Facebook Derivatives Update
Open Rack V1

- What it is:
  - First Industry 21” Standardized Rack Infrastructure
  - Key Component of Open Compute Project (OCP)
  - Modular Mounting
  - Component Disaggregation - Next Major Step Forward for Datacenter Efficiency
  - Utilize Full Component Lifetime
  - Power Supplies is First
  - Innovative Cable-less Power Delivery
Open Rack Singlet

Front View

Back View
Note: 120/208Vac doesn't need a DC PDU since the AC voltage is in-line UPS

FB owned Data Center power configurations

- **120/208 UDB**
  - 277/480
    - 20A
    - ~13kW
  - 230/400
    - 32A
    - ~20kW
  - ~8.2kW Ex. UDB
  - 120/208 <8kW
    - A: 30A
    - B: 30A
    - ~8.2kW
  - 120/208 >8kW
    - A: 30A
    - B: 30A
    - ~16.4kW Ex. Half servers on each PDU
  - 277/480 UDB
    - A: 30A
    - B: 30A
    - ~13kW

Jbox 30A

20A

230/400

32A

30A

AC PDU

AC PDU

AC PDU

AC PDU

AC PDU

AC PDU

AC PDU

AC PDU

AC PDU

AC PDU

AC PDU

AC PDU

AC PDU

AC PDU

DC

DC

DC

DC

~20kW

~13kW

~8.2kW Ex. UDB

~8.2kW

~16.4kW Ex. Half servers on each PDU

~13kW
Data Center power configurations

277/480

~13kW ~13kW

~8kW Ex. UDB

120/208

“8KW nonUDB” 1 AC PDU

120/208

~8kW ~8kW

~16kW Ex. Half servers on each PDU

Note: 120/208Vac doesn’t need a DC PDU since the AC voltage is in-line UPS
Open Rack 208V – “8kW non UDB”

- What it is

- Using the current V1 PowerShelf we can only use 1 AC PDU and therefore we are limited by the 30A breaker tapbox

- Max of 8.2kW per rack:
  - Winterfell – 12.4kW – NO
  - Knox Type IV – 9.6kW – NO
  - Knox Type V – 6.9kW – YES
Data Center power configurations

277/480

~13kW

2 AC PDU

~13kW

AC PDU

DC

AC PDU

AC PDU

120/208

~8kW

Ex. UDB

AC PDU

AC PDU

AC PDU

AC PDU

120/208

~8kW

120/208

~8kW

~16kW

Ex. Half servers on each PDU

\[ \text{”>8KW non UDB”} \]

2 AC PDU

Note: 120/208Vac doesn’t need a DC PDU since the AC voltage is in-line UPS
Data Center power configurations

"8KW UDB"

~13kW

~13kW

~8kW

Ex. UDB

120/208

120/208

120/208

~8kW

~8kW

~8kW

~16kW

Ex. Half servers on each PDU

Note: 120/208Vac doesn’t need a DC PDU since the AC voltage is in-line UPS
Open Rack 208V – “>8kW nonUDB” or “8KW UDB”

- Option 1: upgrade DC breaker and plug-in tapbox to 50A
  - Can support

- Option 2: Modify an OCP compliant PowerShelf created by Delta
  - Up to 16.4kW per rack
  - Each PowerShelf has dual AC input therefore can be used for UDB system <8.2kW per rack

- Winterfell – 12.4kW – YES
- Knox Type IV – 9.6kW – YES
- Knox Type V – 6.9kW – YES
- UDB – dual 208Vac PDU - YES
V1 Power Shelf
V1 OpenRack

AC input only (N+1)

700W*6 = 4.2kw*3 = 12.6kW per Rack

12Vdc Output via Busbars
Dual input AC Powershelf
208V PowerShelf

**UDB Configuration N(N+1)**

- 2.1kW
- 2.1kW
- 2.1kW
- 2.1kW
- 2.1kW
- 2.1kW

12Vdc Output via Busbars

2.1kW x 2 = 4.2kW x 3 = 12.6kW per Rack
Limited to 8.2kW due to breaker limit

**Up to 16.4kW Configuration (N+1)**

- 2.1kW
- 2.1kW
- 2.1kW
- 2.1kW
- 2.1kW
- 2.1kW

12Vdc Output via Busbars

2.1kW x 5 = 10.5kW x 3 = 31.5kW per Rack
Limited to 16.4kW due to breaker limit
Open Rack - Cold Storage - Design

- Low cost, efficient storage rack for rarely accessed data:
  - Two Power Zones
  - One Power Shelf w/ 5 PSUs (4+1)
  - AC input only – No DC backup
  - 16 Knox trays and 2 Winter Fell
  - One 10G and 1G switch per 3 racks
Open Rack - Cold Storage - Design

AC PDU

277VAC IN – Single Phase

Half PDU

277VAC
One RJ45 for PSU
Fail detection

Bus Bar

WF

Knox x8

Power Shelf
Open Rack - Cold Storage - Design

- Power Box to power Switches and BloodHound
- 1 BloodHound per 3 racks
- Middle Rack houses BloodHound, Switches and Power Box
Lessons Learned
Facebook Open Rack V1
Thin Data Cables for Thin Cable Volume

Cable Tray only 1 inch wide

10 Gig with small cross-section

1Gig Cat6 With Rectangular Cross section
Why Does the DC Power Clip Float?

Motion from shipping IT Gear in the rack causes damage to the busbar

Adding the +/- 4mm vertical float eliminates the relative motion between busbar and clip

Guide pins align clip to busbar

+/- 4mm vertical float
+/- 3mm horizontal float
Lower Cost Design IT Gear Support Bracket

Current design uses a spring plunger to retain the support bracket into the rack.

New design will replace the spring plunger with thread forming screw

Both Designs will be available on OCP website
Clip Efficiency

Clip Drop

- Semi #1
- Semi #2
- Semi #3
- Bright #1
- Bright #2
- Bright #3

mv drop vs Current (A)
Busbar Efficiency

Power Disipation
(current flowing through 1 busbar blade from top to bottom)

Load (A) vs. Power (W) graph showing the relationship between load and power dissipation.
Backup
Modular Mounting

- OU = 48mm
- Tool-less Knife Shelving
- Power Shelf Adjustable in
  - 0.5 OU increments
  - IT equipment can have various heights – 1 OU, 1.5 OU, 2 OU, etc.
Rack

Open Rack
Three 13U Power Zones in one rack

10U Equipment Bay

12.5V 4.2KW Power Shelf

23.6” (600mm)
120mm  180  180  120mm

Bus Bar pairs 3mm thick 17mm apart

3U
Tool-less Knife Mounting

Rack - Chassis mounting scheme

0.5U vertical pitch
Innovation: Cable-less Power Delivery

- Clip
- Bus Bar
- PDU
- Power Shelf
Bus Bar

600mm

538mm
Open Rack Singlet

Front View

Back View
V1 Power Shelf

Input DC

Input AC

Three 12.5V outputs

Rear View

Front View
Open Rack - Cold Storage – Qualification

- Bus bar characterization
- Power Box characterization
- Holdup Time analysis
- BloodHound Fail detection
- Rack power monitoring
- Datacenter connection
- Mechanical check
- Cabling check
Open Rack Schedule Overview

<table>
<thead>
<tr>
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<tr>
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<tr>
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<td>Deployment</td>
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<td>EVT</td>
<td>PVT</td>
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<td>Open Rack V1 Cold Storage</td>
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<td>EVT</td>
<td>DVT</td>
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Legend:
- EVT: Environmental Validation Test
- PVT: Production Validation Test
- Deployment: Deployment Phase
Open Rack – Team

Gloria Lau - Team Manager
Pierluigi Sarti – Technical Lead Rack and Power
Steve Mills – Mechanical Engr
Veerendra Mulay – Thermal Engr
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