

OPEN.



FOR
BUSINESS.



OCP
SUMMIT



Rack & Power

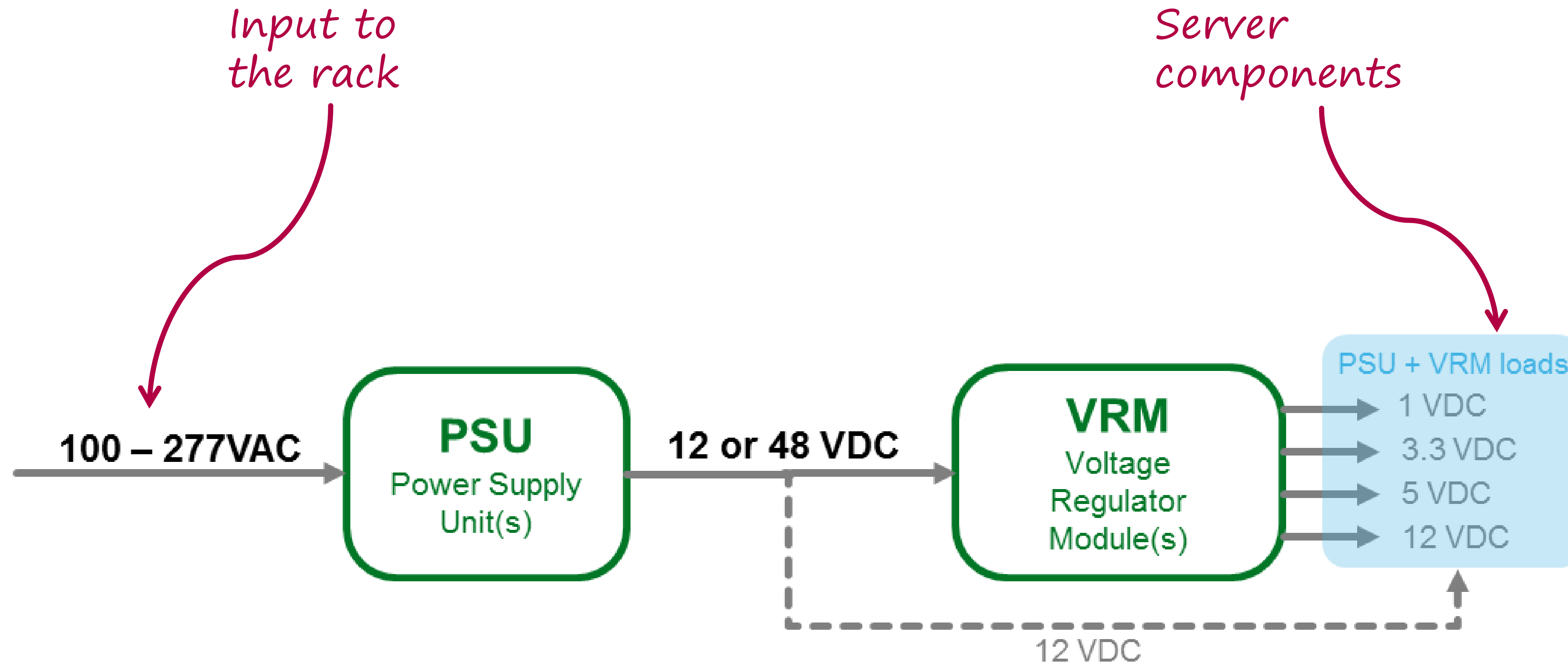
Efficiency Analysis of Rack Power Architectures

Liang Zhang – Director Hyperscale Solutions
Schneider Electric

OPEN. FOR BUSINESS



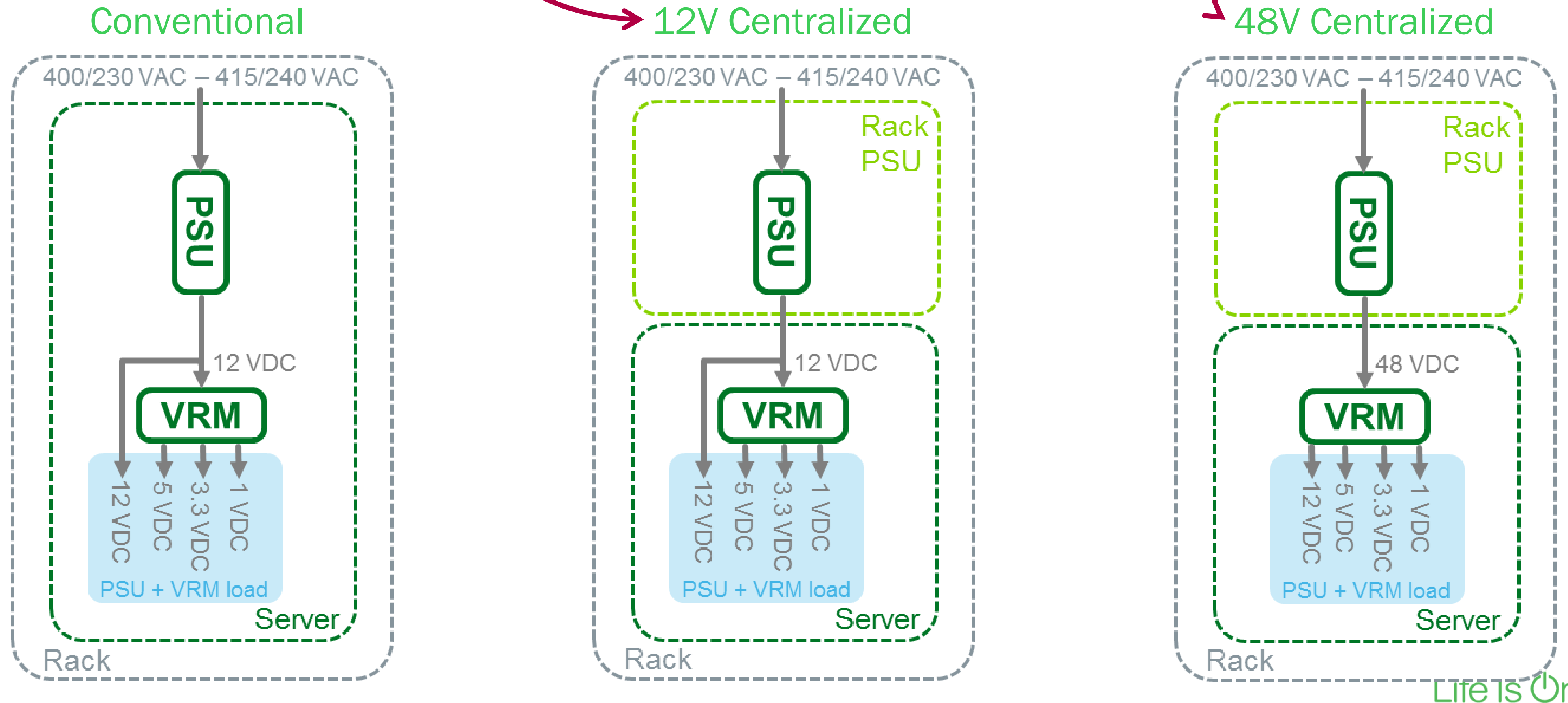
Analysis considers from rack input to server components



The 3 rack architectures

Are centralized rack PSUs more efficient?

Is 48VDC much more efficient than 12VDC?

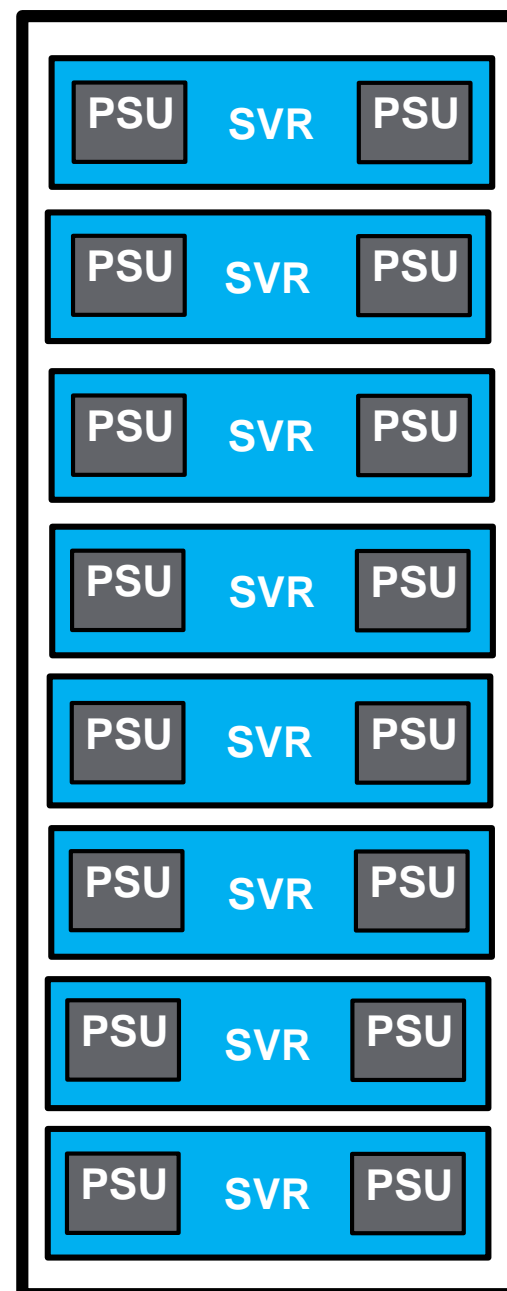


Life IS On

Conventional server PSUs are oversized by design

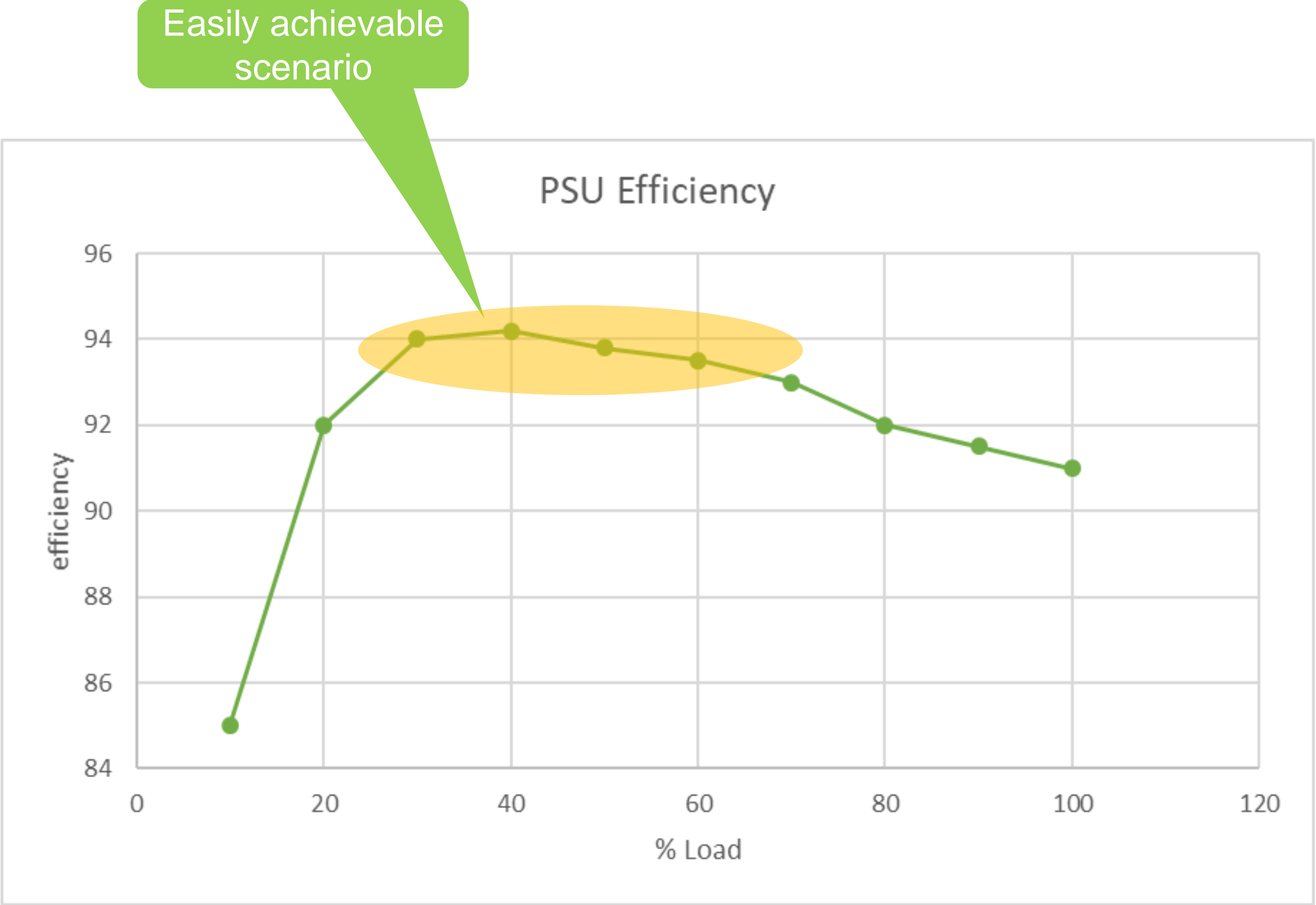
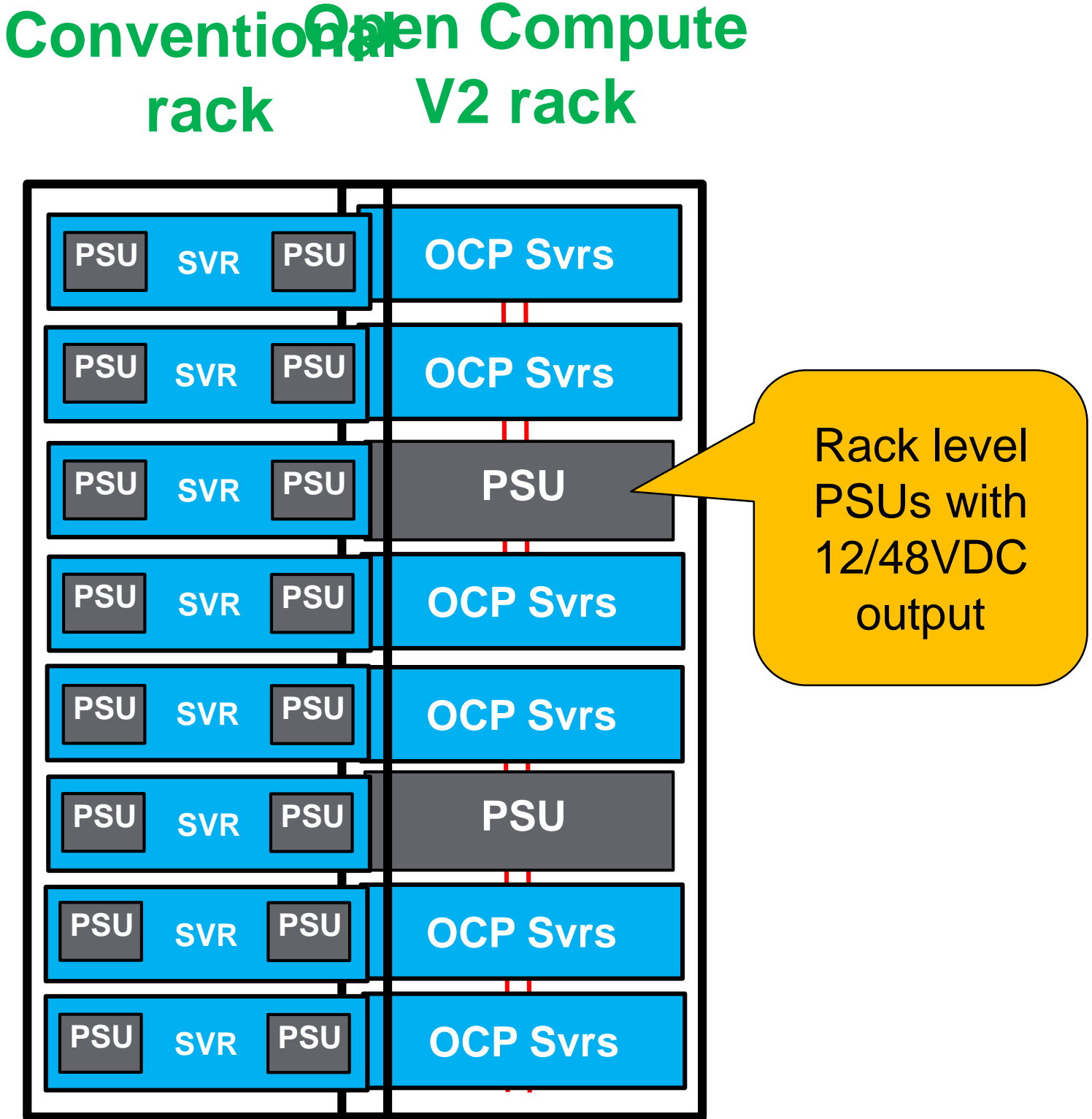
- Typical 2N design
- Engineered by the manufacturer assuming worst case chassis configuration & loading

Conventional rack



Centralized PSUs minimize oversizing

- Can be configured N+1
- Scaled while in the field, better matching actual loading

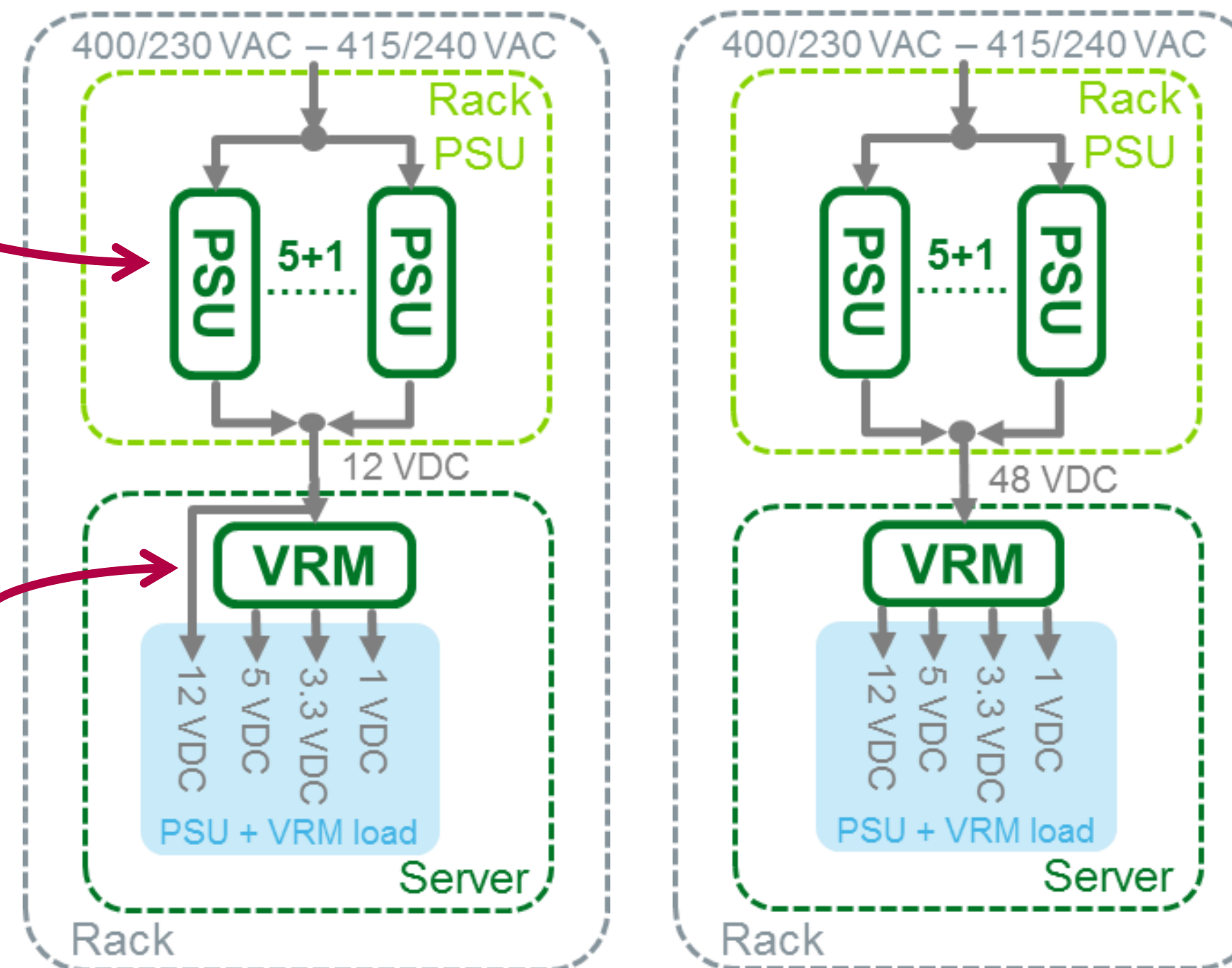


12 & 48VDC rack distribution looks similar

We looked at the 2 major components

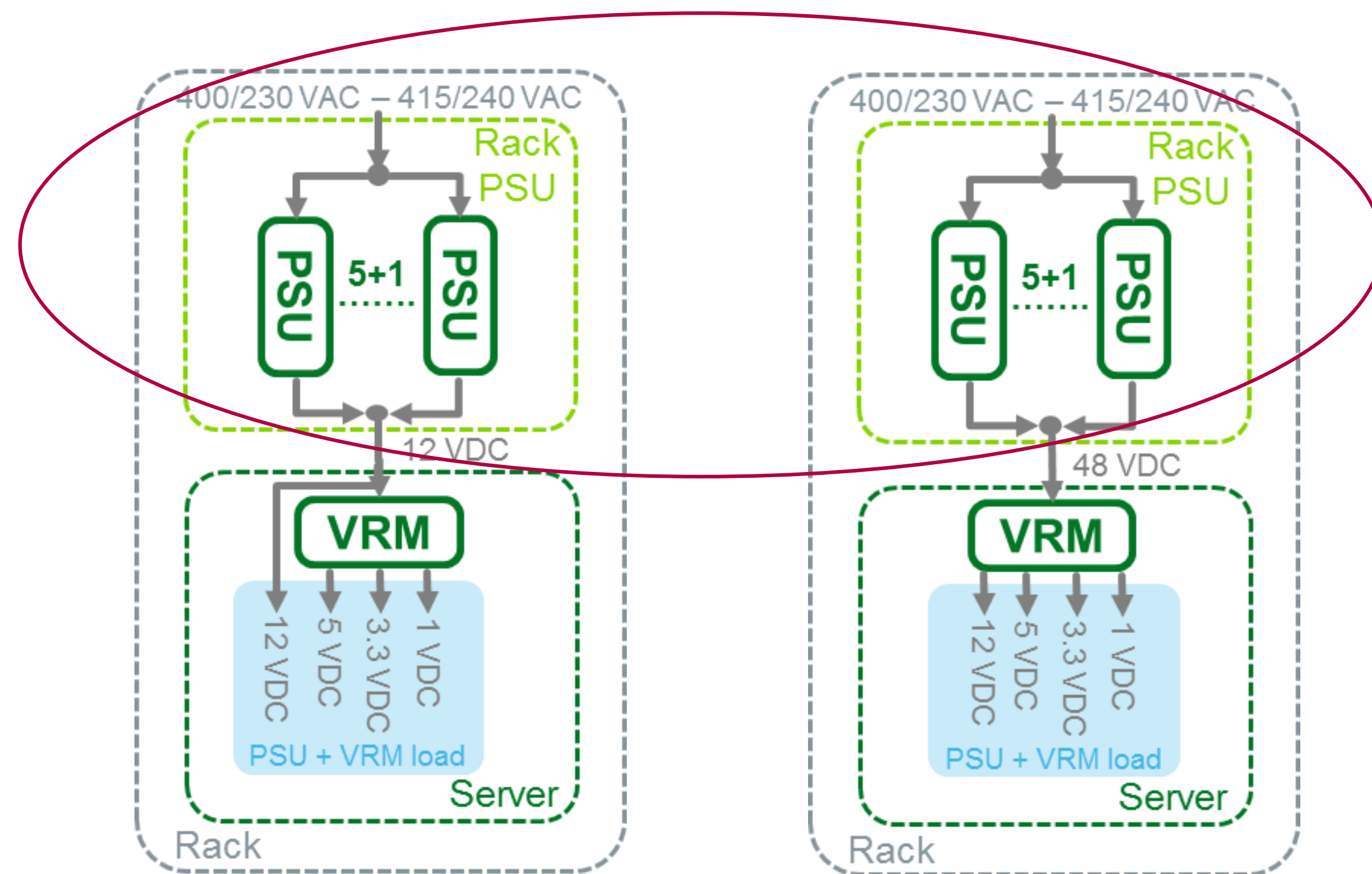
AC → 12 or 48VDC PSUs

12 or 48VDC → PoL Voltage Regulator Modules



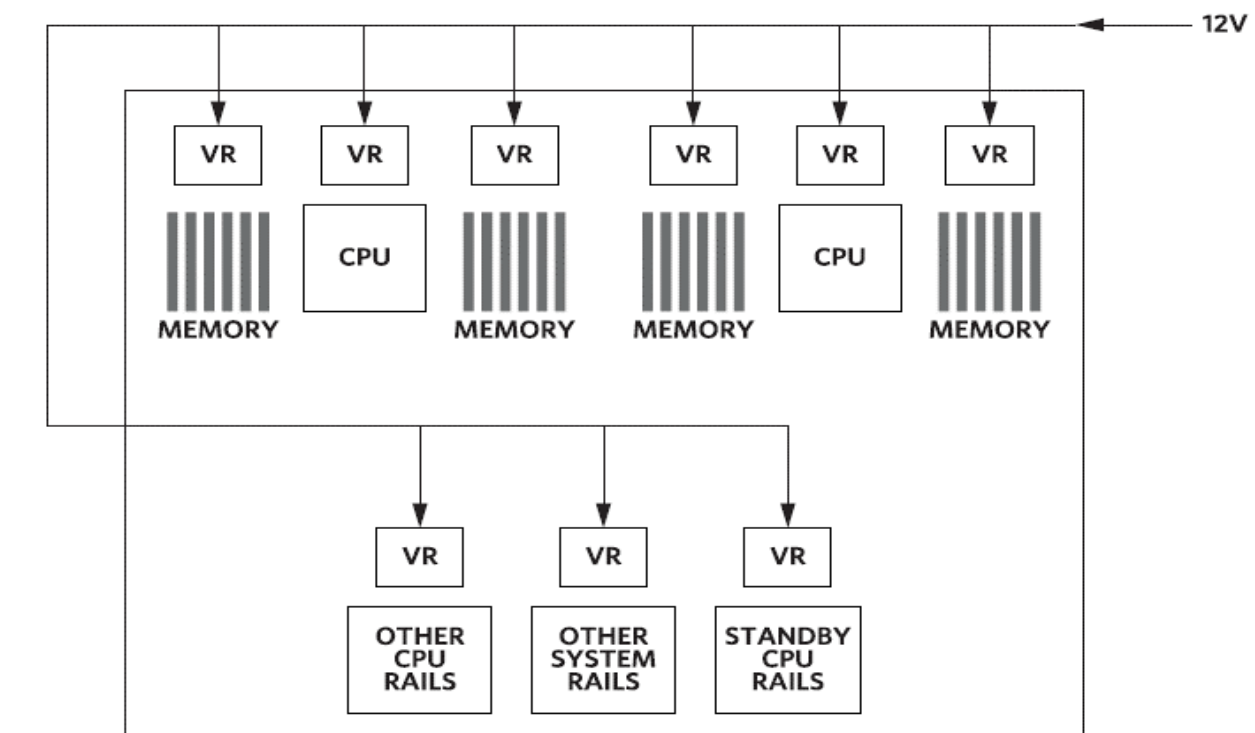
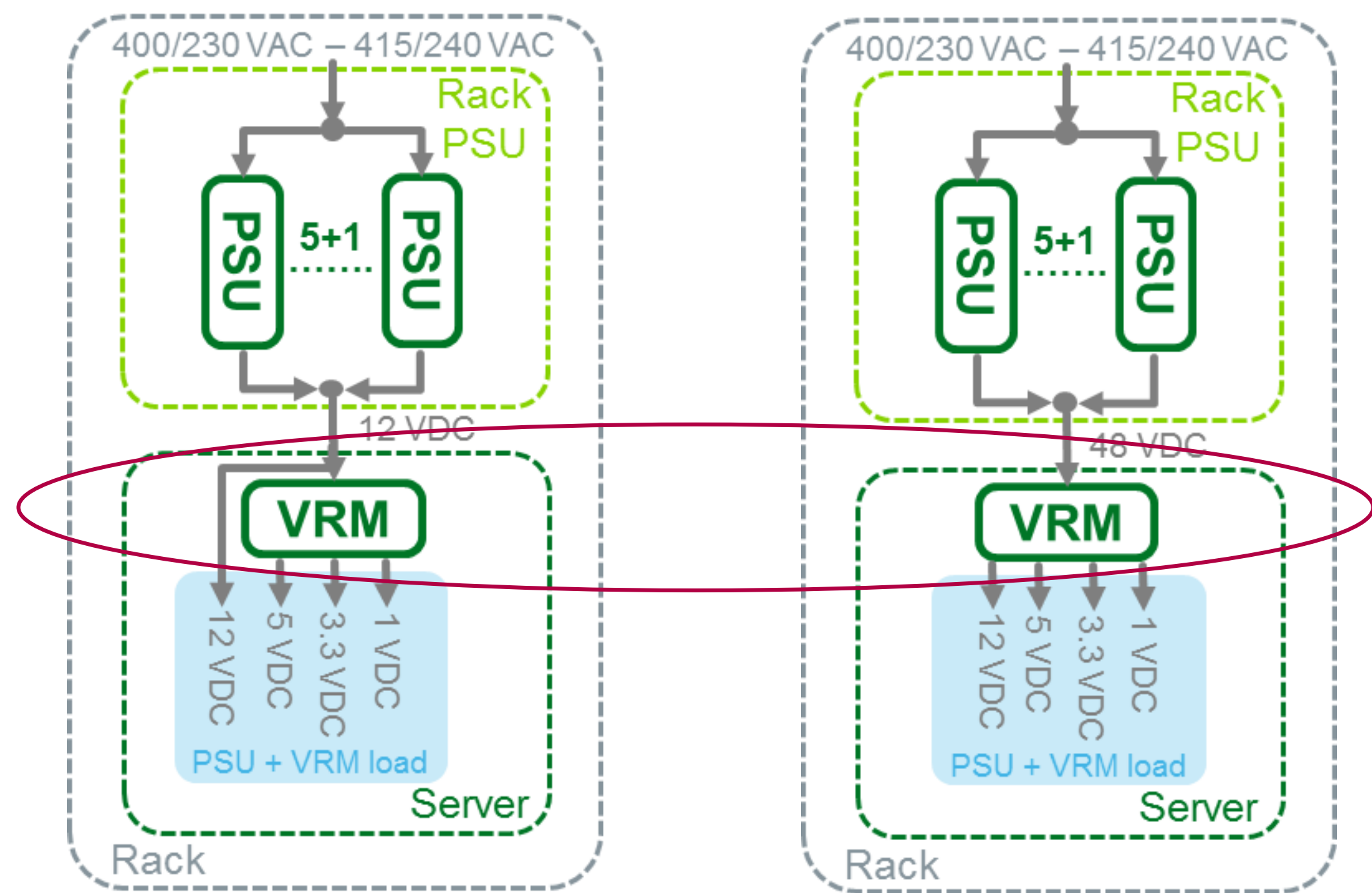
48VDC PSU can edge out 12VDC efficiency

- Both 12VDC and 48VDC PSUs can achieve Titanium (96%) efficiency.
- Due to I^2R losses, 48VDC is less costly to achieve higher efficiencies for the same power level and density.



New 48VDC VRMs bring density and some efficiency

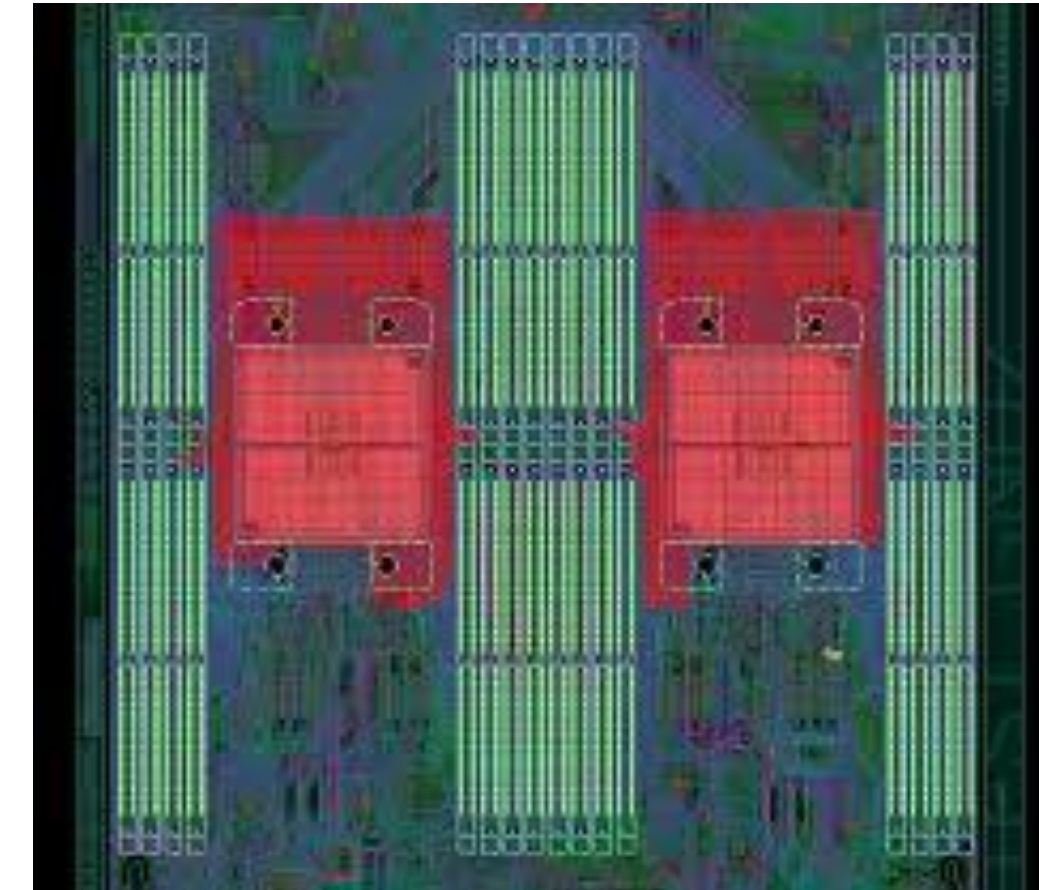
- In the past several years, 48VDC commercially available Voltage Regulator Modules (VRMs) have come to market.
- 48VDC → PoL VRs can provide slightly higher efficiencies depending on configuration. 2% efficiency gain is possible.



* Images courtesy of Maxum Integrated and Vicor

Density and 48VDC

- Increasing chip performance is driven by three main levers:
 - Increase the number of cores
 - Increase transistor count (density)
 - Increase frequency / clock speed
- The need to increase frequency and the use of GPUs is driving chips from 150watts to up to 300 watts.
- Chip packages with VRs allow for use of 48VDC on the board and higher power densities.



Putting the numbers together – Efficiency Calculator

Tool Demonstration

Data Center Rack Power Architecture Efficiency Calculator - Google Chrome

Secure | <https://www.schneider-electric.com/en/work/solutions/system/s1/data-center-and-network-systems/trade-off-tools/data-center-rack-power-architecture>

Life Is On | Schneider Electric | RACK POWER ARCHITECTURE EFFICIENCY CALCULATOR | [Twitter](#) | [LinkedIn](#) | [Print](#) | [Email](#) | [Info](#) | [Help](#)

Inputs

Data Center Characteristics

N. America | United States | Nationwide data

Electric Cost per KWh: \$ (USD) | 0.101 | Override

PSU + VRM Capacity: 1,000 kW (DC)

Conventional ITE Level PSU Architecture

Server PSU Redundancy: N (1+0)

Oversize Factor: 1.5

Peak Server PSU Eff.: 90.0%

Peak 12 VDC VRM Eff.: 88.0%

12 VDC Load: 15%

Rack Level PSU Architectures

Rack PSU Redundancies: N+1 (5+1)

Oversize Factor: 1.2

Peak 12 VDC Rack PSU Eff.: 94.0%

Peak 48 VDC Rack PSU Eff.: 95.0%

48 VDC VRM Eff. Improvement: +2.0%

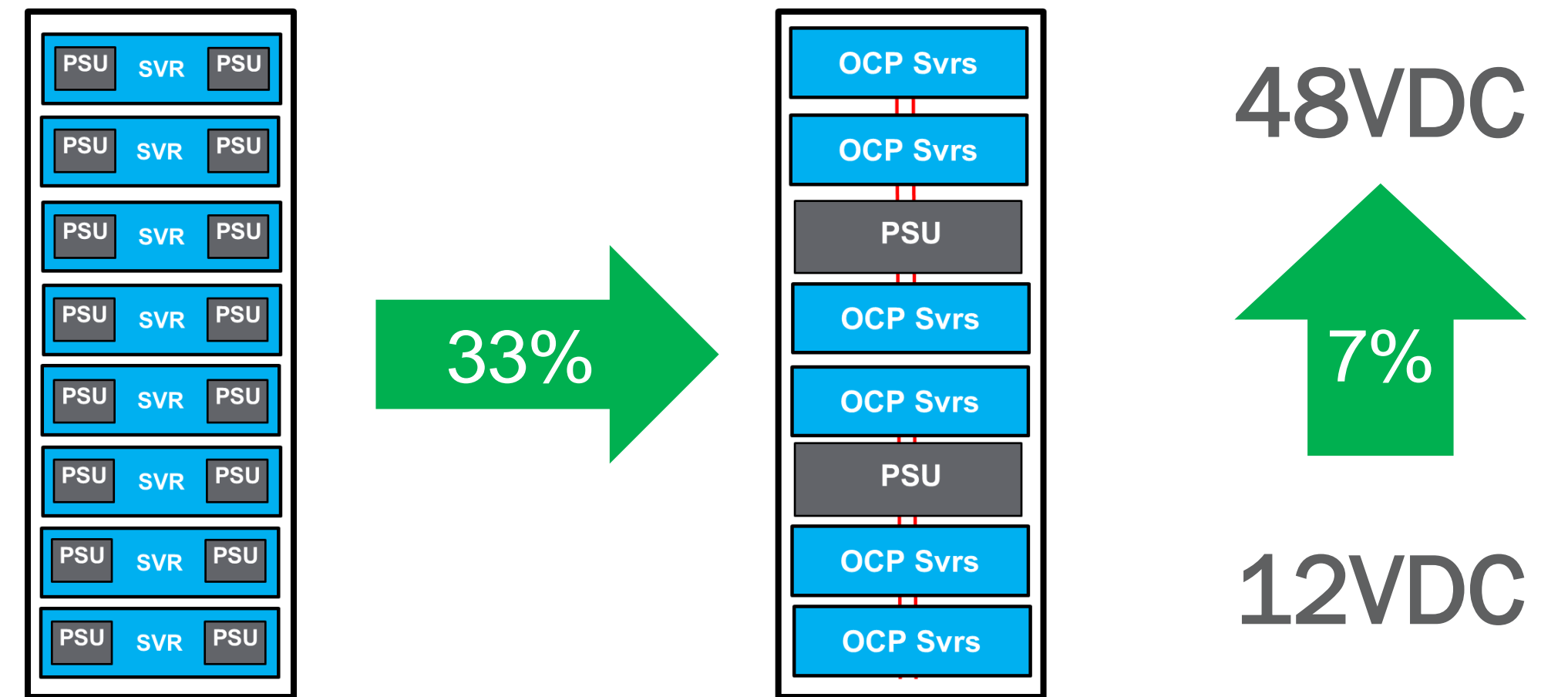
Results

Overall Efficiency at 50% Load: Efficiency

	Conventional	12 VDC	48 VDC
Efficiency	79.1%	83.0%	84.1%
Excess PSU Capacity	50%	44%	44%

Analysis Take Away

- Consolidating power supplies provide the most dramatic energy improvement 33% *lower losses*.
- 48VDC rack distributions major advantage is delivering high rack densities, but can provide up to 7% *lower energy losses* over 12VDC



Rack-level architectures do **show significant improvement** in efficiency over conventional servers, primarily due to the reduction in oversizing of the PSUs (both from less redundancy “overhead” and consolidation of server PSUs).

48V direct current is a likely bet for the future, not for the incremental efficiency improvement over 12V direct current, but because of the need for increased compute and density.



OCP
SUMMIT

OPEN.



**FOR
BUSINESS.**



Backup

Tradeoff tool:

<https://www.schneider-electric.com/en/work/solutions/system/s1/data-center-and-network-systems/trade-off-tools/data-center-rack-power-architecture-efficiency-calculator/>

<https://blog.schneider-electric.com/datacenter/2018/05/24/12v-vs-48v-the-rack-power-architecture-efficiency-calculator-illustrates-energy-savings-of-ocp-style-psus/>