Free/Open-source Hardware

An overview on the Open-source philosophy and Open Hardware state of the art

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Introduction

Free (as in Freedom)/Open-source Hardware

Hardware directives or designs that can be freely:

- Used
- Studied
- Shared
- Improved

FO-S Hardware can be observed in many variations such as:

- Electronics (the focus of this talk)
- Mechatronics (3D printers, Prosthethics, etc.)
- And many other

Introduction-Timeline and Licenses

- Hit some licenses here like the OHL etc. be fast we want to go to the eng. meat

Why Free/Open Hardware?

From the researcher/developer standpoint:

- More tools available that are:
  - Free (as in freedom) to use
  - Documented
  - Open for study
  - Overall, **adaptable**
- Community spearheaded
  - *Linus Law*: "Given enough eyeballs, all bugs are shallow"

From the adept/costumer standpoint:

- Transparency and Respect for the user
- Reparability
- Upgradability

Open Hardware Projects

We can split open hardware projects into seven main groups:

- Tools for Hardware Development*
- Instruction Set Architectures (ISAs)
- Systems-on-Chip (SoC)
- Micro-controllers
- Embedded Systems
- Single-Board computers
- Other Computing Systems
- FPGAs

Tools for Hardware Development

Open ISAs

Directives for processing operations (i.e. structure and set of instructions)

Talk about AVR and the other Berkley ISAs up until RISC-V.

Cascading effect for opening other technologies.

Systems-on-Chip

Digital system designs for implementing into FPGAs or silicon: - Processors VexRISC-V for example.

Micro-controllers

Arduino

ESPressif

Embedded Systems

Pinecil

Single-Board Computers

Single-Board Computers (SBCs) are full computing systems, running an Operating System and providing above-microcontroller performance at low-power and low-cost. Therefore they can be designated for more complex IoT and Embedded functions and simple Desktop operations.

- **Raspberry Pi**: Partial Open design of the board, Closed Processor Design, Closed ISA
- **VisionFive / VisionFive2** (2021/2022): Full open board design, Open Procesor Design, Open ISA (RISC-V)
- **MangoPi**(2022-):

VisionFive

FPGAs

Field-Programmable Gate Arrays are the smallest unit for reconfigurable hardware:

- A mesh of CLBs (Configurable Logic Blocks) containing LUTs (Look-Up tables) allows hardware-level reconfigurability
  - Look-Up Tables are small memory devices that contain the logic outputs for different logic inputs
- The mesh then interacts with DSPs (Digital Signal Processor)
- The FPGA can then be integrated into a board to expand on the I/O capabilities

As of now most Open-Hardware FPGA boards are based on FPGA devices made with Lattice's ICeStorm suite:

- ICe40 boards
- ECP5

ICE40

Single-Board Computers

Roadmap

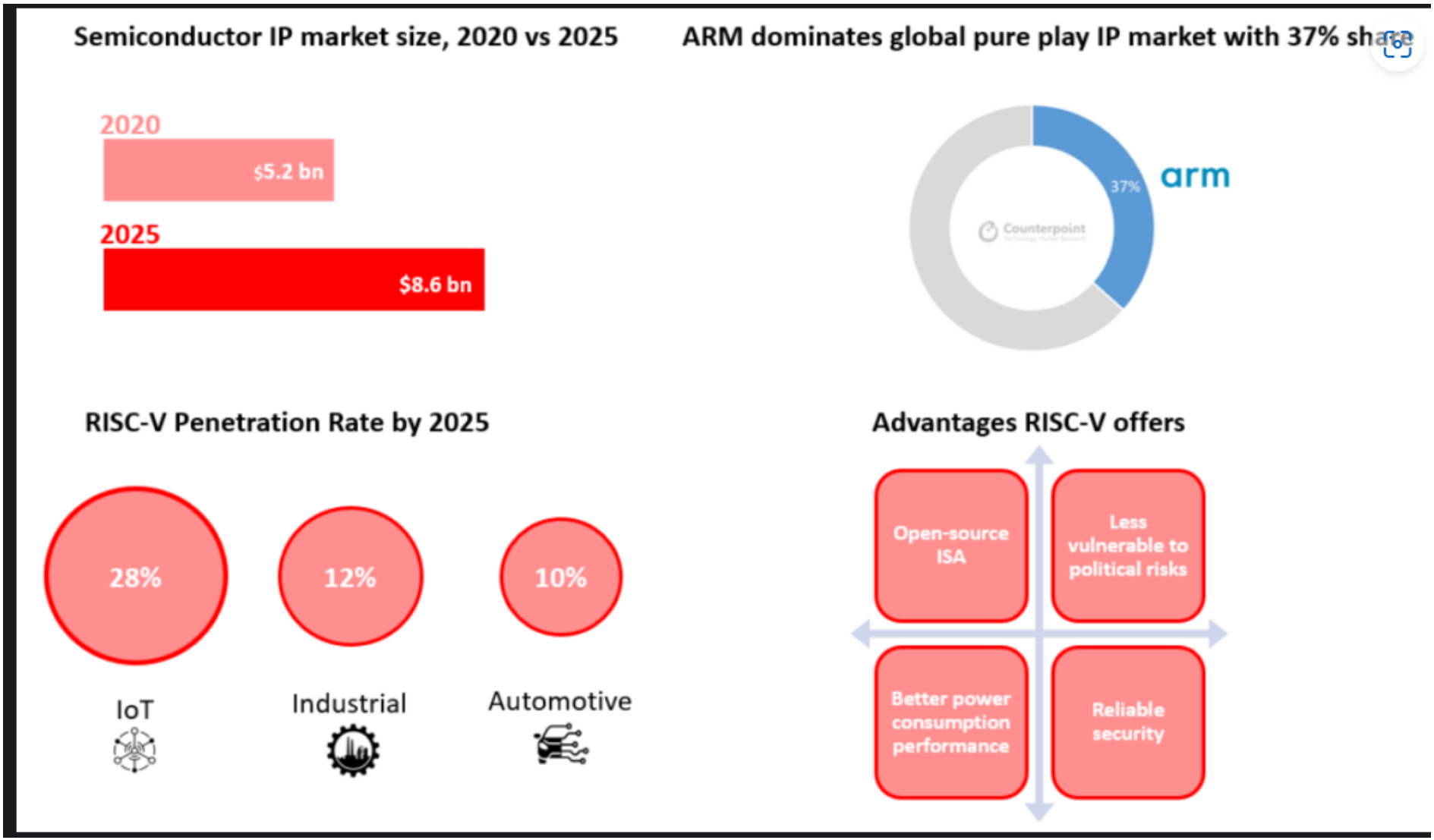

Figure 1: Summary of the Hardware Market state

So you want to develop F-OS Hardware?

Conclusion

To sum up here are some bullet points that you hopefully retained from this presentation:

- What is Free and Open Hardware
- Basic notions on the presented technologies
- Advantages of opening hardware designs