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**AWS Technical Essentials  
Student Guide  
Version 4.2.8**

**100-ESS-42-EN-SG**

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Corrections or feedback on the course, please email us at:

[aws-course-feedback@amazon.com](mailto:aws-course-feedback@amazon.com).

For all other questions, contact us at:

<https://aws.amazon.com/contact-us/aws-training/>.

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# AWS Technical Essentials

## Getting Started on AWS

Version 4.2



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This instructor-led training introduces AWS products and services with exercises and hands-on activities. This training is designed for anyone new to Amazon Web Services so you can gain proficiency in AWS services and make informed decisions about IT solutions based on your business requirements. This training helps you gain the knowledge required to start working on your projects using AWS.

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## Introductions and Logistics

- Class introductions
- Logistics, bathrooms, breaks
- Participation
- Parking lot
- Cell phones
- Course Errata



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Student errata for the course can be found here: <http://bit.ly/2mZUPPY>

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## Course Objectives

This course teaches you how to:

- Recognize terminology and concepts as they relate to the **AWS platform** and navigate the **AWS Management Console**.
- Understand the **foundational services**, including Amazon Elastic Compute Cloud (EC2), Amazon Virtual Private Cloud (VPC), Amazon Simple Storage Service (S3), and Amazon Elastic Block Store (EBS).
- Understand the **security measures** AWS provides and key concepts of AWS Identity and Access Management (IAM).
- Understand AWS **database services**, including Amazon DynamoDB and Amazon Relational Database Service (RDS).
- Understand AWS **management tools**, including Auto Scaling, Amazon CloudWatch, Elastic Load Balancing (ELB), and AWS Trusted Advisor.

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The course objectives are shown on the slide.

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## Module Layout

- Module 1: **Introduction and History of AWS**
- Module 2: **Foundational Services** – Amazon EC2, Amazon VPC, Amazon S3, Amazon EBS
  - **Lab 1: Build your VPC and launch a web server**
- Module 3: **Security, Identity, and Access Management** - IAM
- Module 4: **Databases** – Amazon DynamoDB and Amazon RDS
  - **Lab 2: Build your database server and interact with it**
- Module 5: **AWS Elasticity and Management Tools** – Auto Scaling, Elastic Load Balancing, Amazon CloudWatch, and AWS Trusted Advisor
  - **Lab 3: Scale and load balance your application and monitor activity**
- Module 6: Course Wrap-Up
- Module 7: Course Appendix

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# Module 1

## Introduction and History of AWS



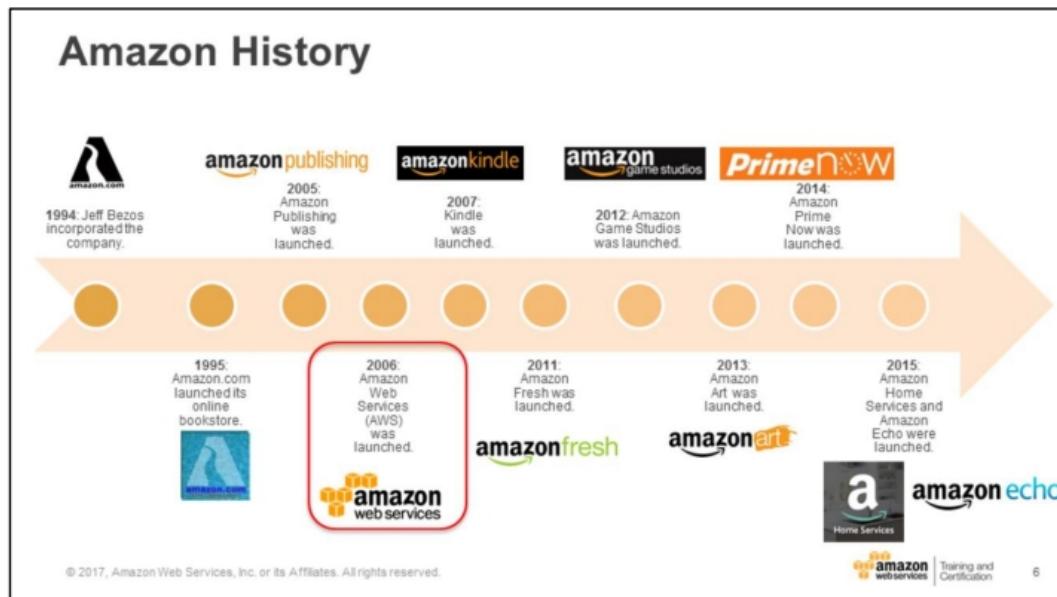
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Module 1 describes the history and fundamental elements of Amazon Web Services (AWS), and shows you how to navigate the AWS Management Console. The AWS Management Console is the graphical user interface (GUI) to access AWS. AWS is also accessible through the command line interface (CLI) and software development kits (SDKs). This module discusses the AWS global infrastructure and basic principles of deploying on AWS.

By the end of this module you will be able to:

- Describe the history of AWS.
- Recognize the AWS global infrastructure.
- Navigate the AWS Management Console.

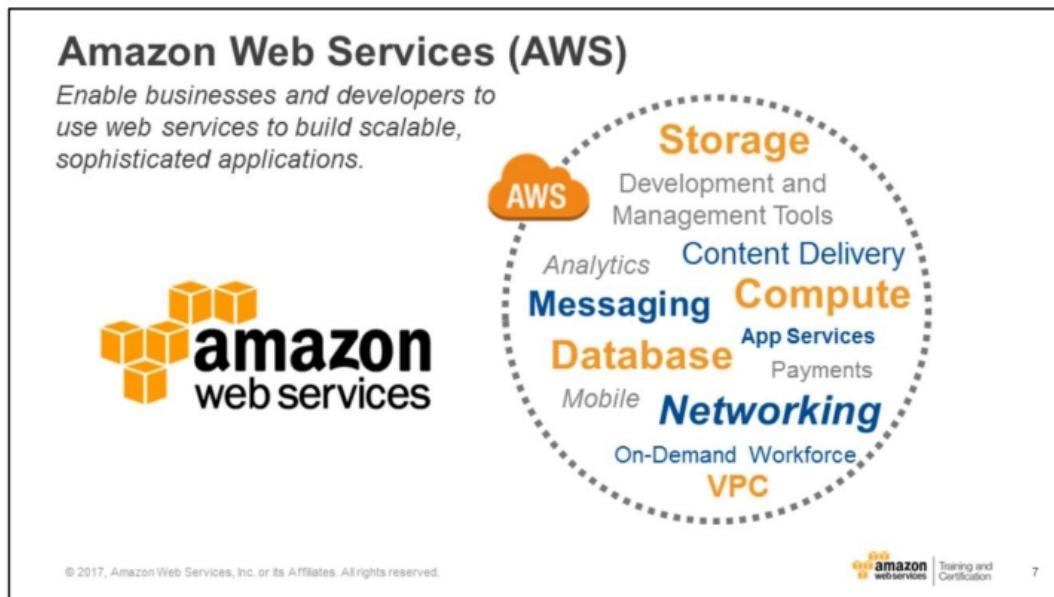
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Jeff Bezos incorporated the company in 1994, and Amazon.com was launched in 1995 as an online bookstore. Amazon.com, Inc. is an American multinational electronic commerce company with its headquarters in Seattle, Washington. It is the world's largest online retailer. Amazon has continued to grow and officially launched Amazon Web Services (AWS) in 2006. More came after, including Amazon Publishing, the Kindle, Amazon Game Studios, and Amazon Art.

After over a decade of building and running the highly scalable web application Amazon.com, the company realized that it had developed a core competency in operating massive-scale technology infrastructure and data centers and embarked on a much broader mission of serving a new customer segment—developers and businesses—with a platform of web services they can use to build sophisticated, scalable applications. Today, AWS is the fastest-growing multi billion-dollar enterprise IT vendor in the world.

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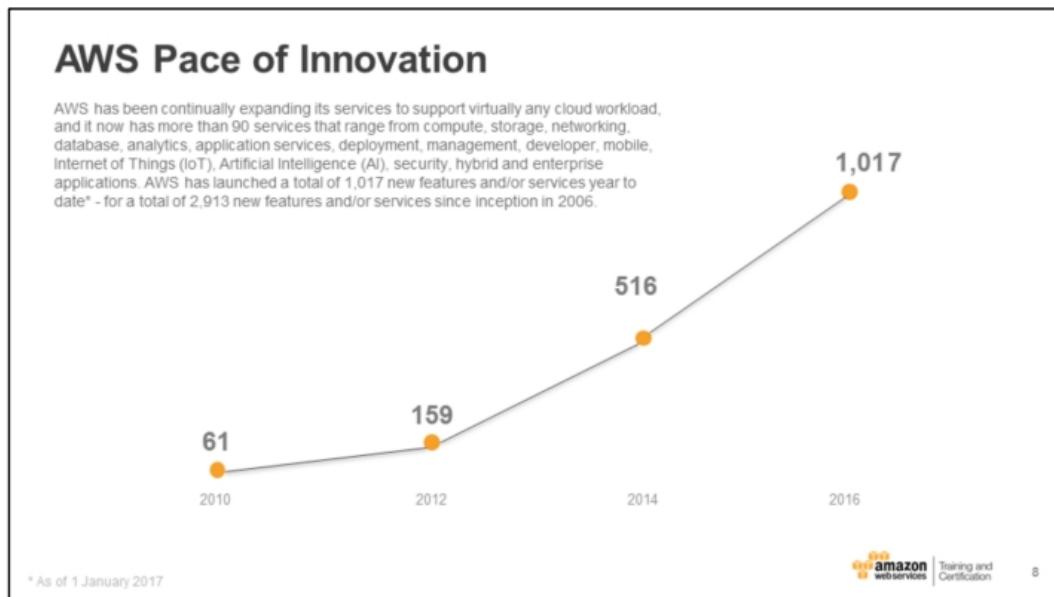


Amazon Web Services is 10+ years in the making. Amazon Web Services, also abbreviated to AWS, is a collection of remote computing services called *web services*. These web services make up a cloud computing platform offered via the Internet. We deliver web-based cloud services for storage, computing, networking, databases, and more.

The AWS mission is to enable businesses and developers to use web services to build scalable, sophisticated applications. Web services is another name for what people now call “the cloud.”

For more information, see: <http://aws.amazon.com>

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AWS is continually expanding its services to support virtually any cloud workload.

Innovation is in our DNA, and our structure and approach to product development and delivery is fundamentally different from that of other IT vendors. We have decentralized, autonomous development teams that are working directly with customers. They are empowered to develop and launch based on what they learn from interactions with customers. We iterate products continuously, and the newest is instantly available to customers. No need to upgrade, deploy, or migrate. When a feature or enhancement is ready, we “push” it out.

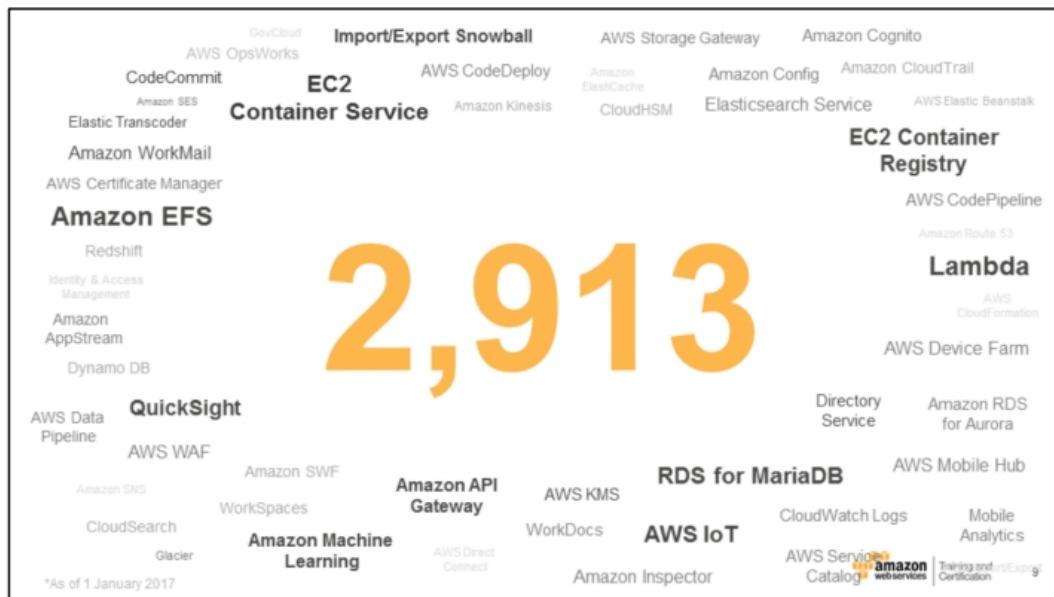
This approach also enables us to very rapidly introduce and iterate on new services.

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## AWS Training and Certification

## Module 1: Introduction and History of AWS



As of January 1, 2017, AWS has launched 2,913 new services and updates to existing services.

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## AWS Customers

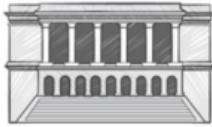
**Enterprise Customers**

Amazon Web Services delivers a mature set of services specifically designed for the unique security, compliance, privacy, and governance requirements of large organizations.



**Public Sector**

Paving the way for innovation and supporting world-changing projects in government, education and nonprofit organizations.



**Startups**

From the spark of an idea, to your first customer, to IPO and beyond, let Amazon Web Services help you build and grow your startup.



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Training and Certification
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**Enterprise Customers:** Enterprise cloud computing with AWS can help IT increase innovation, agility, and resiliency; all while reducing cost. With AWS, you can build enterprise cloud solutions quickly and without a big up-front investment. The free tier allows you to prototype virtually any application for free.

**Startup Customers:** Our innovations free you to scale quickly, go to market faster, and control costs. AWS Activate is a free program with resources for startups to get the most out of AWS from day one.

**Public Sector Customers:** AWS offers scalable, cost-effective cloud services that public sector customers can use to meet mandates, reduce costs, drive efficiencies, and accelerate innovation.

For more information, see:

- <http://aws.amazon.com/contract-center/>
- Enterprise Cloud Computing: <http://aws.amazon.com/enterprise/>
- Free Tier: <https://aws.amazon.com/free/>
- Startups on Amazon Web Services: <http://aws.amazon.com/start-ups/>

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- AWS in the Public Sector: <https://aws.amazon.com/government-education/>

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## Advantages and Benefits of AWS Cloud Computing



Trade capital expense  
for variable expense.



Increase speed and  
agility.



Benefit from massive  
economies of scale.



Stop spending money on  
running and maintaining  
data centers.



Stop guessing  
capacity.



Go global in minutes.

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Cloud computing provides a simple way to access servers, storage, databases, and a broad set of application services over the Internet. AWS owns and maintains the network-connected hardware required for these application services, while you provision and use what you need via a web application.

**Trade capital expense for variable expense:** Instead of investing heavily in data centers and servers before you know how you're going to use them, you can pay only when you consume computing resources and pay only the amount you consume.

**Benefit from massive economies of scale:** By using cloud computing, you can achieve a lower variable cost than you can get on your own. Because usage from hundreds of thousands of customers is 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.

**Stop guessing capacity:** Eliminate guessing about your infrastructure capacity needs. When you make a capacity decision before deploying an application, you often end up either sitting on expensive idle resources or dealing with limited capacity. With cloud computing, these problems go away. You can access as much or as little as you need and scale up and down as required with only a few minutes' notice.

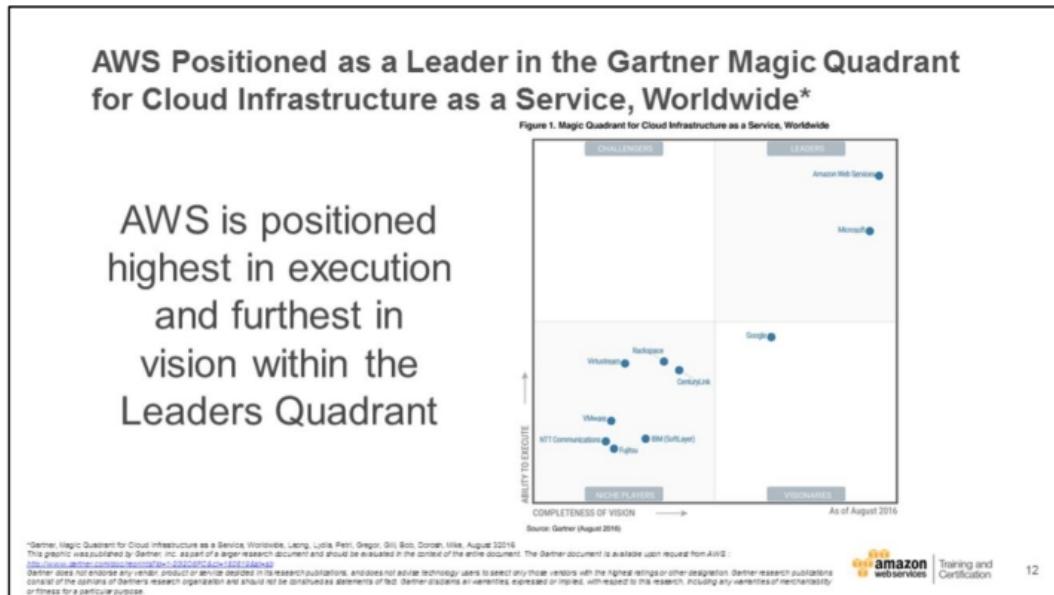
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**Increase speed and agility:** In a cloud computing environment, new IT resources are only ever a click away, which means you reduce the time it takes to make those resources available to your developers from weeks to just minutes. This results in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

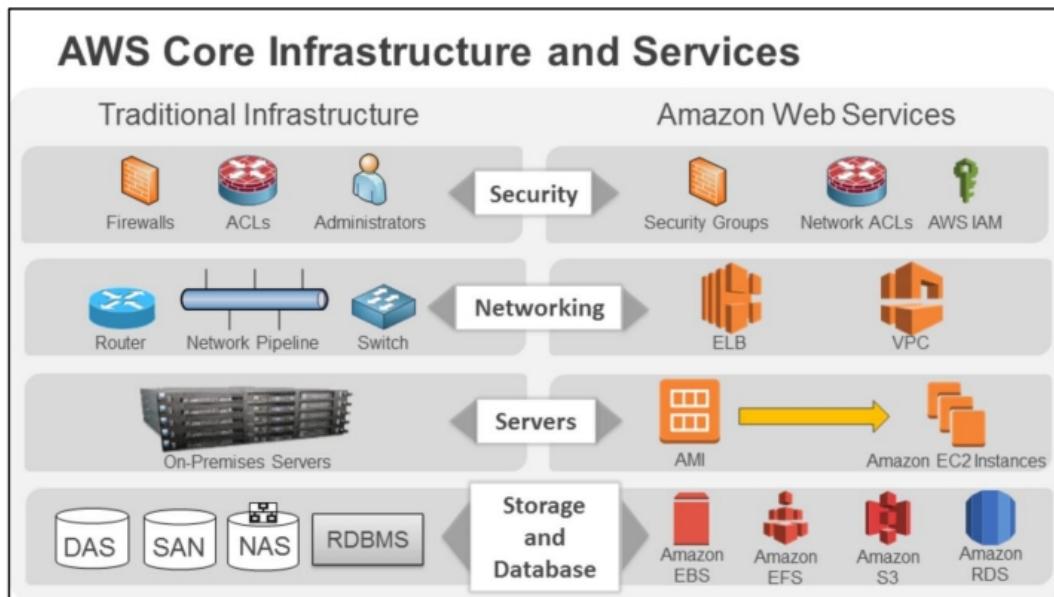
**Stop spending money on running and maintaining data centers:** Focus on projects that differentiate your business, not the infrastructure. Cloud computing lets you focus on your own customers, instead of on the heavy lifting of racking, stacking, and powering servers.

**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.

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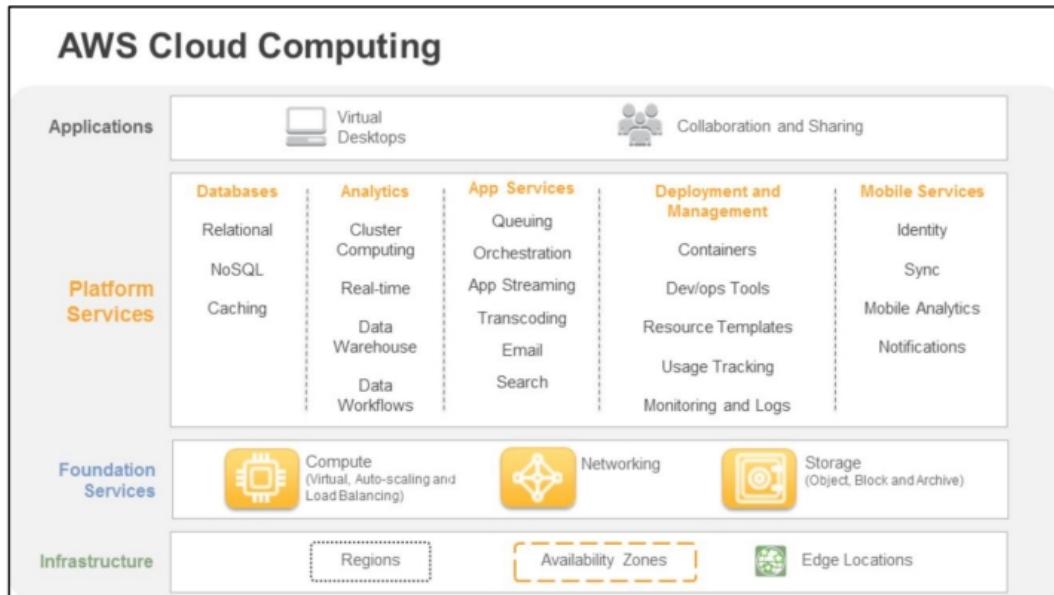


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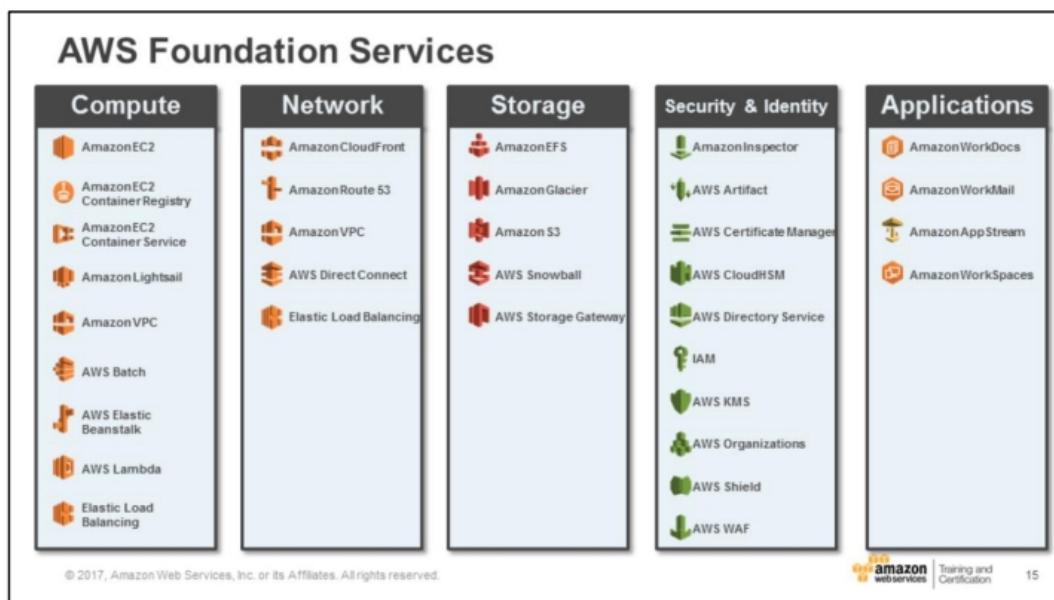
Many of our services and terminology have analogs in the traditional IT space. This side-by-side comparison shows how AWS products and services relate to a traditional infrastructure.

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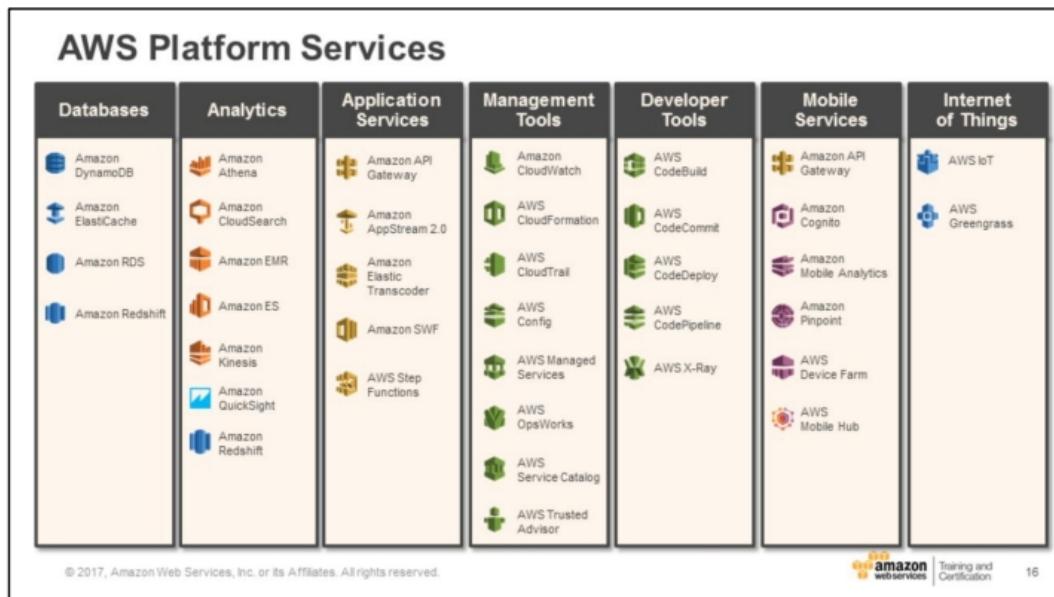
AWS cloud computing provides a simple way to access servers, storage, databases, and a broad set of application services over the Internet. AWS owns and maintains the network-connected hardware required for these application services, while you provision and use what you need.

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## AWS Global Infrastructure

### Regions

- Geographic locations
- Consist of **at least two** Availability Zones

### Availability Zones

- Clusters of data centers
- **Isolated from failures** in other Availability Zones

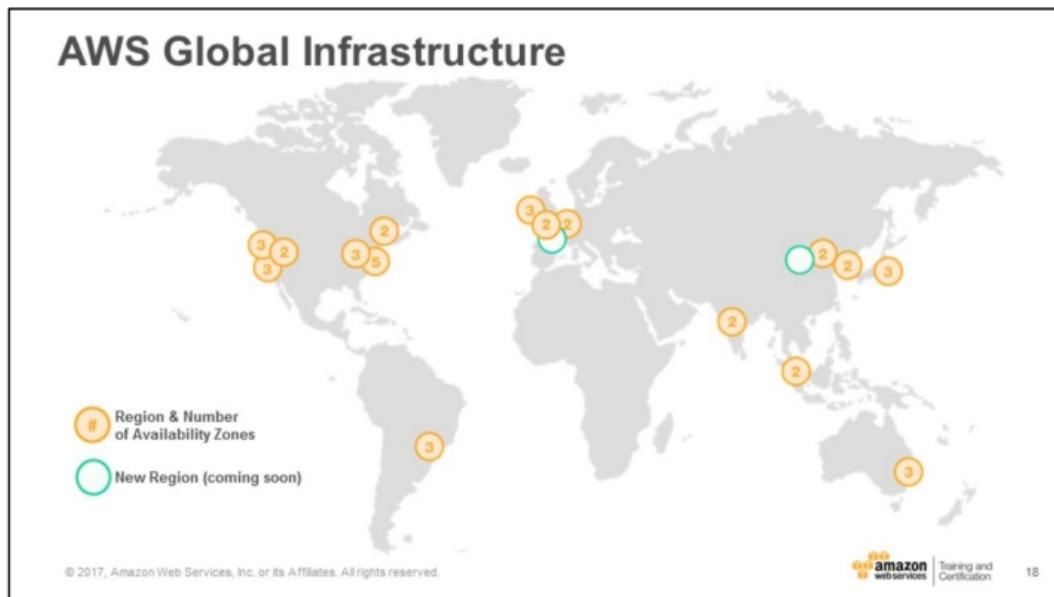
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AWS Regions are geographic locations that contain multiple Availability Zones. Availability Zones consist of data centers clustered in a region. Each Availability Zone is engineered to be isolated from failures in other Availability Zones.

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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. As you and all customers grow their businesses, AWS will continue to provide infrastructure that meets your global requirements.

As of March 2017, the AWS Cloud operates 42 Availability Zones within 16 geographic Regions around the world, with five more Availability Zones and two more Regions coming online throughout the next year.

The AWS GovCloud (US) Region is an isolated region 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.

You can run applications and workloads from a region to reduce latency to end users while avoiding the up-front expenses, long-term commitments, and scaling challenges associated with maintaining and operating a global infrastructure.

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

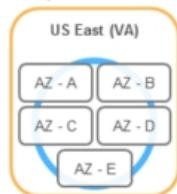
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## AWS Global Infrastructure

At least 2 Availability Zones per region.

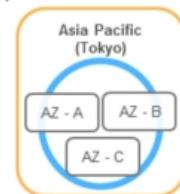
Examples:

- US East (N. Virginia)
  - us-east-1a
  - us-east-1b
  - us-east-1c
  - us-east-1d
  - us-east-1e



- Asia Pacific (Tokyo)

- ap-northeast-1a
- ap-northeast-1b
- ap-northeast-1c



*Note: Conceptual drawing only. The number of Availability Zones (AZ) may vary.*

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Each region is a separate geographic area that has multiple locations isolated from each other, known as Availability Zones. Each Availability Zone is isolated, but the Availability Zones in a region are connected through low-latency links. Where natural disasters or fault lines are a consideration, AWS isolates its Availability Zones so that they are not easily affected at the same time. For example, where earthquakes are a problem, AWS would not build two Availability Zones on the same fault line. When you launch an instance, you can select an Availability Zone or let AWS choose one for you. If you distribute your instances across multiple Availability Zones, you can design your application so that if an instance fails, an instance in another Availability Zone can handle requests.

For more information, see:

- <http://aws.amazon.com/about-aws/global-infrastructure/regional-product-services/>
- <http://docs.aws.amazon.com/AWSEC2/latest/UserGuide/using-regions-availability-zones.html>
- <https://www.amazonaws.cn/en/>

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## High Availability Using Multi-AZ Deployments

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AWS highly recommends that you provision your compute resources across multiple Availability Zones. If you have multiple instances, you can run them across more than one Availability Zone and get added redundancy. If a single Availability Zone has a problem, all assets in your second Availability Zone are unaffected.

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## AWS Global Infrastructure – Edge Locations

- 70\* edge locations
- Local points of presence that support AWS services like:

-  Amazon Route 53
-  Amazon CloudFront
-  AWS WAF
-  AWS Shield

\*as of March 2017

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Edge locations help lower latency and improve performance for end users.

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# AWS Management Console Demonstration



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Look at the AWS Management Console so you are familiar with the navigation:

- Selecting a region.
- Dragging and dropping service icons at the top for quick use.
- Verifying what is included in the left navigation pane.

For more information, see: <https://console.aws.amazon.com/console/home>

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## Knowledge Check

**Q:** What is the AWS term for physically distinct groups of **data centers** within a region?

**Availability Zone**

**True or False:** There are more **Regions** than **Edge locations**.

**False**

**True or False:** AWS owns and maintains the infrastructure required for application services. You provision and use them as needed.

**True**

**Q:** How do **Availability Zones** in the same region differ?

**Each Availability Zone is isolated, but the Availability Zones in a region are connected through low-latency links.**

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In this module, you learned about the history of Amazon and AWS, the global infrastructure of AWS, and how to navigate the AWS Management Console.

Test out some of your new skills!

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# Module 2

# AWS Foundational Services



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## Module 2 Layout

- Amazon Elastic Compute Cloud (EC2)
- Amazon Virtual Private Cloud (VPC)
  - **Lab 1: Build your VPC and launch a web server**
- Amazon Storage Services
  - Amazon Simple Storage Service (S3)
  - Amazon Elastic Block Store (EBS)

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# Amazon Elastic Compute Cloud (EC2)



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Understand Amazon Elastic Compute Cloud (EC2) concepts, including:

- Instances vs. servers
- Types and families
- Ephemeral vs. persistent storage (root instance volumes)
- Amazon Machine Images (AMIs)
- Bootstrapping/user data

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## Amazon Elastic Compute Cloud (EC2)



Amazon EC2

- **Resizable** compute capacity
- Complete control of your computing resources
- **Reduced time required** to obtain and boot new server instances

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Amazon EC2 instances are virtualized servers in Amazon's data centers.

Amazon EC2 is designed to make web-scale computing easier for developers. With Amazon EC2's simple web service interface, you can obtain and configure capacity with minimal friction. It provides you with complete control of your computing resources and allows you to run on Amazon's proven computing environment.

Amazon EC2 reduces the time required to obtain and boot new server instances, which helps you to quickly scale capacity as your computing requirements change. Amazon EC2 changes the economics of computing by allowing you to pay only for capacity that you actually use. Amazon EC2 provides the tools for you to build failure-resilient applications and isolate the applications from common failure scenarios.

For more information, see: <https://aws.amazon.com/ec2/>

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## Amazon EC2 Facts

- **Scale capacity** as your computing requirements change
- Pay only for capacity that you actually use
- Choose **Linux or Windows**
- Deploy across **AWS Regions** and **Availability Zones** for reliability
- Use **tags** to help manage your Amazon EC2 resources

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Amazon EC2 presents a true virtual computing environment, allowing you to use web service interfaces to launch instances with a variety of operating systems, load them with your custom application environment, manage your network's access permissions, and run your image using as many systems as you need.

You can programmatically scale your computing capacity as your requirements change. You pay only for capacity that you actually use and can choose Linux or Windows. You can leverage the AWS global infrastructure to deploy across regions and Availability Zones (AZs) for reliability.

For more information, see:

[http://docs.aws.amazon.com/AWSEC2/latest/UserGuide/Using\\_Tags.html](http://docs.aws.amazon.com/AWSEC2/latest/UserGuide/Using_Tags.html)

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## Launching an Amazon EC2 Instance via the Management Console



1. **Determine the AWS Region** in which you want to launch the Amazon EC2 instance.
2. **Launch** an Amazon EC2 instance from a pre-configured Amazon Machine Image (AMI).
3. **Choose an instance type** based on CPU, memory, storage, and network requirements.
4. **Configure** network, IP address, security groups, storage volume, tags, and key pair.

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Before you create your first Amazon EC2 instance, decide which region you want to have that instance in. The AMI comes pre-installed with many AWS API tools and with CloudInit. AWS API tools enable scripting of important provisioning tasks from within an Amazon EC2 instance. AMIs are like building blocks of EC2 instances. They are templates of a computer's volumes. AMIs can have public or private access. You can also create gold master images of your Amazon EC2 infrastructure, which allow you to decrease your boot times.

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## Amazon Machine Image (AMI) Details



An AMI includes the following:

- A template for the **root volume** for the instance (for example, an operating system, an application server, and applications).
- **Launch permissions** that control which AWS accounts can use the AMI to launch instances.
- A block device mapping that specifies the **volumes to attach** to the instance when it is launched.

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amazon web services | Training and Certification

An AMI is a template that contains a software configuration such as an operating system, application server, and applications. You use an AMI to launch an instance, which is the copy of the AMI running as a virtual server on a host computer in Amazon's data center. You can launch as many instances as you want from an AMI. You can also launch instances from as many AMIs as you need.

You can create your own AMI by customizing the instance that you launch from a public AMI and then saving the configuration as a custom AMI for your own use. You can also buy, share, and sell AMIs.

For more information, see:

<http://docs.aws.amazon.com/AWSEC2/latest/UserGuide/AMIs.html>

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## Instances and AMIs

Select an AMI based on:

- Region
- Operating system
- Architecture (32-bit or 64-bit)
- Launch permissions
- Storage for the root device

The diagram shows a central orange square labeled 'AMI' with a grid icon. Two arrows point from it to two grey rounded rectangles labeled 'Host computer'. The top one contains a single orange square labeled 'Instance'. The bottom one contains three orange squares labeled 'Instances'. Above the 'Host computer' boxes, the text 'Launch instances of any type' is written. In the top right corner of the slide, there is a small icon of a stack of orange cubes inside a dashed orange square.

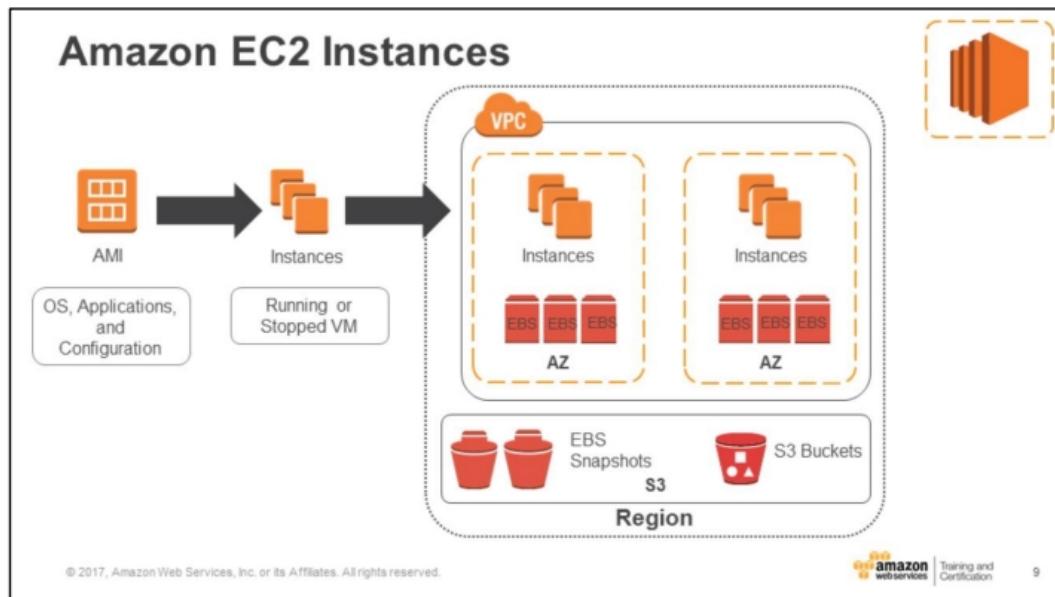
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You select an AMI based on region, operating system, architecture, launch permissions, and storage for the root device. Launch permissions determine availability of an AMI and are either public (the owner grants launch permissions to all AWS accounts), explicit (the owner grants launch permissions to specific AWS accounts), or implicit (the owner has implicit launch permissions for an AMI).

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You can launch multiple instances of different types from a single AMI when launching an EC2 instance. An instance type essentially determines the hardware of the host computer used for your instance. Each instance type offers different compute and memory capabilities. Select an instance type based on the amount of memory and computing power that you need for the application or software that you plan to run on the instance. Your instance keeps running until you stop or terminate it or until it fails.

Instances are deployed in the Amazon EC2 public cloud or the Amazon Virtual Private Cloud in an Availability Zone within a region. You can configure security and network access on your Amazon EC2 instance.

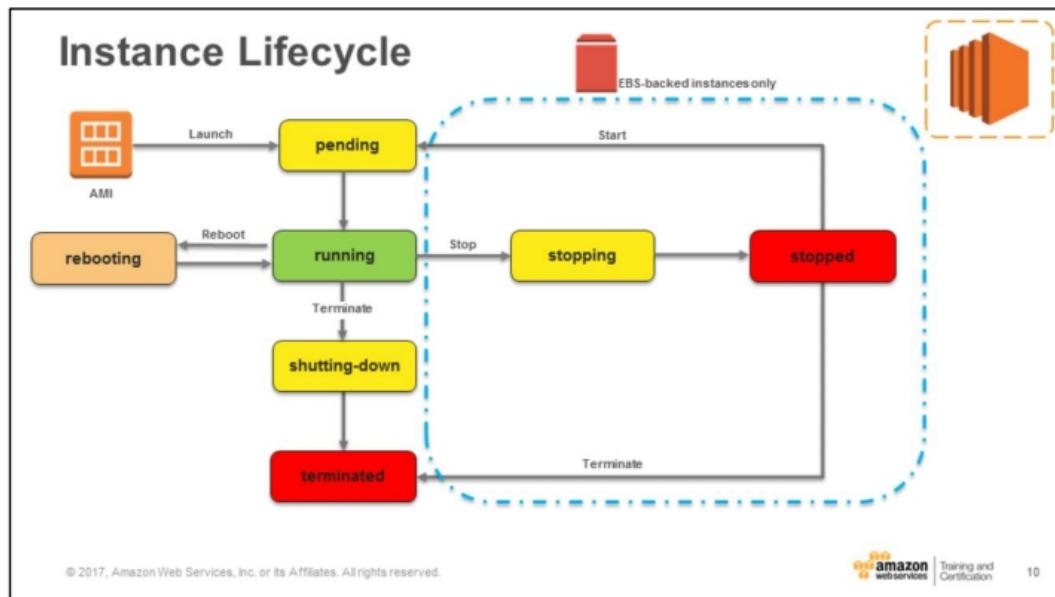
Customers can deploy to multiple Availability Zones within a region. You choose which instance types you want, and then start, terminate, and monitor as many instances of your AMI as needed, using the web service APIs or the variety of management tools provided.

Amazon EC2 instances can leverage Amazon Elastic Block Store (EBS) volumes in each Availability Zone. Determine whether you want to run in multiple locations, use static IP endpoints, or attach persistent block storage to your instances. Amazon EBS volumes can be saved using "snapshots." Additionally, Amazon S3 buckets can be used to store data objects needed by Amazon EC2 instances. Pay only for the

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resources that you actually consume, such as instance-hours or data transfer.

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The slide shows the lifecycle of an instance launched from an AMI. Note that you can only stop and start instances that are EBS-backed.

An EC2 instance can be in one of the following states:

- Pending: When you launch an instance, it enters the pending state and the instance moves to a new host computer. The instance type specified at launch determines the hardware of the host computer for your instance.
- Running: AWS uses the AMI specified at launch to boot the instance. When the instance is ready for you, it enters the running state. You can connect to your running instance and use it as you would a computer sitting in front of you. When your instance is in the running state, you're billed for each hour or partial hour that you keep the instance running. You are billed for all running instances, even if they are idle and not being connected to.
- Rebooting: You can reboot your instance through the Amazon EC2 console, Amazon EC2 CLI, and the Amazon EC2 API. It is recommended that you reboot your EC2 instance instead of running the operating system reboot from the instance. When an instance is rebooted, it remains on the same host computer and maintains its public DNS name, private IP address, and any data on its instance store volumes. Rebooting an instance doesn't start a new instance billing hour.

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- Shutting down: When you've decided that you no longer need an instance, you can terminate it. The instance will enter the shutting-down state. You will stop incurring charges as soon as the instance enters shutting-down or terminated states.
- Terminated: A terminated instance remains visible in the console for a while before it is deleted. You cannot connect to or recover a terminated instance.
- Stopping: Amazon EBS-backed instances can be stopped. When you stop an instance, it enters the stopping state.
- Stopped: Amazon EBS-backed instances in the stopped state are no longer eligible for hourly usage or data transfer fees. AWS does charge for the storage of EBS volumes on stopped instances. You can modify certain attributes of stopped instances, including the instance type. Starting a stopped instance puts it back into the pending state, which moves the instance to a new host machine. When you stop and start an instance, you lose any data on the instance store volumes on the previous host computer.

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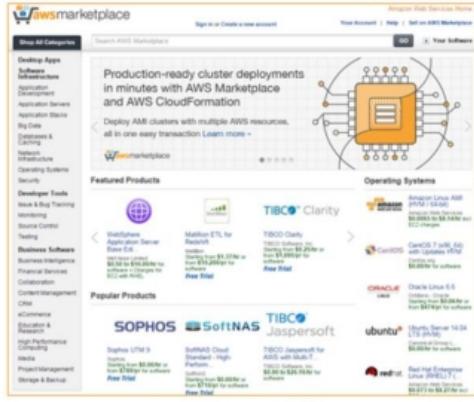
## AWS Marketplace – IT Software Optimized for the Cloud



- Online store to discover, purchase, and deploy IT software on top of the AWS infrastructure.
- Catalog of 2700+ IT software solutions including Paid, BYOL, Open Source, SaaS, and free-to-try options.
- Pre-configured to operate on AWS.
- Software checked by AWS for security and operability.
- Deploys to AWS environment in minutes.
- Flexible, usage-based billing models.
- Software charges billed to AWS account.

**Includes AWS Test Drive.**

<https://aws.amazon.com/marketplace>



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Free Account | Help | Get on AWS Marketplace

View Software

Amazon Linux AMI (HVM / 64bit)

Amazon Linux AMI (HVM / 64bit) - \$0.0000 to \$0.1000 per hour

TIBCO Clarity

TIBCO Clarity - \$0.0000 to \$0.1000 per hour

CentOS 7 (x86\_64) with Updates (HVM / 64bit)

Oracle Linux 7.4 (x86\_64) with Updates (HVM / 64bit)

ubuntu

Red Hat Enterprise Linux (RHEL) 7.1 (x86\_64)

AWS and Oracle have worked together to offer customers convenient options for deploying enterprise applications in the cloud. Customers can build enterprise-grade solutions hosted by Amazon Web Services using database and middleware software by Oracle, and can also launch entire enterprise software stacks from Oracle on Amazon EC2.

New and existing SAP customers can confidently deploy their SAP solutions on SAP-certified Amazon EC2 instances in production environments because SAP and AWS have tested the performance of the underlying AWS resources, verified their performance, and certified them against the same standards that apply to servers and virtual platforms.

AWS also provides infrastructure services that allow customers to easily run Microsoft Windows Server applications in the cloud, without the cost and complexity of having to purchase or manage servers or data centers. Available AMIs allow customers to start running fully supported Windows Server virtual machine instances in minutes.

Customers may also rely on the global infrastructure of AWS to power everything from custom .NET applications to enterprise deployments of Microsoft Exchange Server, SQL Server, or SharePoint Server.

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Software launched from AWS customers automatically deploys onto Amazon Elastic Compute Cloud (EC2), which is the AWS compute service. AWS customers use 143 million hours a month of Amazon EC2 for AWS Marketplace software products.

The benefits of AWS Marketplace include:

- Easy product discovery
- Streamlined buying experience
- Simplified billing
- Expedited deployment cycles
- Optimized software capacity
- Matched spend to actual usage
- Trust vetted and scanned products

AWS Test Drive provides a private IT sandbox environment that contains preconfigured server based solutions. In under an hour, and using a step-by-step lab manual and video, you can launch, sign in, and learn about these popular third-party IT solutions powered by AWS and AWS CloudFormation.

For more information, see: <https://aws.amazon.com/marketplace>

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## Choosing the Right Amazon EC2 Instance



AWS uses Intel® Xeon® processors to provide customers with high performance and value. EC2 instance types are optimized for different use cases, workload requirements and come in multiple sizes.

Consider the following when choosing your instances:

- Core count
- Memory size
- Storage size and type
- Network performance
- CPU technologies

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Choosing the right EC2 instance type matters.

AWS has a wide variety of EC2 compute instances. Most are based on Intel Xeon processors.

Intel® Xeon processors are compatible with the broadest range of ecosystem software, which helps developers to develop their application rapidly. IT also values Xeon processors for higher performance and reliability.

Each instance type or family is optimized for different workloads or use cases. Within each type or family we have multiple sizes: Large, XLarge, 2XLarge, etc.

When you choose your instance type, you should consider the several different attributes of each family, such as number of cores, amount of memory, amount and type of storage, network performance, and Intel processor technologies.

Larger instances are better for workloads that scale.

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## Get the Intel® Advantage



Intel's Haswell microarchitecture on new X1, C4, D2, and M4 instances, with custom Intel® Xeon® v3 processors, provides new features:

Haswell microarchitecture can boost existing applications performance by **30% or more** for better workload performance and faster response times.

Hardware Assisted technologies, such as Intel® AVX2.0 instructions, can double the floating-point performance for compute-intensive workloads and provide additional instructions for compression and encryption

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In 2016, AWS launched our C4, D2, and M4 instances based on Intel's latest 22nm Haswell microarchitecture. They all use custom Intel® Xeon® v3 processors designed and built especially for AWS.

X1 is based on Intel E7 enterprise class CPU.

Haswell can boost application performance, which helps workloads to perform better or deliver faster response time. Haswell instances also include newer hardware-assisted technologies for workload acceleration, such as AVX 2.0, which doubles the floating point performance compared to AVX 1.0 for high performance compute (HPC) and financial modeling kinds of workload.

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## X1 Instance - Tons of Memory

The X1 instance:

- Features up to 2TB of memory and 100 vCPU.
- Uses Intel E7 v3 Haswell processors.
- Is designed for demanding enterprise workloads, including production installations of SAP HANA, Microsoft SQL Server, Apache Spark, and Presto.



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For more information, see: <https://aws.amazon.com/blogs/aws/ec2-instance-update-x1-sap-hana-t2-nano-websites/>

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## Intel® Processor Technologies

**Intel® AVX:** Provides dramatically better performance for highly parallel HPC workloads such as *life science engineering, data mining, financial analysis*, or other technical computing applications. AVX also enhances *image, video, and audio processing*.

**Intel® AES-NI:** Enhance your security with these new encryption instructions that reduce the performance penalty associated with encrypting/decrypting data.

**Intel® Turbo Boost Technology:** Provides more computing power when you need it with performance that adapts to spikes in your workload.

**Intel Transactional Synchronization (TSX) Extensions:** Enable execution of transactions that are independent to accelerate throughput.

**P state & C state control:** Gives you the ability to individually tune each cores performance & sleep states to improve application performance.

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In addition to the new X1, C4, D2, and M4 instance families based on Haswell, with its host of new microarchitecture features, our other EC2 instances are based on Intel Xeon processors. These Xeon processors have important technology features that you should be aware of.

**Intel® AVX** is perfect for highly parallel HPC workloads, such as *life sciences or financial analysis*.

**Intel® AES-NI** accelerates encryption/decryption of data and therefore reduces the penalty you would pay by using encryption.

**Intel® Turbo Boost Technology** automatically gives you more computing power when your workloads are not fully using all CPU cores. Think of it as automatic overclocking when you have thermal headroom.

**Intel Transactional Synchronization (TSX) Extensions** enable execution of transactions that are independent in order to accelerate throughput. Intel® TSX delivers outstanding performance gains for multi-threaded applications that are

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developed using a coarse-grained lock (a single lock for the entire hash table) that behaves like a fine-grained lock (multiple locks for smaller table sections). Coarse-grained locks are easier to use, easier to understand, and easier to debug. In summary, Intel TSX provides a set of instruction set extensions that allow programmers to specify regions of code for transactional synchronization. Programmers can use these extensions to achieve the performance of fine-grained locking while actually programming using coarse-grained locks.

**P state and C state control** on the 8xlarge (when a user has the whole 2S machine) provides the ability to individually tune each core's performance and sleep states to improve application performance.

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AWS Instance Type	High Memory X1	Compute-Optimized C4	Storage-Optimized D2	General Purpose M4	Memory-Optimized R3	IO-Optimized I3	Graphics-Optimized G2	Burstable Performance T2
Intel Xeon Processor	E7-8880 v3	E5-2666 v3	E5-2676 v3	E5-2686 v4 E5-2676 v3	E5-2670 v2	E5-2686 v4	E5-2670	Intel Xeon Family
Intel AVX	AVX 2.0	AVX 2.0	AVX 2.0	AVX 2.0	Yes	Yes	Yes	Yes
Intel AES-NI	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Intel Turbo Boost	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Intel TSX	Yes	No	No	No	No	No	No	No
Per core P- and C-state control	No	Yes (8xlarge only)	No	No	No	No	No	No
SSD Storage	EBS Optimized by default	EBS Optimized by default	No	EBS Optimized by default	Yes	Yes	Yes	EBS only

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This chart provides you with a quick reference to the individual Intel® technologies that were explained on the previous slide and to which EC2 instance contains each Intel technology.

For each instance, a few key technologies are identified to end customers because they have significant impact on the performance of some workloads. More details are discussed later in the presentation, but for now, be aware that different instances have different instructions and capabilities that will affect performance beyond just frequency.

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## Current Generation Instances



Instance Family	Some Use Cases
<b>General purpose (t2, m4, m3)</b>	<ul style="list-style-type: none"> <li>Low-traffic websites and web applications</li> <li>Small databases and mid-size databases</li> </ul>
<b>Compute-optimized (c4, c3)</b>	<ul style="list-style-type: none"> <li>High performance front-end fleets</li> <li>Video-encoding</li> </ul>
<b>Memory-optimized (r3)</b>	<ul style="list-style-type: none"> <li>High performance databases</li> <li>Distributed memory caches</li> </ul>
<b>Storage-optimized (i2, d2)</b>	<ul style="list-style-type: none"> <li>Data warehousing</li> <li>Log or data-processing applications</li> </ul>
<b>GPU instances (g2)</b>	<ul style="list-style-type: none"> <li>3D application streaming</li> <li>Machine learning</li> </ul>

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Each vCPU is a hyperthread of an Intel Xeon core for M4, M3, C4, C3, R3, HS1, G2, I2, and D2.

Amazon EC2 lets you choose from several different instance types to meet your computing needs. Each instance provides a predictable amount of dedicated compute capacity and is charged per instance-hour consumed. First-generation (M1) general purpose instances provide a balanced set of resources and a low-cost platform that is well suited for a wide variety of applications. Second-generation (M3) general purpose instances provide a balanced set of resources and a higher level of processing performance compared to first-generation general purpose instances. Instances in this family are ideal for applications that require higher absolute CPU and memory performance. Applications that can benefit from the performance of second-generation general purpose instances include encoding applications, high traffic content management systems, and Memcached applications. High-memory instances offer large memory sizes for high-throughput applications, including database and memory-caching applications. High-CPU instances have proportionally more CPU resources than memory (RAM) and are well suited for compute-intensive applications. There are also various high-storage and cluster-computer instance types available.

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For more information, see:

- <http://docs.aws.amazon.com/AWSEC2/latest/WindowsGuide/instance-types.html>
- <http://docs.aws.amazon.com/AWSEC2/latest/UserGuide/instance-types.html>
- <http://aws.amazon.com/ec2/instance-types/>

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## Instance Metadata

- Is **data** about your **instance**.
- Can be used to **configure or manage** a running instance.



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Instance metadata is divided into categories.

For more information, see:

<http://docs.aws.amazon.com/AWSEC2/latest/UserGuide/ec2-instance-metadata.html#instancedata-data-categories>

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## Retrieving Instance Metadata



To view all categories of instance metadata from within a running instance, use the following URI:

`http://169.254.169.254/latest/meta-data/`

On a Linux instance, you can use:

- `$ curl http://169.254.169.254/latest/meta-data/`
- `$ GET http://169.254.169.254/latest/meta-data/`

All metadata is returned as text (content type `text/plain`).



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Because your instance metadata is available from your running instance, you do not need to use the Amazon EC2 console or the AWS CLI. This can be helpful when you're writing scripts to run from your instance. Note that you are not billed for HTTP requests that are used to retrieve instance metadata and user data.

For more information, see:

<http://docs.aws.amazon.com/AWSEC2/latest/UserGuide/ec2-instance-metadata.html>

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## Instance User Data

- Can be passed to the instance **at launch**.
- Can be used to perform common **automated configuration tasks**.
- Runs scripts after the instance starts.



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Instance user data can be used to build more generic AMIs that can be modified by configuration files supplied at launch time. It is important to note that, although you can only access instance metadata and user data from within the instance itself, the data is not protected by cryptographic methods. Anyone who can access the instance can view its metadata.

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## Adding User Data



- You can specify user data when launching an instance.
- User data can be:
  - Linux script – executed by **cloud-init**
  - Windows batch or PowerShell scripts – executed by **EC2Config** service
- User data scripts run once per instance ID by default.

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You can specify user data to configure an instance during launch or to run a configuration script. To attach a file, select the As file option and browse for the file to attach. The cloud-init package is an open-source application built by Canonical that is used to bootstrap Linux images in a cloud computing environment, such as Amazon EC2.

User data information:

- User data is treated as opaque data: what you give is what you get back. The instance is responsible for interpreting user data.
- User data is limited to 16 KB. This limit applies to the data in raw form, not base64-encoded form.
- User data must be base64-encoded before being submitted to the API. The Amazon EC2 command line tools perform the base64 encoding for you. The data is decoded before being presented to the instance.
- User data is executed only at launch. If you stop an instance, modify the user data, and start the instance, the new user data is not executed automatically by default.

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## User Data Example Linux

The diagram illustrates a user data example for a Linux instance. It features a code snippet in a yellow box:

```
#!/bin/sh
yum -y install httpd
chkconfig httpd on
/etc/init.d/httpd start
```

An arrow points from the first line of the code to a callout box containing the text: "User data shell scripts must start with the #! characters and the path to the interpreter you want to read the script."

Another arrow points from the remaining lines of the code to a callout box containing the text: "Install Apache web server", "Enable the web server", and "Start the web server".

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The slide shows an example of user data on Linux. You can also provide user data to an instance on Linux by using the `#cloud-config` directive – a format defined by cloud-init.

For more information, see:

<http://docs.aws.amazon.com/AWSEC2/latest/UserGuide/user-data.html>

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## User Data Example Windows

```
<powershell>
Import-Module ServerManager
Install-WindowsFeature web-server, web-webserver
Install-WindowsFeature web-mgmt-tools
</powershell>
```

Import the Server Manager module for Windows PowerShell.

Install IIS  
Install Web Management Tools

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You can send user data to a Windows instance with a PowerShell script (shown in slide) or with a set of Windows batch commands.

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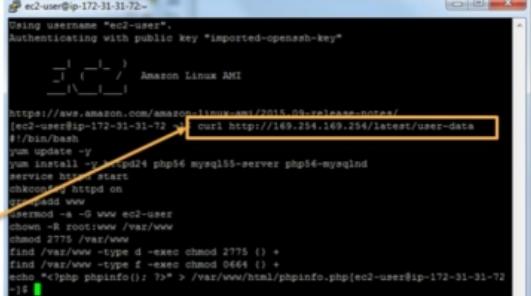
## Retrieving User Data



To retrieve user data, use the following URI:  
**http://169.254.169.254/latest/user-data**

On a Linux instance, you can use:

```
$ curl http://169.254.169.254/latest/user-data/
$ GET http://169.254.169.254/latest/user-data/
```



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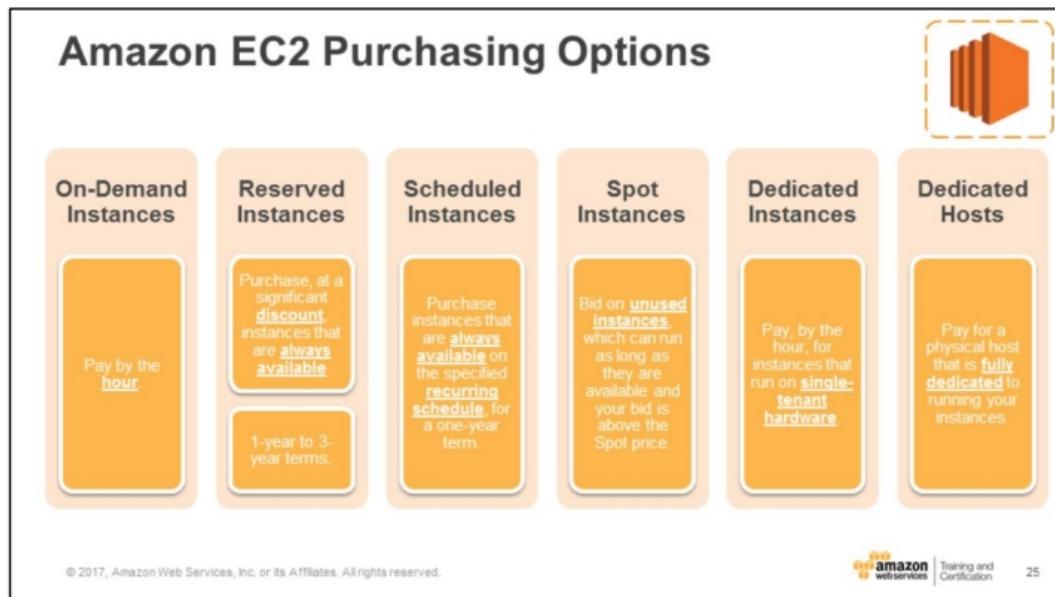
To retrieve instance user data, use the following URI:

**http://169.254.169.254/latest/user-data**

For more information, see:

<http://docs.aws.amazon.com/AWSEC2/latest/UserGuide/ec2-instance-metadata.html#instancedata-user-data-retrieval>

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On-Demand Instances are free-tier eligible. They have the lowest up-front cost and the most flexibility. You pay for an hour at a time with no up-front commitments or long-term contracts. This is great for applications with short-term, spiky, or unpredictable workloads.

Amazon EC2 Reserved Instance pricing allows you to reserve computing capacity for 1-year to 3-year terms at a significantly discounted hourly rate. Reserved Instances provide a billing discount and capacity reservation that is applied to instances to lower hourly running costs. A Reserved Instance is not a physical instance. The discounted usage price is fixed for as long as you own the Reserved Instance, which allows you to predict compute costs over the term of the reservation. If you are expecting consistent, heavy, use, Reserved Instances can provide substantial savings over owning your own hardware or running only On-Demand Instances.

Scheduled Reserved Instances enable you to purchase capacity reservations that recur on a daily, weekly, or monthly basis, with a specified duration, for a 1-year term. You reserve the capacity in advance, so that you know it is available when you need it. You pay for the time the instances are scheduled, even if you do not use them. Scheduled instances are a good choice for workloads that do not run continuously, but do run on a regular schedule and take a finite time to complete.

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Spot Instances enable you to bid on unused EC2 instances, which can lower your Amazon EC2 costs significantly. The hourly price for a Spot instance (of each instance type in each Availability Zone) is set by Amazon EC2 and fluctuates depending on the supply of and demand for Spot instances. Your Spot Instance runs whenever your bid exceeds the current market price.

Spot Instances are a cost-effective choice if you can be flexible about when your applications run and if your applications can be interrupted. Amazon EC2 does not terminate Spot instances with a specified duration (also known as Spot blocks) when the Spot price changes. This makes them ideal for jobs that take a finite time to complete, such as batch processing, encoding and rendering, modeling and analysis, and continuous integration.

An Amazon EC2 Dedicated Host is a physical server with EC2 instance capacity fully dedicated to your use. Dedicated Hosts allow you to use your existing per-socket, per-core, or per-VM software licenses, including Microsoft Windows Server, Microsoft SQL Server, SUSE, and Linux Enterprise Server. Dedicated Hosts and Dedicated Instances can both be used to launch Amazon EC2 instances onto physical servers that are dedicated for your use. There are no performance, security, or physical differences between Dedicated Instances and instances on Dedicated Hosts. However, Dedicated Hosts give you additional visibility and control over how instances are placed on a physical server.

Dedicated instances are Amazon EC2 instances that run in a virtual private cloud (VPC) on hardware that's dedicated to a single customer. Your Dedicated Instances are physically isolated at the host hardware level from instances that belong to other AWS accounts. Dedicated Instances may share hardware with other instances from the same AWS account that are not Dedicated Instances

For more information, see:

- <http://aws.amazon.com/ec2/pricing/>
- <http://docs.aws.amazon.com/AWSEC2/latest/UserGuide/instance-purchasing-options.html>
- <http://docs.aws.amazon.com/AmazonVPC/latest/UserGuide/dedicated-instance.html>

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# Networking Amazon VPC



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Understand Virtual Private Cloud (VPC) concepts including:

- Subnets
- Security
- Networking
- VPN

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## Amazon Virtual Private Cloud (VPC)



Amazon VPC

- Provision a **private, isolated virtual network** on the AWS cloud.
- Have complete control over your virtual networking environment.

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With Amazon Virtual Private Cloud (VPC), you can define a virtual network topology that closely resembles a traditional network that you might operate in your own data center. You have complete control over your virtual networking environment, and you can easily customize the network configuration for your Amazon VPC, such as selection of IP address range, creation of subnets, configuration of route tables, and network gateways.

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## VPCs and Subnets



- A **subnet** defines a range of IP addresses in your VPC.
- You can launch AWS resources into a subnet that you select.
- A **private subnet** should be used for resources that won't be accessible over the Internet.
- A **public subnet** should be used for resources that will be accessed over the Internet.
- Each subnet must reside entirely within one Availability Zone and cannot span zones.

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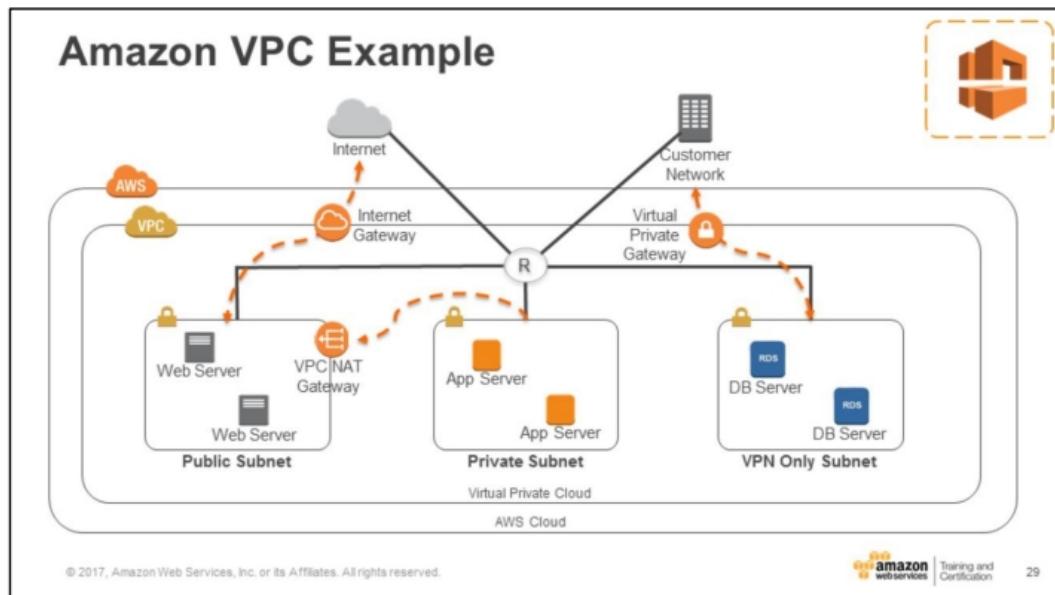
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AWS assigns a unique ID to each subnet. Regardless of the type of subnet (public or private), the internal IP address range of the subnet is always private.

A public subnet has a route to an Internet gateway (i.e., for a web server accessible from the Internet).

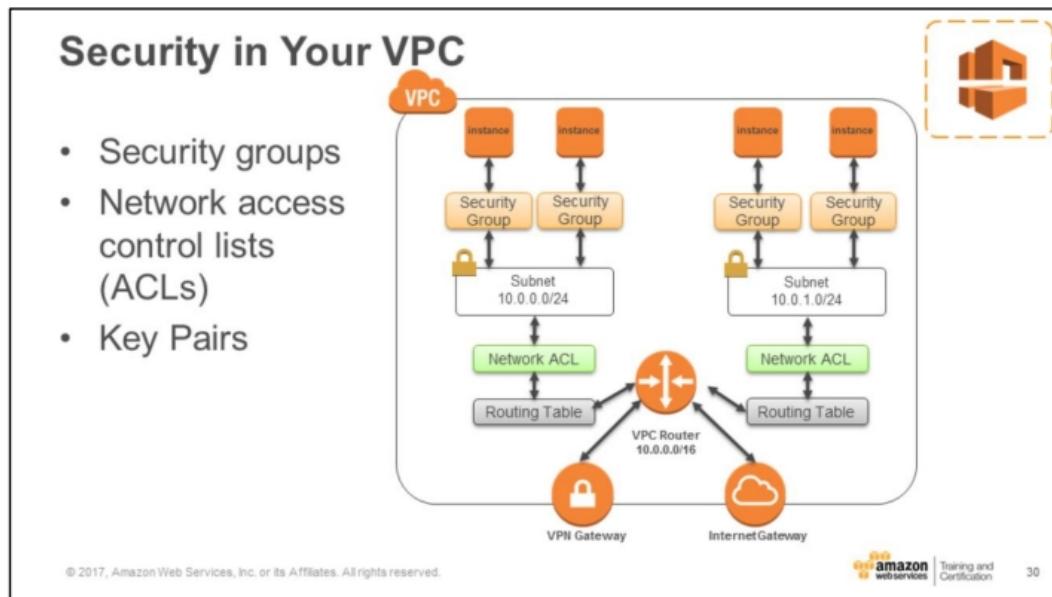
A private subnet has no route to an Internet gateway (i.e., for a database server only accessed within the VPC).

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Amazon Virtual Private Cloud, also known as Amazon VPC, allows you provision a logically isolated section of the AWS cloud where you can launch AWS resources in a virtual network that you define. You have complete control over your virtual networking environment, including selection of your own IP address range, creation of subnets, configuration of route tables, network access control lists, and network gateways. You can easily customize the network and configuration for your Amazon VPC instance. For example, you can create a public-facing subnet for your web servers that require access to the Internet and place your back-end systems, such as databases or application servers, in a private-facing subnet with no Internet access. You can leverage multiple layers of security, including security groups and network access control lists, to help control access to Amazon EC2 instances in each subnet. Additionally, you can create a hardware virtual private network (VPN) connection between your corporate data center and your VPC, which allows you to leverage the AWS cloud as an extension of your corporate data center.

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Amazon VPC provides various features that you can use to increase and monitor the security for your VPC:

- Security groups act as a firewall for associated Amazon EC2 instances, controlling both inbound and outbound traffic at the instance level.
- Network access controls lists (ACLs) act as a firewall for associated subnets, controlling both inbound and outbound traffic at the subnet level.
- Amazon EC2 uses public-key cryptography to encrypt and decrypt login information. Public-key cryptography uses a public key to encrypt a piece of data, and the recipient uses the private key to decrypt the data. The private and public keys are known as a *key pair*. To log in to your instance, you must create a key pair, specific the name of the key pair when you launch the instance, and provide the private key when you connect to the instance. Linux instances have no password, and you use a key pair to log in using SSH. Windows instances require a key pair to obtain the administrator password to log in using RDP.

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## VPN Connections



VPN Connectivity option	Description
AWS Hardware VPN	You can create an <b>IPsec</b> hardware VPN connection between your VPC and your remote network.
AWS Direct Connect	AWS Direct Connect provides a <b>dedicated private</b> connection from a remote network to your VPC.
AWS VPN CloudHub	You can create multiple <b>AWS hardware VPN</b> connections via your VPC to enable communications between various remote networks.
Software VPN	You can create a VPN connection to your remote network by using an Amazon EC2 instance in your VPC that's running a <b>software VPN appliance</b> .

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You can connect your VPC to remote networks by using a VPN connection.

For more information, see:

- <http://docs.aws.amazon.com/AmazonVPC/latest/UserGuide/vpn-connections.html>
- [http://docs.aws.amazon.com/AmazonVPC/latest/UserGuide/VPN\\_CloudHub.html](http://docs.aws.amazon.com/AmazonVPC/latest/UserGuide/VPN_CloudHub.html)

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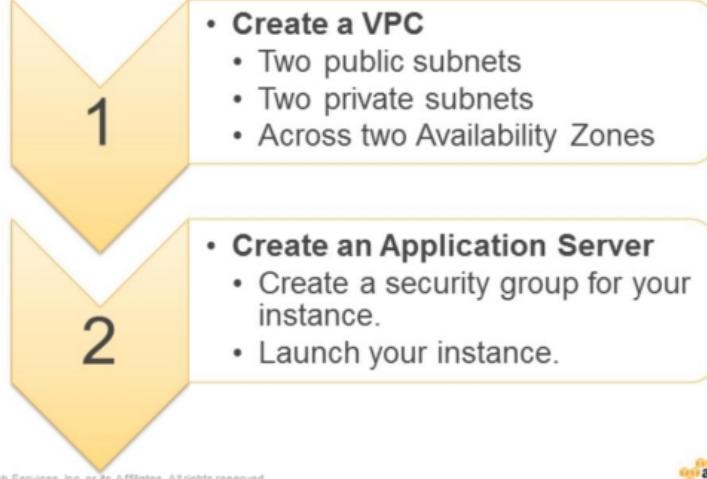
# Lab 1

## Build your VPC and Launch a Web Server

45 minutes

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## Lab 1 Overview



1 • **Create a VPC**

- Two public subnets
- Two private subnets
- Across two Availability Zones

2 • **Create an Application Server**

- Create a security group for your instance.
- Launch your instance.

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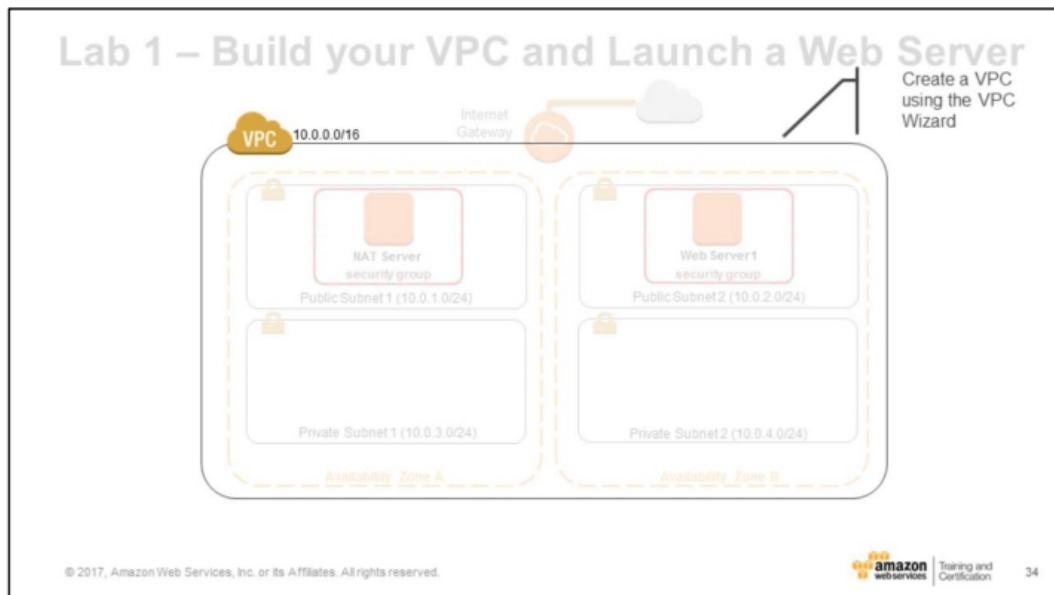
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For more information, see:

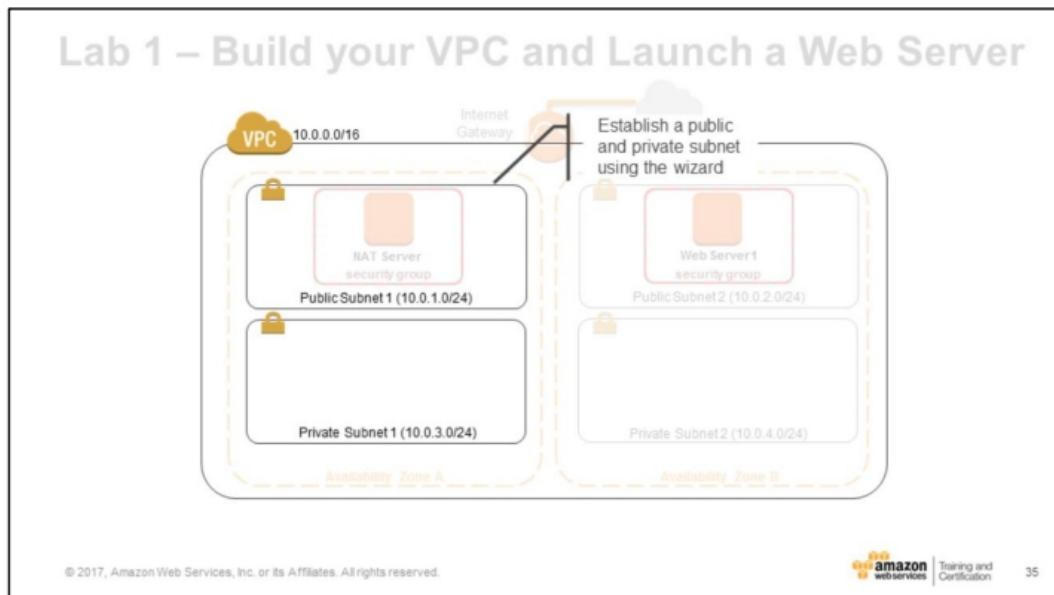
AWS Web Hosting Best Practices: <https://aws.amazon.com/whitepapers/web-application-hosting-best-practices>

Hosting a Web App on Amazon Web Services:  
<http://docs.aws.amazon.com/gettingstarted/latest/wah-linux/web-app-hosting-intro.html>

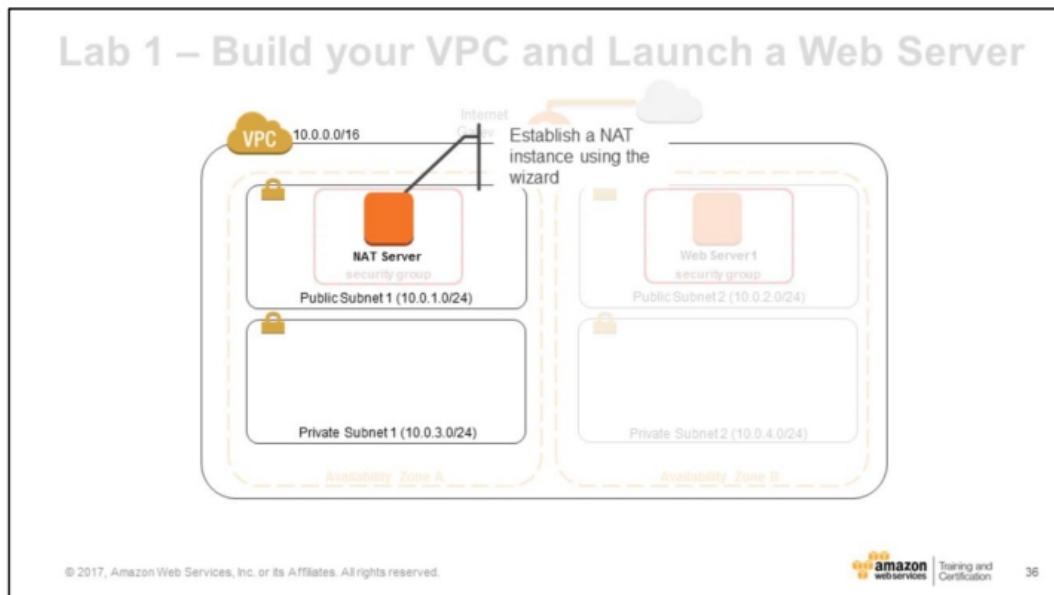
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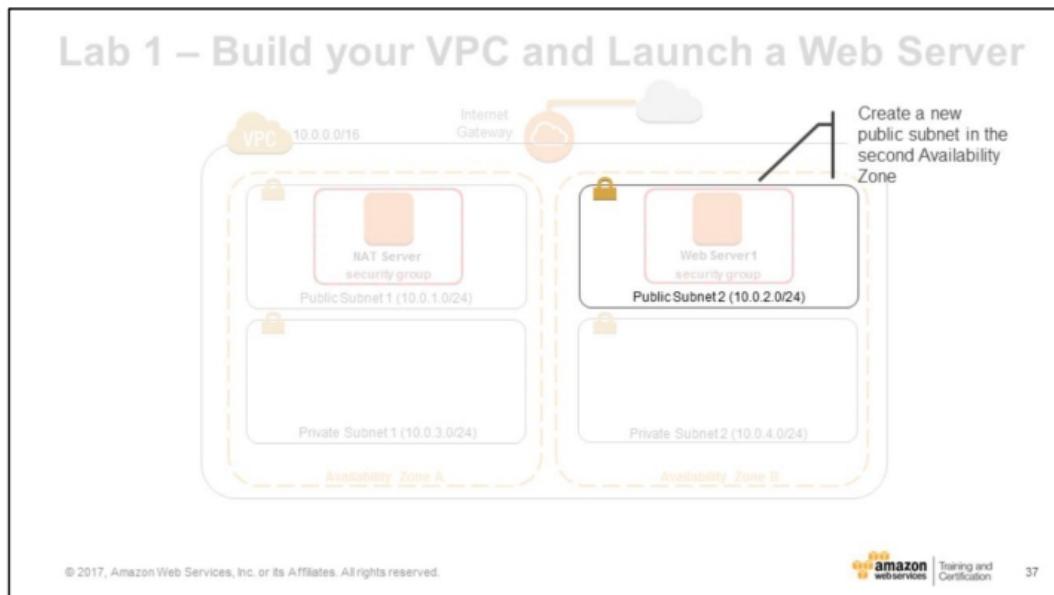
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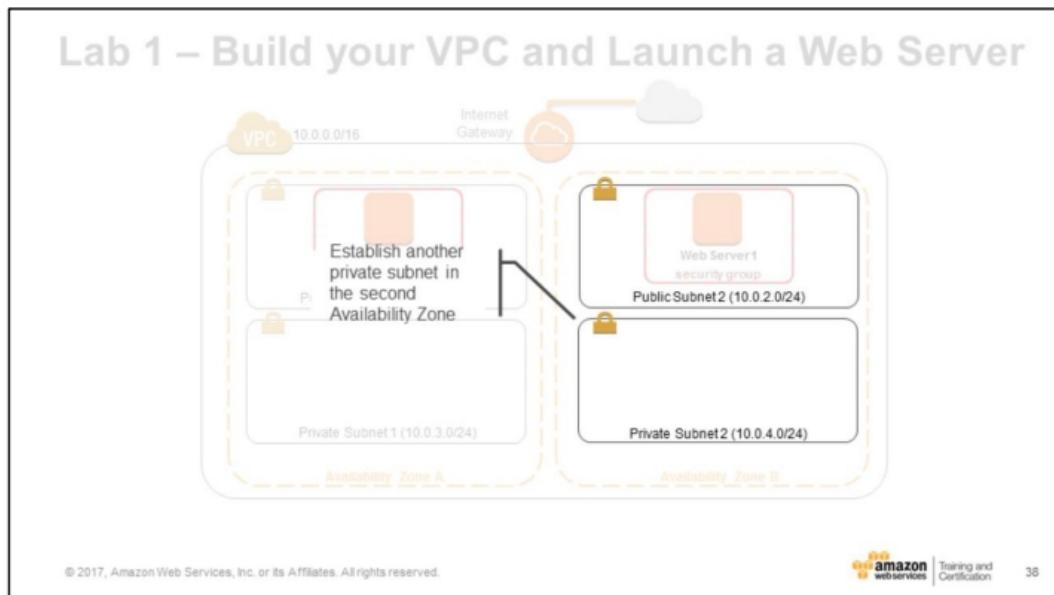
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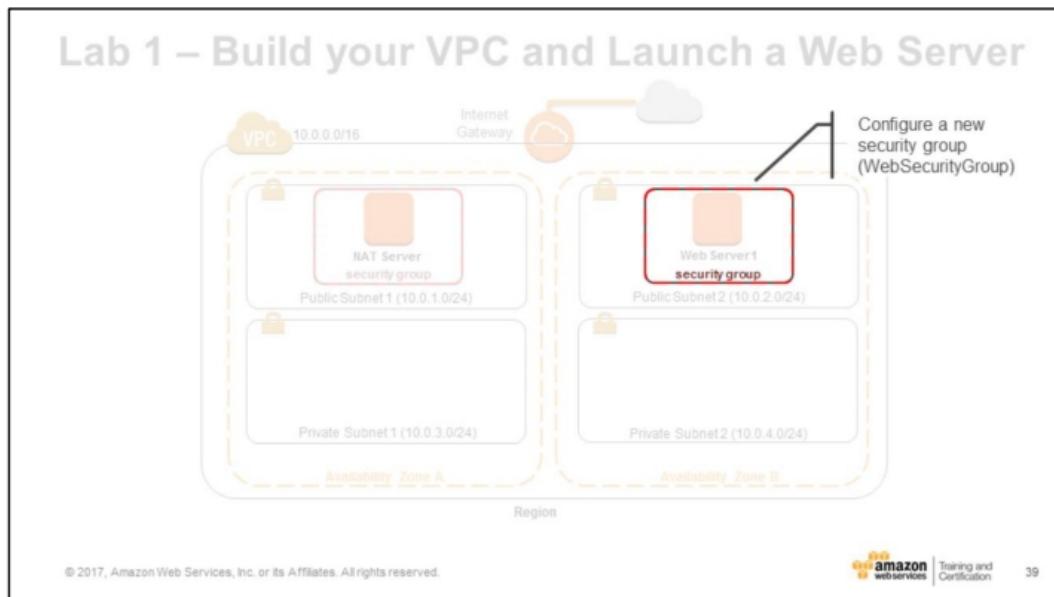
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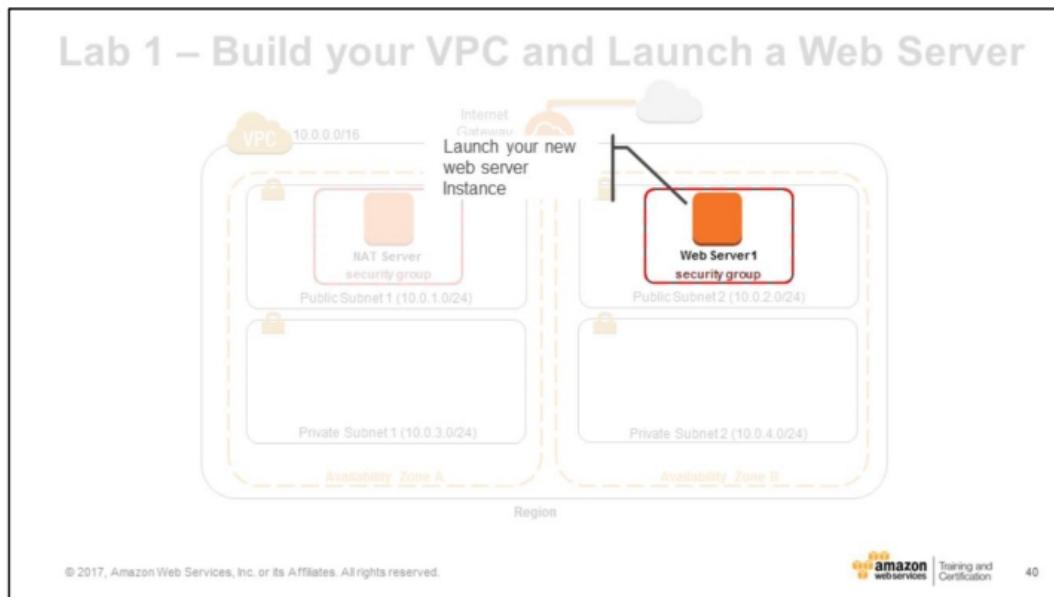
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## Lab 1 – Build your VPC and Launch a Web Server

~ 45 min.

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# Storage Services

## Amazon S3 and Amazon EBS



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Understand storage options including:

- Amazon S3 (Requests, Buckets, Objects, Access, Protecting Data, Notifications, Replication, Request Routing, Optimization, Lifecycle Management with Glacier)
- Amazon EBS (Volumes, Snapshots, Optimization, Encryption, Performance)

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## Amazon Simple Storage Service (S3)



Amazon S3

- Storage for the Internet
- Natively online, HTTP access
- Storage that allows you to store and retrieve **any amount of data**, any time, from anywhere on the web
- **Highly scalable**, reliable, fast and durable

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Amazon S3 is designed to make web-scale computing easier for developers. Amazon S3 provides a simple web services interface that can be used to store and retrieve any amount of data, at any time, from anywhere on the web. It gives any developer access to the same highly scalable, reliable, secure, fast, inexpensive infrastructure that Amazon uses to run its own global network of websites.

For more information, see: <http://aws.amazon.com/s3/>

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## Amazon S3 Facts



- Can store an **unlimited number of objects** in a bucket
- Objects can be **up to 5 TB**; no bucket size limit
- Designed for **99.999999999% durability** and **99.99% availability** of objects over a given year
- Can use **HTTP/S** endpoints to store and retrieve any amount of data, at any time, from anywhere on the web
- Is highly scalable, reliable, fast, and inexpensive
- Can use optional server-side **encryption** using AWS or customer-managed provided client-side encryption
- Auditing is provided by access logs
- Provides standards-based **REST** and **SOAP** interfaces

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Here are some facts about Amazon S3. There is a 100-bucket limit per account. You can store an unlimited number of objects in a bucket. The size of an object can be up to 5 TB, and there is no limit to the size of a bucket. Amazon S3 is designed for 99.999999999% durability and 99.99% availability of objects over a given year. You can use HTTP or HTTPS endpoints to store and retrieve any amount of data, at any time, from anywhere on the web. Most importantly, Amazon S3 is highly scalable, reliable, fast, and inexpensive.

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## Common Use Scenarios

- Storage and backup
- Application file hosting
- Media hosting
- Software delivery
- Store AMIs and snapshots

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Advanced use scenarios:

**Using Amazon DevPay with Amazon S3:** Amazon DevPay enables you to charge customers for using your Amazon S3 product through Amazon's authentication and billing infrastructure. You can charge any amount for your product, including usage charges (storage, transactions, and bandwidth), monthly fixed charges, and a one-time charge.

**Publishing Content Using Amazon S3 and BitTorrent:** You can direct your clients to your BitTorrent-accessible objects by giving them the .torrent file directly or by publishing a link to the BitTorrent URL of your object.

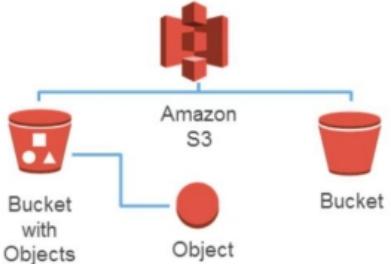
**Hosting a Static Website on Amazon S3:** You can host a static website on Amazon S3 by configuring a bucket for website hosting and then uploading your website content to the bucket.

For more information, see:

- <http://docs.aws.amazon.com/AmazonS3/latest/dev/UsingDevPay.html>
- <http://docs.aws.amazon.com/AmazonS3/latest/dev/S3TorrentPublish.html>
- <http://docs.aws.amazon.com/AmazonS3/latest/dev/WebsiteHosting.html>

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## Amazon S3 Concepts



- Amazon S3 stores data as objects within **buckets**
- An object is composed of a file and optionally any **metadata** that describes that file
- You can have **up to 100 buckets** in each account
- You can **control access** to the bucket and its objects

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To get the most out of Amazon S3, you need to understand a few simple concepts. First, Amazon S3 stores data as objects within buckets.

An object is composed of a file and any metadata that describes that file. To store an object in Amazon S3, you upload the file you want to store into a bucket. When you upload a file, you can set permissions on the object and add any metadata.

Buckets are logical containers for objects. You can have one or more buckets in your account. For each bucket, you can control access: in other words, who can create, delete and list objects in the bucket. You can also view access logs for the bucket and its objects and choose the geographical region where Amazon S3 will store the bucket and its contents.

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## Object Keys

An object key is the unique identifier for an object in a bucket.

http://**doc**.s3.amazonaws.com/2006-03-01/AmazonS3.html

Bucket      Object/Key

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Because the combination of a bucket, key, and version ID uniquely identifies each object, Amazon S3 can be thought of as a basic data map between "bucket + key + version" and the object itself. Every object in Amazon S3 can be uniquely addressed through the combination of the web service endpoint, bucket name, key, and optionally, a version.

For example, in the URL <http://doc.s3.amazonaws.com/2006-03-01/AmazonS3.html>, "doc" is the name of the bucket and "2006-03-01/AmazonS3.html" is the key.

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## Amazon S3 Security



- You can **control access** to buckets and objects with:
  - Access Control Lists (ACLs)
  - Bucket policies
  - Identity and Access Management (IAM) policies
- You can upload or download data to Amazon S3 via **SSL** encrypted endpoints.
- You can **encrypt data** using AWS SDKs.

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### Data Access:

- IAM policies: With IAM policies, you can only grant users within your own AWS account permission to access your Amazon S3 resources.
- ACLs: With ACLs, you can only grant other AWS accounts (not specific users) access to your Amazon S3 resources.
- Bucket Policies: Bucket policies in Amazon S3 can be used to add or deny permissions across some or all of the objects within a single bucket. Policies can be attached to users, groups, or Amazon S3 buckets, enabling centralized management of permissions. With bucket policies, you can grant users within your AWS account or another AWS account access to your Amazon S3 resources.

**Data Transfer:** For maximum security, you can securely upload data to and download data from Amazon S3 via the SSL encrypted endpoints. The encrypted endpoints are accessible both from the Internet and from within Amazon EC2 so that data is transferred securely both within AWS and to and from sources outside of

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AWS.

**Data Storage:** Amazon S3 provides multiple options for protecting data at rest. Customers who prefer to manage their own encryption keys can use a client encryption library such as the Amazon S3 Encryption Client to encrypt data before uploading to Amazon S3.

Alternatively, they can use Amazon S3 Server Side Encryption (SSE) if you prefer to have Amazon S3 manage encryption keys for you. With Amazon S3 SSE, you can encrypt data on upload simply by adding an additional request header when writing the object. Decryption happens automatically when data is retrieved.

Amazon S3 SSE uses one of the strongest block ciphers available: 256-bit Advanced Encryption Standard (AES-256). With Amazon S3 SSE, every protected object is encrypted with a unique encryption key. This object key itself is then encrypted with a regularly rotated master key. Amazon S3 SSE provides additional security by storing the encrypted data and encryption keys in different hosts. Amazon S3 SSE also makes it possible for you to enforce encryption requirements. For example, you can create and apply bucket policies that require that only encrypted data can be uploaded to your buckets.

Instead of using Amazon S3 SSE, you can also encrypt your data before sending it to Amazon S3. You can build your own library that encrypts your object data on the client side before uploading it to Amazon S3. Optionally, you can use an AWS SDK to automatically encrypt your data before uploading it to Amazon S3.

For more information, see:

<http://docs.aws.amazon.com/AmazonS3/latest/dev/UsingClientSideEncryption.html>

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## Amazon S3 Versioning

- Protects from **accidental overwrites and deletes** with no performance penalty.
- Generates a **new version with every upload**.
- Allows easily retrieval of deleted objects or **roll back** to previous versions.
- Three states of an Amazon S3 bucket
  - Un-versioned (default)
  - Versioning-enabled
  - Versioning-suspended



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Versioning is a method of keeping multiple variants of an object in the same bucket. You can use versioning to preserve, retrieve, and restore every version of every object stored in your Amazon S3 bucket. With versioning, you can easily recover from both unintended user actions and application failures.

In one bucket, for example, you can have two objects with the same key, but different version IDs, such as photo.gif (version 111111) and photo.gif (version 121212).

If you version-enable a bucket, it can never return to an unversioned state. You can, however, suspend versioning on that bucket.

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## Amazon S3 Object Lifecycle



**Lifecycle management** defines how Amazon S3 manages objects during their lifetime. Some objects that you store in an Amazon S3 bucket might have a well-defined lifecycle:

- Log files
- Archive documents
- Digital media archives
- Financial and healthcare records
- Raw genomics sequence data
- Long-term database backups
- Data that must be retained for regulatory compliance

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Lifecycle management defines how Amazon S3 manages objects during their lifetime. Some objects that you store in an Amazon S3 bucket might have a well-defined lifecycle: if you are uploading periodic logs to your bucket, your application might need these logs for a week or a month after creation, and after that you might want to delete them. Some documents are frequently accessed for a limited period of time. After that, you might not need real-time access to these objects, but your organization might require you to archive them for a longer period and then optionally delete them.

Digital media archives, financial and healthcare records, raw genomics sequence data, long-term database backups, and data that must be retained for regulatory compliance are some of the kinds of objects that you might upload to Amazon S3 primarily for archival purposes.

When you configure a lifecycle rule, you specify the storage class you want to transition the object to and the number of days after object creation to transition it. You can transition objects to the Standard – Infrequent Access (IA) storage class, archive them to Amazon Glacier, or have them permanently deleted. Standard - IA is useful for data such as backups and other older, infrequently accessed data where high performance continues to be a requirement. It is suitable for objects greater than 128 kilobytes that you want to keep for at least 30 days. There is a retrieval fee

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associated with Standard - IA objects.

For more information, see:

- [Amazon S3 Pricing](#)
- <http://aws.amazon.com/solutions/case-studies/yelp/>

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## Amazon S3 Pricing

- Pay only for what you use
- No minimum fee
- Prices based on location of your Amazon S3 bucket
- Estimate monthly bill using the **AWS Simple Monthly Calculator**
- Pricing is available as:
  - Storage Pricing
  - Request Pricing
  - Data Transfer Pricing: data transferred out of Amazon S3



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Amazon S3 pricing is based on capacity and bandwidth actually used. Because Amazon S3 is an Internet-scale service that runs natively across an entire region, it can handle significant request throughput and bandwidth output. All bandwidth into Amazon S3 is free, but AWS charges a rate on bandwidth out. Most importantly, since Amazon S3 can handle any amount of data, it is important to note that you only pay for the amount of space you use. Prices are based on a prorated GB per month.

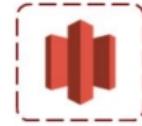
There is also a pricing calculator online as a reference. Note that pricing listed is in the US East (N. Virginia) Region at the time this training was developed.

For more information, see:

- Online Pricing Calculator: <http://calculator.s3.amazonaws.com/calc5.html>
- <https://aws.amazon.com/s3/pricing/>

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## Amazon Glacier



- Long term low-cost archiving service
- Optimal for infrequently accessed data
- Designed for 99.99999999% durability
- Three to five hours' retrieval time
- Less than \$0.01 per GB/month (depending on region)

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For more information about Glacier pricing, see:  
<https://aws.amazon.com/glacier/pricing/>

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## Amazon S3 Storage Classes

Storage Class	Durability	Availability	Other Considerations
Amazon S3 Standard	99.999999999%	99.99%	
Amazon S3 Standard - Infrequent Access (IA)	99.999999999%	99.9%	<ul style="list-style-type: none"> <li>Retrieval fee associated with objects</li> <li>Most suitable for infrequently accessed data</li> </ul>
Glacier	99.999999999%	99.99% (once restored)	<ul style="list-style-type: none"> <li>Not available for real-time access</li> <li>Must restore objects before you can access them</li> <li>Restoring objects can take 3-5 hours</li> </ul>

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Each object in Amazon S3 has a storage class associated with it.

**S3 Standard** is ideal for performance-sensitive use cases and frequently used data. Standard is the default storage class in S3.

**S3 Infrequent Access (IA)** is optimized for long-lived and less frequently accessed data, such as backups and older data that are accessed less but still require high performance.

**Glacier** is suitable for archiving data where access is infrequent and a retrieval time of several hours is acceptable. Archived objects are not available for real-time access: they must be restored before they can be accessed. The Glacier storage class is very low-cost.

**S3 Reduced Redundancy Storage (RSS)** is designed for noncritical, reproducible data stored at lower levels of redundancy standards than the Standard or IA classes, thus reducing cost.

For more information, see:

- <http://docs.aws.amazon.com/AmazonS3/latest/dev/storage-class-intro.html>
- <https://aws.amazon.com/s3/storage-classes/>

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