

Internship Proposal:

Enabling clusters with Dynamic Distributed Systems

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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 of infrastructure 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 stability, dynamics of applications, *etc.* On the top of this, operating systems and applications are required to have *self*-* attributes, such as self-organized, self-healing, self-configuring, self-managed, self-optimized, *etc.* Such distributed architectures are sometime gathered under the generic term of *Autonomic Computing*, referring to self-* properties of distributed systems adapting to unpredictable topological changes.

Clustering is a well-known and widely used technique to structure and organize networks. It aims at arranging the nodes of the network into groups according to some metrics, *e.g.*, the distance with respect to some particular nodes in terms of hops or times, the node load, geographic location, community gathering, network technology, applications, *etc.* Clustering mainly leads to organize the network hierarchically.

Internship Assignment

We propose to focus on the particular problem of *Maximal Independent Set* (MIS) construction. An independent set is a set of non adjacent processes of the system. An independent set is *maximal* if it is not a subset of any other independent set. Classically, MIS is use to "span" the system with a sparse set of processes.

More specifically, MIS is particularly relevant in the context of wireless networks because it can be used as an initial and basic spanning distributed structure [6].

Whereas independent set construction was extensively studied in the context of static distributed systems (refer for instance to [3, 5, 7, 4, 1]), this problem does not receive any attention in dynamic systems at the best of our knowledge. The main goal of this project is to fill this gap.

More precisely, the internship aims at studying the MIS problem within highly dynamic distributed systems, unified in a framework [2] called *Time-Varying Graphs* (TVG), which are represented as time-ordered sequences of graphs defined over a fixed set of nodes.

The scientific agenda is mainly threefold:

- Studying independence problems in the context of TVG with the goal to define (maximal) independent sets that make sense in dynamic systems ;
- Second, the main challenge is to produce necessary and sufficient conditions to enable existence of (maximal) independent sets in highly dynamic systems ;
- Third, we would like to design some distributed algorithms that meet these necessary and sufficient conditions in order to obtain optimal solutions (with respect to impossibility results).

References

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