



# Storing the Datasphere

# Enabling Development Through Storage Leadership



## RESEARCH

### **Data Creation**

Device Physics  
Data Movement  
Data Security



## PoCs

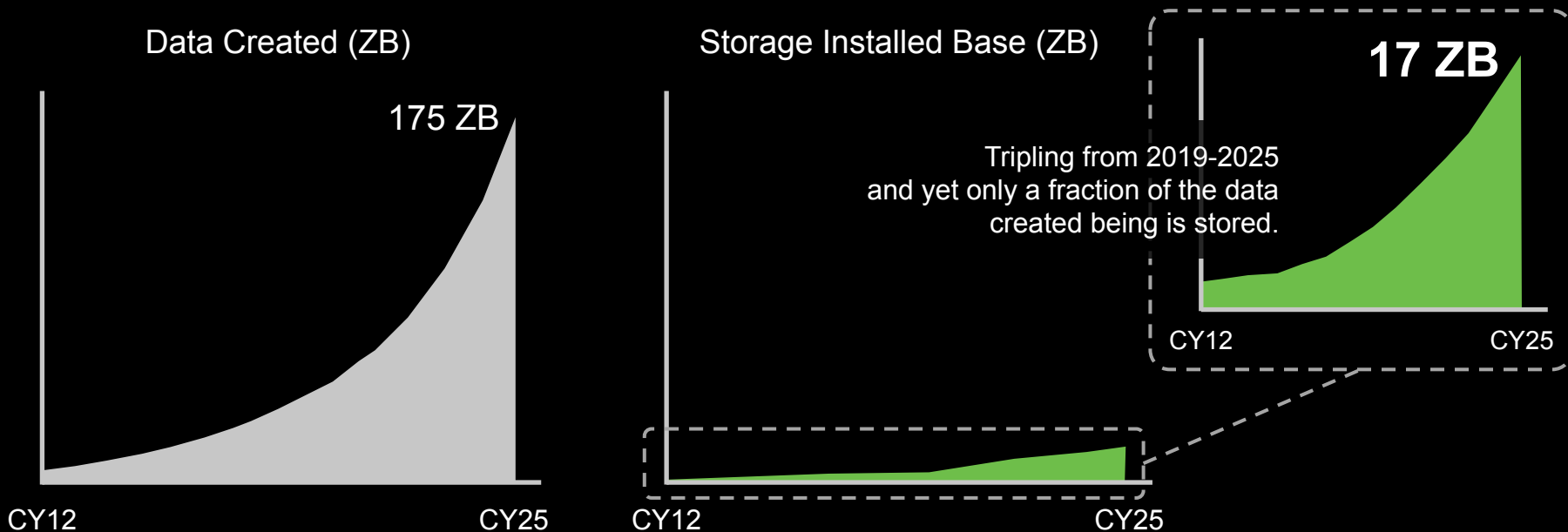
Market Vertical Enablers



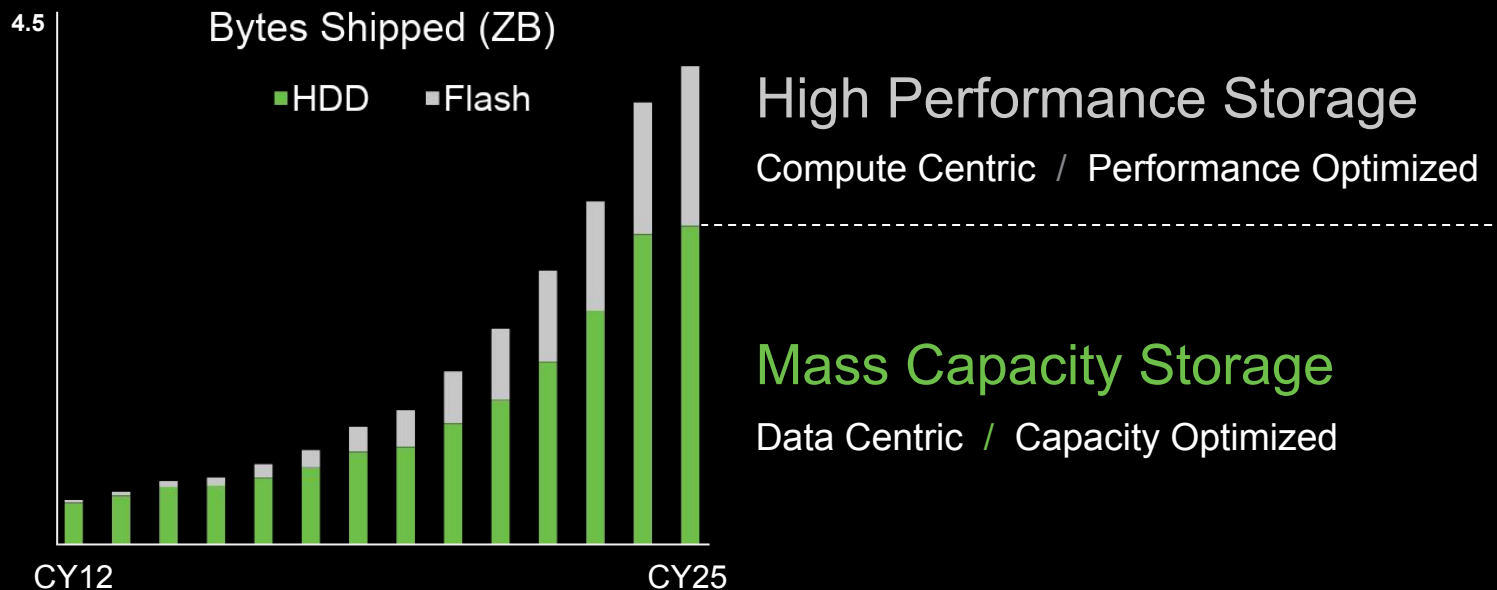
## Communities

OEC  
OCP  
Linux  
LF Edge  
Akraino  
IIC

# Massive Growth in Data Driving Demand for Storage

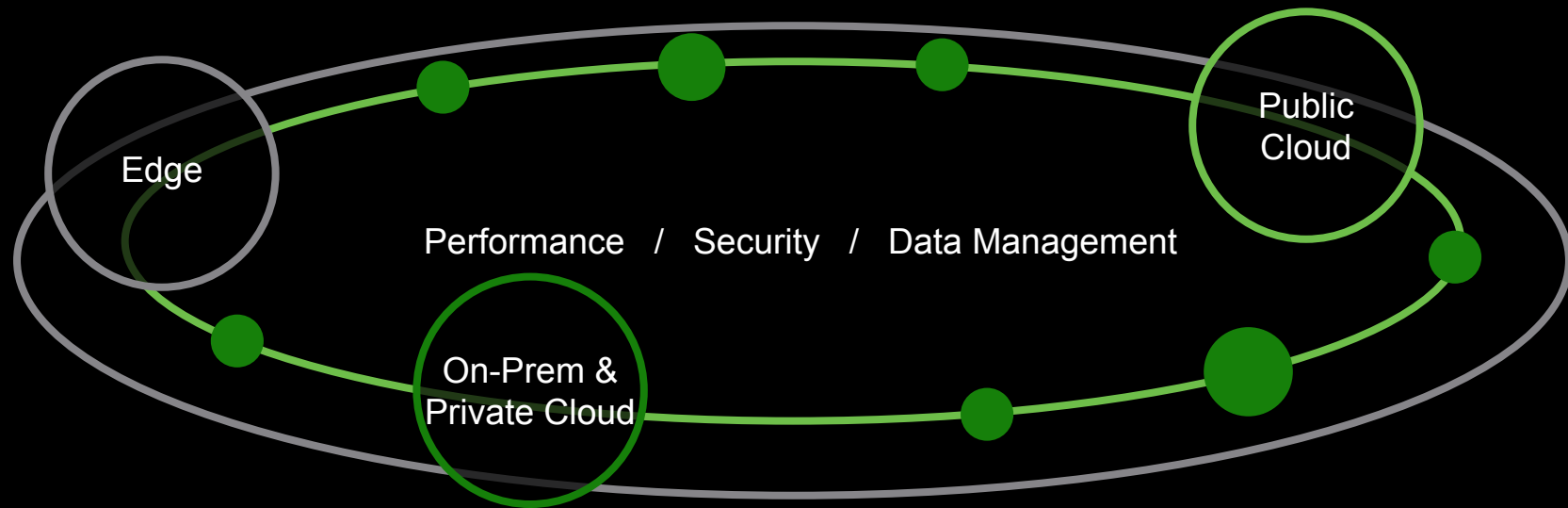


# HDDs to Fulfill a Majority of Datasphere Storage Exabyte Shipments



# The Perfect Future

Seamless and Secure Data Storage and Movement across the Datasphere



**Efficient**

**Simple UX**

**Outcome Driven**

**Secure**

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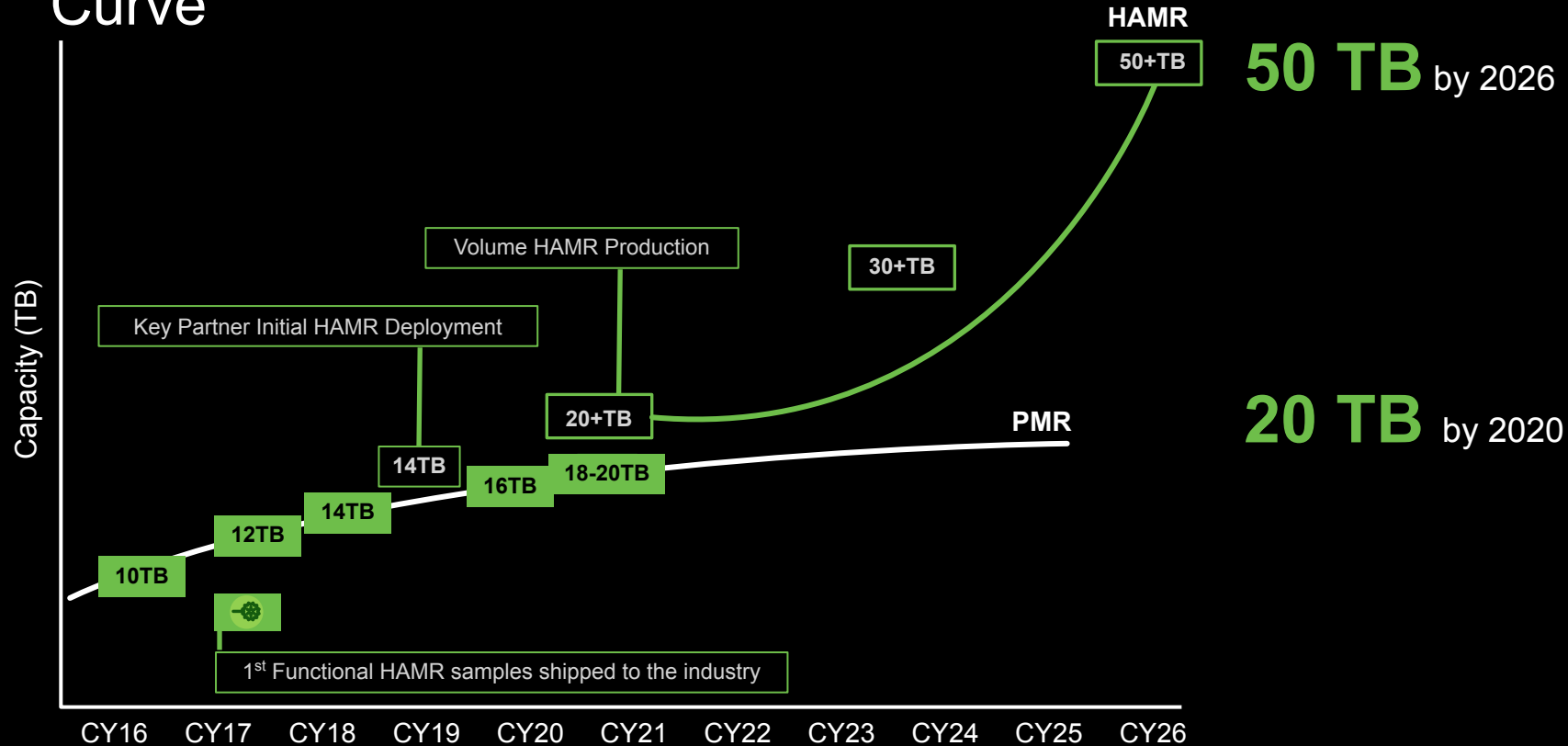
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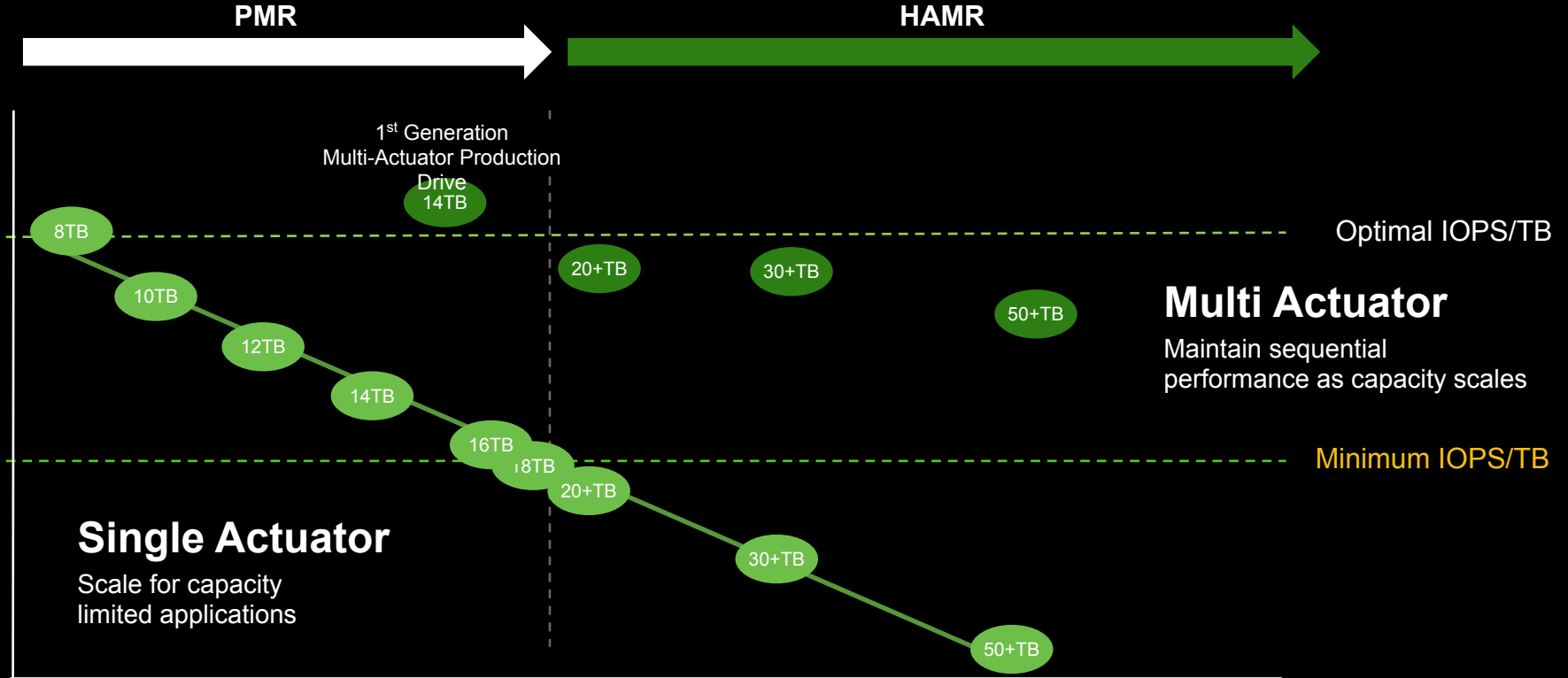
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# Seagate Technology Continues to Drive the Areal Density Curve



# Multi-Actuator Technology Addresses Performance and Capacity Needs



IOPS – Input / Output Operations per Second  
PMR – Perpendicular Magnetic Recording



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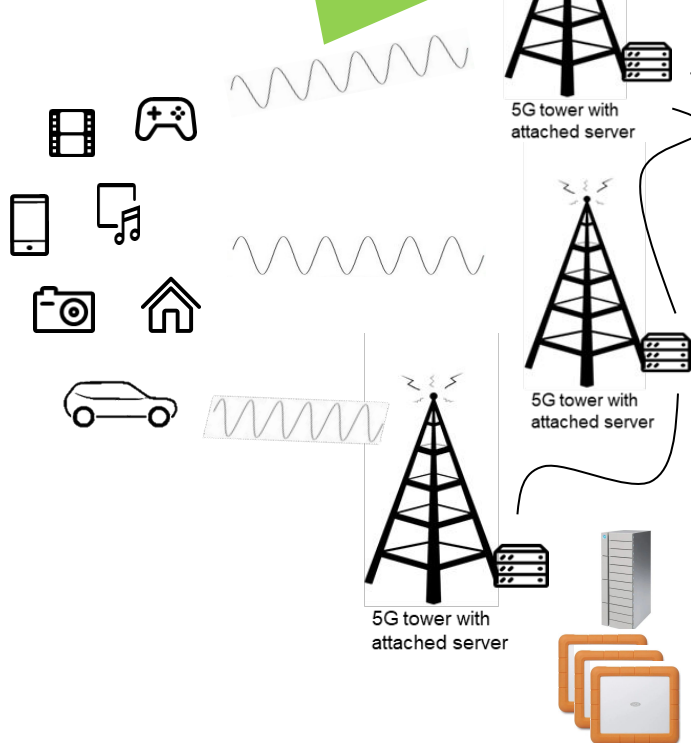
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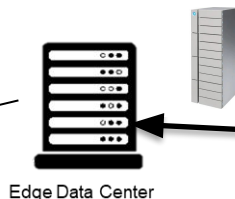
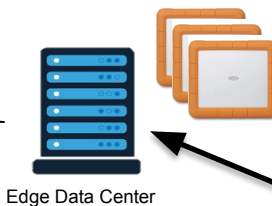
# Connectivity Scenario - Storage Locality

5G from the endpoints to the towers.

- Provides low latency and high b/w
- Only over limited distance.



OEC Goal - We need to work as a community to define the latency and storage requirements at each location



Fiber Optic from the Edge to the Cloud

- Largest amount of data movement.
- Worst case latencies. 100's of msec



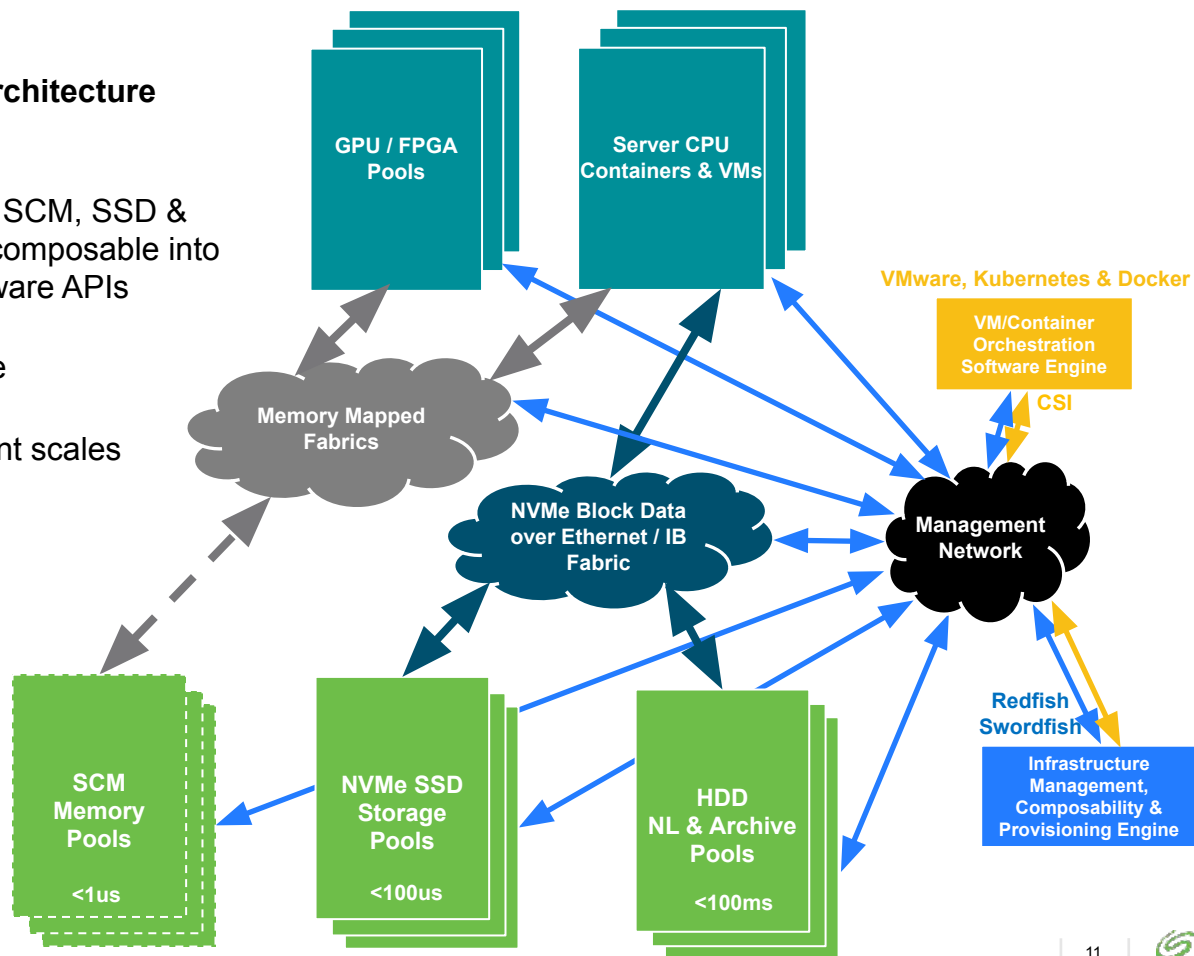
Public or Private Cloud

Coax or Fiber Optic between edge devices.

- Higher bandwidth to move large amounts of data.
- Longer latencies inhibit which applications can be run. Is 10 msec required?
- Copper vs. Fiber Optic trade-offs between capability and economics.

# Composable Datacenter Vision

- **OEC Opportunity: Storage Reference Architecture Definitions**
- Disaggregated CPU, GPU, FPGA, DRAM, SCM, SSD & HDD building blocks that are dynamically composable into application specific hardware through software APIs
- Containerized orchestration client Software
- Composable Fabrics can be built at different scales



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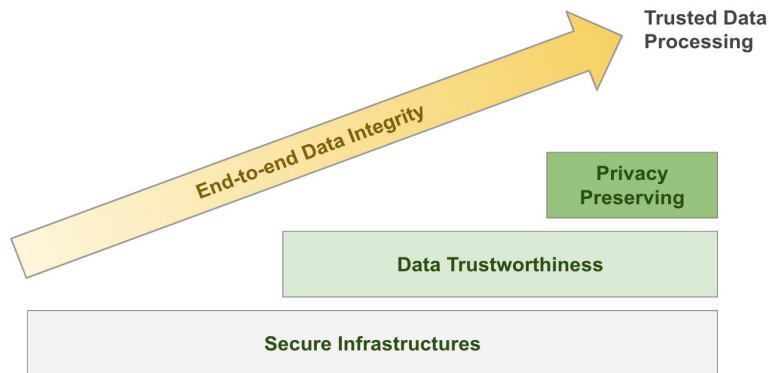
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# Security Explained:

“Next generation compute infrastructures require a new security paradigm with data trustworthiness & privacy at its core.”

Builds on

- Secure Infrastructures
  - Open Standards and Open Source security IP
- Data Trustworthiness
  - Data Integrity & Provenance
- Privacy Preserving



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Enablers**

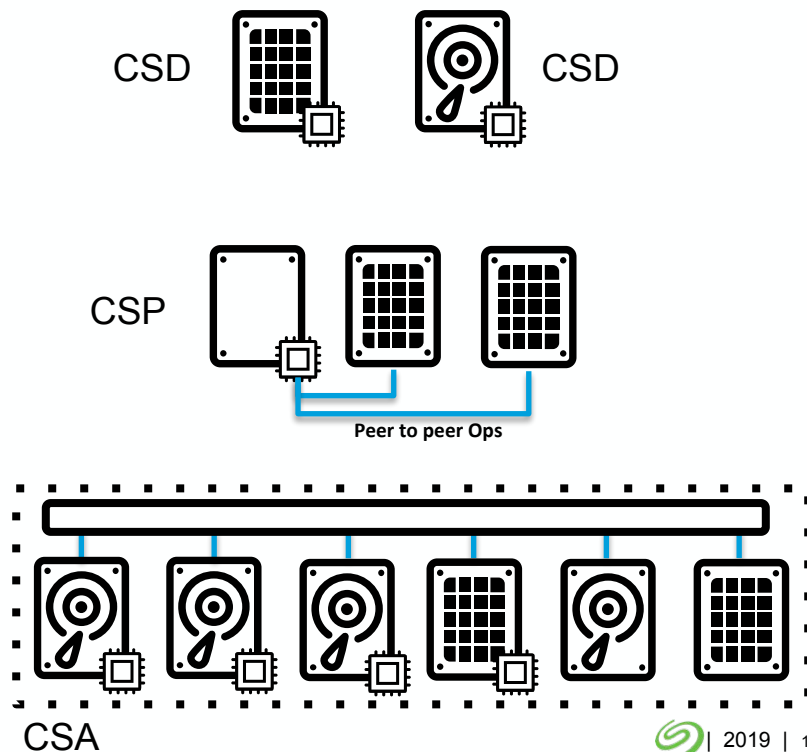


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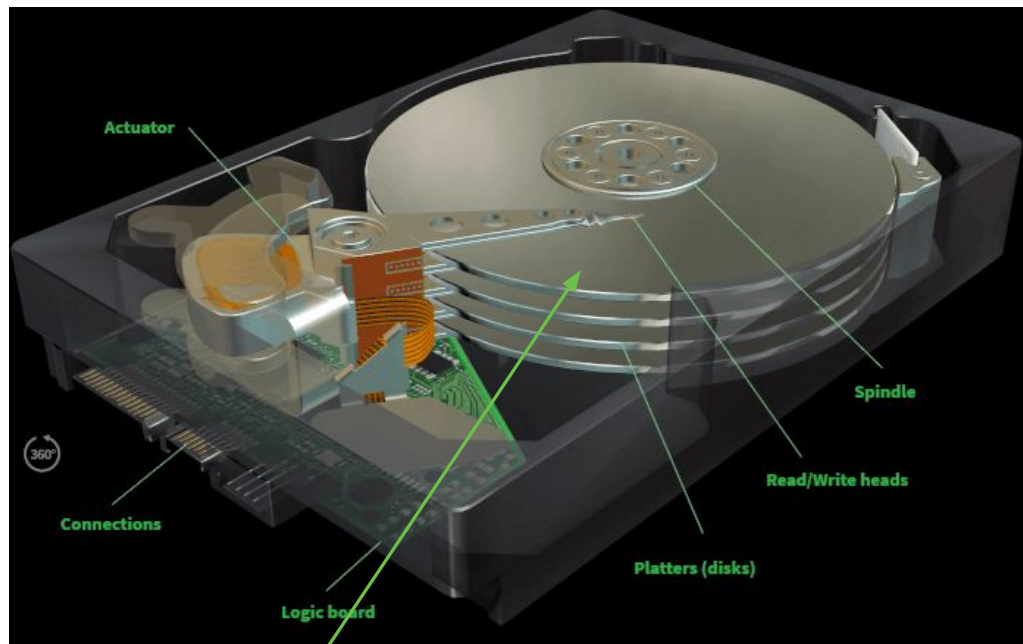
# Computational Storage - Improving abstraction and add value through device intelligence

- **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)





# Seagate Factory Edge Solution



HGA

~10mm

Slider

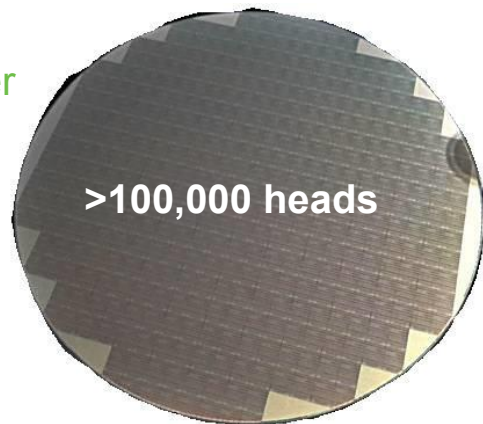
~100um

~10nm

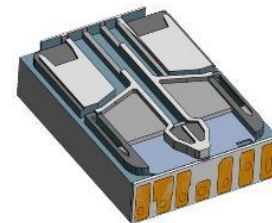
- Factories in Minnesota, Ireland, Thailand, China, Singapore

## HDD Head Manufacturing

Wafer



Slider



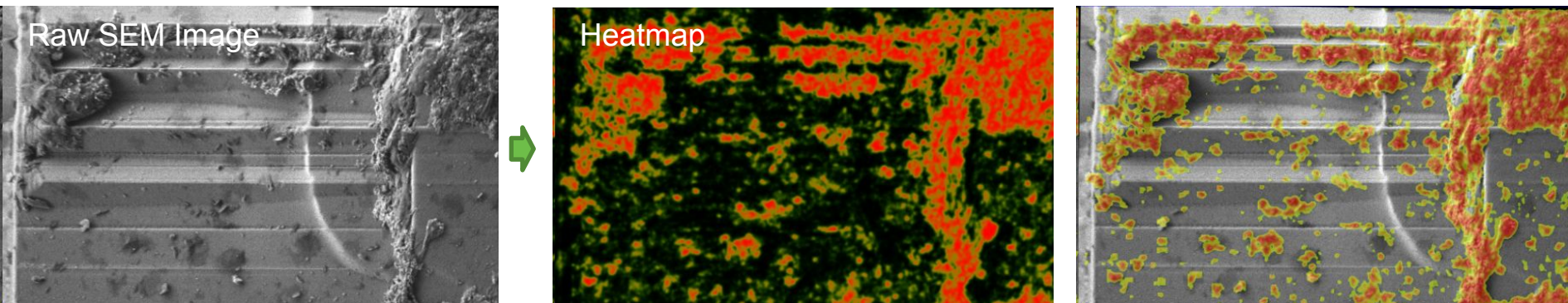
- **Manufacture ~3M heads / day**



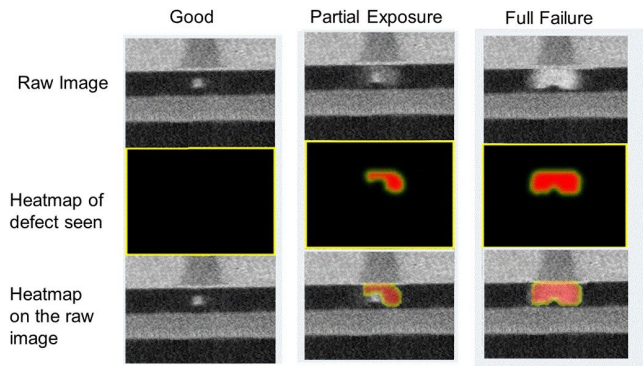


# High Volume Manufacturing Challenges Automated

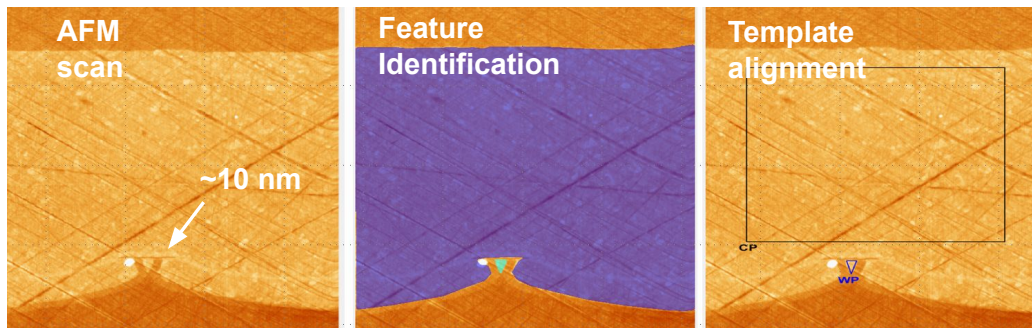
Sub uscale SEM contamination identification and quantification:



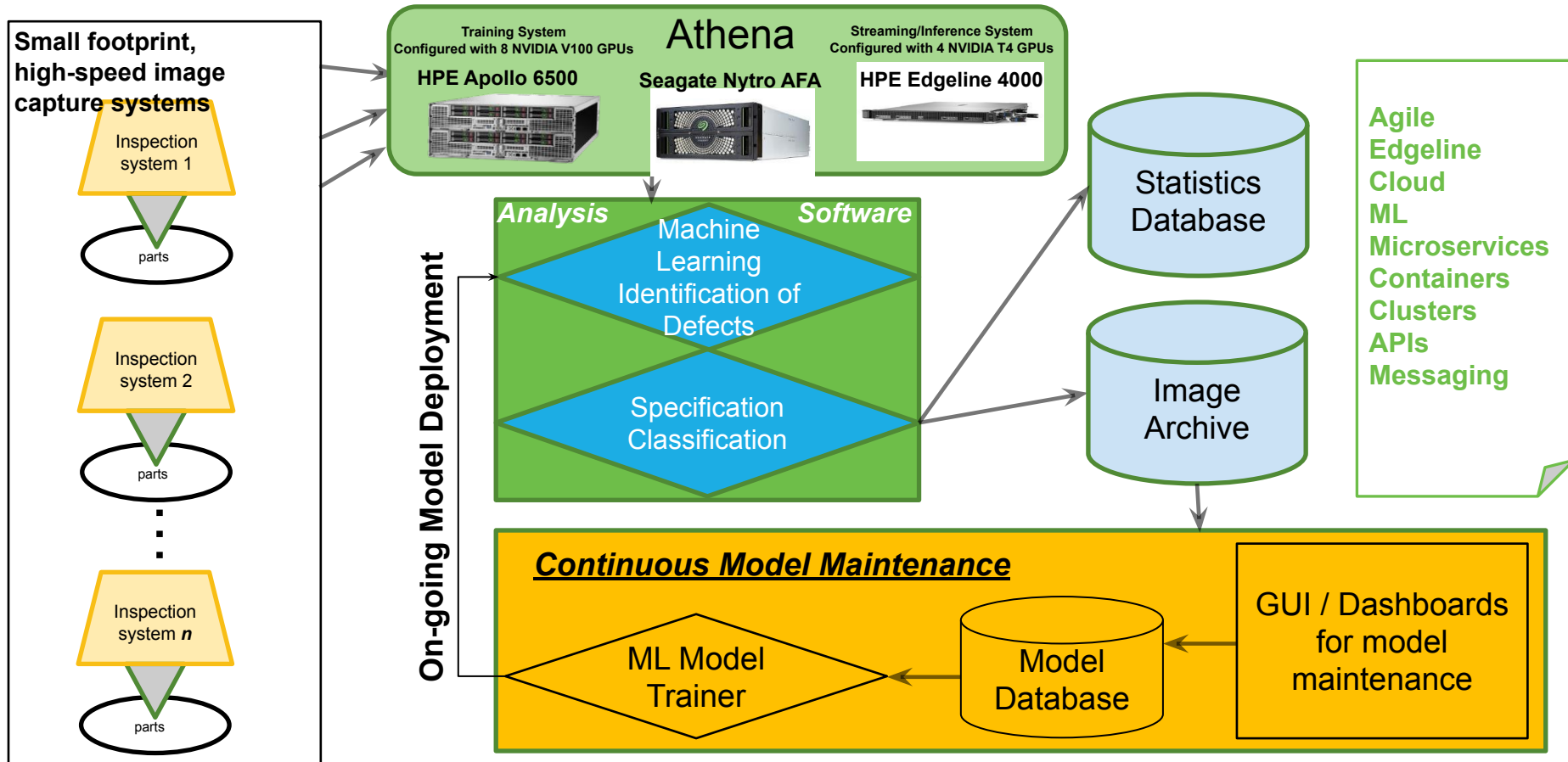
HAMR NFT lapping defects



AFM topography automated feature identification and template alignment



# High Volume Inspection with Centralized Analysis



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2020: The year to define and document the storage requirements and latencies via evaluations and PoCs.

Thanks