



# RISC-V is Inevitable

**Calista Redmond**  
CEO RISC-V International

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OPENHW<sup>GROUP</sup>  
— PROVEN PROCESSOR IP —



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# And to an amazing team!

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- Tiffany Sparks (RISC-V International)
- Philipp Tomsich (VRULL)
- Stefan Wallentowitz (Hochschule München Univ. of Applied Sciences)



# 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)

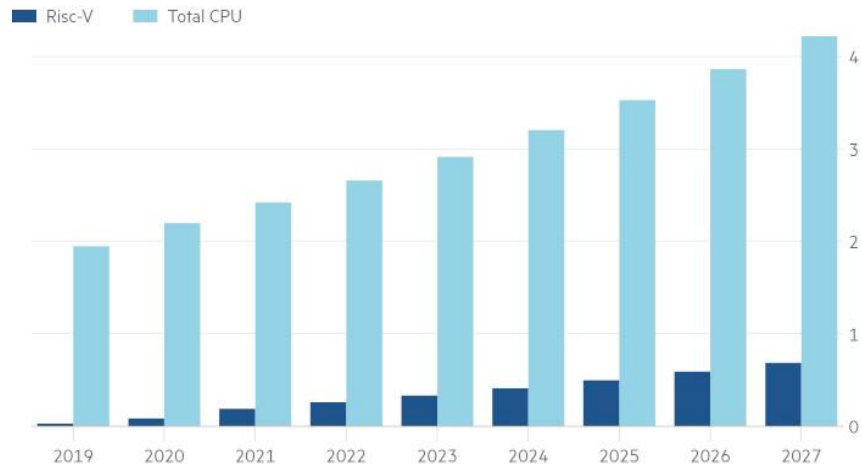


Shared investment is driving the fastest growing ecosystem

# 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.

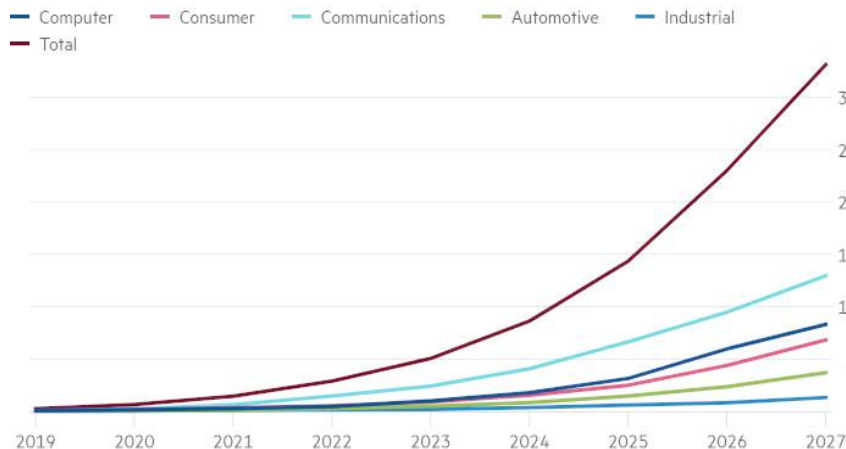
Market share of semiconductor IP for CPUs, \$ (bn)



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.

Total forecast revenues \$ (bn), Risc-V artificial intelligence systems on a chip, by application



Source: Semico Research

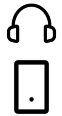
## RISC-V enables profound innovation from low end to high end applications



**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

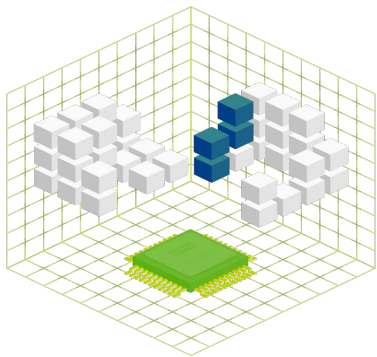


**Strategic imperative and investment** by  
commercial sector and geographies



**Modern design approaches** leveraged for  
fewer instructions

# RISC-V leads on innovation



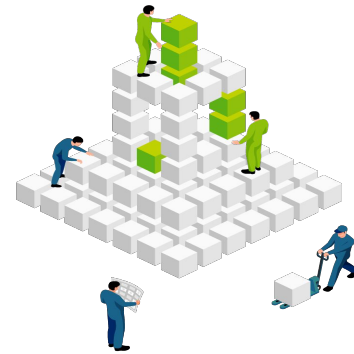
## Domain-specific extensions

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



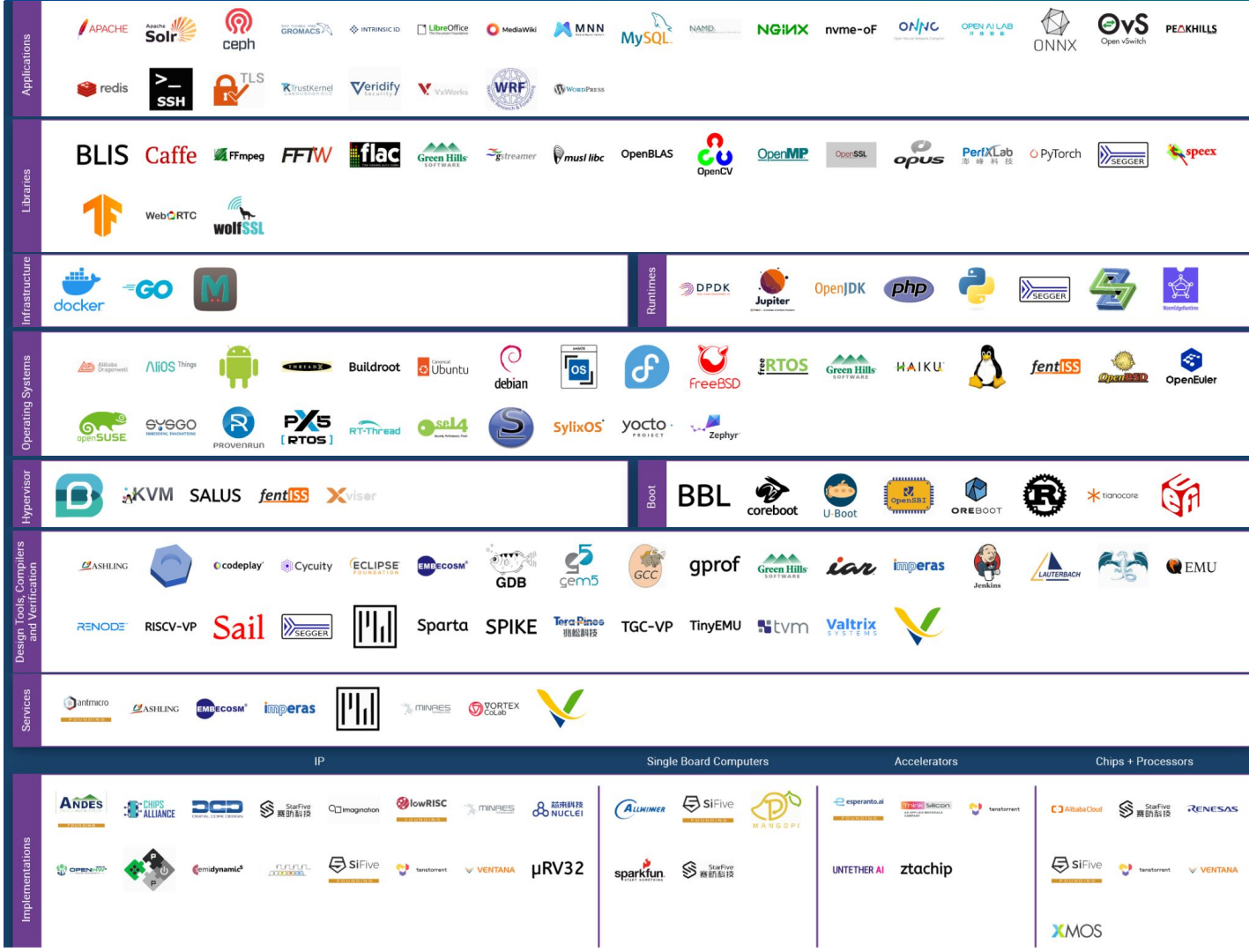
## Building a contributor culture

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



# RISE

RISC-V Software Ecosystem

**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



Learn more at [riseproject.dev](https://riseproject.dev)

## 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



EPAC accelerators target HPC applications



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



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



HPC-centric software test suite for GCC and LLVM



**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



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



**XiangShan**

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



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



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



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



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



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



Xuantie C906 processor Tops MLPerf Tiny v0.7 Benchmark



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



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



AX45MPV RISC-V Multicore 1024-bit Vector Processor



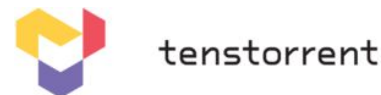
SiFive Intelligence X280 RISC-V processor picked for use in Google AI compute nodes



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



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



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



European Commission

EU [announced a new European Chips Act of €15 billion](#)

This adds to €30 billion of current public investments

February 8, 2022



EuroHPC  
Joint Undertaking

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



**Pedro Sánchez** @sanchezcastejon · 24 May

Representante gubernamental de España

Gracias, @PGelsinger, por elegir España para el laboratorio pionero de procesadores RISC-V en @BSC\_CNS. Hoy aprobamos el #PERTE\_Chip con el que aspiramos a crear un ecosistema sólido para el futuro de la computación en Europa y atraer grandes inversiones en semiconductores.



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

February 7, 2022



MeitY  
Government of India

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



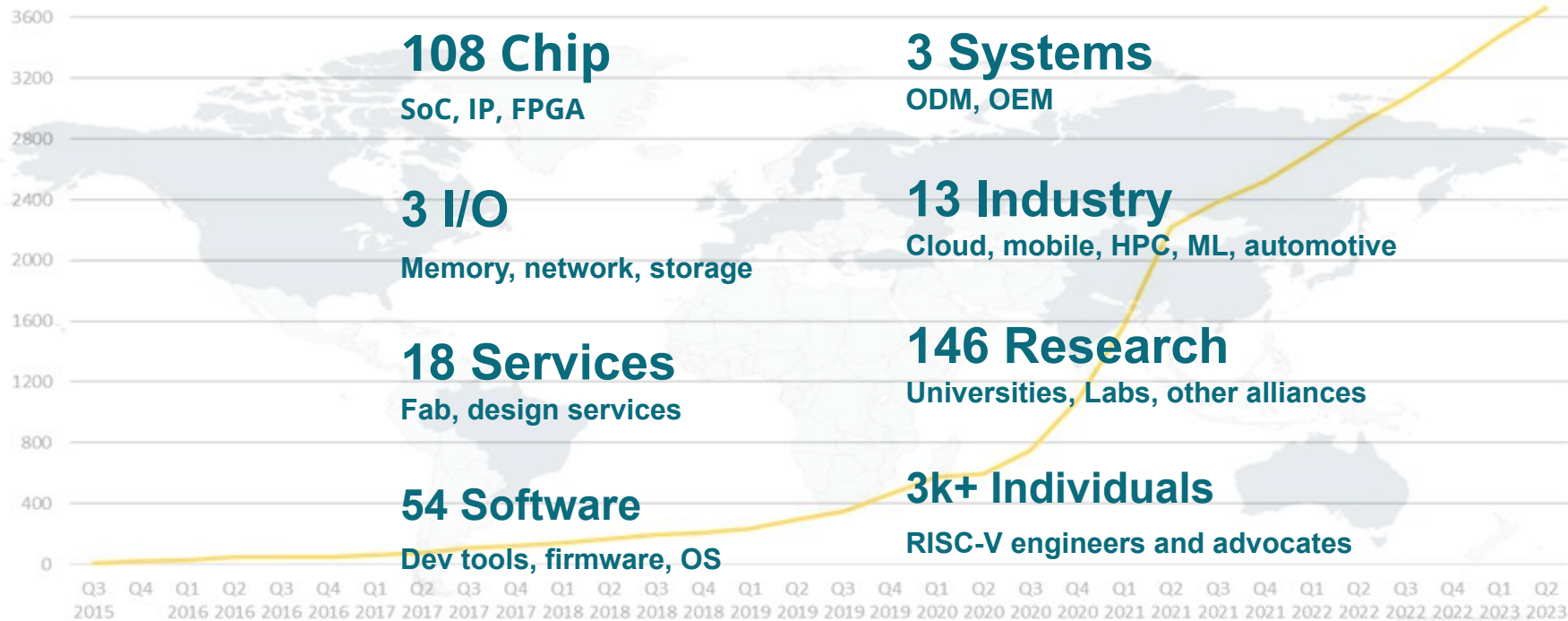


**Provides structure and  
governance of critical technical  
deliverables**

**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



[riscv.org/risc-v-learn-online/](https://riscv.org/risc-v-learn-online/)

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.



WeChat



[www.riscv.org](http://www.riscv.org)



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@calista\_redmond



risc-v-international  
calistaredmond



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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