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White Paper

Altair Radioss™ Performance on Supermicro BigTwin™ and AMD EPYC™

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

Executive Summary

Altair Radioss

Altair Radioss is a leading structural analysis solver for highly non-linear problems under dynamic loadings. Altair Radioss has established itself as a leader and an industry standard for automotive crash, drop & impact analysis, terminal ballistic, blast and explosion effects and high velocity impacts.

Exceptional Memory Bandwidth

OpenFOAM is a memory-intensive workload that benefits from AMD EPYC's 8 channels of memory bandwidth and the BigTwin optimized design.

High Density, Maximized Value

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

Conclusion

Scale-out testing on the BigTwin™ cluster shows impressive results on the Altair Radioss models. Results showed a general, and expected, trend of better scaling as the model sizes increased. Smaller model sizes are best suited for smaller clusters to avoid the problem of over decomposition which will, at some point, negatively impact performance.

Supermicro BigTwin™: Where performance meets efficiency for HPC applications

Performance: Support the highest performance AMD® EPYC™ processors for up to 64 cores / 128 threads, up to 2TB of DDR4 memory, and up to 6 hot-swap All-Flash NVMe/SAS3/ SATA3 drives per node for the most demanding workloads.

Density: Incredibly high density with up to 4 hot swappable nodes in a 2U form factor with flexible and robust IO options--1G, 10G, 25G, or 100G Ethernet or 100G InfiniBand, and up to 2 additional low-profile PCI-E 3.0 x16 expansion slots per node.

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

AMD EPYC: The right choice for Computer Aided Engineering

Designed from the ground up for a new generation of solutions, AMD EPYC implements a philosophy of choice without restriction. Choose the number of cores and sockets that meet your needs without sacrificing key features like memory and I/O.

Each EPYC processor can have from 8 to 32 cores with access to incredible amounts of I/O and memory regardless of the number of cores in use, including 128 PCIe lanes, and access to 2 TB of high speed memory per socket across 8 memory channels.

AMD EPYC for Structural Analysis

Memory bandwidth is a critical factor in maximizing performance of explicit Structural Analysis workloads. AMD EPYC server processors' exceptional memory bandwidth ensures that you get the most out of your system, minimizing execution time and increasing overall utilization of your deployment.

The EPYC Advantage
AMD EPYC server processors offer up to 8 memory channels of DDR4-2666 per CPU, yielding exceptional memory bandwidth.

Many High-Performance Compute (HPC) workloads require you to balance performance vs per-core license costs to manage your overall cost. AMD EPYC processors offer a consistent set of features across the product line, allowing users to optimize the number of cores required for their workloads without sacrificing features, memory channels, memory capacity, or I/O lanes. Whether you need 8, 16, 24, or 32 physical cores per socket, you will have access to 8 channels of memory per processor across all EPYC server processors.

As workloads demand more processor cores, the communications between processor cores becomes critical to efficiently solving the complex problems faced by customers. As cluster sizes increase, the communication requirements between nodes rises quickly and can limit scaling at large node counts. AMD and Altair have collaborated to offer solutions for Structural Analysis workloads enabling exceptional performance and low implementation costs.

The EPYC Advantage
Performance - The AMD EPYC processor brings 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.

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, 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 is leading the industry in understanding many of the state-of-art computing hardware's potential for powering complex simulation software applications and environments.

The EPYC Advantage
Collaboration between AMD and Altair offers high performance and scalability for solving multi-physics problems in automotive, aerospace, electronics, defense and R&D applications. Altair Radioss helps companies understand and predict design behavior in complex environments, such as automotive crash, airplane ditching or blast effect on vehicles.

AMD and Altair have continued their partnership and AMD EPYC is fully supported on Altair products.

Altair's PBS Professional™ is a fast, powerful workload manager designed to improve productivity, optimize utilization & efficiency, and simplify administration for HPC clusters, clouds and supercomputers. PBS Pro can help maximize the utilization of an AMD cluster and increase the job throughput of RADIOSS.

Performance Benchmarks and Testing

Altair Radioss benchmarks provide hardware performance data measured using sets of benchmark problems selected to represent typical usage. These tests were run with MPI. Future testing will include hybrid MPI/MP.

The Altair Radioss benchmark cases provide 2 workloads to predict performance on large and small models. The small model, 1M11, has around 1 million elements and the large model, T10M, has around 10 million elements. More information on the benchmarks is available at https://altairhyperworks.com/Benchmark.aspx

Altair Radioss testing was performed on a 32-node cluster of dual-socket AMD EPYC 7351 processors. Each EPYC 7351 processor has 16 cores with a base frequency of 2.4 GHz and a boost frequency of 2.9 GHz. Each system has a total of 16 channels of dual-rank DDR4-2666 memory, 8 channels per processor.

Compute Nodes	
Servers	Supermicro BigTwinTM AS2123BT-HNC0R
CPUs	2 x EPYC 7351 -OR- 2x EPYC 7451
Cores	16 per socket / 32 cores per node
Memory	256GB Dual-Rank DDR4-2666
NIC	Mellanox ConnectX-5 EDR 100Gb Infiniband x16 PCIe
Storage: OS	1 x 256 GB NVMe
Storage: Data	1 x 1 TB NVMe
Software	
OS	RHEL 7.5 (3.10.0-862.el7.x86_64)
Mellanox OFED Driver	MLNX_OFED_LINUX-4.3-3.0.2.1 (OFED-4.3-3.0.2)
MPI Version	Intel MPI (l_mpi-rt_2018.3.222)
Application	Altair Radioss 13.3.1
Network	
Switch	Mellanox EDR 100Gb/s Managed Switch (MSB7800-ES2F)
Configuration Options	
BIOS Setting	SMT=OFF, Boost=ON, Determinism Slider = Power
OS Settings	Transparent Huge Pages=ON (Default), Swappiness=0, Governor=Performance

Altair Radioss Performance and Scaling: Taurus FFB50 (T10M)

The Taurus FFB50, or T10M, is the larger of the two benchmark models with around 10 million elements. Altair Radioss Structural Explicit solver was run with the T10M model with 2ms of simulation time.

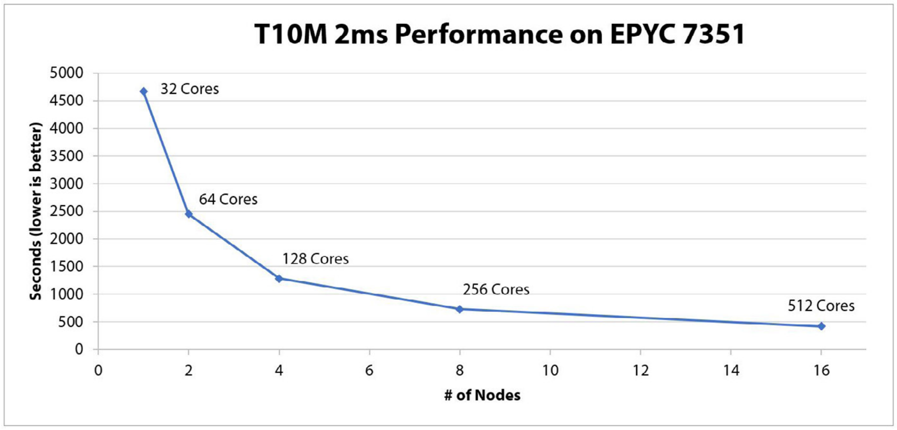

Figure 1. *T10M 2ms Performance on EPYC 7351*

As figure 1 shows, the elapsed compute time of this large model scales well with additional nodes, including all the way up to 512 cores in 16 nodes. Exceptional memory bandwidth and capacity allows us to scale efficiently to large core and node counts while still being cost effective. Figure 2 highlights the scaling factor as additional nodes are added. Testing was run with pure MPI. Future testing will include hybrid MP/MPI.

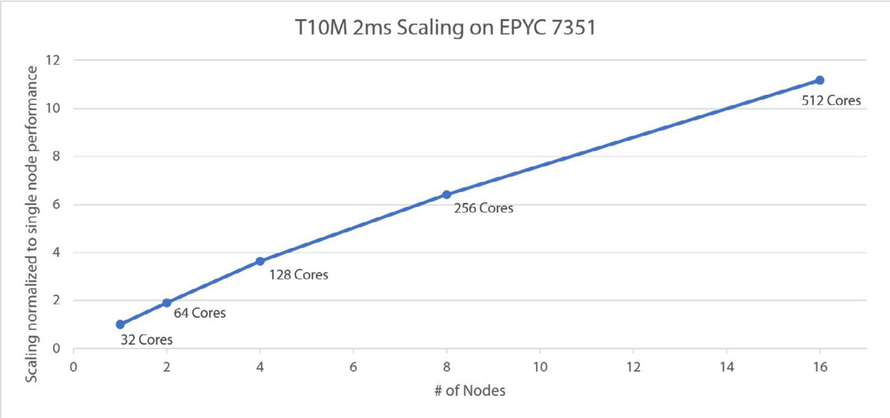

Figure 2. *T10M 2ms Scaling on EPYC 7351*

Altair Radioss Performance and Scaling: NEON FE (1M11)

The NEON FE benchmark simulates a frontal crash of a 1996 Chrysler Neon traveling at 50km/h colliding with a rigid wall. This analysis simulates the performance of the Neon (with refined mesh) through the first 80ms of the crash event. The complete model includes approximately 1 million elements and is considered a medium-large size model by 2008 standards but is considered small today.

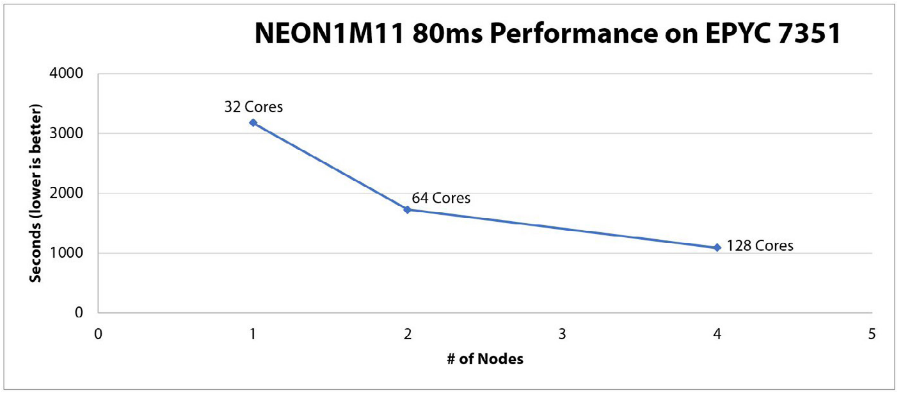

Figure 3. *NEON1 M11 80ms Performance on EPYC 7351*

Figure 3 shows that this model scales exceptionally well to 128 cores, 4 nodes. Being a small model, this type of workload is susceptible to over decomposition in which the model is broken down beyond effectiveness. Therefore, scaling to larger core and node counts could hurt performance due to spending too much time in communication compared to computation. The best performance balance on smaller models is around 1-4 nodes. Figure 4 shows the scaling factor as additional nodes are added.

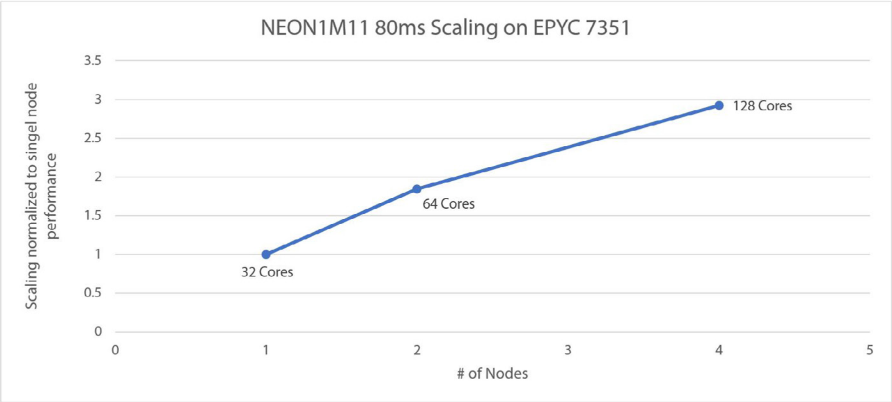

Figure 4. *NEON1 M11 80ms Scaling on EPYC 7351*

Conclusion

Scale-out testing on the EPYC cluster shows impressive results on these Altair Radioss models. Results showed a general, and expected, trend of better scaling as the model sizes increased. Smaller model sizes are best suited for smaller clusters to avoid the problem of over decomposition which will, at some point, negatively impact performance. This testing was run using MPI. Future testing will include hybrid MP/MPI.

Altair Radioss Structural Analysis application is architected to deliver accuracy, performance, and scalability to meet your Structural Analysis needs, empowering you to go further and faster as you optimize your product's performance. Altair Radioss includes well-validated physical modeling capabilities to deliver fast, accurate results across the widest range of Structural Analysis applications.

For More Information

Together, AMD, Supermicro, and Altair empower the development of fast, accurate structural analysis simulations running on cost-effective clustered systems.

- For more information about AMD's EPYC line of processors visit: **http://www.amd.com/epyc**
- For more information about Supermicro's AMD EPYC-based servers, visit: **http://www.supermicro.com/epyc**
- For more information about Altair visit: **https://www.altair.com**

About Super Micro Computer, Inc.

Supermicro® (NASDAQ: SMCI), the leading innovator in high-performance, high-efficiency server technology is a premier provider of advanced server Building Block Solutions® for Data Center, Cloud Computing, Enterprise IT, Hadoop/Big Data, HPC and Embedded 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.

Learn more on www.supermicro.com

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