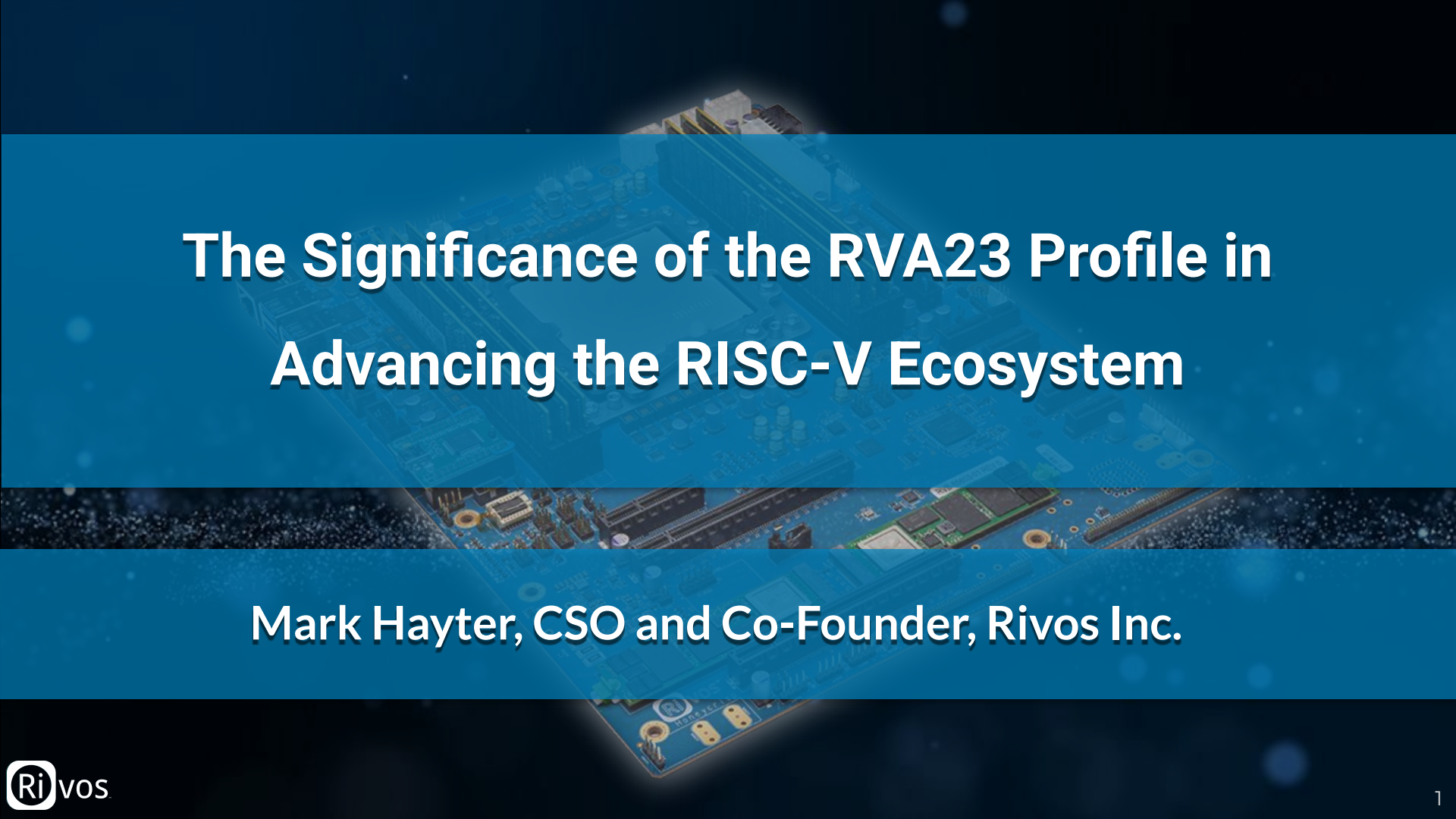
The Significance of the RVA23 Profile in Advancing the RISC-V Ecosystem



Mark Hayter, CSO and Co-Founder, Rivos Inc.

Rivos

Open ISA

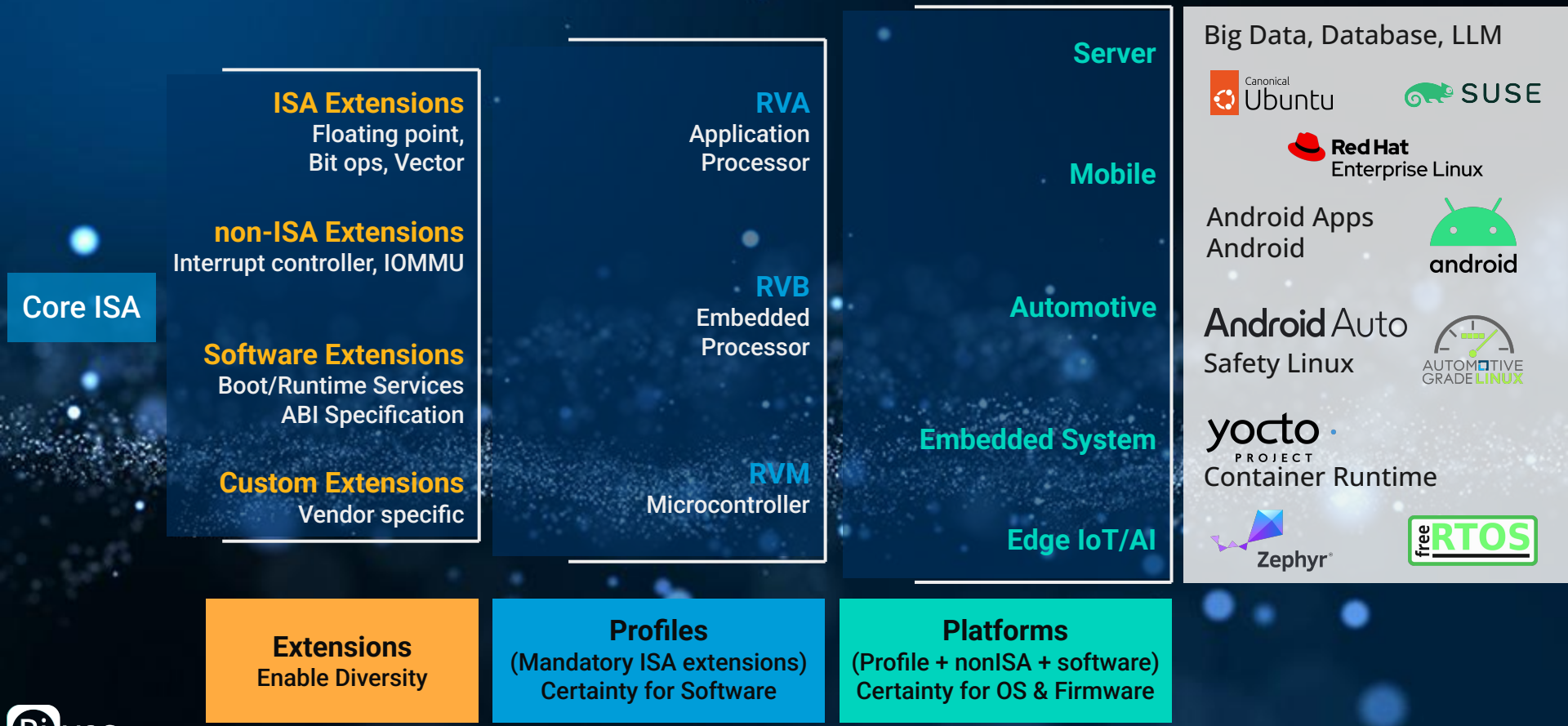
Software Ecosystem
(OSes, Platforms, Libraries, Domain specific applications)

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



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) and Embedded (RVB) and 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

Mobile

Laptops

Servers

Embedded

Microcontrollers

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

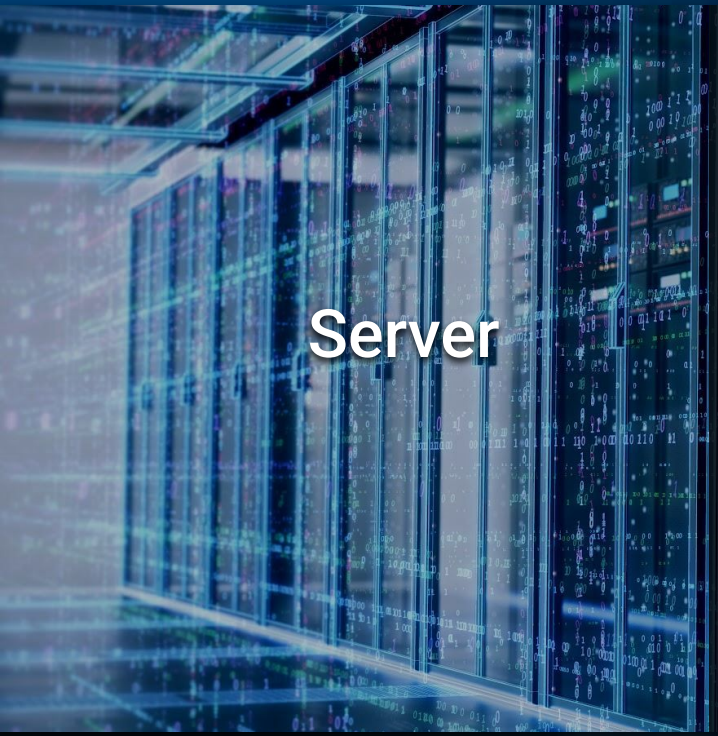
Auto

RISC-V Server Platform

- Certainty for OS developers and full distribution suppliers
- Builds on the RVA23 Profile, 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 Server



RVA23 - designed to address the needs of servers, client devices, automotive and other compute intensive use cases

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

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

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

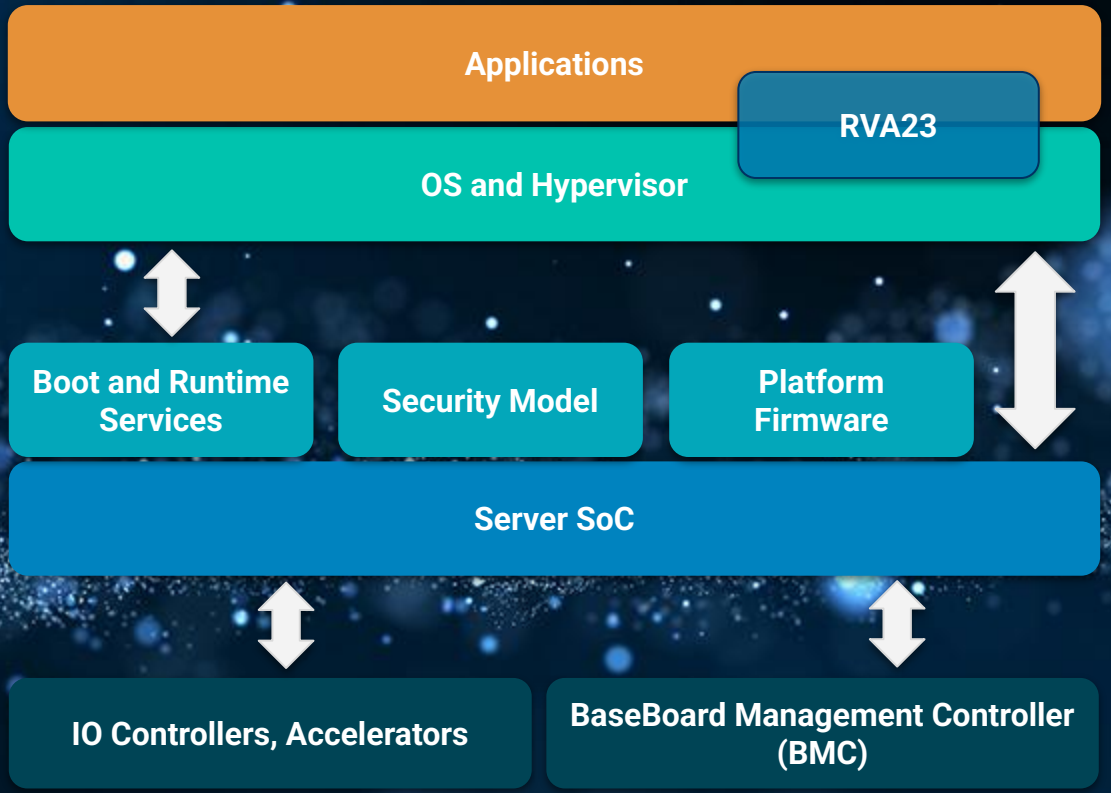
Optional

- 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.

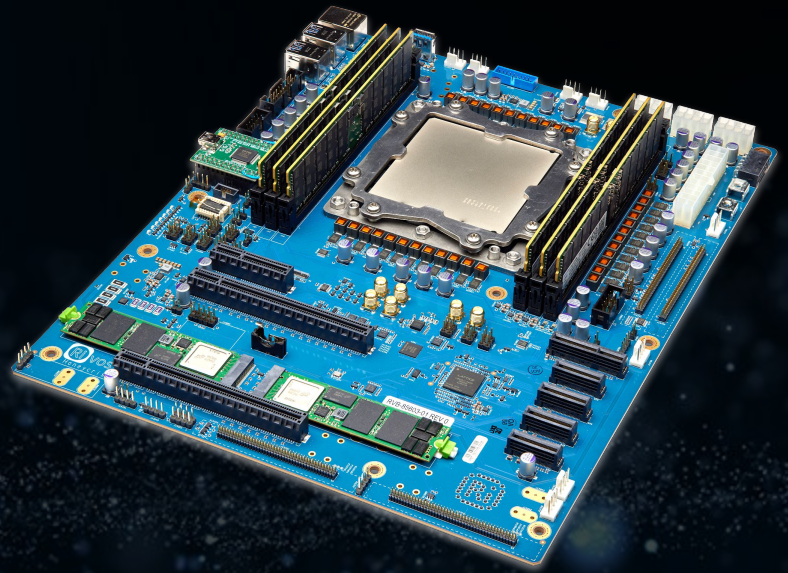
RISC-V Server Platform: Built on RVA23

- 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

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

RVA23, Server Platform and Rivos

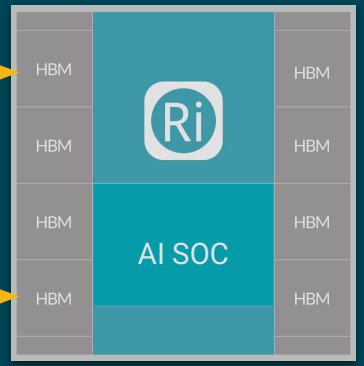
RVA23
Ratified ISA

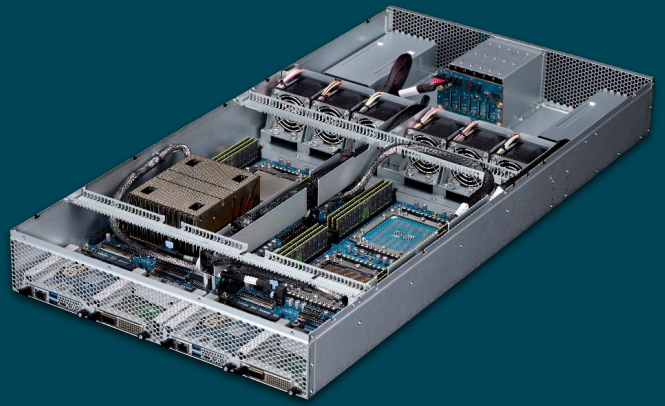
Server Platform
Specification

Rivos
RISC-V CPU
Implementation

Rivos
AI GPGPU

tsmc
N3E





Rivos Software-defined Silicon for modern Data Center workloads

- Highest end RISC-V implemented in TSMC 3nm Process
- Rivos GPGPU based AI & Data Analytics Accelerator
- Open source software to support AI and work with existing code

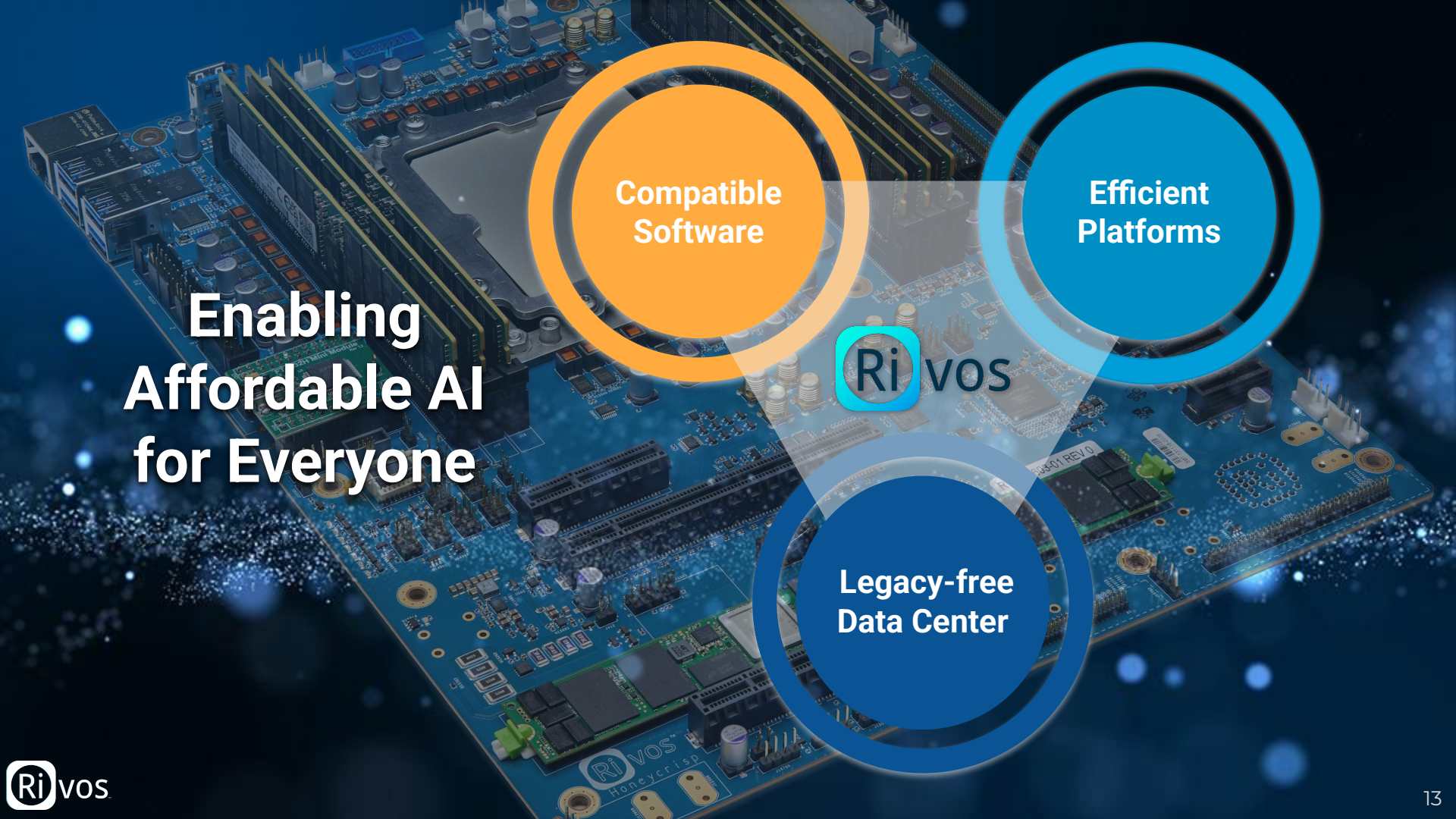
Rivos

See us at our Booth and our DC-SCM at the ASpeed Booth

L0425, 4F, Area “System Integration Solution”, Nangang Exhibition Hall 1 Close to Entrance L

ASpeed will show the Rivos DC-SCM card with their AST2750 BMC at their Computex booth 4F,Nangang Hall 1 #M1220

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


Enabling
Affordable AI
for Everyone
Compatible
Software
Efficient
Platforms
Rivos
Legacy-free
Data Center