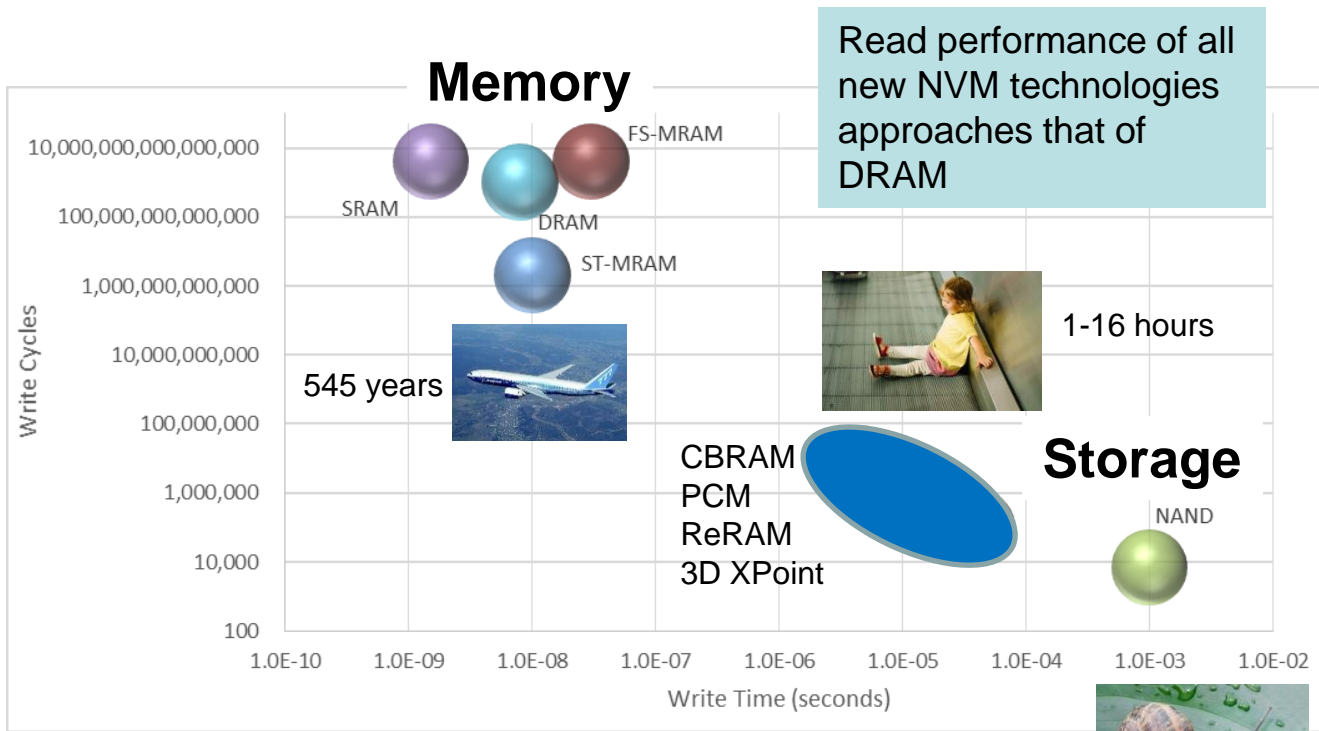


# All MRAM NVMe SSD - It is Fast!

Terry V Hulett  
VP & GM Systems Solutions  
Everspin Technologies, Inc.

# MRAM is Memory with Persistence



- MRAM is only NVM that can be written enough times to avoid wear leveling
- Write performance is a requirement for a true SCM, otherwise it is just faster storage



# Recently in the News

## Everspin Readies Industry's First 256Mb Perpendicular Spin Torque MRAM for Production and is Now Sampling Customers

*Everspin to demonstrate the benefits of its proprietary pMTJ MRAM technology at Flash Memory Summit*

### **Everspin to show world's fastest SSD**

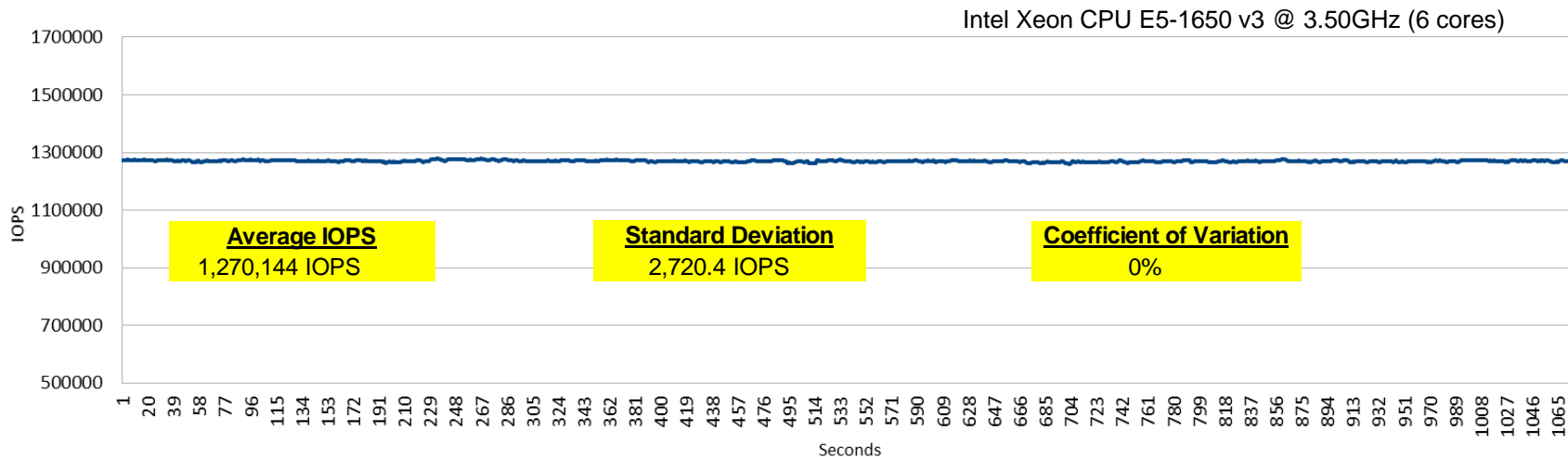
Next week, at the [Flash Memory Summit](#), Everspin will demo what it bills as the world's fastest SSD, a single PCIe card capable of 1.5 million random 4k writes per second. Since most flash SSD-based arrays can't manage 1 million *reads* per second, yeah, it's fast.

By [Robin Harris](#) for [Storage Bits](#) | August 4, 2016 -- 12:15 GMT (05:15 PDT)

# What Besides ST-MRAM is Needed to Make an SSD?

- Slight modification from standard DDR3/4 controller
  - Smaller page size & slightly longer row access latencies
- Reset\* must stay low during power cycles (pull down resistor)
- Power fail detection (need <10us)
  - Decoupling capacitance on 12V will provide this
  - Finish storing write transactions that have made it to device
  - Close open pages
  - Set appropriate status bits
- Single bit Hamming ECC
- Develop an NVMe controller fast enough to keep up

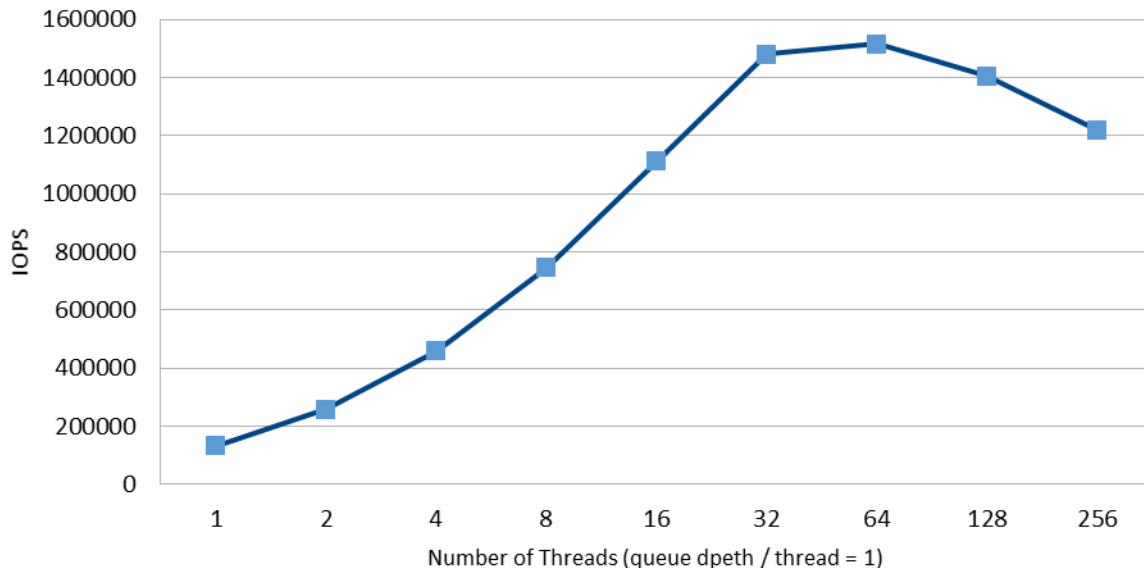
## Long Term Performance Stability



- Standard Ezfio test without modification
- 8 threads and 8 queues increases to 1.5M

# 1.5M 4KB Random Writes

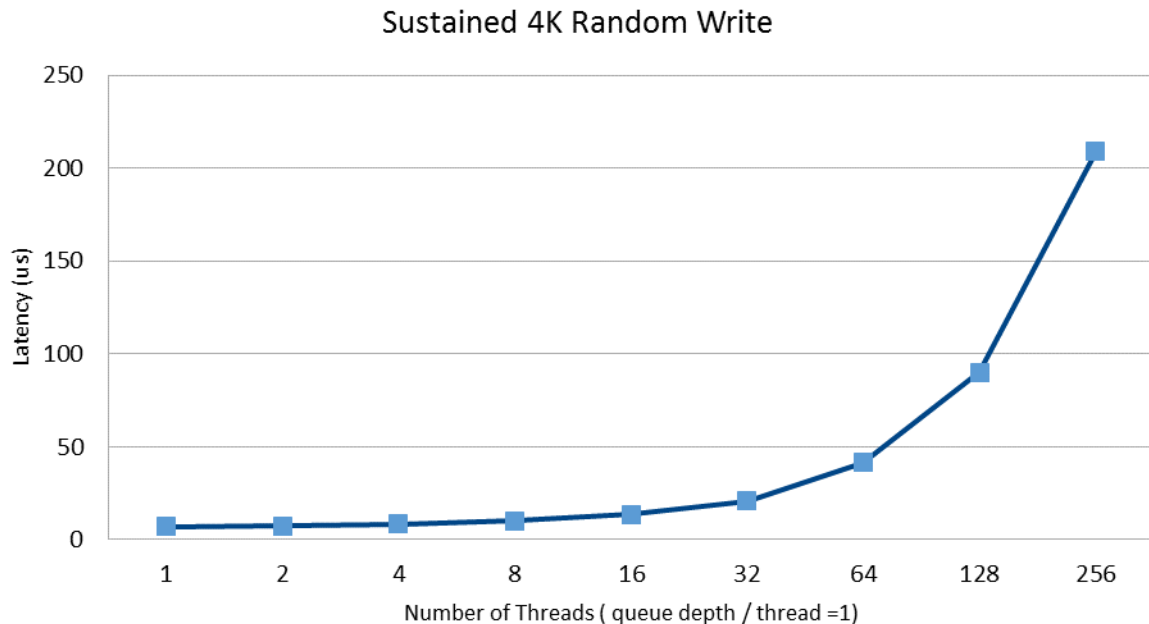
Sustained 4K Random Write



Intel Xeon CPU E5-1650 v3 @ 3.50GHz (6 cores)

- 6GB/s on PCIe Gen3 X8
- Reads and Read/Write mixes are similar

# 6us Write Latency



Intel Xeon CPU E5-1650 v3 @ 3.50GHz (6 cores)

- Going much lower will require a thinner SW stack

# Application Development Platform



**Available Now**

## KEY FEATURES

*PCIe Gen3 x8 with NVMe  
1.5 Million Random 4KB Write,  
Read or Read/Write IOPS  
1 Gigabyte Storage Capacity  
256Mb DDR3 pMTJ ST-MRAM  
Ultra Low  $\mu$ sec Latency  
Power Fail Safe*

## KEY BENEFITS

*Write Data at full PCIe Speed  
Protected Writes without  
System Support (No BIOS, No  
UPS, No Batteries & No  
Supercaps)  
Fast Power Fail Recovery*

**FEATURING EVERSPIN'S  
LATEST ST-MRAM**



**256Mb DDR3 ST-MRAM**  
*Perpendicular MTJ*





# Thank You!

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