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WholesaleData

Taiwan Earthquake Fiber Cuts: a Service Provider View

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nanog39 – Toronto, Canada – 2007/02/05

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Taiwan Earthquake fiber cuts: a service provider view

- Building a backbone from USA to Asia
- 2006 Asian Backbone | The reconstruction year
- Earthquake off Taiwan on Dec 26, 2006
- The damage(s)
- Repairing subsea cables
- Current Situation
- Lessons for the future

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USA to Asia Backbones | Transpac & Intra Asia Cable Systems

China-US | Japan-US | PC-1 | TGN-P

Combined with

APCN-2

C2C

EAC

FNAL

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2006 Spotlight on Asia | Expansion

Add Geographies

- Singapore (2 sites)
- Tokyo

Consolidate presence

- Hong Kong

Upgrade Bandwidth on all Segments

- Manila
- Sydney

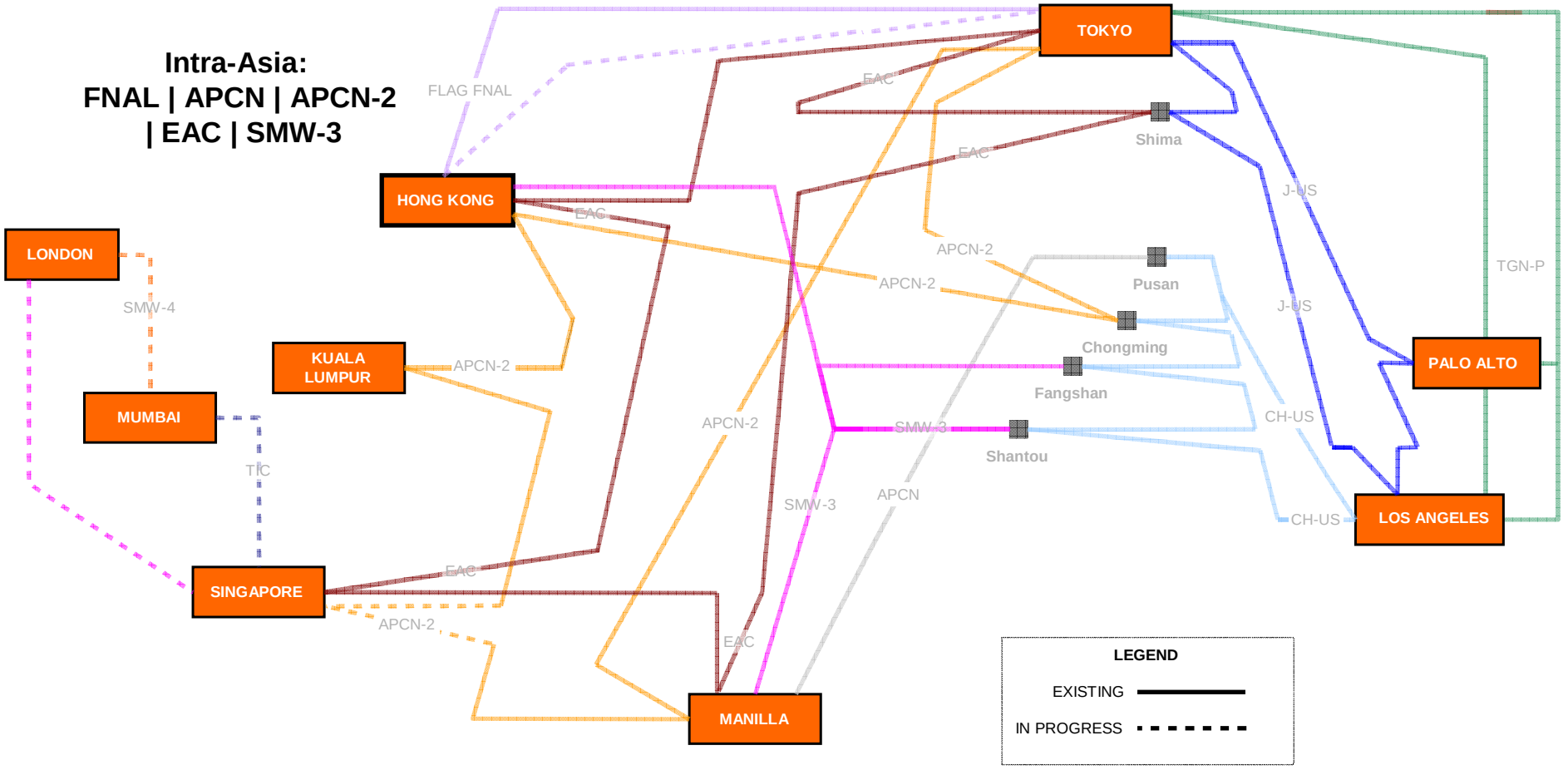
Planning and Design Musts

- Subsea cables diversity
- Always favour low latency (RTD …)
- Improve POP meshing intra-Asia

AS6453 Asia Backbone | Physical Routes Diversity

TransPac: C-US | J-US | TGN-P

Intra-Asia: FNAL | APCN | APCN-2 | EAC | SMW-3



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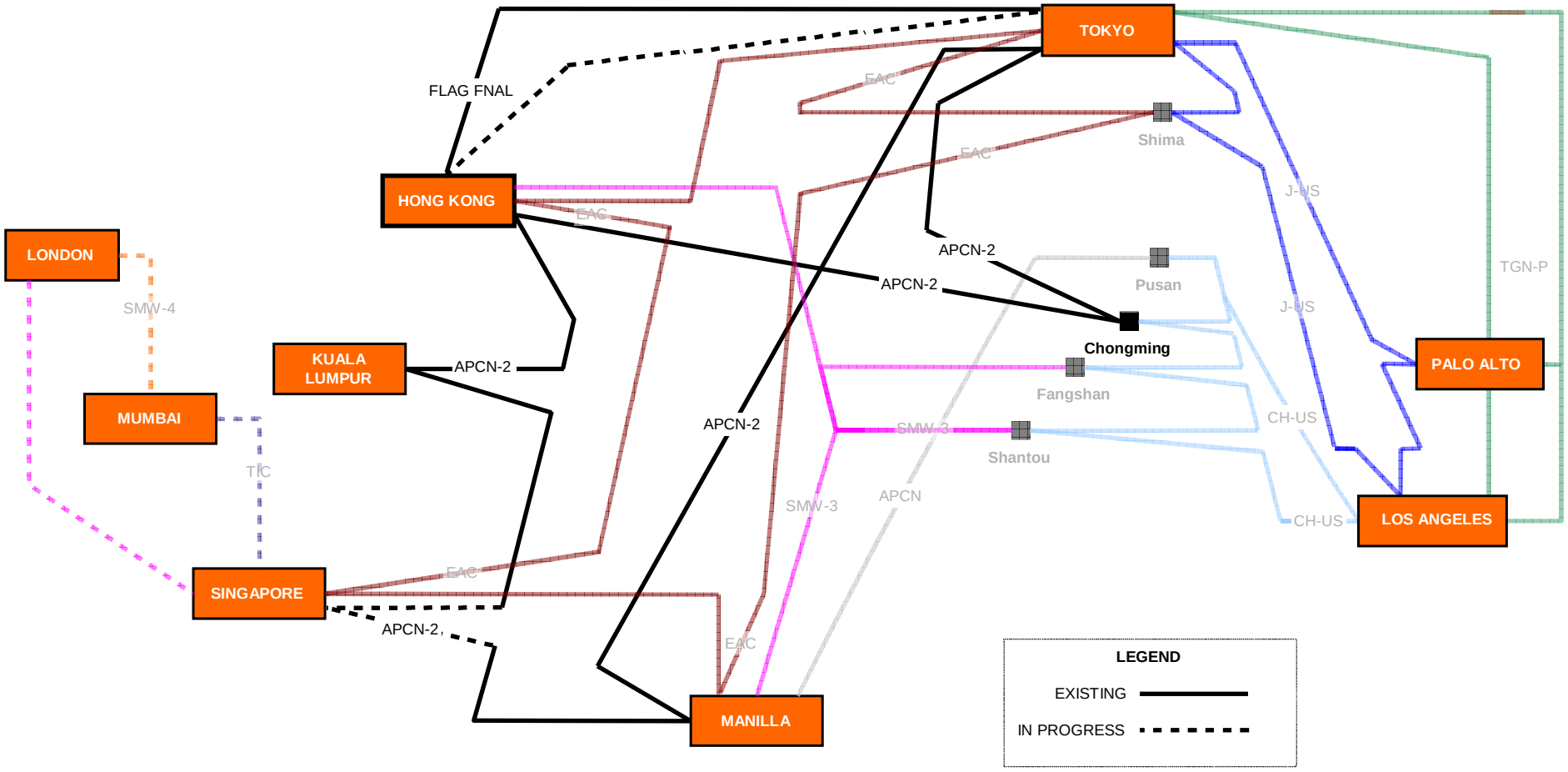
South East Asia Cable Systems – FNAL & APCN-2



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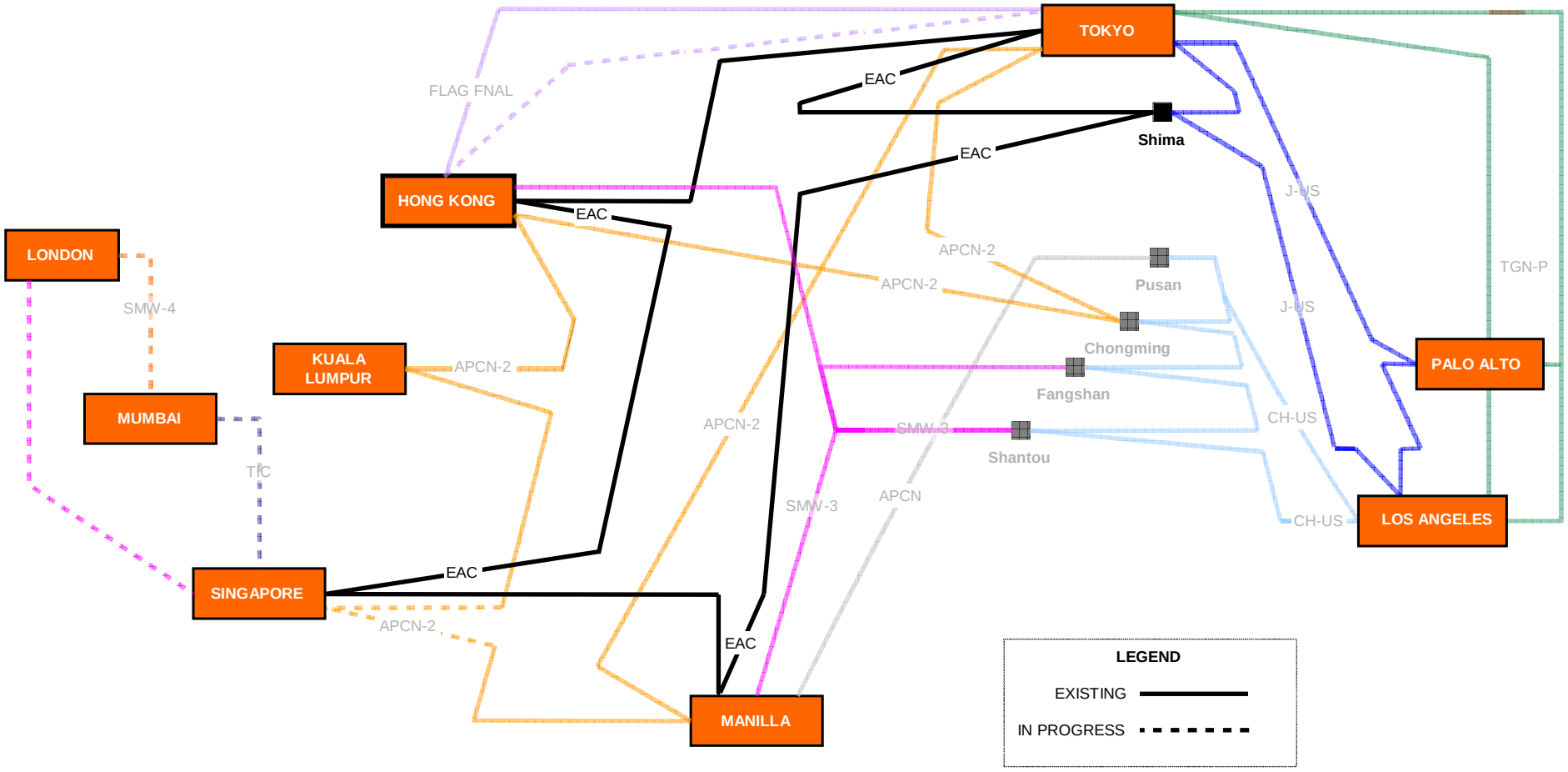
South East Asia Cable Systems - EAC



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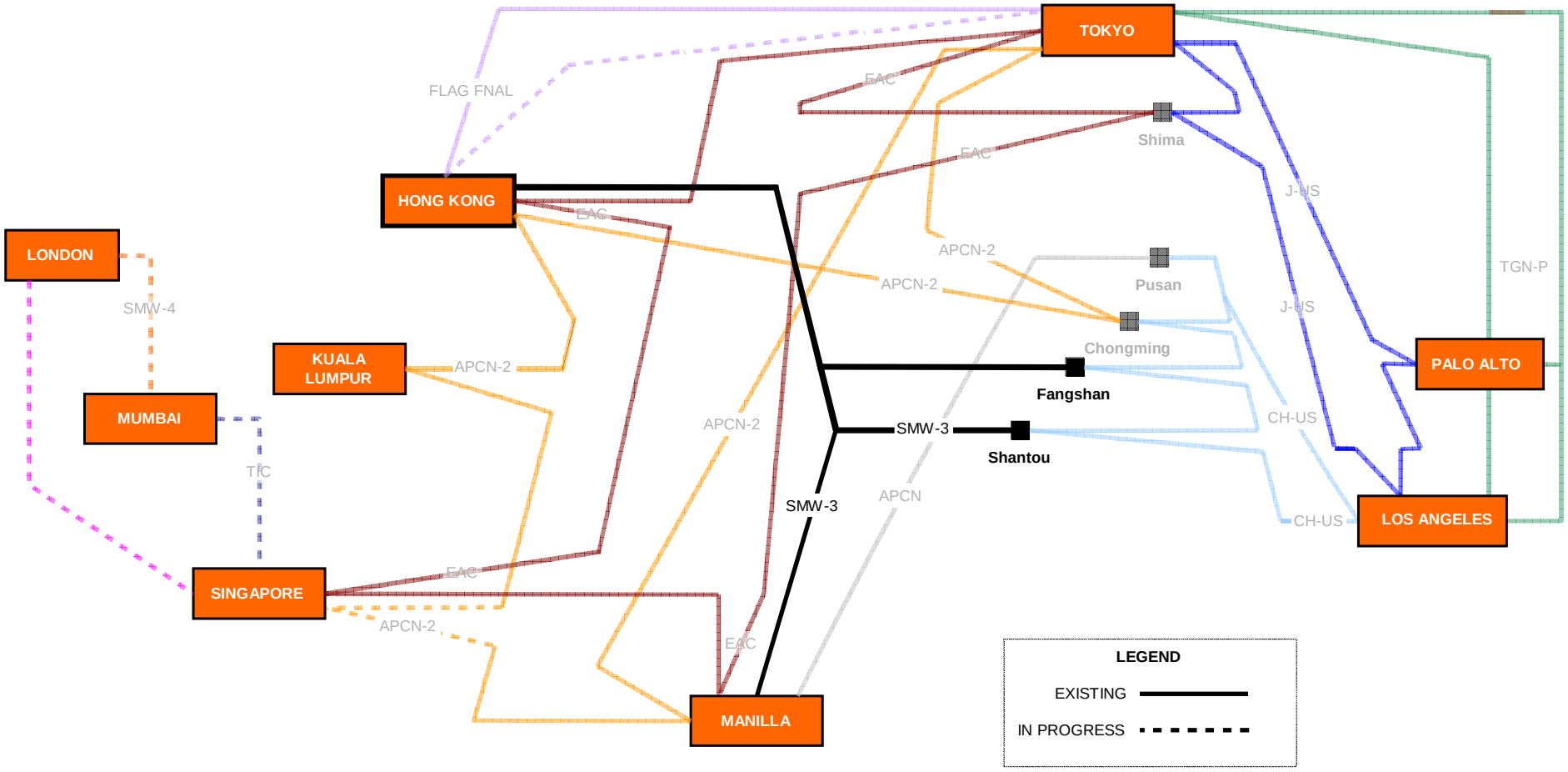
South East Asia Cable Systems – SMW-3



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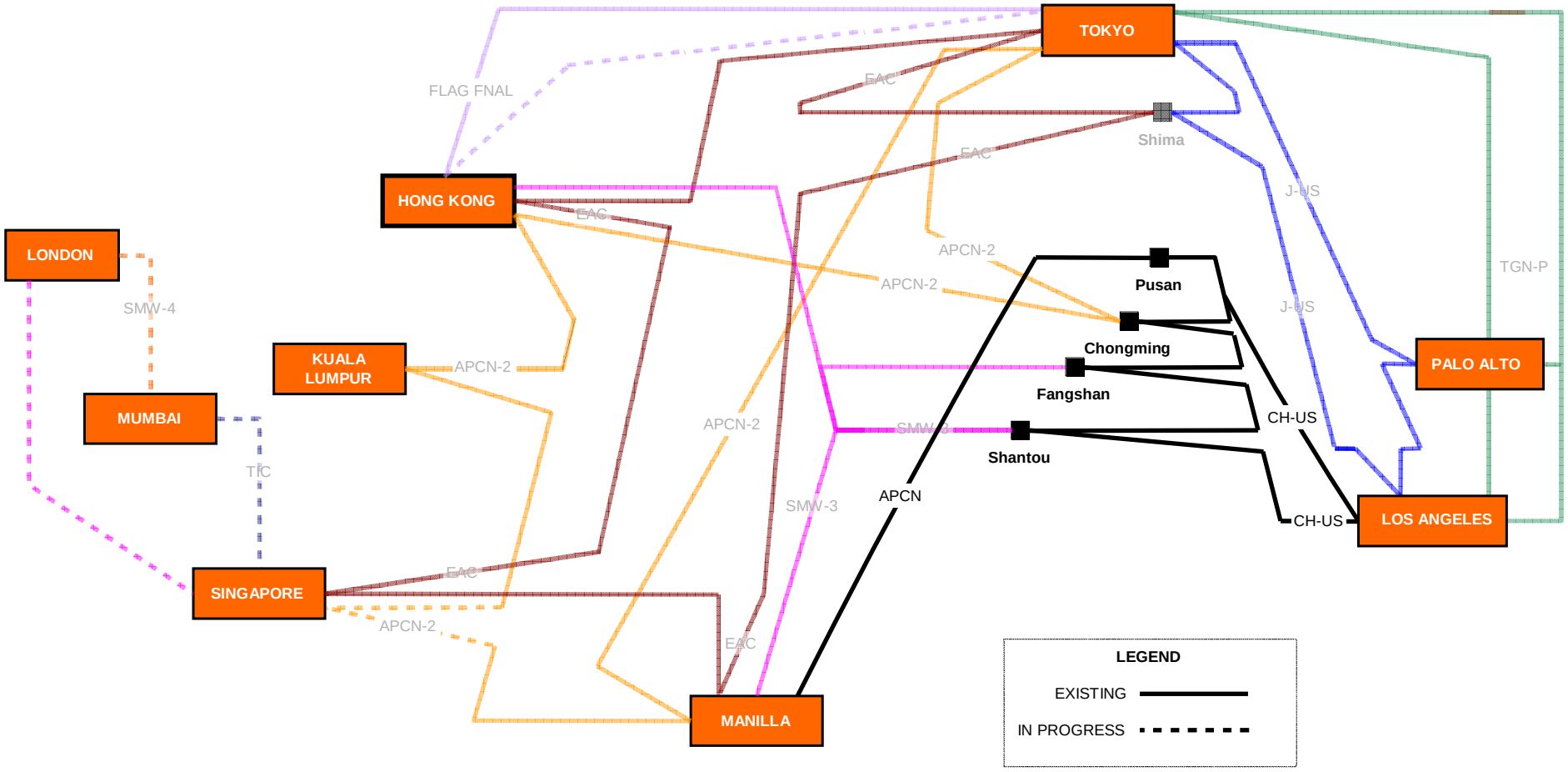
South East Asia Cable Systems – APCN & China-US



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Earthquake Magnitude 7.1 - TAIWAN REGION
2006 December 26 12:26:21 UTC (or 07:26:21 AM EST)

Earthquake Details

Magnitude	**7.1** (Major)
Date-Time	**Tuesday, December 26, 2006 at 12:26:21 (UTC)** = Coordinated Universal Time **Tuesday, December 26, 2006 at 8:26:21 PM** = local time at epicenter Time of Earthquake in other Time Zones
Location	21.825°N, 120.538°E
Depth	10 km (6.2 miles) set by location program
Region	TAIWAN REGION
Distances	90 km (55 miles) SSE of **Kao-hsiung, Taiwan** 120 km (75 miles) SSW of **T'ai-tung, Taiwan** 375 km (235 miles) SSW of **T'AI-PEI, Taiwan** 800 km (495 miles) N of **MANILA, Philippines**
Location Uncertainty	horizontal +/- 4.8 km (3.0 miles); depth fixed by location program
Parameters	Nst=222, Nph=222, Dmin=282.4 km, Rmss=0.93 sec, Gp= 32°, M-type=teleseismic moment magnitude (Mw), Version=Q
Source	USGS NEIC (WDCS-D)
Event ID	uswtai

This event has been reviewed by a seismologist.

First aftershock – 8 min later – 6.9
Second aftershock – 4 min later - 5.2
Third aftershock - 3 hours later - 5.5

Source: earthquake.usgs.gov

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Luzon Strait | The North to South Asia Favoured Passage

APCN-2

C2C

EAC

FNAL

What makes the Luzon Strait so attractive to cable builders?

Three routes are available to link South East & Northern Asia (Japan-Korea):

1. Luzon Strait between Taiwan & Philippines
   - 320 km width
   - 2600m sill depth in Bashi Channel (north)
2. Route south of the Philippines
   - adds lots of mileage & hence latency
3. Formosa Strait
   - Narrowest part is 130 km width
   - 70 m depth (too close to fishermen)

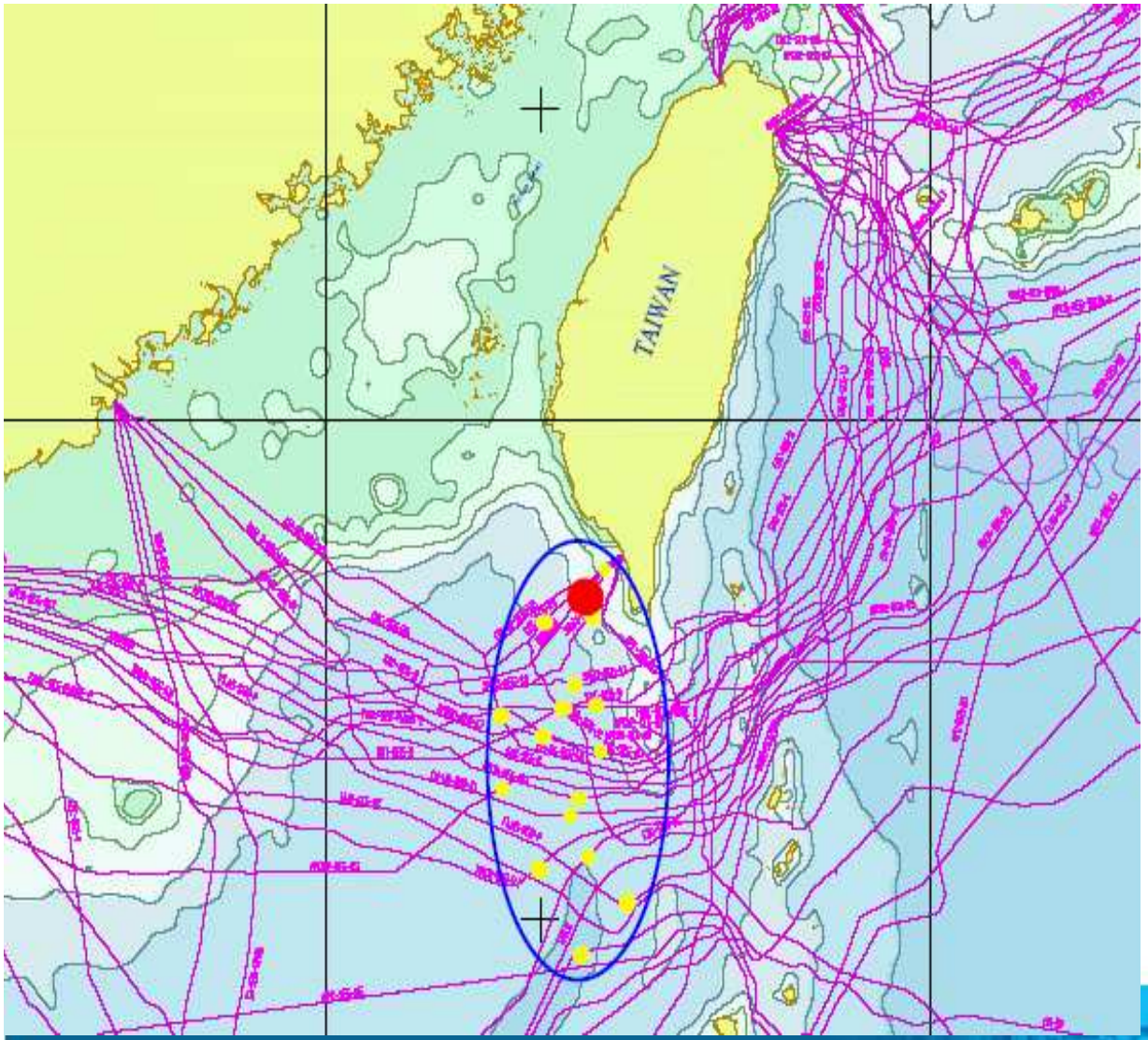
Given the current market requirements, the Luzon Strait is the best subsea cable route alternative.

Even though many of the cables are **ring-protected**, *both legs* pass through the Bashi Channel (earthquake epicenter) and the cable systems suffered *multiple failures* causing the entire cable system to be **out of service**.

- 9 Cables via Luzon strait: 7 down.

No cables are available to offer restoration. Wait on cable repairs.

Impacted Cable Systems
-- map courtesy of PCCW (thank you!)



- 6 major cable systems are being affected including resilience path/cable
- Impacted area is around 300km by 150km
- Traffic connecting to Southern Taiwan is severely affected, communication in/out HK, Southeast Asia are severely affected
- Traffic going thru North Taiwan to Japan is not being affected

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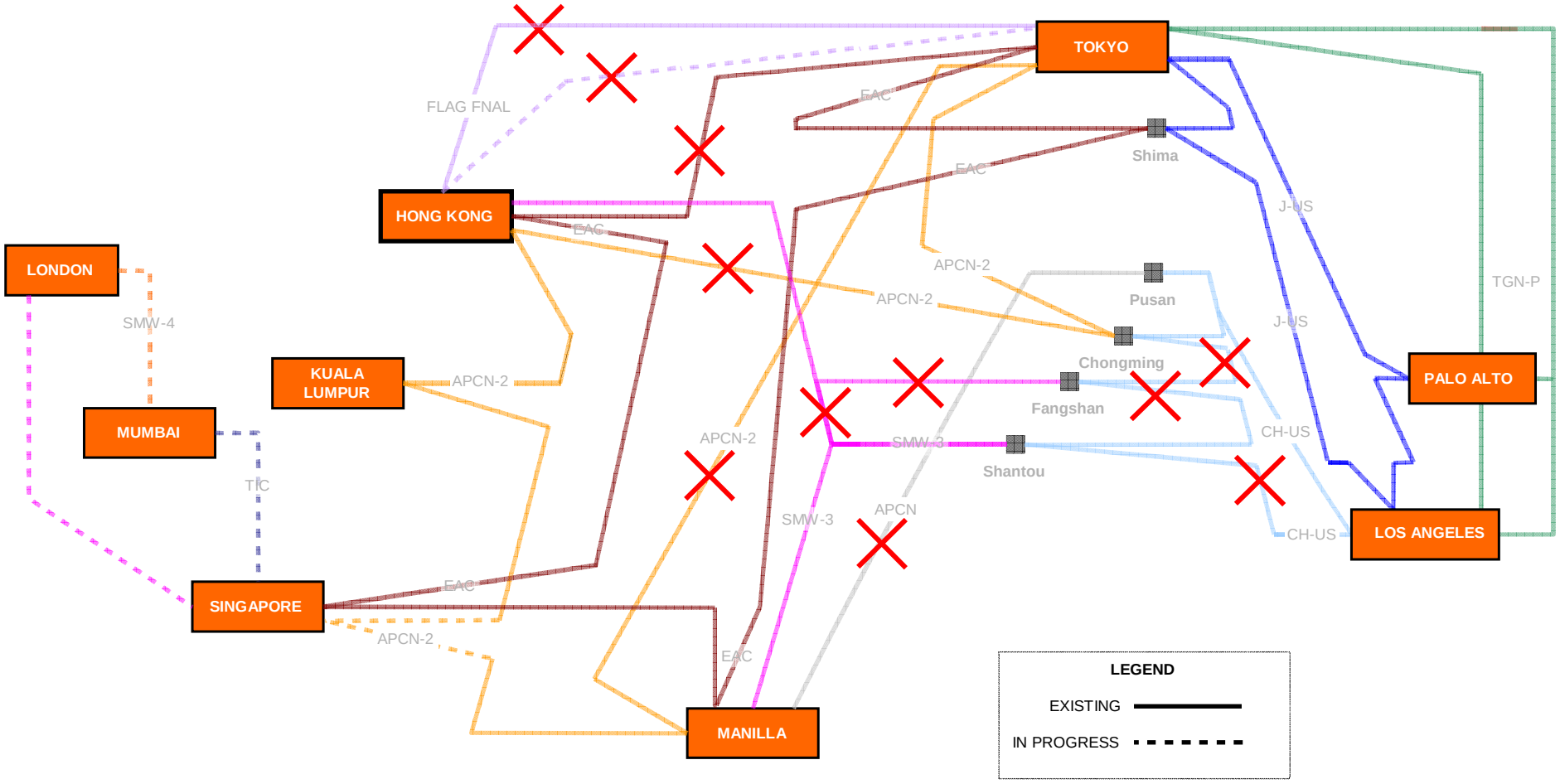
Taiwan Earthquake December 26, 2006 | Cable Faults



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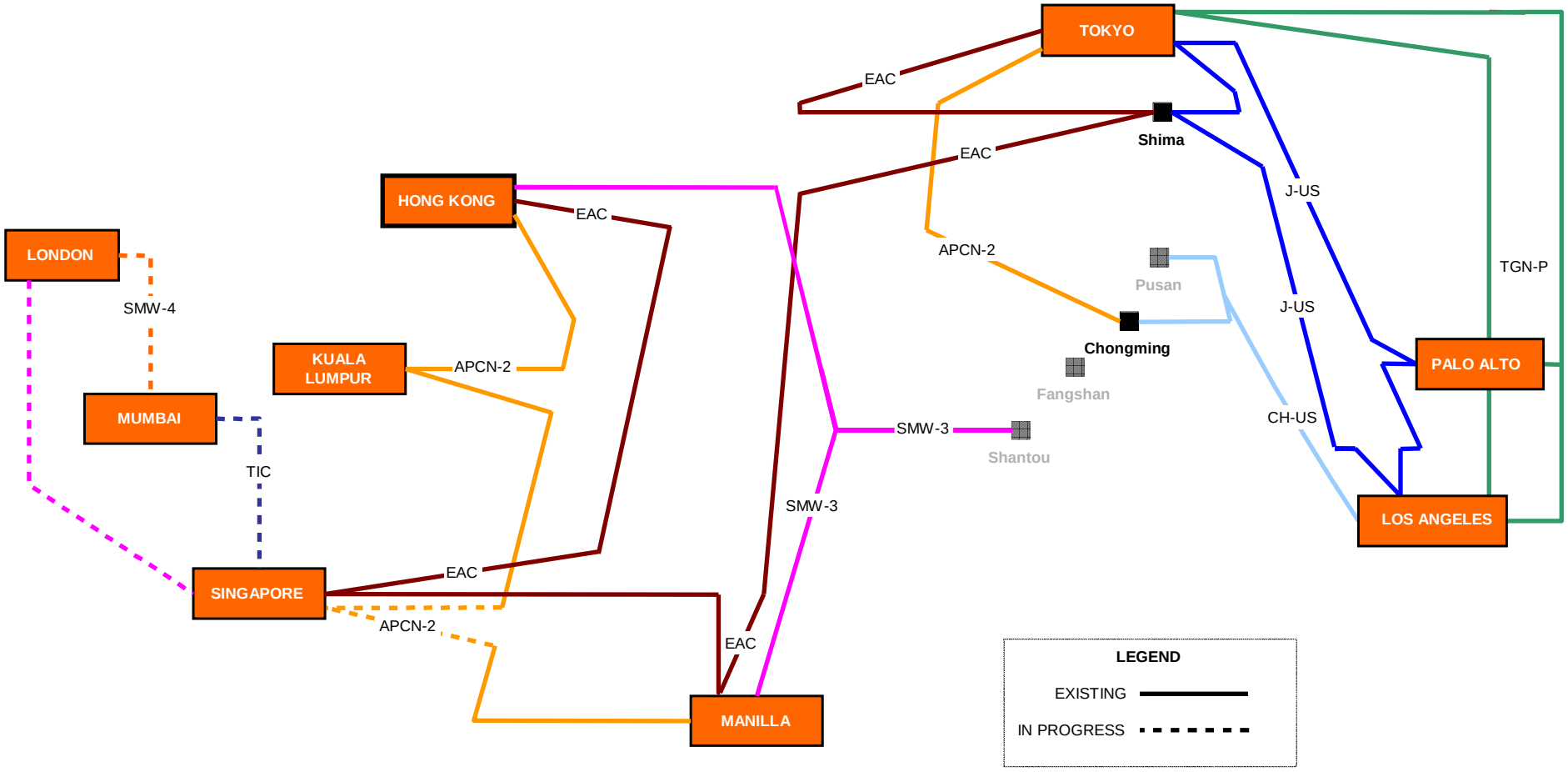
Taiwan Earthquake December 26, 2006 | Remaining Cable Routes



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Reparing a subsea cable system | The task…

- Subsea Fiber optic are 21 millimeters in diameter
- Subsea cables lay on the ocean floor.
- Quakes displace cables from their original location (not as much as a tsunami…)
- Quakes cause landslide, stir sediment layers and can bury cables
- The Bashi Channel is 2500-4000m deep
- A remotely-operated vehicle (underwater robot) cannot operated below a depth of 2000 m
- 18 faults to repair
- Each repair takes around 7 days but repair companies quote 10 days to allow for weather

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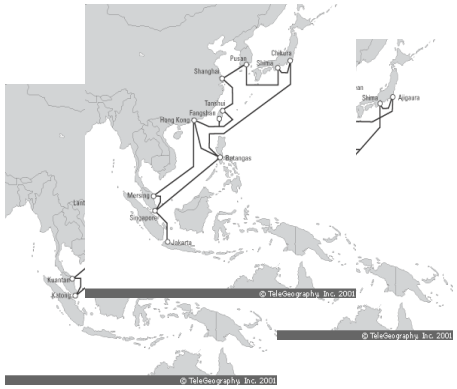
Reparing a subsea cable system | The means…

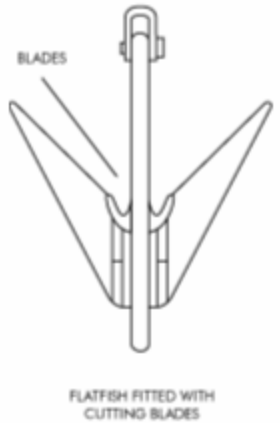
Cable repair ship in the area.

Powerful vessel equipped to maintain station and perform cable repair in rough weather conditions.

All spares, including spare cable, a number of cable bodies and jointing kits.



Not so rough weather



A grapnel fitted with a cutter and a grabbing tool.

45 by 60 cm (18 by 24 in)

Dropping grapnel + dragging oceanfloor + recover cable = 16 hours

Average repair duration = 7 days

Repairing a submarine cable

1. The fault is initially located by testing from the terminal stations. The repair ship can recover the cable using a variety of grapnels. The grapnel is lowered from the repair vessel and traverses the cable line on the seabed. A grapnel is a special device that can simultaneously cut and seize cables.

2. After the cable is found and hooked by the grapnel , it is cut in situ and one end is raised and brought onto the ship.

3. A buoy is attached to the end of the recovered cable, which is then replaced on the ocean floor. Recovery of the other cable end with the grapnel then proceeds.

4. After the other end of the cable is recovered on board and the faulty cable section is removed, replacement cable is jointed in and the cable is deployed back to the buoy.

5. The end of the cable attached to the buoy is brought aboard, and it is spliced to the replacement cable.

6. After a series of tests, the cable is released and lowered onto the ocean floor.

Source: http://www1.alcatel-lucent.com/submarine/products/marine/index.htm

http--www.nowhere.per.sg-swf-repairing.swf.url

When the going gets tough

- Dec 28 – EAC repaired
- Jan 2 – Start establishing a L2VPN on our sister company's assets
  - L2VPN – Singapore to Santa Clara via Chenai (India)
  - L2VPN – Hong Kong to London
- Jan 12 – Regain partial backbone via China-US (HK- LA route)
- Jan 29 – APCN Regained HK to Palo Alto route

And now for something really different…

- Jan 30 – all Intra-Asia backbone repaired and in service!
- (yeah. Finally)

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AS6453 Asia Backbone | Physical Routes Diversity

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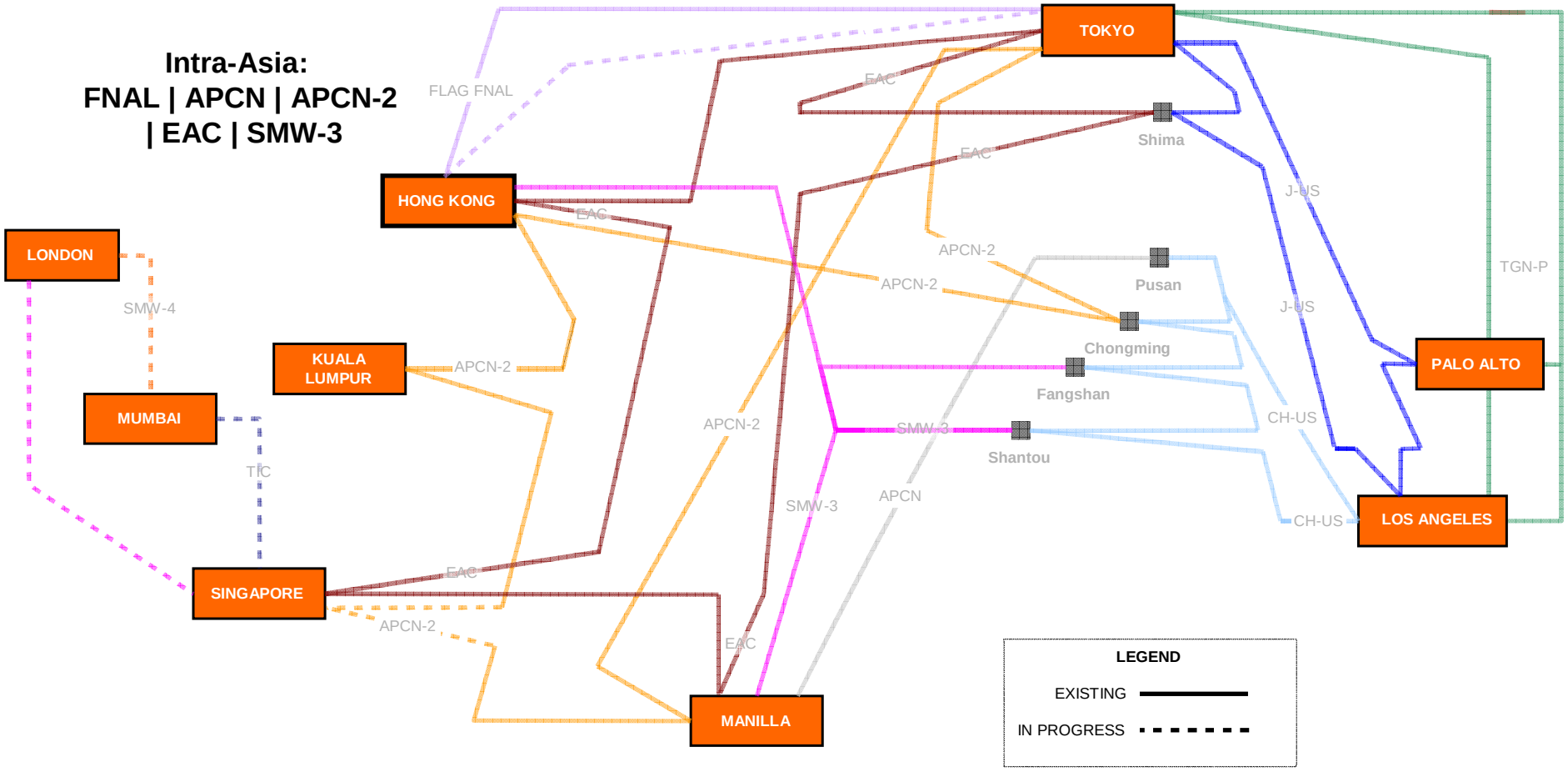

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Go West! | Remarkable Central Asian build-out

- April 2002: RFS for i2i; 8.12Tb capacity; 160Gb lit, 50% Bharti 50% Singtel owned
- Feb 2004: VSNL and Asia Netcom announce their Tata Indicom cable (TIC) between Chennai and Singapore cable ; RFS was nov 2004 with an initial lit capacity of 320gbps and a design capacity of 5.12Tbps; connects into EAC and on to North America.
- Oct 2005: BSNL announces India-Sri Lanka cable
- Dec 2005: Seamewe-4 operational; Sept 2006: Falcon operational
- March 2006: BSNL and MSNL announce new India-Singapore cable
- August 2006: VSNL announces new multi-terabit India-Europe cable, RFS mid 2008, named IMEWE and new intra-Asia cable (Singapore-HK-Japan) RFS Q3 2007

Lessons | Circle the globe and go West!

Three Asia to Europe cable projects announced since December

1. TransPacific Express (TPE): China –US cable
   - US-Qindao and US-Shanghai, branches to Korea and Taiwan
   - 5.12Tb design capacity; 1.28Tb lit initially;
   - 500 million US$, RFS end 2008
2. Flag NGN with 4 cables
   - **System 1:** Asia - India, Malaysia, Singapore, Indonesia, Vietnam, Philippines, Brunei, Hong-Kong
   - **System 2:** Africa - Kenya, Mozambique, Republic of South Africa, Tanzania, Madagascar, Mauritius
   - **System 3:** Mediterranean - Greece, Cyprus, Turkey, Malta, Libya, Lebanon
   - **System 4:** Trans-Pacific - US West Coast, Japan, China and Hong Kong (2009)
   - To be built over next 36 months; 1.28Tb, 1.5 billion $
3. EAC Pacific
   - Japan-US Northern route and Philippines-US via Guam and Hawai as Southern route
   - Philippines-Japan to close the ring; 2.56Tb design capacity (4 fiber pairs) ;
   - 636 million $ committed, RFS july 2008
4. IMEWE + TIC
   - Japan, Hong Kong, Singapore, India (Chennai, Mumbai), Middle East, UK
   - 600 million , RFS , mid 2008 (India Europe) q3 2007 (intra-Asia)

Will more than double trans-Pacific capacity

Pr. Cuthbert Calculus

Thank you.