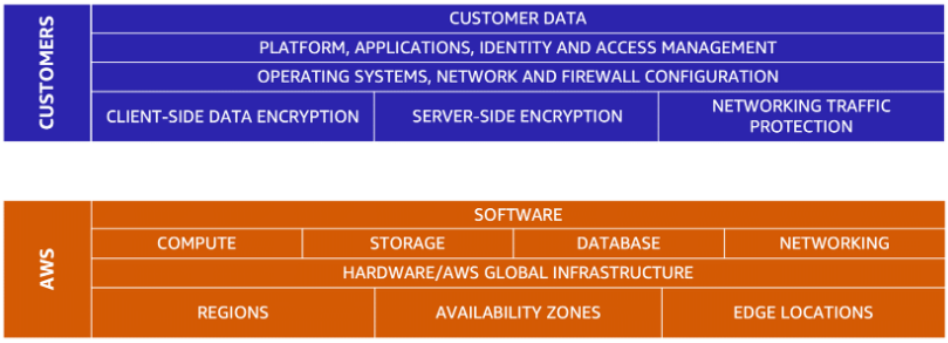
Shared Responsibility model

The AWS shared responsibility model

Throughout this course, you have learned about a variety of resources that you can create in the AWS Cloud. These resources include Amazon EC2 instances, Amazon S3 buckets, and Amazon RDS databases. Who is responsible for keeping these resources secure: you (the customer) or AWS?

The answer is both. The reason is that you do not treat your AWS environment as a single object. Rather, you treat the environment as a collection of parts that build upon each other. AWS is responsible for some parts of your environment and you (the customer) are responsible for other parts. This concept is known as the **shared responsibility model**.

The shared responsibility model divides into customer responsibilities (commonly referred to as "security in the cloud") and AWS responsibilities (commonly referred to as "security of the cloud").



You can think of this model as being similar to the division of responsibilities between a homeowner and a homebuilder. The builder (AWS) is responsible for constructing your house and ensuring that it is solidly built. As the homeowner (the customer), it is your responsibility to secure everything in the house by ensuring that the doors are closed and locked.

Customers: Security in the cloud

Customers are responsible for the security of everything that they create and put *in* the AWS Cloud.

When using AWS services, you, the customer, maintain complete control over your content. You are responsible for managing security requirements for your content, including which content you choose to store on AWS, which AWS services you use, and who has access to that content. You also control how access rights are granted, managed, and revoked.

The security steps that you take will depend on factors such as the services that you use, the complexity of your systems, and your company's specific operational and security needs. Steps include selecting, configuring, and patching the operating systems that will run on Amazon EC2 instances, configuring security groups, and managing user accounts.

AWS: Security of the cloud

AWS is responsible for security *of* the cloud.

AWS operates, manages, and controls the components at all layers of infrastructure. This includes areas such as the host operating system, the virtualization layer, and even the physical security of the data centers from which services operate.

AWS is responsible for protecting the global infrastructure that runs all of the services offered in the AWS Cloud. This infrastructure includes AWS Regions, Availability Zones, and edge locations.

AWS manages the security of the cloud, specifically the physical infrastructure that hosts your resources, which include:

- Physical security of data centers
- Hardware and software infrastructure
- Network infrastructure
- Virtualization infrastructure

Although you cannot visit AWS data centers to see this protection firsthand, AWS provides several reports from third-party auditors. These auditors have verified its compliance with a variety of computer security standards and regulations.

User Permission and Access

AWS Identity and Access Management (IAM)

AWS Identity and Access Management (IAM) enables you to manage access to AWS services and resources securely.

IAM gives you the flexibility to configure access based on your company's specific operational and security needs. You do this by using a combination of IAM features, which are explored in detail in this lesson:

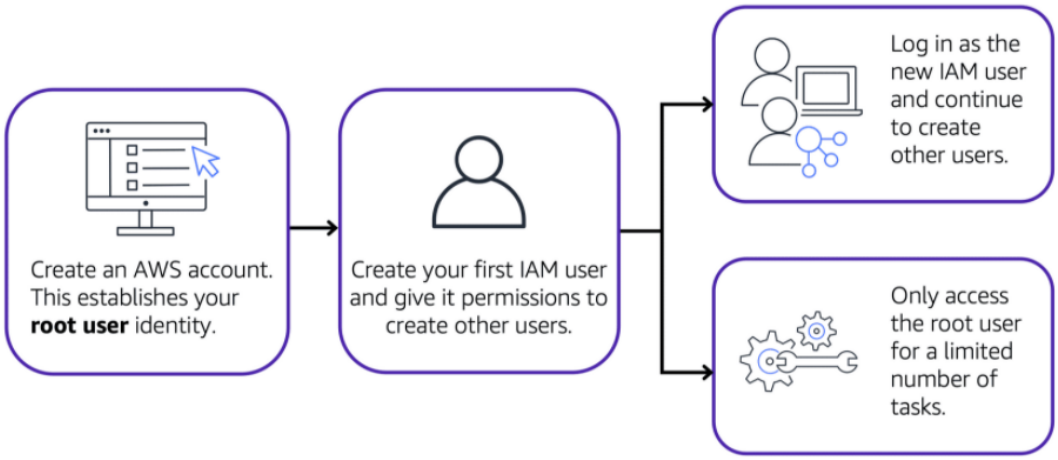
- IAM users, groups, and roles
- IAM policies
- Multi-factor authentication

You will also learn best practices for each of these features.

AWS account root user

When you first create an AWS account, you begin with an identity known as the **root user**.

The root user is accessed by signing in with the email address and password that you used to create your AWS account. You can think of the root user as being similar to the owner of the coffee shop. It has complete access to all the AWS services and resources in the account.



Best practice:

Do **not** use the root user for everyday tasks.

Instead, use the root user to create your first IAM user and assign it permissions to create other users.

Then, continue to create other IAM users, and access those identities for performing regular tasks throughout AWS. Only use the root user when you need to perform a limited number of tasks that are only available to the root user. Examples of these tasks include changing your root user email address and changing your AWS support plan.

IAM users

An **IAM user** is an identity that you create in AWS. It represents the person or application that interacts with AWS services and resources. It consists of a name and credentials.

By default, when you create a new IAM user in AWS, it has no permissions associated with it. To allow the IAM user to perform specific actions in AWS, such as launching an Amazon EC2 instance or creating an Amazon S3 bucket, you must grant the IAM user the necessary permissions.

Best practice:

We recommend that you create individual IAM users for each person who needs to access AWS.

Even if you have multiple employees who require the same level of access, you should create individual IAM users for each of them. This provides additional security by allowing each IAM user to have a unique set of security credentials.

IAM policies

An **IAM policy** is a document that allows or denies permissions to AWS services and resources.

IAM policies enable you to customize users' levels of access to resources. For example, you can allow users to access all of the Amazon S3 buckets within your AWS account, or only a specific bucket.

> Best practice:
>
> Follow the security principle of **least privilege** when granting permissions.
>
> By following this principle, you help to prevent users or roles from having more permissions than needed to perform their tasks.
>
> For example, if an employee needs access to only a specific bucket, specify the bucket in the IAM policy. Do this instead of granting the employee access to all of the buckets in your AWS account.

Example: IAM policy

Here's an example of how IAM policies work. Suppose that the coffee shop owner has to create an IAM user for a newly hired cashier. The cashier needs access to the receipts kept in an Amazon S3 bucket with the ID: AWSDOC-EXAMPLE-BUCKET.

```
{
  "Version": "2012-10-17",
  "Statement": {
    "Effect": "Allow",
    "Action": "s3:ListObject",
    "Resource": "arn:aws:s3:::
AWSDOC-EXAMPLE-BUCKET"
  }
}
```

This example IAM policy allows permission to access the objects in the Amazon S3 bucket with ID: *AWSDOC-EXAMPLE-BUCKET*.

In this example, the IAM policy is allowing a specific action within Amazon S3: ListObject. The policy also mentions a specific bucket ID: AWSDOC-EXAMPLE-BUCKET. When the owner attaches this policy to the cashier's IAM user, it will allow the cashier to view all of the objects in the AWSDOC-EXAMPLE-BUCKET bucket.

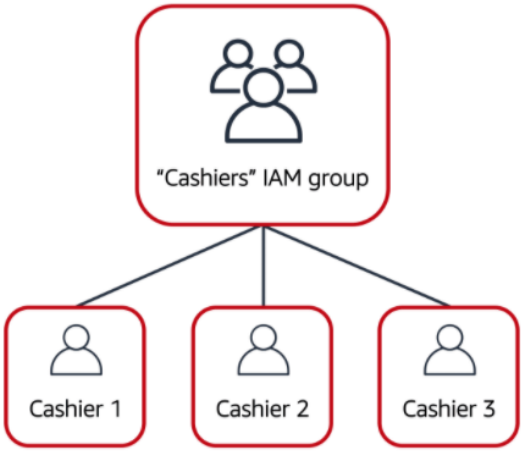
If the owner wants the cashier to be able to access other services and perform other actions in AWS, the owner must attach additional policies to specify these services and actions.

Now, suppose that the coffee shop has hired a few more cashiers. Instead of assigning permissions to each individual IAM user, the owner places the users into an **IAM group**.

IAM groups

An IAM group is a collection of IAM users. When you assign an IAM policy to a group, all users in the group are granted permissions specified by the policy.

Here's an example of how this might work in the coffee shop. Instead of assigning permissions to cashiers one at a time, the owner can create a "Cashiers" IAM group. The owner can then add IAM users to the group and then attach permissions at the group level.



Assigning IAM policies at the group level also makes it easier to adjust permissions when an employee transfers to a different job. For example, if a cashier becomes an inventory specialist, the coffee shop owner removes them from the "Cashiers" IAM group and adds them into the "Inventory Specialists" IAM group. This ensures that employees have only the permissions that are required for their current role.

What if a coffee shop employee hasn't switched jobs permanently, but instead, rotates to different workstations throughout the day? This employee can get the access they need through **IAM roles**.

IAM roles

In the coffee shop, an employee rotates to different workstations throughout the day. Depending on the staffing of the coffee shop, this employee might perform several duties: work at the cash register, update the inventory system, process online orders, and so on.

When the employee needs to switch to a different task, they give up their access to one workstation and gain access to the next workstation. The employee can easily switch between workstations, but at any given point in time, they can have access to only a single workstation. This same concept exists in AWS with IAM roles.

An IAM role is an identity that you can assume to gain temporary access to permissions.

Before an IAM user, application, or service can assume an IAM role, they must be granted permissions to switch to the role. When someone assumes an IAM role, they abandon all previous permissions that they had under a previous role and assume the permissions of the new role.

> Best practice:
>
> IAM roles are ideal for situations in which access to services or resources needs to be granted temporarily, instead of long-term.

Multi-factor authentication

Have you ever signed in to a website that required you to provide multiple pieces of information to verify your identity? You might have needed to provide your password and then a second form of authentication, such as a random code sent to your phone. This is an example of **multi-factor authentication**.

In IAM, multi-factor authentication (MFA) provides an extra layer of security for your AWS account.

AWS Organization

One way to install order and to enforce who is allowed to perform certain functions in what account is to make use of an AWS service called AWS Organizations.

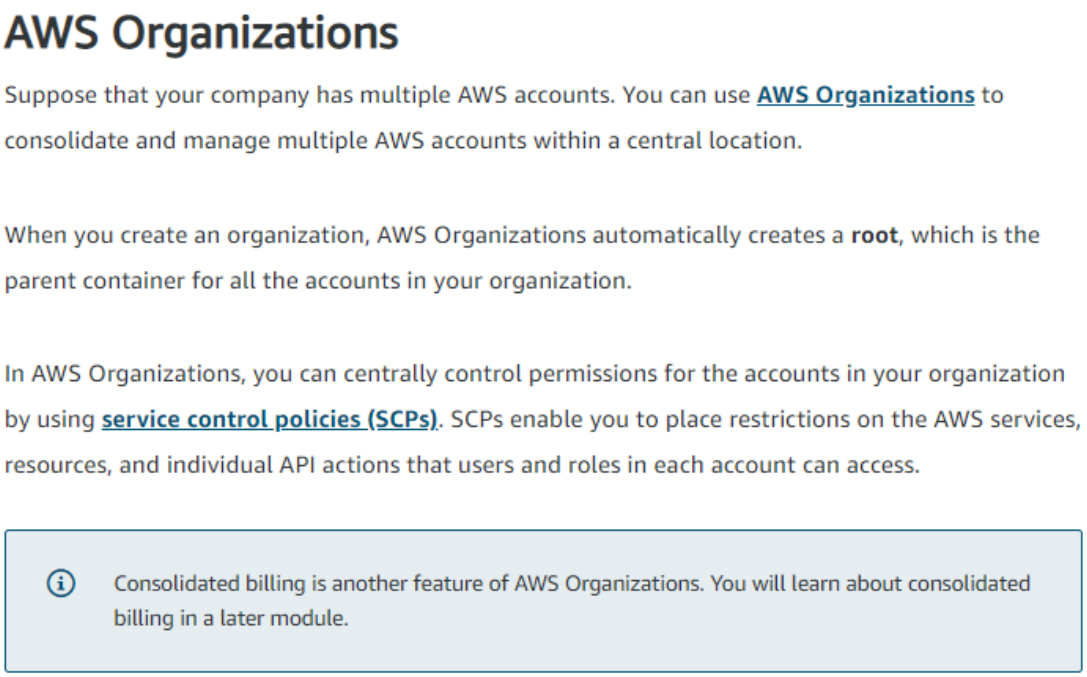
The easiest way to think of Organizations is as a central location to manage multiple AWS accounts. You can manage billing control, access, compliance, security, and share

resources across your AWS accounts. Let's outline some of the main features of AWS Organizations, shall we?

The first is centralized management of all your AWS accounts. Think of all those AWS accounts, we had: A, B, C, F, G. Now you can combine them into an organization that enables us to manage the accounts centrally, and wow. Now we've found Accounts D and E in the process. Next up is consolidated billing for all member accounts. This means you can use the primary account of your organization to consolidate and pay for all member accounts. Another advantage of consolidated billing is bulk discounts. Cash money, indeed.

The next feature is that you can implement hierarchical groupings of your accounts to meet security, compliance, or budgetary needs. This means you can group accounts into organizational units, or OUs, kind of like business units, or BUs. For example, if you have accounts that must access only the AWS services that meet certain regulatory requirements, you can put those accounts into one OU, or if you have accounts that fall under the developer OU, you can group them accordingly.

One of the last main features we'll touch upon is that you have control over the AWS services and API actions that each account can access as an administrator of the primary account of an organization. You can use something called service control policies, or SCPs, to specify the maximum permissions for member accounts in the organization. In essence, with SCPs you can restrict which AWS services, resources, and individual API actions, the users and roles in each member account can access.



Organizational units

In AWS Organizations, you can group accounts into organizational units (OUs) to make it easier to manage accounts with similar business or security requirements. When you apply a policy to an OU, all the accounts in the OU automatically inherit the permissions specified in the policy.

By organizing separate accounts into OUs, you can more easily isolate workloads or applications that have specific security requirements. For instance, if your company has accounts that can access only the AWS services that meet certain regulatory requirements, you can put these accounts into one OU. Then, you can attach a policy to the OU that blocks access to all other AWS services that do not meet the regulatory requirements.

Compliance

AWS Artifact

Depending on your company's industry, you may need to uphold specific standards. An audit or inspection will ensure that the company has met those standards.

AWS Artifact is a service that provides on-demand access to AWS security and compliance reports and select online agreements. AWS Artifact consists of two main sections: AWS Artifact Agreements and AWS Artifact Reports.

To learn more, select the + symbol next to each section.

AWS Artifact Agreements

Suppose that your company needs to sign an agreement with AWS regarding your use of certain types of information throughout AWS services. You can do this through **AWS Artifact Agreements**.

In AWS Artifact Agreements, you can review, accept, and manage agreements for an individual account and for all your accounts in AWS Organizations. Different types of agreements are offered to address the needs of customers who are subject to specific regulations, such as the Health Insurance Portability and Accountability Act (HIPAA).

AWS Artifact Reports

Next, suppose that a member of your company's development team is building an application and needs more information about their responsibility for complying with certain regulatory standards. You can advise them to access this information in **AWS Artifact Reports**.

AWS Artifact Reports provide compliance reports from third-party auditors. These auditors have tested and verified that AWS is compliant with a variety of global, regional, and industry-specific security standards and regulations. AWS Artifact Reports remains up to date with the latest reports released. You can provide the AWS audit artifacts to your auditors or regulators as evidence of AWS security controls.

The following are some of the compliance reports and regulations that you can find within AWS Artifact. Each report includes a description of its contents and the reporting period for which the document is valid.

Customer Compliance Center

The **Customer Compliance Center** contains resources to help you learn more about AWS compliance.

In the Customer Compliance Center, you can read customer compliance stories to discover how companies in regulated industries have solved various compliance, governance, and audit challenges.

You can also access compliance whitepapers and documentation on topics such as:

- AWS answers to key compliance questions
- An overview of AWS risk and compliance
- An auditing security checklist

Additionally, the Customer Compliance Center includes an auditor learning path. This learning path is designed for individuals in auditing, compliance, and legal roles who want to learn more about how their internal operations can demonstrate compliance using the AWS Cloud.

DDOS Attack

D-D-o-S, DDoS, the distributed denial-of-service. It's an attack on your enterprise's infrastructure, and you've heard of it. Your security team might have written a plan for it, and you know that many businesses have been devastated by it.

In normal operations, your application takes requests from customers and returns results. In a DDoS attack, the bad actor tries to overwhelm the capacity of your application, basically to deny anyone your services. But a single machine attacking your application has no hope of providing enough of an attack by itself, so the distributed part is that the attack leverages other machines around the internet to unknowingly attack your infrastructure. The bad actor creates an army of zombie bots, brainlessly assaulting your enterprise. The key to a good attack, and I call it that when I should call it powerful. I mean, it's definitely chaotic evil, but the key is to have the assault commander do the smallest amount of work needed, and have the targeted victim receive an unbearable load of resulting work they must process through.

So let me cherry-pick a few specific attack examples that work really well. The UDP flood. It is based on the helpful parts of the internet, like the National Weather Service. Now anyone can send a small request to the Weather Service, and ask, "Give me weather," and in return, the Weather Service's fleet of machines will send back a massive amount of weather telemetry, forecasts, updates, lots of stuff. So the attack here is simple. The bad actor sends a simple request, give me weather. But it gives a fake return address on the request, your return address. So now the Weather Service very

happily floods your server with megabytes of rain forecasts, and your system could be brought to a standstill, just sorting through the information it never wanted in the first place. Now that is one example of half a dozen low-level, brute force attacks, all designed to exhaust your network.

Some attacks are much more sophisticated, like the HTTP level attacks, which look like normal customers asking for normal things like complicated product searches over and over and over, all coming from an army of zombified bot machines. They ask for so much attention that regular customers can't get in.

They even try horrible tricks like the Slowloris attack. Mm-hmm. Imagine standing in line at the coffee shop, when someone in front of you takes seven minutes to order their whatever it is they're ordering, and you don't get to order until they finish and get out of your way. Well, Slowloris attack is the exact same thing. Instead of a normal connection, I would like to place an order, the attacker pretends to have a terribly slow connection. You get the picture. Meanwhile, your production servers are standing there waiting for the customer to finish their request so they can dash off and return the result. But until they get the entire packet, they can't move on to the next thread, the next customer. A few Slowloris attackers can exhaust the capacity of your entire front end with almost no effort at all. I could go on monologuing for hours just talking about the elegantly evil architecture of these attacks, but we are on the clock here, and it is time to stop these attacks cold. And here's the cool solution: You already know the solution.

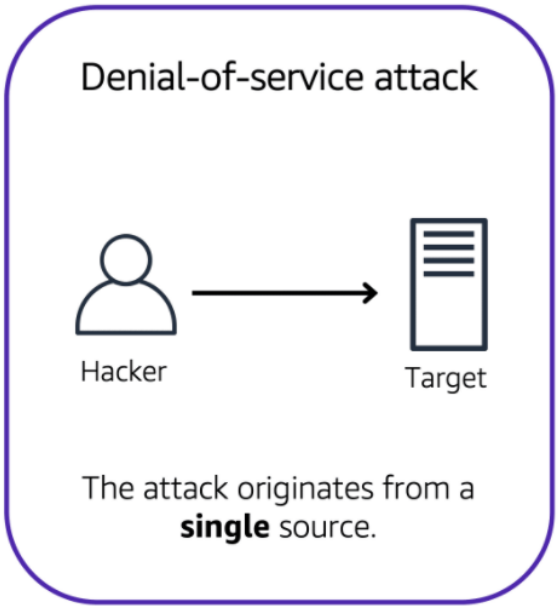
Everything we've been talking about over this entire course is not only good architecture, but it also helps solve almost all DDoS attack vectors with zero additional effort or cost. First attack, the low level network attacks like the UDP floods. Solution, security groups. The security groups only allow in proper request traffic. Things like weather reports use an entirely different protocol than the ones your customers use. Not on the list, you don't get to talk to the server. And what's more, security groups operate at the AWS network level, not at the EC2 instance level, like an operating system firewall might.

So massive attacks like UDP floods or reflection attacks just get shrugged off by the scale of the entire AWS Regions capacity, not your individual EC2's capacity. This is a case where our size is a huge advantage in your protection. I won't say it's impossible to overwhelm AWS, but the scale it would take, it would be too expensive for these bad actors. Slowloris attacks? Look at our elastic load balancer. Because the ELB handles the http traffic request first, so it waits until the entire message, no matter how fast or slow, is complete before sending it over to the front end web server. I mean, sure, you can try to overwhelm it, but remember how the ELB is scalable and how it runs at the region level?

To overwhelm ELB, you would once again have to overwhelm the entire AWS region. It's not theoretically impossible, but too massively expensive for anyone to pull off. For the sharpest, most sophisticated attacks, AWS also offers specialized defense tools called AWS Shield with AWS WAF. AWS WAF uses a web application firewall to filter incoming traffic for the signatures of bad actors. It has extensive machine learning capabilities, and can recognize new threats as they evolve and proactively help defend your system against an ever-growing list of destructive vectors.

Denial-of-service attacks

A **denial-of-service (DoS) attack** is a deliberate attempt to make a website or application unavailable to users.

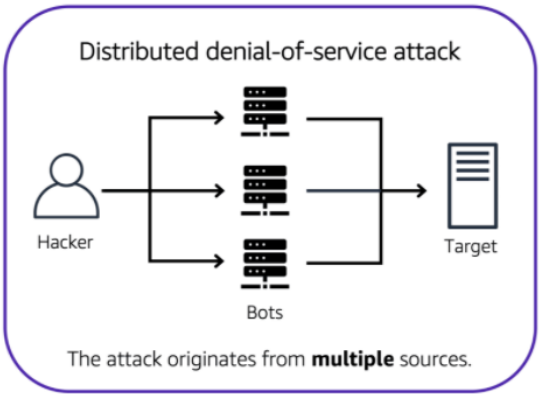


For example, an attacker might flood a website or application with excessive network traffic until the targeted website or application becomes overloaded and is no longer able to respond. If the website or application becomes unavailable, this denies service to users who are trying to make legitimate requests.

Distributed denial-of-service attacks

Now, suppose that the prankster has enlisted the help of friends.

The prankster and their friends repeatedly call the coffee shop with requests to place orders, even though they do not intend to pick them up. These requests are coming in from different phone numbers, and it's impossible for the coffee shop to block them all. Additionally, the influx of calls has made it increasingly difficult for customers to be able to get their calls through. This is similar to a **distributed denial-of-service attack**.



In a distributed denial-of-service (DDoS) attack, multiple sources are used to start an attack that aims to make a website or application unavailable. This can come from a group of attackers, or even a single attacker. The single attacker can use multiple infected computers (also known as "bots") to send excessive traffic to a website or application.

To help minimize the effect of DoS and DDoS attacks on your applications, you can use **AWS Shield**.

AWS Shield

AWS Shield is a service that protects applications against DDoS attacks. AWS Shield provides two levels of protection: Standard and Advanced.

To learn more, select the + symbol next to each service.

AWS Shield Standard

AWS Shield Standard automatically protects all AWS customers at no cost. It protects your AWS resources from the most common, frequently occurring types of DDoS attacks.

As network traffic comes into your applications, AWS Shield Standard uses a variety of analysis techniques to detect malicious traffic in real time and automatically mitigates it.

AWS Shield Advanced

AWS Shield Advanced is a paid service that provides detailed attack diagnostics and the ability to detect and mitigate sophisticated DDoS attacks.

It also integrates with other services such as Amazon CloudFront, Amazon Route 53, and Elastic Load Balancing. Additionally, you can integrate AWS Shield with AWS WAF by writing custom rules to mitigate complex DDoS attacks.

Additional Security Services

AWS Key Management Service (AWS KMS)

The coffee shop has many items, such as coffee machines, pastries, money in the cash registers, and so on. You can think of these items as data. The coffee shop owners want to ensure that all of these items are secure, whether they're sitting in the storage room or being transported between shop locations.

In the same way, you must ensure that your applications' data is secure while in storage **(encryption at rest)** and while it is transmitted, known as **encryption in transit**.

AWS Key Management Service (AWS KMS) enables you to perform encryption operations through the use of **cryptographic keys**. A cryptographic key is a random string of digits used for locking (encrypting) and unlocking (decrypting) data. You can use AWS KMS to create, manage, and use cryptographic keys. You can also control the use of keys across a wide range of services and in your applications.

With AWS KMS, you can choose the specific levels of access control that you need for your keys. For example, you can specify which IAM users and roles are able to manage keys. Alternatively, you can temporarily disable keys so that they are no longer in use by anyone. Your keys never leave AWS KMS, and you are always in control of them.

AWS WAF

AWS WAF is a web application firewall that lets you monitor network requests that come into your web applications.

AWS WAF works together with Amazon CloudFront and an Application Load Balancer. Recall the network access control lists that you learned about in an earlier module. AWS WAF works in a similar way to block or allow traffic. However, it does this by using a **web access control list (ACL)** to protect your AWS resources.

Here's an example of how you can use AWS WAF to allow and block specific requests.

Suppose that your application has been receiving malicious network requests from several IP addresses. You want to prevent these requests from continuing to access your application, but you also want to ensure that legitimate users can still access it. You configure the web ACL to allow all requests except those from the IP addresses that you have specified.

When a request comes into AWS WAF, it checks against the list of rules that you have configured in the web ACL. If a request did not come from one of the blocked IP addresses, it allows access to the application.

However, if a request came from one of the blocked IP addresses that you have specified in the web ACL, it is denied access.

Amazon Inspector

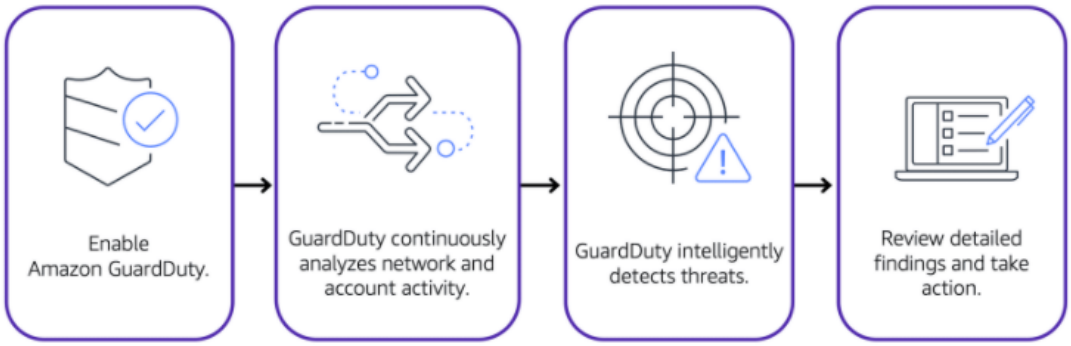
Suppose that the developers at the coffee shop are developing and testing a new ordering application. They want to make sure that they are designing the application in accordance with security best practices. However, they have several other applications to develop, so they cannot spend much time conducting manual assessments. To perform automated security assessments, they decide to use **Amazon Inspector**.

Amazon Inspector helps to improve the security and compliance of applications by running automated security assessments. It checks applications for security vulnerabilities and deviations from security best practices, such as open access to Amazon EC2 instances and installations of vulnerable software versions.

After Amazon Inspector has performed an assessment, it provides you with a list of security findings. The list prioritizes by severity level, including a detailed description of each security issue and a recommendation for how to fix it. However, AWS does not guarantee that following the provided recommendations resolves every potential security issue. Under the shared responsibility model, customers are responsible for the security of their applications, processes, and tools that run on AWS services.

Amazon GuardDuty

Amazon GuardDuty is a service that provides intelligent threat detection for your AWS infrastructure and resources. It identifies threats by continuously monitoring the network activity and account behavior within your AWS environment.



After you have enabled GuardDuty for your AWS account, GuardDuty begins monitoring your network and account activity. You do not have to deploy or manage any additional security software. GuardDuty then continuously analyzes data from multiple AWS sources, including VPC Flow Logs and DNS logs.

If GuardDuty detects any threats, you can review detailed findings about them from the AWS Management Console. Findings include recommended steps for remediation. You can also configure AWS Lambda functions to take remediation steps automatically in response to GuardDuty's security findings.