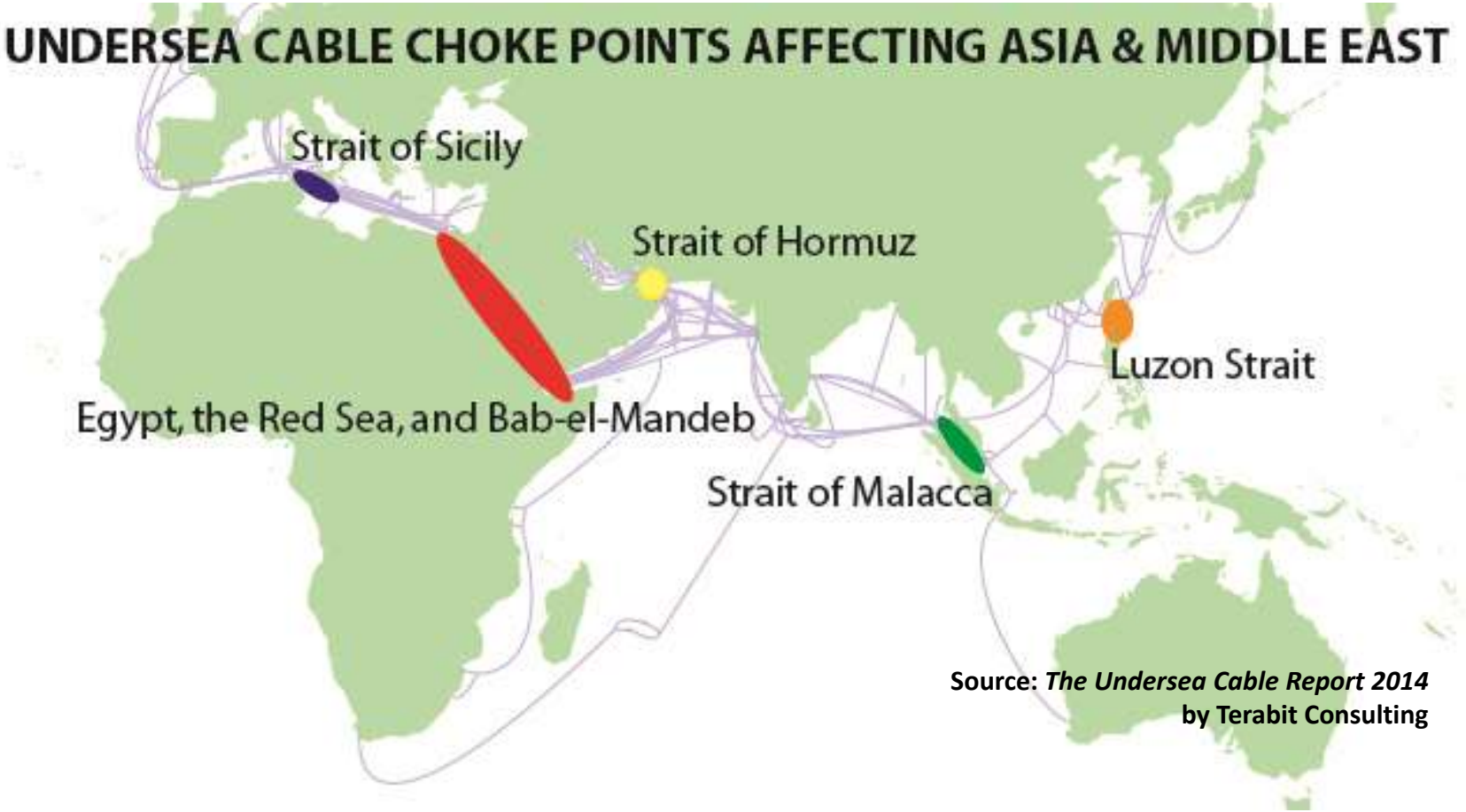
Pan-Regional Fiber Benefits Markets with Strong Connectivity

- Mesh connectivity throughout the region would increase all countries' network reliability and provide critical outlets of connectivity
  - e.g. Allowing Singapore to have a stronger alternative to the Strait of Malacca and the Egyptian bottleneck
- Stimulating the region's overall demand presents a greater market opportunity for transit providers and submarine cable operators in wealthier countries.
  - e.g. Increasing the addressable transit market opportunity for Malaysia, Kazakhstan, Russia, and Azerbaijan

Reason #3

In financial terms, the viability of constructing coherent pan-Asian terrestrial fiber optic connectivity can be guaranteed by capturing even a small portion of bandwidth demand between Asia and Western Europe.

Terrestrial as a Solution for Submarine



Source: *The Undersea Cable Report 2014* by Terabit Consulting

The global telecommunications industry is <u>desperate</u> for a cost-effective solution that would avoid undersea choke points.

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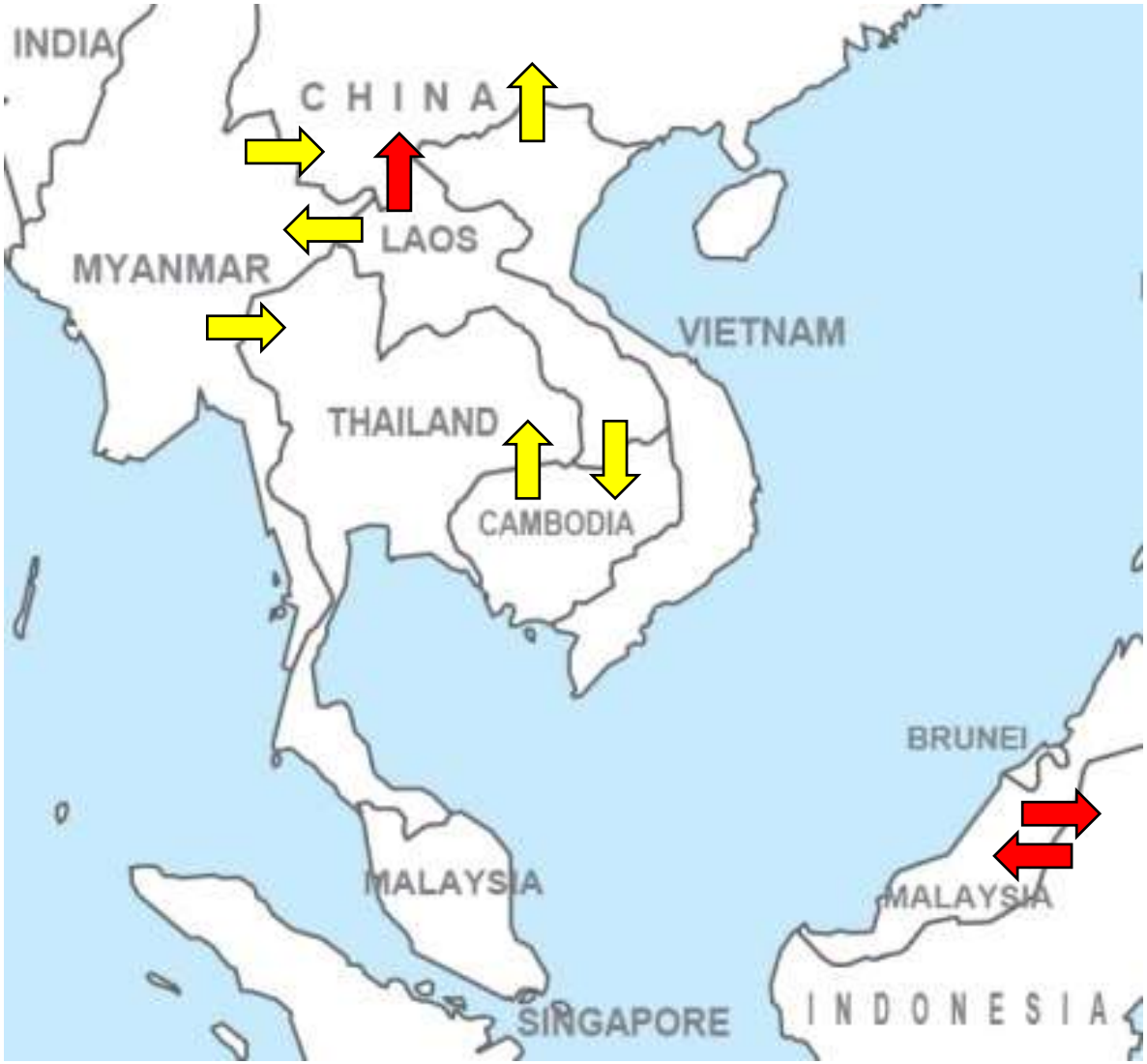
Strong Growth in Europe-to-Asia Bandwidth Demand

	2007	2008	2009	2010	2011	2012	2013	2014
FLAG Europe-Asia (FEA) (formerly FLAG)	20	50	50	50	110	140	240	240
Sea-Me-We-3 (SMW3)	150	150	200	200	200	200	410	480
Sea-Me-We-4 (SMW4)	640	640	1,500	1,500	1,700	2,000	3,590	3,590
Falcon	200	200	200	200	300	390	390	520
Seacom / TGN Eurasia			80	100	110	240	240	480
India-Middle East-Western Europe (I-ME-WE)				260	640	2,560	3,660	3,660
Europe-India Gateway (EIG)					240	240	700	700
Gulf Bridge International Cable System (GBI) /MENA						480	1,180	1,980
TOTAL ACTIVATED EUROPE-TO-ASIA SUBMARINE CAPACITY (Gbps)	**1,010**	**1,040**	**2,030**	**2,310**	**3,300**	**6,250**	**10,410**	**11,650**
CAGR (2007-2014)	**41.2%**							

Plus two new Europe-to-Asia projects: Sea-Me-We-5 and AAE-1

Part 5:
Identification of Priority Cross-Border Terrestrial Links

Priority Trans-border Projects in ASEAN



High Priority

Lao PDR to Yunnan

Indonesia to/from Malaysia

Medium Priority

Cambodia to Thailand

Lao PDR to Cambodia

Lao PDR to Myanmar

Myanmar to Thailand

Myanmar to Yunnan

Vietnam to Yunnan

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Envisioned ASEAN Fiber Network Based on Priority Trans-Border Links

LEVERAGING LINEAR INFRASTRUCTURE

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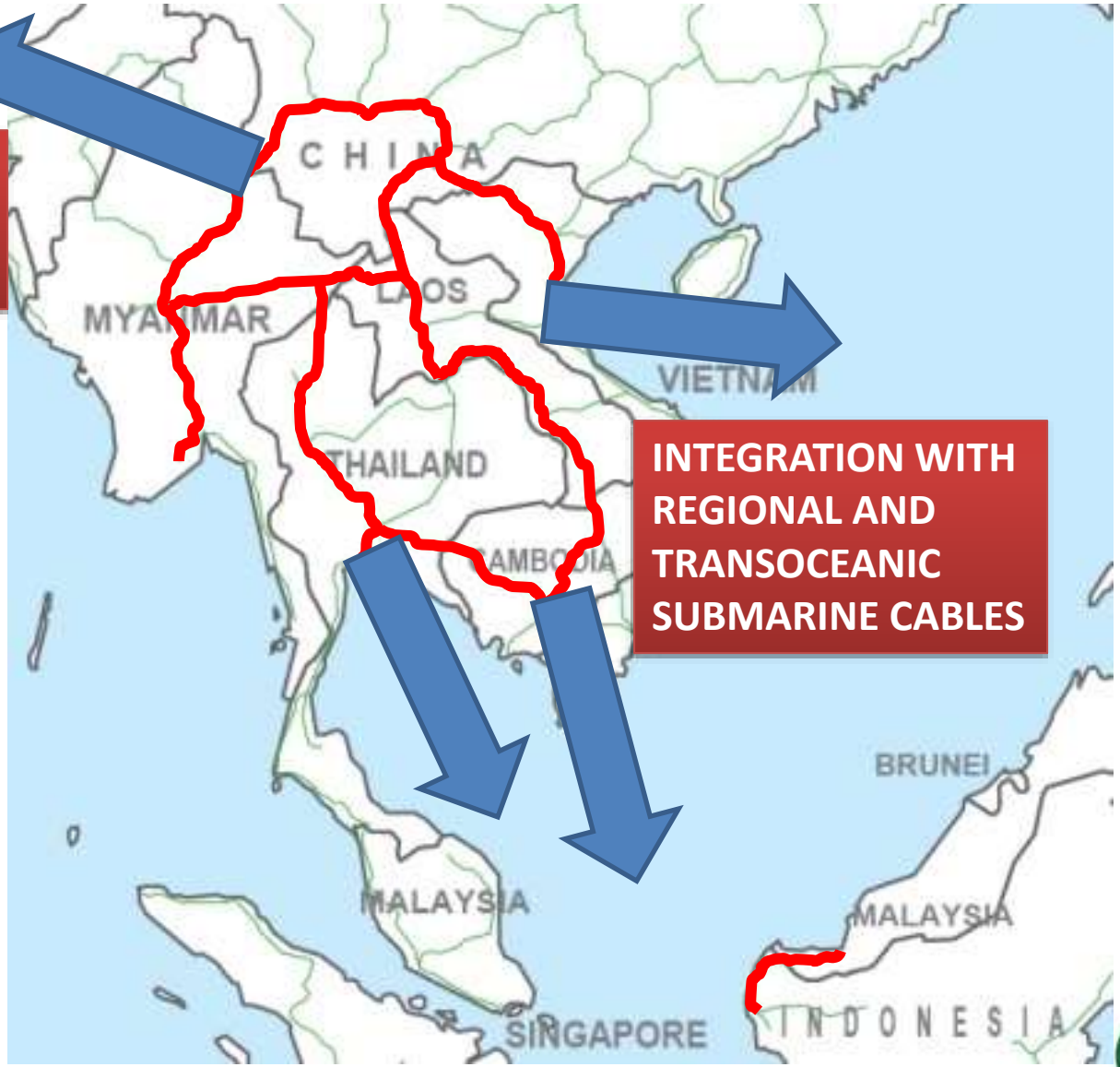
Metcalfe's Law: The Value of a Network is Proportional to the Square of the Number of Nodes



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Priority Projects in North & Central Asia

High Priority Trans-Border Projects

- Turkmenistan ↔ Kazakhstan
- Kyrgyz Republic ↔ Uzbekistan
- Tajikistan ↔ Uzbekistan
- Turkmenistan ↔ Uzbekistan

Medium Priority Trans-Border Projects

- Kyrgyz Republic ↔ Kazakhstan
- Uzbekistan ↔ Kazakhstan
- Kyrgyz Republic ↔ Tajikistan

South & West Asia Priority Projects

High Priority Trans-Border Projects

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

Medium Priority Trans-Border Projects

- India ↔ China
- India ↔ Nepal
- Iran ↔ Pakistan

Afghanistan & Mongolia Priority Projects

High Priority Trans-Border Projects

- Mongolia ↔ China
- Mongolia ↔ Russia

Medium Priority Trans-Border Projects

- Afghanistan ↔ China
- Afghanistan ↔ Iran
- Afghanistan ↔ Tajikistan
- Afghanistan ↔ Uzbekistan

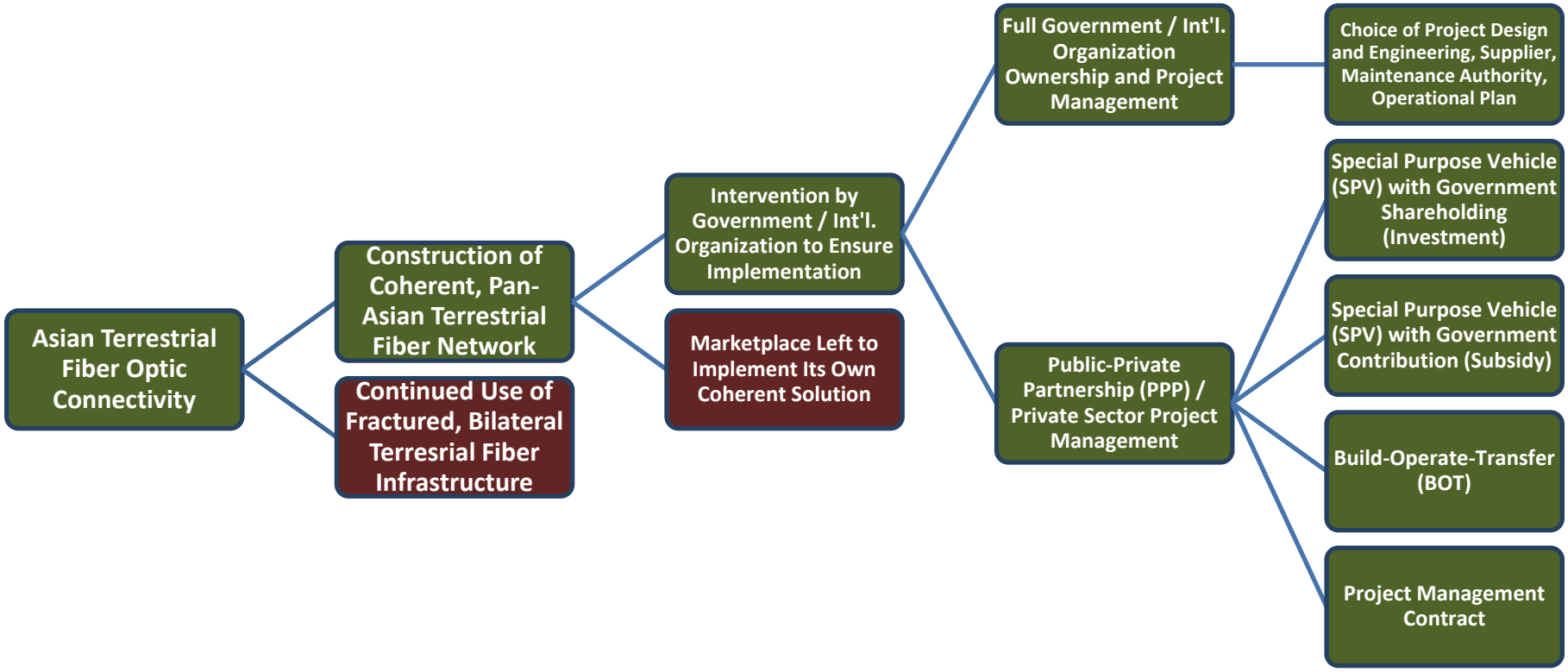
Part 5:
The Case for Installing a Terrestrial Pan-Asian Fiber Optic Network Along Highway Rights-of-Way

International Highway Infrastructure

- In the near-term, many of the countries in the region will be upgrading existing highway infrastructure and installing new links
- Simultaneous installation of high-capacity fiber and ducts would be a negligible marginal cost in most projects

Part 6: Intervention to Ensure Network Development

Options for Government/UN Participation



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Part 7: Principles to Guide Network Development

Principles to Guide Future Network Development

1. **Fully integrated and coherent**
   - Mesh configuration to allow for in-network healing in the event of physical cable outages or political instability affecting connectivity in specific countries.
2. **Functioning and monitored as single, uniform network**
   - Most existing multi-national terrestrial networks cannot offer uniform quality-of-service guarantees between endpoints (as good as “weakest link” or “weakest operator”).
3. **Leveraging existing infrastructure**
   - Right-of-way procurement and uniform construction techniques would be enabled through the use of the Asian Highway network, Pan-Asian Railway project, or power transmission networks.

Principles to Guide Future Network Development

(Continued)

4. Cost-effective

- With suitable transmission capacity and fiber count, a pan-regional terrestrial fiber network could compete effectively with submarine cable on both a regional and intercontinental basis.

5. Open access and non-discriminatory pricing

- In order to achieve development and policy goals, as well as to serve the region's consumers, all purchasers of capacity must be able to access the network on an equal, non-discriminatory basis.

6. Developed and managed by a Special Purpose Vehicle (SPV)

- SPV shareholding would ensure the neutrality and efficiency of the network
- Allows participation by all stakeholders while still maintaining arm's-length terms over all capacity sales and leases.

Thank you!

Intelligence, Analysis, and Forecasting for the International Telecommunications Infrastructure Community

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