Rack-Ready High-Power ELSFPs

A Co-Development to Support CPO Deployment in AI Scale-Up and Scale-Out Datacenters

Nandita Aggarwal

Sr. Manager, Laser Engineering, Ayar Labs

Willie Chen

Technical Supervisor, Wiwynn



OCP FUTURE TECHNOLOGIES SYMPOSIUM

October 14, 2026
San Jose, California

From liquid-cooled rack to ELSFP

L11 rack

Wiwynn

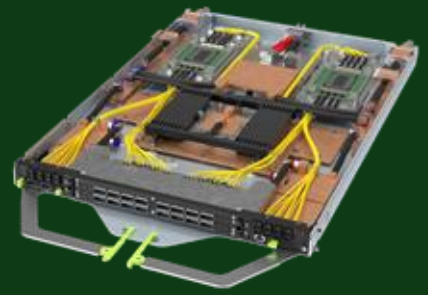
Liquid-cooled rack housing the compute trays



L10 tray

Wiwynn

Liquid-cooled compute tray hosting CPO and front-panel ELSFP slots



Cold plate

Wiwynn

Parallel-flow manifold serving multiple ELSFP modules; flexible TIM



ELSFP + Optical Engine

Ayar Labs

8 × 23 dBm channels, active TEC control, multi-vendor laser die

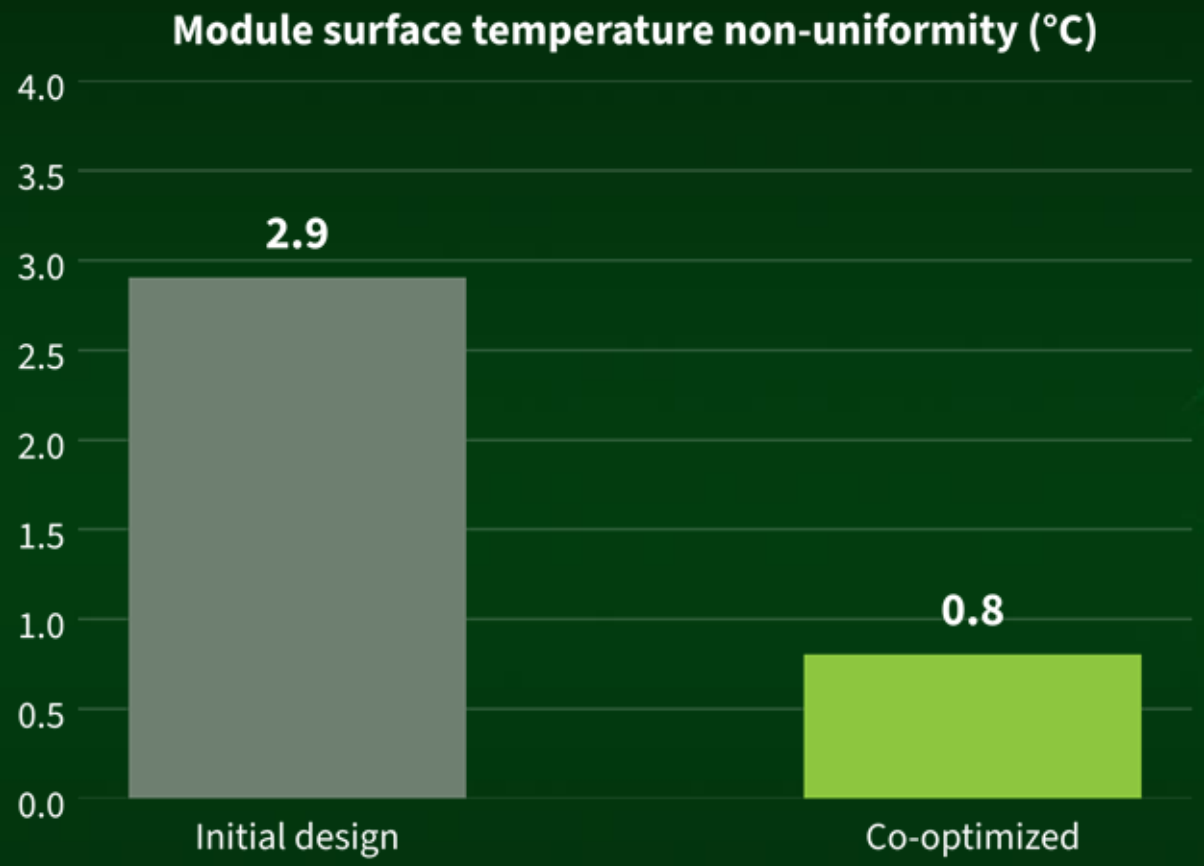


- Wiwynn defined the boundary conditions
  (Coolant flow, coolant temp, pressure, splits in the cooling architecture, thermal resistance stack up etc)
- Ayar Labs designed the laser solution using those boundary conditions

Co-optimized module thermals

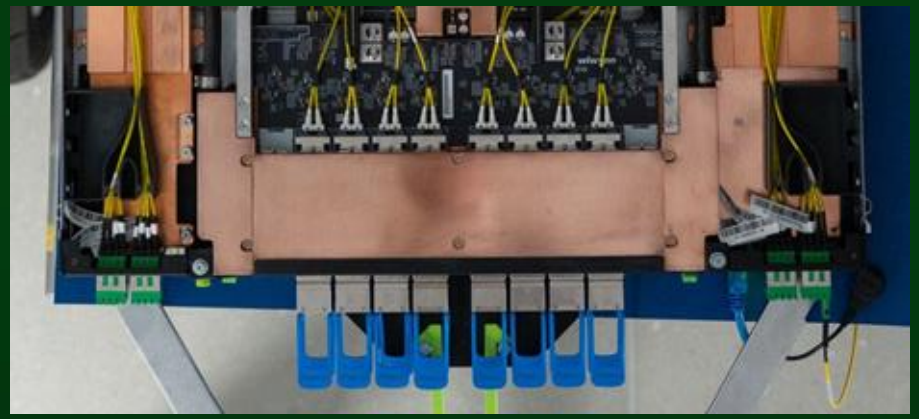
- Active TEC inside the ELSFP holds every laser at its set point
- Joint Ayar Labs / Wiwynn CFD (Computational Fluid Dynamics) and simulation across plate + module
- Surface temperature non-uniformity cut by >3x
- Uniform surface → lower TEC power, longer lifetime and higher predictability





100+ ELSFPs tested

- Ayar Labs designed ELSFPs were tested in Wiwynn's cold plate
- Test conditions:
  - 50 °C laser die temperature
  - -20dB back reflection
  - All lasers ON



8 × 23 dBm
channels per module

45 °C
coolant inlet

-20dB OBR
optical back reflection to the system

100+
Modules characterized

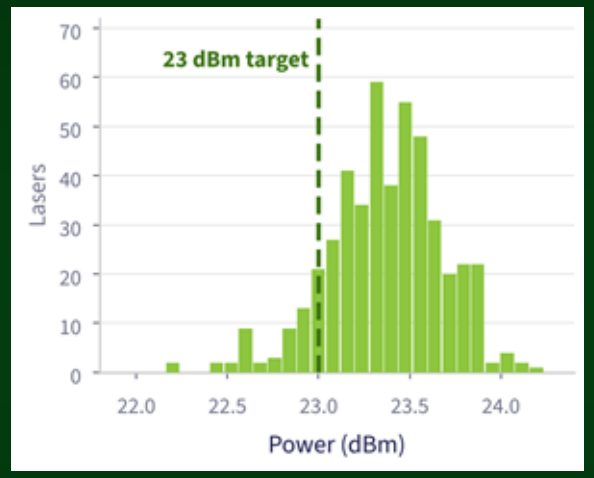
Distributions over 100+ ELSFPs, with -20dB OBR

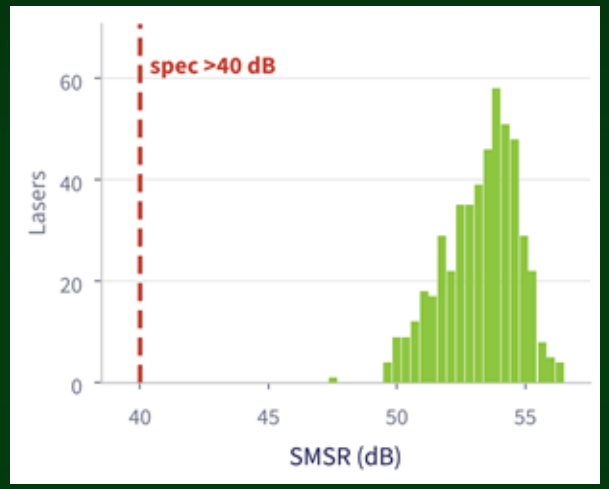
23.4 dBm
mean output power · σ 0.32 dB

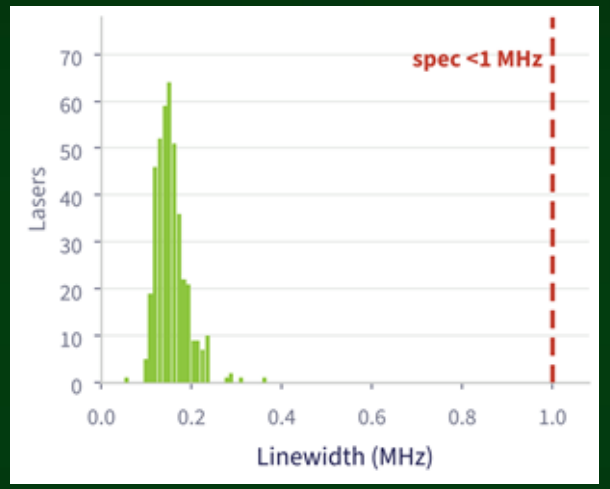
53 dB
mean SMSR · σ 1.5 dB

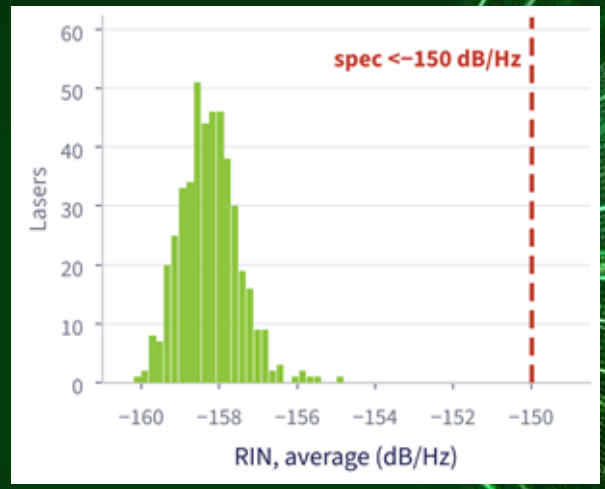
0.16 MHz
mean linewidth · σ 0.04 MHz

−158 dB/Hz
mean average RIN · σ 0.8 dB/Hz

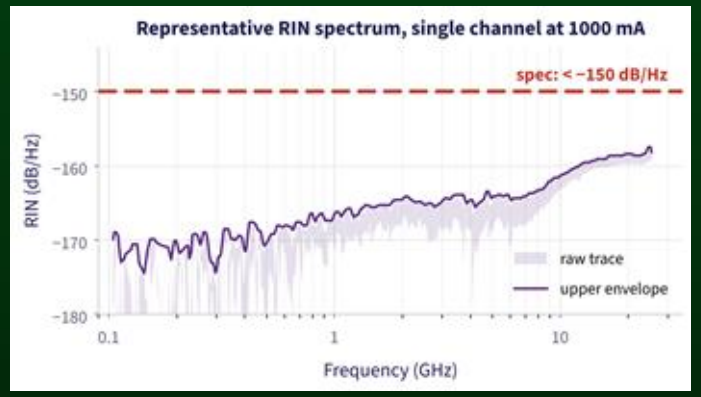








Every laser meets spec with margin. SMSR >47 dB (spec >40 dB), linewidth <0.37 MHz (spec <1 MHz), RIN <−154 dB/Hz (spec <−150 dB/Hz), all measured at 50 °C die temperature with −20 dB back-reflection.



Representative RIN spectrum, single channel: stays below −150 dB/Hz up to 26.5 GHz

Cold plate designed for a pluggable ELSFP

Uniform surface temperature profile

Same surface temperature profile across all the 20 ELSFPs with ~45°C inlet coolant

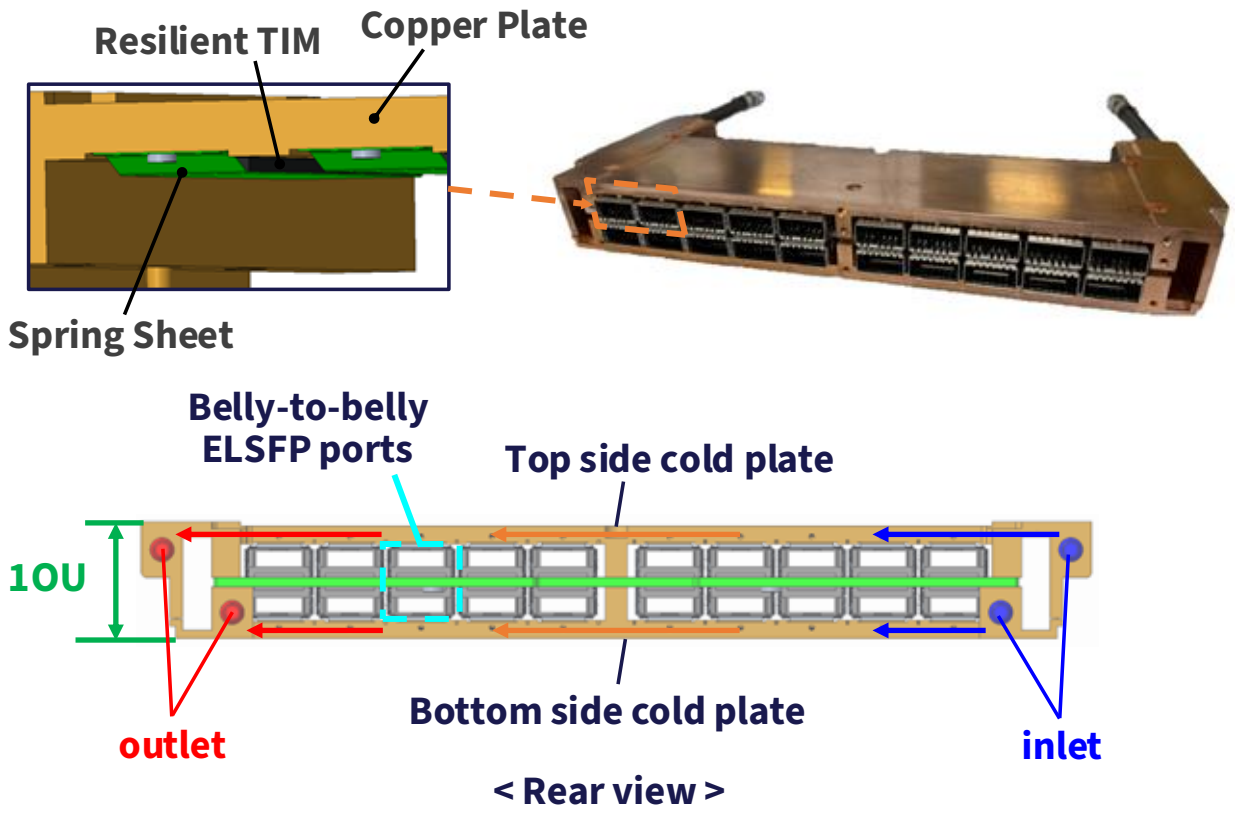
Resilient TIM on a metal spring sheet

Tested for 100s of repeated insertions without any TIM wear-out; no re-application in the field

Compact design for high density systems

Cooling 20 belly-to-belly ELSFPs within 1OU height

ELSFP Cold Plate :

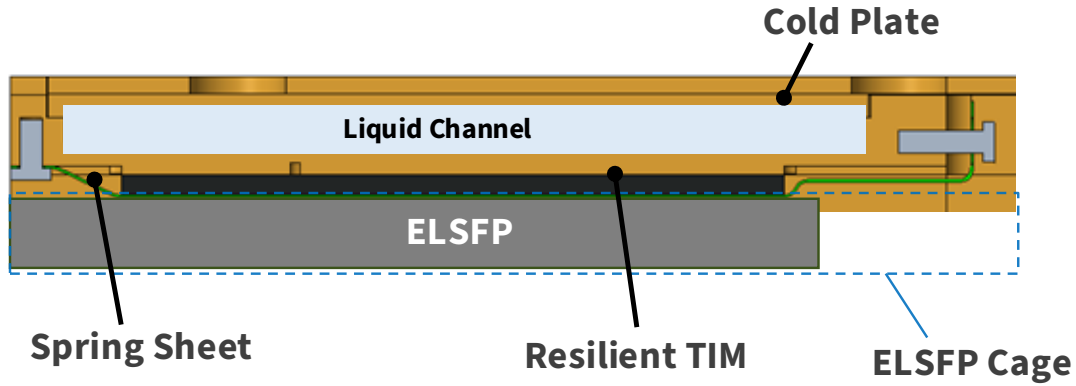


Two design challenges: thermal contact and hot spots

1. Thermal contact through a cage opening

Challenge: The ELSFP cage limits the contact area, and the soft TIM could be damaged during ELSFP insertion

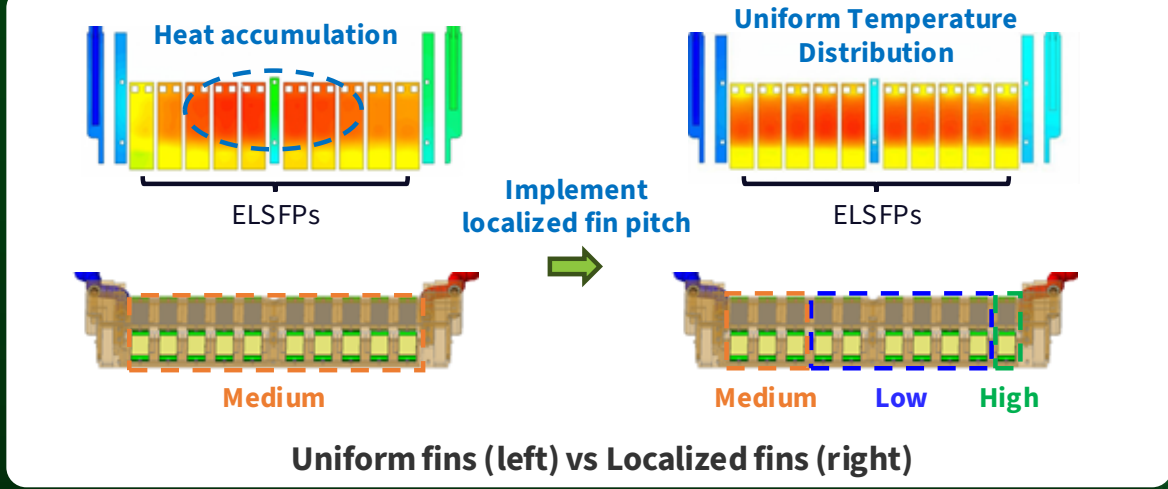
Solution: A graphite resilient TIM supported by a beryllium-copper spring sheet, pressed against the copper plate



2. Heat builds up at the centre of the plate

Challenge: With uniform fin gap, the middle ELSFPs ran hotter, resulting in a surface temperature variation of 2.9 °C across the cold plate

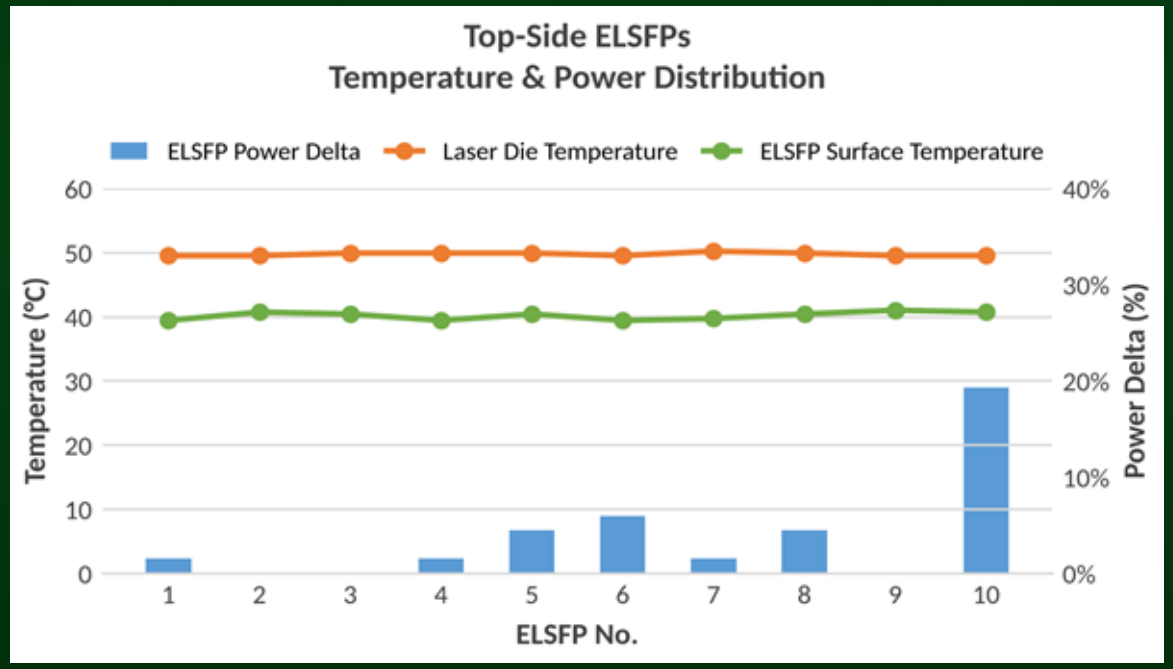
Solution: Localized fin gaps redistribute the flow, dropping the temperature variation to 0.8 °C



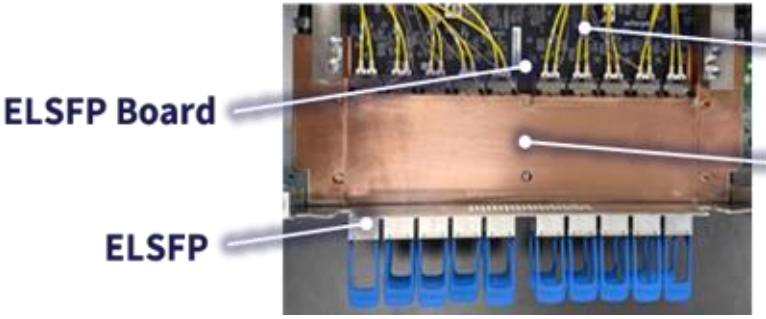
Thermal validation result across 20 ELSFPs

50 ±1 °C
Laser die temperature,
all 20 ELSFPs

45°C, 1.3 LPM
Coolant supply temperature
and flow rate



< Test Setup >



Top-side ELSFPs shown; bottom side follows the same pattern.
Better cold-plate flatness will reduce surface variation further.

Takeaways for the SROI community

Serviceable by design

Front-pluggable ELSFP with highly repeatable behavior due to clever thermal & TIM design

Thermally co-designed

Wiwynn cold plate + Ayar Labs ELSFP: ≤0.8 °C non-uniformity at 45°C inlet

By the numbers statistics

23 dBm class, σ ≈ 0.3 dB across , >150dB/Hz RIN, sub-MHz LW, >40dB SMSR, >100 ELSFP modules

Let’s align

Open to working with OCP on ELSFP thermal interface and cold-plate requirements

OCP FUTURE TECHNOLOGIES SYMPOSIUM

October 14, 2026
San Jose, California

