# Azure Fundamentals

The Azure Fundamentals exam covers three topics:

* Describe Cloud Concepts (25%-30%)
* Describe Azure Architecture and Services (35%-40%)
* Describe Management and Governance (30%-35%)

# 1. Cloud Concepts

# 1.1. Azure Cloud Computing

Cloud computing allows you to have your services in the Cloud data center instead of in a physical location. This way, you can easily adjust the resources you need and delegate maintenance to the Cloud provider.

Services: Computer Power (CPU, RAM), Virtual Machines, Storage, Databases, Networking, Internet of Things (IoT) and Machine Learning (ML).

## 1.1.1. Shared Responsibility Model

When you have an on-premises datacenter you are responsible for everything. On the contrary, when you use Cloud computing you can decide how much responsibility you want to delegate to the Cloud provider. This depends on the types of service you select: Infrastructure as a Service(IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS).

Is important to clarify that sometimes the responsibility depends on the situation. For example, if you user a cloud SQL database, the cloud provider is responsible for maintaining the database. However, if you deployed a virtual machine and installed an SQL database on it, you’d be responsible for database patches and updates.

## 1.1.2. Cloud Models

The cloud model defines the deployment type of cloud resources.

### 1.1.2.1 Private Cloud

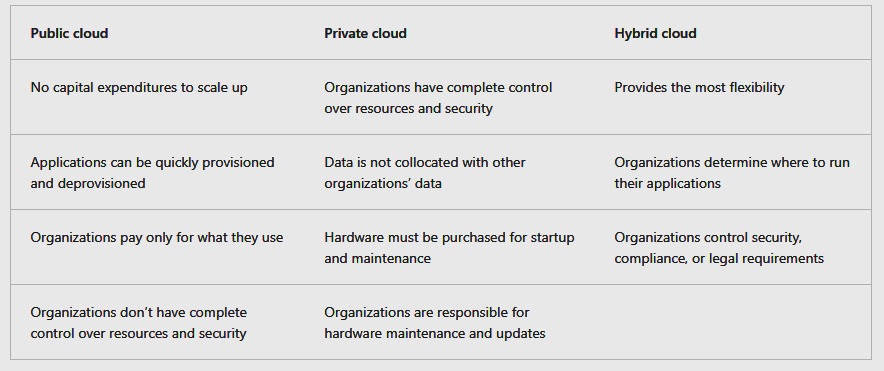
Is the natural evolution from the corporate datacenter. Is a cloud that is built, controlled and maintained by a single entity. This allows greater control but higher cost since you need to pay for all the available resources even if you’re not using them at all times. You may host you own datacenter, a dedicated offsite datacenter or a third party may have a dedicated datacenter for your company.

### 1.1.2.2 Public Cloud

A public cloud is built, controlled and maintained by a third-party cloud provider. Anyone that wants to purchase cloud services can access and user resources.

### 1.1.2.3 Hybric Cloud

Hybrid cloud is a computing environment where both public and private clouds get interconnected. You may need private cloud only for certain highly sensible services and may be comfortable having the rest in a public cloud. Thus, hybrid cloud allows balancing security and affordability.



### 1.1.2.4 Multi Cloud

Multi Cloud is when you have services with more than one cloud provider. It may be due to your organization migrating from one provider to another, or because you need to use features from both providers.

In any case, **Azure Arc** can help you manage your cloud environment, whether it’s a public Azure cloud, a private cloud in your datacenter, a hybrid configuration or a multi-cloud environment.

There is also a specialized **Azure VMware Solution** for running VMware workloads with seamless integration and scalability. This is useful when you have previously stablished a VMware private cloud environment but want to migrate to a publich or hybrid cloud.

## 1.1.3. Consumption base model

Cloud computing operates on a consumption-based model using operation expenditure (OpEx). On the contrary, a traditional datacenter uses capital expenditure (CapEx) because you need to estimate your current and future capacity and pay for it upfront.

The advantages of cloud services are:

* No upfront cost.
* No need to purchase or manage infrastructure.
* You can add or remove resources whenever you need to and adjust payment (easy to scale).

Cloud computing is a way to rent computer power and storage from someone else’s datacenter. You can treat cloud resources like you would resources in your own datacenter. However, unlike your own datacenter, when you’re done using cloud resources, your give them back.

# 1.2. Advantages of Cloud

Cloud computing allows you to have your services in the Cloud data center instead of in a physical location

## 1.2.1. High Availability

One of the most important considerations when deploying an application to the cloud is availability. Azure provides different SLA (Service Level Agreements) which are agreements between provider and customer for guaranteeing a stated level of service.

SLAs are related to service availability or uptime. The client may be credited if the SLA is not met. Common values for uptime in Azure are 99% (7.2 hrs per month), 99.9% (43 min per month), 99.95% (22 min per month) and 99.99% (4.32 min per month).

## 1.2.2. Scalability

Scalability refers to the ability to adjust resources to meet demand and is another important advantage of cloud services. Scalability allows the client to response to a system overload and to avoid overpaying for additional services.

Scaling usually has two varieties: vertical and horizontal. Vertical scaling focuses on increasing or decreasing the capabilities of resources. Horizontal scaling adds or subtracts the number of resources.

## 1.2.3. Reliability

Reliability is the ability of a system to recover from errors and continue to function. The cloud, due to its decentralized design, naturally supports reliable and resilient infrastructure because you can deploy resources in different regions around the world. In some cases, the cloud environment can automatically switch to another region.

## 1.2.4. Prediction

Predictability in the cloud lets you move forward with confidence. Predictability can be focused on performance or costs.

**Performance predictability** focuses on predicting the resources required to deliver a positive experience for customers. If you suddenly need more resources, **autoscaling** can deploy additional resources to meet demand, then scale back when it decreases. Or, if traffic is mostly concentrated in one area, **load balancing** will help redirect some of the overhead to areas with less stress.

**Cost forecasting** focuses on forecasting the cost of cloud spending. With the cloud, you can track resource usage in real time, monitor resources to ensure you're using them most efficiently, and apply data analytics to find patterns and trends to help better plan resource deployments. By operating in the cloud and using cloud insights and analytics, you can predict future costs and adjust resources as needed. You can even use tools like total cost of ownership (TCO) or pricing calculators to get an estimate of your potential cloud spend.

## 1.2.5. Security and Governance

Cloud provides several useful **governance** features. You can set a **template** to help ensure the deployed resources meet corporate standards and requirements. Plus, you can **update** all your deployed resources to new standards. Cloud-based **auditing** helps flags any resource that’s out of compliance and provides mitigation strategies. This process can also be automated.

On the **security** side, **infrastructure as a service** provides the maximum security since you’re able to handle physical resources, operative system and installed software, including patches and maintenance. **Platform as a service** and **software as a service** both take care of patches and maintenance automatically. Also, cloud is prepared to deal with attacks such as DDoS (distributed denial of service).

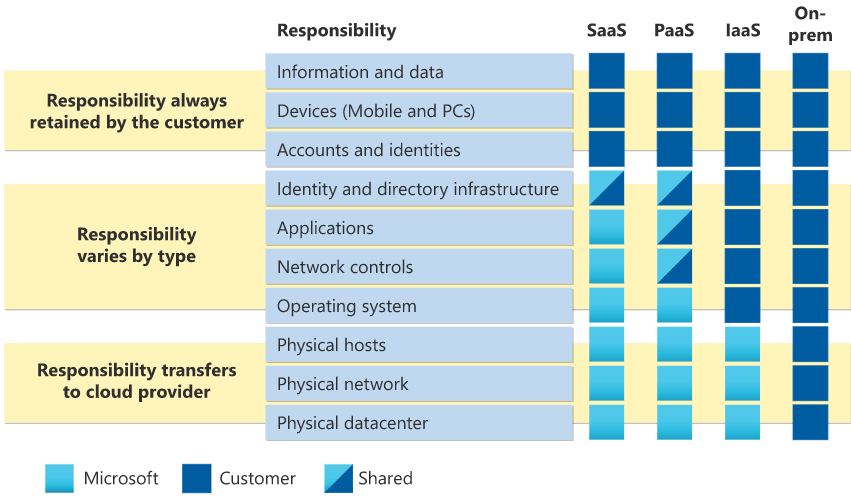
## 1.2.6. Manageability

Management comes in two forms. **Management of the cloud** is about controlling cloud resources such as: automatic **scale**, **templates**, **monitoring** and **alerts** based on configured metrics.

**Management in the cloud** refers to the way you can manage resources: through a **web portal**, using a **CLI**, using **APIs** or using **PowerShell**.

# 1.3. Cloud Services

Cloud services are IaaS, PaaS and SaaS. Each of them have particular advantages. Responsibility of cloud services is always shared.



## 1.3.1. IaaS

Infrastructure as a Service places most of the responsibility on the client. The provider is responsible for maintaining the physical infrastructure and its access to the internet. The client is responsible for the installation, configuration, patching, updates and security.

Common scenarios are:

* Lift-and-shift migration: You’re standing up cloud resources similar to your on-prem datacenter, and then simply moving the things running on-prem to running on the IaaS infrastructure.
* Testing and development: You have established configurations for development and test environments that you need to rapidly replicate. You can stand up or shut down the different environments rapidly with an IaaS structure, while maintaining complete control.

## 1.3.2. PaaS

In Platform as a Service the cloud provider maintains the physical infrastructure, physical security and connection to the internet, as well as the operating systems, middleware, development tools and business intelligence services that make up a cloud solution. In a PaaS scenario, you don’t have to worry about the licensing or patching for operating systems and databases. Common scenarios are:

* Development framework: PaaS provides a framework that developers can build upon to develop or customize cloud-based applications. Cloud features like scalability, high-availability and multi-tenant capability are included, reducing the amount of coding that developer must do.
* Analytics or business intelligence: Tools provided as a service allow organizations to analyze and mine their data, finding insights and patterns and predicting outcomes to improve forecasting, product design decisions, investments returns, and other business decisions.

## 1.3.3. SaaS

Software as a Service is the most complete cloud service where you’re basically renting or using a fully developed application. Email, financial software, messaging applications and connectivity software are all common examples of SaaS implementation:

* Email and messaging.
* Business productivity applications.
* Finance and expense tracking.

# 2. Azure Architecture and Services

In this module, the main architectural components of Azure will be introduced. You'll learn about the physical organization of Azure: data centers, availability zones, and regions; and also about the organizational structure of Azure: resources and resource groups, subscriptions, and management groups.

After completing this module, you will be able to:

* Describe Azure regions, region pairs, and sovereign regions.
* Describe Availability Zones.
* Describe Azure data centers.
* Describe Azure resources and resource groups.
* Describe subscriptions.
* Describe management groups.
* Describe the hierarchy of resource groups, subscriptions, and management groups.

## Azure Command Line

PowerShell:

Get-date

bash // change to bash CLI

Azure Commands:

az version // shows Azure version

az upgrade

az interactive // interactive mode where you can hit tab for displaying options.

// no need to use az in interactive mode

exit // exit interactive mode

# 2.1. Azure Physical Infrastructure

The Azure physical infrastructure is divided into physical and management infrastructure.

## 2.1. Physical Infrastructure

The physical infrastructure starts with datacenters which are facilities with resources arranged in racks, with dedicated power, cooling and networking infrastructure. Azure has datacenters around the world that are grouped into Azure Regions or Azure Availability zones.

## 2.1.1. Regions

A region is a geographical are on the planet that contains one or more datacenters that are nearby and networked together with a low-latency network. When you deploy a resource with Azure, you’ll often choose the region where you want your resource deployed.

## 2.1.2. Availability Zones

Availability zones are physically separate datacenters within an Azure region and are set up to be an isolation boundary. If one zone goes down, the others continue working because they have independent power, cooling and networking. Availability zones are connected through high-speed, private fiber-optic networks. Every Azure region that supports zones has at least 3 of them to guarantee resiliency.

* Zonal services: You pin the resource to a specific zone (for example, VMs, managed disks, IP addresses)
* Zone-redundant services: The platform replicates automatically across zones (for example, zone-redundant storage, SQL Database)
* Non-regional services: Service are always available from Azure geographies and are resilient to zone-wide outages as well as region-wide outages.

## 2.1.3. Region Pairs

Most Azure regions are paired with another region within the same geography (such as US, Europe, or Asia) at least 300 miles away. This approach allows for the replication of resources across a geography that helps reduce the likelihood of interruptions because of events such as natural disasters, civil unrest, power outages, or physical network outages that affect an entire region. For example, if a region in a pair was affected by a natural disaster, services would automatically fail over to the other region in its region pair.

* If an extensive Azure outage occurs, one region out of every pair is prioritized to make sure at least one is restored as quickly as possible for applications hosted in that region pair.
* Planned Azure updates are rolled out to paired regions one region at a time to minimize downtime and risk of application outage.
* Data continues to reside within the same geography as its pair (except for Brazil South) for tax- and law-enforcement jurisdiction purposes.

Most regions are paired in two directions, meaning they are the backup for the region that provides a backup for them (West US and East US back each other up). However, some regions, such as West India and Brazil South, are paired in only one direction. In a one-direction pairing, the Primary region does not provide backup for its secondary region. So, even though West India’s secondary region is South India, South India does not rely on West India. West India's secondary region is South India, but South India's secondary region is Central India. Brazil South is unique because it's paired with a region outside of its geography. Brazil South's secondary region is South Central US. The secondary region of South Central US isn't Brazil South.

## 2.1.4. Sovereign Regions

In addition to regular regions, Azure also has sovereign regions. Sovereign regions are instances of Azure that are isolated from the main instance of Azure. You may need to use a sovereign region for compliance or legal purposes.

Azure sovereign regions include:

* US DoD Central, US Gov Virginia, US Gov Iowa and more: These regions are physical and logical network-isolated instances of Azure for U.S. government agencies and partners. These datacenters are operated by screened U.S. personnel and include additional compliance certifications.
* China East, China North, and more: These regions are available through a unique partnership between Microsoft and 21Vianet, whereby Microsoft doesn't directly maintain the datacenters.

# 2.2. Azure Management Infrastructure

The management infrastructure includes Azure resources and resource groups, subscriptions and accounts.

## 2.2.1. Resources and resource groups

A resource is the basic building block of Azure. Anything you create, provision, deploy is a resource. Virtual machines, virtual networks, databases, cognitive services are all considered resources within Azure.

Every resource needs to be in a resource group which is just a grouping of resources. A single resource can only be in one group at the time and resource groups can’t be nested (not possible to have groups inside groups). When you apply an action to a resource group, that action will apply to all resources within, including deleting or granting access.

## 2.2.2. Subscriptions

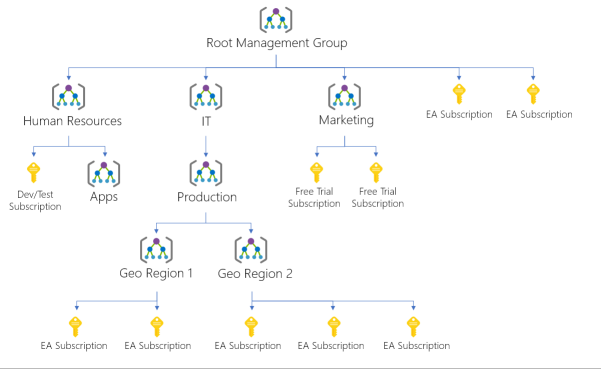
Subscriptions are a unit of management, billing and scale. Subscriptions allow you to logically organize resource groups and facilitate billing.

Using Azure requires an Azure subscription which provides you with access to products and services. An Azure subscription links to an Azure account, which is an identity in Azure Active Directory (Azure AD) or in a directory that Azure AD trusts. An account it’s required to have at least one subscription but it can contain multiple ones. Multi-subscriptions are used to define boundaries of two types:

* Billing boundary: Determines how an Azure account is billed for using Azure. You might want to create one subscription for your production workload and another for you development and testing workloads.
* Access control boundary: Used to limit access to products and functionalities. You can choose to separate environments for developing and testing. You can also reflect the organization structure: limit one team to lower-cost resources and enable full access for the IT department.

## 2.2.3. Management groups

Resources are grouped into resource groups which are then grouped into subscriptions. Subscriptions can be further contained into management groups. Management groups can be nested giving you enterprise-grade management at a large scale. A limit of 10,000 management groups can be supported in a single directory supporting until six levels of depth.



# 2.3. Azure Compute and Networking Services

Compute services are virtual machines, containers and similar. On the other hand, networking services include Azure virtual networks, Azure DNS and Azure ExpressRoute.

## 2.3.1. Azure Virtual Machines

VMs are a way to provide infrastructure as a Service (IaaS) in the form of a virtualized server. Just like a physical computer, you can customize all of the software running on your VM. This makes it a perfect choice when you need to have total control over the operative system, the ability to run custom software and to use custom hosting configurations.

Using virtual machines you don’t have to worry about buy and maintain physical hardware but you’ll still need to configure, update and maintain the software that runs on the VM.

You can use an image to rapidly provision a VM. An image is a template that may already include OS and specialized software for a given task.

## 2.3.2. Scale Sets

You can group VMs together to provide high availability, scalability and redundancy. Scale sets is one of the two possible ways of grouping VMs.

Scale sets let you create and manage a group of identical, load-balanced VMs. You just need to create one virtual machine and Azure helps you automatize the replication and monitoring to automatically decide when to scale up or down based on preconfigured parameters. Scale sets also deploy a load balancer that makes sure your resources are being used efficiently.

## 2.3.3. Availability Sets

Availability sets are conceived to help you build a more resilient, highly available environment. Availability sets group VMs in two ways: update domain and fault domain.

The update domain groups VMs that can be rebooted at the same time. When applying updates only one update domain is offline at the time. Then, 30 minutes are given before the update begins in the next update domain.

Fault domains group the VMs by common power source and network switch. By default, an availability set will split you VMs across up to three fault domains. This helps protect against a physical power or networking failure. There is no extra cost for configuring an availability sets.

## 2.3.4. When to use VMs

During testing and development because you can combine different OS and application configurations. After using then you can easily remove the VMs.

When you need to run certain applications in the cloud like SharePoint to extend you on-premises network. Is also useful when you want to make lift and shift which means moving applications from your physical servers to the cloud.

During disaster recovery you can extend your on-premises network to the cloud to cover for the service your own network is missing.

## 2.3.5. VM Resources

When you create a VM you have the chance to pick resources including:

* Size (purpose, number of processor cores, and amount of RAM)
* Storage disks (hard disk drives, solid state drives, etc.)
* Networking (virtual network, public IP address, and port configuration)

## 2.3.6. VM commands

Create a virtual machine:

az vm create \

--resource-group learn-f7bf9502-0169-4d33-8ba7-8f95838e5008 \

--name my-vm \

--image UbuntuLTS \

--admin-username azureuser \

--generate-ssh-keys

Configure Nginx:

This commang uses a github script to download the latest package from internet using apt-get update. Then it installs Nginx and then sets the home page to /var/www/html/index.html to print a welcome message.

az vm extension set \

--resource-group learn-f7bf9502-0169-4d33-8ba7-8f95838e5008 \

--vm-name my-vm \

--name customScript \

--publisher Microsoft.Azure.Extensions \

--version 2.1 \

--settings '{"fileUris":["https://raw.githubusercontent.com/MicrosoftDocs/mslearn-welcome-to-azure/master/configure-nginx.sh"]}' \

--protected-settings '{"commandToExecute": "./configure-nginx.sh"}'