



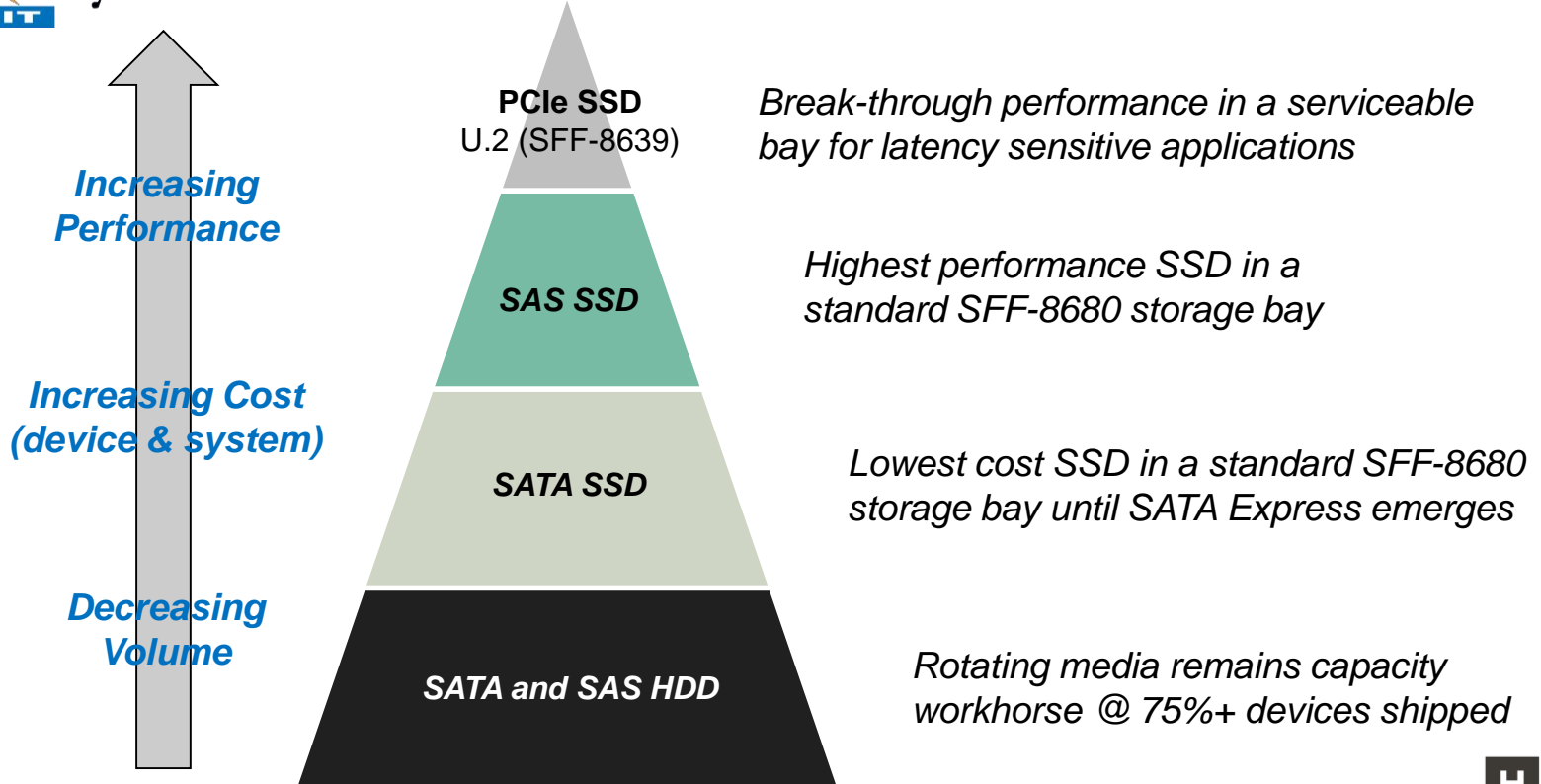
SAS – Storage Workhorse of the Data Center

Balaji Venkateshwaran – SSD Product Marketing, HGST

Tom Heil – Sr. Systems Architect, Avago Technologies

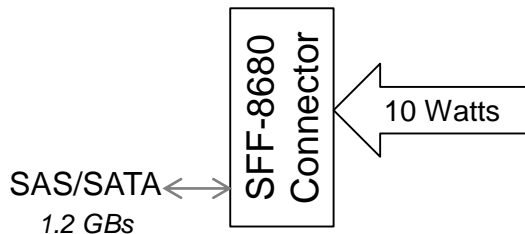
2018 Datacenter Storage Device Hierarchy

(Serviceable form factors)

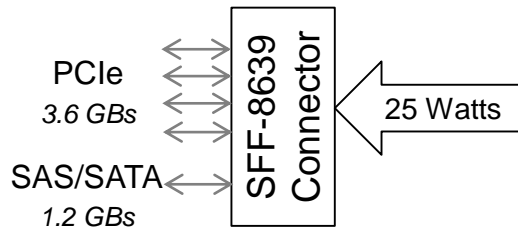


PCIe Performance Advantage Comes at a Cost

**Standard SAS/SATA
Storage Bay (server)**



**U.2 PCIe/SAS/SATA
Storage Bay (server)**



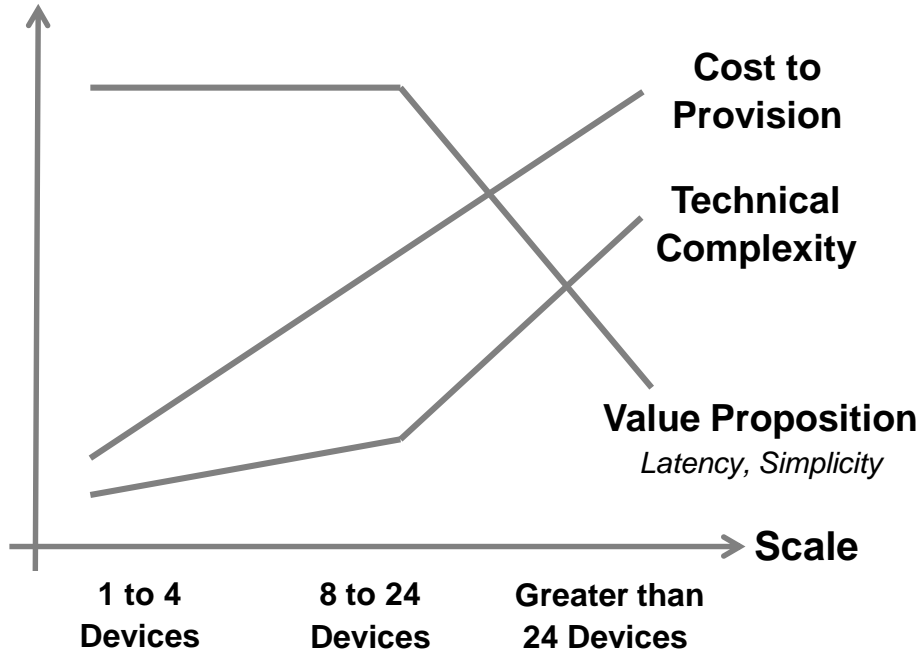
24 Bays: Standard vs. U.2



	SFF-8680	SFF-8639
SerDes	24	120
Power (Watts)	240	600



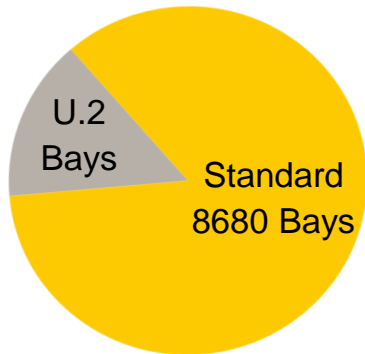
PCIe Scalability Further Challenged “Beyond the Box”



PCIe Sweet Spot – Small Number of Locally Attached Devices

Total Datacenter Storage Bay Population

PCIe Highly Effective in Low-latency Cache and Storage Tier



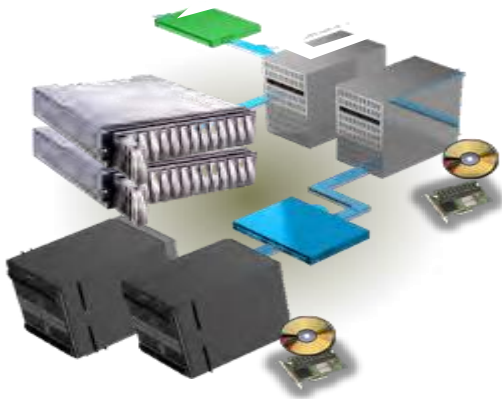
SAS Remains Backbone of Scalable Storage
SAS SSD Remains Fastest Device in Standard Bay



PCIe and SAS are complementary, will co-exist for the foreseeable future

SAS Spans the Storage Spectrum

Direct Attach Storage



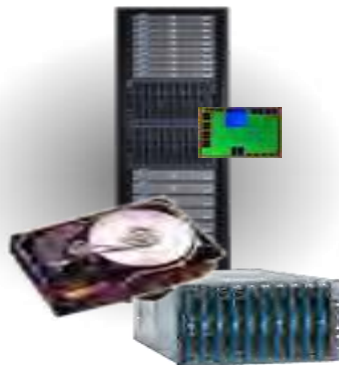
- **Controllers/ROCs/HBAs**
- **Expanders**
- **Storage Blades**

External Storage



- **NAS/SAN Heads**
- **Native SAS Connect**
- **Controllers/ROCs/HBAs**
- **Expanders**

HDD/SSD



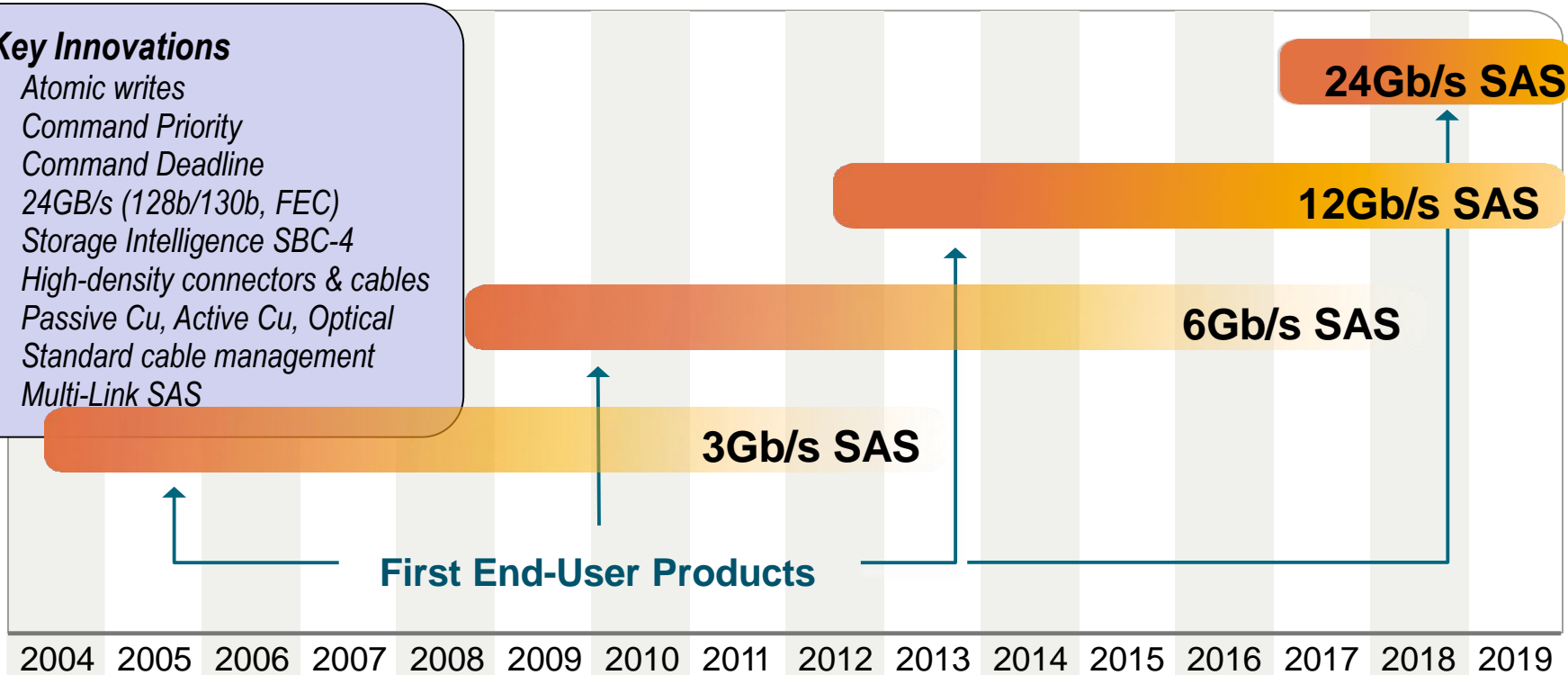
- **SAS and SATA SSDs**
- **SAS and SATA HDDs**

Scale to 1,000's of Devices
Serviceable Infrastructure
Reliable Error Handling at Scale
Mature, robust ecosystem

SAS Roadmap – Continuing to Innovate

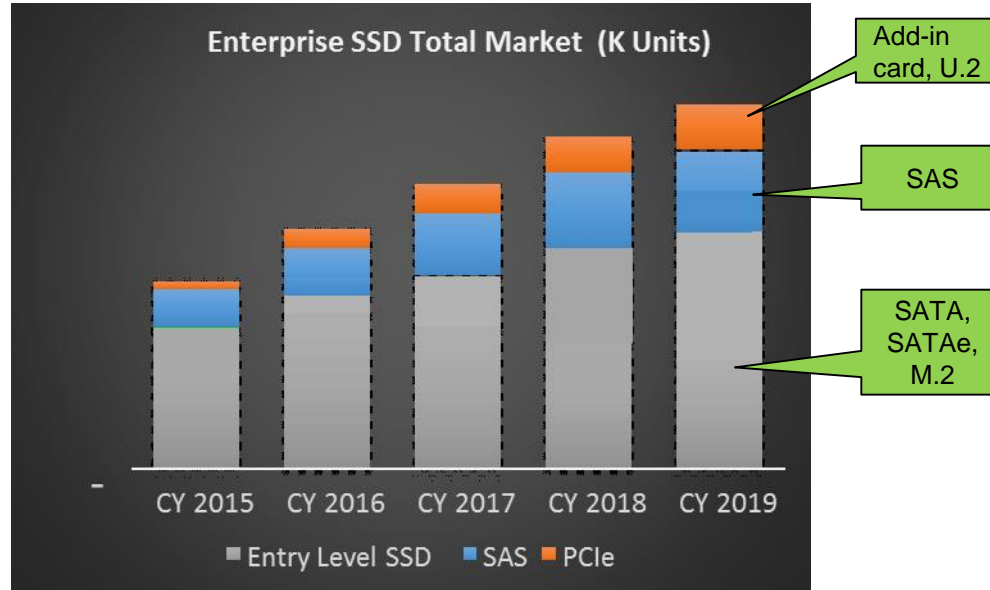
Key Innovations

- Atomic writes
- Command Priority
- Command Deadline
- 24GB/s (128b/130b, FEC)
- Storage Intelligence SBC-4
- High-density connectors & cables
- Passive Cu, Active Cu, Optical
- Standard cable management
- Multi-Link SAS



SCSI Trade Association

Datacenter SSD Market Opportunity



Source: IDC and HGST Market Data

- PCIe SSDs – ideal for low-latency server and storage applications
- SAS SSDs – continues to be preferred in mainstream storage applications
- Entry Level SSDs – SATA continues to be volume leader in a bay until replaced by SATA Express; M.2 rules non-serviceable

Current State of SAS SSDs



- 4TB max SAS SSD capacity available today
- Wide endurance range: 0.5 – 40 Drive Writes Per Day
- Aggregate sequential throughput = 25GB/s
- Aggregate random throughput = 5 Million IOPS
- Critical Enterprise Features - High Availability (dual porting)
- End to End Data Path Protection

Scalability



Throughput



Latency



Stability



Reliability



Power



Cost



SAS SSDs build on the proven SAS interface to deliver benefits of Flash in Data Center applications

PCIe SSD



- Ideal for low-latency storage applications
- Limited and expensive scalability

SAS SSD



- Proven and robust interface
- Truly scalable, scales cost effectively

SAS continues to be the Storage workhorse in Data Centers due to proven scalability and robustness in the Enterprise