

EPI Forum

Barcelona, 9-10.10.2024.



Next Arm Processor FUJITSU-MONAKA and Its Technologies



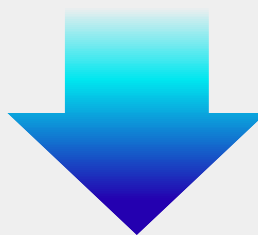
2024 October 9th, 2024

Advanced Technology Development Unit

Fujitsu Limited

Fujitsu's Next ARM Processor

- Creating a new era of computing power is mandatory for the future society with massive data generation and processing
- Ever-increasing power requirements in datacenters is critical, and the power efficiency in CPU (consists of 60%) will be a vital factor for a sustainable future
- Fujitsu shall utilize its depth in supercomputing technology to seek for a solution



FUJITSU-MONAKA

- **Develop a power efficient CPU "MONAKA" for datacenters, scheduled for shipping in 2027**
- **Targeted for wide range of usage from datacenter to edge including AI and possibly HPC**
- **Contribute to the realization of carbon-neutral society**

Fujitsu Arm Processor “MONAKA”



Fujitsu microarchitecture

3D multicore architecture

Confidential Computing



High-performance

- Cloud native 3D multicore design
- Proven microarchitecture
- High memory bandwidths



Energy Efficient

- Leading-edge process technology
- Ultra low voltage operation



High Reliability

- Multiple VM Confidential Computing
- Mainframe class RAS for stable operation

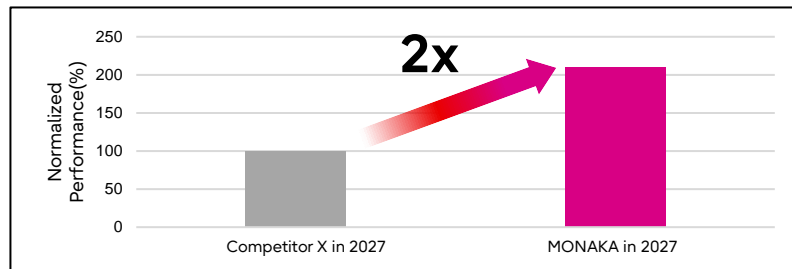


Easy to Use

- Open & de-facto standard software stacks
- Fujitsu compiler technology
- Air-Cooling for easy deployment

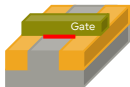
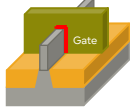
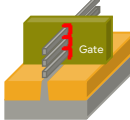


Performance per Watt



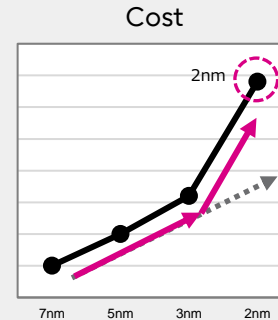
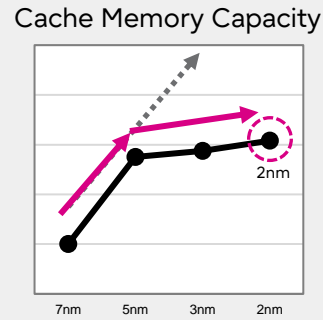
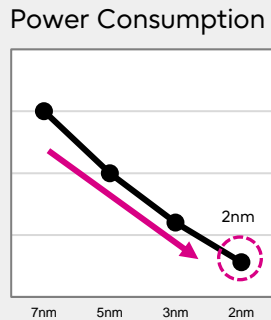
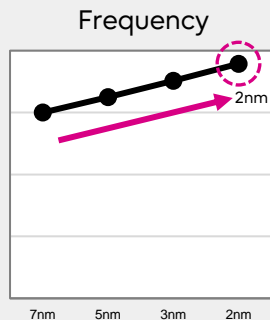
Semiconductor Trends -High Performance-

- (Pros.)
Continuing improvements in semiconductor performance and power consumption, due to advancements in transistor structures
- (Cons.)
Pressure from slowing cache memory capacity and the dramatic cost increases

	Transistor Type		
	Planar	FinFET	GAA (Gate-All-Around)
Technology node	~20nm (K computer : 45nm)	16nm ~ 3nm (Fugaku : 7nm)	2nm~ (MONAKA : 2nm)
Semiconductors Structures			

Semiconductor Trends*

*Fujitsu estimation



Architectural innovation is required to meet demand of performance, power and cost

3D Microarchitecture

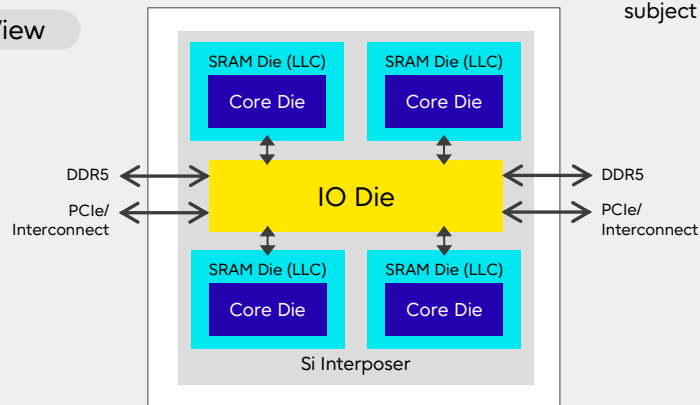
● MONAKA adopts 3D multicore architecture

- 2nm is used only for core die (top die), balancing performance and power consumption
- All the last level cache are in 5nm SRAM die (bottom die), tightly coupled with core die through TSV
- 2nm area is less than 30% of total die size, contributing to cost-efficiency

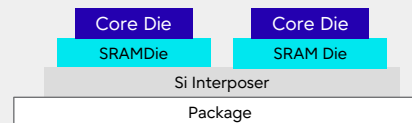
FUJITSU-MONAKA Specification

- Armv9-A Architecture
 - SVE2 for AI and scientific computing
 - 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 possible

Top View



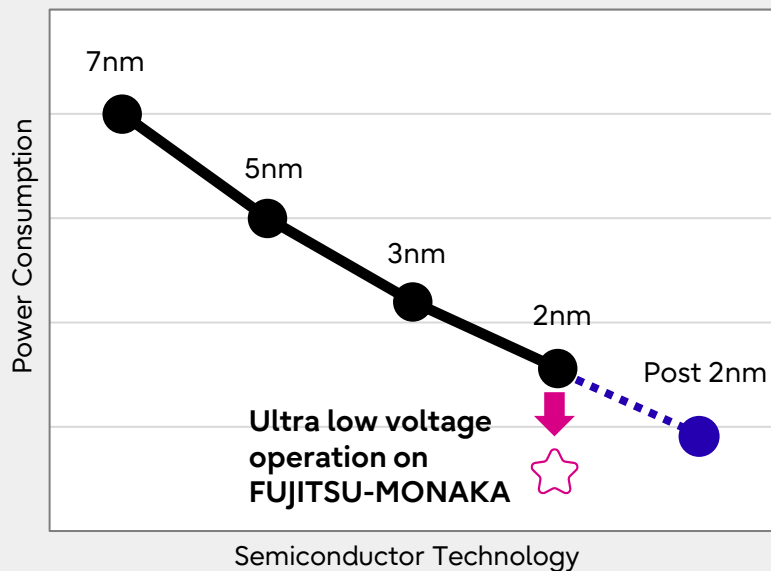
Side view



Ultra Low Voltage Technology -Energy Efficient-

- FUJITSU-MONAKA's ultra low voltage operation technology enables **energy saving comparable to one generation ahead of 2nm**

Trend of Semiconductor Power*



- Reducing power consumption by lowering voltage of the CPU

$$P \propto C V^2 f$$

C : Capacity

V : Voltage

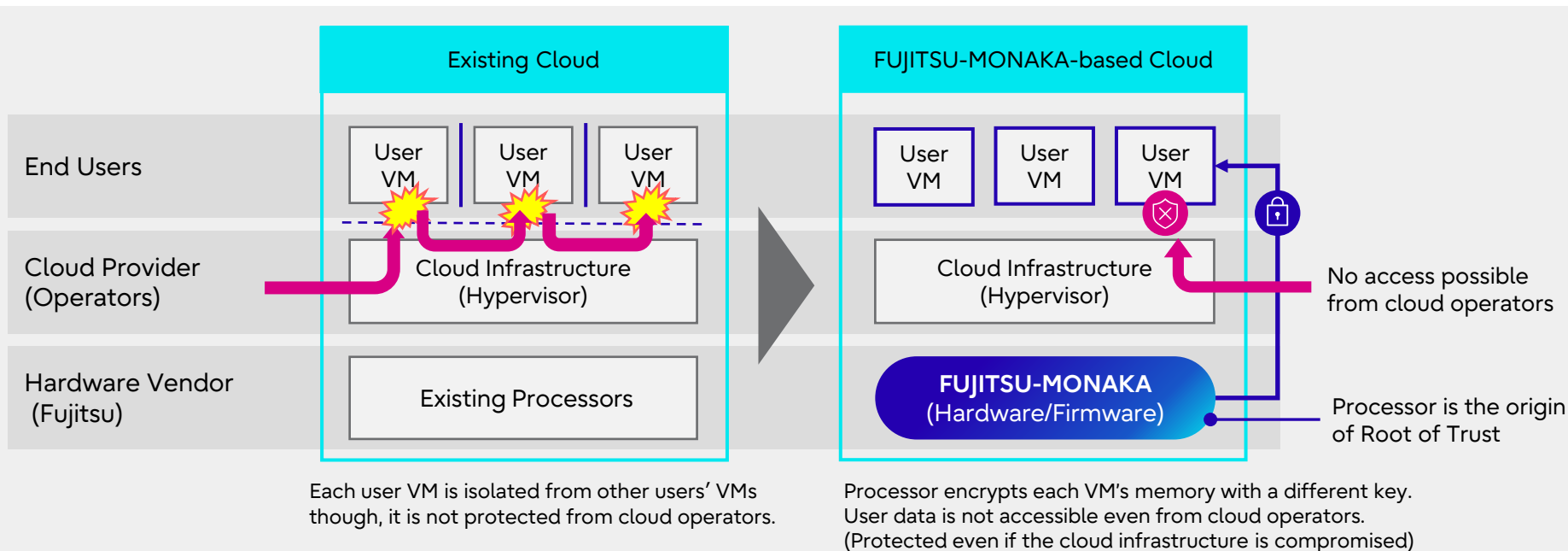
f : Clock Frequency

- Fujitsu develops **custom circuits including SRAM using our proprietary CAD**, which enables stable operation at an ultra low voltage

Security Enhancements -High Reliability-

● Confidential Computing

- Protecting end-user data in memory by encrypting every VM with a different key generated by the processor& firmware
- This is expected to be an essential technology in cloud, edge and environments handling sensitive data



Software Ecosystem - Easy to Use -

- **Supports industry standard software**

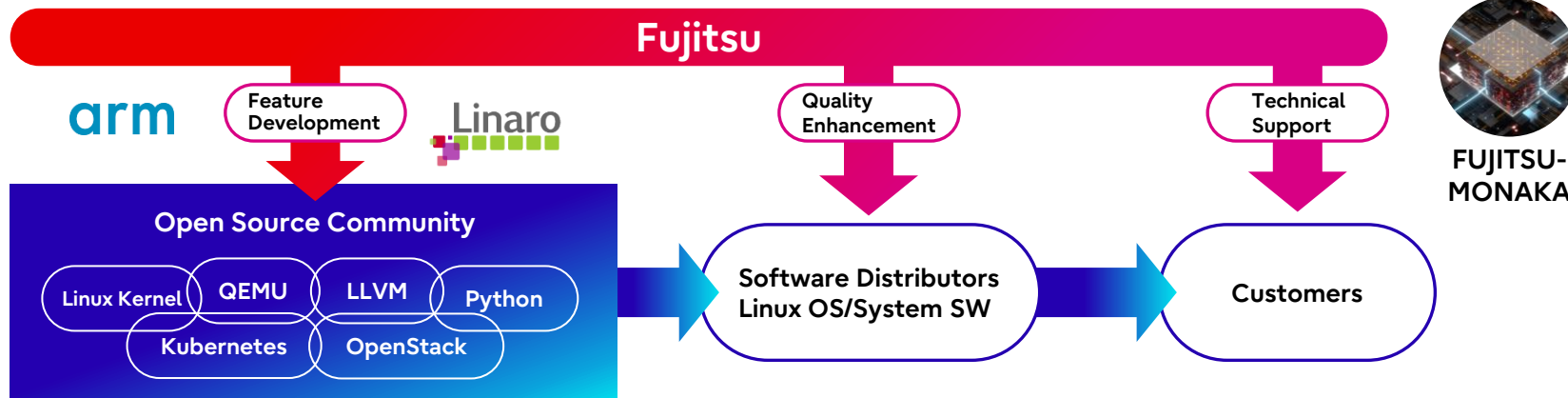
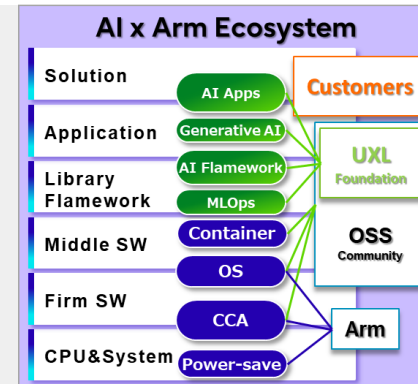
- Standard Linux OS support and system architecture

- Continue and expand OSS development activities for FUJITSU-MONAKA
 - OSS development for Fugaku/A64FX: GCC, glibc, live-patch, papi, etc
- Comply with standard system architecture (Arm System Ready) and support major distributions

- Arm software ecosystem

- Working on the standard tools (Python/Java/LLVM) to provide higher performance on FUJITSU-MONAKA.
- Focus on AI applications & frameworks development for AI best optimized ecosystem with UXL

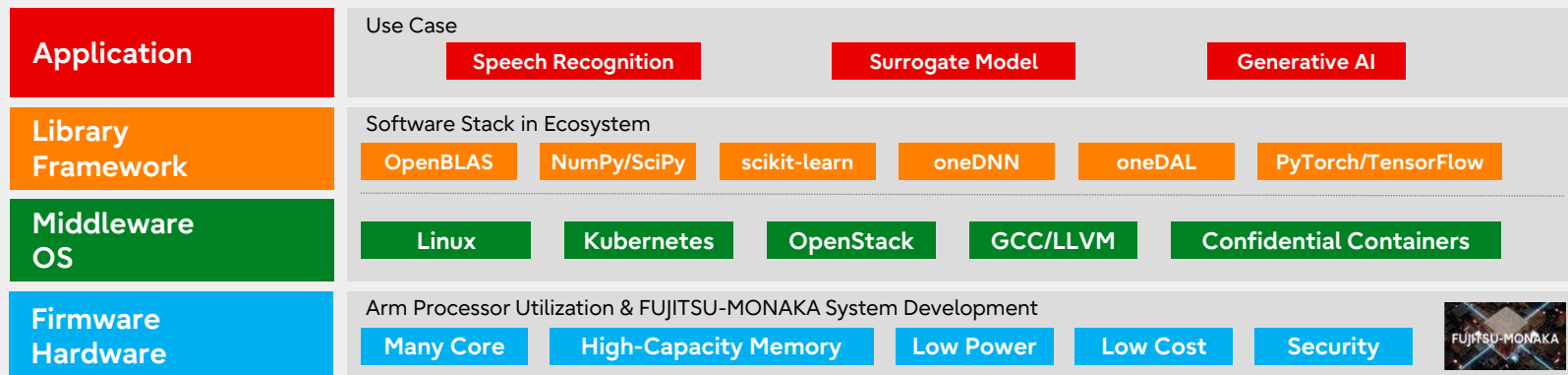
► Enabling smooth transition of customer assets and continuously enhancing performance



Software Overview -Arm x Software Ecosystem-

Fujitsu co-develops the software ecosystems globally

- The FUJITSU-MONAKA AI software stack is being co-developed 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

EPI FORUM



EuroHPC
Joint Undertaking

PLATINUM SPONSORS



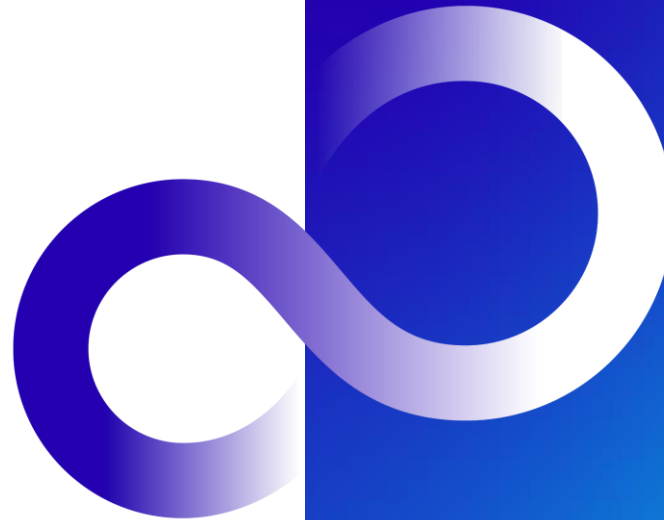
EVIDEN



GOLD SPONSORS



Thank you



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