

OCP Engineering Workshop 10 August 2016| Durham, NH

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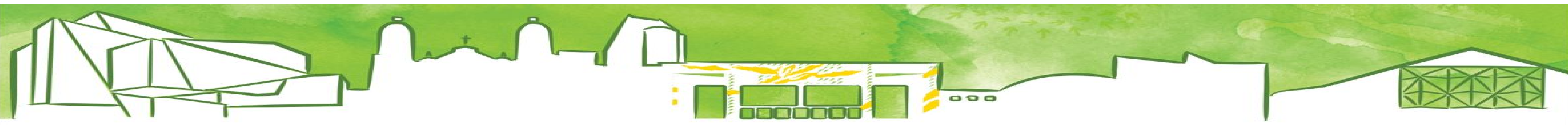
Overview of Open Rack Standard V2.0

Steve Mills
Technical Lead - Facebook

Goals for Open Rack V2.0 Today

Part 1: Overview of what is changing in V2.0

Part 2: Rigorous review of the Standard details



Overview of Open Rack Standard V2.0:

What's Covered?

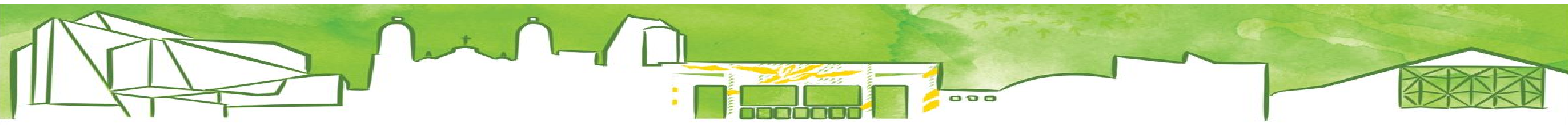
Rack Frame

12V:

- Busbar
- Interconnect
- Power Shelf

48V:

- Busbar
- Interconnect
 - Power Shelf
 - Rectifiers
 - IT tray power
- BBU
- Rack Management Controller



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48V Motivations

Mike Lau and Xin Li
Technical Lead Managers - Google

Why we're here...

48VDC Power/UPS

Alternative Form
Factor Support



Open Rack



Why 48V Power Architecture?

Efficient 48V to PoL VR technologies

Reduced distribution losses & voltage drop

Support higher power

Flexibility in deployment

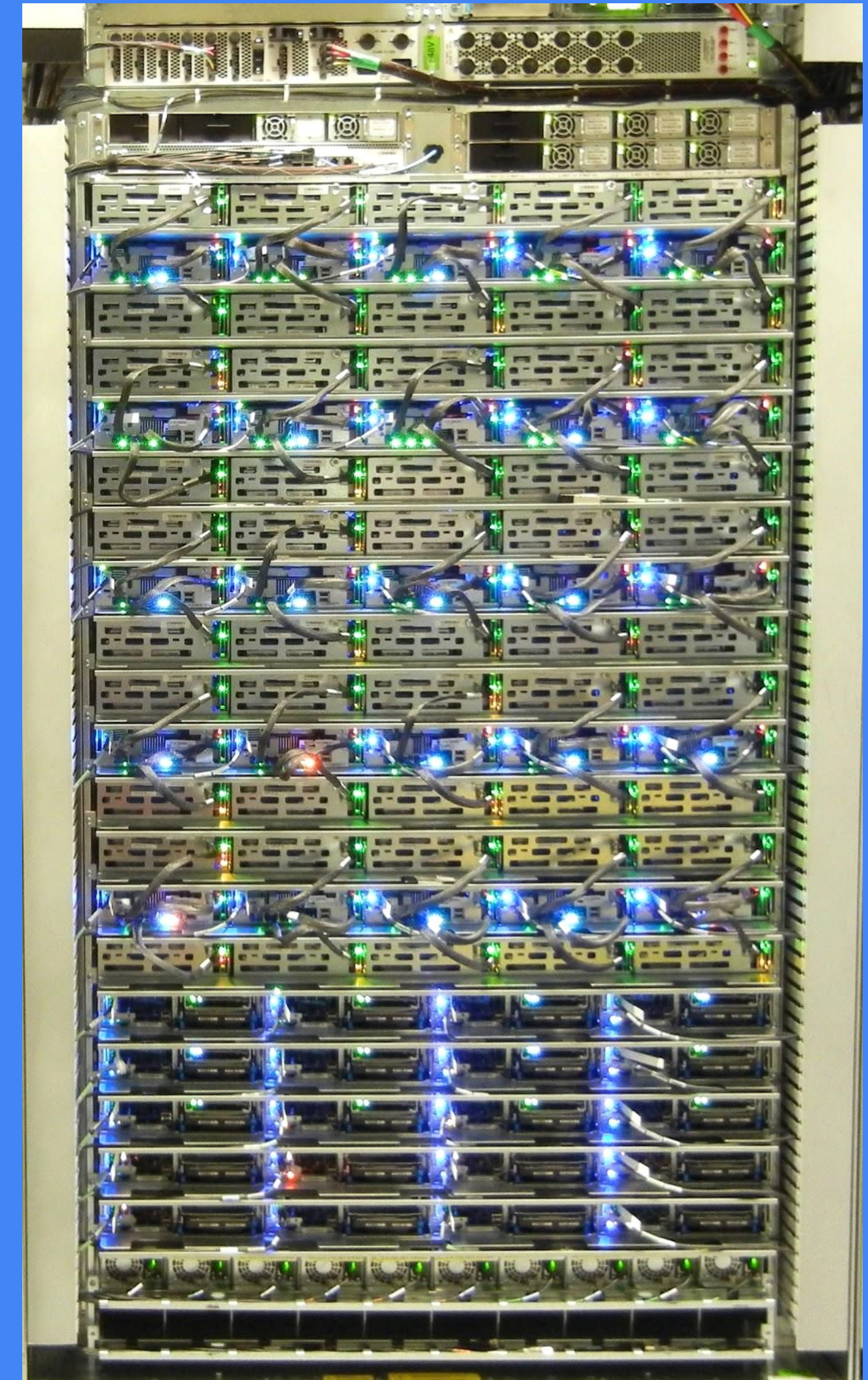
“Safe” Voltage - SELV

Cost-effective and reliable in-rack UPS

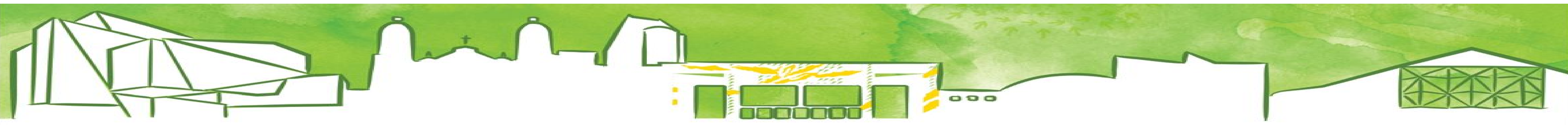
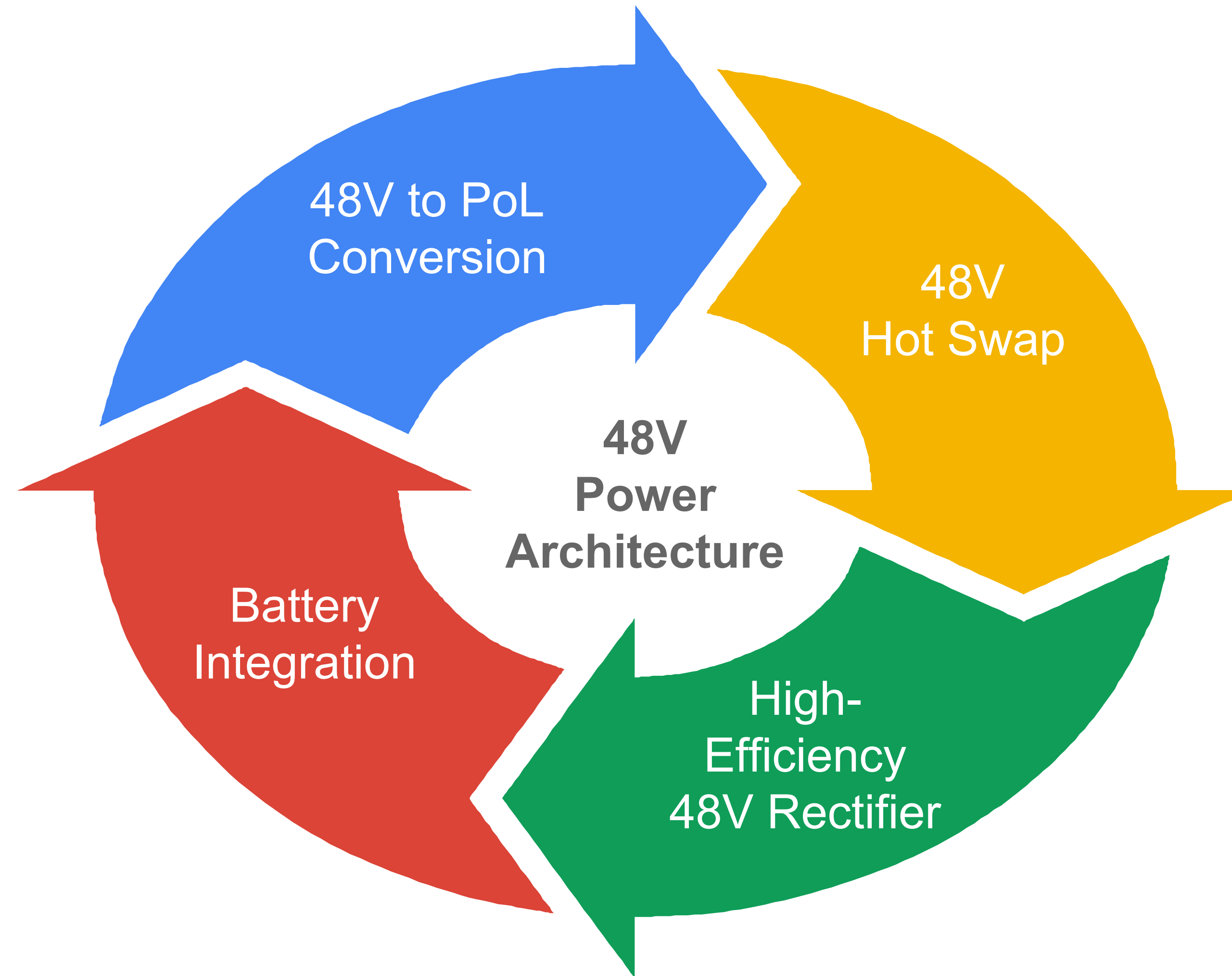
AC-to-48VDC

48V to PoL
Payloads

48VDC UPS



Key Technologies Around 48V



48V to Point-of-Load Technology

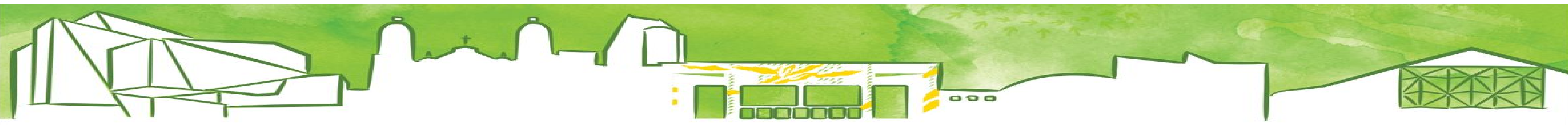
Google deployment at scale since 2010

High-efficiency conversion

Isolated and non-isolated versions

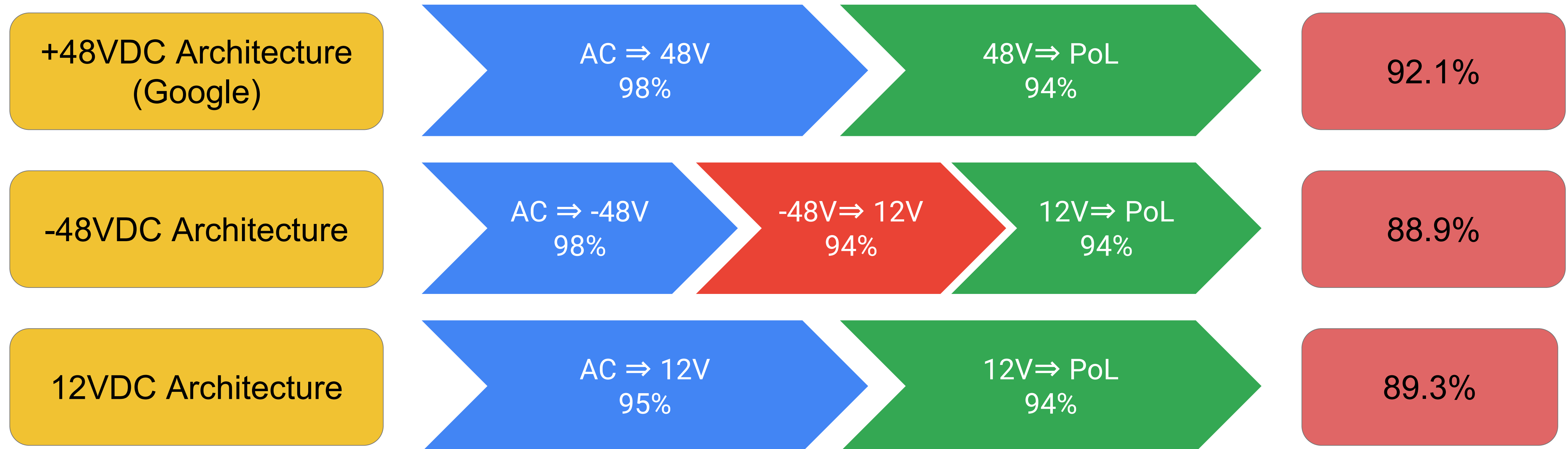
Multi-source solutions available

Google enabled suppliers to sell solutions to Industry

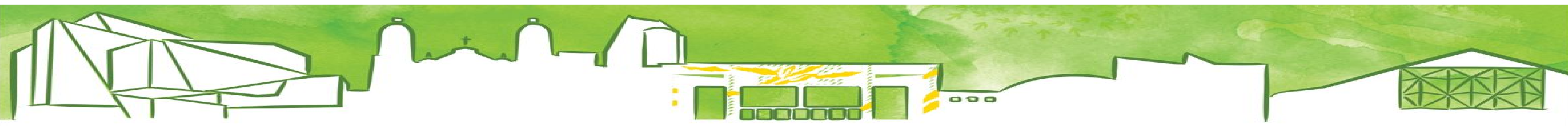


Typical Conversion Efficiency

System Efficiency



Note: Distribution Loss reductions provide additional efficiency gains @ 48V



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Mechanical Highlights

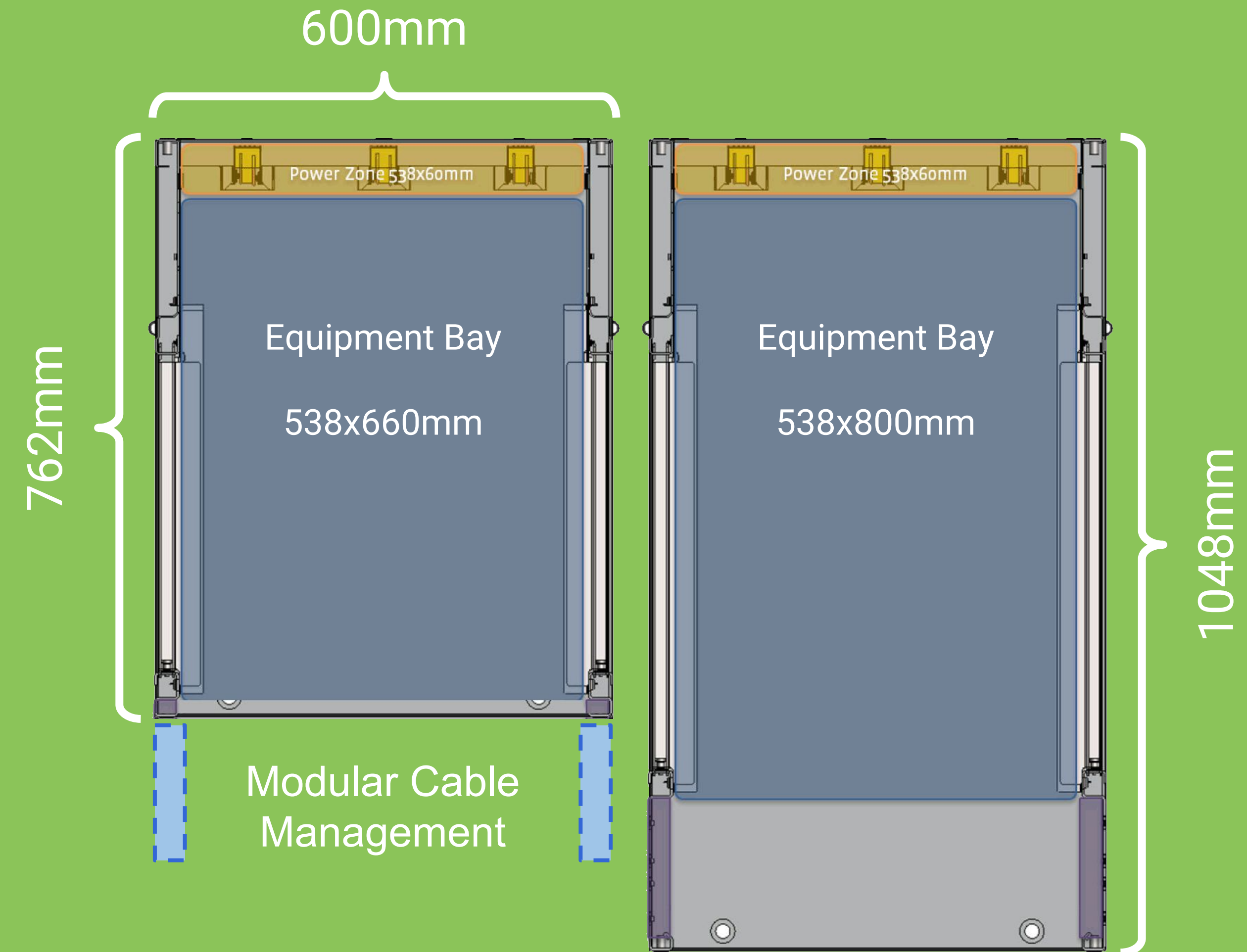
Mike Lau
Mechanical Technical Lead Manager - Google

Rack Sizing and Configurations

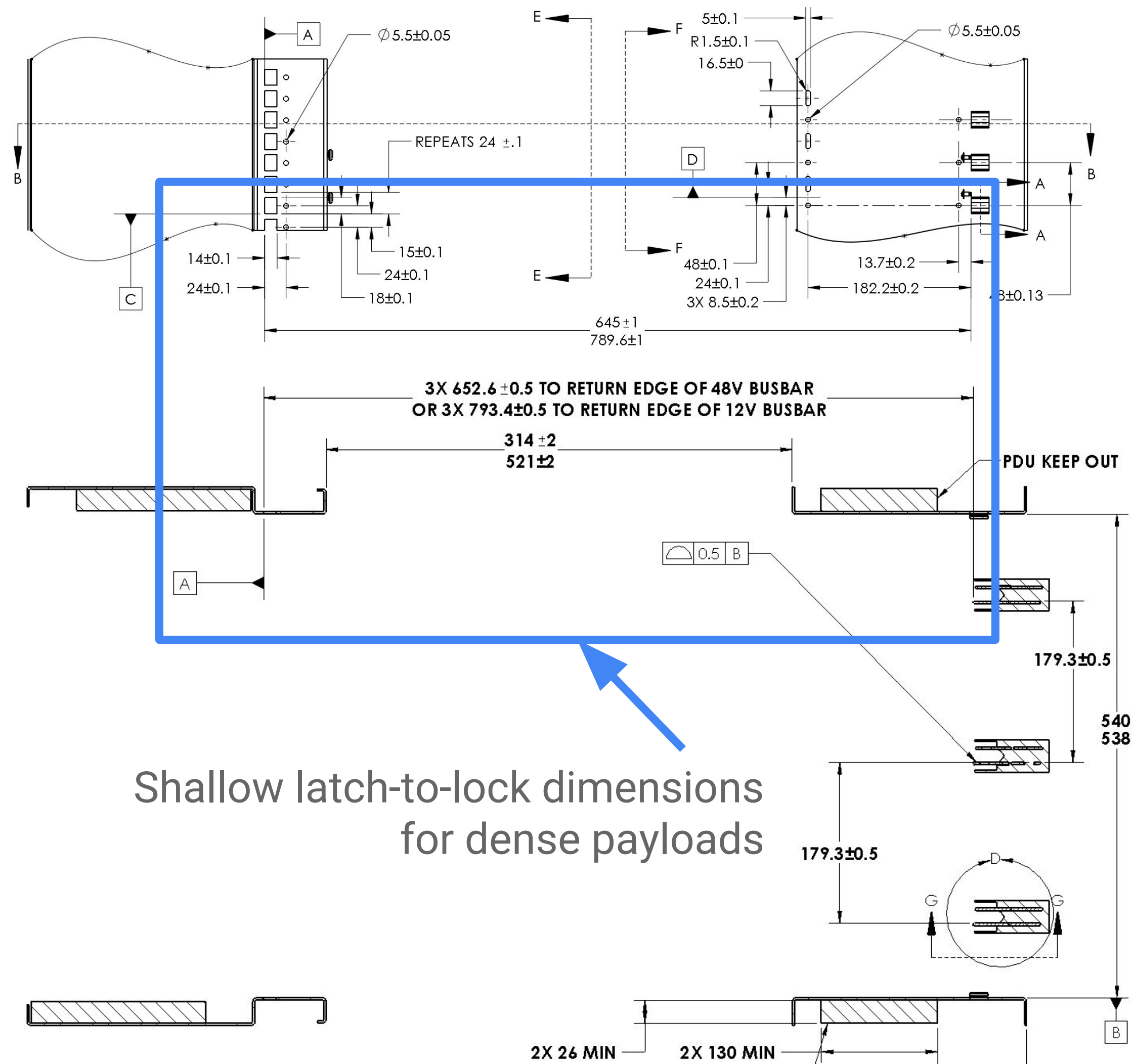
Shallow-depth rack design for increased deployed density and optimized cooling

Maintains 600mm exterior width

New 762mm base rack with provisions for cable management expansion



IT Gear Interface Points

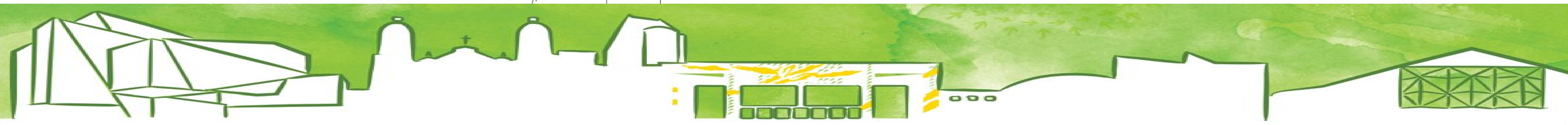


Reduction in exterior rack depth with minimal reduction in IT Gear depth

- Driven by latch to rear stop dimension
 - 645mm for high-density designs
 - 789.6mm for existing V1.2

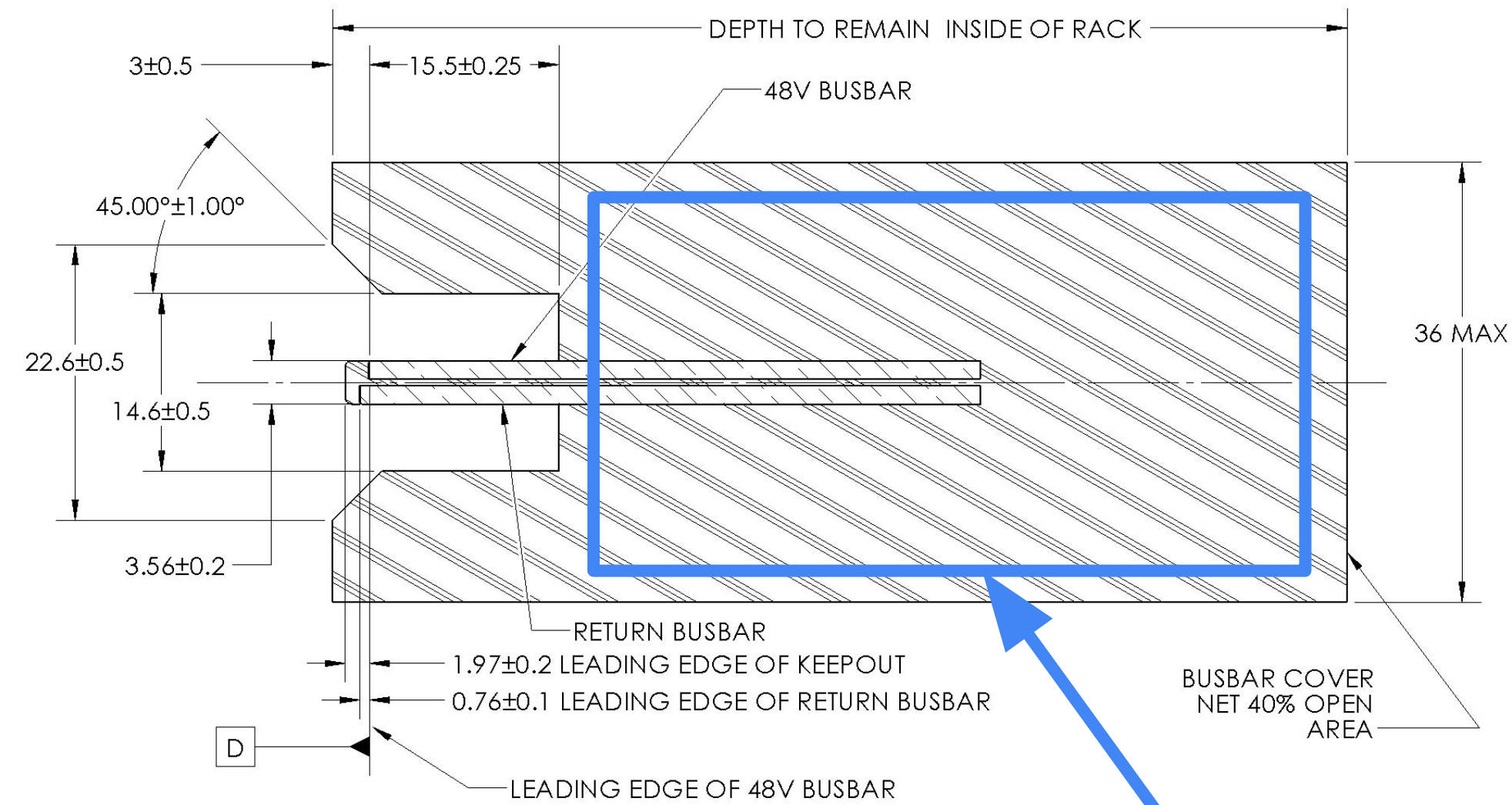
Rack interface design unchanged

- Busbar-as-a-module for 48V and 12V
- Upgrade path to 48V



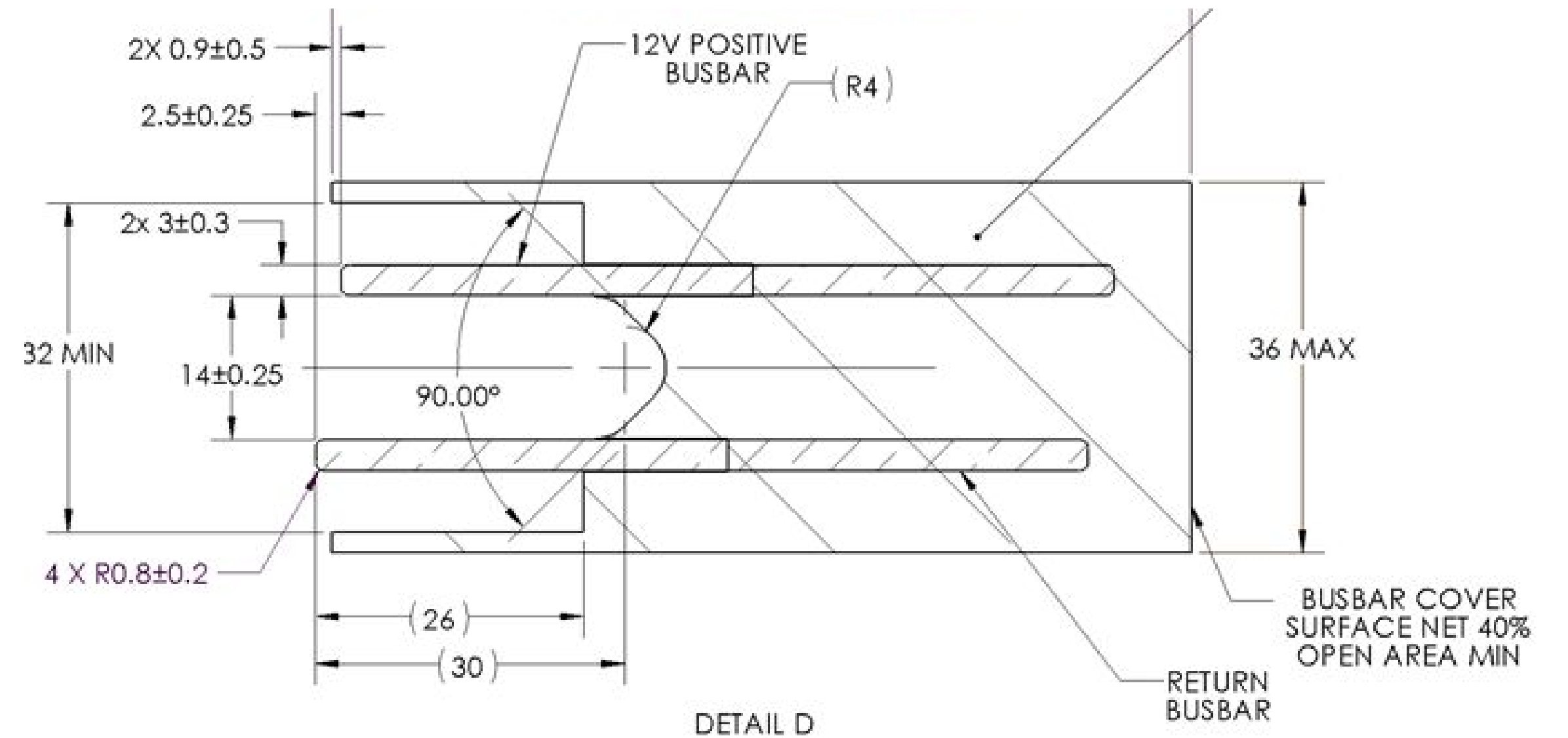
Rack-Level Busbar

48V Busbar



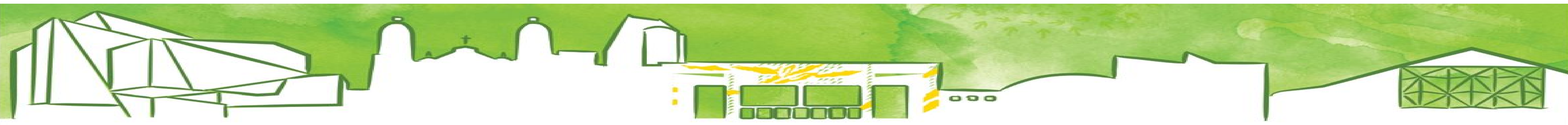
Volume for busbar expansion

12V Busbar



Common volume reserved for busbars between 48V and 12V configurations

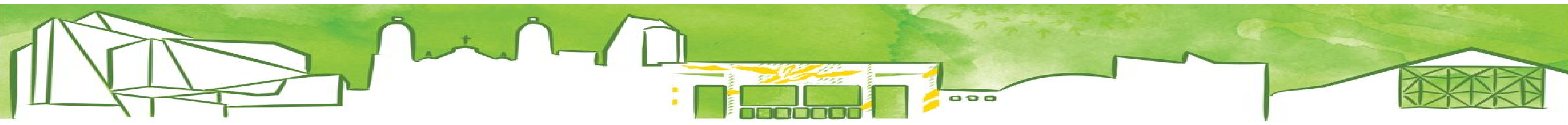
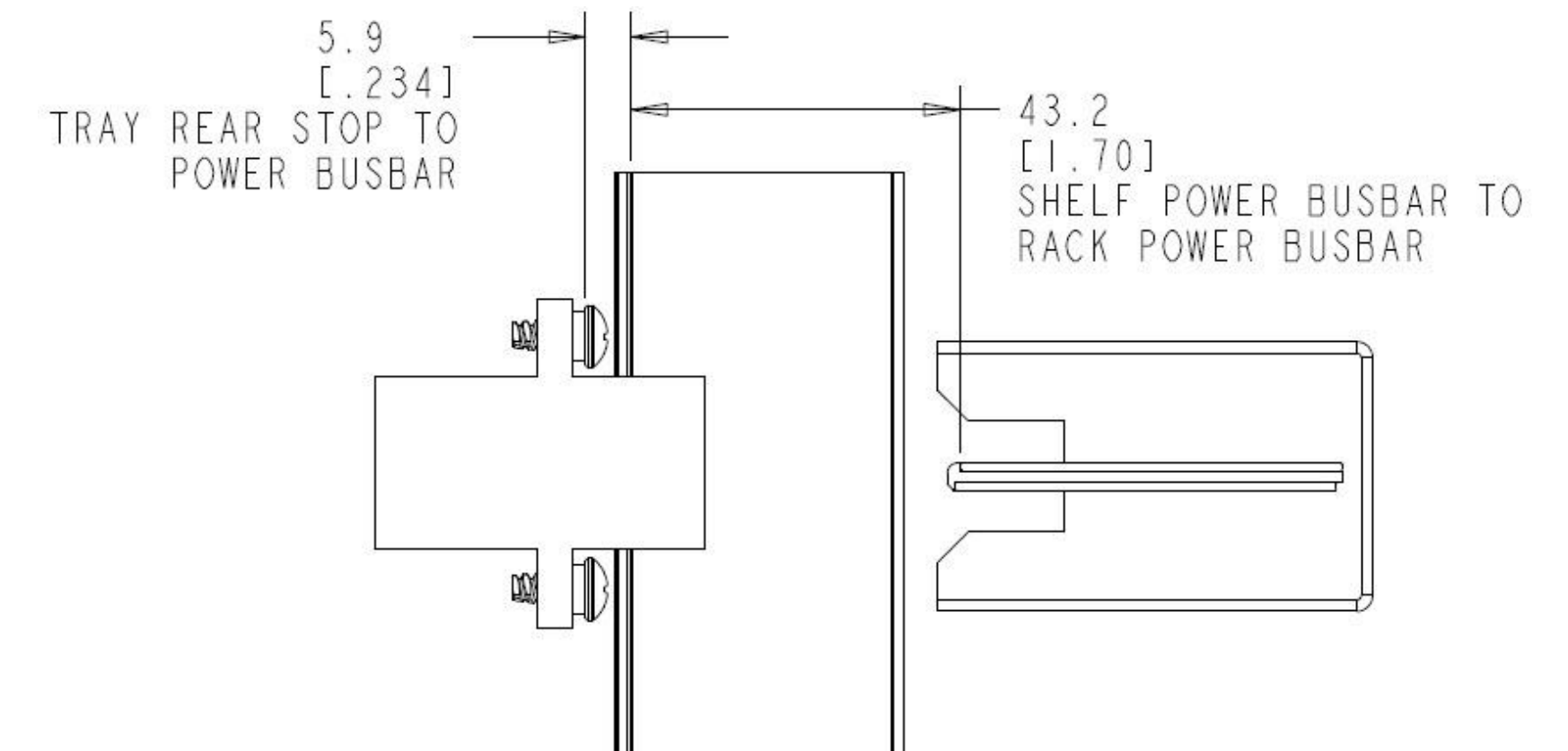
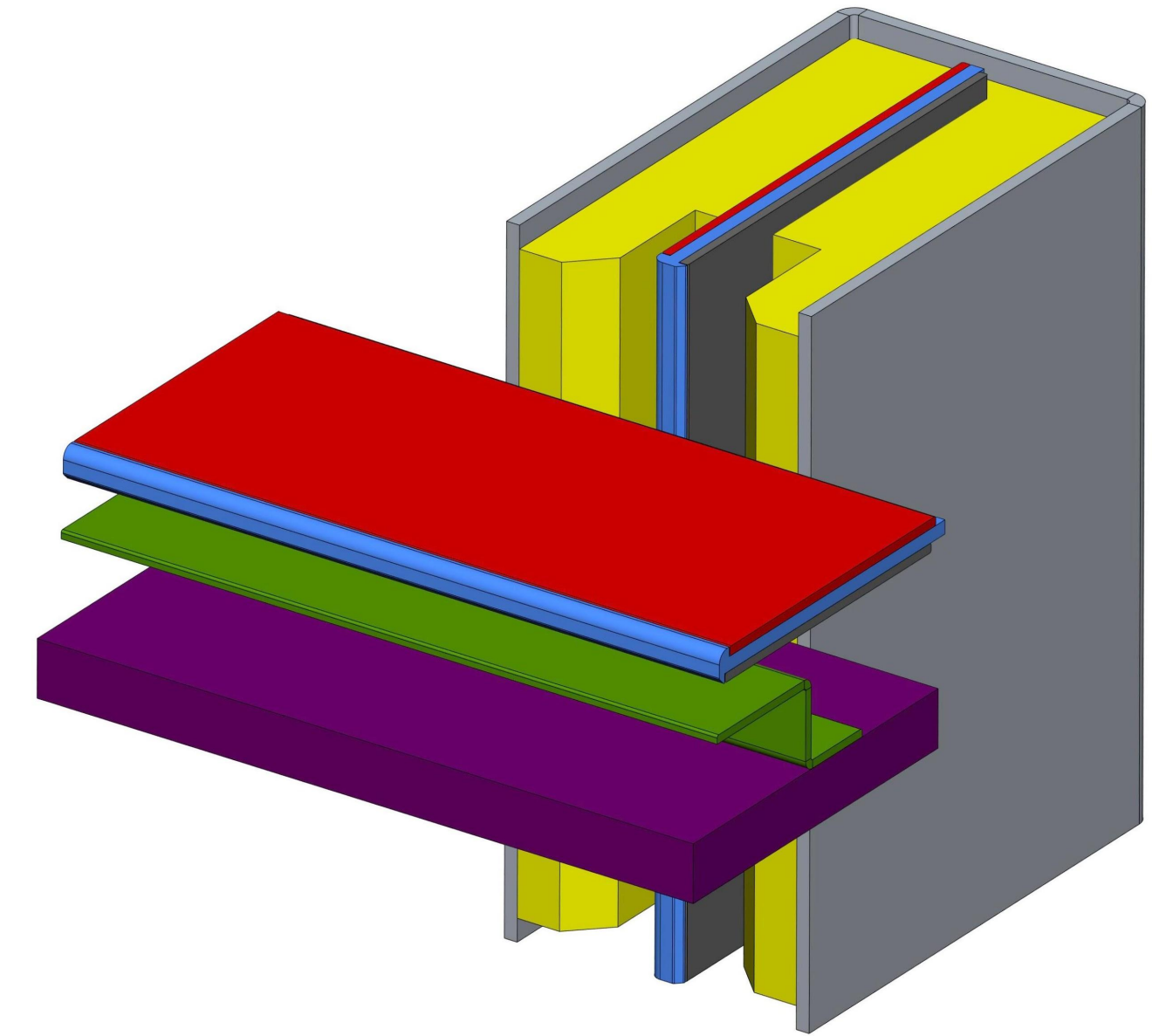
- 48V busbar features thin Power and Return busbar assembly
- Scalable power capacity while maintaining mating interface via busbar depth and profile



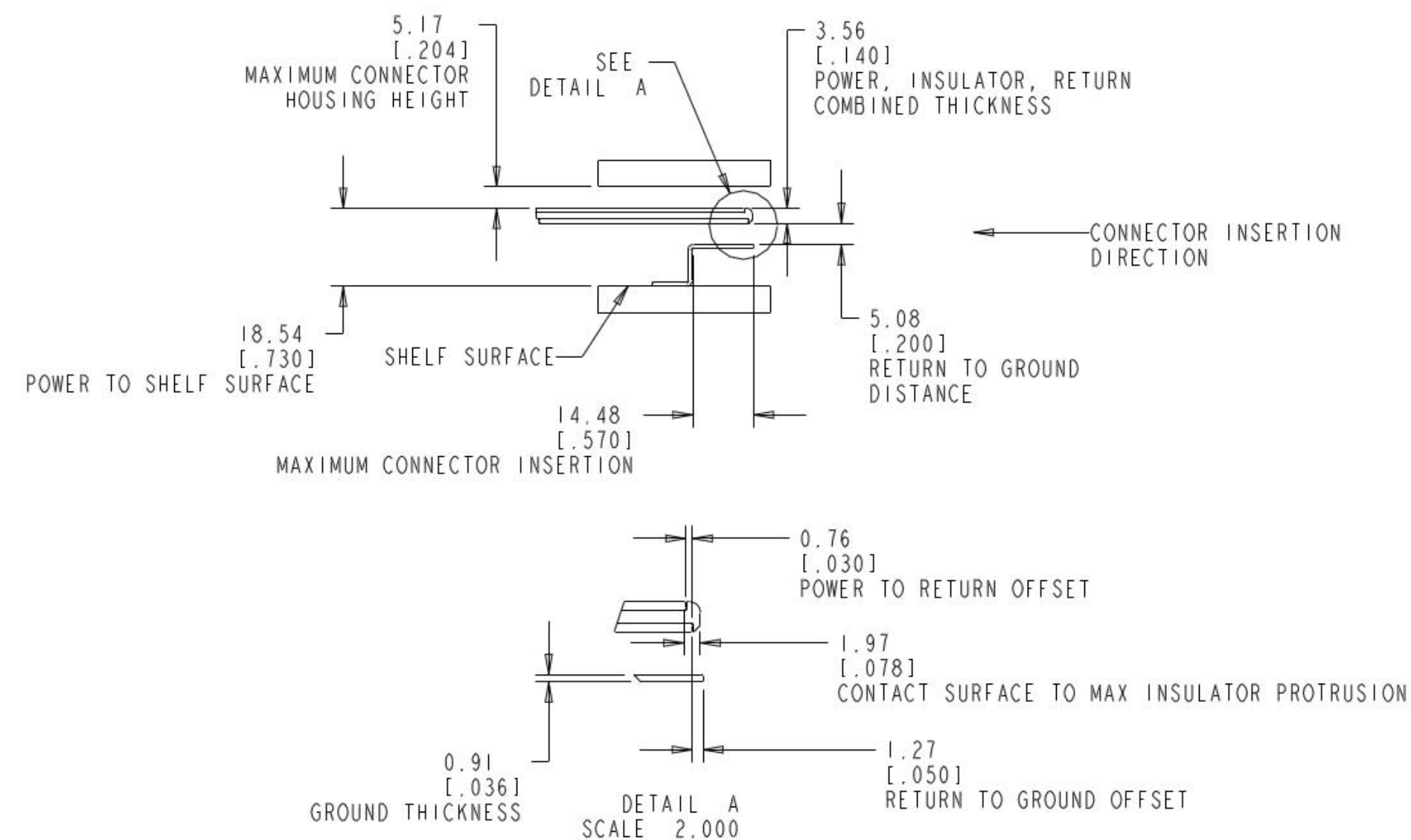
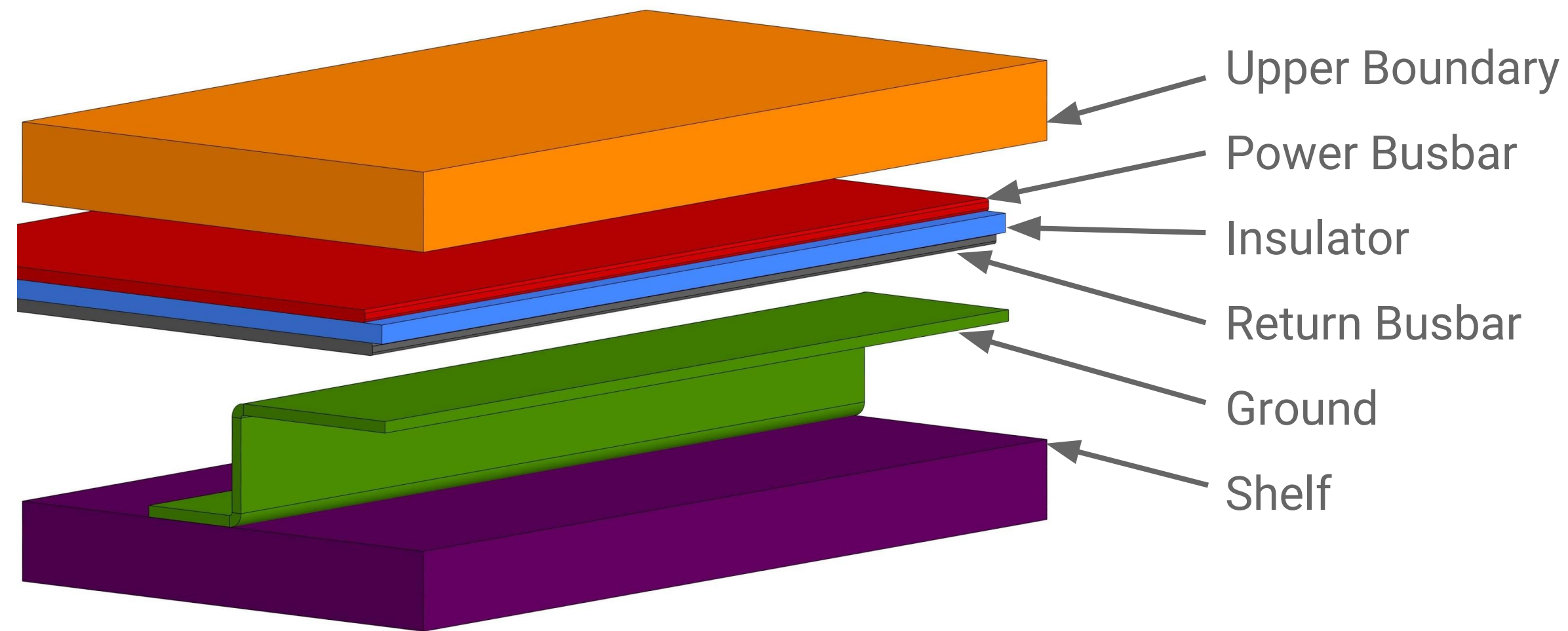
Rack Power Distribution and Interconnect

Scalable ecosystem of busbars and connectors

- Low-cost and efficient rack-level and shelf-level busbars
- Scalable and pitch agnostic connectors
- Common power delivery interconnect across payload product lines
- Busbar and connector configuration prevents accidental connection of 12V gear into 48V rack

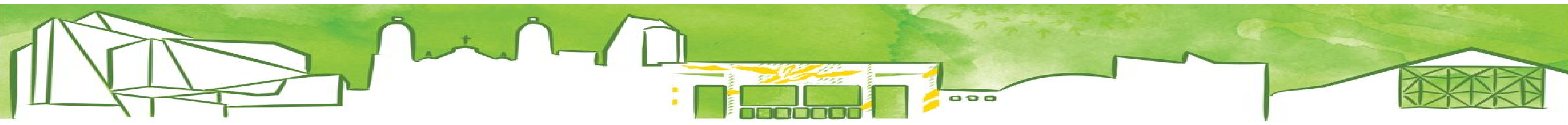


Shelf-Level Busbar



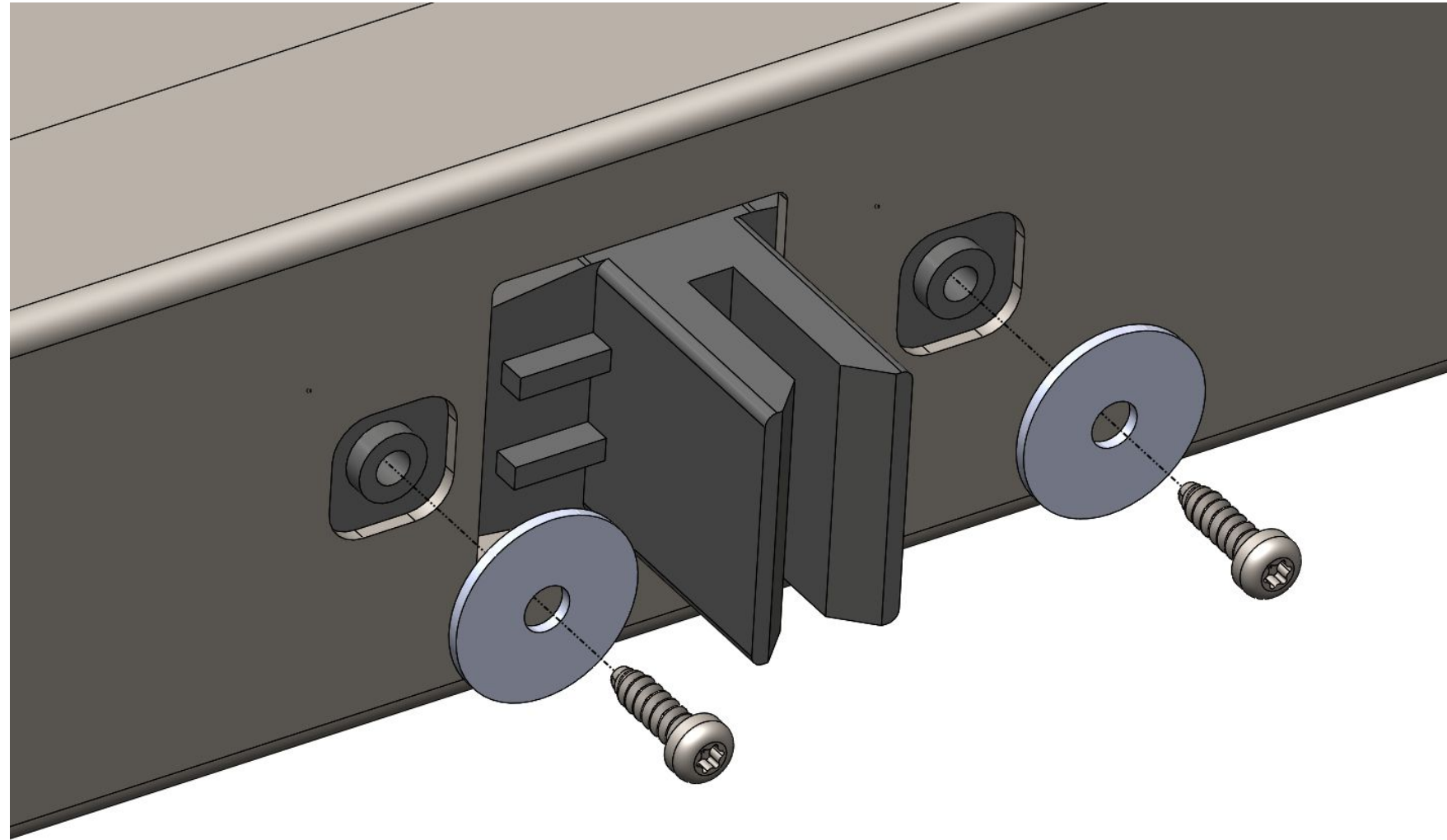
Pitch agnostic IT Tray power delivery

- Horizontal position of connector within IT Tray not fixed to discrete positions
- One shelf; multiple width IT Trays
- Shares power/return busbar interface as Rack-Level Busbar

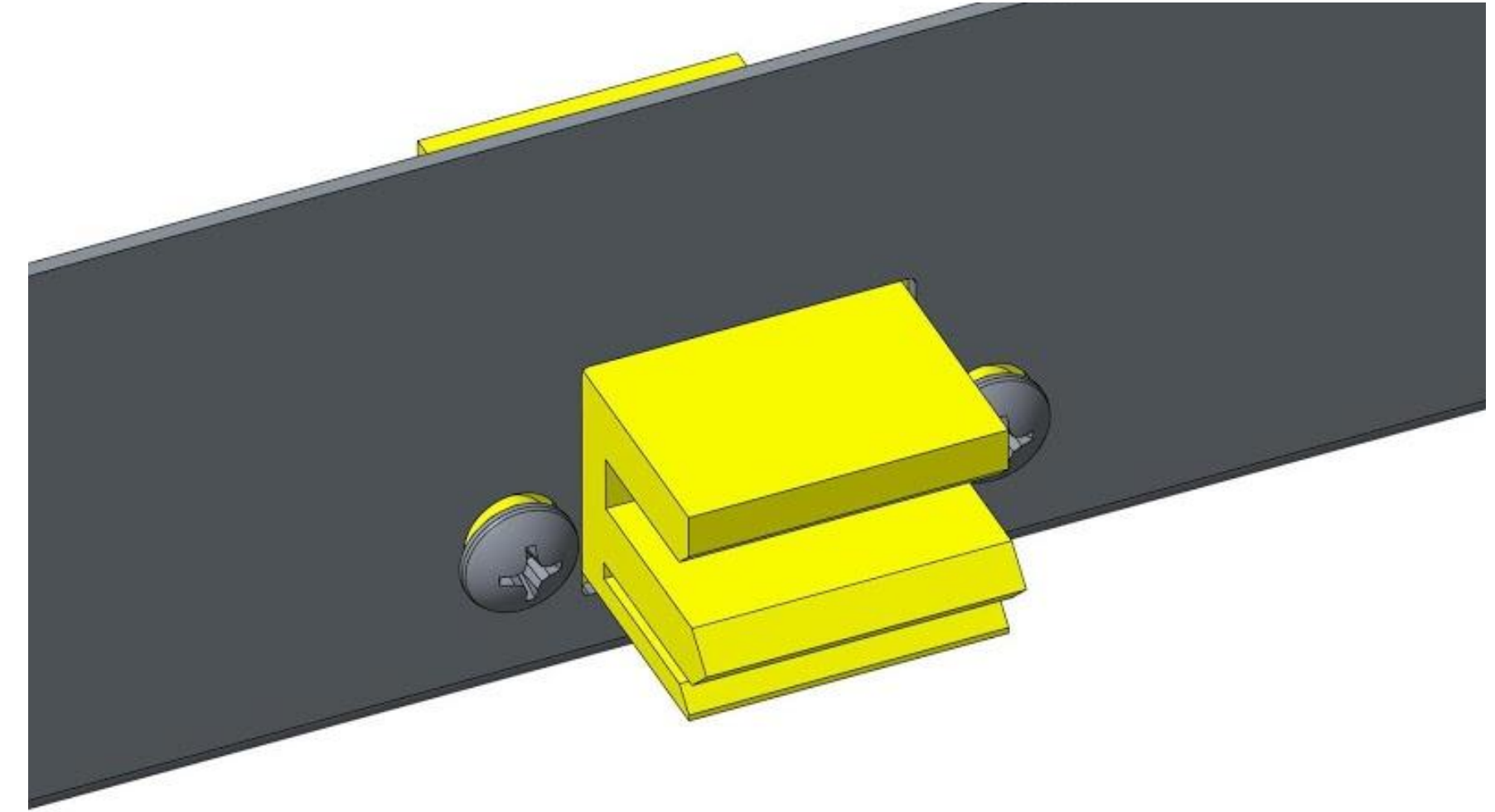


48V Connector Mount

IT Gear to Rack-Level Busbar

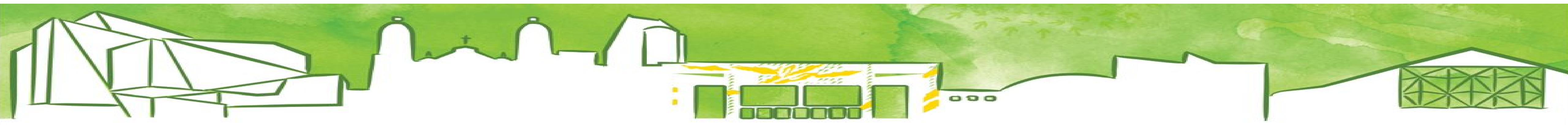


IT Tray to Shelf-Level Busbar



Panel-mounted, floating connectors at rear of IT Gear and IT Trays

- Vertical orientation for mating with Rack-Level busbars
- Horizontal orientation with chassis ground connection for mating with Shelf-Level busbars



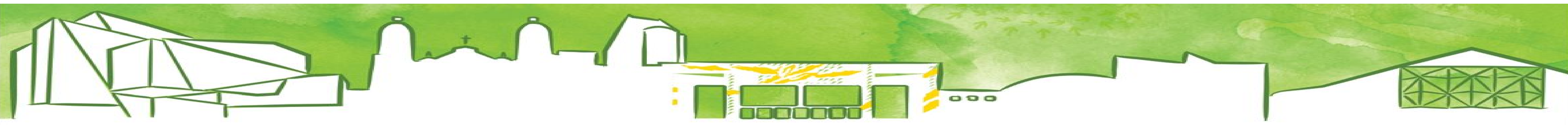
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Power Highlights

Xin Li
Power Technical Lead Manager - Google

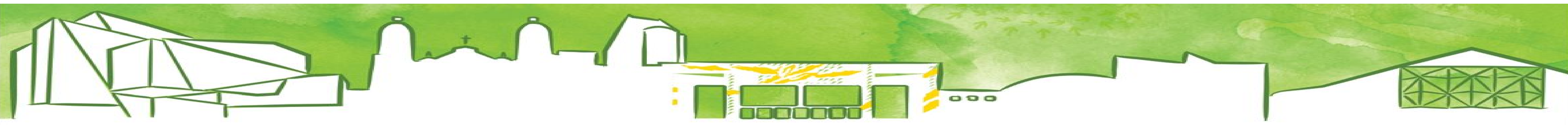
48V Power Requirements List

- Rack electrical requirement
- IT tray power requirement
- 48V rectifier unit power requirement
- 48V battery backup unit power requirement



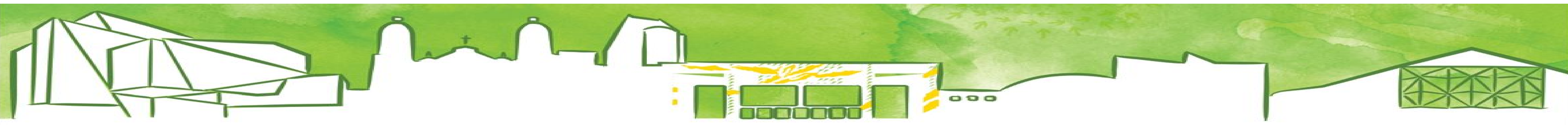
48V Rack-Level Electrical Highlights

- Operating voltage range: 40V - 59.5V
- Nominal voltage: 54.5V
- Grounding: 48V return grounded at power shelf level



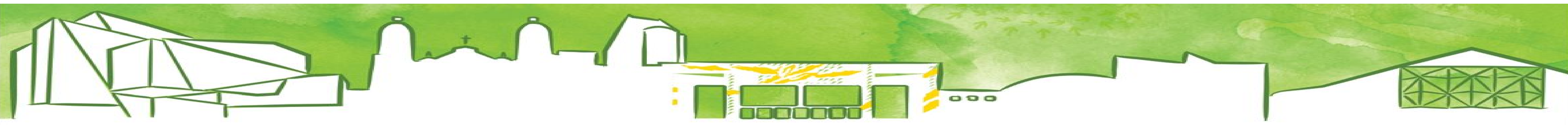
48V IT Tray Highlights

- Operating input voltage range: 40V - 59.5V
- Hot Swappable
- CPU and DDR rails: 48VtoPoL VRs are recommended
- Minimum VR efficiency requirement
- Power monitoring



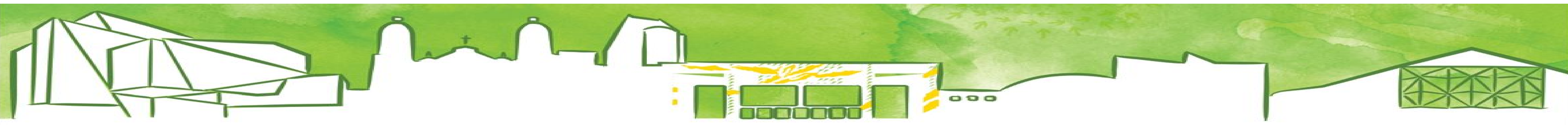
48V Rectifier Highlights

- Input rated voltage 200V to 240V AC or 200V to 277Vac
- Output voltage programmable from 42V - 58 Vdc, output defaulted to 54.5V
- Peak efficiency > 97.0% at $V_{in} = 230VAC$, measured with fans
- Capable of operating as either +48V or -48V system polarity.
- Redundant, parallel operation with load sharing
- Hot swappable
- Firmware Interface



48V Battery Back-Up Unit Highlights

- Operating input voltage range: 38V - 59.5V
- Hot Swappable
- Multi-operating states
- Remote firmware update



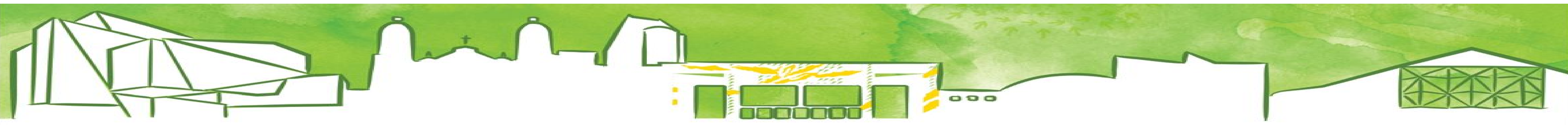
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Rack Management Highlights

Chris Moynihan
Software Tech Lead - Google

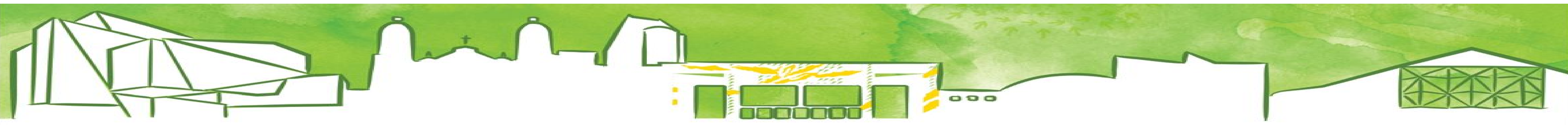
Rack Management Highlights

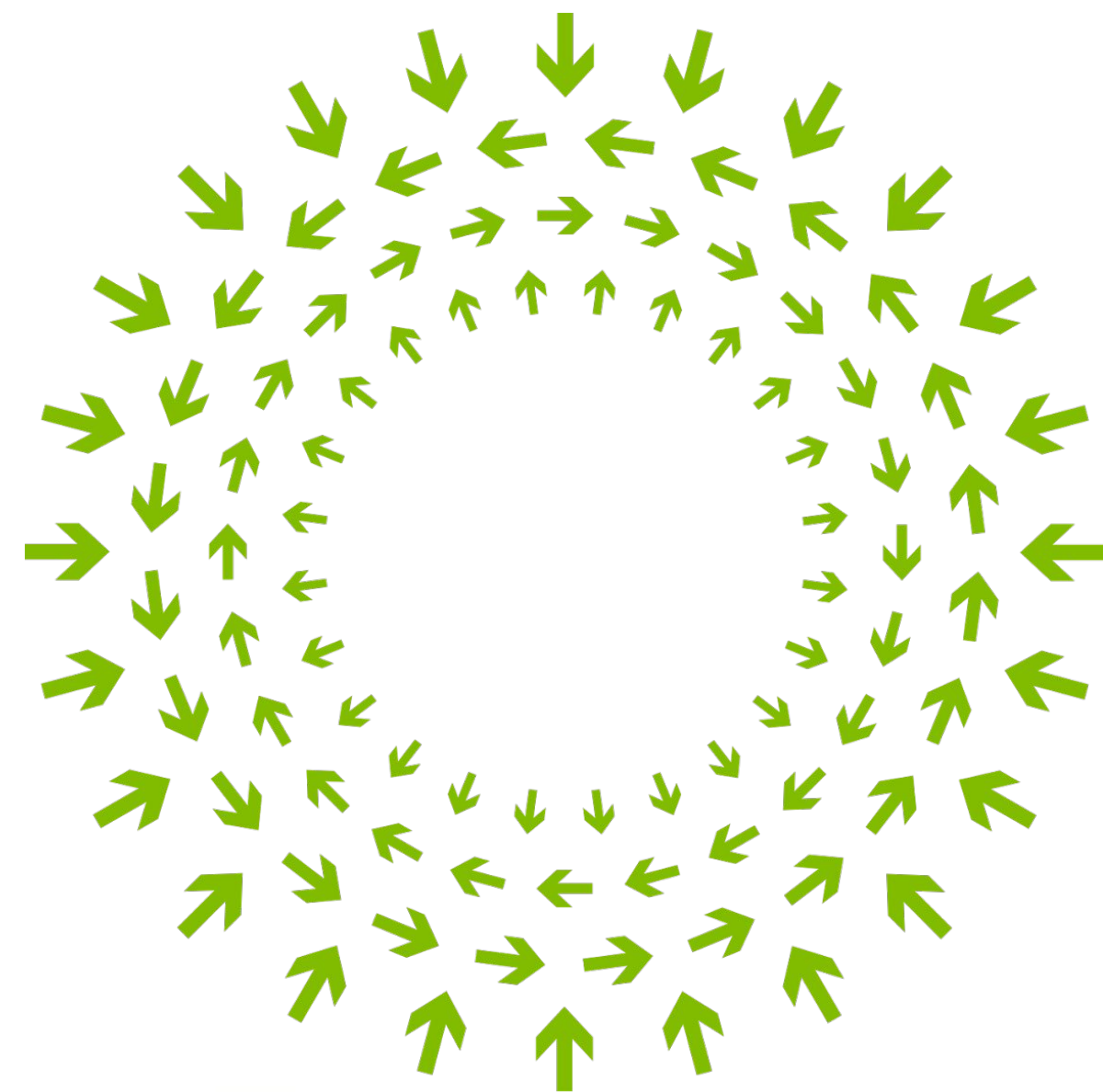
- Optional rack management controller. Open to a range of solutions.
- Minimum features
 - 1GE ethernet
 - Power shelf management (rectifiers and optional BBUs)
 - Hot swappable



Rack Management Highlights: Preferred Features

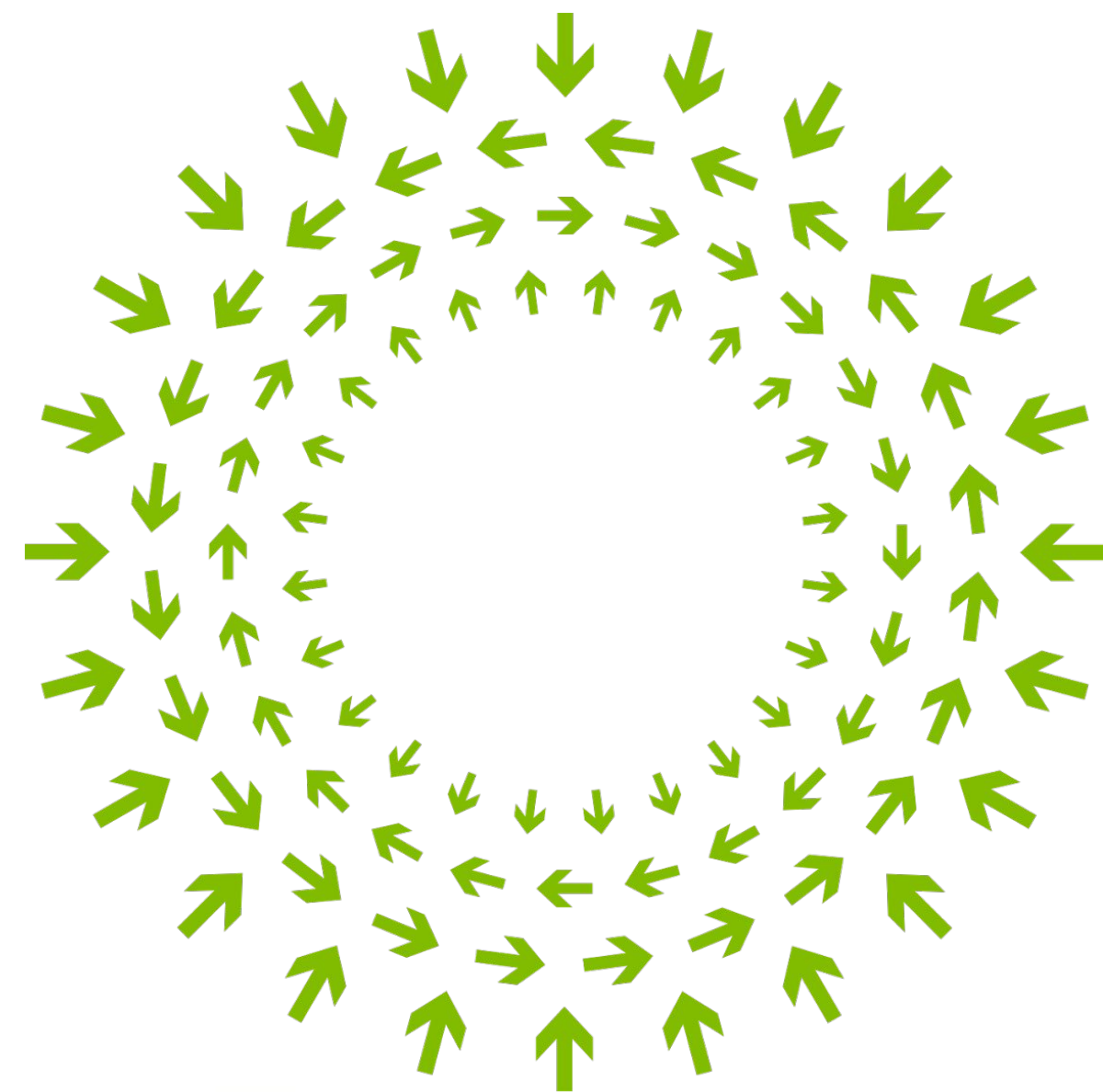
- Support a variety of rack devices over some or all of the following:
 - RS485
 - CAN
 - Ethernet
- Remote firmware update for all rack devices on serving rack
- Debug/basic management console (RS232)





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Compute Project



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