

Accelerated EuRopean clOud

AERO - an Open-source Journey

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AERO Motivation

- Cloud Service Providers (CSPs) offer a diverse & rich HW/SW ecosystem for deploying applications
 - Mainly driven by US companies
 - Strong **dependencies** to overseas technology providers
 - Increased **security** & **data privacy** concerns
 - **Limited flexibility** for custom designs that satisfy requirements of the European market & ecosystem
- European Processor Initiative (EPI) develops the first EU made chip and compute units (processors & accelerators)
- To achieve EU sovereignty, the cloud SW ecosystem needs to follow HW developments



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Vision

Enable 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 European 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.



PIERER
INNOVATION

UBITECH
UNIVERSITÀ DI TORINO

SIPEARL

Red Hat

FORTH
Forschungsinstitut für Software- und Systemtechnik

Virtual Open Systems

UNIVERSITÀ DI PISA

UNIVERSITÉ
DE GENÈVE

sednai

MANCHESTER
1824

codeplay*





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HW Platforms - Testbeds

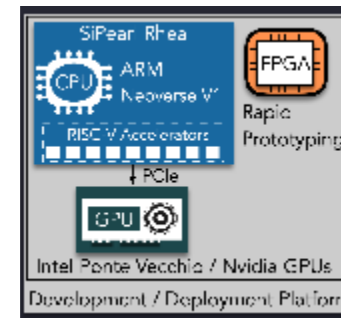
Envisioned development & deployment platform

- SIPEARL's Rhea processor
 - ARM Neoverse V1 processors
 - PCIe support for GPUs
 - RISC-V accelerators
- Expected in Q1 2026

Alternative options for development

- Ampere platforms
 - ARM Neoverse N1 processors
 - PCIe support for GPUs
 - FPGA boards to test RISC-V accelerators
- AWS Graviton3 instances
 - ARM Neoverse V1 processors
 - No custom accelerators
 - Low level firmware cannot be modified

Hardware



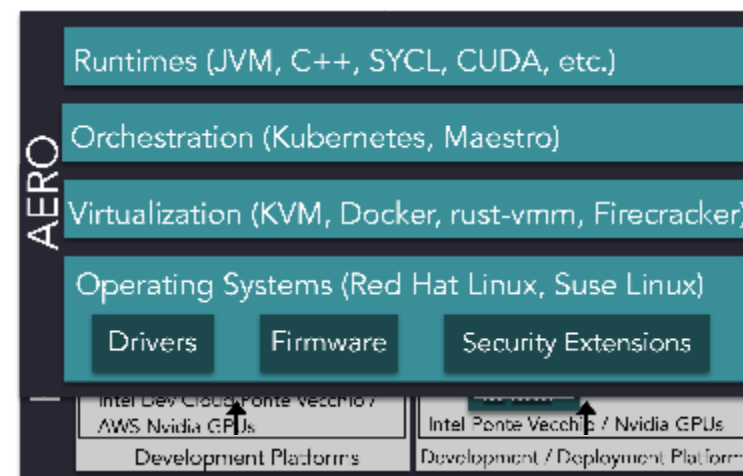


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System Software

- Execution Runtimes
 - Optimized execution of programming languages & runtime systems serving as the backbone of software deployed/executed on cloud
 - OpenJDK, GraalVM → managed programming languages (Java, Python, Scala, R, etc.)
 - TornadoVM → GPU HW acceleration of managed programming languages
 - SYCL & DPC++/OneAPI → HW acceleration of non-managed applications running in C/C++
- Cloud orchestration & Management Frameworks
 - Kubernetes, Maestro



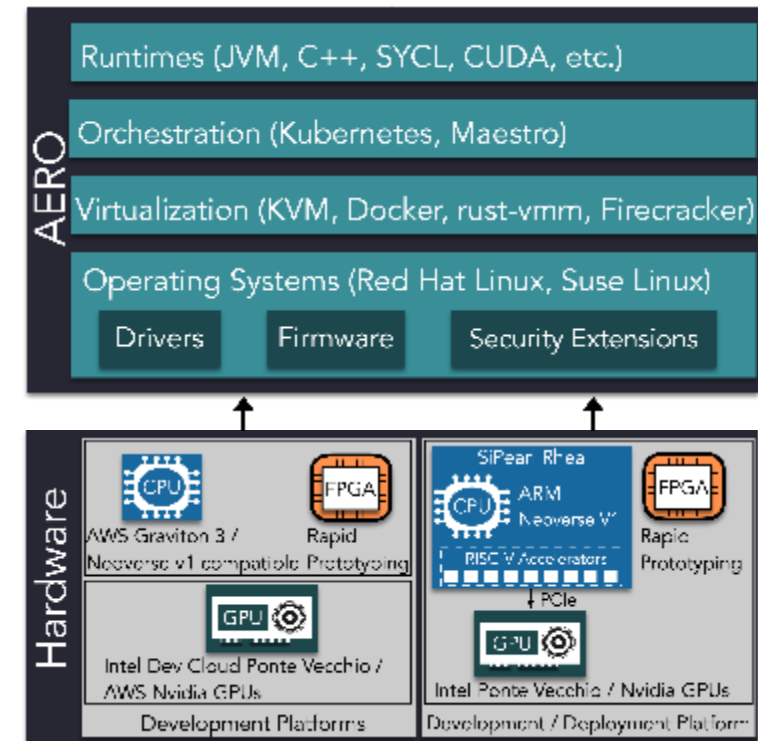


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System Software

- Virtualization Technologies
 - VMs (KVM, VOSySmonitor), containers (Docker), microVMs (Firecracker)
- Operating Systems – Drivers – Firmware
- Security extensions
 - Provide software interfaces for harnessing the underlying security IP blocks of Rhea
 - Design & prototype future post-quantum encryption algorithms



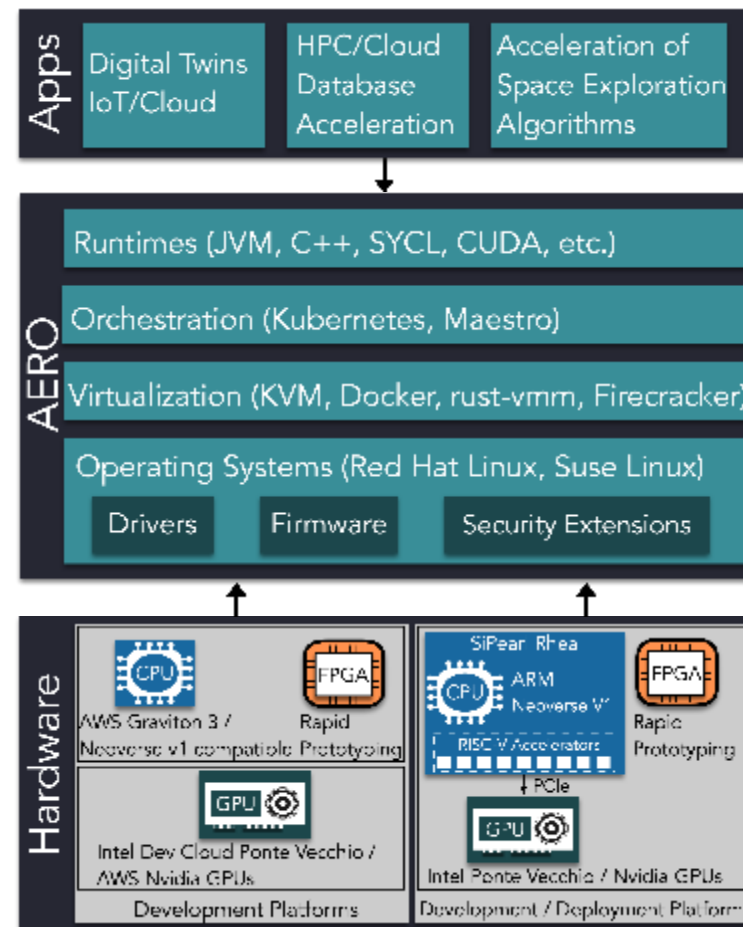


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Application Software

- Three pilots
 - Automotive domain (digital twins)
 - Algorithms for space exploration (analytics)
 - Database acceleration for scientific computing





Current Status

- AERO is currently in the “Optimization Phase”
 - Performing various optimizations across the software stack:
 - compilers, runtime systems, system software, drivers, auxiliary deployment services
- Waiting for access to Rhea-based testbeds
 - In the meantime, keep working on Ampere platforms, Grace platforms, AWS and ARM Fast Models



Building open-source, creating legacy!

➤ Summary of key software elements:

- Virtualization Layer: **VOSySmonitor**
- OS Layer: **Red Hat Linux**, **Suse Linux**
- Security Layer: **Microsoft SEAL**
- Programming Languages & Runtimes: **TornadoVM** (Java), **Mandrel** (Java), **TeraHeap** (Java), **oneAPI DPC++**
- Cloud Containerization & Orchestration Layer: **K8s/Knot**, **Firecracker**, **Maestro** (UBITECH)
- Cloud-based Enterprise Microservices: **Quarkus** (Java)



*Bold is used to mark the open-source technologies



Thank you!



aero-project.eu



github.com/AERO-Project-EU



zenodo.org/communities/aero



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European Health and Digital Executive Agency (HaDEA)



UK Research and Innovation,
Innovate UK



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
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Innovation



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