THE NEXT WAVE OF FLASH STORAGE IN THE DATA CENTER – CAN IT BE CLIENT?

IRI TRASHANSKI
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STORAGE DRIVERS

CLIENT MARKET UPDATE

HYPERSCALE DIRECTION

FUTURE TRENDS
WHAT HAPPENS ON THE INTERNET IN A MINUTE?

6 MILLION FACEBOOK VIEWS
320+ NEW ACCOUNTS
20 MILLION PHOTO VIEWS
100+ NEW ACCOUNTS

facebook  Google  Twitter  YouTube  flickr  amazon.com  LinkedIn

2+ MILLION SEARCH QUERIES
1.3 MILLION VIDEO VIEWS
$83,000 IN SALES

639,800 GB OF GLOBAL IP DATA TRANSFERRED
BILLIONS OF NEW DEVICES CREATING MORE DATA

DEVICES/USERS (MM IN LOG SCALE)

SOURCE: MORGAN STANLEY
RESULTING IN HUGE DEMAND FOR STORAGE

SOURCE: IDC, CISCO VNI, GARTNER, MMI
DRIVING SSD VOLUMES IN ENTERPRISE AND CLIENT

SOURCE: MARVELL MARKET INTELLIGENCE
HUGE NAND GROWTH IN DATA CENTER SEGMENT

2014

- 75% Client
- 17% Enterprise
- 8% Data Center
- 15EB

2018

- 59% Client
- 35% Enterprise
- 6% Data Center
- 85EB

SOURCE: MARVELL MARKET INTELLIGENCE
MULTIPLE SSD SEGMENTS

Direct PCIe attached, VDI, analytics, software aware, extreme performance

>4GB SCSI IO, SAS highly random, high redundant, backup, dual data path, failover,

~4GB/s IO, random IOPS, high capacity, server attached

<2GB/s SATA/PCIe, read intensive, client-like
CLIENT: LESS BUT FASTER NAND CHANNELS
FEWER BUT BIGGER NAND DIES

NUMBER OF DIES FOR DRIVE CAPACITY

SPEED PER CHANNEL

SOURCE: MARVELL MARKET INTELLIGENCE
CLIENT MARKET TRENDS

**2013**

- **4CH**: 80%
- **8CH**: 20%

**2017**

- **2CH**: 70%
- **4CH**: 20%
- **8CH**: 10%

**Comparison of Interfaces**

- **PCIe**: 81% in 2013, 73% in 2017
- **SATA**: 19% in 2013, 27% in 2017

**Comparison of Form Factors**

- **M.2**: 75% in 2013, 71% in 2017
- **2.5"**: 25% in 2013, 29% in 2017
- **mSATA**: 0% in 2013, 4% in 2017
HYPERSCALE ≠ ENTERPRISE

- Spend time to save $ vs. Spend $ to save time
- Software orientated
- Huge Capacity Growth
- CapEx and OpEX → calls for efficiency
- Interactive applications support

![Graph showing categories: Write Intensive, Mixed-use, Read Intensive]
HYPERSONELE SSD PRICING IS GETTING SIMILAR TO CLIENT

COST PER GB HIGHER THAN FOR CLIENT

- Demand for over provisioning and longer endurance NAND
- Specific FW features
- Power loss data protection
- Security

![Graph showing cost per GB ($)](image)
SERVER ATTACHED TO DRIVE BULK OF UNITS

SOURCE: MARVELL MARKET INTELLIGENCE
WITH 75% OF THE VOLUME GOING TOWARD HYPERSCALE

SOURCE: MARVELL MARKET INTELLIGENCE
# SSD Needs: Hyperscale Is Not Enterprise

## Comparison Table

<table>
<thead>
<tr>
<th>Enterprise</th>
<th>Hyperscale</th>
<th>Client</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAS Enterprise SSD Controller</td>
<td>SATA/PCIe Client SSD Controller</td>
<td>SATA/PCIe Client SSD Controller</td>
</tr>
<tr>
<td>Dual path</td>
<td>Cloud redundant data</td>
<td>Single path</td>
</tr>
<tr>
<td>SLC/eMLC</td>
<td>LDPC MLC/TLC</td>
<td>LDPC MLC/TLC</td>
</tr>
<tr>
<td>Advanced processor and data flow</td>
<td>New adaptive multi-core/DMA architecture</td>
<td>Dual/ Tri-Core</td>
</tr>
<tr>
<td>Complex SCSI protocol</td>
<td>ATA and New defined Flash-optimized SSD protocol for all SSDs: NVM Express</td>
<td>Simple ATA command and NVMe</td>
</tr>
<tr>
<td>RAID host bus adaptor</td>
<td>Direct PCIe interface, SATA</td>
<td>SATA and PCIe</td>
</tr>
<tr>
<td>IOPS centric</td>
<td>Highly sequential, high random</td>
<td>User experience</td>
</tr>
</tbody>
</table>
LEVERAGING ENTRY LEVEL MASS MARKET TECH

THE FISHER SPACE PEN
SEALED PRESSURIZED INK CARTRIDGE

RUSSIANS USED
A PENCIL

Stainless steel, precision-machined socket prevents leaks and oozing, yet delivers instant uniform ink flow.

Ultra-hard tungsten carbide ball

Thisotropic ink in a hermetically sealed and pressurized reservoir writes three times longer.

Sliding float separates ink from pressurized nitrogen gas

Gas plug

Ink will not dry out for over one hundred years! Writes at any angle at temperatures of -30°F to +250°F.

Developed For
NASA

Made in U.S.A.
SATA: VARIOUS TIERS BASED ON CLIENT HW

- **CLIENT**
  - 5K RandomW
  - DWPD<0.5
  - <4W

- **HYPERSCALE**
  - 8-10K RandomW
  - DWPD<3
  - <5W

- **ENTERPRISE**
  - 10K RandomW
  - DWPD<10
  - <6W
## NVMe TO DRIVE ADOPTION OF PCIe SSDs

<table>
<thead>
<tr>
<th>Feature</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 X BANDWIDTH</td>
<td></td>
</tr>
<tr>
<td>4 X IOPS</td>
<td></td>
</tr>
<tr>
<td>8 X IMPROVED LATENCY</td>
<td></td>
</tr>
<tr>
<td>EQUIVALENT POWER</td>
<td></td>
</tr>
<tr>
<td>STANDARD BASED</td>
<td></td>
</tr>
</tbody>
</table>
NVMe PCIe vs SATA SSD

- Bandwidth
- IOPS
- Power
- Latency
- Cost

NVMe SSD

SATA SSD
M.2 & 2.5 TO DRIVE PCIe ADOPTION IN HYPERSCALE

SOURCE: MARVELL MARKET INTELLIGENCE
PATH TO LEVERAGE CLIENT TECHNOLOGY IS OBVIOUS

- **CLIENT**
  - >200K IOPS
  - DWPD <0.5
  - <9W

- **HYPERSCALE**
  - >200K IOPS
  - DWPD <3
  - <9W

- **PCIe CARDS**
  - >700K IOPS
  - DWPD <10
  - <25W
Marvell Extends Leadership in SSD Market with Groundbreaking PCIe 3.0 NVMe Express SSD Controller

The Marvell 88SS1093 delivers high-performance data center and client solid-state storage solutions with new Flash-optimized architecture and advanced NANDedge LDPC technology.

SANTA CLARA, Calif. — (Aug 5, 2014) — Marvell (NASDAQ: MRVL) today announced the introduction of its first native Non-Volatile Memory Express (NVMe) solid-state drive (SSD) controller, the 88SS1093. The Marvell® 88SS1093 NVMe SSD controller delivers high-performance solid-state storage solutions with a fully Flash-optimized architecture overcoming the SAS/SATA performance limitations by optimizing hardware and software to take full advantage on NAND and addressing the needs of data centers and client systems that utilize next-generation PCIe 3.0 SSD storage. The 88SS1093 also integrates Marvell’s 5th generation NANDedge™ error-correcting, low-density parity check (LDPC) technology for higher reliability and endurance boost that was previously announced with Marvell’s 5th generation SATA SSD controller, the 88SS1074.

PCle Gen 3x4 | NVMe 1.1 | LDPC
NEW TECHNOLOGY DRIVING INNOVATION AND LOWERING PRICES

LATENCY vs. PRICE PER GB:
- DRAM
- DIMM SSD
- PCIe Cards
- PCIe SSD
- SSD
- HDD
FUTURE INNOVATION

INTEGRATION

M.2 AGGREGATION

STORAGE SEPARATION

REPURPOSING
FUTURE OF DATA CENTER

COMMODOITY HARDWARE

OPEN SOURCE SOFTWARE

Distributed  Efficient  Reliable  Scalable  Economical
THANK YOU!