



HYPERION RESEARCH

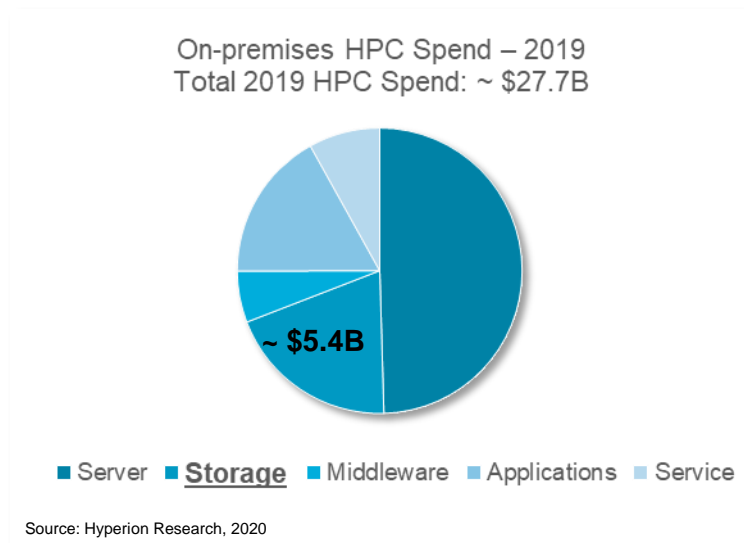
Storage and Interconnects Market Update

May 2021

www.HyperionResearch.com
www.hpcuserforum.com

Mark Nossokoff

HPC Storage is an Attractive Market



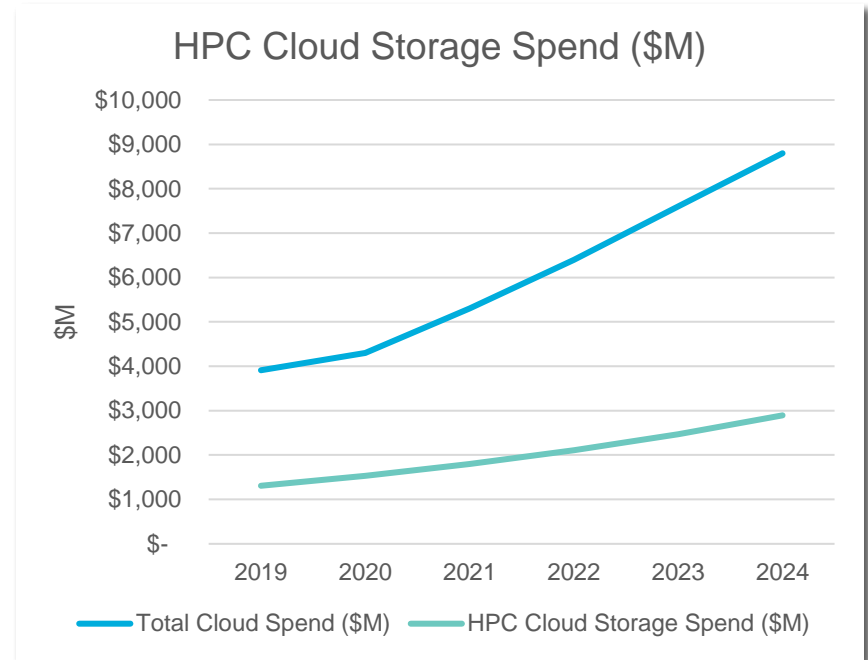
- **Storage historically the highest growth HPC element**
- **Storage represents ~ 20% of HPC spending**
- **For every \$1 spent on compute, ~ \$0.40 is spent on storage**

Area (\$M)	2019	2020	2021	2022	2023	2024	CAGR '19-'24
Server	\$13,710	\$12,671	\$14,097	\$16,683	\$18,813	\$19,758	7.6%
Add-on Storage	\$5,426	\$5,105	\$5,737	\$6,873	\$7,945	\$8,406	9.1%
Middleware	\$1,613	\$1,500	\$1,671	\$2,004	\$2,275	\$2,404	8.3%
Applications	\$4,689	\$4,345	\$4,725	\$5,540	\$6,144	\$6,339	6.2%
Service	\$2,238	\$2,032	\$2,164	\$2,492	\$2,711	\$2,742	4.1%
Total Revenue	\$27,677	\$25,653	\$28,394	\$33,592	\$37,889	\$39,648	7.5%

HPC Cloud Storage Forecast

Approaching \$3B in 2024

- **Total cloud spend of \$3.9B in 2019**
- **~1/3 is storage**
- **17.3% increase in storage spend in 2020**



Source: Hyperion Research, 2020

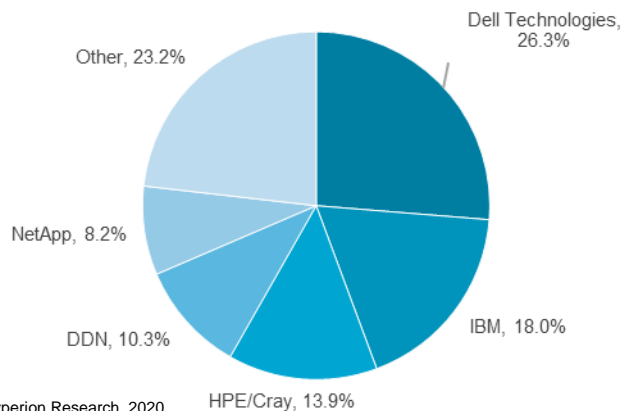
	2019	2020	2021	2022	2023	2024
Total Cloud Spend (\$M)	\$ 3,910	\$ 4,300	\$ 5,300	\$ 6,400	\$ 7,600	\$ 8,800
HPC Cloud Storage Spend (\$M)	\$ 1,303	\$ 1,529	\$ 1,793	\$ 2,104	\$ 2,467	\$ 2,894

Source: Hyperion Research, 2020

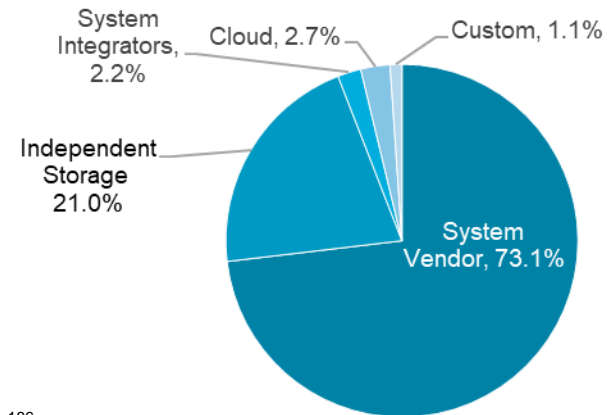
2020 HPC Storage Vendor Preferences

Dell Technologies top preferred HPC storage vendor

2020 Storage Vendor Preferences



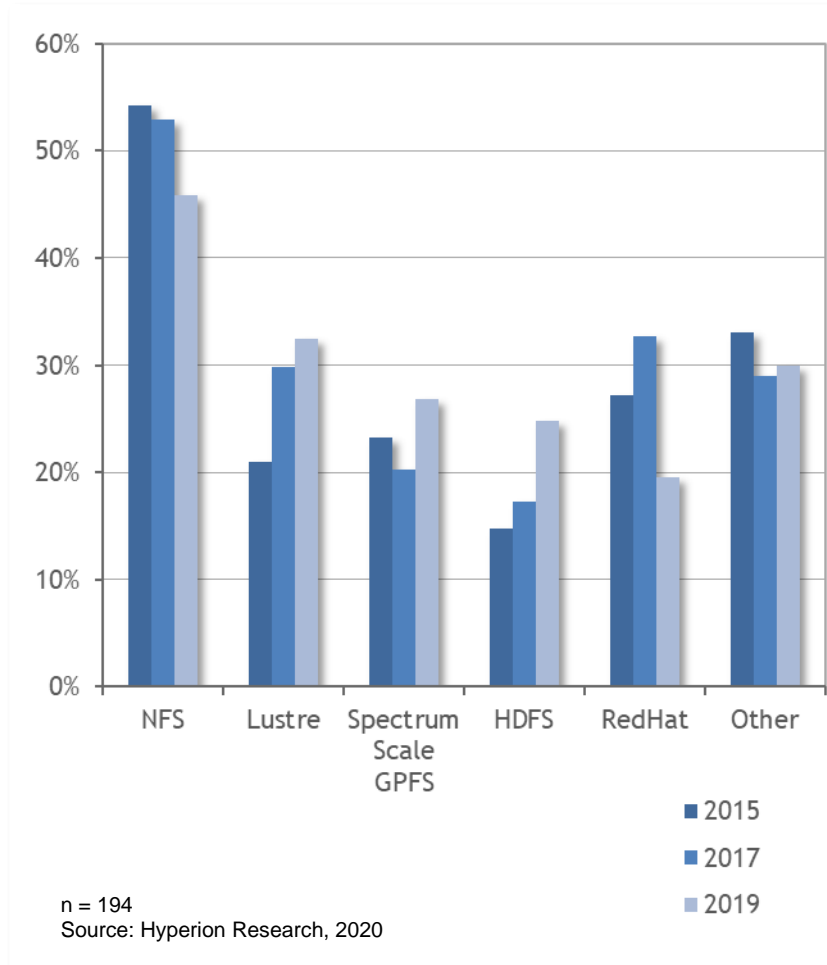
2020 Storage Vendor Types



- **Dell Technologies also preferred most in Academia and Industry sectors**
- **IBM second preferred overall**
- **HPE/Cray preferred 3rd overall but tops in Government**
- **DDN 4th overall and top independent storage vendor**

File System Landscape is Changing

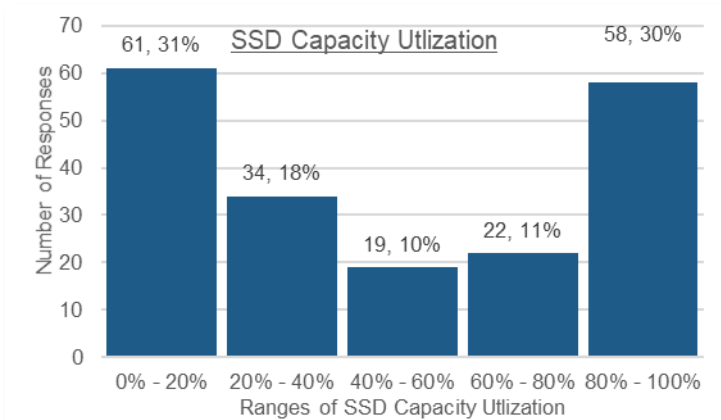
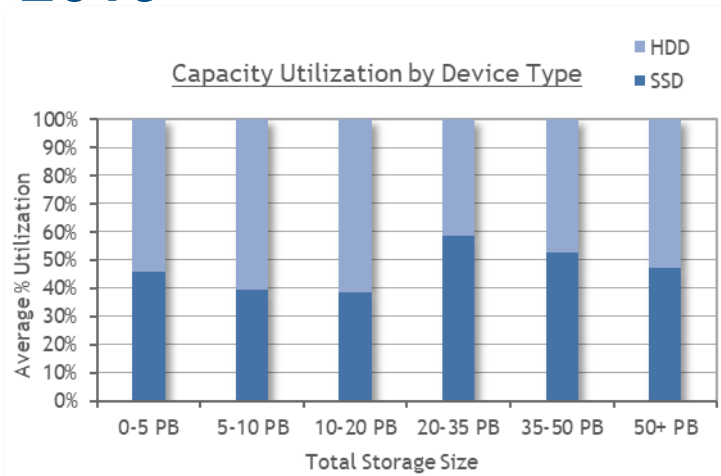
Lustre continues its adoption growth



- **Academia and Government tend towards Lustre**
- **Industry tends towards NFS**
- **GFS, CEPH and PanFS in “Other”**
- **Expect shifts to continue as enterprises increasingly adopt HPC-enabled AI**

SSDs Becoming Storage Medium of Choice

Surveyed sites deployed 45% of capacity on SSDs in 2019



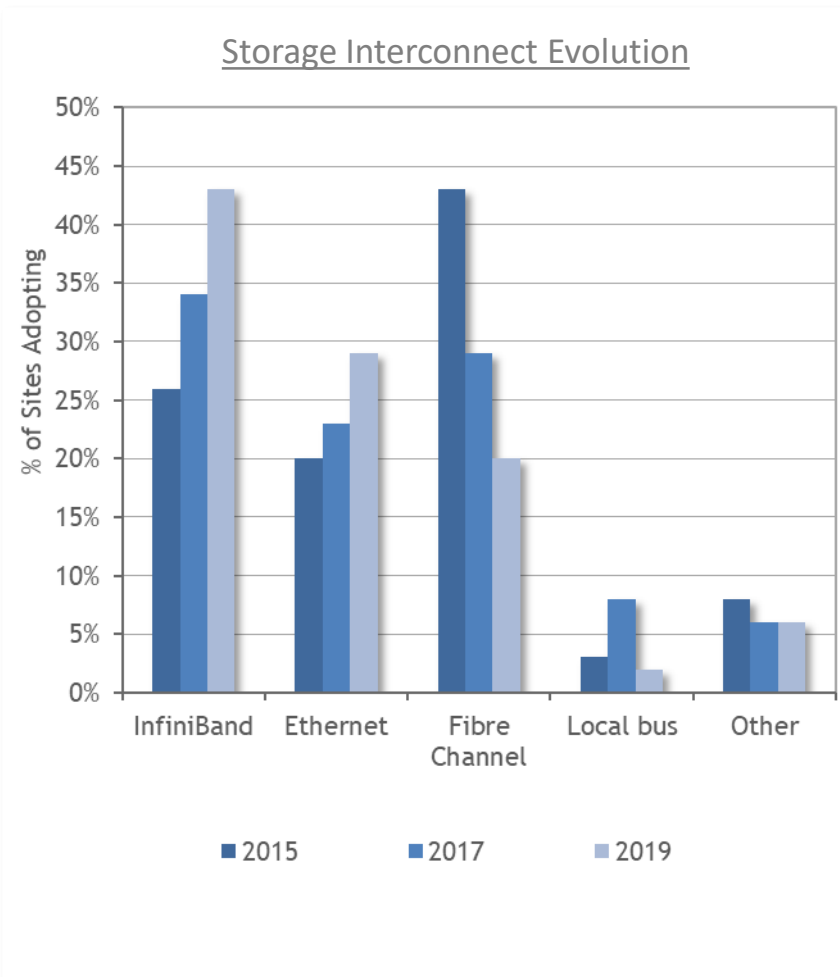
- **86% of sites deployed flash-based storage**
- **Wide range of media mix**
 - 15% were all flash
 - 71% were hybrid
 - 14% were all HDD
- **~ 60% of the sites have strong tendency (> 80% of respective capacity) towards either SSD or HDD**

n = 194

Source: Hyperion Research, 2020

Storage Interconnects Entering Spotlight

InfiniBand the leading storage interconnect



- **InfiniBand increasingly being adopted**
- **Ethernet also exhibiting growth**
- **Fibre Channel continues decline**
- **Interconnects becoming increasingly important to deliver the bandwidth required to keep GPU and other accelerator-based nodes fully utilized**

Future Research Direction

On-premises continues to evolve

Existing (add-on external)

- **Spending and forecast**
- **Vendor preferences and market share**
 - Storage
 - Interconnect
- **Technology preferences and adoption**
 - File systems
 - Storage media
 - Interconnects

Future

- **Use cases**
 - Ephemeral, durable
 - File, block, object
 - Scratch, user, home directory, project, campaign, archive
- **Capacity**
- **Internal to servers and compute nodes**

Future Research Direction (continued)

Cloud storage driving new use cases

- **Identify, measure, and forecast capacity and spending**
 - User spending
 - CSP consumption
- **Sector, vertical and segment differentiation**
- **Parallel file system adoption**
 - Requirements for cloud high performance parallel file systems (price, performance, scale)
 - Sentiment and opportunity for current leading high performance parallel file systems
- **Cloud workload usage and requirements**
 - Establish which workloads/applications are best suited to drive cloud storage spending
 - Use cases – ephemeral/durable; file/block/object

Future Research Direction (continued)

Data management and ease of use present opportunities

- **Data and workflow management**
 - Migration of HPC workloads to the cloud
 - Intersection of 5G with edge computing and computational storage
- **Efforts to support increased adoption of HPC-enabled AI by the Enterprise**
 - Deployment
 - Ease of use
 - Maintenance
- **Application of AI techniques in storage solutions**
 - Predictive maintenance
 - Data placement

Future Research Direction (continued)

Innovations continue with new technology

- **Storage for Containers**
 - Current adoption and success
 - When and where appropriate?
- **POSIX compliancy**
 - Required?
 - Relaxed compliance - to what extent?
- **Interconnects**
 - System
 - Storage
 - Memory
- **Additional memory topics**
 - Big memory
 - Persistent memory
 - In-memory/near-memory computing

Storage Panel

- **Questions explored:**
 - Please describe one or two storage-related areas where innovation is required.
 - How will these innovations benefit HPC users?
 - What is being done to address these areas of innovation?
- **Panelists**
 - Jeff Denworth, Chief Marketing Officer, VAST Data
 - Jeff Lundberg, Senior Product Marketing Manager, Hitachi Vantara
 - Mohamad El-Batal, Office of the CTO, Seagate Technologies



THANK YOU!



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