Graph grammar-based transformation for context-aware architectures supporting group communication

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Abstract. Handling context-aware dynamically adaptable architectures contributes to the design of self-configuring software systems. This kind of problem for communicating systems is even more challenging since adaptation should address simultaneously the different levels. This is necessary for handling both changes in the low level constraints and evolutions in the high level requirements. In this paper, we address this problem by providing a model-based, rule-oriented approach that supports the adaptation process based on a run-time transformation of the system architecture. Such architecture may represent the different possible service compositions and the associated architectural configurations. We consider the multi-level models of the communicating system architecture and the intra-level architecture transformations as the elementary adaptation actions. We handle consistently the related inter-level adaptation actions by considering additional architectural relationships viewing the lower level architecture as a refinement of the upper level.We provide the algorithms characterizing the multi-level architecture-based adaptation process. We then develop a rule-oriented implementation using graph grammar and handling architectural transformations as graph transformation rules. We consider Emergency Response and Crisis Management Systems (ERCMS) as a case study from the more general group communication systems to which our results apply.

1 Introduction

Designing and implementing self-adaptive communicating systems is a complex task, which may be addressed via model-based design approaches associated with automated management techniques for dynamic architectural adaptability. In self-adaptable applications, components are created and connected, or removed and disconnected during the execution. The architectural changes respond to constraints of the communication and resources execution capacities variations. Providing solutions for distributed software systems supporting group communication requires managing dynamically evolving group membership and dynamically connecting deployment nodes.