Chapter 13

Monitoring Services in a Federated Cloud: The RESERVOIR Experience

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ABSTRACT

This chapter presents the need, the requirements, and the design for a monitoring system that is suitable for supporting the operations and management of a Federated Cloud environment. The chapter discusses these issues within the context of the RESERVOIR Service Cloud computing project. It first presents the RESERVOIR architecture itself, then introduces the issues of service monitoring in a federated environment, together with the specific solutions that have been devised for RESERVOIR. It ends with a review of the authors’ experience in this area by showing a use-case application executing on RESERVOIR, which is responsible for the computational prediction of organic crystal structures.

INTRODUCTION

The emerging Cloud computing paradigm (Carr, 2008)(Wallis, 2008)(M. Armbrust et al., 2009) for hosting Internet-based services in virtualized environments, as exemplified by the Amazon Elastic Compute Cloud (EC2) or Google’s AppEngine, aims to facilitate the creation of innovative Internet scale services without worrying about the computational infrastructure needed to support them. At present, no single hosting company can create a seemingly infinite infrastructure capable of serving the increasing number of on-line services, each having massive amounts of users and

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access at all times, from all locations. To cater to the needs of service creators, it is inevitable that the Service Cloud is going to be composed of a federation of sites from various infrastructure providers. Only by partnering and federating with each other, can infrastructure providers take advantage of the diversity factor and achieve the economies of scale needed to provide a seemingly infinite compute utility.

Service Clouds are just the latest incarnation of a concept that has been around since the 1960’s, namely the manifestation of a general-purpose public computing utility. Throughout the history of computing we have seen such utilities appear in one form or another. Even though some success stories exist, such as in the area of high performance scientific computing, where Grid computing made significant progress over the past decade, none of these attempts materialized into a true general purpose compute utility that is accessible by anyone, at any time, from anywhere. Now however, the advent of new approaches utilizing an always-on Internet and virtualization, has brought about system designs which will enable the desired progress. An example of such a system design is the RESERVOIR Service Cloud, which is described in the next section.

RESERVOIR

The RESERVOIR FP7 project (Rochwerger et al, 2009)(Rochwerger et al, 2009b)(Rochwerger et al, 2011) aims to support the emergence of Service-Oriented Computing as a new computing paradigm and to investigate the fundamental aspects of Service Clouds as a fundamental element of the Future Internet.

RESERVOIR is a Service Cloud which has a new and unique approach to Service-Oriented Cloud computing. In the RESERVOIR model there is a clear separation between service providers and infrastructure providers. Service providers are the entities that understand the needs of particular business and create and offer service applications to address those needs. Service providers do not need to own the computational resources needed by these service applications, instead, they lease resources from an infrastructure provider.

The infrastructure provider owns and leases out sections of a computing cluster, which supplies the service provider with a finite pool of computational resources. The cluster is presented as a Service Cloud site which is capable of allocating resources to many service providers at the same time. Through federation agreements, multiple infrastructure providers can factor together all of their compute resources thus offering a seemingly infinite resource pool for their customers - the service providers.

The high-level objective of RESERVOIR is to significantly increase the effectiveness of the compute and service utility model thus enabling the deployment of complex services on a Service Cloud that spans infrastructure providers and even geographies, while ensuring QoS and security guarantees. In doing so, RESERVOIR provides a foundation where resources and services are transparently and flexibly provisioned and managed like utilities.

RESERVOIR ARCHITECTURE

The essence of the RESERVOIR Service Cloud is to effectively manage a service specified as a collection of virtual execution environments (VEEs). A VEE is an abstraction representing both virtual machines running on a generic hypervisor infrastructure, as well as any application component that can be run (and/or migrated) on a leased infrastructure (e.g., Web applications on Google’s App Engine, a Java based OSGi bundle). A Service Cloud, such as RESERVOIR, operates by acting as a platform for running virtualized applications in VEEs, which have been deployed on behalf of a service provider.