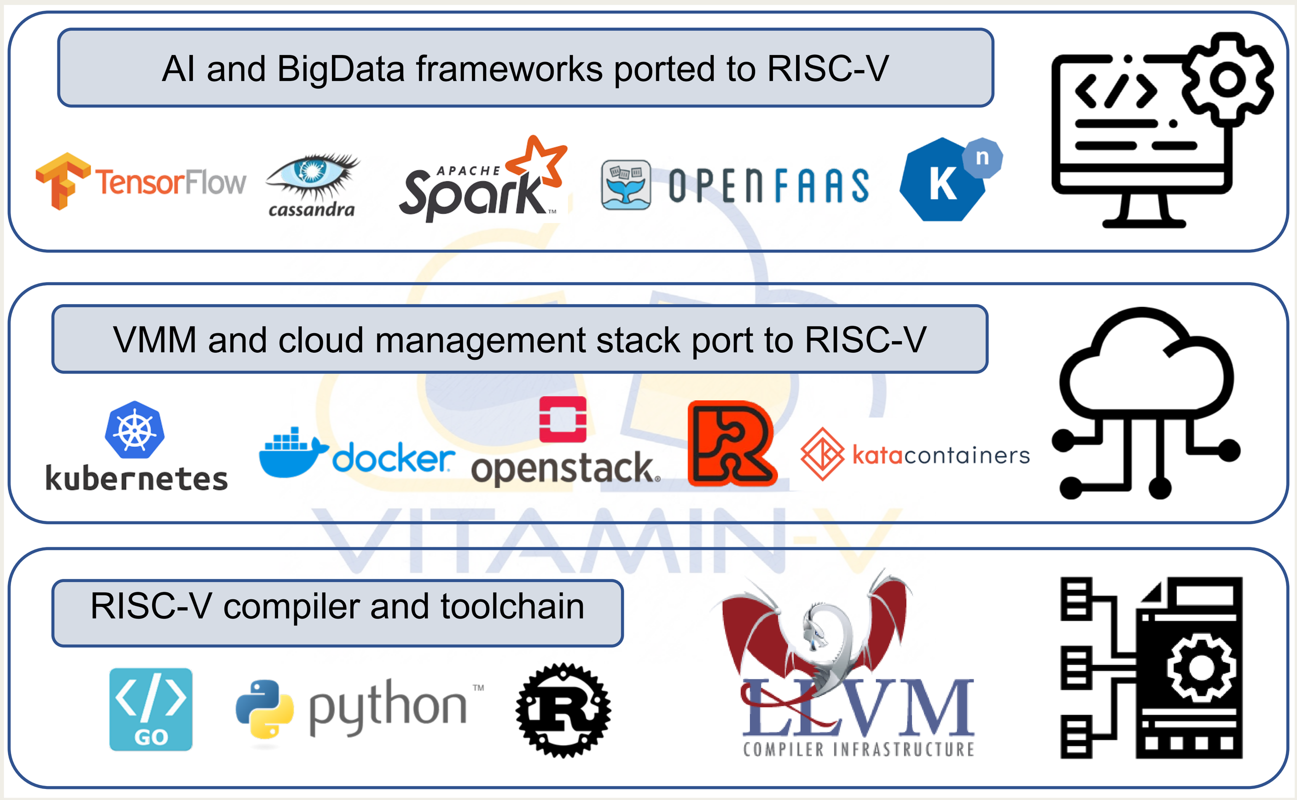
Enabling an OpenStack-based cloud on top of RISC-V hardware

Diego Marrón [1] Aaron Call [1] Josep Ll. Berral [2,1] Ramon Nou [1]

[1]Barcelona Supercomputing Center [2]Universitat Politècnica de Catalunya - BarcelonaTECH

Abstract



The European Union's technological sovereignty strategy centers around the RISC-V Instruction Set Architecture, with the European Processor Initiative leading efforts to build production-ready processors. Focusing on realizing a functional RISC-V cloud ecosystem, the Vitamin-V European project developed an OpenStack cluster utilizing genuine hardware. In this poster, we detail the efforts done in porting and setting up the cluster and the many software services required by OpenStack to properly run on real hardware. In this poster, we detail our efforts on building an minimal viable prototype OpenStack cluster using real hardware. The cluster is almost functional, and we expect it to be complete in the next few months.

Introduction

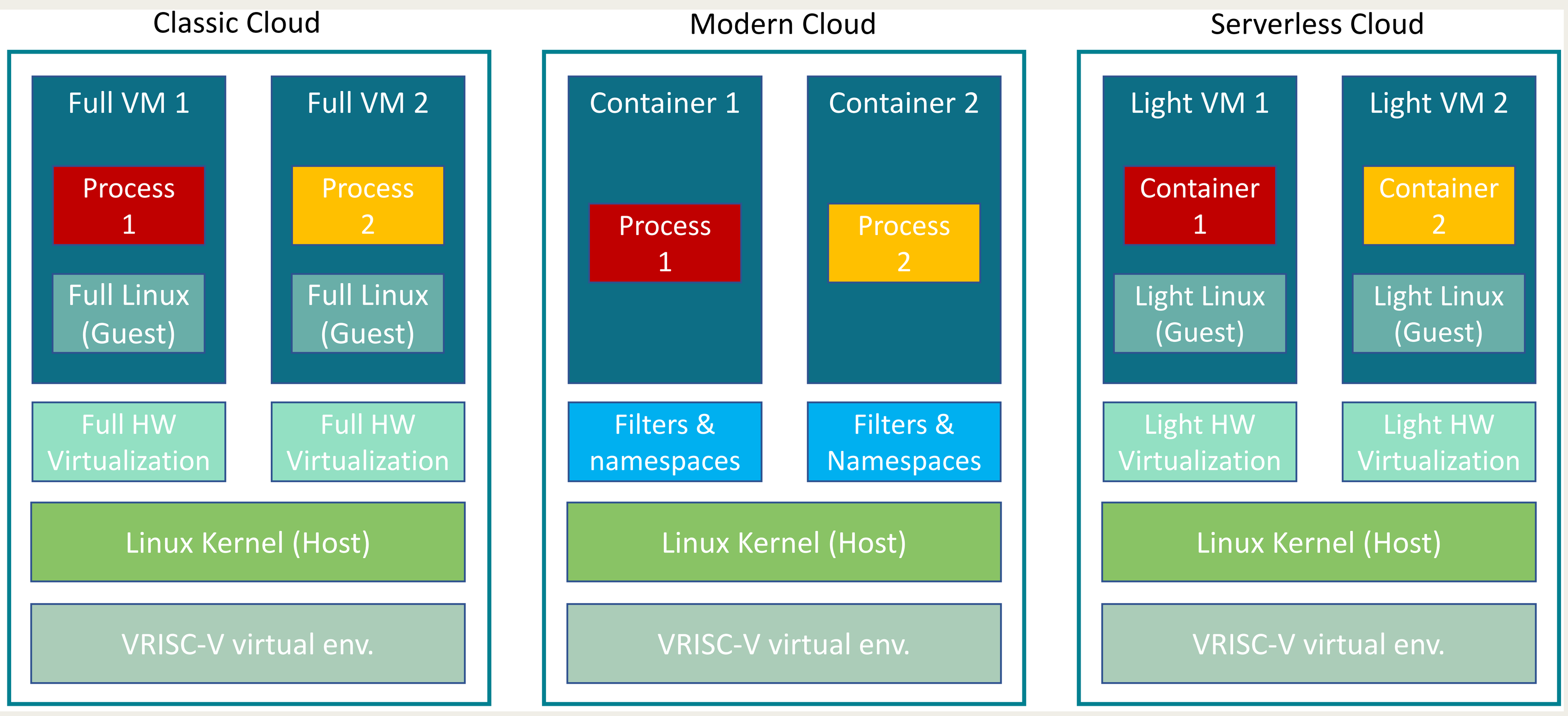


Figure 1. Vitamin-V Cloud Setups

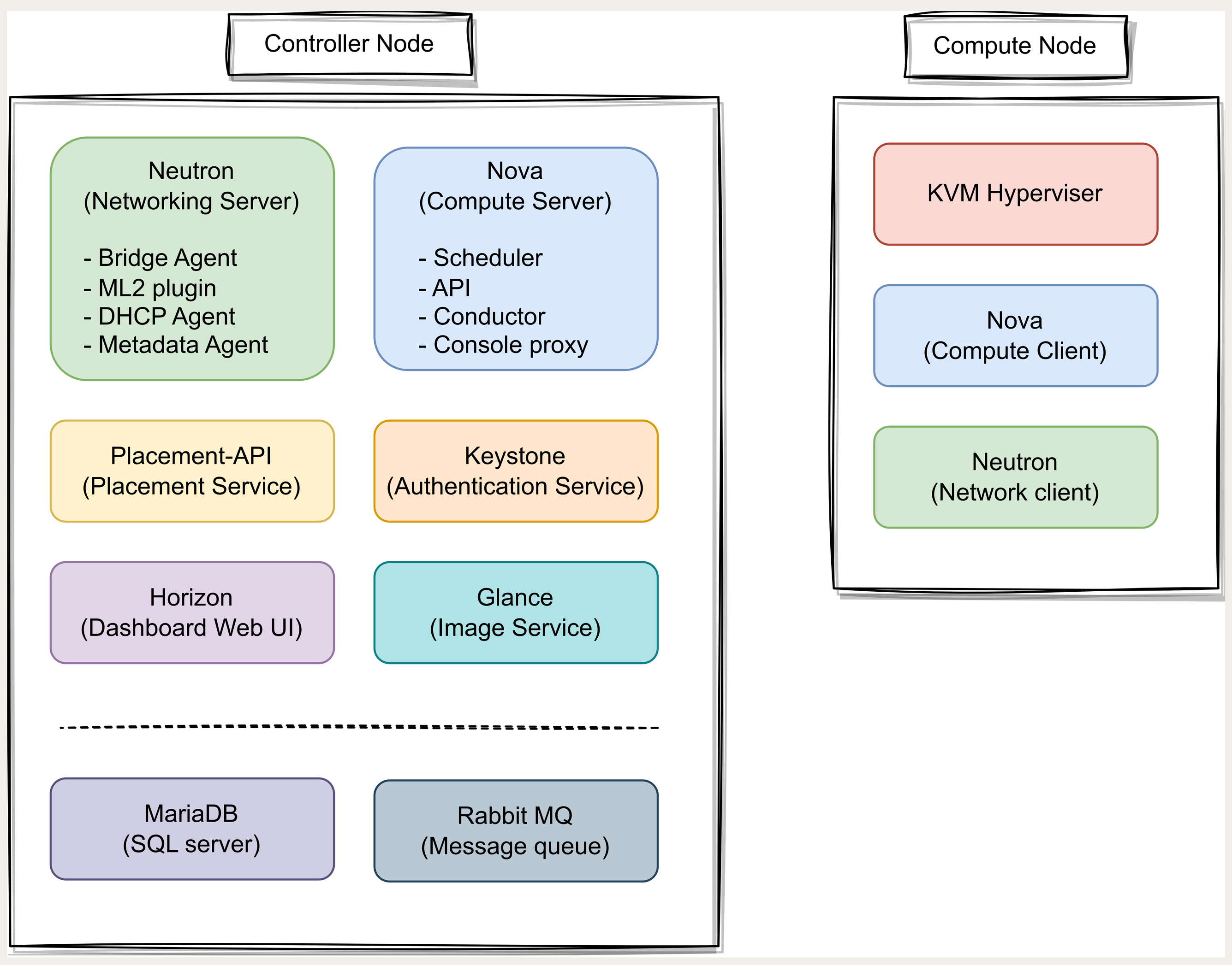
The RISC-V Instruction Set Architecture (ISA) is at the core of the European Union's technological sovereignty plans. One key initiative in this direction is the European Processor Initiative (EPI) [Kovač 2019], which aims to produce processors ready for mass production based on the RISC-V open-source ISA. These processors are intended to be used in various applications, including cloud computing and data centers.

The omics sciences require big-data processing infrastructures. Thus, supercomputers and datacenters are an essential requirement [Eisenstein 2015]. However, most current computing architectures are proprietary and closed-source technologies such as x86 and ARM, which creates concerns about the reliability of privacy and security.

In this poster, we explain our work to enable an OpenStack-based cloud environment on top of RISC-V using the Lichee PI 4A boards [SiPeed n.d.]. Enabling such an environment allows us to demonstrate a functional cloud on RISC-V and evaluate how well traditional cloud workloads perform on top of it.

OpenStack

Due to the novelty of both RISC-V chips and OS (Linux), building the cluster from scratch presented several challenges at different levels: operating system, distribution, and packages. OpenStack consists of numerous software services, each exhibiting varying levels of maturity for the RISC-V architecture. While some components worked seamlessly on RISC-V, others necessitated an intricate setup process due to the absence of essential libraries. These often had to be constructed from source code.



Acknowledgements

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Experimental Platform

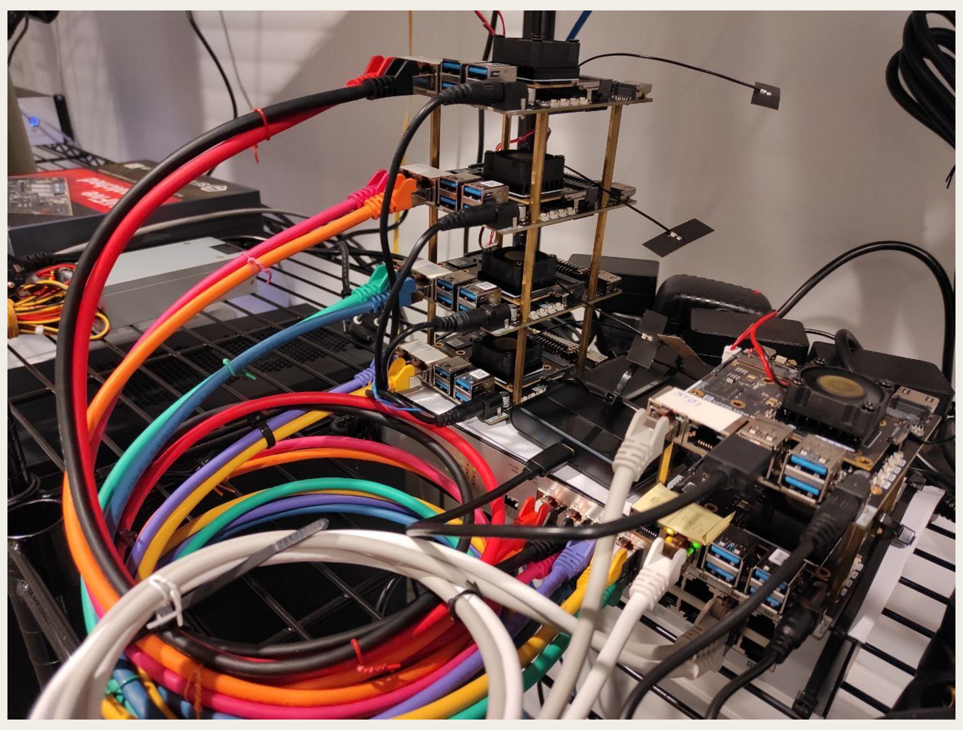

Figure 2. Lichee PI 4A cluster running OpenStack

As the hardware platform, we are using a RISC-V development board by Sipeed, the Lichee PI 4A owing to their balanced pricing and capabilities. More specifically, the utilized development platform provides a TH1520 RISC-V CPU (4 Threads), 16GB of RAM, and 128GB of storage. In addition, it also provides a dual Gigabit Ethernet a feature particularly interesting when building an OpenStack cluster.

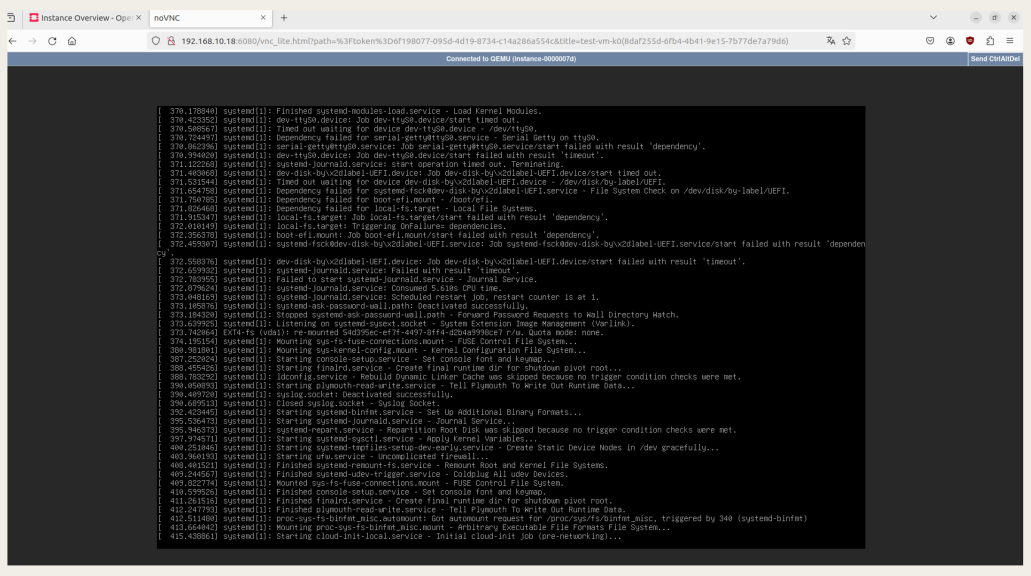

Figure 3. Linux boot on VM

We have currently already booted a Linux kernel on top of an OpenStack instantiated VM using qemu as hypervisor.

Future Work

Currently, we have been able to run the basic OpenStack dashboard and we can identify the hardware resources available in the cluster as well as to instantiate VMs. This dashboard is shown in figure 4. Next steps include having multiple VMs inside a single node as well as to demonstrate a multi-board OpenStack managed cloud. As future work we will evaluate its performance running Vitamin-V targeted workloads on top of it.

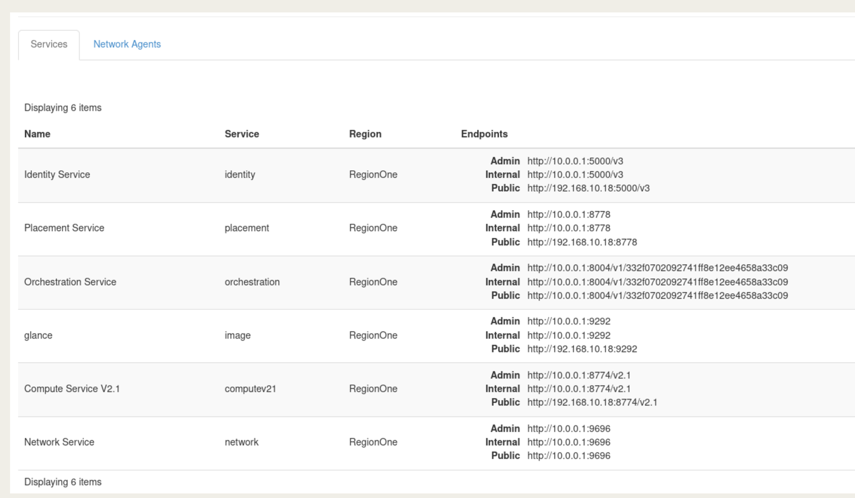

Figure 4. OpenStack Dashboard

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