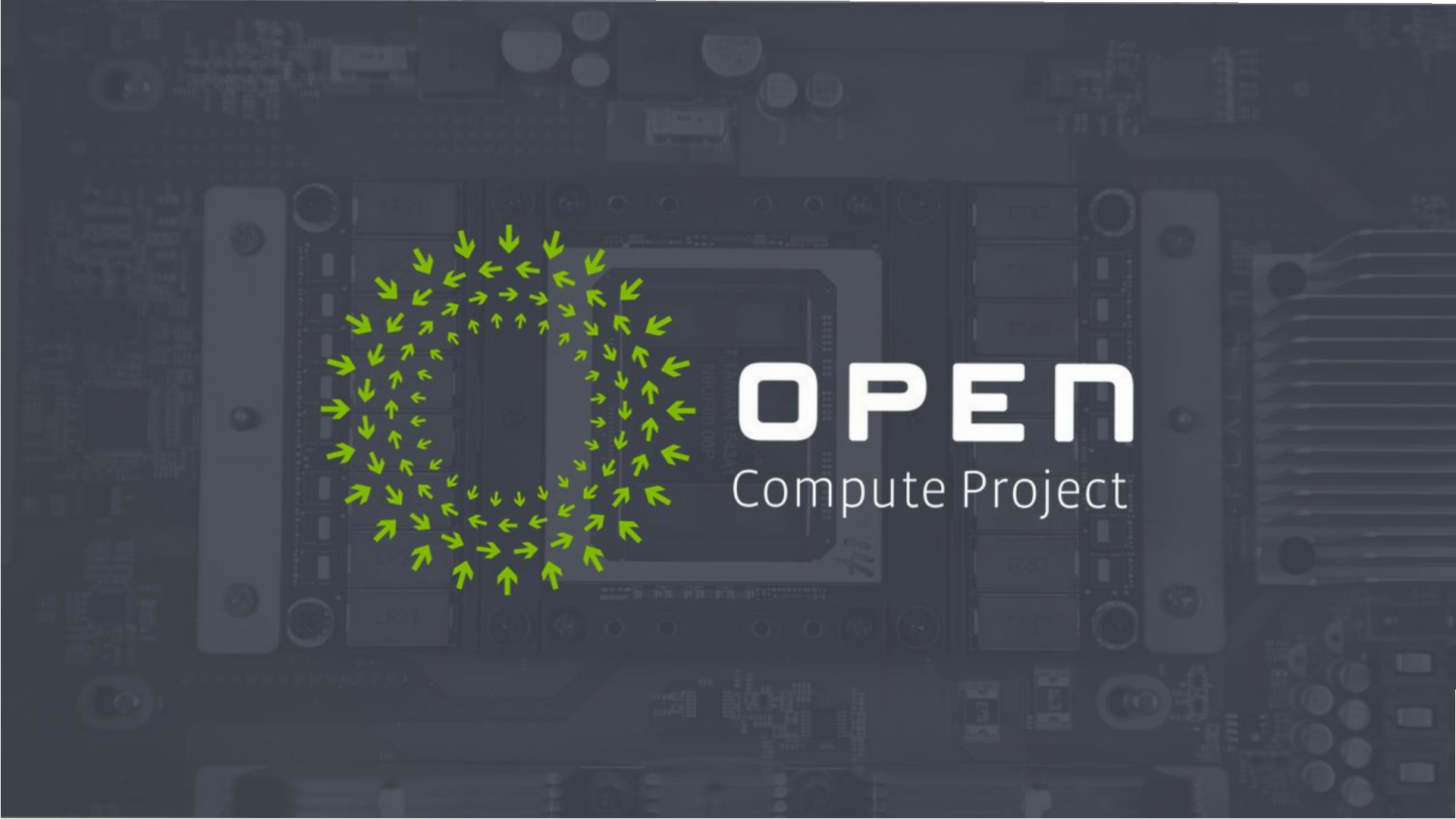
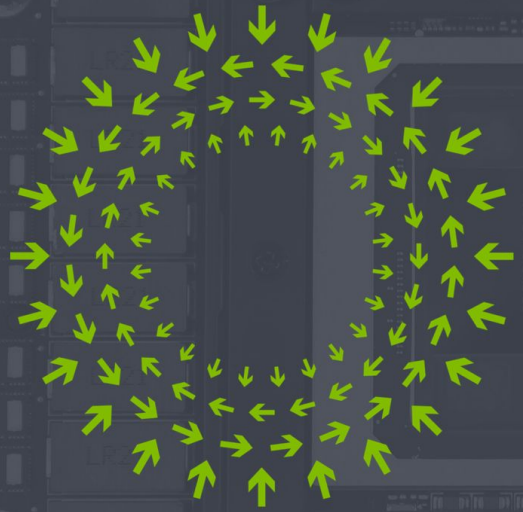

OPEN
Compute Project

# Agenda



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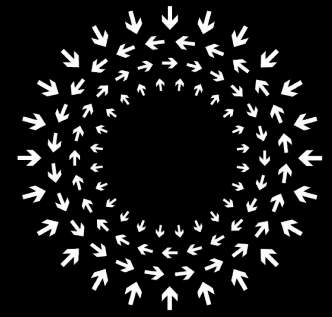



**Welcome to the OCP Rack & Power Workshop!**

**Thank you to Steve Mills for organizing and to Delta for hosting.**


# The OCP Members and Community

**Archna Haylock**
**Community Director**
**Archna@opencompute.org**

# Foundation Staff

Rocky Bullock
Chief Executive Officer

ArchnaHaylock
Director, Community

Steve Helvie
VP, Channel Development

Bill Carter
Chief Technology Officer

Dirk Van Slyke
Director, Marketing & Communications

Michael Schill
Membership Community Specialist

John Laban
Representative, Europe

Rajeev Sharma
Director, Software & Technologies

Kali Burdette
Manager, Meeting & Events

Nick Bullock
Director, Finance

# Foundation Board

Mark Roenigk
Chairman/President
Facebook

Joshua Matheus
Goldman Sachs

Jason Waxman
Intel Corporation

Bill Laing
Microsoft Corporation

Brian Stein
Rackspace

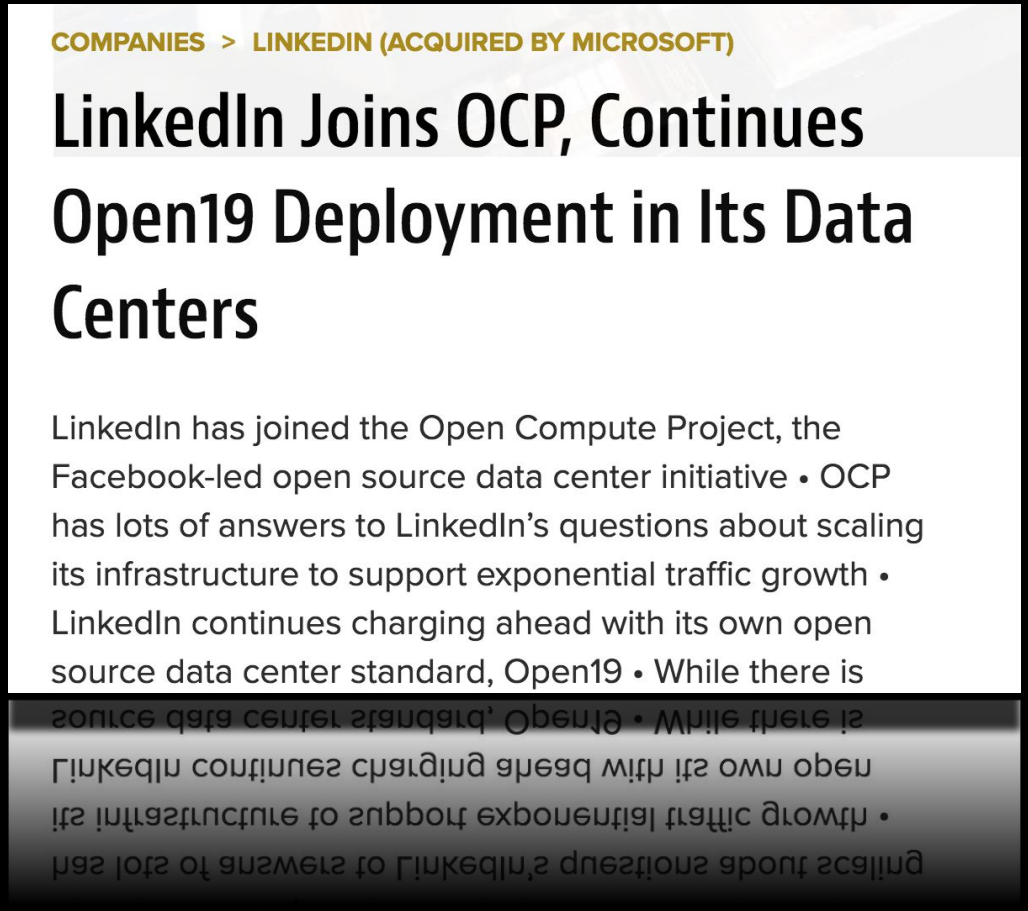
Andy Bechtolsheim
Individual

Rocky Bullock
Non-Voting

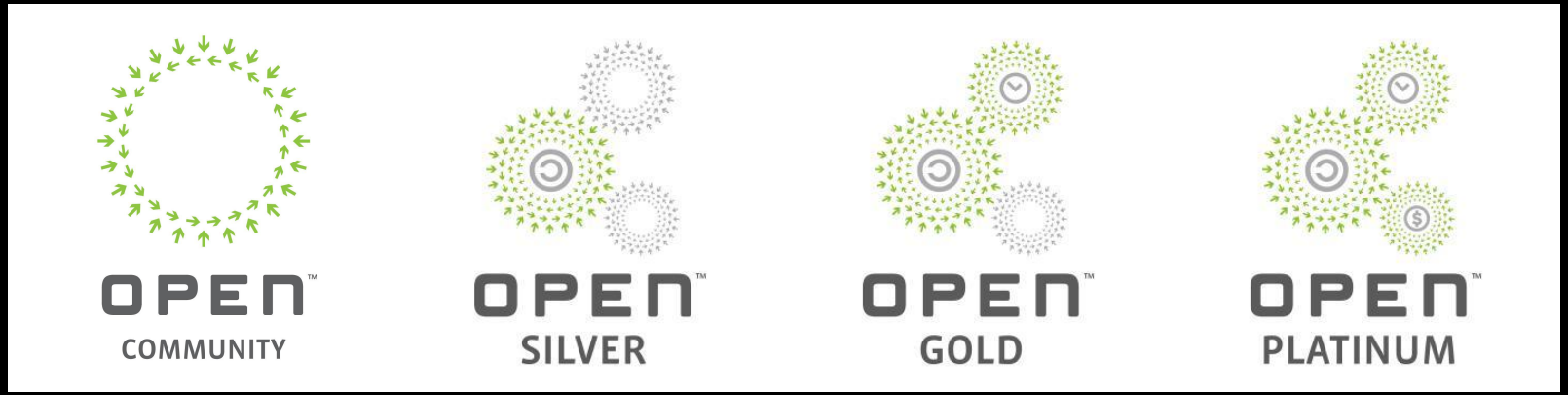
# OCP Membership Facts

- ~200 Corporate Members
  - Adopters
  - Suppliers (HW and SW)
  - Solution Providers
- 6000 participants in our community
  - Technical (HW and SW)
  - Sales/Business Development
  - Executives
  - Manufacturing/Process
  - Facilities
  - Academia
- Member Companies from all over the world

OCP Membership Directory:
https://www.opencompute.org/membership/membership-organizational-directory


COMPANIES > LINKEDIN (ACQUIRED BY MICROSOFT)
LinkedIn Joins OCP, Continues Open19 Deployment in Its Data Centers
LinkedIn has joined the Open Compute Project, the Facebook-led open source data center initiative • OCP has lots of answers to LinkedIn's questions about scaling its infrastructure to support exponential traffic growth • LinkedIn continues charging ahead with its own open source data center standard, Open19 • While there is

# OCP Corporate Membership



| Features | Community | Silver | Gold | Platinum |
|---|---|---|---|---|
| Sponsorship | — | 1 event | 2 events | 3 events |
| Eligible for becoming a SP/Reseller | ✓ * | ✓ * | ✓ * | ✓ * |
| Summit sponsorship discount | — | 10% | 15% | 20% |
| Speaking engagements | — | 1 | 2 | 3 |
| PL or IC position eligibility | 1 PL position | 1 PL or IC position | 2 PL or IC positions | 3 PL or IC positions |
| Voting keys | — | 1 | 2 | 3 |
| OCP Accepted™ product recognition | ✓ | ✓ | ✓ | ✓ |
| OCP Inspired™ product recognition | — | ✓ | ✓ | ✓ |
| Contributions | — | — | 1 | 2 |
| Cost | $2,500 | $60,000 | $50,000 | $40,000 |

* There is an additional fee to becoming a SP/Reseller.

# OCP Membership Benefits

- Connect with other Industry leaders and innovators
- Get access to new industry trends
- Collaborate with like-minded participants to create leading edge solutions to industry challenges.
- Become part of a global community
- Participate in projects that are paving the way and addressing real time concerns of the community.
- Contribute your subject matter expertise while retaining control of your IP
- Showcase your OCP recognized products to potential adopters
- Join the “open” movement to achieve efficiency and growth and make an impact

# OCP Community : Projects and SubProjects

SERVER

PCI 3.0 Mezz

NETWORKING

ONL, ONIE, SAI, SONiC, Campus Branch Wireless

STORAGE

JDA Project

RACK & POWER

Adv Cooling Solutions, Power Shelf Interoperability

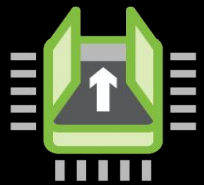
HW MGMT

HPC

TELCO

DC Facility

Modular DC



Open Sys FW

SECURITY

# OCP Projects - GET INVOLVED

- Each Project has a charter - READ IT
- Each Project has volunteer leaders - 1 or 2 Project Leads and 1 Tech Steering Committee Rep - INTRODUCE YOURSELF
- Some Projects have 1 or more sub-projects.
- Each Project has a WIKI page. Sub-projects have their own WIKI. - READ IT
- Each Project/sub-project has a mailing list. - JOIN THE LIST
- Each Project/sub-project meets separately for their calls - some are monthly, some are weekly. - ATTEND THE CALLS
- All calls are recorded. - LISTEN IF YOU CAN NOT ATTEND LIVE
- Projects have workshops. - REGISTER FOR WORKSHOPS

# From Concepts to Contributions….


PL

Project
Community

ICR

Spec
Design
Product
R/A

- From Project Community
- From other Open Orgs
- From Another Community via PL/IC/CTO

- Revisions
- Collaboration with other Project Teams

- IC Vote
- OCP Recognition
- Marketplace if SP

# What is OPEN hardware?

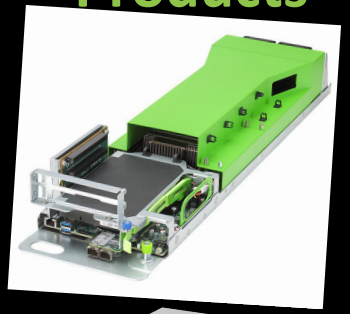
Specifications

Design Packages

Embedded SW

Contributed with a **Royalty-free, non-assert** License (CLA)

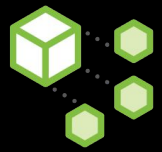
Products



IP retained by OEM/ODM

# How this Community Contributes, Collaborates, & Consumes

**Specifications**



Reference Architecture

Tested Configurations

White Papers

Embedded Software

**Design Files**

**Product Recognition**

Case Studies

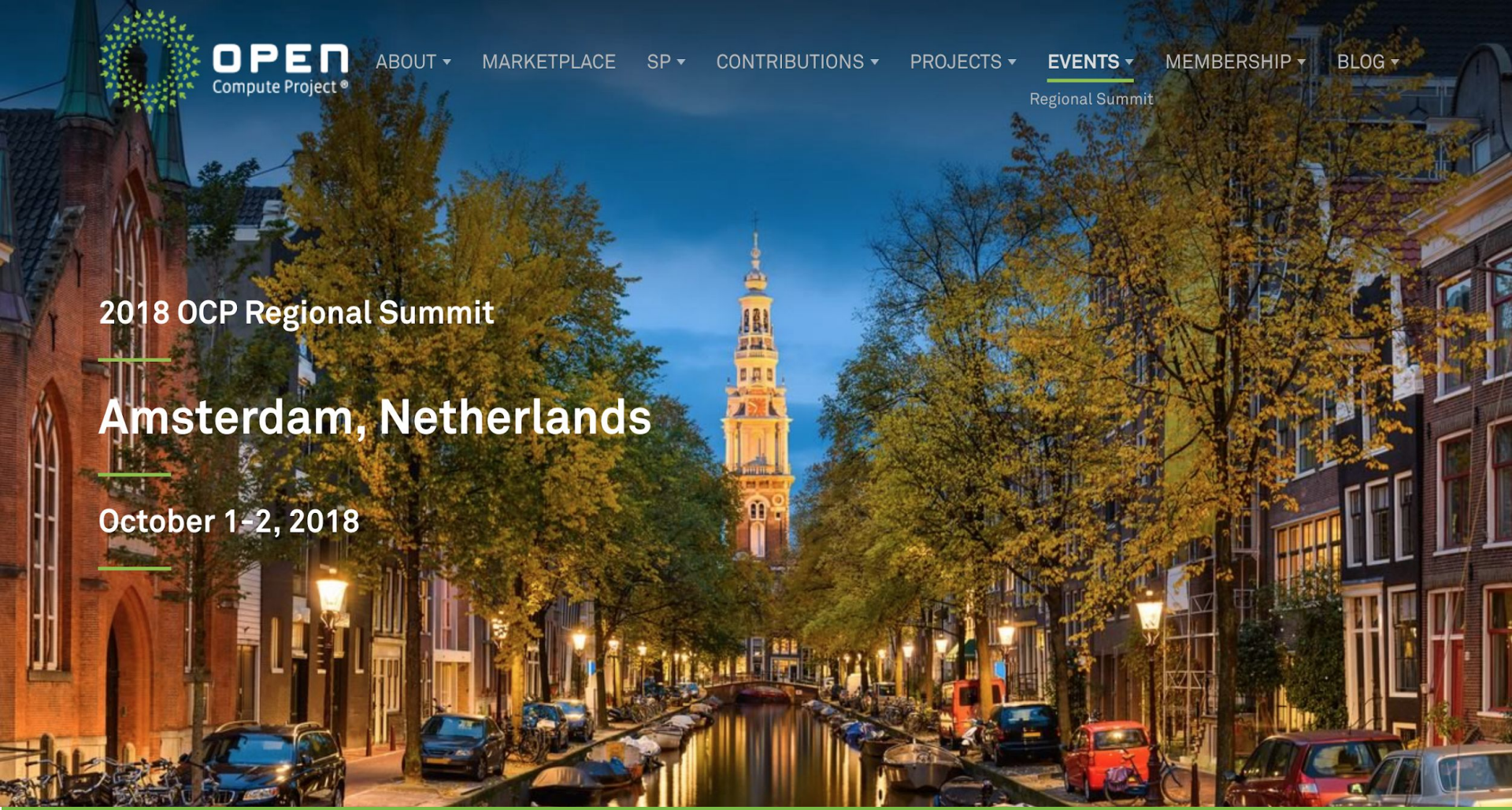
Workshops Summits

Testimonials Seminars

Videos

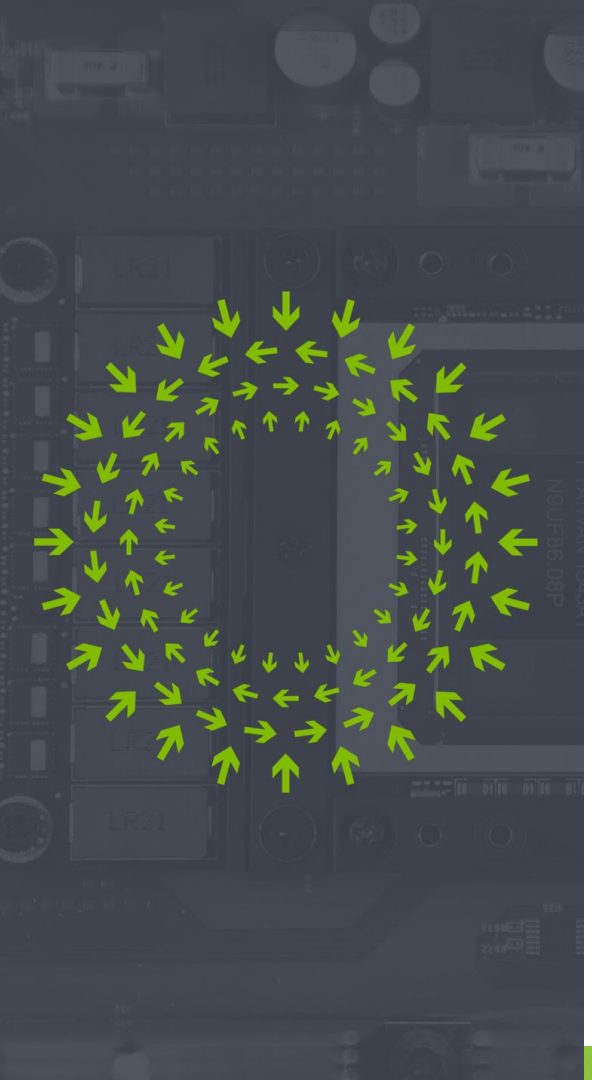
# OCP Upcoming Events

- Workshop Today will be videotaped and will be available on the OCP Past Events page.
- Networking Engr Workshop – Target late Aug, San Jose, CA @ TBD. More info on OCP Events Page shortly.
- DCD Cloud + Colo - Day 0 (Oct 29) Workshops in planning stage - stay tuned
- IC Meetings occur every 6 weeks – to vote on any upcoming contributions and discuss strategic direction of the projects.
- OCP Regional Summit – Oct 1-2 Amsterdam, The Netherlands. Sponsorships still available and membership discounts are applied (20% for Platinum, 15% for Gold, 10% for Silver, 5% for Community). Registration is OPEN!!
- OCP Summit – March 14-15, 2019 San Jose, CA. Bundle Discounts are available if interested in both Europe and US Summits.


OPEN
Compute Project
ABOUT
MARKETPLACE
SP
CONTRIBUTIONS
PROJECTS
EVENTS
Regional Summit
MEMBERSHIP
BLOG
2018 OCP Regional Summit
Amsterdam, Netherlands
October 1-2, 2018

# Rack and Power Project Engineering Workshop

24 July 2018 - Fremont



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10:45 Rack and Power Project Update

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2:45 Wrap-Up

# Rack & Power Project Scope

## Open Rack Standard

- Mechanical and Electrical standard for scale out
- DC distribution:  12VDC or 48VDC option
- Power & Resiliency options
- NEBS/Seismic considerations

## EIA-310 Compatible Enclosures

- Sub-rack Enclosures
- CG-Open Rack-19 standard

## Power Distribution and Conversion

- Applicable to OpenRack and EIA-310
- Power Rectifiers
- In-Rack Battery Backup
- Interoperability and component re-use

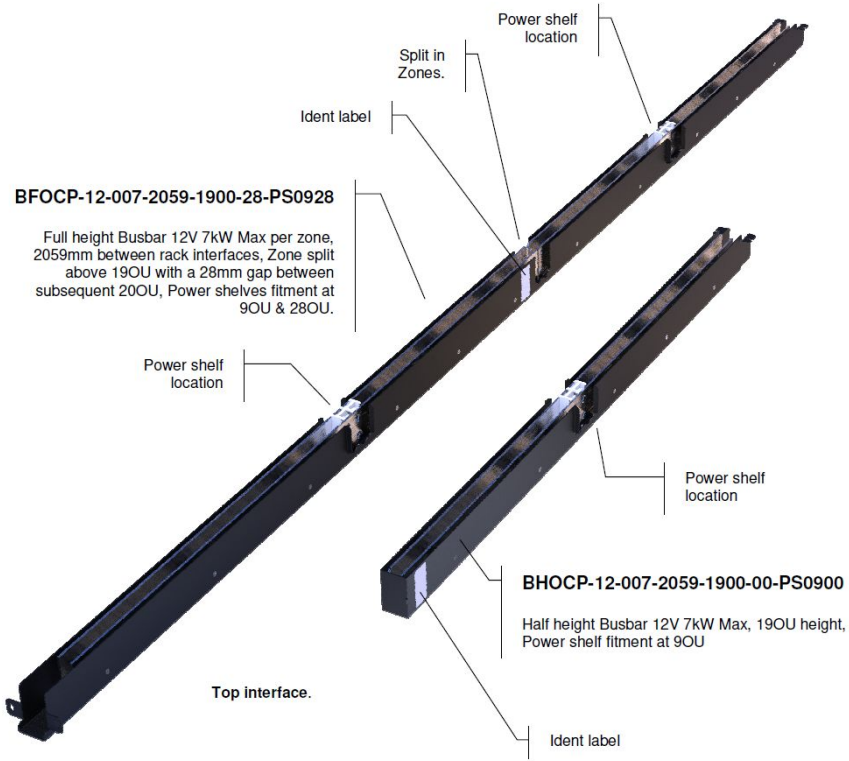
# Rack and Power Project Update

| Name | Status | Contributor |
| --- | --- | --- |
| Seismic Kit for Open Rack | Approved! | Nokia |

This specification defines Optional Seismic kit for Open Rack V2 to fulfill the Zone 4 criteria defined by Telcordia GR-63-CORE

Specification Link

| Name | Status | Contributor |
| --- | --- | --- |
| Open Rack Busbar Interface Specification | Approved! | Rittal |




Defines the technical specifications between the:
- Busbar assembly
- Open Rack frame
- Power Shelves

[Specification Link]

| Name | Status | Contributor |
| --- | --- | --- |
| Indicator Specification | Community Review | Facebook |

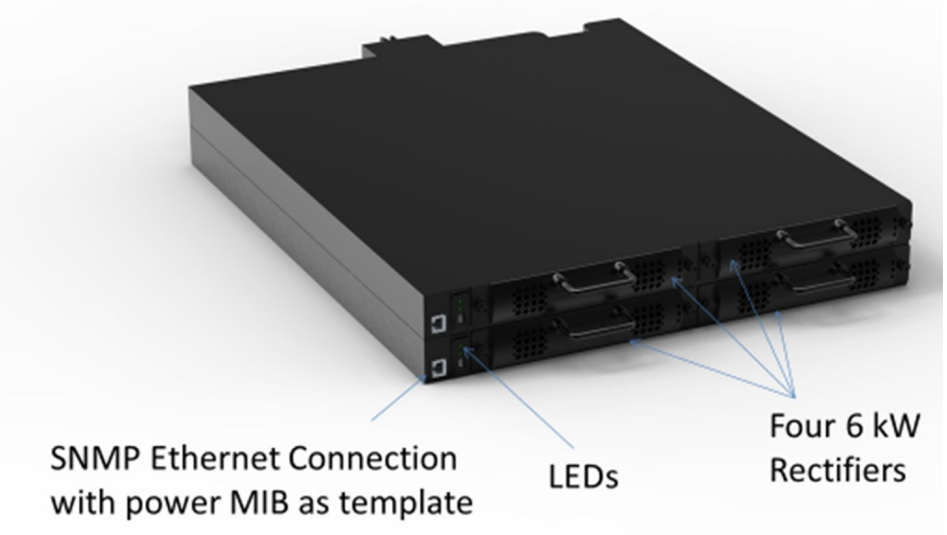
*Table 4. OCP indicator legends*

| Meaning | Preferred | Alternate |
| --- | --- | --- |
| **Power On/Good** |  | PWR |
| **AC Good** |  | AC OK |
| **DC Good** |  | DC OK |
| **Fault** |  | FAULT |
| **Status** |  | STS |
| **Fan** |  | FAN |
| **Over Temperature** |  | OVER TEMP |
| **Drive #** |  | DRIVE # |
| **End of Life Reached (BBU)** | EOL | N/A |

Provide standards for OCP:

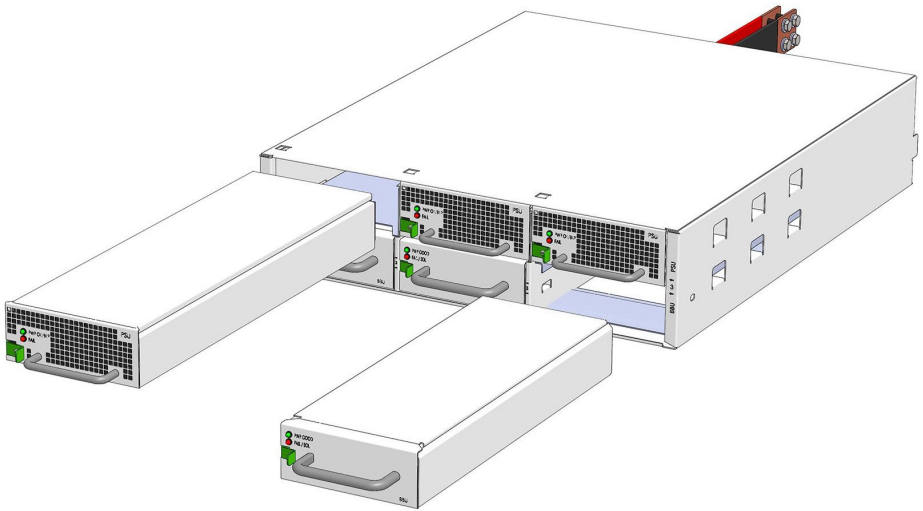
- Icons
- LED color
- LED behavior
- Indicator Placement

| Name | Status | Contributor |
| --- | --- | --- |
| True Three Phase 380 – 480 Vac to 48Vdc Power Shelf | Community Review | ABB |



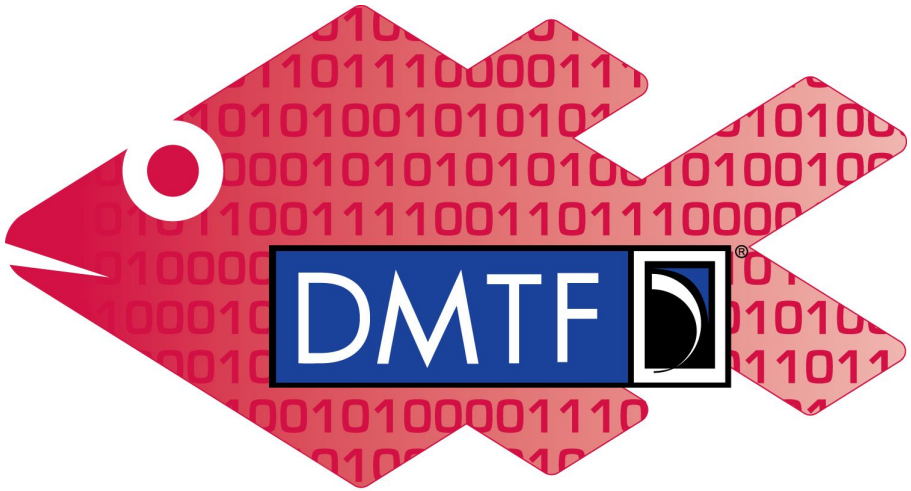

This True Three Phase 380-480Vac to 48Vdc Power Shelf powers 24kW of load equipment from a single 50A whip.

| Name | Status | Contributor |
| --- | --- | --- |
| Power Shelf Interoperability Specification | In Development | Shared |



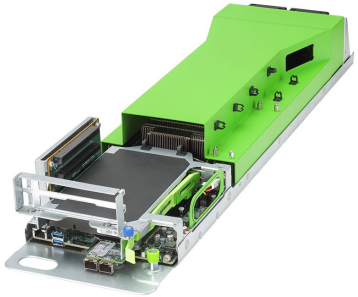
Enable multi-vendor sourcing of power components such as PSUs, Power Shelves, and BBUs, by ensuring interoperable functions.

| Name | Status | Contributor |
| --- | --- | --- |
| Rack and Power Redfish Profile | In Development | Shared |




Create and publish an open industry standard specification and schema that meets the expectations of end users for simple, modern and secure management of scalable platform hardware

# OCP HW Management Strategy

| *Describe* | *Prescribe* | *Test* | OCP Recognized Products |
| --- | --- | --- | --- |
| DMTF | **OCP Profiles** | **Redfish Interop Validator** |  |

# OCP Strategy for HW Management

Open Source DCIM





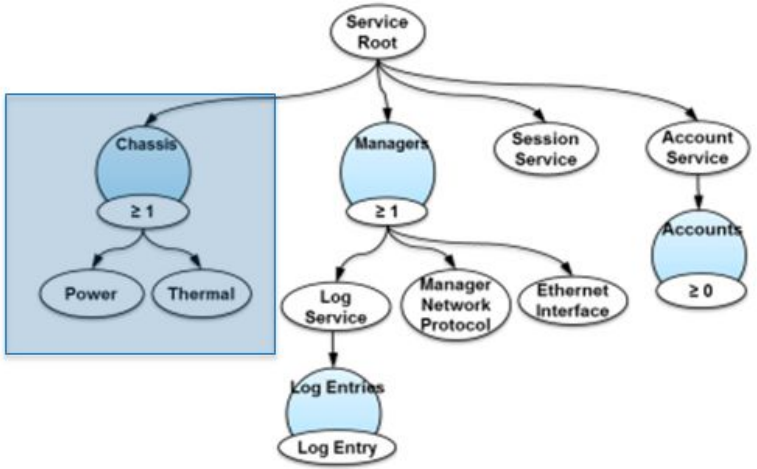
BASELINE PROFILE

Server Profile | Network Profile | Storage Profile | POWER Profile | EDGE Profile

HDD Health

| Name | Status | Contributor |
| --- | --- | --- |
| Rack and Power Redfish Profile | In Development | Shared |


OCP Hardware Management Baseline Profile




Profile will include existing power and thermal schema

•Additional NEW resources such as powershelves, energystoragemodules, psumodules

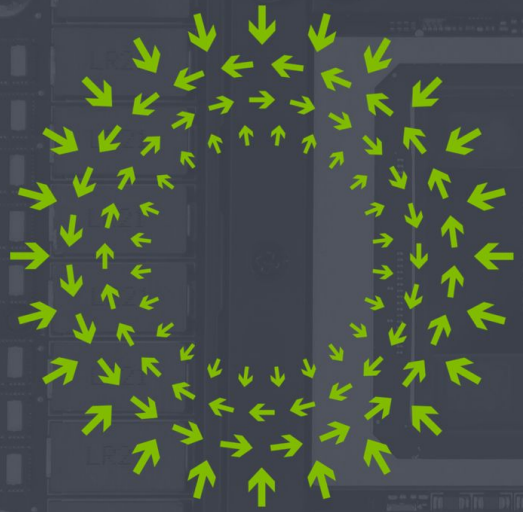
•Can include objects from DCIM like smart PDUs

IS THE ABOVE THE MOST LOGICAL WAY TO REPRESENT THE WHERE THE PROFILE FITS?

| Name | Status | Contributor |
|---|---|---|
| Rack and Power Redfish Profile | In Development | Shared |

| | Activity | Target Completion Date |
|---|---|---|
| 1 | Generate initial list of elements for the rack and power schema/mock-up | Done |
| 2 | Generate mock-up and test with validator to create initial feel of the validation process | Done |
| 3 | Consolidate additional elements needed for the schema/mock-up<br>•Upload updated checklist<br>•Solicit inputs from members | Sept 7, 2018 |
| 4 | Schedule semi-monthly calls | By August Rack&Power Meeting |
| 5 | Finalize process for determining the baseline for the Rack&Power profile | Will be done on semi-monthly calls |

# Agenda



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PENGUIN COMPUTING

# Standardize Power SKU Options

Alex Lin / July 24th, 2018

OCP Rack & Power Workshop

# About Penguin Computing

- U.S.-based 20 year old, global provider of hardware, software and services for HPC, AI, & storage
- Home to Scyld® Beowulf cluster software & bare metal HPC on cloud Penguin Computing On-Demand™
- Over 300 OCP racks delivered to date based on Tundra™ Extreme Scale design
- Platinum OCP member, Penguin CTO Phil Pokorny is HPC representative of the OCP Incubation Committee

OPEN PLATINUM

# Open Rack Specification

- Rack Depth (800mm, 660mm)
- DC Busbar Voltages (12Vdc, 48Vdc)
- DC Busbar numbers (3, 1)
- No. of OpenU / Rack Heights (Not specified)
  - Common examples: 20OU, 22OU, 40OU, 44OU

Source: Open Rack Standard

# Power SKU Overview (12VDC)

| Key Spec \ Product | Product A | Product B | Product C | Product D | Product E |
|---|---|---|---|---|---|
| Form Factor | 1U | 3U | 2.5U | 2.5U | 2U / 4U |
| Rectifiers | 6x 3kW | 9x 3.3kW | 6x 3kW | 6x 2.5kW | 6x ? |
| Max. Capacity (per Shelf) | 18kW | 26.4kW | 18kW | 12.5kW | 12.5kW |
| Input | 200-277 / 346-480 VAC | 208/ 230/400 / 277/480 VAC | 100/115/230/277 VAC | 208/230 VAC | N/A |
| Busbar No. | 3 | 3 | 1 | 1 | 3 |
| Busbar Amperage | 244 A ~ 488A | 350 A | 732 A | 488 A ~ 1,016 A | 170 A ~ 339 A |

# Power SKU Overview (48VDC)

| Key Specification \ Manufacturer | Product A | Product B | Product C | Product D |
|---|---|---|---|---|
| Form Factor | 1U | 2U | 2U (?) | 2U |
| Rectifiers | 6 x 4kW | 9x 3.5kW | 12x ? | 4x 6kW |
| Max. Capacity (per Shelf) | 19.5 kW | 28 kW | 33 kW | 24 kW |
| Input | 200 – 277 VAC | 176–305 VAC | 346~415 VAC | 380~480 VAC |
| Busbar No. | 1 or 3 | 3 | 1 | 1 |
| Busbar Amperage | 243 A ~ 900A | > 117 A | 413 A | 300 A |

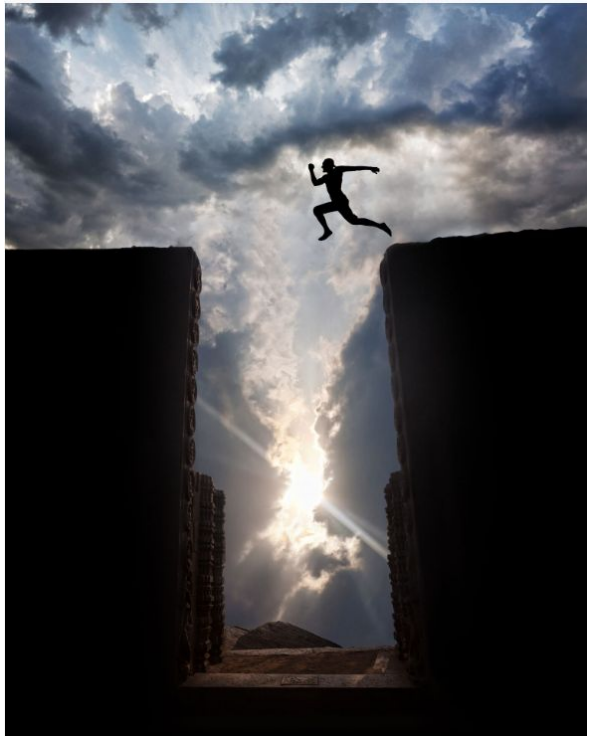
# Design Challenges

Designing for customers, Penguin Computing found the following issues:

- Compatibility
  - Wattage and current ratings are not as clearly defined
  - Difficult to switch power SKUs across manufacturers
    - Ex. Choosing PDUs on EIA racks
    - Ex. The bolt pattern of some products is offset by about 0.5 OU higher than the corresponding rack space
- High capacity / density
  - Multiple powershelves + A/B redundancy = 4 (or more) power cords to the rack.
  - Single IP management
  - 3 busbars

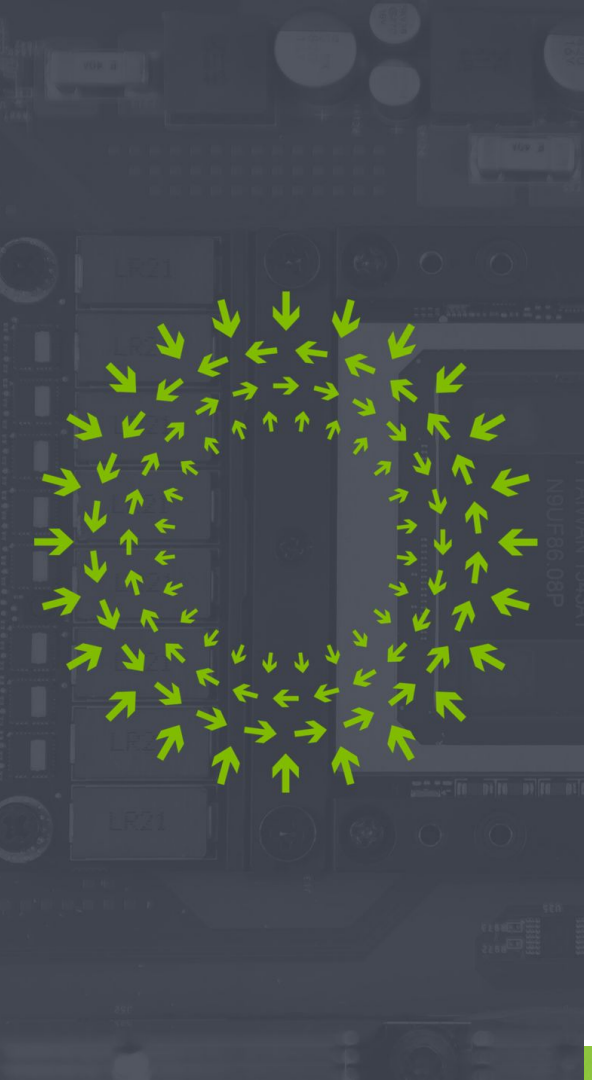
# Wish List

- Power shelves & busbars for all sorts of Open Racks
- 48V: 3 busbars to achieve higher power & lower the build cost (PDB space, busbar materials)
- 2 power cords for A+B redundancy




www.penguincomputing.com

1-888-PENGUIN



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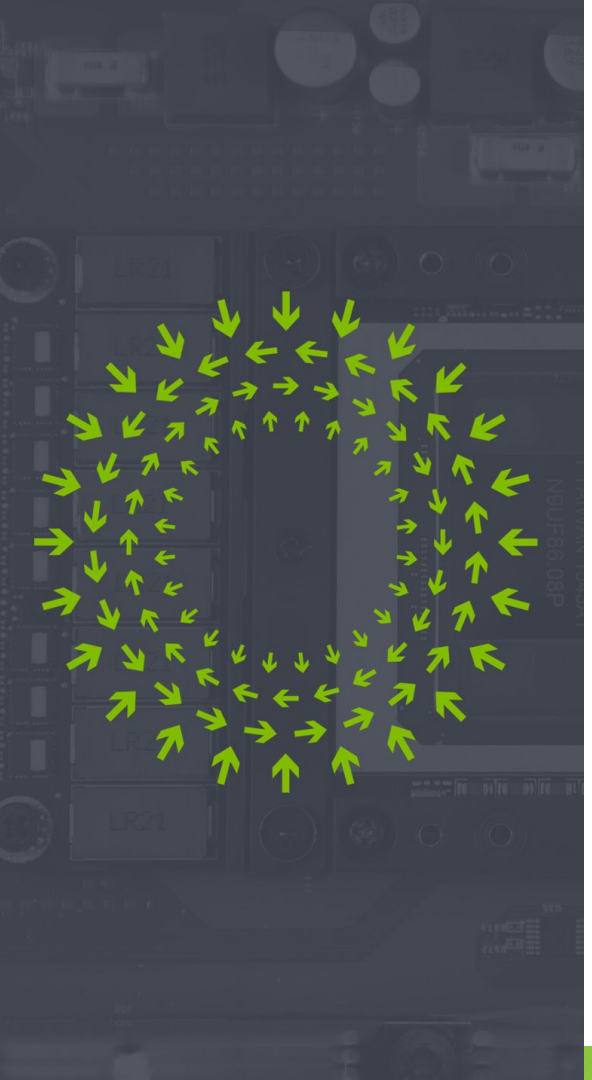

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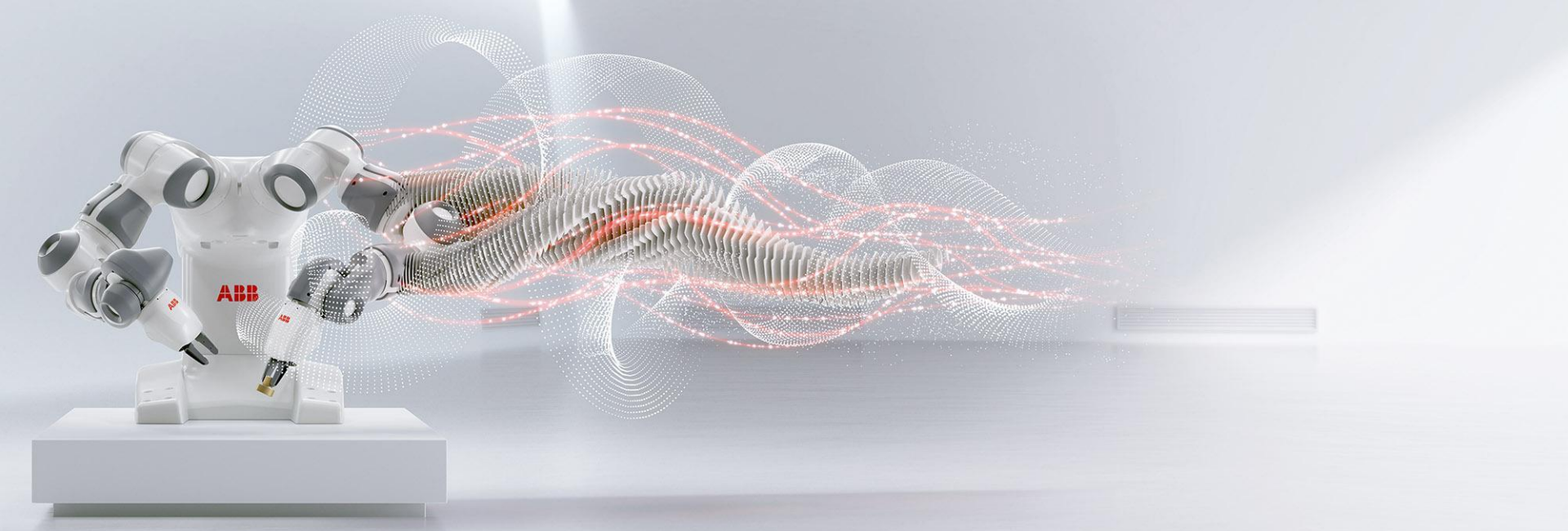


# True Three Phase 380 – 480 Vac to 48Vdc Power Shelf

July 2018 Update

# GE Critical Power (Industrial Solutions) is NOW ABB

- GE Critical Power, part of GE Industrial Solutions
- Now a Part of ABB Electrification Products Industrial Solutions
- Business as usual
- Increased investment and growth
- Expect increased OCP support

# True Three Phase 380 – 480 Vac to 48Vdc Power Shelf

Scope

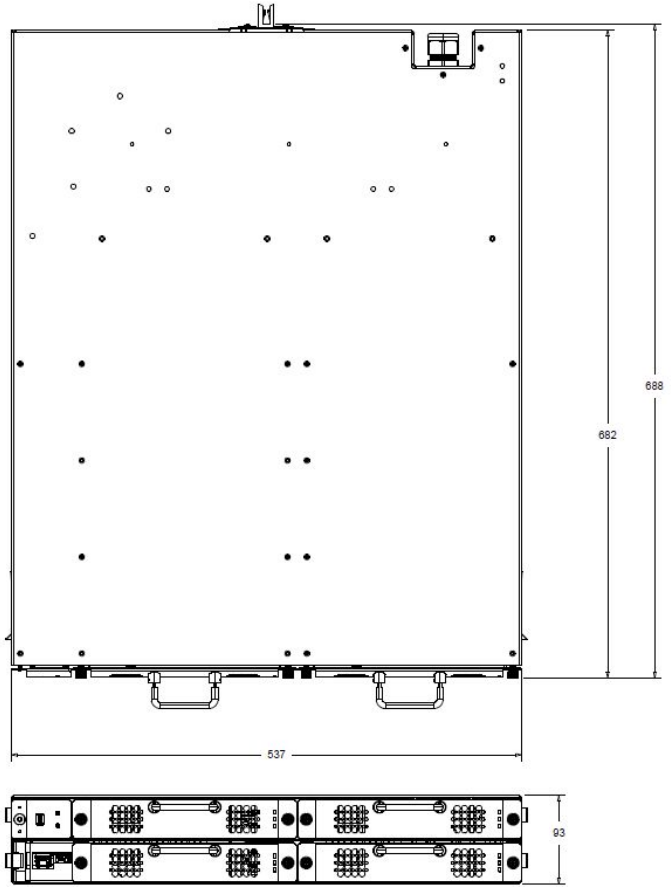
This Submitted document defines the technical specifications for:

- A true 3 phase 380 – 480 Vac to 48Vdc Power Shelf used in Open Compute Project Open Rack Standard V2.0
- The shelf is 2 open rack units high
- Is fed with a single 50A AC cord whip
- Delivers power using bus bar clips onto the 48V bus located in the shallow depth (660mm) cabinet as defined in Open Rack Standard V2.0
- Any / Multiple Position in the rack

# True Three Phase 380 – 480 Vac to 48Vdc Powe

Update / Traction

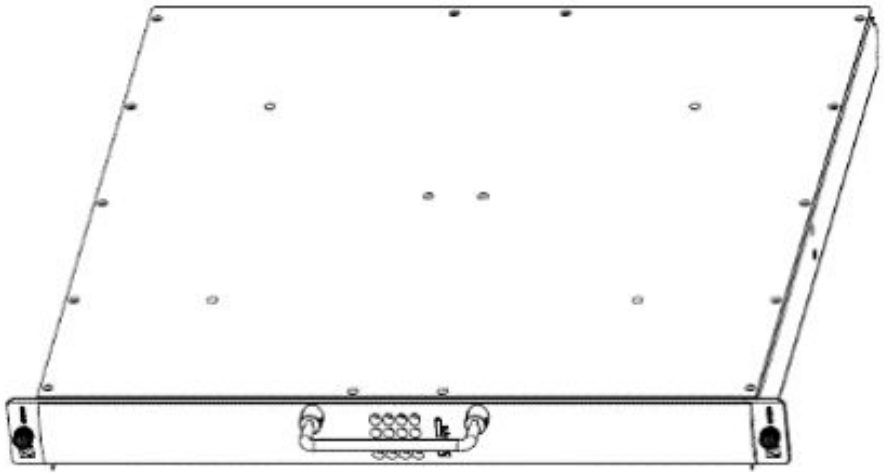
- 48V, 24KW Power Shelf
- Redesigned some internal parts and connector harness
- Now procuring pre-assembled power module connector and cable assembly
- Submitted up-dated CAD file, only minor changes to rail compliance
- Revision of the specification to follow shortly
- Limited interest to date



# True Three Phase 380 – 480 Vac to 48Vdc Power Shelf

Next Steps

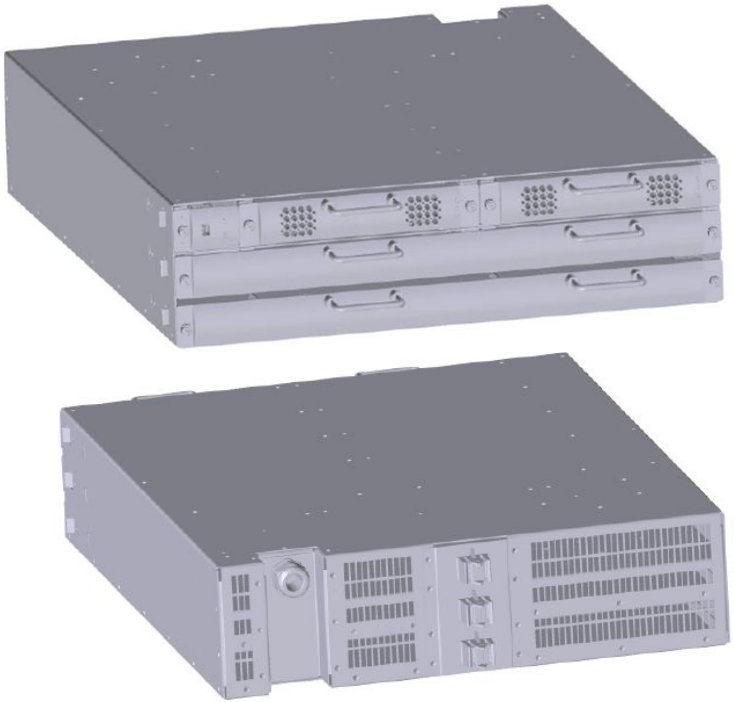
- Battery Module
- 48V battery –12V VRLA modules
- 1 or 2 open rack units high
- Delivers power using bus bar clips onto the 48V bus located in the shallow depth (660mm) cabinet as defined in Open Rack Standard V2.0
- Connectorized hot-plug module
- Integrated battery management
- ~3.8KW for 1 minute – 1 RU PbA version
- Weighs 40 lbs for 1 RU PbA version
- Other battery chemistries being evaluated



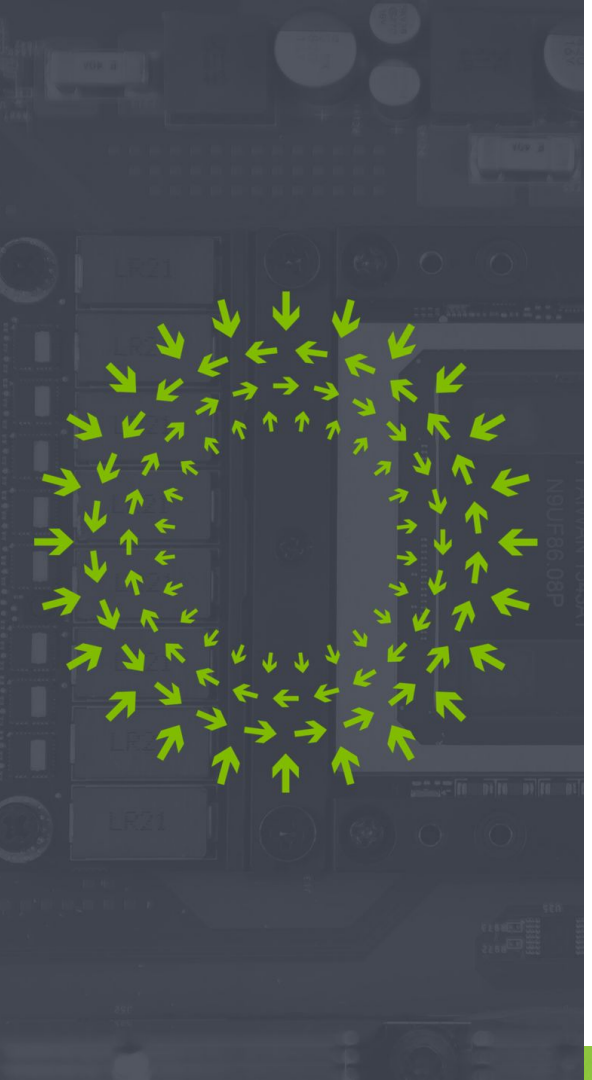
# True Three Phase 380 – 480 Vac to 48Vdc Power Shelf

Next Steps

- 12V, two Module, 12V Power Shelf
- 3RU, includes 2 RU of battery
- feasibility Study – 3-4KW per module?
- Much Higher current
- Assessing interest



- Bi-directional converter for higher (48V) internal battery voltage and discharge voltage regulation



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2:00 Advanced Cooling Sub-Project Roadmap Discussion

2:45 Wrap-Up

# Schneider Electric OCP V2 Rack

## Submission for OCP Inspired recognition

OCP Rack & Power Workshop 24 July 2018

Life Is On

APC by Schneider Electric

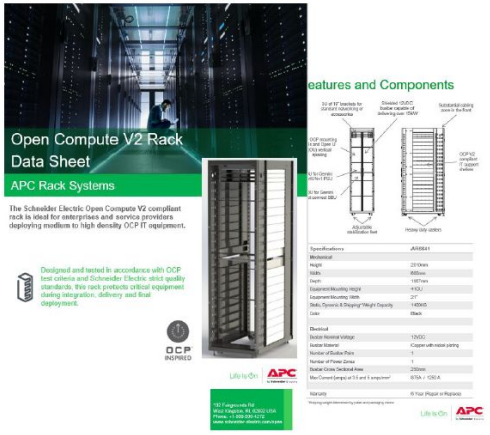
# OCP V2 Rack Submission

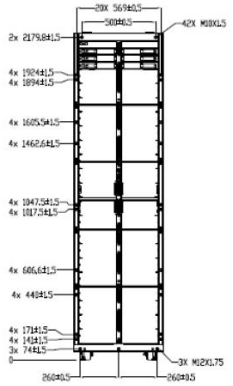
**V2 Rack** submission complies with OCP Open Rack Standard V2.0
(12V derivative)

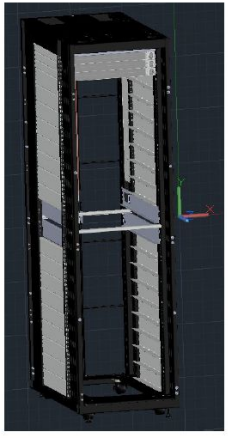
Requesting ‘OCP Inspired’

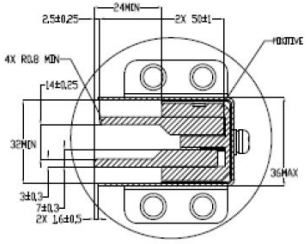
Documentation supporting submission:
- Orderable SKU:  AR6641
- Data Sheet
- 2D submittal drawings, DWG and PDF
- 3D DWG Model
- This PPT

Initial stocking strategy to cover NAM & Europe







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# AR6641 – OCP Open Rack V2 Complaint

| Specifications | AR6641 |
|---|---|
| **Mechanical** | |
| Height | 2010mm |
| Width | 600mm |
| Depth | 1067mm |
| Equipment Mounting Height | 41OU |
| Equipment Mounting Width | 21” |
| Static, Dynamic & Shipping* Weight Capacity | 1400KG |
| Color | Black |
| | |
| **Electrical** | |
| Busbar Nominal Voltage | 12VDC |
| Busbar Material | Copper with nickel plating |
| Number of Busbar Pairs | 1 |
| Number of Power Zones | 1 |
| Busbar Cross Sectional Area | 250mm |
| Max Current (amps) at 3.5 and 5 amps/mm$^2$ | 875A / 1250 A |
| | |
| Warranty | 5 Year (Repair or Replace) |

# Testing

Testing conducted to ensure performance for fully integrated deployments

Internal DVT tests

- Static test, 1680kg → no deformation
- Dynamic rolling 1000m, 1400kg → no deformation
- 6mm step test, 1400kg, 5 times → pass, no deformation
- 1” gap test, 1400kg, 5 times → pass, no deformation
- 5° ramp test, 1400kg → roll off pallet and roll on pallet

3rd Party Standards

- Vibration Resonance ASTM D3580-95 Method A
- Drop and Impact Test Schedule A – ASTM D4169-16
- Random Vibration Test Schedule E – ASTM D4169-16
- UL Mechanical Safety – UL 60950-1-07 (including tilt 10 degrees (IEC))

# Compatible with Gemini – 15kW N+1 PSU

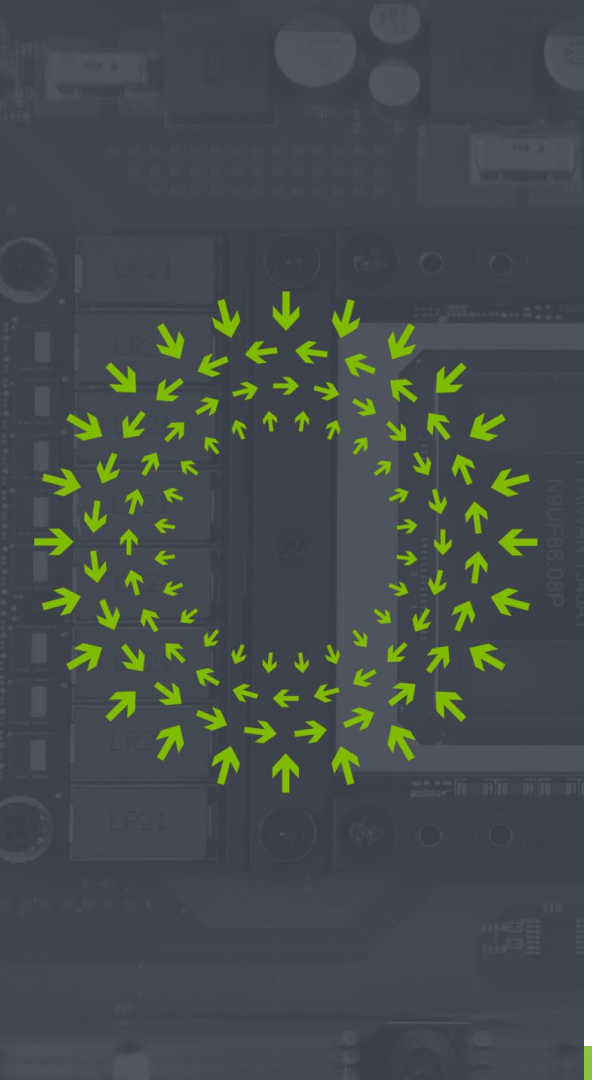
Existing OCP Inspired PSU

Basic Specs

- 15kW N+1 or 9kW 2N
- Modular input ATS for 2N input when in N+1 configuration
- 2OU
- 208-240VAC input
- 3kW hot pluggable modules
- 80 Plus Platinum efficiency – 94% @ 50 – 80% load
- Separate BBU shelf direct connects to busbar
- PSU can communicate with 2 BBU shelves

# OCP Tenets for Schneider Electric OCP V2 Rack

- Efficiency
  - Electrical efficiency: Supports centralized PSU with busbar distribution
- Scale
  - 1400kg load capability supports shipping fully integrated racks
  - Busbar can support over 15kW per rack
  - Supply chain capable to supporting any volume
- Openness
  - Complies with existing OCP V2 rack spec
- Impact
  - Schneider Electric supply chain & channel will be able to support customers of all sizes



# Agenda

10:30 Welcome

10:45 Rack and Power Project Update

11:00 Preferred Rack Level Power SKUs for Open Rack

Noon Lunch and a Word from our sponsor Delta

1:00 Power Shelf Interoperability Specification Update

1:15 GE Power Shelf Contribution Update

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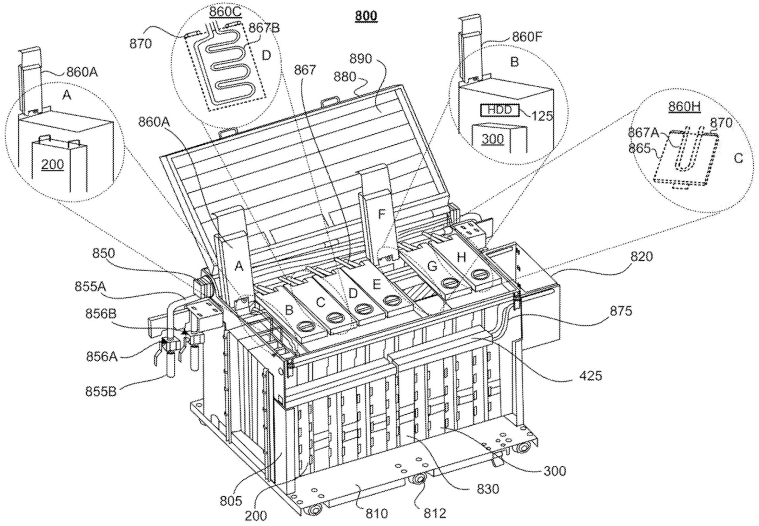
2:45 Wrap-Up

# Project Discussion: Enabling Advanced Cooling in Open Rack


Steve Mills Technical Lead Facebook
Bill Carter CTO Open Compute

# OCP Announces Advanced Cooling Solutions Sub Project




The new sub-project will focus on standardization and definition of :

critical interfaces,

operational parameters,

and environmental conditions

... enable a non-proprietary, multi-vendor supply chain for ‘warm water’ cooling.

# Discussion:  Scope of Charter

The project may support more than one type of cooling architecture, such as:

- Direct liquid cooled cold plate solutions
- immersion type solutions (single phase and 2-phase materials)
- compressed air solutions

Successful projects delivered by this project will include:

- a supply chain offering a variety of interchangeable liquid cooled-enabled IT devices (servers, storage, etc.)
- a supply chain for liquid-enabled racks from multiple providers

# Discussion:  Scope of Charter

**In-Scope Activities**

- Determination of wetted materials, quality, and type
- Fluid physical properties and types
- Operating conditions and parameters
- Metrology of heat extraction performance
- DC to Rack Interfaces for Facility water loops
- Hot-plug drip-less valves between IT Gear and Rack
- Recommended Cold-plate attachment methods

**Out of Scope Activities**

REAR CHILLER DOOR or RDHx solutions

# Advanced Cooling Sub-Project Meeting Info

Project meetings begin August 15th!

Meetings are scheduled for the first and third Wednesday of the month.

9-10am Pacific time.

Call details are available here.

Join the mailing list:
http://lists.opencompute.org/mailman/listinfo/opencompute-acs

Wiki:
https://www.opencompute.org/wiki/Rack_%26_Power/Advanced_Cooling_Solutions

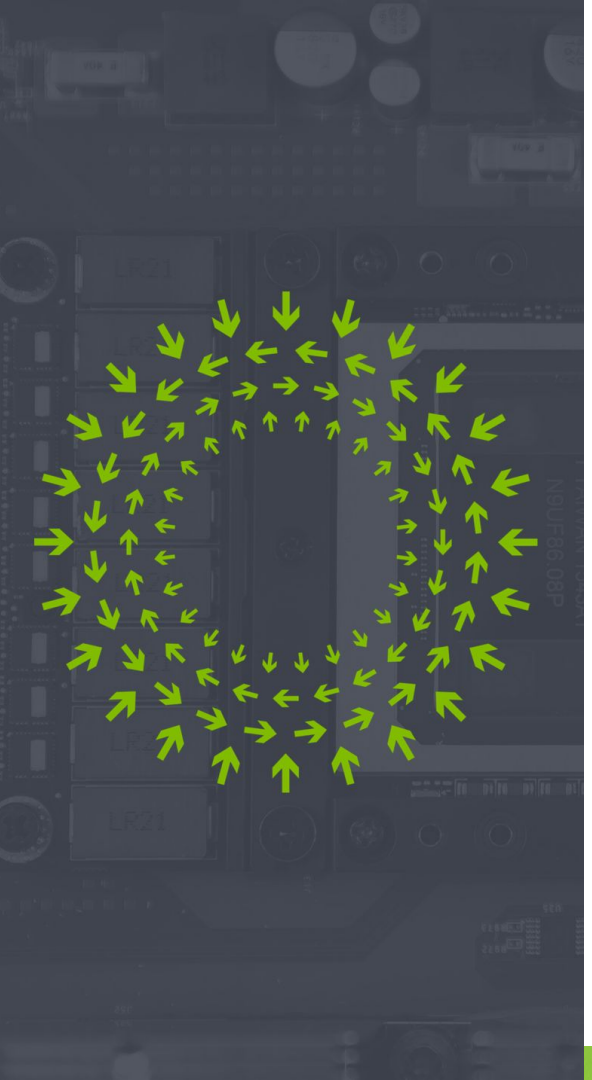
# Discussion:  Identify Topics for Work Flows

Direct Contact IT Gear Liquid Cooling

- IT Gear Interface Definitions
- Hot-plug, dripless valve specifications
- Coolant Pump Management Protocols

Immersion

- IT Gear Specifications
- Facility Requirements
- Management Protocols



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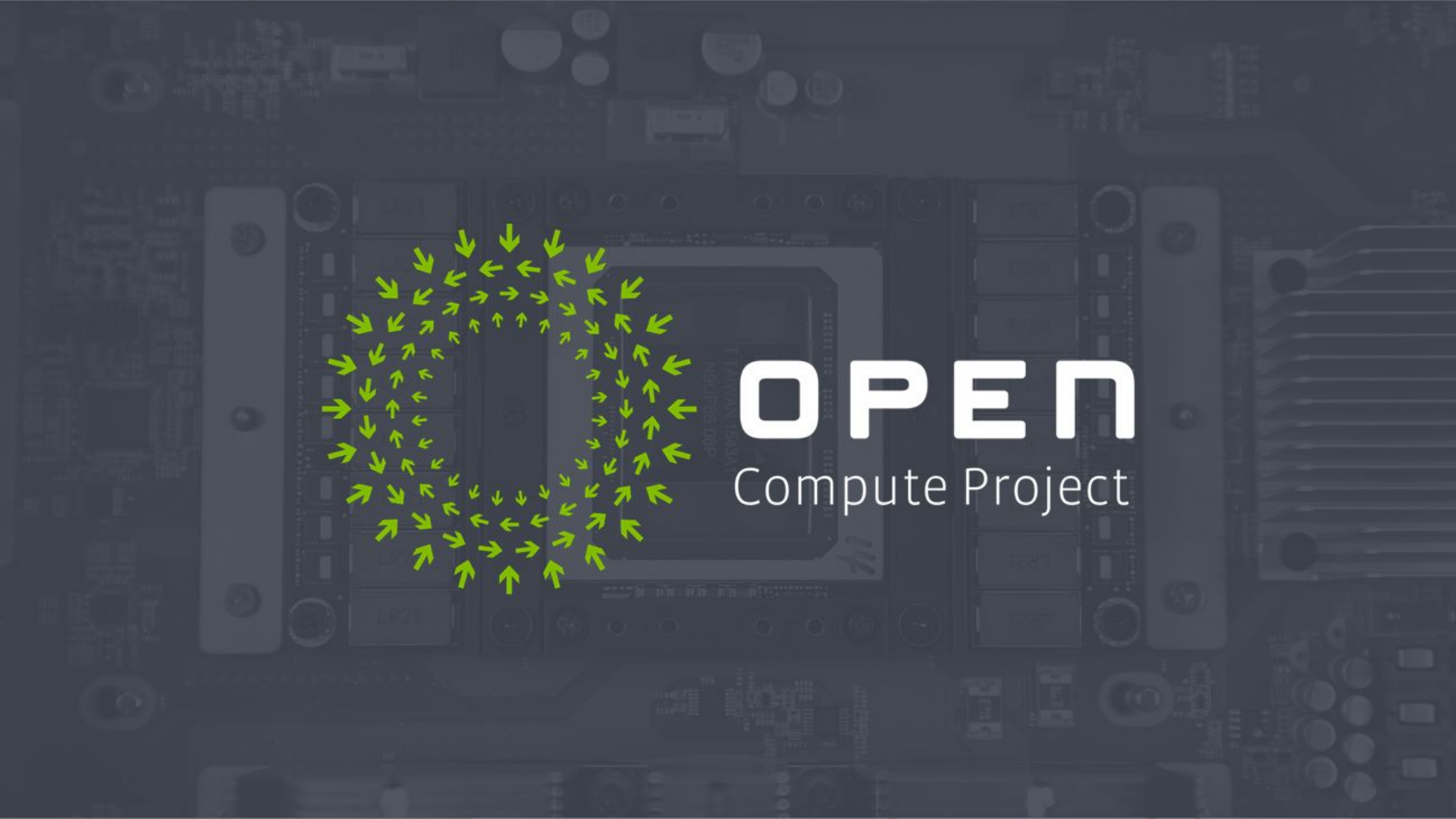
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