



**AWS Academy Cloud Architecting
Module 03 Student Guide
Version 2.0.5**

200-ACACAD-20-EN-SG

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AWS Academy Cloud Architecting

Module 3: Adding a Storage Layer

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Welcome to Module 3: Adding a Storage Layer.

Module overview



Sections

1. The simplest architecture
2. Using Amazon S3
3. Storing data in Amazon S3
4. Moving data to and from Amazon S3
5. Choosing Regions for your architecture

Demonstrations

- Amazon S3 Versioning
- Amazon S3 Transfer Acceleration

Labs

- Guided Lab: Hosting a Static Website
- Challenge Lab: Creating a Static Website for the Café



Knowledge check

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This module includes the following sections:

1. The simplest architecture
2. Using Amazon S3
3. Storing data in Amazon S3
4. Moving data to and from Amazon S3
5. Choosing Regions for your architecture

This module also includes:

- An *educator-led demonstration* that will show you how the *Amazon S3 versioning* feature works.
- An *educator-led demonstration* that will show you how to configure *Amazon S3 Transfer Acceleration*.
- A *hands-on guided lab*, where detailed step-by-step instructions explain how to *create an Amazon S3 bucket and configure it to host a simple website*.
- A *hands-on challenge lab* where you will *deploy a static website to support the café scenario*. You will be provided with limited guidance because the tasks that are involved closely mirror the guided lab activity that you completed earlier in the module.

Finally, you will be asked to complete a *knowledge check* that will test your understanding of key concepts covered in this module.

Module objectives



At the end of this module, you should be able to:

- Recognize the problems that Amazon Simple Storage Service (Amazon S3) can solve
- Describe how to store content efficiently using Amazon S3
- Recognize the various Amazon S3 storage classes and cost considerations
- Describe how to move data to and from Amazon S3
- Describe how to choose a Region
- Create a static website

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At the end of this module, you should be able to:

- Recognize the problems that Amazon Simple Storage Service (Amazon S3) can solve
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- Describe how to move data to and from Amazon S3
- Describe how to choose a Region
- Create a static website

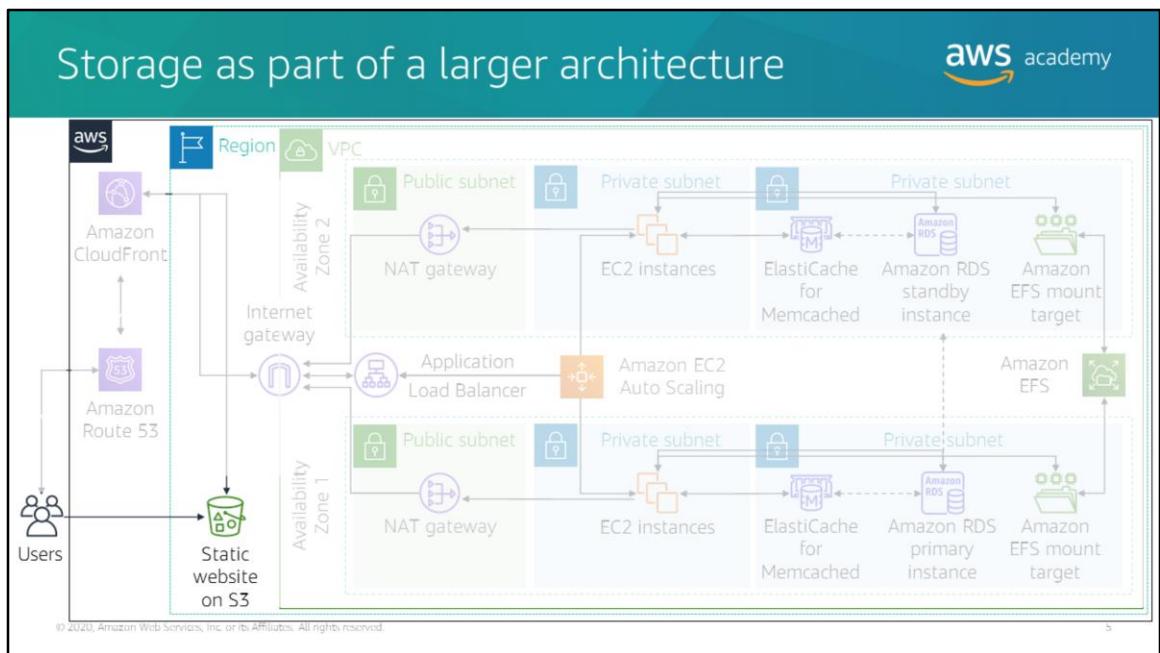
Module 3: Adding a Storage Layer

Section 1: The simplest architecture

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Introducing Section 1: The simplest architecture.



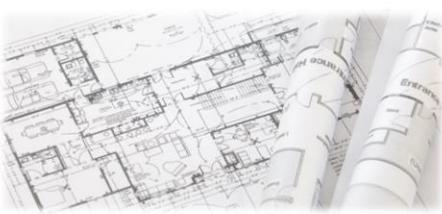
As each module introduces new features, those parts of this larger diagram will be revealed.

In this module, you start with one of the simplest of architectures that can be implemented on AWS, which is creating a static website by hosting it entirely on Amazon S3. You will also learn about the various Amazon S3 storage options and some key considerations for when you choose a Region on AWS.

Café business requirement



The café has just started up. They want to establish a simple static website that provides customers with basic information about the café (including a menu, store hours, location, and more).



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The café has a single location in a large city, where they sell desserts and coffee. The business is owned by Frank and Martha, a husband-and-wife team who work at the café. Their daughter, Sofía, and their other employee, Nikhil—who is a secondary school student—also work at the café.

The café currently doesn't have a marketing strategy. They mostly gain new customers when someone walks by, notices the café, and decides to give it a try. The café has a reputation for high-quality desserts and coffees, but their reputation is limited to people who have visited, or who have heard about them from their customers.

Sofía suggested that they should expand community awareness of what the cafe has to offer. Frank and Martha agreed. The café doesn't have a web presence yet, and they don't currently use any cloud computing services. However, that situation is about to change. The first challenge will be to create a basic website for the café.

You will learn more details about the business requirements—and how to use Amazon Web Services to meet those business requirements—throughout this module.

Module 3: Adding a Storage Layer

Section 2: Using Amazon S3

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Introducing Section 2: Using Amazon S3.

Amazon S3

An **object** storage service:

- It stores massive (unlimited) amounts of unstructured data
- Data files are stored as objects in a **bucket** that you define
- 5 TB is the maximum file size of a single object
- All objects have a REST-accessible globally unique URL (universal namespace)
- All objects have a **key**, **version ID**, **value**, **metadata**, and **subresources**

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Amazon S3 is an *object storage* service. It enables you to store virtually unlimited amounts of data. Data files are stored as objects. You place objects in a bucket, which you define. Every bucket must have name that is globally unique across Regions. This means that the bucket name must be unique across all AWS customer accounts.

The objects you store can vary in size from 0 bytes to 5 TB. Though individual objects cannot be larger than 5 TB, you can store as much total data as you need.

Each object has five consistent characteristics.

First, it has a *key*, which is the name that you assign to an object. You use the object key to retrieve the object. In the AWS Management Console, you can create a directory inside a bucket, and upload an object to that directory. However, in reality, Amazon S3 does not know about directories, so the key value includes the full path relative to the bucket root.

Objects also include a *version ID*. In a bucket, a key and version ID uniquely identify an object. You will learn more about versioning later in this module.

The *value* of the object is the actual content that you store. It can be any sequence of bytes. Object values are immutable, which means that after you upload an object, you cannot modify the value. If you want to modify the object, you must make a change outside of Amazon S3 and then reupload the object.

Objects also include *metadata*, which is a set of name-value pairs you can use to store information about the object. You can assign metadata, which is referred to as *user-defined metadata*, to your objects in Amazon S3. Amazon S3 also assigns *system-metadata* to these objects, which it uses for managing objects.

Finally, Amazon S3 also uses *subresources* to store additional object-specific information.

Amazon S3 benefits



Durability



- It ensures data is not lost
- S3 Standard storage provides 11 9s (or 99.99999999%) of durability

Availability



- You can access your data when needed
- S3 Standard storage class is designed for four 9s (or 99.99%) availability

Scalability



- It offers virtually unlimited capacity
- Any single object of 5 TB or less

Security



- It offers fine-grained access control

Performance



- It is supported by many design patterns

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Amazon S3 provides many features that make it an important component of many solutions built on AWS.

First, it provides *durability*, which describes the average annual expected loss of objects. 11 9s of durability means that every year, there is a 0.000000001 percent chance of losing an object. For example, if you store 10,000 objects on Amazon S3, you can expect to incur a loss of a single object once every 10,000,000 years on average. Amazon S3 redundantly stores your objects on multiple devices across multiple facilities in the Amazon S3 Region you designate. Amazon S3 is designed to sustain concurrent device failures by quickly detecting and repairing any lost redundancy. Amazon S3 also regularly verifies the integrity of your data by using checksums.

Amazon S3 also provides four 9s (or 99.99 percent) of *availability*. Availability refers to your ability to access your data quickly, when you want it. It also provides a virtually unlimited capacity to store your data, so it is *scalable*. Amazon S3 has robust *security* settings. It provides many ways to control access to the data that you store, and also enables you to encrypt your data.

Finally, Amazon S3 is *highly performant*, with a first-byte latency that is measured in milliseconds for most storage classes. For more information about [S3 performance design](#)

[patterns](#), see the Amazon S3 Documentation. Common approaches include using caching for frequently accessed content; configurable retry and timeout logic for objects that receive significant request traffic in a short period of time; and horizontal scaling and request parallelization for high throughput across the network.

Amazon S3 common usage patterns



Amazon S3



What problems can you solve by using Amazon S3?
You will now consider some [use cases](#).

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Now that you know about many Amazon S3 features, how can you use these features to address your needs?

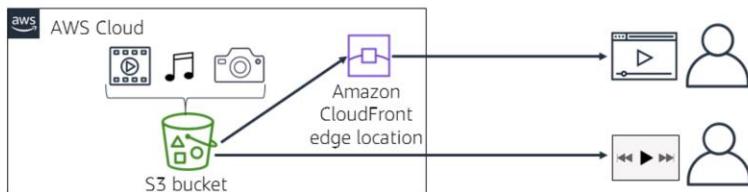
In this section of the module, you will learn about four common use cases that use Amazon S3 as an essential part of a robust architectural solution.

Amazon S3 use case 1: Store and distribute web content and media

Build a redundant, scalable, and highly available infrastructure that hosts video, photo, or music uploads and downloads.

 <https://<bucket-name>.s3.amazonaws.com>

 <https://<bucket-name>.s3.amazonaws.com/video.mp4>



The diagram illustrates the architecture for storing and distributing media content. In the AWS Cloud, there is an S3 bucket containing various media objects (represented by icons of a video camera, a musical note, and a camera). These objects are also processed by other services like Lambda. An arrow points from the S3 bucket to an "Amazon CloudFront edge location". From this edge location, two separate arrows point to two user devices. One device shows a video player interface, and the other shows a photo viewer interface, indicating that the content is being delivered directly from the S3 bucket via CloudFront.

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One common use scenario for Amazon S3 is to use it for *media hosting*. In this use case, Amazon S3 is used to store and distribute videos, photos, music files, and other media. This content can be delivered directly from Amazon S3 because each object in Amazon S3 has a unique HTTP URL.

Alternatively, Amazon S3 can serve as an origin store for a content delivery network (CDN), such as *Amazon CloudFront*. The elasticity of Amazon S3 makes it well-suited for hosting web content that needs bandwidth to address extreme demand spikes. Also, because you do not need to provision storage for Amazon S3, it works well for fast growing websites that host data-intensive, user-generated content, such as video and photo-sharing sites.

Securing Amazon S3 buckets and objects



- Newly created S3 buckets and objects are **private** and **protected** by default
- When use cases must share Amazon S3 data –
 - Manage and control the data access
 - Follow the **principle of least privilege**
- Tools and options for controlling access to Amazon S3 data –
 - [Block Public Access](#): It is enabled on new buckets by default, simple to manage
 - [IAM policies](#): A good option when the user can authenticate using IAM
 - [Bucket policies](#): You can define access to a specific object or bucket
 - [Access control lists \(ACLs\)](#): A legacy access control mechanism
 - [S3 Access Points](#): You can configure access with names and permissions specific to each application
 - [Presigned URLs](#): You can grant time-limited access to others with temporary URLs
 - [AWS Trusted Advisor](#): bucket permission check: A free feature



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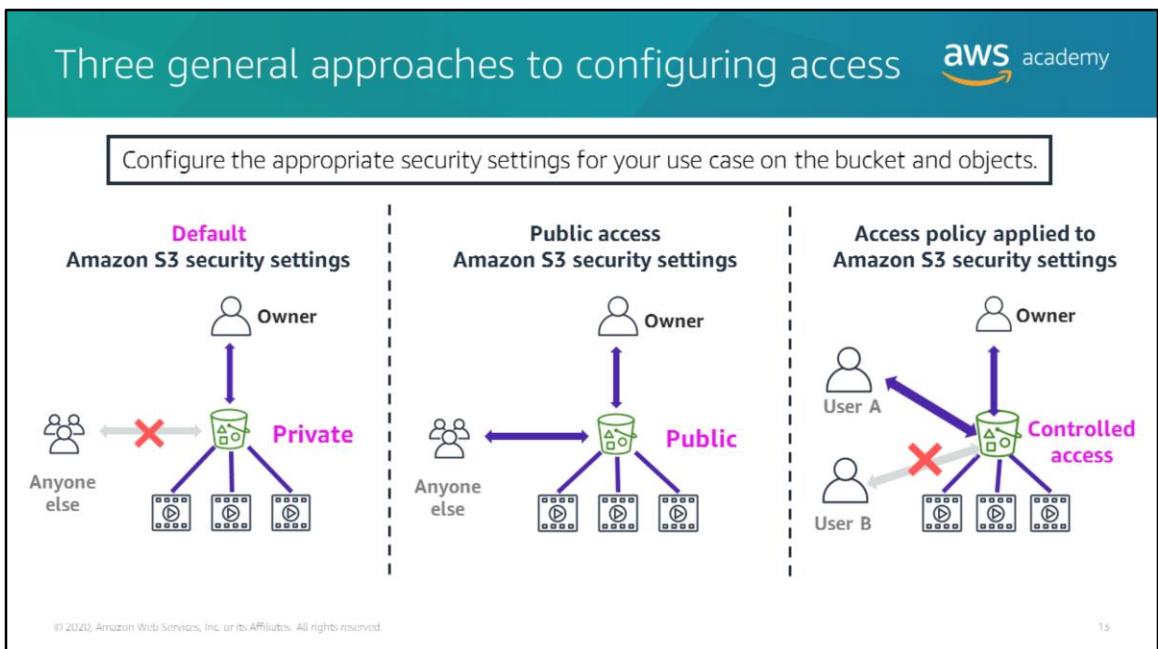
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By default, all S3 buckets are private and can be accessed *only* by users who are explicitly granted access. It is essential that you manage and control access to Amazon S3 data. AWS provides many tools and options for controlling access to your S3 buckets or objects, such as:

- Using *Amazon S3 Block Public Access*. These settings override any other policies or object permissions. Enable *Block Public Access* for all buckets that you don't want to be publicly accessible. This feature provides a straightforward method for avoiding unintended exposure of Amazon S3 data.
- Writing *AWS Identity and Access Management (IAM) policies* that specify the users or roles that can access specific buckets and objects.
- Writing *bucket policies* that define access to specific buckets or objects. This option is typically used when the user or system cannot authenticate by using IAM. Bucket policies can be configured to grant access across AWS accounts or to grant public or anonymous access to Amazon S3 data. If bucket policies are used, they should be written carefully and tested fully. You can specify a deny statement in a bucket policy to restrict access. Access will be restricted even if the users have permissions that are granted in an identity-based policy that is attached to the users.
- Creating *S3 Access Points*. Access points are unique hostnames that enforce distinct

permissions and network controls for requests that are made through it. Customers with shared datasets can scale access for many applications by creating individualized access points with names and permissions that are customized for each application.

- Setting *access control lists (ACLs)* on your buckets and objects. ACLs are less commonly used (ACLs predate IAM). If you use ACLs, do not set access that is too open or permissive.
- *AWS Trusted Advisor* provides a bucket permission check feature. It is a useful tool for discovering if any of the buckets in your account have permissions that grant global access.



Here are three different general approaches to configuring access to objects in an S3 bucket.

The scenario on the left shows the default security settings for Amazon S3. By default, all Amazon S3 buckets and the objects stored in them are private (*protected*). The only entities with access to a newly created, unmodified bucket are the account administrator and the AWS account root user. The resource owner can grant specific access permissions to others, but anyone not granted those permissions will not have access.

The scenario in the middle shows an occasion where S3 security settings have been disabled and anyone can publicly access the objects stored in the bucket.

Caution! Using an Amazon S3 bucket to host a static website is an example of setting up an AWS architecture quickly. However, for most Amazon S3 use cases, you would not want to grant public access to Amazon S3. *Most use cases do not require public access*. More often, you use Amazon S3 to store data that is used by an application that runs outside of Amazon S3, or to back up sensitive data. For these common use cases, public access to buckets that hold data should never be granted.

The scenario on the right shows a case where Amazon S3 was configured to provide controlled access. User A was granted access to the objects in the bucket, but User B was denied access. Controlled access scenarios are common. They can be configured by the bucket owner by using one or more of the tools or options for controlling access to Amazon S3 data this module discussed earlier.

Consider encrypting objects in Amazon S3

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- **Encryption** encodes data with a *secret key*, which makes it unreadable
 - Only users who have the secret key can decode the data
 - Optionally, use AWS Key Management Service (AWS KMS) to manage secret keys
- *Server-side* encryption
 - On the bucket, enable this feature by selecting the **Default encryption** option
 - Amazon S3 encrypts objects before it saves the objects to disk, and decrypts the objects when you download them
- *Client-side* encryption
 - Encrypt data on the client side and upload the encrypted data to Amazon S3
 - In this case, you manage the encryption process



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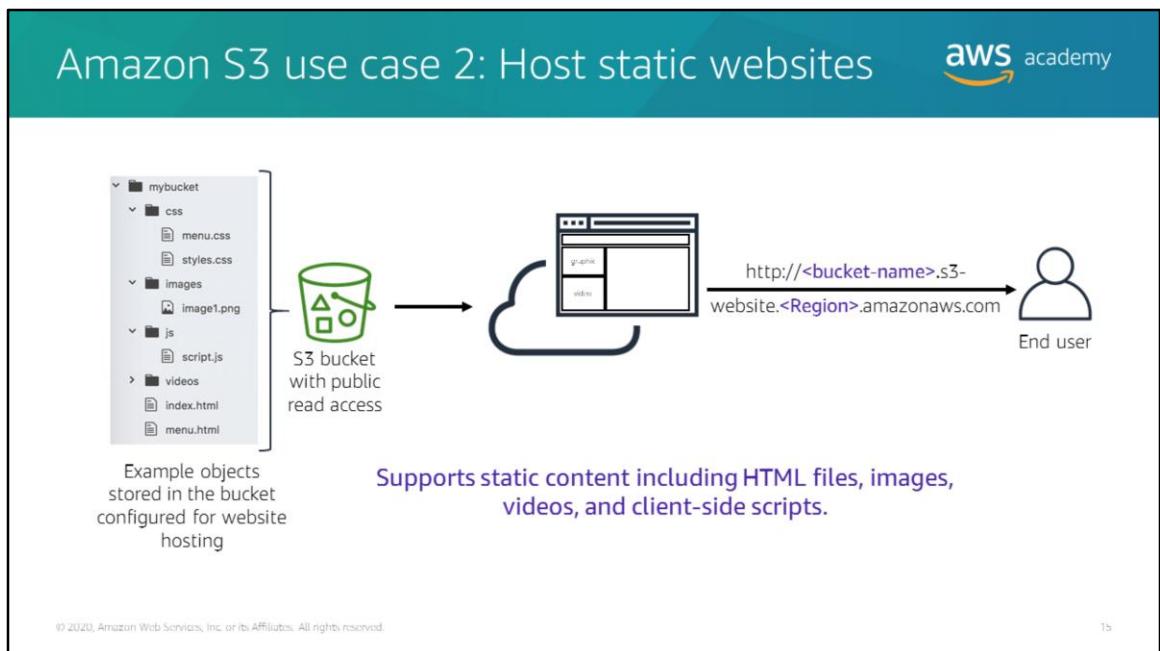
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When your objective is to protect digital data, *data encryption* is an essential tool. Data encryption takes data that is legible and encodes. Encrypted data is unreadable to anyone who does not have access to the secret key that can be used to decode it. Thus, even if an attacker gains access to your data, they cannot make sense of it.

You have two primary options for encrypt data stored in Amazon S3.

When you set the **Default encryption** option on a bucket, it enables *server-side encryption*. With this feature, Amazon S3 encrypts your object before it saves the object to disk. And then Amazon S3 will decrypt it when you download the object.

Client-side encryption is the other option. When you use this approach, you encrypt the data on the client side before you upload it to Amazon S3. In this case, you manage the encryption process, the encryption keys, and related tools. Like server-side encryption, client-side encryption can reduce risk by encrypting the data with a key that is stored in a different mechanism than the mechanism that stores the data itself.



A second Amazon S3 use case is to use the service to host a static website. On a static website, individual webpages include static content. They might also contain client-side scripts.

By contrast, a *dynamic* website relies on server-side processing, which might involve database queries that run in response to server-side scripts, such as PHP, JSP, or ASP.NET. Amazon S3 does not support server-side scripting. However AWS offers other services that enable you to host dynamic websites.

To host a *static* website, configure an S3 bucket for website hosting. Then, upload your website content to the bucket.

The example shows that the static site might consist of HTML files, images, videos, and client-side scripts in formats such as JavaScript.

With this approach, you do not need to run a virtual machine that hosts a web server. In fact, you do not need to run a server. However, you can still host a website. Amazon S3 provides a low-cost solution for web hosting that includes high performance, scalability, and availability.

Amazon S3 best practice: Versioning

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- Protects against accidental overwrites and deletes with no performance penalty
- Generates a new version with every upload
- Enables easy retrieval of deleted objects or rollback to previous versions
- Three possible states of an S3 bucket –
 1. **Default: Versioning not enabled**
 2. Versioning-enabled
 3. Versioning-suspended

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1b

S3 bucket with versioning enabled

Delete Marker\ Current Version

V1

V2

V1 (Restored)

Current Version

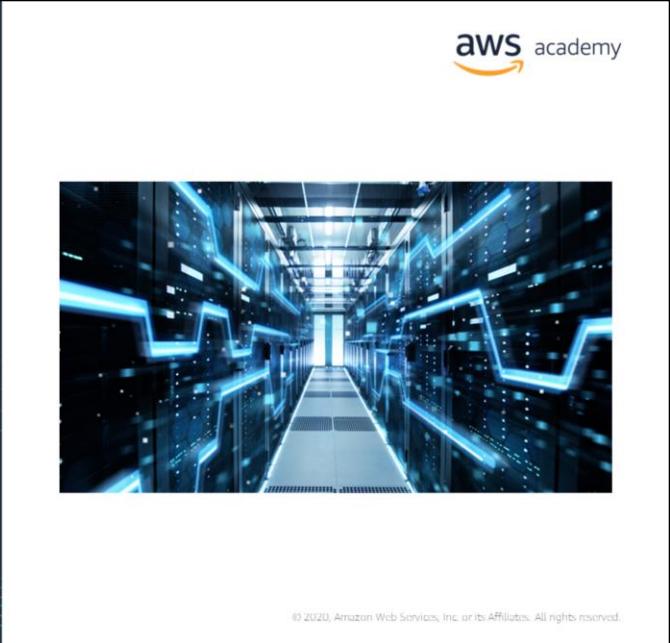
Amazon S3 provides customers with a highly secure and durable storage infrastructure. *Versioning* offers an additional level of protection. It provides a way to recover data if an application fails, or when customers accidentally overwrite or delete objects.

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 an S3 bucket.

- If you delete an object, instead of removing it permanently, Amazon S3 inserts a delete marker, which becomes the current object version. You can always restore the previous version.
- Overwriting an object results in a new object version in the bucket. You can always restore the previous version.

Buckets can be in one of three states: unversioned (the default), versioning-enabled, or versioning-suspended. After you enable versioning for a bucket, you can never change it to an unversioned state. You can, however, suspend versioning on that bucket.

Demonstration:
Amazon S3 Versioning



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Now, the educator might choose to demonstrate Amazon S3 versioning using the AWS Management Console.

Support for Cross-Origin Resource Sharing (CORS)

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The diagram shows a cloud storage layer containing two green buckets. An HTML file and a JavaScript file are served from these buckets. A dashed line labeled 'CORS' connects the JavaScript file to a separate box labeled 'CORS'. This box contains an example of a CORS configuration XML document.

```
<CORSConfiguration>
<CORSRule>
<AllowedOrigin>http://www.example.com</AllowedOrigin>
<AllowedMethod>PUT</AllowedMethod>
<AllowedMethod>POST</AllowedMethod>
<AllowedMethod>DELETE</AllowedMethod>
<AllowedHeader>*</AllowedHeader>
<MaxAgeSeconds>3000</MaxAgeSeconds>
<ExposeHeader>x-amz-server-side-encryption</ExposeHeader>
<ExposeHeader>x-amz-request-id</ExposeHeader>
<ExposeHeader>x-amz-id-2</ExposeHeader>
</CORSRule>
</CORSConfiguration>
```

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Cross-origin resource sharing (CORS) defines a way for client web applications that are loaded in one domain to interact with resources in a different domain. With CORS support, you can build rich client-side web applications with Amazon S3 and selectively allow cross-origin access to your Amazon S3 resources.

To configure your bucket to allow cross-origin requests, you create a CORS configuration. A CORS configuration is an XML document with rules that identify:

- The origins that you will allow to access your bucket.
- The operations (HTTP methods) that will support for each origin. In this example, PUT, POST, and DELETE requests are allowed from the `http://www.example.com` origin, which could be configured using Amazon Route 53 to be another S3 bucket.
- Other operation-specific information.

For more information about CORS, see the [Cross-Origin Resource Sharing \(CORS\)](#) AWS documentation.

Module 3 - Guided Lab: Hosting a Static Website

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You will now complete Module 3 – Guided Lab: Hosting a Static Website.

Guided lab: Tasks



1. Create a bucket in Amazon S3
2. Upload content to your bucket
3. Enable access to the objects
4. Update the website

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In this guided lab, you will complete the following tasks:

1. Create a bucket in Amazon S3
2. Upload content to your bucket
3. Enable access to the objects
4. Update the website



A clock icon with the text "~ 20 minutes" indicates the duration of the lab.

The AWS Academy logo is in the top right corner.

**Begin Module 3 -
Guided Lab: Hosting a
Static Website**

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It is now time to start the guided lab.

Guided lab debrief: Key takeaways

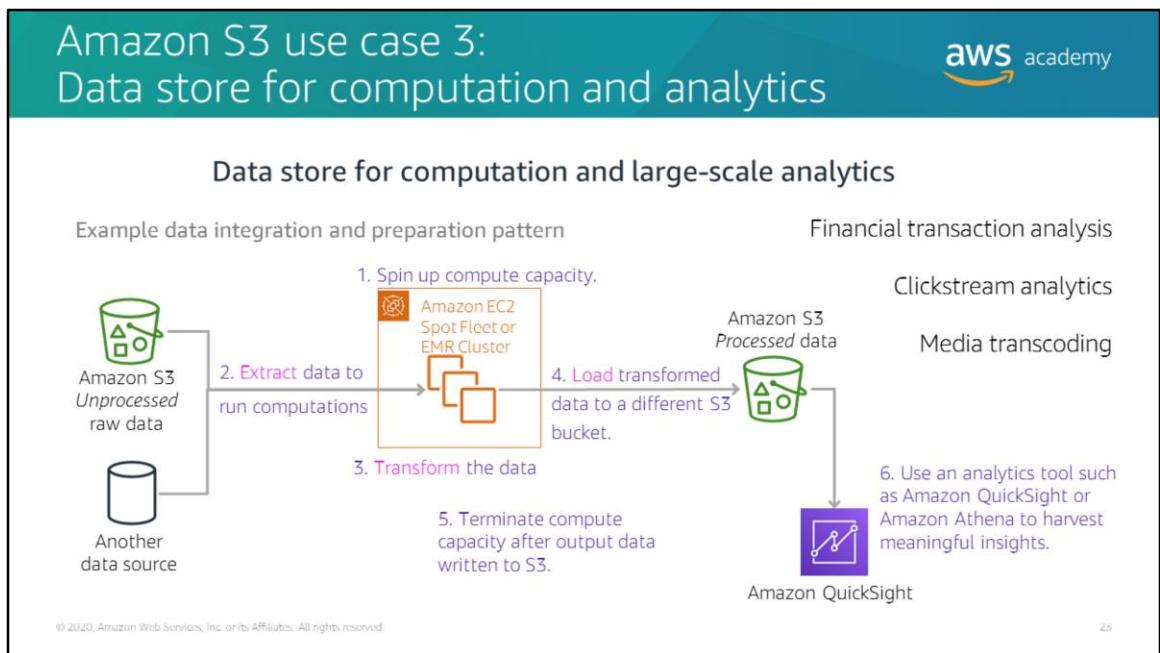


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Your educator might choose to lead a conversation about the key takeaways from this guided lab after you have completed it.



You can also use Amazon S3 as a data store for computation or large-scale analytics, such as financial transaction analysis, clickstream analytics, and media transcoding. Amazon S3 can support these workloads because of its horizontal scaling ability, which enables multiple concurrent transactions.

In the example here, an Amazon Elastic Compute Cloud (Amazon EC2) Spot Fleet is spun up when the bid price for Spot Instances is low, or when an Amazon EMR cluster is spun up. Regardless, after the compute capacity is available, *raw unprocessed* data is extracted from Amazon S3 and also from another data source. The data is run through compute algorithms that integrate and transform it. The resulting *processed* data is loaded into a different Amazon S3 bucket. Now that the data has been processed, the compute capacity is terminated to save on costs. Finally, an analytics tool, such as Amazon QuickSight, might be used to harvest meaningful insights from the processed data. This is just one example scenario of how Amazon S3 can play an essential role for data storage in a large-scale analytics solutions architecture.

Amazon S3 use case 4: Back up and archive critical data

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Amazon S3 as a data backup solution

The diagram illustrates the use of Amazon S3 as a data backup solution. It features two main boxes: 'Corporate data center' on the left and 'AWS Cloud' on the right. Inside the 'Corporate data center' box is an icon representing server racks. Inside the 'AWS Cloud' box are icons for 'AWS Cloud' (with the AWS logo), 'Amazon EC2 servers' (represented by three orange squares), and 'Amazon S3' (represented by a green bucket). Arrows point from both the server racks and the EC2 servers to the Amazon S3 bucket, indicating the flow of data from on-premises and cloud-based sources to the storage layer.

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In the fourth and final use case discussed in this module, Amazon S3 is used as a data backup solution. Because of its highly durable and scalable nature, Amazon S3 works well as a data backup and archival tool.

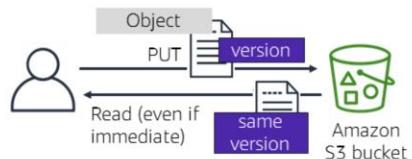
In the scenario, data is backed up from an on-premises corporate data center, and also from a large number of Amazon EC2 servers. These servers run applications that generate data.

Additionally, you can move long-term data from Amazon S3 standard storage to Amazon Simple Storage Service Glacier. This process will be discussed in further detail later in this module. Another Amazon S3 option you can configure on your buckets—to achieve even higher levels of durability—is *cross-Region replication*. In cross-Region replication, objects that are uploaded to a bucket in one Region will be automatically copied to other S3 buckets in other Regions.

Amazon S3 data consistency model



- Amazon S3 is **strongly consistent** for all new and existing *objects* in all Regions
 - Provides **read-after-write consistency** for all **GET**, **LIST**, and **PUT** operations on objects in S3 buckets
 - The consistency model offers an advantage for big data workloads
- Bucket configurations have an eventually consistent model



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Many customers develop big data analytics applications that use Amazon S3 for object storage. These applications often require access to an object immediately after a write. Prior to December, 2020, Amazon S3 provided eventual consistency for overwrite PUTS and DELETES in all Regions. However, Amazon S3 is now *strongly consistent* for all new and existing S3 objects in all AWS Regions.

Amazon S3 achieves high availability by replicating data across multiple servers within AWS data centers. If a PUT request is successful, the data is safely stored. Any read (GET or LIST) that is initiated following a successful PUT response will return the data written by the PUT. This strong read-after-write consistency exists automatically for all applications, without changes to performance or availability.

Strong consistency simplifies the migration of on-premises analytics workloads by removing the need to make changes to support applications. It also removes the need for extra infrastructure, such as S3Guard, to provide strong consistency.

While objects are strongly consistent, Amazon S3 *bucket configurations* have an *eventual consistency* model. For example, if you delete a bucket and immediately list all buckets, the deleted bucket might still appear in the list. However, within a short period of time, if you run the list bucket command again, the deleted bucket will no longer appear in the list buckets results.

For more details, read the [Amazon S3 strong consistency](#) documentation.

Section 2 key takeaways



The image shows a large, antique-style key lying on a teal-colored wooden surface. A small white rectangular tag is tied to the handle of the key with a string. The tag has the word "Takeaway" written on it in a black, cursive font. The background is a dark teal color with some geometric patterns at the bottom.

- Buckets must have a **globally unique name** and are defined at the Region level
- Buckets are **private** and protected by default
- Amazon S3 security can be configured with IAM policies, bucket policies, access control lists, S3 access points, and presigned URLs
- Amazon S3 is **strongly consistent** for all new and existing objects in all Regions
- **5 TB** is the maximum size of a single object
- Amazon S3 is often used as a data store for computation and analytics, and as a backup and archive service for critical data

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Some key takeaways from this section of the module include:

- Buckets must have a globally unique name and are defined at the Region level
- Buckets are private and protected by default
- Amazon S3 security can be configured with IAM policies, bucket policies, access control lists, S3 access points, and presigned URLs
- Amazon S3 is **strongly consistent** for all new and existing objects in all Regions
- 5 TB is the maximum size of a single object, but you can store a virtually unlimited number of objects
- Amazon S3 is often used as a data store for computation and analytics, and as a backup and archive service for critical data

Module 3: Adding a Storage Layer

Section 3: Storing data in Amazon S3

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Introducing Section 3: Storing data in Amazon S3.

Amazon S3 and Amazon S3 Glacier storage classes

S3 Standard:
Frequently accessed data

S3 Standard IA:
Long-lived, infrequently accessed data

S3 One Zone IA:
Long-lived, infrequently accessed, non-critical data

Amazon S3 Glacier or Deep Archive:
Archiving rarely accessed data

Amazon S3 Intelligent Tiering
Automatically moves your objects between storage classes based on data access patterns.

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[Amazon S3 Storage Class details](#)

Now that you have built a website using Amazon S3, here is a comparison of the different Amazon S3 storage classes and their characteristics.

S3 Standard offers high durability, availability, and performant object storage *for frequently accessed data*. Because it delivers low latency and high throughput, S3 Standard is appropriate for a wide variety of use cases, including cloud applications, dynamic websites, content distribution, mobile and gaming applications, and big data analytics. It provides durability across at least three Availability Zones.

S3 Standard-Infrequent Access (S3 Standard-IA) offers all the benefits of Amazon S3 Standard, but it runs on a different cost model to store infrequently accessed data, such as older digital images or older log files. There is a 30-day minimum storage fee applied to any data placed in it, and also a higher cost to retrieve data from S3 Standard-IA than from S3 Standard storage.

S3 One Zone-IA stores data in a single Availability Zone. It is ideal for customers who want a lower-cost option and who do not need the availability and resilience of S3 Standard or S3 Standard-IA. It's a good choice for storing secondary backup copies of on-premises data or easily re-creatable data. You can also use it as cost-effective storage for data that is replicated from another AWS Region.

S3 Intelligent-Tiering is designed to *optimize costs by automatically moving data to the most cost-effective access tier*, without performance impact or operational overhead. For a small monthly monitoring and automation fee per object, Amazon S3 monitors access patterns of the objects in S3 Intelligent-Tiering. It moves objects that have not been accessed for 30 consecutive days to the infrequent access tier. If an object in the infrequent access tier is accessed, it is automatically moved back to the frequent access tier. There are no retrieval fees when using S3 Intelligent-Tiering and no additional tiering fees when objects are moved between tiers.

Amazon S3 Glacier is a secure, durable, and low-cost storage class for data archiving. You can

reliably store any amount of data at costs that are competitive with or cheaper than on-premises solutions. To keep costs low, but suitable for different needs, you have three options for retrieving data, with varying access times and cost:

- *Expedited* retrievals are typically made available within 1–5 minutes
- *Standard* retrievals typically complete within 3–5 hours
- *Bulk* retrievals typically complete within 5–12 hours

Amazon S3 Glacier Deep Archive is the lowest-cost storage class for Amazon S3. It supports the long-term retention and digital preservation for data that might be accessed once or twice in a year. Data is stored across at least three geographically dispersed Availability Zones, protected by 11 9s (99.99999999 percent) of durability, and can be restored within 12 hours.

For more details about [Amazon S3 Storage Classes](#), see the AWS Documentation.

Amazon S3 lifecycle policies

Configure an [Amazon S3 Lifecycle Policy](#) to delete or move objects based on age.

The diagram illustrates the object's lifecycle through three stages:

- Amazon S3 Standard:** Contains a video icon and the file name "video.mp4". A green arrow labeled "30 days" points to the next stage.
- Amazon S3 Standard-IA:** Contains a video icon and the file name "video.mp4". A green arrow labeled "60 days" points to the next stage.
- Amazon S3 Glacier:** Contains a video icon and the file name "video.mp4". A green arrow labeled "365 days" points to a trash can icon, indicating the final step is "Delete".

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You can configure the lifecycle of your objects to manage how they are stored throughout their lifecycle. A **lifecycle configuration** is a set of rules that define actions that Amazon S3 applies to a group of objects.

After an S3 lifecycle policy is set, *your data will automatically transfer to a different storage class* without any changes to your application.

By using lifecycle policies, you can cycle data at regular intervals among different Amazon S3 storage types. This cycling reduces your overall cost because you pay less for data as it becomes less important over time. In addition to being able to set lifecycle rules per object, you can also set lifecycle rules per bucket.

For more information about object lifecycle management, see the [Object Lifecycle Management](#) AWS documentation details.

Amazon S3 costs



No charge for:

Pay only for use, including:

GBs of objects stored (per month). Different pricing per *Region* and per *storage class*.

Transfer OUT to other Regions or the internet.

PUT, COPY, POST, LIST, GET, SELECT, lifecycle transition, data retrieval requests.

Data transfers IN from the internet to Amazon S3.

Transfers between S3 buckets or from Amazon S3 to any services in the same AWS Region.

Transfer OUT to Amazon CloudFront.

DELETE and CANCEL requests.

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With Amazon S3, you pay only for what you use. There is no minimum fee. There are four cost components to consider when you decide which Amazon S3 storage class best fits your data profile—storage pricing, request and data retrieval pricing, data transfer and transfer acceleration pricing, and data management features pricing.

Details about Amazon S3 pricing can be found at [Amazon S3 Pricing](#).

Section 3 key takeaways



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- Amazon S3 storage classes include –
 - S3 Standard
 - S3 Standard-IA
 - S3 One Zone-IA
 - S3 Intelligent-Tiering
 - S3 Glacier
 - S3 Glacier Deep Archive
- An Amazon S3 lifecycle policy can delete or move objects to less expensive storage classes based on age
- Transferring data in from the internet to Amazon S3 is free, but transferring out to other Regions or to the internet incurs a fee

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Some key takeaways from this section of the module include:

- Amazon S3 storage classes include – S3 standard, S3 standard-Infrequent Access, S3 One Zone-Infrequent Access, S3 intelligent-Tiering, S3 Glacier, and S3 Glacier Deep Archive
- An Amazon S3 lifecycle policy can delete or move objects to less expensive storage classes based on age
- Transferring data in from the internet to Amazon S3 is free, but transferring out to other Regions or to the internet incurs a fee

Module 3: Adding a Storage Layer

Section 4: Moving data to and from Amazon S3

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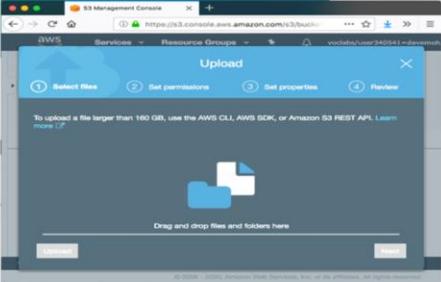
Introducing Section 4: Moving data to and from Amazon S3.

Moving objects to Amazon S3

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 AWS Management Console

Upload or download by using a browser.



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 AWS Command Line Interface

Upload or download from a terminal command prompt or in a call from a script.

- Example upload command:
`$ aws s3 cp test.txt \s3://AWSDOC-EXAMPLE-BUCKET/test.txt`

 AWS Tools and SDKs

Move objects programmatically by using AWS tools or SDKs.

5.5

In the guided lab earlier in this module, you uploaded files to Amazon S3 by using the web browser interface provided by the AWS Management Console. It is the simplest way to move data in to or out of Amazon S3. It offers a wizard-based approach, including the option to drag and drop files that you want to copy into a bucket.

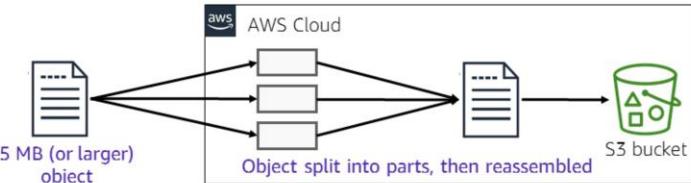
In this section of the module, you will learn about some additional options available for moving data into and out of Amazon S3.

Two of those options include using the AWS Command Line Interface (AWS CLI) or the AWS SDKs.

An example AWS CLI upload command is shown. In the command, you specify `aws` to invoke the AWS CLI, then you specify the service, which is `S3`. Next, you issue a `cp` (or `copy`) subcommand, followed by `test.txt` which is the local file (that exists on your computer) that should be copied. Finally, the `s3://AWSDOC-EXAMPLE-BUCKET/test.txt` parameter indicates the bucket where the file should be uploaded, and the key (`AWSDOC-EXAMPLE-BUCKET/test.txt`) where the object value (contents) should be stored.

The [S3 AWS CLI Command Reference](#) provides further details.

Multipart upload



The diagram illustrates the Multipart upload process. A large document icon labeled "5 MB (or larger) object" is shown being uploaded to the AWS Cloud. Inside the cloud, the object is split into three smaller rectangular parts. These parts are then reassembled into a new document icon, which is then stored in an S3 bucket represented by a green container icon.

- Files can be uploaded by using the Multipart Upload API
 - You can upload a single object as a set of parts
 - Each part is a contiguous portion of the object's data
 - After all parts of your object are uploaded, Amazon S3 assembles these parts and creates the object
- Typically only used for files larger than 100 MB
- Advantages –
 - Quick recovery from network issues: If transmission of any part fails, only need to retransmit that part
 - Ability to pause and resume object uploads
 - Improved throughput: Upload parts in parallel to improve throughput

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The Multipart Upload API enables you to consistently upload large objects in manageable parts. Benefits include:

- *Improved throughput* – You can upload parts in parallel to improve throughput.
- *Quick recovery from any network issues* – Smaller part sizes minimize the impact of restarting a failed upload due to a network error.
- *Ability to pause and resume object uploads* – You can upload object parts over time. After you initiate a multipart upload, there is no expiration. You must explicitly complete or stop the multipart upload.
- *Ability to begin an upload before you know the final object size* – You can upload an object as you are creating it.
- *Ability to upload large objects* – By using the multipart upload API, you can upload large objects, up to 5 TB.

Note that files must be at least 5 MB in size to use the multipart upload feature.

Amazon S3 Transfer Acceleration

The diagram illustrates the difference between Standard S3 upload and S3 Transfer Acceleration. In the 'Standard S3 upload' section, a document icon labeled 'Any file types' is shown being uploaded via 'Internet' to an 'S3 bucket' represented by a green bucket icon with a white triangle. In the 'versus' section, under 'S3 Transfer Acceleration', the same document icon is shown being uploaded via 'Internet' to a 'CloudFront edge location' (represented by a purple square icon), which then routes the data to the 'S3 bucket'. The AWS academy logo is in the top right corner.

- Accelerates Amazon S3 data transfers
- Uses optimized network protocols and the AWS edge infrastructure
- Typical speed improvement:
 - 50–500% for cross-country transfer of larger objects
 - Can go even higher under certain conditions
- [Amazon S3 Transfer Acceleration Speed Comparison Tool](#)
 - Shows speed advantage gained (by Region)

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Amazon S3 Transfer Acceleration enables fast and easy data transfer into an S3 bucket by taking advantage of Amazon CloudFront and AWS edge locations, which are globally distributed. This data is then routed to Amazon S3 over an optimized network path.

Use Transfer Acceleration when:

- You have customers all around the world who upload to a centralized bucket
- You transfer gigabytes or terabytes of data across continents on a regular basis
- You underutilize the available bandwidth when you upload files to Amazon S3 over the internet

Demonstration:
S3 Transfer
Acceleration



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Now, the educator might choose to demonstrate the S3 Transfer Acceleration tool.

Moving large amounts of data into Amazon S3: AWS Snowball



AWS Snowball

Petabyte-scale data transport

- Can transport multiple terabytes of data into or out of Amazon S3
 - Multiple devices can be used to transfer petabytes
- Addresses concerns of large data transfers (network costs, transfer times, security)
 - *Example:* To transfer 10 petabytes (10 million GB) over the internet with a 10 Gbps upload speed would take over 100 days
- To use –
 - Create a job in the AWS Management Console and a Snowball will be shipped to you.
 - Attach to your local network, then download and run the Snowball Client
 - Select the file directories to transfer (encrypted) to the device
 - Ship the device back and track the status

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AWS Snowball is a petabyte-scale data transport option that doesn't require you to write any code or purchase any hardware to transfer your data. All you need to do is create a job in the AWS Management Console, and a Snowball appliance will be shipped to you. Attach the appliance to your local network and transfer files directly onto it. Then, ship it back and track the status of your shipment. When it arrives at the secure Amazon facility, the data will be transferred into your AWS account.

Moving large amounts of data into Amazon S3: AWS Snowmobile





AWS
Snowmobile



AWS Snowmobile
Exabyte-scale data transport

- A 45-foot-long (13.7 meters) shipping container, pulled by a semi-trailer truck
- Can transfer up to 100 PB per Snowmobile
- Offers multiple layers of security –
 - Dedicated security personnel
 - GPS tracking, alarm monitoring, 24/7 video surveillance
 - Optional escort security vehicle while in transit
 - Data encrypted with 256-bit encryption keys

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AWS Snowmobile is an even larger data transfer option that operates in exabyte scale. An exabyte is 1 million terabytes or 1 billion gigabytes. It should only be used to move extremely large amounts of data into AWS. A Snowmobile is a 45-foot-long (13.7 meters) ruggedized shipping container that is pulled by a semi-trailer truck. You can transfer 100 PB per Snowmobile.

If you tried to transfer 100 petabytes of data over the internet, with an upload speed of 10 Gbps (assuming a TCP/IP overhead of 10%), it would take approximately 1018 days (almost three years) to finish uploading the data. That would not be practical. In such cases, using AWS Snowmobile to transfer the data would be a better option.

Snowmobile uses multiple layers of security designed to protect your data, including dedicated security personnel, GPS tracking, alarm monitoring, 24/7 video surveillance, and an optional escort security vehicle while in transit. All data is encrypted with 256-bit encryption keys managed through AWS Key Management Service (AWS KMS) and designed to ensure both security and full chain-of-custody of your data.

Section 4 key takeaways



The slide features a large, ornate key resting on a teal-colored wooden background. A white rectangular tag is tied to the key's handle, with the word "Takeaway" written in a black, cursive font. The overall aesthetic is clean and professional, with a dark blue header and footer.

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- The **S3 multipart upload** option is a good option for files larger than 100 MB and in situations where network connectivity might be inconsistent
- **Amazon S3 Transfer Acceleration** uses edge locations and can significantly increase the speed of uploads
- **AWS Snowball** provides a way to transfer *petabytes* of data, and **AWS Snowmobile** provides a way to transfer *exabytes* of data to AWS

Some key takeaways from this section of the module include:

- The S3 multipart upload option is a good option for files larger than 100 MB and in situations where network connectivity might be inconsistent
- Amazon S3 Transfer Acceleration uses edge locations, and can significantly increase the speed of uploads
- AWS Snowball provides a way to transfer petabytes of data, and AWS Snowmobile provides a way to transfer exabytes of data to AWS

Module 3: Adding a Storage Layer

Section 5: Choosing Regions for your architecture

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Introducing Section 5: Choosing Regions for your architecture.

Choosing a Region: Compliance and latency considerations



- Data residency and regulatory compliance
 - Are there relevant Region **data privacy laws**?
 - Can customer data be stored **outside the country**?
 - Can you meet your **governance** obligation?
- Proximity of users to data
 - Small differences in **latency** can impact customer experience
 - Choose the Region closest to your users

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There are many considerations when you decide what Region to host your data in.

First, you should consider *data privacy laws* and your regulatory compliance requirements. Data you store on AWS is subject to the laws of the country and locality where it is stored. In addition, some laws dictate that if you are operating your business in their jurisdiction, you cannot store that data anywhere else. Similarly, *compliance* standards (such as the U.S. Health Insurance Portability and Accountability Act, or HIPAA) have strict guidelines on how and where data can be stored.

Second, *proximity* is an important factor in choosing your Region, especially when *latency* is a critical factor. In most cases, the latency difference between using the closest Region and the farthest Region is relatively small, but even small differences in latency can impact customer experience. Customers expect responsive environments, and as time passes and technology becomes more and more powerful, those expectations also rise.

Choosing a Region: Service availability and cost considerations



- Service and feature availability
 - Not all AWS services are available in all Regions
 - Consult the [AWS Region Table](#) for details
 - Services expand to new Regions regularly
 - Can use some services cross-Region, but at increased latency
- Cost-effectiveness
 - Costs vary by Region
 - Some services like Amazon S3 have costs for transferring data out
 - Consider the cost-effectiveness of replicating the entire environment in another Region



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When you choose a Region, a third important consideration is the *availability of AWS services and features*. Though AWS strives to make services and features available everywhere, the complications that arise from having a global reach make it challenging to accomplish that goal. Instead of waiting until a service is available everywhere before launching it, services are released when they are ready. Service availability is then expanded as soon as possible.

A fourth consideration when you choose a Region is *cost*. Service costs can differ depending on which Region they are used in. For example, an Amazon EC2 instance in the us-east-1 Region might not cost the same as if it ran in the eu-west-1 Region. Typically, the difference in cost might not be enough to supersede the other three considerations. However, in cases where the latency, compliance, and service availability differences between Regions are minimal, you might be able to save by using the lower-cost Region for your environment.

Finally, in circumstances where your customers are in different areas of the world, consider optimizing their experience by replicating your environment in multiple Regions that are closer to them. Because you would then be distributing your load across multiple environments, your costs for components in each environment might go down even as you add more infrastructure. For example, adding a second application environment might allow you to cut your processing and storage capacity requirements in half in each environment. Because AWS is designed to enable that kind of flexibility, and because you only pay for what you use, you could scale your existing environment down as a way to mitigate the cost of adding another environment.

The downside to that approach is that you now have two environments to manage. Also, not all of your components will scale down enough to mitigate all the costs of the new components. Additionally, you might need to maintain one single storage source of truth in one Region, such as a primary Amazon Relational Database Service (Amazon RDS) instance. Your secondary Region would need to communicate with the storage instance, which might increase latency and cost for those operations.

Module 3 – Challenge Lab:
Creating a Static Website
for the Café

The slide features a dark blue background with a teal geometric pattern at the bottom left. The title 'Module 3 – Challenge Lab: Creating a Static Website for the Café' is centered. In the top right corner is the AWS Academy logo. Below the title is a wireframe diagram of a homepage layout labeled 'HOMEPAGE'. It includes sections for 'LOGO', 'IMAGE BANNER', 'NAVIGATION', 'CONTENT', 'NEWS', and 'FOOTER'. To the right of this is a hand-drawn wireframe of a mobile device screen. A red marker is shown drawing on the screen, with annotations like 'width = 300 px', 'height = 200 px', and '20px'.

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You will now complete Module 3 – Challenge Lab: Creating a Static Website for the Café.

The business need: A simple website



Sofía mentioned to Nikhil that she wants a website that will showcase the café visually through images, and provide customers with business details.



Frank likes the website idea. He has been taking photos that can be used to highlight the café's menu items.

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Sofía mentioned to Nikhil that she would like the café to have a website that will showcase the café visually through images. The website should also provide customers with business details, such as the location of the store, the business hours, and telephone number.

Nikhil is pleased to create the first website for the café. During this activity, you will take on the role of Nikhil and work on producing the results that everyone back at the café hopes you can deliver. Perhaps you can even exceed their expectations!

Challenge lab: Tasks



1. Extracting the files that you need for the lab
2. Creating an S3 bucket to host your static website
3. Uploading content to your S3 bucket
4. Creating a bucket policy to grant public read access
5. Enabling versioning on the S3 bucket
6. Setting lifecycle policies
7. Enable cross-Region replication

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In this challenge lab, you will complete the following tasks:

1. Extracting the files that you need for the lab
2. Creating an S3 bucket to host your static website
3. Uploading content to your S3 bucket
4. Creating a bucket policy to grant public read access
5. Enabling versioning on the S3 bucket
6. Setting lifecycle policies
7. Enable cross-Region replication

Challenge lab: Final product

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http://<bucket-name>.s3-website-<region>.amazonaws.com

The diagram illustrates the final product of a challenge lab. On the left, a laptop screen shows a static website for a café, featuring images of pastries and a descriptive text. The URL in the browser bar is http://<bucket-name>.s3-website-<region>.amazonaws.com. On the right, the AWS Cloud interface is shown with two regions: Region 1 and Region 2. Each region contains an Amazon S3 bucket icon. A double-headed arrow connects the laptop to the Region 1 S3 bucket, indicating the direct connection between the website and the storage layer.

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4b

In this challenge lab, you will create a static website for the café. The website will be hosted on Amazon S3. After the S3 bucket is created and properly configured for website hosting, a web browser should be able access the website directly by using the assigned Amazon S3 endpoint URL.

The screenshot shows a challenge lab landing page. In the top left corner is a timer icon with the text "~ 60 minutes". In the top right corner is the AWS Academy logo. The main title "Begin Module 3 – Challenge Lab: Creating a Static Website for the Café" is centered on the page. Below the title is a large image of a blue ceramic cup filled with coffee, resting on a dark surface next to a wooden scoop containing coffee beans. At the bottom left of the page is a small copyright notice: "© 2020, Amazon Web Services, Inc. or its Affiliates. All rights reserved." At the bottom right is a page number "4 /".

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~ 60 minutes

Begin Module 3 –
Challenge Lab:
Creating a Static
Website for the Café

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4 /

It is now time to start the challenge lab.

Challenge lab debrief: Key takeaways



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Your educator might now choose to lead a conversation about the key takeaways from the challenge lab now after you have completed it.

Module 3: Adding a Storage Layer

Module wrap-up

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It's now time to review the module and wrap up with a knowledge check and discussion of a practice certification exam question.

Module summary



In summary, in this module, you learned how to:

- Recognize the problems that Amazon Simple Storage Service (Amazon S3) can solve
- Describe how to store content efficiently using Amazon S3
- Recognize the various Amazon S3 storage classes and cost considerations
- Describe how to move data to and from Amazon S3
- Describe how to choose a Region
- Create a static website

In summary, in this module, you learned how to:

- Recognize the problems that Amazon Simple Storage Service (Amazon S3) can solve
- Describe how to store content efficiently using Amazon S3
- Recognize the various Amazon S3 storage classes and cost considerations
- Describe how to move data to and from Amazon S3
- Describe how to choose a Region
- Create a static website

Complete the knowledge check



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It is now time to complete the knowledge check for this module.

Sample exam question



Company salespeople upload their sales figures daily. A Solutions Architect needs a **durable storage solution** for these documents that also **protects against users accidentally deleting** important documents.

Which action will protect against unintended user actions?

- A. Store data in an EBS volume and create snapshots once a week.
- B. Store data in an S3 bucket and enable versioning.**
- C. Store data in two S3 buckets in different AWS Regions.
- D. Store data on EC2 instance storage.

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Look at the answer choices and rule them out based on the keywords that were previously highlighted.

The correct answer is B. If a versioned object is deleted, then it can still be recovered by retrieving the final version. Response A would lose any changes that were committed since the previous snapshot. Storing the data in two S3 buckets (response C) would provide slightly more protection, but a user could still delete the object from both buckets. EC2 instance storage (response D) is temporary storage and should never be used for data requiring durability.

Additional resources



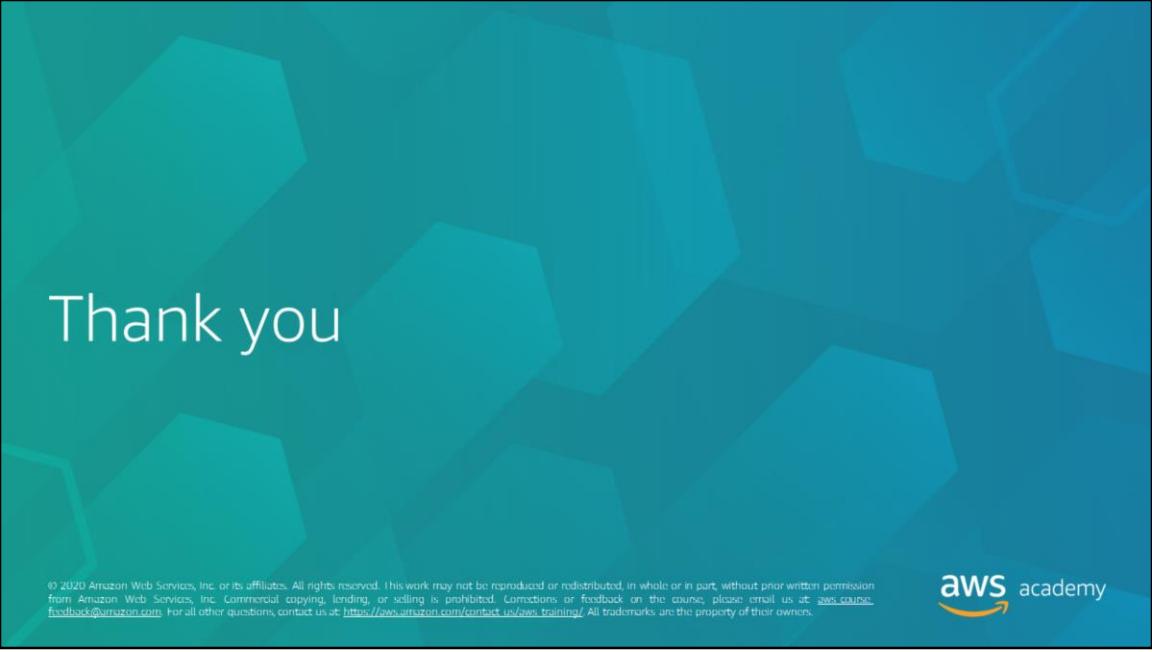
- [Amazon S3 Developers Guide](#)
- [Amazon S3 FAQs](#)
- [Amazon S3 Common Use Scenarios](#)
- [AWS Storage Services Whitepaper](#)
- [Amazon S3 Storage Classes Comparison](#)
- [Amazon S3 Block Public Access](#)

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5.5

If you want to learn more about the topics covered in this module, you might find the following additional resources helpful:

- [Amazon S3 Developers Guide](#)
- [Amazon S3 FAQs](#)
- [Amazon S3 Common Use Scenarios](#)
- [AWS Storage Services Whitepaper](#)
- [Amazon S3 Storage Classes Comparison](#)
- [Amazon S3 Block Public Access](#)



Thank you

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Thank you for completing this module.