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

Type de contrat: CDD de la fonction publique
Niveau de diplôme exigé: Bac + 5 ou équivalent
Fonction: Doctorant

A propos du centre ou de la direction fonctionnelle

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.

Contexte et atouts du poste

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 planes 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 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 elastic and reliable network. 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 dynamcity 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

Mission confiée

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).

Principales activités

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

Compétences

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.

Avantages sociaux

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

Rémunération

From 1982 euros before taxes