

Storage at the Edge

Jason Feist – Managing Technologist
CTO Office

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| Seagate Investing in HDD Technology for Hyperscale Growth



Growing Exabyte Demand

- Enable Storage Density
- Store Multiple Copies



Maintain SLAs With High Performance

- High Availability
- Low Response Time



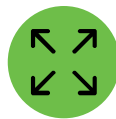
Reduce TCO

- CAPEX
- OPEX



Areal Density

- Technology: HAMR
- Focus: 20TB in 2020, >20% CAGR



Scale IOPS With Capacity

- Technology: Multi Actuator, Parallelism
- Focus: Random Read IOPS, Latency



Reduce TCO

- Technology: Helium, Chassis Design
- Focus: Power Consumption, \$ / TB

Future Hyperscale/Cloud development is focused on Mass Capacity Storage Innovation



| Seagate Innovating for Emerging Edge Requirements



Increased Security Threats

- Multi Tenant Access
- Expansion of Device and Software Access



Access to Large Data Sets

- AI/ML
- Network Congestion and Bandwidth



Hybrid Cloud

- Provisioning and orchestration
- QoS



Data Protection

- Technology: SED, Attestation
- Focus: RISCv, HW Root of Trust, Provenance



Data Flow

- Technology: NVMe, CxL/GenZ
- Focus: Composable Architecture, Computational Storage, Logistics



Smart/Autonomous

- Technology: Containers, IoT
- Focus: CSI driver, Management Visualizations

Edge Storage Innovation is focused on Protecting, Moving, and Analyzing the Data Created



Agenda

Products

Lyve Shuttles to simplify and enable data movement and emerging IT4 ecosystems to develop

DataCenter Infrastructure

Mass Capacity, Composable, and Observable

Security

RoT, Attestation, Provenance

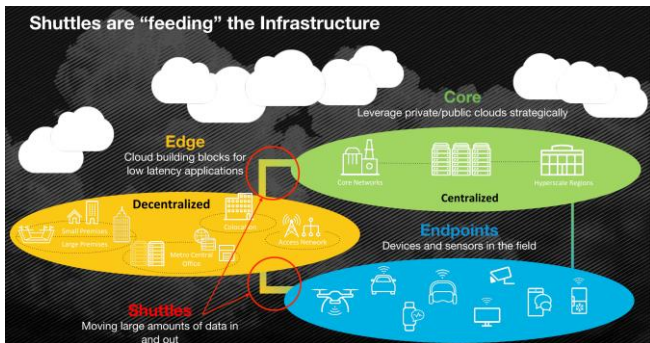
Computational Storage

HW acceleration and Efficiency



A family of options to help ingest, store, and analyze your data

Simple, Secure, Efficient



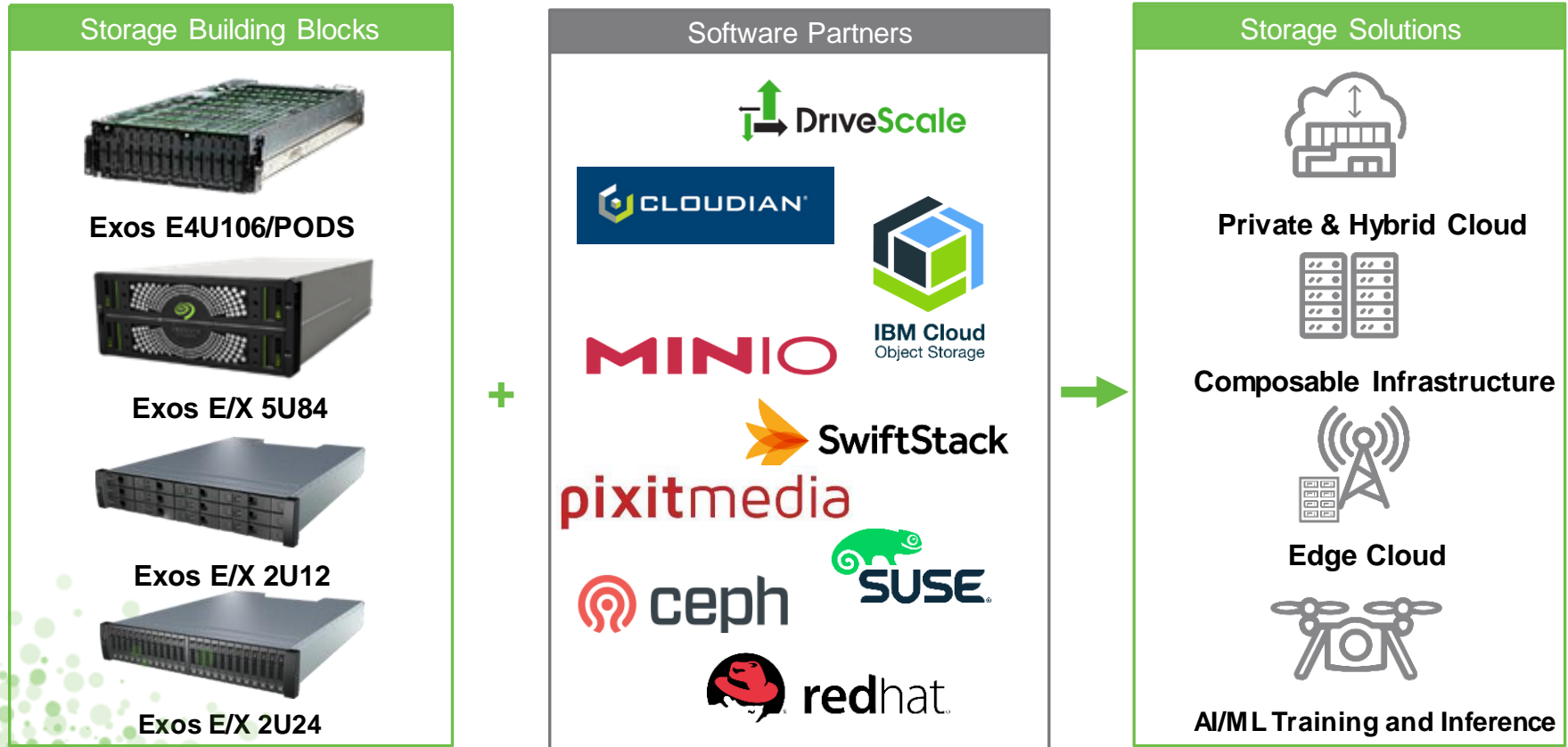
LYVEDRIVE™

This section displays a variety of Lyve Drive storage solutions, each with a brief description of its capabilities.

- Lyve Drive Cards**
High-capacity, high-performance flash cards that are perfect for IoT data collection.
- Lyve Drive Card Reader**
A portable solution for ingesting the most popular endpoint data sources.
- Lyve Drive Mobile Array**
This scaled, high-performance, 8-bay array is ruggedized and easy to transport.
- Lyve Drive Shuttle**
Autonomous data storage and transport solution with network connectivity and touchscreen technology.
- Lyve Drive Array Shipper**
Lyve Drive Cartridge Shipper
Designed for secure, durable transport of cartridges and arrays.
- Lyve Drive Thunderbolt 3 Connector**
Connect to any interface or existing system with this versatile device.
- Lyve Drive Cartridge**
High-capacity, portable single drive solution with U.2 interface.
- Lyve Drive Modular Array**
This high-performance 4-bay array allows you to build what you need for your workflow.
- Lyve Drive Cartridge Mount**
Lyve Drive Array Mount
Easily offer storage products to a variety of surfaces in the field and at the edge.
- Lyve Drive Rackmount Receiver**
This high-performance datasphere ingestion hub will mount two arrays to your data center fabric.



Storage Solutions for Different Data Needs



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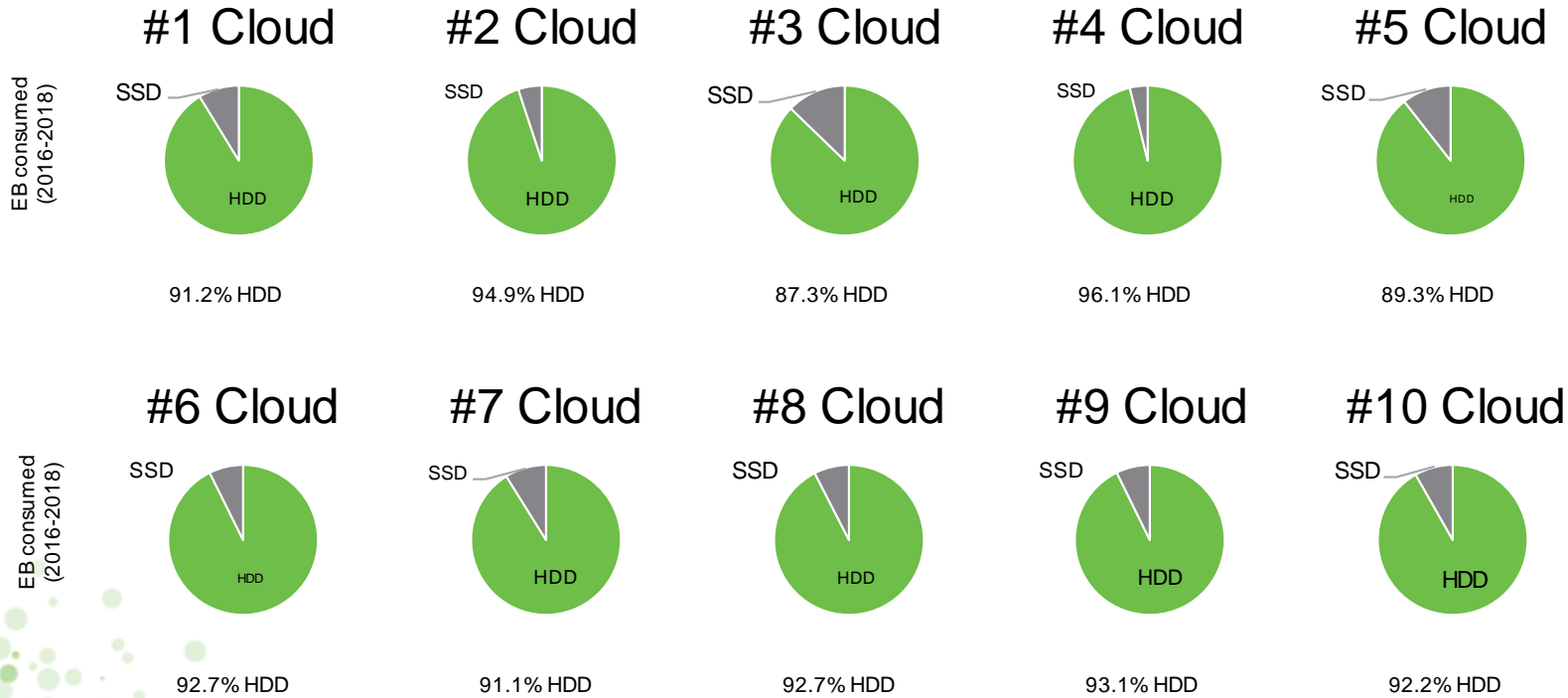
Computational Storage



HW acceleration and Efficiency



Top 10 Hyperscale clouds – Mass capacity devices dominate storage



Source: IDC Cloud Infrastructure Index 2019



Ease Composability & Scale

Disaggregated dynamically composable datacenter

- CPUs, GPUs, FGAs, DRAMs, SCMs, SSDs & HDDs

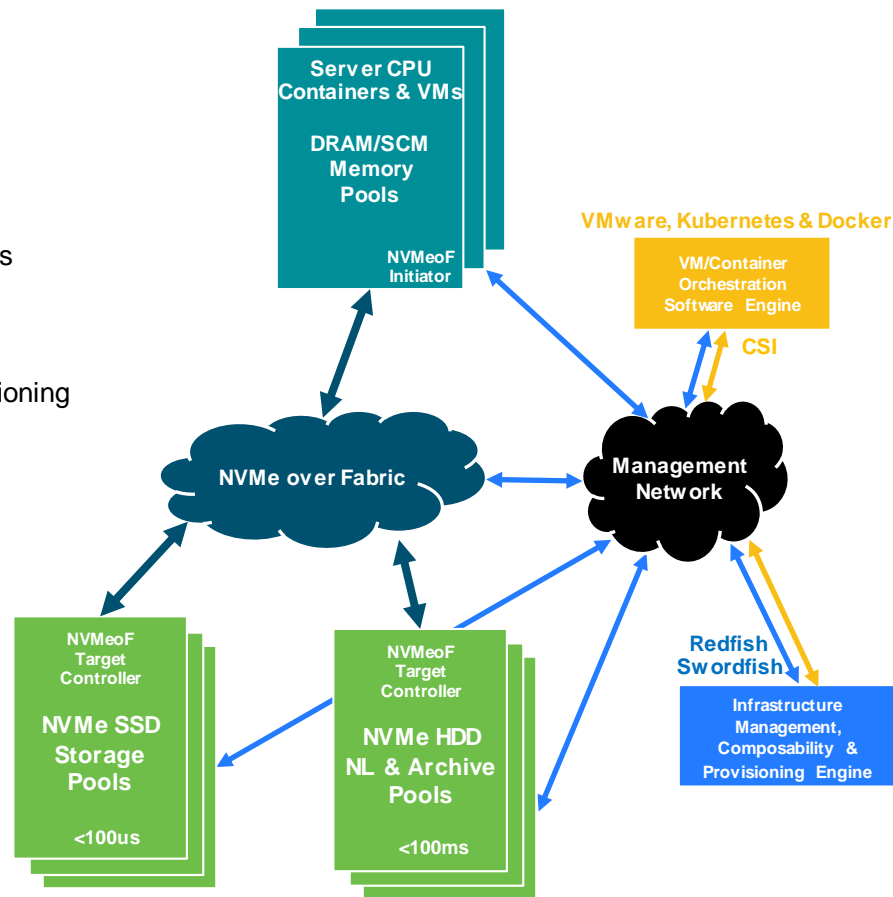
Reduce TCO

- Standard API Manageability, Composability & Provisioning
- Minimize storage IO bridging

Containerized orchestration

Composable Fabrics can be built at different scales:

- NVMeoF (Block Inter-Rack → Intra-Datacenter)



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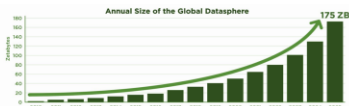


HW acceleration and Efficiency



Protecting your IP, Insight, Value through secure infrastructures

Rise of the Edge - Security Challenges



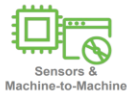
90%

90% of Data should be Protected *



45%

45% of Data will be protected *



20%

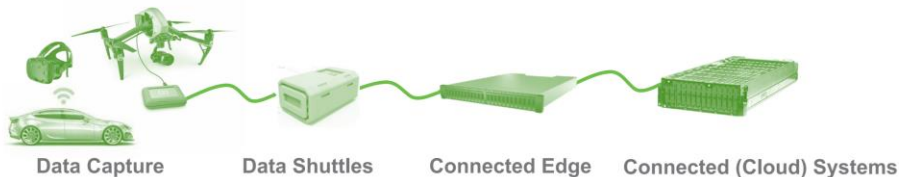
20% of the data could impact life or Death *



* IDC Data Age 2025 study, sponsored by Seagate www.DataAge2025.com

Seagate Confidential | 2

Trusted Data Ecosystems



Protecting your IP, Insight, Value through secure infrastructures

Today

Seagate Secure - Self Encrypting Drive (SED)



Provides confidentiality for data stored on media

- High-speed AES256-XTS data encryption
- High quality keys managed by drive
- High-level of assurance
 - Crypto: NIST FIPS 140-2
 - Product: Common Criteria
 - Supply Chain: ISO 20243



Provides secure disposal of data/device

- Data Purge via Cryptographic Erase of data stored on media
 - NIST SP800-68rev1
 - ISO/IEC-27040:2015

Protect
Provision
Encrypt
Erase

Tomorrow

Product Provenance Assurance/Trust



Seagate And IBM Work Together To Help Reduce Global Hard Drive Counterfeiting With Blockchain Technology

Product provenance IBM Blockchain Platform, Seagate's advanced 'hardware engineering' and constant testing to help...

COMPUTERWORLD

IBM and Seagate

Seagate is testing a blockchain ledger to track hard drives

Seagate and IBM have partnered to build a blockchain distributed ledger to track tens of millions of hard drives as they move through the supply chain from any manufacturers to technology integrators.

By Sandra Martin

Seagate Is Using IBM Blockchain To Fend Off Computer Counterfeiters

Michael del Castillo

IBM, Seagate Team Up to Tackle Hard Drive Fakes With Blockchain

IBM and Seagate Launch Blockchain-Based System to Fight Counterfeit Hard Drives

IBM and Seagate Launch Blockchain-Based System to Fight Counterfeit Hard Drives



Visible
Observable
Authentic

Beyond



What is RISC-V?

- A high-quality, license-free, royalty-free RISC ISA specification originally from UC Berkeley
- Standard maintained by non-profit RISC-V Foundation
- Suitable for all types of computing system, microcontrollers to supercomputers
- Numerous proprietary and open-source cores
- Experiencing rapid uptake in industry and academia
- Supported by growing shared software ecosystem
- A work in progress...



OPEN
Compute Project

Security Project Charter
Revision 1.0

Enable
Analyze
Connect



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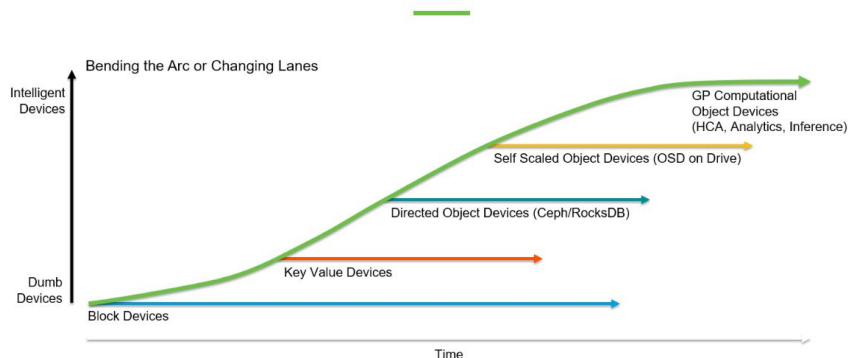


HW acceleration and Efficiency



Looking forward to intelligent solutions for new markets

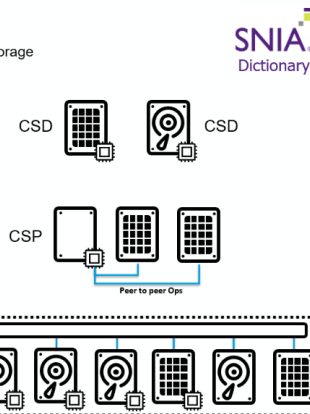
Bending the Arc or Changing Lanes



What

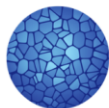
Types of Computational Storage

- **Computation Storage Service (CSS):** A data service or information service that performs computation on data where the service and the data are associated with a storage device.
- **Computational Storage Drive (CSD):** A storage element that provides Computational Storage Services and persistent data storage.
- **Computational Storage Processor (CSP):** A component that provides Computational Storage Services for an associated storage system without providing persistent data storage.
- **Computational Storage Array (CSA):** A collection of Computational Storage Devices, control software, and optional storage devices.
(Many options here)



SNIA
Dictionary

Human Cell Atlas – A case study in distributing analytics



HUMAN
CELL
ATLAS

HCA Mission:

To create comprehensive reference maps of all human cells—the fundamental units of life—as a basis for both understanding human health and diagnosing, monitoring, and treating disease.

- Reference maps are created through Single Cell RNA Sequencing (scRNA)
 - Determines all the RNA features in a cell (i.e. active cell gene expression)
 - Mathematical analysis and transformations are used to identify, "cluster" and visualize cell types, life-cycles and processes
- UCSC Genomics Institute is one of many contributing research centers - with a focus on detecting new cell types and outliers as more and more samples are taken.

Seagate's Involvement:

Engaged with UCSC in order to:

- Provide a storage system to meet the Biology Research team's needs.
- Work with Engineering/CS department on development of optimized storage interface.
- Extend storage system to provide computational capabilities at the drive or storage system level.
- Hypothetical "dream" goal would be to provide a general purpose computing environment suitable to distribute research algorithms to the drive itself.



Thank You

