Intel[®] Xeon[®] Platinum 9200 Processor. Performance evaluation for Numerical Weather Prediction and Climate Modeling

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Tests document performance of components on a particular test, in specific systems. Differences in hardware, software, or configuration will affect actual performance. Consult other sources of information to evaluate performance as you consider your purchase. For more complete information about performance and benchmark results, visit www.intel.com/benchmarks.

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"Prediction is very difficult, especially about the future"

Niels Bohr, Physicist, 1885-1962



NWP and Climate Modeling HPC

Tornadoes

In fine-scale grids, FV3 is recreating storms that lead to tornadoes. offering hope for predicting them on a global scale.



Hurricanes

At medium scales, FV3 can render and forecast hurricanes, a notorious problem in recent years for the National Weather Service.



Global

FV3 is speedy and accurate enough to guide both weather and climate models. Here it pictures global carbon dioxide flows.



IMAGE COURTESY: (CLOCKWISE FROM LEFT) LUCAS HARRIS, NOAA/GFDL; C. BICKEL/SCIENCE; XI CHEN (PRINCETON UNIVERSITY); NASA'S GODDARD SPACE FLIGHT CENTER

COSMO weather model governing equations



IMAGE COURTESY: THOMAS SHULTHESS (CSCS)



NWP and ESM HPC centers in Top500

From TOP500 List - June 2018

| Rank | Site | System | Cores | Rmax (TFlop/s) | Rpeak (TFlop/s) | Power (kW) |
|------|---|--|---------|-------------------|--------------------|---------------|
| 20 | United Kingdom Meteorological Office United Kingdom | Cray XC40, Xeon E5-2695v4 18C 2.1GHz, Aries interconnect Cray Inc. | 241,920 | 7,038.9 | 8,128.5 | |
| 25 | Japan Meteorological Agency Japan | Cray XC50, Xeon Platinum 8160 24C 2.1GHz, Aries interconnect Cray Inc./Hitachi | 135,792 | 5,730.5 | 9,125.2 | 1,354 |
| 26 | Japan Meteorological Agency Japan | Cray XC50, Xeon Platinum 8160 24C 2.1GHz, Aries interconnect Cray Inc./Hitachi | 135,792 | 5,730.5 | 9,125.2 | 1,354 |
| 31 | National Center for Atmospheric Research (NCAR) United States | Cheyenne - SGI ICE XA, Xeon E5- 2697v4 18C 2.3GHz, Infiniband EDR HPE | 144,900 | 4,788.2 | 5,332.3 | 1,727 |
| 36 | ECMWF United Kingdom | Cray XC40, Xeon E5-2695v4 18C 2.1GHz, Aries interconnect Cray Inc. | 126,468 | 3,944.7 | 4,249.3 | 1,897 |
| 37 | ECMWF United Kingdom | Cray XC40, Xeon E5-2695v4 18C 2.1GHz, Aries interconnect Cray Inc. | 126,468 | 3,944.7 | 4,249.3 | 1,897 |

www.top500.org

- 47 supercomputing centers from TOP500 list with a dedicated mission for operational weather prediction, research meteorology, environmental and climate science. It includes Canadian Hare and Brooks Cray XC40 supercomputers at SSC/ECCC
- + Multi-disciplinary supercomputing centers which allocate a lot of compute hours for ESM (e.g. ALCF, OLCF, NERSC, TACC, KISTI, KAUST, BSC...)
- + Medium size HPC centers (members of weather consortiums) and Cloud Service Providers



Evolution of ESM/NWP HPC center architecture over the last decade



Arch of ESM HPC centers in 2006-2018

Data represents an architecture view of supercomputing centers from Top500 which are 100% dedicated to weather/climate.

Data source: www.top500.org



NWP and ESM HPC centers in Top500

Data source: www.top500.org

Distribution by OEM



Cray covers almost a half of NWP/ESM HPC in Top500

Distribution by arch



INTRODUCING SECOND GENERATION INTEL® XEON® SCALABLE PROCESSORS





Introducing Intel[®] Xeon[®] Platinum 9200 Processor

Leadership CPU performance per socket¹

Double memory bandwidth for memory intensive workloads²

Intel® DL Boost instruction for inference

Highly integrated high density compute solution optimized for performance

1 Intel® Xeon® Platinum 9282 compared against Intel® Xeon® Platinum 8180 2 Comparing Intel® Xeon® Platinum 9200 Processors against 2nd Gen Intel® Xeon® Scalable Processors

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2S Intel[®] Xeon[®] Platinum 9200 Processor



- Intel® Xeon® Platinum 9200 Processors consist of two die in a BGA package
- Multi-chip processor with single hop latency for any of the CPU die to memory in a 2S node
- Key IO/mem features include:
 - 12 ch DDR4 2933 MT/s per CPU
 - 4 UPI x20 wide at 10.4GTs per CPU
 - x80 PCIe G3 lanes per 2S Node in Intel® Server Systems S9200WK*

* Intel® Server Systems S9200WK supports 2 x16 Gen3 slots (per 1U node); 4 x16 Gen3 slots (per 2U node)



Intel[®] Xeon[®] Platinum 9200 Processor: SKU Options

| SKU | Cores | Threads | L3 cache (MB) | Base Frequenc y (GHz) | Max Turbo Frequenc y (GHz) | DDR4 (MHz) | Max CPU sockets supported | Max memory per socket (TB) | Max Memory Bandwidth per 2S node (GB/s) | UPI links | TDP (W) |
|------|-------|---------|---------------------|-----------------------------|-------------------------------------|---------------|---------------------------------|--|--|--------------|---------|
| 9221 | 32 | 64 | 71.5 | 2.1 | 3.7 | 2933 | 2 | 1.5 | 562 | 4 | 250 |
| 9222 | 32 | 64 | 71.5 | 2.3 | 3.7 | 2933 | 2 | 1.5 | 562 | 4 | 250 |
| 9242 | 48 | 96 | 71.5 | 2.3 | 3.8 | 2933 | 2 | 1.5 | 562 | 4 | 350 |
| 9282 | 56 | 112 | 77 | 2.6 | 3.8 | 2933 | 2 | 1.5 | 562 | 4 | 400 |



Intel[®] S9200WK Product Family Compute Module

| Compute Module Technical Specifications | | | | | | | |
|---|--|--|---|--|--|--|--|
| | 1 | 2 | 3 | | | | |
| Compute Module | 1U ½ width Liquid-Cooled Compute Sled | 2U ½ width Liquid- Cooled Service Sled | 2U ½ width Air- Cooled Compute/Service Sled | | | | |
| Processor | Intel® Xeon® Platinum 9200 Processors | | | | | | |
| Hot-swap Storage | None | 2x U.2 2.5" SSDs | 2x U.2 2.5" SSDs | | | | |
| NVMe Storage | 2 M.2 per node | 2 M.2 & 2 U.2 per node | 2 M.2 & 2 U.2 per node | | | | |
| Chassis (2U Configuration) | 2U/4 liquid-cooled nodes | 2U/2 liquid-cooled nodes | 2U/2 air-cooled nodes | | | | |
| PCle* Gen 3 | Two low profile PCIe cards through riser slot 1&2 riser cards | Four low profile PCIe cards through riser slot 1&2 riser cards | Four low profile PCIe cards through riser slot 1&2 riser cards | | | | |
| M.2 support | 2x M.2 80/110 mm per node | | | | | | |
| Video | eo One display port on front panel per Compute Module | | | | | | |
| Cooling | Direct-to-chip Liqui | High-velocity Air- Cooling | | | | | |



Single node gen-to-gen study on Intel[®] Xeon[®] CPU

Selected applications: WRF, MPAS-A, HOMME, NEMO

Selected suite of NWP and ESM workloads for performance study





Best performance on IA with Intel[®] tools



□ Example from NCAR: Intel® compiler outperforms GNU compiler by 30% on WRF CONUS-12km workload on **NWSC Cheyenne** supercomputer powered by Intel[®] Xeon[®] E5-2697v4 CPU

Fig. 1: Comparison of Intel 18.0.1 and Gnu 8.1.0 compilers with various

Runs made using CONUS 12 km Benchmark Case on 2 Nodes

Source: https://www2.cisl.ucar.edu/sites/default/files/Akira Kyle Presentation.pdf

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Evaluated Systems

- S Intel[®] Xeon[®] E5-2697v3 ("Haswell"): Intel Reference Platform, 2x Intel[®] Xeon[®] E5-2697 v3 processor (2.6GHz, 14C), 8x16GB DDR4-2133, HT on (1 thread/core), Turbo on, BIOS: SE5C610.86B.01.01.0028.121720182203, Microcode: 0x3e, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86_64
- 2S Intel[®] Xeon[®] E5-2697v4 ("Broadwell"): Intel Reference Platform, 2x Intel[®] Xeon[®] E5-2697 v4 processor (2.3GHz, 18C), 8x16GB DDR4-2400, HT on (1 thread/core), Turbo on, BIOS: SE5C610.86B.01.01.0028.121720182203, Microcode: 0xb000030, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86_64
- SIntel® Xeon® Gold 6148 ("Skylake"): Intel Reference Platform, 2x Intel® Xeon® Gold 6148 processor (2.4GHz, 20 cores per socket), 12*16GB DDR4-2666, HT on (1 thread/core), Turbo on, BIOS: SE5C620.86B.00.01.0016.020120190930, Microcode ver 0x2000050, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86_64
- 2S Intel[®] Xeon[®] Platinum 8260 ("Cascade Lake SP"): Intel Reference Platform, 2x Intel[®] Xeon[®] 8260 Intel processors (2.4GHz, 24C), 12x16GB DDR4-2933, BIOS: SE5C620.86B.02.01.0008.031920191559, Microcode: 0x400001c, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86_64
- 2S Intel[®] Xeon[®] Platinum 9242 ("Cascade Lake AP"): Intel Reference Platform, 2x Intel[®] Xeon[®] 9242 processors (2.2GHz, 48C), 24x16GB DDR4-2933, BIOS: SE5C620.86B.0D.01.0456.033120191654, Microcode: 0x4000021, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86_64



WRF: CONUS-12km



https://www.mmm.ucar.edu/weather-research-andforecasting-model



WRF (Weather Research and Forecasting) model is a mesoscale numerical weather prediction system designed for both atmospheric research and operational forecasting needs. It features two dynamical cores, a data assimilation system, and a software architecture facilitating parallel computation and system extensibility. The model serves a wide range of meteorological applications across scales from tens of meters to thousands of kilometers.

Application: WRF v3.9.1.1 Workload: CONUS-12km. 3 hour weather forecast over continental United States with a horizontal mesh resolution of 12km and 35 vertical layers.

Dataset: http://www2.mmm.ucar.edu/wrf/bench/benchdata_v3911.html



Value Proposition:

Intel® Xeon® Scalable Processor 9242 improved performance by up to 3.6x compared to the Intel® Xeon® Processor E5-2697v3

Performance results are based on testing as of April 29, 2019 and may not reflect all publicly available security updates. See configuration disclosure for details. No product 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 you contemplated purchases, including the performance to that product, when combined with other products. Intel does not control or audit the design or implementation of this protomers to visit the referenced. Web sites referenced will be control and the encourages all of its customers to visit the referenced. Web sites referenced will be the product as the accurate the performance benchmark data are accurate to the product of the protomers to visit the referenced. Web sites referenced will be the product and benchmark data are accurate to the product of the protomation of the product of the performance will be the product and benchmark data are accurate. ther names and brands may be claimed as the property of ems available for purchase.



WRF: CONUS-2.5km



https://www.mmm.ucar.edu/weather-research-andforecasting-model



WRF (Weather Research and Forecasting) model is a mesoscale numerical weather prediction system designed for both atmospheric research and operational forecasting needs. It features two dynamical cores, a data assimilation system, and a software architecture facilitating parallel computation and system extensibility. The model serves a wide range of meteorological applications across scales from tens of meters to thousands of kilometers.

Application: WRF v3.9.1.1 Workload: CONUS-2.5km. 3 hour

weather forecast over continental United States with a horizontal mesh resolution of 2.5km and 35 vertical layers.

Dataset: http://www2.mmm.ucar.edu/wrf/bench/benchdata v3911.html



Value Proposition:

Intel® Xeon® Scalable Processor 9242 improved performance by up to 4x compared to the Intel® Xeon® Processor E5-2697v3

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MPAS-A



https://mpas-dev.github.io

MPAS-A (The Model for Prediction Across Scales – Atmosphere) is a non-hydrostatic atmosphere model that is part of a family of Earthsystem component models collectively known as MPAS. All MPAS models have in common their use of centroidal Voronoi tessellations for their horizontal meshes, which has motivated the development of a common software framework that provides a high-level driver program and infrastructure for providing parallel execution, input and output, and other software infrastructure. The component models and framework that comprise MPAS are being developed collaboratively between Los Alamos National Laboratory (LANL) and the National Center for Atmospheric Research (NCAR).

Application: MPAS-A v6.1 Workload: 120km L56. 16 days global forecast with a horizontal mesh resolution of 120km and 56 vertical lavers. Dataset:

http://www2.mmm.ucar.edu/projects/mpas/benchmark/v6.x/



Value Proposition:

Intel® Xeon® Scalable Processor 9242 improved performance by up to 4.07x compared to the Intel® Xeon® Processor E5-2697v3

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NEMO





http://www.nemo-ocean.eu

NEMO (Nucleus for European Modelling of the Ocean) is an ocean modelling framework which is contains numerical solutions of ocean, sea-ice, tracers and biochemistry equations and their related physics. It also provides pre- and post-processing tools and the interface to the other components of the Earth System. NEMO allows several ocean related components of the Earth System to work together or separately. It also allows a two-way nesting via the AGRIF software. It is interfaced with the remaining component of the Earth System (atmosphere, land surfaces, ...) via the OASIS coupler." NEMO is used for oceanographic research, operational oceanography seasonal forecast and climate studies, and it is used by various universities and meteorological services. Application: NEMO v4.0. Workload: ORCA2 ICE PISCES





Value Proposition:

Intel® Xeon® Scalable Processor 9242 improved performance by up to 4.4x compared to the Intel® Xeon® Processor E5-2697v3

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HOMME



https://github.com/homme-dycore



HOMME (The High-Order Method Modeling Environment) is the spectral element dynamical core of community climate atmospheric model (CAM), part of the NCAR Community Earth System Model (CESM-2) as well as the related DOE E3SM model. CESM is a widely-used Earth system model and an important source of simulations used by the Intergovernmental Panel on Climate Change.

Workload: WACCM. The WACCM is baroclinic instability simulation in a "whole atmosphere" (extending to lower thermosphere) configuration.

Value Proposition:

- Intel® Xeon® Scalable Processor 9242 improved performance by up to 3.87x compared to the Intel® Xeon® Processor E5-2697v3
- Faster execution allows researchers to run longer simulations and more ensemble members, enabling study of more climate change scenarios and greater confidence in predictions.
- Ability to push many atmospheric tracers in reasonable time allows detailed representation of high-altitude chemical processes such as stratospheric ozone loss.

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SUMMARY: Single Node Performance

Intel[®] Xeon[®] Generational Performance (Single Node)



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Performance comparison of multiple SKUs of Intel[®] Xeon[®] Platinum 9200 Processor



9222 SKU (250W) can be an optimal solution for memory intensive workloads when both performance and power consumption are critical for customer.

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AMD WRF Performance Claim (1 of 2)

April 4, 2019, The Next Platform, AMD Sponsored Content



https://www.nextplatform.com/2019/04/04/back-to-the-hpc-future-with-next-generation-amd-epyc-processors/

Claim: 2S AMD EPYC 7601 outperforms 2S Xeon 8180 by 1.44x on WRF CONUS-12km workload

Response:

AMD utilizes GNU to compile WRF as it creates that biggest gap between Intel and AMD. Not realistic for HPC customers that want extract the most performance out of Xeon platforms

- Intel analysis and <u>other industry analysis</u> show that performance degradation could be up to 50% when using GNU Fortran vs Intel Fortran compiler on Intel Xeon platforms.
- When utilizing Intel compiler on Xeon platforms, Xeon 8180 Intel leads EPYC 7601 by 31%
- 2S Cascade Lake-AP 56C 9282 can deliver up to 154% higher performance vs AMD EPYC 7601 (Refer to next slide).

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AMD WRF Performance Claim (2 of 2)

April 4, 2019, The Next Platform, AMD Sponsored Content

WRF v3.9.1.1 CONUS-12km Single Node Performance



Source of AMD performance data: <u>https://www.amd.com/system/files/documents/wrf-and-amd-epyc-the-right-combination-for-weather-modeling.pdf</u>

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(intel)

Summary

- Intel® Xeon® Platinum 9200 Processor delivers leadership performance for NWP and Climate workloads. Performance evaluation of end-to-end community workloads (WRF, MPAS, NEMO, HOMME) showed up to 4.8x performance improvement for Intel® Xeon® Platinum 9200 Processor compared to previous generations of Intel® Xeon® processor.
- 2. For WRF CONUS-12km workload comparison with publicly available AMD data showed **up to 154%** higher performance of 2S Intel® Xeon® Platinum 9200 Processor compared to 2S AMD EPYC 7601.
- 3. Availability of multiple 9200 SKUs provides flexibility in decision process where customers can choose a SKU optimized for performance or performance/power.
- 4. To get the best performance on Intel® Xeon® architecture it is critical to use Intel Software Tools.

Optimization Notice: 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, 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. Notice Revision #2011080. For more complete information about performance and benchmark results, visit 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 www.intel.com/benchmarks. Configuration: Refer to Detailed Workload Configuration Slides. Performance results are based on testing as of January 30, 2019 to April 30, 2019 and may not reflect all publicly available security updates. See configuration disclosures for details. No product can be absolutely secure. *Other names and brands may be claimed as property of others, presentation

Configuration details (1/6)

WRF CONUS-12km (higher is better): 25 Intel® Xeon® E5-2697 v3 Processor: 1-node Intel reference platform. 2x Intel® Xeon® E5-2697 v3 processor (2.6GHz, 14C), 8x16GB DDR4-2133. HT on (1 thread/core). Turbo on, 1 SSD SATA, BIOS: SE5C610.86B.01.01.0028.121720182203, Microcode: 0x3e, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes. Kernel: 3.10.0-957.5.1.el7.crt1 x86 64. WRF version 3.9.1.1. Workload: CONUS-12km. compiled with AVX512. Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3. Relative performance=1.00. tested by Intel on 04/29/2019. 2S Intel® Xeon® E5-2697 v4 Processor: 1-node Intel reference platform, 2x Intel® Xeon® E5-2697 v4 processor (2.3GHz, 18C), 8x16GB DDR4-2400, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C610.86B.01.01.0028.121720182203, Microcode: 0xb000030, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86 64. Workload: CONUS-12km, compiled with AVX512. Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3, Relative performance=1.16, tested by Intel on 04/29/2019. 2S Intel® Xeon® Gold 6148 processor: 1-node Intel reference platform, 2x Intel® Xeon® Gold 6148 processor (2.4GHz, 20 cores per socket). 12*16GB DDR4-2666, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C620.86B.00.01.0016.020120190930, Microcode ver 0x2000050, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes. Kernel: 3.10.0-957.5.1.el7.crt1.x86 64. Workload: CONUS-12km. compiled with AVX512. Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3, Relative performance=1.68, tested by Intel on 04/29/2019. 2S Intel® Xeon® Platinum 8180 processor: 1-node Intel reference platform, 2x Intel® Xeon® Platinum 8180 processor (2.5GHz, 28 cores per socket). 12*16GB DDR4-2666, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C620.86B.00.01.0016.020120190930, Microcode ver 0x2000050, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86 64. Workload: CONUS-12km, compiled with AVX512. Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3, Relative performance=1.91, tested by Intel on 04/29/2019. 2S Intel® Xeon® Platinum 8260 Processor: 1-node Intel reference platform, 2x Intel® Xeon® 8260 Intel processors (2.4GHz, 24C), 12x16GB DDR4-2933, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C620.86B.02.01.0008.031920191559. Microcode: 0x400001c, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86_64. Workload: CONUS-12km, compiled with AVX512, Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3, Relative performance=1.88, tested by Intel on 04/29/2019. Intel® Xeon® Platinum 9222 Processor: 1node Intel reference platform, 2x Intel® Xeon® 9222 processors (2.2GHz, 32C), 24x16GB DDR4-2933, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C620.86B.0D.01.0456.033120191654, Microcode: 0x4000021, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86 64. Workload: CONUS-12km, compiled with AVX512, Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3. Relative performance=3.07, tested by Intel on 04/29/2019. 25 Intel® Xeon® Platinum 9242 Processor; 1-node Intel reference platform, 2x Intel® Xeon® 9242 processors (2,2GHz, 48C). 24x16GB DDR4-2933. HT on (1 thread/core). Turbo on. 1 SSD SATA. BIOS: SE5C620.86B.0D.01.0456.033120191654. Microcode: 0x4000021. Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes. Kernel: 3.10.0-957.5.1.el7.crt1.x86 64. Workload: CONUS-12km, compiled with AVX512, Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3, Relative performance=3.62, tested by Intel on 04/29/2019. Intel® Xeon® Platinum 9282 Processor: 1-node Intel reference platform, 2x Intel® Xeon® 9282 processors (2.6GHz, 56C), 24x16GB DDR4-2933, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C620.86B.0D.01.0456.033120191654, Microcode: 0x4000021, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1 x86 64. Workload: CONUS-12km. compiled with AVX512. Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3. Relative performance=3.68. tested by Intel on 04/29/2019.



Configuration details (2/6)

WRF CONUS-2.5km (higher is better): 2S Intel® Xeon® E5-2697 v3 Processor: 1-node Intel reference platform, 2x Intel® Xeon® E5-2697 v3 processor (2.6GHz, 14C), 8x16GB DDR4-2133, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C610.86B.01.01.0028.121720182203, Microcode: 0x3e, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86 64. WRF version 3.9.1.1, Workload: CONUS-2.5km, compiled with AVX512, Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3, Relative performance=1.00, tested by Intel on 04/30/2019. 2S Intel® Xeon® E5-2697 v4 Processor: 1-node Intel reference platform. 2x Intel® Xeon® E5-2697 v4 processor (2.3GHz, 18C), 8x16GB DDR4-2400, HT on (1 thread/core). Turbo on, 1 SSD SATA, BIOS: SE5C610.86B.01.01.0028.121720182203, Microcode: 0xb000030, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86_64. Workload: CONUS-2.5km, compiled with AVX512, Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3, Relative performance=1.25, tested by Intel on 04/30/2019. 2S Intel® Xeon® Gold 6148 processor: 1-node Intel reference platform, 2x Intel® Xeon® Gold 6148 processor (2.4GHz, 20 cores per socket), 12*16GB DDR4-2666, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C620.86B.00.01.0016.020120190930, Microcode ver 0x2000050, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86 64. Workload: CONUS-2.5km, compiled with AVX512, Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3. Relative performance=1.78. tested by Intel on 04/30/2019. 2S Intel® Xeon® Platinum 8260 Processor: 1-node Intel reference platform. 2x Intel® Xeon® 8260 Intel processors (2.4GHz, 24C), 12x16GB DDR4-2933, HT on (1 thread/core). Turbo on, 1 SSD SATA, BIOS; SE5C620.86B.02.01.0008.031920191559, Microcode: 0x400001c, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86 64. Workload: CONUS-2.5km, compiled with AVX512, Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3, Relative performance=2.04, tested by Intel on 04/30/2019. . Intel® Xeon® Platinum 9222 Processor: 1-node Intel reference platform, 2x Intel® Xeon® 9222 processors (2.2GHz, 32C), 24x16GB DDR4-2933, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C620.86B.0D.01.0456.033120191654, Microcode: 0x4000021, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86 64. Workload: CONUS-2.5km. compiled with AVX512. Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3. Relative performance=3.71. tested by Intel on 04/29/2019. 2S Intel® Xeon® Platinum 9242 Processor: 1-node Intel reference platform. 2x Intel® Xeon® 9242 processors (2.2GHz, 48C), 24x16GB DDR4-2933. HT on (1 thread/core). Turbo on, 1 SSD SATA. BIOS: SE5C620.86B.0D.01.0456.033120191654, Microcode: 0x4000021, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86 64. Workload: CONUS-2.5km, compiled with AVX512, Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3, Relative performance=4.00, tested by Intel on 04/30/2019. Intel® Xeon® Platinum 9282 Processor: 1-node Intel reference platform, 2x Intel® Xeon® 9282 processors (2.6GHz, 56C), 24x16GB DDR4-2933, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C620.86B.0D.01.0456.033120191654, Microcode: 0x4000021, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86_64. Workload: CONUS-2.5km, compiled with AVX512, Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3. Relative performance=4.37. tested by Intel on 04/29/2019.



Configuration details (3/6)

MPAS-A (higher is better): 2S Intel® Xeon® E5-2697 v3 Processor: 1-node Intel reference platform, 2x Intel® Xeon® E5-2697 v3 processor (2.6GHz, 14C), 8x16GB DDR4-2133, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C610.86B.01.01.0028.121720182203, Microcode: 0x3e, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86_64. WRF version 3.9.1.1. Workload: 120km L56. compiled with AVX512. Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3. Relative performance=1.00. tested by Intel on 04/26/2019. 2S Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3. Relative performance=1.00. tested by Intel on 04/26/2019. 2S Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3. Relative performance=1.00. tested by Intel on 04/26/2019. 2S Intel® Parallel Studio XE 2018 Update 3. Relative performance=1.00. tested by Intel on 04/26/2019. 2S Intel® Parallel Studio XE 2018 Update 3. Relative performance=1.00. tested by Intel on 04/26/2019. 2S Intel® Parallel Studio XE 2018 Update 3. Relative performance=1.00. tested by Intel on 04/26/2019. 2S Intel® Parallel Studio XE 2018 Update 3. Relative performance=1.00. tested by Intel® Parallel Studio XE 2018 Update 3. Relative performance=1.00. tested by Intel® Parallel Studio XE 2018 Update 3. Relative performance=1.00. tested by Intel® XE 2018 Update 3. Relative performance=1.00. tested by Intel® XE 2018 Update 3. Relative performance=1.00. tested by Intel® XE 2018 Update 3. Relative performance=1.00. tested by Intel® XE 2018 Update 3. Relative performance=1.00. tested by Intel® XE 2018 Update 3. Relative performance=1.00. tested by Intel® XE 2018 Update 3. Relative performance=1.00. tested by Intel® XE 2018 Update 3. Relative performance=1.00. tested by Intel® XE 2018 Update 3. Relative performance=1.00. tested by Intel® XE 2018 Update 3. Relative performance=1.00. tested by Intel® XE 2018 Update 3. Relative performance=1.00. tested by Intel® XE 2018 Update 3. Relative performance=1.00. tested by Intel® XE 2018 Update 3. Relative performance=1.00. tested by Intel® XE 2018 Update 3. Relative performance=1.00. tested by Intel® XE 2018 Processor: 1-node Intel reference platform, 2x Intel® Xeon® E5-2697 v4 processor (2.3GHz, 18C), 8x16GB DDR4-2400, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C610.86B.01.01.0028.121720182203, Microcode: 0xb000030, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86 64. Workload: 120km L56, compiled with AVX512, Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3, Relative performance=1.24, tested by Intel on 04/26/2019. 2S Intel® Xeon® Gold 6148 processor: 1-node Intel reference platform, 2x Intel® Xeon® Gold 6148 processor (2.4GHz, 20 cores per socket), 12*16GB DDR4-2666, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C620.86B.00.01.0016.020120190930, Microcode ver 0x2000050, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86_64. Workload: 120km_L56, compiled with AVX512, Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3. Relative performance=1.67. tested by Intel on 04/26/2019. 25 Intel® Xeon® Platinum 8260 Processor: 1-node Intel reference platform. 2x Intel® Xeon® 8260 Intel processors (2.4GHz, 24C). 12x16GB DDR4-2933. HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C620.86B.02.01.0008.031920191559, Microcode: 0x400001c, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes. Kernel: 3.10.0-957.5.1.el7.crt1.x86 64. Workload: 120km L56, compiled with AVX512, Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3, Relative performance=1.95, tested by Intel on 04/26/2019. Intel® Xeon® Platinum 9222 Processor: 1-node Intel reference platform, 2x Intel® Xeon® 9222 processors (2.2GHz, 32C), 24x16GB DDR4-2933, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C620.86B.0D.01.0456.033120191654. Microcode: 0x4000021. Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes. Kernel: 3.10.0-957.5.1.el7.crt1 x86 64. Workload: 120km L56. compiled with AVX512. Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3. Relative performance=3.26. tested by Intel on 04/29/2019. 2S Intel® Xeon® Platinum 9242 Processor: 1-node Intel reference platform, 2x Intel® Xeon® 9242 processors (2.2GHz, 48C), 24x16GB DDR4-2933, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C620.86B.0D.01.0456.033120191654, Microcode: 0x4000021, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.eI7.crt1.x86 64. Workload: 120km L56, compiled with AVX512, Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3, Relative performance=4.07, tested by Intel on 04/26/2019. Intel® Xeon® Platinum 9282 Processor: 1-node Intel reference platform, 2x Intel® Xeon® 9282 processors (2.6GHz, 56C), 24x16GB DDR4-2933. HT on (1 thread/core). Turbo on. 1 SSD SATA. BIOS: SE5C620.86B.0D.01.0456.033120191654. Microcode: 0x4000021. Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3,10.0-957.5,1,el7,crt1.x86 64, Workload: 120km L56, compiled with AVX512, Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3, Relative performance=4.87, tested by Intel on 04/29/2019.

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Configuration details (4/6)

HOMME (higher is better): 2S Intel® Xeon® E5-2697 v3 Processor: 1-node Intel reference platform, 2x Intel® Xeon® E5-2697 v3 processor (2.6GHz, 14C), 8x16GB DDR4-2133, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C610.86B.01.01.0028.121720182203, Microcode: 0x3e, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86 64. HOMME version dungeon28ps://github.com/homme-dycore, WACCM benchmark, Intel Parallel Studio XE 2018 Update 3, Intel MPI 2018u3, Relative performance=1.00, tested by Intel on 04/29/2019. 2S Intel® Xeon® E5-2697 v4 Processor: 1-node Intel reference platform, 2x Intel® Xeon® E5-2697 v4 processor (2.3GHz, 18C), 8x16GB DDR4-2400, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C610.86B.01.01.0028.121720182203, Microcode: 0xb000030, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86_64. HOMME version dungeon28ps://github.com/hommedycore, WACCM benchmark, Intel Parallel Studio XE 2018 Update 3, Intel MPI 2018u3, Relative performance=1.12, tested by Intel on 04/29/2019. 2S Intel® Xeon® Gold 6148 processor: 1-node Intel reference platform, 2x Intel® Xeon® Gold 6148 processor (2.4GHz, 20 cores per socket), 12*16GB DDR4-2666, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C620.86B.00.01.0016.020120190930, Microcode ver 0x2000050, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86_64. HOMME version dungeon28ps://github.com/homme-dycore, WACCM benchmark, Intel Parallel Studio XE 2018 Update 3, Intel MPI 2018u3, Relative performance=1.66, tested by Intel on 04/29/2019. 2S Intel® Xeon® Platinum 8260 Processor: 1-node Intel reference platform, 2x Intel® Xeon® 8260 Intel processors (2.4GHz, 24C), 12x16GB DDR4-2933, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS; SE5C620.86B.02.01.0008.031920191559, Microcode: 0x400001c, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86 64. HOMME version dungeon28ps://github.com/homme-dycore, WACCM benchmark, Intel Parallel Studio XE 2018 Update 3, Intel MPI 2018u3, Relative performance=1.94, tested by Intel on 04/29/2019. Intel® Xeon® Platinum 9222 Processor: 1-node Intel reference platform, 2x Intel® Xeon® 9222 processors (2.2GHz, 32C), 24x16GB DDR4-2933, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C620.86B.0D.01.0456.033120191654, Microcode: 0x4000021, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86_64. HOMME version dungeon28ps://github.com/homme-dycore, WACCM benchmark, Intel Parallel Studio XE 2018 Update 3, Intel MPI 2018u3, Relative performance=3.66, tested by Intel on 04/29/2019. 2S Intel® Xeon® Platinum 9242 Processor: 1-node Intel reference platform, 2x Intel® Xeon® 9242 processors (2.2GHz, 48C), 24x16GB DDR4-2933. HT on (1 thread/core). Turbo on, 1 SSD SATA. BIOS: SE5C620.86B.0D.01.0456.033120191654, Microcode: 0x4000021, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86 64. HOMME version dungeon28ps://github.com/homme-dycore, WACCM benchmark, Intel Parallel Studio XE 2018 Update 3, Intel MPI 2018u3, Relative performance=3.87, tested by Intel on 04/29/2019. . Intel® Xeon® Platinum 9282 Processor: 1-node Intel reference platform, 2x Intel® Xeon® 9282 processors (2.6GHz, 56C), 24x16GB DDR4-2933, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C620.86B.0D.01.0456.033120191654, Microcode: 0x4000021. Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes. Kernel: 3.10.0-957.5.1.el7.crt1.x86 64. HOMME version dungeon28ps://github.com/homme-dvcore. WACCM benchmark. Intel Parallel Studio XE 2018 Update 3. Intel MPI 2018u3. Relative performance=4.15. tested by Intel on 04/29/2019.



Configuration details (5/6)

NEMO (higher is better): 2S Intel® Xeon® E5-2697 v3 Processor: 1-node Intel reference platform, 2x Intel® Xeon® E5-2697 v3 processor (2.6GHz, 14C), 8x16GB DDR4-2133, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C610.86B.01.01.0028.121720182203, Microcode: 0x3e, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86_64. WRF version 3.9.1.1, Workload: ORCA2_ICE_PISCES, compiled with AVX512, Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3, Relative performance=1.00, tested by Intel on 04/25/2019. 2S Intel® Xeon® E5-2697 v4 Processor: 1-node Intel reference platform, 2x Intel® Xeon® E5-2697 v4 processor (2.3GHz, 18C), 8x16GB DDR4-2400, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C610.86B.01.01.0028.121720182203, Microcode: 0xb000030, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86_64. Workload: ORCA2_ICE_PISCES, compiled with AVX512, Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3, Relative performance=1.23, tested by Intel on 04/25/2019. 2S Intel® Xeon® Gold 6148 processor: 1-node Intel reference platform, 2x Intel® Xeon® Gold 6148 processor (2.4GHz, 20 cores per socket), 12*16GB DDR4-2666, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C620.86B.00.01.0016.020120190930, Microcode ver 0x2000050, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86_64. Workload: ORCA2_ICE_PISCES, compiled with AVX512, Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3, Relative performance=1.74, tested by Intel on 04/25/2019. 2S Intel® Xeon® Platinum 8260 Processor: 1-node Intel reference platform, 2x Intel® Xeon® 8260 Intel processors (2.4GHz, 24C), 12x16GB DDR4-2933, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C620.86B.00.01.0098.03120191559, Microcode: 0x400001c, O



Configuration details (6/6)

STREAM Triad (higher is better): 2S Intel® Xeon® E5-2697 v3 Processor: 1-node Intel reference platform, 2x Intel® Xeon® E5-2697 v3 processor (2.6GHz, 14C), 8x16GB DDR4-2133, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C610.86B.01.01.0028.121720182203, Microcode: 0x3e, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.e17.ct11.x86_64. Benchmark software: STREAM, Compiler: Intel® Compiler IC19, Optimized libraries: AVX512, Relative performance=1.00, tested by Intel on 02/06/2019. 2S Intel® Xeon® E5-2697 v4 Processor: 1-node Intel reference platform, 2x Intel® Xeon® E5-2697 v4 Processor (2.3GHz, 18C), 8x16GB DDR4-2400, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C610.86B.01.01.0028.121720182203, Microcode: 0xb00030, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.e17.ct1.x86_64. Benchmark software: STREAM, Compiler: Intel® Compiler IC19, Optimized libraries: AVX512, Relative performance=1.14, tested by Intel on 02/06/2019. 2S Intel® Xeon® Gold 6148 processor: 1-node Intel reference platform, 2x Intel® Xeon® Gold 6148 processor (2.4GHz, 20 cores per socket), 12*16GB DDR4-2666, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C620.86B.00.01.0016.020120190930, Microcode ver 0x2000050, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.e17.ct1.x86_64. Benchmark software: STREAM, Compiler: Intel® Compiler IC19, Optimized libraries: AVX512, Relative performance=1.71, tested by Intel on 02/06/2019. 2S Intel® Xeon® Platinum 8260 Processor: 1-node Intel reference platform, 2x Intel® Xeon® 8260 Intel processors (2.4GHz, 24C), 12x16GB DDR4-2933, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C620.86B.02.01.0008.031920191559, Microcode: 0x400001c, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixe

HPL (higher is better): 2S Intel® Xeon® E5-2697 v3 Processor: 1-node Intel reference platform, 2x Intel® Xeon® E5-2697 v3 processor (2.6GHz, 14C), 8x16GB DDR4-2133, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C610.86B.01.01.0028.121720182203, Microcode: 0x3e, Oracle Linux, Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86_64. High Performance Linpack v2.1, compiled with Intel(R) Parallel Studio XE 2019 for Linux, Intel MPI and MKL Version 19.0.1.144, Relative performance=1.00, tested by Intel on 01/30/2019. 2S Intel® Xeon® E5-2697 v4 Processor: 1-node Intel reference platform, 2x Intel® Xeon® E5-2697 v4 Processor: 1.000030, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86_64. High Performance Linpack v2.1, compiled with Intel(R) Parallel Studio XE 2019 for Linux, Intel MPI and MKL Version 19.0.1.144, Relative performance=1.25, tested by Intel on 01/30/2019. 2S Intel® Xeon® Gold 6148 processor: 1-node Intel reference platform, 2x Intel® Xeon® Gold 6148 processor: 1-node Intel reference platform, 2x Intel® Xeon® Gold 6148 processor: 1-node Intel reference platform, 2x Intel® Xeon® Gold 6148 processor: 1.1x86_64. High Performance=2.37, tested by Intel on 02/06/2019. 2S Intel® Xeon® Gold 6148 processor: 1-node Intel reference platform, 2x Intel® Xeon® B260 Intel processors (2.4GHz, 24C), 12x16GB DDR4-2933, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C620.86B.00.01.0016.020120190930, Microcode ve 0x2000050, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86_64. High Performance=2.37, tested by Intel on 02/06/2019. 2S Intel® Xeon® Platinum 8260 Processor: 1-node Intel reference platform, 2x Intel® Xeon® 8260 Intel processors (2.4GHz, 24C), 12x16GB DDR4-2933, HT on (1 thread/core), Turbo on, 1 SSD SATA, BIOS: SE5C620.86B.02.01.0008

