

Performance Comparison Analysis of Linux Container and Virtual Machine for Building Cloud

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Abstract. In these days, Cloud computing is provided by various service ways, and it is possible that practical implement and service by virtualized environment. With developing of cloud computing techniques, many companies propose the different type of platforms through research the relevant technique. Among other platforms, we are going to talk about the performance comparison analysis of Linux Container and Virtual Machine in this paper. We built Cloud environment first on Docker which is based on Linux Container and Hypervisor which is Virtual Machine, we analyzed each of the size, Boot speed, and CPU performance. With this analysis result, Users will be able to understand characteristic of each platforms, and they will be able to choose the platforms reasonably what they need.

Keywords: Cloud Computing, Virtual Machine, Linux Container, Hypervisor

1 Introduction

In these days, the attention of Cloud computing is getting higher and many relevant products launched [1]. Cloud computing environment is the new paradigm that could optimize, support flexible and allow scalability the computing resources requested by the user [2]. Cloud computing provides the 'Virtualized IT resources service' using Internet technique, Users can borrow and use the IT resources(Software, Storage server, Server, Network) as much as they need. They can get real-time expandability by load balancing service, and they just pay as much as they use.

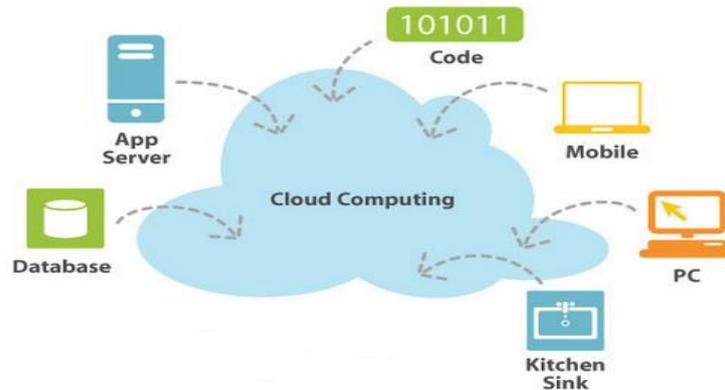


Fig. 1. Cloud computing

The front-runners of IT industry area such as MS, Google, IBM, declared that Cloud computing would be the most important technique in their near future. The necessary base technique for Cloud computing is Virtualization Server technique which is called Hypervisor. Above this, various techniques based on IT have been used for Cloud computing [3].

In this paper, we analyze performance comparison of Virtual Machine Hypervisor and Linux Container. Hypervisor means technique that several virtual machines which have independent CPU, Memory and Network, OS share the mechanic server resource. Docker is the Application level virtualization software. It can help managing computer environment separated from OS using the Libcontainer which is Linux container system.

Actually, Docker's basic concept is not that much different from existing virtualization. Only have difference method of approach. Existing virtualization loads hardware and OS in one time.

Therefore in this treatise, we want have practical and reasonable standard of technique selection for proper service after testing and analyzing the Cloud environment on the VM and Docker system.

2 Related research

Cloud computing is the technique that after virtualization, provide the resources from various and separated computers with On-demand method. It maximizes the efficiency of resources and minimizes administrative costs. So lately it is rising up as a new Internet environment trend.

2.1 Openstack

Openstack is opensource software for building public and private cloud. It is Cloud operation system for control and accumulated resources such as server, storage, network, virtualization techniques. Openstack is composed of Open source developer, companies, users for building Cloud. It was started by Austin (made by Rackspace and NASA).And now, It is huge community of more than 139 countries, 3000 people, 200 partners.

2.2 Virtual Machine

Virtualization has used even before Cloud computing was activated, and later it has been settled as a important technique for resource- provisioning, multi-tenancy, and system constitution in IaaS. Cloud computing's core technique is solving the problem using the virtualized resources.

Hypervisor is the virtual platform software that implement multiple OS in mechanical server. It is operated as a kind of middle-ware between CPU and OS, and is divided into two - Full Virtualization and Para Virtualization by the virtualization way[4].

2.3 Docker

Docker which is operated in application area is the virtualization platform that can build and distribute Application. Developers and system manager can distribute and test software what they developed easily and quickly in seperated OS environment by Docker[5]. Docker is the tool that manages Linux Container(LXC). Linux Conatiner is one of the OS system-level virtualization method. It implements several isolated Linux system Containers in single control host. Linux kernel compromises cgroups and allocates resources(CPU, Memory, Block I/O, Network, etc) without starting virtualization machine.

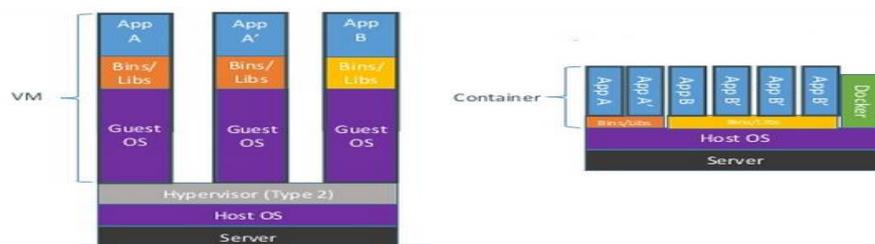


Fig. 1. comparison Vms and Docker

2.4 comparisons Docker and VM

KVM is Full Virtualization method and it means virtualizing way from hardware to OS. And this kind of virtualization is the combination of hardware + software which is used very basically, so it is easy to understand. And this method is easy to understand because of isolated OS. Also easy to apply their policy of system, network, user, security and can use various OS[6]. However it has few weaknesses as well. In case of VM's distribution, it distributes images included even OS, that cause a waste of resource. In comparison with KVM, Docker Cloud is just implemented and distributed, without including Guest OS, it can be implemented in short time and use resource economically though, Only can virtualize and distribute with Linux Operating System[7].

3 System construction environment

Constructs Cloud environment under same 2 servers. One for KVM as a virtualization tool in Openstack Platform and the other one for Docker. The reason why choose KVM for Hypervisor is that KVM is the Full virtualization method and mostly contrast with Docker. And also it is provided to user as a basic service at Ubuntu Server.

4. System Performance Comparison Analysis

4.1 Size-Comparison

For size-comparison, we evaluated how many photos each system could make in same condition HDD.

Table 1. KVM size

Scale	10GB	20GB	40GB
Number of VMs	45	22	11

Table 2. Docker size

Number of Containers	100+
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As you can check from Table 3 and Table 4, VM generated by KVM uses Full-Virtualization, and specifies the size from when it's generated. When we use Ubuntu-Desktop, we need resources more than 8GB, so it is difficult to generate VM more than 50 on 500GB Hard-disk. On the contrary, Container generated by Docker doesn't

contain OS but only installed software resources, so its size is smaller than VM's. In the case of Ubuntu 14.04 docker image which only have basic software, it only uses half of the same 500GB HDD and 177MB of resources to generate more than 100 images.

4.2 Average boot-time

To measure the average boot-time, we generated 20 images on each server and checked the boot time. Each server has same condition of H/W and S/W. We monitored the use of CPU of Host OS while Images was being boot by NMON tool.

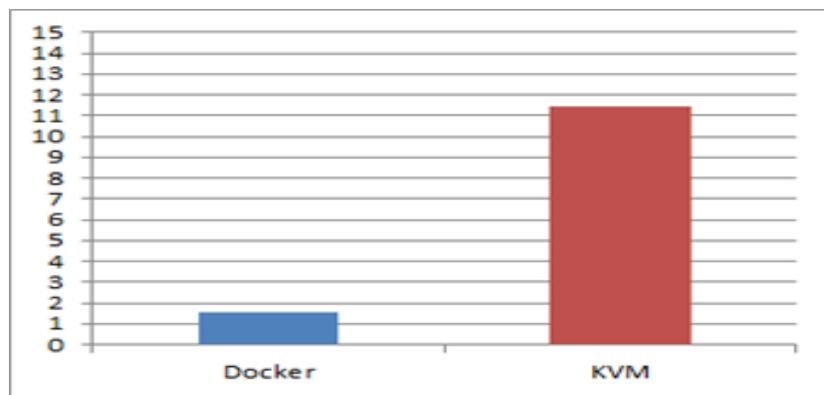


Fig. 2. Docker vs KVM average boot-time

In Fig. 3, in case of Docker, average boot-time is 1.53s and standard deviation is ± 0.03 , in case of VM, average boot-time is 11.48s and standard deviation is ± 3.4 s. These mean that Docker's boot-time is faster than VM. In case of VM, it need time for Guest OS's boot-time. But in case of Docker, it use Host OS, so its boot-time is very short. And also after boot, till get stable ready state for being operated, VM spend much CPU-resources. But Container doesn't need to spend that much of resource.

4.3 Operation speed Measurement

For Operation speed measurement, we use code of python language to calculate 100000! and we get average operation process time and standard deviation after repeat 100 times on VM and Docker image.

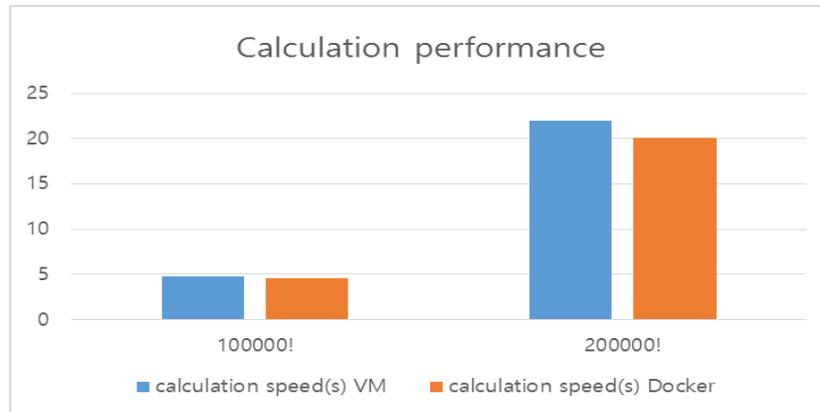


Fig. 3. CPU Calculation Performance

In Fig. 4. with Docker environment, operation speed of 100000! is 4.546s and standard deviation is $\pm 0.02s$. And in case of VM environment, operation speed is 4.793s and standard deviation is ± 0.05 . With this result, we could evaluate operation speed of Docker is faster.

5 Conclusion

Cloud computing technique is being steadily extended and evolved. For this reason, we built and analyzed the Cloud through research for comparison between VM and Docker. Cloud comprised of Docker doesn't contain Guest OS, so the waste of CPU-resource and storage is small. For this reason, boot-time, time of generating and distributing images are short. This is benefit of using Docker cloud when compared with VM Cloud. Of course, it has weakness as well. VM is operated individually enough to be expressed like it provides new computer to user. Because of this, it is easy to manage and apply the policy of system, network, user, security. Also user can user various virtualization OS regardless of Host OS. With our treatise, we would examine the strengths and weaknesses of each server and evaluate from service design level for providing service with proper virtualization way depending on service environment by building of Cloud, rather than evaluate only superiority of each methods. In the near future, we expect that new project related to Docker would come out soon from Openstack, so need to research consistently about VM and Docker.

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