



# AERO

## Accelerated EuRopean clOud

An open source software ecosystem for the EPI hardware

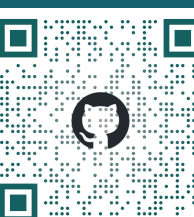
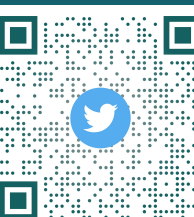
### Vision

Enabling the future heterogeneous EU cloud infrastructure

AERO will **upbring** and **optimise** all components necessary to **achieve out-of-the-box heterogeneous execution** of the cloud ecosystem on the EU processor. The outcome will be a set of **compilers, runtime systems, operating systems, system software**, and auxiliary **software deployment services**.

Accelerate the adoption of the EU cloud ecosystem

AERO will accelerate the **adoption** of the EU cloud ecosystem via **upstreaming** to **open source projects, communicating** and **disseminating** AERO's results to **industry, academia, and standardization bodies**.



<https://aero-project.eu>



[https://twitter.com/AERO\\_Project\\_EU](https://twitter.com/AERO_Project_EU)



<https://github.com/AERO-Project-EU/>



Funded by the European Union



# AERO

## Accelerated EuRopean cLOud

An open source software ecosystem for the EPI hardware

### Goals & Expectations

#### Strategic Liaisons

- Liaison with EU initiatives
- Assist standardization efforts

#### Embracing open source

- Engage open source community
- Facilitate collaborations & partnerships

#### Communication & Exploitation

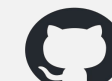
- Creation of an engaged community
- Organization & coordination of common events
- Supplement our own communication activities
- Commercialisation support



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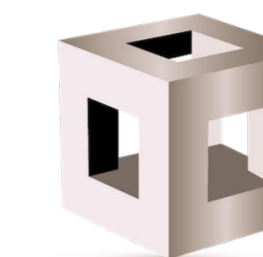
Funded by the European Union

# OpenCUBE - Open-Source Cloud-Based Services on EPI Systems

Ivy Peng<sup>1</sup>, Utz-Uwe Haus<sup>2</sup>, Martin Schulz<sup>3</sup>, Craig Prunty<sup>4</sup>, Pedro Marcuello<sup>5</sup>, Emanuele Danovaro<sup>6</sup>, Mathilde Leuridan<sup>6</sup>, Tiziano Müller<sup>2</sup>, Nina Mujkanovic<sup>2</sup>, Celine Scetbun<sup>4</sup>, Stefano Markidis<sup>1</sup>

<sup>1</sup> KTH <sup>2</sup> HPE <sup>3</sup> TU-Munich <sup>4</sup> Sipearl <sup>5</sup> Semidynamics <sup>6</sup> ECMWF

horizon-opencube.eu



OpenCUBE



## Objectives and Ambition

Design, implement and validate a full-stack software stack of a European Cloud computing blueprint that will be:

- Deployed on European HW infrastructure
- For industrial & consumer cloud workloads
- For the whole computing continuum
  - From edge to cloud and HPC
  - Targeting the entire continuum
- Enable energy-efficiency at all levels
- Built on industry standard open APIs
  - Using open-source components
  - Working with standards bodies

## Goals

**Design and deploy a hardware platform**

- Capable of hosting European Processor Initiative (EPI) processor
- Supporting EU developed accelerators
- Based on requirements of representative cloud workloads

**Design and deliver a full software stack**

- Enabling cloud servers
- Leveraging EPI-based platforms

**Enable system-wide efficiency**

- Via heterogeneous data centre architecture
- Deploying eased programmability
- Leveraging heterogeneous resources

**Fully test and validate the deployed stack**

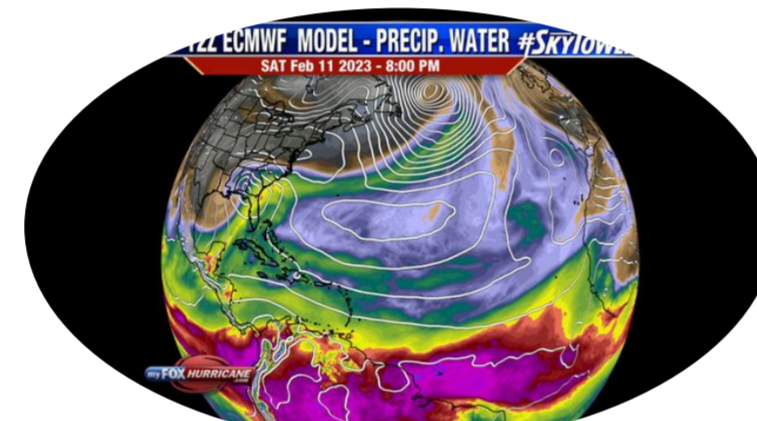
- With a diverse set of applications
- Traditional cloud-native and HPC workloads
- Emerging coupled workflows

## Driver Workloads

OpenCUBE will support cloud-native and complex workflows on the convergence of Cloud and HPC computing

### Weather Forecasting

IFS software is a major European resource representing many years of investment by ECMWF[1] and its Member States. The IFS has been developed for over 30 years and it runs operationally, providing time-critical global forecasts several times per day.

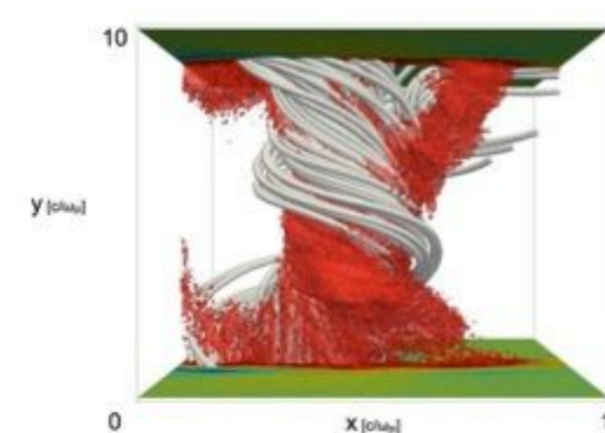


Source: [https://www.myfoxxhurricane.com/ecmwf\\_pwat\\_atl.html](https://www.myfoxxhurricane.com/ecmwf_pwat_atl.html)

[1] P. Bauer, A. Thorpe, and G. Brunet. The quiet revolution of numerical weather prediction. Nature 525, no.7567: 47-55, 2015.

### Space Weather & ML

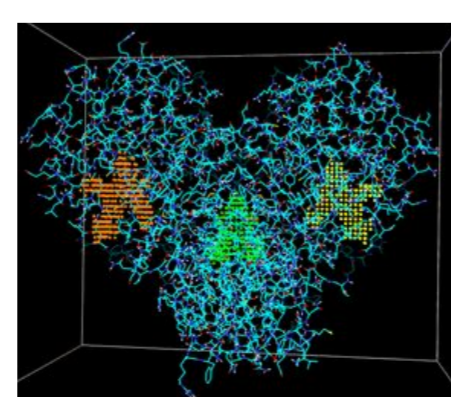
iPIC3D [2] is an open-source C++ and MPI Particle-in-Cell code for the simulation of space plasma. The workflow will run iPIC3D simulation on the HPC partition with ML classification of simulation results on the cloud partition



Markidis, S., & Lapenta, G. (2010). Multi-scale simulations of plasma with iPIC3D. Mathematics and Computers in Simulation, 80(7), 1509-1519.

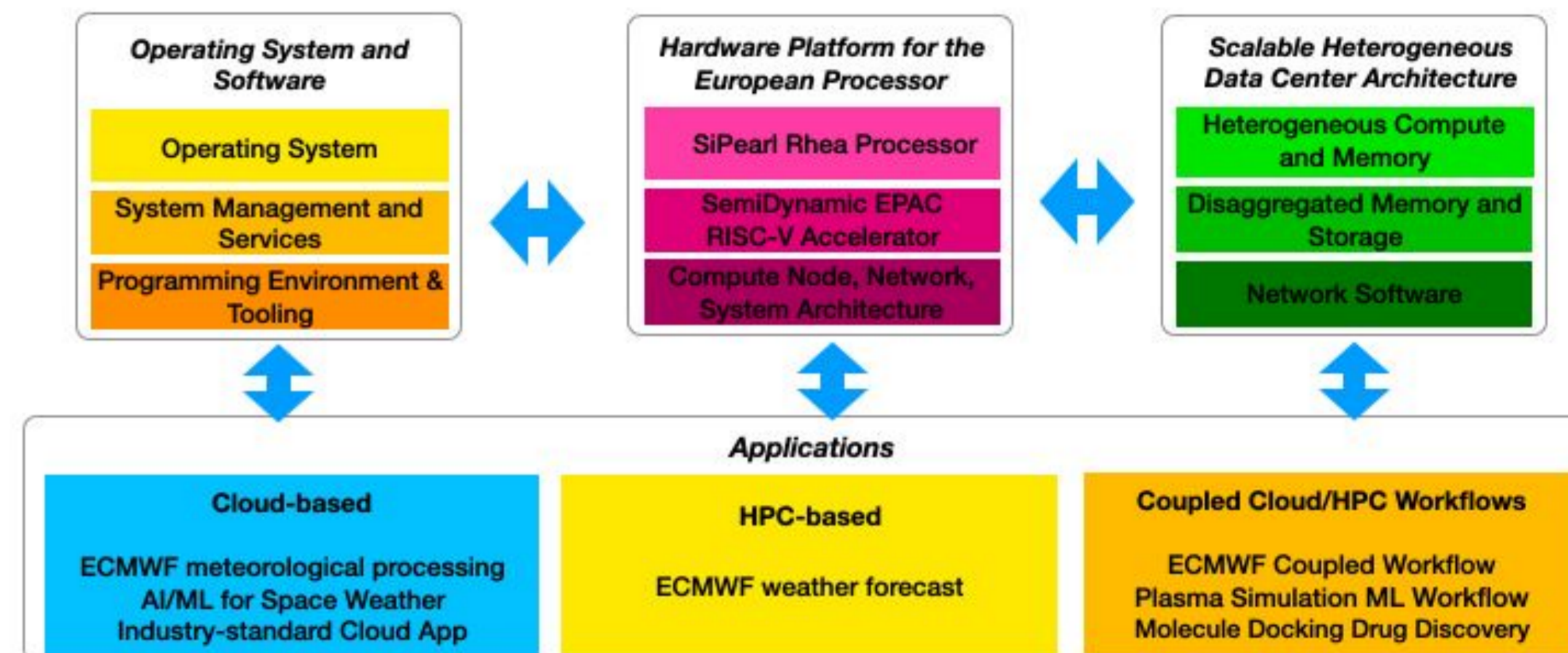
### High-Throughput Molecular Docking for Drug Discovery

AutoDock software[3], one of the most used software for molecular docking will be used to test on widely used databases, such as DrugBank database, Enamine database, ZINC15, and Cambridge.



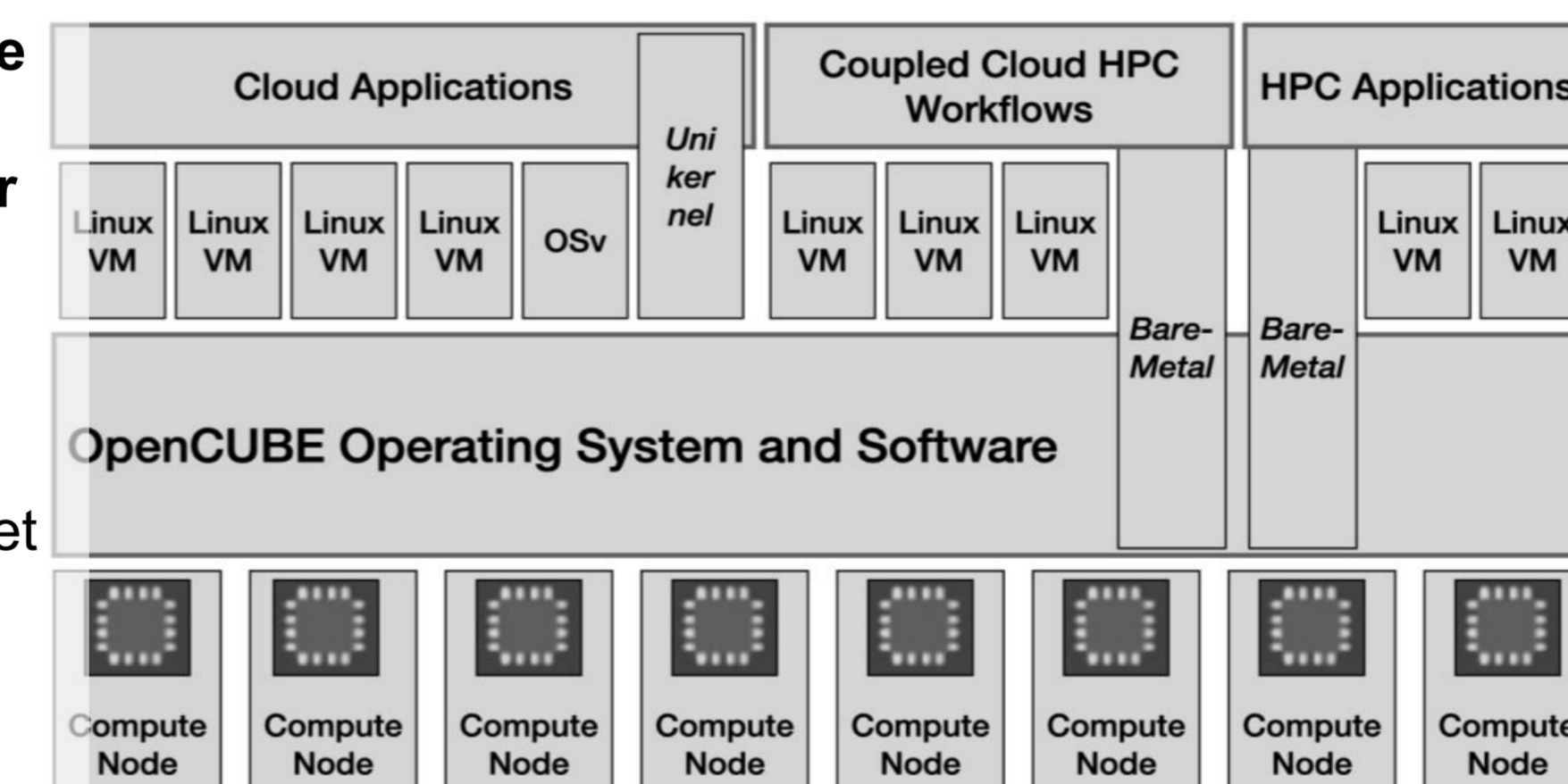
[3] Goodsell, D. S., Sanner, M. F., Olson, A. J., & Forli, S. (2021). The AutoDock suite at 30. Protein Science, 30(1), 31-43.

## Methodology



OpenCUBE will provide the first full cloud stack on heterogeneous data center built on

- Sipearl Rhea CPU
- Semidynamics RISC-V EPAC
- High performance Ethernet
- Heterogeneous main memory
- Fabric-attached memory



## Roadmap and Future work

- Will design and develop the prototype hardware infrastructure based on Sipearl CPU and Semidynamics accelerator
- Will design and develop an open-source software stack, including OS, system software, and middleware for cloud services on the HW infrastructure
- Will perform validation and evaluation of OpenCUBE prototype implementation with the driver applications
- Will establish and maintain strong interaction with other European and International R&I activities to provide bidirectional feedback between them and the OpenCUBE project



SIPEARL



ECMWF

Technical University of Munich

TUM



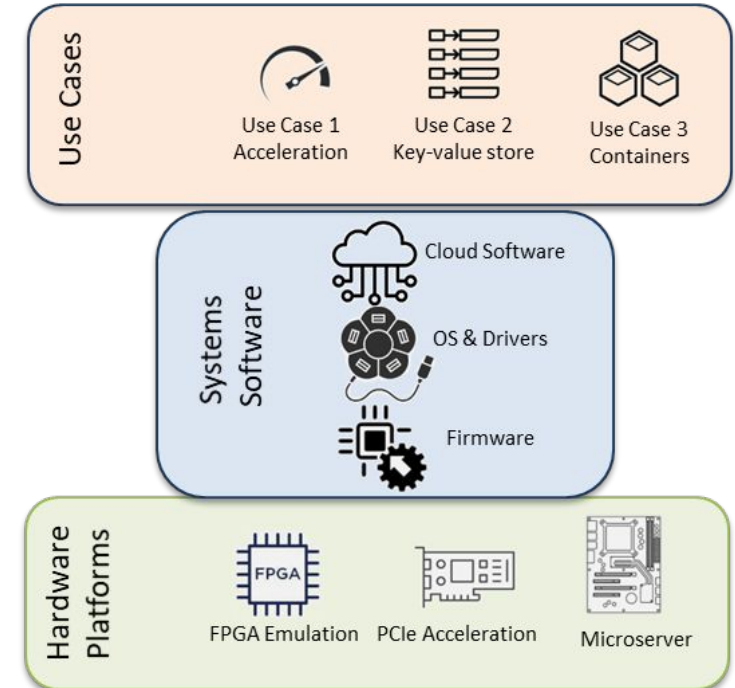
Hewlett Packard Enterprise

EU Horizon Project No. 101092984-OpenCUBE - HORIZON-CL4-2022-DIGITAL-EMER-01



RISER will develop the first all-European RISC-V cloud server infrastructure, significantly enhancing Europe's open strategic autonomy.

- Develop & validate open-source designs for standardized form-factor system platforms
  - PCIe Acceleration Card, Microserver (Blade)
  - Use cases: acceleration, networked storage, containerized execution
- Enabling the path towards a European-based cloud infrastructure
  - The first Cloud architecture using RISC-V processor technology being developed within the EPI and EUPILOT projects
  - Key technologies:
    - RISC-V processors, PCI-Express/CXL, Cache-coherent Chip-to-Chip links
- Open hardware interfaces
  - Expand the interface possibilities of EPI/EUPILOT processors:
    - High-speed networking and storage capabilities
    - Essential support for cloud applications and services deployment



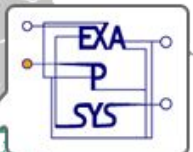
Call: Open source for  
cloud-based services, GA Nr:  
101092993 (HaDEA)



# Consortium Skills & Contributions

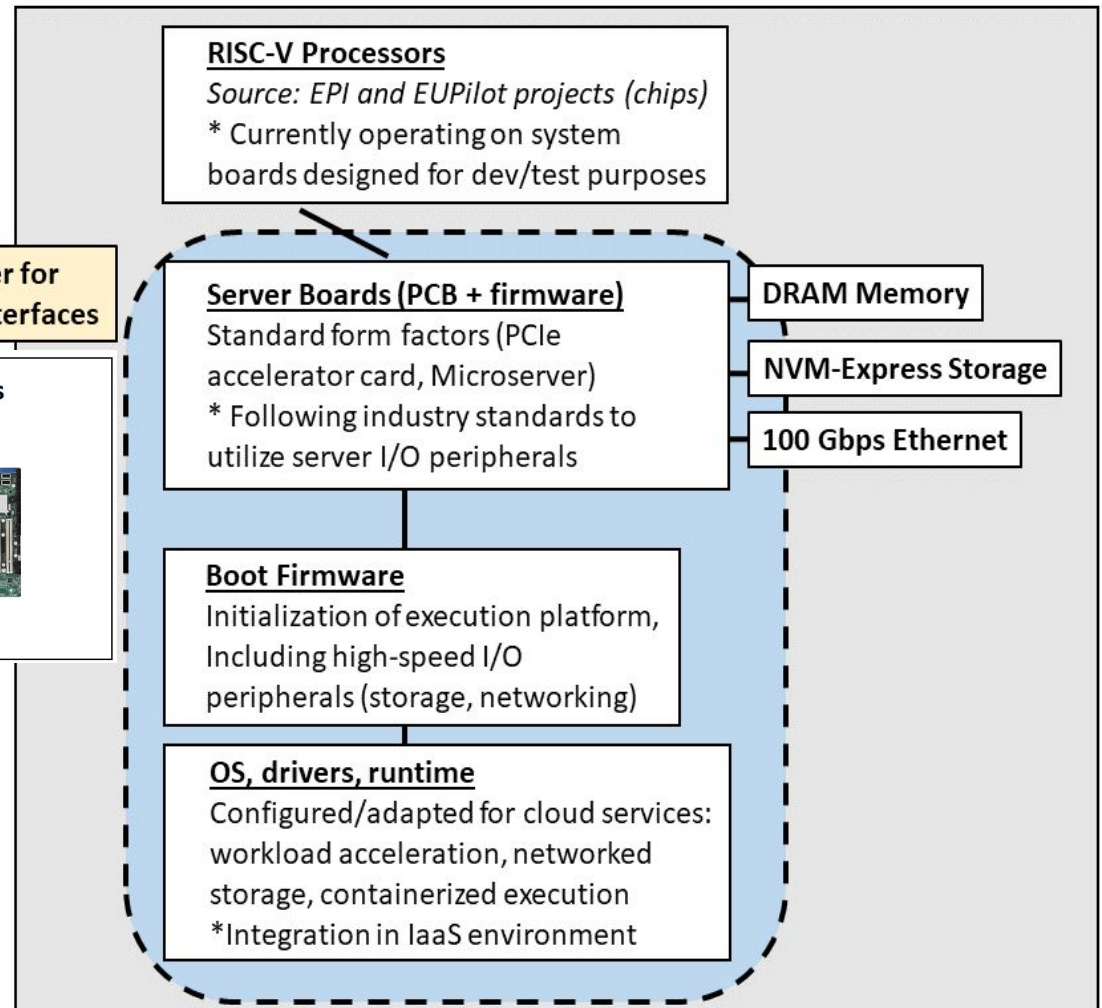
<https://riser-project.eu>

<https://twitter.com/RiserProject>



RISER: RISC-V based Linux server for cloud services, built on open interfaces

RISER: RISC-V for Cloud Services



**Integrated all-European Hardware and Open-Source Software for Cloud Services and Applications**

**Contact:** Dr. Manolis Marazakis  
**Organization:** FORTH (Greece)  
**Email:** maraz@ics.forth.gr

*Concertation and Consultation on Computing Continuum: From Cloud to Edge to IoT: May 10-11, 2023 - Brussels*

# Goals and expectations

Vitamin-V aims to develop further RISC-V ...

## 1) Open-source virtual environments

QEMU, Gem5, cloud-FPGA

## 2) Open software validation suites

Software bugs, Malicious code

## 3) Open-source cloud hardware-software stacks

Compiler and tool-chain: LLVM, JVM, Python, ...

VMMs and container suites: VOSySmonitor, KVM, QEMU, Docker,

RustVMM and Kata containers

Cloud management middleware: OpenStack, Kubernetes

AI & BigData applications: Apache Spark and Google Tensorflow.

# Vision

- Hardware will be as good as the software that runs on top of it.
- Embracing RISC-V and Open-Source:
  - **Collaborative effort** beyond the timespan of the project
  - **Comparable to standardization**
  - **Higher-impact** of project's results
- **Computing continuum**
  - Cloud (Vitamin-V), HPC (EPI, EUPILOT, other), Automotive (SELENE, KDT JU calls)
  - Heterogeneous IoT-Edge-Cloud continuum convergence.