SDC
STORAGE DEVELOPER CONFERENCE
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Concepts on Moving From SAS connected JBOD to an Ethernet Connected JBOD (EBOD)

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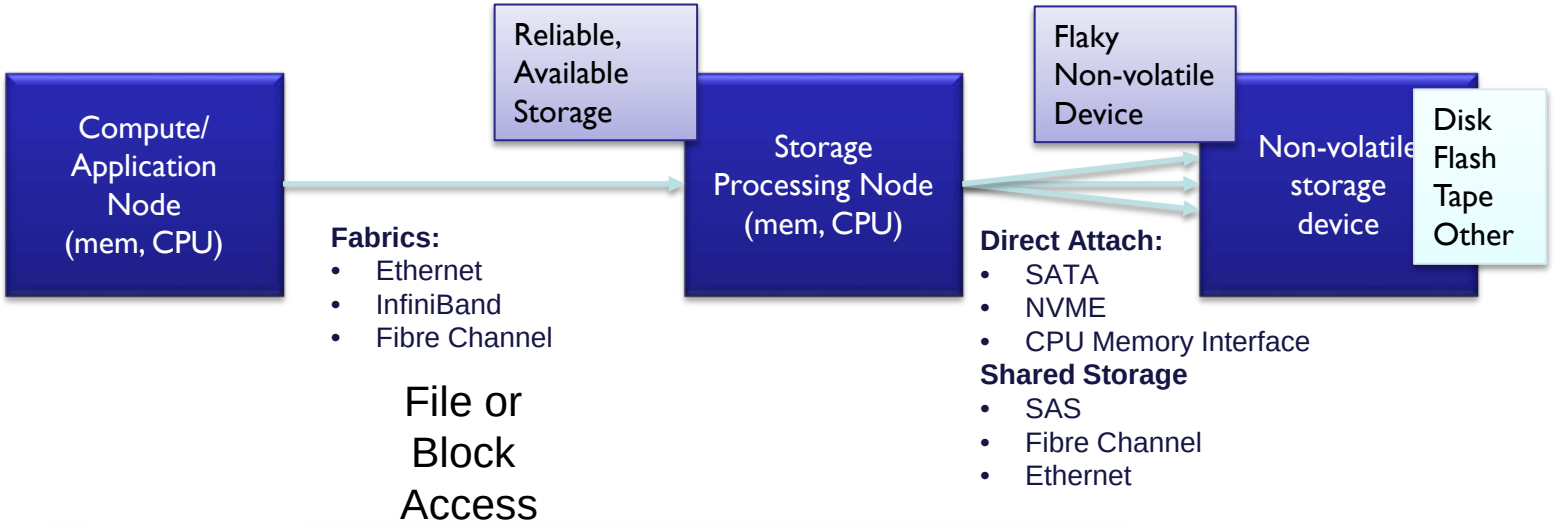
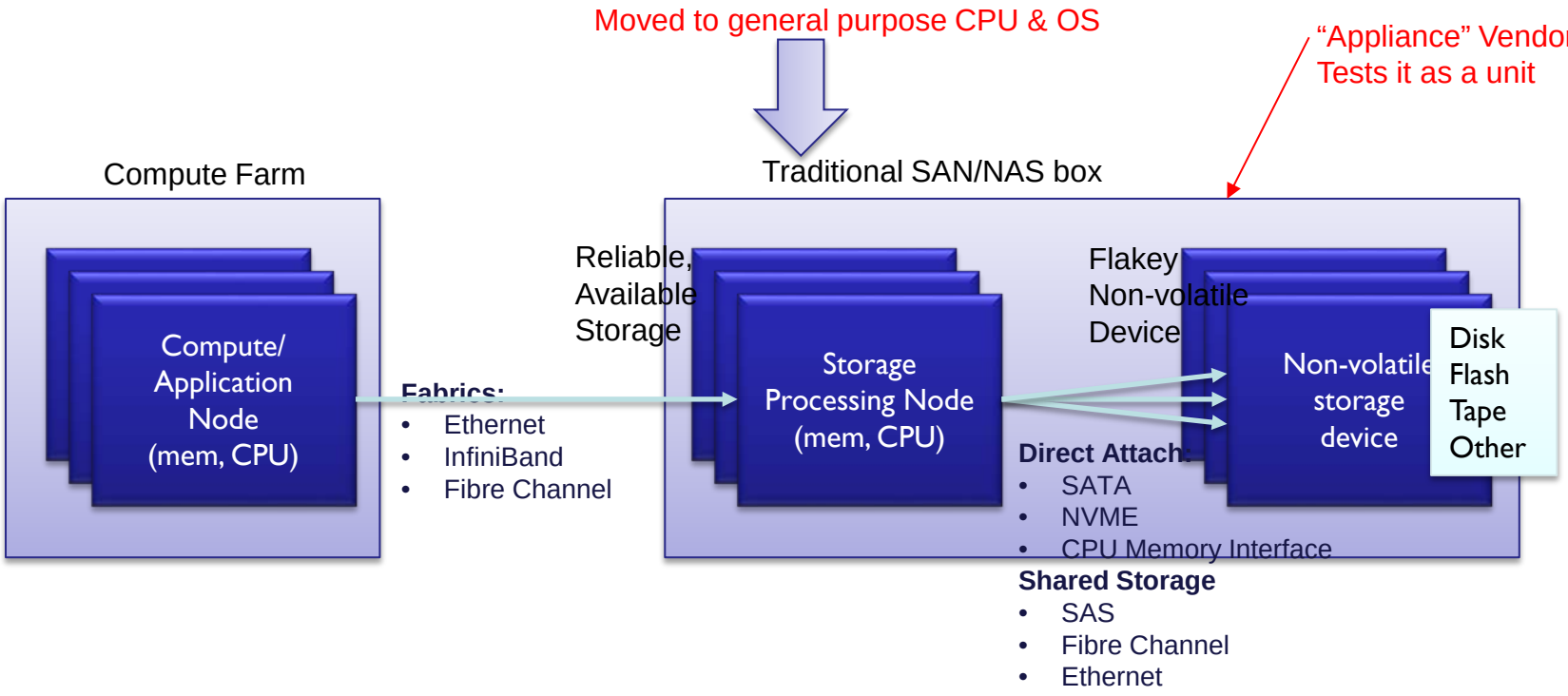
Re-Thinking Software Defined Storage Conceptual Model Definition

- Three “entitities”
  - Compute Node
  - Storage Node
  - Flakey Storage Devices
- Front end fabric: Ethernet, IB, FC
- Back end fabric: Direct Attached or Shared Storage

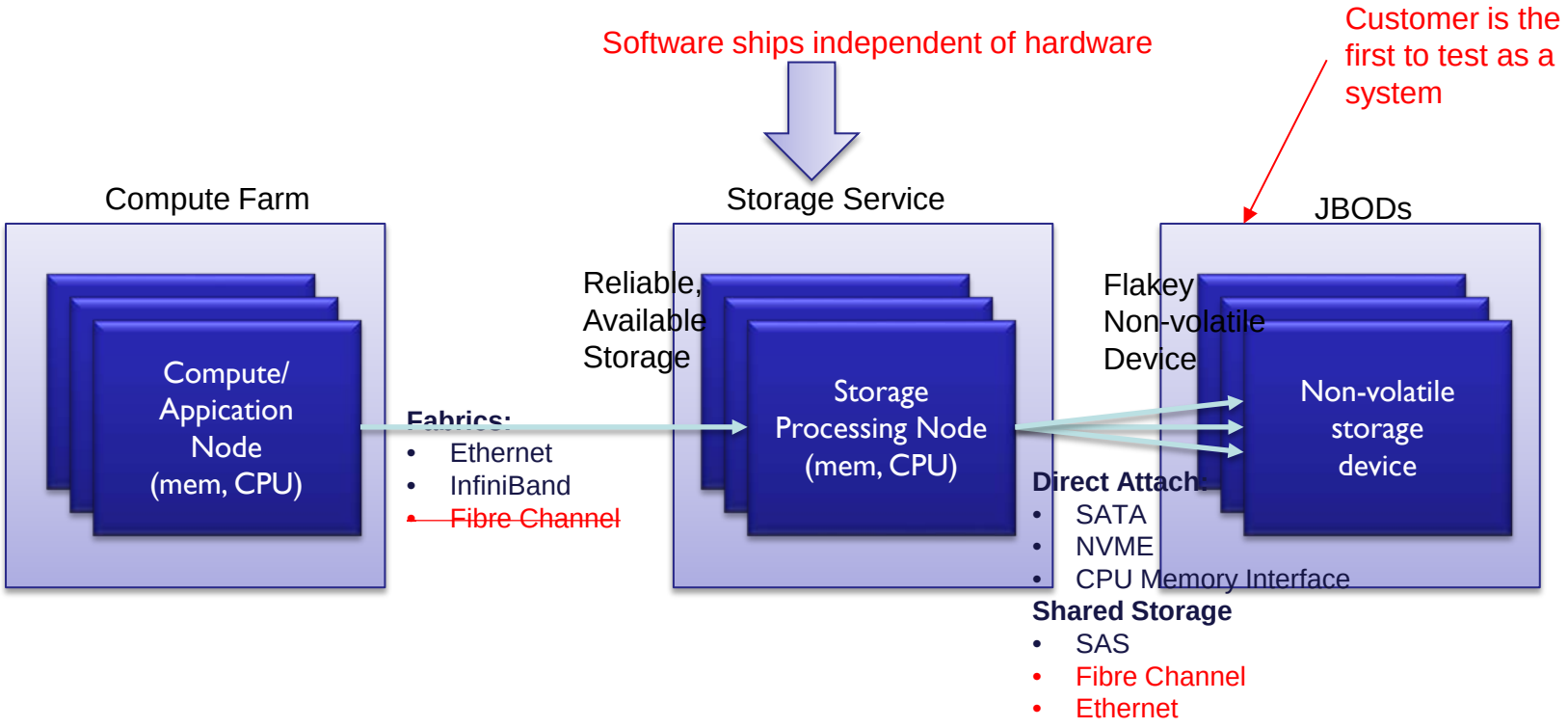


Yesterday's Storage Architecture: Still highly profitable



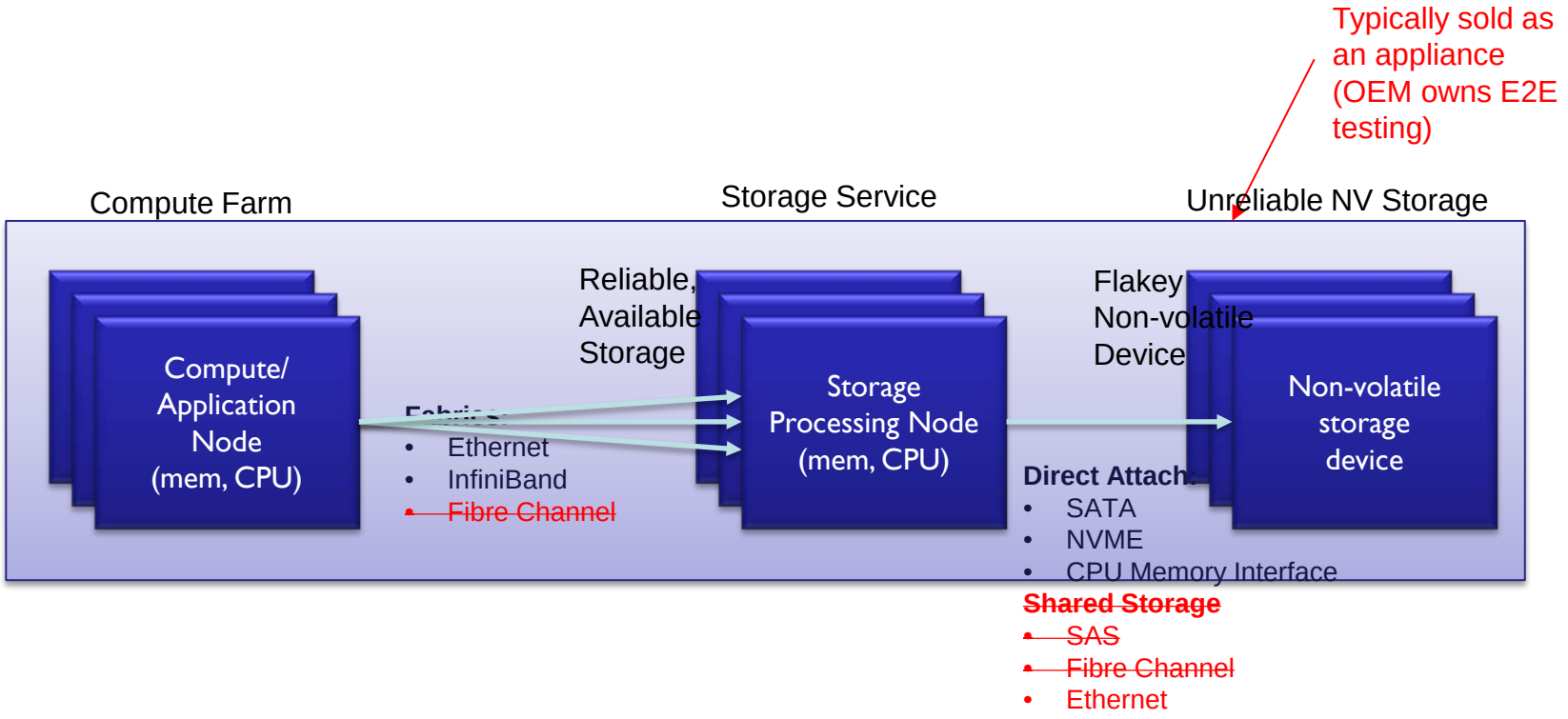
Today: Software Defined Storage (SDS)
"Converged" Deployments

- The rise of componentization of storage – but an interop nightmare for the user



Today: Software Defined Storage (SDS) "Hyper-Converged" (H-C) Deployments

- H-C appliances are a dream for the customer
- H-C $/GB storage is expensive

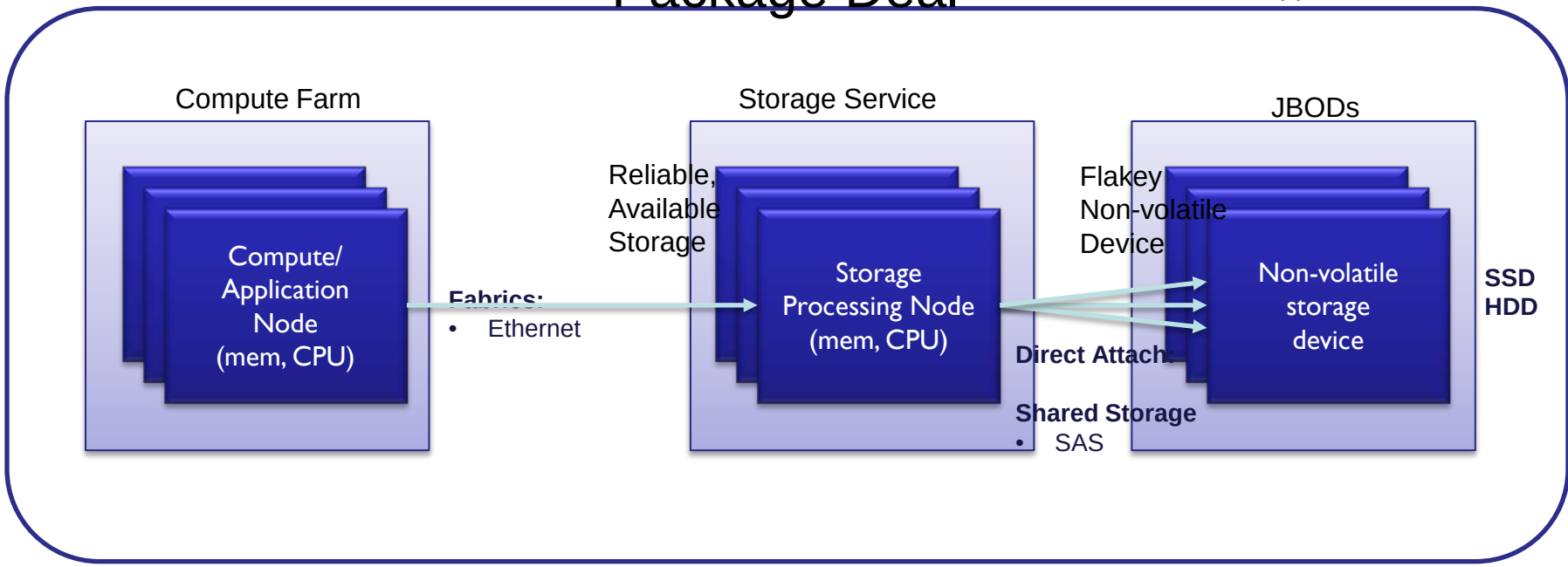


An Example: Microsoft's Cloud Platform System (CPS)

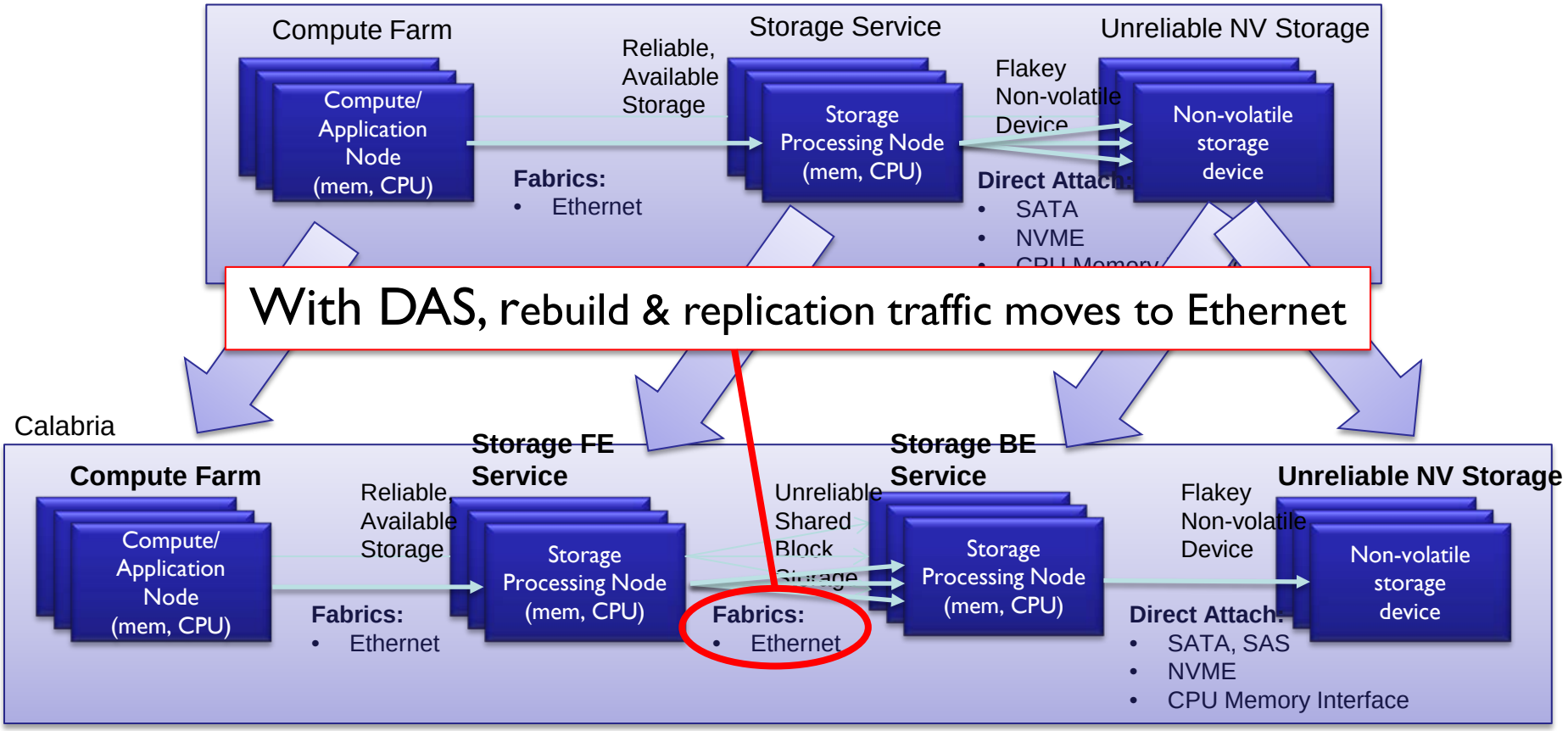
"Azure aligned innovation"
"Appliance like experience"
"Single Throat to Choke"

Package Deal

Shipped as of Oct/2014

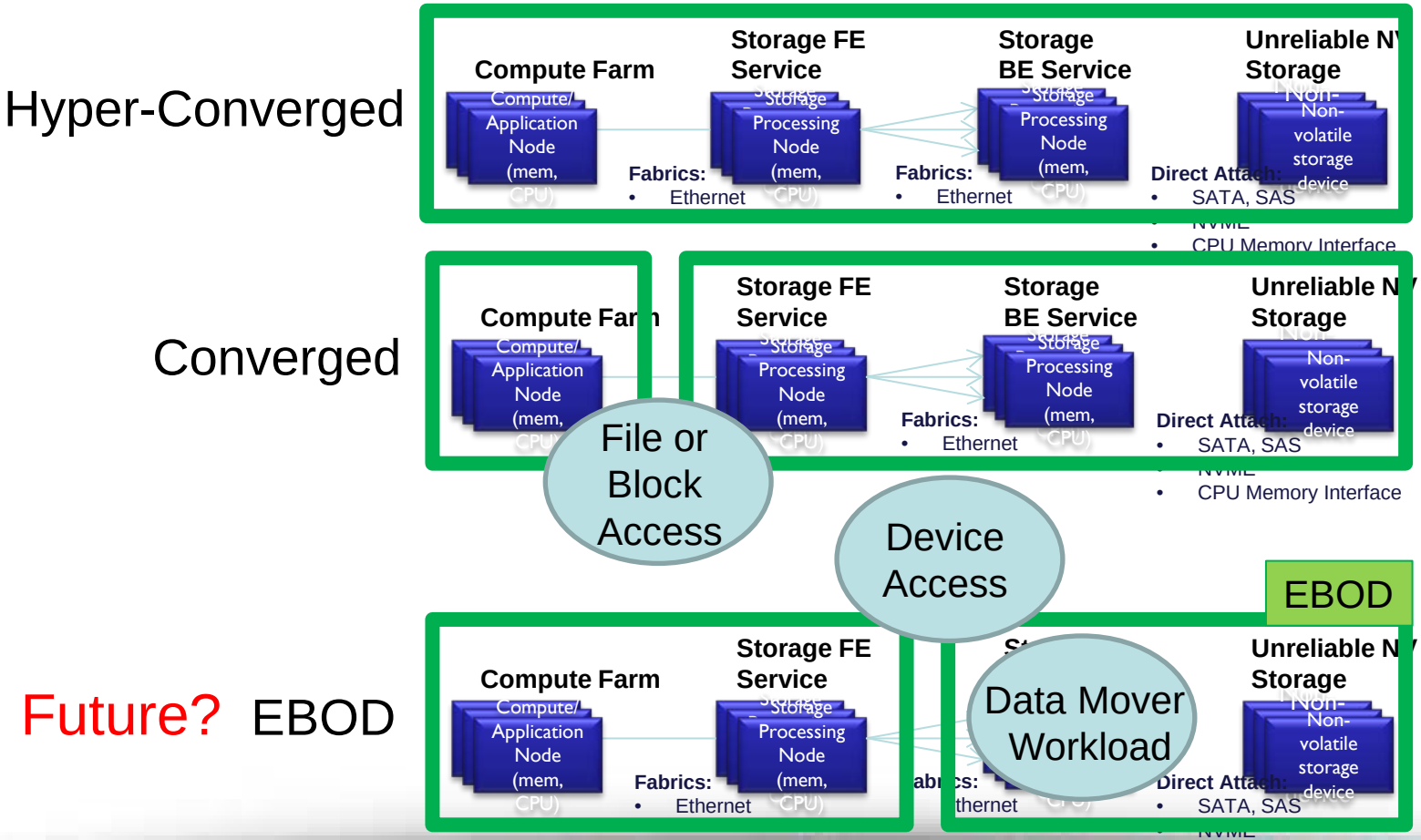


SDS with DAS



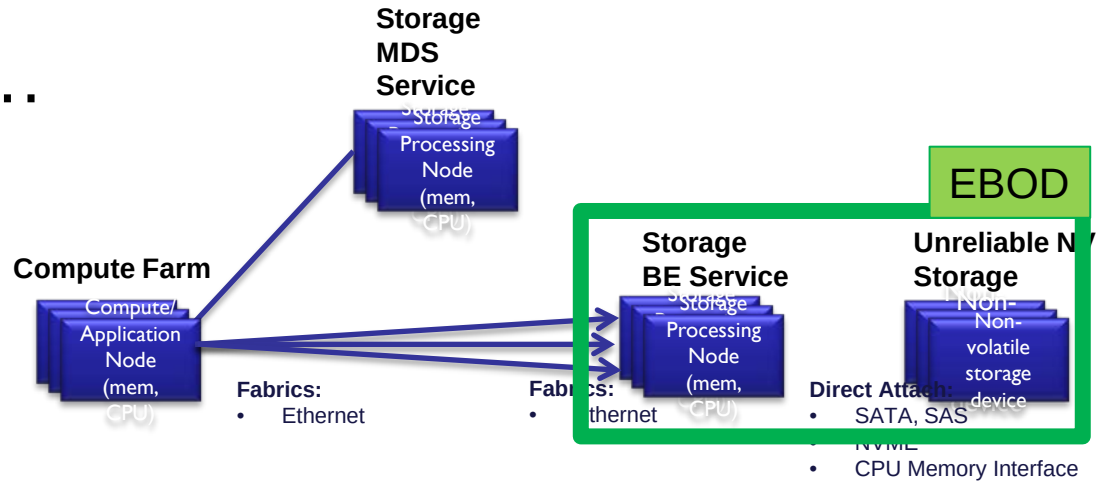
Software Defined Storage Topologies

= physical host boundary, blue is workload on physical node, arrows can go between physical nodes

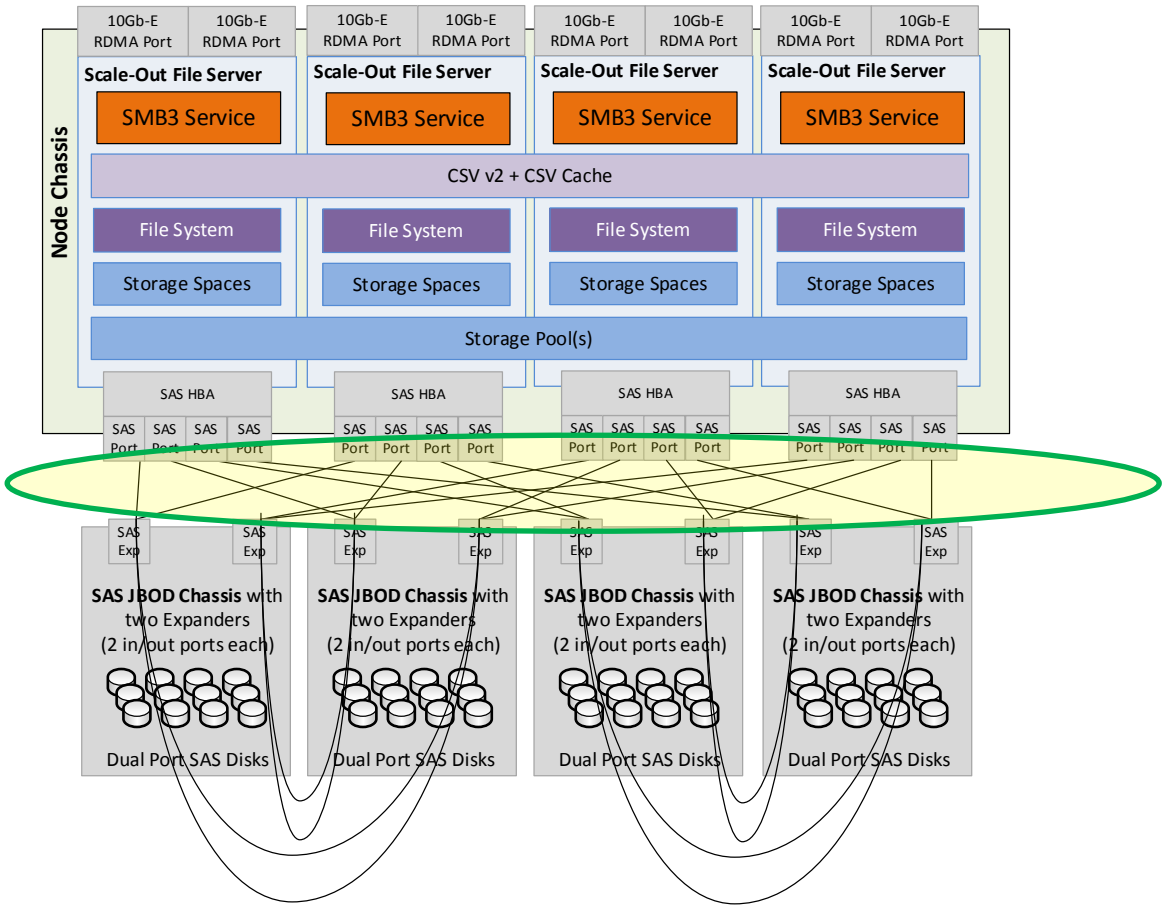


EBOD Works for a Variety of Access Protocols & Topologies

- SMB3 “block”
- Lustre – object store
- Ceph – object store
- NVME Fabric?…
- T10 Objects



I have a problem… shared SAS interop



Example Storage Cluster (Microsoft's CPS)

My Nightmare Experience

- Disk multi-path interop
- Expander multi-path interop
- HBA distributed failures

SAS Shared Fabric

- Multi-Initiator
- Multi-Path

There is a good reason why customers prefer appliances!

To Share or Not to Share?

- Shared SAS:
  - Customer deployment can have serious bugs
  - Failure of a FE node: JBOD fails over to another node
  - Failure of a JBOD: all data is replicated
- Non-Shared SAS (or SATA or NVME or SCM)
  - Customer deployment more straightforward
  - Failure of a FE node: EBOD fails over to another node
  - Failure of a EBOD: all data is replicated
  - New Ethernet traffic
    - Triple replica (3x increase bandwidth on Ethernet)
    - Rebuild traffic

Hyper-Scale Cloud Tension – Fault Domain Rebuild Time

- Rebuild time is a function of
  - Number of disks/size of disk behind a node
  - Speed of network and how much of it you want to use
- Storage cost reduction is driving higher drive counts behind a node (>30 drives)
  - Causes higher network costs because rebuild time must occur in constant time

Large # drives require extreme network bandwidth

TB behind one node	% BW utilization	Net speed (gb/s)	# nodes in rebuild	Min for rebuild
180	25	40	120	20
1080	25	40	120	120
1080	50	100	120	24

- Conclusions:
  - Required network speed offsets benefits of greater density
  - Fault domain for storage is too big

Private Cloud Tension – Not enough Disks

- Goal is entry point at 4 nodes (or less)
- If used same 30 disk JBOD
  - Loss of one node implies loss of 30 disks (180 TB)
  - To recover from node loss, must have 25% of capacity idle for single node failure, 50% idle for dual node fault tolerance
- Conclusion:
  - Fault domain is too large

Goals in Refactoring SDS

- Optimize workloads for class of CPU
  - **Backend is "data mover" (EBOD)**
    - Primarily movement of data and background tasks
      - Data Integrity, caching, …
    - Little processing power
  - **Frontend is "general purpose CPU"**
    - Still need accelerators for data movement, data integrity, encryption, etc.

EBOD Goals

- Reduce Storage Costs
  - Right size config for front end and back-end workloads
- Reduce size of fault domain (and rebuild traffic and network bandwidth requirements)
  - Small Private Clouds
  - Move storage fabric to Ethernet
- Build on more robust ecosystem of DAS
  - Keep topology for storage device simple

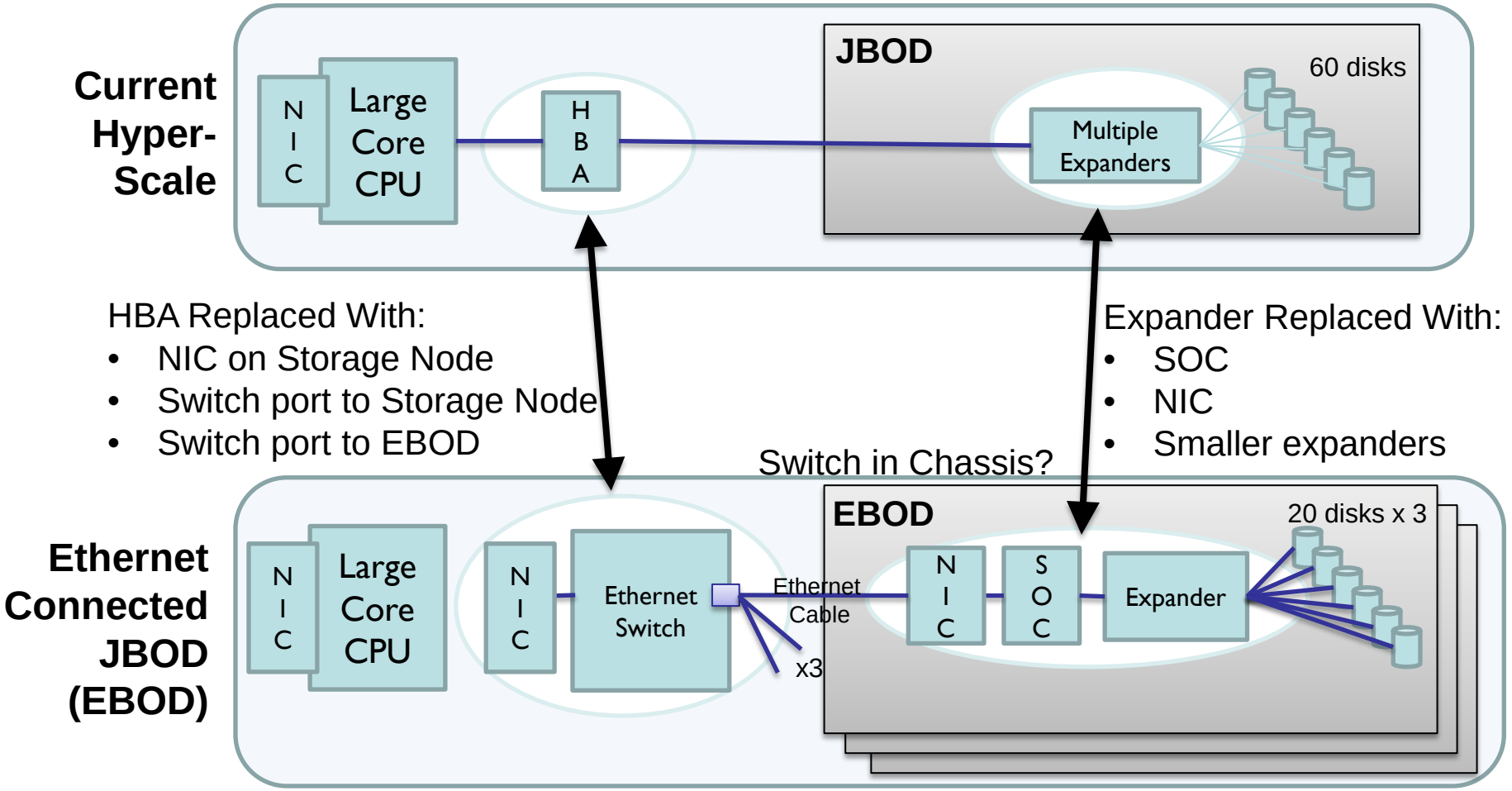
EBOD Design Points

- Ethernet Connected JBOD
  - **High End Box** (NVME, Storage Class Memory)
  - **Volume Box** (Some NVME/SSD, HDD)
  - **Capacity Box** (primarily HDD, some NVME/SSD)
- What If we used “small core” CPU?
- Fewer disks because cheaper CPU

EBOD Volume Box

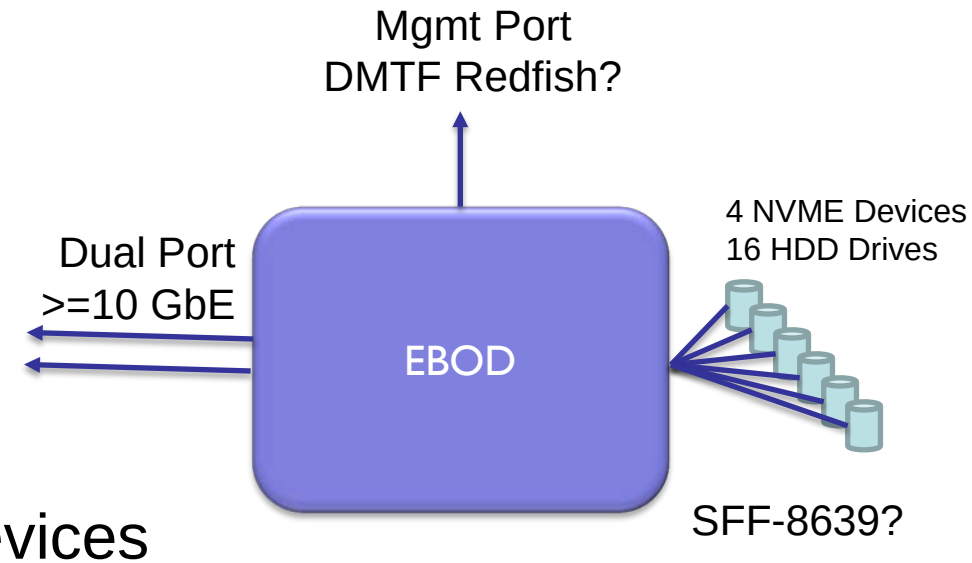
- Enable an Ethernet connected JBOD with low disk count at *very* low cost
  - Critical to hit a price point similar to existing SAS JBODs that are integrated into the chassis
  - Export just raw disks to keep CPU as simple as possible, and SDS as close to hardware as possible
    - Needed for Storage Class Memory
  - Enable front end nodes (big core) to create reliable/available storage

Comparing Storage Node Design Points



EBOD Volume Concept

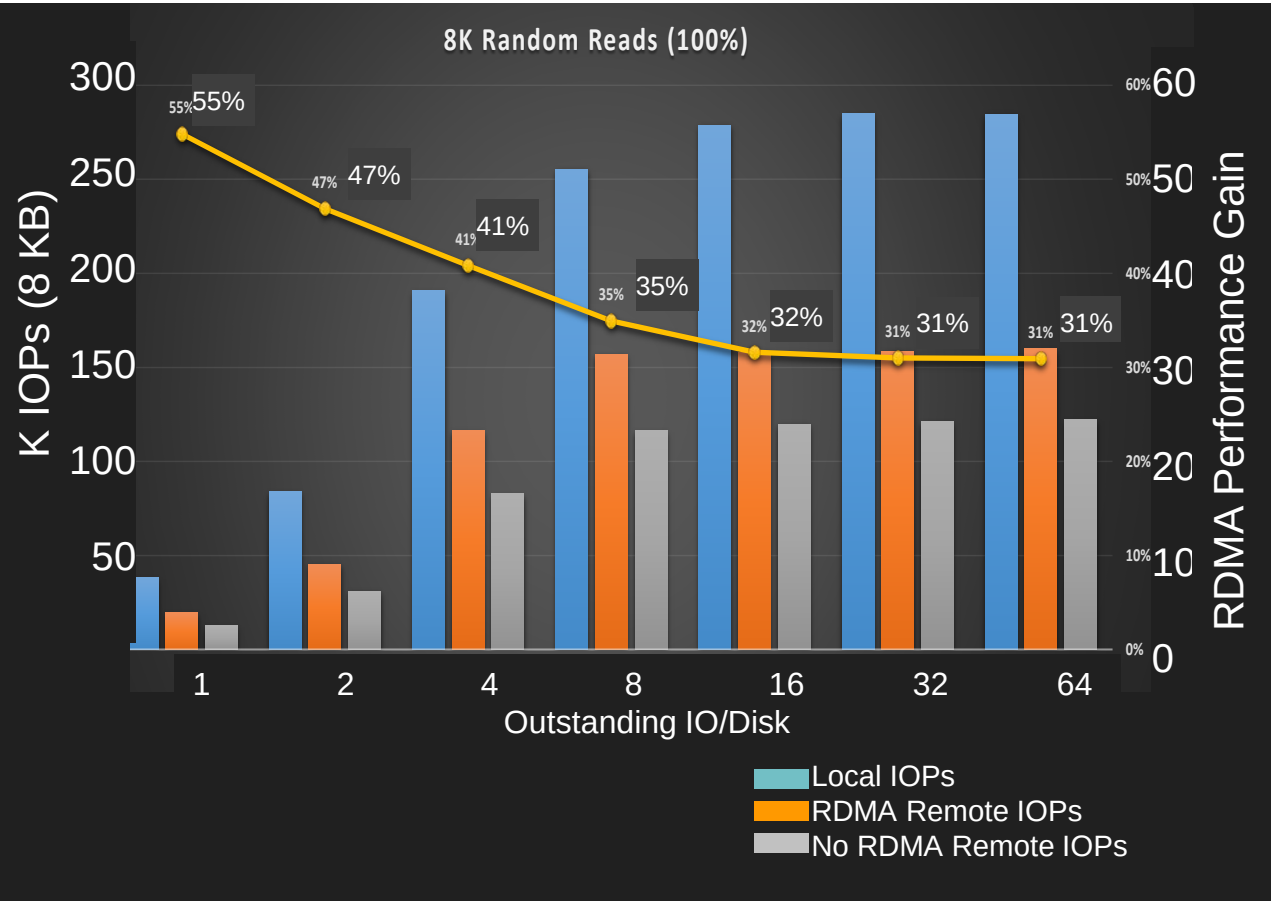
- CPU and Memory cost optimized for EBOD
- Dual attach >=10 GbE
- SOC with integrated
  - RDMA NIC
  - SATA/SAS/PCIE connectivity to ~20 devices
- Universal connector (SFF-8639)
- Management
  - Out-of-band management through BMC
  - In-band management with SCSI Enclosure Services



Volume EBOD Proof Point

- Intel Avaton Microserver
- PCIE Gen 2
- Chelsio 10 GbE NIC
- SAS HBA
- SAS SSD

EBOD Avaton Microserver POC, 8K Random Reads IOPs



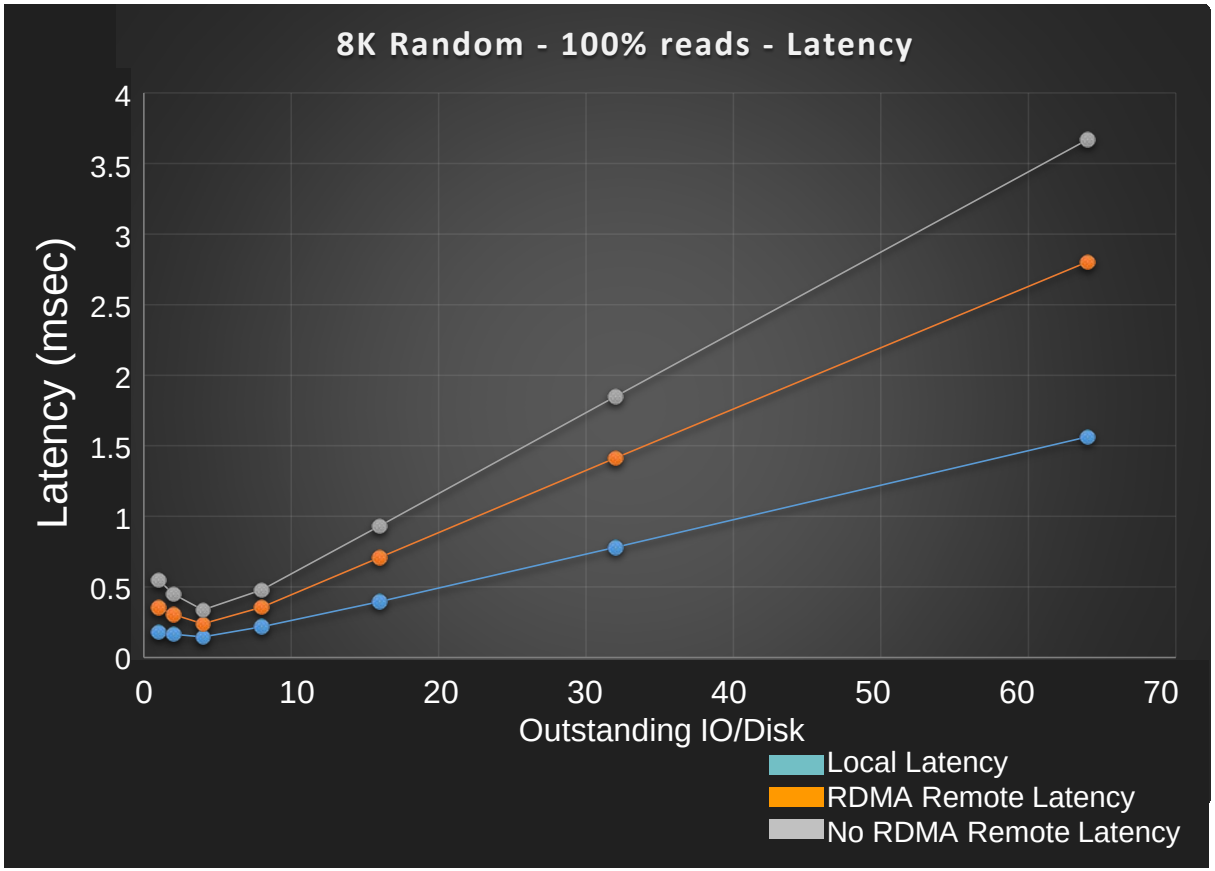
- Max remote performance
  - ~159K IOPS w/ RDMA
  - ~122K IOPS w/o RDMA
- Higher Performance gain with RDMA at lower IOPs
- At Higher queue depths, RDMA gains reduce to ~30%
  - CPU% capped at 122K (28 outstanding IOPs/7 SSDs)
  - CPU is bottleneck

Remote Access is bottlenecked on Network Speed

Configuration

- Intel Avaton Microserver
  - PCIE Gen 2
- Chelsio 10 GbE NIC
- SAS HBA
- SAS SSD

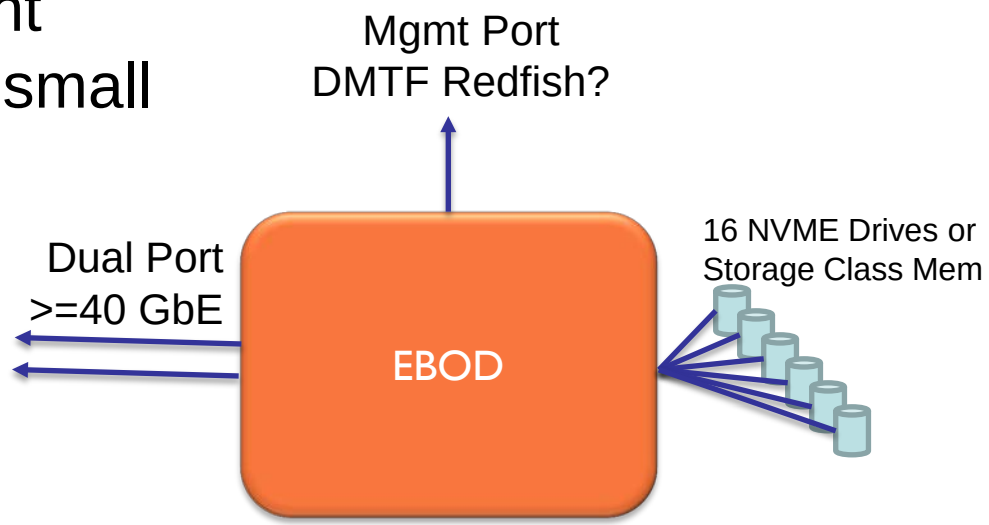
EBOD Avaton Microserver POC - 8K Random Reads, Latency



- With RDMA
  - At least 65% speedup in IO latency (~75% at higher IOPs)
- Remote Latency drops at 4 outstanding IO/disk (7 disks)
- Goes back up at 8 outstanding IO/disk

EBOD Performance Concept

- Goal is highest performant storage, thus big-CPU is small part of total cost
  - Hi-speed CPU reduces latency
- Dual attach >=40 GbE
- SOC with integrated
  - RDMA NIC
  - PCIE connectivity to ~20 devices
- Possibly all NVME attach or Storage Class Memory



See "SMB3.1.1 Update" SDC Talk for Dual 100 GbE early results

Summary

EBOD enables

- Shared storage on Ethernet using DAS storage
  - DAS storage has better interop within eco-system
- Price point of EBOD must be carefully managed
  - Microserver CPU is viable for broad spectrum of perf
  - Integrated SOC solution is preferred
- Low price point of EBOD CPU/Memory enables smaller fault domain (fewer disks can be behind the Microserver)

Q&A

Outstanding Technical Issues

- Enclosure level
  - How to manage storage enclosure? SCSI Enclosure Services (SES)?
  - Base Management? DMTF Redfish or IPMI?
  - How to provision raw storage?
  - Liveness of drives/enclosure
- How to fence individual drives?
- Security model
- Advanced features in EBOD?
  - Low latency, integrity check, caching, …