Broadcom 9400 Tri-Mode Controller, Anwendungsgebiete und Tipps zum NVMe-Einsatz
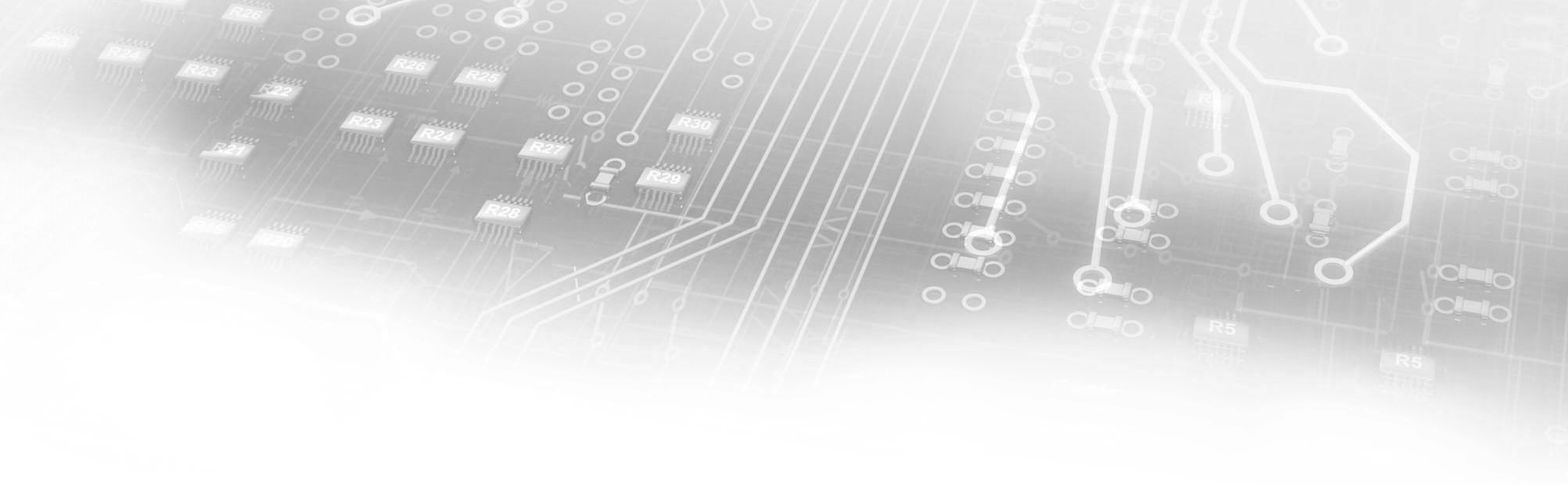
Dietmar Hinze

Field Application Engineer

20.02.2019

Overview

- Broadcom Overview (in short)
- Tri-mode Controller (Overview)
- Eco-System Update

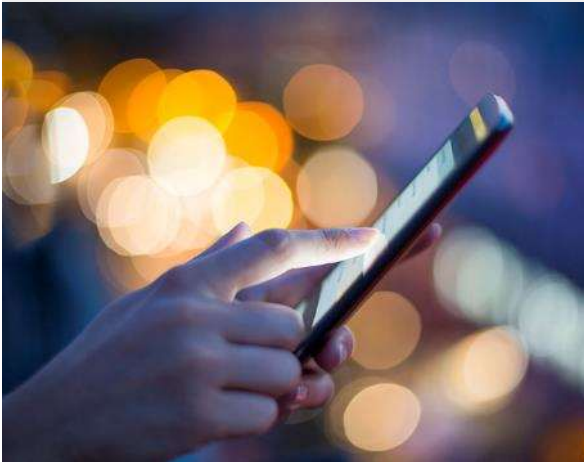**BROADCOM**®

Broadcom Overview

Global Technology Leadership

Data Center	Broadband	Mobile	Industrial
• Enterprise • Cloud • Telecom	• DSL • Cable • PON	• Wi-Fi/Bluetooth • GNSS • RF Filters	• Automotive • Factory automation • Alternative energy

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Data Center: Networking & Storage Connectivity

Server Connectivity

Networking

Storage

SSD

Ethernet Connectivity (Switching, Controller, PHY)

Custom ASICs

Optical Components

NVMe/SAS/SATA/PCIe Connectivity

Fibre Channel SAN Switches & HBAs

SSD/HDD Controller

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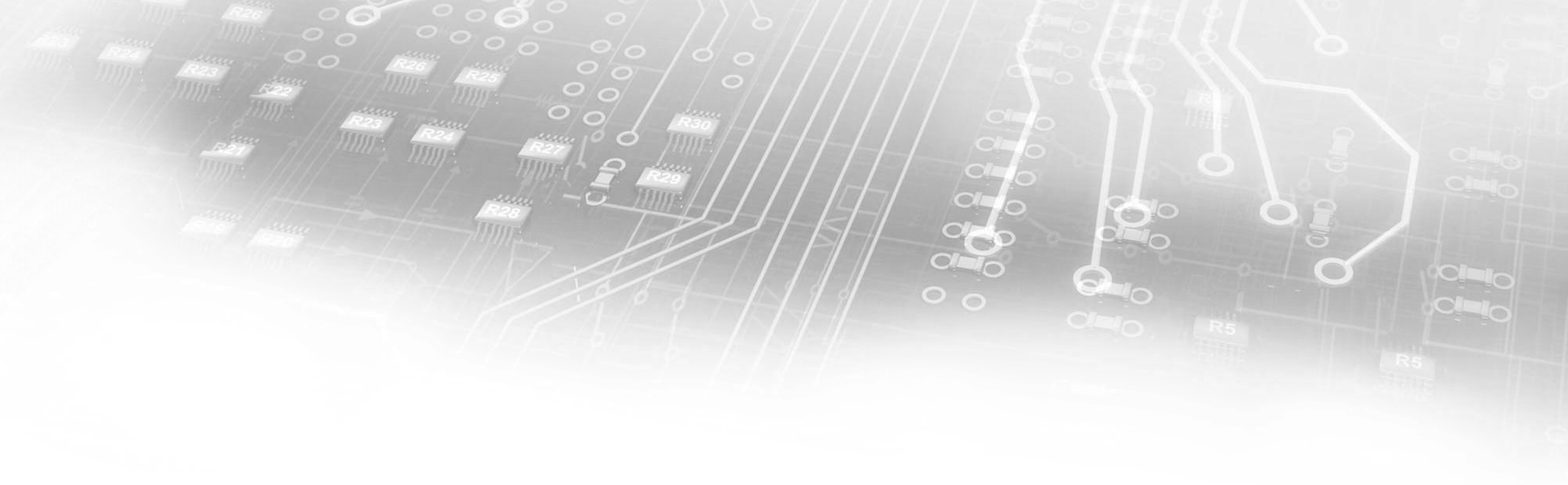
Tri-Mode Controller

PCIe/SAS/SATA Host Bus & MegaRAID Adapter

MegaRAID Adapter

Operating System

SAS/SATA/NVMe
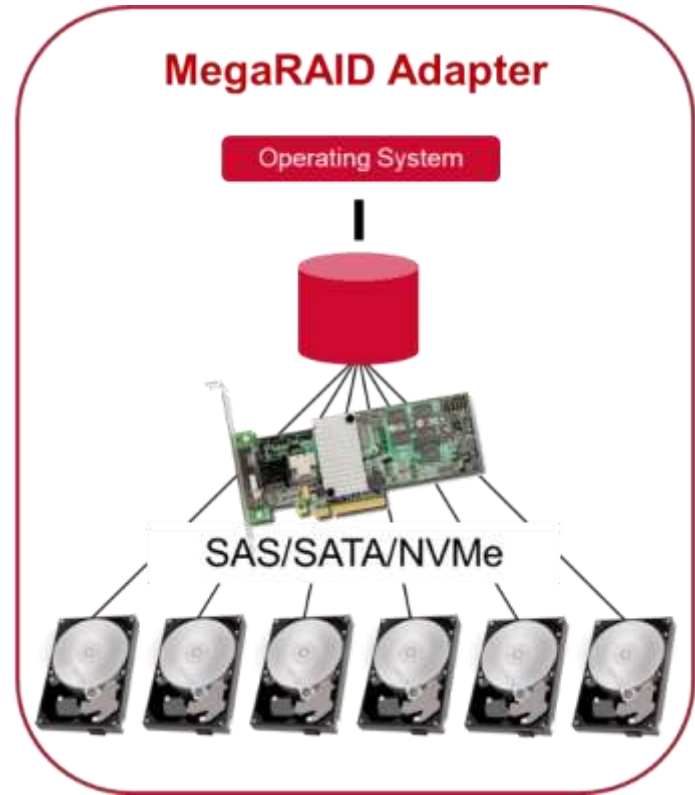
Application

General purpose Servers

High Storage Demand

High Data Protection Demand

Host Bus Adapter

Operating System

SAS/SATA/NVMe
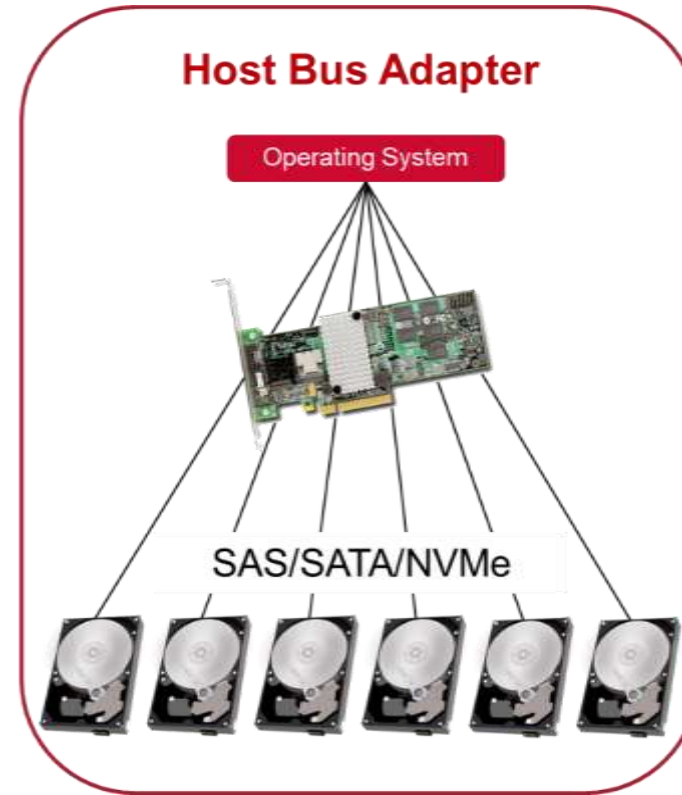
Application

Software defined Storage

Attaching external RAID Devices

Attaching Tape Storage Drives

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Board Name Decoder

MegaRAID SAS
94 6 0 - 16i

Brand Name
MegaRAID SAS = MegaRAID Entry, Value, Feature
BCL SAS = Host Bus Adapters

Connectors
"X"i = # of Internal ports
"X"e = # of External ports
"X"i"X"e = # of Internal and External ports

Technology
9 = SATA+SAS+PCIe

Generation

	Host Interface	Storage
1	PCIe Gen 1	3 Gb/s SAS / SATA
2	PCIe Gen 2/3	6 Gb/s SAS / SATA
3	PCIe Gen 3	12 Gb/s SAS / SATA
4	PCIe Gen 3	Tri-mode 12 Gb/s SAS/ SATA/ PCIe 3
5	PCIe Gen 4	Tri-mode 12 Gb/s SAS/ SATA/ PCIe 4
6	PCIe Gen 4	Tri-mode 24 Gb/s SAS/ SATA/ PCIe 4

Subcategory
0 = HBA Initiator / Target
1 = HBA Integrated RAID
4 = MegaRAID Entry (iMR)
6 = MegaRAID Value
8 = MegaRAID Feature

Linear Variant Digit
Starts at "0"; This digit is used for changes that are meant show succession from an older version to a newer version.

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Introducing 9400 Family HBA & MegaRAID

- New Chipdesign utilizing ARM A15 1.2Ghz architecture
- Larger L2 Cache and OCM
- TRI-Mode SerDes supporting SAS/SATA/NVMe Media

- Updated Memory Controller with 16% increased bandwith
- Higher Memory Capacity with up to 4GB of DRAM
- Onboard flash memory for automated Cache offload

- Improvements to Fastpath
- Minimized Firmware based IO processing
- Parallel IO Processing

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HBA 9400 Series Tri-Mode Storage Adapters
9400-16i, 9400-16e, 9400-8i, 9400-8e, 9405W-16i, 9405W-16e

16-port Tri-Mode HBAs
9405W-16i (05-50047-00)
9405W-16e (05-50044-00)

16-port Tri-Mode HBAs
9400-16i (05-50008-00)
9400-16e (05-50013-00)
9400-8i8e(05-50031-02)

8-port Tri-Mode HBAs
9400-8i (05-50008-01)
9400-8e (05-50013-01)

Applications
– High-port count SAS/SATA/NVMe adapters for direct attached high connectivity applications
– Tri-Mode connectivity enabling maximum data center flexibility
– Flexible solutions for cloud computing
– External storage requiring high connectivity SAS/SATA interface for host or drive side connect

Key Features
– Tri-Mode Storage Interface Ports
  • SFF-8680 Bay
    ▪ x1 SAS
    ▪ x1 SATA
    ▪ x2 SAS (Multi Link)
    ▪ Two x1 SAS (Dual port usingMPIO)
  • SFF-8639 (U.2) Bay
    ▪ x2, x4 NVMe
– Supports 12, 6, and 3Gb/s SAS and 6, 3Gb/s SATA data transfer rates
– Up to 8 storage interface PCIe links.
– Each link supporting x4 or x2 link widths up to 8.0 GT/s (PCIe Gen3) per lane
– PCIe Gen3 x16 Host Interface for max. throughput

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MegaRAID 9400 Series Tri-Mode Storage Adapters
9460-16i, 9460-8i, 9440-8i, 9480-8i8e

16-port Tri-Mode RAID
9460-16i (05-500011-00)

8-port Tri-Mode RAID/iMR
9460-8i (05-50011-02) & 9440-8i (05-50008-02)

8-internal / 8-external -port Tri-Mode RAID
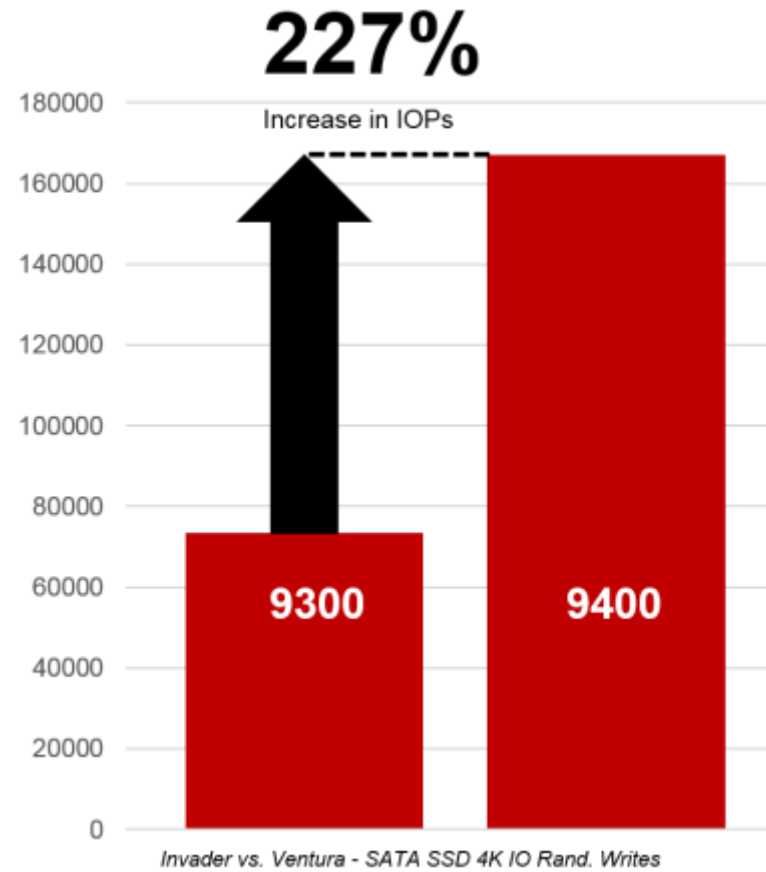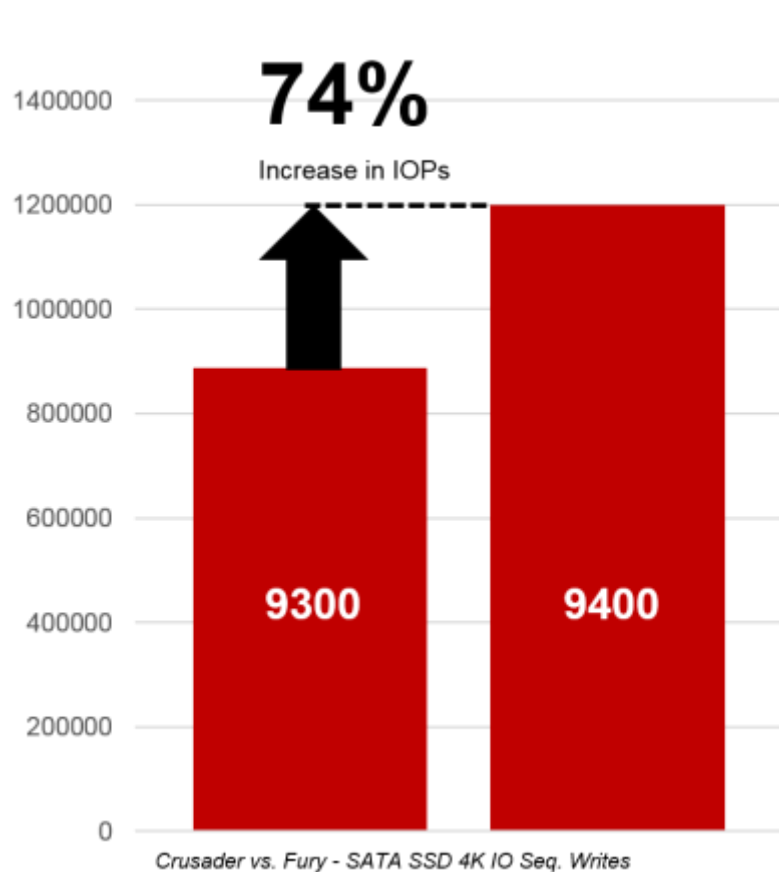9480-8i8e (05-500031-00)

Applications
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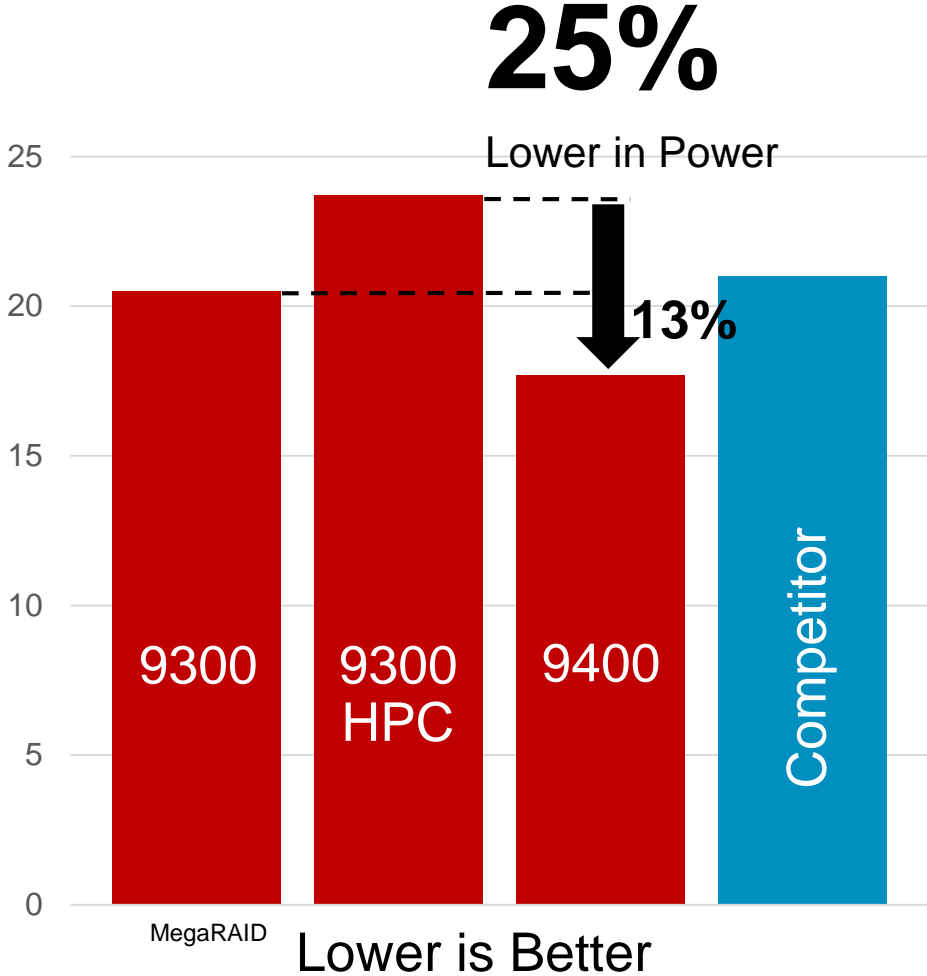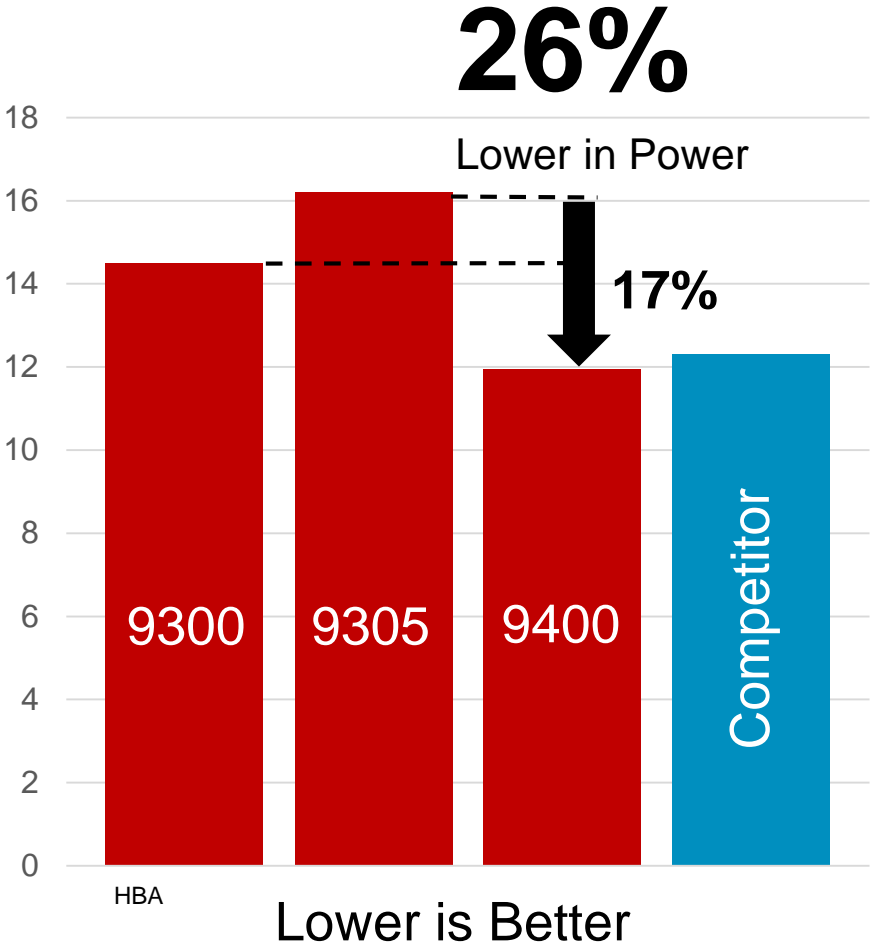- Each link supporting x4 or x2 link widths up to 8.0 GT/s (PCIe Gen3) per lane

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Let SATA SSDs rock!

74% Increase in IOPs

1400000
1200000
1000000
800000
600000
400000
200000
0

9300   9400

Crusader vs. Fury - SATA SSD 4K IO Seq. Writes

227% Increase in IOPs

180000
160000
140000
120000
100000
80000
60000
40000
20000
0

9300   9400

Invader vs. Ventura - SATA SSD 4K IO Rand. Writes

Improved Fastpath engine shows best SSD performance

- 9400 HBA Family performs 74% higher in Seq. Writes
- 9400 HBA Family increases bandwith by up to 7% in Writes
- 9400 MegaRAID Family perfoms up to 44% higer in Seq. Writes (RAID 5)
- 9400 MegaRAID Family increases bandwith by up to 13% in Writes (RAID 5)

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Reduced Power

26%
Lower in Power

18
16
14
12
10
8
6
4
2
0

9300 9305 9400 Competitor

17%

HBA

Lower is Better

25%
Lower in Power

25
20
15
10
5
0

9300 9300 HPC 9400 Competitor
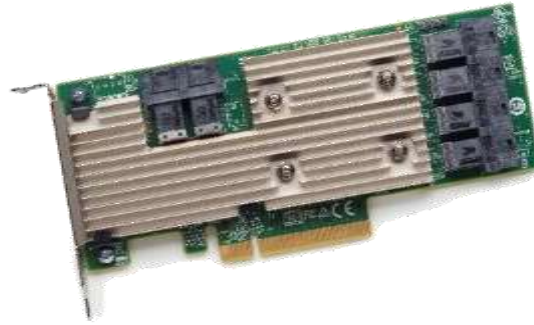
13%

MegaRAID

Lower is Better

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Place it right

SAS 9300 family

- Any standard 8 Port Opportunity
  - Backup/Tape
  - External SAS Storage

SAS 9305 family

- Need for high direct attached possibility
  - Software Defined Storage
  - Block Storage
  - Low Latency
  - Multiple Expander Systems

SAS 9400 family

- High Performance needs
- Low Power / Heat needs
- NVMe Connection

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Major differentiators - HBAs

|	9300 family (Fury)	9305 family (Cutlass)	9400 family (Tomcat/Crusader)
Port Count	8	16-24	8-16
Connectivity	SAS/SATA	SAS/SATA	SAS/SATA/NVMe
IR support	Yes	No	No
Performance	1.45M IOPs / 6.000 MB/s	1.5M IOPs / 6.400 MB/s	1.7M IOPs / 6.840 MB/s
Power Consumption	14.5W max.	16.2W max.	11.95W max
Cooling Requirements	200 LFM @ 55°C	200 LFM @ 55°C	200 LFM @ 55°C
Price	$	$$	$$$

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Place it right

MegaRAID 9300 family

- Any standard 8 Port Opportunity
- SSD Caching

MegaRAID 9300-16i/24i/8i8e family

- Need for high direct attached possibility
- Eliminating Expander issues
  - Connectivity issues
  - Latency
- SSD Caching
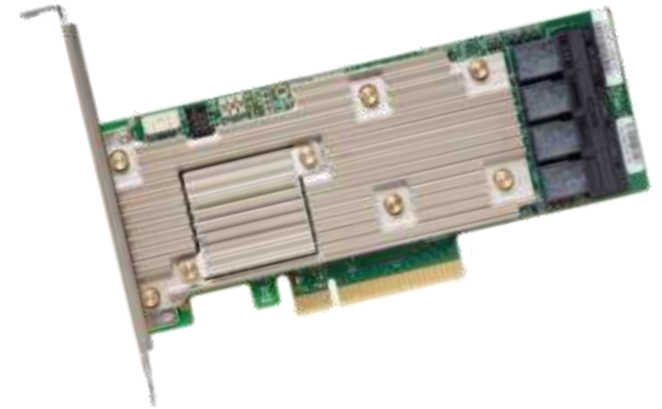
MegaRAID 9400 family

- High Performance needs
- Low Power / Heat needs
- NVMe Connection
- Flash/SSDs as Primary Storage

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Major differentiators - MegaRAID

	9300 family (Invader)	9300 family (Intruder)	9400 family (Harpoon/Ventura)
Port Count	8	16-24	8-16
Connectivity	SAS/SATA	SAS/SATA	SAS/SATA/NVMe
Cache	1-2GB	2-4GB	2-4GB
CacheVault onboard	No	Yes (Supercap option)	Yes (Supercap option)
Cache Cade support	Yes	Yes	No
LSA support (WebGUI)	Yes	Yes	Yes
Performance	0.9M IOPs / 6.000 MB/s	1M IOPs / 6.400 MB/s	1.4M IOPs / 6.840 MB/s
Power Consumption	20.5W max.	23.7W max.	17.7W max
Cooling Requirements	200 LFM @ 55°C	300 LFM @ 55°C	250 LFM @ 55°C
Price	$	$$	$$$

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Introducing next Generation Management

OS GUI - LSI Storage Authority

- Webbased GUI

- Same Feature-Set like MSM

- No client side installation needed

- Compare to MSM
    - Significantly better performance
    - Highly secure (as secure as browser)
    - Less backend traffic to server
    - Can be scripted using ReST
    - Has potential to run on BMC

Command Line - Unified StorCLI

- Merge of SASxFlash/SASxIRCU & StorCLI

- Single Point of Management

- Use of common StorCLI command set

- Enhanced command set

PreBoot - MegaRAID Human Interface Infrastructure (HII)

- Integration in servers UEFI BIOS

- Single Point of Configuration

- Additional functions (e.g. FW update)

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SAS / SATA – Just Better!

Lower Power
- Up to 25% lower in power consumption
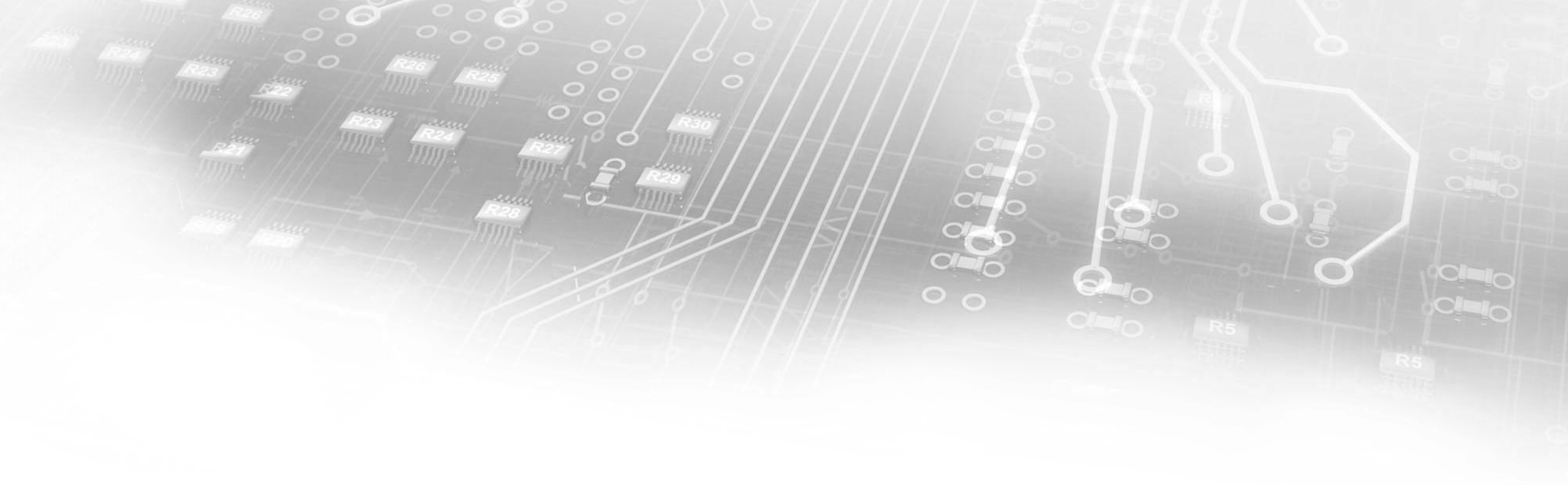- Reduced cooling requirement

High Performance
- Up to 247% performance improvement over previous Generation
- Best solution to work with SSD

Updated Management & Monitoring
- Unified StorCLI combines CLI for HBA and MegaRAID
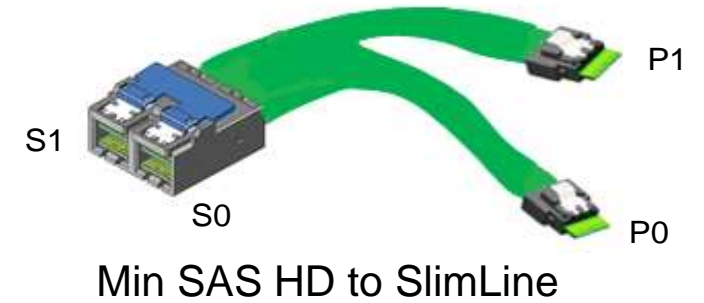- Webbased GUI LSA

backwards compatible for generations!
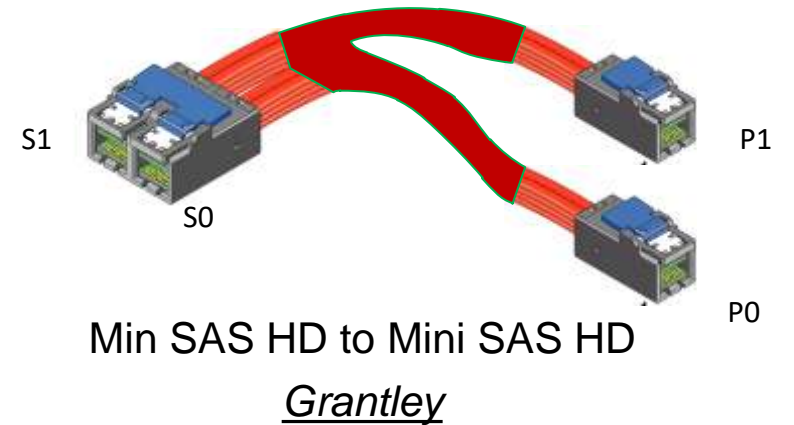
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NVMe Ecosystem Update

U.2 Enabler Cable

- x4 NVMe drive connect requires a special cable

- Cable re-orders lanes and effectively de-swizzles the adapter layout

- U.2 Enabler Cable also necessary for maximizing card flexibility when connecting to x2 and x1 NVMe drives

Min SAS HD to Mini SAS HD
Grantley

Min SAS HD to SlimLine

Min SAS HD to OcuLink
Purley
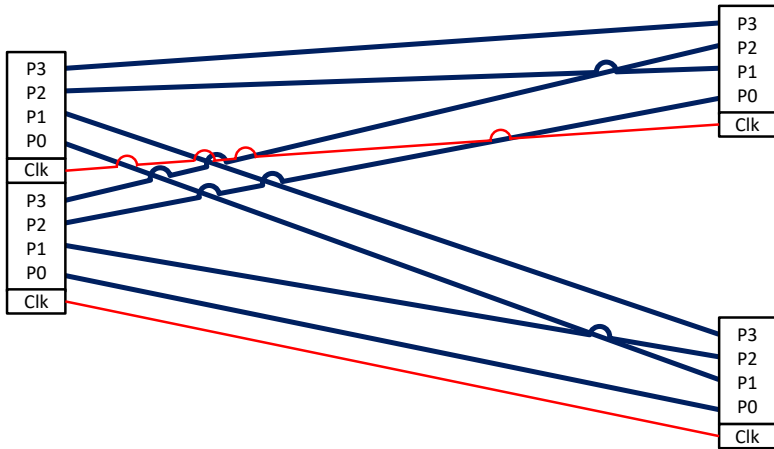
These cables are for NVMe usage only – unproper cabling can cause damage of Controller and Media

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# Adapter Cable Information

Ventura/Crusader Adapter Cables

MPN	Description	Where Used	Status
05-50061-00	Cable, U.2 Enabler, HD to HD(W) 1M	Intel Grantley or backplanes using legacy PCIe Mini SAS HD wiring. Also works with SMC backplanes, but without LED functionality.	Production
05-50062-00	Cable, U.2 Enabler, HD to OCuLink 1M	Intel, SMC Oculink based backplanes	Production
05-50063-00	Cable, U.2 Enabler, HD to SlimLine 1M	Backplanes with 2x4 Simline connectors	Production
05-50065-00	Cable, U.2 Enabler, HD to SFF8639 0.5M	Direct connect to SFF-8639 drives. 0.5M cable.	Production
05-50064-00	Cable, U.2 Enabler, HD to SFF8639 1M	Direct connect to SFF-8639 drives. 1M cable.	Production
05-60008-00	Cable, U.2 Enabler, HD to HD(W), SMC 1M	Targeted for SMC Purley backplanes and supports LED functionality.	Prototype

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Usage Scenarios – NVMe getting started

- ## Single 16 Port MegaRAID / HBA
 - 2 pcs. x4 NVMe Media
  - 8 pcs. SAS/SATA Media

✓ Best of both Worlds – Performance & Capacity

✓ Single Monitor and Management

✓ Saving PCIe Lanes by using single Controller

✓ NVMe Data Protection utilizing HW MegaRAID

✗ PCIe x8 Host Connection potential Performance bottleneck

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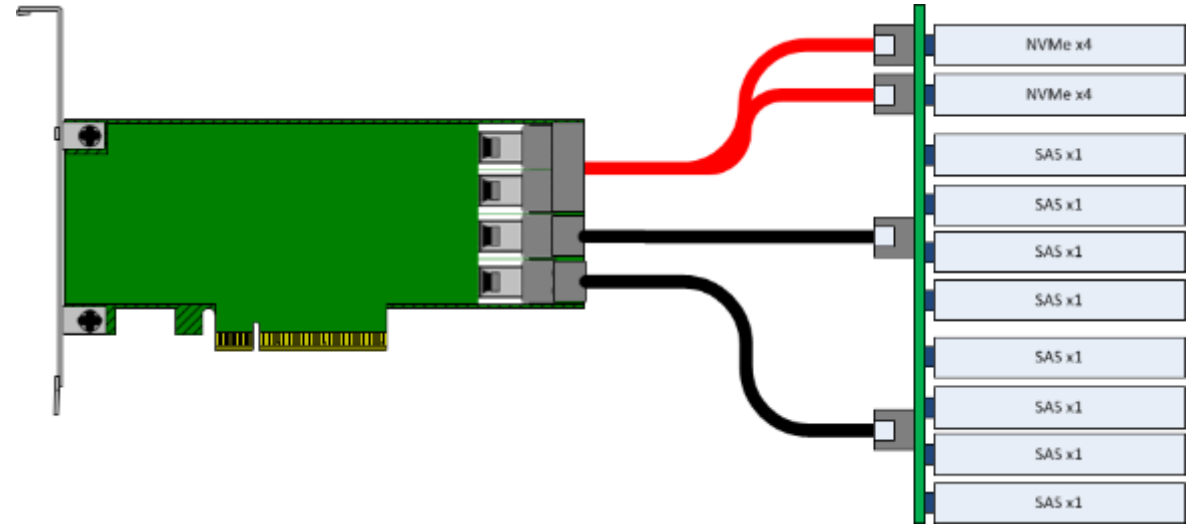
Usage Scenarios – Get the max out of it

- **1x 16 Port MegaRAID / HBA**
  - 4 pcs. x4 NVMe Media

- **1x 8/16 Port MegaRAID / HBA**
  - 8 pcs. SAS/SATA or

  - 20 pcs. SAS/SATA Media

✓ Max of both worlds
✓ Single Monitor and Management
✓ NVMe Data Protection utilizing HW MegaRAID
✓ Bandwith optimization by using multiple PCIe x8 Slots

✗ Multiple Controllers have to be managed
✗ Higher PCIe lane usage

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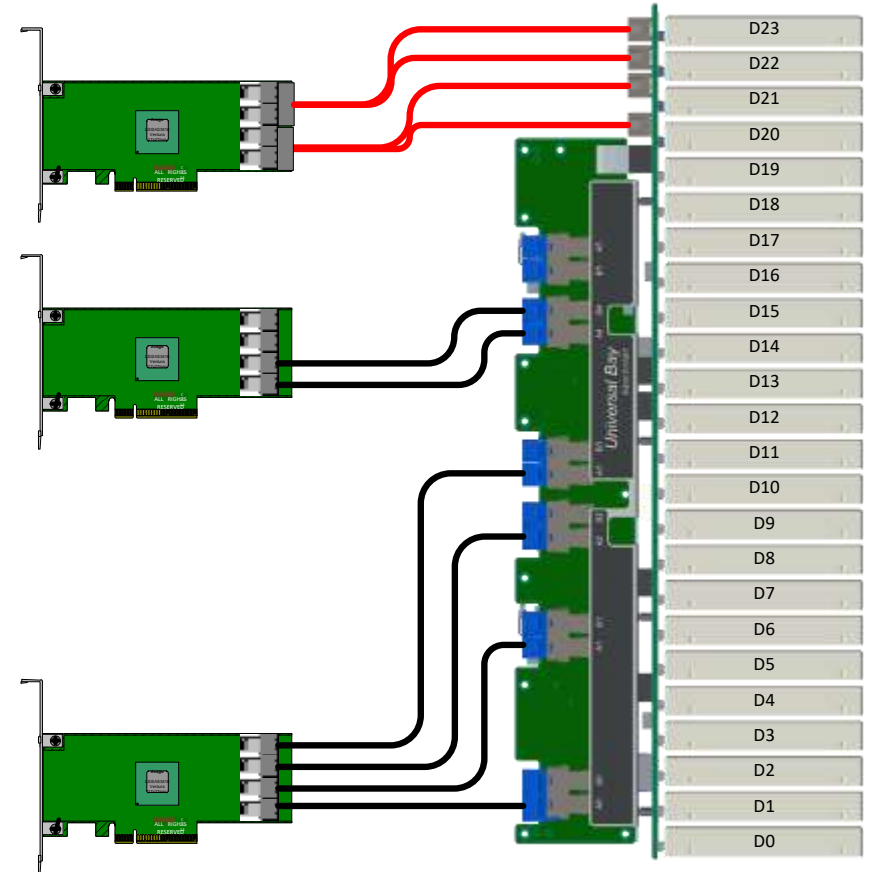
Configuration considerations

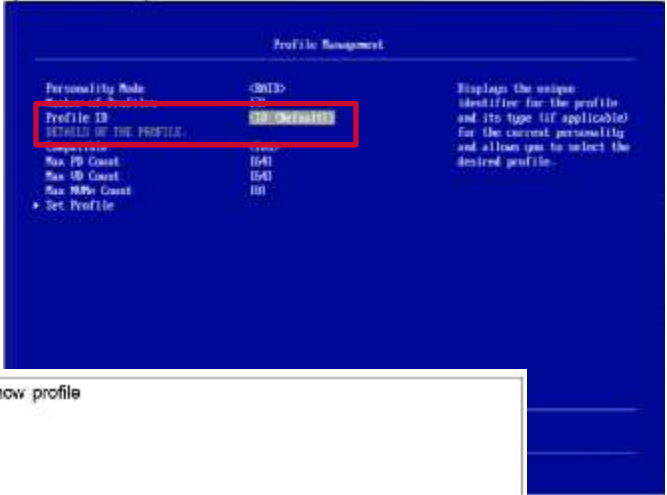| Item	Answers
Determine what type of NVMe enabled system/backplane will be used.	• Has the backplane a SAS expander and NVMe slots
Determine how to properly connect the adapter to NVMe drives.	• Must use U.2 Enabler Cable • Option without backplane - direct attached cables
Determine how to set the MegaRAID or IT Profiles to enable NVMe.	• SAS/SATA Only Mode(default) • NVMe Only Mode • Mixed Mode
Status LED's on SMC slots	• **SMC issues** with LED control (on white MiniSAS HD backplanes) • FW fix for OCulink backplanes is available • Backplane drives activity LED
How will the OS show the NVMe devices	• NVMe will show up as SCSI device • No differences for the tools (LSA)

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NVMe / Mixed Mode support

	SAS / SATA only	NVMe only	Mixed Mode
MegaRAID 9440-8i	✓	✓	✗ using U.2/NVMe x4
MegaRAID 9460-8i	✓	✓	✗ using U.2/NVMe x4
MegaRAID 9460-16i	✓	✓	✓
MegaRAID 9480-8i8e	✓	✓ For internal Ports only	✓ NVMe supported on internal Ports only
SAS 9400-8i	✓	✓	✗ using U.2/NVMe x4
SAS 9400-16i	✓	✓	✓
SAS 9400-8e	✓	✗	✗
SAS 9400-16e	✓	✗	✗
SAS 9405W-16e	✓	✗	✗
SAS 9405W-16i	✓	✓	✓

Considerations

- U.2 Enable Cable occupies 2 Wide Ports (unswizzle)
- NVMe is not supported for external connectivity (today)

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NVMe Deployment Model

- ## Profile driven
  - MR: Profiles are hold in FW and need to be activated
  - HBA: Profiles requires flashing the proper FW
  - Possible Profiles:
    - SAS/SATA only
    - NVMe only
    - SAS / SATA / NVMe mixed

- ## Set profile either by
  - StorCLI
  - HII (EFI BIOS)

- ## We ship with SAS/SATA profile as default
  - Customer can enable NVMe mixed mode with
  - Storcli (profile 13)

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