



Offer #2023-06119

PhD Position F/M Leveraging Vehicular Computing to Increase Edge and Cloud computation Capabilities

Contract type : Fixed-term contract

Level of qualifications required : Graduate degree or equivalent

Fonction : PhD Position

Context

This research work is part of the PEPR 5G NF-NAI project

Assignment

A powerful approach to enhance mobile applications' performance is enabling mobile devices to offload some of their computational-intensive workloads to the remote servers at the Edge or the Cloud. A considerable literature exists on offloading tasks on static edge servers [MKB18][KLC19][OZC18][DLQS18]. More recently, a new idea of offloading tasks to vehicles is emerging, such as in [ALEGE17][AOW+12]. But unfortunately, vehicles are assumed to be static. More recent work tackles the more challenging dynamic and stochastic case of moving vehicles [SGS+19], where offloading can only occur on vehicles. In [ZZD15][SHC+18], consider a joint allocation strategy considering both vehicles, Edge and Cloud. However, in the former, a task is offloaded to vehicles only if it fails to be offloaded to the Edge or the Cloud. Other works explore the multi-hop capabilities of vehicular networks to allow remote nodes to access the Edge and offload their tasks [DCL20][HL20][HLW20]. We believe that the vehicles can play an essential role in absorbing the computing load on the Edge or the Cloud by allowing resource allocation closer to users with a significant reduction in energy costs for the Edge and delays.

In this Ph.D., we propose to:

1. Evaluate how vehicular computing can be integrated with Edge-Cloud Computing infrastructures.
2. Assess the impact of users' mobility.
3. Assess the impact on energy consumption at the Edge level.
4. Propose more sustainable and nearby computing services to avoid using cellular infrastructure and expensive subscription plans. Reduce high investment expenses at the Edge.

[ALEGE17] Amal A. Alahmadi, Ahmed Q. Lawey, Taisir E. H. El-Gorashi, and Jaafar M. H. Elmirghani. Distributed processing in vehicular cloud networks. In 2017 8th International Conference on the Network of the Future (NOF), pages 22–26, 2017.

[AOW+12] Samiur Arif, Stephan Olariu, Jin Wang, Gongjun Yan, Weiming Yang, and Ismail Khalil. Datacenter at the airport: Reasoning about time-dependent parking lot occupancy. IEEE Transactions on Parallel and Distributed Systems, 23(11):2067–2080, 2012.

[ZZD15] Hongli Zhang, Qiang Zhang, and Xiaojiang Du. Toward vehicle-assisted cloud computing for smartphones. IEEE Transactions on Vehicular Technology, 64(12):5610–5618, 2015

[DCL20] Zizhen Deng, Zhen Cai, and Mangui Liang. A multi-hop vanets-assisted offloading strategy in vehicular mobile edge computing. IEEE Access, 8:53062–53071, 2020.

[DLQS18] Thanh Quang Dinh, Quang Duy La, Tony Q. S. Quek, and Hyundong Shin. Learning for computation offloading in mobile edge computing. IEEE Transactions on Communications, 66(12):6353–6367, 2018.

[HL20] Chung-Ming Huang and Chi-Feng Lai. The delay-constrained and network-situation-aware v2v2i vanet data offloading based on the multi-access edge computing (mec) architecture. IEEE Open Journal of Vehicular Technology, 1:331–347, 2020.

[HLW20] Chung-Ming Huang, Shih-Yang Lin, and Zhong-You Wu. The k-hop-limited v2v2i vanet data offloading using the mobile edge computing (mec) mechanism. Vehicular Communications, 26:100268, 2020.

[KLC19] Yeongjin Kim, Hyang-Won Lee, and Song Chong. Mobile computation offloading for application throughput fairness and energy efficiency. IEEE Transactions on Wireless Communications, 18(1):3–19, 2019.

[MKB18] Farouk Messaoudi, Adlen Ksentini, and Philippe Bertin. Toward a mobile gaming based-computation offloading. In 2018 IEEE International Conference on Communications (ICC), pages 1–7,

2018.

[OZC18] Tao Ouyang, Zhi Zhou, and Xu Chen. Follow me at the edge: Mobility-aware dynamic service placement for mobile edge computing. *IEEE Journal on Selected Areas in Communications*, 36(10):2333–2345, 2018.

[SGS+19] Yuxuan Sun, Xueying Guo, Jinhui Song, Sheng Zhou, Zhiyuan Jiang, Xin Liu, and Zhisheng Niu. Adaptive learning-based task offloading for vehicular edge computing systems. *IEEE Transactions on Vehicular Technology*, 68(4):3061–3074, 2019.

[SHC+18] Fei Sun, Fen Hou, Nan Cheng, Miao Wang, Haibo Zhou, Lin Gui, and Xuemin Shen. Cooperative task scheduling for computation offloading in vehicular cloud. *IEEE Transactions on Vehicular Technology*, 67(11):11049–11061, 2018.

Main activities

- Read and synthesize literature work,
- Propose technical solutions
- Design test and experimental platforms
- Write research papers and reports.
- Present the research works.

Skills

Technical skills and level required:

- Excellent background in networking, machine learning algorithms, and statistical analysis tools.
- Excellent programming skills (e.g. Python, C, C++).
- Excellent English skills, both in written and oral form

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
- Social security coverage

General Information

- **Theme/Domain** : Networks and Telecommunications
System & Networks (BAP E)
- **Town/city** : Palaiseau
- **Inria Center** : [Centre Inria de Saclay](#)
- **Starting date** : 2023-10-01
- **Duration of contract** : 3 years
- **Deadline to apply** : 2023-06-15

Contacts

- **Inria Team** : [TRIBES](#)
- **PhD Supervisor** :
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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.