A Review of Cloud Computing Open Architecture and Its Security Issues

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Abstract— Cloud computing is beginning from the development of parallel computing, distributed computing, shared computing and grid computing. For the sharing resources that contains software, applications, infrastructures and business processes, cloud computing is the main key. Cloud computing has brought new tremendous changes and good opportunities to information technology industry. Cloud computing is a fast growing information technology, has aroused the concern of the whole world. This is a favorable situation to study and application of cloud computing related technologies. However, most existing Cloud Computing platforms have not formally adopted the service-oriented architecture (SOA) that would make them more flexible, extensible, and reusable. By bridging the power of SOA and virtualization in the context of Cloud Computing ecosystem, this paper presents seven architectural principles and also introduces the existing issues in cloud computing. Proposition of solution for these issues has been provided also.

Index Terms— Cloud computing, CCOA, SOA, OSI Model, Security, Virtualization, Encryption,

1 INTRODUCTION

CLOUD is a virtualized pool of computing resources. It can:

•Manage a variety of different workloads, including the batch of back-end operations and user-oriented interactive applications.

• Rapidly deploy and increase workload by speedy providing physical machines or virtual machines.

• Support for redundancy, self-healing and highly scalable programming model, so that workload can be recover from a variety of inevitable hardware/software failure.

• Real-time monitor resources usage, rebalance the allocation of resources when needed [1].

Cloud Computing provides environments to enable resource sharing in terms of scalable infrastructures, middleware and application development platforms, and value-added business applications. The operation models may include pay-as-go utility models, free infrastructure services with value added platform services, fee-based infrastructure services with value-added application services, or free services for vendors but sharing of revenues generated from consumers.

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Typically there are four types of resources that can be provisioned and consumed over the Internet [4].

a. Infrastructure resources, which include computing power, storage, and machine provisioning.
b. Software resources including middleware and development resources.
c. Application resources.
d. Business process resources.

This paper is organized as follows. The first part of Section 2 discusses the two key enabling technologies, Virtualization and SOA, for articulating the value of creating an open architecture for Cloud Computing. The rest of Section 2 presents a Cloud Computing Open Architecture (CCOA) and its seven principles for building extensible and flexible Cloud Computing systems and applications. The rest of the sections discusses about existing issues in cloud computing and its solutions.

2 OPEN ARCHITECTURE OF CLOUD COMPUTING

Currently, there is no standard definition or specification for Cloud Computing. It may take some time to define the key characteristics of Cloud Computing based on practices in the field. There are following two key enabling technologies could play very important roles in this revolutionary phase:

a. Virtualization technology
b. Service-Oriented Architecture (SOA).

The virtualization technology handles how images of the operating systems, middleware, and applications are pro-created and allocated to the right physical machines or a slice of a server stack. The SOA is the evolution of a system or software architecture for addressing componentization, reusability, extensibility, and flexibility.

3 SEVEN PRINCIPLES OF CLOUD COMPUTING ARCHITECTURE

In this Cloud Computing Open Architecture, we propose an integrated co-innovation and co-production framework to get cloud vendors, cloud partners, and cloud clients to work together based on seven principles. The presented Cloud Computing Open Architecture covers cloud ecosystem

enablement, cloud infrastructure and its management, service-orientation, cloud core on provisioning and subscription, compostable cloud offerings, cloud information architecture and management, and cloud quality analytics. This is a logical and modularized separation, which helps isolate concerns of details of each module during the design process. Since the connections between the identified key architectural principles for Cloud Computing are quite complex, the information exchanges are going through the Cloud Information Architecture and Cloud Ecosystem Management. In the rest of the section, we will introduce the details of each principle [6].

PRINCIPLE 1: INTEGRATED ECOSYSTEM MANAGEMENT FOR CLOUD

Architecture must support the management of the ecosystem of Cloud Computing. This ecosystem includes all involved services and solutions vendors, partners, and end users to provide or consumer shared resources in the Cloud Computing environment. The Cloud Computing ecosystem management layer (1A) provides an integrated on-boarding process and common utilities to hosting environment are used to support the frontend's operations. support the seamless collaboration and message exchanges among cloud vendors, partners, and clients. For example, the onboard progress covers the registration of business entities and users. The business entities include cloud vendors, cloud partners, and enterprise cloud clients. The user entities are end users within a certain business entity (e.g. an employee of a company, or a member of a registered community like a social network), or consumer users in the open Internet space [5] [6].

PRINCIPLE 2: VIRTUALIZATION FOR CLOUD INFRASTRUCTURE

There are two basic approaches for enabling virtualization in the Cloud Computing environment.

a. Hardware virtualization that is to manage hardware equipment in plug-and-play mode.
b. Software virtualization, i.e., to use software image management or software code virtualization technology to enable software sharing.

It is noted that this virtualization principle in the Cloud Computing Open Architecture is an extension of the operational system layer in the SOA Solution Stack (also known as SOA Reference Architecture) in the context of Cloud Computing enablement [6].

PRINCIPLE 3: SERVICE-ORIENTATION FOR COMMON

Service-orientation is another driving force to enable Cloud Computing to further realize the business value from asset reusability, composite applications, and mashup services. There are two major types of common reusable services: Cloud Horizontal and Vertical Business Services.

The Cloud Horizontal Business Services consist of various platform services that hide the complexities of middleware, database, and tools.

The Cloud Vertical Business Services include all domain specific or industry-specific utility services [6].

PRINCIPLE 4: EXTENSIBLE PROVISIONING AND SUBSCRIPTION FOR CLOUD

Extensible service provisioning is the unique feature of a Cloud Computing system. Without extensibility, the provisioning part of the Cloud Computing architecture can only support a certain type of resource sharing. This implies that the service provisioning architecture for free use users and paying users are the same. Both types of users can be service providers or consumers from time to time. From service consumers' perspective, they are interested in how to easily access services based on their own business logics and goals [6].

PRINCIPLE 5: CONFIGURABLE ENABLEMENT FOR CLOUD OFFERINGS

Cloud offerings are the final products or services that are provisioned by the Cloud Computing platform. Since all cloud offerings should address certain business goals, cloud offerings are also known as cloud business solutions. Example of cloud offerings is storage cloud and infrastructure cloud. Most cloud offerings are delivered or accessed through Web browsers [6].

PRINCIPLE 6: UNIFIED INFORMATION REPRESENTATION AND EXCHANGE FRAMEWORK

Information representation and message exchange of Cloud Computing resources are very important to enable the collaborative and effective features of Cloud Computing. In CCOA, Cloud Computing resources include all business entities (e.g. cloud clients, partners, and vendors) and the supporting resources such as virtualization related modules, service-orientation related modules, cloud core, and cloud offerings. Just like blood in human bodies, the cloud information architecture uses its information "blood" to form "blood stream" to get all various modules to communicate with each other in an effective way in CCOA [6].

PRINCIPLE 7: CLOUD QUALITY AND GOVERNANCE

The last and most important module in CCOA is the Cloud Quality and Governance. This Section is responsible for the identification and definition of quality indicators for Cloud Computing environment and a set of normative guidance to govern the design, deployment, operation, and management of the cloud offerings. From quality indicators' perspective, Quality of Services (QoS) parameters can be directly used to define cloud entities' reliability, response time, security, and integrity. The integrity can be checked through traceability enablement and compliance validation. Security is a very important aspect of the cloud quality [6].

4 CLOUD COMPUTING ISSUES

In the last few years, cloud computing has grown from being a promising business concept to one of the fastest growing segments of the IT industry. But as more and more information

on individuals and companies is placed in the cloud, concerns are beginning to grow about just how safe an environment it is. These are the following concerning issues for the cloud computing [2] [3].

a. Security
b. Privacy
c. Reliability
d. Legal Issues
e. Open standard
f. Compliance
g. Freedom
h. Long-term Viability

5 Solution for existing issues

To advance cloud computing, the community must take proactive measures to ensure security. The solutions for the existing issues are the following [7].

a. Data encryption.
   Before storing it at virtual location, encrypt the data with your own keys and make sure that a vendor is ready for security certifications and external audits.
b. Identity management.
c. Access control.
d. Reporting of security incidents, personnel and physical layer management should be evaluated.
e. You should minimize personal information sent to and stored in the cloud.
f. CSP should maximize the user control and provide feedback.
g. Organizations need to run applications and data transfer in their own private cloud and then transmute it into public cloud.
h. There are many legal issues exist in the cloud computing, Cloud Security Alliance should design relevant standards as quickly as possible.

6 Related Work and Discussions

The purpose of the proposed approach is to bring the power of SOA and virtualization together to help realize and explore business value of Cloud Computing. We would like to encourage the research community to work together to refine CCOA and focus on the theoretical analysis of CCOA to build solid foundations for Cloud Computing. As for future research topics, we will work on the detailed architectural building blocks and interaction patterns for all ten modules defined in CCOA, as well as standard service interfaces (or APIs) between solution-oriented architectural building blocks and their hosting Cloud Computing infrastructure. Through these interfaces, the hosting infrastructure and value-added cloud services or offerings cooperatively determine proper resource provisioning and management action [6].

7 Conclusions

In this paper, we have proposed the Cloud Computing Open Architecture (CCOA) based on seven architectural principles by integrating the power of service-oriented architecture (SOA) and virtualization technology of hardware and software. We discuss a fresh technology: cloud computing. Describe its definition and some existing issues. There is no doubt that the cloud computing is the development trend in the future. Cloud computing brings us the approximately infinite computing capability, good scalability, service on-demand and so on, also challenges at security, privacy, legal issues and so on. To welcome the coming cloud computing era, solving the existing issues becomes utmost importunity!

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