Flash in PC and Enterprise Computing

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We said last year...

SSD had benefits for PCs:

- **Acoustics**
- **Reliability**
- **Durability**
- **System responsiveness and performance**
- **System start/boot up**
- **Power consumption**
- **Potential weight reduction**

And, We Delivered

Flash Benefits in Dell Products:

- **Acoustics**
- **Reliability**
- **Durability**
- **Performance**
- **Boot time**
- **Power**
- **Weight**

Corporate Mainstream & Ultra Portable

Mobile Workstations

Gaming

Consumer

SSD

Internal flash assist

Flash in PCs is a Continuing Focus

A Year of Progress for PCs

Standards

– NVMHCI specification completed

– T13/ATA command set improved

Products

– SSDs of all kinds

– Flash acceleration products (e.g. H-HDD, Intel Turbo Memory)

Surprises

– Markets: SSDs with lower capacity/cost for emerging markets

– Technology: Faster than expected MLC adoption in PCs

– Value: >10k RPM performance in notebooks (already!)

What About Enterprise?

SSD Benefits

- **Embedded intelligence**
- **Random I/O performance**
- **Power consumption**
- **Storage density**

SSD Focus: Performance

Today

Desired Enterprise Performance

RR	RW
✅	❌
SR	**SW**
❌	❌

RR	RW
✅	=
SR	**SW**
=	=

Goal: Better than HDD

SSD Focus: Reliability

Today

Desired Enterprise Reliability

MTBF ✓	BER ✓
WEAROUT ✗	SMART ✗

MTBF ✓	BER ✓
WEAROUT =	SMART =

Goal: Better than HDD

SSD Focus: Random I/O

Increasing CPU cores

Core 1   Core 2
Bus
L2 Cache

10+ Cores
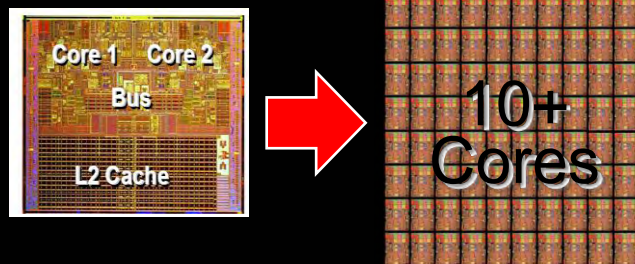
Increasing Virtualization

VM   VM   VM   VM   VM
Virtualization Layer

Increasing Storage IO

IB		2.5Gt/s	5.0Gt/s	10.0Gt/s
FC		1-2 Gb/s 2-4 Gb/s	8Gb/s	
EN	10/100 Mb/s	1.0Gb/s	10.0Gb/s	40/100Gb/s
I/O	PCIe	2.5 Gt/s	5.0 Gt/s	10.0 Gt/s
	PCI			
HDD	SAS	3.0 Gb/s 6.0Gb/s	12.0Gb/s	
	SATA	1.5Gb/s 3.0Gb/s 6.0Gb/s	12.0Gb/s	
	PATA			

2000   2005   2010+
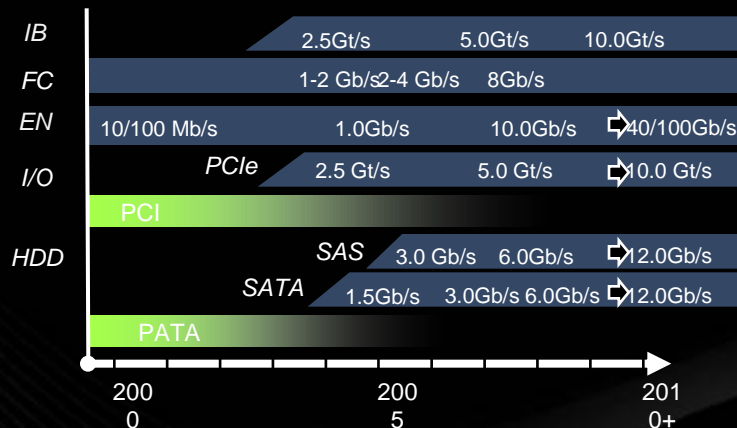
Increasing SAN Scalability

V V M M   V V M M   Server Virtualization
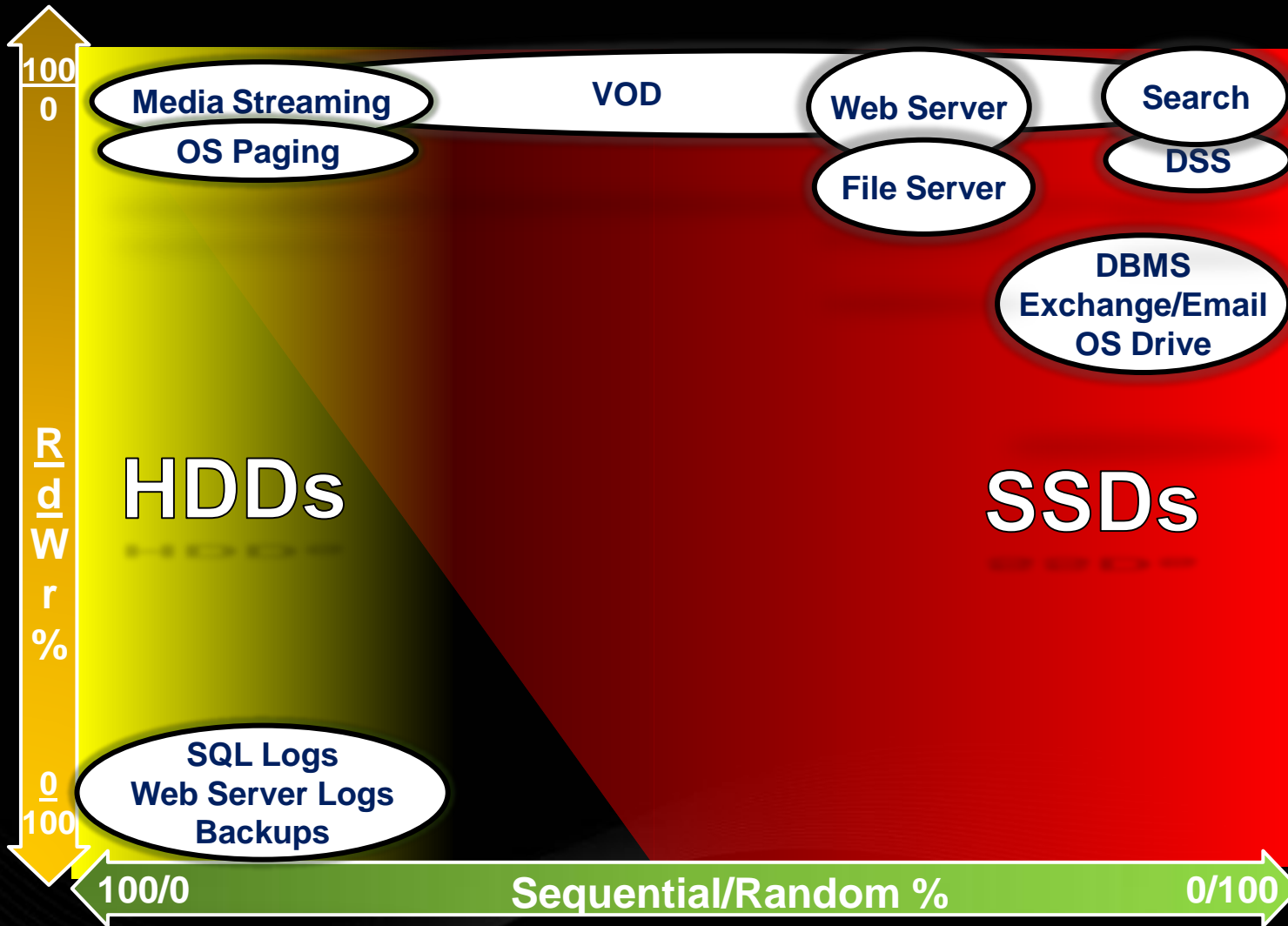V M M   IO Virtualization (IOV)

1GE/10GE

SAN

Storage Virtualization

DELL
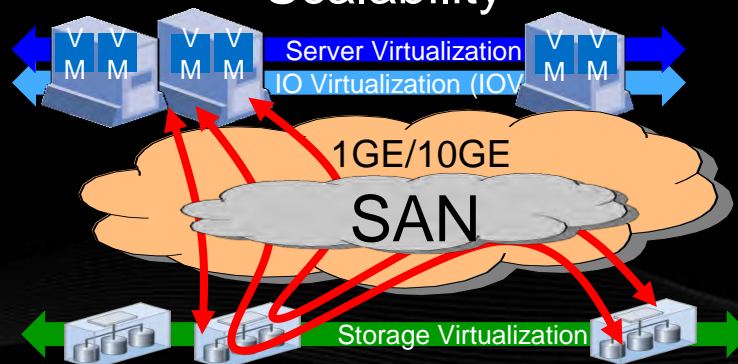
SSD Focus: Green IOPS
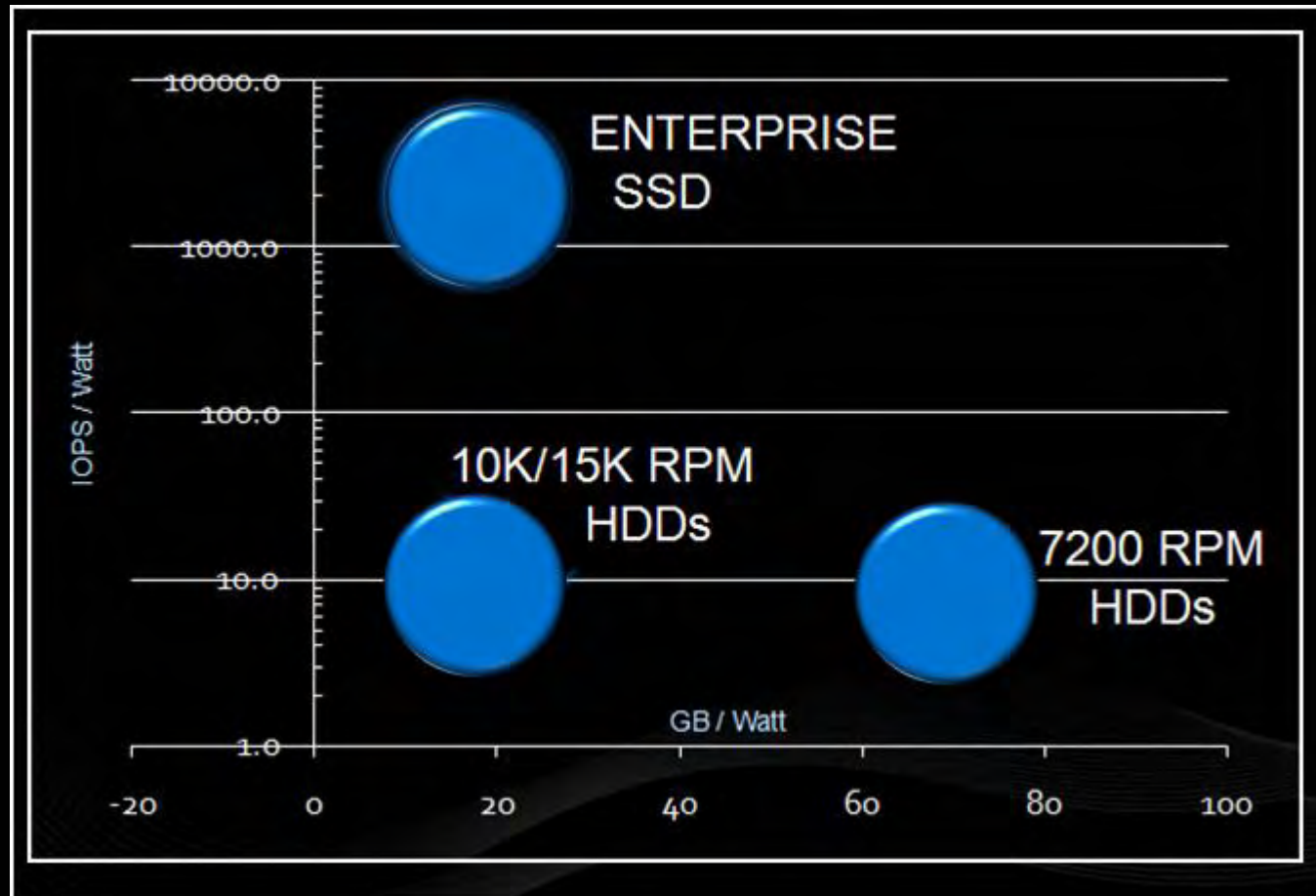
Enterprise Applications
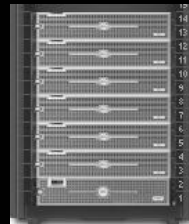
System Possibilities

Flash Goals:
Costs: reduce 30-40% y/y
Density: increase 50% y/y
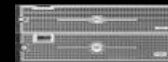Power: reduce 30% y/y

1300 2.5" SAS drives

Today

130 SAS + SSD

Benefits:
Comparable Performance
2X Lower Costs
9X Lower Power

2011 ?

All SSD

Benefits:
Better Performance
10X Lower Costs
23X Lower Power

SSD Segmentation

Market	Platform Types
Enterprise – High Performance 300X SSD 20-50K RR IOPS	Storage / Servers
Enterprise – Mid Performance, Power, Reliability 66X SSD 10K RR IOPS	Servers / Storage Workstations
Enterprise – Performance. Power, Reliability 10X SSD 4K RR IOPS	Servers Workstations
Enterprise – Boot, Power, Reliability 2X SSD ~600 RR IOP	Blades, Servers

Cost, IOPS, Duty Cycle

Industry Focus Needed

- **Standards: NVMHCI, SMART**

- **Enterprise Performance: > Enterprise HDD**

- **Enterprise Reliability: > Enterprise HDD**

- **Performance Complexity : Simplified positioning**

Dell

PC and Enterprise Systems