



# The Changing World with WDC

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# Safe Harbor | Disclaimers

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# About Western Digital Corporation



## TRUST



- **A data storage leader**
- **"Under the hood" of major OEMs**
- **Millions of devices shipped annually**

## VALUE



- **Among the highest SSD/HDD MTBF rates**
- **Certified solutions (Msft, Oracle, VMware)**
- **Single source for storage devices & systems**

## INNOVATION



- **12,000+ active patents, 500 new/yr**
- **\$2.5 billion invested annually in R&D**
- **Leader in Open Community initiatives**

# Broad Storage Portfolio

## Consumer

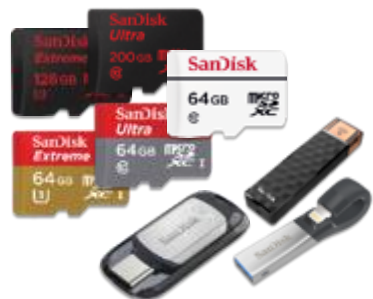
### Imaging



### WD Software



### microSD™ Cards & Mobile Storage



### Solid State Drives (internal and external)



### Wearable Audio



### USB Drives



## Mobile & Industrial

### Embedded & Removable



### Surveillance



WD Purple

## Client Computing

### Laptop, Desktop & Commercial SSDs



WD Black WD Blue

### Solid State Storage

#### FlashMAX® III PCIe



Ultrastar® SAS SSD

Ultrastar® SN100 NVMe PCIe

### HDD Storage



Ultrastar® He<sup>8</sup> and He<sup>10</sup>



Ultrastar® Archive Ha<sup>10</sup>

## Data Center/Enterprise

### Active Archive System



WD Gold (Data center)



WD Red



### Flash Systems, Software & Drives



FlashSoft® Software



# Growth in Data

Volume

↑

Velocity

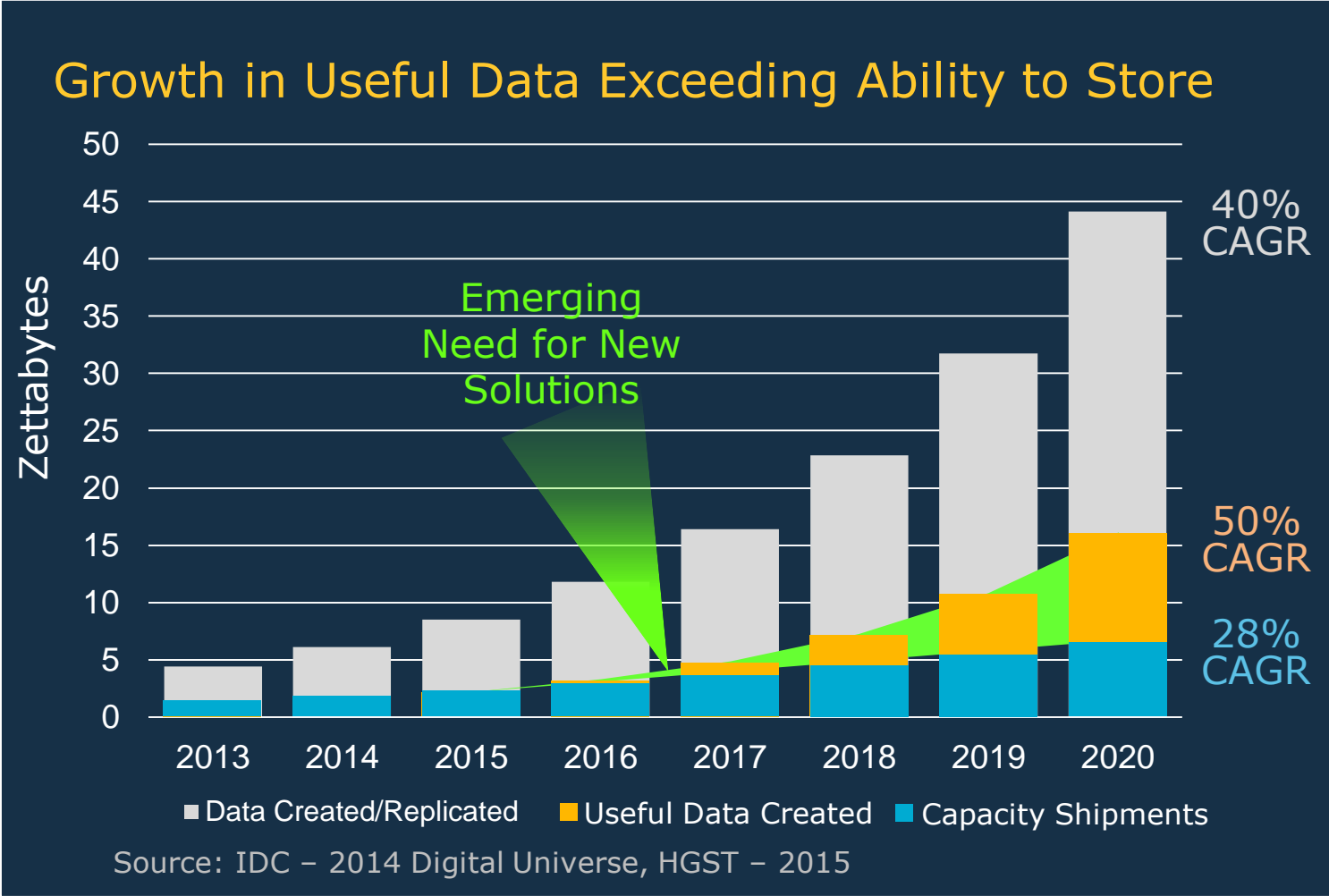
→

Variety

■ ● ▲  
—

Value

↗



Changing Nature of Data Driving New Demands in Data Storage

# Changing Nature of Data

## Fast Data

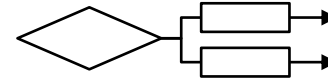
Machine Learning



Autonomous Machines



Real-time Decisions



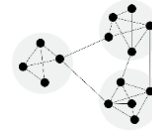
Performance

## Big Data

Predictions



Connections



Insights



Capacity

**Fast Data and Big Data Driving Increased Demands on Storage**

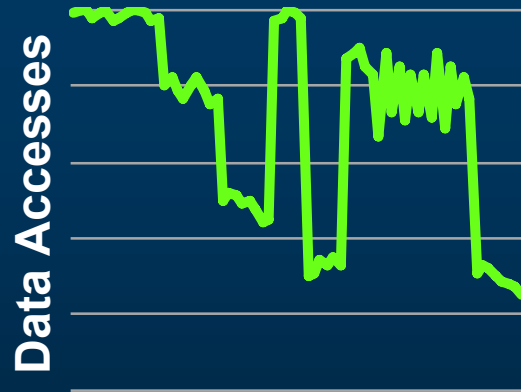


# Different Storage Applications

## Emerging Customer Viewpoint

### Capacity Drive Targets

#### Mainstream

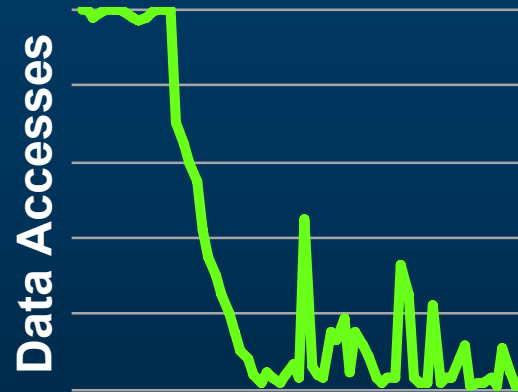


Age of Data →

*Frequent Writes,  
Frequent Reads*

Analytics, Content,  
Compliance, Audit, Data  
Captures...

#### Active Archive

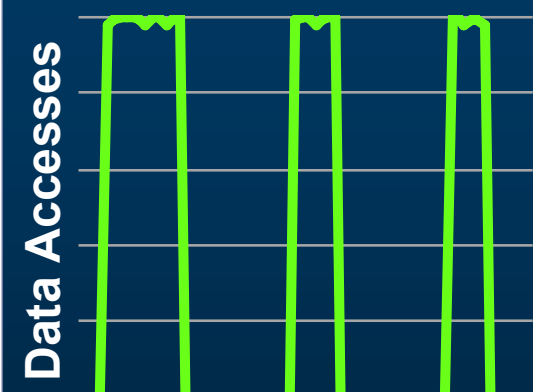


Age of Data →

*Write Once, Read  
Frequent (less over time)*

Social media, Online  
content, Online backup,  
Medical records,  
Scientific, Digital assets

#### Deep Archive



Age of Data →

*Write-Once,  
Read Occasionally*

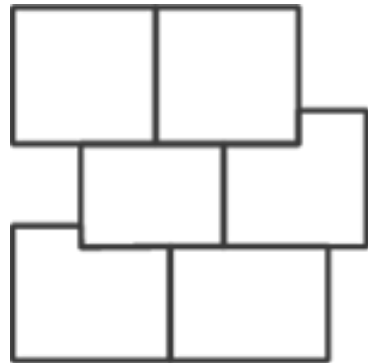
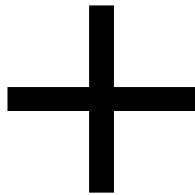
Bulk Backup & Restore,  
Archived records, "Last  
copies"

# High Capacity SMR Solution: HGST Ha10

- Combines Helium & SMR
- Achieves Industry First 10TB Capacity Point
- Enterprise Grade Quality & Reliability



Helium



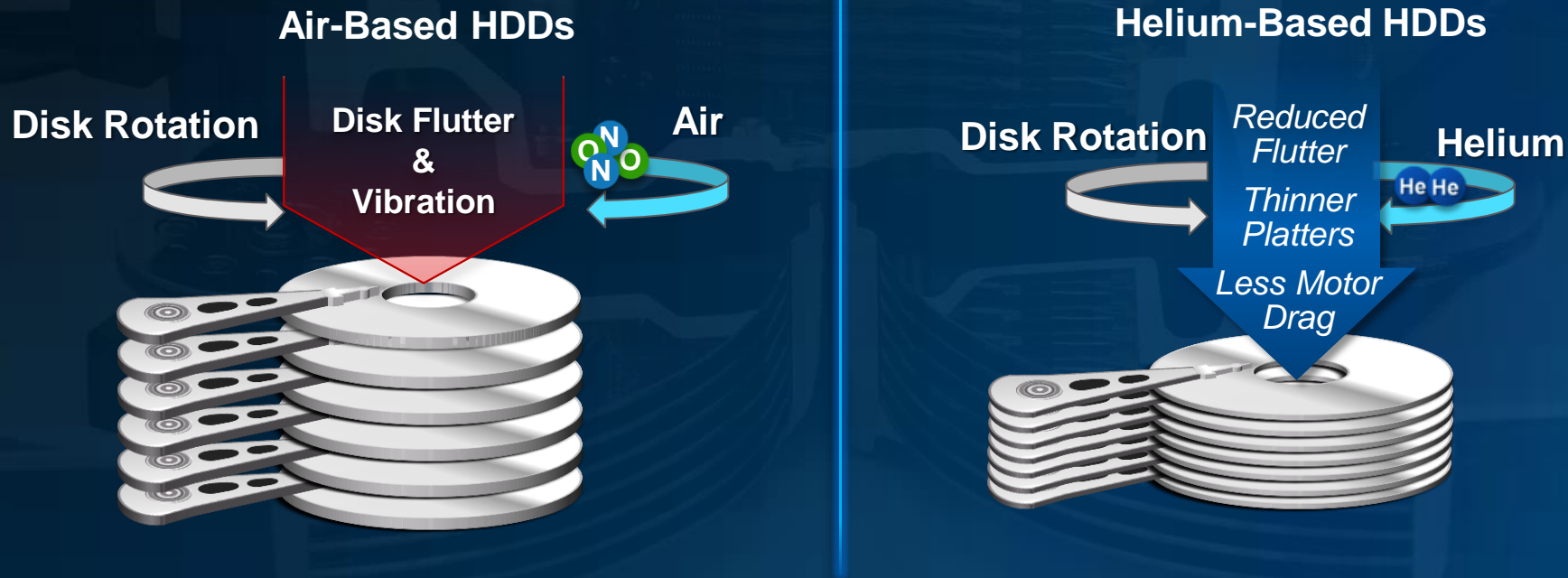
SMR



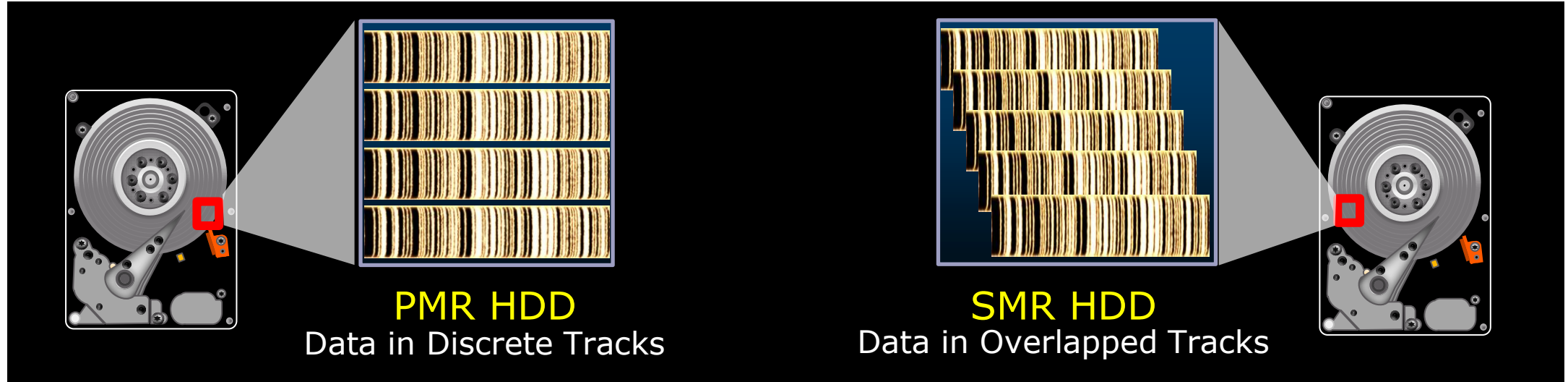


# Helium Benefits: Helium vs. Air HDDs

It begins with Helium being 1/7<sup>th</sup> the density of air



# SMR: A Fundamentally Higher Capacity Drive



**25%** More Capacity

## Host-Managed SMR

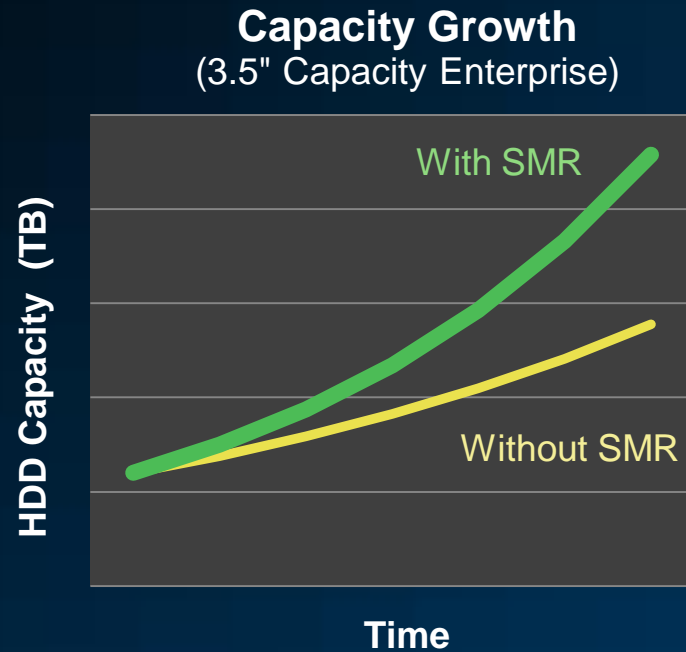
- Host software changes required
- Predictable performance
- Sequential Workload

## Host-Aware SMR

- Host software changes recommended
- Performance can vary
- Random Writes Supported

# The SMR Advantage

It's much more than just higher capacities



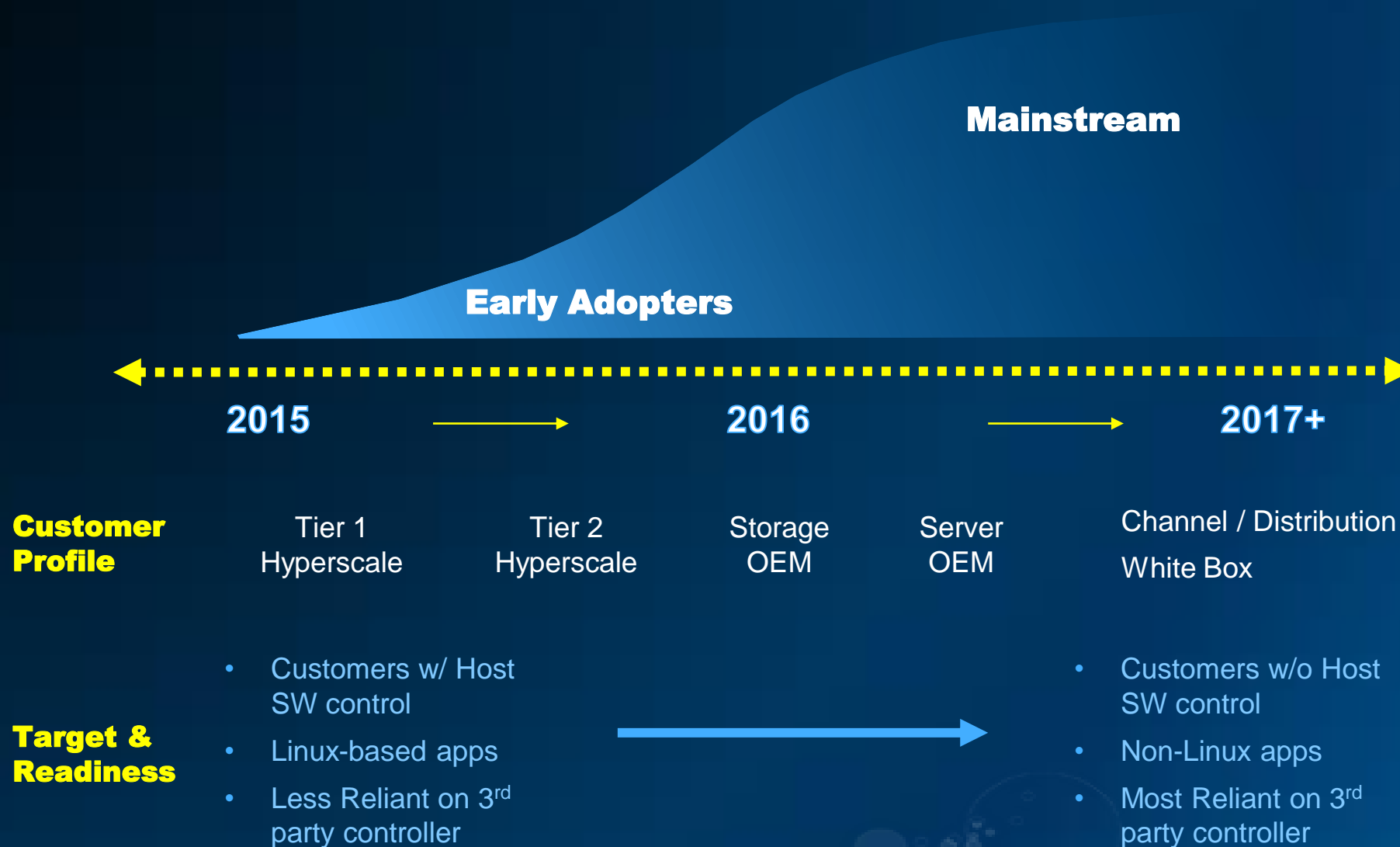
## Areal Density Accelerator

- Much higher track density
- Overall AD growth 25%/Y vs. 15%/Y
- Provides a scalable path to future SMR products & recording technologies

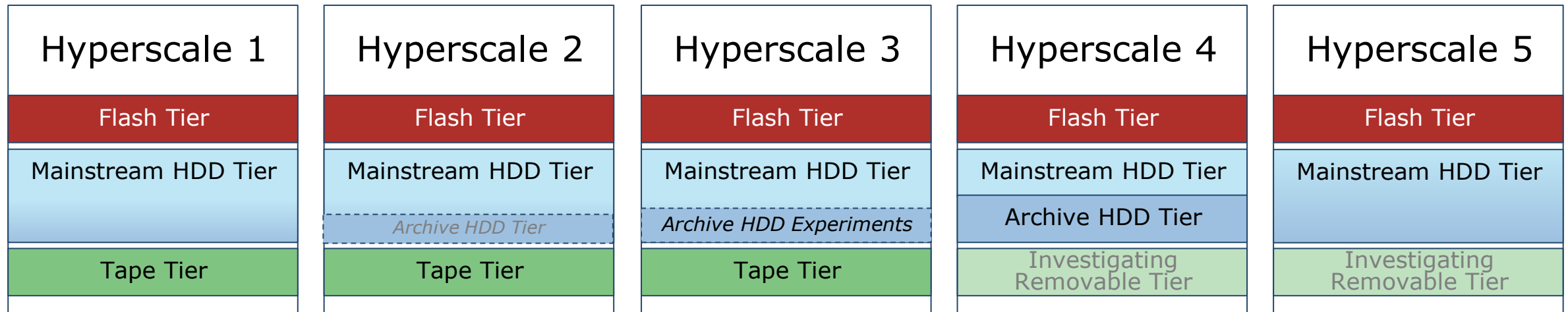


# Market Adoption of Host-Managed SMR

## Customer Readiness



# The Evolving Face of Hyperscale HDD Tiering



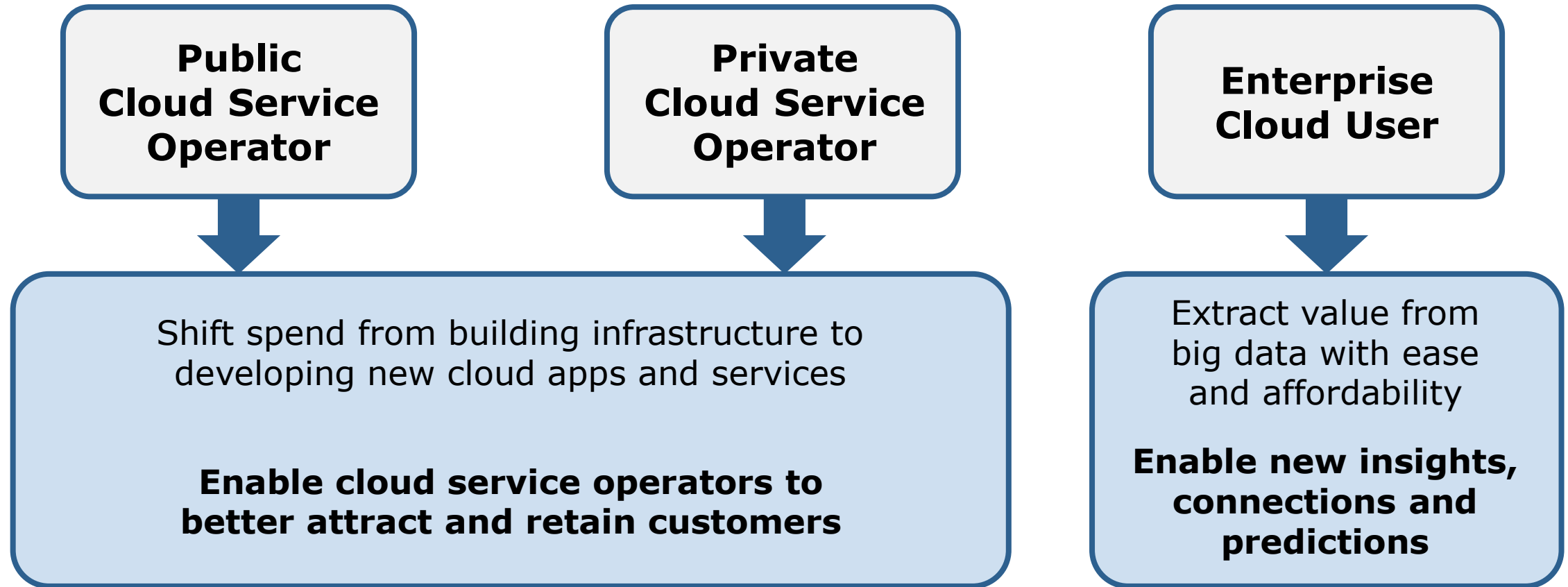
## HDD Usage in the Hyperscale is Evolving

- Some of the largest hyperscale deployments are eliminating multiple tiers of HDD storage
  - Better addresses workloads and services
  - Higher efficiencies
- **Active archiving and multiple HDD tiers still key**
  - Application-specific cloud service providers
  - Specific vertical market data centers
  - Hybrid cloud, traditional IT

## Tape Has A Place in Hyperscale

- Tape provides great economic justification at very large scale
- At scale, tape provides lowest TCO-burdened \$/TB
- Latency prevents tape from being used for active data or active archive data
  - Ideal for largest of data sets and for “last copies” of data where “hours” of latency is acceptable
- **Active Archive HDD systems and tape are compatible and serve different purposes**




# Accelerating Success for Cloud Datacenters



**Western Digital Enables Cloud Datacenter Operators and Users to Transform Their Business to Compete More Effectively in Today's Data Centric World**

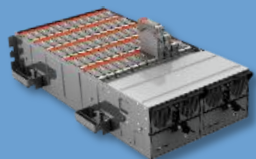






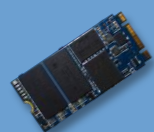


# Alternatives for Building Cloud Scale Datacenters

	Software Development	System Integration	Turnkey Systems
Pros	<ul style="list-style-type: none"><li>▪ Customized to Needs</li><li>▪ Tight Control</li></ul>	<ul style="list-style-type: none"><li>▪ No Development Cost</li><li>▪ Choice of HW &amp; SW</li></ul>	<ul style="list-style-type: none"><li>▪ No Development Cost</li><li>▪ Ease of Deployment</li></ul>
Cons	<ul style="list-style-type: none"><li>▪ Engineering Costs</li><li>▪ No Shared Learning</li></ul>	<ul style="list-style-type: none"><li>▪ Cost of Integration</li><li>▪ Support Complexity</li></ul>	<ul style="list-style-type: none"><li>▪ Less Choice of HW</li><li>▪ Less HW Leverage</li></ul>
Addressable Market			

**Turnkey Systems Enable Broad Adoption of Cloud Without Hidden Costs**

# Broadest Range of Technology Building Blocks

System Architecture	Performance Block Storage	Performance File Storage	Active Archive Object Storage
System Software	Ceph		Object Storage
Storage Platforms	HDD 		SSD 
Storage Devices	HDD  	SSD   	

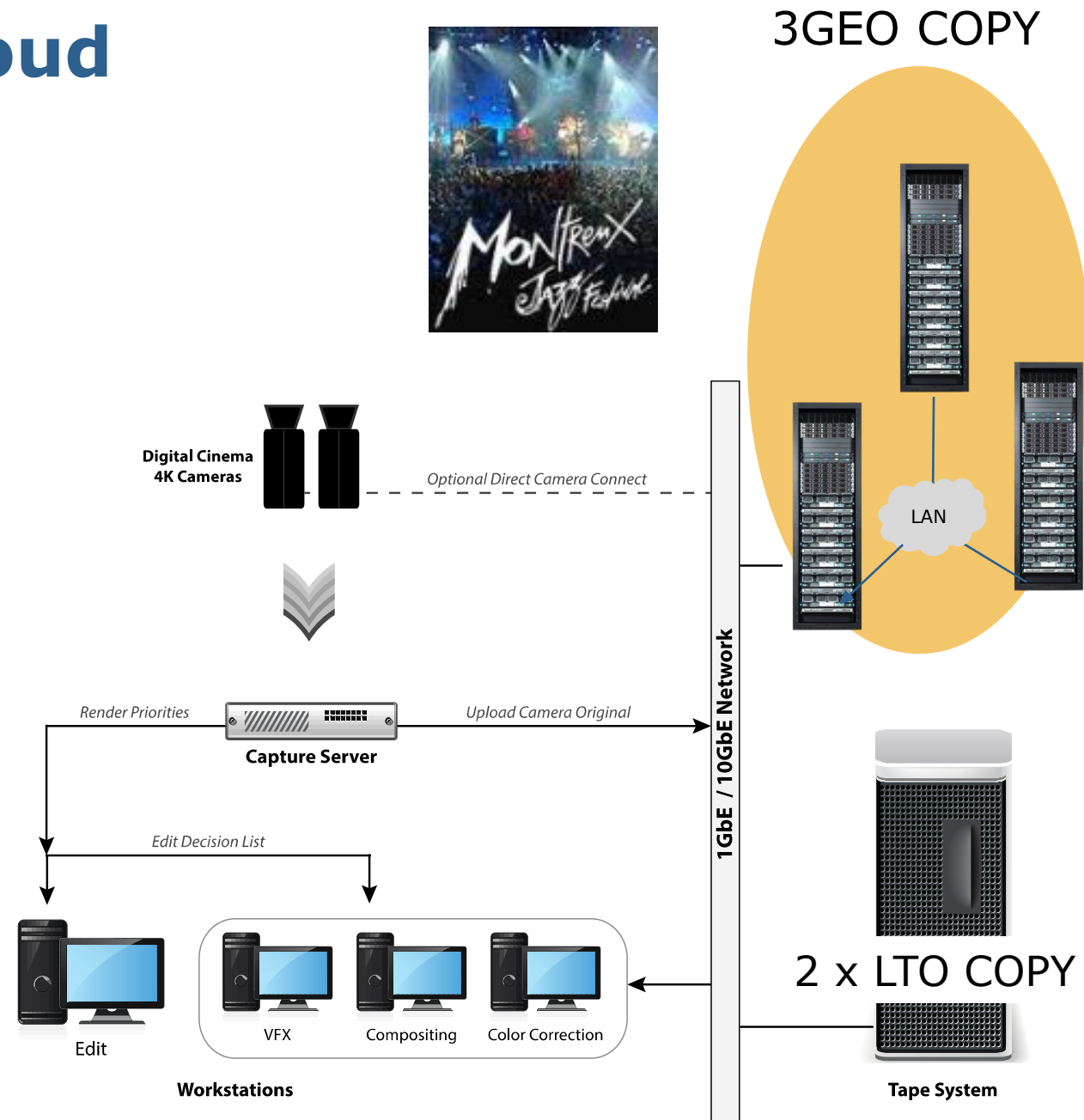


**Delivering Unmatched Value Through Broad Points of Innovation**

# Object Store as Private Cloud

## Montreux Festival

- **+45 years of Montreux Jazz festivals**
  - 5000 hours of high quality audio & video
  - 3000 concerts descriptions
- **Selected HGST Object Store as the scale-out Archive System for Copy 1**
  - 2 More copies on LTO Tape
- **The 3 main objectives:**
  - Enable end-user access in a series of Jazz Café's
  - Save the recordings 100 Year in a secure archive
  - Make the archive available for cultural and scientific projects (live archive)





Q&A

Thank you



# Hs<sup>14</sup> Enterprise SMR Implementation

Choice of all SMR implementations

HGST SMR HDD	Host Managed SMR		Host Aware SMR	
	Host Managed SMR		Host Aware SMR	Drive Managed SMR
Customer View	Host Managed SMR		Host Aware SMR	Drive Managed SMR
	100% ZBC/ZAC implementation is mandatory		100% or Partial ZBC/ZAC implementation	No SW change required

# SMR SDK Released to the Community

Download Now: <http://github.com/hgst>



- Allows Linux apps access to Host-Managed SMR HDD
- Ensures new command sets flow through HBA
- Emulates Host Managed SMR on PMR drives