

Chapter 9: Virtualization and Cloud Computing



IT Essentials 7.0



Chapter 9 - Sections & Objectives

- 9.1 Virtualization
 - Install a virtual machine on a computer.
 - Explain server virtualization.
 - Install virtualization software on a computer.
- 9.2 Cloud Computing
 - Compare cloud computing concepts.
 - Describe the uses of the cloud.
 - Explain characteristics of public, private, hybrid and community cloud computing.



9.1 VIRTUALIZATION



Cloud Computing and Virtualization

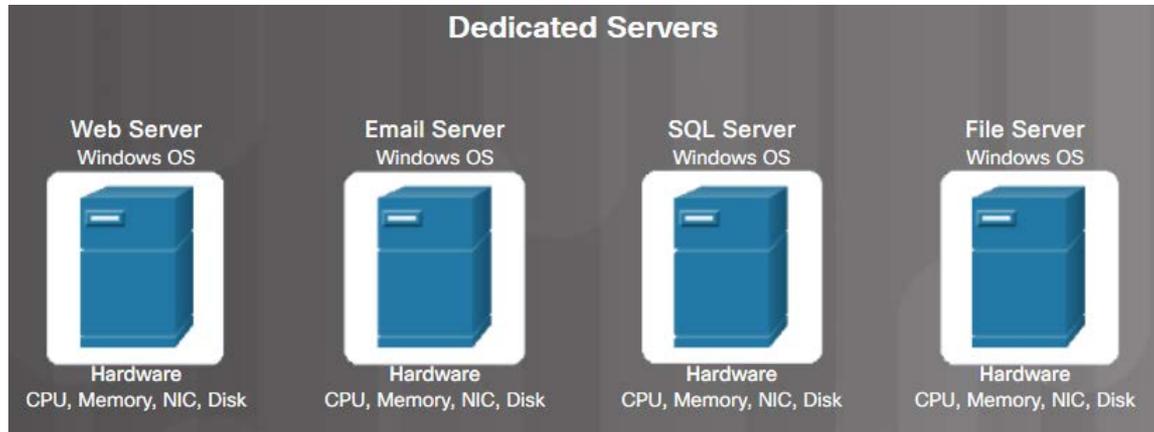
- Virtualization enables a single computer to host multiple independent virtual computers called **virtual machines (VM)** that share the host computer hardware.
- Virtualization software separates the actual physical hardware from the VM instances.
- An image of a VM can be saved as a file and then be re-started when required.
 - Cloud computing separates the applications from the hardware.
 - Service providers such as Amazon Web Services (AWS) own and manage the cloud infrastructure.
- Virtualization is the foundation which supports cloud computing.





Traditional Server Deployment

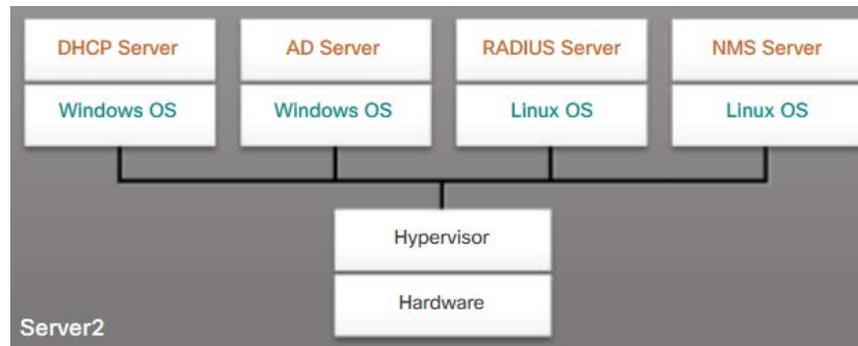
- Traditionally, organizations delivered applications and services using powerful dedicated servers.
- These dedicated servers are equipped with large amounts of RAM, powerful CPUs, and multiple large storage devices.
- Disadvantages include: wasted resources, single-point of failure, and server sprawl.





Server Virtualization

- Server virtualization takes advantage of idle resources to reduce the number of servers required.
- A program called the **hypervisor** is used to create and manage computer resources and multiple VM instances.
- It provides VMs access to the hardware in the physical machine such as CPUs, memory, disk controllers, and NICs.
- Each VM runs a complete and separate operating system.





Advantages of Server Virtualization

- Better use of resources
- Less space required
- Less energy consumed
- Reduced cost
- Faster server provisioning
- Maximize server uptime
- Improved disaster recovery
- Support for legacy systems





Boot Options

■ Dual Boot

- You can have multiple operating systems installed on a single PC.
- Each OS must be on its own hard drive or partition.
- The Boot Loader (boot.ini) allows you to choose between them at boot time.

■ Client-Side Virtualization

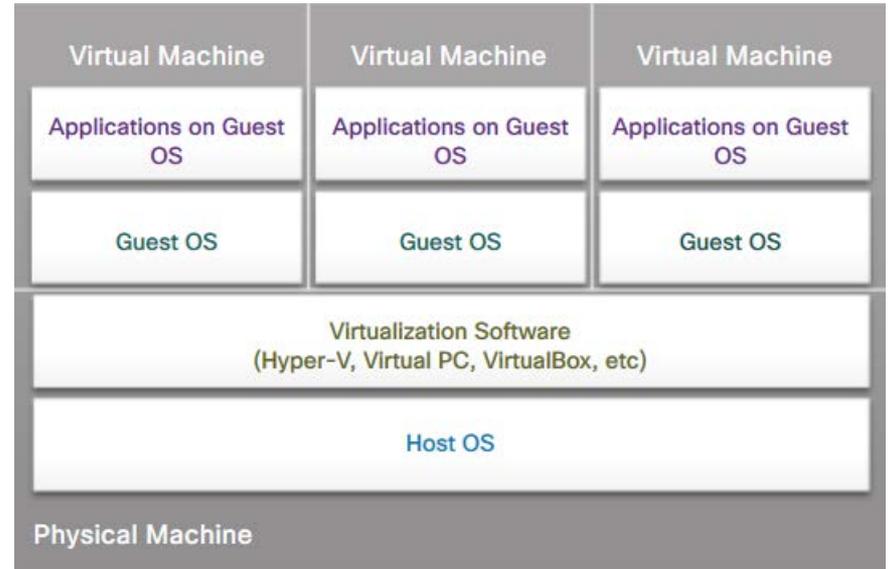
- Occurs when a host machine uses its system resources to host a virtual machine sometimes called a guest.
- A host machine must be a physical machine that is powered on and controlled by a user.
- A virtual machine uses the system resources on the host machine to boot and run an OS.
- The OS of the virtual machine is independent of the OS installed on the host machine.





Client-Side Virtualization

- Client-side virtualization enables users to run VMs on their local computer.
- Allows users to test new operating systems, software, or to run older software.
- **Host computer** – The physical computer controlled by a user.
- **Host OS** - The operating system of the host computer.
- **Guest OS** - The operating system that is running in the VM.





Client-Side Virtualization

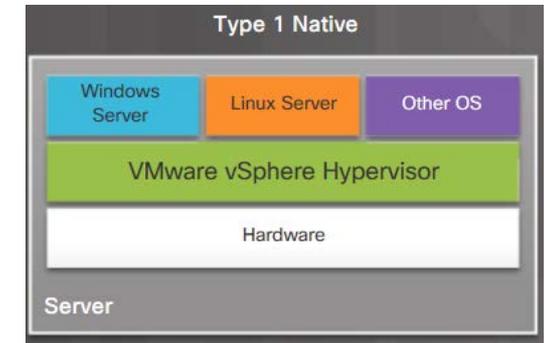
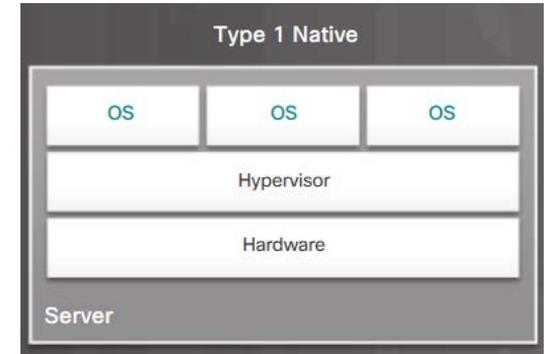
▪ Benefits

- Smaller physical footprint
- Less power and AC requirements
- Centralized management capability
- Lower costs because corporate images are managed centrally on a server
- Protection of corporate data and virtual images through centralized management of security policies
- Improved user experience due to local execution of applications
- Allows multiple operating systems to run on a single PC simultaneously.
- Allows for the creation of a VM to support applications not supported by the host OS.



Type 1 Hypervisors

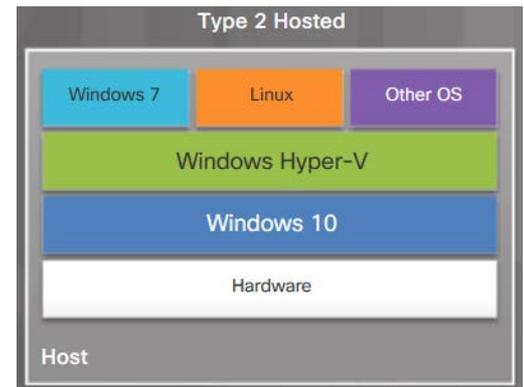
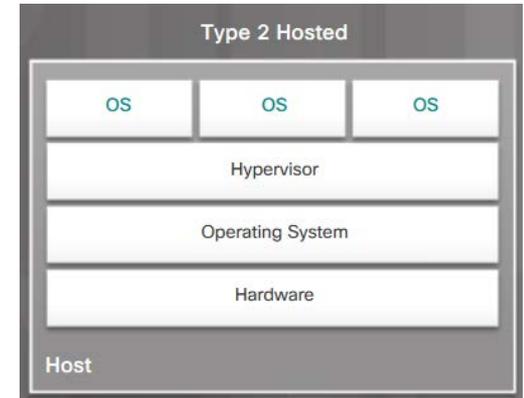
- Also known as **native** hypervisor.
- Typically used with server virtualization. For example, they are used in data centers and cloud computing.
- Runs directly on the hardware of a host and manage the allocation of system resources to VMs.
- Installed directly on a server.
- Type 1 hypervisors include VMware vSphere / ESXi, Xen, and Oracle VM Server.





Type 2 Hypervisors

- Also known as **hosted** hypervisors.
- Commonly used with client-side virtualization.
- Work with the host computer to create and use multiple VMs.
- Does not require management console software.
- Type 2 hypervisors include VMware Workstation, Windows Hyper-V, and Oracle VirtualBox.





Virtual Machine Requirements

Windows Hyper-V Minimum Requirements for Windows 10

Host OS	Windows 10 Pro or Windows Server (2012 and 2016)
Processor	64-bit CPU with Second Level Address Translation (SLAT)
BIOS	CPU support for VM Monitor Mode Extension (VT-c on Intel CPUs)
Memory	Minimum 4GB system RAM
Hard Disk Space	At least 15GB per VM

Hyper-V is included in Windows 10 Pro



Virtual Machine Requirements

Windows Hyper-V Minimum Requirements for Windows 8

Host OS	Windows 8 Pro or Enterprise 64-bit OS
Processor	64-bit CPU with Second Level Address Translation (SLAT)
BIOS	BIOS-level Hardware Virtualization support
Memory	Minimum 4GB system RAM
Hard Disk Space	At least 15GB per Virtual OS



Virtual Machine Requirements

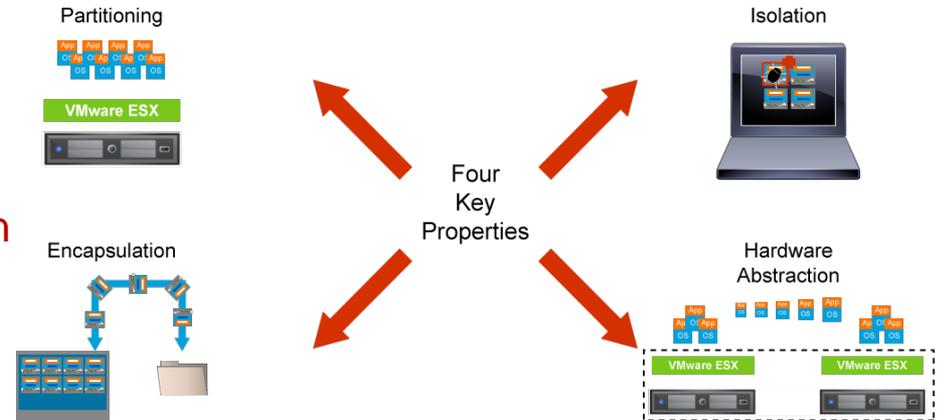
Windows Virtual PC Requirements in Windows 7

Processor	1 GHz 32-bit or 64-bit Processor
Memory	2GB
Hard Disk Space	At least 15 GB per Virtual OS



Key Concepts: VM Benefits

- **Partitioning** – A single host can serve many VMs. The memory capacity of a host and the memory requirements for VMs are a limiting factor.
- **Isolation** – VMs that share the same host are completely isolated from each other. The only operational hazard is improper design of resources that are shared, such as network bandwidth or disk access.
- **Encapsulation** – VMs are a set of files that describe files and define their resource usage and specify unique identifiers. As such, VMs are extremely simple to back up, modify, or even duplicate.
- **Hardware abstraction** – VMs are easily moved between hosts. Hardware abstraction simplifies maintenance and allows for load balancing of available physical server resources.



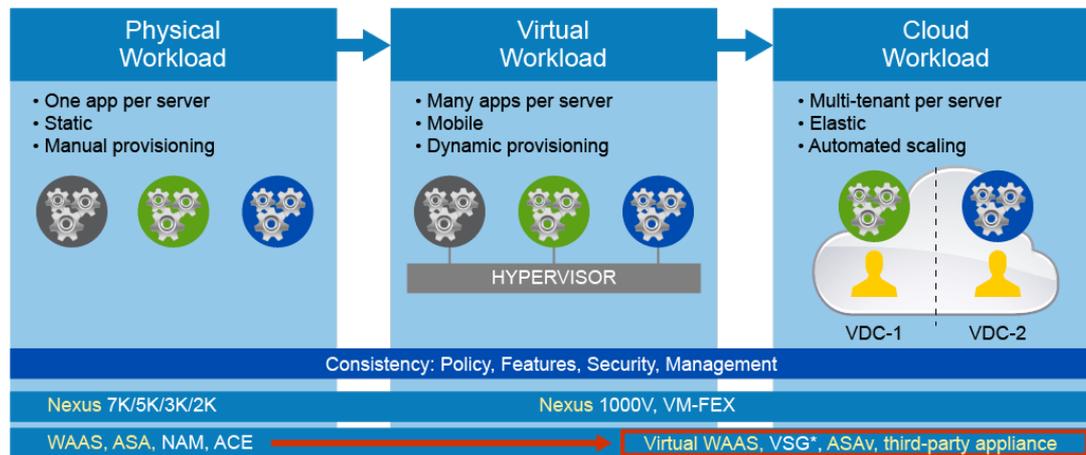


9.2 CLOUD COMPUTING



Journey into the Cloud

- Cloud computing allows applications to be accessed over the Internet by individual users or businesses using any device, anywhere in the world.
- Cloud Computing and Virtualization are not the same thing.
 - Cloud computing separates the application from the hardware whereas virtualization separates the OS from the underlying hardware.





Cloud Computing Characteristics

Rapid Elasticity

- Capabilities provisioned and released to scale outward and inward with demand.
- Capabilities often appear unlimited.

Resource Pooling

- Pooled to serve multiple consumers.
- Dynamically assigned and reassigned according to consumer demand.



On-Demand Self-Service

- Provision computing capabilities.
- Server time and network storage
- No human interaction

Broad Network Access

- Available over the network
 - Mobile phones, tablets, laptops, workstations

Measured and Metered Service

- Automatically control and optimize resources
- Usage can be monitored, controlled, and reported



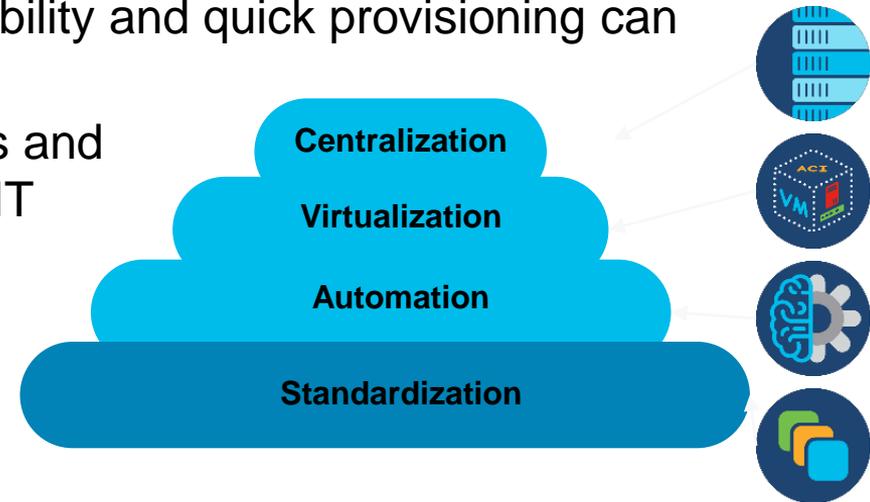
Cloud Computing Benefits

- **Corporate Benefits:**
 - The company only needs to pay for the amount of processing and storage capacity that it uses.
 - The company can increase processing and storage capacity as needed and then decrease capacity when it is no longer needed.
 - The company does not need to be concerned about how to handle increasing data storage and processing demands with in-house data center equipment.
- **Lab Benefits:**
 - Virus and worm attacks are more easily controlled in a virtualized environment, thus helping to protect the network and its devices from attack.
- **User Benefits:**
 - Allows users to access data anywhere and at any time



IT Principles that Form the Cloud

- Cloud computing is feasible due to the fundamental principles that are applied in modern IT infrastructures and data centers:
 - **Centralization** (such as consolidation) that aggregates the computing, storage, network, and application resources in central locations, or data centers
 - **Virtualization**, by which seamless scalability and quick provisioning can be achieved
 - **Automation**, which creates time savings and enables user-based self-provisioning of IT services
 - **Standardization**, which makes possible integration of components from multiple vendors





Cloud Services

- Cloud service providers can provide various services tailored to meet customer requirements:
 - Software as a Service (SaaS)
 - Platform as a Service (PaaS)
 - Infrastructure as a Service (IaaS)
 - Anything as a Service (XaaS)
- Each cloud model offers specific features and functionalities.

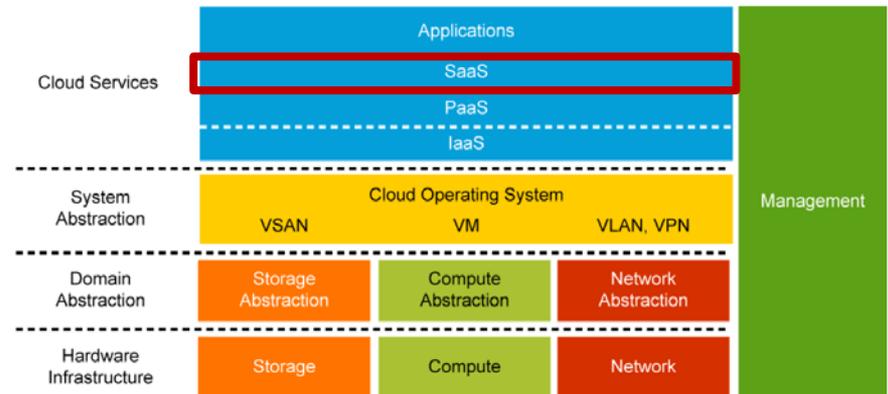
SaaS	<ul style="list-style-type: none">• Software applications (e.g., email, office 365, ..) are provided over the network on a subscription basis• Typically used by end users
PaaS	<ul style="list-style-type: none">• Includes tools and services used to deliver the applications• Includes OS and applications stack• Typically requested by application and software developers
IaaS	<ul style="list-style-type: none">• Includes network, computers (virtual or dedicated), and storage• Typically used by organization infrastructure and network architects



Cloud Architecture

▪ Software as a Service (SaaS)

- Also known as cloud application services.
- Utilizes the internet to deliver applications, which are managed by a third-party vendor, to its users.
- Reduces the time and money spent on tedious tasks such as installing, managing, and upgrading software.
- Most commonly utilized option for businesses in the cloud market.
- A majority of SaaS applications run directly through your web browser, which means they do not require any downloads or installations on the client side.
- **Best for an organization that does not have the technical knowledge to host and maintain applications at their local site.**





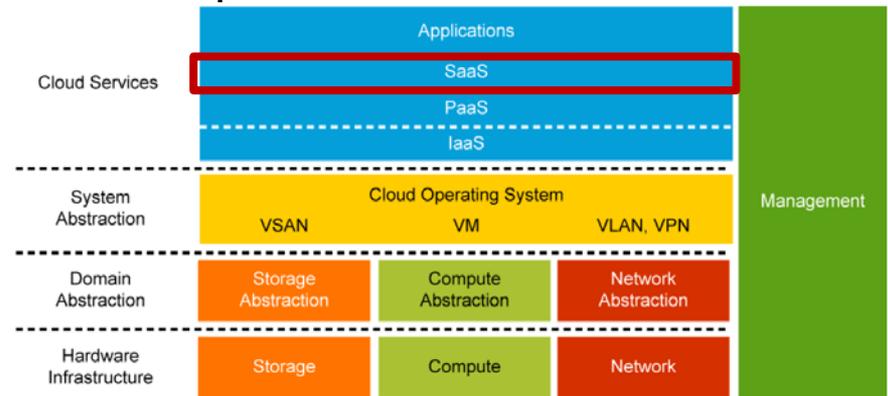
Cloud Architecture

■ SaaS Characteristics

- There are a few ways to help you determine when SaaS is being utilized:
- Managed from a central location
- Hosted on a remote server
- Accessible over the internet
- Users not responsible for hardware or software updates

■ Examples:

- Google Apps
- Dropbox
- Salesforce
- Cisco WebEx
- GoToMeeting

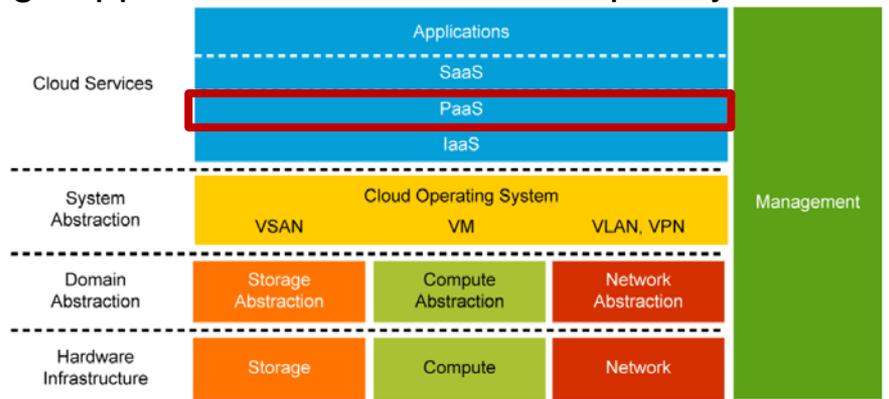




Cloud Architecture

Platform as a Service (PaaS)

- Delivers a framework for developers that they can build upon and use to create customized applications.
- Provides a cloud components to certain software while being used mainly for applications.
- All servers, storage, and networking can be managed by the enterprise or a third-party provider while the developers can maintain management of the applications.
- Allows customers to develop, run, and manage applications without the complexity of building and maintaining the infrastructure typically associated with developing and launching an app.
- Frees users from having to install in-house hardware and software to develop or run a new application.





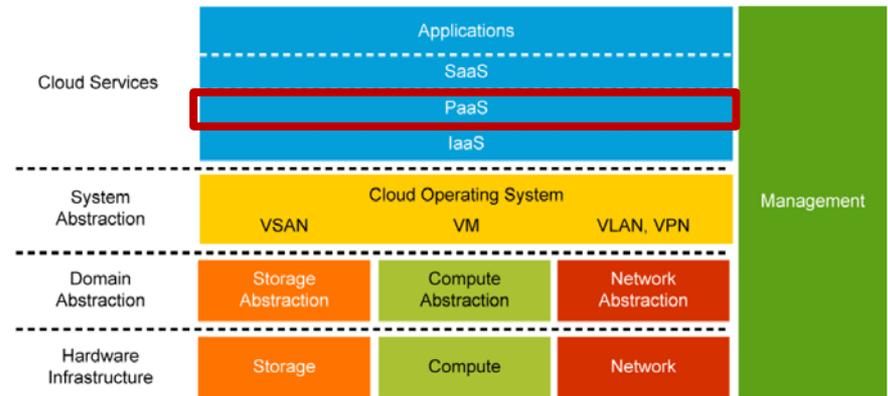
Cloud Architecture

■ PaaS Characteristics

- Builds on virtualization technology, so resources can easily be scaled up or down as your business changes.
- Provides a variety of services to assist with the development, testing, and deployment of apps.
- Accessible to numerous users and locations via the same development application.
- Integrates web services and databases.

■ Examples:

- Amazon Web Services
- Windows Azure
- Google App Engine
- Apache Stratos
- OpenShift

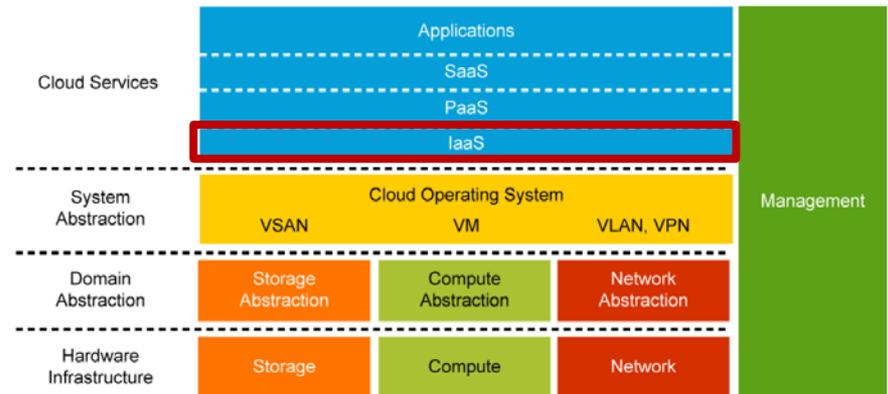




Cloud Architecture

▪ Infrastructure as a Service (IaaS)

- Made of highly scalable and automated compute resources.
- Fully self-service for accessing and monitoring computers, networking, storage, and other services.
- Easy to automate deployment of storage, networking, servers, and processing power
- Allows businesses to purchase resources on-demand and as-needed instead of having to buy hardware outright.
- Cloud service providers have extended the IaaS model to also provide IT as a service (ITaaS).





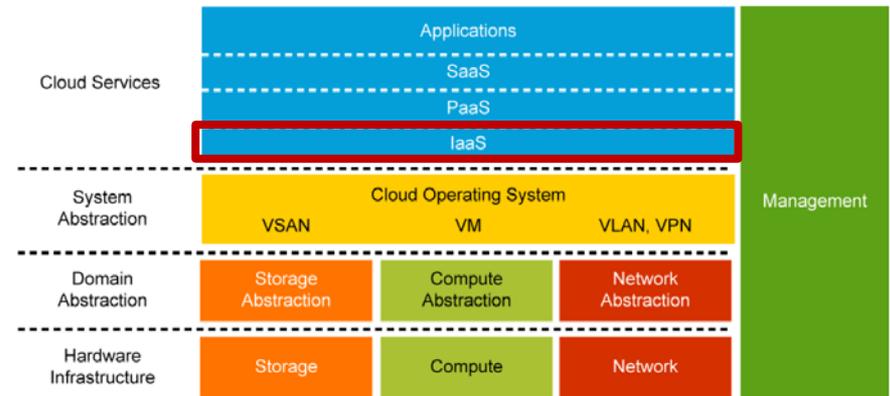
Cloud Architecture

■ IaaS Characteristics

- Resources are available as a service
- Cost varies depending on consumption
- Services are highly scalable
- Multiple users on a single piece of hardware
- Organization retain complete control of the infrastructure
- Dynamic and flexible

■ Examples:

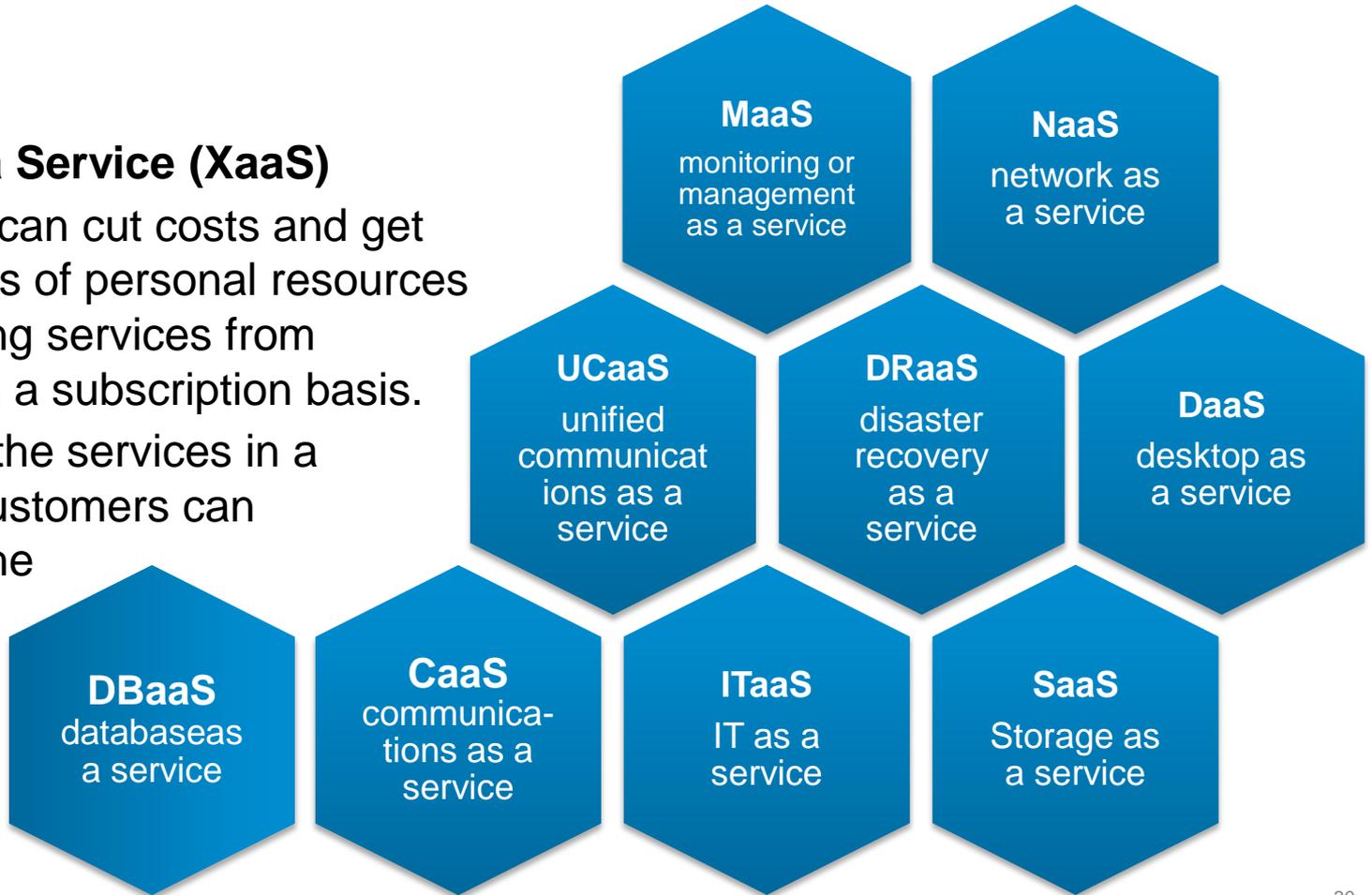
- Rackspace
- Amazon Web Services (AWS)
- Microsoft Azure
- Google Compute Engine (GCE)





XaaS

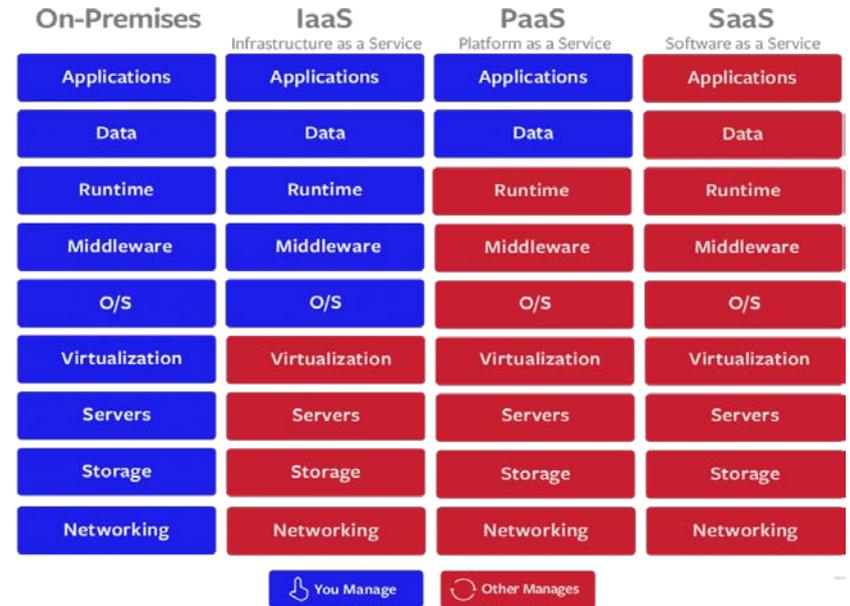
- **Anything as a Service (XaaS)**
 - Businesses can cut costs and get specific kinds of personal resources by purchasing services from providers on a subscription basis.
 - Includes all the services in a cloud that customers can order over the Internet.





Cloud Services

- **Virtual Desktop Infrastructure** – Provides a uniform learning environment to all users.
- **Virtual Application Stream** – A form of on-demand software distribution.
 - A hosted solution used to deploy an application (Learning Management System (LMS) or gradebook).
- **IaaS** – a client gets only infrastructure.
- **PaaS** – a client gets infrastructure and software for application development
- **SaaS** – a client gets a ready-to-use application in the cloud.





9.3 CHAPTER SUMMARY



Chapter 9: Virtualization and Cloud Computing

- Explain server virtualization.
- Install virtualization software on a computer.
- Describe uses of the cloud.
- Explain characteristics of public, private, hybrid and community cloud computing.

