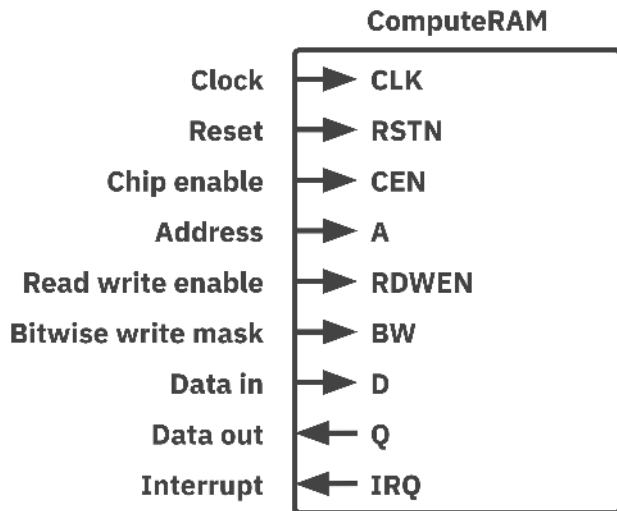


ComputeRAM Product Brief

ComputeRAM is an SRAM macro with integrated computing capability. It is a semiconductor IP product designed to enable microcontroller-based systems to run AI, DSP, and other linear algebra routines up to **100x faster and more energy efficient**.

Block Diagram



Highlights

- Drop-in replacement to conventional memory with the added capability to compute on stored content
- Optimized for linear algebra workloads such as AI and DSP
- CPU agnostic and compatible with any ISA such as Arm, RISC-V, x86, or others
- Software development kit (SDK) ensures compatibility with standard development frameworks (Tensorflow Lite, PyTorch, ONNX) and is extensible to other BLAS-based libraries.
- SDK also includes libraries of optimized routines and kernels ready for deployment

Overview

ComputeRAM enables licensees to seamlessly integrate in-memory computing capabilities into existing chip designs. A ComputeRAM macro shares the same memory interface as conventional SRAM and is compatible with any microcontroller-based SoC (Arm, RISC-V, x86, or otherwise).

Applications include processors for IoT, automotive and industrial use cases, wearables, and embedded reality. ComputeRAM unlocks game-changing performance for linear algebra-heavy workloads, such as AI or DSP, without losing performance on other workloads.

Memory Features:

- Available as a 17 kB macro in GlobalFoundries 22FDX process; Memory Compiler and FinFET variants under development
- Low-power sleep mode with data retention
- Built using proven foundry SRAM bit cells, fully CMOS strictly obeys foundry DFM/DRC rules

Compute Features:

- Bit-accurate computation
- Matrix-vector product computation primitive
- Intermediate and full-precision modes
- Fixed point, signed, and unsigned integer data types
- Programmable interrupt pin asserts when computation completes

Deliverables:

- Testing resources: SystemVerilog and UVM test benches, Verilog, C++ functional & SystemC models
- *.lib, *.lef, *.ndm, *.gds files for backend integration
- Software development kit (SDK)
- ComputeRAM emulation kit on Renode, support for other frameworks under development
- Datasheet, App Notes, User Guides
- Customisation services



Programming a ComputeRAM-Based System

ComputeRAM's SDK allows programmers to develop and port new and existing libraries to a ComputeRAM-enabled system. Running linear algebra-intensive applications on a ComputeRAM-based system results in dramatic performance gains, as shown in the plot below. When users implement a 64×256 matrix-vector product (non-sparse, 8b weight/8b input) on an Arm Cortex-M0 using ComputeRAM instead of standard SRAM, post-synthesis gate-level simulation results at typical operating conditions (25°C, 0.8V VCS) result in improvements of up to 130x in latency and 150x in energy efficiency. The code snippet highlights how ComputeRAM can be easily programmed as conventional memory and for computation.

The SDK also includes libraries of ComputeRAM-optimised AI and DSP building blocks. Simulation results using the MLPerf™ Tiny benchmarks, at typical operating conditions, show that a ComputeRAM-enabled low-footprint microcontroller achieves improvements of up to 32x in energy efficiency and 30x in latency compared to the best-performing AI accelerator submission (GAP9 EVK N31 for the Anomaly Detection benchmark).

ComputeRAM code for $A \cdot B = C$

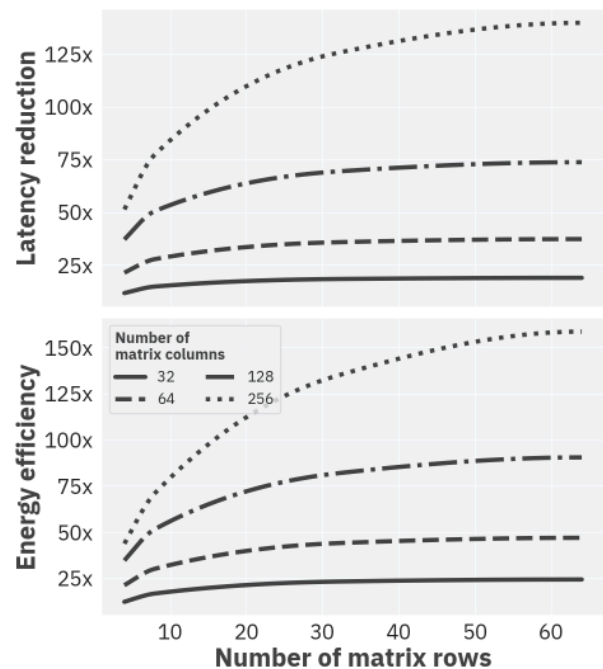
```
C/C++
int *matrixA;
int *vectorB;
int *vectorC;

configureComputeRAM(...)

// MatrixA is kept in-memory
memcpy(matrixA, ...)

// Continuously compute C=A*B
while(device_is_running)
    // Load new vectorB
    memcpy(vectorB, ...)
    // Compute is self-triggered
    memcpy(..., vectorC)
```

ComputeRAM performance multipliers



About Synthara

Synthara is a Swiss company founded in 2019 by Dr. Manu V Nair and Dr. Alessandro Aimar, based on their work at the Institute of Neuroinformatics, ETH Zürich, and the University of Zürich. It has raised over USD 15 million in funding from EU and Swiss grants and venture capital funds such as HTGF, Excellis, and DeepIE. Synthara's mission is to enable a future where artificial intelligence is ubiquitous by developing next-generation processing systems that are orders of magnitude faster and energy efficient while ensuring they are easy to use and integrate for its customers.

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