

“FUGAKU” – World’s Fastest Computer

Birth of Fugaku

Fujitsu has been developing supercomputer systems since 1977, equating to over 40 years of direct hands-on experience.

Fujitsu determined to further expand its HPC thought leadership and technical prowess by entering into a dedicated partnership with Japan’s leading research institute, RIKEN, in 2006. This technology development partnership led to the creation of the “K Computer,” successfully released in 2011.

The “K Computer” raised the bar for processing capabilities (over 10 PetaFLOPS) to successfully take on even larger and more complex challenges – consistent with Fujitsu’s corporate charter of tackling societal challenges, including global climate change and sustainability.

Fujitsu and Riken continued their collaboration by setting aggressive new targets for HPC solutions to further extend the ability to solve complex challenges, including applications to deliver improved energy efficiency, better weather and environmental disaster prediction, and next generation manufacturing. Fugaku, another name for Mt. Fuji, was announced May 23, 2019.

Achieving The Peak of Performance

Fujitsu Ltd. And RIKEN partnered to design the next generation supercomputer with the goal of achieving Exascale performance to enable HPC and AI applications to address the challenges facing mankind in various scientific and social fields. Goals of the project included building and delivering the highest peak performance, but also included wider adoption in applications, and broader applicability across industries, cloud and academia. The Fugaku name symbolizes the achievement of these objectives.

Fugaku’s designers also recognized the need for massively scalable systems to be power efficient, thus the team selected the ARM Instruction Set Architecture (ISA) along with the Scalable Vector Extensions (SVE) as the base processing design. The design was further optimized to deliver high core density and handle large vector size, high memory bandwidth and high-speed interconnect. Finally, all these elements were built in a system on chip (soc) implementation.



Ruling the Rankings

- **First place:** Top 500 list
- **First place:** HPCG
- **First place:** Graph 500
- **First place:** HPL-AI (real world applications)
- First time in history that single system ranks No. 1 on all four lists. Check out the [Comparative HPC Performance](#) for the full list.

Core to the achievement is the development of the Fujitsu A64FX microprocessor. The A64FX is based upon ARM architecture and is the first processor to leverage the ARM v8.2A Scalable Vector Extension (SVE) SIMD instruction set with 512-bit vector implementation.

The Fugaku installation, as of June 2020, is a system comprised of over 155,000 of these high performance A64FX CPUs connected with a TOFU-D interconnecting high-speed network. Peak performance has been shown to be approximately 537 PetaFLOPS.

Fujitsu Proprietary IP

The A64FX also changed the paradigm of how memory can be used and allocated for supercomputing requirements, by adapting HBM2 (High Bandwidth Memory), which is a high-performance stacked memory system embedded onto the A64FX chipset. This technology allows the Fugaku to cope with both full-precision and half-precision operations as well as integer dot operations, which are useful for Artificial Intelligence, Machine Learning and deep learning applications.

Unique to the Fugaku is its Proprietary Tofu (torus fusion) Interconnect. This is a network that essentially connects all the nodes directly, resulting in low latency and high bandwidth (6.8GB/s per link). This means that up to approximately 390,000 nodes can be connected by this mesh torus connection architecture – an architecture originally developed for the K-computer.

In order to take full advantage of the performance capabilities built into the A64FX, Fujitsu leverages the IHK/McKernal in a design that enables the operating system to use both LINUX and the McKernal simultaneously.

HPC Performance Leader of the World

Fujitsu brought Fugaku online a year earlier than planned to help fight against the Coronavirus pandemic (COVID-19), supporting worldwide Research and Government institutions by working to understand how the virus is transmitted and how it spreads, as well as providing the processing power to understand and probe multiple vaccine options simultaneously.

Initially installed at RIKEN in December 2019, Fugaku has now grown to approximately 400 racks with 384 nodes. Representing the very pinnacle of HPC performance, Fugaku is nearly 100 times more powerful than the “K Computer.”

In June 2020, Fugaku became the fastest rated supercomputer in the world, displacing the IBM Summit that had reigned for several years. It is the first time in history that a supercomputer has achieved greater than 1 Exaflop of performance (1.4 Exaflops).

In November 2020, Fugaku was tuned to increase its performance and HPC-AI benchmark to 2.0 Exaflops, further extending its lead over any other HPC solution implementation. Today, the Fugaku is solidly at the top of the HPC TOP500 list and delivers nearly twice the performance of any other system utilizing the HPCG benchmark.

The commercially available versions of Fugaku have been installed at the University of Regensburg (for simulations in Quantum Chromodynamics (QCD)), Minho Advanced Computing Center/Portugal, Stonybrook University, Sandia National Labs, Lawrence Livermore, and many more locations.



About ViON Corporation

ViON Corporation is a cloud service provider with over 40 years' experience designing and delivering enterprise data center solutions for government agencies and commercial businesses. The company provides a large portfolio of IT as-a-Service, including infrastructure, multi-cloud and artificial intelligence (AI) solutions. Focused on supporting the customer's IT modernization requirements, ViON's Enterprise Cloud is changing cloud management for the market, providing a streamlined platform to audit and control technology in an evolving multi-cloud world. The ViON Marketplace® allows customers to research, compare, procure and manage a full range of everything as-a-Service solutions from leading manufacturers via a single portal. ViON delivers an outstanding customer experience at every step with professional and managed services, backed by highly-trained, cleared resources. A veteran-owned company based in Herndon, Virginia, the company has field offices throughout the U.S. (vion.com).

To learn more, go to vion.com/cloud or email us at info@vion.com