Optimizing Server Flash with Intelligent Caching
(Enterprise Storage Track)

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Definition of Intelligent

in·tel·li·gent [in-**tel**-i-*juh* nt] Show IPA

adjective

1. having good understanding or a high mental capacity; quick to comprehend, as persons or animals: *an intelligent student.*
2. displaying or characterized by quickness of understanding, sound thought, or good judgment: *an intelligent reply.*
3. having the faculty of reasoning and understanding; possessing intelligence: *intelligent beings in outer space.*
4. *Computers.* pertaining to the ability to do data processing locally; smart: *An intelligent terminal can edit input before transmission to a host computer.* Compare dumb (def 8) .
5. *Archaic.* having understanding or knowledge (usually followed by *of*).

Source: Dictionary.com

Intelligent Caching Topics

- Coherency
- Dynamic Cache Sizing
- Complimentary to the Storage Caching
- Coordinated Caching

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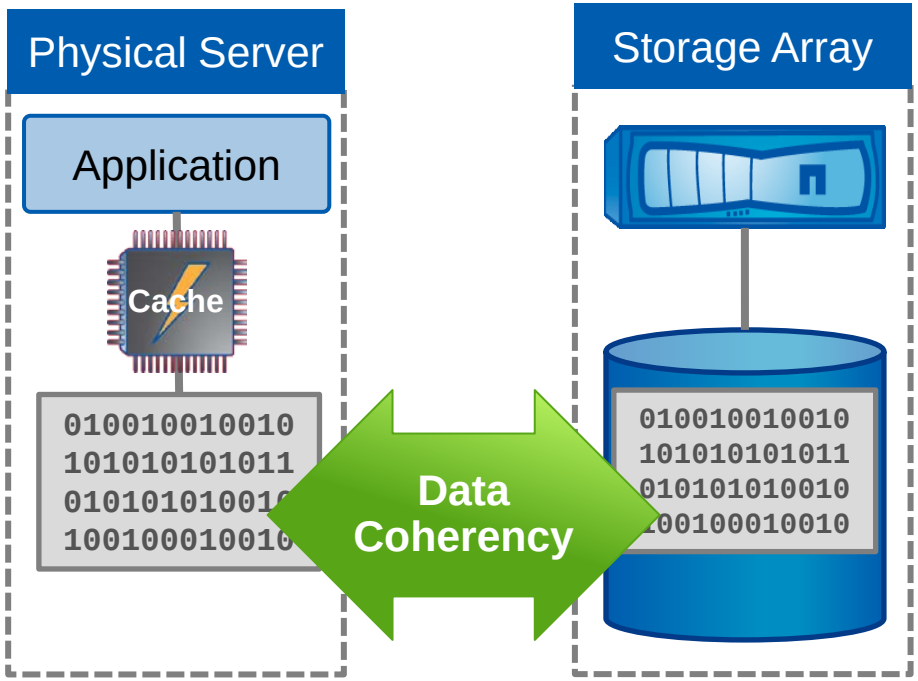
Data Coherency Implications with Caching

What is data coherency?

- Consistency between data in cache and data on disk

Why is data coherency important?

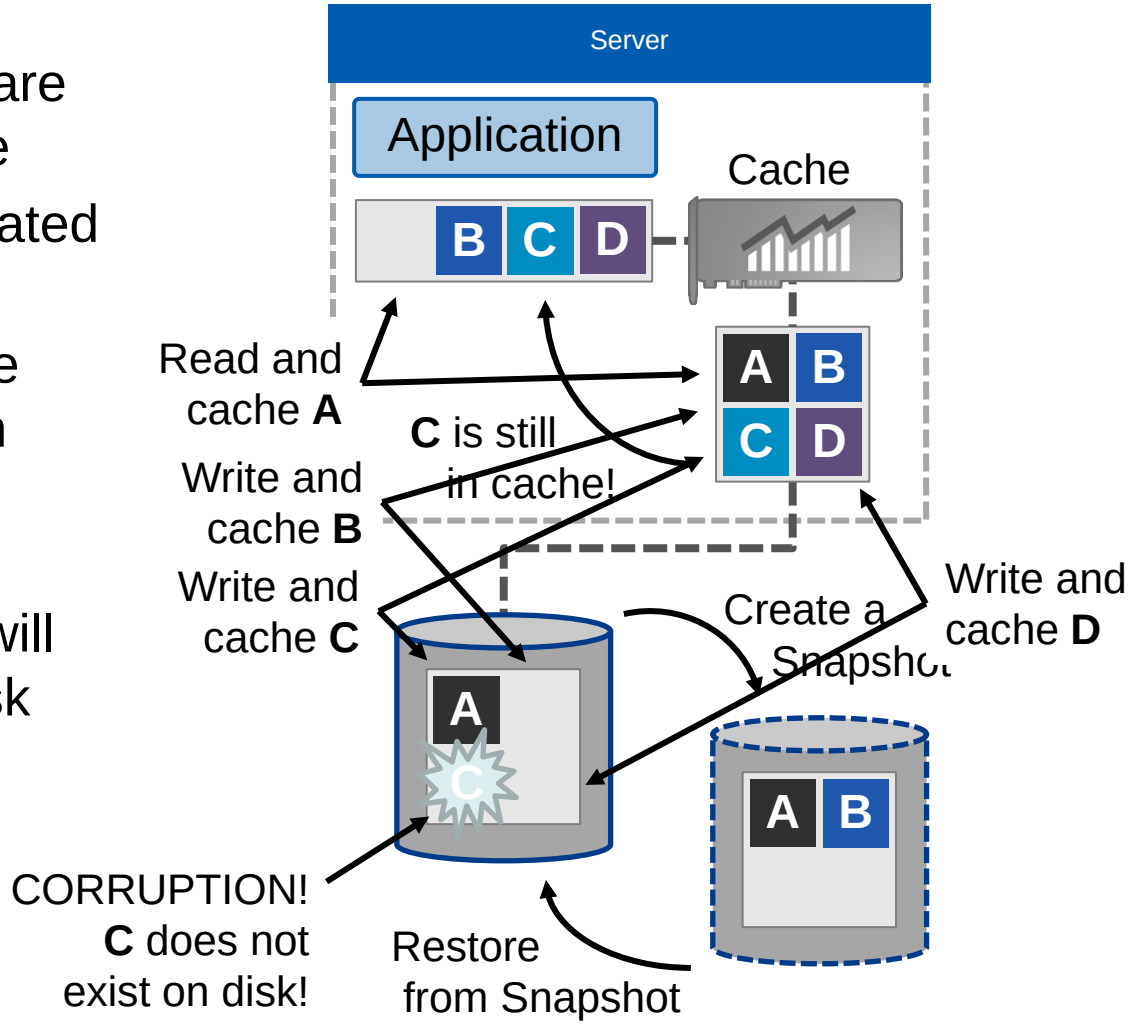
- Caches that don't recognize changes to the primary data copy (e.g. via SnapRestore®) will cause data corruption issues



- When does the cache invalidate data?
- Is the cache a write-through or a write back cache?
- Does the cache retain data across a reboot etc?

Non-Coherent Cache Behavior

- Reads and writes are inserted into cache
- Snapshots are created for backup
- A Snapshot restore leaves dirty data in cache
- Further reads and writes by the app will corrupt data on disk



Introducing NetApp's Flash Accel

Flexible Deployment

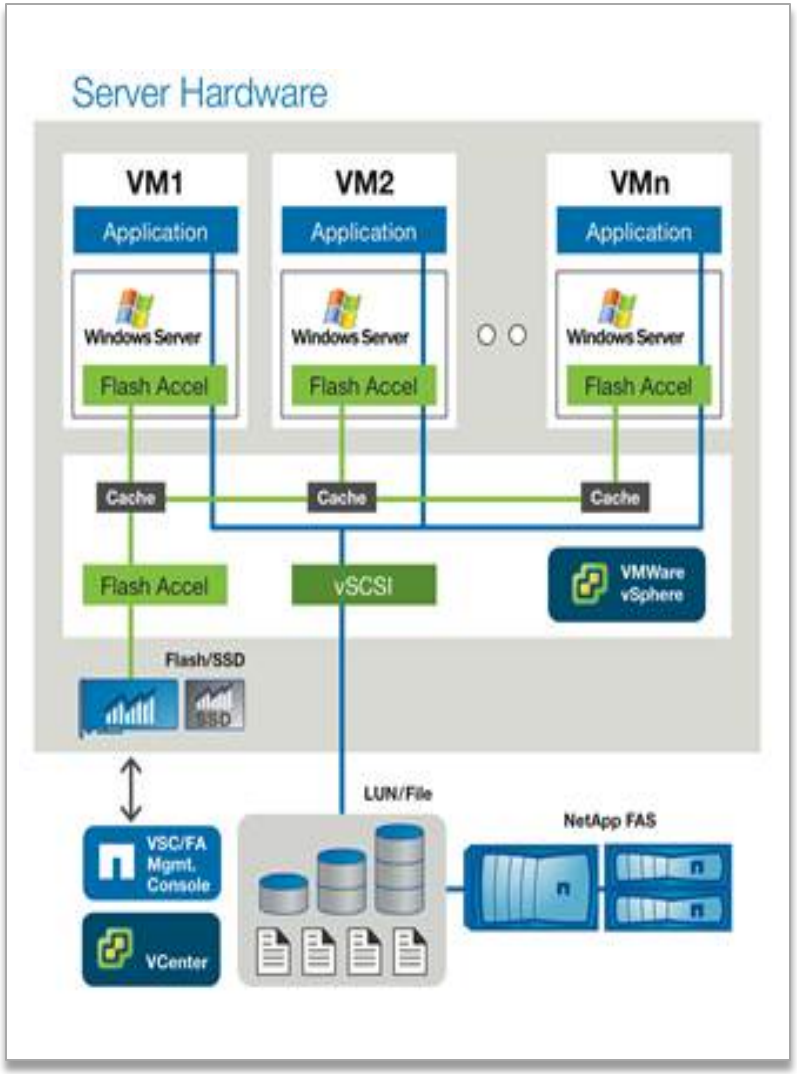
- Software only, compatible with any server PCI-e flash or SSD drive
- Choose your own flash device

Sustainable High Performance

- *Intelligent* data coherency: block-level invalidation rather than flush entire cache
- Persistent cache across VM / server reboots

Extend ONTAP value into the server

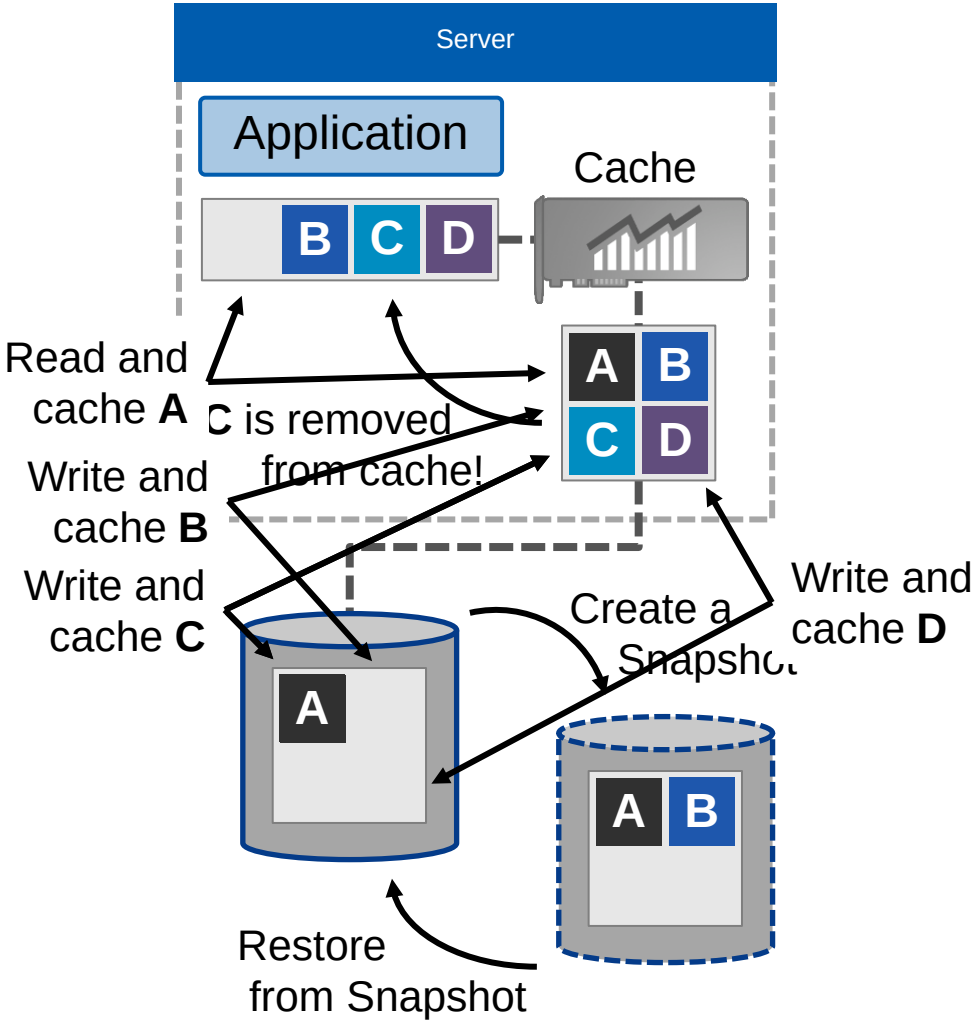
- Mechanism for deeper ONTAP integration in the future



Coherent Cache Behavior

And Flash Accel Intelligent Invalidation

- Reads and writes are inserted into cache
- Snapshots are created for backup
- Cache invalidation by Flash Accel corrects cache, while keeping the cache persistent
- Data coherency is maintained for further reads and writes by the application



Intelligent Caching Topics

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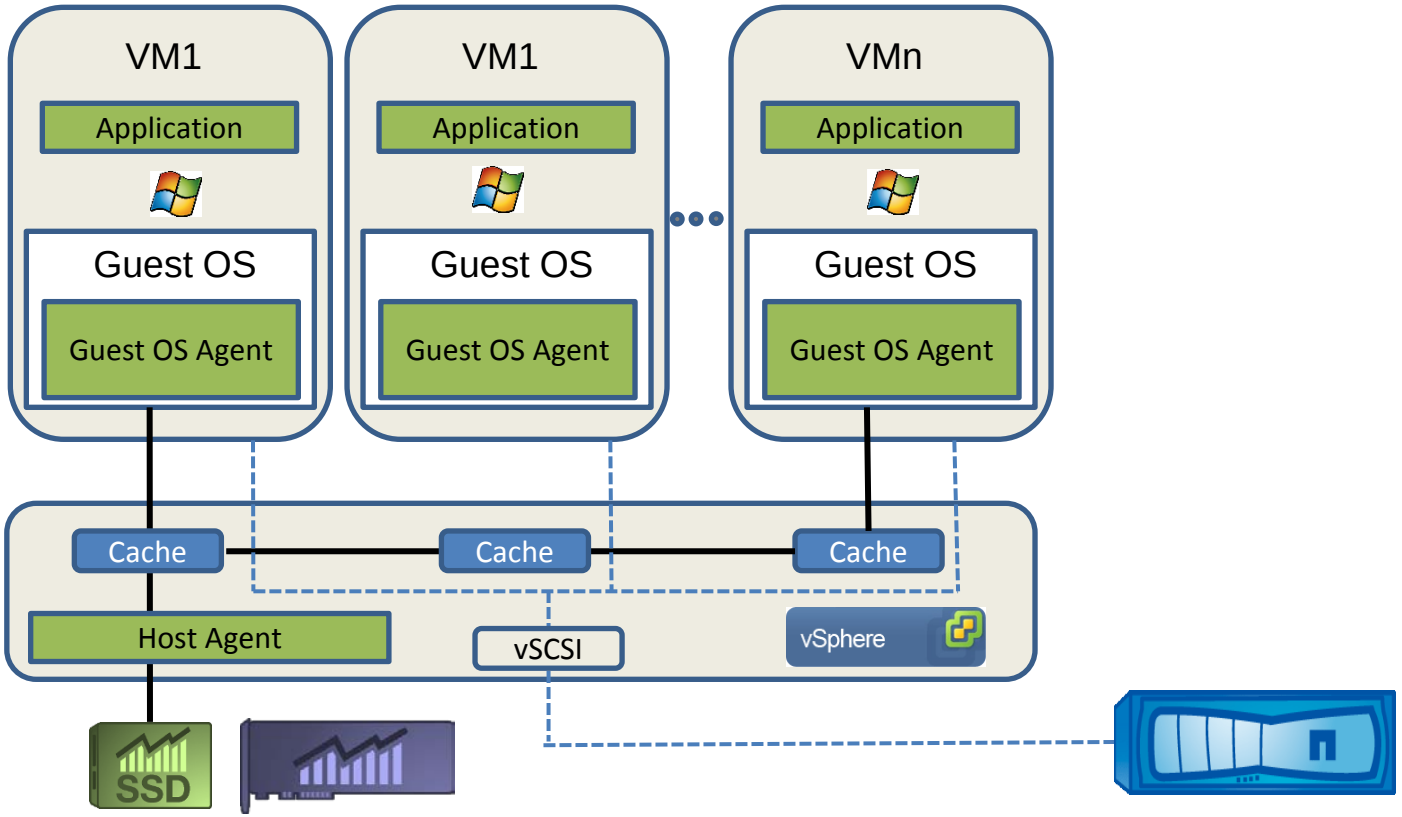
Dynamic Cache Sizing

- Intelligent Cache is one that adjusts dynamically based on the workload

Application gets busy

Agent recognizes need for more cache and requests it

Cache grows to accommodate



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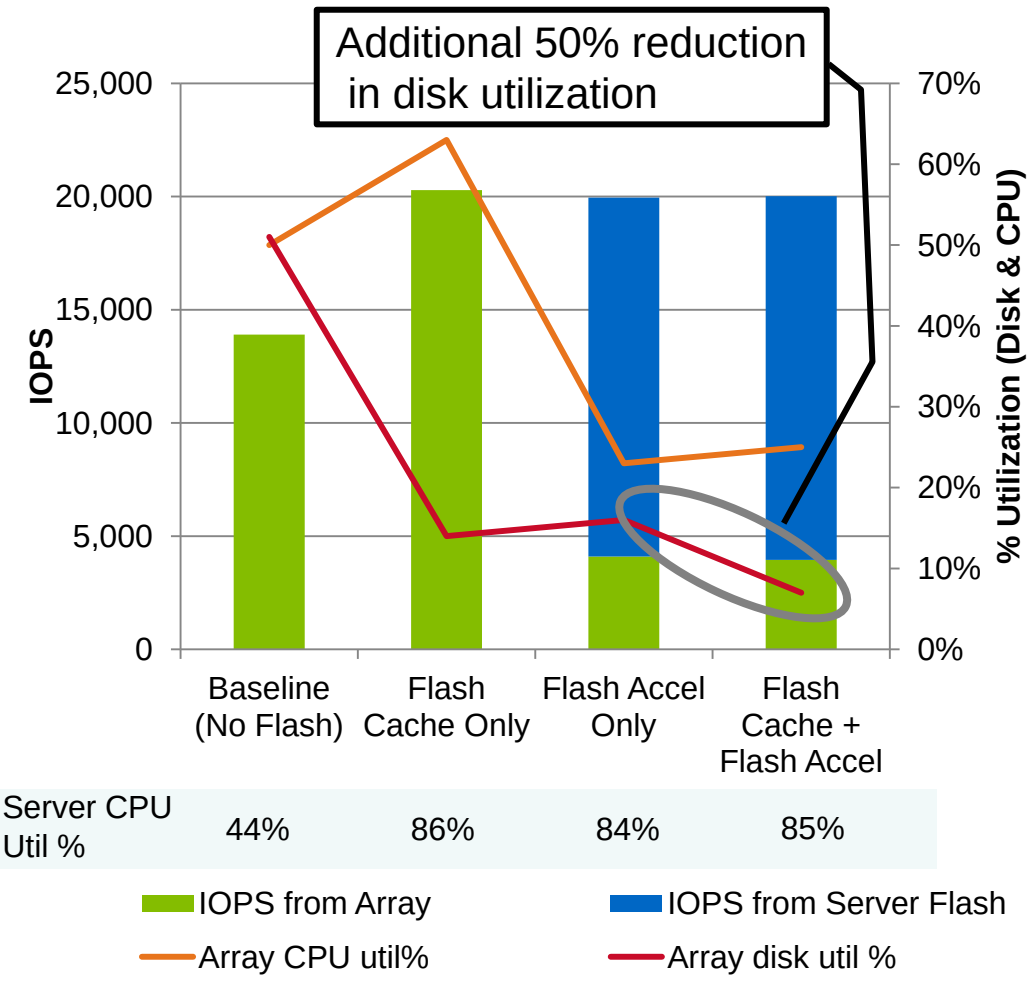
Flash Accel and Flash Cache



Flash Cache alone increases IOPS by 45%

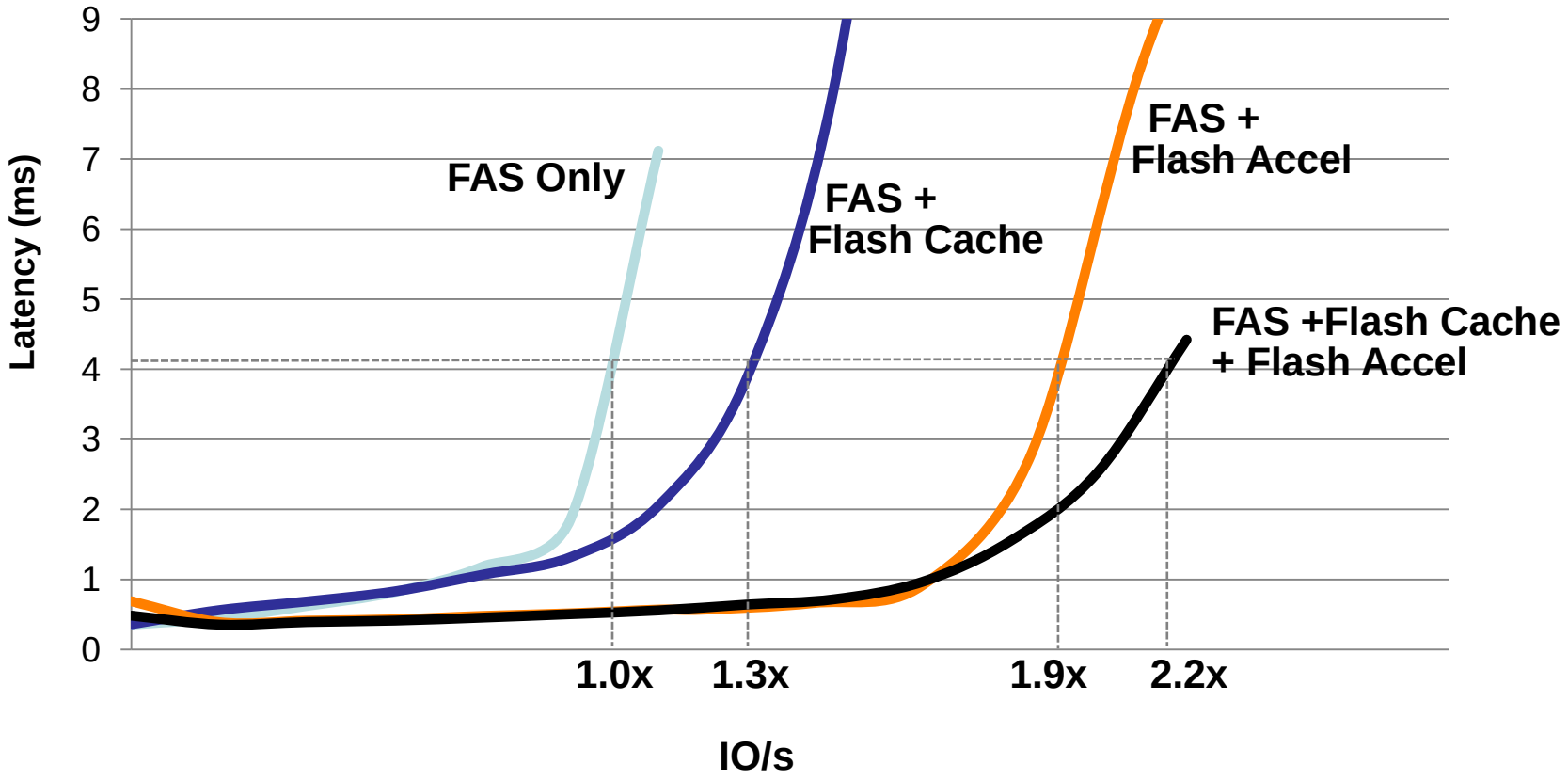
Flash Accel achieves same IOPS but offloads 80% to server

Flash Cache + Flash Accel: best of both worlds

Adding Flash Accel to Flash Cach potentially reduce stg cost by 30%

WS Size: 500GB; Cache Sizes: 500GB; Server flash: LSI Nytro WarpDrive PCI-e; Server Cache Hit: 80%; Flash Cache Hit: 90%: Read/Write : 90%/10%. Simplified Single Workload Environment; Working Set > Cache. Performance data will change based on system and workload configuration.

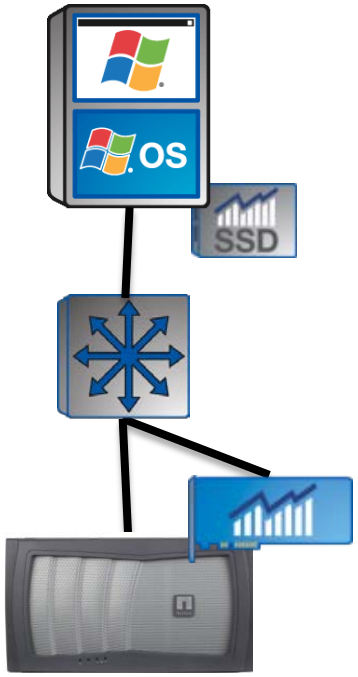
Adding Flash Accel to Flash Cache Provides 2.2X IOPS Increase



Note: Tested FAS3270 with SATA Drives, Micron P320 PCI-e card on ESX host

Coordinated Caching

MS Exchange server



User Data

Meta Data

NetApp Storage Controller
w/ Flash Cache

1. No Caching (baseline)

2. Add storage Caching
   206% increase in IOPS

3. Add server Caching
   224% increase in IOPS

4. Coordinated Caching
   246% increase in IOPS