

CASE STUDY



Seamless and Flexible In-Memory Computing with ComputeRAM on Arm



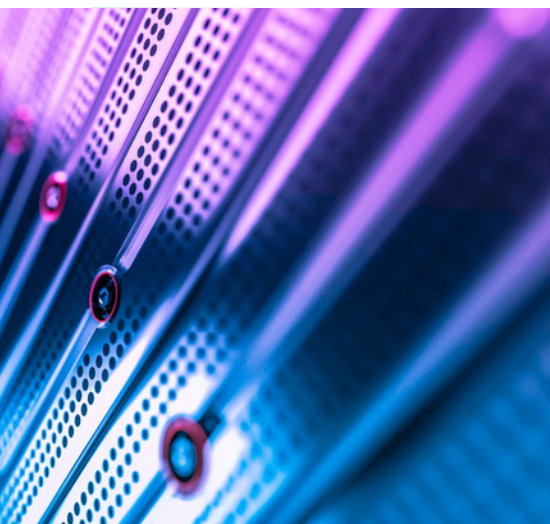
- + Name: Synthara AG
- + Vertical: IoT and embedded
- + Funding: USD 15 million
- + HQ: Zurich, Switzerland
- + Founded: 2019

PROBLEM:

The computing landscape has evolved significantly from 20 years ago when embedded applications relied on standard microcontrollers. Today, advanced technologies, such as AI and 5G, have dramatically increased computing demands, requiring specialized accelerators such as NPUs, GPUs, TPUs, and DSPs.

This has resulted in a fragmented and rapidly changing hardware and software ecosystem, raising costs and time to market. The fast-paced evolution of AI adds further uncertainty, making it difficult for chipmakers and system integrators to keep up, potentially rendering designs obsolete within months, and threatening the viability of new AI products.





SOLUTION:

Synthara ComputeRAM is a drop-in replacement for conventional SRAM, preserving standard memory functions while introducing the capability to perform matrix-matrix operations directly within the memory (in-memory computing - IMC). By offloading repetitive tasks inherent to matrix operations, ComputeRAM-based systems can achieve the flexibility of a microcontroller combined with the performance of an accelerator. This integration significantly reduces system workload by over 90 percent, enhancing responsiveness and efficiency. Additionally, ComputeRAM is fully CMOS-compatible, utilizing the same memory interface and eliminating the need for significant redesigns. Synthara also provides compatible mathematical libraries to ensure smooth integration with existing software.

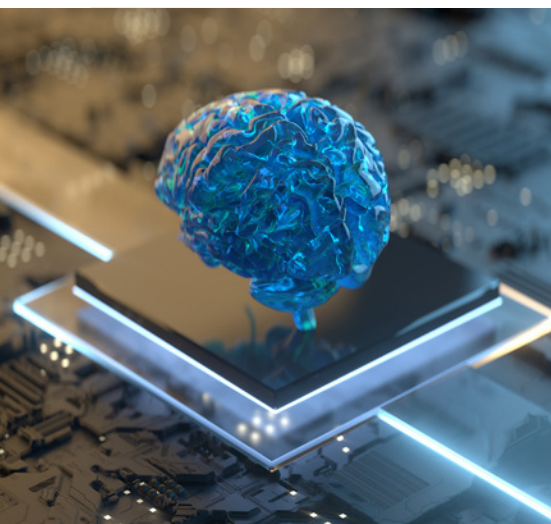
ComputeRAM excels in matrix-intensive workloads such as AI, signal processing, and communication while adapting to the rapidly evolving landscape of computing workloads. It enhances every aspect of computing on current platforms without compromising functionality, allowing customers to integrate it with their hardware and software seamlessly. For instance, replacing on-chip SRAM in an Arm Cortex-M0 with ComputeRAM can lead to AI and DSP performance up to 30 times faster and more energy-efficient than leading accelerators on benchmarks such as MLPerf Tiny, without requiring major software rewrites. For more information, readers should see Synthara's application notes [here](#).



Revolutionizing Microcontrollers with ComputeRAM

ComputeRAM is a transformative solution for customers striving to maintain a competitive edge in a fast-paced, evolving market. Specifically designed for embedded computing platforms, ComputeRAM enables adaptability to shifting market demands, empowering its customers to innovate more swiftly and effectively. This ability ensures they are well-prepared for the future of AI and beyond. ComputeRAM offers unparalleled opportunities for cost and performance optimization, delivering significant advantages to its customers:

- + **Enhanced Computing Performance:** Integrating ComputeRAM into existing product lines boosts computing performance and efficiency by orders of magnitude.
- + **Seamless System Integration:** ComputeRAM is a direct replacement for on-chip SRAM, simplifying system design, while greatly expanding the application potential for microcontroller-based SoCs.
- + **Compatibility with existing toolchains:** Synthara provides low-level libraries with APIs identical to standard linear algebra primitives (BLAS), ensuring that customer-facing toolchains, such as emulators, compilers, and applications, remain unchanged.
- + **Superior performance at lower frequencies:** Customers can achieve exceptional performance with ComputeRAM variants of existing products, even at lower operating frequencies, opening up new monetization and product opportunities.
- + **Accelerated AI and signal processing:** By accelerating AI, signal processing, and communication algorithms, ComputeRAM offers flexibility, while also enhancing performance and energy efficiency. This helps companies preserve and build upon current innovations.



- + **Extended product lifecycle:** Performance gains from ComputeRAM can help delay or even eliminate the need to migrate to the latest, most expensive process nodes.
- + **Versatility across applications:** The flexibility and performance of a ComputeRAM-based system enable a single product line to be used across multiple applications, simplifying development and maximizing return on investment.
- + **Reduced design complexity:** ComputeRAM eliminates the need for dedicated AI and DSP accelerators in many edge applications, helping to reduce design complexity and silicon costs.

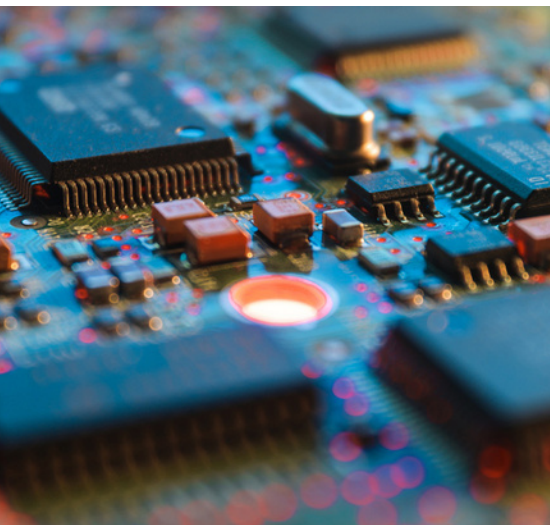
ComputeRAM complements and significantly enhances the capabilities of the systems it integrates with, positioning Synthara customers for success in the next wave of technological advancements.

How Arm Flexible Access for Startups Empowered Innovation

1. Zero-Cost Access to a Broad Range of Proven Arm IP

Synthara is a member of the Arm Flexible Access for Startups program, which helped to support the development of ComputeRAM. The program's zero-cost access to Arm IP during the prototype development process allowed Synthara to save costs and protect cash flow as an early-stage startup. In addition, Arm's proven, extensively verified IP helped to de-risk the entire prototype development process for Synthara.

"Synthara's co-founder and CTO, Alessandro Aimar, says, "Using the Arm cores removed the question mark for us."



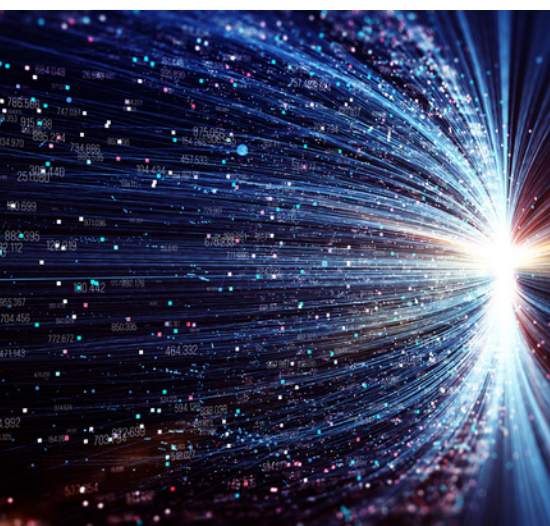
Synthara sees access to the Arm Cortex-M0 processor as particularly important. Synthara ComputeRAM provides the “heavy lifting” for more compute-intensive memory and AI workloads, while Cortex-M0 delivers the flexibility and control necessary to deploy an algorithm. This means that a ComputeRAM-enhanced microcontroller can address a broad set of compute-intensive use cases, eliminating the need for dedicated AI and DSP accelerators in many edge applications, lowering design complexity and silicon cost, and unlocking new commercial opportunities for chip and device makers.

2. Ecosystem and Technical Support for Seamless Software Integration

Synthara's focus is the seamless integration of ComputeRAM into new and existing embedded systems from a hardware and software perspective. Arm aids these efforts by delivering world-leading software support and verification services. Being able to develop its products in line with a fully developed Arm software ecosystem was incredibly useful to Synthara, particularly with the startup developing a supporting SDK.

Synthara also utilized ongoing technical support throughout the prototype development process. The startup regularly contacted the Arm account team to solve technical challenges, particularly on the software side.

Manu Nair, Synthara's co-founder and CEO, says: “Arm was quick and responsive to our (often sudden) requests. The clear and actionable support enabled us to close our design quickly and efficiently.”



What's Next for Synthara

Synthara has thrived in the startup process, translating what was on the whiteboard in the initial scoping stages into reality. Support from Arm Flexible Access for Startups played a significant role in this process and contributed to the validation of its game-changing ComputeRAM solution.

“We would happily recommend the Arm Flexible Access for Startups to any other startup,” said Nair.

USEFUL LINKS

<https://www.synthara.ai/>

<https://synthara.ai/articles/>

<https://www.arm.com/products/flexible-access/startup>

<https://www.arm.com/products/silicon-ip-cpu/cortex-m/cortex-m0>