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LISA SPELMAN
VICE PRESIDENT
GENERAL MANAGER, XEON PRODUCTS

NEW OPPORTUNITIES AT THE INTELLIGENT EDGE

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Qwilt
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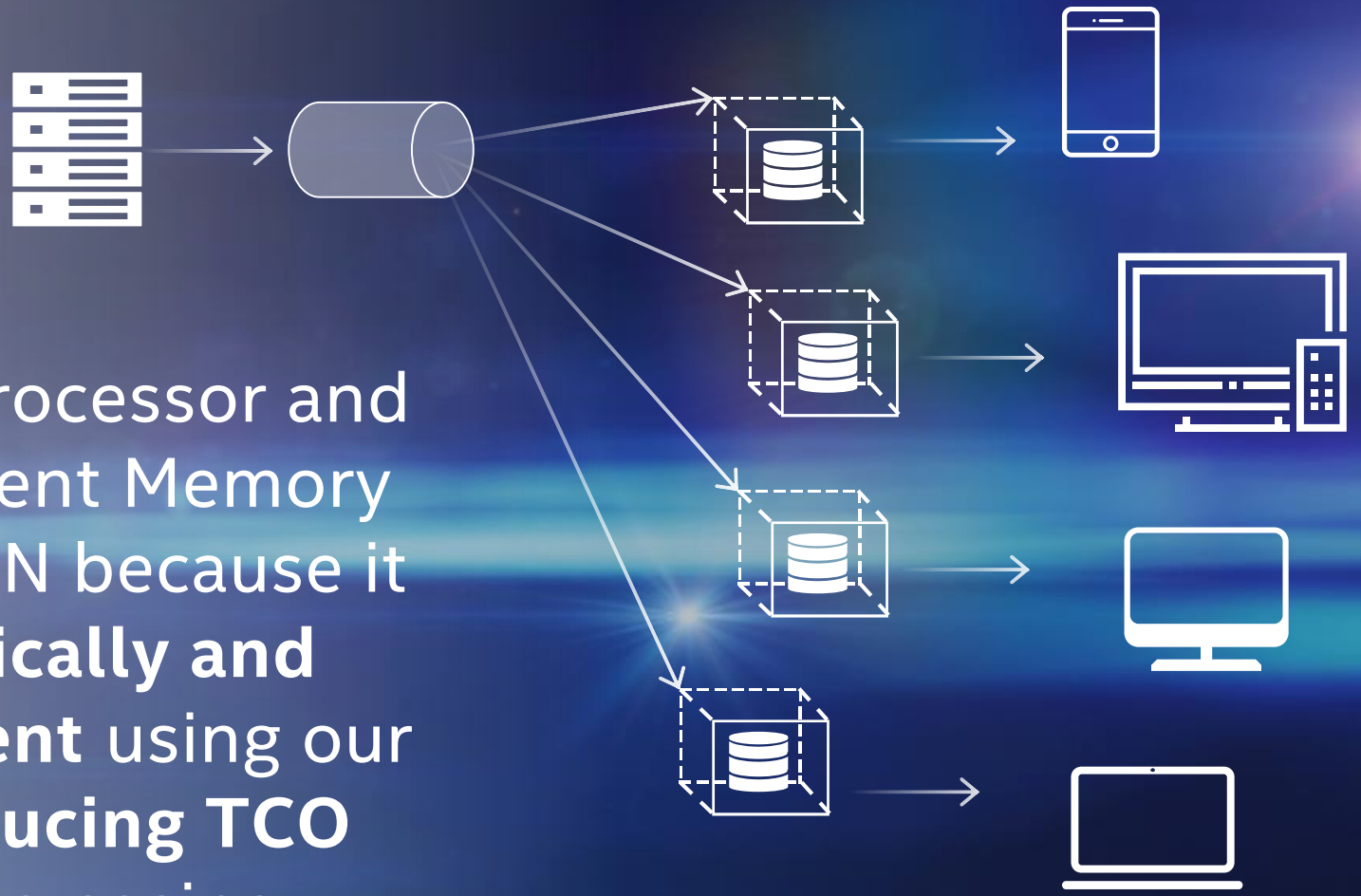
COMCAST



"Intel's Xeon Scalable Processor and Intel Optane DC Persistent Memory are a great fit for our CDN because it enables us to **dynamically and efficiently deliver content** using our mid-cache servers **reducing TCO** while significantly increasing performance."

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Source: Cisco Visual Networking Index: Forecast and Trends, 2017-2922 White Paper, Doc ID 1551296909190103, Feb 2019

THE INTELLIGENT IOT EDGE

DRIVERS FOR EDGE
LATENCY, BANDWIDTH, SECURITY, CONNECTIVITY


SIEMENS
Healthineers
STUART SCHMEETS
SENIOR DIRECTOR OF MRI R&D COLLABORATIONS
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SIEMENS
Healthineers
intel

EXPANDING PORTFOLIO BREADTH

INTEL® ETHERNET 800 SERIES

INTEL® XEON® D-1600

INTEL® AGILEX™

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DRIVING WORKLOAD INNOVATION

- Advanced, Multi-function Accelerators
- Flexibility For Highly-Differentiated Products
- H/W Re-Programmability For Evolving Market Requirements & Changing Standards

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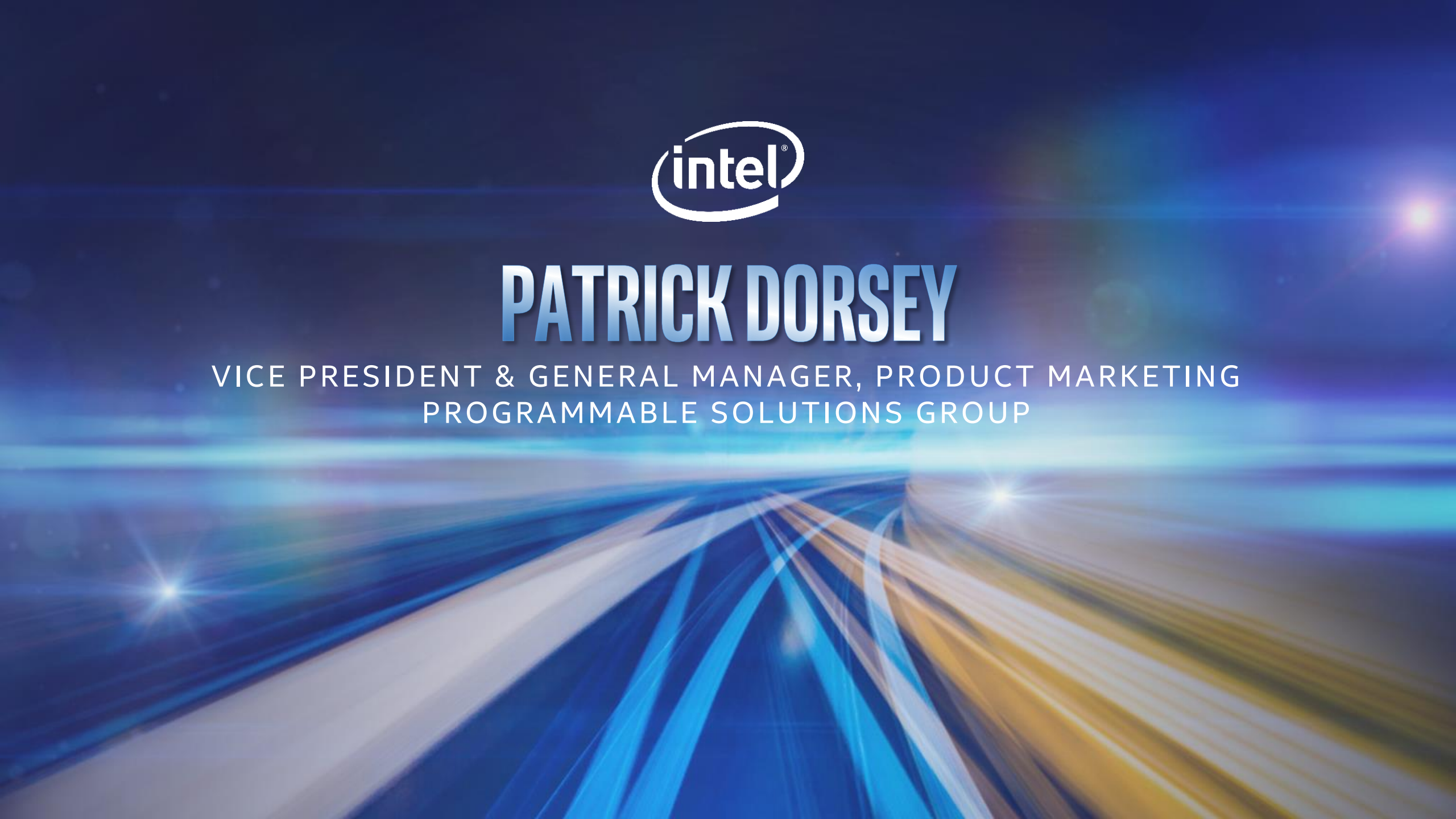
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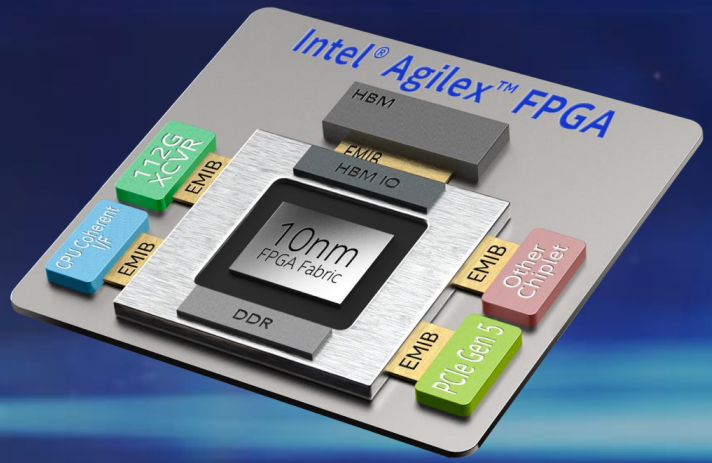
PATRICK DORSEY
VICE PRESIDENT & GENERAL MANAGER, PRODUCT MARKETING
PROGRAMMABLE SOLUTIONS GROUP

INTEL® AGILEX™ FPGA

INTEL INNOVATION FOR ULTIMATE AGILITY & FLEXIBILITY



HIGH PERFORMANCE COMPUTE

10NM PROCESS TECHNOLOGY

COMPUTE EXPRESS LINK (CXL)
MEMORY-COHERENT ACCELERATION

MASSIVE BANDWIDTH

ADVANCED 3D PACKAGING

ANY-TO-ANY INTEGRATION
ANY NODE, ANY SUPPLIER, ANY IP

RAPID INTEL® eASIC™
DEVICES OPTIMIZATION

ANY DEVELOPER

INTEL® QUARTUS® PRIME
DESIGN TOOL FOR HW DEVELOPERS

ONEAPI
FOR SW DEVELOPERS

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CONVERGED WORKLOAD ACCELERATION

INFRASTRUCTURE ACCELERATION

NETWORK | SECURITY | REMOTE MEMORY ACCESS

APPLICATION ACCELERATION

AI | SEARCH | VIDEO TRANSCODE | DATABASE
40 TFLOPS OF DSP PERFORMANCE

STORAGE ACCELERATION

COMPRESSION | DECOMPRESSION | ENCRYPTION
MEMORY HIERARCHY MANAGEMENT

WORLD'S FIRST FPGA WITH COHERENT ATTACH

AND COMPREHENSIVE MEMORY SUPPORT WITH INTEL® XEON® SCALABLE PROCESSORS

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INTEL® XEON® D-1600 PROCESSOR

INTEL® QUICKASSIST TECHNOLOGY | INTEL® ETHERNET | INTEL® VIRTUALIZATION TECHNOLOGY

COMPUTE

UP TO 1.29X MORE
INTEGER THROUGHPUT[1]

NETWORK

UP TO 1.25X MORE
PACKET FORWARDING[2]

STORAGE

UP TO 1.4X HIGHER
READ/WRITE THROUGHPUT[3]

UP TO 2.7X LOWER
LATENCY[3]

CISCO FORTINET JUNIPER NETWORKS kontron S&T Group SEAGATE

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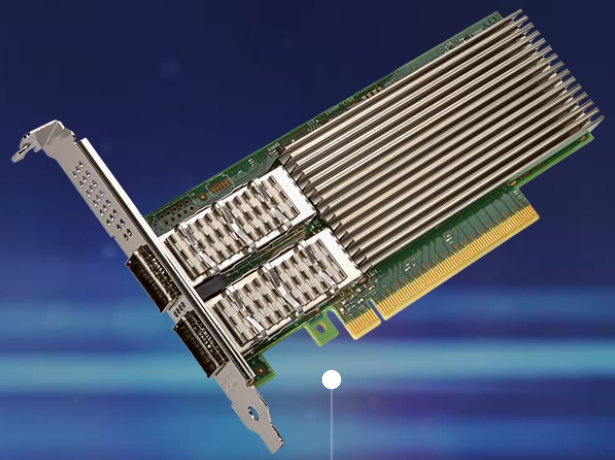
INTEL® ETHERNET ADAPTER 800 SERIES

100GBE FOUNDATIONAL ETHERNET



WITH ADQ

>45%
LATENCY REDUCTION[4]

>30%
MORE THROUGHPUT[5]

redis

APPLICATION DEVICE QUEUES

DELIVERING CONSISTENT
APPLICATION RESPONSE TIME

ADDITIONAL ADVANCED CAPABILITIES

ENHANCED DYNAMIC DEVICE PERSONALIZATION (DDP)
IWARP & ROCE V2 RDMA SUPPORT

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DATA CENTRIC APPLICATION INNOVATION

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THE MODERNIZATION OPPORTUNITY

5 YEARS AVERAGE SERVER LIFECYCLE

5 YEARS AGO
>9M SERVERS
WERE SOLD

$900B UNTAPPED BUSINESS POTENTIAL

Source: IDC, Server Upgrade Cycles: Why Faster Is Better, Doc #US44236318, Nov 2018
Source: IDC, Worldwide Quarterly Server Tracker Final Historical Pivot 2018Q4, March 2019

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THE VALUE OF REFRESH

5 YEAR REFRESH

ENTERPRISE IT

3.77X

OLTP DATABASE[6]

CLOUD INFRASTRUCTURE

3.52X

VM DENSITY[7]

COMMS SERVICE PROVIDER

2.36X

DPDK L3 FORWARDING[8]

TECHNICAL COMPUTING

11X

LINPACK[9]

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Microsoft
ARPAN SHAH
GENERAL MANAGER OF AZURE INFRASTRUCTURE
#datacentric
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SECURITY EMBEDDED IN ALL OUR PRODUCTS

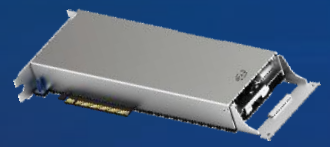
HARDWARE ENHANCED SECURITY FEATURES DESIGNED TO BUILD
A MORE TRUSTED FOUNDATION FOR COMPUTING

SECURITY MITIGATIONS

CPU ARCHITECTURE
UPDATES TO ENHANCE
PROTECTION

DATA PROTECTIONS

ENCRYPTION
IN FLIGHT, AT REST, IN USE



INTEL® SGX CARD

TRUSTED PLATFORM

MULTI-LAYERED, OPEN
SOURCE SECURITY LIBRARIES
FOR DATA CENTER

THREAT DETECTION
PLATFORM INTEGRITY
DATA SOVEREIGNTY

FULL-STACK SOLUTIONS

HARDENED VIRTUALIZATION
HOSTING PLATFORM
WITH LOCKHEED MARTIN

LOCKHEED MARTIN

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LISA DAVIS
VICE PRESIDENT AND GENERAL MANAGER,
DIGITAL TRANSFORMATION & SCALE SOLUTIONS

AVAILABILITY

DETERMINISTIC QUALITY
OF SERVICE

HARDENED SECURITY SOLUTION

HARDENED VIRTUALIZATION PLATFORM ADDRESSING FULL RANGE OF SECURITY CONTROLS

INTEGRITY

TRUSTED BOOT
THROUGH RUNTIME

CONFIDENTIALITY

VM ENCRYPTION
& ISOLATION

INTEL® XEON® SCALABLE PROCESSOR
INTEL® BOOT GUARD
INTEL® RDT
INTEL® AES-NI

HARDENED BIOS
HARDENED HYPERVISOR

LOCKHEED MARTIN

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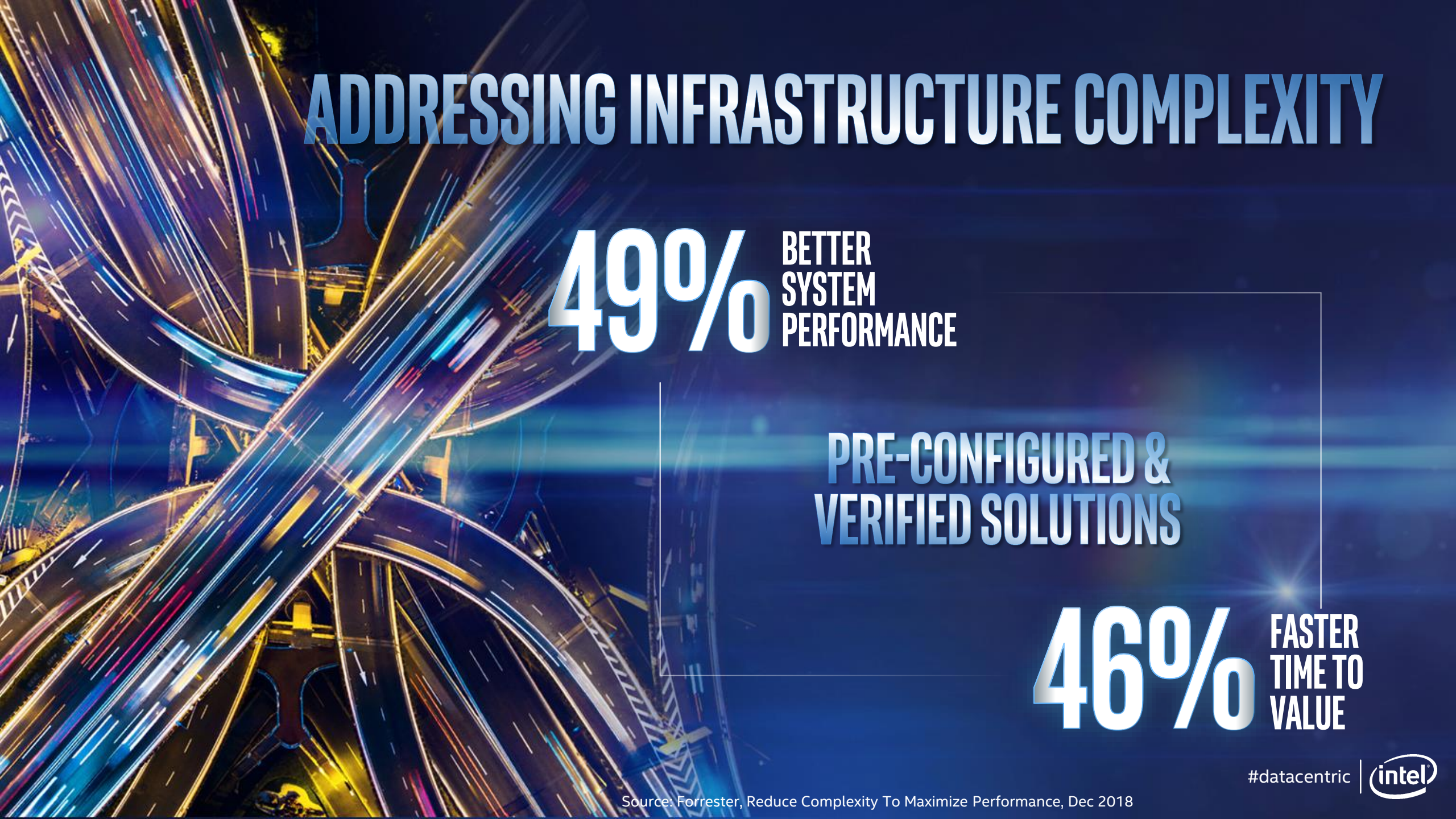
ADDRESSING INFRASTRUCTURE COMPLEXITY
49% BETTER SYSTEM PERFORMANCE
PRE-CONFIGURED & VERIFIED SOLUTIONS
46% FASTER TIME TO VALUE
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Source: Forrester, Reduce Complexity To Maximize Performance, Dec 2018

INTEL® SELECT SOLUTIONS

BOOST IT VELOCITY

WITH PRE-DEFINED AND VERIFIED
INFRASTRUCTURE SOLUTION STACKS
AVAILABLE FROM A
RANGE OF PARTNERS

>50 VERIFIED PARTNER SOLUTIONS

INCREASE SYSTEM LEVEL PERFORMANCE

WITH HIGHLY OPTIMIZED
CONFIGURATIONS
OF INDUSTRY-LEADING
INTEL DATA CENTER TECHNOLOGIES

intel® select solution

UNPARALLELED HW / SW ECOSYSTEM

TO ACCELERATE YOUR
PACE OF INNOVATION ACROSS
CRITICAL BUSINESS WORKLOADS

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MAKING WORKLOAD ACCELERATION EASY WITH INTEL® SELECT SOLUTIONS

ANALYTICS

- MICROSOFT SQL SERVER WINDOWS SERVER — UPDATED
- MICROSOFT SQL SERVER LINUX* — UPDATED
- SAP HANA* — NEW

ARTIFICIAL INTELLIGENCE

- BIGDL ON APACHE SPARK
- AI INFERENCING — NEW

HYBRID CLOUD

- MICROSOFT AZURE STACK
- RED HAT OPENSHIFT CONTAINER PLATFORM
- VMWARE VSAN — UPDATED
- MICROSOFT AZURE STACK HCI — UPDATED
- HUAWEI FUSIONSTORAGE
- BLOCKCHAIN: HYPERLEDGER FABRIC* — UPDATED
- HARDENED SECURITY WITH LOCKHEED MARTIN — NEW

NETWORK TRANSFORMATION

- UNIVERSAL CUSTOMER PREMISES EQUIPMENT
- NFVI: RED HAT — UPDATED
- NFVI: UBUNTU — UPDATED
- NFVI: FUSIONSPHERE
- VISUAL CLOUD DELIVERY NETWORK — NEW

HPC

- SIMULATION & MODELING* — UPDATED
- PROFESSIONAL VISUALIZATION* — UPDATED
- GENOMICS ANALYTICS* — UPDATED
- HPC & AI CONVERGED CLUSTERS — NEW

* Coming Soon

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vmware®
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VICE PRESIDENT OF ENGINEERING IN
STORAGE & AVAILABILITY
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INTEL® SELECT SOLUTIONS PARTNER DELIVERY

ISV/OSV

BROAD INSTITUTE
ubuntu
HUAWEI
LOCKHEED MARTIN
Microsoft
redhat
SAP
vmware

OEM

ADVANTECH
Celestica
FUJITSU
HITACHI
HUAWEI
inspur
Lanner
Lenovo
NEC
NOKIA
QCT
Silicom Ltd. Connectivity Solutions
Sugon
SUPERMICRO
wiwynn

SCALE

ADLINK Leading EDGE COMPUTING
advania data centers
avanade
atipa
BOSTON Servers | Storage | Solutions
CASWELL Complete Your Solutions
CDW
dataON DataONSTORAGE
EQUUS COMPUTE SOLUTIONS
H3C
MEGWARE
mercury systems
NEXCOM
NOR-TECH
PREMIER
QNAP
RSC
shi
World Wide Technology
WORTMANN AG
ZTE

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Lenovo
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SUMMARY

SPANNING INTELLIGENT EDGE TO CLOUD

UNMATCHED PORTFOLIO TO MOVE, STORE, PROCESS DATA

2ND GENERATION INTEL® XEON ® SCALABLE PROCESSORS WITH INTEL® DEEP LEARNING BOOST

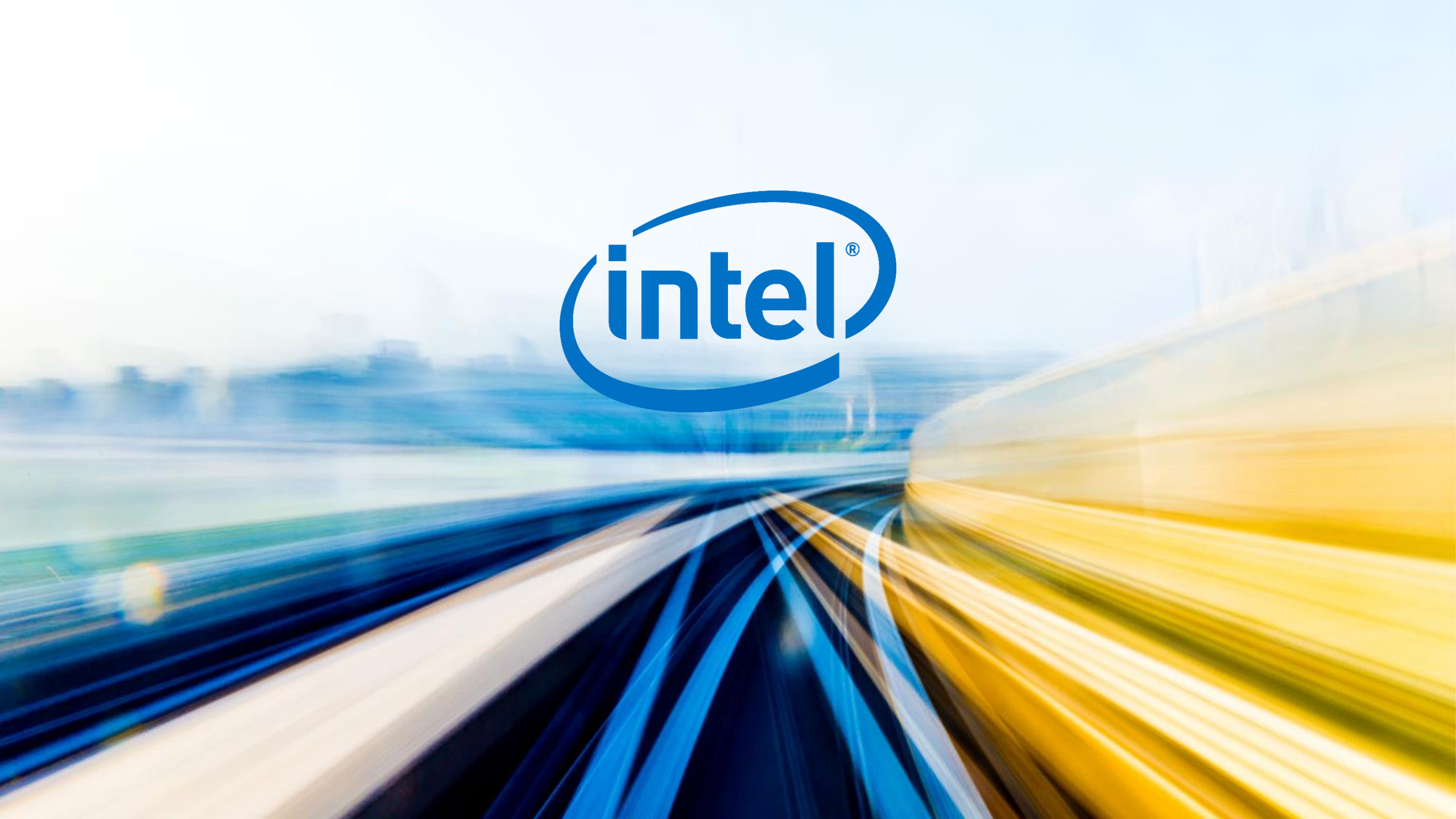
THE ONLY CPU WITH INTEGRATED AI ACCELERATION

NETWORK-OPTIMIZED TECHNOLOGY

WINNING 5G WITH THE INDUSTRY'S PLATFORM OF CHOICE

INTEL® OPTANE™ PERSISTENT MEMORY

BREAKING THROUGH MEMORY AND STORAGE BARRIERS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1 Up to 29% more compute integer throughput with Intel® Xeon® D-1623N processor compared with Intel® Xeon® D-1513N processor. Tested by Intel Corp as of 3/20/2019. 1x Intel® Xeon® D-1623N processor, Platform: Echo Canyon, 2 x 32GB DDR4 2400 ECC(64GB Total Memory) ,OS: Red Hat 7.6 with Kernel: 3.10.0-957.5.1.el7.x86_64, Bios: GNVDTRL1.86B.0010.D75.1902060802, uCode: 0xe00000c, Benchmark: SPECrate*2017_int_base (Estimated), Compiler: ICC 19.0.1.144, Storage: Intel® SSD D3-S4510 Series 1.92TB, Score: 19.7 (Estimated) compared to 1x Intel® Xeon® D-1513N processor, Platform: Echo Canyon, 2 x 32GB DDR4 2400 ECC(64GB Total Memory) ,OS: Red Hat 7.6 with Kernel: 3.10.0-957.5.1.el7.x86_64, Bios: GNVDTRL1.86B.0010.D75.1902060802, uCode: 0xe00000c, Benchmark: SPECrate*2017_int_base (Estimated), Compiler: ICC 19.0.1.144, Storage: Intel® SSD D3-S4510 Series 1.92TB, Score: 15.2 (Estimated)

2 Up to 25% performance improvement with Intel® Xeon® D-1653N processor compared with Intel® Xeon® D-1553N processor on router and packet forwarding. Tested by Intel Corp as of 3/20/2019. 1x Intel® Xeon® D-1653N processor, Platform: Echo Canyon, 2 x 32GB DDR4 2400 ECC(64GB Total Memory) ,OS: Ubuntu 18.04 LTS with Kernel: 4.15.0-42-generic x86_64, Bios: GNVDTRL1.86B.0010.D52.1708180300, uCode: 0xE00000A, Benchmark: VPP 18.10 IPV4 FIB, Compiler: DPDK 18.08, Network: 2x Intel® Ethernet Controller X552 (4x 10G ports), Storage: Intel® SSD D3-S4510 Series 240GB, Score: 17.3 (1Core/2T Mpackets/s (64B)) compared to 1x Intel® Xeon® D-1553N processor, Platform: Echo Canyon, 2 x 32GB DDR4 2400 ECC(64GB Total Memory) ,OS: Ubuntu 18.04 LTS with Kernel: 4.15.0-42-generic x86_64, Bios: GNVDTRL1.86B.0010.D52.1708180300, uCode: 0xE00000A, Benchmark: VPP 18.10 IPV4 FIB, Compiler: DPDK 18.08, Network: 2x Intel® Ethernet Controller X552 (4x 10G ports), Storage: Intel® SSD D3-S4510 Series 240GB, Score: 13.8 (1Core/2T Mpackets/s (64B))

3 Up to 1.4X higher read & write throughput & 2.7X lower in latency response with Intel® Xeon® D-1627 processor compared with Intel® Xeon® D-1521 processor. Tested by Intel Corp as of 3/20/2019. 1x Intel® Xeon® D-1627 processor, Platform: Echo Canyon, 2 x 32GB DDR4 2400 ECC(64GB Total Memory) ,OS: Red Hat 7.6 with Kernel: 3.10.0-957.5.1.el7.x86_64, Bios: GNVDTRL1.86B.0010.D75.1902060802, uCode: 0xe00000c, Benchmark: Local IOPS (FIO 3.1) Compiler: Red Hat 4.8.5-36-GCC, Q-depth=32, Storage: Intel® SSD D3-S4510 1.92TB (boot), 3x Intel® SSD D3-S4510 1.92TB (Application), Score: 23834.66 (IOPS) & 9962.44us (99th Latency) for Sequential 64K 70Read/30Write, compared to 1x Intel® Xeon® D-1521 processor, Platform: Echo Canyon, 2 x 32GB DDR4 2400 ECC(64GB Total Memory) ,OS: Red Hat 7.6 with Kernel: 3.10.0-957.5.1.el7.x86_64, Bios: GNVDTRL1.86B.0010.D75.1902060802, uCode: 0xe00000c, Benchmark: Local IOPS (FIO 3.1) Compiler: Red Hat 4.8.5-36-GCC, Q-depth=32, Storage: Intel® SSD D3-S4510 1.92TB (boot), 3x Intel® SSD DC S3520 800GB (Application), Score: 16421.33 (IOPS) & 27493.44us (99th Latency) for Sequential 64K 70Read/30Write

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4
> 45% latency reduction with Open Source Redis using 2nd gen Intel® Xeon® Scalable Processors and Intel® Ethernet 800 Series with ADQ.
Calculation: (new - old) / old x 100%
Rtt Average Latency across all run for baseline vs ADQ
(382-1249)/1249 * 100% = -69% Reduction in Rtt Average Latency

5
> 30% throughput improvement with Open Source Redis using 2nd gen Intel® Xeon® Scalable Processors and Intel® Ethernet 800 Series with ADQ.
Calculation: (new - old) / old x 100%
Transaction Request Rate across all run for baseline vs ADQ
(79601-44345)/44345 * 100% = 80% Throughput Improvement

Source: Intel internal testing as of February 2019
Configuration details provided in the following tables:

	SUT	Client
Test by	Intel	Intel
Test date	2/11/2019	2/11/2019
Platform	Intel® Server Board S2600WFTF	Dell* PowerEdge* R720
# Nodes	1	11
# Sockets	2	2
CPU	2nd Generation Intel® Xeon® Scalable processor 8268 @ 2.8GHz	Intel® Xeon® processor E5-2697 v2
Cores/socket, Threads/socket	24/48	12 / 24
ucode	0x3000009	0x428
HT	On	On
Turbo	On	On
BIOS version	SE5C620.86B.01.00.0833.051120182255	2.5.4
System DDR Mem Config: slots / cap / run-speed	8 slots / 128GB / 2400MT/s	16 slots / 128GB / 1600MT/s
System DCPMM Config: slots / cap / run-speed	2 slots / 1024GB	-
Total Memory/Node (DDR+DCPMM)	1024GB	128GB
Storage - boot	1x Intel SSD (OS Drive 64GB)	1x Dell (OS Drive 512GB)
Storage - application drives	-	-
NIC	1x Intel® Ethernet Network Adapter E810-CQDA2	1x Intel® Ethernet X520-DA2
PCH	Intel® C620 Series Chipset	Intel® C600 Series Chipset
Other HW (Accelerator)		
OS	CentOS 7.6	CentOS 7.4
Kernel	4.19.18 (Linux.org Stable)	3.10.0-693.21.1.el7
IBRS (0=disable, 1=enable)	1	0
eIBRS (0=disable, 1=enable)	0	0
Retpoline (0=disable, 1=enable)	1	0
IBPB (0=disable, 1=enable)	1	0
PTI (0=disable, 1=enable)	1	1
Mitigation variants (1,2,3,3a,4, L1TF)	1,2,3,L1TF	1,2,3,L1TF
Workload & version	Redis 4.0.10	redis-benchmark 4.0.10
Compiler	gcc (GCC) 4.8.5 20150623	-
NIC Driver	ice 08.15	ixgbe 4.4.0-k-rh7.4

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Performance results are based on testing as of dates shown in configuration and may not reflect all publicly available security updates. See configuration disclosure for details. No product or component can be absolutely secure. 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 www.intel.com/benchmarks.

6. HammerDB OLTP Database: 1-node, 2x Intel(R) Xeon(R) CPU E5-2697 v2 on Canoe Pass with 256 GB (16 slots / 16 GB / 1866) total memory, ucode 0x42d on RHEL7.6, 3.10.0-957.el7.x86_64, 2 x Intel DC P3700 PCI-E SSD for DATA, 2 x Intel DC P3700 PCI-E SSD for REDO, HammerDB 3.1, HT on, Turbo on, result: OLTP Warehouse workload=2.24M, test by Intel on 2/1/2019. 1-node, 2x Intel(R) Xeon(R) CPU E5-2699 v4 on Wildcat Pass with 384 GB (24 slots / 16 GB / 2133) total memory, ucode 0xb00002e on RHEL7.6, 3.10.0-957.el7.x86_64, 2 x Intel DC P3700 PCI-E SSD for DATA, 2 x Intel DC P3700 PCI-E SSD for REDO, HammerDB 3.1, HT on, Turbo on, result: OLTP Warehouse workload=5.08M, test by Intel on 2/1/2019. 1-node, 2x Intel(R) Xeon(R) Platinum 8280 CPU on Wolf Pass with 384 GB (12 slots / 32 GB / 2933) total memory, ucode 0x4000013 on RHEL7.6, 3.10.0-957.el7.x86_64, 2 x Intel SSD DC P4610 for DATA, 2 x Intel SSD DC P4610 for for REDO, HammerDB 3.1, HT on, Turbo on, result: OLTP Warehouse workload=8.45M, test by Intel on 2/1/2019.

7. Virtualized Infrastructure: 1-node, 2x Intel® Xeon® Processor E5-2697 v2 on Canon Pass with 256 GB (16 slots / 16GB / 1600) total memory, ucode 0x42c on RHEL7.6, 3.10.0-957.el7.x86_64, 1x Intel 400GB SSD OS Drive, 2x P4500 4TB PCIe, 2*82599 dual port Ethernet, Virtualization Benchmark, VM kernel 4.19, HT on, Turbo on, result: VM density=21, test by Intel on 1/15/2019. 1-node, 2x Intel® Xeon® Processor E5-2699 v4 on Wildcat Pass with 512 GB (16 slots / 32GB / 2133) total memory, ucode 0xB00002E on RHEL7.6, 3.10.0-957.el7.x86_64, 1x Intel 400GB SSD OS Drive, 2x P4500 4TB Optane PCIe, 2*82599 dual port Ethernet, Virtualization Benchmark, VM kernel 4.19, HT on, Turbo on, result: VM density=53, test by Intel on 1/15/2019. 1-node, 2x Intel® Xeon® Platinum 8280 Processor on Wolf Pass with 768 GB (24 slots / 32GB / 2666) total memory, ucode 0x2000056 on RHEL7.6, 3.10.0-957.el7.x86_64, 1x Intel 400GB SSD OS Drive, 2x P4500 4TB PCIe, 2*82599 dual port Ethernet, Virtualization Benchmark, VM kernel 4.19, HT on, Turbo on, result: VM density=74, test by Intel on 1/15/2019.

8. DPDK L3 Forwarding: 1-node, 2x Intel® Xeon® Processor E5-2680v2 on Crown Pass platform with 128GB DDR3 1867MT/s (16x 8GB), OS: Ubuntu 18.04 LTS Kernel: 4.15.0-42-generic, Bios: SE5C600.86B.02.06.0007.082420181029 uCode: 0x42d, Storage: 1x 240GB KINGSTON* SA400S3, Network: 6x Intel® Ethernet Network Adapter XXV710-DA2, Benchmark: DPDK L3fwd, version: DPDK v18.08, complier: gcc7.3.0, score: 122.74 (Max Gbits/s 1518B)). 1-node, 2x Intel® Xeon® Processor E5-2680v4 on Supermicro*-X10DRX platform with 256GB DDR4 2400MT/s (8x32GB), OS: Ubuntu 18.04 Kernel: 4.15.0-42-generic, Bios: American Megatrends Inc.* version: '2.0' uCode: 0xb00002e, Storage: : 1x Intel® SSD D3-S4510 (240GB), Network: 4x Intel® Ethernet Network Adapter XXV710-DA2, Benchmark: DPDK L3fwd, version: DPDK v18.08, complier: gcc7.3.0, score: 171.5 (Max Gbits/s 1518B)). 1-node, 2x Intel® Xeon® Gold 6230N Processor on Neon City platform with 192GB DDR4 2933MT/s (12 x 16GB), OS: Ubuntu 18.04 Kernel: 4.20.0-042000rc6-generic, Bios: PLYXCRB1.86B.0568.D10.1901032132 uCode: 0x4000019, Storage: 1x Intel® SSD D3-S4510 (240GB), Network: 6x Intel® Ethernet Network Adapter XXV710-DA2, Benchmark: DPDK L3fwd, version: DPDK v18.08, complier: gcc7.3.0, score: 289.8 (Max Gbits/s 1518B))

9. Intel® Distribution of Linpack: 1-node, 2x Intel Xeon processor E5-2697 v2 on Canoe Pass with 768 GB (24x 32GB 2933) total memory, ucode 0x42d on RHEL7.6, 3.10.0-957.el7.x86_64, IC19u1, AVX512, HT off, Turbo on, score: Linpack GF/s=546, test by Intel on 2/16/2019. 1-node, 2x Intel Xeon processor E5-2699 v4 on Wildcat Pass with 384 GB (12 X 32GB 2666 (2400)) total memory, ucode 0xb00002e on RHEL7.6, 3.10.0-957.el7.x86_64, IC18u2, AVX2, HT off, Turbo on, score: Linpack GF/s=1434, test by Intel on 2/16/2019. 1-node, 2x Intel® Xeon® Platinum 9282 cpu on Walker Pass with 768 GB (24x 32GB 2933) total memory, ucode 0x400000A on RHEL7.6, 3.10.0-957.el7.x86_64, IC18u2, AVX2, HT off, Turbo on, score: Linpack GF/s=6411, test by Intel on 2/16/2019.