Ubiquitous Networks: Stability, Optimization and Self-Control

Mots clés :
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Résumé du projet de recherche (Langue 1)

Future networks will interconnect such a large number of dynamic nodes, Users’ devices, machines, smart things that a deep transformation of today’s architectural paradigm is required. It will not be possible anymore adopting traditional management and control (declared objectives and observed behavior) for future networks. Dynamic or static modeling for (open or closed loop) control will become very complicated and unstable if not supplemented with a variety of novel control techniques, including (nonlinear) dynamic systems, computational intelligence, intelligent control (adaptive control, learning models, neural networks, fuzzy systems, evolutionary and genetic algorithms), and artificial intelligence. This emerging self-organization recalls the metaphor of the collective intelligence emerging in insects communities, like in in termites nest (often analyzed as complex systems). From this point of view, indeed future network fabric will behave like a complex system (around stability attractors) where small (real, virtual) nodes will look like simple living systems (e.g. termites). If this evolution will naturally make the network robust and resilient against attack, on the other hand the expected level of dynamicity and complexity will imply the dependence of the network’s global characteristics (e.g., connectivity and average delay rate) on some local parameters (e.g., communication path and transmission probability) and as such the risk of instabilities. In other words, network behaviour may be influenced by phase transitions (i.e. an abrupt change in some operating characteristics may take place with a relatively small variation of certain parameters). As such, assuring network stability will be a hot issue. Main goal of the thesis will be developing and demonstrating a novel paradigm for empowering future ubiquitous network with self-* features for ensuring stability, optimization and self-control-management. Thesis will develop the vision of a network whose functioning is not simply mediated by the "knowledge" of the network itself (e.g. coded in information models), as in traditional management paradigms, but rather it is steered by an “intrinsic knowledge”, acquired during the real of functioning through dynamic adaptation and learning; This “intrinsic knowledge” is coded and stored in the form of automatic control-loops and neural networks structures solving, in a distributed way, utility functions and functionals.