

Broadband Infrastructure in the ASEAN-9 Region

**Markets, Infrastructure, Missing Links,
and Policy Options for Enhancing Cross-Border
Connectivity**

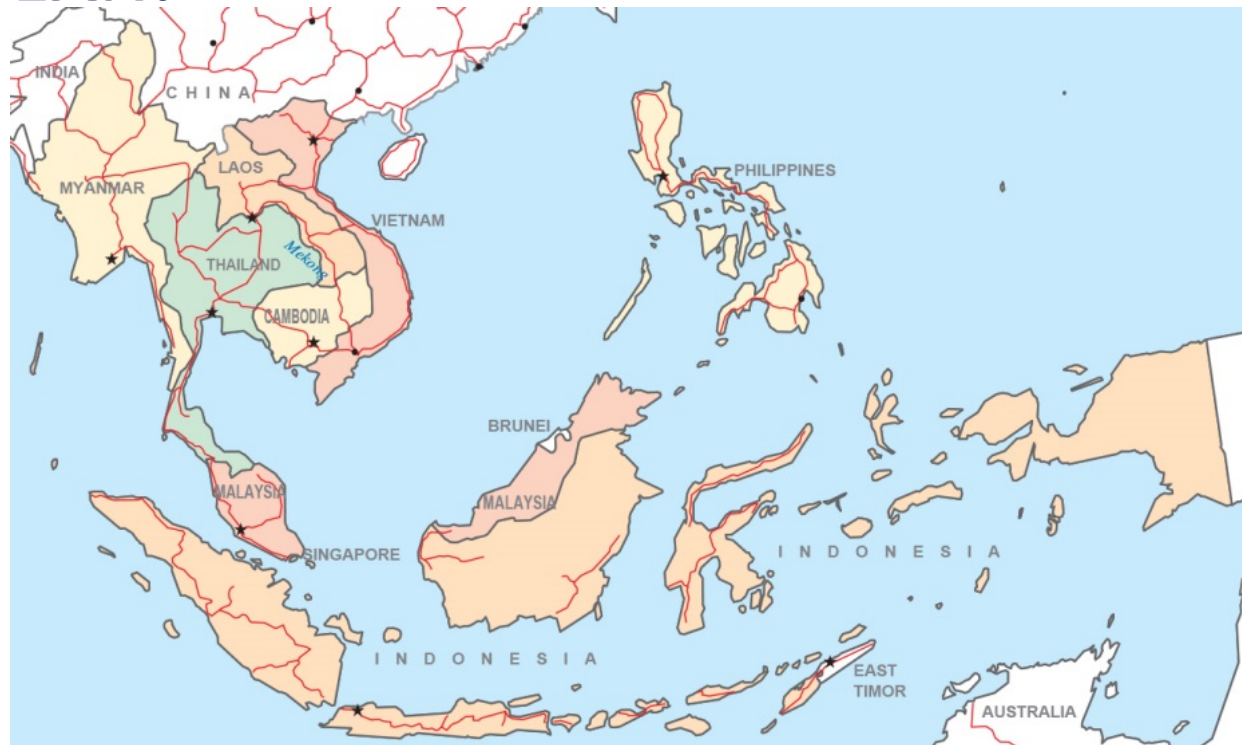
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Part 1: Background and Methodology

Project Scope

Between late-2012 and mid-2013, Terabit Consulting performed a **detailed analysis of broadband infrastructure and markets in the 9 largest member countries of ASEAN:**

-  Cambodia
-  Indonesia
-  Lao PDR
-  Malaysia
-  Myanmar
-  Philippines
-  Singapore
-  Thailand
-  Vietnam



Scope (cont'd.)

- **The data and analysis for each country included:**
 - ✓ **Telecommunications market overview and analysis of competitiveness**
 - ✓ **Regulation and government intervention**
 - ✓ **Fixed-line telephony market**
 - ✓ **Mobile telephony market**
 - ✓ **Internet and broadband market**
 - ✓ **Consumer broadband pricing**
 - ✓ **Evaluation of domestic network connectivity**
 - ✓ **International Internet bandwidth**
 - ✓ **International capacity pricing**
 - ✓ **Historical and forecasted total international bandwidth**
 - ✓ **Evaluation of international network connectivity including terrestrial fiber, undersea fiber, and satellite**
 - ✓ **Evaluation of trans-border network development and identification of missing links**

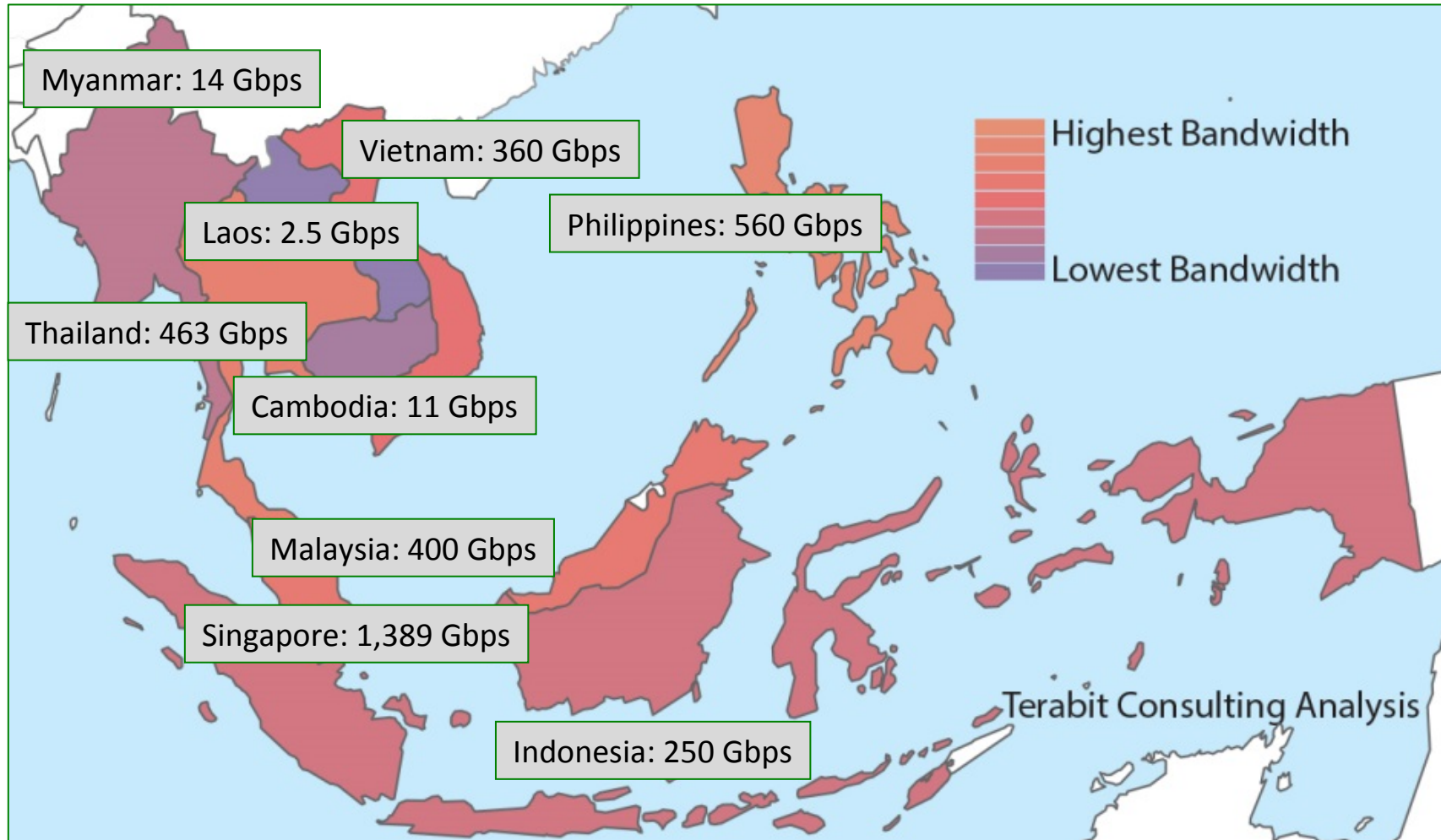
Sources of Data

- **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 data and intelligence regarding infrastructure, demand, traffic flows, pricing, and market share is unsurpassed**

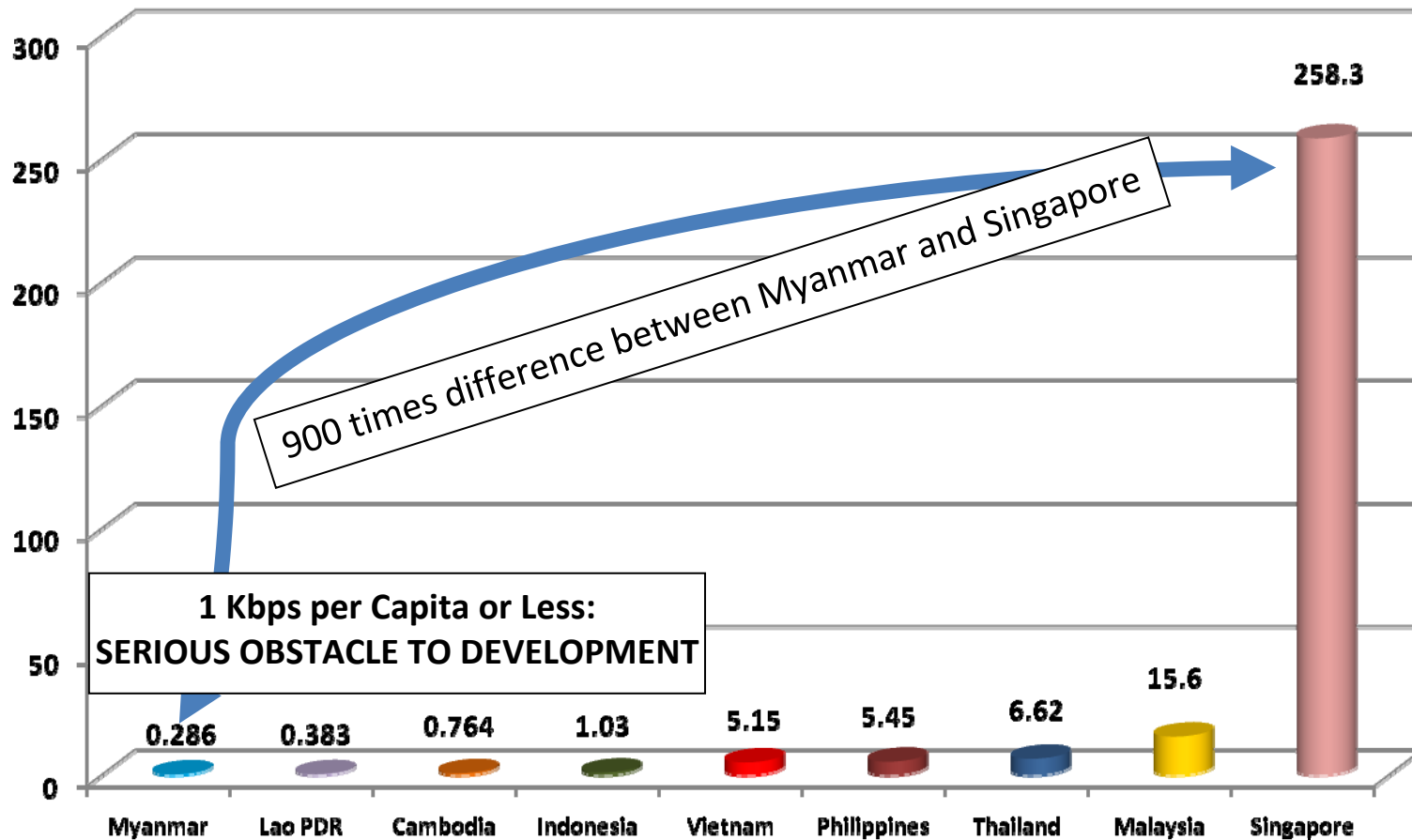


Part 2: State of the ASEAN-9 Bandwidth and Broadband Markets

International Internet Bandwidth, YE12



Int'l. Internet Bandwidth per Capita (Kbps)



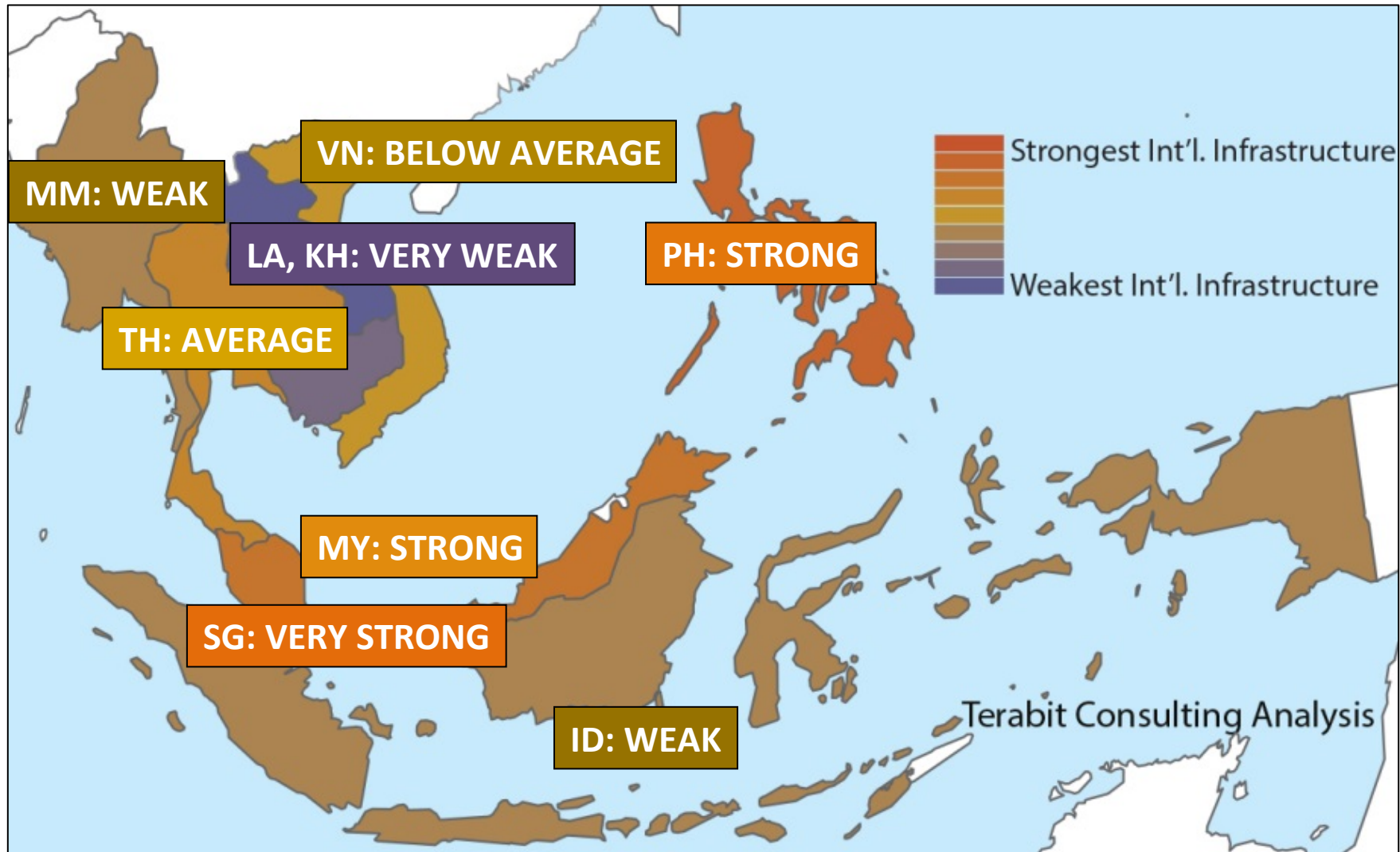
International Bandwidth Infrastructure

- **Singapore: By far, the strongest in the region**
 - 10 interregional submarine cables as of 2013
 - 6 additional regional systems (Malaysia/Indonesia)
 - Additional fiber via Causeway and Second Link
- **Philippines and Malaysia: Strong**
 - PLDT has 3 cable stations, Globe has 2, Pacnet has 2
 - Malaysia served by FLAG, Sea-Me-We-3, SAFE, Sea-Me-We-4, APCN-2, Asia Submarine-Cable Express, AAG
 - Time dotCom shareholder in Unity transpacific cable
- **Thailand: Average**
 - FLAG, Sea-Me-We-3, Sea-Me-We-4, AAG
- **Vietnam: Below average, but improving**
 - Sea-Me-We-3 was supplemented by TGN-IA (2009) and AAG (2010)

International Bandwidth Infrastructure

- **Indonesia: Weak**
 - Served by Sea-Me-We-3 but most other infrastructure routes through Singapore
- **Myanmar: Weak**
 - Served by Sea-Me-We-3
 - Planned Sea-Me-We-4 link via Bangladesh and planned Sea-Me-We-5
- **Cambodia and Lao PDR: Very Weak, with no direct interregional connectivity**
 - Cambodian membership in AAG was too late, relies on Ezecom backhaul via Thailand and Vietnam
 - Lao PDR served exclusively by low-capacity terrestrial trans-border links

International Bandwidth Infrastructure

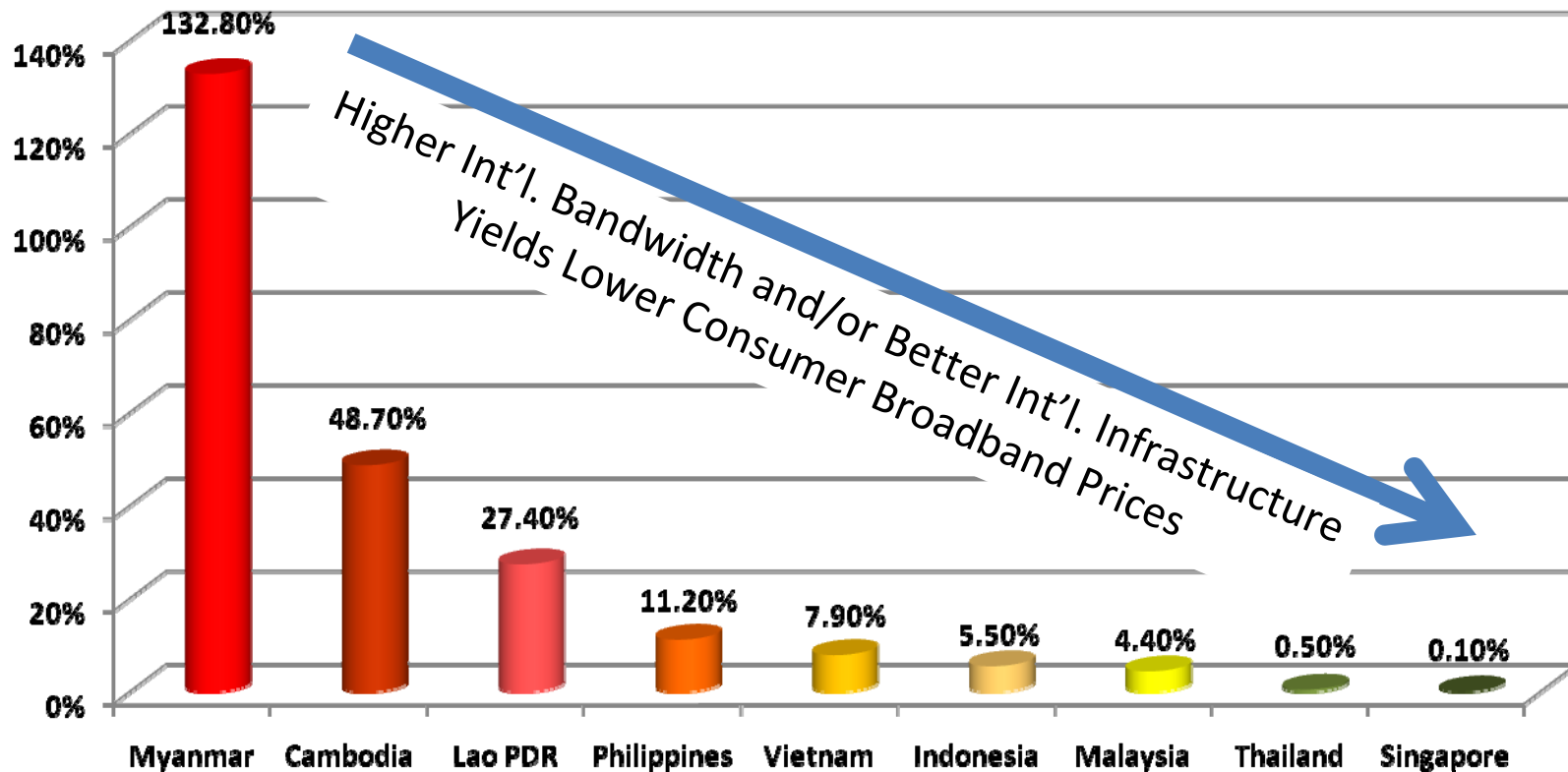


The Impact of Low International Bandwidth & Weak International Infrastructure

- **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 tools including telemedicine, distance learning, scientific/research nets
- **More specifically within the telecom environment: higher wholesale and consumer prices, and lower broadband adoption rates**
 - Cambodia, Indonesia, Lao PDR, Myanmar, Philippines, Thailand, and Vietnam: \$70 to \$100 per Mbps wholesale
 - *Compared to Singapore: \$10 per Mbps*

Weak Int'l. Bandwidth Impacts Consumer Pricing

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

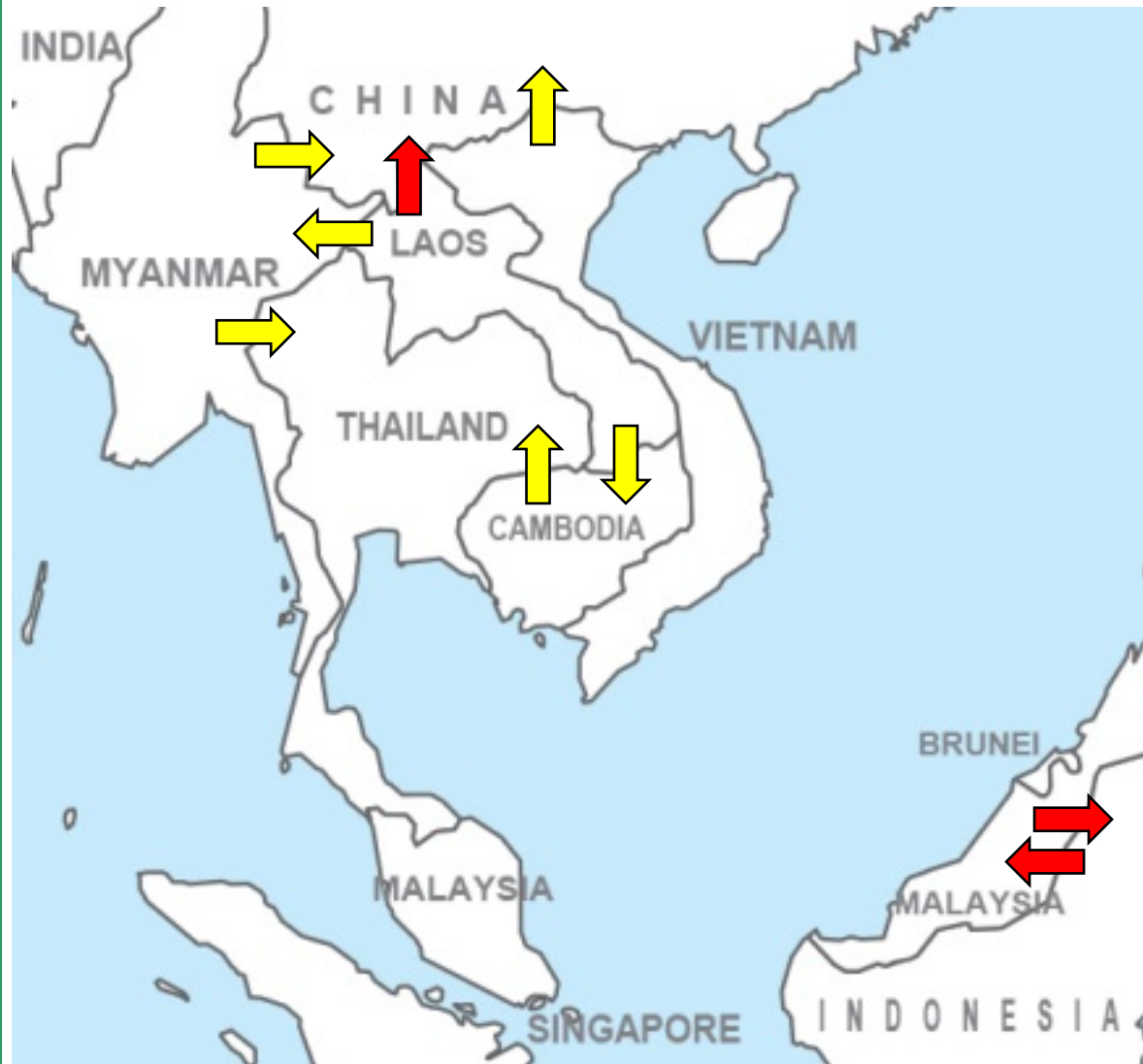


Overview of Broadband Status

	GDP per Capita, YE 2012 (PPP, USD)	Int'l. Bandwidth per Capita (Kbps)	Int'l. Connectivity	Domestic Connectivity	IP Transit Price	Competitiveness of Telecom Market	Fixed and Mobile Broad-band Infrastructure	Annual 1 Mbps Broadband Subscription + Installation as % of Nominal GDP per Capita
Cambodia	\$2,400	0.8	Weak	Adequate	Very Expensive	Reasonably Competitive	Very Limited	48.7%
Indonesia	\$4,900	1.0	Weak	Adequate	Expensive	Competitive	Growing	5.5%
Lao PDR	\$2,900	0.4	Weak	Limited	Very Expensive	Less Competitive	Very Limited	27.4%
Malaysia	\$16,400	15.6	Excellent	Adequate	Reasonably Priced	Reasonably Competitive	Relatively Strong	4.4%
Myanmar	\$1,900	0.3	Weak	Limited	Very Expensive	Uncompetitive but Planned Liberalization	Very Limited	132.8%
Philippines	\$4,300	5.5	Excellent	Relatively Strong	Very Expensive	Less Competitive	Growing	11.2%
Singapore	\$59,500	258.3	Excellent	Very Strong	Inexpensive	Reasonably Competitive	Very Strong	0.1%
Thailand	\$9,240	6.6	Average	Relatively Strong	Very Expensive	Reasonably Competitive	Average	0.5%
Vietnam	\$3,550	5.2	Somewhat Weak	Limited	Expensive	Less Competitive	Limited	7.9%

Part 3: Identification of Priority Cross-Border Terrestrial Links

Priority Terrestrial Fiber Links



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

High-Priority Terrestrial Fiber Links

International Border	Current Status	Recommendation
Lao PDR to Yunnan Province	ETL operates a fiber link to Yunnan Province, China via Boten.	The Lao PDR-China route would benefit from greater competition.
Malaysia to Indonesia	Although undersea connectivity exists between Indonesia and Malaysia, no direct connectivity is present between the countries' states on the island of Borneo.	A new terrestrial fiber link between Indonesia and Malaysia would greatly improve the region's connectivity and is warranted by the countries' linguistic, economic, and cultural ties. Such a link would also improve connectivity to the Malaysian states of Sabah and Sarawak, which have traditionally relied upon transit capacity through Peninsular Malaysia.

Medium-Priority Terrestrial Fiber Links

International Border	Current Status	Recommendation
Cambodia to Thailand	The route provides one of Cambodia's primary paths to international submarine connectivity and has limited competition, with both Telecom Cambodia and Ezeacom operating infrastructure.	Because the development of submarine connectivity to Cambodia is uncertain, the country is strongly dependent on its terrestrial links and consumer prices remain extremely high, in part because of limited infrastructure competition.
Lao PDR to Cambodia	Existing fiber infrastructure is weak and capacity is controlled by Enterprise of Telecommunications of Lao (ETL). There are no submarine cables in Cambodia but future projects are under consideration.	Demand between the two countries is weak but transit traffic from Lao PDR via Cambodia could increase if a new Cambodian submarine cable is constructed.
Lao PDR to Myanmar	Demand between the two countries is weak but Myanmar hosts the Sea-Me-We-3 cable.	Access to Myanmar's Sea-Me-We-3 landing point could improve Lao PDR's options for connectivity.
Myanmar to Thailand	As the Myanmar telecommunications market opens to competition, there will be increased demand for additional international paths.	Additional Myanmar-Thailand capacity should be considered, especially in light of high consumer broadband costs in Myanmar (132.8% of per-capita GDP per Mbps).
Myanmar to Yunnan Province	As the Myanmar telecommunications market opens to competition, there will be increased demand for additional international paths.	Additional Myanmar-China capacity should be seriously considered, but relations between the two nations have weakened since 2011.
Vietnam to Yunnan Province	VNPT and China Telecom operate a link between Vietnam and China within the aegis of the China-Southeast Asia Cable.	The existing link is believed to follow the Youyiguan Pass; additional connectivity via Yunnan Province should be considered.

Envisioned Regional Fiber Network Based on Priority Trans-Border Links

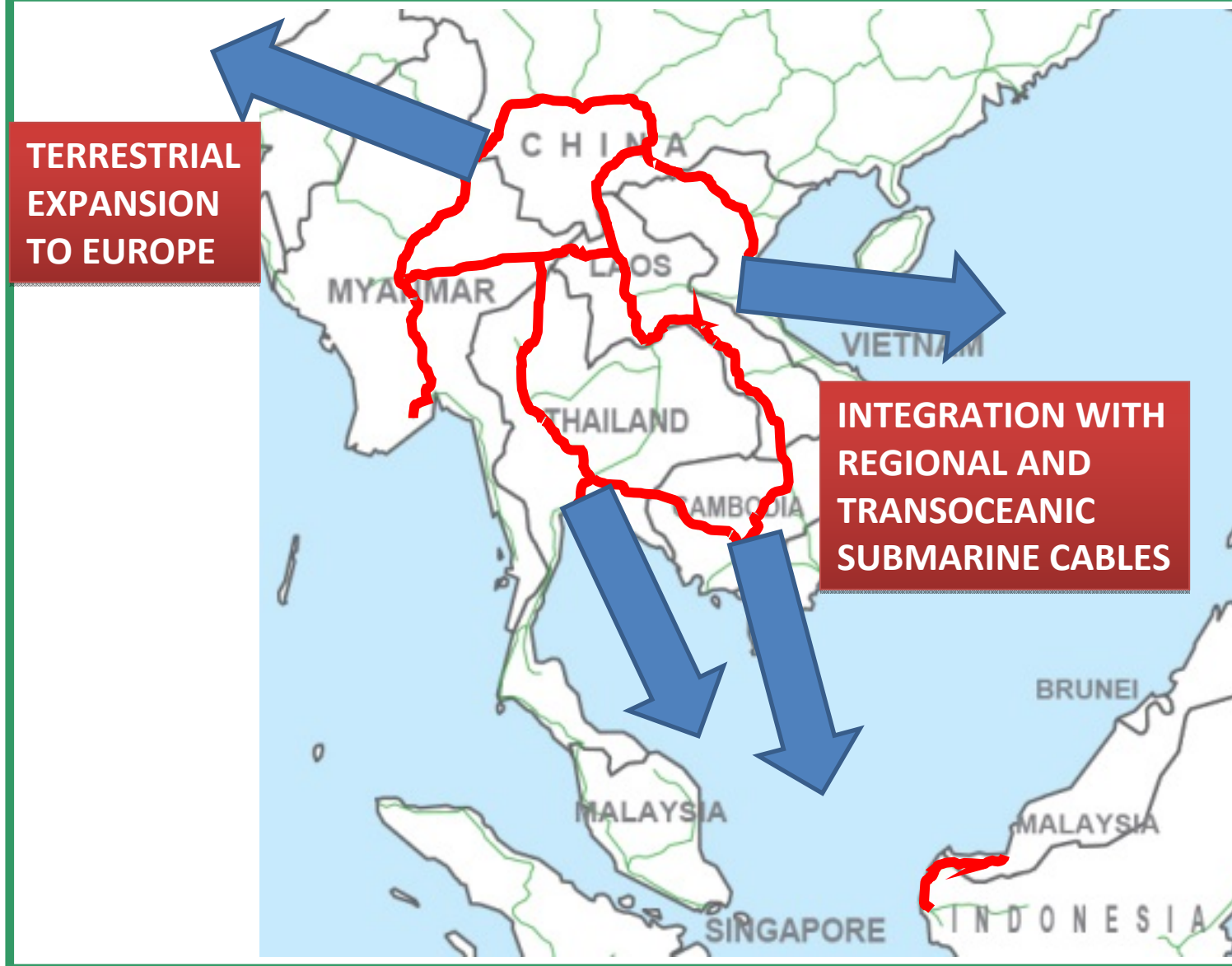


Part 4: The Case for a Holistic, Pan-Asian Approach to Network Development

Understanding Int'l. Infrastructure in the Region

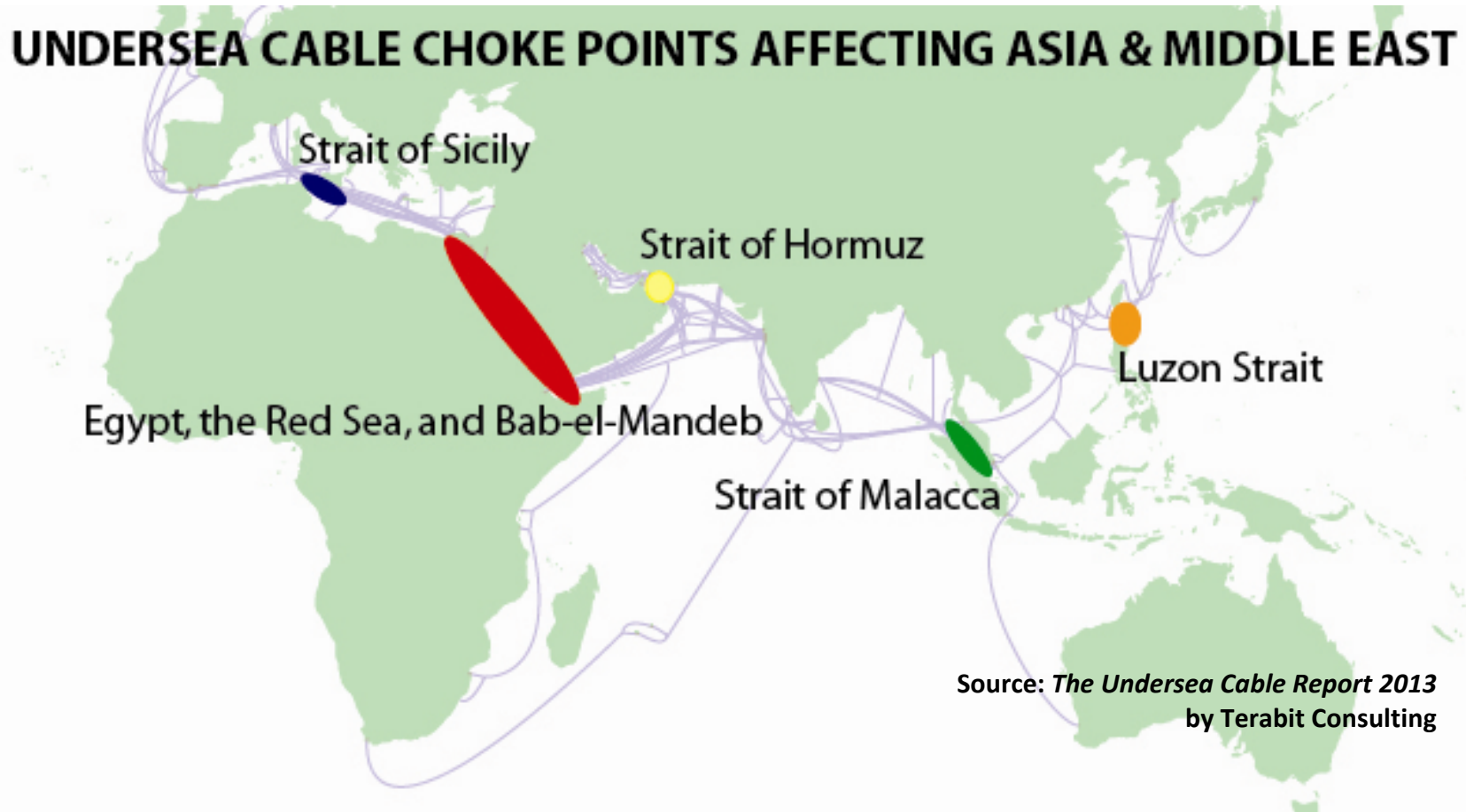
- The vast majority of traffic is Internet Protocol
- The majority of IP traffic is still destined for North America and Europe (i.e., location of most content)
- Intra-Asian demand mostly destined for hubs (e.g. HK)
- Bilateral, trans-border IP demand is minimal
- Therefore: trans-border terrestrial links should be viewed holistically, as a means of
 - Accessing and supplementing interregional fiber networks
 - Increasing efficiency and equality and reducing prices
 - Providing redundancy and restoration paths to avoid submarine cable 'choke points'
- Terrestrial networks should not be evaluated on the merit of trans-border (bilateral) demand alone

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



Terrestrial as a Solution for Submarine

UNDERSEA CABLE CHOKES POINTS AFFECTING ASIA & MIDDLE EAST



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

Overall Weakness of Existing Trans-Border Connectivity

- **Limited Geographic Scope**
 - Most terrestrial links are trans-border, point-to-point
 - The region's few multi-national networks fail to function coherently
- **Little or No Network Redundancy**
 - Point-to-point links can only be used by operators who own alternative pathways; mesh network configuration is needed
- **Low Transmission Capacity**
 - Typically 10 Gbps or less, preventing economies of scale and placing existing terrestrial links at a significant disadvantage to submarine
- **Lack of Open Access and Prohibitive Pricing**
 - Most terrestrial is operated for the benefit of incumbent operators, and third parties are unable to access the networks cost-effectively
- **No Viable Intercontinental Terrestrial Bandwidth**
 - Intercontinental traffic is aggregated over vulnerable subsea links

Part 5: The Case for Intervention to Ensure Network Development

Market Failure: Broadband Divide

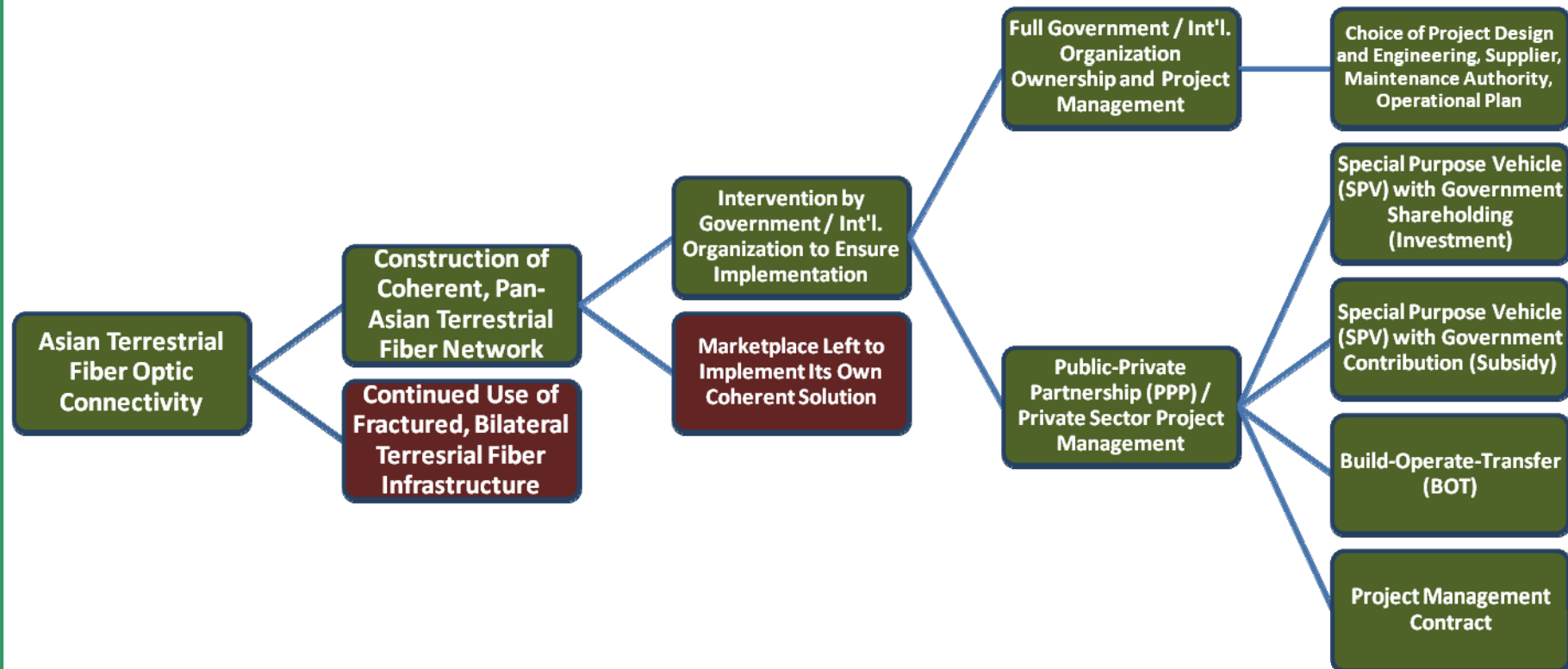
- The analysis of broadband markets and infrastructure in the ASEAN-9 sub-region and adjoining provinces revealed that low-cost, high-speed, and high-quality broadband services are concentrated in markets that are wealthy, urban, and/or coastal, while poor, rural, and/or inland markets are often neglected.
- The analysis showed that the chasm between the broadband “have” and “have-not” markets results in vast differences in international fiber connectivity, domestic connectivity, the pricing of IP transit capacity, the competitiveness of telecommunications and Internet markets, fixed and mobile broadband infrastructure, and the affordability of consumer broadband services.

The Need for Intervention

Intervention (by government or int'l. organizations) is required to ensure the implementation of a pan-Asian terrestrial fiber optic network for 5 reasons:

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

Options for Government/UN Participation



Available Public-Private Partnership Options

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

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

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

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

Build-Operate-Transfer (BOT)

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

Awarding of Project Management Contract

- A tender is issued to select one or more network operators responsible for the construction, operation, maintenance, and commercialization of the pan-Asian terrestrial fiber optic network.
- The contract recipient is paid to manage the cable and assume these responsibilities, including the sales of capacity to operators. The contract recipient's management fees may be fixed or based on a percentage of revenue.
- The network remains the property of the Government(s), which collect all profits (less management fees).

Part 6: 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

- 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.

Part 7: Gaining Support for the Project

Stakeholder Participation is Key

- **The Study (pp. 37-40) identifies 95 potential stakeholders in ASEAN-9 that should be involved in the project, including:**
 - National Regulatory Authorities
 - Incumbent Operators and Major International Gateway Operators
 - Competitive Telecommunications Operators and ISPs
 - Road and Railway Authorities/Operators
- **Suppliers and contractors should also be consulted in the development stage.**

Convincing Governments of the Project's Advantages

1. Benefits to consumers

- Myanmar, Cambodia, and Lao PDR: 1 Mbps of consumer broadband costs 132.8%, 48.7%, and 27.4% of per-capita GDP
- Only Singapore and Thailand offered broadband access that is considered to be truly affordable.
- Better, more cost-effective connectivity in the region will greatly reduce consumer prices in less developed markets and improve broadband reliability throughout the region.

2. Economic growth

- Improvement in ICT infrastructure yields:
 - Increased demand for the output of other industries (demand multiplier)
 - New opportunities for production in other industries (supply multiplier)
 - New goods and services for consumers (final demand)
- It also increases firms' innovation capabilities and increases the probability of new products, innovations, and organizations

Convincing Governments of the Project's Advantages

(Continued)

3. Increased government revenue

- Growth in economic output from ICT investment results in greater tax revenue
- Increased employment in the telecommunications sector
- Greater collections from telecom licenses and excise

4. Regional stability through better international and intercultural relations

- More efficient routing of trans-border traffic would encourage trans-border initiatives in the education, healthcare, and research sectors that would not otherwise be possible.

Convincing the Private Sector of the Project's Advantages

- 1. The network would offer the private sector reliable, high-capacity international fiber paths across all borders**
 - Compared to low-capacity, less-reliable links currently in service
- 2. The network would finally provide a cost-effective alternative to undersea cable “choke points”**
 - Of interest not only to operators, but communications-critical industries (e.g. finance)
- 3. Commercial arguments can be made on a case-by-case basis to win support of incumbent operators wary of competition.**

Road Map / Next Steps

- **Terabit Consulting is analyzing additional markets in North and Central Asia**
- **Critical cross-border projects throughout Asia are being identified**
- **As more market analyses are completed, the viability of a coherent pan-Asian network is becoming clearer**
- **Detailed Feasibility Study (DFS) should be undertaken**
- **Rough Order of Magnitude (ROM) costing exploration should be initiated**
- **Determination of support among stakeholders**
- **Identification of financing options**

Terabit Consulting's Overall Thoughts

- Terabit Consulting has worked on dozens of key fiber infrastructure projects in every region of the globe
- The Pan-Asian network opportunity is among the strongest it has seen
- Commercially viable; initial evaluation of business case inputs are very positive
- The network would be critical to ensure greater broadband equality, promote regional economic/social development
- Urgently needed by global telecommunications operators who must compensate for submarine cable choke-points
- Urgently needed by governments and communications-critical industries who are compromised by submarine cable choke-points
- However, the project can only be achieved with persuasive intervention by UNESCAP and governments

Thank you!



**Intelligence, Analysis, and Forecasting
for the International Telecommunications
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