GAP9 next generation processor for hearables and smart sensors

Multidimensional computing for context-aware ANC, neural network based noise reduction, 3D sound, multisensor analysis and more

The next generation of hearables products makes new demands on embedded audio processors. They will require a multidimensional blend of digital signal processing with sophisticated neural network based algorithms delivered at ultra low energy and latency.

Our second generation GAP9 processor enables a market leading audio experience for hearable devices with features like neural network steered, ultra-low latency, active noise cancellation, neural network based noise reduction and 3D sound in hearable devices such as Truly Wireless Stereo earbuds.

The GAP9 platform is exceptionally power efficient for voice, music and image processing. It gives a headroom in both energy and processing power that can be used to develop innovative new features with no compromise in area, cost or energy.

GAP9 also allows for multi sensor analysis (vision and sound) and is a perfect solution for battery-powered smart security systems and smart building sensors.

Our sophisticated toolset and GAP9's inherent homogeneity and scalable performance make development significantly easier.

GAP9 Highlights

Best-in-class DSP for music and voice audio power and quality performance

Best-in-class programmable ultra low latency audio processing for ANC, ASRC and more

Best-in-class ultra low energy neural network performance for AI based or driven algorithms

Familiar, easy to use toolchain for embedded digital signal processing and neural network development

Key application areas

New audio experiences for hearables

- Active noise cancellation (ANC) with neural network based acoustic scene detection
- Noise reduction (DNN-NR)
- Speech intelligibility
- Voice separation
- Immersive 3D sound
- Spoken language understanding

Always on, battery operated inference on images, sounds and more

- Occupancy management
- Surveillance systems
- Face detection / identification
- Speaker detection / identification
- Voice driven user interfaces

Easy development

State of the art toolchain with a wide range of supported models and frameworks

- RISC-V C / C++ toolchain with full support for ISA extensions based on GNU toolset (GCC & GDB)
- GAP AutoTiler code generator for explicit memory movement
- Generator library with DSP/NN kernel support
- GAPflow tools providing end-to-end code generation from NN frameworks such as TensorFlow and PyTorch
- AudioTools mapping audio graphs onto hardware resources from MatLab templates
- PULP OS, FreeRTOS™
- Cross OS PMSIS cluster & device API
- Debug support including on-chip debug
- GVSOC SoC Simulator and visual code profiler

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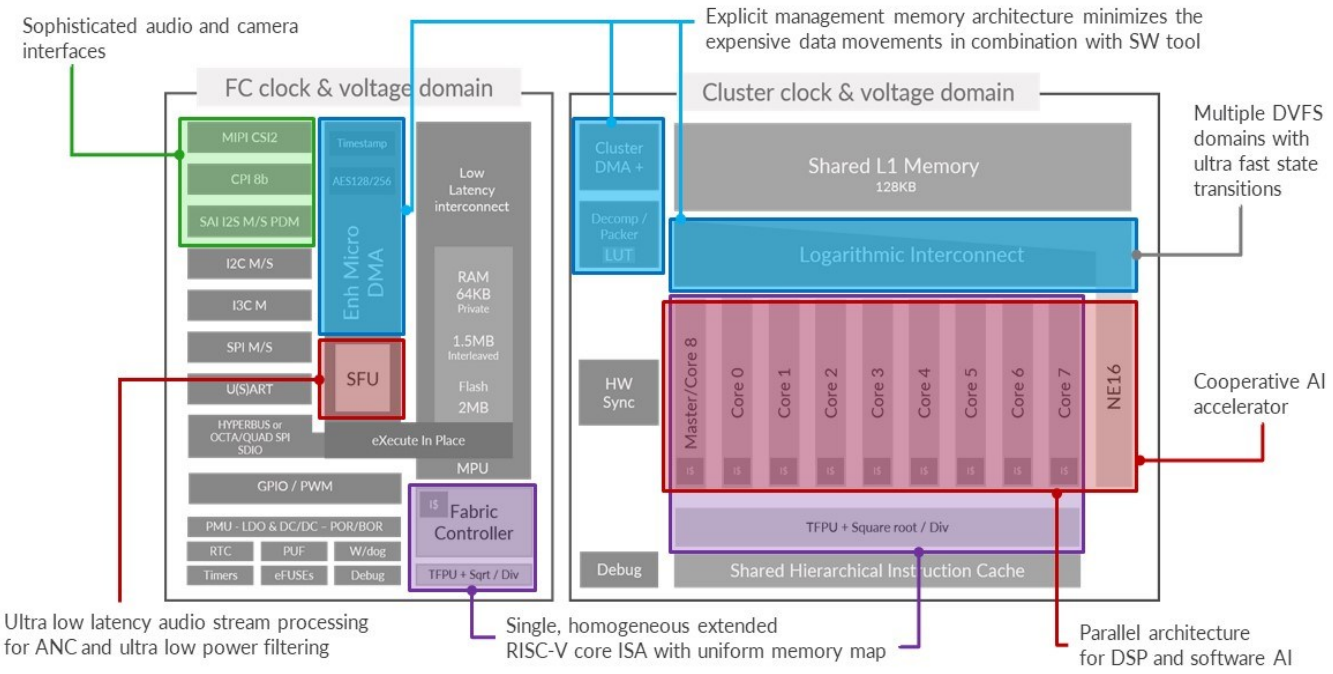
GAP9 architectural highlights



GAP9 is a unique combination of a powerful low power microcontroller, a programmable compute cluster with a hardware neural network accelerator and sample by sample audio filtering unit.

This combination of homogeneous processing units with integrated hardware acceleration blocks achieves a perfect balance between ultra low power consumption and latency and flexibility and ease of use.

All the 10 cores in GAP9 are based on the RISC-V Instruction Set Architecture extended with custom instructions automatically used by the GAP toolchain. The compute cluster is perfectly adapted to handling combinations of neural network and digital signal processing tasks delivering programmable compute power at extreme energy efficiency.

The architecture employs adjustable dynamic frequency and voltage domains and automatic clock gating to tune the available compute resources and energy consumed to the exact requirements at a particular point in time.

GAP9's revolutionary Smart Filtering Unit is perfectly adapted to ultra low latency (1uS) PDM to PDM filtering tasks but so flexible that it can simultaneously be used as a block filtering coprocessor for tasks executing on the cores.

GAP9 has a rich set of interfaces including 3 Serial Audio Interfaces capable of handling up to 48 incoming or outgoing audio signals.

GAP9's hierarchical and demand-driven architecture is perfectly suited to design the next generation of hearable products and applications for battery-powered smart sensors.

GAP9 Features

Performance

- System performance of 330µW/GOP
- Up to 370 MHz internal clock
- Up to 15.6 GOPs DSP and 32.2 GMACs machine learning
- Deep Sleep: ~45uW, wake up time : ~2.5ms
- Integrated LDO/DC-DC
- 1.8V—I/O voltage
- 1.8V—5.5 V regulator supply voltage
- 0.4ms cold boot time
- 2µs to power and start cluster

Hardware features

- 9 core RISC-V compute cluster with AI accelerator and 1 core RISC-V controller
- Smart Filtering Unit for sample by sample 1.3µs audio filtering
- Transprecision floating-point support (IEEE 32-bit and 16-bit and bfloat16)
- On-the-fly hardware AES128/256 encryption / decryption and PUF
- 1.6MB retentive L2 RAM
- 2MB non volatile memory
- Optional external high-speed low-power Quad-/Octal-SPI RAM and Flash
- Multi channel PCM/PDM SAI interfaces
- CSI-2 camera interface
- WL-CSP 3.7mm x 3.7mm - BGA 5.5mm x 5.5mm package options

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