



RISC-V Hardware - Where are we?

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About me

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Canonical Ltd.



Core, SoC, Board

What's the difference?



Core

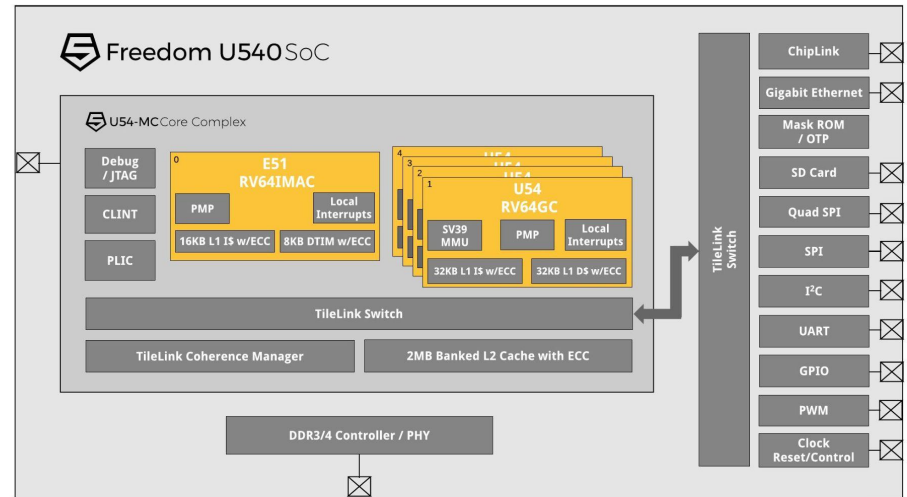
- The logic that runs RISC-V instructions.
- Usually written in Verilog or VHDL.
- Kind of like programming, but also not. It's a design not a program.
- Tools convert designs to transistors and connections inside chips.
- FPGAs are very flexible chips that can test designs, but usually much slower than finished hardware.

```
1741 //=====
1742 //           Define the MEDELEG register
1743 // Machine Exception Delegation Register
1744 // 64-bit Machine Mode Read/Write
1745 // Providing the CPU Status
1746 // the definiton for MEDELEG register is listed as follows
1747 //=====
1748 assign edeleg_upd_val[15:0] = {iui_regs_src0[15], 1'b0,
1749                               iui_regs_src0[13:12], 2'b0,
1750                               iui_regs_src0[9:0]};
1751
1752 always @(posedge regs_clk or negedge cpurst_b)
1753 begin
1754     if(!cpurst_b)
1755         edeleg[15:0] <= 16'b0;
1756     else if(medeleg_local_en)
1757         edeleg[15:0] <= edeleg_upd_val[15:0];
1758     else
1759         edeleg[15:0] <= edeleg[15:0];
1760 end
1761 assign medeleg_value[63:0] = {48'b0, edeleg[15:0]};
1762
1763 // decode the vector value
```



SoC - System on a Chip

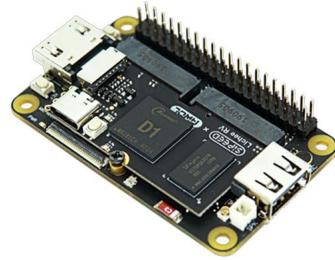
- The physical chip.
- Needs core's, but also many other pieces of logic such as
 - Buses
 - Caches
 - Clock tree
 - Memory controller
 - Peripheral devices like GPIO, Timers, I2C, MMC, USB, PCI, etc.
- Peripherals and other "IP" usually bought from vendors like Cadence, Designware, Synopsys, etc.





Board

- The actual “computer” you can use.
- SoCs need many external components to run properly. Eg.
 - Crystal(s) for timekeeping
 - Power management
 - Decoupling
 - External RAM
 - PHYs
 - Connectors
 - etc.





Boards available now

Short history of RISC-V hardware



SiFive, Inc.

Wikipedia: “In 2015, researchers Krste Asanović, Yunsup Lee, and Andrew Waterman from the University of California Berkeley founded SiFive. ...”

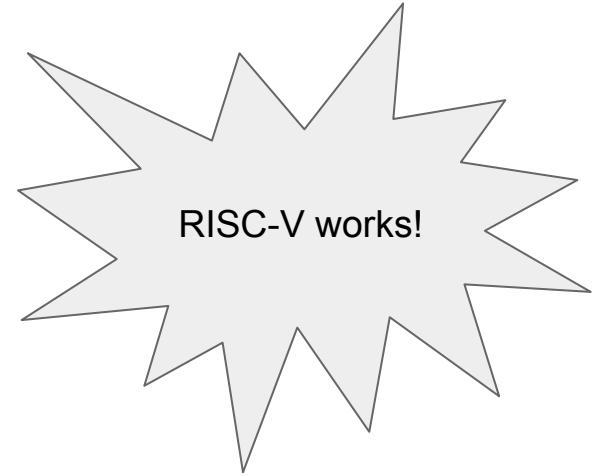
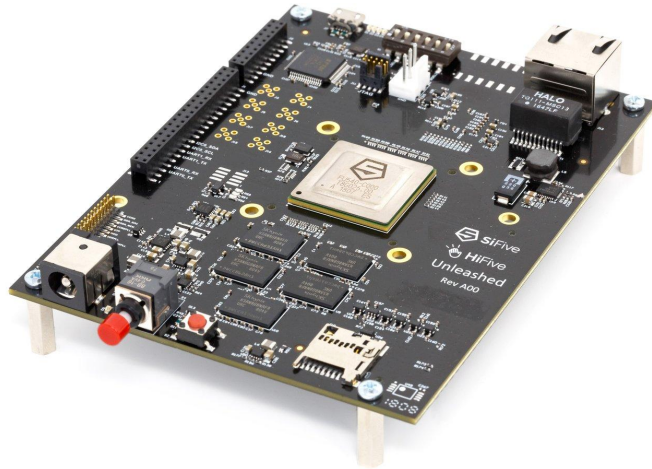
They’re a “fabless semiconductor company”, so want to sell RISC-V cores and other designs but not SoCs.





2018

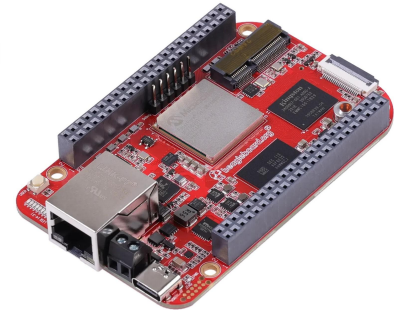
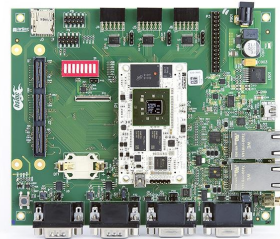
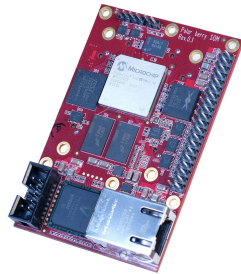
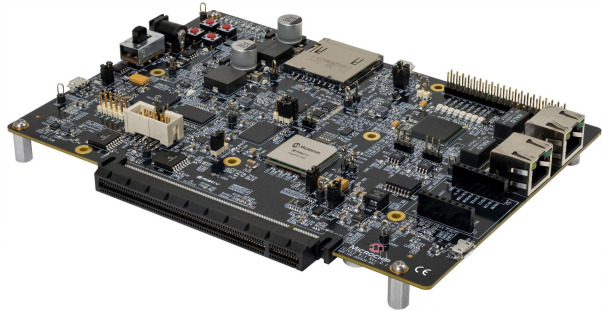
	SiFive
Core	U54
SoC	FU540
Board	HiFive Unleashed





2020

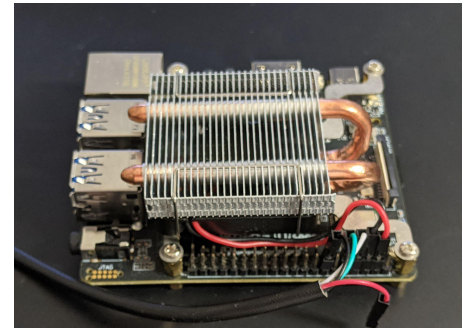
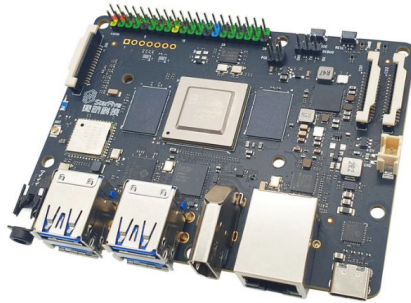
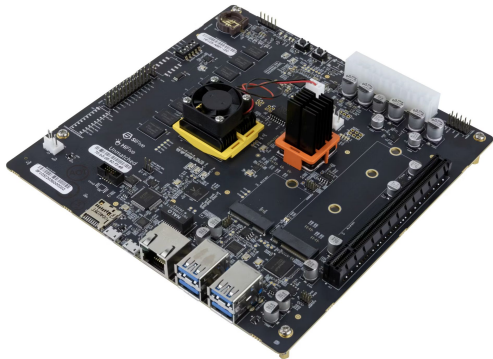
	SiFive	Microchip	Sundance	Aries Embedded	...	BeagleBoard (2023)
Core	U54					
SoC		PolarFire SoC				
Board		Icicle Kit	PolarBerry	M100PFEVPS	...	BeagleV Fire





2020, 2021

	SiFive	StarFive	BeagleBoard/Seed Studio
Core	U74		
SoC	FU740	JH7100	
Board	HiFive Unmatched	VisionFive V1	BeagleV Starlight





StarFive

Started as the chinese branch of SiFive, but independent soon after.

The chinese SoC vendor with most upstream presence. They already have patches for their upcoming JH8100 SoC upstream.



StarFive
赛昉科技



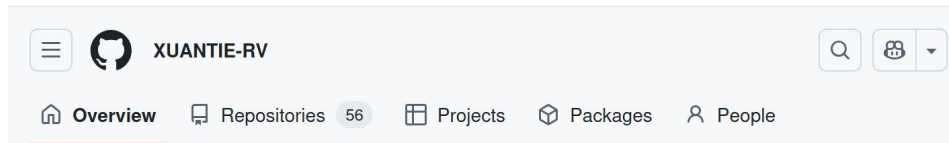
Alibaba T-Head



Design company in the Alibaba Group.

Overlap with the design company behind the CSky architecture.

Source freely available for some of their cores.



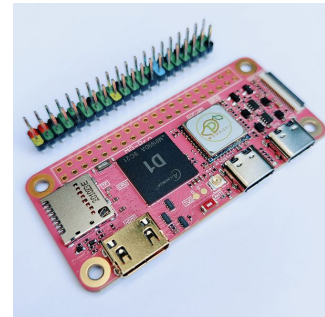
Popular repositories

<p>wujian100_open Public</p> <p>IC design and development should be faster simpler and more reliable</p> <p>Verilog 1.9k 575</p>	<p>openc910 Public</p> <p>OpenXuantie - OpenC910 Core</p> <p>Verilog 1.2k 315</p>
<p>riscv-aosp Public</p> <p>Patches & Script for AOSP to run on Xuantie RISC-V CPU</p> <p>467 76</p>	<p>openc906 Public</p> <p>OpenXuantie - OpenC906 Core</p> <p>Verilog 333 104</p>



2021

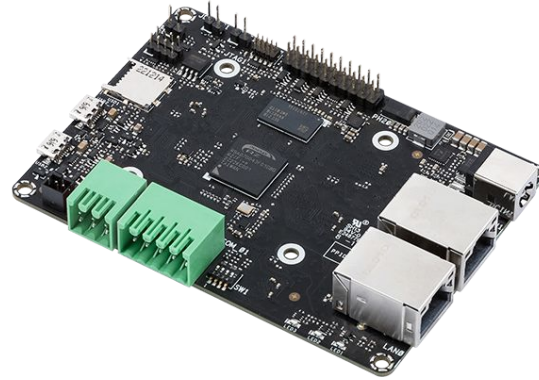
	T-Head	Allwinner	Sipeed	MangoPi	...
Core	XuanTie C906				
SoC		D1 (sun20iw1p1)			
Board			Nezha Lichee RV Dock X86 Panel	MQ-Pro	...





2022

	Andes	Renesas	ASUS
Core	AX45MP		
SoC		RZ/Five	
Board		RZ/Five EVK	Tinker V

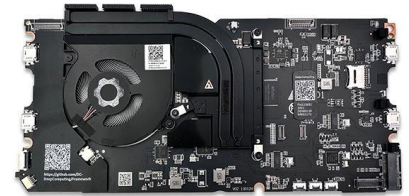
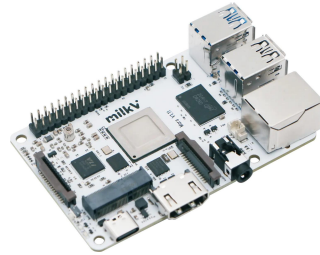
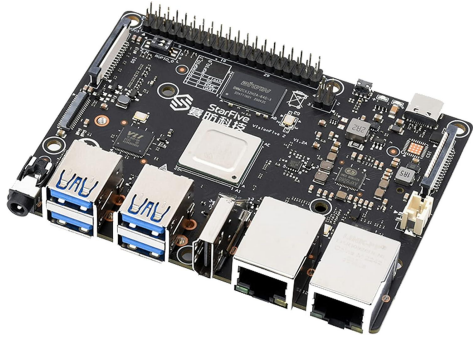


Unable to run general purpose RISC-V distro
:(



2022+

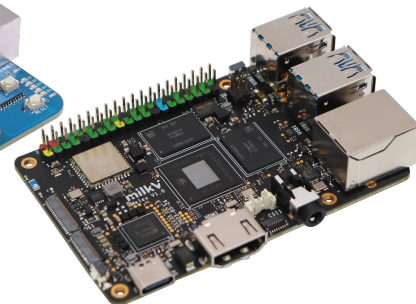
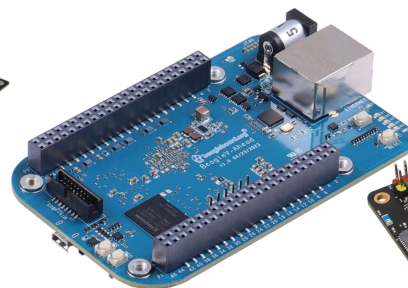
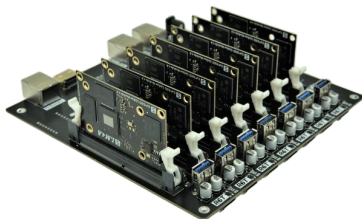
	SiFive	StarFive	PINE64	Milk-V	DeepComputing		
Core	U74						
SoC		JH7110					
Board		VisionFive 2	Star64	Mars	Mars CM (Lite)	ROMA Laptop	Framework Motherboard





2023

	T-Head	Sipeed			BeagleBoard	Milk-V
Core	XuanTie C910					
SoC	TH1520					
Board		LicheePi 4A	LicheePi Cluster 4A	LicheePi Console 4A	BeagleV Ahead	Meles





2023

	T-Head	SOPHGO	Milk-V
Core	XuanTie C930		
SoC		Sophos SG2042	
Board			Pioneer



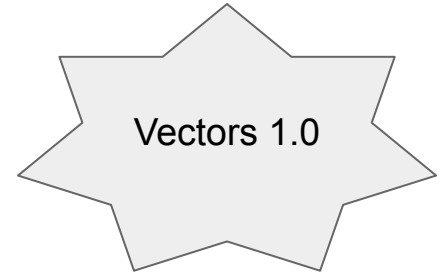
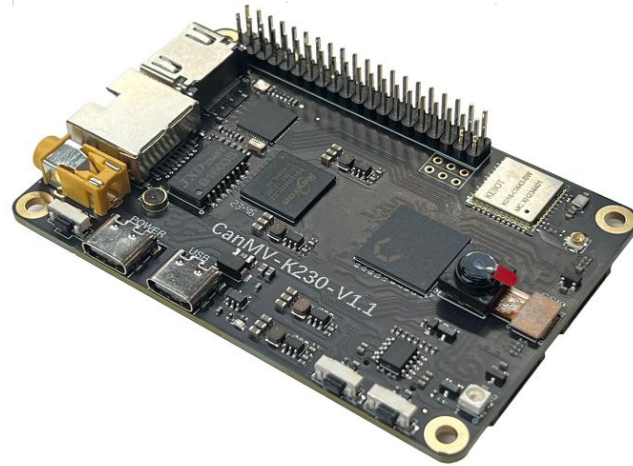
Pioneer

64 cores,
128GB
memory!



2023

	T-Head	Canaan
Core	XuanTie C908	
SoC		Kendryte K230
Board		EVB CamMV-K230

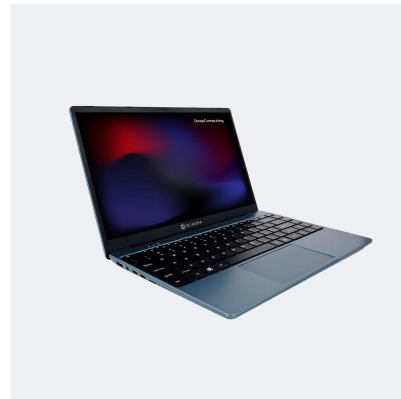
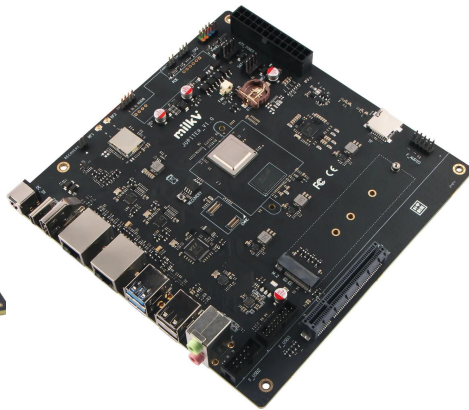
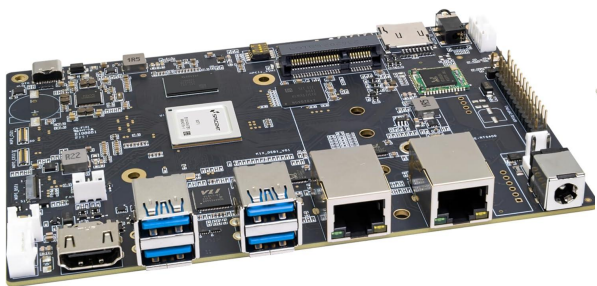




2024

Vectors
1.0

	SpacemiT	BananaPi	Milk-V	DeepComputing	...
Core	X60				
SoC	M1	K1			
Board		BPI-F3	Jupiter	ROMA Laptop II	...





Hardware bugs with logo!



2024-08-07 EVA MICHELY

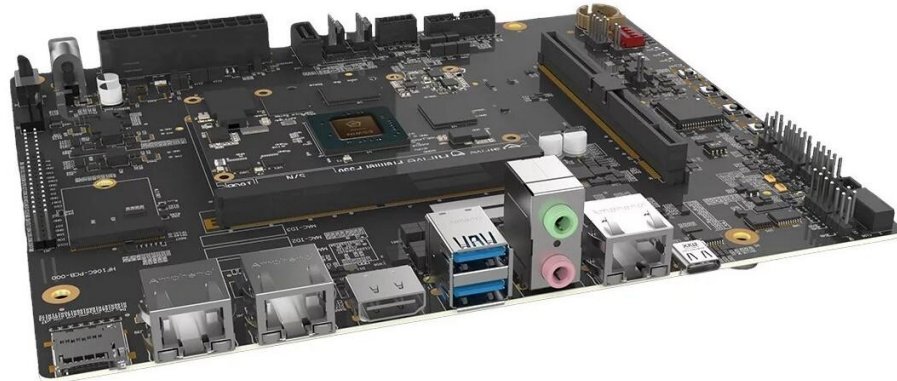
GhostWrite vulnerability breaks integrity of T-Head RISC-V CPU

A new vulnerability named GhostWrite fully compromises the integrity of



2024

	SiFive	ESWIN	Milk-V	Sipeed	...
Core	P550				
SoC		EIC7700			
Board	HiFive Premier P550		Megrez	LicheePi 5A	...





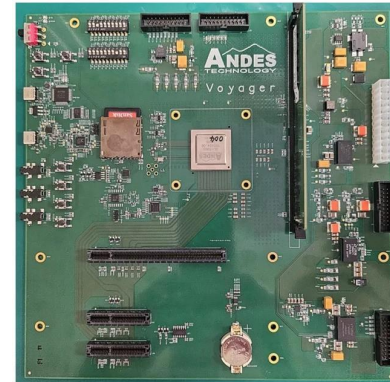
Looking forward



2025

	Andes	DeepComputing	...
Core	AX45MP + NX27V		
SoC	QiLai		
Board	Voyager	Unnamed	...

- “The QiLai leverages TSMC’s 7nm process technology”
- At least 3 PCIe slots





RISC-V Servers



Ventana Micro Systems



Rivos Inc.

Judging by the amount of open source work done by these companies it's going to be awesome when their hardware finally arrive :)



RISC-V Accelerators



Esperanto Tech



Tenstorrent

Both have made PCIe accelerator cards with many little RISC-V cores.

Will they make stand-alone RISC-V servers?



Chinese Academy of Sciences

The Chinese Academy of Sciences in cooperation with industry is creating an “open-source high-performance RISC-V processor”: XiangShan.

How will it perform once it is taped out?



Open-Source High-Performance RISC-V Processor

Repository

Document

Open Source

Xiangshan adopts the [MulanPSL2](#) license, and open sourcing all design code and development flow. Contributions from the community are welcome.

High Performance

Xiangshan is the world's top-performing open-source processor core, continuously pushing for higher performance.

RISC-V

Xiangshan uses the open [RISC-V](#) instruction set architecture, supporting RV64GCBVH.

Agile Development

Xiangshan uses the [Chisel](#) HDL, pioneering an agile development process and infrastructure for high-performance processors.

Microarchitecture Innovation

Xiangshan is an excellent microarchitecture research platform, enabling the academic exploration of innovations. [Acknowledgments](#)

Industrial Level

Xiangshan collaborates closely with industry partners to meet commercial processor requirements.



Thank you! Questions?



Quick FAQ

- I just want something easy to try out RISC-V Linux
 - Get a JH7110 based VisionFive 2 or Milk-V Mars board. Careful: Mars CM (Lite) device trees not upstream yet.
- I want to play with RISC-V vectors
 - Get a SpacemiT K1 or M1 based board. Be prepared to run the vendor kernel. Only basic patches upstream so far.
- I want the latest and greatest
 - Get the HiFive Premier P550, but be prepared to run the vendor kernel for a while.
- I want graphics
 - Good luck. Nothing is upstreamed properly, so it's either a cheap board with vendor kernel and Imagination drivers or the HiFive Unmatched board with an old Radeon PCI card.