

# NVDIMM-X

Deliver DRAM performance at NAND Capacity

by

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Xitore, Inc.

# Executive Summary

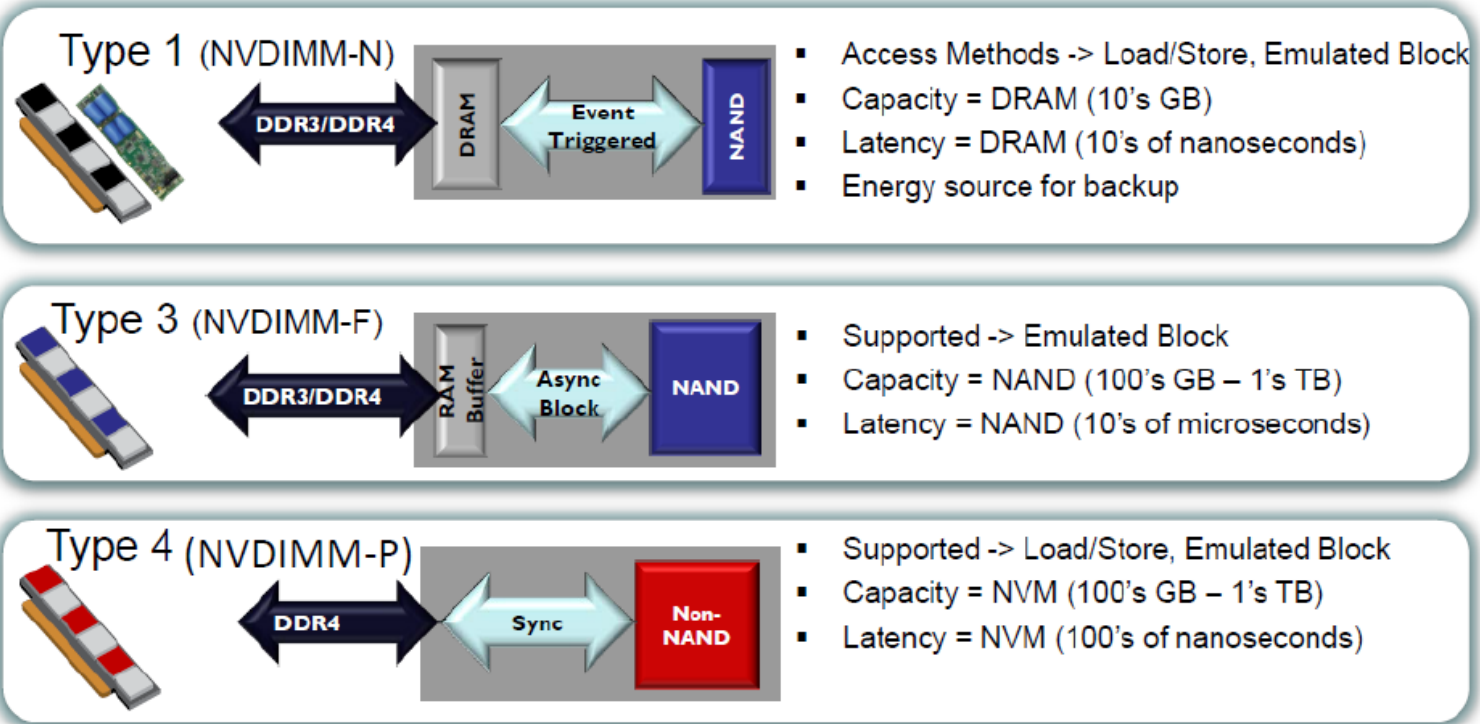
Xitore has designed a highly disruptive, patent protected, solid state storage device. Every performance metric is second to none, including speed, latency (access time), power consumption and volumetric space (see table below).

|  | PCIe x4<br>(Gen 4.0)* | Xitore<br>NVDIMM-X** | Approx.<br>Improvement % |
|--|-----------------------|----------------------|--------------------------|
| <b>Speed (GB/sec)</b>                      | 8                     | 25.6                 | 320%                     |
| <b>Latency -- Access time (uSec)</b>       | 85                    | 2                    | 4250%                    |
| <b>Power Consumption (W)</b>               | 25                    | 15                   | 167%                     |
| <b>Volumetric Space (inch<sup>3</sup>)</b> | 10                    | 2                    | 500%                     |
| <b>Cost (\$/GB)</b>                        | Same                  | Same                 | 0%                       |

\* Current best solution on the market; PCI Sig specification --- see <https://pcisig.com/specifications>

\*\* Xitore data from simulation model and JEDEC standards --- see <http://www.jedec.org/>

# NVDIMM Standards



# Xitore is NVDIMM-X

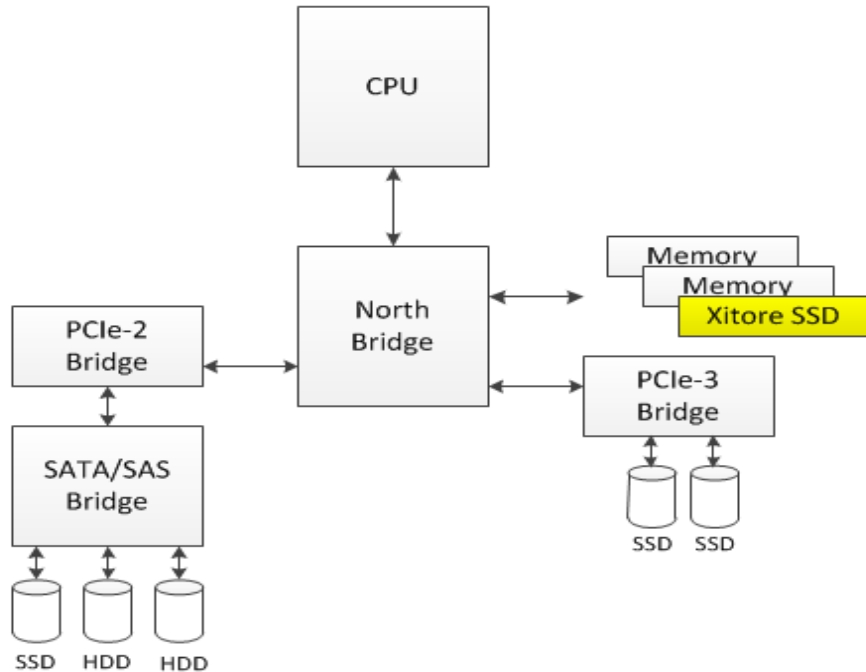
- DDR4 Form Factor
- 256GB - 4TB NAND Flash (SLC, MLC)
- Substantial Local Cache
- 25.6GB/s host interface bandwidth
- Fixed sub 2us latency
- Single-Chip Solution
  - Embedded Xitore Cache and NVM Controller
- External DRAM DIMM is NOT Required

## Features include:

- Security, Comp/De-comp,
- Error Detection/Correction,
- Scrambler/Descrambler
- E2E CRC Protection
- Power Failure Backup System
- 128 Queuing capability
- Xitore Device Driver
- Garbage Collection, Program and Read Disturbed, Static & Dynamic Wear Leveling



# Where NVDIMM-X reside in the System?



## Solution Today (PCIe)

Bandwidth 8GB/sec

Latency Avg. 50-85usec

IOPS 585,000

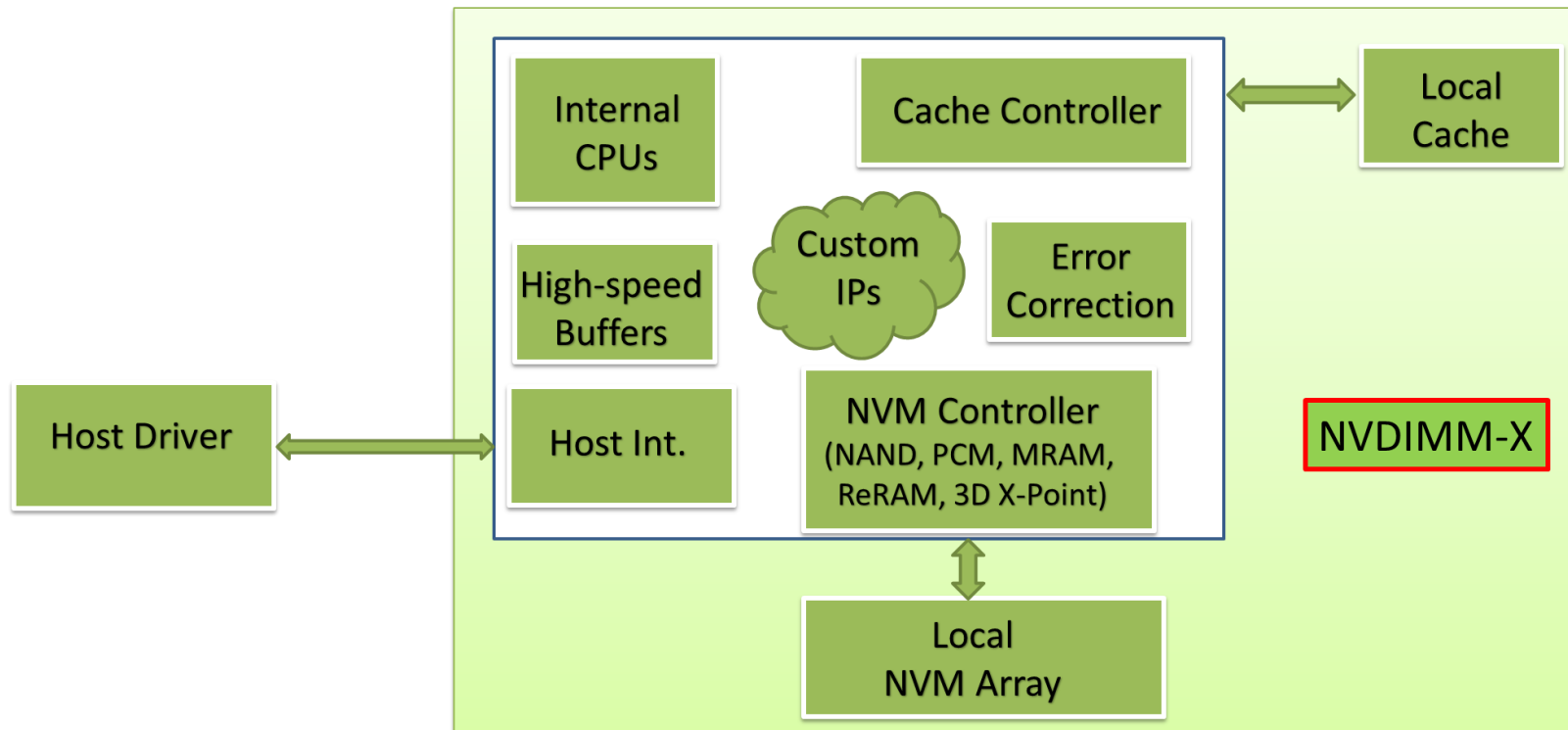
## Xitore Solution

25.6GB/sec (+300%)

Fixed Latency 2Usec (-4,250%)

IOPS 4,000,000 (+680%)

# Xitore IP



# The Cost of High Latency

**amazon.com**

“...every 100ms of latency cost them 1% in sales”

**Google**

“...an extra 500ms in search page generation time dropped traffic by 20%”

**TABB  
GROUP**

“...a broker could lose \$4M per millisecond if their electronic trading platform is 5ms behind the competition”

# Data Center Impact

- Superior performance metrics will significantly improve operational effectiveness and efficiency by boosting all forms of data input and retrieval.



## Power

**Xitore DIMMs consume 60% less power than today's PCIe storage solutions**

- 3.5% power savings per server
- Estimated \$10K/month cost (power) savings
  - Based on 42U Rack, 50K servers

**Xitore DIMMs improves IOPS/Watt by 1700%!**

- Xitore solution produces 267K IOPS/watt
  - SSDs 15K/watt, HDDs 40/watt



## Performance

**Xitore DIMMs increases bandwidth from 8 to 25.5GB/s, and at fixed low latency (2us)**

- VM support improved by 35%, which saves Cap/OpEx
- Latency improvement of 4250%!
- Bandwidth improvement of 320%!



## Space

**Xitore DIMMs fits into existing DRAM slots**

- DIMM slots typically readily available
- PCI slots freed up for other system needs (NIC, video or SSD)
- Customized rack servers will realize up to 20% space saving



# Technology Comparison

|                           | Xitore NVDIMM-X                                    | Proprietary 1                                | Proprietary 2   | NVDIMM-N   | NVDIMM-F   | NVDIMM-P   | PCIe      |
|---------------------------|--|--|---|------------|------------|------------|-----------|
| Performance               | 25.6GB/sec   | 1 GB/sec                                     | 12.8GB/sec  | 25.6GB/sec | 12.8GB/sec | 25.6GB/sec | 8GB/sec   |
| Latency                   | 2usec  | 5usec  | 100usec   | 2-5usec    | 10-100usec | 10-20usec  | 85-50usec |
| Power                     | 15 Watt  | 20 Watt                                      | 15 Watt   | 15 Watt    | 15 Watt    | 15 Watt    | 25 Watt   |
| Density                   | >4TB   | >64GB  | 256GB   | >32GB      | 256GB      | >1TB       | >4TB      |
| Is this Storage solution? | Yes, Single Chip Controller, No External DRAM Req. | Yes, Two 3rd Party SATA Controllers & Bridge | No, Requires 3rd Party Embedded SATA Controller, & External DRAM DIMM (*) | No         | Yes        | Yes        | Yes       |

Note: (\*) Very large DRAM, Persistence, Non-Storage Solution

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Santa Clara, CA

- NVDIMM-X is the only single chip solution that incorporates:
  - ✓ Embedded Cache Controller
  - ✓ Embedded Flash, NVM Controller
  - ✓ Operates at Host DRAM interface speed of up to 25.6GB/sec
  - ✓ Has capability of 2usec Latency
  - ✓ Does NOT require external DRAM DIMM as Cache to function
  - ✓ Highest Density
  - ✓ Lowest Power
  - ✓ Smallest Form factor
  - ✓ The only single module solution, Xitore's SSD-On-A-DIMM



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