

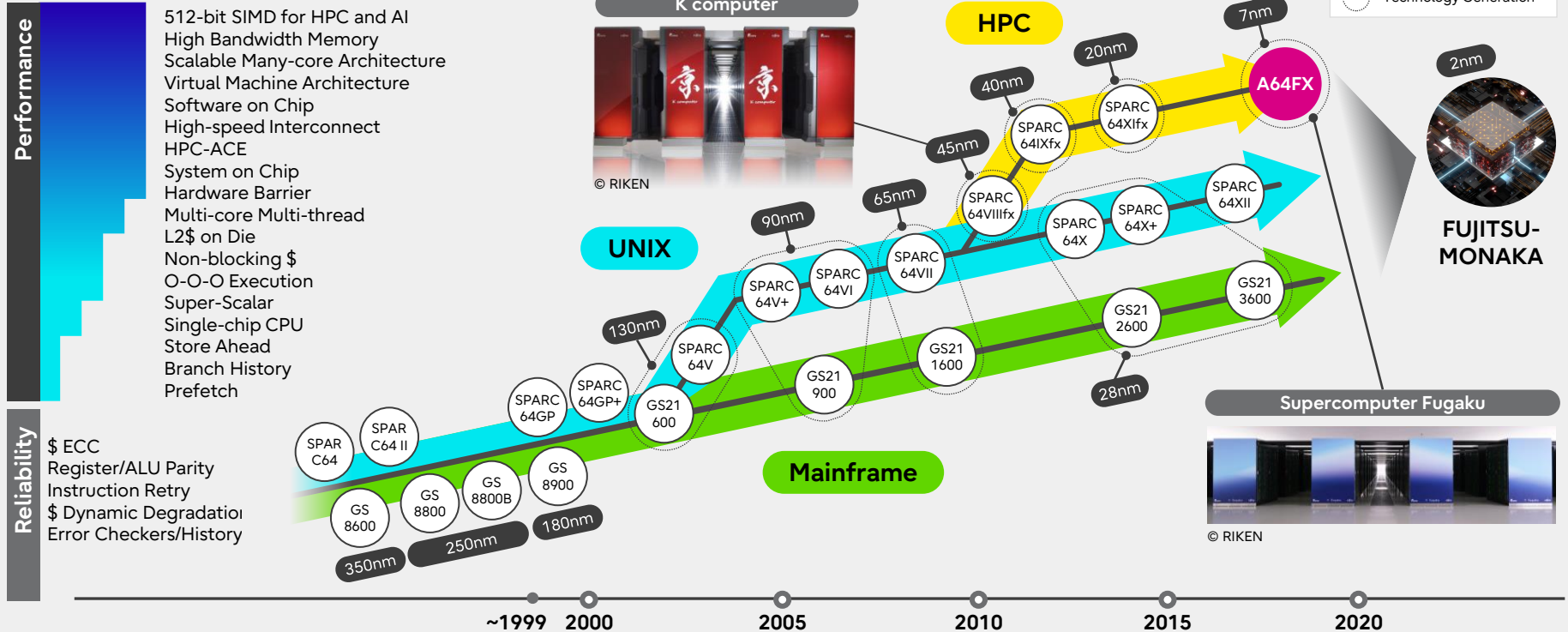
Next Arm-based Processor FUJITSU-MONAKA and Its Software Ecosystem



Fujitsu Limited

Fujitsu Processor Development

Persistent Evolution for over 60 years : Always targeting No.1



The Next Stage as World's Top Processor FUJITSU-MONAKA



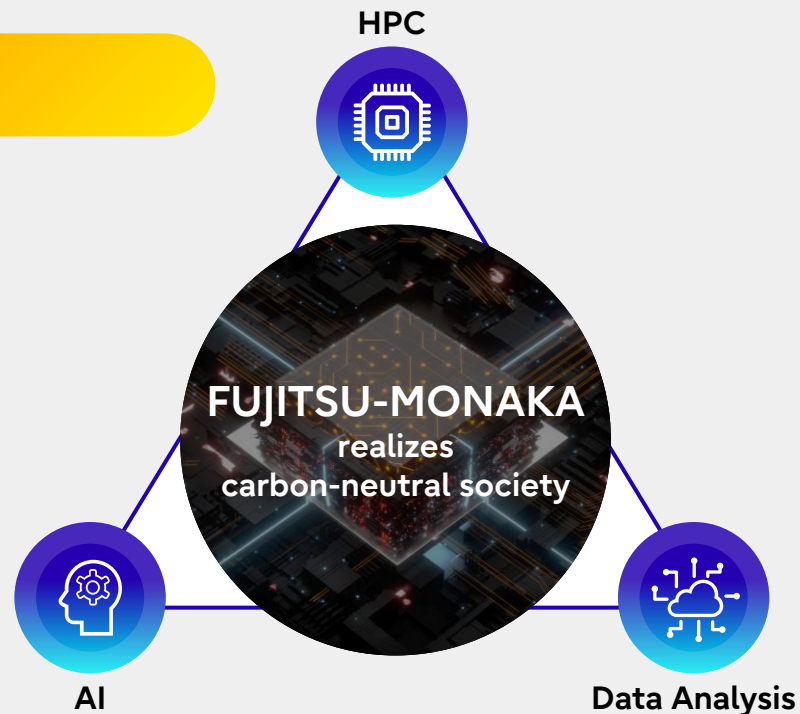
Arm-based ultra power efficient processor (To be shipped in 2027)

Inheritance from Fugaku

- Many-core architecture
- High memory bandwidth
- Ultra-low voltage operation
- Building software stack using real applications
- Promoting expansion of the Arm ecosystem

Standardize and optimize datacenter workloads

- Expand the scope of the software stack to datacenter systems
 - Co-development with open-source communities to build an ecosystem
- Meet the future demands of datacenters
 - Performance, power efficiency, reliability and usability



Hardware Overview -FUJITSU-MONAKA-

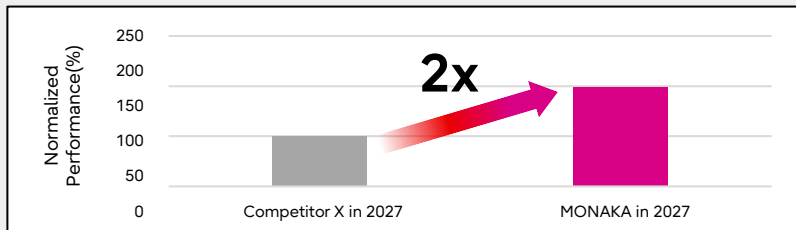
FUJITSU-MONAKA Specification

- **Armv9-A Architecture** - SVE2 for AI and HPC
- Confidential Computing for security
- **144 cores x 2 sockets (288 cores per node)**
- **Ultra low voltage for energy-efficiency**
- **3D chiplet**
 - Core Die 2nm
 - SRAM Die/IO Die 5nm
- **DDR5 12 channels**
- **PCI Express 6.0 (CXL3.0)**
- **Air cooling**

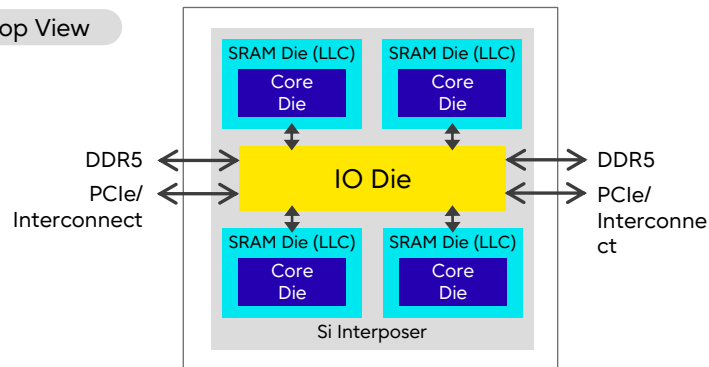
Performance Goals in 2027 (Compared to a competitor)



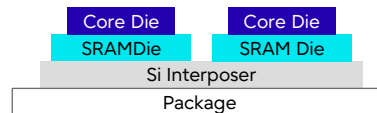
Application Performance



Top View



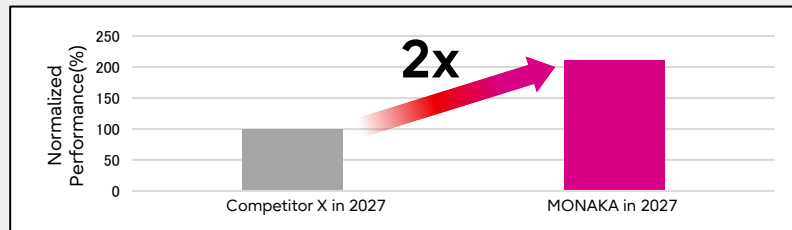
Side view



subject to change



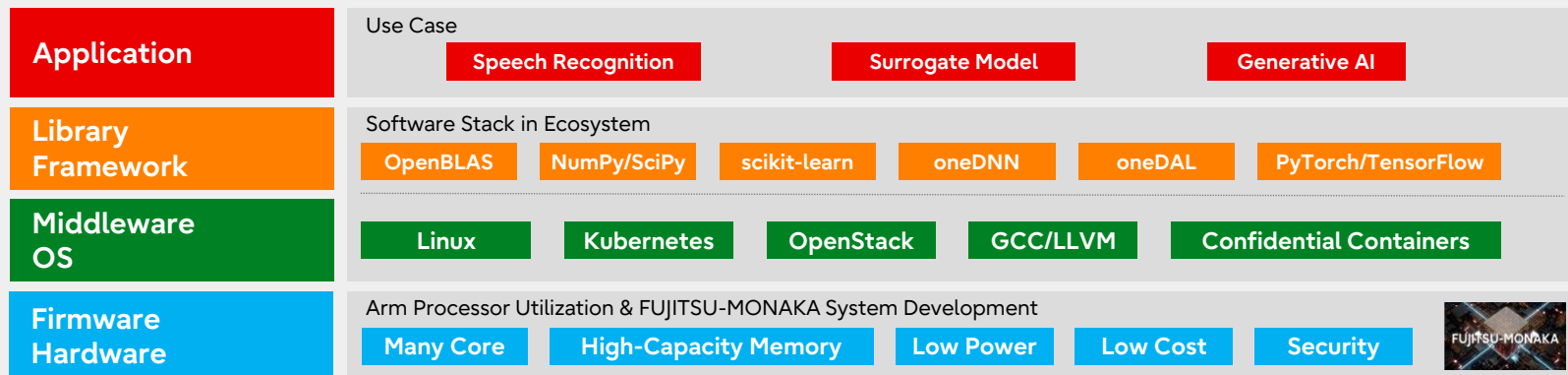
Performance per Watt



Software Overview -Arm x Software Ecosystem-

Fujitsu co-develops hardware and co-enhances software ecosystems globally

- The FUJITSU-MONAKA software stack is being co-enhanced with the community, focusing on OSS



Our recent activities

- 1** Enhancing Arm Support in LLVM Community
- 2** Promoting Growth of the Confidential Computing Technology
- 3** Joining UXL Foundation and Contributing to the AI Libraries
- 4** Use Case Creation Through Customer Co-Creation

1 Enhancing Arm Support in LLVM Community

Integrate Fujitsu's compiler technology into OSS to expand our technology worldwide

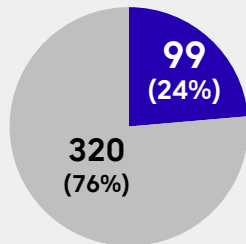
- Aim to ensure applications' behavior and to improve the performance using LLVM for FUJITSU-MONAKA
- Work on enhancing LLVM for various Arm systems, looking ahead to FUJITSU-MONAKA

Quality enhancement with Fujitsu test suite

- Significant contribution to improving the quality of Flang*, which the community identifies as a need

* LLVM's Fortran frontend

Number of reported issues of Flang in 2023



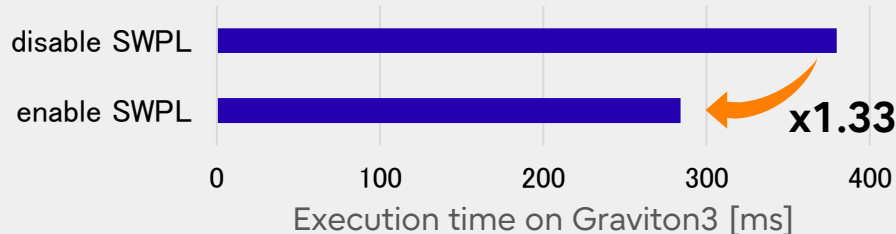
■ from Fujitsu ■ from Others

Several applications and libraries can be built by resolving reported issues

Apply Fujitsu's optimization technology to LLVM

- Enhance software pipelining (SWPL) for AArch64

Specific Loop Speedups



Fujitsu will continue these enhancements, contributing not only to FUJITSU-MONAKA but also to the Arm ecosystem.

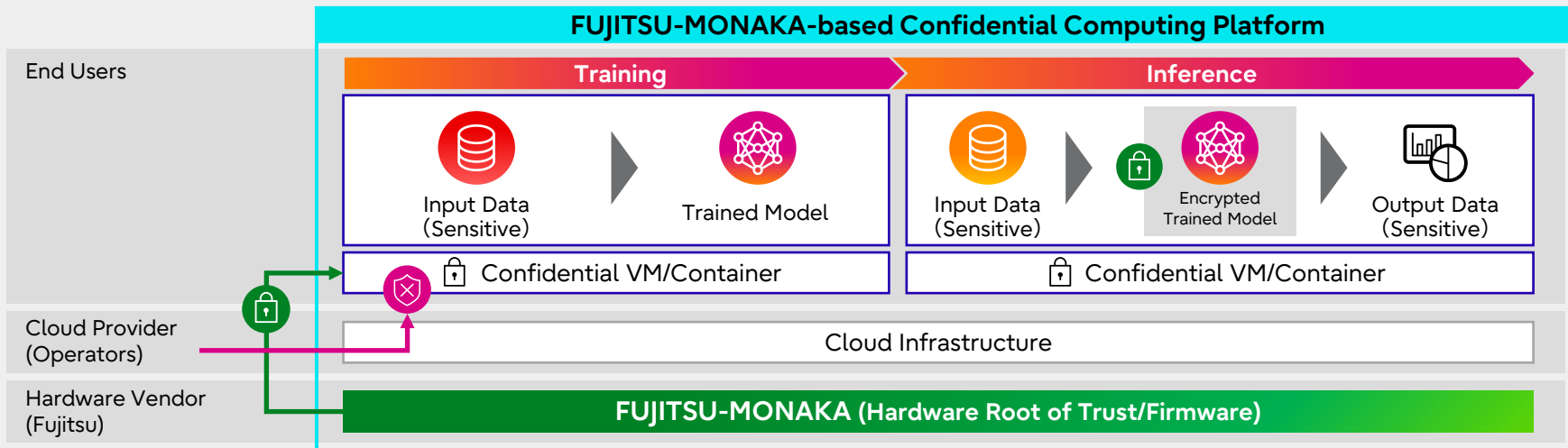
2 Promoting Growth of the Confidential Computing Technology

Fujitsu will deliver a secure, high-performance platform with FUJITSU-MONAKA

- Research and verification to promote OSS software development for confidential computing
- Contributing to the Arm CCA ecosystem's expansion by closely working with the communities and partners

The Confidential Computing platform can protect user's sensitive data and provide safety

- For AI workloads, this platform protects privacy of input/output data and intellectual property of trained models



Processor encrypts each VM's memory with a different key.
Expected to be an essential technology in cloud, AI and HPC environments that deals with sensitive data.

3 Joining UXL Foundation and Contributing to the AI Libraries

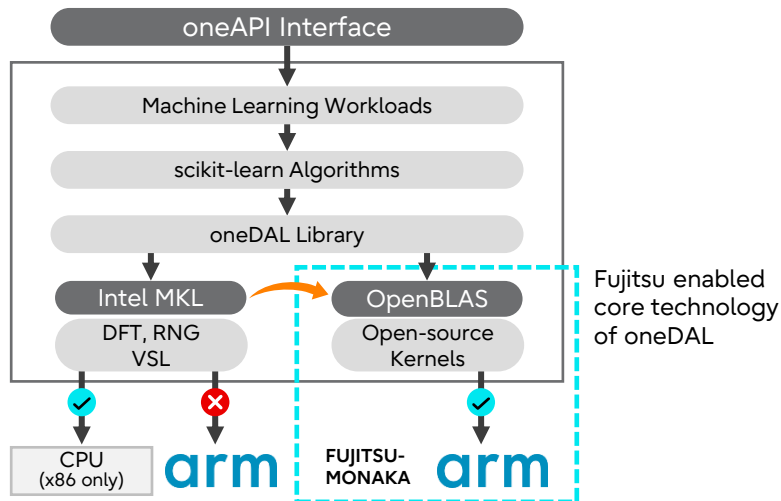
Build an open-source ecosystem for AI computing on the UXL Foundation

- Deliver a multi-architecture, multi-vendor open-source software accelerator ecosystem
- Especially focus on the oneAPI Data Analytics Library (oneDAL)



First successful Arm enablement for oneDAL

- Successfully replaced MKL MATH functions with optimized open-source compute kernels of OpenBLAS



Speedup for ML algorithms

- Achieved up to 40x perf. speedup for ML algorithms compared to the current ARM default perf. by replacing MATH functions



Future Outlook

- Continue to accelerate AI-ML algorithms further
- Contribute to the widespread use of open-standard software running on both CPU and GPU

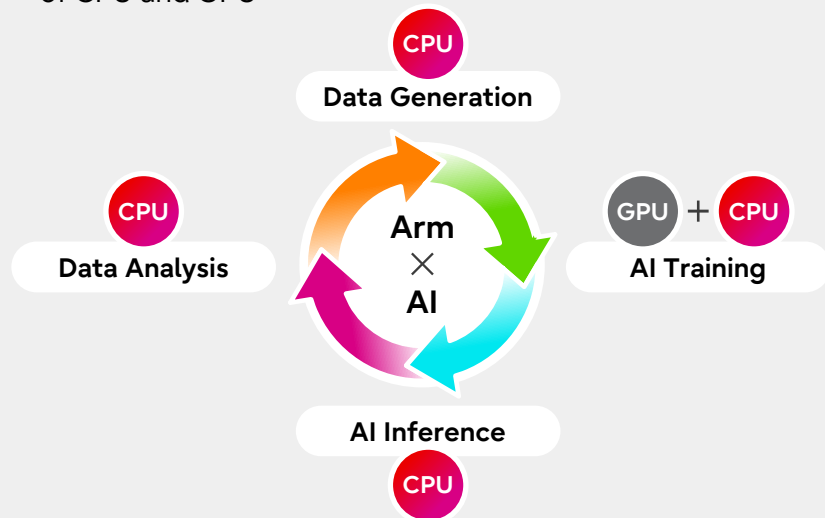
4 Use Case Creation Through Customer Co-Creation

Broadening the scope of the Arm ecosystem through customer co-creation

- Designing an Arm ecosystem where simply replacing the Arm CPU with FUJITSU-MONAKA results in performance improvement
- Co-creating use cases with customers that leverage the features of FUJITSU-MONAKA, with an emphasis on AI and data utilization

Examples of FUJITSU-MONAKA use cases

- Investigating AI use cases for FUJITSU-MONAKA by validating various AI models
- Evaluating the overall solution performance with a combination of CPU and GPU



Some examples of ongoing projects

Generative AI

LLM

Acceleration of LLM and RAG performance

AI Application

Speech recognition

Improved response/power efficiency

Surrogate Model

Chemistry

Accelerated predictions to aid material development

Why don't we co-create use cases that leverage Arm CPUs?

Conclusion

- Fujitsu develops high performance and energy-efficient processor called FUJITSU-MONAKA using our own microarchitecture and innovative 3D many-core architecture
- This processor will meet future computing demand of performance, power, reliability and usability for wide range of usage in the datacenter including AI and HPC
- Fujitsu co-enhances software ecosystem with OSS communities and co-creates use case with customers

* This presentation is based on results obtained from a project subsidized by the New Energy and Industrial Technology Development Organization (NEDO)

Thank you

