Post-doctoral position: ‘Strategies for software resource roll-out & dynamic reconfiguration inside a telecom operator software infrastructure’

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deadline for application: June 30 2018

4 rue du clos Courtel 35510 CESSON SEVIGNE - France

Your role

Technological watch and analysis of strategies for software resource deployment and their dynamic reconfiguration inside a telecom operator software infrastructure.

You'll find hereafter the context description for this work.

Your mission and its main scientific objectives are specified in the section "Entity".

The telecommunication ecosystem is currently undergoing deep changes due to significant progress in usage and technologies. This technological advancement is drawn by techno-economic models that come along with new paradigms aiming for the multiplication of opportunities for innovation and opex reduction.

The challenge consists in evolving current network operators' infrastructures into an IT approach, doing as possible with commercial off-the-shelf, general purpose facilities, to support network functions and services which are virtualized, flexible and programmable. NFV (Network Function Virtualization) and SDN (Software-Defined Networks) are the technologies driving this IT transformation. For these new network infrastructure and services to meet the required flexibility and programmability, it is necessary to design a management system addressing the diversity of the infrastructure resources, and to optimize their use by automating network service rolling-out and configuration, while guarantying the associated service level agreements.

This is the goal of an Orange Labs' project, which aims at designing a Global Operating System (GlobalOS), allowing the operator to dynamically mobilize a set of resources making up such an infrastructure, to manage them, and to expose them to third parties. The design of the GlobalOS relies on modelling principles coming from software technologies whose goal is to realize an abstraction layer providing a unified view of resources and services, thus easing the automation of their management. This is achieved by each hardware and software resource being described as a component or a set of components. The relations with its environment are modelled as dependencies of different natures, e.g. activation precedence, membership/containment, location… Those resources can have controllers that enable them to be programmed or configured. Deployment automation and hot configuration on infrastructures will make use of descriptors to, e.g. describe how to locate services while taking into account parameters and constraints such as runtime features, QoS needs, resource dependencies at runtime, and service dependencies [SDN].

The distribution and heterogeneity of infrastructures leads to the use of different resource modelling languages [FSI]. The description of a service to be deployed on different infrastructure entities could include various description files that may be written in different languages. Thus, checking the consistency of a deployment requires these different languages to be considered.

Your profile

Educational background

- Ph.D close to network virtualization, cloud computing, distributed software infrastructure or IT modelling, checking tools.
- English, Notions of French

Experience

- A first experience in system or software architecture, or in virtualization mechanisms (network, servers)
- Self-motivated, willing to learn, methodical , independent

Scientific knowledge and technical skills

- Specification, description and deployment languages
- modelling tools based on mathematical logic
- resource virtualization or network programing techniques
- Operating Systems, distributed software architectures

Interest

This postdoc shall be an opportunity to work in an innovative international company, and to perform research activities on high-level, state-of-the-art topics in the domain of telecom network transformation, converging network and IT. You'll benefit from the AMI team experience on infrastructures and their managing system.

You shall have the opportunity to attend international conferences where you'll be able to present your research work. The results of this postdoc may also give way to patent registration.

References

[Alloy] Software Abstractions, Logic, Language, and Analysis, Revised Edition, The MIT press 2012.

[FSI] Stéphanie Challita, Fawaz Paraiso, Philippe Merle. Towards Formal-based Semantic Interoperability in Multi-Clouds: The FCLOUDS Framework. 10th IEEE International Conference on Cloud Computing (CLOUD), Jun 2017, Honolulu, Hawaii, United States. pp.710 - 713, 2017.

[LOC] J.-B. Stefani, "Components as location graphs", Formal Aspects of Component Software, FACS 2014.

[OCCI] http://www.occiware.org

[SDN] "Software-Defined Networking: A perspective from within a service provider environment", RFC7149.

[SMO] Smart Organizations and Smart Artifacts: Fostering Interaction Between People, Technologies and Processes, L. Caporarello, B. Di Martino, M. Martinez, Springers. 2014.

[TOSCA-v1.0] Topology and Orchestration Specification for Cloud Applications Version 1.0., 25 Nov. 2013.

[TOSCA NFV] TOSCA Simple Profile for Network Functions Virtualization (NFV) Version 1.0. ,11 May 2017.

Entity

Scientific objectives – awaited results

Software resources are described by means of a formal model (language) that allow to specify the service component chains (e.g. VNF, Virtual Network Functions) and the dependencies with regard to the infrastructure resources (e.g. virtual machines, servers). The model also describes the constraints related to the requirements on the one hand, and related to the resource limitations on the other hand (performance, SLA, application component requirements in terms of resources, and expressed as dependencies…).

The goal of the postdoc is to study data models representing the distributed infrastructure, to install a multi-technology trial platform (multi-VIM, i.e. multiple Virtual Infrastructure Managers). The idea is to work on the elaboration of a common infrastructure model, whose semantics would enable the «Model once, generate anywhere», principle [SMO].

Awaited achievements

The Postdoc shall tend to address the following technical locks :

1) Heterogeneity of the available technologies for IT infrastructure management (VIM) and for Wide-area-network infrastructures (WIM), VIM dependency to infrastructure POP (Point Of Presence), consumer context dependencies (user views) and provider context dependencies (organization of resources, of their manager). This lock shall be dealt-with through the study and the implementation of an experimental multi-VIM (e.g. Openstack and Kubernetes), and WIM, possibly multi-WIM (i.e. SDN controllers in charge of connectivity link between data centers also called infrastructure POP).

2) Potential inconsistency between the different infrastructure data models, for instance during an infrastructure update, or the update of an application impacting the instantiated infrastructure. So this covers both static and dynamic aspects: deployment operations (possibly hot), which can be held using APIs or scheduled in scripts, will be compared, together with the associated data models. Typically, the TOSCA semantics [TOSCA-v1.0] could be compared to the one of OCCI [OCCI] before checking that their structure and behavior are consistent with one another, e.g. using a tool like [Alloy].

3) Absence of a common abstract infrastructure model and of the associated semantics to represent resources and consistently use APIs. The core of such a model shall be designed in compliance with the one proposed by ETSI for Network Virtual Functions, it could rely on the OCCI meta-model.

4) Difficulty to roll out and update compound network applications requiring several VIMs. This difficulty and the potential solutions are to be tackled based on the example of such a deployment.

5) Difficulty to choose appropriate checking methods and tools. A set of checking methods and tools shall be proposed with pros and cons.

The proposed methodological approach could be as follows:

- T0 : State of the art on modelling of heterogeneous distributed infrastructure and APIs
- T0+2 months : Implementation of an experimental multi-VIM platform
- T0+3 months : Comparative analysis of infrastructure models adapted to deployment of compound network services

- T0+5 months: Elaboration of a common abstract infrastructure model
- T0+6 months : Evaluation of solutions using tools from the IT world (software structure consistency checking)
- T0+8 months : Proof of concept
- T0+10 months : Valuation and publication (patents, conferences, papers)

contract

Post Doc