

FUJITSU Supercomputer PRIMEHPC FX1000

A supercomputer based on technologies cultivated through the supercomputer Fugaku, enabling the creation of ultra-large-scale systems of over 1.3 EFLOPS.

The FUJITSU Supercomputer PRIMEHPC FX1000 features technologies developed together with RIKEN for use in the supercomputer Fugaku to provide high performance, high scalability, and high reliability, as well as one of the world's highest levels of ultra-low power consumption. The PRIMEHPC FX1000 helps pioneer new horizons in the fields of research and development using supercomputers. It has a minimum hardware configuration of 48 nodes in Japan and 192 nodes overseas.

A supercomputer with a newly developed Arm CPU

The A64FX, developed by Fujitsu, is the world's first CPU to implement a Scalable Vector Extension (SVE), an extension of the Armv8.2-A instruction set architecture for supercomputers. Manufactured using the state-of-the-art 7nm process, the A64FX has 48 computing cores and either two or four assistant cores. It can provide a theoretical peak double-precision floating-point operations performance of 3.3792 TFLOPS. Furthermore, it is capable of high-throughput single-precision/half-precision floating-point computation and 8bit/16bit integer operations using its 512-bit wide SIMD units. This calculation performance shines in processing applications such as AI.

Each node consists of one processor, and uses HBM2 (High Bandwidth Memory 2), a world first for a general-purpose CPU. Each node has a tremendous 1,024 GB/s of memory bandwidth.

Tofu Interconnect D (TofuD), which is used to connect nodes, has the same 6D mesh/torus architecture while increasing the amount of simultaneous transmission 1.5-fold compared to previous models. It directly connects nodes with low latency and high bandwidth (6.8 GB/s per link). The scalable TofuD can connect up to around 390,000 nodes, creating ultra-large-scale systems of 1.3 EFLOPS or more.

Microarchitecture with high processing performance

The A64FX's microarchitecture was developed using technologies that Fujitsu has refined through its experience with supercomputers, mainframes, and UNIX servers.

The A64FX carries on from the CMG (Core Memory Group) of the PRIMEHPC series, which enables scalable performance improvement when using multiple cores, as well as VISIMPACT (Virtual Single Processor by Integrated Multi-core Parallel Architecture), which realizes highly efficient hybrid parallel processing, OS interrupt processing by assistant cores, and MPI asynchronous communication. The A64FX also enhances functions such as SIMD functions.

The A64FX also features further improvements of the energy-saving technologies developed for the K computer and the PRIMEHPC series to provide high job execution performance and exceptional performance/power rates in large-scale systems.

High-density installation and efficient direct water cooling

The PRIMEHPC FX1000 has two nodes on a compact 23 cm x 28 cm board (CMU: CPU Memory Unit). Up to 192 CMUs can be installed in a dedicated rack, for up to 384 nodes per rack, an exceptional installation density.

The main components are directly water cooled, achieving a water-cooling ratio of 90% or greater. This enables high-density installation while maintaining a high level of reliability. Lowering component temperatures using water cooling reduces leak currents and power consumption, as well as lowering component failure rates.

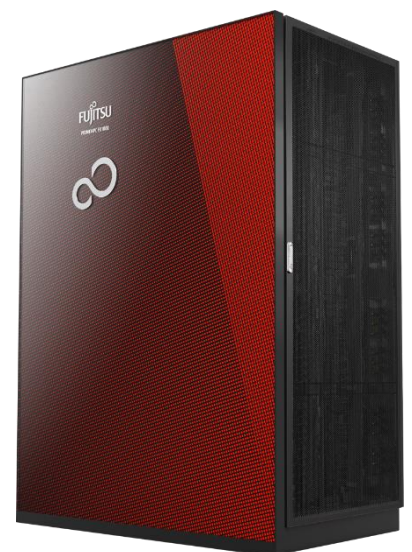
HPC software stack with an extensive usage track record

The FUJITSU Software Technical Computing Suite, which has an extensive track record of use in large-scale systems, is used for the software stack, offering excellent operability and stability. FUJITSU Software FEFS, a scalable distributed file system, compilers for high-level optimization for the A64FX, and other software improve application execution performance.


The industry-standard Red Hat Enterprise Linux is used as the OS, so software migration is easy.

The reliability and operability to support large-scale systems

The PRIMEHPC FX1000 provides total support for large-scale system reliability, availability, and operability. It does this through the A64FX, with RAS functions refined by Fujitsu through use in mission-critical servers; TofuD, with its highly flexible 6D mesh/torus architecture; its software stack, which provides efficient system management and job operation management functions, and more.



FUJITSU Supercomputer PRIMEHPC FX1000 Specifications



	CPU	Name	A64FX
		Instruction set architecture	Armv8.2-A SVE
		Number of cores	Computational node: 48 cores + 2 assistant cores I/O and computational node: 48 cores + 4 assistant cores
		Clock	2.2 GHz
		Theoretical peak performance	3.3792 TFLOPS (double precision)
	Node	Architecture	1 CPU/node
		Memory capacity	32 GiB (HBM2, 4 stacks)
		Memory bandwidth	1,024 GB/s
		Interconnect	Tofu Interconnect D
	Main unit	Form factor	Dedicated rack
		Maximum number of nodes	384 nodes/rack
		Cooling method	Water cooling
	Software	OS	Red Hat Enterprise Linux 8
		HPC middleware	FUJITSU Software Technical Computing Suite



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