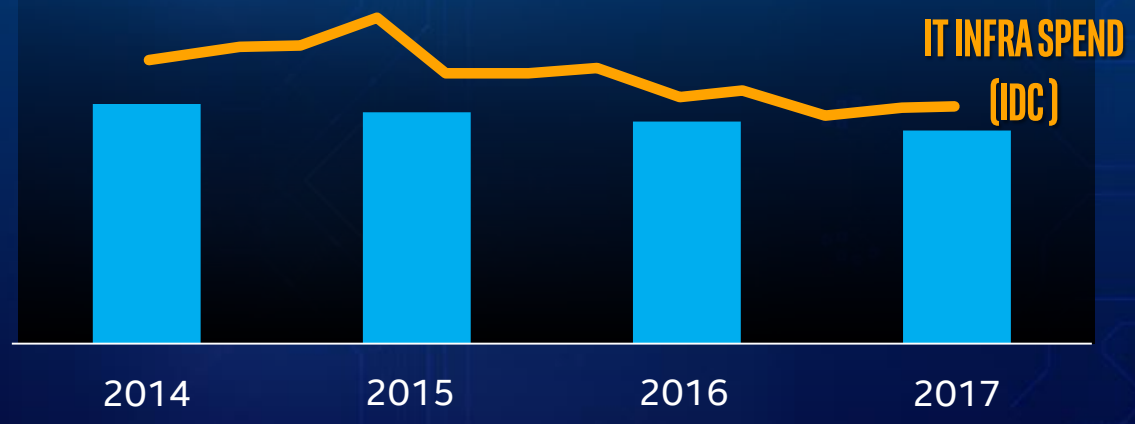

intel
DATA-CENTRIC INNOVATION SUMMIT
AUGUST 8, 2018 | SANTA CLARA, CA


DATA-CENTRIC INNOVATION SUMMIT
FUTURE OF THE ENTERPRISE
RAJEEB HAZRA
CORPORATE VICE PRESIDENT
DATA CENTER GROUP

2014-2017: THE BEAR ERA

BUSINESS ENVIRONMENT

DCG E&G REVENUE VS IDC INFRA SPEND[1]



FACTORS

MACROECONOMIC UNCERTAINTY + EVOLVING CLOUD STRATEGIES = IT INFRASTRUCTURE DECLINE

INDUSTRY SENTIMENT

"We are seeing CIOs increasingly reconsidering data center build-out"

ENTERPRISETECH INSIDE ADVANCED SCALE CHALLENGES — January 4, 2014

"...research shows steady drop in on-premise hardware spend "

ComputerWeekly.com — April 10, 2016

Are Corporate Data Centers Obsolete In The Cloud Era?

Forbes — June 11, 2016

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

[1]Source: Intel; IDC Quarterly IT Infra Tracker Q1 2018

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2014-2017: THE BEAR ERA

WE BELIEVED...

BUSINESS TRANSFORMATION
is inevitable... and will drive
Increased IT Investment

- Legacy infra will “age” faster
- Enterprise will “go hybrid” and adopt private clouds
- AI will drive on-prem infra growth

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...AND INVESTED IN

Accelerating Private / Hybrid Cloud

Azure Stack
Google Cloud Platform
redhat
vmware

Expanding Analytics & Growing AI

cloudera
ORACLE
SAP
sas
Apache Spark

intel select solution
Accelerating Time to Value

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OUR STRATEGY IS DELIVERING

PRIVATE CLOUD GROWTH

2013: 6% Adoption

2018: 12% Adoption[1]

CLOUD REPATRIATION

80% Of Companies

Report Repatriation Activity[2]

AI / ANALYTICS ON PREM

CPU deployment

2X Growth Rate

('14 – '16) vs ('17 – '21)[3]

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[1]Source: IDC Cloud Infrastructure Tracker 1Q18, June 2018

[2]Source: IDC Cloud and AI Adoption Survey, January 2018; n=400

[3]Source: Intel estimate

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AI / ANALYTICS ON PREM
CPU deployment
2X Growth Rate
('14 – '16) vs ('17 – 21)[3]

DCG E&G REVENUE

2014 – 2017 CAGR
4%

1H'18 (VS 1H'17)
6%

"Server Market Sizzles in Q1, Better Prospects Ahead in 2018"
Nasdaq
June 4, 2018

[1]Source: IDC Cloud Infrastructure Tracker 1Q18, June 2018
[2]Source: IDC Cloud and AI Adoption Survey, January 2018; n=400
[3]Source: Intel estimate

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INTEL® XEON® PROCESSOR: HEARTBEAT OF THE ENTERPRISE

INTEL® XEON® SCALABLE PROCESSOR

65% performance gain across broadest range of workloads[1]

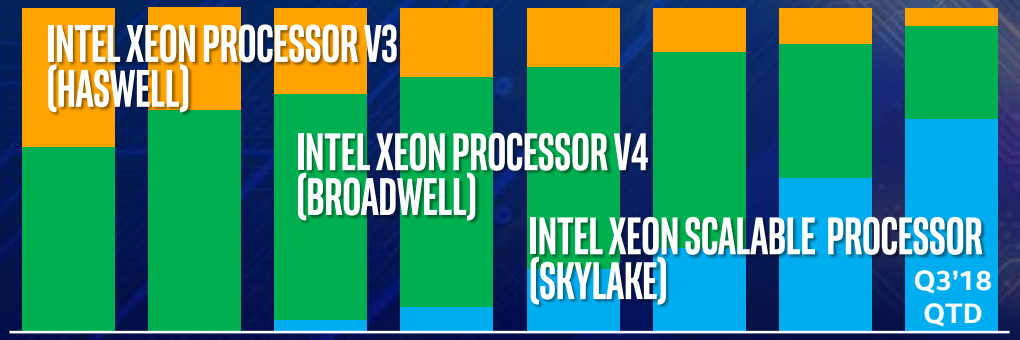
Leadership virtualization perf[2]

Unified stack for unparalleled manageability and RAS consistency

CREATING AND DELIVERING VALUE

Fastest ramp & highest mix to top end skus since Intel Xeon processor E5 v2 Family.

Enterprise Segment CPU Mix[3]



Performance results are based on testing as of 04/01/2018 and may not reflect all publicly available security updates. See configuration disclosure for details. No product can be absolutely secure. For more complete information about performance and benchmark results, visit www.intel.com/benchmarks. Configurations 1, 2: see slide Performance Benchmark Disclosure. 3: Source: Intel

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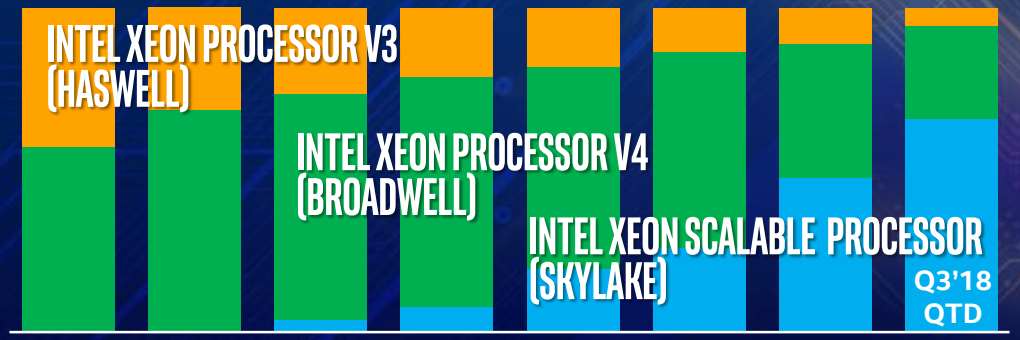

PLATFORM INNOVATION

Intel Ethernet | Intel Omni-Path Fabric | Intel Silicon Photonics | Intel FPGAs | Intel SSDs

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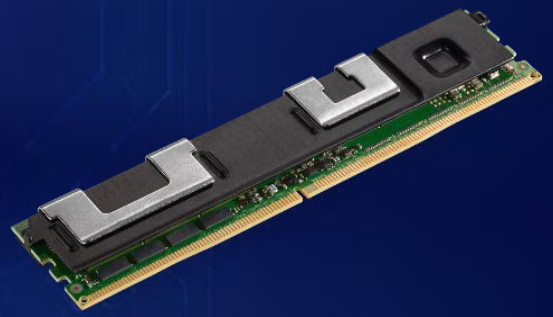
ENABLING REVOLUTIONARY CAPABILITIES



intel OPTANE™ DC PERSISTENT MEMORY

intel select solution

SAP

SAP Founder Hasso Plattner
SAPPPHIRE 2018 keynote

FASTER START TIMES FOR LESS DOWNTIME

DRAM with SSD Storage

Persistent Memory with SSD Storage

12.5X IMPROVEMENT[3]

INCREASED MEMORY CAPACITY REDUCING TCO

>3 TB PER CPU SOCKET

TOTAL MEMORY CAPACITY

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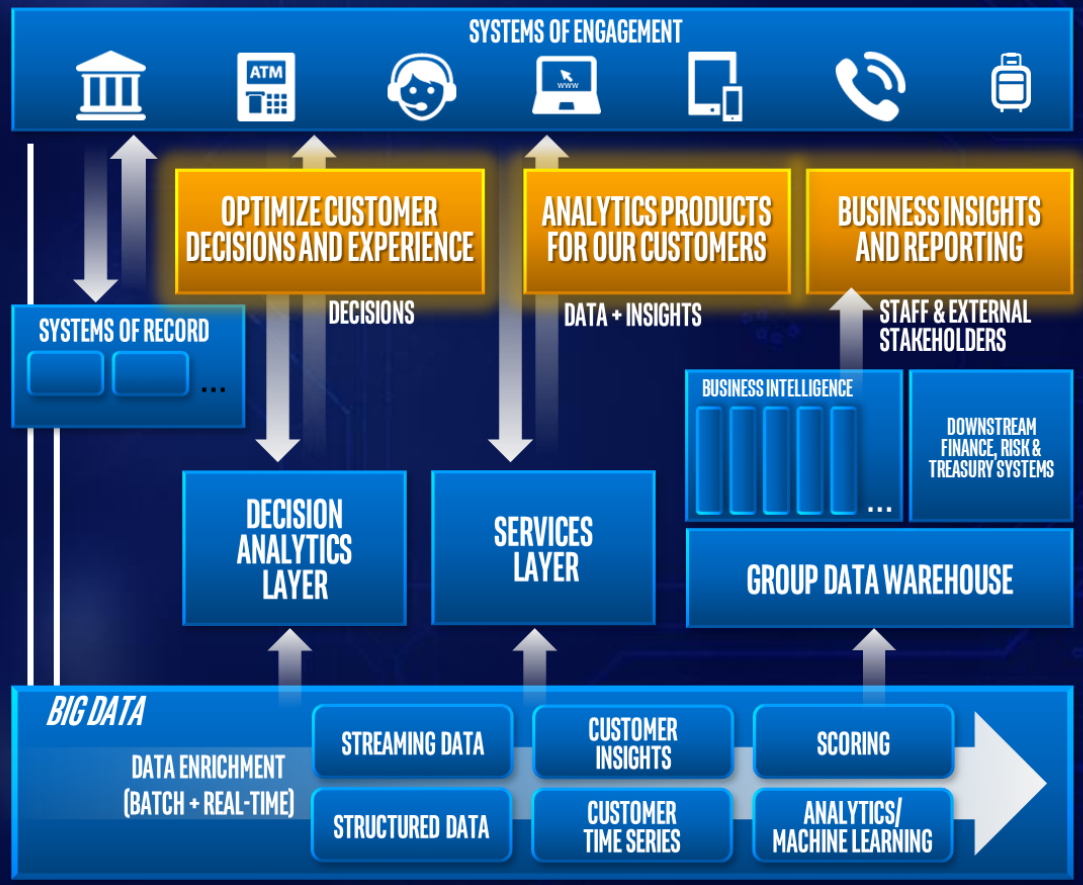
ACCELERATING ENTERPRISE AI

EXAMPLE: FINANCIAL SERVICES WORKFLOW



UnionPay 银联

intel XEON PLATINUM inside™

China Union Pay
Deploy Neural Network for
Fraud Detection On
Intel® Xeon® Processor

60% INCREASE IN COVERAGE

20% INCREASE IN ACCURACY

WITHOUT DISRUPTING THEIR WORKFLOW[1]

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[1]Source: https://www.intel.com/content/dam/www/public/us/en/documents/case-studies/union-pay-case-study.pdf

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INTEL® SELECT SOLUTIONS

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PRIVATE CLOUD

- MICROSOFT AZURE STACK*
- WINDOWS SERVER* SDS
- VMWARE CLOUD FOUNDATION*
- BLOCKCHAIN: HYPERLEDGER FABRIC
- RED HAT OPENSHIFT* CONTAINER
- NFVI: UBUNTU*
- VMWARE VSAN*
- NFVI: RED HAT*

ANALYTICS

- MICROSOFT* SQL SERVER BUSINESS OPERATIONS
- MICROSOFT* SQL SERVER ENTERPRISE DATA WAREHOUSE
- SAP* HANA CERTIFIED APPLIANCES

ARTIFICIAL INTELLIGENCE

- BIG DL ON APACHE SPARK*

HPC

- GENOMICS ANALYTICS
- SIMULATION & MODELING
- SOFTWARE DEFINED VISUALIZATION

ACCELERATING INTEL® ARCHITECTURE INNOVATION INTO THE MARKET

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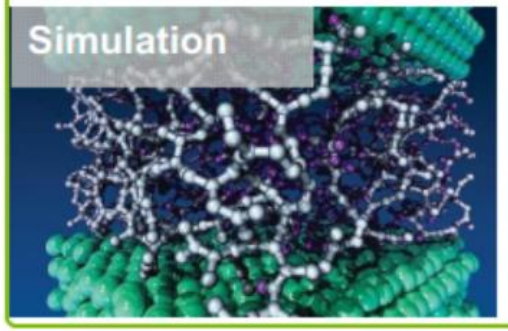
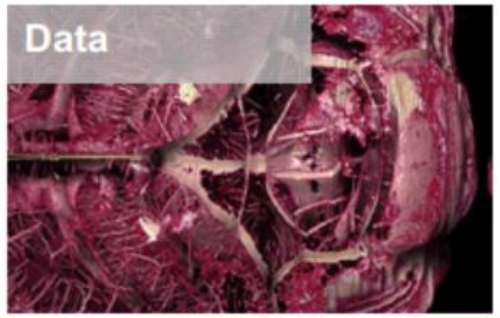
ENABLING THE EXASCALE ERA
CONVERGED ARCHITECTURE FOR HPC+AI

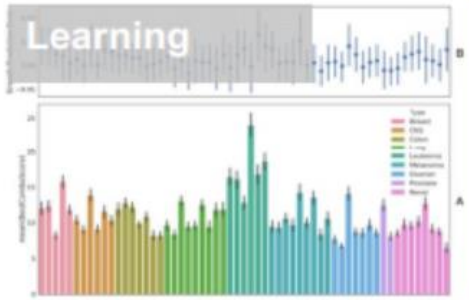
U.S. DEPARTMENT OF ENERGY | Office of Science

Intel/Cray Aurora supercomputer planned for 2018 shifted to 2021
Scaled up from **180 PF to over 1000 PF**

Support for three "pillars"







NEW CPU MICROARCHITECTURE
ADVANCED INTERCONNECT
NOVEL MEMORY / STORAGE HIERARCHY
HIGH PERFORMANCE CONVERGED SOFTWARE

WINNING WITH ...

ZERO DISTANCE FROM OUR CUSTOMERS

- Unmatched Global Sales Force
- Long -term Co-Design
- Joint Product Innovation
- ...

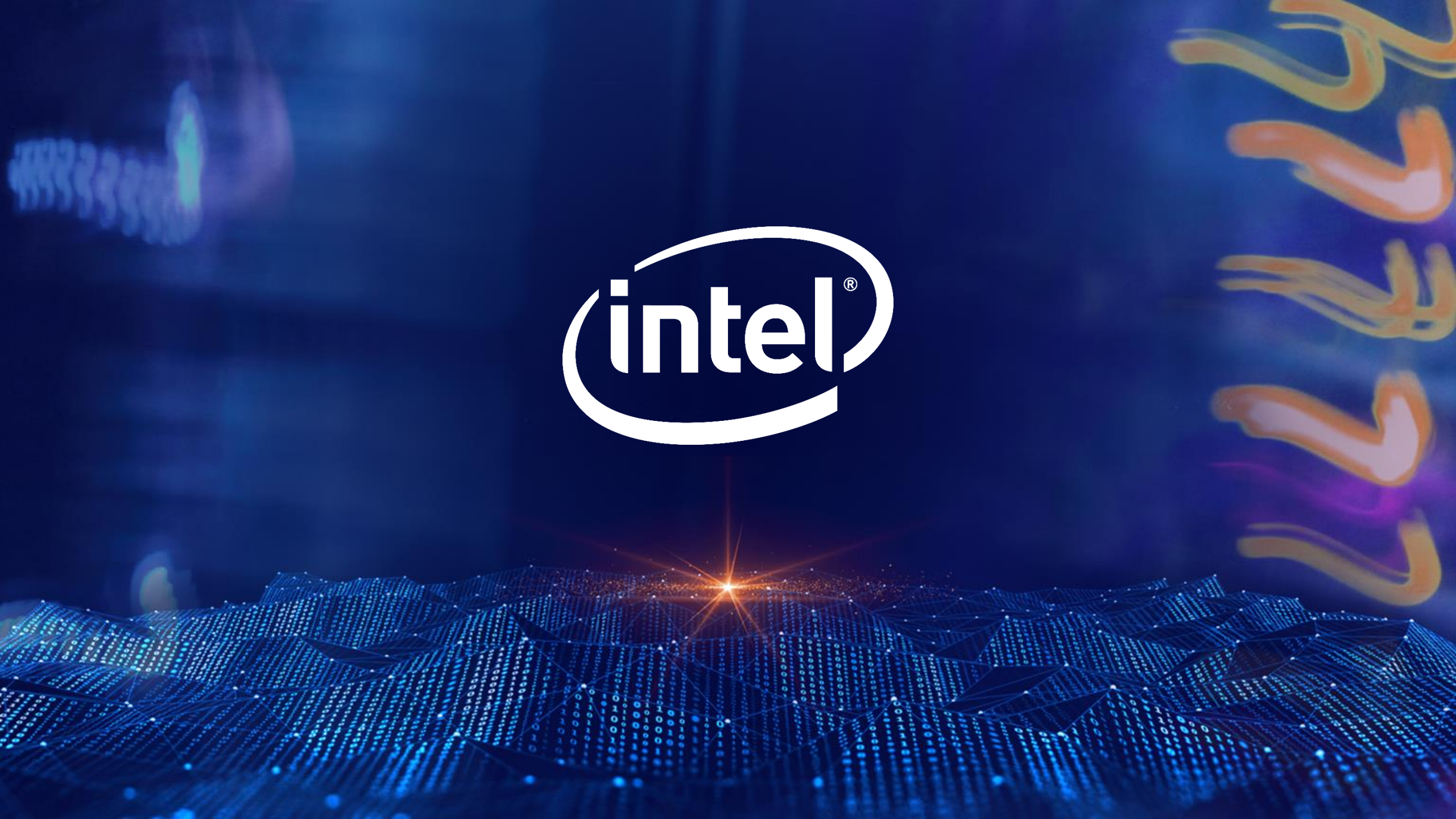
BREAKTHROUGH INNOVATIONS

- New Microarchitecture
- Silicon Photonics
- AI Acceleration
- ...

UNMATCHED PARTNER SCALE

- Software Optimization
- Solution with ISVs & SI
- Partner Marketing
- ...

UNMATCHED CAPABILITIES + SCALE + SCOPE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1. Up to 1.35x on app virtualization – based on Intel internal testing as of 04/01/2018 on SPECvirt_sc* 2013: 1-node, 2x Intel® Xeon® Platinum 8180, Wolfpass platform, Total memory 768 GB, 24 slots / 32 GB/ 2666 MT/s DDR4 RDIMM, HyperThreading : Enable, Turbo: Enable, Storage (boot): 1x 400GB DC3700, Storage (application): 2 * 4TB DC P4500 PCIe NVME, Network devices: 2 x 82599ES dual port 10GbE, Network speed: 10GbE, ucode: 0x043, OS: Red Hat Enterprise Linux* 7.4, Kernel: 3.10.0-693.11.6.el7.x86_64 x86_64 vs. 1-node, 2x Intel® Xeon® cpu E5-2699 v4, Wildcat Pass - S2600WTTS1R, Total memory 512GB, 16 slots / 32 GB/ 2400 MT/s DDR4 RDIMM, HyperThreading : Enable, Turbo: Enable, Storage (boot): 1x 400GB DC3700, Storage (application): 2 * 4TB DC P4500 PCIe NVME, Network devices: 2 x 82599ES dual port 10GbE, Network speed: 10GbE. ucode: 0x02A, OS: Red Hat Enterprise Linux* 7.4, Kernel: 3.10.0-693.11.6.el7.x86_64 x86_64
2. 1.65X Average 2S Performance: Geomean based on Normalized Generational Performance (estimated based on Intel internal testing as of 04/01/2018, on OLTP brokerage benchmark, HammerDB, SPECjbb®2015, SPEC*int_rate_base2017, SPEC*fp_rate_base2017, SPEC*virt_sc 2013, STREAM* triad, LAMMPS, DPDK L3 Packet Forwarding, Intel Distribution for LINPACK)
   a) Up to 1.35x on app virtualization – based on Intel internal testing as of 04/01/2018 on SPECvirt_sc* 2013: 1-node, 2x Intel® Xeon® Platinum 8180, Wolfpass platform, Total memory 768 GB, 24 slots / 32 GB/ 2666 MT/s DDR4 RDIMM, HyperThreading : Enable, Turbo: Enable, Storage (boot): 1x 400GB DC3700, Storage (application): 2 * 4TB DC P4500 PCIe NVME, Network devices: 2 x 82599ES dual port 10GbE, Network speed: 10GbE, ucode: 0x043, OS: Red Hat Enterprise Linux* 7.4, Kernel: 3.10.0-693.11.6.el7.x86_64 x86_64 vs. 1-node, 2x Intel® Xeon® cpu E5-2699 v4, Wildcat Pass - S2600WTTS1R, Total memory 512GB, 16 slots / 32 GB/ 2400 MT/s DDR4 RDIMM, HyperThreading : Enable, Turbo: Enable, Storage (boot): 1x 400GB DC3700, Storage (application): 2 * 4TB DC P4500 PCIe NVME, Network devices: 2 x 82599ES dual port 10GbE, Network speed: 10GbE. ucode: 0x02A, OS: Red Hat Enterprise Linux* 7.4, Kernel: 3.10.0-693.11.6.el7.x86_64 x86_64
   b) Up to 1.45x on server side Java - estimates based on Intel internal testing as of 04/01/2018 on SPECjbb*2015 MultiJVM max-jOPS: # Nodes: 1, # Sockets: 2, SKU: Intel® Xeon® Platinum 8180 Processor, Platform: S2600WF (Wolf Pass), Memory configuration: 12 slots / 32 GB / 2666 MT/s DDR4, Total Memory per Node: 384, Baseline: ucode:0x2000030, Red Hat Enterprise Linux* 7.4, Kernel: 3.10.0-693.el7.x86_64. Update: ucode:0x2000043, Red Hat Enterprise Linux* 7.4, Kernel: 3.10.0-693.11.6.el7.x86_64 vs. # Nodes: 1, # Sockets: 2, SKU: Intel® Xeon® Processor E5-2699 v4, Platform: Wildcat Pass /<S2600WT>, Total memory configuration/node: 8 slots / 32 GB / 2400 MT/s DDR4 RDIMM , Total Memory per Node: 256 GB, . Baseline: ucode: 0xB000020, OS: Red Hat Enterprise Linux* 7.4, Kernel: 3.10.0-693.el7. x86_64. Update: ucode: 0xB00002a, OS: Red Hat Enterprise Linux* 7.4, Kernel: 3.10.0-693.11.6.el7.x86_64 .
   c) Up to 1.55x on integer throughput performance - estimates based on Intel internal testing as of 04/01/2018 on SPECint*_rate_base2006 : 1-Node, 2 x Intel® Xeon® Platinum 8180M Processor on Wolf Pass SKX with 384 GB Total Memory on Red Hat Enterprise Linux* 7.4 using Benchmark software: SPEC CPU® 2017, Compiler: Intel® Compiler IC18 OEM, Optimized libraries: AVX512. Data Source: Request Number: 40, Benchmark: SPECrate*2017_int_base, Score: 281 Higher is better vs. 1-Node, 2 x Intel® Xeon® Processor E5-2699 v4 on Wildcat Pass with 256 GB Total Memory on Red Hat Enterprise Linux* 7.4 using Benchmark software: SPEC CPU® 2017 v1.2, Optimized libraries: IC18.0_20170901, Other Software: MicroQuill SMART HEAP, Script / config files : xCORE-AVX2. Data Source: Request Number: 40, Benchmark: SPECrate*2017_int_base, Score: 181 Higher is better
   d) Up to 1.55x on technical compute app throughput - estimates based on Intel internal testing as of 04/01/2018 on SPECfp*_rate_base2006: 1-Node, 2 x Intel® Xeon® Platinum 8180M Processor on Wolf Pass SKX with 384 GB Total Memory on Red Hat Enterprise Linux* 7.4 using Benchmark software: SPEC CPU® 2017, Compiler: Intel® Compiler IC18 OEM, Optimized libraries: AVX512. Data Source: Request Number: 39, Benchmark: SPECrate*2017_fp_base, Score: 236 Higher is better vs. 1-Node, 2 x Intel® Xeon® Processor E5-2699 v4 on Wildcat Pass with 256 GB Total Memory on Red Hat Enterprise Linux* 7.4 using Benchmark software: SPEC CPU® 2017 v1.2, Optimized libraries: IC18.0_20170901, Other Software: MicroQuill SMART HEAP, Script / config files : xCORE-AVX2. Data Source: Request Number: 39, Benchmark: SPECrate*2017_fp_base, Score: 148 Higher is better
   e) Up to 1.6x on est STREAM - triad - estimates based on Intel internal testing as of 04/01/2018 on STREAM - triad: 1-Node, 2 x Intel® Xeon® Platinum 8180M Processor on Wolf Pass SKX with 384 GB Total Memory on Red Hat Enterprise Linux* 7.4 using Benchmark software: STREAM , Compiler: Intel® Compiler IC17, Optimized libraries: AVX512. Data Source: Request Number: 37, Benchmark: STREAM - Triad, Score: 201.24 Higher is better vs. 1-Node, 2 x Intel® Xeon® Processor E5-2699 v4 on Wildcat Pass with 256 GB Total Memory on Red Hat Enterprise Linux* 7.4 using Benchmark software: STREAM, Optimized libraries: IC16, Other Software: AVX2. Data Source: Request Number: 37, Benchmark: STREAM - Triad, Score: 124.78 Higher is better
   f) Up to 1.6X higher Oracle database transactions – estimates based on Intel internal testing on HammerDB as of 04/01/2018: 1-Node, 2 x Intel® Xeon® Platinum 8180 Processor, Wolf Pass /S2600WF, Total Memory 768 GB, 24 slots/ 32 GB/2666 MT/s /DDR4 RDIMM, Red Hat Enterprise Linux* 7.4, Kernel: 3.10.0-693.11.6.el7.x86_64, uCode: 0x043, Hammerdb 2.23, Oracle 12.1, SSD DC S3700 series 800 GB, 2 x Intel DC P3700 PCI-E SSD for DATA, 2 x Intel DC P3700 PCI-E SSD for REDO, HT Yes, Turbo Yes. vs. 1-Node, 2 x Intel® Xeon® Processor E5-2699 v4, Wildcat Pass platform, Total Memory 384GB, 24 slots/16 GB/2133 MT/s DDR4 RDIMM, Red Hat Enterprise Linux* 7.4 Kernel: 3.10.0-693.21.1.el7.x86_64, uCode: 0x02A, Hammerdb 2.23, Oracle 12.1, SSD DC S3700 series 800 GB, 2 x Intel DC P3700 PCI-E SSD for DATA, 2 x Intel DC P3700 PCI-E SSD for REDO, HT Yes, Turbo Yes.
   g) Up to 1.75x on DPDK L3 Packet Forwarding - estimates based on Intel internal testing as of 04/01/2018: 1-node, 2x Intel® Xeon® Platinum 8180, Platform: Neon City, Total Memory 192GB, 12 slots / 16 GB/ 2666 MT/s DDR4 RDIMM, Benchmark: DKDK 17.11 L3fwd Sample App, gcc version 6.3.0, HyperThreading: Yes, Turbo: No, Kingston SUV400S37/240G boot, network devices: 2 x Intel XXV710-DA2, 5.51 firmware. ucode: 0x043, OS: Red Hat Enterprise Linux* 7.4, Kernel: 3.10.0-693.11.6.el7.x86_64 vs. 1-node, 2x Intel® Xeon® E5-2699v4, Mayan City platform, Total Memory 64GB, 8 slots / 8 GB/ 2400 MT/s DDR4 RDIMM, HyperThreading : Yes, Turbo: No, Kingston SUV400S37/240G boot, network devices: 2 x Intel XXV710-DA2, 5.51 firmware. ucode: 0x02a, OS: Red Hat Enterprise Linux* 7.4, Kernel: 3.10.0-693.11.6.el7.x86_64
   h) Up to 2.2x on LAMMPS - estimates based on Intel internal measurements as of 04/01/2018: 1-node, 2-sockets of Intel® Xeon® Gold 6148, Platform: Wolf Pass / S2600WF/H48104-850, Memory configuration: 12 slots / 16 GB/ 2666 MT/s DDR4 RDIMM, Total Memory per Node: 192, Hyper-Threading: Yes, Turbo: Off, ucode: x043, OS: Red Hat Enterprise Linux* 7.4, Kernel: 3.10.0-693.11.6.el7.x86_64, Score: 74 vs. 1-node, 2-sockets of Intel® Xeon® E5-2699 v4, Platform: Grantley / S2600WTT/H48298-300, Memory configuration: 8 slots / 16 GB/ 2400 MT/s DDR4 RDIMM, Total Memory per Node: 128, HyperThreading : Yes, Turbo: Off, ucode: 0x02A, OS: Red Hat Enterprise Linux* 7.4, Kernel: 3.10.0-693.21.1.el7.x86_64, Score: 33.3 Higher is better
   i) Up to 2.2x Linpack throughput - estimates based on Intel internal testing as of 04/01/2018 on Intel® Distribution of LINPACK: 1-Node, 2 x Intel® Xeon® Platinum 8180M Processor on Wolf Pass SKX with 384 GB Total Memory on Red Hat Enterprise Linux* 7.4 OS Kernel: 3.10.0-693.11.6.el7.x86_64, Update uCode: 0x043 using Benchmark software: MP Linpack 2018.0.006, Compiler: l_mpi_2018.1.163, Optimized libraries: AVX512, Array 80000. Data Source: Request Number: 38, Benchmark: Intel® Distribution of LINPACK, Score: 3367.5 Higher is better vs. 1-Node, 2 x Intel® Xeon® Processor E5-2699 v4 on Wildcat Pass with 256 GB Total Memory on Red Hat Enterprise Linux* 7.4 OS Kernel: 3.10.0-693.21.1.el7.x86_64 , uCode: 0x02A using Benchmark software: MP Linpack 2018.0.006, Optimized libraries: l_mpi_2018.1.163, AVX2, Array 80000, Other Software: MicroQuill SMART HEAP, Script / config files : xCORE-AVX2. Benchmark: Intel® Distribution of LINPACK, Score: 1427.23 Higher is better
3. https://blogs.saphana.com/2018/06/12/harnessing-hyperscale-processing-more-data-at-speed-with-persistent-memory