2018-00290 - Data analytics for optimized resources' management in future 5G networks

Contract type: Public service fixed-term contract
Level of qualifications required: Graduate degree or equivalent
Function: PhD Position

About the research centre or Inria department

Inria, the French National Institute for computer science and applied mathematics, promotes “scientific excellence for technology transfer and society”. Graduates from the world’s top universities, Inria's 2,700 employees rise to the challenges of digital sciences. With its open, agile model, Inria is able to explore original approaches with its partners in industry and academia and provide an efficient response to the multidisciplinary and application challenges of the digital transformation. Inria is the source of many innovations that add value and create jobs.

Context

This Ph.D. candidate position is funded by the "Inria"-"Nokia Bell Labs France" common Lab under a research action named "Analytics and Machine Learning".

The thesis will be supervised by Yassine Hadjadj-Aoul (University of Rennes 1), Abdelkader Outtagarts (Nokia Bell Labs France) and Gerardo Rubino (INRIA).

Subject description

The ever-increasing demands in data traffic augmented with the diversification of services' requirements are challenging the infrastructure of fixed and mobile network operators [4]. To overcome such issues, the research community is directing its efforts towards defining the future 5G standard, which includes improvements at different layers and levels [3].

In the light of the recent advances in both cloud computing and networking, particularly with the emergence of Network Functions Virtualization (NFV) [5] and the separation of the control and the data plans with Software Defined Networking (SDN), new opportunities are offered for a more agile, elastic and reliable network. In such a context, the slicing of the 5G infrastructure into different functional, logical networks is recognized as a key enabler for the realization of a carrier grade network [1][2]. However, an optimal orchestration requires an accurate knowledge, in real-time, of the whole system. This would be prohibitively expensive in terms of overload, which would affect the network efficiency.

In this respect, there is a need for a lightweight and smart framework, which allows the creation of consistent and dynamic slices taking into account the resources' variability and the micro-services utilization (i.e. cloud resources) for a more optimized system's management. Thus, brand new strategies need to be elaborated to:

1. efficiently capture the dynamicity of resources in a costless way by:
   1. identifying the Key Performance Indicators (KPI) of 5G systems using Machine Learning techniques such as Principal Component Analysis (PCA)
   2. correcting and completing missing measurements using filtering techniques or predicting tools
   3. elaborating an efficient adaptive monitoring strategy, which allows reducing significantly
the signaling overhead
2. creating dynamically adjustable slices guaranteeing the quality’s requirements of the supported services using:
   1. statistical analysis of historical data workload for forecasting the resource demand
   2. control theory-based techniques and online learning.

**Keywords:** 5G, Dynamic slicing, SDN, NFV, Micro-services, Monitoring, Data analytics

**References**


**Assignment**

**Objective of the thesis**

The objective of this PhD thesis is to propose new strategies towards the creation and management of dynamical slices in the context explained above. The thesis will particularly focus on the use of machine learning techniques to create an abstracted view of the network, which allows dynamical adjustment of the needed resources, while guaranteeing the quality of the supported services and QoE (quality of Experience).

**Main activities**

**Thesis work plan**

**First year**:
- Examining the related work on the ongoing 5G standard and particularly on slicing
- Identifying the KPIs for 5G systems
- Proposing a new strategy to significantly reduce the amount of signaling overhead
- Identifying the problems pointed-out in the thesis description and identifying new problems
- Writing a research paper survey and/or a report

**Second year**:
- Proposing new strategies for an efficient monitoring of the slices in the context of 5G systems
- Simulating/emulating and analyzing the proposed solutions
- Building a testbed/demo for the proposed solutions using the Nokia Innovation Steering Platform
- Writing research papers

**Last year**:
- Proposing new strategies for the elaboration of dynamically adjustable slices
- Simulating, emulating and analyzing the proposed solutions
- Testing experimentally the proposed solutions on the developed testbed using a Nokia Innovation Steering Platform
- Writing research papers
- Writing the thesis report
Skills

Technical skills:
- Telecommunication: good knowledge of communication systems
- Mathematics: good mathematical background (Algebra, Estimation theory, ...)
- Programming: Python, ...
- Artificial intelligence (optional): deep learning.

Languages:
- English
- French (optional)

Relational skills:
- Good ability to work in groups.
- A passion for innovation, novelty, curiosity.
- Good communication skills: oral fluency, clear, concise.

Other valued appreciated:
- positive, constructive spirit.
- originality.

Benefits package
- Subsidised catering service
- Partially-reimbursed public transport
- Social security
- Paid leave
- Flexible working hours
- Sports facilities

Remuneration
From 1982 euros before taxes

General Information
- **Theme/Domain**: Networks and Telecommunications
  System & Networks (BAP E)
- **Town/city**: Rennes
- **Inria Center**: CRI Rennes - Bretagne Atlantique
- **Starting date**: 2018-05-01
- **Duration of contract**: 3 years
- **Deadline to apply**: 2018-04-30

Contacts
- **Inria Team**: DIONYSOS
- **Recruiter**: Hadjadj-aoul Yassine / yassine.hadjadj-aoul@irisa.fr

The keys to success

The candidate, who already has an initial research experience through a master's or other internship, wishes to develop his/her skills on an ambitious original research topic.

The candidate will have a solid foundation in communication systems, as well as experience and interest in scientific software development.

He or she is interested in both theoretical modelling and analysis, but also in an experimental
approach around communication systems. He wants to develop his skills in artificial intelligence.

Interested, enthusiastic in nature, the candidate likes to work in a team, solve complex problems and share his or her experience.

He or she must feel comfortable in a scientific environment, enjoys confronting ideas, likes contradictions and has a desire to communicate results within and outside the team.

With a very good level of English, he is able to cope in an international environment and can convince people of his ideas while having a strong ability to listen and adapt.

**Conditions for application**

Please submit online: your resume, cover letter and letters of recommendation.

For further information, please send an email to yassine.hadjadj-aoul@irisa.fr

**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.

**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.