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Towards on Cloud Computing Standardization

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Abstract

Several computing paradigms have promised to deliver this computing vision, of which the latest one is known as Cloud computing. The term of cloud denotes the infrastructure as a "Cloud" from which businesses and users are able to access applications from anywhere in the world on demand. Cloud Computing is a new paradigm for the provision of computing infrastructure, and provides all the resources including networks, servers, storage, applications, and services as a service. This paradigm shifts the location of this infrastructure to the network to reduce the costs associated with the management of hard-ware and software resources. This paper intends to provide comprehensive review on Cloud computing in terms standardization in de jure standardization organizations such as ITU-T and JTC1, and de facto standardization organizations.

Keywords: *cloud computing, international standards, recommendation.de jure, de facto*

1. Introduction

With the significant advances in Information and Communications Technology (ICT) over the last half-century, and computing is being transformed to a model consisting of services that are commoditized and delivered in a manner. In such a model, users access services based on their requirements without regard to where the services are hosted or how they are delivered. Several computing paradigms have promised to deliver this computing vision, of which the latest one is known as Cloud computing. The term of cloud denotes the infrastructure as a "Cloud" from which businesses and users are able to access applications from anywhere in the world on demand. Thus, the computing world is rapidly transforming towards developing software for millions to consume as a service, rather than to run on their individual computers. This concept is known as Cloud computing, and it represents a paradigm shift that will redefine the relationship between buyers and sellers of IT-related products and services.

The Cloud is drawing the attention from the Information and Communication Technology (ICT) community, thanks to the appearance of a set of services with common characteristics, provided by important industry players. However, some of the existing technologies the Cloud concept draws on (such as virtualization, utility computing or distributed computing) are not new [17]. The term cloud is used as a metaphor for the Internet, based on how the Internet is depicted in computer network diagrams and is an abstraction for the complex infrastructure it conceals [14].

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The followings are the key characteristics of Cloud computing [14].

- **Agility** improves with users able to rapidly and inexpensively re-provision technological infrastructure resources. The cost of overall computing is unchanged, however, and the providers will merely absorb up-front costs and spread costs over a longer period.
- **Cost** is claimed to be greatly reduced and capital expenditure is converted to operational expenditure. This ostensibly lowers barriers to entry, as infrastructure is typically provided by a third-party and does not need to be purchased for one-time or infrequent intensive computing tasks. Pricing on a utility computing basis is fine-grained with usage-based options and fewer IT skills are required for implementation (in-house). Some would argue that given the low cost of computing resources, that the IT burden merely shifts the cost from in-house to outsourced providers. Furthermore, any cost reduction benefit must be weighed against a corresponding loss of control, access and security risks.
- **Device and location independence** enable users to access systems using a web browser regardless of their location or what device they are using (e.g., PC, mobile). As infrastructure is off-site (typically provided by a third-party) and accessed via the Internet, users can connect from anywhere.
- **Multi-tenancy** enables sharing of resources and costs across a large pool of users thus allowing for:
  - **Centralization** of infrastructure in locations with lower costs (such as real estate, electricity, etc.)
  - **Peak-load capacity** increases (users need not engineer for highest possible load-levels)
  - **Utilization and efficiency** improvements for systems that are often only 10–20% utilized.
- **Reliability** improves through the use of multiple redundant sites, which makes cloud computing suitable for business continuity and disaster recovery. Nonetheless, many major cloud computing services have suffered outages, and IT and business managers can at times do little when they are affected.
- **Scalability** via dynamic ("on-demand") provisioning of resources on a fine-grained, self-service basis near real-time, without users having to engineer for peak loads. Performance is monitored and consistent and loosely-coupled architectures are constructed using web services as the system interface.
- **Security** typically improves due to centralization of data, increased security-focused resources, *etc.*, but concerns can persist about loss of control over certain sensitive data. Security is often as good as or better than under traditional systems, in part because providers are able to devote resources to solving security issues that many customers cannot afford. Providers typically log accesses, but accessing the audit logs themselves can be difficult or impossible. Ownership, control and access to data controlled by "cloud" providers may be made more difficult, just as it is sometimes difficult to gain access to "live" support with current utilities. Under the cloud paradigm, management of sensitive data is placed in the hands of cloud providers and third parties.

This paper provides comprehensive review on Cloud computing in terms standardization in de jure standardization organizations such as ITU-T and JTC1, and de facto standardization organizations.

3. ITU-T SG13 and SG17

ITU (International Telecommunication Union) is the United Nations specialized agency for information and communication technologies – ICTs. ITU-T studied on cloud computing from the FG Cloud (Focus group on cloud computing), and it was decided that SG13 will lead the cloud computing standardization activity, and SG17 will cover the cloud security. The following ITU-T Recommendations are developed, and it will be expanded for the cloud computing standards.

- **ITU-T Y.3501**, Cloud Computing Framework and high-level requirements: This Recommendation provides a cloud computing framework by identifying high-level requirements for cloud computing. The Recommendation addresses the general requirements and use cases for: (i) cloud computing;, (ii) Infrastructure as a Service (IaaS), Network as a Service (NaaS), and Desktop as a Service (DaaS) cloud services;, amd (iii) inter-cloud, end-to-end resource management, and cloud infrastructure.
- **ITU-T Y.3510**, Cloud Computing Infrastructure Requirements: This Recommendation identifies requirements for cloud infrastructure capabilities to support cloud services. The scope of this Recommendation includes: overview of cloud infrastructure, requirements for compute resources, requirements for network resources, requirements for storage resources, and requirements for resource abstraction and control. Abstraction and control of physical resources are essential means to achieve on-demand and elastic characteristics of cloud infrastructure.
- **ITU-T Y.3520**, Cloud computing framework for end to end resource management: This Recommendation provides a framework for end-to-end cloud computing resource management. This Recommendation includes (i) general concepts of end to end cloud computing resource management, (ii)a vision for adoption of cloud computing resource management in a telecommunication rich environment, and (iii)end-to-end management of cloud resource and services across multiple platforms, i.e. management of any hardware and software used in support of the delivery of cloud services.
- **ITU-T Y.3511**, Framework of inter-cloud computing for network and infrastructure: This Recommendation describes the framework for interactions of multiple cloud service providers (CSPs) that is referred to as inter-cloud computing. Based on use cases involving several CSPs and consideration on different types of service offerings (given in the appendixes), this recommendation describes the possible relationship among multiple CSPs, CSP interactions, and relevant functional requirements.
- **ITU-T X.1600**, Security framework for cloud computing: This Recommendation analyses security threats and challenges in the cloud computing environment, and describes security capabilities that could mitigate these threats and address security challenges. A framework methodology is provided for determining which of these security capabilities will require specification for mitigating security threats and addressing security challenges for cloud computing.

4. Collaborative Teams between ITU-T SG13 and JTC 1 SC 38

The Collaborative Teams on Cloud Computing Overview and Vocabulary (CT-CCVOCAB) and cloud computing reference architecture (CT-CCRA) are established to collaboratively develop a common text for an ITU-T Recommendation | ISO/IEC International Standard on cloud computing overview and vocabulary, and cloud computing reference architecture. The following items are main subject for this groups;

- **ITU-T Y.ccdef | ISO/IEC 17788**, Cloud Computing Overview and Vocabulary: This Recommendation | International Standard provides an overview of cloud computing along with a set of terms, definitions and concepts. It is a terminology foundation for the cloud computing standardization work. This Recommendation | International Standard is applicable to all types of organization (*e.g.*, commercial enterprises, government agencies, not-for-profit organizations).
- **ITU-T Y.ccra | ISO/IEC 17789**, Cloud Computing Reference Architecture: This International Standard|Recommendation specifies the cloud computing reference architecture. The reference architecture includes an overview of the general concepts and characteristics of Cloud Computing, the Cloud Computing components|functions and roles and their capabilities and inter-relationships

5. JTC 1 SC 38

Within ISO and the International Electrotechnical Commission (IEC), joint technical committee ISO/IEC JTC 1, Information technology, subcommittee SC 38, Distributed application platforms and services (DAPS), is active in this field, working on vocabulary and reference architecture, and plans further standards development work in service delivery, scenarios and use cases [1].

After a study period, working group WG 3, Cloud computing, was formed within ISO/IEC JTC 1/SC 38, focusing on producing three deliverables:

- **ISO/IEC 17788**, Information Technology - Cloud Computing Overview and Vocabulary: definitions of cloud terminology
- **ISO/IEC 17789**, Cloud Computing Reference Architecture: an architectural description of cloud computing's major and general elements, actors and roles.
- Information Technology - Cloud Computing – Service Level Agreement (SLA) Framework and Terminology : an overview of SLAs for cloud services, identification of the relationship between the master service agreement and the SLA, SLA concepts and requirements that can be used to build SLAs, and terms and metrics commonly used in SLAs for cloud services. This standard is for the benefit and use for both provider and customer. This standard does not provide a standard structure that would be used for SLA contracts. Contracts are highly customized items between providers and customers so this standard seeks to establish a set of common SLA building blocks (concepts, terms, definitions, contexts) that can then be used to create SLAs that will help avoid confusion and facilitate common understanding between the Cloud Service Providers and the Cloud Service Customers.

These three deliverables are interrelated. Many of the terms used in the reference architecture and SLA refers to terms defined in the vocabulary.

6. De facto Standardization Organizations

6.1. Open Grid Forum

OGF is an open community committed to driving the rapid evolution and adoption of applied distributed computing, and the purpose of this group is the creation of a practical solution to interface with Cloud infrastructures exposed as a service (IaaS). Applied Distributed Computing is critical to developing new, innovative and scalable applications and infrastructures that are essential to productivity in the enterprise and within the science community. OGF accomplishes its work through open forums that build the community, explore trends, share best practices and consolidate these best practices into standards [12].

The OGF is developing on an Open Cloud computing Interface (OCCI), which is an API for managing Cloud computing infrastructure. The purpose of this group is the creation of a practical solution to interface with Cloud infrastructures exposed as a service (IaaS). They are focus on a solution, which covers the provisioning, monitoring and definition of Cloud Infrastructure services. The group should create this API in an agile way as we can have advantages over other groups if we deliver fast. Overlapping work and efforts will be contributed and synchronized with other groups.

6.2. Cloud computing Interoperability Forum

The Cloud Computing Interoperability Forum (CCIF) [3] was formed in order to enable a global cloud computing ecosystem whereby organizations are able to seamlessly work together for the purposes for wider industry adoption of cloud computing technology and related services. A key focus will be placed on the creation of a common agreed upon framework / ontology that enables the ability of two or more cloud platforms to exchange information in an unified manor.

Unified Cloud Interfaces and API's are being developed by the CCIF . Unified Cloud Computing is an attempt to create an open and standardized cloud interface for the unification of various cloud API's. A singular programmatic point of contact that can encompass the entire infrastructure stack as well as emerging cloud centric technologies all through a unified interface. One of the key drivers of the unified cloud interface is to create an API about other api's. A singular programmatic point of contact that can encompass the entire infrastructure stack as well as emerging cloud centric technologies all through a unified interface. In this vision for a unified cloud interface the use of the resource description framework (RDF) is an ideal method to describe a semantic cloud data model (taxonomy & ontology). The benefit to an RDF based ontology languages is they act as general method for the conceptual description or modeling of information that is implemented by web resources. These web resources could just as easily be "cloud resources" or API's. This approach may also allow us to easily take an RDF -based cloud data model and use it within other ontology languages or web services making it both platform and vendor agnostic. Using this approach we're not so much defining how, but instead describing what.

6.3. DMTF

DMTF [4] is also working on virtualization standards in the Virtualization Management Initiative (VMAN). In a press release the Open Virtualization Format standards (OVF) has been announced in March 2009. “As part of the DMTF Virtualization Management Initiative (VMAN), OVF simplifies interoperability, security and virtual machine lifecycle management by describing an open, secure, portable, efficient and extensible format for the packaging and distribution of one or more virtual appliances and applications. This enables

software developers to ship pre-configured, ready-to-deploy solutions, allowing end-users to distribute applications into their environments with minimal effort. The standard can also serve as a building block for Cloud computing."

6.4. Open Cloud Consortium

The Open Cloud Consortium (OCC) [11] is a non-profit organization established and led by the University of Illinois at Chicago that is researching the creation of inter-cloud interfaces in the aim of developing compatibility standards. The goal of such standards is to allow for smooth transitions from one cloud service to another. The OCC is continuing development with an eye to extensibility for the next generation of clouds, such as carrying out experiments with wide-area network clouds using not the widely employed TCP protocol for communications, but rather the new UDP-based Data Transfer (UDT) protocol better suited to high-speed bulk data transfer.

6.5. Cloud Security Alliance

The Cloud Security Alliance [18] is a non-profit organization formed to promote the use of best practices for providing security assurance within Cloud computing, and provide education on the uses of Cloud computing to help secure all other forms of computing.

The Cloud Security Alliance's objectives are to:

- Promote a common level of understanding between the consumers and providers of cloud computing regarding the necessary security requirements and attestation of assurance.
- Promote independent research into best practices for cloud computing security.
- Launch awareness campaigns and educational programs on the appropriate uses of cloud computing and cloud security solutions.
- Create consensus lists of issues and guidance for cloud security assurance.

6.6. ETSI

ETSI [21]Technical Committee (TC) GRID is updating its terms of reference to include the emerging commercial trend towards Cloud computing which places particular emphasis on ubiquitous network access to scalable computing and storage resources. Since TC GRID has particular interest in interoperable solutions in situations which involve contributions from both the IT and Telecom industries, the emphasis is on the Infrastructure as a Service (IaaS) delivery model.

5. Conclusion

Many standardization organizations stepped on cloud computing with their own perspectives, and security and interoperability are the most mentioned cloud computing issues in each organization. In this paper, comprehensive review on Cloud computing in terms standardization in de jure standardization organizations such as ITU-T and JTC1, and de facto standardization organizations are provide.

For the ultimate interoperability for cloud computing, it is expected that more standards will be developed in each standardization organizations. Those activities will make rich environment for the information technology and computing infrastructure.

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