Agenda

• System Overview

• NPO Switch Challenges
  – NPO Fiber
  – Cooling
  – Power Delivery
System Overview
Overview

- Outline: 442mm×43.6mm×730mm, 1RU height
- Switch Main Board (SMB)
  - 51.2Tbps switch ASIC
  - 3.2Tbps 8×400Gbps
    - 8× DR4 with integrated laser source
    - 8× FR4 with external laser source input
- 16×ELSFP with blind-mate connector
- 64×2×400Gbps SN-MT connector at front panel
- Cold plate cooling for switch ASIC and CPO modules
- X86 CPU, optional BMC
- 3+1 fan module, 1+1 PSU
Whitney Front & Rear View

Data I/O
SN-MT Adaptor x 16

ELS
Module x 16

MGMT
USB 2.0 Type-A Console

1+1
PSU

3+1 4056
Fan Module

Drip-less
Fast Release
Connector
3.2T NPO Optical Engine

- Internal Laser Source (ILS) Version
  - Laser: Integrated
  - Power consumption: 56W max, 48W typ.
  - Case temperature: 15-70 °C
- External Laser Source (ELS) Version
  - Laser: External pluggable module;
  - Power consumption: 48W max, 41W typ.
  - Case temperature: 15-85 °C
- Form Factor
  - Compliant to OIF CPO Framework IA.
Whitney NPO Fiber Design

ELS FR4 type
- 16F, Φ3mm
- 16 PMF, Φ3mm
- 1+1 MT Ferrule
- SN-MT (4-fiber each)

ILS DR4 type
- 32F, Φ3mm
- 32F, Φ3mm
- SN-MT (16-fiber each)
- SN-MT (4-fiber each)
NPO Switch Challenges

NPO Fiber
Fiber Configuration Challenge

Challenge For ELS DR4 NPO type:

- 3.2Tbps 8×400G DR4 need 64 fibers;
- The thickness of NPO module is 6.4mm, seems hard to hold a group of 64 fibers;

Suggestions:

- Change to 8×400G FR4, just need 16 fiber core;
- Change to ribbon fiber, four 1×16 parallel fiber, 4.7x1.6mm with 250um SCF (bending direction);
- 125um SCF fiber (need to solve fiber core mark problem for MP);
- 250um 4-core MCF (Industry maturity level);
Mid-Board Connector Arrangement Challenge

**Background:**
- 16 NPO modules are integrated around the Switch ASIC;
- NPO module is designed with a short pigtail;

**Challenge:**
- A lot of mid-board connectors in the system that take up a good amount of space;
Mid-Board Connector Arrangement Challenge

**Suggestions:**

- Use the mini version mid-board connectors;
- Lengthening the pigtail, NPO module connect to the front panel directly;
  - **Pros:**
    - No need the mid-board connector;
  - **Cons:**
    - Inconvenient for module maintenance, need to disassemble the fiber from the front panel;
- Integrate optical connector in NPO, instead of pigtail
  - **Pros:**
    - No need the mid-board connector;
    - No need to change NPO module if fiber failure;
  - **Cons:**
    - This option will increase the difficulty of NPO design;

Mid-Board Connector Arrangement Challenge

Suggestions:

• A customized fiber management box as the liaison between NPO and front panel;
  - Pros:
    • Mid-board connector integrated in the box;
    • Easy for the system assembly;
    • Fibers can divide into different combination inside the box according to the application scenarios;
  - Cons:
    • Need more space in the system;
    • The different switch need a different customized design;
NPO Switch Challenges

Cooling
Cooling System Design Challenge

**Background:**
- High power of SMB area (About 1600W for CPO modules and switch ASIC);
- Realize the NPO switch in 1RU ;

**Challenge:**
- Local area high heat dissipation requirements ;
- The limitations of 1RU space ;
Cooling System Design Challenge

Cooling Solutions:

• Air cooling for Switch ASIC and NPO
  ▪ In 1RU device, no space for the huge heat sink;
  ▪ The 40mm fans can’t provide the enough cooling air;

• Immersion Cooling system
  ▪ NPO modules and the connector interface need to be waterproof, hard to be sealed.

• Cold plate liquid cooling
  ▪ Easy to realize in 1RU space;
  ▪ Meet the heat dissipation requirements of Switch ASIC and NPO;
  ▪ In order to reduce the difficulty of cold plate design, only SMB area use the cold plate, others remain to use the air cooling;
Cooling System Design Challenge

Problem with the cold plate:
- Detachability requirement of cold plate for NPO maintenance;

Suggestion:
- Use separated cold plates for NPO and Switch ASIC;
- Use a toolless assembly plan for NPO cold plate;
NPO Switch Challenges

Power Delivery
Power Delivery Design For SMB

**Background**

- Follow the industry preference, Whitney use an independent small board (SMB) for NPO module and Switch ASIC;

**Challenges:**

- Not enough space for various voltage output, estimate MOS quantity >30 (Other insensitive power supply is provided by the SBB);
Power Delivery design for SMB

Suggestions:

• Voltage regulate on the SMB
  - Need the tiny VRM;
  - Integrated VRM for NPO and Switch ASIC(Pin to pin connect through the PCB hole);
Power Delivery design for SMB

Suggestions:

• Voltage regulate on the SBB:
  – Pros:
    • Easy to realize with the current ecosystem;
  – Cons:
    • Lots of power connectors, PI challenge;

• The SMB merge with the SBB:
  – Pros:
    • Easy to realize with current ecosystem;
    • Good for power delivery and PI performance;
  – Cons:
    • Increase the PCB cost;
Thanks!

For further questions, please contact:
Ivan Kong, ivan.kong@ragilenetworks.com
Kevin Yao, kevin.yao@ragilenetworks.com