

Chapter 3

Cloud Infrastructure: Virtualization

Yushi Shen

Microsoft Corporation, USA

Yale Li

Microsoft Corporation, USA

Ling Wu

EMC² Corporation, USA

Shaofeng Liu

Microsoft Corporation, USA

Qian Wen

Endronic Corp, USA

ABSTRACT

This chapter focuses on the different aspects of cloud computing virtualization. It introduces the fundamental concepts of computer virtualization, storage virtualization, network virtualization, and application virtualization. Virtualization techniques, infrastructure, components, and implementation are described in detail.

VIRTUALIZATION OVERVIEW

What is virtualization? According to Wikipedia, virtualization is the creation of a virtual version of something, such as a hardware platform, operation system, storage devices or network resources. (Wikipedia – Virtualization)

A virtual computer is a logical representation of a computer in software. By decoupling the physical hardware from the operating system, virtualization provides more operational flexibility, and increases the utilization rate of the underlying physical hardware.

Virtualization overcomes the limitations of physical resources, and enables a single physical resource such as server, desktop, storage array or network switch to function as multiple resources, or multiple resources to function as a single resource. It uses the abstraction layer to hide the physical nature of the resources from the users.

When people talk about virtualization, they usually imply system virtualization, one computer appearing to be multiple computers (virtual machine). Each virtual machine has its own CPU, memory, network interface, storage disk and operating system. To the user, it looks like these virtual

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machines are separate computers with their own network identity, applications, and user security. Therefore, virtualization is a technique for hiding the physical characteristics of the computing resources, in a way other systems, applications or end users can interact with those resources.

VIRTUALIZATION PROCESSES

Virtualization is achieved through three key processes: Encapsulation, Isolation and Partitioning.

- Encapsulation is to take a virtual machine, and turn it into a set of VDM files that can easily be copied, moved and backed up. Virtualized servers are encapsulated in storage, allowing the servers and applications to be moved, migrated or deployed.
- Isolation is to hide one virtual machine from another, running on the same hardware platform. So that when one virtual machine crashes, the other virtual machines on the same host remains unaffected.
- Partitioning is to divide the physical resources on a server, so that each virtual machine can access the resources it needs. This can increase server utilization and lower the operation costs.

Virtualization Types

Virtualization allows the sharing of resources between applications, clients and systems. The concept of virtualization includes virtualizations at different hardware resource levels:

- **Server Virtualization:** Enables a single physical server to operate as multiple servers, and in the multiple virtual environments. (Rouse, 2009)
- **Network Virtualization:** Combines the network resources and functionalities, of both hardware and software, into a single

and centrally administered virtual network. Network virtualization allows the segmentation and isolation of network entities. (Lippis III, 2007)

- **Storage Virtualization:** Groups multiple network storage devices into a single virtual storage device, by virtual provisioning, block storage virtualization, file virtualization, virtual storage area networks and logical storage area networks (Rouse, 2006):
- **Virtual Provisioning:** Allocates storage capacity from a centralized pool of disks, according to application requirements. Virtual provisioning improves storage utilization by enabling storage capacities to be allocated on demand;
- **Block storage Virtualization:** Enables the user to move data while keeping applications online. Block storage virtualization optimizes storage resources and enhances performance, availability and data protection;
- **File Virtualization:** Enables the movement of unstructured data without disrupting the application;
- **Virtual Storage Network (VSAN) or Logical Storage Area Network (LSAN):** SAN is used to attach storage devices to servers. VSAN is a virtual SAN, and LSAN is a logical SAN. VSANs are a collection of ports from the switch, while LSANs can span multiple physical fabrics, and allow specific devices on the networks to get connected, and start communicating.

(EMC² Corporation, Virtualized data center and cloud infrastructure)

Advantages of Virtualization

Virtualization can help businesses improve on performance and profitability, while reducing costs. Through hardware consolidation and network resource sharing, virtualization can optimize

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