**2018-01113 - Internship at MiMove: Optimizing Video Quality of Experience in a Mobile Context**

**Contract type :** Public service fixed-term contract  
**Level of qualifications required :** Graduate degree or equivalent  
**Fonction :** Internship Research  
**Level of experience :** From 3 to 5 years

**Context**
This internship is part of the Associate Team HomeNet between Inria Paris’ team MiMove and Princeton University. For more information: https://team.inria.fr/homenet/

**Assignment**
Most mobile devices today are equipped with more than a single interface; e.g., LTE, 3G, and WiFi. Making use of all these interfaces simultaneously is bound to give significant throughput increments over a single interface [1, 6], as well as robustness to path failures. This is particularly interesting with the emergence of pervasive Wifi in big cities (e.g., community Wifi such as Free in Paris and BT WiFi in London). This means that we can potentially use both LTE and WiFi as we move around a city, or even alternate between these two interfaces to reduce the usage of the metered link (cellular) when Wifi is available [2], or in the event of failure of one path (e.g., patchy WiFi coverage). A key research question is, how to support stable application performance in such a dynamic and heterogeneous network environment. This is particularly critical for interactive applications such as video streaming, voice-over-IP, and video conferencing (among others). For instance, in the case of dynamic-adaptive video streaming over HTTP (DASH), the video quality is adapted based on the perceived throughput. Hence, as we enter and exit the range of an access point (AP), the overall throughput changes. This may cause constant quality switches, disrupting the perceived video quality [4]. Moreover, the underlying transmission protocol must be able to quickly shift the load across interfaces as we move between APs. Failure to do so, might yield increased transmission loss at the edge of an AP range, perturbing application performance [3, 5].

The goal of this project is to optimize Quality-of-Experience (QoE) of interactive applications for mobile users. We envision users walking or driving by road-side WiFi AP with full 3G/LTE coverage and patchy WiFi coverage (i.e., community Wifi or WiFi APs on Lampposts). To achieve this goal, we plan to leverage multi-path and cross-layer optimizations. As a first step, we will be studying the impact of multi-pathing on interactive applications in a mobile context. The objective of this study is to answer the following set of open research questions: i) How well do existing multi-path transport protocols support interactive applications in a mobile context? How to accurately and timely switch between interfaces to support preferably multi-pathing? ii) How to do so while sustaining a stable application performance? Answer to these research questions will guide the design of a scheduler that intelligently allocates packets across multi-paths while ensuring stable and reliable interactive applications performance in a mobile context. As part of this design, we will be investigating the benefits of a cross-layer design, where information are pushed across layers to guide the decision of the multi-path scheduler.

The goal of this internship is to collect and analyze packet traces of experiments running over multi-path transport protocol in a mobile context. The student will conduct experiments (walking and/or in-car) to collect data traces that will shed light on the performance of existing multi-path streaming protocol. This also includes setting up the needed platforms to run these experiments (e.g., end-systems running Multi-path TCP and Multi-path Quic). The student will also analyze the collected traces to help answer some of the above research questions. During the internship, the student should develop scientific skills on network systems design and development and wireless technologies as well as scientific writing and presentation. If the student is interested, there is a possibility of staying for the doctoral studies after the internship.

**Main activities**

Main activities:
- Conduct experiments to generate traces of video streaming performance for mobile users
- Analysis of collected traces to understand the limitation of existing transport protocols and adaptive bitrate adaption algorithms
- Development of novel multi-path and cross-layer strategies to improve mobile video streaming quality

Additional activities:
- Attend group meetings and give presentations on work progress
- Assist with writing research articles that describe the work

**Skills**
- Knowledge of Android.

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**General Information**

- **Theme/Domain :** Networks and Telecommunications  
- **System & Networks (BAP E)**  
- **Town/city :** Paris  
- **Inria Center :** CRI de Paris  
- **Starting date :** 2019-03-01  
- **Duration of contract :** 15 months  
- **Deadline to apply :** 2018-12-05

**Contacts**

- **Inria Team :** MIMOVE  
- **Recruiter :** Cruz Teixeira Renata / renata.cruz-teixeira@inria.fr

**About Inria**

Inria, the French national research institute for the digital sciences, promotes scientific excellence and technology transfer to maximize 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.

**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.
- Comfortable communicating in English.
- Kernel-space implementation.
- Comfortable with at least one scripting language (e.g. python).
- Knowledge of network protocols and network development tools.
- Knowledge of matlab or gnu R.

**Benefits package**
- Subsidised catering service
- Partially-reimbursed public transport