PhD offer

INSA CENTRE VAL DE LOIRE

Designing reliable and secure software-intensive systems

The design and development of software-intensive systems is a challenging activity that requires a careful and detailed analysis of all involved components and their inter-relations. This process, commonly known as software architecture, relies on appropriate abstract models for system descriptions. In particular, graph-based models provide visual yet formal and unambiguous architectural specifications that allow to provide guarantees with regard to system correctness and properties, and therefore help design reliable & secure systems.

Systems themselves have grown larger and more complex. This tendency has lead to the consideration of System of Systems (SoS). SoS are themselves comprised of systems and exhibit emergent behaviours. Examples of SoS includes smart-grids, smart-cities and cloud federations. We are interested in two particular techniques to tackle this complexity: auto-adaptation and add-hoc multi-scale architectures.
Multi-scale architectures and models have been designed to tackle complexity of SoS and ease their analysis. Nevertheless, they are mostly informal or semi-formal, critically undermining verification and validation processes. Initially proposed by IBM, auto-adaptive systems aim at autonomously adapting to contextual evolutions, to reliably optimize resources usage while remaining secure. Auto-adaptation techniques have however been mildly studied in the context of SoS, multi-scale architectures, or very large systems.

Objectives: The goal of this thesis is to provide new theoretical and applied tools to help design autonomous, secure and reliable software-intensive systems mastering their complexity. Different research directions can be investigated during this PhD thesis:

- Extend existing graph rewriting tools to integrate advanced rewriting techniques and support the design of correctness-preserving transformation rules.
- Design appropriate formal techniques and meta-models for multi-scale architectures.
- Systematically study impact of scales changes on system properties. Provide formal analysis techniques and tools to predict their (non-)preservation and the appearance of emergent properties.
- Design strategies for the auto-protection and maintenance of IoT systems, particularly in the context of smart cities and smart grids.
- Extend existing self-management tools to enforce aforementioned strategies.

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