Offer #2023-05866

PhD Position F/M Experimental evaluation of sliced cellular networks

Contract type : Fixed-term contract

Level of qualifications required : Graduate degree or equivalent

Fonction : PhD Position

About the research centre or Inria department

The Inria Université Côte d'Azur center counts 37 research teams as well as 8 support services. The center's staff (about 500 people) is made up of scientists of different nationalities, engineers, technicians and administrative staff. The majority of the center's research teams are located in Sophia Antipolis and five of them are based in an Inria antenna in Montpellier. The Inria branch in Montpellier is growing in size, in accordance with the strategy described in the institution's Contract of Objectives and Performance (COP).

Context

This position is open at the Diana project-team at Inria Center at Université Côte d'Azur, in the frame of several major French and European projects on 5G/6G networks.

The overall objective of the DIANA project-team is to design, implement and evaluate advanced networking architectures. To do so, the team works to provide service transparency and programmable network deployments in the context of both wired and next generation wireless cellular networks. The team's methodology includes advanced measurement techniques, design and implementation of architectural solutions, and their validation in adequate experimental facilities. The DIANA team designed, deployed and operates R2lab, a wireless testbed designed with reproducibility as its central characteristics. The team collaborates with Eurecom to deploy and operate an open programmable platform to test post-5G services. Recently, the team enriched R2lab with 5G professional radio units and compute resources managed by Kubernetes clusters to provide an experimental cloud-native environment to test with open source (OAI, SrsLTE) software and some commercially licensed software (e.g. Amarisoft) for 5G/6G networks supporting for example scenarios with disaggregated 5G networks elements. Other recent contributions of the team include: Enhanced Transport-Layer Mechanisms for Multi-Access Edge Computing-Assisted Cellular Networks, Bencharmking Mobile Networks from the Viewpoint of Video Streaming QoE, Introducing Fidelity in Network Emulation, and Enhanced Ray Tracing Techniques for Accurate Estimation of Signal Power.

Assignment

With the advent of softwarization in networks, and in next generation cellular networks in particular, the current trend is to validate network solutions over emulated testbeds that have the advantage to be flexible and easily deployed. The emulation can be done either on one physical machine like Mininet, or on a cluster of physical machines like Maxinet and Distrinet. The main challenge with network emulation is to make sure that the emulation has well passed, and was not bottlenecked by the underlying network conditions or the compute resources. Realism (or fidelity) of an emulation is a sufficient condition for reproducibility of the experiment. We aim in this thesis to propose a new framework for verifying emulation realism in the context of next generation cellular networks with the consideration of network slicing, multi-technologies and multi-actors.

This project will then tackle the important question of verifying the correctness of a cellular network emulation and pinpointing the origins of any degradation. A correct emulation is an important step in the validation of the performance of new network solutions and protocols such the quality of service of deployed slices. It is also a sufficient condition to ensure the reproducibility of network experiments. We therefore believe that this work will greatly contribute to strengthening the scientific and innovation processes in the field of next generation cellular technologies.

Main activities

Network emulation can be disturbed by several phenomena such as a saturation of the underlying network, or a lack of computing resources on the physical machine(s). Verifying if an emulation has well passed is a challenging task as there is no a priori knowledge on what should be the output of the experiment itself. Monitoring the underlying infrastructure can bring some hints, but in many cases such monitoring is not made possible to the experimenter (case of a cloud experiment) and even when made possible, it does not involve a direct link between the infrastructure performance metrics and the experiment itself (the experiment itself can cause congestion of the infrastructure, which is deemed to be normal). In another context in the Diana team, we are working on a framework for emulation validation of wired networks using packet-level measurements at the emulated link level. We aim in this thesis on extending this framework to sliced cellular networks embracing different technologies (edge, core) and actors (e.g. operators, cloud providers), and validating its performance in detecting and troubleshooting emulation anomalies. These heterogenous cellular networks include a higher number of details as compared to wired networks given the complexity of their wireless part (e.g., shared medium, multi-path fading), and they are also subject to more perturbing phenomena such as the interference of other wireless devices. Moreover, the experimental evaluation of disaggregated sliced radio networks involves several components that can also be emulated such as a gNodeB physical layer or a large number of UEs for scalability. The thesis will propose and implement a framework for emulation realism verification that allows (i) to establish reference models of what should be the behavior of a cellular experiment, (ii) to collect measurements about the emulation and build performance metrics that can be compared to their reference values, (iii) detect if the emulation has encountered any problem and identify the parts of the network that are responsible of the degradation, and (iv) propose solutions to remedy from the emulation problems. We will work on testing the proposed framework over wireless platforms, and in particular, the SophiaNode platform, based on R2lab, which allows running reproducible experiments in an anechoic environment.

Skills

Strong knowledge in network protocols, mobile networks, network measurement, data analytics.

Strong programming skills: python, scripting, java/C++, etc.

Benefits package

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Contribution to mutual insurance (subject to conditions)

Remuneration

Gross Salary per month: 2051€ brut per month (year 1 & 2) and 2158€ brut per month (year 3)

General Information

- **Theme/Domain :** Networks and Telecommunications
  System & Networks (BAP E)
- **Town/city :** Sophia Antipolis
- **Inria Center :** Centre Inria d'Université Côte d'Azur
- **Starting date :** 2023-10-01
- **Duration of contract :** 3 years
- **Deadline to apply :** 2023-12-31

Contacts

- **Inria Team :** DIANA
- **PhD Supervisor :**
  Barakat Chadi / Chadi.Barakat@inria.fr

About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

Warning : you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

Instruction to apply

Defence Security :
This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating

to the protection of national scientific and technical potential (PPST).Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

Recruitment Policy :
As part of its diversity policy, all Inria positions are accessible to people with disabilities.