



# Echoes: a 200 GOPS/W Frequency Domain SoC with FFT Processor and I<sup>2</sup>S DSP for Flexible Data Acquisition from Microphone Arrays

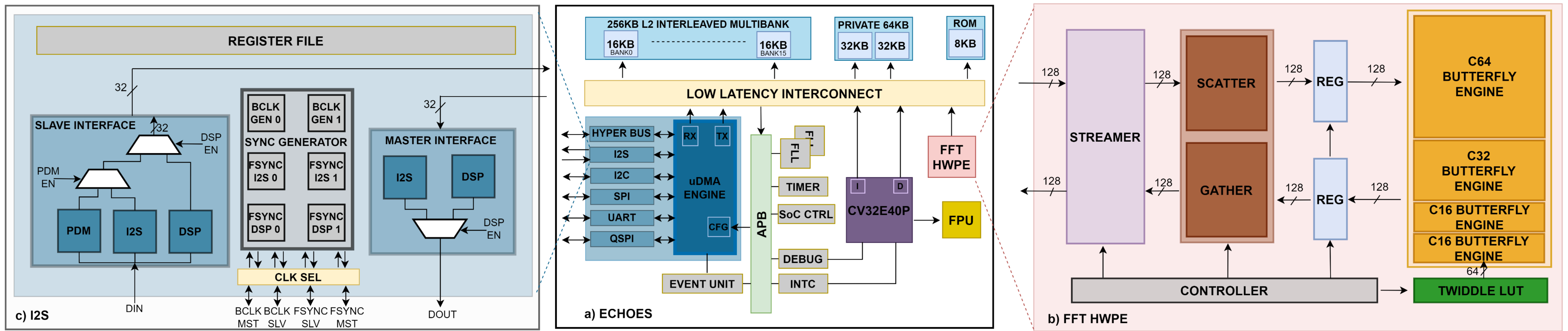
Mattia Sinigaglia, Luca Bertaccini, Luca Valente, Angelo Garofalo, Simone Benatti, Luca Benini, Francesco Conti, and Davide Rossi

## Introduction

We propose Echoes, a Frequency domain SoC for Fast-Fourier Transform efficient computation on flexible data acquisition from a microphone array.

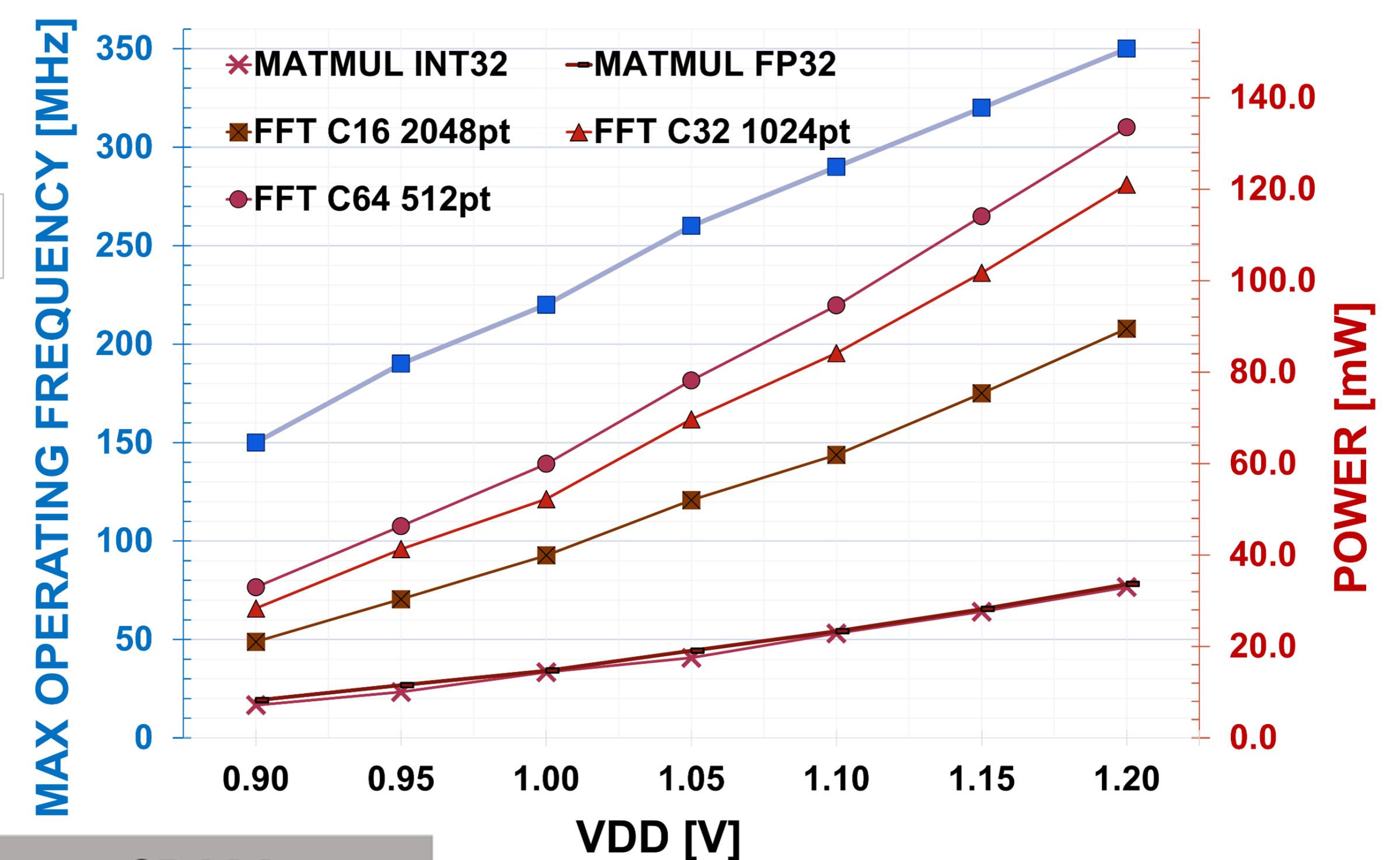
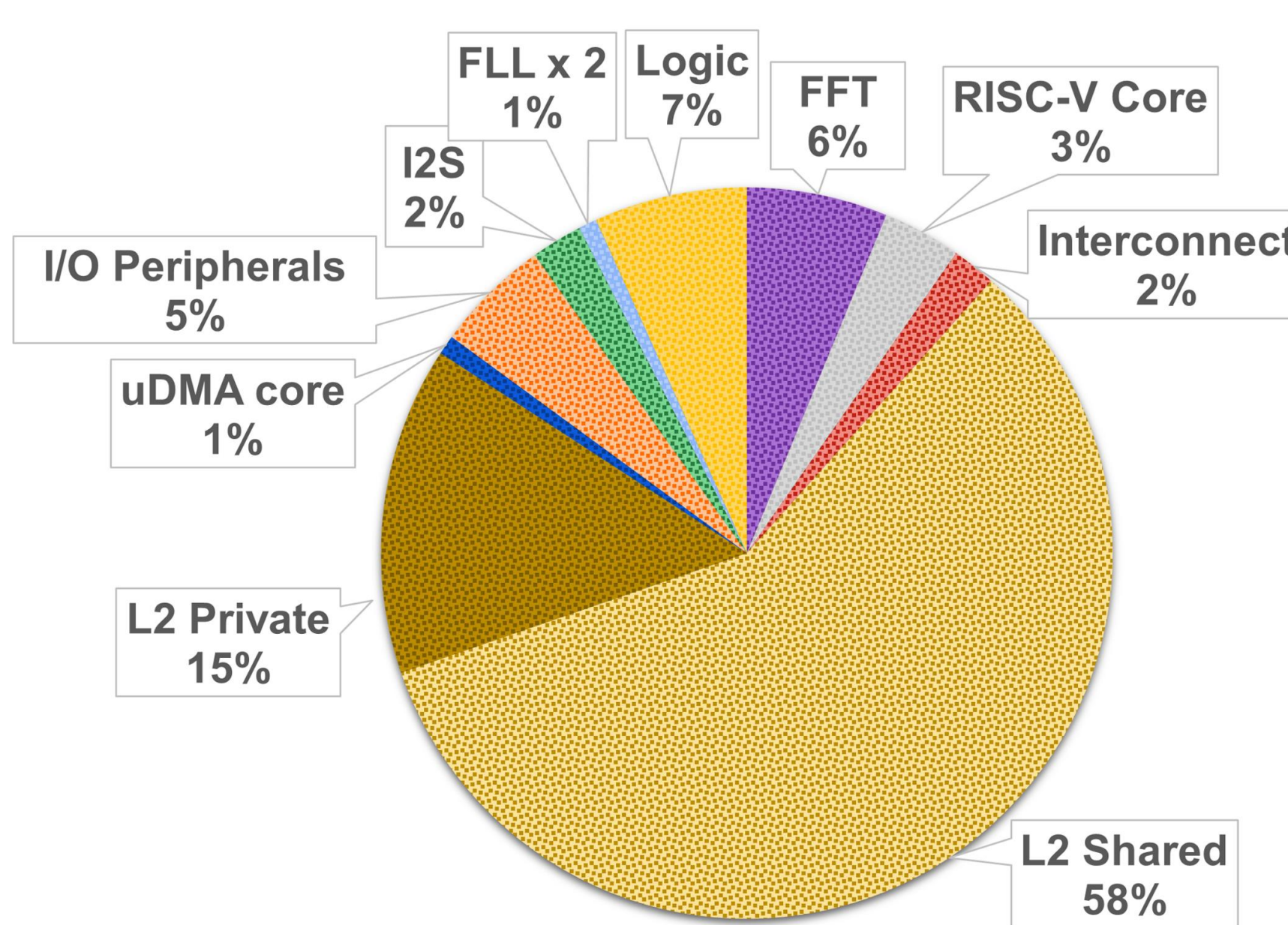
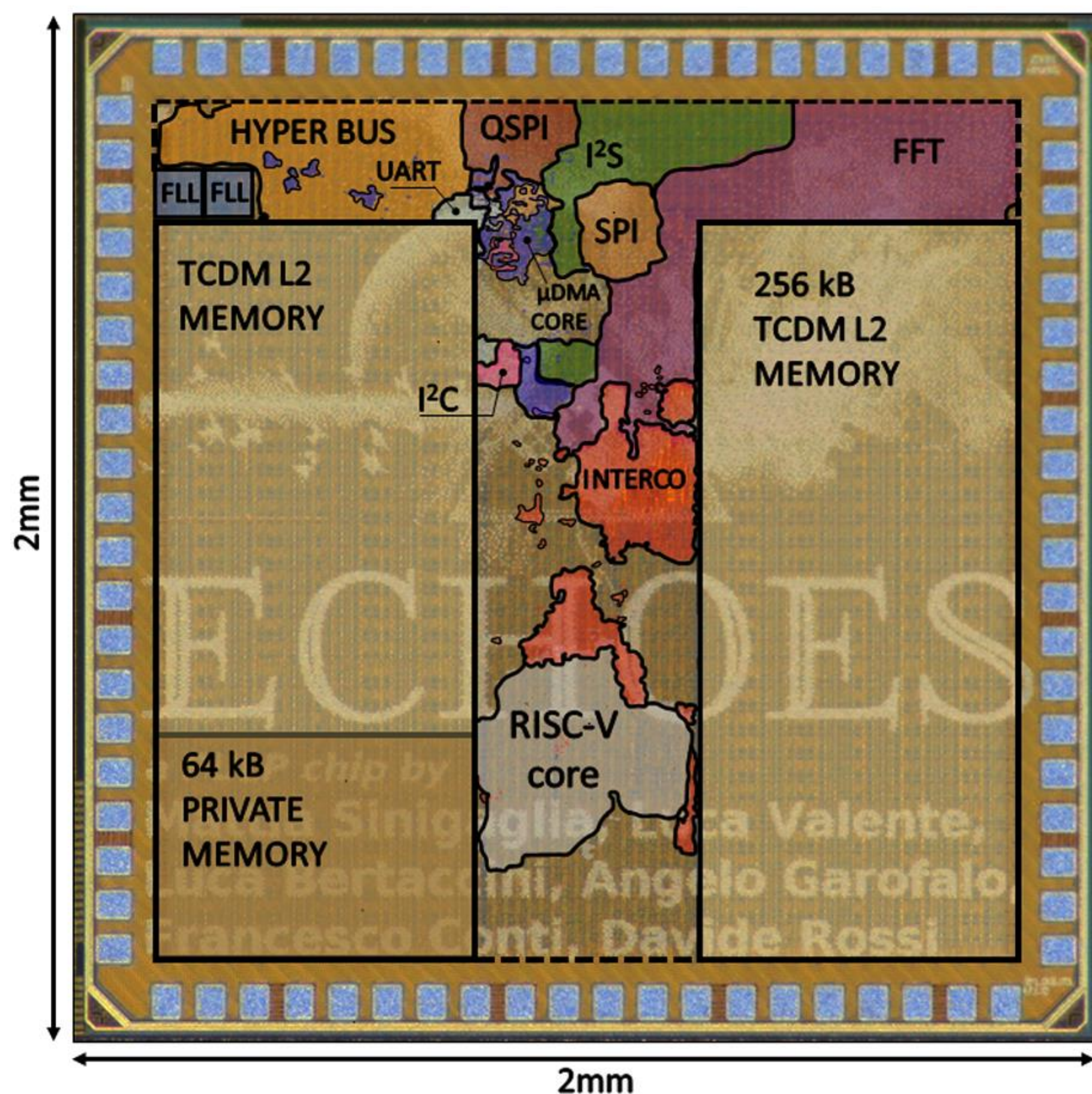
- RISC-V 32-bit processor
- FFT processor
- I<sup>2</sup>S DSP implementation
- 200 GOPS/W @ 0.9V on FFT C16 2048pt

## SoC Overview



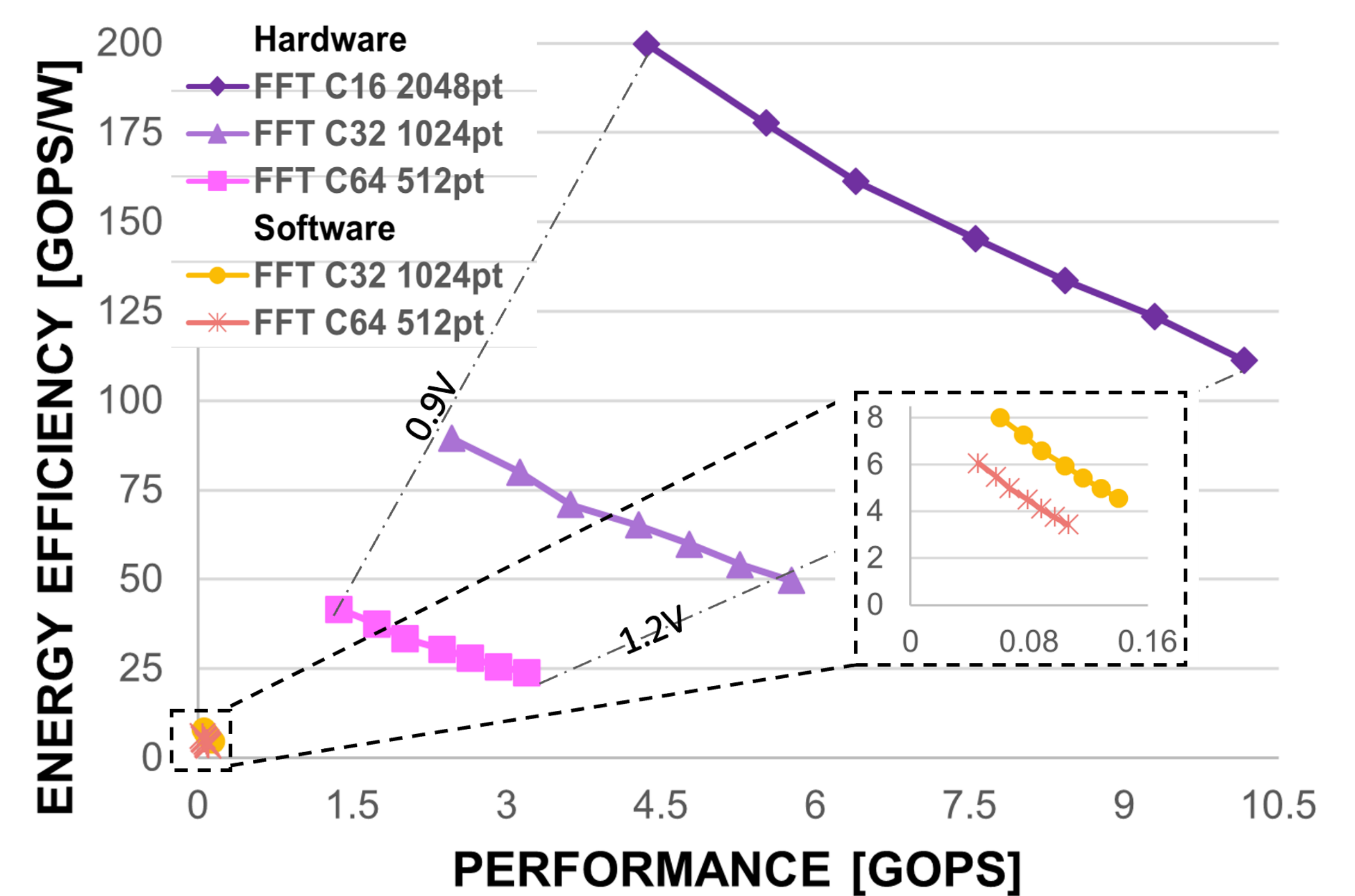
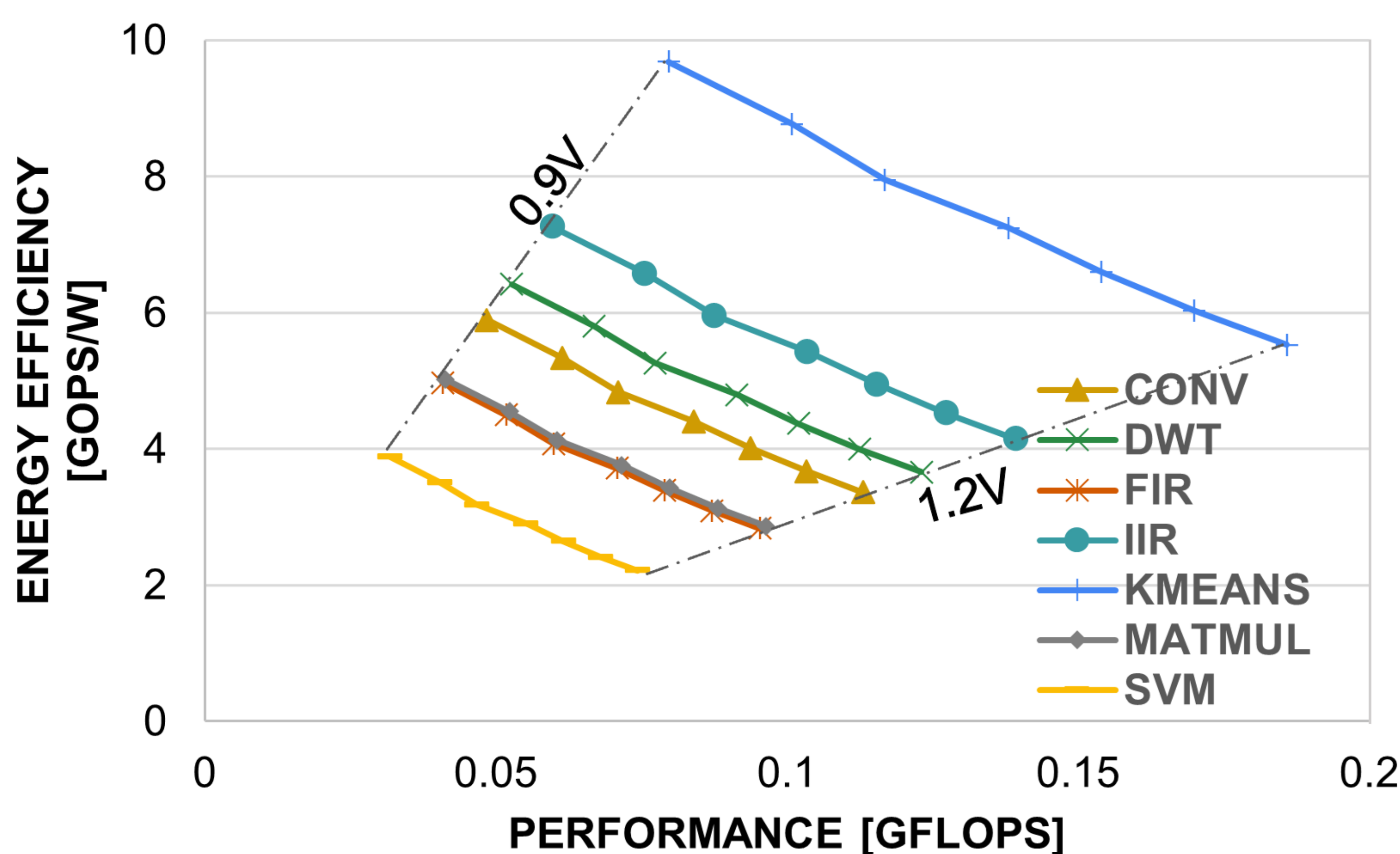
## Physical Implementation

## Power consumption



Technology	Chip Area	SRAM
CMOS 65nm	4mm <sup>2</sup>	256 kB
Vdd Range	Frequency Range	Power Envelope
0.9 - 1.2V	150 - 350MHz	133.5 mW

## DSP – FFT Kernel Benchmark



Kernel	Peak Efficiency SW	Peak Efficiency HW	Gain
FFT C32 1024pt	8 GOPS/W	89.5 GOPS/W	11.2 ×
FFT C64 512pt	6.1 GOPS/W	41.6 GOPS/W	6.9 ×
Kernel	Peak Performance SW	Peak Performance HW	Speedup
FFT C32 1024pt	0.1 GOPS	5.8 GOPS	41.1 ×
FFT C64 512pt	0.1 GOPS	3.2 GOPS	30.1 ×



ETH zürich



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mattia.sinigaglia5@unibo.it

