



HL NAND
www.HLNAND.com

MOSAID

Scalability
Flash
Me
Per
DDR800
Flash
Me
Per
HL NAND
Low Power
High Throughput
Hyperlink Architecture
Independent Bank
Unified Synchronous
Inter
Point-to-Point
Flexibility
+ Generation

A 2/4 TB SATA3 SSD Employing a Single Controller

HakJune Oh

Director, Product Development
MOSAID Technologies Inc.

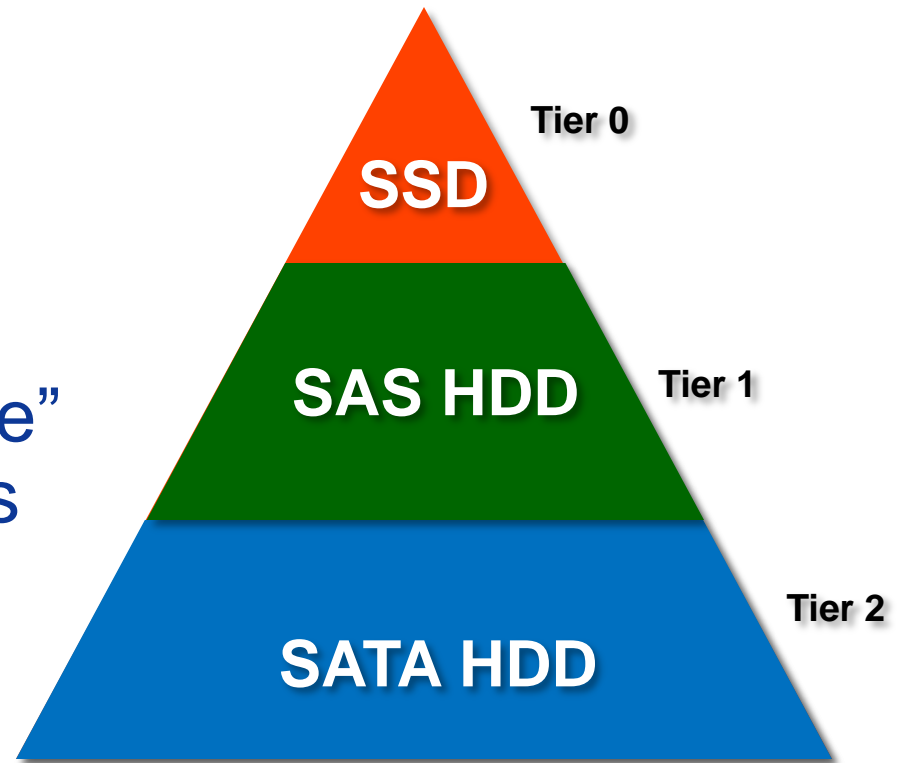
Code
Scalable
Duplex
800MB/s
SSD
EDC
Command Packet
Architecture
AND
Capacity
High Bandwidth
Daisy-chain Cascade

Agenda

- **Introduction**
- **HyperLink NAND (HLNAND) Flash**
- **HLSSD**
- **Summary**

Storage Tiering

- Tiering storage is for efficiency and cost/performance
- More numbers of tier require the “intelligence” to manage data across tiers



Storage Tier with SSD

Goals

- Provide affordable Terabyte-class SSD for large and fast storage pool
- Reduce the number of storage tiers
- Minimize complexity of the intelligence to manage storage tiers

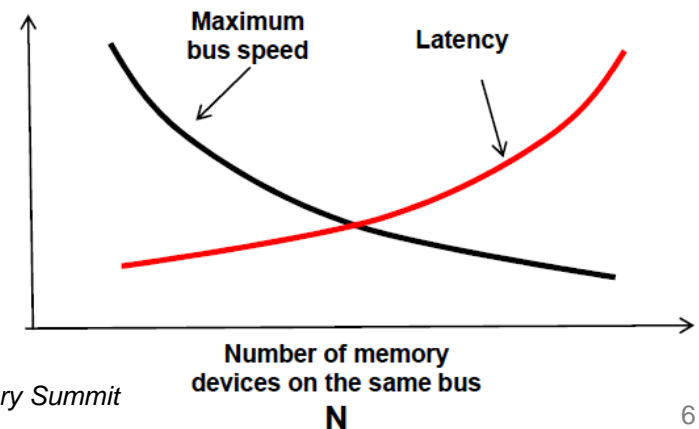
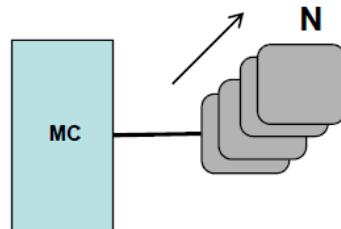
Performance and Scalability (SSD Capacity)

SSD Capacity = # of Channels x
of Devices per Channel x
Flash Device Capacity

- Sandforce SF-2200 & Marvell 88SS9187
 - 8 channels
 - 8 ways per channel
 - 64Gb NAND Flash
- Maximum SSD capacity = 512GB (= 8 x 8 x 64Gb)

Performance and Scalability (SSD Performance)

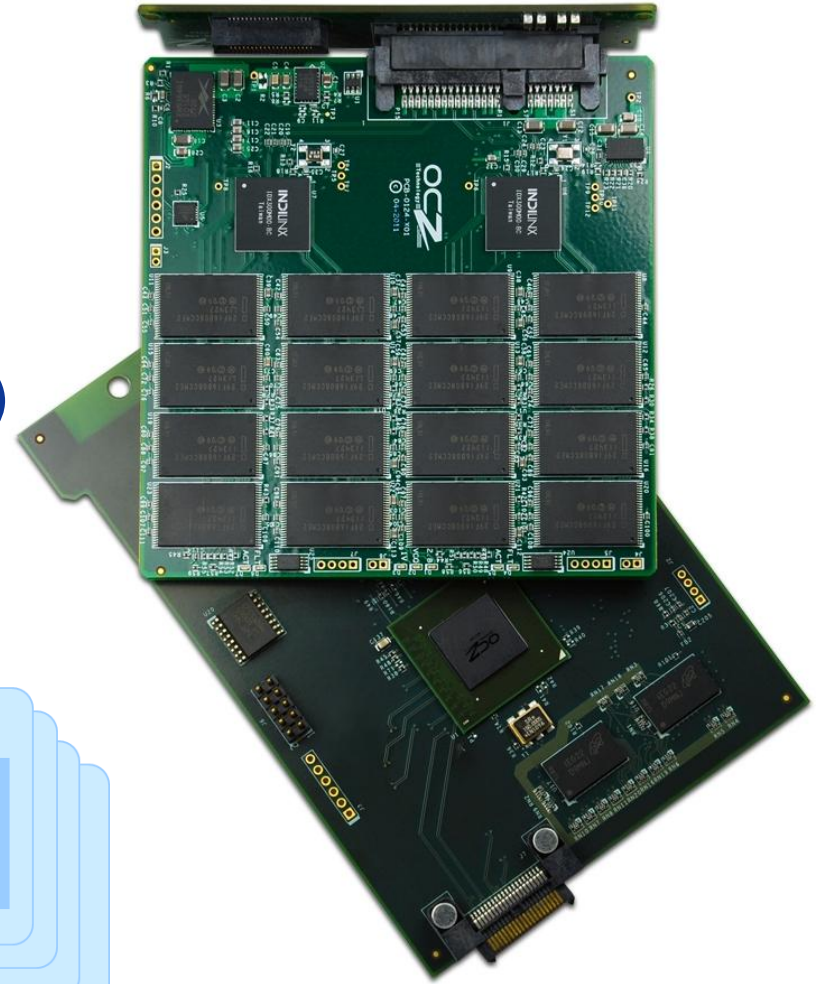
- Adding more channels:
 - System design complexity
 - Poor Signal Integrity (SI)
 - Higher power consumption
 - ECC/IO overhead per channel
 - Complex PCB design requiring 7-10 layers
- Adding more devices per channel:
 - Compromise between performance and # of devices



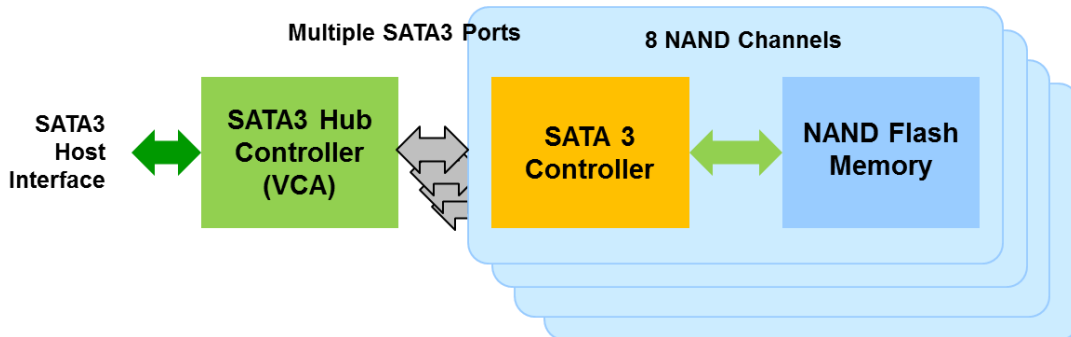
Source: Micron, 2011 Flash Memory Summit

Conventional Terabyte SSD

- Capacity: up to 4TB
- Host interface: SATA3
- Form factor: 3.5"
- 8 SATA3 controllers + 1 SATA3 Hub Controller (VCA)
 - 8 NANDs per SATA3 Controller

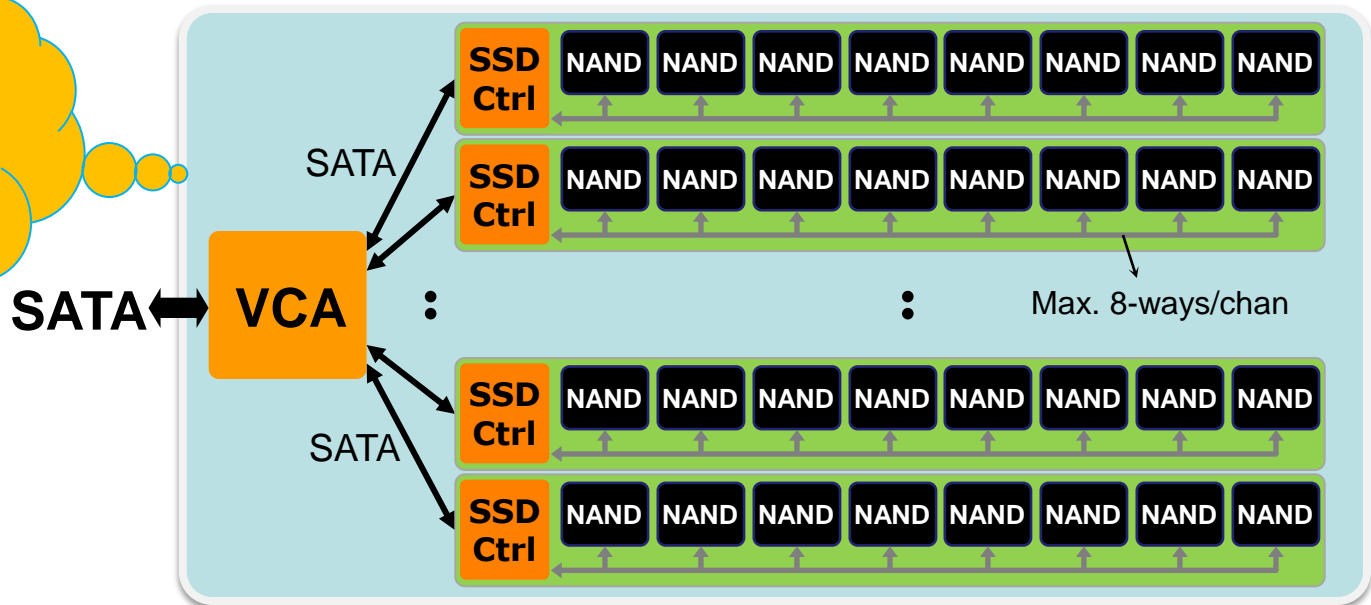


Source: OCZ



Conventional Multi-Level Terabyte SSD

Not Optimized for Cost, Power, Performance



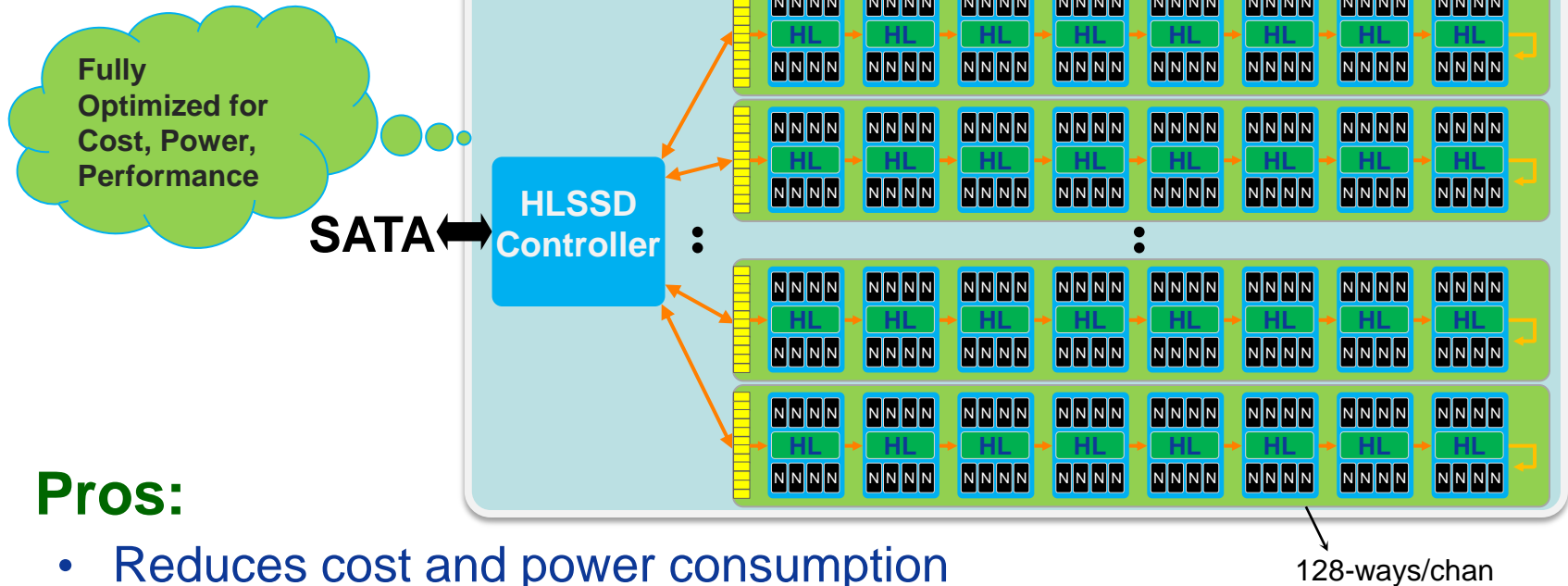
Pros:

- Time to Market – All building components exist today

Cons:

- Multi-level architecture increases **latency** and decreases **performance**
- High **power consumption** because of additional SATA3 links
- More controllers result in higher **cost**, eat up PCB **space**

Single Native Controller Terabyte HLSSD



Pros:

- Reduces cost and power consumption
- Improves overall performance
- Provides more PCB space for more NAND devices

Cons:

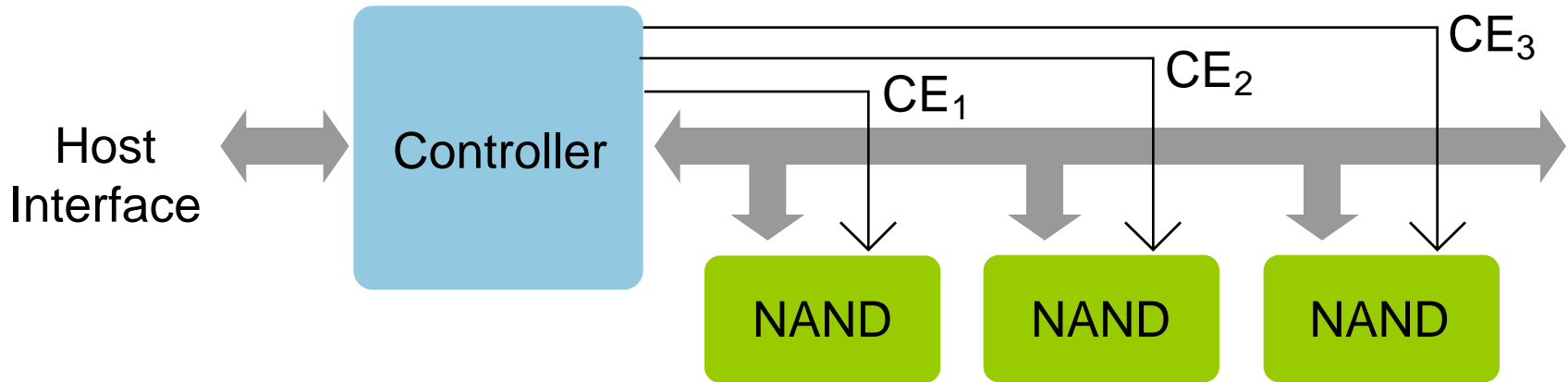
- Controller availability

Agenda

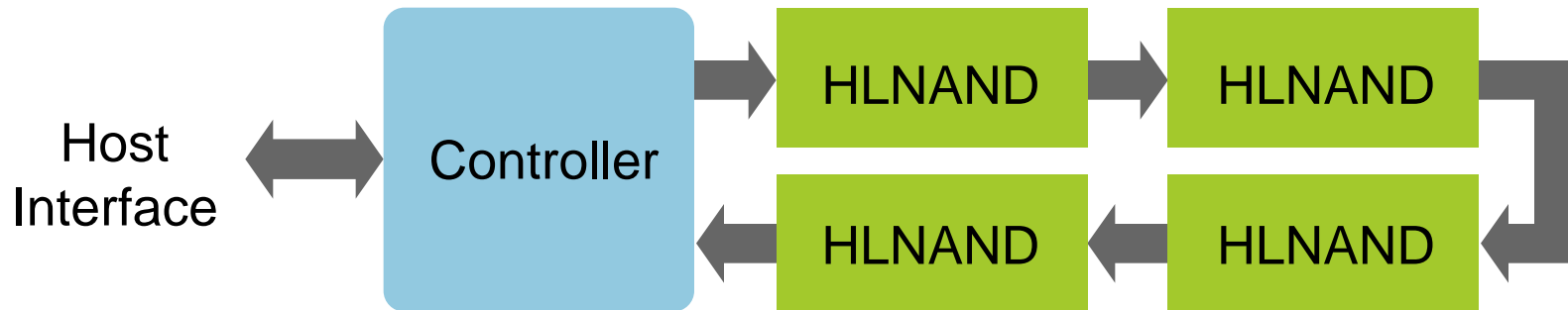
- Introduction
- **HyperLink NAND (HLNAND) Flash**
- HLSSD
- Summary

Bus Topology

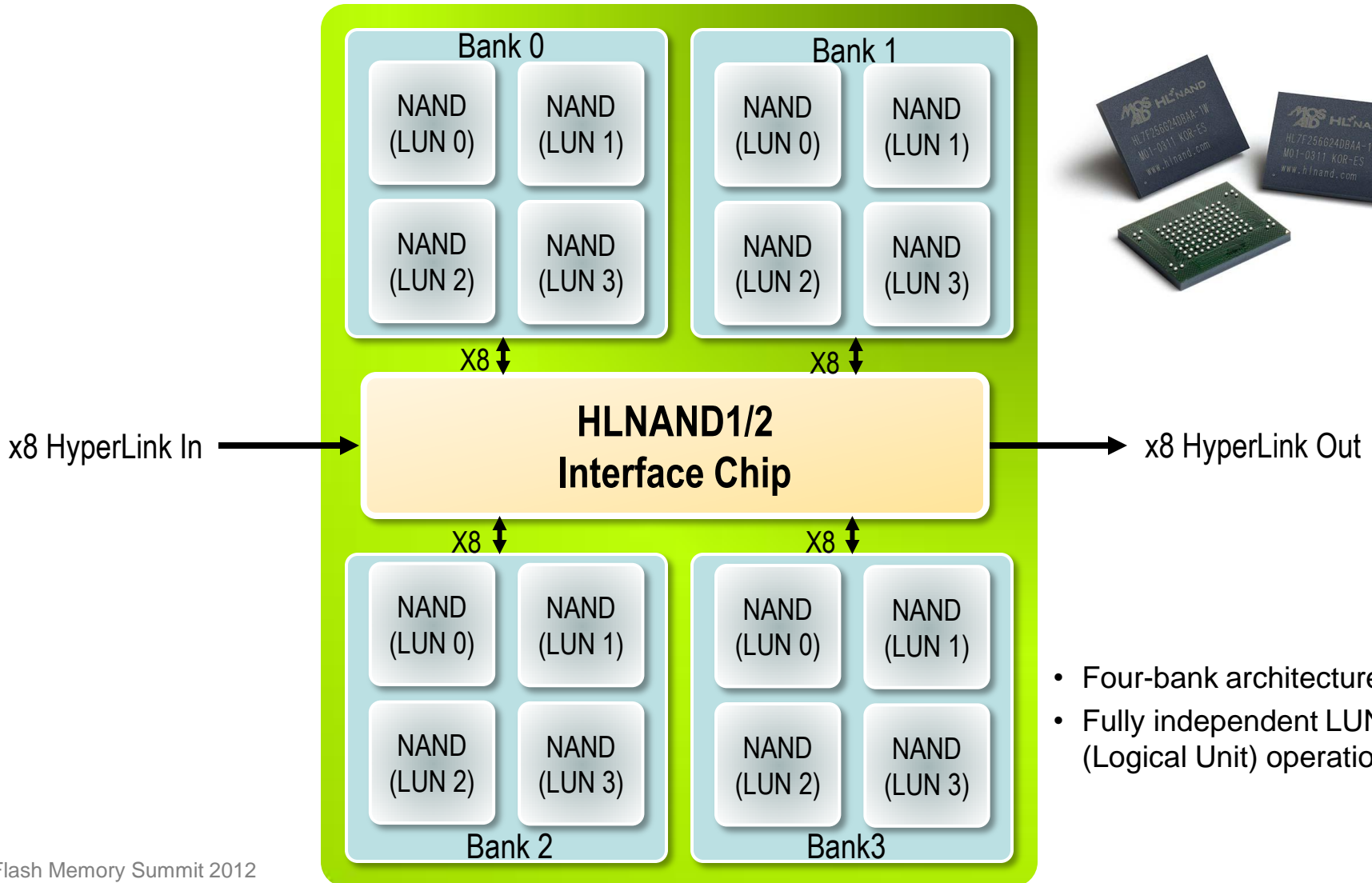
- **Multi-drop Bus Topology in Conventional NAND**



- **Point-to-point Ring Topology in HLNAND**

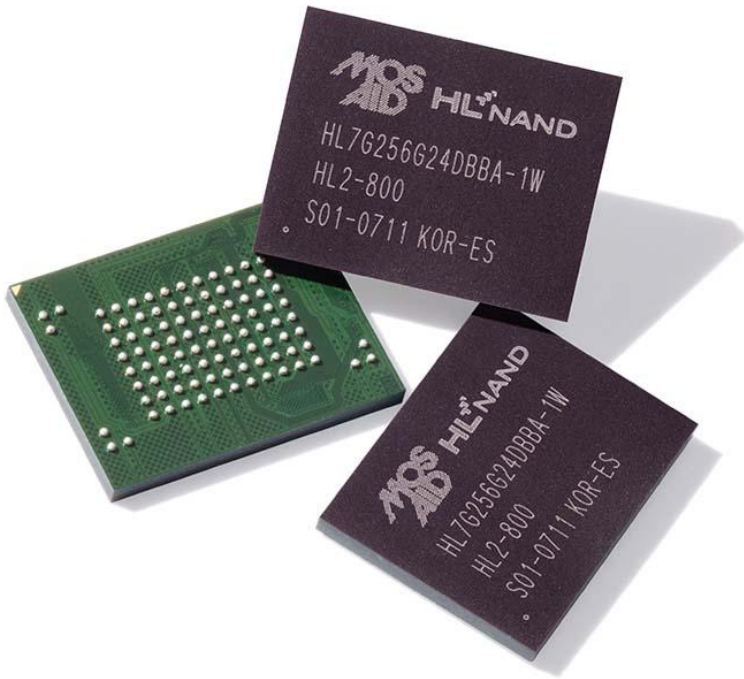


HLNAND MCP Architecture

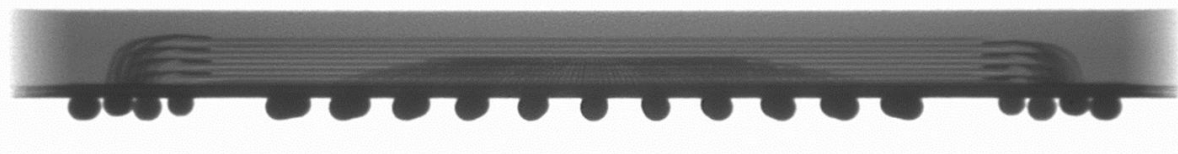
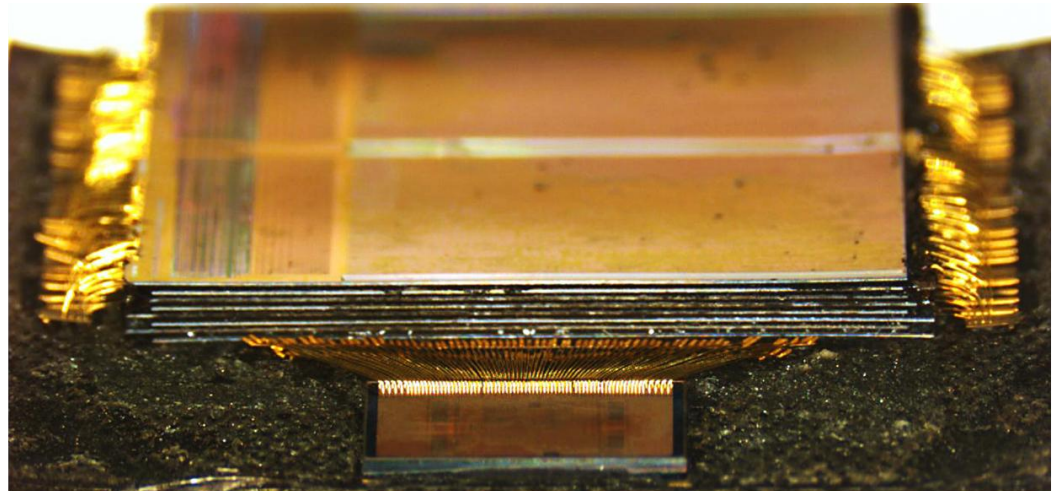


- Four-bank architecture
- Fully independent LUN (Logical Unit) operation

DDR-800 HLNAND



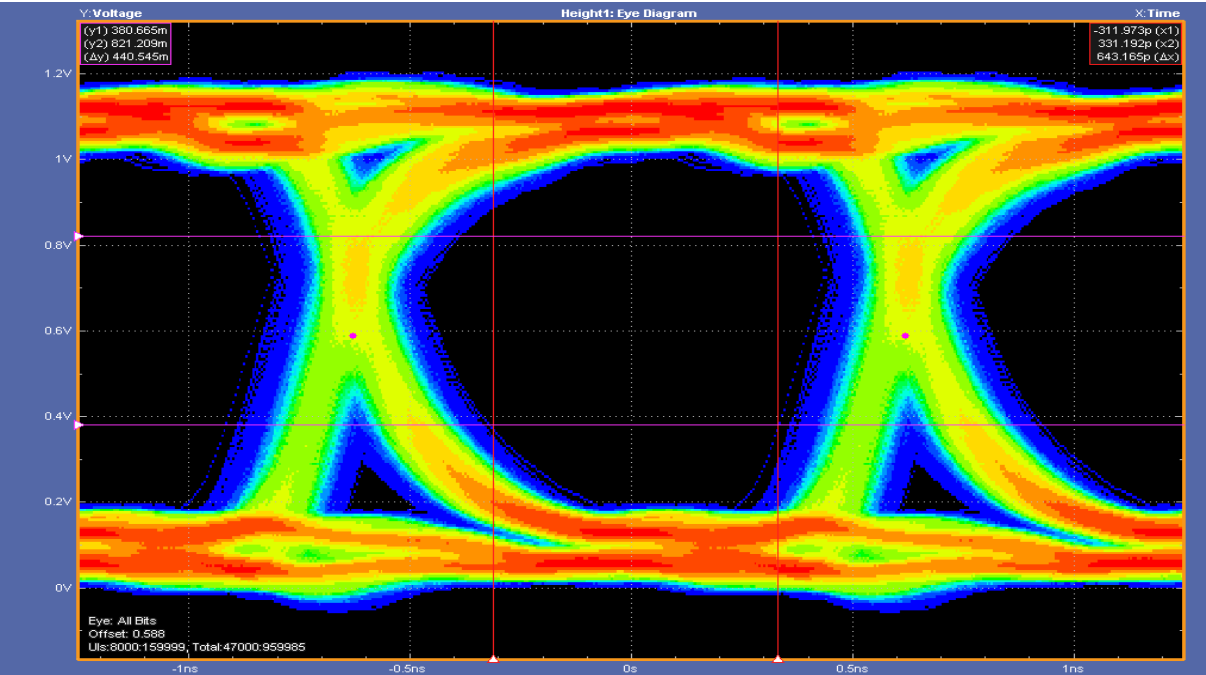
(8+1)-die Stacked View



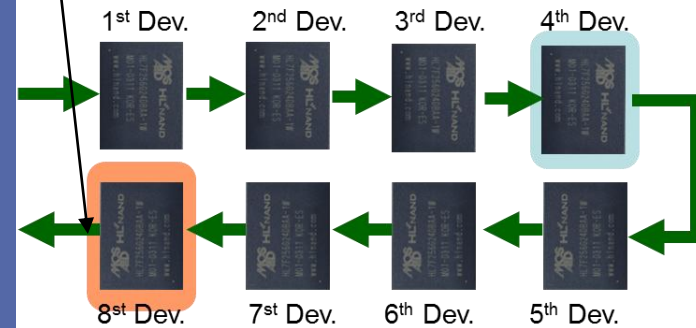
Measured Signal Integrity

(DQ Signals from 8th Dev. @DDR800)

DQ0 (Data Eye)



DQ0





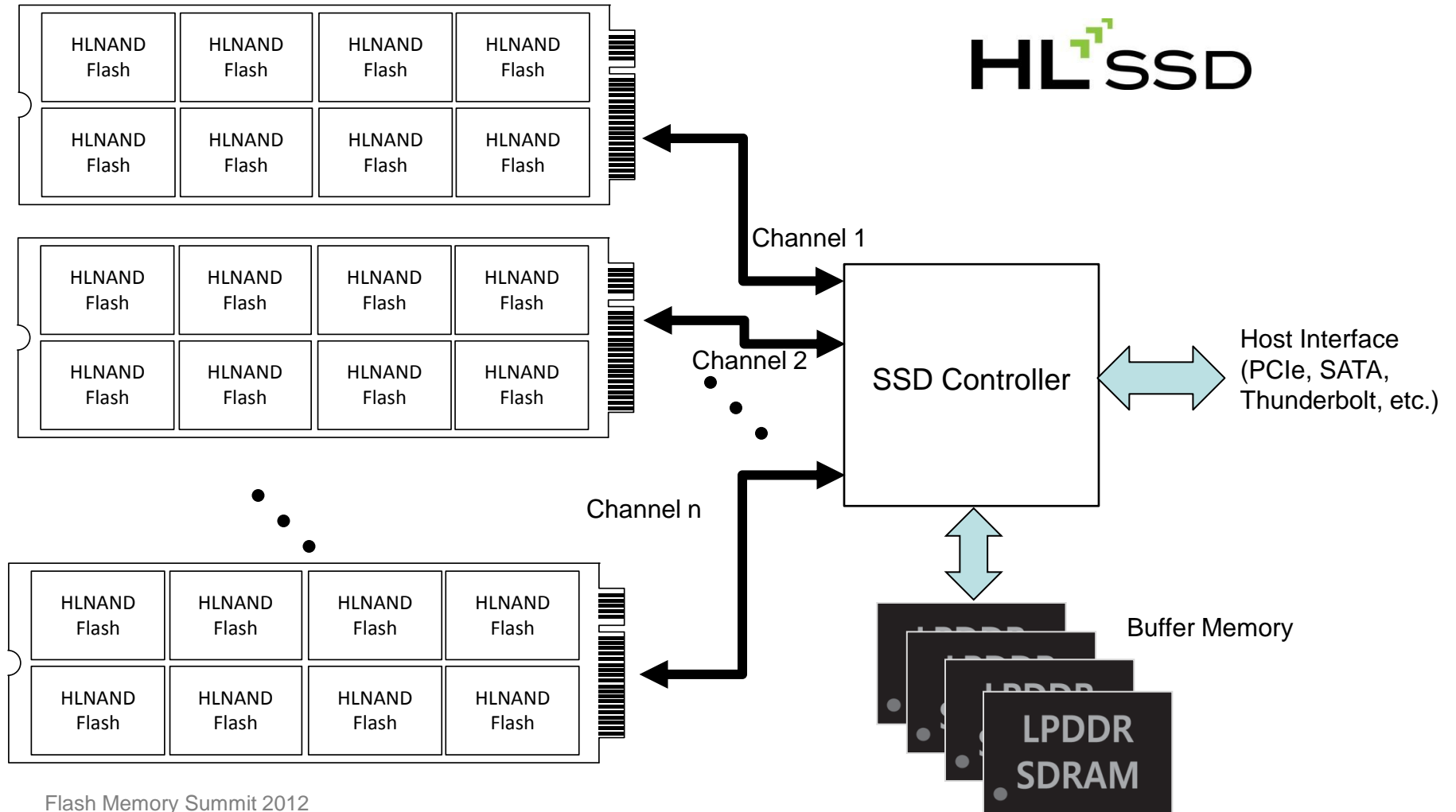
HLNAND Flash Benefits

(Performance, Scalability and Low Power)

- Higher performance 800MB/s and beyond (compared to 200MB/s & 400MB/s for conventional architecture)
- Virtually unlimited number of devices can be cascaded
- Superior signal integrity (SI)
- No ODT required
- Statistically 50% lower power consumption per channel due to power-saving feature
- Scalable without diminishing performance for Terabyte-Class & GB/s-Performance SSDs

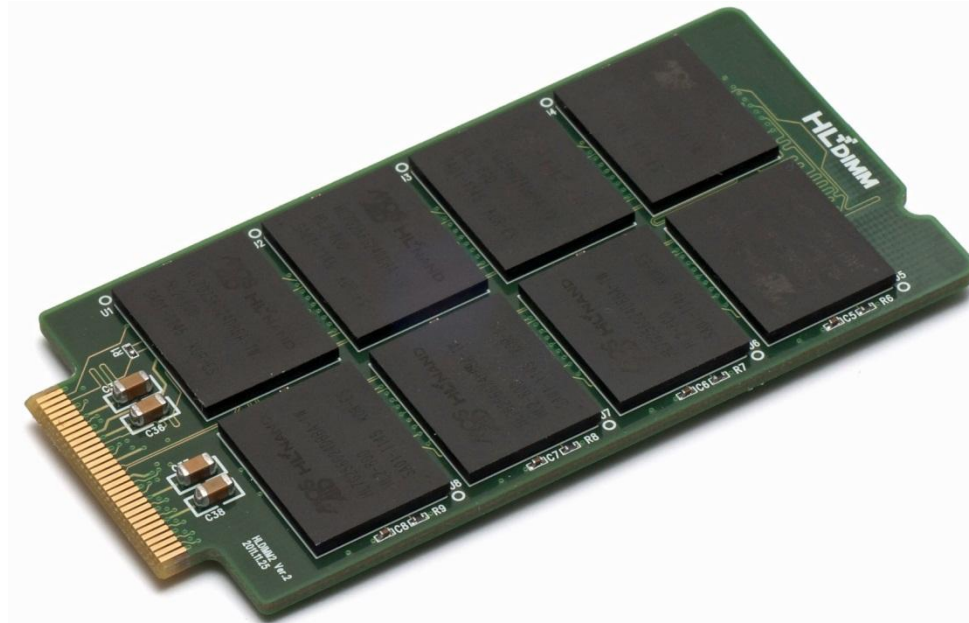
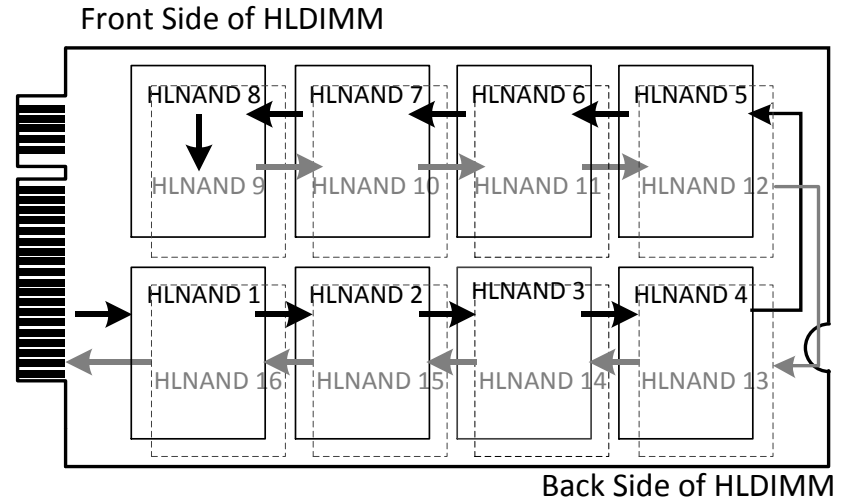
Agenda

- Introduction
- HyperLink NAND (HLNAND) Flash
- **HLSSD**
- Summary



HLDIMM

- Total 16 HLNAND MCPs
- 512GB/1TB per HLDIMM
- Max. 800MB/s Channel per HLDIMM



2TB/4TB HLSSD



2TB HLSSD Test

제목 없음 - ATTO Disk Benchmark

Drive: [-d-] Direct I/O

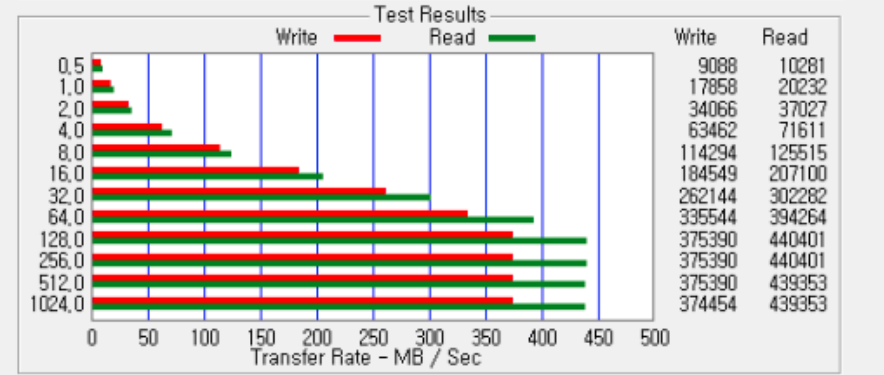
Transfer Size: 0,5 to 1024,0 kb I/O Comparison

Total Length: 4 mb Overlapped I/O

Queue Depth: 4 Neither

Stripe Group: Controlled

<< Description >>



Transfer Size (kb)	Write (MB/Sec)	Read (MB/Sec)
0,5	9088	10281
1,0	17858	20232
2,0	34066	37027
4,0	63462	71611
8,0	114294	125515
16,0	184549	207100
32,0	262144	302282
64,0	335544	394264
128,0	375390	440401
256,0	375390	440401
512,0	375390	439353
1024,0	374454	439353

For Help, press F1 NUM

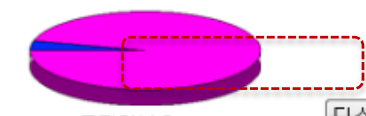
로컬 디스크 (D:) 속성

ReadyBoost	이전 버전	할당량	사용자 지정
일반	도구	하드웨어	공유
			보안

종류: 로컬 디스크

파일 시스템: NTFS

■ 사용 중인 공간:	28,325,834,752바이트	26,3GB
■ 사용 가능한 공간:	1,904,406,298,624바이트	1,73TB
용량:	1,932,732,133,376바이트	1,75TB



드라이브 D:

이 드라이브를 압축하여 디스크 공간 절약(C)

이 드라이브의 파일 속성 및 내용 색인 허용(I)

HLNAND Controller

- Dual-core with hardware accelerator
- Up to 8TB capacity
- SATA 6Gb/s with NCQ (PCIe interface is following)
- Persistent performance in compressed and non-compressed data
- End-to-end data protection
- Full disk encryption with AES-128/256 ECB/CBC/CTR/XTS
- Enhanced randomization for data reliability
- Smart power management for low- and peak-power control



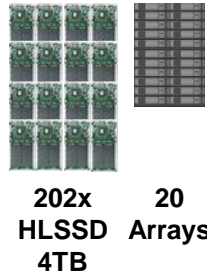
HLSSD vs. Conv. SSD

	HLSSD	Conv. SSD
Capacity	4TB	4TB
# of Controllers	1	8 + 1 (= 9)
# of Channels	4	8 x 8 (= 64)
# of PKG / Channel	16	1
Total # of PKG	64	64
Power Consumption (50/50 Est. mW/MB/s)	8.1	9.8
64GB PKG Cost (8-die stacked)	\$34*	\$45**
Controller Cost (Est.)	\$20	\$150 (\$15*8 + \$30)
PCB, Active & Passive Parts	\$45	\$50
Final BOM for 4TB SSD	\$2,241 (= 64*\$34+\$20+\$45)	\$3,080 (= 64*\$45+\$150+\$50)

HLSSD's saving TCO

1PB Storage Solution

- ✓ GB & IOPS / W
- ✓ \$ / sqft
- ✓ TB / lbs



HLSSD & HDD Deployment		TCO (Est.)
1TB SATA HDD x300	300TB	\$180,000
4TB HLSSD x202	808TB	\$2,197,000
25ea – 15 bay arrays	Rack space	\$232,000
45ea – 450W supplies	Power	\$26,000
	Cooling	\$20,000
Total TCO (Est.) *		\$2,655,000

Note: Real estate cost saving is not included.

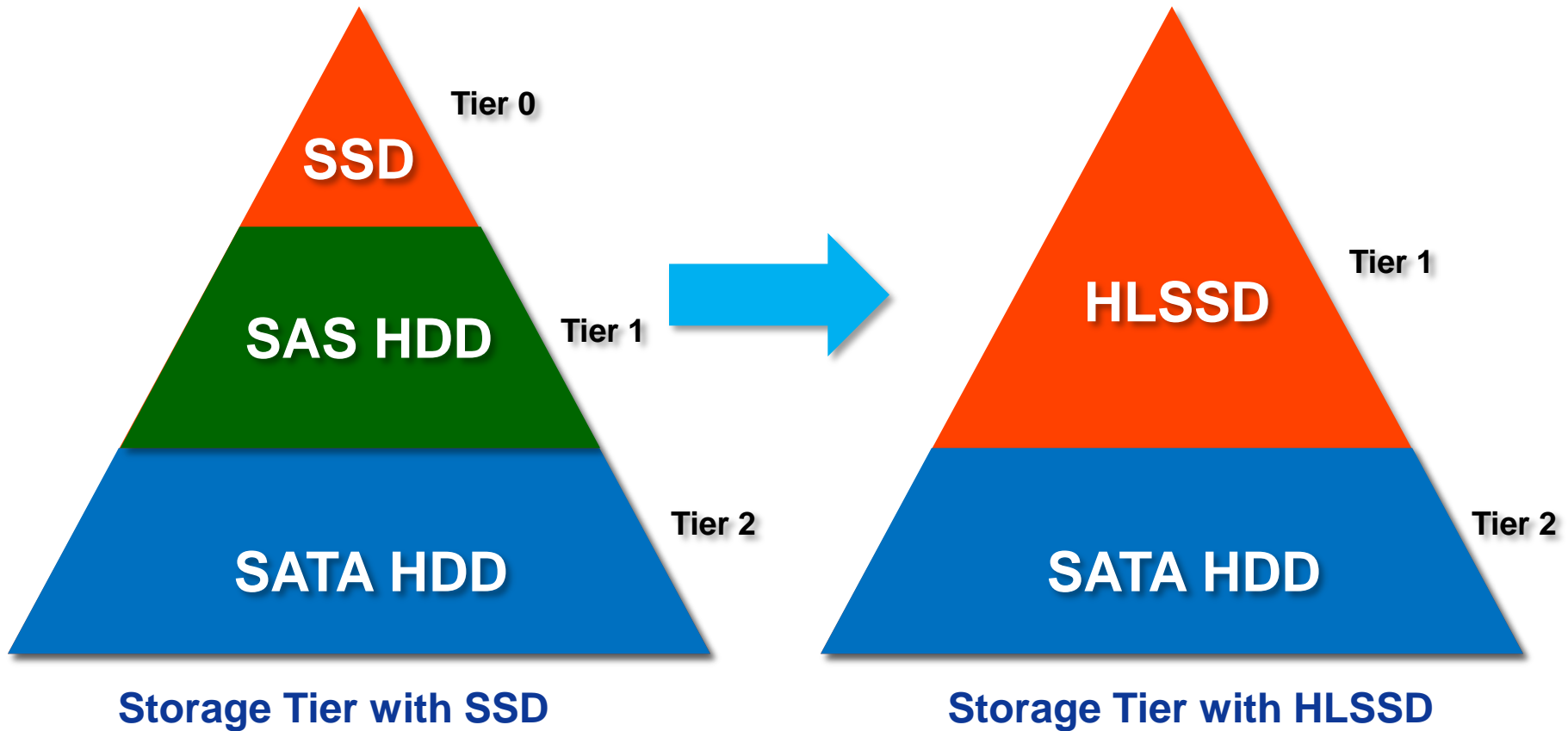


Conv. SSD & HDD Deployment		TCO (Est.)*
1TB SATA HDD x300	300TB	\$180,000
500GB SAS HDD x1600	800TB	\$1,708,000
200GB SAS SSD x 40	8TB	\$130,000
100ea – 15 bay arrays	Rack space	\$930,000
180ea – 450W supplies	Power	\$105,000
	Cooling	\$51,000
Total TCO (Est.)		\$3,104,000

Agenda

- Introduction
- HyperLink NAND (HLNAND) Flash
- HLSSD
- **Summary**

Suggested Storage Tier with HLSSD



Summary

- HLNAND technology delivers affordable Terabyte sized SSDs (2TB/4TB/8TB)
- Single Native Controller based HLSSDs deliver the best \$/IOPS, IOPS/W and IOPS/GB
- Provide fast and large storage pool to minimize the number of storage tiers – no need for more than two “tiers” of storage
- Affordable Terabyte-Class HLSSDs minimize complexity of the intelligence to manage storage tiers

See a demo of HLSSD at Booth 714



HL NAND
www.HLNAND.com

Delivering Terabyte-class SSDs

See a demo of HLSSD at booth 714

MOSAID



HL NAND A NEW STANDARD FOR HIGH-PERFORMANCE FLASH MEMORY

MOSAID

HOME TECHNOLOGY PUBLICATIONS NEWS & EVENTS PARTNERS CONTACT US

WHAT'S NEW

- Jun 27/12 **MOSAID and NOVACHIPS Announce HLNAND SSD Controller Joint Development**
- Apr 3/12 **MOSAID First to Achieve Single Channel, Full Performance 16-Die NAND Flash Stack**
- Nov 9/11 **"Enabling TB Class and GB/s Performance with HLNAND" - MOSAID presents at NVRAMOS11 in Korea**



MOSAID first to achieve single channel, full performance 16-die NAND Flash stack

512Gb HLNAND operating at 333MB/s

[LEARN MORE](#)

PARTNER LOGIN

Username:

Password:

[Register](#) | [Forgot Password](#)

PUBLICATIONS

-  **White Paper**
Enabling Ultra-High Bandwidth Scalable SSDs with HLNAND
-  **64GB HLNAND Flash Module Brief**
-  **64Gb HLNAND Flash MCP Brief**
-  **256GB HLNAND2Flash MCP Brief**

HLNAND™ is a technology developed by MOSAID that is available for licensing from MOSAID
Copyright © 2012 MOSAID Technologies Incorporated. All rights reserved. [Terms](#) | [Privacy Policy](#) & [Code](#)