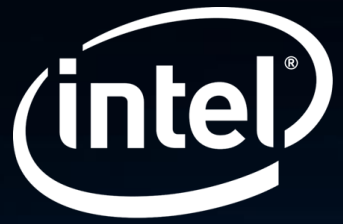


HOW TO MAKE BEST USE OF LEADING NON-VOLATILE MEMORY TECHNOLOGIES

SHIRISH BHARGAVA

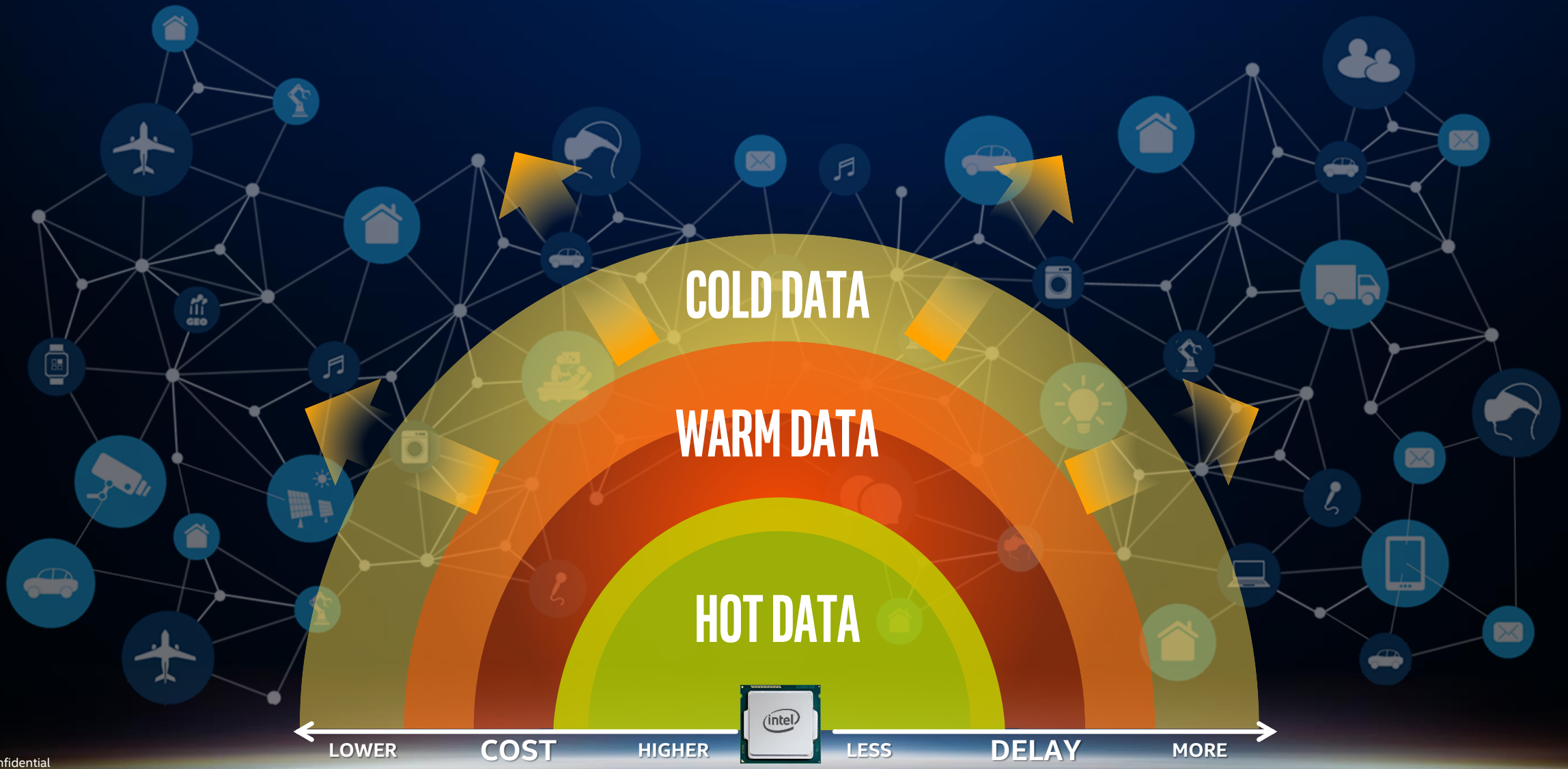
JUNE 13TH, 2018

WE ARE IN A DATA-CENTRIC WORLD

TODAY ALL DATA MUST BE STORED, PROCESSED, ANALYZED & MONETIZED

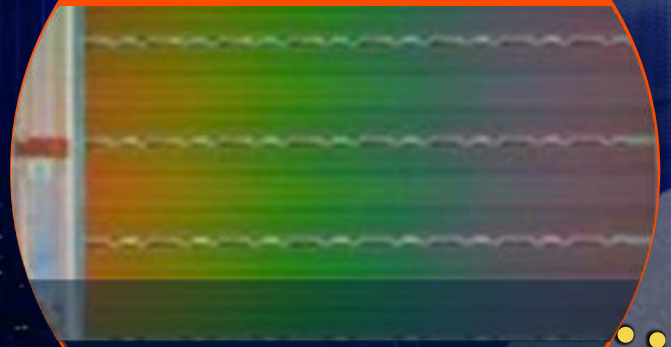
Source: https://www.seagate.com/files/www-content/our-story/trends/files/Seagate-WP-DataAge2025-March-2017.pdf

DATA IS STORED BY DIFFERENT TIERS



STORAGE TRENDS

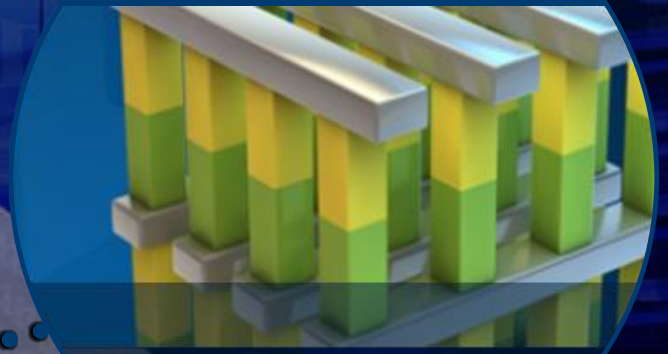
TREND 1
EVOLUTION OF NAND



"BULK STORAGE"

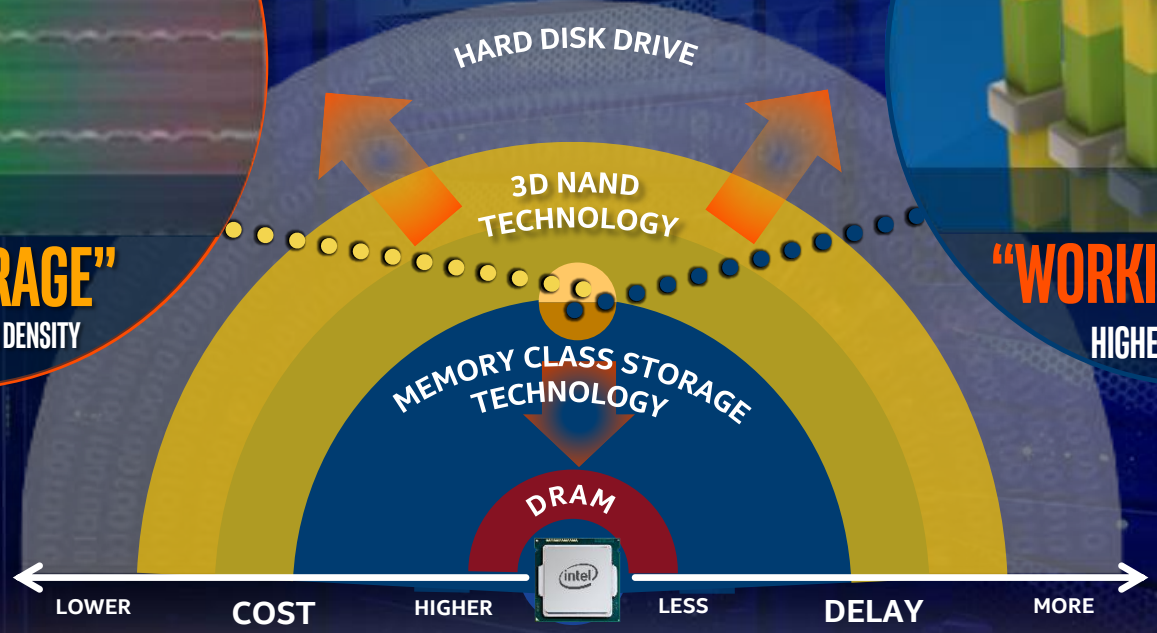
LOWER COST & HIGHER DENSITY

TREND 2
NEW NON-NAND MEDIA



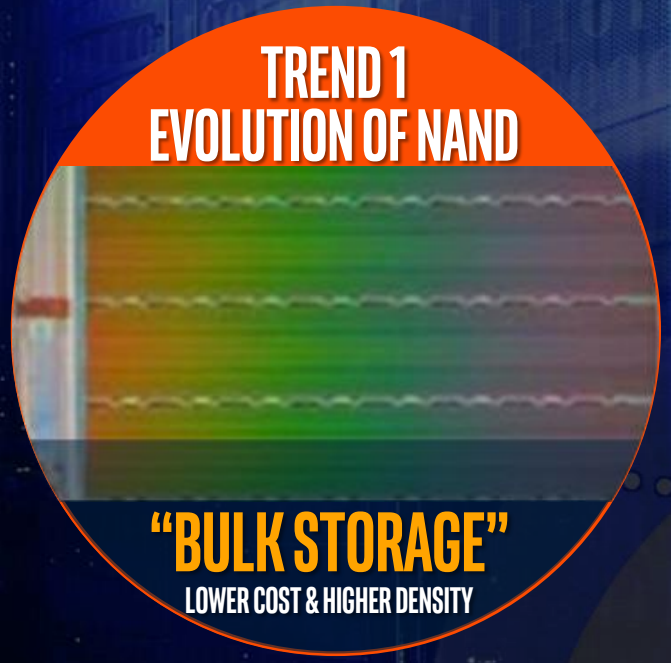
"WORKING STORAGE"

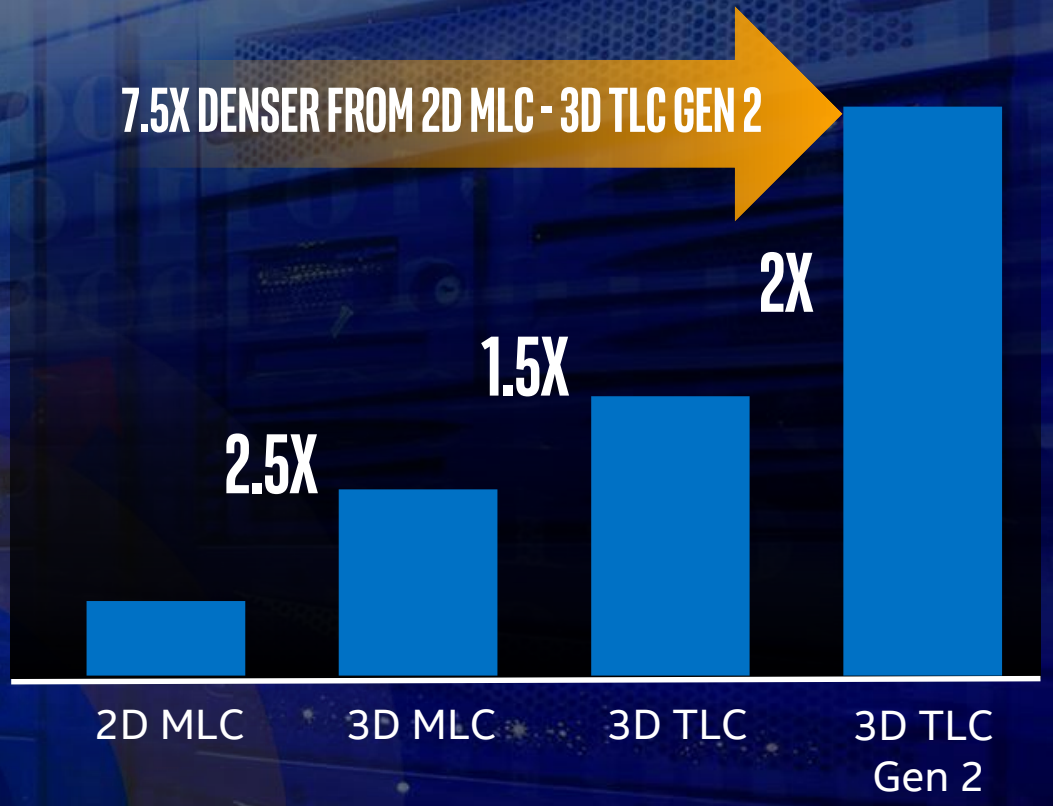
HIGHER PERFORMANCE



HIGH CAPACITY TRADEOFFS

COST AND DENSITY FOR ENDURANCE AND PERFORMANCE

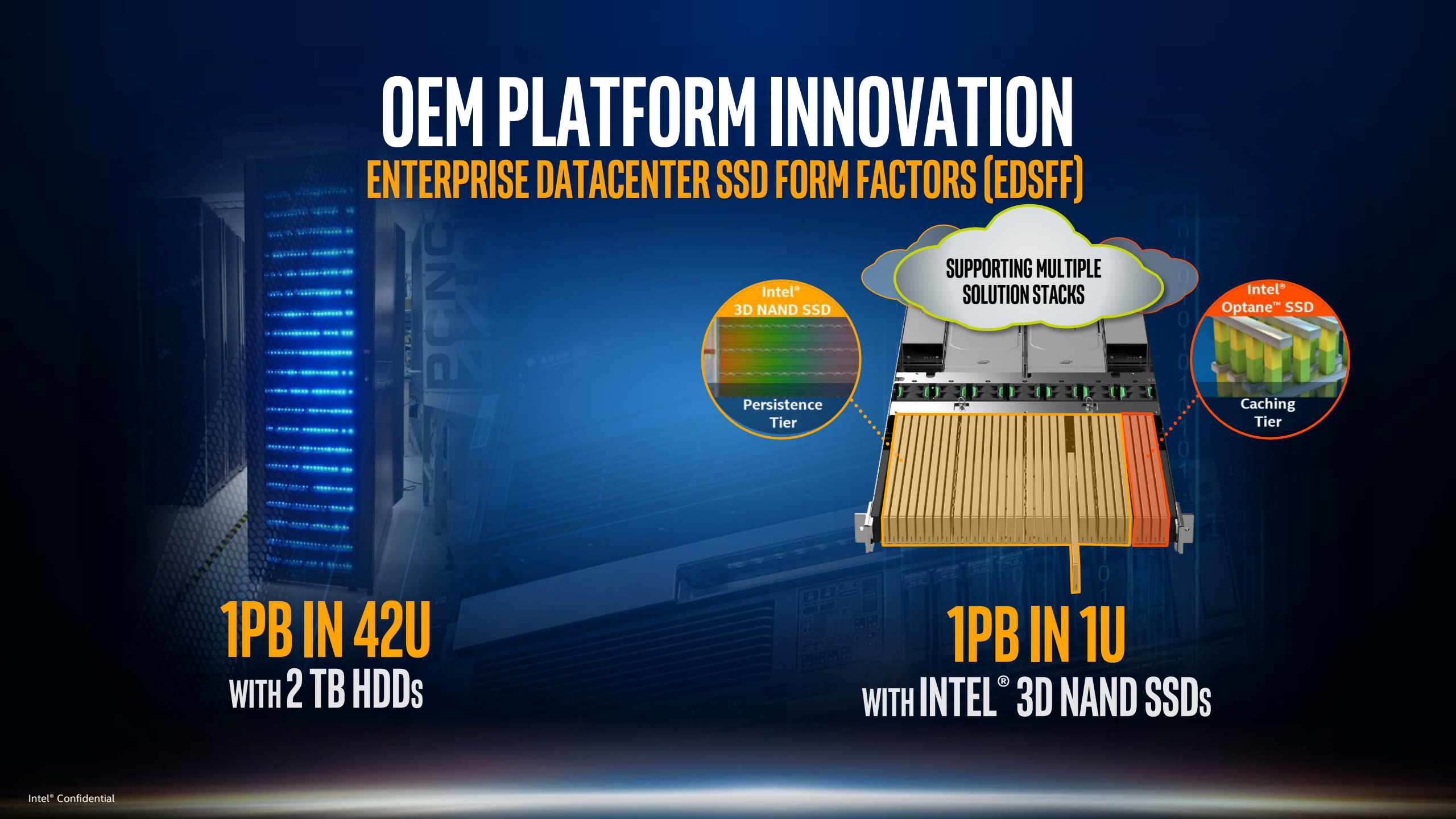




Source: Intel internal analysis of areal density of die sizes measured at Gb/mm2

OEM PLATFORM INNOVATION

ENTERPRISE DATACENTER SSD FORM FACTORS (EDSFF)



1PB IN 42U
WITH 2 TB HDDs

1PB IN 1U
WITH INTEL® 3D NAND SSDs

INTEL® 3D NAND SSD STAC-M3 BENCHMARKS

15 OF 17 WORLD RECORDS[1] AS OF 7/2017

1 - STAC-M3™ Benchmarks on a stack involving Kx Systems kdb+ 3.5 database running on a Lenovo ThinkSystem SR650 server containing 2 x Intel Xeon Platinum 8180 (“Skylake”) CPUs, 4 x Intel SSD P4600 (2.5-inch form factor), and 2 x Intel P4500 SSD (HHHL form factor). SUT ID: KDB170703 - Appendix for more.

INTEL® OPTANE™ TECHNOLOGY

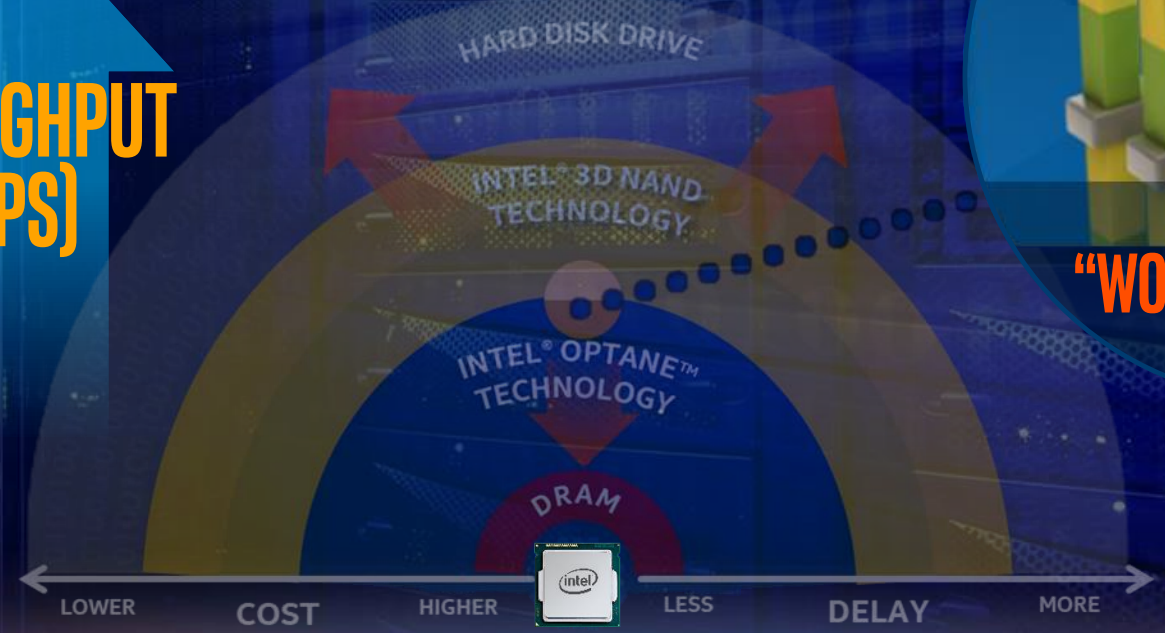
PERFORMANCE AND ENDURANCE FOR DENSITY AND COST/GB

ENDURANCE

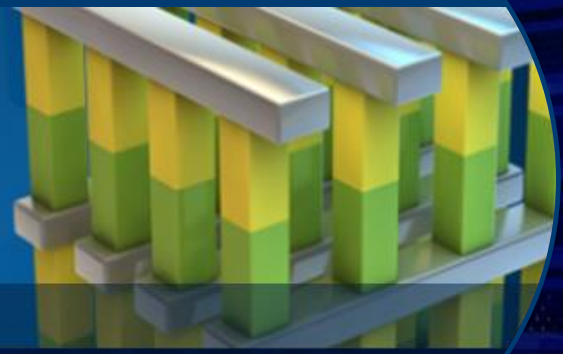
QoS

THROUGHPUT (IOPS)

LATENCY



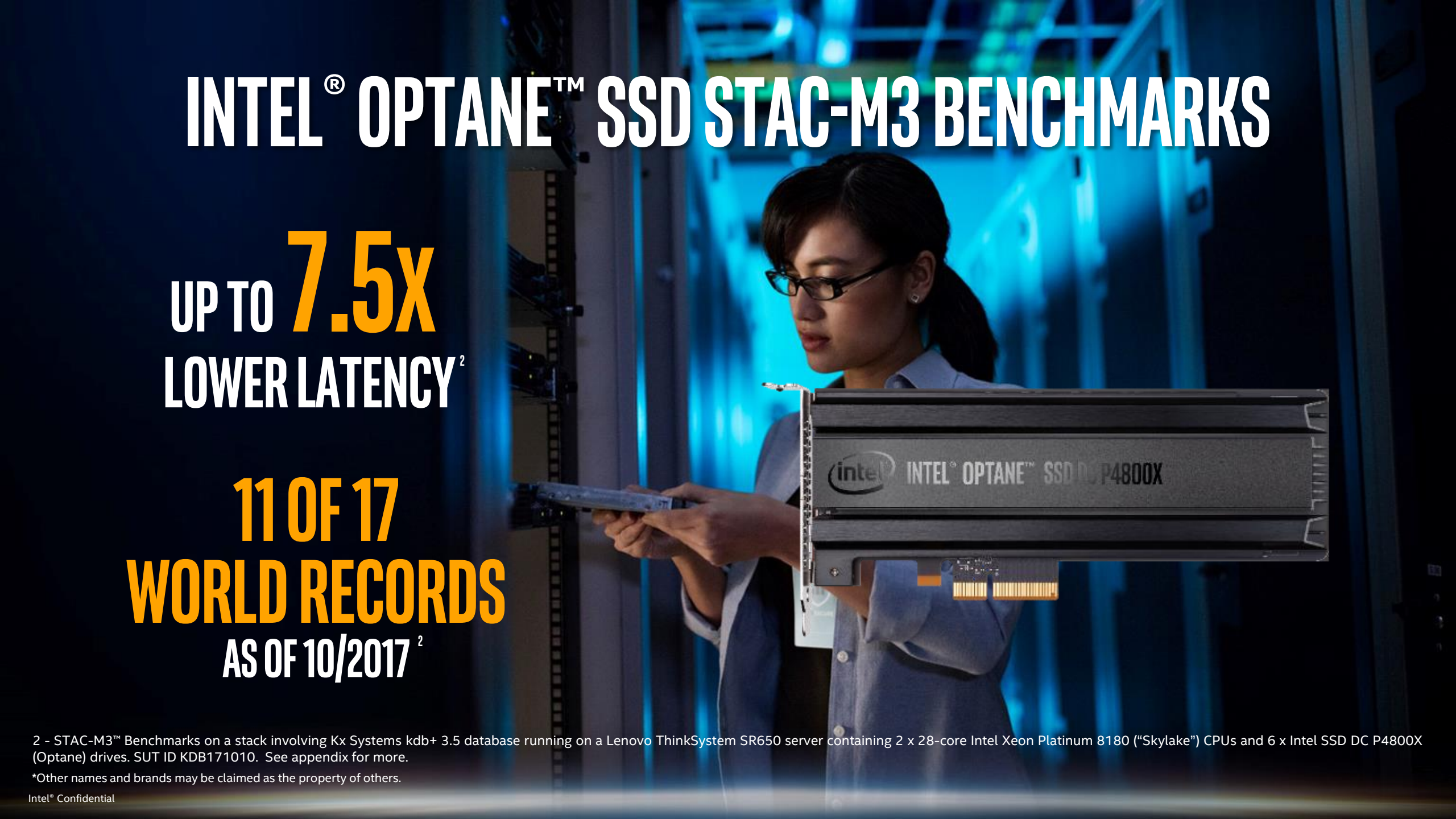
TREND 2
NEW NON-NAND MEDIA



"WORKING STORAGE"

HIGHER PERFORMANCE & ENDURANCE

INTEL® OPTANE™ SSD STAC-M3 BENCHMARKS



UP TO 7.5X LOWER LATENCY[2]

11 OF 17 WORLD RECORDS AS OF 10/2017[2]

2 - STAC-M3™ Benchmarks on a stack involving Kx Systems kdb+ 3.5 database running on a Lenovo ThinkSystem SR650 server containing 2 x 28-core Intel Xeon Platinum 8180 (“Skylake”) CPUs and 6 x Intel SSD DC P4800X (Optane) drives. SUT ID KDB171010. See appendix for more.

*Other names and brands may be claimed as the property of others.

CACHE TO ADDRESS CHALLENGES

YESTERDAY

- CPU 
- 2D NAND 
- HDD 
- HDD 

TODAY

- CPU 
- INTEL® OPTANE™ SSDs 
- 3D NAND 
- 3D NAND 

FUTURE

- CPU 
- INTEL® OPTANE™ SSDs 
- "APACHE PASS" 
- 3D NAND 
- 3D NAND 

INTEL® OPTANE™ SSDs IN CACHE

WITH VMWARE VSAN*

YESTERDAY

- CPU 
- 2D NAND 
- HDD 
- HDD 

~10X PERFORMANCE[3]

9X TCO REDUCTION[3]

TODAY

- INTEL® XEON® SCALABLE PROCESSORS 
- INTEL® OPTANE™ SSDs 4X EFFICIENCY 
- 3D NAND 
- 3D NAND 

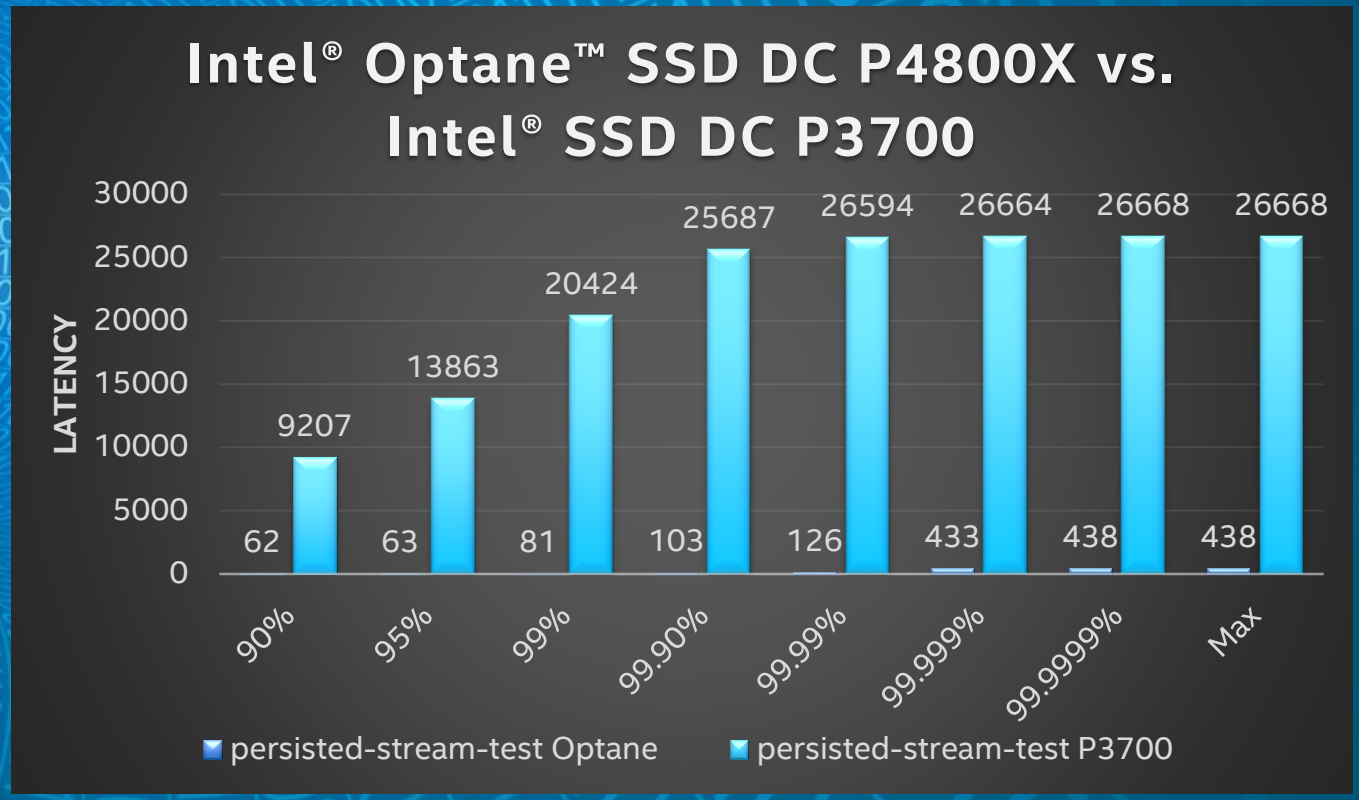
3 – Not a STAC benchmark

INTEL® OPTANE™ SSDs

FOR LOW LATENCY WRITES – STACSTREAM*

IN-MEMORY ISN'T THE ONLY OPTION

- For users fast passing to NAND SSDs or limiting total memory
- Performance traders looking for another option



* Tests conducted by Intel using STACstream tools currently in development. Results do not represent an official STAC Benchmark.

MOVE TO DISAGGREGATION

TARGETING HIGH THROUGHPUT FOR DATA INTENSIVE APPLICATIONS

LOG-BASED STORAGE

- Better utilization of NVMe devices
- Lower latency and cost

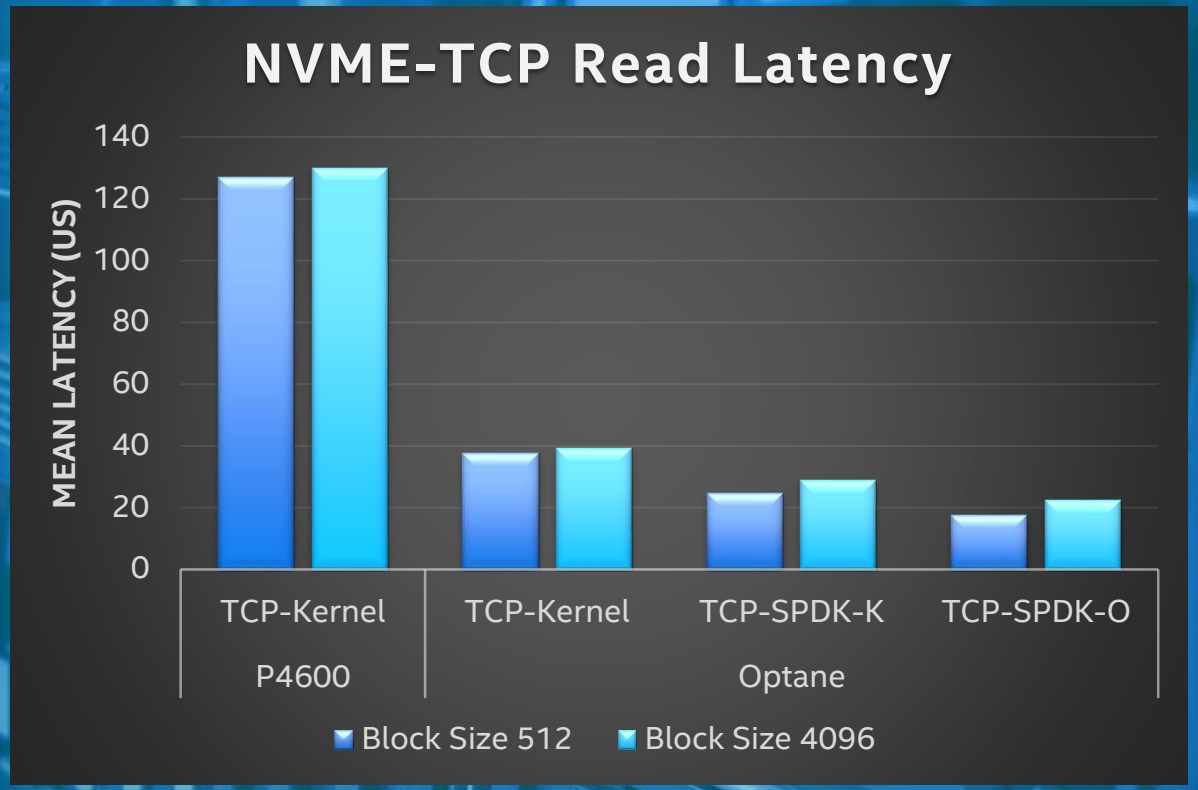
MEMORY LOCALITY

- Dramatically increase memory with Intel® Optane™ SSDs

MORE INCENTIVE TO DISAGGREGATE STORAGE

SOLARFLARE WITH INTEL® OPTANE™ SSDs

- Pointless to optimize the low latency network stack to storage in the past
- With sub 10us latency SSDs it is now worth optimizing
- Onload/SPDK complete user-space target implementation for both networking and storage



Source: Solarflare benchmark was fio, Intel® Xeon® Gold 5122 CPU @ 3.60GHz, Intel® DC SSD P4600 2TB vs. Intel® Optane™ SSD DC P4800X 750GB. Local - measures the performance of fio running on the same machine as the storage. All other data points have fio running on one machine connected back to back using 40G Solarflare NICs.


FUTURE
POSSIBILITIES


CONNECTING THE DOTS...
BREAK THE BOTTLENECK WITH
INTEL® OPTANE™ SSDs!
Store More with 3D NAND!


intel®

APPENDIX

1 - https://stacresearch.com/system/files/asset/files/STAC-M3%20Antuco%20audited%20-%20KDB170703%20-%20v1.0.pdf

2 - https://stacresearch.com/system/files/asset/files/STAC-M3%20Audited%20Report%20-%20KDB171010.pdf

3 - When Comparing results from https://www.evaluatorgroup.com/document/evaluating-server-based-storage-performance-enterprise-workloads to https://www.intel.com/content/www/us/en/storage/evaluator-group-storage-paper.html.

- Previous configuration: Storage media: 1 x P3700 + 4 x Seagate 1TB 10K HDD, Performance: 80 IOmark-VM-HC, Price/Performance: $2048 / IOmark-VM-HC
- Current configuration: Storage media: 2 x P4800X SSD + 4 x P4500 4TB SSD, Performance: 800 IOmark-VM-HC, Price/Performance: $237 / IOmark-VM-HC

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