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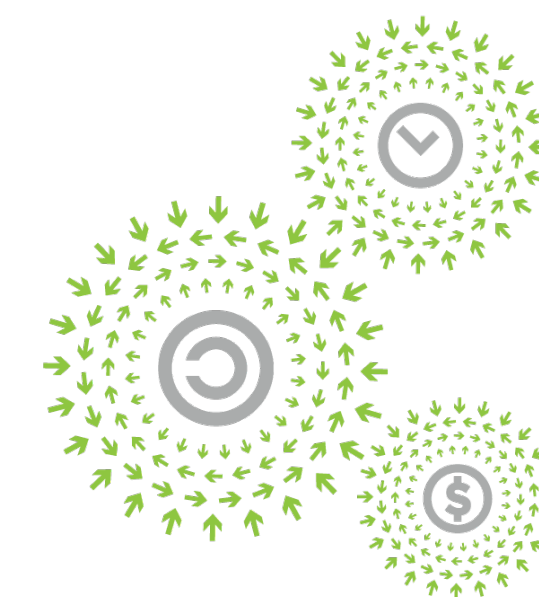




NETWORKING

# MiniPack: Low Power 100G Fabric Architecture - Mechanical & Thermal Cooling Design

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# Agenda

**Minipack HW Overview**

**Minipack Mechanical Deep Dive**



# Minipack – Next-Generation 128x 100G Switch

- **Adopt cutting edge switch ASIC**
- **Support mature optics – 100G CWDM4**
- **Lower Power / Smaller Size**
  - **1/2 height, ~1/2 power** compared to existing Tomahawk based design – Backpack



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Specifications



Specifications



Backpack



Minipack

**Switch ASIC:** Broadcom Tomahawk-3

**Size:** 4RU (vs. 8RU Backpack)

**Power:** ~1.4KW budgetary (At full line rate, fully populated with 128x QSFP28 CWDM4 optics)

**Radix:** 128x



# MiniPack



- Announced during Global Summit in March 2019
- Design formally accepted by OCP in June 2019.

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# Minipack System Components

- ➔ Switch Main Board (SMB)
- ➔ System Control Module (SCM) - FRU
- ➔ Port Interface Module (PIM) - FRU
  - PIM-16Q: Port Interface Module with 16 x QSFP28 100G
- ➔ Fan Control Module (FCM): Top and Bottom
- ➔ Power Distribution System
  - Horizontal Bus Bar (HBAR)
  - Power Distribution Board (PDB): Left and Right
- ➔ DOM (Digital Optics Monitoring) FPGA



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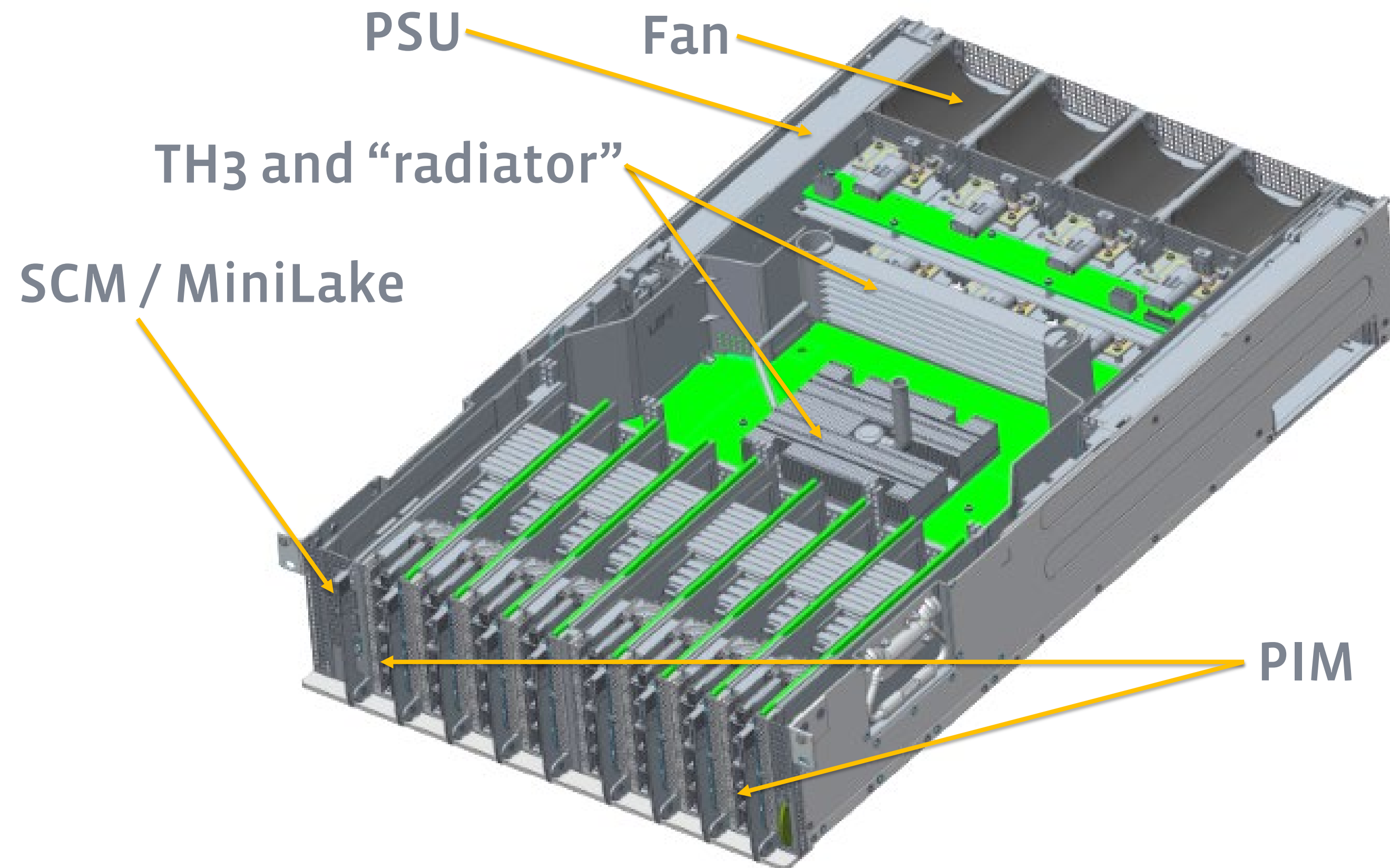
Specifications



Design Files



# Minipack Chassis Architecture

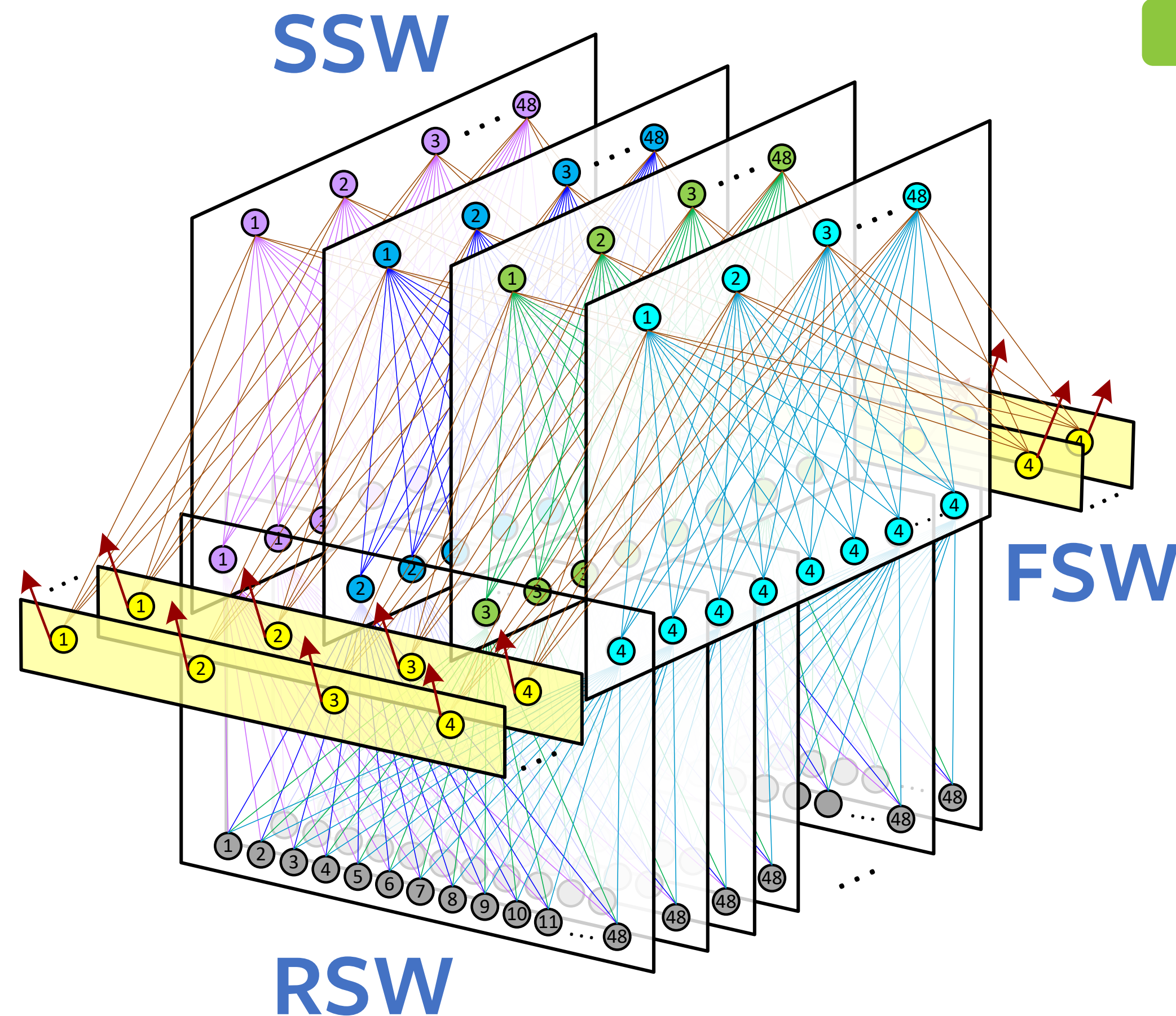


- Orthogonal-direct architecture
  - Opens up airflow path for better thermal efficiency
  - Supports 100G CWDM4-Lite optics with 55 °C case temperature limit
  - Shortens PCB traces for lower loss
- FRU-able, modular PIM (line card)
  - Vertically oriented
  - PIM-16Q
  - Easy to explore other PIM options
- FRU-able SCM (micro-server carrier)



# Where to use Minipack

- Minipack
  - FSW – Fabric Switch
  - SSW – Spine Switch
  - FA – Fabric Aggregator
- Supports multiple generations of rack switches



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Specifications



Design Files



# Minipack : Overall Mechanical Spec.



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- **Chassis Dimensions:** 176.2mm(H) x 440.4mm(W) x 738.1mm(D)
- **Weight:** Fully loaded chassis with all FRUs is 54kg
  - Chassis assy with thermal syphon
  - 8 - Fantray assy
  - 8 - PIM-16Q
  - 1 - SCM
  - 4 -1500w PSU
- **Handle:** One handle and a handle pocket on each side of the chassis



Specifications



# Agenda

Minipack HW Overview

Minipack Mechanical Deep Dive

Specifications



# Minipack : FB Modular Switch Platform



- Orthogonal direct architecture
- Disaggregated data, control, and management plane design

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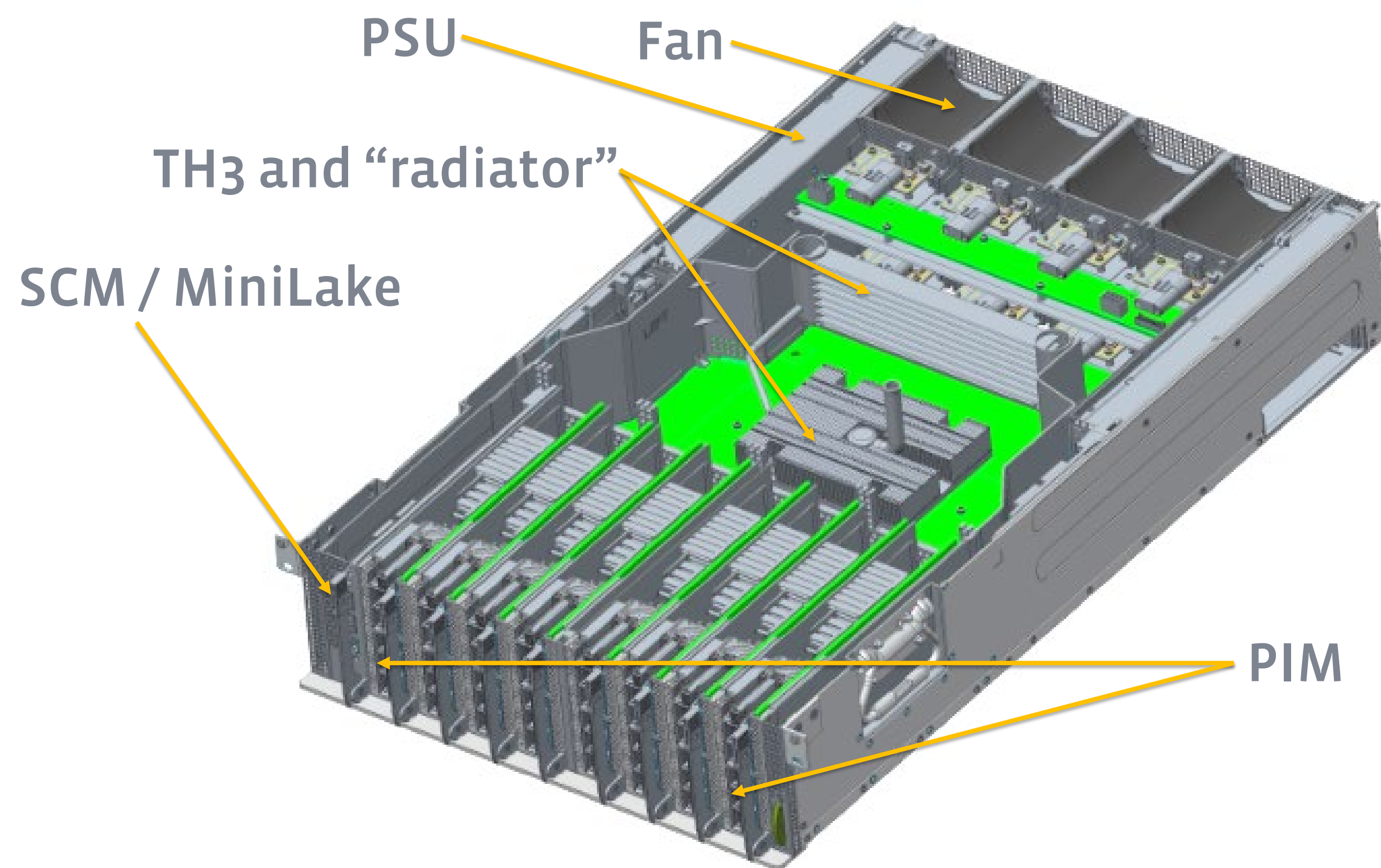
Specifications



# Minipack : FB Modular Switch Platform



- Top Cross-Sectional View



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Specifications

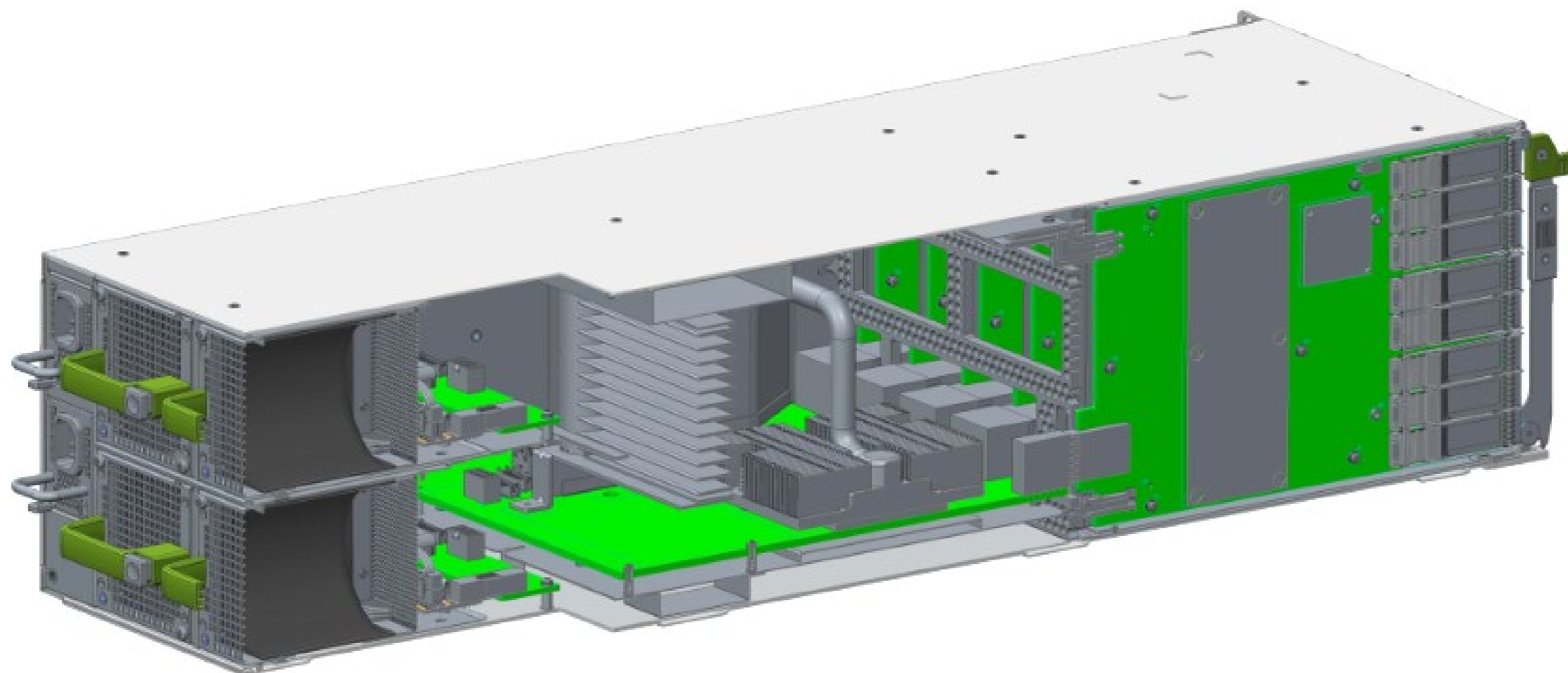


# Minipack : FB Modular Switch Platform



- Side Cross-Sectional View

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Specifications

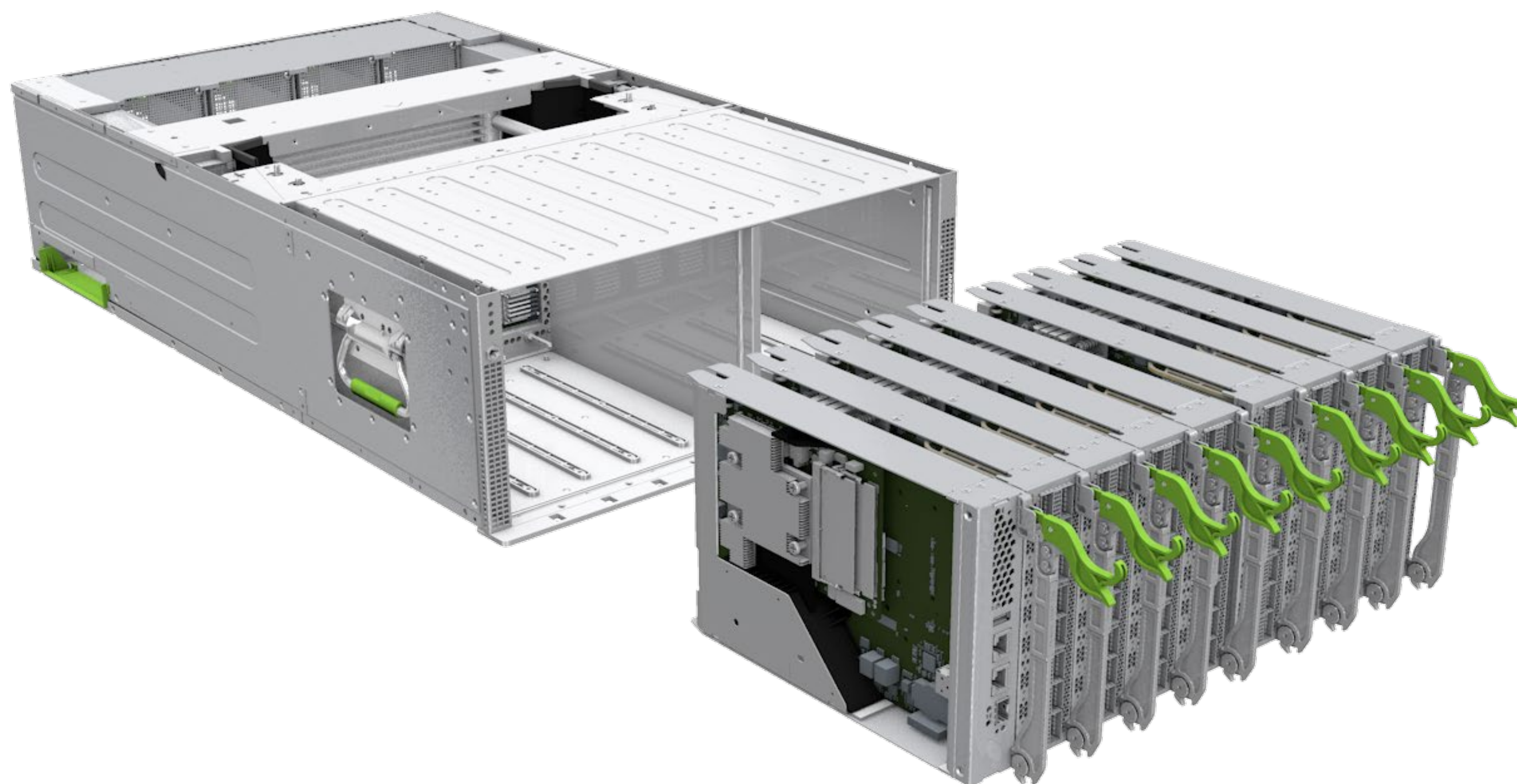


# Minipack : FB Modular Switch Platform



- PIM and SCM slide forward from the chassis

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Specifications

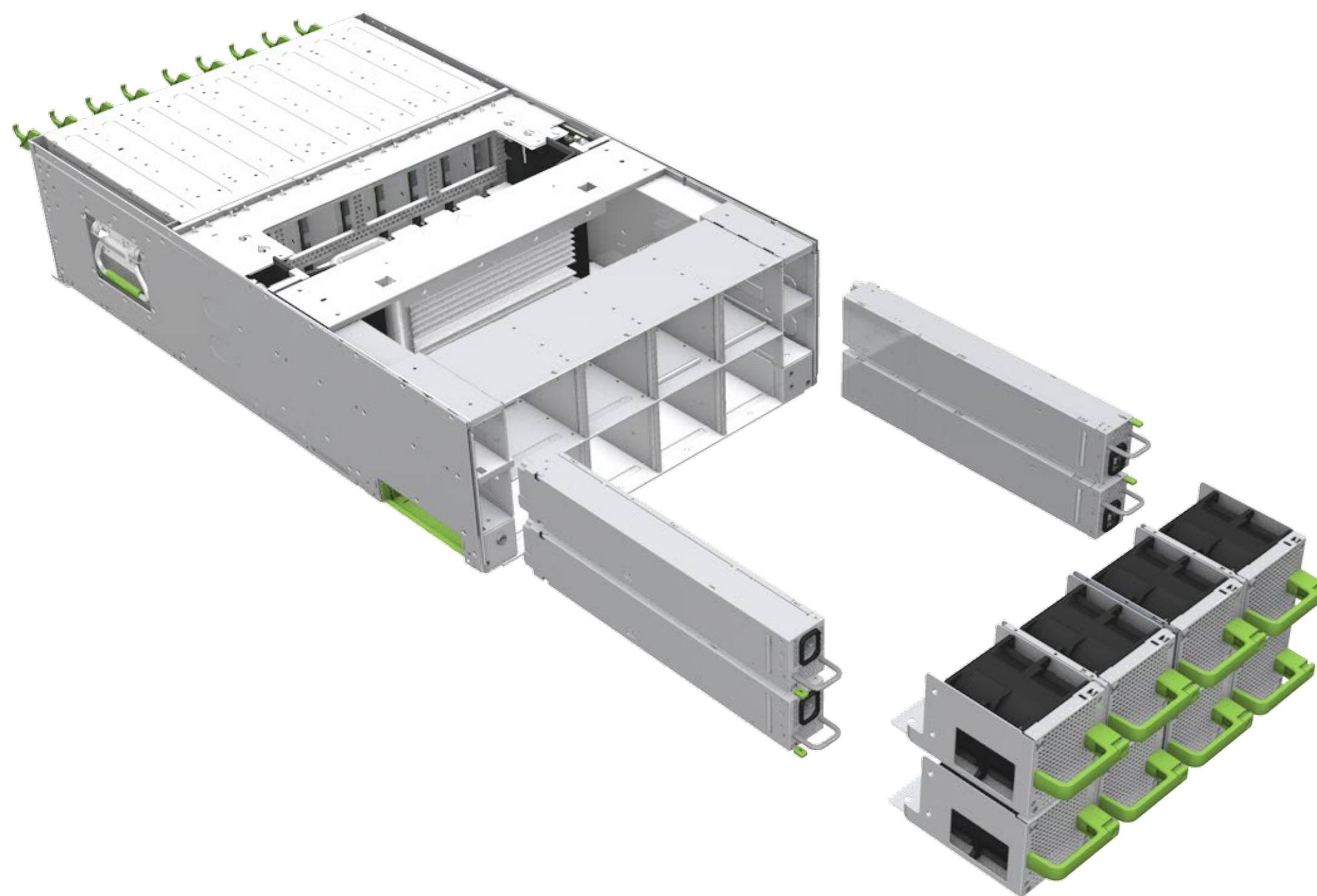


# Minipack : FB Modular Switch Platform



- PSU and Fan module slide outside from the chassis

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Specifications

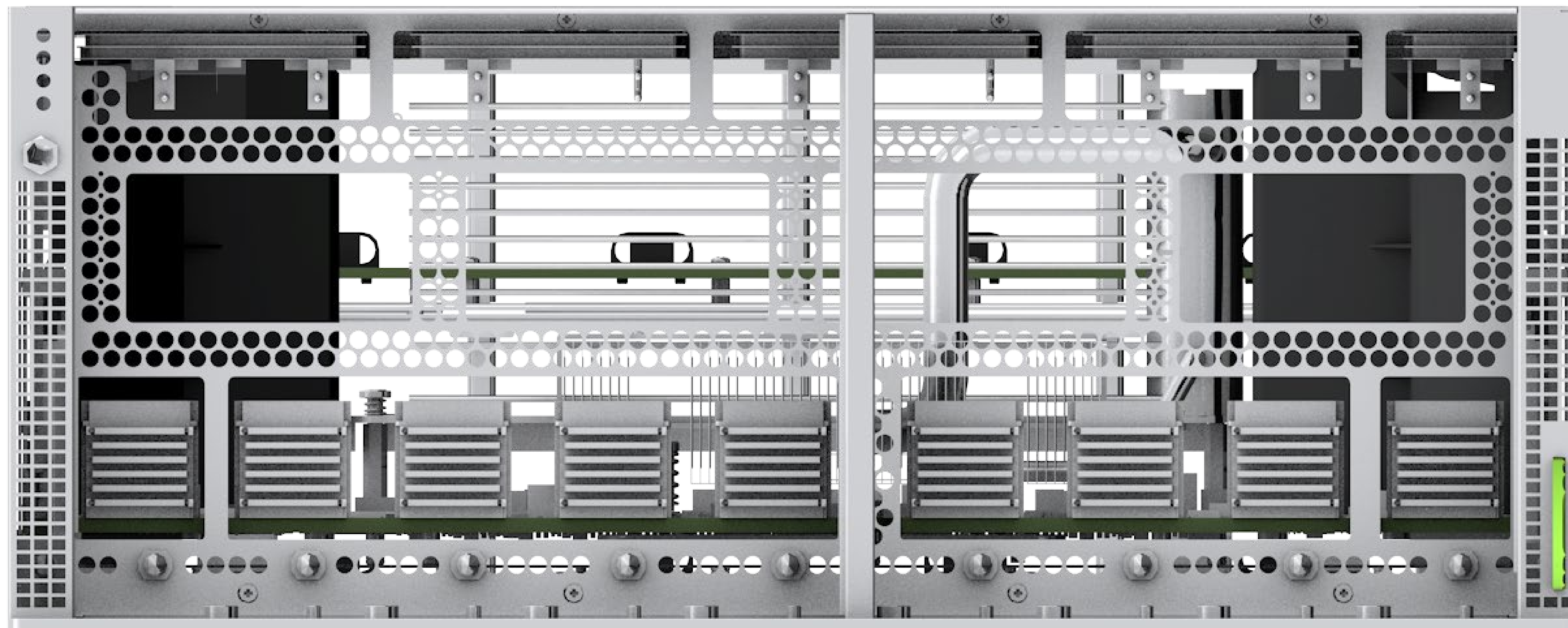


# Minipack : FB Modular Switch Platform



- Showing front to back vent opening

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Specifications

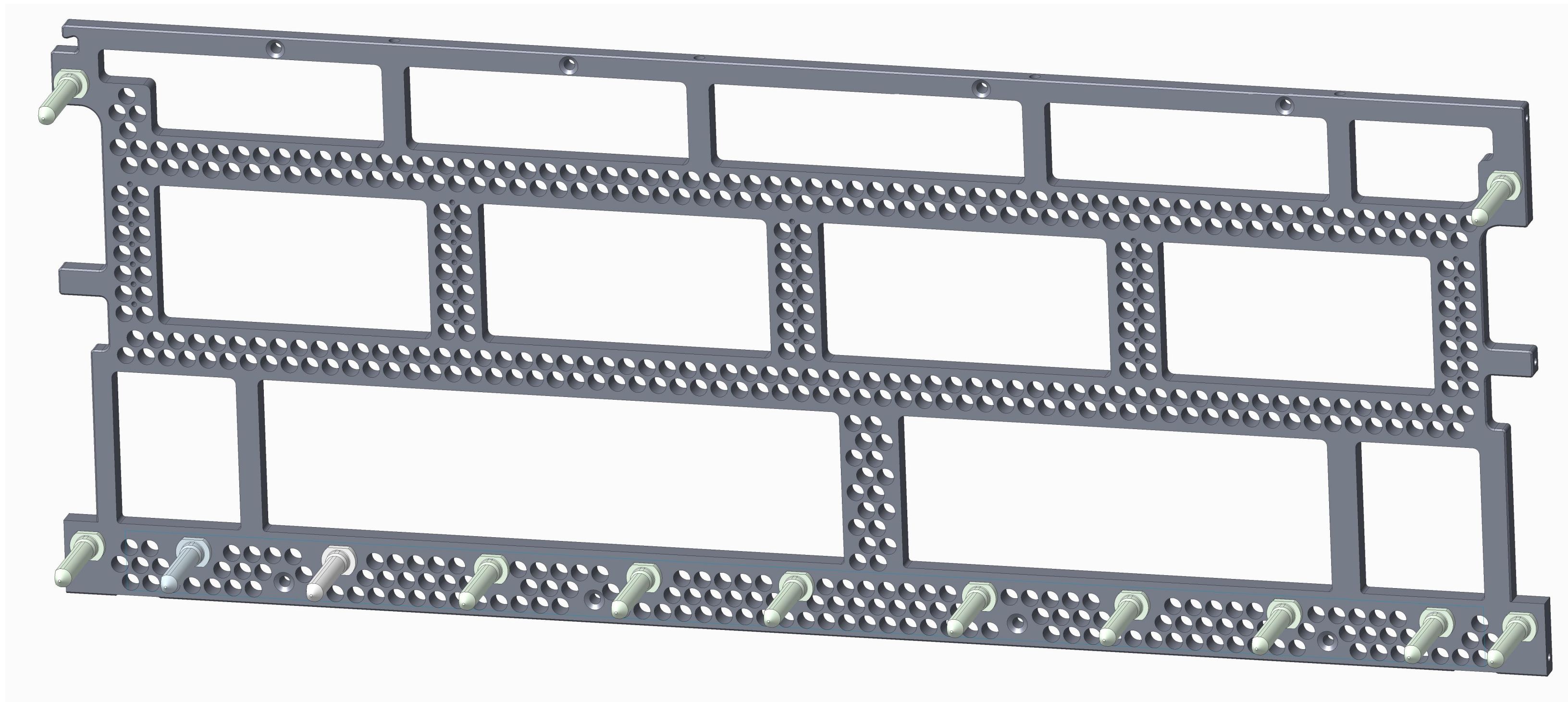


# Minipack : FB Modular Switch Platform



- Metal midplane design to allow maximum airflow to past thru the chassis

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# Innovative Design



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- Disaggregated architecture:
  - Field Replaceable SCM(System Control Module)
  - Field Replaceable PIM(Port Interface Module)
- Orthogonal Direct Chassis Architecture
  - All major module cards are designed to be mated orthogonally
  - Open up more air channel for a better thermal performance
  - Reduce the PCB trace length for better signal integrity
- A sophisticated thermal design to support low cost 55C CWDM4 optics



Specifications



# Minipack System Major Components



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- Switch Main Board (SMB)
- System Control Module (SCM)
- Port Interface Module (PIM)
  - PIM-16Q: Port Interface Module with 16 x QSFP28 100G
- Fan Control Module (FCM)
  - Fan Control Module Top (FCM-T)
  - Fan Control Module Bottom (FCM-B)
- Power Distribution System
  - Horizontal Bus Bar (HBAR)
  - Power Distribution Board Left (PDB-L)
  - Power Distribution Board Right (PDB-R)



Specifications



# Minipack Chassis: 128 x 100G



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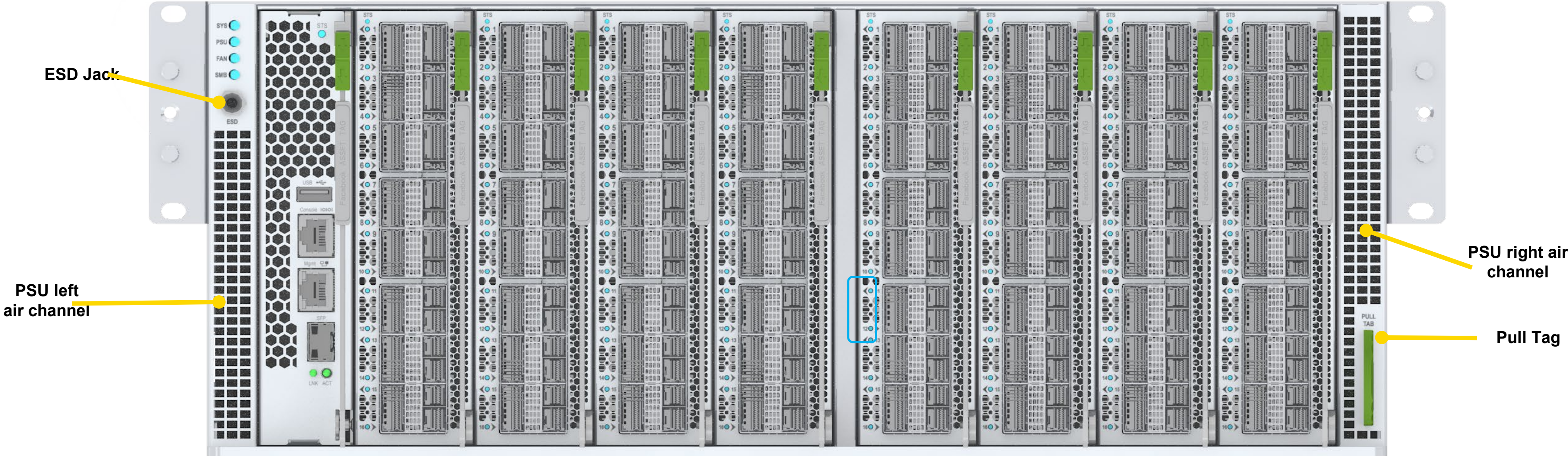
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# Minipack Front View with PIM-16Q



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# Minipack Rear View



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Specifications

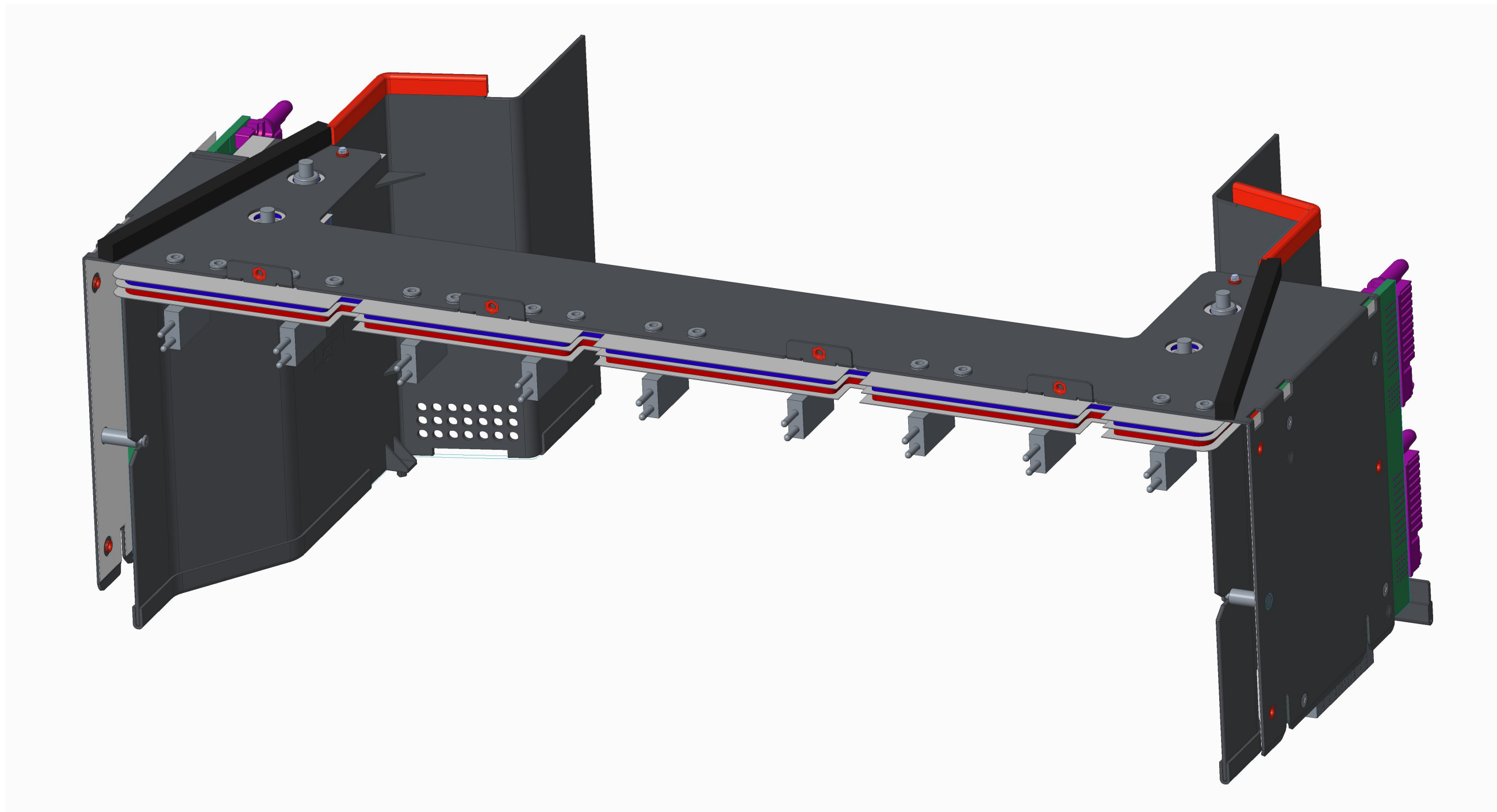


# Power Distribution System

- Two layer busbar assy
- PDB-Left and PDB-Right



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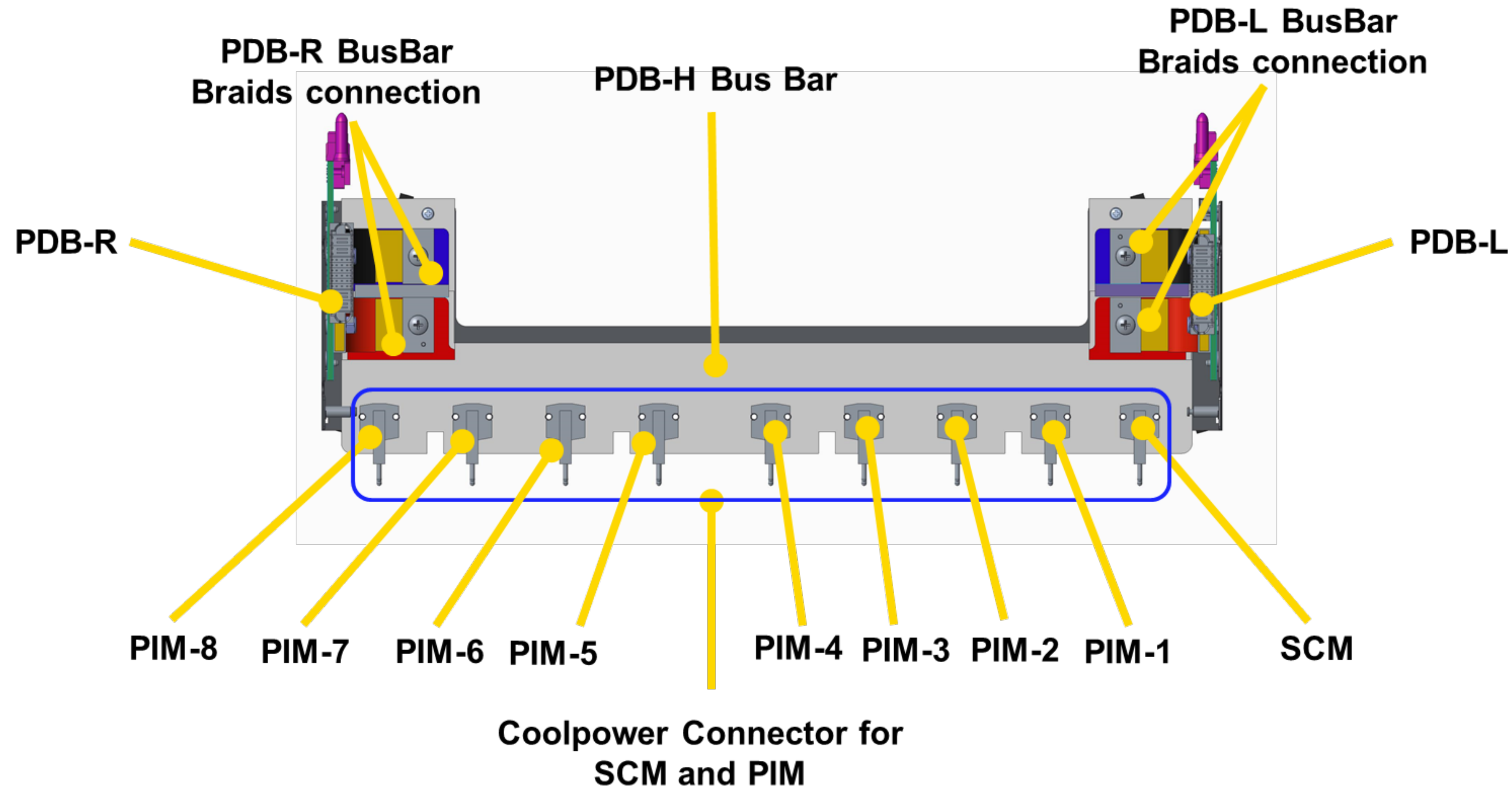
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# Power Distribution System



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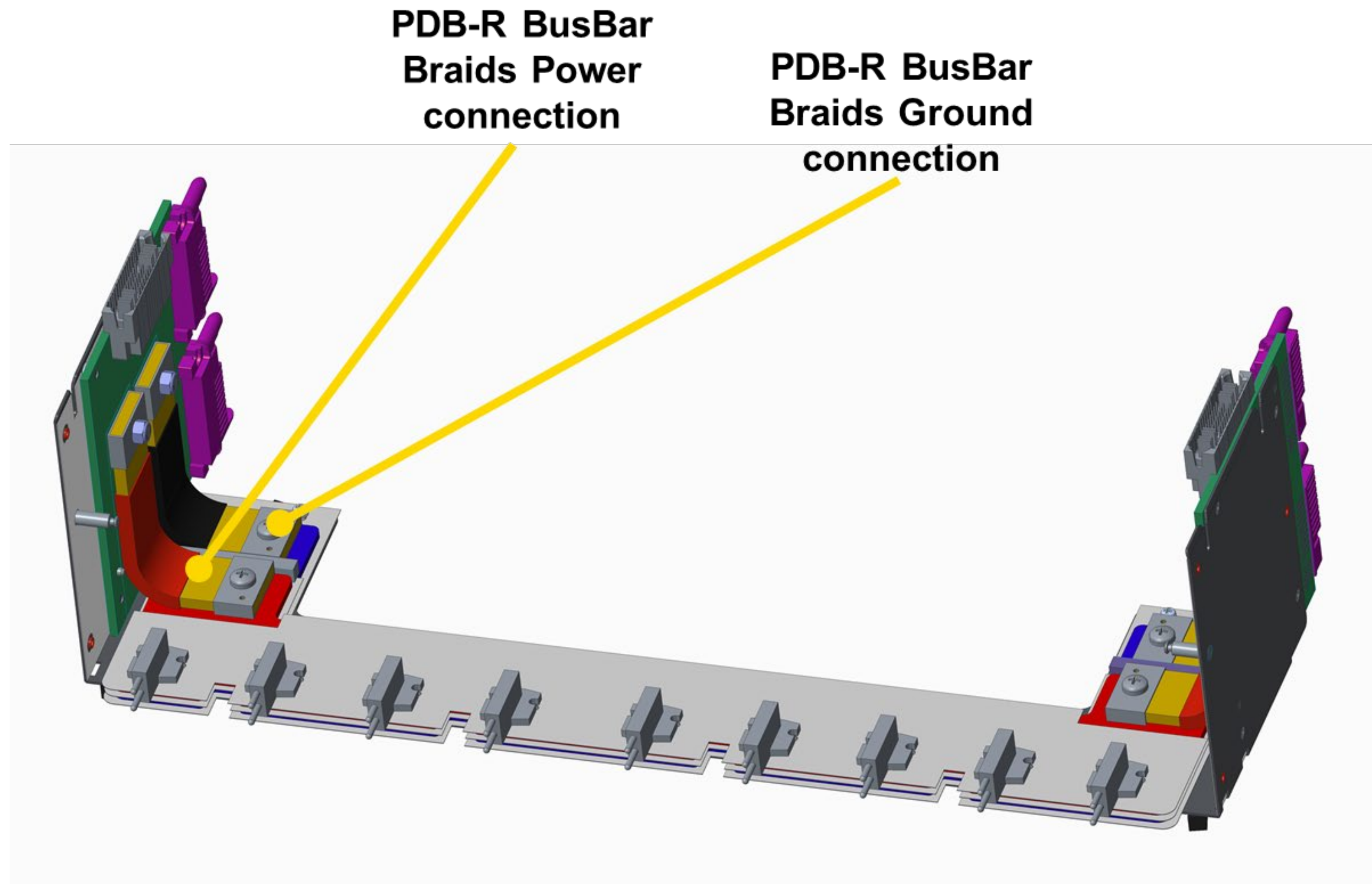
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# Power Distribution System



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Specifications



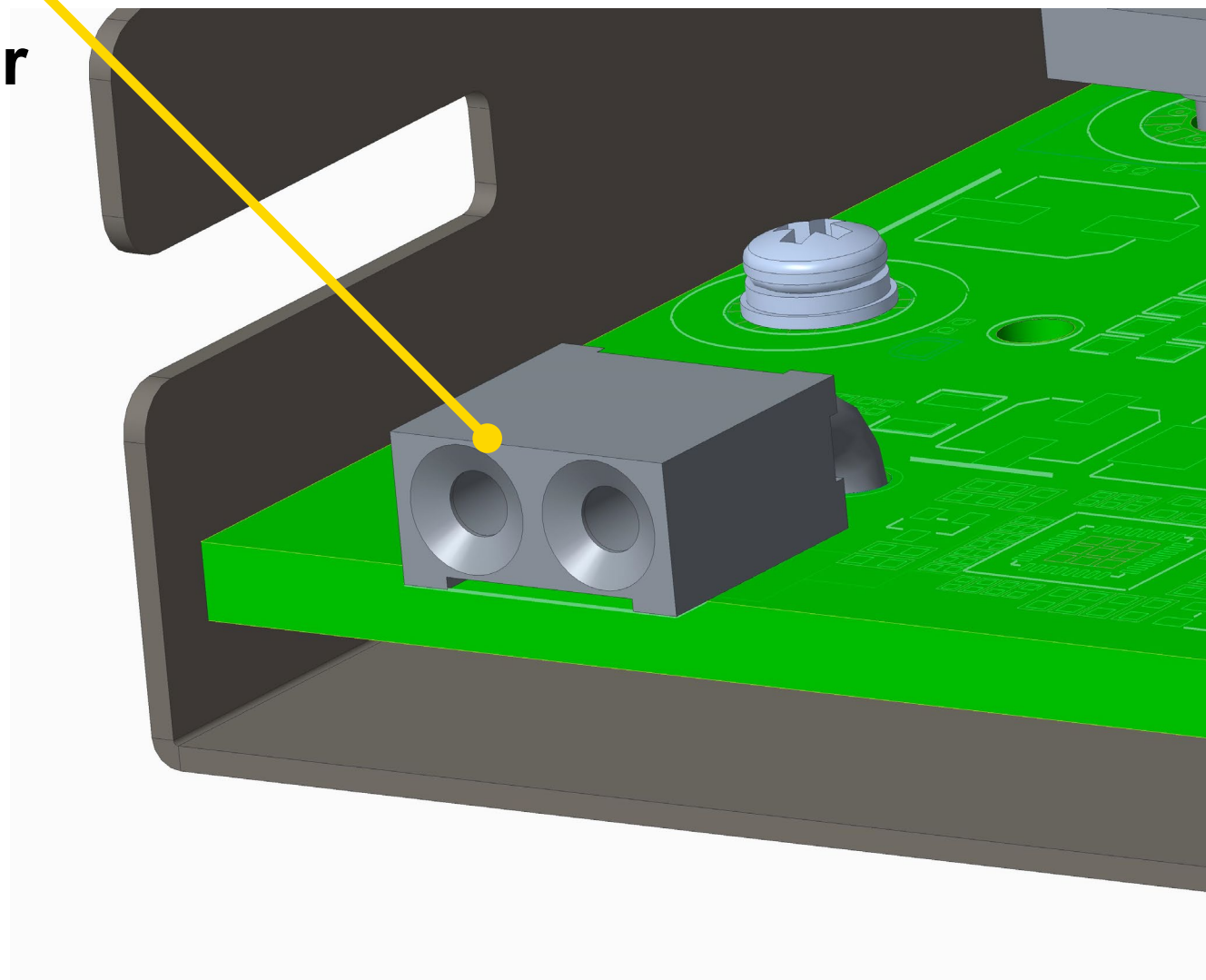
# Power Distribution System



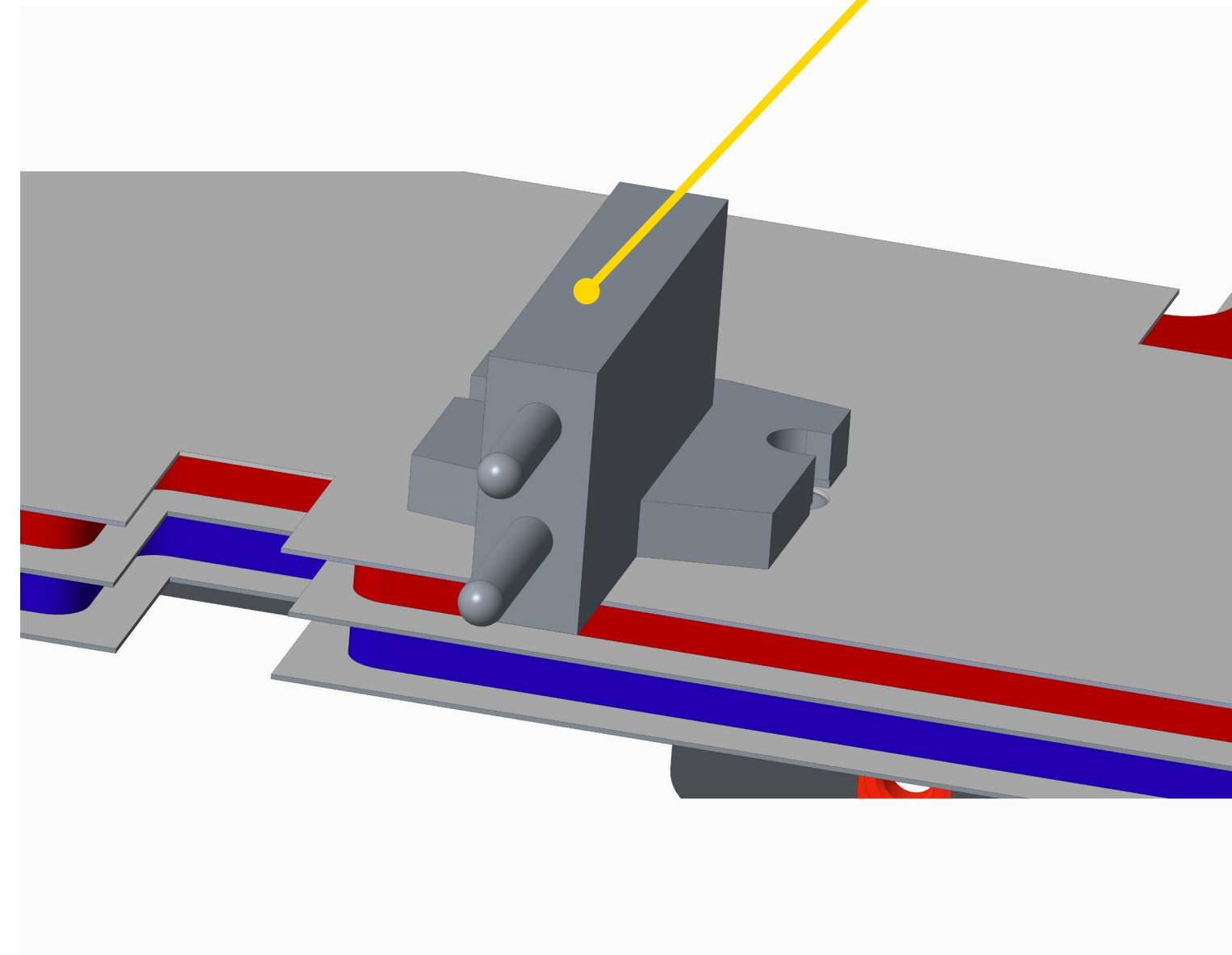
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- CoolPower connector also an Orthogonal Connector

CoolPower  
Module  
side  
connector



CoolPower Busbar  
side connector



Specifications



# FRUs

- Front of the chassis
  - SCM(System Control Module)
  - PIM(Port Interface Module)
- Rear of the chassis
  - Fantray assy
  - PSU



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Specifications



# System Control Module (SCM)

## COMe module

- Minilake

SATA M.2 SSD



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Specifications



# System Control Module (SCM)



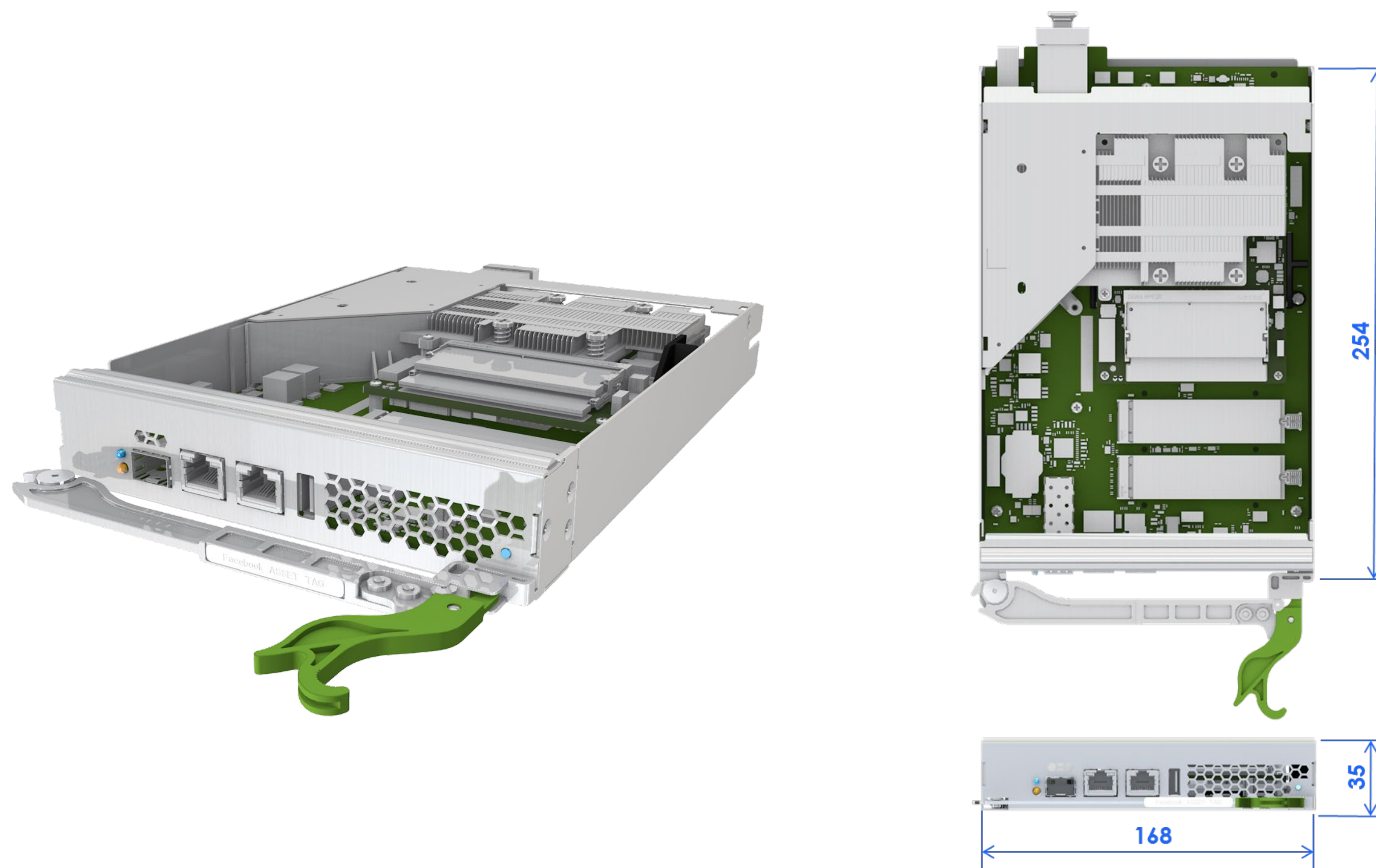
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Specifications

Key to prevent  
inserting in  
wrong slot

(Unit : mm)

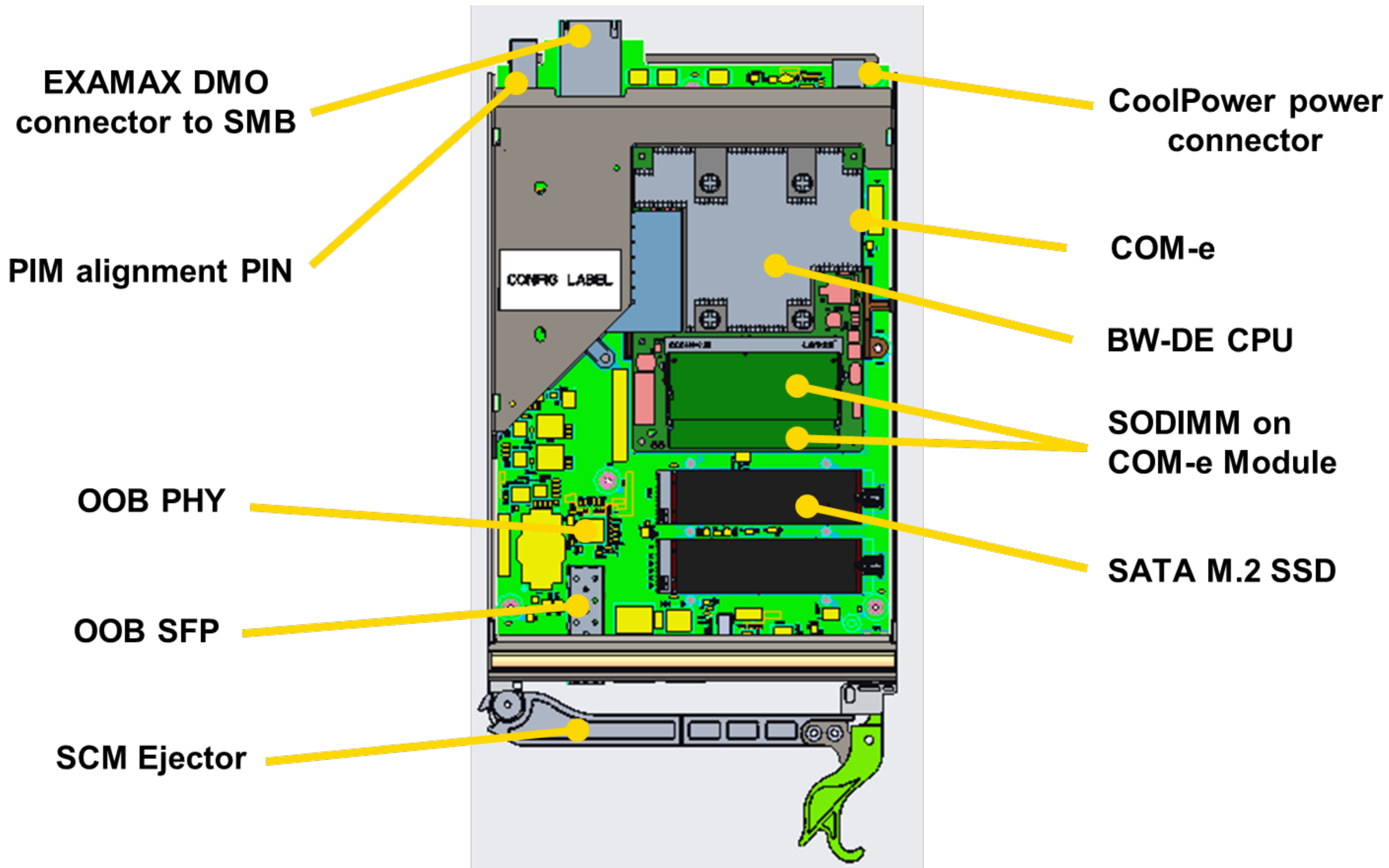




# System Control Module (SCM)



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# Port Interface Module (PIM)



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## Type of PIM

- PIM-16Q: 16 x QSFP28

One DMO Connector to SMB for both data and control plane signals

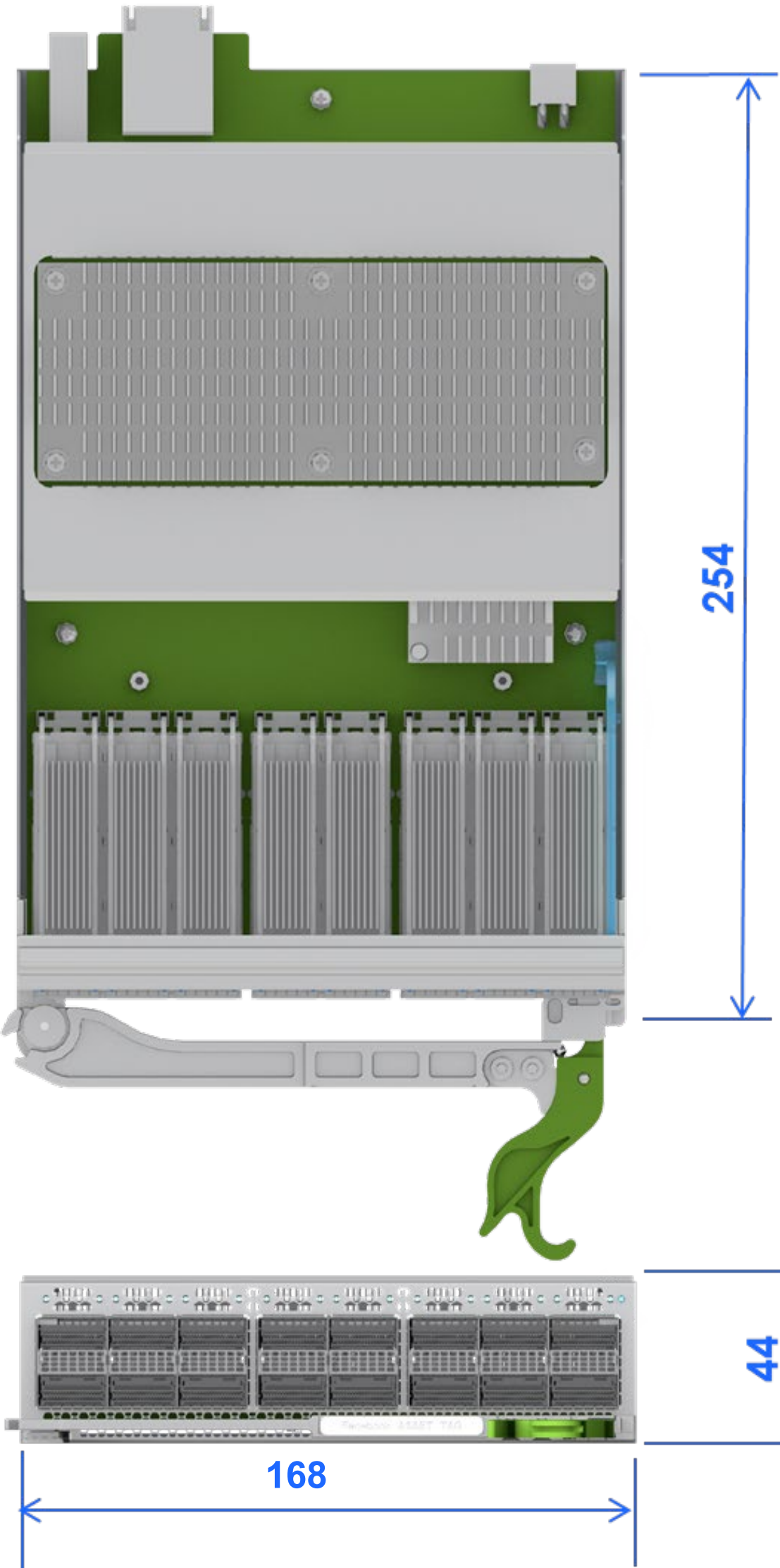
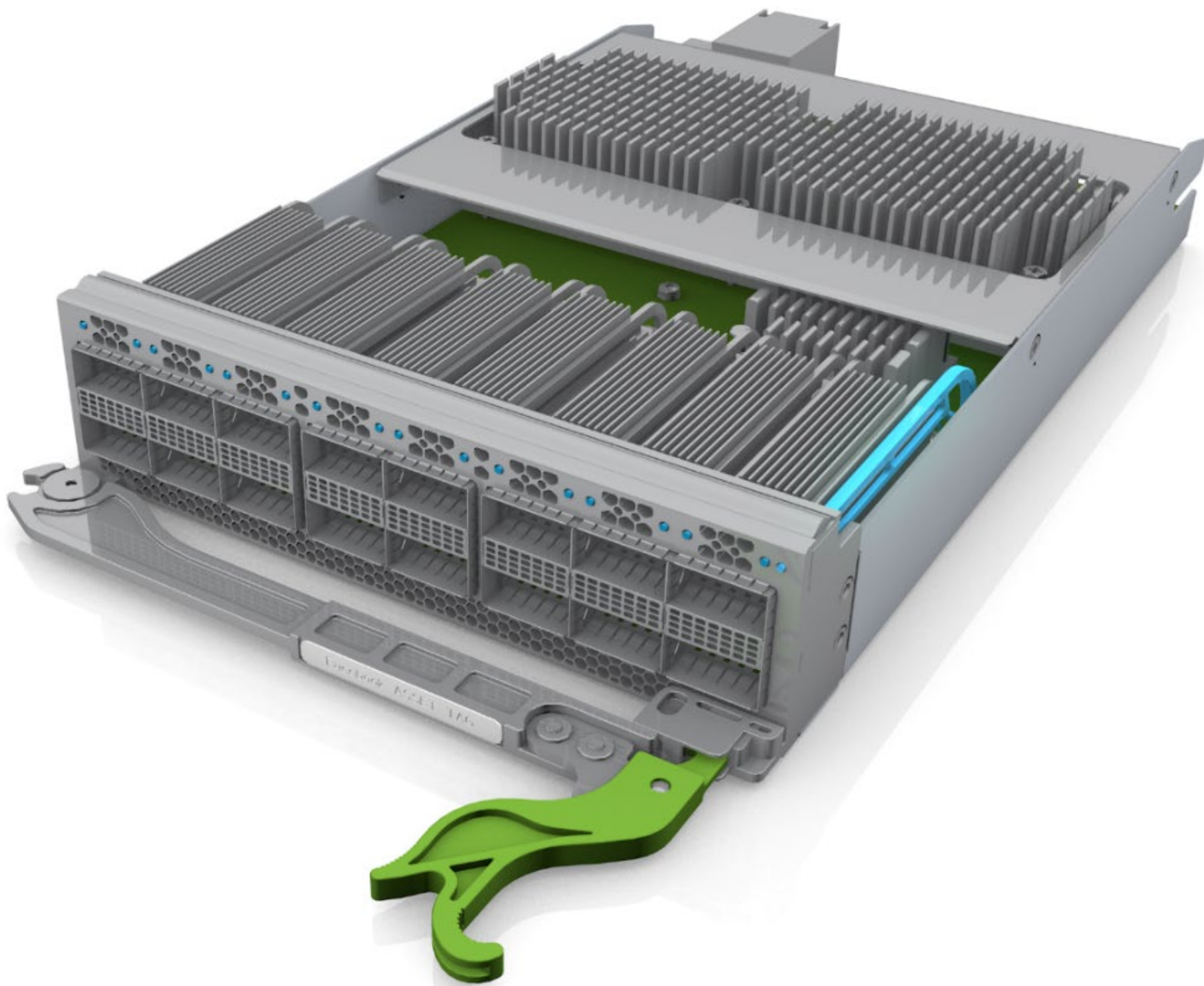
CoolPower connector to power bus bar



Specifications



# PIM-16Q Module



Key to prevent  
inserting in  
wrong slot



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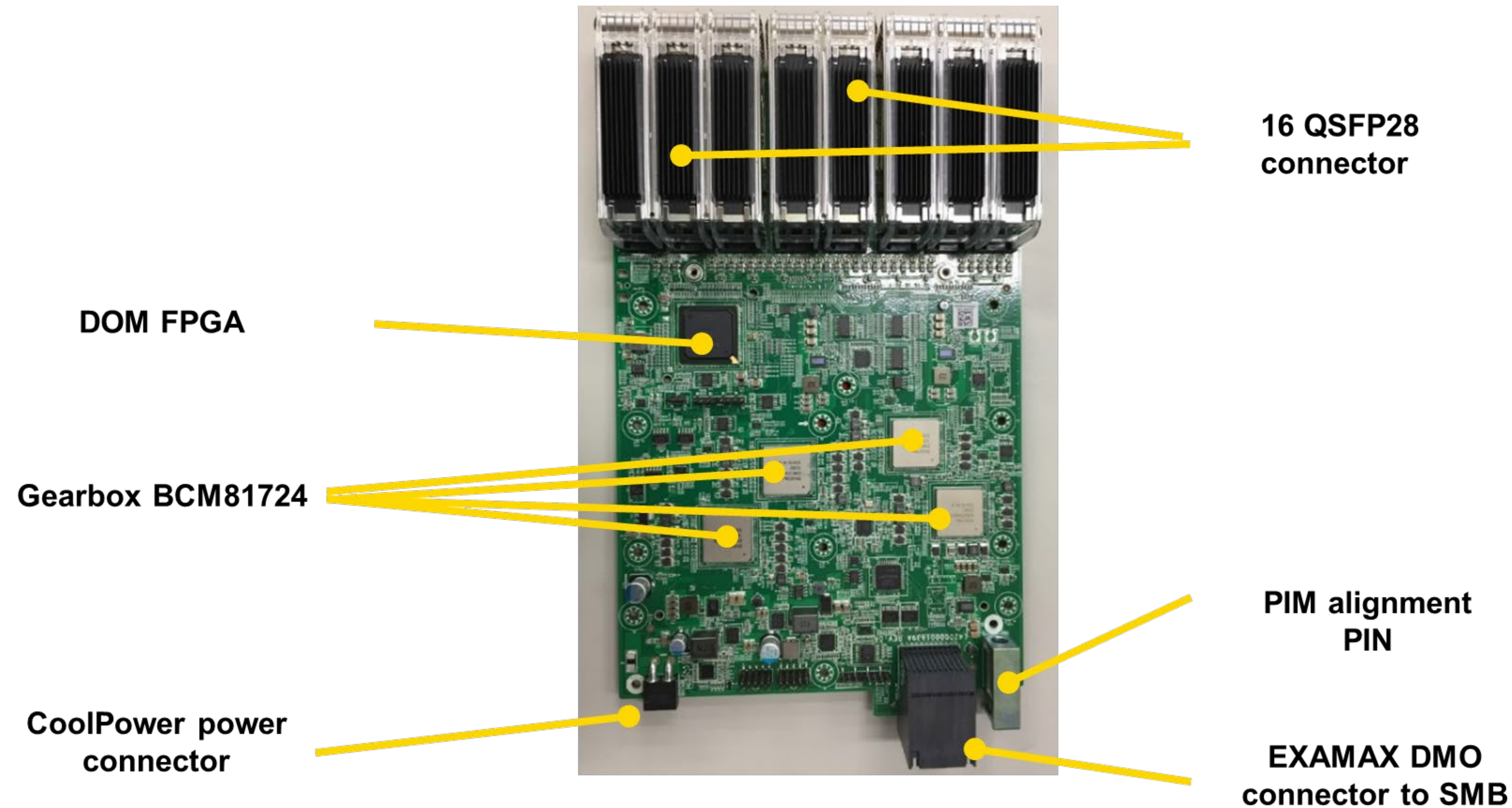
Specifications



# PIM-16Q Components



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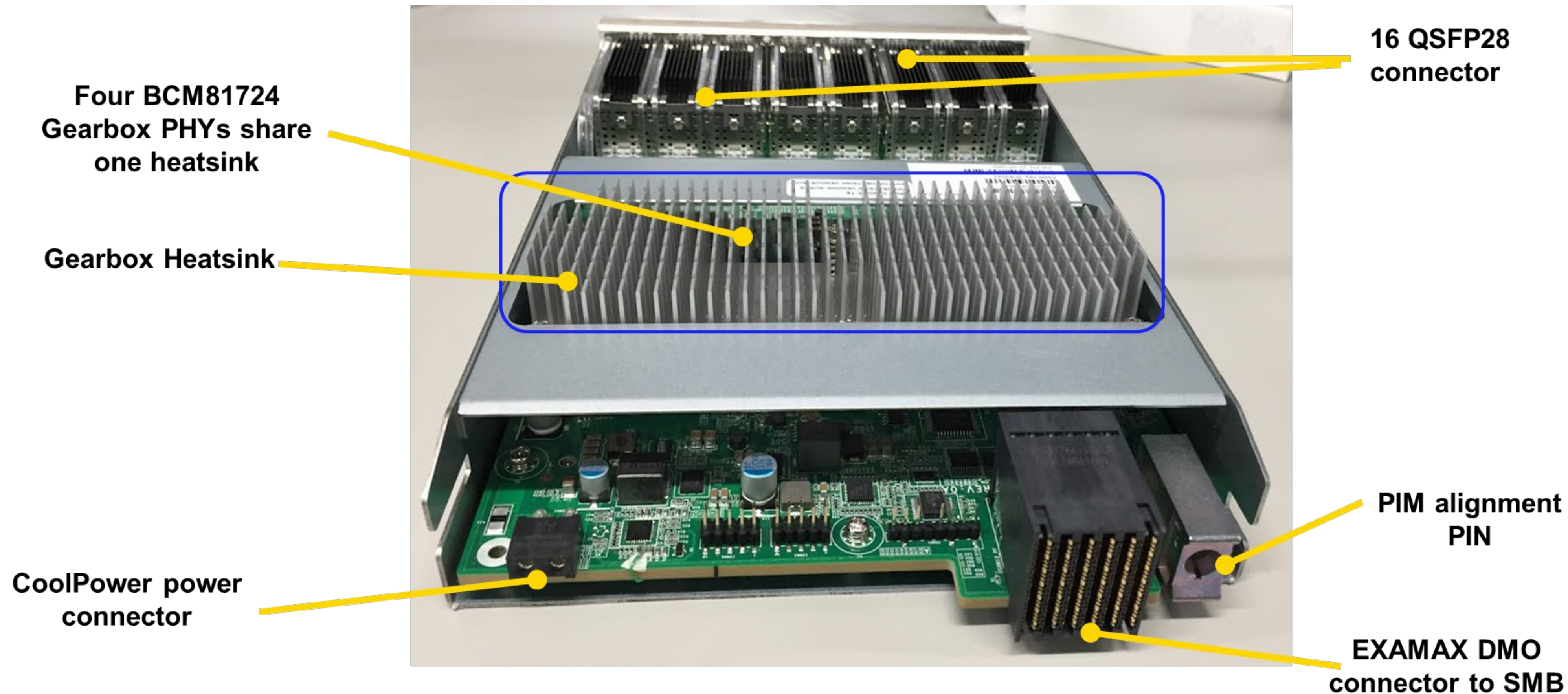
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# PIM-16Q interface



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# Fan-tray Assy



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- Screw-less latch design for easy maintenance
- Powerful 80 x 80 mm CR fan
- Hot swappable
- LED on rear panel
- Each FCM carries 4 Fan-tray, total 8 fan-tray in minipack chassis

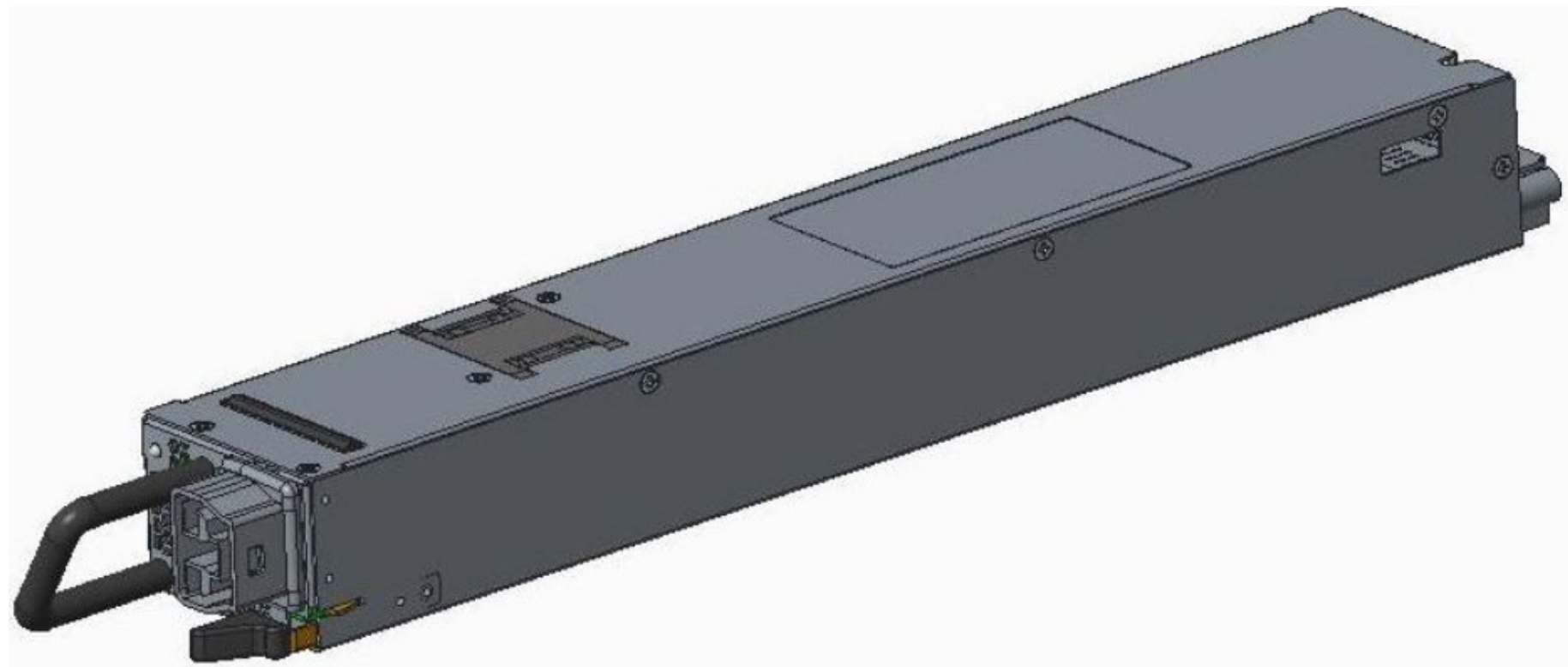


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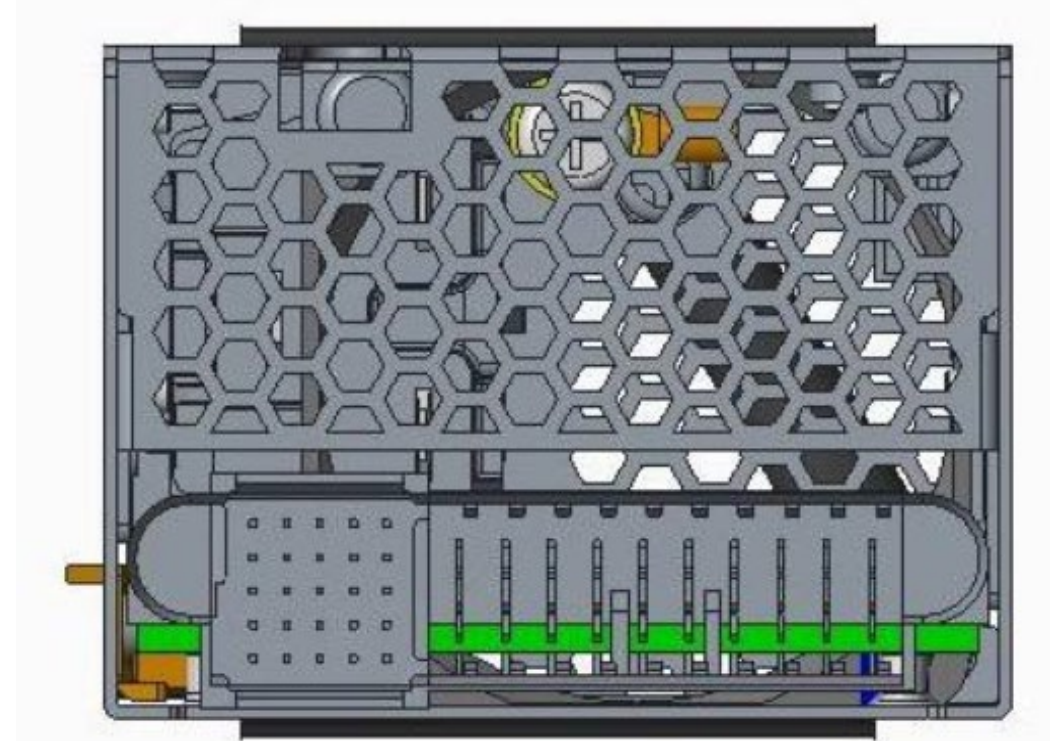


# High Performance PSU

- Keying feature on Minipack chassis to prevent PSU to mate in wrong direction
- Power cord retention is built in on the HVAC connector



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Specifications



# Thermal Design



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- Front-to-rear airflow
  - Ensures N+1 rotor redundancy
- Supports 100G modules at 3.5W with 55°C case temperatures
  - Up to 35°C ambient, 6000ft altitude and under one rotor failure
- Fan control delivers desired margins on all temperature-sensitive components and system-level  $\Delta T$  targets
  - Under typical and high workloads



# Thermal Design



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- Separation between system and PSU airflow channels
- Other items
  - Energy-efficient fan operation (typically  $\leq 5\%$  of system power)
  - System-level  $\Delta T$  targets ensure efficient operation in deployed facilities
  - Thresholds defined for critical parameters to sustain operation under unexpected conditions



# Call to Action

- MiniPack design is available for your use. Please share your experiences with the community.
- Please visit OCP website to learn more on MiniPack design [https://www.opencompute.org/wiki/Networking/SpecsAndDesigns#Facebook\\_Minipack](https://www.opencompute.org/wiki/Networking/SpecsAndDesigns#Facebook_Minipack)





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26–27, September, 2019