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Application domain

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A Component Framework for Java-based Real-Time Embedded Systems

Today we can seend the Java programming language in various types of real-time systems, from industrial control, audio processing, to avionics, and financial sectors. Real-time Java is becoming ubiquitous. However, the real-time domain itself is experiencing a boom that brings demand for large-scale, heterogeneous, dynamically highly adaptive systems with variously stringent QoS requirements.

It is therefore desperately needed to provide an approach addressing these newly emerging challenges. In our research we propose a component oriented framework that facilitates development or real-time Java systems. We employ state-of-the art engineering techniques, such as Component-based Software Engineering, Model-driven Engineering, and Generative programming, to mitigate complexities of this development process.

Key words

Real-time Java, RTSJ, component framework, middleware, CBSE

Academic Career

Since October 2006 : Ph.D. Candidate
INRIA Nord Europe, team ADAM

2001 - 2006 : Master degree
Charles University in Prague, Czech Republic

Research

The Real-Time Specification for Java (RTSJ) is becoming a popular choice in the world of real-time and embedded programming. However, RTSJ introduces many non-intuitive rules and restrictions which prevent its wide adoption. Moreover, current state-of-the-art frameworks usually fail to alleviate the development process into higher layers of the software development life-cycle. In this work we extend our philosophy that RTSJ concepts need to be considered at early stages of software development, postulated in our prior work , in a framework that provides continuum between the design and implementation process. A component model designed specially for RTSJ serves here as a cornerstone. As the first contribution of this work, we propose a development process where RTSJ concepts are manipulated independently of functional aspects. Second, we mitigate complexities of RTSJ-development by automatically generating execution infrastructure where real-time concerns are transparently managed. We thus allow developers to create systems for variously constrained real-time and embedded environments. Performed benchmarks show that the overhead of the framework is minimal in comparison to manually written object-oriented applications, while providing more extensive functionality. Finally, the framework is designed with the stress on dynamic adaptability of target systems, a property we envisage as a fundamental in an upcoming era of massively developed real-time systems.

Main results:

The results the conducted research were publish in the following publications :

(1) Ales Plsek, Frédéric Loiret, Philippe Merle, Lionel Seinturier. *A Component Framework for Java-based Real-time Embedded Systems*. In Proceedings of ACM/IFIP/USENIX 9th International Middleware Conference, December 2008, Leuven, Belgium.

(2) Aleš Plšek, Jir(í Adámek. *Carmen : Software Component Model Checker*. Fourth International Conference on the Quality of Software-Architectures (QoSA'08), October 2008, Karlsruhe, Germany

(3) Aleš Plšek, Philippe Merle, Lionel Seinturier. *A Real-Time Java Component Model*. In Proceedings of the 11th International Symposium on Object/Component/Service-oriented Real-Time Distributed Computing (ISORC'08), May 2008, Orlando, Florida, USA

(4) Michal Malohlava, Aleš Plšek, Frédéric Loiret, Philippe Merle and Lionel Seinturier. *Introducing Distribution into a RTSJ-based Component Framework*. In RNTS 2008 : 2nd Junior Researcher Workshop on Real-Time Computing (JRWRTC'08), October 2008, Rennes France

(5) Aleš Plšek, Philippe Merle, Lionel Seinturier. *Ambient-Oriented Programming in Fractal*. In ECOOP 2007 : 3rd Workshop on Object Technology for Ambient Intelligence, July 2007, Berlin, Germany

(6) Aleš Plšek. *Extending Java PathFinder with Behavior Protocols*. Master's thesis, Advisor : Jirí Adámek, September 2006, Prague, Czech Republic