PERSISTENT MEMORY
SNIA PM SUMMIT
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Workload Analysis and Acceleration
Using NVDIMMs and Software

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Infrastructure Now enabled for Persistent Memory

Backup Triggers
- SAVE_N
- RESET_N
- I2C Command

Memory controller support

Controller functions
- BAEBI spec

Driver support
- Pmem, etc.

OS support
- Linux (native)
- Windows Server 2016 (native)

Debug tools
- DSM, etc

Motherboard support
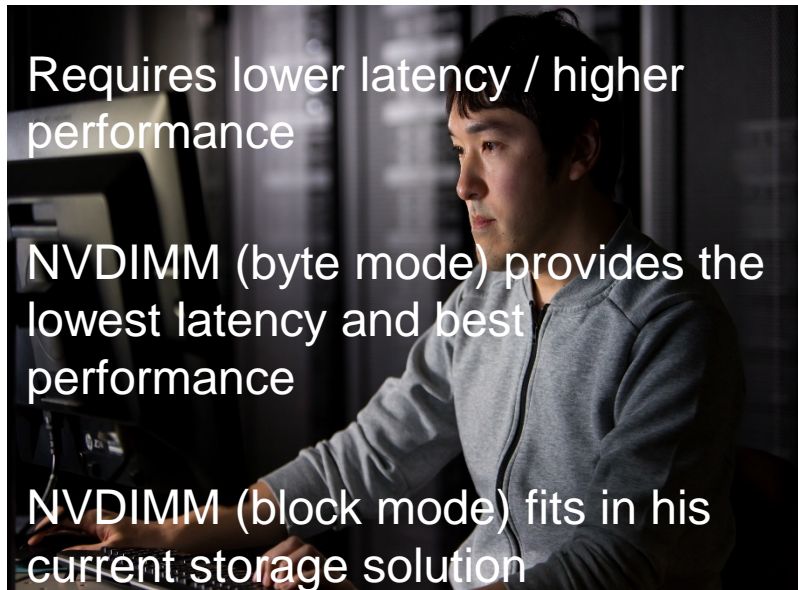- Intel, Supermicro, Tyan, ASUS, Gigabyte, ASRock, etc.
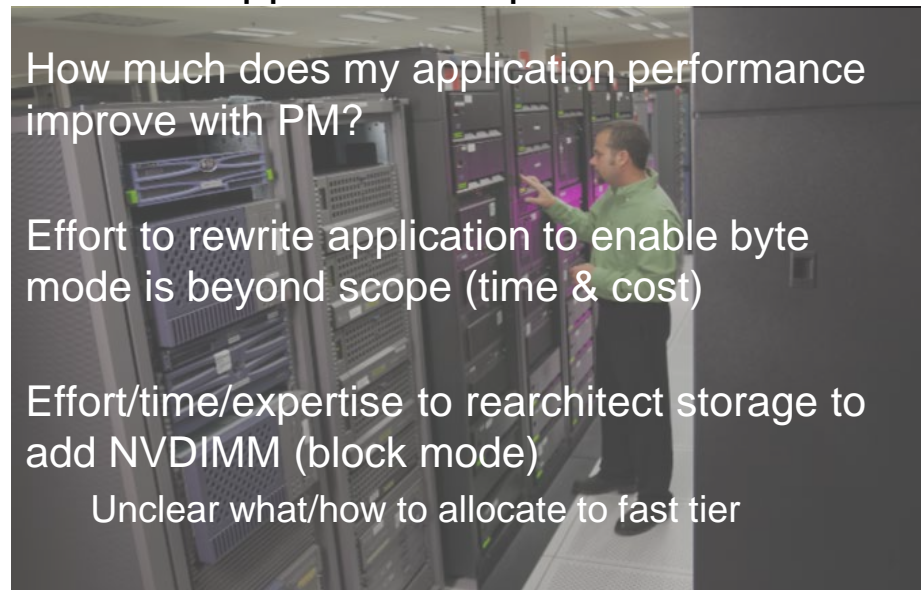
System Support
- HPE, Dell, Supermicro

Applications & Workloads are Not All Equal

Customer

Requires lower latency / higher performance

NVDIMM (byte mode) provides the lowest latency and best performance

NVDIMM (block mode) fits in his current storage solution

Application impact

How much does my application performance improve with PM?

Effort to rewrite application to enable byte mode is beyond scope (time & cost)

Effort/time/expertise to rearchitect storage to add NVDIMM (block mode)

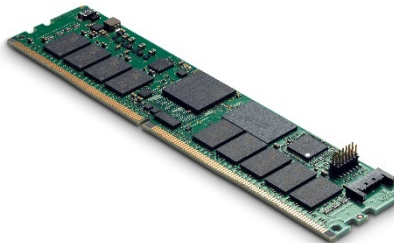Unclear what/how to allocate to fast tier

2018 – The year of "Workload Focus"

- ❖ **Encourages tool capabilities**
  - ◆ Evaluate workloads – executing analytics
  - ◆ Identify Hot, Cool, Cold data categories
  - ◆ Automatic promotion of data to match workload use model

- ❖ **Enables "Memory/Storage" Advisory**
  - ◆ Analyze workload for possible latency/performance improvements
  - ◆ Optimize Memory/Storage for specific workload (capacity, performance, price)
  - ◆ Incorporate workload learning into architecture development

Workload Analysis and Acceleration
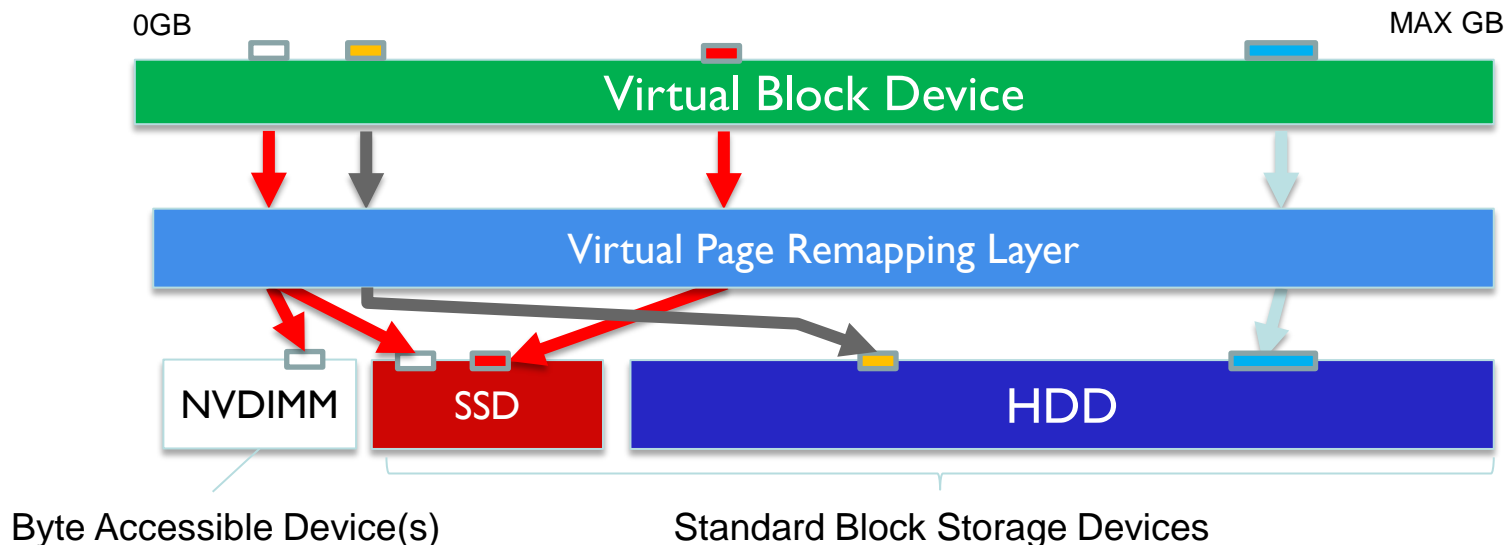## Using NVDIMMs and Software

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NVDIMM Adoption
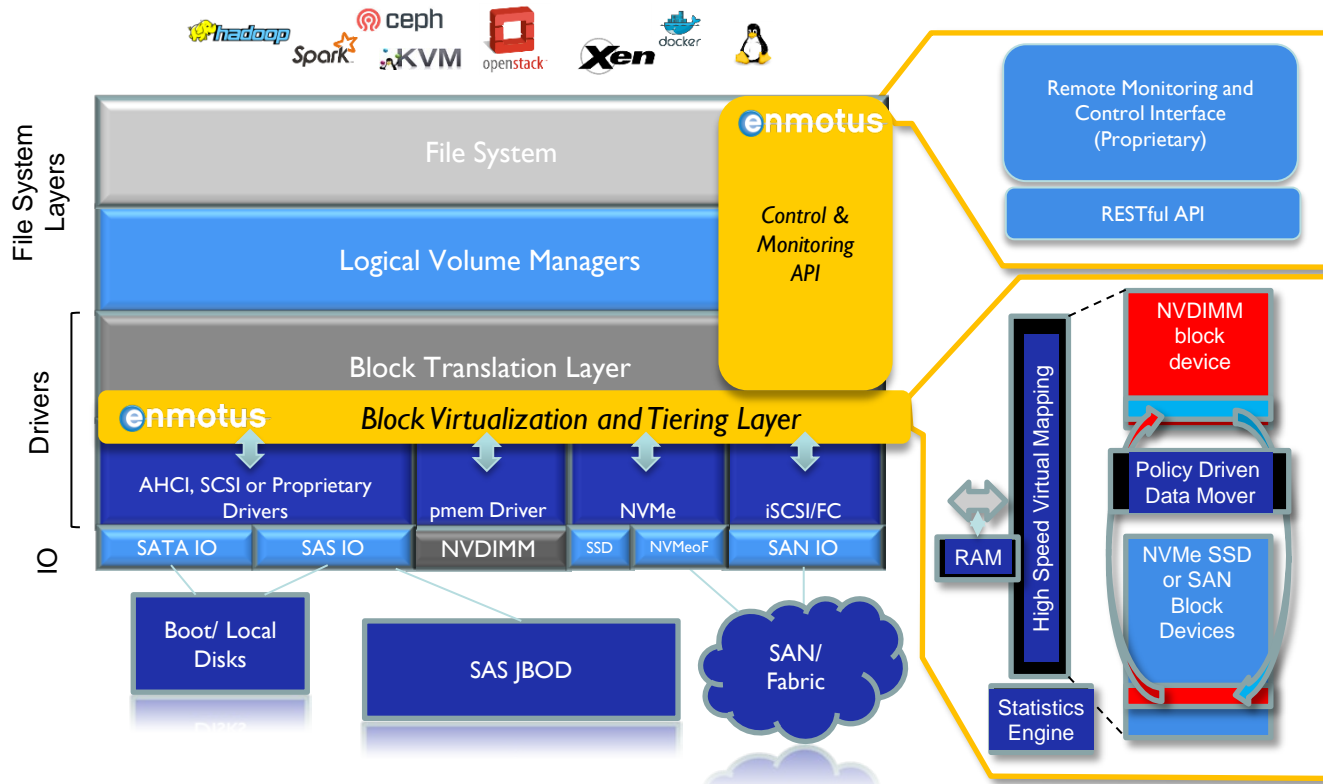
- Applications are not universally byte accessible aware …. yet
  - Will take many years before standard Linux and Windows can adopt NVDIMMs across the board
  - Not universally available to all software and application developers
  - Capacity limits applications from taking advantage w/o rearchitecting

- NVDIMM's are being deployed in specialized areas (e.g. embedded storage applications) but general server support is still limited to a few special SKUs
  - How far can adoption get if restricted in availability

- How can we accelerate adoption?
  - Bridge using block emulation – a language understood by ALL storage applications
  - Combine with multi-tiered architecture to create usable capacities

Leveraging Performance Block IO Emulation-Tiering

- Objective: Bridge to existing applications using a language understood by all applications – block IO
- Leverage the built in block translation modes for Linux (pmem) and Windows
- Combine with performance tiering technology to solve the capacity issue

0GB   MAX GB

Virtual Block Device

Virtual Page Remapping Layer

NVDIMM   SSD   HDD

Byte Accessible Device(s)   Standard Block Storage Devices

Linux Example Stack
(based on Enmotus stack)

How Effective is NVDIMM Block Emulation/Tiering?

Per NVDIMM Performance Delta – Software
Striping increased this to ~2M IOPs

- Demo at SuperComputing Nov 2017 on Dell 740XD with Micron NVDIMMs, Enmotus stack

- Multiple NVDIMM/pmem (block mode) tiered with NVMe drives
- ~2M IOPs achieved on fully tiered data using 6-8 NVDIMMs striped

- 18-20GB/s sustained rate on fully tiered data

- Utilizes NVMe SSD as the capacity portion and "slow" tier

Real Time Block IO Analytics

- Emulation approach that works with today's apps allows better assessment capabilities

- Real time measurement and logging of IO statistics

- Available via log files or RESTful/JSON

- Identify and experiment

  - How much hot data there is instantaneously or over time

  - Can NVDIMM's help an application?

  - Trial NVDIMM insertion into running volume to assess if it can help

Example Implementation – Real Time Tiering

NVMe SSDs
(Slow Devices)

NVDIMM
(Fast Devices)
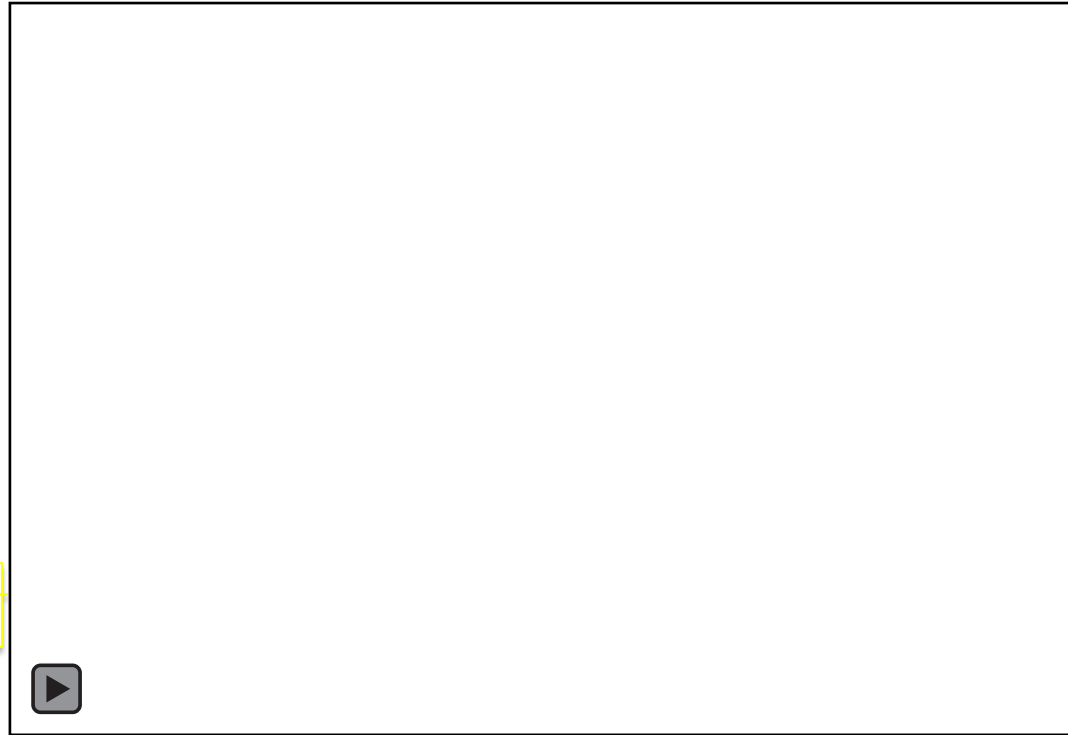
IO Activity

Capacity Range

Conclusions

- Block emulation and tiering for NVDIMMs offers significant performance gains with no change required to application or file system layers

  - Additional software layer introduces latency but still achieve 1M IOPs+

- Eases the transition for applications to full byte level access

- Allows adoption of NVDIMMs to occur more rapidly in supporting servers

- Combined with analytics tools, helps customers decide just how much NVDIMM will help their application rather than guessing

Thank You!