Integrating SSDs into Virtual Servers

Opportunities and Challenges
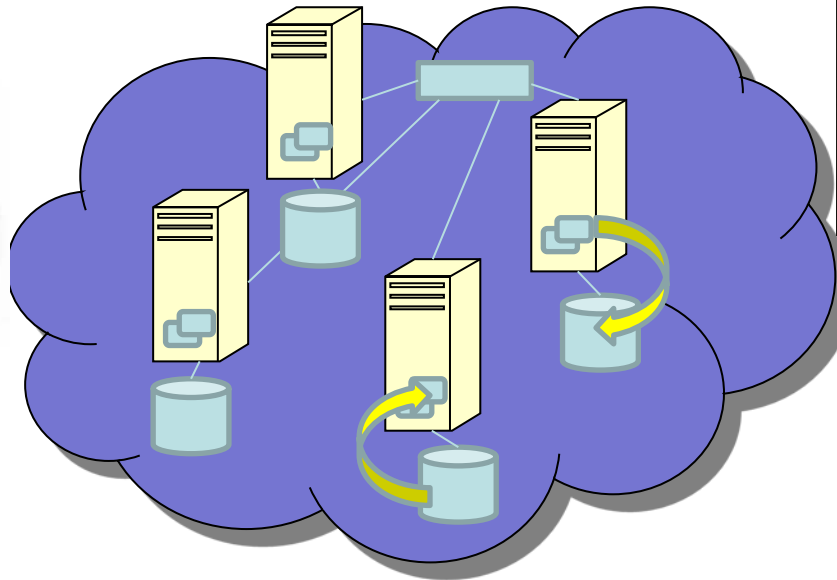
Andy Mills, Enmotus, Inc.

Summary

- Market and Technology Trends
- Virtual Servers and Storage I/O
- Observed Performance Numbers
- SSD Caching and MicroTiering

Markets

Data warehousing, database servers

Data Intensive, Web Servers
Cloud/Grid Clusters
(Social Networks and Emerging Enterprise)

Virtualized Hosting/Cloud Computing

Small Medium Business

Servers

- ~8M servers annually, 23% unit growth, 11% revenue (IDC)
- ~1.8m virtual machine enabled physical servers ship annually
- ~1.3m database servers ship annually
- 700K-1M servers new social network server build-outs
- ~$12BN spent on storage management software

SSDs/Flash Storage

- Server-storage performance gap widening
- 20-100x+ raw performance gains
- 2-10x+ transaction performance gains
- Reduction in power - 100-1000%
- Drives trend back to DAS storage

Server Trends
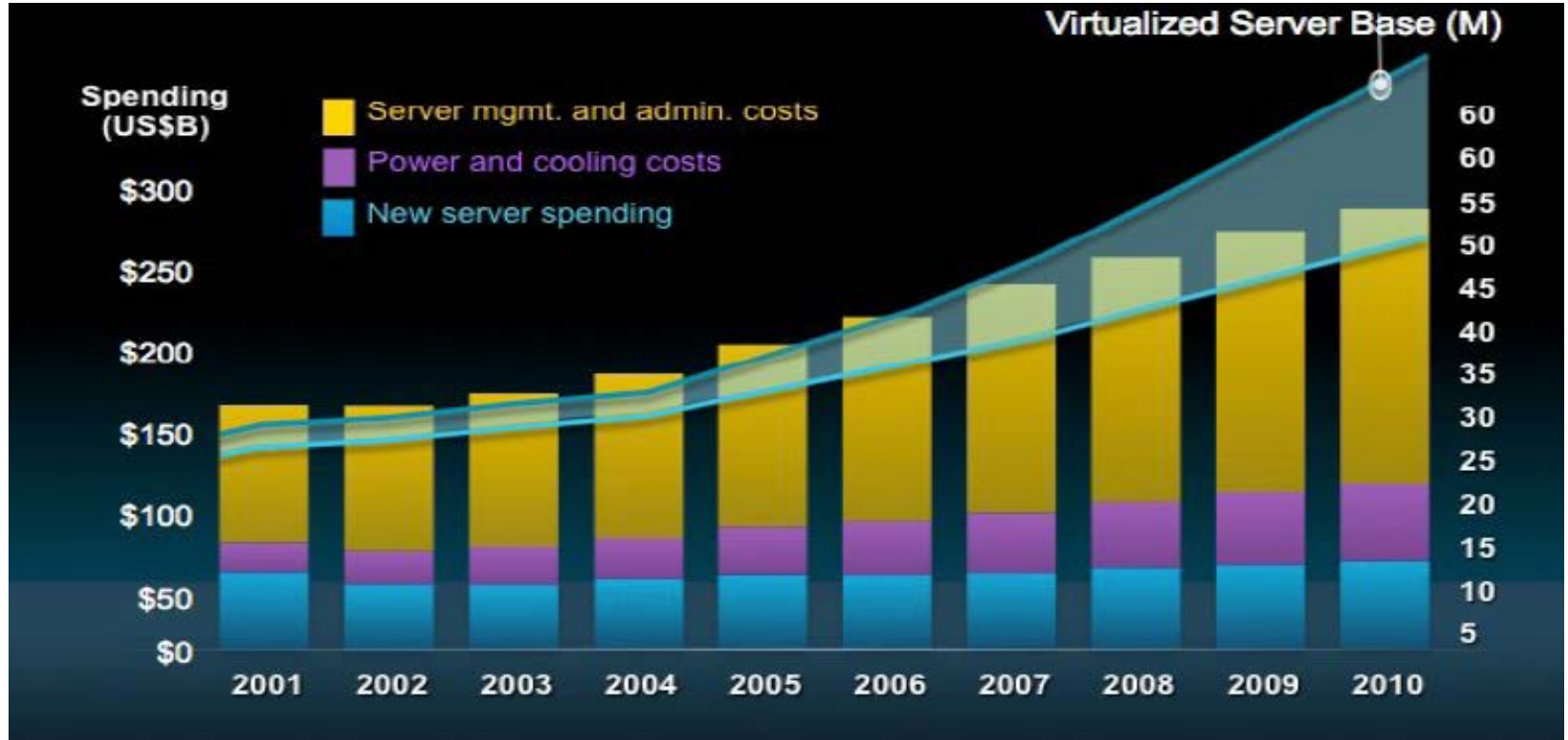
Virtualized servers are growing rapidly and management costs along with them…

Issues for Virtual Servers

- Virtual server environments behave very differently creating the infamous IO blender effect

- SSDs are migrating back into the server creating several integration and reliability issues

- Utility based computing and virtual machines have created a fluid computing environment making the setup more dynamic and unstructured

- Growing trend toward smaller, lower cost clustered virtualized servers that are SAN-less

- Storage virtualization strategies needed for these emerging systems and less sophisticated users
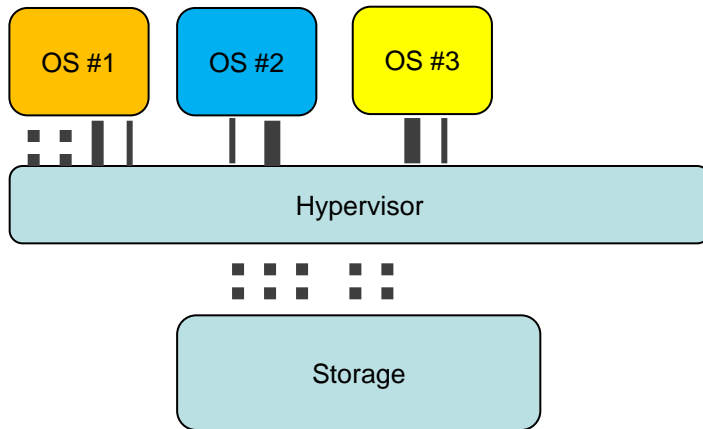
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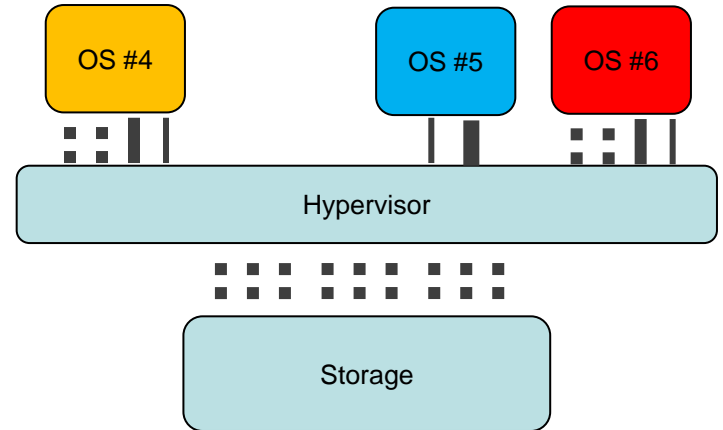# IO Blender Effect
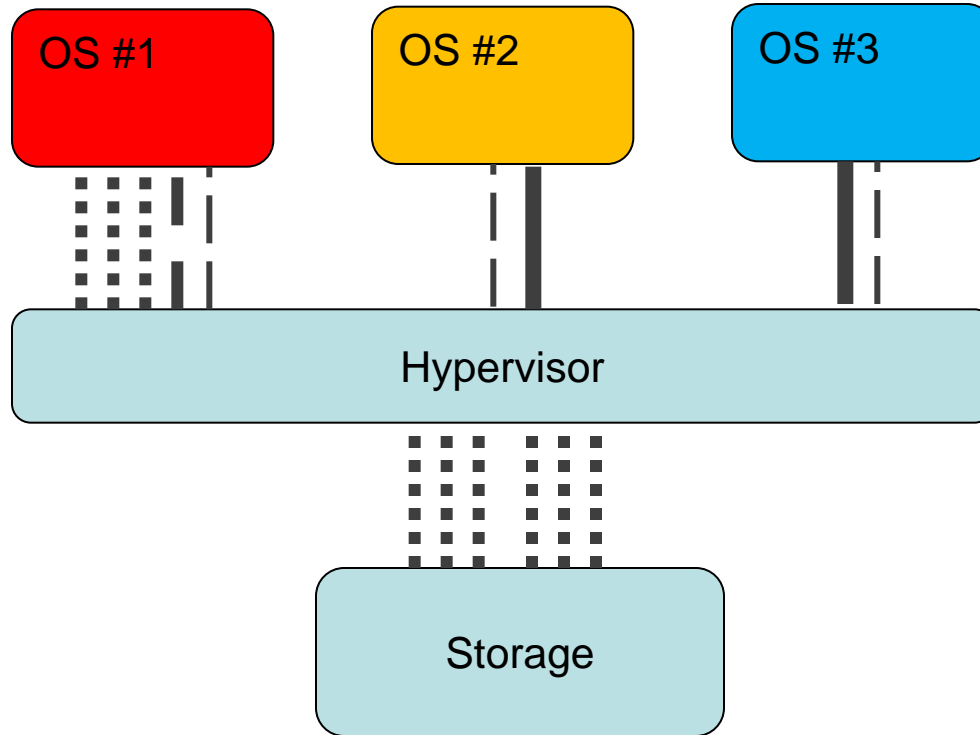
Sequential Streams are turned to Random
Ideally would like the SSD to be servicing the highest activity OS

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Live Machine Migration

Physical Server A

Physical Server B

OS #1   OS #2   OS #3

Hypervisor

Storage

OS #4   OS #5   OS #6

Hypervisor

Storage

Moving or Creating a New VM Changes the Storage IO Balance

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SSD Integration – Today's Options

- **Software Based Caching and Tiering**
  - Client OS only e.g. EMC Fast
  - Hypervisor + Client Driver e.g. FlashSoft/Sandisk
  - Hypervisor e.g. Proximal
  - SSD type agnostic e.g. SATA/SAS SSD or PCIe SSD

- **Hardware Accelerated**
  - RAID adapters with SSD caching
  - PCIe SSDs – new class of storage
  - Intelligent Storage IO Processors – MicroTiering

- **Hybrid Hardware-Software**
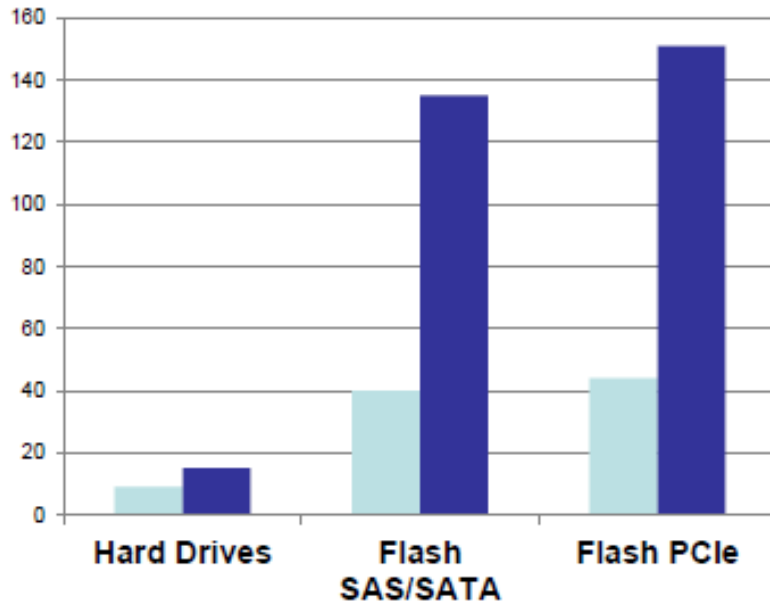 - PCIe SSDs with host based flash management - FusionIO

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Raw SSD Performance
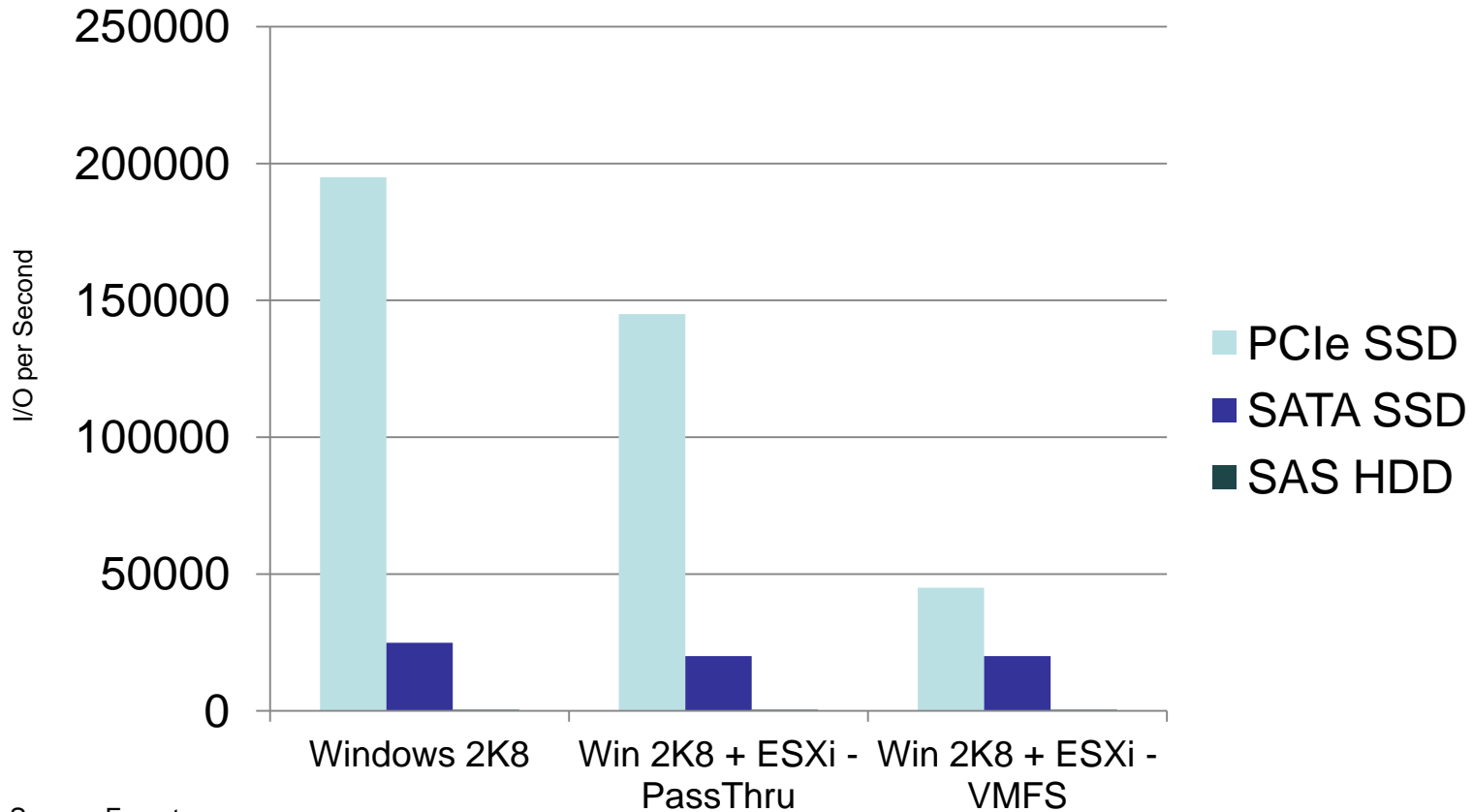
Source: Enmotus

Dell R515, Iometer 2006, 512B Random Read IOPs

Application Performance

TPM (in 000s) using DBT-2 at 1,000 warehouses

SchoonerSQL based on 5.1.44
Stock MySQL 5.1.44

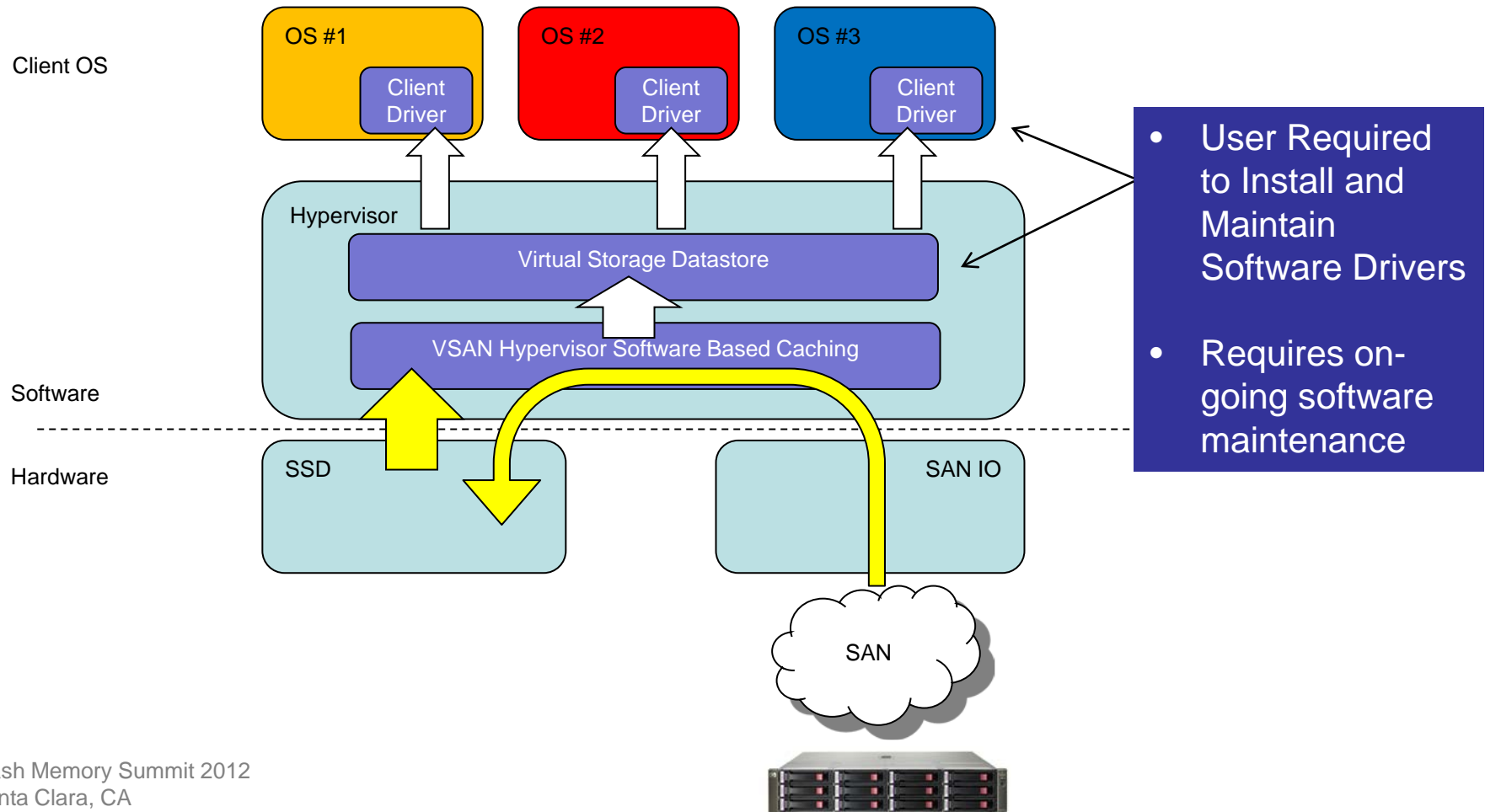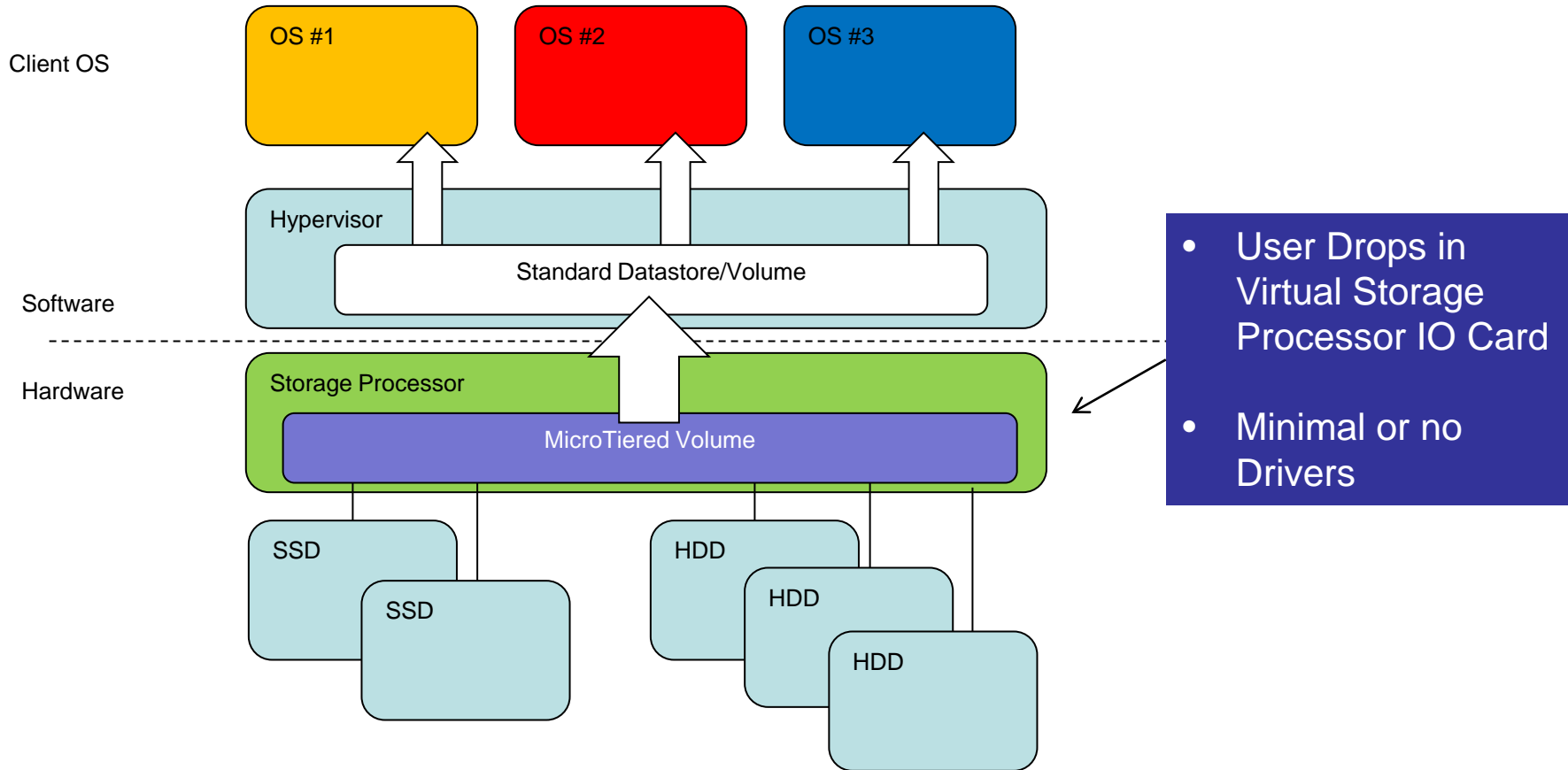Source: Schooner Information Technology

- 4-5x increase from HDD to SAS/SATA SSD

- Only 10% incremental when SSD performance is more than doubled

- 7-8x possible with application and operating system stack enhancements

- Conclusion – ease of use and transparent integration of SSDs most more important than raw IOPs for the next 2-3 years

Traditional applications remain a bottleneck for the next few years

Client OS

OS #1 — Client Driver
OS #2 — Client Driver
OS #3 — Client Driver

Hypervisor

Virtual Storage Datastore

VSAN Hypervisor Software Based Caching

Software

Hardware

SSD

SAN IO

SAN

- User Required to Install and Maintain Software Drivers

- Requires on-going software maintenance

Hardware Accelerated Tiering

Client OS

OS #1

OS #2

OS #3

Hypervisor

Software

Standard Datastore/Volume

Hardware

Storage Processor

MicroTiered Volume

SSD

SSD

HDD

HDD

HDD

- User Drops in Virtual Storage Processor IO Card
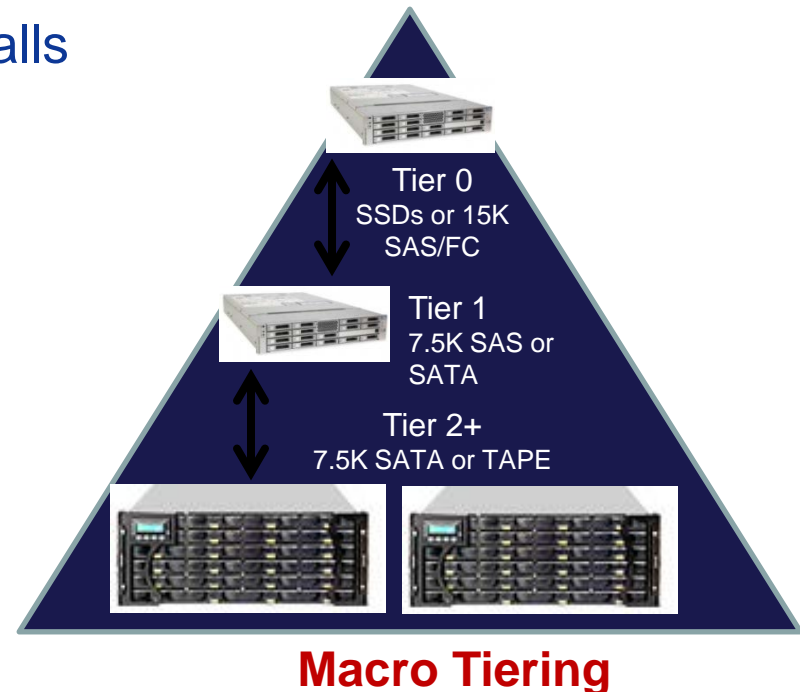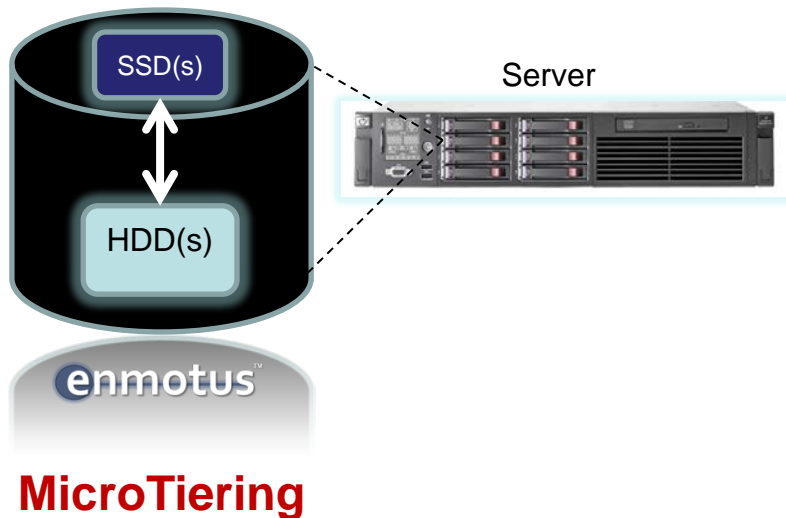
- Minimal or no Drivers

SSDs transparently tiers beneath the standard hypervisor datastore and are load balanced across all OSes

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Pros and Cons

- **Software based caching**
  - SSD is a cache, usually accelerating read only
  - Able to accelerate existing SAN block storage systems
  - Expertise required to maintain drivers at multiple levels and hypervisor levels
  - OS and Hypervisor dependent, requires knowledge

- **Hardware accelerated tiering**
  - SSD is a cache or true data tier (depending on vendor) accelerating both reads and writes
  - Limited to DAS but scales to 200TB+ virtual volumes
  - Easy to deploy – set and forget
  - Bare metal deployment, OS and Hypervisor Agnostic
  - Less sensitive to OS and Hypervisor "versioning"

Enmotus MicroTiering™

- A new class of high performance SSD optimized tiering for non-SAN and hybrid SSD-HDD tiering applications

- 100% transparent automated tiering at sub-hypervisor level

- No hypervisor or client software required

- Legacy volume migration support for upgrade markets

- Bare metal deployment for new installs

SSD(s)

HDD(s)

Server

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MicroTiering

Tier 0
SSDs or 15K SAS/FC

Tier 1
7.5K SAS or SATA

Tier 2+
7.5K SATA or TAPE

Macro Tiering

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Thank you!