High Performance Computing

High Performance Weather Modeling with AMD EPYC™ 7Fx2 Processors

AMD EPYC

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AMD EPYC Processors for HPC

AMD EPYC™ 7Fx2 processors bring high frequencies and very highs ratios of cache per core to the 2nd Gen EPYC family of processors. EPYC 7Fx2 processors build on the large memory capacity, extreme memory bandwidth and massive I/O of the 2nd Gen EPYC family to deliver exceptional HPC workload performance.

High Frequency

Many HPC applications scale very well with frequency. EPYC 7Fx2 series processors offer both base and boost frequencies[5] up to 500 MHz faster than the current EPYC 7002 series models, enabling significant per-core performance.

High Cache Per Core

The 16-core EPYC 7F52 and 8-core EPYC™ 7F32 processors each boast 16 MB of cache for each core. The 24-core EPYC 7F72 processor offers 8 MB of cache per-core.

Model	Cores	Base Freq (GHz)[5]	Boost Freq (Up to)	Cache (MB)
7F72	24	3.2 GHz	3.7 GHz	192
7F52	16	3.5 GHz	3.9 GHz	256
7F32	8	3.7 GHz	3.9 GHz	128

A high ratio of cache per core helps feed data into HPC applications using very high-speed cache memory.

Scalability

With leadership architecture, 2nd Gen EPYC Series Processors demonstrate very high scalability for HPC applications by supporting 8 channels of memory per processor and PCIe® 4.

WRF and AMD: Power Without Compromise

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

For researchers, WRF can produce simulations based on actual atmospheric conditions (i.e., from observations and analyses) or idealized conditions. WRF offers operational forecasting a flexible and computationally efficient platform, while reflecting recent advances in physics, numerics, and data assimilation contributed by developers from the expansive research community.

Single-Node Performance: AMD vs. Intel®

Figure 1 shows 16-core AMD EPYC™ 7F52 and 24-core AMD EPYC™ 7F72 CPUs outperforming 16-core Intel® Xeon® Gold 6242 CPUs by up to an average of

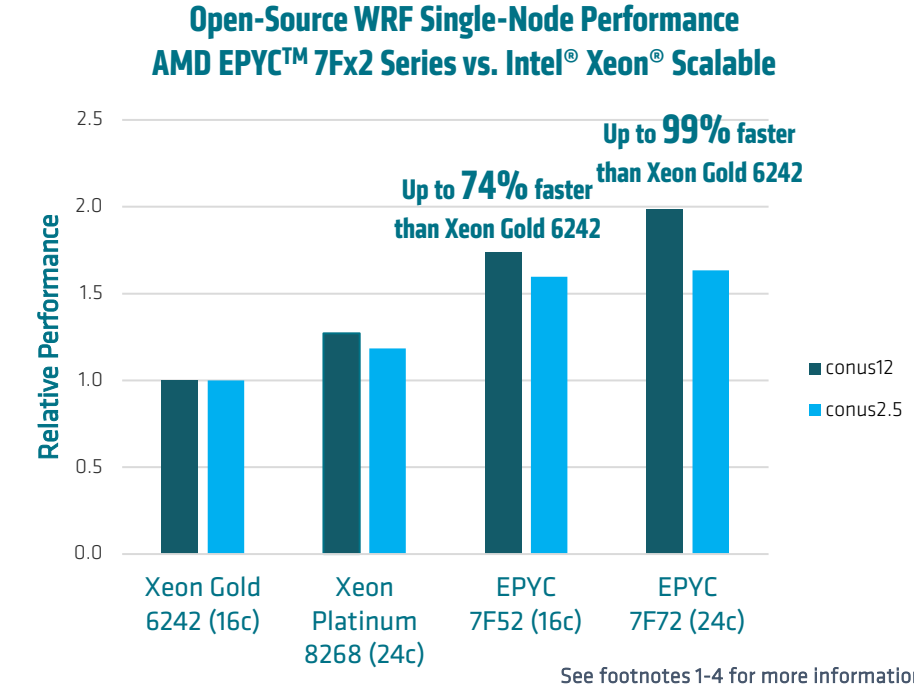

Figure 1 - Single-node AMD EPYC 7Fx2 processors vs. 2nd Gen Intel Xeon Scalable processors.

74% and 99%, respectively. Testing was performed by AMD engineering.[1,2,3,4] Five runs were made for each test, with the average score shown.

Performance Per Core

Comparing 16-core EPYC 7F52 CPUs against 16-core Xeon 6242 CPUs also highlights the ~74% performance per core advantage. Whether you are looking for great single node performance, or high performance per core, the AMD EPYC 7F52 CPU clearly outperforms the Xeon Gold 6242 CPU.

WRF Scaling Performance

Using the larger conus2.5 test to understand scaling, Figure 2 demonstrates how the EPYC 7F52 CPUs efficiently scale through 16 nodes. This scaling demonstrated is not only efficient, but is nearly perfect scaling efficiency. EPYC 7F52 CPUs deliver up to ~99% scaling efficiency at 16 nodes on the conus 2.5 test case.

AMD EPYC 7Fx2 processors are the right choice for optimizing both overall performance and performance per core.

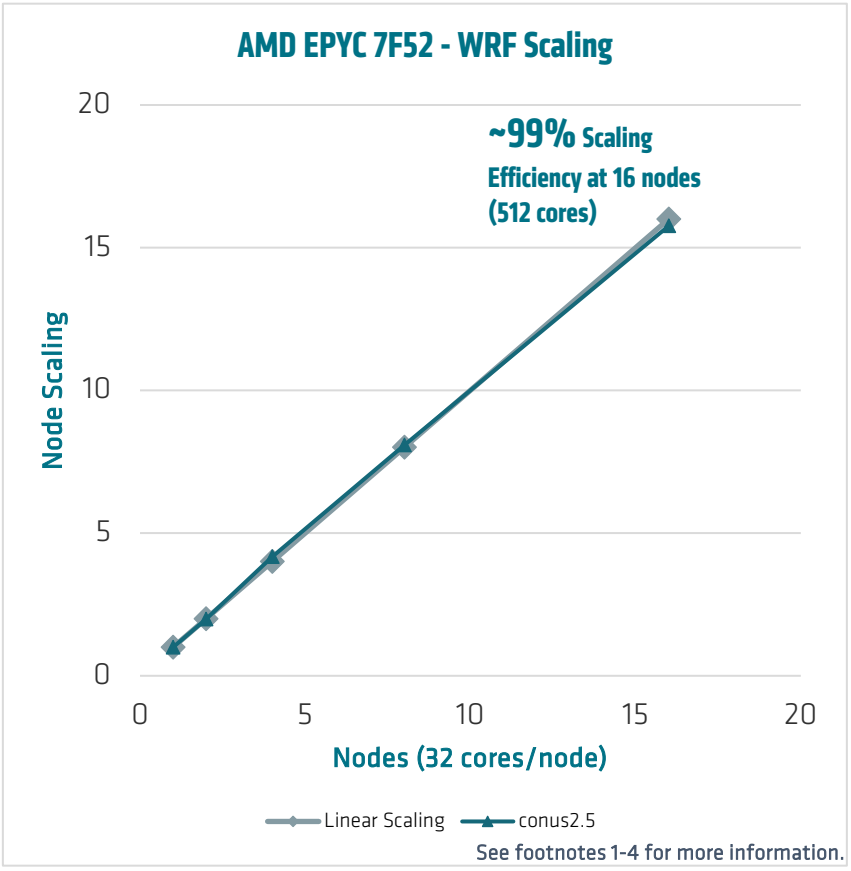

Figure 2 - AMD EPYC 7F52 scaling efficiency on WRF CONUS 2.5km.

Get started with WRF and AMD EPYC today

- 2nd Gen EPYC Processors - https://www.amd.com/en/processors/epyc-7002-series
- AMD EPYC Family of Processors for HPC - https://www.amd.com/en/processors/epyc-for-hpc
- WRF - https://www.mmm.ucar.edu/weather-research-and-forecasting-model *

*Links to third party sites are provided for convenience and unless explicitly stated, AMD is not responsible for the contents of such linked sites and no endorsement is implied.

FOOTNOTES

1. Performance measured with WRF version 3.8.1 which was compiled from source using Intel Parallel Studio XE Cluster Edition 2020, on RHEL 7.7 (3.10.0-1062.el7.x86_64). WRF dependencies used include (AMD) OpenMPI 3.13, (Intel) IntelMPI 2020, netcdf-4.1.3, zlib-1.2.7, libpng-1.2.50, jasper-1.900.1. All libraries were compiled from source. The following compiler flags were used for Intel: -O3 -xCORE-AVX512 -fp-model fast=2 -no-prec-div -qoverride-limits; for AMD: -O3 -xCORE-AVX2 -qoverride-limits.
2. Benchmarks used are the standard CONUS12km and CONUS2.5km WRF benchmarks.
3. AMD EPYC Processor-based System - CPUs: 2x 7F72, 2x 7F52, 16x Micron® 64GB DDR4-3200 DR 1DPC, Mellanox® CX-6 HDR 200 Gb/s IB x16 PCIe® Gen 4, 1x Micron 1100 256 GB SATA (OS), 1x1 TB NVMe™ (Data), BIOS settings: Defaults, plus NPS=NPS4 (7F52), NPS=NPS2 (7F72), SMT = Off, Boost = On, APBDIS=1, Fixed SOC P state=P0, DLWM=off, X2APIC = On, Determinism Slider = Performance, Preferred IO=Enabled.
4. Intel Xeon Scalable Processor-based System - CPUs: 2x Platinum 8268, 2x Gold 6242, 12x 64GB DDR4-2933 DR 1DPC, 1x Micron 1100 256 GB SATA (OS), 1x1 TB NVMe (Data), BIOS settings: Defaults, plus Power Management=Extreme Performance, Hyper-threading=Off, SNC=On, ADDDC=Off.
5. Max boost for AMD EPYC processors is the maximum frequency achievable by any single core on the processor under normal operating conditions for server systems. EPYC-18