51.2T NPO Switch Practice And Challenge

Project Whitney, Mechanical Demo

Ivan Kong, Hardware Engineer, Ragile Networks

OPEN Compute Project®



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

1+1

PSU



3+14056 Fan Module

Drip-less Fast Release Connect. Collaborate. Accelerate.



Whitney Internal View

Fiber Management

ELSFP Board (ELSB) Switch Main Board (SMB)

Switch Base Board (SBB)





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.







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 :

Compute

- 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





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 plat 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, <u>ivan.kong@ragilenetworks.com</u> Kevin Yao, <u>kevin.yao@ragilenetworks.com</u>

