Cloud Computing
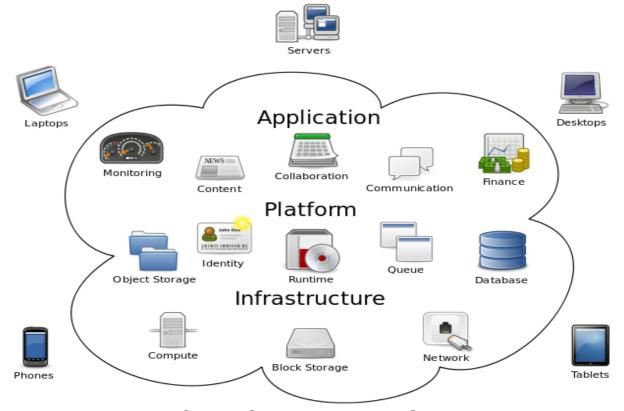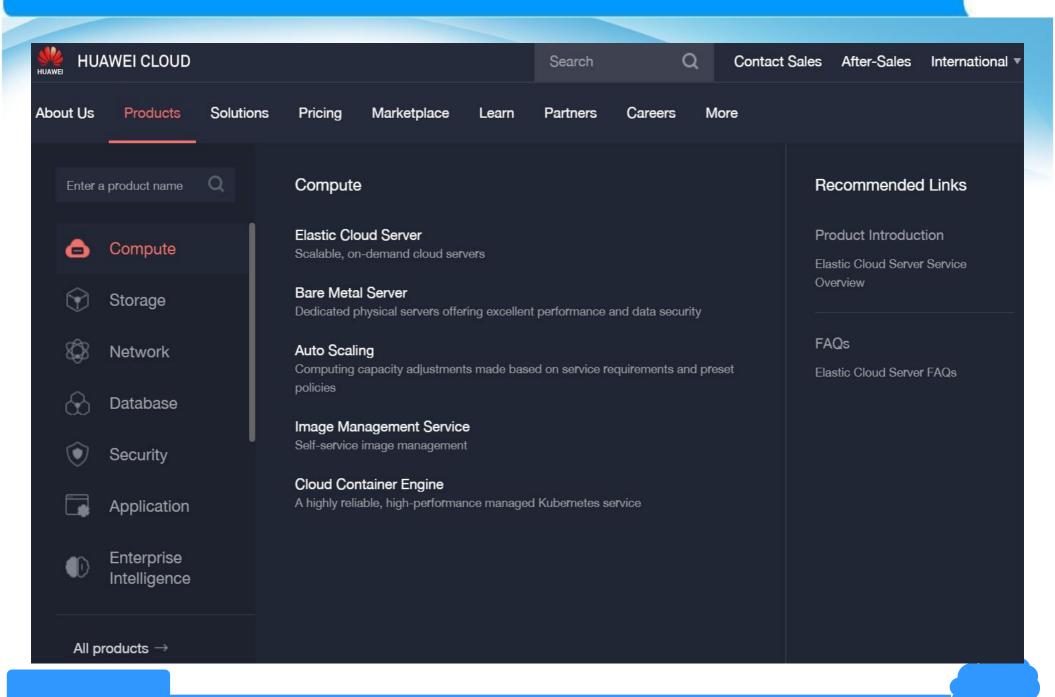
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Cloud Computing

Contents

1. Introduction to distributed systems.
2. Overview of Cloud Computing; Advantages.
3. History.
4. Characteristics.
5. Service and Deployment Models.
6. Concepts of cloud computing services
   - such as Infrastructure as a Service (IaaS) Platform as a Service (PaaS) and Software as a Service (SaaS).
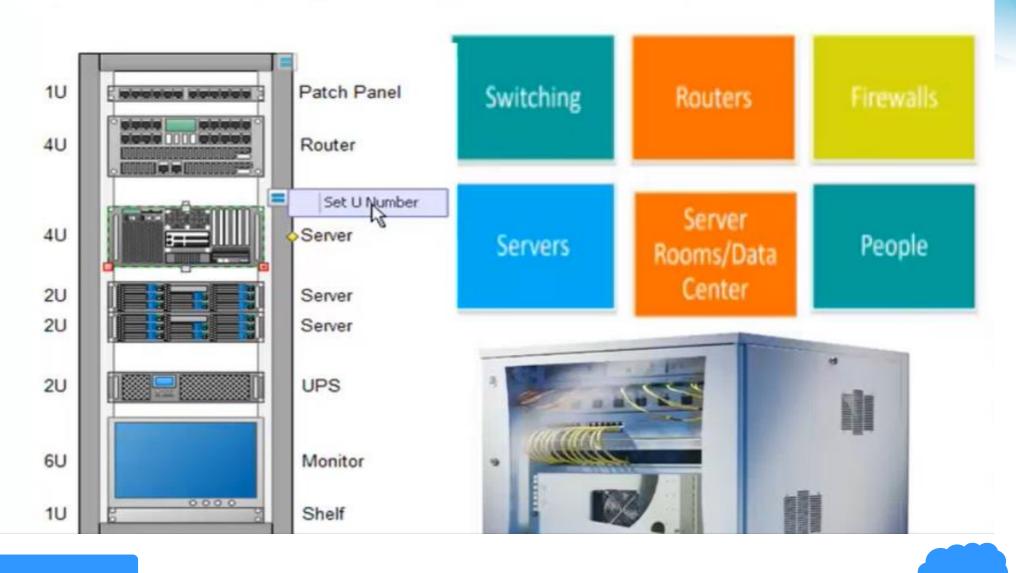   - Virtualization Concepts.
   - Migration Approaches.
   - Resource.

What is Cloud Computing?
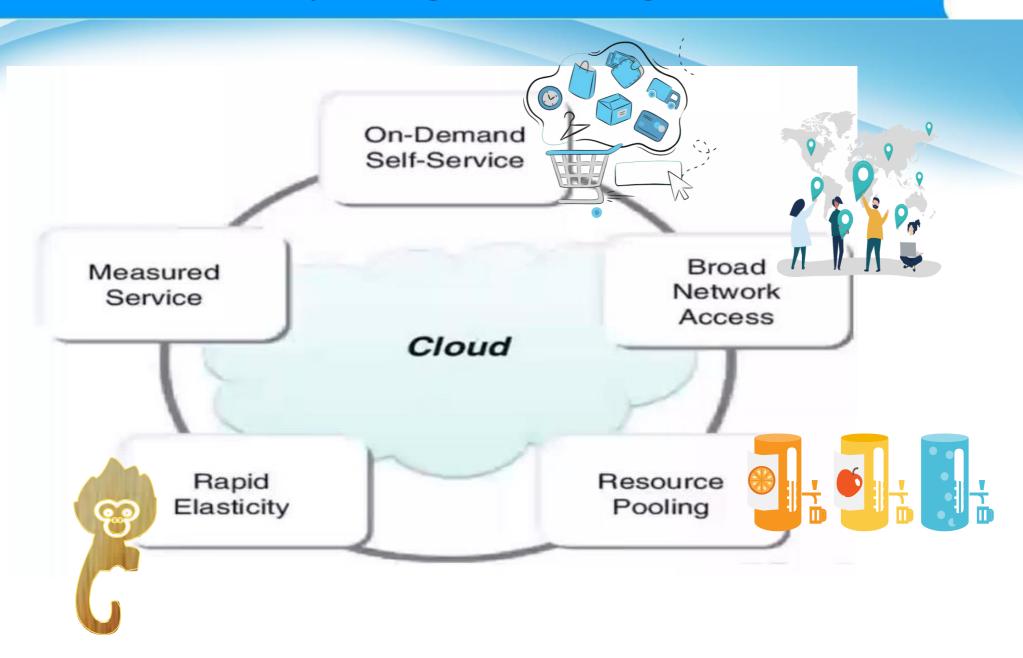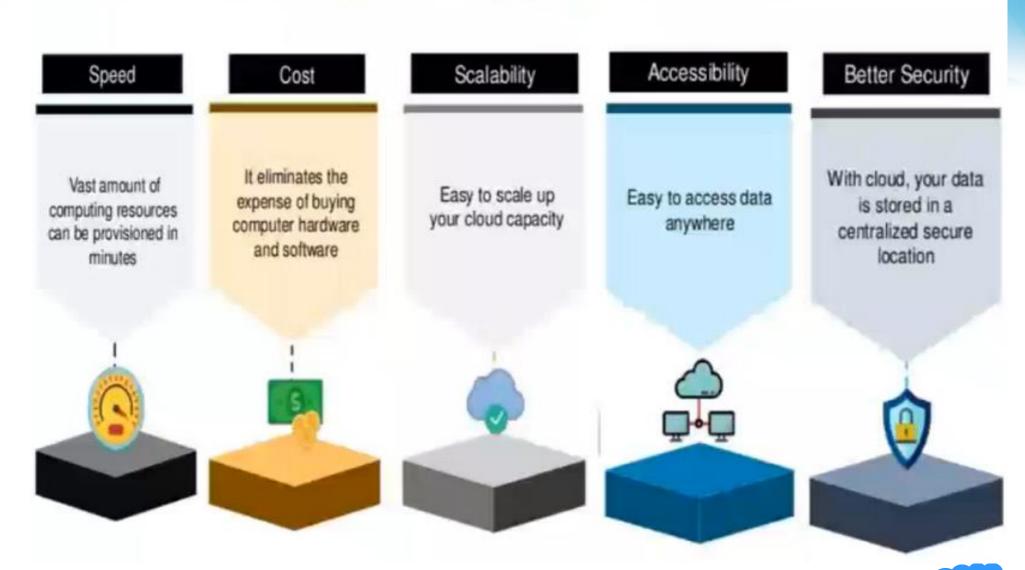
Cloud Computing Advantages

Cloud Computing Advantages
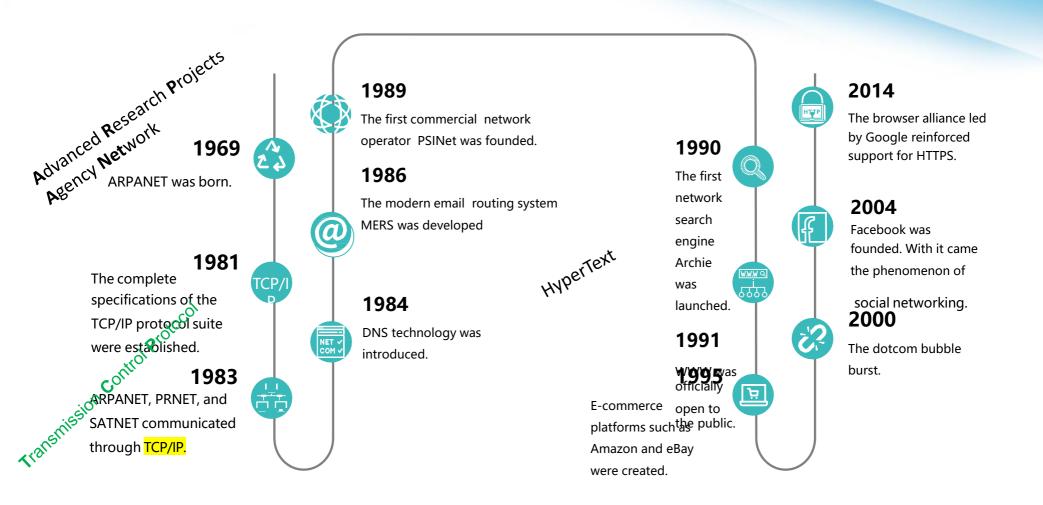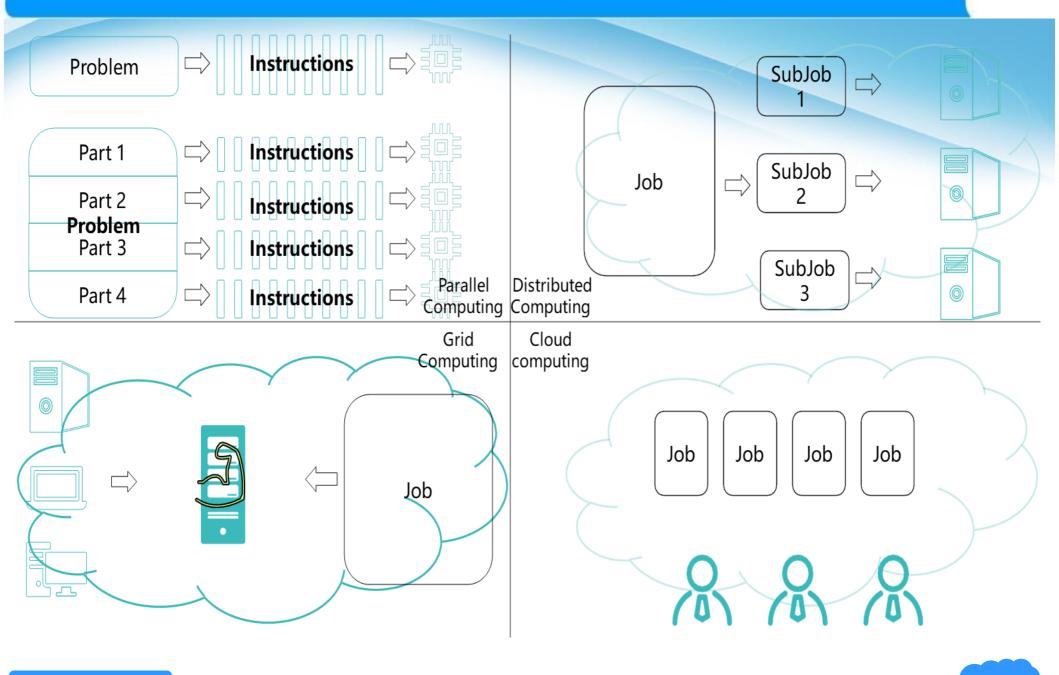
Cloud Computing Benefits:

Speed	Cost	Scalability	Accessibility	Better Security
Vast amount of computing resources can be provisioned in minutes	It eliminates the expense of buying computer hardware and software	Easy to scale up your cloud capacity	Easy to access data anywhere	With cloud, your data is stored in a centralized secure location

A Brief History of the Internet

Advanced Research Projects Agency Network

Transmission Control Protocol

1969

ARPANET was born.

1981

The complete specifications of the TCP/IP protocol suite were established.

1983

ARPANET, PRNET, and SATNET communicated through TCP/IP.

1989

The first commercial network operator PSINet was founded.

1986

The modern email routing system MERS was developed

1984

DNS technology was introduced.

HyperText

1990

The first network search engine Archie was launched.

1991

WWW was officially open to the public.

1995

E-commerce platforms such as Amazon and eBay were created.

2014

The browser alliance led by Google reinforced support for HTTPS.

2004

Facebook was founded. With it came the phenomenon of social networking.

2000

The dotcom bubble burst.

A Brief History of Computing

A Brief History of Computing

Parallel Computing

Problem

Part 1

Part 2

Problem

Part 3

Part 4

Instructions

Instructions

Instructions

Instructions

Instructions
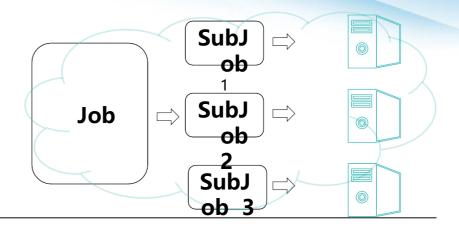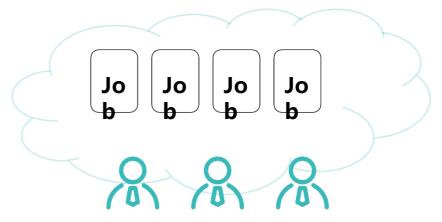
Distributed Computing

Job

SubJob 1

SubJob 2

SubJob 3

Grid Computing

Instructions

Job

Cloud computing

Job

Job

Job

Job

Cloud Computing Evolution

Cloud computing 2.0

Cloud computing 1.0

Cloud computing 3.0

Software-defined, integration

Computing virtualization

Cloud native, app redesign

OpenStack

VMware   AWS

Hyper-V

Xen KVM

Vmware ESX

Docker
CoreOS
Cloud Foundry

Cloud-based infrastructure

Standardization and automation of

resource services

Cloud-native applications

Agile application development

and lifecycle management
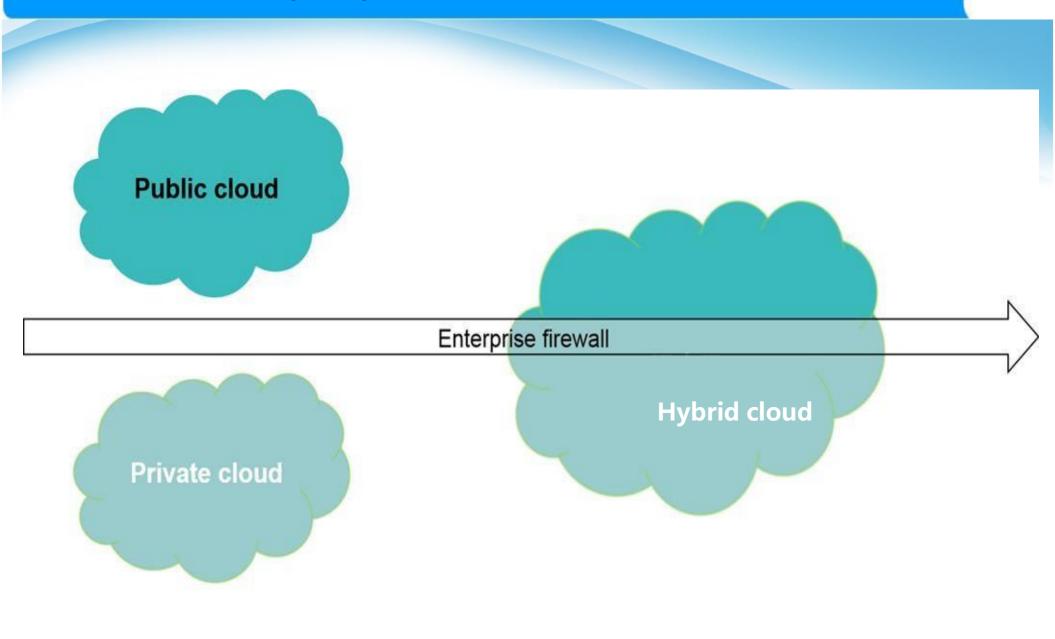
Virtualization

Higher resource utilization

Cloud Deployment Models

Cloud Service Models

Layers	Traditional	IaaS	PaaS	SaaS
Applications	Applications	Applications	Applications	Applications
DATA	DATA	DATA	DATA	DATA
Runtime environment	Runtime environment	Runtime environment	Runtime environment	Runtime environment
Middleware	Middleware	Middleware	Middleware	Middleware
OS	OS	OS	OS	OS
Virtualization	Virtualization	Virtualization	Virtualization	Virtualization
Compute resources	Compute resources	Compute resources	Compute resources	Compute resources
Storage resources	Storage resources	Storage resources	Storage resources	Storage resources
Network resources	Network resources	Network resources	Network resources	Network resources

SW
Pf
I.S.

In-house

In-house
Cloud service provider

In-house
Cloud service provider
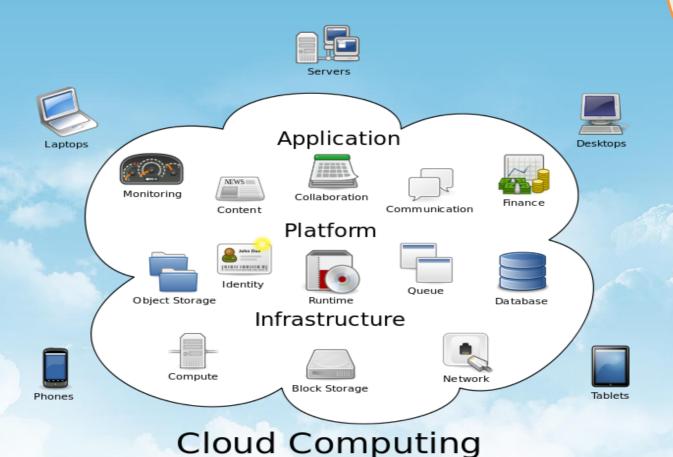
Cloud service provider

Cloud service models

Quiz

1. Which of the following services offered by HUAWEI CLOUD (public cloud) falls

- into the category of SaaS services?

A. Elastic Cloud Server (ECS)

B. Facial recognition

C. Elastic Volume Service (EVS)

D. Object Storage Service (OBS)

Quiz

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    C. Elastic Volume Service (EVS)

    D. Object Storage Service (OBS)

2. The measurable service characteristic of cloud computing means that users pay for how long and how much they use the cloud service.

    A. TRUE

    B. FALSE

Quiz

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- into the category of SaaS services?

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   A. TRUE

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Cloud Computing
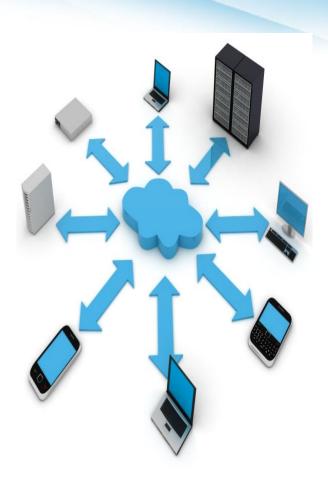
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3

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   - Virtualization Concepts.
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   - Resource.

Foreword

- Cloud computing 1.0 focused on **virtualization** which today has become the foundation of cloud computing. This chapter focuses on the **architecture** and **technologies** involved in compute virtualization.
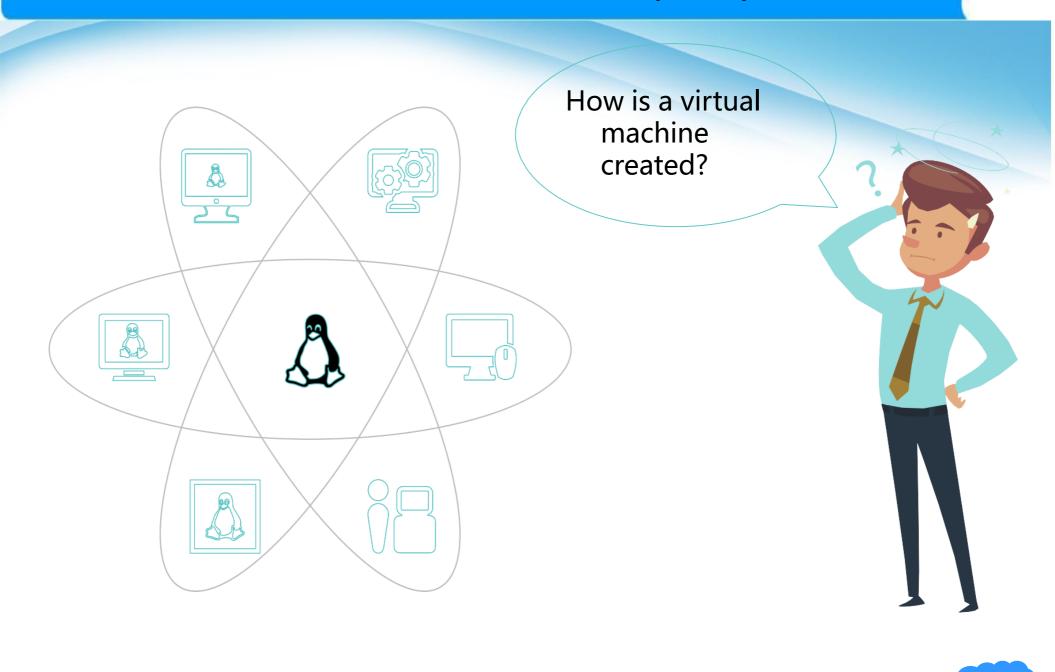
❑ Objectives

- Upon completion of this course, you will:

  - ➢ Be able to describe what virtualization is.

  - ➢ Understand the differences between virtualization and cloud computing.

  - ➢ Understand KVM technology.
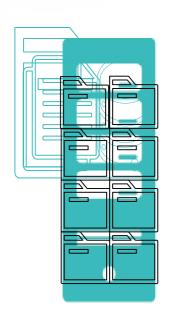
  - ➢ Understand Huawei's FusionSphere virtualization.

Introduction to Compute Virtualization

Contents

1. **Introduction to Virtualization**

2. Introduction to KVM

3. Introduction to FusionCompute
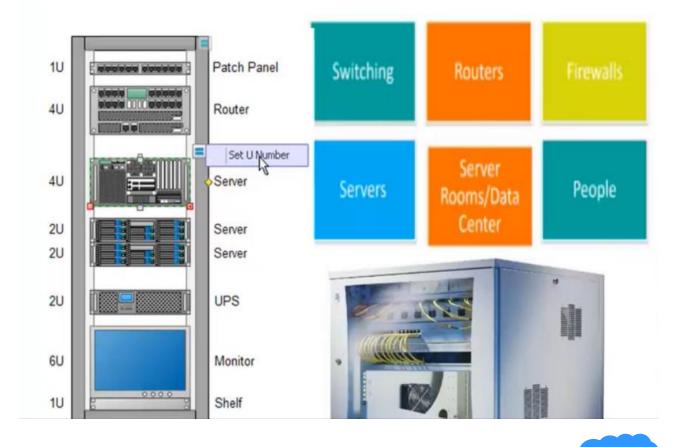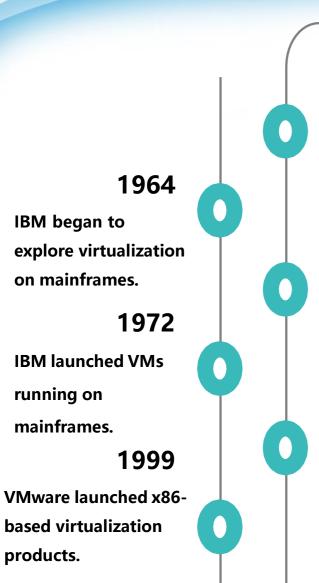
What's a Virtual Machine (VM)?

Datacenter components:

1U	Patch Panel
4U	Router
4U	Server
2U	Server
2U	Server
2U	UPS
6U	Monitor
1U	Shelf

Switching

Routers

Firewalls

Servers

Server Rooms/Data Center

People

A Brief History of Compute Virtualization

2007

HP launched HP-UX Integrity VMs.

1964

IBM began to explore virtualization on mainframes.

1972

IBM launched VMs running on mainframes.

1999

VMware launched x86-based virtualization products.

2006

Qumranet first announced KVM.

2002

Xen was officially open sourced.

2008

Microsoft added Hyper-V in Windows Server 2008 R2.

2008

Linux Container LXC was launched.

2008

By default, RHEL 6.0 supported KVM as the only virtualization option.

2014

Rocket was launched.

2013

was launc Dockerhed.

2011

IBM, Red Hat, HP, and Intel formed the Open Virtualization Alliance to accelerate KVM adoption.

Important Concepts in Compute Virtualization

Physical Server

- Application
- Host OS
- Host Machine

Virtual Machine

- Application
- Guest OS
- Guest Machine
- Virtual Machine Monitor (Hypervisor)
- Host Machine

Guest OS:

Operating system running in a virtual machine (VM)

Guest Machine:

Virtual machine created through virtualization

Hypervisor:

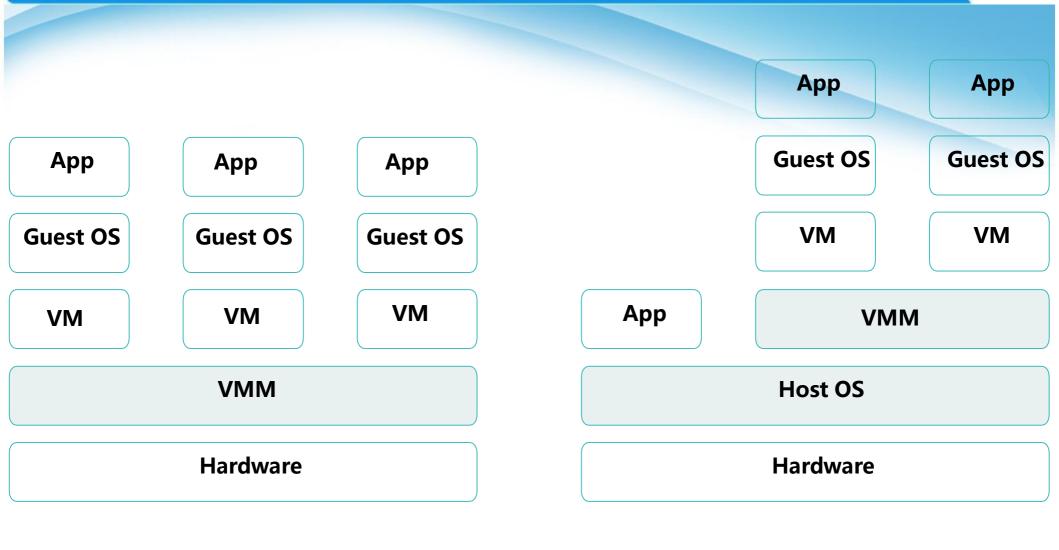Virtualization software

layer, or Virtual Machine

Monitor (VMM) Host OS:

Operating system running in a physical machine
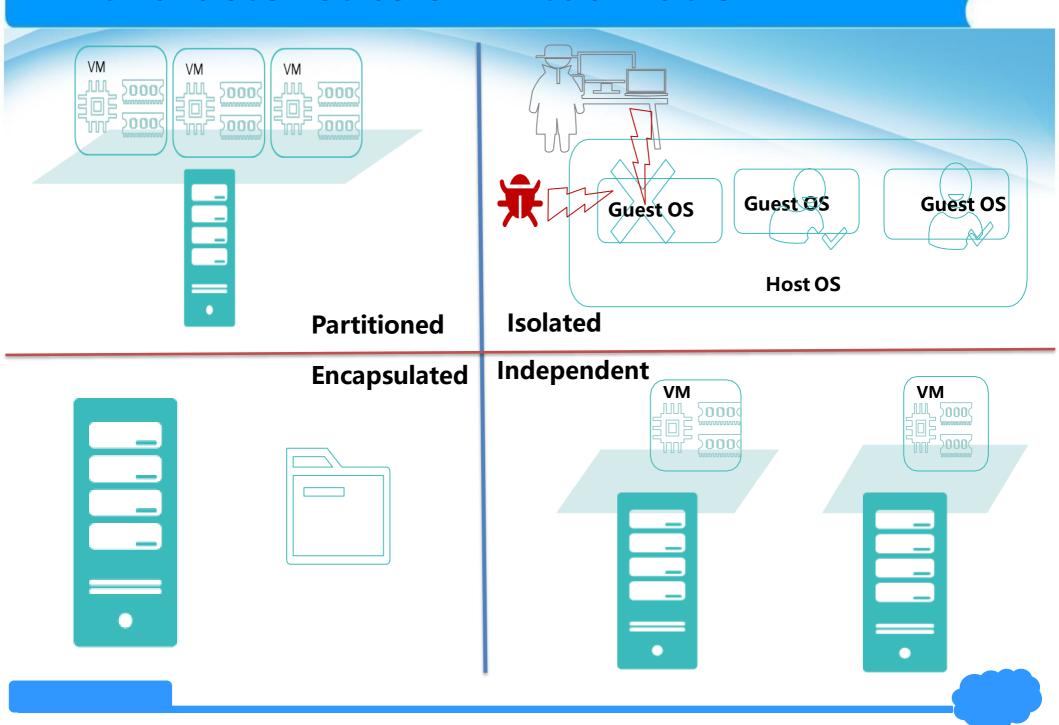
Host Machine:

Physical machine

Types of Compute Virtualization

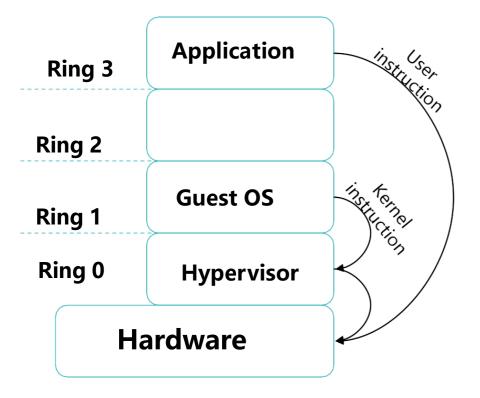| App	App	App
Guest OS	Guest OS	Guest OS
VM	VM	VM

VMM

Hardware

Bare-Metal Virtualization (Type 1)

	App	App
	Guest OS	Guest OS
	VM	VM
App	VMM	

Host OS

Hardware

Hosted Virtualization (Type 2)

Characteristics of Virtualization

Partitioned

Isolated

Encapsulated

Independent

VM

VM

VM

Guest OS

Guest OS

Guest OS

Host OS

VM

VM
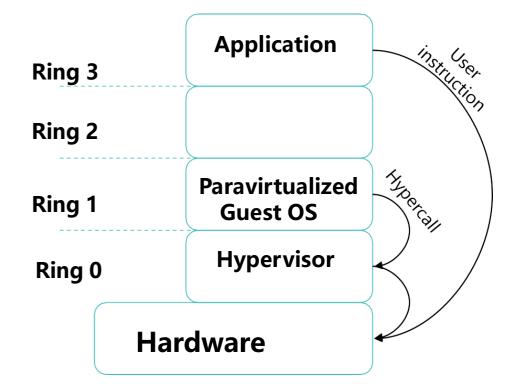
CPU Virtualization

Full virtualization

Ring 3

Ring 2

Ring 1

Ring 0

Application

Guest OS

Hypervisor

Hardware

User instruction

Kernel instruction

Paravirtualization

Ring 3

Ring 2

Ring 1

Ring 0

Application

Paravirtualized Guest OS

Hypervisor

Hardware

User instruction

Hypercall

Memory Virtualization

VM1 VM2 VM3 VM4
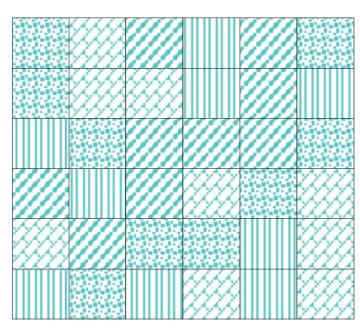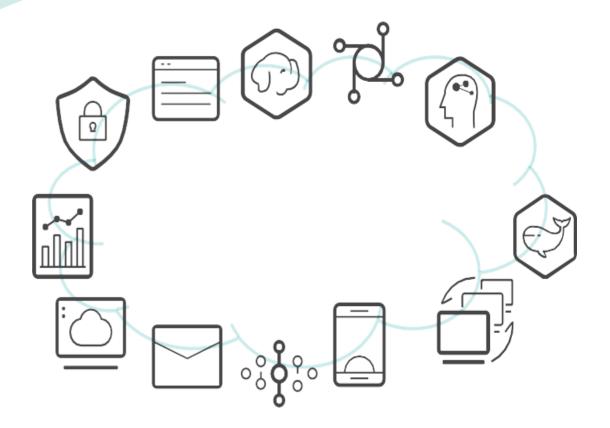
VM memory

Host memory

I/O Virtualization

- Emulation [Full Virtualization]: Complete simulation of the hardware, for example, keyboard and mouse. Access to such hardware depends on the capture of focus by the host, and leads to poor performance in some cases.

- Paravirtualization: Access to hardware drivers is transferred from the I/O frontend to the I/O backend. This mode is usually only used for hard disks and NICs, and delivers high performance.

- IO-through: Hardware devices capable of I/O passthrough, such as hard disks and NICs, are directly allocated to VMs. In Xen, Dom0 allocates hardware devices but does not take part in the access of the hardware. Hardware support is required.
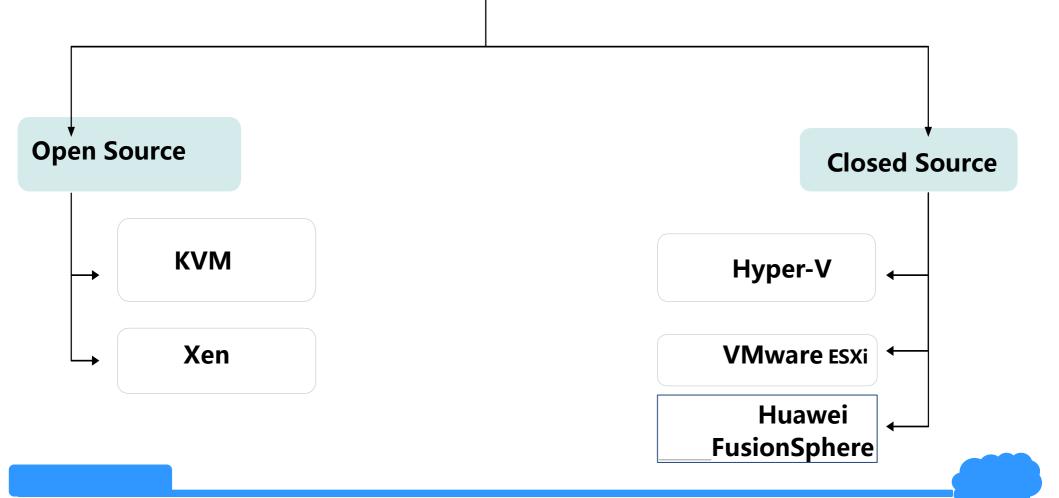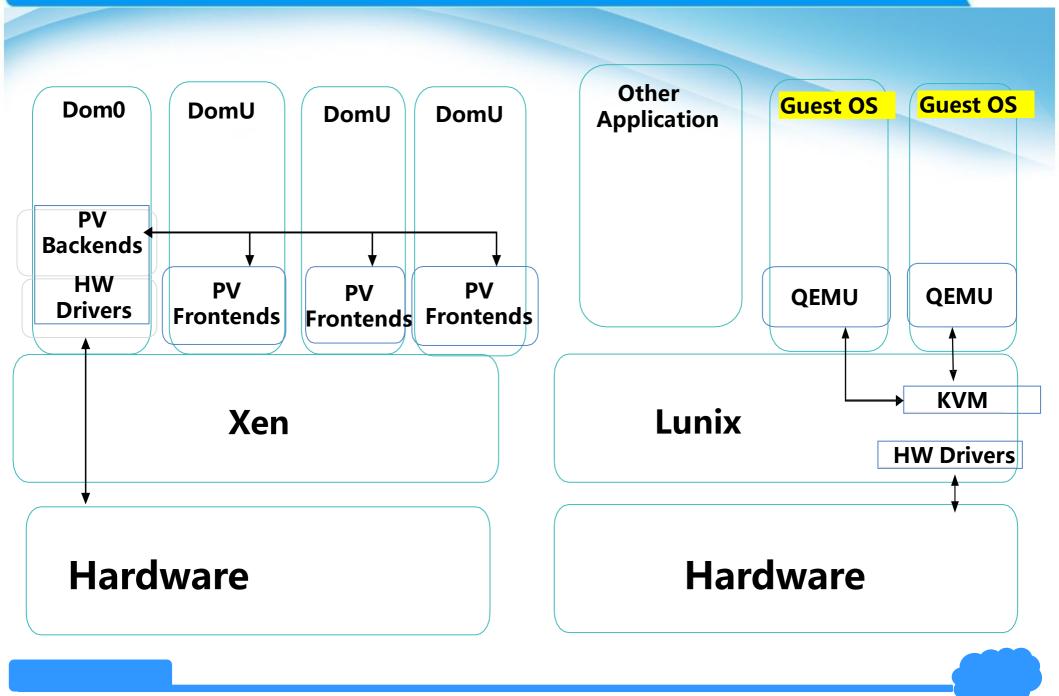
Cloud Computing and Virtualization

Mainstream Compute Virtualization Technologies

Compute Virtualization

CPU virtualization, memory virtualization, I/O virtualization
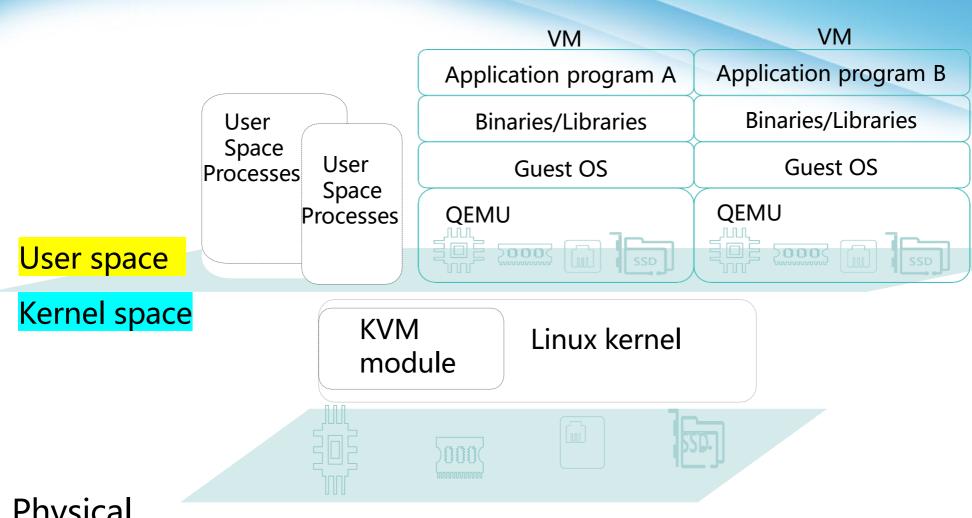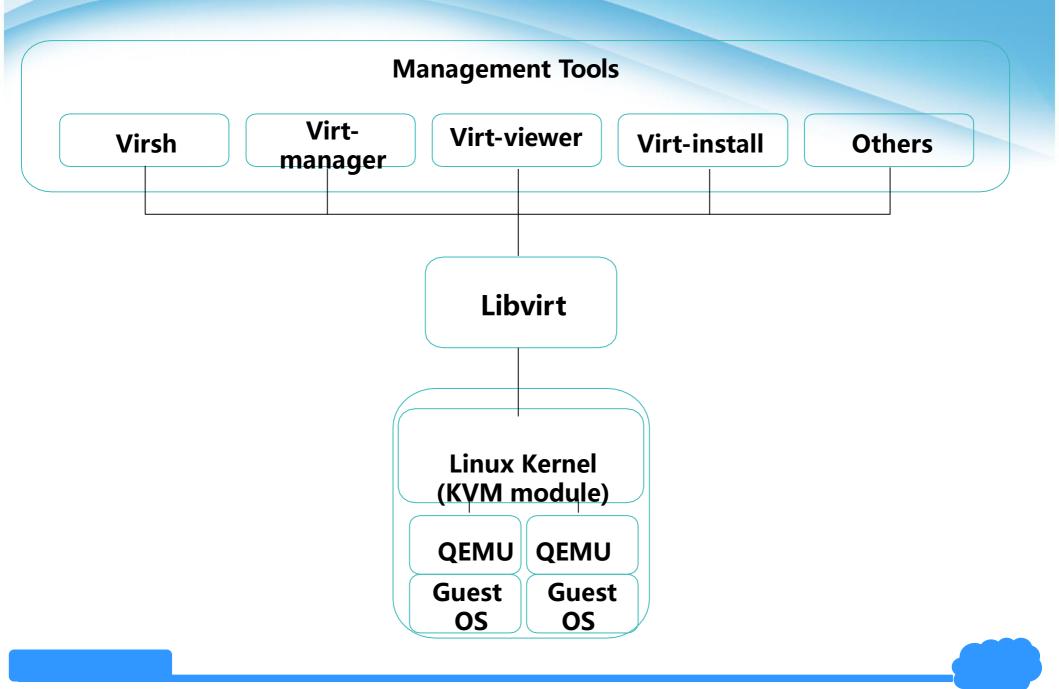
Open Source

- KVM
- Xen

Closed Source

- Hyper-V
- VMware ESXi
- Huawei FusionSphere

Xen vs. KVM

Contents

1. Introduction to Virtualization

2. **Introduction to KVM**

3. Introduction to FusionCompute

What is KVM?

VM

Application program A

Binaries/Libraries

Guest OS

QEMU

VM

Application program B

Binaries/Libraries

Guest OS

QEMU

User Space Processes

User Space Processes

User space

Kernel space

KVM module

Linux kernel

Physical hardware

KVM Architecture

Management Tools

| Virsh | Virt-manager | Virt-viewer | Virt-install | Others |

Libvirt

Linux Kernel (KVM module)

| QEMU | QEMU |
| Guest OS | Guest OS |

Libvirt

VM (Guest OS)	VM (Guest OS)

Hypervisor

Linux host

Node

>>>

VM (Guest OS)		VM (Guest OS)

Hypervisor **Manage-ment Tools** **Hypervisor**

Libvirt

Linux host

Node

KVM I/O Process - Default

KVM I/O Process - Virtio

QEMU

Virtio Backend Driver

vring

Guest OS

Virtio Frontend Driver

1   8

2

3

6   7

Notification

I/O Trap Code

KVM Module

4

Linux Kernel

Device Driver

5

Physical Hardware

Contents

1. Introduction to Virtualization

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3. **Introduction to FusionCompute**

FusionCompute Architecture

VRM

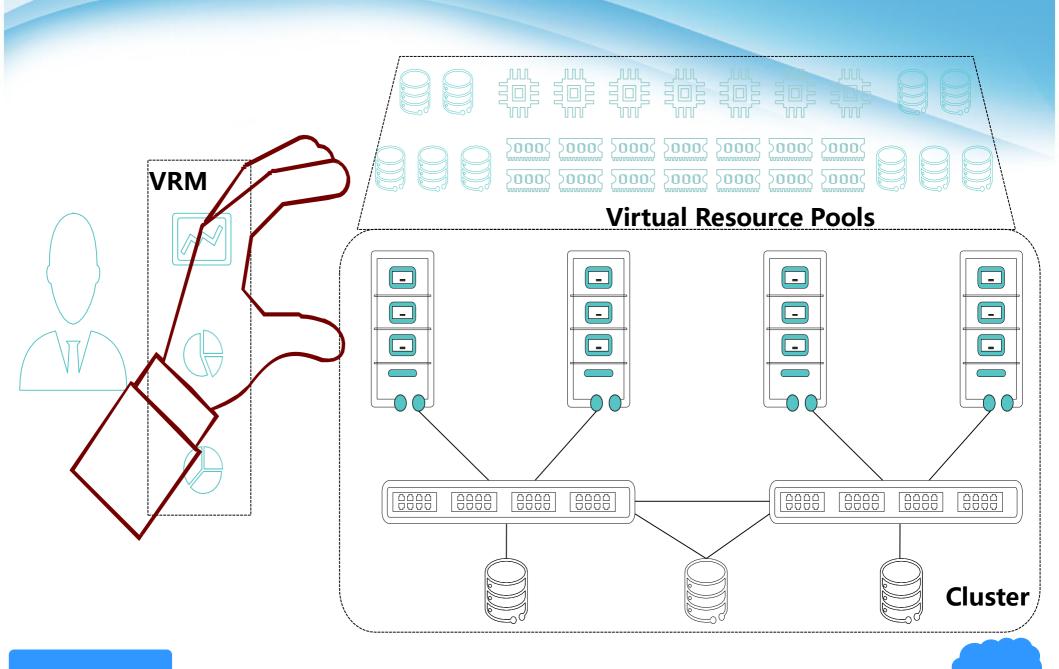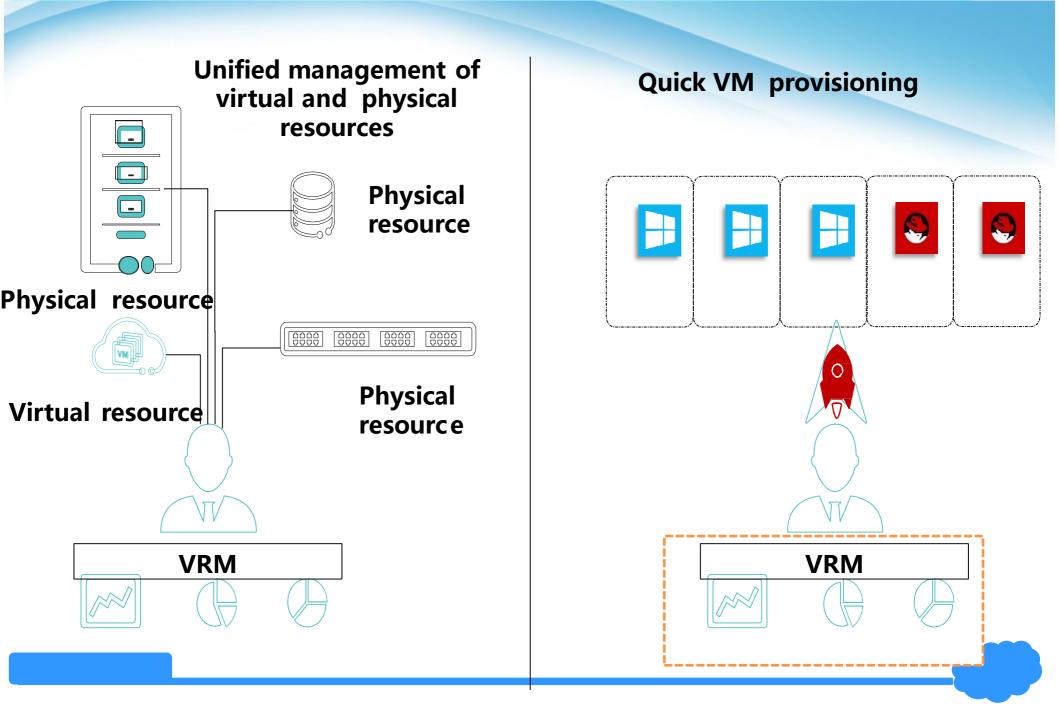Virtual Resource Pools

Cluster

FusionCompute Advantages

Unified management of virtual and physical resources

Physical resource

Physical resource

Virtual resource

Physical resource

VRM

Quick VM provisioning

VRM

Functions of FusionCompute Components

Component	Function
CNA	CNA provides the following functions: • Provides virtual computing functions. • Manages VMs on compute nodes. • Manages compute, storage, and network resources on compute nodes.
VRM	VRM provides the following functions: • Manages block storage resources in clusters. • Manages network resources, such as IP addresses and VLANs in clusters, and assigns IP addresses to VMs. • Manages the lifecycle of VMs in clusters, and allocates and migrates VMs across compute nodes. • Dynamically schedules resources in clusters. • Manages virtual resources and user data in a unified manner and provides elastic computing, storage, and IP address services. • Provides a unified Web UI portal, allowing O&M engineers to remotely access the FusionCompute system to monitor and manage resources, and create and view resource reports.

FusionCompute Advantages

1. In compute virtualization, which of the following allocates CPU and memory resources to VMs?

   A. Guest OS

   B. VMM

   C. Hypervisor

   D. Host OS

2. All open-source virtualization technologies are type 1 virtualization, while all closed-source ones are type 2 virtualization.

   A. TRUE

   B. FALSE

Summary

- This chapter provides basic knowledge about compute virtualization, including CPU, memory, and I/O virtualization. It introduces you to open-source virtualization technology by using KVM as an example, and also to commercial virtualization products by using FusionCompute as an example.

FusionCompute Advantages