



STORAGE DEVELOPER CONFERENCE

SNIA ■ SANTA CLARA, 2016

IOPS: Changing Needs

Tom Coughlin
Coughlin Associates
&
Jim Handy
Objective Analysis

**Coughlin
Associates**

Data Storage Consulting



Outline

- ❑ The Survey
- ❑ Application Distribution
- ❑ Top-Level Survey Results: IOPS, Capacity and Latency
- ❑ Developing storage tiers
- ❑ Implications/Projections
- ❑ Authors & Sources

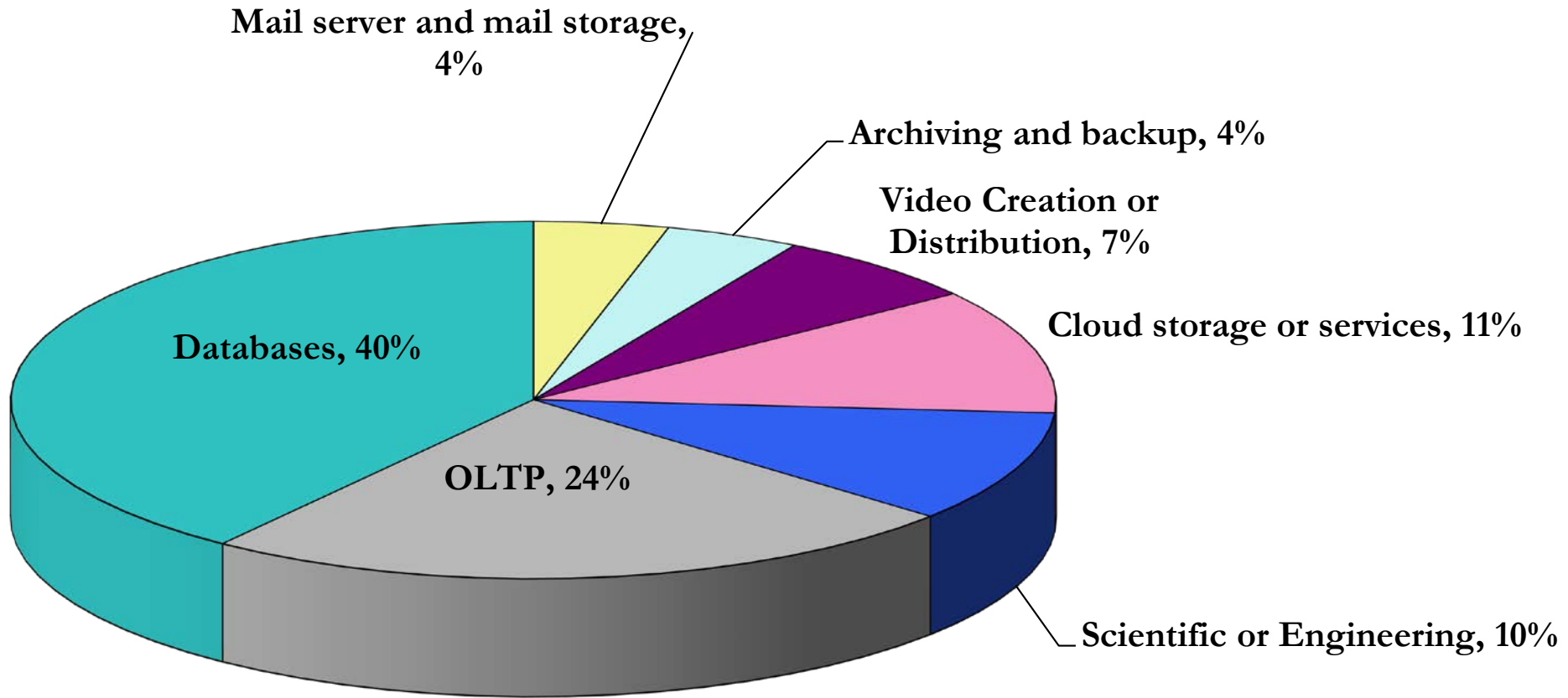
Our Survey

- ❑ Ongoing. Take our survey at:
<http://TinyURL.com/IOPSsurvey>
- ❑ Asks for IOPS, capacity and latency needs
 - ❑ Also their primary applications
- ❑ Some results will appear in a SNIA SSSI white paper
- ❑ Full report, analyzing and interpreting the results, can be purchased online

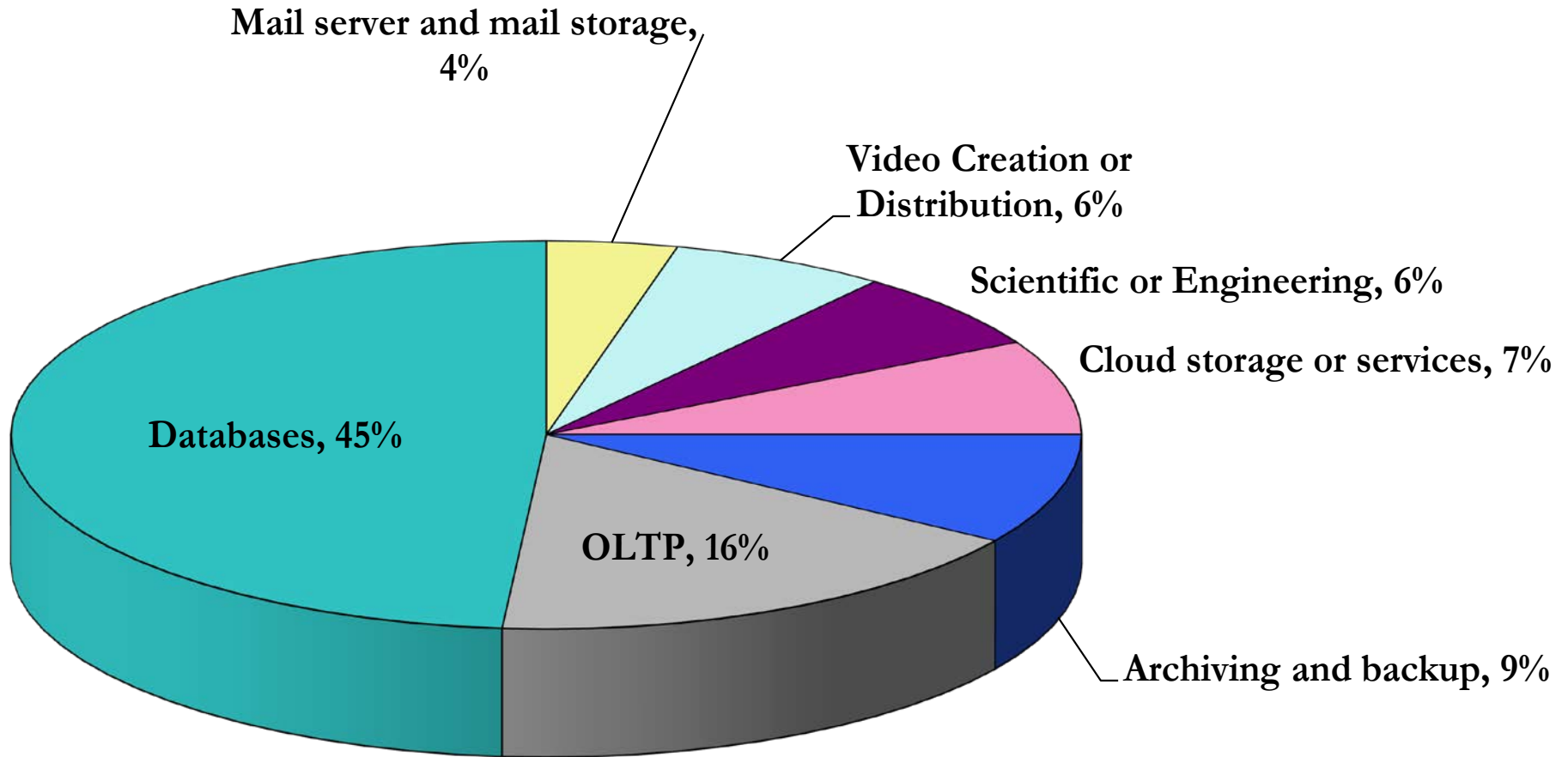
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Applications: 2012



Applications: 2016



Databases

- ❑ Large data sets
- ❑ Random traffic
- ❑ High I/O load
- ❑ Early SSD adopter
 - ❑ Previously used DRAM SSDs
- ❑ Some load the entire DB on flash memory



OLTP

(On-Line Transaction Processing)

- ❑ Verified writes
 - ❑ Write/read back
 - ❑ Doubles I/O load
- ❑ No room for errors
- ❑ Speed is imperative
 - ❑ Delays lose customers



Image courtesy of Square, Inc.

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Archiving & Backup

- ❑ Snapshots and replication gaining momentum
 - ❑ Both require high-speed storage
- ❑ Business continuity places high demands on storage
- ❑ Active archives growing faster than passive archives



Cloud Storage/Services-- Virtualization

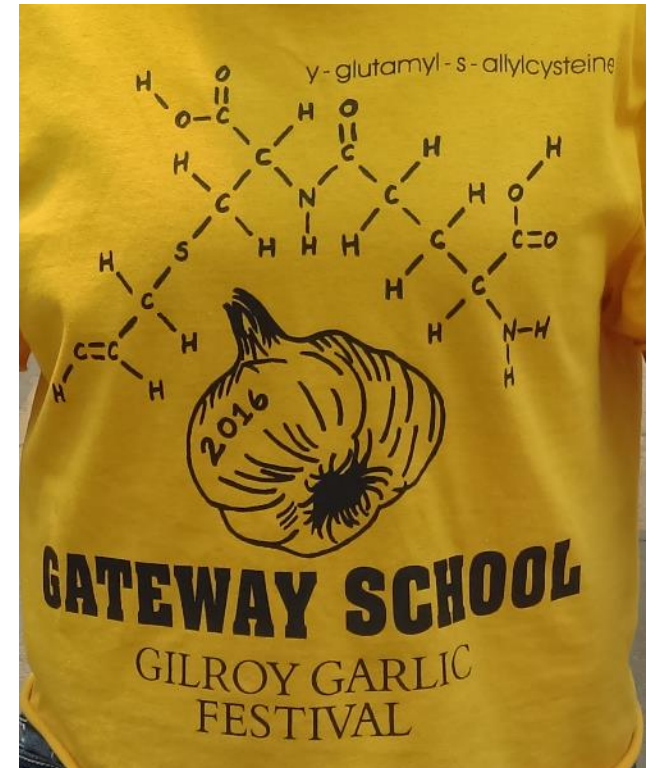
- ❑ The “IO Blender”
 - ❑ Many streams
 - ❑ Scrambled I/O
 - ❑ Highly random
- ❑ Suits SSDs better than HDDs for rapid access
- ❑ Many VM and VDI systems using flash cache to meet demand speed needs



Image courtesy of Waring Corp.

Science & Engineering

- ❑ Complex problems
 - ❑ Genome sequencing
 - ❑ CAD/CAM
 - ❑ Natural Resources
 - ❑ Nuclear modeling
- ❑ Large data sets
- ❑ Expensive talent
 - ❑ Don't want them sitting around waiting



Video Creation or Distribution

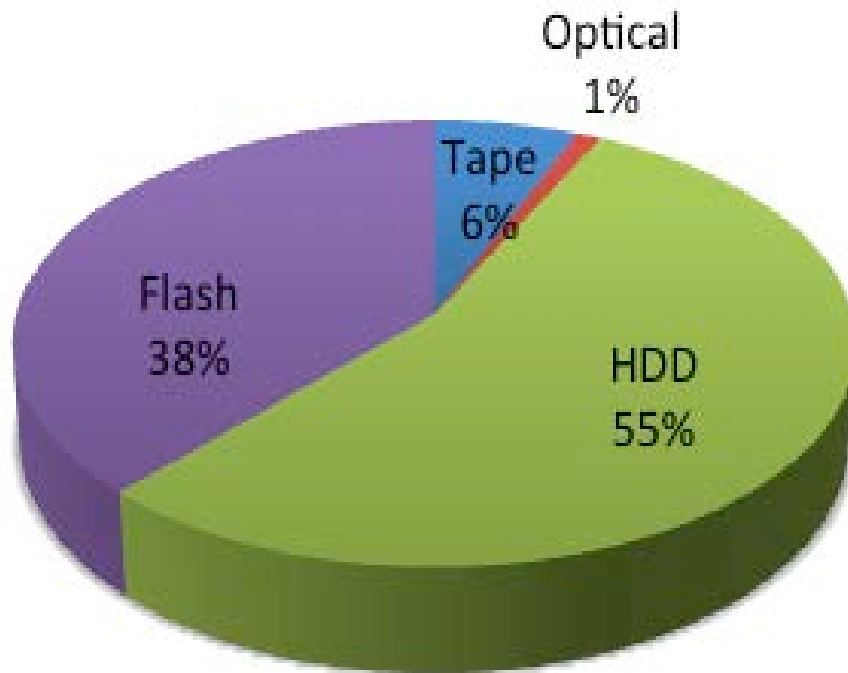
- ❑ Large data sets
- ❑ Multiple video streams
 - ❑ Randomizes access
- ❑ High bandwidth required
- ❑ Expensive talent
 - ❑ Don't want them sitting around waiting



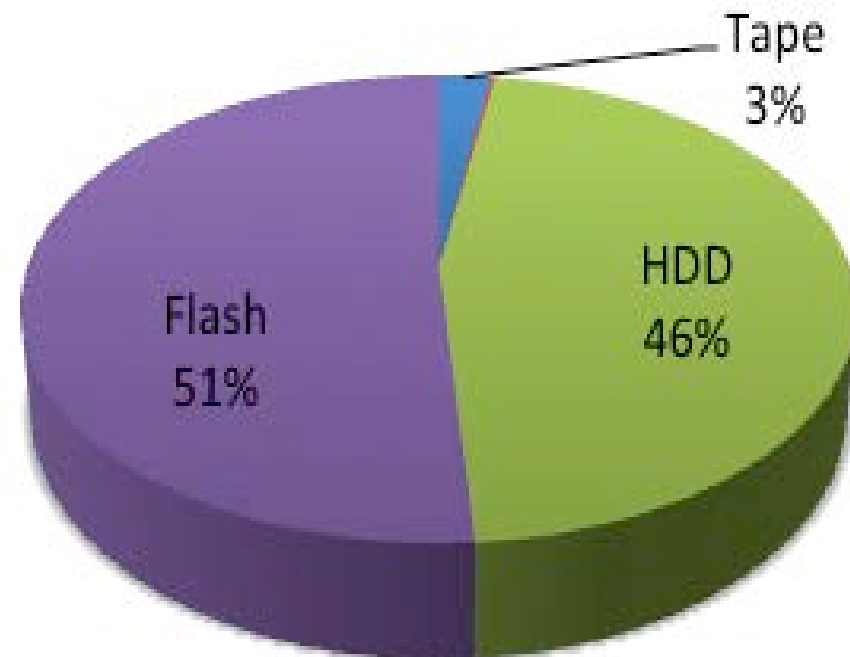
Image courtesy of the US Library of Congress

Flash M&E Revenue Share is Growing

2015



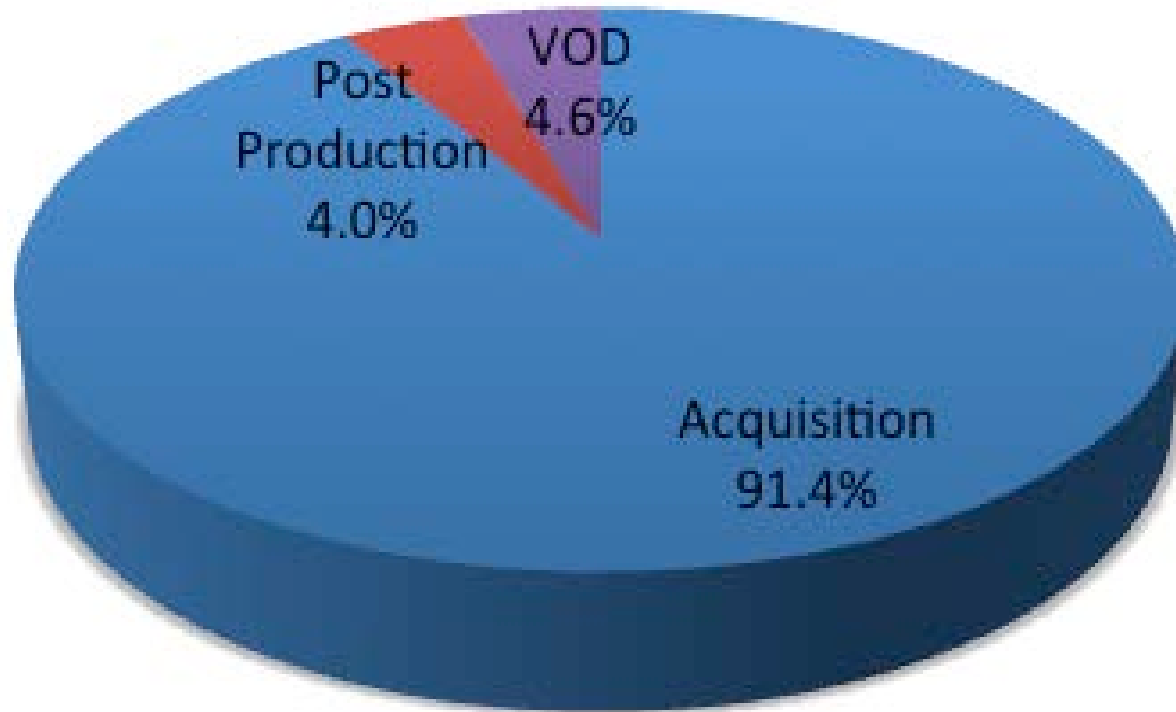
2021



2016 Digital Storage in Media and Entertainment Report, Coughlin Associates

Growing Use of Flash Memory in Media and Entertainment

2021 Projections



Exchange Server

- ❑ Multiple tasks
 - ❑ e-mail
 - ❑ Scheduling/calendars
 - ❑ Data storage
- ❑ Thousands of users
- ❑ Chaotic e-mail workload
 - ❑ Multiple mailboxes
 - ❑ Asynchronous sends & receives
 - ❑ Spam & virus filters

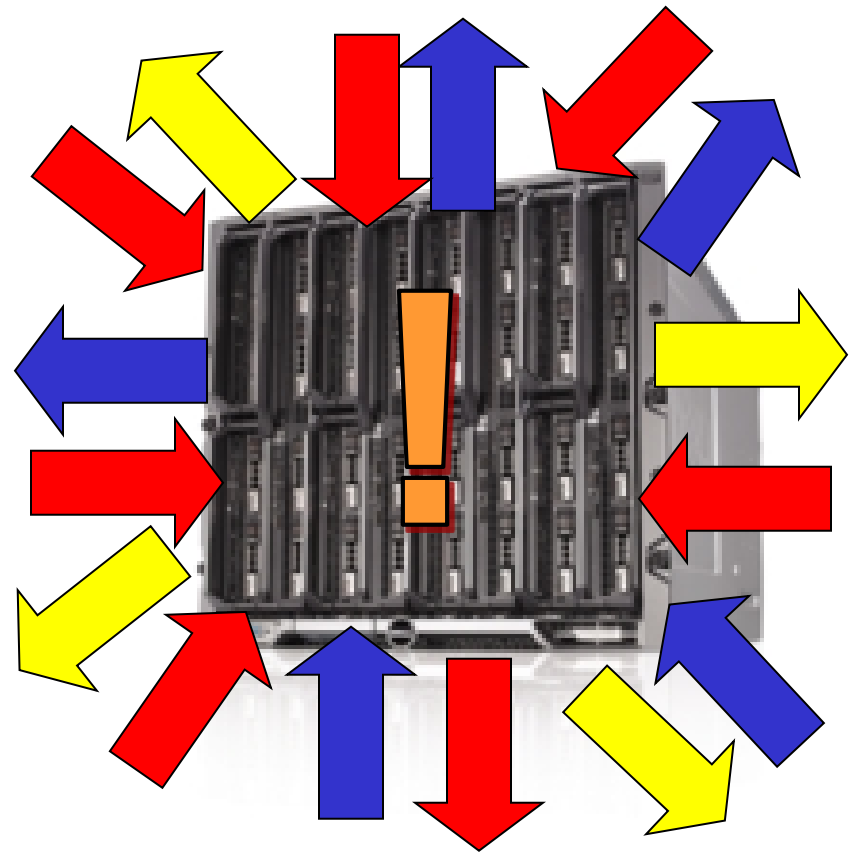


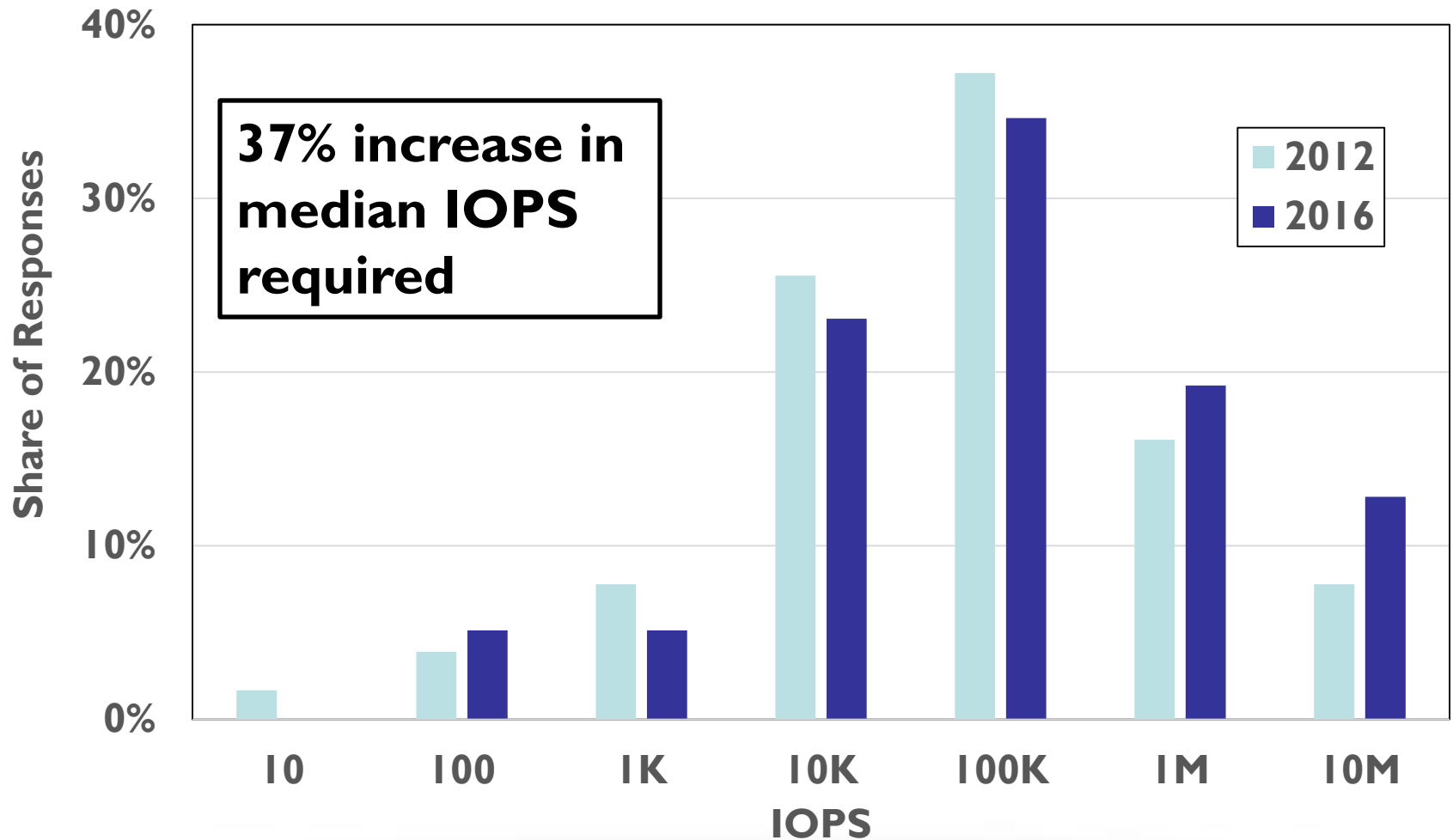
Image courtesy of Dell Computer

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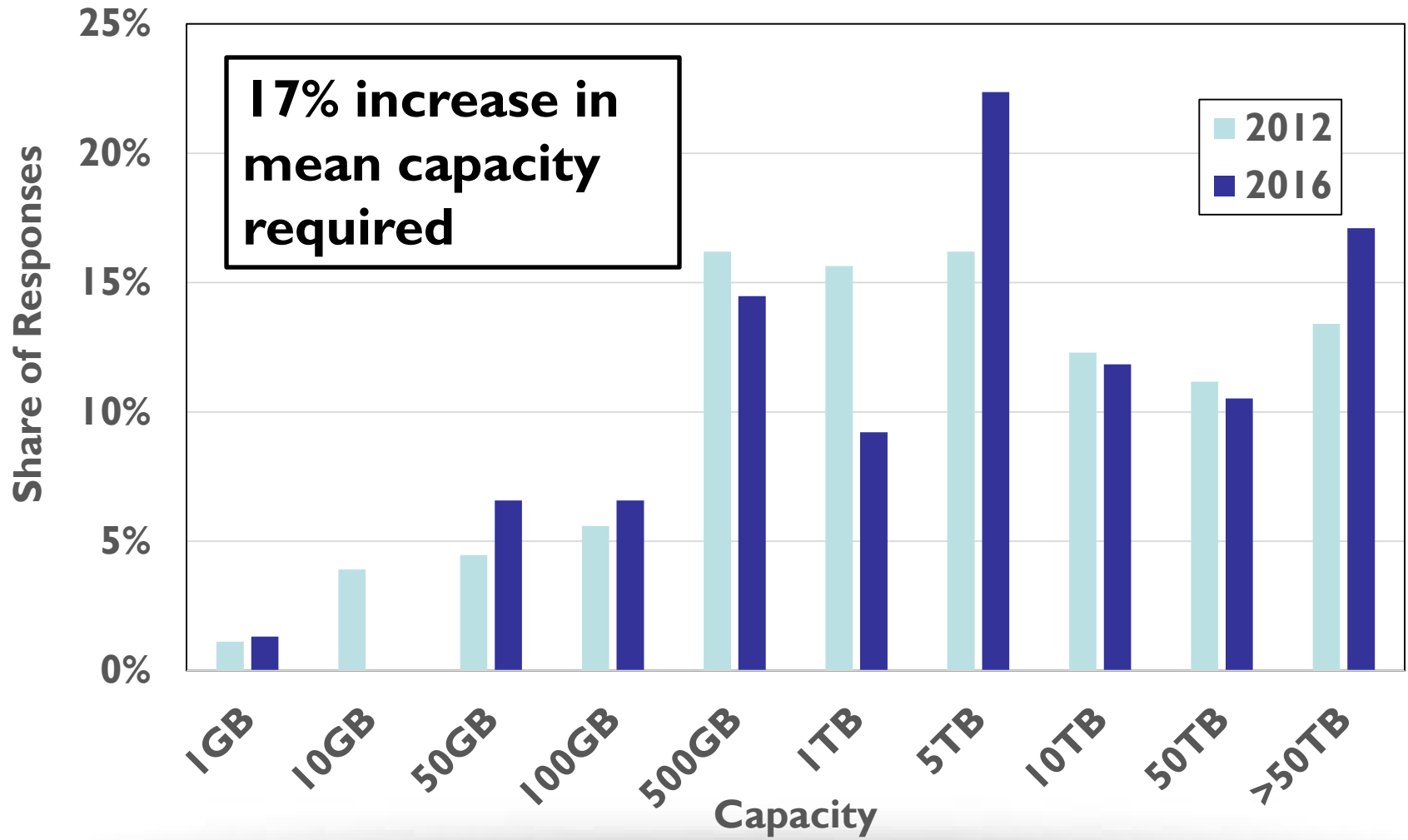
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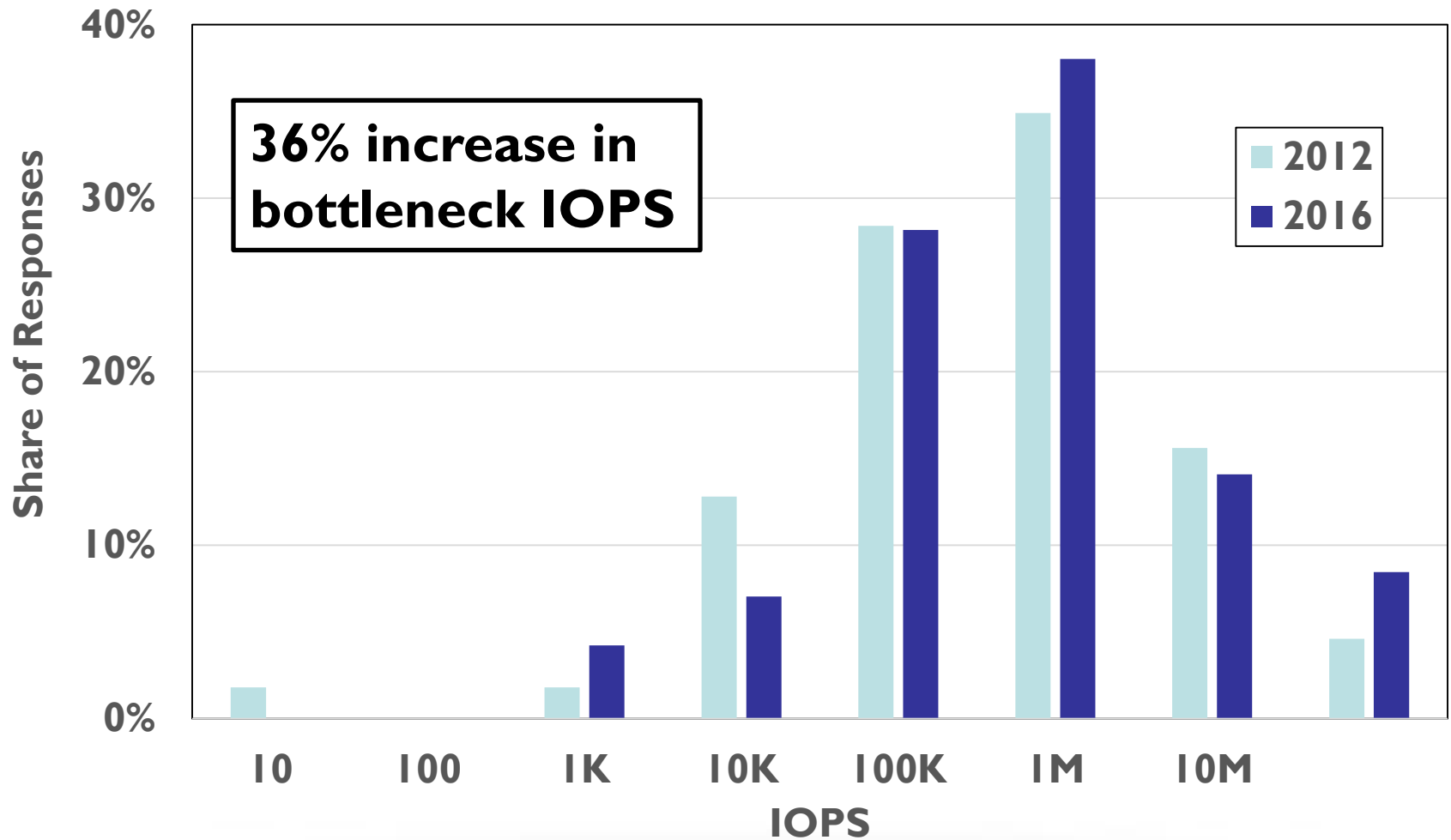
IOPS Required for Dominant Application



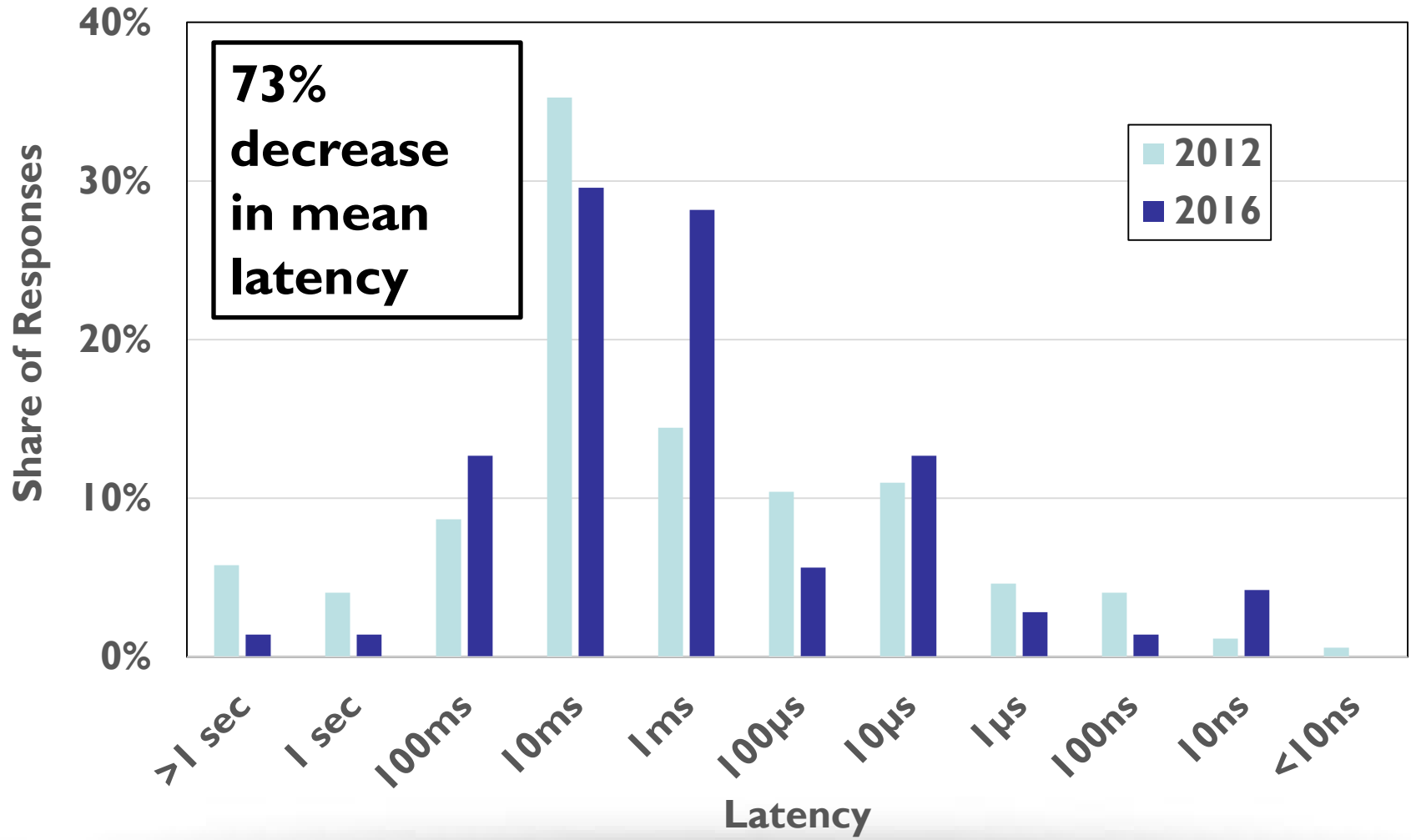
Capacity Required



Other Hardware IOPS Bottleneck



Fastest Latency the System Can Use

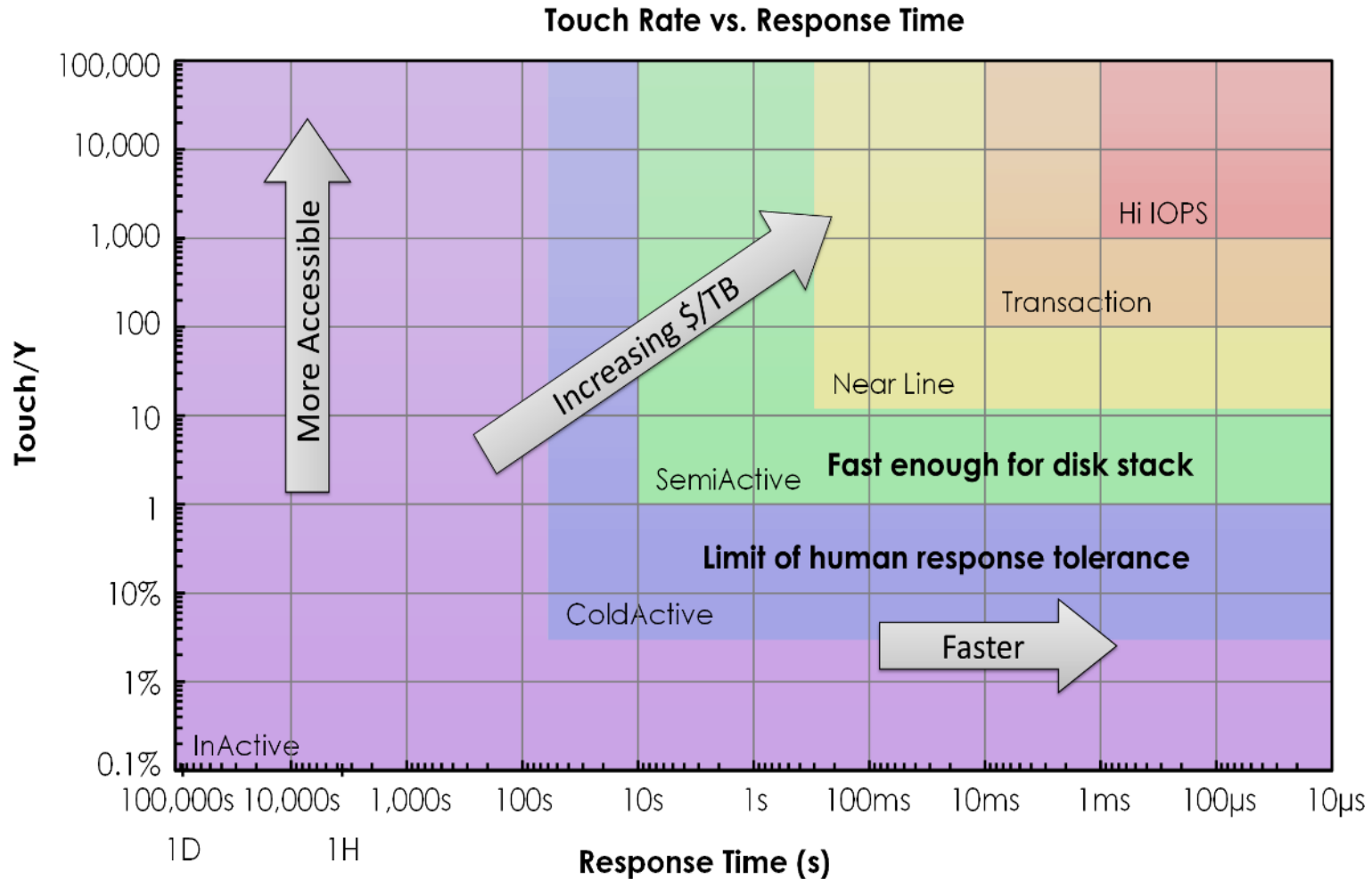


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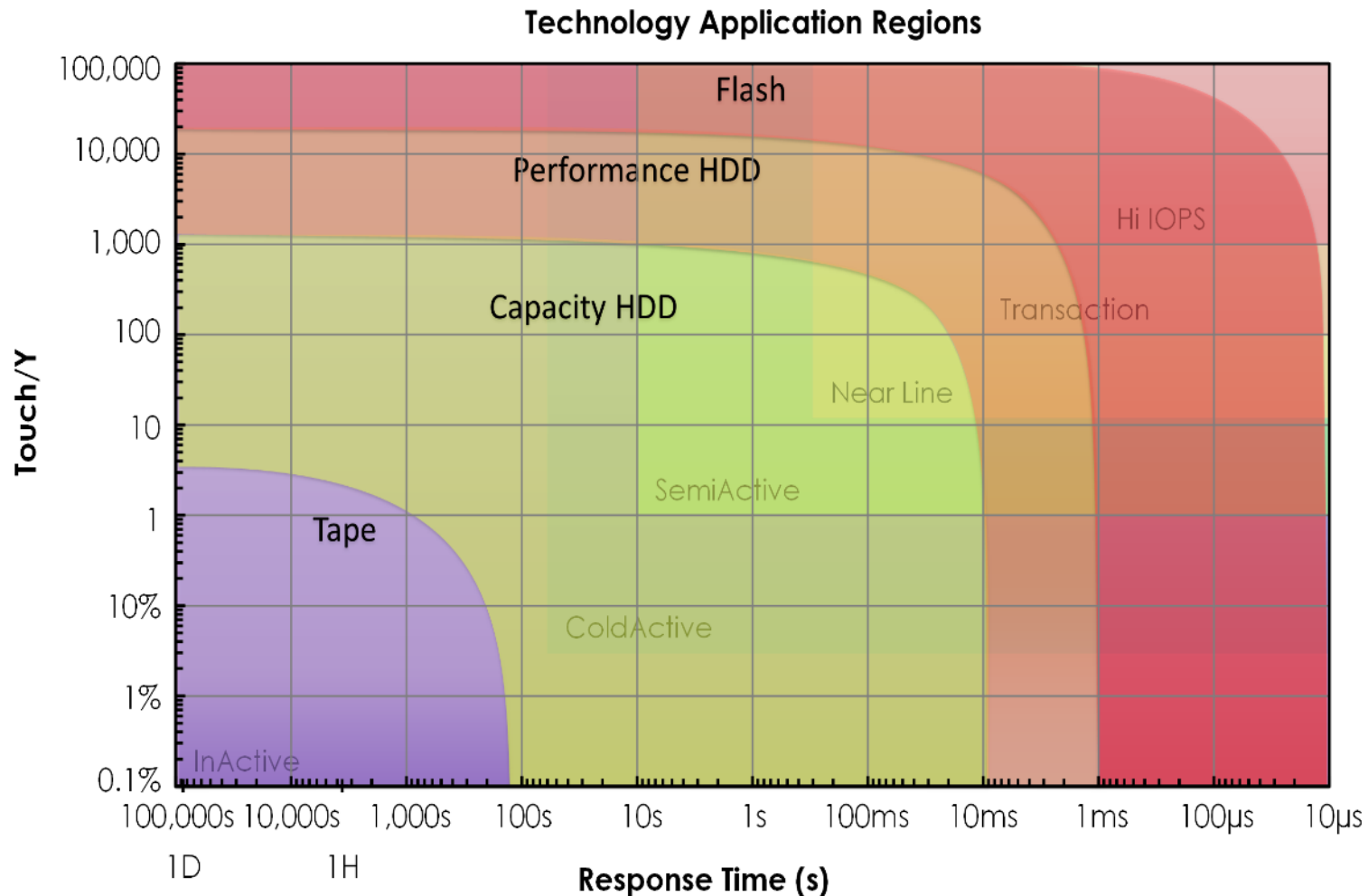
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Touch Rate vs. Response Time

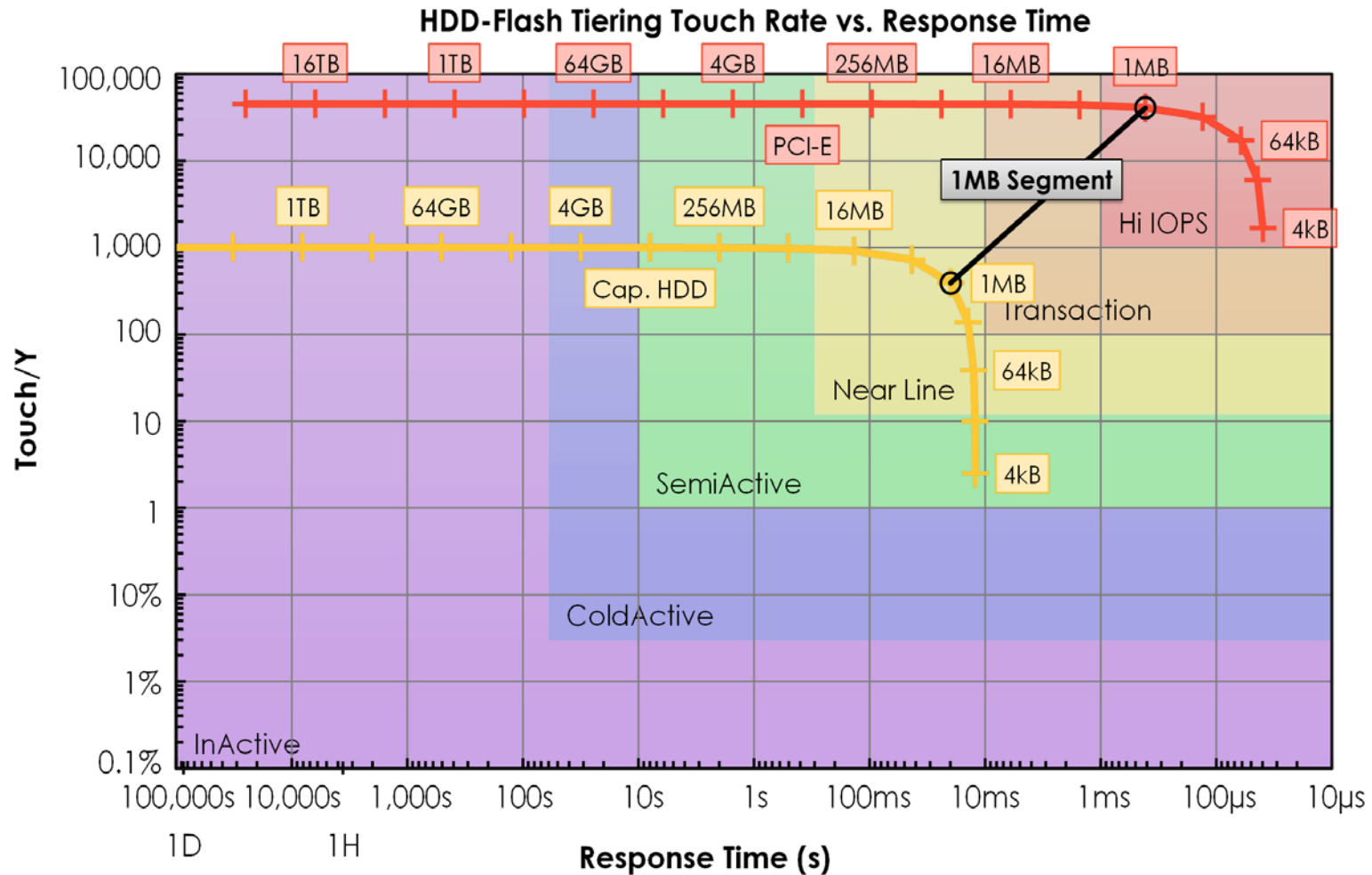
Indicating Various Types of Uses



Digital Storage Technologies Overlaid on the Touch Rate Chart



HDD-Flash Tiering/Caching Touch Rate Chart



How To View Latencies

- ❑ DRAM Access

 - ❑ One heartbeat

- ❑ SSD Access

 - ❑ 1,000 heartbeats

 - ❑ Walking a mile

- ❑ HDD Access

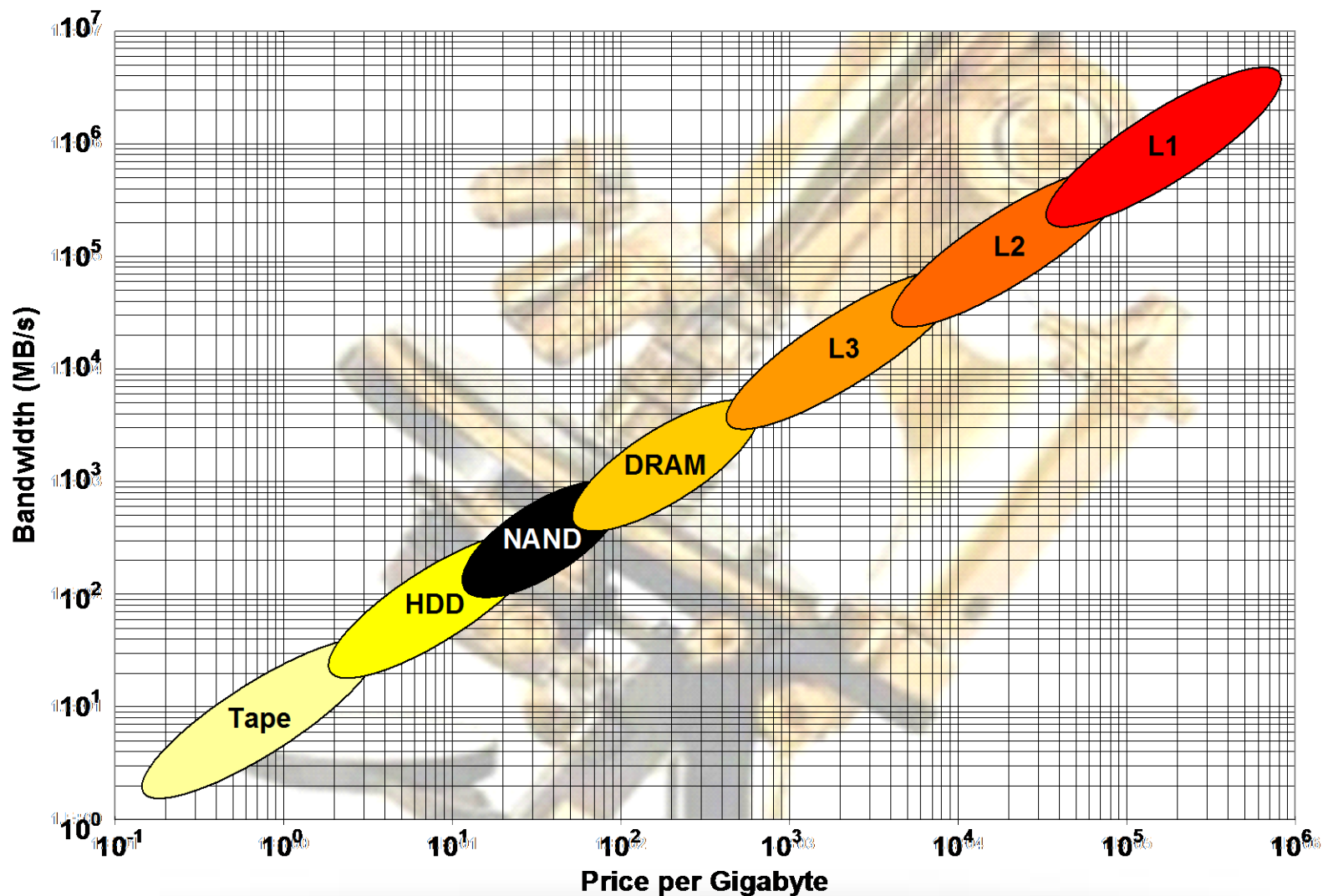
 - ❑ 1,000,000 heartbeats

 - ❑ Riding a bike from San Francisco to Miami

(Thanks to Jim Pappas for this analogy)

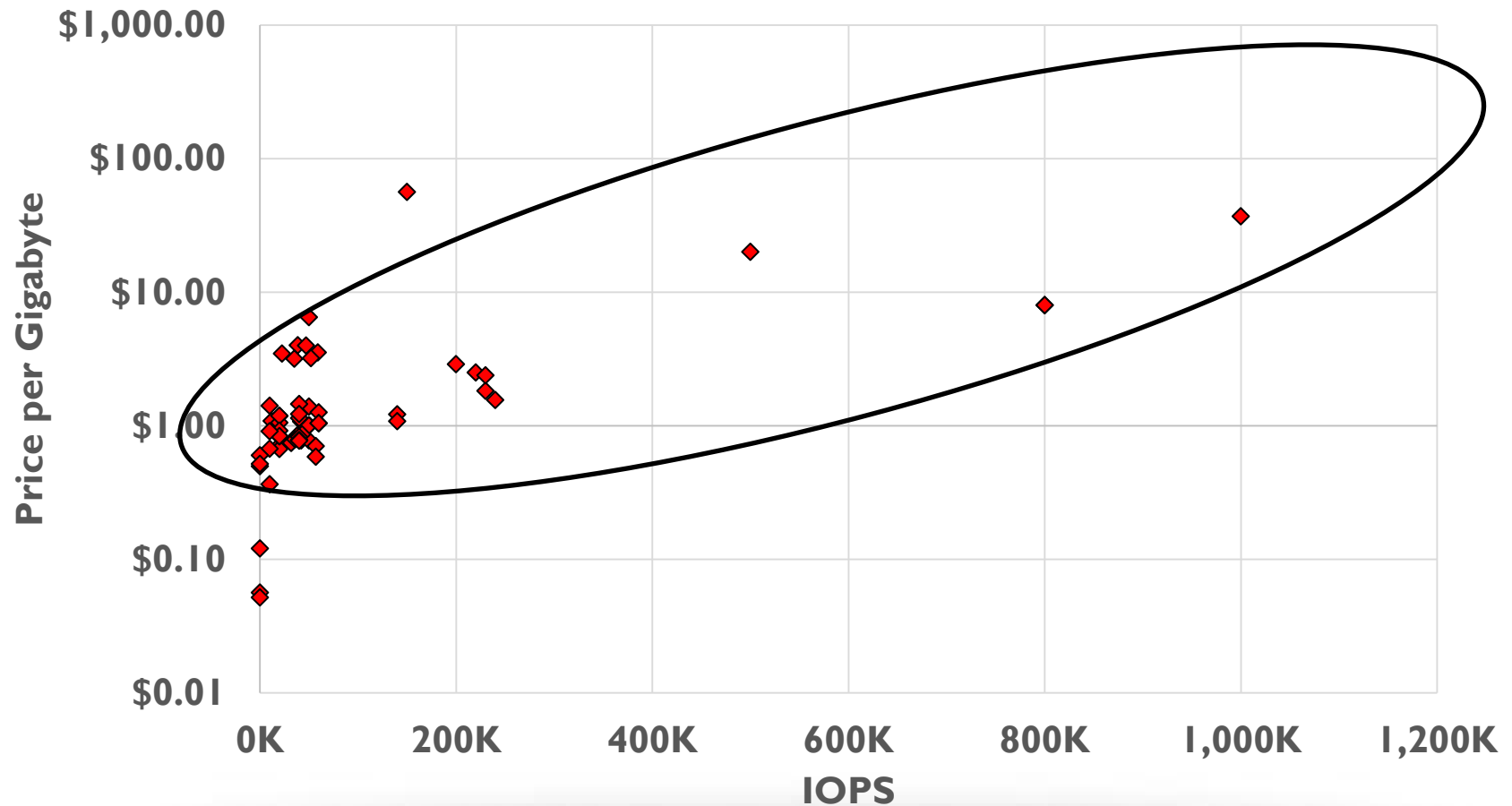
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Memory & Storage Price vs. Bandwidth



From Objective Analysis: *Are Hybrid Drives Finally Coming of Age?*

Price/GB Roughly Follows IOPS



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IOPS by Form Factor

HDD



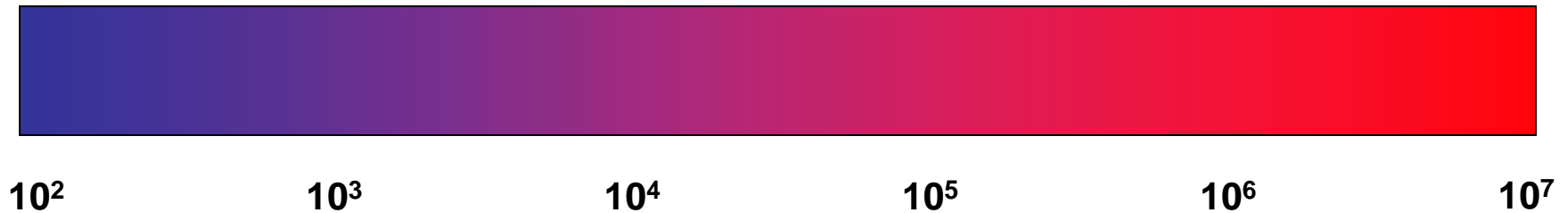
SATA/SAS



NVMe/PCIe



Memory Channel



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Implications/Projections

- ❑ Users need more IOPS and capacity and lower latencies
- ❑ Increased SSDs adoption for higher IOPS
- ❑ HDDs filling a tier behind SSDs
- ❑ Other system elements become the bottleneck
 - ❑ Network, software, servers...
- ❑ Users focusing more attention on IOPS
 - ❑ Translates to growth for both SSDs and HDDs

Report Compiles Survey Results

- ❑ Full details can be purchased for immediate download at www.Objective-Analysis.com
- ❑ Orders can also be processed through Coughlin Associates at:
<http://www.TomCoughlin.com/techpapers.htm> or
by contacting Tom at:
 - ❑ 408-202-5098
 - ❑ Tom@TomCoughlin.com.

Your Presenters



Thomas Coughlin
Coughlin Associates

Tom Coughlin, President, Coughlin Associates is a highly-respected storage analyst and consultant with over 30 years in the data storage industry in engineering and management at high profile companies.



Jim Handy
Objective Analysis

Jim Handy is a widely recognized semiconductor analyst, has over 30 years in the electronics industry. His background includes marketing and design positions at market-leading suppliers.

Source Material

- ❑ **2016 How Many IOPS is Enough?**, Objective Analysis and Coughlin Associates (Objective-Analysis.com/Reports.html#IOPS)
- ❑ **Touch Rate: A metric for analyzing storage system performance**, Steven Heltzer and Tom Coughlin, 2015 (www.tomcoughlin.com/techpapers)
- ❑ **2016 Digital Storage for Media and Entertainment**, Coughlin Associates (www.tomcoughlin.com/techpapers)
- ❑ Objective Analysis report: ***Are Hybrid Drives Finally Coming of Age?*** (Objective-Analysis.com/Reports.html#2010_HHDD)