How Many IOPS is Enough?

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&

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Objective Analysis
Outline

- The Survey
- Application Distribution and Attributes
- More Survey Results: IOPS, Capacity and Latency
- Developing tiers of storage for enterprise (and client) applications
- Implications/Projections
- Authors & Sources
Our Survey

- It is still on-going, we invite end users to take our survey at:  [http://TinyURL.com/IOPSsurvey](http://TinyURL.com/IOPSsurvey)
- The survey asked end users about their IOPS, capacity and latency needs as well as their primary applications
- We plan to do a white paper for the SNIA SSSI group on some of the results
- We plan to publish a full report analyzing and interpreting the results in depth this Fall.
Applications from Survey

- Databases: 37%
- OLTP: 24%
- Cloud storage or services: 15%
- Scientific or Engineering: 13%
- Video Creation or Distribution: 7%
- Archiving and backup: 4%
Application Types

- Cloud Storage/Service-Virtualization
- Databases
- On-Line Transaction Processing (OLTP)
- Video Creation and Distribution
- Science & Engineering
- Exchange Servers
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.
Databases

- Large data sets
- Random traffic
- High I/O load
- Early SSD adopter (and before that used DRAM-based SSDs)
- Some users load their 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
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
Percentage of various recording media in professional video cameras

- Flash memory: 37%
- Magnetic tape: 21%
- Hard disk drives: 20%
- Optical discs: 10%
- Film: 12%

2012 Digital Storage for Media and Entertainment Report, Coughlin Associates
Science & Engineering

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

- Multiple tasks
  - e-mail
  - Scheduling/calendars
  - Data storage
- Scads of users
- e-mail chaos
  - Multiple mailboxes
  - Asynchronous sends & receives
  - Spam & virus filters
- Strangely we didn’t get any of these users yet
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How many IOPS do you need for your dominant application?

79% between 1K and 1M IOPS
What is the range of storage capacity that this application is likely to consume?

Possibly a Bi-Modal Distribution
Maximum IOPS of your system hardware (before another bottleneck)?

78% between 1 K and 1 M IOPS

Good Match to Requirements
Minimum Latency system hardware (before some other bottleneck)?

35% at 10 msec latency
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Today’s DRAMs:
6,000 Times HDDs’ Speed

From: **HDDs and Flash Memory: A Marriage of Convenience**
Memory and Storage Price vs. Bandwidth

From Objective Analysis: Are Hybrid Drives Finally Coming of Age?
$/GB SSD vs. HDD
HDD and Flash on Parallel Paths

Prices: HDD – Price G2, Flash, Objective Analysis
Market Expectations
Price/GB Roughly Follows IOPS

![Graph showing the relationship between price per GB and IOPS. The graph displays a scatter plot with data points indicating a trend where price per GB roughly follows IOPS.]
Device IOPS by Form Factor

HDD | SATA | SAS/FC | 2-Hop | 1-Hop

Cold | Hot

$10^2$ | $10^3$ | $10^4$ | $10^5$ | $10^6$

Mbps
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Implications/Projections (1)

- SSDs will see increasing adoption—for many applications more IOPS is better
- Fast storage will convert from short-stroked HDDs to SSDs in many cases
- HDDs increasing used in a tier behind SSDs for enterprise applications
Implications/Projections (2)

- Other system elements will become the bottleneck
  - Network, software, servers…
- Users will focus more attention on IOPS
  - Understanding will be greater than it is today
  - Assuming higher IOPS will create more data/content and mean more storage
- Net growth of SSDs and HDD (and even tape) storage
Participate in the Survey!

- SSDs will be priced by speed and capacity
  - Users will benefit by knowing their speed & capacity needs
  - Sellers will too!
- Ongoing 5-minute survey at http://TinyURL.com/IOPSsurvey
- Initial results encouraging
- We need more respondents!
The results will be available as a report to be published in late October. It can be pre-purchased today for a 10% discount at www.Objective-Analysis.com. (This discount applies through October 20.) A pdf will be sent as soon as the report is published. Orders can also be processed through Coughlin Associates at: http://www.tomcoughlin.com/techpapers.htm. You can contact Coughlin Associates by calling Tom at 408-978-8184, or e-mailing: Tom@TomCoughlin.com.
Your Presenters

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 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

- How Many IOPS are Enough,
- Two may be Better than One: Why HDD and Flash Belong Together, Tom Coughlin and Jim Handy, SNIA SSSI White Paper, 2010
- Are Hybrid Drives Finally coming of Age?, Objective Analysis, 2010