

AT THE VERY EDGE

Enabling AI

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AI IS MOVING TO THE EDGE



From the cloud



To the edge of IoT

WHY?



CLOUD CONGESTION



PRIVACY



DECISION LATENCY



POWER

But what happens WHEN You GET TO THE VERY EDGE?



AI at the very Edge

WEARABLE
SMALL
EASILY INSTALLABLE
DISTANT FROM POWER
DIFFICULT TO SERVICE



PROBLEMS TO SOLVE

Wide range of compute STATES

- Scale consumption to workload
- Absolute consumption in state
- Speed of transitions between states

Wide range of compute TASKS

- Acquisition, pre-processing, inference, (communication)
- Rapidly changing algorithms

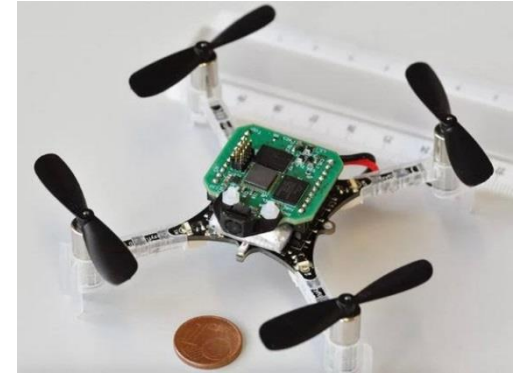
GAP8 enables **AI** at the very Edge

A highly integrated MCU combining a 8 core parallel compute cluster and a single core controller

01

High compute at ultra-low-power

~20x better power efficiency than the state-of-the-art on content understanding applications at < 100mW



02

Agile

Ultra-fast dynamic, power state transitions
Wake up in 0.5ms
1uA standby current



03

Flexible

Fully programmable
Wide range of accelerated algorithms



An example of GAP8's Energy Efficiency

TARGET	CLOCK	TIME	CYCLES	ACTIVE POWER
STM32 F7	216Mhz	99.1ms	21 400 000	60mW
GAP8 *	15.4Mhz	99.1ms	1 500 000	3.7mW
GAP8 *	175Mhz	8.7ms	1 500 000	70mW
GAP8 **	4.7Mhz	99.1ms	460 000	0.8mW

STM 32 H7 216Mhz 40nm

16 x reduction

75 X

Comparison of Latest optimized ARM CMSIS-NN library versus GAP8 implementation of identical CNN graph trained on CIFAR-10 images.
Source*: [ARM processors blog](#)

Running on GAP8 cluster.
* No Hardware Convolution Engine
** With Hardware Convolution Engine

How does GAP8 achieve **Energy Efficiency**?

01

Uniform Extended Instruction Set (ISA)

DSP Extensions
SIMD instructions
Bit manipulation

02

Efficient parallelization

Hardware thread dispatch and synchronization
integrated with automatic clock gating

03

Shared instruction cache

Reducing power overhead of instruction fetch

04

HW Convolution Engine

Single cycle 5 x 5 16 bit fixed point convolution

05

Ultra fast HW state changes

All power management on SoC

Programmable in C/C++

GCC based toolchain

Visual IDE based on Platform IO

Code generation tool (AutoTiler) smooths parallel
code generation

Pre-built generators for a wide range of algorithms

A wide range of use cases are enabled by GAP8

Smart city



“6 cars at traffic light”

Smart spaces



“10 desks free in office”

Industrial



“bearing failing”

Consumer



“hi Martin”

Smart building



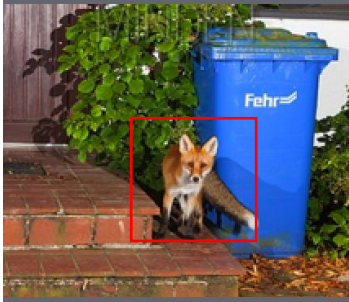
“broken window by stone”

Consumer



“take off”

Security



“not a human”

Government



“wake up! something is happening”

- PEOPLE / OBJECT COUNTING
- VIBRATION ANALYSIS
- ROBOT CONTROL AND NAVIGATION
- SOUND ANALYSIS
- FAR FIELD KEYWORD SPOTTING
- OBJECT RECOGNITION
- HIERARCHICAL ACTIVATION

Open source origins



Best in class Instruction Set Architecture (ISA)
UC Berkeley originated

Open Source Computing Platform
created by ETHZ and UniBo

Engineered as Ultra-low power IoT
Application Processor

GreenWaves staff are on the
RISC-V technical and marketing
committees

GreenWaves is a key contributor
to PULP

**LEVERAGING COMMUNITIES
UNIQUE CAPITAL EFFICIENCY**

GAP8 is Available Now

01

GAPuino GAP8 - buy on the websites:



<https://greenwaves-technologies.com/store/>



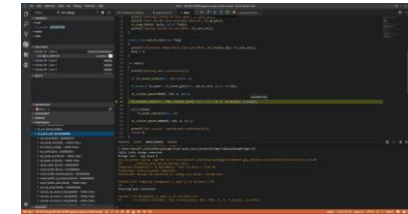
<https://www.seeedstudio.com/GAPUINO-GAP8-Developer-Kit-1st-fully-programmable-multi-core-RISC-V-Processor-for-IoT-Application-p-3090.html>



02

Full open source SDK - get on GitHub

https://github.com/GreenWaves-Technologies/gap_sdk



03

GAP8 engineering samples - buy on website:



<https://greenwaves-technologies.com/store/>



04

GAP8 production qualified - Q2 2019



Thank you!

Questions?

