Editorial:
Experiences with Auto-adaptive and Reconfigurable Systems
(System Level Adaptation)

For this special issue on Experiences with Auto-adaptive and Reconfigurable Systems, we received over 70 submissions. Due to the high volume of submissions, we decided to divide the theme into two sub-topics addressing system-level and application-level concerns respectively, and dedicate a separate part of the special issue to each topic. After a stringent selection process, six papers were selected per part.

There is a growing demand for software systems to perform in dynamic environments, where both functional and non-functional requirements may change. Typically, real-time constraints should be fulfilled and the desired quality of service should be provided. Furthermore, software systems should be able to adapt both statically and dynamically to changing demands. A current emerging trend in software systems requires software entities to be able to reconfigure themselves seamlessly and without user intervention in reaction to changes in their environment, while continuing to provide a guaranteed service. However, the potential system configurations needed in a particular context can hardly be anticipated beforehand. Dynamic non-invasive approaches for providing adaptive system behaviour are therefore required. The development of these systems is a challenge from both the theoretical and practical perspective.

The first part of this special issue on Experiences with Auto-adaptive and Reconfigurable Systems focuses on at system level adaptation, and is composed of the following papers.

‘Dynamic service adaptation’ by Robert Hirschfeld and Katsuya Kawamura is concerned with next generation mobile communication systems and their increasing complexities. The authors anticipate an emerging need for such systems to be open for third-party service providers. Since customers keep switching their service providers, a crucial characteristic of these systems is for their service portfolio to be adjustable to the needs and the preferences of their customers and service level agreements. The paper also suggests infrastructure support for propagating adaptation modules, to coordinate their activation and deactivation, to detect and resolve conflicts and to address safety and security concerns related to mobile code.

‘Adapting workload distribution on software DSM clusters’ by Yen-Tso Liu, Tyng-Yeu Liang and Ce-Kuen Shieh presents the development of a novel method for distributing program threads onto the individual computers of software distributed shared memory (SDSM) clusters. The proposed method has been implemented on a test bed and verified through application to a set of benchmark user programs. The experimental results have shown that the new approach, which takes into consideration both the memory availability of the processors and the CPU power when performing workload distribution, has a significant beneficial impact in terms of maximizing the performance of SDSM applications.

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‘MetaSockets: design and operation of runtime reconfigurable communication services’ by S. M. Sadjadi, P. K. McKinley, E. P. Kasten and Z. Zhou describes the internal architecture and operation of an adaptable communication component called the MetaSocket. Detailed information is given on how adaptive behaviour is implemented and how MetaSockets interact with other adaptive components, including decision makers and event mediators. Evaluation is performed through experiments on a mobile computing testbed, and the results demonstrate the effectiveness of the proposed methods in responding to dynamic wireless channel conditions.

‘Self-tuning caching: the Universal Caching algorithm’ by Ganesh Santhanakrishnan, Ahmed Amer and Panos K. Chrysanthis presents Universal Caching (UC) as a mechanism that captures the generality of the most adaptive cache replacement algorithms with only a limited set of basic criteria for cache replacement decisions. The approach has been tested on Web loads applications where the UC policy was tested using real-world traces from both the server-side and client-side proxies. The UC policy was able to consistently outperform any other fixed choice of algorithm the authors had tested. The author’s conclusion is that the proposed UC policy demonstrates its ability to use a set of simple criteria as a basis for auto-tuning the caching policy.

‘Controlling quality-of-service in distributed real-time and embedded systems via adaptive middleware’ by Richard E. Schantz, Joseph P. Loyall, Craig Rodrigues and Douglas C. Schmidt describes the design and performance of a quality of service management framework that adaptively controls the end-to-end behaviour of distributed real-time and embedded multimedia applications by applying resource management techniques for both processing and communication tasks. The authors have incorporated aspect-oriented software development concepts as key design principles in the middleware frameworks and have used these concepts to develop the UAV video distributor application. The article presents the experiments that use a combination of CPU reservation along with network priority for end-to-end control of resource management policies.

‘A validation approach for neural network-based online adaptive systems’ by Sampath Yerramalla, Edgar Fuller and Bojan Cukic presents a novel methodology for validating adaptive software systems based on online operational monitoring. The validation technique is applied to a neural network-based online self-adaptive system; the intelligent flight control system. The authors claim that the proposed validation technique is applicable to a wide range of online self-adaptive systems with embedded soft-computing learning paradigms. The authors use the concept of run-time monitoring as a powerful tool added to their system as means of validating on-line self-adaptive systems in cases where the assumptions made under the mathematical validation approach no longer hold. By using the data collected from an F-15 fight simulator, the paper provides heuristic evidence to support their findings.

Mehmet Aksit
University of Twente, Enschede, The Netherlands
E-mail: m.aksit@ewi.utwente.nl

Tzilla Elrad
Illinois Institute of Technology, U.S.A.
E-mail: elrad@iit.edu

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Softw. Pract. Exper. 2006; 36:1113–1114
DOI: 10.1002/spe