

PostDoc Position - Baremetal/Container/Virtual Machine: Can we operate different kinds of sandboxing technologies through a single management system?

About Inria

Inria, the French national institute for research in computer science and control, is dedicated to fundamental and applied research in information and communication science and technology (ICST). Inria has a workforce of 3,800 people working throughout its eight research centers established in seven regions of France.

The Postdoctoral researcher will be integrated into the Ascola Research Team localized in Nantes, and the Corse Research Team localized in Grenoble. He/She will be co-supervised by Adrien Lebre (Nantes) and Frederic Desprez (Grenoble).

Mission and activities

The Postdoctoral position aims at proposing reference architecture of a management system in charge of provisioning and operating several kinds of sandboxing systems on top of IaaS infrastructures. From the technical viewpoint, the objective of this work would be to propose such a reference architecture to the OpenStack community in order to unify the Ironic, Nova and Magnum services in charge of operating respectively raw hardware (baremetal), virtual machine (VM) and system containers (Docker).

While Virtual Machines enabled the fast adoption of the Cloud Computing paradigm, the needs in terms of Utility Computing recently evolved to integrate several kinds of sandboxing technics. End-users from the HPC community generally prefer accessing raw hardware in order to deploy customized environments that limit performance degradation. Big Data actors, on their side, investigate advanced solutions built around the concept of system containers (such as Mesos [1] and Dockers [2]). These requirements of these evolutions have a major impact on IaaS management systems that are developing dedicated services to cope with this heterogeneity. In addition to increasing the complexity of the management system, these developments have been achieved in an independent manner, without studying whether correct abstractions could allow the management of any kind of sandboxing technologies in a unified manner.

The first objective of the postdoc is to deal with this challenge by proposing a reference architecture that will extend the Moreno proposal [3]. Among the different challenges the postdoctoral student will have to deal with, they should determine the right abstractions that will enable the development of a unified service leveraging the common sets of internal mechanisms, that is without implementing dedicated services (i.e, image management, scheduler, deployment engine and monitoring) for each kind of sandboxes.

The second objective is to validate the proposal architecture by instantiating it in the OpenStack ecosystem [4]. OpenStack is a cloud management system that controls large pools of compute, storage, and networking resources throughout a datacenter. The OpenStack community gathers more than 500 organizations with groups such as Google, IBM, Intel, ... making the whole ecosystem evolve at a very fast pace. Concretely, the OpenStack software platform relies on tens of services including more than 2 millions of lines of code (mainly Python). This complexity is amplified by the fact that the development cycle is based on a 6-month basis. Proposing reference architecture should enable developers to ease code re-use and thus improve software production.

It is noteworthy to mention that Intel has recently proposed the CIAO system¹, a proof-of-concept that operates VMs and Containers through the same system. However, they do not provide too many details nor publishing any official report.

The work will be structured around the following actions:

- Study the IroniC, Magnum and Nova components from the OpenStack solution to identify overlapping parts between the different modules
- Study the abstractions proposed by Intel in the CIAO system and see to what extent they should be revised to abstract different kinds of sandboxing
- Propose a reference architecture that enables the management of different sandboxing solutions.
- Propose a list of changes that should be performed in the OpenStack ecosystem to simplify the code complexity.

According to the progress made by the postdoctoral researcher, a third objective will consist in investigating which technology is the most appropriated one according to the available hosting resources (dedicated resources vs edge devices).

References

- [1] Hindman, B., Konwinski, A., Zaharia, M., Ghodsi, A., Joseph, A. D., Katz, R. H., ... & Stoica, I. (2011, March). Mesos: A Platform for Fine-Grained Resource Sharing in the Data Center. In *NSDI* (Vol. 11, pp. 22-22).
- [2] Zheng, C., & Thain, D. (2015, June). Integrating Containers into Workflows: A Case Study Using Makeflow, Work Queue, and Docker. In *Proceedings of the 8th International Workshop on Virtualization Technologies in Distributed Computing* (pp. 31-38). ACM.
- [3] Moreno-Vozmediano, R., Montero, R. S., & Llorente, I. M. (2012). IaaS cloud architecture: From virtualized datacenters to federated cloud infrastructures. *Computer*, 45(12), 65-72.
- [4] Sefraoui, O., Aissaoui, M., & Eleuldj, M. (2012). OpenStack: toward an open-source solution for cloud computing. *International Journal of Computer Applications*, 55(3).

Skills and profiles

Strong programming skills (Java and Python)

Software Engineering, in particular (distributed) component models

Knowledge of Cloud environments (OpenStack knowledge will be definitely an advantage)

Autonomy / Curiosity

English language mandatory

Additional information

The candidates are invited to contact Adrien Lebre or Frederic Desprez before applying (firstname.name@inria.fr).

Duration: 12 months

Location: Grenoble, France

Salary: 2 621 euros gross/month

Monthly salary after taxes: around 2 127 euros (medical insurance included)

¹ <https://blogs.intel.com/evangelists/2016/04/26/openstack-open-source-open-mind/>