

NREN NOC Best Practices

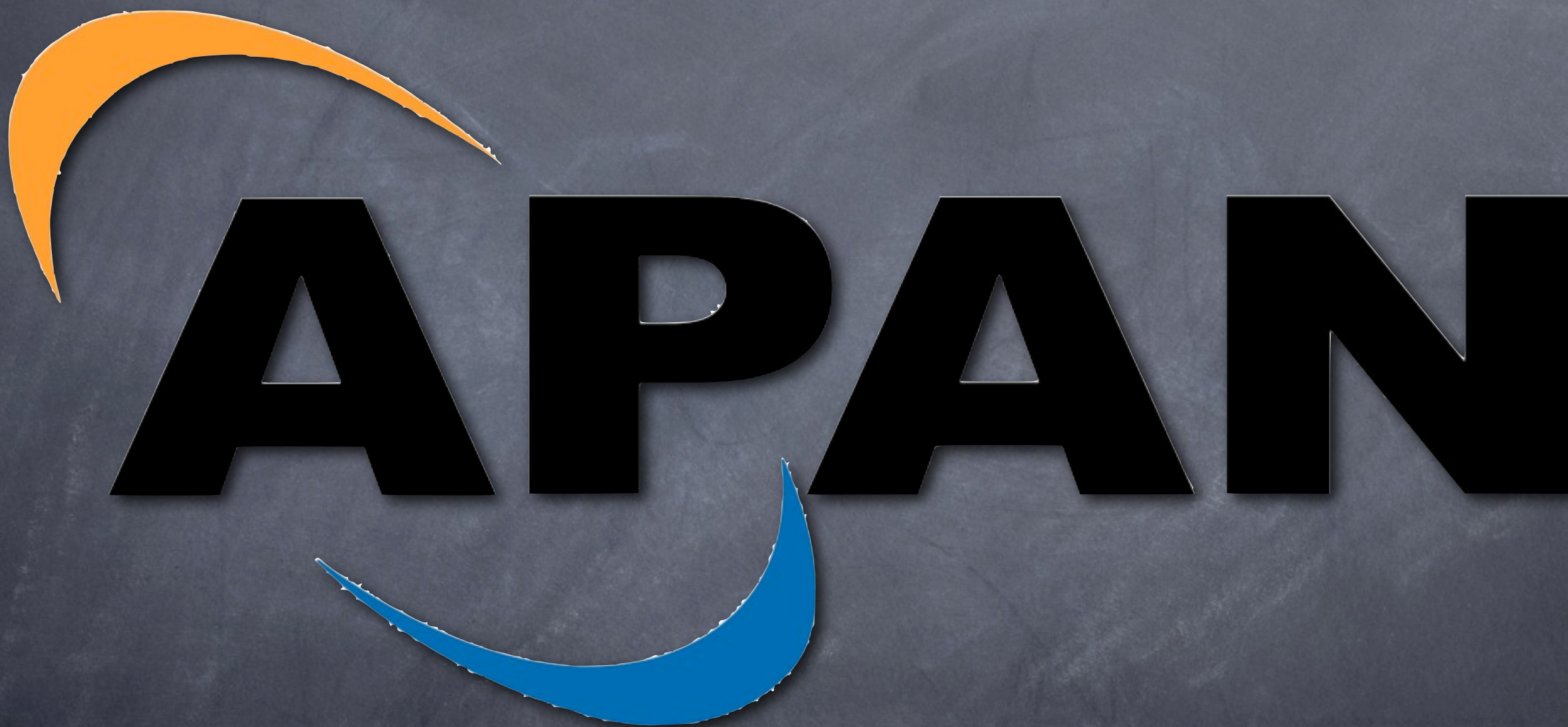
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Who are we?
What is APAN?



What is APAN?

- Asia-Pacific Advanced Network
- None-profit organization
- Exchange point operation



Asia-Pacific Backbone Topology



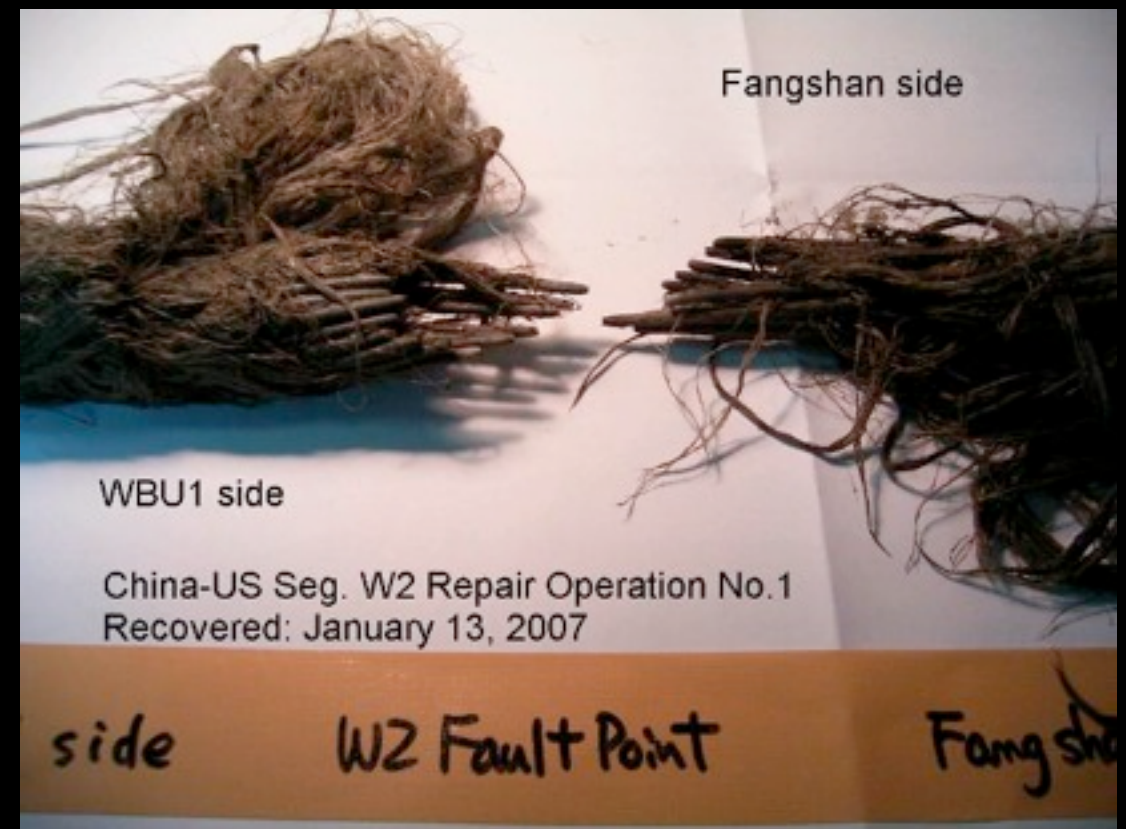
As of April 20th 2010

Fiber cut in 2006

What happened under the sea?

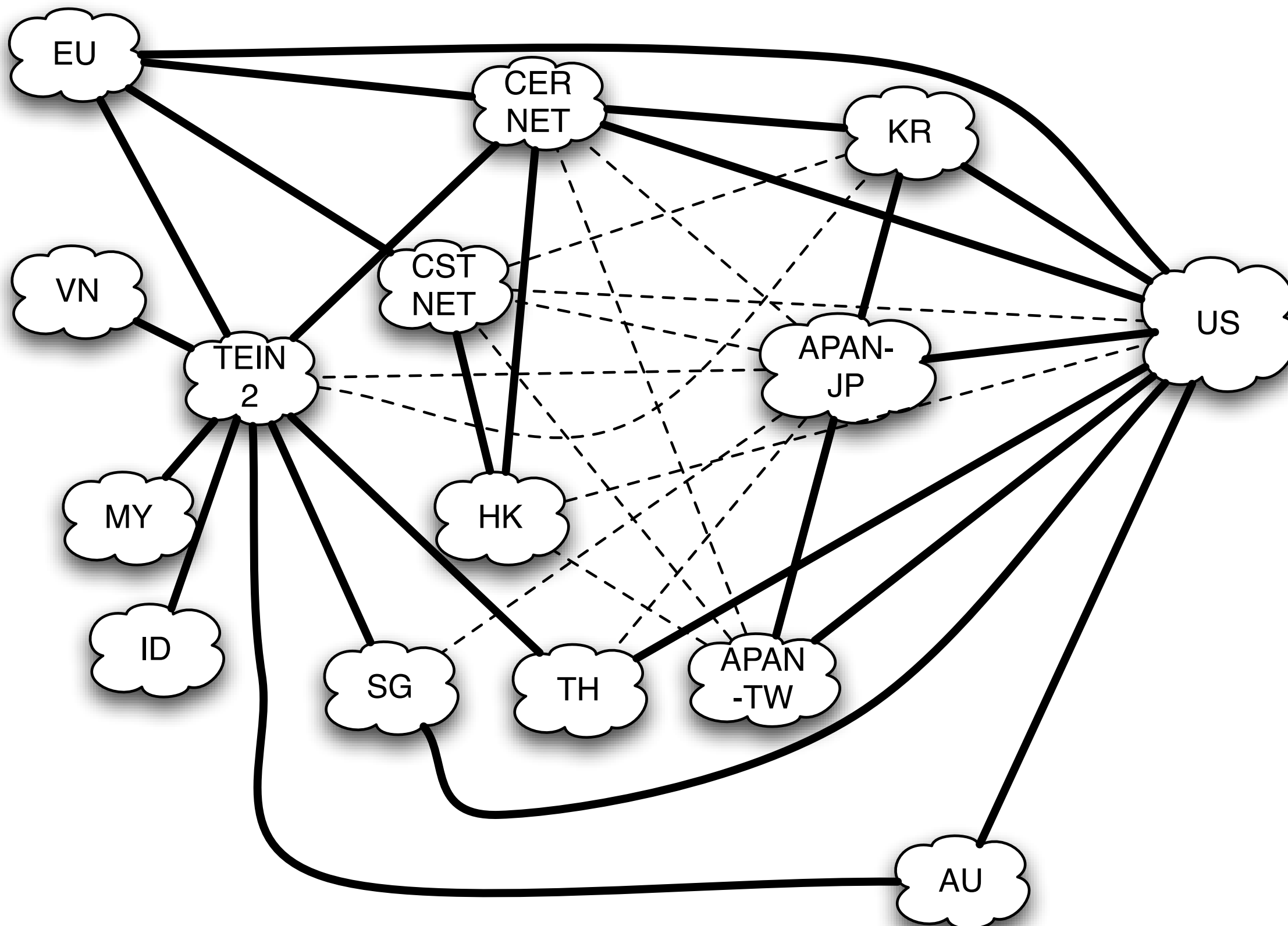


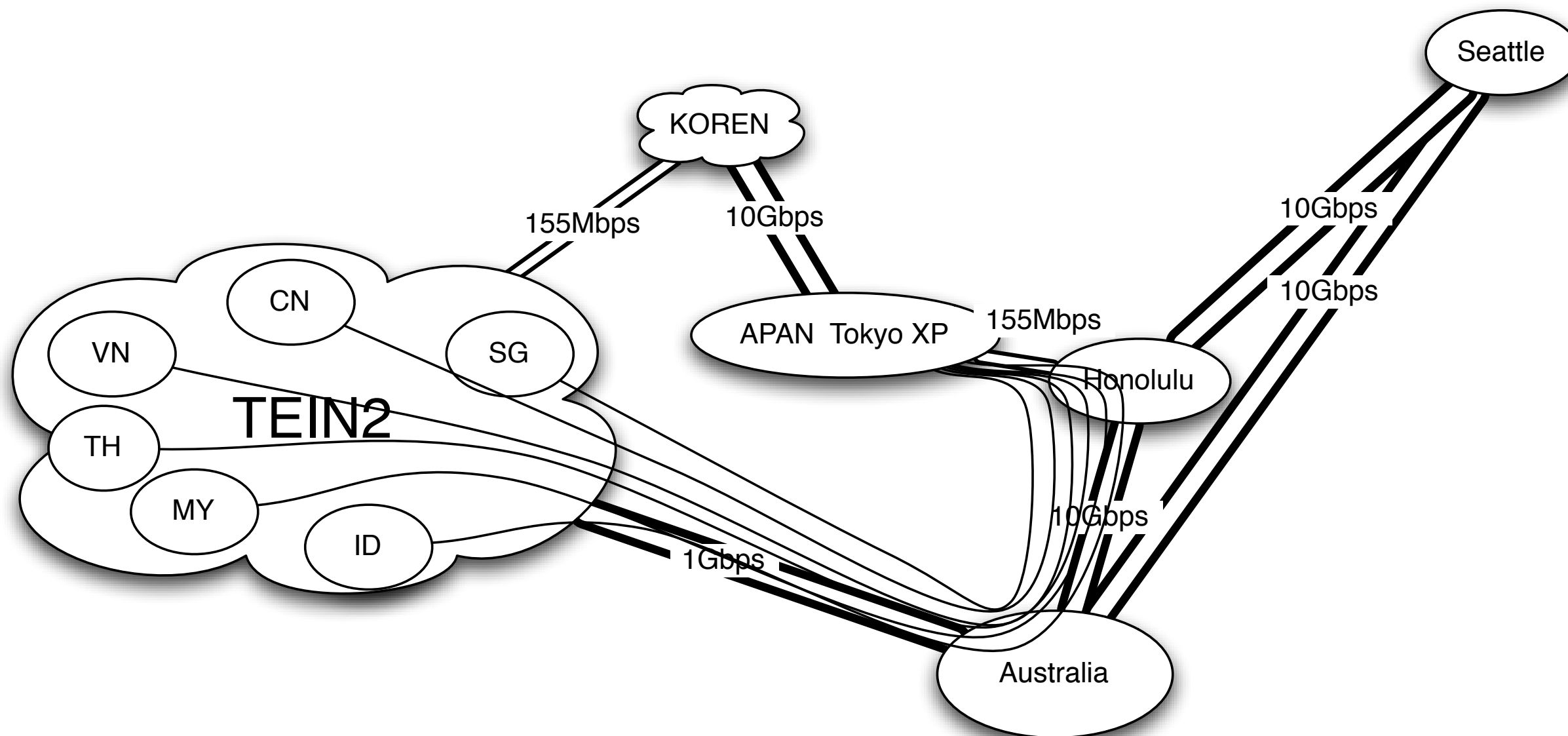
CN-US Cable Outside

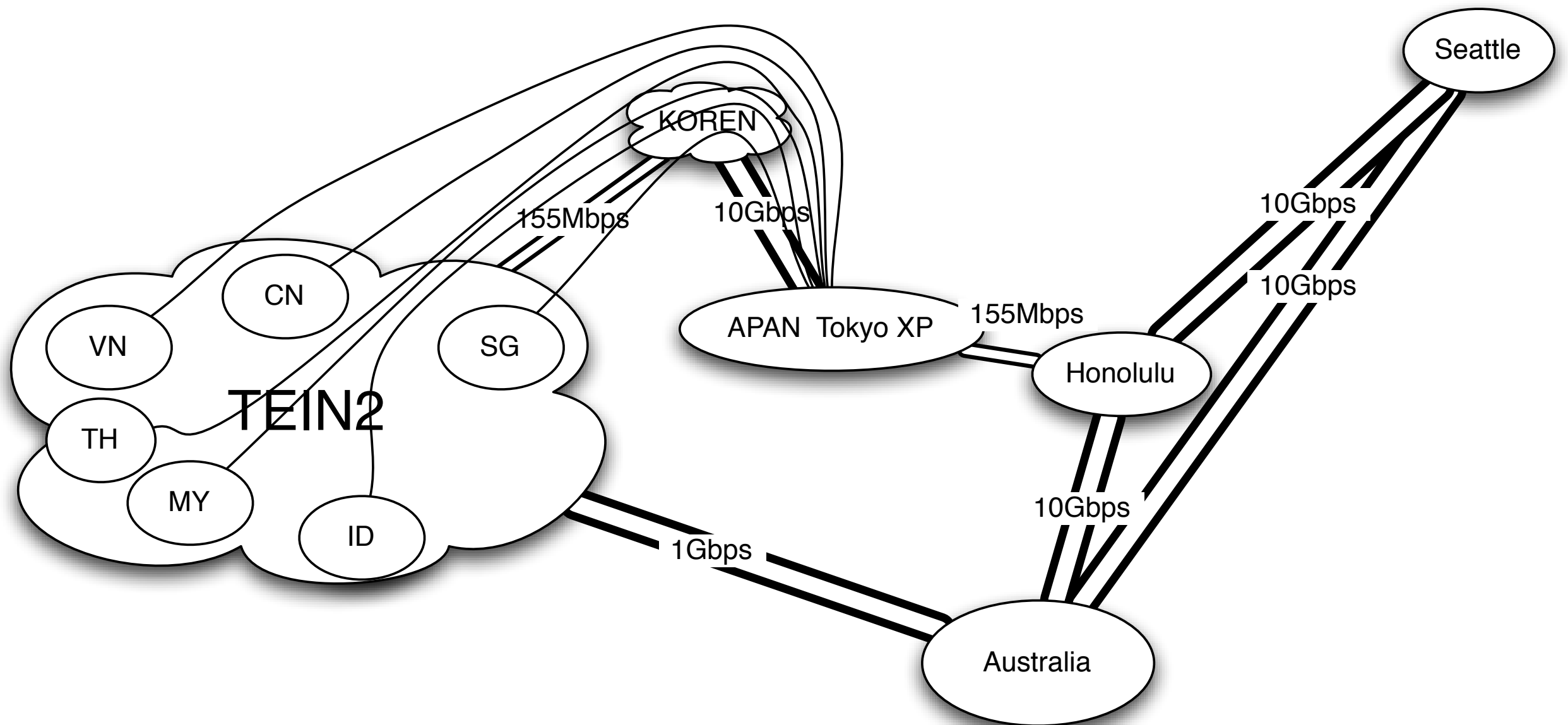


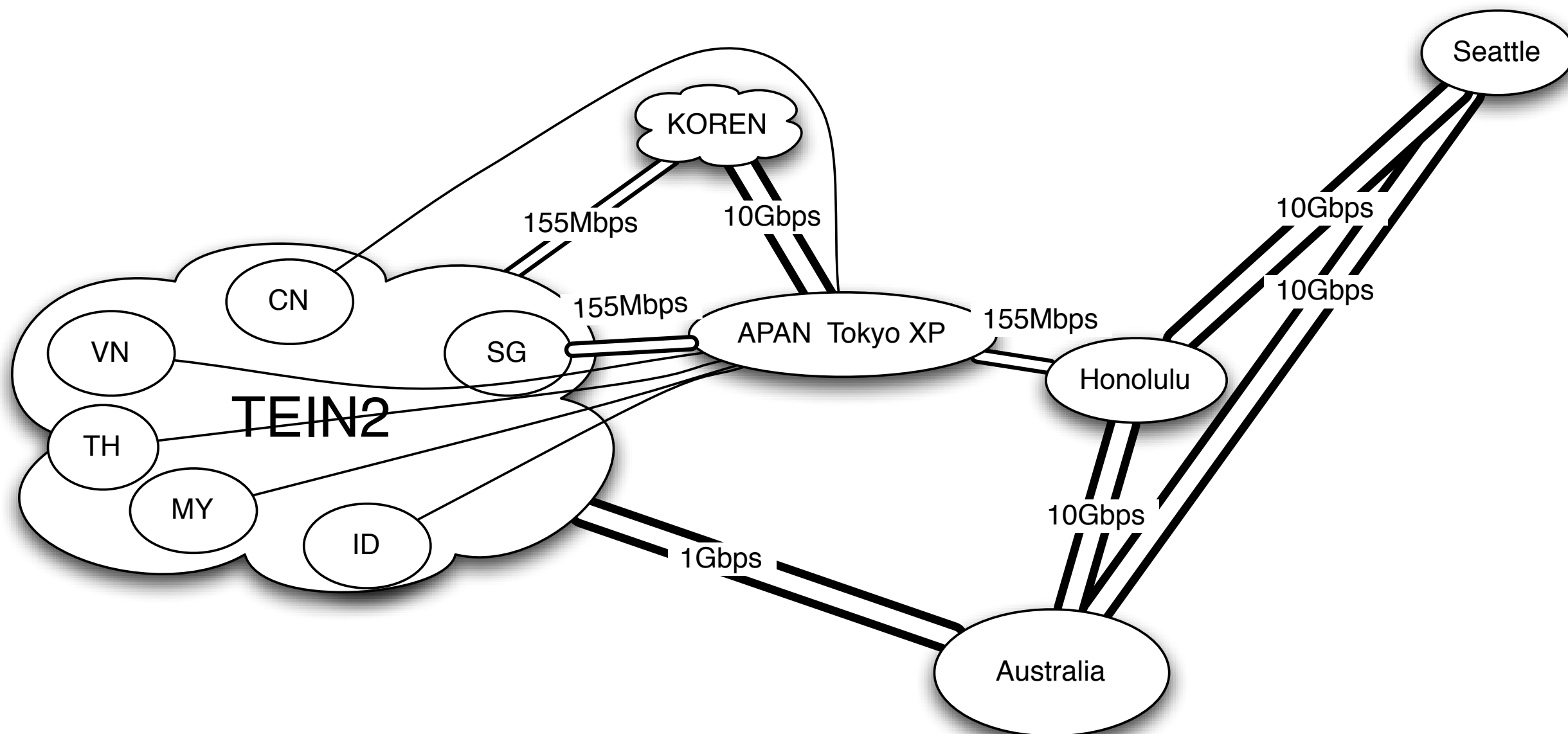
CN-US Cable Inside

These pictures were provided by KDDI.









Routing Path in Asia Pacific

(Estimated Path except APAN-JP)

	Normal		Poor Path		Always been anomaly Path
	Multiple Path		Connectivity Lost or Commodity		

Dec. 27. 2006

Dest Src	APAN-JP	CERNET	APAN-TW	KOREN	ASTI	CSTNET	TEIN2	SingAREN	UniNet	ThaiSARN	KREONET 2	AARNET
APAN-JP		TP2-Abilene	JP-TW Direct	APII	None	KDDI-GW	None	SingAREN via JGN2 SG	TP2-Abilene	None	TP2-Abilene	TP2-Abilene Hawaii
CERNET	TP2-Abilene US?		APAN-APAN-JP US?	CN-KR Direct	None	?	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs
APAN-TW	JP-TW Direct	APAN-JP US?		APAN-JP	None	None	None	?	?	?	APAN-JP APII	APAN-JP
KOREN	APII	CN-KR Direct	APAN-JP		None	None	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	Direct	TEIN2 PoPs
ASTI	None	None	None	None		None	None	None	None	None	None	None
CSTNET	KDDI-GW	?	None	None	None		None	?	?	?	None	?
TEIN2	None	TEIN2-PoPs	None	TEIN2 PoPs	None	None		TEIN2 PoPs	TEIN2 PoPs	TEIN2	KOREN	TEIN2 PoPs

Routing Path in Asia Pacific

(Estimated Path except APAN-JP)

	Normal		Single Path		Always been anomaly Path
	Multiple Path		Connectivity Lost or Commodity		

Jan. 4. 2007

Dest \ Src	APAN-JP	CERNET	APAN-TW	KOREN	ASTI	CSTNET	TEIN2	SingAREN	UniNet	ThaiSARN	KREONET 2	AARNET
APAN-JP		APII SingAREN Hawaii	JP-TW Direct	APII	None	TP2 Abilene - RBnet KDDI-GW	SingAREN via JGN2- SG	SingAREN via JGN2- SG	SingAREN via JGN2- SG	SingAREN via JGN2- SG	TP2- Abilene	TP2- Abilene Hawaii
CERNET	APII SingAREN Hawaii		APAN-JP	CN-KR Direct	None	?	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	?	TEIN2 PoPs
APAN-TW	JP-TW Direct	APAN-JP		APAN-JP	None	None	None	Direct	APAN-JP	APAN-JP	?	APAN-JP
KOREN	APII	CN-KR Direct	APAN-JP		None	None	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	Direct	TEIN2 PoPs
ASTI	None	None	None	None		None	None	None	None	None	None	None
CSTNET	TP2 Abilene - RBnet KDDI-GW	?	?	None	None		?	?	?	?	None	?
TEIN2	SingAREN via JGN2- SG	TEIN2- PoPs	APAN-KR APAN-JP	TEIN2 PoPs	None	None		TEIN2 PoPs	TEIN2 PoPs	TEIN2	KOREN	TEIN2 PoPs



This figure is composed by KDDI.

Routing Path in Asia Pacific

(Estimated Path except APAN-JP)

	Normal		Single Path		Always been anomaly Path
	Multiple Path		Connectivity Lost or Commodity		

Jan. 4. 2007

Dest Src	APAN-JP	CERNET	APAN-TW	KOREN	ASTI	CSTNET	TEIN2	SingAREN	UniNet	ThaiSARN	KREONET 2	AARNET
APAN-JP		APII SingAREN Hawaii	JP-TW Direct	APII	None	TP2 Abilene - RBnet KDDI-GW	SingAREN via JGN2- SG	SingAREN via JGN2- SG	SingAREN via JGN2- SG	SingAREN via JGN2- SG	TP2- Abilene	TP2- Abilene Hawaii
CERNET	APII SingAREN Hawaii		APAN-JP	CN-KR Direct	None	?	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	?	TEIN2 PoPs
APAN-TW	JP-TW Direct	APAN-JP		APAN-JP	None	None	None	Direct	APAN-JP	APAN-JP	?	APAN-JP
KOREN	APII	CN-KR Direct	APAN-JP		None	None	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	Direct	TEIN2 PoPs
ASTI	None	None	None	None		None	None	None	None	None	None	None
CSTNET	TP2 Abilene - RBnet KDDI-GW	?	?	None	None		?	?	?	?	None	?
TEIN2	SingAREN via JGN2- SG	TEIN2- PoPs	APAN-KR APAN-JP	TEIN2 PoPs	None	None		TEIN2 PoPs	TEIN2 PoPs	TEIN2	KOREN	TEIN2 PoPs

Routing Path in Asia Pacific

(Estimated Path except APAN-JP)

	Normal		Single Path		Always been anomaly Path
	Multiple Path		Connectivity Lost or Commodity		

Jan. 9. 2007

Dest Src	APAN-JP	CERNET	APAN-TW	KOREN	ASTI	CSTNET	TEIN2	SingAREN	UniNet	ThaiSARN	KREONET 2	AARNET
APAN-JP		APII SingAREN Hawaii	JP-TW Direct	APII	MAFF-PH Direct	TP2 Abilene - RBnet KDDI-GW	SingAREN via JGN2- SG	SingAREN via JGN2- SG	SingAREN via JGN2- SG	SingAREN via JGN2- SG	TP2- Abilene	TP2- Abilene Hawaii
CERNET	APII SingAREN Hawaii		APAN-JP	CN-KR Direct	APAN-JP	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs
APAN-TW	JP-TW Direct	APAN-JP		APAN-JP	APAN-JP	TEIN2APA PAN-JP	None	Direct	APAN-JP	APAN-JP	APAN-JP APII	APAN-JP
KOREN	APII	CN-KR Direct	APAN-JP		APAN-JP	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	Direct	TEIN2 PoPs
ASTI	MAFF-PH Direct	APAN-JP	APAN-JP	APAN-JP			APAN-JP	APAN-JP	APAN-JP	APAN-JP	APAN-JP	APAN-JP
CSTNET	TP2 Abilene - RBnet KDDI-GW	TEIN2 PoPs	TEIN2APA PAN-JP	TEIN2 PoPs	TEIN2APA PAN-JP		TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs
TEIN2	SingAREN via JGN2- SG	TEIN2- PoPs	APAN-KR APAN-JP	TEIN2 PoPs	APAN-JP	None		TEIN2 PoPs	TEIN2 PoPs	TEIN2	KOREN	TEIN2 PoPs

Routing Path in Asia Pacific

(Estimated Path except APAN-JP)

	Normal		Single Path		Always been anomaly Path
	Multiple Path		Connectivity Lost or Commodity		

Feb. 20. 2007

Dest Src	APAN-JP	CERNET	APAN-TW	KOREN	ASTI	CSTNET	TEIN2	SingAREN	UniNet	ThaiSARN	KREONET 2	AARNET
APAN-JP		JP-CN Direct	JP-TW Direct	APII	MAFF-PH Direct	JP-CN Direct	TEIN2 JP-SG JP-HK	JGN2 SG Direct	TEIN2 JP-SG JP-HK	TEIN2 JP-SG JP-HK	TP2- Abilene	TEIN2 PoPs Hawaii
CERNET	JP-CN Direct		APAN-JP	CN-KR Direct	APAN-JP	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs
APAN-TW	JP-TW Direct	APAN-JP		APAN-JP	APAN-JP	TEIN2APA PAN-JP	None	Direct	APAN-JP	APAN-JP	APAN-JP	APAN-JP
KOREN	APII	CN-KR Direct	APAN-JP		APAN-JP	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	TEIN2 PoPs	Direct	TEIN2 PoPs
ASTI	MAFF-PH Direct	APAN-JP	APAN-JP	APAN-JP			APAN-JP	APAN-JP	APAN-JP	APAN-JP	APAN-JP	APAN-JP
CSTNET	JP-CN Direct	TEIN2 PoPs	TEIN2APA PAN-JP	TEIN2 PoPs	TEIN2APA PAN-JP		None	APAN-JP	APAN-JP	APAN-JP	Direct	APAN-JP
TEIN2	TEIN2 JP-SG JP-HK	TEIN2- PoPs	APAN-KR APAN-JP	TEIN2 PoPs	APAN-JP	None		TEIN2 PoPs	TEIN2 PoPs	TEIN2	KOREN	TEIN2 PoPs

- Typhoon No. 8 (Japanese name), Morakot (English name) attacked Kaohsiung in 2008.

Prof. Kasahara's report

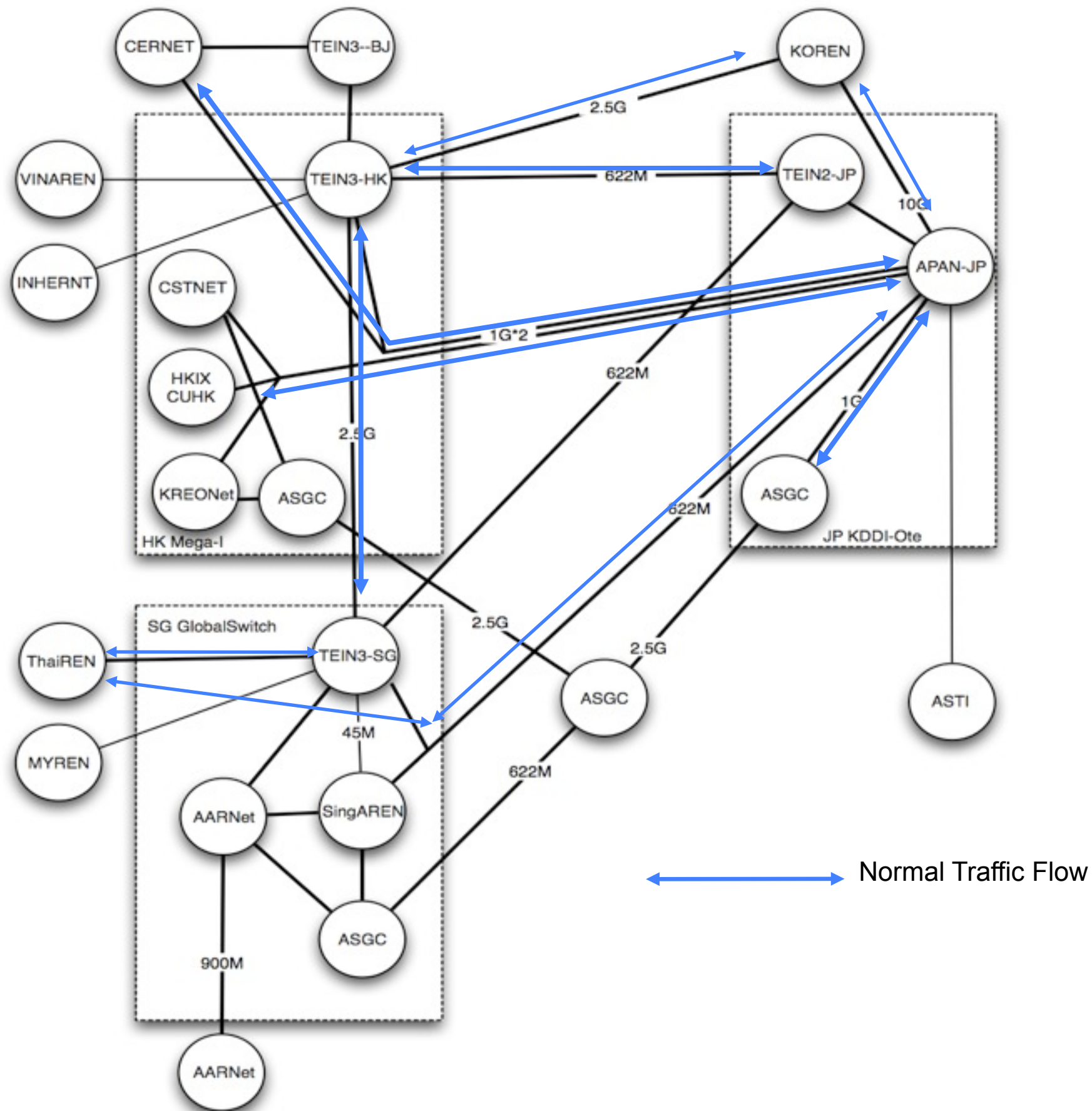


Temporal Routing in Asia during Undersea Cable Disruption

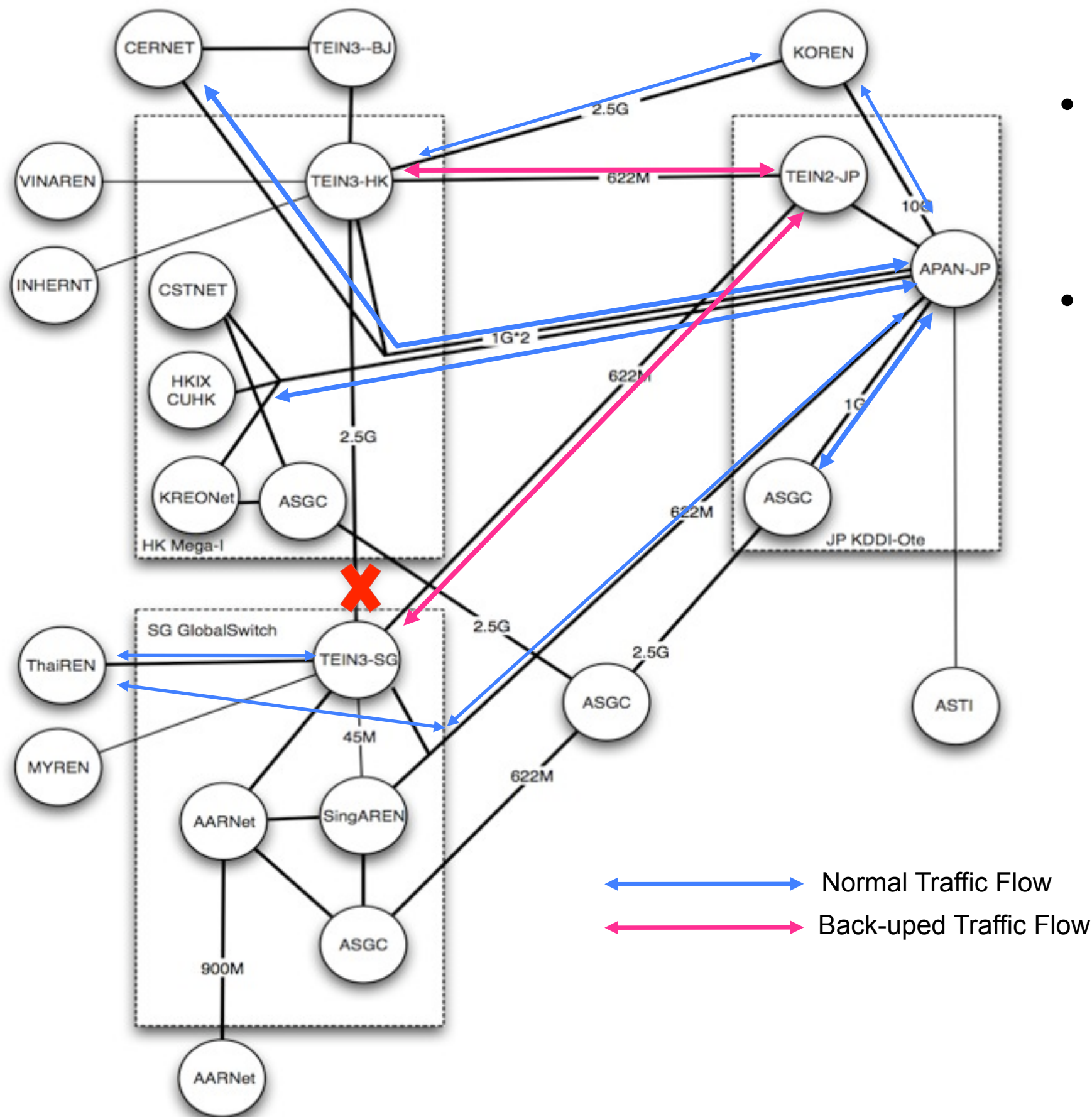
APAN-JP NOC

13th August 2009

Normal Layer3 Topology and Traffic of Asian NRENs

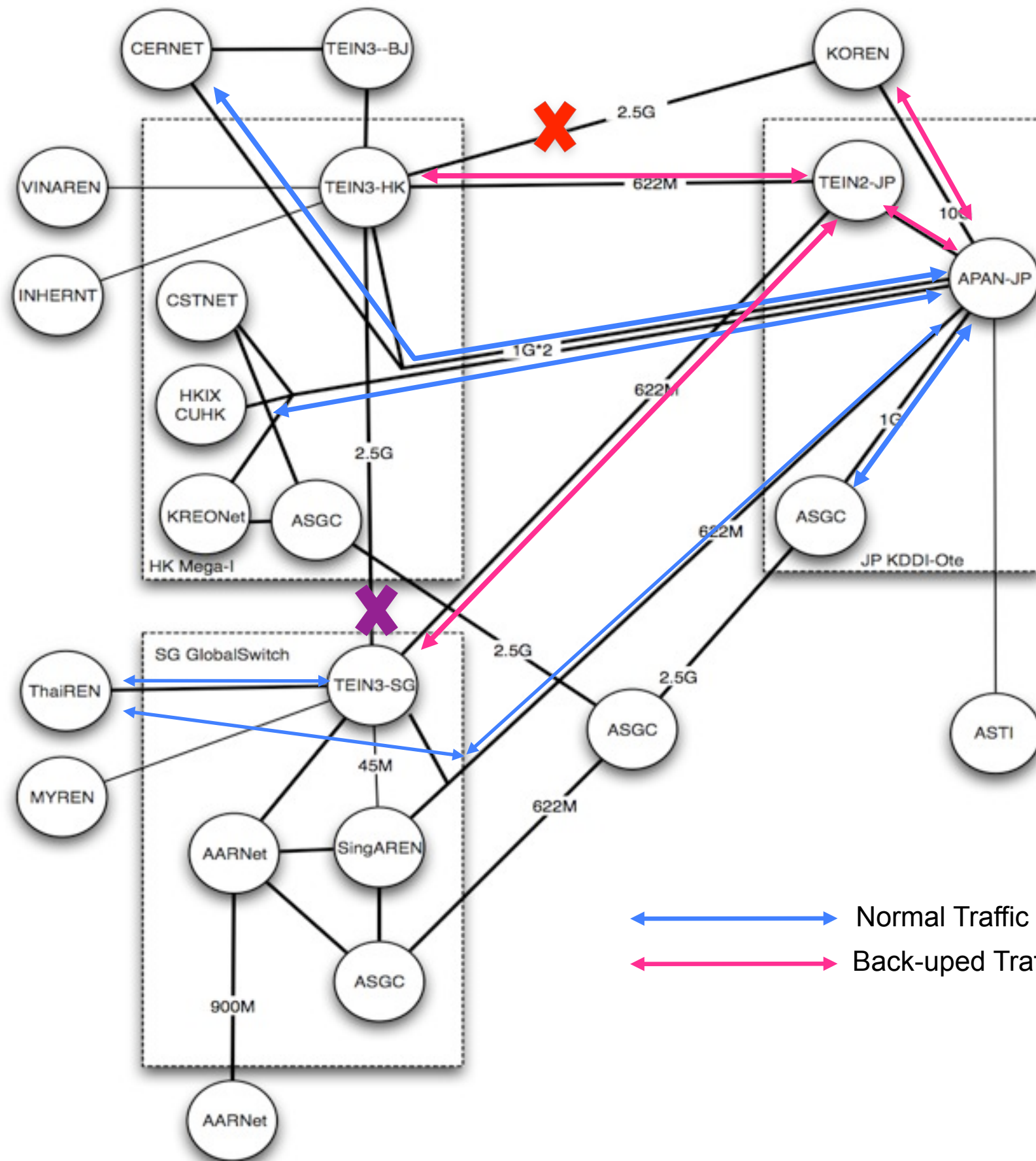


First impact on August 6th



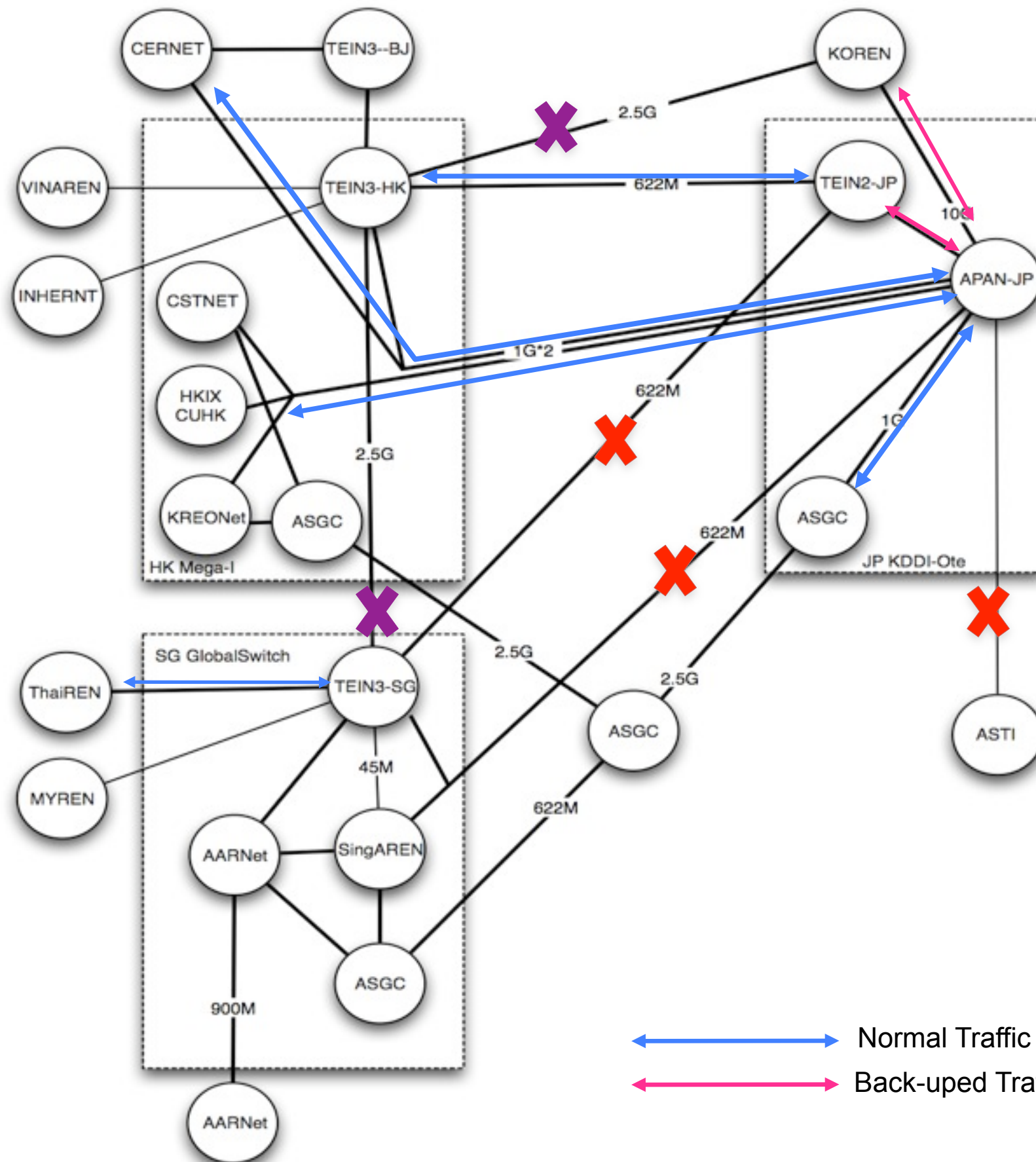
- TEIN3 HK-SG 2.5G circuit was interrupted due to EAC cable system frailer
- The traffic between TEIN3-HK and SG Pops shifted to NII's TEIN3-JP back up links

Second impact on August 9th



- TEIN3 SG-KR 2.5G circuit was interrupted due to “EAC cable system” frailer
- The traffic between KOREN and TEIN3 network shifted to APII/ JGN2plus 10G link

Third impact on August 12th (Current)



- The fault was detected on Segment 7 of APCN2
- Additionally, segment 1 of the APCN2 is also currently under repair
- Both NII and JGN2plus JP-SG 622 circuit were outage
- The connectivity of TEIN3 SG(and around NREN) and other Asian NREN was interrupted
- JP MAFF's JP-PH 155M circuit was also affected. ASTI has been disrupted the connectivity with R&E network

 Normal Traffic Flow
 Back-uped Traffic Flow

Routing affected as Undersea Cable Disruption

		Destination																
		AARNet (7575)	APAN-IP (7660)	ASCO (3264)	ASGO (24167)	ASTI (3821)	CERNET (4538)	DSTNET (7497)	KOREN (9270)	KREONET (17579)	SingAREN (23895)	TEIN-HK (24489)	TEIN-SG (24490)	ThaisARN (3836)	TWAREN (7539)	UniNet (4621)	Isieternet2 (11537)	GEANT2 (20966)
Source	AARNet (7575)	-	2 - TP2	2 - TP2 A.P	direct	None	TEINS - GEA - TEINH	TEINS - GEA - TEINH - CERNET	2 - TP2 - A.P	2	direct	TEINS - GEA	direct	TEINS - TREN	direct	TEINS - TREN	direct	TEINS
	APAN-IP (7660)	TP2-I2	-	direct	direct	None	direct	direct	direct	direct	TEINU - TEINH - GEA - TEINS	TEINU	TEINU - TEINH - GEA - TEINS	TEINU - TEINH - GEA - TEINS - TREN	ASCO	TEINU - TEINH - GEA - TEINS - TREN	TP2	TP2 - I2
	ASCO (3264)	A.P - TP2 2	direct	-	direct	None	direct	direct	A.P	A.P	None	CERNET	None	None	direct	A.P - TP2 - I2	A.P - TP2	A.P - TP2 - I2
	ASGO (24167)	direct	direct	SINET	-	None	direct	direct	A.P	direct	direct	SINET - TEINU TEINH - GEA	SINET - TEINU TEINH - GEA	SINET - TEINU TEINH - GEA TEINS - TREN	direct	2	direct	2
	ASTI (3821)	None	None	None	None	-	None	None	None	None	None	None	None	None	None	None	None	None
	CERNET (4538)																	
	DSTNET (7497)																	
	KOREN (9270)	A.P - TP2 2	direct	A.P	A.P	None	A.P	A.P	-	None	A.P - TEINU - TEINH - GEA - TEINS	A.P - TEINU	A.P - TEINU - TEINH - GEA - TEINS - TREN	A.P - TEINU - TEINH - GEA - TEINS - TREN	A.P - ASCO	A.P - TEINU - TEINH - GEA - TEINS - TREN	A.P - TP2 - I2	A.P - TP2 - I2
	KREONET (17579)	direct	direct	DSTNET	direct	None	direct	direct	None	-	None	2 - TP2 A.P - TEINU	2 - AAR	2 - AAR - TEINS - TREN	direct	2	direct	2
	SingAREN (23895)	direct	ASGO	ASGO - SINET	direct	None	TEINS - GEA - TEINH	TEINS - GEA - TEINH - CERNET - 9406	ASGO - A.P	ASGO	-	TEINS - GEA	direct	TEINS - TREN	ASGO	TEINS - TREN	ASGO	TEINS
	TEIN-HK (24489)	A.P - TP2 2 - AAR	A.P	None	None	None	direct	CERNET - 9406	TEINU - A.P	None	GEA - TEINS	-	GEA	GEA - TEINS TREN	None	GEA - TEINS TREN	TEINU-A.P	direct
	TEIN-SG (24490)	direct	AAR - I2 - TP2	AAR - I2 - TP2 - A.P	AAR - I2	None	GEA - TEINH	GEA - TEINH - CERNET - 9406	AAR - I2 - TP2 - A.P	AAR - I2	direct	GEA	-	TREN	AAR - I2 - TP2 - A.P - ASCO	TREN	AAR - I2	direct
	ThaisARN (3836)	TEINS	TEINS - AAR	TEINS - AAR - I2 - TP2 - A.P	None	None	TEINS - GEA - TEINH	TEINS - GEA - TEINH - CERNET - 9406	TEINS - AAR - I2 - TP2 - A.P	TEINS - AAR - I2 - TP2 - A.P	TEINS	TEINS - GEA - TEINH	direct	-	TEINS - AAR - I2 - TP2 - A.P	TREN	TEINS - AAR	TEINS
	TWAREN (7539)	direct	ASCO	direct	direct	None	ASCO	ASCO	ASCO - A.P	ASCO - A.P	ASGO	ASCO - CER	2 - AAR	2 - AAR - TEIN - TREN	-	2	direct	2
	UniNet (4621)	TREN - TEINS	2 - TP2	2 - TP2 - A.P	2	None	TREN - TEINS - GEA - TEINH	TREN - TEINS - GEA - TEINH - CERNET - 9406	2 - TP2 - A.P	2	TREN - TEINS	TREN - TEINS - GENAT	TREN - TEINS	TREN	2	-	direct	TREN - TEINS

	<i>Connectivity Lost or Commodity</i>
	<i>Intercontinental Loop Routes</i>
	<i>Unknown (no peering with Compath Project)</i>

Proposal for temporary backup routing

- According to our investigation by comPATH tool, currently there are many intercontinental loop / inefficient routes on Asian NRENs.
- It is important to restore the connection from APAN, TEIN3 to Singapore area.
- We have only one choice to get the connectivity to Singapore area by creating temporary TEIN3-SG - AARnet - ASGC - APAN-JP – TEIN3-HK path.
- The table on next slide shows the expected routing when we implement this temporal backup routing, and Intercontinental loop routes will be disappeared.

Temporal Routing in Asia during Undersea Cable Disruption

		Destination																
		AARNet (7575)	APAN-JP (7660)	ASGC (9264)	ASGC (24167)	ASTI (9821)	CERNET (4538)	OSTNET (7497)	KOREN (9270)	KREONET (17579)	SingAREN (23895)	TEIN3-HK (24489)	TEIN3-SG (24490)	ThaiSARN (3836)	TWAREN (7539)	UniNet (4621)	Internet2 (11537)	GEANT2 (20985)
Source	AARNet (7575)	-	I2 - TP2	I2 - TP2 AJP	I2	None	ASGC - AJP	ASGC - AJP	I2 - TP2 - AJP	I2	direct	ASGC - AJP - TEINJ	direct	TEINS - TREN	direct	TEINS - TREN	direct	TEINS
	APAN-JP (7660)	TP2-I2	-	direct	direct	None	direct	direct	direct	direct	ASGC - AAR - TEINS	TEINJ	ASGC - AAR - TEINS	ASGC - AAR - TEINS - TREN	ASGC	ASGC - AAR - TEINS - TREN	TP2	TP2 - I2
	ASGC (9264)	AJP - TP2 I2	direct	-	direct	None	direct	direct	AJP	AJP	(*1) - TEINS	CERNET	None	(*1) - TREN	direct	AJP - TP2 - I2	AJP - TP2	AJP - TP2 - I2
	ASGC (24167)	direct	direct	SINET	-	None	direct	direct	AJP	direct	direct	AJP	AAR	AAR - TEINS - TREN	direct	AAR - TEINS - TREN	direct	I2
	ASTI (9821)	None	None	None	None	-	None	None	None	None	None	None	None	None	None	None	None	None
	CERNET (4538)																	
	OSTNET (7497)																	
	KOREN (9270)	AJP - TP2 I2	direct	AJP	AJP	None	AJP	AJP	-	None	(*1) - TEINS	AJP - TEINJ	(*1) - TEINS	(*1) - TEINS - TREN	AJP - ASGC	(*1) - TEINS - TREN	AJP - TP2	AJP - TP2 - I2
	KREONET (17579)	direct	direct	OSTNET	direct	None	direct	direct	None	-	(*1) - TEINS	I2 - TP2 AJP - TEINJ	I2 - AAR	I2 - AAR - TEINS - TREN	direct	I2	direct	I2
	SingAREN (23895)	direct	ASGC	ASGC - SINET	direct	None	TEINS - (*2)	TEINS - (*2) - CERNET - 9406	ASGC - AJP	ASGC	-	TEINS - (*2) - TEINJ	direct	TEINS - TREN	ASGC	TEINS - TREN	ASGC	TEINS
	TEIN3-HK (24489)	TEINJ - AJP - ASGC	AJP	None	None	None	direct	CERNET - 9406	TEINJ - AJP	None	TEINJ - (*2) - TEINS	-	TEINJ - (*2)	TEINJ - (*2) - TEINS - TREN	None	TEINJ - (*2) - TEINS - TREN	TEINJ - AJP	direct
	TEIN3-SG (24490)	direct	AAR - ASGC	AAR - I2 - TP2 - AJP	AAR	None	(*2)	(*2) - CERNET	(*2)	AAR - I2	direct	(*2)	-	TREN	AAR - I2 - TP2 - AJP - ASGC	TREN	AAR - I2	direct
	ThaiSARN (3836)	TEINS	TEINS - AAR	TEINS - AAR - I2 - TP2 - AJP	TEINS - (*2)	None	TEINS - (*2)	TEINS - (*2)	TEINS - (*2)	TEINS - (*2)	TEINS	TEINS - (*2) - TEINJ	direct	-	TEINS - AAR - I2 - TP2 - AJP	TREN	TEINS - AAR	TEINS
	TWAREN (7539)	direct	ASGC	direct	direct	None	ASGC	ASGC	ASGC - AJP	ASGC - AJP	ASGC	ASGC - CER	ASGC - AAR - TEINS - TREN	ASGC - AAR - TEINS - TREN	-	I2	direct	I2
	UniNet (4621)	TREN - TEINS	TREN - TEINS - AAR - ASGC	I2 - TP2 - AJP	TREN - TEINS - AAR	None	TREN - TEINS - (*2)	TREN - TEINS - (*2)	TREN - TEINS - (*2)	I2	TREN - TEINS	TREN - TEINS - (*2) - TEINJ	TREN - TEINS	TREN	I2	-	direct	TREN - TEINS

 Connectivity Lost or Commodity
 Intercontinental Loop Routes
 Unknown (no peering with Compath Project)
 improved routes
 (*1) AJP - ASGC - AAR
 (*2) AAR - ASGC - AJP

Summary of NOC's job

- Remember or Data base is required for...
 - Topology map
 - Bandwidth
 - routing policy
 - friendly talking with other NOCs
- NOC should have the policy experts for...
 - violating the routing policy.