

Issues on Supporting Public Cloud Virtual Machine Provisioning and Orchestration

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Abstract—In this paper, we describe three major issues on supporting public cloud virtual machine such as the global scale. First is a heterogeneous provisioning issue. The kinds of operation systems that users require are various like as the required hardware performance diversity. Second, we propose a proper algorithm for guarantee about user's performance and efficiency of the cloud cluster resources together in the view of an operator who provides a cloud service. Thirdly, we describe a VM image management mechanism.

Keywords—Cloud, Public Cloud, Provisioning, Orchestration, VM, Virtual Machine, VM Image, Scheduler, Deployment, Deduplication, Resource Monitoring

I. INTRODUCTION

IaaS(Infrastructure as a Service) is already one of the most popular cloud services to support virtual machines(VM) to users as the computation resources.

There are two types of VM (Virtual Machine). One is a system virtual machine, it can be called by hardware VM, and the other is process virtual machine. System VM provisions a perfect OS independently, and has VM monitor or hypervisor. System virtual machine has several merits such as server consolidation and QoS isolation between VMs. Process virtual machine; it can be named by application VM, and it means an isolated process in OS and prepares independent application running environment from hardware and OS. In this paper, the VM means system virtual machine managed by a hypervisor.

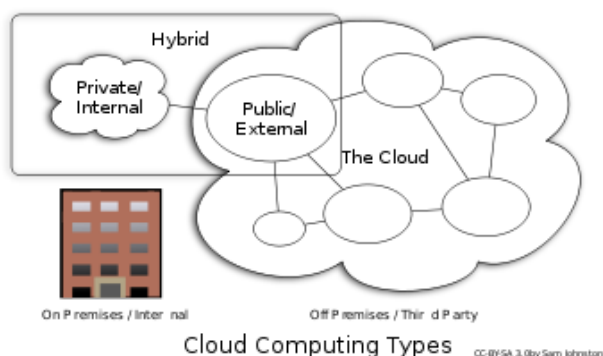


Figure 1. Cloud computing types[1]

Generally speaking, cloud computing is divided into three types such as Figure 1. Private cloud means a cloud system running inner an enterprise internally, public cloud means a service to target general end user undefined, and hybrid cloud means a combination of private cloud and public cloud.

In U.S, a public cloud service to provide VM provisioning is popular since Amazon opens EC2(Elastic Cloud Compute) service for supporting virtual machines to users as the computation resources. However, in Korea, the virtual machine services are still stayed on a private cloud service. In this paper, we describe three major issues on supporting public cloud virtual machine such as the global scale.

First, we explain a cloud virtual machine service including Amazon EC2 system and general cloud computing architecture. Second, we describe the difficulty or problem for supporting public cloud VM service, and then we propose a cloud VM provisioning system to solve the problems described previous.

II. VIRTUAL MACHINE SERVICE

Amazon started the kind of public IaaS service named AWS (Amazon Web Service) first. It includes two major services: EC2 (Elastic Cloud Compute) and S3 (Simple Storage Services). EC2 services VM and S2 services Storage; EC2 is billing in unit of hour and S3 is billing by unit of Giga bytes per a month. User can get from 1 core to 8 cores VM from the EC2 service, and also choose memory and disk space size and the kind of OS.

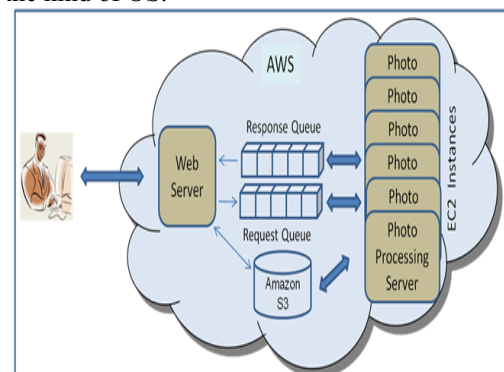


Figure 2. Amazon Web Service [2]

EC2 was implemented using the Xen virtualization tool, but added much more additional utilities.

General cloud system has layers shown in the architecture of Figure 3. Starting from HW machines such as servers, storages, network equipments, network bandwidth, and other utilities, the lowest level in the view of software is the virtualization part. If the provider builds IaaS service then needs a resource provisioning solution, service development environment for PaaS(Platform as a Service), and SaaS(Software as a Service) platform for SaaS service.

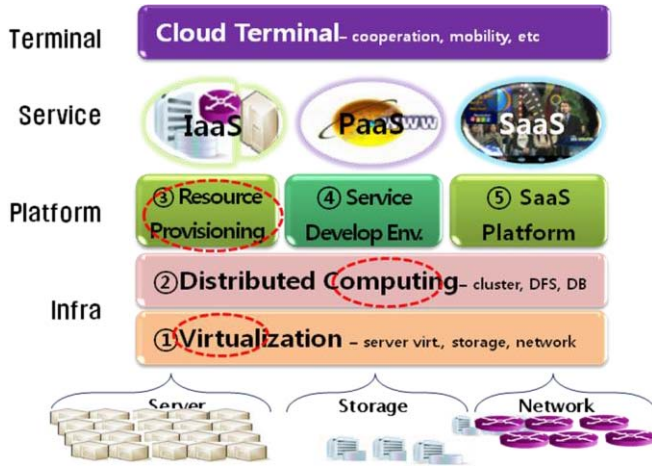


Figure 3. General architecture for building a cloud

III. ISSUES ON VIRTUAL MACHINE MANAGEMENT

A. Characteristics of public cloud

In a private cloud, the number of users is expectable and not variable. On the other hand, the number in a public is very changeable and un-expectable. Additionally, the number is very huge. For example, if a company provides a public cloud that can be accessed by any user, then it could support more than thousands to millions. Describing the scalability in the view of management of cloud IDC, it can be arranged such as Table 1.

TABLE 1. CHARACTERISTICS PRIVATE AND PUBLIC CLOUD

	Private cloud	Public cloud
# of users	$n \cdot 10^3$	$n \cdot (10^3 - 10^7)$
# of cores	$n \cdot 10^4$	$n \cdot (10^3 - 10^8)$
Size of storage (20 GB/person)	100 Tera scale	Exa scale
# of nodes	thousands	$n \cdot (10^4 - 10^8)$
Size of VM images (4 GB/VM)	10 Tera scale	100 Peta scale
# of on-line users	fixed	variable

First problem is about scale of the number of users, the number of cores, the number of online users, and the size of the storage for keeping user's VMs. And second problem is about the end user's behaviour.

Because of the scale and user's behaviour, there are some issues for constructing public cloud VM provisioning system.

B. Three major problems

First is a heterogeneous provisioning issue. The kinds of operation systems that users require are various like as the required hardware performance diversity.

Second one is an issue on scheduling or deployment. When a user requires a new VM, which machine is most proper among the available nodes on the cloud system. Generally, packing method and stripping method are used for deployment of VMs in servers. Packing method is to assign the new VM into the least available resource but possible as shown in (a) of Figure 4, and stripping method is to assign the new VM into a least load machine as shown in (b) of Figure 5. The packing method, however, can't guarantee the user's performance even though it is used for maximizing the utilization of servers. On the other hand, the stripping method is in-efficient in the view of the server utilization.

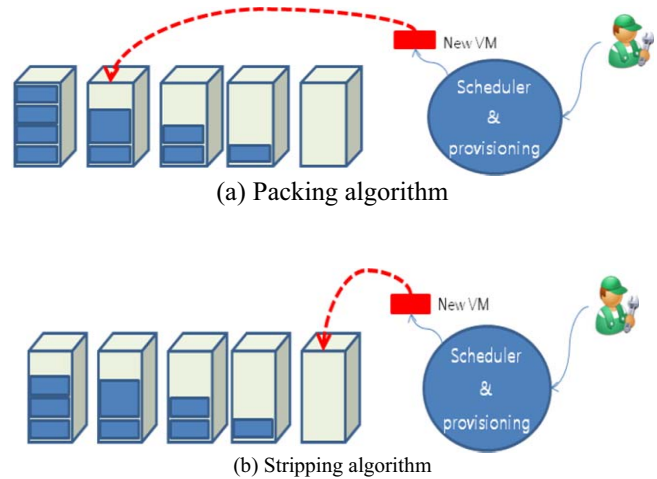


Figure 4. Two algorithms for deployment

Third one is concerned about the size of VM itself. Generally, the size of the VM image is between 1G and 16G. If a cloud service centre support 1 million users, it could be over peta-scale size. Over there, users can stay in his/her VM with in-out frequently, and want that their environment still keeps on the cloud centre even if they came back long time later. Thus cloud service operators can't destroy the user's VM images.

In the next chapter, we propose a VM management system to solve these problems.

IV. A VM MANAGEMENT SYSTEM

A. Architecture

A VM management system designed and implemented in ETRI is constructed with architecture shown in Figure 5. It has two major parts; one is cluster management and the other is VM management part. Cluster management manages the hardware cluster and services on the cluster, provisions operation system, and recovers node failure. VM management is compounded by three components; VM provisioning, VM scheduler, and VM image manager. Each of them is mapping to one of the issues described previous.

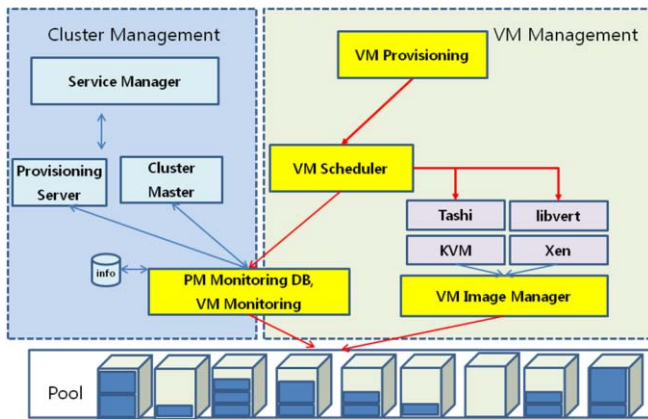


Figure 5. Architecture of the cloud system

B. Heterogeneous provisioning

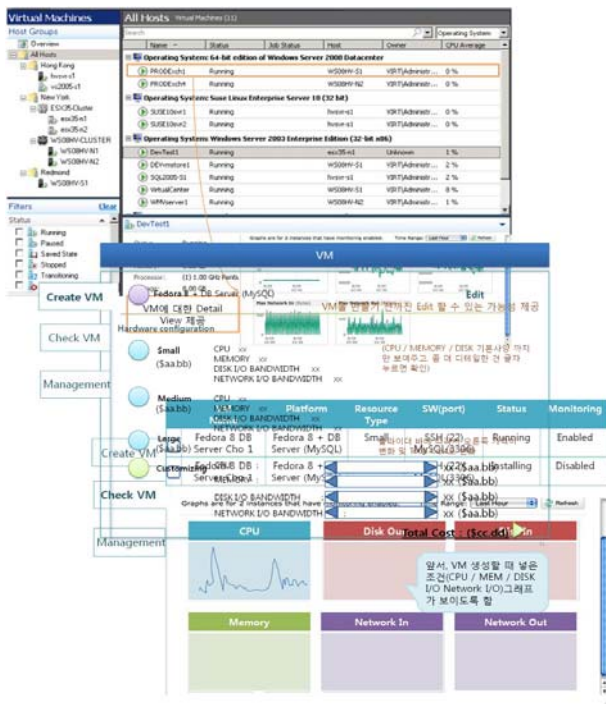


Figure 6. Provisioning user interface

The VM provisioning is focused on heterogeneous VM provisioning mechanism. It provides a virtual machine with user's specification rapidly. It calls tashi[3] client commands for provision KVM or Xen VM currently.

C. VM scheduler

We propose a proper algorithm for guarantee about user's performance and efficiency of the cloud cluster resources together in the view of an operator who provides a cloud service. An enterprise user who is such as a game service company requires least live migration and maximized VM server utilization.

In this paper, we propose a new min-max algorithm for considering the user's performance and server utilization together. It avoids a node that has too low utilization in the min-max algorithm. It is why that the node could be turn down after explicit migration of the idle VM. This can cause a effectiveness of electronic saving. But it considers load balancing to guarantee user's performance.

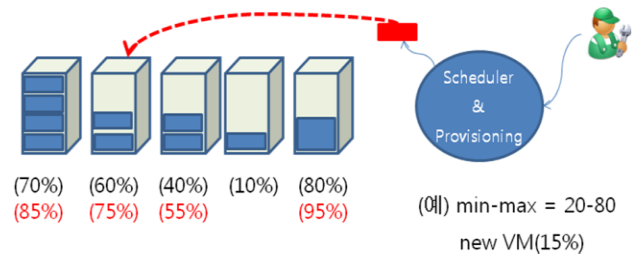


Figure 7. Min-max algorithm

The min-max algorithm decides a physical node for allocating new VM using following method.

$$f(n) = \max\{n: (L_{current}(n) + L_{new}(n))\} \&\& \{n: \min < L_{current}(n)\}$$

where, n : the physical node for allocating new VM
 $L_{current}(n)$: the system load before allocation new VM
 $L_{new}(n)$: the system load predication of new VM

The scheduling algorithm proposed in this paper considers system load-awareness, electronic effectiveness and load balancing together.

D. VM image management

VM image management was started the fact that VM image consumes a lot of disk space. If two difference VMs use same OS kernel, then many parts of two VM images are duplicated. Thus we can detect the same data chunk and keep just one copy if the two chunks same.

For reducing VM image size, we use de-duplication mechanism and FUSE interface. It has 5 major components. First one is de-duplication adaptation layer that is similar to FUSE interface. Second, cache management is for caching and sink on-using in the local file. Third, de-duplication itself component de-duplicates and stores the chunk during writing. Fifth component is key-map that is a kind of chunk hash

function. And the last one is restoration part. It recovers the image or file from chunks by gathering.

V. CONCLUSIONS

In this paper, we described the method to provide a virtual machine provisioning service. Especially, public cloud VM management system has to be considered some issues based on the scale and user's un-expected behaviour when they use their own VM. The cloud compute system proposed in this paper is designed considered those problems. It has three major functionalities; heterogeneous VM provisioning, load-aware min-max dynamic scheduler, and de-duplication based VM image management.

The cloud compute system is still on-going implemented. It could be finished by this December. For the future work, we will focus on a service management that can be in physical machine and virtual maching

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