WHITE PAPER

MAXIMIZING A+ BIGTWIN® SERVER PERFORMANCE WITH AMD EPYC™ 7Fx2 PROCESSORS

Balanced compute resources, memory bandwidth, and network bandwidth deliver outstanding performance and scalability for popular simulation software

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SUPERMICRO

Supermicro (Nasdaq: SMCI), the leading innovator in high-performance, high-efficiency server and storage technology is a premier provider of advanced server Building Block Solutions® for Enterprise Data Center, Cloud Computing, Artificial Intelligence, and Edge Computing Systems worldwide. Supermicro is committed to protecting the environment through its "We Keep IT Green®" initiative and provides customers with the most energy-efficient, environmentally-friendly solutions available on the market.

Executive Summary

In this white paper, we discuss the performance results of three industry-leading physics simulation software packages that are solving complex real-world problems, running on Supermicro's latest A+ BigTwin server with AMD EPYC™ 7Fx2 processors.

Supermicro's A+ BigTwin servers demonstrate high scalability and speed with exceptional memory bandwidth and floating-point performance, offering organizations the benefit of the right balance between scalability and density for their workloads to operate these applications.

Physics Simulation Software Packages: Altair RADIOSS, WRF, and ANSYS Fluent

Altair RADIOSS

RADIOSS is a leading structural analysis solver for highly non-linear problems under dynamic loadings. RADIOSS has established itself as a leader and an industry standard for automotive crash simulation, drop & impact analysis, terminal ballistic, blast and explosion effects, and high-velocity impacts. With a sophisticated customer base that values performance, reliability, safety, and innovation, the RADIOSS team is committed to supporting the most up-to-date, advanced computing architectures and integrating new technologies to improve performance, scalability, and usability. RADIOSS leads the industry in understanding many of the state-of-art computing hardware's potential for powering complex simulation software applications and environments.

Weather Research and Forecasting Model (WRF)

The Weather Research and Forecasting (WRF) Model is a next-generation mesoscale numerical weather prediction system designed for 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, numeric, and data assimilation contributed by developers from the expansive research community.

ANSYS Fluent

ANSYS Fluent is a general-purpose computational fluid dynamics (CFD) and multi-physics tool that empowers you to go further and faster as you optimize your product's performance. Fluent software contains the broad physical modeling capabilities needed to model flow, turbulence, heat transfer, and reactions for industrial applications. Fluent covers a broad reach, including special capabilities to model in-cylinder combustion, aero-acoustics, turbomachinery, and multiphase systems. AMD and ANSYS have an ongoing technology partnership to deliver exceptional performance for customers.

Supermicro A+ BigTwin: Where Performance Meets Efficiency for Modern and Complex Applications

Compute requirements are increasing, while datacenter space is not. Supermicro's innovative A+ BigTwin family of servers, powered by AMD EPYC processors, offers incredible core density with a rich feature set. Innovative server design meets innovative CPU architecture to drive new levels of value for the datacenter.

- **Performance:** Supports the high-performance AMD EPYC processors for up to 64 cores/128 threads, up to 4TB of DDR4 memory, and 6 hot-swap drives (4 NVMe and 2 SATA3) per node for the most demanding workloads.
- **Density**: Incredible high-density with up to 4 hot-swappable nodes in a 2U form factor provides flexible and robust IO options – 1G, 10G, 25G, or 100G Ethernet or 100G InfiniBand, and up to 2 additional low-profile PCI-E 4.0 x16 expansion slots per node.

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- **Efficiency**: Designed with power and cost efficiency in mind, BigTwin reduces power consumption with shared cooling and power design, leveraging redundant 2200W and optional 2600W Titanium level high-efficiency (96%) power supplies (Full redundancy based on configuration and application load).

A+ BIGTWINS WITH AMD EPYC PROCESSORS

AMD EPYC Processors for High Performance Computing (HPC)

The AMD EPYC processor brings a new balance to the datacenter. The highest core count yet in an AMD x86-architecture server processor, large memory capacity, memory bandwidth, and I/O density are all brought together in the right balance to help performance reach new heights.

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

High Frequency

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

High Cache per Core

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

Model	Cores	Base Freq (GHz)	Boost Freq[3] (Up to GHz)	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

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A+ BigTwin WRF Scalability and Performance

With leadership architecture, 2nd Gen AMD EPYC Series Processors demonstrate very high scalability for HPC applications by supporting 8 channels of memory per processor and PCI-E 4.0. Building on dominant performances at a single node, Figure 1 demonstrates how the AMD EPYC 7F72 CPUs efficiently scale through 4 nodes. The scaling in Figure 1 is showing nearly perfect scaling efficiency. AMD EPYC 7F72 CPUs deliver up to ~103% scaling efficiency at 4 nodes.

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

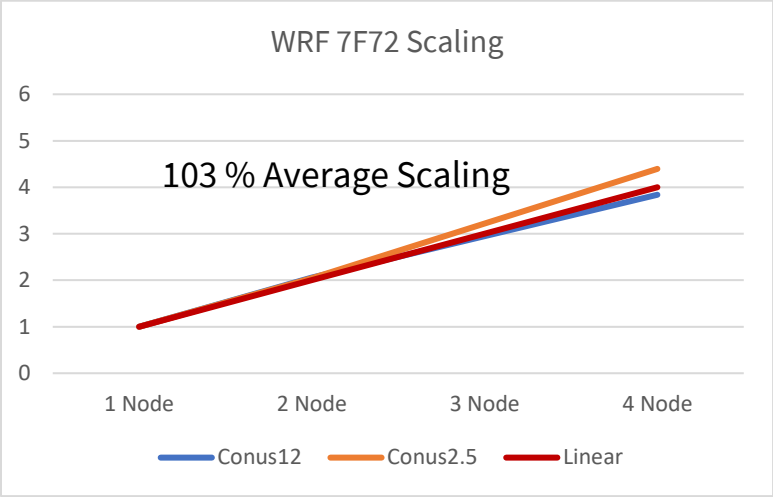

Figure 1. AMD EPYC 7F72 Scaling Performance on WRF Benchmark

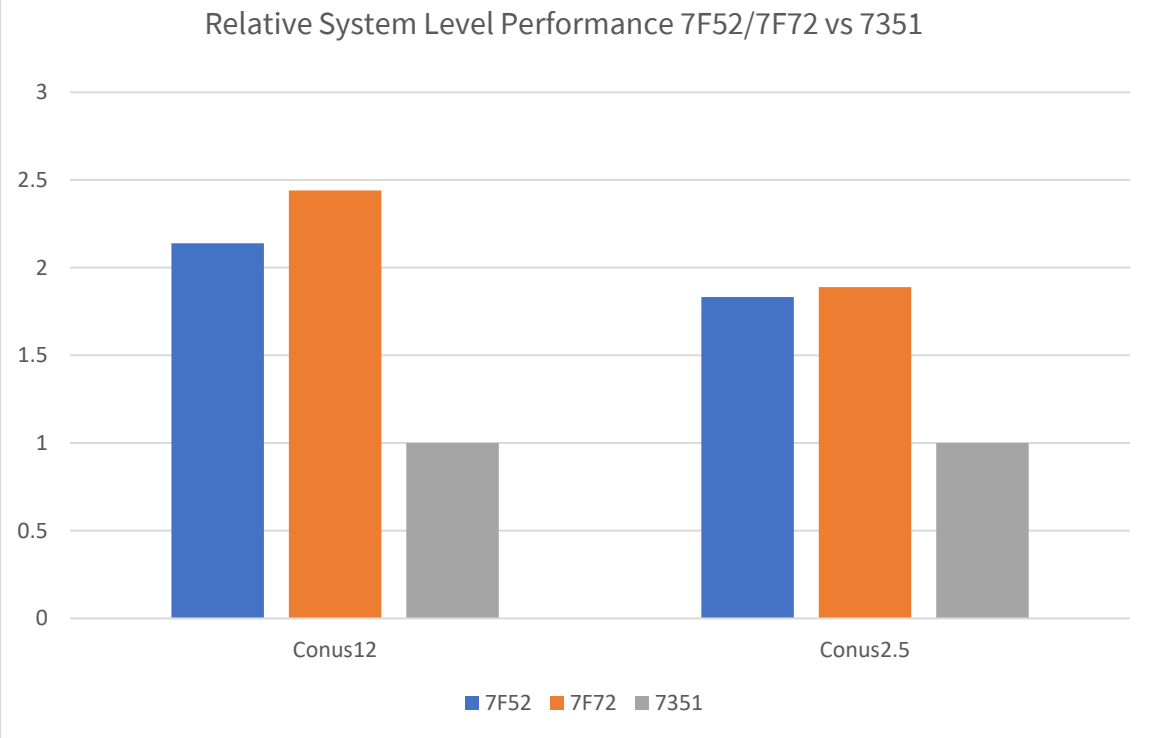

Figure 2. Shows the performance gain when comparing the 2nd Gen 16-core AMD EPYC 7F52 with the 16-core 1st Gen AMD EPYC 7351 CPUs. Performance gain is up to 62%.

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A+ BigTwin ANSYS Fluent Scalability and Performance

Building on dominant performances at a single node, Figure 3 demonstrates how the AMD EPYC 7F72 CPUs efficiently scale up through 4 nodes. This scaling is not only efficient but is super-linear for these large Fluent benchmark models. AMD EPYC 7F72 CPUs deliver up to ~102% scaling efficiency at 4 nodes. Super-linear speedup of Fluent is often caused by the availability and use of larger amounts of "fast" memory (e.g., cache or local memory).

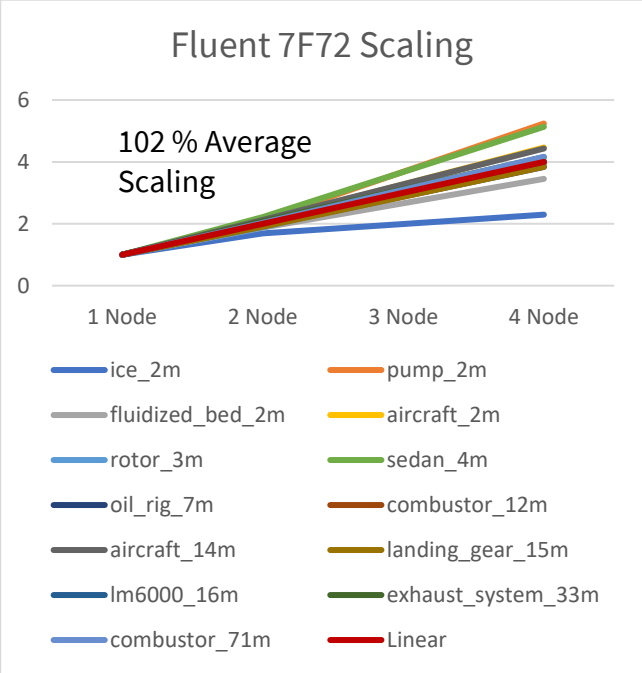

Figure 3. AMD EPYC 7F72 Scaling Performance on Fluent benchmarks

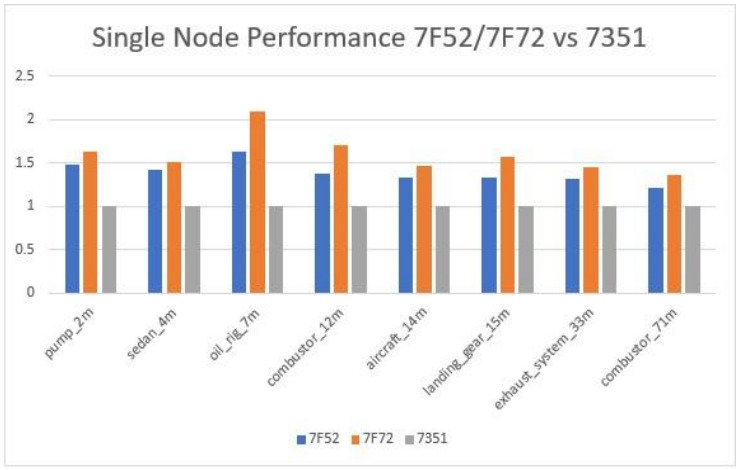

Figure 4. Shows the performance gain when comparing the 16-core AMD EPYC 7F52 with the 16-core AMD EPYC 7351 CPUs. Performance gain is up to 62%.

A+ BigTwin Altair RADIOSS Scalability and Performance

Figure 5 shows how AMD EPYC 7F72 CPUs performance for Altair RADIOSS efficiently scale up to at least 4 nodes. This scaling performance running the large t10m benchmark is exceptional for an FEA application**.**

Whether you are running jobs on a single node, or scaling out on a large cluster, AMD EPYC 7Fx2 CPUs are the right choice for maximizing your performance per core.

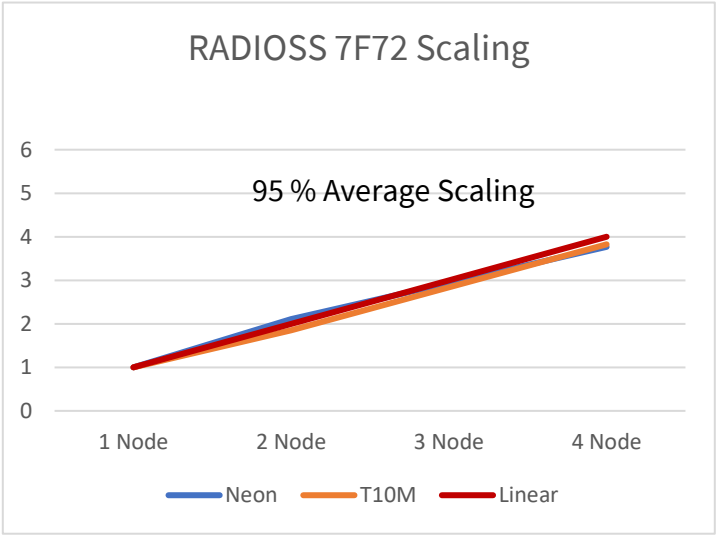

Figure 5. AMD EPYC 7F72 Scaling Performance on Altair RADIOSS benchmarks

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Conclusion

Modern modeling, analytics, and mathematical software require demanding workloads with balanced memory bandwidth, floating-point performance, and network I/O. Supermicro's A+ BigTwin servers, powered by AMD EPYC processors, provide exceptional memory bandwidth and floating-point performance, offering organizations the benefit of the right balance between scalability and density for their workloads.

Get more info about AMD EPYC

- 2nd Gen AMD 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

Get started with Altair RADIOSS, WRF, and ANSYS Fluent with AMD EPYC today

- Altair - http://www.altair.com
- WRF - https://www.mmm.ucar.edu/weather-research-and-forecasting-model
- ANSYS - http://www.ansys.com

FLUENT & WRF SERVER CONFIGURATION	
Compute node	
Servers	Supermicro BigTwin AS -2124BT-HNTR
CPU	2x EPYC 7F72 -OR- 2x EPYC 7F52
Cores	EPYC 7F52: 16 cores per socket / 32 cores per node EPYC 2F72: 24 cores per socket / 48 cores per node
Memory	1,024GB Dual-Rank DDR4-2933
NIC	Mellanox CX-6 HDR 200Gb/s x16 PCI-E Gen 4
Storage: OS	1x 960 GB U.2
Storage: Data	1x 1 TB NVMe M.2
Software	
OS	RHEL 7.7 (3.10.0-1062.el7.x86_64)
Mellanox OFED Driver	MLNX_OFED_LINUX-4.7-1.0.0.1
MPI Version	Platform MPI (platform_mpi-09.01.04.03)
Fluent version	19 release 1
OpenMPI Version	4.0.1
WRF Version	3.8.1
Compiled with ICC	2018.3.222
BIOS Setting	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
OS Settings	Transparent Huge Pages=disabled, Swappiness=disabled, Governor=Performance
Network	
Switch	Mellanox HDR 200 Gb/s (QM8700); EDR cable at 100Gb/s

FOOTNOTES

1. Performance measured with Altair Radioss version 2018 on RHEL 7.7 (3.10.0-1062.el7.x86_64), running theT10M benchmarks.
2. AMD EPYC Processor-based System - CPUs: 2x 7F72, 2x 7F52, 16x Micron™ 64GB DDR4-2933 DR 1DPC, Mellanox™ CX-6 HDR 200 Gb/s IB x16 PCIe® Gen 4, 1x Micron 1100 960 GB U.2 (OS), 1x 1TB 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.
3. 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

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