

## ***Special Issue on Software Architecture and Mobility***

### ***Guest Editors:***

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E-businesses are increasingly facing the need for porting the provision of their e-services to mobile customers. Evolving requirements, such as reliability, security, scalability, performance and privacy, from fixed to mobile settings, has revealed new and important challenges. This is due to the behavioural constraints that mobility poses, and that were not faced in traditional distributed settings. Examples include: dynamic network topology, changes in location, constrained resource availability, communication protocols heterogeneity, unstable connectivity, and so forth. Industrial practice is demonstrating that such transition is not straightforward and tends to be costly. In particular, the evolution may break the architecture of the software system, thus calling for substantial and expensive changes. Even when the system is (re) built from scratch, it is unclear if and how the state of the art in software architectures relates to the requirements and concerns brought forward by mobile software systems. Likewise, there is still a lack of systematic software engineering methods and techniques, which can assist in developing and evolving mobile software systems.

This Special Issue on *Software Architectures and Mobility* is commissioned to address these gaps by strengthening the cross fertilization of advances from requirements and domain engineering, software architectures, and middleware to systematically develop and evolve dependable software architectures supporting mobility. The objective is to address challenges and share novel results in developing and evolving dependable mobile software systems.

A representative list of topics of interest for this Special Issue includes:

- Relating non-functional requirements to architectures for mobile environments;
- Patterns and architectural styles for mobility;
- Model Driven Architectures and mobility;
- Software Product Line Architectures and mobility;
- Aspects Oriented Software Architectures for mobile environments;
- Service Oriented Software Architectures and mobility;
- Middleware induced software architectures for mobile environments;
- Security, trust and privacy issues in software architectures for mobile environments;
- Performance, reliability, heterogeneity, scalability, and dependability issues in software architectures for mobile systems;
- Architectural stability and related technical/economical issues importing distributed architectures to mobile settings;
- Architectural-centric maintenance and evolution in mobile environments;
- Architectural centric testing for mobility;
- Empirical and industrial studies (e.g., architectural changes upon moving from fixed distributed to mobile environments, positive/negative results, and pitfalls).

The Special Issue has featured extended contributions from the First International Workshop on Software Architectures and Mobility (SAM), affiliated with the International Conference on Software Engineering. We have also solicited invited positions from key researchers in the field. There are six articles in this issue, selected from 26 papers in response to our call (23% acceptance rate). Each was rigorously reviewed by at least three independent reviewers, in two phased-selection process. Articles were selected based on their originality, quality, and relevance to the theme.

The invited “*Software Architecture and Mobility: A Roadmap*” by *Nenad Medvidovic and George Edwards* opens the Special Issue by relating the areas of software architecture and mobility from two related perspectives: (1) mobile software, which represents the computing functionality designed to migrate across hardware devices at runtime and execute on mobile hardware platforms, and (2) mobile systems, which are computing applications that include mobile software and hardware elements. The roadmap reports on advances in both these areas and motivates challenges and opportunities for future research in the area.

*The commentary of Michel Wermelinger and Arosha Bandara* complements Medvidovic and Edwards Roadmap by discussing additional, alternative concepts, issues and approaches to software architecture and mobility. The commentary provides a reflection on the meaning of mobility in the context of software architectures. It touches upon two crucial aspects of mobile systems that can benefit from a principled architectural approach to autonomy and privacy.

Following on from the work of Medvidovic and Edwards, another commentary by Judith Bishop and Theo Danzfuss on “*Software Architecture and Mobility –Casually Connected Collaboration*”, discusses a conceptual model, for computer Supported Cooperative Work (CSCW), which can be used to distinguish casually connected collaboration from other kinds and it identifies the architectural requirements for its mobility.

*The contribution of Michele Sama, David S Rosenblum, Zhimin Wang, and Sebastian Elbaum “Multi-Layer Faults in the Architectures of Mobile, Context-Aware Adaptive Applications”* reports that a classical architectural style for a Context-Aware Adaptive Application (CAAA) is typically layered and tends to incorporate context-awareness components to support processing context values, which are responsible for triggering adaptive changes. They further observe that such layering exhibits new kinds of failures that arise as a result of faults that are specific to the choice of technology for implementing specific layers. The manuscript investigates the occurrence of such faults and failures that manifest across architectural layers; it describes samples of such failures in four representative CAAs.

*The contribution of Andres Fortier, Gustavo Rossi, Silvia E Gordillo, and Cecilia Challiol “Dealing with Variability in Context-Aware Mobile Software”* reports on new mechanisms for handling variability, during the evolution of a single mobile context-aware architecture and across different domains. The authors propose a set of design structures, together with their underlying rationale, for realizing mobility

requirements, such as location sensing, behavior adaptation, and the like in relation to variability. Their proposal is illustrated with case studies from different domains.

*“Ambient-PRISMA: Ambients in Mobile Aspect-Oriented Software Architecture”* by Nour Ali, Isidro Ramos, and Carlos Solis presents an approach for modeling and developing mobile applications by combining aspect-oriented architectural approaches with concepts from Ambient Calculus. Ambient-PRISMA follows Model Driven Engineering to represent mobility and location in a software architecture. The authors report on a middleware and a case tool, which support the approach.

*“Promoting the development of secure mobile agent applications”* by Carles Garrigues, Sergi Robles, Joan Borrell and Guillermo Navarro Arribas, presents an architectural-driven approach to the design and implementation of applications based on secure agents. The authors describe architectural-driven mechanisms for implementing cryptographic protocols for this category of systems.

*“An Architecture-Driven Software Mobility Framework”* by Sam Malek, George Edwards, Yuriy Brun, Hossein Tajalli, Joshua Garcia, Ivo Krka, Nenad Medvidovic, Marija Mikic-Racic, and Gaurav Sukhatme, presents an integrated architecture-driven framework for the modeling, analysis, implementation, deployment, and run-time migration of software systems executing on mobile and heterogeneous platforms. The authors describe how their framework deals with challenges posed by both logical and physical mobility. They report on their experience in applying the framework to a family of distributed mobile robotics systems and identify several future applications, which may benefit from their work.

A special issue can only hope to represent a small selection of current research. Nevertheless, this issue has collected an interesting cross-section of papers that contribute to the state of the art, and that we hope will stimulate further work in the area of software architecture and mobility. We would like to thank all the authors who contributed and the many referees, who played an important part in the selection process. A thank is due to the Editor-in-Chief of JSS, Hans van Vliet, whose enthusiastic support enabled the Special Issue to proceed and for the editorial team for their helpful support.

### **Reviewers for Software Architecture and Mobility:**

*Clemens Szyperski, Jan Bosch, Jan Jurjens, Gordon Blair, Gruia-Catalin Roman, Paris Avgeriou, Ivica Crnkovic, Paola Inverardi, Marta Kwiatkowska, Vittorio Cortellessa, T.H. Tse, Steffen Becker, Tomas Bures, Judith Stafford, Michel Chaudron, Eric Matthew Dashofy, Roshanak Roshandel, Luciano Baresi, Muhammad Ali Babar, Paul Gruenbacher, Ian Gorton, Schahram Dustdar, Gian Pietro Picco, Mirco Musolesi, Rami Bahsoon, Licia Capra, Wolfgang Emmerich, Mohamed E. Fayad, Paolo Bellavista, Andrea Arcuri, Massimiliano Di Penta, Nour Ali, Sam Malek, John Georgas, ark Klein, Jose Antonio Montenegro, Sonia Ben Mokhtar, Antonia Lopes, Hassan Gomaa, Antinisca Di Marco, Genaina Rodrigues, David M. Chess, Bruno Wassermann, L McNamara, Christian Zirpins, Behzad Bordbar, Rafael Capilla, Vivek Nallur, Joao P Sousa, Guilin Wang, Onolaja Olufunmilola, Christopher Staite, Daniele Quercia, Sarah Al Azzani.*