Trainings & Technologies

AWS S3 *vs* EBS *vs* EFS

	S3	EBS	EFS
Type of storage	Object storage. You can store virtually any kind of data in any format.	Persistent block level storage for EC2 instances.	POSIX-compliant file storage for EC2 instances.
Features	Accessible to anyone or any service with the right permissions	Deliver performance for workloads that require the lowest-latency access to data from a single EC2 instance	Has a file system interface, file system access semantics (such as strong consistency and file locking), and concurrently-accessible storage for multiple EC2 instances
Max Storage Style	Virtually unlimited	16 TiB for one volume	Unlimited system size
Max File Size	Individual Amazon S3 objects can range in size to a maximum of 5 terabytes.	Equivalent to the maximum size of your volumes	47.9 TiB for a single file
Performance (Latency)	Low, for mixed request types, and integration with CloudFront	Lowest, consistent; SSD-backed storages include the highest performance Provisioned OPS SSD and General Purpose SSD that balance price and performance.	Low, consistent; use Max I/O mode for higher performance
Performance (Throughput)	Multiple GBs per second; supports multi-part upload	Up to 2 GB per second. HDD-backed volumes include throughput intensive workloads and Cold HDD for less frequently accessed data.	10+ GB per second. Bursting Throughput mode scales with the scales with the size of the file system. Provisioned throughput mode offers higher dedicated throughput than bustring throughput
Durability	Stored redundantly across multiple AZs; has 99.999999999% durability	Stored redundantly in a single AZ	Stored redundantly across multiple AZs

	S3	EBS	EFS
Availability	S3 Standard – 99.99% availability S3 Standard-IA – 99.9% availability S3 One Zone-IA – 99.5% availability. S3 Intelligent Tiering – 99.9%	Has 99.999% availability	99.9% SLA. Runs in multi – AZ
Scalability	Highly scalable	Manually increase/decrease your memory size. Attach and detach additional volumes to and from your EC2 instance to scale.	EFS file systems are elastic, and automatically grow and shrink as you add and remove files.
Data Accessing	One to millions of connections over the wed; S3 provides a REST web services interface	Single EC2 instance in a single AZ Amazon EBS Multi-Attach a single Provisioned IOPS SSD (io1 or io2) volume to up to 16 Nitro-based instances that are in the same Availability Zone.	One to thousands of EC2 instances or on-premises servers, from multiple AZs, regions, VPCs, and accounts concurrently
Access Control	Uses bucket policies and IAM user policies. Has Block Public Access settings to help manage public access to resources.	IAM Policies, Roles, and Security Groups	Only resources that can access endpoints in your VPC, called a mount target, can access your file system; POSIX-compliant user and group-level permissions.
Encryption Methods	Supports SSL endpoints using the HTTPS protocol, Client-Side and Server-Side Encryption (SSE-S3, SSE-C, SSE – KMS)	Encrypts both data-at-rest and data-in-transit through EBS encryption that uses AWS KMS CMKs.	Encrypt data at rest and in transit. Data at rest encryption uses AWS KMS. Data in transit uses TLS.
Backup and Restoration	Use versioning or cross-region replication	All EBS volume types offer durable snapshot capabilities.	EFS to EFS replication through third party tools or AWS DataSynch
Pricing	Billing prices are based on the location of your bucket. Lower costs equals lower prices. You get cheaper prices the more you use S3 storage.	You pay Gb-month of provisioned storage, provisioned IOPS-month, GB-month of snapshot data stored in S3	You pay more the amount of file system storage used per month. When using the Provisioned Throughput mode you pay for the throughput you provision per month.

	S3	EBS	EFS
Use Cases	Web serving and content management, media and entertainment, backups, big data analytics, data lake	Boot volumes, transactional and NoSQL databases, data warehousing & ETL	Web serving and content management,enterprise applications, media and entertainment, home directories, database backups, developer tools, container storage, big data analytics
Service endpoint	Can be accessed within and outside a VPC (via S3 bucket URL)	Accessed within one's VPC	Accessed within one's VPC

1. S3 is cheaper than EBS and EFS in pure storage costs
2. EBS and EFS has higher performance than S3
3. EBS is meant to be used as volumes for EC2 instances
4. S3 does not have a hierarchy (flat environment) for files unlike EFS
5. S3 has a built-in query feature
6. S3 offers strong consistency for all types of requests, except listing all buckets immediately after deleting a bucket, which is eventually consistent.

AWS CloudTrail vs CloudWatch

CloudTrail vs CloudWatch

- CloudWatch is a monitoring service for AWS resources and applications. CloudTrail is a web service that records API activity in your AWS account. They are both useful monitoring tools in AWS.
- By default, CloudWatch offers free basic monitoring for your resources, such as EC2 instances, EBS volumes, and RDS DB instances. CloudTrail is also enabled by default when you create your AWS account.
- With CloudWatch, you can collect and track metrics, collect and monitor log files, and set alarms. CloudTrail, on the other hand, logs information on who made a request, the services used, the actions performed, parameters for the actions, and the response elements returned by the AWS service. CloudTrail Logs are then stored in an S3 bucket or a CloudWatch Logs log group that you specify.
- You can enable detailed monitoring from your AWS resources to send metric data to CloudWatch more frequently, with an additional cost.
- CloudTrail delivers one free copy of management event logs for each AWS region. Management events include management operations performed on resources in your AWS account, such as when a user logs in to your account. Logging data events are charged. Data events include resource operations performed on or within the resource itself, such as S3 object-level API activity or Lambda function execution activity.

CloudTrail vs CloudWatch

- CloudTrail helps you ensure compliance and regulatory standards.
- CloudWatch Logs reports on application logs, while CloudTrail Logs provide you specific information on what occurred in your AWS account.
- CloudWatch Events is a near real time stream of system events describing changes to your AWS resources. CloudTrail focuses more on AWS API calls made in your AWS account.
- Typically, CloudTrail delivers an event within 15 minutes of the API call. CloudWatch delivers metric data in 5 minutes periods for basic monitoring and 1 minute periods for detailed monitoring. The CloudWatch Logs Agent will send log data every five seconds by default.

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AWS **Elastic Beanstalk** vs **CloudFormation** vs **OpsWorks** vs **CodeDeploy**

AWS Elastic Beanstalk	AWS CloudFormation	AWS OpsWorks	AWS CodeDeploy
•AWS Elastic Beanstalk makes it even easier for developers to **quickly deploy and manage applications** in the AWS Cloud. Developers simply upload their application, and Elastic Beanstalk **automatically handles the deployment details** of capacity provisioning, load balancing, auto-scaling, and application health monitoring. •This **platform-as-a-service solution** is typically for those who want to deploy and manage their applications within minutes in the AWS Cloud without worrying about the underlying infrastructure. •AWS Elastic Beanstalk supports the following languages and development stacks: •Apache Tomcat for Java applications •Apache HTTP Server for PHP applications •Apache HTTP Server for Python applications •Nginx or Apache HTTP Server for Node.js applications •Passenger or Puma for Ruby applications •Microsoft IIS for .NET applications •Java SE •Docker •Go • Elastic Beanstalk also supports deployment versioning. It maintains a copy of older deployments so that it is easy for the developer to rollback any changes made on the application.	AWS CloudFormation is a service that gives developers and businesses an easy way to create a **collection of related AWS resources** and provision them in an orderly and predictable fashion. This is typically known as "**infrastructure as code**". The main difference between CloudFormation and Elastic Beanstalk is that CloudFormation deals more with the AWS infrastructure rather than applications. AWS CloudFormation introduces two concepts: The **template**, a JSON or YAML-format, text-based file that describes all the AWS resources and configurations you need to deploy to run your application. The **stack**, which is the set of AWS resources that are created and managed as a single unit when AWS CloudFormation instantiates a template. CloudFormation also supports a rollback feature through template version controls. When you try to update your stack but the deployment fails midway, CloudFormation will automatically revert the changes back to their previous working states. CloudFormation supports Elastic Beanstalk application environments. This allows you, for example, to create and manage an AWS Elastic Beanstalk–hosted application along with an RDS database to store the application data. AWS CloudFormation can be used to bootstrap both Chef (Server and Client) and Puppet (Master and Client) softwares on your EC2 instances. CloudFormation also supports OpsWorks. You can model OpsWorks components (stacks, layers, instances, and applications) inside CloudFormation templates, and provision them as CloudFormation stacks. This enables you to document, version control, and share your OpsWorks configuration. AWS CodeDeploy is a recommended adjunct to CloudFormation for managing the application deployments and updates.	AWS OpsWorks is a configuration management service that provides managed instances of Chef and Puppet. OpsWorks lets you use **Chef** and **Puppet** to automate how servers are configured, deployed, and managed across your EC2 instances or on-premises compute environments. OpsWorks offers three services: Chef Automate Puppet Enterprise OpsWorks Stacks OpsWorks for Puppet Enterprise lets you use Puppet to automate how nodes are configured, deployed, and managed, whether they are EC2 instances or on-premises devices. OpsWorks for Chef Automate lets you create AWS-managed Chef servers, and use the Chef DK and other Chef tooling to manage them. OpsWorks Stacks lets you create stacks that help you manage cloud resources in specialized groups called layers. A layer represents a set of EC2 instances that serve a particular purpose. Layers depend on **Chef recipes** to handle tasks such as installing packages on instances, deploying apps, and running scripts. Compared to CloudFormation, OpsWorks focuses more on orchestration and software configuration, and less on what and how AWS resources are procured.	AWS CodeDeploy is a service that coordinates application deployments across EC2 instances and instances running on-premises. It makes it easier for you to rapidly release new features, helps you avoid downtime during deployment, and handles the complexity of updating your applications. Unlike Elastic Beanstalk, CodeDeploy does not automatically handle capacity provisioning, scaling, and monitoring. Unlike CloudFormation and OpsWorks, CodeDeploy does not deal with infrastructure configuration and orchestration. AWS CodeDeploy is a building block service focused on helping developers deploy and update software on any instance, including EC2 instances and instances running on-premises. AWS Elastic Beanstalk and AWS OpsWorks are end-to-end application management solutions. You create a **deployment configuration file** to specify how deployments proceed. CodeDeploy complements CloudFormation well when deploying code to infrastructure that is provisioned and managed with CloudFormation.

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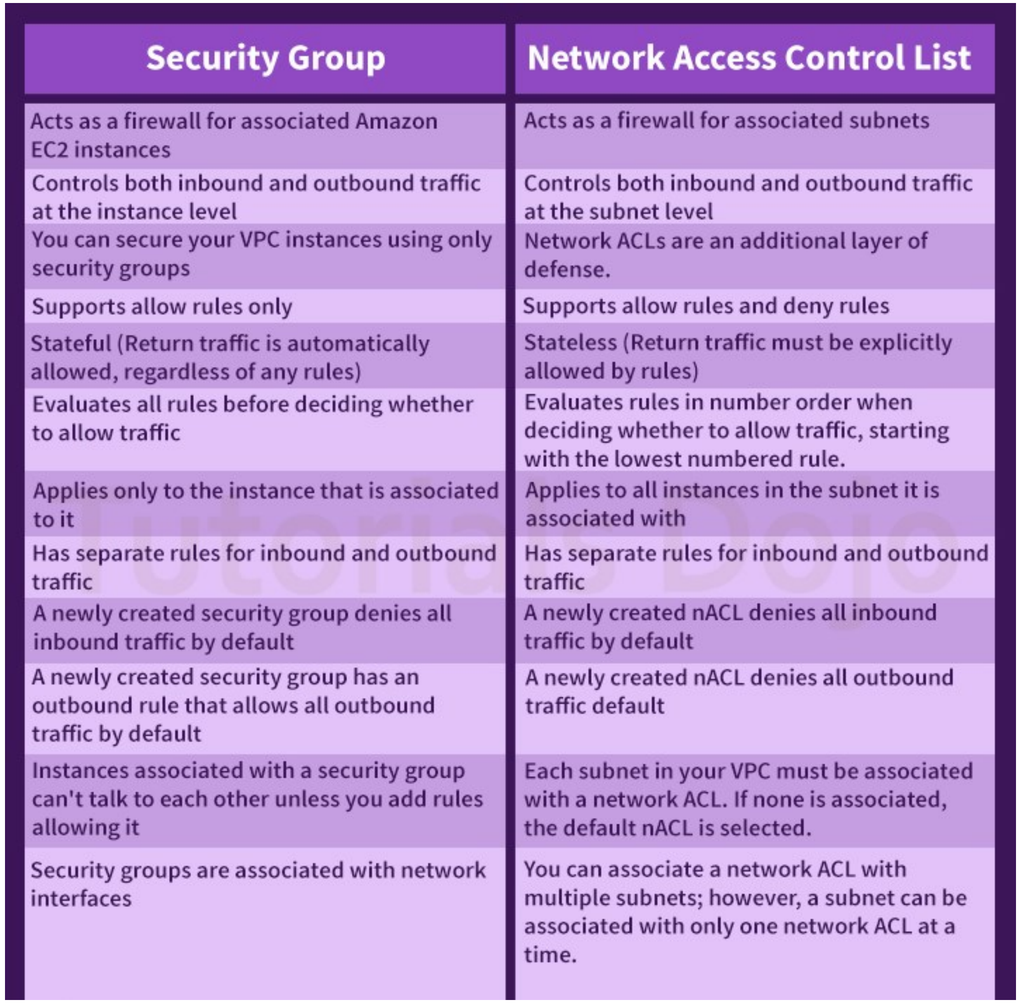
AWS **Seurity Group** vs **NACL**

Security Group vs NACL



Security Group	Network Access Control List
Acts as a firewall for associated Amazon EC2 instances	Acts as a firewall for associated subnets
Controls both inbound and outbound traffic at the instance level	Controls both inbound and outbound traffic at the subnet level
You can secure your VPC instances using only security groups	Network ACLs are an additional layer of defense.
Supports allow rules only	Supports allow rules and deny rules
Stateful (Return traffic is automatically allowed, regardless of any rules)	Stateless (Return traffic must be explicitly allowed by rules)
Evaluates all rules before deciding whether to allow traffic	Evaluates rules in number order when deciding whether to allow traffic, starting with the lowest numbered rule.
Applies only to the instance that is associated to it	Applies to all instances in the subnet it is associated with
Has separate rules for inbound and outbound traffic	Has separate rules for inbound and outbound traffic
A newly created security group denies all inbound traffic by default	A newly created nACL denies all inbound traffic by default
A newly created security group has an outbound rule that allows all outbound traffic by default	A newly created nACL denies all outbound traffic default
Instances associated with a security group can't talk to each other unless you add rules allowing it	Each subnet in your VPC must be associated with a network ACL. If none is associated, the default nACL is selected.
Security groups are associated with network interfaces	You can associate a network ACL with multiple subnets; however, a subnet can be associated with only one network ACL at a time.

Your VPC has a default security group with the following rules:

1. Allow inbound traffic from instances assigned to the same security group.
2. Allow all outbound IPv4 traffic and IPv6 traffic if you have allocated an IPv6 CIDR block.

Your VPC has a default network ACL with the following rules:

1. Allows all inbound and outbound IPv4 traffic and, if applicable, IPv6 traffic.
2. Each network ACL also includes a non modifiable and non removable rule whose rule number is an asterisk. This rule ensures that if a packet doesn’t match any of the other numbered rules, it’s denied.

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AWS **ECS** vs **LAMBDA**

Amazon EC2 Container Service (ECS)	AWS Lambda
•Amazon ECS is a highly scalable, high performance **container management** service that supports **Docker containers** and allows you to easily run applications on a managed cluster of Amazon EC2 instances. ECS eliminates the need for you to install, operate, and scale your own cluster management infrastructure. •With ECS, deploying containerized applications is easily accomplished. This service fits well in running batch jobs or in a microservice architecture. •You have a central repository where you can upload your Docker Images from ECS container for safekeeping called **Amazon ECR**. •Applications in ECS can be written in a stateful or stateless matter. •The **Amazon ECS** CLI supports Docker Compose, which allows you to simplify your local development experience as well as easily set up and run your containers on Amazon ECS. •Since your applications still run on EC2 instances, **server management is your responsibility**. This gives you more granular control over your system. •It is up to you to **manage scaling and load balancing** of your EC2 instances as well, unlike in AWS Lambda where functions scale automatically. •You are charged for the costs incurred by your EC2 instances in your clusters. Most of the time, Amazon ECS costs more than using AWS Lambda since your active EC2 instances will be charged by the hour. •One version of Amazon ECS, know as **AWS Fargate**, will fully manage your infrastructure so you can just focus on deploying containers. AWS Fargate has a different pricing model from the standard EC2 cluster. •ECS will automatically recover unhealthy containers to ensure that you have the desired number of containers supporting your application.	•AWS Lambda is a **function-as-a-service** offering that runs your code **in response to events** and automatically manages the compute resources for you, since Lambda is a serverless compute service. With Lambda, you do not have to worry about managing servers, and directly focus on your application code. •Lambda automatically scales your function to meet demands. It is noteworthy, however, that Lambda has a maximum execution duration per request of 900 seconds or 15 minutes. •To allow your Lambda function to access other services such as Cloudwatch Logs, you would need to create an execution role that has the necessary permissions to do so. •You can easily integrate your function with different services such as API Gateway, DynamoDB, CloudFront, etc. using the Lambda console. •You can test your function code locally in the Lambda console before launching it into production. •Currently, Lambda supports only a number of programming languages such as Java, Go, PowerShell, Node.js, C#, Python, and Ruby. ECS is not limited by programming languages since it mainly caters to Docker. •Lambda functions must be **stateless** since you do not have volumes for data storage. •You are charged based on the number of requests for your functions and the duration, the time it takes for your code to execute. To minimize costs, you can throttle the number of concurrent executions running at a time, and the execution time limit of the function. •With **Lambda@Edge**, AWS Lambda can run your code across AWS locations globally in response to Amazon CloudFront events, such as requests for content to or from origin servers and viewers. This makes it easier to deliver content to end users with lower latency.

AWS **S3 Transfer Acceleration** vs **Direct Connect** vs **VPN** vs **Snowball Edge** vs **Snowmobile**

S3 Transfer Acceleration (TA)	AWS Direct Connect	AWS VPN	Snowball	Snowmobile
•Amazon S3 Transfer Acceleration makes public Internet transfers to S3 faster, as it leverages Amazon CloudFront's globally distributed AWS Edge Locations. •There is no guarantee that you will experience increased transfer speeds. If S3 Transfer Acceleration is not likely to be faster than a regular S3 transfer of the same object to the same destination AWS Region, AWS will not charge for the use of S3 TA for that transfer. •This is not the best transfer service to use if transfer disruption is not tolerable. •S3 TA provides the same security benefits as regular transfers to Amazon S3. This service also supports multi-part upload. •S3 TA vs AWS Snow* •The AWS Snow* Migration Services are ideal for moving large batches of data at once. In general, if it will take more than a week to transfer over the Internet, or there are recurring transfer jobs and there is more than 25Mbps of available bandwidth, S3 Transfer Acceleration is a good option. •Another option is to use AWS Snowball or Snowmobile to perform initial heavy lift moves and then transfer incremental ongoing changes with S3 Transfer Acceleration. •S3 TA vs Direct Connect •AWS Direct Connect is a good choice for customers who have a private networking requirement or who have access to AWS Direct Connect exchanges. S3 Transfer Acceleration is best for submitting data from distributed client locations over the public Internet, or where variable network conditions make throughput poor. •S3 TA vs VPN •You typically use (IPsec) VPN if you want your resources contained in a private network. VPN tools such as OpenVPN allow you to setup stricter access controls if you have a private S3 bucket. You can complement this further with the increased speeds from S3 TA.	•Using AWS Direct Connect, data that would have previously been transported over the Internet can now be delivered through a private physical network connection between AWS and your datacenter or corporate network. Customers' traffic will remain in AWS global network backbone, after it enters AWS global network backbone. •Benefits of Direct Connect vs internet-based connections •reduced costs •increased bandwidth •a more consistent network experience •Each AWS Direct Connect connection can be configured with one or more **virtual interfaces**. Virtual interfaces may be configured to access AWS services such as Amazon EC2 and Amazon S3 using public IP space, or resources in a VPC using private IP space. •You can run IPv4 and IPv6 on the same virtual interface. •Direct Connect does not support multicast. •A Direct Connect connection is **not redundant**. Therefore, a second line needs to be established if redundancy is required. Enable *Bidirectional Forwarding Detection* (BFD) when configuring your connections to ensure fast detection and failover. •AWS Direct Connect offers SLA. •Direct Connect vs IPsec VPN •A VPC VPN Connection utilizes IPSec to establish **encrypted network connectivity** between your intranet and Amazon VPC **over the Internet.** VPN Connections can be configured in minutes and are a good solution if you have an immediate need, have low to modest bandwidth requirements, and can tolerate the inherent variability in Internet-based connectivity. AWS Direct Connect **does not involve the Internet**; instead, it uses **dedicated, private network connections** between your intranet and Amazon VPC. •You can combine one or more Direct Connect dedicated network connections with the Amazon VPC VPN. This combination provides an IPsec-encrypted private connection that also includes the benefits of Direct Connect.	•AWS VPN is comprised of two services: •AWS Site-to-Site VPN enables you to securely connect your on-premises network or branch office site to your Amazon VPC. •AWS Client VPN enables you to securely connect users to AWS or on-premises networks. •Data transferred between your VPC and datacenter routes over an encrypted VPN connection to help maintain the confidentiality and integrity of data in transit. •If data that passes through Direct Connect moves in a dedicated private network line, AWS VPN instead encrypts the data before passing it through the Internet. •VPN connection throughput can depend on multiple factors, such as the capability of your customer gateway, the capacity of your connection, average packet size, the protocol being used, TCP vs. UDP, and the network latency between your customer gateway and the virtual private gateway. •All the VPN sessions are **full-tunnel VPN**. (cannot split tunnel) •AWS Site-to-Site VPN enables you to create **failover** and CloudHub solutions **with AWS Direct Connect**. •AWS Client VPN is designed to connect devices to your applications. It allows you to choose from **OpenVPN-based client**.	•Snowball is a **petabyte-scale data transport** solution that uses secure appliances to transfer large amounts of data into and out of AWS. •Benefits of Snowball include: •lower network costs, •Shorter transfer times, •and security using 256-bit encryption keys you manage through AWS Key Management Service (KMS).. •Similar to Direct Connect, AWS Snowball is **physical hardware**. It includes a 10GBaseT network connection. You can order a device with either **50TB** or an **80TB** storage capacity. •Data transported via Snowball are stored in Amazon S3 once the device arrives at AWS centers. •AWS Snowball is not only for shipping data into AWS, but also out of AWS. •AWS Snowball can be used as a quick order for additional temporary petabyte storage. •For security purposes, data transfers must be completed **within 90 days of a Snowball's preparation**. •When the transfer is complete and the device is ready to be returned, the E Ink shipping label will automatically update to indicate the correct AWS facility to ship to, and you can track the job status by using Amazon Simple Notification Service (SNS), text messages, or directly in the console. •Snowball is the best choice if you need to more securely and quickly transfer terabytes to many petabytes of data to AWS. Snowball can also be the right choice if you don't want to make expensive upgrades to your network infrastructure, if you frequently experience large backlogs of data, if you're located in a physically isolated environment, or if you're in an area where high-bandwidth Internet connections are not available or cost-prohibitive. •If you will be transferring data to AWS on an ongoing basis, it is better to use AWS Direct Connect. •If multiple users located in different locations are interacting with S3 continuously, it is better to use S3 TA. •You **cannot** export data directly from S3 Glacier. It should be first restored to S3.	•Snowmobile is Snowball with larger storage capacity. Snowmobile is literally a mobile truck. •Snowmobile is an **Exabyte-scale data transfer** service. •You can transfer up to **100PB** per Snowmobile. •Snowmobile uses multiple layers of security to help 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 you manage through the AWS Key Management Service (KMS). •After the data transfer is complete, the Snowmobile will be returned to your designated AWS region where your data will be uploaded into the AWS storage services such as S3 or Glacier. •Snowball vs Snowmobile •To migrate large datasets of 10PB or more in a single location, you should use Snowmobile. For datasets less than 10PB or distributed in multiple locations, you should use Snowball. •If you have a high speed backbone with hundreds of Gb/s of spare throughput, then you can use Snowmobile to migrate the large datasets all at once. If you have limited bandwidth on your backbone, you should consider using multiple Snowballs to migrate the data incrementally. •Snowmobile **does not** support data export. Use Snowball/Snowball Edge for this cause. •When the data import has been processed and verified, AWS performs a software erasure based on NIST guidelines.

- **S3 Transfer Acceleration (TA)**
- Amazon S3 Transfer Acceleration makes public Internet transfers to S3 faster, as it leverages Amazon CloudFront's globally distributed AWS Edge Locations.
- There is no guarantee that you will experience increased transfer speeds. If S3 Transfer Acceleration is not likely to be faster than a regular S3 transfer of the same object to the same destination AWS Region, AWS will not charge for the use of S3 TA for that transfer.
- This is not the best transfer service to use if transfer disruption is not tolerable.
- S3 TA provides the same security benefits as regular transfers to Amazon S3. This service also supports multi-part upload.
- ***S3 TA vs AWS Snow****
  - The AWS Snow* Migration Services are ideal for moving large batches of data at once. In general, if it will take more than a week to transfer over the Internet, or there are recurring transfer jobs and there is more than 25Mbps of available bandwidth, S3 Transfer Acceleration is a good option.
  - Another option is to use AWS Snowball Edge or Snowmobile to perform initial heavy lift moves and then transfer incremental ongoing changes with S3 Transfer Acceleration.
- ***S3 TA vs Direct Connect***
  - AWS Direct Connect is a good choice for customers who have a private networking requirement or who have access to AWS Direct Connect exchanges. S3 Transfer Acceleration is best for submitting data from distributed client locations over the public Internet, or where variable network conditions make throughput poor.
- ***S3 TA vs VPN***
  - You typically use (IPsec) VPN if you want your resources contained in a private network. VPN tools such as OpenVPN allow you to setup stricter access controls if you have a private S3 bucket. You can complement this further with the increased speeds from S3 TA.
- ***S3 TA vs Multipart Upload***
  - Use multipart upload if you are uploading large files and you want to handle failed uploads gracefully. With multipart upload, each part of your upload is a contiguous portion of the object's data. You can upload these object parts independently and in any order. If transmission of any part fails, you can retransmit that part without affecting other parts.
  - For S3 TA, as the name implies, accelerates your transfer speeds, not just for upload but also for download speed. There is no reason why you can't use S3 TA and multipart upload together, but if you are only handling small files, using multipart upload is not necessary.

- **AWS Direct Connect**
- Using AWS Direct Connect, data that would have previously been transported over the Internet can now be delivered through a **private physical network connection** between AWS and your datacenter or corporate network. Customers' traffic will remain in AWS global network backbone, after it enters AWS global network backbone.
- Benefits of Direct Connect vs internet-based connections
    - reduced costs
    - increased bandwidth
    - a more consistent network experience
- Each AWS Direct Connect connection can be configured with one or more **virtual interfaces**. Virtual interfaces may be configured to access AWS services such as Amazon EC2 and Amazon S3 using public IP space, or resources in a VPC using private IP space.
- You can run IPv4 and IPv6 on the same virtual interface.
- Direct Connect does not support multicast.
- A Direct Connect connection is **not redundant**. Therefore, a second line needs to be established if redundancy is required. Enable *Bidirectional Forwarding Detection* (BFD) when configuring your connections to ensure fast detection and failover.
- AWS Direct Connect offers SLA.
- Direct Connect vs IPsec VPN
    - A VPC VPN Connection utilizes IPSec to establish **encrypted network connectivity** between your intranet and Amazon VPC **over the Internet.** VPN Connections can be configured in minutes and are a good solution if you have an immediate need, have low to modest bandwidth requirements, and can tolerate the inherent variability in Internet-based connectivity. AWS Direct Connect **does not involve the Internet**; instead, it uses **dedicated, private network connections** between your intranet and Amazon VPC.
- You can combine one or more Direct Connect dedicated network connections with the Amazon VPC VPN. This combination provides an IPsec-encrypted private connection that also includes the benefits of Direct Connect.

- **AWS VPN**
- AWS VPN is comprised of two services:
  - AWS Site-to-Site VPN enables you to securely connect your on-premises network or branch office site to your Amazon VPC.
  - AWS Client VPN enables you to securely connect users to AWS or on-premises networks.
- Data transferred between your VPC and datacenter routes over an encrypted VPN connection to help maintain the confidentiality and integrity of data in transit.
- If data that passes through Direct Connect moves in a dedicated private network line, AWS VPN instead encrypts the data before passing it through the Internet.
- VPN connection throughput can depend on multiple factors, such as the capability of your customer gateway, the capacity of your connection, average packet size, the protocol being used, TCP vs. UDP, and the network latency between your customer gateway and the virtual private gateway.
- All the VPN sessions are **full-tunnel VPN**. (cannot split tunnel)
- AWS Site-to-Site VPN enable you to create **failover** and CloudHub solutions **with AWS Direct Connect**.
- AWS Client VPN is designed to connect devices to your applications. It allows you to choose from **OpenVPN-based client**.

- **Snowball Edge**
- Snowball Edge is a **petabyte-scale data transport** solution that uses secure appliances to transfer large amounts of data into and out of AWS.
- Benefits of Snowball Edge include:
  - lower network costs,
  - Shorter transfer times,
  - and security using 256-bit encryption keys you manage through AWS Key Management Service (KMS)..
- Options for device configurations
  - **Storage optimized** – this option has the most storage capacity at up to 80 TB of usable storage space, 24 vCPUs, and 32 GiB of memory for compute functionality. You can transfer up to **100 TB** with a single Snowball Edge Storage Optimized device.
  - **Compute optimized** – this option has the most compute functionality with 52 vCPUs, 208 GiB of memory, and 7.68 TB of dedicated NVMe SSD storage for instance. This option also comes with 42 TB of additional storage space.
  - Compute Optimized with GPU – identical to the compute-optimized option, save for an installed GPU, equivalent to the one available in the P3 Amazon EC2 instance type.
- Similar to Direct Connect, AWS Snowball Edge is **physical hardware**. It includes a 10GBaseT network connection. You can order a device with either **50TB** or an **80TB** storage capacity.
- Data transported via Snowball Edge are stored in Amazon S3 once the device arrives at AWS centers.
- AWS Snowball Edge is not only for shipping data into AWS, but also out of AWS.
- AWS Snowball Edge can be used as a quick order for additional temporary petabyte storage.
- You can cluster Snowball Edge devices for local storage and compute jobs to achieve 99.999 percent data durability across 5–10 devices, and to locally grow and shrink storage on demand.
- For security purposes, data transfers must be completed **within 360 days of a Snowball Edge's preparation**.
- When the transfer is complete and the device is ready to be returned, the E Ink shipping label will automatically update to indicate the correct AWS facility to ship to, and you can track the job status by using Amazon Simple Notification Service (SNS), text messages, or directly in the console.
- Snowball Edge is the best choice if you need to more securely and quickly transfer terabytes to many petabytes of data to AWS. Snowball Edge can also be the right choice if you don't want to make expensive upgrades to your network infrastructure, if you frequently experience large backlogs of data, if you're located in a physically isolated environment, or if you're in an area where high-bandwidth Internet connections are not available or cost-prohibitive.
- For latency-sensitive applications such as machine learning, you can deploy a **performance-optimized SSD volume (sbp1)**. Performance optimized volumes on the Snowball Edge Compute Optimized device use NVMe SSD, and on the Snowball Edge Storage Optimized device they use SATA SSD. Alternatively, you can use capacity-optimized **HDD volumes (sbg1)** on any Snowball Edge.
- If you will be transferring data to AWS on an ongoing basis, it is better to use AWS Direct Connect.
- If multiple users located in different locations are interacting with S3 continuously, it is better to use S3 TA.
- You **cannot** export data directly from S3 Glacier. It should be first restored to S3.

- **Snowmobile**
- Snowmobile is Snowball Edge with larger storage capacity. Snowmobile is literally a mobile truck.
- Snowmobile is an **Exabyte-scale data transfer** service.
- You can transfer up to **100PB** per Snowmobile.
- Snowmobile uses multiple layers of security to help 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 you manage through the AWS Key Management Service (KMS).
- After the data transfer is complete, the Snowmobile will be returned to your designated AWS region where your data will be uploaded into the AWS storage services such as S3 or Glacier.
- Snowball Edge vs Snowmobile
  - To migrate large datasets of 10PB or more in a single location, you should use Snowmobile. For datasets less than 10PB or distributed in multiple locations, you should use Snowball Edge.
  - If you have a high speed backbone with hundreds of Gb/s of spare throughput, then you can use Snowmobile to migrate the large datasets all at once. If you have limited bandwidth on your backbone, you should consider using multiple Snowball Edge to migrate the data incrementally.
  - Snowmobile **does not** support data export. Use Snowball Edge for this cause.
- When the data import has been processed and verified, AWS performs a software erasure based on NIST guidelines.