



RISC-V is Inevitable

Calista Redmond

CEO RISC-V International

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@risc_v



 RISC-V® Summit Europe 2023

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Barcelona
Supercomputing
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Topics

- RISC-V has redefined the future of computing
- The RISC-V community has made incredible progress
- Europe is investing deeply in RISC-V
- Strategic engagement in RISC-V is essential



RISC-V has redefined the future of computing

**RISC-V is the most prolific and
open Instruction Set
Architecture in history**

- RISC-V is inevitable
- RISC-V enables the best processors
- RISC-V is rapidly building the strongest ecosystem

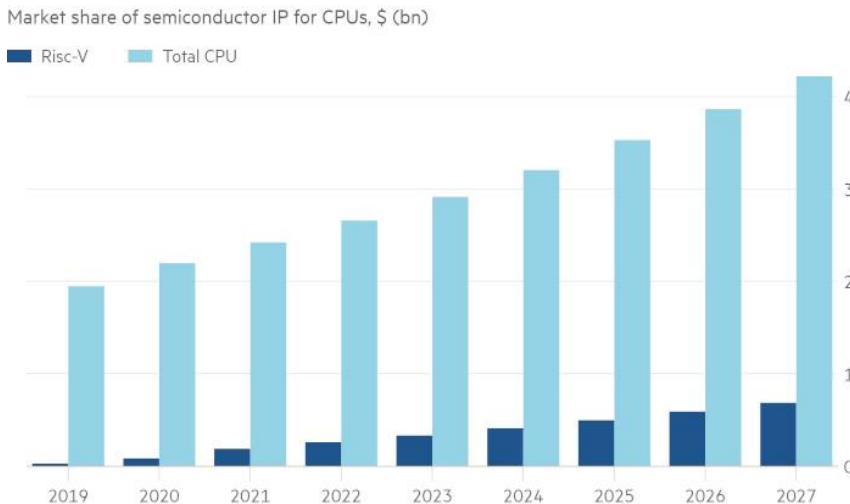
RISC-V is inevitable

Mission: RISC-V is the industry standard ISA across computing

-  >10 Billion RISC-V cores already shipped
-  Innovation and adoption moving rapidly across all domains
-  Demand at every performance level (low to ludicrous)
-  Shared investment is driving the fastest growing ecosystem

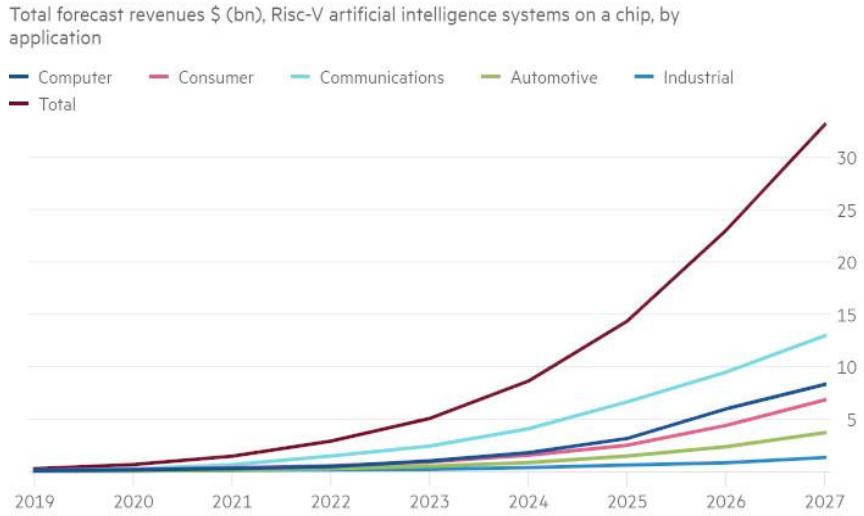
RISC-V semiconductor IP total market share forecast to grow from 1% to 16% by 2027

Semico Research forecasts that 62.4B RISC-V chips will ship by 2024.



Source: Semico Research

Strongest growth is underway in AI with 25B RISC-V AI SoCs coming to market by 2027, with expected revenue of \$291B.



Source: Semico Research

RISC-V enables profound innovation from low end to high end applications

-  **Inherent and sustainable performance** and efficiency advantage with extensions designed simply, for easy implementation
-  **Design flexibility and freedom** afford increased innovation potential across multiple variables
-  **Supported by massive community**, enabling the most efficient designs scalable to the full spectrum of applications

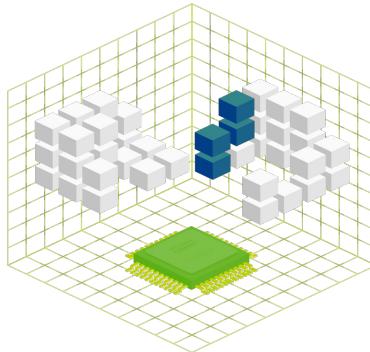
RISC-V enables the best processors

RISC-V is rapidly building the strongest ecosystem

RISC-V instrumented with software top of mind

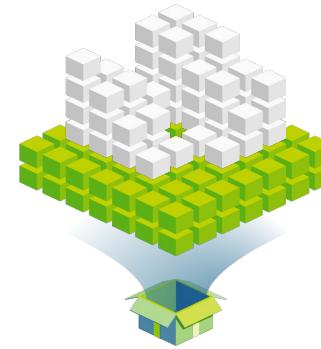
-  **Open standards enable software choice**
Applications keen to run on RISC-V.
-  **Toolchain and OS support** required for Extension ratification
-  **Single hypervisor standard** to simplify and unify application support
-  **Thousands of software developers** bringing workloads to RISC-V
-  **Strategic imperative and investment** by commercial sector and geographies
-  **Modern design approaches** leveraged for fewer instructions

RISC-V leads on innovation



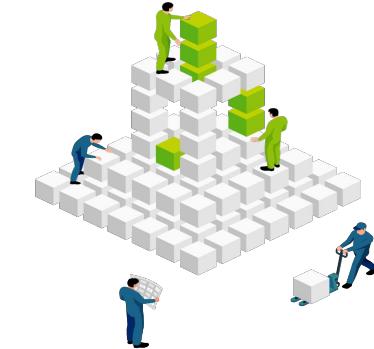
Domain-specific extensions

Drive the definition of extensions using quantitative and software-driven methodologies to benefit **domain-specific software** workloads and coexistence of **vendor-specific extensions**



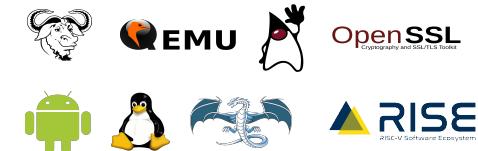
Platform standardization

Attract independent software vendors and **reduce platform fragmentation** for hardware/software interoperability with off-the-shelf devices and software



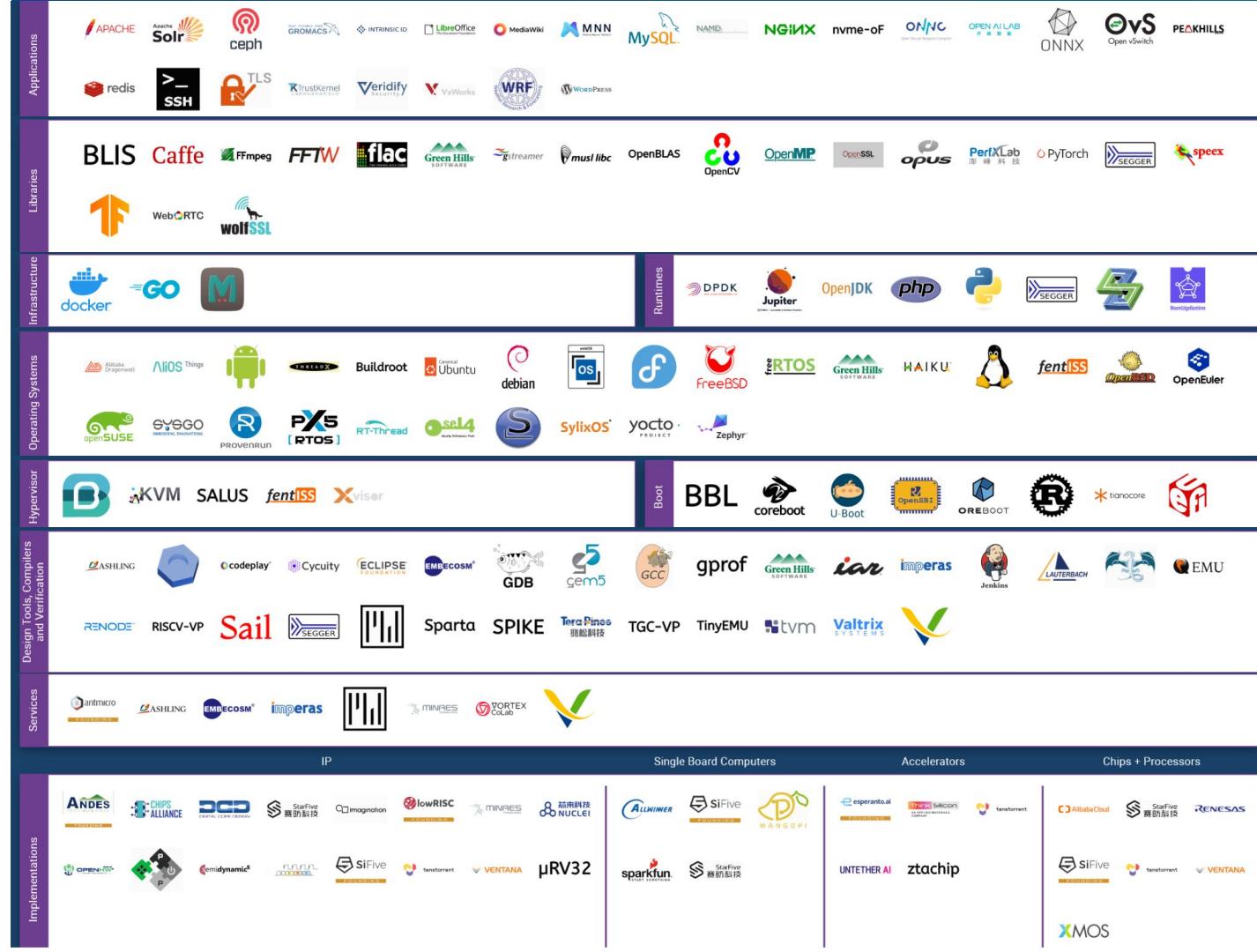
Building a contributor culture

Collaborate closely with major **Open-Source Projects** to better align our standardization and member contributions with each upstream project's processes





Accelerating and building the strongest ecosystem



Source: <https://landscape.riscv.org/>

RISC-V software ecosystem status:
<https://sites.google.com/riscv.org/software-ecosystem-status>

Updated June 2023

Welcome



Goal: Accelerate
open source software
on RISC-V



A standard hardware architecture with clear open standards

Align on highest priorities and avoid duplication of work



An open source software ecosystem built on top of standardized hardware

Areas of Focus

- Development Tools
- Language Runtimes
- System Firmware
- Kernel & Virtualization
- Compilers & Toolchain
- Simulators and Emulators



Community Progress

- Automotive
- HPC + Data Center
- AI ML
- Safety + Security
- Open Hardware + Software

The RISC-V
community
has made
incredible
progress

Automotive



RISC-V will capture 10%
of the Automotive
market by 2025

Counterpoint, September 2021



ADAS chips capable of 176 trillion ops per second with 12 RISC-V CPU cores



SoC.one and Imagination partner to enable adoption of RISC-V for automotive applications



Automotive portfolio announced targeting cockpit electrification, ADAS, safety, and others applications



NSITEXE selects ImperasDV for advanced RISC-V processor hardware design verification



EMSA5-FS Functional Safety Embedded RISC-V Processor certified ASIL-D ready for functional safety (FuSa) automotive applications.



eVocore P8700 CPU has been licensed for applications including automotive driver assistance systems (ADAS) and autonomous driving

High Performance Computing



Significant investments in multiple geographies specifying RISC-V



E4 Computer Engineering, with Università di Bologna and CINECA to build the first operational RISC-V based cluster targeted to the codesign of HPC applications



Researchers from the Technical University of Munich (TUM) have designed a chip to implement post-quantum cryptography



HPC-centric software test suite for GCC and LLVM



First fully customizable, 64-bit RISC-V core family for handling large amounts of data for ML, AI, and HPC



EPAC accelerators target HPC applications



Developing a high-performance RISC-V Out-of-Order processor core for the European eProcessor project



Barcelona Supercomputing Center
Centro Nacional de Supercomputación

BCS-CNS and Intel to jointly set up lab to develop next generation RISC-V supercomputers

BSC Develops 4 Open-Source Hardware Components Based on RISC-V



An Open-Source High-Performance RISC-V Processor from China Academy Sciences and Peng Cheng Lab

Data Center & Cloud



RISC-V CPU core market will grow 115% CAGR, capturing >14% of all CPU cores by 2025

Semico Research, December 2021



1,000-Core RISC-V AI accelerator designed for data centers



RISC-V Catapult cores address a range of markets including data center and high performance computing



RISC-V Xuantie processors with 4 open cloud and edge processors



MTIA v1 AI inference accelerator with two RISC-V processor cores (one with vector) customized for compute and control



Announced Veyron V1 high performance processors for Client Compute, Automotive, 5G Open RAN, AI, and Data Center



AndesCore AX65 targets high performance applications including data center



Transforms the way SOC architects and system software developers define new products

AI / ML



RISC-V-based AI SoCs will grow 73.6% CAGR to 25B units and \$291B in revenue by 2027

Semico Research, December 2021

RISC-V

Alibaba Cloud

Xuantie C906 processor Tops MLPerf Tiny v0.7 Benchmark

Codasip

L31 and L11 RISC-V embedded cores enable AI/ML edge customization



Fraunhofer

RISC-V Processor Core of Fraunhofer IPMS now ready for Edge AI

ANDES TECHNOLOGY

AX45MPV RISC-V Multicore 1024-bit Vector Processor

SiFive

SiFive Intelligence X280 RISC-V processor picked for use in Google AI compute nodes

esperanto.ai

Industry Milestone of Generative AI Models Running on ET-SoC-1, launched SDK enabling acceleration of parallelized HPC workloads

UNTETHER AI

Boqueria AI device features over 1400 RISC-V processors for at-memory compute



tenstorrent

Tenstorrent ultra high performance RISC-V CPUs and AI accelerators for AI and HPC.

Europe is investing deeply in RISC-V

- **TRISTAN:** Together for RISc-V Technology and ApplicatioNs, € 54.3M
- **ISOLDE:** KDT project with more than 40 partners from 9 different countries
- **The EuroHPC Joint Undertaking (EuroHPC JU):** Call for proposals for HPC based on RISC-V
- **European Processor Initiative:** 30 partners from 10 European countries design and implement a roadmap for a new family of low-power European processors
- **Parallel Ultra Low Power Platform (PULP):** Joint effort between ETH Zürich and University of Bologna

Billions of collective investment in RISC-V



EU [announced a new European Chips Act of €15 billion](#)
This adds to €30 billion of current public investments

February 8, 2022



EuroHPC JU allocates €270 million to build RISC-V chips for HPC
December 16, 2022

Spain Approves €12.25b Semiconductor Investment Plan with RISC-V lab at BSC, and investment in Spain

May 25, 2022



Intel Creates \$1B Innovation Fund To Grow RISC-V Market (And Attract New Foundry Customers) ... Joins RISC-V Board
February 7, 2022



India Ministry for Electronics & Information Technology launched Digital India RISC-V (DIR-V) program for commercial SHAKTI & VEGA silicon.
April 27, 2022



Industry Leaders Launch RISE to Accelerate the Development of Open Source Software for RISC-V
May 31, 2023

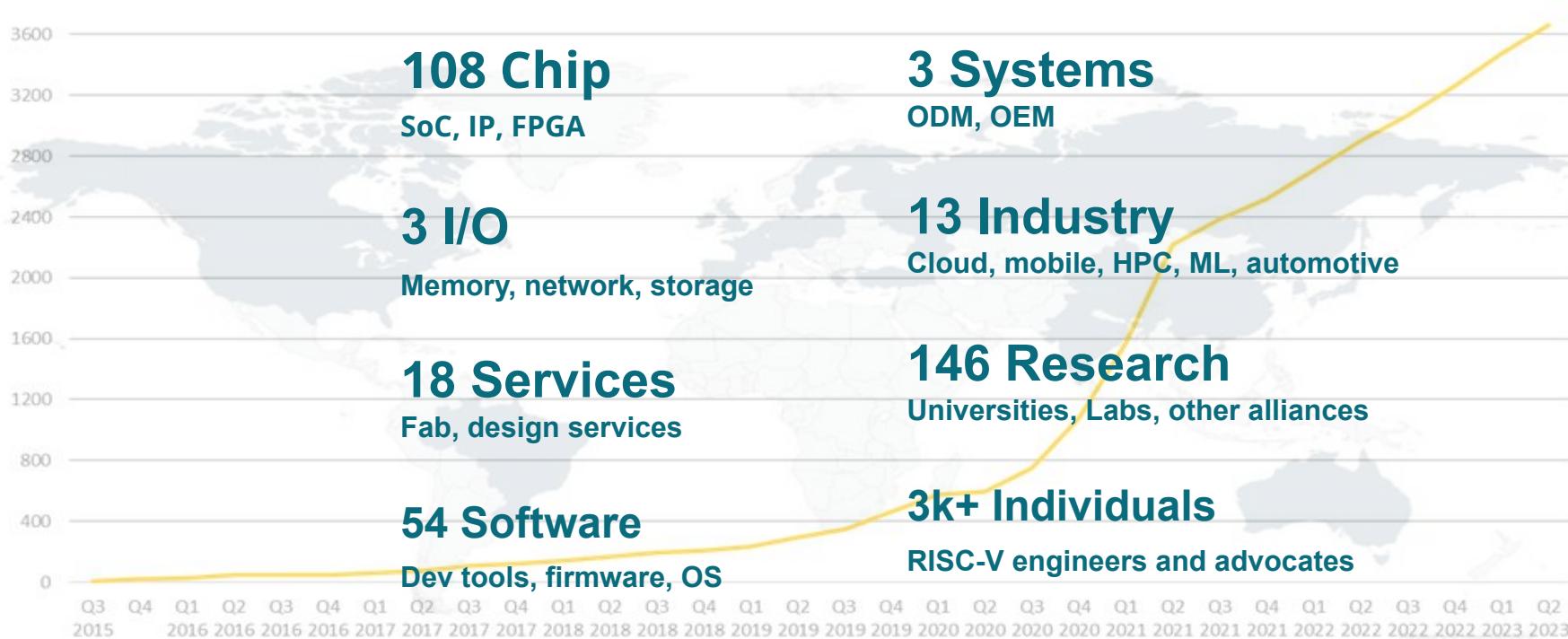


**Provides structure and
governance of critical technical
deliverables**

**Funds programs to support your
success and RISC-V
proliferation**

**Strategic
engagement
in RISC-V is
essential**

More than 3,664 RISC-V Members across 70 Countries



May 2023

Extensions + Profiles Ratifications

7 ratifications in 2023 already,
with over a dozen more moving
towards ratification!

Formally ratified 5 profiles that
are already widely adopted.

2023 Ratification Highlights

- Code Size Reduction
- Platform Interrupts
- Total Store Memory Ordering
- High Performance Counters

RISC-V Learn Online accelerates careers, builds industry talent

20k+ courses taken since
program launch in 2021

New!

RISC-V Foundational Associate Certification and RISC-V Fundamentals Course

- **Students** - understand fundamental concepts, gain competitive distinction in job search
- **Current employees** - increase entry level knowledge
- **Hiring** - ensure candidate knowledge to transition quickly into your company
- **Universities** - understand industry expectations of students entering the workforce



Benefit of joining RISC-V

- ✓ Accelerate technical traction and insight
- ✓ Contribute technical priorities, approaches, and code
- ✓ Gain strategic and technical advantage
- ✓ Increase visibility, leadership, and market insight
- ✓ Fill and increase engineering skills, retain and attract talent
- ✓ Build innovation partner network and customer pipeline
- ✓ Deepen, engage, and lead in local and industry developer network
- ✓ Showcase RISC-V products, services, training, and resources



RISC-V is a community of passionate,
dedicated, and invested stakeholders

As individuals

As companies

As universities

As public institutions and non-profits

As nations

As one Global, connected movement

**Build RISC-V into
your company
strategy, and your
personal mission**



RISC-V is Inevitable

This is the open era of computing.



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Membership Options

[RISC-V Membership details may be found online here](#)

Premier Member Benefits

- Board seat and Technical Steering Committee seat included at \$250k level
- Technical Steering Committee seat included at \$100k level
- Board level includes seat on RISC-V Legal Committee
- Eligible to lead workgroup and/or committee
- Use of RISC-V Trademark for commercialization
- Member logo / name listing on RISC-V website, alphabetical with Premier members
- Solution / Product listing highlighted on RISC-V Exchange, noted with member level
- 4 case studies a year
- 2 blogs per month
- 2 social media spotlights per month
- Spotlight member profile
- Event sponsorship discount

Premier Requirements

- Membership open to any type of legal entity
- \$250k Annual membership fee that includes Board seat and TSC seat
- \$100k Annual membership fee that includes TSC seat

Strategic Member Benefits

- 3 Board reps elected for the Strategic tier, including Premier members that do not otherwise have a board seat
- Eligible to lead workgroup and/or committee
- Use of RISC-V Trademark for commercialization
- Member logo / name listing on RISC-V website, alphabetical with Strategic members
- Solution / Product listing highlighted on the RISC-V Exchange, noted with member level
- 1 case study a year
- 1 blog per month
- 1 social media spotlight per month
- Event sponsorship discount

Strategic Member Requirements

- Membership open to any type of legal entity
- Annual membership fee based on employee size
 - 5,000+ employees: \$35k
 - 500-5,000 employees: \$15k
 - <500 employees: \$5k
 - <10 employees & company <2 yrs old: \$2k

Community Member Benefits

- Two Board representatives
- 1 Community Board representative, elected
- 1 Individual Board representative, elected
- Member logo / name listing on RISC-V website, by member level
- 1 case study a year
- 1 blog per quarter
- 1 social media spotlight per quarter
- Event sponsorship discount

Community Requirements

- Membership open to
 - academic institutions,
 - non-profits,
 - individuals not representing a legal entity
- No annual membership fee