Chapter 18
Semantic Modelling of Resource Dependability for SLA-Based Service Governance

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ABSTRACT

In this chapter we present a survey of research work related to the semantic modelling of security, semantic SLA modelling, and the current state of the art in SLA-based system governance. Based on this survey, and after observing the essential aspects needed to semantically model an SLA, we first propose a semantic model of resource dependability. This model can be used to semantically encode in SLA the service commitments (to customers) and resource capacity (from suppliers) in terms of usage, performance, and other QoS characteristics that represent non-functional properties. On the basis of this model, we propose a flexible approach to SLA-based system governance that allows for elastic provisioning of resources (by autonomic processes) that meet NFP requirements. This approach can be used to monitor and manage services such that they meet (and continue to meet) agreed levels of QoS.

INTRODUCTION

ICT systems today are increasingly composed of a set of resources that span multiple organisations; that is, they comprise a combination of in-house locally managed resources and 3rd party services that are often used under the terms of a contractual agreement. At one extreme, the system can be rapidly composed through ad hoc discovery and composition of services for short-term inter-enterprise collaboration on a specific project. At the other extreme, an organisation may use a value chain that comprises services provided by known suppliers through long-standing business

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relationships. In both cases (and all those that lie on the continuum in between), service providers today are conscious of the need to manage access to, use of, and performance of their own services, as well as the adequate provision of the resources (which are themselves services) that underpin them, in order to meet (and continue to meet) their individual business goals, even in the face of failure or underperformance of services. To do this requires service providers to describe the Non-Functional Properties (NFPs, especially dependability characteristics) of their services and to agree the Quality of Service (QoS) that consumers of the service can expect (as well as their associated obligations). This Chapter reviews the current state-of-the-art in terms of modelling NFPs and will show that capturing these in a structured fashion does not adequately address today's loosely coupled cross-organisational systems, in which the inter-dependencies, resources and threats to their NFPs (e.g. performance and availability) change dynamically. In this Chapter we present solutions to modelling resource dependability in a semantically tractable way through extending a base dependability metric ontology; encoding QoS commitments (as metric constraints) in bilateral Service Level Agreements (SLAs); monitoring QoS according to these SLAs to determine aggregate service commitments and resource capacity; and managing service behaviour through local service adaptation, as part of a governance framework that can be used to maintain end-to-end (system-level) properties and to balance trade-offs between competing dependability attributes.

CHAPTER STRUCTURE

This Chapter contains the following four parts:

1. An analysis of relevant background;
2. A proposed solution to semantic modelling of resource dependability;
3. A flexible approach to SLA-based system governance; and
4. A discussion of future directions.

In this Chapter, we present a survey of research work related to semantic modelling of security, semantic SLA modelling, and the current state of the art in SLA-based system governance. This Chapter provides an overview of existing approaches in two areas: (1) tools and approaches to model and analyse security, risk and vulnerabilities of IT landscapes and (2) SLA modelling, SLA negotiation and deployment. The former gives an understanding of the risk to which a provider of ICT services may be exposed, while the latter provides a means to model these and capture how the dynamics of the runtime system can indicate the presence of a threat and effectiveness of mitigation strategies.

The review is followed by a proposal for a semantic model of resource dependability. This approach aims to encode service commitments to customers and resource capacity in a semantic driven way.

On the basis of this model, we then propose a framework for elastic service provisioning that allows services to be deployed in such a way that they can be managed to meet the stated QoS requirements.

The Chapter concludes with a list of future research directions.

BACKGROUND

In a typical security modelling approach, a system is described as a collection of assets or resources, which typically include computers, networks and data. These have properties such as confidentiality, integrity and availability, which are important to the organisation operating the system. They also have vulnerabilities whereby these properties can be undermined.