Panel: Persistent Memory Adoption in Operating Systems (-ish)

Moderator: Jeff Chang | AgigA Tech, NVDIMM SIG Co-Chair
Meet The Experts

Tom Talpey
Architect
Microsoft

Tom Coughlan
Senior Engineering Manager
Red Hat

Amit Golander
CTO
Plexistor

Pratap Subrahmanyanam
Fellow
VMware
A Few Opening Remarks…

NVDIMM

Non-Volatile Dual Inline Memory Module: [Hardware] A dual inline memory module that operates as standard RAM while also having persistence across power cycles.

- pg 190, 2016 SNIA Dictionary
The Three Legged Stool
The Three Legged Stool
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HARDWARE BUILDING BLOCKS
The Three Legged Stool

HARDWARE BUILDING BLOCKS

SOFTWARE INFRASTRUCTURE
The Three Legged Stool

HARDWARE BUILDING BLOCKS

SOFTWARE INFRASTRUCTURE

APPLICATIONS
The Three Legged Stool

HARDWARE BUILDING BLOCKS

SOFTWARE INFRASTRUCTURE

STANDARDS

APPLICATIONS
The Three Legged Stool

- **HARDWARE BUILDING BLOCKS**
- **SOFTWARE INFRASTRUCTURE**
- **APPLICATIONS**
- **VALIDATION PROGRAM**
- **STANDARDS**
The Three Legged Stool

- HARDWARE BUILDING BLOCKS
- SOFTWARE INFRASTRUCTURE
- APPLICATIONS

VALIDATION PROGRAM

STANDARDS
First Question

▲ Amit, what does Plexistor do?
PM Adoption

Amit Golander, PhD
Plexistor, CTO
Where does Plexistor fit in?

Enterprise-grade platform to make PM trivially consumable by applications
From Promise to Delivery in 3-4 years

<table>
<thead>
<tr>
<th>PM Summit Focus</th>
<th>Plexistor Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan. 2013 What are the problems?</td>
<td></td>
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<tr>
<td>Jan. 2014 The Future of Computing – The convergence of Memory and Storage</td>
<td>Concept Prototype</td>
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<tr>
<td>Jan. 2015 Realizing the Benefits of the Convergence…</td>
<td>Alpha AutoTiering</td>
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<tr>
<td>Jan. 2017 Delivering on the Convergence…</td>
<td>GA Clones, PMoF</td>
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Legacy and PM aware

SDM v2.1
as SW or pre-installed SKUs (partners)

Kernel 4.4+
Ubuntu 16.04
RHEL 7.3

HPE Proliant Gen9
Supermicro X10

16GB NVDIMM-N
JEDEC FW
The Plexistor SDM Solution

- Installed on top of Linux w/ NVDIMM driver
  - www.plexistor.com/download/
- Runs any application on bare metal, container or virtualization
- Enterprise-grade features:
  - Storage and Memory semantics concurrently
  - Auto-tiering between NVDIMMs and Flash SSDs
  - Light-weight Clones
  - Mirroring to PMoF
  - NUMA optimized, Dashboarding, Proactive support, Forward migration…
**Performance**

PM & SDM delivers, provides data services and is production ready.
Application-agnostic PMoF is around the corner
## Example: Oracle Database for OLTP

### Baseline
- Exadata X6-2 Full Rack
- Running Oracle RAC 12C

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<thead>
<tr>
<th>Max IOPS</th>
<th>Throughput</th>
<th>Latency</th>
<th>#Cores</th>
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</thead>
<tbody>
<tr>
<td>5.6M</td>
<td>21GB</td>
<td>250us</td>
<td>72</td>
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License cost **$2.1M**

### Plexistor Solution
- 1 HPE 2x2699 server
- Running Oracle 12C

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<th>Max IOPS</th>
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<th>Latency</th>
<th>#Cores</th>
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<td>30GB</td>
<td>2us</td>
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License cost **$540K**

Run the exact same application Faster and at **75% lower cost**
Now To The Panel…
Accelerating SQL 16 with PM

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<thead>
<tr>
<th></th>
<th>Row Updates / Second</th>
<th>Avg. Time / Txn (ms)</th>
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<tbody>
<tr>
<td>NVMe SSD</td>
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<td>0.379</td>
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<tr>
<td>Dax Mode NVDIMM-N</td>
<td>124,917</td>
<td>0.192</td>
</tr>
</tbody>
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*From Neal Christiansen @ FMS’16*