DATA-CENTRIC INNOVATION DAY
MOVE | STORE | PROCESS
THE DATA-CENTRIC WORLD

OVER
HALF
OF THE
WORLD’S
DATA

WAS CREATED IN THE LAST
2 YEARS

LESS THAN
2% HAS BEEN ANALYZED

Source: Data Age 2025, sponsored by Seagate with data from IDC Global DataSphere. Nov 2018.
INDUSTRY MEGA TRENDS

PROLIFERATION OF CLOUD COMPUTING

GROWTH OF AI & ANALYTICS

CLOUDIFICATION OF THE NETWORK & EDGE
EXPLOSION IN DEMAND FOR COMPUTE

INCREASING COMPUTE DEMAND
DIVERSIFYING WORKLOAD NEEDS

Source: Intel analysis
**DATA-CENTRIC INFRASTRUCTURE FOCUS**

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<th>MOVE FASTER</th>
<th>STORE MORE</th>
<th>PROCESS EVERYTHING</th>
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**SOFTWARE & SYSTEM-LEVEL OPTIMIZED**
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<td><strong>2ND GENERATION INTEL® XEON® SCALABLE</strong></td>
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<td><strong>INTEL® AGILEX™</strong></td>
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2ND GENERATION INTEL® XEON® SCALABLE PROCESSORS

>50
STANDARD SKUS

DOZENS
CUSTOM SKUS

8 TO 56
CORES PER SOCKET

4.5TB
MEMORY PER SOCKET

1 TO 8
 SOCKETS

INTEL® OPTANE™ DC PERSISTENT MEMORY

INTEL® DEEP LEARNING BOOST

INTEL® SPEED SELECT TECHNOLOGY

NETWORK-OPTIMIZED SKUS

CLOUD-OPTIMIZED SKUS

SECURITY MITIGATIONS

BUILDING ON 20 YEARS OF DATA CENTER PROCESSOR INNOVATION
ALL NEW LEVEL OF ADVANCED PERFORMANCE

INTEL® XEON® PLATINUM 9200 PROCESSORS

HIGHEST PERFORMANCE

UP TO 56 CORES
PER SOCKET

HIGHEST BANDWIDTH

UP TO 12 CHANNELS
NATIVE DDR4 MEMORY

LEADERSHIP

PERFORMANCE PER RACK

DESIGNED FOR THE MOST DATA-INTENSIVE WORKLOADS

Leadership performance per rack based on 4 benchmarks (Integer Throughput, Floating Point Throughput, Memory Bandwidth and LINPACK).
WORLD RECORD + REAL WORKLOAD PERFORMANCE LEADERSHIP

MAXIMIZING MAINSTREAM SKUS

UP TO 1.33X AVERAGE PERF GAIN GEN ON GEN

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 can be absolutely secure. For more complete information about performance and benchmark results, visit www.intel.com/benchmarks. Intel's compilers may or may not optimize to the same degree for non-Intel microprocessors for optimizations that are not unique to Intel microprocessors. These optimizations include SSE2, SSE3, and SSSE3 instruction sets and other optimizations. Intel does not guarantee the availability, functionality, or effectiveness of any optimization on microprocessors not manufactured by Intel. Microprocessor-dependent optimizations in this product are intended for use with Intel microprocessors. Certain optimizations not specific to Intel microarchitecture are reserved for Intel microprocessors. Please refer to the applicable product User and Reference Guides for more information regarding the specific instruction sets covered by this notice.
AI: THE FASTEST GROWING WORKLOAD

AI DATA CENTER LOGIC SILICON TAM

$2.5B
INFERANCE

$8-10B
INFERANCE

TRAINING

>50% OF THE AI SI OPPORTUNITY

Source: AI SI TAM is based on amalgamation of analyst data and Intel analysis, based upon current expectations and available information and are subject to change without notice.
INTEL OPTIMIZATION FOR CAFFE RESNET-50

INTEL DEEP LEARNING BOOST
OPTIMIZING AI INFERENC
MAKING AI ON IA EASY
INTEL® DL BOOST ECOSYSTEM SUPPORT

- Microsoft
- Tencent Cloud

- JD.COM
- Alibaba Group

- OPTIMIZED SW & FRAMEWORKS
- SOFTWARE VENDORS
- CLOUD SERVICE PROVIDERS
- ENTERPRISES

3.4X IMAGE RECOGNITION
2.4X TEXT DETECTION
2-4X ML INFERENCEING
4.43X VIDEO ANALYSIS

8 DIFFERENT WORKLOADS

Caffe, mxnet, OpenVINO, ONNX, PaddlePaddle, PyTorch, TensorFlow

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CLOUDIFICATION OF THE NETWORK

DATA CENTER | CLOUD

CORE

ACCESS | EDGE

DEVICES | THINGS

THE NETWORK MOVES TO IA


NFV DEFINED

1ST NFV PROOF OF CONCEPTS

20% OF COMMS SPS ADOPT NFV

DPDK MOVES TO LINUX FOUNDATION

65% NETWORK IS VIRTUALIZED

1ST 100% CLOUD-NATIVE NETWORK

at&t  Rakuten

#datacentric  intel
2nd Gen Intel Xeon Scalable Processors with Intel® Speed Select Technology

SKUS Optimized for Unique Network Needs

Up to 1.76x Network Workload Performance vs 1st Generation Intel Xeon Scalable

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SYSTEM-LEVEL OPTIMIZATION UNLEASHES PERFORMANCE
LAUNCHING TODAY

DATA-CENTRIC PORTFOLIO

MOVE FASTER
INTEL® ETHERNET 800 SERIES ADAPTER

STORE MORE
INTEL® SSDs
INTEL® OPTANE™ DC PERSISTENT MEMORY

PROCESS EVERYTHING
2ND GENERATION INTEL® XEON® SCALABLE
INTEL® XEON® D-1600
INTEL® AGILEX™
REMOVING STORAGE BOTTLENECKS

DUAL-PORT
INTEL® OPTANE™ DC SSD D4800X

INTEL® SSD D5-P4326
QLC NAND ‘RULER’

24X7 ACCESS
FOR MISSION CRITICAL ENTERPRISE STORAGE

UP TO 20X
STORAGE RACK CONSOLIDATION
VS HARD DRIVES

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INTEL® OPTANE™ DC PERSISTENT MEMORY
MEMORY INNOVATION 10 YEARS IN THE MAKING

ECOSYSTEM SUPPORT

SOLUTION OPTIMIZATION

TECHNOLOGY INNOVATIONS

UP TO 36TB 8 SOCKET SYSTEM

9.1B BW ON HANA RECORDS

NEW WORLD RECORD

UP TO 8X MORE VM INSTANCES

MEETING SUB-mS SLA

Performance results are based on testing 8X (2/19/2019), and may not reflect all publicly available security updates. No product can be absolutely secure. See configuration disclosure for details. 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 information go to www.intel.com/benchmarks.

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# LAUNCHING TODAY

## DATA-CENTRIC PORTFOLIO

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**Intel®** select solution

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SYSTEM CONFIGURATION: LEADERSHIP PERFORMANCE PER RACK

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Performance per rack leadership based on 4 benchmarks (Integer Throughput, Floating Point Throughput, Memory Bandwidth and LINPACK). Details below:

Integer Throughput:
1-node, 2x Intel® Xeon® Platinum 9282 processor on Walker Pass with 768 GB (24x 32GB 2933) total memory, ucode 0x40000010 on CentOS Linux release 7.6.1810, 4.20.0+, IC19u1, AVX512, HT on, Turbo on, score: est int throughput=628, test by Intel on 3/14/2019. Rack performance estimate of 40192. 42U rack, 32U dedicated to compute, total of 64 compute nodes. 64 * 628 = 40192

1-node, 2x AMD* EPYC* 7601, https://www.spec.org/cpu2017/results/res2019q1/cpu2017-20190304-11124.html, score: 301, test by Dell on Feb 2019. Rack performance estimate of 19264. 42U rack, 32U dedicated to compute, total of 64 compute nodes. 64 * 301 = 19264

Floating Point Throughput:
1-node, 2x Intel® Xeon® Platinum 9282 processor on Walker Pass with 768 GB (24x 32GB 2933) total memory, ucode 0x4000010 on CentOS Linux release 7.6.1810, 4.20.0+, IC19u1, AVX512, HT on, Turbo on, score: est fp throughput=522, test by Intel on 3/14/2019. Rack performance estimate of 33408. 42U rack, 32U dedicated to compute, total of 64 compute nodes. 64 * 522 = 33408


Memory Bandwidth:
1-node, 2x Intel® Xeon® Platinum 9282 processor on Walker Pass with 768 GB (24x 32GB 2933) total memory, ucode 0x4000010, on CentOS Linux release 7.6.1810, 4.20.0+, IC19u1, AVX512, HT off, Turbo on, score: Stream Triad=407Gib/s, test by Intel on 3/14/2019. Rack performance estimate of 26048. 42U rack, 32U dedicated to compute, total of 64 compute nodes. 64 * 407 = 26048

1-node, 2x AMD* EPYC* 7601, https://www.spec.org/cpu2017/results/res2019q1/cpu2017-20190304-11126.html, score: 290, test by AMD as of June 2017. Rack performance estimate of 18560. 42U rack, 32U dedicated to compute, total of 64 compute nodes. 64 * 290 = 18560

LINPACK:
1-node, 2x Intel® Xeon® Platinum 9282 processor on Walker Pass with 768 GB (24x 32GB 2933) total memory, ucode 0x4000010 on CentOS Linux release 7.6.1810, 4.20.0+, IC19u1, N 210000, HT off, Turbo on, Benchmark Config: Nb=232, N=168960, P=4, Q=4, Score =1095GFs, tested by Intel as of July 31, 2018. Rack performance estimate of 70.08 TFLOPs. 42U rack, 32U dedicated to compute, total of 64 compute nodes. 64 * 1095 = 70.08 TFLOPs
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 changes 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. See configuration disclosure for details.

2.19x LAMPS*: Water: 1-node, 2x Intel® Xeon® Platinum 8160L cpu on Wolf Pass with 192 GB (12 slots / 16GB / 2666) total memory, ucode 0x200004d on Oracle Linux server release 7.6, 3.10-0.862.14.4.e7.crt1.x86_64, Intel SSDSC2BA80, LS-Dyna 9.3-Explicit AVX2 binary, 32r, HT on, Turbo on, test by Intel on 2/26/2019. 1-node, 2x Intel® Xeon® Platinum 9242 cpu on Intel reference platform with 384 GB (24 slots / 16GB / 2933) total memory, ucode 0x4000017 on CentOS 7.6, 3.10-0.957.5.1.e7.x86_64, Intel SSDSC2BA80, LS-Dyna 9.3-Explicit AVX2 binary, 32r, HT on, Turbo on, test by Intel on 3/19/2019.

2.01x LS-Dyna* Explicit, 32r: 1-node, 2x Intel® Xeon® Platinum 8160L cpu on Wolf Pass with 192 GB (12 slots / 16GB / 2666) total memory, ucode 0x200004d on Oracle Linux server release 7.6, 3.10-0.862.14.4.e7.crt1.x86_64, Intel SSDSC2BA80, LAMPS version 12 Dec 2018, 2x Intel® Xeon® Platinum 8242 cpu on Intel reference platform with 384 GB (24 slots / 16GB / 2933) total memory, ucode 0x4000017 on CentOS 7.6, 3.10-0.957.5.1.e7.x86_64, Intel SSDSC2BA80, LAMPS version 12 Dec 2018, Water, HT on, test by Intel on 3/3/2019.

1.39x BAOBJECT: 1x Intel® Xeon® Platinum 8260L cpu on S2600WFS with 768 DDR GB (24 slots / 32GB / 2666) total memory, ucode 0x400000a on CentOS 7.5, 3.10-0.957.1.3.e7.x86_64, Intel 480GB SSD OS Drive, Intel X7272, 2x Intel® Xeon® Platinum 8242 cpu on Intel reference platform with 384 GB (24 slots / 16GB / 2933) total memory, ucode 0x4000017 on CentOS 7.6, 3.10-0.957.5.1.e7.x86_64, Intel SSDSC2BA80, LS-Dyna 9.3-Explicit AVX2 binary, 32r, HT on, Turbo on, test by Intel on 3/19/2019.

1.54x AsiaInfo** BS*: 1-node, 2x Intel® Xeon® Platinum 8180 cpu on S2560WF with 768 GB (24 slots / 32GB / 2666) total memory, ucode 0x2000035 on RedHat 7.3, 3.10-0.957.1.3.e7.x86_64, Intel 480GB SSD OS Drive, Intel X7450, 2x Intel® Xeon® Platinum 8242 cpu on S2600WFS with 192 DDR + 1024 Intel DCPMM GB (12 slots / 16 GB / 2666 DDR + 8 slots / 128 GB / 2666 Intel DCPMM) total memory, ucode 0x400000a on RedHat 7.3, 3.10-0.957.1.3.e7.x86_64, Intel 480GB SSD OS Drive, Intel X7272, X86_64, Intel 480GB SSD OS Drive, Intel X7272, 2x Intel® Xeon® Platinum 8180, HT on, test by Intel/AsiaInfo on 12/27/2018. 1-node, 2x Intel® Xeon® Platinum 8242 cpu on S2600WFS with 192 DDR + 1024 Intel DCPMM GB (12 slots / 16 GB / 2666 DDR + 8 slots / 128 GB / 2666 Intel DCPMM) total memory, ucode 0x400000a on RedHat 7.3, 3.10-0.957.1.3.e7.x86_64, Intel 480GB SSD OS Drive, Intel X7272, 2x Intel® Xeon® Platinum 8180, HT on, test by Intel/AsiaInfo on 1/8/2019. 1-node, 2x Intel® Xeon® Platinum 8260L cpu on S2600WFS with 192 DDR + 1024 Intel DCPMM GB (12 slots / 16 GB / 2666 DDR + 8 slots / 128 GB / 2666 Intel DCPMM) total memory, ucode 0x400000a on RedHat 7.3, 3.10-0.957.1.3.e7.x86_64, Intel 480GB SSD OS Drive, Intel X7272, 2x Intel® Xeon® Platinum 8180, HT on, test by Intel/AsiaInfo on 1/8/2019. 1-node, 2x Intel® Xeon® Platinum 8260L cpu on S2600WFS with 192 DDR + 1024 Intel DCPMM GB (12 slots / 16 GB / 2666 DDR + 8 slots / 128 GB / 2666 Intel DCPMM) total memory, ucode 0x400000a on RedHat 7.3, 3.10-0.957.1.3.e7.x86_64, Intel 480GB SSD OS Drive, Intel X7272, 2x Intel® Xeon® Platinum 8180, HT on, test by Intel/AsiaInfo on 1/8/2019. 1-node, 2x Intel® Xeon® Platinum 8260L cpu on S2600WFS with 192 DDR + 1024 Intel DCPMM GB (12 slots / 16 GB / 2666 DDR + 8 slots / 128 GB / 2666 Intel DCPMM) total memory, ucode 0x400000a on RedHat 7.3, 3.10-0.957.1.3.e7.x86_64, Intel 480GB SSD OS Drive, Intel X7272, 2x Intel® Xeon® Platinum 8180, HT on, test by Intel on 2/14/2018. 1-node, 2x Intel® Xeon® Platinum 8260L cpu on Intel reference platform with 384 GB (24 slots / 16GB / 2933) total memory, ucode 0x4000017 on CentOS 7.6, 3.10-0.957.5.1.e7.x86_64, Intel SSDSC2BA80, LS-Dyna 9.3-Explicit AVX2 binary, 32r, HT on, Turbo on, test by Intel on 3/19/2019.

To analyze performance improvements for this system, 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.
1x inference throughput baseline on Intel® Xeon® Platinum 8180 processor (July 2017) – Tested by Intel as of July 11th 2017: Platform: 2S Intel® Xeon® Platinum 8180 CPU @ 2.5GHz (28 cores), HT disabled, turbo disabled, scaling governor set to "performance" via intel_pstate driver, 384GB DDR4-2666 ECC RAM. Centos Linux release 7.3.1611 (Core), Linux kernel 3.10.0-514.10.2.el7.x86_64, SSD: Intel® SSD DC S3700 Series (800GB, 2.5in SATA 6Gb/s, 25nm, MLC). Performance measured with: Environment variables: KMP_AFFINITY="granularity=fine,compact", OMP_NUM_THREADS=56, CPUFreq set with cpupower frequency-set -d 2.5G -u 3.8G, -g performance. Caffe: (http://github.com/intel), revision f96b759f7b2b281833f690a2f267158b8b2b150b5c. Inference measured with "caffe time --forward_only" command, training measured with "caffe time" command. For "ConvNet" topologies, synthetic dataset was used. For other topologies, data was stored on local storage and cached in memory before training. Topology specs from http://github.com/intel/download/optimized_models/ResNet-50, Intel C++ compiler ver. 17.0.2 20170213, Intel MKL small libraries version 2018.0.170425. Caffe run with "numactl -1".

5x inference improvement on Intel® Xeon® Platinum 8180 processor (October 2018) with continued optimizations – Tested by Intel as of November 19th 2018 2S socket Intel(R) Xeon(R) Platinum 8180 CPU @ 2.5GHz/2.5GHz (28 cores/28 cores) HT disabled, turbo disabled, scaling governor set to "performance" via intel_pstate driver, 384GB DDR4-2666 ECC RAM. Centos Linux release 7.3.1611 (Core), Linux kernel 3.10.0-514.10.2.el7.x86_64, SSD: Intel® SSD DC S3700 Series (800GB, 2.5in SATA 6Gb/s, 25nm, MLC). Performance measured with: Environment variables: KMP_AFFINITY="granularity=fine, compact", OMP_NUM_THREADS=56, CPUFreq set with cpupower frequency-set -d 2.5G -u 3.8G, -g performance. Caffe: (http://github.com/intel), revision f96b759f7b2b281833f690a2f267158b8b2b150b5c. Inference measured with "caffe time --forward_only" command, training measured with "caffe time" command. For "ConvNet" topologies, synthetic dataset was used. For other topologies, data was stored on local storage and cached in memory before training. Topology specs from https://github.com/intel/download/optimized_models/ResNet-50, Intel C++ compiler ver. 17.0.2 20170213, Intel MKL small libraries version 2018.0.170425. Caffe run with "numactl -1".

2x more inference throughput on Intel® Xeon® Platinum 8280 processor with Intel® DL Boost – Tested by Intel as of 2/20/2019. 2 socket Intel® Xeon® Platinum 8280 Processor, 28 cores HT On Turbo On Total Memory 384 GB (12 slots/ 32GB/ 2933 MHz). BIOS: SECC620.68B.01.0271.120720180605 (ucode: 0x200000d4, Ubuntu 18.04.1 LTS, kernel: 4.15.0-45-generic, SSD 1x sda INTEL SSDSC2CA800 SSD 745.4 GB, nvm1 Intel® SSDPE2KX040T7 SSD 3.7TB, Deep Learning Framework: Intel® Optimization for Caffe version: 1.1.3 (commit hash: 7010334f159da224523f3e3a9d6316ca06bb0a9a), ICC version 10.1, MKL DNN version: v.01 (commit hash: 830a10059a0c1d0e3a1d94195104c2f8799035a, model: https://github.com/intel/download/opcache/download/optimized_models/ResNet-50/download, BS=64, synthetic Data, 4 instance/2 socket, Datatype: INT8 vs Tested by Intel as of July 11th 2017: 2S Intel® Xeon® Platinum 8180 CPU @ 2.5GHz (28 cores), HT disabled, turbo disabled, scaling governor set to "performance" via intel_pstate driver, 384GB DDR4-2666 ECC RAM. Centos Linux release 7.3.1611 (Core), Linux kernel 3.10.0-514.10.2.el7.x86_64, SSD: Intel® SSD DC S3700 Series (800GB, 2.5in SATA 6Gb/s, 25nm, MLC). Performance measured with: Environment variables: KMP_AFFINITY="granularity=fine, compact", OMP_NUM_THREADS=56, CPUFreq set with cpupower frequency-set -d 2.5G -u 3.8G, -g performance. Caffe: (http://github.com/intel/download/optimized_models/ResNet-50, Intel C++ compiler ver. 17.0.2 20170213, Intel MKL small libraries version 2018.0.170425. Caffe run with "numactl -1".


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2.01x medical image classification performance improvement for NeuSoft: Tested by Intel and HiSign as of 02/01/2019. 2 socket Intel® Xeon® Platinum 8260 Processor, 24 cores HT On Turbo ON Total Memory 768 GB (12 slots/ 64GB/ 2666 MHz), BIOS version 1.018 (ucode 0x4000000), RedHat 7.5 kernel 4.19.3-1.el7.elrepo.x86_64, Compiler: gcc 4.8.5, Deep Learning Framework: Intel® Optimizations for Caffe v1.1.2, Topology: modified Alexnet, custom dataset, BS=1. Comparing performance on same system with FP32 vs INT8 w/ Intel® DL Boost.


SYSTEM CONFIGURATION: SKUS OPTIMIZED FOR UNIQUE NETWORK NEEDS

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Up to 1.76x gains on networking workloads based on OVS DPDK: Tested by Intel on 1/21/2019 1-Node, 2x Intel® Xeon® Gold 6130 Processor on Neon City platform with 12x 16GB DDR4 2666MHz (384GB total memory), Storage: 1x Intel® 240GB SSD, Network: 4x Intel XXV710-DA2, Bios: PLYXCRB1.86B.0568.D10.1901032132, ucode: 0x200004d (HT= ON, Turbo= OFF), OS: Ubuntu* 18.04 with kernel: 4.15.0-42-generic, Benchmark: Open Virtual Switch (on 4C/4P/8T 64B Mpacket/s), Workload version: OVS 2.10.1, DPDK-17.11.4, Compiler: gcc7.3.0, Other software: QEMU-2.12.1, VPP v18.10, Results: 9.6. Tested by Intel on 1/18/2019 1-Node, 2x Intel® Xeon® Gold 6230N Processor on Neon City platform with 12x 16GB DDR4 2999MHz (384GB total memory), Storage: 1x Intel® 240GB SSD, Network: 6x Intel XXV710-DA2, Bios: PLYXCRB1.86B.0568.D10.1901032132, ucode: 0x4000019 (HT= ON, Turbo= OFF), OS: Ubuntu* 18.04 with kernel: 4.20.0-42000rc6-generic, Benchmark: Open Virtual Switch (on 6P/6C/12T 64B Mpacket/s), Workload version: OVS 2.10.1, DPDK-17.11.4, Compiler: gcc7.3.0, Other software: QEMU-2.12.1, VPP v18.10, Results: 15.2. Tested by Intel on 1/18/2019 1-Node, 2x Intel® Xeon® Gold 6230N Processor with SST-BF enabled on Neon City platform with 12x 16GB DDR4 2999MHz (384GB total memory), Storage: 1x Intel® 240GB SSD, Network: 6x Intel XXV710-DA2, Bios: PLYXCRB1.86B.0568.D10.1901032132, ucode: 0x4000019 (HT= ON, Turbo= ON (SST-BF)), OS: Ubuntu* 18.04 with kernel: 4.20.0-42000rc6-generic, Benchmark: Open Virtual Switch (on 6P/6C/12T 64B Mpacket/s), Workload version: OVS 2.10.1, DPDK-17.11.4, Compiler: gcc7.3.0, Other software: QEMU-2.12.1, VPP v18.10, Results: 16.9