NIA
NATIONAL INFORMATION SOCIETY AGENCY

Internet Traffic and Network Management
- Lesson Learned -

December 7, 2016

Yeong Ro, LEE
lyr@nia.or.kr

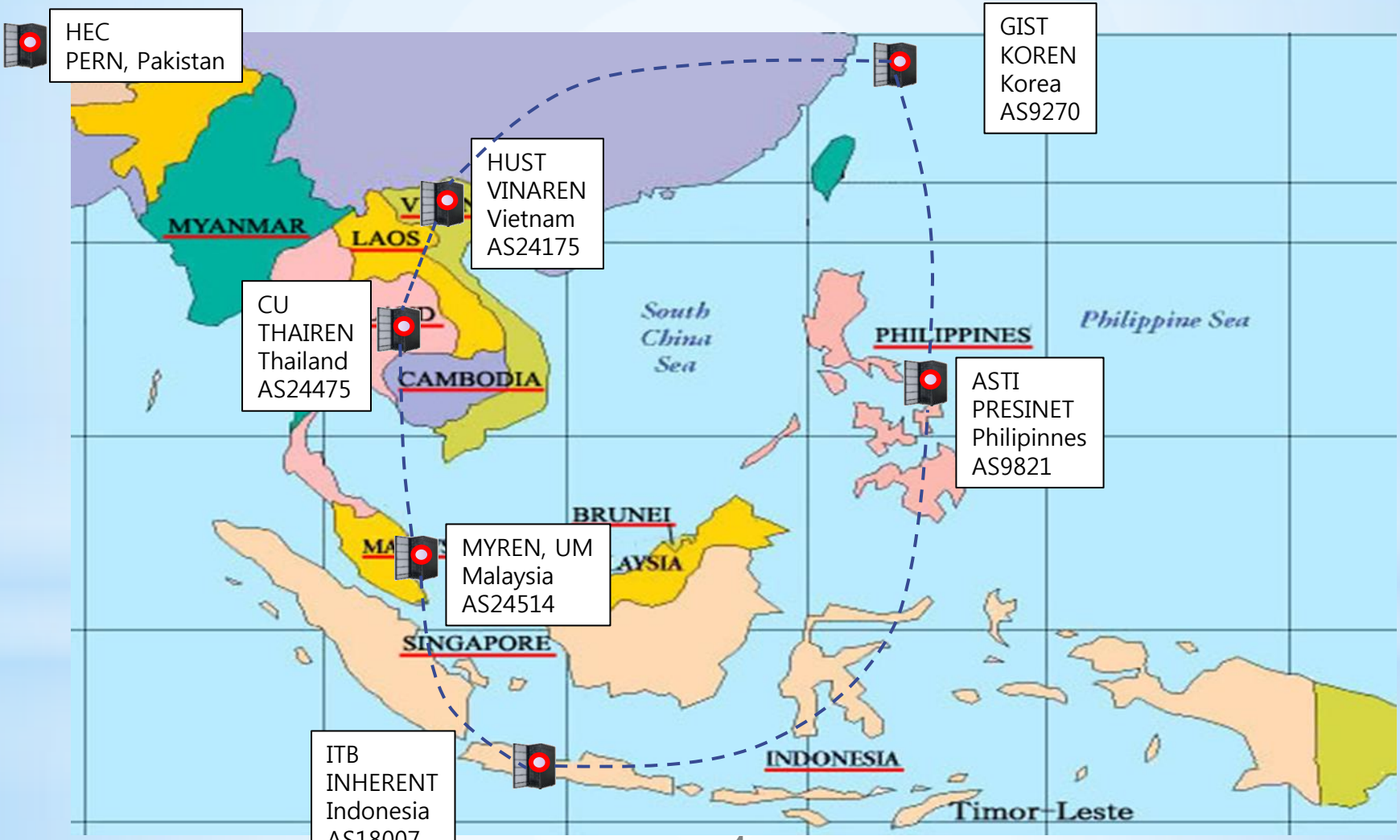
Internet traffic and network management is one of the four pillars of focus for AP-IS. In a recent ESCAP study on broadband networks in the Association of Southeast Asian Nations (ASEAN) subregion, findings show that **the lack of diversity in ICT internet connectivity reduces competition and increases the cost of access to global internet networks, including via submarine cables. The study found a varied level of costs for Internet transit connectivity, which is correlated with the cost of fixed broadband subscriptions.** Landlocked developing countries, where other constraints such as power supply are prominent, have particularly been vulnerable to this challenge.

Case Study for the ASEAN Sub-region

. Test Server Selection
. Target Nodes Selection
. Results of the Measurement

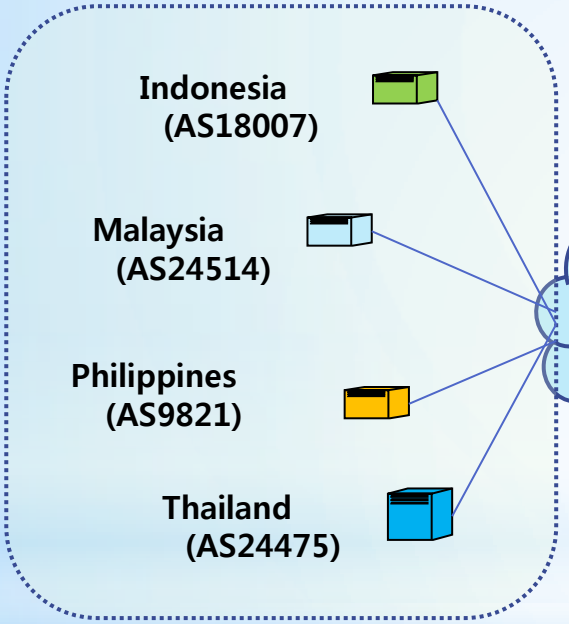
Test Systems Location in TEIN

Internet Traffic & Quality Measurement among 5 countries :Vietnam, Malaysia, Indonesia, Thailand and Philippines



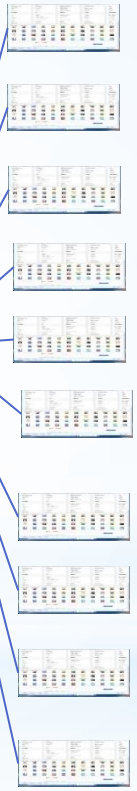
Source Nodes and Target System

Source Nodes on TEIN



International Commercial Network)

Target Nodes on Ookla



Phnom Penh, Cambodia,
(MekongNet)

Vientiane, Lao PDR,
(Lao Telecom)

Jakarta, Indonesia
(Telekomunikasi Indo, Biznet, CBN,
Qiandra Information)

Kuala Lumpur, Malaysia,
(U-Mobile, Maxis)

Yangon Myanmar,
(Redlink Communications)

Manila, Philippines,
(SKY Broadband, Dunham Bush International

Bangkok,Thailand
(Shama Thunder, Internet Thailand PCL,
PEA, CS LOX INFO)

Hanoi, Vietnam
(Viettel)

Singapore
(Singtel, Viewqwest Pte, SGIX)

Brunei
(DST Comm)

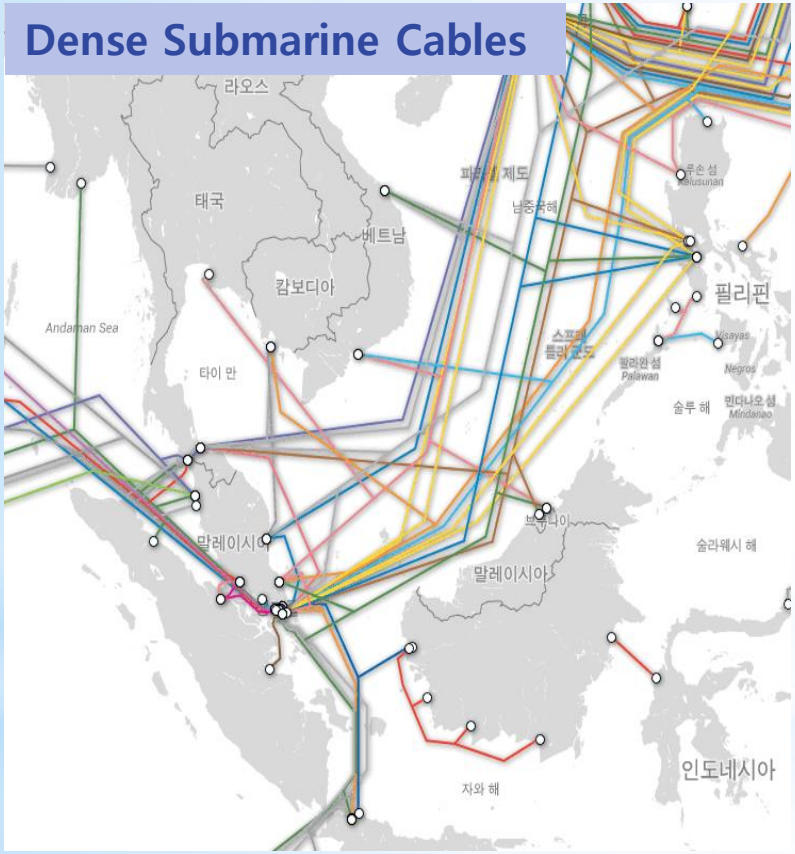
ASEAN Case Study

Summary of the test results

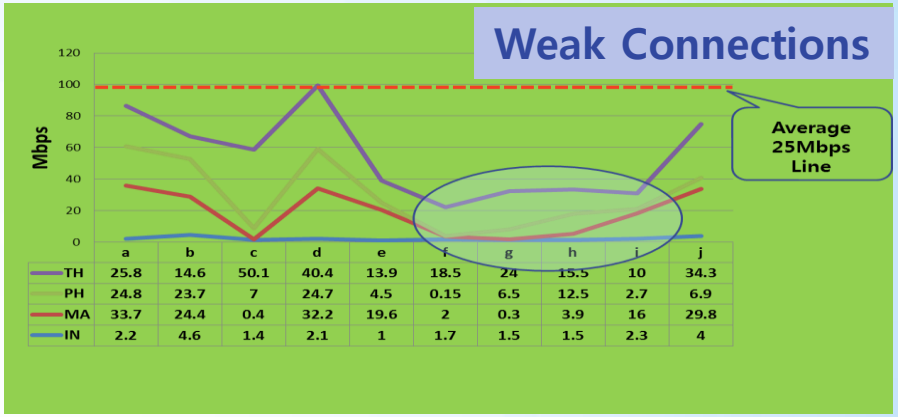
Destinations		Speed (Mbps)		Latency (msec)	No. of Hops	Trace Route		
To (Target)	ISP (Target)	Down	Up			Tromboning Index(B/A)	Geo. Distance (km) -A	Routing Distance (km)-B
B	B-1	24.8	42.9	112.1	8(3)	13.6	1770.3	24050
C	C-1	23.7	46.6	129.6	8(0)	2.1	2816.4	5949
	C-2	8.5	4.6	88.7	14(0)	9.7	2816.4	27201
	C-3	7.5	7.1	109.8	8(2)	10.1	2816.4	28317
	C-4	0.7	6	120.1	13(0)	1.7	2816.4	4850
D	D-1	7	20.8	124.5	12(1)	13.6	2011.7	27352
E	E-1	11	22.3	76.8	5(26)	10.0	2494.5	25049
	E-2	24.7	55.1	66.8	7(0)	1.5	2494.5	3768
F	F-1	4.5	7.6	145.1	13(18)	11.8	2655.4	31281
G	G-1	0.15	0.02	156.6	6(9)	300.0	80.5	24153
	G-2	4.2	3.1	1	8(0)	297.4	80.5	23941
H	H-1	7.3	46.9	108.8	15(0)	12.3	2172.6	26792
	H-2	6.5	5.4	106.7	12(11)	2.0	2172.6	4259
	H-3	22.4	20.3	103.7	20(3)	10.4	2172.6	22699
	H-4	5.5	1	120.5	9(0)	11.7	2172.6	25437
I	I-1	12.5	39.1	93.5	5(3)	2.4	1770.3	4169
J	J-1	2.7	2.6	136.1	7(24)	20.9	1287.5	26915
K	K-1	5.3	4.4	73	5(2)	1.5	2414	3701
	K-2	6.9	2.4	71.3	6(1)	11.1	2414	26882
	K-3	2.2	1	126.6	6(25)	10.3	2414	24961
	K-4	3.4	2.5	123.8	11(2)	10.4	2414	25049

Weak Connectivity and Tromboning

Dense Submarine Cables

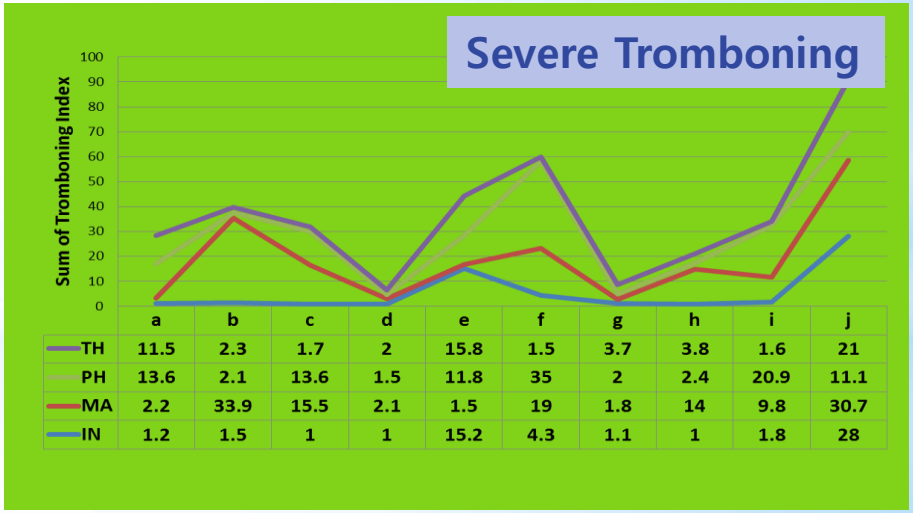


Weak Connections



	a	b	c	d	e	f	g	h	i	j
TH	25.8	14.6	50.1	40.4	13.9	18.5	24	15.5	10	34.3
PH	24.8	23.7	7	24.7	4.5	0.15	6.5	12.5	2.7	6.9
MA	33.7	24.4	0.4	32.2	19.6	2	0.3	3.9	16	29.8
IN	2.2	4.6	1.4	2.1	1	1.7	1.5	1.5	2.3	4

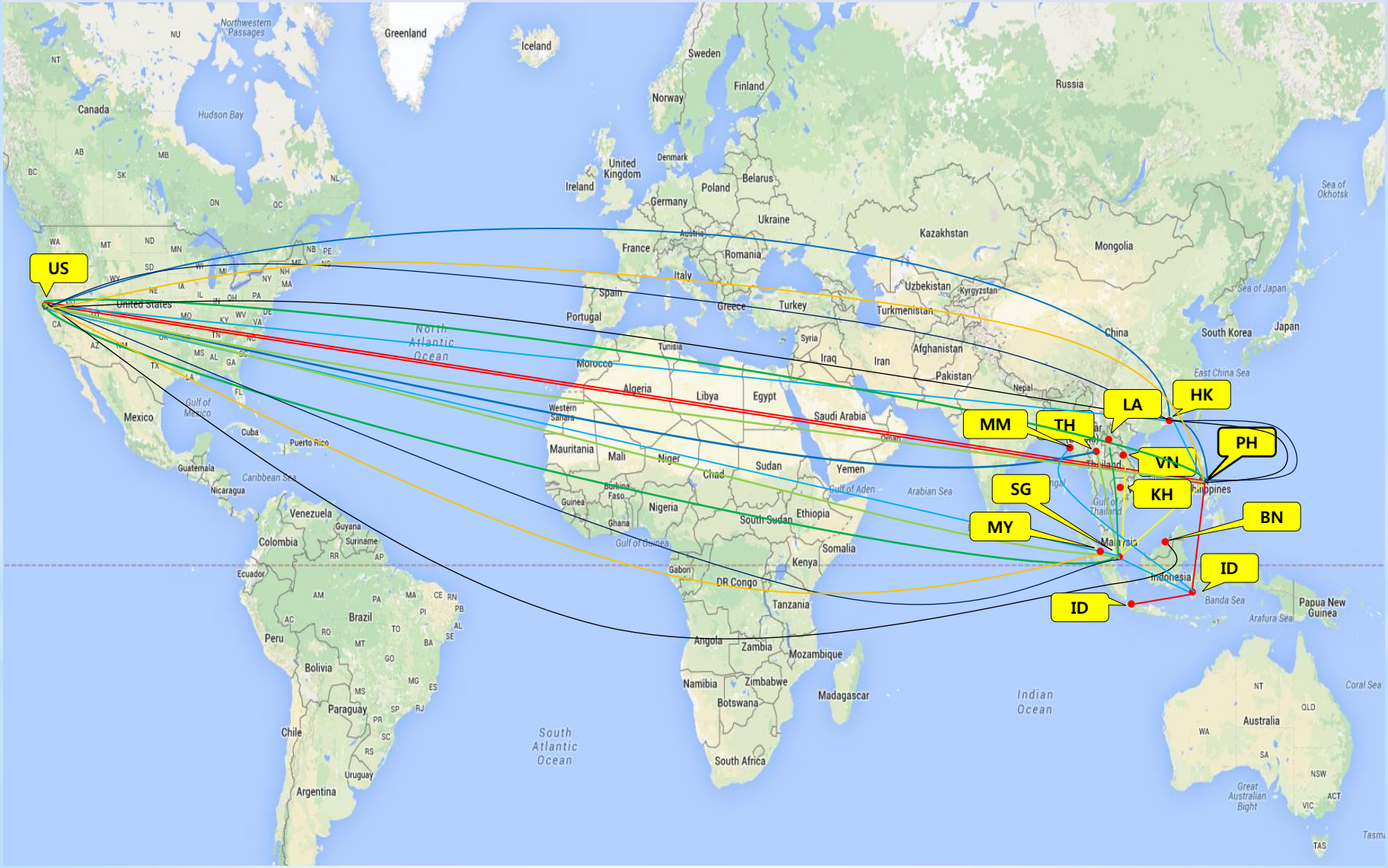
Severe Tromboning



	a	b	c	d	e	f	g	h	i	j
TH	11.5	2.3	1.7	2	15.8	1.5	3.7	3.8	1.6	21
PH	13.6	2.1	13.6	1.5	11.8	35	2	2.4	20.9	11.1
MA	2.2	33.9	15.5	2.1	1.5	19	1.8	14	9.8	30.7
IN	1.2	1.5	1	1	15.2	4.3	1.1	1	1.8	28

Internet Routing Map from A to Neighboring States

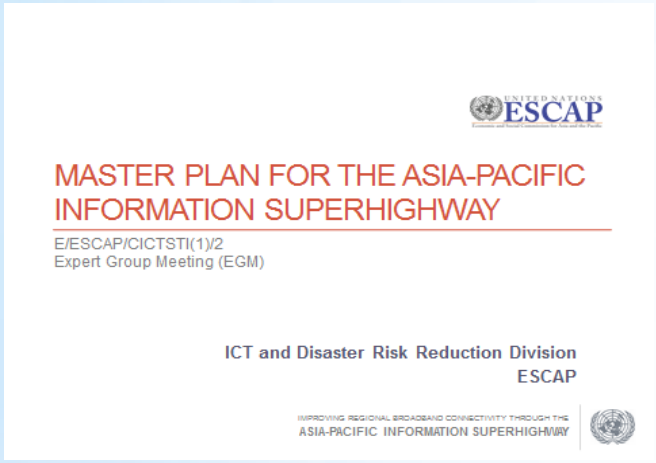
Routing Map

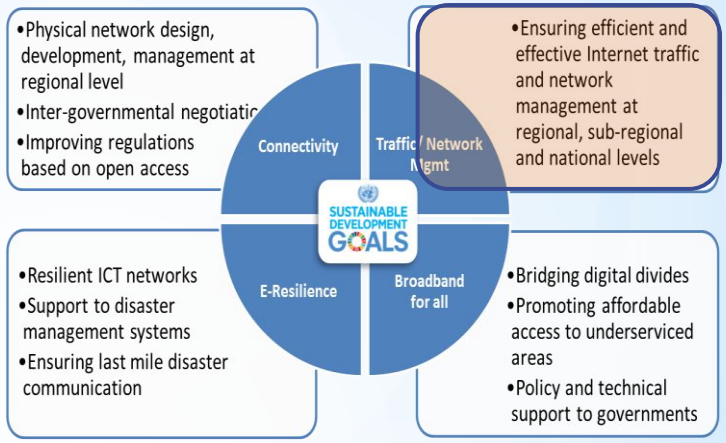


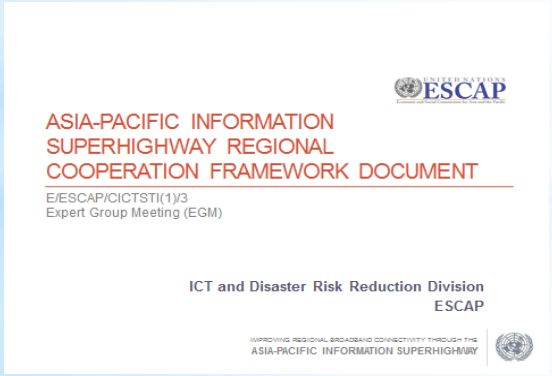
Internet Routing Map from A to Domestic City

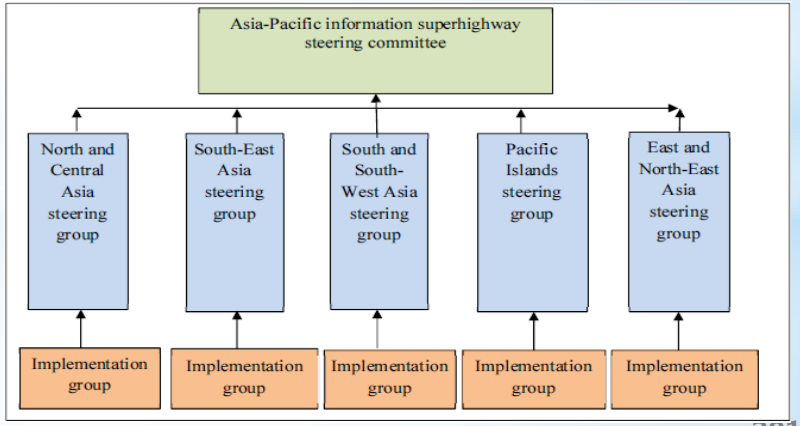
Routing Map

Master Plan & RCF





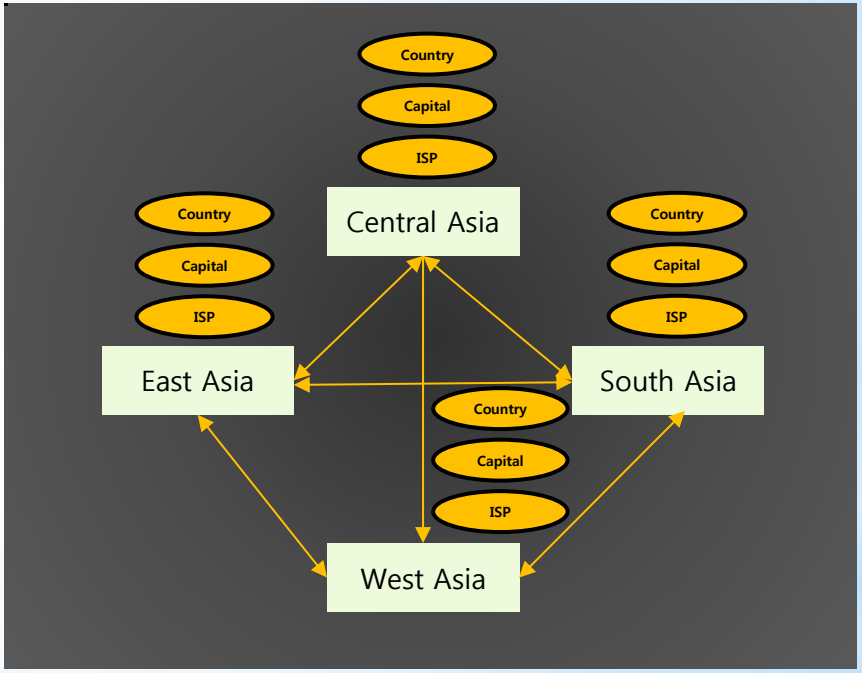




Trial Tests for the other Sub-regions

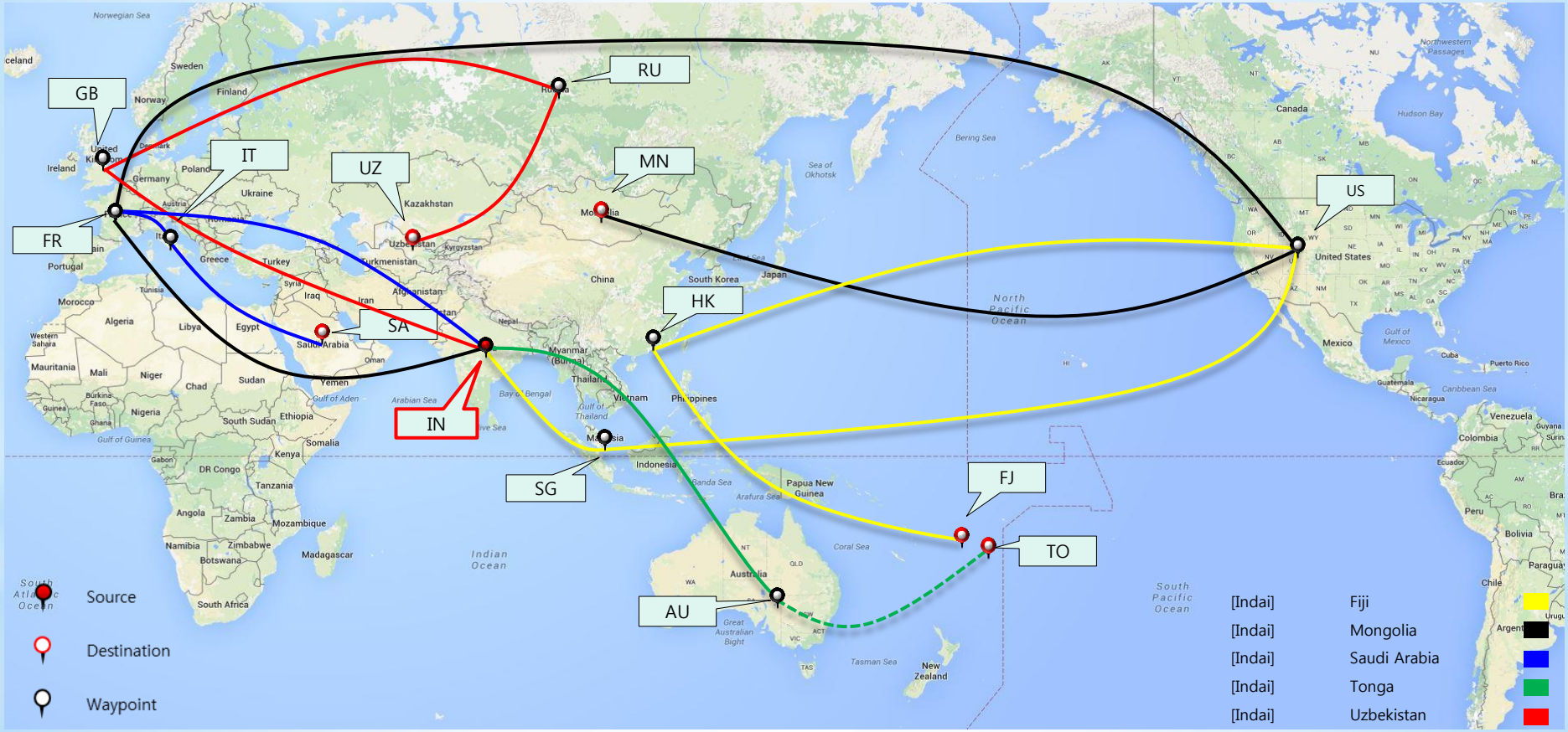
Test Server & Target Selection I

Sub-region	Country	City
Central Asia	Uzbekistan	Tashkent
East Asia	Mongolia	Ulaanbaatar
South Asia	India	New Delhi
	Nepal	Kathmandu
West Asia	Saudi Arabia	Riyadh



It was possible with the Nepal and Mongolia's cooperative support

Internet Routing Map

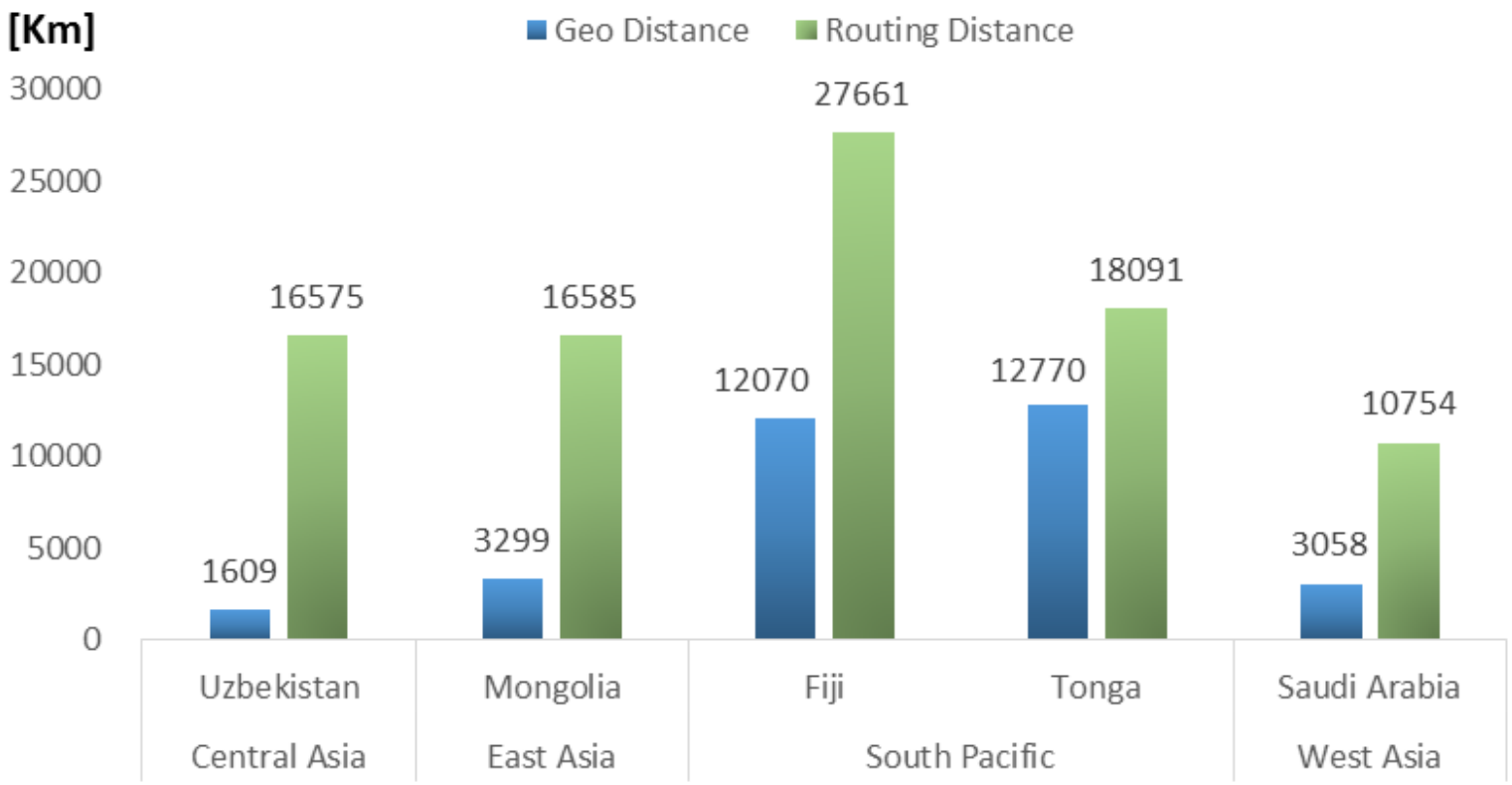


Summary of Test Results

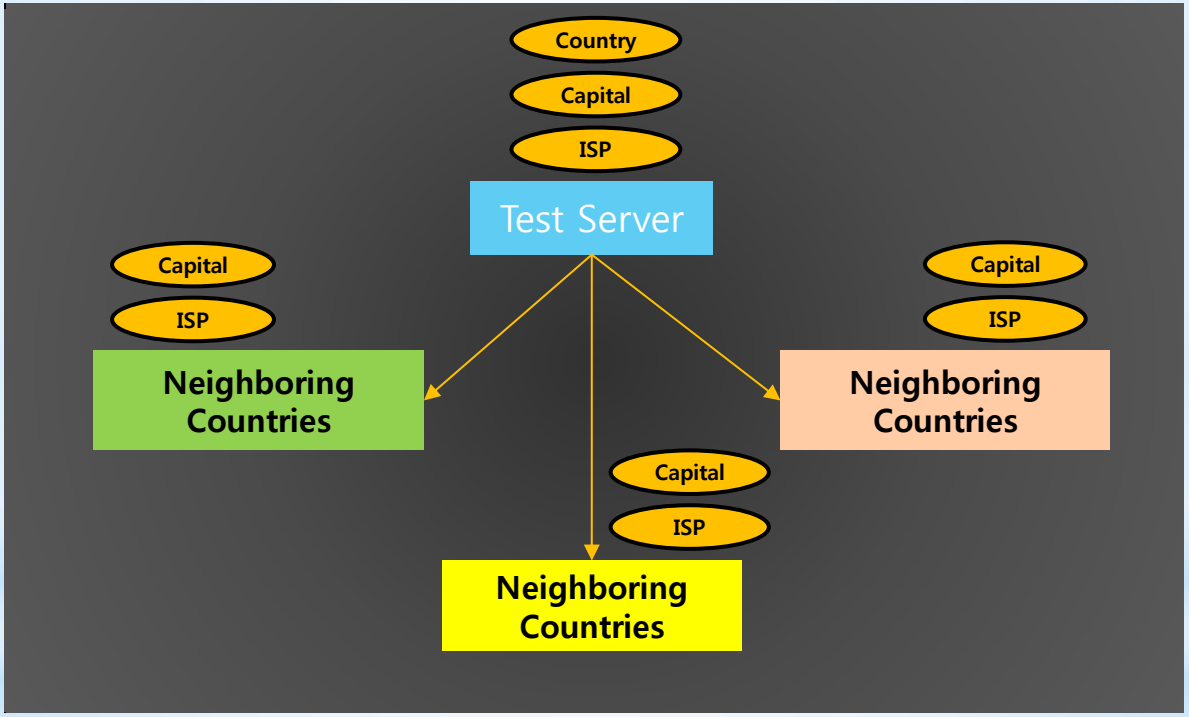
- Source: India
- Target : 4 other sub-regions

Source	Destination			DOWNLOAD (Mbps)	UPLOAD (Mbps)	LATENCY (MS)	SERVER_NAME	Geo. Distance (Km) - A	Routing Distance (Km) - B	Tromboning Index [B/A]	No. of Hops
Continent	Target Sub-region	Target Country	ISP								
South Asia - India	Central Asia	Uzbekistan	Beeline Uz	4.92	0.37	309	Tashkent	1609	18322	11.38	15(11)
			Sharq Telecom	4.84	0.45	270	Tashkent	1609	16976	10.55	20(3)
			UMS	6.44	0.53	285	Tashkent	1609	14427	8.96	8(11)
	East Asia	Mongolia	Gemnet LCC	4.24	0.54	292	Ulaanbaatar	3299	14609	4.43	11(2)
			Kewiko LCC	4.26	0.44	394	Ulaanbaatar	3299	20350	6.17	15(2)
			Mobicom	4.63	0.55	206	Ulaanbaatar	3299	14440	4.38	18(1)
			STXCitinet LCC	3.34	0.38	267	Ulaanbaatar	3299	16941	5.13	12(14)
	South Pacific	Fiji	Connect Internet Services	3.08	0.34	461	Suva	12070	13641	1.13	14(2)
			Unwired Fiji	0.30	0.30	412	Suva	12070	24496	2.03	12(6)
			Vodafon Fiji	4.23	0.53	290	Suva	12070	44847	3.72	16(1)
		Tonga	TCC	-	-	-	Nukualofa	12770	18091	1.42	15(6)
	West Asia	Saudi Arabia	Mobity	4.17	0.49	200	Riyadh	3058	11371	3.72	16(1)
			Saudi Telecom Company	7.35	0.60	174	Riyadh	3058	14291	4.67	15(1)
			Speed Net	2.14	0.38	202	Riyadh	3058	12108	3.96	15(3)
			Zain KSA	1.64	0.13	274	Riyadh	3058	5247	1.72	10(4)

Source: East Asia, India
Destination: Target countries by continent

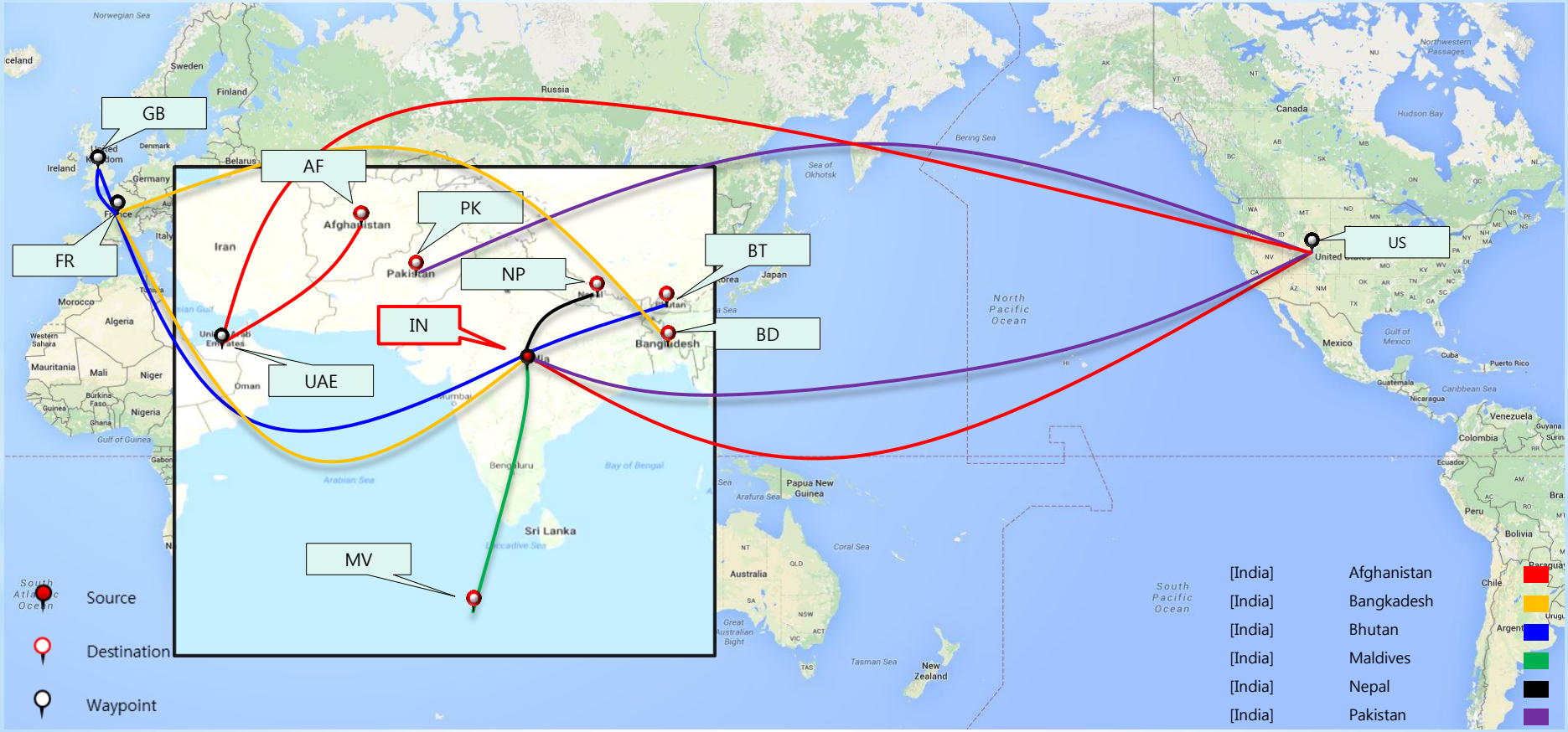


Test Server & Target Selection II



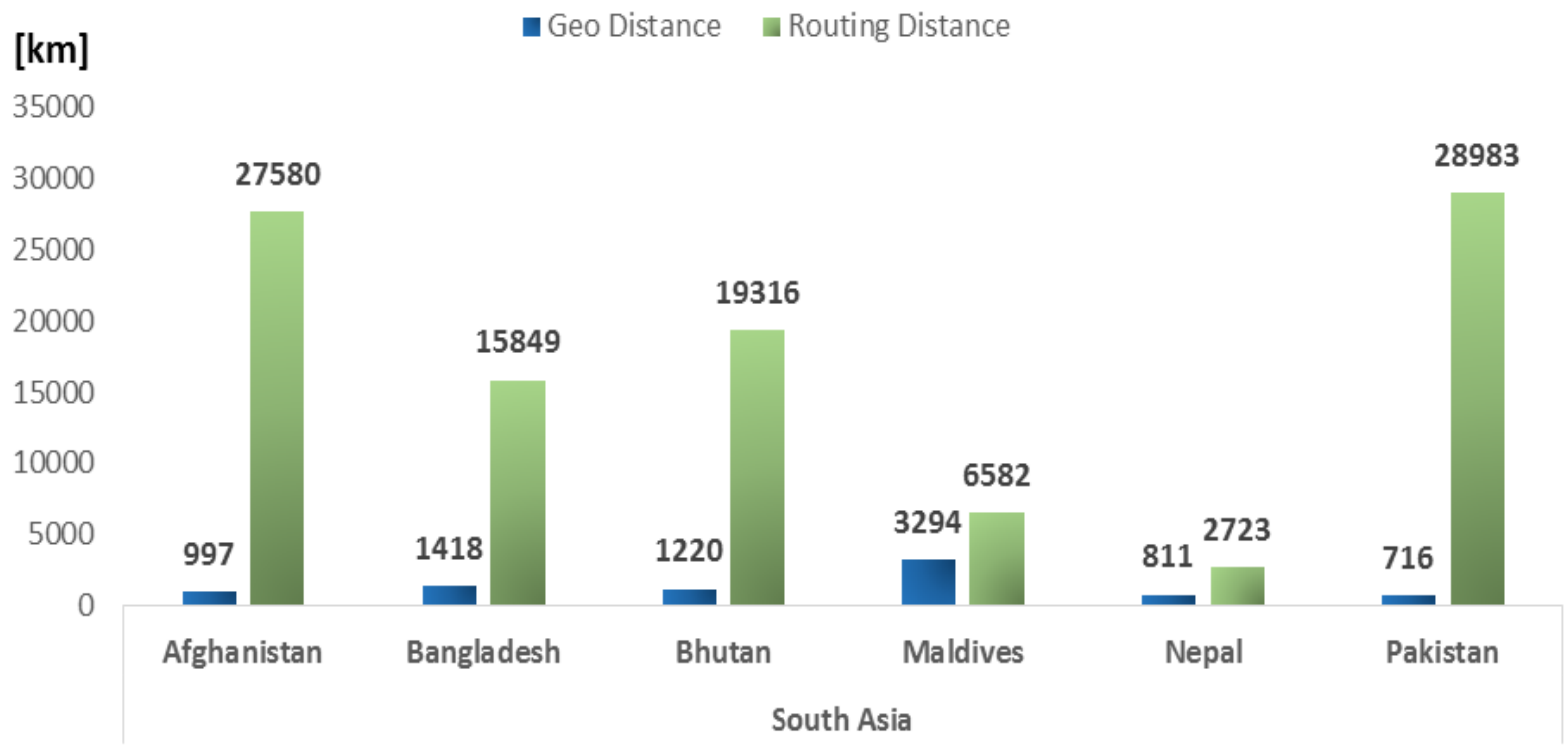
India Case

Internet Routing Map



Target Sub-region	Country	ISP	Geo. Distance (Km) - A	Routing Distance (Km) - B	Tromboning Index [B/A]	No. of Hops
South Asia	**Afghanistan**	**Afghan Wireless**	**997**	**27580**	**27.66**	**17(4)**
	Bangladesh	**bdHUB Limited**	**1418**	**15849**	**11.18**	**15(1)**
	Bhutan	**Tashi InfoComm Ltd**	**1220**	**19316**	**15.83**	**17(3)**
	Maldives	**Ooredoo Maldives**	**3294**	**6582**	**2.00**	**9(2)**
	Nepal	**Websurfer Nepal**	**811**	**2723**	**3.36**	**11(1)**
	Pakistan	**Telenor**	**716**	**28983**	**40.48**	**17(1)**

Source: South Asia, India
Destination: Neighboring countries in the continent



Direction Forward

. Focal Points
. As-is and To-be Model

Focal Point

- Filling the Missing Links identified
- Regional Terrestrial Broadband Backbone
- Seamless Cross Border Connectivity

Terrestrial Broadband Backbone Connectivity (TBBC)

Internet Traffic Exchange Connectivity (ITEC)

- Open/Neutral Access to IXPs
- Establishing More Regional IXPs and Local IXPs
- Keep the regional traffic exchanged regionally

Next Step toward APIS

Category			As-Is	To-Be
Infrastructure & ICT Connectivity	TBBC		· Most countries are interconnected with fiber · Some weak or insufficient capacity observed	· At least one direct land based fiber link to each neighboring country · Regional Terrestrial Backbone Network : hybrid mesh and ring · Center Node establishment for low cost and reliable delivery of traffics
	ITEC		· Dependent on global transit providers · Poor direct peering · Some countries no peering among domestic ISPs	· Direct bilateral peering/transit between neighboring states · Intra/Inter Regional Transit Nodes · Domestic Traffic exchanged domestically
Transit Price and Quality	Monthly Internet Transit Cost (US$/Mbps)		· Min 6 US$ (2014) · Max 100 US$ (2013)	less than 2 US$ * re-adjustable year by year considering the fair market price; in 2015, Min < 2 US$ in US, Europe Market
	Average Speed	Down	· 0.2~43 Mbps	More than 25 Mbps
		Up	· 0.3~57 Mbps	More than 25 Mbps
	Latency (msec)		· 13~363 msec	less than 100 msec
	Tromboning Index		· 1~34	less than 5

NIA
NATIONAL INFORMATION SOCIETY AGENCY

Thank You

Contact Information
Yeong Ro, LEE
lyr@nia.or.kr