Intel® Xeon® Platinum 9200 Processor. Performance evaluation of Numerical Weather Prediction and Climate Models

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NWP and ESM HPC centers in Top500

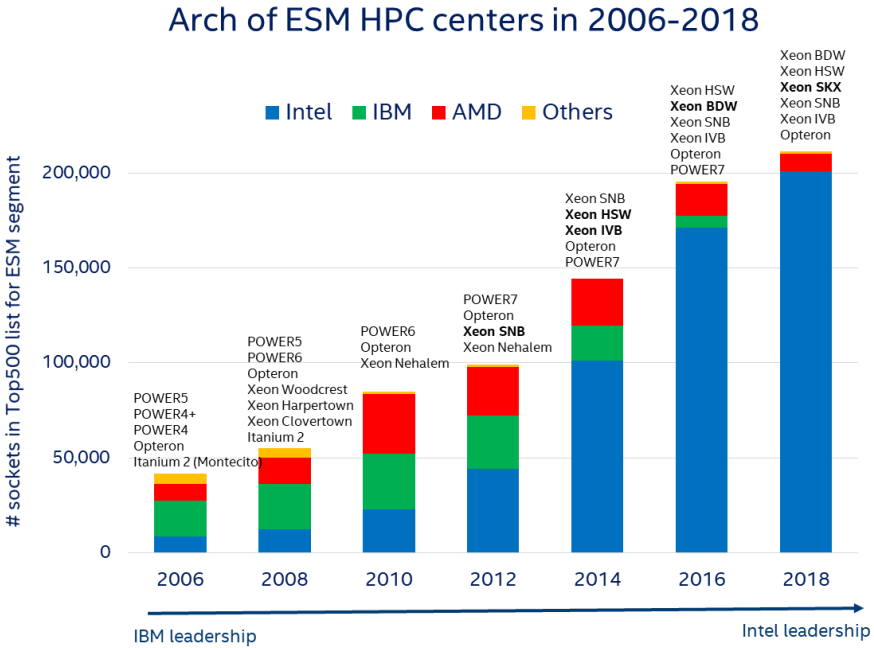
From TOP500 List - June 2018

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 and research weather prediction, environmental and climate science. It includes NWSC Cheyenne system.
- + 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



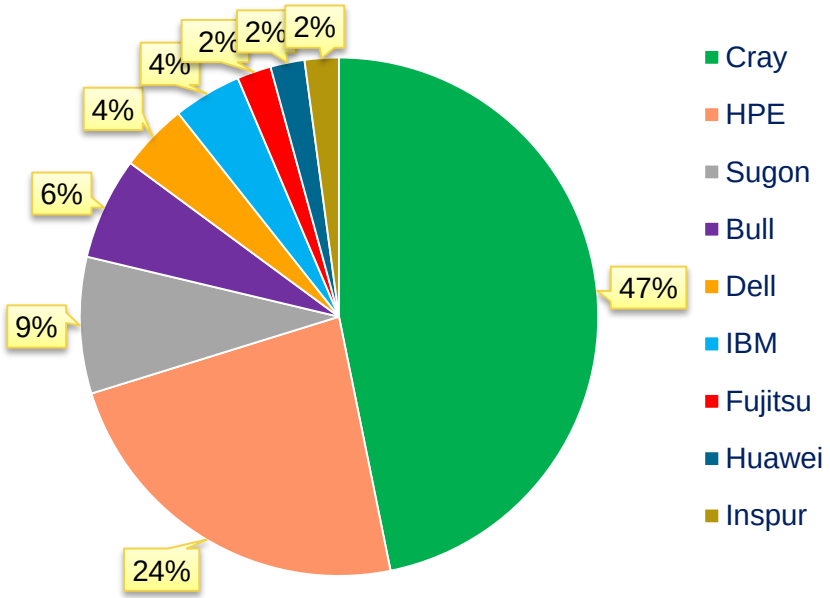
Data represents an architecture view of supercomputing centers from Top500 which are 100% dedicated to weather/climate.

Data source: www.top500.org

NWP and ESM HPC centers in Top500

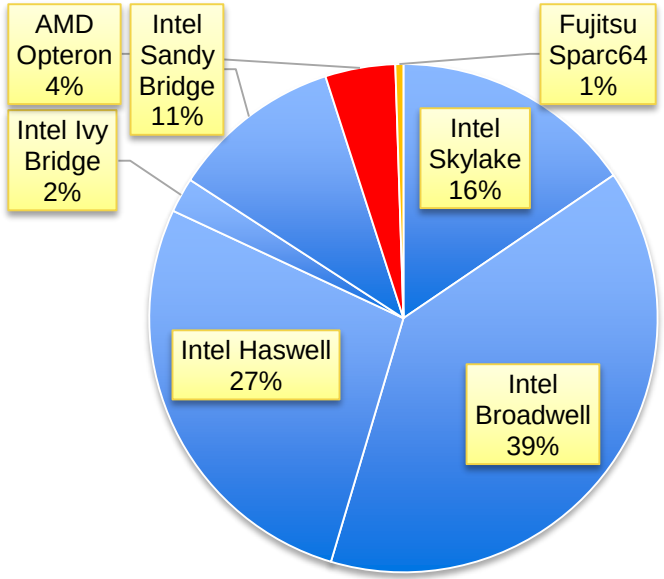
Data source: www.top500.org

Distribution by OEM



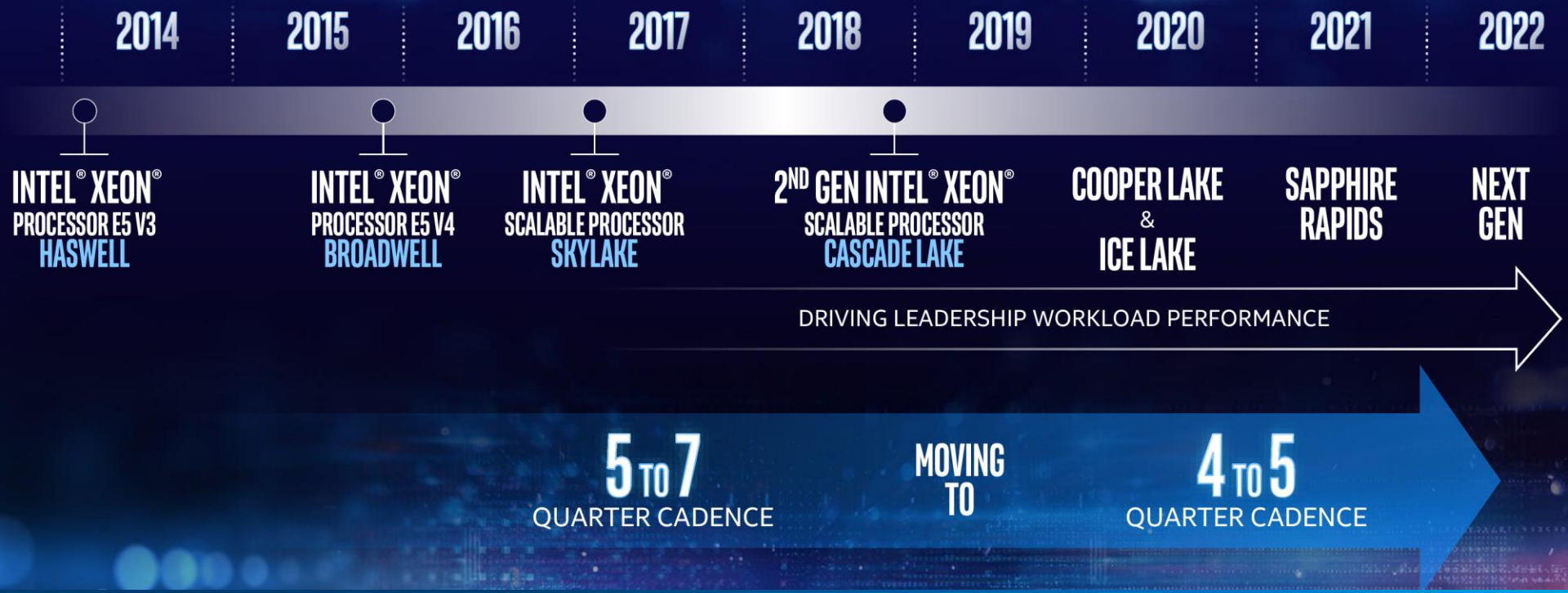
- **Cray** covers almost a half of NWP/ESM HPC in Top500

Distribution by arch



- **95%** of NWP/ESM HPC runs on Intel architecture

INCREASING THE PACE OF INNOVATION



INTRODUCING SECOND GENERATION
INTEL® XEON® SCALABLE PROCESSORS

INTEL® XEON® PLATINUM 9200 PROCESSORS

A NEW CLASS OF ADVANCED PERFORMANCE

INTEL® XEON® PLATINUM 8200 PROCESSORS

INTEL® XEON® GOLD 6200 PROCESSORS

INTEL® XEON® GOLD 5200 PROCESSORS

INTEL® XEON® SILVER 4200 PROCESSORS

INTEL® XEON® BRONZE 3200 PROCESSORS

BUILT-IN VALUE | **UNINTERRUPTED** LEADERSHIP WORKLOAD **PERFORMANCE** | **GROUNDBREAKING** MEMORY INNOVATION | **EMBEDDED** ARTIFICIAL INTELLIGENCE **ACCELERATION** | **HARDWARE ENHANCED** **SECURITY** | **ENHANCED** AGILITY & UTILIZATION

Introducing Intel® Xeon® Platinum 9200 Processor

Leadership CPU performance per socket[1]

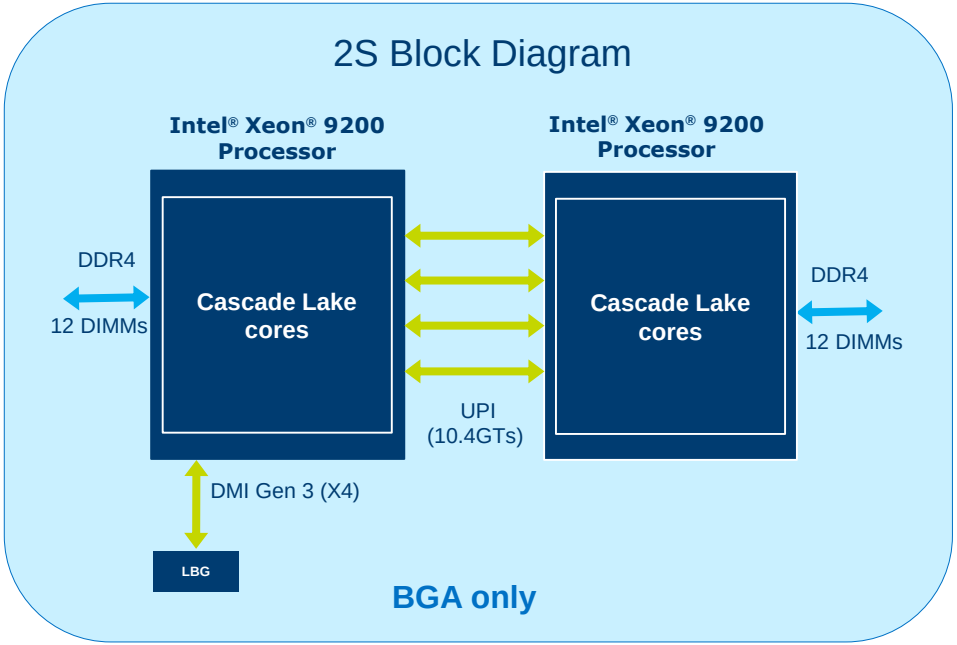
Double memory bandwidth for memory intensive workloads[2]

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

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*

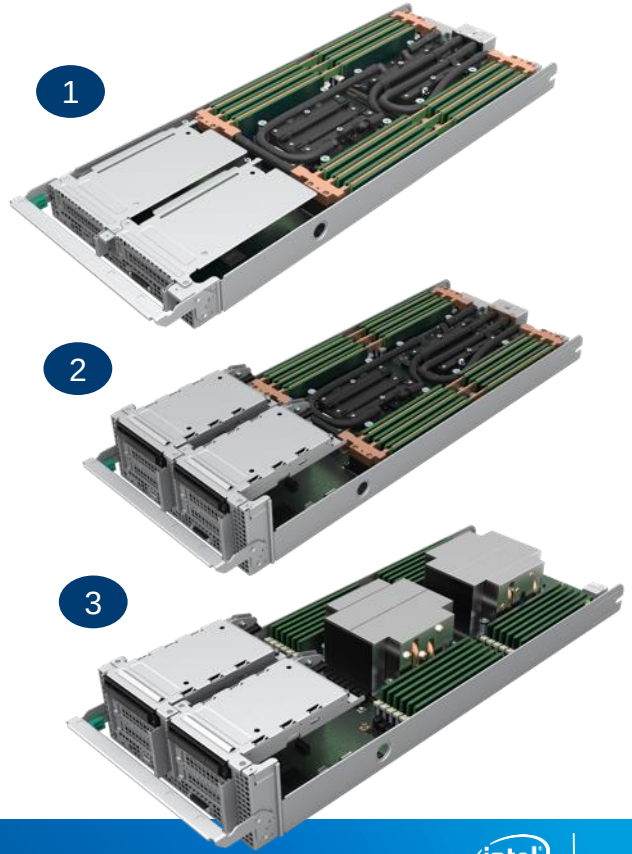
* Intel® Server Systems S9200WK supports 2 x16 Gen3 slots (per 1U node); 4 x16 Gen3 slots (per 2U node)

Intel® Xeon® Platinum 9200 Processor: SKU Options

SKU	Cores	Threads	L3 cache (MB)	Base Frequency (GHz)	Max Turbo Frequency (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
PCIe* 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	One display port on front panel per Compute Module		
Cooling	Direct-to-chip Liquid-Cooling via cold-plates		High-velocity Air-Cooling

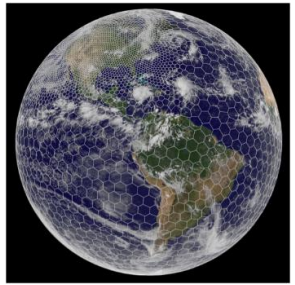


Single node gen-to-gen study on Intel® Xeon® CPU

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

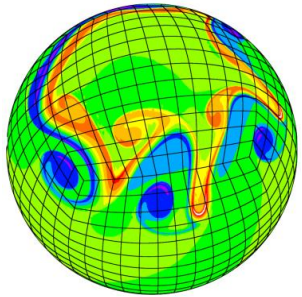
Selected suite of NWP/ESM workloads

WRF



MPAS-A

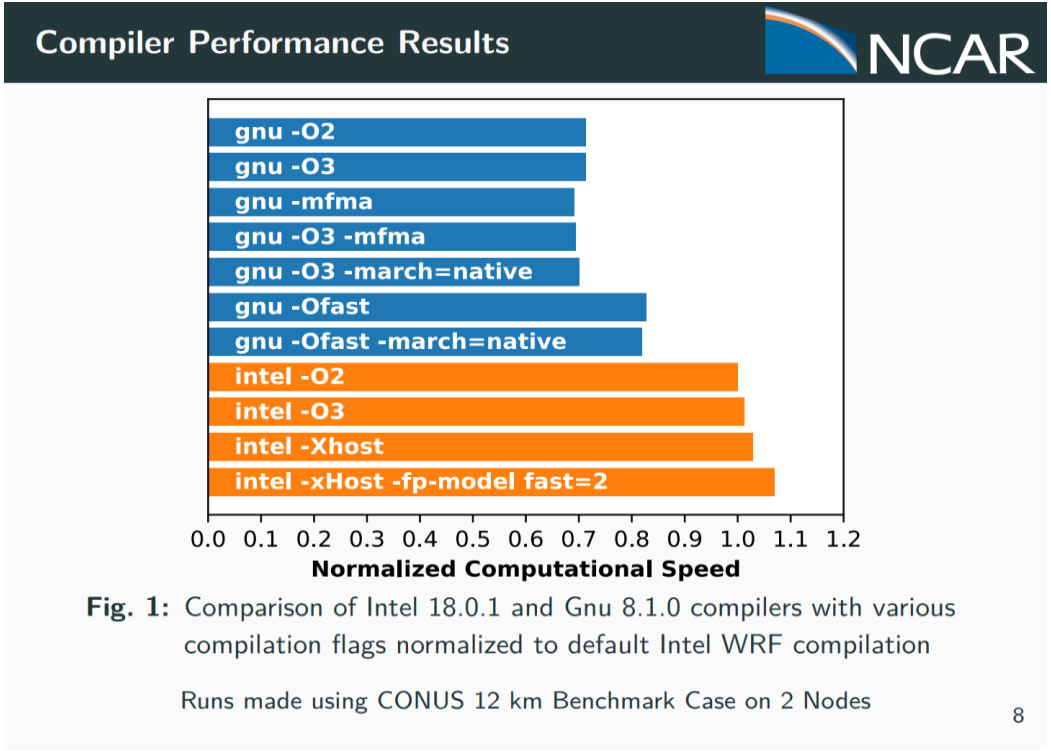
NEMO



HOMME

Application	Version	Dataset	Compiler/MPI	Run
WRF	3.9.1.1	CONUS-12km, CONUS-2.5km	Intel 2018 update 3	Out-of-the-box
MPAS-A	6.1	120km_L56, dycore+physics	Intel 2018 update 3	Out-of-the-box
NEMO	4.0	ORCA2_ICE_PISCES	Intel 2018 update 3	Out-of-the-box
HOMME	dungeon28	WACCM, NE=8	Intel 2018 update 3	Out-of-the-box

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

Source: https://www2.cisl.ucar.edu/sites/default/files/Akira_Kyle_Presentation.pdf

Evaluated Systems

- 2S 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

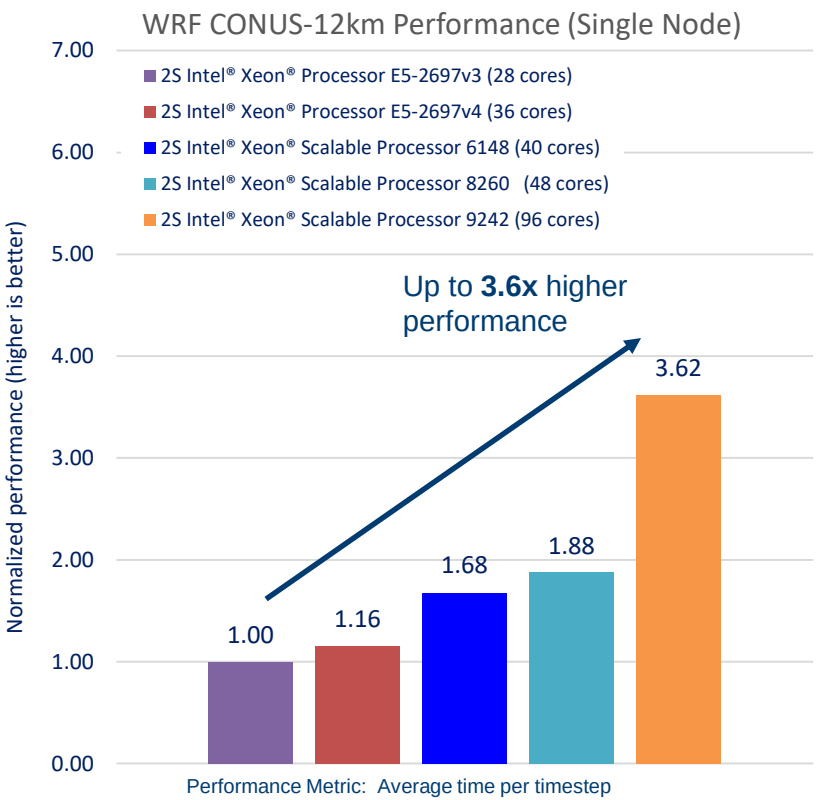
- 2S Intel® Xeon® E5-2697v4 (**"Broadwell"**): Intel Reference Platform, 2x Intel® Xeon® E5-2697 v4 processor (2.3GHz, 18C), 8x16GB DDR4-2400, HT on (1 thread/core), Turbo on, BIOS: SE5C610.86B.01.01.0028.121720182203, Microcode: 0xb000030, Oracle Linux Server release 7.6 (compatible with RHEL 7.6) on a 7.5 kernel using ksplice for security fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86_64

- 2S Intel® 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

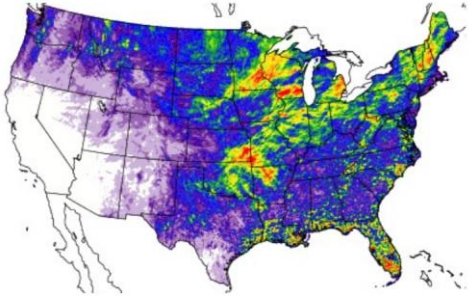


https://www.mmm.ucar.edu/weather-research-and-forecasting-model

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.

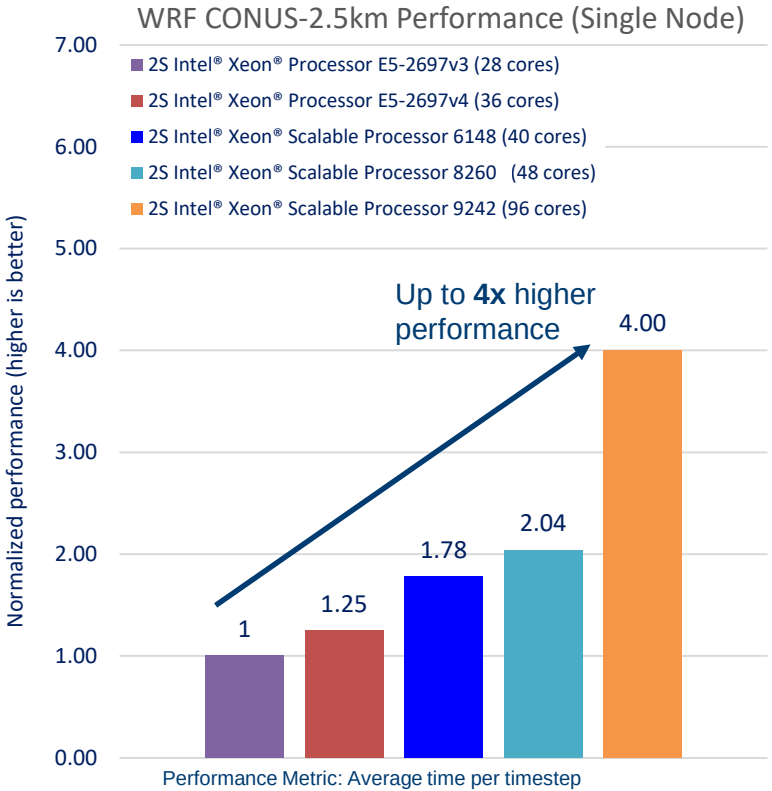
Dataset: http://www2.mmm.ucar.edu/wrf/bench/benchdata_v3911.html



Value Proposition:

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

WRF: CONUS-2.5km

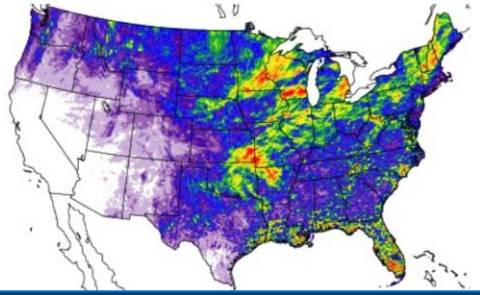


https://www.mmm.ucar.edu/weather-research-and-forecasting-model

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.

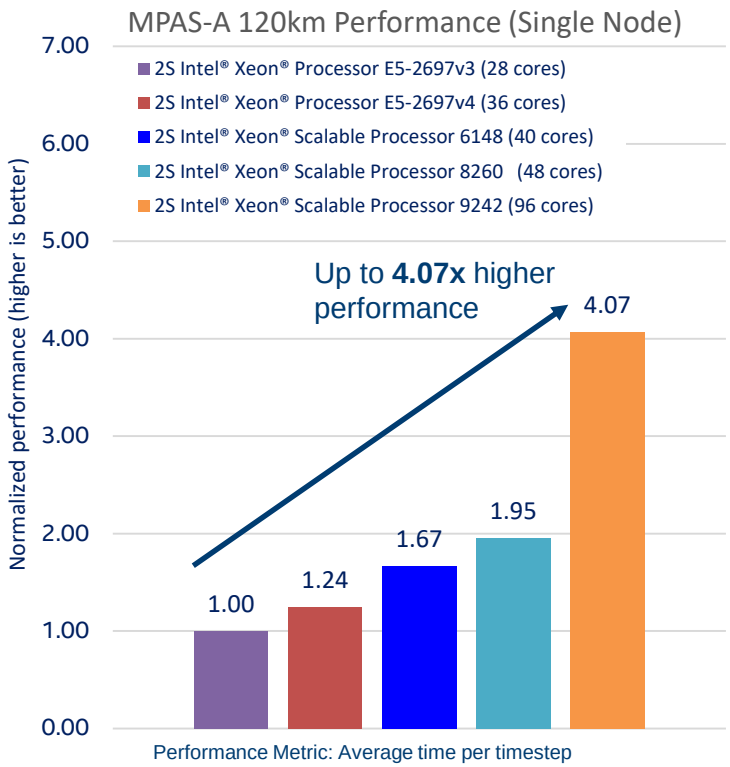
Dataset: http://www2.mmm.ucar.edu/wrf/bench/benchdata_v3911.html



Value Proposition:

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

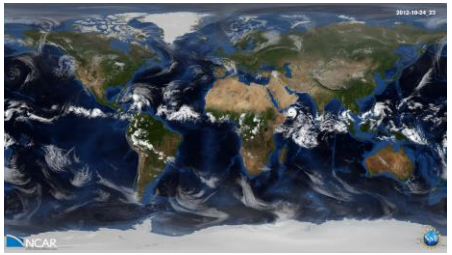
MPAS-A



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 Earth-system 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).

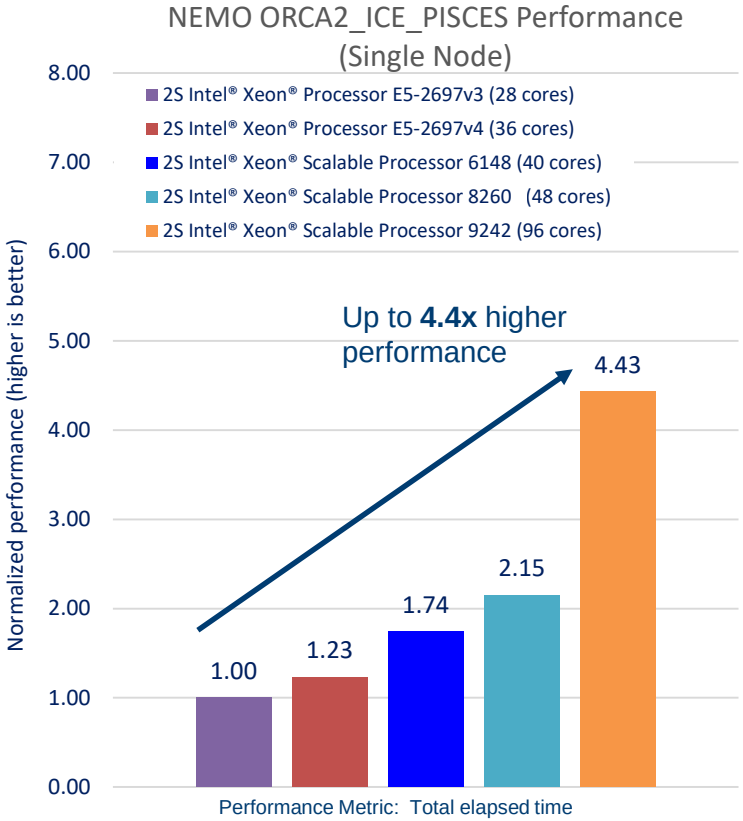
Application: MPAS-A v6.1 Workload: 120km_L56. 16 days global forecast with a horizontal mesh resolution of 120km and 56 vertical layers. **Dataset**: http://www2.mmm.ucar.edu/projects/mpas/benchmark/v6.x/



Value Proposition:

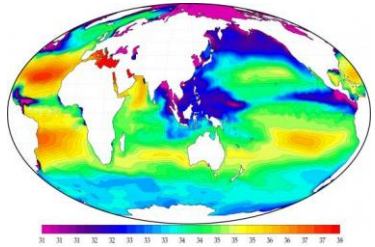
- Intel® Xeon® Scalable Processor 9242 improved performance by up to 4.07x compared to the Intel® Xeon® Processor E5-2697v3

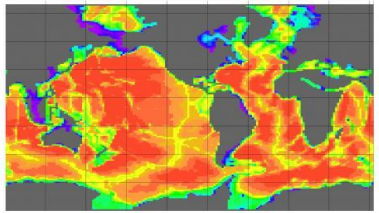
NEMO



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**

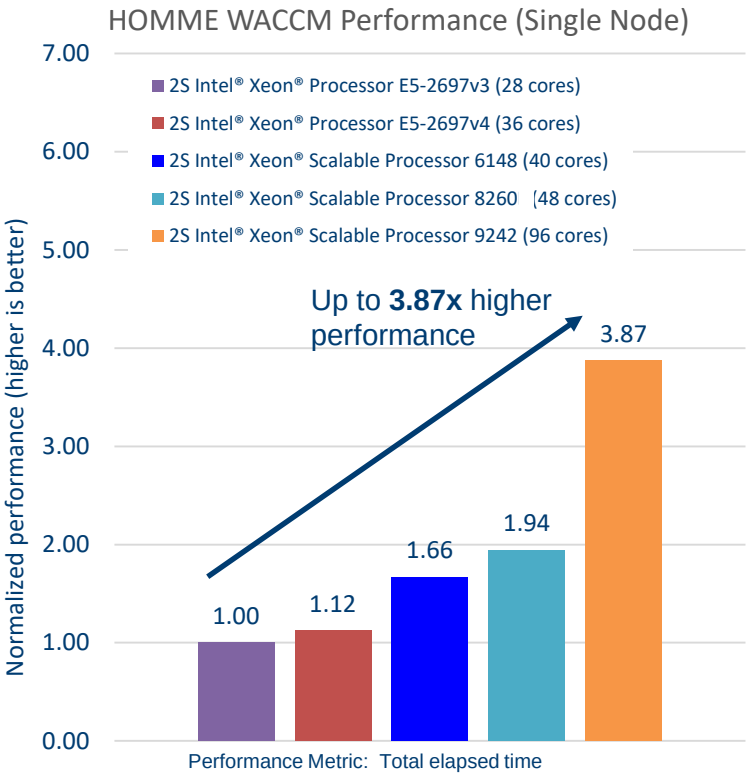




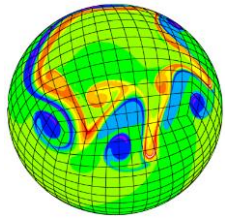
Value Proposition:

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

HOMME



https://github.com/homme-dycore



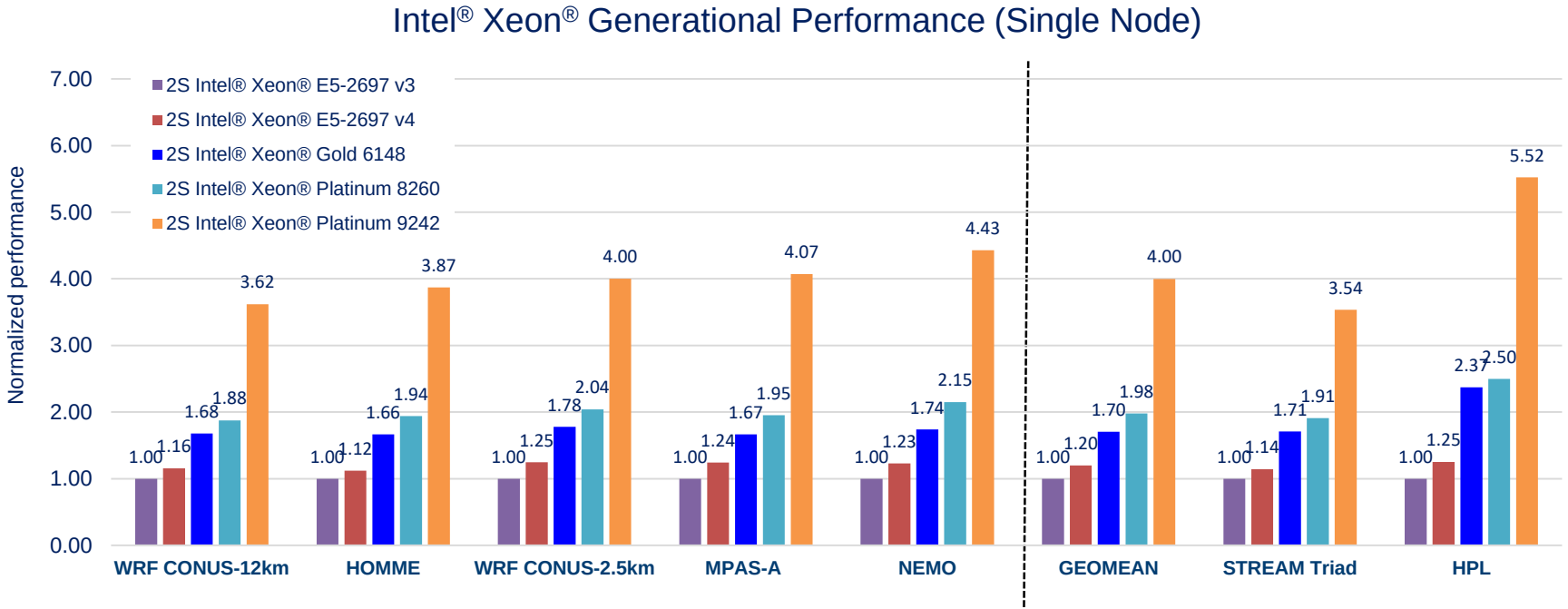
HOMME (The High-Order Method Modeling Environment) is the spectral element dynamical core of community climate atmospheric model (CAM), part of the NCAR Community Earth System Model (CESM-2) as well as the related DOE E3SM model. CESM is a widely-used Earth system model and an important source of simulations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

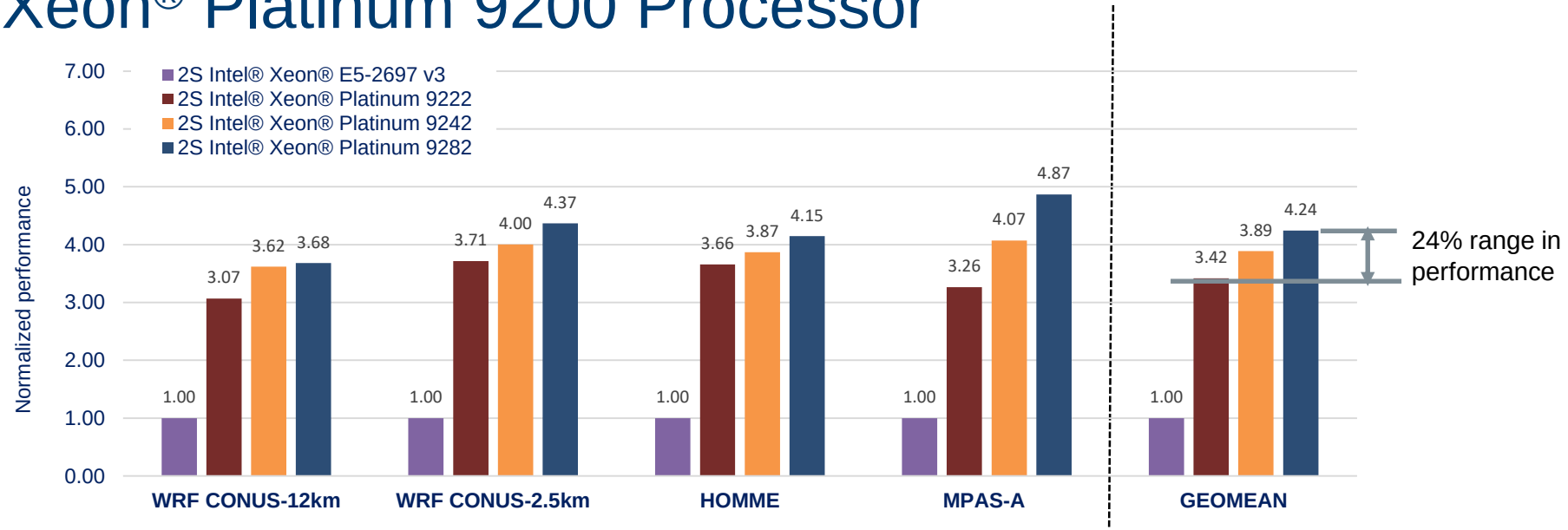
- Intel® Xeon® Scalable Processor 9242 improved performance by up to 3.87x compared to the Intel® Xeon® Processor E5-2697v3
- Faster execution allows researchers to run longer simulations and more ensemble members, enabling study of more climate change scenarios and greater confidence in predictions.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

SUMMARY: Single Node Performance



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 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 your contemplated purchases, including the performance of that product when combined with other products. Intel does not control or audit the design or implementation of third party benchmark data or Web sites referenced in this document. Intel encourages all of its customers to visit the referenced Web sites or others where similar performance benchmark data are reported and confirm whether the referenced benchmark data are accurate and reflect performance of systems available for purchase. Refer to Configuration: HPC Workloads – WRF CONUS-12km, WRF CONUS-2.5km, MPAS-A, NEMO, HOMME, STREAM Triad, HPL . *Other names and brands may be claimed as the property of others.

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

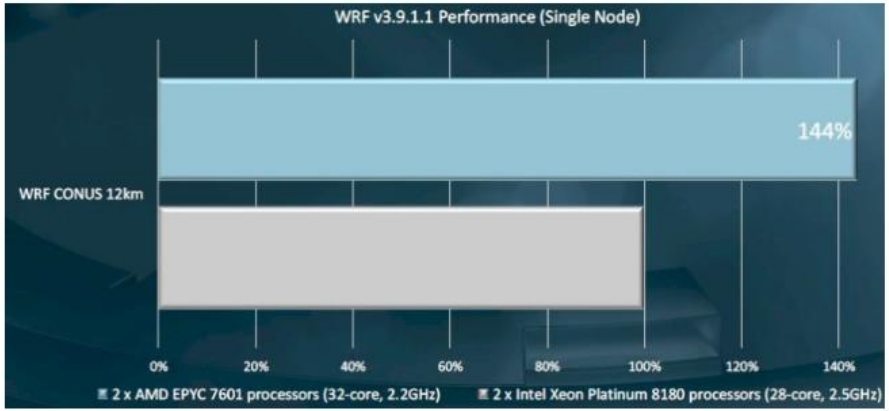


9222 SKU (250W) can be an optimal solution for memory intensive workloads when both performance and power consumption are critical for customer.

Comparison of Intel® Xeon® vs AMD EPYC and NVidia V100 for WRF

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

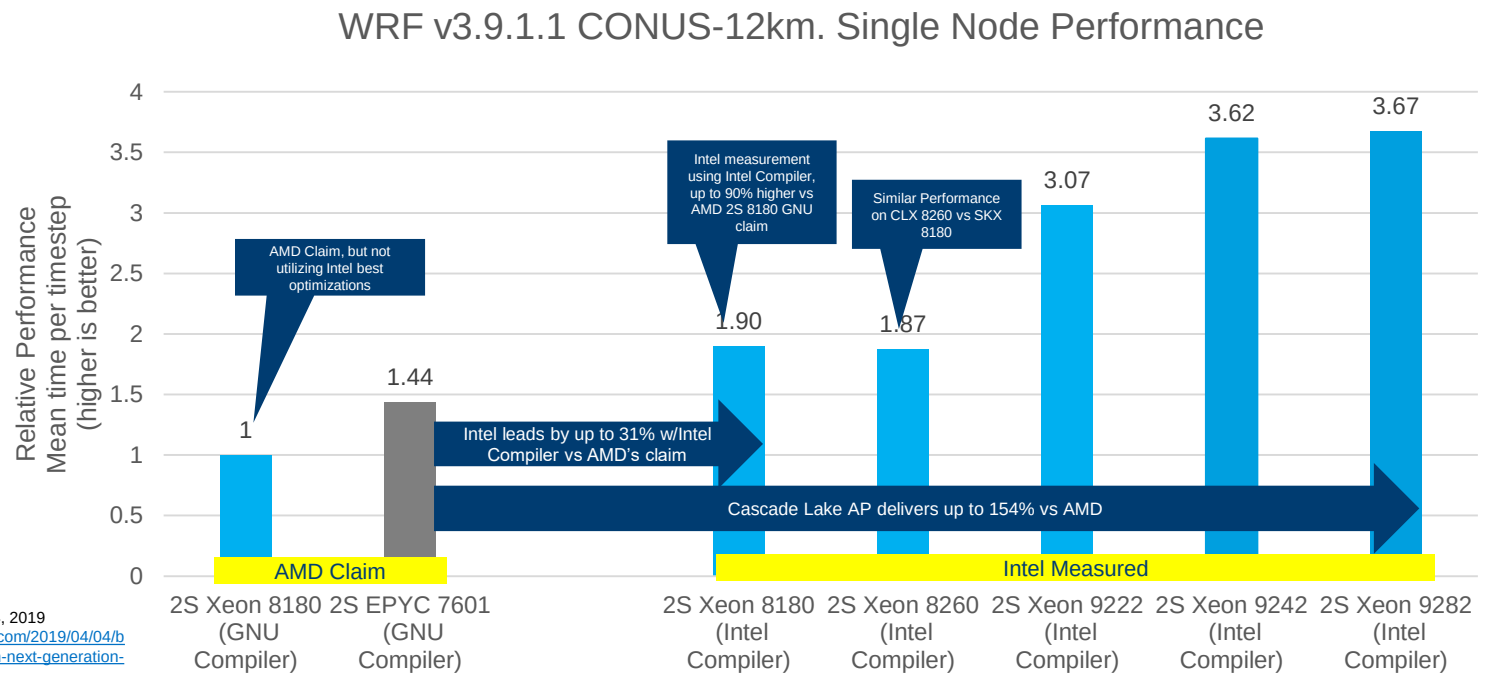
Response:

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 other industry analysis 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).*

AMD WRF Performance Claim (2 of 2)

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

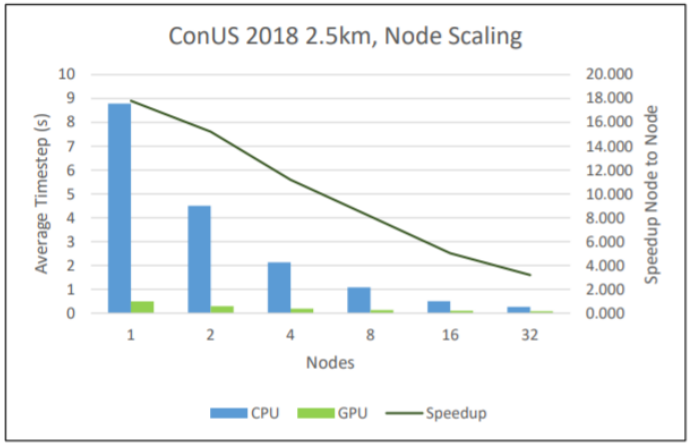


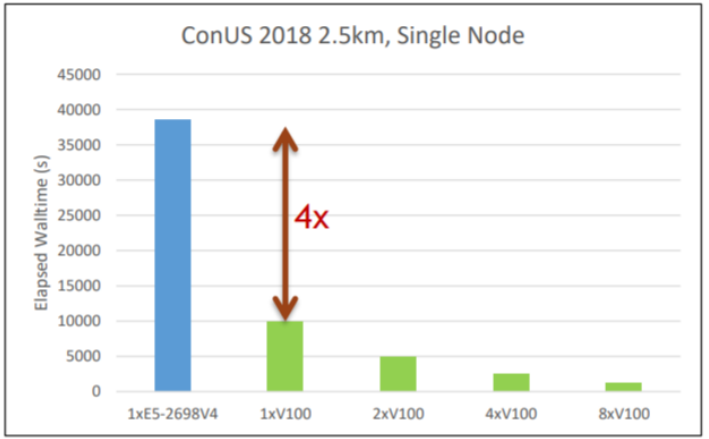
Source: AMD claim
The Next Platform, April 4, 2019
https://www.nextplatform.com/2019/04/04/back-to-the-hpc-future-with-next-generation-amd-epyc-processors/

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

NVidia WRF Performance Claim (1 of 2)

September 18, 2018, 8th Multicore Workshop at NCAR





https://www2.cisl.ucar.edu/sites/default/files/Posey-NVIDIA_MC8_AS_Update.pdf

Claim: 1x V100 GPU outperforms 1S Xeon E5-2697v4 by 4x on WRF CONUS-2.5km workload

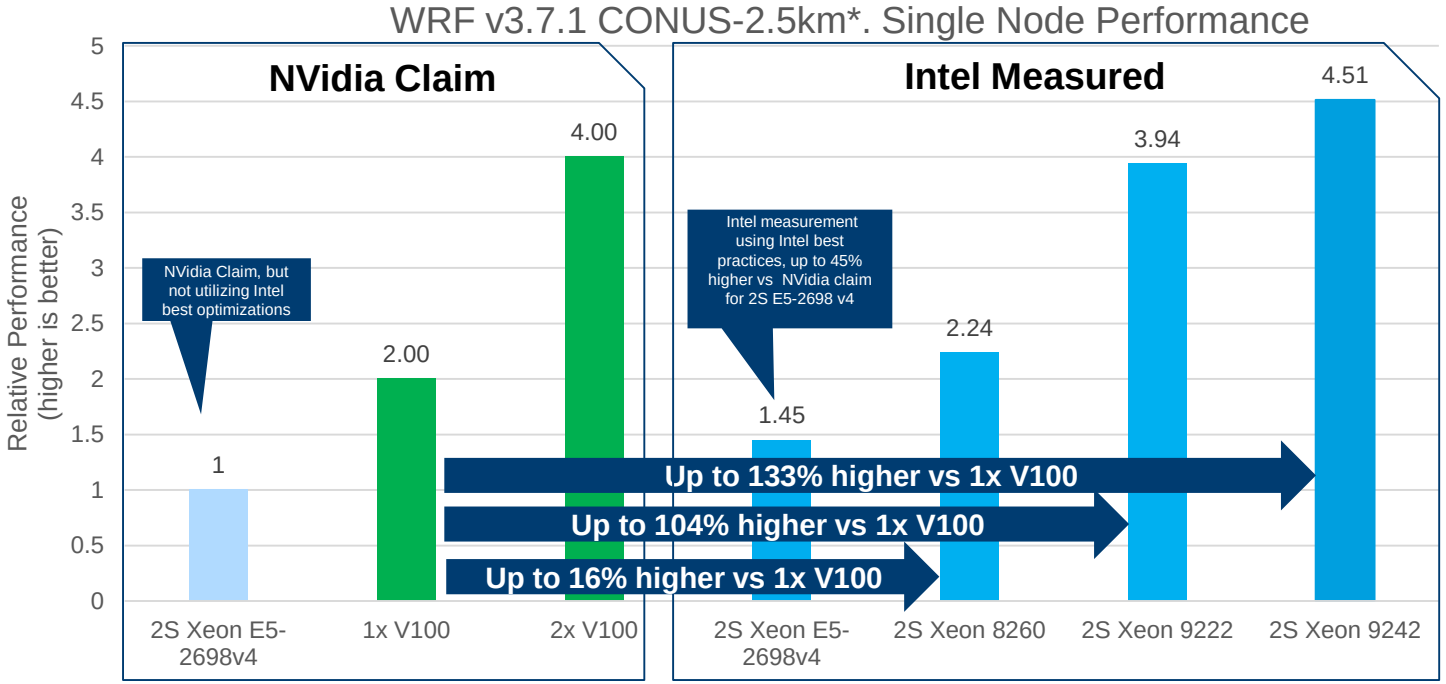
Response:

NVidia utilizes modified industry standard CONUS-2.5km benchmark configuration to exploit the most performance out of GPU. Old generation of Intel Xeon is used for comparison between V100 and Intel CPU. No information on compiler and build options has been provided for Intel CPU.*

- *2S Cascade Lake-AP 48C 9242 can deliver up to 154% higher performance vs 1x V100 (Refer to next slide).*
- *When utilizing Intel compiler with best practices, Xeon E5-2698v4 performance can been increased by 45% vs NVidia claim.*

**Modifications to standard CONUS-2.5km: WSM6, RRTMG, radt=3, 5-layer TDS*

NVidia WRF Performance Claim (2 of 2)



*Modifications to standard CONUS-2.5km: WSM6, RRTMG, radt=3, 5-layer TDS

Source: NVidia claim
8th Multicore Workshop.September 18, 2018
https://www2.cisl.ucar.edu/sites/default/files/Posey-NVIDIA_MC8_AS_Update.pdf

Performance Metric: Average time per timestep

Summary

1. 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. For WRF CONUS-2.5km workload comparison with publicly available NVidia data showed **up to 133%** higher performance of 2S Intel® Xeon® Platinum 9200 Processor compared to 1x Tesla V100 GPU.

Configuration details (1/6)

WRF CONUS-12km (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-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:** 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-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. **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-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® 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: 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. **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: 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.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=4.07, 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.

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/homme-dycore, 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-dycore, WACCM benchmark, Intel Parallel Studio XE 2018 Update 3, Intel MPI 2018u3, Relative performance=4.15, tested by Intel on 04/29/2019.

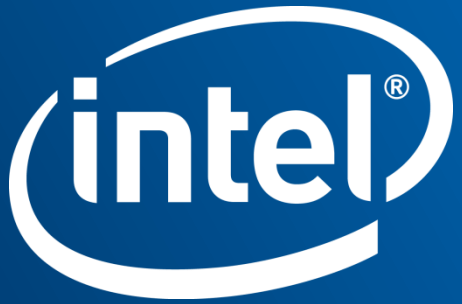
Configuration details (5/6)

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.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: ORCA2_ICE_PISCES, compiled with AVX512, Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3, Relative performance=2.15, tested by Intel on 04/25/2019. **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: ORCA2_ICE_PISCES, compiled with AVX512, Intel® Parallel Studio XE 2018 Update 3 and Intel MPI 2018 Update 3, Relative performance=4.43, tested by Intel on 04/25/2019.

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.el7.crt1.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: 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. 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.el7.crt1.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 fixes, Kernel: 3.10.0-957.5.1.el7.crt1.x86_64. Benchmark software: STREAM , Compiler: Intel® Compiler IC19, Optimized libraries: AVX512, Relative performance=1.89, tested by Intel on 03/03/2019. **2S Intel® Xeon® Platinum 9242 Processor:** 1-node Intel reference platform, 2x Intel® Xeon® 9242 processors (2.2GHz, 48C), 24x16GB DDR4-2933, 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. Benchmark software: STREAM , Compiler: Intel® Compiler IC19, Optimized libraries: AVX512, Relative performance=3.59, tested by Intel on 02/26/2019.

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 (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. 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 (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. High Performance Linpack v2.1, compiled with Intel(R) Parallel Studio XE 2018 for Linux, Intel MPI and MKL Version 19.0.1.144, Relative 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.02.01.0008.031920191559, 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. 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=2.75, tested by Intel on 03/07/2019. **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. 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=5.52, tested by Intel on 03/05/2019.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