Role of Networking in Cloud Computing by Adopting Service-Oriented Virtualization

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Abstract

A holistic vision towards the convergence of Networking and Cloud computing scale emerging commercial infrastructure on demand within minutes or seconds ,instead of days or months avoiding idle server.Web based services eliminates the need for maintaining expensive computing facilities by companies and institutes through the use of Virtualisation and Resource time sharing. VMware customer-proven virtualization and cloud infrastructure solutions ensure efficiency through control, and utilization and automation, agility with freedom of choice. Promises to providecomputing resources on demand ,pay-as-you-go creates a flexibility and cost effective in a cloud environment.Virtualisation enable changes in computing domains that bridge the gap between Service Oriented Architecture (SOA) when applied in Network as a Service (NaaS) paradigm.A study of how to increase the performance of application that utilises cloud infrastructure for storing and processing data can be achieved by using Amazon S3(Simple Storage Service) and Amazon EC2(Elastic Compute Cloud).In this article we present the recent research progress in the development of Service Oriented Network Virtualisation for supporting the Cloud computing through NaaS.We also discuss the challenges in network- cloud convergence and the most significant recent advances for large scale distributed pool of abstracted, virtualized, dynamically scalable computing functions and services are delivered on demand to cloud users through internet.

Keywords: Network Virtualisation,

Cloudcomputing,ServiceOriented Architecture ,Network – as-a-Service (NaaS).

1.Introduction

Cloud computing represent remote delivery of ever increasing number of computing resources that are leased from big data centers only when needed by the cloud customers. The cloud computing paradigm holds great promise for the performance hungry scientific computing community that provides a cheap alternative to supercomputers, a much more reliable platform than commodity clusters, designed to replace the small-to-medium size enterprise data center [2]. Especially in public Cloud environment customers obtain the services from the third party Cloud provider.Commercial providers such as Amazon, Rackspace,Microsoft offer environment for developing and deploying applications.

Recent research indicates that networking performance has a significant impact on quality of cloud services. The networks with Quality of Services (QoS) capabilities became essential ingredient.For example,a high performance application utilizes Cloud infrastructure for storing and processing a large set of data may require high response delay[1]. The time period that an application has to wait for receiving the required result can be minimized by the use of Storage Services such Amazon S3(Simple Storage Service) and Amazon EC2(Elastic Compute Cloud).Amazon S3 (Simple Web Services) interface that can be used to store and retrieve any amount of data with AWS, at any time, from anywhere on the web with highly scalable,

reliable, secure, fast, inexpensive infrastructure that Amazon uses to run its own global network of web sites[6]. The service aims to maximize benefits of scale to developers and describes API operation, related request and response. In contrast, most of the clouds time-share the resources and use virtualization to abstract away from the actual hardware, thus increasing the concurrency of users.

Amazon Elastic Computing Cloud (EC2) is an IaaS cloud computing service that opens Amazon's large computing infrastructure to its users in a sense that its service is elastic by launching or terminating new virtual machines. Amazon EC2 abides by a Service Level Agreement (SLA) in which the user is compensated if the resources are not available for acquisition atleast 99.95 percent of time.Amazon EC2 is a feasible platform for applications that don't need advanced network performance[7].

2.Role of Networking in Cloud

The network is a barrier to achieve the promise of cloud computing. Network services are bound to physical network hardware and topology which results in limited scalability, increased complexity and inflated costs for customers. In the absence of a viable solution, many data centers develop to automate hardware provisioning and configuration[11]. This approach does not fix the underlying problem and, in most cases, requires expensive hardware upgrades and binds network operations even more tightly to a particular vendor.

Virtualize network. Server virtualization the decouples and isolates the workload from the underlying hardware, virtualization network decouples network services from the underlying physical network hardware. This enables programmatic creation of agile, virtual networks that meet the needs of clouds for the first time.Nicira delivers the first network virtualization platform that enables the network for cloud. Nicira's Network Virtualization Platform (NVP) is software that operates at the edge of any existing IP network and faithfully reproduces the entire networking environment in the virtual space. NVP transforms a

physical network into a generalized pool of network capacity.

Full network virtualization is the essential next step for capitalizing on the promise of cloud computing. The right network operational model for the future enables isolated and distinct networks to be created, deleted, expanded, contracted and migrated on demand, leveraging the existing physical network as a generalized pool of network capacity just as physical servers are used as a generalized pool of compute capacity for virtual workloads.

Virtualized networks change the deployment model for physical network hardware, just as compute virtualization has changed the deployment model for servers. The new deployment model allows all physical devices to be racked and cabled once, and then programmatically provisioned and re-purposed on demand. Virtualized networks remove vendor lock-in from the equation, allowing the physical IP fabric to be built using the best price performance solution.

Nicira brings the flexibility of virtualization to the network, combining the standard attributes of traditional physical networking with the operational requirements of the cloud.

3.Service Oriented Network Virtualization in Future Network

Virtualization for networks, storage and servers is reshaping the way organizations use IT. Network virtualization allows to divide IT needs among virtual, not physical, resources, and locate these services wherever it makes the most economic and operational sense over a private, hybrid or public Cloud[10].It's a simple and compelling concept and businesses have embraced virtualization with good reason. But virtualization is full of technological intricacies and pitfalls that often prevent businesses from taking full advantage of it.

Network virtualization in internet is a way of abstraction of resources and physical Hardware from users .It can be described as a networking environment that allows one or more multiple service providers to compose heterogeneous virtual networks that coexist together but in isolation from each other

and deploy customized end-to-end services on those virtual networks by effectively sharing and utilizing underlying network resources provided by network infrastructure. Cloud Computing really is accessing and services needed to perform functions with dynamically changing needs.The Cloud in virtualization of resources that manage and maintain itself.

The principle behind network virtualization is – separation of policy from mechanism-in internet. The role of internet service provider is divided into Infrastructure Provider(InPs) who manage the physical infracture and Network Service Provider(SPs) who create virtual networks offering end-to-end network services. SOA provides effective

Key attribute of network virtualization include abstraction (details of the network resources are hidden), indirection(indirect access to network resources combined to form different virtual networks), resource sharing(utilized by multiple virtual networks) and isolation (loose or strict isolation between virtual networks). A network virtualization environment, in which the service providers SP1 and SP2 construct two virtual networks by using resources obtained from the Infrastructure providers InP1and InP2.Enable a single SP to obtain control over the entire end-to-end service that belongs to different domains facilitates the end-to-end QoS (Quality of Service) provisioning.



Fig.Network virtualization environment

3.1 Scalability

Cloud computing for NaaS requires network service description to be able to support dynamic adaptive service specification, which open topic for future research. NaaS based network and Cloud convergence brings in new challenges . The service provisioning require a balance between richness of information for accurate service description and abstraction of service information for scalable networking.Network service description language (applicable to heterogeneous types of resources) for network cloud convergence must have sufficient support for resource virtualization

3.2 Performance

Topology and connectivityinformation ,networking capabilities and QoS properties are important aspects.QoSa parameters of network service is difficult task, particularly in the dynamic large scale networks for public Cloud service provisioning.An approach based on idea of providing a middleware layer for mapping and forwarding sevices. The Open Service Discovery Architecture (OSDA) can serve as a middleware for inter-domain service discovery.A capability matrix was developed on bandwidth ,delay and jitter.

3.3 Reliability

Service discovery ,an integral part in peer-topeer(P2P) network where various technologies have been developed for scalable and reliable service discovery in large scale P2P networks.An enhanced data-model of service information to support semantical or hybrid service discovery. The increasing number of available services with dynamic changes and complexity of services require a higher degree of automation for service discovery. Decentralized registry structure and search protocols to achieve scalability in complex networking environment.

4.Service-OrientedNetwork Virtualization for Convergence of Networking and Cloud Computing

SOA as a very effective architecture for heterogeneous system integration offers a promising approach to facilitate network virtualization in future internet. The resource in network infrastructure can be encapsulated into network infrastructure-as-a-Service paradigm.A Service Oriented network virtualisation architecture was developed which consists of physical infrastructure layer, virtual network layer and service network layer from bottom to top.Analytical modeling and analysis techniques are used to evaluate end to end QoS in serviceoriented network virtualization have also been developed.

For example the Service Oriented Network Architecture(SONA) developed by Cisco provides a framework for implementing IaaS in the network domain.By applying SOA in network virtualisation makes loose coupling a key feature of interaction among InPs,SPs and applications.Various virtualized computing resources, including both hardware (eg.CPU capacity and storage space) and software applications delivered to customers as services through the Infrastructure-as-a-Service, Platform-as-a Service, Software-as-a Service paradigms. The Open Grid Forum(OGF) is working on the Open Cloud Computing Interface(OCCI) standard defines SOA compliant open interface for interacting with cloud infracture.OGF has formed a work group (NSI-WG) developing Network Service Interface for architecture, encapsulates networking capabilities in form of services accessible through a standard interface.

Anetwork virtualization is the way of Mapping two disperate networks into a single ,unified network. This makes it look as if all remote networks are in a single place.

From a service provisioning perspective, the services delivered to end users are essentially composite network-Cloud services that comprises both computing services provided by Cloud infrastructure and network services offered by network infrastructure.SOA principle which offers a uniform mechanism for coordinating networking and computing system for Cloud service provisioning.

NaaS enables matching Cloud service requirements with networking capabilities by discovering the appropriate network services.Composition of network and computing services expands the spectrum of Cloud services that can be offered to users. The loose coupling feature of SOA provides a flexible and effective mechanism in network-cloud convergence.It supports the interaction between networking / Clouding infrastructure and serviceprovisioning functions as well as collabouration among heterogeneous networking and computing systems.A major researchproject IRMOS(Interactive Real-time Multimedia Applications on Service Oriented Infrastructures) where an intelligent Service Oriented Infrastructure(ISONI) Network was developed.ISONI consists of a network of resources networking, computing including and storage resources, managed and controlled by ISONI middleware.It allows resource sharing among multiple services. The idea behind ISONI is to provide a Service-Oriented- infrastructure(SOA) components and services.

The NEBULA project sponsored by NSF aims at developing a potential future Internet architecture that provides a trustworthy networking for the emerging Cloud computing model of always available network services.

Cloud networking is an important work package in the EU-funded SAIL(Scalable and Adaptive Internet Solution) project. Research progress on technologies foe SOA reported that SOA- based Virtual Network Operator (VNO) business model and developed system architecture(including networking,computing and storage) service and compose infrastructure services to meet customer requirements.An architectural solution for Cloud service provisioning was proposed also applies SOA in IP network virtualization for supporting Cloud computing. The marketplace was also employed with this solution to allow trading Ipnetwork resources between infrastructure providers and Cloud service

providers.CoSwitch, a switching mechanism for efficiently support SDN in cloud data centers. The investigation employed NGSON to provide inter cloud operation supporting Dynamic by routing, composition and delivery of services through multiple clouds. Cisco's Vframe Data Center(DC) solution aims to offer service orchestration that enables virtualizednetworking, computing and storage resources based on service-oriented network architecture.Cisco also developed the Unified Service Delivey Solution with goal of composing resources in the data centers and end-to-end IP networks for Cloud service provisioning.

Standard bodies and industries have also started working on related specificatons.ITU-T launched a focus Group on cloud computing (FG Cloud) in May 2010, which aims at contributing with networking aspects for flexible Cloud infrastructure in order to better support Cloud service/application to make use of communication networks and Internet Service.Alliance for Telecommunications Industry Solutions(ATIS) launched Cloud Service Forum(CSF) in 2011, which focuses on telecom operators provision of cloud services. Its main objective includes exposure of the resources and capabilities of telecom infrastructure as a Web services to enable reusing service components provided by different network domains.

5. Web Service Based Delivery System

The main approach to implement SOA, Web Service serve as key enabling technologies of NaaS paradigm that forms a technical foundation for network cloud convergence gives a high structure for a Web service based delivery system for composite network cloud services. A service registry in which both network and cloud service providers make their services available by publishing service description. When a service consumer, typically an application needs to utilize a cloud service, it sends a request to the service broker. The service broker discovers available Cloud and network services by searching the registry and composes the appropriate network and cloud services into a composite service that meets the customer's requirement. A survey notes that service operations including description, discovery and composition may be realized by various technologies.

For example, an application utilizes the cloud for storing and processing data, an application sends the broker a service request that specifies requirements for service functions such as data transmission processing and storage as well as requirements on service performance such as the maximum service delay and the minimum computing capability and storage space.Multiple providers for different types of services exist in a cloud environment.CloudIaaS providers like Amazon,GoGrid and Rackspace are available for providing computing capability and storage space as service.AT&T,Verizon Comcast are available to provide network services for data transmission. The service broker will search service description published at the registry. The broker may select Amazon EC2 for meeting the computing capability.requirement and Amazon S3 for meeting the storage space requirement ,select Comcast network service for data transmission between application host device and S3 disk(locate at different sites). They meet the requirements of end-to-end response time which ,include network delay for data transmission(in both Comcast and Verizon networks), latency for accessing the S3 virtual disk and the computing delay introduced by EC2 virtual machine. The broker compose all participating service into one composite service for the application.

6. Challenges in Virtualization

The network research community address these challenge ,namely decoupling service provisioning in network infrastructure Abstraction in network functionalities are in general termed as network virtualization which is key attribute in future networking paradigm.

6.1 Planet Lab and GENI projects: The role of virtualization in the internet has evolved from research method to a fundamental attribute of the internetworking paradigm.Ec2 Cloud related work:Hazelhurst examines the performance and storage cost of running the Montage workflow on EC2.The High-Energy Nuclear Physics (HENP)

STAR experiment evaluated Standard Benchmarks and usefulness of cloud for e-Science applications. Wang-et-al study the impact of virtualization on network performance

6.2 FEDERICA Project: A FP7 project with a core objective to create a Europe-wide infrastructure of network resources can be sliced to provide a virtual Internet environment.

6.3 AGAVE project: An open end-to-end Internet service provisioning solution in which a research on the Software Defined Network(SDN). For example ,the Open Flow protocol that is currently under active study, follows the virtualization principle by separating network control . IRTF (Internet Research Task Force):Created the Virtual Network Research Group (VNRG)in early 2010,which specify focuses on network virtualization. In July 2009 ITU-T established the Focus Group Future Network (FG-FN) where network was found to be the fundamental study topic in telecom domain.

7. Conclusion

In the past, cloud services providers had to choose between offering a complete enterprise network service model or an operational model of virtualization. A virtualized network enables the best of both worlds — dynamic network security, QoS, visibility, elastic scale, automated provisioning, ondemand network services and pay-as-you-go pricing — all with the operational efficiency of virtualization.

Adding virtualized compute services is now standard operating procedure for cloud service providers. Dynamic provisioning of elastic compute and storage capacity defines cloud as we know it today. However, on-demand provisioning of port level network services, such as security access control and quality of service (QoS) guarantees, have been out of reach for services providers because of the manual operations required to provision, monitor and account for such services in a dynamic environment. The impact of Virtualization in networking leads todelivering simple IP connectivity, the demands on thephysical network are greatly reduced and requirements affecting the virtual networks operating decoupled from the physical infrastructure for specialized hardware features are eliminated.

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