The Significance of the RVA23 Profile in Advancing the RISC-V Ecosystem

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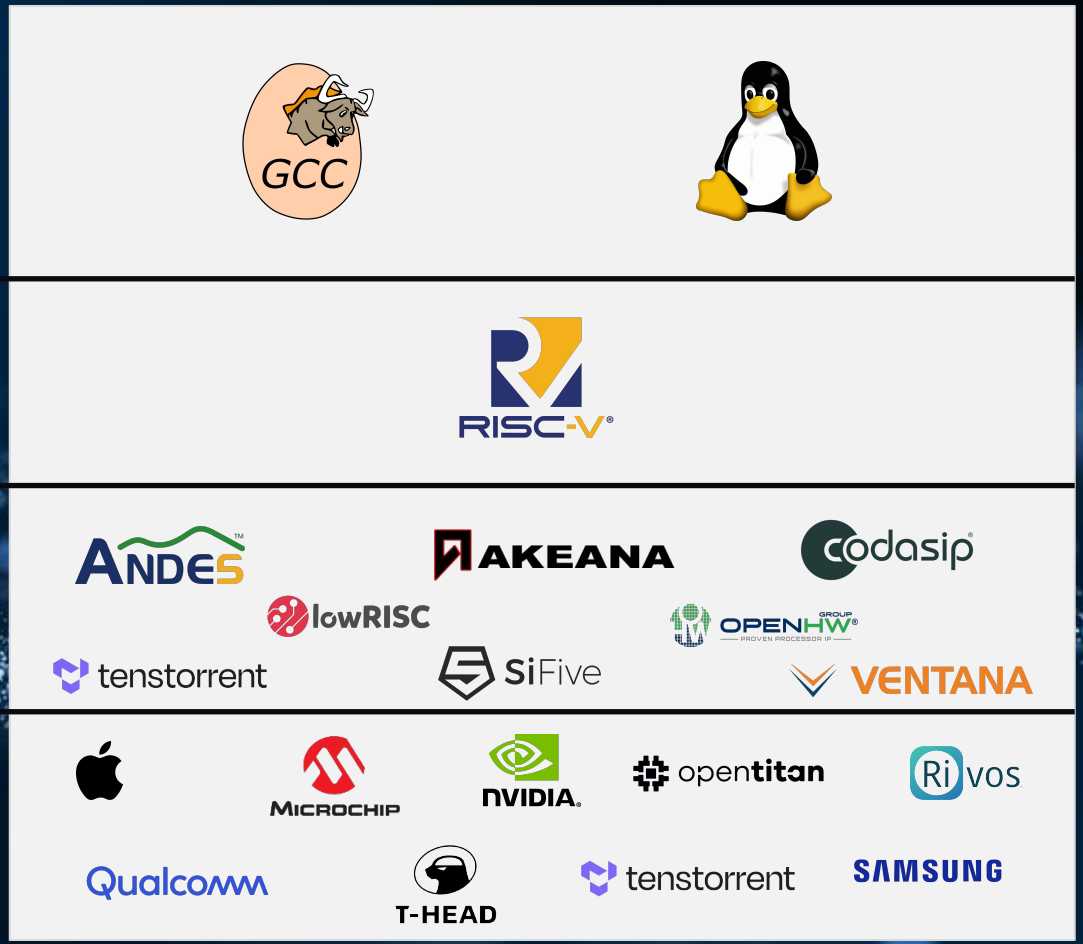
Open ISA

Software Ecosystem
(OSes, Platforms, Libraries,
Domain specific applications)

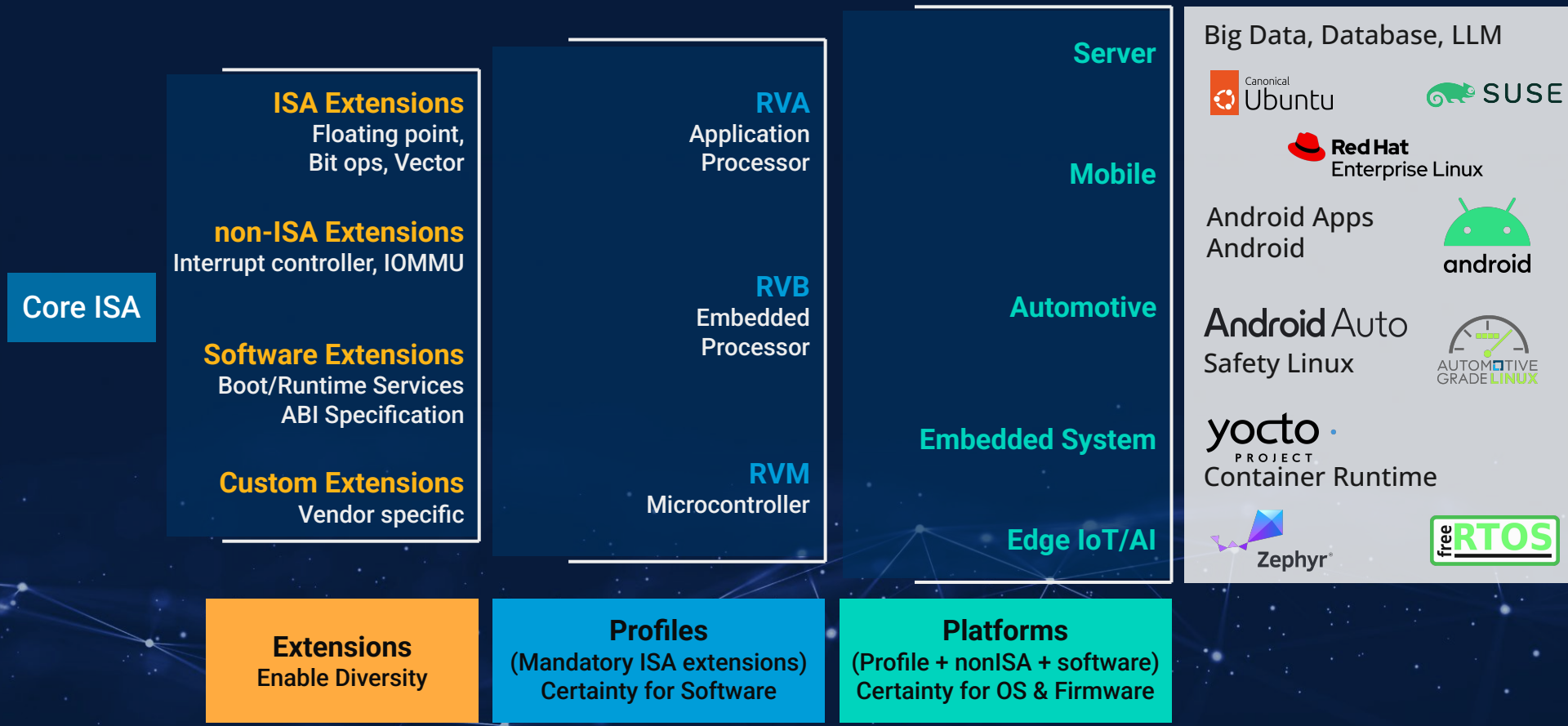
ISA: Instruction Set Architecture
(Interface between
Hardware & Software)

Implementation: IP
May leverage open and/or
proprietary IP

Implementation: SoC
Competitive opportunity



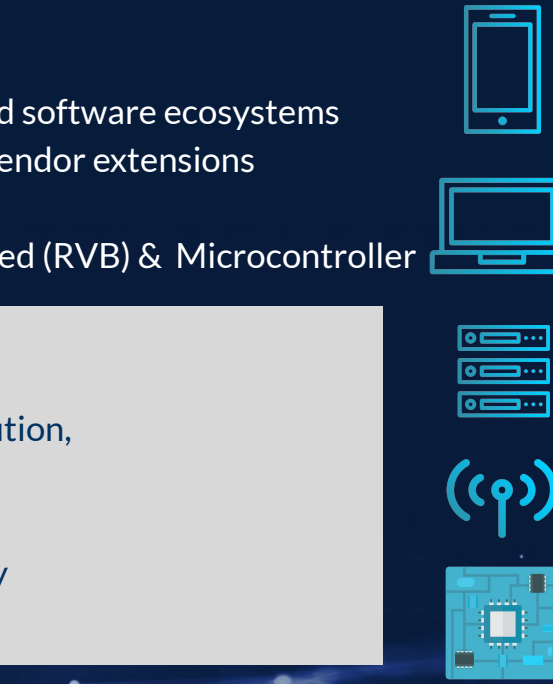
Profiles, Platforms and the Software Ecosystem



RISC-V

Importance of Profiles

- Standard ISAs are critical to the growth of both hardware and software ecosystems
- RISC-V gains broad applicability from many extensions and vendor extensions
- Promote compatibility, innovation and make adoption easier
- Profiles cover different domains: Application (RVA), Embedded (RVB) & Microcontroller



RVA23 Profile

- Certainty for developers writing applications: binary distribution, download from repo/store
- Standardizes the 64-bit application processors ISA
- Enables seamless user level (application) software portability across hardware implementations

Enables RISC-V software ecosystem to flourish across industries and application spaces

Importance of Platforms

- Operating systems and distributions have more than just the application software
- Promote compatibility, innovation and make adoption easier
- Platforms cover different domains: Server, Mobile, Automotive,...

Mobile

Laptops

Servers

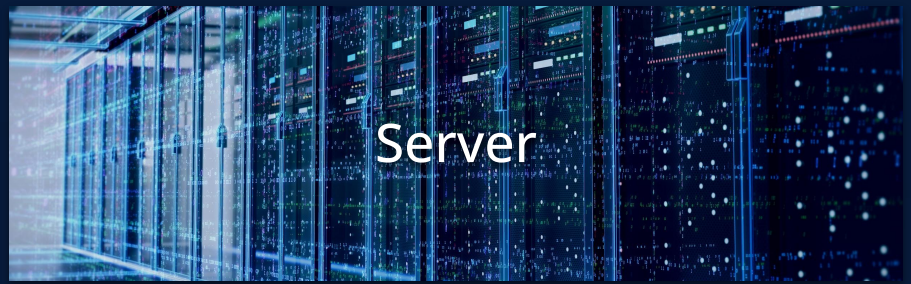
Auto

RISC-V Server Platform (upcoming)

- Certainty for OS developers and full distribution suppliers
- Builds on RVA23 Profile, Server SOC Spec, Boot & Runtime Services Spec, and Security Model
- Enables OS and hypervisor vendors to support multiple RISC-V vendors with a single binary OS image

Platform Specifications align RISC-V to industry standards; enabling solutions from all vendors to work

Benefits from RVA23 for Auto and Server



Auto needs structure, consistency and coordination

- Instructions that software can rely on to be present
- Consistent hardware implementations across a range of RISC-V suppliers
- Automotive SIG defining strategy for value chain coordination
- Scalable profiles covering ECU, Zonal Controllers and Central car compute areas

Teams deploying servers need confidence things will work; RVA23 and RISC-V Server specification together enable this.

- OS and hypervisor vendors support different SoCs with a single binary OS image
- App vendors provide a single binary image
- Security from pre-boot to application
- RAS and Management

Benefits from RVA23 for Mobile and Laptops

Energy-efficient performance and downloadable Apps from a Store. RVA23 enables this.

- Vector extensions enable AI, media, string/memory… at required speeds
- Significant code density improvements with Bit manipulation and other "ambient" instructions
- Binary compatibility allows single Apps across vendors
- Enables consistent, performant implementations
- Basis for OS platform spec

Client devices need installable application packages and running multi-user and protected environments.
RVA23 enables this.

- Hypervisor extension for additional protection
- Similar requirements to mobile devices
- Enables consistent developer experience for writing for RISC-V, on RISC-V

Key New User Mode Features in RVA23

New Mandatory

- V Vector extension (optional in RVA22)
- Zvfhmin Vector half-precision floating-point
- Zvbb Vector basic bit-manipulation instructions
- Zvkt Vector data-independent execution latency
- Zihintntl Non-temporal locality hints
- Zicond Integer conditional operations
- Zimop may-be-operations
- Zcmop Compressed may-be-operations
- Zcb Additional compressed instructions
- Zfa Additional floating-Point instructions
- *Zawrs Wait-on-reservation-set instructions*
- Supm Pointer masking, (PMLEN=0..7)

Localized

- Zvkng Vector crypto NIST algorithms with GCM
- Zvksg Vector crypto ShangMi algorithms with GCM

Development (expected mandatory soon)

- Zabha Byte and halfword atomic memory ops
- Zacas Compare-and-Swap instructions
- Ziccamoc Main memory regions CAS support
- Zvbc Vector carryless multiplication
- Zama16b Misaligned loads, stores, and AMOs

Optional

- Zfh Scalar half-precision floating-point
- Zbc Scalar carryless multiply
- Zicfilp Landing Pads
- *Zicfiss Shadow Stack*
- Zvfh Vector half-precision floating-point
- Zfbfmin Scalar BF16 converts
- Zvfbfmin Vector BF16 converts
- Zvfbfwma Vector BF16 widening mul-add

Implementations are strongly recommended to raise illegal-instruction exceptions on attempts to execute unimplemented opcodes.

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```
function_entry:
    addi sp,sp,-8
    sd x1,(sp)
    sspush x1
     :
    ld x1,(sp)
    addi sp,sp,8
    sspopchk x1
    ret
```

Implementations are strongly recommended to raise illegal-instruction exceptions on attempts to execute unimplemented opcodes.

Call to Action: Develop with RVA23

RISC-V CPU developers: make your processor available for binary application distribution

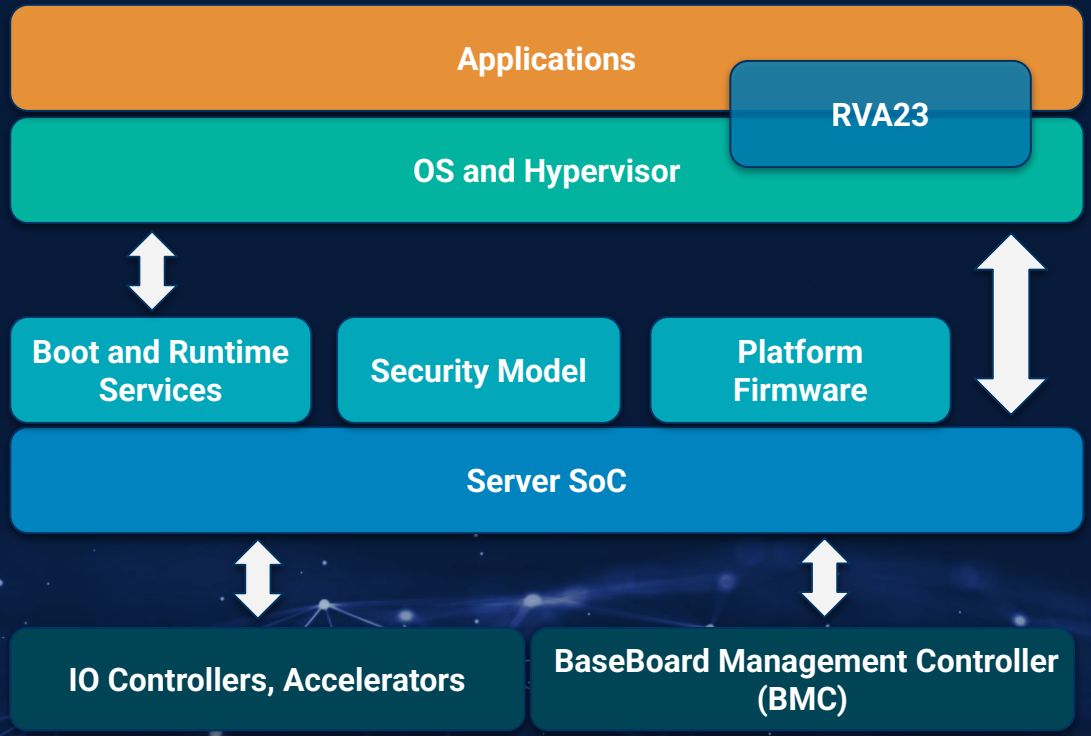
RISC-V Application developers: use RVA23 as your optimization target

Compatibility and efficiency for industries reliant in virtualized, scalable and secure capabilities

RISC-V®

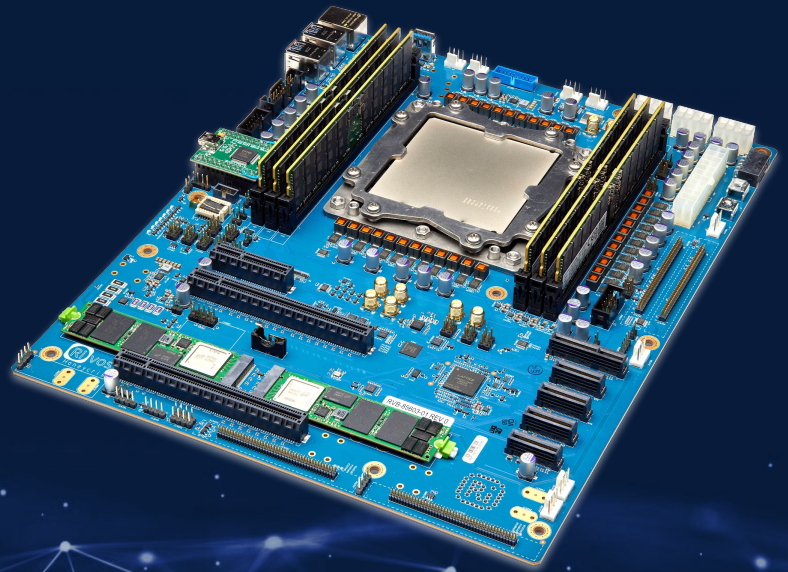
RISC-V Server Platform: Built on RVA23

- Standardized SoC hardware interfaces such as PCIe root ports, IOMMU, and Interrupt Controllers
- Boot and Runtime services using UEFI and ACPI
- BMC for provisioning and management using standards such as MCTP, PLDM, IPMI, and Redfish
- Security Model guides debug authorization, secure boot, firmware updates, firmware resilience, and other use cases



RISC-V Server SoC Specification Outline

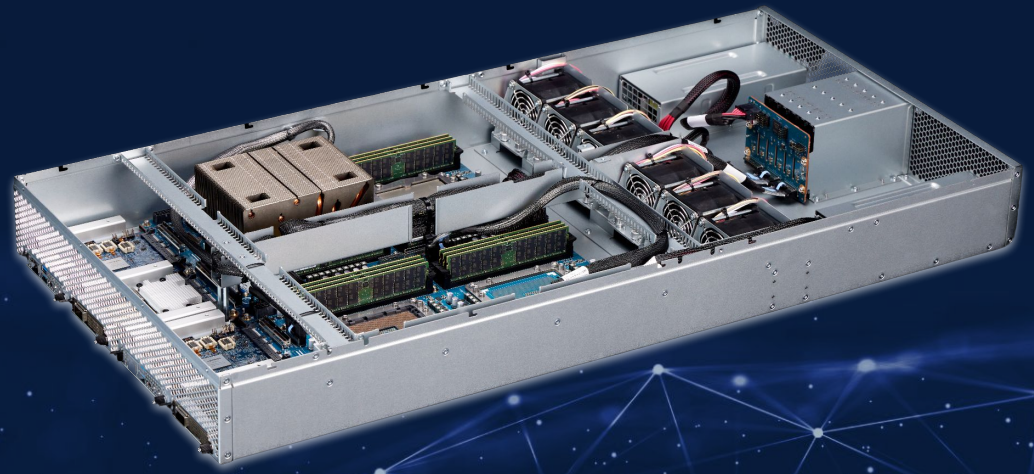
- Clocks, Timers, and Interrupt Controllers
- IOMMU
- PCIe Subsystem
  - ECAM and PCIe memory space
  - Access Control Services
  - Handling of ID and address routed transactions
  - Message Signaled Interrupts
  - Precision Time Management
- Reliability, Availability, and Serviceability
- Quality of Service
- Manageability
- Performance Monitoring
- Security



Enables OS and hypervisor vendors to support SoCs with a single binary OS image distribution model

Call to Action: Help Final Stages of Server Platform

Specification is going to Public Review: please help with feedback
Server SoC developers: Adopt the Platform Specification for your parts



Compatibility and efficiency for industries reliant in virtualized, scalable and secure capabilities

RISC-V®

Building the Server Software Ecosystem Together

> Hardware and software vendors are rallying around the RVA23 profile to bring consistency to the enterprise and high-performance compute landscape.
>
> Through close collaboration, Rivos and Canonical are enabling the benefits of standardization on RISC-V whilst opening up the flexibility for vendor-specific optimizations. This balanced approach ensures stability, security, and performance. These requirements are essential for robust and performant enterprise solutions.
>
> – Gordan Markus Director, Silicon Alliance, Canonical

Rivos and Canonical bring RISC-V Ubuntu for Data Centers

Enabled by RVA23 Profile and Server Platform

Same distribution will work for all vendors following the specs

https://www.youtube.com/@RivosInc/videos

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Shameless Plug for RISC-V Taipei Day & Computex

ASpeed will show the Rivos DC-SCM card with their AST2750 BMC at their Computex booth

Intentend to open the KiCAD schematics (and web viewable schematic)

RISC-V®

Shared Vision based on Standards

Building a stronger RISC-V ecosystem together with Profiles and Platforms