



# STORAGE INDUSTRY SUMMIT

The Future of Computing:  
The Convergence of Memory  
and Storage through  
Non-Volatile Memory (NVM)

JANUARY 21, 2015, SAN JOSE, CA



Jim Handy  
Objective Analysis  
Director

**How Persistent Memory will Change  
Our Approach to Computing**



# How Persistent Memory Will Change Our Approach to Computing

Jim Handy



OBJECTIVE  
ANALYSIS

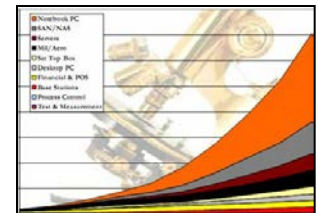
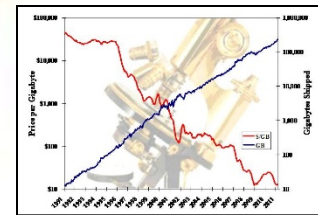
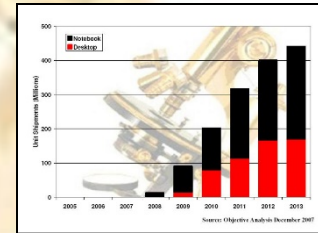
# OBJECTIVE ANALYSIS



**Profound  
Analysts**

**Reports &  
Services**

**Custom  
Consulting**



# Agenda

- Where does data reside?
- Where can data reside?
- Where should data reside?
- Where will data reside?



# 1

**WHERE DOES DATA RESIDE?**

# Storage or Memory?

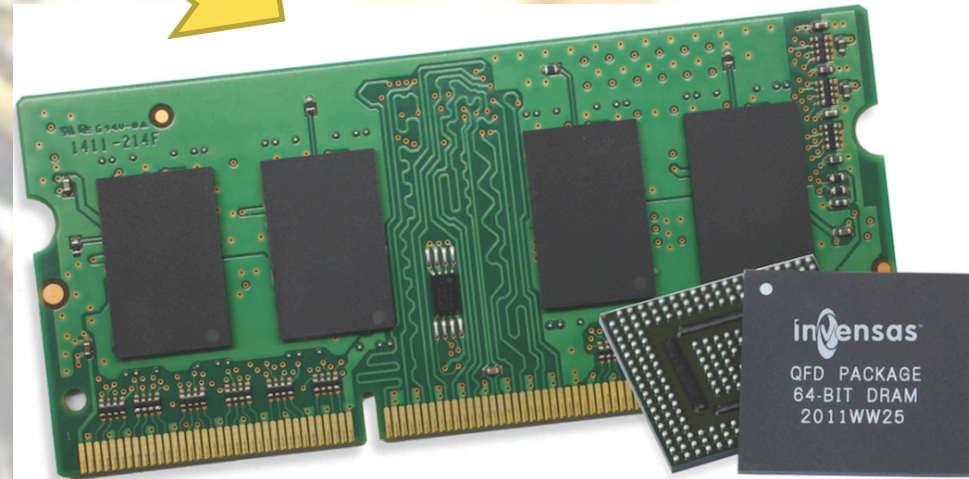
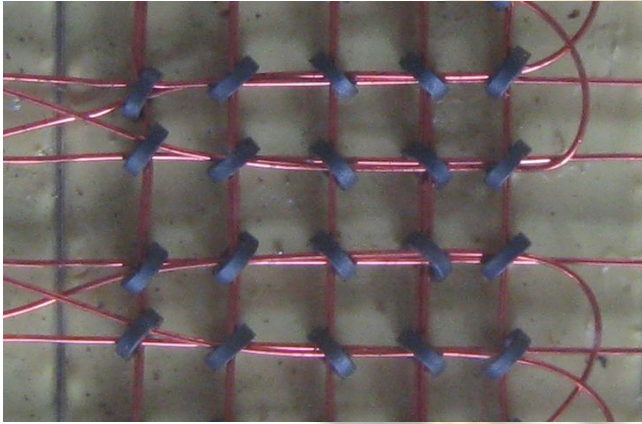
## Storage

- Persistent
- Reliable
- Slow
- Serial
- Cheap
- Low-power
- Shared
- Replaceable

## Memory

- Volatile
- Unreliable
- Fast
- Random
- Costly
- Power-hungry
- Local
- Embedded

# How Did That Happen?



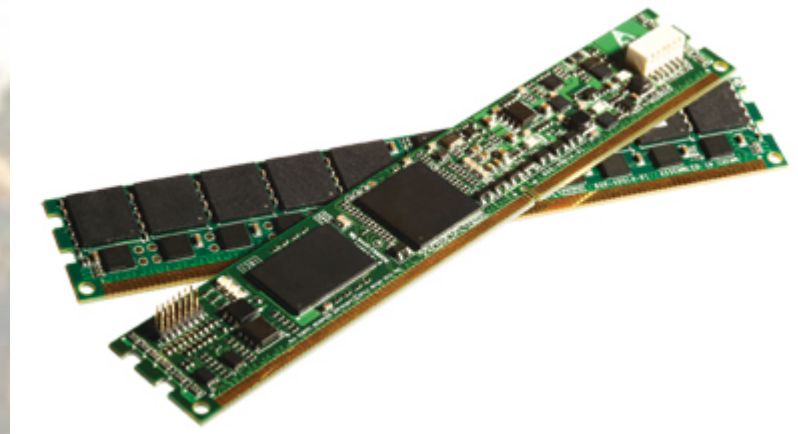


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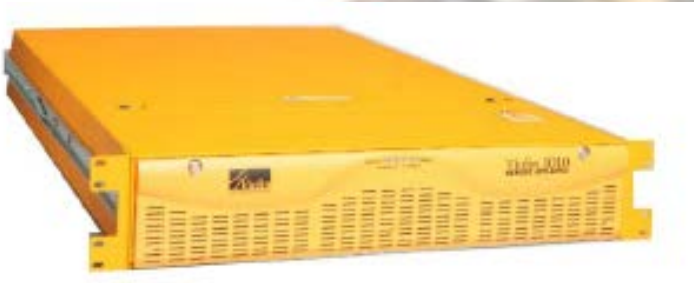
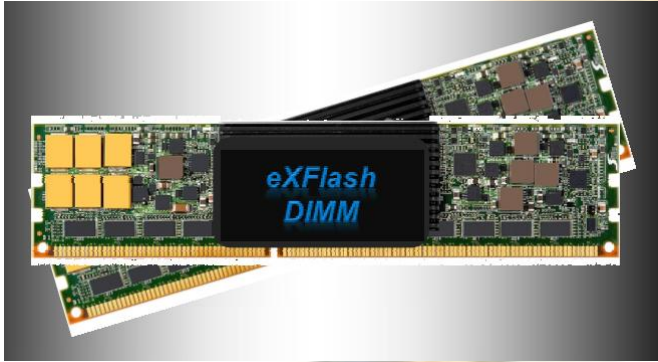
**WHERE CAN DATA RESIDE?**

# Today Data Can Be Everywhere!

- Offline
- Near-line
- DAS
  - SSD, PCIe
- Memory
  - NVDIMM-N
  - NVDIMM-F

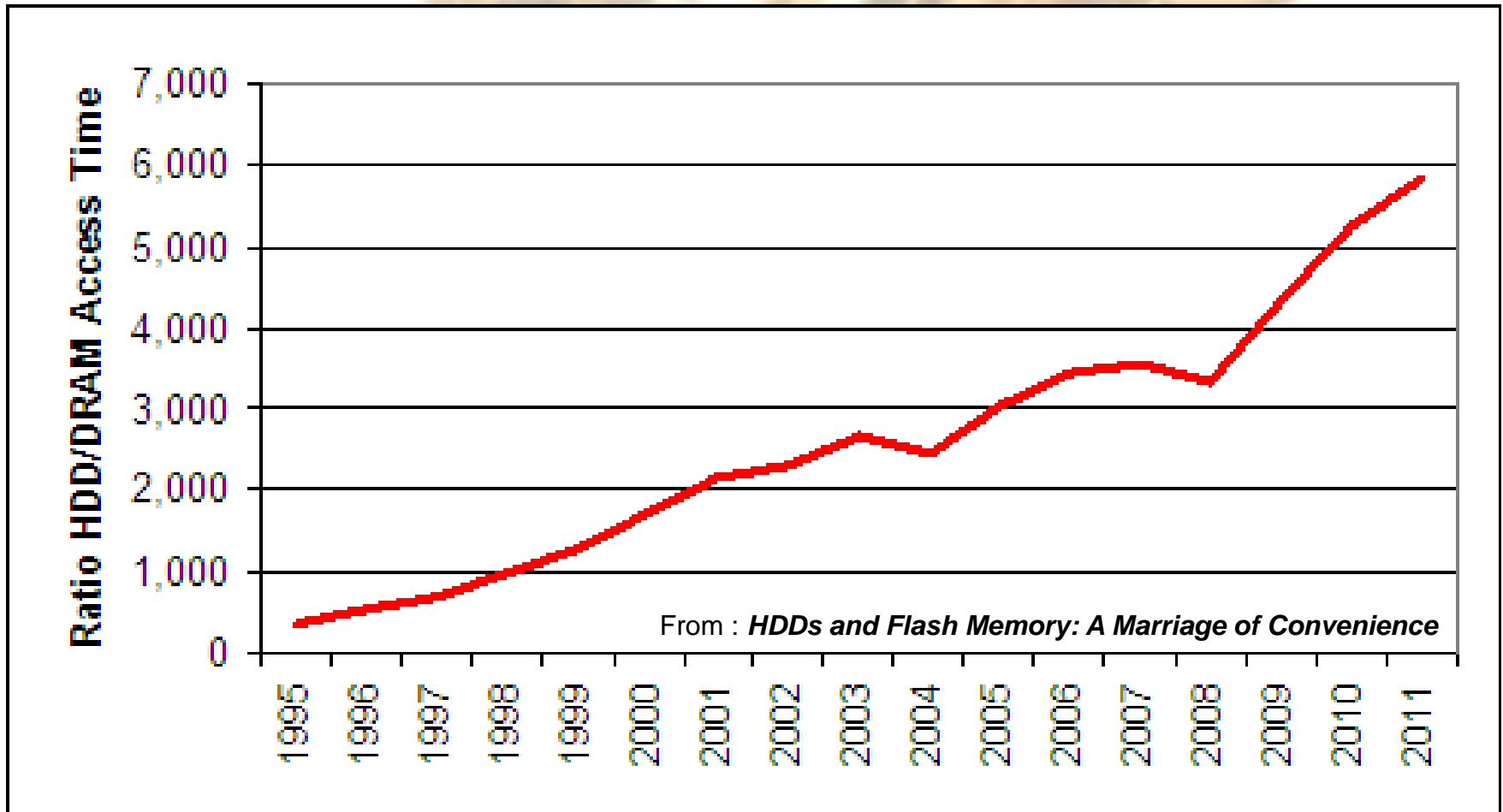


# NAND Flash Is Finding Its Niche



# NVDIMMs Are Fast!

DRAM bus is now 6,000 Times HDDs' Speed





# 3

**WHERE SHOULD DATA RESIDE?**

# Current & Future Models



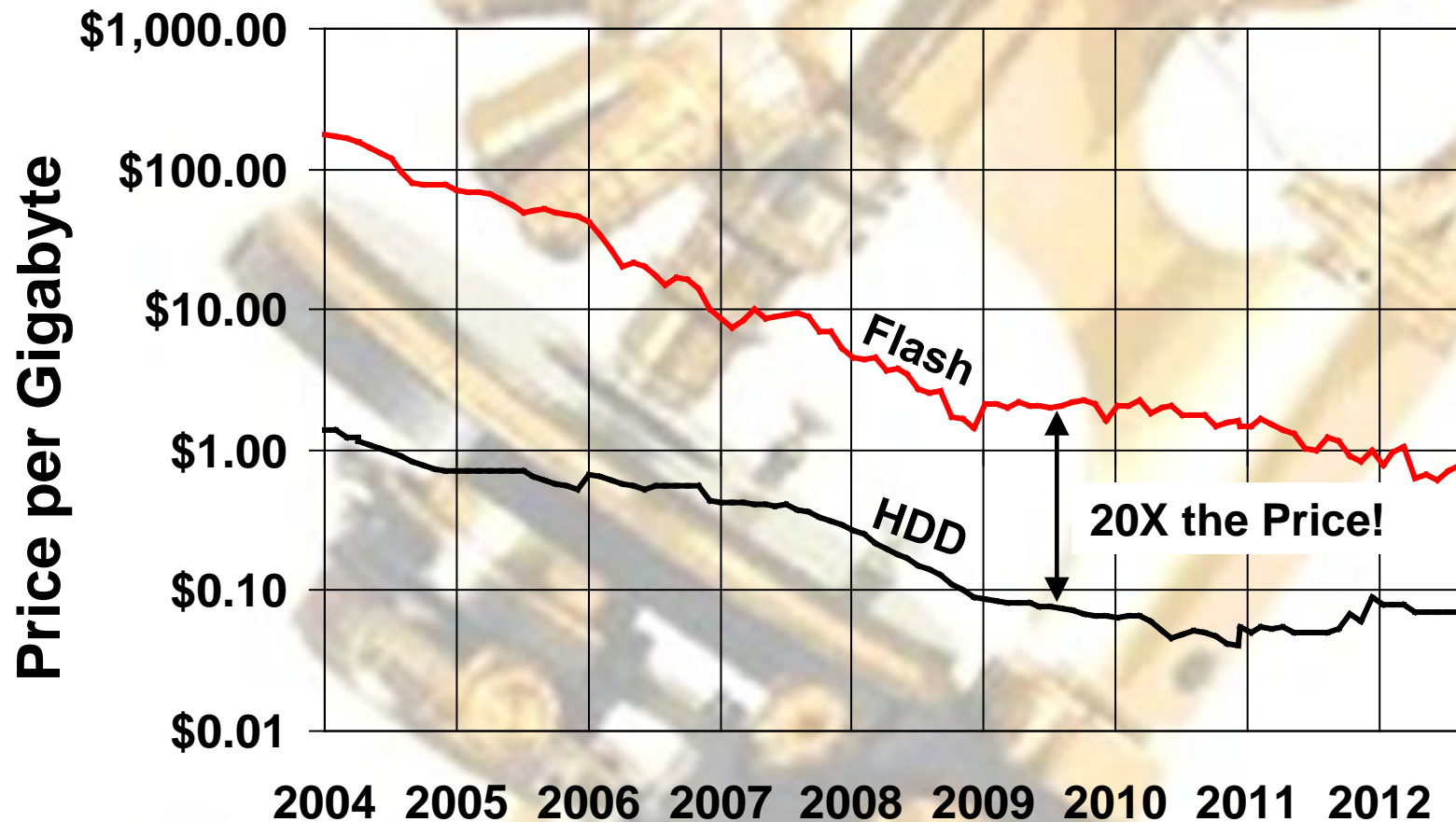
## Current Model

- Work with data in memory
- Store data in storage
- Reconfirm all storage writes

## Future Model

- Work with data in memory
- Store data in memory
- No reconfirmation

# But PM Won't Eliminate HDDs



HDD Pricing Courtesy of PriceG2

# Reasonable Approach

- Cold data on HDD
- Warm data in SSDs
- Hot data in NVDIMMs
- Expendable data in DRAM

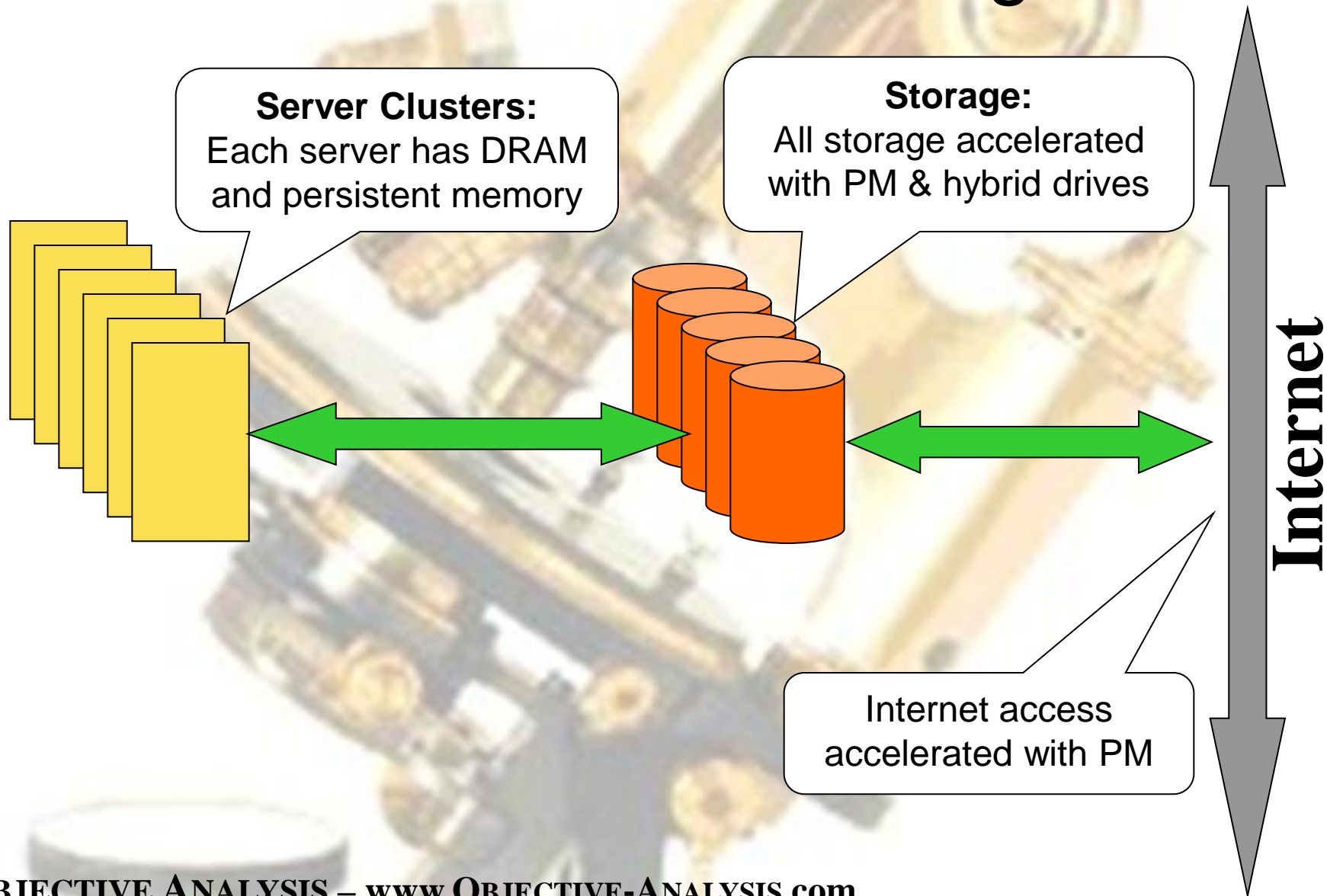
Automatic data placement



# 4

**WHERE WILL DATA RESIDE?**

# A Model For Data Storage





# The Result? **SPEED!**

# Summary

- Applications are crafted around older technologies
- Flash is bringing about change
- Future systems will liberally use persistent memory



# Thank You!

**Jim Handy**

**OBJECTIVE  
ANALYSIS**