



**AWS Academy - Cloud Foundations  
Module 01 Student Guide  
Version 1.0.0**

**100-ACFNDS-10-EN-SG**

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# Module 1, Section 1: Cloud Concepts Overview



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Welcome to Module 1, Section 1 – Cloud Concepts Overview.

## What's In This Module



- Part 1: What is Cloud Computing?
- Part 2: Six Advantages of Cloud Computing
- Part 3: What is Amazon Web Services (AWS)?
- Part 4: The AWS Cloud Adoption Framework

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In this module, we are going to discuss the basics of cloud computing.

# Module Objectives



**Goal:** Discuss key concepts related to cloud computing and the advantages of cloud computing.

- 💡 Define different types of cloud computing
- 💡 Describe six advantages of cloud computing
- 💡 Describe cloud deployment models

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## Module Objectives

The goal of this module is to help you understand the foundations and advantages of cloud computing and Amazon Web Services. We will:

- Define different types of cloud computing to understand internet-based computing and three broad categories of cloud computing.
- Describe the six advantages of cloud computing that are helping organizations make the decision to get out of the low-value parts of IT and focus on things that drive business success.
- Describe three cloud deployment models to understand alternative models of cloud usage.

After this overview, you will have the opportunity to complete a Knowledge Assessment.



## Part 1: What is Cloud Computing?

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# What is Cloud Computing?



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What does cloud computing mean to you?

Take a moment to provide a quick sentence on what you understand cloud computing to be.  
(There's no wrong answer.)

# What is Cloud Computing?



Cloud computing is the **on-demand** delivery of compute power, database storage, applications, and other IT resources through a cloud services platform **via the internet** with **pay-as-you-go** pricing.



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*Web services* is another name for what people call *the cloud*.

Cloud computing services are like building blocks that customers assemble to meet their technology infrastructure requirements and accomplish their business goals. With cloud computing, organizations can consume on-demand computing and storage resources rather than building, operating, and improving infrastructure on their own.

For more information, see <https://aws.amazon.com/what-is-cloud-computing/>.

# What is Cloud Computing?



Cloud computing enables you to stop thinking of your infrastructure as hardware, and instead think of it (and use it) as software.



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Before cloud computing, you would have to provision capacity based on guessing theoretical maximum peaks. If you didn't meet your projected maximum peaks, or you exceeded them, you would be paying for expensive resources that would stay idle or have insufficient capacity to meet your needs.

# What is Cloud Computing?



- 💡 Hardware solutions are **physical**. This means they require:
  - 💡 Space
  - 💡 Staff
  - 💡 Physical security
  - 💡 Planning
  - 💡 Capital expenditure
- 💡 Guess at theoretical maximum peaks
  - 💡 Is there enough resource capacity?
  - 💡 Do we have sufficient storage?

What if your needs change?

*You have to go through the **time, effort, and cost** required to change all these.*

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Managing hardware takes away time and resources you could be using to improve your architecture and your application.

For example, before cloud computing, if you wanted to provision a new web site, you would have to go out and buy the hardware, rack and stack it, put it in a data center, and then manage it or have someone else manage it. This approach is very expensive.

# What is Cloud Computing?



Software is flexible.

If your needs change, your software can change much more **quickly, easily, and cost-effectively** than your hardware.

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Accessing and using your infrastructure as software offers a number of benefits—flexibility in particular. With a cloud services provider like AWS, you don't have to anticipate your hardware needs ahead of time and then order, install, and set it up at your data center. You also don't need to undergo a long procurement cycle. With a few clicks, you can provision exactly what you need—and it will be available to you in a few minutes. That means you can provision and terminate resources as necessary on AWS, instead of paying for hardware when you're not using it. You can treat resources as temporary and disposable resources, free from the inflexibility and constraints of a fixed and finite IT infrastructure.

By harnessing the power of AWS, you can be more agile and efficient with change management, testing, reliability, and capacity planning.

# Three Models of Cloud Computing



## IaaS

Infrastructure  
as a Service

## PaaS

Platform  
as a Service

## SaaS

Software  
as a Service

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Cloud services can fall into one of three primary categories, based mainly around how much control (and responsibility) you have over how the service is configured.

### IaaS (Infrastructure as a Service):

You manage the server, which can be physical or virtual, as well as the operating system (Windows or Linux). In general, the data center provider has no access to your server.

Basic building blocks for cloud IT:

- Networking features
- Compute
- Data storage space

### PaaS (Platform as a Service):

Someone else manages the underlying hardware and operating systems. This enables you to run applications without managing underlying infrastructure (i.e., patching, updates, maintenance, hardware and operating systems). PaaS also provides a framework for developers that they can build upon to create customized applications.

### SaaS (Software as a Service):

Facebook and Dropbox are examples of SaaS. You manage your Facebook contacts and Dropbox files, while the service provider takes care of all of the data centers, servers,

networks, storage, maintenance, patching, etc. All you worry about is the software and how you want to use it. You are provided with a complete product that is run and managed by the service provider.

# Three Cloud Deployment Models

The diagram illustrates three cloud deployment models. The first, 'All-In Cloud', shows a central square node connected to four yellow cloud-like shapes. The second, 'Hybrid', shows a central square node connected to a white cloud shape on the left and an orange server rack icon on the right. The third, 'Private Cloud (On-premises)', shows a central square node connected to an orange server rack icon, which is situated within a white cloud shape.

All-In Cloud      Hybrid      Private Cloud  
(On-premises)

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### "All-In" Cloud:

A cloud-based application is fully deployed in the cloud, and all parts of the application run in the cloud. Applications in the cloud have either been created in the cloud or have been migrated from an existing infrastructure. Cloud-based applications can be built on low-level infrastructure pieces (for example, networking, compute or storage) or can use higher-level services that provide abstraction from the management, architecting, and scaling requirements of core infrastructure.

### Hybrid:

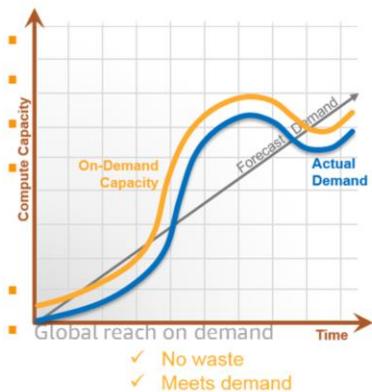
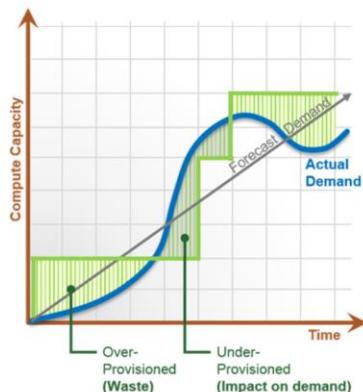
A hybrid deployment is a way to connect infrastructure and applications between cloud-based resources and existing resources that are not located in the cloud. The most common method of hybrid deployment is between the cloud and existing on-premises infrastructure (sometimes called *on-prem*). On-premises infrastructure is located within the physical confines of an enterprise, often in the company's data center. A hybrid deployment model is used to extend an organization's infrastructure into the cloud while connecting cloud resources to an internal system. For more information on how AWS can help you with your hybrid deployment, please visit our hybrid page at <https://aws.amazon.com/enterprise/hybrid/>.

### Private Cloud (On-premises):

When you run a cloud infrastructure from your own data center, that's called on-premises or private cloud. While this kind of deployment lacks many of the benefits of cloud computing, it

does provide dedicated resources and is a popular choice for organizations who need to meet certain compliance standards. In most cases, this deployment model is the same as legacy IT infrastructure while using application management and virtualization to increase resource utilization.

# All-In Cloud versus On-Premises

**All-In Cloud****On-Premises**

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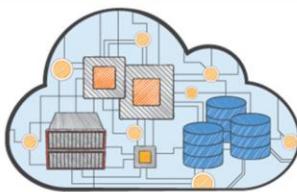
Let's take a closer look at *capacity* in the All-In Cloud and On-Premises solutions.

In the “All In” solution, capacity is in sync with demand. Resources are provisioned and decommissioned in response to demand with only a couple clicks.

In contrast, in “On-Premises” deployments, because you rely on physical hardware, you have to forecast your capacity needs well in advance of the actual demand. Instead of resources that expand and contract with demand, the on-premises solution results in idle, wasted resources waiting for demand to catch up. If demand suddenly outpaces capacity, the shortfall may result in unhappy customers. Your ability to respond quickly to this situation can be limited by long procurement cycles or by constraints on where you house your IT resources. Furthermore, building an on-premises infrastructure can be slow and expensive.

# All-In Cloud versus On-Premises





**All-In Cloud**

- 📦 No upfront investment
- 📦 Low ongoing costs
- 📦 Focus on innovation
- 📦 Flexible capacity
- 📦 Speed and agility
- 📦 Global reach on demand



**On-Premises**

- 📦 Large initial purchase
- 📦 Labor, patches, and upgrade cycles
- 📦 Systems administration
- 📦 Fixed capacity
- 📦 Long procurement cycle and setup
- 📦 Limited geographic regions

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To summarize:

- With the All-In solution, you avoid the large capital purchases required for an On-Premises solution. You have immediate access to resources without having to procure, install, and configure cabling, racks, servers, and storage in a physical location with appropriate facilities like cooling and power. Instead, you just click to order and pay for the resources you need, which are available almost immediately.
- Cloud computing helps you reduce ongoing IT costs in multiple ways. AWS continually lowers prices due to massive economies of scale and continual improvements. Multiple pricing options also help you optimize costs based on your unique workloads. You **pay only for what you use** on a **variable**, monthly basis. On-premises solutions typically require upgrades on 1-year, 3-year, or 5-year cycles.
- Cloud gives you managed IT resources on demand, at a fraction of the cost of traditional infrastructure. This cost savings empowers organizations to shift resources toward **innovative** new projects that grow their business by focusing on “apps not ops.”
- Predicting how customers are going to adopt your new application is complex, making it difficult to estimate your infrastructure capacity needs. **Flexible capacity** means that your resources are dynamic. You can quickly provision resources as demand goes up and turn off what you don’t need as demand declines.
- Cloud computing’s **speed and agility** makes it possible for you to respond to changing market conditions. With AWS, resources can be provisioned as needed. This self-service environment changes how you develop and deploy applications, allowing your team to experiment more quickly

and more frequently. The amount of time it takes to get a server procured, delivered, and running limits this in a traditional infrastructure.

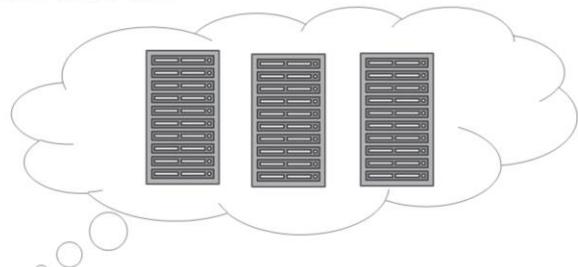
- With on-premises, it is hard to deliver great performance to a distributed user base. So, companies focus on one geographic region at a time to save costs and time. Without geographical limitations, you can deploy your application in any of the AWS regions around the world with lower latency and at minimal cost.

## What can you do in the cloud?



You can use a cloud computing platform for:

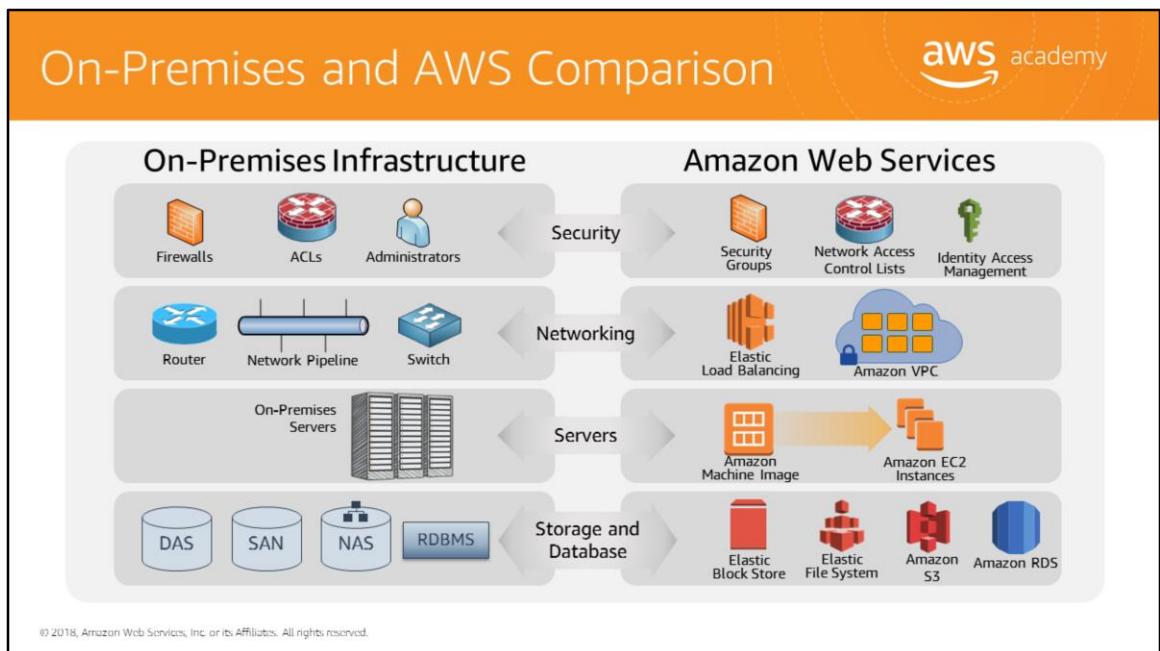
- Application Hosting
- Backup and Storage
- Content Delivery
- Websites
- Enterprise IT
- Databases



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You can use the cloud computing platform for the following:

- **Application Hosting** – use on-demand infrastructure to host internal or SaaS applications
- **Backup and Storage** - store data and build dependable backup solutions
- **Content Delivery** - distribute content worldwide, with high data transfer speeds
- **Websites** – host static and dynamic websites
- **Enterprise IT** - host internal- or external-facing IT applications in AWS's secure environment
- **Databases** – use a variety of scalable database solutions, from hosted enterprise database software to non-relational database solutions



Many of our services have analogs in the traditional IT space and terminology. This side-by-side comparison shows how Amazon Web Services (AWS) products and services relate to a traditional infrastructure.

## Summary



- 💡 Cloud computing is the on-demand delivery of IT resources online with pay-as-you-go pricing.
- 💡 Three models of cloud computing are:
  - 💡 Infrastructure as a Service (IaaS)
  - 💡 Platform as a Service (PaaS)
  - 💡 Software as a Service (SaaS)
- 💡 All-in cloud, hybrid, and private cloud are three cloud deployment models.
- 💡 Cloud services are available to replace traditional on-premises computing activities.

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## Part 2: Six Benefits of Cloud Computing

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Why are so many companies interested in moving to the cloud? Let's take a look at the benefits companies can realize from a move to the cloud.

## Advantage #1: Capex to Variable Expense



Trade **capital expense** for **variable expense**.

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### Advantage 1: Trade Capital Expense for Variable Expense

Instead of having to invest heavily in data centers and servers before you know how you're going to use them, you can pay only when you use computing resources, and pay for how much you use.

Source:

<https://d1.awsstatic.com/whitepapers/aws-overview.pdf>

## Capital Expense vs. Variable Expense



- 💡 Capital expense (capex): Funds used by a company to acquire, upgrade, and maintain physical assets such as property, industrial buildings, or equipment.
- 💡 Variable expense: A variable expense is an expense that is easily altered or avoided by the person bearing the cost.

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Remember the data center example where we racked and stacked the hardware and then had to manage it all? You have to pay for everything in the data center whether you use it or not. Furthermore, when you purchase a hardware solution, you cannot take advantage of the same massive economies of scale that Amazon can.

By using the cloud, businesses won't have to invest money into data centers and servers (capital expense, or capex) and can pay for only what they use (variable expense) in a pay-as-you-go fashion. This lets businesses save money on technology and enables them to adapt to new applications with as much space as needed in minutes, rather than weeks or days. Maintenance is reduced so the business can spend more time focusing on the core goals of the business.

Source:

<https://www.investopedia.com/terms/c/capitalexpenditure.asp>

Overview of Amazon Web Services:

[https://aws.amazon.com/whitepapers/overview-of-amazon-web-services.](https://aws.amazon.com/whitepapers/overview-of-amazon-web-services)

## Advantage #2: Economies of Scale



Benefit from **massive economies of scale**.

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### **Advantage 2: Benefit from massive economies of scale.**

By using cloud computing, you can achieve a lower variable cost than you can get on your own.

Source:

<https://d1.awsstatic.com/whitepapers/aws-overview.pdf>

## Economies of Scale



- 💡 Hardware solutions are **physical** and require:
  - 💡 Space
  - 💡 Staff
  - 💡 Physical security
- 💡 Significant cost to procure and house these resources
- 💡 No purchasing power
- 💡 Cloud providers leverage hundreds of thousands of customers to achieve economies of scale



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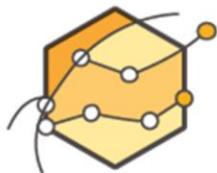
Data centers require hardware which in turn requires space, staff, and physical security. Significant cost and time is associated with the procurement of these resources. Additionally, purchasing power is limited to the size of their individual purchases.

In contrast, with usage from hundreds of thousands of customers aggregated in the cloud, providers such as Amazon Web Services can achieve higher economies of scale, which translates into lower pay-as-you-go prices.

Sources:

AWS | What Is Cloud Computing - Benefits of the Cloud. Amazon Web Services, Inc.N.p., n.d.Web. 31 Aug. 2014.

## Advantage #3: Capacity Planning



**Eliminate guessing** on your capacity needs.

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### **Advantage 3: Stop guessing about capacity.**

Eliminate guessing on your infrastructure capacity needs.

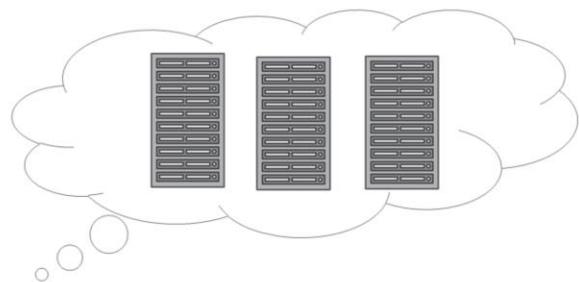
Source:

<https://d1.awsstatic.com/whitepapers/aws-overview.pdf>

## Guessing about Capacity



- 💡 What are the potential maximum peaks in usage?
- 💡 Is there enough resource capacity at peak?
- 💡 Is the amount of storage sufficient?



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Before cloud computing, we had to guess about how much resources would be required to accommodate usage peaks. That method also assumed that you could accurately predict the usage peaks. When you guess, it is very likely that you will probably either buy too much or too little. If you buy too much, you've wasted money. If you buy too little, you will have downtime.

With cloud computing, these problems go away. You can access as much or as little as you need, and scale up and down, scale in and out as required with only a few minutes notice.

## Advantage #4: Speed and Agility



Increase **speed** and **agility**.

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### **Advantage 4: Increase speed and agility.**

In a cloud computing environment, new IT resources are only a click away, which means you reduce the time it takes to make those resources available to your developers from weeks to just minutes. This results in a dramatic increase in agility for the organization, since the cost and time it takes to experiment and develop is significantly lower.

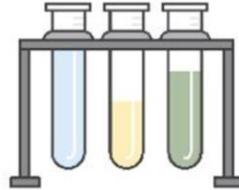
Source:

<https://d1.awsstatic.com/whitepapers/aws-overview.pdf>

## Increase Speed and Agility



- 💡 Rapid availability of new resources
  - 💡 Provision resources in minutes, not weeks
- 💡 Increase Innovation
  - 💡 Quick, low cost experimentation
  - 💡 Leverage pre-fabricated functionality without requiring in-house expertise . (i.e., data warehousing, analytics)
- 💡 Increase experimentation
  - 💡 Explore new avenues of business with minimal risk and expense
  - 💡 Test with different configurations



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Organizational agility is a core differentiator in today's rapidly changing business environment. For organizations to succeed in a constantly changing world, they need to improve their ability to change and adapt.

Cloud services provide instant global reach and rapid availability of new resources that enables you to quickly change or scale your technology. You can safely experiment with new ideas and encourage innovation at a very low cost. You may even find success with ideas that simply weren't feasible in the past due to hardware or budget constraints.

## Advantage #5: Spend Strategically



**Stop spending money** on running and maintaining data centers.

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### **Advantage 5: Stop spending money running and maintaining data centers.**

Focus on projects that differentiate your business, not the infrastructure. Cloud computing lets you focus on your own customers, rather than on the heavy lifting of racking, stacking, and powering servers.

# Stop Spending Money on Data Centers



- Focus on customers
- Focus on projects that differentiate the business
- Delegate the racking, stacking and powering of servers to the cloud provider

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Focus on your core business – what you are good at – rather than on managing infrastructure. Let someone else manage that for you. Focus on projects that differentiate the business, not the infrastructure.

## Advantage #6: Ease of Deployment



**Go global** in minutes.

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### **Advantage 6: Go global in minutes.**

Easily deploy your application in multiple regions around the world with just a few clicks. This means you can provide a lower latency and better experience for your customers simply and at minimal cost.

For more on the innovations that make the AWS cloud unique see  
[https://www.youtube.com/watch?v=JIQETrFC\\_SQ](https://www.youtube.com/watch?v=JIQETrFC_SQ).



You can be operating locally today and become available globally in minutes by leveraging Amazon CloudFront and our global network of edge locations. Deploying in the region where your customers are helps you provide lower latency and a better experience at minimal cost.

To learn more about specific locations available see <https://aws.amazon.com/about-aws/global-infrastructure/>.

## Summary



Trade **capital expense** for **variable expense**.

Benefit from **massive economies of scale**.

**Eliminate guessing** on your capacity needs.

Increase **speed** and **agility**.

**Stop spending money** to run and maintain data centers.

**Go global** in minutes.

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The six benefits discussed in this section provide a strong value proposition for moving to the cloud. Each of these benefits should be considered when deciding between an on-premises or cloud solution.

For more information see <https://d1.awsstatic.com/whitepapers/aws-overview.pdf>.



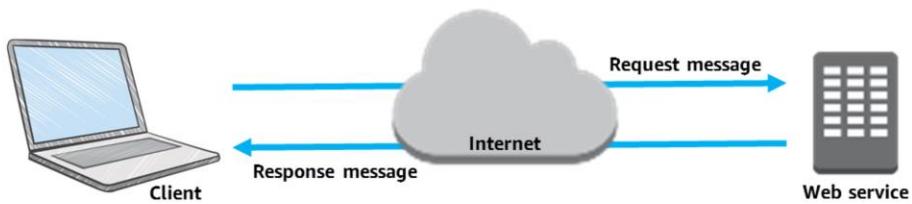
## Part 3: What is Amazon Web Services (AWS)?

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## What are Web Services?



A **web service** is any piece of software that makes itself available over the internet and uses a **standardized format** (XML or JSON) for the request and the response of an **API interaction**.



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A web service is any service that:

- Is available over the Internet or private (intranet) networks
- Uses a standardized data format (XML or JSON)
- Is not tied to any one operating system or programming language
- Is self-describing via an interface definition file
- Is discoverable

## What is AWS?

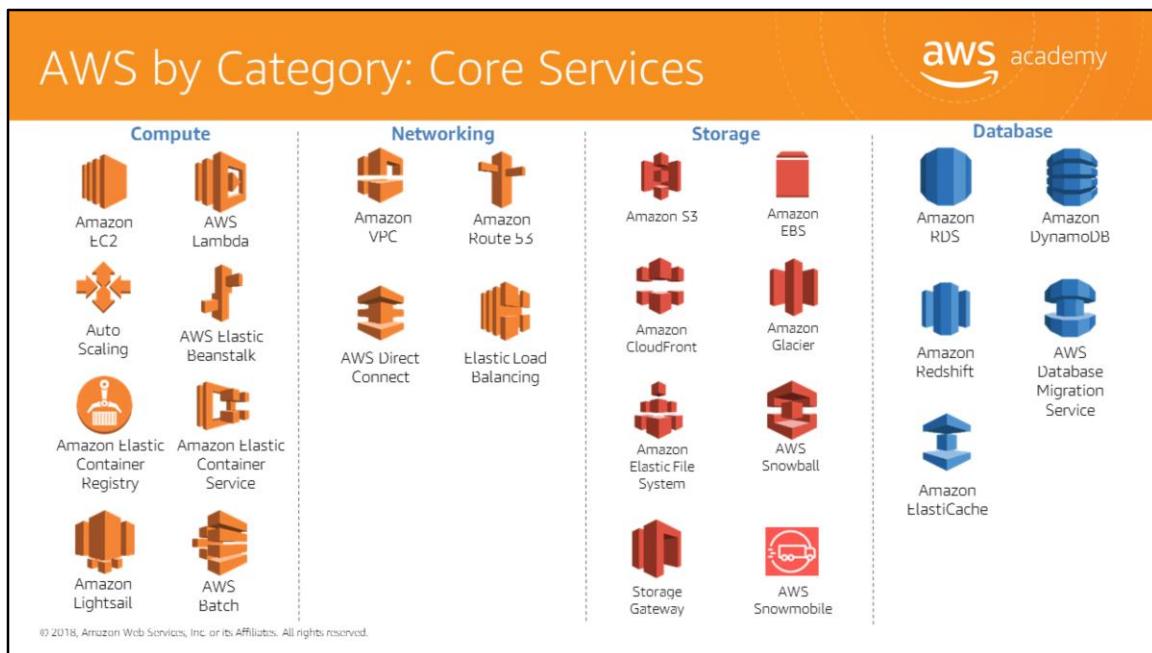


AWS is a **secure cloud services** provider with **more than 50 different services** that include solutions for:



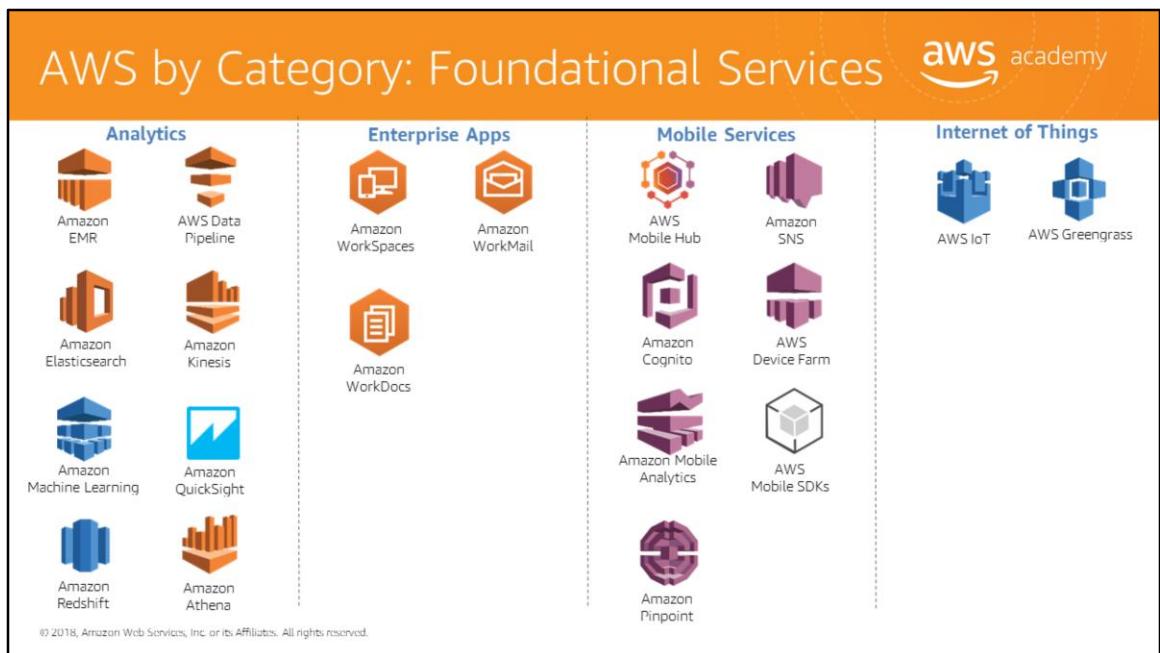
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AWS is a secure cloud services provider with more than fifty services to help businesses scale and grow. The AWS cloud provides a broad set of infrastructure services—such as compute power, storage options, networking, and databases—delivered as an on-demand utility that is available in seconds, with pay-as-you-go pricing. All of these services sit on AWS global infrastructure.



AWS offers many services. *Core services* refers to a broad and deep group of core cloud infrastructure services. The blue label denotes the service group category. Each of the individual icons represents a service within that group.

AWS services are typically grouped into different categories like compute, networking, storage, applications, databases, and analytics.



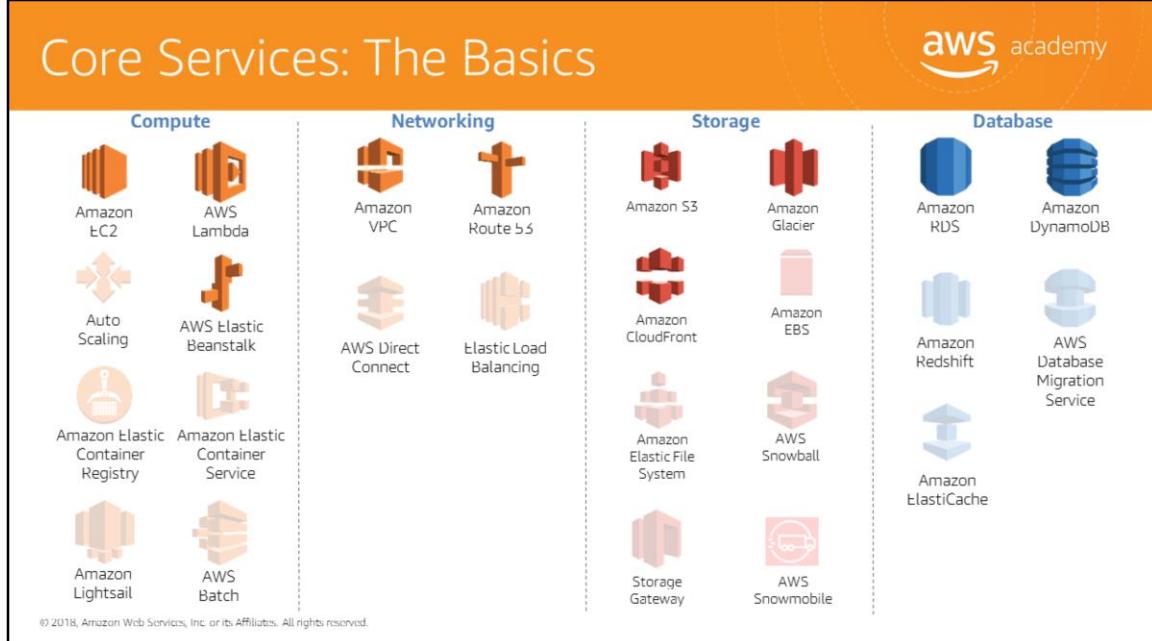
*Foundational services* refers to groups of services that offer cloud-based solutions for the analytics, enterprise, mobile, and IoT platforms.

## AWS by Category: Developer and Operations Services

Developer Tools	Management Tools	Security & Identity	App Services
AWS CodeCommit AWS CodeDeploy AWS X-Ray	Amazon CloudWatch AWS CloudFormation AWS CodePipeline AWS CodeBuild AWS Trusted Advisor	AWS Identity and Access Management Amazon Inspector AWS Key Management Service AWS Certificate Manager	AWS Directory Service AWS CloudHSM AWS WAF AWS Shield
	AWS CloudTrail AWS OpsWorks	AWS Service Catalog AWS Organizations	Amazon API Gateway Amazon AppStream Amazon CloudSearch Amazon Elastic Transcoder Amazon SES Amazon SNS Amazon SQS Amazon SWF

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The AWS Developer Tools is a set of services designed to enable developers and IT operations professionals practicing DevOps to rapidly and safely deliver software.



The array of AWS services can be intimidating as you start your journey into the cloud. Initially, you only need to focus on a few "core" services. You will need to understand the AWS Global Infrastructure, several Compute services, Networking & Content Delivery, Storage, Databases, Security & Identity Access Management, and, finally, Management Tools. Specifically, you should understand the following services from the core service group:

- Compute
  - Amazon EC2
  - AWS Lambda
  - AWS Elastic Beanstalk
- Networking
  - Amazon VPC
  - Amazon Route 53
  - DNS (Domain Name Services)
- Storage
  - Amazon S3 (Simple Storage Service)

- Amazon Glacier
- Databases
  - Amazon RDS (Relational Database Service)
  - Amazon DynamoDB (Non Relational Database)

# Core Services: The Basics

The diagram illustrates the core AWS services, organized into two main categories: Management Tools and Security & Identity.

**Management Tools:**

- Amazon CloudWatch
- AWS CloudFormation
- AWS CloudTrail
- AWS Config
- AWS OpsWorks
- AWS Service Catalog
- AWS Trusted Advisor

**Security & Identity:**

- AWS Identity and Access Management
- AWS Directory Service
- Amazon Inspector
- AWS CloudHSM
- AWS Key Management Service
- AWS WAF
- AWS Organizations
- AWS Certificate Manager
- AWS Shield

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From the Developer and Operations group, you should also understand the following:

- Management Tools
  - CloudWatch
  - AWS CloudFormation
- AWS Identity and Access Management (IAM)

## Access to AWS Services



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- AWS Management Console
  - Access on the go with AWS Console Mobile App
- AWS Command Line Interface (AWS CLI)
- Software Development Kits (SDK)



You may wonder how to access this broad array of services. You can access them in any of three ways: using the AWS Management Console, the AWS Command Line Interface (AWS CLI), and via Software Development Kits (SDKs). For access on the go, you can use the AWS Console Mobile App to quickly view resources on the go (<https://aws.amazon.com/console/mobile/>).

The AWS Management console breaks down AWS services into separate categories, like Compute, Management Tools, Mobile Services, etc. Each category has a number of different services in it, and all of the services can be accessed from the console. For example, the Compute category contains Amazon EC2, Amazon EC2 Container Service, Amazon Lightsail, AWS Elastic Beanstalk, AWS Lambda, and AWS Batch.

The CLI is a unified tool to manage your AWS services. With just one tool to download and configure, you can control multiple AWS services from the CLI and automate them through scripts. The CLI User Guide instructs you on how to install and configure the tool. After that, you can begin making calls to your AWS services from the CLI. For more information about the CLI see <https://docs.aws.amazon.com/cli/latest/userguide/cli-chap-welcome.html>.

Simplify using AWS services in your applications with an Application Programming

Interface (API) tailored to your programming language or platform. For more information about SDK access see <https://aws.amazon.com/tools/>. More information about API access can be found at <https://docs.aws.amazon.com/apigateway/latest/developerguide/welcome.html>.



## Part 4: The AWS Cloud Adoption Framework

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The AWS Cloud Adoption Framework (AWS CAF) helps organizations understand how cloud adoption transforms the way they work, and it provides structure to identify and address gaps in skills and processes.

# AWS Cloud Adoption Framework (CAF)

The diagram illustrates the AWS Cloud Adoption Framework (AWS CAF) as a central concept surrounded by six interconnected perspectives, each represented by a hexagon:

- Business** (Top, Teal)
- People** (Top Right, Yellow)
- Governance** (Bottom Right, Orange)
- Platform** (Bottom, Pink)
- Security** (Bottom Left, Green)
- Operations** (Top Left, Light Green)

**AWS CAF** is written in orange in the center of the hexagons.

- Perspectives in planning, creating, managing, and supporting a modern IT service
- Guidelines for establishing, developing, and running AWS environments
- Structure for business and IT teams to work together

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AWS Professional Services created the AWS Cloud Adoption Framework (AWS CAF) to help organizations develop efficient and effective plans for their cloud adoption journey. The guidance and best practices provided by the framework help you build a comprehensive approach to cloud computing across your organization, and throughout your IT lifecycle.

The AWS CAF breaks down the complex process of planning a move to the cloud into manageable pieces called perspectives. Perspectives represent essential areas of focus that span people, processes, and technology. Capabilities within each perspective identify which areas of your organization require attention. From that, actions are organized into prescriptive work streams that support a successful cloud journey.

The AWS CAF provides guidance that supports each unit in your organization so that each area understands how to update skills, adapt existing processes, and introduce new processes to take maximum advantage of the services provided by cloud computing. Thousands of organizations around the world have successfully migrated their businesses to the cloud, relying on the AWS CAF to guide their efforts. AWS and our partners provide tools and services that can help you every step of the way to ensure complete understanding and

transition.

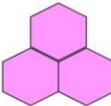
# Six Core Perspectives



**Business Perspective**  
How will your architectural approaches **align technical delivery to business imperatives?**



**Platform Perspective**  
What patterns, guidance, and tools are necessary to optimize your use of **technology services** on AWS?



**People Perspective**  
What **skills** are needed in order to adopt the AWS cloud platform? Examples include guiding processes of role descriptions, training, certification, and mentoring.



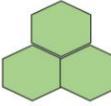
**Security Perspective**  
How will you define and implement the required levels of security, governance, and risk management to **achieve compliance**?



**Governance Perspective**  
How to update the staff skills and **organizational processes** necessary to ensure business governance in the cloud, and manage and measure cloud investments to evaluate business outcomes?



**Operations Perspective**  
How will you provide process, guidance, and tools for optimum **operational service management** of the AWS environment?



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At the highest level, the AWS Cloud Adoption Framework (AWS CAF) organizes guidance into six areas of focus, called perspectives. Each perspective covers distinct responsibilities owned or managed by functionally related stakeholders. In general, the Business, People, and Governance Perspectives focus on business capabilities; while the Platform, Security, and Operations Perspectives focus on technical capabilities.

For more information about the AWS CAF see <http://bit.ly/AWSCAF>.

## Summary



- 💡 Defined cloud computing and alternative implementation models
- 💡 Described the advantages of cloud computing
- 💡 Explored AWS services
- 💡 Discussed the AWS CAF

To finish this module:

- 💡 Complete:  **Knowledge Assessment**

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## Up Next: Section 1.02 – Cloud Economics

Review Pricing Fundamentals  
Understand Total Cost of Ownership

Up next, we will move on to Section 1.02 where we review the basics of cloud economics.

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## Module 1, Section 2: Cloud Economics



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Welcome to Module 1, Section 2 – Cloud Economics.

## What's In This Module



- Part 1: Fundamentals of Pricing
- Part 2: Total Cost of Ownership (TCO)

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# Module Overview



**Goal:** Review and understand the service pricing philosophy and the elements of cloud total cost of ownership (TCO)

- 💡 Understand the AWS pricing philosophy
- 💡 Review fundamental pricing characteristics
- 💡 Understand the elements of Total Cost of Ownership

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The goal of this module is to introduce you to the economic considerations of different service options so that you can identify a cost optimization strategy for your solution. You will learn the fundamentals of pricing and we will discuss Total Cost of Ownership (TCO) which is used to calculate the total cost of purchasing and operating a technology product during its useful life. TCO gives businesses a framework to evaluate competing solutions to a problem and will be part of cloud conversations with your business partners.



# Part 1: Fundamentals of AWS Pricing

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# AWS Fundamentals



- 💡 Pay for AWS fundamentals:
  - 💡 Compute
  - 💡 Storage
  - 💡 Outbound data transfer
- 💡 No charge:
  - 💡 Inbound data transfer
  - 💡 Data transfer between services within the same region
- 💡 Charge for aggregated outbound

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There are three fundamental characteristics you pay for with AWS: compute, storage, and data transfer out. These characteristics vary slightly depending on the AWS product you are using. However, these are the core characteristics that have the greatest impact on cost.

Although you are charged for data transfer out, there is no charge for inbound data transfer or for data transfer between other AWS services within the same AWS Region. The outbound data transfer is aggregated across Amazon EC2, Amazon S3, Amazon RDS, Amazon SimpleDB, Amazon SQS, Amazon SNS, and Amazon VPC, and then charged at the outbound data transfer rate. This charge appears on the monthly statement as AWS Data Transfer Out.

# AWS Pricing Model



## AWS Pricing Policy:

While the number and types of services offered by AWS have increased dramatically, our philosophy on pricing has not changed: at the end of each month, *you pay for what you use*. You can start or stop using a product at any time. No long-term contracts required.



- 💡 Pay for what you use
- 💡 Pay less when you reserve
- 💡 Pay less when you use more
- 💡 Pay even less as AWS grows

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This philosophy is what underlies AWS pricing.

AWS offers a range of cloud computing services. For each service, you pay for exactly the amount of resources you actually need. This **utility-style** pricing model includes:

- Pay per use
- Pay less when you reserve
- Pay less when you use more
- Pay even less as AWS grows

Let's take a closer look at these core concepts of pricing.

Note: The AWS pricing white paper is available at  
[https://d0.awsstatic.com/whitepapers/aws\\_pricing\\_overview.pdf](https://d0.awsstatic.com/whitepapers/aws_pricing_overview.pdf).

## Pay for What You Use



Pay only for the services you consume, with no large upfront expenses.



- 💡 Lower variable costs
- 💡 Adapt to changing business needs

Benefits:

- 💡 Adapt to changing business needs
- 💡 Redirect focus on innovation and invention

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Unless you build data centers for a living, you have likely spent too much time and money building them. With AWS, you no longer need to dedicate valuable resources to building costly infrastructure, including purchasing servers, software licenses, or leasing facilities. With AWS, you can replace large upfront expenses with lower variable costs and pay only for what you use and for as long as you need it. All AWS services are available on demand, require no long-term contracts, and have no complex licensing dependencies.

## Pay Less When You Reserve



### Invest in reserved instances

- 💡 Save up to 75%
- 💡 Options:
  - 💡 All Upfront (**AURI**) → largest discount
  - 💡 Partial Upfront (**PURI**) → lower discounts
  - 💡 No Upfront payments (**NURI**) → smaller discount



### Benefits:

- 💡 Minimize risk
- 💡 Predictably manage budgets
- 💡 Comply with policies that require longer-term commitments

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For certain services like Amazon EC2 and Amazon RDS, you can invest in reserved capacity.

With Reserved Instances, you can save up to 75% over equivalent on-demand capacity.

Reserved Instances are available in 3 options:

- All up-front reserved instance (**AURI**)
- Partial up-front reserved instance (**PURI**)
- No upfront payments reserved instance (**NURI**).

When you buy Reserved Instances, the larger the upfront payment, the greater the discount.

To maximize your savings, you can pay all up-front and receive the largest discount. Partial up-front RIs offer lower discounts but give you the option to spend less up front. Lastly, you can choose to spend nothing up front and receive a smaller discount, allowing you to free up capital to spend in other projects.

By using reserved capacity, your organization can minimize risks, more predictably manage budgets, and comply with policies that require longer-term commitments.

## Pay Less By Using More



Realize volume-based discounts

- 💡 **Savings** as usage increases
- 💡 **Tiered pricing** for services (for example, Amazon S3, EBS, EFS) → *the more you use, the less you pay per GB*
- 💡 Data transfer **IN** is *always free*
- 💡 Multiple storage services deliver **lower** storage costs based on needs



Benefits:

- 💡 Choosing the right combination of storage options **helps you reduce cost** while preserving performance, security and durability.

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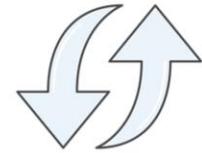
With AWS, you can get volume based discounts and realize important savings as your usage increases. For services like Amazon S3, pricing is tiered, meaning the more you use, the less you pay per GB. In addition, data transfer IN is always free of charge. As a result, as your AWS usage needs increase, you benefit from the economies of scale that allow you to increase adoption and keep costs under control.

As your organization evolves, AWS also gives you options to acquire services that help you address your business needs. For example, AWS' storage services portfolio offers options to help you lower pricing based on how frequently you access data and the performance you need to retrieve it. To optimize your savings, choose the right combination of storage solutions that help you reduce costs while preserving performance, security and durability.

## Pay Even Less as AWS Grows



As AWS grows:



- AWS is focused on lowering cost of doing business
- Results in AWS passing savings from economies of scale to you
- Since 2006, AWS has **LOWERED PRICING** 61 times
- Future higher performing resources replace current resources for no extra charge.

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AWS is constantly focused on reducing data center hardware costs, improving operational efficiencies, lowering power consumption, and generally lowering the cost of doing business. These optimizations and AWS's substantial and growing economies of scale result in passing savings back to you in the form of lower pricing. Since 2006, AWS has lowered pricing **61** times.

Another benefit of AWS growth is that future, higher performing resources replace current ones for no extra charge.

## Custom Pricing



Meet varying needs through custom pricing

- Available for high-volume projects with unique requirements



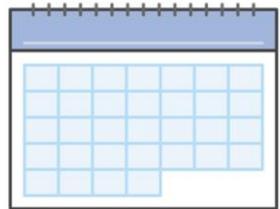
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AWS realizes that every customer has different needs. If none of the AWS pricing models work for your project, custom pricing is available for high-volume projects with unique requirements.

# AWS Free Tier



AWS Free Tier helps customers get started in the cloud.



## Limitations:

- Only new customers
- Up to one year
- Applicable to only certain services and options

For more details: [www.aws.amazon.com/free](http://www.aws.amazon.com/free)

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To help new AWS customers get started in the cloud, AWS offers a free usage tier. If you're a new AWS customer, you can run a free Amazon EC2 T1 micro instance for a year while also leveraging a free usage tier for Amazon S3, Amazon Elastic Block Store, Amazon Elastic Load Balancing, AWS data transfer and other AWS services.

# No Charge



AWS services for no additional charge:

- Amazon Virtual Private Cloud (VPC)
- AWS Identity and Access Management (IAM)
- Consolidated Billing



Other no charge\* AWS services:

- AWS Elastic Beanstalk
- AWS CloudFormation
- AWS Auto Scaling
- AWS OpsWorks

\*Note: There may be charges associated with other AWS services used in conjunction with these services.

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AWS also offers a variety of services for no additional charge:

- **Amazon VPC: Amazon Virtual Private Cloud (Amazon VPC)** lets you provision a logically isolated section of the AWS Cloud where you can launch AWS resources in a virtual network that you define.
- **AWS Identity and Access Management (IAM)** controls your users' access to AWS services and resources.
- **Consolidated Billing** is a billing feature in AWS Organizations to consolidate payment for multiple AWS accounts or multiple AISPL accounts. Consolidated billing provides: **one bill** for multiple accounts, the ability to **easily track** each account's charges, and the opportunity to decrease charges as a result of volume pricing discounts from **combined usage**. Moreover, you can consolidate all your accounts using Consolidated Billing and get tiered benefits.
- **AWS Elastic Beanstalk\*** is an even easier way for you to quickly deploy and manage applications in the AWS cloud.
- **AWS CloudFormation\*** gives developers and systems administrators an easy way to create a collection of related AWS resources and provision them in an orderly and predictable fashion.
- **AWS Auto Scaling\*** automatically adds or removes resources according to conditions you define. The resources you are using increase seamlessly during demand spikes to maintain performance and decrease automatically during demand lulls to minimize costs.
- **AWS OpsWorks\*** is an application management service that makes it easy to deploy and operate applications of all shapes and sizes.

**\*Note:** Although there is no charge for these services, there may be charges associated with other AWS services used in conjunction with these services. For example, when auto scaling launches additional EC2 instances there will be charges for those instances.

# In Review



There is no charge for:

- ─ Inbound data transfer
- ─ Data transfer between services within the same region
- ─ Pay for what you use
- ─ Start and stop any time
- ─ No long-term contracts required
- ─ Some services are free but AWS services used in conjunction with these services are not

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While the number and types of services offered by AWS have increased dramatically, our philosophy on pricing has not changed: at the end of each month, you pay only for what you use, and you can start or stop using a product at any time. No long-term contracts are required. The best way to estimate costs is to examine the fundamental characteristics for each AWS service, estimate your usage for each characteristic, and then map that usage to the prices posted on the website.

The service pricing strategy gives you tremendous flexibility to choose the services you need for each project and to pay only for what you use.

There are a number of free AWS services, including Amazon VPC, Elastic Beanstalk, AWS CloudFormation, IAM, AWS Auto Scaling, AWS OpsWorks, and Consolidated Billing. While the services themselves are free, the resources that they provision are not. Additionally, there is no charge for inbound data or data transfer between services within the same region; however, outbound data transfer costs are tiered.

For more information about pricing for specific services, see  
<http://aws.amazon.com/pricing/>.

For more information about AWS pricing in general, see our white paper at  
[https://d0.awsstatic.com/whitepapers/aws\\_pricing\\_overview.pdf](https://d0.awsstatic.com/whitepapers/aws_pricing_overview.pdf).

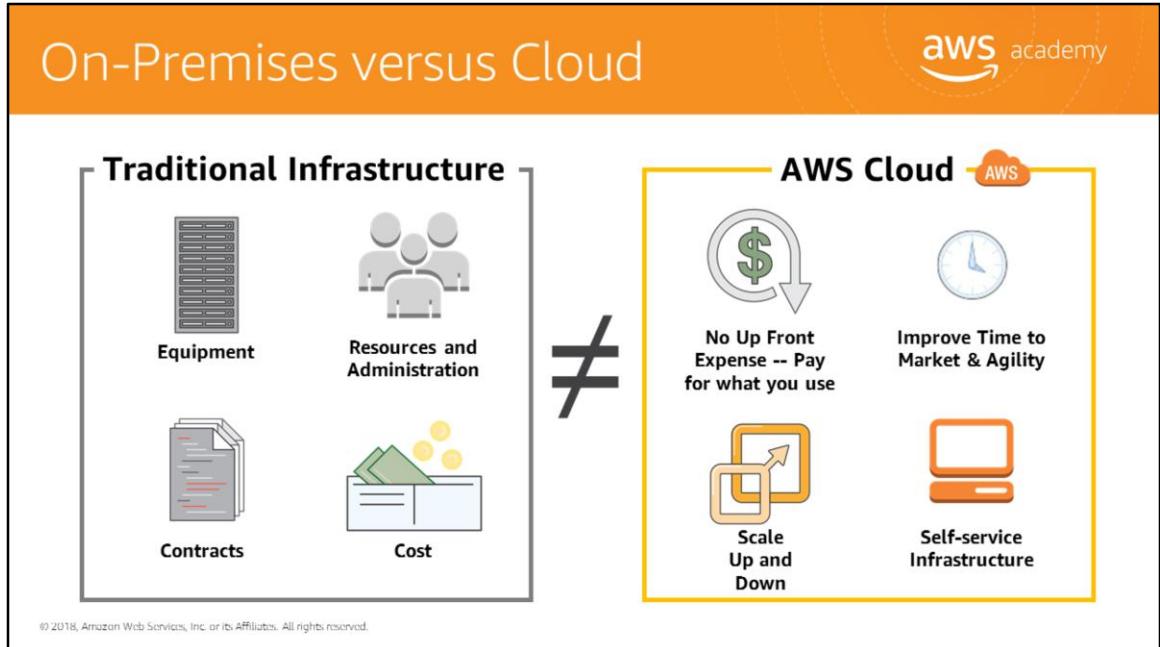


## Part 2: Total Cost of Ownership (TCO)

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Now that you understand the AWS pricing philosophy and how different AWS services are priced, let's take a look at Part 2: Total Cost of Ownership (TCO). In addition to prices, businesses often want to understand the TCO, which is a financial estimate that helps buyers and owners determine the direct and indirect costs of a product or system. It reflects the purchase price of an asset *plus* the costs of operation. TCO information is especially helpful when you are making the decision of whether or not to deploy on AWS.

Let's move forward to the final part of our economic discussion and review both TCO and the TCO Calculator.



On-premises versus cloud is a question being asked by many businesses. The difference between these two options is how they are deployed.

An on-premises infrastructure is installed locally on a company's own computers and servers. There are several fixed costs, also known as capital expenses, associated with the traditional infrastructure: facilities, hardware, licenses, and maintenance staff. Scaling up can be expensive and time consuming. Scaling down does not reduce fixed costs.

A cloud infrastructure is purchased from a service provider who builds and maintains the facilities, hardware, and maintenance staff. A customer pays for what is used. Scaling up or down is simple. Costs are easy to estimate because they are depend service usage.

It is difficult to compare an on-premises IT delivery model with the AWS cloud. The two are so very different that they use different languages:

- On-premises IT is a discussion based on capital expenditure, long planning cycles, and multiple components to buy, build, manage, and refresh over time.
- AWS is a discussion about flexibility, agility, and consumption based costs.

So, how can we identify the best option?

## What is Total Cost of Ownership (TCO)?



**Total Cost of Ownership (TCO)** - financial estimate to help identify direct and indirect costs of a system.

Why use TCO?

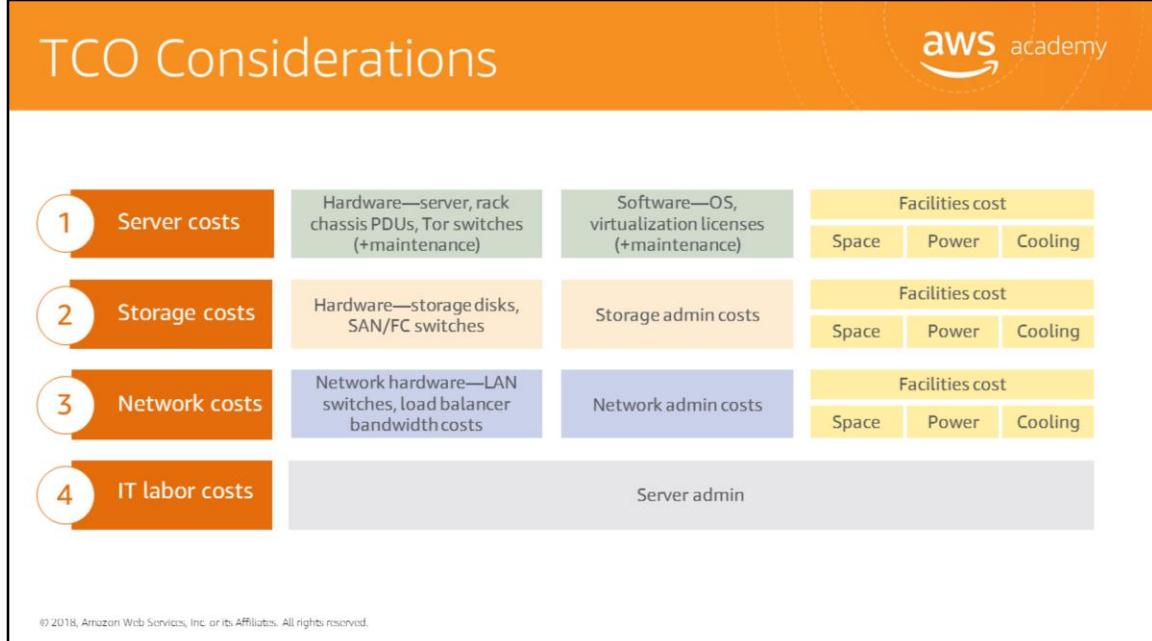
- To compare the costs of running an **entire infrastructure environment or specific workload** on-premises versus on AWS.
- To budget and **build the business case** for moving to the cloud.



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We can identify the best option by comparing the on-premises solution to a cloud solution. Total Cost of Ownership (TCO) is a tool that can be used for this comparison. TCO is a financial estimate intended to help buyers and owners determine the direct and indirect costs of a product or system. TCO includes the cost of a service plus all the costs associated with owning the service.

In the cloud environment, TCO is used for comparing the costs of running an entire infrastructure environment for a specific workload in an on-premises or co-location facility to the same workload running on a cloud-based infrastructure. This comparison is done for budgeting purposes or to build a business case for business decisions regarding the optimal deployment solution.



So, what are some of the costs associated with data center management? These costs include:

- **Server** costs include both hardware and software costs and facilities cost to house the equipment.
- **Storage** costs are associated with the hardware, administration and facilities.
- **Network** costs are similar to the storage costs and include hardware, administration, and facilities costs.
- **IT labor** costs are required to administer the entire solution.

When comparing an on-premises to cloud solution, it is important to accurately assess the true costs of both options. With the Cloud, most costs are upfront and readily calculated. For example:

- Cloud providers give transparent pricing based on different usage metrics – RAM, storage, bandwidth, among others.
- Pricing is frequently fixed per unit of time.

Customers gain certainty over pricing and are then able to readily calculate costs based on several different usage estimates.

Compare this to on-premise technology. Although they are sometimes difficult to determine, calculations of in-house costs must take into account all:

- **Direct costs** that accompany running a server like power, floor space, storage, and IT operations to manage those resources
- **Indirect costs** of running a server like network and storage infrastructure.

Please note that this diagram is conceptual and does not include every cost item. For example, depending on the solution you are implementing, software costs can include database, management, and middle-tier costs. Facilities costs can include upgrades, maintenance, building security, taxes, and so on. IT labor costs can include security admin and application admin costs. This is an abbreviated list to demonstrate the type of costs are involved in data center maintenance.

## On-Premises versus All-In Cloud

You could save **96%** a year by moving your infrastructure to AWS.  
Your three year total savings would be **\$159,913**

3 Year Total Cost of Ownership		
	On-Premises	AWS
Server	\$91,922	\$2,547
Storage	\$67,840	\$4,963
Network	\$7,660	\$-----
IT – Labor	\$ -----	\$-----
<b>Total</b>	<b>\$167,422</b>	<b>\$7,509</b>

AWS cost includes business level support

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Let's take a look at a cost comparison. This example shows a cost comparison for an on-premises and cloud solution over 3 years.

For this comparison, two similar environments were constructed to represent the on-premises and AWS environments. (Note: additional direct and indirect costs associated with the on-premises solution have not been included.) The components of the on-premises solution include:

- 1 virtual machine with 4 CPUs, 16 GB of RAM, and Linux operating system
- Average utilization is 100%
- Optimized by RAM

The components of a comparable AWS environment include:

- 1 m4.xlarge instance with 4 CPUs, 16 GB of RAM,
- Instance type – 3 year partial upfront reserved instance

The cost difference between these solutions is significant – a 96% annual savings on cloud infrastructure versus an on-premises solution. (Note: On-premise three year total solution cost = \$502,266, AWS Cloud three year total solution cost = \$22,537. Savings = (\$502,266 - \$22,537)/\$502,266=96%.) This comparison helps a business clearly understand the differences between the alternatives.

So, what is the difference in the costs? Remember, the on-premises solution is “predicted” and then continues to incur costs whether or not the capacity is utilized. In contrast, the AWS solution

is commissioned when needed and decommissioned when the resources are no longer in use resulting in the lower overall costs.

# AWS Simple Monthly Calculator

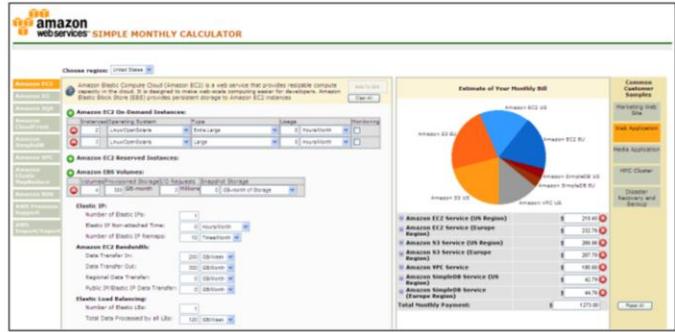


Use the Simple Monthly Calculator to:

- ☐ Estimate monthly costs
- ☐ Identify opportunities to reduce monthly costs
- ☐ Use templates to compare services and deployment models

Access the Simple Monthly Calculator at:

<http://calculator.s3.amazonaws.com/index.html>



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There are tools available to assist you with these comparisons. The **AWS Simple Monthly Calculator** helps estimate a monthly AWS bill. Using this tool, you can add, modify and remove services from your 'bill' and it will recalculate their estimated monthly charges automatically. The calculator incorporates a wide array of pricing calculations across all services in all regions. It also shows breakdown of features for each service in each region.

The Simple Monthly Calculator is a tool that helps you:

- Estimate monthly services costs when using AWS
- Identify opportunities for cost reduction
- Use templates to model solutions to compare services and deployment models

The calculator also shows common customer samples and their usage. You can click on "Disaster Recovery and Backup" sample or "Web Application" sample and see usages of each service.

You can launch the Simple Monthly calculator at  
<http://calculator.s3.amazonaws.com/index.html>.

# AWS TCO Calculator

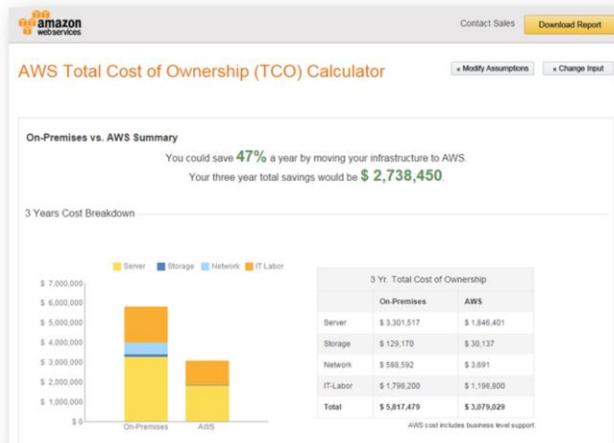


Use the TCO calculator to:

- 💡 Estimate cost savings
- 💡 Use detailed reports
- 💡 Modify assumptions

Accessing the TCO Calculator:

💡 <https://awstcoccalculator.com>



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The AWS TCO Calculator helps you evaluate the TCO of a solution. Eliminating the need to invest in large capital expenditures (or *capex*) and providing a pay-as-you-go model that empowers you to invest in the capacity you need and use it only when you require it helps reduce TCO.

The TCO calculator is a tool that helps you:

- Estimate cost savings when using AWS
- Use detailed set of reports (which can be used in executive presentations)
- Modify assumptions that best meet your needs

An additional benefit of the calculator includes the ability to weigh the financial considerations of owning and operating a data center versus using a cloud infrastructure. Also, the TCO calculator explains the assumptions and the methodology behind the calculations.

You can launch the TCO calculator at: <https://awstcoccalculator.com>.

## Additional Benefit Considerations



### Hard Benefits

- Reduced spending on compute, storage, networking, security
- Avoidance of hardware and software purchases (CapEx)
- Reductions in operational costs, backup and disaster recovery
- Reduction in operations personnel



### Soft Benefits

- Reuse of service and applications that allow you to define, and redefine solutions using the same cloud service
- Increased developer productivity
- Improved customer satisfaction
- Improved employee morale
- Agile business processes able to quickly respond to new and emerging opportunities
- Increase global reach

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Cloud Total Cost of Ownership (TCO) defines what will be spent on the technology after adoption – or what it costs to “run the engine.” Typically, a TCO analysis looks at the “as is” on-premise infrastructure and compares this with the cost of the “to be” infrastructure state in the cloud. While this is easy to calculate, it may only provide a narrow view of the total financial impact of moving to the cloud.

A Return on Investment (ROI) analysis can be used to determine the value generated while taking spending and saving into consideration. This analysis starts by identifying the hard benefits in terms of direct and visible cost reductions and efficiency improvements. Next, soft savings are identified. Soft savings are value points that are challenging to accurately quantify but can be more as or more valuable than the hard savings. It is important for you to understand both hard and soft benefits to understand the full value of cloud.

Now, let’s review a case study from Delaware North to see an actual TCO example.

## Case Study: Total Cost of Ownership



Delaware  
North.

**Background:**

- Growing global company with over 200 locations
- 500 million customers, \$3 billion annual revenue

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**Background:**

Delaware North originated in 1915 as a peanut and popcorn concessions vendor; today, it's a major food and hospitality company. Although the company deliberately keeps a low profile, it is a leader in the food-service and hospitality industry. Delaware North serves more than **500 million customers** annually at more than **200 locations** around the world, including venues as diverse as the Kennedy Space Center in Florida, London Heathrow Airport, Kings Canyon Resort in Australia, and the Green Bay Packers' Lambeau Field in Wisconsin. This global presence has turned Delaware North into a **\$3 billion enterprise**.

## Case Study: Total Cost of Ownership



Delaware  
North.

**Background:**

- Growing global company with over 200 locations
- 500 million customers, \$3 billion annual revenue

**Challenge:**

- Meet demand to rapidly deploy new solutions
- Constantly upgrade aging equipment

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**Challenge/Opportunity:**

The company's on-premises data center was becoming too expensive and inefficient to support its global business operations, so it turned to AWS to move most of its enterprise applications and operations to the cloud.

Kevin Quinlivan, Delaware North's Chief Information Officer, says, "As the company continued to grow, the **demand to rapidly deploy new solutions** to meet customer requirements increased as well. This fact, combined with the **need to constantly upgrade aging equipment**, required an even greater commitment of resources on our part. We had to find a better strategy."

## Case Study: Total Cost of Ownership

Delaware  
North.**Background:**

- Growing global company with over 200 locations
- 500 million customers, \$3 billion annual revenue

**Challenge:**

- Meet demand to rapidly deploy new solutions
- Constantly upgrade aging equipment

**Criteria:**

- Broad solution to handle all workloads
- Ability to modify processes to improve efficiency and lower costs
- Eliminate busy work (e.g. patching software)
- Achieve a positive return on investment (ROI)

© 2018, Amazon Web Services, Inc. or its Affiliates. All rights reserved.**Criteria:**

After a successful migration of about 50 websites to AWS in 2013, Delaware North evaluated the cost benefit and total cost of ownership to move their IT infrastructure to AWS. Their focus was to answer C-level business demands for measurable benefits that could convince an executive committee that the AWS cloud was the right approach.

The evaluation process centered on three criteria:

- 1) A cloud solution needed a broad set of technologies that could **handle all of Delaware North's enterprise workloads** while delivering support for critical functions.
- 2) From an operational perspective, Delaware North wanted the features and flexibility to **modify core IT processes to improve efficiencies and lower costs**. This included **eliminating redundant or time-consuming tasks** like patching software and pushing test and development tasks through outdated systems that, in the past, added months to the deployment of new services.
- 3) Financial requirements needed to **demonstrate a return on investment (ROI)** with a solid cost-benefit justification for moving away from their existing data center environment.

## Case Study: Total Cost of Ownership

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- Achieve a positive return on investment (ROI)

**Solution:**

- Moved its on-premises data center to AWS
  - Eliminated 205 servers (90%)
  - Moved nearly all apps to AWS
- Three-year Amazon EC2 Reserved Instances

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### Solution:

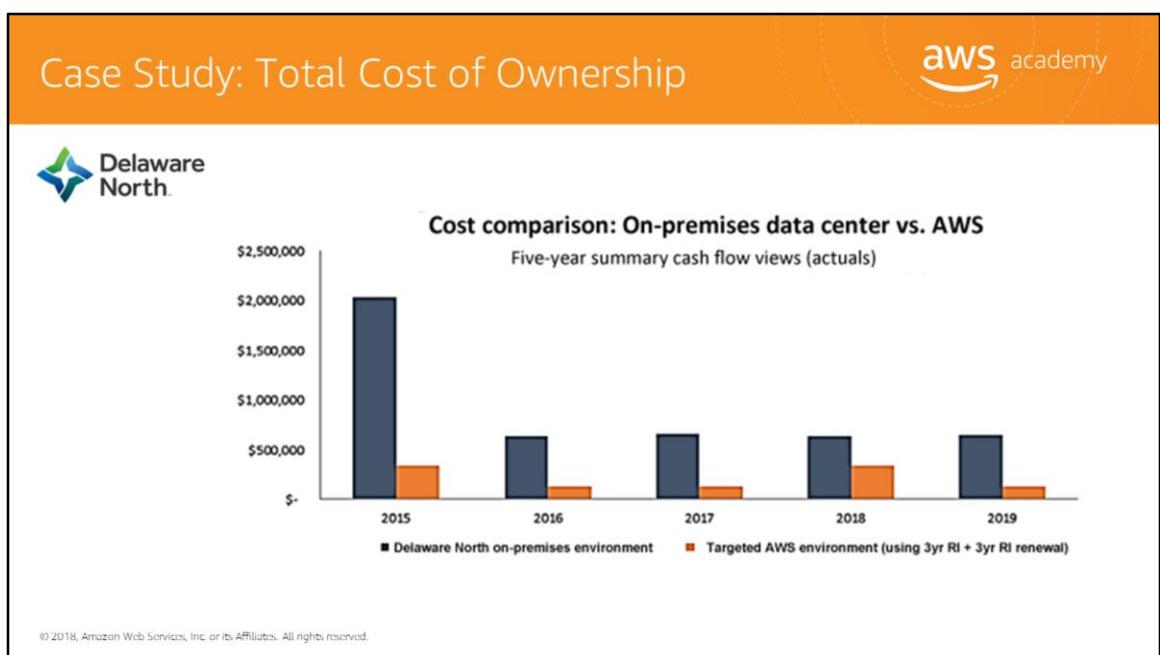
A cost comparison completed by Delaware North demonstrated that it could save \$3.5 million based on a five-year run rate by **moving its on-premises data center to AWS** and using three-year Amazon EC2 Reserved Instances (RI) and Reserved Instance renewals.

Quinlivan noted that the deep technology stack available on AWS was more than sufficient to meet the company's technical and operational requirements. The pricing structure of the AWS offerings, which includes paying only for what is used, provided total cost of ownership benefits which was presented to senior leaders.

Quinlivan stated, "We compared the costs of keeping our on-premises data center versus moving to the AWS cloud, measuring basic infrastructure items such as hardware cost and maintenance." He also says "We estimate that moving to AWS will save us at least \$3.5 million over five years by **reducing our server hardware by more than 90 percent**. But the cost savings will likely be greater due to additional benefits, like the increased compute capacity we can get using AWS. That lets us continually add more and larger workloads than we could using a traditional data center infrastructure, and achieve savings by only paying for what we use."

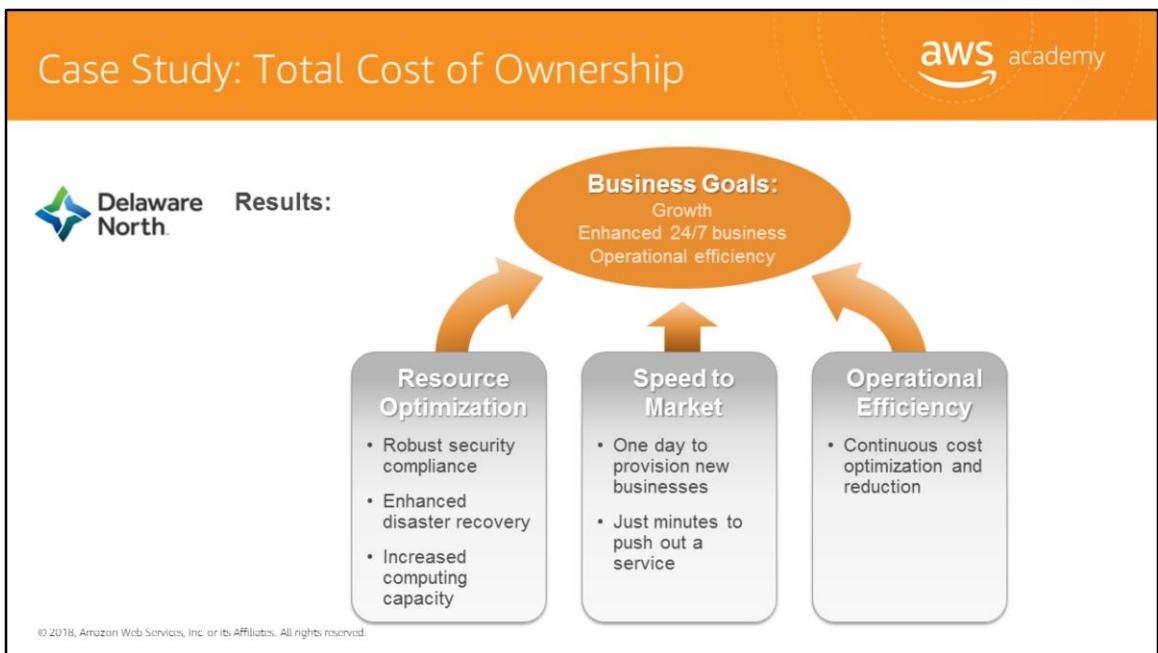
Delaware North moved almost all of its applications to AWS, including enterprise software such as its Fiorano middleware, Crystal Reports and QLIK business intelligence solutions, its Citrix virtual desktop system, and Microsoft System Center Configuration Manager, which is used to manage workstations.

The most dramatic physical change was the **elimination of 205 servers**; everything running on that hardware was migrated to AWS. The IT department decided to keep about 20 servers on-premises at the new headquarters building to run communications and file-and-print tasks. “We erred on the side of caution to ensure there is no latency with these tasks, but once we reach a certain comfort level, we may move these to the cloud as well,” says Brian Mercer, Senior Software Architect for the project.



### Cost Comparison:

A cost comparison done by Delaware North showed that it could save \$3.5 million based on a five-year run rate by moving its on-premises data center to AWS and using three-year Amazon EC2 Reserved Instances (RI) and Reserved Instance renewals.



### Results:

Six months into its cloud migration, Delaware North was realizing benefits in addition to its data center consolidation, including cost-effective security compliance, enhanced disaster recovery, and faster deployment times for new services.

"Robust security in a retail environment is critical for us because of our many retail operations, and AWS is enormously helpful for that," says Brian Mercer, the senior software architect for the project. "By leveraging the security best practices of AWS, we've been able to eliminate a lot of compliance tasks that in the past took up valuable time and money."

He adds that the company also has increased its disaster recovery capabilities at a lower cost than what was available in its previous data center deployment. "It significantly improved our business continuity capabilities, including seamless failovers," he says.

The solution is also helping Delaware North operate with greater speed and agility. For example, it can bring in new businesses—either through contracts or acquisitions—and get them online much faster than in the past by eliminating the need for traditional IT procurement and provisioning. It used to take between two and three weeks to provision new business units; now it takes one day. The Delaware North IT team is also using AWS to overhaul its operations by eliminating outdated and cumbersome processes, cleaning up documentation, and leveraging the benefits of running test and development tasks in combination with rapid deployment of services.

through the cloud.

"Our DevOps team can now spin up the resources to push out a service in just minutes, compared to the weeks it used to take," says Brian Mercer. "With AWS, we can respond much faster to business needs. And we can start repurposing time and resources to deliver more value and services to our internal teams and to our customers."

# Resources to Get You Started

**AWS Economics Center**  
<http://aws.amazon.com/economics/>

**AWS TCO Calculator**  
<https://awstcoccalculator.com>

**Simple Monthly Calculator**  
<https://calculator.s3.amazonaws.com/index.html>

**Case studies and research**  
<http://aws.amazon.com/economics/>

**AWS Total Cost of Ownership (TCO) Calculator**

Contact Sales   Download Report

On-Premises vs. AWS Summary  
You could save **47%** a year by moving your infrastructure to AWS.  
Your three year total savings would be **\$ 2,738,450**.

3 Years Cost Breakdown

Category	On-Premises	AWS
Server	\$ 3,301,517	\$ 1,846,401
Storage	\$ 129,170	\$ 36,137
Network	\$ 588,592	\$ 3,691
IT-Labor	\$ 1,798,200	\$ 1,198,800
Total	\$ 5,817,479	\$ 3,079,029

AWS cost includes business level support.

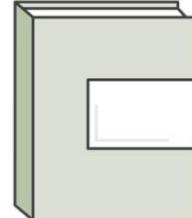
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If you are interested in learning more, there are a number of resources available. Here are some links for you to look at later, try out the simple online calculator, and access additional resources.

## In Review



- 💡 TCO is a valuable tool
- 💡 The AWS Simple Monthly Calculator can be used to provide accurate cost estimates
- 💡 The AWS TCO Calculator can be used to estimate cost savings
- 💡 The TCO Calculator:
  - 💡 Detailed reports with 3-year TCO comparison by cost categories
  - 💡 Executive reports
  - 💡 Assumptions that can be tailored to business needs



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TCO is a valuable tool that can be used to understand and compare the costs associated to different deployments. AWS provides the AWS Simple Monthly Calculator and the TCO Calculator to assist you with the calculations needed to estimate cost savings.

Use the Simple Monthly Calculator to:

- Estimate monthly costs
- Identify opportunities to reduce monthly costs
- Use templates to compare services and deployment models

The TCO calculator has:

- Detailed reports that show a 3-year TCO comparison by cost categories
- Reports that are appropriate for inclusion in executive presentations
- The ability to modify assumptions for business needs

To estimate cost savings when using AWS:

- Use a detailed set of reports
- Modify assumptions that best meet business needs.

## Module 1.0.2 Review:



- 💡 Explored the fundamental of AWS pricing
- 💡 Reviewed TCO concepts
- 💡 Introduced the AWS Simple Monthly Calculator and the TCO Calculator

Up Next...

- 💡 Complete:  **Knowledge Assessment**

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In review, we:

- Explored the fundamental of AWS pricing
- Reviewed the Total Cost of Ownership (TCO) concepts, the AWS Simple Monthly Calculator and the AWS TCO calculator.



## Up Next: Unit 1.0.3 – AWS Global Infrastructure Overview

Review AWS Global Infrastructure  
Understand Managed vs Unmanaged Services



Thanks for participating!

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## Module 1, Section 3: AWS Infrastructure Overview

**aws** academy

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## What's In This Module



### Part 1: AWS Global Infrastructure

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In this module, we will review the AWS Global Infrastructure to understand the platform that hosts the AWS services.

## Module Overview



**Goal:** Understand the AWS global infrastructure and the types of services that are available.

- 💡 Examine the AWS global infrastructure
- 💡 Understand the difference between AWS Regions, Availability Zones, and edge locations

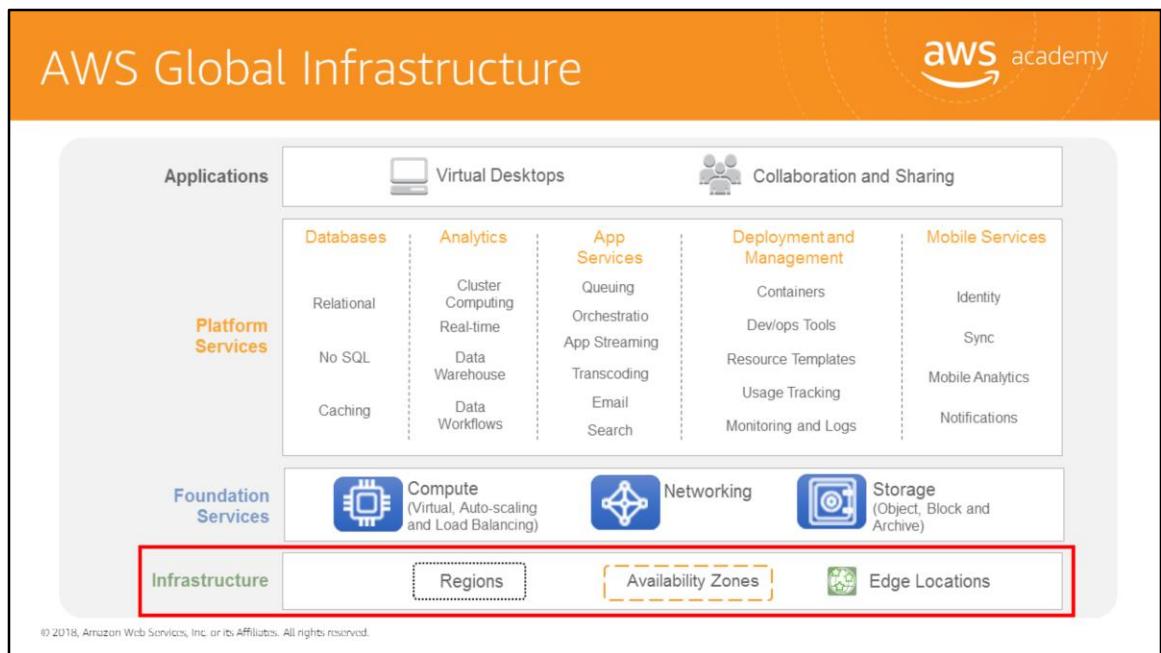
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The goal of this module is to review the AWS Global Infrastructure to gain a clear understanding of what the infrastructure includes and what AWS Regions, Availability Zones, and edge locations are.



# Part 1: AWS Global Infrastructure

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As we discussed earlier, AWS provides a broad set of services—such as compute power, storage options, networking, and databases—delivered as an on-demand utility that is available in seconds, with pay-as-you-go pricing. All of these services sit on AWS global infrastructure.

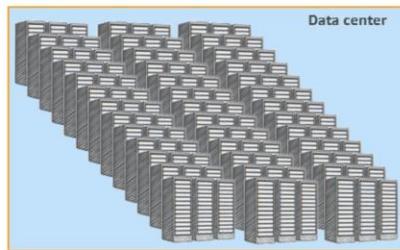
AWS's global infrastructure can be broken down into three elements: Regions, Availability Zones, and edge locations.

Let's take a more in depth look at the AWS infrastructure and see what these are.

# AWS Data Centers



- 💡 Data centers are securely designed
- 💡 A datacenter is a location where actual physical data resides
- 💡 A data center typically has 50,000 to 80,000 physical servers
- 💡 All data centers are online. No data center is "cold"
- 💡 AWS custom network equipment:
  - 💡 Multi-ODM sourced
  - 💡 Amazon custom network protocol stack



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The foundation for the AWS infrastructure are the *data centers*. AWS data centers are built in clusters in various global regions. Key data center facts:

- Data centers are designed with several factors in mind.
  - Each location is carefully evaluated to mitigate environmental risk.
  - Data centers have a redundant design that anticipates and tolerates failure while maintaining service levels.
  - To ensure availability, critical system components are backed up across multiple isolated locations known as Availability Zones.
  - To ensure capacity, AWS continuously monitors service usage to deploy infrastructure to support availability commitments and requirements.
- Data center locations are not disclosed and all access to them is restricted.
- In case of failure, automated processes move customer data traffic away from the affected area.
- A single data center typically houses several thousand servers; larger data centers are undesirable.
- All data centers are online and serving customers; no data center is "cold."
- AWS utilizes custom, multi-ODM sourced network equipment. *ODM* stands for *original design manufacturer*, which designs and manufactures products based on specifications from a second company. The second company then rebrands the

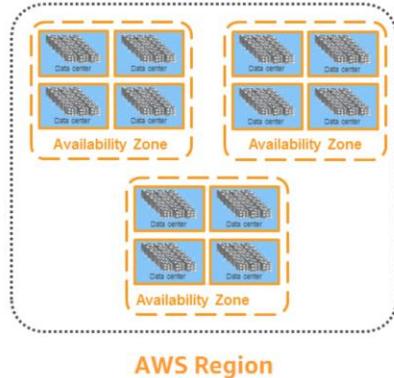
products for sale.

For more information on AWS data centers, see  
<https://aws.amazon.com/compliance/data-center/>.

# AWS Regions



- 💡 An AWS Region is a **geographical area**.
- 💡 Each Region is made up of **two or more Availability Zones**.
- 💡 AWS has **18 Regions** worldwide.
- 💡 You enable and control **data replication** across Regions.
- 💡 Communication between Regions uses **AWS backbone network** connections infrastructure.



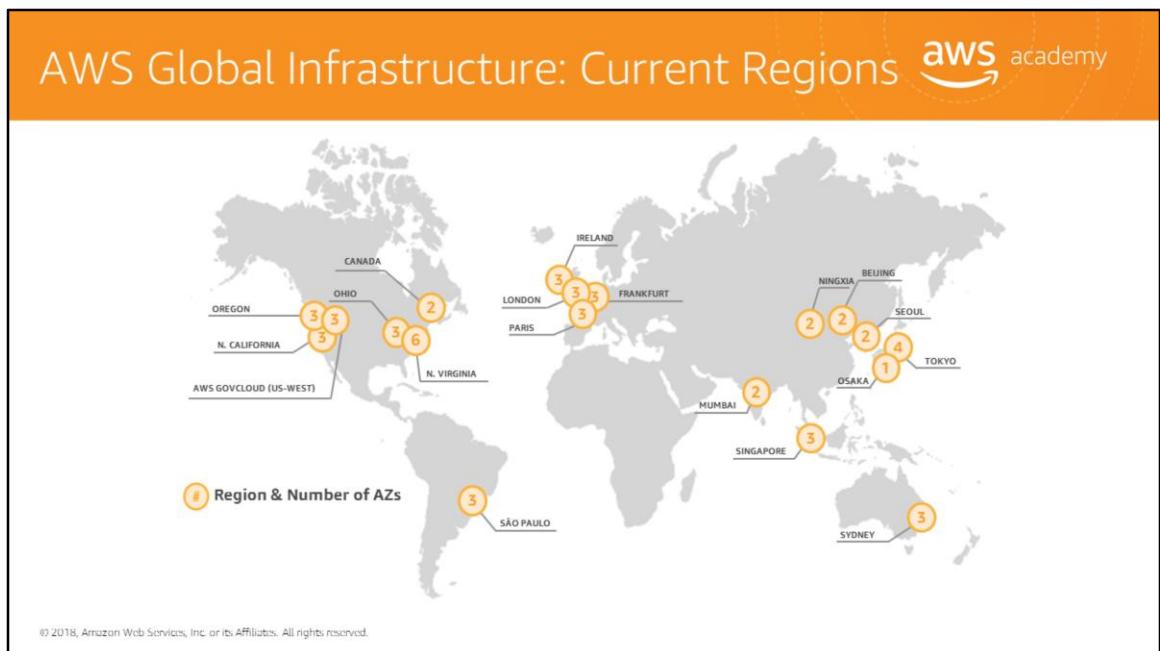
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The AWS Cloud infrastructure is built around Regions and Availability Zones (AZs). An *AWS Region* is a physical location in the world where we have multiple AZs. To achieve fault tolerance and stability, regions are isolated from one another. Resources in one region are not automatically replicated to other regions. Each AWS Region **contains two or more** Availability Zones.

When you store data in a specific region, it is not replicated outside that region. AWS *never* moves your data out of the region you put it in. It is your responsibility to replicate data across regions, if your business needs require that. AWS provides information about the country, and—where applicable—the state where each region resides; you are responsible for selecting the region to store data in based on your compliance and network latency requirements. When you distribute applications across multiple Availability Zones, be aware of location-dependent privacy and compliance requirements, such as the EU Data Privacy Directive. When selecting a region, it is also important to consider which region will help you optimize latency while minimizing costs and adhering to whatever regulatory requirements you may have.

Let's dive deeper on this point. If you are leveraging cloud computing services you can easily deploy your application in multiple regions. For instance, you can have an application in a region nearest your headquarters such as San Diego and then also have a deployable

application in a region in the East Coast. Let's say your largest customer base is located in Virginia. Within a few clicks of your mouse, you can easily deploy in the US East region to provide a better experience for your customers. You will be minimizing latency and increasing agility for your organization within minutes and with minimal cost.



To see the regions currently available, navigate to AWS homepage (<https://aws.amazon.com>) and scroll down to global network of regions and edge locations in the middle of the page. Edge locations can be found at <https://aws.amazon.com/cloudfront/details/>.

The isolated GovCloud (US) Region is designed to allow US government agencies and customers to move sensitive workloads into the cloud by addressing their specific regulatory and compliance requirements.



AWS products and services are available by region so you may not see all regions available for a given service. AWS is steadily expanding its global infrastructure to help customers achieve lower latency and higher throughput and to ensure that your data resides only in the region you specify.

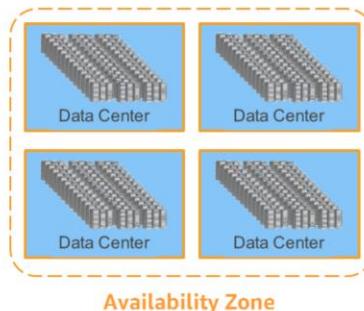
The AWS Cloud has announced plans to expand with 17 new Availability Zones in four new geographic Regions: Bahrain, Hong Kong, Sweden, and a second AWS GovCloud Region in the eastern US.

For more information about global infrastructure, see <http://aws.amazon.com/about-aws/globalinfrastructure/>.

# AWS Availability Zones



- 💡 Each Availability Zone is:
  - 💡 Made up of **one or more** data centers.
  - 💡 Designed for **fault isolation**.
  - 💡 Interconnected with other Availability Zones using high-speed **private** links.
- 💡 You choose your Availability Zones.
- 💡 AWS recommends replicating across Availability Zones for resiliency.



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Availability Zones(AZs) consist of one or more discrete data centers, each with redundant power, networking, and connectivity, housed in separate facilities. Some Availability Zones have as many as six data centers; however, no data center can be part of two Availability Zones.

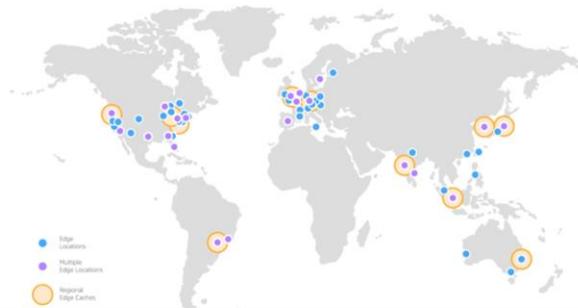
Each Availability Zone is designed as an independent failure zone. This means that Availability Zones are physically separated within a typical metropolitan region and are located in lower-risk flood plains (specific flood-zone categorization varies by region). In addition to having discrete uninterruptable power supply and onsite backup generation facilities, they are each fed via different grids from independent utilities to further reduce single points of failure. Availability Zones are all redundantly connected to multiple tier-1 transit providers. AZs in a region are connected through low-latency links.

You are responsible for selecting the Availability Zones where your systems will reside. Systems can span multiple Availability Zones. You should design your systems to survive temporary or prolonged failure of an Availability Zone if a disaster occurs. Distributing applications across multiple Availability Zones allows them to remain resilient in most failure situations, including natural disasters or system failures.

## AWS Edge Locations



- 💡 An edge location is where users access AWS services.
- 💡 It is a global network of 114 points of presence (103 edge locations and 11 regional edge caches) in 56 cities across 24 countries.
- 💡 Specifically used with Amazon CloudFront, a global content delivery network (CDN), to deliver content to end users with reduced latency.
- 💡 Regional edge caches used for content with infrequent access.



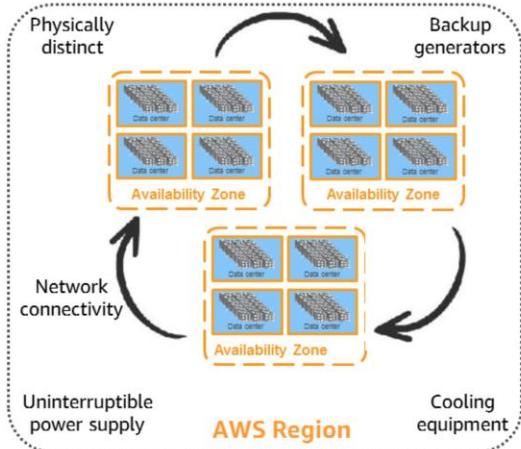
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- An edge location is where end users access AWS services.
- They are located in most of the major cities around the world and serve requests for Amazon CloudFront and Amazon Route 53. Edge locations are currently located in North America, Europe, Asia, Australia, and South America. AWS Edge locations offer CloudFront, Amazon Route 53, AWS Shield, and AWS Web Application Firewall (WAF) services.
- CloudFront is a content delivery network (CDN) used to distribute content to end users to reduce latency. Amazon Route 53 is a DNS service. Requests going to either one of these services will be routed to the nearest edge location automatically.
- Regional edge caches, used by default with Amazon CloudFront, are utilized when you have content that is not accessed frequently enough to remain in an edge location. Regional edge caches absorb this content and provide an alternative to that content having to be fetched from the origin server.

# AWS Infrastructure Features



- 💡 **Elastic and Scalable**
  - 💡 Elastic infrastructure; dynamic adaption of capacity
  - 💡 Scalable infrastructure; adapts to accommodate growth
- 💡 **Fault-tolerant**
  - 💡 Continues operating properly in the presence of a failure
  - 💡 Built-in redundancy of components
- 💡 **High availability**
  - 💡 High level of operational performance
  - 💡 Minimized downtime
  - 💡 No human intervention



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The AWS Cloud infrastructure is built around Regions and Availability Zones. AWS Regions provide multiple, physically separated and isolated Availability Zones. An AWS Region contains two or more Availability Zones. An Availability Zone is a data center (or collection of data centers). Availability Zones are connected with low latency, high throughput, and highly redundant networking. Availability Zones are physically distinct and each has equipment like uninterruptible power supplies, cooling equipment, backup generators and security to ensure uninterrupted operations.

This infrastructure has several valuable features:

- First, it is **elastic and scalable**. This means resources can dynamically adjust to increases or decreases in capacity requirements. It can also rapidly adjust to accommodate growth.
- Second, this infrastructure is **fault tolerant** which means it has built-in component redundancy which enables it to continue operations despite a failed component.
- Finally, it requires minimal to **no human intervention** while providing high availability with minimal down time.

## Summary



- 💡 Examined the AWS Global Infrastructure to understand:

- 💡 Data centers
- 💡 Regions
- 💡 Availability Zones
- 💡 Edge locations

To finish this module:

- 💡 Complete: **Knowledge Assessment**

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## Up Next: Module 2 – AWS Core Services - Compute

Overview of Services

Managed and Unmanaged Services

Introduction to Compute Services

In Unit 2, we look at the core Amazon Web Services (AWS) to better understand the specifics of each service. We will start in Module 2, Unit 1 with an overview of services, a review of the meaning of managed and unmanaged services, and a discussion of compute services.

# Image Sources



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