OPEN. FOR BUSINESS.
SAS / SATA / NVMe Storage

Rackspace Barreleye G2 48V OpenPOWER Platform

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Agenda

- Introduction
- What is tri-mode?
- Why tri-mode?
- Implementation
  - Details & Alternatives
- Samples
Zaius & Barreleye G2

Capabilities

**ZAIUS** Motherboard
- 2 x POWER9 LaGrange
- 48V input
- Front IO & service access
- 80 Lanes of PCIe Gen4
- 32 Lanes of OpenCAPI / NVLink 2.0
- Open Source BMC & Host Firmware

**BARRELEYE** G2 Chassis
- Full-depth 48V open rack v2
- Hot swap fans and VGA access
- 2 OU chassis supports FHFL cards
- High density & hot swap storage bay
- Tri-mode Support (SAS / SATA / NVMe)
Storage Today & Past

• Separate connector pinout / backplane

• Separate mid-plane

• Separate controller
Tri-Mode Storage:

- Interchangeable SAS / SATA / NVMe Support in the SAME slot
- Hot-swap between different devices (Where firmware support is available)
- 1 Backplane
- 1 Mid-plane / Expander board
- 1 Controllers
Why Tri-mode?

• Mixed market forecast

• Bare metal as service
  • Avoid Reconfiguration
  • Hardware RAID
  • Hot-swap support

• Rackspace Perspective
  • Complex infrastructure
  • Increasingly mixed deployments (HCI)
  • Price Volatility

Percentage of Total Enterprise SSD consumption
Forecast based on number of units

<table>
<thead>
<tr>
<th></th>
<th>SATA</th>
<th>SAS</th>
<th>NVMe</th>
</tr>
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<tbody>
<tr>
<td>2017</td>
<td>61%</td>
<td>18%</td>
<td>20%</td>
</tr>
<tr>
<td>2018</td>
<td>55%</td>
<td>21%</td>
<td>23%</td>
</tr>
<tr>
<td>2019</td>
<td>52%</td>
<td>21%</td>
<td>27%</td>
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<tr>
<td>2020</td>
<td>48%</td>
<td>22%</td>
<td>30%</td>
</tr>
<tr>
<td>2021</td>
<td>42%</td>
<td>24%</td>
<td>34%</td>
</tr>
</tbody>
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Source: BCM DCSG Normalized based on IDC, Trend Focus
Barreleye G2 Storage

Tri-mode

- 24 Drives
- SAS / SATA / NVMe
- NVMe Hardware RAID
- Tri-mode Hot-Swap
Tri-mode Storage

Demo 1

Hot-Swap SATA with NVMe
Tri-mode Storage

Demo 2
Building hardware RAID on NVMe with Broadcom 9460-16i

SATA HW RAID

NVMe RAID
**Ideal Tri-mode Storage Reference Architecture**

- **Tri-mode RAID Controller / HBA**
- **Tri-mode Expander**
- **96 HIGH SPEED LANES IN DRIVE BACK PLANE**
- **24 “U.3” SAS / SATA / NVMe Drive Slots**
- **Drive Back-Plane**

**Details:**
- X8 PCIe Gen4
- X16 PCIe Gen4
- X8 SAS [7:0]
- X8 PCIe
- X8 PHY
- X8 PHY
- X8 PHY
- X8 PHY
- X8 PHY
- X8 PHY
- X8 PHY
- X8 PHY

**STORAGE EXPANDER BOARD**
Tri-Mode Storage:

Requirements of Specification / Samples

- One Backplane
  - One connector
  - Less high-speed lanes to backplane

- One Mid-plane
  - Tri-mode Expander

- One HBA / RAID Controller

SAS
SATA
NVMe
Tri-Mode Storage:
Requirements of Specification / Samples

- One Backplane
  - Single connector
- Less high-speed lanes to backplane
- Drives should change form-factor
Tri-Mode Storage:
Requirements of Specification / Samples

One Mid-plane Solution
• Tri-mode Expander
Tri-Mode Storage:
Requirements of Specification / Samples

- One HBA / RAID Controller

X8 SAS [7:0]  
X8 PCIe
X8 PCIe

Tri-mode RAID Controller

X8
PCIe Gen4
X16
PCIe Gen4
Double Plumb U.2

Single lane SAS / SATA , Dual lane NVMe
Barreleye G2 Tri-mode Storage
Actual Implementation

80 HIGH SPEED LANES IN DRIVE BACK PLANE

BCM 9465-16i/CAPI 2.0 / HBA

X8 PCIe Gen4
X16 PCIe Gen4

MiniSAS Conn

SAS 35X48
PEX 9797

STORAGE EXPANDER BOARD

SlimSAS Conn

8x4 NVMe & 12x2 NVMe (U.2)

SEP

x1 SAS / SATA wired to 24 Drives (U.2)

CPLD

I2C
SGPIO
From SEB
From SEB

X8 PHY
X8 PHY
X8 PHY
X8 PHY
X8 PHY
X8 PHY
X8 PHY
X8 PHY
X8 PHY [7:0]
X8 PHY [15:8]
X8 PHY [23:16]
Barreleye G2 Tri-mode Storage

Actual Implementation: PCIe Gen3 U.2 Backplane
Barreleye G2 Tri-mode Storage
Using Separate Controllers for SAS / SATA and NVMe
Barreleye G2 Tri-mode Storage
Using Tri-mode Controller for SAS / SATA and NVMe
Barreleye G2 Tri-mode Storage
Using Separate Controllers for SAS / SATA and NVMe
Specification Update
Universal Backplane Implementation Guidance

- SFF-TA-1001 (U.3): Common drive bay definition
  - Specification ratified October 2017
  - Defines a universal backplane definition for SAS, SATA, and NVMe drives
  - Simplifies multi-protocol backplane design and lowers cost
  - U.3 Drives backwards compatible to U.2 bays

- SFF-TA-1005 (UBM): Universal Backplane Management
  - Backplane management framework
    - LEDs and much more
  - Unifies capabilities of various backplane management schemes
    - SGPIO (SFF-8485), 2Wire SES, and I2C PCA9555
  - Provides a method to manage and control SAS/SATA/NVMe backplanes
  - Resolves x2 and x1 NVMe drive support challenges
Tri-mode Storage Enhancements
PCle Gen3 U.2 Universal Backplane
Possible Adoption & Upgrades

Adopting PCle Gen3 U.2 Tri-mode Backplane
• SATA support by adding 1 or 2 lanes per U.2 NVMe connector

Upgrading to PCle Gen4 U.3 Tri-mode Backplane
• Amphenol
• PCle Gen4 NVMe (16 GT/s)
• SAS 4.0 (22.5GT/s)
• Tri-mode expander
• U.3 Connectors
Design Package

Available on OCP Server Wiki and GitHub

Enhancements Coming Throughout 2018

GitHub
https://github.com/opencomputeproject/zaius-barreleye-g2 (don’t forget to install Git LFS)

OCP
http://www.opencompute.org/wiki/Server/Working#Open_Rack
THANK YOU
Archive Material
U.3 vs U.2
PCIe Gen3 U.2 Universal Backplane
Possible Adoption & Upgrades

FIGURE 3-1 PORT USAGE OVERVIEW