A propos du centre ou de la direction fonctionnelle

Grenoble Rhône-Alpes Research Center groups together a few less than 650 people in 37 research teams and 8 research support departments.

Staff is localized on 5 campuses in Grenoble and Lyon, in close collaboration with labs, research and higher education institutions in Grenoble and Lyon, but also with the economic players in these areas.

Present in the fields of software, high-performance computing, Internet of things, image and data, but also in simulation in oceanography and biology, it participates at the best level of international scientific achievements and collaborations in both Europe and the rest of the world.

Contexte et atouts du poste

This postdoc will take place in the Inria Agora research group located in the La Doua Campus in Lyon. The student will work with three members of the group: Dr. Juan Faire, Dr. Gana Iova and Prof. Fabrice Valois. Considering the evolution of the sanitary situation a certain level of remote working is expected. The applicant will work with existing software tools such as simulators and optimizers made available by the Agora group. There are no regular travel foresee for this position.

Mission confiée

Contexte: Under the supervision of Dr. Juan Faire, and with the help of Dr. Gana Iova and Prof. Fabrice Valois, the recruited postdoc will study the Direct-to-Satellite IoT (DTS-IoT) communication paradigm. DTS-IoT is a promising approach to deliver data transfer services to IoT devices in remote areas where deploying terrestrial infrastructure is not appealing or feasible. In this context, low-Earth orbit (LEO) satellites can serve as passing-by IoT gateways to which devices can offload buffered data to. However, transmission distances and channel dynamics, combined with highly constrained devices on the ground make DTS-IoT a very challenging problem.

Challenges: Existing IoT medium access control (MAC) schemes need to be revised and/or extended to scale up to potentially millions of devices simultaneously at sight from LEO. Furthermore, the limited available energy and latency provoked by the long channel range (~600 km) complicates negotiation approaches based on extensive handshakes. However, DTS-IoT brings a unique opportunity to accomplish these challenges by exploiting the predictable nature of orbital mechanics, delay tolerance, and learning from frequent revisit to service areas by passing by satellites.

Objective: The main objective and responsibility of the postdoc is to research methods, algorithms and protocols that could tackle the DTS-IoT challenges. Moreover, the derived solutions will be inspired, mapped, and applied to existing LoRaWAN and NB-IoT standards, now being considered for a series of public/private DTS-IoT projects.

Collaboration: The DTS-IoT topic is currently a hot topic both in the academic and industrial sectors. We foresee academic collaborations with researchers from IRIT / ENSEEIHT Toulouse, as well as foreign laboratories such as i2CAT in Barcelona and Universidad de Chile in Chile. Cooperation is on its way with Semtech (the company that developed LoRa), and we are extending it to the DTS-IoT topic. Finally, several companies such as Lacuna, Kinesis, and Swarm are pursuing DTS-IoT activities and will be contacted as potential partners for this activity.

Bibliography:


Informations générales

- **Thème/Domaine**: Réseaux et télécommunications
- **Système de réseaux (BAP E)**
- **Ville**: VILLEURBANNE
- **Centre Inria**: CRI Grenoble - Rhône-Alpes

**Date de prise de fonction souhaitée**: 2021-11-01
**Durée de contrat**: 1 an, 4 mois
**Date limite pour postuler**: 2021-05-23

**Contacts**

- **Equipe Inria**: AGORA
- **Recruteur**: Fraire Juan Andres / juanfraire@inria.fr

A propos d’Inria

Inria est l’institut national de recherche dédié aux sciences et technologies du numérique. Il emploie 2600 personnes. Ses 200 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3500 scientifiques pour relever les défis du numérique, souvent à l’interface d’autres disciplines. L’institut fait appel à de nombreux talents dans plus d’une quarantaine de métiers différents, 900 personnes d’appui à la recherche et à l’innovation contribuent à faire émerger et grandir des projets scientifiques ou entrepreneuriaux qui impactent le monde. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 180 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.

**Consignes pour postuler**

**Starting date**: 1st November 2021, duration: 16 months.

**Applicants should hold a PhD defended after 1st September 2019.**

Applications have to be made on-line on the Inria web site before end of 2nd May.

**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 technique de la nation (PPST). L’institut s’efforce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l’économie.

**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.
enhance scalability and resource efficiency when used for DTS-IoT. This can be achieved by exploiting space-specific predictable features. The server/core of the network will then be placed in gateways/base-stations by an adequate split of functionalities via network function virtualization.

4. Formalize optimization models and methods that can exploit available information of the expected topology and traffic. The goal is to support the accurate decision taking on devices/satellites that could enhance the extraction ratio while minimizing the energy cost (i.e., collisions).

5. Explore learning techniques to derive and predict network parameters; indeed, machine learning models would properly abstract the expected network behaviour, particularly the expected traffic load, in order to throttle the network behaviour.

Note: The prioritization and weight of the activities will be defined depending on the profile of the recruited postdoc.

Methods:

1. Protocol Models (Engineer approach): detailed protocol models (i.e., physical, link and network layers) will be implemented to study the expected performance and resource consumption of DTS-IoT by means of simulations. Model also includes a core network module for the architecture axis. Target platforms for such simulations are NS3, Omnet++, or Python libraries.

2. Abstract Models (Computer Science approach): system-level models will be developed to abstract the network elements and time-dependent resources to then enable optimized decision making based on Mixed Integer Linear Programming (MILP) or Markov Decision Processes (MDP) models.

3. Learning Models (Data Science approach): machine learning models should be constructed and fitted to the dynamic behaviour of satellite passes over devices on ground surface. Resulting model can be used to drive decisions on devices/satellites. Data sets for this learning approach will be generated from the realistic simulator mentioned above.

Compétences

Applicants with a PhD in Computer Sciences, Telecommunication Engineering, or Applied Sciences with proven publication record are welcomed. Good mathematical background, performance evaluation and wireless networking as well as practical skills with programming languages (e.g. C/C++, Python) are required. Expertise in algorithmics, protocol simulation (Omnet++, NS3, Python), network optimization (i.e., heuristics), congestion management, space networking protocols (i.e., CCSDS), orbital dynamics (and related tools such as STK), space technology (i.e., nano-satellites), and machine learning (i.e., scikit-learn, Pytorch) will be positively valued. Fluency English level is mandatory, French language is not mandatory but welcomed. We look for empathic, proactive, and self-driven applicants.

Avantages

- 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 (after 6 months of employment) 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
- Social security coverage

Rémunération

Gross salary: 2,653 euros before deduction of tax incomes