Circa 2003

Interface: GPU
OpenGL
Direct-X

Offload GFX computation

Application

GPUs get very fast

CPU

HDD
Circa 2008

CPU & GPU OpenCL model

- Ship the data to the processor with the best available function
Storage devices get **very fast**
CPU, GPU, FPGA OpenCL model

- (FPGAs) Ship the data to “a better function engine”
We want to do this...

CPU, GPU, FPGA, SSD OpenCL model

- (SSD)
  - Embed the function with the data
  - Ship the function to the data
How do we get there?

▸ How did GPUs do it?

1. Do some things far better than the CPU
2. Standardize access to the functions
   ▸ OpenGL has been tracking device improvements since 1992
3. Define compelling use cases
What do we do better than the CPU?

Answer: **Store massive amounts of data**...

So... Anytime it makes sense to “bring the function to the data”

- **Database**
  - Search / Compare, Merge, Update, ...
- **Video**
  - Encode, Transcode
- **Scientific**
  - “Simple” data transformations

Source: FMS 2013 Micron Keynote, Ed Doller
What about Software Defined Storage?

- “SDS” today generally implies an x86 server with software services running on it
  - Great start for offloading fixed functions, e.g.
    - RAID, Encryption, Compression, Deduplication, Tiering, Snapshot, Replication, HA, ...
  - Need standard APIs for using an internal, or user-generated, function (e.g. an OpenCL “Kernel”)
  - Attached via legacy iSCSI or FC... SLOOOOW
NVMe over Fabric
Software Defined Storage

Advantages of SAN:
- Isolate storage from server
  - Easier to service
  - Capacity can be re-allocated

Advantages of DAS:
- Low latency
- High BW

The best of both storage approaches... plus:
- Non-Proprietary architecture
- Standard Ethernet switch fabric
- Open industry management tools
- Completely compatible with legacy applications
  - Volumes appear as a local NVMe device
With NVMe over Fabric, we can do this...

OpenCL using CPU, GPU, FPGA, and SSDs
The Mangstor NMX series of storage arrays is the perfect high performance Server-SAN storage for clustered applications...

Small workgroup clusters

Dense full-rack clusters

- Storage arrays
- Redundant Switches
- Application Servers
Full-Rack Cluster
NVMe over Fabric, Software defined Storage

- Scalable capacity & BW shared by multiple clients
- Over 500 Gbps BW *
  • With Failover / redundancy

* (5 Storage arrays, using 56Gb links)
Why not Software Defined Storage Devices?

▸ With NVMe Storage Devices offload *media control*
  • FTL mapping, Wear leveling, Garbage collection, ECC, ...

▸ Mangstor has developed an SSD with a 100 core processor onboard
  • NVMe host interface and Flash control completely done in Firmware on these cores
  • Other functions to be provided by these cores

▸ Others are developing SSDs with many more cores than in previous generations
Industry Call to Action

- Continue NVMe standard development to take advantage of compute functions in the SSD.
- Begin deploying OpenCL compatible reference code and whitepapers using in-storage processing
  - Available first in SDS arrays
  - Migrating into SDS devices
Intelligent storage products