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On the Stepwise and Disciplined Engineering of Adaptive Service-Oriented Applications

Otto-von-Guericke-Universität Magdeburg

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Abstract

Service technology geared by its SOA architecture and enabling Web-Services is rapidly gaining in maturity and acceptance. Consequently, most of world-wide (private and corporate) cross-organizations are embracing this paradigm by publishing, requesting and composing their businesses and inherent applications in the form of (web-)services. Nevertheless, to face harsh competitiveness, such service-oriented cross-organizational applications are increasing pressed to be highly composite, *adaptive*, *knowledge-intensive* and very reliable. In contrast to that, Web Services standards such as WSDL, BPEL, WS-CDL and many others offer just static, manual and purely process-centric knowledge-scarce ah-doc techniques to deploy such services. Furthermore, current research proposals to leverage such standards towards more correctness and adaptability are still in their infancy stages and do not thus scale up to realistic and wide adoption. Indeed, potential service-oriented applications such as E-commerce, E-Banking and E-health are required to be highly adaptive and dependable, while being mostly governed by volatile *rule-centric* knowledge.

The main aim of this thesis consists therefore in leveraging the development of service-oriented applications towards more reliability, dynamic adaptability and knowledge-intensiveness. After a throughout study and critical analysis of the current state-of-art, this thesis puts forwards an innovative stepwise and disciplined approach towards engineering and deploying dynamically adaptive rule-centric service-oriented applications. More specifically, the approach starts by intuitively eliciting structural service features through stereotyped service-based UML-class diagrams. For the behavioral service features, the approach proposes to govern any involved business activity through respective intensional event-driven business rules, we then leverage towards operational architectural ECA-driven rules. For the crucial conceptual phase, the approach puts forwards a tailored service-oriented Petri nets framework, we refer to as adaptive CSRV-NETS, that exhibits the following potential characteristics. First, the framework smoothly builds on the previous business-level phase, by soundly integrating behavioral event-driven business rules and stateful services, both at the type and instance level. Second, with its intrinsic true-concurrent semantics based on rewriting-logic, the framework provides formal validation through a tailored and compliant extension of the MAUDE language and its reflection capabilities. Third, the framework explicitly separates between orchestration for modelling rule-intensive single services and choreography for cooperating several services through their balanced governing interactive business rules. Fourth, by capitalizing on aspect-oriented potentials for separation of concerns and adaptability, the framework is smoothly shifted towards runtime adaptability, through a compliant aspectual-level. Such adaptability-level allows for dynamically shifting up and down any rule-centric behavior of the running CSRV-NETS-based service-components. Last but not least, towards bridging the gap to Web-Service technology, we developed an aspectual .Net framework that is fully compliant with the above approach founded phases.

Contents