

Network Architecture Under Cloud Ecosystems

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Abstract

Cloud computing is a hot technology of attracting so many eyeballs currently. Before its success, cloud computing has to overcome the service assurance obstacle that customers trust cloud service safe enough to deploy their critical applications upon it. Since devices such as hosts and networks are underlying infrastructures that support cloud computing, this paper demonstrates a S2R(Services mapped To Resources) model between devices and cloud services to solve this obstacle. S2R model leads all resource devices including hosts and networks etc to deliver a FPACS(Fault, Performance, Accounting, Configuration, Security) interface to support up-level scalable service delivery and assurance. The implementation of S2R will help put off customers' doubts about cloud computing and makes future network architecture take a new view under cloud ecosystems.

Keywords: Cloud Computing, communication network, TMN.

1. Introduction

Along with the development of Cloud Computing technology, many cloud computing platforms delivering scalable services such as computing, storage and network etc are emerging. The cloud computing platform deployed on the data center network forms an individual cloud

ecosystem which provides services to inside or outside customers. These individual cloud ecosystems [1] form a global cloud ecosystem based on communication network including internet and telecommunication network. In the global cloud ecosystem, all kinds of cloud computing services constitute a scalable resource delivery platform on which business companies deploy a service without buying a bulk of devices and pure consumers access services without a special equipment.

Before its success, cloud ecosystem has to overcome the obstacle that customers trust it safe enough to deploy their critical applications upon it [2].

This paper analyzes these difficulties from the angle of mutual effect between devices especially network infrastructures and cloud ecosystem. On one hand, network infrastructure satisfies the requirements of cloud ecosystem.[3] analyzes the impact of e-Learning on China Education and Research Network (CERNET). On the other hand, cloud ecosystem depends on network's ability[4]. Internet lacks robust network management ability, just best of effort, and low-bandwidth and high-delay. Telecommunication network lacks openness like internet. In both networks, devices lacks programmability flexibility which is urgently needed by cloud computing. As an example, the purpose of OpenFlow [5] is to make internet programmable that support researchers' idea can be deployed in public internet switches and routers.

Now individual cloud ecosystem is in a stage with the ability of scalable delivery of resources according to customers' requirements. But the Achilles' heel is without an uniform service assurance which includes the FPACS(Fault, Performance, Accounting, Configuration, Security)management ability. This paper shows an idea that cloud ecosystem should cooperate with network infrastructure much more. So we present a S2R model inspired from TMN Model in tele-communication network to solve these problems above. Network infrastructure can open his functionality to be used by cloud services. For example, these interfaces can be the type of web services. S2R model leads all resource devices including network devices to deliver a FPACS interface to support up-level scalable service delivery and assurance.

The rest of this paper is organized as follows. First, we analyze present situation and difficulties that cloud ecosystem faces in Section 2. Section 3 presents our solution:S2R model. Then we discuss future cloud ecosystem based on our S2R model in section 4. Finally, we conclude the paper in section 5.

2. Present Situation Analysis

2.1. Cloud Ecosystem

Comparing with traditional hosting, cloud computing has a few distinct characteristics. For example, service categories are different such as Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS). Cloud service is sold on demand, and fully managed by the provider. And its implementation mechanism is different. Cloud ecosystem deliver scalable services through virtualization of current all kinds of resources(such as computing, storage, network, etc) based on distributed computing in a data center network.

But there are many obstacles that hamper cloud ecosystem meet the criteria of enterprise IT [6].

Why are not big companies willing to deploy core application in commercial cloud service provider's domain and just deploy cloud experimentation in their own data center network. The core reason is because the technology of cloud computing is in the stage of service delivery and not in the stage of service assurance. For example, Amazon cloud platform proves its ability to deliver scalable cloud service of computing(CPU and memory), storage and network. But it lacks the mechanism of service assurance just like FCAPS management in TMN which is implemented in tele-communication network.

Current cloud operators just implement the clouds all by themselves without supports from most of the key corporate vendors such as resource devices vendors, network device vendors. Only after these devices vendors take part in the process of both service delivery and assurance of cloud ecosystem, problems mentioned above can be conquered. This paper presents a S2R model for the purpose of constructing an uniform model that can support service delivery and assurance of cloud based on all kinds of devices. Cloud ecosystem relies especially on network infrastructure development, so we start with an introduction of network infrastructure below.

2.2. Network Infrastructure

A single cloud ecosystem lives on data center network in a LAN. Cloud services communicate through communication network with customers. Communication network has to evolve to better meet cloud computing's challenges.

Facing the pressure of cloud Ecosystem, communication network especially for internet has to be a higher bandwidth and lower-delay network. Even they can

provide ability of compression which reduces storage costs and I/O bandwidth.

Conventionally, network infrastructure has many valuable service abilities that can be opened to cloud ecosystem such as AAA(Authentication, Authorization and Accounting) infrastructure, session initiation and management, bill support and network management etc. In fact, over the years, network infrastructure operators fear becoming dumb pipes which they can only take profits from providing bits stream without other profits. Especially with the coming of cloud economy, the most profitable is a variety of services based on massive users. This urges network operators try their best to shake off this quandary. Originally, they tried to be a walled garden [6] that they develop, deploy and maintain every kinds of services all by themselves. But very soon, they find out they have no advantage over others in this aspect. So how should network operators meet the challenge of cloud era?

Smart pipe [7] comes with the tide of fashion. Its purpose is to leverage operator's existing or unique service abilities, their operator customer relationships advantages, to gain profits beyond just as a communication pipe. Network operators have to become network cloud operators. If network operators open their service abilities' interfaces to other clouds and users, others will have choices of selecting some network operator's communication network service to construct a network robust cloud. So cloud ecosystem can depends on internet and telecommunication network's infrastructures and service abilities to build a robust cloud ecosystem with service delivery and assurance.

3. S2R Model

Then how to bring network infrastructure and cloud computing services together to

deliver a harmonious cloud ecosystem with the ability of service assurance? Luckily, we can learn much from the traditional tele-communication network which is a network on which services can be controlled and managed.

TMN(Telecom Management Network) is the model of tele-communication network. According to TMN model, devices vendors, network management developers, service providers work together. For example, vendors supply there devices' management interface which can let upper level configure and manage resources in their device on delivery of their devices. Figure 1 shows the TMN architecture.

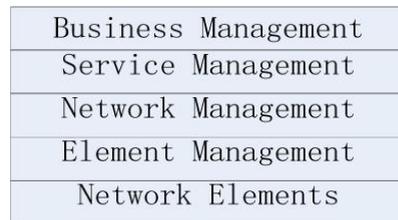


Figure 1 TMN management architecture

We present the S2R Model here that maps cloud computing services to its corresponding resources in underlying network infrastructure which ensures a robust cloud services' FCAPS management. Figure 2 shows that once all resource devices supports the interface that supports FCAPS management function, the cloud provider will not implement the virtualization of resource by private standards. This will help reduce the pressure of cloud provider, and enhance enthusiasm of resource vendors taking part in the cloud computing domain. And most importantly, the internet will be open to cloud computing. In the past, there is no uniform Network Management infrastructure for internet where devices only support weak network management interface such as SNMP. In the cloud era, since complicated service and billing logic resides in internet

devices, so the corresponding network and billing management functions are needed. In this world, every device will support FCAPS interface, will work together for the cloud ecosystem.

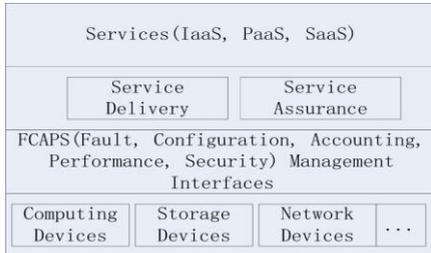


Figure 2 S2R (Services mapped To Resources) Model: Cloud Service Delivery And Assurance

4. Network Architecture Based on S2R

Based on our S2R model, future network architecture under cloud ecosystem can be divided into many kinds of specialized clouds. Network operators open their fundamental service abilities as service cloud, such as security cloud, session setup cloud, billing support cloud and communication cloud etc.

An individual cloud relies on these network service cloud to deliver multifarious scalable and robust services to outside customers. All of these individual cloud ecosystems constitute a global cloud ecosystem. To cope with pervasive requirement of cloud era, communication network should improve basic abilities best suitable for the Cloud Ecosystem. For example, it should support wider bandwidth and lower delay than before. And this future network architecture will deliver many abilities demonstrated as below.

4.1 Traditional Network Abilities Openness

Based on S2R model, many traditional infrastructures service abilities can be opened to cloud ecosystem:

(1) APIs for devices or networks. For example, operators can provide the router's programmability to enterprise cloud, let them customize their own route policy.

(2) User interface which shares user resources with enterprise cloud. Most important technology of this aspect is SIP protocol.

(3) Personalization and Quality of service. According the requirements of enterprise clouds, communication operators can provide personalized services.

(4) Location-based services.

(5) Billing and Payment. If other clouds use network operators' user resource, they have to rely on billing services provided by network operators.

(6) network management service. A powerful network management system is constructed to manage all network devices and resources

Cloud era makes the network world is becoming flat. Based on S2R model, the situation all kinds of network infrastructure abilities are opened results in a service construction transform from conventionally vertically integrated services to horizontal integration services.

Infrastructures service clouds will be deployed not only by network operators. They can also be deployed by anyone. Two network clouds: session management cloud and security cloud are demonstrated below.

4.2 Session Setup Cloud

Cloud Mashup is luring for end users. Fancy a mobile user can setup a call through fixed operator's or internet's line. Or a user of MSN can send a message to his FACEBOOK account. Then how to implement cloud mashup while ensuring maximizing the benefits of every party in this scenario?

Based on an uniform session setup cloud, cloud services can be easily mashed up. Cloud service mashup constitutes two parts, one is service interface

invocation, another is session setup.

4.3 Security Cloud

A cloud service operator also has to face the security problems, such as secrecy, authentication, non-reputation and integrity etc. Unlike the past, now both data and data processing are in the realm of cloud provider in the cloud era. So new security issues arise which make the situation of security much more grim dramatically.

So constructing a professional security cloud based on our S2R model is urgently needed. In the security cloud, those technologies in internet that have been developing so slowly will develop rapidly to support cloud computing services.

5. Conclusion

This paper starts with the analysis of current problems of cloud computing, and give a S2R model with the objective of constructing a harmonious global cloud ecosystem including cloud services and its underlying network infrastructure with the ability of service delivery and assurance. We think based on our model, future network architecture under cloud ecosystem will take a new view.

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