Proposition de recherche doctorale

# Runtime adaptation of middleware connectors for emergent mobile systems

**Mots clés :**

- **Directeur de thèse** : valérie ISSARNY
- **Co-encadrant(s)** :
- **Unité de recherche** : Laboratoire inconnu!
- **Ecole doctorale** : École Doctorale Informatique, Télécommunications, Électronique de Paris
- **Domaine scientifique principal**: Divers

## Résumé du projet de recherche (Langue 1)

Given the prevalence of mobile networking environments and systems (smartphone applications), physical world sensing and actuation devices as well as networks of them, and IT systems hosted on global networking and computing infrastructures (the Internet, the Cloud), the possibilities of emergent mobile systems have reached unprecedented levels. Such systems are dynamically composed according to networked resources in the environment, which is not anymore limited to the immediate neighborhood of the users. This perspective is in accordance with the various viewpoints, definitions, and envisaged solutions found in the research literature and practice that constitute the vision of the Future Internet and, one of its growing constituents, the Internet of Things. Emergent mobile systems integrate system domains – enumerated above – that differ significantly in terms of interaction paradigms, communication protocols, and data representation models, provided by supporting middleware platforms. Specifically considering interaction paradigms, the client/server, publish/subscribe, tuple space, and data streaming paradigms are among the most widely employed ones today, with numerous related middleware platforms. Hence, enabling emergent mobile systems calls for advanced interoperability solutions. Existing cross-domain interoperability efforts are based on bridging communication protocols, wrapping systems behind standard technology interfaces, and/or providing common API abstractions In particular, such techniques have been applied by widely established system integration paradigms, such as, service oriented architecture (SOA), enterprise service bus (ESB), or simply the Web. However, state of the art interoperability efforts poorly address cross-domain interoperability, with integration solutions that: (i) lack precise comprehension of constituent systems' interaction semantics versus end-to-end semantics of the integration; (ii) are typically static, which makes them inapplicable to emergent mobile systems; and (iii) do not offer any dependability or quality of service (QoS) guarantees for the end-to-end integration. In the ARLES project-team, we have been working on interoperability solutions for emergent mobile systems. In particular, we have focused on modeling and analysis of middleware semantics. Interaction semantics of middleware protocols and paradigms are formally modeled and analyzed by relying on the connector abstraction from the software architecture field. This work builds on the extensive literature on software architecture, process algebra, protocol verification and protocol conversion. We study the compositionality of the middleware connector semantics of constituent systems and the resulting end-to-end semantics of the integrated system. In this way, correctness of the conversion can be assessed.

## Résumé du projet de recherche (Langue 2)

In the above context, this thesis will aim at enabling runtime-adaptive middleware connectors for emergent mobile systems. The targeted solution will feature: • Dynamic automated adaptation of middleware connectors. Based on the elicited middleware connector models, analysis and mapping of interaction semantics of constituent systems towards the integrated system needs to be carried out at runtime. The aim is to enable emergent mobile systems that are adaptive in a dynamic context based on runtime-acquired knowledge. In particular, reconfiguration of end-to-end middleware connectors will be enabled during the lifetime of the integrated system. • Dependable integration of middleware connectors. Besides functional middleware semantics of constituent systems, non-functional semantics related to, e.g., fault-tolerance and QoS, need to be understood, modeled and mapped. The aim is to enable emergent mobile systems that are realistic and to assess the limitations and constraints of the dynamic automated adaptation approach. • Validation. Besides its formal foundation, the above work will be practically validated through the implementation of enabling software infrastructure that will support runtime-adaptive middleware connectors for emergent mobile systems.

## Informations complémentaires (Langue 2)

Candidates should have strong interest and/or knowledge in the following areas: • Middleware architectures and distributed systems • Software architecture • Formal verification of distributed systems • Mobile computing