Job vacancy #2023-05865

PhD Position F/M Monitoring Plane for mobile cellular networks

Contract type: Fixed-term contract
Level of qualifications required: Graduate degree or equivalent
Function: 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 in 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, Benchmarking 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

Networks are witnessing a revolution nowadays with the advent of virtualization and softwarization allowing to deploy network functions and services in data centres, placed at the edge of the network. The efficient placement of these functions and services, and the orchestration of communications between them and with the users, requires the deployment of a monitoring plane allowing to discover and profile the available computing resources at the edge in real time and, in parallel, provide stakeholders (operators, providers and end users) with a sufficient level of information on the capacity and connectivity of these resources to be able to optimize network management and Quality of Experience (QoE) of end users. We aim in this thesis on contributing to the deployment and evaluation of this monitoring plane.

This thesis has two main outcomes. First, it will allow a better understanding of the efficiency and granularity of existing monitoring solutions for mobile edge networks. Second, it will bring to the community a new solution able to accommodate the different users requests in a flexible manner and to cover the different parts of a mobile edge system by bridging together different views on the system. Indeed, an efficient and flexible monitoring plane is key for a network management that improves the end users quality of experience and that troubleshoots the network in case of failures and service degradation.

Main activities

The challenges towards the aforementioned objective are multiple. First, an efficient network management that takes into account the quality of experience of end users does not only depend on simple network metrics such as the delay, or physical proximity, but rather on a complex set of metrics such as the bitrate in both directions, the jitter, the packet loss rate, the context of mobility, the device properties, etc. The collection of all these metrics in an accurate and timely way represents a real
challenge. Further, and given the large number of devices foreseen at the edge and their mobility and time dynamics, the measurement plane has to be of low cost, able to scale with the number of users, devices and services, and must track the whole system in an efficient manner. This is another challenge facing the development of a monitoring plane for future edge networks. The first objective of this thesis is to go over the existing solutions for mobile edge monitoring, and benchmark them to evaluate their capacity to accommodate the requirements of different applications during the service orchestration phase. We will focus in particular on how information is collected, what information is collected, and to which extent existing solutions can improve the service optimization at the edge by taking into account the requirements of applications and the amount of available resources, both in the network and the computing infrastructure. For this study, we will follow an experimental approach and deploy scenarios over wireless platforms such as Mininet WiFi, R2lab wireless platform or the SophiaNode platform. We will be evaluating the performance of existing solutions (according to the above criteria), and how well the orchestration of resources at the edge can benefit from a larger spectrum of measurement data towards a better management of edge network resources and a better Quality of Experience / Quality of Service for end users.

Departing from the results of the previous study, the second objective of this thesis is to come up with a new flexible monitoring solution able to cover the different parts of a mobile edge system such as the wireless channel and the edge cloud part, and to customize the level of information provided based on the requirements of the network management plane. This new solution will mainly consist on bridging the wireless channel view with the cloud and network view in one view able to shed light on the different events that can happen inside the network and on the computing nodes of the edge cloud. We will devise experimentation scenarios to prove the flexibility of our monitoring solution and its efficiency to accommodate the different monitoring requests.

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.