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An Integrated Resource and Reputation Management Platform for Collaborative Cloud Computing

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Abstract

The collaborative cloud computing (CCC) which is collaboratively supported by various organizations (Google AppEngine, Amazon's EC2, IBM's Blue-Cloud, Microsoft's Azure) offers a promising future for distributed cloud resources. Trust and security have prevented businesses from fully accepting cloud platforms. To provide trustworthiness between clouds, providers must first secure virtualized data center resources, sustain user privacy, and preserve data integrity. This paper suggests using a trust-overlay network over multiple data centers to implement an integrated resource and reputation management system for establishing trust between service providers and data owners. Therefore, we propose a platform called Harmony which incorporates key technological innovations by enhancing the efficiency and effectiveness of resource and reputation management to meet user's diverse Qos demands.

Keywords: Collaborative Cloud Computing, Reputation Management, Resource Management

1. Introduction

Cloud computing has increasingly becoming a popular computing standard, in which cloud providers offers a flexible resources over the internet. Many cloud providers such as Google App Engine, Amazon's EC2, IBM's Blue-Cloud, and Microsoft's Azure provide services which offers storage and computing. Cloud providers provide the cloud services to cloud customers. Cloud customers are charged by the actual usage of computing resources.

Cloud is a type of parallel and distributed system which consists of a collection of interconnected computers. These computers are dynamically provisioned and presented as one or more unified computing resources which are established through negotiation between the service provider and consumers. The resources can be allocated dynamically based on the requirements of the user. The cloud customers may access applications and data of the Cloud from anywhere at any time, it is difficult for the cloud providers to allocate the cloud resources dynamically and efficiently. The demand for scalable resources has been increasing very rapidly. Especially during a peak time, a single cloud may not be able to provide sufficient resources for an application. Also, researchers may need to set up a virtual lab environment connecting several clouds for fully utilizing idle resources. Today, organizations are considering cloud services for a range of technology applications – from computing, email, storage. Cloud services have emerged as a viable option for IT organizations to reduce complexity in their environments and ensure Quality of Service (QoS) while reducing the burden on their infrastructure and resources.

They can help IT departments more rapidly scale their resources while retaining the flexibility to adapt to changing business requirements. Cloud services can provide "elasticity" by enabling organizations to put the right amount of resources in the right place at the right time. Cloud collaboration services can help organizations become more nimble, reduce operating costs, collaborate more efficiently internally and across global borders

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and regions, significantly improve worker productivity, and better allocate their internal resources, among other important benefits. Thus, enhancements in cloud computing are absolutely leading to a promising future for Collaborative Cloud Computing (CCC), where globally distributed cloud resources belonging to different organizations are collectively pooled and used in a cooperative manner to provide services.

2. Collaborative Cloud Computing

A CCC platform interconnects physical resources for efficient resource sharing between clouds, and provides a virtual view of a large amount of resources to customers. This virtual organization is transparent to cloud customers. When a cloud does not provide the sufficient resources demanded by its customers, it requests for the usage of resources in other clouds. Cloud collaboration allows clients and cloud applications to simultaneously use resources multiple clouds. This system supports universal and dynamic collaboration in a multi-cloud environment. It lets clients simultaneously use resources from multiple clouds (Figure 1).

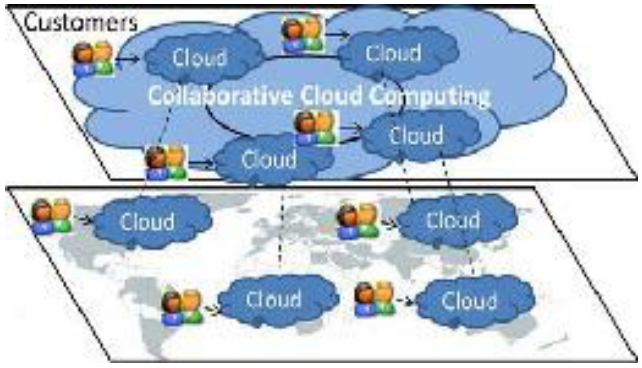

Figure 1. An example of collaboration cloud computing.

CCC operates in a large-scale environment involving thousands or millions of resources across different geographically distributed areas, and it is also dynamic as entities may enter or leave the system and resource utilization and availability are continuously changing. This environment makes efficient resource location and resource utilization, a non-trivial task called as resource management (resMgt). Further, due to the individual characteristics of entities in CCC, different nodes provide different QoS in resource provision. A node may provide low QoS because of system problems (e.g., machines break down due to insufficient cooling) or because it is not willing to provide high QoS in order to save costs. Also, nodes may be attacked by viruses and Trojan horse programs. This weakness is revealed in all the cloud platforms built by Google, IBM, and Amazon and security has been recognized as an important factor in grids. Thus, resMgt needs reputation management (repMgt) to measure resource provision QoS for guiding resource provider selection.

3. Preliminary Study

Cloud resource orchestration such as resource provision, configuration, utilization and decommission across a distributed set of physical resources in cloud has been studied in recent years. In previous methods, the resMgt and repMgt have typically been addressed separately. However, simply building and combining individual resMgt and repMgt systems in CCC will produce doubled, high overhead. Most previous resMgt and repMgt approaches are not sufficiently efficient or effective in the large-scale and dynamic environment of CCC.

4. Resource Management

In Previous approaches, resMgt assumes only a single QoS demand of users, such as efficiency or security. From a available number of resource providers, the resMgt approach would choose the one with the highest available resource which is considered the Qos based on efficiency, while the repMgt approach would choose the one with the highest reputation which is considered the Qos based on security. The resMgt approach is efficiency-oriented where as the repMgt approach is security- oriented. The former may lead to a low service success rate while the latter may overload the node with many resource requests.

5. Reputation Management

In Previous methods, repMgt systems neglect resource heterogeneity by assigning each node one reputation value for providing all of its resources. We claim that node reputation is multi-faceted and should be differentiated across multiple resources (e.g., CPU, bandwidth, and memory). For example, a person trusts a doctor for giving advice on issues related to medical but not related to financial issues. Similarly, a node can perform well for

computing services does not necessarily perform well for storage services. Thus, previous repMgt systems are not effective enough to provide correct guidance for trustworthy individual resource selection.

To ensure the successful deployment of CCC, the issues of resMgt and repMgt must be jointly addressed for both efficient and trustworthy resource sharing in three tasks:

1. Efficiently locating required trustworthy resources,
2. Choosing resources from the located options, and
3. Fully utilizing the resources in the system while avoiding overloading any node.

6. Proposed Work

By identifying and understanding the interdependencies between resMgt and repMgt, we introduce Harmony, a CCC platform with harmoniously integrated resMgt and repMgt. It can achieve enhanced and joint management of resources and reputation across distributed resources in CCC. Different from the previous resMgt and repMgt methods, Harmony enables a node to locate its desired resources and also find the reputation of the located resources, so that a client can choose resource providers not only by resource availability but also by the provider's reputation of providing the resource. In addition, Harmony can deal with the challenges of large scale and dynamism in the complex environment of CCC.

The following are the three components of Harmony needed in each stage of resource marketing: location, selection and transaction.

1. Integrated multi-faceted resource/reputation management,
2. Multi-QoS-oriented resource selection, and
3. Price-assisted resource/reputation control.

7. Overview of Harmony

Assume that resource types (e.g., CPU, bandwidth and memory) are globally defined and known by every node. The resource information (denoted by Ir) includes the resource provider's IP address, resource type, available amount, resource physical location, price, etc. A general distributed method for resource location is to store resource availability information in some directory nodes, and forward the requests for a particular resource to the corresponding directory nodes. Similarly, a general distributed method for repMgt is to store reputation information of nodes in some directory nodes, and forward the requests to the corresponding directory nodes. The techniques for accurate reputation calculation can be directly adopted by this work. For multi-faceted resource/reputation management, Ir should be differentiated based on resource type, the reputation of a node should be differentiated based on the QoS of providing different types of resources (denoted by Rr), and a node's Ir and Rr should be stored in the same directory node. This enables a requester to find its requested resources along with the reputations of resource providers in providing the requested resources, which are used for selecting resource providers.

To achieve this goal, as shown in the upper layer in Figure 2 Harmony pools all the resource information of each resource type into a cluster. It also distinguishes the reputation feedbacks for a resource provider by resource types, and stores the feedback into the corresponding resource cluster.

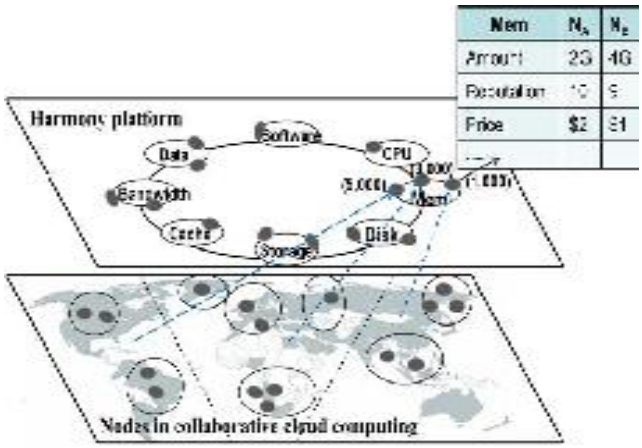

Figure 2. The harmony platform.

Within each cluster, Harmony further groups the resource information of physically close nodes into one node in order to enable requesters to find physically close resources. Hence all resource information Ir of each resource type in the system is stored in a cluster, to search for one resource, a directory node only needs to probe nodes in its cluster rather than executing system-wide probing. Pooling together the information of the same resource into a smaller cluster of physically close nodes reduces the probing latency and cost, thus improving resource discovery efficiency.

8. Conclusion

In this paper, we propose an integrated resource/reputation management platform, called Harmony, for collaborative cloud computing. The integrated resource/ reputation management component efficiently and effectively collects and provides information about available resources and reputations of providers for providing the types of resources. The multi-QoS-oriented resource selection component helps requesters choose resource providers that offer the highest QoS measured by the requesters' priority consideration of multiple QoS attributes. The price-assisted resource/reputation control component provides incentives for nodes to offer high QoS in providing resources. The experimental results also show that Harmony achieves high scalability, balanced load distribution, locality-awareness, and dynamism-resilience in the large-scale and dynamic CCC environment.

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