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A Comparative Analysis of the Two Main Hypervisors and Virtualization

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Abstract: Presently, numerous major corporations are advancing virtualization technology to investigate the hypervisor layer. Hypervisors facilitate efficient memory management and support multi-core operating systems. The utility of hypervisors stems from their capacity to utilize high-performance servers and to rapidly resume operations following a system failure. Current hypervisor technology exhibits an imperfect caching system. Furthermore, instances occur where insufficient disk space during data storage necessitates system reinstallation. This study examines the current technologies of hypervisors, specifically focusing on VirtualBox and VMware Workstation hypervisors. Based on these findings, this paper compares and analyzes two principal hypervisors.

Keywords: Virtualization technology; Hypervisor; VirtualBox; VMware Workstation; Multi-core operating system; Caching system

1. Introduction

The hypervisor layer is a software layer that virtualizes system resources and enables multiple VMS to access a single hardware host. It is also responsible for allocating CPU and memory resources and handling operating system services such as I/O. The implementation of the hypervisor layer is based on virtualization, which allows traditional computing resources to be scaled according to actual needs, integrating processors, storage, and networking into a virtual physical system. Hypervisors fall into two categories: the one that runs directly on the system's hardware, and the other that runs on the host operating system which has been virtualized.[1] Various network cloud and hardware platforms support these hypervisors.

I analyze the technologies used in latest hypervisors, based on my technological analysis, VMware is better than Microsoft Hypervisor-V. The VMware hypervisor is more compatible, more secure, and more advanced in hardware configuration.

2. Related works

History

In 1964, IBM designed and introduced CP-40, which provided the first virtual machine management program with the beginning of production use of the software testing tool CP-40. The first stable version was not released until 1972.

In 1974, Gerald Popek and Robert Goldberg divided virtual machine hypervisors into two types: bare metal hypervisors and managed hypervisors. One runs on the hardware and the other on the operating system.

In 2007, Citrix acquires XenSourse and its Xen Project. KVM merges into the Linux kernel mainline in Kernel version 2.6.20. VMware introduces Storage vMotion.

In 2017, VMware releases vSphere 5.1, which includes vSphere Storage Appliance, vSphere Data Protection, vSphere replication and vShield Endpoint.

In 2019, VMware purchased Project pacific, a project that will re-architect vSphere, deeply integrate and embed Kubernetes, Tanzu, to provide new clusters simultaneously attached in multiple environments for centralized management and operations. [2]

3. Preliminaries

3.1 Hypervisor type

Mainstream hypervisors in the market fall into two categories: Type One is the bare VM hypervisors, which are directly installed on physical hardware. They are lightweight operating systems and do not rely on device drivers or other firmware when accessing hardware. In this case, security is higher and performance is more efficient because the hypervisor layer is isolated from the vulnerable operating system. [3] The second type is the managed hypervisor, which is a software layer running on the operating system of the host and cannot directly call the computer resources. The communication between the hardware and the hypervisor must be realized through the additional level of the operating system, so the managed hypervisor has a certain delay in performance, but for the end user and software testing, this delay is not a problem.[4]

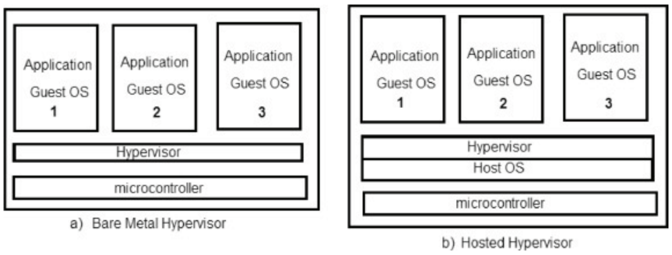

Figure 1. two different types of hypervisors

(Armin et al., 2018)

3.2 Definition of a Virtual Machine

The machine consists of logical memory, which allocates the appropriate address space to the process according to the instruction level of the user. A virtual machine is a computer system simulated by software with complete hardware capabilities that can support running in a completely isolated environment. Depending on the abstraction level of the virtual machine, the virtual machine is classified as supporting a single process or a system. Virtual software provides the basic architecture for emulating multiple virtual machines on a system, each of which can be run separately to improve productivity. VMS are subdivided. Process VMS run only individual processes on the virtual platform, and system VMS maintain a complete environment and provide access to virtual hardware.

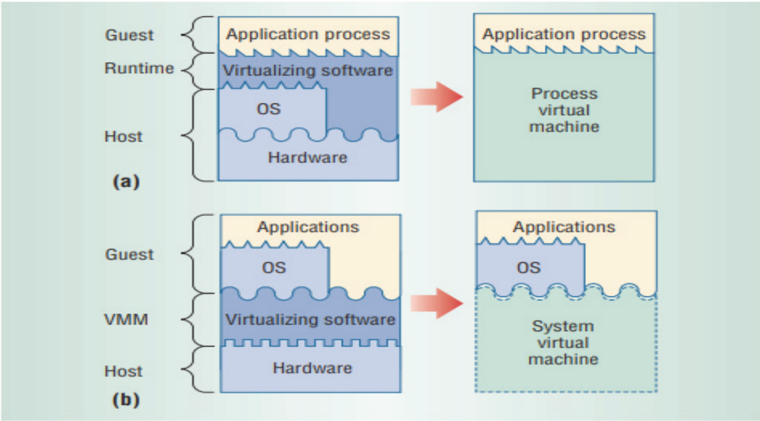

Figure 2. process and system VMs

(J. E., 2005)

3.3 Unique virtual machine hypervisor-KVM

The most central technology in server virtualization is the kernel-based virtual machine, which has the characteristics of Type 1 and Type 2 hypervisors. KVM is a part of the Linux code that is limited by the complexity of the Linux kernel and features and benefits of Linux. Recently, heterogeneous virtualization KHV based on kvm has been proposed to provide memory management and hardware support to reduce latency and improve security.[5]

4. Technical and logic explanation of hypervisor

4.1 Type2 VMware hypervisor

4.1.1 Working principle

Virtual Box hypervisors are usually built on the operating system. They rely on hardware, run as a program in the guest operating system, rely heavily on the hosted operating system, support multiple virtual machine access, and finally call the overall computer resources.[6] (Figure 3)

4.1.2 Technology used in type2 hypervisor

Introduce the cloud computing model, virtual shared pools can be supported for fast provisioning and configuration, providing users with hardware infrastructure and dynamically scaling applications. Cloud computing application virtualization isolates VM from each other to provide more reliable security for users. One or more hardware resources in the cloud are divided and used by several virtual machines, which

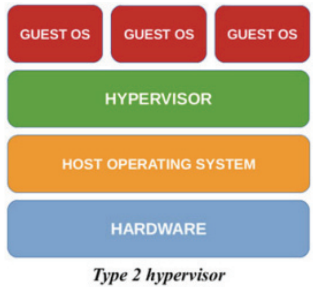

Figure 3. Type2 internal structure (Martin, 2016)

are connected to different clouds. In addition, the cloud computing environment also provides a number of placement algorithms to reduce the migration of hypervisors and reduce unnecessary network power consumption.[7]

4.1.3 Application of type2 hypervisor

First, VMware's virtualization hypervisor can help users integrate existing IT resources in the way of server virtualization to improve the utilization of the company's CPU and memory resources. Second, VMware hypervisor can help us better manage the work flow of the entire platform, monitor the use of resources in real time, and quickly allocate virtual servers once there are new projects to improve operational efficiency. Finally, VMware add SWOT and TOWS analysis, the elastic architecture enables the platform to have good scalability. [8]

4.2 Type1 Microsoft hypervisor

4.2.1 Working principle

A thick software layer manages VM's hardware, runs on the VM monitoring machine as code on the basis of complex basic hardware. VMS accessed are independent. If one VM crashes, other VMS are not affected. Microsoft hypervisor can move between different clients easily. [6]

4.2.2 Technology used in type1 hypervisor

Microsoft Research uses VCC to validate Microsoft Hyper-V hypervisor. VCC has embedded specifications and annotations that validate low-level C code functional attributes, with the ultimate goal that all annotations will eventually be integrated into the code base and that software developers can maintain deficiencies to manage procedural layer deficiencies and adjust new patterns.[9]

4.2.3 Application of type2 hypervisor

Hyper-V can help extend private cloud environments to provide more flexible on-demand IT distribution services. More efficient use of hardware, improved business continuity, and improved development and testing efficiency. After the desktop infrastructure is established, VMS in the VM pool can be used by users when they are connected to the same server. [10]

5. Comparative analysis

Based on a review of the current literature on technology, hypervisor type 1 appears superior. VMware supports a broader range of operating systems, enhancing user accessibility, while Hyper-V is limited to Windows, Linux, and FreeBSD. VMware's processor-based pricing may reduce costs for large enterprises compared to Hyper-V's core-based pricing. The latest iteration of VMware's technology also shows enhanced performance stability. Consequently, I choose Hypervisor type 1 for its superior features and performance. [11]

6. Conclusion

In summary, this paper is structured into six sections to present its findings. The two types of virtual hypervisors exhibit distinct advantages across various applications, with type 1 hypervisors demonstrating marginal superiority. However, this study does possess certain limitations. The efficacy of the chosen virtual hypervisor varies according to distinct needs and contexts. Additionally, the survey results may be subject to temporal limitations. During the investigative process, it is advisable to broaden the types of survey subjects for comparison to enhance the overall data validity.

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