ABSTRACT

How to manage cloud services efficiently is difficult for large scale of services with frequently changing Quality of Service (QoS) in cloud computing environment. A multiple-dimension publish/subscribe (pub/sub) and JXTA based cloud service management mechanism, consists of registry overlay, service publisher and subscriber, is proposed to manage cloud services with active QoS refreshing and fast subscribe capability. The registry overlay with multiple managers cooperating on JXTA, can manage large scale services discovery. The service model with QoS describes a formal model for pub/sub based service management, and a fast subscribing algorithm with filter matrix and multi-dimension index is proposed. The filter matrix helps to reduce candidate services and the multi-dimension index is used to find satisfied services fast. Based on pub/sub and JXTA, the cloud management system is realized. The experiments show that the proposed cloud service management mechanism has good publication and subscribing performance, and is faster than traditional methods for large scale cloud services.

KEYWORDS

Cloud Service, JXTA, Multi Dimension, Publish/Subscribe, QoS, Service Management

INTRODUCTION

In cloud computing, resources including storage, computation and software are provided as services over the Internet, and then various cloud business models can be described by terminology of “X as a service (XaaS)” where X could be infrastructure, platform, and software (Michael et al., 2010, Murugaiyan et al., 2014). Cloud computing is designed based on the Service-Oriented Architecture (SOA), a loosely coupled software development mechanism, where Web services have become a main stream interface for cloud computing to provide cross-platform and transparent services (Ferrer et al., 2012).

SOA consists of service provider, service registry, and service consumer, and SOA involves three basic operations: service publication, discovery, and binding (Mandal et al., 2014, Papazoglou et al., 2008). The Universal Description, Discovery and Integration (UDDI) is a traditional web service management mechanism, and current infrastructures of registries require replication of all web service publications in all Universal Business Registries or a JUDDI server (Sivashanmugam et al., 2004; Apache et al., 2015). The traditional service registry like UDDI is limited and should be improved (Lin...
et.al, 2012). Especially, the single point accessing problem of UDDI would contribute to slow service registration and discovery for the ever increasing amount of web services in the cloud environment.

Quality of Service (QoS) is an important criterion in service discovery, but QoS is not stored in the traditional UDDI. In the cloud environment, it is common that many web services provide the same function, but have different QoS metrics for different consumers. The web services discovery with selection algorithms tries to find the candidate web services with optimal QoS (Zheng et.al, 2014). Thus, the traditional UDDI system cannot meet the requirement for cloud service considering QoS.

The publish/subscribe (pub/sub) paradigm is a flexible many-to-many communication model with features as loosely coupling, anonymity, and scalability (Ma et.al, 2014; Jayaram et.al, 2011). Topic-based pub/sub enables information consumers to register to a set of predefined topics. It is helpful to import pub/sub paradigm into cloud service management, and the pub/sub mechanism can be used to improve the active notification capabilities when the web services state changes, i.e. iff the web services QoS is changed, the corresponding consumers are notified promptly.

The matchmaking technique is a key technology for the pub/sub mechanism and the cloud service discovery. For pub/sub, the matchmaking technique is of great importance to improve the matching speed of describers, and then different techniques have been employed to improve matching efficiencies in recent years (Li et.al, 2005; Jayaram et.al, 2011; Carzaniga et.al, 2003; Tao et.al, 2006; Zhao et.al, 2011; Qin et.al 2014). Reducing matching subscription spaces and constructing index structures are two main methods to improve matching efficiencies (Li et.al, 2005; Jayaram et.al, 2011). SIENA (Carzaniga et.al, 2003), HYBRID (Tao et.al, 2006), TAMA (Zhao et.al, 2011), REIN (Qin et.al 2014) are representative index structure matching methods. All above matching methods can be referred but they cannot be used in the cloud service management with multiple QoSes directly. So a new pub/sub service model with QoS is demanded before importing pub/sub into cloud service management.

In order to construct an active mechanism to support scalable service registration and discovery, we proposed a pub/sub and JATA based cloud service management method with QoS. The cloud service management system consists of registry overlay, publisher, and subscriber. The registry overlay is organized by multiple management peers using JXTA network, all the web services with QoS values are stored in the registry overlay, and each manager is also a pub/sub rendezvous. The service model with QoS describes the matching rules for pub/sub in the cloud service management formally. A fast subscribe algorithm with the filter matrix and multi-dimension index is proposed to fasten matching. In the experiments, some real services with QoS are input to test the performances of cloud service publication, subscribing and discovery.

The rest of this paper is organized as follows. Next, we present the pub/sub based cloud service management system and the service model with QoS. We then implement a fast service subscribing method with the filter matrix and multi-dimension index and evaluate the performance.

**CLOUD SERVICE MANAGEMENT ARCHITECTURE**

Web service is a main interface form in the cloud environment, especially in SaaS, so mass cloud services exist. A lot of cloud services have to be integrated appropriately to be found, to be used by other web services, and then be composed into a new cloud service. Combing pub/sub into the web service management can realize an active mechanism to recognize and do the reaction to the consistent changing services station.

Pub/sub architecture has publishers and subscribers, whereas, service provider, consumer, and registry are three main entities of SOA. In our pub/sub based cloud service management system, shown in Figure 1, the service publisher, who can publish the cloud service to the registry overlay independently, is not the same as the service provider, while the subscriber is similar to the consumer in SOA.

The registry overlay, where all service manager nodes cooperate with each other by P2P network, is a web services registry centre having QoS. In our cloud service management system, the P2P
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