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New Asian IP Backbone Architecture

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Pacnet

MyNOG

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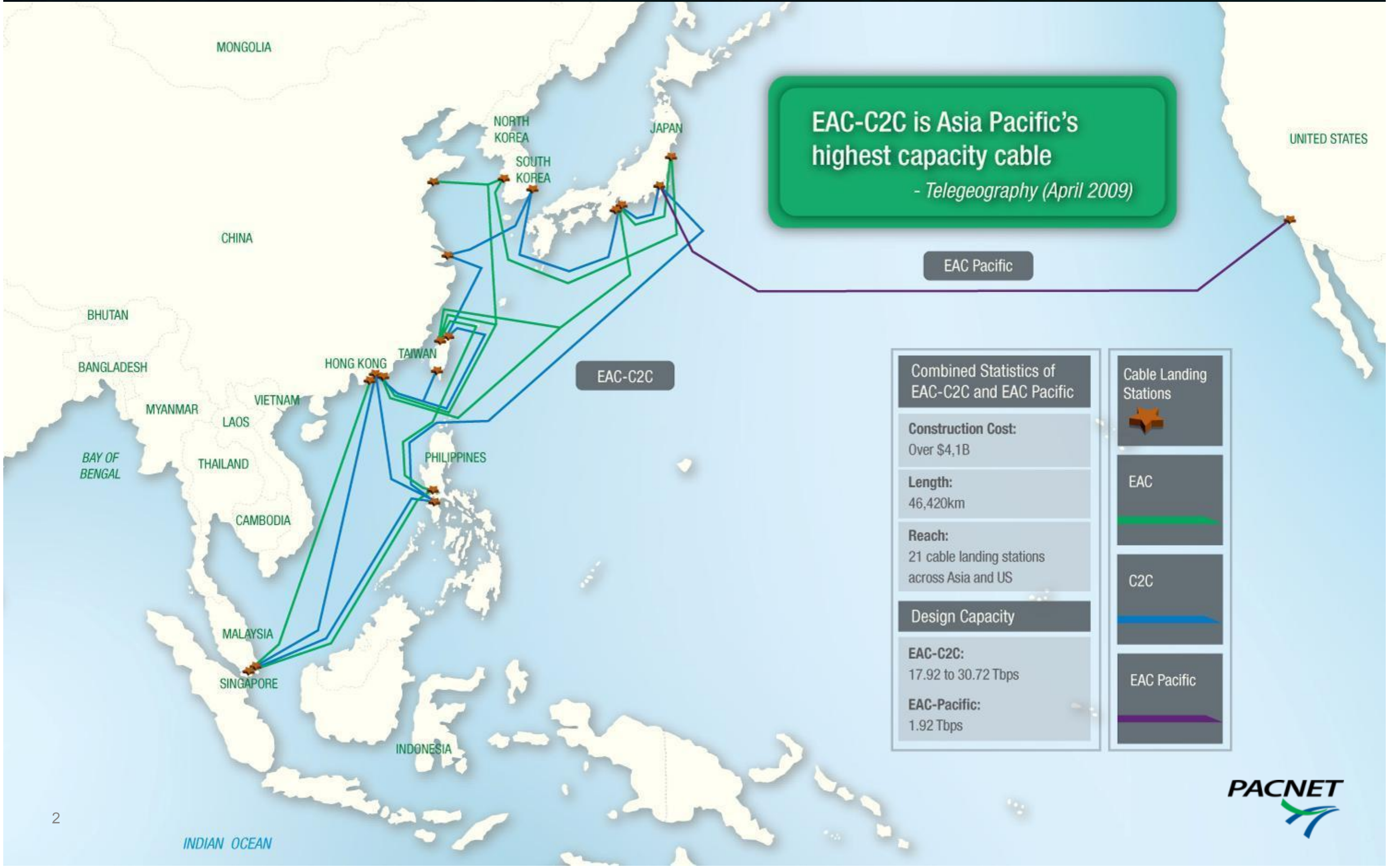
Who is Pacnet?



EAC-C2C is Asia Pacific's highest capacity cable

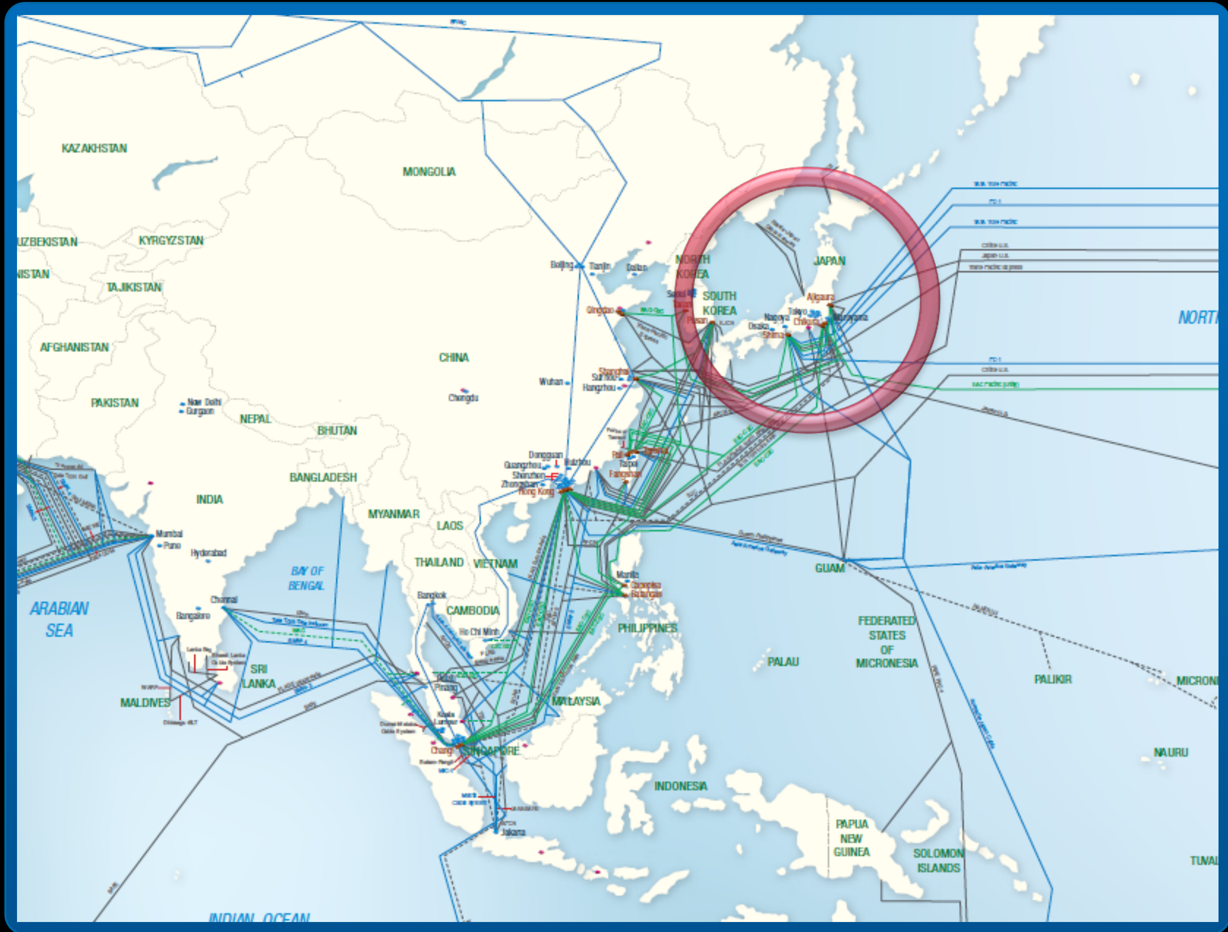
- Telegeography (April 2009)

Combined Statistics of EAC-C2C and EAC Pacific
Construction Cost: Over $4,1B
Length: 46,420km
Reach: 21 cable landing stations across Asia and US
Design Capacity
EAC-C2C: 17.92 to 30.72 Tbps
EAC-Pacific: 1.92 Tbps

International Connectivity in Asia

- Countries in the Asia Pacific region connect to each other primarily using subsea cables – over 88% of intra-Asia traffic is through subsea cables

- Primary gateway for US – Asia traffic is Japan



International Connectivity in Asia

- Unique Positioning
  - Intra-Asia IP communications is mainly over subsea cable systems
  - Typically a RING topology bridging multiple countries is used
  - Cable length between cable landing stations is not too long, for example, between 1,800km – 3,400km (EAC)

Asia <> US IP Backbone Design

A. Layer 3 backbone circuits in Asia connect to US via Cable Landing Stations in Japan

B. Layer 3 backbone circuits connect to Tokyo/Osaka POPs from Asian countries, then both POP connect to US IP POPs

C. A + B combination

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Subsea Network Operations

SDH Ring Protection

- Unidirectional 1+1 subnetwork connection protection (**SNCP**)
- Multiplex Section-Dedicated Protection Rings (**MS-SD Ring**)
- Multiplex Section-Shared Protection Rings (**MS-SP Ring**)

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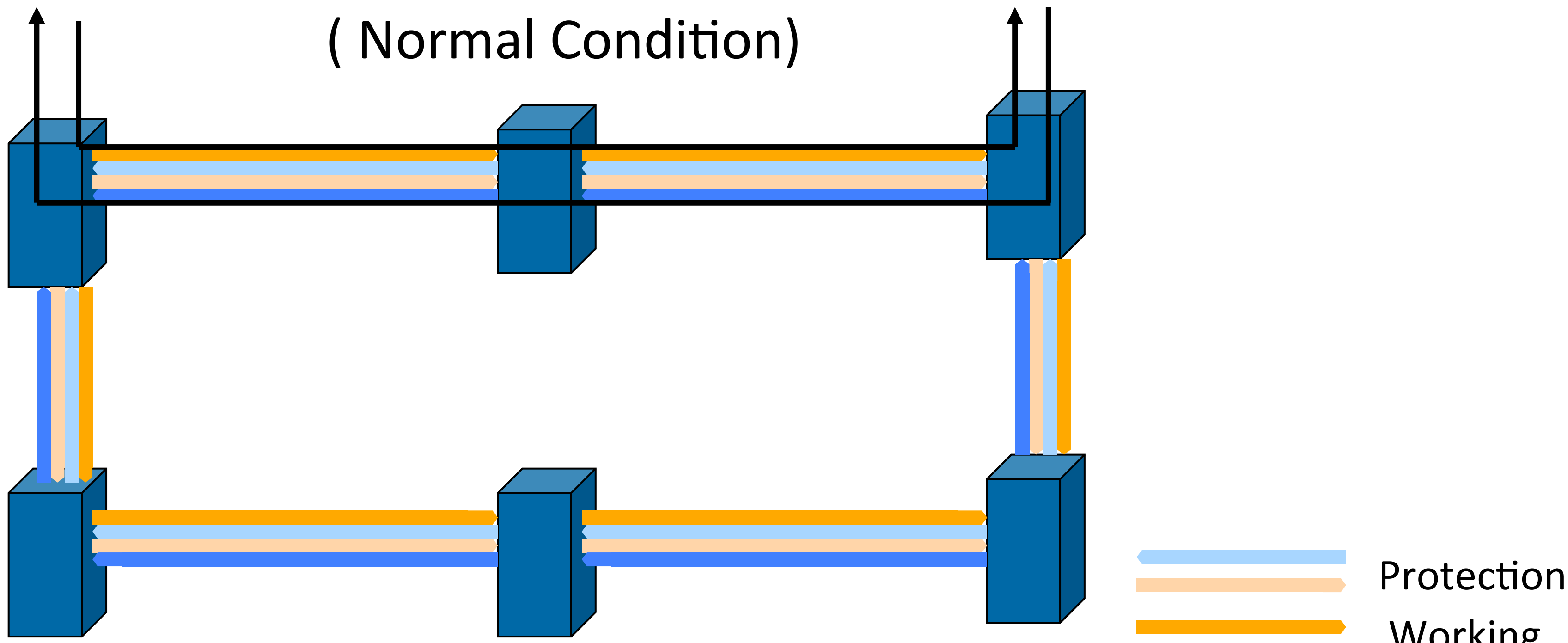
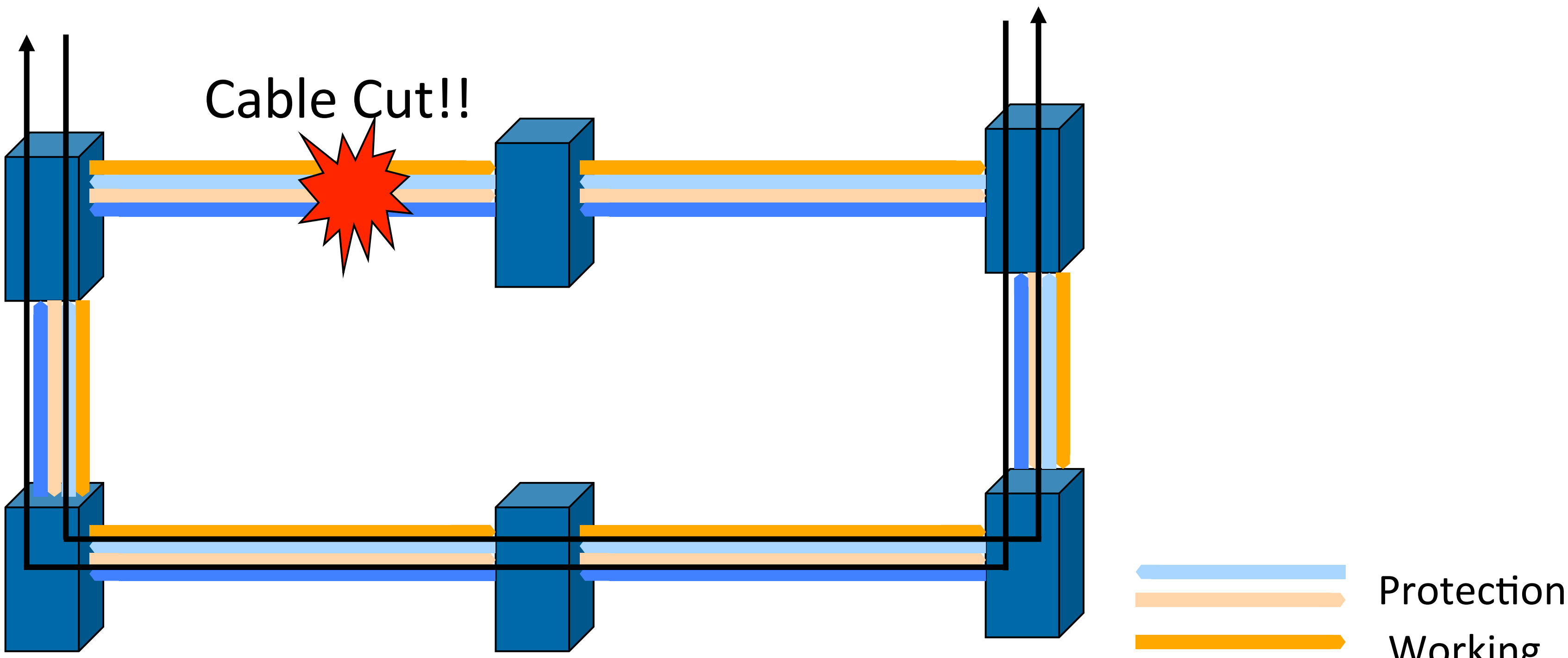
SDH Ring Protection

- MS-SP Ring Protection



SDH Ring Protection

- MS-SP Ring Protection + TOP (TransOceanic Protocol)



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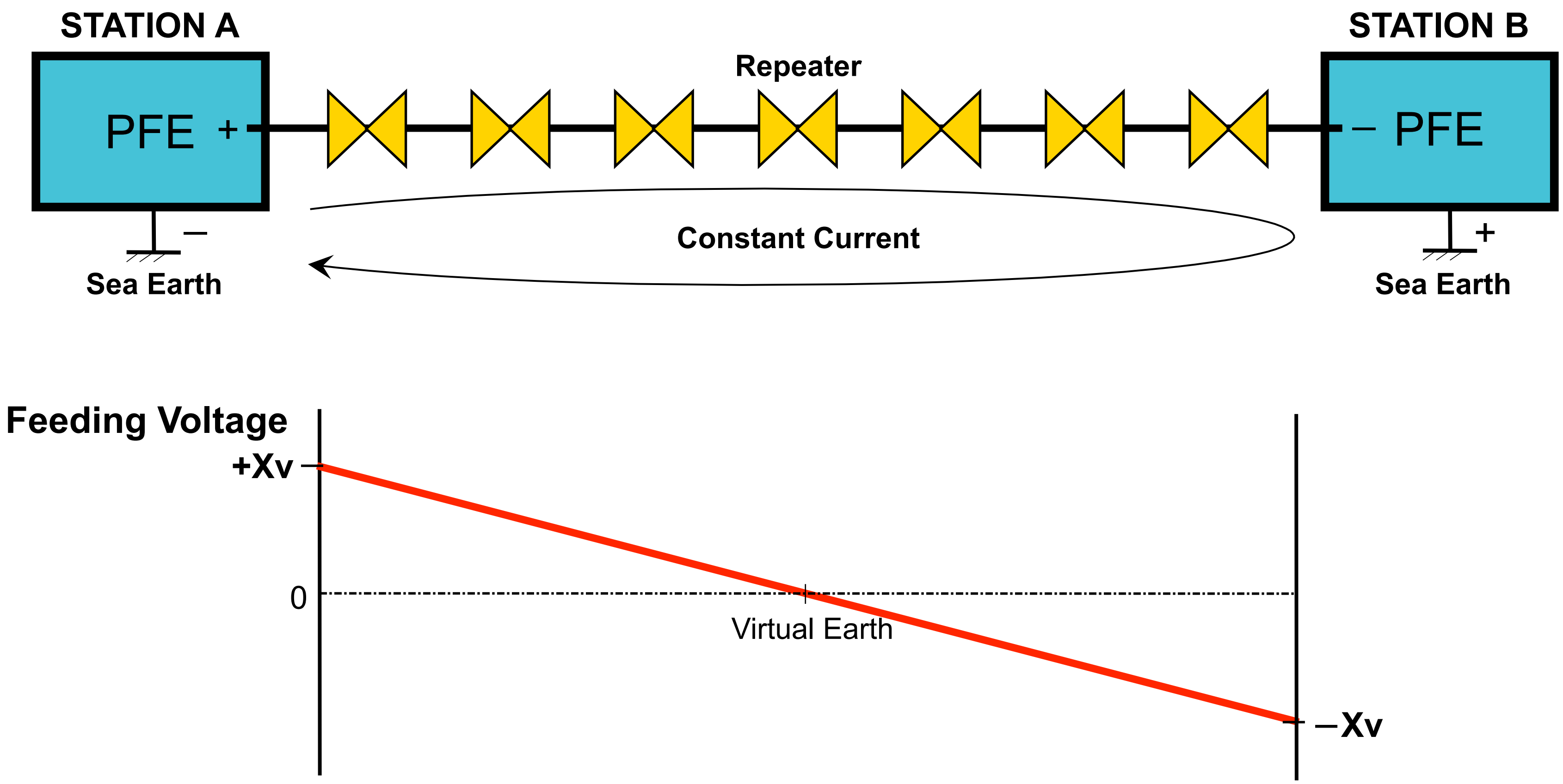
Power Feeding (Normal)



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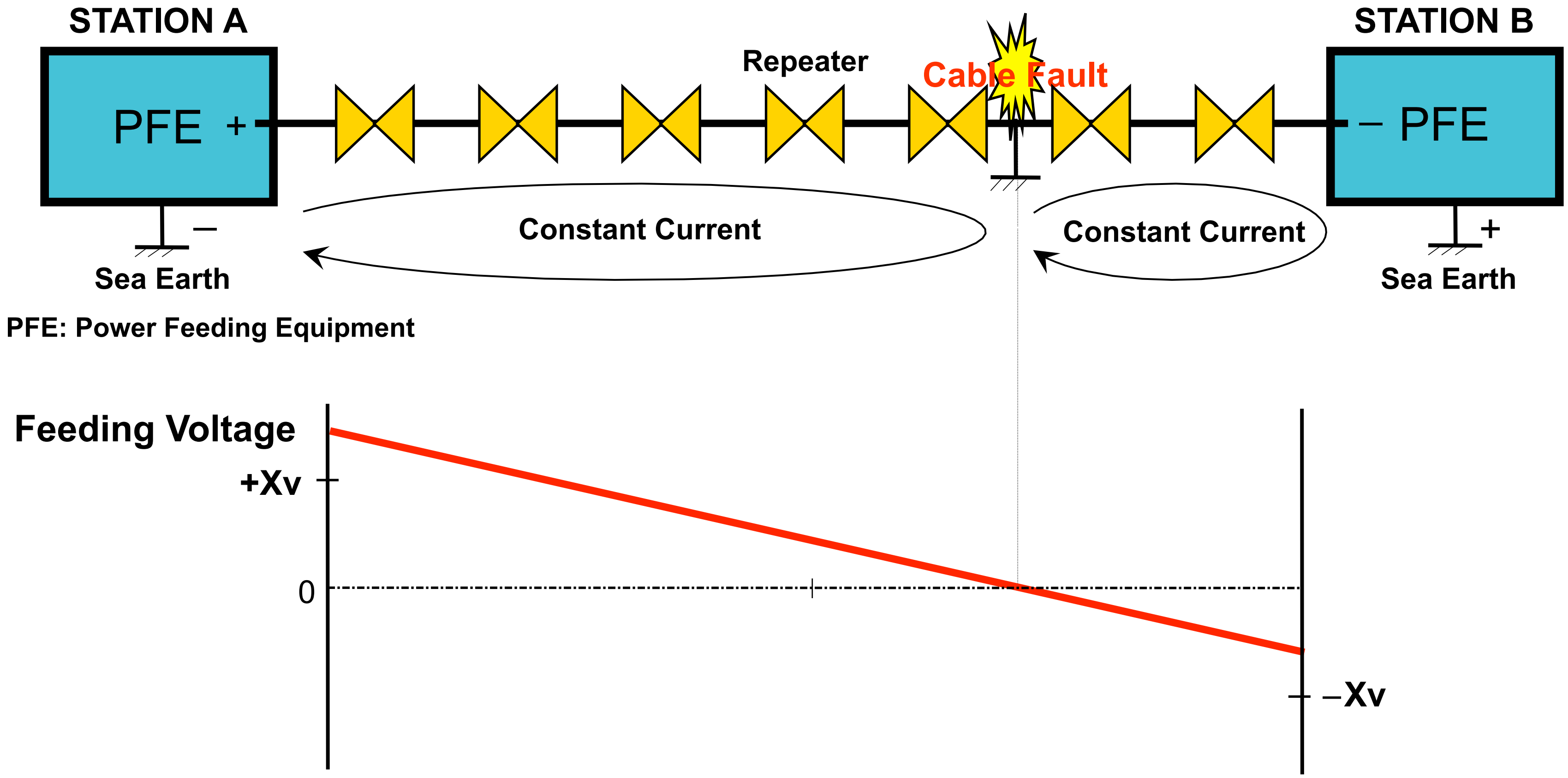
Power Feeding in Cable Fault



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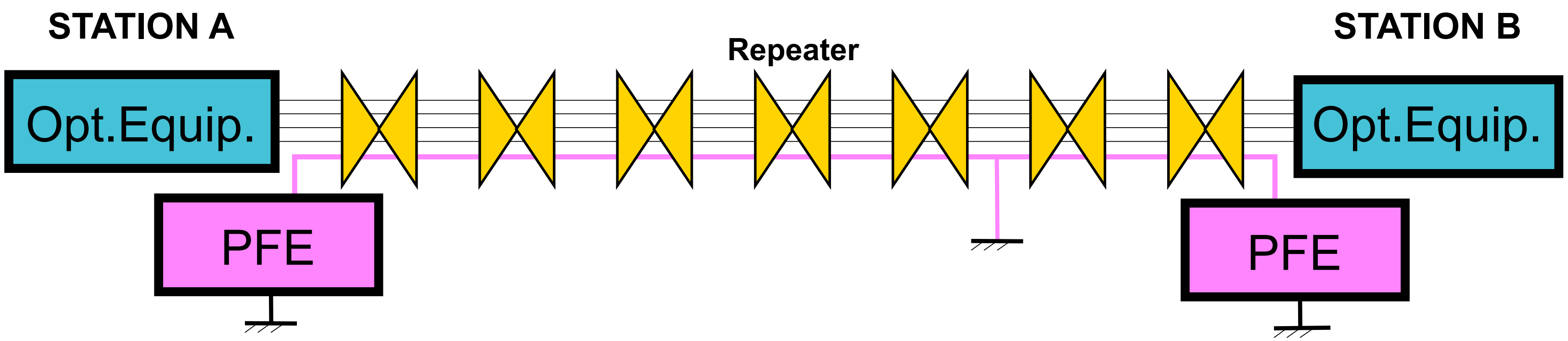
Fault location (1)

1. Shunt Fault

   DC current into the ocean → **Voltage measurement**

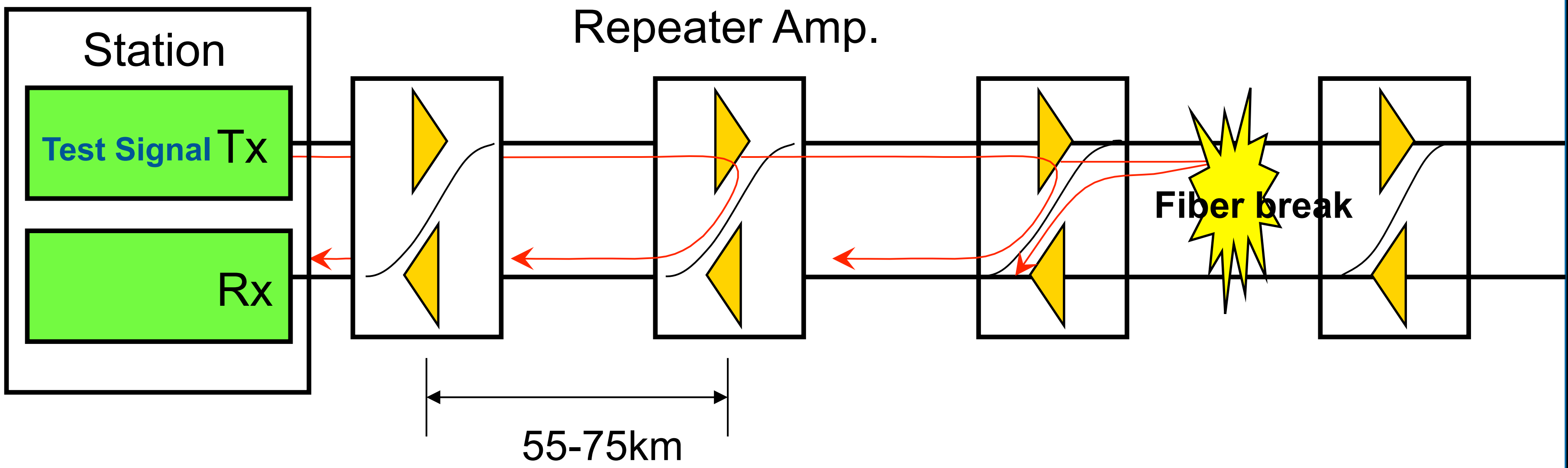


Fault location (2)

1. Cable cut

   (1) Fiber Break → **Optical measurement**

   (2) DC current into the ocean → **Voltage measurement**



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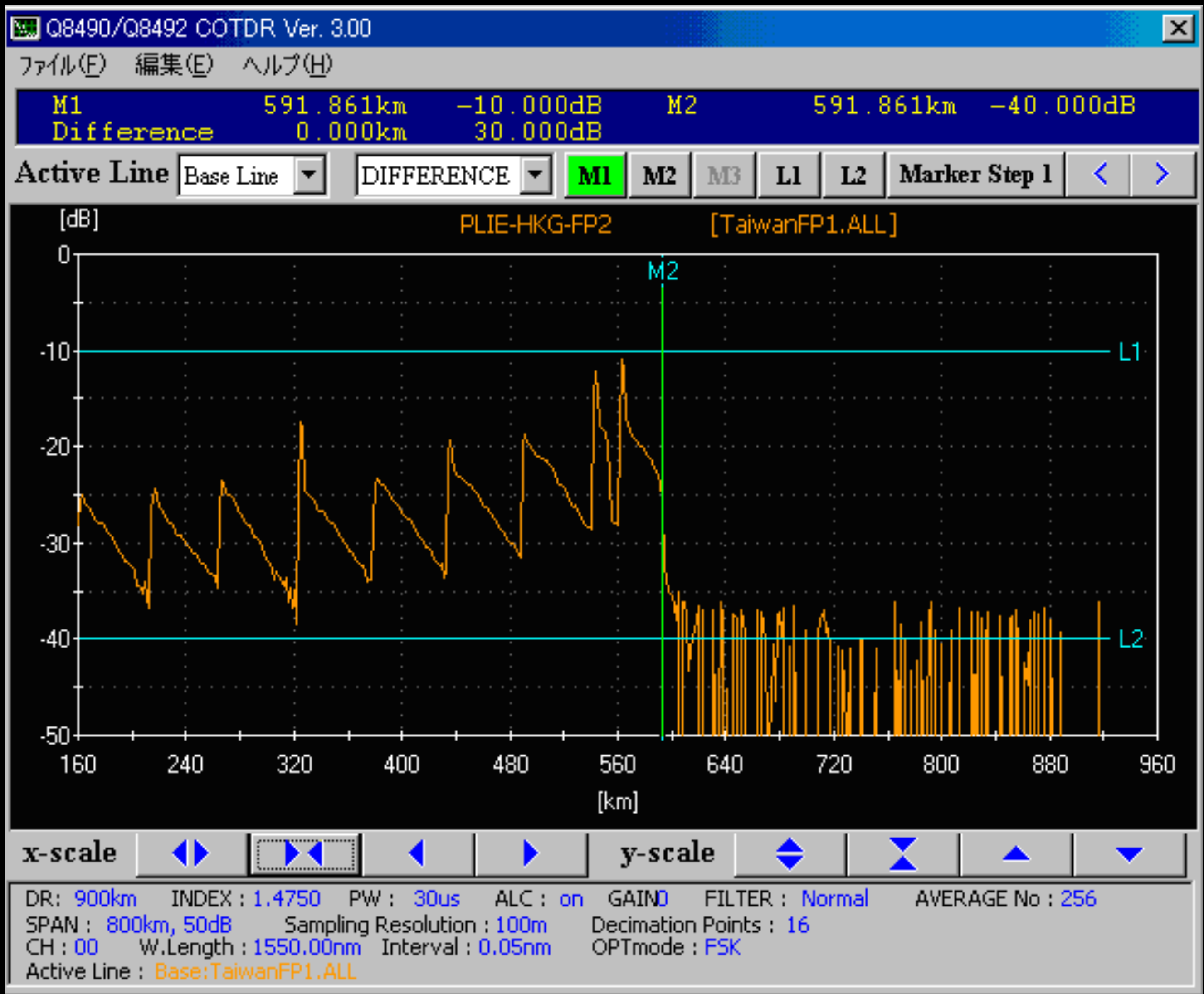
COTDR (Coherent Optical Time Domain Reflectance)



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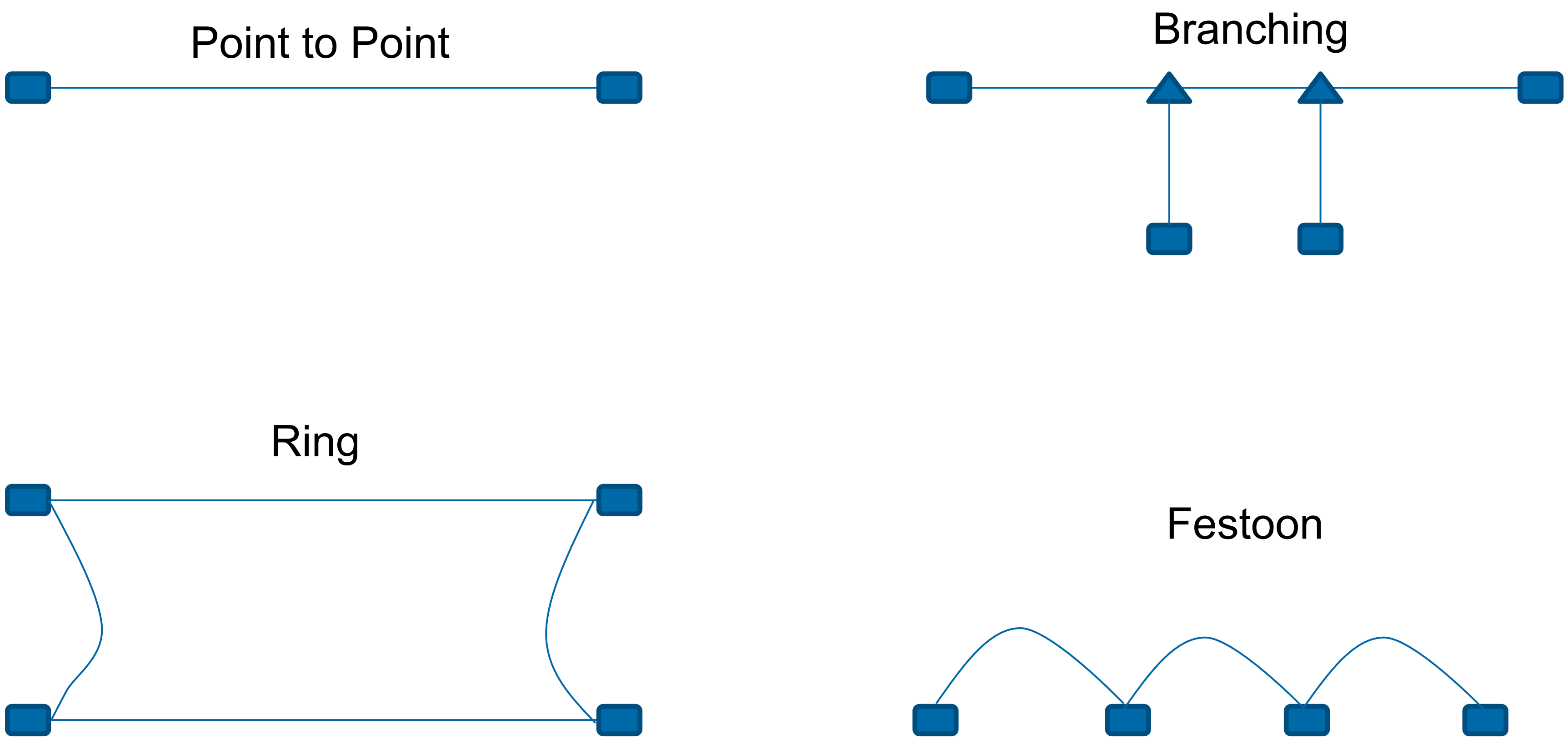
Network Topology of Subsea Cable

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IP Backbone in Asia

Design Challenges in Asia

- Internet traffic volume, as well as traffic direction from each Asian country is different – therefore Internet backbone design is not efficient now
- Not easy to change “traffic aggregation point”
- Low statistical multiplexing effect on international circuits due to backbone bandwidth and customer port bandwidth being the same

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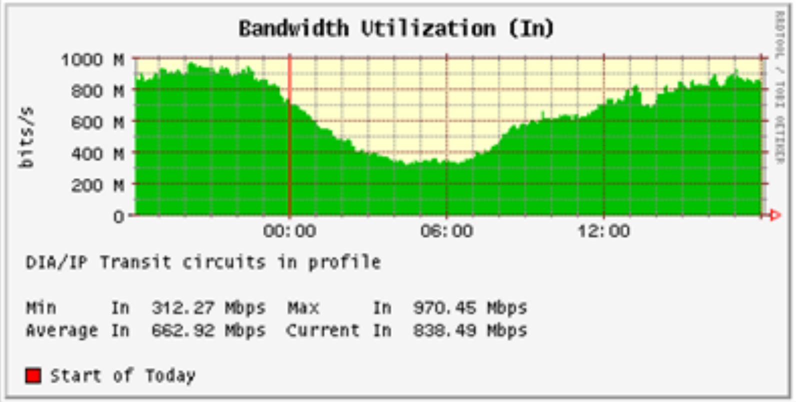
Design Challenges in Asia

Generated at: **GMT 2009/12/08 10:06 AM**
Graph in Time Zone: **Asia/Hong_Kong**

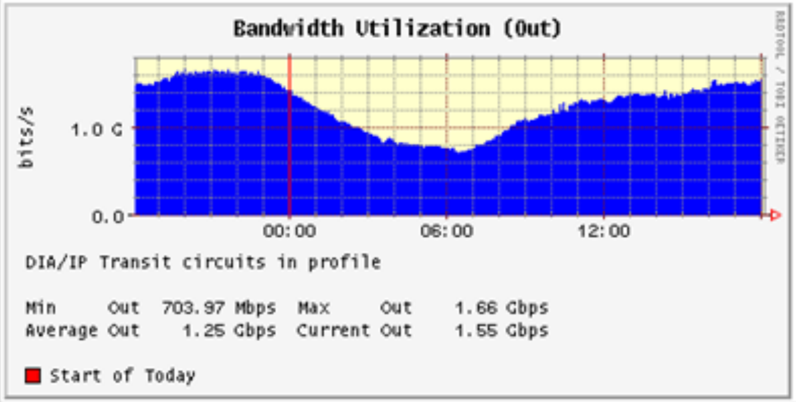
All - DIA/IP Transit circuits in profile

Daily Graph (5 minute averages)



Korea

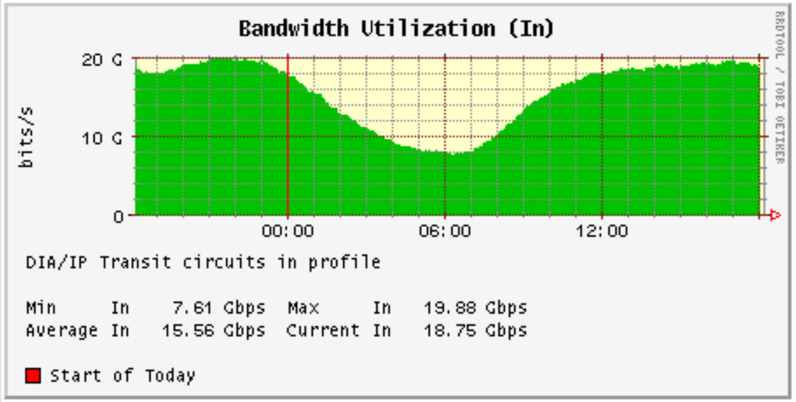
Daily Graph (5 minute averages)



Generated at: **GMT 2009/12/08 10:09 AM**
Graph in Time Zone: **Asia/Hong_Kong**

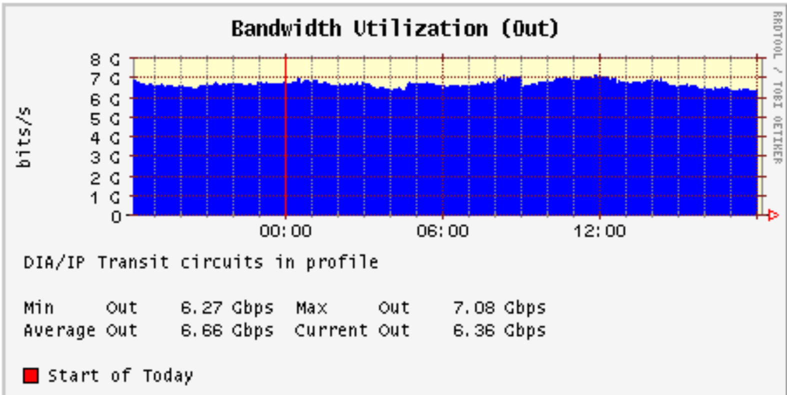
All - DIA/IP Transit circuits in profile

Daily Graph (5 minute averages)



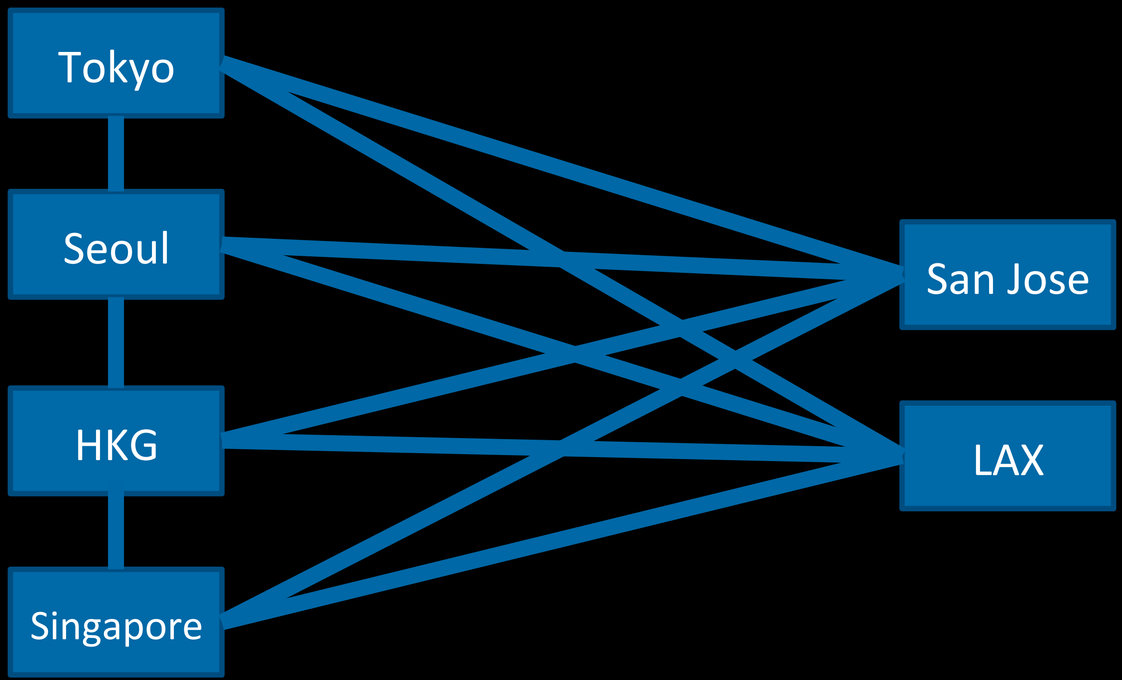
Rest of Asia

Daily Graph (5 minute averages)



IP Backbone Design

Simple Layer3 Network Connectivity



As commonly known, IP architects can see topology using traceroute easily.
(But SP can hide actual topology using MPLS-TE anyway)

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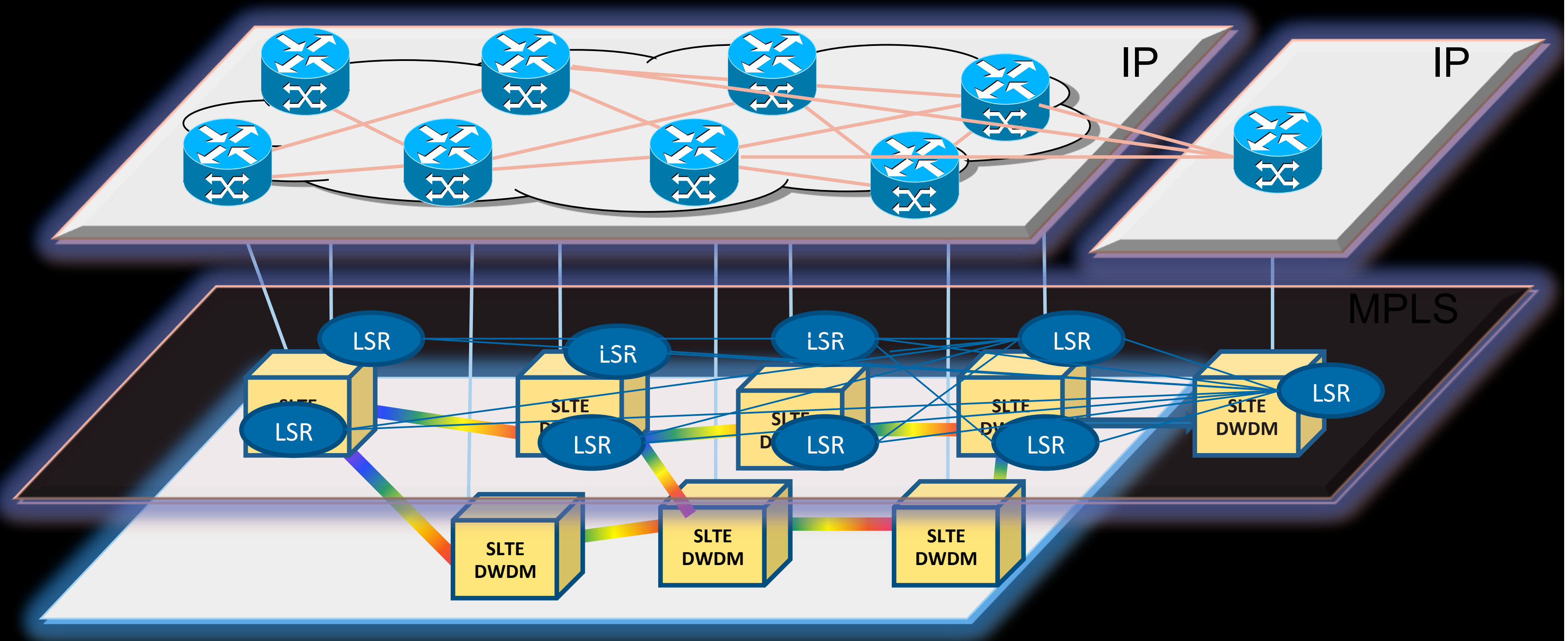
IP Backbone and Layer 1 Backbone



Each Layer has each network topology and restoration and rerouting technology

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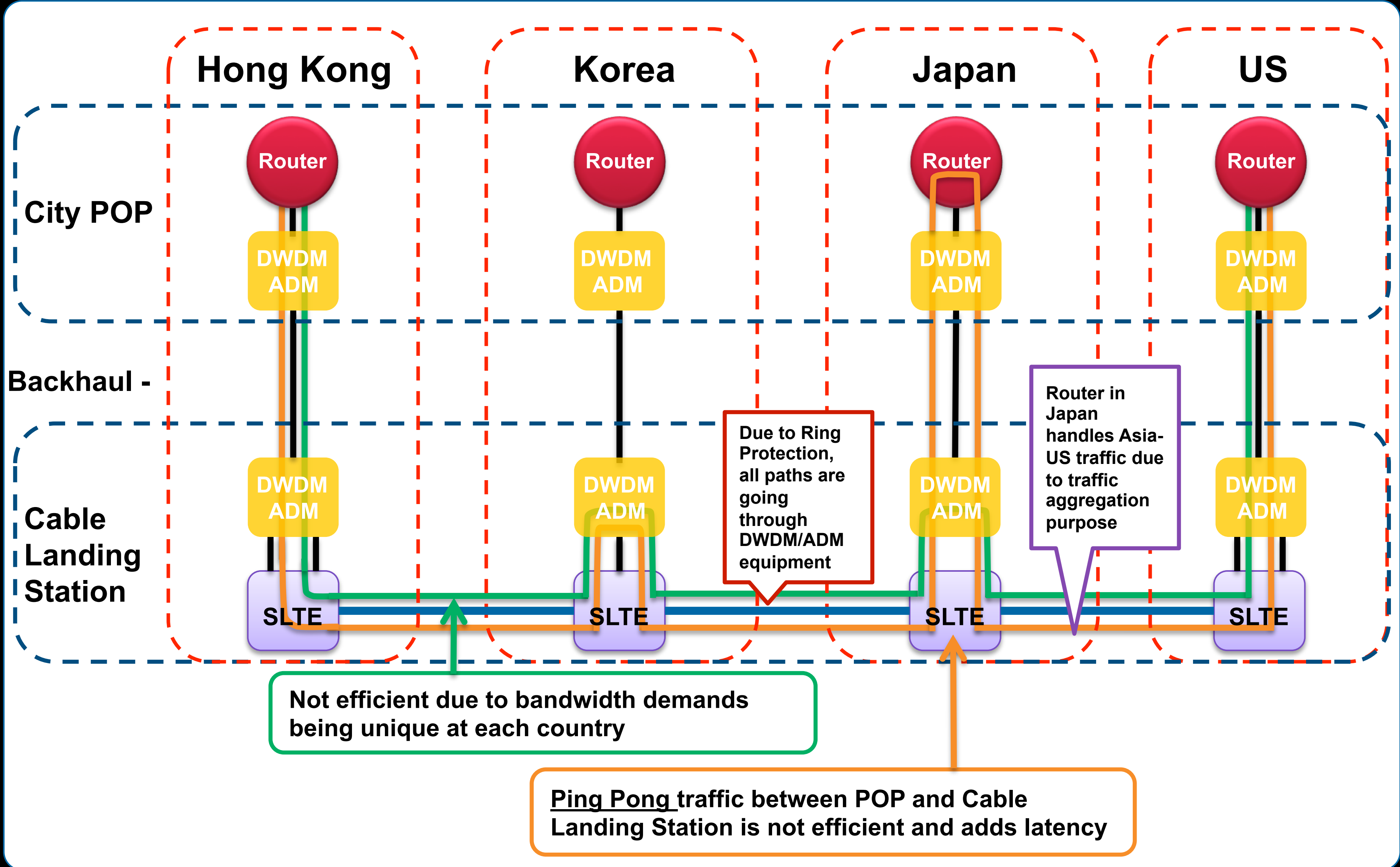
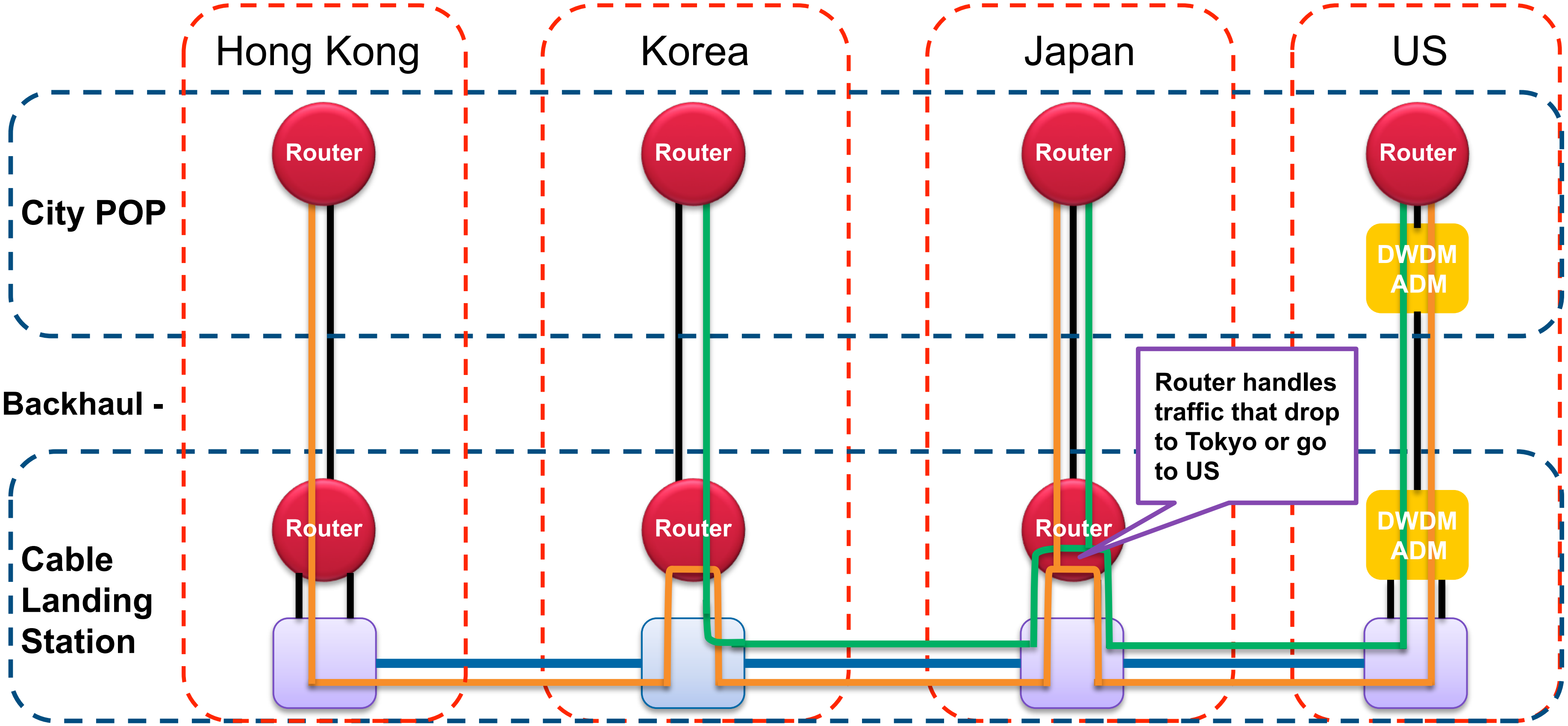
Traditional Asia <> US IP Backbone Architecture

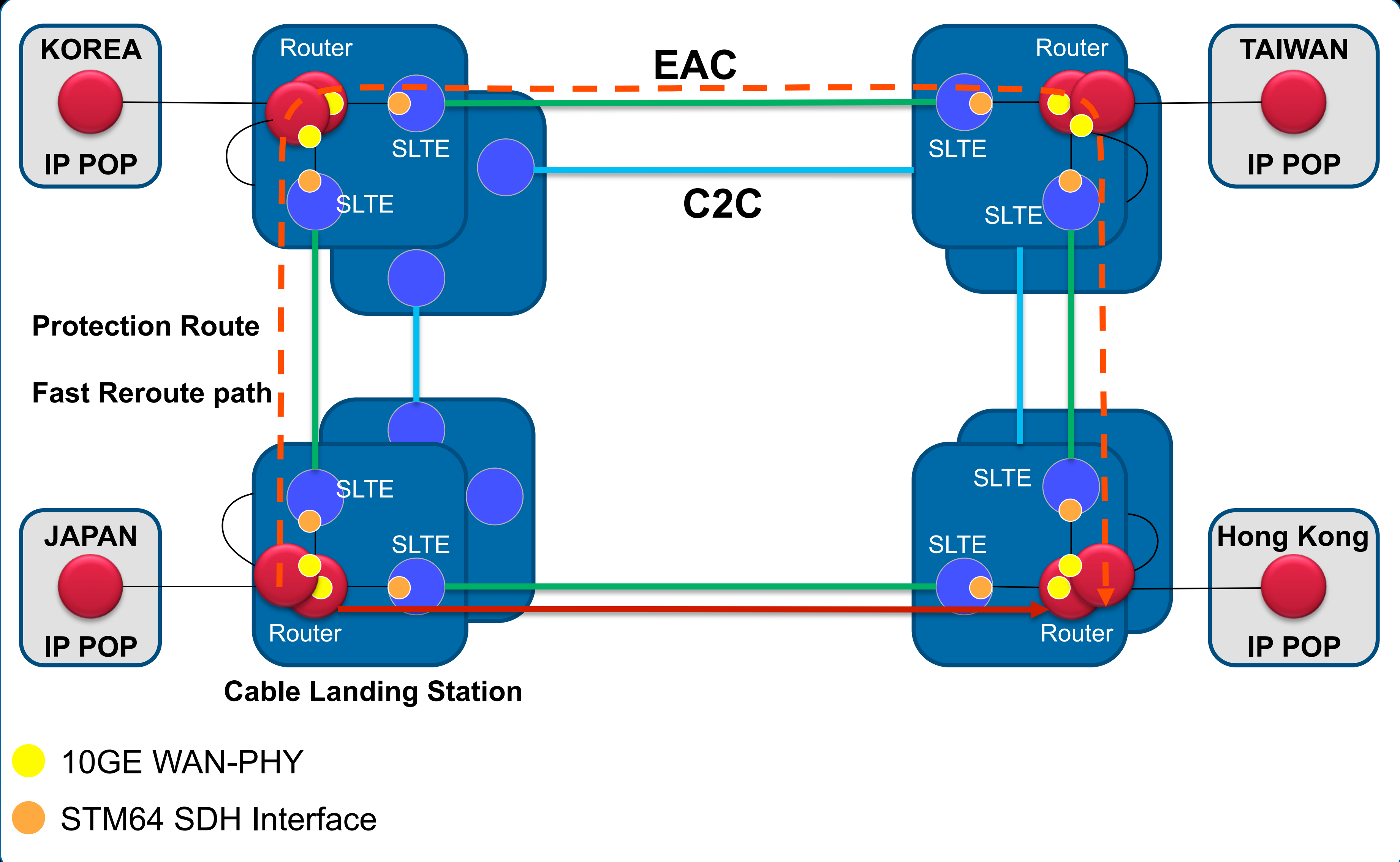


NEW Asia <> US IP Backbone Architecture

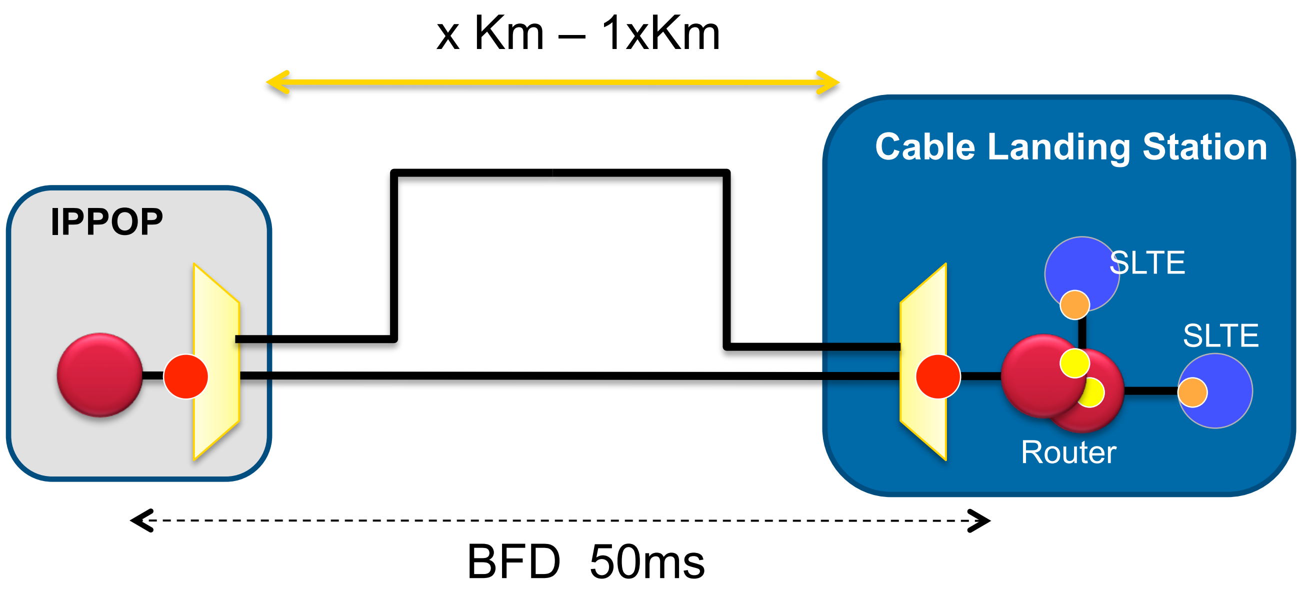


Ability to manage traffic flow and capacity utilization

Circuit Protection by Router



Backhaul Configuration



- 10GE WAN-PHY
- STM64 SDH Interface
- 10GE LAN-PHY

BFD is possible solution and also IEEE802.1ag (CC) is also other way to maintain 10GE LAN-PHY Backhaul Circuits.

Router Configuration

- Interface carrier-delay
  - Backhaul side : 100ms
  - Subsea side : 0ms
- Backbone Circuits (n x 10Gbps)
  - Link Aggregation
    - Reduce IPv4 allocation /30
    - LACP Hello can help failure detection

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Design Concept

- No longer traditional Ring Protection mechanism on top of subsea cable system
- Use 10GE WAN-PHY since WAN-PHY Interface detects alarm of subsea portion from OTN
- MPLS LSR will perform FRR (Active and Standby LSPs) instead of Ring Protection – Subsea is basically 1+1 conf, Active + standby LSPs therefore is reasonable.
- Traffic monitoring will be based on LSP traffic data
- LSP hierarchy
- Additional RR hierarchy
- No GMPLS/ASON, “no c-place and d-plane separation”

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Network Advantages

- Contingency plan
  - City POP failure and cable cut by earthquake
- Route Flexibility
  - Explicit LSP allows us to utilize alternative active paths using "Protection Path"
- Better traffic aggregation by Cable Landing Station routers
  - Eliminate SDH level hierarchy, aggregation is LSP level with flexible BW
- Easy to upgrade subsea portion to 40G or 100G in near future
- Eliminate SDH related CAPEX at Cable Landing Station

Operational Preparation

At Cable Landing Stations

- High performance Router with redundancy
- No Virtual Router
- Single Interface card will be used as much as possible
  - Spare and reusable purpose
- Of course, IPv6 is enabled