# SiFive P870-D RISC-V Server CPU

Steve McDowell, Chief Analyst
8/14/24

## CONTEXT

The SiFive P870-D is a new cutting-edge RISC-V-based processor specifically designed for data center applications. As part of SiFive's broader family of high-performance processors, the P870-D is engineered to meet the growing demands for compute density, power efficiency, and system resilience in modern infrastructure environments.

## BACKGROUND: WHO IS SIFIVE?

SiFive is a leading semiconductor company that designs and develops processors based on the RISC-V instruction set architecture (ISA). Founded in 2015 by the inventors of RISC-V, SiFive has positioned itself as a pioneer in the open-source hardware movement, advocating for a more transparent and collaborative approach to processor design.

SiFive's mission is to empower innovation by providing customizable and scalable processor solutions that can be tailored to meet the specific needs of diverse applications across various industries, from consumer electronics to high-performance computing.

## BACKGROUND: RISC-V VS ARM

**RISC-V** is an open-source ISA that offers a modular and flexible architecture, allowing developers to customize and extend the instruction set to suit specific applications. This open standard approach fosters innovation and collaboration, enabling a broad ecosystem of developers and companies to contribute to the advancement of RISC-V technology. The RISC-V ecosystem has grown rapidly, increasing adoption in academia, startups, and established technology companies.

**Arm**, on the other hand, is a proprietary ISA that has long dominated the mobile and embedded processor markets. Arm processors are known for their power efficiency and performance, making them the architecture of choice for smartphones, tablets, and, increasingly, data centers and edge computing devices.

**Comparison**:

- **Customization**: RISC-V's open-source nature allows for greater customization and flexibility than Arm, which is constrained by licensing and proprietary design rules.

- **Ecosystem**: While Arm has a more mature and extensive ecosystem, RISC-V is rapidly catching up, particularly in open-source software, tools, and community support.

- **Cost**: RISC-V offers a cost advantage as it does not require licensing fees, making it an attractive option for companies looking to reduce costs while maintaining performance.

- **Adoption**: Arm has a larger market share, especially in established sectors like mobile and data centers. However, RISC-V is gaining traction, particularly in emerging markets and specialized applications.

# NEW: SIFIVE P870-D

The SiFive P870-D is a purpose-built processor explicitly designed for datacenter applications. It is part of a broader family of high-performance processors aimed at addressing the increasing demands for compute density, power efficiency, and resilience in modern infrastructure.

Key features and attributes of the P870-D include:

1. **High Compute Density**: The P870-D is optimized for workloads that require parallel execution of many compute tasks, which SiFives says makes the new part ideal for applications such as RISC-V build servers, video streaming, storage, and web appliances.

2. **Customizable and Scalable Architecture**: The processor includes the CHI interface and supports integration with complementary network-on-chip (NoC) technology providers like Arteris.

3. **System Resilience**: The P870-D is designed with robust error-handling capabilities, including protections on memories, processor architectural

states (register files, control, and status registers), and key structures of the datapath, like interconnects and shared cache controllers.

4. **Power and Size Efficiency**: Unlike traditional processors prioritizing performance at any cost, the P870-D focuses on delivering performance within specific size and power constraints.

5. **AI Integration**: The processor is designed to work with dedicated AI processing units, allowing for a combination of general-purpose computing and specialized AI workloads. This hybrid approach is essential for addressing the power and cost challenges associated with AI-driven applications in data centers.

6. **RISC-V Optimization**: The P870-D aligns with the broader RISC-V ecosystem, leveraging open-source and first-party software that is increasingly optimized for RISC-V architectures.

# ANALYSIS

The SiFive P870-D represents a significant advancement for RISC-V in the data center, offering a combination of performance, efficiency, and flexibility that is well-aligned with modern infrastructure needs.

As RISC-V continues gaining traction as a viable alternative to Arm, the P870-D will likely play a key role in furthering its adoption across various industries. With its focus on customization, scalability, and AI integration, the P870-D positions SiFive as a strong competitor in the alternative server processor market.

The big unknown is whether there's a market for RISC-V, and, more critically, standalone RISC-V processors, in the data center, where even independent Arm-based processor vendors struggle. Where Ampere Computing once had a solid footprint, but is being supplanted by internally designed Arm-based processors, like AWS Graviton.

At the same time, Arm will undoubtedly continue to raise its license fees to help justify its over-the-top valuation. As Arm becomes more expensive, that opens the door to alternative architectures like RISC-V. The irony is that RISC-V-based designs are taking a road already paved by Arm, which enabled an ecosystem friendly to alternative architectures. Arm broke the x86 monopoly in the server market.

If there's a market for RISC-V in the data center, then SiFive is clearly the company best positioned to be an early leader in the space. We can size the

market and talk about its enormous TAM, but it's simply too early to fully understand whether the market's ready for what SiFive is selling.

.