Chapter 39
Securely Communicating With an Optimal Cloud for Intelligently Enhancing a Cloud's Elasticity

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ABSTRACT

One of the principle features on which cloud environments operate is the scaling up and down of resources based on users' needs, called elasticity. This feature is limited to the cloud's physical resources. This article proposes to enhance the elasticity of a cloud in an intelligent manner by communicating with an optimal external cloud (EC) and borrowing additional resources from it when the cloud runs out of resources. This inter-cloud communication is secured by a model whose structure is similar to the Kerberos protocol. To choose the optimal EC for a particular request of a user, a list of parameters, collectively termed as RePVoCRaD, are enumerated. Once chosen, trust is established with the chosen EC and inter-cloud communication begins. While existing works deal with third parties to establish or secure inter-cloud communication, this work is novel in that there is absence of third parties in the entire process, thereby reducing security threats and additional costs involved. Evaluating this work based on turnaround time and transaction success rate, in a real-time cloud environment, it is seen that the cloud's elasticity is so enhanced that it successfully accommodates its users' additional demands by the fastest means possible.

1. INTRODUCTION

Cloud computing, a fast-growing technology, allows the cloud users to enjoy all the computing components as a service on-demand, instantly and dynamically. Cloud providers attract users by creating an illusion of availability of unlimited resources at one's disposal using a feature called *Elasticity*. This is

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carried out by instant on-demand provision (scaling up) and withdrawal (scaling down) of resources. Thus, elasticity is agile and also ensures low operating cost (Armbrust et al., 2010; Dustin oWens, 2010; Varia, 2011). However, it works within the available resources of a cloud. If the demand of cloud users exceeds this limit, then the cloud will be unable to satisfy the user's needs (Chiu, 2010). Such a situation calls for interoperating with other clouds (Rochwerger et al., 2011).

Interoperability is the ability of one cloud to use another cloud, which is ready to accept a transaction with the requesting cloud thus presenting to the user an increased volume of resources (Bernstein & Vij, 2011; Grozev & Buyya, 2014). In our work, the requesting cloud is considered to be a private cloud of an organization and is termed as internal private cloud (IPC). On the other hand, the cloud (private, public or hybrid) which is ready to accept the transaction with the IPC is considered as external cloud (EC).

Within the IPC, elasticity is provided by effectively distributing its resources among its users using any of the following: Self Adaptive Particle Swarm Optimization (SAPSO) algorithm (Jeyarani, Nagaveni, & Vasanth Ram, 2011), Queue Based Q-Learning algorithm (Meera & Swamynathan, 2015) or live migration of resources allocated to the users (Kirthica & Sridhar, 2015a). In our work, the scope of elasticity is intelligently enhanced further by borrowing resources from an EC. The EC is considered *optimal* when it satisfies a particular request of a user in terms of resources in a prompt manner. Such an optimal EC is identified using a set of parameters collectively termed as *RePVoCRaD*. The EC so identified may be open to different types of users including individuals, professionals, organizations and malicious users. Hence, interoperating with such an EC causes an indirect security threat. Therefore, in order to securely interoperate with the EC, we have proposed a modified version of the Trusted Federation model (Bernstein & Vij, 2011). An additional level of security is also provided to prevent intentional or unintentional usage of the obtained resource by other users of the EC (Kirthica & Sridhar, 2015b).

This solution to achieve a secure inter-cloud communication for enhancing elasticity is novel with the following highlights:

1. Communication is not with a random EC but with the optimal EC at the time a user's request is raised.
2. Resource is provided from multiple clouds (IPC and ECs) to accommodate demand of a single user.
3. There is no use of third parties or external components throughout the process.

Third parties or external components with their inherent security related weaknesses such as getting corrupted, being imitated and being eavesdropped, result in an increased area for compromise. Furthermore, additional costs are incurred to purchase, hire, setup and maintain these components. In our work, as there are no third parties involved these security threats and additional costs are avoided. Moreover, the intricate process of identifying the optimal EC, establishing inter-cloud communication and providing security does not involve the user, thereby providing convenience to him.

The rest of the paper is organized as follows. Section 2 briefs the existing works in cloud interoperation. Section 3 deals with the flow of activities involved in extending elasticity by communicating with ECs. The detailed design of the proposed work is discussed in Sections 4, 5 and 6. The implementation and evaluation details of our work are provided in Section 7. Section 8 concludes the paper by giving the overall contribution of our work and possible future works in the area.

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