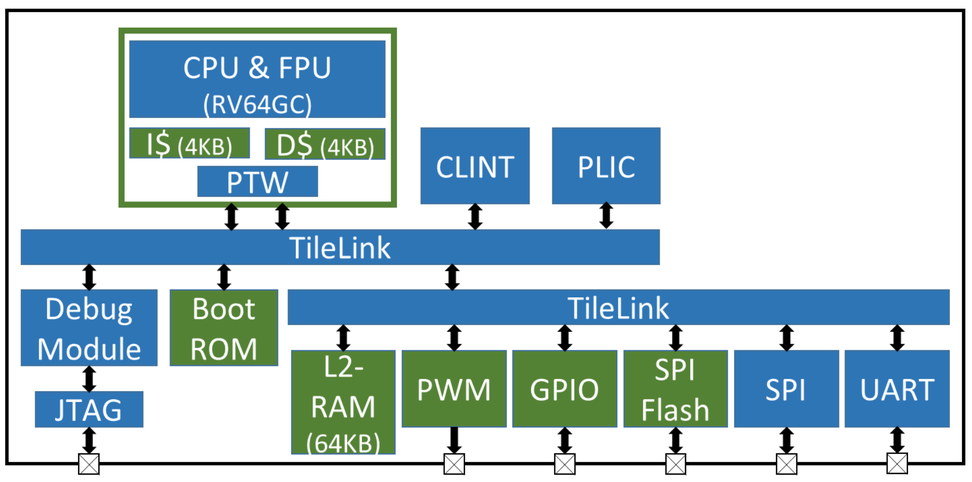
Live Demonstration:
Rocket-core on ROHM-180nm and VexRiscv-core on SOTB-65nm

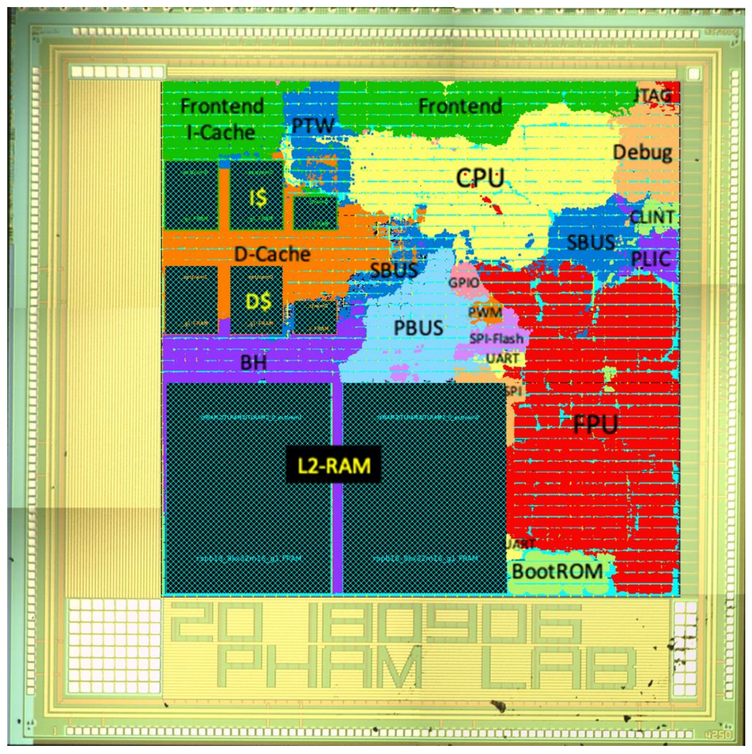
Tuan-Kiet Dang, Trong-Thuc Hoang, Cong-Kha Pham
The University of Electro-Communications (UEC), Tokyo, Japan

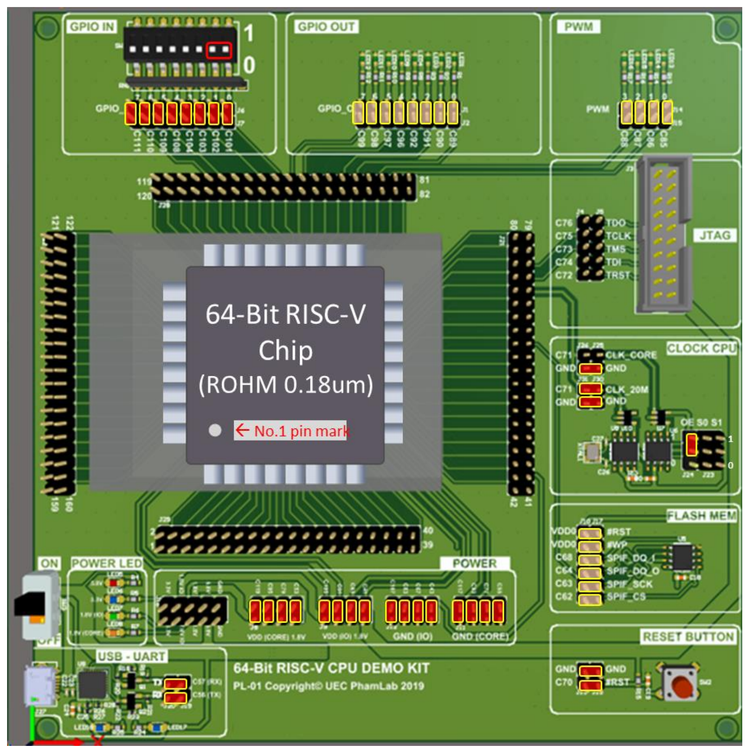
ABSTRACT

This demonstration shows two working chips, one ROHM-180nm chip with Rocket core and one SOTB-65nm chip with VexRiscv core. The Rocket and VexRiscv chips were taped out in September 2018 and August 2019, respectively. The ROHM-180nm Rocket chip is also the first RISC-V chip taped out in Japan. These two chips were among the first RISC-V chips in our laboratory when we started studying RISC-V. The purpose of the two chips is to test and try different Very Large-Scale Integrated circuit (VLSI) implementation strategies.

I. ROCKET CHIP

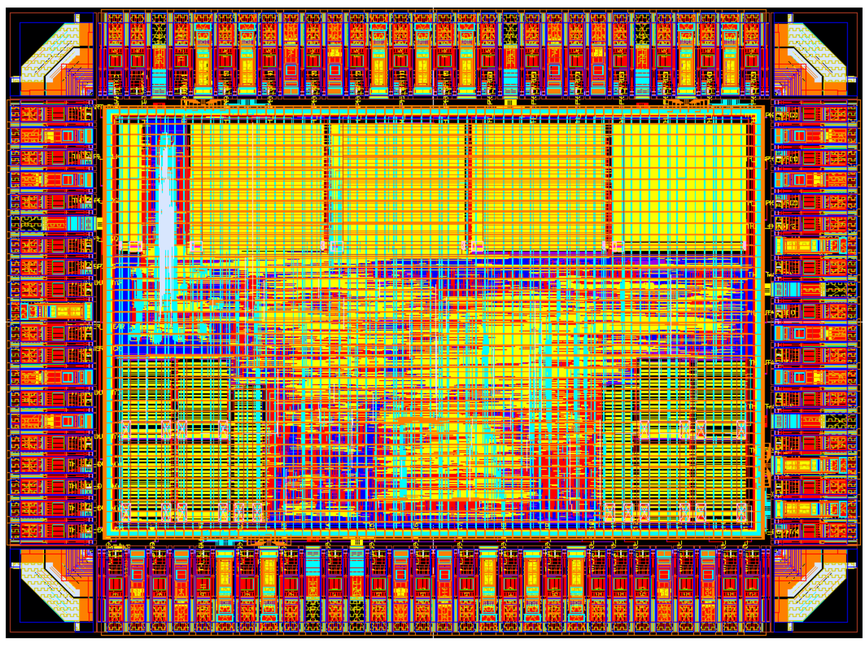


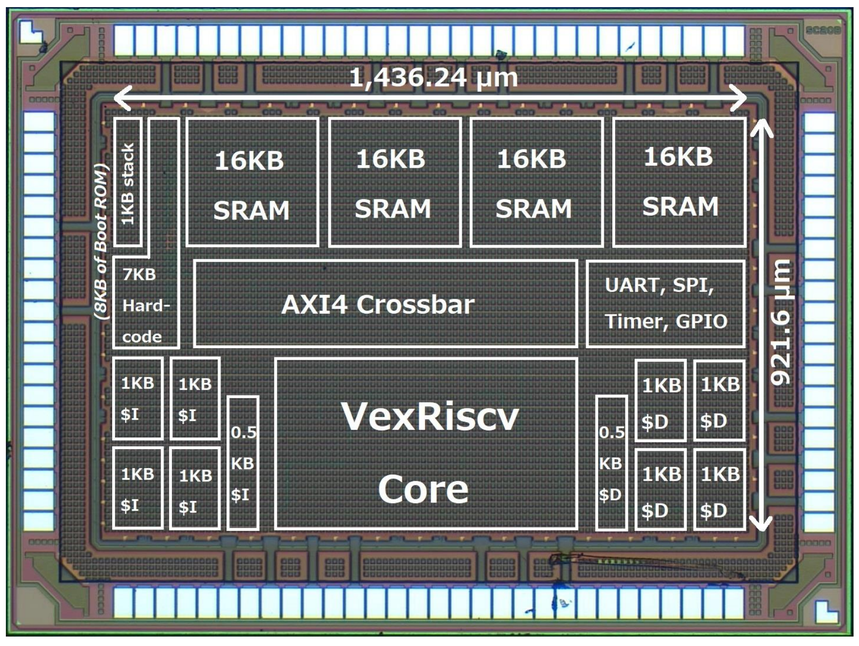


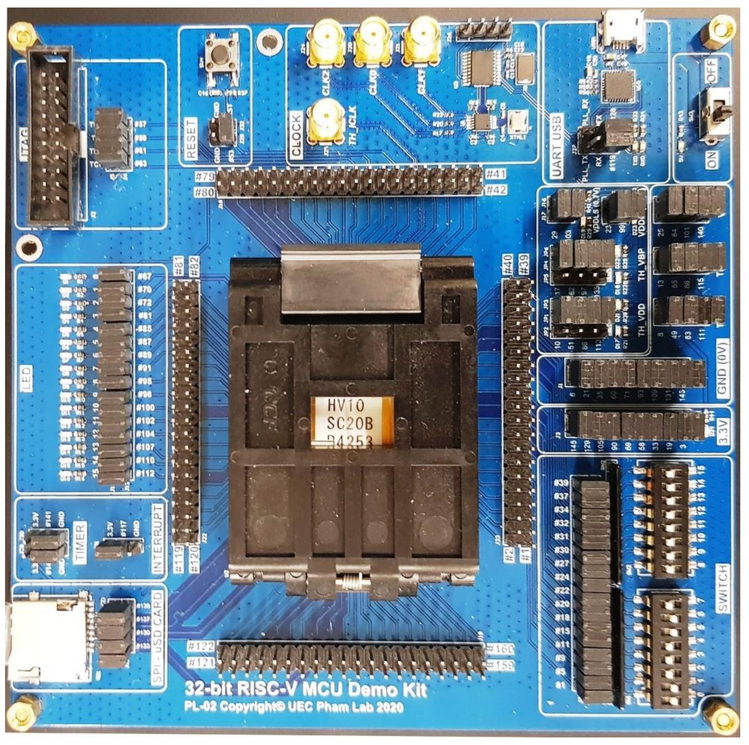


- Based on SiFive Freedom GitHub (Freedom U540-C000)
- Process: ROHM-180nm fab. on September 2018
- Single-core Rocket with RV64GC
- Have MMU with L1 and L2 caches: 4KB instruction cache, 4KB data cache, and 64KB L2 cache
- Core area of 3.75×3.75-mm^2 with ~302k gate-count
- Maximum operating frequency ~80MHz

II. VEXRISCV CHIP







- Based on SpinalHDL/Vexriscv GitHub (Briey SoC)
- Process: SOTB-65nm fab. on August 2019
- Single-core VexRiscv with RV32IM
- Chip core benchmark: 1.27 DMIPS/MHz and 2.4 Coremark/MHz
- Core area of 1.44×0.92-mm^2 with ~349k gate-count
- Peak performance of 156-MHz operating frequency @ 1.2-V V_{DD} and +1.6-V V_{BB} (power density of 270µW/MHz)
- Best power density of 33.4µW/MHz @ 0.5-V V_{DD} and +0.8-V V_{BB} (operating frequency of 15-MHz)

REFERENCES

[1] SiFive Freedom: https://github.com/sifive/freedom
[2] VexRiscv: https://github.com/SpinalHDL/VexRiscv
[3] T.-T. Hoang, *et al*: Low-power High-performance 32-bit RISC-V Microcontroller on 65-nm Silicon-On-Thin-BOX (SOTB), *ELEX*, 2020.

ACKNOWLEDGEMENT

The chip in this study has been fabricated through the activities of VDEC, the University of Tokyo in collaboration with Synopsys Inc., Cadence Design Systems, Mentor Graphics, ROHM Corporation, and Toppan Printing Corporation.

hoangtt@uec.ac.jp