



Beyond Capacity

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Seagate Technology

OPEN. FOR BUSINESS.



After 7 manuscripts, reflect
about your mission for what
you can be it do together



We All Joined The Engineering Tribe of High Tech at Some Point

When things have been done at a certain level and we are creating the building blocks of our children's future, we are setting the professional standard for the start of our children's future. **of our children's future.** business case is setting new tech standards.



My Daughter in 2004

200KB



Just like my children, our
Fast forward 12 years
technology has grown



My
Daughter
in 2016

4MB

Remind us
of what we
know





From
200KB

What does 20x
to 4MB
the data find us?





Boredom

Tiredness

Belonging

Joy

Happiness

My Daughter in 2016

Sadness

Thoughtfulness

4MB

Remind us of what we know

Seeking



Which detail would
I want to forget??

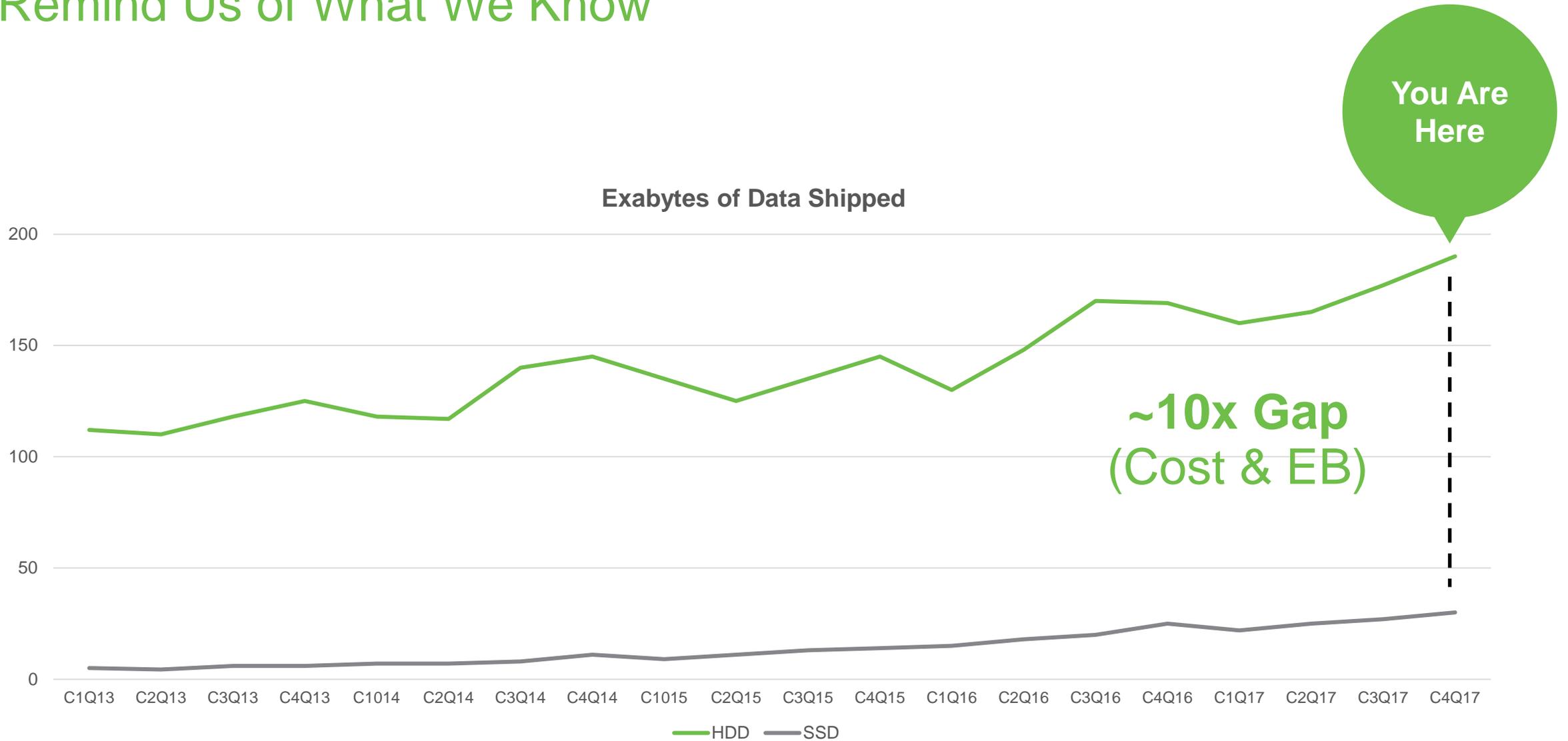
Our Ultimate Goal

So here at Seagate, we want you to think about what life might be like if we could **remove one thing**



Our story is a story of
having **“a good”** and **“rest”** **“forces”**

Remind Us of What We Know



Hyperscale/Hyperconverged/SDS/Virtualization To Save The Day



Legacy:
The Story of “Or”



Hyperscale/Hyperconverged
The Story of “And”

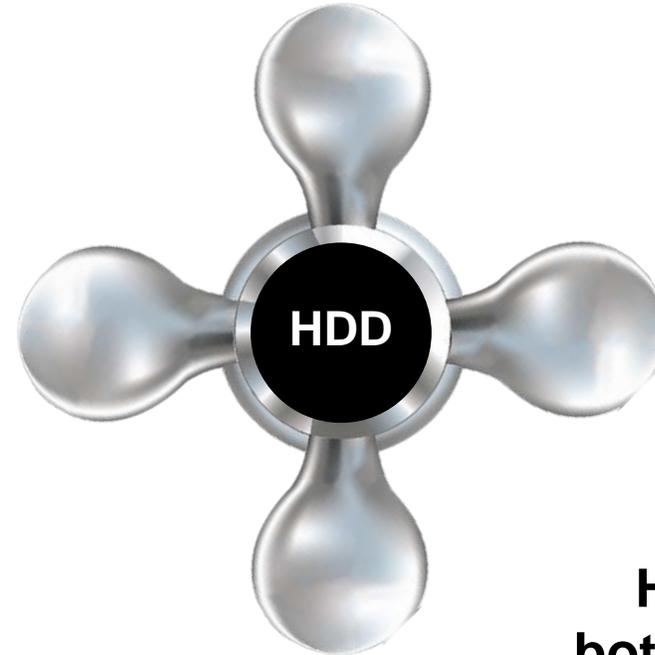
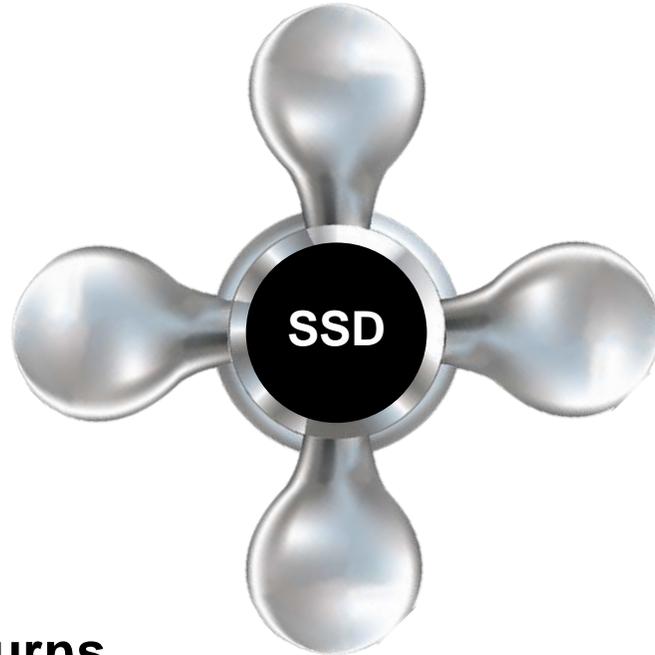


Today

220°



The Law of Diminishing Returns



32°



HDD performance bottlenecks virtually unchanged for years

70°

Desired Temperature

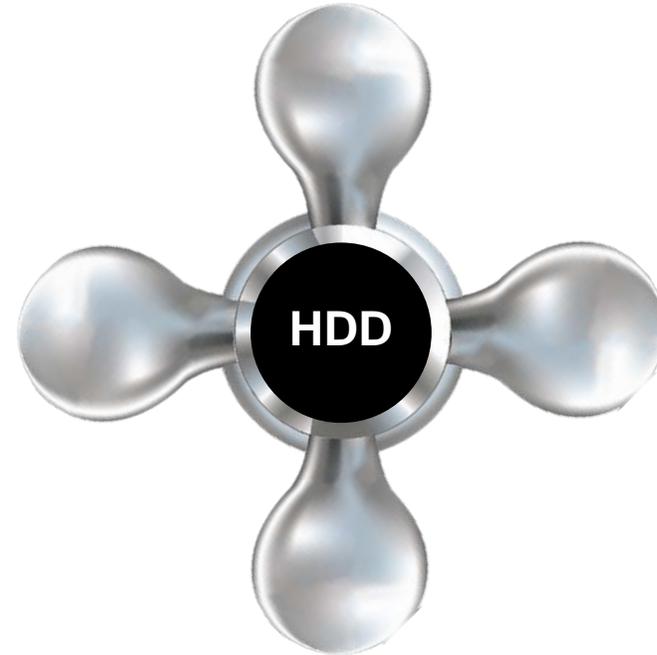
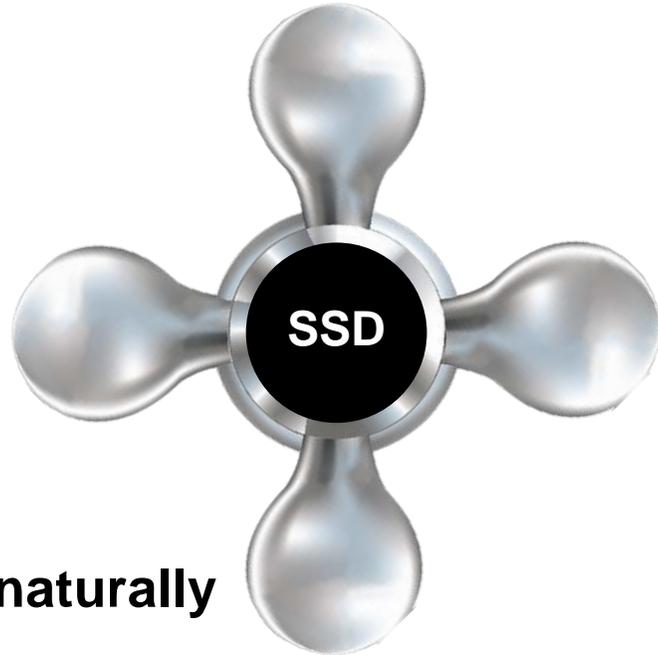


Tomorrow

220°



Let this happen naturally



70°

Desired Temperature

~~32°~~
2x 64°



Fix the bottleneck



What Are Our Challenges to Preserve Our Memories?



Keep the gap of cost, and therefore EB growth at 10x (or greater)



Look to challenge a long established bottleneck on the HDD, and innovate to preserve the most retention of our memories at the greatest efficiency.



Innovation: Density

Capacity Growth:

Step 1:

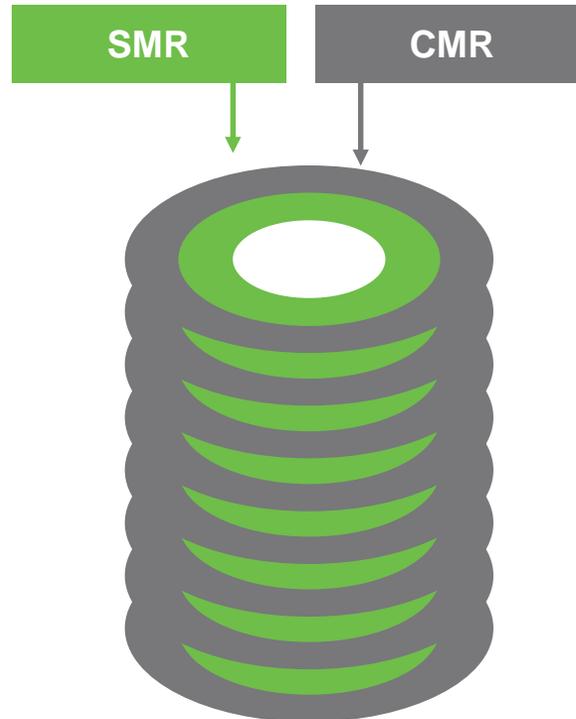
Zone Block Devices

Software development at OCP underway to control dataflow and data warmth

Step 2:

HAMR

Core technological achievement to keep pace with Industry Exabyte demand



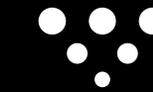
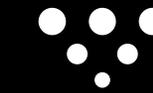
PAIN POINTS



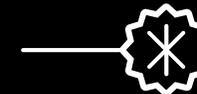
Growing Exabyte Demand

Enable Storage Density

Store Multiple Copies



HDD TECHNOLOGIES



Areal Density

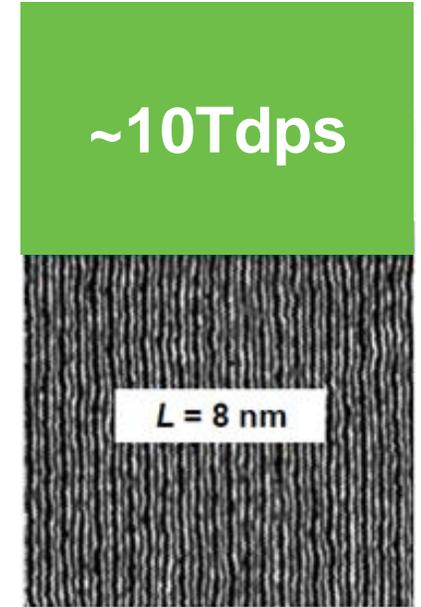
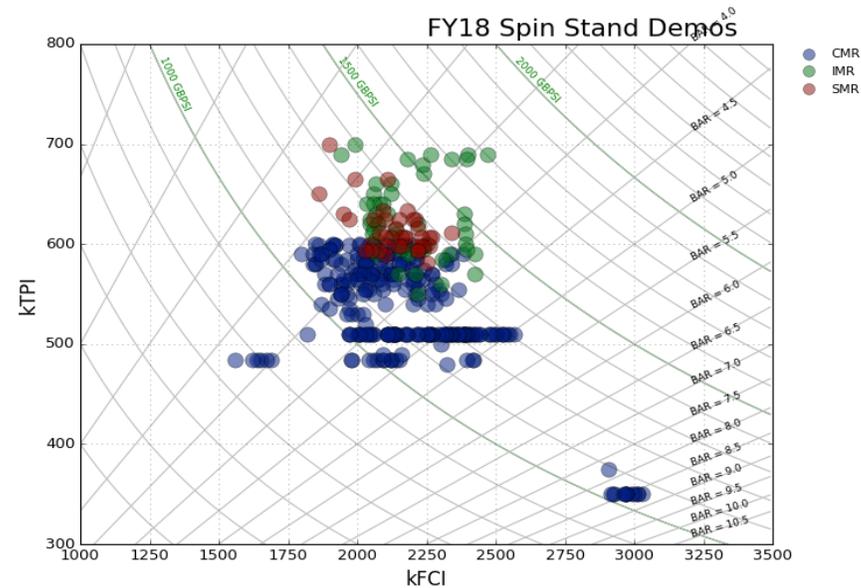
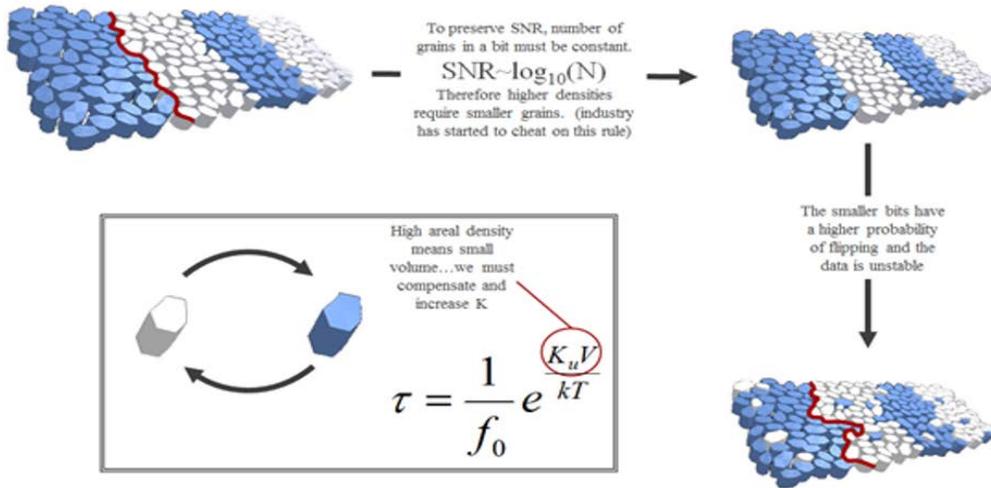
Technology: HAMR

Focus: 20TB by 2020



Innovation: The Technology

Capacity growth starts at the media



SEAGATE has created production media up to **2Tbps**

SEAGATE has created media in research up to **10Tbps**

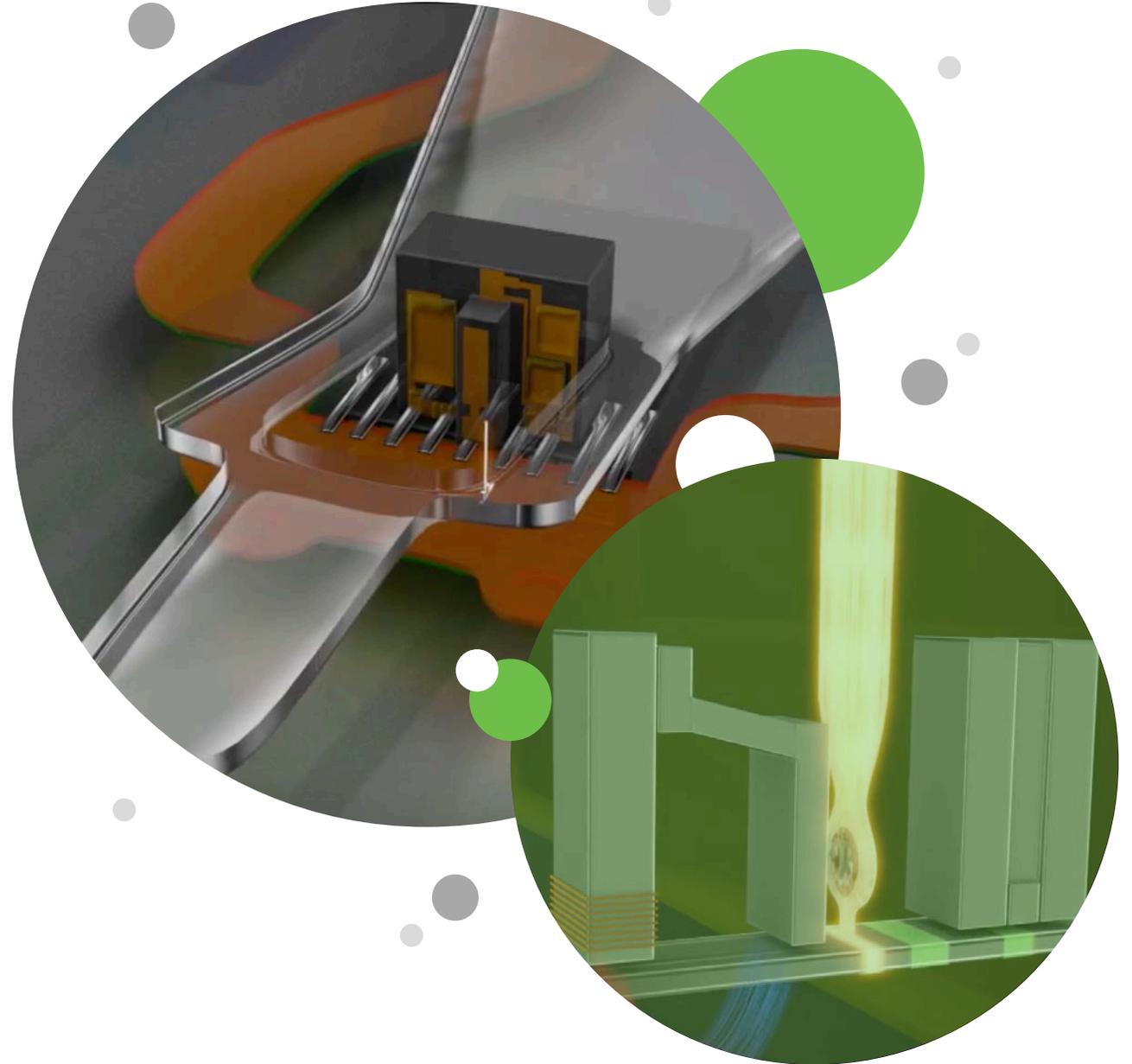
9 YEARS of 30% CAGR demonstrated with HAMR



Innovation: The Technology

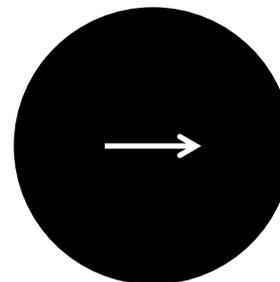
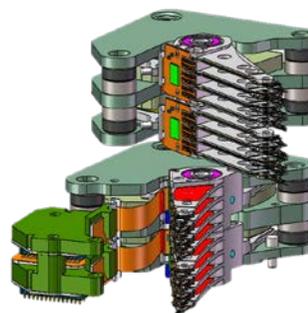
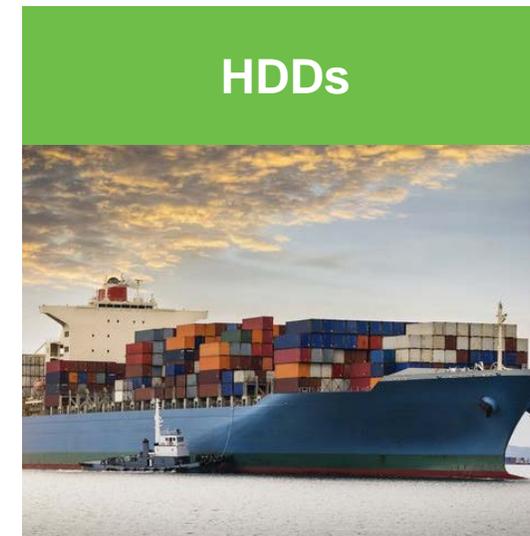
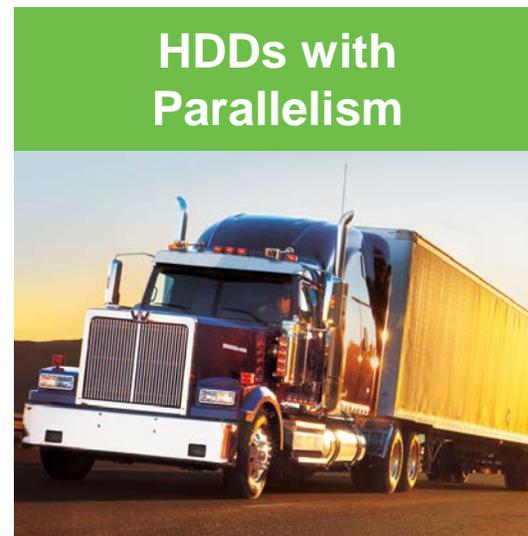
Investment in precision manufacturing, optics, mechanical/electrical/chemical engineering

Energy assisted technology is needed to continue this amazing growth in the Hyperscale world.



Performance Enablement

- Cost, Size, Performance matter in the data center!
- Logistics has known this model for years
- All are required for customer experience



Innovation: Performance

IOPS Growth:

Step 1:

Latency Bounded IO – ICC – Banding

- Command priority, queues, locality optimization
- Unfortunately latency boundaries become encountered

Step 2:

Dual Actuator

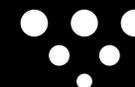
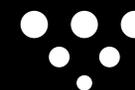
- Enable 1 drive slot to perform like 2 drives
- Significantly less power than 2 drives, avoid slot tax!



Maintain SLAs with High Performance

High Availability

Low Response Time



Scale IOPS with Capacity

Technology: Multi Actuator, Parallelism

Focus: Random Read IOPS, Latency



Innovation: Performance

1 Slot in the Datacenter → Performance of 2X → Enable TCO

Up to 2018

3.5" NL Performance History

- Spindle Speed
- Disk Size
- Actuator Mass

Random Read performance has been flat

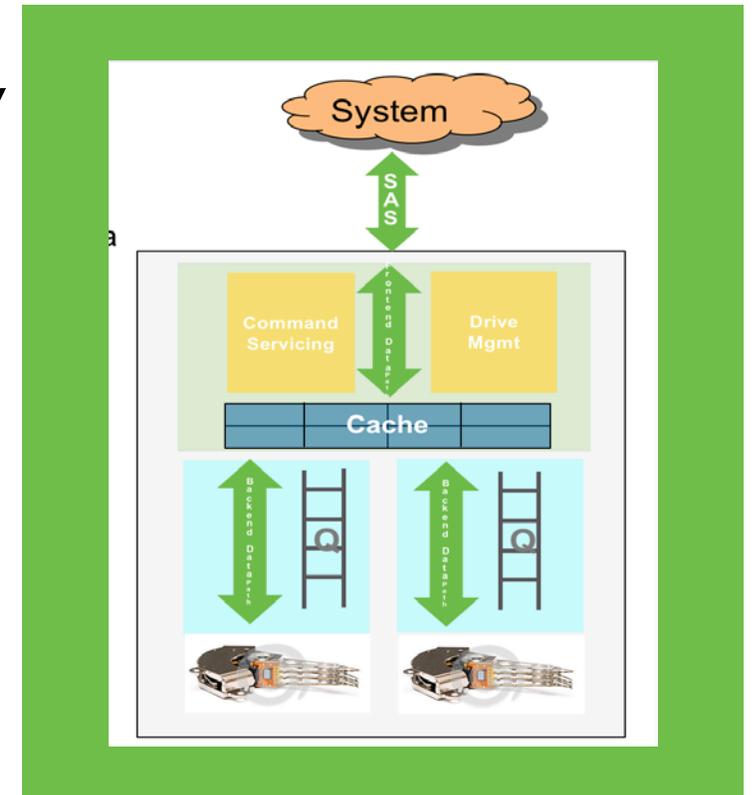
Ingest:

Open the pipe from the SSDs to allow software defined storage to scale

Read IOPS:

- We can't predict what users will read...yet ;)
- Need to give analytics access to the data lakes with efficient model

2019 and beyond

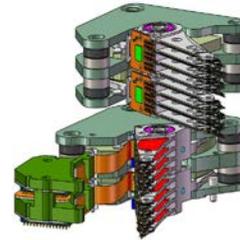


Beyond Capacity:

Latency is critical to data center growth

Software solutions to keep IO/TB sufficient in the short term (1-2 years).

Hardware solutions to enable storage economics for the data center longer term



Dual Actuator

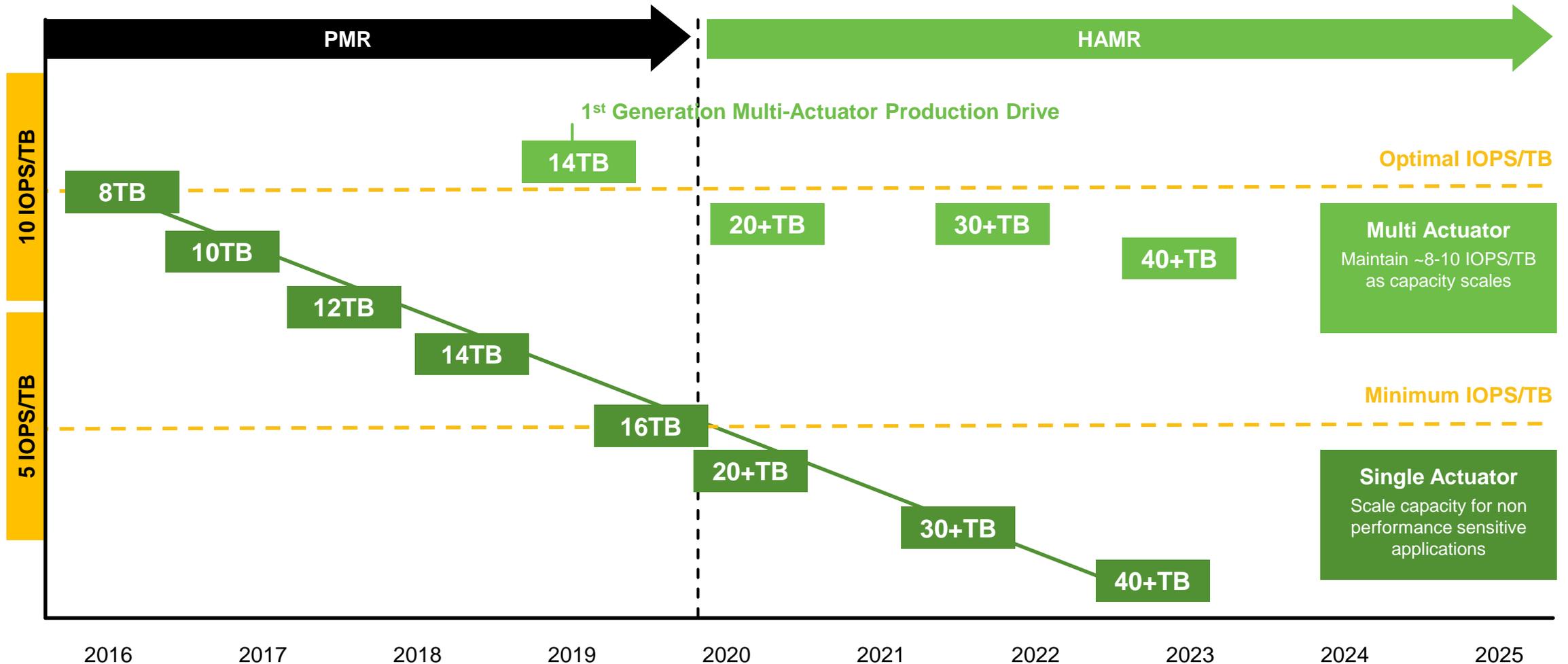
LBIO



Random Read IOPS	160 IOPS in 1 st half of 2019	10 IOPS/TB achieved on 10-12-14TB
Power	Significantly less than 2 drives	Optimized for customer use case
TCO	Significantly less than 2 drives	
Sequential Fill	~500MB/Sec!	No change to traditional NL Allows writes/reads prioritization
Compatibility	Seamless integration to all future capacity growth recording techniques. (HAMR)	Works with both SAS & SATA devices



Ensuring Hard Drives Can Meet Hyperscale Workload Requirements



The Bottom Line:

1.

Capacity

Improve the Density of the Data Center

2.

Performance

Enable the users to access the data to continue achieving service level agreements

3.

Collaboration

Work closely to ensure software genius fully optimize hardware capability



Our story does not end here,
but what we do here sets up
what we can give to the future



**A World Where
History Is More
Than a Grainy
Shadow**

**1000
questions?**

**I live in a 100
year old
house built by
Ruth Comfort
Mitchell**

**We are asking
you to help us
create this
vision...**

Together



OCP SUMMIT

Backup

