



STORAGE DEVELOPER CONFERENCE

SNIA ■ SANTA CLARA, 2016

# IOPS: Changing Needs

Tom Coughlin  
Coughlin Associates  
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Objective Analysis



# Outline

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

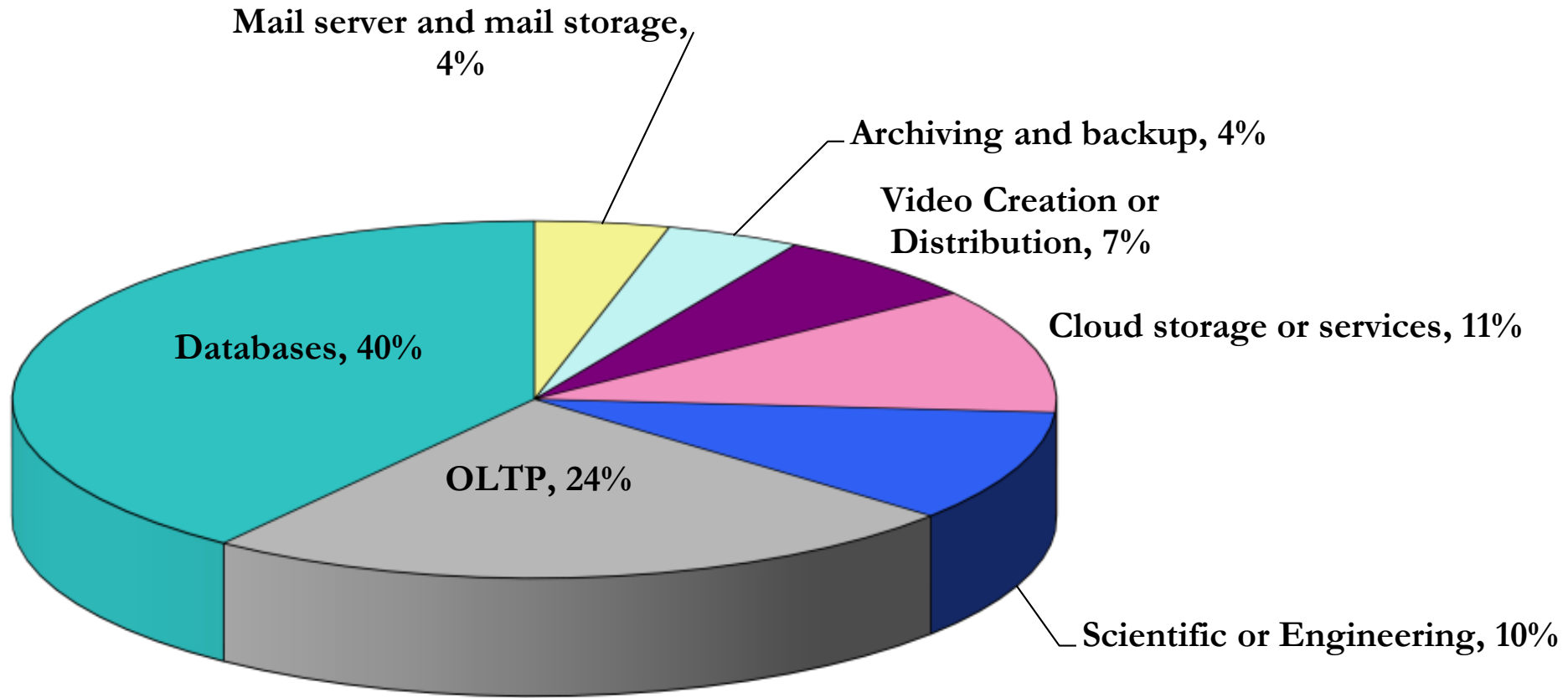
# Our Survey

- ❑ 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

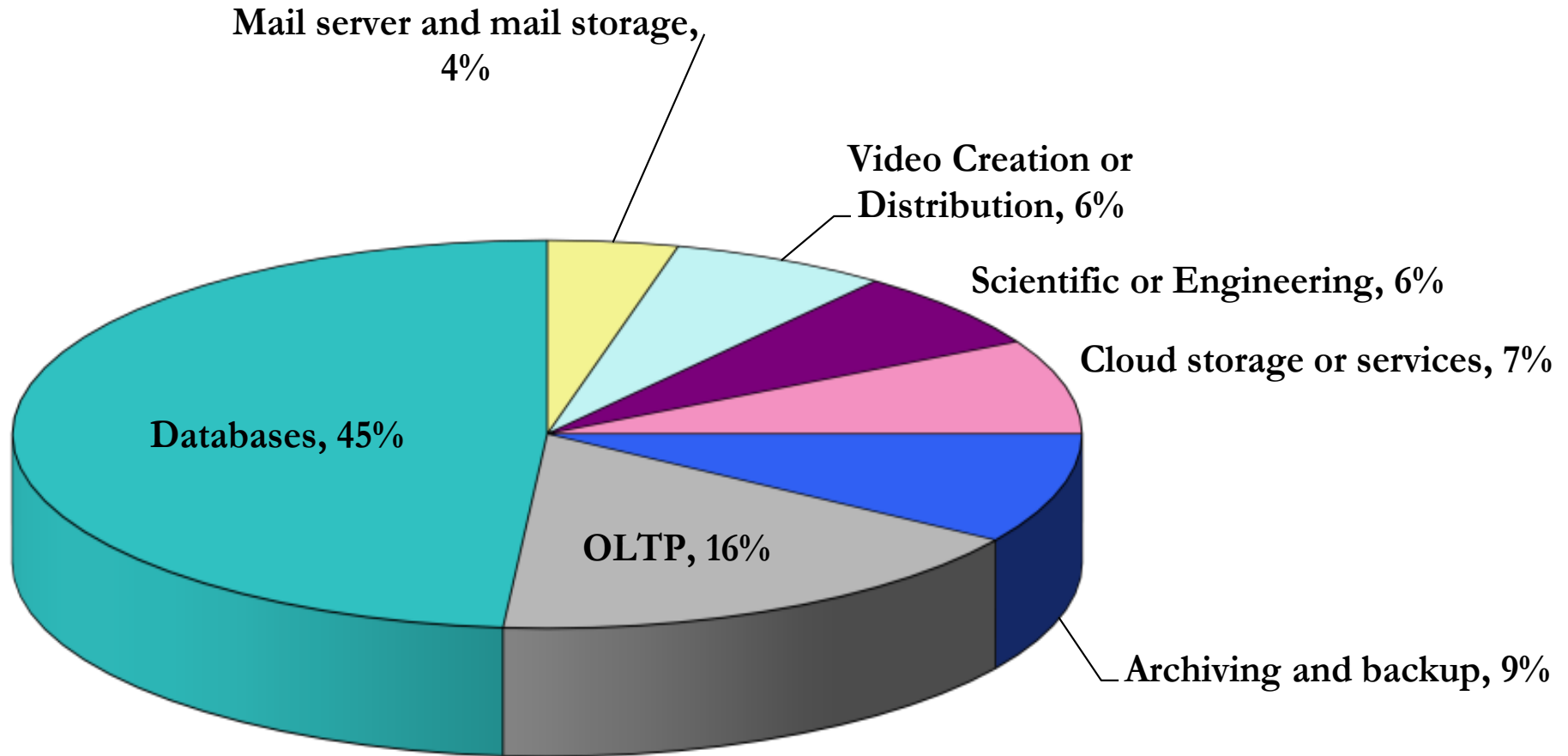
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# Applications: 2012



# 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.



# 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

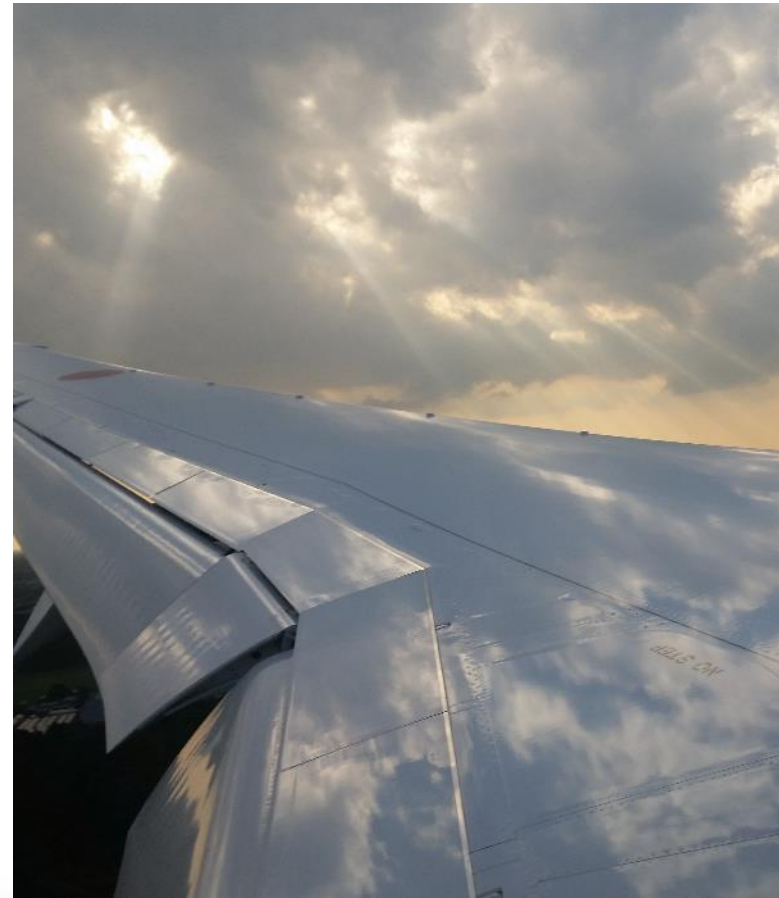
- ❑ The “IO Blender”
  - ❑ Many streams
  - ❑ Scrambled I/O
  - ❑ Highly random
- ❑ Suits SSDs better than HDDs for rapid access
- ❑ Many VM and VDI systems using flash cache to meet demand speed needs



Image courtesy of Waring Corp.

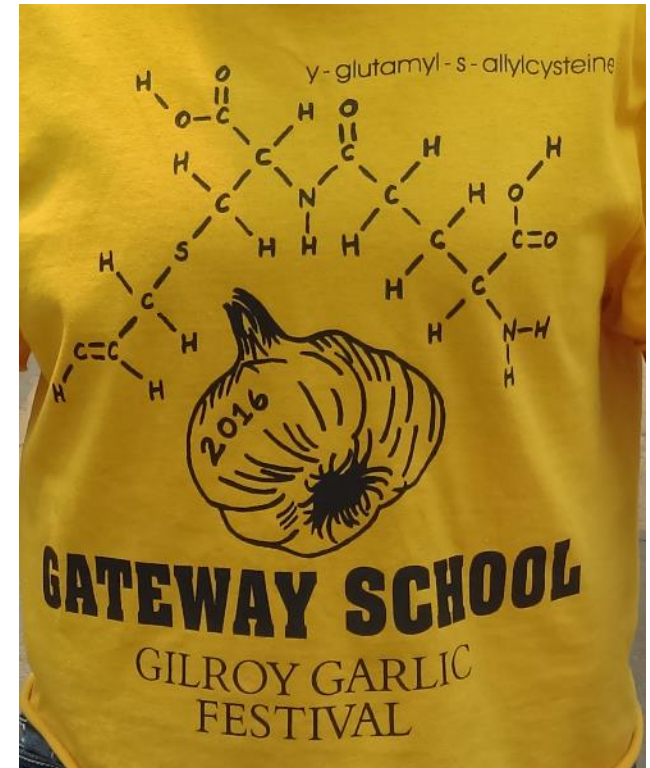
# Cloud Storage or Services

- ❑ Cloud storage is efficiently used
  - ❑ Cost-benefit is well understood (opex versus capex)
- ❑ Performance is a key differentiator
- ❑ Purchasers are more sophisticated



# 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

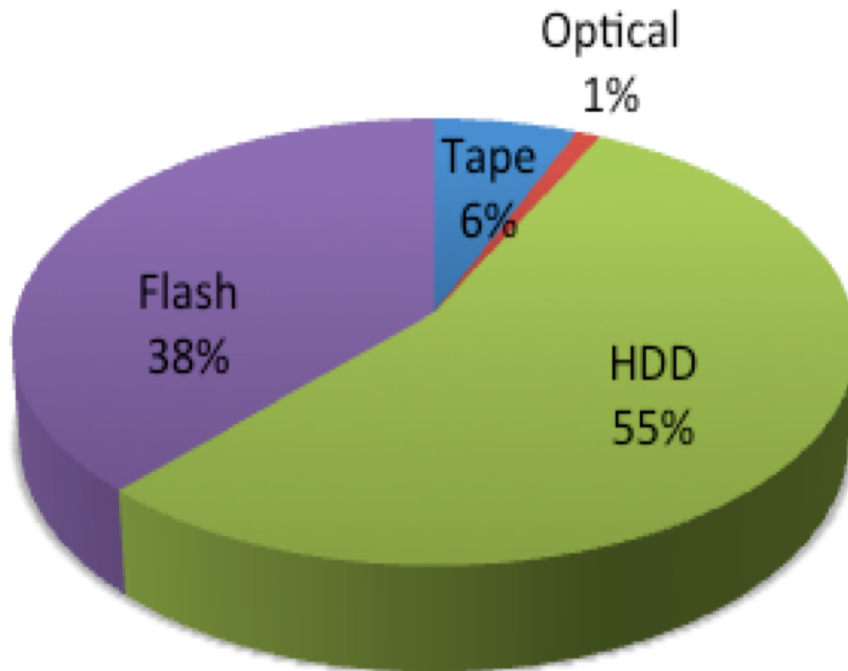
- ❑ Large data sets
- ❑ Multiple video streams
  - ❑ Randomizes access
- ❑ High bandwidth required
- ❑ Expensive talent
  - ❑ Don't want them sitting around waiting



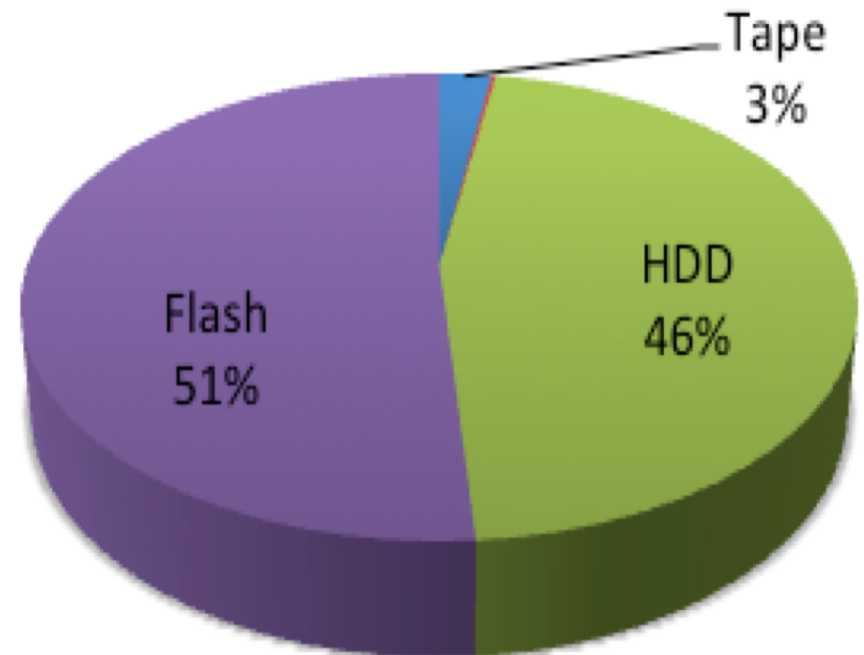
Image courtesy of the US Library of Congress

# Flash M&E revenue share is growing

**2015**



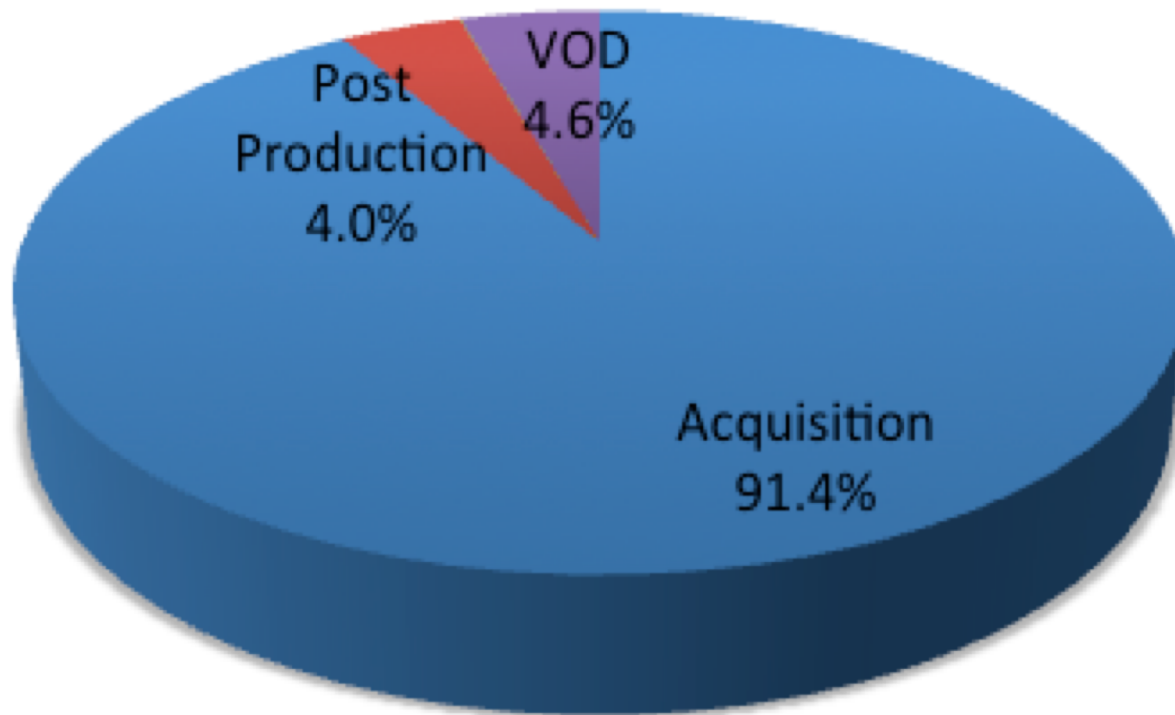
**2021**



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

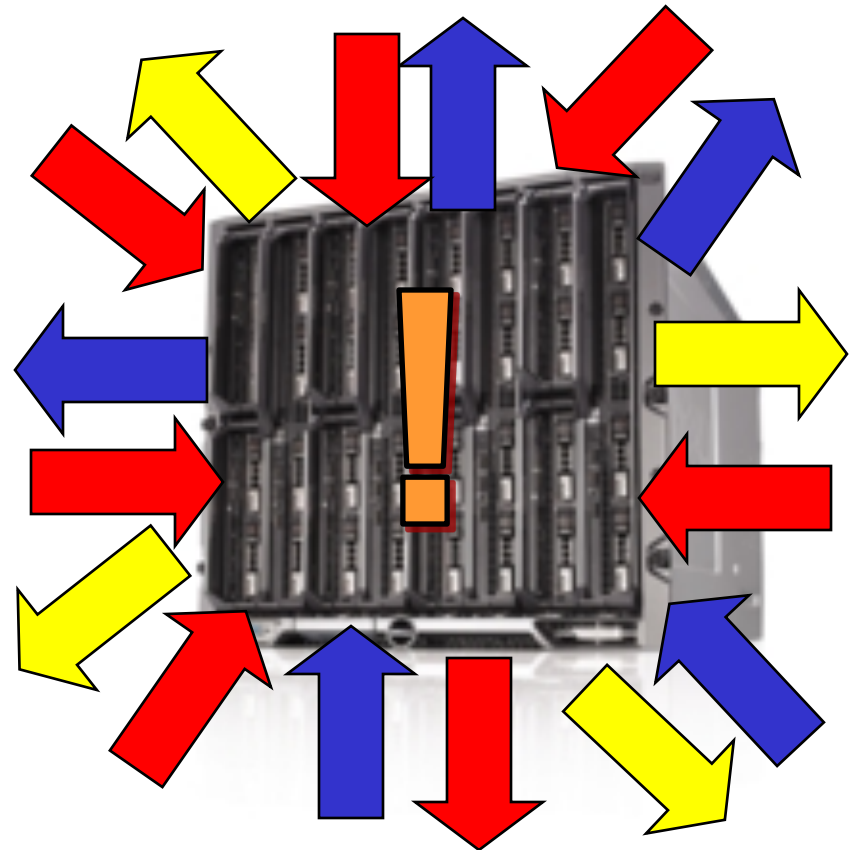


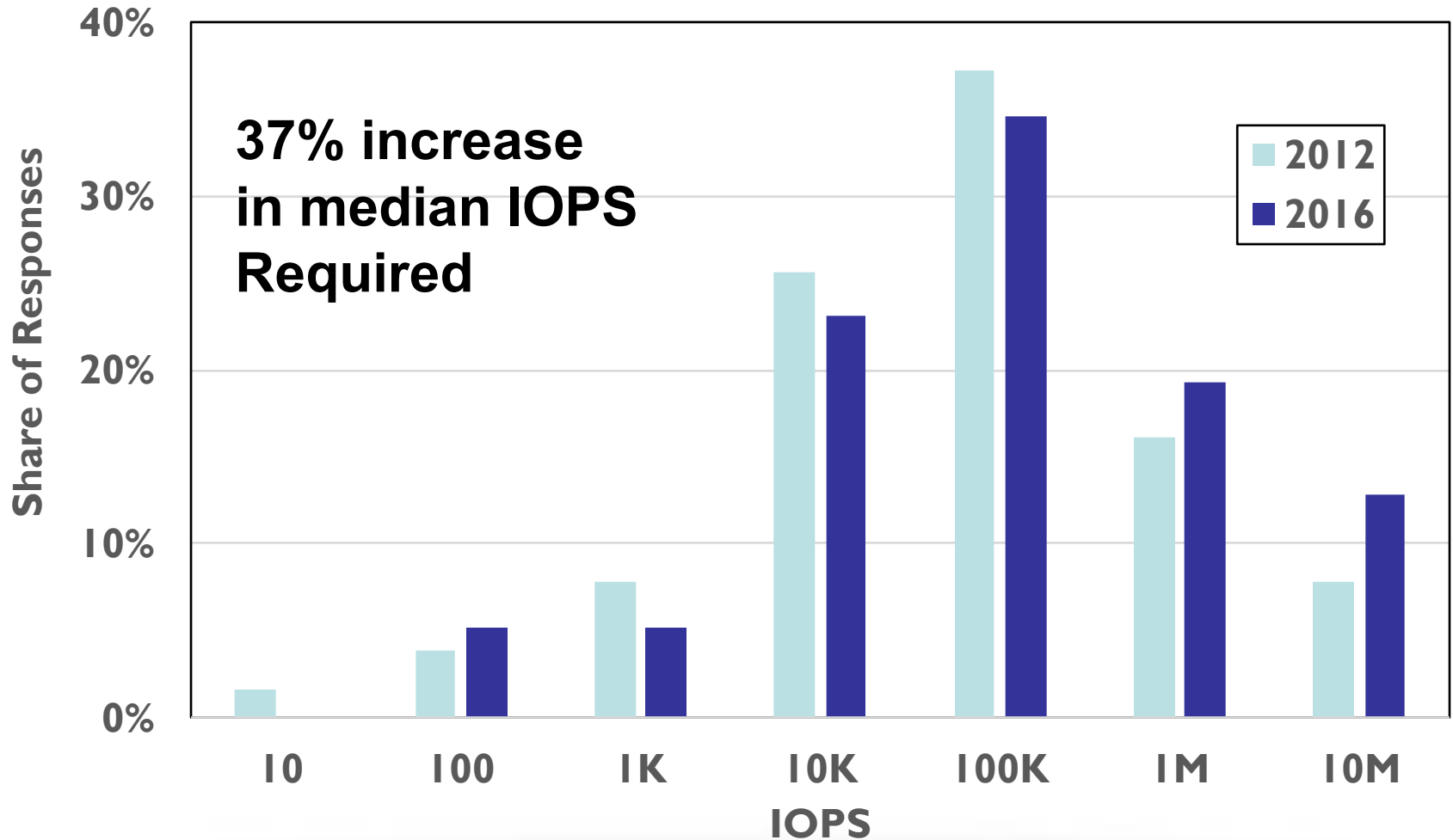
Image courtesy of Dell Computer



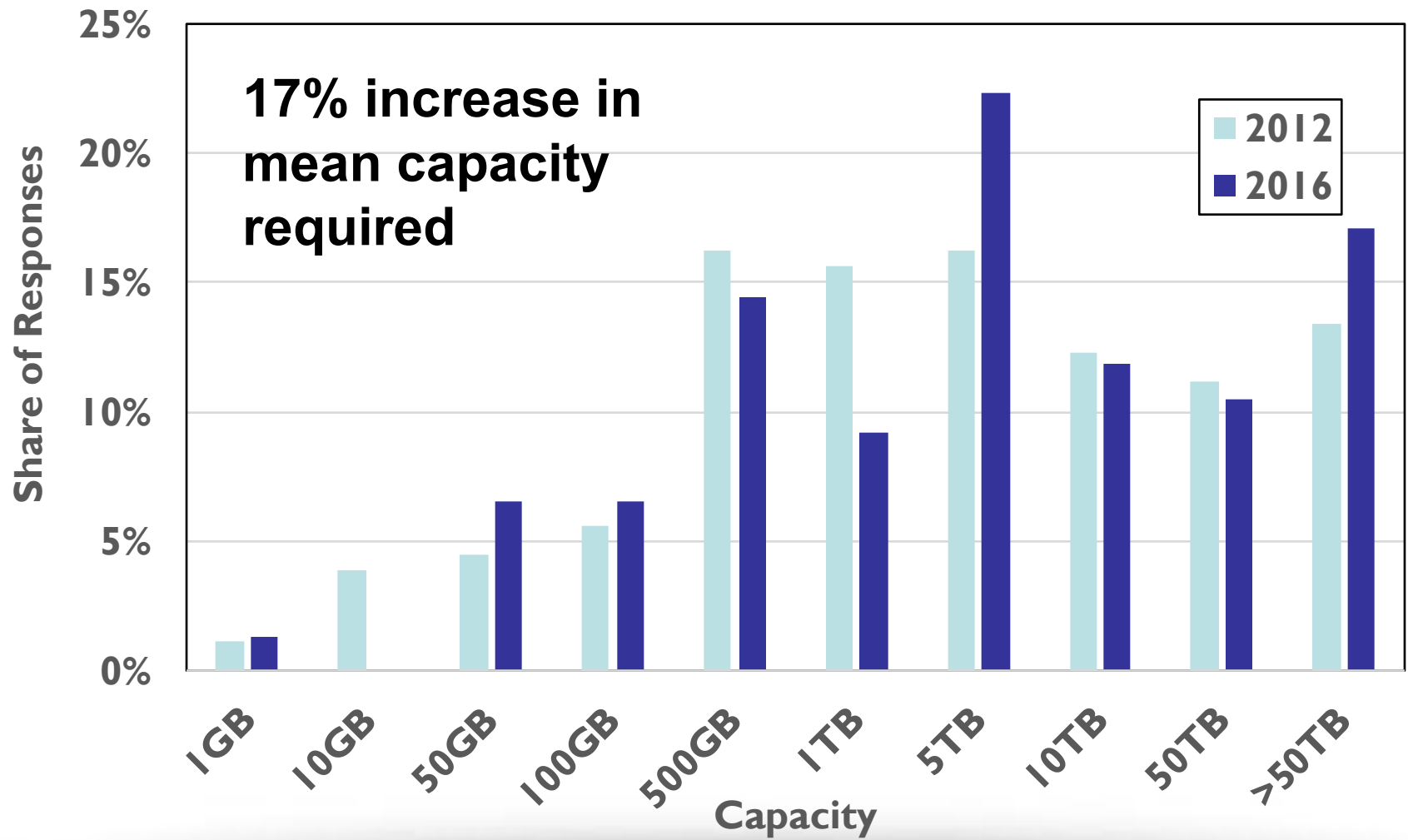
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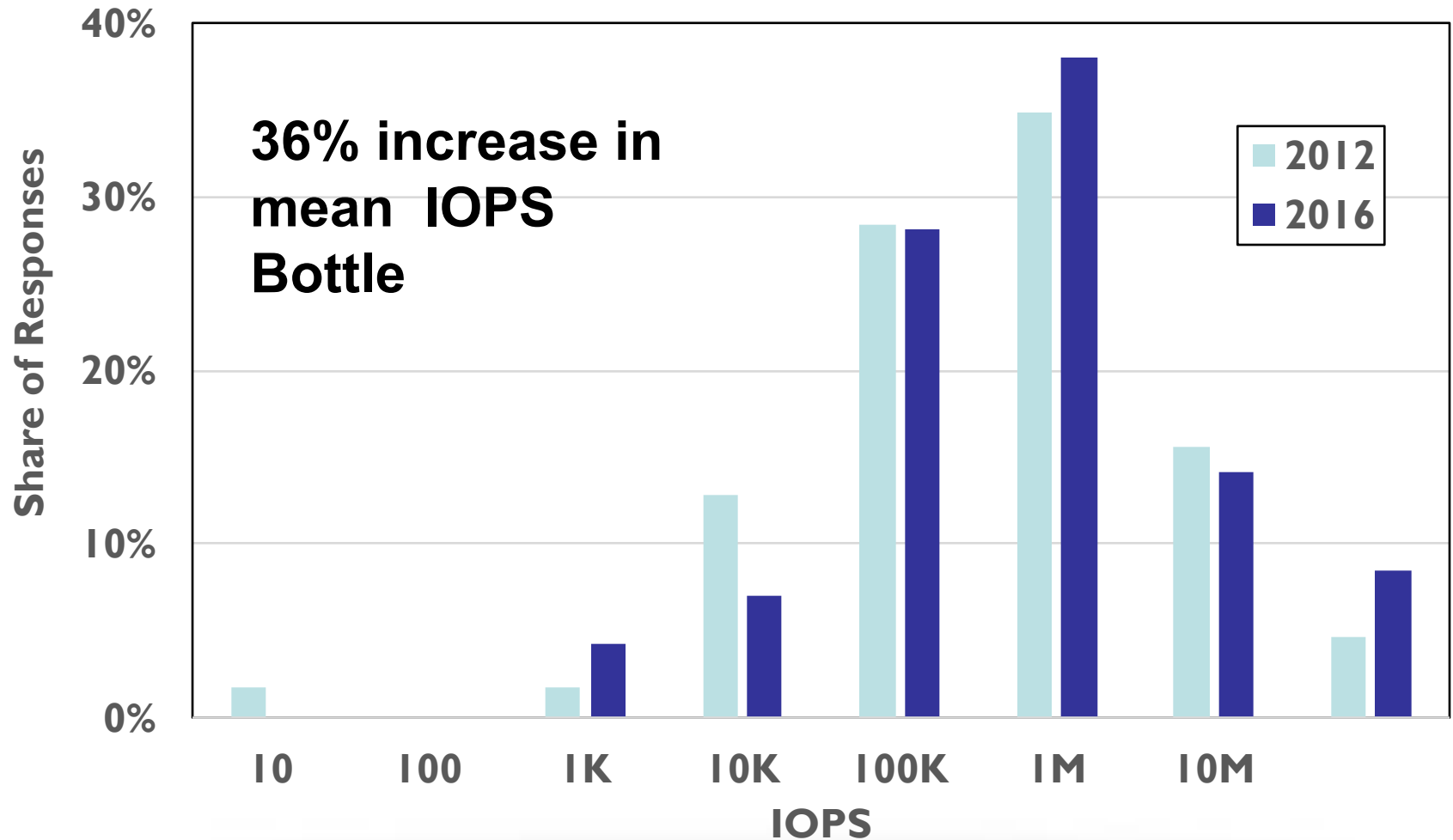
# IOPS Required for Dominant Application



# Capacity Required

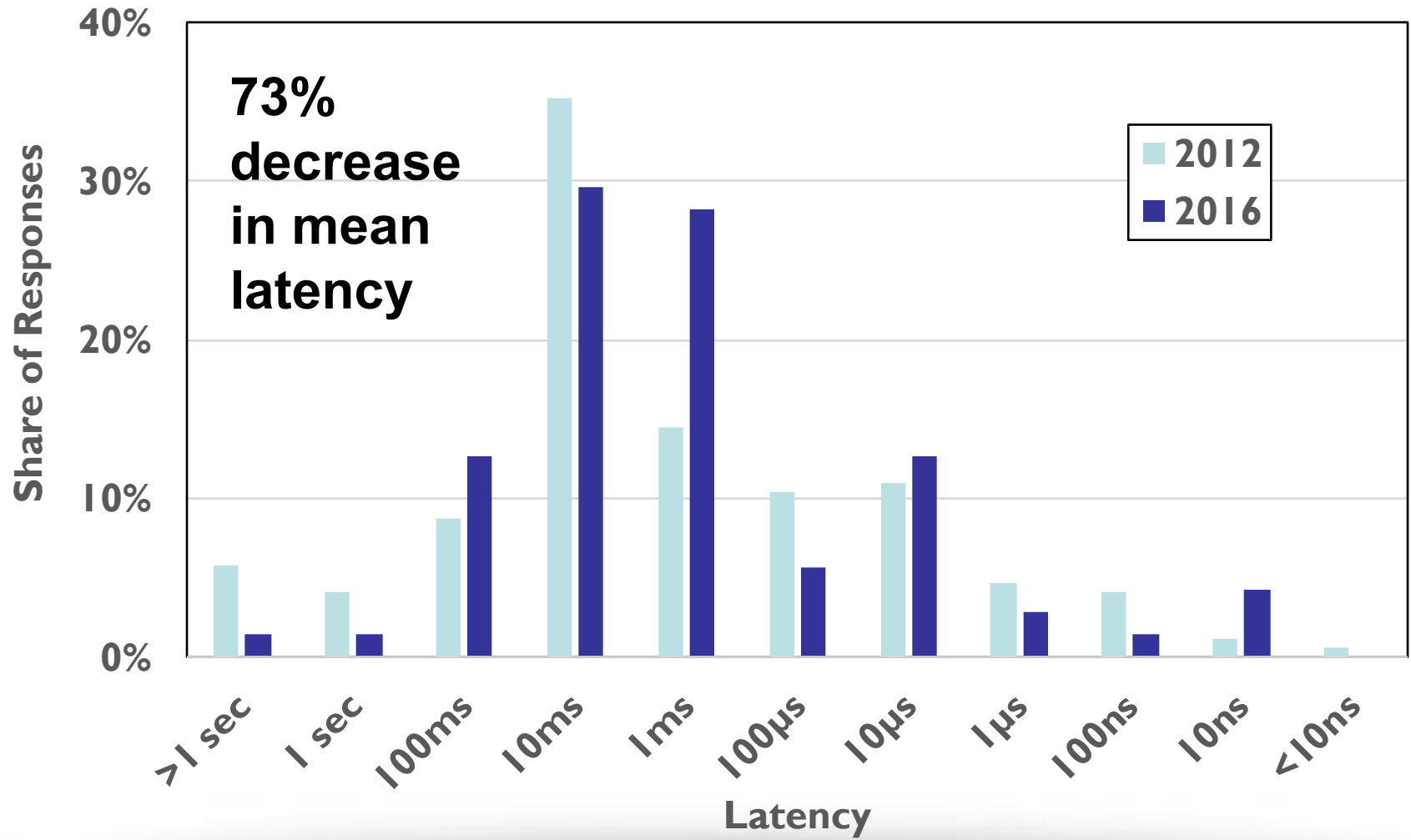


# Other Hardware IOPS Bottleneck



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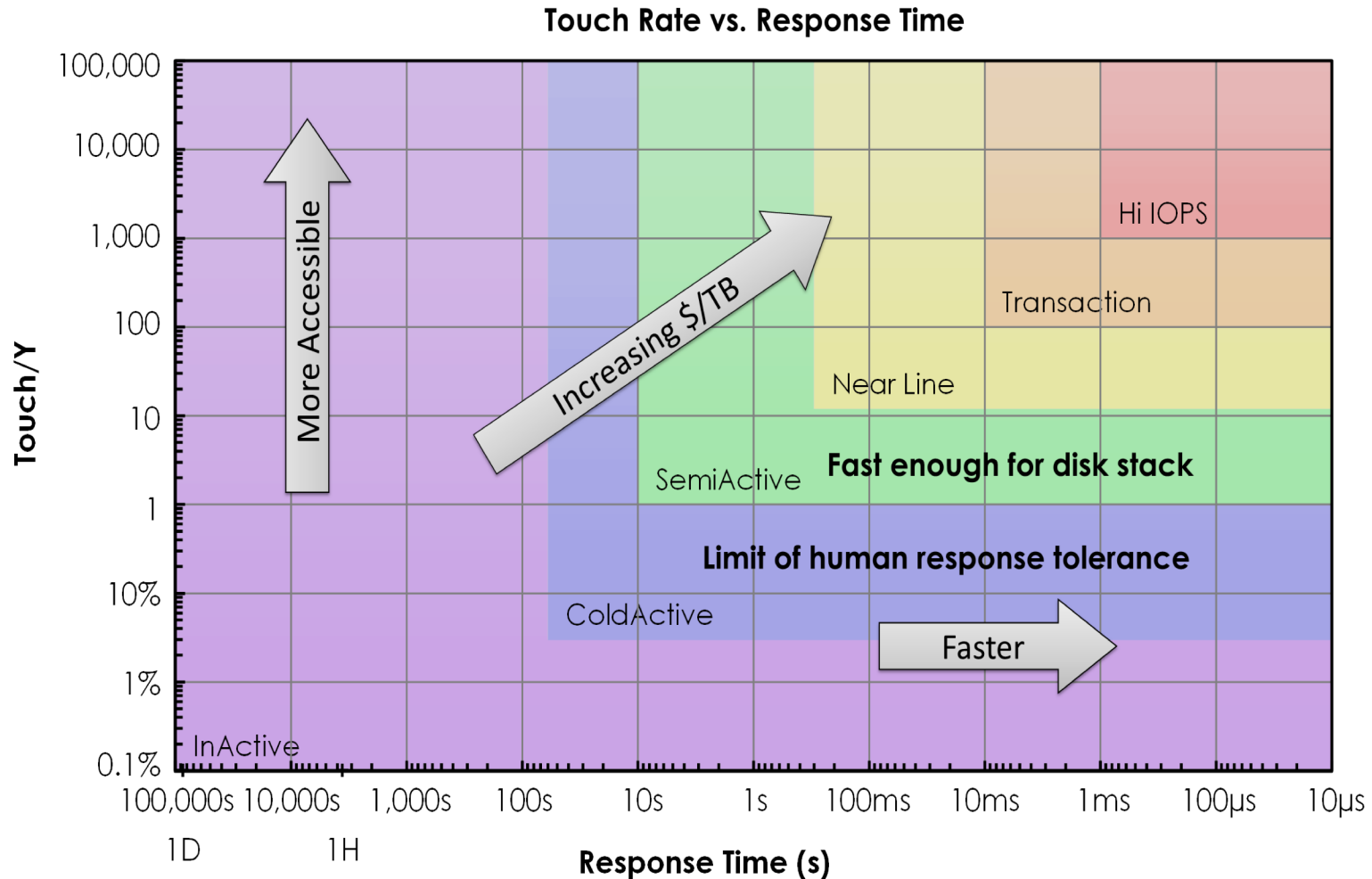
# Fastest Latency the System Can Use



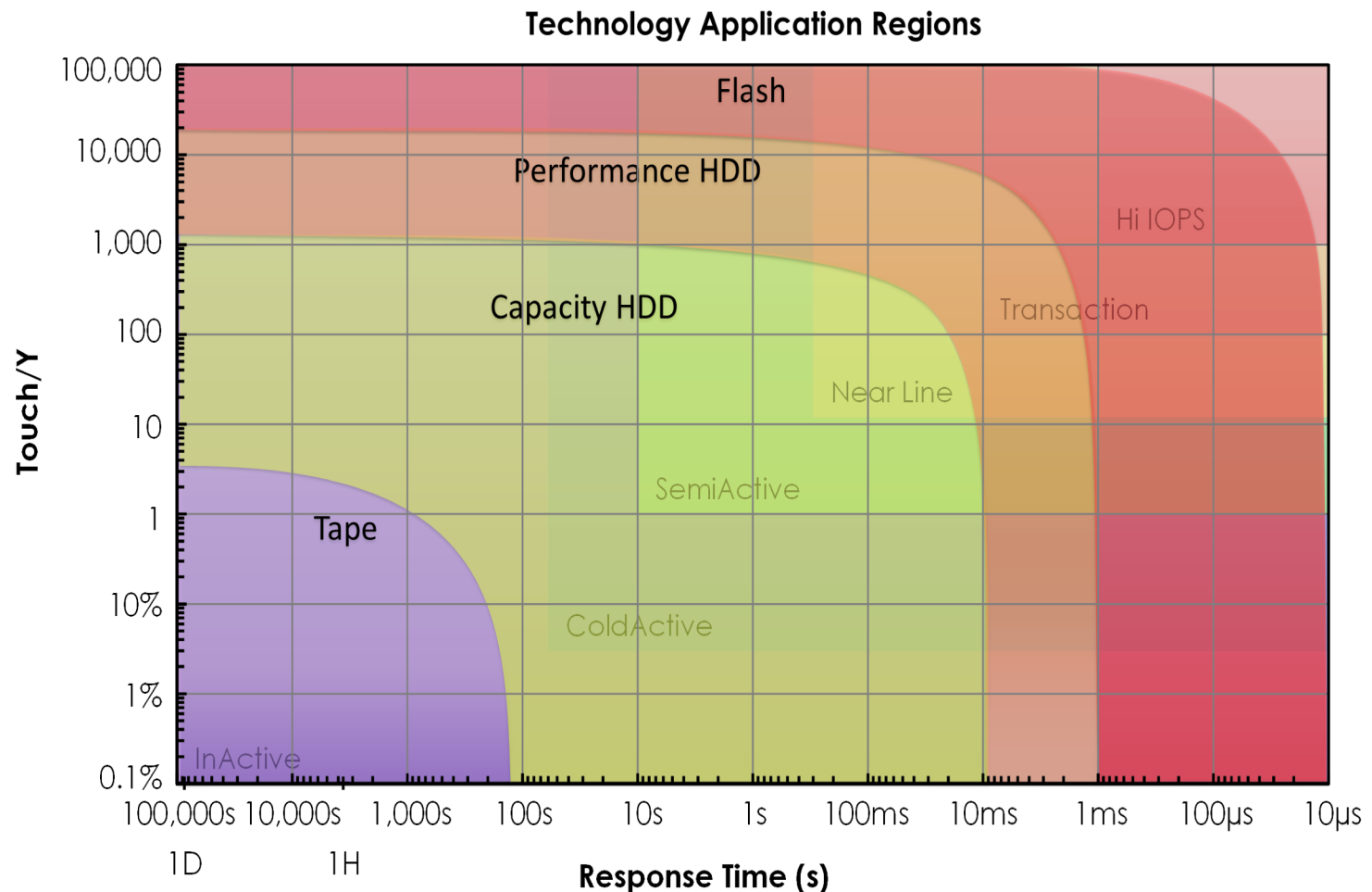
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# Touch rate versus response time indicating various types of uses

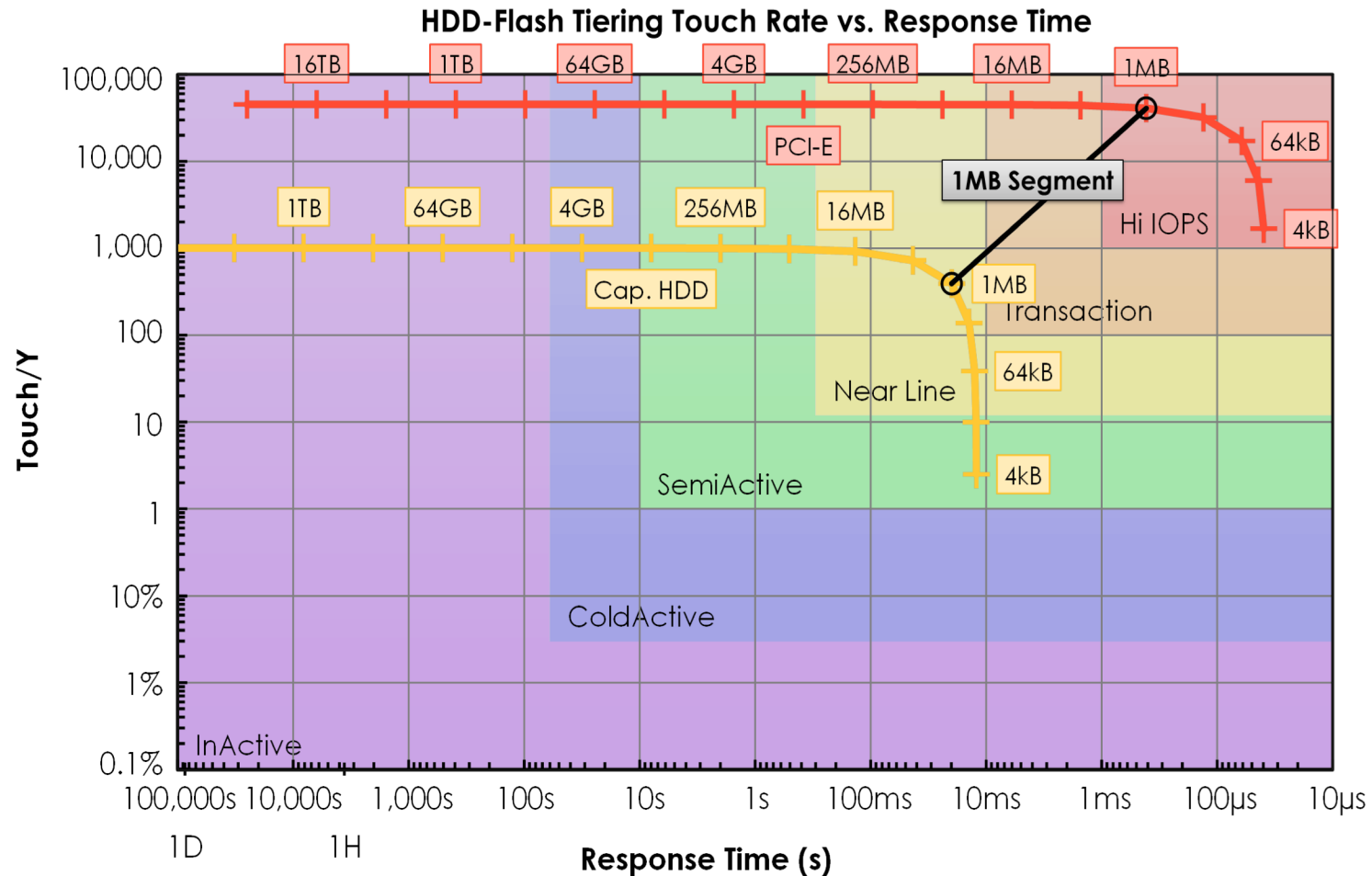


# Digital storage technologies overlaid on the Touch Rate chart





# 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

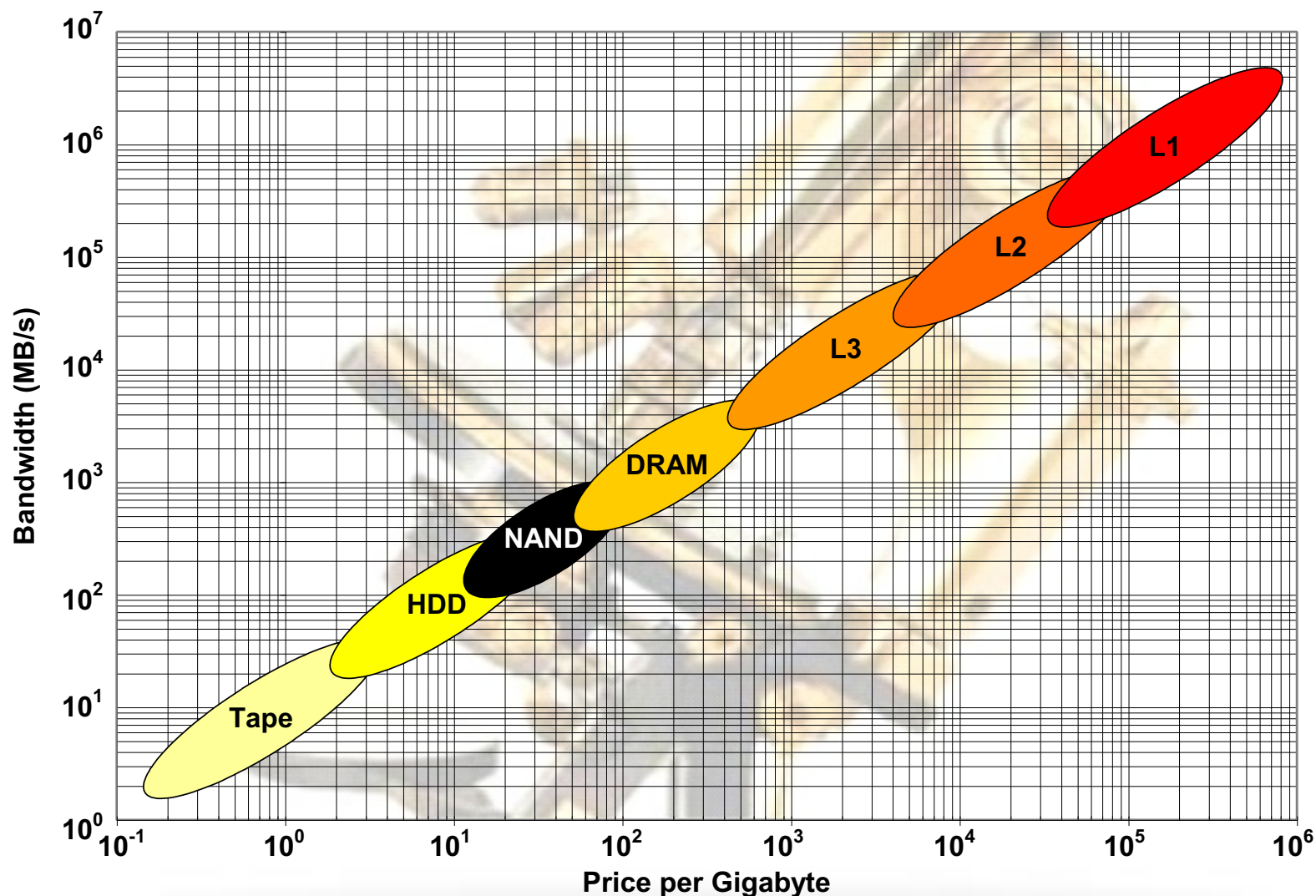
  - ❑ 1,000,000 heartbeats

    - ❑ Riding a bike from San Francisco to Miami

(Thanks to Jim Pappas for this analogy)

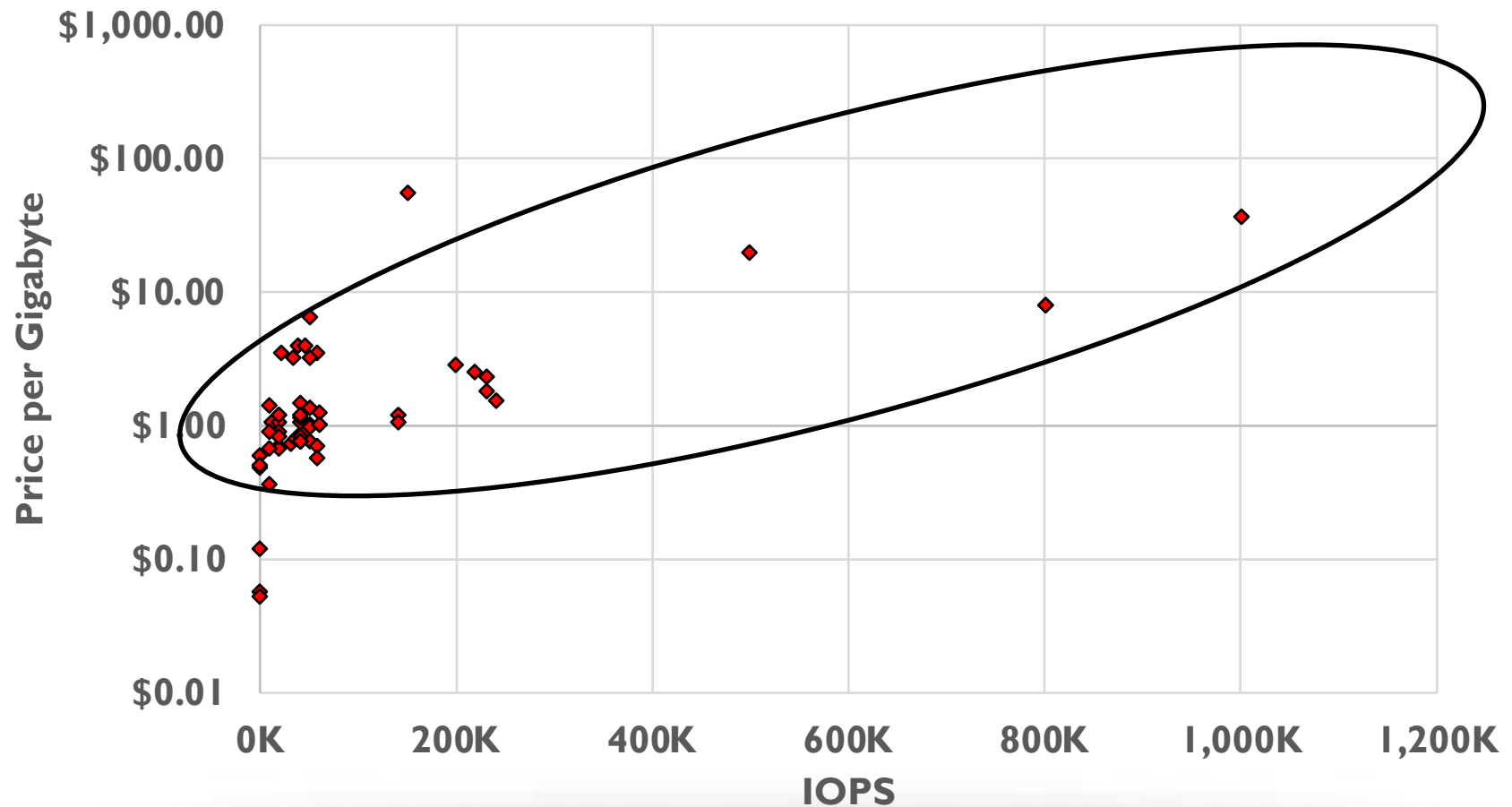
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# Memory & Storage Price vs. Bandwidth



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# Price/GB Roughly Follows IOPS



# 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](http://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](mailto: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
- ❑ **Touch Rate: A metric for analyzing storage system performance**, Steven Heltzer and Tom Coughlin, 2015 ([www.tomcoughlin.com/techpapers](http://www.tomcoughlin.com/techpapers))
- ❑ **2016 Digital Storage for Media and Entertainment**, Coughlin Associates ([www.tomcoughlin.com/techpapers](http://www.tomcoughlin.com/techpapers))
- ❑ Objective Analysis report: ***Are Hybrid Drives Finally Coming of Age?***