Analysis of Interoperability and Standards for Cloud Computing

Dr. Sunita Varma
Computer Technology and Application Department
Shri GS Institute of Technology & Science Indore

Yunus Khan
Computer Engineering Department
Jawaharlal Institute of Technology Borawan Khargone

Abstract : Cloud interoperability will enable cloud infrastructures to evolve into a worldwide, transparent platform in which applications aren't restricted to enterprise clouds and cloud service providers. We must build new standards and interfaces that will enable enhanced portability and flexibility of virtualized applications. Cloud computing in computer science in recent times is considered as one of the emerging areas. This flexible infrastructure is providing excellent facilities for business entrepreneurs. Cloud computing offers the IT industry, however, has yet to be satisfactory research and development in this area. Our contribution in this paper focuses on the concept of cloud computing is one of the most advanced new technology for computer world. In this paper we analyze what are the different standards for cloud infrastructure and also study how interoperability is important factor in cloud environment. Cloud interoperability refers to customers' ability to use the same artifacts, such as management tools, virtual server images, and so on, with a variety of cloud computing providers and platforms.

Keywords: Cloud Standards, Interoperability, Data Center, Virtualization.

I. INTRODUCTION

Due to the unprecedented success of internet in last few years, computing resources is now more ubiquitously available. It enabled the realization of a new computing concept called Cloud Computing. Infrastructure and service are two different kinds of service provided in cloud computing. Infrastructure providers manage cloud platforms and lease resources according to usage. Service providers rent resources from infrastructure providers to serve the end users. Cloud computing has begun to emerge as a hotspot in both industry and academiacs. It represents a new business model and computing paradigm, which enables on demand provisioning of computational and storage resources. Economic benefits consist of the main drive for cloud computing due to the fact that cloud computing offers an effective way to reduce capital expenditure.

Cloud computing has the following main characteristics

- Multi-tenancy – IT resources are shared between different users and customers
- Rented service delivery model – customers pay for the service instead of buying software licences and hardware
- On-demand usage/flexibility – cloud services can be used almost instantly and can easily be scaled up and down
- External data storage – a customers' data is usually stored externally at the location of the cloud computing vendor.

Cloud computing provides three main service models as shown in fig. 1

1. **Software as a Service (SaaS) –** The cloud provider provides the cloud consumer with the capability to deploy an application on a cloud infrastructure [1].
2. **Platform as a Service (SaaS) –** The cloud provider provides the cloud consumer with the capability to develop and deploy applications on a cloud infrastructure using tools, runtimes, and services supported by the CSP [1].

3. **Infrastructure as a Service (SaaS)** – The cloud provider provides the cloud consumer with essentially a virtual machine. The cloud consumer has the ability of processing, storage, networks, etc. It deployes and run arbitrary software supported by the operating system run by the virtual machine [1].

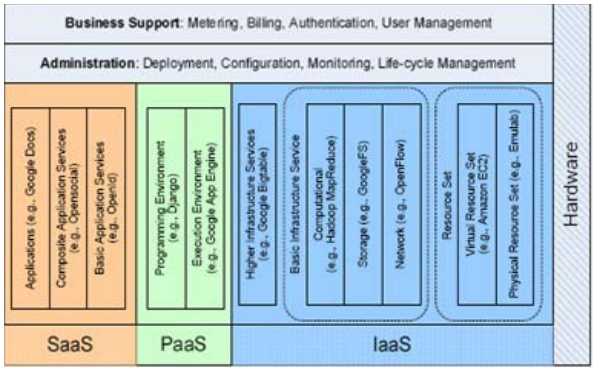

Fig. 1 Cloud Computing Services

II. SUPPORTING TECHNIQUES

Cloud computing has leveraged a collection of existing techniques, such as Data Center Networking (DCN), Virtualization, distributed storage, MapReduce, web applications and services, etc.

Modern data center has been practically employed as an effective carrier of cloud environments. It provides massive computation and storage capability by composing thousands of machines with DCN techniques.

Virtualization technology has been widely used in cloud computing to provide dynamic resource allocation and service provisioning, especially in IaaS. With virtualization, multiple OSs can co-reside on the same physical machine without interfering each other.

MapReduce [2] is a programming framework that supports distributed computing on mass data sets. This breaks large data sets down into small blocks that are distributed to cloud servers for parallel computing. MapReduce speeds up the batch processing on massive data, which makes this model to be preference of computation model for cloud venders.

Apart from the benefits, the former techniques also present new threats that have the capability to jeopardize cloud security. For instance, modern data center suffers bandwidth under-provisioning problems [3], which may be exploited and may consequently perform a new DOS attack [4] due to the shared infrastructure in cloud environments. Virtual Machine (VM) technique also has the capability to enable adversaries to perform cross-VM attacks and timing attacks due to VM co-residence.

III STANDARDS OF CLOUD COMPUTING SERVICE DELIVERY

Delivery model is not primarily one of fundamental protocol architecture. Cloud-based email still uses SMTP, cloud-based resource location still uses the DNS, and so on. Most aspects of the computing infrastructure needn't be changed for cloud computing, so why is there such a clamor for cloud computing standards?

Two words — nervous users. Organizations contemplating a move toward cloud computing are understandably wary of becoming overly dependent on the wrong technology or provider. The Internet's success has made many people aware of standards' role in keeping infrastructure from becoming captive to a single vendor. Vendors understand these concerns well and are quick to address potential customers' fears about vendor lock-in by playing the standards card. Standards, they tell prospective customers, will guarantee that those customers won't regret the move to cloud computing even if they become unhappy with their vendor.

IV. WORLD-CLASS SECURITY

1. Provision of world-class security at every level.

Security is more than just user privileges and password policies. It's a multidimensional business imperative, especially for platforms that are responsible for customer data. Cloud-computing platforms must have detailed, robust policies and procedures in place to guarantee the highest possible levels of

- Physical security
- Network security
- Application security
- Internal systems security
- Secure data-backup strategy
- Secure internal policies and procedures
- Third-party certification

2. Trust and Transparency

Provide transparent, real-time, accurate service performance and availability of information.

Cloud-computing platforms should provide customers with detailed information about service delivery and performance in real time, including:

- Accurate, timely, and detailed information about service performance data and planned maintenance activities
- Daily data on service availability and transaction performance
- Proactive communications

3. True Multitenancy

Deliver maximum scalability and performance to customers with a true multitenant architecture.

Leading Web applications—including Google, eBay, and Salesforce CRM—run on a single code base and infrastructure shared by all users. A multitenant architecture allows for high scalability and faster innovation at a lower cost. Single-tenant systems, on the other hand, are not designed for large-scale cloud-computing success. The internal inefficiencies of maintaining a separate physical infrastructure and/or separate code lines for each customer make it impossible to deliver quality service or innovate quickly. Multitenancy provides customers with the following benefits:

- Efficient service delivery, with a low maintenance and upgrade burden
- Consistent performance and reliability based on an efficient, large-scale architecture
- Rapid product release cycles.
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4. Proven Scale

Support millions of users with proven scalability. With any cloud-computing service, customers benefit from the scale of the platform. A larger scale means a larger customer community, which can deliver more and higher-quality feedback to drive future platform innovation. A larger customer community also provides rich opportunities for collaboration between customers, creating communities that can share interests and foster best practices. Cloud-computing platforms must have

- Proof of the ability to scale to hundreds of thousands of subscribers
- Resources to guarantee the highest standards of service quality, performance, and security to every customer
- The ability to grow systems and infrastructure to meet changing demands
- Support that responds quickly and accurately to every customer
- Proven performance and reliability as customer numbers grow.

5. High Performance

Deliver consistent, high-speed performance globally. Cloud-computing platforms must deliver consistent, high-speed systems performance worldwide and provide detailed historical statistics to back up performance claims, including

- Average page response times
- Average number of transactions per day.

6. Complete Disaster Recovery

Protect customer data by running the service on multiple, geographically dispersed data centers with extensive backup, data archive, and failover capabilities.

Platforms providing cloud-computing services must be flexible enough to account for every potential disaster. A complete disaster recovery plan includes

- Data backup procedures that create multiple backup copies of customers' data, in real time, at the disk level
- A multilevel backup strategy that includes disk-to-disk-to-tape data backup in which tape backups serve as a secondary level of backup, not as the primary disaster-recovery data source. This disk-oriented model ensures maximum recovery speed with a minimum potential for data loss in the event of a disaster.

7. High Availability

Equip world-class facilities with proven high availability infrastructure and application software. Any platform offering cloud-computing applications need to be able to deliver very high availability. Requirements for proving high availability include

- Facilities with reliable power, cooling, and network infrastructure
- High-availability infrastructure: networking, server infrastructure, and software
- N+1 redundancy
- Detailed historical availability data on the entire service, not just on individual servers.

V. Cloud Interoperability

Cloud interoperability refers to customers' ability to use the same artifacts, such as management tools, virtual server images, and so on, with a variety of cloud computing providers and platforms.

Cloud interoperability will enable cloud infrastructures to evolve into a worldwide, transparent platform in which applications aren't restricted to enterprise clouds and cloud service providers. We must build new standards and interfaces that will enable enhanced portability and flexibility of virtualized applications. Up to now, significant discussion has occurred around open standards for cloud computing. In this context, the "Open Cloud Manifesto" (www.opencloudmanifesto.org) provides a minimal set of principles that will form a basis for initial agreements as the cloud community develops standards for this new computing paradigm.

VI Security and Privacy

In cloud computing, a data center holds information that end-users would more traditionally have stored on their computers. This raises concerns regarding user privacy protection because users must outsource their data. Additionally, the move to centralized services could affect the privacy and security of users' interactions. Security threats might happen in resource provisioning and during distributed application execution. Also, new threats are likely to emerge. For instance, hackers can use the virtualized infrastructure as a launching pad for new attacks. Cloud services should preserve data integrity and user privacy. At the same time, they should enhance interoperability across multiple cloud service providers. In this context, we must investigate new data-protection mechanisms to secure data privacy, resource security, and content copyrights.

VII Conclusion

In this paper we discuss all the issues related with cloud computing interoperability and standardization with respect to current cloud environment. In which we study all the seven standards of cloud computing defined by NIST. We have identified the most representative facts and features of cloud computing standardization, as well as discussing the interoperability, which may be exploited by adversaries in order to perform various operations on cloud. Defense strategies and suggestions were discussed as well.

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