Conceptualization and Future Works

- A Pre-feasibility Study on the Asia-Pacific Information Superhighway in the ASEAN Sub-region
(July 2014 ~ July 2015)

October 1, 2014

APIS Project Team

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Background and Introduction

❑ Project Structure

- Partnership between ESCAP and Ministry of Science, ICT & Planning of ROK
- ASEAN pre-feasibility study conducted by NIA/experts (LoA between ESCAP and NIA)
- Time Frame: Aug 2014 – July 2015

❑ Background

- ASEAN identified as a strategic sub-region for initiating "APIS"
  * In 2013, 'An In-Depth Study on the Broadband Infrastructure in the ASEAN-9 Region', Manila Consultation
- Support and collaborate ASEAN Master-plan on ICT connectivity

❑ Key Objectives

- Provide concrete and possible configurations/concept of APIS
- Conduct gap analysis between "as-is" and "to-be", for more universal, affordable, reliable international connectivity in the ASEAN region
- Identify potential APIS network topology in the ASEAN region
- Recommend implementation models, including funding mechanisms and partnerships

❑ Key Activities from October 2014

- International Internet Traffic Quality Measurement for ASEAN countries: traffic route, bandwidth, speed, data loss, latency
- In-depth interviews/surveys from Government, regulators, ISPs in ASEAN countries.

Time Table

Description	Stages	Time Frame
▪ Provide related ESCAP's studies, data in ESCAP's broadband back bone map, Asian Highway Agreement and other related documents	1st Stage	by 15/08/2014
▪ Facilitate collaborations between related experts and the Partner Institution		by 31/08/2014
▪ First workshop (Korean experts)		by 31/08/2014
▪ Examine related data/documents and conduct secondary data analysis		by 31/09/2014
▪ Participation and presentation in the South Asia regional Expert Consultation Meeting and CICT		By 31/10/2014
▪ Facilitate Internet traffic & quality measurement between selected countries and the Partner Institution	2nd Stage	by 30/10/2014
▪ On-line Measurement of Internet Speed and traffic in selected countries ▪ Surveys and face to face Interviews with Regulators and Operators		by 30/11/2014
▪ Collect and analyze data gathered from on-line, off-line		By 31/12/2014
▪ Submission of the first interim report: Conceptualization of Asian Information Superhighway	3rd Stage	by 31/12/2014
▪ Second workshop (Korean + ASEAN experts)		by 31/01/2015
▪ Gap analysis between As-is and To-be in international backbone connectivity of ASEAN		by 31/03/2015
▪ Submission of the report draft		by 30/04/2015
▪ Review and comments on the report draft		by 31/05/2015
▪ Submission of the final report		by 31/07/2015

Expert Consultation

Deliverables of the Study

Summary	• Executive Summary of the Report
Chapter I	• Conceptualization of APIS • Naming of APIS for ASEAN
Chapter II	• Regional Circumstance and ASEAN members' plan • Internet Traffic & Quality Analysis • To-be modeling and Gap Analysis between "As Is" and "To Be"
Chapter III	• Regional Network Topology and Options • Cross-Border Connectivity Improvement Plan (L1~L3) • Regional IXP establishment and Operational Model • Technology and Products applicable to the Network • Overall Amount of Investment for APIS
Chapter IV	• APIS Implementation Model and Regional Cooperation Model • * PPP Model Suggestion including SPV • E-Application and Contents deployment Model
Conclusion	• Conclusion and Policy Recommendation

* This presentation mainly covers "Red Colored" and some collaborative action items to be done

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History of ICT in ASEAN

ASEAN Sub-region

Master Plan on ASEAN Connectivity (2010)

ASEAN ICT Master Plan 2015 (Jan. 2011)

Mactan Cebu Declaration "Connected ASEAN: Enabling Aspirations" (Nov. 2012)

- ASEAN Broadband Corridor
- diversity of international connectivity
- ASEAN Internet Exchange Network
- ASEAN Single Telecommunications Market

- Increase Penetration
- Improve Affordability
- Achieve Universal Access

Global/ Regional

UN MDG
Resolution 64/186(Dec.2009)
UN Conference on Sustainable Development(Rio +20)

ITU's Global Broadband Targets 2015,

- Making Broadband Policy Universal
- Making Broadband Affordable(Less Than 5% of Average monthly Income)
- Connecting Homes to Broadband
- Getting People online

ESCAP GA resolution 62/5, 60/252, 64/186, 67/194, 67/195

ESCAP Resolution 69/10 (May, 2013)

- To promote regional cooperation to formulate and implement coherent information and communications technology policies
- To further develop a regional connectivity environment, regional and sub-regional levels
- To achieve a seamless regional information and communications space, with particular attention paid to gaps in backbone infrastructure networks

Expert Consultation on the APIS (Manila, Baku, Almaty,Paro,2013~2014)

Key Words Abstraction

- Diversity of international connectivity
- Seamless Infrastructure Networks and Backbone, Reliable Network
- Well balanced Network
- Fully integrated and coherent mesh configuration;
- Uniform construction the use of Asian Highway, Trans-Asian railway and power transmission
- Single uniform network that offers quality-of-service guarantees
- Missing Links, Cross Border Connectivity
- Judicious mix of land and sea based fiber optic cables

→ **Geo-spatially Balanced Connectivity**

- ASEAN Internet Exchange Network, ASEAN IXPs
- diversity of international connectivity
- IP Transit /Peering
- Cost of Transport back to the primary exchange
- Heavy Reliance on IXP in advanced countries
- International Back haul cost
- Emergency Communications and Resiliency

→ **Regional Internet(IP) Connectivity**

- Making Broadband Affordable(Less Than 5% of Average monthly Income)
- Connecting Homes to Broadband
- Getting People online
- Bridge the digital divide within ASEAN
- Improve Affordability
- Universal Service Achieve/Universal Access
- Increase Penetration

→ **Low Cost and Broadband Affordability**

- Open access and non-discriminatory pricing
- Network neutrality and scalability that allows participation by all stakeholders

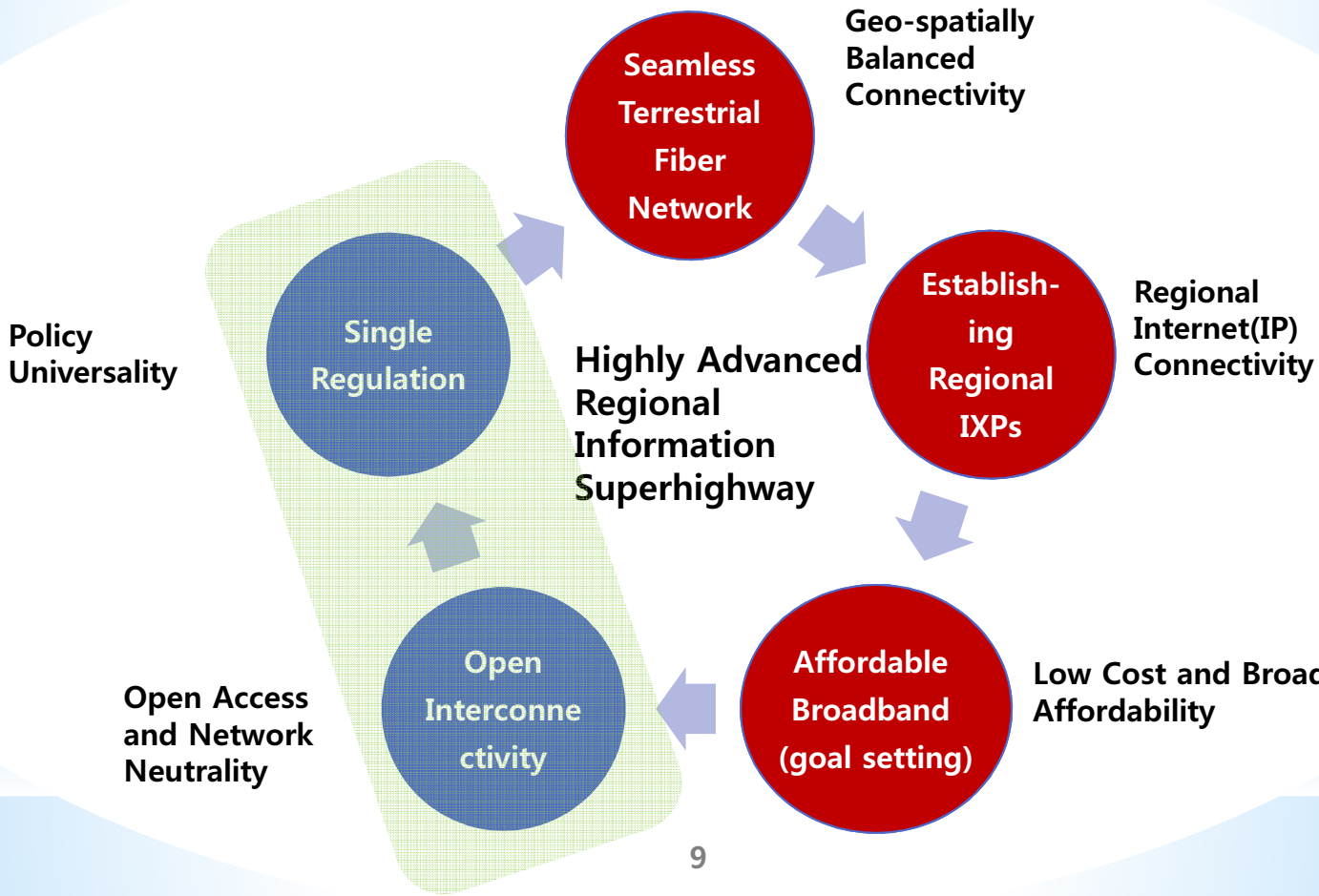
→ **Open Access and Network Neutrality**

- Single Telecom Market
- ASEAN Single Telecommunications Market
- Making Broadband Policy Universal(ITU)
- Enabling Environment, Capacity building

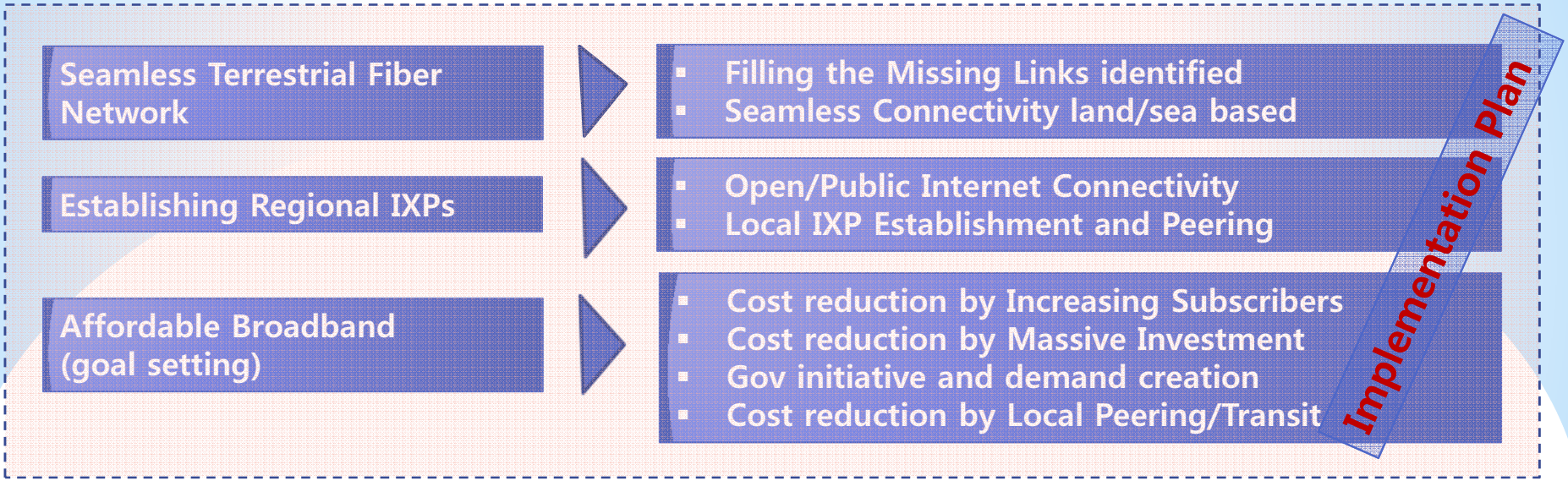
→ **Policy Universality**

Main Area of the Study

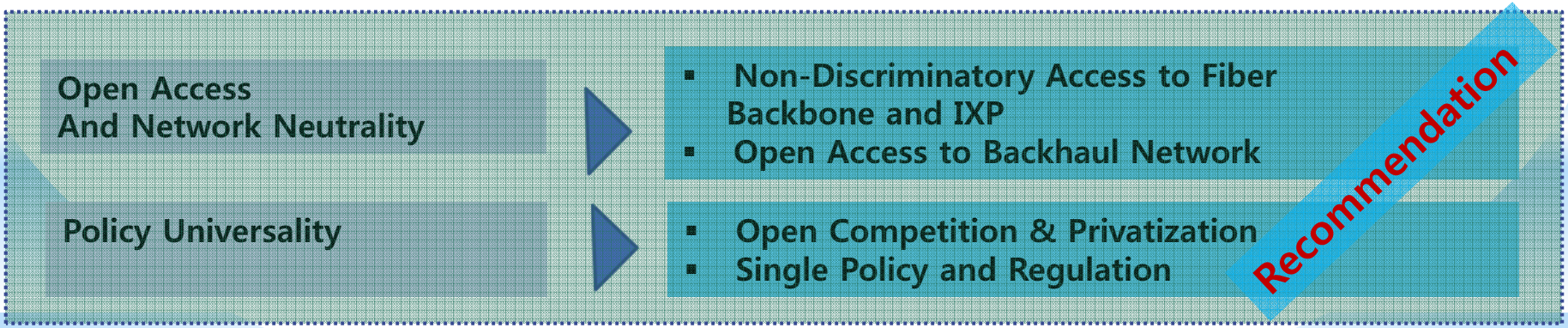
- 3 main targets: Seamless Terrestrial Network, Regional IXPs, Broadband Affordability
- 2 other areas, Single Regulation and Open Interconnectivity, should be further studied for making policy consensus among Governments



Key Action Items identified



* This subject to adjustable later after evaluation of total cost and expense



APIS Direction and Implications

- "PACE" Naming: " Pan-ASEAN ICT Connectivity & Exchange"
- Network operators, service providers should be involved in PACE project at the very outset
- Implementation plan must be implementable and beneficial both Operators and Subscribers

Status Quo

- ASEAN : Master Plan on ASEAN Connectivity(2010), ASEAN ICT Master Plan 2015(2011)
  "Most of Infrastructure plans were accomplished but ASEAN Internet eXchange Network is at Risk"
  (mid-term evaluation, in 2013)
- ESCAP : Resolution 69/10 in May,2013, Expert Consultation Conclusions & Recommendations
  " Promote and strengthen regional cooperation, collaborate with international and regional organizations" is in need
- Many Experts : "However, missing terrestrial links, submarine dependency, high price and gap, low penetration were observed" , " need to follow global norms such as Single, Uniform, non-discriminatory, neutral, open access, competition.."

Implications

- PACE Program should be substantial and Implementable in real world
- PACE Program should be beneficial for both network operators and Subscribers
  - Low cost to operators,
  - Reasonable price to subscribers
- PACE Program should be enforced by the Government of each member states
  - e.g. Enrollment PACE in the Inter-Governmental Agenda of UN

Feature of PACE : Regional Inter-connectivity View

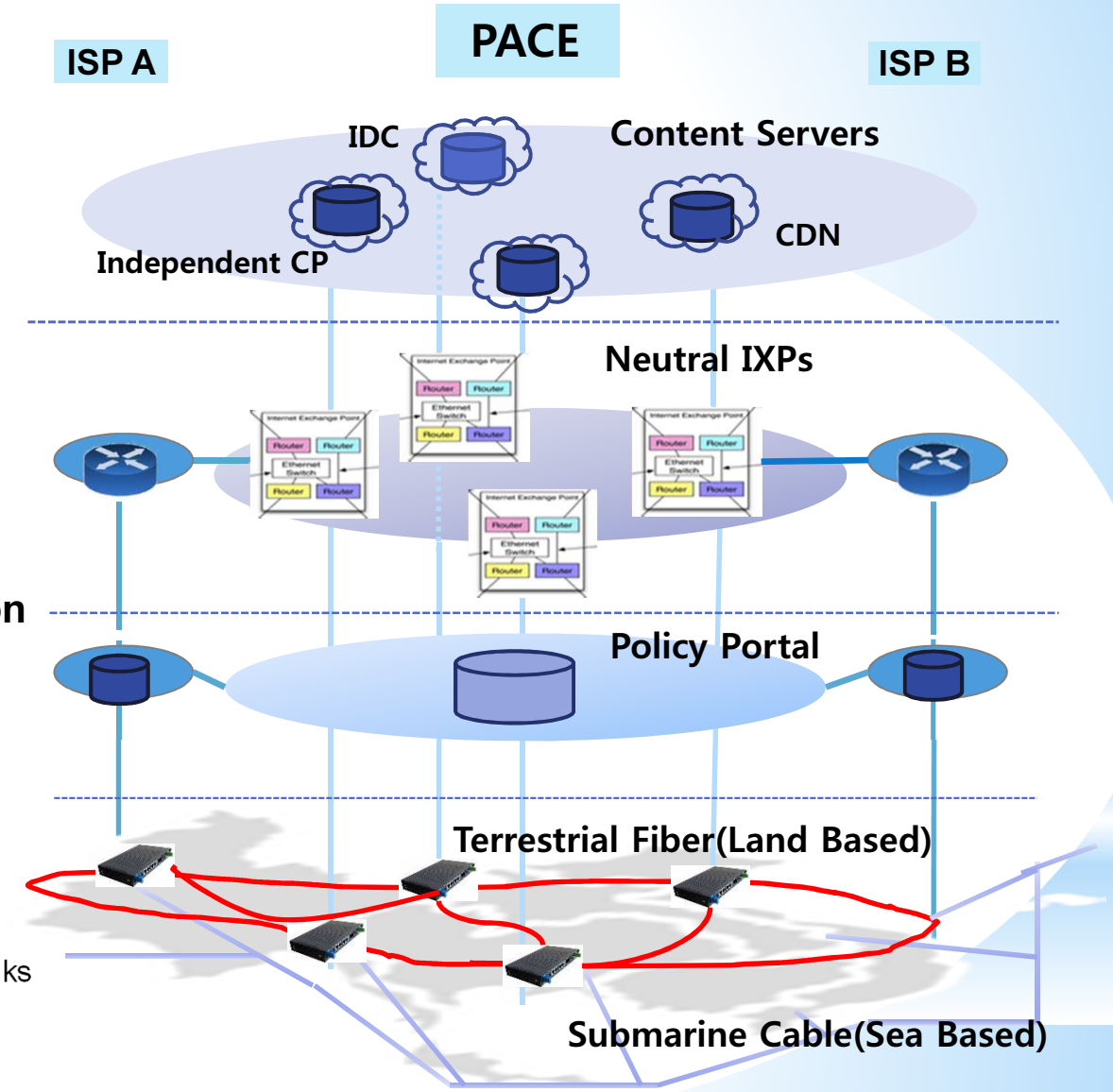
e-application Service
- Content Provisioning
- Internet Data Center
- Content Delivery Network

Open/Neutral IP Exchange
- Domestic Neutral IP Exchange
- Regional IP Transit
- Fiber Connectivity Between IXPs (Optional)

Single Policy and Administration
- SPV coordinates IP Routing and Peering/Transit and Non-discriminatory Rule settings by the collaboration with Regulators in the region
- Policy and Regulation Registry, Database

Fiber Infrastructure
- Well balanced Submarine/Terrestrial Fiber Network, owned by operators
- Filling and Inter-connecting the Missing Links

Data and content Storage



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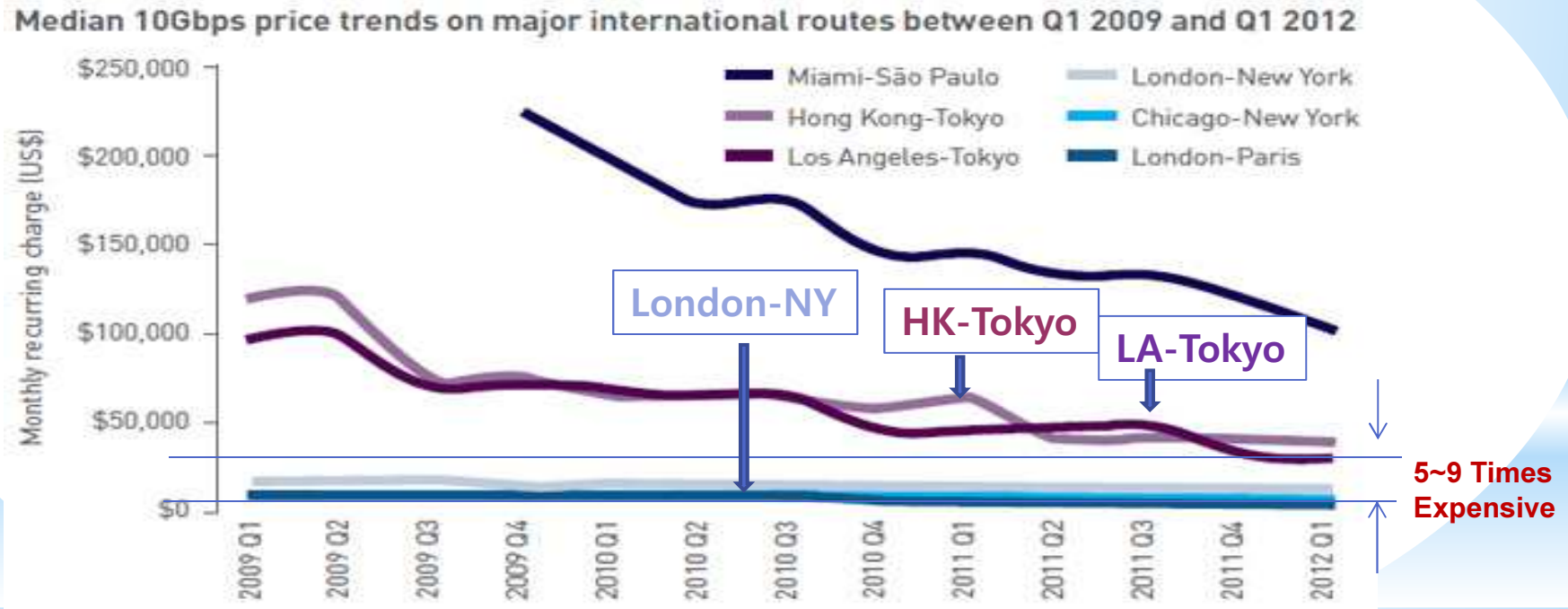
COST : Asia in/out route price, but declining

10Gbps prices on intra-Asia routes remain five times the price of comparable connections within the US and up to nine times the price of comparable connections on intra-European routes even though 10Gbps median monthly lease prices on the Los Angeles-Tokyo route fell 37% between Q1 2011 and Q1 2012

Price Trend of 10 Gbps international routes

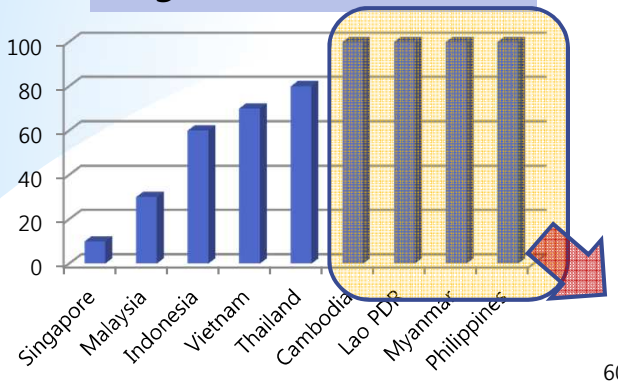


* Source : John Hagel, Deloitte, 2014.5, @KPCB

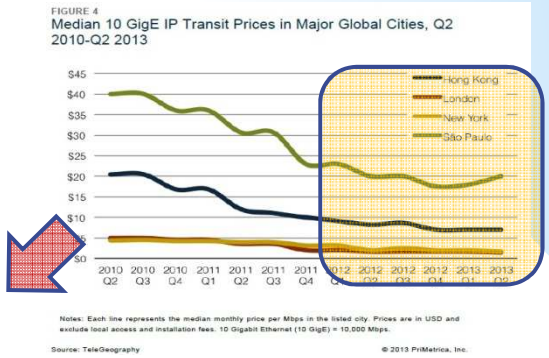
COST：Structural High Cost and High Price

High Transit Price, High Transport Cost and Low level of regional traffic exchange may result in high service price

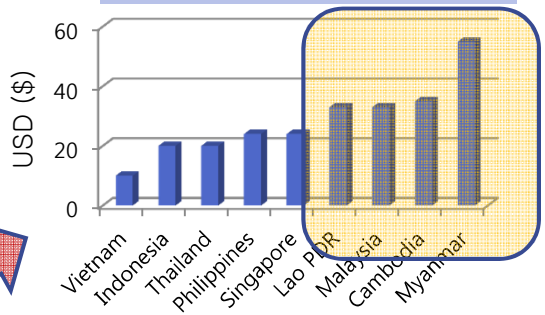
Regional Transit Prices



Inter-regional Transit Prices

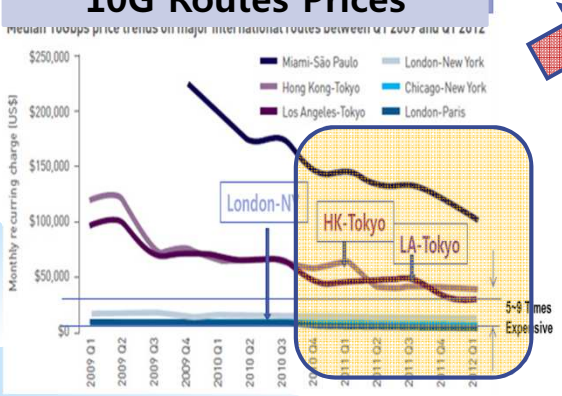


Monthly Internet Prices

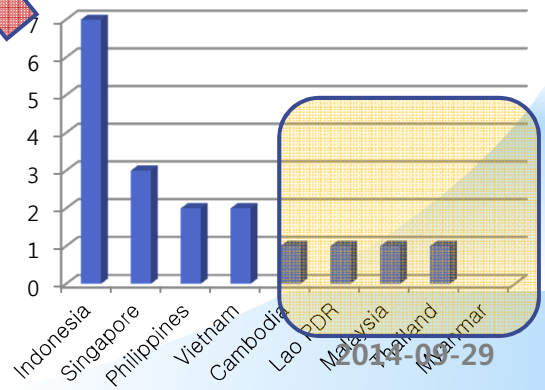


- Year 2012 / Lowest options/ equipment & installation fee excluded

10G Routes Prices



Numbers of IXPs

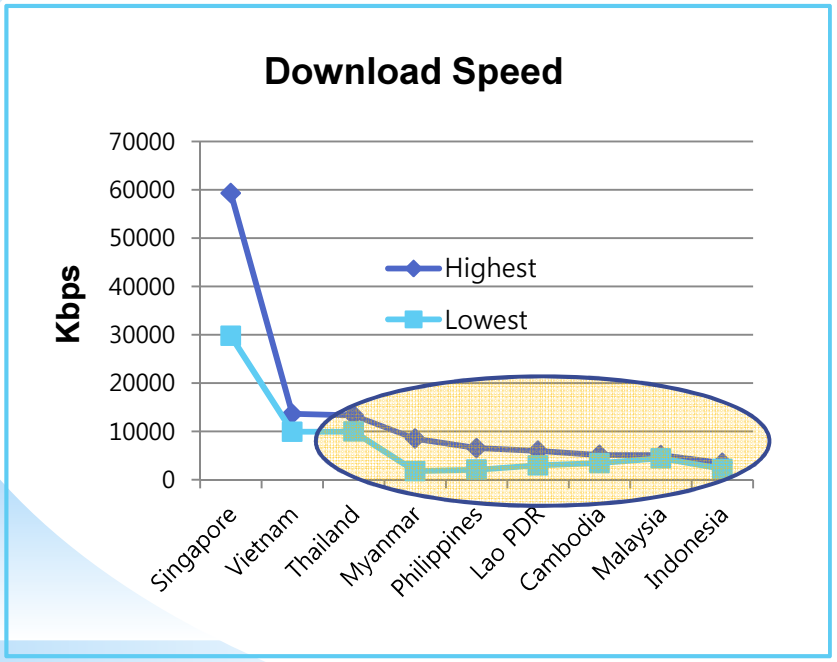


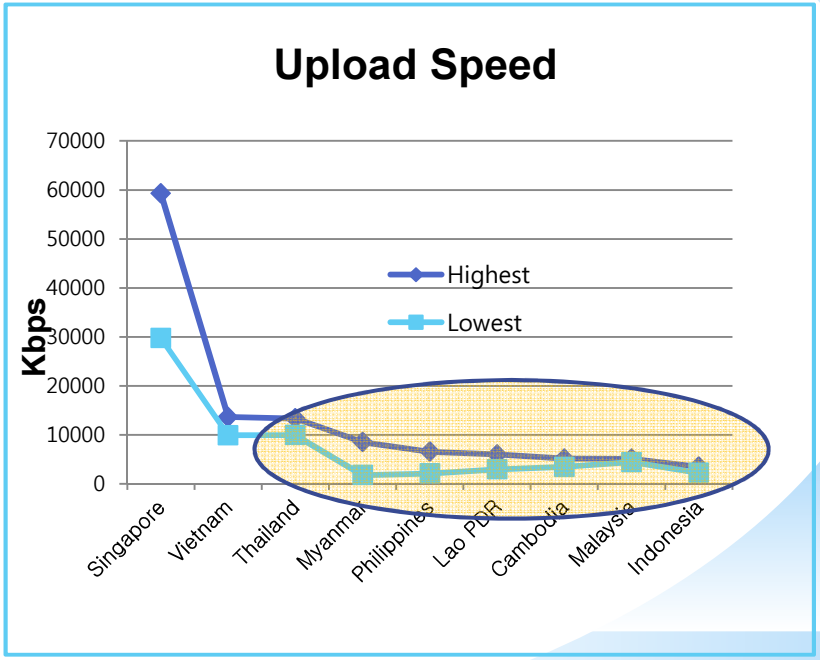
* Source : Terabit Consulting, 2013, www.telegeography.com
http://www.submarinenetworks.com/news/global-bandwidth-pricing-trends

QUALITY : Speed

Using Ookla speed test data, relatively low speed and big speed gap among members were observed

		Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
Down laod	Highest	5125	3472	5987	5099	8503	6536	59279	13328	13615
	Lowest	3425	2238	2951	4417	1772	2085	29731	9948	9903
Up laod	Highest	5828	1891	6146	4027	6283	2265	43980	4209	11773
	Lowest	3690	974	2786	3428	1260	673	17297	2281	7382





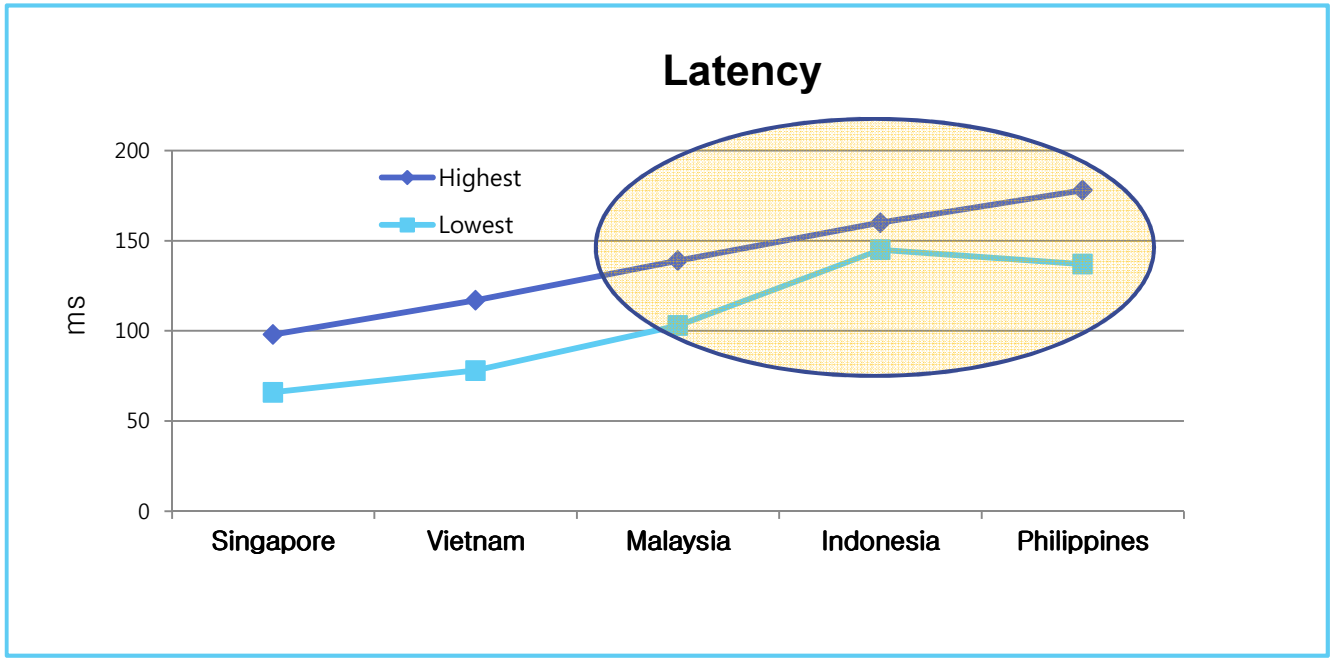
- Source: Ookla http://www.speedtest.net/
- Based on daily data for a year (2013. 01. 01 ~ 2013. 12.31)

QUALITY : Latency

In the 5 member countries, relatively high domestic latency was observed

	Indonesia	Malaysia	Philippines	Singapore	Vietnam
Highest	160	139	178	98	117
Lowest	145	103	137	66	78

- Unit : ms / based on year 2013



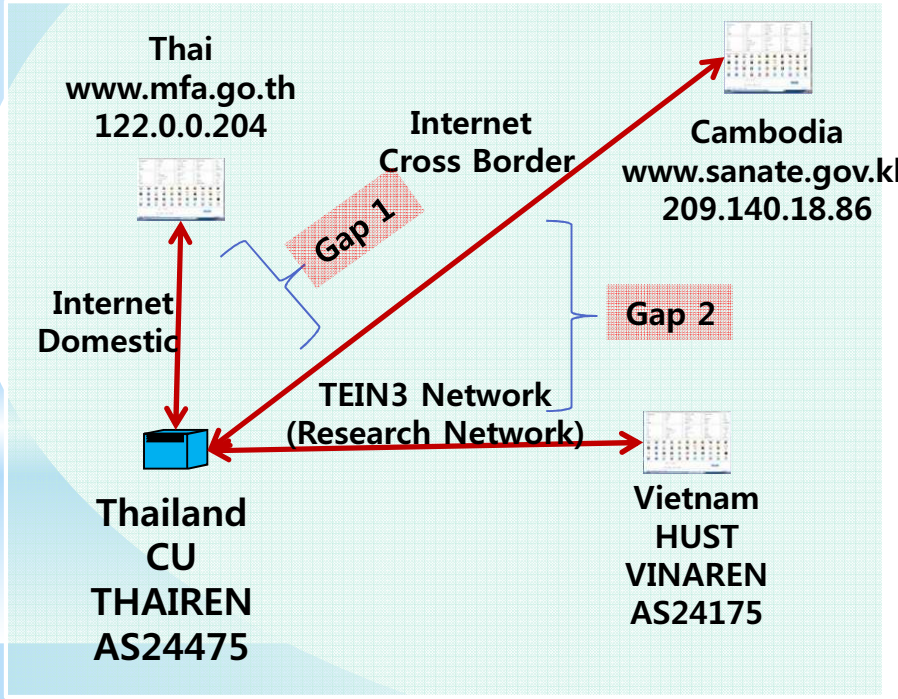
- Source: Ookla http://www.speedtest.net/
- Based on daily data for a year (2013. 01. 01 ~ 2013. 12.31)

IP TRAFFIC ROUTES

Tromboning still exists, e.g. actual IP Traffic route between Thailand and Cambodia seems to be Thailand -> SanJose , USA -> Cambodia. This may cause high cost of Internet and price

```
Wed Feb 12 12:11:12 2014 from 203.237.53.37
traceroute to 122.0.0.204 (122.0.0.204), 30 hops max, 60 byte packets

1 161.200.25.126 (161.200.25.126) 1.246 ms 2.855 ms 1.415 ms
2 161.200.255.214 (161.200.255.214) 4.845 ms 5.471 ms 5.133 ms
3 122.155.253.57 (122.155.253.57) 6.495 ms 6.286 ms 5.833 ms
4 122.155.253.226 (122.155.253.226) 7.615 ms 7.015 ms 122.155.253.222
(122.155.253.222) 6.233 ms
5 * * 202.47.236.73 (202.47.236.73) 5.548 ms
6 202.47.236.102 (202.47.236.102) 6.603 ms * 7.312 ms
7 202.47.247.216 (202.47.247.216) 6.011 ms 5.934 ms 5.476 ms
8 61.19.228.134 (61.19.228.134) 8.835 ms 5.744 ms 5.331 ms
9 122.0.1.13 (122.0.1.13) 4.778 ms 6.664 ms 6.476 ms
```




```
traceroute to 209.140.18.86 (209.140.18.86), 30 hops max, 60 byte packets

1 161.200.25.126 (161.200.25.126) 3.618 ms 3.827 ms 4.142 ms
2 * * *
3 * ptw-cr-1-gi-0-1-1-to-chula-link-1.uni.net.th (202.28.212.221) 7.999 ms *
4 * pyt-cr-03-te-0-1-0-2-to-0-0-4-gi-01-bdr-pyt.uni.net.th (202.28.210.242) 47.272 ms
*
5 * 122.155.224.25 (122.155.224.25) 51.521 ms *
6 61.19.7.61 (61.19.7.61) 50.566 ms * *
7 61.19.7.74 (61.19.7.74) 10.290 ms * *
8 * * *
9 * xe-10-0-2.edge2.SanJose3.Level3.net (4.53.210.145) 269.785 ms *
10 * * * , 11 * * *, 12 * * *, 13 * * *, 14 * * *, 15 * * *, 16 * * *
17 * GIGLINX-INC.ear1.Atlanta2.Level3.net (4.35.6.114) 423.615 ms *
18 * * 63.247.65.18 (63.247.65.18) 285.174 ms
19 static-222-135-73-69.nocdirect.com (69.73.135.222) 269.383 ms * 269.575 ms
20 static-2-18.140.209.nocdirect.com (209.140.18.2) 268.934 ms static-222-135-73-
69.nocdirect.com (69.73.135.222) 269.110 ms 268.558 ms
21 static-2-18.140.209.nocdirect.com (209.140.18.2) 268.876 ms
268.609 ms 268.222 ms
22 * * *
```

```
traceroute to 203.191.48.229 (203.191.48.229), 30 hops max, 60 byte packets

1 161.200.25.126 (161.200.25.126) 0.637 ms 0.890 ms 1.252 ms
2 161.200.255.214 (161.200.255.214) 1.368 ms 2.530 ms 2.245 ms
3 * * ptw-cr-1-gi-0-1-1-to-chula-link-1.uni.net.th (202.28.212.221) 4.039 ms
4 * pyt-cr-04-te-0-6-0-2-to-0-0-0-gi-02-bdr-pyt.uni.net.th (202.28.218.22) 40.408 ms *
5 pyt-bdr-02-to-pyt-link-1.thairen.net.th (202.29.12.9) 3.319 ms * *
6 sg-ge-03-v4.bb.tein3.net (202.179.249.65) 75.894 ms * *
7 * hk-xe-03-v4.bb.tein3.net (202.179.241.101) 92.363 ms *
8 * 202.179.241.86 (202.179.241.86) 104.996 ms *
9 119.18.142.149 (119.18.142.149) 115.942 ms * *
10 * 119.18.143.74 (119.18.143.74) 121.510 ms *
11 203.191.48.229 (203.191.48.229) 125.108 ms * *
```

NETWORK INFRA Missing Links

Some missing fiber-optic links and insufficient capacity are identified in the member countries even though many regional connectivity programs have been undergoing

	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
Cambodia									
Indonesia									
Lao PDR	541 km								
Malaysia		1782 km							
Myanmar			235 km						
Philippines									
Singapore				C'way/Bridge					
Thailand	803 km		1,754 km	506 km	1,800 km				
Vietnam	1228 km		2130 km						

- Presence of Trans-border fiber
- No physical connection
  (Intra-ASEAN region)
  - Laos PDR-Myanmar
  - Malaysia-Indonesia(Borneo)
  - Vietnam-Philippines
  - Malaysia(Sarawak)-Philippines
- Insufficient bandwidth or capacity
  - Laos PDR-Cambodia
- International capacity pricing
  (Unreasonable to use)
  - Thailand-Cambodia

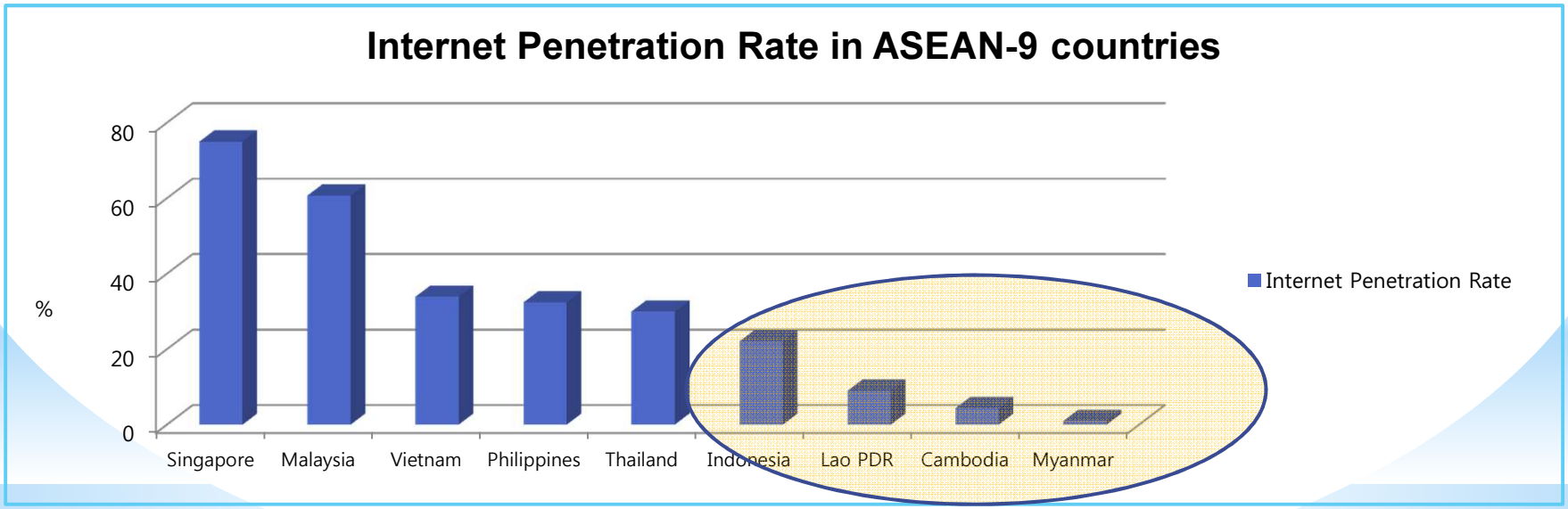
* Source : Terabit Consulting, 2013

DEMAND

Big gap on penetration exists inside region, narrowing the gap among the members should be one of the PACE's goals

	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
Internet Penetration Rate (%)	4.4	22.1	9.0	60.7	1.0	32.4	75.0	30.0	33.9
Rank	8	6	7	2	9	4	1	5	3

- Based on year 2012

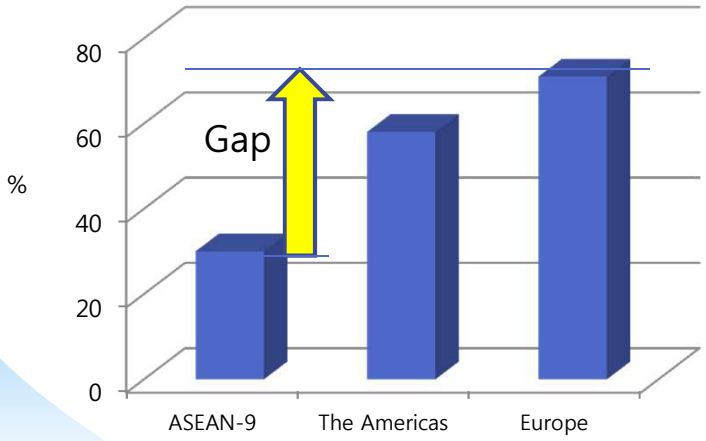


- Source: Terrabit Consulting

DEMAND

Average Internet and Smart Phone penetration in ASEAN-9 is relatively low but growth rate is higher than any other Region

	ASEAN-9	The Americas	Europe
Internet Penetration Rate (%)	30	58	71



ASEAN countries' high Internet market growth especially strong growth in the Internet enabled Smart phones

'Big' Internet Markets (India / Indonesia / Nigeria / Mexico / Philippines) = +20% Growth in 2013 = Strong, Material Penetration Upside

Countries with Internet Penetration ≤45%

Rank	Country	2013 Internet Users (MMs)	2013 Internet User Growth	2012 Internet User Growth	Population Penetration	Total Population (MMs)
1	India	154	27%	36%	13%	1,221
2	Indonesia	71	13	15	28	251
3	Nigeria	57	19	21	33	173
4	Mexico	46	11	14	38	119
5	Philippines	38	27	18	36	106
6	Egypt	38	13	29	44	85
7	Vietnam	37	14	16	39	92
8	South Africa	20	20	41	41	49
9	Pakistan	19	12	14	10	193
10	Thailand	18	12	6	27	67
11	Ukraine	15	17	22	34	45
12	Kenya	14	17	105	32	44
13	Venezuela	13	11	9	44	28
14	Peru	11	7	5	38	30
15	Uzbekistan	10	22	52	37	29
	Top 15	560	18%	24%	22%	2,532
	World	2,609	9%	11%	37%	7,098

@KPCB Source: United Nations / International Telecommunications Union, US Census Bureau. Indonesia Internet user data from APJII (12014). 156

Developing 'Big' Smartphone Markets (China / India / Brazil / Indonesia / Russia) = +32% Growth in 2013 = Strong, Material Penetration Upside Remains

Markets with ≤45% Penetration

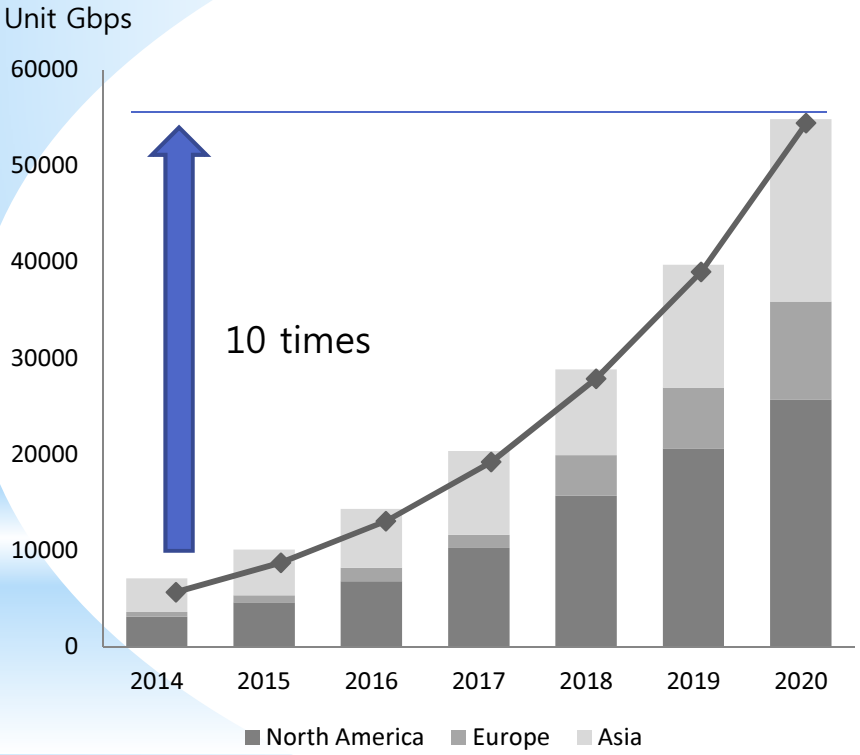
Rank	Country	2013 Smartphone Subs (MMs)	2013 Smartphone Sub Growth	Population Penetration	Total Population (MMs)	2014E Smartphone Sub Growth
1	China	422	26%	31%	1,350	19%
2	India	117	55	10	1,221	45
3	Brazil	72	38	36	201	30
4	Indonesia	48	42	19	251	36
5	Russia	46	30	33	143	27
6	Mexico	22	49	19	119	39
7	Egypt	21	41	25	85	36
8	Italy	21	33	34	61	41
9	Spain	21	20	44	47	17
10	Philippines	20	43	19	106	36
11	Nigeria	20	43	12	173	39
12	South Africa	20	32	41	49	27
13	Thailand	18	27	27	67	23
14	Turkey	18	32	22	81	28
15	Argentina	17	40	41	43	34
	Top 15	905	33%	23%	3,996	28%
	World	1,786	28%	25%	7,098	24%

@KPCB Source: Informa. 158

DEMAND

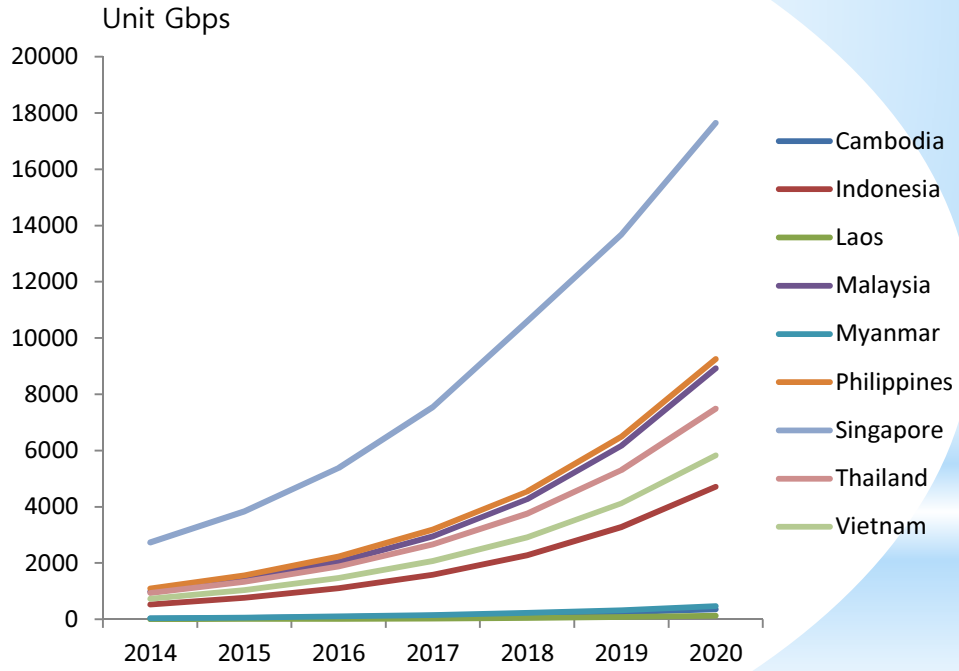
By combining Terabit data and international traffic ratio of other reference, APIS International total Network traffic can be calculated but should be re-calculated later

Traffic Volume by Regions



Source: assumption based on internal data

Traffic Volume for each member



Source : Terabit consulting, 2013

POLICY

Many ICT related Plans, Strategies and Projects have been created and undergoing by each member states, next ASEAN ICT Master Plan after 2015 is also under discussion in ASEAN Community. APIS seems not to be a simple matter but that of multiple collaboration and cooperation. Harmonized framework is another key factor for success of APIS

Cambodia	o National Strategic Development Plan o Draft ICT Policy o IT 21 o ITU National Broadband Policy	Philippines	o The Philippine Digital Strategy o Integrated Government Project, iGovPhil
Indonesia	o Indonesia ICT 2025 o Palapa Ring Project	Singapore	o iN2015 Master Plan o Next Generation National Broadband Network
Lao PDR	o Laos Vision 2020 o Nation ICT Policy o Laos e-Government project	Thailand	o Second ICT Master Plan 2009~2013 o IT 2010 o IT 2020
Malaysia	o MyICMS 886 Strategy o The 10th Malaysia Plan 2011~2015 o National Broadband Plan o National Broadband Initiative o National Creative Industry Policy o National IT Agenda o Spectrum management and reframing	Vietnam	o Vietnam's Posts and Telecommunication Development Strategy until 2010 and Orientation until 2020 o Public Telecommunications Service Program 2011~2015
Myanmar	o Myanmar ICT Master Plan o e-Government project		

* Source: CONEX, www.kisa.or.kr

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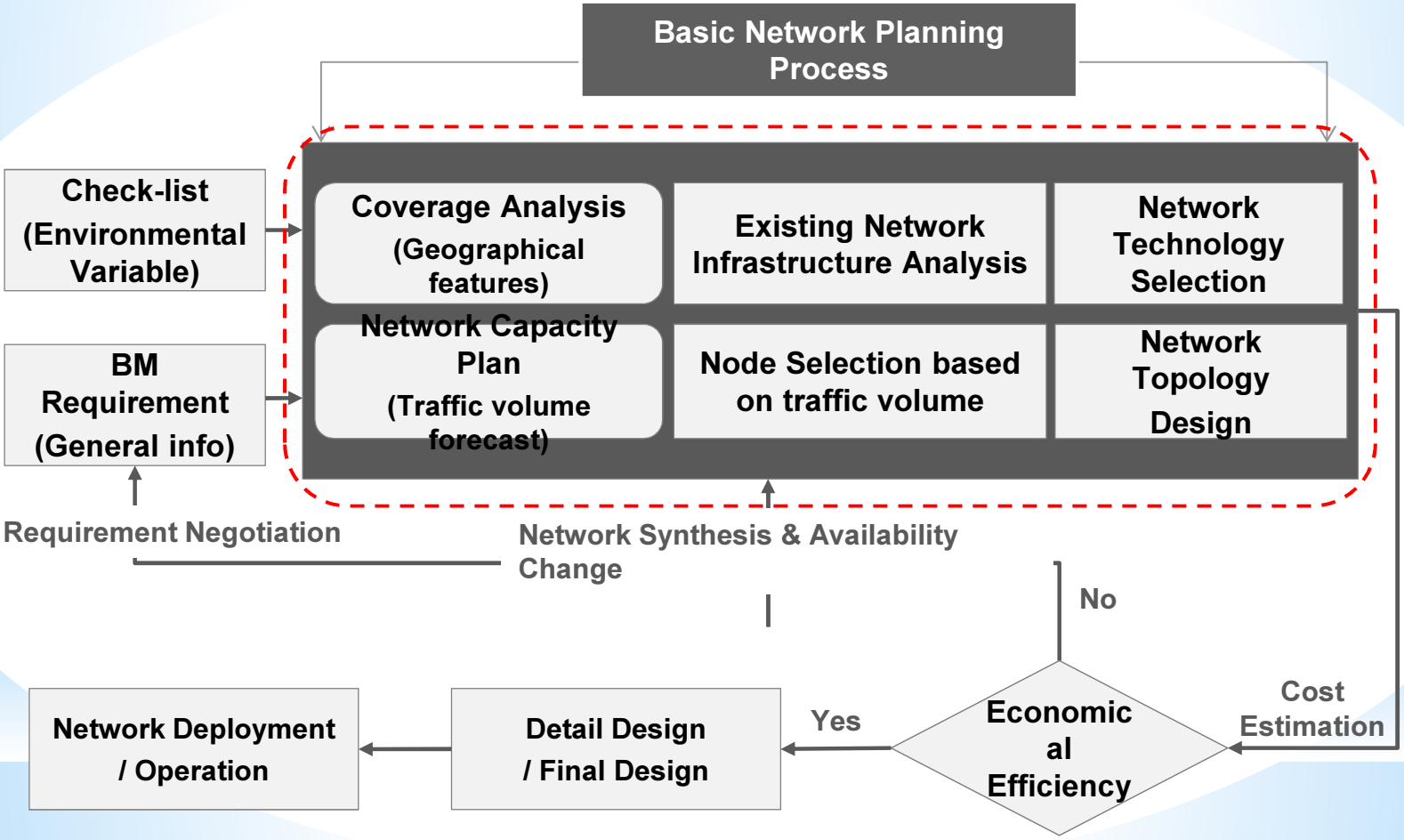
Introduction of Network Design : Process

It is possible to design network architecture and functions when service types have been clearly defined; to design network capacity when traffic volume has been identified



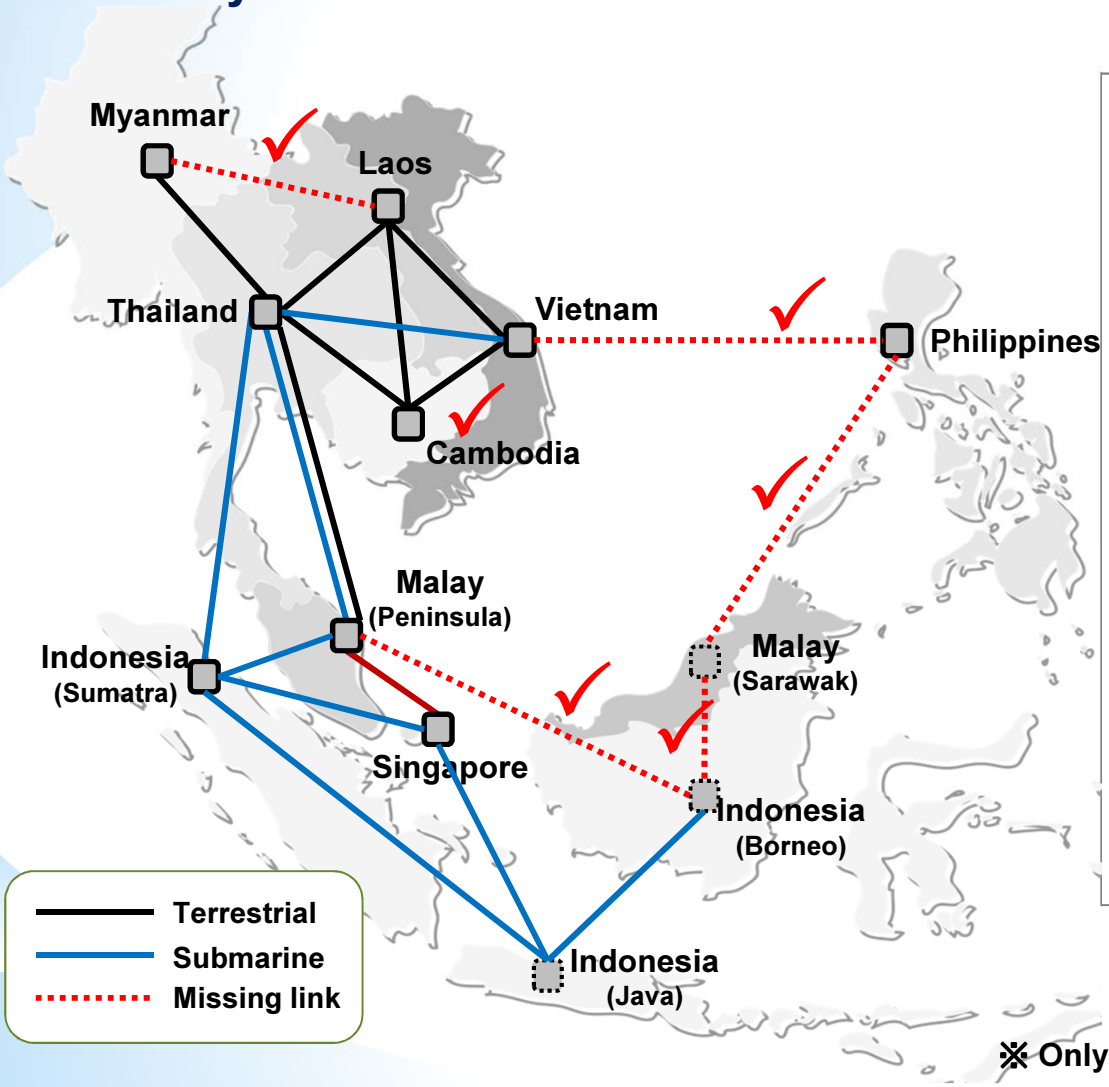
Introduction of Network Design : Traffic Modeling

There are several methodologies to estimate current and future traffic based on limited data. These methodologies may vary in different ISPs.

	Mean Value Computation	Trend Analysis	Comparative Analysis (Compensation)
Applied part	**Current Traffic Estimation**	**Future Traffic Estimation**	**Detailed Traffic Estimation**
Description	• Calculate by multiplying average traffic volume per subscriber by the total number of subscriber, while considering concurrent access rate of the service	• Compute the growth trend based on reliable growth rate data if past traffic data of the service to forecast is not available	• Refer to comparative data to yield detailed traffic data by applying similar pattern of a target country or ISP.
Condition	• Need to acquired data such as concurrent access rate or traffic volume per subscriber	• Need to secure reliable growth rate data and past traffic data of the service to forecast	• Need to secure reliable detailed data from target country or ISP
Pros	• Can use exact data if it is available	• Can use various options reflecting growth rate (e.g. Cisco VNI, GDP growth rate)	• Trustworthy, using similar countries growth as reference & comparing data
Cons	• Need to decide which criteria for calculation (population or internet user) is more reasonable	• Hard to forecast traffic, user growth rate • Need to use premade & accumulated traffic forecast methodology	• Various traffic growth depending on target countries' environment • Cannot reflect special characteristic of comparison country

International Backbone in ASEAN : current status

For utilizing existing network infrastructure, explicit current status will be mandatory.



Key Findings

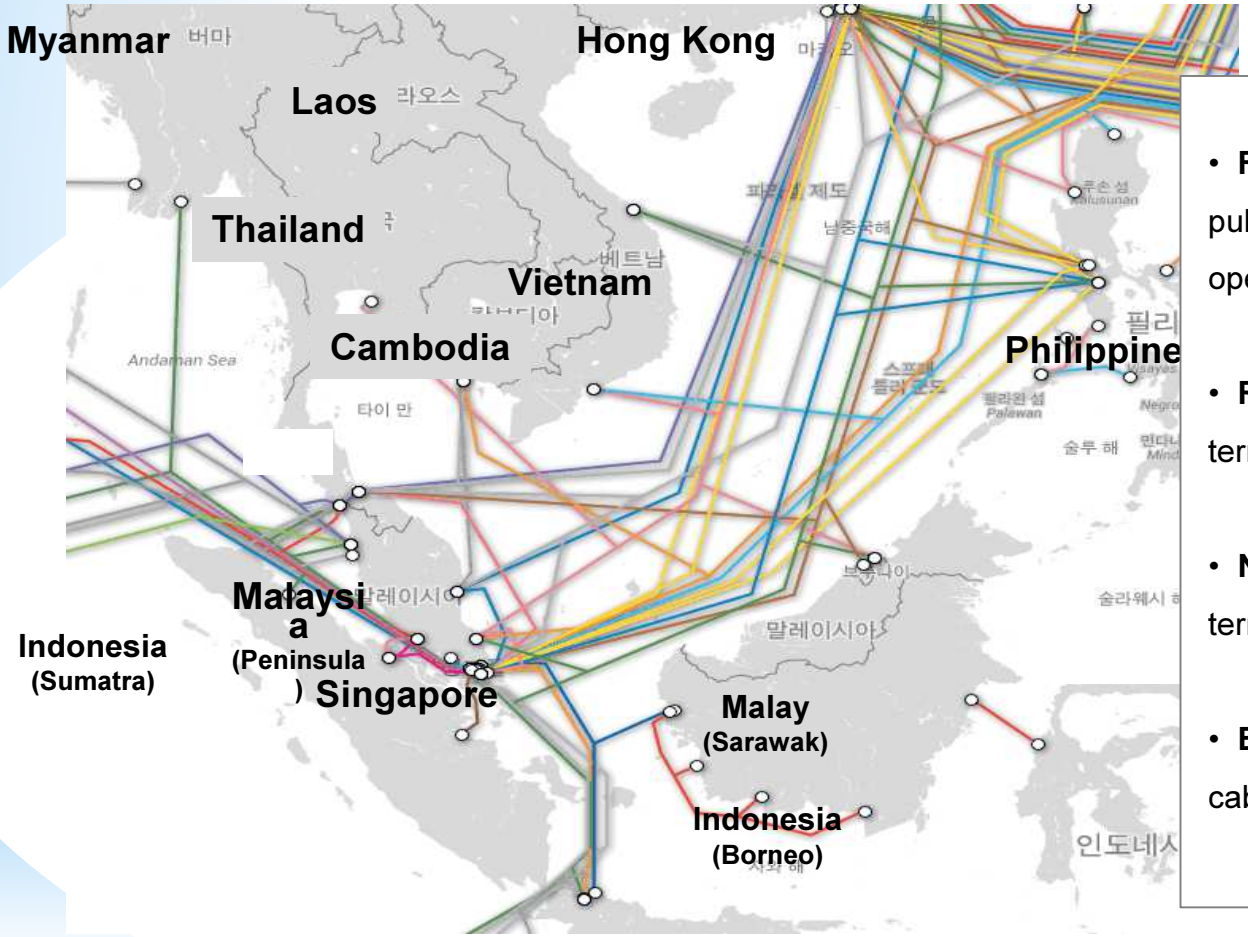
- **No physical connection**
  (Intra-ASEAN region)
  - Laos-Myanmar
  - Malaysia-Indonesia(Borneo)
  - Vietnam-Philippines
  - Malaysia(Sarawak)-Philippines
- **Insufficient bandwidth or capacity**
  - Laos-Cambodia
- **International capacity pricing**
  (Unreasonable to use)
  - Thailand-Cambodia

Source: Terabit report (2013)

※ Only ASEAN internal cable are considered

International Backbone in ASEAN : current status

Limited information of existing cable status is the one of the big challenges



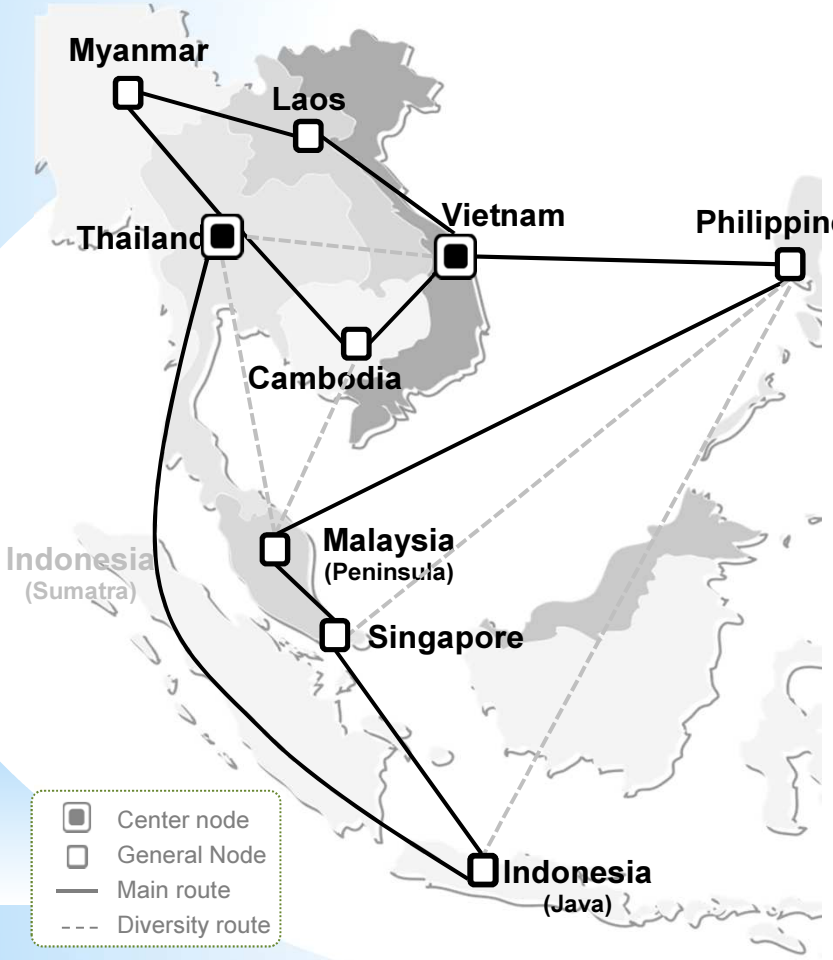
Challenges

- **Few data** of terrestrial cables in public media (Only submarine cables opened)
- **Regulation issues** to deploy terrestrial cable between countries
- **No guarantee** to use existing terrestrial and submarine cables
- **Expensive Cost** for submarine cables compared to terrestrial cables

Source: submarinecablemap.com

APIS Network Design : Physical and Logical Design Overview

These considerations will contribute to designing network topology, node, and link.

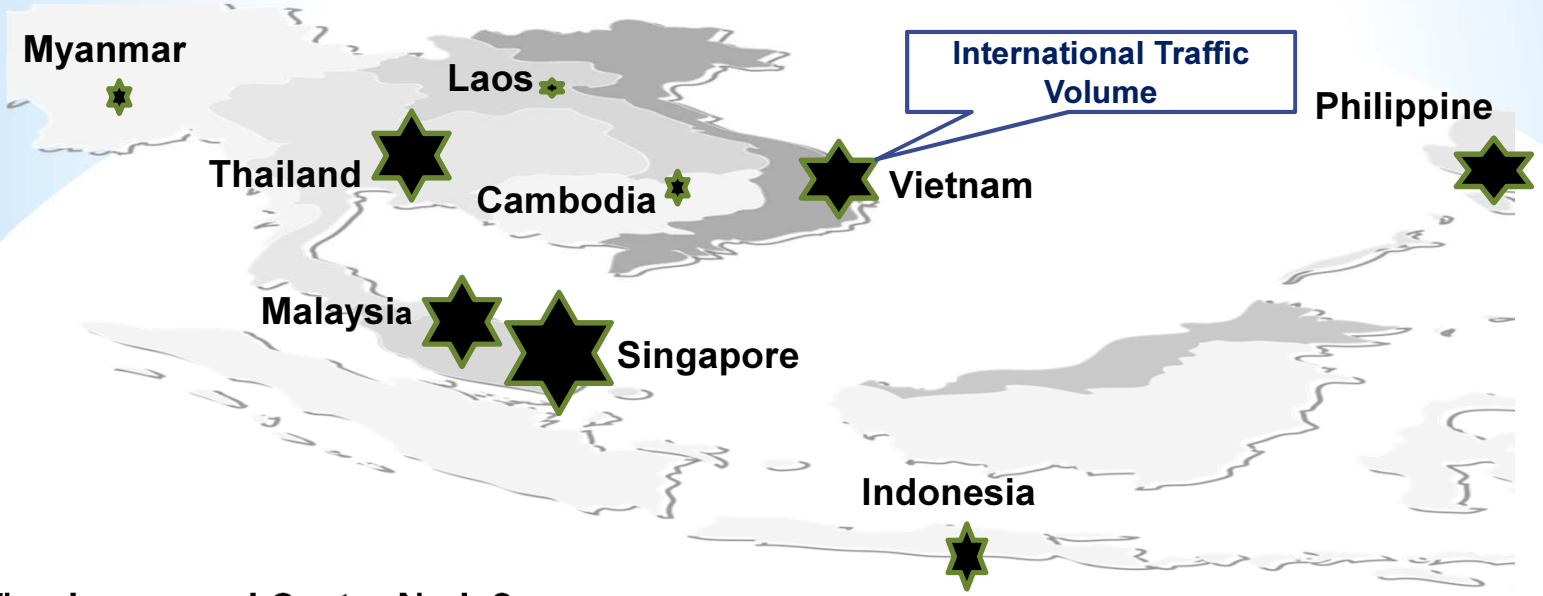


Considerations for Network Design

- **Geography**
  - Landlocked
  - City
  - Distance
  - Road
- **Infrastructure**
  - Cable
  - Equipment
  - Facility
  - Utilization
- **Capacity Plan**
  - Historical Traffic
  - Traffic Forecast
  - Traffic Flow
- **Logical Design**
  - Routing Protocol
  - Quality of Service
  - Redundancy

APIS Network Design : Necessity of Center Node

Location of Center Nodes can be determined at the best efficiency in consideration of international traffic volume and some other factors



Why do we need Center Node?

Operation view

- No matter what topology we may design, having center nodes make system efficient in the operation view
- As we handle the traffic mainly in the Center Nodes, less cost and resources are required
- As there are different infrastructure level within ASEAN countries, it is much more efficient to have Center Node where the infrastructure level is higher than other countries

Connectivity view

- From external connectivity view, having center nodes are much more efficient compare to having external connection in every country.
- Also in case of star and hybrid topology, it is essential to have Center Nodes to have connection within ASEAN countries

APIS Network Design : Center Node Selection

For APIS center node selection, geographic location, intra-ASEAN connectivity, and International connectivity are the important factors.

Country	Geographic location	Domestic Infrastructure	International connectivity	Intra-ASEAN connectivity
Cambodia	✡	✡✡	✡	✡✡✡✡
Indonesia	✡	✡✡	✡	✡✡
Lao P.D.R.	✡	✡	✡	✡✡
Malaysia	✡✡	✡✡✡	✡✡✡✡	✡✡
Myanmar	✡	✡	✡	✡
Philippines	✡	✡✡✡	✡✡✡✡	✡✡
Singapore	✡✡	✡✡✡	✡✡✡✡	✡✡
Thailand	✡✡✡✡	✡✡✡	✡✡✡✡	✡✡✡✡
Vietnam	✡✡✡✡	✡✡	✡✡✡	✡✡✡✡

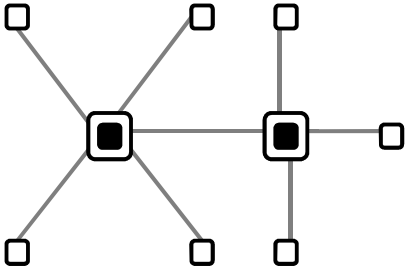
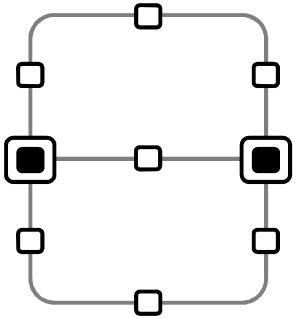
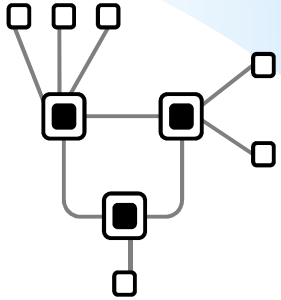
Considerations

- The most important consideration was about the geographic location. As this project is aiming for well-balanced system
- Domestic infrastructure such as IT, Transportation, Electricity infrastructure is one of the key factors for selection center node
- The International connectivity would be very important factor as it is related to the connection to TASIM and SASEC
- Intra-ASEAN connectivity is also important as it is directly related to the Capex of this project

* remark: Factors as below would also be the key factors or Center Node Selection
- Disaster: less disaster such as earthquake, tsunami area would be preferred
- Volume of Traffic: The area able to handle more traffic would be preferred

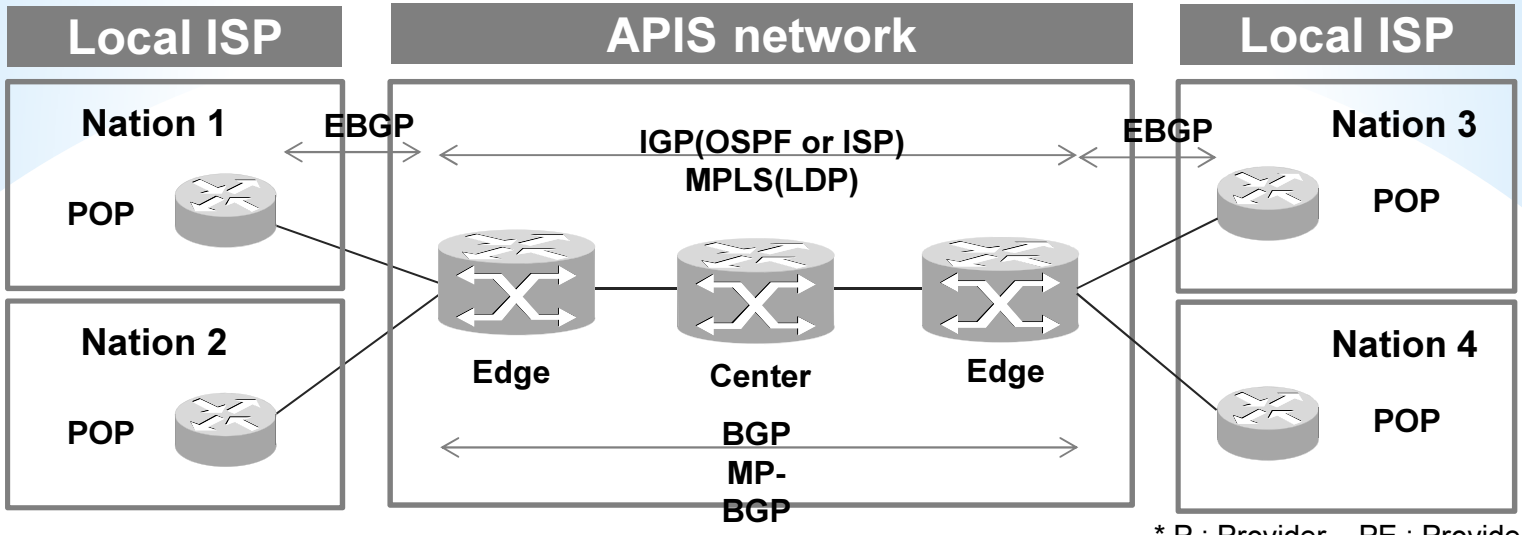
APIS Network Design : Physical Connectivity Modeling

Three types of topology design based on network design components

Index	Star	Ring	Hybrid (Ring+Star)
Topology			
	• Dual Center • Center ~ Edge: Star	• Dual Center • Center ~ Edge: Ring	• Three Center: Ring • Center ~ Edge: Star
CAPEX	• Medium	• High	• Low
Management	• Easy	• Hard	• Medium
Stability	• Low	• High	• Medium
Scalability	• Easy	• Hard	• Easy

APIS Network Design : Logical Design Model

To efficiently control the traffic flow, optimal routing protocols need to be designed and selected.

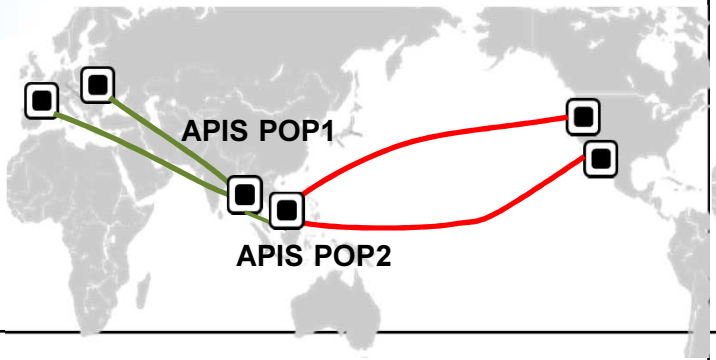
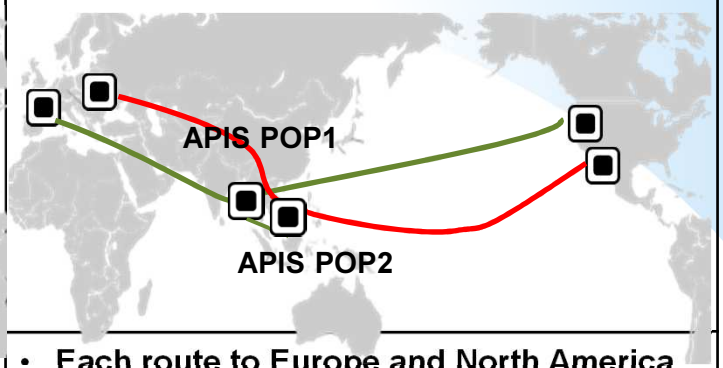


* P : Provider, PE : Provider Edge

APIS PE ~ Local ISP	APIS network (MPLS-VPN Backbone)
• Recommendation on adopting EBGP • Distribute bigger than C class address for the establishing routing table (Transit, Peering Policy) • Direct peering with other countries by APIS L2 VPN	• Run MPLS-LDP • OSPF or ISIS for the IGP • Implementing FC (Fast Convergence) • MP-BGP for transmit VPN Prefix, IPv6 • Providing L2, L3 VPN service

APIS Network Design : External Connectivity

For the fault tolerant interconnectivity to Europe and America, we need to have two POPs and links

Index	Option 1	Option 2
Topology		
Description	• 2 routes to Europe in POP1 • 2 routes to North America in POP1 • Connecting TASIM in POP1, SASEC in POP2	• Each route to Europe and North America in POP1 • Each route to Europe and North America in POP2 • Connecting TASIM in POP1, SASEC in POP2
Pros	• Minimizing the physical Latency	• In case of failure in one APIS POP, external connectivity would be secured
Cons	• In case of failure in one APIS POP, externa l connectivity would not be secured	• Physical Latency gets worse compare to option1
Considerations	• Physical Latency, Network Redundancy, Connectivity	
NA & Europe PoP (example)	• North America: San Jose, LA, Seattle • Europe: Amsterdam, London, Frankfurt	

※ POP: Point of Presence

APIS Network Design : Connectivity to SASEC, TASIM

SASEC : West Main POP (e.g. - Thailand),

TASIM: East Main POP (e.g. - Vietnam) in consideration of geo- spatial fiber cable route, latency

Collaboration

For more reliable and implementable Network Design, we need some more fact based information as below ;

ASEAN Connectivity

- Submarine & terrestrial **cable status**: Capacity, Route, stakeholder by country
- Submarine & terrestrial **cable usage** status by country
- **Transmission** topology, capacity, equipment status

Capacity Planning

- **International traffic** status by country
- **Traffic ratio** by continent such as North America, Europe, and Asia
- Domestic/International **traffic forecast** (-2020)

Node Positioning

- Existing **IXP location** by country
- Top 3 cities of **traffic volume**
- City disaster occurrence by country

Collaboration with ASEAN through APIS Working Group

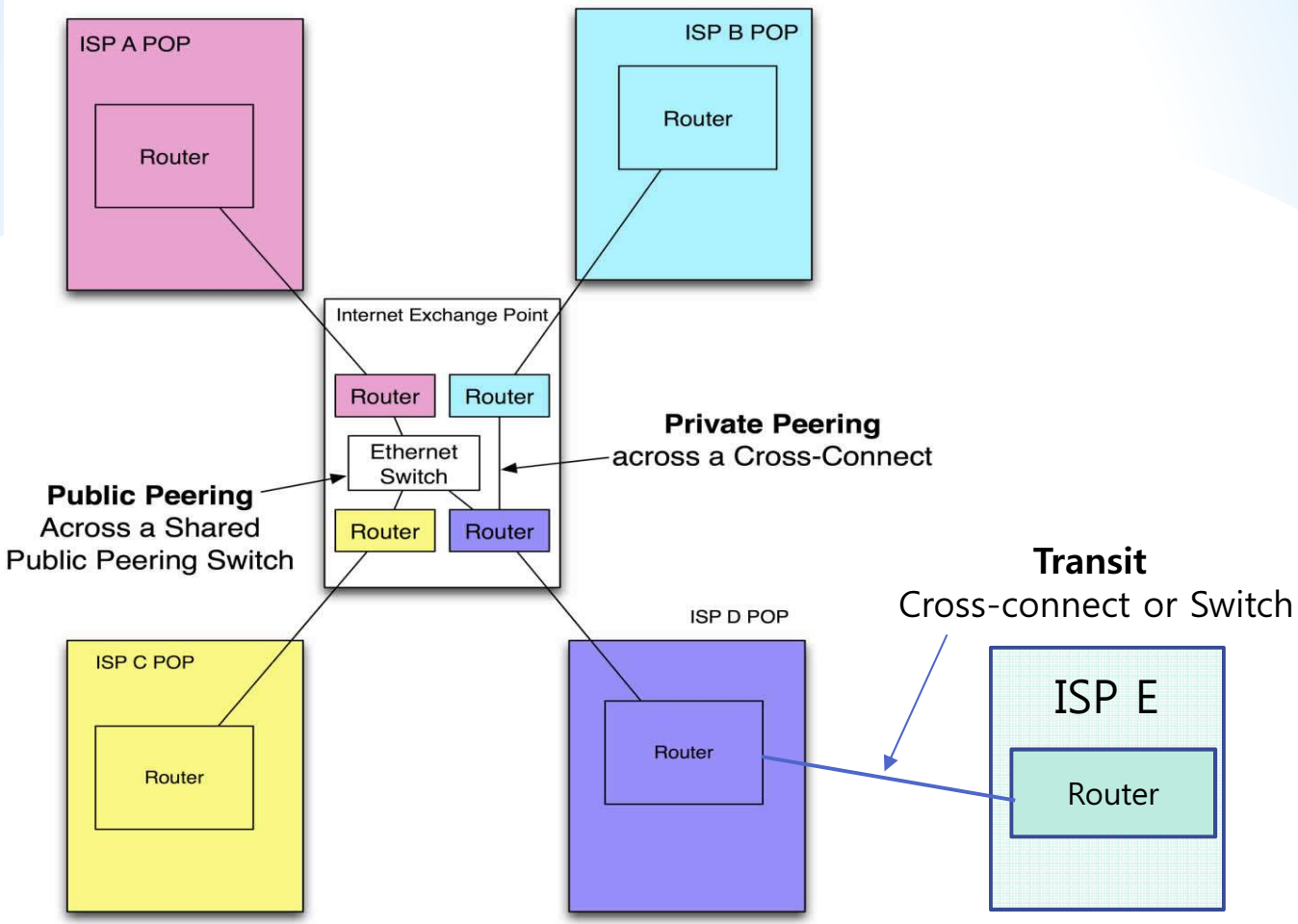
IXPs : Roles & Benefits

According to the growth of Internet Traffic Volume, number of Internet Service Provider, Contents Distribution Network Operator and Large Scale Network Savvy Content Providers since 1990', IXPs serve as a meeting points between local networks and exchanging points traffic in/out abroad

The benefits in having a local IXP are:

- Reducing international transit costs
  - better utilization of international bandwidth
  - local content does not flow through international transit and back again
- Improving QoE and QoS by reducing geographical distance from local content and network latency
- Encouraging hosting of local content
  - local Internet ecosystem
  - infrastructure, content cache, local content development
  - e-application and e-government
- Pulling in international content (e.g. Google) and content delivery infra (e.g. CDN)

IXPs : Typical Feature

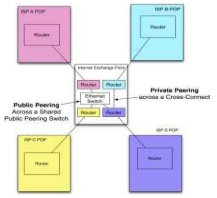


IXP : Implementation Model

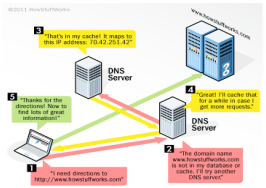
- **Common elements for Establishing Internet Exchange Infra**

. Domestic Bandwidth Production
. Local Loop Infra by ISP to carry bandwidth to users
. International Capacity that allows them to reach foreign destination
. Publication of Content

- **Key Element for well established Eco-system**



IXP



DNS
ENUM
IPv4,IPv6

Local Content (CDN)

Regulation (Competition)

Regional & International Connectivity

IXP： Operational Model

Selecting the best IXP operational Model is one of the important issues to be determined, mixed Euro and US model can be considered

Factors for IXP Model		Recommendation	Comments	Similarity
Neutrality	Carrier	Neutral	Open Competition by Equal Access to the Network	Euro Model
	ISP	Neutral	Fair market competition	Euro Model
	Colocation	Optional	Utilize the Major Carriers or Public Organization that has Existing Network Infra	Mixed
Organization		Not for profit	Best for new comers	Euro Model
Pricing		Cost based	Not for profit means cost based pricing	Euro Model
Pricing flexibility		Fixed and equal	Lower the entrance barrier to the ISP who want to peer	Euro Model
Contract		One contract for all Colo and Peering	Simple and easy to peer	USA Model
Peering Fabric distribution	Domestic	Connected with Fiber	One contract in Domestic peering	Mixed
	Cross Border	Optional	Utilize the Major Carriers or Public Organization that has Existing Network Infra	Mixed
Peering Model		Public	Equal condition of connect for new players	Euro Model
Information Shared		Openly	All the information shared	Euro Model
Cross Connects		Colocation operate Cross Connect Fabric	Reduce duplication of Connect Fabric	USA Model

Table of Contents

Time Table

Description	Stages	Time Frame
▪ Provide related ESCAP's studies, data in ESCAP's broadband back bone map, Asian Highway Agreement and other related documents	1st Stage	by 15/08/2014
▪ Facilitate collaborations between related experts and the Partner Institution		by 31/08/2014
▪ First workshop (Korean experts)		by 31/08/2014
▪ Examine related data/documents and conduct secondary data analysis		by 31/09/2014
▪ Participation and presentation in the South Asia regional Expert C onsultation Meeting and CICT		by 31/10/2014
	2nd Stage	by 30/11/2014
▪ Submission of the first interim report: Conceptualization of Asian Information Superhighway	3rd Stage	by 31/12/2014
▪ Second workshop (Korean + ASEAN experts)		by 31/01/2015
▪ Gap analysis between As-is and To-be in international backbone c onnectivity of ASEAN		by 31/03/2015
▪ Submission of the report draft		by 30/04/2015
▪ Review and comments on the report draft		by 31/05/2015
▪ Submission of the final report		by 31/07/2015

Already finished

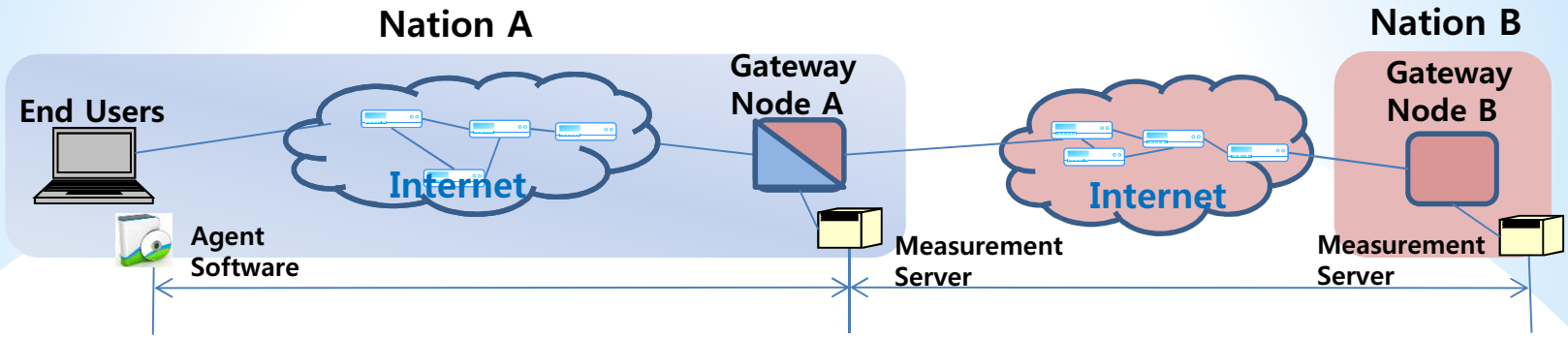
Data to be measured or surveyed

Measuring the Internet Service bandwidth/speed, packet loss, delay/latency, traffic routes analysis among ASEAN 9 countries

*** ASEAN 9 : Singapore, Malaysia, Thailand, Vietnam, Philippines, Indonesia, Cambodia, Lao PDR, and Myanmar**

	Items	Unit	Method	Comments
Inter national	Internet Speed	Mbps	Amount of packets per second from a source to a destination	
	Packet Loss	%	Amount of packet lost at a destination per total packets transmitted from a source	
	Delay/Latency	msec	Round trip time from a source to a destination	Data in Some countries available, but 3 countries, Cambodia, Lao PDR, Myanmar unavailable
	Trace Route	hops and routes	Packet route and hops when a packet pass from source to destination	
Domestic	Internet Speed	Mbps	Amount of packets per second from a source to a destination	
	Packet Loss	%	Amount of packet lost at a destination per total packets transmitted from a source	
	Delay/Latency	msec	Round trip time from a source to a destination	

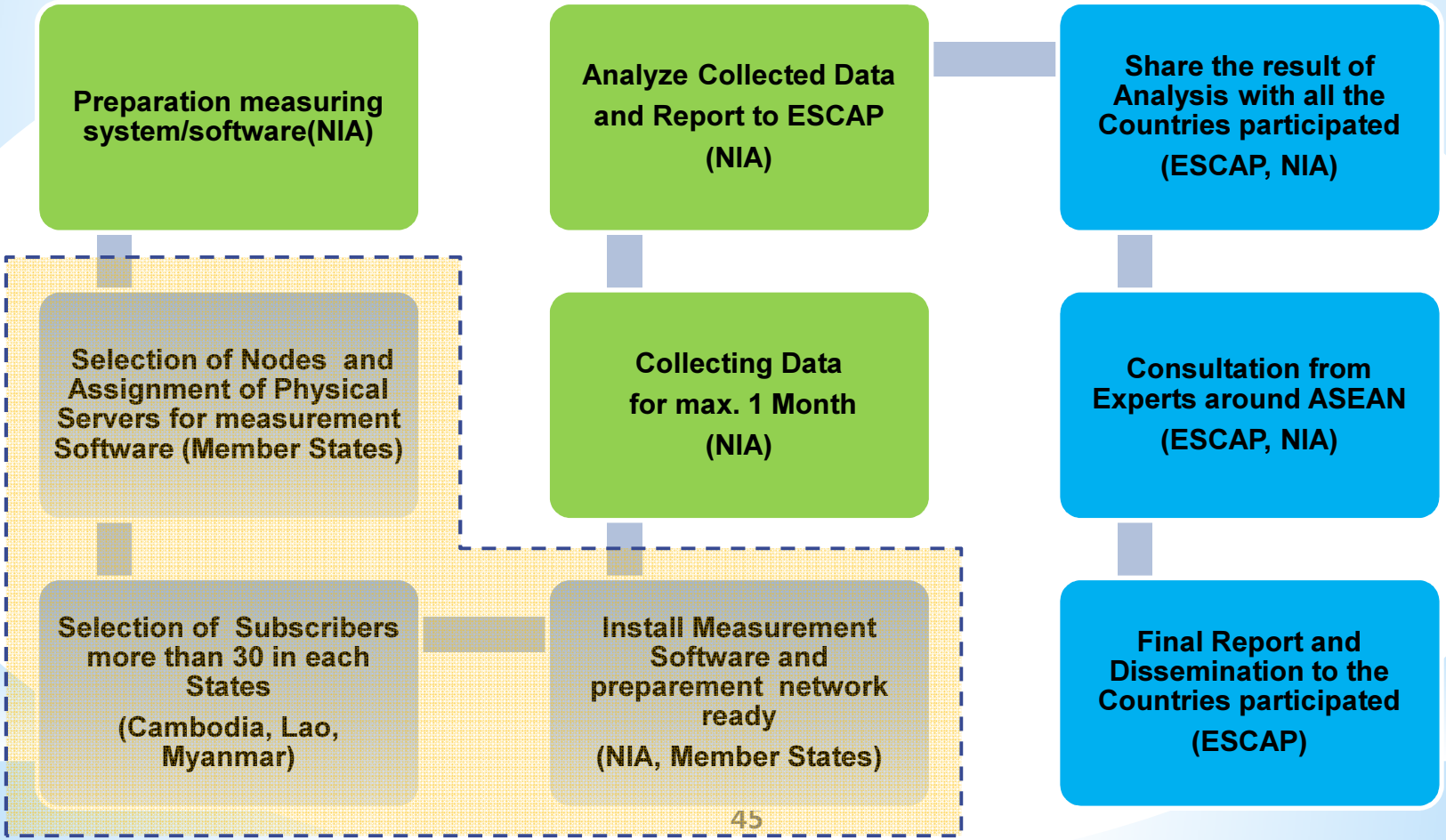
Figure of Measurement



	Domestic Internet	International Internet
Interval	From End User to Measurement Node	Between Gateway Nodes
Metrics	Internet Speed, Packet Loss, Delay/Latency	Internet Speed, Packet Loss, Delay/Latency, Routing Analysis
Nations	Cambodia, Lao PDR, Myanmar	ASEAN 9 States
Local Arrangement	- Selection of minimum 30 Subscribers per nation and download the Agent Software to the subscriber's computers - Selection of Gateway Node, measurement software installation and Internet ready in the Gateway Node	- Selection of Gateway Node, measurement software installation and Internet ready in the Gateway Node

Measurement Procedure

It takes about two months to measure Internet services, after selecting nodes, preparing measurement servers and installing software and agent program. Shaded area is especially what UNESCAP request you to cooperate with NIA.



Hardware Server Minimum Requirement for the Measurement

H/W	Server in the Node	• CPU Intel Quadcore 2.4Ghz , Memory 4Gbyte or more • 80G HDD x 2(RAID 1 mirroring), 1000Base-T NIC x 2 • Linux 2.6.18 OS or beyond	1 set per Node (Total 9 Servers in t he Region)
	Agent Progra m at the Subs criber	• CPU Intel Core2 DUO 1.4Ghz , Memory 2GByte • 100/1000 Mbps Gigabit Ethernet Interface • OS Winows 7 or beyond	30 PCs (30 Subscribers)

* Other utilities such as Space, Electric power, Local Networking readiness are required to remain as usual

Discussion

* Questions or Comments on the Presentation
* Discussions for…
  - Internet Traffic and Speed Measurement
  - Local Arrangements and Interview
  - Broadband Service Status and Future Demand Update
  - …

Thank you

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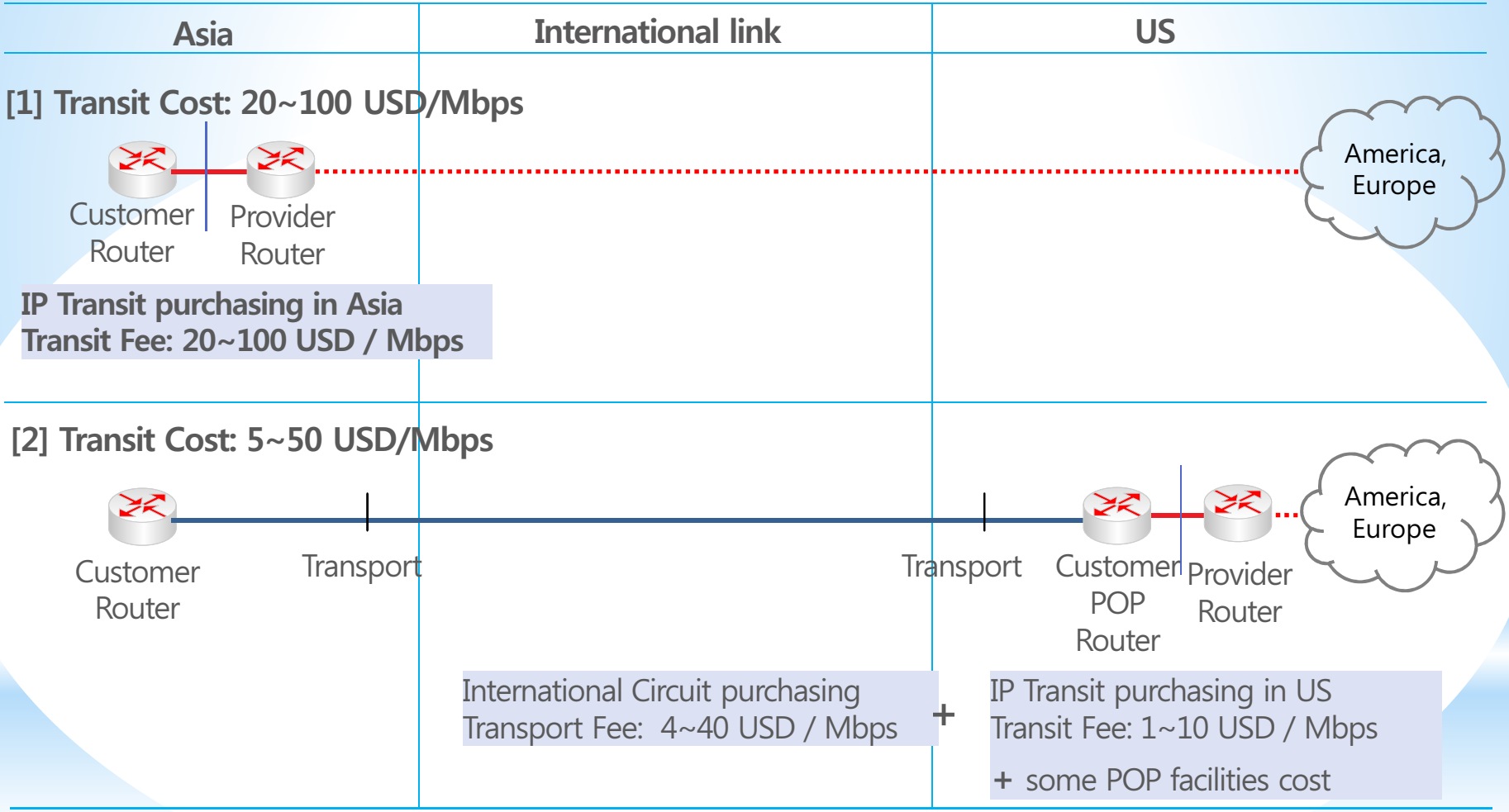
* [Ref.] Global IP Transit Cost (to US)



* If International circuit (Connectivity↑), IP transit cost decreased.
* Transit Cost = Circuit Transport Fee + Transit Fee