

# Delivering Outstanding HPC & AI Performance with 3<sup>rd</sup> Generation Intel® Xeon® Scalable Processors

up to  
**53%**  
better  
performance  
than previous  
generation for  
top HPC applications<sup>2</sup>

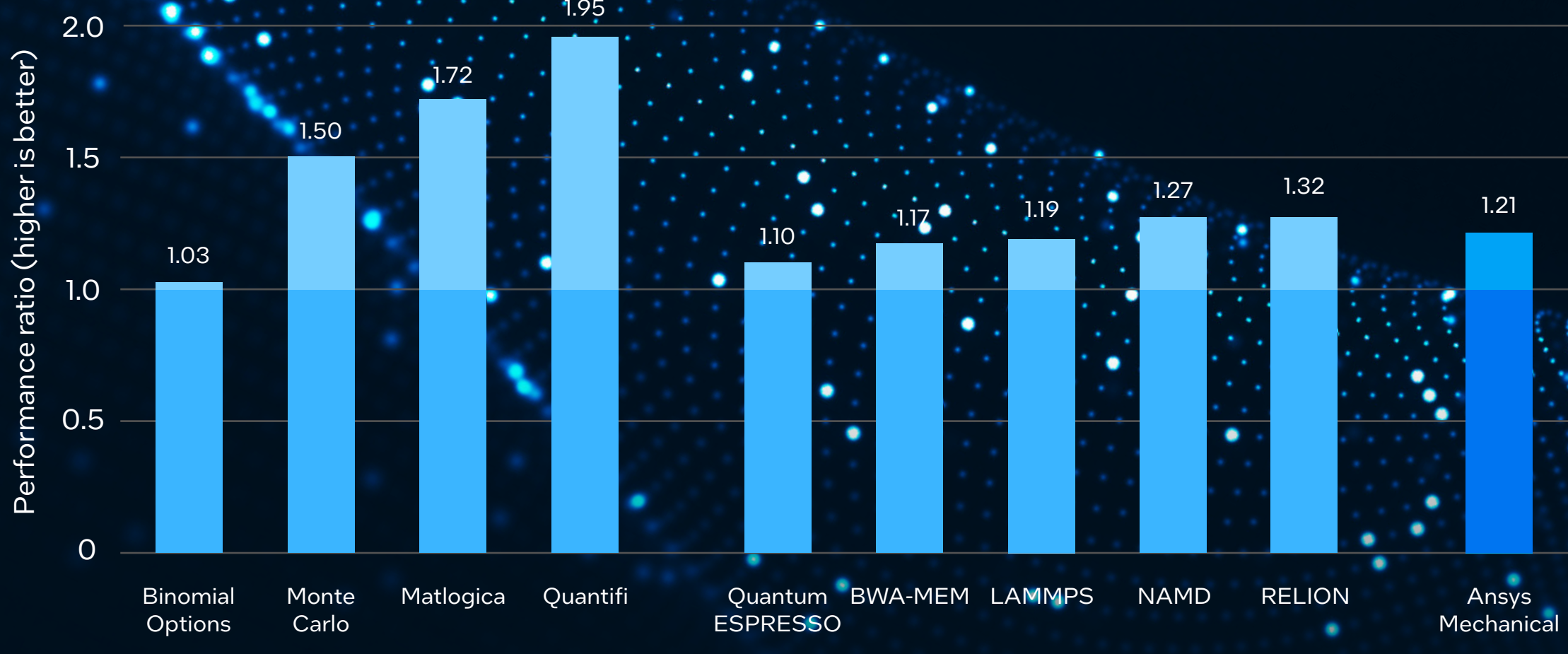
up to  
**74%**  
better  
performance  
than previous generation  
for AI natural language  
processing<sup>3</sup>

## 3<sup>rd</sup> Gen Intel® Xeon® Scalable processors vs AMD EPYC™ processors

Across top vertical workloads

**32%**  
better performance  
(geomean)

**2x**  
better performance  
per core

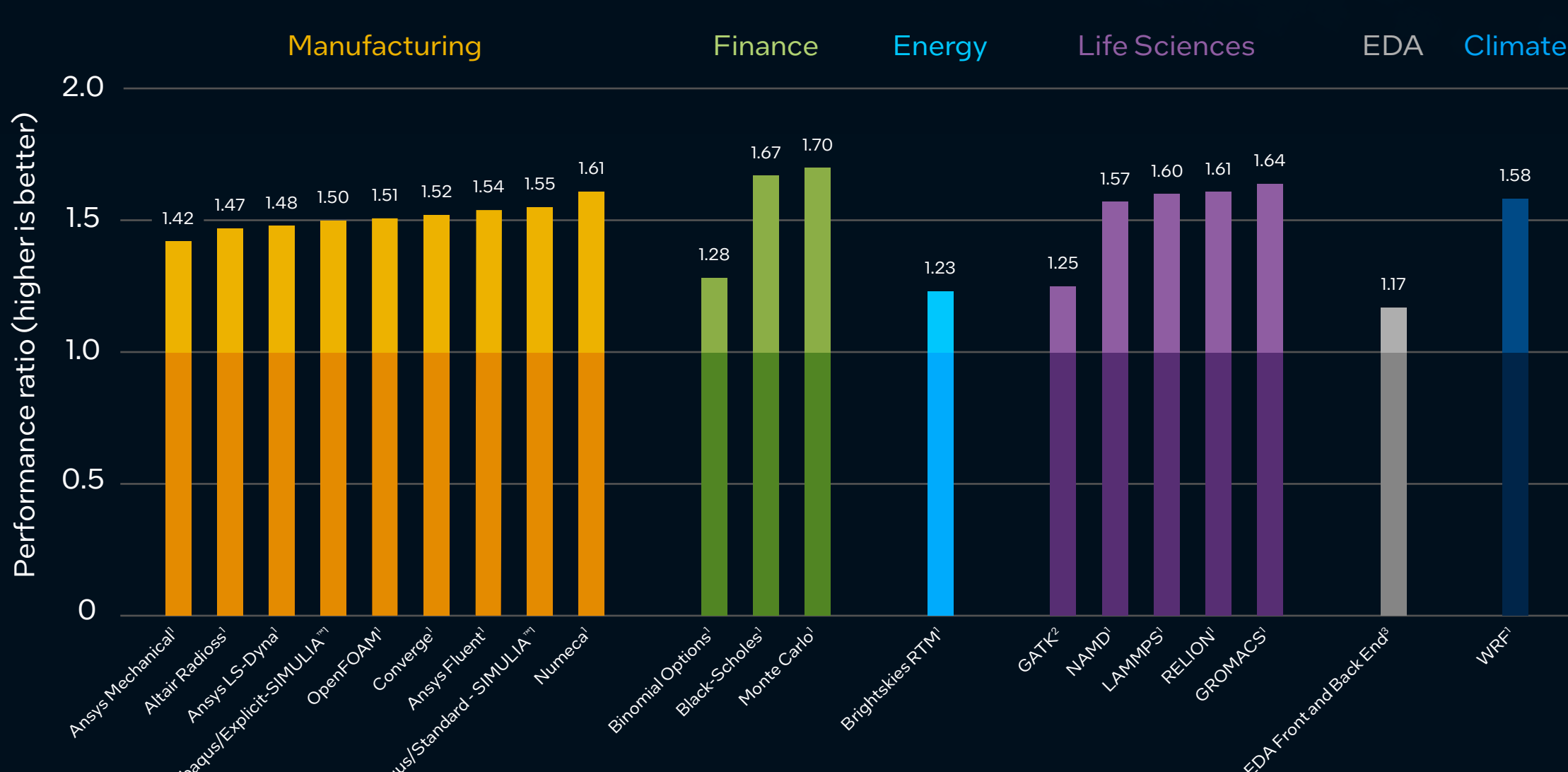


Better performance at fewer cores  
Intel® Xeon® 8380 processor (40 cores) versus AMD 7763 (64 cores)

Head-to-head  
Intel® Xeon® processor  
versus AMD 7543—  
both 32 cores

## Generational performance leap for 20 key HPC workloads

**49%**  
improvement  
(geomean)  
over previous  
generation



## 1 oneAPI

## Optimizing Applications for Intel® Xeon® Scalable Processors

The Intel® oneAPI HPC toolkit provides the foundational tools to build, test, and optimize applications for today's diverse HPC architectures—including world-class compilers, performance libraries, and parallel models. With this rich set of tools that developers are already familiar with, it's easy to optimize applications for your HPC environment.

## How We Do It

**8 memory channels** raises the bar for Intel® Xeon® Scalable processor memory bandwidth

**Up to 40 cores** boosts performance for compute-bound codes

**New core microarchitecture** enhances performance for wide range of applications



The only mainstream datacenter CPU with **built-in AI** acceleration

Intel® **AVX-512 acceleration** boosts performance for a range of workloads

Intel® **Speed Select Technology** offers more granular control over CPU performance

High-performance SKU engineered for **liquid-cooled systems**

**PCIe Gen 4** support with 64 lanes means more, faster I/O

**20+**

years of ecosystem enablement & investment means most HPC applications are optimized for Intel® Xeon® Scalable processors.

For More Information: [www.intel.com/hpc-processors](http://www.intel.com/hpc-processors)



### Footnotes

- 1 Intel® Xeon® 8380 processor versus Intel® Xeon® 8280 processor  
2 Intel® Xeon® 6348 processor versus Intel® Xeon® 6252 processor  
3 Intel® Xeon® 6342 processor versus Intel® Xeon® 6248R processor

See backup for configuration details. Results may vary.

### Configuration Details: Competitive

Binomial Options: 2S Intel® Xeon® Platinum 8380 processor (40C, 2.3GHz, 270W); Intel® Server System; 256GB, 16x16GB 3200MHz DDR4; CentOS Linux 8.3.2011, 4.18.0-240.11.el8\_3.crt1.x86\_64, SE5C6200.86B.0021.D40.2101090208, 0x261, App Version: v1.0; Build notes: Tools: Intel® C++ Compiler 2020u4, Intel® Threading Building Blocks; threads/core: 2; Turbo: used; Build knobs: -O3 -xCORE-AVX512 -qopt-zmm-usage-high -fimt-domain-exclusion=31 -fimt-accuracy-bits=11 -no-prec-div -no-prec-sqrt 2S AMD EPYC 7763 (64C, 2.45GHz, 280W); GIGABYTE R282-Z92 server; 512GB, 16x32GB 3200MHz DDR4; NP54, CTPD=280W, Determinism=Power, Red Hat Enterprise Linux 8.3, 4.18, ucode 0xa001114, App Version: v1.0; Build notes: Tools: Intel® C++ Compiler 2020u4, Intel® Threading Building Blocks; threads/core: 2; Turbo: used; Build knobs: -O3 -fimt-accuracy-bits=11 -no-prec-div -no-prec-sqrt; Workloads tested by Intel and results as of May 2021.

Monte Carlo: See [37] at [www.intel.com/3gen-xeon-config](http://www.intel.com/3gen-xeon-config). Results may vary.

MatLogica Provided Vector Accelerator Library XVA pricing benchmark: 2S Intel® Xeon® Platinum 8380 processor @ 2.30GHz 40 cores on Intel® platform with 512 GB DDR4 memory (8(DIPC)/32GB/SK Hynix 1.2v/3200 MT/s), HT on, Turbo on, CentOS Linux 8.4, internal Bios SE5C6200.86B.0020.P23.2103261309 Release Date: 03/16/2021, CentOS Linux release 8.4.2105, Metalogical Libraries AADC-demo-2021-10-01-cd0737f-M9s6, Run Instructions: taskset -c \$EXEFILE \$CONFIG \$INPUT file (for Intel® Xeon® processor avx512 CONFIG=512 used), export OMP\_NUM\_THREADS=1, 2 thread/core, optimized with AVX512 and Metalogical AADC libraries, test by Intel on 10/14/2021. 2S AMD EPYC™ 7763 @ 2.45GHz 64-Core Processor on GIGABYTE R282-Z92-00 with 512 GB DDR4 memory (8(DIPC)/32GB/SK Hynix 1.2v/3200 MT/s), HT on, Turbo on, Bios: GIGABYTE M07 Release Date: 09/03/2021, CentOS Linux release 8.4.2105, Metalogical Libraries AADC-demo-2021-10-01-cd0737f-M9s6, Run Instructions: taskset -c \$EXEFILE \$CONFIG \$INPUT file (for AMD EPYC avx2 CONFIG=256 used), export OMP\_NUM\_THREADS=2, 2 threads/core, optimized with AVX2 and Metalogical AADC libraries, test by Intel on 10/14/2021.

Quantifi Credit Option Pricing AI Inference: 2S Intel® Xeon® 8380 processor @ 2.30 GHz (40 cores/processor), Turbo ON, HT ON, 512GB DDR4-3200, CentOS Linux Version 8, BIOS Version: SE5C6200.86B.0022.D08.2103221623, BIOS Release Date: 03/22/2021. 2S AMD EPYC 7763 @ 2.45 GHz (64 cores/processor), Turbo ON, HT ON, 512GB DDR4-3200, CentOS Linux Version 8, BIOS Version: M06, BIOS Release Date: 07/10/2021. Tested by Intel. Libraries: python 3.8.11, intel-tensorflow 2.6.0, Turbo=ON, All platforms: python Quantifi-Inference.py, 2 threads/core (all platforms). Tested by Intel as of 10-12-2021.

Quantum ESPRESSO AUSURFT12, PSIWAT: 2S Intel® Xeon® Platinum 8380 processor (40C, 2.3GHz, 270W); Intel® Server System; 256GB, 16x16GB 3200MHz DDR4; CentOS Linux 8.3.2011, 4.18.0-240.11.el8\_3.crt1.x86\_64, SE5C6200.86B.0021.D40.2101090208, 0x261, App Version: 6.3; Build notes: Tools: Intel® Fortran Compiler 2021.2, Intel® MKL 2021.2, ELPA 2020.11; threads/core: 2; Turbo: used; Build knobs: -O2 -align-array64byte -threads -heap-arrays 4096 -xCORE-AVX512 -qopt-zmm-usage=high -fp-model fast=2 -complex-limited-range -assume byterecl -qopenmp 2S AMD EPYC 7763 (64C, 2.45GHz, 280W); GIGABYTE R282-Z92 server; 512GB, 16x32GB 3200MHz DDR4; NP54, CTPD=280W, Determinism=Power, Red Hat Enterprise Linux 8.3, 4.18, ucode 0xa001114, App Version: 6.3; Build notes: Tools: Intel® Fortran Compiler 2021.2, Intel® MKL 2021.2, ELPA 2020.11; threads/core: 2; Turbo: used; Build knobs: -O2 -align-array64byte -threads -heap-arrays 4096 -march=core-avx2 -fp-model fast=2 -complex-limited-range -assume byterecl -qopenmp. Workloads tested by Intel and results as of May 2021.

BWA-MEM2 on Intel® Xeon® processor versus AMD EPYC: 2S Intel® Xeon® Platinum 8380 processor (40C, 2.3GHz, 270W); Intel® Server System - 256GB, 16x16GB 3200MHz DDR4; CentOS Linux release 8.4.2105, 4.18.0-240.11.el8\_3.crt1.x86\_64, ucode 0xd000270, 2S AMD EPYC 7763 (64C, 2.45GHz, 280W); GIGABYTE R282-Z92 server - 512GB, 16x32GB 3200MHz DDR4; CentOS Linux release 8.4.2105, 4.18.0-240.11.el8\_3.crt1.x86\_64, ucode 0xa001114; NP54 yields best performance for EPYC. Baseline code: BWA-MEM, v0.7.17; optimized code (OpenOmics): BWA-MEM2, v2.2.1. Datasets used: Reference sequence: version GRCh38; Read dataset: 10M reads from SRR7733443 (151bp each) and HG004 (250bp each). Tested by Intel as of September 2021.

LAMMPS (Polyethylene, Stillinger-Weber, Tersoff, Water); 2S Intel® Xeon® Platinum 8380 processor (40C, 2.3GHz, 270W); Intel® Server System; 256GB, 16x16GB 3200MHz DDR4; CentOS Linux 8.3.2011, 4.18.0-240.11.el8\_3.crt1.x86\_64, SE5C6200.86B.0021.D40.2101090208, 0x261, App Version: v2020-10-29; Build notes: Tools: Intel® MKL 2020u4, Intel® C++ Compiler 2020u4, Intel® Threading Building Blocks 2020u4, Intel® MPI 2019u8; threads/core: 2; Turbo: used; Build knobs: -O3 -p -xCORE-AVX512 -qopt-zmm-usage=high 2S AMD EPYC 7763 (64C, 2.45GHz, 280W); GIGABYTE R282-Z92 server; 512GB, 16x32GB 3200MHz DDR4; NP54, CTPD=280W, Determinism=Power, Red Hat Enterprise Linux 8.3, 4.18, ucode 0xa001114, App Version: v2020-10-29; Build notes: Tools: Intel® MKL 2020u4, Intel® C++ Compiler 2020u4, Intel® Threading Building Blocks 2020u4, Intel® MPI 2019u8; threads/core: 2; Turbo: used; Build knobs: -O3 -p -march=core-avx2; Workloads tested by Intel and results as of May 2021.

NAMD: See [36] at [www.intel.com/3gen-xeon-config](http://www.intel.com/3gen-xeon-config). Results may vary.

RELION: See [38] at [www.intel.com/3gen-xeon-config](http://www.intel.com/3gen-xeon-config). Results may vary.

Ansys Mechanical 2021R2 on Endeavor (HDR Fabric): 21% improvement across all SP cases (V21sp-1, V21sp-2, V21sp-3, V21sp-4). Intel® Xeon® Platinum 8380 processor (32 cores, 48M Cache, 2.60 GHz), RAM 256 GB, 16x16GB 3200 MT/s DDR4, Hynix HMA82GR7CJR8N-XN, HDR based Lustre, BIOS SE5C6200.86B.0020.P23.2103261309, BIOS Settings HT=on, Turbo Boost ON, SNC 2, Microcode 0xd000270, Intel® Management Engine: 04.04.04.053; BMC 2.78; OFED stack Mellanox mlnx-5.1-2.5.8.0- default, Intel® MPI 2019u9 used throughout. 2018u3 used where needed. Intel® MKL used for Intel® platforms; Intel® Math Kernel Library Version 2020.0.0 Product Build 20191122, AMD BLIS used for AMD platforms. Intel® Compiler Version: 2019.0.0, Intel® Fortran Compiler Version 19.0.0 (Build: 20190206), Intel® C/C++ Compiler Version 19.0.0 (Build: 20190206), Tested by Intel as of October 2021.

BWA-MEM2 on Intel® Xeon® processor versus NVIDIA A100: 2S Intel® Xeon® Platinum 8380 processor (40C, 2.3GHz, 270W); Intel® Server System - 256GB, 16x16GB 3200MHz DDR4; CentOS Linux release 8.4.2105, 4.18.0-240.11.el8\_3.crt1.x86\_64, ucode 0xd000270, NVIDIA A100: one A100 GPU from the following DGX machine: Nvidia DGX A100 320GB; GPU: 8X A100-SXM4-40GB; CPU: Dual AMD EPYC 7742 64-Core Processor; RAM: 1 TB; Storage: 8 PB (lustre fs). Datasets used: Reference sequence: version GRCh38; Read dataset: 50x WGS ERR194147 (NA12878/HG001) from Illumina HiSeq 2000. Baseline code: BWA-MEM, v0.7.17; optimized code (OpenOmics): BWA-MEM2, v2.2.1. For details on NVIDIA system see <https://at-cg.github.io/posts/ParaBricks-WGS/>. Tested by Intel as of September 2021.

### Configuration Details: Generational

For the following applications (Intel® Xeon® 8280 processor versus Intel® Xeon® 8380 processor): NAMD, LAMMPS, RELION, GROMACS, Monte Carlo, Black-Scholes, Binomial, LS Dyna, Fluent, OpenFOAM, RADIOSS, Converge, Numea, WRF: See [108] at [www.intel.com/3gen-xeon-config](http://www.intel.com/3gen-xeon-config). Results may vary.

Ansys Mechanical: Intel® Xeon® 8280 processor; Config Date: 1/21/2021; Platform: Intel® Server System; CPU Details: 2 CPUs per node; Stepping: 6; 28c @ 2.7GHz; # CPU Sockets: 2; # CPU Cores: 28; CPU Base Frequency: 2.7 GHz; CPU Max Frequency: 4.0 GHz; CPU Base TDP: 205 W; RAM: 192GB, 12x16GB 2933MHz DDR4, Micron 18ASF2G72PDZ-2G9E1; Hard Drive: 480GB Model: ATA Intel® SSD SC2KG48 (scsi); Cluster File System: OPA based Lustre; BIOS: SE5C620.86B.02.01.0012.070720200218; HT=ON; TURBO=ON; Microcode: 0xd000270; Intel® Management Engine: 04.01.04.381; BMC: 2.48. Operating System: CentOS Linux 8.3.2011; Kernel: 4.18.0-240.11.el8\_3.crt1.x86\_64; OFED stack: OPA 10.10.3.11, Lustre 2.10.8-default; App Version: 2021 R1; Data collected: 2/2/2021; Build notes: Hyper-Threading Enabled, Turbo Enabled, Intel® Fortran Compiler 19.0.0; Intel® C/C++ Compiler 19.0.0; Intel® Math Kernel Library 2020.0.0; Intel® MPI Library 2018 Update 3; One thread per core, 52ppn.

Intel® Xeon® 8280 processor; Config Date: 1/21/2021; Platform: Intel® Server System; CPU Details: 2 CPUs per node; Stepping: 6; 40c @ 2.3GHz; # CPU Sockets: 4; # CPU Cores: 40; CPU Base Frequency: 2.3 GHz; CPU Max Frequency: 2.3 GHz; CPU Base TDP: 250 W; RAM: 256GB 16x16GB 3200MT/s DDR4, Hynix HMA82GR7CJR8N-XN; Hard Drive: SSDSC2KG96 960GB; Cluster File System: HDR based Lustre; BIOS: SE5C6200.86B.02.01.D40.2103100308; BIOS Settings: HT=on TURBO=ON; Microcode: 0x8d055260; Intel® Management Engine: 04.04.03.249; BMC: 2.66; Operating System: CentOS Linux release 8.3.2011; Kernel: 4.18.0-240.11.el8\_3.crt1.x86\_64; OFED stack: Mellanox mlnx-5.1-2.5.8.0-default; App Version: 2021 R1; Data collected: 4/8/2021; Build notes: Intel® Fortran Compiler 19.0.0; Intel® C/C++ Compiler 19.0.0; Intel® Math Kernel Library 2020.0.0; Intel® MPI Library 2018 Update; cores: 80ppn. Tested by Intel as of October 2021.

Simulia Abaqus/Explicit: Intel® Xeon® Platinum 8380 processor 2/6 (40c); 2.3/2.1/1.8, RAM 256GB 16x16GB 3200MT/s DDR4, Hynix HMA82GR7CJR8N-XN; Intel® SSD SC2KG96 960GB; HDR based Lustre; BIOS SE5C6200.86B.0020.P23.2103261309; HT=ON; TURBO=ON; Microcode 0xd000270; Intel® Management Engine: 04.04.04.053; BMC 2.78; OFED stack Mellanox mlnx-5.1-2.5.8.0- default. Intel® Xeon® Platinum 8280L processor 2/6 (2.7GHz) 2.7/2.2/1.8, RAM 192GB, 12x16GB 2933MHz DDR4, Hynix HMA82GR7CJR8N-WM; hard drive 480GB Model: ATA Intel® SSD SC2KG48 (scsi); OPA based Lustre; BIOS SE5C620.86B.02.01.0012.070720200218; HT=ON; TURBO=ON; Microcode 0x4002f01, Abaqus2021HF4, Intel® MKL 2020 Update 2. Tested by Intel as of October 2021.

Simulia Abaqus/Standard: Intel® Xeon® Platinum 8380 processor 2/6 (40c); 2.3/2.1/1.8, RAM 256GB 16x16GB 3200MT/s DDR4, Hynix HMA82GR7CJR8N-XN; Intel® SSD SC2KG96 960GB; HDR based Lustre; BIOS SE5C6200.86B.0020.P23.2103261309; HT=ON; TURBO=ON; Microcode 0xd000270; Intel® Management Engine: 04.04.04.053; BMC 2.78; OFED stack Mellanox mlnx-5.1-2.5.8.0- default. Intel® Xeon® Platinum 8280L processor 2/6 (2.7GHz) 2.7/2.2/1.8, RAM 192GB, 12x16GB 2933MHz DDR4, Hynix HMA82GR7CJR8N-WM; hard drive 480GB Model: ATA Intel® SSDSC2KG48 (scsi); OPA based Lustre; BIOS SE5C620.86B.02.01.0012.070720200218; HT=ON; TURBO=ON; Microcode 0x4002f01, Abaqus2021HF4, Intel® MKL 2020 Update 2. Tested by Intel as of October 2021.

Brightskies Reverse Time Migration: Intel® Xeon® Platinum 8280L processor @ 2.70GHz; Platform/Motherboard: S2600WFD Intel® Server System J46732-80; BIOS: SE5C620.86B.0X.02.0001.051420190324; RAM: 12x16GB (192GB) DDR4 2666; OS: Ubuntu 20.04.3 LTS; Kernel: 5.4.0-89-generic; Microcode: 0x5003102, Intel® Xeon® Platinum 8380 processor @ 2.30GHz; Platform/Motherboard: M50CYP2SB2U Intel® Server System K8801-301; BIOS: SE5C6200.86B.0022.D64.2105220049; RAM: 16x32GB (512GB) DDR4 3200; OS: Ubuntu 20.04.3 LTS; Kernel: 5.4.0-89-generic; Microcode: 0xd0002b1, Application version 4.0.0. Build: Intel® oneAPI 2021.4, CBS = x (best score). Tested by Intel as of October 2021.

### GATK whole genome sequencing:

Config 1: Test by Intel as of 11/14/2019, 1 application node and 4 compute nodes. Application node configuration: 2x Intel® Xeon® Gold 6252 processor (24 cores, 210 GHz), 1x Intel® Server Board S2600WFT, 192 GB (12x 16 GB DDR4 2666 MHz, IDCC), 1x 960 GB Intel® SSD D3-S4510 Series (2.5 in SATA 6 Gb/s, 3D2, TLC); 1x 1.6 TB Intel® SSD DC P4610 1.6 TB (3D NAND PCIe 3.1x4, 3D1, TLC); high-performance network: 1x Intel® Ethernet Converged Network Adapter X550-T2, model X550T2. Compute node configuration: 2x Intel® Xeon® Gold 6348 processor (28 cores) @ 2.60 GHz, Intel® Hyper-Threading Technology = ON, Intel® Turbo Boost Technology = ON, total memory 512 GB (16 slots/32 GB/3200 MHz); BIOS version: 22D08; BMC 2.66, SDR 0.31, CPLD 3p0; uCode: 0x0b000280; storage - Scratch drive: 1x Intel® SSD P4610 1.6 TB (3D NAND PCIe 3.1x4, 3D1, TLC); high-performance network: 1x Intel® Ethernet Converged Network Adapter X550-T2 (10 GbE), model X550T2.

EDA front end and back end (7 workloads): Intel® Xeon® 6248R processor (24 cores); 3.0GHz/4.0GHz/3.6GHz; HDD 2x1.2TB SAS; BIOS 3.3-IN001, 02/12/2020; OS SLES12 SP5; kernel 4.12.14-122.7-default, Turbo enabled, hyper-threading disabled, Intel® Xeon® 6342 processor (24 cores); 2.8GHz/3.5GHz/3.3GHz; HDD 2x2.4TB SAS; BIOS 1.0-IN001, 03/12/2021; OS SLES12 SP5; kernel 4.12.14-122.60-default, Turbo enabled, hyper-threading disabled. Tested by Intel as of April 2021.

### Notices and Disclaimers

Performance varies by use, configuration and other factors. Learn more at [www.intel.com/PerformanceIndex](http://www.intel.com/PerformanceIndex).  
Performance results may be based on testing as of dates shown in configurations and may not reflect all publicly available updates. See backup for configuration details. No kernel or component can be absolutely secure.  
Your costs and results may vary.  
Intel does not control or audit third-party data. You should consult other sources to evaluate accuracy.  
Intel technologies may require enabled hardware, software, or service activation.  
This offering is not approved or endorsed by OpenCFD Limited, producer and distributor of the OpenFOAM software via [www.openfoam.com](http://www.openfoam.com), and owner of the OPENFOAM® and OpenCFD® trademarks.  
© Intel Corporation. Intel, the Intel logo, and other Intel marks are trademarks of Intel Corporation or its subsidiaries. Other names and brands may be claimed as the property of others.