

PostDoc Position 1

Solutions for self-managed, massively distributed SDN Infrastructures to interconnect edge data centers

Keywords: Software Defined Networking (SDN), Fog/Edge Computing, OpenStack, NFV

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 jointly supervised by Lucas Nussbaum (RESIST Research Team, Nancy) and Damien Saucez (DIANA Research Team, Sophia Antipolis). Intense collaborations are also expected with Abdelhadi Chari (Orange Labs), in the context of the DISCOVERY project.

Context

The general tendency today in Cloud infrastructures deployments is to use a small number of very large data centers, distributed at an international scale, from which the various Cloud services (IaaS, PaaS, SaaS) are delivered to users located in a large geographic area.

This deployment model is well-suited to actors of Over The Top Cloud (like Amazon). But it is less obvious for traditional operators of telecommunication services (like Orange). Actually, one can see today that there are real advantages to exploring a different approach, based not only on centralized infrastructures, but that would be composed of a large number of distributed Cloud infrastructures, distributed throughout the network of operators, and at the edge: in local and regional Point of Presence (PoP), in customer premises, or even inside core network equipment. There are at least two contexts where such distributed Cloud infrastructure would make sense for operators. First is to allow the deployment of applications with locality constraints. Those constraints can be technical like latency (e.g., for augmented reality), or legal – data must remain inside a given geographical area (e.g., for medical services). The second context is to provide the operator with the required infrastructure to deploy applications of virtualized network functions (NFV). Indeed, operators are in the process of considering the deployment of advanced network functions (Gi-LAN mobile interface, level 4 to 7 services such as firewalls or load balancers, EPC mobile core, IMS...) as virtual machines or containers deployed on COTS x86 hardware. The distributed Cloud infrastructure could provide the IaaS layer that will support for the deployment of those NFV applications.

A major prerequisite for the suitability of this distributed Cloud is the availability of a management solution that is both simple, evolvable, and economically efficient to allow operations teams to easily manage the whole infrastructure, deploy and interconnect network functions, and modify the localization and the network connectivity between deployed resources. Solutions available today, either commercial or open source, do not meet all these requirements. They are based mainly on the use of two traditional approaches of distributed systems management: federation and centralized management, which both have major limits in terms of complexity, scalability, reliability, and cost-efficiency.

Several works have started since a few years to address those challenges by proposing solutions for the management of distributed clouds, inspiring from techniques used in P2P systems ([1,2, 3]). Indeed, P2P technologies offer interesting features to meet the above-mentioned goals (auto-discovery, redundancy, self-management, unlimited scalability). But those works have two major limitations: first, the network underlay was not considered, that is, how to manage the interconnections between deployed systems, both inside an infrastructure and between several infrastructures, each with its own network engine (the SDN component of the cloud solution). Then, most of those propositions rely on a completely new framework for infrastructure management, ignoring those that are considered for the future operational deployments. That made impossible any real deployment of the proposed solutions. Finally, aspects related to reliability, which are critical in the context of telecommunication infrastructures, have been mostly ignored in the design of the proposed solutions.

Missions and activities

The overall objective of this project is to explore and propose approaches for the design of the networking component of a self-managed and massively distributed cloud infrastructure. The proposed design should meet requirements at several levels:

- Manageability (monitoring and measurement capabilities, auto-discovery, etc.)
- Ability to provide various advanced services (flat connectivity, L2/L3 VPNs, NFVs)
- Reliability and performance (SLA, redundancy, disaster recovery, HA, ...)

The post-doc researcher will start by evaluating the existing solutions for distributed SDN that might be suitable for the fog/edge context, both inside the OpenStack project (Gluon, Tricircle, Tacker, DragonFlow) and outside of OpenStack (e.g., ONOS), and propose new approaches, that will be evaluated in the context of OpenStack and of the DISCOVERY Inria project.

References

- [1] Towards a P2P Cloud : Reliable Resource Reservations in Unreliable P2P Systems. Kalman Graffi, Dominik Stingl, Christian Gross, Hoang Nguyen, Aleksandra Kovacevic and Ralf Steinmetz Technische Universität Darmstadt, Multimedia Communications Lab (KOM). December 2010.
- [2] Design and Implementation of a P2P Cloud System. Ozalp Babaoglu and Moreno Marzolla, Michele Tamburini. Università di Bologna, Dipartimento di Scienze dell'Informazione. March 2012.
- [3] Greening the Internet with Nano Data Centers. Vytautas Valancius, Georgia Tech. Nikolaos Laoutaris, Telefonica Research, Laurent Massoulié, Thomson. December 2009.

Skills and profiles

- Strong system programming and networking skills
- Knowledge of Cloud environments (OpenStack knowledge will be definitely an advantage)
- Autonomy / curiosity
- Mastery of scientific and technical English

Additional information

The candidates are invited to contact Lucas Nussbaum and Damien Saucez before applying (firstname.lastname@inria.fr)

Duration: 12 months

Location: Nancy, France

Salary: 2621 euros gross/month

Monthly salary after taxes: around 2172 euros (medical insurance included).