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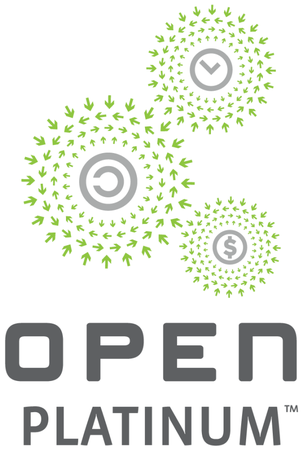
Open Rack Standard V3 Power System

Hamid Keyhani
Facebook

Shaun Harris
Microsoft



Key ORv3 Power Features

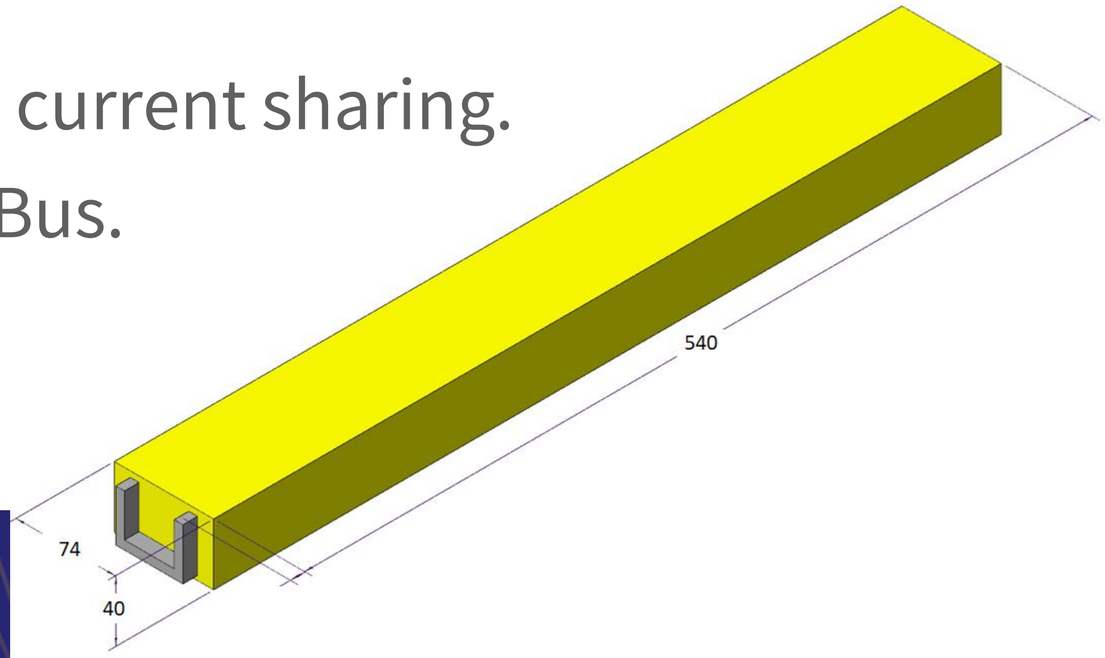
- One power zone with 48V output voltage.
- Flexible and modular power system:
  - Add more power and/or backup as needed.
  - can be placed anywhere in the rack.
- Independent Power & Battery systems – Higher reliability.
- Universal 7-pin AC power input, allows different voltage configs.
- Peak transient power shaving - with regulated battery approach.

Main V3 New Power Components

1. Power shelf – 3 options. 15kW N+1, 17.2k to 51kW N+N.
2. 48V rectifier module – 3kW.
3. Shelf Management Controller (SMC)
4. Pluggable output connector for the power/battery Shelf.
5. Universal 7-pin Input Connector for the Power Shelf.
6. Independent Battery Shelf.
7. Regulated Battery backup module.

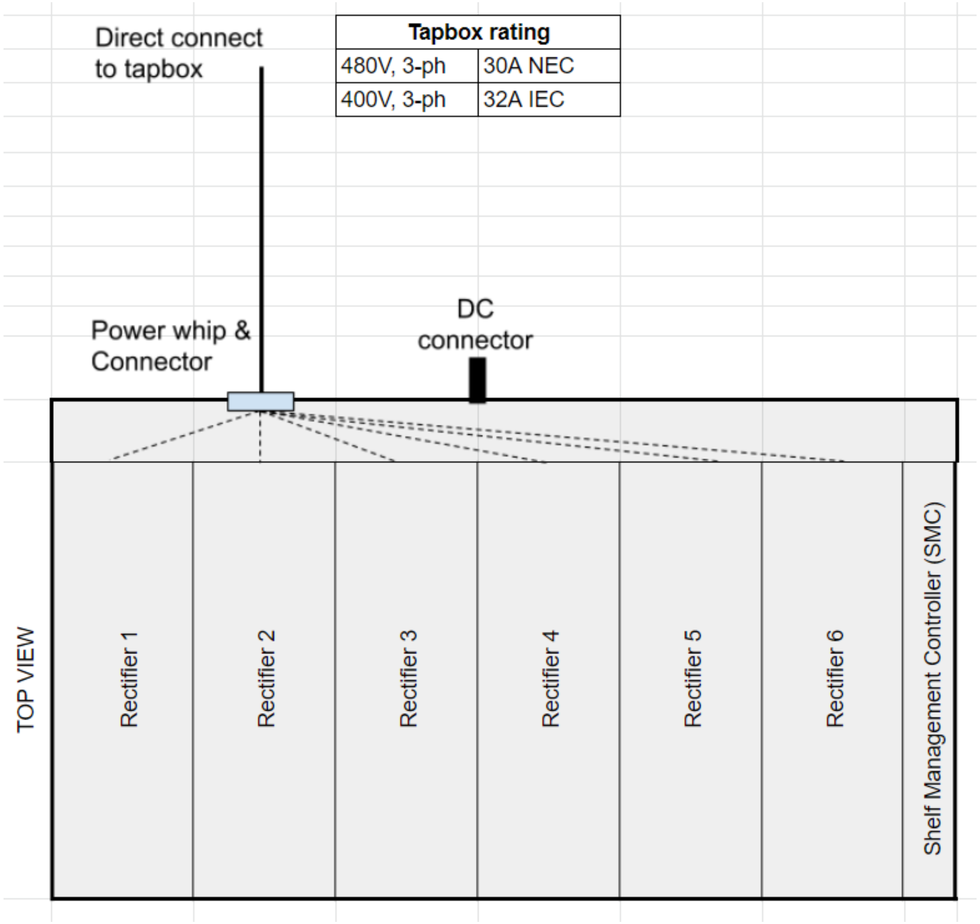
3kW 48V Rectifier

- Input: Single-phase, 200~277V +/- 10%, 50/60Hz.
- Fixed 50V output voltage → see *Narrow-range concept later.*
- Efficiency (incl. fan):
  - Peak: 97.5%
  - Full-load : 96.5%
- Dedicated analog bus (I-bus) for active current sharing.
- Communication with SMC through PMBus.

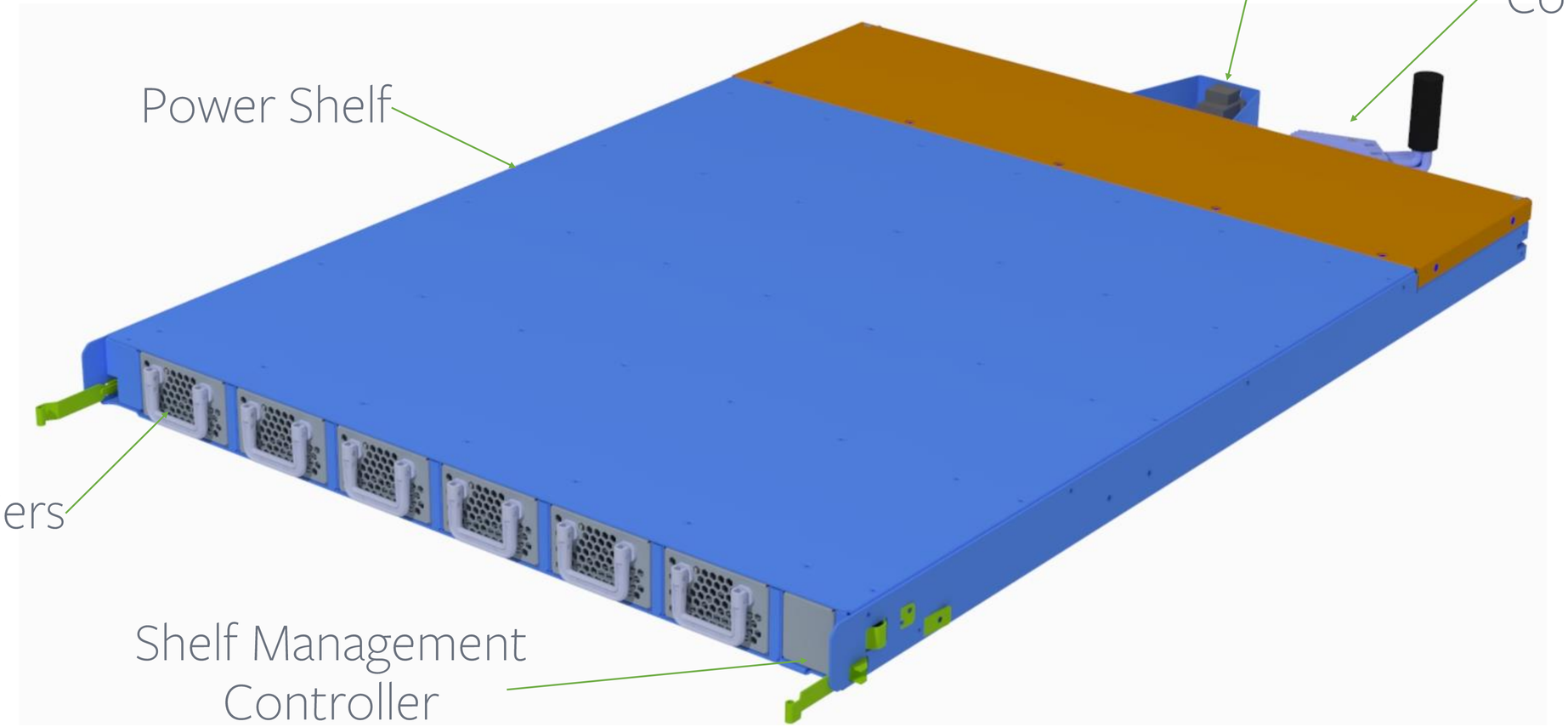


Power Shelf – Option 1

- 1OU shelf with one AC power input.
- 6x 3kW rectifier slots.
- Output power:
  - 15kW with N+1.
- 3-phase, 200~277V_{L-N} nominal input.
- Direct connect to tap-box/facility – no intermediate PDU.

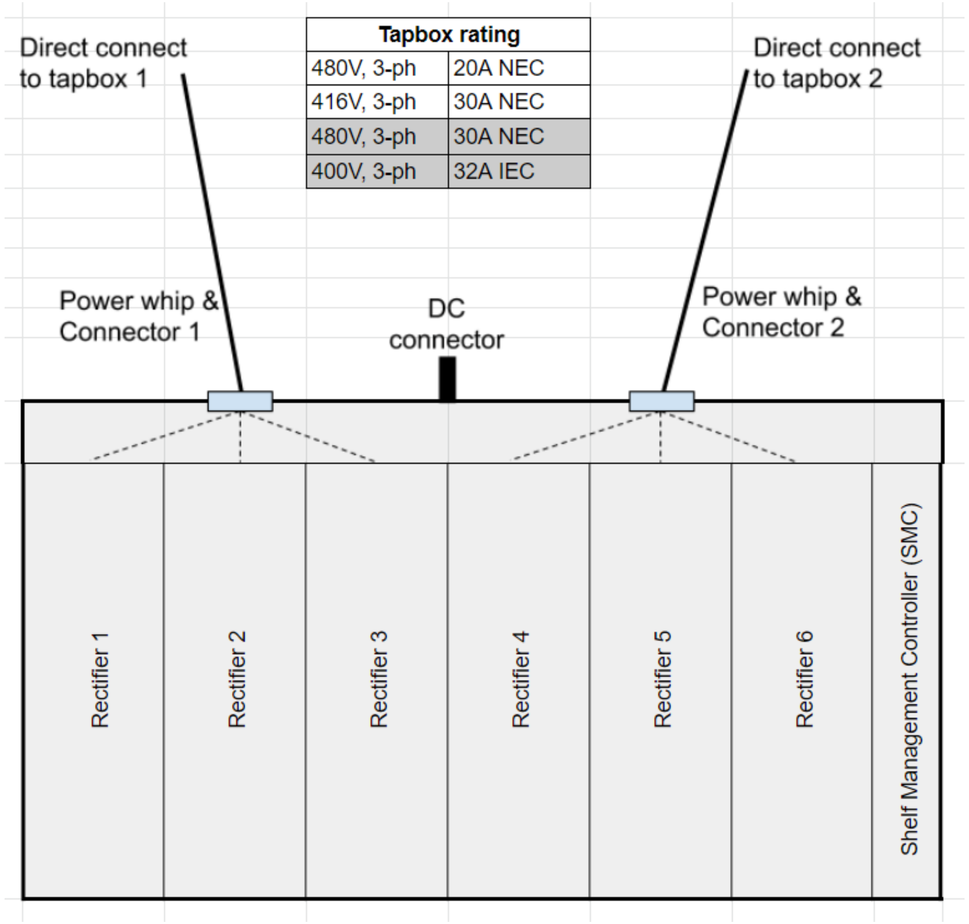


Power Shelf – Option 1



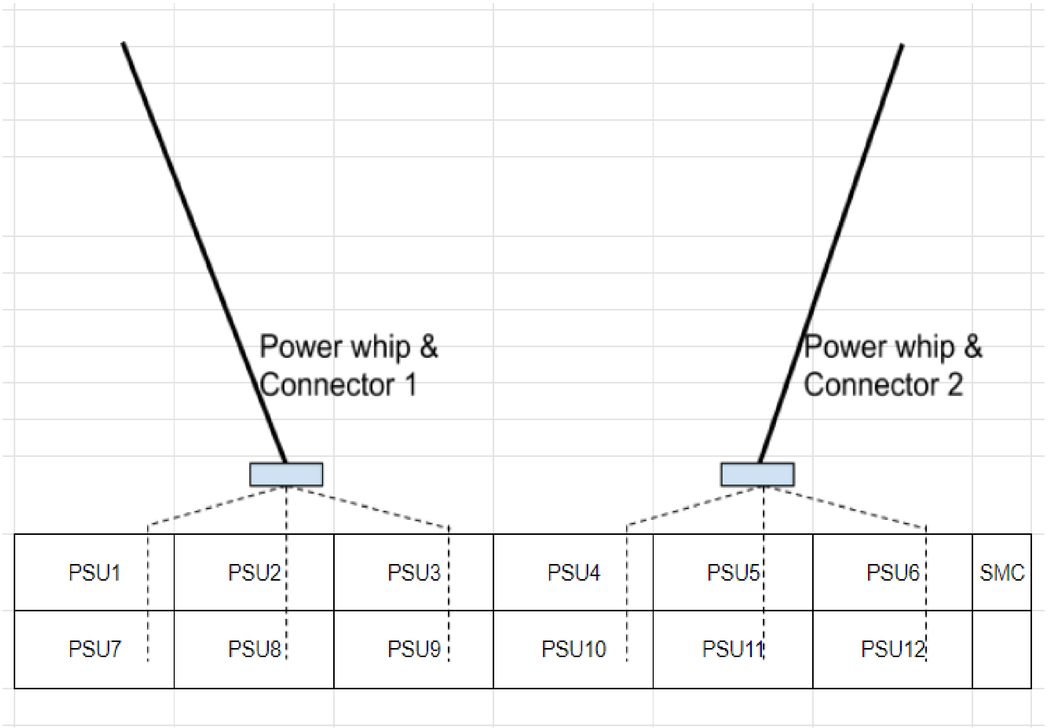
Power Shelf – Option 2

- 1OU shelf with two AC power input.
- 6x 3kW rectifier slots.
- Output power:
  - 15kW with N+1
- 3-phase, 200~277V_{L-N} nominal input.
- Direct connect to tap-boxes/facility – no intermediate PDU.



Power Shelf – Option 3

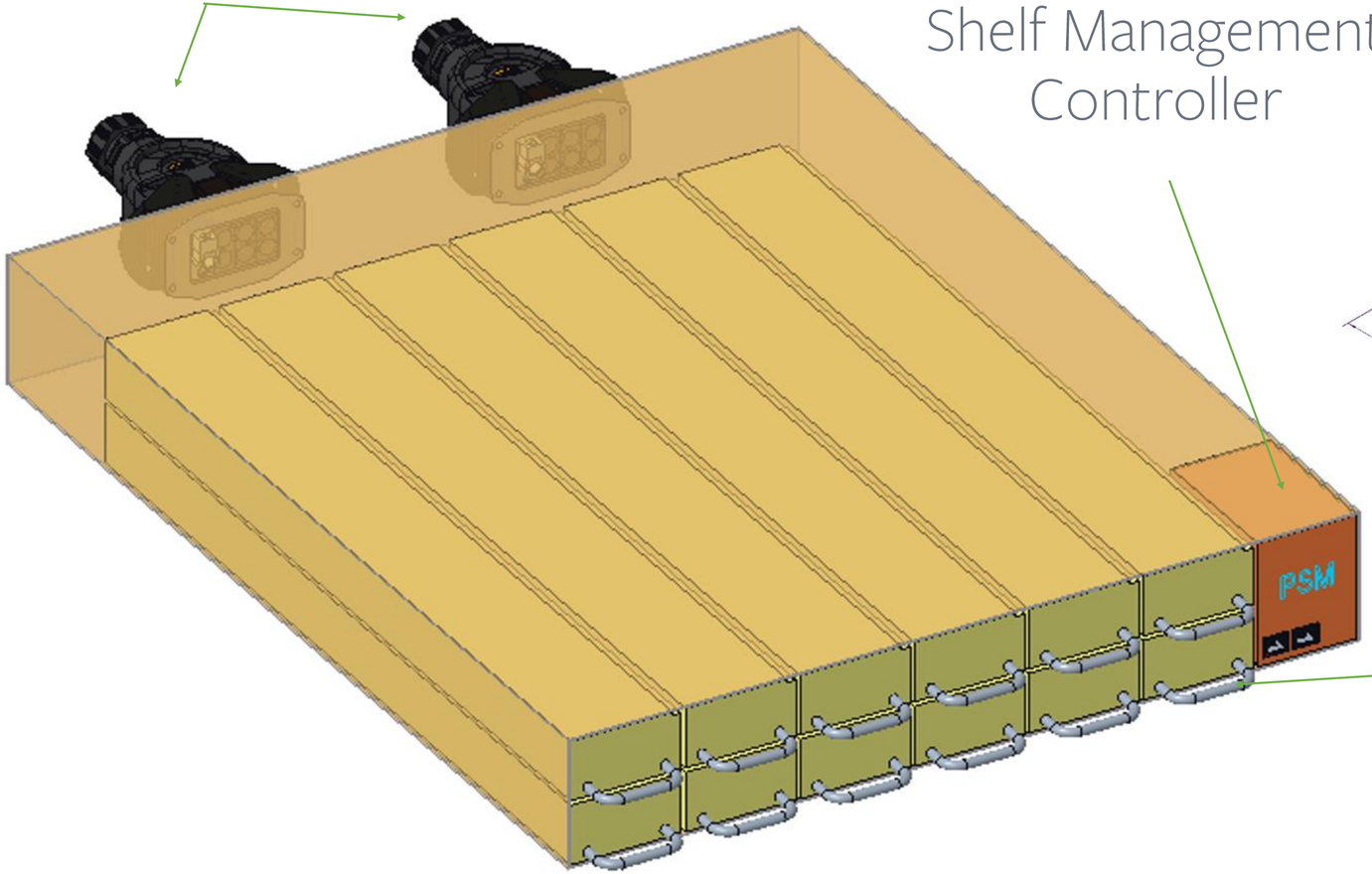
- 2RU shelf with two AC power input.
- 12x 3kW rectifier slots.
- Output power:
  - 18kW with N+N.
  - 33kW with N+1.
- 3-phase, 200~277V_{L-N} nominal input.
- Direct connect to tap-boxes/facility – no intermediate PDU.

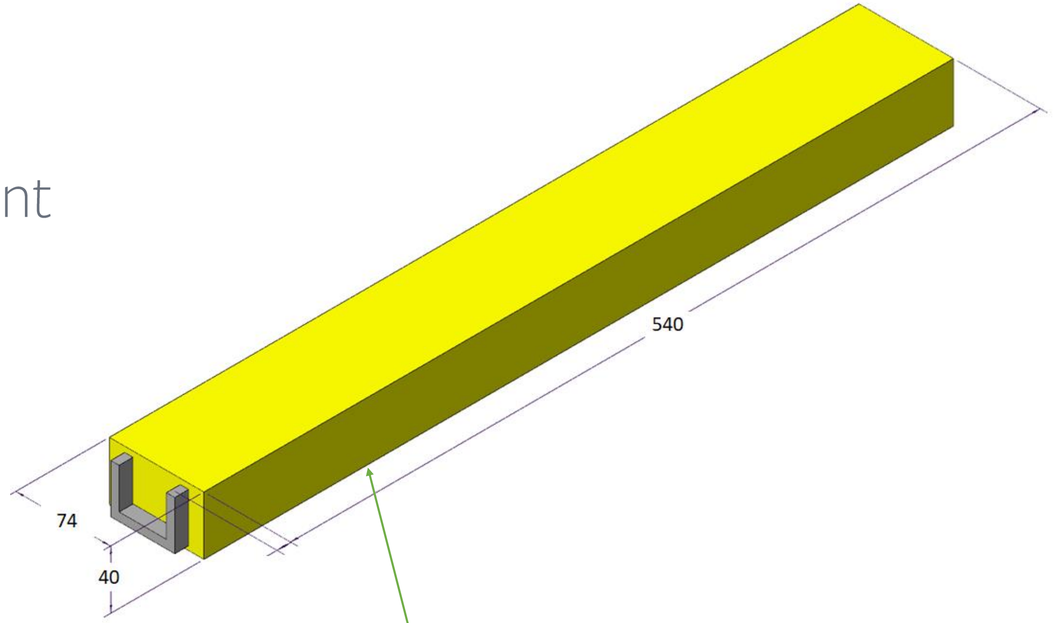


Power Shelf – Option 3

Universal Input Connector

Shelf Management Controller

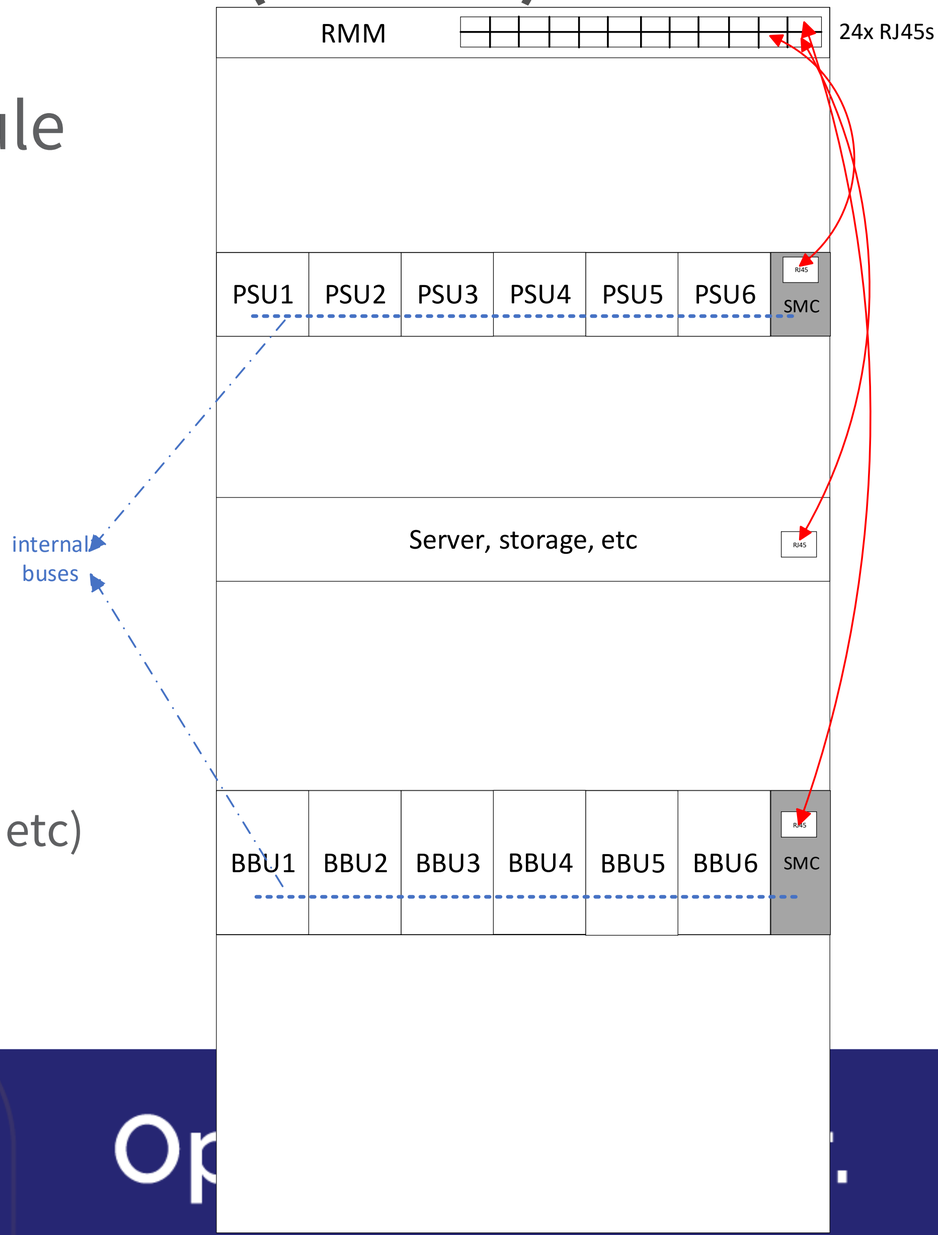




Rectifiers

Shelf Management Controller (SMC)

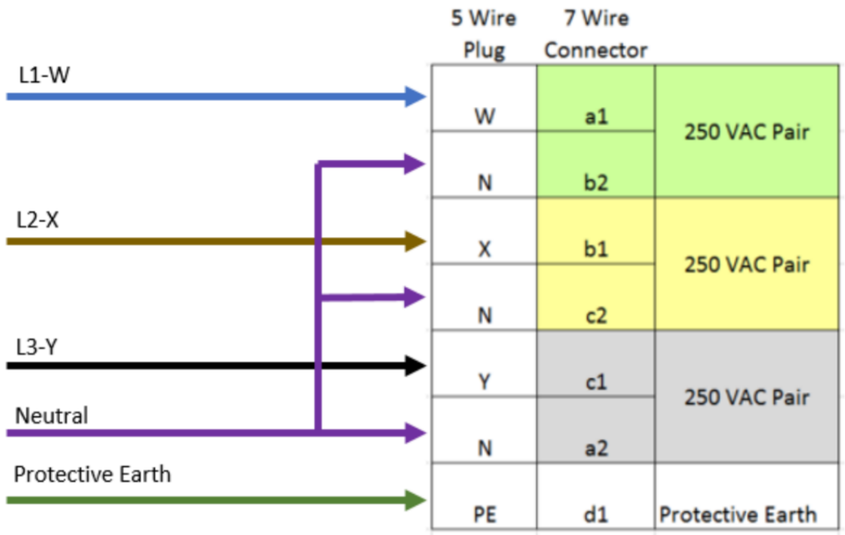
- Universal shelf monitoring and control module
  - Used for both battery and power shelves.
- Communication upstream through:
  - Modbus RTU(RS485)
  - Ethernet
  - Emergency GPIO signals
- Single PMBus bus for communication with rectifiers or battery packs
  - Monitors and collect parameters (voltage, current, SOH, faults, etc)
  - Remote Firmware Update
  - Send command to components (battery test, etc)

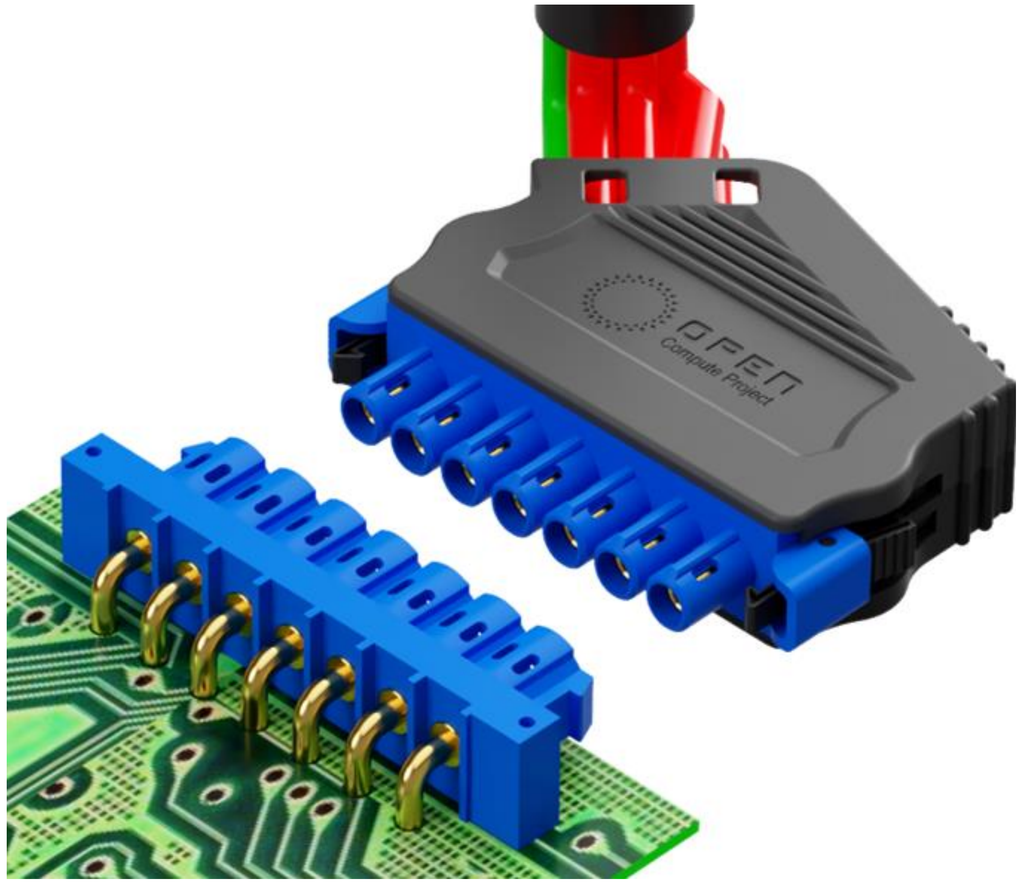


Universal Power Shelf Input Connector

- 7 pin connector to be configurable as:
  - Star, Delta, or Single-phase Connection
- Includes branching on the connector plug to allow various voltage configs.
- 50A/480V

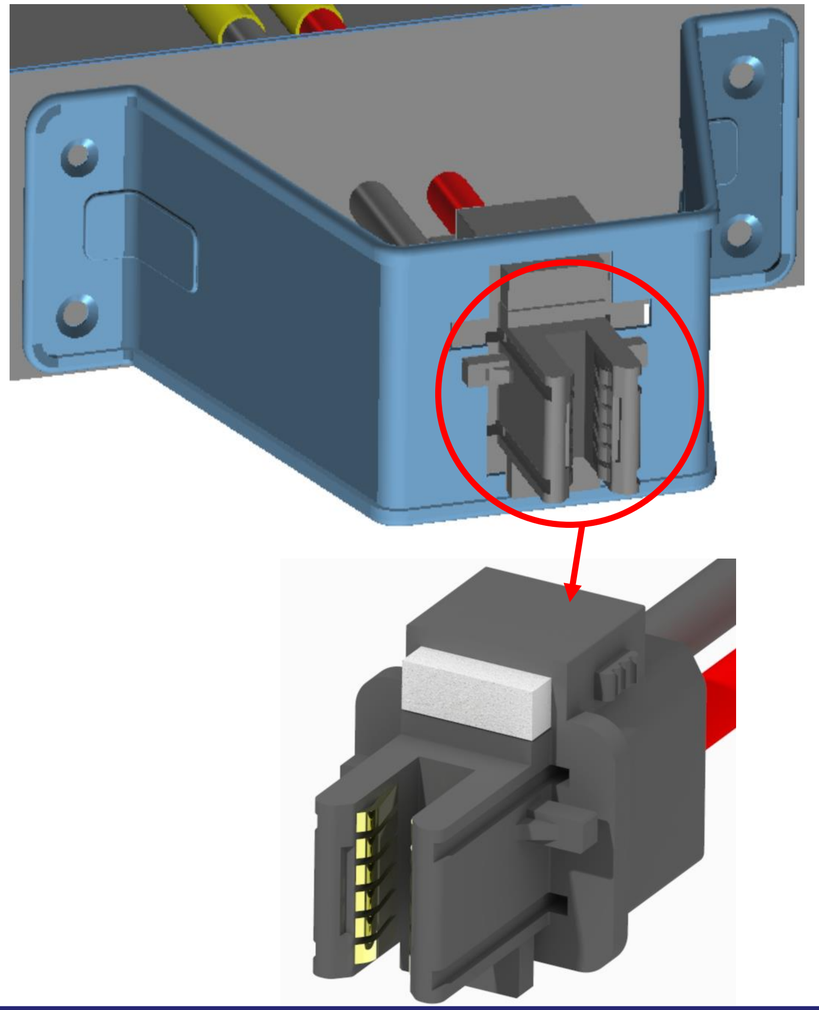
Ex. Star config:





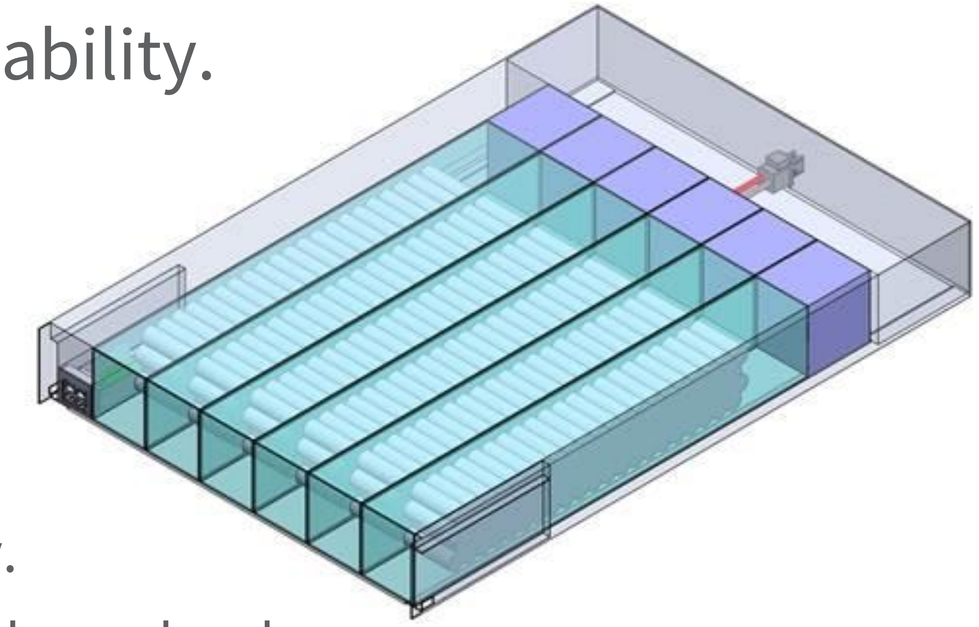
Power and Battery Shelf Output Connector

- Floating connector blindmates to busbar.
  - Allows placing power/battery shelves any desirable location on the rack.
  - Can add more power and/or battery shelves as needed.
- Assembled on the rear side of the power and battery shelves.
- 48V/500A rated.

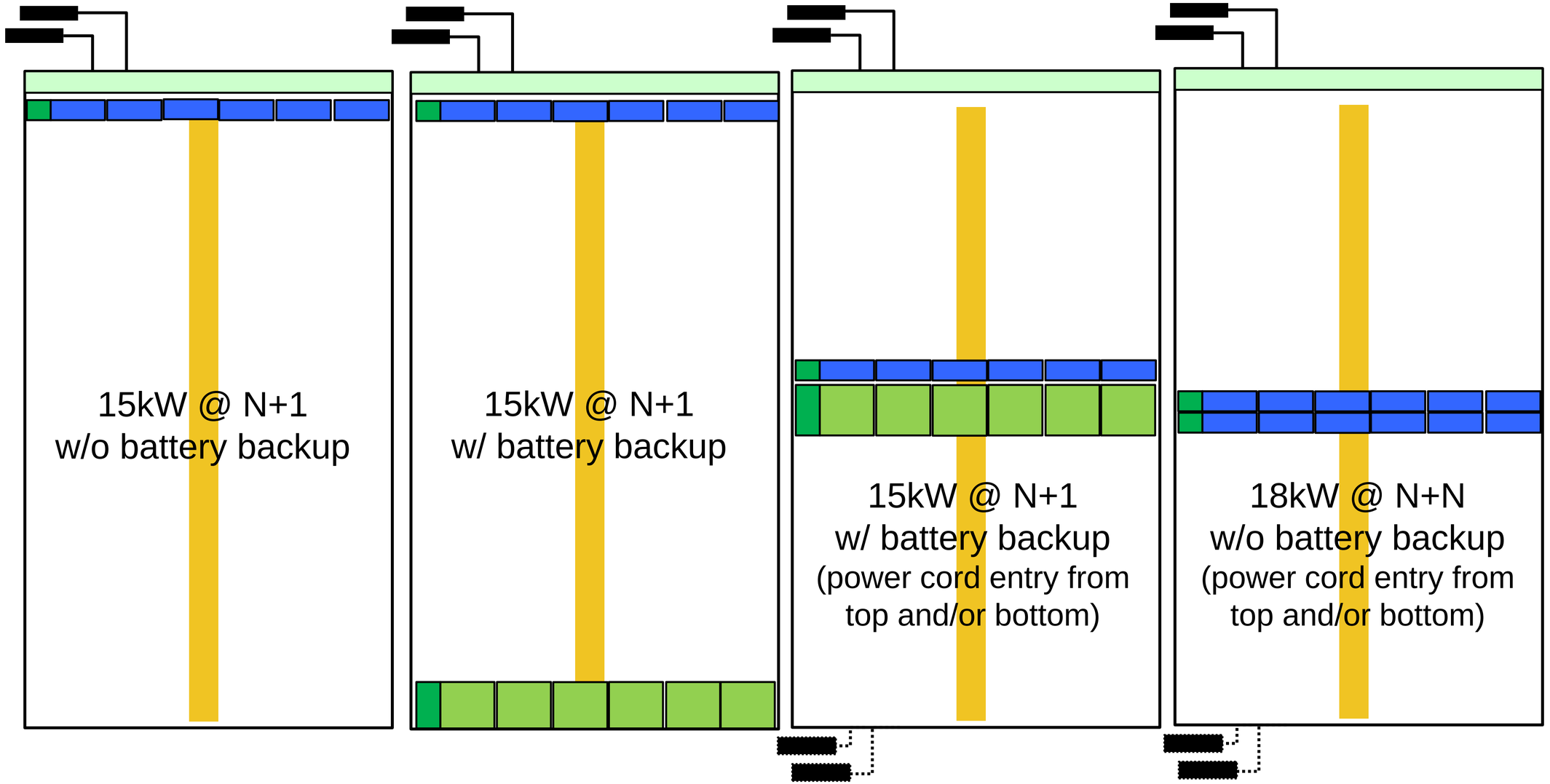


Regulated Battery Module and Shelf

- Independent Battery system – Higher reliability.
- Match the power shelf: 15kW w/ N+1.
  - Design target: EoL *3~5 minute backup in **20U***.
- dc-dc converter after the battery:
  - Batteries share current equally and age similarly.
  - Allow mixing old and new batteries or different charge levels.
  - Allow peak transients power shaving.
  - Fixed 48V output voltage → more efficient power system *(narrow range 48V Concept)*

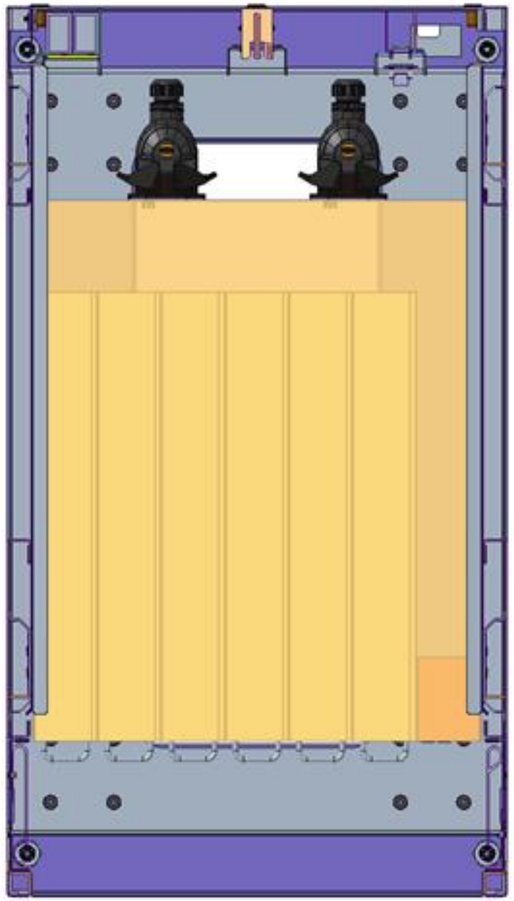


Some rack power config examples



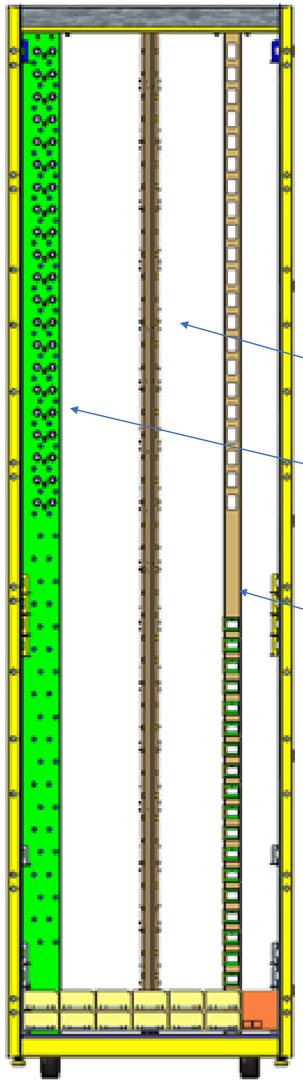
Some rack power config examples

Top view



Cold Aisle

1x Power Shelf
17.2kW

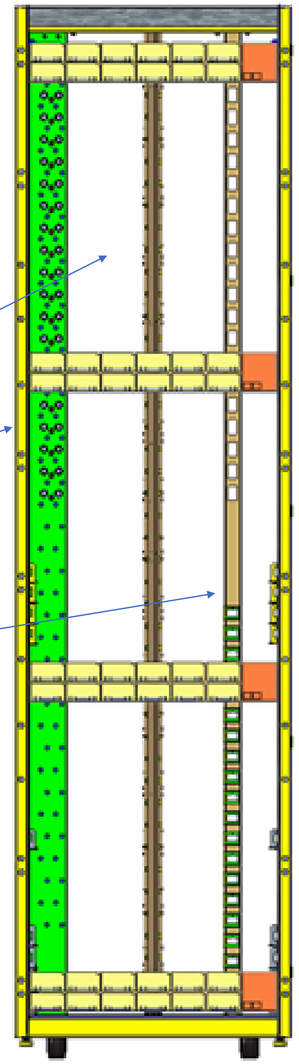


48V bus bar

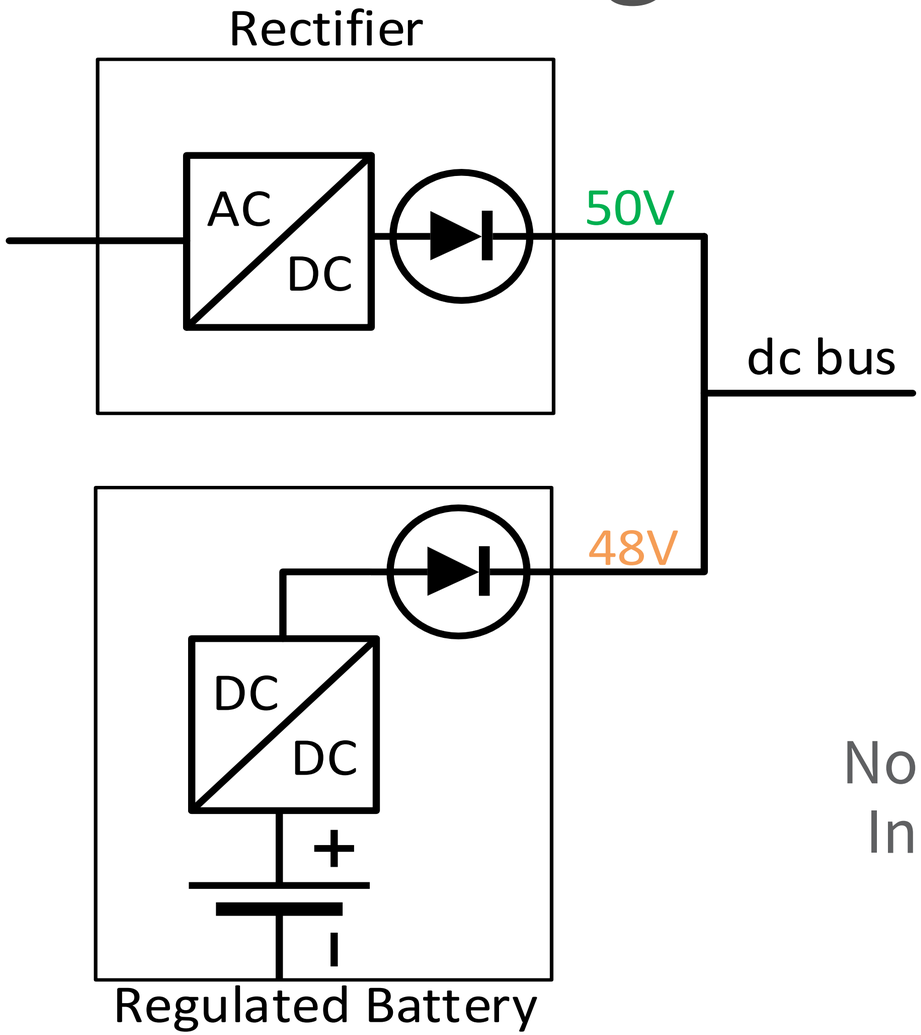
Liquid cooling manifold

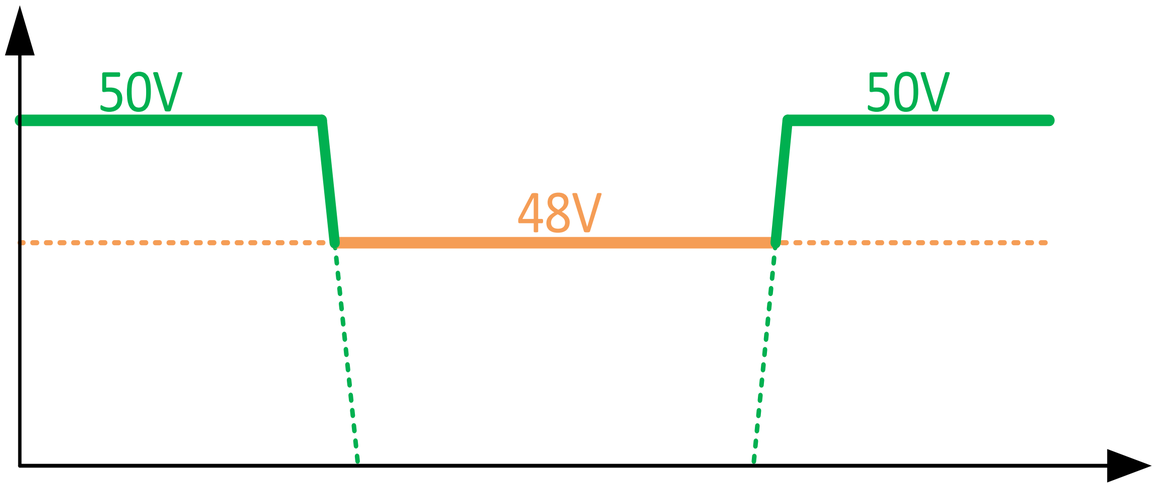
Rack Mgmt Bus

4x Power Shelf
68kW



Narrow-range 48V Architecture

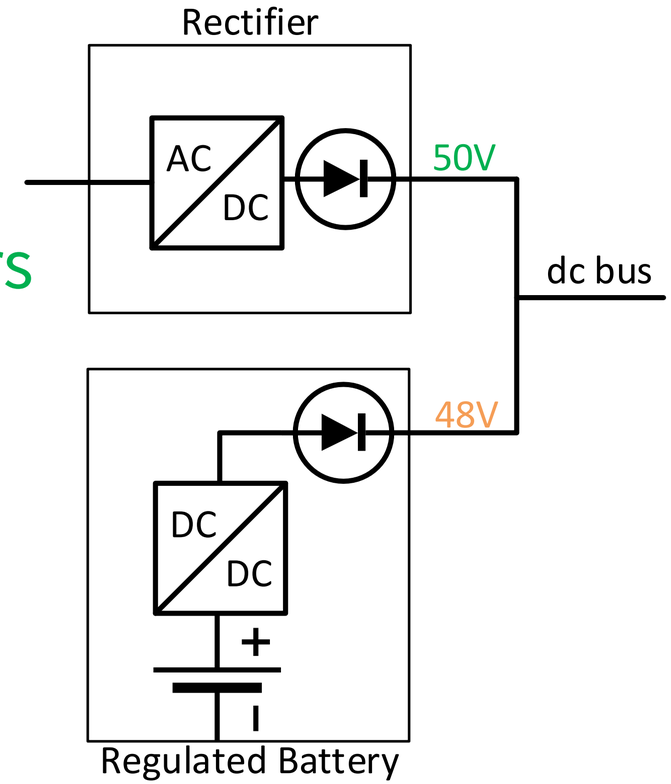




Normally, rectifiers are on and DC bus voltage is 50V.
In case of ac outage, batteries output 48V to DC bus.

Narrow-range 48V Benefits

- Minimizing voltage range significantly reduces component size, both voltage and current rating.
- On IT Gears, enable efficient 4:1 fixed ratio converters and downstream conventional 12V PoL converters.
  - Fixed ratio converter output 12V +/-10% or better.
- Power to flow naturally, not with software control and dependency.
- Simplify rectifier design with fixed output voltage.



Call to action

- First drafts of Specs will be posted on Rack & Power wiki by end of October.
  - www.opencompute.org/wiki/Open_Rack/SpecsAndDesigns
  - Please review and provide us feedback!
- Encourage potential end-customers to join this effort.
  - We’re going to start prototyping and demonstrate the design.

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