

# Transformation For Growth

Compete in  
the Era of  
**SMART.**

2014 Consultants &  
System Integrators Interchange

## Transforming Data Economics with IBM FlashSystems



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Flash Solutions Sales Leader  
Storage Platforms, Systems & Technology Group  
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# The **Flash** Market is Heating Up... Fast

“IDC predicts that solid state storage revenue will grow from \$1.7 billion in 2011 and reach \$5.6 billion by 2016, resulting in a **26.8% CAGR** from 2011 to 2016.

IDC expects the amount of NAND solid state technology being shipped into the enterprise to grow an impressive **20x**, reaching almost **2.9EB annually** by 2016.”

Flash technology offers superior performance, efficiency and reliability



Flash optimized systems are evolving to be less expensive than earlier technology



Flash creates new workload opportunities



Source: “Taking Enterprise Storage to Another Level: A Look at Flash Adoption in the Enterprise”, August 2012, IDC



# IBM Ranked #1

for Flash Storage(SSA) Market Share, Worldwide based on revenue for 2013



**Global market acceptance**  
*#1 with 25% market share*



**Clear leadership position**  
*44% greater revenue than next closest competitor\**



**278% growth from 2012**  
*82 PB total flash shipped in 2013\**



*\*Calculations by IBM based on Gartner Report: Market Share Analysis: SSDs and Solid-State Arrays, Worldwide, 2013*



# Disk Relative to the Rest of IT

*In the last 10 years:*

CPU Performance 8 - 10x increase

DRAM Speed 7- 9x

Network Speed 100x

Bus Speed 20x

Disk Speed 1.2x .....and everything waits



Source: IBM and Industry Estimates



# Why **FLASH** matters?

Flash delivers performance and values -

- to boost the applications running your business.

Low Latency: **Do things faster**

High Scalability: **Do more things concurrently**

Low TCO: **Save money and boost value**

Eliminate the storage tier bottleneck -

- and drive efficiency across the entire data path!



# Flash Is All About Applications

Increase  
Performance

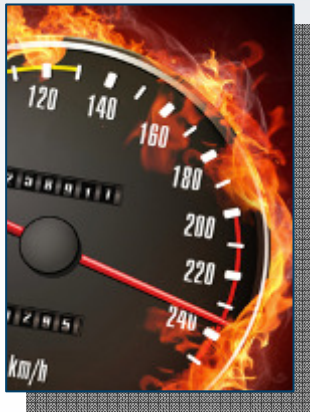
Reduce  
Costs

Enable  
Opportunities

**Faster Applications**  
**Higher Productivity**

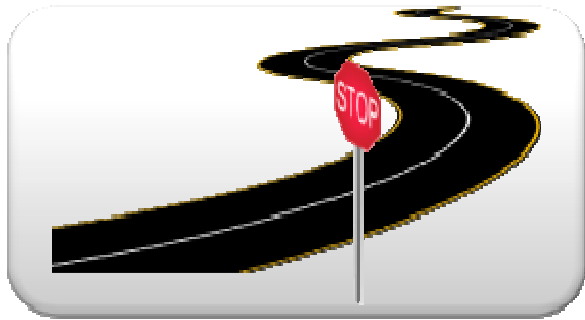
**Scale Business**  
**Reduce CAPEX**

**Application Efficiency**  
**Optimize Resources**



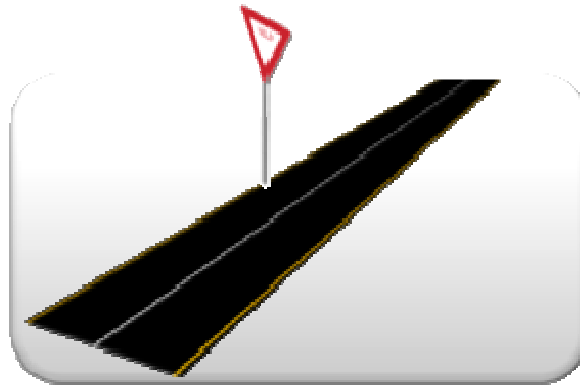


# When the destination is your data...



## HDD Array

- Controller designed for slow spinning media



## SSD Array

- Faster media with controller limitations.



## IBM FlashSystem

- Optimized to be the fastest access to your data

Get there eventually

Get there faster

**There.**



# SSD is NOT Flash Storage

## SSD is NOT Flash Storage

Flash inside a Disk Enclosure

Technology designed for Disk, not Flash

Data protection outside SSD

Data Path handled by OS/Controllers outside SSD

Performance is reduced and marginal

## Common in hybrid arrays

Focus is to maintain functionality and consolidation

Focus on Tiering and Data Movement

SSD competes with all other disks' for resources

When performance matters (which is ALWAYS), SSD is not the best



Added Latency by: **SSD**

Controllers

SW Layers

SAS Controllers

HDDs

Tiering

Shared data path





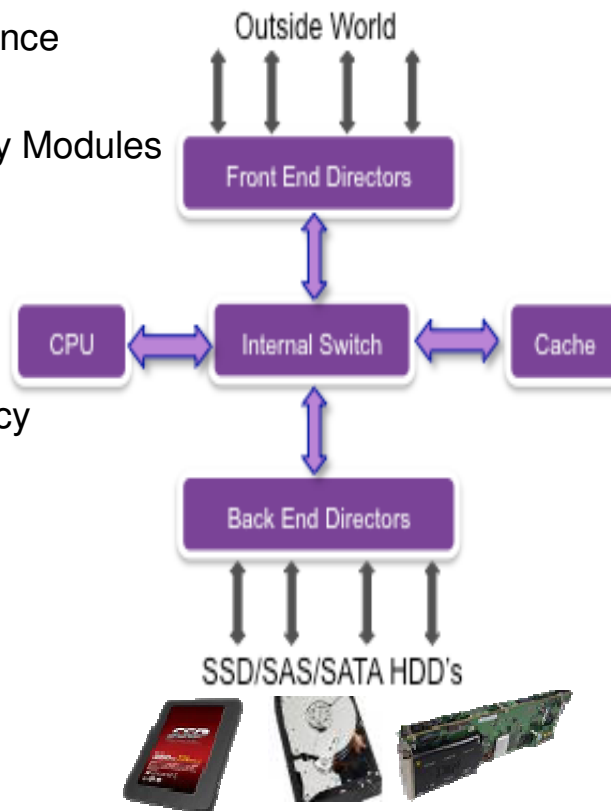
# FlashSystem vs. All Flash with Hybrid Hardware

## FlashSystem

- Best Latency / Best Performance
- Architecture design for Flash
- Higher reliability MicroLatency Modules
- Reduced footprint
- Rack space reductions
- Power/Cooling savings
- Simplicity
- Maximum application efficiency

## Hybrid Hardware with SSDs

- Architecture designed for HDD
- Lower reliability third party SSDs
- Lower density
- Higher power consumption
- Challenges managing third party suppliers for design, manufacturing and support

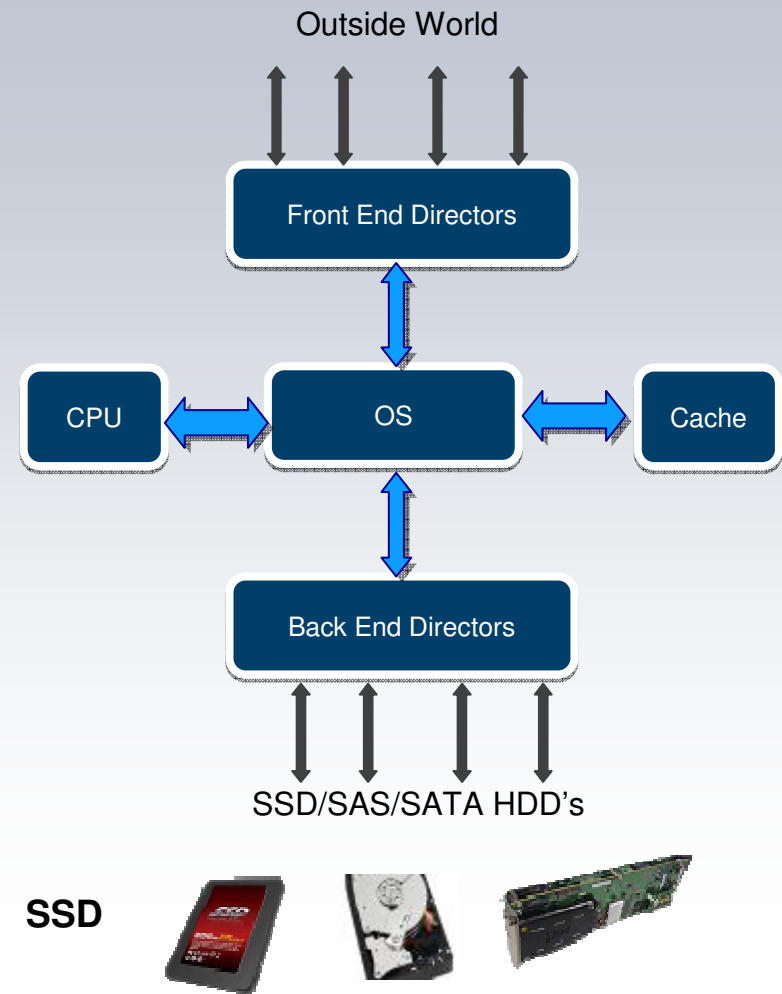


# All Flash with Hybrid Hardware

*Software-based designs = Software constrained data path*

❖ **Added latency by:**

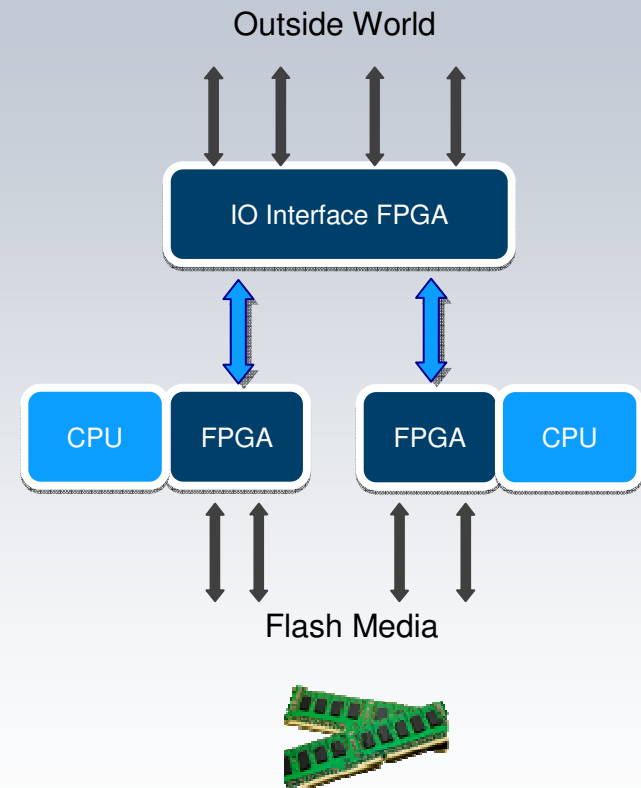
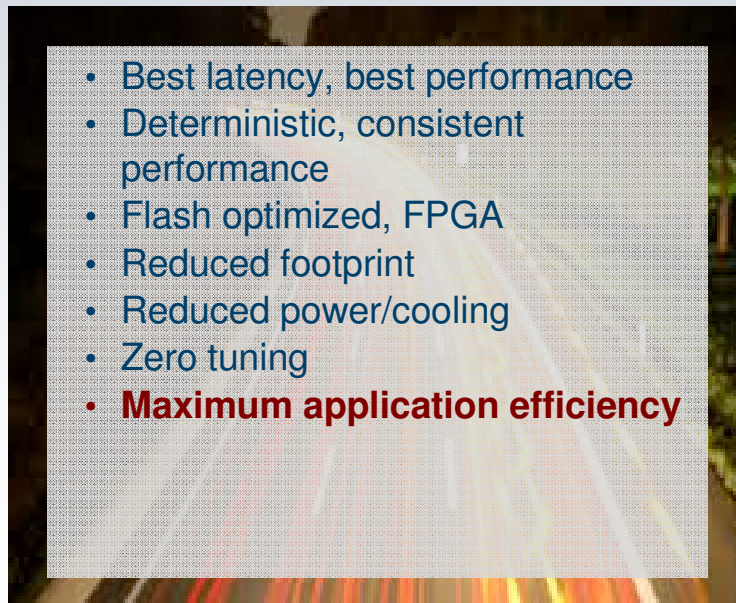
- SW-layer data management & protection
- Array and disk controllers
- Shared bus and tiering
- SSD form factor enclosure



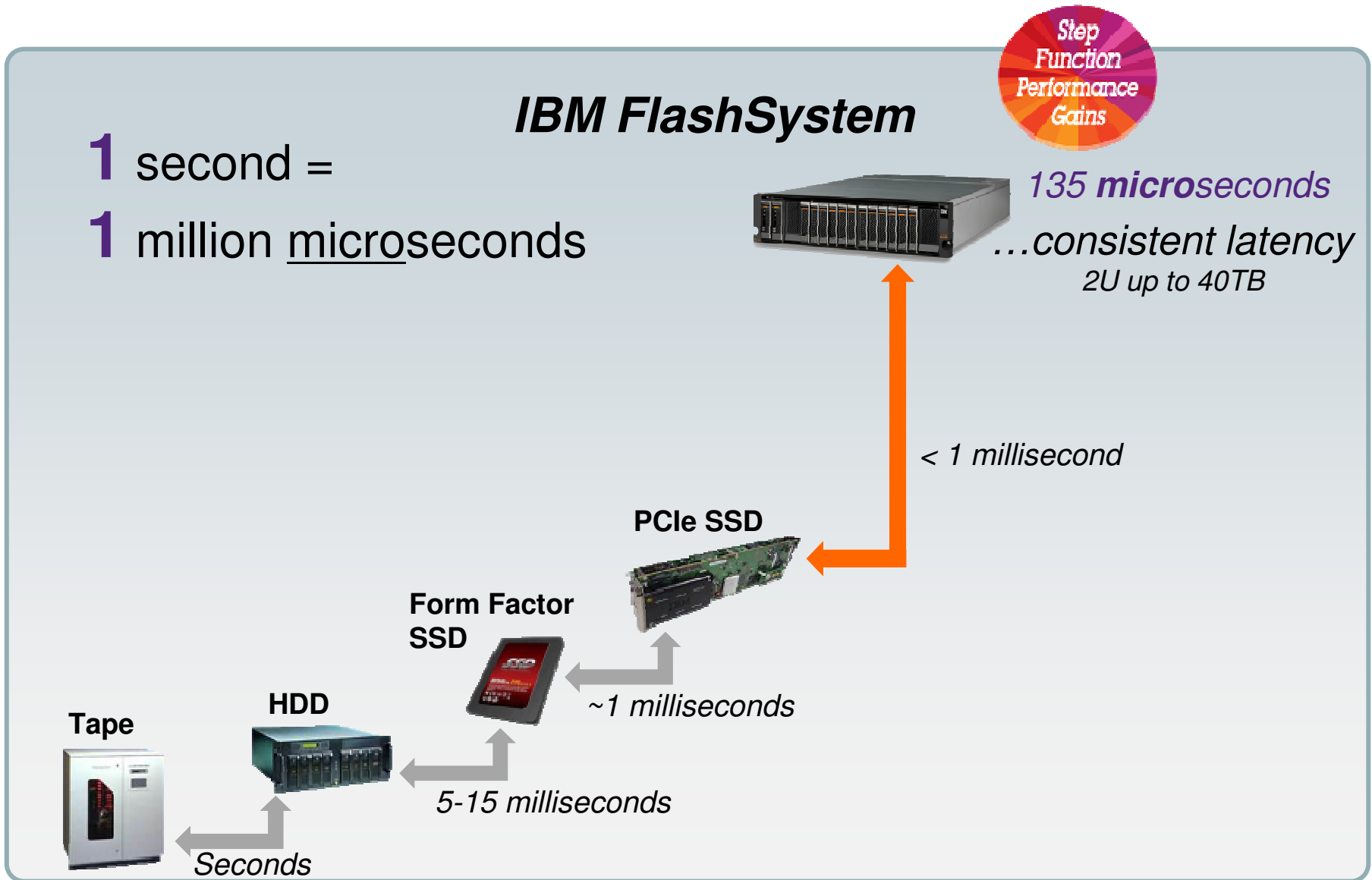
# FlashSystems Explained

## Hardware-based designs: HW controlled data path

- ❖ **Lowest latency and max efficiency with:**
  - ❖ Optimized FPGA HW data path
  - ❖ Custom HW design
  - ❖ Massive parallelism handling data



# A *Tipping Point* in Systems



# IBM Flash System – Highlights

It is an all-flash memory device, purpose-built to deliver the lowest possible latency..

- Up to 48 Usable TB in a 2U appliance
- Up to 1.1M IOPS capability @ 90-135  $\mu$ s latencies
- Up to 8GB/s bandwidth
- < 625 watts of power consumption
- 8x 16GB FC or 16x 8GB FC or 8x 40GB IB connections



... Coupled with the most reliable, redundant design in the industry



- High quality Flash chips – eMLC
- Unique Variable Stripe RAID (VSR) protection within the module
- 2D RAID for system wide data protection
- Highest oversubscription rate (33%) the industry



# Introducing the solution, the FlashSystem 840 replacing performance HDD in your data center



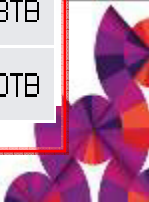
Data center optimized to deliver extreme performance, flexible capacity and total system protection

## Performance at-a-glance

<b>Minimum latency</b>	
Write	90 $\mu$ s
Read	135 $\mu$ s
<b>Maximum IOPS 4 KB</b>	
Read (100%, random)	1,100,000
Read/write (70%/30%, random)	775,000
Write (100%, random)	600,000
<b>Maximum bandwidth 256 KB</b>	
Read (100%, sequential)	8 GB/s
Write (100%, sequential)	4 GB/s

## Capacity Options

Flash module configuration	2x1TB	4x1TB	6x1TB	8x1TB	10x1TB	12x1TB	8 x 2TB	10x2TB	12x2 TB	8x4TB	10x4TB	12x4TB
Raw capacity	2.7TB	5.5TB	8.2TB	11.0TB	13.7TB	16.5TB	22.0TB	27.5TB	33.0TB	44.0TB	55.0TB	66.0TB
RAID 0 usable capacity	2TB	4TB	6TB	8TB	10TB	12TB	16TB	20TB	24TB	32TB	40TB	48TB
RAID 5 usable capacity	N/A	2TB	4TB	6TB	8TB	10TB	12TB	16TB	20TB	24TB	32TB	40TB





# How to compete using the value of Data Economics

*FlashSystem 840 vs. "whatever"*



**IBM FlashSystem 840**



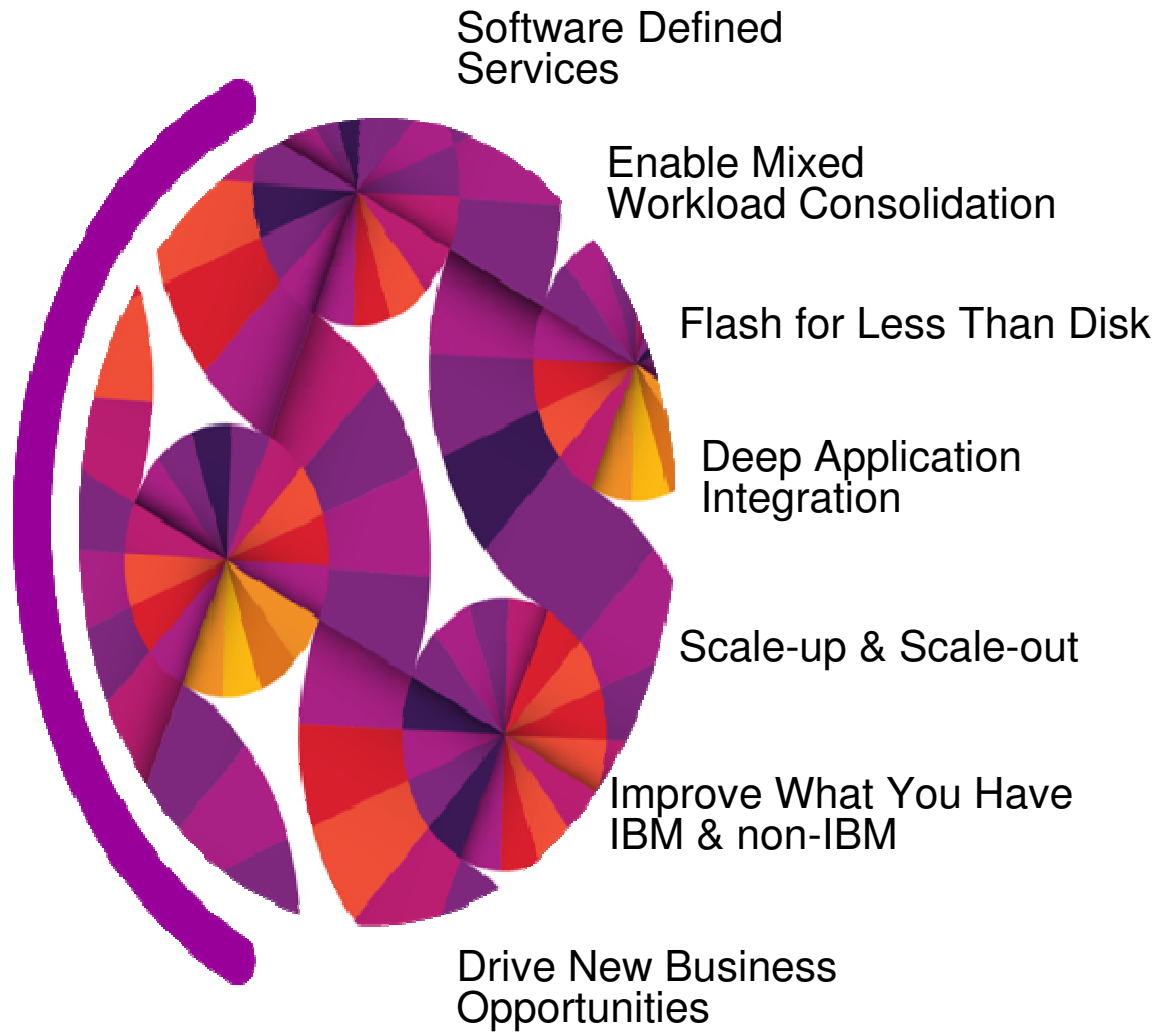
**Mystery All Flash, SSD-based Array**

Price per GB	Latency (minimum)	Power	Space	Capacity density (GB/U)	IOPS density (IOPS/U)
30% better	3x lower	20% lower	300% less	97% better	3x better

**Data can come from specs, benchmarks or better, a real POC!**



# IBM FlashSystem V840



# IBM FlashSystem V840

Accelerate applications with enterprise-class, advanced storage capabilities

- *IBM Real-time Compression*
- *IBM Easy Tier®*
- *Thin provisioning*
- *Copy services*
- *Data Virtualization*
- *Highly available configuration*



## Extreme Performance

- Scalable to 2.5 million IOPS
- Scalable to 19.2 GB/s
- Mixed Workload Consolidation

## IBM MicroLatency™

- 200 µs response time
- Flash-optimized design

## Macro Efficiency

- Scale up to 40TB usable and up to 200TB effective capacity in only 6U
- Scale up to 320TB usable and up to 1.6PB effective capacity in only 36U
- Effective capacity possible with optional Real-time Compression

## Enterprise Reliability

- Advanced Data Services
  - Copy Services, mirroring, replication, external virtualization, VAAI
- Concurrent code load
- Hot swappable architecture
- AES 256, HW-based encryption
- Fully redundant controllers



# Software Defined Storage Services

Software Defined Services



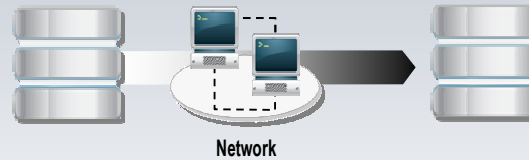
Thin provisioning



Dynamic growth

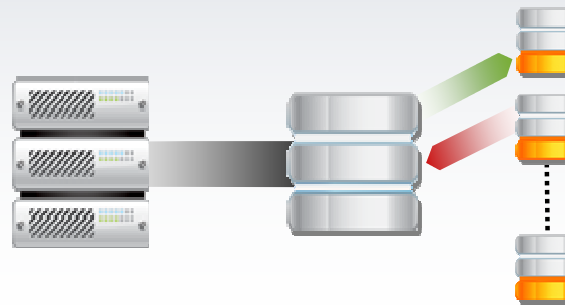
Purchase only the storage you need

High availability configurations



Enable continuous data availability

Copy Services



Eliminate application downtime for backup

Test disaster recovery plans



Validate business continuity strategy

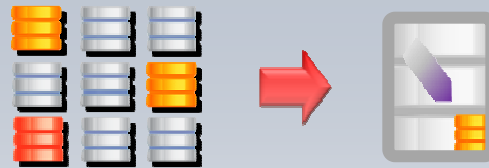


# Flash for Less Than the Cost of Disk



Flash for Less Than Disk

Real-time Compression

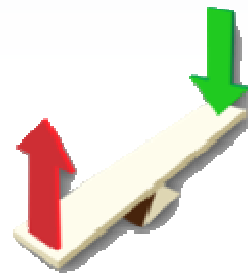


Store up to 5X more data with less flash

Thin Provisioning



Purchase only the storage you need

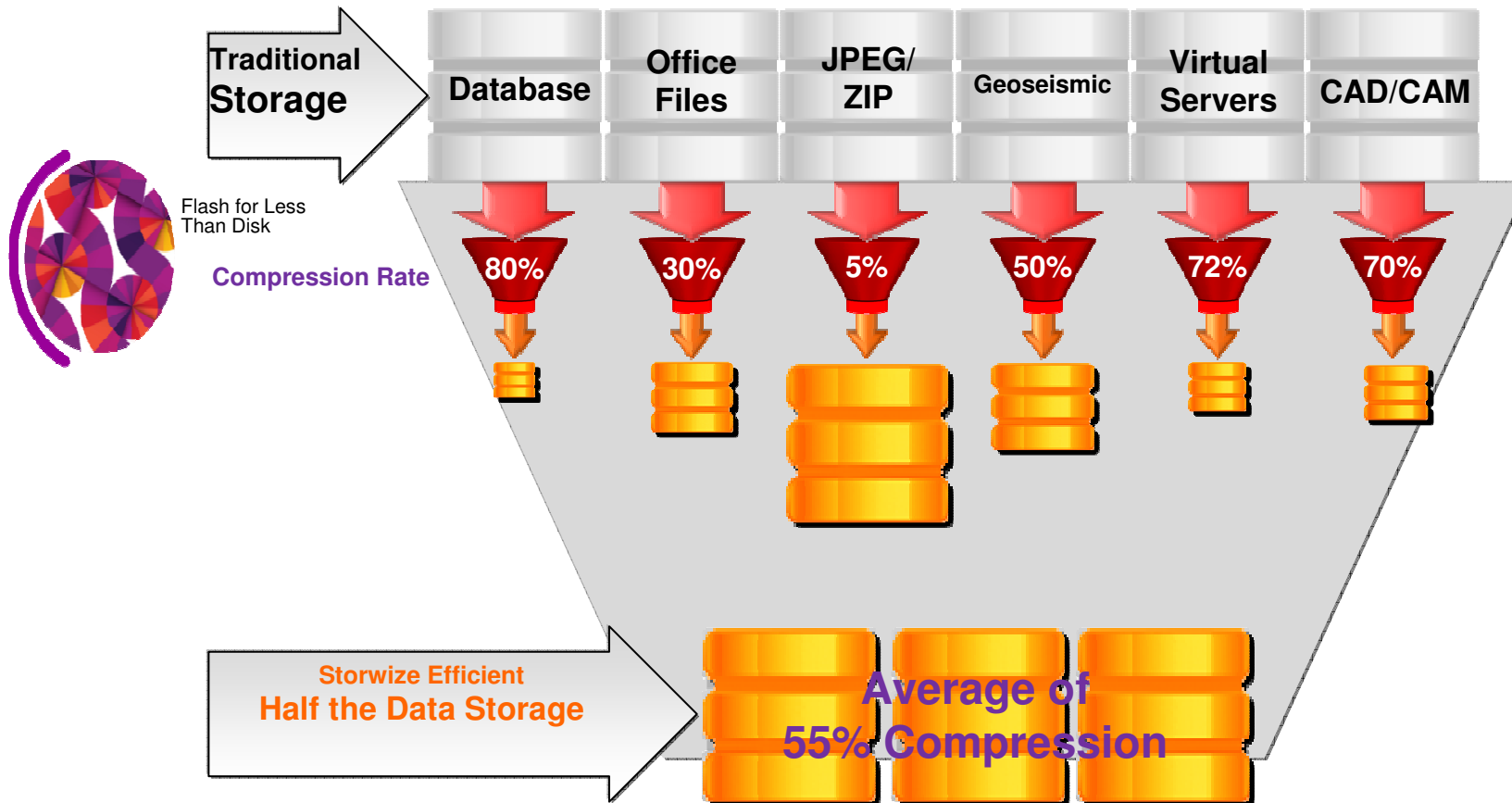


## Tipping Point Economics

- Low latency with high IOPS flash replaces shelves of HDD and enables server consolidation
- Decrease storage TCO with lower space, power and cooling costs



# How IBM V840 delivers.. *Flash at less than disk prices*



Real-time Compression, for active and inactive data





# FlashSystem V840 and VMware®: an ideal fit



## *Driving efficiency, performance, flexibility & scale in virtualized environments*

- Redefine Tier 1 performance for workloads with diverse I/O patterns
- Optimize your data tier with thin provisioning, snapshots, and real-time compression

Area	Integration	Value
Management	<b>vCenter plug-in</b>	<ul style="list-style-type: none"><li>• Storage visibility</li><li>• Self-service provisioning with controlled delegation</li></ul>
Business Continuity	<b>SRA for Site Recovery Manager</b>	<ul style="list-style-type: none"><li>• Automated Storage and Host<ul style="list-style-type: none"><li>• Failover</li><li>• Failover testing</li><li>• Failback</li></ul></li></ul>
Performance	<b>VAAI</b>	<ul style="list-style-type: none"><li>• Hardware accelerated VM copy/migration</li><li>• Hardware accelerated VM initiation</li><li>• Accelerate VMFS (no SCSI reservation)</li></ul>



# IBM Storwize Family delivers .... *Data Virtualization*



“ .....we can now make changes during business hours. ....we estimate to have saved £1m/year in overtime. ”

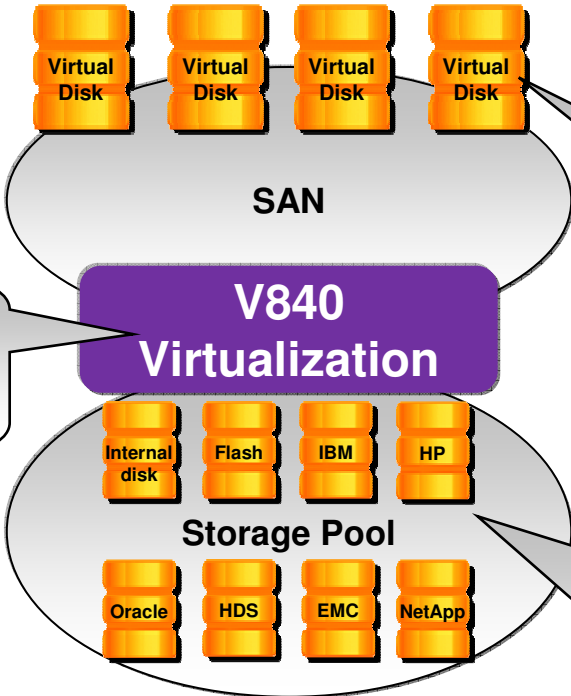
UK Bank

Manage the storage pool from a central point

Apply common services across the storage pool

Make changes to the storage without disrupting host applications

Combine the capacity from multiple arrays into a single pool of storage



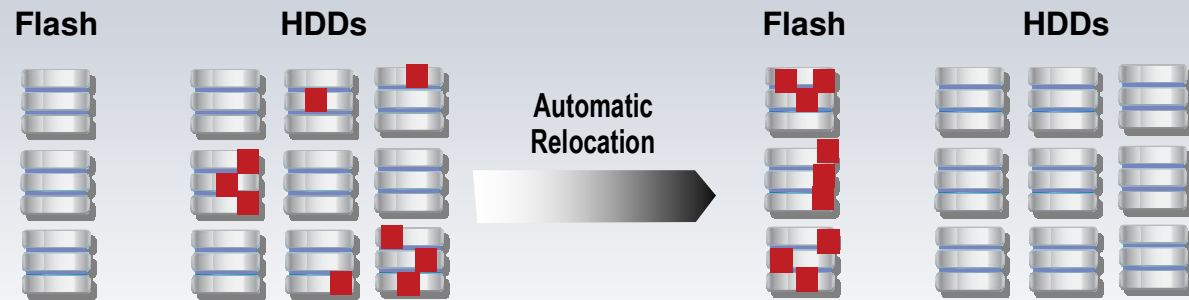
# FlashSystem V840 Virtualizes IBM and Third Party Storage



Improve What  
You Have  
IBM & non-IBM

## IBM Easy Tier<sup>®</sup> flash storage management

Optimized performance at lower overall cost

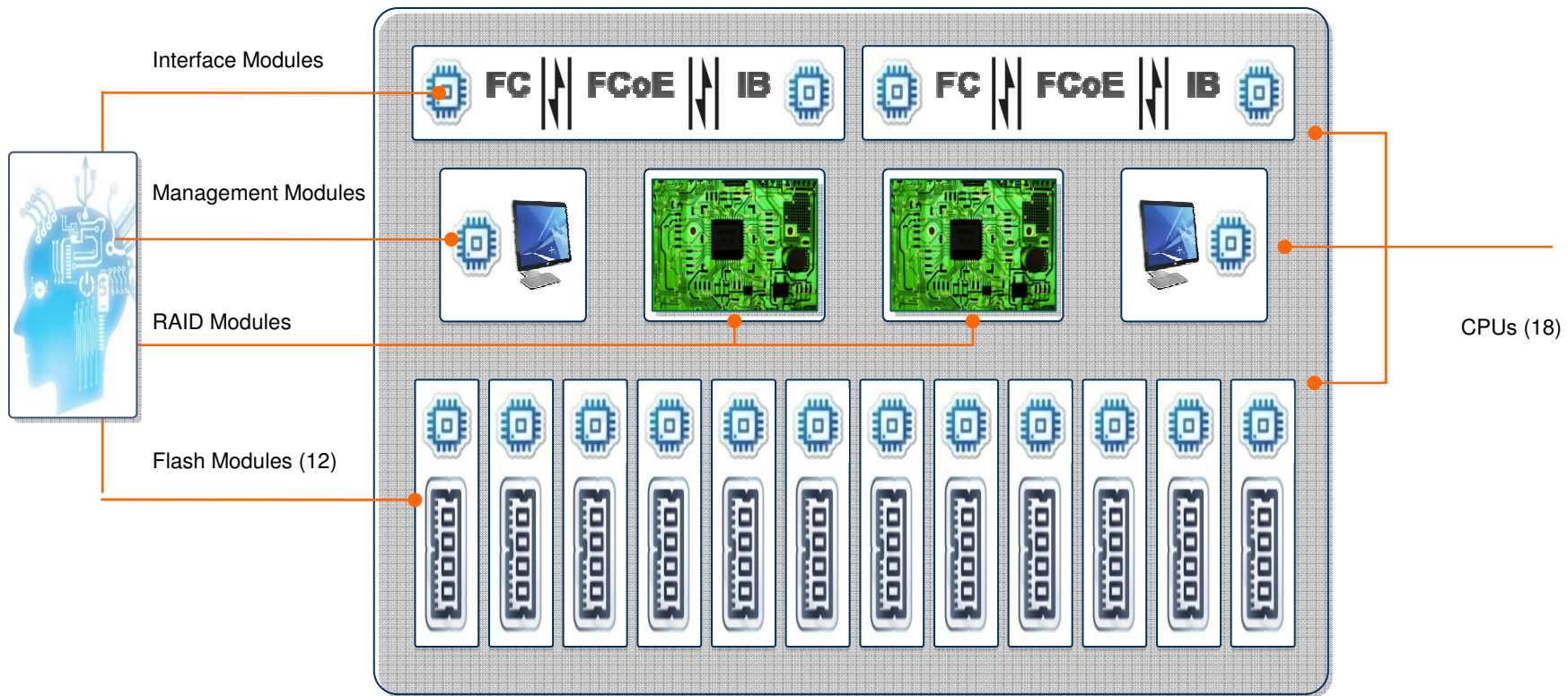


Preserve your **existing** investment in storage

- ✓ Manage
- ✓ Tier
- ✓ Protect
- ✓ Compress with Real-time Compression



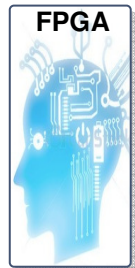
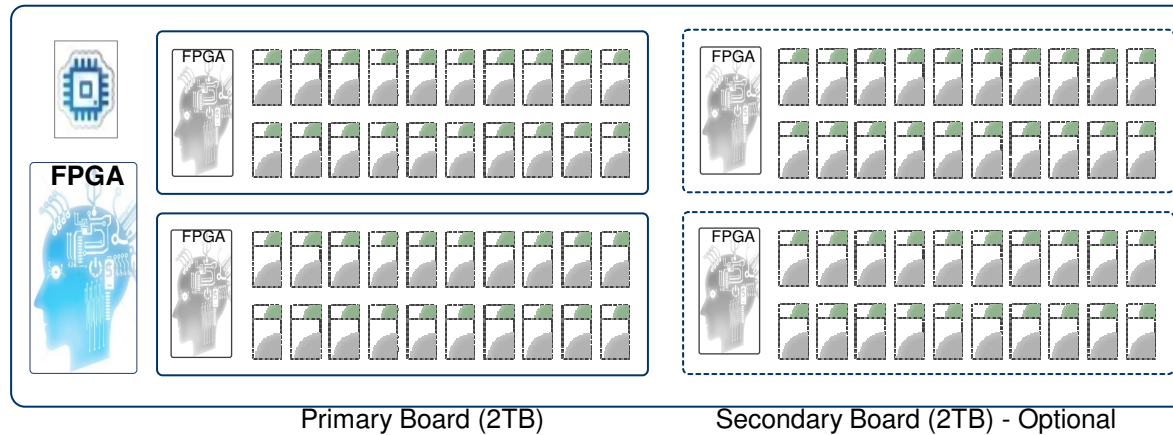
# FlashSystem Core Performance Concepts



- FlashSystem provides a hardware-only data path
  - Custom FPGA-based data movement decreases latency vs. software
- Lower latency on standard SAN interfaces vs. competitors
- Distributed out-of-data-path CPU processing



# Flash Module Architecture



**Gateway Interface FPGA**  
*I/O interface and Direct Memory Access path*



**Control PPC and DRAM**  
*Out of Data path operations*  
*Garbage collection, Error Handling, System Health*  
*Wear Leveling, Statistics, etc.*



**Flash Controller - FPGA**  
*2 or 4 per Module*  
*Data path, Hardware I/O logic*  
*Look up Tables and Write Buffer*  
*Each controls 20 flash Chips*



**Flash Chips**  
*20 per Flash Controller*  
*40 or 80 per Module*



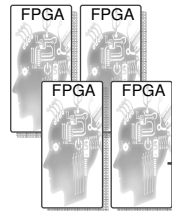
Data



XOR parity

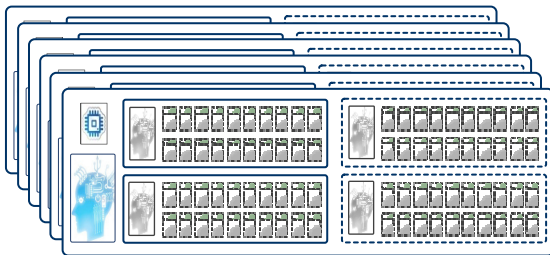


# Scalability and Parallelism



## Up to 4 Controllers per Module

- Each can do 40 4K DMA operations in parallel  
Includes VSR Operations (36 without VSR)



## Up to 40 Controllers per FlashSystem 840

- 1,600 4K DMA operations in parallel

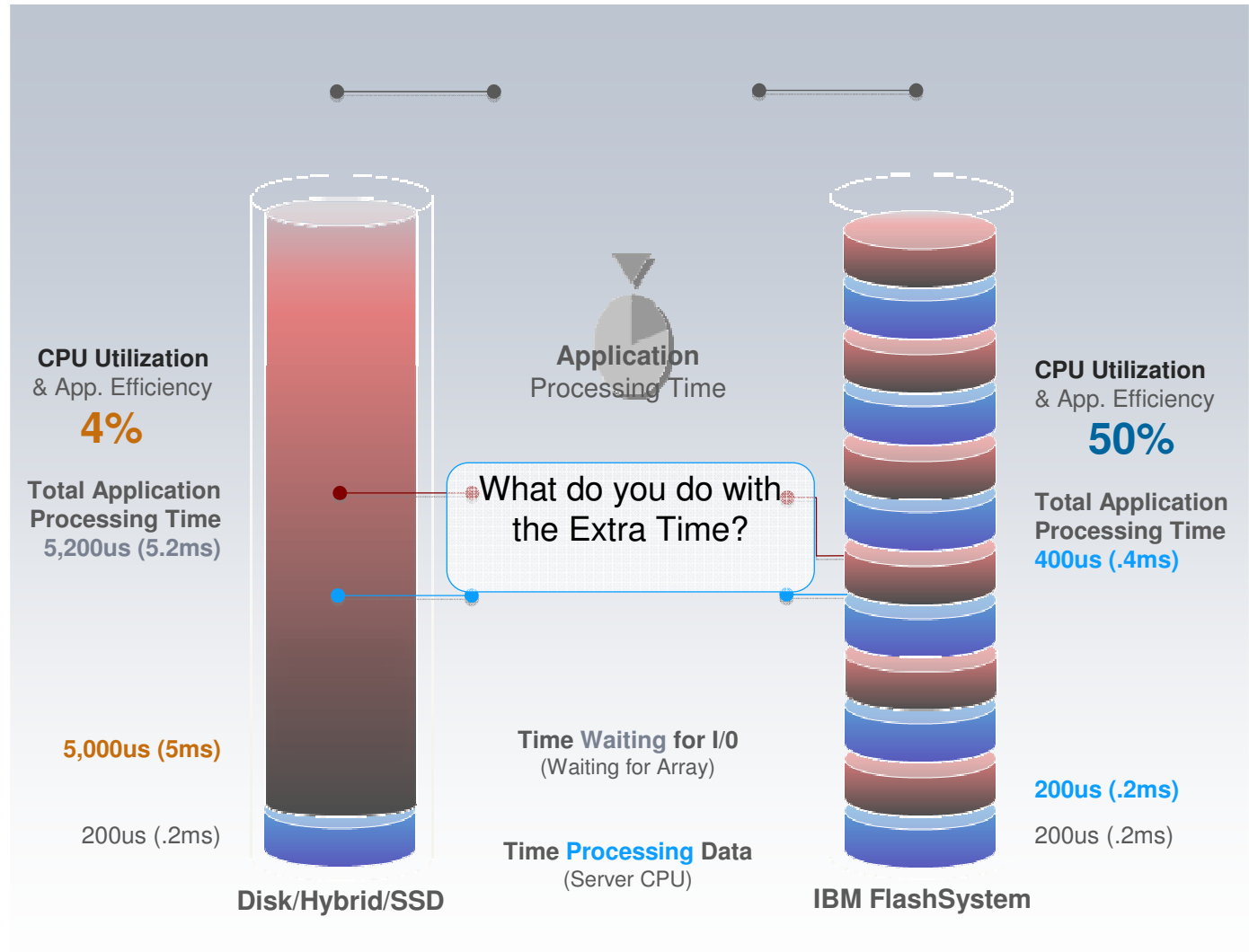
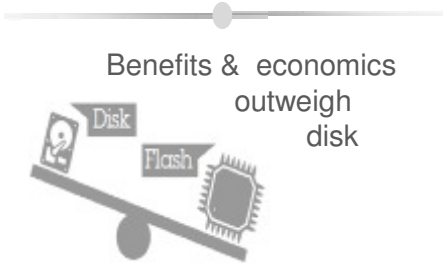
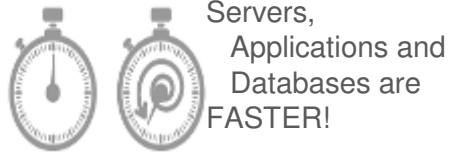
The FlashSystem 840 can also issue **8 concurrent operations** per flash chip.

With up to 80 chips per flash module and 12 flash modules per system, the FlashSystem can service up to **7,680 simultaneous operations in flash.**





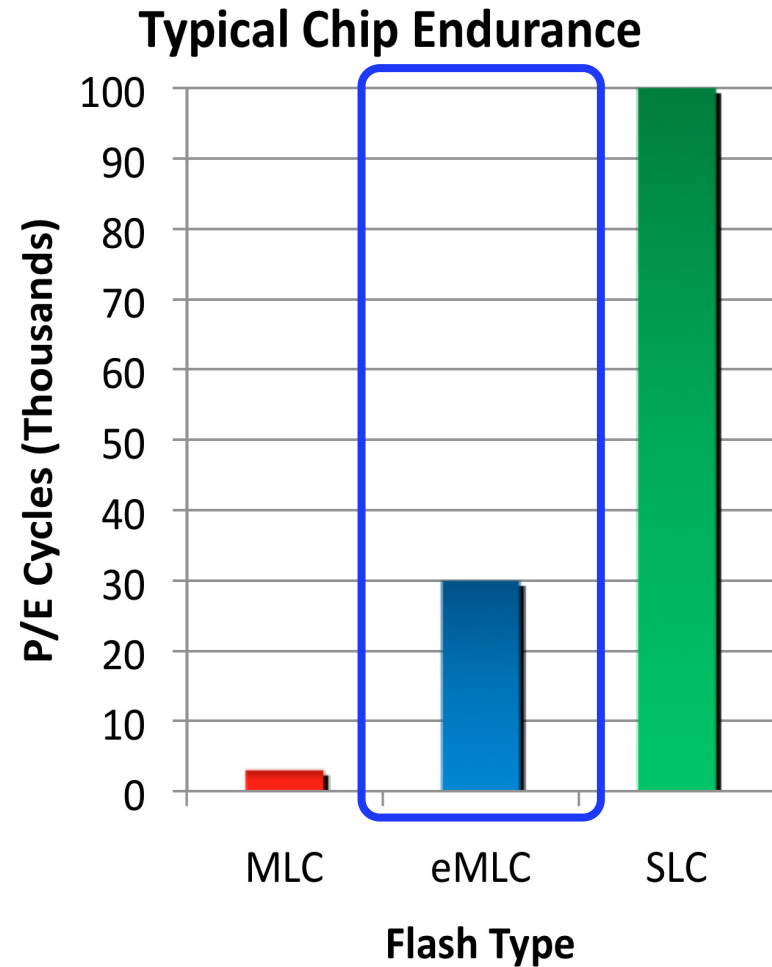
# Latency translates to Application Efficiency



# Flash Quality Matters..

## There are three types of flash

- MLC: Multilevel cell flash is consumer-grade
  - eMLC: is Enterprise-grade
    - 10x improvement over MLC
  - SLC: Single-level cell
    - 33x improvement over MLC
- eMLC will handle most enterprise applications workload requirements
- IBM FlashSystem technologies has
- Variable Stripe RAID™
  - 2D Flash RAID™
  - Wear leveling
  - Over-provisioning
- Increases system life by **improving the endurance** of both eMLC and SLC



# Flash Quality Matters..

	MLC	eMLC	SLC
# of P/E Cycles	3K	30K	100K
Cost	\$	\$\$ (2x)	\$\$\$\$ (4x)

Flash Life =  $\frac{\text{Flash Capacity} * \text{Flash Quality}}{\text{Write Bandwidth}}$

Considering 10 TB capacity & write bandwidth of 1Gbps,

– eMLC Flash Life =  $10 * 30000 / 1\text{Gbps} = \sim 9.5 \text{ Yrs}$

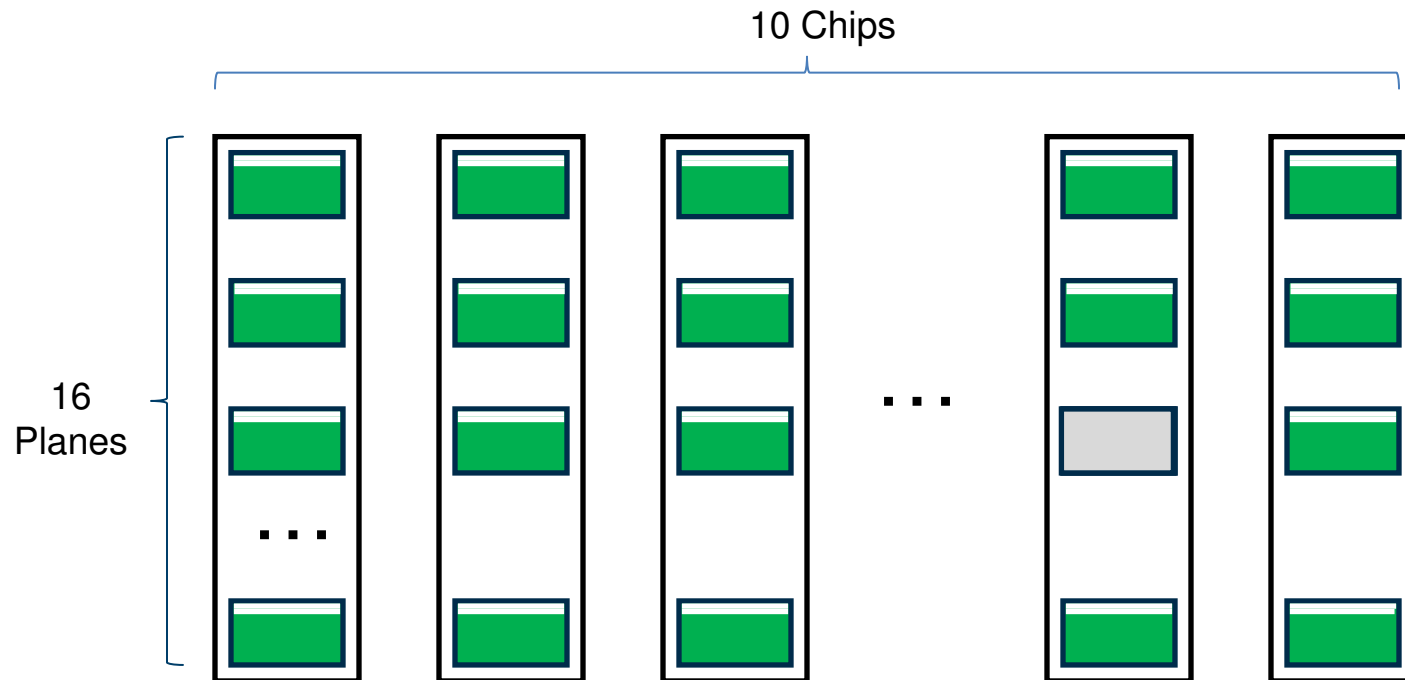
– MLC Flash Life =  $9.5 / 10 = \sim .95 \text{ Yrs} = \sim 11-12 \text{ months}$

**For the same capacity & write bandwidth, eMLC provides 10x more endurance than MLC**

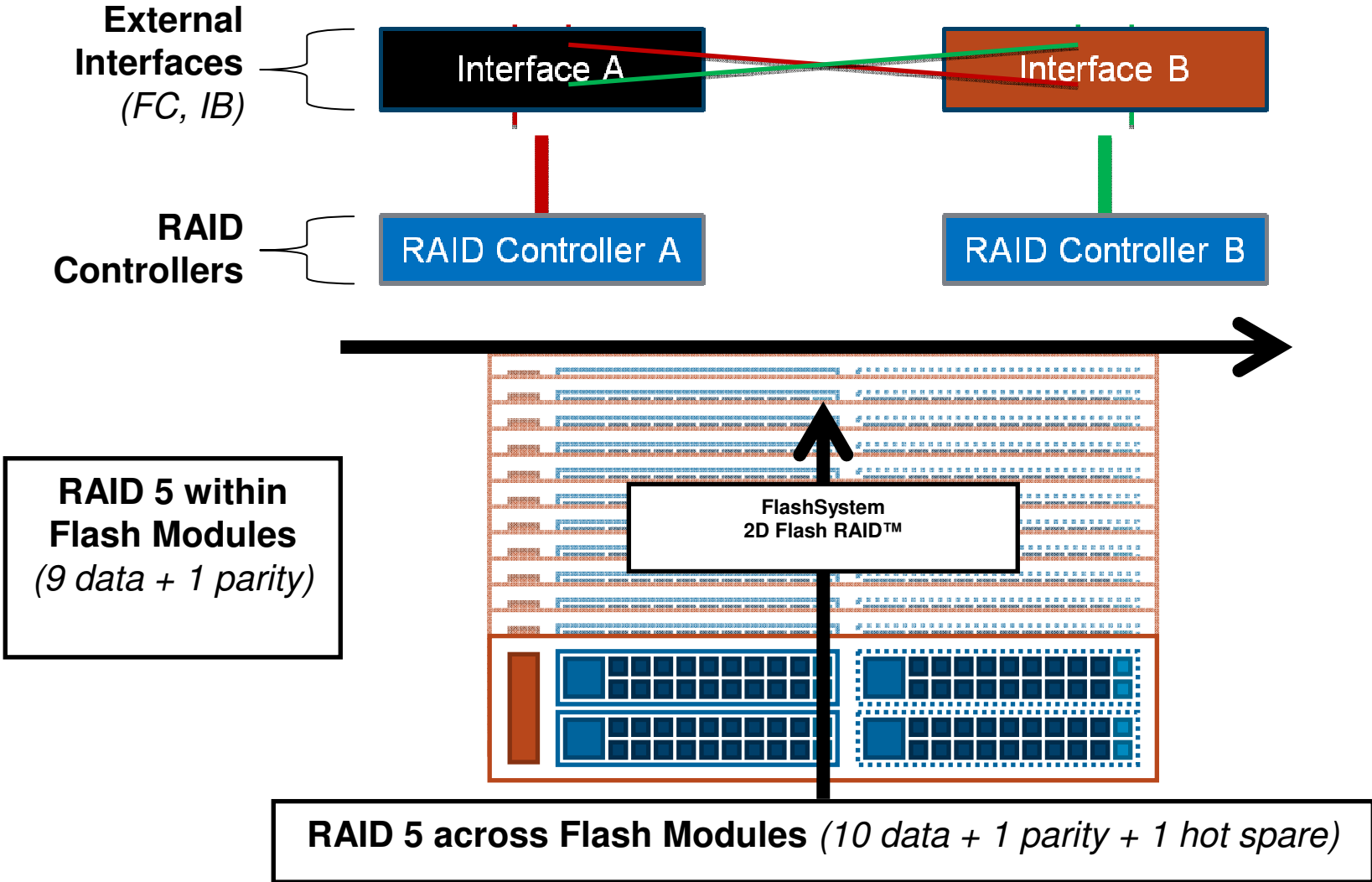


# Variable Stripe RAID™ (VSR)

- Patented VSR allows RAID stripe sizes to vary.
- If one die fails in a ten-chip stripe, only the failed die is bypassed, and then data is restriped across the remaining nine chips – **Reusing the remaining capacity in both the chip & the stripe**
- **Higher availability; Fewer maintenance events due to flash failures**



# 2D Flash RAID™



# All-Flash is About *Economics*



“spectacular”; processing huge number of transactions in one day, lower response times...

*Core Financial Transactions*



...5TB in 3.5 inches of rack space vs. 1,300 disk for 400K IOPs, less than 1/10<sup>th</sup> the cost...

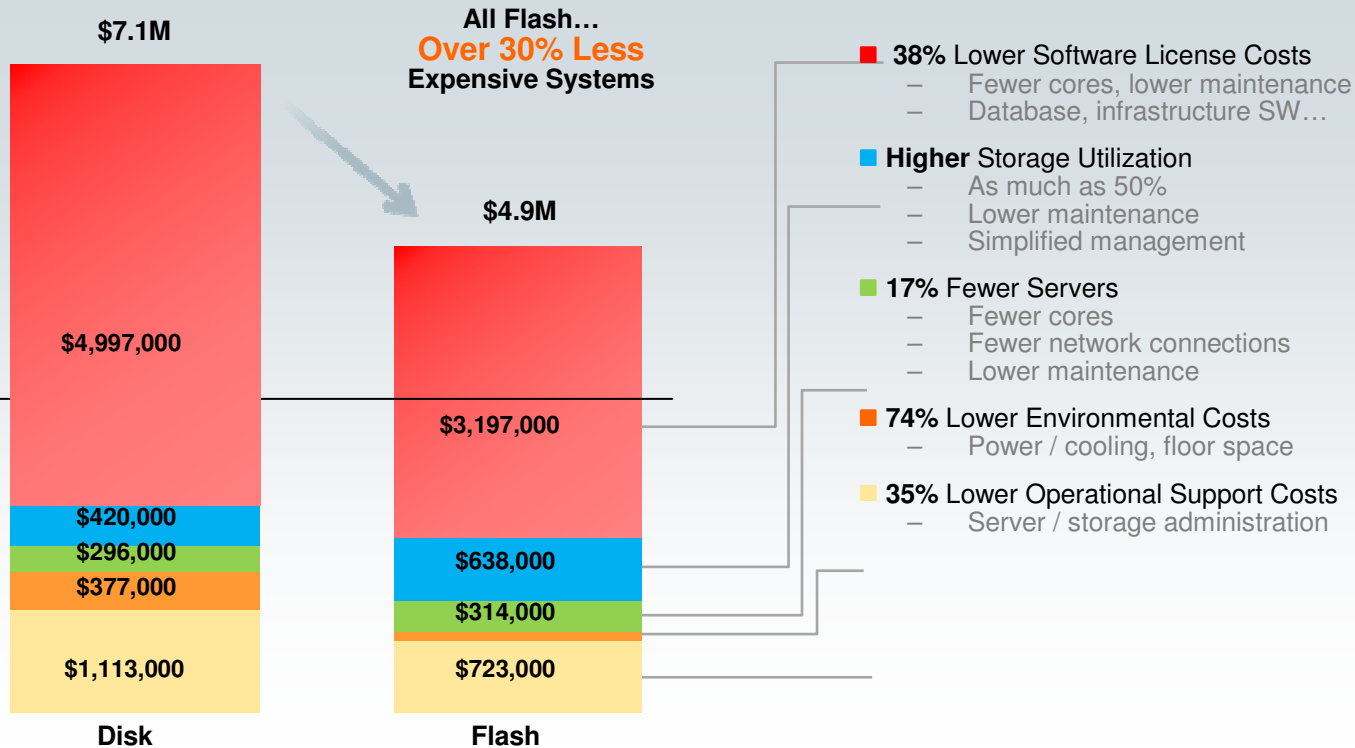
*Cloud Storage*



...75% less rack space, 90% less power, 83% faster data compression...

*SAP*

Source: IBM Client Experiences

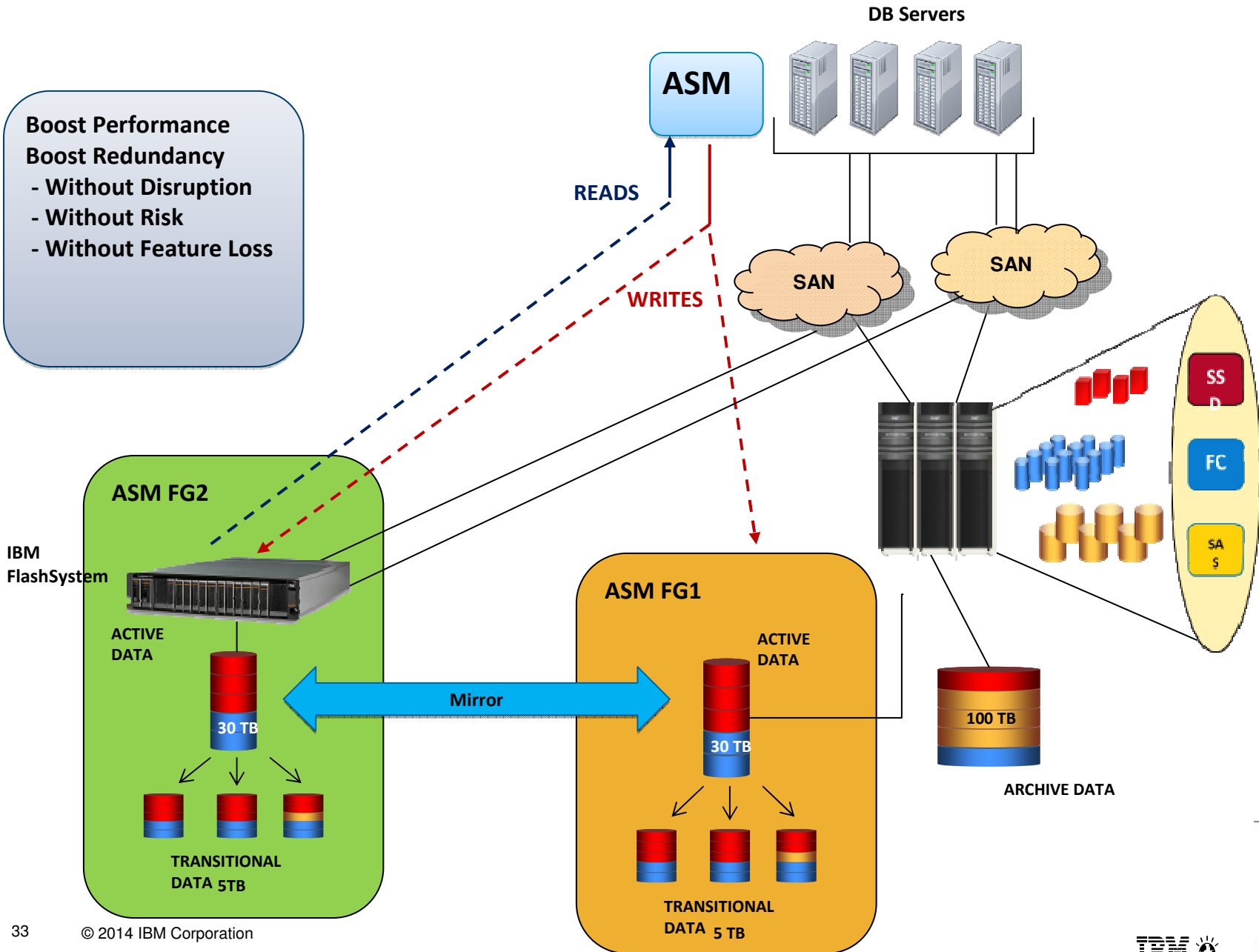


Source: Wikibon, March 2013



# Flash Integrates Seamlessly

Boost Performance  
 Boost Redundancy  
 - Without Disruption  
 - Without Risk  
 - Without Feature Loss



# A Few IBM Flash Systems Customers..



monster worldwide



# Coca-Cola Bottling Co. Consolidated

## Delivering deeper insight into customer demand four times faster



Case Study



Video



### 75 percent

reduction in processing time without replacing a single server

### 20x more

data crunched within the existing window and SLAs

### 150 million

cases of product per week

#### Solution Components

- SAP ERP
- JDA Manugistics
- IBM FlashSystem 820
- IBM SAN Volume Controller



**Business challenge:** CCBCC needed to process more data to accurately anticipate customer demand without increasing time-to-insight or exceeding SLAs.

**The solution:** CCBCC now processes 20 times more forecasting data, down to the store level, which enables them to match manufacturing output with demand, enables earlier logistics planning and increases profitability.

**“By using IBM FlashSystem to accelerate our insights into customer demand, we’re better placed than ever before to offer unbeatable levels of service to our customers across the United States.”**

—Tom DeJuneas, Infrastructure Manager, CCBCC



## Transforming customer service with ultra-fast flash storage

**30x faster**

than tier 1 EMC VMAX storage

**3.6x more**

iPhone activations per minute

**#1 ranking**

in customer satisfaction among national carriers



### Solution Components

- Oracle RAC
- IBM AIX
- IBM FlashSystem 820
- IBM SAN Volume Controller
- Microsoft Lync

**Business challenge:** Sprint's call-center agents needed fast, reliable access to respond to customer issues. Existing storage infrastructure was unable to keep up.

**The solution:** Sprint deployed IBM FlashSystem to dramatically improve performance and resolve customer queries faster, while slashing energy consumption, data center footprint and overall operations cost.

**"IBM FlashSystem solution allows us to identify and address potential customer issues faster, helping us to maintain and build our subscriber numbers—which is absolutely the most critical metric in our industry."**

—Karim Abdullah, Director of IT Operations, Sprint Nextel





# Major Home Improvement Store

## Building competitive advantage with flash analytics

**12x faster**

business analytics performance

**85 percent**

reduction in batch process time

**80 percent**

decrease in power consumption

### Solution Components

- SAS
- IBM FlashSystem 840, 820
- IBM SAN Volume Controller
- IBM Storwize V7000
- VMware VDI
- SPLUNK



**Business challenge:** This home improvement company needed to quickly download information from multiple production databases and perform analytics. The existing storage took 6 to 8 hours to complete, impacting end user access.

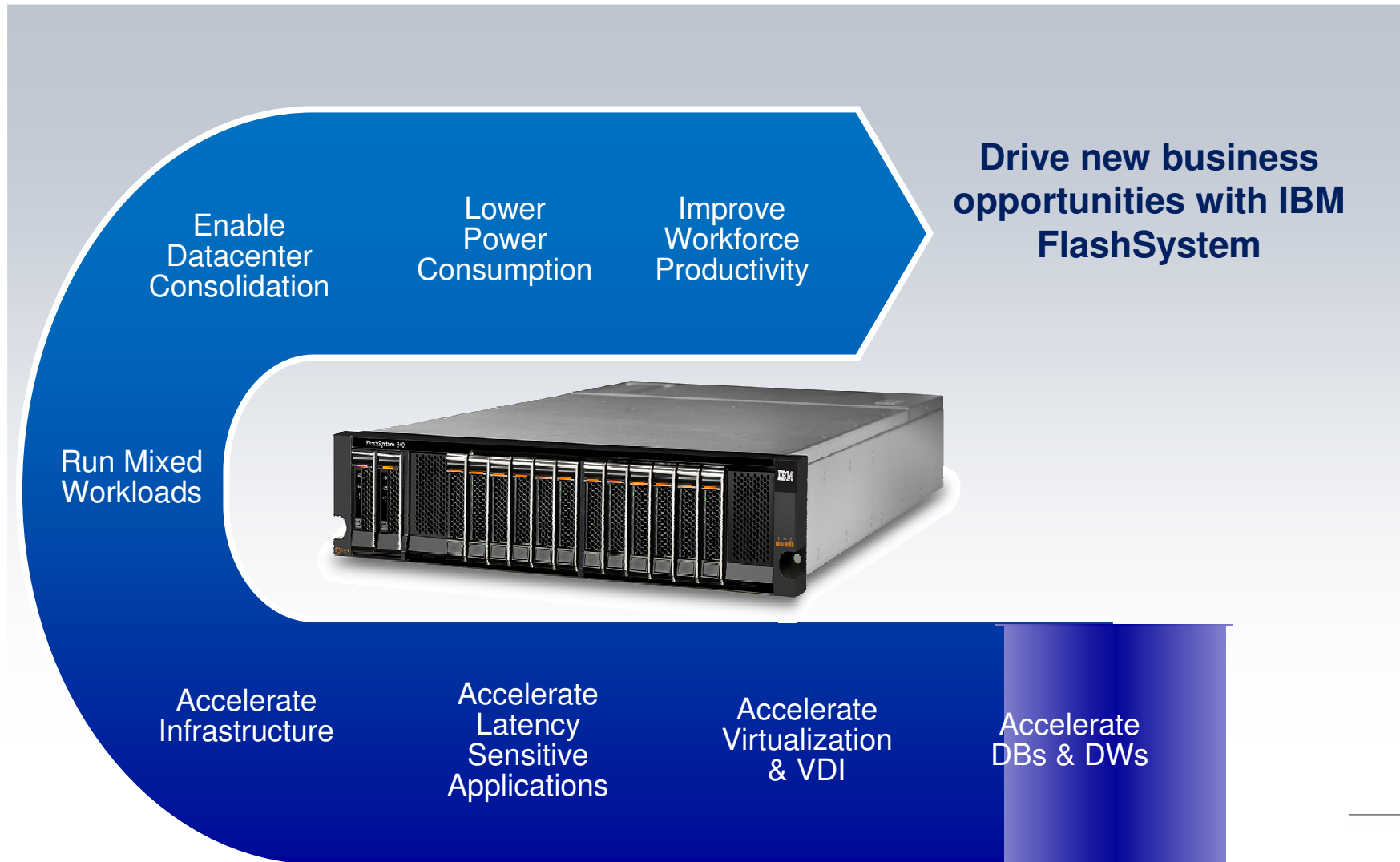
**The solution:** The company moved mission critical applications off EMC VMAX on to IBM FlashSystem and reduced key batch processes from hours to minutes.

**“IBM’s FlashSystem’s performance and management is incredible. We will be implementing a lot more IBM Flash this year.”**

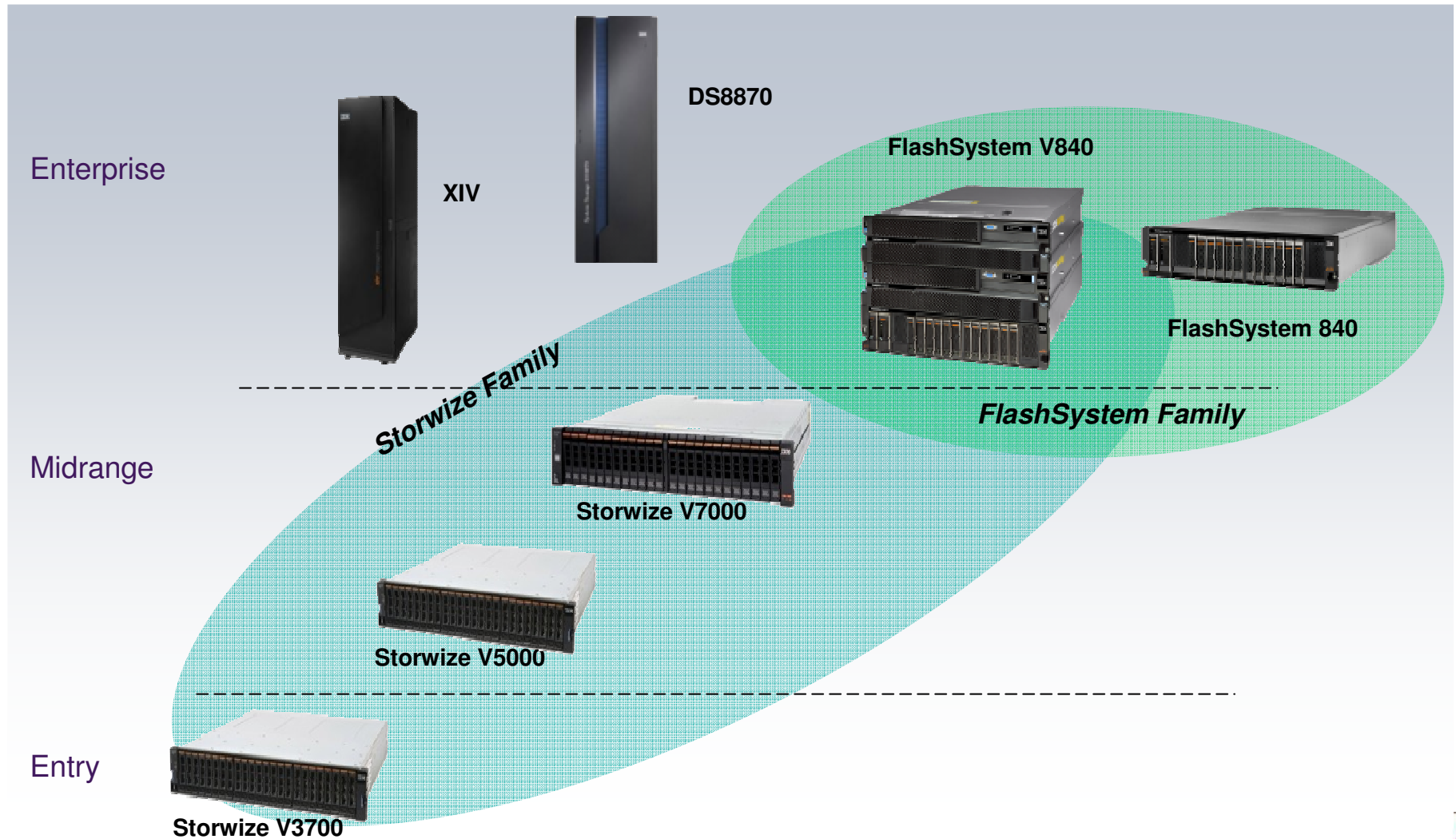
— Senior Director, Enterprise Storage



# FlashSystem Means Performance and Economics



# IBM Disk & Flash Portfolio



# Summary

- **Flash is breaking new ground**
  - Changes the way we look at IT infrastructure and how we define performance.
- **Hard disk drives continues to have a future**
  - In data center
  - Storing data you rarely need to access.
- **IBM FlashSystem family enables a new future**
  - IT is no longer constrained and pained by the need to deploy HDD for performance.

Learn more at [ibm.com/storage/flash](http://ibm.com/storage/flash)





धन्यवाद  
Hindi

谢谢  
Simplified Chinese

תודה רבה  
Hebrew

Спасибо  
Russian

Simplified Chinese

Gracias  
Spanish

شكراً  
Arabic

Thank You  
English

Obrigado  
Brazilian Portuguese

Grazie  
Italian

감사합니다  
Korean

Danke  
German

Merci  
French

நன்றி  
Tamil

謝謝  
Traditional Chinese

ขอบคุณ  
Thai

