Inria Associate Teams programme

Intermediate report (Year 1)

**Associate Team acronym:** EfDyNet (Efficient Dynamic Resource Allocation in Networks)

**Period of activity:** 2019.

**Principal investigator (Inria):** Frédéric Giroire (COATI, Inria Sophia Antipolis)

**Principal investigator (Partner Institution):** Brigitte Jaumard (Concordia University, Montréal, Canada).

1. **Future of the Associate Team**
   Would you like to pursue this Associate Team for one more year?  ☒ Yes  ☐ No

2. **Website of the Associate Team**
   [https://team.inria.fr/coati/projects/efdynet/](https://team.inria.fr/coati/projects/efdynet/)

3. **List of participants**

   **EPI Coati:** David Coudert, (DR Inria), Giuseppe Di Lena (PhD Student, 2018-2021), Adrien Gausseran (PhD Student, 2018-2021), Frédéric Giroire (CR CNRS), Joanna Moulierac (MC Univ. Côte d'Azur)

   **Concordia University:** Brigitte Jaumard (professor, chair), Huy Duong (PhD student since June 2018), Quang Anh Nguyen (PhD student since Sep. 2018), Shima Ghanei Zare (PhD student since Sep. 2018), Jean Tonioli (Master student 2018-2020)

   During the first year, we organized the following visits:
   - To Montréal: D. Coudert (July 12-27), A. Gausseran (3 months, Sep. 4- Dec. 4), F. Giroire and J. Moulierac (Oct. 8-18).
   - To Nice: B. Jaumard (Jun 20-24 and Dec. 7-21).

4. **Achievements and Planned activities**

   **Context:** Networks are evolving rapidly in two directions. On the one hand, new network technologies are developed for different layers, and in particular flexible optical technologies (enabling to allocate a fraction of the optical spectrum rather than a fixed wavelength), Software Defined Networks (SDN), and Network Function Virtualization (NFV). On the other hand, the traffic patterns evolve and become less predictable due to the increase of cloud and mobile traffic. In this context, there are new possibilities and needs for dynamic resource allocations. During the first year, we obtained the following achievements:

   - **Reconfiguration.** We studied how to use SDN and NFV to allow the flexible deployment of new services in order to meet changing application requirements. We proposed efficient methods to reconfigure networks to close to optimal operational states during time, at the optical layer [1], at the user layer [2], and for Service Function Chains (SFC) [3,11,12].

   - **Protection against failures.** The emergence of the NFV and SDN paradigms also led to rethink the way networks can be protected against failures. In [7,10], we developed two scalable mathematical models for a path-based protection scheme with a global rerouting strategy for the classic network dimensioning problem with protection against Shared Risk Link Group (SLRG) failures.
**- Software tool.** We tested our solutions by emulation using Mininet, the most popular tool when it comes to evaluate SDN propositions. However, for some of our resource intensive experiments, the host running Mininet was overloaded. To tackle this issue, we developed a new generic tool Distrinet, a way to distribute Mininet over multiple hosts [8]. The distribution is automatically deployed in a Linux cluster, Grid5000, or in Amazon EC2. The tool was made available for the community [13] and will be demonstrated in CoNEXT 2019.

**- Scheduling.** We also consider the placement of cloud resources inside a data center [3,6]. Traditionally, this is done by a task orchestrator without taking into account network constraints. According to recent studies, network transfers represent up to 50% of the completion time of classical jobs. In [3], we propose a new scheduling framework taking into account the competition between communications for the network resources.

**- Seminars.**
- F. Giroire, presentation of the thematic of EfDyNet, during a team seminar at Concordia.

**Work program for next year:**
In the second year of the project, a first axis is to deepen our understanding of the multi-level network reconfiguration. A second axis is to consider the specific challenges brought by the 5G technology, and in particular, network slices.

5G is envisioned to allow a multi-service network supporting a wide range of communication scenarios with a diverse set of performance and service requirements. The concept of network slicing has been proposed to address these diversified service requirements. A network slice is an end-to-end logical network provisioned with a set of isolated virtual resources on a shared physical infrastructure. Network slicing will thus be a fundamental feature of 5G networks.

We started working on the efficient methods for the provisioning of static slices [4]. Our plan for next year is to tackle the problem of reconfiguring slices in very dynamic environments with a high churn of slice demands.

Last, more generally, we plan to study efficient ways to carry out service placements at the edge of the network to solve the challenges introduced by the 5G, Mobile Edge Computing or Fog Computing paradigms, i.e., how to efficiently handle the needs in computing, routing, and storing of very dynamic applications.

**5. Budget requested for the coming year**

**Planned visits in the coming year:**

**Requested Budget:** 13 000 euros.

**Additional Fundings:**
- Brigitte Jaumard has secured several contracts with CIENA on topics related to the ones of the associate team. Four Ph.D. students and one master student are working in the next years 2 or 3 years on the optimization of next-generation networks.
- We have current discussion with MITACS and CIENA for potential collaboration and grants to hosts students in 2020.
- The 3 months visit of A. Gausseran was funded by the EUR-DS4H.
- The work of G. Di Lena is funded by and Orange Ph.D. grant (CIFRE).
- We are planning to apply to the next year editions of France-Quebec calls.
Publications of the project

International Journals


International Conferences


Extended Abstracts and Demos


National Conference.


Code