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

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.

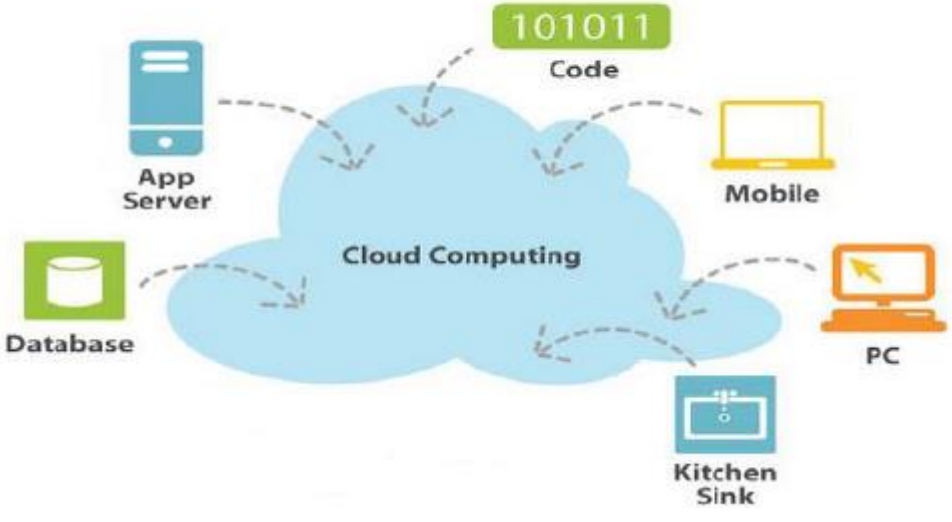

Fig. 1. Cloud computing

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 Clud computing.
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 Applicaition level virtualization software. It can help managing computer environment seperated 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 hardwear 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 software controls large pools of compute, storage, and networking resources throughout a datacenter, managed through a dashboard or via the OpenStack API. OpenStack works with popular enterprise and open source technologies making it ideal for heterogeneous infrastructure.

Hundreds of the world's largest brands rely on OpenStack to run their businesses every day, reducing costs and helping them move faster. OpenStack has a strong ecosystem, and users seeking commercial support can choose from different OpenStack-powered products and services in the Marketplace.

The software is built by a thriving community of developers, in collaboration with users, and is designed in the open at our Summits.

2.2 Virtual Machine

In computing, a **virtual machine** (**VM**) is an emulation of a computer system. Virtual machines are based on computer architectures and provide functionality of a physical computer. Their implementations may involve specialized hardware, software, or a combination.

There are different kinds of virtual machines, each with different functions:

- **System virtual machines** (also termed full virtualization VMs) provide a substitute for a real machine. They provide functionality needed to execute entire operating systems. A hypervisor uses native execution to share and manage hardware, allowing for multiple environments which are isolated from one another, yet exist on the same physical machine. Modern hypervisors use hardware-assisted virtualization, virtualization-specific hardware, primarily from the host CPUs.
- **Process virtual machines** are designed to execute computer programs in a platform-independent environment.

Some virtual machines, such as QEMU, are designed to also emulate different architectures and allow execution of software applications and operating systems written for another CPU or architecture. Operating-system-level virtualization allows the resources of a computer to be partitioned via the kernel. The terms are not universally interchangeable.

2.3 Docker

Docker is a set of coupled software-as-a-service and platform-as-a-service products that use operating-system-level virtualization to develop and deliver software in packages called containers. The software that hosts the containers is called Docker Engine**.** It was first started in 2013 and is developed by Docker, Inc. The service has both free and premium tiers.

Containers are isolated from one another and bundle their own software, libraries and configuration files; they can communicate with each other through well-defined channels. All containers are run by a single operating-system kernel and are thus more lightweight than virtual machines. Containers are created from *images* that specify their precise contents. Images are often created by combining and modifying standard images downloaded from public repositories.

2.4 comparisons Docker and VM

Docker is container based technology and containers are just user space of the operating system. At the low level, a container is just a set of processes that are isolated from the rest of the system, running from a distinct image that provides all files necessary to support the processes. It is built for running applications. In Docker, the containers running share the host OS kernel.

A Virtual Machine, on the other hand, is not based on container technology. They are made up of user space plus kernel space of an operating system. Under VMs, server hardware is virtualized. Each VM has Operating system (OS) & apps. It shares hardware resource from the host.

VMs & Docker – each comes with benefits and demerits. Under a VM environment, each workload needs a complete OS. But with a container environment, multiple workloads can run with 1 OS. The bigger the OS footprint, the more environment benefits from containers. With this, it brings further benefits like Reduced IT management resources, reduced size of snapshots, quicker spinning up apps, reduced & simplified security updates, less code to transfer, migrate and upload workloads.

3 System construction environment

Due to its relevance and complexity, the topic of Environmental Management in production operations has been very appealing for the business and academic communities. A more efficient approach to environmental issues related to
Production operations brings many advantages to the organization, as well as to the society as a whole. Within this context, special attention should be devoted to specific economic sectors with distinctive character, such as the Building and Construction sector (B&C). This particular sector has a significant environmental impact due to large quantity of required materials, as well as due to the specific features of its operations. The B&C sector is a fundamental part of many global economies. The sector contributes will form the baseline for the identification of further research opportunities in this particular field. The paper is structured into five sections: the introduction; a systematic analysis regarding environmental management systems in B&C sector; the research method; the results, discussion and future research directions.

4. System Performance Comparison Analysis

The use of relay transmission has been shown to offer significant performance benefits, including being able to achieve spatial diversity through node cooperation and extending coverage without requiring large transmitter powers. This has made them attractive options to be used in cellular, ad-hoc networks and military communications. The two most common relaying protocols are Decode and Forward (DF) and Amplify and Forward (AF). The AF protocol is a simple scheme, which amplifys the signal transmitted from the source and forwards it to the destination, and unlike the DF protocol, no decoding at the relay is performed. In this paper, we consider a two-way wireless system where two source nodes, A and B, communicate with each other through the aid of relay node(s) using an AF protocol.

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+

As you can check from Table 3 and Table 4, VM generated by KVM uses Full-Virtualizaion, 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

In order to study large scale cloud systems, a cloud simulation framework that is capable of simulating as close as possible real cloud behaviors is a huge advantage. To deliver such a framework, VM operations such as booting, migrating, suspending, resuming and turning off should be correctly modeled. While models for some actions such as turning off can be a simple constant, operations such as booting or migrating require advanced models. Following previous works that focused on the migration operation and showed that minimalist models are not appropriate, we deal, in this paper, with the boot action. The time it takes to boot a VM is an important element for many operations of a cloud system. For instance, if a sporadic VM is mandatory to perform a task, the time to boot it, is an important information that may become critical if this time is significant. More generally, considering the boot time is essential for VM allocation strategies.

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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