JEREMY'S IT LAB

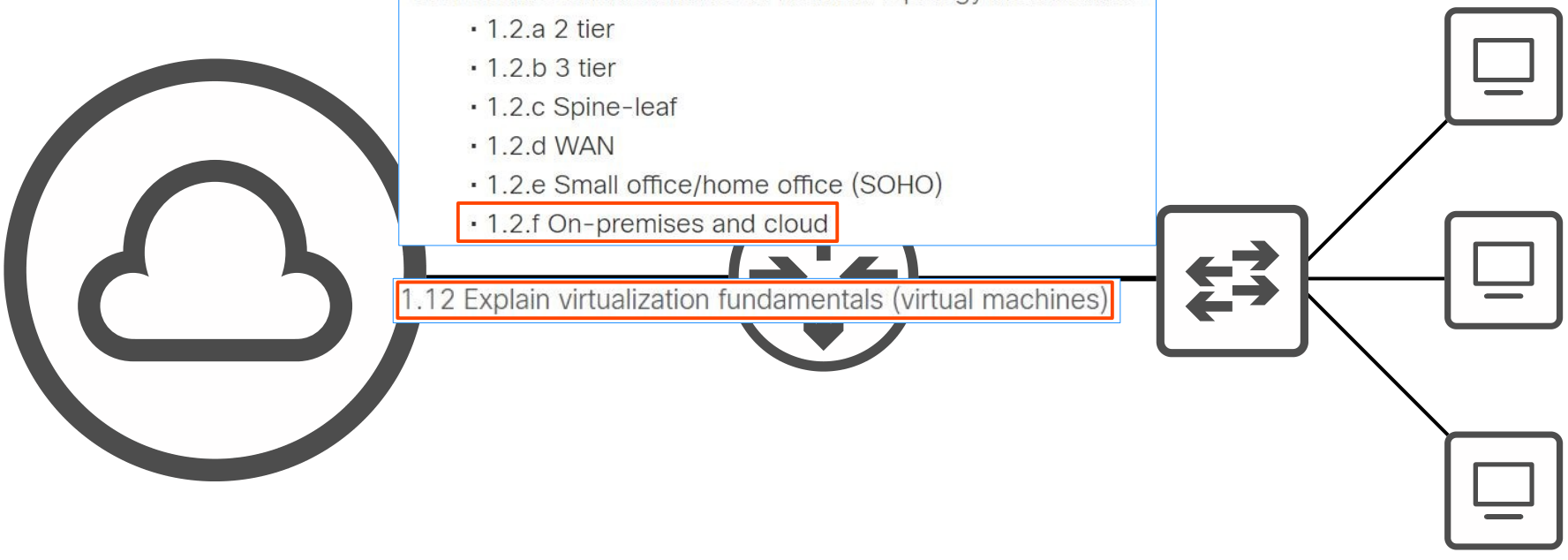
CCNA Day 54

Virtualization & Cloud

1.2 Describe characteristics of network topology architectures

- 1.2.a 2 tier
- 1.2.b 3 tier
- 1.2.c Spine-leaf
- 1.2.d WAN
- 1.2.e Small office/home office (SOHO)
- 1.2.f On-premises and cloud

1.12 Explain virtualization fundamentals (virtual machines)



Things we'll cover

- Intro to Virtualization
  - → Virtual servers
  - → Virtual networks
- Intro to Cloud Computing
  - → Essential Characteristics
  - → Service Models
  - → Deployment Models
- Connecting to Public Clouds

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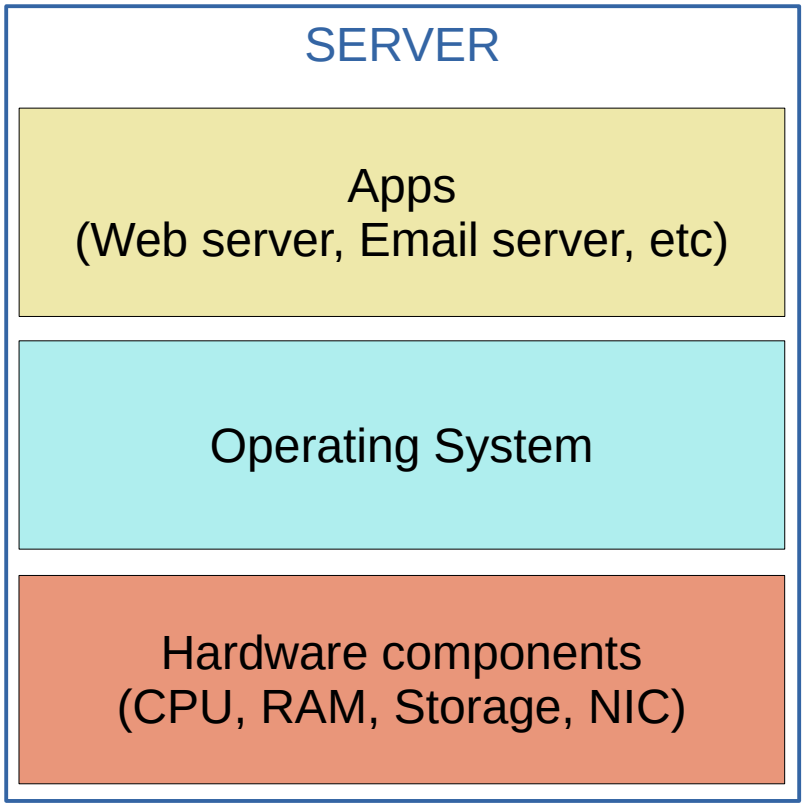
Server Hardware

- Although Cisco is more known for their networking devices (routers, switches, firewalls), they also offer hardware servers such as UCS (Unified Computing System).

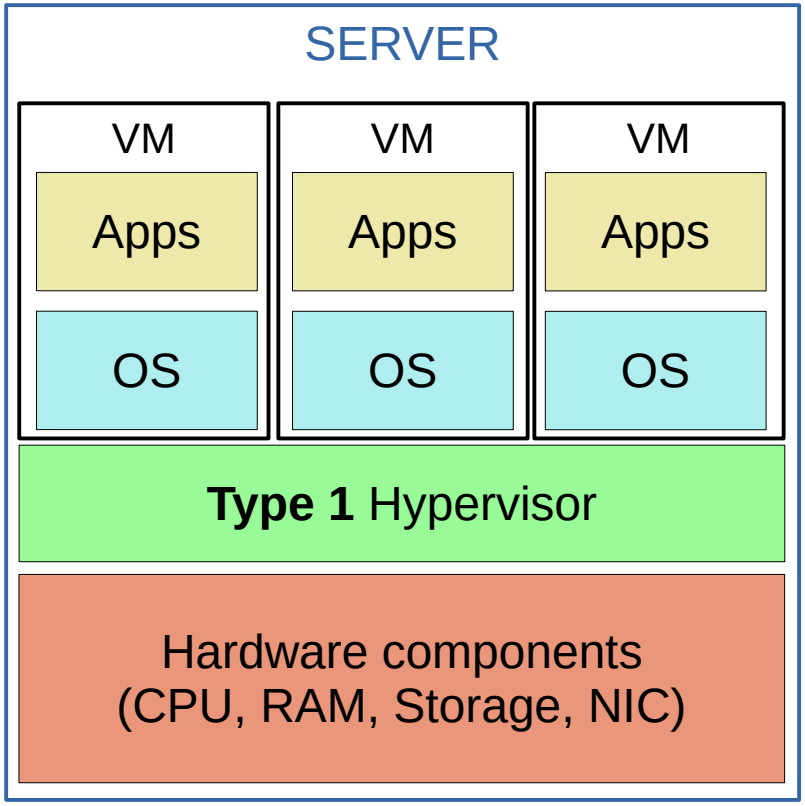
- The largest vendors of hardware servers include Dell EMC, HPE, and IBM.

Servers before Virtualization



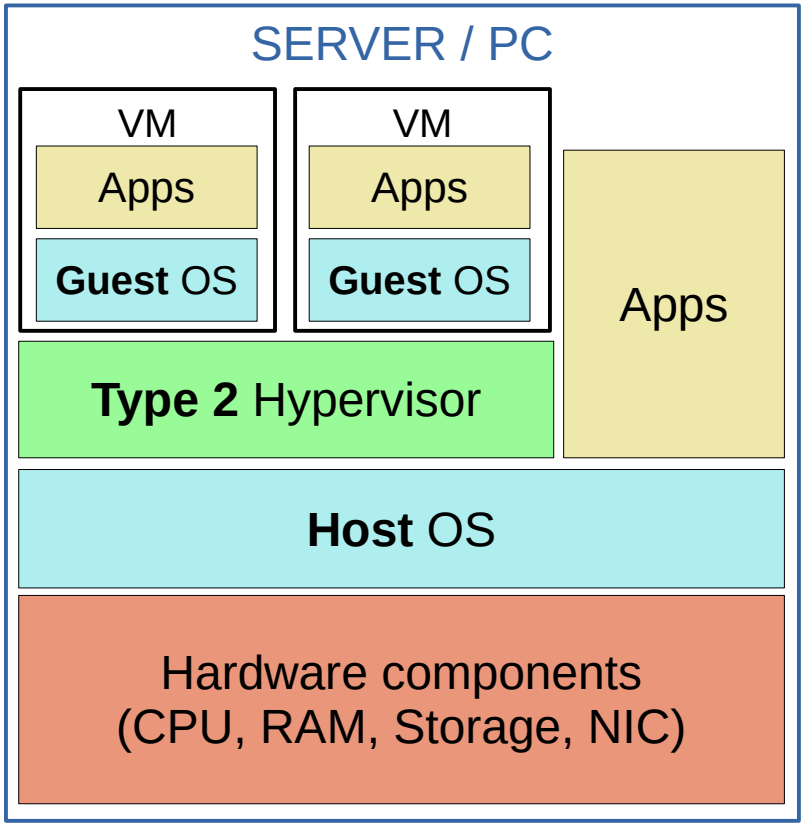
- Before virtualization, there was a one-to-one relationship between a physical server and an operating system.
- In that operating system, apps providing services such as a web server, email server, etc. would run.
- One physical server would be used for the web server, one for the email server, one for the database server, etc.
- This is inefficient for multiple reasons:
  → Each physical server is expensive and takes up space, power, etc.
  → The resources on each physical server (CPU, RAM, Storage, NIC) are typically under-used.

Virtualization (Type 1 Hypervisor)



- Virtualization allows us to break the one-to-one relationship of hardware to OS, allowing multiple OS's to run on a single physical server.
- Each instance is called a VM (Virtual Machine).
- A **hypervisor** is used to manage and allocate the hardware resources (CPU, RAM, etc) to each VM.
- Another name for a hypervisor is VMM (Virtual Machine Monitor).
- The type of hypervisor which runs directly on top of the hardware is called a **Type 1** hypervisor.
  → Examples include VMware ESXi, Microsoft Hyper-V, etc.
- Type 1 hypervisors are also called *bare-metal hypervisors* because they run directly on the hardware (metal).
  → Another term is *native hypervisor*
- This is the type of hypervisor used in data center environments.

Virtualization (Type 2 Hypervisor)



- **Type 2** hypervisors run as a program on an operating system like a regular computer program.
  → Examples include VMware Workstation, Oracle VirtualBox, etc.
- The OS running directly on the hardware is called the **Host OS**, and the OS running in a VM is called a **Guest OS**.
- Another name for a Type 2 hypervisor is *hosted hypervisor*.
- Although Type 2 hypervisors are rarely used in data center environments, they are common on personal-use devices (for example, if a Mac/Linux user needs to run an app that is only supported on Windows, or vice versa).

Why Virtualization?

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- **Partitioning:** -Run multiple operating systems on one physical machine.
  -Divide system resources between virtual machines.

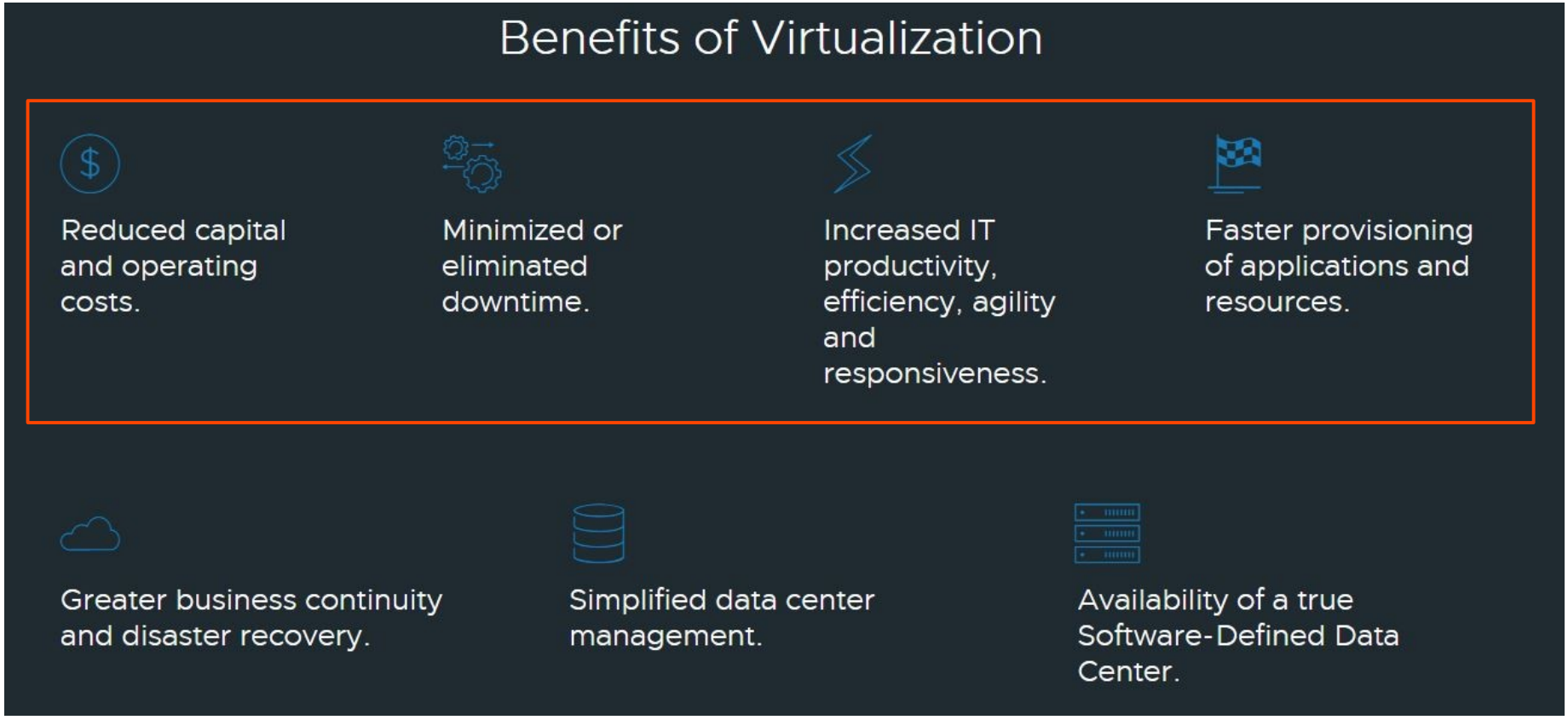
- **Isolation:** -Provide fault and security isolation at the hardware level.
  -Preserve performance with advanced resource controls.

- **Encapsulation**: -Save the entire state of a virtual machine to files.
  -Move and copy virtual machines as easily as moving and copying files.

- **Hardware Independence**: -Provision or migrate any virtual machine to any physical server. ’

https://www.vmware.com/solutions/virtualization.html

Why Virtualization?



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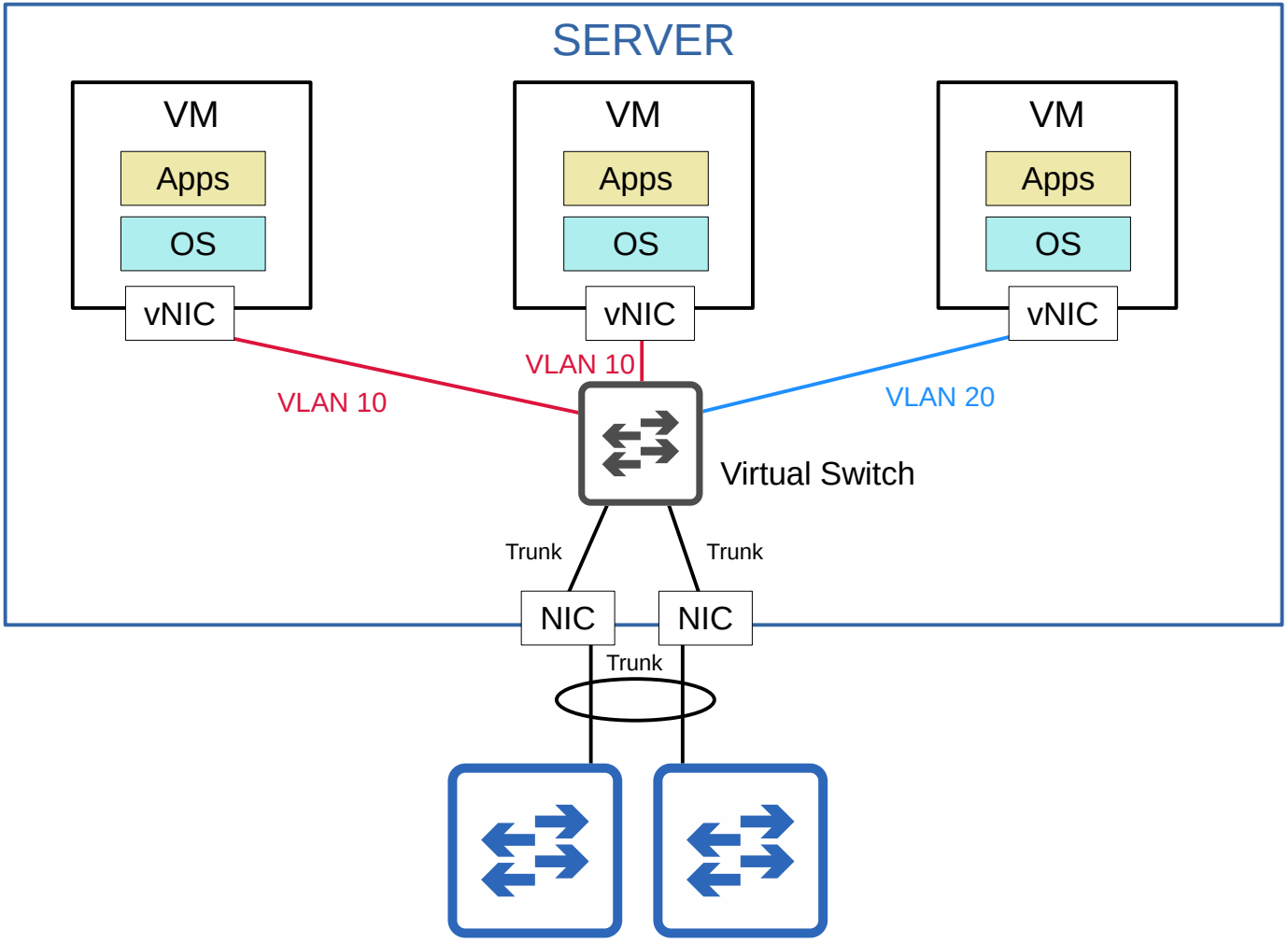
Connecting VMs to the Network



- VMs are connected to each other and the external network via a virtual switch running on the hypervisor.
- Just like a regular physical switch, the vSwitch's interfaces can operate as access or trunk ports and use VLANs to separate the VMs at Layer 2.
- Interfaces on the vSwitch connect to the physical NIC (or NICs) of the server to communicate with the external network.

Cloud Services

- Traditional IT infrastructure deployments were some combination of the following:

On-Premises

→All servers, network devices, and other infrastructure are located on company property.
→All equipment is purchased and owned by the company using it.
→The company is responsible for the necessary space, power, and cooling.

Colocation

→Data centers that rent out space for customers to put their infrastructure (servers, network devices).
→The data center provides the space, electricity, and cooling.
→The servers, network devices, etc are still the responsibility of the end customer, although they are not located on the customer's premises.

- Cloud services provide an alternative that is hugely popular, and is continuing to grow.
- Most people associate 'cloud' with public cloud providers such as AWS.
  →Although this is the most common use of cloud services, it's not the only one.

Cloud Services

- The American NIST (National Institute of Standards and Technology) defined cloud computing in SP (Special Publication) 800-145.

- It is free to read here: https://csrc.nist.gov/publications/detail/sp/800-145/final

> Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models.

- To understand what the cloud is, let's look at the following outlined in SP 800-145:
  → Five essential characteristics
  → Three service models
  → Four deployment models

The Five Essential Characteristics of Cloud

The five essential characteristics of cloud computing are:

- **On-demand self-service**
- **Broad network access**
- **Resource pooling**
- **Rapid elasticity**
- **Measured service**

On-Demand Self-Service

On-demand self-service. A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.

- The customer is able to use the service (or stop using the service) freely (via a web portal) without direct communication to the service provider.

Broad Network Access

Broad network access. Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).

- The service is available through standard network connections (ie. the Internet or private WAN connections), and can be accessed through many kinds of devices.

Resource Pooling

Resource pooling. The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, and network bandwidth.

- A pool of resources is provided by the service provider, and when a customer requests a service (for example creates a new VM), the resources to fulfill that request are allocated from the shared pool.

Rapid Elasticity

Rapid elasticity. Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.

- Customers can quickly expand the services they use in the cloud (for example, add new VMs, expand storage, etc) from a pool of resources that appears to be infinite. Likewise, they can quickly reduce their services when not needed.

Measured Service

Measured service. Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service.

- The cloud service provider measures the customer's usage of cloud resources, and the customer can measure their own use as well. Customers are charged based on usage (for example, X dollars per gigabyte of storage per day).

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The Three Service Models of Cloud

- In cloud computing, everything is provided on a ‘service’ model.
- For example, rather than the end user buying a physical server, mounting it on a rack, installing the hypervisor, creating the VMs, etc, the service provider offers all of this as a service.
- There are a variety of services referred to as ‘_____ as a Service’ or ‘__aaS’.

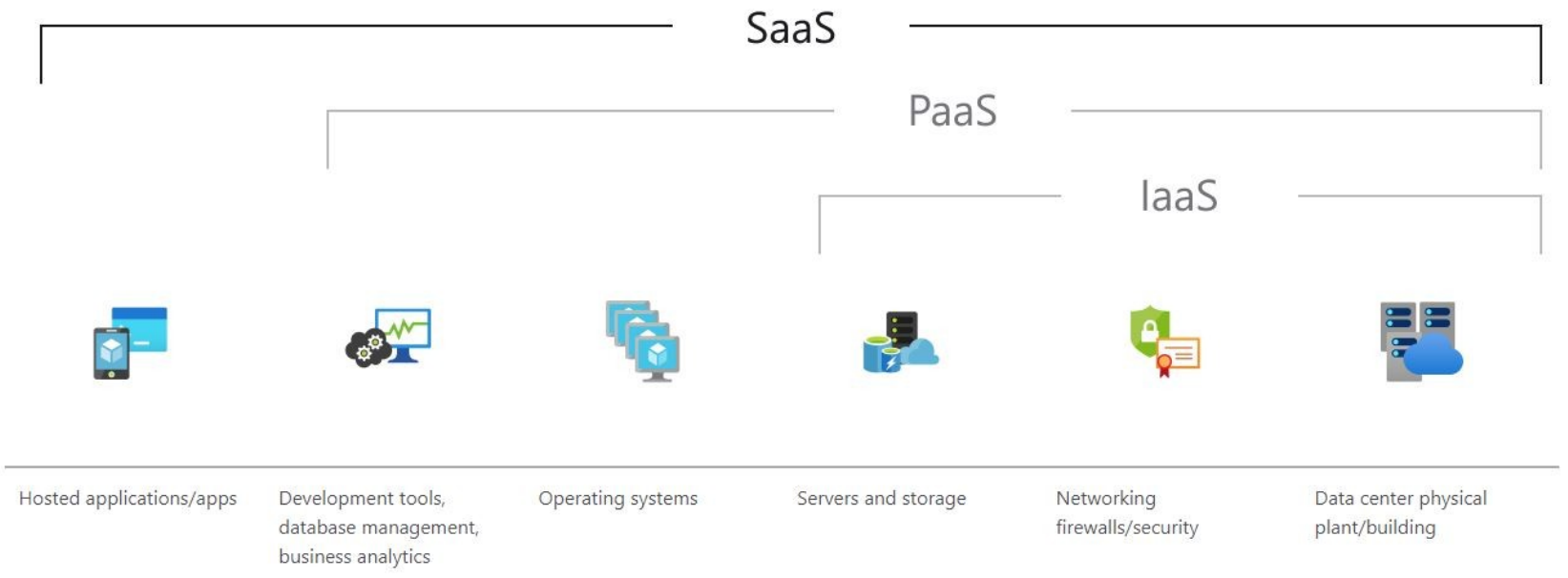
The three service models of cloud computing are:

- **Software as a Service (SaaS)**
- **Platform as a Service (PaaS)**
- **Infrastructure as a Service (IaaS)**

Software as a Service (SaaS)

Software as a Service (SaaS). The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through either a thin client interface, such as a web browser (e.g., web-based email), or a program interface. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings.

- Microsoft Office 365 is a popular example of SaaS.

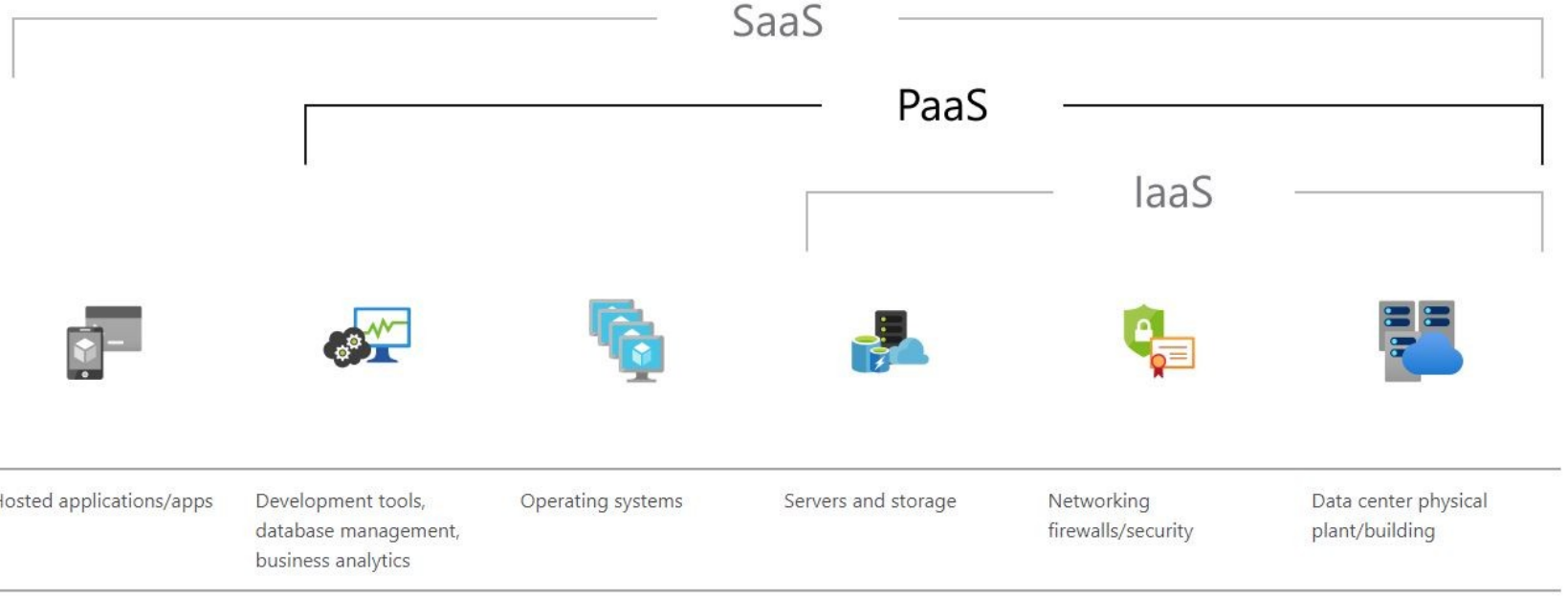


azure.microsoft.com/en-us/overview/what-is-saas/

Platform as a Service (PaaS)

Platform as a Service (PaaS). The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages, libraries, services, and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly configuration settings for the application-hosting environment.

- Examples include AWS Lambda and Google App Engine.

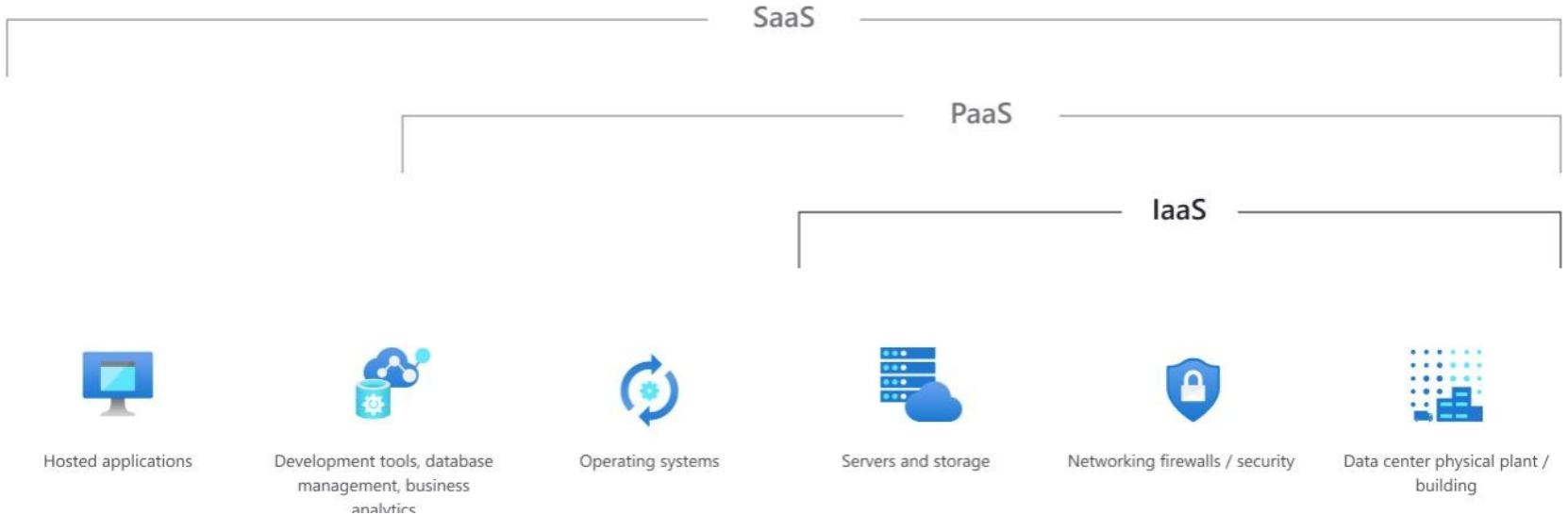


azure.microsoft.com/en-us/overview/what-is-paas/

Infrastructure as a Service (IaaS)

Infrastructure as a Service (IaaS). The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, and deployed applications; and possibly limited control of select networking components (e.g., host firewalls).

- Examples include Amazon EC2 and Google Compute Engine.



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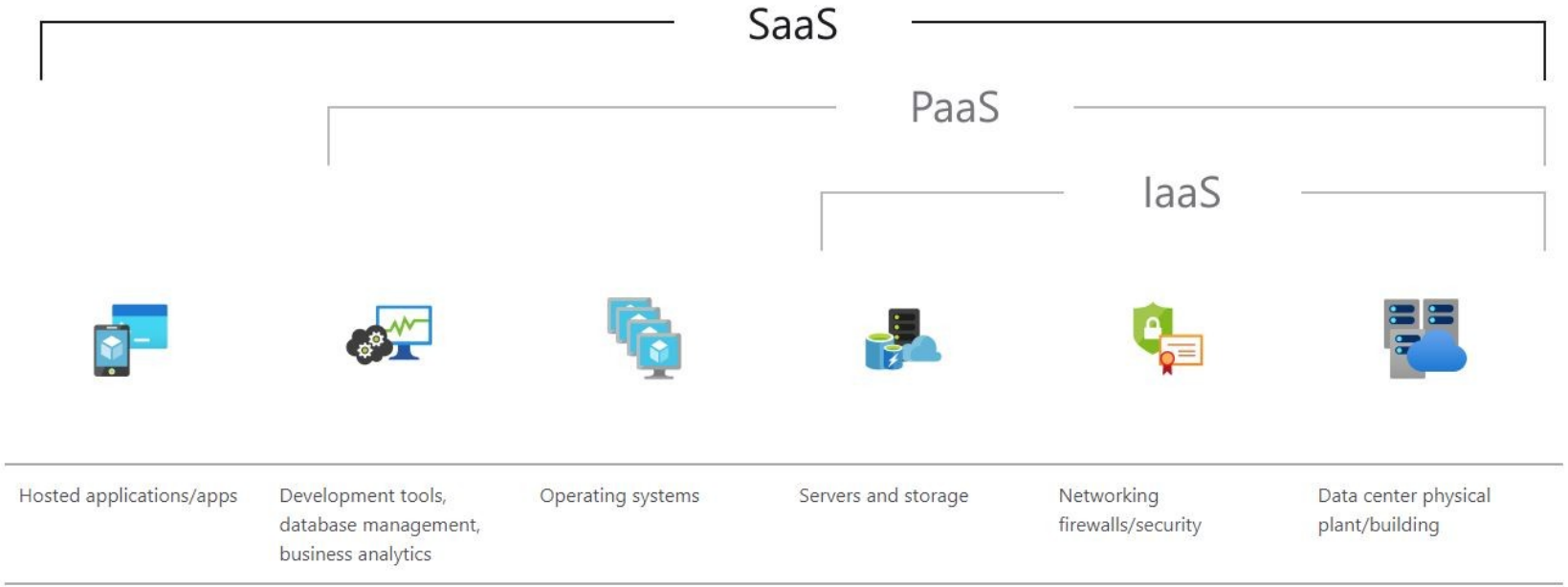

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The Four Deployment Models of Cloud

- Most people assume that ‘cloud’ means public cloud providers such as AWS, Azure, and GCP.
- Although ‘Public cloud’ is the most common deployment model, it’s not the only one.

The four deployment models of cloud computing are:

- **Private cloud**
- **Community cloud**
- **Public cloud**
- **Hybrid cloud**

Private Cloud

Private cloud. The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units). It may be owned, managed, and operated by the organization, a third party, or some combination of them, and it may exist on or off premises.

- Private clouds are generally only used by large enterprises.
- Although the cloud is private, it may be owned by a third party.
  → For example, AWS provides private cloud services for the American DoD.
- Private clouds may be on or off premises.
  → Many people assume that ‘cloud’ and ‘on-prem’ are two different things, but that is not always the case.
- The same kinds of services offered are the same as in public clouds (SaaS, PaaS, IaaS), but the infrastructure is reserved for a single organization.

Community Cloud

Community cloud. The cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be owned, managed, and operated by one or more of the organizations in the community, a third party, or some combination of them, and it may exist on or off premises.

- This is the least common cloud deployment.
- Similar to private cloud, but the infrastructure is reserved for use by only a specific group of organizations.

Public Cloud

Public cloud. The cloud infrastructure is provisioned for open use by the general public. It may be owned, managed, and operated by a business, academic, or government organization, or some combination of them. It exists on the premises of the cloud provider.

- This is the most common cloud deployment.

- Popular public cloud service providers include:
  - → AWS (Amazon Web Services)
  - → Microsoft Azure
  - → GCP (Google Cloud Platform)
  - → OCI (Oracle Cloud Infrastructure)
  - → IBM Cloud
  - → Alibaba Cloud

Hybrid Cloud

Hybrid cloud. The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds).

- This is basically any combination of the previous three deployment types.
- For example, a private cloud which can offload to a public cloud when necessary.

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Benefits of Cloud Computing

- **Cost**
  →CapEx (Capital Expenses) of buying hardware and software, setting up data centers etc. are reduced or eliminated.

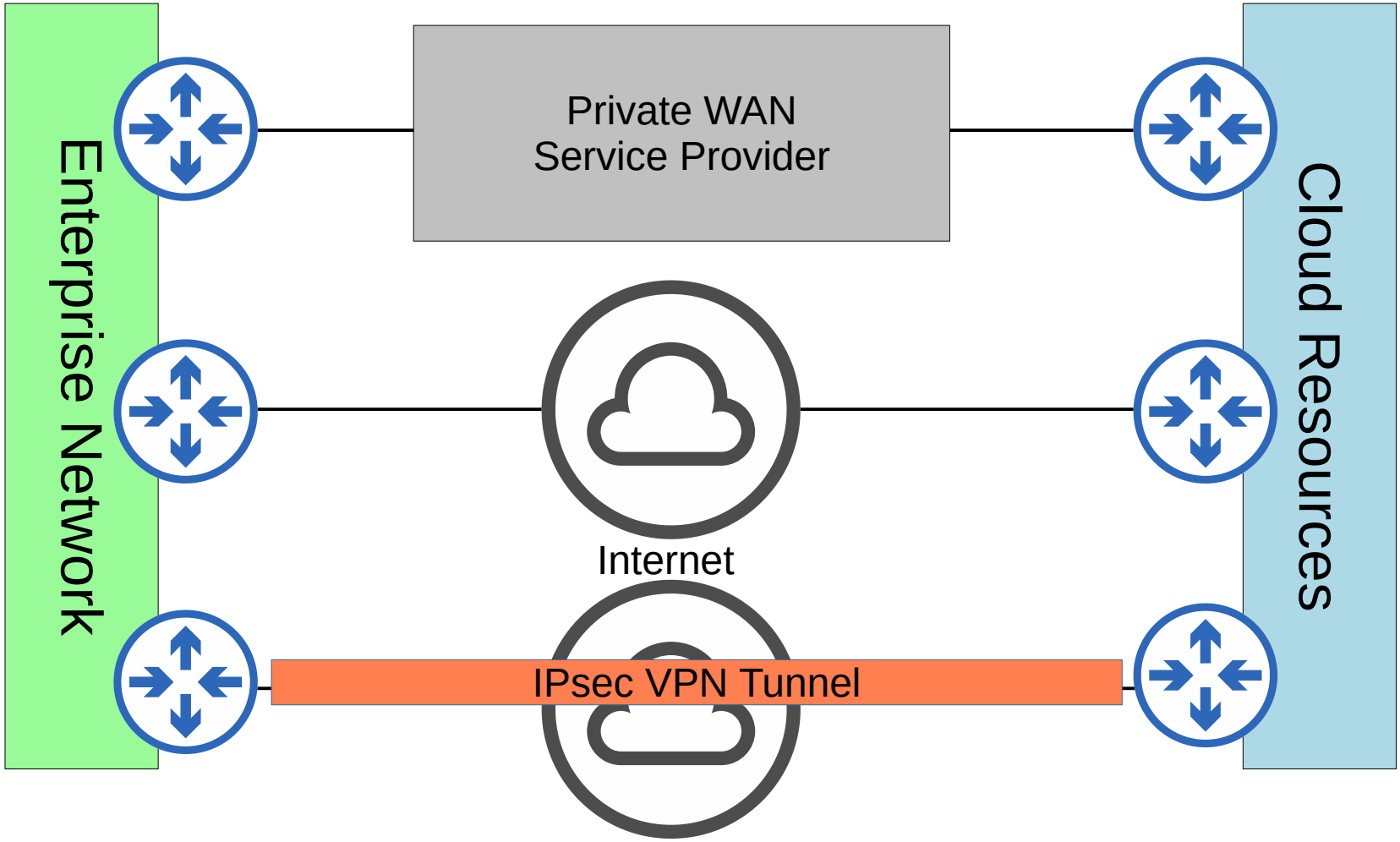
- **Global Scale**
  →Cloud services can scale globally at a rapid pace. Services can be set up and offered to customers from a geographic location close to them.

- **Speed/Agility**
  →Services are provided on demand, and vast amounts of resources can be provisioned within minutes.

- **Productivity**
  →Cloud services remove the need for many time-consuming tasks such as procuring physical servers, racking them, cabling, installing and updating operating systems, etc.

- **Reliability**
  →Backups in the cloud are very easy to perform. Data can be mirrored at multiple sites in different geographic locations to support disaster recovery.

Connecting to Cloud Resources



Things we covered

- Intro to Virtualization
  - → Virtual servers
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ExSim-Max™ PRACTICE EXAMS

Quiz 1

Which statement about virtual machines is true?

a) The hypervisor is used to manage and allocate hardware resources to VMs.

b) Type 1 hypervisors run on a host OS.

c) Type 2 hypervisors run directly on top of the hardware.

d) Only a single VM can exist per physical server.

Quiz 2

Which of the following hypervisor types is known as a *native* hypervisor?

a) Type 1

b) Type 2

c) Type 3

Quiz 3

Which of the following is NOT an essential characteristic of cloud computing?

a) Measured service

b) Resource pooling

c) Rapid elasticity

d) Infinite resource pool

e) Broad network access

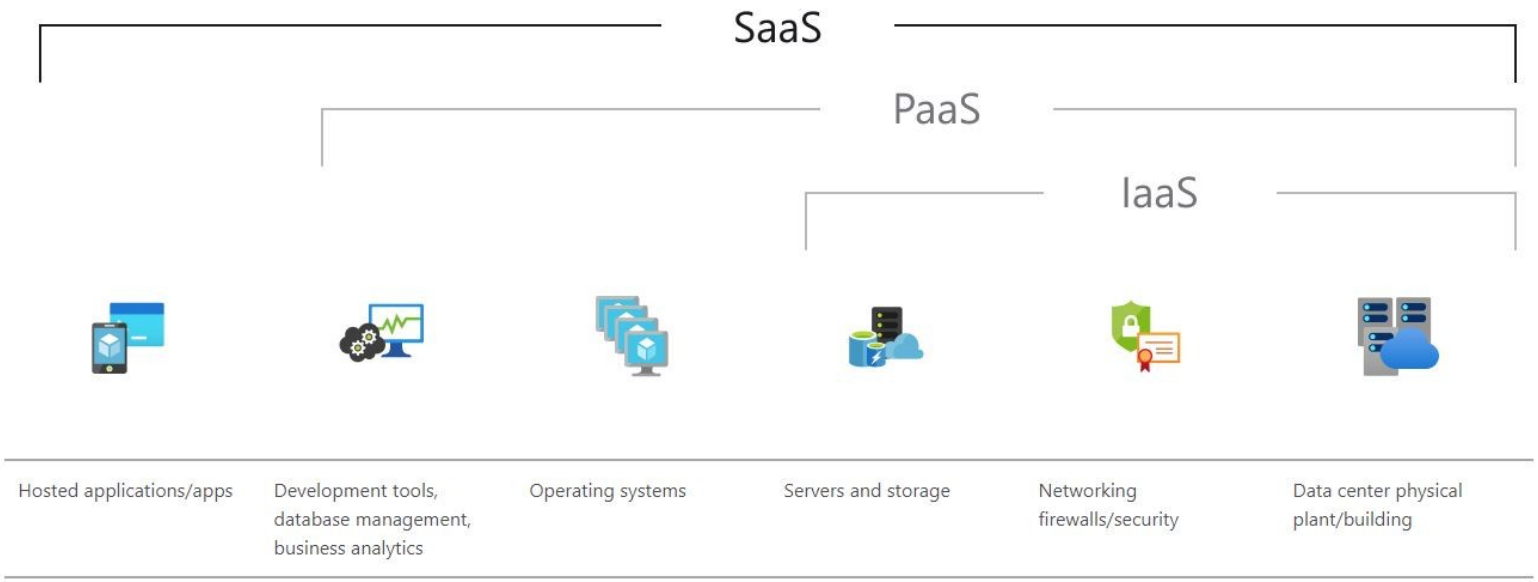
Quiz 4

Which of the following cloud service types allows customers to use applications running on the provider's cloud infrastructure?

a) IaaS

b) PaaS

c) SaaS



Quiz 5

Which of the following cloud deployment types may exist off premises?

a) Public cloud

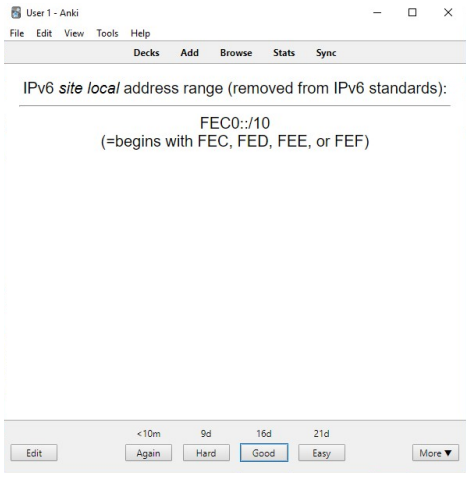
b) Private cloud

c) Community cloud

d) All of the above

Supplementary Materials

- Review flash cards
  (link in the description)



- Virtualization lab

JCNP-Level Channel Members

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Joseph Chase	Samil Cañas	Njoku Valentine	Donald Sabusap	funnydart
Khoa Dang	Scott Corbitt	Viktor Balogh	Gustavo BR	velvijaykum
Dragos Hirnea	Martin Keilaus	Suki Ghuman	Prakaash Rajan	Channel has been deleted
tanvir Khan	Tebogo Kgoloane	Kenneth Williams	Nasir Chowdhury	Boson Software
Charlesetta Estelle	Павел М	Seamus Mooney	Erlison Santos	Devin Sukhu
Gerrard Baker	Abraham Yeiah	Brandon Byers	Marko Barbaric	Yonatan Makara
		Marcel Lord	Ed Velez	Vance Simmons

*as of July 25th, 2021