



Western Digital®

# Storage from Edge to Cloud

Enabling the next generation of Anywhere Intelligence

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October, 2018

# Agenda

- Introduction to Western Digital
- Storage Industry Evolution
  - SSD and HDD—where we have been, where we are going
- The Edge and The Cloud
  - New use cases, new storage needs
- Wrap-Up



# Forward-Looking Statements

## *Safe Harbor | Disclaimers*

This presentation contains forward-looking statements that involve risks and uncertainties, including, but not limited to, statements regarding our data center products and technologies, expectations regarding data usage and storage, our business strategy, growth opportunities, and demand and market trends. Forward-looking statements should not be read as a guarantee of future performance or results, and will not necessarily be accurate indications of the times at, or by, which such performance or results will be achieved, if at all. Forward-looking statements are subject to risks and uncertainties that could cause actual performance or results to differ materially from those expressed in or suggested by the forward-looking statements.

Key risks and uncertainties include volatility in global economic conditions, business conditions and growth in the storage ecosystem, impact of competitive products and pricing, market acceptance and cost of commodity materials and specialized product components, actions by competitors, unexpected advances in competing technologies, difficulties or delays in manufacturing, and other risks and uncertainties listed in the company's filings with the Securities and Exchange Commission (the "SEC") and available on the SEC's website at [www.sec.gov](http://www.sec.gov), including our most recently filed periodic report, to which your attention is directed. We do not undertake any obligation to publicly update or revise any forward-looking statement, whether as a result of new information, future developments or otherwise, except as required by law.

# Who is Western Digital?

*Provider of storage solutions covering all parts of the data lifecycle*

**Western Digital**

**SanDisk**

**H G S T**  
a Western Digital brand



G-Technology™



**Headquartered in San Jose, CA, but**

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# Western Digital Storage Device Evolution

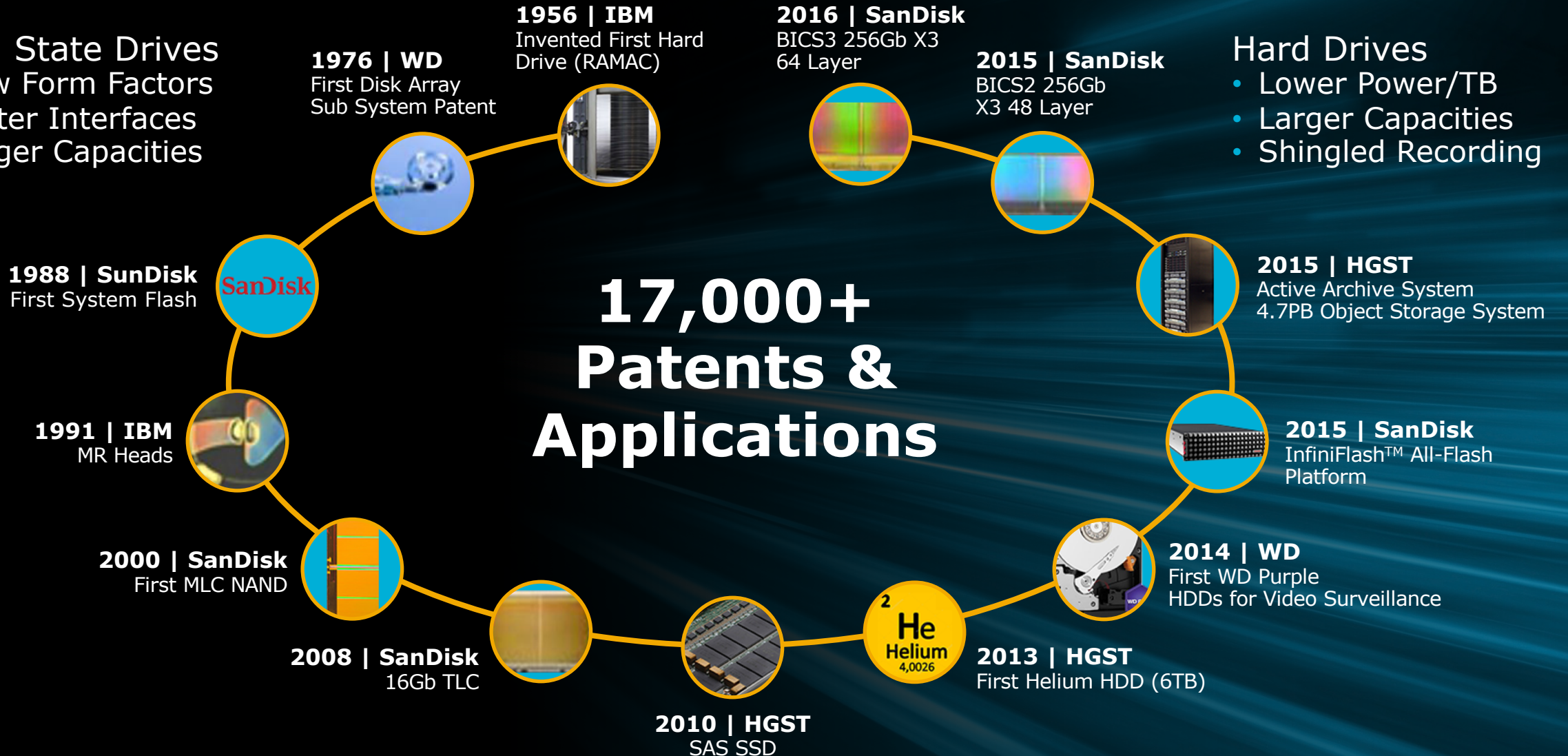
Enabling new uses and optimizing older ones

## Solid State Drives

- New Form Factors
- Faster Interfaces
- Larger Capacities

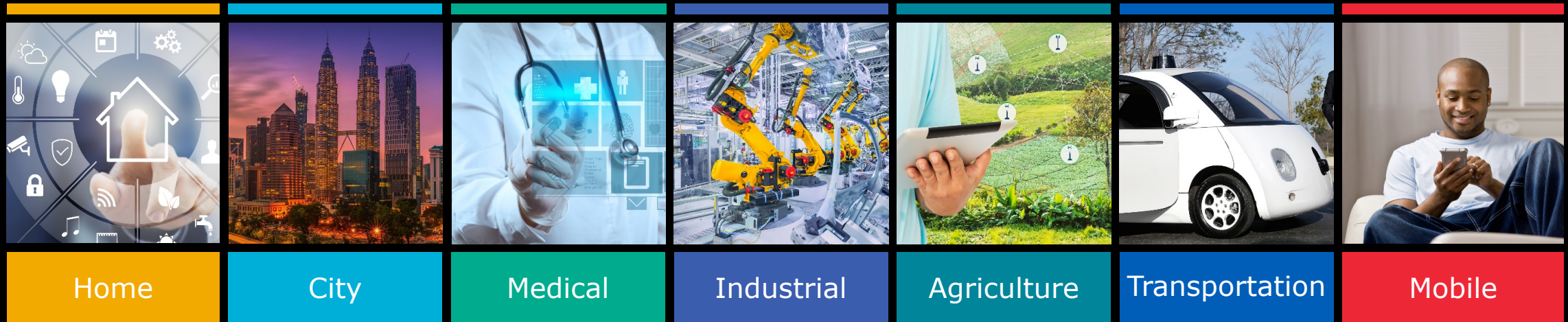
## Hard Drives

- Lower Power/TB
- Larger Capacities
- Shingled Recording



# Data Transforming the World

*from Edge to Cloud*



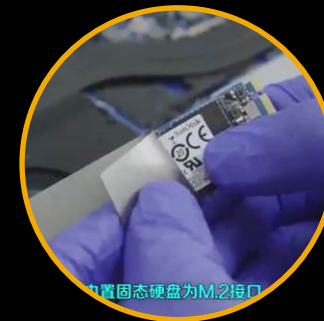
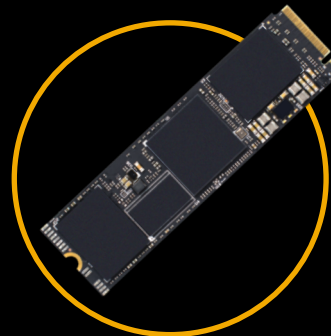
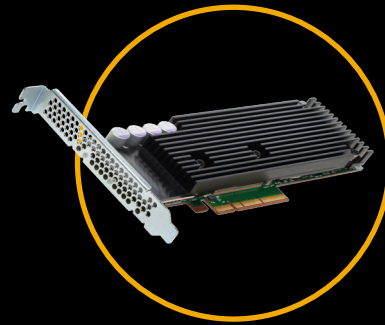
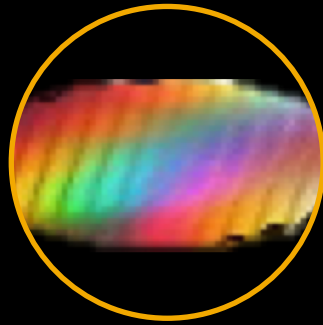
**▲ CLOUD**    **Home Content Sharing**    **Adaptive Infrastructure**    **Genomics Research**    **Supply Chain Optimization**    **Crop Yield Optimization**    **Precision Navigation**    **Personalized Recommendations**

**EDGE ▼**    **Home Automation**    **Facial Recognition/Surveillance**    **Wearable Diagnostics**    **Manufacturing Robotics**    **Real-time Sensors/Controls**    **Autonomous Vehicles**    **Location-based Services**



# SSD Evolution

## Evolution of Form Factors

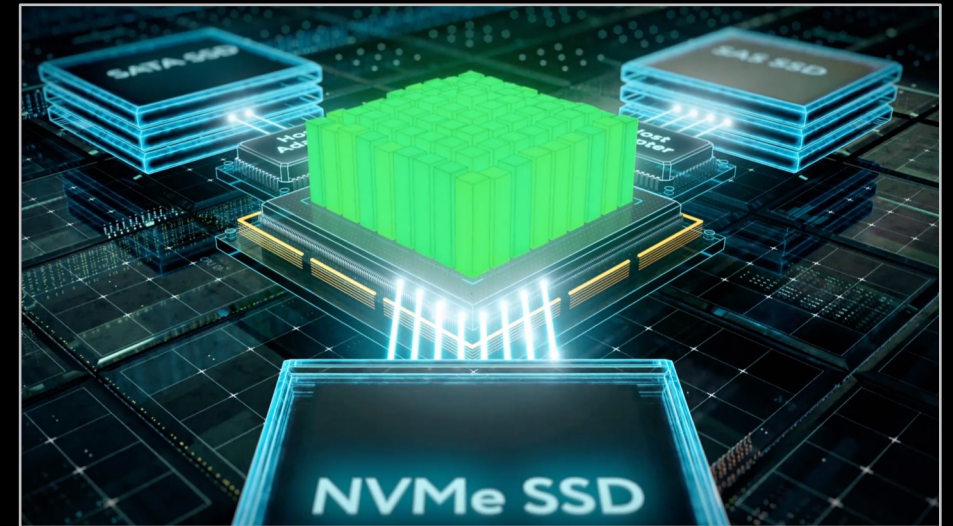
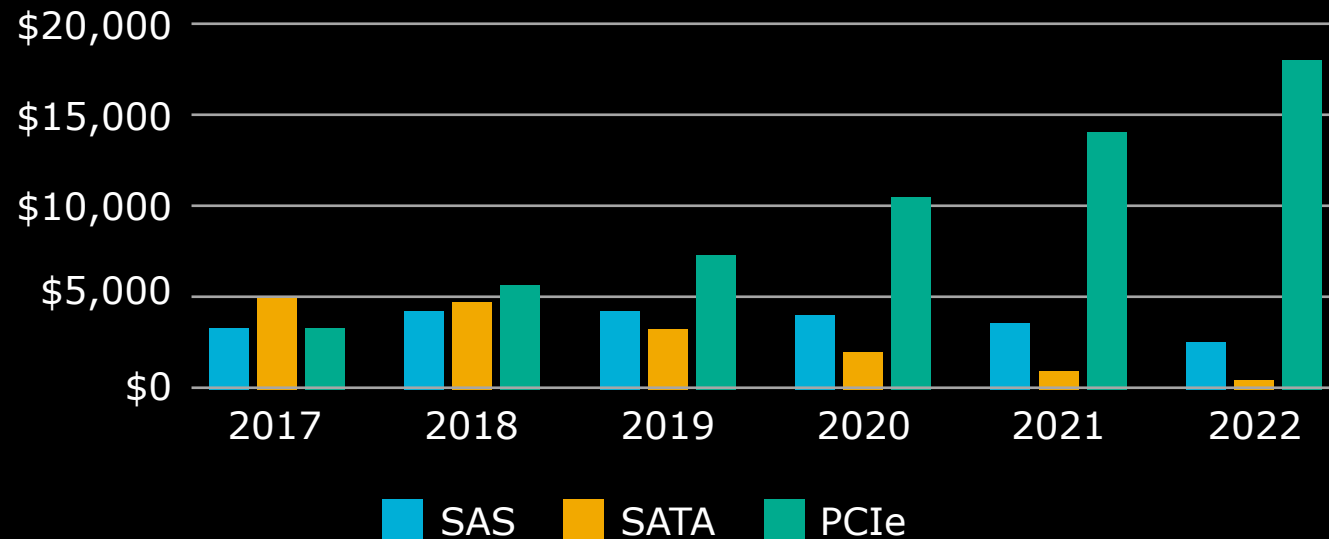


Traditional HDD form factors are not ideal for NAND packaging.  
Standards initiatives lag vendor designs.

# SSD Evolution

## Evolution of Interfaces

Enterprise SSD Revenue by Interface (1)



1) IDC SSD Market Forecast, May 2018

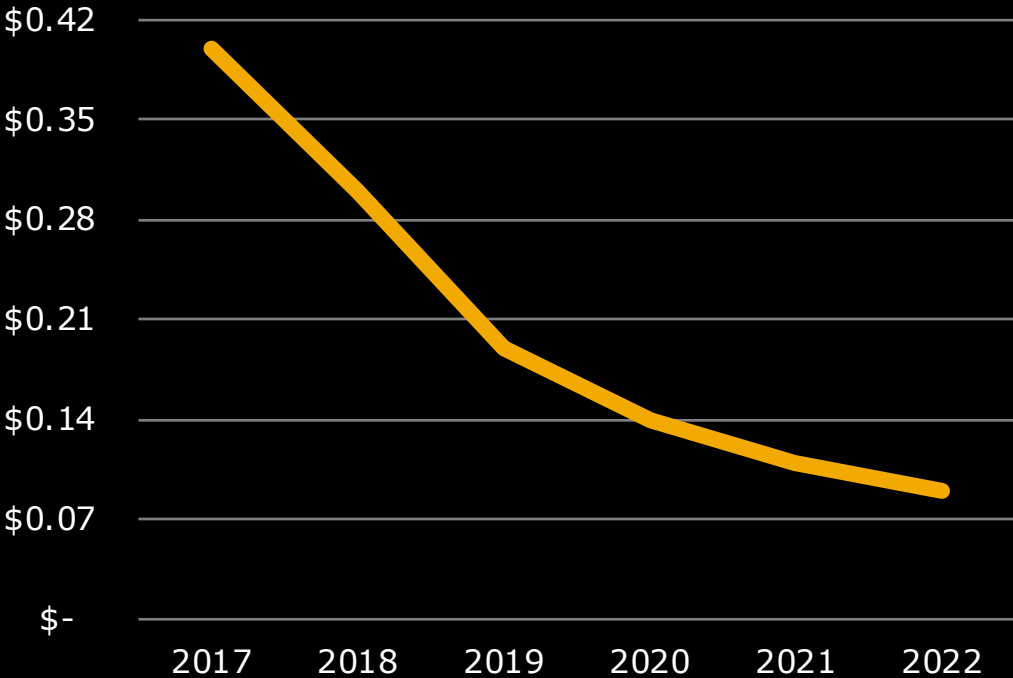
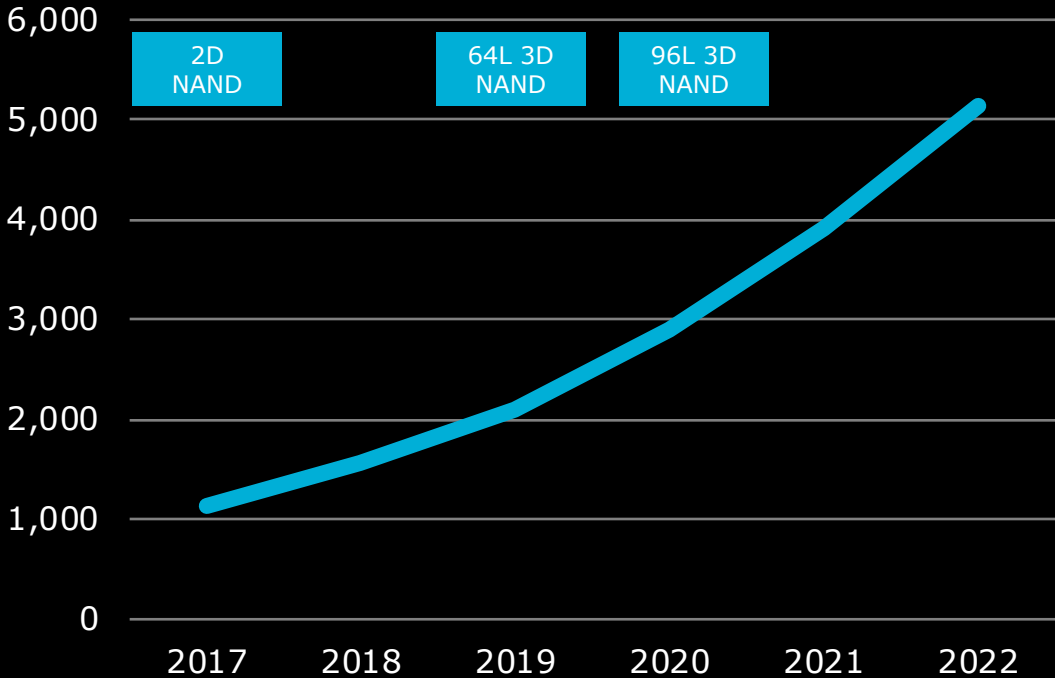
PCIe with NVMe protocol is becoming the interface of choice as it is optimized for NAND Flash. More lanes, better fail-over, lowest latency



# SSD Evolution

## Evolution of Capacity

Enterprise SSD Average Capacity



1) IDC SSD Market Forecast, May 2018

Enterprise SSD capacity increases by 53.2%

While Cost/GB drops 26.1%!

# HDD Evolution: Power/TB (TCO)

## Air-sealed HDD



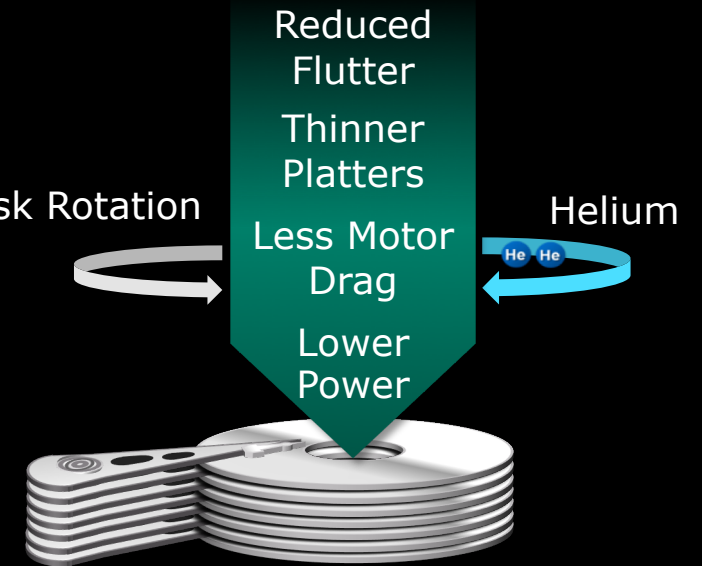
Disk Rotation



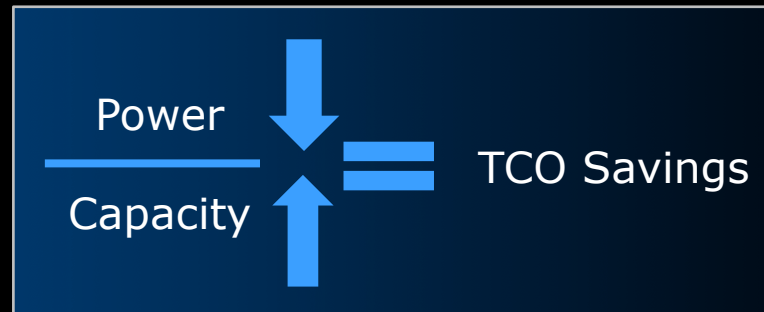
Air – 6 Disk



Disk Rotation



Helium – 7 Disk



Helium-sealed HDD  
Western Digital introduced the world's first helium drive in 2013

Going forward HDD design is all about TCO



# HDD Evolution: Capacity Increase



## Helium

Reduced turbulence for maximum head stability



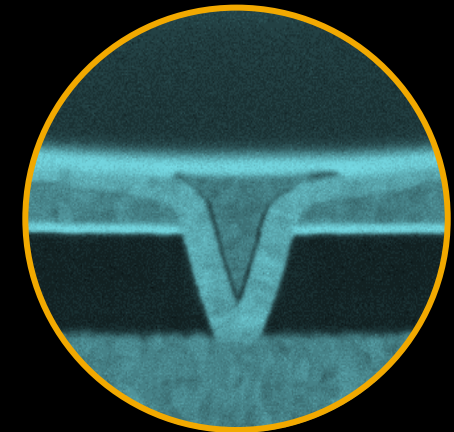
## Micro Actuator

Provides finer control and supports higher track density



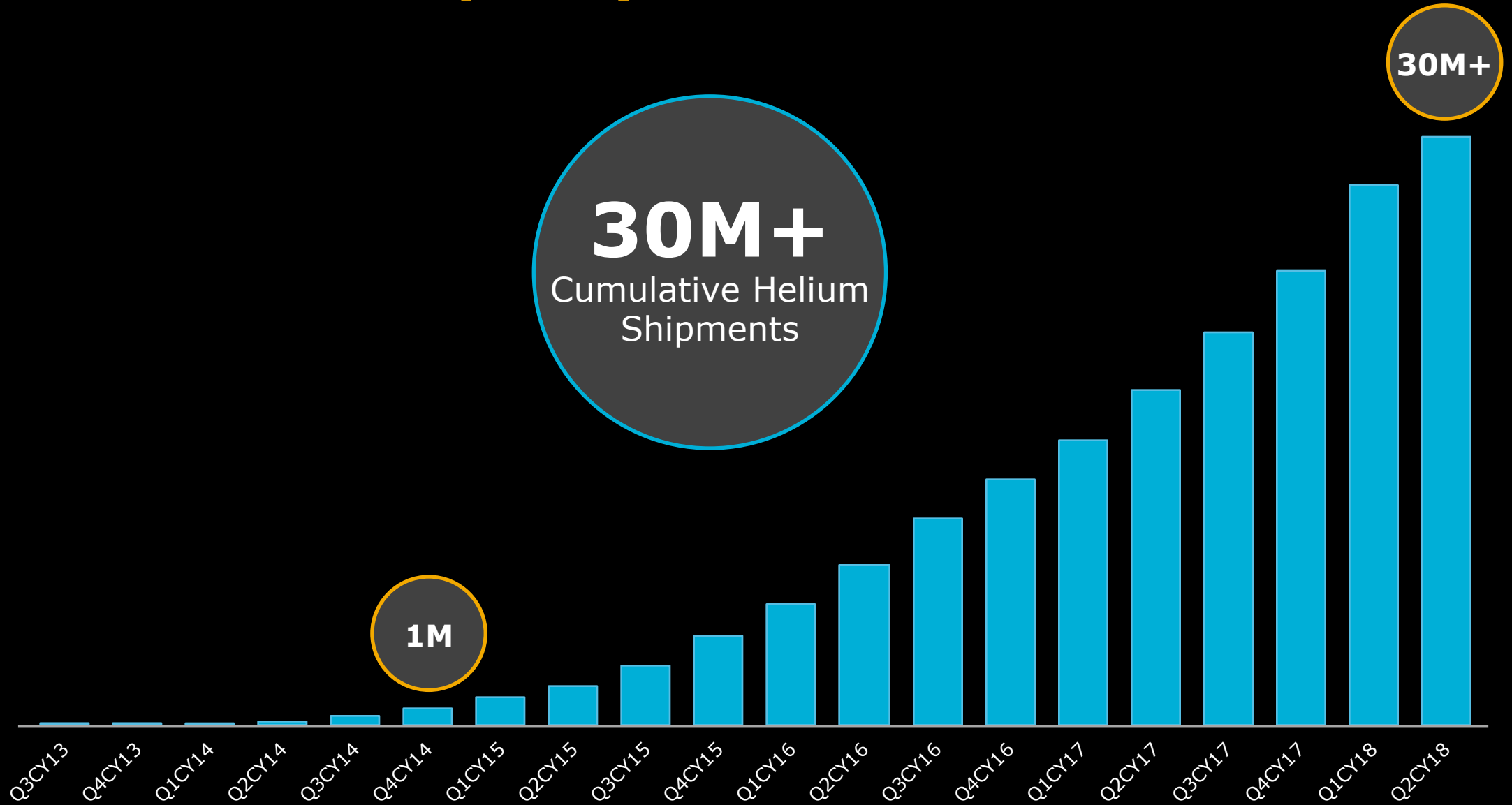
## Damascene Process

Enables greater process control and complex head structures



# HDD Evolution: Capacity Market Leader

Cumulative Western Digital  
Helium HDD Shipments (M)

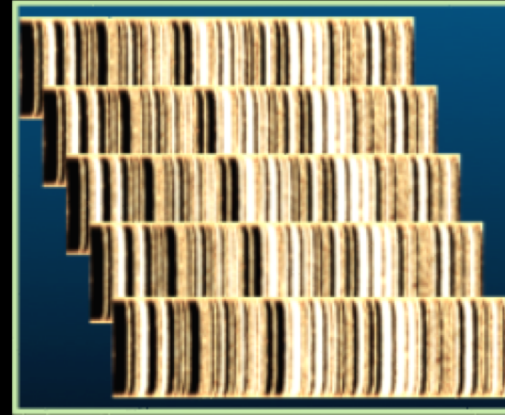


# HDD Evolution: Shingled Recording



**PMR HDD**

Data in Discrete Tracks



**SMR HDD**

Data in Overlapped Tracks



- Increased capacity at same drive generation
- Lower cost/TB and power/TB

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Ideal for Surveillance, Object Storage, Archive.  
Currently used in Huawei OceanStor.

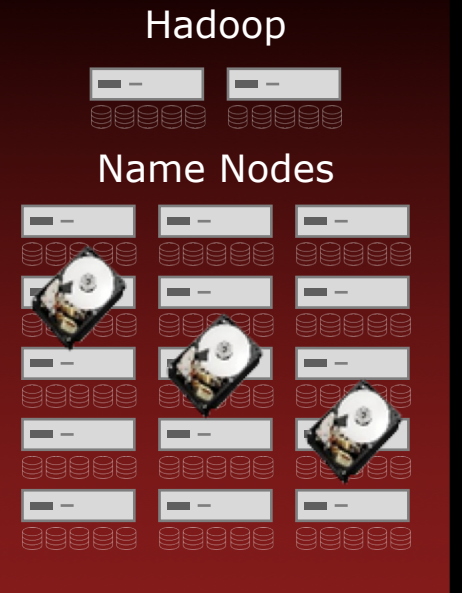
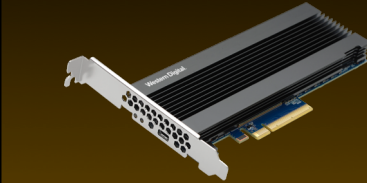
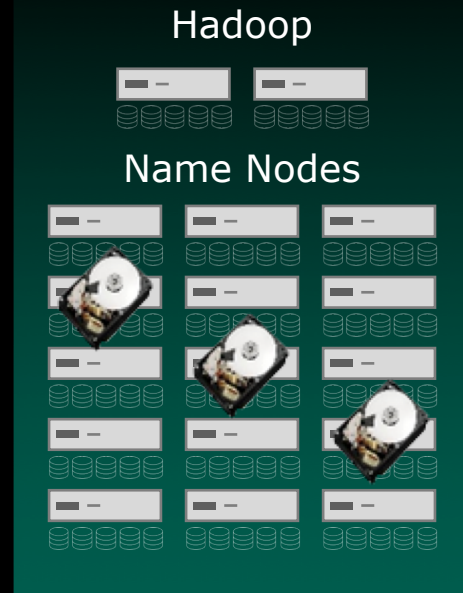
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# Edge-to-Cloud: Video Surveillance Use Case



# Edge-to-Cloud: Ride-Sharing Service Use Case



Capture

AI Inferencing

Big Data

AI Training

Archive

Edge

Cloud

# Data Is Transforming the World

**Western Digital is evolving  
with HDDs and SSDs to meet  
these opportunities**



An abstract graphic consisting of numerous thin, overlapping lines in shades of red, orange, yellow, and cyan. These lines flow and curve across the left and bottom portions of the image, creating a sense of motion and digital energy.

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