2019-01280 - PhD Position F/M Resilience-as-a-Service for xRAN slices using Machine Learning

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 research institute for the digital sciences, promotes scientific excellence and technology transfer to maximise its impact.
It employs 2,400 people. Its 200 agile project teams, generally with academic partners, involve more than 3,000 scientists in meeting the challenges of computer science and mathematics, often at the interface of other disciplines.
Inria works with many companies and has assisted in the creation of over 160 startups.
It strives to meet the challenges of the digital transformation of science, society and the economy.

Contexte et atouts du poste

This PhD will be conducted in the context of a collaboration between Nokia and Inria. The starting date of the PhD is flexible, and could be as soon as 1st of March 2019.

Mission confiée

The data traffic demand is exponentially growing and becoming increasingly diverse. Indeed, future 5G mobile networks shall support multiple technical and service requirements, such as high throughput, low-latency, high reliability and availability, large storage capacity, cost-efficiency and operational energy-efficient features. That context brings many new challenges to develop suitable 5G technology. In order to cope with the conflictual requirements, future wireless 5G networks have to change in two ways. First, network deployments have to get dense (cells smaller and part of base station closer to the mobile user) and tightly coordinated (severe interference avoidance). Second, networks have to dynamically adapt to meet the diverse requirements of multiple applications. For this, it has to be flexible, intelligent, distributed and programmable. That is why, it has been suggested using for 5G: **network function virtualization (NFV)**, **xRAN architecture** (that includes SDN principles) and **network slicing** in order to cope with multiple constraints and demands. Inspired from SDN approach, the xRAN architecture decouples the control plane from the data plane and split in independent components (centralized and distributed BBU and RRH/RRU) the traditional one size RAN. xRAN relies basically on **software-defined access points** that may be configured remotely in a similar way than SDN switches. Such a design approach enables to dynamically instantiate, update, manage and delete XRAN slices in a very cost-efficient way. xRAN combined with NFV and slicing driven by data analytics, will definitely provide more open, agile and evolving RAN characterized by a simple architecture, an independence between data delivery infrastructure and control functionalities, and surely reduced deployment and operational costs.

In such a context, the following main issues should be addressed: (A) in which way xslice should be created and maintained? (B) How failures and errors observed in xslices in xRAN should be detected and proceeded? (C) In which way, physical and virtual resource dedicated to fix failures should be opened, allocated and registered upon the xslice reconfiguration? And (D) in which way resilient solutions that mutualize virtual resources between multiple tenants may operate?

There is a large panel of network resilience solutions that may be deployed inside a given network. The choice of "suitable" solutions depends on the investment that the infrastructure provider is willing to make and the type of involved services. The traditional solutions may be either *reactive or predictive resilience approaches*

Principales activités

The goal of this phD is to offer a resilient efficient low-cost xRAN infrastructure by relying on data analytics (error prediction thus policy prediction) and on process automation (collect/monitoring/decision and achievement). To reach this goal we propose a dynamic resilience solution that combines advantages of reactive and predictive approaches, i.e., optimal resource (physical and virtual) utilization and timely reaction in a xRAN architecture. The resilience reconfiguration procedure will be running as a background Machine Learning-based automatic process during the life-cycle of a slice. Decisions will be taken based on massive data collected inside the network. Here, we identify key challenges on Machine Learning associated with this idea, concerning the phases of life-cycle of a slice. They are:

1. *The network state forecasting*: using Machine Learning techniques working on time-varying covariates and landmark analysis applied to discretized network state maps.
2. *The resilience update instant*: using Machine Learning in order to classify criticality of anomalies (massive and isolated) and therefore to decide if it is worthy or no to launch an update cycle of a resilience solution.
3. *The reconfiguration of resilience solutions*: The problem shall be formulated as a multi-objective optimization one and solved using heuristics inspired from AI techniques.

Compétences

- A solid mathematical background, especially in probability and statistics.
- A good background in networking technology and familiar with LTE RAN and 5G.
- A perfect proficiency in Python/C/C++ or tensorflow/keras, or other scripting languages.
- Good communication skills (written and verbal) in both English and French are required.

Avantages

- Subsidised catering service
- Partially-reimbursed public transport

Informations générales

- **Thème/Domaine :** Réseaux et télécommunications
  Système & réseaux (BAP E)
- **Ville :** Rennes
- **Centre Inria :** CRI Rennes - Bretagne Atlantique
- **Date de prise de fonction souhaitée :** 2019-03-01
- **Durée de contrat :** 3 ans
- **Date limite pour postuler :** 2019-06-30

Contacts

- **Equipe Inria :** DIONYSOS
- **Directeur de thèse :**
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A propos d'Inria

Inria, l'institut national de recherche dédié aux sciences du numérique, promeut l'excellence scientifique et le transfert pour avoir le plus grand impact. Il emploie 2400 personnes. Ses 200 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3000 scientifiques pour relever les défis des sciences informatiques et mathématiques, souvent à l'interface d'autres disciplines. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 160 start-up. L'institut s'efforce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l'économie.

L'essentiel pour réussir

- The candidate should demonstrate a good motivation and autonomy.
- The candidate should be eager to tackle new challenges in the area of machine learning and deep learning, distributed optimizations.

Consignes pour postuler

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

For more information, please contact sofiene.jelassi@inria.fr

Sécurité défense :
Ce poste est susceptible d'être affecté dans une zone à régime restrictif (ZRR), telle que définie dans le décret n°2011-1425 relatif à la protection du potentiel scientifique et technique de la nation (PPST). L'autorisation d'accès à une zone est délivrée par le chef d'établissement, après avis ministériel favorable, tel que défini dans l'arrêté du 03 juillet 2012, relatif à la PPST. Un avis ministériel défavorable pour un poste affecté dans une ZRR aurait pour conséquence l'annulation du recrutement.

Politique de recrutement :
Dans le cadre de sa politique diversité, tous les postes Inria sont accessibles aux personnes en situation de handicap.

Attention: Les candidatures doivent être déposées en ligne sur le site Inria. Le traitement des candidatures adressées par d'autres canaux n'est pas garanti.

Rémunération

monthly gross salary amounting to 1982 euros for the first and second years and 2085 euros for the third year