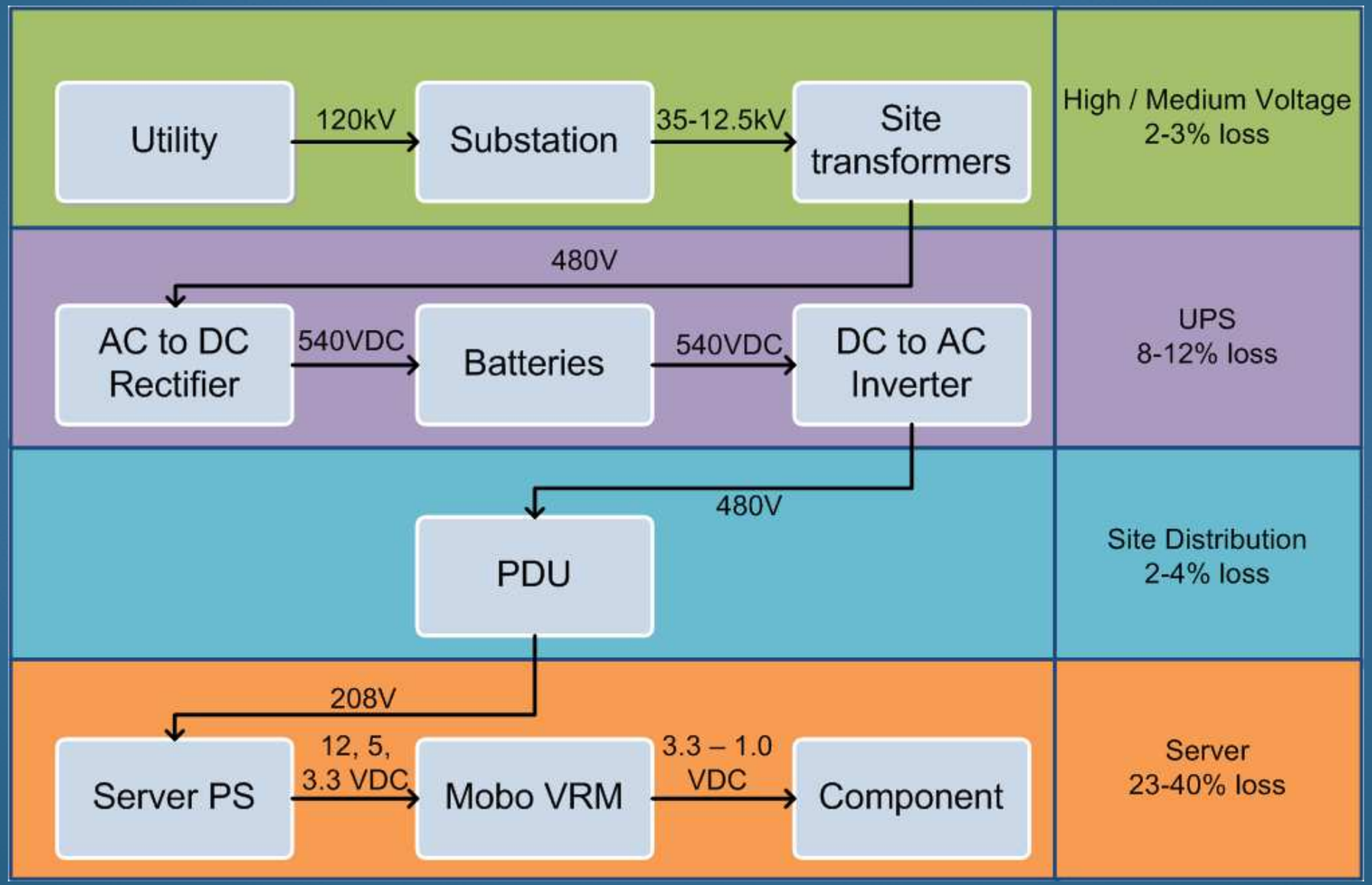
facebook

Efficient Power Distribution

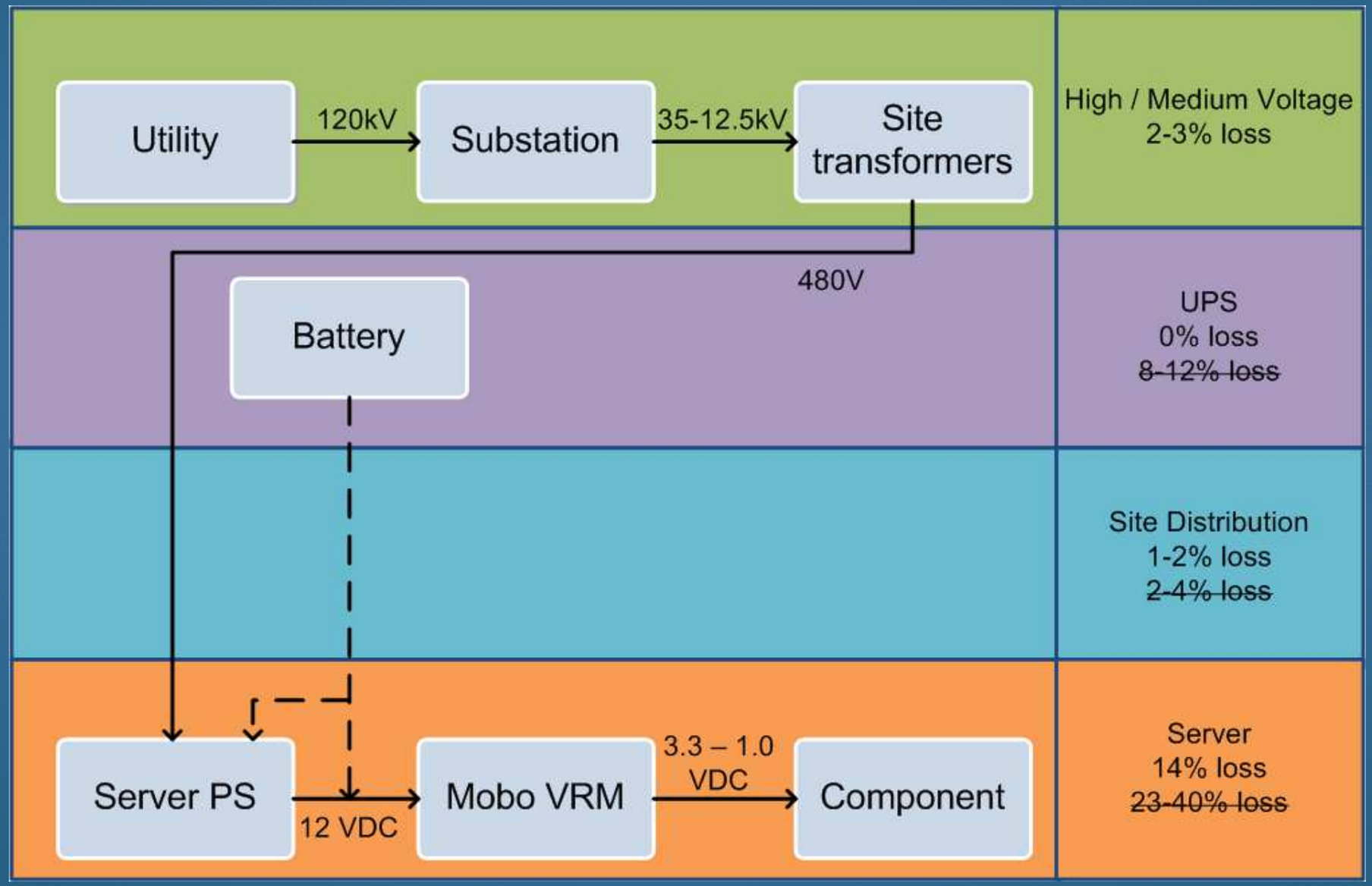
277Vac distribution w/o centralized UPS
95% High Efficiency solution
Battery Cabinet as Distributed Backup Energy Unit

Pierluigi Sarti
Technical Lead, Power
August 17, 2011

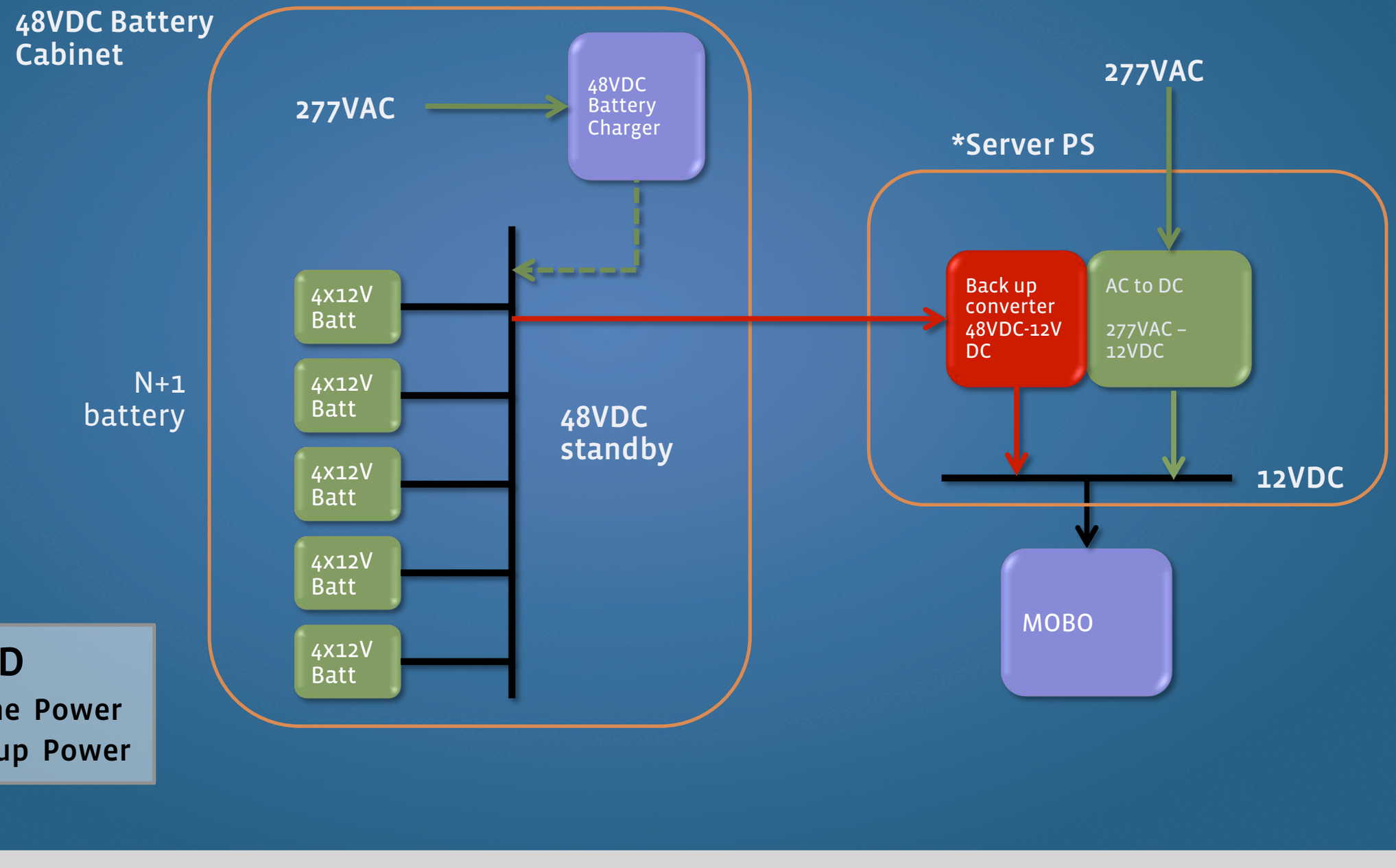
Traditional power distribution



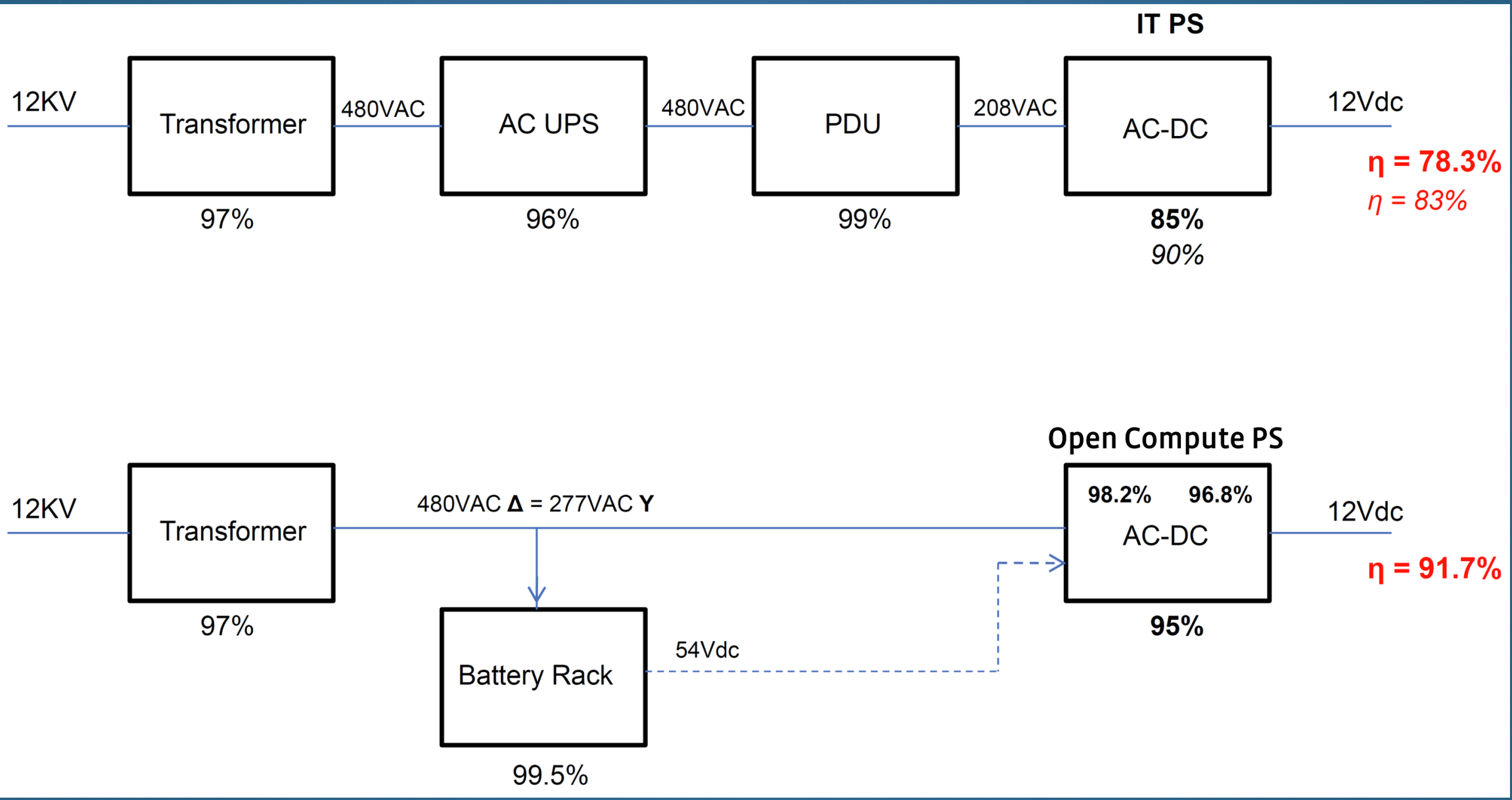
Optimized power distribution



Power Backup Scheme



A modern ‘std power distribution’ vs. ‘Open Compute power’

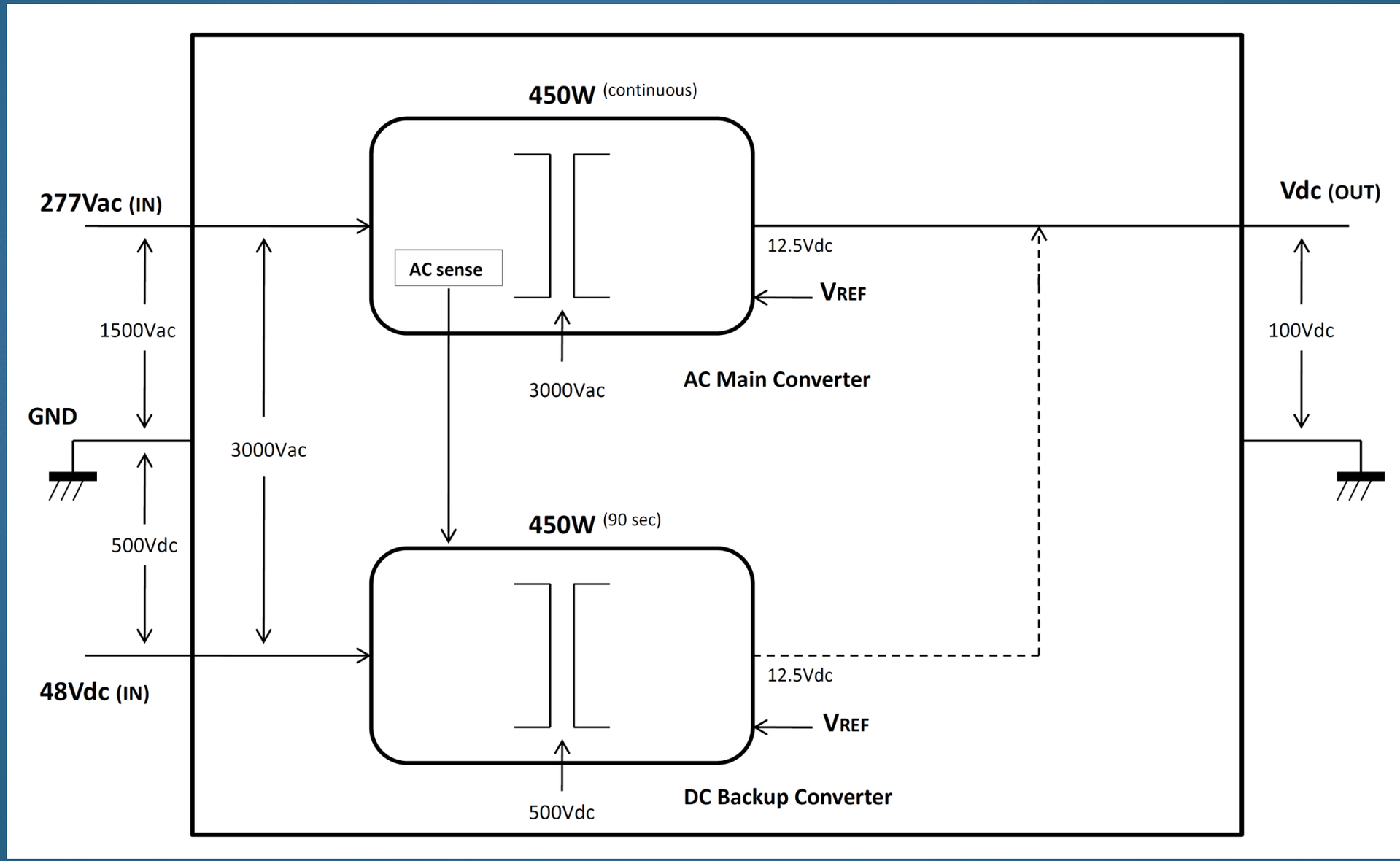


DC offline UPS – CapEx saving

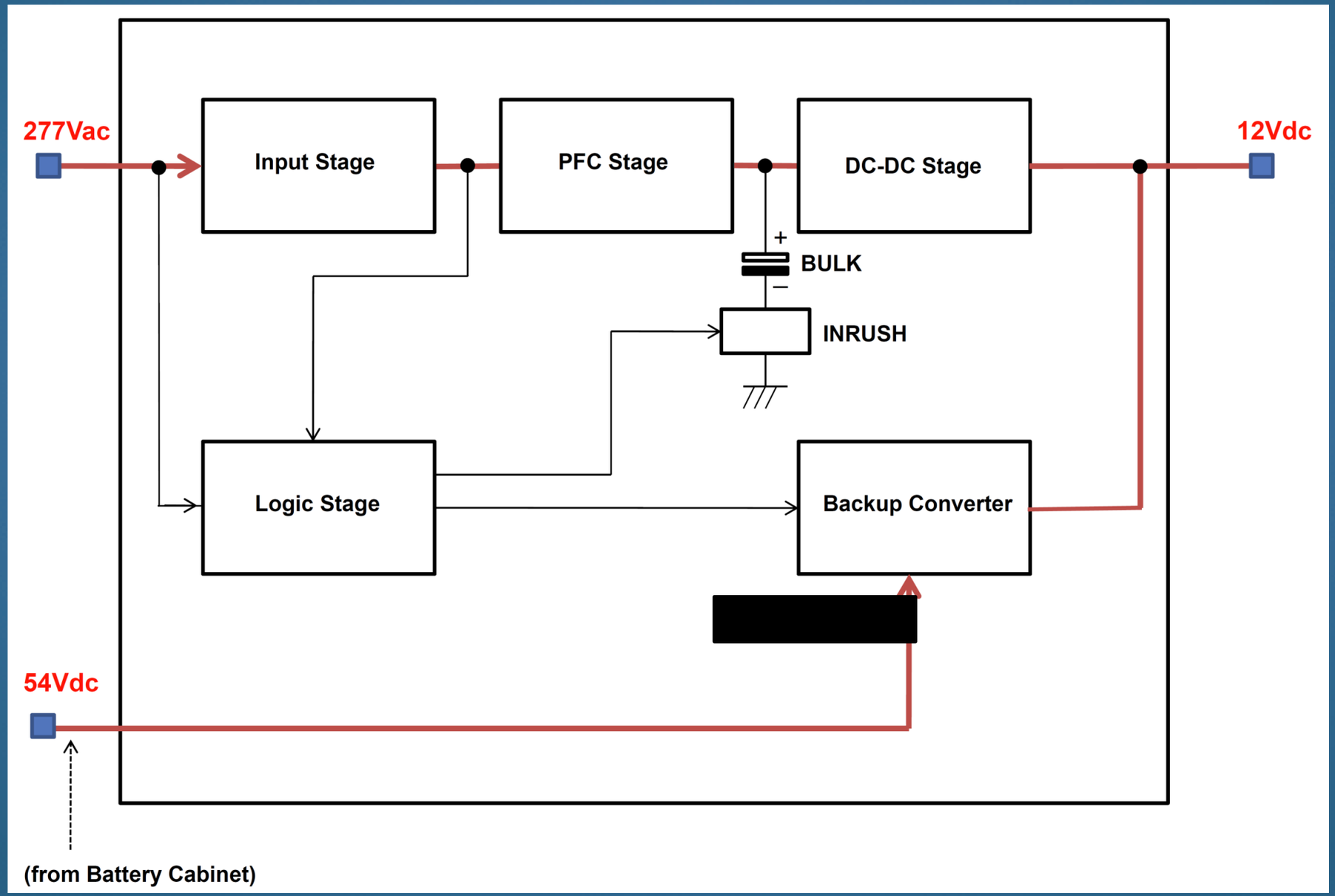
Traditional UPS & PDU
$2.00 / W

Optimized UPS & no PDUs
$0.10 - $0.35 / W

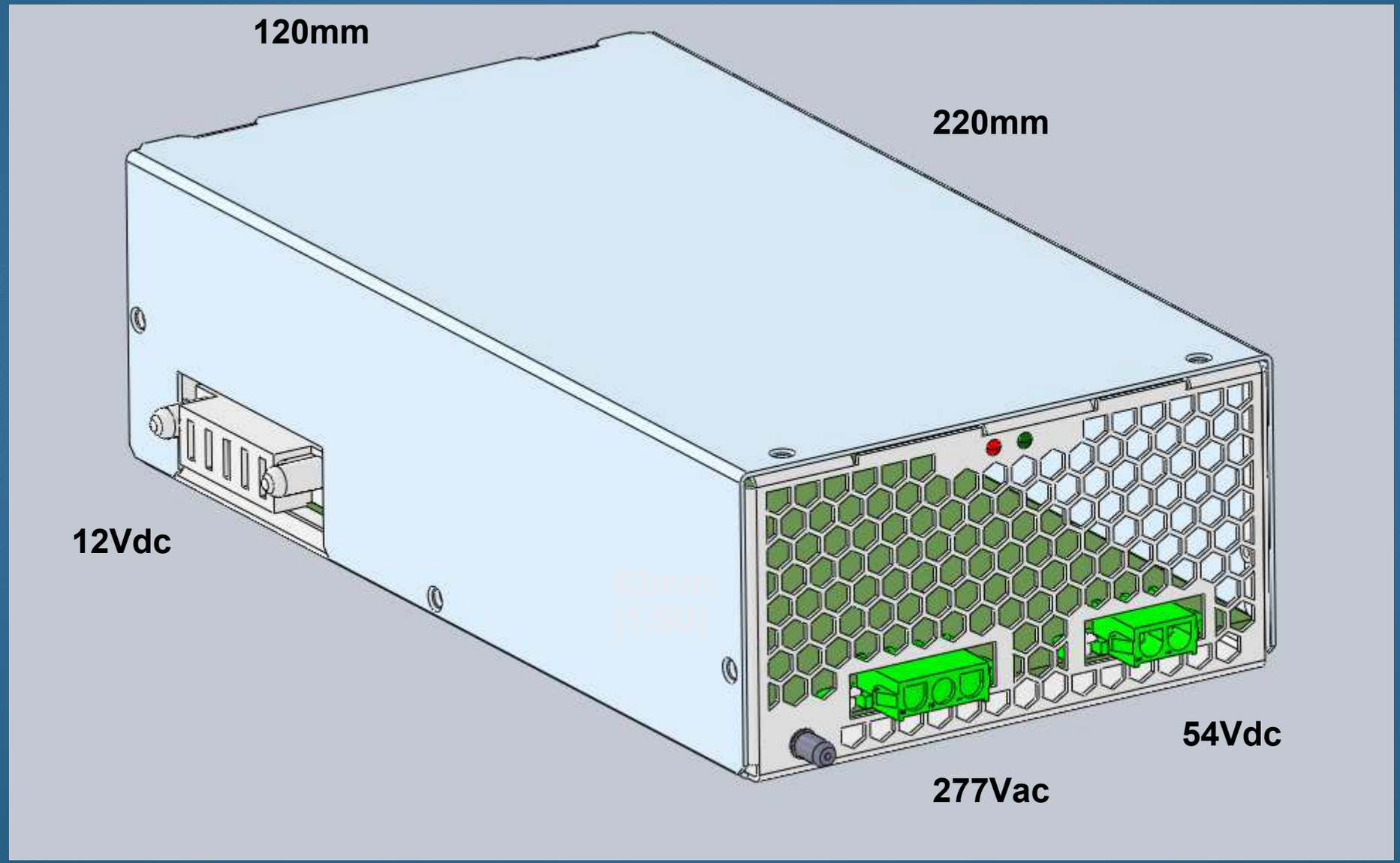
Dual-input Open Compute 450W PSU - high level block diagram



Dual-input Open Compute 450W PSU - functional block diagram



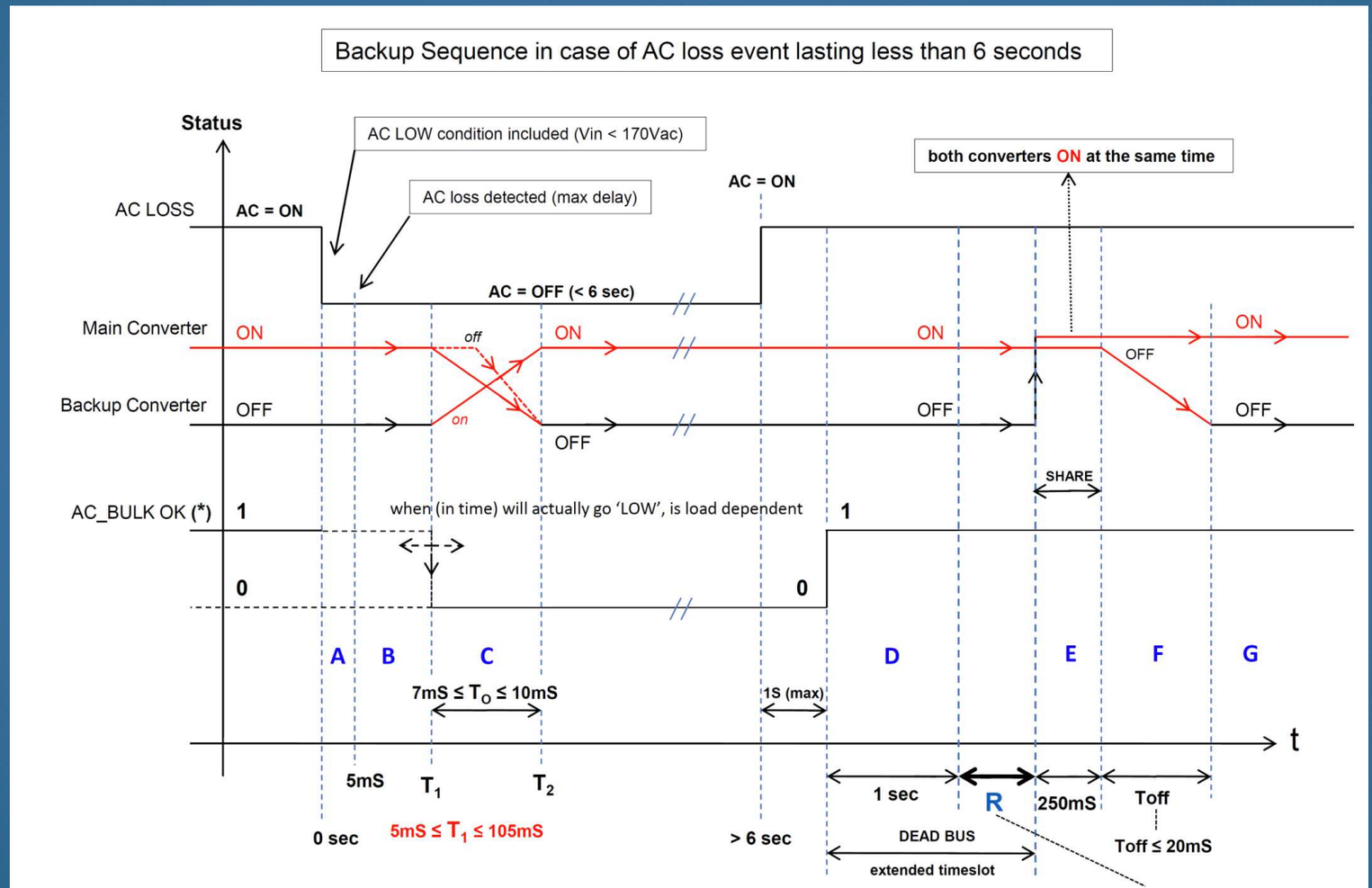
OCP 450w PSU form factor



OCP 450W Power Supply

- Custom 1.5U tall, high volume
- 48VDC backup equipped
- HE AC–DC switching
- 180 – 290 VAC wide input range
- 94.5% efficient
- Low iTHD < 5%
- High Power Factor > 0.99
- Board-to-board mating connector
- Pin and plunger mounting
- Single low-speed cooling FAN
- Random restart after AC outage avoids Genset potential start-up issues

OCP PSU Backup Sequence

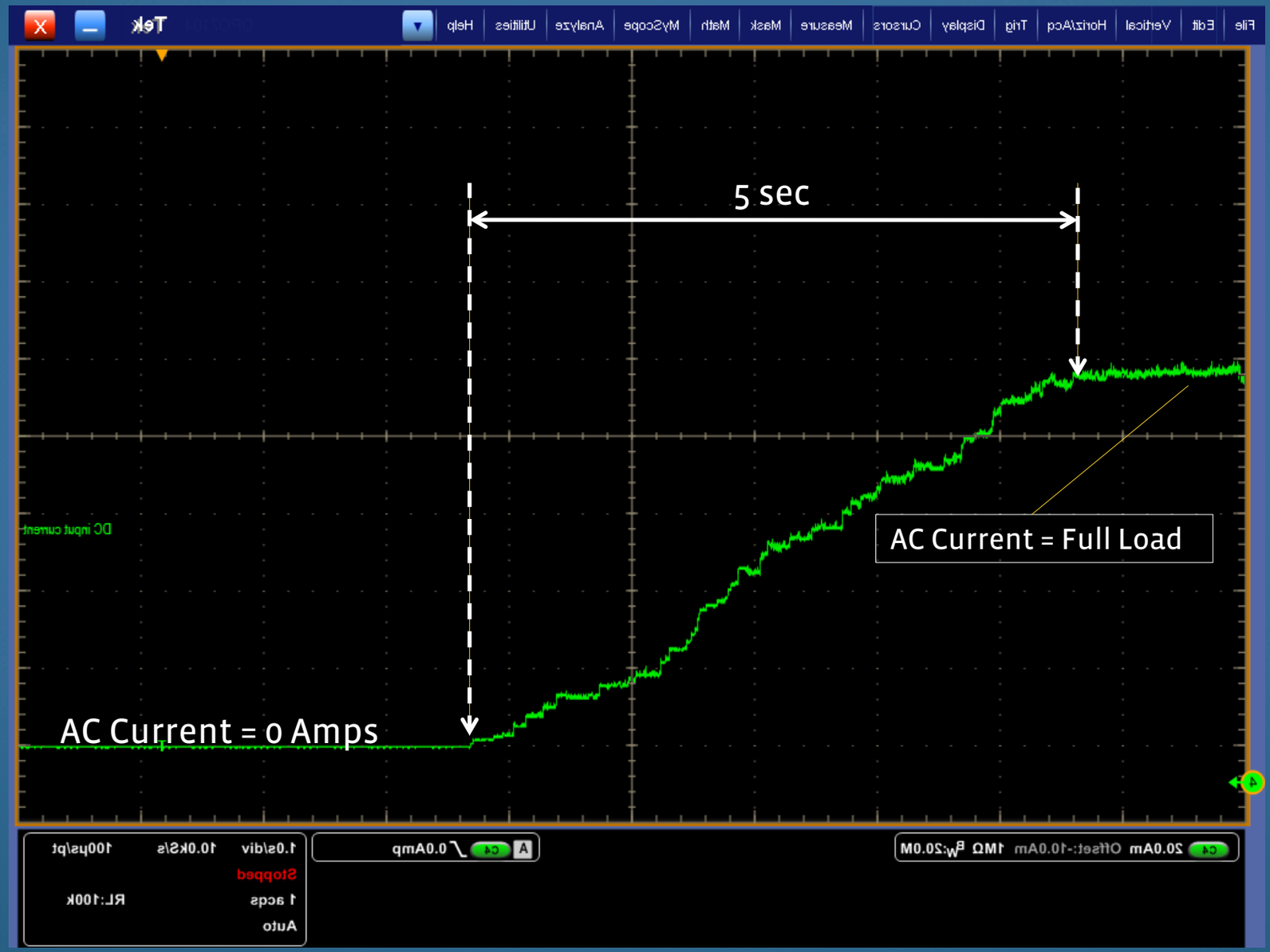


(*) 'AC_BULK OK' signal will go 'LOW' after any AC loss, but it is load-dependent **when**

T_1 (max) = 105mS: there is 100mS time-out for backup engagement after a detected 'AC LOSS' signal, regardless the load

The start of a Backup Sequence is primarily driven by 'AC LOSS' signal, in conjunction with 'AC_BULK OK' signal

AC Random Restart (real measurement)



OCP 450W PS Efficiency targets

- Efficiency target (277Vac input) :

  Eff. > 95% (50% to 90% of full load)

- Efficiency also exceeds **C**limate **S**avers **C**omputing **I**nitiative “PLATINUM” std.

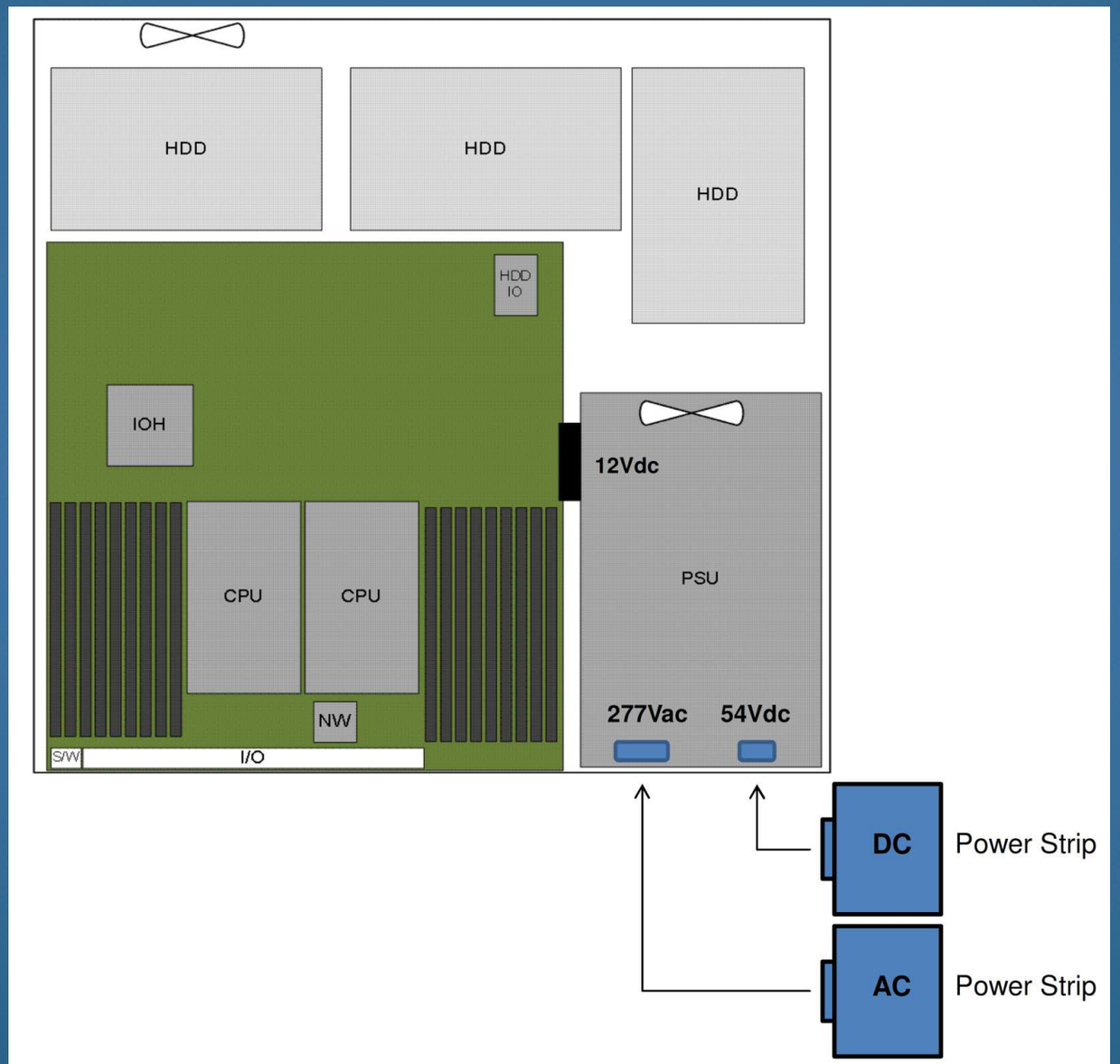
- Power Quality target (277Vac input) :

  PF > 0.95 (> 20% of full load)

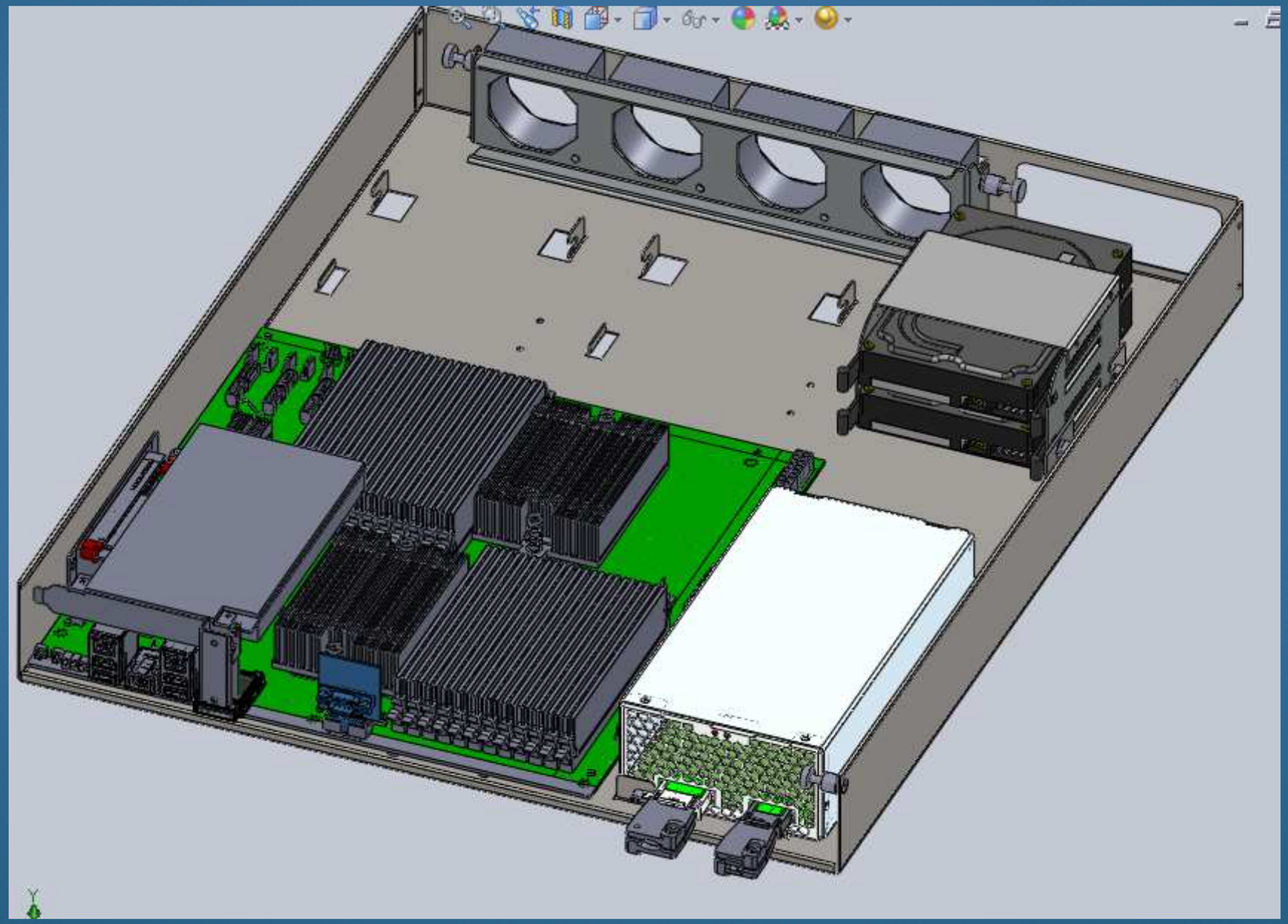
  THD < 10% (> 20% of full load)

- High PF & low iTHD reduce losses in transformers, noise in power lines, Neutral Current, GenSet start-up problems, etc.

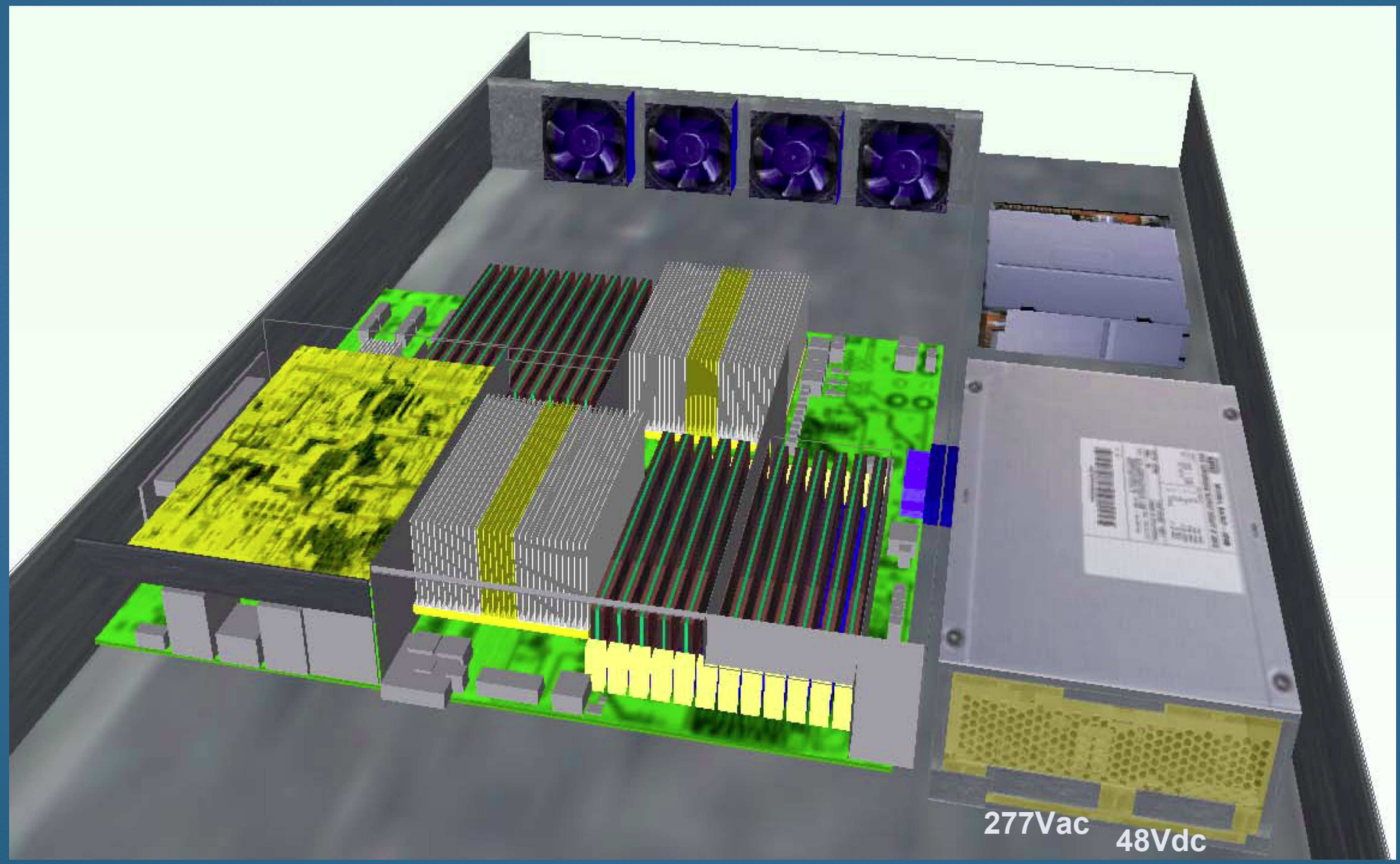
Server level with custom power strips (top view)



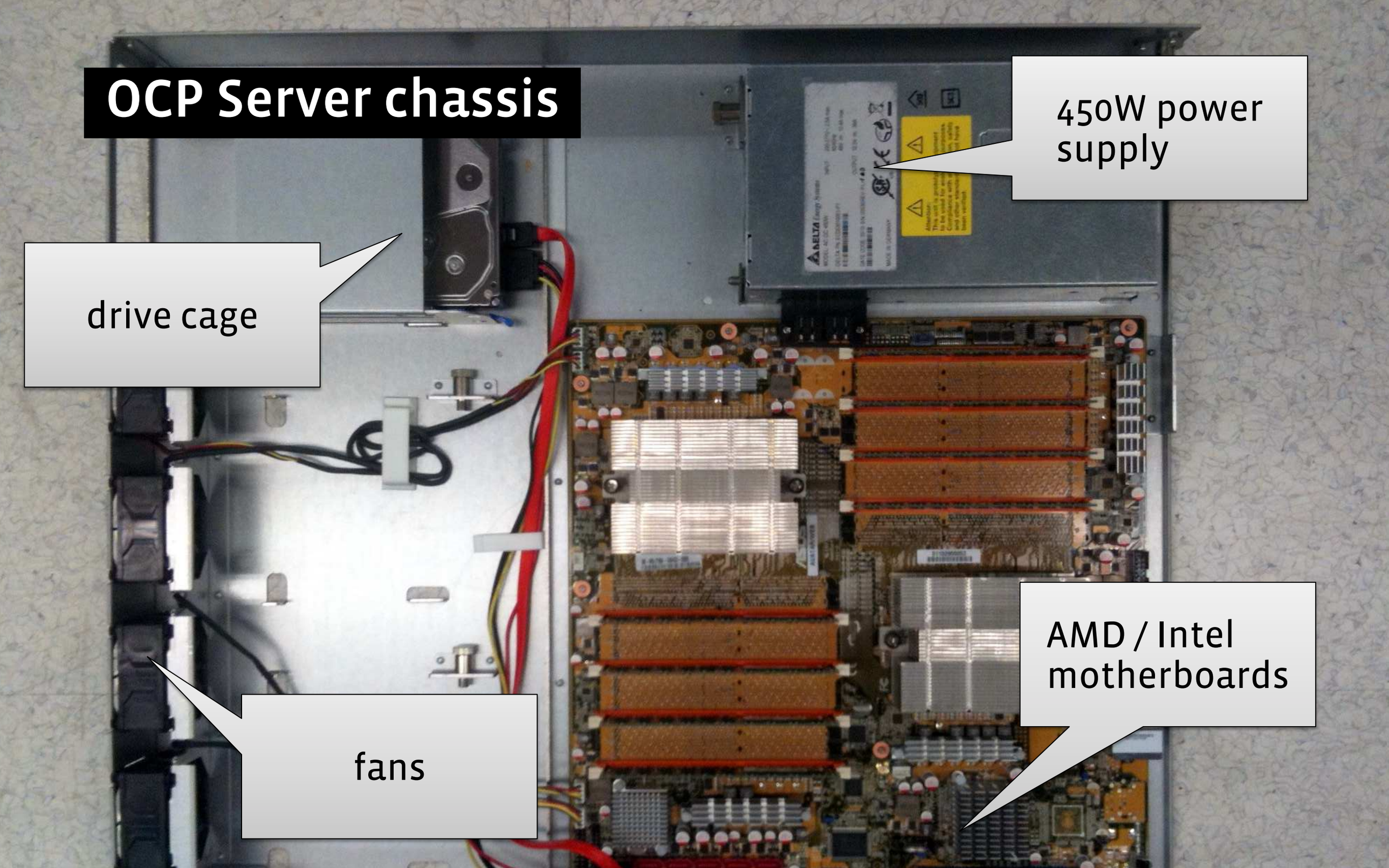
OCP Server chassis



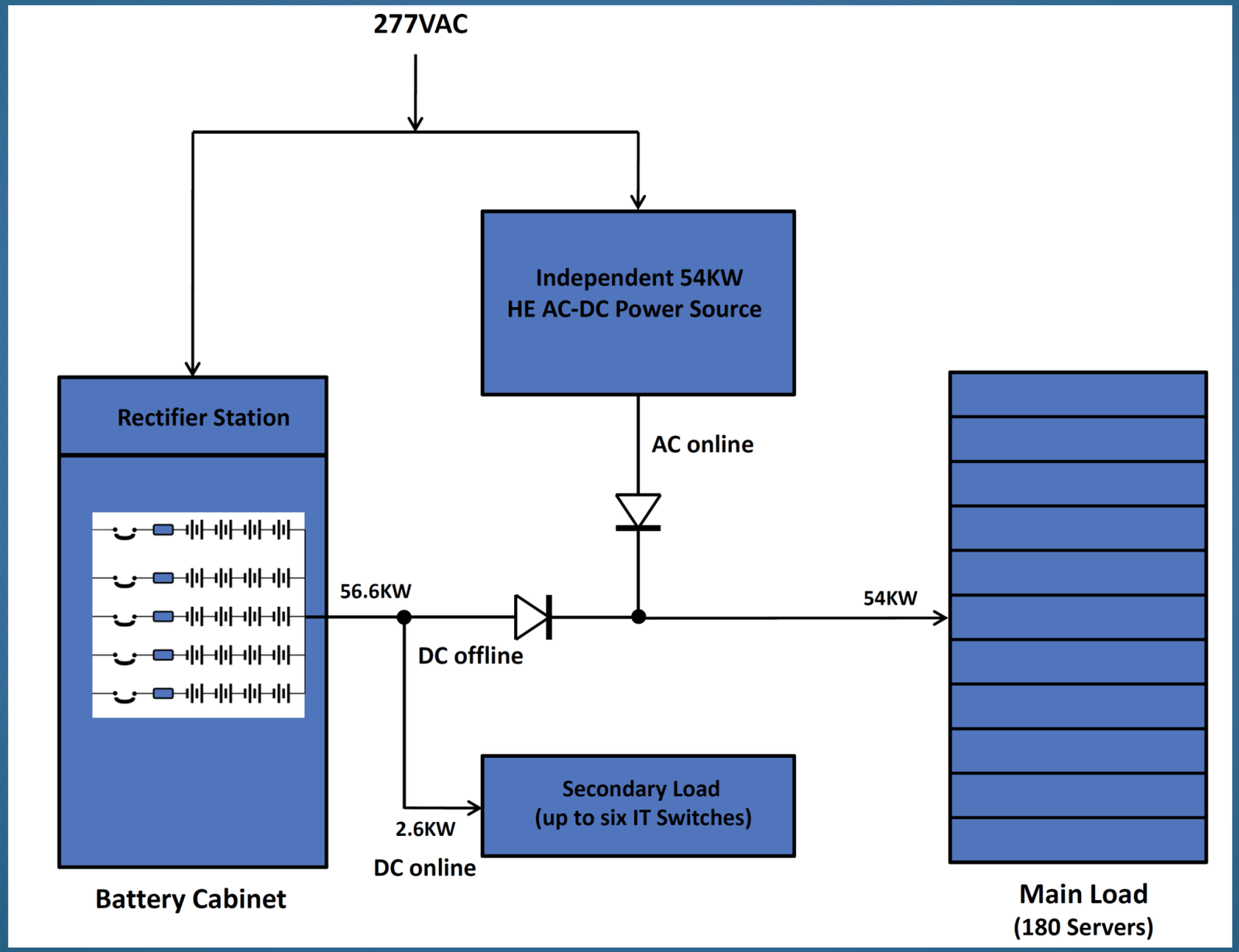
OCP Server chassis



OCP Server chassis



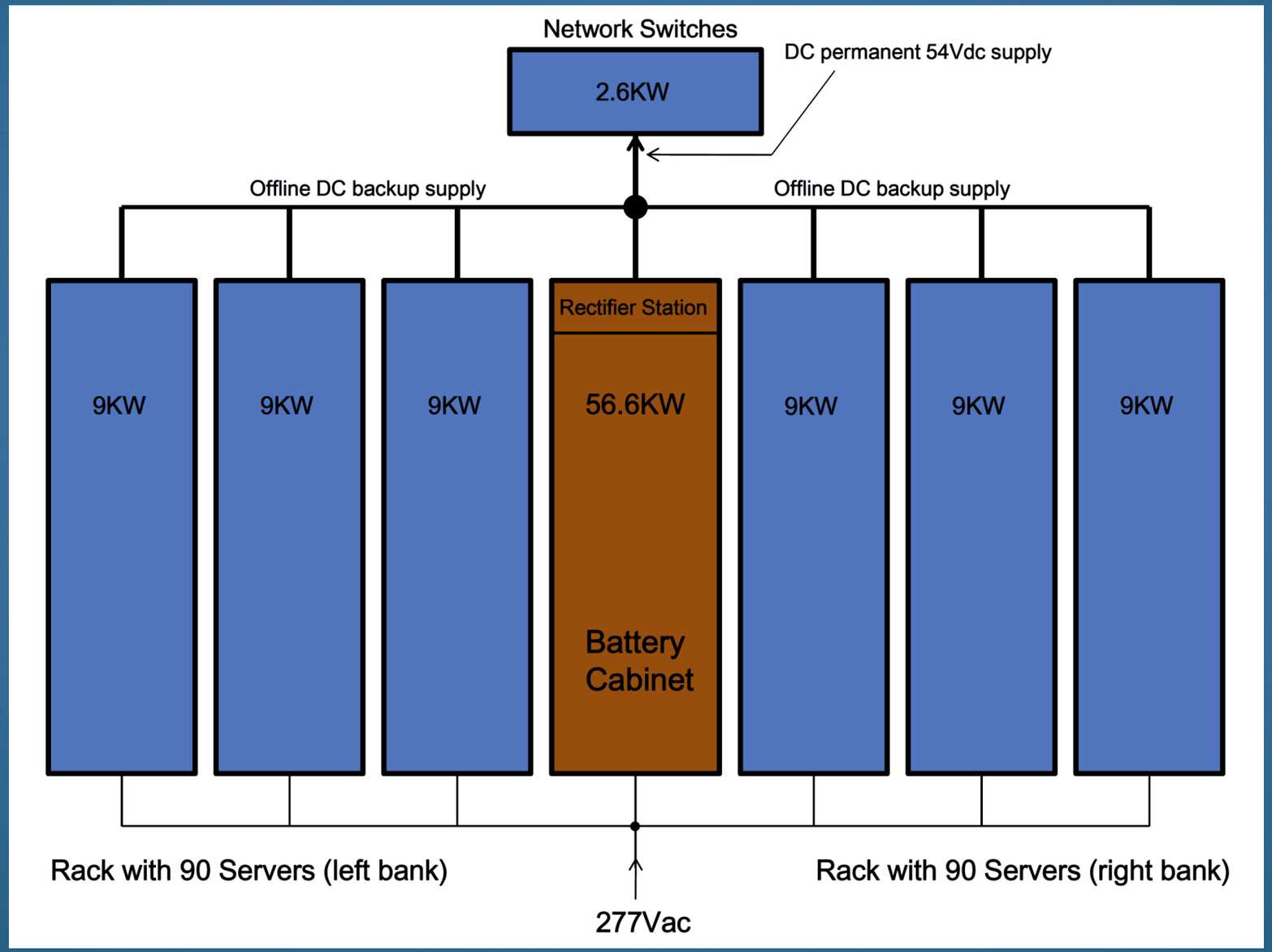
System & Backup Power – Functional Block Diagram



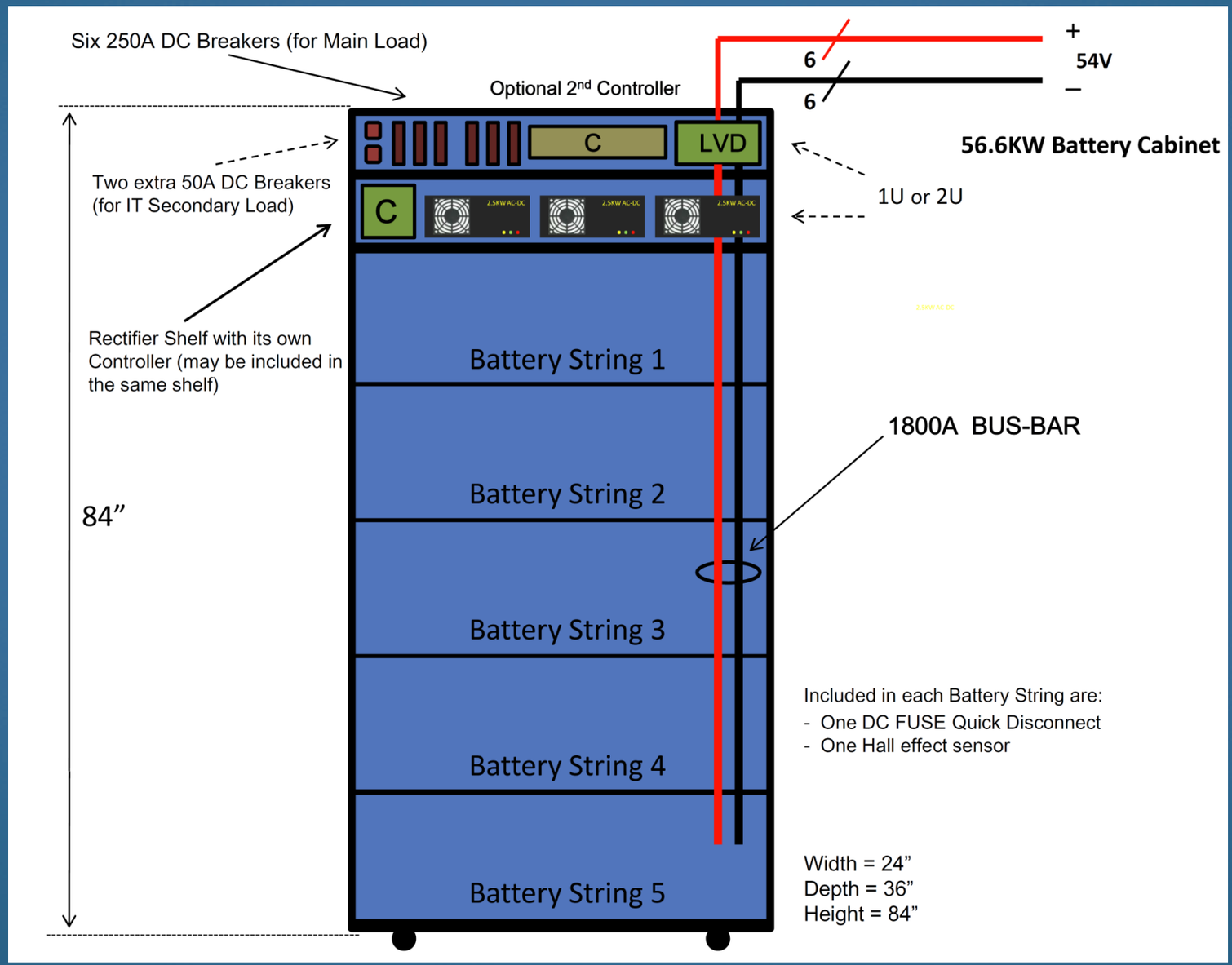
OCP Battery Cabinet

- Custom DC offline UPS
- 56kW or 75kW, 277VAC 3-phase input
- Six 48VDC 175A outputs
- 45 sec backup time at full load
- 95% efficient Rectifiers for batteries charging and online power for IT Switches
- 20 sealed VRLA high-discharge batteries
- Battery monitoring system (impedance measurement), Vbatt, Ibatt, temperature
- Two 50A 48VDC aux outputs for IT Switches

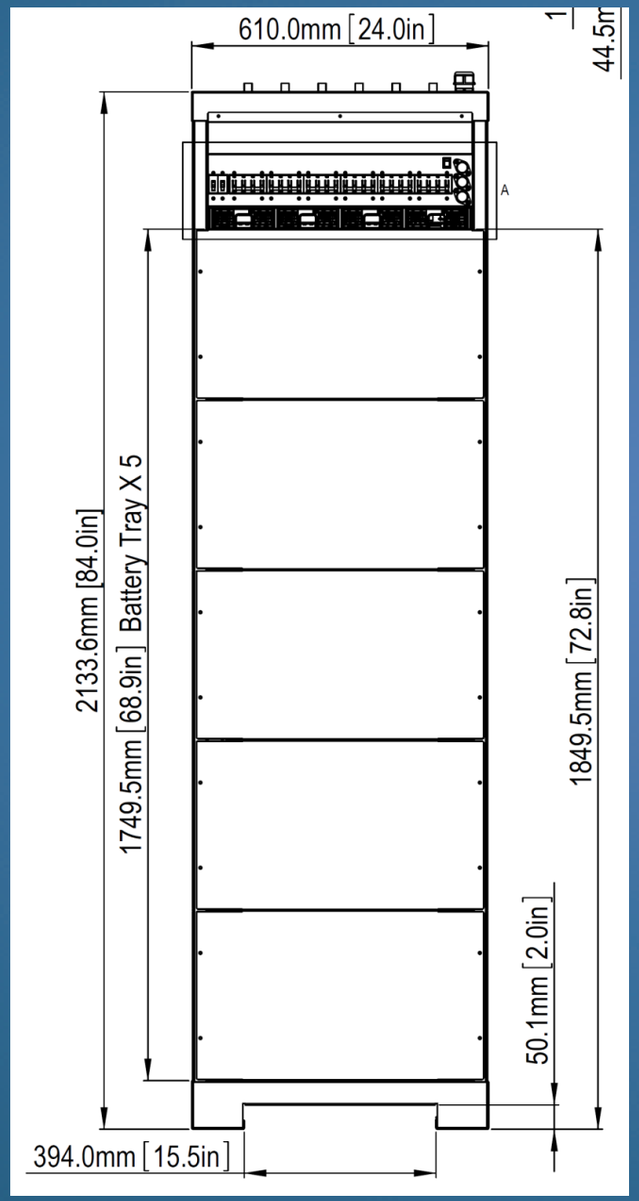
OCP Whole System

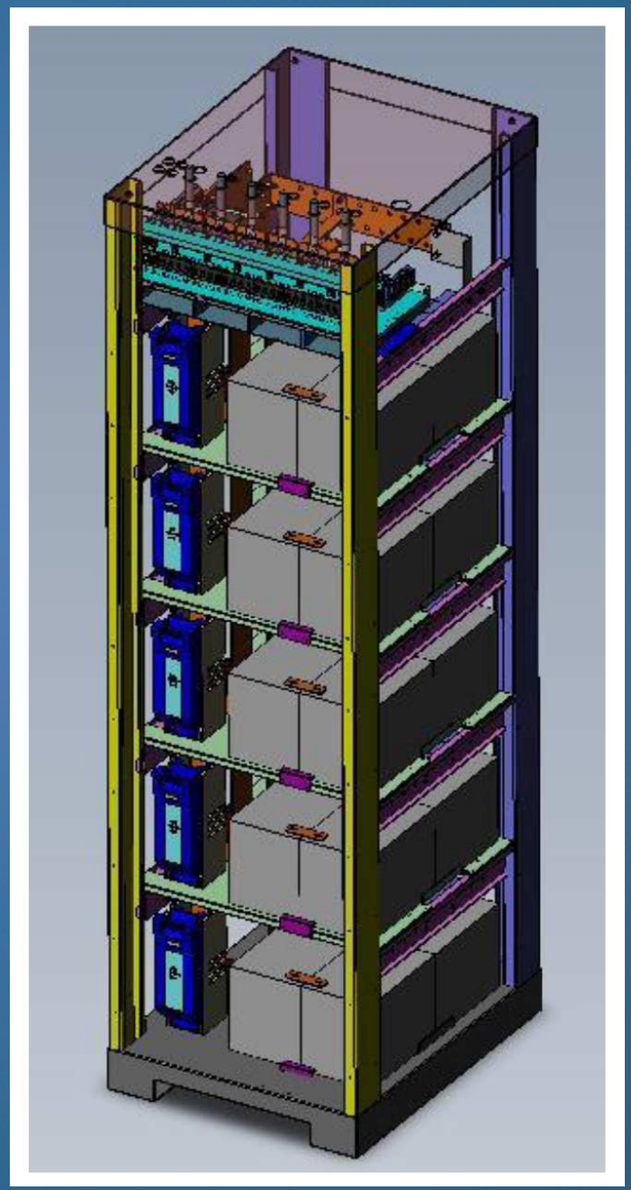


OCP DC Offline Backup Energy Unit: Battery Cabinet

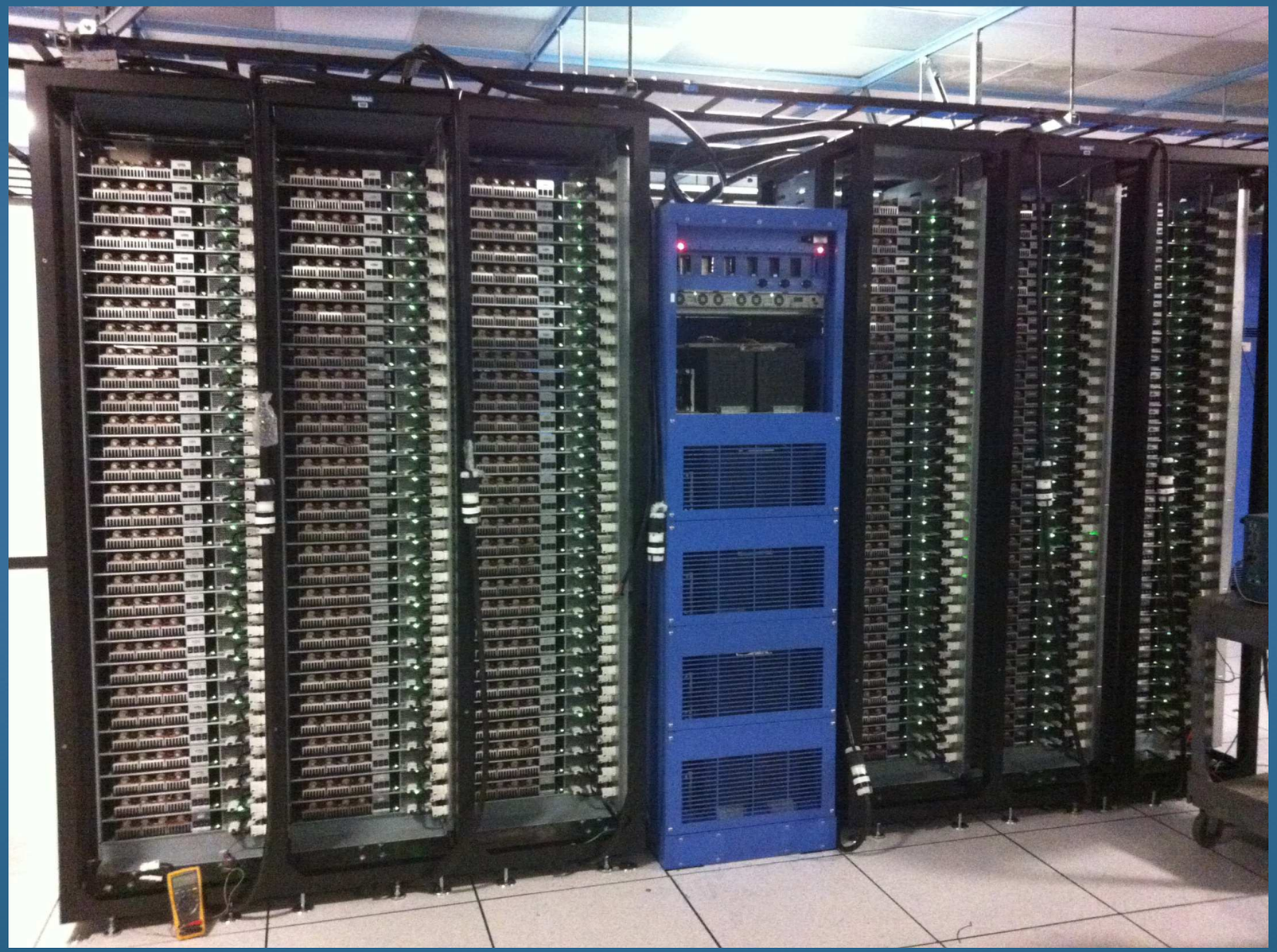


OCP 56.6KW Battery Cabinet

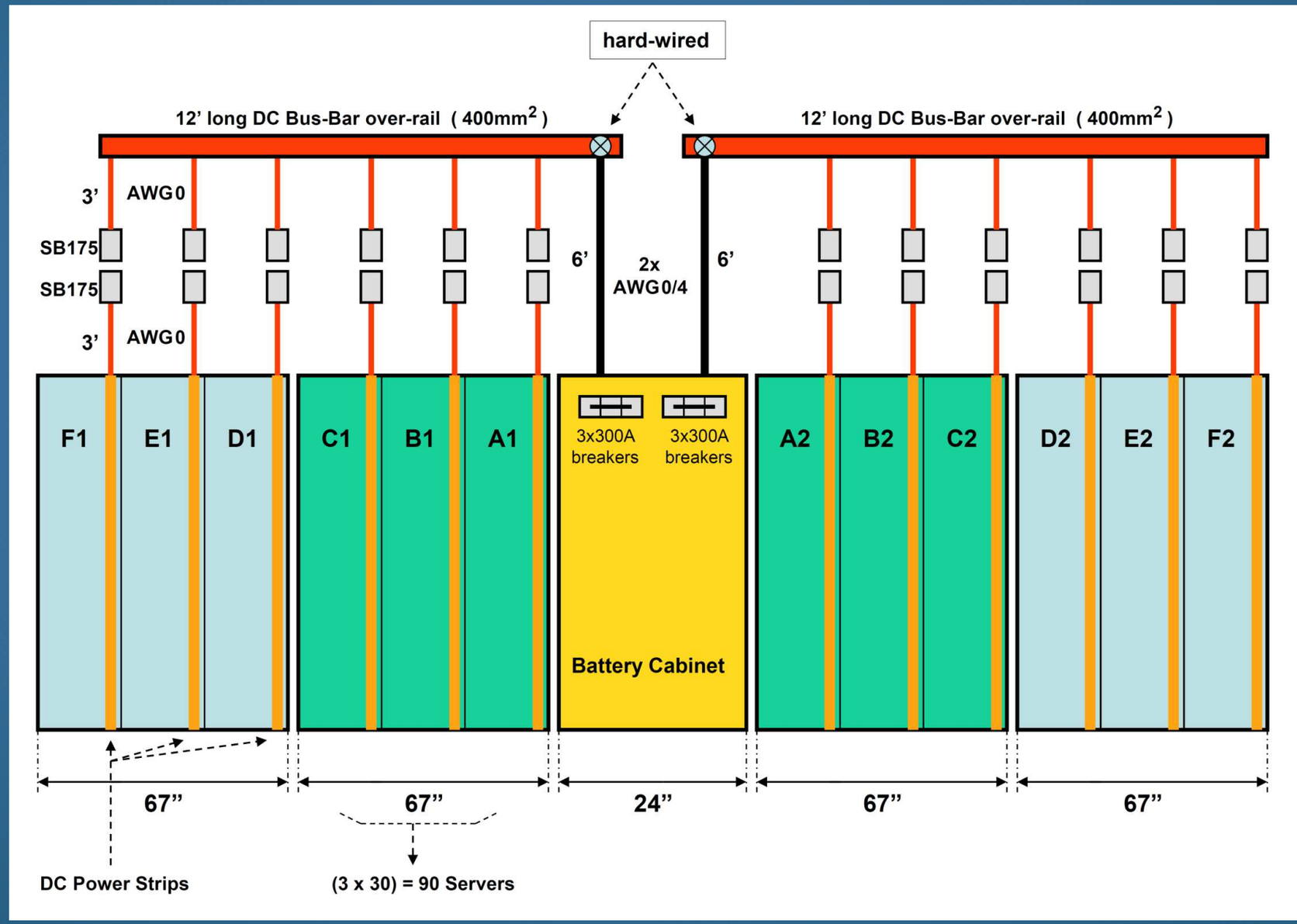




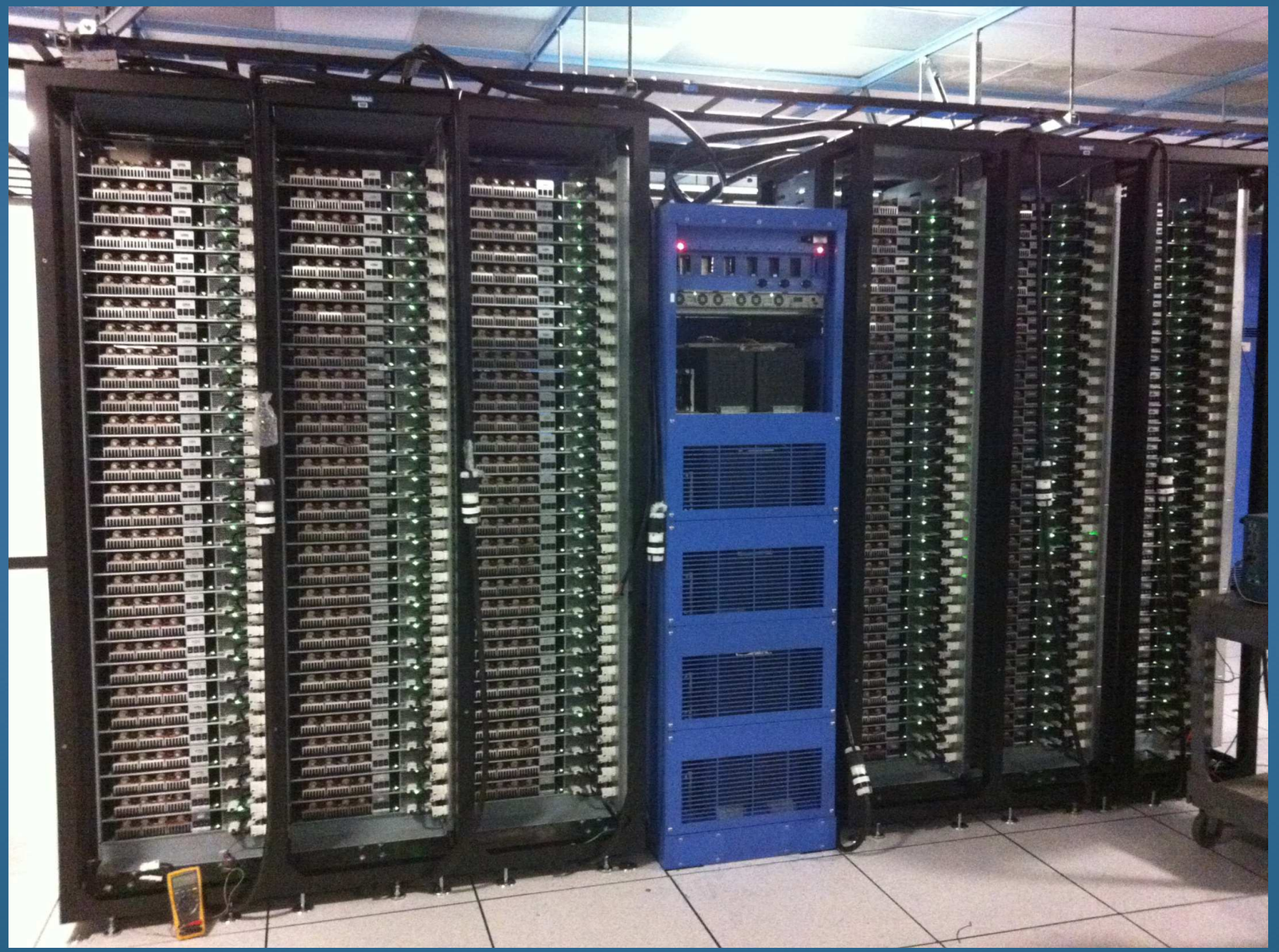
Open Compute Project – Whole System



High-Current DC bus-bar enhancement

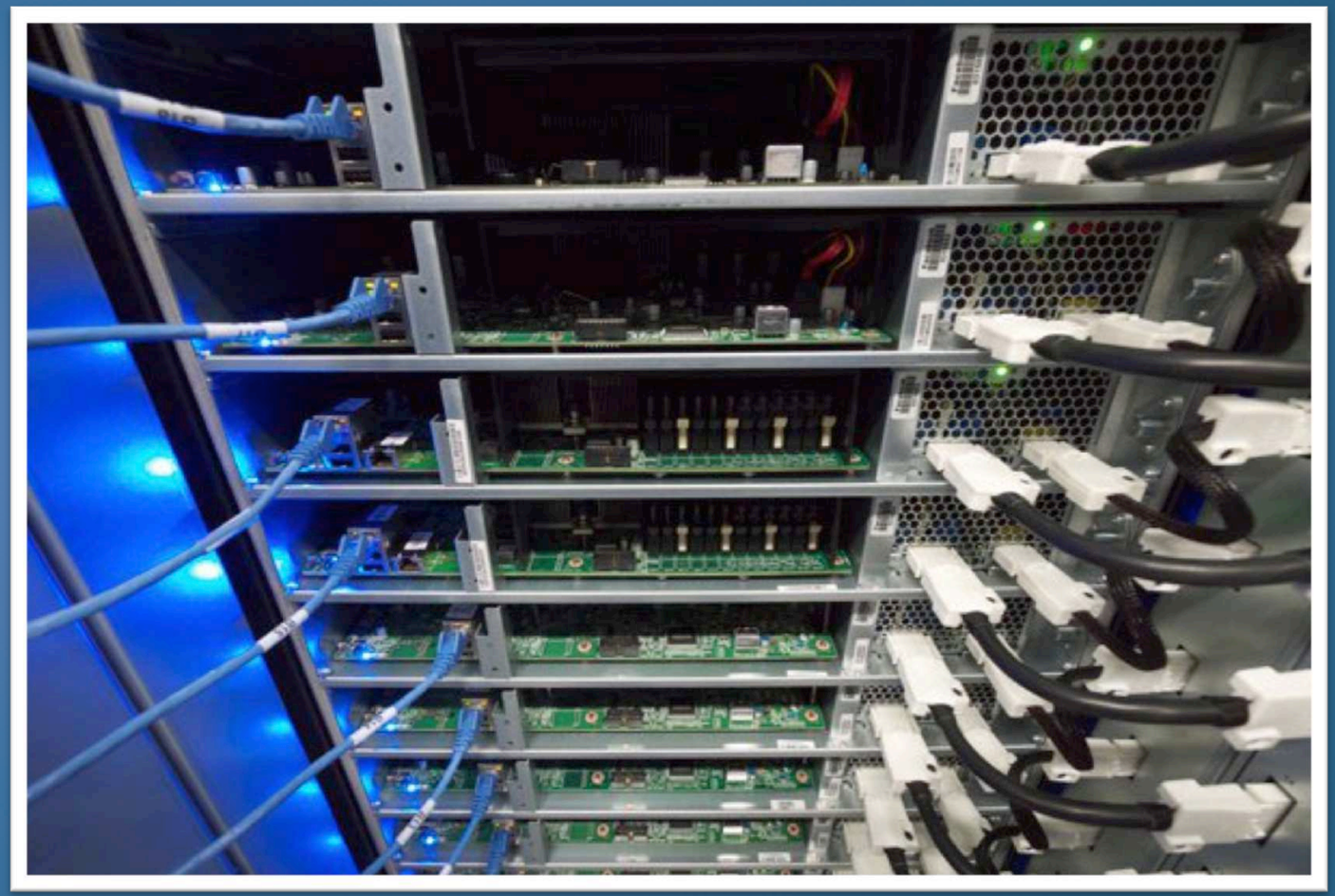


Open Compute Project – Whole System

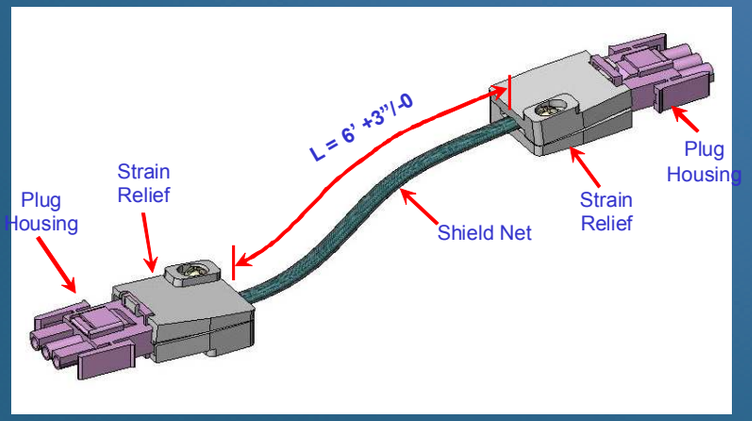


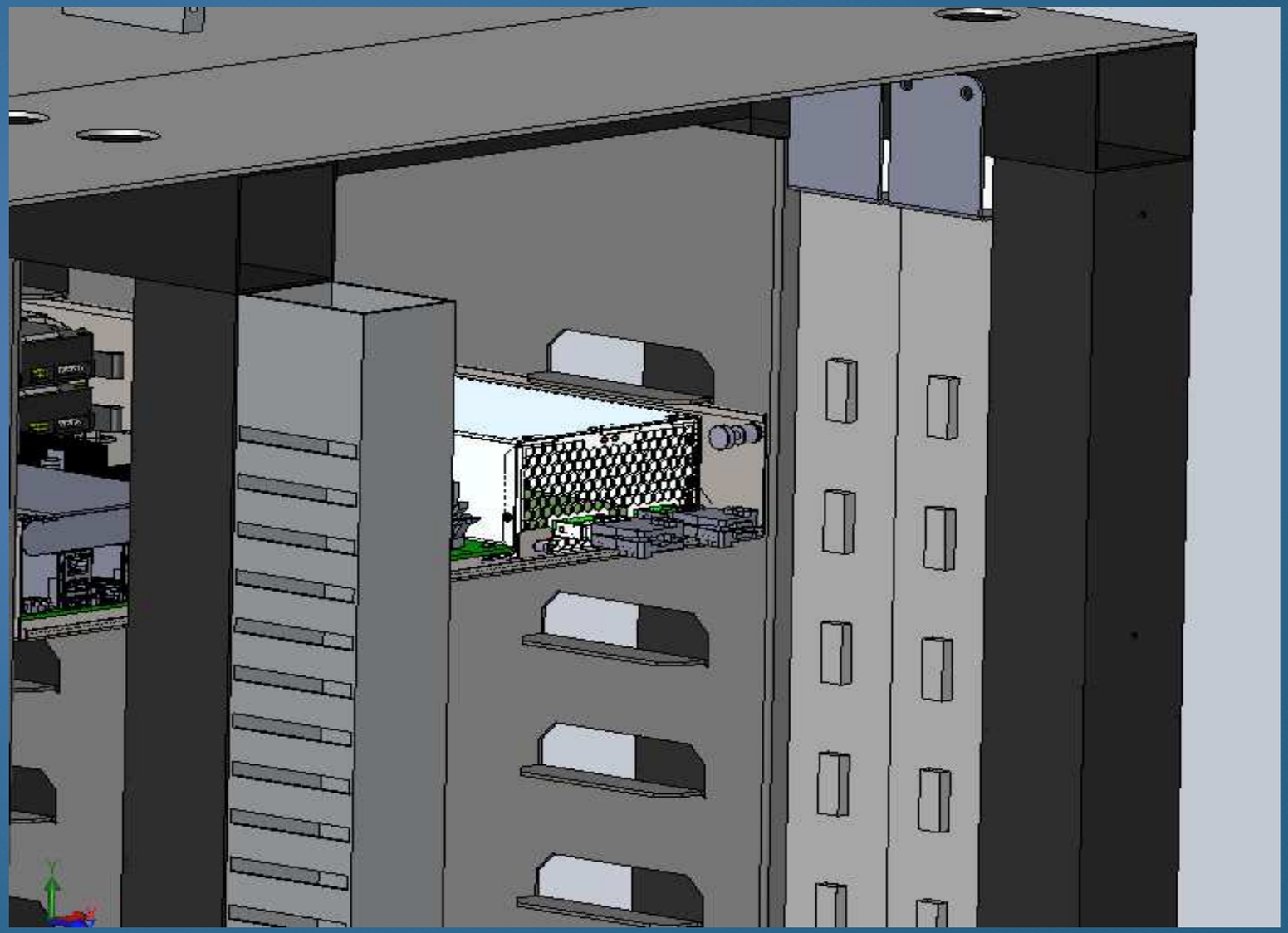
Rack level cabling

- Front access only
- Network cable management harness
- 30 outlets 277VAC (custom AC power strip)
- 30 outlets 48VDC (custom AC power strip)
- Custom 277VAC and 48VDC power cords



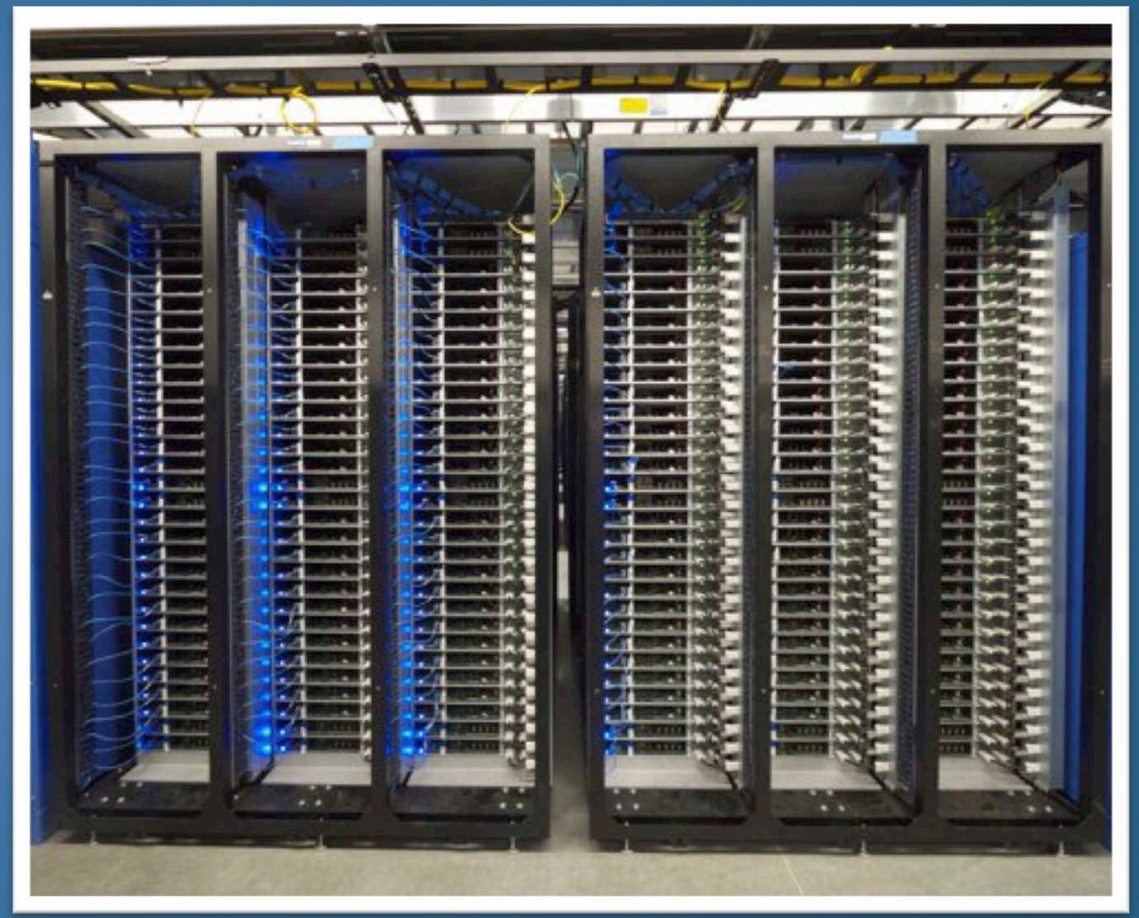
AC & DC Power Strips in the triplet rack column





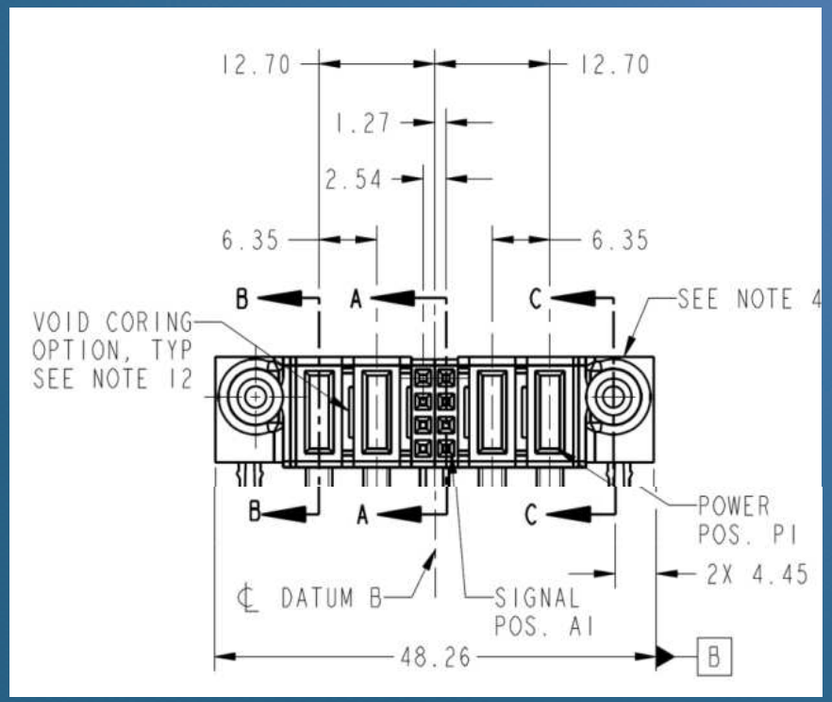
Triplet Rack

- Triplet RACK design – 90 servers
- Fast deployment, rolling casters with levelers
- Welded 2” square-tube frame, powder coat finish
- Hot/cold isle containment
- Six 1U auxiliary shelves (IT Switches)
- High IT Switch port utilization

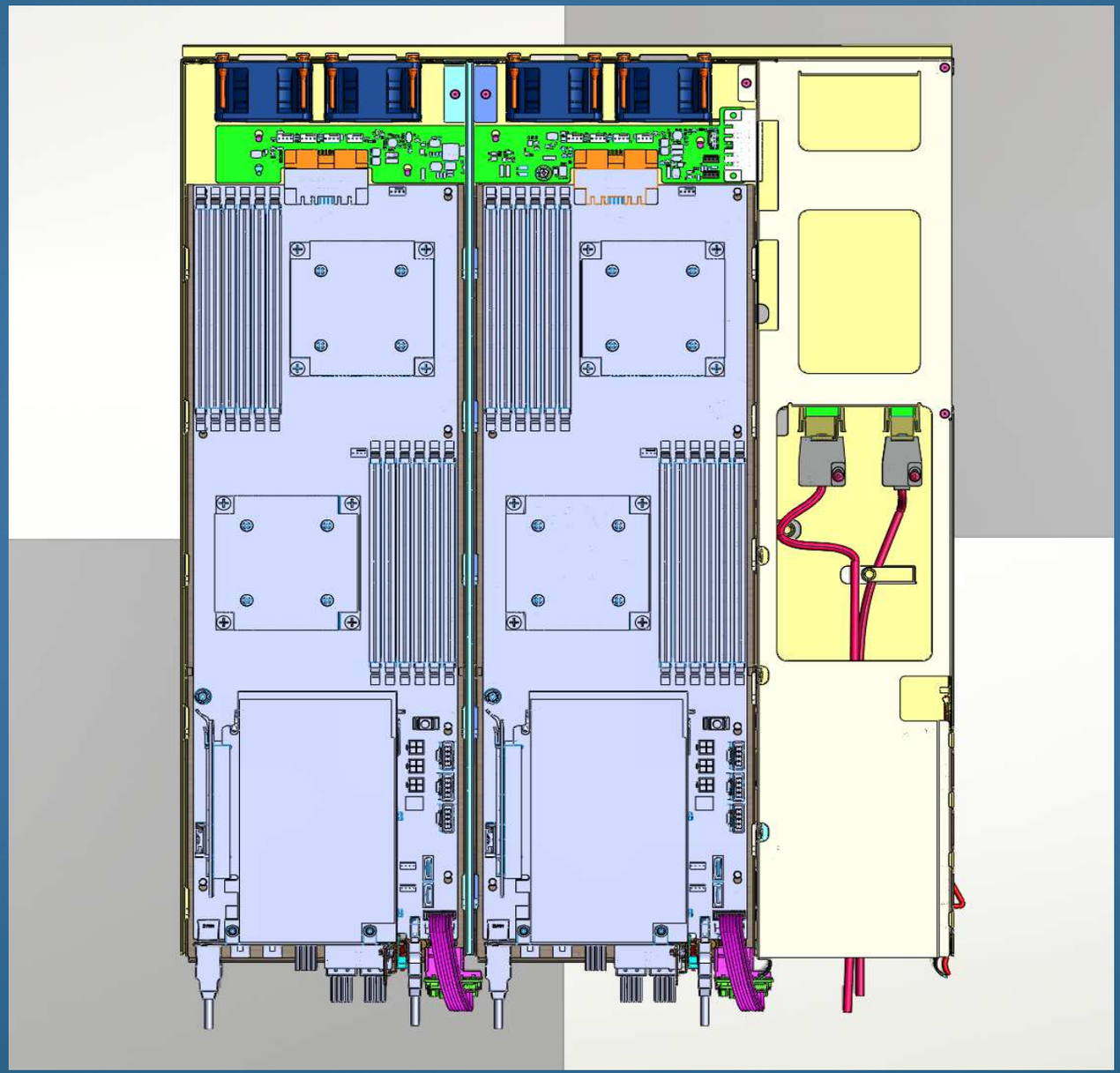


Open Compute 700-SH power supply

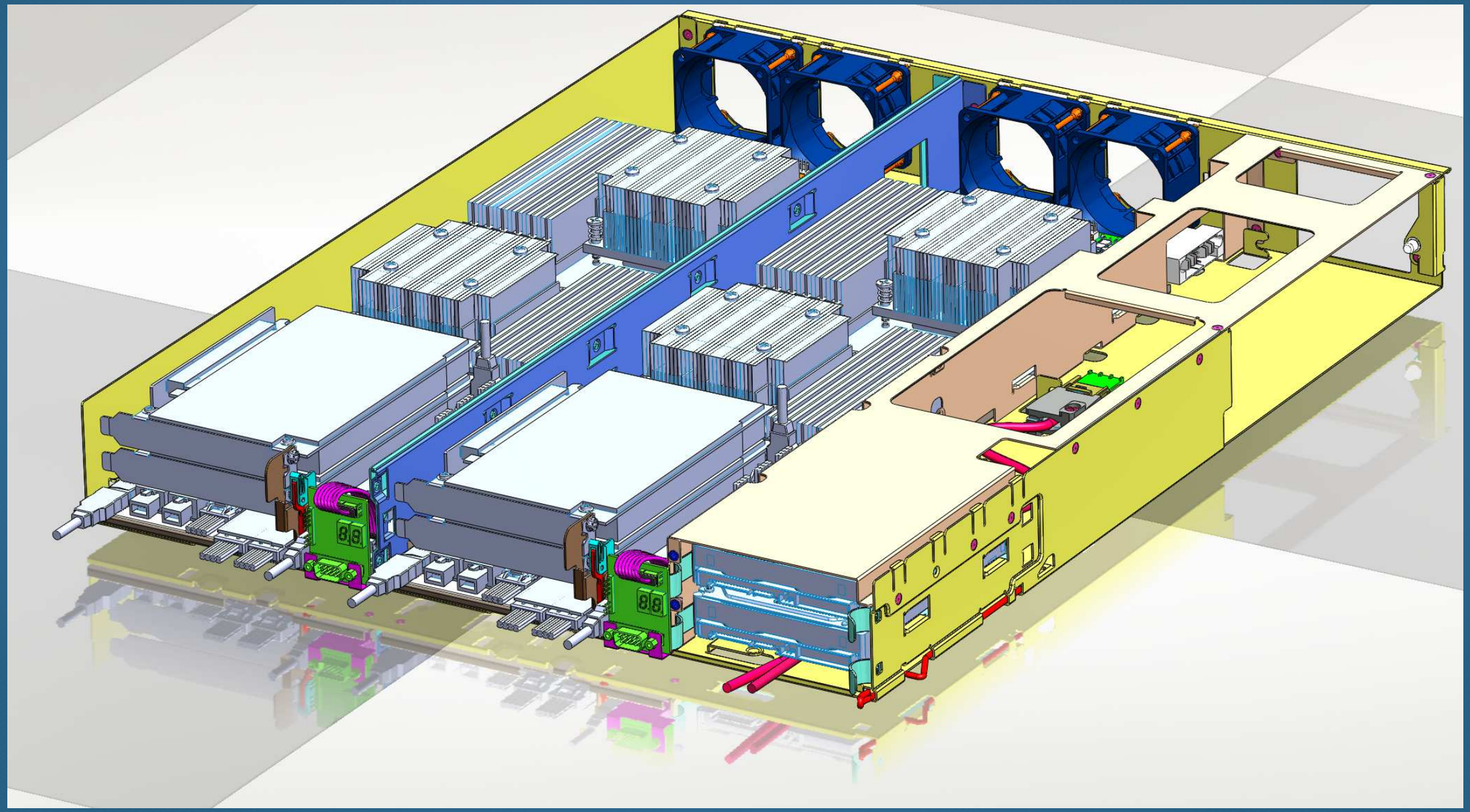
- 700W output
- High power DC backup mode
- Output Current sharing capable
- Same form factor as Open Compute 450W power supply
- Updated output connector, back compatible
- Efficiency exceeding 95% on broad load range



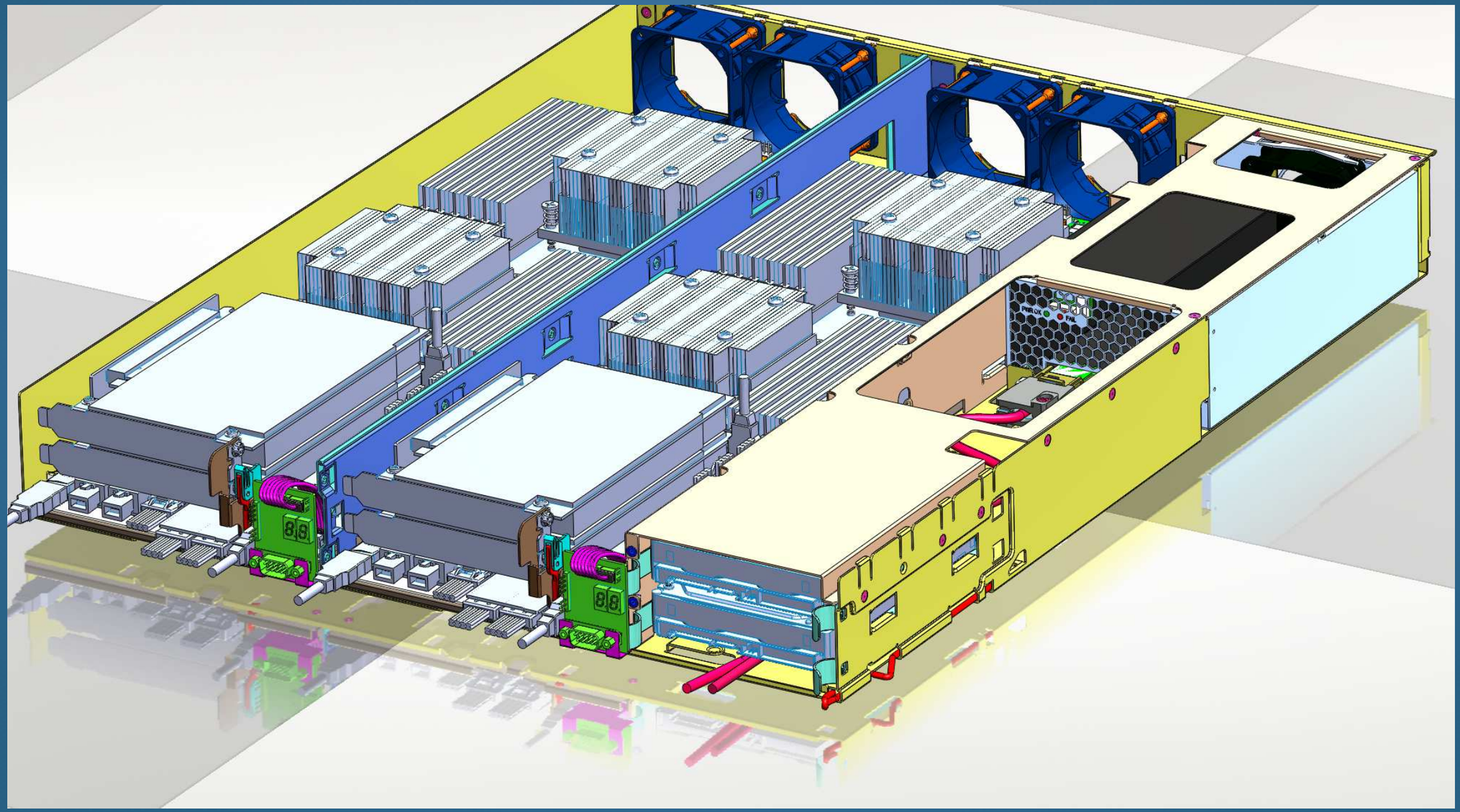
New Windmill System with OCP 700W-SH PSU



New Windmill System with OCP 700W-SH PSU not installed



New Windmill System with OCP 700W-SH PSU installed



facebook