Memory & Storage Day

DATA CENTER TECHNOLOGY OVERVIEW

Kristie Mann

Senior Director of Product Management

Non-Volatile Memory Solutions, Data Center Group

INTEL'S DATA CENTRIC PORTFOLIO FOUNDATION

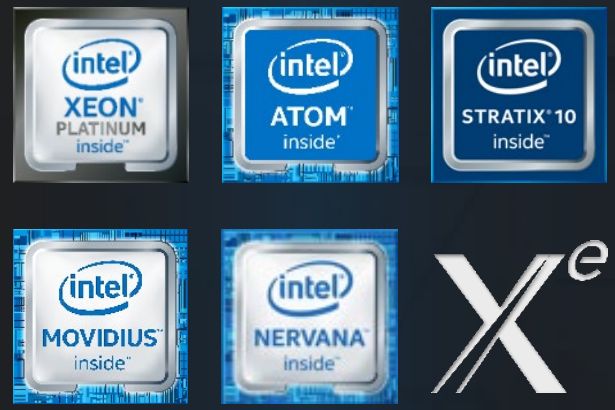
MOVE FASTER

- intel ETHERNET
- intel SILICON PHOTONICS
- BAREFOOT NETWORKS

STORE MORE

- intel OPTANE DC PERSISTENT MEMORY
- intel OPTANE DC SOLID STATE DRIVE
- intel 3D NAND SSD

PROCESS EVERYTHING



SOFTWARE & SYSTEM-LEVEL OPTIMIZED

intel select solution

* Source: Intel

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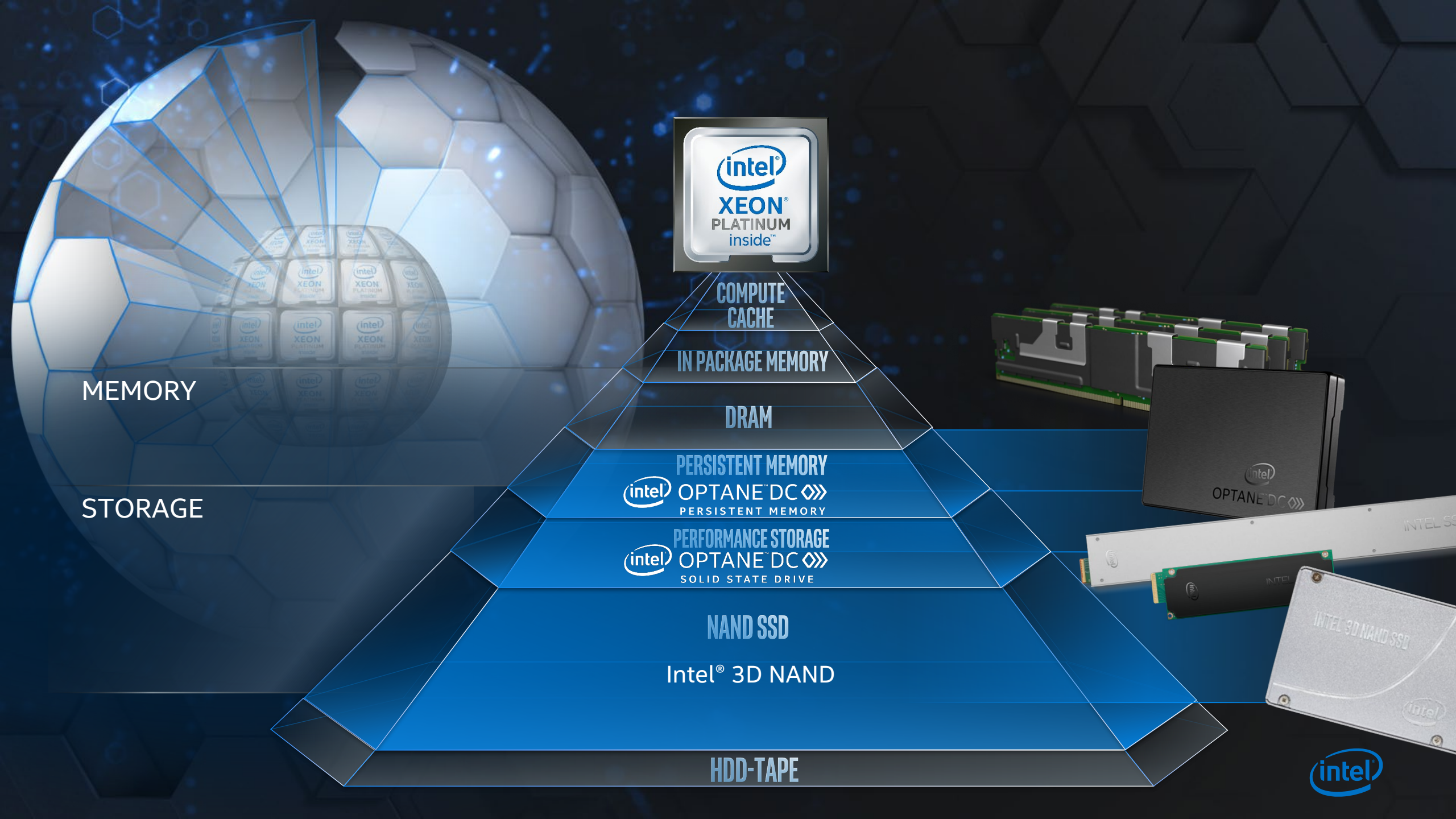
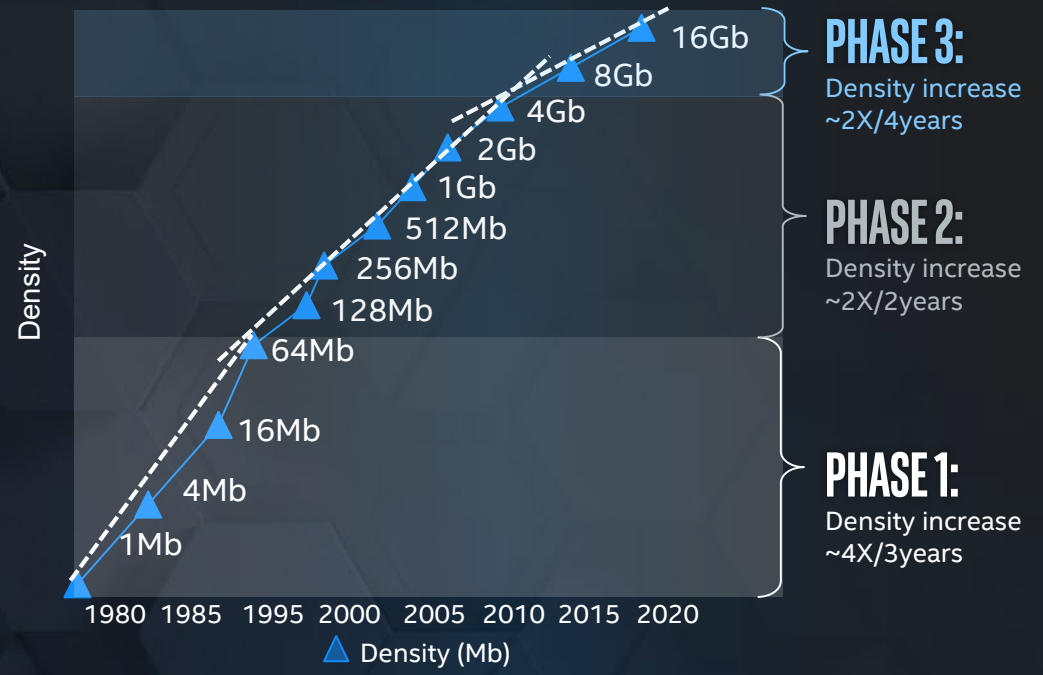
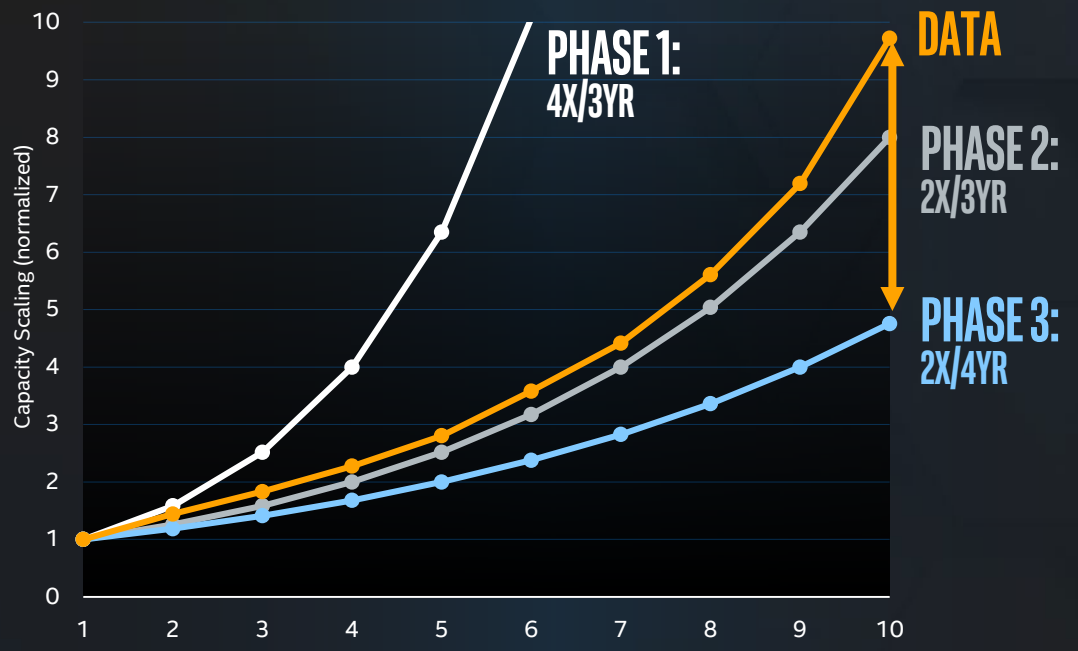

MEMORY
STORAGE
intel
XEON
PLATINUM
inside
COMPUTE CACHE
IN PACKAGE MEMORY
DRAM
PERSISTENT MEMORY
intel OPTANE DC
PERSISTENT MEMORY
PERFORMANCE STORAGE
intel OPTANE DC
SOLID STATE DRIVE
NAND SSD
Intel® 3D NAND
HDD-TAPE
OPTANE DC
INTEL 3D NAND SSD
intel

MEMORY TECHNOLOGY SCALING

RATE OF GROWTH IN DRAM DENSITY IS SLOWING



GAP BETWEEN DATA AND MEMORY CAPACITY IS INCREASING



Source: Data Age 2025, sponsored by Seagate with data from IDC Global DataSphere, Nov 2018
Source: "3D NAND Technology – Implications for Enterprise Storage Applications" by J.Yoon (IBM), 2015 Flash Memory Summit & Yole Développement

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A STRONG MEMORY & STORAGE FUTURE

	TODAY	FUTURE		
	2ND GEN INTEL XEON SCALABLE (CASCADE LAKE)	COOPER LAKE / ICE LAKE	SAPPHIRE RAPIDS	FUTURE INTEL XEON PROCESSOR
intel OPTANE DC PERSISTENT MEMORY	APACHE PASS	BARLOW PASS	3RD GEN DC PERSISTENT MEMORY	4TH GEN DC PERSISTENT MEMORY
intel OPTANE DC SOLID STATE DRIVE	Intel® SSD DC P4800X (COLDSTREAM)	ALDER STREAM	NEXT GENERATION	NEXT GENERATION
INTEL® 3D NAND SSD	INTEL® SSD DC P46XX/P45XX	CLIFFDALE-R/ARBORDALE + (96-L, 144-L)	NEXT GENERATION	NEXT GENERATION

For each processor above, Intel® Optane™ DC Persistent Memory will be supported on select SKUs

INTEL® OPTANE™ TECHNOLOGY IN THE DATA CENTER

DATABASE

intel OPTANE™ DC PERSISTENT MEMORY

EFFICIENT IN-MEMORY DATABASES

SAP

2.4X PERF GAIN VS. 3-YEAR OLD SERVERS

MORE VIRTUALIZED DATABASES INSTANCES

Microsoft SQL SERVER

36% MORE VMS AT SIMILAR COST

AI/ANALYTICS

intel OPTANE™ DC PERSISTENT MEMORY

FASTER ANALYTICS INSIGHTS

APACHE Spark™

8X FASTER QUERIES VS. DRAM+HDD

INCREASED ANALYTICS THROUGHPUT

宝信软件 BAOSIGHT

37% MORE TRANSACTIONS PER SECOND

VIRTUALIZED INFRASTRUCTURE/STORAGE

intel OPTANE™ DC PERSISTENT MEMORY

intel OPTANE™ DC SOLID STATE DRIVE

DENSER HYPER-CONVERGED INFRASTRUCTURE

vmware® VSAN

60% MORE VMS PER NODE

DENSER HYPER-CONVERGED INFRASTRUCTURE

Microsoft AZURE STACK HCI

36% MORE VMS AT SIMILAR COST

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NEXT GEN CONTENT DELIVERY NETWORKS:
LIVE LINEAR CONTENT AT THE EDGE

SAME QUALITY OF SERVICE, SCALE CONTENT AT A REDUCED COST AND TCO

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"With next generation Intel® Xeon® Scalable processor and Intel® Optane™ DC Persistent Memory Qwilt **doubled the amount of content** it can store in our edge caches **per node**"

Mr. Mark Fisher

Vice President, Marketing and Business Development, Qwilt

intel OPTANE™ DC PERSISTENT MEMORY

A SOLUTION LEVEL APPROACH
TO DATA-CENTRIC ARCHITECTURE

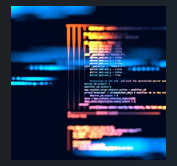
TECHNOLOGY INNOVATIONS

NEW MEDIA INVENTION

PROCESSOR ARCHITECTURE

MEMORY MODULE DEVELOPMENT

SOLUTION OPTIMIZATION

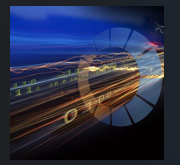


SOFTWARE DEVELOPMENT

PLATFORM AND SYSTEM INTEGRATION EXPERTISE

WORKLOAD OPTIMIZATION

ECOSYSTEM ENGAGEMENT



SOFTWARE ECOSYSTEM

CLOUD SERVICES PROVIDERS

OEM PARTNERS

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GROWING GLOBAL ECOSYSTEM FOR intel OPTANE™ DC PERSISTENT MEMORY

SOFTWARE

Apache CASSANDRA
Apache Spark
Microsoft
CLOUDERA
NetApp
AsiaInfo
AEROSPIKE
TRANSWARP 星环科技
SAP
sas
SUSE
MySQL
redis
ORACLE
redhat
FORMULUS BLACK
MEMCACHED
宝信软件 BAOSIGHT
ubuntu
GIGASPACES innovate with confidence
vmware
Qwilt

CSPS & COSPS

kx
Alibaba Group 阿里巴巴集团
Microsoft Azure
Google Cloud
海鑫科金 HISIGN TECHNOLOGY
平安云
Baidu 百度
packet
BONC 东方国信
Tencent Cloud
SK telecom
快手 KUAISHOU TECHNOLOGY
人大金仓 Kingbase
Kingsoft Cloud KSCLOUD
中国航信 TravelSky

OEMS & SIS

QINGCLOUD
CDW
DELL EMC
ORACLE
Hewlett Packard Enterprise
ZTE
scalar
accenture
inspur
CISCO
Lenovo
Capgemini
SUPERMICRO
Atos
PENGUIN COMPUTING
FUJITSU
Inventec
QCT
HBC
World Wide Technology
intel

GROWING GLOBAL ECOSYSTEM FOR intel OPTANE™ DC PERSISTENT MEMORY

中国航信 TravelSky

"TravelSky, the world's third-largest Global Distributions System (GDS) provider, focuses on providing all stakeholders in aviation industry with first-class service. After two rounds of serious evaluation, we chose Intel® Optane™ DC Persistent Memory to upgrade our Fare system, one of our critical applications. I believe this innovative technology will bring us more memory bandwidth, less latency and higher computing capacity while significantly reducing TCO. "

Mr. Wen Gong

Vice GM, Data Centre Operations, TravelSky

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USING INTEL OPTANE TECHNOLOGY

INTEL® OPTANE™ DC PERSISTENT MEMORY MOMENTUM

AIST ADVANCED INDUSTRIAL SCIENCE AND TECHNOLOGY LARGE VM MEMORY	Argonne NATIONAL LABORATORY HPC	Blue Sky STUDIOS IN-HOUSE APPS	CERN IN-HOUSE APPS	epcc HPC
EVONIK POWER TO CREATE SAP HANA	ETRI ARCUS	GEBERIT SAP HANA	JÜLICH Forschungszentrum HPC	NCI HPC
NBP NAVER BUSINESS PLATFORM LARGE VMS	NITRADO SERVER HOSTING GAME SERVER & APPLICATION HOSTING	panZura ELASTICSEARCH, VMWARE VSPHERE	phoenixNAP GLOBAL IT SERVICES VMWARE ESX	TACC HPC
T··Systems· SAP HANA	UC San Diego MSQL, LMDB, ROCKSDB, MONGODB, MEMCACHED, REDIS	中国科学技术大学 University of Science and Technology of China AUTOMATION, REDFISH INTEGRATION	verizon media HADOOP	ZTO 中通快递 ZTO EXPRESS SPARK, AI

200 PROOFS-OF-CONCEPTS IN PROCESS WITH A TOTAL PIPELINE OF >500 OPPORTUNITIES

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SUMMARY

TRANSFORMATIONAL
DATA CENTRIC STRATEGY

MULTIPLE GENERATIONS
WITH NEW CAPABILITIES UNDER DEVELOPMENT

DRIVING BROAD ECOSYSTEM INNOVATION
TO FUEL CUSTOMERS DATA NEEDS

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- Intel technologies' features and benefits depend on system configuration and may require enabled hardware, software or service activation. Performance varies depending on system configuration.
- No product or component can be absolutely secure.
- Tests document performance of components on a particular test, in specific systems. Differences in hardware, software, or configuration will affect actual performance. For more complete information about performance and benchmark results, visit http://www.intel.com/benchmarks .
- Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. For more complete information visit http://www.intel.com/benchmarks .
- Intel® Advanced Vector Extensions (Intel® AVX)* provides higher throughput to certain processor operations. Due to varying processor power characteristics, utilizing AVX instructions may cause a) some parts to operate at less than the rated frequency and b) some parts with Intel® Turbo Boost Technology 2.0 to not achieve any or maximum turbo frequencies. Performance varies depending on hardware, software, and system configuration and you can learn more at http://www.intel.com/go/turbo.
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Intel® Optane™ DC persistent memory pricing & DRAM pricing as of September 17, 2019. Pricing referenced in TCO calculations is provided for guidance and planning purposes only and does not constitute a final offer. Pricing guidance is subject to change and may revise up or down based on market dynamics. Please contact your OEM/distributor for actual pricing.

SAP

2.4x better runtime performance: Performance results are based on testing by Intel® IT as of March 12, 2019. Baseline: three-node (1-master + 2-slave) SAP HANA® 2 scale-out configuration. Per Node: 4 x Intel® Xeon® processor E7-8880 v3 (2.3 GHz, 150 W, 18 cores), CPU sockets: 4; microcode: 0x400001c; RAM capacity: 64 x 32 GB DIMM, RAM model: DDR4 2133 Mbps; storage: GPFS, approximately 21.8 TB of formatted local storage per node, SAN storage for backup space only; network: redundant 10 gigabit Ethernet (GbE) network for storage and access, redundant 10G network for node-to-node; OS: SUSE 12 SP2*, SAP HANA: 2.00.035, GPFS: 4.2.3.10. Average time of 50 individual test queries executed 30–50 times each, for a total of approximately 25,000 steps: 2.81 seconds.

New configuration, one master node SAP HANA 2 scale-up configuration: CPU: 4 x 2nd Generation Intel® Xeon® Platinum 8260 processor (2.2 GHz, 165 W, 24 cores), CPU sockets: 4; microcode: 0x400001c, RAM capacity: 24 x 64 GB DIMM, RAM model: DDR4 2133 Mbps; Intel® Optane™ DC persistent memory: 24 x 126 GB PMM; storage: XFS*, 21 TB; network: redundant 10 GbE network; OS: SUSE 15, SAP HANA: 2.00.035, Intel BKC: WW06. Average time of 50 individual test queries executed 30–50 times each, for a total of approximately 25,000 steps: 1.13 seconds.

Virtualized SQL

Performance results are based on testing as of Feb. 1, 2019 and may not reflect all publicly available security updates.
Baseline configuration (DRAM): 2x 2nd Gen Intel® Xeon® Platinum 8276 @ 28 cores/socket. Memory: 768 GB (24x32 GB DDR4@2666 MHz). Network: Intel® X520 SR2 (10 Gbps).
Storage: 8x Samsung* PM963M.2 960 GB, 4x Intel® SSDs S3600 (1.92 TB). BIOS: WW02'19. OS/VM: Windows Server 2019. WL Version: OLTP Cloud Benchmark (internal private customer confidential workload). Dataset/instance or workload size: 1.1 TB. Security mitigations: variants 1,2,3 enabled. Performance of 22 SQL VM instances.
New config (DCPMM): 2x 2nd Gen Intel® Xeon® Platinum 8276 @ 28 cores/socket. Memory: 1 TB (8x128 GB Intel® Optane™ DC persistent memory in Memory Mode + 12x 16 GB DDR4@2666 MHz). Network: Intel® X520 SR2 (10 Gbps).
Storage: 8x Samsung* PM963M.2 960 GB, 4x Intel® SSDs S3600 (1.92 TB). BIOS: WW02'19. OS/VM: Windows Server 2019. WL Version: OLTP Cloud Benchmark (internal private customer confdential workload). Dataset/instance or workload size: 1.5 TB. Security mitigations: variants 1,2,3 enabled. Performance of 30 SQL VM instances.

Spark

Tested by Intel on February 24th 2019. Common testing details: 2x 2nd Gen Intel Xeon Platinum 8280M processor, 8xHDD ST1000NX0313, BIOS: SE5C620.86B.0D.01.0134.100420181737, OS: Fedora release 29, kernel: 4.20.6-200.fc29.x86_64, 1-replica uncompressed & plain encoded data on Hadoop, Spark: 1 * Driver (5GB) + 2 * Executor (62 cores, 74GB), spark.sql.oap.rowgroup.size=1MB, Oracle JDK 1.8.0_161 , 3TB data scale, 9 I/O intensive queries, 9 threads. Memory config of baseline: 24x32GB DDR4. Memory config of system with Intel Optane DC persistent memory: 8x128GB DCPMM in App Direct Mode + 12x16GB DDR4.

Baosight

Tested by Intel and Baosight on January 8, 2019. **Shanghai Baosight xInsight*** v2.0 (self-defined workload); OS: CentOS* 7.5 Kernel 3.10.0-957.1.3.el7.x86_64. Testing by Intel and Baosight completed on Jan 8, 2019. Security Mitigations for Variants 1, 2, 3 and L1TF in place. BASELINE: 2nd Gen Intel® Xeon® Platinum processor 8260L, 2.3 GHz, 24 cores, turbo, and HT on, BIOS 1.0180, 768GB total memory, 32 slots / 32GB / 2666 MT/s / DDR4 LRDIMM, 1 x 480GB / Intel® SSD Data Center (Intel® SSD DC) S4500 + 2 x 1TB / Intel® SSD DC P4500. NEW: 2nd Gen Intel® Xeon® Platinum processor 8260L, 2.3 GHz, 24 cores, turbo, and HT on, BIOS 1.0180, 192GB total memory, 12 slots / 16GB / 2666 MT/s / DDR4 LRDIMM and 1024GB DCPMM, 8 slots/ 128 GB / 2666 MT/s Intel® Optane™ DC persistent memory, 1 x 480GB / Intel® SSD DC S4500 + 2 x 1TB / Intel® SSD DC P4500.

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VMware vSAN:

Intel internal testing as of March 31, 2019. Base configuration: four nodes, 2 x Intel® Xeon® Gold 6230 processor, Intel® Server Board S2600WFT, total memory: 384 GB, 12 slots/32 GB/2,666 megatransfers per second (MT/s) DDR4 RDIMM, Intel® Hyper-Threading Technology (Intel® HT Technology) enabled, Intel® Turbo Boost Technology enabled, Intel® Volume Management Device (Intel® VMD) enabled, storage (boot): 1 x 960 GB Intel® SSD 3520 M.2 SATA, storage (cache): 2 x 375 GB Intel® Optane™ SSD DC P4800X PCIe* with NVM Express* (NVMe*), storage (capacity): 6 x 2 TB Intel SSD DC P4510 PCIe with NVMe; network devices: 1 x 25Gb Intel® Ethernet Converged Network Adapter XX710-DA2, network speed: 10 GbE, OS/software: VMware vSphere 6.7.0*, build 10764712. Benchmark: VMware VMmark® for Incremental Memory, performance of 95 VMs. VMware VMmark® is a product of VMware, Inc.

DCPMM configuration: four nodes, 2 x Intel Xeon Gold 6252 processor, Intel Server Board S2600WFT, total memory: 512 GB Intel® Optane™ DC persistent memory, 4 slots/128 GB/2,666 MT/s and 128 GB 8 slots/16 GB/2,666 MT/s DDR4 RDIMM, Intel HT enabled, Intel Turbo Boost Technology enabled, Intel VMD enabled, storage (boot): 1 x 960 GB Intel SSD 3520 M.2 SATA, storage (cache): 2 x 375 GB Intel Optane SSD DC P4800X PCIe with NVMe, storage (capacity): 6 x 2 TB Intel SSD DC P4510 PCIe with NVMe; network devices: 1 x 25Gb Intel Ethernet Converged Network Adapter XX710-DA2, network speed: 25 GbE, OS/software: vSphere 6.7.0, build 10764712. Benchmark: VMware VMmark® for Incremental Memory, performance of 152 VMs. VMware VMmark® is a product of VMware, Inc.

Azure Stack HCI:

Intel internal testing as of February 15, 2019. Common testing details: Vmfleet Test: Each VM with 1 Core,8 GB Memory, 40 GB VHDX. Test setup: Threads=2 , Buffer Size= 4KiB, Pattern: Random, Duration = 300 Seconds, Queue Depth=16, 30% write.

Baseline configuration: 2 x Intel® Xeon® Gold 5218 processor, Intel® Server Board S2600WFT, 256 GB total memory (8 x 32 GB, 2,666 megatransfers per second [MT/s]), Intel® Hyper-Threading Technology (Intel® HT Technology) enabled, Intel® Turbo Boost Technology enabled, storage (boot): 1 x 480 GB Intel® SSD DC 3520 U.2 SATA, storage tier: 4 x 1.6 TB Intel SSD DC P4610 PCIe* NVM Express* (NVMe*), 1 x 25 gigabits per second (Gbps) Chelsio* network adapter, 10 GbE, Windows Server 2019 Datacenter edition* build 17763. Performance of 41 VMs per node.

DCPMM configuration: 2 x Intel Xeon Gold 6230 processor, Intel Server Board S2600WFT, 512 GB Intel® Optane™ DC persistent memory (4 x 128 GB, 2,666 MT/s), 192 GB DRAM (12 x 16 GB, 2,666 MT/s), Intel HT Technology enabled, Intel Turbo Boost Technology enabled, storage (boot): 1 x 480 GB Intel SSD DC 3520 M.2 SATA, storage (cache): 2 x 375 GB Intel Optane SSD DC P4800X, storage (capacity): 4 x 4 TB Intel SSD DC P4510 PCIe NVMe, 1 x 25 gigabits per second (Gbps) Chelsio network adapter, 25 GbE, Windows Server 2019 Datacenter edition build 17763. Performance of 56 VMs per node.