# *Flash In the Data Center*

Violin
Silicon Storage

## *Enterprise-grade Silicon Storage*


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# *Flash in the Data Center*

Violin Silicon Storage

*Nothing like the laptop market – Data Centers need Silicon Storage*

- Scalability
  - Thousands of Servers per Data Center
  - 10-100TB of Active Data per Data Center
- Reliability
  - Flash devices fail….online serviceability is important
  - Data loss is unacceptable & ECC insufficient
  - Redundancy/RAID is a requirement
- Performance
  - 70/30 Read/Write Mix
  - 24x7 Operation => Sustained Writes are important
  - Many applications => Access Patterns are Random
- Power
  - No power left for anything else!
  - Need to reduce spindles and servers

# Enterprise-Grade Silicon Storage

## Completing the Virtualized Data Center

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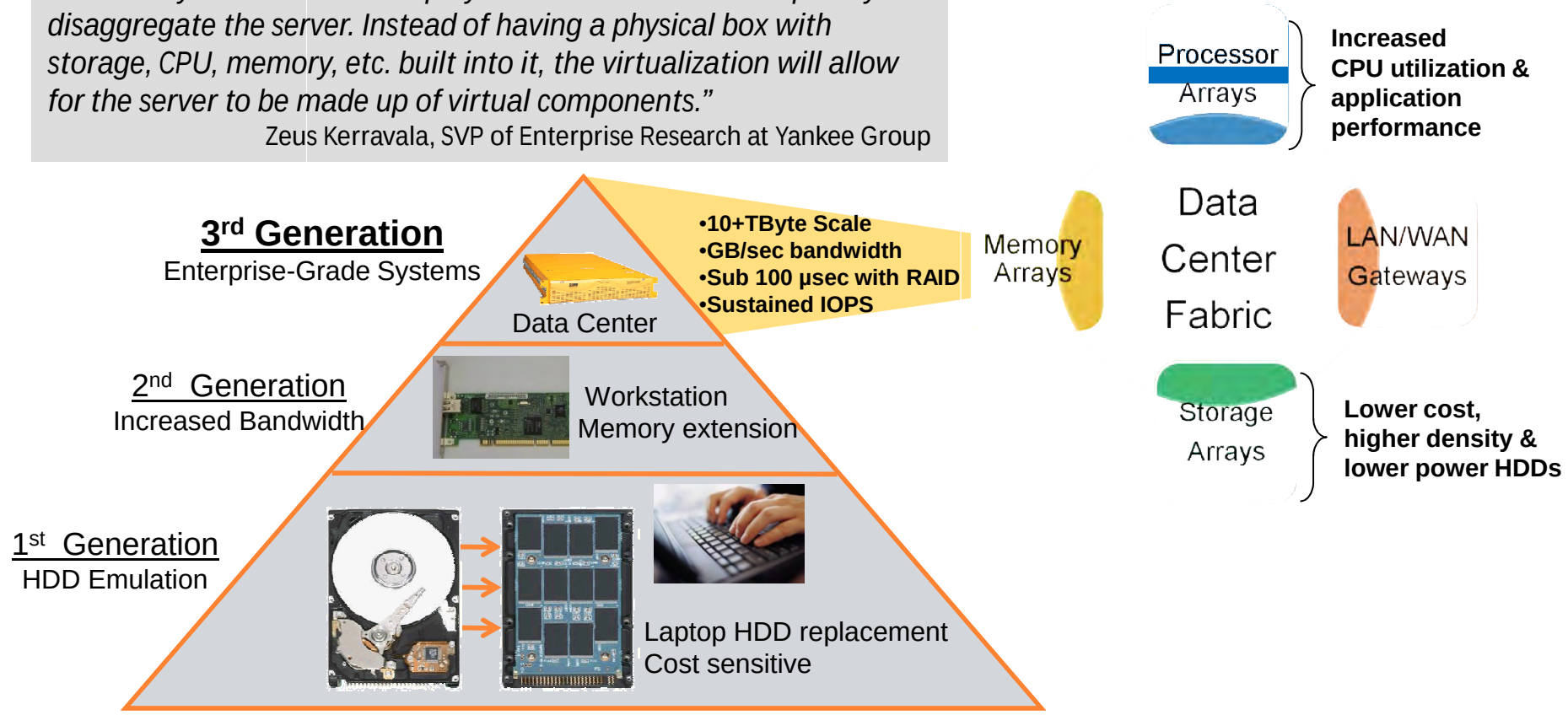
*Silicon storage dramatically improves Data Center performance, scale and economics.*

*"Eventually virtualization will play a different role and completely disaggregate the server. Instead of having a physical box with storage, CPU, memory, etc. built into it, the virtualization will allow for the server to be made up of virtual components."*

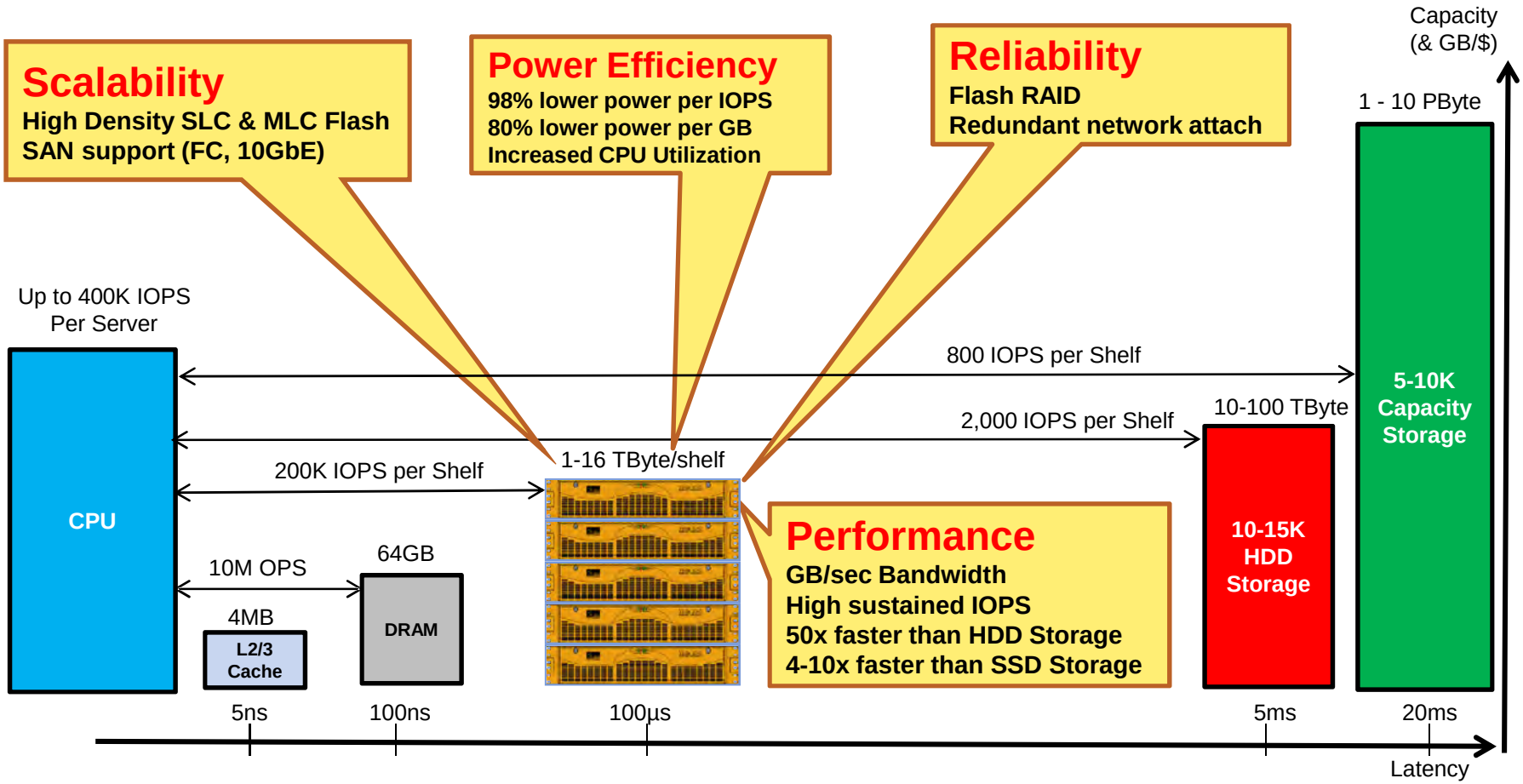
Zeus Kerravala, SVP of Enterprise Research at Yankee Group



# Silicon Storage Benefits

Violin Silicon Storage

***Modular architecture designed to scale solid state in the data center***



# *Violin: Enterprise-Grade Silicon Storage*
## *3rd Generation Flash Architecture*

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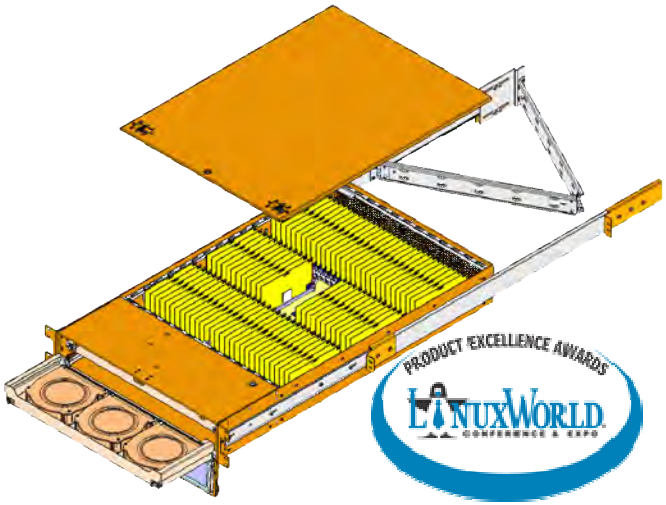
***1st platform built from the ground-up for the Flash Data Center***

**Violin 1010 Memory Appliance**




**LinuxWorld 2008**
Most Innovative Hardware Solution

1. **Dramatic Application Acceleration**
2. **Flash-Optimized RAID**
3. **Flexible Data Center Integration**
4. **Lowest TCO for Performance Storage**
5. **Greener Flash Data Center**

# Sustained Flash Performance

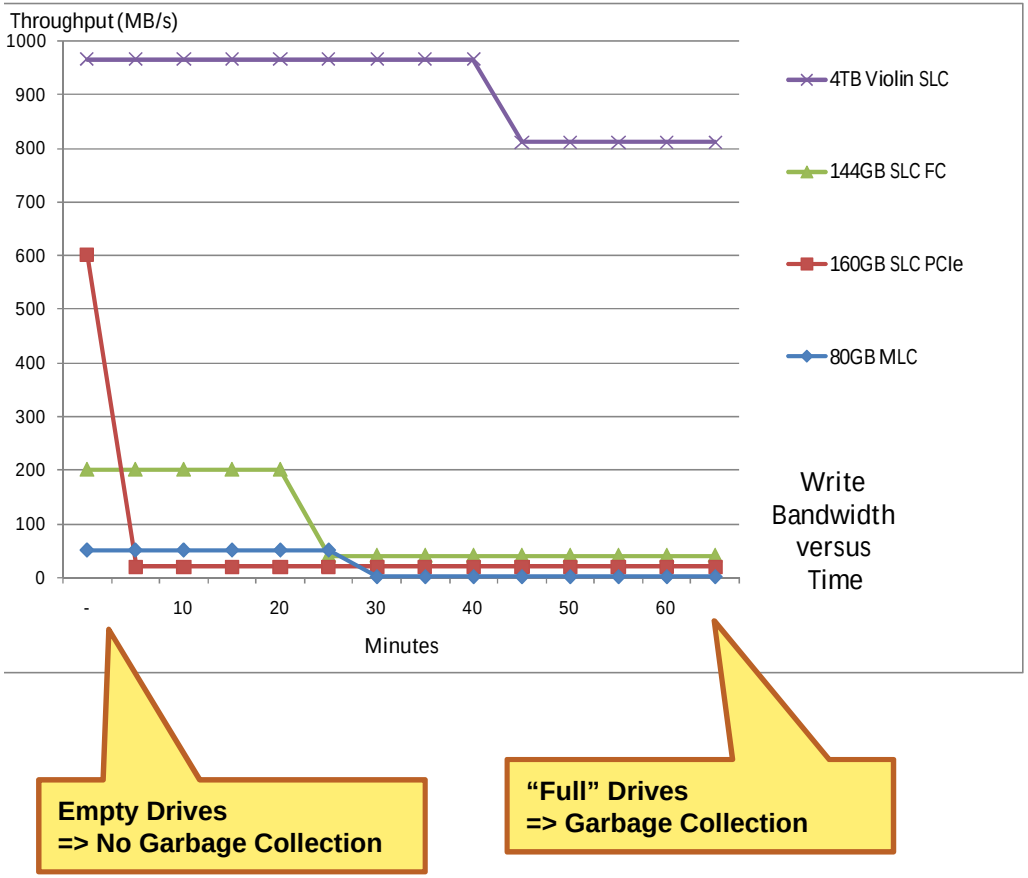
Violin Silicon Storage

***Enterprise Data Centers can't cope with the Flash "Cliff of Death"***

## Violin Architecture

- Extreme Bandwidth
  - 500+ Flash Interfaces
  - 4000+ Flash devices
- Distributed Garbage collection
  - Background process on each VIMM
  - Implemented in hardware
- Non-blocking Erases
  - Performed in background
  - Never block Read/Write
- Low Write amplification
  - Typically <4 Writes per User Write
  - Writes performed in background

**Industry's Highest Sustained Random Write IOPS**



# Simple SAN Deployment

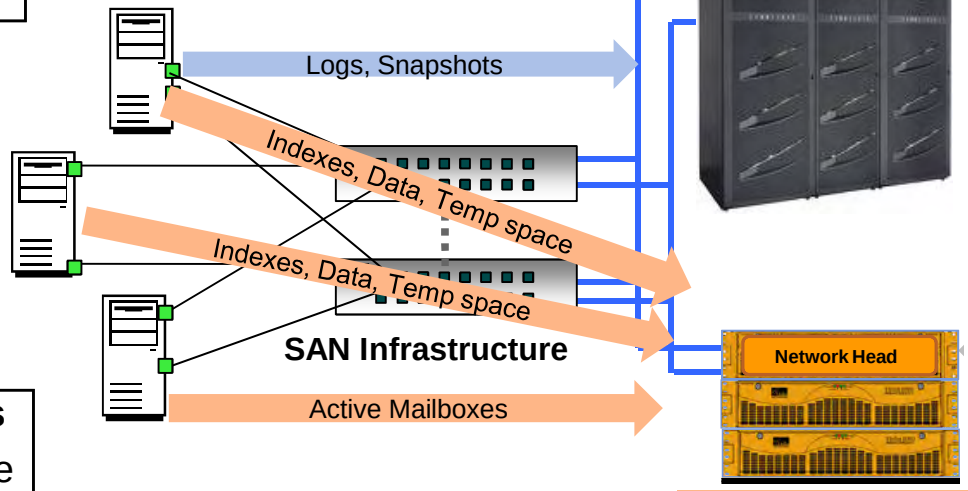
Violin Silicon Storage

***High activity LUNs moved to Silicon storage to increase performance and reduce cost & power***

**OLTP Database**
- Oracle,
- SQL Server

**Data Warehousing**
- Oracle
- Greenplum

**Enterprise Apps**
- MS Exchange




**Capacity Storage**
Snapshots for back-up
Log Files
Long term file storage

**HDD Storage**
- 3K IOPS per shelf
- 5000 µsec latency
- 10- 1000 TByte

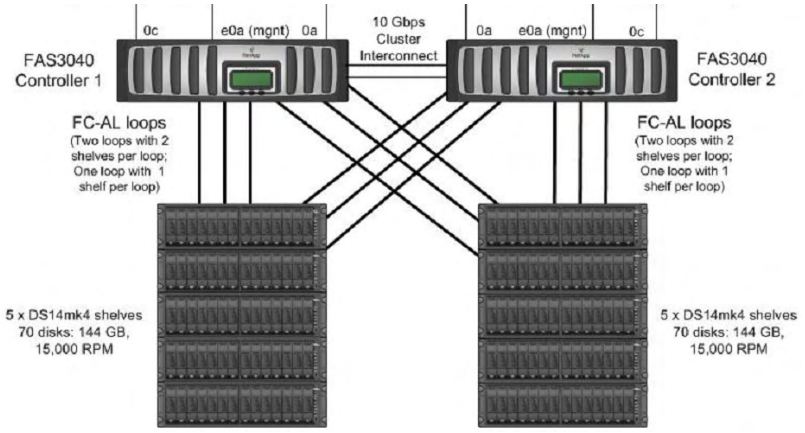
**Silicon Storage**
- 200K IOPS per shelf
- < 200 µsec latency
- 1-100 TByte

**Performance Storage**
Indexes
Data/Tables
Temp space
Snapshots for Analytics

# Lower Cost IOPS
## 25x Improvement over Disk Storage

*Silicon Storage reduces the power & costs of a 200K IOPS HDD storage system by greater than 90%; CPU Utilization also improved*

HDD Performance Storage

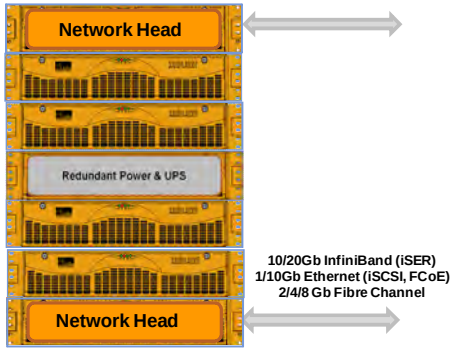



Application Improvement
45 Min -> 4 minutes

ORACLE

20x Improvement
Latency, IOPS

Silicon Storage
(Violin)




| | |
|---|---|
| 200 IOPS per HDD | = 3000 IOPS per shelf |
| | = $13 per IOPS |
| | = $30K per TB |
| 20W per HDD | = 0.2W/GB or 0.1W per IOPS |
| 5 Year Lifetime | = >1 Replacement/Year per TByte |

| | |
|---|---|
| 10,000 IOPS per VIMM | = 200,000 IOPS per shelf |
| | = $0.50 per IOPS |
| | = $30K per TB |
| | = 0.25W/GB or 0.003W per IOPS |
| 10 Year Lifetime | = <0.1 Replacement/Year per TByte |

# Lower Cost Transactions

*Silicon Storage dramatically increases the Transactions Per Second (TPS) and enables server consolidation, DBA reduction and 90% power savings.*

HDDs
10 x 4450
480 HDDs
DBA Time
Weekly Maintenance
18kW

x10

SSDs
13 x 4150
65 SSDs
DBA Time
12kW

x13

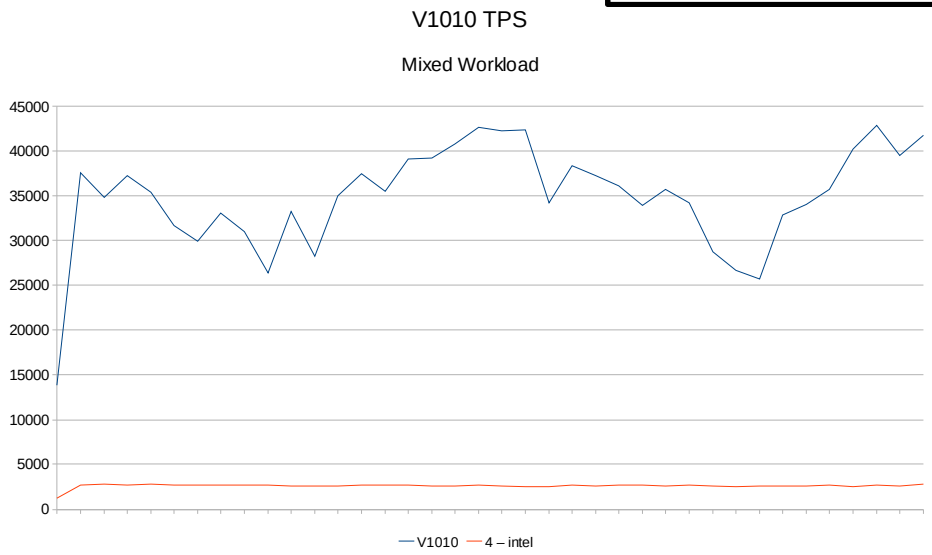
Silicon Storage
1x 4150
1 x Violin 1010
1.2kW

x1

10x Improvement
Total Cost, Power, Space & Units


## Violin Memory - Juice

*Violin delivered 80% of the transaction rate achieved running the entire database in server memory*




3K -vs- 40K TPS... means you would need potentially 13x more from the 4 SSD+ RAID Intel configuration ( or 50 disks ) to get similar performance.

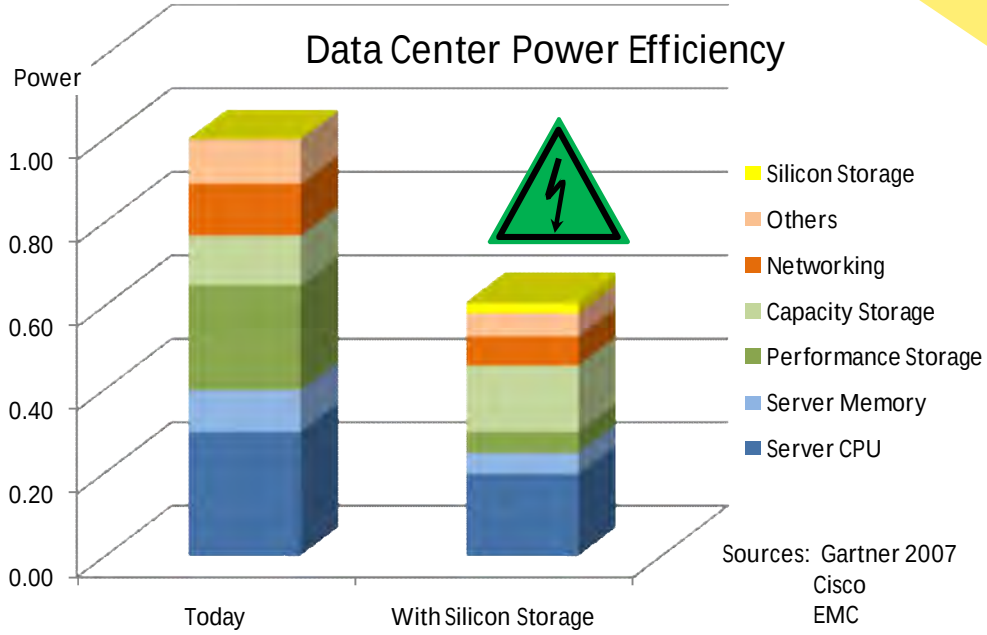
# Green Flash Data Centers

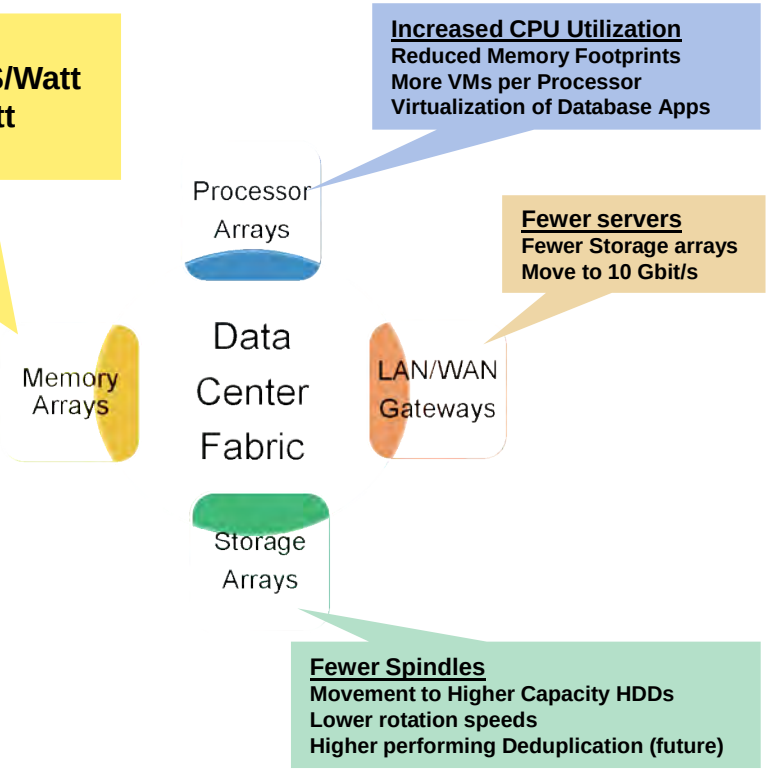
## Reducing Data Center Power by 30%

Violin Silicon Storage

*The power usage of Storage (37%) and Servers (35%) can be dramatically reduced by Silicon Storage and Fewer Spindles*

**Violin Flash:**
- ✓**90% less power than 15K HDDs: 400 IOPS/Watt**
- ✓**90% less power than Servers: 4 GB/Watt**
- ✓**"Instant On" with Low idle power**



# *Thank You!*

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