Chapter 9

Federated IaaS Resource Brokerage

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ABSTRACT

This paper presents the CloudAnchor brokerage platform for the transaction of single provider as well as federated Infrastructure as a Service (IaaS) resources. The platform, which is a layered Multi-Agent System (MAS), provides multiple services, including (consumer or provider) business registration and deregistration, provider coalition creation and termination, provider lookup and invitation and negotiation services regarding brokerage, coalitions and resources. Providers, consumers and virtual providers, representing provider coalitions, are modelled by dedicated agents within the platform. The main goal of the platform is to negotiate and establish Service Level Agreements (SLA). In particular, the platform contemplates the establishment of brokerage SLA – bSLA – between the platform and each provider or consumer, coalition SLA – cSLA – between the members of a coalition of providers and resource SLA – rSLA – between a consumer and a provider. Federated resources are detained and negotiated by virtual providers on behalf of the corresponding coalitions of providers.

INTRODUCTION

The emergence of Cloud Computing as a new trend computing paradigm is attractive to business owners as it eliminates the requirement to plan ahead for provisioning and gives enterprises the flexibility to manage the contracted resources according to the current workload. The market for the cloud services, specifically the IaaS cloud computing market, is still maturing and brokers are emerging as the preferential middleware to match demand and offer between stakeholders. In particular, Small and Medium sized Enterprises (SME), which are typically in the early stages of adopting the cloud paradigm or provid-
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ing cloud services, require support services and platforms to increase their competitiveness. For SME providers, brokers offer additional business opportunities and simplify the management and integration of disparate cloud services – potentially across different providers – fostering the creation of provider coalitions; for SME consumers, brokers provide seamless provider lookup and invitation as well as SLA negotiation services, increasing the chances of meeting their resource requirements at the best price and in time. The ultimate goal of this research is to support the adoption and provision of IaaS by SME both as consumers and as providers.

This paper addresses the design and development of the CloudAnchor business-to-business (B2B) brokerage platform with provider discovery and invitation as well as negotiation, establishment and management of resource service level agreements regarding single provider and federated resources. This problem is by nature distributed, decentralised, dynamic and involves multiple stakeholders (consumer and provider businesses) continuously entering and leaving the system (open system). The stakeholders are, not only, loosely coupled, but, depending on the situation, can either compete (consumers and providers compete for getting and leasing resources) or cooperate (coalitions of providers). Furthermore, these businesses wish to retain autonomy, privacy and the control of their strategic knowledge, leading to the adoption of the agent-based paradigm.

The CloudAnchor brokerage platform implements an open event-driven multi-layered agent-based architecture. Businesses are represented by dedicated autonomous agents and are, thus, able to specify their self-models, by uploading their strategic knowledge (lookup, invitation, acceptance and negotiation strategies), resource offers (providers) or resource requests (consumers), as well as build peer models of their business partners based on the outcomes of their previous interactions (individual peer trust). The layered approach allows the distribution and delegation of the interface, agreement, enterprise (knowledge and processes) and negotiation related tasks to corresponding dedicated agents, representing each business by a set of task specialized agents rather than by a single agent to increase the overall responsiveness.

The platform provides multiple services, including (consumer or provider) business registration/deregistration, provider lookup and invitation, provider coalition creation/termination and agreement negotiation/termination. To support these functionalities, the platform contemplates the negotiation, establishment and termination of brokerage, coalition and resource agreements: (i) a brokerage SLA (bSLA) is a contract between the platform and a business (provider or consumer); (ii) a coalition SLA (cSLA) is a contract between a coalition of providers and the resulting virtual provider; and (iii) a resource SLA (rSLA) is a contract between a consumer and a provider (single or a virtual provider) regarding a given resource.

In terms of external events, there are business registration/deregistration, resource request/offer and SLA fulfilled/violated events. These events drive the execution of the business registration service, business deregistration service, resource provider lookup and invitation service, provider resource availability publication service and SLA termination service. In particular, whenever a consumer requests a new resource via its interface agent (resource request event), it triggers the resource finding process. The consumer enterprise agent automatically looks up and invites providers for negotiation. If the invited provider enterprise agents accept the invitation, dedicated delegate market agents are created by both consumer and provider enterprise agents to negotiate and establish the rSLA. If the providers were not able to provide single-handedly the resource, the platform attempts to create a virtual provider. Virtual providers are temporary coalitions of single providers established on the fly to provide federated resources, i.e., resources which were not offered by any single provider. When an rSLA terminates, the parties involved (consumer and provider) receive an agreement fulfilled or agreement violation event.