New Asian IP Backbone Architecture

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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
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
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)
• MS-SP Ring Protection

( Normal Condition)
• MS-SP Ring Protection + TOP (TransOceanic Protocol)
Power Feeding (Normal)

STATION A

PFE +

Sea Earth

Repeater

Constant Current

STATION B

PFE -

Sea Earth

Feeding Voltage

+Xv

0

Virtual Earth

−Xv
Power Feeding in Cable Fault

PFE: Power Feeding Equipment

STATION A

PFE

+ 

Sea Earth

PFE

Repeater

Cable Fault

STATION B

PFE

Sea Earth

Feeding Voltage

\(+X_v\)

\(0\)

\(-X_v\)
1. Shunt Fault
DC current into the ocean → **Voltage measurement**
1. Cable cut
   (1) Fiber Break → **Optical measurement**
   (2) DC current into the ocean → **Voltage measurement**

Fault location (2)
COTDR (Coherent Optical Time Domain Reflectance)
Network Topology of Subsea Cable

- Point to Point
- Branching
- Ring
- Festoon
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
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)
Each Layer has each network topology and restoration and rerouting technology
Traditional Asia <> US IP Backbone Architecture

Due to Ring Protection, all paths are going through DWDM/ADM equipment. Cable Landing Station - Backhaul - City POP:

Hong Kong - Korea - Japan - US

Router in Japan handles Asia-US traffic due to traffic aggregation purpose.

Due to bandwidth demands being unique at each country, the Ping Pong traffic between POP and Cable Landing Station is not efficient and adds latency.

Not efficient due to bandwidth demands being unique at each country.
NEW Asia <> US IP Backbone Architecture

Ability to manage traffic flow and capacity utilization

Router handles traffic that drop to Tokyo or go to US
Circuit Protection by Router

STM64 SDH Interface

10GE WAN-PHY

SLTE

Router

EAC

C2C

Protection Route

Fast Reroute path

Cable Landing Station

KOREA IP POP

IP POP

JAPAN IP POP

HONG KONG

TAIWAN

IP POP

SLTE

SLTE

SLTE

SLTE

SLTE

Router

10GE WAN-PHY

STM64 SDH Interface
Backhaul Configuration

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
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”
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