Resilient Distributed Systems (RDS) are large-scale distributed systems that remain de-pendable despite their very dynamic, open-ended, and inherently unpredictable environ-ments. This combination of system and environment properties makes development of soft-ware architectures for RDS using contemporary architecture models and abstractions very challenging.
Therefore, the thesis proposes: (1) new architecture abstractions that are tailored for building dynamic software architectures for RDS, (2) design models and processes that endorse these abstractions at design time, and (3) means for efficient implementation, execu-tion, and analysis of architectures based on these abstractions.
Specifically, the thesis delivers (1) by introducing the DEECo component model, based on the concept of component ensembles. Contributing to (2), the thesis presents the Invari-ant Refinement Method, governing dependable, formally-grounded design of DEECo-based architectures, and the ARCAS method, focusing on dependable realization of open-ended dynamic component bindings typical for DEECo. Furthermore, it pursues (3) by presenting a formal operational semantics of DEECo and its mapping to Java in terms of an execution environment prototype – jDEECo. Additionally, the semantics is used as a basis for formal analysis via model checking. Finally, the thesis validates DEECo by presenting a dynamic architecture of an RDS ensuring adaptive task deployment in ad-hoc cloud systems.