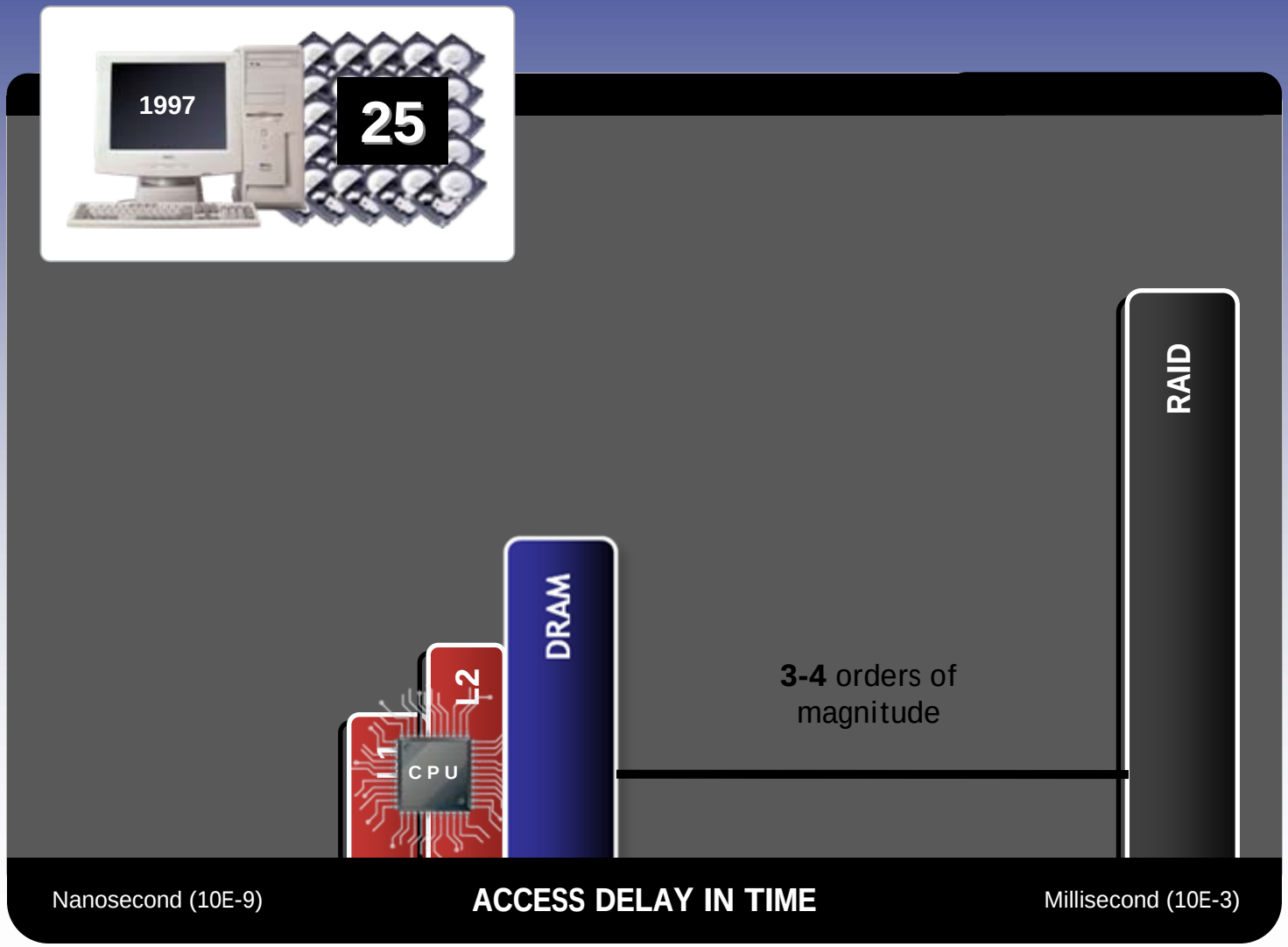
NAND Flash as a High Density Server Memory

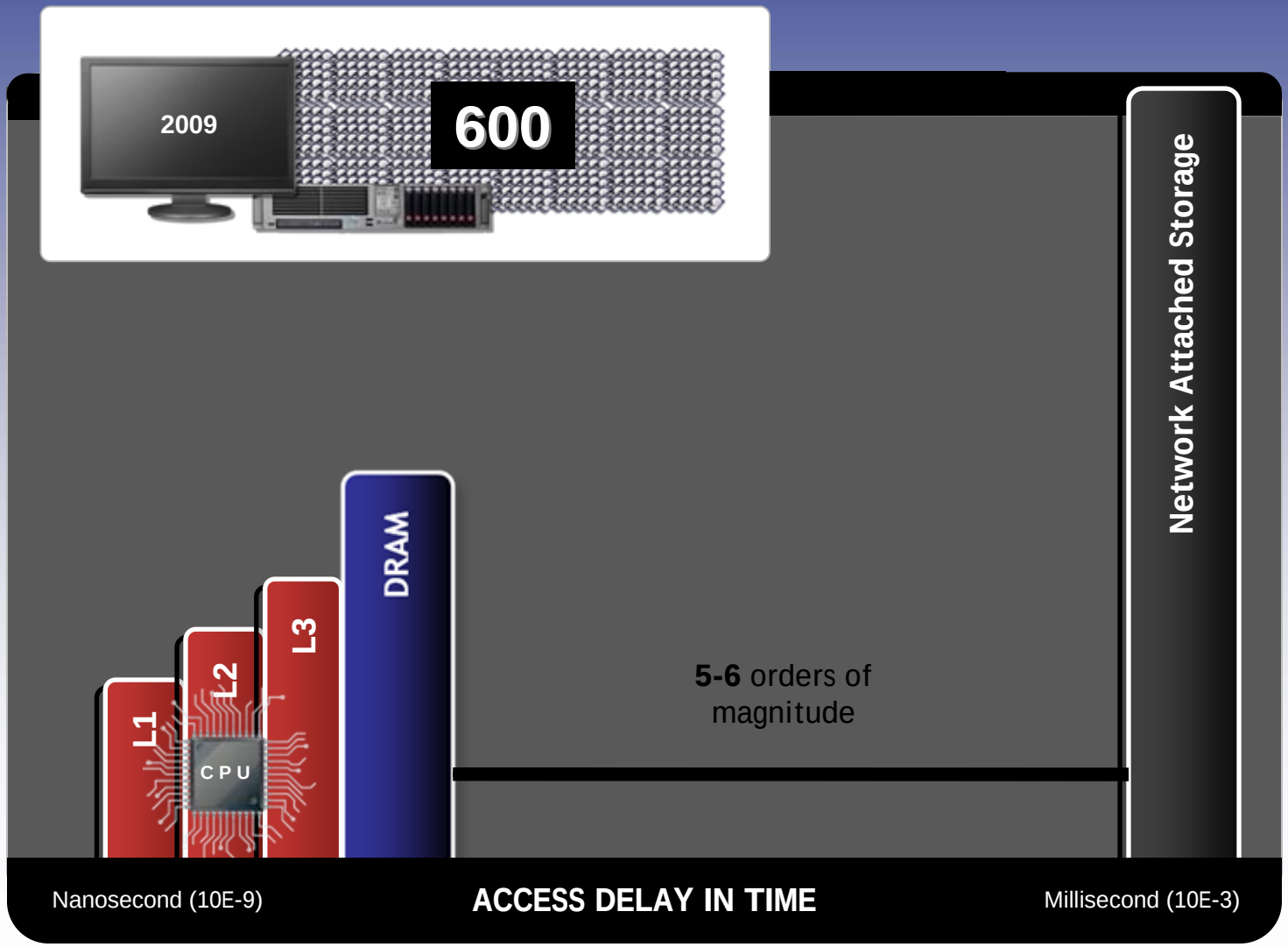
David Flynn

The industry 20 years ago

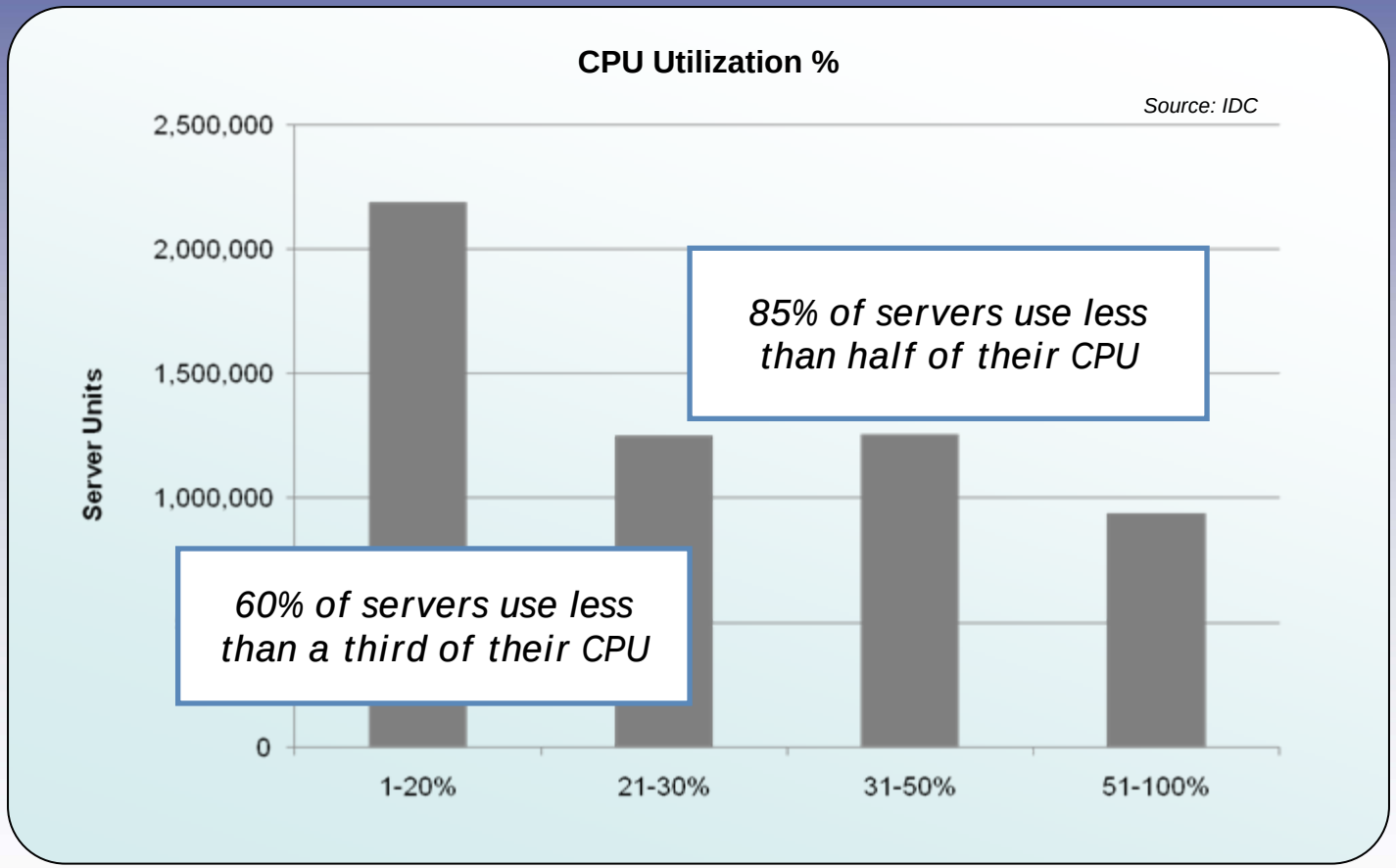
Where the industry went



Where the industry is today



CPU Utilization



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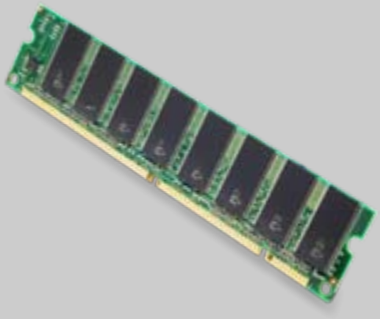
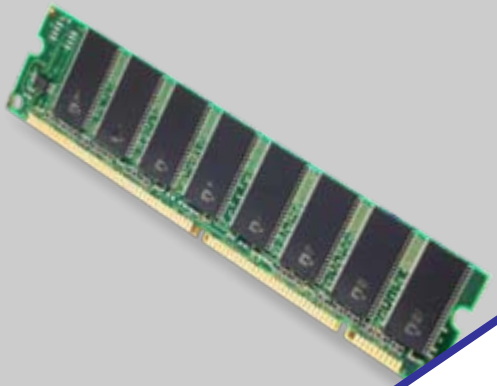
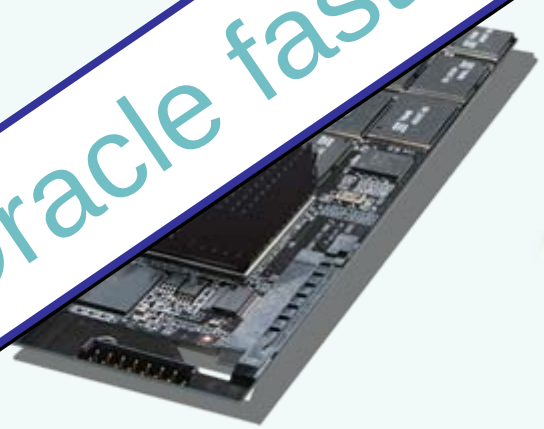
What's *really* Needed…

DRAM	Disk	Need
		
Like • Really fast • Rarely fails **Don't Like** • Volatile • Expensive • Limited capacity	**Like** • Non-volatile • Cheap • Large capacity **Don't Like** • Really slow • Often fails	**Want** • Non-volatile • Really fast • Large capacity • Reasonable price • Low energy • Never fails

Compared to RAM

RAM	ioMemory
	
• 16 GB	• 640 GB 40x
• $125 p	• $25 per GB (list) 1/5th
• 1.0	• 10 Watts per TB 1/100th
	• 39 bit & self healing
	• Non-Volatile

ioMemory runs Oracle faster

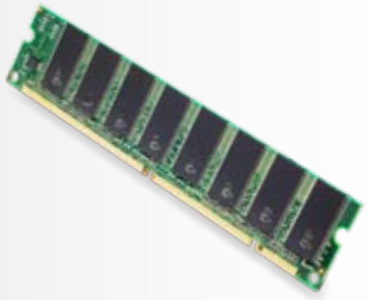
ioMemory – Performs Better than DRAM

ioMemory

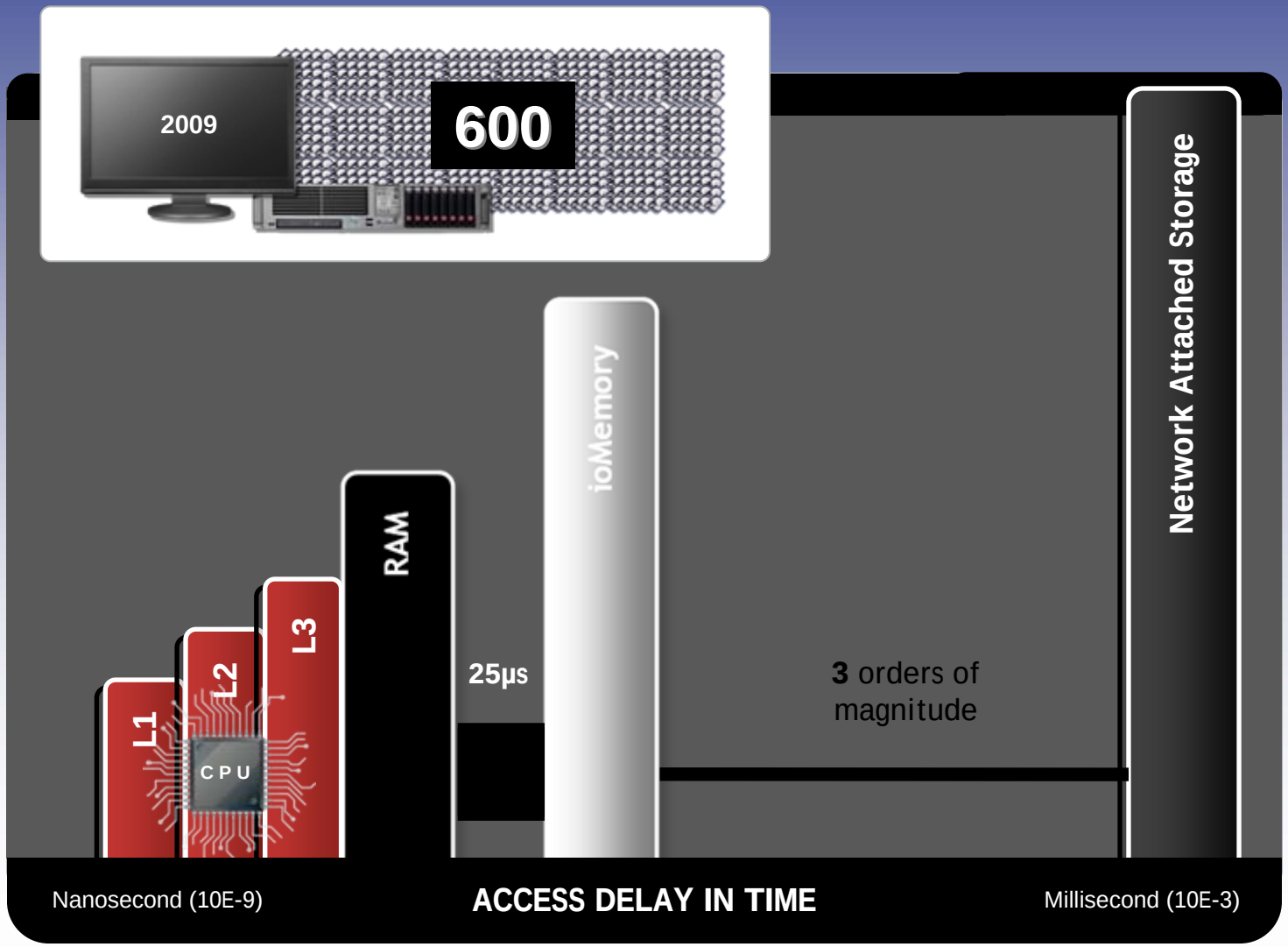
- Only moderate amounts of DRAM needed
- Enhances cache locality in CPU's L1, L2, L3 caches
- Non-volatile so it's usually indexed for speed of access
- Non-volatile so data is ready immediately
- ioMemory runs at full memory bandwidth
  - Data only goes across memory bus once (supplied from PCIe)
  - Does not waste CPU to move data (uses DMA engine)

High-density DRAM

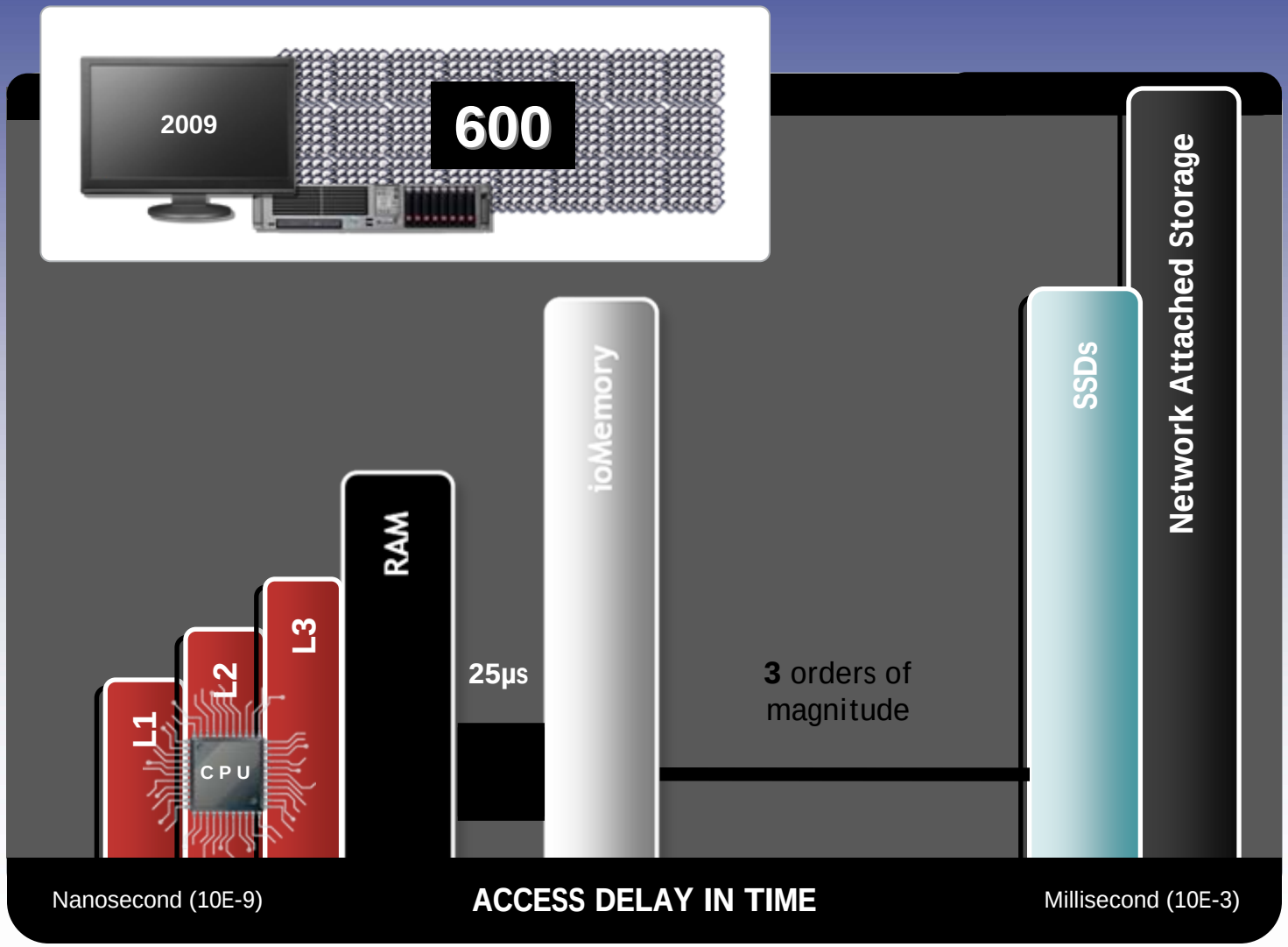
- Overloaded memory bus runs 30% slower
- Destroys the cache locality in CPU's L1, L2, L3 caches
- Volatile and changing so it's seldom indexed
- Takes hours to "warm-up" - load data into DRAM
- RAMDISK runs at ½ memory bandwidth
  - A single I/O takes two transfers across the memory bus
  - The CPU must manually read from memory then write



ioMemory Maximizes Value Potential



ioMemory Maximizes Value Potential



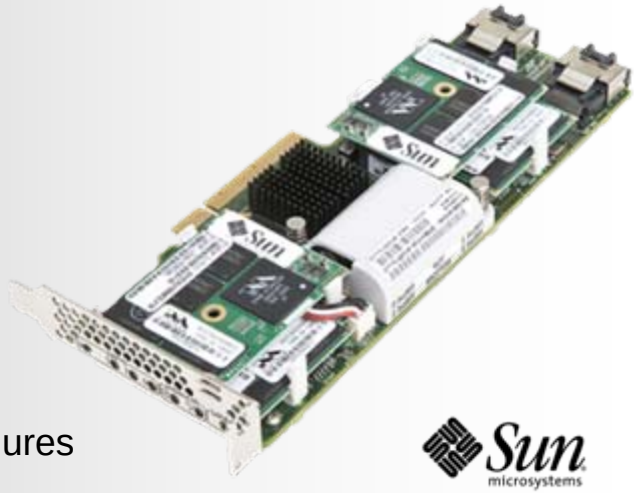
Alternative Approaches

ioMemory – A cheaper, higher density memory

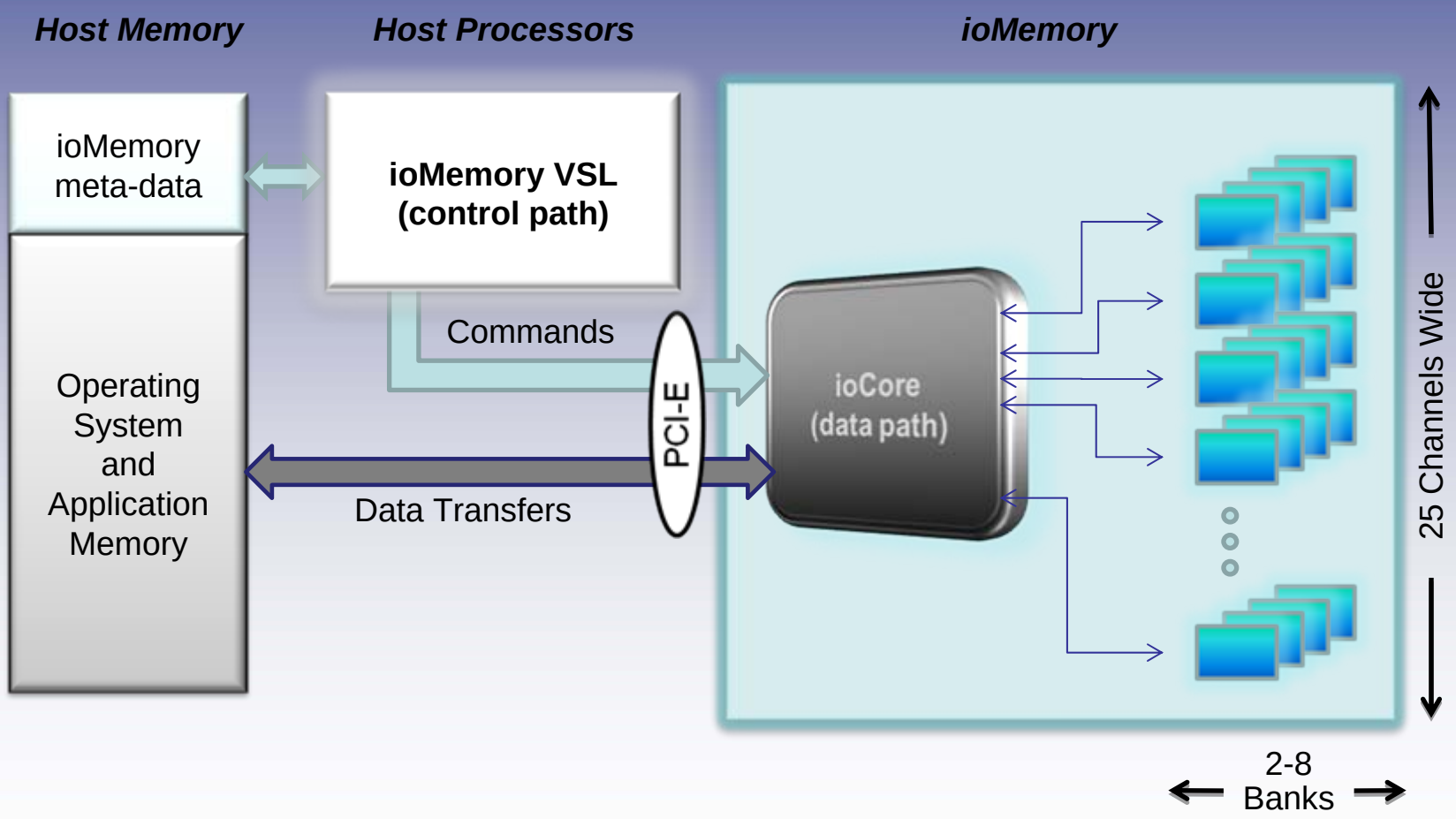
- Each CPU core has independent parallel access
- Lower access latency increases application acceleration
- Less complexity, lower cost, less power, less space
- Complete solution soup-to-nuts software & hardware
- Self healing, no servicing required
- “Flashback Protection” chip-level redundancy

SSD – A more expensive, faster disk drive

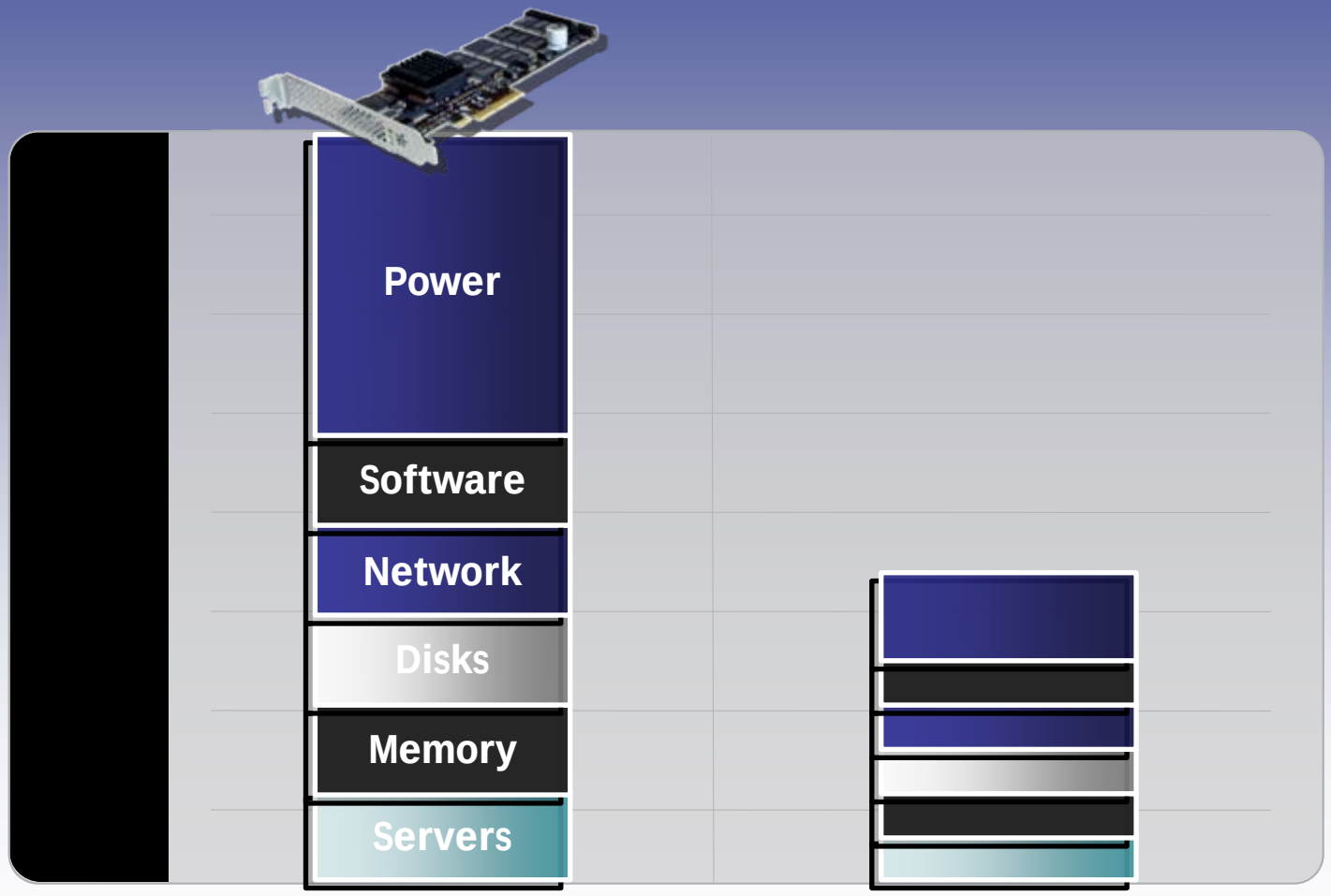
- Embedded CPU’s serialize access
- RAID increases latency and batches completions
- RAID 1 or 5 sacrifices capacity and performance
- Major technologies from several different vendors
- Manual maintenance required to service failures
- Super-capacitors and embedded processors are prone to failures



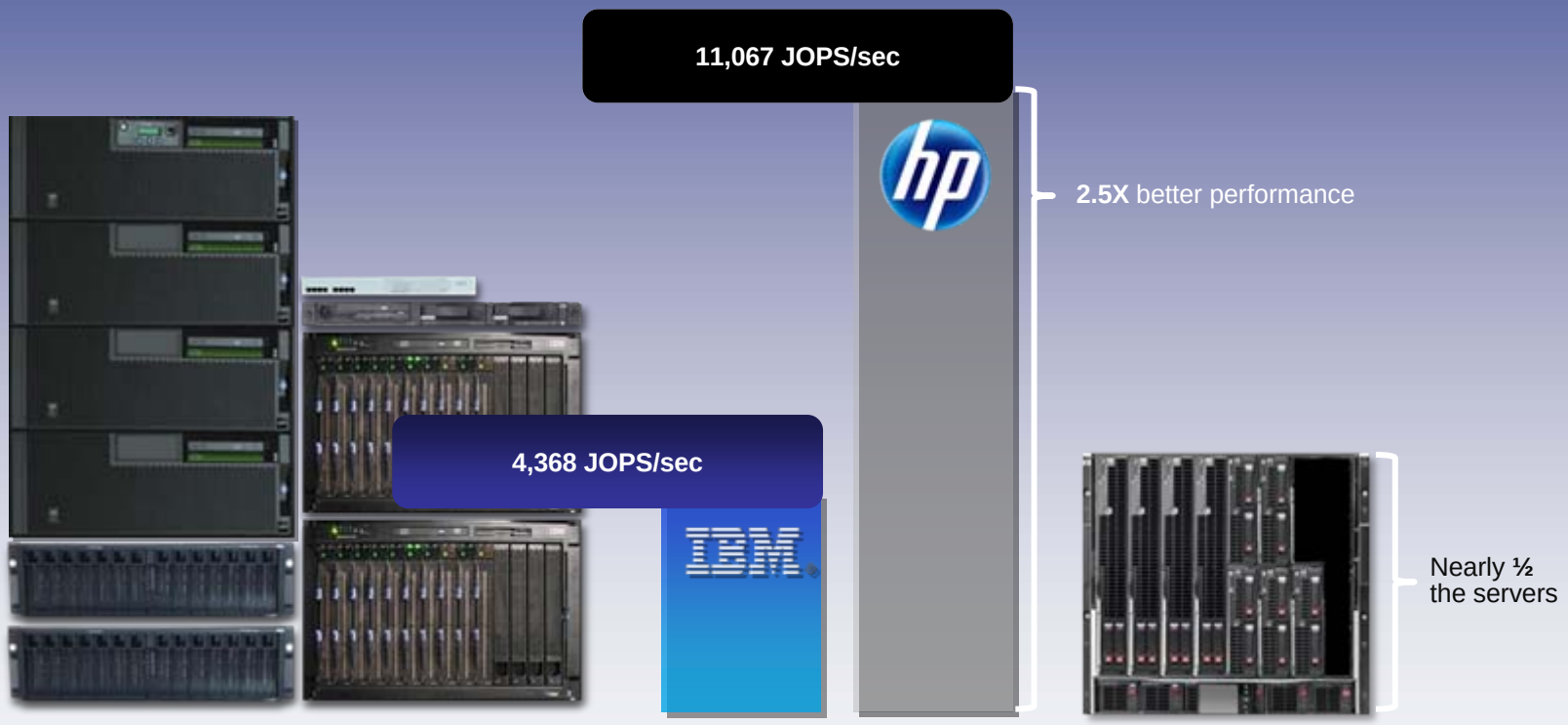
ioMemory Split-Path Architecture



ioMemory Consolidates…



HP & ioMemory jAppServer results



- WebSphere 6.1
- IBM HS20
- **40** cores, **40** chips

- Oracle Weblogic 10.3
- HP BL460c
- **24** cores, **6** chips

Case Study

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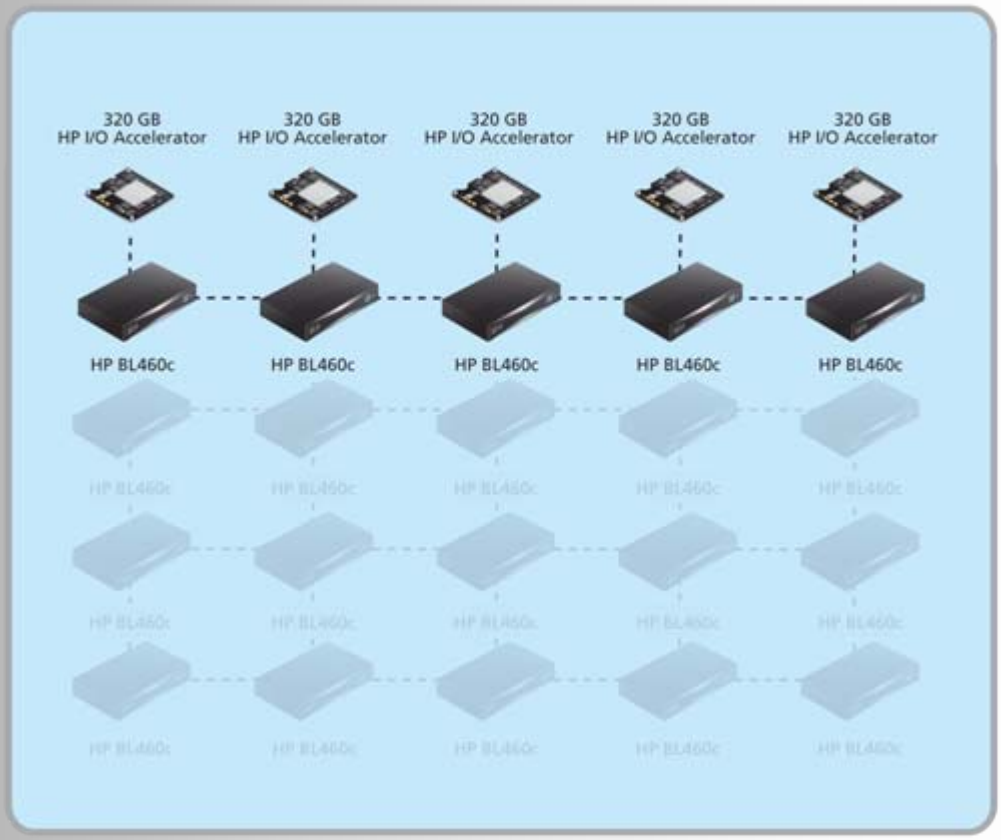
AFTER



Case Study

One of the world's fastest growing Webmonsters

- Over 900% more database queries per second
- Dramatically improved server replication for most current data
- Over 800% improvement to disaster recovery back-up time
- Cut server footprint, power costs, and IT overhead by 75%
- Full and immediate ROI on repurposed servers with
- Continued ROI on operational cost saving

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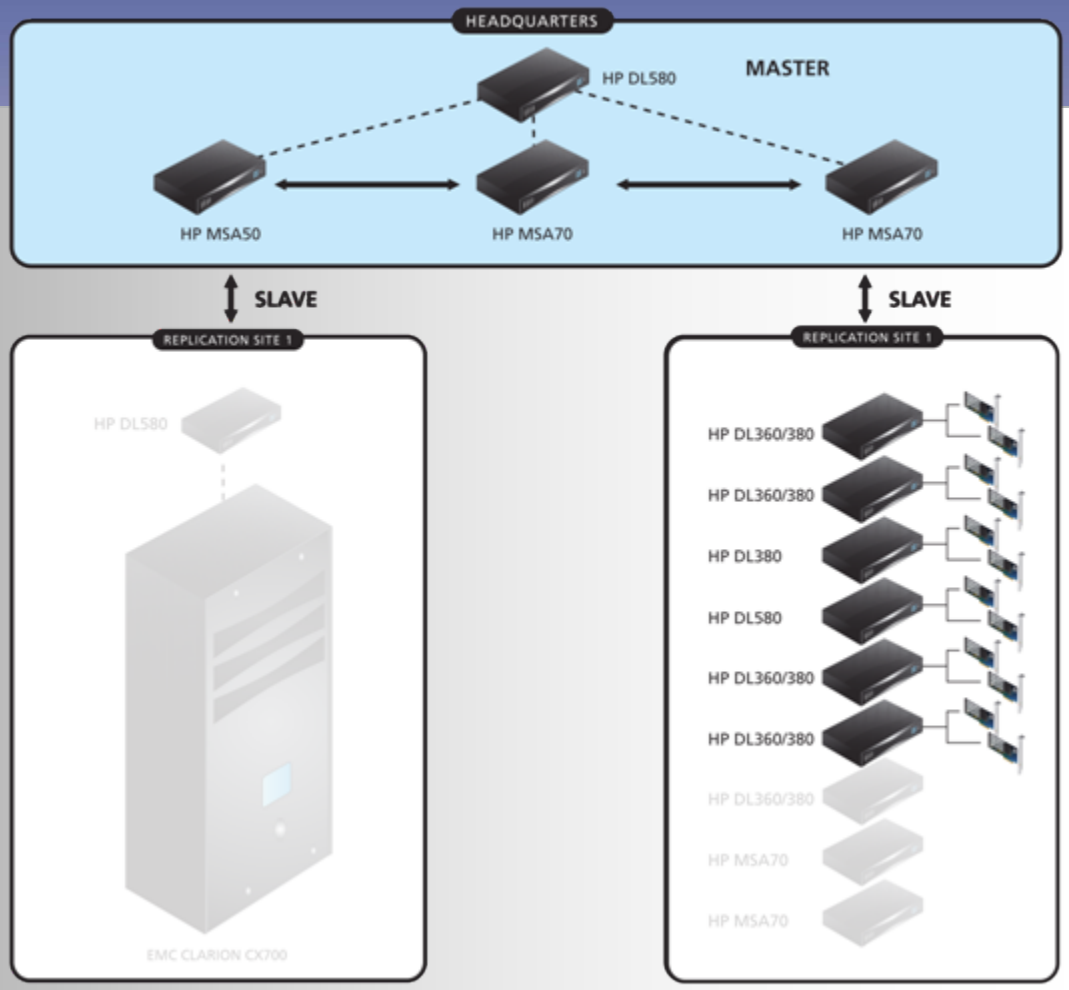
Case Study

CLOUDMARK

AFTER



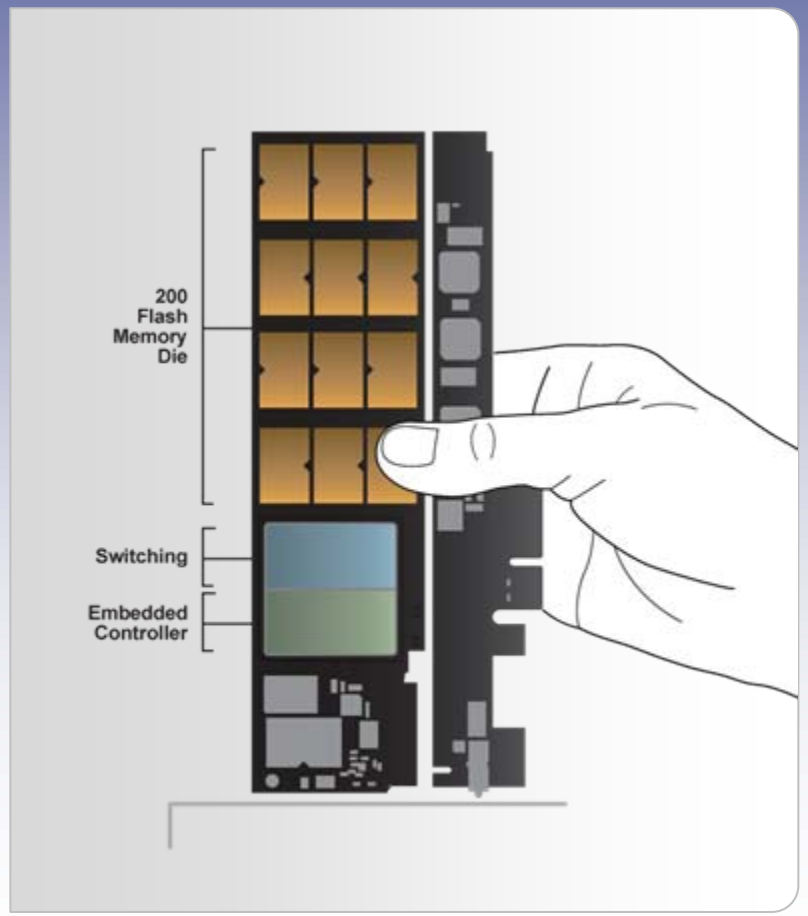
Case Study

Internet security company that protects over 1 billion inboxes

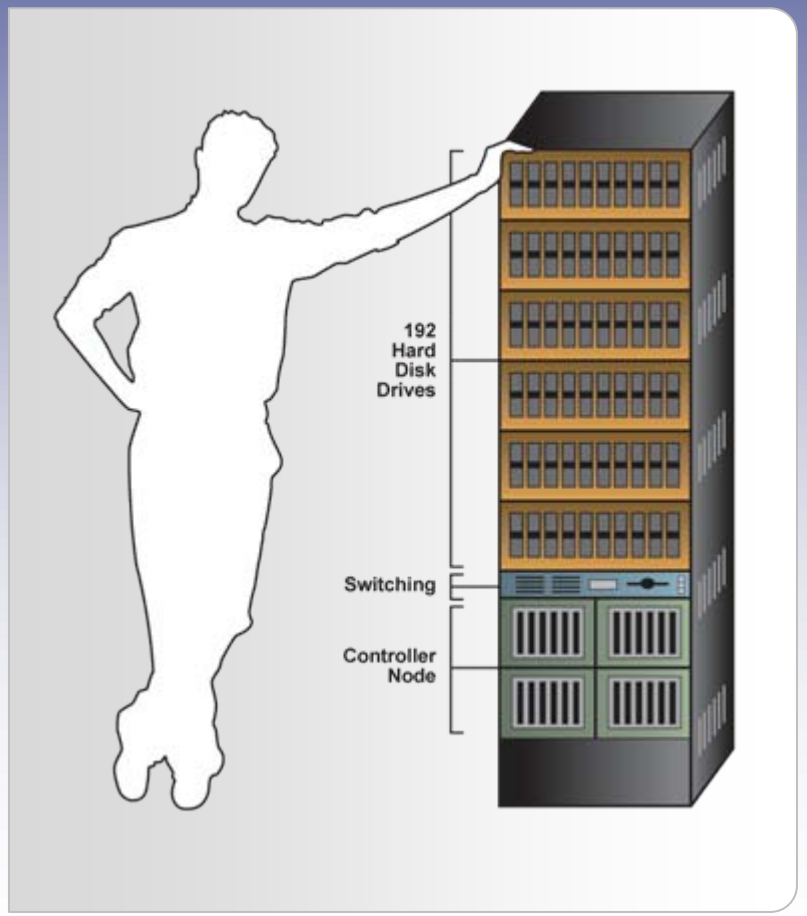
- 5x improvement to
  - Database replication performance
  - Data intensive query response
  - Analysis routines
- Eliminating 210 failure points from system
- Implemented full system redundancy
- Dramatically lowered power and cooling expenses

Disruption

By deploying ioMemory…



Cloudmark eliminated the need for this…



Other Customer Examples

- Does a 30 to 1 server reduction for their reliable messaging system
- HMO achieves a 200 HDD to 1 ioMemory reduction for their Data Warehouse
- Department of Defense takes NASTRAN from 3-days to 6-hours
- Stock exchange doubles the performance of their trading systems
- FAST unstructured text search 2 min response times reduced to 0.2 seconds
- Dynamics NAV gets a 4x performance improvement

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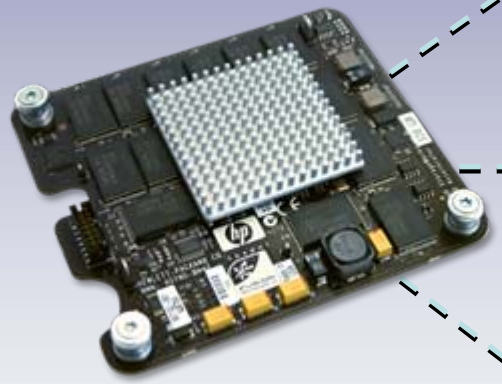
Customer Snapshot

Data-Intensive Applications for ioMemory



TRANSACTION PROCESSING

- 100x faster response time
- 10x the transactions per second

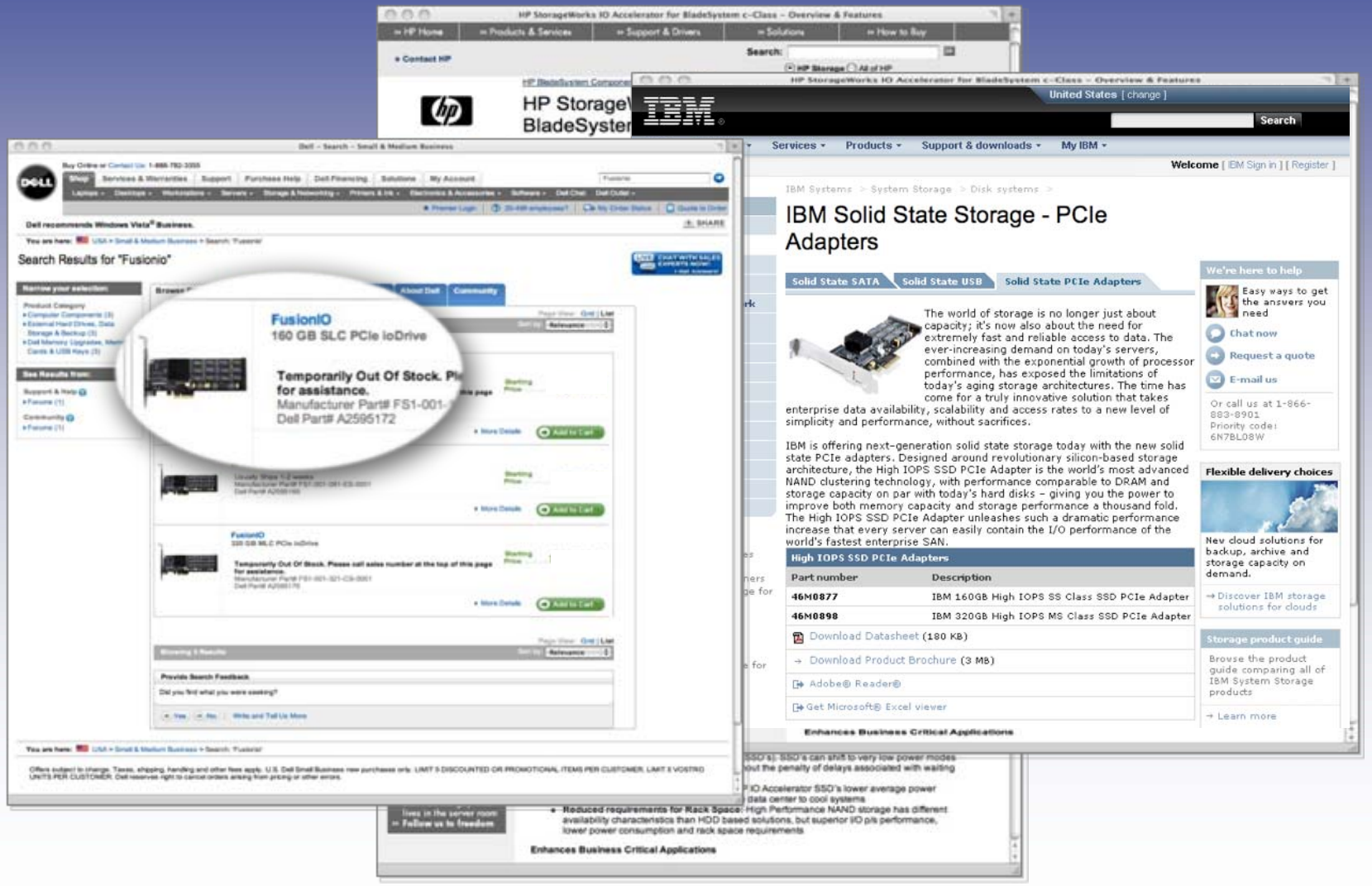
VIRTUALIZATION

- Host 4x more virtual machines
- Avoid service interrupts due to I/O contention
- Save or resume virtual machine states in seconds

APPLICATION SERVER

- 3-10x application acceleration
- “All-bladed”

Available from all major server vendors



Questions?

Thank You