



Orchestrating a brighter world



# THE UNIVERSITY OF TSUKUBA CREATES PEGASUS, A 'HUGE MEMORY' AI SUPERCOMPUTER WITH THE SUPERMICRO SUPERBLADE®

*University of Tsukuba Center for Computational Sciences,  
Creates a Huge Memory HPC System for Researchers in a  
Wide Range of Disciplines.*



## INDUSTRY

University and Industrial  
Research

## CHALLENGES

- Large Memory Access  
Required Per CPU Core
- Highest Density Computing  
and GPU platform in  
minimum footprint for HPC  
and AI applications.
- High Density Compute  
Infrastructure

## Introduction

The Center for Computational Sciences at the University of Tsukuba is a multidisciplinary center that partners with many organizations on basic research in several areas. As part of an ongoing project to deliver state-of-the-art computing capabilities to a wide range of researchers, the University of Tsukuba, with NEC (as the prime contractor), has created a supercomputer that will address the computing and storage needs using Supermicro SuperBlade. The system is among the first in the world to use NVIDIA H100 GPUs and 4<sup>th</sup> Gen Intel® Xeon® Scalable processors.

## Challenges

The Center for Computational Sciences at the University of Tsukuba determined that a new HPC system was needed to address the increasing needs of researchers. As new AI research, Data Science, and Computational Science applications are used and developed, a system with significant amounts of memory per process is needed to address these initiatives. While on the contrary, the technical trend is that the number of cores per CPU continues to increase, and the amount of RAM per core continues to

decrease. The University of Tsukuba needed a solution that addressed a number of requirements: fast CPU processing, extensive memory access, and the latest GPU processing.

## SOLUTION

Supermicro SuperBlade®

SBE-610J2-822 Enclosure

- 5 Blades per Enclosure
- Ethernet Switch
- 96% efficiency Titanium Level redundant power supplies

SBI-611E-5T2N Blade

- 4<sup>th</sup> Gen Intel® Xeon® Scalable Processor
- NVIDIA H100 80GB PCIe GPU
- Intel® Optane™ Persistent Memory 300 series – 2048GB Persistent Memory
- 128GB DDR5 Memory
- NVIDIA ConnectX-7 400Gb/s InfiniBand HCA

## Solution

The Center for Computational Sciences at the University of Tsukuba selected the Supermicro SuperBlade® for its new supercomputer that addresses large memory needs with the latest GPU technologies for HPC and AI applications.

Specifically, the University of Tsukuba acquired 120 Supermicro 6U SuperBlades (in 24 enclosures, 5 SuperBlades per enclosure). Each SuperBlade ([SBI-611E-5T2N](#)) blade server is powered by 4<sup>th</sup> Gen Intel® Xeon® Platinum 8468 processors (350W TDP) and contains a single NVIDIA® H100 Tensor Core GPU 80GB HBM2E and 128GB DDR5-4800MHz of memory per blade. In addition, each node contains Intel® Optane™ Persistent Memory 300 series. Utilizing the NVIDIA Quantum-2 400Gb/s InfiniBand networking platform, each blade uses the NVIDIA ConnectX®-7 HCA to connect to the NVIDIA Quantum-2 switch.

Below is an image of SuperBlade used in the University of Tsukuba's new supercomputer Pegasus.



*SuperBlade 6U Enclosure with Five Blades*

## BENEFITS

Faster and More Complex Simulations

Additional Research Domains

Lower Energy Usage

The 120-node Pegasus supercomputer at the University of Tsukuba has a theoretical peak performance of 6.51 Petaflops in double precision with a measured LINPACK performance of 3.48 Petaflops. The overall cluster ranks #190 on the latest (June 2023) TOP500 list of the fastest supercomputer in the world. To learn more about the entire system performance, visit <https://www.top500.org/system/180170/>. In addition, Pegasus ranks #12 on the June, 2023 Green500 list, demonstrating an amazing 40.448 GFlops/Watt as one of the world's most energy-efficient Green Supercomputers.



*Supermicro SuperBlade with the Latest GPU, CPU, Memory, Networking, and Storage Technologies.*

The total memory in the cluster of Pegasus has a huge 255 TB (Terabyte) (15 TB DDR5 + 240 TB Persistent Memory), with a file system of 7.1 PB with an I/O capability of 40 GB/s.

In addition to the hardware components, an extensive software ecosystem is deployed on the servers, consisting of:

- Ubuntu
- Intel oneAPI (C++/C/Fortran, oneMKL, MPI, VTune, Trace Analyzer&Collector)
- NVIDIA HPC SDK (C++/C/Fortran/Cuda, cuBLAS, cuTENSOR, cuFFT, ..., Open MPI, NVSHMEM, NCCL, Profilers, Debugger)
- Open Source SDK (GNU Compilers, Python, PMDK, Open MPI)
- Tensorflow, Keras, PyTorch, ...
- JupyterHub, TensorBoard, Nextcloud, Gfarm

## Benefits

The University of Tsukuba realized a significant improvement in the performance of their application workloads due to four main factors:

- 1) Higher performance with the 4<sup>th</sup> Gen Intel Xeon Scalable processors
- 2) Use of NVIDIA H100 Tensor Core 80GB PCIe GPU

- 3) NVIDIA Quantum-2 InfiniBand networking provides ultra-low latency, high message rate, and extreme bandwidth to enable all resources in the cluster to run at peak performance
- 4) Additional huge memory space with Intel Optane Persistent Memory 300
- 5) Significant energy savings as one of the most energy-efficient supercomputers in the world (40.448 GFlops /Watt)

"Supermicro SuperBlade included in the NEC solutions has delivered an amazing set of HPC products realizing higher density in just five racks and integrated the highest performance and the latest generation processors, persistent memory, GPU, and network technologies. With the huge memory supercomputer, our university will be able to increase our research in areas such as large-scale data analysis, new applications of big data AI, and system software research. This high-density HPC system integrated the combination of 4th Gen Intel Xeon Scalable processors, NVIDIA H100 Tensor Core 80GB PCIe GPU, and high-speed InfiniBand NDR networking, all in a Supermicro SuperBlade has given us a fantastic HPC system that we will use for years."

- Prof. Taisuke Boku, Director of the Center for Computational Sciences, the University of Tsukuba.

Learn more about CCS at: <https://www.ccs.tsukuba.ac.jp/eng/>

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## SUPERMICRO

Supermicro is a global leader in high performance, green computing server technology and innovation. We provide our global customers with application-optimized servers and workstations customized with blade, storage, and GPU solutions. Our products offer proven reliability, superior design, and one of the industry's broadest array of product configurations, to fit all computational need.

For more information, visit [www.supermicro.com](http://www.supermicro.com)

## NEC

NEC established itself as a leader in the integration of IT and network technologies while promoting the brand statement of "Orchestrating a brighter world." NEC enables businesses and communities to adapt to rapid changes taking place in both society and the market as it provides for the social values of safety, security, fairness and efficiency to promote a more sustainable world where everyone has the chance to reach their full potential.

For more information, visit [www.nec.com](http://www.nec.com)