2018-00672 - Service Problems within Highly Dynamic Distributed Systems

**Context**

The availability of wireless communications has drastically increased in recent years and established new applications. Humans, agents, devices, robots, and applications interact together through more and more heterogeneous infrastructures, such as mobile ad hoc networks (MANET), vehicular networks (VANET), (mobile) sensor and actuator networks (SAN), body area networks (BAN), as well as always evolving network infrastructures on the Internet. In such networks, items (users, links, equipments, etc.) may join, leave, or move inside the network at unforeseeable times.

The dynamics of such networks, the heterogeneity of devices, usages, and participants, and often the unprecedented scale to consider, make the design of such infrastructures extremely challenging. For a vast majority of them, the dynamics are also unpredictable. Furthermore, designing applications on top of such networks requires to deal with the lack (or weakness) of infrastructures and numerous topological changes.

Therefore, it becomes necessary to define and to develop new accurate models capturing the features of the considered objects: users' mobility, system instability, dynamics of applications, etc. Recently, numerous models (refer to [1,2,3], [4] for a survey) for these harsh environments have been gathered in a general framework: the Time-Varying Graphs (TVGs) [5]. Based on this framework, DELYS team recently proposed a quite thoroughgoing study of fixed point problems (like maximal matching, minimal dominating set, maximal dominating set, etc) in highly dynamic systems [6,7,8]. In particular, some necessary and sufficient topological conditions are exhibited for these problems.

**Assignment**

The main goal of the thesis is to provide a similar study about problems without fixed point in highly dynamic systems. Such problems refer to service tasks that are a priori unpredictably triggered on demand by some participants. We propose to focus on one of the following fundamental problems: Mutual Exclusion, Token Circulation, or Propagation of Information with Feedback. All this problems received great attention in static systems but have barely been considered in the context of highly dynamic systems.

**Main activities**

The scientific agenda is mainly threefold:
- First, studying service problems in the context of TVG with the goal to provide a specification that makes sense in highly dynamic systems;
- Producing necessary and sufficient conditions on the system (e.g., network dynamic, network topology, etc.) to enable existence of solutions to this specification in highly dynamic systems;
- The design of distributed algorithms that meet these necessary and sufficient conditions in order to

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**General Information**

- **Theme/Domain**: Distributed Systems and middleware
  - System & Networks (BAP E)
- **Town/city**: Paris
- **Inria Center**: CRI de Paris
- **Starting date**: 2018-10-01
- **Duration of contract**: 3 years
- **Deadline to apply**: 2018-06-09

**Contacts**

- **Inria Team**: DELYS
- **Recruiter**: Franck Petit / franck.petit@inria.fr

**The keys to success**

There you can provide a “broad outline” of the collaborator you are looking for which you consider to be necessary and sufficient, and which may combine:

- tastes and appetencies,
- area of excellence,
- personality or character traits,
- cross-disciplinary knowledge and expertise...

This section enables the more formal list of skills to be completed and ‘lightened’ (reduced):

- “Essential qualities in order to fulfil this assignment are feeling at ease in an environment of scientific dynamics and wanting to learn and listen.”
- “Passionate about innovation, with expertise in Ruby on Rails development and strong influencing skills. A thesis in the field of **** is a real asset.”

**Conditions for application**

**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.
obtain optimal solutions (with respect to impossibility results)

**Skills**

A PhD grant is available at Sorbonne University. Located on the Pierre and Marie Curie campus (4, place Jussieu, Paris), the position is open for three years starting in autumn 2018.

The position is offered to students who hold a Master degree in Computer science, and are interested in theory of distributed computing. A solid knowledge in algorithms, synchronization, concurrency, and fault-tolerance will be appreciated.

To apply, please provide the following information:

- A resume or Curriculum Vitae;
- A list of courses and grades of the last two years of study;
- Names and contact details of three references (people who can recommend you), whom we will contact directly.

**Benefits package**

- Subsidised catering service
- Partially-reimbursed public transport
- Flexible working hours