Why is SSS Crucial to the Data Center?
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Jim Handy
OBJECTIVE ANALYSIS
Semiconductor Market Research

• Market consulting/research firm
  – Market analysis, strategies, white papers
• Highly-respected lead analysts
  – Jim Handy: Memories & SSDs
  – Lane Mason: Memory chips
  – Tom Starnes: Processors
• Industry experience & 25+ years in field
• Reports, Competitive Analysis, Consulting
Agenda

- Flash rationales are maturing
- The form factor conundrum
- The “Computer of Tomorrow”
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What Folks Said About SSDs in 2005

• “It’s fast and rugged.”
  – Military: “We’ll take rugged!”
    • “We’ll also take fast erase!”

• “It has no mechanical wear.”
  – HDD Makers: “What about wear-out?”

• “$/GB will fall below that of HDDs.”
  – Mother Nature: “Don’t count on it!”
NAND vs. HDD $/GB


Price per Gigabyte

$1,000.00

$100.00

$10.00

$1.00

$0.10

$0.01

20X the Price!

HDD Pricing Courtesy of PriceG2

OBJECTIVE ANALYSIS – www.OBJECTIVE-ANALYSIS.com
Viewpoints Matured by 2009

• “Lower power than HDDs.”
  – Everyone: “Damn costly way to save power!”
• “Super-high IOPS”
  – SNIA: “Is that FOB or over time?”
  – Users: “How many IOPS do I need?”
• “Works well as a cache”
  – Start-Ups: “Want some software with that?”
    • “How about some deduplication and compression?”

Report: How Many IOPS is Enough?
What We Think in 2014

• “It reduces footprint, power, licensing…”
  – “Hard to predict without actually doing it, though!”
• “It saves money”
  – “Same reply.”
• “It augments HDDs”
  – HDD Makers: “We told you so!”
• “It’s been proven – it works”
Why Flash is Imperative

Today’s DRAMs are 6,000 Times HDDs’ Speed

From: HDDs and Flash Memory: A Marriage of Convenience
Flash in Computing

- It’s a migration:
  - 2004: SSD
  - 2005: Turbo Memory
  - 2006: PCIe SSDs
  - 2007: Hybrid HDD
  - 2008: Flash-based appliances
  - 2009: Compression
  - 2010: Caching, Braidwood
  - 2011: Deduplication
  - 2012: Ultrabook
  - 2013: Flash DIMMs
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Which Form Factor Is Right?
Why SSDs?

• Because flash is storage
  – Storage belongs in an HDD package
• Because it smoothes the transition from HDD to flash
• Because nothing has to be redesigned
  – Same hardware
  – Same software
Why NOT SSDs?

• Because the I/O hardware slows it down
• Because the I/O software slows it down
• Because SSDs behave differently than HDDs:
  – Irregular delays
  – Wear issues
Why PCIe?

• Because it’s faster than disk interfaces
• Because all servers have a free PCIe slot
• Because it’s close to the CPU
• Because there’s a lot of power
• Because PCIe RAID cards are well supported
Why **NOT** PCIe?

- Because you can’t hot swap, and **all** storage must be hot swappable
- Because standards are relatively new
  - Many devices were designed prior to the advent of these standards
- Computing has abandoned DAS for a shared storage model
Why All-Flash Arrays?

• Because they can be optimized for flash
  – A closed system can do things that an open system cannot
  – Many include deduplication and compression
• Because they compete head-on with NAS and SAN
• Because you can fit more flash in if you don’t use an SSD form factor
Why **NOT** All-Flash Arrays?

- Because you’re going up against established vendors
- Because most systems don’t need that much performance
Why Hybrid HDDs?

• It’s a natural evolution from DRAM cache to flash cache
  – Similar algorithms, similar hardware
• All of the storage of an HDD with most of the performance of an SSD
• Because hybrids are cheaper than SSDs
Why **NOT** Hybrid HDDs?

- Because HDDs are still cheaper
  - This will fade over time
- Because the technology is new and unknown
- Because most users don’t think that an 8GB cache is big enough
Why Flash as Memory?

• Because it IS memory!
  – Random access
  – Bus architecture

• Because that’s the fastest interface

• Because it scales better than PCIe

• Because flash is cheaper than DRAM
  – DRAM: $7.20/GB
  – NAND: $0.38/GB
Flash cheaper than DRAM

From: Hybrid Drives: How, Why, & When?
Why **NOT** Flash as Memory?

- Because it’s not already supported by standard software
- Because it’s storage, and until that mind-frame is shaken it can’t play a role of cheap/slow memory
- Because users worry about wear
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The Computer of the Future
Flash is Everywhere!

Server Clusters:
Each server has DRAM and NAND memory

Storage:
All storage is accelerated with flash & hybrid drives

Each server has a caching SSD

Internet access is accelerated with flash

Internet
Summary

• The industry’s vision for flash use is maturing
• Eventually flash will break away from storage form factors
• Tomorrow’s computers will sprinkle flash liberally throughout the system
Thank You!

Jim Handy