WHITE PAPER

HIGH PERFORMANCE BUILDING BLOCKS: A+ BIGTWIN® SERVER FOR OPENFOAM® AND WRF WITH 3RD GEN AMD EPYC™ PROCESSORS

Construct Optimized IT Solutions with World Record Performance and Excellent Scalability

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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 OpenFOAM and WRF, running on Supermicro's latest A+ BigTwin server with 3rd Gen AMD EPYC™ 7713 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.

HPC Applications: OpenFOAM and WRF

OpenFOAM

OpenFOAM is a free, open-source computational fluid dynamics (CFD) software package developed by OpenCFD Ltd at ESI Group and distributed by the OpenFOAM Foundation. It has a large user base across most areas of engineering and science, from both commercial and academic organizations. OpenFOAM has an extensive range of features to solve anything from complex fluid flows involving chemical reactions, turbulence, and heat transfer, to solid dynamics and electromagnetics.

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. WRF can produce simulations based on actual atmospheric conditions (i.e., from observations and analyses) or idealized conditions for researchers. 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.

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

Compute requirements are increasing, while data center space is not. Supermicro's innovative A+ BigTwin family of servers, powered by 3rd Gen 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 data center.

- **Performance:** Supports the high-performance AMD EPYC processors for up to 64 cores/128 threads, up to 4TB of DDR4 memory, and six 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.
- **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+ BIGTWIN WITH 3RD GEN AMD EPYC PROCESSORS

AMD EPYC Processors for High Performance Computing (HPC)

Built on the x86 architecture innovations of the record setting EPYC 7002 processors, AMD EPYC™ 7003 Series Processors are the new standard for the modern data center. With higher frequencies, high core counts, high memory bandwidth, and capacity, AMD EPYC 7003 processors enable exceptional HPC performance across multiple industry verticals.

The new L3 Cache design can increase the cache hit to miss ratio over the previous design. Improved cache sharing also allows larger blocks to fit directly into the cache, whereas previously, they would fall into the main memory. Improvements made in the cache fetching and eviction policies manage data more efficiently. All these benefits result in an uplift in HPC workloads in addition to the core and memory improvements.

High Core and Density, 512 Cores and 1024 Threads in 2U for HPC

The Dual AMD EPYC 7713 processors used for each Supermicro A+ BigTwin system node have 64 cores with 128 threads per socket. It can clock up to 3.675GHz with 225W TDP and boasts 256MB of L3 cache with the 3rd Gen AMD EPYC (Milan) architecture. In addition, Supermicro's A+ BigTwin features four dual socket nodes in a 2U form factor, resulting in 512 cores and 1024 threads in one system.

CPU Model	Cores	Base Freq (GHz)	Boost Freq[3] (Up to GHz)	Cache (MB)
7713	64	2.0 GHz	3.675 GHz	256

A+ BigTwin OpenFOAM Scalability and Performance

Building on dominant performances at a single node, Figure 1 demonstrates how the AMD EPYC 7713 CPUs efficiently scale up through 8 nodes. This scaling is efficient and shows a much higher performance curve than the linear line for the OpenFOAM benchmark. AMD EPYC 7713 CPUs deliver up to ~144% scaling efficiency at eight nodes.

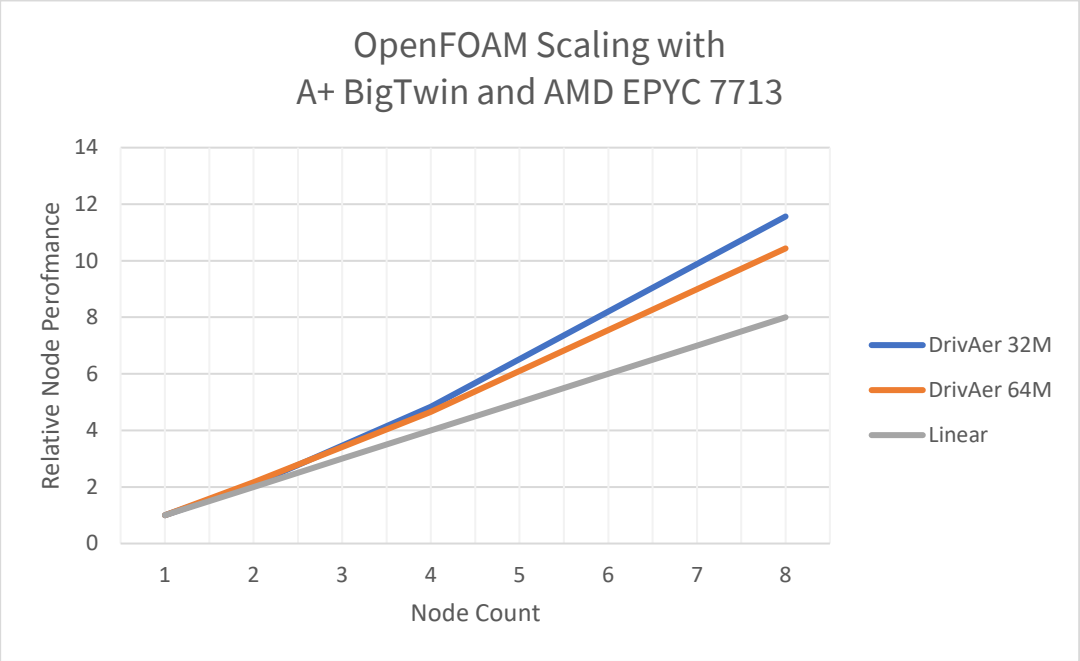

Figure 1

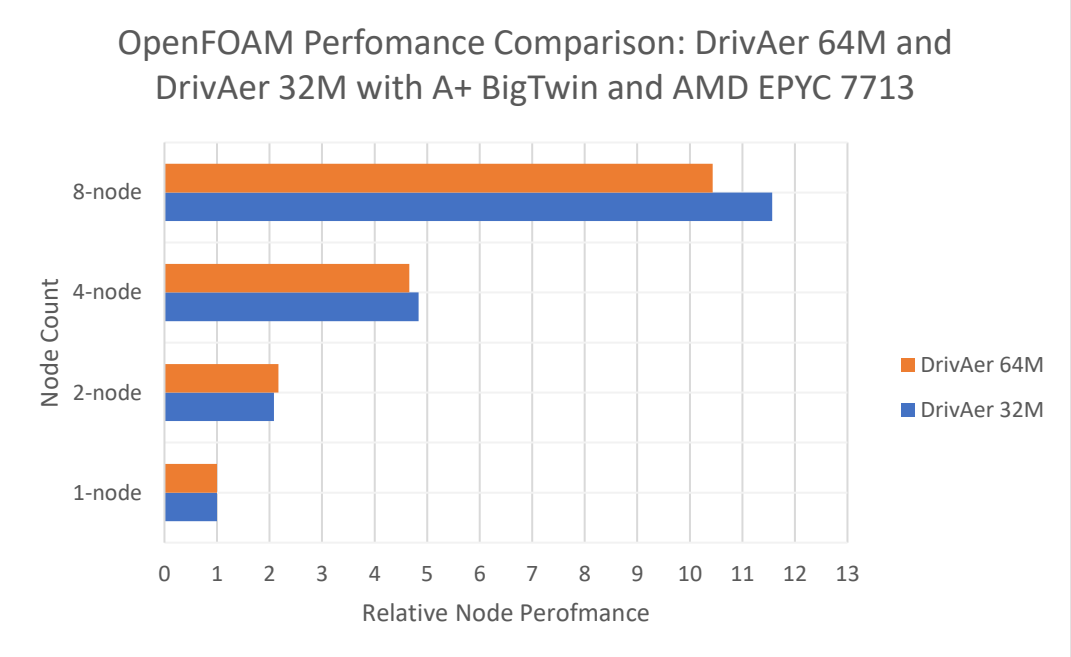

Figure 2

A+ BigTwin WRF Scalability and Performance

With leadership architecture, 3rd Gen AMD EPYC Series Processors demonstrate very high scalability for HPC applications by supporting eight channels of memory per processor and PCI-E 4.0. Building on dominant performances at a single node, Figure 3 demonstrates how the 3rd Gen AMD EPYC 7713 CPUs efficiently scale through 8 nodes. 3rd Gen AMD EPYC 7713 CPUs deliver more than ~94% scaling efficiency between 1 to 8 nodes.

3rd Gen AMD EPYC Processors are the right choice for maximizing both overall performance and performance per core.

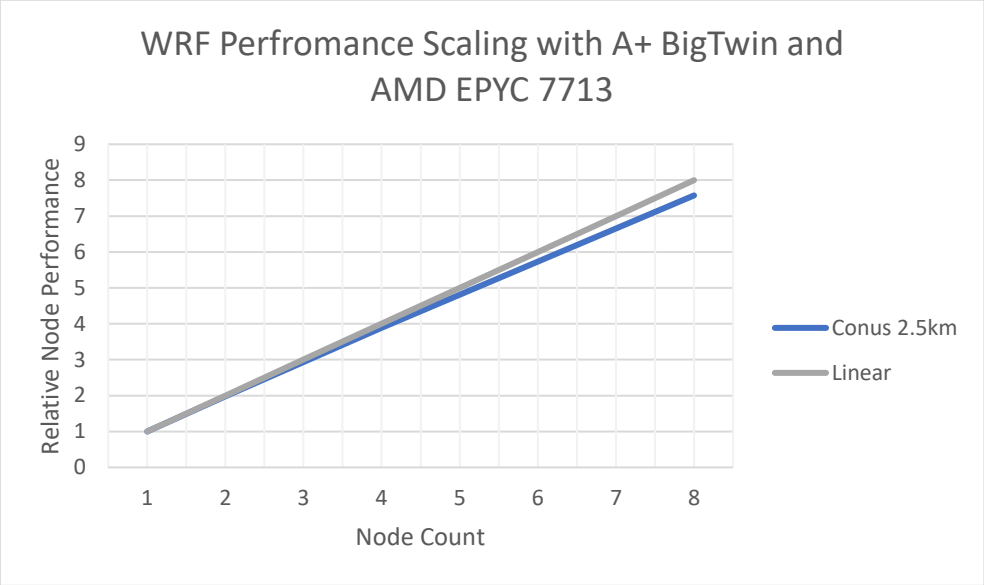

Figure 3

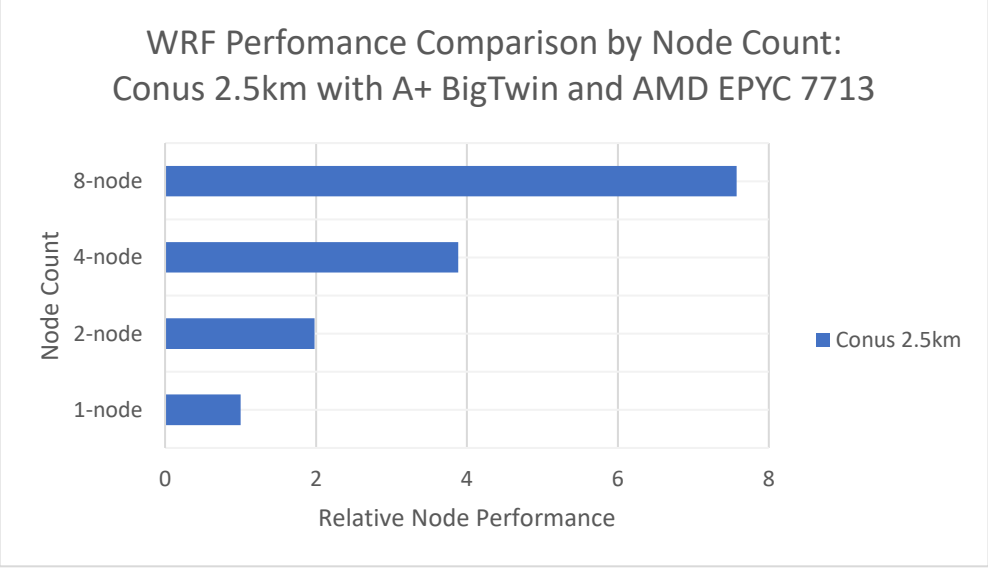

Figure 4

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 3rd Gen 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 Processors

- 3rd Gen AMD EPYC Processors - https://www.amd.com/en/products/epyc-server
- AMD EPYC Family of Processors for HPC - https://www.amd.com/hpc

Get started with OpenFOAM and WRF with Supermicro A+ and AMD EPYC Processors today

- OpenFOAM - https://www.openfoam.com/
- WRF - https://www.mmm.ucar.edu/weather-research-and-forecasting-model

OpenFoam & WRF SERVER CONFIGURATION	
Compute node	
Servers	Supermicro BigTwin AS -2124BT-HNTR
CPU	2x EPYC 7713 (per node)
Cores	EPYC 7713: 64 cores per socket / 128 cores per node
Memory	256GB Dual-Rank DDR4-3200 per node / 1,024GB total
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 8.3 (4.18.0-240.el8.x86_64)
Mellanox OFED Driver	MLNX_OFED_LINUX-5.2-1.0.4.0
OpenFoam Version	v2012
MPI version	4.1.1a1
Compiler	AOCC 2.3.0
WRF Version	4.1.5
OpenMPI version	4.1.1a1
Compiler	ICC compiler 2020
BIOS Setting	BIOS settings: Defaults, plus NPS=NPS4, SMT = Off, Boost = On, APBDIS=1, Fixed SOC P state=P0, X2APIC = On, Determinism Slider = Power, IOMMU=Disabled, Preferred IO=Enabled, Preferred IO Value=41
OS Settings	Transparent Huge Pages=disabled, Swappiness=disabled, Governor=Performance
Network	
Switch	Mellanox HDR 200 Gb/s (QM8700); HDR cable at 200Gb/s

DISCLAIMER

Testing performed by AMD Internal labs as of 03/01/2021. Results shown are averages of multiple runs and individual results may vary.

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