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FOR BUSINESS.

OCP SUMMIT

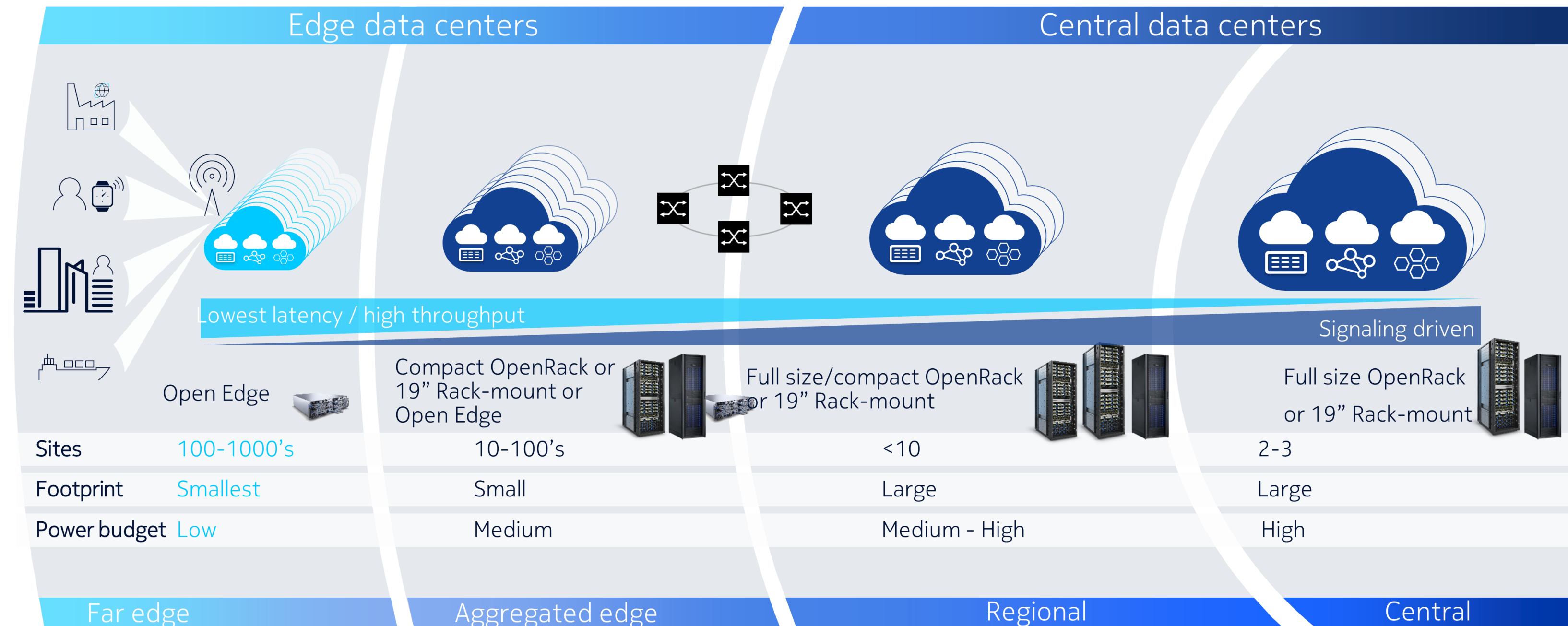# Nokia is a Platinum Member of the Open Compute Project and an OCP Solution Provider

Open edge server key objectives

- **Edge site requirements**
  - Limited floor space -> small form factor
  - Varying thermal conditions -> extended temperature range
  - Varying types of power feed -> DC, AC, 3-phase, 1-phase with PDUs
 - Limited power feed capacity -> system scaleability from one chassis to multiple racks

- **Accelerator support (e.g. cRAN/ MEC)**

- **OCP design principles**
  - Centralized power feed
  - Front access
  - Tool-les maintenance
  - Vanity free desing

	Edge data centers		Central data centers	
	Open Edge	Compact OpenRack or 19" Rack-mount or Open Edge	Full size/compact OpenRack or 19" Rack-mount	Full size OpenRack or 19" Rack-mount
		Lowest latency / high throughput		Signaling driven
Sites	100-1000's	10-100's	<10	2-3
Footprint	Smallest	Small	Large	Large
Power budget	Low	Medium	Medium - High	High
	Far edge	Aggregated edge	Regional	Central

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Open edge chassis overview

Key specifications

- 3U, 19" mountable (EIA-310 compatible)
- 130.6 x 440 x 430 mm (H x W x D)
- 1U and 2U, half width sleds are supported
- Redundant, centralized power supply
  - 2000 W max power feed capacity, 80+ Platinum
  - AC (100..127/ 200..240 VAC) and DC (-48 VDC) options
- Sled power feed capacity 400 W (1U sled), 700 W (2U sled), 12 VDC

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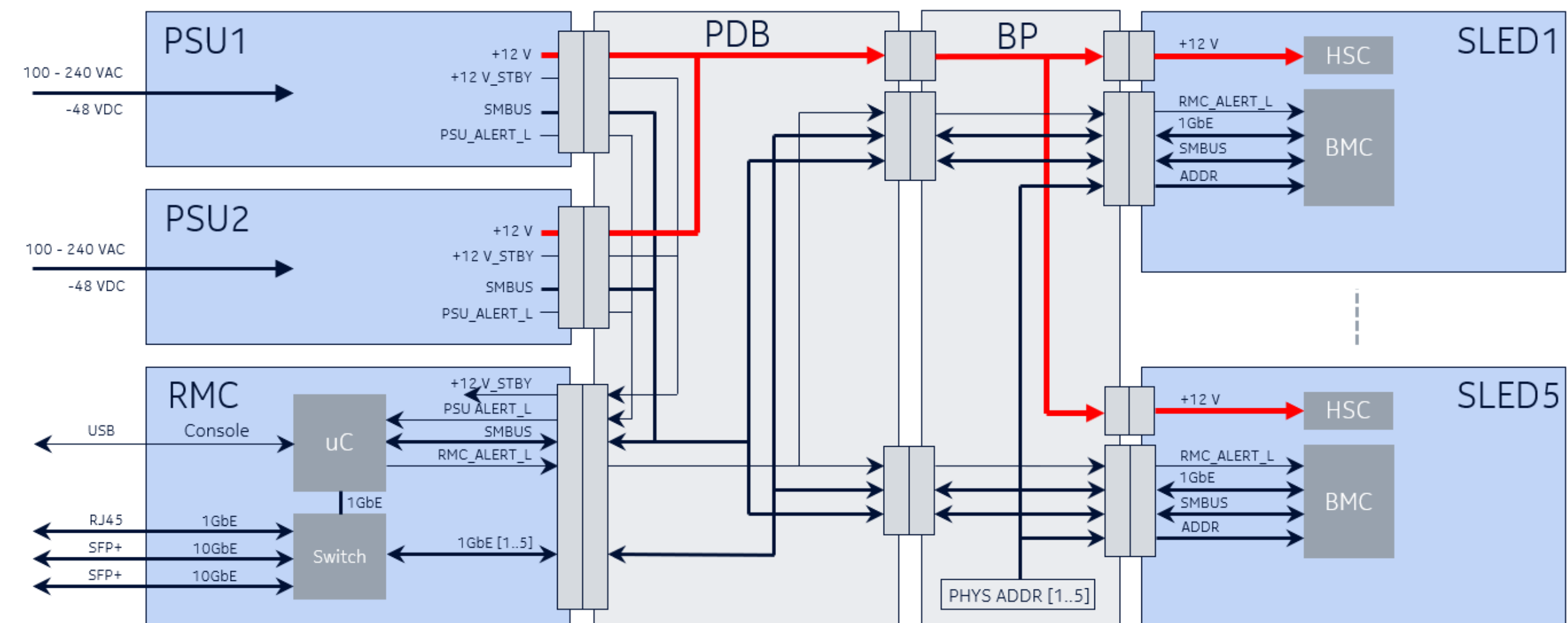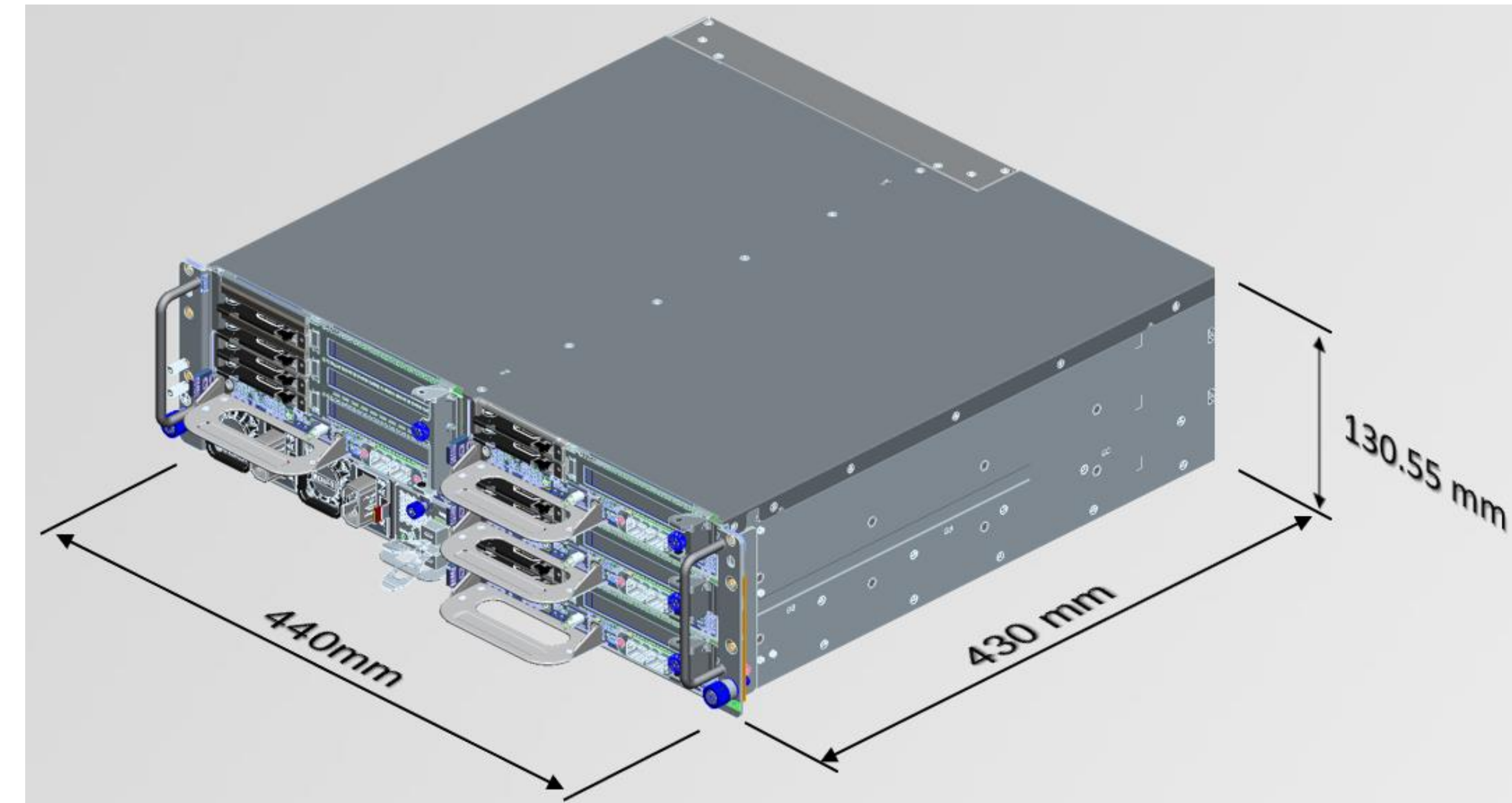
Open edge chassis overview

Key specifications

- Cooling: Fan units are part of sled solution
  - Air flow direction configurable: front to rear/rear to front
- Chassis management controller (RMC)
  - PSU management (control, sensors, ..)
  - Management Ethernet interface to sleds
    - 1 GE to all sleds via backplane
    - 1x 1 GE (RJ45) + 2x 10 GE (SFP+) front panel interface for external connectivity and chaining of multiple chassis
- Power distribution board and chassis backplane provide connectivity between RMC, sleds and PDUs


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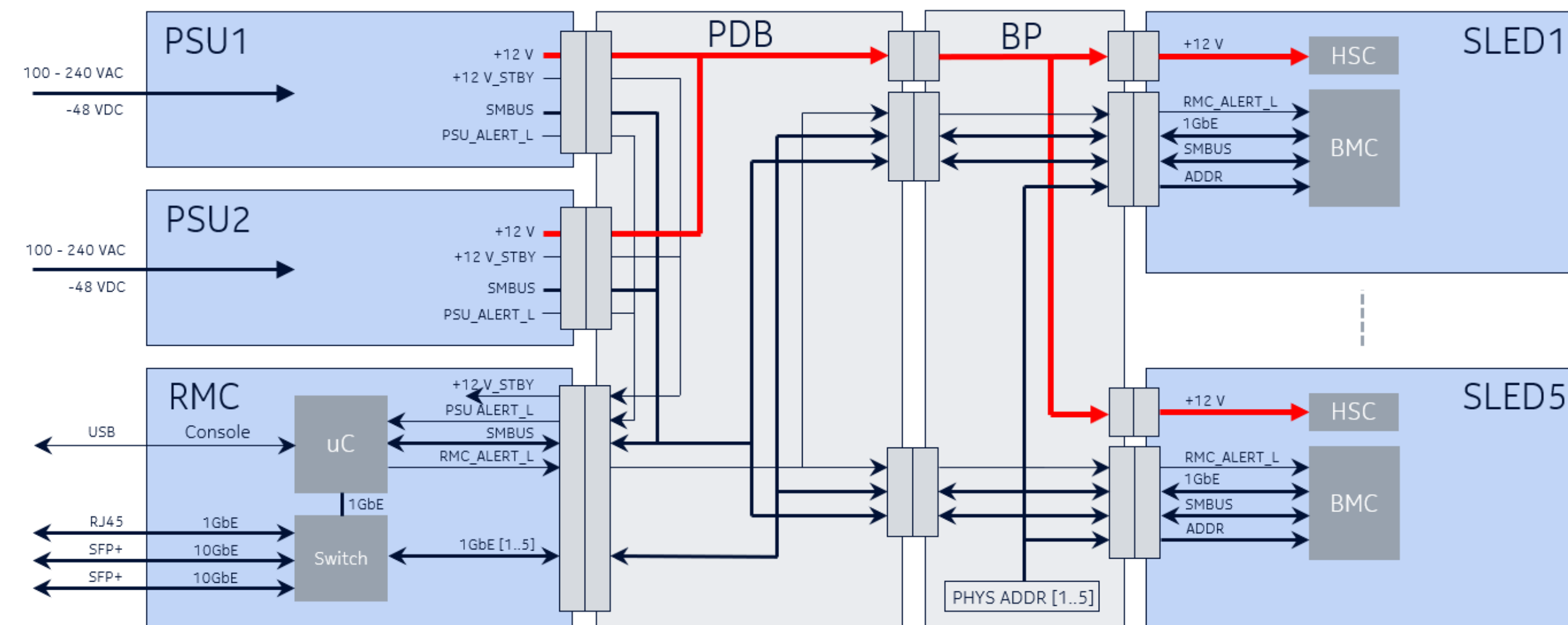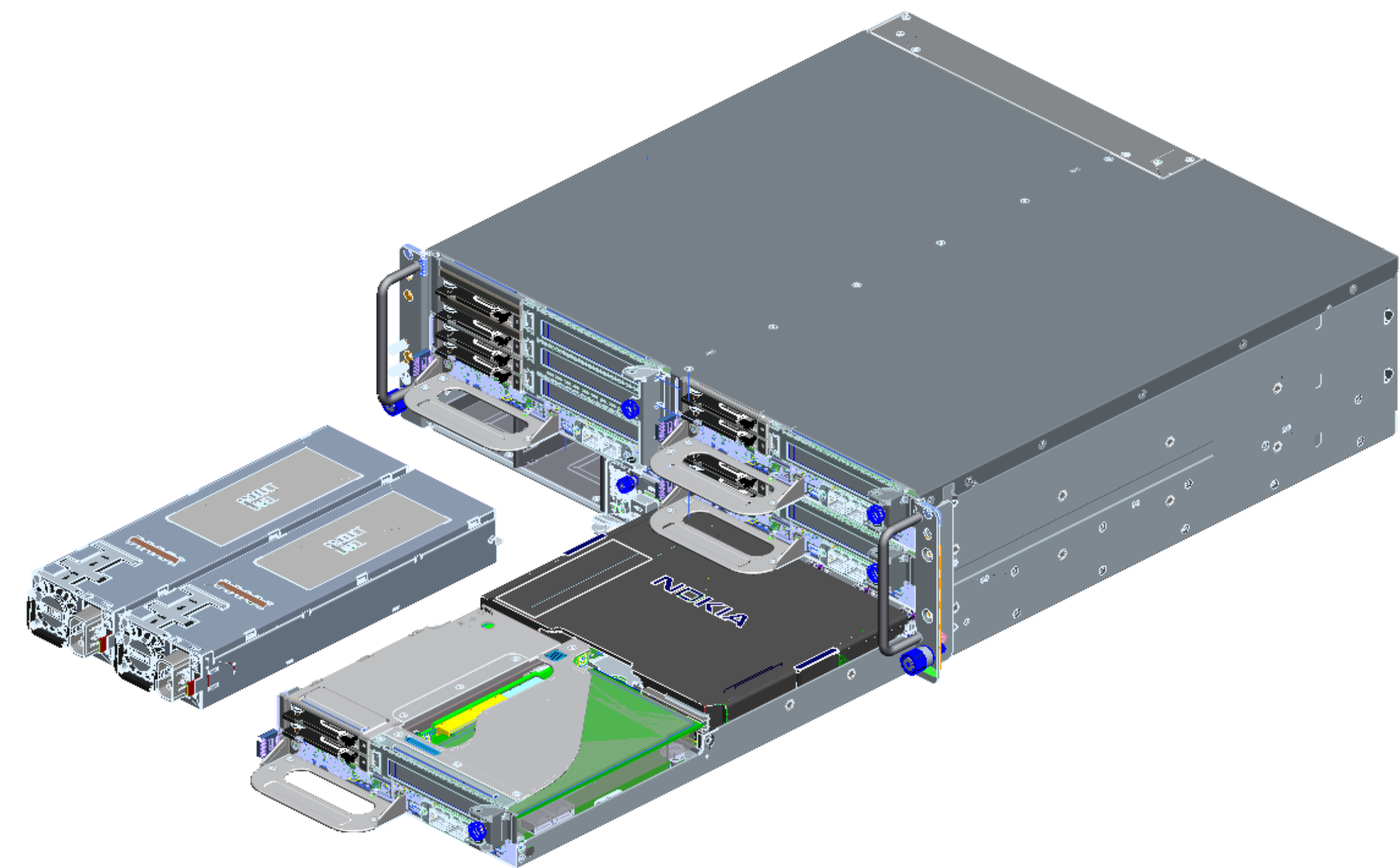
Open edge chassis construction

Simple construction, few parts

- Steel enclosure

- Mounting brackets

- Backplane assembly

- Power distribution board

- Support brackets for 1U sleds, tool-less

No integrated user plane switch

- Computing and networking decoupled to allow optimization of subsystems

AirMax Power, 40 A

AirMax VS2

HCI, 80 A

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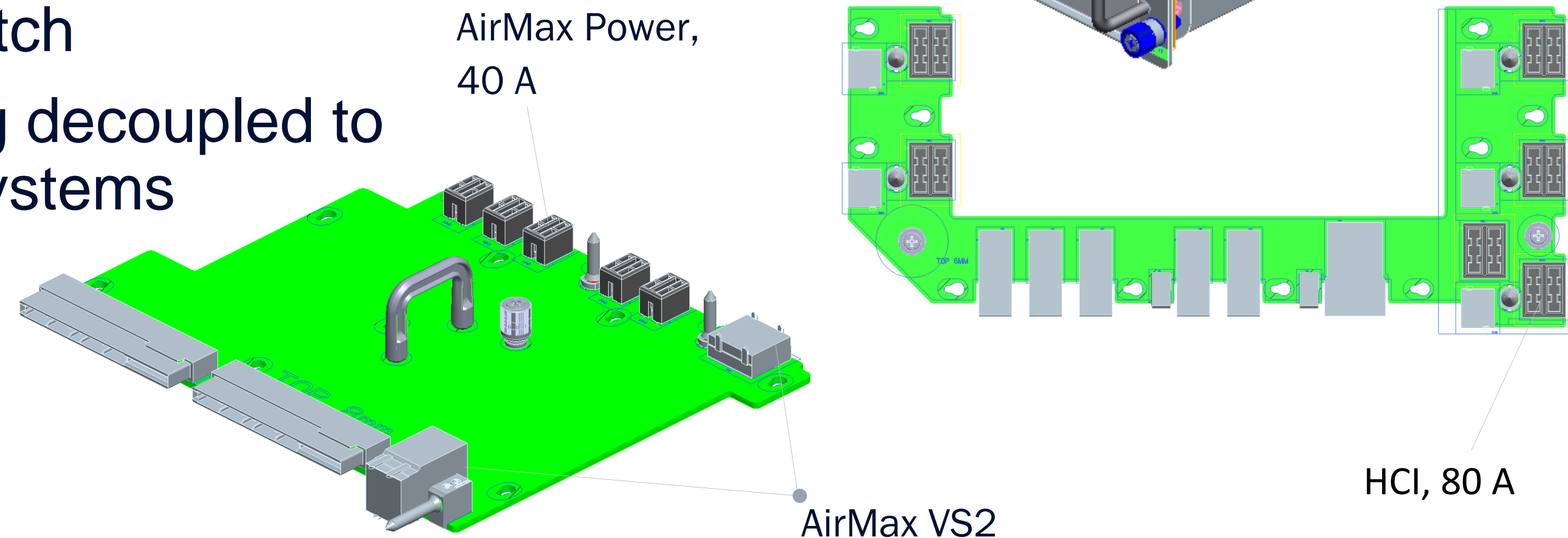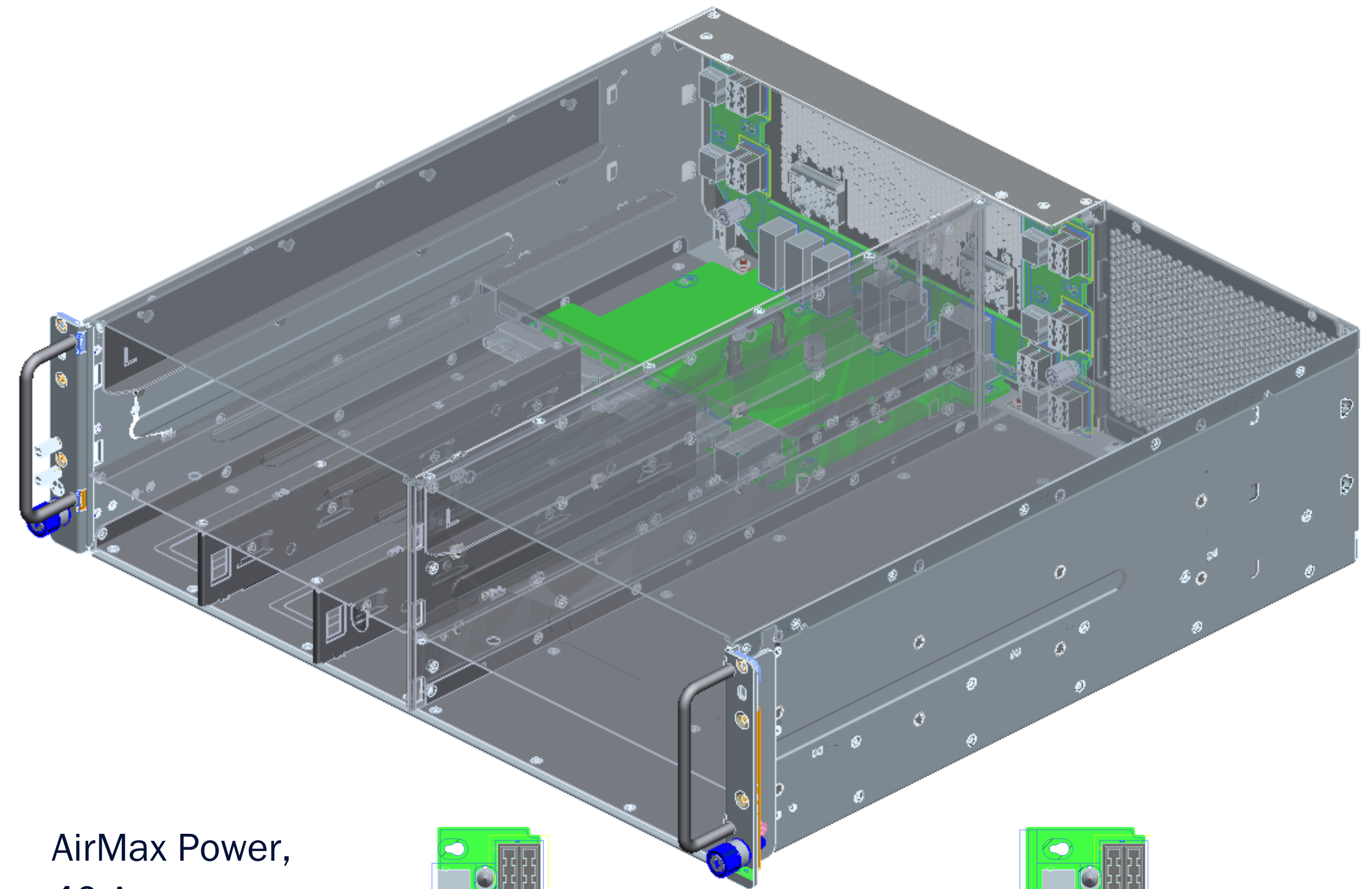
Open edge chassis front view

PSU2   PSU1   RMC   1U / 2U sleds

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1U and 2U sleds are supported

- Open edge chassis allows flexible installation of both 1U and 2U sleds
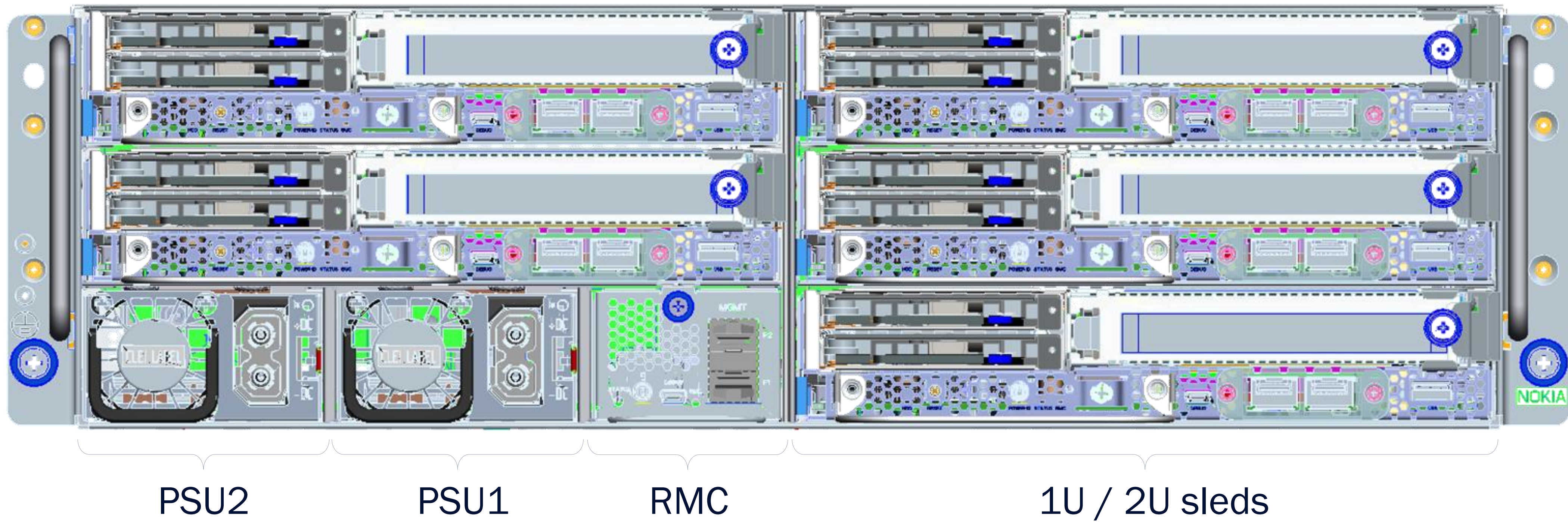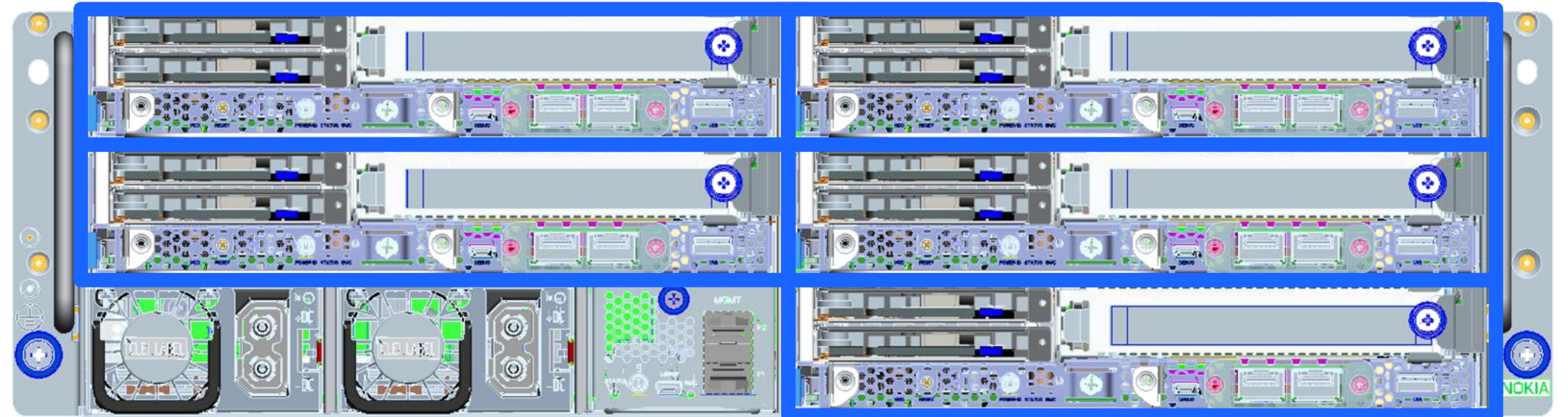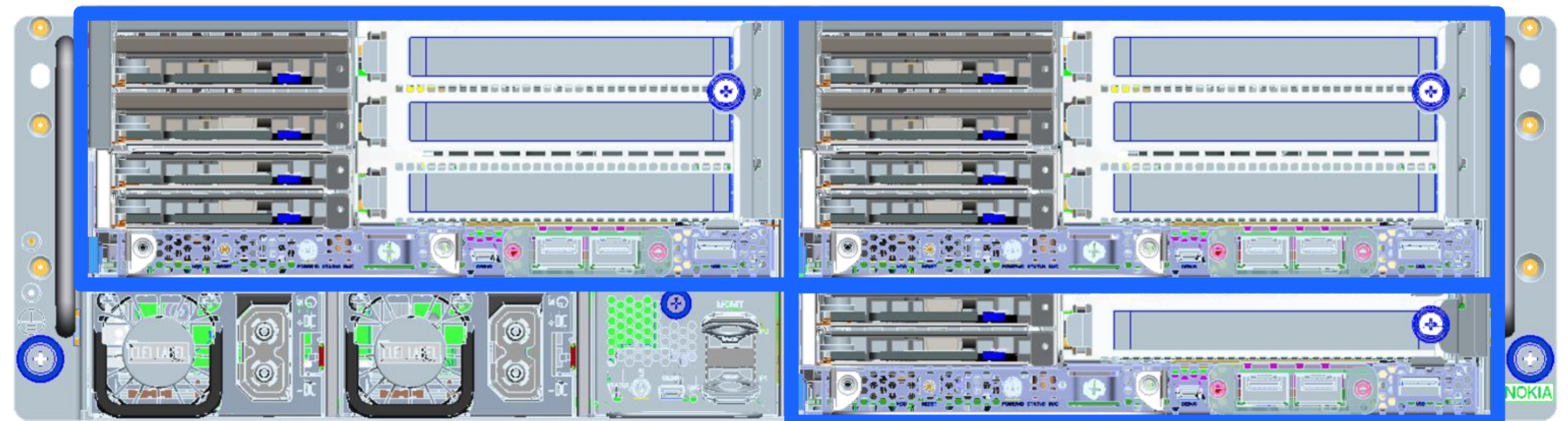- Supported configurations are
  - 5x 1U
  - 3x 1U + 1x 2U
  - 1x 1U + 2x 2U
- A support bracket for 1U sled is removed when installing a 2U sled (tool-les)

5x 1U

1x 1U + 2x 2U

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Server sled, 1U

Key specifications

- 1U, half width
- 215 mm x 41 mm x 423 mm (W x H x D)
- Power consumption 400 W, max
- Single-socket CPU, Intel® Xeon® Scalable Family, Thermal Design Power (TDP): max. 205 W
- PCH options: Intel C621, C627 (with QAT)
- Memory: 6 x DDR4-2933 + 2 x Intel Optane
- Single riser for disks and add-in cards
- Extension slots
  - PCIe x16, FHHL, 75 W
  - OCP Mezzanine 2.0, PCIe x16
- Storage
  - 2 x hot-plug SSD, SATA/NVMe, 2.5 ", 7/9.5 mm
  - 2 x M.2 SSD, SATA/NVMe, 2280/22110

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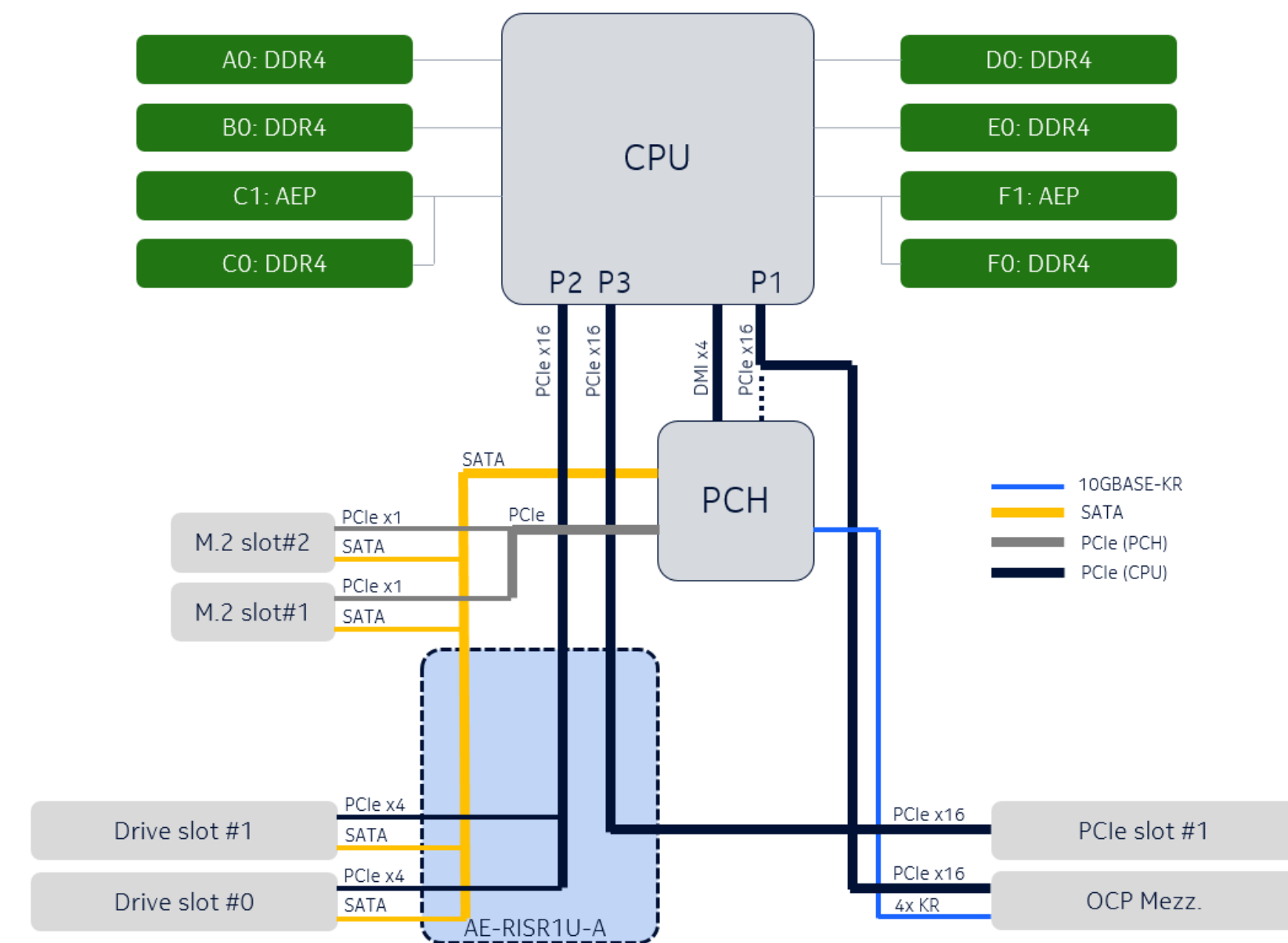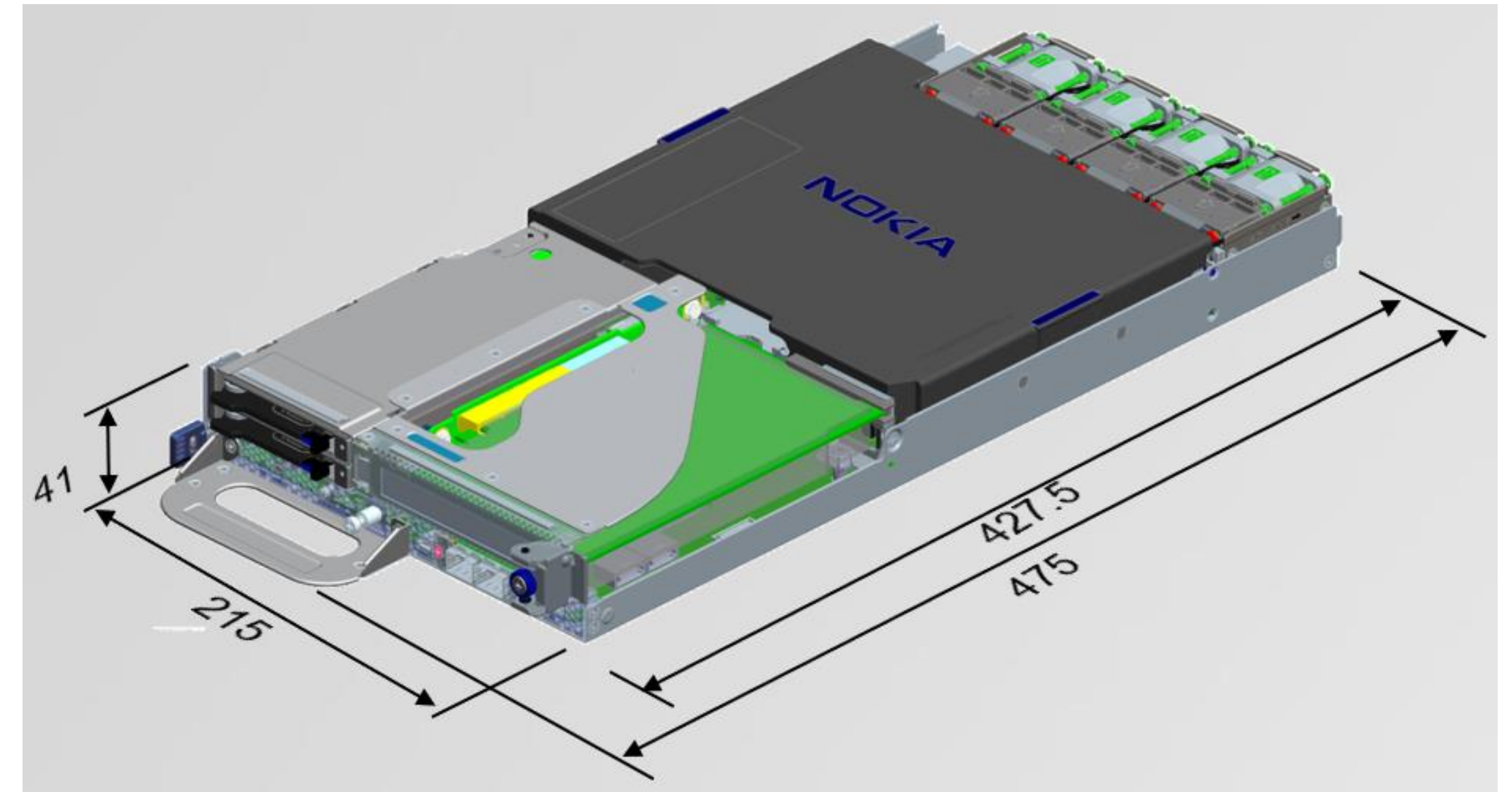
Server sled, 2U

Key specifications

- 2U, half width
- 215 mm x 83.6 mm x 423 mm (W x H x D)
- Power consumption 700 W, max
- Single-socket CPU, Intel® Xeon® Scalable Family, Thermal Design Power (TDP): max. 250 W
- PCH options: Intel C621, C627 (with QAT)
- Memory: 6 x DDR4-2933 + 2 x Intel Optane
- Single riser for disks and add-in cards
- Extension slots
  - 1 x PCIe x16, FHFL, dual-wide, 300 W max
  - 1-2 x PCIe x8, FHHL, 75 W max
  - OCP Mezzanine 2.0, PCIe x16
- Storage
  - 2 x hot-plug SSD, SATA/NVMe, 2.5 ", 7/9.5 mm
  - 2 x hot-plug SSD, SATA/NVMe, 2.5 ", 7/9.5/15 mm
  - 2 x M.2 SSD, SATA/NVMe, 2280/22110

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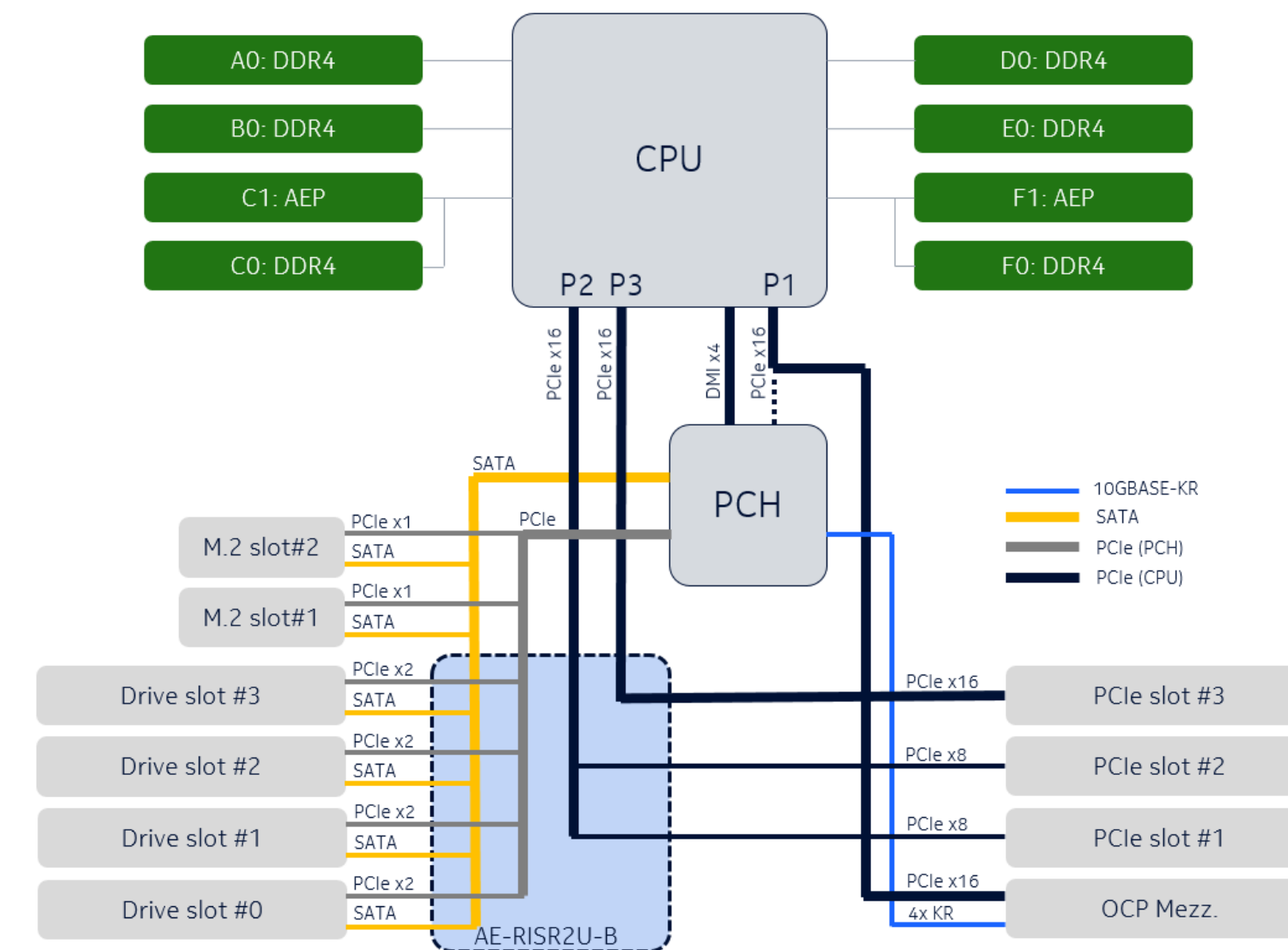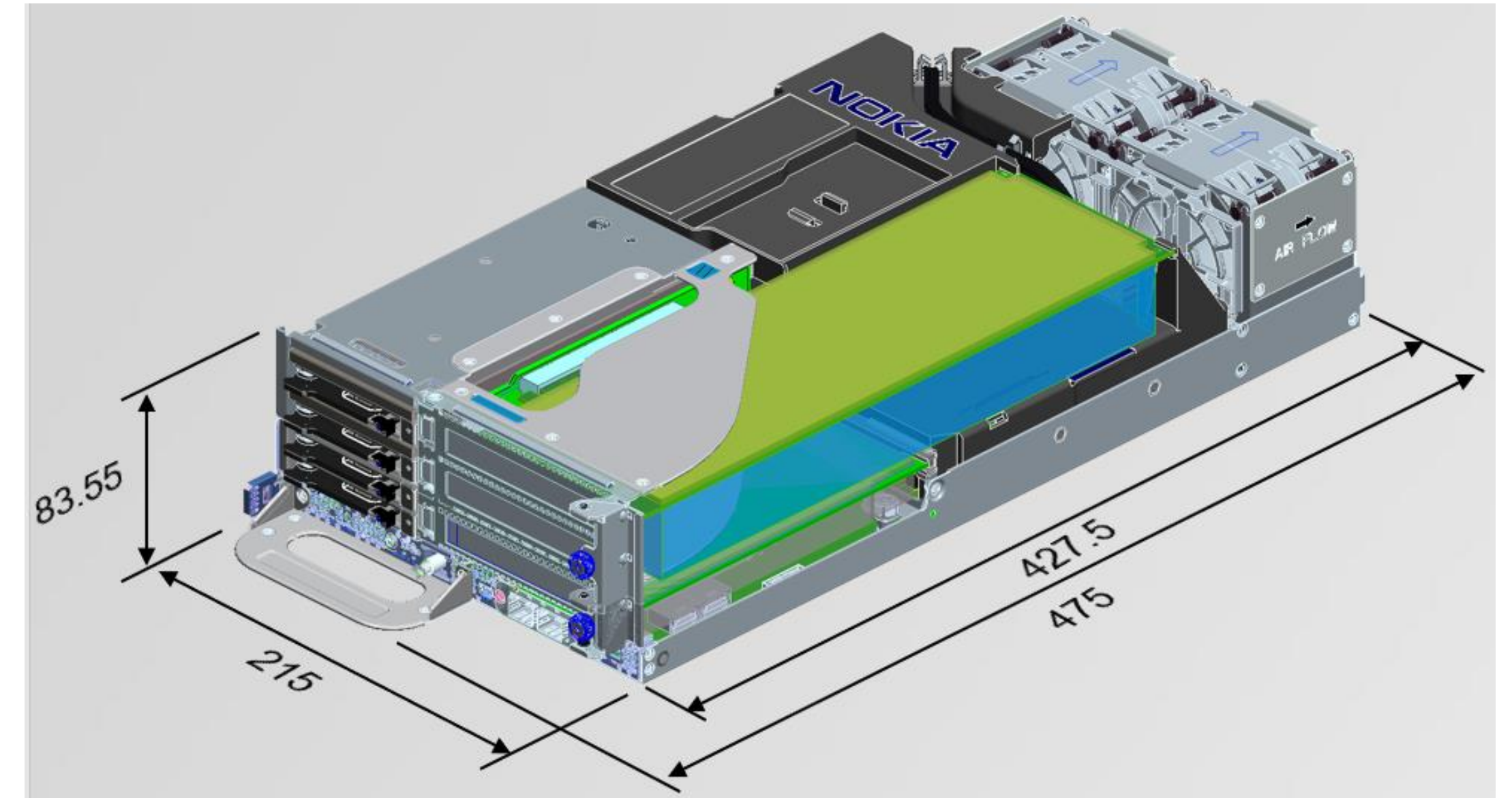
RMC

Chassis management controller (RMC)

- PSU management (control, sensors, ..)

  - Control and supervision of PSUs

  - Access to sensor data (voltages, currents, power consumption)

- RMC controller from AST2500 family

  - USB debug port in front panel

- On-board unmanaged Ethernet switch simplifies HW management connectivity

  - Single management interface for entire chassis

    - 1 GE management Ethernet interface to all sleds via backplane (1000BASE-T)

    - 1x 1 GE (RJ45, 1000BASE-T)

    - 2x 10 GE (SFP+) front panel interface for external connectivity and chaining of multiple chassis

RMC block diagram:
- USB — Console → uC
- uC ← PSU ALERT_L, SMBUS, +12 V_STBY
- uC → RMC_ALERT_L
- uC — 1GbE — Switch
- RJ45 — 1GbE → Switch
- SFP+ — 10GbE → Switch
- SFP+ — 10GbE → Switch
- Switch → 1GbE [1..5]
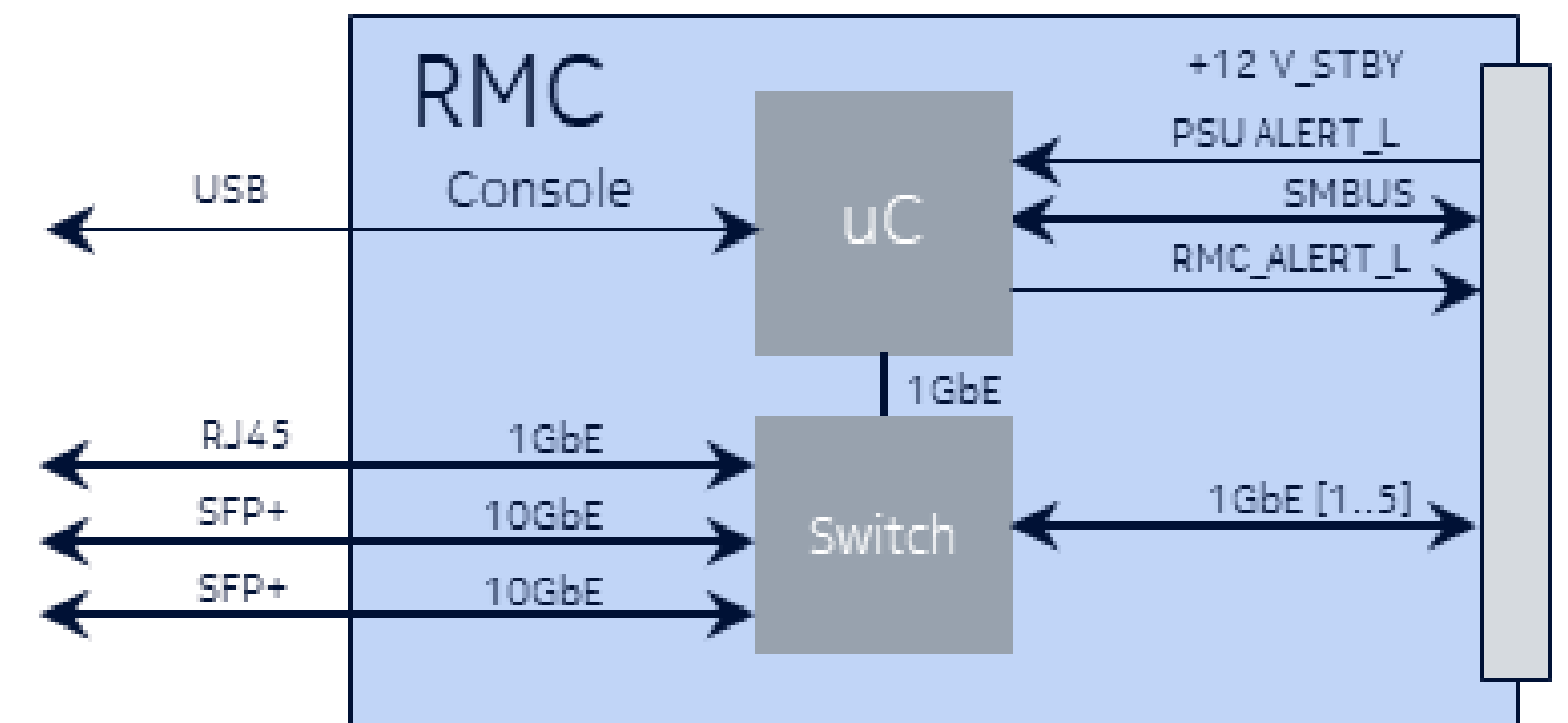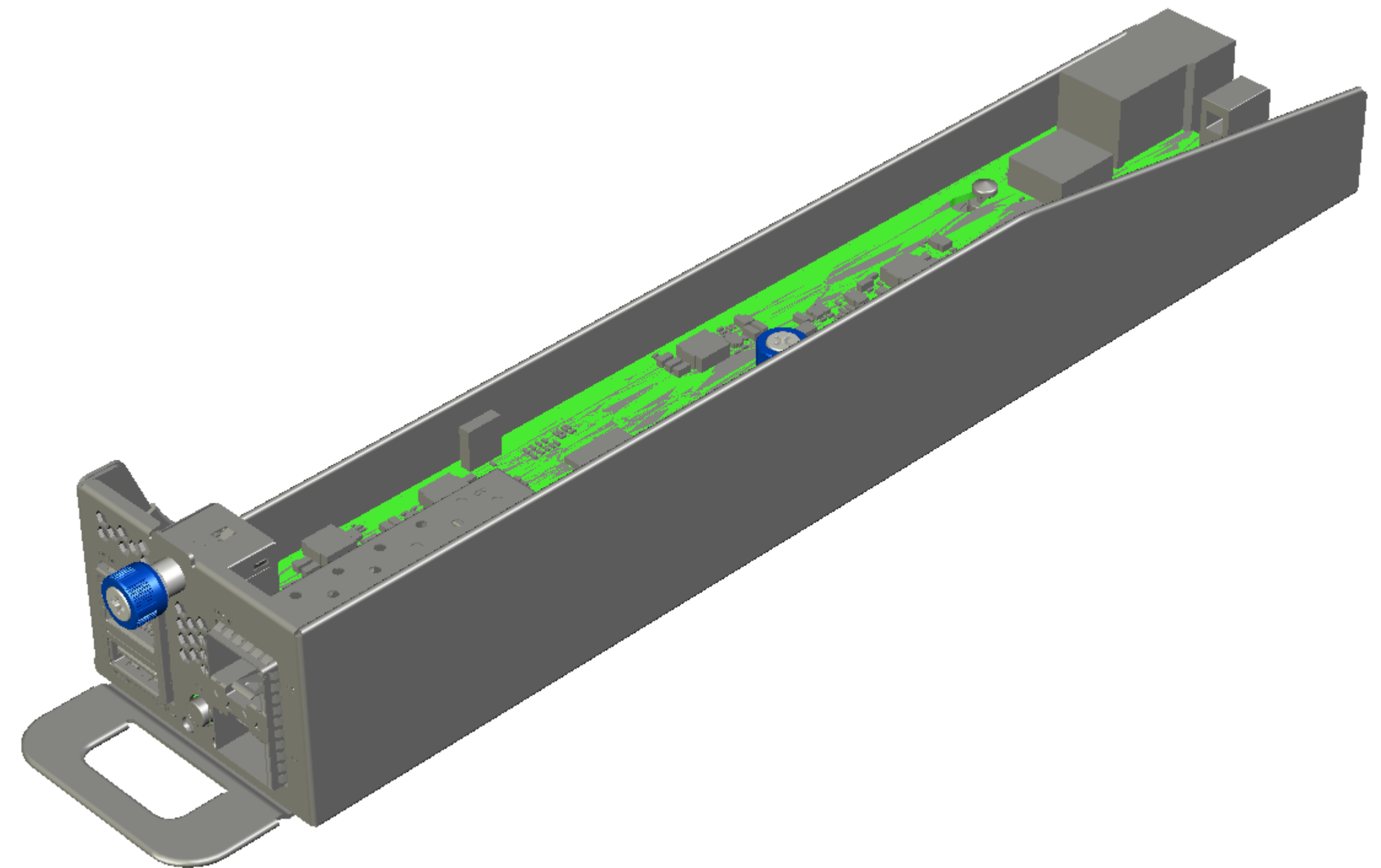
Rack installation solution

Compact rack solution for edge sites

- small form factor of chassis (depth 430 mm) enables installation to racks with small footprint (600 x 600 mm)

- Front maintenance

Rail kit

- Compatible with 19" rack mechanics (EIA-310)

- Adjustable rail adapts to front-rear post distances of 450 – 750 mm.

- Chassis mounting

  - Front: thumb screws to front post + optional screw fixing for additional robustness

  - Rear: T-standoffs on rail for vertical retention

Grounding

- Grounding point in mounting bracket (2-hole lug)

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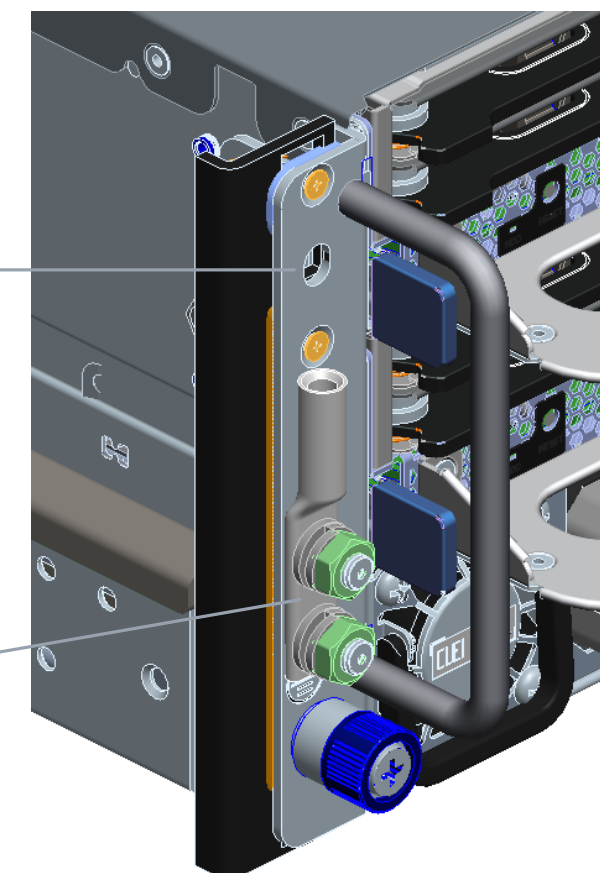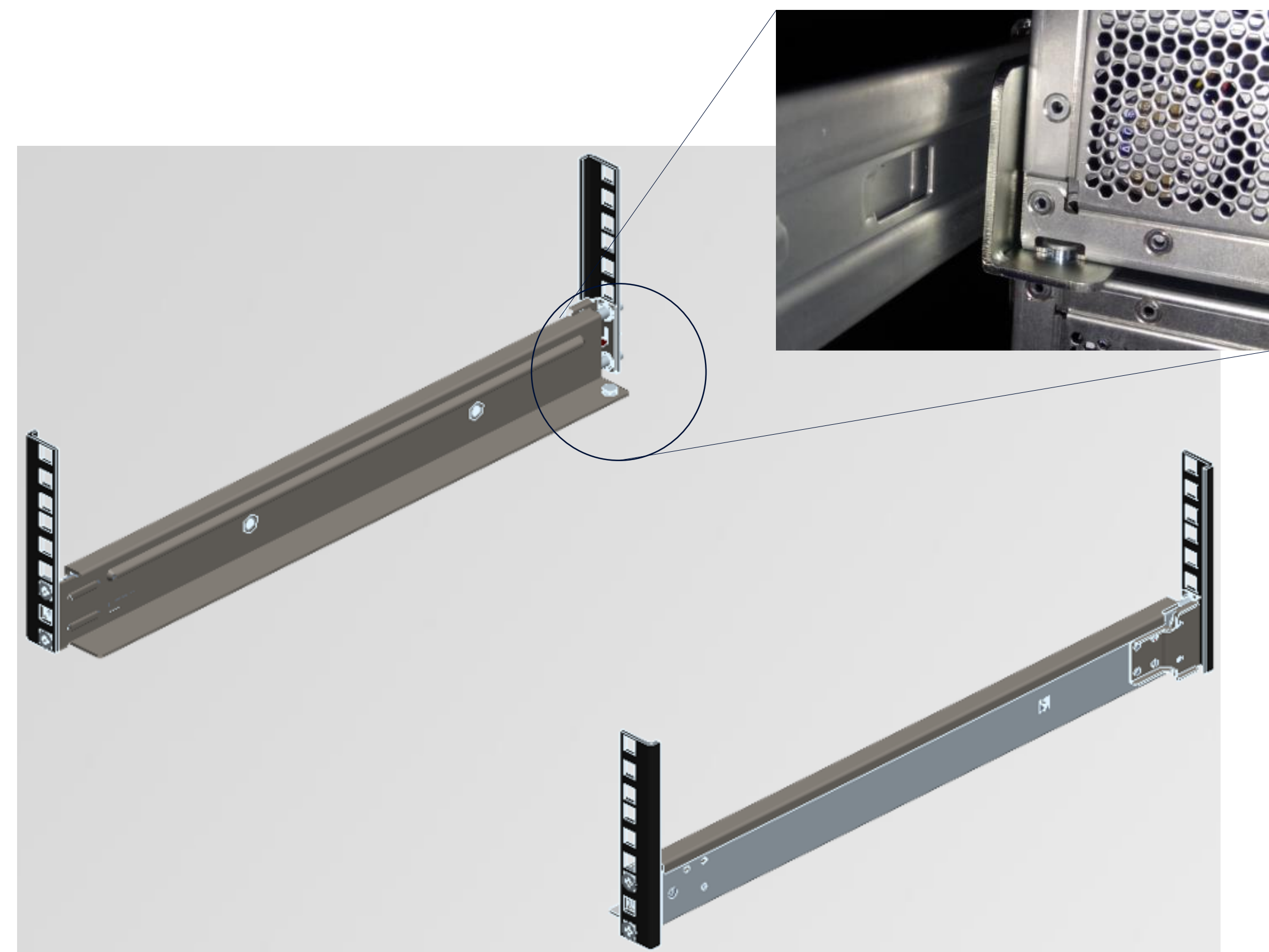
Key environmental and regulatory compliancy

Operating conditions

- Operating temperature range: -5 C …+45 C [ETSI EN300 019-1-3 Class 3.2]
- Short term operating temperature: -5 C to +55 C [GR-63-CORE]
- Operating humidity: 5 % to 95 %

EMC

- EN300386 (v1.6.1)
- FCC CFR47 15 (class A), CISPR 22/32 (class A) CISPR 24
- TEC/EMI/TEL-001/01/FEB-09 and TEC/IR/SWN-2MB/07/MAR-10
- GR-1089-CORE, and more

Safety

- IEC 62368-1:2014
- GR-1089-CORE (electrical safety, grounding and bonding)

Seismic tolerance

- GR-63-CORE (Zone 4)

Acoustic noise

- GR-63-CORE (equipment room criteria)

Fire resistance

- GR-63-CORE (shelf level criteria)

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Nokia plan for contribution to OCP

- Nokia plan is to is to contribute Open edge server chassis specification and design files and apply for OCP accepted™ product recognition.

- Target timeline for spec contribution is 4th quarter 2018 and target to have product available on OCP marketplace in early 2019

- Draft of Open edge server chassis specification: http://files.opencompute.org/oc/public.php?service=files&t=e4bf4116a070a7d7d418d0f2c284cd4b&download

- Draft of Open edge server specification: http://files.opencompute.org/oc/public.php?service=files&t=ada3b7aabae6f81ae73c00a30ea6fa5a&download

- "**openEDGE**" *sub-project, under the Telco Project, being launched to further evolve this contribution*

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AirFrame Transport optimized 36OU ORv2 Rack variant.

Mike Moore/Americas Region Product Manager – Data Center Solutions/Nokia

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Experiences from 42OU ORv2 deployments

Typical Installations

- Number of racks in one installation is typically less than 10 per site.

- No greenfield installation, installations are done to existing brownfield sites.

  - Requirement to adapt to existing environment.

- Everything is redundant in order to guarantee high availability for the service.

  - Switches, NICs, cabling, HDDs/SSDs, …

- Telco requirements like NEBS are still mandatory in many cases.

- Installations are customer specific.

  - No common blueprint, customized configurations required.

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Transportation

- Rack and stack on site is typically not allowed.

    - Pre-installed racks are preferred.

- Installation sites are all over the world and due to long lead times sea cargo is not possible.

    - Air freight is used for pre-installed racks.

- Current Nokia Open Rack v2 height is 42 OU

    - Height x width x depth: 2258 mm x 600 mm x 1067 mm.

    - Palleted rack crate height is ~2500 mm which creates challenges for air freight.

- Transportation tolerance according to NEBS is required.

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Site Physical Limitations

- Fully equipped Open Rack v2 weight is >800 kg $\rightarrow$ >1200 kg/m2

    - Floor load capacity sometimes limits the configurations.

- Rack depth is limited in many locations

    - Old telco central office sites can limit depth to 800 mm

    - Edge sites are typically existing radio sites where rack depth is max 600 mm

- Old sites typically also have limitations due to

    - Elevator capacity

    - Delivery path height (door openings)

- Site surveys have to be done before shipping.

    - Colo Facility Guidelines for OCP racks defined in OCP Data Center Facility project is providing good framework.

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Power and Cooling

- Old telco sites typically have -48VDC power feed infrastructure with battery rooms

- Several AC power feed options for global use cases are needed, e.g.

  - 110VAC, 208VAC, 230VAC, 380VAC, single phase, three phase, 50/60 Hz, different wattages, different connectors, …

- Power cabling from top and bottom both need to be supported.

- Site power budgets quite often limit size of installations

  - Limitation can be as low as 4 kW per rack

- Site cooling capacity quite often limits rack configurations

  - Limitation can be as low as 4 kW per rack

- Integrated BBUs not in use

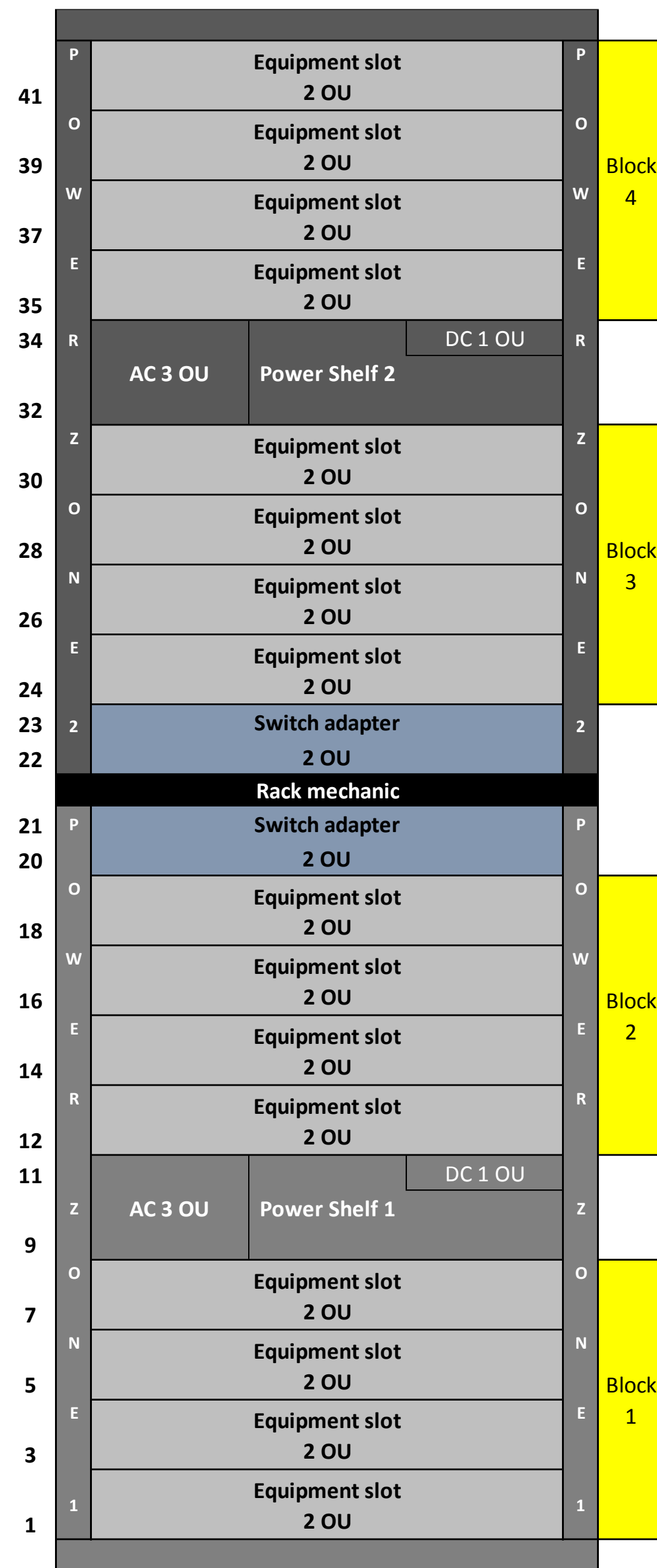 - Difficult to manage due to lithium (transportation limitations)

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Typical Rack Level configurations

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Current Nokia AirFrame Open Rack v2

- Two independent power zones
  - One 12 VDC busbar per power zone
- Power shelf options
  - 208/415V AC
  - ETSI Negative 48V DC
- 4 OU for switches by default
- 32 OU for IT devices
  - Divided in 4 identical blocks

Four different block types defined
  - Compute block
  - 3x JBOD block
  - Dual 1x JBOD block
  - Compute + 1x JBOD block

P	Equipment slot 2 OU	P	
41			
O	Equipment slot 2 OU	O	Block 4
39			
W	Equipment slot 2 OU	W	
37			
E	Equipment slot 2 OU	E	
35			
34 R		DC 1 OU	R
	AC 3 OU	Power Shelf 2	
32			
Z	Equipment slot 2 OU	Z	
30			
O	Equipment slot 2 OU	O	Block 3
28			
N	Equipment slot 2 OU	N	
26			
E	Equipment slot 2 OU	E	
24			
23 / 22 2	Switch adapter 2 OU	2	
	Rack mechanic		
21 / 20 P	Switch adapter 2 OU	P	
O	Equipment slot 2 OU	O	
18			
W	Equipment slot 2 OU	W	Block 2
16			
E	Equipment slot 2 OU	E	
14			
R	Equipment slot 2 OU	R	
12			
11		DC 1 OU	
Z	AC 3 OU	Power Shelf 1	Z
9			
O	Equipment slot 2 OU	O	
7			
N	Equipment slot 2 OU	N	Block 1
5			
E	Equipment slot 2 OU	E	
3			
1	Equipment slot 2 OU	1	

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Typical configurations with 42 OU Rack

- Most typical target configuration for Telco NFV use case is:

  - Three Compute blocks

  - Compute + 1x JBOD block

  - Two Leaf switches

  - One HW management switch

  - Optionally single Spine switch that reduces amount of Compute units

  - → Up to 45 servers and one JBOD (up to 45 disks)

- However previously mentioned limitations in allowed weight, used power or cooling capacity often limits the configuration

  - Unnecessary cost in transportation

  - Unnecessary material in rack frame, air blockers, busbar's etc.

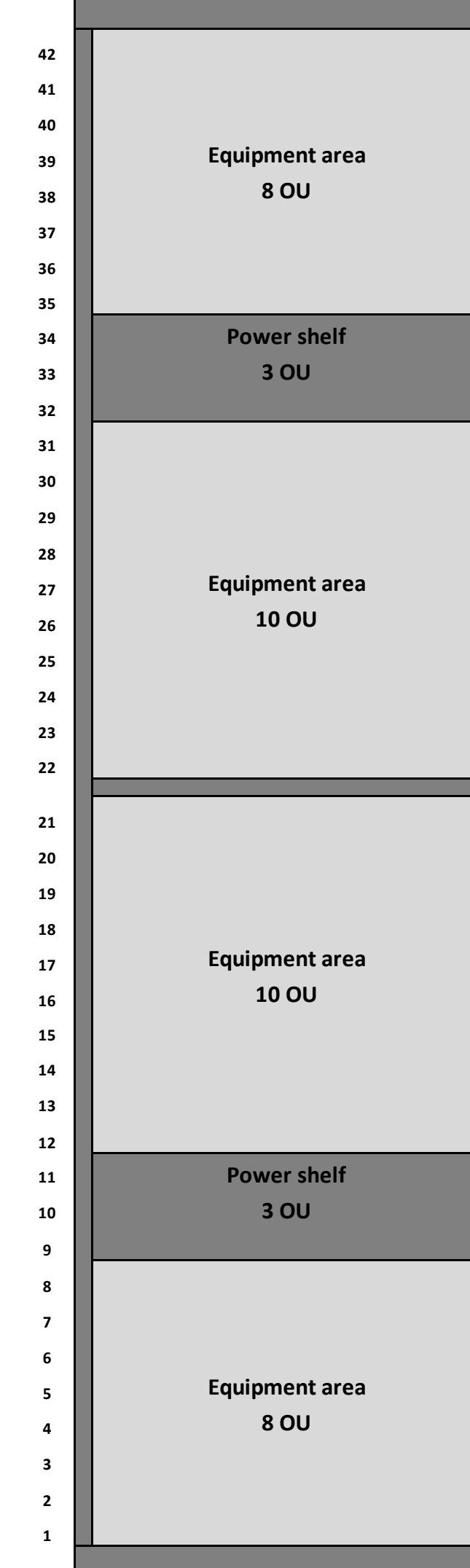 - Average server amount in configurations is 36

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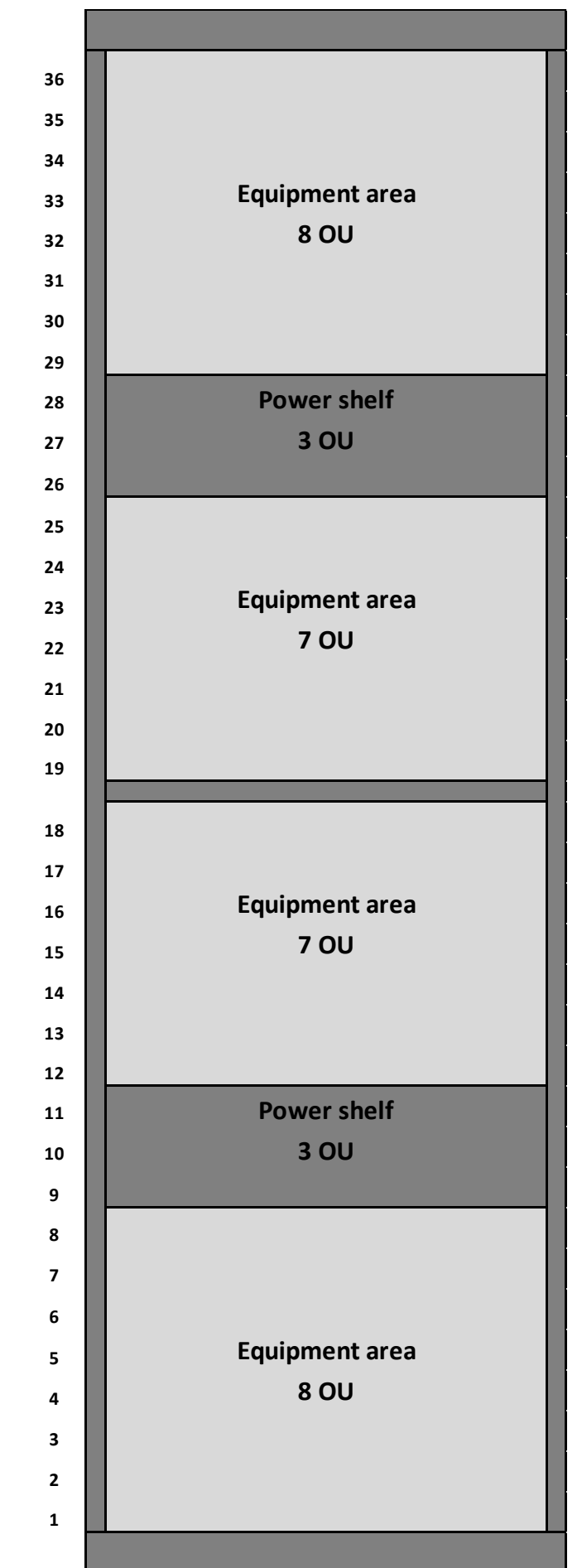# New 36 OU ORv2 rack proposal

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36 OU Open Rack proposal

- Modification from current 42 OU to 36 OU rack frame
- Compliant with Open Rack v.2.0 standard
- Seismic zone 4 compliancy with 800 kg IT load
- 36 OU installation space for equipment
- Optional side panel and door sets
- Dimensions: 1970 mm x 600 mm x 1067 mm
- Weight: ~140 kg

- Better compatibility with limited space/power/cooled Telco sites
  - Less height, weight and power consumption
- Easier handling compared to current 42 OU rack
  - Transportation with standard cargo planes
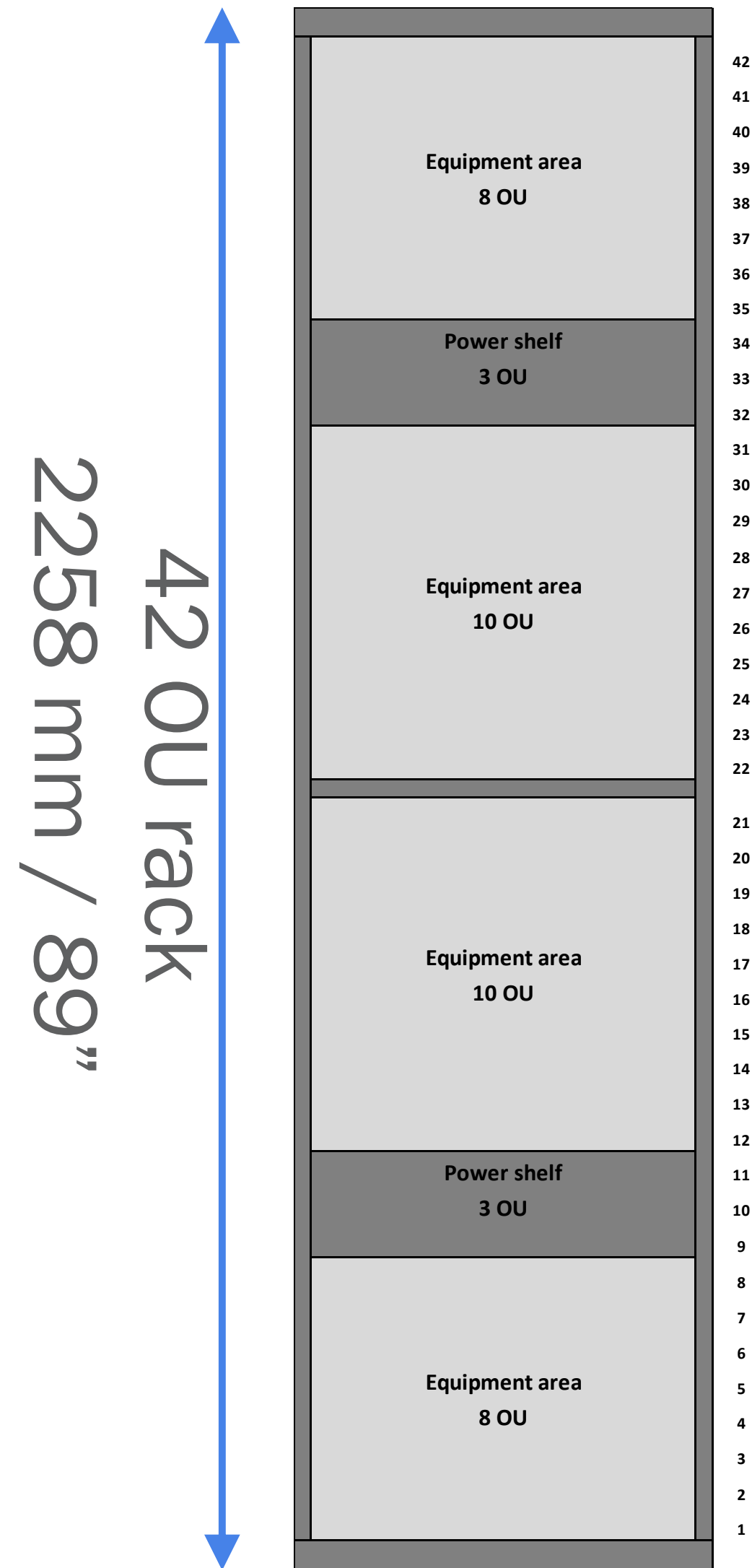 - Easier handling on limited sites (ramps, lifts, corridors, stairs)

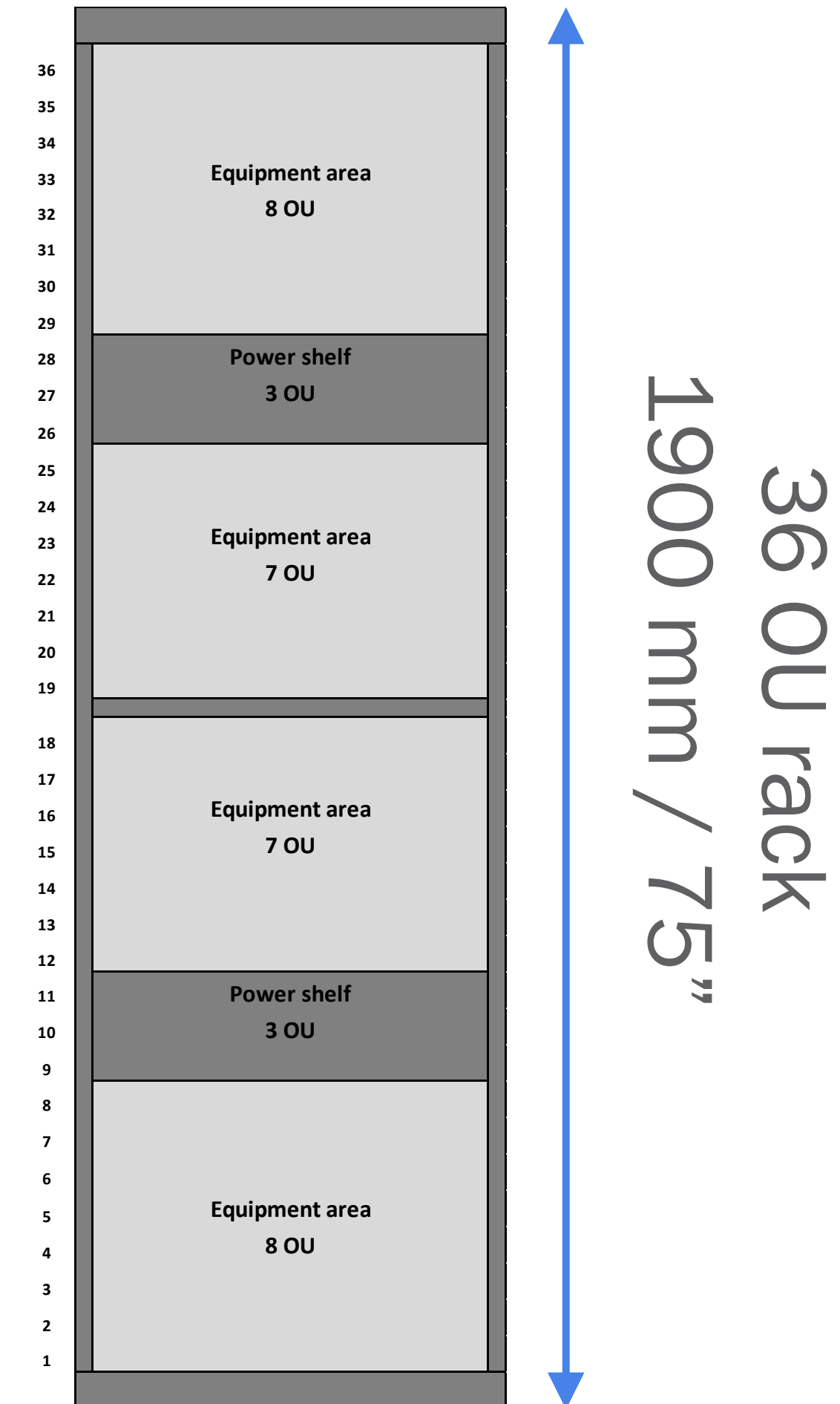Current 42 OU rack

New 36 OU rack

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Open rack comparison 42 OU / 36 OU

42 OU rack
2258 mm / 89"

Equipment area
8 OU

Power shelf
3 OU

Equipment area
10 OU

Equipment area
10 OU

Power shelf
3 OU

Equipment area
8 OU

Example rack configurations
with full server configuration

	42 OU	36 OU
Server qty	48	39
Weight	812 kg 1790 lbs	690 kg 1520 lbs
Power (typical)	12 kW	10 kW

36 OU rack
1900 mm / 75"

Equipment area
8 OU

Power shelf
3 OU

Equipment area
7 OU

Equipment area
7 OU

Power shelf
3 OU

Equipment area
8 OU

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Planned Telco NFV optimized configuration with 36 OU rack

- Most typical target configuration for Telco NFV use case is:

  - Two Compute blocks

  - Compute + 1x JBOD block

  - Two Leaf switches

  - One HW management switch

  - Optionally single Spine switch

  - → Up to 36 servers and one JBOD or 39 servers

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Summary

Summary

Why alternative rack height is needed

- Transportation of 42OU Open Rack requires special arrangements in airfreight

- Some of the Central Office installation sites has height limitations
    - Height of doors
    - Height of elevators
    - Height of CO equipment rooms

- Rack weight and power consumption is sometimes an issue
    - In these cases optimal weight and power consumption can be achieved with the smaller rack

PLAN for Nokia Open Rack variant is to contribute the spec and apply for OCP Inspired recognition. Target timeline for spec contribution is 2nd quarter 2019 and target to have product available on OCP marketplace in 2019

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