Panel Discussion: Quakes on the AP Internet

Taiwanese Earthquake Impact for R&E networks in AP region
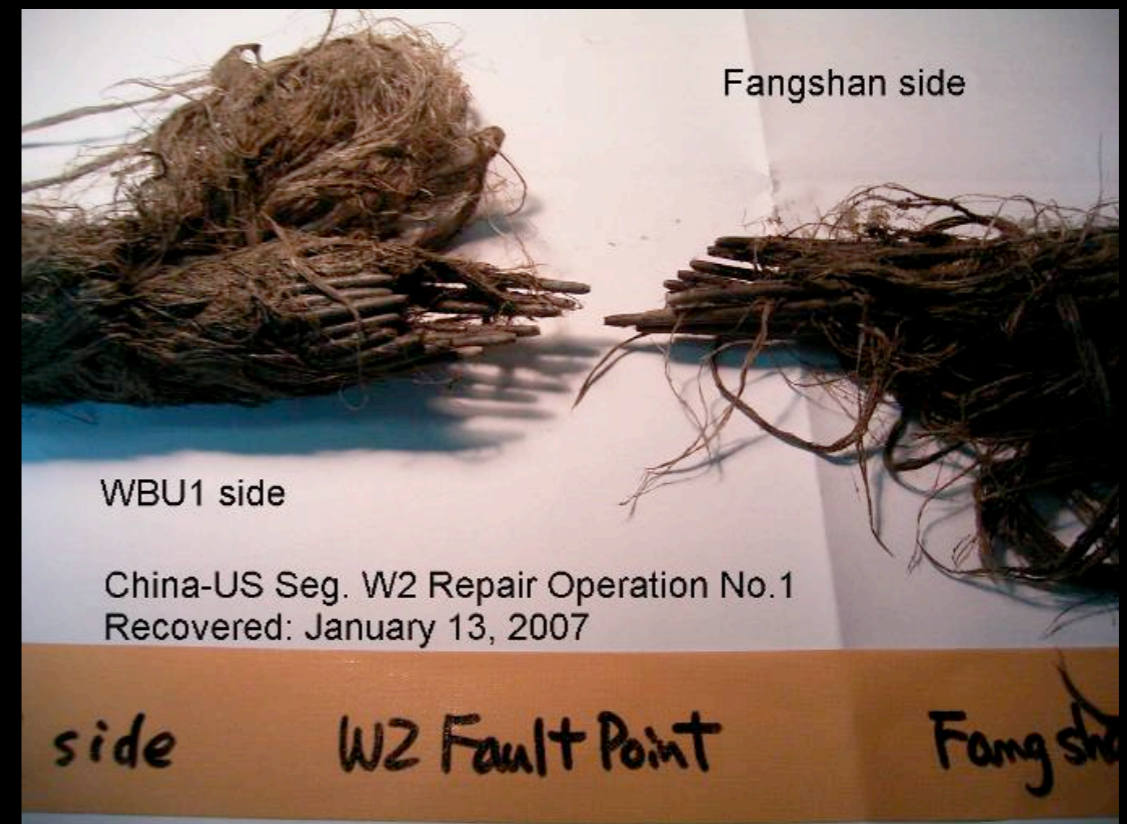
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APAN Tokyo XP

All the slides were the presentation materials of 23rd APAN Meeting in Manila. You can get the original slides from APAN website.

What happened under the sea?

CN-US Cable Outside

Fangshan side

WBU1 side

China-US Seg. W2 Repair Operation No.1
Recovered: January 13, 2007

side   W2 Fault Point   Fong sh

CN-US Cable Inside

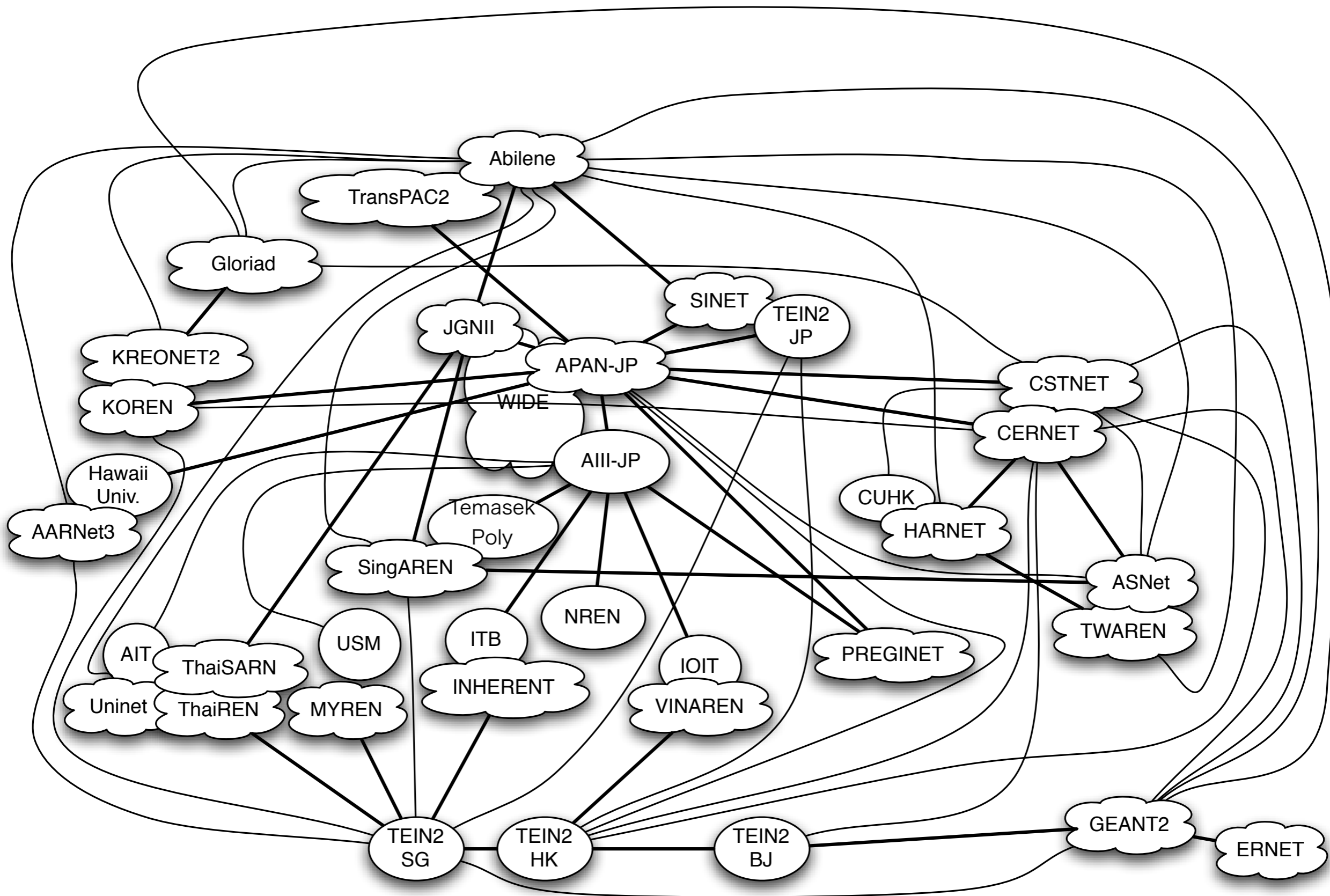*These pictures were provided by KDDI.*

Background

- On December 26th, 21:27(JST) 2006, earthquake occurred in the southern Taiwan, then following Japan circuits became outage.

  - MAFFIN JP-PH circuit (155M) - JGN2 JP-TH circuit (50M) - JGN2 JP-SG circuit (155M)
  - NICT JP-HK circuit (2.4G)   - TEIN2 JP-HK circuit (622M) - TEIN2 JP-SG circuit (622M)

- Since APAN-JP has two or more links to the one destination, we have been designed our routing in consideration of redundancy. However the situation could give the poor solution against the simultaneous circuits outage.

- This is short story how NOC respond in the worst circuits outage we have ever experienced.
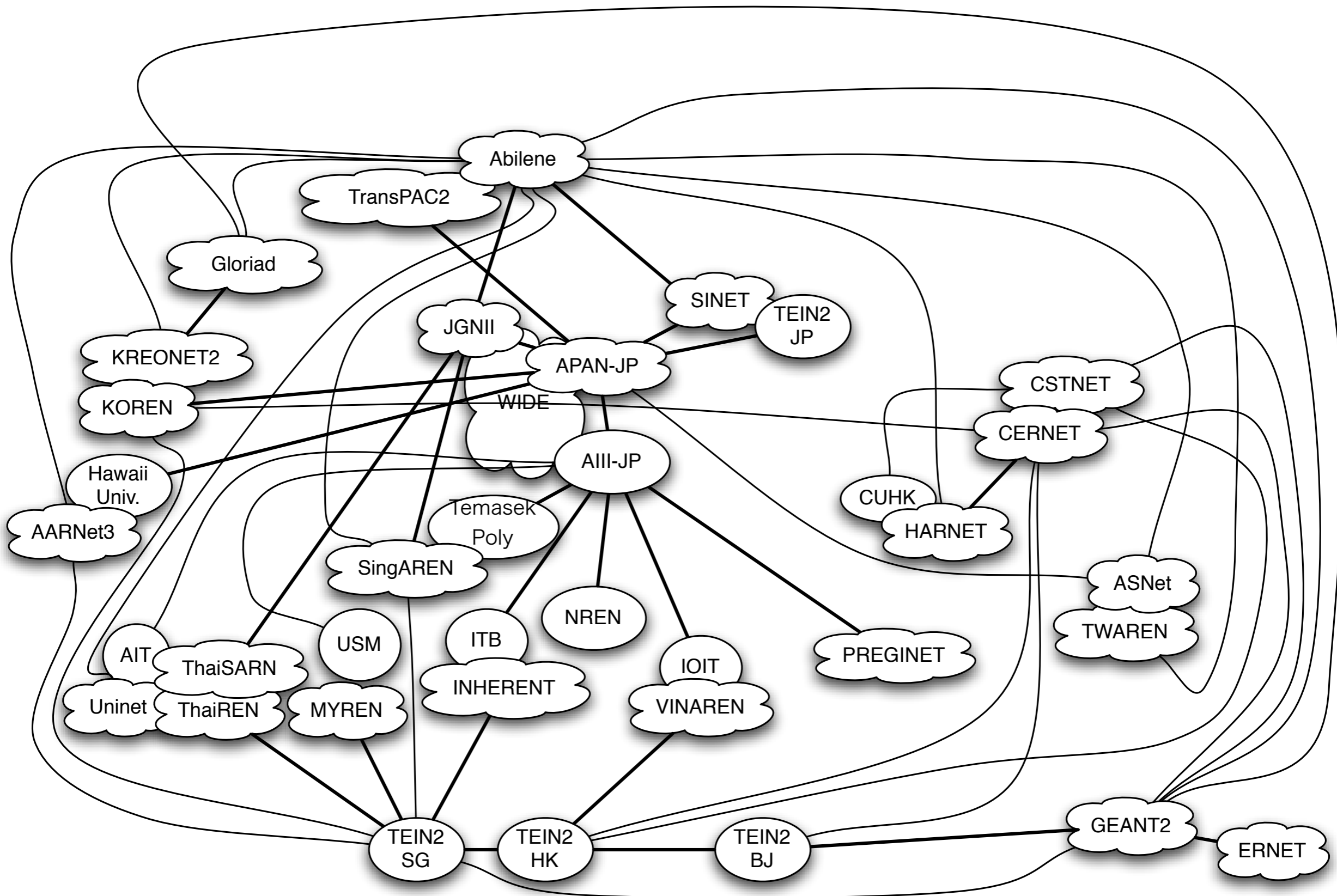
Network Situation after Earthquake
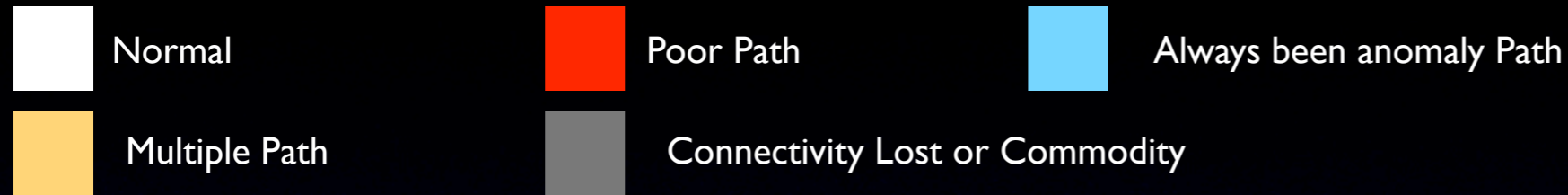## (Jan. 5, 2007)
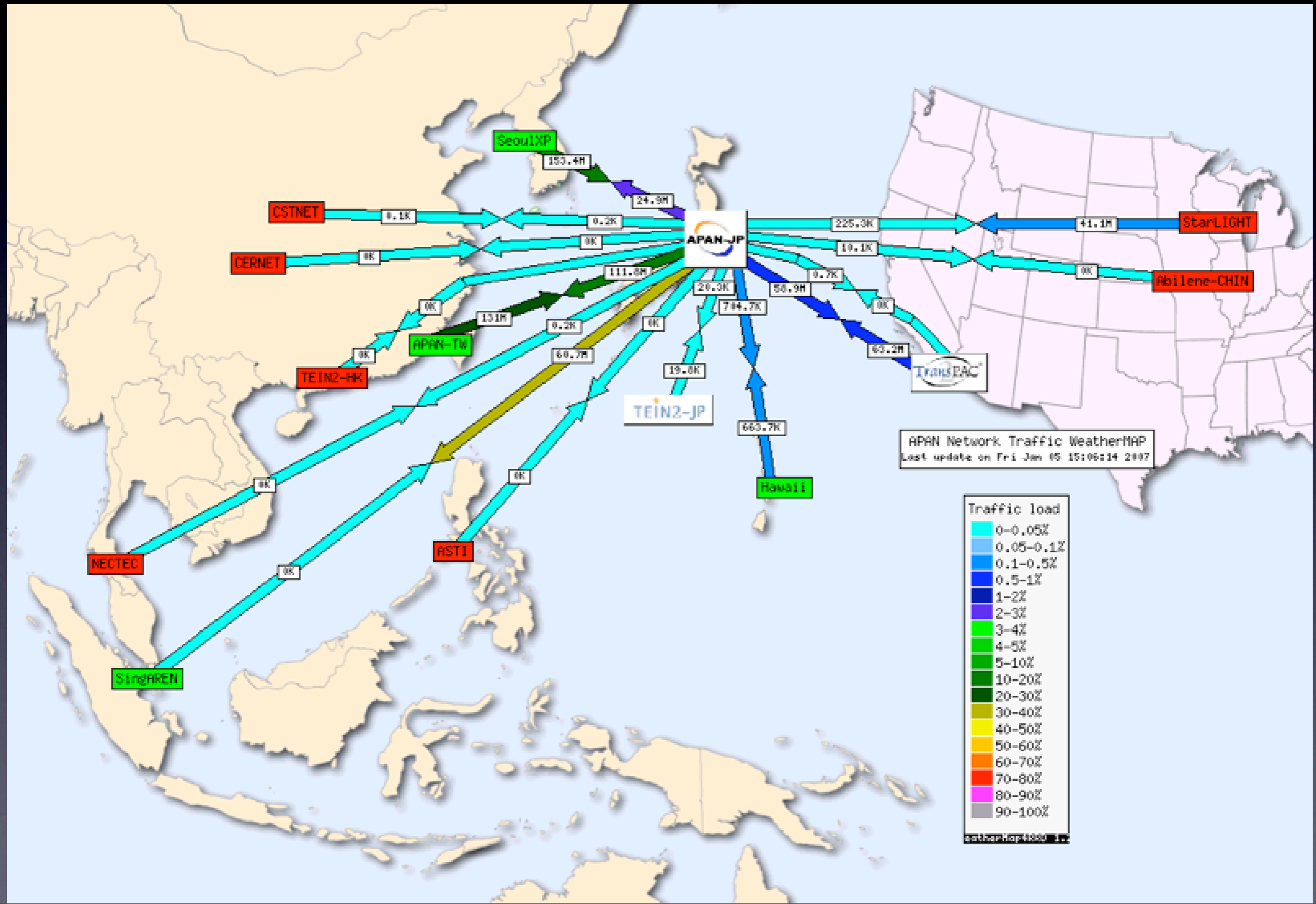
Before the earthquake

Just after the earthquake

Routing Path in Asia Pacific
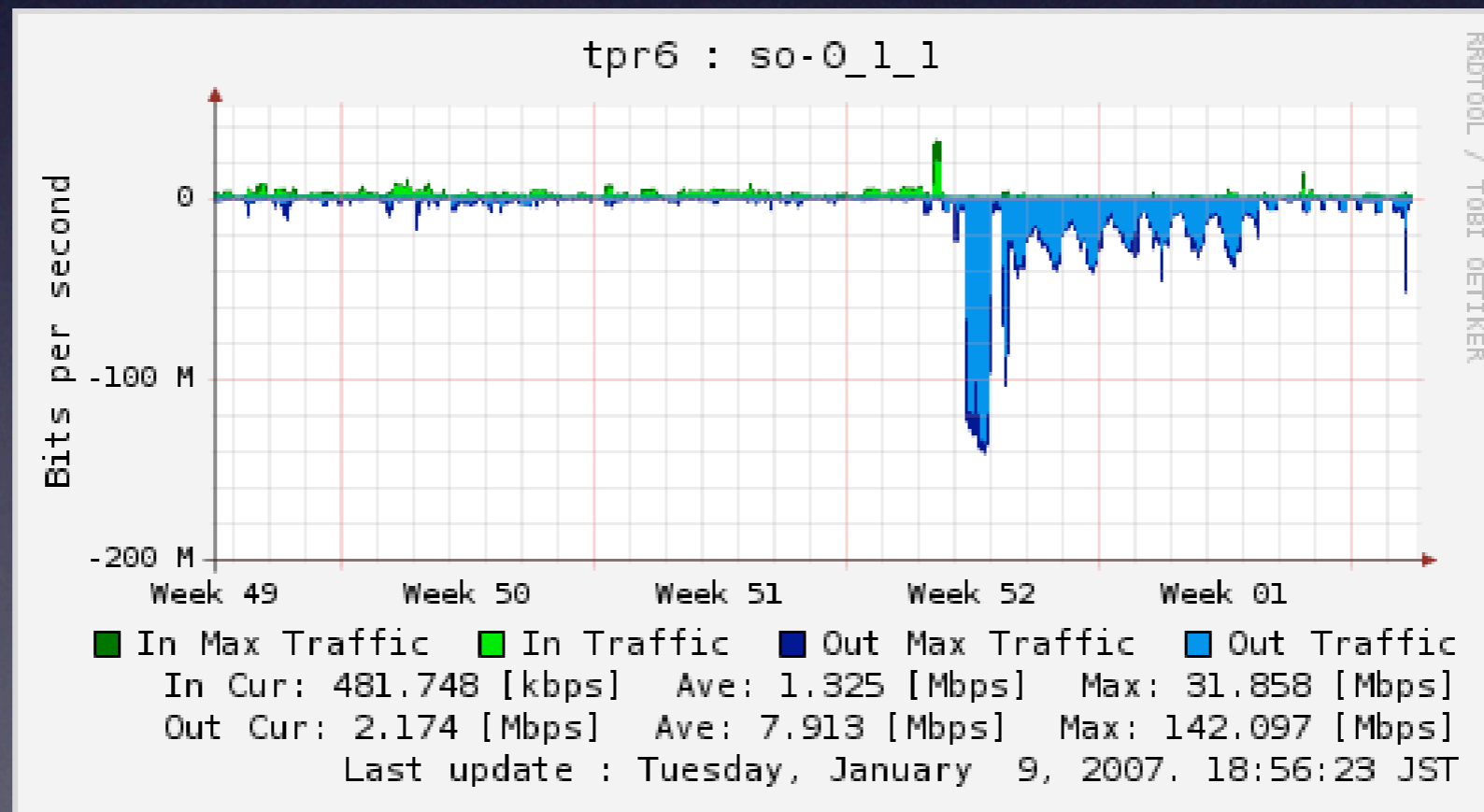
(Estimated Path except APAN-JP)

	Normal		Poor Path		Always been anomaly Path
	Multiple Path		Connectivity Lost or Commodity		Dec. 27. 2006

| Src \ Dest	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	SingARENv ia 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

Securing the connectivities -1-

- Activate the Hawaii Link
  - When the TEIN2 network launched, we applied the route filter for TEIN2 routes via Hawaii so that not flow the traffic from APAN - Hawaii - AARNet - TEIN2. There was a good advice from Mark Prior/AARNet, then we removed the filter and got the connectivity with TEN2 again via Hawaii(12/27)
  - However, since the traffic on Hawaii link unexpectedly increased (140/155Mbps), we had to examine the next solutions.

tpr6 : so-0_1_1

```
In Max Traffic    In Traffic    Out Max Traffic    Out Traffic
In Cur: 481.748 [kbps]    Ave: 1.325 [Mbps]    Max: 31.858 [Mbps]
Out Cur: 2.174 [Mbps]    Ave: 7.913 [Mbps]    Max: 142.097 [Mbps]
Last update : Tuesday, January  9, 2007. 18:56:23 JST
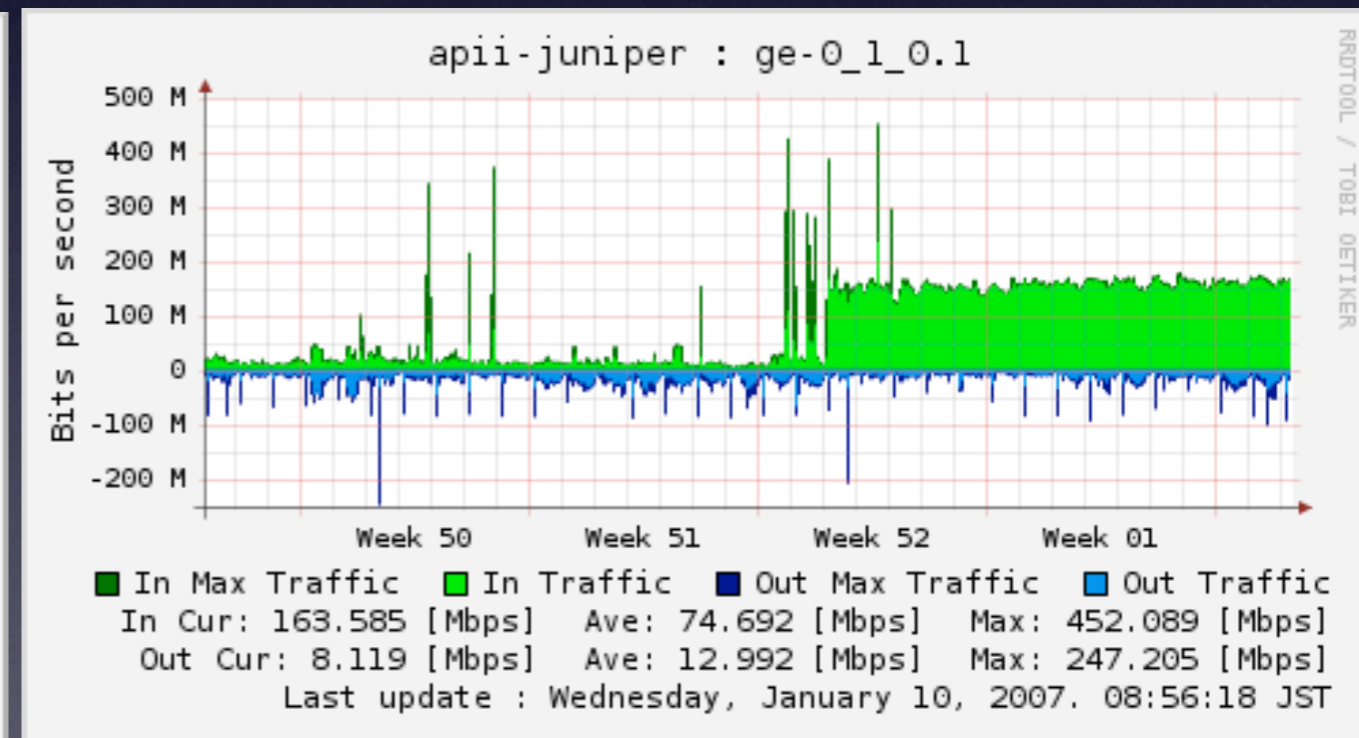```

# Securing the connectivities -2-

- Efficient use of APII JP-KR link
  - We decided using APII-KR link for backup at the sight of Hawaii link congestion. We asked KOREN NOC to transit CERNET and TEIN2 routes. Then, 150Mbps or more over traffic flowed on APII JP-KR link.
  - However, this time, the 155Mbps link between KOREN and CERNET became congestion.
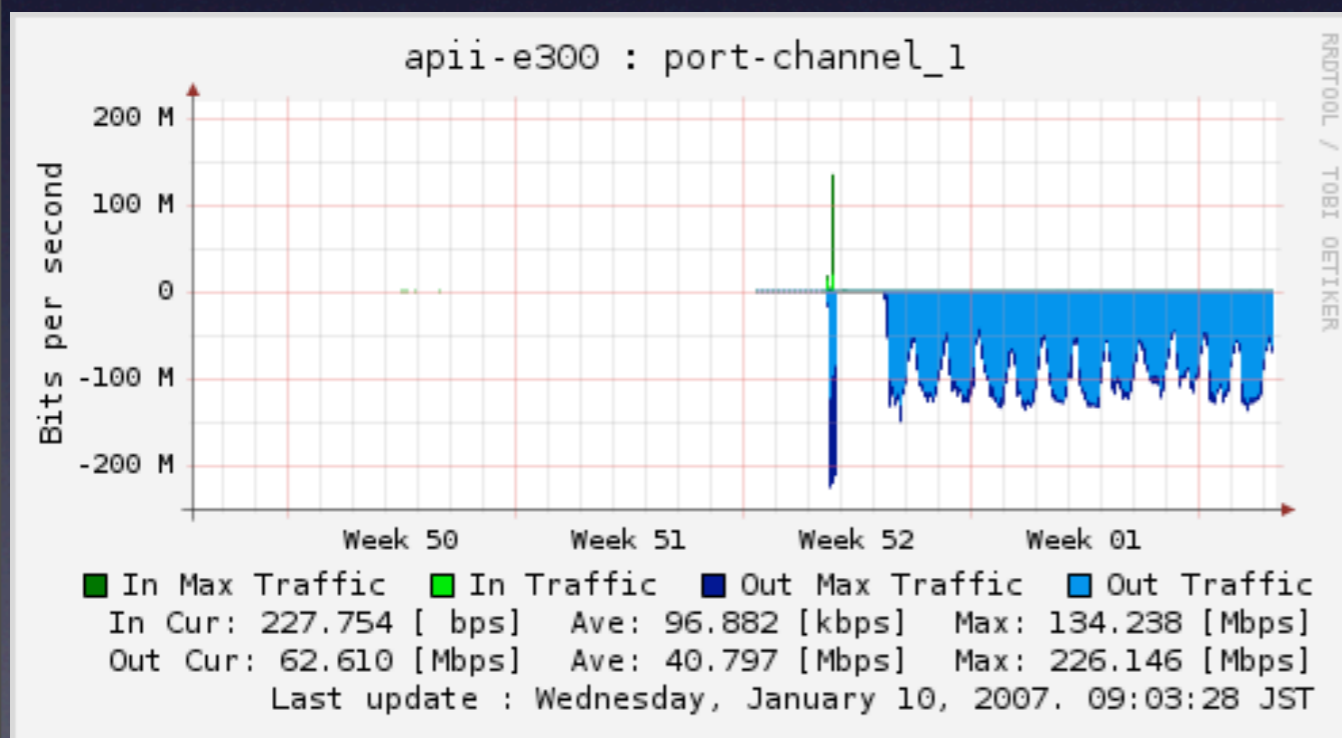


APII new 10G link



APII 1G link

# Securing the connectivities -3-

- Efficient use of SingAREN link over JGN2 Singapore circuit
  - At the sight of KOREN - CERNET link congestion, next, we decided the traffics for TEIN2 turned into SingAREN link under cooperations of SingAREN, JGN2 and TEIN2 NOC.
  - As a result, most of the traffic for TEIN2 passed through the JGN2 Singapore circuit and the traffic for CERNET passed through the APII JP-KR link.
  - It was believed fine traffic tuning in the limited network resources.

# 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 |

| Src \ Dest | 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 | SingARENv ia 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 |

| Src \ Dest | 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 |

# Response for Circuit Restoration -1-

- **JGN2 SG circuit**
  - According to JGN2 NOC, JGN2-SG circuit was also affected by the earthquake. But circuit provider NTT-c rapidly restored it by the re-route the cable system.
  - It seems that it re-routed in the EAC cable system that with little damage.

- **TEIN2 JP circuits**
  - Information from TEIN2-JP NOC, both TEIN2 JP-SG and JP-HK circuits were outage due to damaged by the earthquake. The circuit provider tried to restore it by the re-route using other cable system, but the securing 622M bandwidth was hard to keep.

- **NICT HK circuit for CERNET and CSTNET**
  - Information from circuit division of KDDI, there was only one portion that damaged by earthquake in FLAG cable system, but cable repair ship and schedule were still under the coordinating. Moreover, since the bandwidth is 2.4G, it is difficult to restore it by the re-route with other cable system.

# Response for Circuit Restoration -2-

- Restoration of JGN2 Thai circuit  --- Jan. 9 18:30(JST)
  - According JGN2 NOC
    - APCN would be planned to complete restoration on 30. Jan.
    - SWM3 backup cable for JGN2 TH link will be planned to complete restoration on 20. Jan.
  - KDDI restored the circuit provisionally (as 45Mbps)
    Re-routed JGN2 Thai circuit :  KDDI ATM - EAC - (SG) - SWM3 - (TH) - CAT

    "Retest News! " Jan, 22  18:30(JST)
    Re-routed JGN2 Thai circuit :  KDDI ATM -  SWM3 - (TH) - CAT

- Restoration of MAFFIN JP-PH circuit  --- Jan. 9 19:50(JST)
  - According to circuit division of KDDI,  it takes long time to the complete restoration of  APCN2 cable system. (Cable repair scheduling will be on Jan. 29)
  - KDDI provisionally restored the circuit by the re-routing and restored.
    Re-routed APCN2 cable :
    Tokyo - Chikura - kitaibaraki - Chongming(CN) - China Land - Lantau(HK) - Kuantan(MY) - Ktong(SG) - Batangas(PH) - Manila
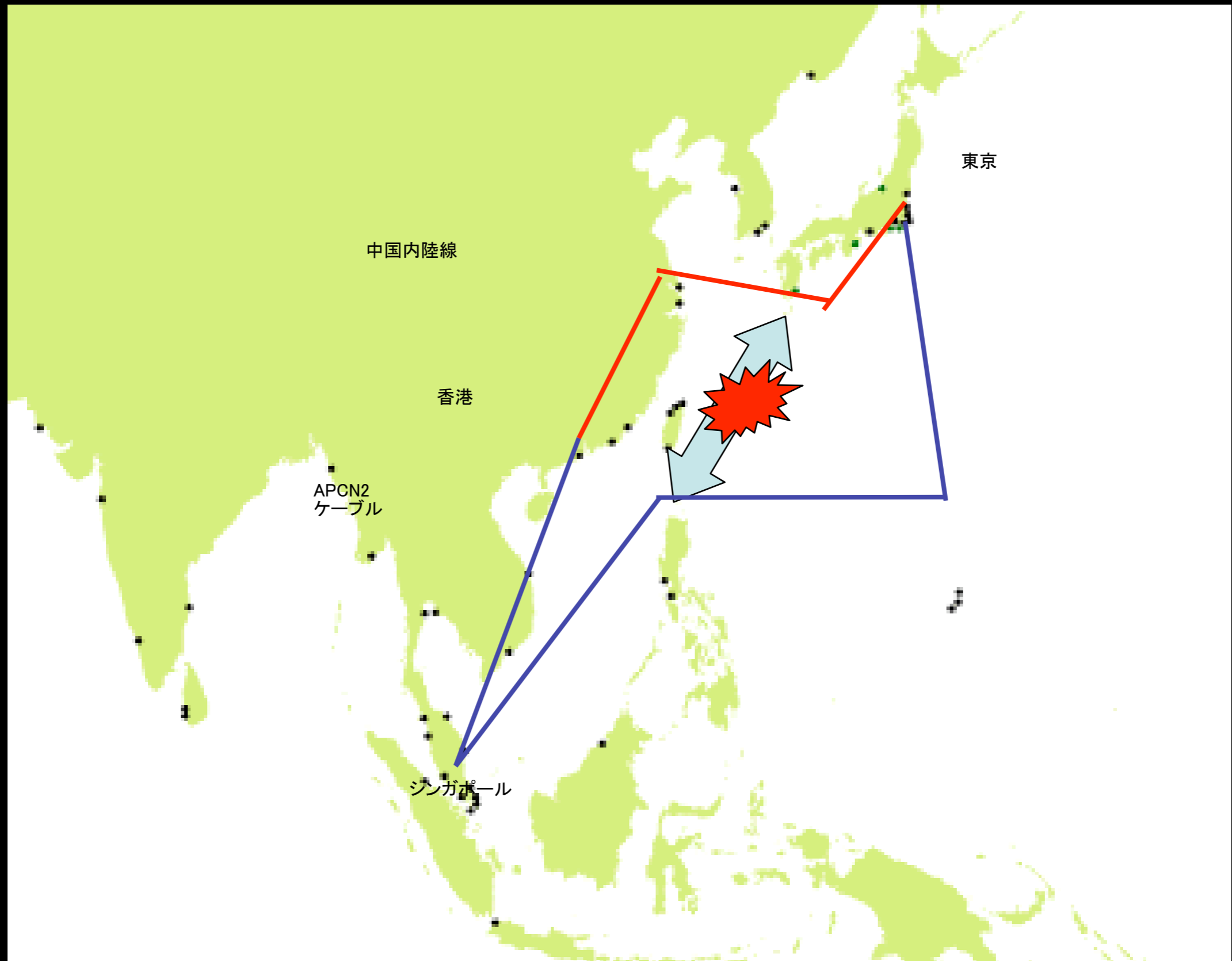
This figure is composed by KDDI.

# Routing Path in Asia Pacific
## (Estimated Path except APAN-JP)
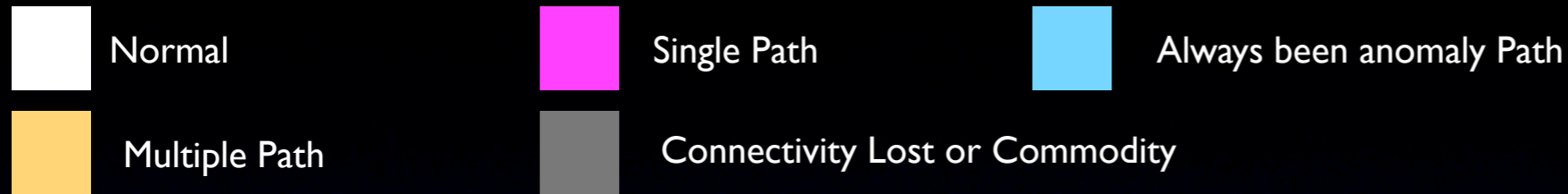
Legend:
- □ Normal
- ■ Single Path (magenta)
- ■ Always been anomaly Path (blue)
- ■ Multiple Path (orange)
- ■ Connectivity Lost or Commodity (gray)

Jan. 4. 2007

| Src \ Dest | 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)

Legend: ⬜ Normal · 🟪 Single Path · 🟦 Always been anomaly Path · 🟧 Multiple Path · ⬛ Connectivity Lost or Commodity

Jan. 9. 2007

| Src ＼ Dest | 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)
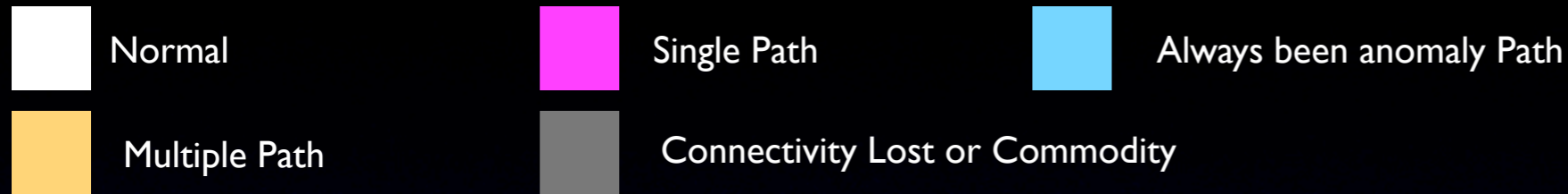
| Src \ Dest | APAN-JP | CERNET | APAN-TW | KOREN | ASTI | CSTNET | TEIN2 | SingAREN | UniNet | ThaiSARN | KREONET 2 | AARNET |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| APAN-JP | | JP-CN Direct | JP-TW Direct | APII | MAFF-PH Direct | JP-CN Direct | TEIN2 JP-SG JP-HK | JGN2 SG Direct | 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 |

special configuraion for
the medical demonstration

# orginal design
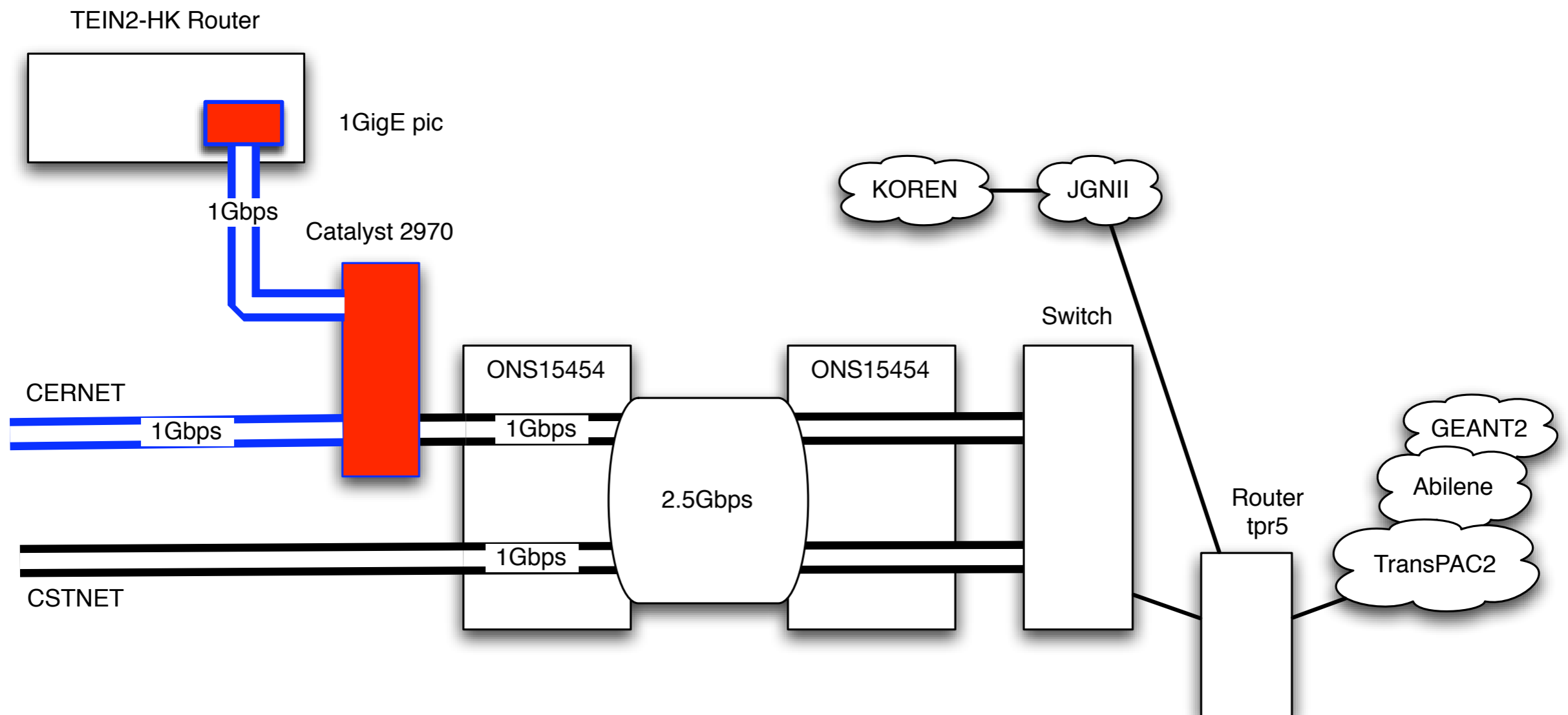
# special design for the demonstration
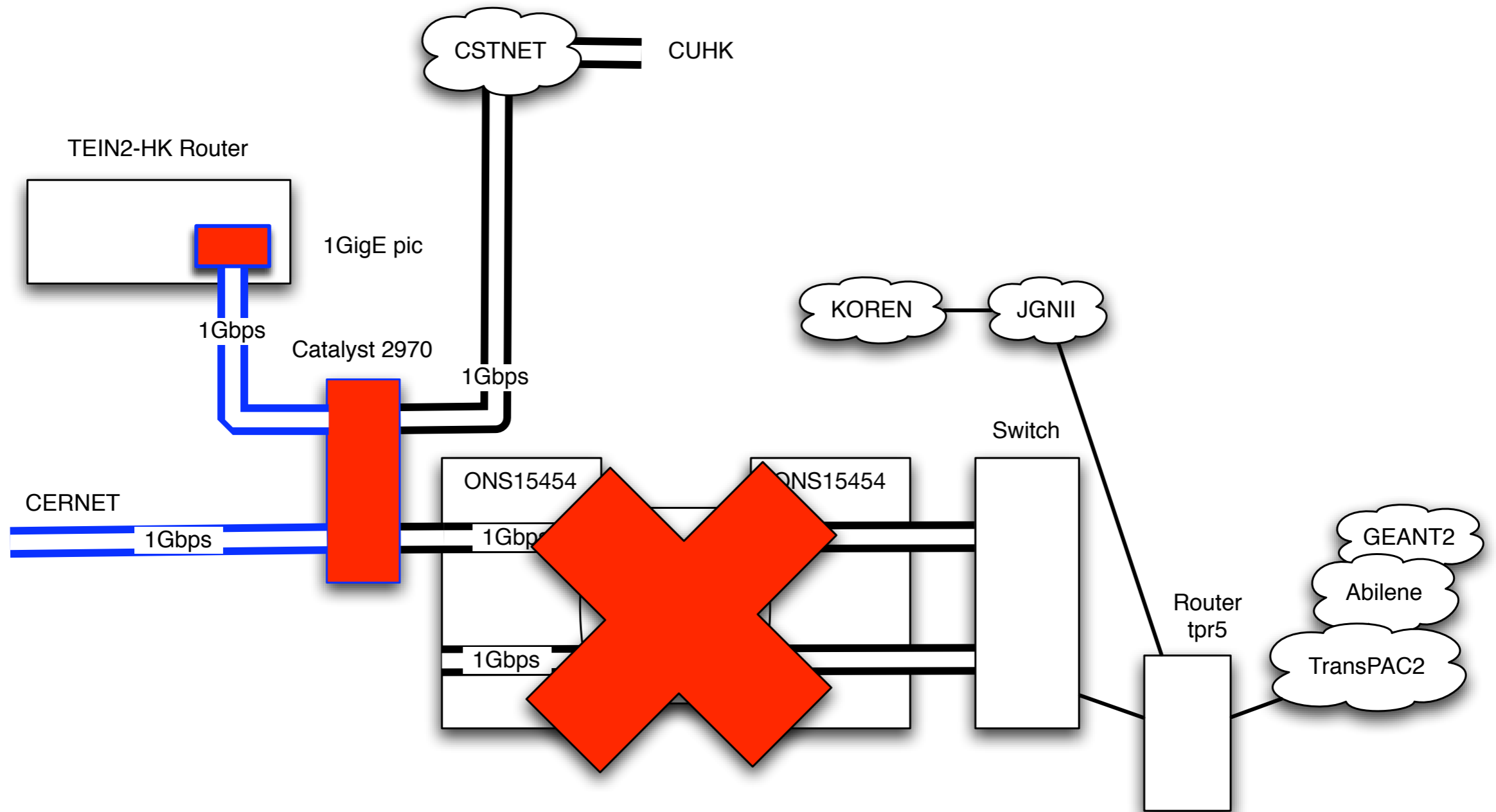
# Summary

- When a large scale outage of cable system occurred, NOC should do,
  - Securing the connectivities.
  - Information-sharing and cooperation with circuit providers carrier.
  - If possible, strong request for restoration.

- Routing support in human resources.
  - Even though R&E networks, overview routing whole of asian pacific are is difficult.
  - There are poor information of network topology and operation data of circuit.
  - There are some routing policies.
  - Optimum routing was not cover only by dynamic routing but manual routing.

- Operation information and status for each circuit.
  - Need the operation information of circuit beyond the neighbor.
    How congest the link? Is the circuit available or not?
  - Provide the knowledge of what paths or links other NRENs has.
  - Checking the routing path to the non-direct peering.

- Cooperation among NOCs.
  - That was impressed!
  - Cooperation was strengthened further.

# Thanks to...

- **All R&E NOCs,**

  Especially,

    - AARNet NOC
    - CSTNET NOC
    - JGN2 NOC
    - KOREN NOC
    - PREGINET NOC
    - SingAREN NOC
    - TEIN2 NOCs

- **And circuit providers,**

    - KDDI
    - NTT-com
    - CAT Telecom
    - INOVE communication

  (Alphabetic Sequence)