NVDIMMs: Setting a New Memory Standard for Supercharging Datacenter Performance

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It’s All In The Title…

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News & Analysis

JEDEC Announces Support for Hybrid NVDIMM Modules

Gary Hilson

6/2/2015 10:00 AM EDT

2 comments

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TORONTO — JEDEC Solid State Technology Association has approved the first standards for support of hybrid DDR4 memory modules.

The standards work is being done by JEDEC's JC-45 Committee for Memory Modules, which developed the non-volatile DIMM (NVDIMM) taxonomy in collaboration with Storage Network Industry Association's NVDIMM Special Interest Group (SIG), a sub-committee of SNIA's Solid State Storage Initiative.

The new standard defines hybrid DDR4 memory modules as those that plug into standard DIMM sockets and appear like a DDR4 SDRAM to the system controller, yet contain non-volatile memories such as NAND flash on the module. These hybrid module families may share the memory channel with other standard DDR4 DIMMs. Publication of the standard is expected later this year, said Bill Gervasi, co-vice-chair of the JEDEC JC-45 Committee for DRAM Modules, in an interview EE Times.

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JEDEC NVDIMM Taxonomy

NVDIMM-N

RATIFIED

- Memory mapped DRAM. Flash is not system mapped.
- Access Methods -> direct byte- or block-oriented access to DRAM
- Capacity = DRAM DIMM (1's -10's GB)
- Latency = DRAM (10's of nanoseconds)
- Energy source for backup

NVDIMM-F

RATIFIED

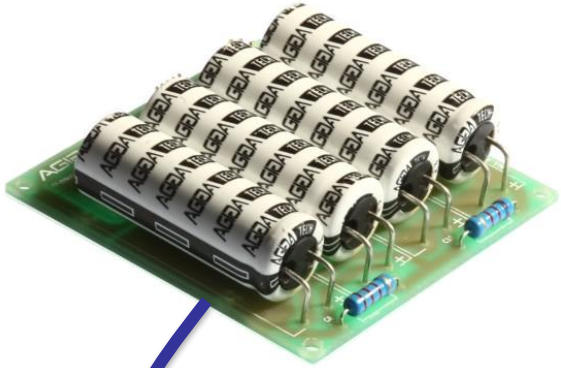
- Memory mapped Flash. DRAM is not system mapped.
- Access Method -> block-oriented access to NAND through a shared command buffer (i.e. a mounted drive)
- Capacity = NAND (100's GB-1's TB)
- Latency = NAND (10's of microseconds)

NVDIMM-P

PROPOSED

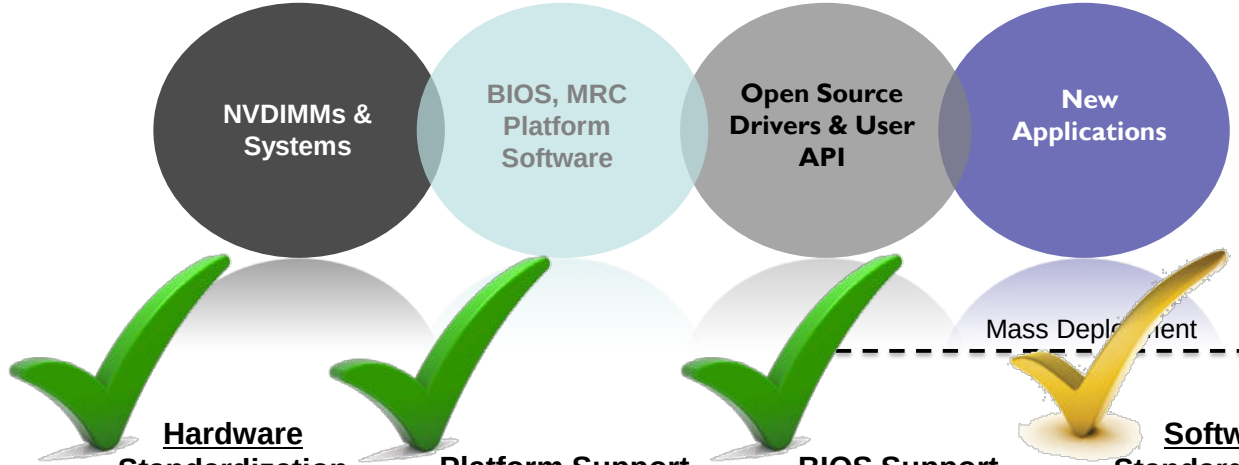
- Memory mapped Flash AND memory mapped DRAM
- Two access mechanisms: persistent DRAM (–N) and block-oriented drive access (–F)
- Capacity = NVM (100's GB-1's TB)
- Latency = NVM (100's of nanoseconds)

NVDIMM-N: Looks Like DRAM, Acts Like Flash



DRAM access during normal operation
DRAM contents moved to NAND Flash during power loss
External power source (typically supercaps) during backup
Data restored on system recovery

NVDIMM Ecosystem



Hardware Standardization
- System management, health monitoring
- System support H/W trigger (ADR)
- Mechanical (pwr src)
- JEDEC NVDIMM

Platform Support
- Off-the-shelf and OEM platform support for NVDIMM today
- System supported H/W trigger (ADR)
- Mechanical (pwr src)

BIOS Support
- NVDIMM-aware BIOS
- Intel mods to MRC to support NVDIMMs
- JEDEC NVDIMM I2C command set
- JEDEC SPD

Software Standardization
- Applications
- Linux NVDIMM-aware kernel 4.1
- NVM Programming Model
- API's

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Supercharging Datacenter Performance

su·per·charg·er

/'soopər,CHärjər/

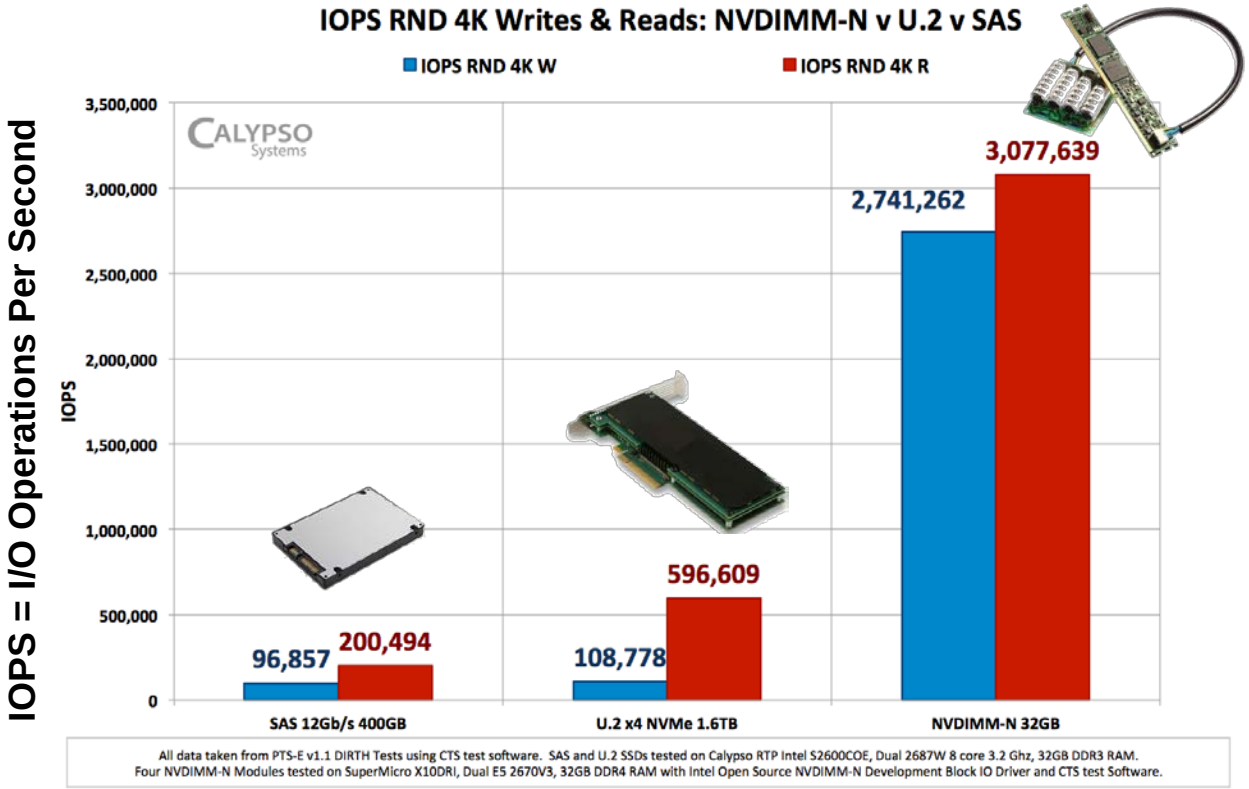
noun

a device that increases the pressure of the fuel-air mixture in an internal combustion engine, used in order to achieve greater efficiency.

YAHOO! Answers

- Improves engine performance ~50%
- Cost of installation ~$5,000

Comparing Data Center “Superchargers”



Source: Calypso Systems, Aug'15

Tale Of The Tape…

STORAGE TYPE	IOPS RANDOM 4K WRITE	IOPS RANDOM 4K READ	EST COST	$/GB	$/IOPS
SAS 12Gb/s 400GB	96,857	200,494	~ $ 1,500	$ 3.75	0.0155
U.2 x4 NVMe 1.6TB	108,778	596,609	~ $ 3,000	$ 1.88	0.0276
NVDIMM-N 32GB	2,741,262	3,077,639	~ $ 1,200	$ 37.50	0.0004

- NVDIMM-N shows up to 25x Write/5x Read performance, BUT…
- Has limited capacity and high $/GB, BUT…
- REALLY low $/IOPS, AND…
- No endurance/wear-out issues, AND…
- We're just getting started!

Data Center Use Cases

- In-Memory Database: Journaling, reduced recovery time, x-large tables
- Enterprise Storage: Tiering, caching, write buffering and metadata storage
- Virtualization: Higher VM consolidation with greater memory density
- High-Performance Computing: Check point acceleration and/or elimination
- Other: Object stores, unstructured data, financial & real-time transactions

A Real-World Example

Storage Industry Summit (Jan 20, 2015)

NVDIMMS in Enterprise Storage Arrays drive performance

Tom McKnight, Vice President of Hardware Platform @ Nimble Storage

Conclusion

- NVDIMMs combined with PCIe NTB's have enabled Integrated Enterprise Storage Platforms to achieve significant performance improvements *(> 4X Write IOP latency improvement !!)*

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